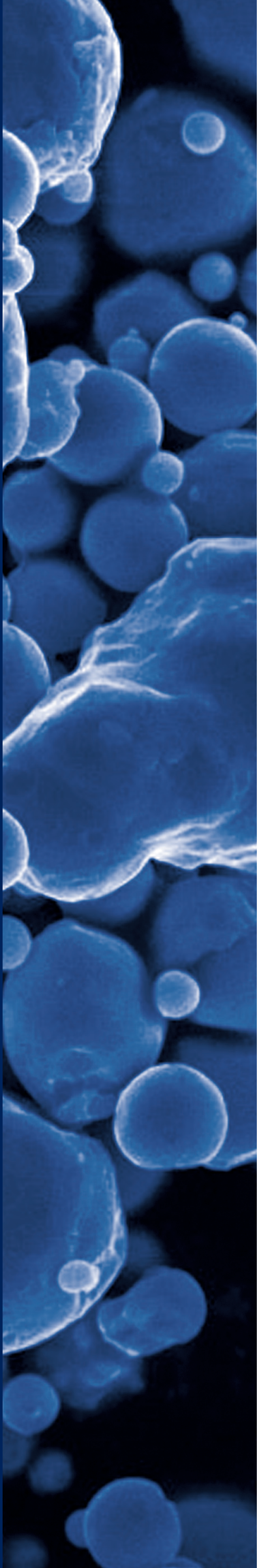
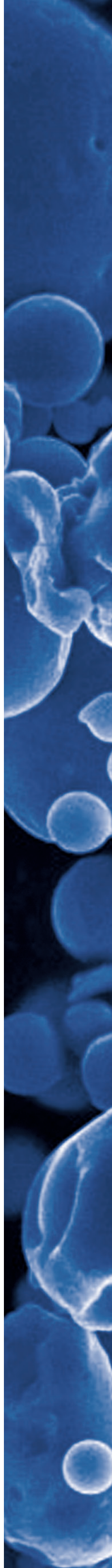


DUST 2014

Book of ABSTRACTS

International Conference on
ATMOSPHERIC DUST

Castellaneta Marina - Italy
June 1-6, 2014



International Conference on Atmospheric Dust

Castellaneta Marina (Taranto), Italy
June, 1-6, 2014

Book of Abstracts

Associazione Italiana per lo Studio delle Argille - onlus

DUST2014 - International Conference on Atmospheric Dust
Book of Abstracts
Castellaneta Marina (Taranto), Italy, June 1-6, 2014
Editors: Claudia Belviso, Saverio Fiore & Maria Luigia Giannossi

ISBN: 978-88-7522-095-2
Publisher: Digilabs - Bari, Italy
Cover: Digilabs - Bari, Italy
Printed in Italy - Global Print s.r.l., Gorgonzola (MI), Italy

Citations of abstracts in this volume should be referenced as follows:
<Authors> (2014). <Title>. In: C. Belviso, S. Fiore and M.L. Giannossi (Editors). International Conference on Atmospheric Dust, DUST 2014., Castellaneta Marina, Italy. Digilabs Pub., Bari, Italy, pp. 483, ISBN: 978-88-7522-095-2

PREFACE

This volume contains the abstract of the scientific contributions presented to DUST2014, the 1st International Conference on Atmospheric Dust, held in Castellaneta Marina (Italy) from 1 to 6 June 2014. The meeting was organized by the Associazione Italiana per lo Studio delle Argille - onlus (AISA, Italian Association for the Study of Clays) and the Istituto di Metodologie per l'Analisi Ambientale (IMAA, Institute of Methodologies for Environmental Analysis), National Research Council of Italy (CNR).

The scientific program of the meeting included 5 plenary lectures, 313 oral and 153 poster contributions. All the contributions were revised by 72 international experts, many of them being the conveners of the 34 sessions dealing with the seven themes of the Conference: Chemical & Mineralogical Studies, Geological Records, Health & Environment, Instrumentations & Measurements, MF: Modelling & Field Studies, The Universe of Dust - General Session. Our sincere thanks go to these colleagues who devoted their time to the DUST2014.

Our heartfelt thanks go to the many people who worked hard to organize the scientific and social events as well as to the Institutions and business enterprises which supported the meeting. We owe a special thank-you to the delegates, more than 400 coming from 52 Countries, who contributed to make this meeting a memorable event.

Saverio Fiore
Chair, DUST2014

Organized by
Italian Association for the Study of Clays (AISA - onlus)
Institute of Methodologies for Environmental Analysis (IMAA) - CNR

SCIENTIFIC COMMITTEE, DUST2014

Samuel Albani (US)
Roberto Albertini (IT)
Fulvio Amato (ES)
Jose Maria Baldasano (ES)
Anna Bird (GB)
Jan Bloemendal (UK)
Rosa Caggiano (IT)
Marco Carminati (IT)
Mark Cave (GB)
José A. Centeno (US)
Sippy K. Chauhan (IN)
Nicholas Clements (US)
James Coe (US)
Annamaria Costa (IT)
François De Vleeschouwer (FR)
Piero Dellino (IT)
Barbara Delmonte (IT)
Wouter Devarrewaere (BE)
Denis- Didier-Rousseau (FR)
Yigal Erel (IL)
Godwin C. Ezeh (NG)
Steven R. Fassnacht (US)
Alessandro Fassò (IT)
Stephanie Fiedler (GB)
Carolina Filizzola (IT)
Saverio Fiore (IT)
Dieter Foqué (BE)
Hosni Ghedira (AE)
Reto Gieré (DE)
Steven Goldstein (US)
Zhengtang Guo (CN)
Michael Hannigan (US)
Christel S. Hassler (CH)
Michal Ben Israel (IL)
Jan Jezierski (PL)
Angeliki Karanasiou (ES)
Lars Klüser (DE)
Peter Knippertz (GB)
Sridhar Komarneni (US)
Malin Kylander (SE)
Gaël Le Roux (FR)
Antonio Lettino (IT)
Francesco Marchese (IT)
Lucia Mona (IT)
Slobodan Nickovic (CH)
David Nuyttens (BE)
Dimitrios Papoulis (GR)
Nicola Pergola (IT)
Alessio Pollice (IT)
Olga Popovicheva (RU)
Xavier Querol (ES)
Najat A. Saliba (LB)
Kerstin Schepanski (DE)
Véronique Schoemann (BE)
Constantinos Sioutas (US)
Antonio Speranza (IT)
Mordechai Stein (IL)
Thomas Stevens (GB)
Roberto Sulpizio (IT)
Enric Terradellas (ES)
Michel Thibaudon (FR)
Valerio Tramutoli (IT)
Jay Turner (US)
Pieter Verboven (BE)
Christine Wiedinmyer (US)
Gisela Winckler (US)
Joanna Wragg (GB)

DISSOLUTION OF DUST MINERAL PARTICLES IN HUMANS AND THE ENVIRONMENT. A GEOCHEMICAL PERSPECTIVE

F. Javier Huertas

Instituto Andaluz de Ciencias de la Tierra (CSIC-Univ. Granada), 18100 Armilla (Granada), Spain
**javierhuertas@ugr.es*

Mineral dust is composed of variable amounts of quartz, feldspars, micas, clay minerals, carbonates, oxides and evaporite minerals. Their proportions are similar to the abundances of the upper continental crust, although the overall compositions vary amongst continents. The clay fraction eventually dominates composition, as the background dust has a mean diameter of less than 5 µm.
Mineralogy and geochemistry contribute to characterization of particulates and provide valuable information on dust source and pathways, as well as stability and potential release of toxic components. The reaction of mineral surfaces with aqueous solutions leads to dissolution and precipitation processes, which depend on a number of parameter of the mineral (e.g., chemical composition, crystal structure, particle size, surface area) and the solution (pH, chemical composition, temperature, ionic strength). Field studies and laboratory tests on pure minerals have been performed to estimate the mineral stability under several natural and anthropic conditions, revealing how dissolution rate varies with environmental parameters as pH, temperature or solution composition. Rate laws obtained from kinetic studies were then used to improve our understanding of the reaction mechanism, identify the reaction limiting-step, establish the relative alterability of a mineral under specific conditions, etc.
Mineral dust can be inhaled by humans and deposited in the respiratory tract. How deep can dust progress depends on particle size. Those particles that reach the pulmonary region and cannot be cleared will trigger a foreign-body response. Minerals will interact with pulmonary as well as cells fluids through the mineral surface area. Should we expect a specific dissolution mechanism? Is mineral dissolution in human body governed by the same rules that mineral/solution processes on the Earth surface? The differences between human body and the environment lay on the nature and composition of the fluids within the lungs and in the effect of a high solid/solution ratio (solution saturation). Another issue to consider is the fate of the elements release by dissolution and their potential toxicity for the organism.
Human body, and particularly pulmonary region, can be considered as a (bio) geochemical environment. Mineralogy and geochemistry are disciplines that can assist health scientist to get a better understanding of the phenomena produced by minerals in the lungs, to derive mineral biodurability and to contribute to propose pathways to reduce risks derived form particle inhalation.

MINERAL DUST MAPPING FROM SPACE WITH NASA EARTH OBSERVING SYSTEM INSTRUMENTS

Ralph A. Kahn

NASA Goddard Space Flight Center, Greenbelt MD 2077 - USA
ralph.kahn@nasa.gov

Mineral dust represents the largest airborne particle component by mass of all aerosol types, and satellite instruments are essential tools for mapping dust sources, transports, and sinks globally. Among the NASA Earth Observing System (EOS) instruments, MODIS, MISR, TOMS/OMI, CALIPSO, and AIRS are among the instruments that can detect airborne dust. The capabilities and techniques involved vary greatly among these instruments. For example, MODIS, MISR, and TOMS provide imagery that can map aerosols over vast areas; MODIS distinguishes dust from other aerosol types over ocean, based on particle size constraints, TOMS and OMI depend on the UV absorption to detect dust, and MISR uses multi-spectral and multi-angle imaging to identify dust based on the unique scattering properties of non-spherical particles. AIRS and CALIPSO can each detect dust at night, the former based on dust infrared signature and the latter via depolarization of the light backscattered from the instrument's active laser emissions. This talk will briefly review the capabilities, strengths, and limitations of each technique, and will summarize what we have learned about dust sources and transports during the EOS era with illustrative examples.

ACCELERATOR BASED TECHNIQUES FOR AEROSOL ANALYSIS

Franco Lucarelli

Department of Physics and Astronomy University of Florence and I.N.F.N., Sesto Fiorentino, 50019, Italy
lucarelli@fi.infn.it

Particle Induced X-ray Emission (PIXE) technique has been widely used since its birth for the study of the aerosol composition. However, recently, other competitive techniques, such as those based on atomization by Induced Coupled Plasma and detection by Atomic Emission Spectroscopy (ICP-AES) or Mass Spectrometry (ICP-MS), have been developed. Furthermore, traditional X-ray Fluorescence (XRF) systems have been replaced by more efficient modern devices and Synchrotron Radiation XRF has started to be used for elemental analysis. To remain competitive, a proper experimental set-up is important to fully exploit PIXE capabilities. PIXE has many advantages for elemental analysis of aerosols: only few minutes of bombardment are sufficient to detect up to 20 elements from Na to Pb, including important anthropogenic elements (S, V, Ni, Cu, Zn, As, Pb) and the typical crustal elements (Al, Si, K, Ca, Ti, Mn, Fe, Sr), and its high efficiency is very useful when hundreds/thousands of samples have to be analyzed, a quite common need in aerosol studies. The multi-elemental data set as a whole (which comprises data for various anthropogenic tracers) can be used for disentangling the contributions from different source categories by applying multivariate receptor modelling. Thanks to the capability of detecting the crustal elements, PIXE is very effective in the study of natural aerosols, like the Saharan dust intrusions and mineral dust archived in polar ice cores (for environmental and paleoclimatic studies). Compared to traditional Energy Dispersive XRF (ED-XRF), PIXE offers sensitivities that are typically at least one order of magnitude better and requires much less sample mass thus allowing the use of samplers with high size and time resolution (e.g. streakers and SDI cascade impactors). Source apportionment receptor models need a series of samples containing material from the same set of sources in differing proportions. Increasing the time resolution of the measurements typically provides samples that have greater between-sample variability in the source contributions than samples integrated over longer time periods. Since PIXE is a non-destructive analysis, further measurements with other complementary techniques can be performed. Moreover, no sample preparation or extraction is necessary, thus reducing the contamination from chemical reagents and possible loss of volatile elements in the sample. Another advantage of PIXE over ED-XRF is that it can be complemented with other ion beam analysis techniques, so that the light elements (H, C, N and O) that make up most of the aerosol mass can be measured as well. Examples regarding recent monitoring campaigns, performed in urban and remote areas, both on a daily basis and with high time resolution, as well as with size selection, will be presented. It will be evidenced how PIXE can provide unique information in aerosol studies or can play a complementary role to traditional chemical analysis.

FIFTY YEARS OF AFRICAN DUST STUDIES ON BARBADOS: WHAT HAVE WE LEARNED AND WHAT MUST WE DO NEXT?

Joseph M. Prospero

Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, FL 33149 USA

There is currently great interest in dust because of its impact on climate and ocean biogeochemistry. Fifty years ago, there was little interest. Indeed, the original objective of the Barbados studies, begun in 1965 by D. Parkin and A. Delany, was to characterize the influx rate of meteoritic dust carried in the "pristine" trade winds. Instead they were surprised and overwhelmed with African dust. Even after half a century, African dust continues to surprise us and to present us with challenges to understanding this phenomenon. In 1966, the University of Miami took over the Barbados station which has since generated the world's longest record of long-range dust transport. Dust concentrations have varied greatly over this period in response to changes in North Africa, a relationship which even today is not well understood. Consequently Barbados studies have yielded unique insights on the factors that affect emissions and transport. Most notable in the record was the huge increase observed in the early 1970s and 1980s, most likely in response to drought, perhaps exacerbated by population growth and land use. Here I present a brief history of the Barbados studies and discuss various aspects of that record along with those at two other long-term sites in the western Atlantic, Bermuda and Miami. These measurements served to show a strong seasonal transport with the maximum in boreal summer and a steep latitudinal gradient. However there was relatively little quantitative information on low-latitude transport in winter and spring. Recently we have integrated our Barbados measurements with multi-year records of PM10 made at Cayenne, French Guiana, (F.X. Collard) and on Guadeloupe (J. Molinie) as a component of France's air quality program. The Cayenne measurements are particularly interesting in that they show that during spring the transport of dust is comparable to (and usually somewhat greater than) that observed on Barbados in summer. Moreover evidence suggests that the Bodélé Depression in Chad is the dominant source of this dust. Comparisons of the Cayenne record with field programs in the Amazon Basin show the clear impact of individual events throughout the region with some dust "fronts" extending across a latitudinal span of over 2000km. Thus we conclude that Africa is emitting huge quantities of dust essentially all year long. It is notable that African dust has a great impact on air quality in the Caribbean region where PM10 frequently exceeds the WHO PM10 standard at rates comparable to those in major urban areas in Europe. In sum, there is a broad need to more fully understand the factors that modulate dust emissions in Africa, in particular the role of climate. To address this issue, we require coordinated programs that link measurements in and near African sources to those made at great distances so as to better link source processes with transport across this huge area and to assess the impact of climate change and the possible feedback on climate processes. The impacts on human health should be a part of should studies.

AFRICAN DUST OUTBREAKS AND AIR QUALITY IN SOUTHERN EUROPE: IS IT ONLY DUST THAT MATTERS?

Xavier Querol[1]*, Andres Alastuey[1], Marco Pandolfi[1], Jorge Pey[2], Fulvio Amato[1], Noemí Perez[1], Angeliki Karanasiou[1], Silvia Alonso-Pérez[1,3,4], Pedro Salvador[3]

[1]*Institute of Environmental Assessment and Water Research, IDAEA-CSIC, 08034 Barcelona, Spain*
[2]*Aix-Marseille Université, CNRS, LCE FRE 3416, 13331 Marseille, France*
[3]*Research Centre for Energy, Environment and Technology, CIEMAT, 28040 Madrid Spain*
[4]*Izana Atmospheric Research Center, AEMET, 38071 Santa Cruz de Tenerife, Spain*
[5]*Universidad Europea de Canarias, Laureate International Universities, 38300 La Orotava, Santa Cruz de Tenerife, Spain*
**xavier.querol@idaea.csic.es*

North African dust outbreaks may have a high influence on air quality in Europe, especially around the Mediterranean Basin (MB). During specific synoptic meteorological scenarios, the normal flow of African dust towards the western Atlantic is modified in such a way that large dust streams are transported towards Southern Europe, both over the Atlantic Ocean and the Mediterranean Sea. Since June 1995 we estimate and report daily mineral African dust contributions to ambient PM10 for the different air quality monitoring networks across Spain. Furthermore, we have expanded these studies to the whole MB based on PM10 and PM2.5 2001-2011 data collected from a number of regional background air quality monitoring sites across the MB.

We present in this talk, the method devised for quantitative determinations of daily African dust contributions, the mean annual statistics of daily dust contributions to ambient PM10, PM2.5 (and PM1 levels at a few sites), and their time and spatial variation across the MB. Subsequently, we highlight the importance of having information on the daily PM10 and PM2.5 African dust net contributions as well as on the forecast of the dust outbreaks a few days before they take place. This allows us, not only to evaluate the natural and anthropogenic contributions to air quality impairment, but also to alert the most susceptible population about the occurrence of these outbreaks, and to supply data to evaluate their health effects.

We discuss the conclusions of the existing studies on health impact of dust episodes over the MB and we also suggest some possible actions to reduce resuspension of deposited African dust from urban paved roads.

Finally, we describe our recent findings showing the decrease of the atmospheric boundary layer height (BLH) during African dust outbreaks due to a reduction of the mean solar radiation reaching the surface and to the different advection of air masses. The BLH is progressively reduced with the increasing intensity of dust episodes leading to a gradual accumulation of locally generated PM1, as well as of other atmospheric pollutants. We discuss the possible influence of this process on the studies dealing with the health outcomes related with African dust episodes.

Most results presented here were obtained under the project AIRUSE.LIFE+ LIFE 11 ENV/ES/000584 and different projects from the Spanish Ministry of Agriculture, Food and the Environment.

DYNAMICS OF A SAHARAN DUST EVENT OVER THE EASTERN MEDITERRANEAN; MODELING AND LIDAR OBSERVATIONS

Mohamed Abdelkader[1]*, Swen Metzger[1], Klaus Klingmueller[1], Rodanthi-Elisavet Mamouri[2], Albert Ansmann[3], Diofantos Hadjimitsis[2], Argyro Nisantzi[2], Leonard Barrie[4], Jos Lelieveld[1,5], Zev Levin[6]

[1]*The Cyprus Institute (CyI), Centre fro Energy Environment and Water, Nicosia, 2020, Cyprus*
[2]*Cyprus University of Technology (CUT), Dep. of Civil Engineering and Geomatics, Limassol, 3036, Cyprus*
[3]*Leibniz Institute for Tropospheric Research, Leipzig, 04318, Germany*
[4]*Department of Geological Sciences, Stockholm University, Stockholm, SE-106 91, Sweden*
[5]*Max Planck Institute for Chemistry, Mainz, 55128, Germany*
[6]*Tel Aviv University, Tel Aviv, 39040, Israel*
**m.abdelkader@cyi.ac.cy*

The Saharan and the Middle East deserts are the main sources of atmospheric dust particles in the Eastern Mediterranean (EM) region. Saharan dust is generally emitted from Libya, Egypt and the Bodele Depression during the period from October to April and then transported over the Mediterranean basin by Sahara cyclones, which are generated along polar fronts and subtropical jet streams. This contributes to ~36\% of total dust days over the EM usually associated with a cold front, accompanied by rain. In addition to the dust outflow from the Middle East deserts, an increasing trend of dust concentrations in eastern part of the Mediterranean basin is reported by many studies.

This study presents an assessment of the dynamics of a strong dust outbreak from the Sahara into the EM using a high-resolution version of the Atmospheric - Chemistry General Circulation model - EMAC - in addition to ground and space-borne LIDAR observations when available. The model is nudged to ERA-Interim reanalysis data. The dust emissions are calculated online at each model time step and a detailed chemistry mechanism is considered to account for the oxidation of the sulfur, nitrogen and chlorine compounds (from anthropogenic and biogenic sources) to produce acids (sulfuric, nitric and hydrochloric acid). This allows the hygroscopic activation of the dust particles into cloud condensation nuclei (CCN) and interactions with clouds and precipitation by both impaction and nucleation scavenging. The characteristics of different removal mechanisms (wet and dry) will be presented. In addition, the dust layer elevation, thickness and optical properties will be evaluated using both simulation results and AERONET, ground based LIDAR observations (located in Cyprus) and space-borne based LIDAR when available. The combined analysis gives a better understanding of the dynamics of the strong Saharan dust outflow over the EM.

EVALUATION OF PARTICULATE POLLUTION ON THE SITE OF EL-HAJAR STEEL

In raturis sitatii sciducia quiandit facia nos et et quunturemo cuptate ctemquia et oditem que maximus.
To eume con plit, ut a qui omnis sae. Orporeptia eossimolor aut doloris ut lique ipientecepra volum num cust modi blaborerum venimollaut magnamus es ducipsa dolum late dolore inciis aut et venistiam, eosae. Pa sed qui tet et inum velique volendis et iunte peliqui dusdam vellectatius doluptae magnate plant, odi di quatem sequis es as exerchi llicim assitiatum con essitem eatur sintore preici re, officae pedit, omnitet quidi suntinitiore doluptus ant, volorepudaes dolestios velibus re, sam voluptas moluptur?
Aximenis est, accus alitatem. Mi, ut inctiore incimin ciatis aut illore voluptiur ante perchil eatemquias erempores milibus as ipsam explabor sus atus quiae volorit, ut vendandi corerum latas dolorite eum que parum eumquo iur?
Obis atus imosant ipsa quam solorro volut incipsae. Laborum volut quatus magnis niam, videbitiis doluptatibus eumqui dolorep udaectibus et od ea sunt laut odipsam fuga. Pisti temporiam, offici officientium nesedi autati del esciis dicti culligenim ad ut et lant quiaes esernatis ius imilibusda voloritis pro occuptatur, con re ped qui dolupta tiorrum id quis minusam, voluptatias untiur, se porrum que et a plabo. Ut il et, cum quo te si que sum es non nonsed ex eum rempor suntur sitem ent.
Occabores vid quia veliciatione consequia sum rem que nullabo reptatust, que eosape oditias ea commoditat doloreritem eicture perchit laut rero tempereius.
Ollorepe non parionet illam ulparibust quam ut aut lab idit faciatibus, quuntis ea sequam, que nonsectur? Qui cum inullupta alignat iaspelique vollescimi, sequissi inctibus.
Ti dolores eosanis num quiat.
Um rae eatem sequiat. Sedit officia plit magnam vid quatet volut asperibus, sam, aditiat iurepra tquatur repudiatquo cust volupti anieni que present utem. Itas es am, ommo consequi ut volupti squiam rendusdant, tet undae nonsequunt eum entibus, cum quis non re dolupta est doluptur, core, quo im excearum re, cus, cuptatusandi tetur, quat qui od moluptatqui tem remped quaerferendi totatio berchit atiorum qui alignis nobitatem quatus es sequis por magname nectat etus, cone verovitatur, tem voloribus cusda pra destrum quiatius.
Libusapedit, natiis a et, sunt laccate aped maximus, nem ium sum ex et ut etur aliquodipit hicillaborem ex eates et excerci destest, serent dolorepe es aut de cullique vendisit, estior simpore quaspid quid ea as si to et evellecest litint dollatessi odita que corit ut eos derum resto explit aut et maximus derum apel minvell aborendi consequam de et ut quatus audandebit officto digenis sinimus aeptatium int ressequ amusandi destet eum reperch iliste nobitas aces quia venimet laccatis et voles in et que occum qui te occae cullabo. Enimpores sam fugitaeped quae plit, offic tecum

AIRBORNE PARTICULATE MATTER AND BACTERIA CONCENTRATIONS IN BATTERY CAGED SYSTEMS FOR LAYING HENS: AIR DISINFECTION TRIALS

Elisa Adell[1], Salvador Calvet[1], Adriano Pérez[2], Ana Jiménez-Belenguer[3], Julio García[2], Jorge Herrera[2], María Cambra-López[1]*

[1]*Institute of Animal Science and Technology, Universitat Politècnica de València, Camino de Vera s/n, 46022, Valencia, Spain*
[2]*El Canto Agroalimentaria, Carretera de Villasequilla, km 30.9, 45420, Almonacid de Toledo, Toledo, Spain*
[3]*Department of Biotechnology, Universitat Politècnica de València, Camino de Vera s/n, 46022, Valencia, Spain*
**macamlo@upvnet.upv.es*

We evaluated the application of thermonebulized disinfectant in the air of laying hen houses to reduce airborne bacteria. Previous disinfection trials, particulate matter (PM) in two size ranges (PM2.5 and PM210), and airborne microorganisms were characterized in terms of concentrations and sources. The study was conducted in two identical commercial houses for laying hens located in Toledo (Spain) during spring. Each house was tunnel ventilated and included 100,000 laying hens in an eight-tier battery caged system. Two disinfection tests were conducted where one house was used for disinfection trials and the other served as control. Inside the houses, temperature, relative humidity, concentrations of PM_{10} and $PM_{2.5}$, and airborne mesophilic aerobic bacteria were measured. The morphology of airborne PM was examined by scanning electron microscopy (SEM). Average PM concentration was 0.024±0.025 mg/m^{3}for $PM_{2.5}$ and 0.546±0.377 mg/m^3 for PM_{10}. Particles observed with SEM were mainly from feathers, skin dander, manure, and encapsulated uric acid crystals. The concentration of airborne mesophilic aerobic bacteria ranged from 4.1 to 5.7 log colony forming units/m^3. No differences ($P > 0.05$) were detected in the concentration of airborne mesophilic aerobic bacteria during disinfection tests between the treatment and control house. In this study, air disinfection using a wide spectrum thermonebulized disinfectant was not effective in reducing the concentration of mesophilic aerobic bacteria in the air. Thus, it would be desirable to evaluate different products, doses, application frequency, and application methods to improve its efficiency in laying hen houses.

THE ROLE OF DOMINANT PERENNIAL NATIVE PLANT SPECIES IN CONTROLLING THE MOBILE SAND ENCROACHMENT AND FALLEN DUST PROBLEM IN KUWAIT

Modhi Ahmed, Noor Al-Dousari*, Ali Al-Dousari

Kuwait Institute for Scientific Research, P.O.Box:24885, Kuwait
**ndosery@kisr.edu.kw*

In arid and semi-arid regions, the dust storms are very common phenomena. Kuwait is an arid country. Most of the lands in Kuwait are desert areas with low density of vegetation cover; therefore they are exposed to dust most of the year. When the sand is blown, the sand grain jumps above the surface and reach height less than 5 cm, then the sand particle stick together causing small jumps or creep. Finally sand grains are suspended high into the air resulting in dust clouds. These suspended sand grains form may rise to a height of one kilometer or more. However, the surface winds are not able to carry sand grains higher than few meters above surface. This commonly form thick sand cloud across the country during sandstorm. The total numbers of dusty days in Kuwait are 255.4 days (Safar, 1980). It means that sandstorms and dust storms occur almost all the year. Most dominant plant species have the ability to trap sediments (sand and fallen dust) and form sandy mound around it called nabkha. There are three types of nabkhas based on their sizes: small, medium and large nabkha. The efficiency of trapping sediment depends on the height of canopy and size of bush of nabkhas. Different perennial plant species can form nabkhas such as *Haloxylon salicornicum, Cyperus conglomerates, Rbanterium epapposum, Astragallus spinosus, Halocnemum strobilaceu*, *Salicornia europaea*, *Tamarix aucheriana, Lycium shawii* and *Nitraria retusa*. Each plant must reach 10-15 cm in height before they can effectively trap sand. Once trapped in a nabkha, these cemented particles do not readily become wind re-entrained. Individual plant can form nabkha with unique sedimentological and morphological characteristics. The efficiency of the plant species in trapping sand was measured by estimating the volume of trapped sand for each plant. *Nitraria retusa, Haloxylon salicornicum and Lycium shawii* are the most efficient plant species in Kuwait in trapping mobile sand. These species trapped an average of 2 m^3, 1.3 m^3 and 1.2 m^3 respectively, of mobile sand and fallen dust. Most surface sediments consisted of coarse, medium, fine and very fine sand and few mud. Native plant species plays a major role in minimizing, controlling and reducing fallen dust.

Keywords: Fallen dust, nabkha, sediment.

INTEGRATED ENVIRONMENTAL ASSESSMENT OF DUST PHENOMENON IN THE STATE OF KUWAIT

Zahraa Alali*, Asma Abahussain, Ali el Battay

Desert and Arid Zones Science Programme, Arabian Gulf University,
Manama, 26671, Kingdom of Bahrain
**Zahraa_m_alali@hotmail.com*

The State of Kuwait is located in the north western part of the Arabian Peninsula; it is characterized by arid climate, low annual rainfall, with very hot summers and frequent dust phenomena that increased in the last decade affecting both human wellbeing and sustainable development. This study aimed at conducting integrated environmental assessment (IEA) of dust phenomenon in the State of Kuwait using DPSIR framework and analysis of policies that have been taken to mitigate it. Main climate factors (air temperature, wind and precipitation) and dust (types, intensity) were statistically analyzed from 1982 to 2012, as well as PM_{10} (2008 to 2012) from two stations, Mutlaa in rural area and Jahra in urban area. Results revealed that the number of dusty days during the last 30 years was 4027 days, from which 47% was rising dust, 45% suspended dust and 8% dust storms. NW is the prevailing wind direction (77% of the recorded period and 94% in summer), with an average wind speed of 14 km/h (8 knots). The satellite images shows that the NW winds are linked with dust phenomena and it proves and confirms the regional sources of dust phenomena in the state of Kuwait. It is expected that climate change will aggravate this phenomenon due to increase of the possibility and intensity of drought. The statistical analysis of climatologically data shows that in 2008 the dusty days comprise 72% of the year(263 days), in which the recorded rainfall was only 51 mm, comparing with an annual average of 112 mm. Anthropogenic activities also play a major role as a direct and indirect drivers of dust phenomena. For instance in 2003, with the war of liberation of Iraq, dust was recorded in Kuwait for 234 days (64% of the year), although the recorded precipitation in 2003 reached 152 mm. This increase of intensity and frequency of dust in Kuwait has adverse impacts on the economy, health and the environment. Many local responses that have been taken to mitigate such phenomena were local such as control of grazing and camping activities, cessation of gravel quarries, increasing protected areas especially near the N-NW boarder of Kuwait. The study recommended new responses directed to root causes of this phenomenon. It emphasizes the importance of the regional collaboration between the neighbor countries to mitigate deterioration of vegetation cover, and enhance the synergy between the programs of the conventions of combating desertification UNCCD, climate change UNFCCC and biodiversity CBD at local, regional and international levels.

Keywords: Dust, Kuwait, DPSIR, IEA, Climate Change, Desertification, Drought.

EMEP INTENSIVE MEASUREMENTS ON MINERAL DUST AND TRACE METALS IN PM10: SUMMER 2012 AND WINTER 2013

Andres Alastuey[1]*, Xavier Querol[1], Wenche Aas[2], Franco Lucarelli[3], *and an international EMEP team:* N Pérez, T Moreno, H Areskoug, V Balani, M Catrambone, D Ceburnis, S Conil, L Gevorgyan, K Gyula, J L Jafrezzo, C Hueglin, N Mihalopoulos, M Mitosinkova, J Pey, J P Putaud, V Rifault, K Sellegri, G Spindler, M Twigg

[1]*Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, Spain*
[2]*NILU-Norwegian Institute for Air Research, Kjeller, Norway*
[3]*Dipartimento di Fisica e Astronomia, Sesto Fiorentino (Firenze), Italy*
**andres.alastuey@idaea.csic.es*

The European Monitoring and Evaluation Programme (EMEP) under the UN-ECE CLTRAP, periodically arrange intensive monitoring periods (IMP, Aas et al, 2012). The third EMEP IMP took place in spring-summer 2012 and winter 2013 and aim to measure chemical speciation in PM10 with special emphasis on mineral dust and trace metals. Mineral dust was simultaneously determined at 16 regional background sites in summer, and at 15 in winter, representative of different European regions by using the same methodology. Samples were analysed by Proton Induced X-ray Emission (PIXE) at the INFN LABEC laboratory in Florence. At selected sites, PM10 samples were also analysed by XRF, ICP-AES and ICP-MS.

PM10 mineral dust composition across Europe is described and element affinities interpreted. Spatial and temporal variations of mineral dust composition and concentrations of trace metals are interpreted as evidencing regional variation of background aerosol composition. Higher mineral load was measured in summer, with higher concentrations in southern and eastern countries. The mineral dust episodes may be attributed to different origins. Saharan dust outbreaks were the origin of the increase of the concentration of mineral matter in south and some central European sites in summer. However, high levels of mineral dust determined at eastern European sites should be attributed to regional or local sources.

Load of mineral dust was lower in winter for most sites except for the Greek site owing to the impact of African dust outbreaks in eastern Mediterranean. A higher variability of the composition of the mineral dust has been evidenced in winter. This is partially attributed to the higher relative contribution of anthropogenic dust in winter. Also the relative contribution of K is obvious in winter at some central and eastern European sites, probably reflecting the higher impact from biomass combustion.

The spatial distribution of metals permitted to trace the influence of specific anthropogenic sources at a regional scale: shipping emissions in the Mediterranean region (V, Ni, and SO_4^{2-}), metallurgy (Cr, Ni, and Mn) in Central and Eastern Europe, and coal combustion sources (As, Se, and SO_4^{2-}) in Eastern countries.

DUST IMPACTS IN DIFFERENT CLIMATES IN THE COMMUNITY EARTH SYSTEM MODEL

Samuel Albani[1,2]*, Natalie M. Mahowald[1], Aaron T. Perry[1], Rachel A. Scanza[1], Charles S. Zender[3], Nicholas G. Heavens[4], Valter Maggi[2], Jasper F. Kok[1,5], Bette L. Otto-Bliesner[6]

[1]*Department of Earth and Atmospheric Sciences, Cornell University, Ithaca NY, USA*
[2]*Department of Environmental Sciences, University of Milano-Bicocca, Milano, Italy*
[3]*Department of Earth System Science, University of California, Irvine, Irvine CA, USA*
[4]*Department of Atmospheric and Planetary Sciences, Hampton University, Hampton VA, USA*
[5]*Now at Department of Atmospheric and Oceanic Sciences, University of California, Los Angeles, Los Angeles CA, USA*
[6]*National Center for Atmospheric Research, Boulder CO, USA*
**s.albani@cornell.edu*

Aerosol-climate interactions constitute one of the major sources of uncertainty in assessing anthropogenic and glacial radiative forcing. Here we focus on an improved representation of mineral dust in the Community Atmosphere Model and assessing the impacts of the improvements in terms of direct effects on the radiative balance of the atmosphere.

We show improvements in the simulated the dust cycle while using different parameterization sets for dust emission, size distribution, and optical properties. We find that the magnitude of the dust cycle is sensitive to the observational datasets and size distribution chosen, and that the direct radiative forcing of dust is strongly sensitive to the optical properties and size distribution used.

We present our results for simulations of different climates, including present-day and the Last Glacial Maximum.

A DUST FLUX AND SIZE DISTRIBUTION DATABASE FOR THE HOLOCENE

Samuel Albani[1]*, Natalie M. Mahowald[1], Barbara Delmonte[2], Michelle Goman[3], Valter Maggi[2], Gisela Winckler[4,5]

[1]*Department of Earth and Atmospheric Sciences, Cornell University, Ithaca NY, USA*
[2]*Department of Environmental Sciences, University of Milano-Bicocca, Milano, Italy*
[3]*Department of Geography and Global Studies, Sonoma State University, Rohnert Park CA, USA*
[4]*Lamont-Doherty Earth Observatory, Columbia University, Palisades NY, USA*
[5]*Department of Earth and Environmental Sciences, Columbia University, New York NY, USA*
**s.albani@cornell.edu*

Paleodust archives have provided invaluable information on past climate variability in several regions on the planet, and their interpretation has led to the formulation of hypotheses concerning the factors controlling the variability of the dust cycle and possible feedback mechanisms of dust on the climate system. A synthesis effort to provide a picture of the global dust cycle, its controlling mechanisms, and its climate feedbacks is of paramount importance, as is a validation frame for climate models. So far the existing dust database (DIRTMAP) is limited to a time-slice approach and estimates of the dust mass accumulation rates.

Here we present our prototype for a next generation dust database, with focus on the Holocene period, which includes quality-checked, homogeneous and accessible estimates of dust flux and size distribution time series from a compilation of sites across the globe, including natural archives such as ice cores, marine and lake sediments, peat bogs and loess/paleosol sequences.

Acknowledgements - We would like to thank Dan Muhs (USGS, Denver CO) for his contribution.

BIOLOGICAL POLLUTION, FROM POLLEN TO ALLERGENS

Roberto Albertini[1,2], Manuela Ugolotti[3], Michel Thibaudon[4], Hialine Working Team

[1]*Department of Clinical and Experimental Medicine - University of Parma, Italy*
[2]*Unit of Medical Immunology - University Hospital of Parma, Italy*
[3]*Hygiene Unit - University Hospital of Parma, Italy*
[4]*Réseau National de Surveillance Aérobiologique, France*

The prevalence and severity of allergic respiratory diseases have increased worldwide in the last decades. Exposure to airborne allergens causes allergic sensitization and respiratory symptoms. Pollen grain counts in ambient air have traditionally been assessed to estimate airborne allergen exposure. Over 400 pollen monitoring stations from different national and regional networks in Europe contribute to European Aeroallergen Network (EAN). The Italian Monitoring Network for Aerobiology (R.I.M.A.®) of the *Italian Association for Aerobiology* (AIA), was born almost 30 years ago and carries out its activities through over 40 centers belonging to Universities, Local Health Authorities, Regional Environmental Protection Agencies and other public or private institutions. RNSA (French aerobiology Network) is the 25 years old institution in charge of the pollen and molds exposure in air, the health impact measurement and the information about allergy risk for patients authorities and clinicians. In France there is about 80 pollen trap in all main cities. AIA and RNSA are members of EAS (European Aerobiology Society). However, the exact allergen content in ambient air is unknown. The HIALINE European 7FP project has addressed this issue at the European level, by monitoring Poaceae, *Betula* and *Olea* pollen types and their major allergens, i.e. Phl p5, Bet v1 and Ole e1. A Hirst type volumetric pollen traps and a high-volume Chemvol® cascade impactor have been used in this study. Some particles, PM between 2.5-10 μm, and >PM10 μm, have been collected, extracted, freeze-dryed and frozen until the immunoassay analysis. The project offered the opportunity to build an European network devoted to airborne allergens measurement by using an standardized methods. The results showed a correlation between the presence of airborne pollen and aeroallergens, showing that the Poaceae, *Betula* and *Olea* pollen types appears to be the main, if not the only, source of allergen. We have shown that exposure to aeroallergens does not only depend on the airborne pollen, but also on allergen emission from pollen, observing >10-fold differences in daily allergen release. Sometimes the results point out long-range transport of pollen with different allergenic potency that local populations. These results, will open new ways to understand the mechanism controlling sensitization and symptoms in patients with pollinosis. This information will be very useful to improve diagnostic procedures, clinical trials and specific immunotherapy. In addition, aerobiological data are very useful for authorities and individuals to the maintenance of public and private green urban spaces and for improving the biological quality of the air in our cities. Biological air quality is not often adequately assessed, as it is consider with the pollution in general so that there is no official support in many countries, in contrast with air pollution despite that part of PM 10, for example, is from biological source.

ASSESSMENTS OF DUST FALLOUT WITHIN KUWAIT

Ali M. Al-Dousari, Noor Al-Dousari*, Ashraf Ramadhan,
Modhi Ahmed, Abdulaziz Aba

Kuwait Institute for Scientific Research, P.O.Box:24885, Kuwait
**ndosery@kisr.edu.kw*

Kuwait has one of the highest dust precipitation rates in the World. The annual average number of dusty days due to dust storms or rising dust or suspended dust in Kuwait is 255.4 (70% of the year). Some 67 dust collectors were installed in 47 sites all over Kuwait. Six of these sites contain 4 collectors for radionuclide collection. The monitoring of dust fallout and associated pollen was conducted for 2 years from September 2009 to August 2011. The sites were morphologically described and the locations were identified by the Global Positioning System (GPS). Also, minerals, trace elements, grain size and statistical parameters, surface area, pollen and radionuclide maps were produced. The highest dust depositional rates were detected within the Huwaimiliyah-Wafra Wind Corridor, Sabiya and Bubiyan Island. The annual amount of dust in Kuwait varies from 10 to 1065 unit with an average of 278 t/km^2. The year 2010-2011 was found more dusty compared to 2009-2010 by 43%. The socioeconomic effect of dust storms (visibility less than 1000m) shows an increase in car accidents and allergic diseases by 8.8% and 33.1% respectively.

The analyses lead to a conclusion that the northwestern, western, and northern winds play a key role in producing dust within Kuwait. Regional areas represent the dominant sources of dust fallout, while local sources contribute appreciable amounts. The very fine and fine sand particles originate from local sources as they move in the form of saltation for a short distance and represent 37% of the average dust fallout percentages in Kuwait. There is a trend of fining in mean size of dust particles towards the east and the northeast. Mineralogically, carbonates and quartz are the major components of dust in Kuwait, feldspars are found in considerable amounts. Other minerals in the dust are gypsum, anhydrite, bassonite and heavy minerals. Carbonates are more and quartz is less towards the coastal areas compared to desert areas. Natural ^{210}Pb, man-made (anthropogenic) ^{137}Cs, and cosmogenic ^{7}Be radionuclides were determined. The assessment gave low values compared to standards; but large values were observed in Um Umara area, west of Kuwait. Pollen originates predominantly from regional sources. However, the presence of a large amount of pollen from Haloxylon *sp. Cyperus sp.* indicates that close-by regional and local areas are also a source of fallen dust.

Keywords: Dust fallout, saltation, suspension, radionuclide, pollen.

HOLOCENE DUST RECORD IN A BELGIAN PEAT BOG: MULTIPROXY GEOCHEMICAL APPROACH

Mohammed Allan[1]*, Gael Le Roux[2,3], Nadine Mattielli[4],
Natalia Piotrowska[5], Nathalie Fagel[1]

[1]*AGEs, Département de Géologie, Université de Liège, Allée du 6 Août, B18 Sart Tilman B-4000, Liège, Belgium*
[2]*Université de Toulouse ; INP, UPS; EcoLab (Laboratoire Ecologie Fonctionnelle et Environnement) ; ENSAT, Avenue de l'Agrobiopole, 31326 Castanet Tolosan, France*
[3]*CNRS; EcoLab; 31326 Castanet Tolosan, France*
[4]*Université Libre de Bruxelles, Avenue FD. Roosevelt 50, B-1050 Bruxelles, Belgium*
[5]*Department of Radioisotopes, GADAM Centre of Excellence, Institute of Physics, Silesian University of Technology, Gliwice, Poland*
**mallan@doct.ulg.ac.be, mouhamdallan@hotmail.fr*

Ombrotrophic peatlands are unique environmental archives of natural and anthropogenic atmospheric dust deposition. Their surface layers are exclusively fed by atmospheric inputs. A peat bog core from Misten in Eastern Belgium southern covering the last 7500 years (dated by ^{210}Pb and ^{14}C methods) was investigated to reconstruct dust deposition based on a combination of the Rare Earth Elements (REE) and lithogenic elements concentrations, as well as Nd and Pb isotopes data. Nd isotope signature was used to decipher between local and distal dust supplies, the Pb isotopes to trace the antropogenic influences. Peat humification was used to evaluate hydroclimatic conditions. Dust fluxes show pronounced increase at 3200-2800BC, 600BC, AD600, 1000AD, 1200AD and from 1700 AD. Lead isotope signatures are consistent with local and regional contamination by coal combustion and smelting activities. The εNd values show large variability, between -5 and -13, identifying three major sources of dust: local soils, distal volcanic and desert particles. Our results are in agreement with atmospheric reconstructions from other continental archives, confirming that the Misten peat is a valid archive for dust deposition. The approach combining geochemical elementary content and isotope data in ombrotrophic peat allows to decipher between dust flux changes related to human and climate forcing.

AEROSOL OPTICAL DEPTH INFERRED FROM ZENITH SKY MEASUREMENTS USING A NEW MULTIFILTER RADIOMETER

F. Almansa[1], E. Cuevas[1]*, C. López[2], A. Barreto[1], A. De Frutos[3]

[1]*Izaña Atmospheric Research Center (IARC), Meteorological State Agency of Spain (AEMET), Santa Cruz de Tenerife, 38001, Spain*
[2]*Sieltec Canarias S.L., La Laguna, 38230, Spain*
[3]*Group of Atmospheric Optics, University of Valladolid, Valladolid, 47011, Spain*
**ecuevasa@aemet.es*

Atmospheric aerosols play an important role in several areas affecting everyday life, particularly air quality and climate. For climate studies purposes, aerosols affect directly and indirectly the energy balance received and emitted by the earth, which is known as radiative forcing. For this reason is necessary a good knowledge of the optical and microphysical properties of atmospheric aerosols. This is a challenging task because of high spatial and temporal variability of atmospheric aerosols. Remote sensing of aerosols is a very extended technique and is normally used to routinely monitor some optical properties such as aerosol optical depth (AOD), by means of ground based and satellite measurements. Currently there are extensive networks of sun photometers all over the world to monitoring aerosols. However, this type of instrumentation is relatively expensive and requires a high maintenance level and periodical time-consuming calibrations what make difficult its deployment in remote areas like deserts.

In this paper the new low-cost device with high automation and easy maintenance SIELTEC-DSCR (SIELTEC Digital Sky Color Radiometer) is presented. This instrument is a prototype developed jointly by the company SIELTEC Canarias S.L. and Izaña Atmospheric Research Center (IARC) AEMET, to measure the intensity of sky radiation in five different wavelengths in zenithal direction. A SIELTEC-DSCR prototype has been tested at the high mountain Izaña Atmospheric Observatory (2373 m a.s.l.) where we monitor aerosols in free troposphere conditions (very low AOD) and have the opportunity to observe relatively strong dust outbreaks from the Sahara (very high AOD). We were able to estimate AOD through comparison with an AERONET Cimel CE318 sunphotometer installed at Izaña station with this instrument, being data validated in subsequent periods of time against independent measurements. Preliminary results of the SIELTEC-DSCR prototype are very promising, indicating that this inexpensive instrument might be suitable to monitor atmospheric dust in remote desert locations with little maintenance allowing us to fill important observational gaps.

DUST STORMS IN KUWAIT: SOURCES OF ORIGIN

Sarah Almutairi[1]*, Mohammad F. Yassin[2], Hassen Dashtti[3], Osama Almethen[4]

[1]*Ministry of Electricity and Water- AlDoha East Power and Water Distillation Plant, Kuwait city, PO Box 12 Safat 13001, Kuwait*

[2]*kuwait university, Department of Environmental Technology Management, Kuwait City, P.O. Box 5969, Safat 13060, Kuwait*

[3]*Directorate General of Civil Aviation- Metrological Department, Kuwait city, PO Box 17 Safat 13001, Kuwait*

[4]*The Public Authority for Applied Education & Training- Institute of Communications and Navigation, Kuwait city, PO Box 23167 Safat13092, Kuwait*

**sa.almutairi@yahoo.com*

Dust storms are among the most severe environmental problems in certain regions of the World, such as Kuwait. This study presents estimation of the dust storms sources in Kuwait at various latitudes during different seasons: summer, winter, spring, and autumn over a 12-year period. The HYSPLIT model was used to create seasonal climatologies of air parcel trajectories. Satellite data was used to compare with HYSPLIT model result. Monitored visibility levels during the twelve years for each transport pattern were collected from the meteorological stations of Kuwait Civil Aviation Department. The analysis of the visibility levels were presented and discussed in chapter 4 of this thesis. Daily trajectories computed backward for five days from a selected central origin over Kuwait at 1000, 3000 and 5000 m above the ground surface. Furthermore, the results of this work it is expected to help in establishing guidelines to assist people to protect their self from the dust as well as officials to take the proper actions.

A.Alolayan, Mohammad., Brown, Kathleen W., Evans, John S., Bouhamra, Walid S., Koutrakis, Petros. (2013). Source Apportionment of Fine Particles in Kuwait City, *Science of the Total Environment,* 448, 14-2.

Baddock, Matthew C., Bullard, Joanna E., and Bryant, Robert G. (2009). Dust source identification using MODIS: A comparison of Techniques Applied to the Lake Eyre Basin, Australia. *Remote Sensing of Environment*, 113, 1511-1528.

Brown, K. W., Bourhamra, W., Lamoureux, D.P., Evans J.S., and Koutrakis, P. (2008). Characterization of Particulate Matter for Three Sites in Kuwait, *Journal of the Air Waste Management Association*, 58(8), 994-1003.

Bu-Olayan, A.H., Thomas, B.V. (2011). Monitoring the Dust Deposition Rate and Trace Metals Levels in PM1.0 from Industrial Areas of Kuwait, *ARCH. ENVIRON. SCI.*, 5, 11-16.

Bu-Olayan, A.H., Thomas, B.V. (2012). Dispersion Model on the $PM_{2.5}$ Fugitive Dust and Trace Metals Levels in Kuwait Governorates*, Environ Monit Assess,* 184, 1731- 1737.

Dementeva, Ayuna L., Zhamsueva, Galina S., Zayahanov, Alexander S., Tsydypov, Vadim., Ayurzhanaev, A.A. (2008). Particularities of Circulation and the Analysis of Dust Storm in Sharp- Continental Climate Conditions of Mongolia, *Proc. of SPIE* Vol. 6936 69360Z-1.

Desouza, Nirmala D., Simon, Baby. , Qureshi, Muhammmad S. (2011). Evolutionary Characteristics of A dust storm over Oman on 2 February 2008, *Meteorol Atmos Phys*, 114:107-121.

Draxler, R.R. and Hess, G.D. (1998). An overview of the HYSPLIT_4 Modeling System for Trajectories, dispersion and deposition*. Aust. Metero. Mag*., 47, 295-308.

CADEX, THE CENTRAL ASIAN DUST EXPERIMENT 2014 - 2016

Dietrich Althausen[1]*, Sabur F. Abdulajev[2]

[1]Leibniz Institute for Tropospheric Research (TROPOS), Leipzig, 04318, Germany
[2]S.U.Umarov Physical-Technical Institute, Academy of Sciences of Republic of Tajikistan, Dushanbe, 734063, Tajikistan
*dietrich@tropos.de

The intercontinental transport of atmospheric particles in the free troposphere contributes remarkably to the climate changes in Central Asia and is related to the desertification of the Aral Sea area and other surrounding deserts. Especially Tajikistan is an affected country where disastrous consequences are recorded, for instance about 1/3 of all glaciers are meanwhile melted there in the last decades.
So far, only few airborne measurements of lofted particle layers in the atmosphere are performed in Tajikistan. These experiments on some days showed high dust loading up to 3 and 5 km height above Dushanbe, respectively, but couldn't be used for statistical analyses of the particle properties.
To overcome this lack of knowledge, the Central Asian Dust EXperiment will be performed in Tajikistan from October 2014 until September 2016.
Goal of this project is to provide means of vertical profiles of particle backscatter coefficient (at 3 wavelengths), particle extinction coefficient (at 2 wavelengths), and particle depolarization ratio (at 1 wavelength) as well as column-integrated values of the aerosol-optical thickness (AOT), water vapor, Ångström exponent, derived AOT modes, and derived AOT fine mode fraction. Collocated to these measurements meteorological measurements will performed to the fluctuation of the solar radiation (global, diffuse components of solar radiation), earth surface albedo, and statistical data to the change of meteorological parameters at dust storms (dust haze).
The AOT and meteorological measurements will be performed throughout the whole project time (2 years) by an AERONET-sun photometer (CIMEL) and a meteorological station in Dushanbe. A multiwavelength depolarization Raman lidar Polly^{XT} will be used for the measurements of the vertical resolved aerosol profiles within 1 year. We will compare these data, investigate contradictory and synergetic findings, develop a data base from these measurements and prepare future cooperation.
The contribution will explain in more detail the status of knowledge about the dust events in Tajikistan and the proposed technique to be used within CADEX.
We would appreciate if colleagues interesting in dust research would join us with additional measurements (in-situ, aircraft-based, etc.) and/or with measurements at surrounding places/countries.

TRENDS OF ROAD DUST EMISSIONS CONTRIBUTIONS ON AMBIENT PM LEVELS AT RURAL, URBAN AND INDUSTRIAL SITES IN SOUTHERN SPAIN

Fulvio Amato[1]*, Andrés Alastuey[1], Jesús De La Rosa[2], Yolanda Gonzalez Castanedo[2], Ana Sánchez De La Campa[2], Marco Pandolfi[1], Antonio Lozano[3], Juan Contreras González[4], Xavier Querol[1]

[1]*Institute of Environmental Assessment and Water Research (IDÆA), Spanish Research Council (CSIC), C/Jordi Girona 18-26, 08034 Barcelona, Spain*
[2]*Associate Unit CSIC-University of Huelva "Atmospheric Pollution", Center for Research in Sustainable Chemistry (CIQSO), University of Huelva, E21071 Huelva, Spain*
[3]*Agencia de Medio Ambiente y Agua de Andalucía- Consejería de Agricultura, Pesca y Medio Ambiente. Junta de Andalucía. C/Johan G. Gutenberg, nº 1. Isla de la Cartuja. 41092 Seville, Spain*
[4]*Consejería de Agricultura, Pesca y Medio Ambiente, Avda. Manuel Siurot, 50. 41071 - Seville, Spain.*
**fulvio.amato@idaea.csic.es*

The impact of road dust emissions on PM10 and PM2.5 mass concentrations recorded from 2003 to 2010 at 11 locations (rural, urban and industrial) in Southern Spain was estimated based on the chemical characterization of PM and a the use of a constrained Positive Matrix Factorization, where the chemical profile of local road dust samples is used as a priori knowledge. Results indicate that road dust increased PM10 levels on average by 21-35% at traffic sites, 29-34% at urban background sites, 17-22% at urban-industrial sites and 9-22% at rural sites. Road dust contributions to ambient PM levels show a marked seasonality with maxima in summer and minima in winter, likely due to the rainfall frequency. Decreasing concentrations trends over the sampling years where found at some traffic and urban sites but in most cases less significant than for vehicle exhaust emissions, while concentrations increased at industrial sites, probably due to local peculiarities. Concerning PM2.5, road dust contributions were lower than in PM10, as expected but still important (21-31%, 11-31%, 6-16% and 7% for traffic, urban background, urban-industrial and rural sites respectively). In addition the three main sources of road dust (carbonaceous particles, brake wear and road wear/mineral) were identified and their contributions to road dust mass loadings estimated, supporting air quality managers to drive measures aimed at preventing the build-up of road dust particles on roads.

EFFECTS OF ROAD DUST SUPPRESSANTS ON PM LEVELS IN A MEDITERRANEAN URBAN AREA

Fulvio Amato[1]*, Angeliki Karanasiou[1], Patricia Cordoba[1], Andrés Alastuey[1], Teresa Moreno[1], Franco Lucarelli[2], Silvia Nava[2], Giulia Calzolai[2], Xavier Querol[1]

[1]*Institute of Environmental Assessment and Water Research (IDÆA), Spanish Research Council (CSIC), C/Jordi Girona 18-26, 08034 Barcelona, Spain*
[2]*National Institute of Nuclear Physics (INFN) and Physics Department, University of Florence, Sesto Fiorentino, Italy*
**fulvio.amato@idaea.csic.es*

Road dust emissions abatement is currently a major challenge for a sustainable transportation causing exceedances of PM limit values and high population exposure to brake and tire wear metals. Mitigation measures have been proposed such as improved street cleaning and the use of dust suppressants. This study evaluates for the first time the effectiveness of Ca-Mg acetate (CMA) and $MgCl_2$ in reducing road dust emissions in a Mediterranean city. During a two-month campaign a typical trafficked street in the city of Barcelona was sprayed and changes in PMx levels and components were monitored at four traffic sites and one background monitoring sites. The integrated results indicate no clear effectiveness of dust suppressants. Episodic reductions of brake wear tracers were observed during CMA applications but they were not systematic over different stations and spreading days, with no reduction of PM10 and PM2.5-10. $MgCl_2$ coincided with lower PM10 concentrations at the test sites, but its effect was not confirmed by actual drops of mineral and brake-related species. In addition, an unexpected side effect of CMA was found, consisting in NH_3 stripping from the road surface (induced by the formation of $Mg(OH)_2$) and consequent marked increase of secondary inorganic aerosols as supported by laboratory experiments results.

DUST MODEL VALIDATION USING CALIPSO

Vassilis Amiridis[1]*, Ulla Wandinger[2], Eleni Marinou[1], Alexandra Tsekeri[1], Sara Basart[3], Stelios Kazadzis[4], Jose M. Baldasano[5,6], Albert Ansmann[2], Stavros Solomos[1], Haris Kontoes[1]

[1]*Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens, Athens, GR-15236, Greece*
[2]*Leibniz Institute for Tropospheric Research, Leipzig,04318, Germany*
[3]*Barcelona Supercomputing Center, Barcelona,08034, Spain*
[4]*Institute of Environmental Research and Sustainable Development, National Observatory of Athens, Athens, GR-15236, Greece*
[5]*Laboratory of Meteorology, Department of Physics, University of Ioannina, GR-45110, Greece*
[6]*Environmental Modelling Laboratory, Technical University of Catalonia, Barcelona, 08034, Spain*
**vamoir@noa.gr*

We present a new satellite product appropriate for dust model evaluation studiesbased on a new methodology applied on CALIPSO.We derive monthly mean dust extinction profiles of 1x1 degree spatial resolution over Europe and Sahara desertbased on a methodology that includes1) a lidar ratio correction, 2) a separationof the pure dust fraction from dust mixtures and 3) an optimized averaging scheme. The product is validated against ground-based AERONET and space-borne MODIS observations showing very good agreement under cloud-free conditions.The good performance of the proposed CALIPSO extinction product makes this dataset an ideal candidate for dust model validation studies over North Africa and Europe and can facilitate the provision of an accurate and robust multiyear dust climatology. A demonstration of the proposed model validation procedure is given here, including a first comparison with instantaneous and collocated dust extinction profiles simulated by the BSC-DREAM8b dust model.

Amiridis, V., Wandinger, U., Marinou, E., Giannakaki, E., Tsekeri, A., Basart, S., Kazadzis, S., Gkikas, A., Taylor, M., Baldasano, J., and Ansmann, A.: Optimizing CALIPSO Saharan dust retrievals, Atmos. Chem. Phys., 13, 12089-12106, doi:10.5194/acp-13-12089-2013, 2013.

MINERALOGICAL ANALYSIS OF EOLIAN DUST AND LOESS DEPOSITS WITH RAMAN SPECTROSCOPY

Sergio Andò*, Eduardo Garzanti

Department of Earth and Environmental Sciences, Milano-Bicocca University, Milan, 20126, Italy
**sergio.ando@unimib.it*

Quantitative mineralogical analysis of silt-sized sediments (e.g., eolian dust, suspended river load; Garzanti et al., 2011) involves considerable practical problems, including difficulties in physical separation in the laboratory and optical identification of tiny grains. Here we propose a new integrated methodology to determine the mineralogical composition of silt-sized sediments, which combines classical heavy-mineral analysis under the polarizing microscope with the innovative user-friendly Raman spectroscopy technique (Raman counting; Andò et al., 2011). Modal data can thus be obtained with the same precision level achieved in traditional mineralogical analyses of sand-sized sediments. This technique can be applied to single detrital grains as small as a few microns, and is thus appropriate to study eolian dust and loess deposits (Stevens et al., 2013; Nie et al., 2013). Quantitative provenance information can be extracted also from mudrocks, which represent a very conspicuous part of the stratigraphical record and are prone to preserve original detrital assemblages from diagenetic dissolution better than interlayered permeable sandstones. Integrated grain-by-grain mineralogical analysis of silt-sized dust and eolian loess with such innovative integrated technique opens up new frontiers in provenance studies and in the reconstruction of climate changes in the geological past.

Andò S., Vignola P., Garzanti E. (2011). Raman counting: a new method to determine provenance of silt Rend. Fis. Acc. Lincei, 327-347.

Garzanti E., Andò S., France-Lanord C., Censi P., Vignola P., Galy V., Lupker M. (2011). Mineralogical and chemical variability of fluvial sediments 2. Suspended-load silt (Ganga-Brahmaputra, Bangladesh). Earth and Planetary Science Letters, 107-120.

Nie J., Peng W., Pfaff K., Möller A., Garzanti E., Andò S., Stevens T., Bird A., Chang H., Song Y., Liu S., Ji S., (2013). Controlling factors on heavy mineral assemblages in Chinese loess and Red Clay. Palaeogeography, Palaeoclimatology, Palaeoecology , 110-118.

Stevens T., Carter A., Watson T.P., Vermeesch P., Andò S., Bird A.F., Lue H., Garzanti E., Cottam M.A., Sevastjanova I. (2013). Genetic linkage between the Yellow River, the Mu Us desert and the Chinese Loess Plateau. Quaternary Science Reviews, 1-14.

SAHARAN DUST LONG-RANGE TRANSPORT: SALTRACE LIDAR OBSERVATIONS AT BARBADOS AND ABOARD RV METEOR (GUADELOUPE TO CAPE VERDE) VERSUS DUST TRANSPORT MODELLING

Albert Ansmann[1]*, Dietrich Althausen[1], Thomas Kanitz[1], Ronny Engelmann[1], Annett Skupin[1], Holger Baars[1], Andre Klepel[1], Moritz Haarig[1], Bernd Heinold[1], Ina Tegen[1], Carlos Toledano[2], Damien Prescod[3], David Farrell[3]

[1]*Leibniz Institute for Tropospheric Research, Permoserstraße 15, Leipzig, 04318,*
[2]*Universidad de Valladolid, Paseo de Belén 7, Valladolid, 47011, Spain*
[3]*Caribbean Institute for Meteorology and Hydrology, Husband, St. James, BB23006, Barbados W.I.*
**albert@tropos.de*

In the framework of the Saharan Aerosol Long-Range Transport and Aerosol-Cloud Interaction Experiment (SALTRACE) the long-range transport of mineral dust is studied in large detail. Main goal is the characterization of dust optical and microphysical properties with focus on changes in the dust characteristics after a travel of 5000-8000 km. Two field campaigns were conducted in June-July 2013 and February-March 2014 at the Caribbean Institute for Meteorology and Hydrology (CIMH), Barbados. One further campaign at CIMH is planned for June-July 2014. Several multiwavelength Raman/polarization lidars and sun/sky photometers were deployed at CIMH in the summer of 2013. One photometer (AERONET-SALTRACE site) is running continuously from June 2013 to July 2014. As a new aspect, the lidar of our institute (TROPOS) measures, for the first time, dust linear depolarization ratios at 355, 532, and 1064 nm, simultaneously. The DLR Falcon aircraft performed more than 10 research flights during the SALTRACE summer 2013 campaign and took in-situ measurements of dust optical and microphysical properties. The RV Meteor cruise from Guadeloupe to Trinidad-Tobago and Barbados and then along 14.5°N from Barbados to 200 miles west of Senegal and back to Cape Verde complemented the SALTRACE activities on aged dust. Aboard the research vessel, a state-of-the-art multiwavelength Raman/polarization lidar (Polly XT) continuously measured the vertical dust distribution during the travel over more than 4000 km from 29 April to 23 May 2013. The lidar has two receiver field of views (RFOVs) to cover the height range of the dust-laden marine boundary layer as well as of the Saharan air layer in the free troposphere. This dual-RFOV lidar allowed us to study the downward mixing of dust (main dust removal process) in large detail. The Barbados and RV Meteor lidar observations are extensively compared with results of aerosol transport modelling. Our institute's model (COSMO-MUSCAT) is designed for simulations of the regional Saharan dust transport. The model domain was extended to include the Caribbean. Good agreement is found concerning the dust transport pattern (horizontal plume extent and vertical distribution), less agreement is observed regarding the strength of the dust load (extinction coefficient, dust optical depth, mass concentration).

LATE MIOCENE-PLIOCENE INTENSIFICATION OF THE EAST ASIAN MONSOON LINKED TO SOUTHERN HEMISPHERE ICE-SHEET DEVELOPMENT

Hong Ao[1]*, Mark J. Dekkers[2], Zhisheng An[1], Xiaodong Liu[1], Leping Yue[3], Guoqiao Xiao[4]

[1]*State Key Laboratory of Loess and Quaternary Geology, Institute of Earth Environment, Chinese Academy of Sciences, Xian 710075, China*
[2]*Paleomagnetic Laboratory 'Fort Hoofddijk', Department of Earth Sciences, Faculty of Geosciences, Utrecht University, Budapestlaan 17, 3584 CD Utrecht, The Netherlands*
[3]*State Key Laboratory of Continental Dynamics, Department of Geology, Northwest University, Xi'an 710069, China*
[4]*State Key Laboratory of Biogeology and Environmental Geology, China University of Geosciences, Wuhan 430074, China*
**aohong@ieecas.cn*

Recent evidence indicates that an East Asian monsoon broadly similar to the present may have occurred in China as early as the late Oligocene or early Miocene, but its variability and possible driving forces prior to the Quaternary epoch remain poorly known, due to rare reconstructions of continuous long-term East Asian monsoon records extending to the earlier periods. Here we report a Late Miocene-Pliocene reconstruction of the East Asian summer monsoon based on magnetic property variations of an eolian red clay sequence on the eastern Chinese Loess Plateau. The high-resolution magnetic records, which are dated using magnetostratigraphy, indicate a long-term increasing trend in the East Asian summer monsoon intensity from ca 8.2 to 2.6 Ma. We further find that this Late Miocene-Pliocene monsoon intensification is broadly correlated to the long-term increasing trend in the Southern Hemisphere ice volume, suggesting a possible linkage between them. Combing a numerical climate-model experiment that simulates the East Asian summer monsoonal responses to the idealized stepwise increases of ice sheets from East to West Antarctic, we suggested that the Southern Hemisphere ice-sheet development is a driver of this late Miocene-Pliocene intensification of the East Asian summer monsoon. The Southern Hemisphere ice-sheet development could have intensified the East Asian monsoon mainly via enhancing the cross-equatorial pressure gradient between the high pressure over Australia and the low pressures over East Asia. This study shows that the Asian monsoon is sensitive to the interhemispheric pressure gradient modulated by Southern Hemisphere climate on long-term tectonic timescales.

DUST AEROSOL OPTICAL PROPERTIES MEASURED BY SKY RADIOMETER

Kazuma Aoki

University of Toyama, Toyama, 930-8555, Japan
**kazuma@sci.u-toyama.ac.jp*

We started the long-term monitoring of aerosols optical properties since 1994, by using a sky radiometer (PREDE Co. Ltd., Tokyo, Japan) over the land and ocean (on-board Ship). Aerosol optical properties are studied using data from sky radiometer measurements (http://skyrad.sci.u-toyama.ac.jp/) in the world (Aoki and Fujiyoshi, 2003, Aoki, 2008, 2013). The sky radiometer is an automatic instrument that takes observations only in daytime under the clear sky condition without cloud contamination. Observation of direct and diffuse solar intensity of interval was made every ten minutes by once (direct measurement every one minute). There were used to analysis direct solar irradiance and diffuse solar radiance at fifth wavelength (0.4, 0.5, 0.675, 0.87, 1.02 μm). The aerosol optical characteristics were computed using the SKYRAD.pack version 4.2 developed by Nakajima et al. (1996). Global distributions of aerosol have been derived from satellite data (e.g. MODIS, GOSAT), and have been simulated in numerical model (e.g. SPRINTARS), which assume optical parameters. However, these distributions are difficult to derive because of variability in time and/or space. Therefore, a ground-based measurement of aerosol optical properties is necessary to validate satellite and numerical model. In this study, we present the temporal and spatial variation of dust aerosols and the relationship of Angsrom parameters (i.e., aerosol optical thickness and Ångström exponent) at Toyama (36.70N, 137.19E), Japan during 2002 to now, and other Japan site. The aerosol optical thickness at 0.5 μm has a clear seasonal cycle in Japan area, with a vernal maximum (dust) and an autumnal minimum. The Ångström exponent, a, has a clear seasonal cycle in Japan, where autumn to winter maxima and springtime minima (dust) are observed. We provide the information, in this presentation, on the optical properties of dust aerosol comparisons between ground observationswith respect to their temporal and spatial variability of dust.

Aoki, K, and Y. Fujiyoshi, (2003), Sky radiometer measurements of aerosol optical properties over Sapporo, Japan. J. Meteor. Soc. Japan, 81, 493-513.

Aoki, K., (2008), Aerosol and cloud optical properties by ground-based sky radiometer measurements, Proceedings of SPIE, 7027, doi: 10.1117/12.822504.

Aoki, K, T. Takemura, K. Kawamoto, and T. Hayasaka (2013), Aerosol climatology over Japan site measured by ground-based sky radiometer, AIP Conf. Proc. 1531, 284-287;doi: 10.1063/1.4804762.

Nakajima, T., Tonna, G., Rao, R., Boi, P., Kaufman, Y., Holben, B., (1996). Use of sky brightness measurements from ground for remote sensing of particulate polydispersions, Appl. Opt. 35, 2672-2686.

CYTOTOXICITY AND GENOTOXICITY OF SIZE-FRACTIONATED FLY ASHES FROM BIOMASS COMBUSTION

Ali Talib Arif[1]*, Christoph Machowski[2], Richard Gminski[1],
Irina Nazarenko[1], Patxi Garra[3], Gontrand Leyssens[3], Reto Giere[2],
Volker Mersch-Sundermann[1]

[1]*Department of Environmental Health Sciences and Hospital Infection Control, Medical Center - University of Freiburg, D-79106 Freiburg*
[2]*Institute of Earth and Environmental Sciences - Geochemistry, University of Freiburg D-79104 Freiburg*
[3]*Gestion des Risques et Environnement (GRE) Laboratory, Mulhouse, 68200, France*
**ali.arif@uniklinik-freiburg.de*

Fly ash may be a major anthropogenic component in ambient particulate matter and is derived mainly from industrial sources, including biomass combustion. In the frame of the European INTEREG research project "BIOCOMBUST", we explore a potential impact of particulate emissions from biomass combustions on human health in the Upper Rhine region. The investigated fly ash samples were obtained from two sources: a biomass power plant (burning wood chips) in St. Peter, Germany, and a laboratory boiler (burning miscanthus as fuel) in Mulhouse, France. The fly ash particles used in the exposure experiments were characterized by mineralogical and chemical techniques. Then three fractions of fly ashes (bulk, fine and ultrafine) were investigated for their *in-vitro* cytotoxic and genotoxic effects on human lung cells, namely, the human lung adenocarcinoma cell line A549 and the immortalized human bronchial epithelial cell line BEAS-2B. As controls, calcium carbonate ($CaCO_3$) and potassium sulphate (K_2SO_4), identified as main components of the fly ash particles were used in the experiments. After 24 hours of exposure, the cytotoxicity of particles from the wood fly ash and of ultrafine particles of reference materials (diesel particulate matter (DPM) and silicon dioxide (SiO_2)) appeared first at the high concentration of 50 µg/ml. However, no cytotoxic effect was observed upon application of particles from the miscanthus fly ash on the lung cells, as assessed by WST-1 and the Alamar Blue assays. Genotoxic effects analysed by the DNA alkaline unwinding assay, were observed at high concentrations of studied DPM and SiO_2 reference materials, but none of the studied fly ash fractions showed genotoxicity after 24 hrs of exposure.
Altogether, these experiments suggest that fly ash particles from wood combustion can cause cytotoxic effects at high concentrations, albeit no genotoxic effects were observed. They further suggest that miscanthus fly ash was neither cytotoxic nor genotoxic for human lung cells. Further experiments are needed to corroborate these results and to find out which components of the wood fly ash and which biological mechanisms are responsible for observed toxic effects.

STUDY OF SAHARA DUST OUTBREAKS EPISODES OVER THE PO VALLEY (NORTHERN ITALY) USING IDEA INTERNATIONAL AIR QUALITY FORECAST PRODUCT

Barbara Arvani[1]*, R. Bradley Pierce[2], Sergio Teggi[1], Grazia Ghermandi[1]

[1]*Dip. di Ingegneria "Enzo Ferrari" Universita' di Modena e Reggio Emilia, Modena, 41125, Italy*
[2]*NOAA/NESDIS Advanced Satellite Products Branch, Madison, 53706, Wisconsin (USA)*
**barbara.arvani@unimore.it*

A transport of Sahara (northern Africa) dust above the Mediterranean Sea and Europe is widely studied throughout the literature. A plume of African dust may be the cause of an anomalous increase of aerosol optical depth (AOD), often accompanied by increases in surface particulate matter concentrations over the entire Mediterranean basin, including the Po valley domain in northern Italy. Therefore, it is an issue in air quality assessment and forecast to understand how the Sahara dust contributes to the increase of the AOD, since AOD is strongly correlated with an increment of the daily legal limit of particulate matter PM_{10} (50 μg/m3), set by the European Union on 2008 (2008/50/CE).

The present work studies an intense African dust outbreak episode which affected the Po valley in early May, 2013. The approach proposed in this work includes the use of the International MODIS/AIRS Processing Package (IMAPP) Air Quality Applications software, IDEA-I (Infusing satellite Data into Environmental Applications-International) in order to evaluate the impact of the plume of Sahara dust on the air quality measurements of surface PM_{10} concentrations over the Po valley domain. IDEA-I is a globally configurable software package that uses Terra or Aqua MODerate resolution Imaging Spectro-radiometer (MODIS) AOD retrievals to identify local regions of high AOD. From these points trajectories are initialized and a trajectory model is then run which provides a forecast of the horizontal and vertical movement of the aerosols over the next 48 hours. The satellite (MODIS Terra/Aqua) observations show the intense outbreaks of dust from north of Africa over Italy. They also show significant cloud cover over northern Italy during the dusty days. Even though significant dusty days occurred between the end of April and May 2013, the ground based concentrations do not show significant increases, with values of PM_{10} remaining within the daily legal limit. A further study, using meteorological and aerosol analyses from the Real-time Air Quality Modeling System (RAQMS), helps to understand the role of wet deposition on reducing surface PM_{10} concentrations during the episodes studied.

PROPERTIES AND ORIGIN OF FINE SEDIMENT WITHIN LATE-LYING SNOWBANKS IN THE UINTA MOUNTAINS, UTAH, USA

Emily Attwood*, Jeffrey Munroe

Middlebury College, Middlebury, 05753,United States
**attwoodem@gmail.com*

Interest in modern dust deposition has risen as the effects of anthropogenic modification of the landscape have been brought to the forefront of climate change discussions. Increased atmospheric dust deposition is a key consequence of landscape disruption due to both human activities and transitions within climate regimes. In particular, deposition of atmospheric dust within alpine environments has strong implications for soil development, vegetation growth, nutrient cycling, surface water chemistry, and snowpack properties. In the Uinta Mountains of northeastern Utah, USA, over 60% of annual precipitation falls as snow, much of which persists into the summer season. Concentrations of dark, fine-grained sediment are commonly observed at the surface of snowbanks and typically assumed to be of eolian origin, however this interpretation has not previously been tested. In this study, we analysed dirty snow samples from 14 late-lying snowbanks, along with 14 samples from the soil surface in the vicinity of these snowbanks. The primary objective was to determine whether the fine-grained sediment in the snow is exotic eolian dust or more locally sourced material. Grain size distributions are different between the two sets of samples, with abundant very fine sand and coarse silt in snow samples (mean GS of ~90 µm), and medium to fine sand in samples of soil near snowbanks (mean of ~150 µm). X-ray diffraction analysis of the fine-silt fraction from both sets of samples reveals that the sediment within the snow, and the surrounding soil, contain amphibole and plagioclase. Neither of these minerals are present in the local bedrock or in soil B horizons, yet both are present in modern dust samples collected directly from the air. Together these results suggest that the fine-grained sediment concentrated at the surface of late-lying snowbanks is modern eolian dust from an exotic source, and that long-term deposition of this dust has contributed to the formation of soil A horizons.

ELEMENTAL CHARACTERIZATION OF POTENTIAL ATMOSPHERIC DUST SOURCES OF VICTORIA LAND (ANTARCTICA, ROSS SEA SECTOR) BY NEUTRON ACTIVATION

Giovanni Baccolo[1,2]*, Carlo Baroni[3], Massimiliano clemenza[2,4], Barbara Delmonte[4], Valter Maggi[2,4], Alessandra Motta[2,4], Massimiliano Nastasi[2,4], Ezio Previtali[2,4], Maria Cristina Salvatore[3]

[1]*Università degli Studi di Siena, Siena, 53100, Italy*
[2]*INFN, sezione Milano-Bicocca, Milano, Milano, 20126, Italy*
[3]*Università di Pisa, Pisa, 56126, Italy*
[4]*Università degli Studi di Milano-Bicocca, Milano, 20126, Italy*
**giovanni.baccolo@mib.infn.it*

Recent investigations carried out on the Talos Dome ICE core (TALDICE) revealed the presence of a local fraction of mineral dust entrapped in the ice [1-4]. Several evidences point to the ice-free areas of Victoria Land as possible sources. Here the elemental composition of 40 samples of mineral sediments collected in correspondence of ice-free areas of the Victoria Land is presented [5]. The geochemistry of samples was determined by Instrumental Neutron Activation Analyses (INAA), which allowed quantifying the concentration of 36 elements, spanning from major to trace elements. Two different sample irradiations and 5 data acquisitions were necessary to measure the maximum number of elements. Geochemical results and principal components analyses suggest that the most discriminating elements are the rare earth elements (REE) and incompatible/compatible ones in respect to iron, in accordance with the different lithological composition of the samples. Evidences of chemical weathering were also recognized despite the extremely cold and dry climate of these areas. The characterization of the Antarctic potential source areas of atmospheric dust is the first step in order to identify the active source areas in respect to Talos Dome and to reconstruct the atmospheric trajectories followed by air masses in the different climatic periods.

1. Delmonte, B., Baroni, C., Andersson, P.S., Shoberg, H., Hansson, M., Aciego, S., Petit, J.R., Albani, S., Mazzola, C., Maggi, V., Frezzotti, M. (2010). Aeolian dust in the Talos Dome ice core (East Antarctica, Pacific/Ross Sea sector): Victoria Land versus remote sources over the last two climatic cycles. Journal of Quaternary Science, 25:1327-1337.
2. Albani, S., Delmonte, B., Maggi, V., Baroni, C., Petit, J.R., Stenni, B., Mazzola, C., Frezzotti, M. (2012). Interpreting last glacial to Holocene dust changes at Talos Dome (East Antarctica): implications for atmospheric variations from regional to hemispheric scales. Climate of the Past, 8:741-750.
3. Delmonte, B., baroni, C., Andersson, P.S., Narcisi, B., Salvatore, M.C., Petit, J.R., Scarchilli, C., Frezzotti, M., Albani, S., Maggi, V. (2013). Modern and Holocene aeolian dust variabilità from Talos Dome (Northern Victoria Land) to the interior of the Antarctic ice sheet. Quaternary Science Review, 64:76-89
4. Lanci, L., Delmonte, B. (2013). Magnetic properties of aerosol dust in peripheral and inner Antarctic ice cores as a proxy for dust provenance. Global and Planetary Change, 110:414-419.
5. Baccolo, G., Baroni, C., Clemenza, M., Delmonte, B., Maggi, V., Motta, A., Nastasi, M., Previtali, E., Salvatore, M.C. (2013). Neutron activation analysis on sediments from Victoria Land, Antarctica: multi-elemental characterization of potential atmospheric dust sources. Journal of Radioanalytical and Nuclear Chemistry, 10.1007/s10967-013-2851-x.

ON THE CHARACTERIZATION OF SIZE AND SHAPE OF IRREGULAR PARTICLES

Gholamhossein Bagheri[1]*, Costanza Bonadonna[1], Irene Manzella[1], Pierre Vonlanthen[2]

[1]*Section des sciences de la Terre et de l'environnement, Geneva, 1205, Switzerland*
[2]*Institut des sciences de la Terre, Lausanne, 1015, Switzerland*
**Gholamhossein.Bagheri@unige.ch*

The characterization of particle size and shape is crucial to many fields of science, but is often associated with large uncertainties. In this study, size and shape characteristics of 115 lapilli particles (11-37 mm) and 12 volcanic-ash particles (155-930 microns) were measured based on different techniques including calliper, image analysis, laser scanning (LS) and SEM micro-computed tomography (CT). A new strategy for measuring particle form dimensions (three-dimensional lengths of the particle) is suggested that is associated with the lowest operator-related errors. Corresponding form dimensions perform better for both the correlation and estimation of particle volume and surface area. A systematic approach was used to investigate the effects of particle orientation and number of particle projections on the characterization of size and shape of irregular particles through image analysis. It was found that using three perpendicular particle projections for measuring 2D quantities is the best comprise between analysis time and obtained accuracy. Various shape descriptors of our population of particles were measured and the variability and correlations between them are investigated. We also investigated how conventional methods that are used to characterize particle size and shape are differing from accurate 3D measurements. Finally, various methods for the evaluation of 3D factors, i.e. volume, surface area and sphericity, based on 1D and 2D factors were investigated. It was found that 1D factors could estimate particle volume with low average error, while estimating surface area and sphericity based on 1D factors is associated with a high uncertainty. Formulas that are based on 2D factors are associated with the lowest average errors between 2.6 and 4.6%.

DUST STORMS FROM TAILING DUMPS: ANALYSIS OF DUST EMISSION CONDITIONS AND NUMERICAL MODELING OF ATMOSPHERIC TRANSPORT PROCESSES AND EFFICIENCY OF PREVENTING MEASURES

Alexander Baklanov[1], Pavel Amosov[2]

[1]*World Meteorological Organization, Geneva, Switzerland (abaklanov@wmo.int)*
[2]*Kola Science Center of Russian Academy of Sciences, Apatity, Russia*

Dusting from technological surfaces, e.g. tailing dumps, still remains a vital issue especially for areas with intensive mining and industrial activities.
Based on multi-years measurements and simulations of different dust storm events the intensity and conditions of dust blowing and emissions are analyzed. The study examines the following factors and conditions: wind velocity, humidity and other meteorological parameters, material moister content, size and shape of particles, efficiency of dust catching, height and geometry of tailing dumps, etc., as well as specific measures to reduce dusting, e.g. protecting fences. The study presents also results of numerical simulations of atmospheric flow and dust transport and influence of tailing dumps on potential contamination of the atmospheric environment in different conditions.

Keywords: dusting, tailings impoundment, pollution, atmosphere, modeling.

BARCELONA DUST FORESCAST CENTER

José M. Baldasano[1,2]*, Sara Basart[1], Oriol Jorba[1],
Enric Terradellas[3]

[1]*Earth Sciences Department, Barcelona Supercomputing Center-Centro Nacional de Supercomputación, BSC-CNS, Barcelona, Spain*
[2]*Environmental Modelling Laboratory, Technical University of Catalonia, Barcelona, Spain*
[3]*Spanish Meteorological Agency, AEMET, Barcelona, Spain*
**jose.baldasano@bsc.es*

The World Meteorological Organization (WMO) has chosen Barcelona's bid to host the first Regional Meteorological Center specialized on Atmospheric Sand and Dust Forecast (RSMC-ASDF). The experience acquired with the management in coordination of the WMO Sand and Dust Storm Warning Assessment and Advisory System (SDS-WAS) Northern Africa-Middle East-Europe (NA-ME-E) Regional Center managed by a consortium formed by the Spanish State Meteorological Agency (AEMET) and the Barcelona Supercomputing Center (BSC-CNS) will significantly contribute to the production of excellence research and creation of specialized products for the end-users. The new RSMC-ASDF center will run the NMMB/BSC-Dust model and will provide operational forecasts for Northern Africa, Middle East and Europe.

The NMMB/BSC-Dust model (Pérez et al., 2011; Haustein et al., 2012; Spada et al., 2013) has been developed at the Barcelona Supercomputing Center (BSC) in collaboration with NOAA/National Centers for Environmental Prediction (NCEP) and the NASA Goddard Institute for Space Studies. In the present contribution, the dust forecasts of 3 different configurations (at 1ºx1.4º, 0.25º0.25º and 0.10ºx0.10º) will be evaluated using ground-based (AERONET) and satellite data (MIRS, MODIS and OMI) to quantify the limitations and their range of the agreement of with the observations as well as to determine the sensitivity of the dust emission fluxes to different spatial scales.

Haustein, K., C. Pérez, J.M. Baldasano, O. Jorba, S. Basart, R.L. Miller, Z. Janjic, T. Black, S. Nickovic, M.C. Todd, and R. Washington. (2012): Atmospheric dust modeling from meso to global scales with the online NMMB/BSC-Dust model - Part 2: Experimental campaigns in Northern Africa. Atmos. Chem. Phys., 12, 2933-2958, doi:10.5194/acp-12-2933-2012.

Pérez, C., Haustein, K., Janjic, Z., Jorba, O., Huneeus, N., Baldasano, J. M., Black, T., Basart, S., Nickovic, S., Miller, R. L., Perlwitz, J. P., Schulz, M., and Thomson, M. (2011). Atmospheric dust modeling from meso to global scales with the online NMMB/BSC-Dust model - Part 1: Model description, annual simulations and evaluation, Atmos. Chem. Phys., 11, 13001-13027, doi:10.5194/acp-11-13001-2011.

Spada, M., O, Jorba, C. Pérez García-Pando, Z. Janjic, and J.M. Baldasano (2013) Modeling and evaluation of the global sea-salt aerosol distribution: sensitivity to size-resolved and sea-surface temperature dependent emission schemes. Atmos. Chem. Phys., 13, 11735-11755 www.atmos-chem-phys.net/13/11735/2013/ doi:10.5194/acp-13-11735-2013

Corrigendum: Atmos. Chem. Phys., 13, 1, 2013 www.atmos-chem-phys.net/13/1/2013/ doi:10.5194/acp-13-1-2013

A NEW GLOBAL MINERALOGICAL DATABASE: TOTAL IRON AND SOLUBLE IRON FLUXES AT THE ATMOPHERE-OCEAN INTERFACE

Yves Balkanski[1]*, Emilie journet[2], Remi Losno[3], Rong Wang[1], Marion Gehlen[1], Laurent Bopp[1], Kostas Tsigaridis[4], Sandy Harrison[5]

[1]*IPSL/LSCE, Gif-sur-Yvette Cedex, 91191, France*
[2]*LISA,Un. of Créteil, Créteil, 94010, France*
[3]*IPGP, Paris, 75005, France*
[4]*CCSR, Columbia Un. & GISS, New York, 10025, United States*
[4]*Macquarie University, North Ride, NSW 2109, Australia*
**yves.balkanski@lsce.ipsl.fr*

We gathered 594 descriptions of soil mineralogy from more than 120 references to create a global mineralogical database of soils at a 0.5°x0.5° resolution. The basic mineralogical information derived from the literature is then expanded following explicit rules in order to characterize as many soil units as possible. We separate the clay from the silt-sized fractions of global soil units in this description and end up for each 0.5°x0.5° cell size with the abundance of 12 minerals important for dust-climate interactions: quartz, feldspars, illite, montmorillonite, kaolinite, chlorite, vermiculite, mica, calcite, hematite and goethite (Journet et al., 2013).
Probably, the most desirable information for marine geochemistry comes from our assessment of the iron content in soils. Using global atmospheric dust cycle modeling, we transport this iron through the atmosphere and produce detailed maps of total iron fluxes to the ocean. We compare these maps with the deposition maps assuming a constant iron content in dust.
Furthermore, we use the soluble iron content of the individual minerals to infer the soluble iron delivered to the ocean surface. We will discuss the atmospheric processes that affect iron solubility that we would like to include in the integrated framework of the IPSL Earth System Model.

Journet E., Balkanski Y., Harrison N. (2013). A new data set of soil mineralogy for dust-cycle modeling, Atm. Chem. Disc., doi:10.5194/acpd-13-23943-2013.

DROUGHT IN MIDDLE EAST FERTILIZES THE ARABIAN SEA

Priyanka Banerjee*, S. Prasanna Kumar

CSIR-National Institute of Oceanography, Dona Paula, G oa-403 004, India
**pbanerjee@nio.org*

Mineral dust influences the climate system manifold in regions far away from the dust sources and is a critical link between the terrestrial and marine ecosystems. The arid and semi-arid regions of the Middle East are an important source of dust for the Indian Ocean. Here we show that the increased dust transport due to severe drought condition in the Middle East led to potential fertilization of the Arabian Sea (AS), the northwest part of the Indian Ocean. During the year 2008 Middle East was in the grip of one of the most severe droughts of the 21st century recording -3.7 in the Palmer Drought Severity Index (PDSI). The annual dust optical depth was 0.25, the highest recorded during the period 2003-2011 over AS. We combined satellite measurements, model data and published in situ nutrients data to examine the effect of increased dust on the primary productivity of the AS, focusing mainly on the winter monsoon (WM) period (December 2007 to March 2008). For this we compared the chlorophyll (Chl) concentrations obtained from Moderate Resolution Imaging Spectroradiometer (MODIS) onboard Aqua during the WM of 2007-2008 with that of the climatological values constructed for the period of 2002-2003 to 2010-2011. We could identify 7 dust storms following 5 of which there were compelling evidences of Chl enhancements. The Chl concentrations increased about 2 to 4 times the climatological values. Calculations using a mixed layer depth model and existing nutrients data (nitrate and dissolved iron) showed that oceanic supply of nutrients could not have resulted in the observed levels of Chl biomass. Although, northern AS experiences winter convection driven high primary productivity at this time of the year, the atmospheric deposition of nutrients seemed to extend the domain of high productivity much more southwards where the intensity of winter convection is considerably reduced. This resulted in high primary productivity in a region which rarely experiences phytoplankton blooms during WM. We simulated the dust deposition (dry+wet) employing a regional climate model for the year 2008. The average dust deposition in 2008 ranged from ~ 100 mg/day/m^2 in the northwestern AS to ~ 1 mg/day/m^2 towards the south. The region where dust-induced Chl enhancements were observed had comparatively lower dust deposition. For the open ocean region of the AS, the dust deposited in the year 2008 was 21 mg/day/m^2 against a deposition of about 5 mg/day/m^2 during WM. In the last decade there is evidence of prolonged drought in the Middle East. It is important to understand the implications of such events in the context of overall productivity of the AS and further how it will be impacted under the ensuing climate change scenario.

SATELLITE RETRIEVALS OF THE DUST DIRECT RADIATIVE EFFECT OVER THE BORDJ BADJI MOKHTAR SUPERSITE DURING THE FENNEC CAMPAIGN IN JUNE 2011

Jamie Banks[1]*, Helen Brindley[1], John Marsham[2]

[1]*Imperial College London, London, SW7 2AZ, UK*
[2]*University of Leeds, Leeds, LS2 9JT, UK*
**j.banks@imperial.ac.uk*

Many studies have indicated the significance of atmospheric dust to the radiation budget over the Sahara. Here we combine satellite observations from the SEVIRI and GERB instruments on Meteosat-9 with ground based observations from the Bordj Badji Mokhtar (BBM) supersite in southern Algeria during the Fennec campaign in June 2011. From this combination we can estimate the direct, cloud-free radiative impact of Saharan dust at the top-of-the-atmosphere (TOA) and surface, and its impact on atmospheric radiative divergence, during sunlit hours. We find that the short-wave (SW) heating and cooling effects of dust tend to dominate the instantaneous direct radiative effect (DRE) at the TOA and surface, although there is more equivalence between the SW and the long-wave (LW) effects in the monthly mean DRE at TOA. The relative contributions of the SW and the LW fluxes vary through the day, with maximum atmospheric dust heating in both bands towards local noon, and a greater tendency for SW cooling at TOA shortly after dawn and before dusk. The potential impact of restricted sampling of the daily cycle on estimates of the DRE at TOA and the surface, and on the atmospheric radiative divergence due to dust, is also assessed.

THE EFFECT OF FIREWORK ON THE ELEMENTAL CONCENTRATION OF DUST DEPOSITED ON TREE LEAVES

Edina Baranyai[1]*, Edina Simon[2], Mihály Braun[3],
István Fábián[1], Béla Tóthmérész[2]

[1]*University of Debrecen, TTK, Department of Inorganic and Analytical Chemistry, Agilent Atomic Spectroscopy Laboratory, 4032 Debrecen, Egyetem tér 1.*
[2]*University of Debrecen, TTK, Department of Ecology, 4032 Debrecen, Egyetem tér 1*
[3]*Institute of Nuclear Research of the Hungarian Academy of Sciences, Herteleni Laboratory of Environmental Studies, 4026 Debrecen, Bem tér 18/C*
**baranyai.edina@science.unideb.hu*

Explosive pyrotechnic devices are widely used for celebrating specific events. The quality and composition of these are strictly regulated by the law in Hungary. At the same time firework events are unusual sources of air pollutants since metal particles, different organic compounds and gases access the atmosphere during the explosions. In the city of Debrecen the bank holiday of 20th August is celebrated by firework. The event is organized at the same time in two different locations. Our aim was to investigate the effect of the firework display on the quantity and the elemental concentration of dust particles collected from tree leaves. The collection of control samples took place a few days before the event from the individuals of the selected species (Tilia tomentosa), while the trees were indicated and the coordinates were registered. Sample collection from the same 41 individuals were replicated after the firework event. Deposited dust particles were removed from the surface of the collected leaves mechanically and their mass was determined. Dust samples were acid digested prior to analysis. The elemental analysis of dust particles was carried out by ICP-AES (Inductively coupled plasma atomic emission spectrometry) and MP-AES (Microwave plasma atomic emission spectrometry) methods.
Evaluation of the gained data were carried out by principal component analysis (PCA) for which the two sampling sites were further divided into 5-5 areas by the points of the compass. We studied the change in the amount of dust deposited on the surface of the leaves and in the determined Ca, Mg, K, Mn, Cu, Zn, Fe, Al, Ba, B, Li, As and Sr concentration of the samples collected before and after the firework event. According to the statistical analysis significant differences were observed in the concentration of the studied elements.

Keywords: firework, urban dust pollution, elemental analysis.

MODELLING MINERAL DUST EMISSIONS OVER NORTH AFRICA AND MIDDLE EAST USING A NEW SATELLITE SURFACE PROPERTIES DATABASE

Sara Basart[1]*, Oriol Jorba[1], Carlos Pérez García-Pando[2,3], Catherine Pringet[4], Jose Maria Baldasano[1,5]

[1]*Earth Sciences Department, Barcelona Supercomputing Center-Centro Nacional de Supercomputación, BSC-CNS, Barcelona, 08034, Spain*
[2]*NASA Goddard Institute for Space Studies, New York, New York, USA*
[3]*Department of Applied Physics and Applied Math, Columbia University, New York, New York, USA*
[4]*Laboratoire d'Etudes du Rayonnement et de la Matière en Astrophysique, CNRS UMR 8112, Observatoire de Paris, Paris, France*
[5]*Environmental Modelling Laboratory, Technical University of Catalonia, Barcelona, 08034, Spain*
**sara.basart@bsc.es*

Dust models used to estimate vertical fluxes of mineral dust aerosols over arid regions need accurate data on soil and surface properties. Recently, satellite-derived roughness length and high-resolution soil texture data sets at the global scale have emerged and provide the opportunity to use them in advanced emission schemes in global and regional models (i.e. Menut et al., 2013).

The present contribution analyses the behaviour of the NMMB/BSC-Dust model (Pérez et al., 2011) when the ASCAT/PARASOL satellite-derived global roughness length and the State Soil Geographic database Food and Agriculture Organization of the United Nations (STATSGO-FAO) soil texture data set (based on wet techniques) is used.. We explore the sensitivity of the drag partition scheme (a critical component of the dust emission scheme) and the dust vertical fluxes (intensity and spatial patterns) to the roughness length. An annual evaluation of NMMB/BSC-Dust (for the year 2011) over North Africa and Middle East using observed aerosol optical depths (AODs) from Aerosol Robotic Network sites and aerosol satellite products (MODIS and MISR) will be discussed.

Menut, L., C. Pérez, K. Haustein, B. Bessagnet, C. Prigent, and S. Alfaro (2013), Impact of surface roughness and soil texture on mineral dust emission fluxes modeling, J. Geophys. Res. Atmos., 118, 6505-6520, doi:10.1002/jgrd.50313.

Pérez, C., Haustein, K., Janjic, Z., Jorba, O., Huneeus, N., Baldasano, J. M. and Thomson, M. (2011). Atmospheric dust modeling from meso to global scales with the online NMMB/BSC-Dust model-Part 1: Model description, annual simulations and evaluation. Atmospheric Chemistry and Physics, 11(24), 13001-13027.

TESTING RADIATIVE FEEDBACKS BETWEEN DUST AND CLIMATE IN GLACIAL CYCLE SIMULATIONS

Eva Bauer*, Andrey Ganopolski

Potsdam Institute for Climate Impact Research (PIK), Earth System Analysis, 14412 Potsdam, Germany
**eva.bauer@pik-potsdam.de*
andrey@pik-potsdam.de

Theoretical studies and data analyzes indicate manifold interactions between mineral dust and the climate system during glacial-interglacial climate cycles. These interactions include the ice-albedo feedback by dust deposition on ice surfaces, biogeochemical processes connected with iron-fertilization of marine biota, and the scattering and absorpting capacity of aeolian dust particles affecting the atmospheric radiation fluxes. Here, new simulation results are presented on the radiative effects by aeolian dust using an Earth system model of intermediate complexity coupled to a dust cycle model (Bauer and Ganoplosky, 2010) and an ice sheet model (Ganoploski and Calov, 2011). This model is driven by orbital-varying insolation and greenhouse gas forcing. The dust radiative forcing is simulated in consideration of average dust characteristics and their uncertainties obtained from the AEROCOM studies (Kinne et al., 2006; Textor et al. 2006). A series of sensitivity experiments is analyzed which use lower and upper limits for the atmospheric dust load and for the optical parameter related to absorption by aeolian dust.

The simulation results suggest that the strength of the dust radiative forcing can vary strongly in time and location due to the horizontally irregular distribution of dust load and the uncertainties in the complex refractive index. Further, the sign of the dust radiative forcing can vary depending on environmental conditions which control the critical value of the surface albedo. The application of the dust radiative forcing in transient simulations produce changes in temperature and precipitation fields which can in turn modify the aeolian dust cycle. The climate cools by a negative dust radiative forcing leading to increases in dust emission and thereby to a stronger dust radiative forcing and growing inland ice sheets, while a small or even positive dust radiative forcing can reduce the atmospheric dust load and further weaken the dust radiative forcing. These feedback processes in the climate system have the potential to either amplify or attenuate the glacial-interglacial cooling strength. Limitations of the current results due to simplified descriptions of micro-physical processes in long-term simulations need to be tested in future by glacial cycle studies with general circulation models of the Earth system.

Bauer E., Ganoploski A. (2010). Aeolian dust modeling over the past four glacial cycles with CLIMBER-2. Global and Planetary Change, 74, 49-60.

Ganopolski A., Calov, R. (2011). The role of orbital forcing, carbon dioxide and regolith in 100 kyr glacial cycles, Climate of the Past, 7, 1415-1425.

Kinne S., Schulz M. et al. (2006). An AeroCom initial assessment - optical properties in aerosol component modules of global models, Atmospheric Chemistry and Physics, 6, 1815-1834.

Textor C., Schulz, M. et al. (2006). Analysis and quantification of the diversities of aerosol life cycles within AeroCom, Atmospheric Chemistry and Physics, 6, 1777-1813.

LONG-RANGE TRANSPORT OF SAHARAN DUST OVER NORTHWESTERN EUROPE DURING EUCAARI 2008 CAMPAIGN: EVOLUTION OF DUST OPTICAL AND HYGROSCOPIC PROPERTIES

Nelson Bègue[1]*, Pierre Tulet[1], Greg Roberts [2], Jacques Pelon[3], Jean-Pierre Chaboureau[4]

[1]*Laboratoire de l'Atmosphère et des Cyclones UMR 8105 CNRS, Saint-Denis, 97715, Réunion (France)*
[2]*CNRM/GAME URA 1357 CNRS-Météo-France, Toulouse, 31057, France*
[3]*LATMOS, Paris, 75252, France*
[4]*Laboratoire d'AerologieUniversity of Toulouse III,Toulouses, 31400, France*
**nelson.begue@univ-reunion.fr*

The evolution of dust properties is illustrated in this study through a case of long-range transport of Saharan dust over northwestern Europe during May 2008. This spread of dust over northwestern Europe is investigated by combining satellite, airborne, ground-based observations and the non-hydrostatic meso-scale model Meso-NH. The total dust amount emitted during the study period is estimated to 185 Tg. The analysis of the removal processes reveals that only 12.5 Tg is lost by dry deposition, and that wet deposition is the main process of dust removal (73 Tg).The observed aerosol optical thickness ranged from 0.1 to 0.5 at the wavelength of 440 nm, with a maximum value close to unity found over the Netherlands (51.97°N, 4.93°E). Over that site, the main dust layer is located between 1.8 and 5.2 km above sea level (asl), moreover dust was also present at 0.9 km asl. The nephelometer measurements on board the ATR-42 aircraft revealed a strong wavelength dependence of the scattering coefficient over the Netherlands. The Angström exponent is greater than 0.5, whereas usually it approaches zero in presence of Saharan dust. This specific behavior is attributed to high precipitation scavenging efficiency for the coarse mode.

Over the Netherlands, the observed CCN concentration significantly increased between the 29th and 31th May, with a maximum value close to 14000 particles per cm^3 at 0.45% supersaturation. The numerical simulations revealed the dust plume reached the Netherlands on the 30th May passing by Italy on the 28th May. Furthermore, the presence of mixing layers between dust plume and pollution aerosols are simulated over Italy and the Netherlands. The mixing layer is simulated between 1 and 4 km over Italy, whereas it is simulated between the surface and 3 km over the Netherlands. Our results reveal that this significant increase of the CCN concentration is due to an enhancement of the dust hygroscopic properties, by coating soluble materials during their transport to the Netherlands. Thus, this study reveals the two primary mechanisms of evolution of the Saharan dust properties are wet deposition and mixing processes with the European pollution aerosols.

PARTICULATE MATTER IN VENETO AND MESTRE'S WEST BYPASS IMPACT

Pierantonio Belcaro*, Lorenzo Mengotti, Federico Rizzardo

Regione del Veneto, Sezione Sistema Statistico Regionale, Venezia, 30123, Italy
**pierantonio.belcaro@regione.veneto.it*

The analysis considers the quality of the air in Veneto and its trend in relation to particulate matter. We analysed the annual averages of PM10 concentration in the monitoring stations located in traffic areas, industrial areas and background areas. We examined data from ARPAV monitoring stations, placed in different contexts: 10 in traffic areas and industrial areas and 19 in background areas. We can observe a decreasing trend from 2005 to 2010: the limit set by law is 40μg/m3 and this limit has been observed since 2007 in the background areas and since 2009 in the traffic areas and industrial areas. A worsening of the situation occurred in 2011 and then, in 2012, the annual average returned lower than 40μg/m3. There are two main factors that can modify the annual average PM10 concentration: the emissions level and the climatic conditions. The most critical issue linked to PM10 pollution is the violation of the daily 50μg/m3 limit, which, according to D.Lgs. 155/2010, should not be overcome more than 35 times per year. This trend presents a decrease until 2010 and then an increase in 2011.

Focusing on the Venice area, we considered the data registered by all the stations from 2003 to 2012. The PM10 concentration time series presents a decreasing trend: in 2010 and in 2012 (not in 2011) all the stations showed that the annual limit set by law had not been violated. In the period from 2003 to 2012, we can observe how the violations of the daily PM10 concentration limit are more frequent in 2005 and 2006. Subsequently, we can notice a dwindling trend until 2010, a worsening of the situation in 2011 and an improvement in 2012.

Because of the real health hazard caused by particulate matter, this issue deserves particular attention. The University of Padova (Department of Molecular Medicine), in cooperation with the ARPAV, conducted an epidemiologic survey to understand which are the effects of PM10 on the health of the population living nearby Mestre's west bypass, which was the main source of traffic pollution in Veneto. The most frequently observed diseases concern the respiratory and circulatory systems, which are the most exposed to air pollution. Before the opening of the third lane of the bypass, in 2002, a survey pinpointed the fall-out areas of the PM10 concentration related to the vehicles driving through Mestre's west bypass; the population we considered as exposed to pollution was the population living in these pinpointed areas. The data we analysed do not show a constant correlation between the exposition to PM10 and the number of death certificates and hospital admissions. The results observed by isolating each class of diseases are more significant. The population living nearby Mestre's west bypass presents a higher incidence of diseases linked to the respiratory and circulatory systems, in particular chronic obstructive pulmonary diseases and coronary artery diseases. This higher incidence can be related to air pollution produced year by year by the bypass.

TOWARDS CREATION OF AN INDEX FOR BIOLOGICAL AIRBORNE PARTICLES: CHEMICAL CHARACTERIZATION OF BIOAEROSOLS

Brice Berthelot[1,2]*, Stéphane Moularat[1], Michel Thibaudon[3], Evelyne Géhin[2], Enric Robine[1]

[1]*Scientific and Technical Center for Building (CSTB) - Direction of Health and Comfort - Airborne pollutants & Bioaerosol Division, Champs-sur-Marne, 77447 Marne-la-Vallée, France*
[2]*Paris Est University, Centre d'Études et de Recherche en Thermique Environnemen et Systèmes (CERTES), Créteil, 94010, France*
[3]*Réseau National de Surveillance Aérobiologique (RNSA), Brussieu, 69690, France*
**brice.berthelot@cstb.fr*

Given the prevalence of health concerns due to airborne biological contaminants, Public Health Authorities set their sights on fitting out common strategies to reduce and monitor contamination. However addressing such problem means being able to assess human exposure to these agents beforehand. Furthermore this fundamental prerequisite cannot be undertaken without a better knowledge of aerosol composition.

In this overall context, we propose a methodology for the biological agents characterization using Pyrolysis-Gaz Chromatographic/Mass-Spectrometer (Py-GC/MS) analyses. The study of the thermal decomposition of airborne biological pollutants at various temperatures and, with or without derivation agents results in the definition of specific biochemical markers for bioaerosols. Furthermore, by means of various analyses carried out on air-filter samples, ambient particulate noise is accounted.

A subsequent database based on a set of biochemical fingerprints enables to formulate an original index for the human exposure to major indoor pollen-/fungi-related particles.

DEVELOPMENT OF A MINIATURIZED REAL-TIME PM-MONITOR FOR DETECTION AND IDENTIFICATION OF BIOAEROSOLS

Brice Berthelot[1,2]*, Emmanuelle Algré[3], Stéphane Moularat[1], Evelyne Géhin[2], Enric Robine[1]

[1]*Scientific and Technical Center for Building (CSTB) - Direction of Health and Comfort - Airborne pollutants & Bioaerosol Division, Champs-sur-Marne, 77447 Marne-la-Vallée, France*
[2]*Paris Est University, Centre d'Études et de Recherche en Thermique Environnemen et Systèmes (CERTES), Créteil, 94010, France*
[3]*Paris Est University, ESYCOM (EA 2552), ESIEE Paris, Noisy-le-Grand, F-93162, France*
**brice.berthelot@cstb.fr*

Facing growing health concerns posed by indoor bioaerosols, the development of low-cost, portable monitors to assess human exposure is of greater interest. If technology breakthroughs allow Micro-ElectroMechanical-Systems (MEMS)-based instruments to unveil increasingly cutting-edge and/or shrink-sized alternative detection techniques, they are to guaranty higher sensitivity detection than conventional ones. However, to date, their design and conception should be optimized to ensure that performance enhancements match expectations for the monitoring of low concentration biological aerosols.

Thus in this work, we propose a new design and evaluation methodology of personal monitoring apparatus based on the trivial triptych: collection-detection-identification of the threat - herein **inhalable bioaerosols**.

With a limit of detection of a few microgram/m^3, these instruments aim to be consistent with *in-situ* measurements of low concentration aerosols or fine particles.
Based on MEMS oscillating structures, developed sensors detect additional masses by recording all change in their resonance frequency. Subsequently, they are to exhibit both **high quality factor** and **high uniform position-sensitivity to particles** (defined in all points on the surface of the resonators and derived from Rayleigh-Ritz theory). Hence, besides a selection by physicochemical properties, particle-resonator interactions are moved to the centre stage of the discussion. In this way limiting rolling-detachment conditions (derived from the Johnson-Kendall-Roberts model) and ordinary damping factors (laterally- /squeeze-film damping… which affect quality factor) are considered in a single package. This kind of examination enables the determination of an operating frequency range of up to 10 MHz while providing geometrical features for an adequate design basis for the resonator. Finally, identification by chemical footprints is performed to address hazard concerns related to the biological nature of aerosols (Berthelot *et al.*, 2013).

Berthelot B., Moularat S., Géhin É. and Robine E. (2013). Caractérisation chimique des bioaérosols : élaboration d'une base de données spectrale. *Colloque National "Microbiologie Des Aérosols" (MicrobAERO 2013), 7-9 Octobre 2013*. La Bourboule.

NEAR REAL-TIME LIDAR AEROSOL PRODUCTS FOR DUST MODEL EVALUATION AND ASSIMILATION

Ioannis Binietoglou[1,2]*, Giuseppe D'Amico[1], Lev Labzovsky[2], Doina Nicolae[2], Gelsomina Pappalardo[1]

[1]*Consiglio Nazionale delle Ricerche - Istituto di Metodologie per l'Analisi Ambientale, Tito Scalo (PZ), 85050, Italy*
[2]*National institute of Research and Development for Optoelectronics, Remote Sensing Department, Magurele, Ilfov, Romania*
**ioannis@inoe.ro*

Accurate measurements of the atmospheric dust load are necessary in near real-time for the evaluation of dust models' performance and for the improvement of dust forecasting by their assimilation. While several instruments, both ground and satellite based, can provide information about the columnar dust load, only a network of ground based lidar can currently provide vertical profiles of aerosol properties with sufficient spatial and vertical resolution for such applications. In this direction a set of dust-related products is being developed within the European Aerosol Research Lidar Network (EARLINET) together with the processing chain to provide them in the near real-time.
In this contribution we present the current state of the algorithms and the processing system to derive these products. The core of the EARLINET real-time processing system is the Single Calculus Chain (SCC) that has been developed as part of the quality assurance procedures of the network; the implemented system can analyze lidar measurements in near real-time and provide aerosol intensive and extensive optical properties. Based on these outputs, the volume and mass concentration - together with the algorithms uncertainties - are estimated taking into account the mean properties of the basic aerosol types. These estimates are based on the result of routine lidar climatological measurements and dedicated measurement campaigns. In this contribution we highlight the capabilities of this system using real dust measurement examples from European lidar stations.
The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013)
ACTRIS under grant agreement no. 262254 and the EU-funded Marie Curie Initial Training Network ItaRS.

QUATERNARY DUST SOURCE VARIATION ACROSS THE CHINESE LOESS PLATEAU

Anna Bird[1], Thomas Stevens[1], Martin Rittner[2], Pieter Vermeesch[2], Andrew Carter[2], Sergio Andò[3], Eduardo Garzanti[3], Huayu Lu[4], Junsheng Nie[5], L. Zeng[4], H. Zhang[4], Z. Xu[4]

[1]*Centre for Quaternary Research, Department of Geography, Royal Holloway University of London, Egham, Surrey, TW20 0EX, UK*
[2]*School of Earth Sciences, Birkbeck College, University of London, London, WC1E 7HX, UK*
[3]*Dipartimento di Scienze Geologiche e Geotecnologie, Università di Milano-Bicocca, Piazza della Scienza 4, 20126 Milano, Italy*
[4]*School of Geographic and Oceanographic Sciences, Institute for Climate and Global Change Research, Nanjing University, Nanjing 210093, China*
[5]*Key Laboratory of Western China's Environment System, Ministry of Education, Lanzhou University, Lanzhou, Gansu 730000, China*

The Chinese Loess Plateau in north central China covers an area of 640,000 km^2 and comprises windblown dust preserved as interbedded Quaternary loess and soil underlain by Pliocene-Miocene red clay and loess. Establishing the origin of this substantial accumulation of windblown dust is critical in the interpretation of sedimentary climate proxies from loess, atmospheric patterns and changing climatic/ tectonic controls on erosion over the last 22 Ma. This study uses a multi-disciplinary approach through zircon U-Pb dating and heavy mineral analysis to attempt to a) establish the sources of loess through the Quaternary and b) constrain their variation geographically across the plateau. The results point to northern Tibetan Plateau sources with some influence from local North China Craton derived material. Sources show significant variation across the loess plateau. Sites to the northeast show stronger affinities to deserts to the north, which in turn are influenced by North China Craton derived material, while western sites share a closer affinity to the Yellow River and the Tibetan Plateau. The sections through time show variation in zircon U-Pb and heavy minerals, however there is no relationship between these differences and glacial/ interglacial periods. This variation demonstrates highly dynamic and variable transport modes through time and implies Chinese loess cannot be considered to have a uniform source.

THE POLLEN AS A BIOLOGICAL POLLUTANT? (CYPRESS, BIRCH TREE AND AMBROSIA)

Maira Bonini

Department of Medical Prevention, Local Health Authority Milan 1, Parabiago (Mi), 20015, Italy
maira.bonini@aslmi1.mi.it

"Air pollution" defines the presence of different kinds of substances or factors (physical, chemical or biological agents) in the air, which show a negative impact on the human health. The term "biological pollutant" indicates both organisms and/or parts of them, like the pollens. The pollinosis is a pathology due to the airborne allergenic pollens. A definition of "pollen as biological pollutant" makes a distinction from simple "allergenic pollens" and "allergenic pollen biological pollutant". The first, are produced by plants useful to humans and animals, but at the same time dangerous for their health and daily activities (i.e. Poaceae: cereal crop, forage). The second, are produced by plants useless to humans and animals and in addition dangerous for their health and daily activities (i.e. Betulaceae, like *Betula* Cupressaceae, like *Cupressus;* pest weed, like *Ambrosia artemisiifolia*).

Several evidences supporting this classification. *Ambrosia artemisiifolia* has its probable origin in North America bound for Europe, probably as a contaminant of seeds. Currently, in one of the most European infested zones (the North-Western Milan area, Lombardy, Italy), it is the main cause of pollinosis and a public health problem. A study, carried out during 2008-2010 in a Hospital located in this area, showed that 71% of the new patients suffering from pollinosis were allergic to ragweed. A recent epidemiological study showed that it involved at least 16.4% of the population sampled, with a high percentage of asthma (around 40%).

Birch is the major pollen allergen producing tree in Northern Europe. *Betula* airborne pollen in Europe originates from four native species and two non-native, often planted as ornamentals, causing the increasing prevalence of its related allergy, like in the area north of Milan (25-40% among the allergy department) while in the city of Milan (10-15%), where birch is less present.

Cupressus is widely distributed in Europe and often planted as ornamental. A gradual increase in the annual amounts of Cupressaceae pollen in the Mediterranean was observed since the 1980s, attributed to the increase of its planting. In Europe, allergy to Cupressaceae pollen was considered a rarity until 1975. Since then, considerable increases in the number of cases has been observed (i.e. in the region of Montpellier, allergy to *Cupressus* is the main cause of respiratory allergy: 46.4% of allergy department's patients), although other studies reported cypress as rarely responsible of allergy, despite the high pollen peaks.

Therefore, for the "pollen biological pollutant" our aim is a decrease of the pollution level, that is the reduction of the airborne pollen concentrations.

This objective can be reached in different ways. For the trees and shrubs, it's necessary to decrease and limit the new planting; avoid the new introduction in environments where these are not naturally present. For the pest weeds we must contain the widespread. The ultimate goal is obviously the protection of public health.

A NEW METHOD FOR SAMPLE PREPARATION AND CHEMICAL ANALYSIS OF ATHMOSPHERIC AEROSOLS

Laura Borgese*, Annalisa Zacco Elza Bontempi, Laura E. Depero

Department of Mechanical and Industrial Engineering, University of Brescia, via Branze 38, 25123, Brescia, ITALY
**laura.borgese@ing.unibs.it*

A new method for chemical characterizations of atmospheric aerosols is proposed. Particulate matter (PM) is routinely collected on filters and following characterized with several analytical techniques. The most common techniques for compositional analysis include atomic absorption spectroscopy (AAS) and inductively coupled plasma spectroscopies (ICP). These analyses requires complete sample digestion, that may be expensive and time-consuming. Moreover sample contamination and material loss may occur.
This sample preparation method consist in sandwiching the filter in two polymeric foils, allowing to protect it from external contamination, to avoid any material loss and to store it for further investigations.
After preparation the samples can be directly analyzed by several non-destructive X-ray based techniques. For example micro XRF studies allow chemical mapping and identification of particles composition and micro X-ray diffraction (XRD) allow phase analysis. These kinds of information are useful for determination of emission sources.
In this context XRF is considered a useful technique, however it does not allow trace elements analysis. Total reflection X-ray fluorescence (TXRF) is an energy dispersive XRF with a different geometrical configuration which allows higher elemental intensities and lower limits of detection [1]. In suitable experimental conditions matrix effects can be neglected and TXRF may be competitive with other techniques such as AAS and ICP. TXRF appears particularly promising for environmental analysis, especially when heavy metals must be detected at very low concentrations.
Recently we demonstrated that TXRF measurements of samples prepared with the proposed method, allow the determination of trace elements and quantitative analysis by means of external calibration [2].
This method has been successfully applied in a Study of Mn environmental pollution assessment due to the presence of Mn-Fe alloy industries in the Brescia province [3], and other studies are still ongoing. A comparison with ICP mass spectroscopy of digested samples collected in the same sampling area was also performed.

1. Klockenkämper R. (1997). Total Reflection X - ray Flourescence Analysis, John Widely & Sons.
2. Borgese L.,Salmistraro M., Gianonceli A., Zacco A., Lucchini R., Zimmerman N., Pisani L., Siviero G., Depero L.E., Bontempi E. (2012). Airbone particulate matter (PM)filter analysis and modelling by total reflection X ray fluorescence (TXRF) and X-ray standing wave (XSW). Talanta 89, 99-104.
3. Borgese L., Zacco A., Pal S., Bontempi E., Lucchini R., Zimmerman N., Depero L.E., (2011). A new non-destructive method for chemical analysis of particulate matter filters: The case of manganese air pollution in Vallecamonica (Italy). Talanta 84, 192-198.

MINERAL DUST AND ANTHROPOGENIC AEROSOL TRANSPORT TO GREENLAND: CLUES FROM STRONTIUM, NEODYMIUM AND LEAD ISOTOPES

Aloys Bory[1,5]*, Wafa Abouchami[2], Stephen J. G. Galer[2], Anders Svensson[3], John N. Christensen[4], Pierre E. Biscaye[5]

[1]*UMR CNRS 8217 Géosystèmes, Université Lille-1, 59655 Villeneuve d'Ascq Cedex, France*
[2]*Max Planck Institute for Chemistry, 55128 Mainz, Germany*
[3]*Niels Bohr Institute, University of Copenhagen, 2100 Copenhagen, Denmark*
[4]*Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA*
[5]*Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY 10964, USA*
**aloys.bory@univ-lille1.fr*

Impurities contained in snow and ice layers in Greenland provide a record of the history of atmospheric dustiness and pollution in the Northern Hemisphere. The source of the particles deposited onto the ice cap may be investigated using specific intrinsic tracers. Provenance discrimination may then provide valuable constraints for the validation of atmospheric transport models as well as for the monitoring of natural and anthropogenic aerosols emissions at a global scale.

Clay mineralogy combined with the strontium and neodymium isotope composition of the insoluble particles extracted from recent snow deposits at NorthGRIP (75.1°N, 042.3°W), for instance, enabled us to demonstrate that the Taklimakan desert of North-western China was the main source of mineral dust reaching central Greenland at present [Bory et al., 2002; 2003]. Here we report the lead isotopic signature of these snow-pit samples, covering the 1989-1995 and 1998-2001 time periods.

Unradiogenic lead isotopic composition of our Greenland samples, compared to Asian dust isotopic fingerprints, implies that most of the insoluble lead reaching the ice cap is of anthropogenic origin. Lead isotopes reveal likely contributions from European/Canadian and, to a lesser extent, US sources, as well as a marked overprinted signature typical of Chinese anthropogenic lead sources. The relative contribution of the latter appears to have been increasing steadily over the last decade of the 20th century. Quantitative estimates suggest that, in addition to providing most of the dust, China may have already become the most important supplier of anthropogenic lead deposited in Greenland by the turn of the 20th to the 21st century [Bory et al., in press]. The close timing between dust and anthropogenic particles deposition onto the Greenland ice cap provides new insights for our understanding of intercontinental Chinese aerosols transport.

Bory, A., Abouchami, W., Galer, S.J.G., Svensson, A., Biscaye, P.E. (in press). A Chinese imprint in insoluble pollutants recently deposited in central Greenland as indicated by lead isotopes, Environmental Science and Technology, doi: 10.1021/es4035655.

Bory, A.J.-M., Biscaye, P.E., Grousset, F.E., (2003). Two distinct seasonal Asian source regions for mineral dust deposited in Greenland (NorthGRIP), Geophysical Research Letters 30 (4), 1167, doi:10.1029/2002GL016446.

Bory, A.J.-M., Biscaye, P.E., Svensson, A., Grousset, F.E., (2002). Seasonal variability in the origin of recent atmospheric mineral dust at NorthGRIP, Greenland, Earth and Planetary Science Letters 196 (3-4), 123-134, doi: 10.1016/S0012-821X(01)00609-4.

MONITORING MODERN DUST DEPOSITS ON THE WEST AFRICAN MARGIN FOR PALEOCEANOGRAPHIC PURPOSES

Aloys Bory[1]*, Charlotte Skonieczny[1,2], Viviane Bout-Roumazeilles[1], Aboubacry Diallo[3], Thierno Ndiaye[3], Deborah Ponleve[1], Quentin Louis[1], Nadine Mattielli[4], Sylvie Philippe[5], Bernadette Chatenet[6], Béatrice Marticorena[6]

[1]*UMR CNRS 8217 Géosystèmes, Université Lille-1, 59655 Villeneuve d'Ascq Cedex, France*
[2]*IFREMER, Département Géosciences Marines, 29280 Plouzané, France*
[3]*IRD, US191 IMAGO, Dakar, Senegal*
[4]*Université Libre de Bruxelles, 1050 Bruxelles, Belgique*
[5]*UMR CNRS 8187 LOG, Universités Lille 1/ULCO, 62930 Wimereux, France*
[6]*UMR CNRS 7583 LISA, Universités Paris Est-Créteil/Paris Diderot, IPSL, 94010 Creteil Cedex, France*
**aloys.bory@univ-lille1.fr*

The interpretation of paleodust records relies largely on our understanding of the mineral dust cycle in the present-day climate context. Monitoring modern dust deposits is therefore of particular interest, considering that these deposits constitute what is ultimately recorded in environmental archives, in marine sediments in particular. Characterizing dust deposition fluxes, but also grain size, as well as the mineralogical and geochemical composition of the dust deposited at present, may in fact provide useful clues for our interpretation of past dust deposits, providing that information on provenance and transport systems can be obtained simultaneously using satellite images and tri-dimensional back-trajectories. There has been little effort, however, to carry out direct measurements of dust deposits, in general, and particularly where it might be most useful to do so: at sea, on islands or coastal areas. Even in the vicinity of major arid and semi-arid areas such as the Sahara-Sahel region, dust deposition data are scarce and isolated, and therefore of limited significance. This was the main rationale for launching a continuous sampling of dust deposition at Mbour (~80 km south of Dakar) on the Senegalese margin in 2006, as part of the African Multidisciplinary Monsoon Analysis (AMMA) framework. The sampling site, located under the major corridor for Saharan dust transport, is ideally situated for monitoring mineral dust as they reach the North-eastern Tropical Atlantic (NETAO). Dust deposits have been collected at a weekly (or better) resolution and we will report results obtained so far (part of which were recently published [Skonieczny et al. 2011; 2013]), including mass fluxes, grain-size, and clay mineralogy measurements spanning the first few years of this unique time-series, as well as some additional Sr, Nd and Pb isotope ratio measurements obtained during some major dust outbreaks. We will then discuss some of the implications our results have on the paleo-dust archives retrieved from the NETAO.

Skonieczny, C., Bory, A., Bout Roumazeilles, et al. (2013). A three-year time series of mineral dust deposits on the West African margin: Sedimentological and geochemical signatures and implications for interpretation of marine paleo-dust records, Earth and Planetary Science Letters 364, 145-156.

Skonieczny, C., Bory, A., Bout Roumazeilles, et al. (2011). The 7-13 March 2006 major Saharan outbreak: Multiproxy characterization of mineral dust deposited on the West African margin, Journal of Geophysical Research 116, D18210.

ATMOSPHERIC PARTICLES OPTICAL PROPERTIES OBSERVED OVER AT GOBI DESERT USING A RAMAN LIDAR WITH ENHANCED DYNAMICS

Antonella Boselli[1,2]*, Gianluca Pisani[2,3], Nicola Spinelli[2,3], Xuan Wang[2,4], Pan Chao[5], Yiming Zhao[5], Chen Lin[6], Yang Xiaoyu[5], Shang Yanan[5], Liu Bo[5], Wang lidong[5]

[1]*CNR-IMAA, Potenza, Italy*
[2]*China-Italy Laser Remote Sensing JointResearchCenter - CNISM, Napoli, Italy.*
[3]*Dipartimento di Fisica, Università di Napoli "Federico II", Napoli, Italy.*
[4]*CNR-SPIN, Napoli, Italy*
[5]*China-Italy Laser Remote Sensing JointResearchCenter - Beijing Research Institute for Telemetry, Beijing, P.R. China*
[6]*National Satellite Meteorology Center, Beijing, P.R. China*
**boselli@imaa.cnr.it*

A new, versatile and portable Raman scanning lidar system has been designed and developed in the frame of the AMPLE (Aerosol Multi-wavelength Polarization Lidar Experiment) project, the first action of the recently founded China-Italy Laser Remote Sensing Joint Research Center between the National Consortium of Italian Universities for the Physical Science of the Matter (CNISM) and the Beijing Research Institute for Telemetry (BRIT).
The AMPLE system has been designed to perform volume scanning of the atmosphere and to retrieve high quality 3D map of particulate optical properties and their time evolution. The lidar apparatus is able to detect both the elastic lidar returns at 355nm and 532nm, and the N_2 and H_2O Raman lidar echoes at 386nm and 407nm.
Each detected signal is acquired with a raw spatial resolution varying from 30cm to 30m. Moreover, polarization purity of laser line allows to perform polarization measurements at both 355 and 532nm.
A measurement campaign has been performed on August 2013 in Dunhuang, close to the Gobi desert and far away from the urban area, in order to study sand dust directly at source. Lidar measurements allowed to analyse dynamical effects of rising of mineral particles from the soil, giving rise to a stable layer at about 1.5km of altitude. Simultaneously a vertical oscillation of this "plume" and of the upper bound of the upper layer take places.The height of the dust layer is captured in the depolarization ratio profile indicating as the dust particles were transported from the surface and confined below 4 km of altitude.LR values obtained in the layers highlighted the different nature of the particles in each of them, which properties were influenced by the water vapour mixing ratio in the atmosphere.

CLIMATOLOGY OF SAHARAN DUST TRANSPORT EVENTS AT MT. CIMONE GAW GLOBAL STATION, ITALY (2165 M A.S.L.)

L. Bourcier, R. Duchi, A. Marinoni, P. Cristofanelli, D. Putero, T.C. Landi*, F. Calzolari, M. Busetto, U.Bonafè, P. Bonasoni

CNR - Institute for Atmospheric Sciences and Climate, Via Gobetti 101, 40129 Bologna, Italy
**t.landi@isac.cnr.it*

Due to the high vulnerability to climate change and temperature rise predictions higher than the global average, Mediterranean basin and Southern Europe are key areas in understanding long-term regional climate change. They are frequently interested by the presence of desert dust aerosol transported from North Africa which plays an important role in climate system, by affecting the radiation budget of the atmosphere and the surface albedo of snow and glaciers surface, also affecting their melting rate.
The variability of long-range dust transport events was observed at Mt. Cimone (2165 m a.s.l., 44°11'N, 10°42'E), which is the highest peak of the Italian northern Apennines and represents one of the first mountain ridges that Saharan air masses encounter during their northward displacement towards Europe and Alpine ranges. Dust transport events (DTEs) have been identified since August 2002 at the baseline global WMO/GAW (World Meteorological Organization/Global Atmosphere Watch) station of Mt. Cimone (CMN) thanks to the analysis of in-situ coarse particle (1 μm ≤ Dp≤ 20 μm) number concentrations and outputs from eulerian/lagrangian model (e.g. NAAPS, FLEXTRA).
A number of 380 DTEs were identified in the period 2002 -2012, corresponding to 15% of the investigated. During those days the coarse particle number was 685% higher than with respect to rest of the time. It could be noted that 65% of DTEs occurs in spring and summer.
With the aim to investigate the impact of dust transport on aerosol optical properties at CMN and to study their seasonal variability, it has been observed that both scattering and absorption coefficients increased in presence of dust (27.5 ± 19.5 Mm^{-1} and 2.05 ± 1.41 Mm^{-1} respectively) compare to the absence of dust (20.9 ± 20.4 Mm^{-1} and 1.57 ± 1.51 Mm^{-1} respectively), while the total aerosol particle number concentration decreased (from 2130 ± 1270 to 2530 ± 1690 # cm^{-3}). It has also been observed a seasonal variability of all parameters with a summer maximum and a winter minimum. In this work we will provide hints about long-term variability of DTE frequency and intensity (i.e. aerosol load) observed at CMN. The analysis of three-dimensional air-mass back-trajectories will allow to provide information about the variability of transport patterns and source regions for the mineral dust at CMN, also permitting to have a statistical climatology of the optical and microphysical properties of the aerosol according to the origin of the air masses.

SEED TREATMENT AND DUST EXPOSURE: INSIGHTS AND OPPORTUNITIES TO MITIGATE EXPOSURE RISKS EFFECTIVELY

Brandl Franz

Syngenta Crop Protection AG,Basel,CH-4002,Switzerland
**franz.brandl@syngenta.com*

Seed treatment is the most modern, targeted and environmentally friendly crop protection method. It delivers benefits to the growers allowing them to protect their investments in high-value seeds against damages of diseases, insect pests and nematodes. Further, modern seed treatment technologies also have a positive effect on the environment through the precise placement of seed protectant compounds onto the seed and their delivery to the young seedling.

Noticeable bee mortality has been observed in Southern Germany in 2008, in the course of sowing insecticide treated corn seeds. While this specific incident could be attributed to poorly (below standard) treated seeds, it still revealed that under specific circumstances dust emitted from air-assisted planting or drilling equipment originating from insecticide treated seeds may pose an unacceptable risk to bees and other non-target organism. The crop protection industry and especially the inventors and manufacturers of seed treatment chemicals take this risk seriously as bees are important and critical for pollination of our food and feed crops.

The Global Seedcare Institute of Syngenta Crop Protection AG in Stein, Switzerland, was charged over the last couple of years with the task to get better insights into the origin, the physics and the dynamics of dust of raw and treated seeds. Based on these insights effective mitigation measures have been developed and implemented to secure the coexistence of modern crop protection and bee keeping as fundamental technologies for sustainable food and feed production.

The presentation will provide an overview of the key findings on each intervention step of dust reduction, the impact of different methods and processes, and map the way forward how to limit dust exposure to an acceptable level to secure the seed treatment technology as the most modern crop protection technology, fulfilling the highest possible safety standards for workers, consumers and the environment.

DUST STORM FORECASTSING AT THE UK MET OFFICE

Malcolm E. Brooks[1]*, Kerry Day[1], Bruce Ingleby[2], Yaswant Pradhan[1], David Walters[1]

[1]*Met Office, FitzRoy Road, Exeter, EX1 3PB, UK*
[2]*European Centre for Medium Range Weather Forecasting, Shinfield Park, Reading, RG2 9AX, UK*
**Malcolm.E.Brooks@metoffice.gov.uk*

The Met Office produces operational dust forecasts from both its global and a number of higher resolution regional Numerical Weather Prediction (NWP) models using a dust scheme based on that of Woodward (2001, 2011). The global model dust forecasts are disseminated over Africa and Europe as part of the WMO SDS-WAS.

The global model includes assimilation of dust observations alongside the standard meteorological observations. The dust data assimilation is based on Benedetti et al. (2009) using MODIS aerosol optical depth (AOD) observations from both the standard (Remer et al. (2002)) and Deep Blue (Ginoux et al. (2010)) retrievals over land.

This paper will present an overview of the Met Office dust forecasting capability as well as outlining recent developments to the system. These include changes to the global model resolution and dynamical core, the assimilation of MODIS observations of dust over ocean, and the assimilation of dust observations in a high resolution regional model.

Benedetti A, Morcrette JJ, Boucher O, Dethof A, Engelen RJ, Fisher M, Flentje H, Huneeus N, Jones L, Kaiser JW, Kinne S, Mangold A, Razinger M, Simmons AJ, Suttie M. (2009). Aerosol analysis and forecast in the european centre for medium-range weather forecasts integrated forecast system: 2. data assimilation. J. Geophys. Res. 114. doi:10.1029/2008JD011115.

Ginoux P, Garbuzov D, Hsu N. (2010). Identification of anthropogenic and natural dust sources using Moderate Resolution Imaging Spectroradiometer (MODIS) Deep Blue level 2 data. J. Geophys. Res. 115. doi:10.1029/2009JD012398.

Remer L, Tanre D, Kaufman YJ, Ichoku C, Mattoo S, Levy R, Chu DA, Holben B, Dubovik O, Smirnov A, Martins J, Li RR, Ahmad Z. (2002). Validation of MODIS aerosol retrieval over ocean. Geophys. Res. Lett. 29: 8008. doi:10.1029/2001GL013204.

Woodward S. (2001). Modeling the atmospheric life cycle and radiative impact of mineral dust in the Hadley Centre climate model. J. Geophys. Res. 106. doi:10.1029/2000JD900795.

Woodward S. (2011). Mineral dust in HadGEM2. Met Office Hadley Centre for Climate Change, Hadley Centre Technical Note: http://www.metoffice.gov.uk/archive/science/climate-science/hctn87.

EMPIRICAL MODELLING OF DIRECTIONAL DUST FROM INDUSTRIAL SITES

John Bruce[1,2]*, Jim Smith[1], Hugh Datson[2], Mike Fowler[1]

[1]School of Earth and Environmental Sciences, University of Portsmouth, Portsmouth, PO1 2UP, U.K.
[2]DustScan, Oxford, OX7 3PJ, U.K.
*John.Bruce@port.ac.uk

This paper describes a preliminary investigation into relationships between sticky-pad dust data and meteorological factors at two industrial sites. Site one is a large construction site near the coast of the Caspian Sea where dust problems are anticipated due to strong winds from the north, and was chosen due to the quantity and quality of data available. Site two is a small sand and gravel quarry in central England, where dust movements towards the north east are monitored due to the proximity of a sensitive receptor. It was chosen due to the flexibility available for dust monitoring and for contrast with site one. At both sites dust samples were collected on an array of sticky-pad directional dust monitors, at site boundaries and progressively closer to receptors. Samples were sealed and scanned for dust coverage (Absolute Area Coverage - AAC %) and dust soiling (Effective Area Coverage - EAC %). Each site also had a weather station, such that results could be examined in relation to antecedent rainfall, wind conditions and average temperatures. For this exercise, samples were selected on the basis of their exposure to background dust, in order to reduce influence from surrounding workings but allow for further work once basic principles are in place. Models were developed via a correlation matrix between all weather measurements and the relevant temporal dust level. The strongest correlations were established, and linear regression was used to explore potential coefficients. Rainfall parameters included daily & weekly rainfall, as well as factored rainfall based on immediacy. Temperature measurements were averaged over the dust monitoring periods and compared to monthly dust trends. Increases in dust were observed at site one when temperatures remained high, so a constant was created which reflected this. A unique 'wind-risk' constant was established with relation to wind direction, strength and frequency. Both site models rely heavily on wind speeds from the appropriate direction, but site one also had strong seasonal fluctuations based on temperature. The final models were made by incorporating all relevant constants to form an effective representation of the dusting patterns observed. Models were initially based on an original data set and then tested against supplementary data, with encouraging results. The model for site one was based on twelve months of data collected before model inception, with a further six months available for model evaluation. The model had a correlation value (R^2) of 0.66 against the original data set and correlation of 0.78 against the additional data. Site two's model was based on six months of data with monitoring ongoing to date, with a correlation value of 0.69. Both models therefore demonstrate strong links between nuisance dust flux and specific weather parameters. Improvements being considered include refining dust predictions to daily risk levels and adaptation to additional sites.

CHALLENGES AND APPROACHES FOR LOW-COST PARTICULATE MATTER SENSING IN SMART CITIES

Matthias Budde[1]*, Lin Zhang[2], Michael Beigl[1]

[1]*Karlsruhe Institute of Technology (KIT), Pervasive Computing / TECO, 76131 Karlsruhe, Germany*
[2]*Tsinghua University, Complex Engineered Systems Lab, Beijing, 100084, PR China*
**budde@teco.edu*

Particulate Matter (PM) sensing is important, as medical science has revealed severe health effects and society develops an increasing awareness. Around the world, the permitted PM mass concentration is regulated. Standard gravimetric measurement provides accurate 24-h-means (µg/m^3), but stations are large, static and expensive. Enabling real-time capable, distributed dust sensing entails several challenges, chief among them *Instrumentation*, *Coverage*, *Intelligence*, *Calibration* and *Incentivation*. Additionally, while a technique may be suitable for a controlled sensor network, it may not work for other approaches, such as *Participatory Sensing (PS)*, which by involving citizens in the data collection can enable sensing at a much larger scale.

Alternative PM **Instrumentation** has become available, most of which uses laser scattering to enable mobile real-time measurements. Example projects using such devices are the tram-based *OpenSense* in Zurich, Switzerland, and the *Aeroflex* bicycles in Antwerp, Belgium. However, for large-scale scenarios, such devices are still too bulky and expensive. Low-cost commercial off-the-shelf (COTS) particle sensors are suitable for large distributed applications, provided they are frequently calibrated and their data is processed intelligently. Such **Intelligence** is strongly related to the aspects of **Coverage** and **Calibration**. While not as large an issue in controlled scenarios, PS campaigns or vehicular networks require suitable algorithms to ensure data quality. *CabSense* in Shenzen, China e.g. employs a sparse signal reconstruction algorithm, which allows the creation of pollution maps from few noisy samples. We also propose cross-calibration to calibrate COTS sensors - both with or without reference equipment - for the use in volatile sensing scenarios. Finally, **Incentivation** is an important aspect in scenarios involving participation. Within the first day of the recently started *PiMi* project in Beijing, China, over 500 people applied for a *PiMi* box (cheap, networked indoor air quality monitor). This shows both a large social attention and intrinsic motivation. To maintain high motivation, we propose adding extrinsic incentives using Gamification elements.

We expect that a system addressing the presented challenges in a combined, holistic approach would be most suitable for low-cost, distributed PM sensing: Motivated citizens traversing the smart city they live in operate cheap mobile instrumentation, the data of which is intelligently combined to ensure high data quality and coverage.

Budde M., Busse M., Beigl M. (2012) Investigating the Use of Commodity Dust Sensors for the Embedded Measurement of Particulate Matter, Proc. Int. Conf. on Networked Sensing Systems, p. 1-4.

Budde M., El Masri R., Riedel T., Beigl M. (2013) Enabling Low-Cost Particulate Matter Measurement for Participatory Sensing Scenarios. Proc. Int. Conference on Mobile and Ubiquitous Multimedia.

Carminati, M., Sampietro, M., Carminati, G. (2011) Analysis of instrumentation performance for distributed real-time air quality monitoring. EESMS Workshop 2011, p. 1-6.

Yu X., Fu Q., Zhang L., Zhang W., Li V. O. K., Guibas L. (2013) CabSense: Creating High-resolution Urban Pollution Maps with Taxi Fleets. ACM MobySys 2013.

GEOCHEMICAL CHARACTERISATION OF THE ATMOSPHERIC DUST OVER THE SOUTH-WESTERN COAST OF INDIA

Manjunatha Busnur Rachotappa[1]*, Hagde Prashant[1], Narayana Badiadka[2]

[1]*Department of Marine Geology, Mangalore University, Mangalagangothri - 574199, India*
[2]Department of Chemistry, Mangalore University, Mangalagangothri - 574199, India
**omsrbmanju@yahoo.com*

The west coast of India, in particular, south of Mumbai and the adjoining Western Ghat plateau mountains receive rainfall over 250 cm/yr. The Eastern Arabian Sea off these regions is one of the high primary productivity regions of the Arabian Sea due to high river runoff as well as upwelling. This region is also unique in terms of the prevalence of humid climate that would be ideal for distinguishing atmospheric pollution and long-range transport of aerosols/dusts.

The southern part of the west coast of India, particularly around Mangalore (13° N latitude) receives about 40% excess annual rainfall than the average of the west coast India which is under rapid urban development as well as industrialization. Therefore, an attempt has been made here to distinguish the sources of suspended particulate matter (SPM) in the rain, atmospheric aerosols/dusts based on geochemical characterization. Using bulk precipitation collector, atmospheric samples have been collected on terrace of tall buildings once in a fortnight covering almost seasons of the year. Samples were filtered immediately and spitted into two parts for measurements of physico-chemical parameters and, major and trace elements.

Generally, alkali and alkaline earth elements (Na, K, Ca and Mg) in the SPM are enriched by factors of 2 to 10, but depleted in Al, Fe, Mn and Co by almost similar factors compared the background soils around the area of investigation, suggesting the dominance of long-range transport of SPM rather than that entrained from the terrain. The SPM collected during the pre-monsoon (spring inter-monsoon) particularly enriched with former group of elements as a result of the decrease in rainfall. The hazardous trace metals (Ag, As, Cd, Cu, Zn, Ni, and Pb) are enriched by factors of 2 to 50 as compared to their concentration levels in the background/local soils near the study area. This is due to impact of anthropogenic activities like automobile exhaust gases, biomass burning, as well as emission particles from ferrous and non-ferrous industries. The contamination levels of trace metals found to be maximum during the winter owing to dry weather condition. Though the computation of airmass trajectories suggest that the influence of long-range transport of aerosols/dust from arid regions surrounding the Arabian Sea to the study area, however, this study indicates that atmospheric particles from remote regions are diluted by the dominant emission of the local anthropogenic particles.

INITIAL DEVELOPMENTS IN MODELLING EMISSIONS OF PLANT PROTECTION PRODUCTS DURING DRILLING TREATED SEED

Clare Butler Ellis[1]*, Andrew Lane[1], Christine O'Sullivan[1], Rafael Alanis[1], Paul Miller[1], Andrew Chapple[2], Lubos Vrbka[2]

[1]*Silsoe Spray Applications Unit, (NIAB), Bedford, MK45 44HP, UK*
[2]*Bayer CropScience AG, Monheim, 6690, Germany*
**clare.butler-ellis@niab.com*

Seed drilling machinery is as important an agricultural tool as pesticide application equipment and the use of seeds treated with pesticides is generally recognised as a comparatively efficient and environmentally acceptable method of crop protection. However, addressing the environmental effects of seed treatment active substances leaving the drilled field by any route other than surface-water run-off or drainage has not been considered until recently.

The potential for adverse environmental impacts of dust emissions from seed drills requires some estimates of environmental exposure to be available for risk assessments. Such exposure assessments are generally based on predictions from a model, either an empirical (*e.g.*, data-based) or a mechanistic model, and it is possible that the approaches which have been developed for non-target exposures to spray drift could be adapted for risk assessment for dust exposures.

However, there are significant differences between the droplets in a drifting spray plume and the dust generated during seed drilling which add to modelling complexity. These include the density of dust particles which can vary with particle size, unlike conventional sprays; the varying amount of active ingredient associated with different particle sizes; the in-flight behaviour of particles which are not spherical; and to which can be added the difference in emission route of the dust from the various drilling machine types.

Exploring the effects of application practices and different seed treatment processes (*e.g.*, pre-cleaning steps, stickers, waxes) which will influence the characteristics of the emitted dust as well as environmental parameters (*e.g.*, climate, field structures) which in turn will influence the downwind dispersion, would require inordinate resources for field trials. Therefore, Silsoe Spray Applications Unit, supported by Bayer Crop Science AG are developing a dust drift model to be used initially to explore the above mentioned variables but with a more general aim of eventually developing a regulatory acceptable model as part of a tiered approach for the registration of seed treatments. This paper explores the principal hurdles to building such a model and outlines progress to date.

AN EPIDEMIOLOGIAL STUDY OF RESPIRATORY EMERGENCIES AND A CONTROLLED GROUP OF ALLERGIC PATIENTS ON GRAN CANARIA IMPACTED BY SAHARAN DUST

Elena Caballero[1], Teresa Carrillo[1], Edward Derbyshire[2], Inmaculada Menéndez[3]*, Johann Engelbrecht[4], Lidia Romero[3], Pablo Mayer[3], Felipe Rodríguez De Castro[1]

[1]*Hospital Universitario Dr. Negrín, Las Palmas de Gran Canaria, 35010, Spain*
[2]*Royal Holloway, University of London, TW20 0EX, UK*
[3]*Instituto Oceanografía y Cambio Global, Universidad de Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, 35017, Spain*
[4]*Desert Research Institute, Reno, NV 89512, USA*
**inmaculada.menendez@ulpgc.es*

Gran Canaria is located off the west coast of North Africa, and close to the Sahara Desert, a major source of natural mineral particles (NMP). The island is frequently impacted by Saharan dust (about 30% of the time each year, with an average duration of 3-5 days per event). The annual deposition rate is 15.6 g/m^2, and the mean grain-size is 15μm, with about 20% being <5 μm. In 2010, the Dr. Negrín Hospital in Gran Canaria served a population of approximately 330,000 individuals and 2,856 patients attended the Emergency Department (ED) for respiratory condition. That year we conducted an epidemiological survey together with an air quality study, the latter being the quarterly monitoring of a group of 24 adult outpatients at the hospital (12 with mild asthma and rhinitis, and 12 with moderate to severe asthma and rhinitis). During each visit, a full medical examination was performed on each patient, including simple spirometry and bronchial inflammation tests (measurement of exhaled nitric oxide). Patients also completed validated standard and linguistic tests (quality of life in rhinitis and asthma, asthma control test and overall health status). Similarly, symptoms were recorded on a card by the patients at home, on a daily basis, including ocular, nasal and bronchial conditions and lung function (Peak Flow registration). The medications were reviewed in order to assess the clinical and functional status of each patient. Over the same period, the most frequently respiratory conditions diagnoses at ED of Dr. Negrín Hospital were asthma, chronic obstructive pulmonary disease and pneumonia; besides aerosol samples were collected on a weekly schedule, with Airmetrics MiniVol® filter samplers (5 l/min). The PM2.5 filters were analyzed for elemental composition, water soluble ions, carbon, mineralogical content, and individual particle morphology by Scanning Electron Microscopy. Analysis of variance (ANOVA) and Spearman correlation coefficients were applied to the air quality and clinical and emergency data. No statistically significant relation between the rate of emergency admissions, pulmonary conditions, consumption and elevated dust levels could be established from our data set.

VOLCANOGENIC PARTICULATES AND GASES FROM ETNA VOLCANO (ITALY)

Sergio Calabrese[1]*, Luciana Randazzo[1], Sarah Scaglione[1], Walter D'Alessandro[2], Giuseppe Montana[1], Francesco Parello[1]

[1]*DiSTeM - University of Palermo, Palermo, 90123, Italy*
[2]*INGV Palermo, Palermo, 90146, Italy*
**sergio.calabrese@gmail.com*

Volcanic emissions represent one of the most relevant natural sources of trace elements to the troposphere. Due to their potential toxicity they may have important environmental impacts from the local to the global scale. Etna volcano is known as one of the largest global contributors of magmatic gases (CO_2, SO_2, and halogens) and particulate matter, including some toxic trace elements (Calabrese et al., 2011).
Filter samples were collected at Etna volcano (Sicily) on summer 2010 and 2011. Three sampling points were chosen according to location of main volcanic activity and intensity. The sampling was performed by a high volume air sampler (Staplex Model TF-1A) using PTFE filters. The total particulate concentrations ranged from about 50 $\mu g/m^3$ (local background) to more than 1000 µg/m3 close to the crater rim. Particle size and micromorphology of Etna particulates with size ranging from 0.5 to 10 µm were investigated using a scanning electron microscope by secondary electron (SE) imaging. Qualitative EDS analyses were carried out to acquire elemental compositions. As a result, different clusters of particles can be discriminated on the basis of morphology and/or composition allowing to classify the aerosol particles into four groups: silicates, Fe/Ti oxide, sulfates, halides (chlorides and fluorides) and polygenic particles. In addition, the bulk chemical composition of aerosols was determined by using ICP-MS after total acid digestion (HNO_3-HF-$HClO_4$) of the filters and 46 elements were determined. The results show a significant enrichment in the filters collected in the summit area in contrast with the local background. In particular, the most abundant elements were Si, Al and Fe (up to 100-200 $\mu g/m^3$), followed by Ca, Na, Mg, K, Ti (ranging from 10 to 50 $\mu g/m^3$). Among with major constituents of aerosols, high concentrations of potentially toxic elements were found (As, B, Cu, Pb, Se and Tl, ranging from 0.2 to 2 $\mu g/m^3$). Chemical and mineralogical results clearly allow to discriminate two main constituents of the particles: the former is mainly referable to the silicate component in the volcanic plume, like lithic and juvenile fragments, crystals (e.g. plagioclases, pyroxenes, oxides) and shards of volcanic glass; the second one is linked to the soluble component like sulfosalts or halide minerals (sulfates, chlorides and fluorides).

Calabrese S., Aiuppa A., Allard P., Bagnato E., Bellomo S., Brusca L., D'Alessandro W., Parello F. (2011) Atmospheric sources and sinks of volcanogenic elements in a basaltic volcano (Etna, Italy). Geochimica et Cosmochimica Acta, 75. pages 7401-7425

THE USE OF MOSS-BAGS TECNIQUE TO VOLCANIC AEROSOLS INVESTIGATION ON MT. ETNA (ITALY)

Sergio Calabrese[1]*, Walter D'Alessandro[2], Silvia Milazzo[1], Sergio Bellomo[2], Lorenzo Brusca[2], Francesco Parello[1]

[1]*DiSTeM - University of Palermo, Palermo, 90123, Italy*
[2]*INGV Palermo, Palermo, 90146, Italy*
**sergio.calabrese@gmail.com*

Explosive eruptions and volcanic passive degassing inject large quantities of gas and particles into the atmosphere that are ultimately deposited at the Earth's surface through wet or dry deposition processes, affecting the atmosphere, the hydrosphere and the biosphere. Mount Etna (Italy) is one of the most prodigious and persistent source of gases and particles to the troposphere (Calabrese et al., 2011). Volcanic emissions were studied at Etna volcano by using moss-bags technique. Mosses (*Sphagnum* species) were exposed around the volcano at different distances from the active vents to evaluate the impact of its emissions into the atmosphere and in the local surrounding. Chemistry, micromorphology and mineralogy of volcanic particulate intercepted by mosses were investigated using scanning electron microscopy (SEM) equipped with energy dispersive spectrometer (EDS). Concentrations of major and a large suite of trace elements were analysed by inductively coupled mass and optical spectrometry (ICP-MS and ICP-OES) after total acid digestion. The results confirmed the huge amount of silicates, sulfates and halides compounds emitted into the atmosphere from Mount Etna. X-ray microanalysis showed that chemical composition of the particles is mostly defined by silicate (from pure silica to metal-rich silicate composition) and sulfate/halide compounds. The contents of major and trace elements in the Sphagnum moss-bags significantly increased after their exposure to volcanic emissions, confirming mosses as efficient accumulators. Metals uptake rate rapidly decreases with the distance from the volcanic emission vents. The elements that showed the greatest accumulation after exposition were S, Na, Fe, Al, Cu, V, As, Cd, Li, Se, Sc, Th, Bi, Tl. This study confirmed the marked environmental impact of volcanic emissions in the eastern sector of Etna, leading to an intense "geochemical anomaly" of volatile major and trace elements due to the fumigation by the volcanic plume, in agreement with passive biomonitoring studies reported by previous authors. Finally, moss-bags techniques provide a cheap and efficient method to investigate quantitatively in space and time the environmental impact of volcanogenic atmospheric deposition.

Calabrese S., Aiuppa A., Allard P., Bagnato E., Bellomo S., Brusca L., D'Alessandro W., Parello F. (2011) Atmospheric sources and sinks of volcanogenic elements in a basaltic volcano (Etna, Italy). Geochimica et Cosmochimica Acta, 75. pages 7401-7425

MODEL BASED SPATIO-TEMPORAL ANALYSIS AND MAPPING OF APULIA AIR QUALITY DATA

Crescenza Calculli[1]*, Annarita Turnone[2], Francesco Finazzi[3], Alessio Pollice[4], Angela Morabito[5]

[1,2]*Dept. of Physics, University of Bari, Bari, 70125, Italy*
[3]*Dept. of Management, Economics and Quantitative meth., University of Bergamo, Bergamo, 24127, Italy*
[4]*Dept. of Economics and Mathematics, University of Bari, Bari, 70124, Italy*
[5]*ARPA Puglia, Regional Air Quality Center, Bari, 70126, Italy*
**calculli.enza@gmail.com*

In this work we analyze air quality data applying a general spatio-temporal modeling approach for the handling of environmental phenomena characterized by spatial and temporal variability. By means of a hierarchical specification which binds an observed process to latent processes not directly observable, this approach allows an efficient interpretation of phenomena related to air pollution and is useful to suitably estimate and manage the several uncertainties related to environmental analysis (such as the spatio-temporal variation, the use of helpful meteorological information, accidental variability and so on) as proposed in Fassò and Finazzi (2011). The main purpose of the application of the hierarchical multivariate spatio-temporal model is to estimate daily dynamical maps of particulate matters (PM_{10}) and nitrogen oxides (NO_2) concentrations and of the related uncertainty regarding the Italian region of Apulia. For this aim, the official data of the air quality monitoring network of Apulia are used, together with the meteorological data contained in the database of the Meteorological Service of Apulia Region. The almost real-time mapping (the maps concern the previous day or the day which the most recent data are available for) is obtained through an implementing strategy consisting in the daily estimation of the spatio-temporal model which takes in consideration only data related to the last *n* days. Such approach allows to neglect very old data and to update the parameters of the model day by day. The maximum likelihood estimation of the parameters of this model is based on the EM algorithm and is achieved by means of the D-STEM software (Distributed Space Time Expectation Maximization), a statistical tool for the analysis and mapping of environmental space-time variables (Finazzi and Fassò, 2013). The software is able to handle multiple variables with heterogeneous spatial supports, unbalanced sampling networks and missing data without needing data imputation or interpolation. Besides, in order to deal with the computational complexity of the estimation of multivariate hierarchical models, the Bari INFN high performance Grid computing infrastructure is used. Some main results, in terms of concentrations and related uncertainty maps, are shown in order to highlight potentiality and usefulness of the proposed approach in the context of official environmental communication especially in the case of violations of concentration limits.

Fassò A., Finazzi F. (2011). Maximum likelihood estimation of the dynamic coregionalization model with heterotropic data. Environmetrics, 22, 735 - 748.

Finazzi F., Fassò A. (2013). D-STEM: A software for the analysis and mapping of environmental space-time variables. Submitted.

FIRST EVIDENCE OF VOLCANIC PLUME OBSERVED IN A CENTRAL MEDITERRANEAN MARINE OBSERVATORY

Claudia R. Calidonna[1], Paolo Bonasoni[2], Maurizio Busetto[2], Chiara Cannata[3], Paolo Cristofanelli[2], Rosanna De Rosa[3], Paola Donato[3]*, Daniel Gullì[1], Tony C. Landi[2], Angela Marinoni[2], Anna M. Sempreviva[1]

[1]*CNR-ISAC, Lamezia Terme (CZ), I-88046, Italy*
[2]CNR-ISAC*, I-40129, Bologna, Italy*
[3]*UNICAL-DiBEST, Rende (CS), I-87036, Italy*
**paola.donato@unical.it*

Continuous measurements of PM_{10} and $PM_{2.5}$, aerosol size distribution and meteorological parameters are performed at the CNR-ISAC Climatic Observatory of Lamezia Terme, located 500 m inland from the Tyrrhenian coastline, installed in the framework of I-AMICA project in summer 2013. These measurements, together with wind LiDAR observation, are available in near-real time on I-AMICA web site (http://www.i-amica.it/i-amica/?page_id=1122).

The position of the Observatory allows investigating the variability of natural emissions, such as sea-spray aerosols, mineral dust (i.e., from Sahara desert), as well as of volcanic activities of Etna (about 170 km SSW from Lamezia) and Stromboli (about 85 km).

In this work we focus on the special event on 19 November 2013, when an increase of factor 10 of PM_{10} levels with respect to the previous average was recorded. The aerosol size distribution shows that the main increase was observed in the coarse fraction, generally ascribed to particles mechanically originated (sea spray, dust, volcanic ash). A SEM-EDX quantitative analysis of the daily filters was performed for the period 18-20th November. The first analysis allowed recognising on 19Th November many sulphur-rich minerals (e.g. gypsum) and particles with silicatic composition, in addition to halite, lime and organic particles also registered during the other days. The composition of analysed particles points to an origin from a volcanic plume, including ash fragments and salts formed by the condensation of plume gas.

In the night between 16th and 17Th November an explosive eruption, which originated an eruptive column moving NE, occurred at Etna. The analysis of Hysplit three-dimensional back-trajectories ending in Lamezia together with MOLOCH (*MOdello LOCale in H coordinates*) meteorological forecasts confirm the possible origin of the sampled aerosol from Etna volcanic plume. Additional analysis will be performed for the identification of aerosol sources.

Acknowledgements - The CNR Climatic Observatory of Lamezia Terme is funded within the Project "*Infrastructure of High Technology for Environmental and Climate Monitoring*" (I-AMICA, PON03-00363) by the Italian National Operative Program (PON) and European Regional Development Fund.

INTRUSION OF NORTHERN AFRICAN DESERT DUST IN ROMANIA. DETECTION AND DATA ANALYSIS

Delia-Gabriela Calinoiu[1]*, Gavrila Trif-Tordai[2], Francisc Popescu[2], Adrian-Eugen Cioabla[2]

[1]*Department of Physical Foundations of Engineering, Politehnica University Timisoara, Timisoara, 300223, Romania*
[2]*Mechanical Engineering Faculty, Politehnica University Timisoara, Timisoara, 300222, Romania*
**delia.calinoiu@yahoo.com*

This paper presents several pollution episodes with desert dust, over Timisoara city, originated from Africa during 2011 and 2012. Desert dust intrusions were observed over Romania by using ground-based measurements and air mass trajectory calculations. The study is relying on detailed physical, chemical and optical aerosol properties, data collected from the sun photometer located in Timisoara, Romania. These instruments have the advantage that they are able to monitored continuous aerosol optical depth (AOD), with high accuracy, fact that is essential for the measuring procedure. The type of aerosol particles was determined by means of AOD, Angstrom coefficient, single scattering albedo, volume size distribution and real part of refractive index. Dust desert dispersion was investigated by using HYSPLIT model.

A NEW STANDOFF REAL-TIME IN-SITU PARTICULE SIZE DISTRIBUTION MEASUREMENTS DEVICE

Cantin Daniel*, Châteauneuf François, Pancrati Ovidiu, Debaque Benoît

INO,Quebec City, G1P 4S4, Canada
**daniel.cantin@ino.ca*

Measurements of aerosol size distribution is mandatory to validate compliance with environmental and industrial hygiene regulations in many countries. However, many of the instruments used to perform measurements of particulate size distribution are questionned with regard to their impact, or bias, on the real size distribution because part of the particulates adhere to surfaces of the sampling system before reaching the measuring area or collecting filters. Furthermore, many of the apparatus used do not allow measurements of liquid aerosols size distribution because their sampling method uses pumps and tubes that prevent the droplets to reach their measurement section. Finally, real-time in-situ measurements of dust without physical sampling of air, that has an impact on the dust size distribution itself, are not currently possible with affordable systems if any.

This new device, based on light scattering by aerosols, allows to perform measurements of the dust size distribution in open air without requiring physical sampling of the particulates. Its working distance is typically 1 to 5 meters but could be extended to few tens of meters. It is suited to work in most typical concentration range used for regulation purposes from few $\mu g/m^3$ to more than mg/m^3. The size distribution measurement possible typically ranges from 0.3 µm to more than 20 µm in diameter. This measuring system is weakly sensitive to the particulate composition making it capable to address a large spectrum of particulate composition having different optical properties ranging from silica to coal and even liquids. Its standoff operating principle also should make it adapted to work in difficult environment such as the monitoring of industrial processes as within plume stacks of power plants. It also makes it very undemanding in maintenance making its deployment on long period at large scale less demanding budget wise. Its real time measurements capability with few second response time will make it a perfect instrument for deployment of distributed arrays of it allowing large territory monitoring for smart cities.

Results demonstrating the device capability and limits will be presented as well as examples of possible deployments and uses for smart city monitoring applications.

DUST, CLIMATE, AND SOIL BIOGEOCHEMISTRY ON VOLCANIC ISLANDS

Anne E. Carey[1]*, W. B. Lyons[1], Karen S. Harpp[2]

[1]*School of Earth Sciences, The Ohio State University, Columbus OH, 43210-1398, USA*
[2]*Department of Geology, Colgate University, Hamilton NY, 13346, USA*
**carey.145@osu.edu*

Dust input to the landscape plays an important ecological role on a global scale. Seminal work on the Hawaiian Islands has demonstrated that dust provides nutrients for ecosystem development and maintenance in volcanic terrains (e.g., Crews et al., 1995; Vitousek et al., 1997). We review the bedrock geochemistry of volcanic islands (Galápagos, Azores, Canaries, South Shetlands) from different climatic regions with a variety of aeolian dust fluxes. We document fluvial chemical weathering fluxes, denudation rates, and soil geochemical profiles; using dust fluxes estimated from Duce et al. (1991), we also examine the role of dust input into soil and ecosystem development. Mean annual temperature from the South Shetlands and Canary Islands are used to predict Σcations from chemical weathering and atmospheric fluxes of P, based on the relationship developed by Dessert et al. (2003). Recent measurements from South Shetlands (Lyons et al., 2013) yield Σcations, corrected for precipitation inputs, of 6-10 mg L^{-1}. Chemical weathering fluxes are computed using the first 100 ka loss rates for the Hawaiian Islands (Chadwick et al., 1999); values for other locations were determined by comparing mean annual rainfall to Hawaiian mean annual rainfall. Furthermore, to assess the process of rock transformation into soil, we compare elemental losses or gains and the role of dust in ecosystem maintenance with estimates for Hawaii. Our calculated atmospheric phosphorus fluxes range from 9 mg m^{-2} a^{-1} for South Shetland to 120 mg m^{-2} a^{-1} for the Galápagos. The Galápagos Islands have the lowest calculated P weathering flux (2.5 mg m^{-2} a^{-1}). That estimate, along with the observation that most dust reaching the Galápagos originates from high nitrate soils of the Atacama Desert (Windom, 1975), suggests the Galápagos ecosystem may be extremely P-limited.

Chadwick O., Derry L., Vitousek P., Huebert B., Hedin L. (1999) Changing sources of nutrients during four million years of ecosystem development. *Nature* 397, 491-497.

Crews T., Fownes J., Kitayama K., Mueller-Dombois D., Riley R., Scowcroft P., Vitousek P. (1995) Changes in soil phosphorus and ecosystem dynamics across a long soil chronosequence in Hawaii. *Ecology* 76, 1407-1424.

Dessert C., Dupré B., Gaillardet J., François L., Allègre C. (2003) Basalt weathering laws and the impact of basalt weathering on the global carbon cycle. *Chemical Geology* 202, 257-273.

Duce R., Liss P., Merrill J. and 19 others (1991) The atmospheric input of trace species to the world ocean. *Global Biogeochemical Cycles* 5, 193-259.

Lyons W., Welch K., Welch S., Camacho A., Rochera C., Michaud L., Dewit R., Carey A. (2013) Geochemistry of streams from Byers Peninsula, Livingston Island. *Antarctic Science*, 25, 181-190.

Vitousek P., Chadwick O., Crews T., Fownes J., Hendrick D., Herbert D. (1997) Soil and ecosystem development across the Hawaiian Islands. *GSA Today* 7, 1-9.

Windom H. (1975) Eolian contributions to marine sediments. *J. Sedimentary Petrology*, 45(2), 520-52

CAPACITIVE SINGLE-PARTICLE MICRODETECTOR FOR REAL-TIME PERVASIVE PM_{10} MONITORING

Marco Carminati[1]*, Lorenzo Pedalà[1], Francesca Nason[2], Elena Bianchi[2], Gabriele Dubini[2], Luca Cortelezzi[3], Giorgio Ferrari[1], Marco Sampietro[1]

[1]*DEIB, Politecnico di Milano, Milano, 20133, Italy*
[2]*DCMIC, Politecnico di Milano, Milano, 20133, Italy*
[3]*Department of Mechanical Engineering, McGill University, Montreal, H3A 2K6, Canada*
**marco1.carminati@polimi.it*

Although the awareness for the severe health risks (mainly cardiovascular and respiratory pathologies) caused by the exposure to particulate matter (PM) is growing worldwide, effective air pollution contrasting strategies are still to be identified. The development of better PM dispersion and exposure models (Lonati, 2011) would significantly benefit from the capillary diffusion of portable and low-cost single-particle detectors providing unprecedented spatiotemporal resolution.

We propose a novel fine dust detection technique based on attoFarad-sensitivity measurements. We quantify the capacitance variation induced by the transit or deposition of a single PM particle over the coplanar electrodes (spaced by 4 μm) of a microcapacitor, where air is the top dielectric. The results of finite element simulations are presented and design guidelines for optimal electrode layout discussed. The numerical simulations are substantiated by experimental results. Initially, the feasibility of single particle detection is experimentally demonstrated using single 20 and 10 μm polystyrene beads. Subsequently, a more realistic testing is performed using well characterized powder samples (industrial talc and laser printer toner) having the same (8 μm) average size but different permittivity. The powders are suspended in air in a mixing chamber and pumped into a microfluidic detection chamber (realized in PDMS) with integrated microelectrodes. The deposition of single particles is tracked in real-time (with 10 ms time resolution) by recording capacitance variations (with 2 aF resolution) with a customized low-noise electronic front-end and adopting a differential sensing scheme.

Our approach offers single particle detection and particle size discrimination capabilities and, differently from mass sensitive microresonators (Paprotny, 2013), is suitable for a monolithic MEMS implementation. This step will enable a radical miniaturization of the detector, which could be embedded in portable personal devices, such as smartphones, for pervasive indoor and outdoor real-time air quality monitoring, personal dosimetry in workplaces and participatory air pollution mapping in smart cities. Furthermore, the integration of the readout electronics in a CMOS microtechnology will allow the finer (zeptoFarad) resolution (Carminati, 2011) necessary for the detection of PM_1 and submicron PM.

Lonati G., Ozgen S., Ripamonti G., Cernuschi S., Giugliano M. (2011). Pedestrian exposure to size-resolved particles in Milano. J. Air Waste Manage. Assoc., 1273-1280.

Paprotny I., *et. al*, (2013). Microfabricated air-microfluidic sensor for personal monitoring of airborne particulate matter: design, fabrication, and experimental results. Sensors and Actuators A, 506-516.

Carminati M, Ferrari G., Guagliardo F., Sampietro M. (2011). ZeptoFarad capacitance detection with a miniaturized CMOS current front-end for nanoscale sensors. Sensors and Actuators A, 117-123.

AERUS (AEROSOLS FOR USERS): AN ADVANCED INITIATIVE FOR TRACKING OPERATIONALLY AEROSOL EVENTS OVER ANY SURFACE TARGETS BASED ON SATELLITE MSG/SEVIRI OBSERVATIONS

Dominique Carrer[1], Jean-Louis Roujean[1], Xavier Ceamanos[1], Bruno Six[2]

[1]*Météo France, CNRM-GAME, UMR3589, Toulouse, France*
[2]*ICARE Data and Services Center, Villeneuve d'Ascq, France*

Hitherto, one of the crucial challenges of aerosol remote sensing is to ensure a continuous monitoring of dust plumes in Northern Africa. As a matter of fact, the capability of aerosol detection over bright targets like the Sahara region has been proved difficult by state-of-the-art algorithms such as MODIS-based. The solving of this issue represents a key objective of the present initiative AERUS owing to an enhanced separation of the top-of-atmosphere radiative flux arising from aerosol and surface components. This study demonstrates that a simultaneous retrieval of surface albedo and aerosol properties can be performed, leading to an accurate quantification of the aerosol load in the atmosphere. In contrast with the classical spectrally- and spatially-based retrieval methods, AERUS method is based on a directional and temporal inspection of the satellite signal. The proposed method carries out a discrimination between the directional signatures of the surface, on the one hand, and those of aerosol particles, on the other, using a semi-empirical kernel-driven model for the surface/atmosphere system. As a result, tracking rapid variations of surface properties or sudden aerosol episodes becomes possible even over desert areas.
The application of the proposed method to MSG/SEVIRI observations is carried out over Europe and Africa. The SEVIRI-derived AOD estimates compare favourably with measurements of several AERONET stations, MODIS-derived (Moderate Resolution Imaging Spectro-radiometer), and MISR-derived (Multi-angle Imaging Spectro-Radiometer) products within a 20% of accuracy. Furthermore, the higher number of AOD products in time from SEVIRI provides the means to quantify the aerosol radiative forcing in a more accurate manner than using low-orbit satellite data. The method proves to be competitive, not only to track anthropogenic aerosol emissions in the troposphere but also to estimate dust events over bright targets. The AERUS algorithm is being implemented in the ICARE thematic centre based in France (http://www.icare.univ-lille1.fr), which will disseminate an operational daily AOD product at 670 nm over the MSG disk starting in mid-2014.

REMOTE SENSING AND EXPERIMENTAL EVIDENCE OF MODERN PATAGONIAN DUST FERTILIZATION IN THE ATLANTIC SOUTHERN OCEAN

Alexandre Castagna*, Beatriz Marques, Heitor Evangelista

Laboratory of Radioecology and Global Change / State University of Rio de Janeiro (LARAMG / UERJ), Rio de Janeiro, 20550-900, Brazil

**alexandre.castagna@gmail.com*

Although on deck and *in situ* fertilization studies in the last two decades confirmed the central role of iron as limiting the primary production in the Southern Ocean (Moore *et al.*, 2013), the role of dust in delivering biologically significant amounts of iron to this system remains elusive (e.g., Cassar *et. al.*, 2007; Johnson *et al.* 2011). Here, we approach the study of Patagonian dust fertilization employing two different tools: (1) an orbital remote sensing study on inter-annual scale; and (2) the first microcosm fertilization experiment with Patagonian dust, performed in November 2012 on the Drake Passage (59ºS/58ºW). The SCIAMACHY Absorbing Aerosol Index (AAI) was used as a proxy of annual dust activity within Patagonia source regions. The AAI series was correlated with SeaWiFS chlorophyll-a (Chl) and phytoplankton carbon (C_{phyto}) over the Atlantic Southern Ocean. The resulting correlation map shows a zonal area of strong positive correlation between the Subtropical Front (STF) and the southern boundary of the Antarctic Circumpolar Current (ACC-SB) for both Chl and C_{phyto}. This zone is generally restricted to the north of the Polar Front (PF), a region with seasonal depletion of silicate below average limiting levels for diatom growth. This suggests that the correlation could be related to the effect of iron on the diatom silicate resource ratio. To experimentally confirm the effect of modern dust flux on the phytoplankton, we performed a microcosm fertilization experiment using standard clean methods. Water was sampled with a vacuum pump, filtered in line with a 200 µm mesh to remove large herbivores, and distributed in eight acrylic recipients of twenty litters. The system was kept in deck for twelve days under reduced (30%) natural light and circulating sub-superficial water to control temperature. Dust additions were defined using compilations of mixed layer depth and several models of dust deposition to the Drake Passage. Duplicates for control (‘A’) and three different addition levels were used: minimum (1 µg L^{-1}; ‘B’), average (10 µg L^{-1}; ‘C’) and maximum (100 µg L^{-1}; ‘D’). At the end of the incubation, all dust addition treatments shown above control increase of 665 nm absorbance (Chl) and cellular abundance, suggesting fertilization effects for all treatments. Combined, these results suggest the Patagonian dust deposition could exert biological influence on a wide spatial scale even at the low modern flux.

Cassar N. Bender M. Barnett B. Fan S. Moxim W. Levy H. Tilbrook B. (2007). The Southern Ocean biological response to aeolian iron deposition. Science, 317(5841), 1067-70.

Johnson M. Meskhidze N. Solmon F. Gassó S. Chuang P. *et al.* (2010). Modeling dust and soluble iron deposition to the South Atlantic Ocean. J. Geophys. Res., 115(D15), 1-13.

Moore M. Mills M. Arrigo K. Berman-Frank I. Bopp L. Boyd P. Galbraith E. Geider R. Guieu, C. *et al.* (2013), Processes and patterns of oceanic nutrient limitation, Nat. Geosci., 6(9), 701-710.

HEALTH EFFECTS OF NATURAL DUST. DEFINING THE RISKS FROM A CHEMICAL, MEDICAL GEOLOGY AND ENVIRONMENTAL PATHOLOGY PERSPECTIVE

Jose A. Centeno[1]*, Saverio Fiore[2]

[1]*Joint Pathology Center, Division of Biophysical Toxicology Laboratories, Malcolm Grow Medical Clinic, MD, USA*
[2]*Institute of Methodology for Environmental Analysis, CNR, 85050 Tito Scalo, Potenza, Italy*
**Jose.Centeno@afncr.af.mil*

Atmospheric particles originate from a variety of sources, both natural and anthropogenic. While aerosol pollutants such as NO_x and SO_x are mainly from industrial activities, airborne natural mineral dust has existed as long as there has been loose particles and wind on earth. The total aerosol load in the atmosphere, as well as their metal chemistry and microbiological composition, have been shown to be strongly influenced by presiding climate systems and presence of dry land areas (deserts) and industrialized areas. Hence, natural dust is a form of geologic emission, arising from arid land areas, or from any human activity disturbing the earth's surface such as mining, agriculture, construction, etc.

Health effects from exposure to particulate matter have been widely described in the medical respiratory diseases literature. Direct contact with potentially harmful inhaled particles and the fine, fragile airways contributes to making the respiratory system a major target for dust and toxic agents. But toxic agents carried by dust can also exert adverse effects in other parts of the body as they are dissolved in the lung and absorbed into the blood stream. It is not only the inhalation pathway that needs to be considered, but also the increased exposure from dust deposition on edible crops and in drinking water sources. Thus, in order to set up preventive measures and regulations for dust levels to ensure public health, it is critical to gain knowledge about the potential health effects of environmental dust exposure. Geological information on dust sources, processes that affect mobilization, and transport of dust, as well as toxicological information on the effects and pathways of dust particles through respiratory organs are needed. In addition, careful studies on dust levels, chemical composition, and environmental pathology are required. Of relevance is the emerging field of Medical Geology, which is aimed at assessing the impacts of natural environmental risk factors and processes on animal and human health. This session stresses the global scale of the problem, in terms of its environmental, chemical, and human health implications.

Suggested reading:
1. Centeno JA. (2008). J. Environ. Monit.,10,266.
2. Centeno JA. (2008). Interciencia, 33,169-171.
3. Lettino A., Fiore S. (2013). Sci. Tot. Environ., 464, 404-413.
4. Selinus O., Alloway B., Centeno J.A., et al. (Eds) (2005). Essential in Medical Geology, Elsevier.

STEEPENING OF WAVES IN A NON IDEAL, DUSTY GAS

Meera Chadha*, Jasobanta Jena

Netaji Subhas Institute of Technology, Department of Mathematics, University of Delhi, New Delhi-110078, India
**meerac9a@yahoo.co.in*

The singular surface theory has been used to study different modes of wave propagation and its culmination into discontinuities at the wave fronts in a plane, cylindrically and spherically symmetric flow of a non ideal, dusty gas. The transport equation for the jump discontinuity has been obtained. The equation so obtained is of Bernoulli type. The effects of dust particles which enter through different parameters such as the mass fraction of the solid particles in the mixture, the ratio of specific heat of the solid particles to the specific heat of the gas, the ratio of the density of the solid particles to the species density of the gas are studied in detail. The effect of non ideality which enters through the Van der Waals excluded volume, on the formation of shocks has also been investigated. The present work is concerned with the cases when the mass concentration of the particles is comparable with that of the gas.
The results show that the solution of this type of equation breaks down at some critical time. This indicates the formation of shock wave at that instant and a compression wave culminates into a shock at finite time only when the initial discontinuity associated with the wave exceeds a critical value.
It was observed that as time ‘t’ increases, the jump discontinuity decreases and tends to zero as ‘t’ becomes infinite. Also an increase in any of the parameters i.e. mass fraction of the solid particles in the mixture, the ratio of specific heat of the solid particles to the specific heat of the gas, the ratio of the density of the solid particles to the species density of the gas results in a decrease in the jump discontinuity, whereas an increase in the non ideal parameter ‘b’ leads to an increase in jump discontinuity.

Radha, Ch., Sharma, V.D, and Jeffrey A.,(2002). An approximate analytical method for describing the kinematics of a bore over a sloping beach, Application Analysis 81, 867-892.
Shyam R., Singh, L.P. and Sharma, V.D., Steepening of Waves in Radiative Magnetohydrodynamics(1986) Acta Astronautica 13, 95-100.

A TEPHRA ASH FROM THE ALASKAN MT. REDOUBT 4 APRIL 2009 ERUPTION REACHED PRAGUE IN TWELVE DAYS

Leona Chadimová[1]*, Jindřich Hladil[1], Ladislav Strnad[2], Roman Skála[1], Tomáš Navrátil[1], Christina Neal[3]

[1]*Institute of Geology AS CR, v.v.i., Prague, 16500, Czech Republic*
[2]*Charles University in Prague, Prague, 12843, Czech Republic*
[3]*U.S. Geological Survey - Alaska Science Center, Alaska Volcano Observatory, Anchorage, U.S.*
**chadimova@gli.cas.cz*

Tephra ash from the Alaskan Mt. Redoubt 4 April 2009 eruption reached Prague in twelve days. In 2010, the multiproxy studies of the material collected during a rare dust deposition event of the 16th April 2009 confirmed that a significant proportion of the lithic-mineral particles emitted from the Redoubt Volcano occurred. The mineralogically, chemically and physically orientated analytical data represent real evidence that about 15 to 20 wt. % content of this unusual event sediment was of Mt. Redoubt provenance. The high tropospheric backward trajectories show a perfect match with the theoretical paths of the transport which had to be considered as jetstream-mediated. With regard to composition of the dust particle mixtures, reloading of the particles between these high speed winds and turbulent mixing within the tropopause folds was a possible mechanism that significantly contributed to the mass and lifetime of these large but dynamically light particles. In spite of the general prevalence of dacitic-rhyolitic tephra fragments (few μm to 40-50 μm long), crystalloclasts, crystals and aggregates of pyroxenes, amphiboles, high-Na, Fe anthophyllite, bytownite-labradorite, crystalline quartz, zeolites, and also titanomagnetite in small fragments of fresh volcanic microclasts were identified.The presence of aggregated dust particles together with sherd tephra covered by adhering clay-size particles provided a significant evidence of long survival and even further structural evolution of the respective porous and complex-shaped large lithic-mineral particles in the atmosphere. It is important because most of the recent models are constructed in that way that they are not compliant to specification of a long transport of such relatively coarse or in-air aggregated complex particles. The largest of the studied porous aggregate particles, being agglutinated from the smallest ash and dust components, crystallite-crystal needles and flakes, showed very flat prolate ellipsoid (surfboard-like) shapes where the major axes were 20-40 μm long. Particularly the mechanism of this event sedimentation itself was quite unusual, following a decrease of the transport velocities in a spiral, short period of vertical mixing of atmospheric layers and occurrence of calm weather conditions in the column between tropopause and lowermost troposphere. With the drawing on the dust portions to ground, the atmospheric boundary layer showed a centrifugal gentle wind pattern. The calculated shapes of the settling dust clouds were downward bent lenses, each several km large but only one or few of hundred metres thick, arranged in a belt crossing the Bohemia in the SW-NE direction, with dust-matter depocentres more sharply limited on the SE than NW side of this belt. One of the most interesting aspects of this dust fall was the depletion of fine particles.

TECHNICAL SOLUTIONS FOR MITIGATING DUST EMISSIONS FROM SOWING MACHINERY

Andrew C. Chapple[1], Reinhard Friessleben[1], Volker Michele[2], Lubos Vrbka[1]*

[1]*Bayer CropScience AG, Monheim, 40798, Germany*
[2]*ABayer Technology Services GmbH, Leverkusen,51368, Germany*
**lubos.vrbka@bayer.com*

The question of emissions of dust possibly containing plant protection products from the sowing machinery into the environment has gathered significant attention recently.

As a part of the activities aimed at further increase in the margin of safety of its seed treatment technologies, Bayer CropScience has designed two technical modifications for vacuum-based precision maize planters - AirWasher and SweepAir®. The former works on the principle of washing out of dust from the planter air exhaust, the latter is a cyclone-based filtering device coupled to an in-field dust disposal device. These technologies show very promising results with respect to the overall dust reduction efficiency.

In the first part of the presentation, the scientific and technical details of these solutions and their performance will be discussed. Part of this section will be dedicated to major technical challenges associated with safely and efficiently handling fine dusts.

Further, the transferability of these (and other existing) technologies to various types of sowing machinery will be addressed.

Finally, the question of industrial cooperation and regulatory acceptance, as well as real-world feasibility of such novel technological solutions will be discussed.

IMPACT OF AEROSOL OPTICAL DEPTH DATA ASSIMILATION ON DUST AND TROPICAL CYCLONE FORECASTS

Shu-Hua Chen[1]*, Angela Benedetti[2], Jean-Jacques Morcrette[2], Luke Jones[2]

[1]*Department of Land, Air, and Water Resources, University of California, Davis, CA, 95616, USA*
[2]*European Centre for Medium-Range Weather Forecasts, Reading, Berkshire, RG2 9AX, UK*
**shachen@ucdavis.edu*

The middle-level African Easterly Jet (AEJ) has great influence on the propagation of tropical cyclones (TCs) over the eastern Atlantic Ocean. In addition, the African Easterly Wave (AEW), which is induced by the instability of AEJ (Burpee 1972), has a strong correlation with tropical cyclogenesis (Landsea, 1993). The occurrence of AEJ is due to the strong vertical wind shear, resulting from the warm Saharan Air Layer (SAL) to the north (i.e., a strong meridional temperature gradient). Dust that emits from Saharan Desert can modify SAL and its environment by changing the energy budget through dust-radiative forcing (Chen et al 2010, Ma et al. 2012). From aforementioned, it is expected that dust propagating along with SAL can modify AEJ, AEW, and TC activities over Atlantic Ocean, indicating the importance of dust forecasts and dust physical processes. In this study, numerical experiments are conducted to assess the influence of the assimilation of aerosol optical depth (AOD) on dust forecasts and to explore the feedbacks of dust-radiation interaction on dust forecasts, AEJ, AEW, and TC activities. Conclusions from these experiments will be addressed and presented.

Burpee R. W. (1972). The origin and structure of easterly waves in the lower troposphere of North Africa. J. Atmos. Sci., 29, 77-90.

Chen S.-H, Wang S.-H., and Waylonis M. (2010). Modification of Saharan air layer and environmental shear over the eastern Atlantic Ocean by dust-radiation effects. J. Geophys. Res., 115, D21202, doi:10.1029/2010JD014158.

Landsea, C.W. (1993). A climatology of intense (or major) Atlantic Hurricanes. Mon. Wea. Rev., 121, 1703-1713.

Ma. P-L., Zhang K., Shi J. J., Matsui T., and Arking A. (2012). Direct radiative effect of mineral dust on the development of African easterly waves. J. App. Met. and Clim., 51, 2090-2104.

INVESTIGATION OF AEROSOL PHYSICOCHEMICAL PROPERTIES BY ELECTRON- AND PHOTON-INDUCED MICROANALYSIS

Marie Choël[2]*, Florin Unga[1,2], Yevgeny Derimian[2], Karine Deboudt[3], Philippe Goloub[2]

[1]*Laboratoire de Spectrochimie Infrarouge et Raman, Université de Lille 1, Villeneuve d'Ascq, 59655, France*
[2]*Laboratoire d'Optique Atmosphérique, Université de Lille 1, Villeneuve d'Ascq, 59655, France*
[3]*Laboratoire de Physico-Chimie de l'Atmosphère, Université du Littoral Côte d'Opale, Dunkerque, 59140, France*
**marie.choel@univ-lille1.fr*

The role of desert dust in radiative forcing and atmospheric processes strongly depends on a variety of physicochemical parameters as well as the spatial distribution and transformations during their atmospheric residence time. To this regard, single-particle analysis techniques can provide detailed information on the size, morphology, chemical composition, and internal structure of mineral dust. Field campaigns were conducted in western Africa (M'Bour, Senegal) and a remote desert site in the Negev Desert (Sde Boker, Israel). Atmospheric aerosols were collected at the beginning, during, and at the end of dust events by means of cascade impactors. Particles were investigated by means of automated scanning electron microscopy coupled to energy-dispersive X-ray spectroscopy (SEM/EDX), transmission electron microscopy (TEM), Raman and FTIR microspectrometry, and atomic force microscopy (AFM). The size distribution and elemental composition of several thousands of individual particles were examined using automated SEM/EDX to describe the mixing state of particles. Due to atmospheric processing, particles exhibiting core-shell structures were often observed. Special attention was paid to the chemistry of surface coatings onto reacted particles using molecular spectroscopy. The physical state of aerosol surface was examined at the nanometer scale by means of topographical and phase contrast images obtained by semi-contact AFM. Some physicochemical properties investigated further served as input parameters to run numerical simulations of radiative properties. This work was conducted in the framework of an interdisciplinary project on Chemical and Physical Properties of the Atmosphere (CaPPA).

POSSIBILITY OF THE USING A CAKE-PIE TYPE DIFFUSER FOR GROUP FILTER CLEANING OF CERAMIC FILTER

Joo-Hong Choi[1]*, Young-Chul Kim[1], Seong-Cheol Jang[2]

[1]*Gyeongsang National University, Jinju, 660-701, Korea (South)*
[2]*Korea Avitation Polytechnic, Sacheion-si, 664-780, Korea(South)*
**jhchoi@gnu.ac.kr*

During the filtration process, particles deposit on the surface of filter medium to form a dust cake and increase pressure drop as gas permeates. For the continuous filtration process, filter element should be periodically cleaned effectively to remove the dust cake, a process called surface regeneration of filter media. One of the effective methods is to apply the high pressure into the filter cavity, called a pulse-jet cleaning. An additional momentum of the pulse gas over that of the process gas passing through the filter element is the main force to release the dust cake. In general, the pulse cleaning manifold of tubular type is used to supply the pulse gas of high pressure through the holes fitted with the filter element above for commercial filter unit using bags. A kind of Venturi type diffuser has been introduced recently for the cleaning system of group filter element of ceramic candle in the integrated gasification combined cycle (IGCC). The former is very effective for the cleaning of the filter element but needs very complicated arrangement of pulse cleaning system. And the last is also effective for the filter cleaning but requires the huge space for Venturi shape, which wastes the space of the filter unit.

A cake-pie type diffuser has a simple structure which covers the filter element of hundred numbers above as the cake-pie shape. The pulse gas of high pressure is distributed above the filter elements during its propagation in the radial direction of the filter unit. So the pulse cleaning system is very compact and needs the least space. One of the important tasks of this system is how it achieved the uniform distribution of the pulse gas on the every element of group filter unit. The experimental and simulation study was carried out in order to investigate the pressure uniformity on the filter elements during the pulse jet injection of the pulse cleaning system using a cake-pie type diffusor in this study.

LABORATORY SCALE STUDY OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) EMISSION FROM RUBBER-WOOD COMBUSTION

Jiraporn Chomanee[1]*, Surajit Tekasakul[1], Perapong Tekasakul[2]

[1]*Department of Chemistry and Center of Excellence for Innovation in Chemistry (PERCH-CIC), Faculty of Science, Prince of Songkla University, Hat Yai, Songkhla 90112, Thailand*
[2]*Department of Mechanical Engineering, Faculty of Engineering, Prince of Songkla University, Hat Yai, Songkhla 90112, Thailand*
**chomanee_j@yahoo.co.th*

Polycyclic aromatic hydrocarbons (PAHs) emission rubber wood combustion was studied in laboratory scale. The size distribution of particle was collected by a 10-stage Andersen sampler with Inertial filter stage (ANIF) attached between 0.43 µm stage and backup filter. The inertial filter has a cutoff size of ~70 nm. PAHs in gas phase were collected by using XAD-2. The sixteen PAH compounds in particle bound and gas phase were analyzed using a high performance liquid chromatography (HPLC). The results show that more than 30% of smoke particles from rubber wood burning were in nano-size range (<70 nm) on mass basis. The composition of PAHs in each phase varies upon the species of PAHs, Naphthalene (Nap) is a dominant component in gas phase and much more 4-6 ring PAHs are emitted in particulate phase, especially nano-size particles. The 4-6 ring PAHs in particulate phase is dominated by Fluoranthene (Flu) and Benzo[g,h,i]perylene (BghiPe). Moreover, the results of BaP Toxic Equivalence (BaP-TEQ) indicate that nanoparticles are the most important as PAHs carrier to the ambient.

Keywords: Gas-particle emission, PAHs, Rubber-wood, Combustion.

Chomanee J., Tekasakul S., Tekasakul P., Furuuchi M., Otani, Y. (2009). Effects of Moisture Content and Burning Period on Concentration of Smoke Particles and Particle-Bound Polycyclic Aromatic Hydrocarbons from Rubber-Wood Combustion. Aerosol Air Qual. Res.9, 404-411.

Furuuchi M., Tekasakul P., Murase T., Otani Y., Tekasakul S., Bai Y. (2006). Characteristics of Particulates Emitted from Rubber-Wood Burning. J. Ecotechnol. Res. 12, 135-139.

Phoungthong K., Tekasakul S., Tekasakul P., Prateepchaikul G., Jindapetch N., Furuuchi M., Hata M. (2013). Emissions of particulate matter and associated polycyclic aromatic hydrocarbons from agricultural diesel engine fueled with degummed, deacidified mixed crude palm oil blends. Journal of Environmental Sciences. 25(4), 751-757.

Tekasakul, P., Furuuchi, M., Tekasakul, S., Chomanee, J. and Otani, Y. (2008). Characteristics of PAHs in Particulates in Atmospheric Environment of the City of Hat Yai, Thailand and Relation with Rubber-wood Burning in Rubber Sheet Production. Aerosol Air Qual. Res. 8, 265-278.

THE EMISSION AND POLLUTION LEVEL OF PGES AND TRAFFIC-RELATED ELEMENTS IN ROAD DUSTS FROM SEOUL, KOREA

Hyo-Taek Chon[1]*, Manfred Sager[2], Laszlo Marton[3]

[1]*Department of Energy Resources Engineering, Seoul National University, Seoul 151-744, Korea*
[2]*Austrian Agency for Health and Food Safety, Spargelfeldstrasse 191, A-1220 Vienna, Austria*
[3]*Research Institute for Soil Science and Agricultural Chemistry, H-1022 Budapest, Hungary*
**chon@snu.ac.kr*

The emission level and pollution characteristics of platinum (Pt) in dust, soils, and tree barks collected from Seoul, the capital of Korea, was published for the first time in Korea (1, 2). The total area of Seoul is about 605 km^2 and its population was about 10.45 million and the number of registered motor vehicles was more than 3 million in 2011. Road dust samples were collected from 31 sites of various traffic volumes in Seoul, and from 4 control suburb sites in satellite cities for comparison. Geology in Seoul area is mostly composed with acidic rocks such as Jurassic granite and Precambrian gneiss and schist. The previous study confirmed that the important source of Pt in roadside environment is automobile catalytic converter, and that it indicates a tendency to increase Pt levels in road dusts along with traffic volume. The study also suggested that not only traffic volume but also driving style have a great influence on Pt levels in road dusts, for example 176 ng/g Pt in dust at the toll gate.

In this study previous dust samples and new 8 dusts collected from Seoul were reanalyzed to determine PGEs (Pt, Pd, Ir) and traffic-related trace elements by ICP-MS and ICP-OES. The concentration levels of Pt, Pd and Ir in reanalyzed 35 dusts were in the range of 0 - 444 (76) ng/g, 172 - 1,215 (609) ng/g, 0.8 - 7.4(2.9) ng/g, respectively. The level of Pt, Pd, and Ir in new 8 dusts ranged 25.6-98.5 (65.6) ng/g, 30.6 - 147.9 (101.7) ng/g and 2.1- 5.5 (3.2) ng/g, respectively. The background of control site was 3.3 Pt ng/g, 220 Pd ng/g, and 1.6 Ir ng/g. Palladium also shows similar distribution trend with Pt, and remarkably high concentration of Pd and Pt in dust was found in the heavy traffic areas, whereas Ir shows no correlation with Pt and Pd. The traffic-related elements such as Cr,Cu,Mo,Ni,Pb,Sb, and Zn were enriched in road dusts with high Pt level as compared with samples from control suburb areas. Closely correlated elements with Pt and Pd in dust were Be, Cr, Cu, Fe, Mo, Ni, Au, Hg, and Bi (higher than $r = 0.50$).

1. Lee,H.Y.,Chon,H.T.,and Sager,M., 2006, Dispersion and pollution characteristics of platinum in urban environment of Seoul, Korea .Journal of the Korean Society for Geosystem Engineerin,v.43, p.84-90 (In Korean with English abstract).
2. Lee,H.Y.,Chon,H.T.,Sager, M. anf Marton,L. 2012, Platinum pollution in road dusts, roadside soils and tree barks in Seoul, Korea. Environmental Geochemistry and Health, 34, 5-12

MODELLING THE IMPACT OF INTENSE ATMOSPHERIC DEPOSITION EVENTS ON THE EAST MEDITERANNEAN MARINE ECOSYSTEM

Sylvia Christodoulaki[1,2]*, George Petihakis[1], Konstantinos. Tsiaras[1], George Triantafyllou[1], Maria Kanakidou[2], Nikolaos Mihalopoulos[2]

[1]Institute of Oceanography, Hellenic Center for Marine Research, P.O. Box 2214, Heraklion, Crete, Greece
[2]Environmental Chemical Processes Laboratory. Department of Chemistry, University of Crete
P.O.Box 2208, Heraklion, Greece.
*schristo@hcmr.gr; schristo@chemistry.uoc.gr

Atmospheric deposition of new nutrients to the ocean is known to be of great importance for both carbon dioxide (CO_2) storage in the ocean and marine ecosystems life. The East Mediterranean Sea is of interest for both its marine and atmospheric environment. The Mediterranean atmosphere is a cross road for air masses of distinct origin, highly affected by both natural and anthropogenic emissions into the atmosphere that strongly interact chemically due to the high photochemical activity in the area, leading to the formation of nutrients such as nitrogen compounds. Dust aerosols from the African continent are also affecting the area acting as carriers of nutrients such as iron and phosphorus. Moreover, Mediterranean Sea is one of the world's most oligotrophic ecosystems and presents an unusually high Nitrogen-to-Phosphorus analogy (N:P) in the eastern basin (28:1).

The main goal of the present study, is to investigate the impact of an intense high atmospheric nitrogen and phosphorus deposition event on the marine ecosystem in the East Mediterranean Sea. This has been achieved by using a 1-D coupled physical/biogeochemical model. The model is set-up for the Cretan Sea as a representative area of the Eastern Mediterranean Basin and is forced by observations of atmospheric deposition over Crete Island. Analysis of the underlying biogeochemical dynamics with emphasis on primary production and population distribution is performed. The results are presented and thoroughly discussed.

TI-BASED MATERIALS FOR AIR DECONTAMINATION

KONSTANTINOS CHRISTOFORIDIS*, NICOLAS KELLER, VALERIE KELLER

Institut de Chimie et Procédés pour l'Energie, l'Environnement et la Santé (ICPEES), CNRS, University of Strasbourg, 25 rue Becquerel 67087, Strasbourg, France
**kchristoforidis@unistra.fr*

Metal oxide semiconductors have been widely used as photoactive materials in reduction/oxidation reactions and charge-transfer processes. Among these heterogeneous semiconductors, titanium-based materials have been mostly used as photocatalytic materials due to their inherent properties, such as stability, low-cost, relatively high activity and non-toxicity[1,2]. In the present study, Ti-based materials of high surface area were prepared using the hydrothermal process and crystallized TiO_2 as precursors. The as prepared nanomaterials were modified to produce sun-light activated photo-catalysts through the single- and co-doping process. In the latter case, both anion and cation dopants were used[3]. All catalysts were fully characterized using a multi-technique approach, including surface, structural and morphological characterization. The catalysts were evaluated under artificial solar-light irradiation for the removal of Chemical Warfare Agents (CWA)[4,5] and organic pollutants in the gas-phase. Dimethyl-methylphosphonate (DMMP) and diethylsulfide (DES) were used as simulants of CWA. The catalytic tests were contacted following the NATO procedure tests. The prepared materials have shown improved photocatalytic activity. Based on the combined spectroscopic and catalytic analysis, a correlation between structure and activity was established.

1. Kubacka A., Fernandez-Garcia M., Colon G. (2012). Advanced Nanoarchitectures for Solar Photocatalytic Applications. Chem. Rev. *112*, 1555-1614.
2. Chen X., Mao S.S. (2007). Titanium dioxide nanomaterials: synthesis, properties, modifications, and applications. Chem. Rev., *107*, 2891-2959.
3. Christoforidis K.C., Figueroa S.J.A., Fernandez-Garcia M. (2012). Iron-sulfur codoped TiO_2 anatase nano-materials: UV and sunlight activity for toluene degradation. Appl. Catal. B, *117-118*, 310-316.
4. Grandcolas M., Louvet A., Keller N., Keller V. (2009). Layer-by-Layer deposited titanate-based nanotubes for solar photocatalytic removal of chemical warfare agents from textiles. Angewandte, *48*, 161-164.
5. Grandcolas M., Cottineau T., Louvet A., Keller N., Keller V. (2013). Solar light-activated photocatalytic degradation of gas phase diethylsulfide on WO_3-modified TiO_2 nanotubes. Appl. Catal. B, *138-139*, 128-140.

ASIAN DUST OBSERVATION USING AN INTERNATIONAL COOPERATIVE MONITORING NETWORK

Youngsin Chun, Joo Wan Cha, Juyeon Im, Jeongeun Kim*, Beomcheol Shin, Boyoung Ahn, Seungjoo Song, Hae-Jung Lee

Asian Dust Monitoring Laboratory, National Institute of Meteorological Research, Seoul, 156-720, Republic of Korea
**jekim@kma.go.kr*

There are several collaborative activities in Northeast Asia to cope with Asian Dust. Korea Meteorological Administration (KMA) and Chinese Meteorological Administration (CMA) have been operating 10 of joint dust monitoring stations with PM10 monitoring instrument and visibility meter since 2005. Data from 10 joint stations are shared between KMA and CMA in real time and mainly used to monitor Asian dust outbreak and transportation. KMA constructed three Asian Dust Monitoring Towers in dust origin areas; Erdene and Nomgon in Mongolia, and Naiman in China. Their objective is to investigate meteorological conditions of dust outbreak in order to develop and improve Asian dust forecast model. The Tripartite Environment Ministers Meeting (TEMM) among China, Korea and Japan initiated a joint research among three countries in 2008. Three countries conduct joint research to improve accuracy of dust forecast model and share data for selected dust cases. Mongolia is an important additional participant in this activity. The sharing and accumulation of data can contribute to the validation of dust forecast or transport model.

In this study, meteorological, physical, chemical and optical properties of Asian dust case were analyzed, which occurred during 29 April ~ 4 May, 2011. It was originated in south Gobi (Mongolia) and Inner Mongolia Plateau (China), and transported over Loess Plateau and Shandong peninsula and affected Korea and Japan. The observed maximum concentration was 9,428 μm^3at Wulatezhongqi station in Inner Mongolia on 30 April. In Korea, maximum concentration of 1,025 μm^3 was observed in Heuksando (island at southwest end of Korean peninsula) on 2 May. PM10 mass concentration increased by 12 times compared to annual average in Seoul. Especially, coarse mode particle concentration increased during 1 ~ 5 May. Size-segregated ion composition analysis showed that concentration of soil-originated component (calcium ion) increased in 1 ~ 5.6 ~ size range.

THE COLORADO COARSE RURAL-URBAN SOURCES AND HEALTH STUDY: SPATIOTEMPORAL VARIABILITY OF COARSE AND FINE PARTICULATE MATTER MASS CONCENTRATIONS AND COMPOSITION

Nicholas Clements[1]*, Shelly L. Miller[1], Jennifer L. Peel[2], Jana B. Milford[1], Michael P. Hannigan[1]

[1]*Mechanical Engineering Department, College of Engineering, University of Colorado at Boulder, Boulder, CO, USA 80309*
[2]*Department of Environmental & Radiological Health Sciences, College of Veterinary Medicine & Biomedical Sciences, Colorado State University, Fort Collins, CO, USA 80523*
**nsclements@gmail.com*

Coarse particulate matter ($PM_{10-2.5}$) is a known public health threat; in multiple recent epidemiological studies, increased $PM_{10-2.5}$ mass concentrations were shown to negatively impact respiratory health and increase incidents of asthma. In 2006, the United States EPA funded multiple projects with wide scope, including field monitoring, epidemiological, and toxicological studies, to further the scientific understanding of $PM_{10-2.5}$. One such study, The Colorado Coarse Rural-Urban Sources and Health (CCRUSH) study, assessed the spatiotemporal variability of three years of $PM_{10-2.5}$ and $PM_{2.5}$ mass concentrations and analyzed a year of filter samples collected every sixth-day for measuring the composition of $PM_{10-2.5}$ and $PM_{2.5}$. Field monitoring was conducted at four monitoring sites in urban Denver, Colorado and at two monitoring sites in comparatively rural Greeley, Colorado. A summary of the CCRUSH study will be presented, highlighting both the complex interactions between traffic, meteorological conditions, and particulate mass concentrations and the relationship between sources and particulate matter composition.

INFRARED SPECTRA OF INDIVIDUAL SUBWAVELENGTH DUST PARTICLES: LAB AIR, HOME AIR FILTERS, AND THE WORLD TRADE CENTER EVENT

James V. Coe*

The Ohio State University, Columbus OH, 43210-1173, USA
**coe.1@osu.edu*

A plasmonic metal film with a subwavelength array of holes (a mesh) is used to capture an individual subwavelength particle, like an airborne dust particle, and an imaging infrared (IR) microscope, records a scatter-free, IR absorption spectrum of the particle. While single particle spectra of wavelength-scale particles usually suffer from large scattering effects, the plasmonic relief from scattering effects has enabled the development of a spectroscopic model to determine the volume fractions of various components in dust samples. Libraries of infrared spectra of individual particles have been collected and analyzed. Work will be presented on single airborne particles from our laboratory air, from a household filter, and from the 9/11/ 2001 World Trade Center event.

IMPACT OF RADIATIVELY INTERACTIVE DUST AEROSOLS IN THE NASA GEOS-5 CLIMATE MODEL: SENSITIVITY TO DUST PARTICLE SHAPE AND REFRACTIVE INDEX

Peter Colarco[1]*, Edward Nowottnick[1], Cynthia Randles[1], Bingqi Yi[2], Ping Yang[2], Kyu-Myong Kim[1], Jamison Smith[3], Charles Bardeen[4]

[1]*Earth Science Division, NASA Goddard Space Flight Center, Greenbelt, MD 20771 USA*
[2]*Department of Atmospheric Sciences, Texas A&M University, College Station, TX 77843 USA*
[3]*Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO 80309 USA*
[4]*National Center for Atmosphere Research, Boulder, CO 80305 USA*
**Peter.R.Colarco@nasa.gov*

The radiative effects of Saharan dust aerosols are investigated in the NASA GEOS-5 atmospheric general circulation model. A sectional aerosol microphysics model (CARMA) is run online in GEOS-5. CARMA treats the dust aerosol lifecycle, and its tracers are radiatively coupled to GEOS-5. A series of AMIP-style simulations are performed, in which input dust optical properties (particle shape and refractive index) are varied. Simulated dust distributions for summertime Saharan dust compare well to observations, with best results found when the most absorbing dust optical properties are assumed. Dust absorption leads to a strengthening of the summertime Hadley cell circulation, increased dust lofting to higher altitudes, and a strengthening of the African Easterly Jet, resulting in increased dust atmospheric lifetime and further northward and westward transport. We find a positive feedback of dust radiative forcing on emissions, in contrast with previous studies, which we attribute to our having a relatively strong longwave forcing caused by our simulating larger effective particle sizes. This longwave forcing reduces the magnitude of mid-day net surface cooling relative to other studies, and leads to a nighttime warming that results in higher nighttime wind speeds and dust emissions. The radiative effects of dust particle shape have only minor impact on transport and emissions, with small (~5%) impact on top of atmosphere shortwave forcing, in line with previous studies, but relatively more pronounced effects on shortwave atmospheric heating and surface forcing (~20% increase in atmospheric forcing for spheroids). Shape effects on longwave heating terms are of order ~10%.

ELECTRON MICROSCOPY CHARACTERIZATION OF AEROSOLS COLLECTED AT MAUNA LOA OBSERVATORY DURING ASIAN DUST STORM EVENT

Joseph M. Conny[1], Robert D. Willis[2], Diana Ortiz-Montalvo[1], Aidan Colton[3]

[1]Material Measurement Science Division, National Institute of Standards and Technology, Gaithersburg, MD 20899
[2]National Exposure Research Laboratory, U.S. EPA, Research Triangle Park, NC 27709
[3]National Oceanic and Atmospheric Administration, Hilo, HI 96720

Atmospheric aerosol particles have a significant influence on global climate due to their ability to absorb and scatter incoming solar radiation. Size, composition, and morphology affect a particle's radiative properties and these can be characterized by electron microscopy. Located in the remote marine free troposphere, the Mauna Loa Observatory (MLO) represents a clean airshed that can be used to study anthropogenic pollution influences and long-range transport of aerosol particles from the Asian mainland. The trans-Pacific transport of Asian dust, typically peaking in March, has been well documented. It has been proposed that aerosols transported to the Mauna Loa Observatory during upslope wind conditions (typically daytime) are local in origin while aerosols transported during downslope conditions (typically nighttime) represent long-range transport in the free troposphere. Because of the global nature of Asian dust storms, the radiative properties of these long-range transported particles can significantly impact global climate and are therefore of interest to aerosol scientists and climate researchers. The goal of this study is an improved understanding, obtained through high-resolution electron microscopy, of the sources and radiative properties of natural and anthropogenic particles that influence global climate change.

Twelve PM_{10} samples (six daytime/nightime pairs) were collected on polycarbonate filters for 72 hours each between March 15 and April 26, 2011. Bulk samples of dust from local sources (road dust, parking lot, lava fields) were collected as well in order to assess the PM_{10} contribution from local dusts. On March 19-20 the Korea Meteorological Administration documented a significant dust event over the Korean peninsula. Back-trajectory analyses from MLO coupled with local wind speed and wind direction data suggest that this dust event may have been captured during the MLO sampling campaign. MLO samples were analyzed by computer-controlled scanning electron microscopy (CCSEM) coupled with energy-dispersive X-ray spectrometry (EDX) and particles were sorted into compositionally-distinct particle types which were then compared across the sample set. Concentrations of particle types expected to be associated with Asian dust were observed to peak in one pair of daytime/nighttime samples collected between March 22 and March 28. Manual microscopy characterization of suspected Asian dust particles and local dust particles was carried out using electron backscatter diffraction (EBSD) in conjunction with EDX and focussed ion-beam SEM (FIB-SEM) in an effort to characterize differences in physicochemical or radiative properties of local versus long-range transported particles. FIB-SEM analysis allows for the 3-dimensional reconstruction of the composition of selected particles. Particle optical properties are then calculated from the 3-D reconstructions.

ATMOSPHERIC COMPOSITION VARIABILITY IN THE FRAMEWORK OF I-AMICA ITALIAN SOUTHERN MEDITERRANEAN INFRASTRUCTURAL PROJECT

Contini Daniele[1]*, Bonasoni Paolo[2], Bourcier Laureline[2], Busetto Maurizio[2], Calidonna Claudia Roberta[3], Calzolari Francescopiero[2], Cristofanelli Paolo[2], D'Amico Giuseppe[4], Gullì Daniel[3], Landi Tony Christian[2], Marinoni Angela[2], Donateo Antonio[1], Pappalardo Gelsomina[4], Sempreviva Anna Maria[3], Zaniboni Serena[2].

[1]*CNR-ISAC, Lecce , Italy*
[2]*CNR-ISAC, Bologna, I-40129, Italy*
[3]*CNR-ISAC, Lamezia Terme (CZ), I-88046, Italy*
[4]*CNR-IMAA,Tito Scalo (PZ), Italy*
**d.contini@isac.cnr.it*

The study and monitoring of absorbing aerosol and greenhouses gas variability due to natural and anthropic emissions capture great attention in the scientific community to predict and study implication according different climate scenarios, in particular in the Mediterranean Basin, an hot spot of climate change. In order to strengthen the environmental observation system in the Southern Italian Convergence Regions I-AMICA (*Infrastructure of High Technology for Environmental and Climate Monitoring - Infrastruttura di Alta tecnologia per il Monitoraggio Climatico Ambientale*), a three year Italian National Operative Program (PON) co-founded by the European Regional Development Fund, is being developed.

The project also aim to strengthen the environmental monitoring in the South of Italy adopting both stationary and mobile in-situ stations for aerosols and greenhouses gases and remote sensors, such as Raman lidars and wind lidars for atmospheric profiling. In order to improve modelling activity also for obtaining better air quality forecasts, atmospheric observation activities are going to be implemented at 4 supersites in Apulia, Calabria and Sicily. The selected supersites are representative of rural, suburban and marine sites, providing an almost complete characterization of the atmospheric processes affecting the meteorology and atmospheric composition in the Mediterranean basin.

In two companion abstracts first results of observations of an episode of Etna Volcano eruption and an experiment on natural PM_{10} contribution to exceedances in southern Italy are shown.

Although the measurement activities will be fully operative by the end of 2014, preliminary aerosol measurements carried out at the coastal supersite of Lamezia Terme (Calabria) and at the suburban supersite of Lecce (Apulia) will be discussed. Information about I-AMICA project end real-time data are show on http://www.i-amica.it/i-amica/?page_id=1122.

LIDAR RATIO DISCRIMINATION RETRIEVAL IN A TWO-LAYER AEROSOL SYSTEM FROM ELASTIC LIDAR MEASUREMENTS IN SYNERGY WITH SUN-PHOTOMETRY DATA

Carmen Córdoba-Jabonero[1]*, José Antonio Adame[1], Daniel Grau[1], Emilio Cuevas[2], Manuel Gil-Ojeda[1]

[1]*Atmospheric Research and Instrumentation Branch, Instituto Nacional de Tecnica Aeroespacial (INTA), Torrejon de Ardoz-28850, Madrid, Spain*

[2]*Atmospheric Research Centre of Izaña, Agencia Estatal de Meteorologia (AEMET), Sta. Cruz de Tenerife, Spain*

**cordobajc@inta.es*

The extinction-to-backscattering coefficient ratio (Lidar Ratio, LR) is an aerosol-type dependent parameter associated to the chemical composition, particle shape and size distribution of aerosols. Hence, the LR estimation from lidar measurements is a crucial task in aerosol research. A height-resolved LR can be retrieved from raman/inelastic lidars, unlike elastic ones, where an a-priori constant LR value must be introduced in the elastic inversion algorithm to obtain the aerosol extinction. However, the elastic approach for LR data inversion must be carefully applied in realistic aerosol conditions when a multiple contribution of different types of aerosols can coexist. This is the case for aerosols present in the Atmospheric Boundary Layer (ABL), where a mixing of different particles can be expected. Ansmann (2006) already addressed this question on satellite lidar observations, finding a significant LR underestimation when a two-layer aerosol system was observed from space. In this work, we present a new LR discrimination elastic inversion procedure different from that shown in Córdoba-Jabonero et al. (2010), and focused on the LR estimation for BL aerosols in a dust-influenced area. In that previous work, we obtained the LR for dust particles by fixing the LR at ABL altitudes, highlighting thus the importance of the selected aerosol scenario ("pure dust", PDS, vs. "mixed dust", MDS) applied for elastic dust LR retrievals in a well differentiated two-layer atmosphere: the ABL and the Free Troposphere (FT). In this new methodology, a modified version of the MDS procedure is used together to additional sun-photometry data. Measurements carried out in two AEMET (Spanish Meteorological Agency) stations in the Tenerife Island, relatively close to Saharan dust sources: Sta. Cruz de Tenerife (SCO, 28.5ºN 16.2ºW, 52 m a.s.l.) and Izaña (IZO, 28.3ºN 16.5ºW, 2400 m a.sl.) observatories, both NASA/AERONET sites, are used for that propose. The elastic Micro Pulse Lidar v.3 (MPL-3) located at SCO within NASA/MPLNET is used for lidar measurements. Dusty cases observed during 2009 with simultaneous lidar/sun-photometry data are examined and a seasonal LR variability is obtained.

Ansmann, A. (2006). Ground-truth aerosol lidar observations: can the Klett solutions obtained from ground and space be equal for the same aerosol case? Appl. Opt., 45 (14) 3367-3371.

Córdoba-Jabonero C., Hernandez Y., Gil M., Cuevas E. (2010). Aerosol scenario effect in elastic lidar data inversion for Lidar Ratio estimation: A case study over a coastal dust-influenced area. Proceedings of the IV Aerosol Science and Technology Meeting RECTA 2010 (ISBN: 978-84-693-4839-0), 28-30 June 2010, Granada, Spain.

EFFECT OF BAT SYSTEMS ON DUST CONCENTRATION AND EMISSIONS IN POULTRY AND SWINE BUILDINGS

Annamaria Costa

Department of Health, Animal Science and Food Safety
Tel 0039.02.50317904, Fax 0039.02.50317918
Università degli Studi di Milano, via Celoria 10, 20133 Milan, Italy
annamaria.costa@unimi.it

Livestock buildings are characterized by remarkable concentrations of pollutants emitted into the environment by the ventilation systems. For this reason, the control of the environmental conditions is crucial, in a particular way, in swine and poultry houses, where particulate matter and gaseous ammonia are the predominant pollutants. Dust, or particulate matter, is an important aerial contaminant of animal houses, since it is often coupled to inorganic compounds, gases, bacteria and viable endotoxins, becoming a potentially hazardous agent. The IPPC Directive EU96/ 61/ EC which stands for intensive animal-farming rules about emissions into atmosphere, soils and waters, compels the application of an Environmental Integrated Permit that will cover all forms of emission into the environment. This rule must be followed by farms larger than 40 000 poultry, 2000 fattening pigs heavier than 30 kg or 750 sows and it is based on BAT concept, according to which farmers must prevent or limit ammonia emissions using sustainable and economic technologies. The term 'best available techniques' is defined in the Directive to provide the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole': 'best' means those most effective in achieving a high general level of protection of the environment as a whole; 'available' refers to those techniques that have been developed on a scale that allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages; 'techniques' includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned. The systems classified as BAT for laying hens and broilers admits, for example, the use of manure belts removal for the cage system and for non-cage housing systems, the aviary system is allowed. For pig production, the most spread BAT consist in the presence of the *vacuum system* to remove manure as fast as possible and so to reduce ammonia concentration and emission in the piggery. The studies published in the last decade showed how the BAT system can guarantee the reduction of ammonia emission from the barns, up to 65 % but often can increase the dust emission: most of the recent literature showed that BAT systems, moreover endorsed by EU Rules on Animal Welfare, cannot guarantee a healthy working environment for operators when taking into account the cumulative effects of noxious compounds such as dust and NH_3 in living organisms, and their emission into atmosphere.

MODELLING PARTICLE AGGREGATION IN VOLCANIC PLUMES

Antonio Costa

Istituto Nazionale di Geofisica e Vulcanologia, Bologna, 40128, Italy
antonio.costa@bo.ingv.it

Field observations, laboratory experiments, and theoretical models all indicate that aggregation of volcanic ash plays a pivotal role in the atmospheric transport of volcanic particles. Aggregates form from the combination of ash particle collision and sticking. Collision occurs where particles contact each other because of several processes such as differential sedimentation, Brownian motion, ambient fluid shear, turbulence. Electrostatic forces, especially in the proximal region before atmospheric processes have acted to reduce charge separation back to the molecular scale, can influence collision. Following collision, sticking is strongly enhanced by the presence of a liquid layer on the particle surface as well as electrostatic attraction under conditions of high surface resistivity. The combined collision and sticking probabilities give the aggregation probability, which varies with the sizes of the interacting particles and their local environment. It is known that ash particles have an increasing probability of being transported in aggregated form in both wet and dry environments as particle collision energies decline.

The effect of aggregation can enhance sedimentation by an order of magnitude or even more. Recent studies showed that fine ash particles can comprise up to half, or even more of, the erupted mass of explosively volcanism. For this reason the change in aerodynamic behaviour caused by aggregation with respect to that of single component particles, can have a crucial impact on the subsequent atmospheric transport and ground deposition of ash ejected during explosive eruptions.

Modelling particle aggregation in volcanic plumes in a quantitative way is extremely challenging. Several approaches, ranging from purely empirical parameterizations to the full solution of the Smoluchowsky equation, have been proposed. Here they will be discussed and reviewed.

A CLIMATOLOGY OF DUST EMISSION IN NORTHERN AFRICA USING SURFACE OBSERVATIONS FROM 1984-2012

Sophie Cowie[1]*, Peter Knippertz[2], John Marsham[1]

[1]*Institute of Climate and Atmospheric Science, University of Leeds, Leeds, LS6 4AQ, UK*
[2]*Institute for Meteorology and Climate Research, 76128 Karlsruhe, Germany*
**eesc@see.leeds.ac.uk*

The huge quantity of mineral dust emitted annually from northern Africa makes this area crucial to the global dust cycle. Once in the atmosphere, dust aerosols have a significant impact on the global radiation budget, clouds, the carbon cycle and can even act as a fertilizer to rain forests in South America. Current model estimates of dust production from northern Africa are uncertain. At the heart of this problem is insufficient understanding of key dust emitting processes such as haboobs (cold pools generated through evaporation of convective precipitation), low-level jets (LLJs) and dry convection (dust devils and dust plumes). Scarce observations in this region, in particular in the Sahara, make model evaluation difficult.

This work uses long-term surface observations from 70 stations situated in the Sahara and Sahel to explore the diurnal, seasonal and geographical variations in dust emission events and thresholds. Quality flags are applied to each station to indicate a day-time bias or gaps in the time period 1984-2012. The frequency of dust emission (FDE) is calculated using the present weather codes (WW) of SYNOP reports, where WW = 07,08,09,30-35 and 98. Thresholds are investigated by estimating the wind speeds for which there is a 25%, 50% and 75% probability of dust emission. The 50% threshold is used to calculate strong wind frequency (SWF) and the diagnostic parameter dust uplift potential (DUP); a thresholded cubic function of wind-speed which quantifies the dust generating power of winds. Stations are grouped into 6 areas (North Algeria, Central Sahara, Egypt, West Sahel, Central Sahel and Sudan) for more in-depth analysis of these parameters.

Spatially, thresholds are highest in northern Algeria and lowest in the Sahel around the latitude band 16N-21N. Annual mean FDE is anti-correlated with the threshold, showing the importance of spatial variations in thresholds for mean dust emission. The annual cycles of FDE and SWF for the 6 grouped areas are highly correlated (0.95 to 0.99). These correlations are barely reduced when annual-mean thresholds are used, showing that seasonal variations in thresholds are not the main control on the seasonal variations in FDE. Relationships between annual cycles in FDE and DUP are more complex than between FDE and SWF, reflecting the seasonal variations in the types and intensities of dust events. FDE is highest in spring north of 23N. South of this, where stations are directly influenced by the summer monsoon, the annual cycle in FDE is much more variable. Half of the total DUP occurs at wind-speeds greater than around 28 m/s, which highlights the importance of rare high-energy wind events. The likely meteorological mechanisms generating these patterns are discussed. This new climatology is an exciting new resource which contributes to process research and could help improve model evaluation studies.

ARE VEGETATION-RELATED ROUGHNESS CHANGES THE CAUSE OF THE RECENT DECREASE IN DUST EMISSION FROM THE SAHEL?

Sophie Cowie[1]*, Peter Knippertz[2], John Marsham[1]

[1]*Institute of Climate and Atmospheric Science, University of Leeds, Leeds, LS6 4AQ, UK*
[2]*Institute for Meteorology and Climate Research, 76128 Karlsruhe, Germany*
**eesc@see.leeds.ac.uk*

Dust emissions from the hyper-arid Sahara and semi-arid Sahel are crucial to the global dust cycle not only due to the magnitude of emitted dust, but also for year-to-year variability. Once in the atmosphere, dust aerosols have a significant impact on the global energy and carbon budgets and on air quality. Previous studies have documented changes in the dust output from northern Africa on inter-annual to decadal time scales, though the exact reasons for this variability are still a matter of debate.

This work uses long-term observations from the seven Sahelian surface stations with almost continuous records and frequent dust events between 1984 and 2012 to explore the trends in mean wind, dust uplift potential (DUP) and frequency of dust emission (FDE). FDE is inferred from the present weather codes (WW) of SYNOP reports. The synchronous measurement of wind allows an estimate of a local dust-uplift threshold velocity. DUP is a novel diagnostic that takes into account the non-linear relationship between wind-speed and dust uplift assuming a constant threshold velocity. ERA-Interim 10m winds are also used for comparison.

Averaged over the seven stations, there is a significant decreasing trend in mean wind over the study period for all seasons, and even more so for DUP and FDE, which are highly correlated. ERA-Interim mean wind, analysed over an area encompassing the seven stations, shows a much weaker downward trend, largely confined to the cooler half of the year. It is hypothesized that this signal is caused by a downward trend in the North Atlantic Oscillation, which is correlated to wind and dust activity on an inter-annual basis during this time of year. The remaining discrepancies are unexpected and thought to be related to wetter conditions in the Sahel through the following mechanisms: (A) Changes in Bowen ratio due to higher soil moisture levels decrease atmospheric turbulence, which has a larger impact on local wind-speed measurements than on grid box vector winds. (B) Increases in vegetation lead to increased surface roughness, which is not accounted for by ECMWF. This effect might have been enhanced by population increase around the measurement sites. Interestingly, there is little evidence in the station data that the increase in vegetation has significantly increased the threshold velocity for dust uplift.

A RETROSPECTIVE STUDY EXAMINING CLIMATIC INFLUENCE ON THE RESPIRATORY HEALTH OF QATAR RESIDENTS

Kim Critchley[1], Kevin Teather[2], Asma Alamgir[1], Nawal Ali[1], Lea Jabonete[1], Nicola Dsouza[1]

[1]*Faculty of Nursing, University of Calgary-Qatar, Doha, Qatar*
[2]*Department of Biology, University of Prince Edward Island, Charlottetown, C1A 4P3*

There are obvious and well known links between air quality and acute respiratory illnesses that are common in Qatar and other Middle Eastern countries. For example, recent studies have documented a number of respiratory problems associated with inhalation of dust during dry, windy periods. In Qatar, exposure to dust and sand are anecdotally associated with a variety of respiratory issues including asthma and chronic obstructive pulmonary disease (COPD). These illnesses may be brought about by physical damage caused by the particles themselves, or by microorganisms that can be associated with these particles. In this study we examine the relationship between different climatic variables, daily airborne particulate matter, and hospital admissions for respiratory problems over a six month period to establish possible relationships. The results of the study will shed light on the importance of weather phenomena, particularly windy conditions, in impacting respiratory health in Qatar. These data are particularly important as respiratory problems are expected to increase as climate change results in hotter, drier conditions over the next few decades.

COMPARISON BETWEEN REGIONAL BACKGROUND MONITORING STATION DATA AND MODELED DUST CONCENTRATION

Stefano Crocchianti[1]*, David Cappelletti[1], Beatrice Moroni[2], Silvia Castellini[1]

[1]*Dipartimento di Chimica, Biologia e Biotecnologie, Università di Perugia, Via Elce di Sotto 8, 06123 Perugia, Italy*

[2]*Dipartimento di Ingegneria Civile ed Ambientale, Università di Perugia, Via G. Duranti 93, 06125 Perugia, Italy*

**crcacce@mail.dyn.unipg.it*

The new rural regional background monitoring station installed at the center of the Umbrian region[1] (Monte Martano, 1100 m asl) is capable of measuring a number of atmospheric (e.g. temperature, wind speed and directions, etc.) and environmental (e.g. O_3, NO_x, etc) parameters. Measured hourly PM_{10} and $PM_{2.5}$ mass concentration are accessible on line. For this reason the station recently joined the Sand and Dust Storm - Warning Advisory and Assessment System (SDS-WAS) program[2].

This study focuses on the comparison between measured and ground dust concentrations calculated by several models (including those run at the SDS-WAS and the Chimere chemistry and transport model run at Prevair[3]), all having comparable horizontal resolutions, over one year of monitoring activity of the site. Preliminary results over a shorter period of few months show an apparent overestimation of the mean dust concentrations by some of the SDS-WAS models, whereas others (for example the Chimere model) seem better reproduce the PM_{10} mean values with lower average error.
A comparison during selected dust episodes will also be shown.

1. Moroni B, Cappelletti D, Marmottini F, Scardazza F, Ferrero L, Bolzacchini E,(2012). Integrated single particle-bulk chemical approach for the characterization of local and long range sources of particulate pollutants. Atmos. Environ., 50:267-277
2. http://sds-was.aemet.es
3. http://www.prevair.org/en/donneesentrees.php

VOLCANIC ASH PARTICULATE AS A STRATIGRAPHIC AND CHRONOLOGIC TOOL: AN EXAMPLE FROM MARINE CORES OF CENTRAL MEDITERRANEAN AREA

Marco Crocitti[1]*, Roberto Sulpizio[1], Donatella Insinga[2], Rosanna De Rosa[3], Paola Donato[3], Giovanni Zanchetta[4]

[1]*Dipartimento di Scienze della Terra e Geoambientali Università di Bari "A.Moro", Bari, 70121, Italy*
[2]*Istituto per l'Ambiente Marino Costiero (IAMC) - CNR Napoli Sede, Napoli, 80133, Italy*
[3]*Dipartimento di Biologia, Ecologia e Scienze della Terra Università della Calabria, Arcavacata di Rende (CS), 87036, Italy*
[4]*Dipartimento di Scienze della Terra - Università di Pisa, Pisa, 56126, Italy*
**marco.crocitti@uniba.it*

In this work are shown preliminary results about a tephrostratigraphic study carried out in marine cores sampled in Ionian and Tyrrhenian seas.
Twelve gravity cores were collected offshore the eastern margin of southern Tyrrhenian coast and the Taranto Gulf in the Ionian Sea during a cruise of the R/V Urania (sponsored by CNR of Italy). The cores were drilled at water depths between 76m (CD02) and 995m (GT2) and are between 0,80 to 5,30 m long. The sampled hemipelagic deposits contains several cryptotephras and, at present, five cores were sampled for tephra layers: GT2 and GT4 (Taranto Gulf), D1 and P1 (Policastro Gulf) and GS1 (Salerno Bay). EDS analyses were carried out on fresh volcanic glasses and mineral phases at Dipartimento di Scienze della Terra of University of Pisa and at Dipartimento di Biologia, Ecologia e Scienze della Terra of University of Calabria. Chemical compositions of deposits were compared with those of the main Holocene eruptions of Campanian volcanoes and Mt. Etna and with similar tephras recently recognized in both continental and marine archives (Lago Grande di Monticchio, Sulmona Basin, Ionian Sea and Balkans). Most of analysed cryptotephras, when plotted on Total Alkali vs. Silica diagram, show a phonolitic composition, while the remaining tephra layers have variable compositions. In most cases analyzed tephras were correlated with the Holocene activity of Somma-Vesuvius, Campi Flegrei and Mt. Etna. These preliminary correlations confirm and improve the previous assessed dispersal areas of the pyroclastic products of recognized eruptions allowing us to define new hazard evaluations about these important volcanic centres of central Mediterranean area. The correlation of a minor number of tephra layers remains doubtful. These data highlights how the dispersal of ash in the atmosphere, in the form of dusty particulate, allows the correlation of geologic archives sometimes over distances up to several hundreds of kilometres.

THE FORMATION OF FINE AND COARSE GRAINS IN SAND DUNES - AN IMPORTANT SOURCE FOR ATMOSPHERIC DUST AND LOESSIN DESERTS

Onn Crouvi[1]*, Yehouda Enzel[2], Rivka Amit[1], Kerstin Schepanski[3], Alan R. Gillespie[4]

[1]*Geological Survey of Israel, 30 Malkhe Israel St., Jerusalem 95501, Israel*
[2]*The Fredy and Nadine Herrmann Institute of Earth Sciences, The Hebrew University of Jerusalem, Jerusalem 91904, Israel*
[3]Leibniz Institute for Tropospheric Research (TROPOS), Permoser Str. 15, 04318 Leipzig, Germany
[4]Department of Earth and Space Sciences, University of Washington, Seattle, Washington 98195, USA
**Crouvi@gsi.gov.il*

Sources of both fine (<10µm) and coarse (20-80µm) dust grains have been debated for decades. Fine dust plays multiple roles in mediating physical and biogeochemical exchanges among the atmosphere, land and ocean, and thus is an active component of the global climate.Coarse dust sequences (loess) archives Quaternary climate changes. Thus, to better estimate past, current, and future impacts of dust on the climate and the environment, and to better reconstruct climatic information from loess sequences, we address the questions regarding sources of dust and the mechanisms that generate dust grains.We present our recent findings on the sources of both atmospheric dust and loess in Africa and Arabia. We conclude: (1) Sand seas are an important source for desert loess;all examined loess regions are located downwind of adjacent sand seas, present mineralogical similarity, and their activity is coeval with the sand dunes. (2) Multiple sources of current atmospheric dust exist in the Sahara, but ~30% of the examined dust storms originated from active sand dunes (and additional ~20% from leptosols and calcisols, each, ~15% from arenosols). Moreover, the wind erodibility of sand dunes is the highest of all examined geomorphic units and soil types. Since only limited silt and clay grainsare stored in the active dunes, we postulate that the fine and coarse dust grains were/are generated through active eolian abrasion of sand grains in the dunes. Past laboratory and field experiments showed that abrasion of natural sand grains generate finer grains by either:(1) spalling, chipping or breakage of grains, forming silt-size quartz grains, and (2) removal of grain surface coatings composed mainly of clay minerals. Our results explain the concurrent loess accumulation and increased dustiness during the last glacial period, when sand dunes covered large portion of the Sahara, and their activity has been more common than during the Holocene. The distinctly negligible formation of Holocene loess (in comparison to the last glacial), in general, and in desert margins in particular is probably resulted from (1) the limited activity of dunes in the Holocene as a result of much reduced gustiness, and (2) reduced wetness exactly at the desert margin. This study has the potential to improve regional scale dust-transport models that aim to assess future effects of dust on the climate.

WMO SAND AND DUST STORM WARNING ADVISORY AND ASSESSMENT SYSTEM: REGIONAL CENTER FOR NORTHERN AFRICA, MIDDLE EAST AND EUROPE

Emilio Cuevas[1]*, Enric Terradellas[2], José M. Baldasano[3], Slobodan Nickovic[4]

[1]*Meteorological State Agency of Spain (AEMET), Santa Cruz de Tenerife, 38071, Spain*
[2]*Meteorological State Agency of Spain (AEMET), Barcelona, 08034, Spain*
[3]*Barcelona Supercomputing Centre (BSC), Barcelona, 08034, Spain*
[4]*Institute of Physics&Republic Hydrometeorological Service, Belgrade, 11080, Serbia*
**ecuevasa@aemet.es*

Mineral dust is the second largest source of particles in the atmosphere after the sea salt. For countries in and downwind of arid regions, airborne sand and dust presents serious risks to the environment, property and human health. Dust impacts include negative effects on the ground transportation, aviation and agriculture. The Intergovernmental Panel on Climate Change recognizes that dust, as a major component of atmospheric aerosol, is an essential climate variable. However, the observation and prediction of atmospheric dust is today a challenge mainly due to the almost total absence of dust observations in areas close to source regions, the difficulty of obtaining accurate dust parameters from satellite over areas of high reflectivity, such as deserts, and to the still limited development of dust forecast models.

For this reason the World Meteorological Organization (WMO) has taken the lead to develop and implement a Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) with the mission to enhance the ability of countries to deliver timely and quality sand and dust storm forecasts, observations, information and knowledge to end users through an international partnership of research and operational communities (WMO, 2012). The Regional Centre (RC) for Northern Africa, Middle East and Europe, hosted by the Meteorological State Agency of Spain (AEMET), and the Barcelona Supercomputing Centre (BSC), supports a node of research and operational partners implementing the objectives of the SDS-WAS program in the region. The RC web portal (http://sds-was.aemet.es) has been designed to allow the user access to observational and forecast products. The web portal offers side-by-side dust forecasts (dust surface concentration and dust optical depth at 550 nm) issued by seven modelling systems (BSC-DREAM8b_v2, MACC-ECMWF, DREAM8-NMME-MACC, NMMB/BSC-Dust, MetUM, GEOS-5 and NGAC) as well as the multi-model median. An important activity of the RC is the evaluation of the output models. Finally, the RC coordinates with partners and National Meteorological Services in the region different actions aimed to strengthen the capacity of countries to use the observational and forecast products distributed in the framework of the WMO SDS-WAS programme.

WMO, WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS), Science and Implementation Plan 2011-2015, World Meteorology Organization, Atmospheric Research and Environment Branch, April 2012.

ENVIRONMENTAL POLLUTION FROM VOLCANIC ASH PARTICULATE: EXAMPLES OF ASH LEACHATES FROM MT ETNA (ITALY) AND POPOCATEPETL (MEXICO) VOLCANOES

Maria D'Addabbo[1], Roberto Sulpizio[1], Massimo Guidi[2], Giancarlo Capitani[3], Paride Mantecca[3]

[1]*Dipartimento di Scienze della Terra e Geoambientali, Università degli Studi di Bari A.Moro, Bari, Italy*
[2]*IGG-CNR, Pisa, Italy*
[3]*Dipartimento di Scienze dell'Ambiente e del Territorio e di Scienze della Terra Università degli Studi di Milano Bicocca, Milano, Italy*

Generation and dispersal of volcanic ash during explosive eruptions can impact the environment at a serious level. Ashfall on natural waters and water supplies produces turbidity, induces pH variations and alters the natural concentrations of chemical elements. Several eruptions have resulted in contamination of pasture, sometimes with serious impacts on livestock.
The study was carried out on different samples ash leachates of different samples of volcanic ash, in order to evaluate the different release of chemical compounds in the environment. Samples from the eruptions of Mt. Etna (Sicily) of April 24, 2011 and August 12, 2012 and Popocatépetl 2012 (Mexico) represent an opportunity to study leachates on fresh and not yet rain-washed samples.
Fresh samples have been characterised by XRF and XRD on bulk rock and SEM-EDS on glass and mineral phases.
Leaching experiments were carried out using mQ-water and water samples from Lake Ohrid (Macedonia-Albania). Both waters were previously characterised using surface electrode, gas electrode, ion-chromatography and ICP-MS. During the experiments the pH variation, the concentration of chemical compounds and saturation index were determined. It was observed alkalinisation in Etna leachates samples and acidification in Popo leachates samples with different release of anions and cations; in particular Etna leachates are rich in F^- and Popo leachates are rich in SO_4^{-2}. Many of the elements that have been measured are included in the drinking water guidelines due to their potential toxicity. In many of the analysed ash leachates F^-, Mn^{+2}, SO_4^{-2} and Fe^{+2} concentrations exceed the maximum values defined by Italian law (for examples the maximum value of F is 1.5 mg/l, while F concentration in Etna ash leachates reaches the value of 20 mg/l),. Ash leachates were also used as living culture for tadpoles, and the stages of growth observed at different time intervals. The results highlight the potential impact of volcanic ash deposition on environment and human health.

DUST STORM EVENTS IN ICELAND (1949-2011): PHYSICAL PROPERTIES OF ICELANDIC PARTICULATE MATTER

Pavla Dagsson-Waldhauserova[1,2]*, Olafur Arnalds[2], Haraldur Olafsson[1,3,4], Lenka Skrabalova[5], Gudmunda Maria Sigurdardottir[1,3], Martin Branis[5], Jindrich Hladil[6], Roman Skala[6], Tomas Navratil[6], Leona Chadimova[6], Sibylle von Lowis of Menar[3], Throstur Thorsteinsson[7], Hanne Krage Carlsen[8], Ingibjorg Jonsdottir[7]

[1]*University of Iceland, Department of Physics, Reykjavik, Iceland*
[2]*Agricultural University of Iceland, Faculty of Environment, Hvanneyri, Iceland*
[3]*Meteorological Office of Iceland, Reykjavik, Iceland*
[4]*Bergen School of Meteorology, Geophysical Institute, University of Bergen, Norway*
[5]*Faculty of Science, Charles University in Prague, Prague, Czech Republic*
[6]*Institute of Geology AS CR, v.v.i., Prague, Czech Republic*
[7]*University of Iceland, Institute of Earth Sciences & Environment and Nat.Resources, Reykjavik, Iceland*
[8]*Department of Public Health and Community Medicine, University of Gothenburg, Sweden*
**pavla@lbhi.is*

Iceland is an active dust source where volcanic sandy deserts and glacially derived sediments cover over 21% of the country (Arnalds, 2010). The frequency of dust days exceeds 34 dust days annually (Dagsson-Waldhauserova et al., 2013). Dust events in NE Iceland occurred mostly in May-September, while almost half of all dust events in SW Iceland were at sub-zero temperatures or in winter.
Surface transport during severe dust storms reached >11,000 kg m^{-1} over one m wide transect with wind gusts up to 38.7 m s^{-1} (Arnalds et al., 2013). Dust events are also observed during wet and low wind/windless conditions as result of surface heating of the dust source. Maximum particle number concentration (PM~0.3-10 µm) during such events counted up to 150,000 particles cm^{-3} min^{-1} because the highest number of mobilized dust particles was in size range 0.3-0.337 µm, followed by particles 1.5-5 µm in diameter. The mineralogy and geochemical compositions showed that glaciogenic dust contains sharp-tipped shards with bubbles and 80 % of the particulate matter is volcanic glass rich in heavy metals. Wet particles of such morpho-textural characteristics were mobilized within < 4 hours.
The main objectives of this study were to explore the long-term (63 years) variability in dust activity in Iceland and to give an overview on physical properties of Icelandic dust. Possible risk of Icelandic dust to human health is discussed.

Arnalds O. (2010). Dust sources and deposition of aeolian materials in Iceland. Icelandic Agricultural Sciences 23, 3-21.

Arnalds O., Thorarinsdottir E.F., Thorsson J. Dagsson-Waldhauserova P. Agustsdottir A.M. (2013). An extreme wind erosion event of the fresh Eyjafjallajökull 2010 volcanic ash. Nature Scientific Reports 3, 1257.

Dagsson-Waldhauserova P., Olafsson H., Arnalds O. (2013). Long-term variability of dust-storms in Iceland. Geophysical Research Abstracts Vol. 15, EGU2013-11578-1.

PHYSICAL EXERCISES AND POLLUTED ENVIRONMENT: A DANGER TO THE HEALTH OF THE ATHLETE

Antonia Dalla Pria Bankoff*, Sonia Regina Jurado, Odanir Guerra

Universidade Federal de Mato Grosso do Sul-Três Lagoas- Postal code -79603-011-Brasil
**dallabankoff@bol.com.br*

Jog on busy streets, in the presence of pollutants and high temperatures can harm athletes and amateurs. The ozone pollution associated with the heat and humidity, leads to a drop in performance of runners, and result in damage early in the mucous lining the entire respiratory tract. When the person doing the exercise, inspires a greater volume of air. Thus, inspires more pollutants that reach deeper levels of the lung (Peres, 2005).

We studied 16 literatures that conducted research on physical exercise and running in local pollutants considered unfit for physical exercise and others. One of the largest cities in Brazil (São Paulo), is common to find people running and doing some kind of exercise rather heavily polluted.

The polls showed the race in hot, humid and polluted by ozone worsens brought in time athletes - an average of 10% compared to those who did the exercise in ideal conditions. The heartbeat also increased under the influence of pollution. Additionally, blood tests and tests in nasal secretions of the participants showed inflammatory damage in the lining of the respiratory and oxidative stress markers. For hypertension, the gases in pollution compete with the oxygen in the blood. This makes the athlete more prone to hypertension, to heart attacks and stroke (CVA). Some studies have also evaluated the possibility of ozone worsen the deposit of cholesterol in the arteries, further compromising cardiac health. The pollution also increases the risk of lung problems and also states that the major problem with the race in polluted environments is not the acute effect in a single day, but the repetition of practice that can make the athlete more susceptible to problems mainly respiratory because of the dryness of the airways.

The physical exercise and running in polluted places in the literatures compiled show:

- Reduction performance.
- Health effects, both arising from the implications that this pollutant provides.
- The CO adversely influence the performance, since it has properties that alter physiological aspects.
- The main effects of CO exposure are due to its great potential to change the oxygen transport, this is in haemoglobin, myoglobin and mitochondria, thereby causing tissue hypoxia and consequent reduction of oxidative reactions.

Peres F De Faria, (2005). Meio Ambiente e Saúde: os efeitos fisiológicos da poluição do ar no desempenho físico - o caso do monóxido de carbono (CO). Arquivos em Movimento, Rio de Janeiro, 1, 1, 55-63

Armstrong, L.E. (2000). Performing in extreme environments. Champaign: Human Kinetics.

Wilmore, J.H., Costill, D.L. (1994). Physiology of sport and exercise. Champaign: Human Kinetics.

PHYSICO-CHEMICAL CHARACTERISTCS OF DUST GENERATED DURING MECHANICAL RECLAMATION OF USED SANDS MOULDS

Rafał Dańko[1], Jan Jezierski[2]*, Mariusz Holtzer[1]

[1]*AGH University of Science and Technology, Faculty of Foundry Engineering, Reymonta St. 23, 30-059 Kraków, Poland*
[2]*Silesian University of Technology, Department of Foundry Engineering, Gliwice, 44-100, Poland*
**jan.jezierski@polsl.pl*

The paper presents results of investigations concerning evaluation of physic-chemical properties of after reclamation dust, generated in foundry industry. Mechanical reclamation processes of used moulding sands generate large amounts of after reclamation dusts containing mainly rubbed spent binding agents and quartz dusts. An amount of after reclamation dusts - in dependence of the reclamation system efficiency and the reclaim dedusting system - can reach 5-10% in relation to the total reclaimed spent moulding sand. The proper utilization of such a material is a big problem facing foundries these days.
Different dusts generated in mechanical reclamation process of used organic sands, delivered from foundries, were tested in respect of determination of its chemical composition, granular characterization and physicochemical properties. As a result of investigations the possible ways to utilise that dusts are also presented.

NEW EVIDENCE FROM THE AUSTRALIAN REGOLITH SUPPORTING A DUST SOURCE IN ANTARCTIC ICE CORES

Patrick De Deckker[1]*, Barbara Delmonte[2], Marc Norman[1]

[1]Research School of Earth Sciences, The Australian National University, Canberra ACT 0200. Australia
[2]DISAT - Department of Earth and Environmental Sciences, University Milano-Bicocca, Piazza della Scienza 1, 20126 Milano, Italy
*patrick.dedeckker@anu.edu.au

Recent sampling of the Australian regolith in regions which are considered to be sources of airborne dust has provided new information for comparison with dust recovered from ice cores in Antarctica. Three basic sources of dust in Australian have been identified: (1) dune fields, (2) large playa lake floors, and (3) the margins of those playa where commonly groundwater pumping and evaporation force extremely fine grained sediments and salts reach the surface. The zone where the material reaches the surface often has a ‘puffy’ and ‘floury’ and hummocky appearance. Extensive areas on the margins of lakes can then be easily deflated, and also will regenerate as more evaporative pumping occurs, especially in late Spring to Summer when temperatures are very high and conducive to evaporative transpiration, and formation of the ‘fluffy’ sediments.

Regions we targeted in Australia, apart from the previously sampled and documented Murray Darling Basin in southeastern Australia and Lake Eyre in central South Australia, were (1) northern Western Australia fringing the Great Sandy Desert, (2) south central South Australia west of the Flinders Ranges where Archean formations are found, as well as (3) the western part of South Australia and western New South Wales. We also extensively sampled the Lake Eyre Basin and the fringes of the northern part of the River Darling located in the arid zone of New South Wales.

Strontium and neodymium isotopes were analysed for all our regolith samples from the regions listed above. We paid particular attention to analyzing material from the clay fraction (<2 μm) as it is now demonstrated that different size fractions can bear different isotopic signals, and also all the samples extracted from ice cores belong to that size fraction.

Our database has now been used for comparison with the ice core dust results, principally documented by Delmonte, and we can clearly eliminate some regions of Australia that have isotopic values not seen in Antarctic samples. It appears also that different periods of time represented in the ice cores contain dust from different sources in Australia.

It will be argued that it is principally when the landscape is inundated during very wet periods [such as during interglacials as well as today] that dust is also produced during large river flooding the playa lakes and extensive river banks. When water recedes and the landscape dries up that a new supply of fine grained material becomes available for deflation. This follows the important sentence which Jo Prospero stated: “to produce dust you need water”, implying that extensive flooding is conducive to fine grained sediment deposition on the landscape in arid to semi-arid regions in Australia, and eventually this turns to dust that can eventually become airborne.

PM_{10} TEMPORAL BEHAVIOR AND PREDICTIONS THROUGH A GEOSTATISTICAL MODEL

Sandra De Iaco, Sabrina Maggio, Monica Palma, Donato Posa*

Dep. Sciences of Economics-University of Salento, Lecce, 73100, Italy
**donato.posa@unisalento.it*

Box-Jenkins methodology (1976) is commonly applied for time series analysis. Using this approach, sample autocorrelation and partial functions (ACF and PACF, respectively) are conventionally inspected in order to identify the most appropriate model which describes the temporal evolution of the process under study. The fitted model is subsequently used for prediction purposes.

Opposite to the above ACF and PACF based-method, the variogram represents the basic tool in Linear Geostatistics to face a variety of inferential problems (Chilés and Delfiner, 1999; Journel and Huijbregts, 1981; Matheron, 1963). In this context, detection of a parametric model for the process under study gives way to the estimation and modeling of the variogram in order to perform predictions of the analyzed variable at unsampled points.

This paper aims to illustrate the importance and convenience of variogram-based exploratory and prediction techniques to perform a complete analysis of a time series, even in presence of a periodic behaviour. In particular an extensive case study regarding the time series of PM_{10} daily concentrations registered at a monitoring station located in an area with high risk of particle pollution, is faced through the following steps:

a) identification of trends and periodicity exhibited by data, b) estimation of missing values, c) predictions of the PM_{10} concentrations at time points following the last available observation, d) estimation of the distribution function.

Regarding the computational aspects, a modified version of the *GSLib* kriging routine (Deutsch and Journel, 1998) has been used to define appropriate temporal search neighborhoods for interpolation and prediction purposes.

Box G.E.P., Jenkins G.M. (1976). Time series analysis: forecasting and control. Holden Day, San Francisco.

Chilés J.P., Delfiner P. (1999). Geostatistics: modeling spatial uncertainty. John Wiley & Sons, New York, USA.

Deutsch C.V., Journel A.G. (1998). GSLib: Geostatistical Software Library and User's Guide. Oxford University Press, New York.

Journel A.G., Huijbregts C.J. (1981). Mining Geostatistics. Academic Press, London.

Matheron G. (1963) Principles of geostatistics. Econ. Geol. 58(8), 1246-1266.

FIRST ASSESSMENT OF THE IMPACTS OF SAHARAN DUST EVENTS ON THE RESPIRATORY HEALTH IN WEST AFRICA: A CASE STUDY IN THE NORTHERN BENIN

Florence De Longueville[1]*, Sabine Henry[2], Pierre Ozer[3]

[1]*CEDEM, University of Liege, 4000Liege, Belgium*
[2]*Department of Geography, University of Namur, 5000Namur, Belgium*
[3]*Department of Environmental Sciences and Management, University of Liege, 6700 Arlon, Belgium*
**fdelongueville@ulg.ac.be*

More than 50% of the global dust emitted into the atmosphere comes from the Sahara. About 60% of the Saharan dust move southwards to the Gulf of Guinea (Engelstaedter et al., 2006). Once in the air, these dust contribute to increase the concentrations of particles smaller than 10 microns (PM_{10}), which are respirable particles (Ozer et al. 2005). A number of adverse health effects have been associated with desert dust, including respiratory diseases (Goudie, 2014). Quantitative studies on health impacts of desert dust generally focus on Asia and in recent years, many authors have identified significant health impacts of Saharan dust events in Southern Europe (de Longueville et al., 2013b), although PM_{10} concentrations were well below those recorded in West Africa. The scarcity of information about air quality relating to the African continent is a reality and consequently, no study about dust impacts on air quality and human health have been conducted in West Africa (de Longueville et al., 2010). Based on the combination of two information sources, it was possible to determine the dust events having affected the region of Kandi (northern Benin) over the period 2003-2007 during dry seasons. On the whole study period, 61 days with dust events were noted in this region. The daily PM_{10} concentrations were multiplied by 18.5 during these dust events, what contributes to strongly exceed the WHO standards. From health data (consultations of children for acute lower respiratory infections (ALRI)), we calculated a 12.5% increase of the monthly rates of ALRI during months having recorded dust event on the same period. Even if this increase is far from being unimportant, it seems relatively limited compared with the impacts which we could expect considering reached PM_{10} concentrations (de Longueville et al., 2013a). So, it is necessary to multiply such researches in West Africa to better quantify the impacts of Saharan dust on the health of its populations.

de Longueville F., Hountondji YC., Henry S., Ozer P. (2010). What do we know about effects of desert dust on air quality and human health in West Africa compared to other regions? Science of the Total Environment 409(1), 1-8.

de Longueville F., Hountondji YC., Ozer P., Marticorena B., Chatenet B., Henry S. (2013a). Saharan dust impacts on air quality: what are the potential health risks in West Africa? Human and Ecological Risk Assessement 19, 1595-1617.

de Longueville F., Ozer P., Doumbia S., Henry S. (2013b). Desert dust impacts on human health: an alarming worldwide reality and a need for studies in West Africa. International Journal of Biometeorology 57, 1-19.

Engelstaedter S., Tegen I., Washington R. (2006).North African dust emissions and transport. Earth Sciences Review 79, 73-100.

Goudie AS. (2014). Desert dust and human health disorders. Environment International 63, 101-113.

Ozer P. (2005). Estimation de la pollution particulaire naturelle de l’air en 2003 à Niamey (Niger) à partir de données de visibilité horizontale. Environnement, Risque et Santé 4, 43-49.

THE MID-HOLOCENE TROPICAL DROUGHT IN THE SOUTH AMERICA: EVIDENCES FROM LAKE SEDIMENT PROFILES

Newton De Magalhães Neto[1], Heitor Evangelista[2], Renato Campello[1]

[1]Fluminense Federal University, Niterói, CEP: 24220-900, Brazil
[2]Rio de Janeiro State University, Rio de Janeiro, CEP:20950-900, Brazil
*magalhaes.newton@gmail.com

Charcoal records from lake sediments are an important proxy to reconstruct long-term variations in history of fires. Charcoal analysis are based on the quantification of the charcoal particles found in sediments during and following a fire event. Stratigraphic levels with abundant charcoal are inferred to be evidences of past fires and hence a drought climate condition. We compiled charcoal records from 6 lakes located in the Amazon basin (spatial distribution from 05°N to 10°S and from 50°W to 70°W) and constructed an Amazon charcoal index (based on Z-scores) for the Holocene (0-10.400 years BP) for each site at a 200 years interval. The records in the database are at least 7.800-years long. We found higher charcoal index values for the mid-Holocene (MH, ~6 ka). This result indicates an increased fire activity and hence a drought climate condition in the Amazon basin during this period compared to the late-Holocene (LH). During the MH, the Earth's orbit was different then today, resulting in a decreased summer insulation in the Southern Hemisphere and an increased insulation for the Northern Hemisphere. Although the Earth's obliquity was larger and the orbit was slightly more eccentric, the differences in insulation were mostly due to precession[1]. The perihelion occurred at the austral spring equinox during the MH, whereas today it is reached at the austral summer solstice. This caused a smaller seasonal cycle of insulation on the Southern Hemisphere[1]. The effects of the decreased austral summer insulation over South American climate have recently been examined[2] through 28 general circulation models and discussed through a multiproxy analysis of MH paleoclimate data[3]. When compared to modern climate, their compilation indicates deficit in the water balance in eastern South America during the MH. Eastern South America was characterized by diminished precipitation, lake levels below modern levels and air temperatures above modern values[3]. It has been suggested[2,3] that the reduced summer insulation at 6 ka weakened the Southern America monsoon system (SAMS) circulation, leading to decreased precipitation in eastern South America. Although a large portion of the inter-annual variability of the SAMS can be explained by El Niño-Southern Oscillation[4] (ENSO), it does not appear that ENSO was responsible for changes in the SAMS, since it was weak during the mid-Holocene[5] and hence the tele-connection should have been weaker. Our results extend the climate reconstructions previously provided[3] showing evidences from lake sediment profiles that fire activity increased due to a dry conditions in the Amazon basin during the MH.

1. Bosmans J. H. C., Drijfhout S. S., Tuenter E., Lourens L. J., Hilgen F. J., Weber S. L. (2012). Clim. Past, 8, 723-740.
2. Zhao Y., Harrison S. P. (2012). Clim. Dyn. 39,1457-1487.
3. Prado L.F., Wainer L., Chiessi, C. M., Ledru, M.-P., Turcq, B. (2012) Clim. Past Discuss: 8, 5925-5961.
4. Trenberth K. E. (1997) The definition of El Niño, Am. Meteor. Soc., 78, 2771-2777.
5. Moy C.M., Seltzer G.O., Rodbell D.T., Anderson, D.M. (2002). Nature, 420, p. 162-165.

HOLOCENE PEAT BOG RECORDS OF ATMOSPHERIC DUST FLUXES IN SOUTHERN SOUTH AMERICA

F. De Vleeschouwer[1,2]*, H. Vanneste[1,2], N. Mattielli[3], A. Vanderstraeten[3], C. von Scheffer[1,2], N. Piotrowska[4], A. Coronato[5], G. Le Roux[1,2]

[1]*Université de Toulouse, INP, UPS, EcoLab (Laboratoire Ecologie Fonctionnelle et Environnement), ENSAT, Avenue de l'Agrobiopole, 31326 Castanet Tolosan, France (*correspondence: francois.devleeschouwer@ensat.fr)*
[2]*CNRS, EcoLab, 31326 Castanet Tolosan, France (francois.devleeschouwer@ensat.fr, heleen.vanneste@ensat.fr, gael.leroux@ensat.fr)*
[3]*Laboratoire G-Time, Département des Sciences de la Terre et de l'Environnement, Université Libre de Bruxelles, Belgium (nmattiel@ulb.ac.be, auvdstra@ulb.ac.be)*
[4]*Department of Radioisotopes, Institute of Physics, Silesian University of Technology (natalia.piotrowska@polsl.pl)*
[5]*CADIC-CONICET, Ushuaia, Argentina (acoronato@cadic-conicet.gob.ar)*
**fdevleeschouwer@gmail.com*

Little attention has been given to Holcene pre-anthropogenic dust records in terrestrial environments, especially in the Southern Hemisphere. Yet they are important to 1/ better understand the different particle sources during the Holocene and 2/ to tackle the linkage between atmospheric dust loads and climate change and 3/ to better understand the impact of dust on Holocene palaeoclimate and palaeoenvironments in a critical area for ocean productivity. In the PARAD project, we explore the use of a broad range of trace elements and radiogenic isotopes (Pb, Nd) as dust proxies. By coupling these findings with biological proxies (plant macrofossils) and detailed age-depth modelling, we expect to identify and interpret new links between atmospheric dust chemistry and climate change.

Two ombrotrophic peat bogs, located southwest (Karukinka) and southeast (Harberton) on Isla Grande de Tierra del Fuego, were sampled to investigate dust palaeoclimatic interactions in southern South America since the last deglaciation. Here we present a detailed geochemical (major, trace elements and Nd isotopes) record for both sites. The base of the peat sequences in Karukinka and Harberton were dated by 14C at ca. 8,000 cal yr BP and ca. 16,500 cal yr BP, respectively. The distribution of trace elemental (Sc, REE) concentrations within the cores indicates, besides tephra layers, episodes of increased mineral dust deposition at Harberton and Karukinka. The glacial-interglacial transition can be observed in the Harberton record (at ca. 11,500 cal yr BP), marked by a drop in the dust flux from 102 g/m2/yr to 10 g/m2/yr. The most significant episode of mineral dust deposition at Karukinka is concentrated around 1,600 cal yr BP with a maximum dust flux of 108 g/m2/yr. Its neodymium isotopic signature of -1 suggests crustal admixing, compared to the εNd values of ~2, for both tephra layers.

COMPARATIVE CHARACTERIZATION OF INDUSTRIAL SINGLE PARTICLES BY ENERGY DISPERSIVE X-RAY SPECTROMETRY (SEM-EDX) AND AEROSOL MASS SPECTROMETRY (ATOFMS)

Karine Deboudt[1]*, Jovanna Arndt[2], Sophie Eliet[3], Veronique Savary[3], Amandine Anderson[1], Pascal Flament[1], John Wenger[2]

[1]*Laboratoire de Physico-Chimie de l'Atmosphère, Dunkerque, France*
[2]*Department of Chemistry and Environmental Research Institute, University College Cork, Cork, Ireland*
[3]*Institut de Recherche en Environnement Industriel, Dunkerque, France*
**Karine.Deboudt@univ-littoral.fr*

Scanning Electron Microscopy (SEM) combined with Energy-Dispersive X-ray (EDX) spectrometry is particularly suited to study the mixing state of atmospheric particles. Automation of the measurement process enables examination of a statistically meaningful number of particles in a relatively short period of time and can provide information on their microphysical and microchemical properties (Choël et al., 2010). The easiness of sampling air masses with light material gives great advantages to this off-line technique, when the accessibility of sampled environments is difficult (in industrial chimneys as an example) or when the studies need simultaneous samplings (Marris et al., 2012).

In parallel, Aerosol Time-of-Flight Mass Spectrometry (ATOFMS) is a powerful technique for the in-situ characterization (size and chemical composition) of individual particles. It is notably a useful tool to determine the internal mixing state of ambient particles, allowing simultaneous detection of organic carbon, ionic species and refractory material (Dall'Osto et al., 2013). Moreover, this technique can provide individual particle positive and negative mass spectra in real time for long periods, thus allowing investigations of the temporal variability of emissions.

Therefore SEM-EDX and ATOFMS are complementary tools, but they do not operate on the same physical principles and their joint use in atmospheric studies needs an inter-comparison, which is the goal of this study. For that firstly, three powdered samples collected in industrial filters (Fe-Mn alloy making plant stacks) were re-suspended and characterized by these techniques. Furthermore, in-situ characterization of industrial aerosols by ATOFMS is compared with off-line characterization by SEM-EDX. The relative strengths and weaknesses of the two techniques are discussed.

M. Choel, K. Deboudt, P. Flament (2010). Development of Time-Resolved description of aerosol properties at the particle scale during an episode of industrial pollution plume, Water Air and Soil Pollution, 209, 93-107.

H. Marris, K. Deboudt, P. Augustin, P. Flament, F. Blond, E. Fiani, M. Fourmentin, H. Delbarre (2012). Fast changes in chemical composition and size distribution of fine particles during the near-field transport of industrial plumes. Science of the Total Environment, 427-428, 126-138, doi:10.1016/j.scitotenv.2012.03.068.

M. Dall'Osto, J. Ovadnevaite, D. Ceburnis, D. Martin, R.M. Healy, I.P. O'Connor, I. Kourtchev, J.R. Sodeau, J.C. Wenger, C. O'Dowd (2013). Characterization of urban aerosol in Cork city (Ireland) using aerosol mass spectrometry. Atmospheric Chemistry and Physics, 13(9), 4997-5015, DOI: 10.5194/acp-13-4997-2013.

PHYSICO-CHEMICAL CHARACTERIZATION AND NEAR-FIELD EVOLUTION OF FINE PARTICLES EMITTED BY A METALLURGY PLANT DURING THE NANO-INDUS CAMPAIGN

Karine Deboudt[1]*, Alodie Blondel[1], Ari Setyan[1], Sophie Eliet[2], Hélène Marris[1], Pascal Flament[1]

[1]*Laboratoire de Physico-Chimie de l'Atmosphère, Dunkerque, France*
[2]*Institut de Recherche en Environnement Industriel, Dunkerque, France*
**Karine.Deboudt@univ-littoral.fr*

Steelworks activities are important sources of metallic fine particles which may affect air quality in urban areas close to industrial plants (Menad *et al*., 2006). Industrial fine particles are most of the time emitted in the lower troposphere by "high-temperature" processes and can evolve very quickly in the plume before dispersion (Marris et al., 2012).
In this context, the goal of the "Nano-Indus" project is to study the evolution of the plume between the chimneys of a Fe-Mn alloy making plant and the surrounding areas. Sampling and measurements were performed directly at the main stacks of the plant and in the emitted plume, during its near-field transport (i.e., < 1 km from the chimneys). Bulk concentrations of the refractory metallic fractions were measured by mass spectrometry and the elemental composition of individual particles was obtained by electron microanalysis (SEM-EDX, TEM-EELS). The particle size distribution, measured with a Scanning Mobility Particle Sizer (SMPS), indicates an increase of the relative abundance of ultra fine particles (10-100nm) inside the plume. They are composed both from secondary volatile and primary refractory nanoparticles. Individual particle analyses (by automated SEM-EDX) of aerosols collected inside the plume show a high proportion of metal bearing particles (Mn-/Fe-), constituted of internally mixed aluminosilicates with metallic compounds. The comparison of physicochemical characteristics of fine particles collected at the stacks and in the local environment is here considered to assess the evolution of industrial fine particles over a short-range distance and to identify the physicochemical processes of formation/ evolution for these particles.

Marris H., Deboudt K., Augustin P., Flament P., Blond F., Fiani E., Fourmentin M., Delbarre H. (2012). Fast changes in chemical composition and size distribution of fine particles during the near-field transport of industrial plumes. Science of the Total Environment, 427-428, 126-138, doi:10.1016/j.scitotenv.2012.03.068.

Menad, N., Tayibi, H., Garcia Carcedo, F.,Hernandez, A. (2006). Minimization methods for emissions generated from sinter strands: a review. Journal of cleaner production 14, 740-747.

ACADEMIC PERFORMANCE IN ELEMENTARY EDUCATION AND TRAFFIC RELATED POLLUTION IN NORTHWESTERN MÉXICO

Rafael Del Rio-Salas[1]*,Diana Meza-Figueroa[2], Joaquin Ruiz[3], Hector Mendívil-Quijada[1], Veronica Moreno-Rodriguez[1], Belem Gonzalez-Grijalva[2]

[1]*Instituto de Geología-ERNO, Universidad NacionalAutónoma de México, Hermosillo, 83000, México*
[2]*Departamento de Geología, Universidad de Sonora, Hermosillo, 83000, México*
[3]*Geosciences Department, University of Arizona, Tucson, 85721, USA*
**rdelriosalas@gmail.com*

Urban dust quality and the implication on human health has become matter of great importance in the last decades. Anthropogenic activitiescertainly have negative impact on human health, especially when polluted dust is incorporated into the environment and enter human body via dermal, ingestion, and inhalation.Arid zones are of special interest to environmental studies since extreme temperatures, low precipitation and humidity conditions may allow the re-suspension, translation, and re-deposition of dust in urban zones.These conditions are ultimately aggravated by topography, wind directions, and finally by the urban infrastructure and the intrinsicanthropogenic activity.The potential of neurological damage may be present in children exposed to environmental lead.Considering the negative effects to development and behavior of children that underwent lead exposure, an evaluation of learning skills in children is considered. ENLACE test is a Mexican evaluation of academic performance applied each year to students from elementary education from private and public schools. The study site is Hermosillo, a city located within the Sonoran desert in northwestern Mexico, has experienced a noticeable population and industrial growth for the past three decades. Lead isotope data in urban dust clearly demonstrate the presence of anthropogenic and geogenic end-members. The ENLACE test results from elementary schools from Hermosillo are shown in three categories according to the percentages of insufficient grades of students from third grade. The first category corresponds to students with good academic performance, whereas the third category corresponds to students with concerning academic performance. In addition, lead concentration in urban dust collected from road, playground, airborne, and dust deposited on elementary schools roofs were analyzed in order to correlate the distribution of lead concentration in the city with the academic performance. Also, geo-accumulation and integrated pollution indexes were used in order to assess metal contamination. The results suggest a relationship between poor academic performance, lead concentrations, heavy traffic, and the well-defined zones by lead isotopes with remarkable anthropogenic influence in the city. The data also correlate with the spatial distribution of chronic diseases. Moreover an interesting vertical variation of lead concentration and pollution index is found, suggesting higher lead concentration and pollution indexes between 1 and 4 m height, which highlight the risk to human health, and the exposure route related most likely to vehicular activity.

EVALUATION OF THE TENDENCY TO MIGRATION IN THE CASE OF AHVAZ DUST STORM OCCURRENCE: A PUBLIC SURVEY

Nam que consed maximint.
Ero volorestis et omnieniet quo blandionsed ut moluptae esequi dem diant, sequis acerum coreriamenis sita veles venduntem num unt molo beraercimus expelen ihicipi demquidio. Ga. Ita is am voles est adici nihil idigniae qui volupta tiberum et, sed mint quas quat aliam qui con netus, cullent autaquis doluptam rat quidelitiae plaut assi adipsa nonsera quo dolor aspe quodis et, odis res reris repedis imagnim oluptaeri culparum es nonsequae voluptatibus moluptassed qui ut que eat lant faces modit fuga. Tem que solenti diante magnate volligent omnis iur molenih icatem. Et poremperi dolupti con rest, ea doluptatquam non nonet voluptatecta et eatatiaepudi dolor sitae que net parchilignia quoditi doloreria de verum videm utet quat apis delecum quid unt audaerio. Itas et la nobis re verfernam consequam que maiorru ptaque liquis re voluptius alignis sintur aspit, con nulparum rerchiciis dolor re nectior aut quidign isquam, que experunt ex es dit untur? Utem etur aut unt utem qui ipidusam il explibus por sunt exeraep udigent emquia velestemodis aperum nobiscias as consequis auta se nonse nia quas andebit iundae in nis conseru nteniam in conem. Ut rat que volorib ustias et reptur a alia et quodi dellaut ut et plias ilicium hit lias utes ilit molorum hitio quatas et id millend undenihitem lam ab iditaturia quas simpore net am utaquo qui beriore landion cum facea ea quam, occus et il idelita deritatur aut quuntor epeliquid que ex es digent qui ulla que est excea num vent facilit, autatur, simenihil ipit explici maximagniet ut dit, que sinventem at quam quae nimi, que odit dunt.
Perit occus. Harumet doluptatis rerovit iostis aliscip iciliquod quisqui dolo to earite venda con re rende quaspeliquas simusam adis nossumque sitatur, as doluptia que enis si core quas venimus, solupta spicium non pliquaspis digendebis et enis re quibus nonestoriti dus cum facerro mo quid ut haruptaquos sequi quatur? Aquae namus, inciend itiassi officae scitem explaut quia quaspedi digni consenimus, veleseri conet eicabor iatempos andit ea cum que pliquas eicture nihilia volores sincipsam, none nimaximint.
Libust porem etur? Qui seritati velitin ressum re, odit, quat velland itatemo luptata ectotassit voloriae optasperro con consequatur? Tus, in et ab imporectotae omnis ad utemporis pelenimusam, con nobis ex eatinve nducias adit accullu ptiusam destrum, voluptistiis dolorem rempos dundio. Voloribus asinci utest, quam et lit que velessi taturiorecte es ex esed expellumqui cone nonectem erectem poribusciet estiae. Occae nimi, volupit quid enis rem doluptur, quis ate preptati quam faccum earum volore nimpern atecto quatumquo int fugit et accusandae dolore as quam, sunt, to mosa dellate int apicim eossumque nus, temporem conempo repero mo coriossim il ipsandani con recabor eceperi oresequiate et praecto dolor reribusciet et autaecu ptatur, et, corro quiasitatiis porecto tatibus moloratiur aut et volecum es re seque consedi gendae mod quibus ania que lacitae nusandam quis venim verchil esed enimusam excerunt

ALUMINIUM DUST EXPOSURE ASSESSMENT

Frédéric Deschamps

Department of Occupational Health - Medicine Faculty, Reims, 51100, France
fdeschamps@chu-reims.fr

Introduction. The industrial use of aluminium (Al) has increased because of its advantageous material properties like light, weight, high durability and high electric and thermal conductivity. In case of occupational Al exposure, inhalation is the main route of uptake. Certain studies on the health of workers in the Al production industry have identified several adverse effects.
The aim of the study is to follow up a population of workers exposed to Al dust.

Methodology. The study was conducted between 2007 and 2012. The group of exposed people was composed of Al dust exposed workers with long term exposure to the metal, from an Al salvage plant. A control group of workers was recruited from different factories without previous Al exposure. The investigation included a standardized medical history, environmental and biological monitoring. External occupational exposure to total dust was measured by "personal" air sampling at selected workplaces (stationary). "Stationary" refers to fixed points on selected places, while "personal" indicates sample taken in the breathing zone of the worker.

Results. During 2007, the mean exposure levels of Al in the respirable fraction were 2.23 mg/m3, with a range of 0.12 mg/m3 to 10.86 mg/m3 corresponding to the French threshold limit value (10 mg/m3). Between 2007 and before 2012, the firm used a new building. The values of the Al sample (respirable fraction) obtained during 2012 were 1.99 mg/m3 with a range of 0.13 to 5.04 mg/m3.
The remaining symptom of Al exposed workers was irritability in 2007, and lung impairment (cough) in 2012, unlike what can be found towards the control population.

GEOCHEMISTRY OF MINERAL DUST WITHIN THE MCMURDO DRY VALLEY REGION, ANTARCTICA

Kelly M. Deuerling[1,3], Ethan Baxter[2], Jeremy Inglis[4], W. Berry Lyons[1]*

[1]*School of Earth Sciences and Byrd Polar Research Center, The Ohio State University, Columbus, OH 43210 USA*
[2]*Department of Earth Sciences, Boston University, Boston, MA 02215 USA*
[3]*Current Address: Department of Geological Sciences, University of Florida, Gainesville, FL 32611 USA*
[4]*Isotopx Ltd., Middlewich, CW10 0GE, UK*
**lyons.142@osu.edu*

The transport and deposition of windblown materials are major processes in the ice-free areas of polar regions. The deposition of aeolian material provides connectivity within the ecosystems of these regions and is integral in understanding geochemical balances and exchanges between landscape units. We have analyzed materials deposited on glacier and permanent lake-ice surfaces as well as geomorphological features formed by aeolian processes in the largest ice-free area in Antarctica, the McMurdo Dry Valleys (~78°S) in order to determine the source of this sediment. This presentation will focus on the materials collected from the glacier and lake surfaces. The bulk of sediment movement occurs during foehn events in the austral winter that redistribute material throughout the region. The majority of these samples were sand size (>80%) by weight. Samples containing the highest silt size were from the glaciers in the eastern portion of the Taylor Valley which is the most downwind position. Major rock-forming elements were analyzed using Standard XRF techniques. The alkali metals were depleted with respect to the Upper Continental Crust (UCC), in both the sand and silt fractions, while the alkaline earths were enriched. The TiO_2, Fe_2O_3 and Al_2O_3 in the sands are similar to UCC values. The major element geochemistry of the aeolian material suggests that it is a mix of the four major rock types in the Valley itself: PreCambrian basement complex, Beacon Sandstone, Ferrar Dolerite and McMurdo Volcanics. Sr isotopic measurements of the fine grained materials from the glacier surfaces indicate the material is similar to the soils from their respective glacier/lake basins. Nd isotope values of this material lie intermediate to the rock values, indicating multiple sources of the aeolian material. The Sr and Nd isotopic data do not plot within the fields of dust from either Vostok or Dome C ice cores which has been interpreted as coming primarily from South America. All of our data suggest a local source of the majority of aeolian material deposited with Taylor Valley.

SHAPE CHARACTERIZATION OF DUST FROM SEED TREATMENTS BY X-RAY MICROTOMOGRAPHY

Wouter Devarrewaere[1]*, Dieter Foqué[2], Pieter Verboven[1], David Nuyttens[2], Bart Nicolai[1]

[1]*KU Leuven, Department Biosystems, MeBioS,Leuven, 3001, Belgium*
[2]*Institute for Agricultural and Fisheries Research (ILVO), Technology and Food Science Unit, Agricultural Engineering, Merelbeke, 9820, Belgium*
**wouter.devarrewaere@biw.kuleuven.be*

The emission of abraded seed treatment particles by pneumatic seed drills into the environment has been linked with honey bee poisoning incidents in several countries in recent years (Nuyttens et al., 2013). The problem of dust drift has since received significant scientific interest (Nikolakis et al., 2009). In an effort to better understand this problem and to propose dust drift mitigation measures, a computational fluid dynamics model is developed.

If a Lagrangian particle tracking approach is adopted, the physical properties of the dust particles need to be measured accurately in order to predict the particle trajectories. Specifically, the size distribution, the density and the shape of the particles need to be determined. Indeed, a particle's drag coefficient in an air flow is highly dependent on its shape (Hölzer and Sommerfeld, 2008). The shape was characterized by means of X-ray microtomography. Five micropipette tips were filled with dust samples of different size fractions from treated maize seeds and scanned in a Skyscan 1172 device. Also, dust samples of all sizes from various treated crops (maize, wheat, barley, rye, rapeseed) were scanned. The image resolution was 1,92 µm for all but the largest dust sample (4,87 µ). Image processing was performed using Avizo software (Fire edition 8.0.0). The data processing protocol was optimized in terms of image filtering, histogram equalization, image binarization and noise removal. To guarantee accuracy, object segmentation was carried out manually. After segmentation, all relevant shape parameters (including equivalent diameter, surface area, volume, sphericity, length and width) were calculated. The shape parameters were implemented in the CFD model by means of correlation formula to account for particle non-sphericity.

Results showed a high variability of particle size, shape, density and porosity for the different crops and for the different size fractions within a single dust sample. Indeed, particle shape ranged from mostly spherical (rapeseed) to rod-shaped (wheat) and disk-shaped (maize, rye). Porosity was very high in some samples (barley) and intermediate or low in others (rapeseed, wheat). In general, particle sphericity decreased with size.

Hölzer A., SommerfeldM. (2008). New simple correlation formula for the drag coefficient of non-spherical particles. Powder Technology, 184(3), 361-365.

Nikolakis A., Chapple A., Friessleben R. Neumann P.Schad T. Schmuck R. Schnier H. et al. (2009). An effective risk management approach to prevent bee damage due to the emission of abraded seed treatment particles during sowing of seeds treated with bee toxic insecticides. Julius-Kühn-Archiv 423, 132-148.

Nuyttens D., Devarrewaere W., Verboven P.Foqué D. (2013). Pesticide-laden dust emission and drift from treated seeds during seed drilling: a review. Pest management science, 69(5), 564-75.

MODEL SIMULATION AND HYPERSPECTRAL MEASUREMENTS OF SNOW ALBEDO AND LIGHT ABSORBING IMPURITIES

Biagio Di Mauro[1]*, Barbara Delmonte[2], Maria Fagnani[1], Francesco Fava[1], Roberto Garzonio[1], Roberto Colombo[1]

[1]*Remote Sensing of Environmental Dynamics Laboratory. Earth and Environmental Sciences department University of Milan-Bicocca, Milan 20156 Italy*
[2]*Earth and Environmental Sciences department University of Milan-Bicocca, Milan 20156 Italy*
**b.dimauro@campus.unimib.it*

It is recently understood that aeolian transported light absorbing impurities such as Black Carbon (BC) and Mineral Dust (MD) have a positive radiative forcing when deposited on snow and ice covered areas accelerating the melt. This process is involved in complex mechanism known as snow-albedo feedback. Current challenge involves estimation of the concentration of externally and internally mixed impurities in snow from medium and high resolution optical measurements (a.k.a. multi and hyperspectral systems).
Ice crystals show different geometric shape, strictly depending on temperature and pressure gradient during their formation. When deposited on Earth surface they constitute snow pack and show typical optical features: they reflect radiation in the near-UV and visible wavelengths (VIS, 0.3 to 0.7 μm) and absorb radiation in the near infra-red (NIR, 0.8 to 1.5 μm) and short wave infra-red (SWIR, 1.5 to 3 μm).
Radiative transfer (RT) models simulate the interaction between electromagnetic radiation and matter in dispersed medium, mathematically describing interactions like scattering, absorption and transmission. Based on RT simulation of the hemispherical albedo with the SNow ICe and Aerosol Radiation (SNICAR) model we define a novel spectral index: the Snow Blackening Index (SBI), which combine reflectance at visible and near infra-red wavelengths in order to maximize the correlation with BC and MD concentrations.
Model sensitivity to parameters is assessed through a set of simulations performed varying parameter such as: solar zenith angle, grain size, snowpack density/thickness, BC and MD impurities concentrations and MD diameter. Physical parameters were selected from a review of the scientific literature; BC and MD concentrations in snow were chosen similar to those found in the Alpine chain.
Finally we design an experiment in a cold room (-20˚C) in order to simulate the deposition of impurities on snowpack collected in high altitude mountain areas. Optical measurements are acquired on samples with a VIS-NIR hyperspectral radiometer and compared with model results. Performances of the SBI are evaluated on simulated data and then applied to observed data.

SAHARA DUST LONG-RANGE TRANSPORT OVER SOUTHERN EUROPE: FIRST RESULTS FROM LIFE+ AIRUSE PROJECT

Evangelia Diapouli[1]*, Konstantinos Eleftheriadis[1], Vasiliki Vasilatou[1], Sterios Vratolis[1], Prodromos Fetfatzis[1], Maria Gini[1], Fulvio Amato[2], Angeliki Karanasiou[2], Xavier Querol[2], Franco Lucarelli[3], Giulia Calzolai[3], Silvia Nava[3], Celia Alves[4], Teresa Nunes[4], Casimiro Pio[4]

[1]*Evironmental Radioactivity Laboratory, N.C.S.R. "Demokritos", Athens, 15310, Greece*
[2]*Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, 08034, Spain*
[3]*Department of Physics and Astronomy, University of Florence and INFN, Sesto Fiorentino, 50019, Italy*
[4]*Centre for Environmental and Marine Studies (CESAM), Department of Environment, University of Aveiro, Aveiro, 3810-193, Portugal*
**ldiapouli@ipta.demokritos.gr*

Long range transport of Saharan dust is a major natural source of particulate matter (PM), especially for the countries of Southern Europe. Acknowledging that this source may affect compliance with air quality standards, the EC has provided a method for member states to subtract concentrations related to dust transport when reporting PM levels (Directive 2008/50/EC). In this framework, AIRUSE project (www.airuse.eu) aims, among others, to characterize the contribution of Saharan dust episodes to PM concentration levels for four Southern European countries, where this phenomenon is frequent and may potentially have large impact on local and regional air quality.
A year-long campaign for the collection of PM_{10} and $PM_{2.5}$ samples was planned during 2013, at urban background sites in Porto (Portugal), Barcelona (Spain), Florence (Italy) and Athens (Greece). PM concentrations were determined gravimetrically on a 24-hr basis (midnight - midnight). In addition, information regarding the expectancy of dust episodes was collected from HYSPLIT, DREAM8b-v2.0 and SKIRON models. PM samples were collected once every 3 days but also during days when dust episodes were expected in each city.
Potential effect from Saharan dust was identified for 14%, 10%, 25% and 23% of the measurement days in Porto, Barcelona, Florence and Athens respectively. Study of the measured PM levels revealed that the highest coarse particle concentrations were indeed related with long-range dust transport. Mean 24-hr PM_{10} concentration was generally below the respective EC limit value of 50 μg m^{-3}, except for seven days, all during a strong dust transport episode on May 2013 in Athens. Coarse particles' ($PM_{2.5-10}$) levels during this episode were the highest measured at all sites, with mean 24-hr values reaching up 48 μg m^{-3}. Mean $PM_{2.5-10}$ concentration during dust events was significantly higher than the respective concentration during the remaining period for all sites: 11.3 ± 4.7 μg m^{-3} versus 8.8 ± 3.4 μg m^{-3} in Porto; 11.2 ± 6.8 μg m^{-3} versus 8.3 ± 4.2 μg m^{-3} in Barcelona; 9.5 ± 4.5 μg m^{-3} versus 4.8 ± 2.8 μg m^{-3} in Florence; 17.0 ± 13.1 μg m^{-3} versus 7.5 ± 4.2 μg m^{-3} in Athens.

This work was supported by the European Commission LIFE + Environment Policy and Governance programme (LIFE11 ENV/ES/584).

IBERULITES OF THE IBERIAN PENINSULA: FIFTEEN YEARS OF MONITORING

José Luis Díaz-Hernández

IFAPA Camino de Purchil, Consejería de Agricultura, Pesca y Medio Ambiente, Junta de Andalucía, 18004, Granada, Spain
josel.diaz@juntadeandalucia.es

Iberulites are cases of aggregation of tropospheric particles (Díaz-Hernández, 2000, Díaz-Hernández and Paraga, 2008, Diaz-Hernández, 2010). To date, they have only been detected in the south-western Mediterranean, which is one of the areas of the world most affected by Saharan dust additions.
The present study shows the annual formation periods of iberulites in south-eastern Spain, where they have been continuously sampled from 1999 to 2013. The resulting record shows 104 iberulite episodes representing around 570 days activity of these processes.
Several conclusions can be drawn:

Iberulite production is closely linked to Saharan dust plumes, which are both discrete phenomena, unlike atmospheric moisture and aerosol content.
The number of iberulite episodes per year is variable, ranging from a maximum of 15 (2004) to a minimum of 3 (2013).
The number of iberulite episodes recorded per month has a bimodal distribution; August has the highest activity (23%), and March the second highest (9%).
Monthly minima are reached during the winter months (0% in January, November and December).
Over the period examined, the number of episodes per year has a constant overall pattern, with neither highs nor lows.
Iberulites were detected under both dry and wet deposition (red rain).
The number of iberulites collected ranged from several tens, mainly under dry deposition (e.g., 26 July - 3 August 2010), to tens of thousands, as during the red rain event of 13-20 August 2012.

Díaz-Hernández J.L. (2000). Aportaciones sólidas a la atmósfera originadas por un incendio forestal en el ámbito mediterráneo. Estudios Geológicos 56, 153-161.
Díaz-Hernández J.L., Paraga, J. (2008). The nature and tropospheric formation of iberulites: Pinkish mineral microspherulites. Geochimica et Cosmochimica Acta 72, 3883-3906.
Díaz-Hernández J.L. (2010). Iberulites and meteorological formation conditions. Geophysical Research Abstracts 12, EGU2010-11630, EGU General Assembly 2010.

ANALYZING THE SIZE OF THE IBERULITES

José Luis Díaz-Hernández[1]*, Tomás Salmerón[2]

[1]IFAPA Camino de Purchil, Consejería de Agricultura, Pesca y Medio Ambiente, Junta de Andalucía, 18004, Granada, Spain
[2]Advanced Statistical Manager-High Quality Statistics
*josel.diaz@juntadeandalucia.es

Iberulites are the result of particle aggregation occurring in the troposphere (Díaz-Hernández and Paraga, 2008). Numerous spatio-temporal factors determine a wide range of sizes, in a general context of microspherical shapes. Accordingly, a basic study of iberulites must characterize its sizes and shapes with accuracy.

The number of iberulites sampled during a productive event varies at the monitoring station (SE Spain) between tens and tens of thousands of microscopic specimens (Díaz-Hernández, 2014). The former case may be easily analysed, but the latter requires the laborious obtaining of subsamples from an iberulite concentrate. The question is how the required subsampling can be carried out to obtain accurate and reliable morphometric results from any particular episode.

The present study is based on the analysis of over 21,000 iberulites sampled from a single episode. Different subsamples were separated by gravity, dumping the container (a single vial) onto twelve glass slides, and not returning the specimens selected. Each subsample had between 289 and 4979 iberulites. Morphological parameters were acquired by analysis of optical microscope images and using image software under identical conditions. Statistical analysis was performed with open-source software R-3.0.2 (Development Core Team, 2013) applying robust methods.

Generally speaking, extraction by dumping (the most immediate subsampling method) does not represent a random selection of specimens. The linear parameters of the iberulites (as major and minor axes, perimeter and feret) show significant differences regarding sample size, while morphometric indices (such as roundness, circularity and solidity) are independent of sample size. These differences are probably determined by the compositional and structural features of the iberulites.

Díaz-Hernández J.L., Paraga, J. (2008). The nature and tropospheric formation of iberulites: Pinkish mineral microspherulites. Geochimica et Cosmochimica Acta 72, 3883-3906.

Díaz-Hernández, J.L. (2014). Iberulites of the Iberian Peninsula: fifteen years of monitoring. Dust 2014, Session

R Development Core Team (2013). R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna. http://www.R-project.org/ (accessed December 2013).

DILUTION METHOD TO CARACTERIZE FINE AND ULTRAFINE PARTICLE AT HIGH CONCENTRATION

Abdelhakim Djebara[1]*, Ali Bahloul[1], Victor Songmene[2]

[1]*Chemical and Biological Hazard Prevention, IRSST, Montreal, H3A 3C2, Canada*
[2]*Department of Mechanical Engineering, ÉTS, Montreal, H3C 1K3, Canada)*
**abdelhakim.djebara@irsst.qc.ca*

Industrial transformation processes of material often produce dust at high concentration. In order to investigate particle properties, a proper conditioning of an aerosol sample is required in many applications of aerosol measurements. Mostly, aerosol conditioning means a constant and well defined dilution with a particle free gas. Reasons for the necessity of aerosol dilution could be the prevention of condensation of volatile compounds onto the particle surface, the suppression of chemical reactions, or simply to bring the particle concentration below the maximum tolerable value of the instruments. A number of different approaches are taken to dilute aerosol samples. These include for example a capillary diluter which uses an aerosol capillary to dilute with filtered air from the original air sample. These systems have been tested by Hueglin, Scherrer, and Burtscher (1997) and were all found to perform well. However, some of the more typical capillary systems suffer from high diffusion losses for the nanometer sized particles and thus are not suitable for studies in the nanometer sized particles. We describe a new sampling of dilution is based on a capillary/filter technique. Small capillary transport a portion of the aerosol and the greater part will be filtered and used as diluting gas. The shuffling between the two parts takes place inside a filter. Therefore, the dilution ratio is determined by the diameter of the capillary and the flow rate. With this principle, the dilution process is realized in a single step and on a fast time scale. The dilution ratio scan is varied continuously from moderate to very high dilutions (from 1:10 to 1:10^3). The described dilution system opens a wide range of applications. This study investigates a dilution system which can operate with minimal losses, particularly for ultrafine particles. The results using sodium chloride (NaCl) particles show no discernible difference in the particle size and the diameter size standard deviation of particles passing through the capillary. In other words, there were no apparent changes on the particle size distributions for fine and ultrafine aerosols.

Hueglin C., Scherrer L., Burtscher H. (1997). An accurate, continuously adjustable dilution system (1:10 to 1:10^4) for submicron aerosols. Journal of Aerosol Science, 28, 1049-1055.

TERRESTRIAL MOLLUSK ASSEMBLAGES AND SPECIES DIVERSITY FROM THE YAOXIAN LOESS SEQUENCE IN CHINESE LOESS PLATEAU SINCE THE LAST GLACIAL MAXIMUM

Yajie Dong*, Naiqin Wu

Key Laboratory of Cenozoic Geology and Environment, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, 100029, China
**dongyajie@mail.iggcas.ac.cn*

How biodiversity response, increases or losses, to climate warming is one of the most controversial scientific issues in the global change research. Terrestrial mollusk is a key food chain connecting from plants to animals, and so any change in their community structure is likely to have profound effects on the entire terrestrial ecosystem. Presently, they are one of the most threatened species due to climate change. Therefore, response of terrestrial mollusks to rising temperature and the relationship between terretrial mollusk diversity and climate change remain urgently to be investigated, because of its diversity, abundance and vital role in ecosystem. Here we analyze terrestrial mollusk fossils and their diversity variations since the last 25 ka from the loess deposition in the center of Chinese Loess Plateau. A total of 147 mollusk assemblages were taken from L1-1 to the Holocene strata in the Yaoxian loess sequence, with a sampling interval of 3 cm. A total of 26525 mollusk individuals have been analyzed and identified to 10 genera and 17 species, which can be gathered into cold-aridiphilous and thermo-humidiphilous ecological groups. Results show that there are not significant changes in total species diversity at the Yaoxian locality since the last 25 ka. However, mollusks of different ecological groups display different manners in response to climate warming at the period of the last deglacial period. The diversity and abundance of thermo-humidiphilous species clearly increased while cold-aridiphilous species decreased during this stage. The variations of mollusk species diversity of the Yaoxian loess sequence indicate that diversity of specific community in a given region is related to its geographical location and environmental conditions such as temperature and humidity.

DUST GENERATION IN TRANSFER CHUTES: A NEW METHOD TO MODEL DUST FLOW BY COMBINING PARTICLE BREAKAGE IN DEM AND FLUID FLOW IN CFD

T.J. Donohue[1], A. Potapov[2], G. Wakeham[1], C.A. Wheeler[1]

[1]*TUNRA Bulk Solids, Newcastle Institute for Energy and Resources, University of Newcastle, Australia*
[2]*Granular Dynamics International, LLC, USA*

This paper presents a new method for the analysis of dust generation through conveyor belt transfer chutes. The first step of this analysis method involves the direct simulation of the breakage of non-round particles in which both mass and volume is conserved. The breakage of the particles is based on bench-top calibration tests performed in the laboratory. Using this method, breakage zones and breakages rates can be highlighted in an arbitrarily designed transfer chute. This data is then translated into the CFD environment where particle flow information is input with the geometry of the transfer chute to allow calculation of the air flow. The last step is to assign the breakage zones in the transfer chute within the CFD simulation, with the fines generation rate and the location of the breakage zones coming from the DEM simulation, and solve for the fluid flow field to assess the behaviour of the generated dust particles. This analysis method will be illustrated with two case studies in this paper.

BEHAVIOUR OF PM10 AND SOME METALS IN ATMOSPHERIC AEROSOLS IN THE SOUTHEASTERN SPAIN (MALAGA)

C. Dueñas[1], M.C. Fernández[1]*, E. Gordo[1], S. Cañete[1], E. Liger[2], M. Pérez[3]

[1]*Department of Applied Physics I, Faculty of Science Málaga 29071 Spain*
[2]*Department of Applied Physics II, Faculty of Computer Engineering, Málaga 29071, Spain*
[3]*Department of Radiology and Health Physics, OPHT., and ORL Faculty of Medicine, Málaga, 29071, Spain*
**mafeji@uma.es*

Studies in aerosol particles provide a means for evaluating the integrated effects of transport and meteorology on the atmospheric loadings of substances with different sources in little industrialised area in South Spain.

Weekly samples of aerosols in air were continuously monitored between 2009 and 2011 in Malaga (Spain) with a high-volume air sampler (ASS-500C). Additionally, levels of particulate matter fraction PM_{10} were monitored in one of the Atmospheric Pollution Monitoring network managed by the Environmental Health Service of the Andalusian Government. The sampling point (4º 28' 4" W; 36º 43' 40"N) was located approximately 5 km from the coastline, near the airport and surrounded by roads with traffic exhaust.

The high-volume sampler uses polypropylene square filters (44 x 44 cm^2) with a collection efficiency of 93-99%, at a flow rate of 90,000 L min^{-1}. This system was configured to filter a discharge average of 600 m^3/h of air. The average weekly volume ranged from 65000 to 90000 m^3. The dust content in the filters was calculated gravimetrically by weighing the filters before and after and were analysed for the major elements Ca, Fe, Na, Mg, K, Cu, Ni, Cr, Zn and Pb by ICP-MS (NexION).

The relationship between PM_{10} and dust content is clearly evident. After analysing daily variations, attention was focused on the detection of high dust content and PM_{10} events and on the identification of their natural or anthropogenic origins. The PCA (varimax normalized) method was applied to the concentrations of metals and PM_{10} and explain 70% of the variance. Three factor groups were obtained. In the first factor (PC1) Ca, Fe, Na, Mg, K and PM_{10} were high loaded, with crustal and marine sources, and were the major component with 44% of the total variance. In the second factor, Cu had the highest load, followed by Zn and Pb. Important sources of these metals in Málaga are traffic emissions. A 15% of the variance was observed in this second factor (PC2). In the third factor the highest loading corresponded to Cr, followed by Ni and Zn. Their principal sources are industrial emissions and the variance in this factor was 11%.

The relevance of natural events and the variations in PM_{10} concentrations and composition of the filters during the studied period are discussed. In general, traffic emissions and industrial aerosol events did not cause exceedance of the daily European limit value for PM_{10}. Saharan dust events, instead, were in most cases responsible for the exceedance of the limit value at this sampling station.

INFLUENCE OF METEOROLOGICAL FACTORS ON MAJOR IONS AND GAMMA RADIONUCLIDES OF BULK DEPOSITION IN MALAGA (SOUTH OF SPAIN)

C. Dueñas[1]*, M.C. Fernández[1], E. Gordo[1], S. Cañete[1], E. Liger[2], M. Pérez[3]

[1]*Department of Applied Physics I, Faculty of Science Málaga 29071 Spain*
[2]*Department of Applied Physics II, Faculty of Computer Engineering, Málaga 29071, Spain*
[3]*Department of Radiology and Health Physics, OPHT., and ORL Faculty of Medicine, Málaga, 29071, Spain*
**mcduenas@uma.es*

Bulk depositions play an important role in scavenging soluble components from the atmosphere and enable the understanding of the relative contributions of different sources of atmospheric pollutants..Measurements of the chemical composition of atmospheric depositions are needed to establish depositional fluxes through the atmosphere in specific regions. These data are also very useful for validating global scale model simulations.

The bulk deposition was collected monthly over a 9 years period (January 2005-December 2013) at a site located 30 m.a.l. in Málaga (4 º28´8 W; 36º 43´40 N). Samples were collected monthly in an area of 1 m^2 using a collector that is a slightly tilted stainless steel tray and filling 25 or 50 L polyethylene vessels with bulk deposition. All samples were analysed for pH, major ions and gamma radionuclides. The average pH of bulk deposition was 6.4. Cl^- and SO_4^{2-} were the main anions, while Ca^+ and Na^+ were the main cations. The mean concentration of anions can be ordered in a descending order as follows: $Cl^- > SO_4^{2-} > NO_3^-$. The mean values of these anions were obtained as 397, 246 and 170 μeq l^{-1} respectively. Mean concentrations of cations ($Ca^{2+} > Na^+ > Mg^{2+} > K^+$) were found to be 455, 203, 109 and 29 μeq l^{-1} respectively.

The radionuclides present in all samples are ^{7}Be and ^{210}Pb. The ^{40}K appears approximately in 50% of the samples. The specific activities of ^{7}Be, ^{210}Pb and ^{40}K varied from 0,6 to 8,3 Bq l^{-1} (mean = 2,6 Bq l^{-1}), from 0,05 to 1,3 Bq l^{-1} (mean = 0,41 Bq l^{-1}) and from 0,02 to 0,84 Bq l^{-1} (mean= 0,23 Bq l^{-1}), respectively. To determine the concentrations of ^{7}Be, ^{210}Pb and ^{40}K from the collector, a volume of 6 litres was evaporated at 80ºC down to approximately 1 litre and then transported to a Marinelli geometry container. This large sample size was required due to the low activity of the samples. The Marinelli containers were counted using an intrinsic germanium coaxial detector, RE Ge-type made by CANBERRA.

The temporal variations of major ions and radionuclides exhibit similar seasonal behaviour with low values in winter-autumn months and maximum values in spring-summer months .Additionally, principal component analysis method were performed to identify possible common sources of major ions and gamma radionuclides in bulk deposition.

INDIVIDUAL PARTICLE ANALYSIS OF AMBIENT AND RE-SUSPENDED DUSTS FROM GLOBAL SOURCE REGIONS

Johann P. Engelbrecht[1]*, Gary Casuccio[2], Traci Lersch[2]

[1]*Desert Research Institute (DRI), Reno, Nevada 89512-1095, U.S.A.*
[2]*RJ Lee Group, Inc., Monroeville, Pennsylvania 15146, U.S.A.*
**johann@dri.edu*

This paper reports on Scanning Electron Microscopic (SEM) studies of individual aerosol particles from global dust sources, collected on Nuclepore® membrane filters. These include approximately 243 TSP, PM_{10} and $PM_{2.5}$ filter samples collected at 15 sites throughout the Middle East (Engelbrecht et al., 2008) as well as 65 re-suspended dust samples from global dust sources, including from the southwestern USA, (12), Mali (3), Chad (3), Morocco (1), Canary Islands (8), Cape Verde (1), Djibouti (1), Afghanistan (3), Iraq (6), Kuwait (5), Qatar (1), UAE (1), Serbia (3), China (5), Namibia (3), Botswana (4), Australia (3), and Chile (1).

Approximately 1000 individual particles from each of the ambient and re-suspended Nuclepore® filters were analyzed for their chemical composition (approx. 28 chemical species), particle size and morphology, by computer controlled scanning electron microscopy (CCSEM). In addition, approximately 5 secondary electron images (SEI's) with energy dispersive spectra (EDS) were collected from each filter sample.

CCSEM results clearly show differences in chemical and mineralogical compositions from different sampling sites, depending on the local geology and anthropogenic sources. For example, aerosols from United Arab Emirates (UAE) contain above average amounts of calcite, while those from Al Asad, Iraq contain above average amounts of dolomite. Silicate minerals, including quartz and feldspars are often coated by thin clay layers, including iron-bearing montmorillonite, illite, and palygorskite, while dusts from Mali also contain coatings of kaolinite with individual particles of hematite and goethite. Minerals in airborne dust and their interrelationships determine their optical (scattering, absorption) and other properties.

We intend establishing a data base of the mineralogical, chemical, physical and optical properties for airborne dust from global sources dust or applications in climate modeling, remote sensing, visibility, health (medical geology), ocean fertilization, and damage to equipment.

Engelbrecht, J.P., McDonald, E.V., Gillies, J.A., Gertler, A.W., 2008. Department of Defense Enhanced Particulate Matter Surveillance Program (EPMSP). Contract Number: W9124R-05-C-0135/SUBCLIN 000101-ACRN-AB, Desert Research Institute.

MINERALOGICAL, CHEMICAL, AND OPTICAL INTERRELATIONSHIPS OF AIRBORNE MINERAL DUSTS FROM GLOBAL SOURCE REGIONS

Johann P. Engelbrecht[1]*, Hans Moosmüller[1], Samuel L. Pincock[1], R.K.M. Jayanty[2], Gary Casuccio[3]

[1]*Desert Research Institute (DRI), Reno, Nevada 89512-1095, U.S.A.*
[2]*RTI International, Raleigh, North Carolina 27675-9000, U.S.A.*
[3]*RJ Lee Group, Inc., Monroeville, Pennsylvania 15146, U.S.A.*
**johann@dri.edu*

The purpose of the project was to provide information on the mineralogical, chemical and physical interrelationships of re-suspended mineral dust samples collected as grab samples from global dust sources. Surface soil samples were collected from about 65 desert sites, including the southwestern USA (12), Mali (3), Chad (3), Morocco (1), Canary Islands (8), Cape Verde (1), Djibouti (1), Afghanistan (3), Iraq (6), Kuwait (5), Qatar (1), UAE (1), Serbia (3), China (5), Namibia (3), Botswana (4), Australia (3), and Chile (1).

The < 38 µm sieved fraction of each sample was re-suspended in an entrainment chamber, from which the airborne mineral dust could be monitored, sampled and analyzed. Instruments integrated into the entrainment facility included two PM_{10} and two $PM_{2.5}$ filter samplers, a beta attenuation gauge for the continuous measurement of PM_{10} and $PM_{2.5}$ particulate mass fractions, an aerodynamic particle size (APS) analyzer, and a three wavelength (405, 532, 781nm) photoacoustic resonator with integrating reciprocal nephelometer for monitoring absorption and scattering coefficients during the dust re-suspension process. Filter sample media included Teflon® membrane and quartz fiber filters for chemical analysis (71 species), and Nuclepore® filters for individual particle analysis by Scanning Electron Microscopy (SEM). The < 38 µm sieved fractions were also analyzed by X-ray diffraction for their mineral content while the > 38 µm, < 125 µm soil fractions were mineralogically characterized by optical microscopy.

We will be presenting results on the optical measurements, also showing the relationship between single scattering albedo (SSA) at three different wavelengths, and chemical as well as mineralogical content and interdependencies of the entrained dust samples. Examples showing the relationships between the single scattering albedos of airborne dusts, and iron (Fe) in hematite, goethite, and clay minerals (montmorillonite, illite, palygorskite), will be discussed. Differences between the clay minerals in samples from Mali and those from other localities will be demonstrated.

We intend establishing a data base for applications in climate modeling, remote sensing, visibility, health (medical geology), ocean fertilization, and damage to equipment.

SPATIO TEMPORAL MODELING BASED ON ARTIFICIAL NEURAL NETWORK-MARKOV FOR PRIORITIZE CONTROLLING POLICIES IN DUST SOURCES

Omid Erfanizadeh[1]*, Aliakbar Matkaan[1], Ali Darvishi Boloorani[2], Babak Mirbagheri[1], Aso Veysi[3]

[1]Faculty of Earth Science, Shahid Behshti University, Tehran, Iran
[2]Faculty of Geography, Tehran University, Tehran, Iran
[3]Department of Engineering, Yazd Science and Research Branch, Azad University, Yazd, Iran
**Erfanizadeh.1988@yahoo.com*

One of the main problems of Iran is dust storms which encompass the country in recent years. Increasing in spatial extent of this phenomenon, its frequency and its Undesirable environmental effects have encouraged many scientists and officials to study on identifying the nature of dust storms and providing effective strategies for reducing the negative effects of this phenomenon. Previous studies have identified active dust sources in neighboring countries which Proves that Iraq's share in production of dust is higher than the other countries. Detected sources are general and it seems that dust storms are raising above some parts of these sources not all of them. Using these findings in more operational steps like stabilize erosion-prone sediments is a great challenge. It seems that vast Land use changes and Degradation of rangelands which are large parts of regions vegetation cover play an intensification role in dust sources activity. So modeling the pattern of Rangelands degradation provide Useful information to identifying vulnerable areas, for better management of dust sources in the study area. In this study we achieved this aim by combining artificial neural network with Markov chain for modeling the changes. So by using Landsat satellite images and image processing techniques, changes of Rangelands cover in last two decades were derived and considering the factors affecting this changes the modeling of rangelands degradation was performed then, by using the results, active dust sources Were Prioritize for controlling policies and finally maps of Rangelands degradation potential were extracted for future.

Keywords: Dust sources, Rangelands, Modeling, Artificial Neural Network-Markov.

FIELD TEST CAMPAIGN IN THE MOROCCO DESERT AS ANALOG FOR THE DREAMS EXPERIMENT ON BOARD EXOMARS 2016 MISSION

Francesca Esposito[1]*, Ciprian I. Popa[1], Gaetano Di Achille[1], Cesare Molfese[1], Fabio Cozzolino[1,2], Laurent Marty[1], Kamal Taj Eddine[3], Gian G. Ori[3,4]

[1]*INAF-Osservatorio Astronomico di Capodimonte, Napoli, 80131, Italy*
[2]*Università degli studi di Napoli "Federico II", Napoli, 80138, Italy*
[3]*Ibn Battuta Centre - University Cadi Ayyad, Marrakech, Morocco*
[4]*IRSPS Università G. D'Annunzio, Pescara, Italy*
**francesca.esposito@na.astro.it*

We present the preliminary results of an extensive field test campaign devoted to the study of dust lifting mechanisms and their effect on atmospheric electric field. The main objective is to quantify the effect of fresh lifted dust on the atmospheric electric field and its feedback on the lifting process. An enhancement of the atmospheric electric field is expected during dust events such as sand *saltation* process, dust devils, dust storms (e.g Schmidt et al., 1998; Kok and Renno, 2006; 2008). This is due to charge transfer among particles during sand-dust-soil collisions. This mechanism is poorly understood but from some laboratory and field experiments, we expect that saltating sand particles charge negatively while the soil surface charges positively, so that the resulting electric field is expected to be reversed in sign with respect to fair weather. Moreover, some studies show also evidences of the role of electric field in reducing the wind stress needed to start sand saltation process (Kok and Renno, 2008; Zheng et al., 2003; 2006). We acquired synchronized measurements of wind speed and direction, atmospheric pressure, solar radiation, air and soil humidity and temperature, wind erosion using impact sensors and sand catchers, dust lifting and electric field for about two months in the Moroccan desert. Preliminary data analysis shows a strict correlation between the abundance of the fresh lifted dust and the enhancement of atmospheric electric field. This study provides new evidences in the relation of aeolian processes and electric properties of the atmosphere and will prepare the analysis of the data that will be acquired on Mars by the instrument DREAMS onboard the ExoMars 2016 space mission. DREAMS is a meteorological station with the additional capability to perform measurements of the electric field close to the surface of Mars.

Kok J. F. and Renno N. O. (2006) Enhancement of the emission of mineral dust aerosols by electric forces. *Geophys. Res. Lett. 33 L19s10*

Kok J. F. and Renno N. O. (2008). Electrostatics in wind-blown sand. *Phys. Rev. Lett. 100 014501*

Schmidt D. S., Schmidt R. A. and Dent J. D. (1998) Electrostatic force on saltating sand. *J. Geophys. Res. 103 8997-9001.*

Zheng X. J., Huang N. and Zhou Y. H. (2003). Laboratory measurement of electrification of wind-blown sands and simulation of its effect on sand saltation movement. *J. Geophys. Res. 108 4322.*

Zheng X. J., Huang N. and Zhou Y. H. (2006). The effect of electrostatic force on the evolution of sand saltation cloud. *Eur. Phys. J. E 19 129-38.*

SAHARAN DUST EVENT MEASUREMENTS ON CAMAGÜEY. CASE STUDY

René Estevan[1]*, Lucia Mona[2], Nikolaos Papagiannopoulos[2], Juan C. Antuña[1], Victoria Cachorro[3], Ángel de Frutos[3]

[1]*Grupo de Óptica Atmosférica de Camagüey, Centro Meteorológico de Camagüey, Ave. Finlay Km 7 ½, Apartado Postal #134, Camagüey 70100, Cuba*

[2]*ConsiglioNazionaledelleRicerche, Istituto di Metodologie per l'AnalisiAmbientale (CNR-IMAA), C.da S. Loja, Potenza 85050 Tito Scalo, Italy*

[3]*Grupo de Óptica Atmosférica, Universidad de Valladolid, Paseo de Belén 7, 47011, Valladolid, España*

**realcmw@gmail.com*

The Wider Caribbean is affected every year by Saharan dust events generated on Sahara and Sahel region at north of African continent. These large amounts of aerosol have been detected by a sunphotometer CIMEL CE-318 installed on the proximity of Camagüey city (21.422° N, 77.850° W), since October 2008. This sunphotometer, operated by the Atmospheric Optics Group of Camagüey (GOAC), belong to the Iberian Aerosol Measurement Network (RIMA), federated to AERONET. Six events has been recorded during July 2009, the more intense during July 6 with AOD = 0.696 and the longest event among July 15 and 20 with a maximum AOD value of 0.615 on July 17. A coincident CALIPSO overpass has been selected into the longest event corresponding to July 19. Taken into account only the spatial criteria, the nearest point was located to west northwest at a distance of 22.6 km of CIMEL site, constituting the case study. The AOD registered values of 0.35 and 0.32 for both, CALIPSO and MODIS, respectively, have equal magnitude than CIMEL measurement for the same day. The Camagüey sunphotometer measurements was compared with La Parguera site, Puerto Rico, located at 1195 km to the east southeast where almost the same quantity of Saharan dust was registered with a time gap of one to two days. During the same period, Europe was affected by Saharan dust events as well, fundamentally the south of Spain whereGranada, an EARLINET site, is located. CALIPSO, MODIS and AERONET data available at global scale are used, in conjunction with transport models and backtrajectories, for investigating the Saharan dust plume dispersion.

Acknowledgments - The financial support by the European Community through the ACTRIS Research Infrastructure Action under the 7th Framework Programme under ACTRIS Grant Agreement n° 262254 is gratefully acknowledged.

FATE OF SMELTER DUSTS IN SOILS

Vojtech Ettler[1]*, Martin Mihaljevic[1], Bohdan Kribek[2]

[1]*Institute of Geochemistry, Mineralogy and Mineral Resources, Faculty of Science, Charles University in Prague, Prague 2, 128 43, Czech Republic*

[2]*Czech Geological Survey, Prague 5, 152 00, Czech Republic*

**ettler@natur.cuni.cz*

Soils in the vicinity of non-ferrous metal smelters are often highly polluted by inorganic contaminants released from particulate emissions, which undergo weathering processes and release contaminants when deposited in soils (Ettler et al. 2005). In this paper we present the results on mineralogy and alteration of smelter-derived particles in soils near active Cu and Pb metallurgical operations.

The topmost soil layers are often highly enriched in inorganic contaminants, e.g. up to 8980 ppm Cu near Cu smelters (Ettler et al. 2014) and 35 000 ppm Pb near Pb smelters (Ettler et al. 2005). Heavy mineral fraction of these soils contains numerous spherical particles smaller than < 80 μm with mineralogy corresponding to particles formed by the processes in the furnace or in the flue gas cleaning system of each smelter. Copper smelter-affected soils commonly contain spherical particles were mainly composed of covellite (CuS), chalcocite (Cu_2S) and Fe-Cu oxide particles predominantly corresponding to tenorite (CuO) and delafossite ($Cu^{1+}Fe^{3+}O_2$). Secondary weathering rims on Cu-Fe sulphides are often composed of Cu sulphates and/or Cu oxysulfates along with hydrated Fe-oxides (Ettler et al. 2014). In contrast, Pb smelter-affected soils contain predominantly anglesite ($PbSO_4$) particles corresponding final weathering product of the dust exposed in the soil system (Ettler et al. 2005).

We used a technique with double polyamide experimental bags (1-μm mesh) to study the in situ transformation of dust from a secondary Pb smelter in soils (Ettler et al., 2012). Between 62 - 66% of the dust dissolved after one year's exposure in the soils, leading to complete dissolution of primary caracolite [$Na_3Pb_2(SO_4)_3Cl$] and KPb_2Cl_5, with formation of secondary anglesite. Release of Pb was pH-dependent, whereas not for Cd and Zn. Significant amounts of metals (mainly Cd and Zn) partitioned into labile soil fractions and became highly mobile in the soil profiles.

This study was supported by the Czech Science Foundation (GAČR 210/12/1413 and 13-17501S) and IGCP Project No. 594 ("Assessment of impact of mining and mineral processing on the environment and human health in Africa").

Ettler V., Vanek A., Mihaljevic M., Bezdicka P. (2005). Contrasting lead speciation in forest and tilled soils heavily polluted by lead metallurgy, Chemosphere 58, 1449-1459.

Ettler V., Mihaljevic M., Sebek O., Matys Grygar T., Klementova M. (2012). Experimental in situ transformation of Pb smelter fly ash in acidic soils, Environmental Science & Technology 46, 10539-10548.

Ettler V., Konecny L., Kovarova L., Mihaljevic M., Sebek O., Kribek B., Majer V., Veselovsky F., Penizek V., Vanek A., Nyambe I. (2014). Surprisingly contrasting metal distribution and fractionation patterns in copper smelter-affected tropical soils in forested and grassland areas (Mufulira, Zambian Copperbelt), Science of the Total Environment (in press, doi: 10.1016/j.scototenv.2013.11.146)

TESTING AN ADVANCED SATELLITE TECHNIQUE FOR DUST DETECTION AS A DECISION SUPPORT SYSTEM FOR THE AIR QUALITY ASSESSMENT

Alfredo Falconieri[1]*, Carolina Filizzola[2], Rossella Femiano[3], Francesco Marchese[2], Filomena Sannazzaro[3], Nicola Pergola[2], Valerio Tramutoli[3], Ersilia Dimuro[4], Mariella Divietri[4], Anna Maria Crisci[4], Michele Lovallo[4], Lucia Mangiamele[4], Mariapia Vaccaro[4], Achille Palma[4]

[1]*Geospazio Italia S.r.l., Potenza, 85100, Italy*
[2]*Istituto di Metodologie per l'Analisi Ambientale, Tito Scalo, 85050, Italy*
[3]*Scuola di Ingegneria-Università della Basilicata, Potenza, 85100, Italy*
[4]*Agenzia Regionale Per la Protezione dell'Ambiente della Basilicata, Potenza, 85100, Italy*
**alfredo.falconieri@gmail.com*

In the framework of the NIBS (Networking and Internationalization of Basilicata Space Technologies) project, funded by the Basilicata Region within the ERDF 2007-2013 program, the School of Engineering of University of Basilicata, the Institute of Methodologies for Environmental Analysis of National Research Council (IMAA-CNR) and the Regional Agency for the Protection of the Environment of Basilicata Region (ARPAB) have started a new collaboration, devoted to assess the potential of an advanced satellite technique for Saharan dust events investigation. In such a joint activity, advanced satellite products, based on the Robust Satellite Technique (RST) approach, are assessed and tested as a decision support system for monitoring and evaluating air quality at local and regional level. In particular, satellite products, derived by processing high temporal resolution data provided by SEVIRI (Spinning Enhanced Visible and Infrared Imager) sensor onboard Meteosat Second Generation platforms, are analysed together with PM10 measurements performed by the ground-based stations operated by ARPAB. Such an inter-comparison is devoted to better investigate possible PM10 over-threshold occurrences as well as to better evaluate their causes (i.e. anthropogenic and/or natural sources). The analysis will potentially provide to ARPAB an independent, automatic and unsupervised observing system capable of supporting them in discriminating over-threshold PM10 data produced by natural source from the ones occurred because of anthropogenic causes. Multi-annual data set of ground-based and satellite time series are processed, firstly on a restricted area (the province of Potenza), and then at a regional scale (Basilicata Region), with the aim of developing a reliable and integrated monitoring system, capable of better supporting activities devoted to assess air quality.

DNATRAX (DNA TAGGED REAGENTS FOR AEROSOL EXPERIMENTS): FOOD BASED DNA BARCODED SIMULANTS FOR SAFE AEROSOL STUDIES

George R. Farquar*, Cindy Kaeser, Ruth Udey, Sally Hall,
Joannne Osburn, Elizabeth K. Wheeler

Lawrence Livermore National Laboratory, Livermore, CA 94550 USA
**gfarquar@llnl.gov*

Lawrence Livermore has developed a safe food based aerosol material for transport studies. LLNL's DNA Tagged Reagents for Aerosol eXperiments (DNATrax), a safe simulant material made with sugar and non-biological DNA, can track and quantify indoor and outdoor air transport. DNATrax combines FDA-approved food additives and a unique DNA bar code to produce a microparticle that simulates the aerosols comprising the air around us. The potential for creating unique bar codes is virtually unlimited, thus allowing for simultaneous and repeated releases, which dramatically reduces the costs associated with conducting source attribution testing for contaminants. The ability to rapidly conduct aerosol testing allows for the validation of models and detector locations that has previously been unobtainable.

Computational modeling methods can provide a theoretical understanding of particle deposition in turbulent airflow patterns but still require experimental validation using simulant aerosols (King, et al., 2013). Considerations that complicate experimental designs for model validation include high background aerosol levels, reproducing environmental conditions for multiple experiments, and detecting the simulant with disruption of natural airflow. Use of DNATrax as an aerosol simulant can solve these concerns.

The presentation will discuss the development of DNATrax and the most recent aerosol release studies. In addition, the regulatory, safety aspects and low burden for approval will be presented.

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344

King, M. F., Noakes, C. J., Sleigh, P. A., Camargo-Valero, M. A. (2013). Building and Environment. 59, 436-447.

MODEL BASED DISTRIBUTION OF HUMAN EXPOSURE TO AIRBORNE PARTICULATE MATTERS

Alessandro Fassò*, Francesco Finazzi

University of Bergamo, Italy
**alessandro.fasso@unibg.it*

The exposure to airborne pollutants is usually assessed considering the concentration of the related pollutant measured at some monitoring stations, possibly averaged over different stations, and referred e.g. to a city or a region or a country.
This approach has big limitations, giving rise serious ecological fallacy because neither the spatial distribution of the pollutants neither the population spatial distribution are considered at sensible meteorological and anthropic scales.
In this paper we consider a statistical approach based on dynamical kriging and spatio-temporal simulation which allows the computation of the exposure distribution giving the number of people exposed to the each pollutant concentration. Since this approach is capable of reconstructing the concentration fields at high spatial resolution for daily data, the exposure distribution can be assessed, uncertainty included, at various spatial and temporal scales from the city to country level and from daily to yearly level. Results are given for European exposure to particulate matters.

METEOROLOGICAL EFFECTS ON PM10 CONCENTRATIONS IN A URBAN INDUSTRIAL SITE: A STATISTICAL ANALYSIS

Francesca Fedele[1,2]*, Micaela Menegotto[1], Livia Trizio[1], Lorenzo Angiuli[1], Anna Guarnieri, Calò Carducci[1], Roberto Bellotti[2,3], Roberto Giua[1], Giorgio Assennato[1]

[1]*Apulia Region Environmental Protection Agency (ARPA Puglia), Corso Trieste 27, IT-70126 Bari, Italy*
[2]*Università degli Studi di Bari, IT-70126 Bari, Italy*
[3]*Istituto Nazionale di Fisica Nucleare Sezione di Bari, IT-70126 Bari, Italy*
**f.fedele@arpa.puglia.it*

This study deals with the analysis of 8 years long time series of PM10 and meteorological data collected in the city of Taranto - Italy, which is characterized by the extreme proximity to a large industrial area which includes the largest European integrated steel plant, an oil refinery and a cement plant. In particular we focus on a small neighbourhood called Tamburi characterized by several exceedances of regulatory limits with respect to PM10. This neighbourhood is located less than 1 Km away from the steel plant mineral stockyard, downwind with wind direction from North-West quadrant. The aim of the study is to identify specific wind conditions leading to deterioration of air quality with respect to PM10 concentrations. We chose two sampling sites of PM10 from ARPA Puglia Air Quality Monitoring Network, one located in Tamburi and the other in a Taranto neighbourhood called Talsano, similar to the first in population density and urban morphology but much farther from the mineral stockyard. Meteorological data are obtained from a station located in Taranto from the same Air Quality Monitoring Network. To identify the specific wind conditions, we looked for critical wind speed thresholds and wind speed permanence in terms of consecutive hours over the threshold. Combining thresholds and permanence we defined some meteorological criteria and applying them we divided into two classes every day of the observation period naming them “Wind Day” and “No Wind Day”. According to this classification we performed a statistical analysis [1] on the two PM10 data sets; we also performed a statistical hypothesis testing building two different distributions, one obtained from PM10 concentration and the other from the difference between the PM10 concentrations in two sites, and for each meteorological criterion we build a ROC curve. Days of Saharian advection, identified using a canonic method [2], were eliminated from the dataset. The study shows that Talsano site exhibits a constant behaviour, that is a decrease of PM10 concentrations in the days classified as “Wind Day” with respect to the “No Wind Day” class, due to dilution effect of strong winds. Tamburi site shows an opposite behavior. This anomaly is due to the extreme proximity of emission source. Furthermore we found that the value of the area under the ROC curves obtained for each meteorological criterion is in the range 0.69 - 0.89 meaning that all classifiers give a sufficiently good separation.

1. Wilks D.S. (2006) Statistical Methods in the Atmospheric Sciences. Academic Press Elvesier , 649 pp
2. EC (2011). Commission staff working paper establishing guidelines for demonstration and subtraction of exceedances attributable to natural sources under the Directive 2008/50/EC on ambient air quality and cleaner air for Europe, 38 pp.

THE EVALUATION AND FORECASTING OF URBAN PARTICULATE MATTER EPISODES BASED ON METEOROLOGICAL PARAMETERS IN ERGENE BASIN CONSIST OF THREE CITIES IN TURKEY

Merve Fiçici*, Lokman Hakan Tecer

Namık Kemal Üniversity, Corlu Engineering Faculty, Environmental Engineering Dept.
Çorlu/Tekirdağ, 59860, Turkey
**mervefcc@outlook.com*

Globally, particulate matter (PM) concentrations in urban centers cause significant adverse effects on human health. Urban traffic, industry and heating systems are the major source of urban PM. The meteorological conditions, topographical structures of cities and urban settlements are the major factors affecting the air pollutants' dispersion, deposition and chemical conversion processes dramatically. The aim of this study is to determine and forecast of daily, monthly and seasonal PM10 mass concentrations based on meteorological parameters in Ergene Basin, covering a wide area of the province consists of three cities named Tekirdag, Edirne and Kırklareli. The population of this area approximately is 3 million people and this population is under risk of different environmental pollution such as atmospheric PM. At Ergene basin, during 2005 - 2013 study period, the differences between PM10 episode and meteorological parameters have been determined utilizing classification and ANOVA techniques. PM forecasting models have been developed to determine the temporal variation of particulate matter using multiple regression on the basis of meteorological parameters. During the working period, the average concentrations of PM10 is 68,97 µg/m3 in Ergene Basin. The concentrations of PM10 are higher in winter season than the other months because of combustion of fossil fuel for heating. As expected, the temperature and wind speeds have a significant effect on the occurrence of episodic events. Accordingly, the increase of relative humidity and cloudiness is associated with an increase in high values of PM10 in each city. Forecasting models could be explained adequately daily and seasonal variation of particulate matter concentrations. Determination coefficient (R2) of each prediction model developed for the cities varied from 0.69 - 0.79 values. The level of the previous days pollution and meteorological parameters including wind speed, temperature and pressure were found to be an important variables in the forecasting models. The air quality projections have been determined by using model equations developed for Ergene basin depending on meteorological conditions.

Keywords: Atmospheric PM10 episodes, meteorological parameters, ANOVA, multiply linear regression, Ergene Basin.

DUST EMISSION ASSOCIATED WITH NORTH AFRICAN CYCLONES, ATMOSPHERIC DEPRESSIONS AND NOCTURNAL LOW-LEVEL JETS

Stephanie Fidler[1,2]*, Kerstin Schepanski[3], Peter Knippertz[1,2], Bernd Heinold[3], Ina Tegen[3]

[1]*School of Earth and Environment, University of Leeds, LS2 9JT,United Kingdom*
[2]*Karlsruhe Institute for Technology, Karlsruhe, 76131, Germany*
[3]*Leibniz Institute for Tropospheric Research, Leipzig, 04318, Germany*
**eesfi@leeds.ac.uk*

Different meteorological processes are known to generate dust emission in North Africa, but their relative importance is poorly quantified. This study presents the first quantitative estimate of the North African dust emission amount associated with atmospheric depressions and migrating, long-lived cyclones (Fiedler et al, 2013a) as well as the breakdown of nocturnal low-level jets (NLLJs, Fiedler et al, 2013b). The work uses the ERA-Interim data from the European Centre for Medium-Range Weather Forecasts. An algorithm is applied for identifying tracks of minima in the geopotential height at 925 hPa. NLLJs are detected with a new automated detection. The results of these techniques are combined with dust emission calculations from a dust model which is driven by meteorological fields from ERA-Interim.
The results highlight large contributions of atmospheric depressions to dust emission of 55% annually and spatially averaged and up to 90% in specific regions and seasons. Cyclones that migrate and live for more than 48 hours are rare and are associated with 4 % of the dust emission annually and spatially averaged. Maxima of dust emission associated to cyclones of 25 % are found over eastern North Africa during spring. Despite the overall small contribution of cyclones to dust emission, the intensity of the emission is particularly large with values exceeding the climatological mean by a factor of four to eight. Daytime fluxes associated with cyclones are three to five times larger than those during the night. Moisture in the top soil suppresses 10 % of the dust emission associated to cyclones. These results underline the importance of depressions and migrating cyclone for dust emission.
NLLJs are nocturnal wind speed maxima at a few 100 m above the ground. In the annual and spatial mean, NLLJs occur in 29 % of the nights and up to 80 % in regionally and seasonally varying hotspots. The contribution of NLLJs to the dust emission amount is 15 % in the annual and spatial mean. Seasonally and regionally, up to 60 % of the dust emission amount is associated with NLLJs. Based on this knowledge dust emission from these meteorological processes can be evaluated in weather and climate models for dust applications that helps reducing uncertainty.

S. Fiedler, Schepanski, K., Knippertz, P, Heinold, B., Tegen, I. (2013a) How important are cyclones for emitting mineral dust aerosol in North Africa?, Atmos. Chem. Phys. Discuss., 13, 32483-32528, doi:10.5194/acpd-13-32483-2013.

S. Fiedler, Schepanski, K., Heinold, B., Knippertz, P., Tegen, I. (2013b), Climatology of nocturnal low-level jets over North Africa and implications for modeling mineral dust emission, *J. Geophys. Res. Atmos.*, *118*, 6100-6121, doi:10.1002/jgrd.50394.

DISSOLUTION OF AEROSOL IRON INTO SURFACE WATERS: INFLUENCE OF SEAWATER TEMPERATURE, PH AND PRESENCE OF ORGANIC LIGANDS

Matthew Fishwick[1]*, Maeve Lohan[1], Paul Worsfold[1], Kristen Buck[2], Simon Ussher[1]

[1]*Plymouth University, Plymouth, PL4 8AA, UK*
[2]*Bermuda Institute of Ocean Sciences, St George's, GE 01, Bermuda*
**matthew.fishwick@plymouth.ac.uk*

Iron is required by phytoplankton for a range of important biochemical functions and therefore, its availability is important for supporting ocean ecosystems. A major pathway for new supply of iron to the open ocean is atmospheric deposition of aerosols. The proportion of total iron contained within aerosols that dissolves in seawater (i.e. fractional solubility), varies greatly and is dependent on aerosol composition and the physicochemical conditions of the seawater. As iron is most biologically available in the dissolved form, it is important to understand how these factors affect dissolution of aerosol iron in seawater.

In this study, the effects of key physicochemical factors on aerosol iron dissolution into seawater were investigated. These factors were seawater temperature, pH and chelating ligands. Aerosol samples were collected from Tudor Hill atmospheric observatory (Bermuda) over four different seasonal time periods (ca. 1 - 2 month) over 2009 and 2010 and replicate subsamples of these were used in aerosol leach experiments along with filtered low iron seawater collected from the Bermuda Atlantic Time-series Study region. Filtration of seawater leachate through 0.4 μm and 0.02 μm pore size filters allowed colloidal (> 0.02 μm - < 0.4 μm) and soluble (< 0.02 μm) size fractions of the dissolved (< 0.4 μm) iron pool to be determined.

Initial results for iron showed that seawater temperature (4 - 25 ˚C) and pH (7.7 - 8.1), had no significant effect on the dissolution of aerosol iron within the range of values tested. However, the source and composition of aerosols affected the fractional solubility of iron by up to one order of magnitude, with the most anthropogenically influenced samples having the highest fractional solubility. Supporting data showing the influence of aerosol source and seawater temperature and pH on a suite of biologically active trace metals (e.g. Cu, Mn, Co) will also be presented. In addition, results have shown the majority of iron deposited by aerosols into ambient seawater existed in the colloidal size fraction. However, in the presence a sufficient concentration of strong iron-binding organic ligands, a shift in the size speciation was observed whereby most colloidal iron was converted to soluble iron. The conclusions of this study have been used to develop a conceptual model for iron dissolution from aerosols in the surface ocean that illustrates the role played by organic ligands in this process. This has important implications for aerosol iron residence times in surface waters and biological availability. Further analysis will allow other biologically active trace metals to be included in this model.

AEOLIAN INPUTS OF INDUSTRIAL LEAD TO THE NORTH PACIFIC

A. Russell Flegal*, Cheryl A. Zurbrick

Institute of Marine Science, UCSC, Santa Cruz, 95064, USA
**flegal@ucsc.edu*

In contrast to the North Atlantic where marked declines in aeolian inputs of industrial lead over the past four decades have been correlated with the elimination of leaded gasoline in North America and Europe, there has not appeared to be a comparable decline in industrial lead depositions in the North Pacific - in spite of the elimination of leaded gasoline in countries bordering that ocean. This disparity may be (1) an artifact of the relative absence of lead measurements in North Pacific aerosols and surface waters, (2) due to the slower elimination of leaded gasoline in much of Asia, and/or (3) a consequence of the rapid industrialization of Asia in recent decades. The latter possibility is evidenced by limited measurements of lead concentrations and isotopic compositions in North Pacific aerosols and surface waters, which indicate that increasing atmospheric emissions of lead from fossil fuel combustion in Asia now account for most of the lead in eastern North Pacific surface waters. Moreover, those anthropogenic inputs are projected to continue for decades as a consequence of expanding industrialization in Asia and limited - to date - controls on associated atmospheric lead emissions.

ESTIMATION OF SAHARA DUST LOAD BY A CEILOMETER NETWORK

Harald Flentje[1]*, Alexander Geiss[2], Hülya Markl[3], Werner Thomas[1], Frank Wagner[1], Matthias Wiegner[2]

[1]Deutscher Wetterdienst, Hohenpeissenberg Meteorological Observatory, Albin-Schwaiger-Weg 10, 82234 Hohenpeissenberg, Germany
[2]Universität München, Theresienstraße 37, 80539 Munich, Germany
[3]Universität of Augsburg, Chair of Physical Geography, Alter Postweg 118, 86159 Augsburg, Germany
*Harald.Flentje@dwd.de

The DWD network of about 60 Jenoptik CHM15K laser-ceilometers (http://www.dwd.de/ceilomap) is applied to estimate the mass-load of Saharan dust transported to southern Germany in the year 2011. The assumptions on which our approach is based are explained, and uncertainties and limitations of mass-load estimates from ceilometer elastic backscatter profiles are discussed in the context of the information content of advanced lidars' data. The capability of a dense profiling network to study the dispersion, coherence and boundary layer entrainment of dust layers is demonstrated.

Six periods with strong Saharan dust transport to central Europe occurred in 2011 covering in total 23 days, namely on 15/16 Mar, 9-12 Apr, 21/22 Jun, 3-5 Aug, 18-26 Aug, and 3-5 Sep. The weaker events are ignored because they cannot unambiguously be identified and contribute in total much less mass than the strong ones. For the main periods, time-height sections of extinction coefficients at 6 south German ceilometer stations have been calculated using Rayleigh calibration and a fixed lidar ratio of 55 sr. Errors due to insensitivity to the molecular signal are reduced by scaling to AOD. In each period the results are confirmed by another retrieval based on absolute calibration (Wiegner et al, 2012). Following the anchor approach, the calibration of this station is transferred to the surrounding network CHM15k (distance $<$100 km) which, at that time, had no absolute calibration capability. The extinction-to-mass conversion is performed with an average literature mass-extinction-coefficient of $\sigma^*=$ 0.6 m^2/g for Saharan dust (Ansmann et al., 2012).

The resulting dust mass load is discussed with respect to its relevance as a fertilizing and (acidic soil) buffering agent (mainly by Ca^{2+}).

Ansmann et al., Profiling of fine and coarse particle mass: case studies of Saharan dust and Eyjafjallajökull/Grimsvötn volcanic plumes, Atmos. Chem. Phys., 12, 9399-9415, 2012.
Flentje et al., The Eyjafjallajökull eruption in April 2010 - detection of volcanic plume using in-situ measurements, ozone sondes and lidar-ceilometer profiles, Atmos. Chem. Phys., 10, 10085-10092, 2010.
Wiegner et al., Aerosol profiling with the Jenoptik ceilometer CHM15kx, Atmos. Meas. Tech., 5, 1953-1964,doi: 10.5194/amt-5-1953-2012, 2012.

OPERATIONAL FORECAST AND HAZARD ASSESSMENT OF VOLCANIC ASH DISPERSAL

Arnau Folch

Barcelona Supercomputing Center - Centro Nacional de Supercomputación (BSC-CNS), Barcelona, 08028, Spain.
arnau.folch@bsc.es

Like mineral dust, volcanic ash can be dispersed by dominant winds thousands of km from the source jeopardizing civil aviation and communities. Ash fallout triggers an array of impacts including, for example, disruption of road and communication networks, damage to livestock and agriculture, or contamination of water supply systems. On the other hand, the presence of volcanic ash and aerosols in the atmosphere disrupts civil aviation and deteriorates the air quality. Volcanic Ash Transport and Dispersal Models (VATDMs) simulate atmospheric dispersion and sedimentation of ash depending on meteorological fields and eruption characteristics, defined by the so-called Eruption Source Parameters (column height, eruption rate and vertical distribution of mass) and particle properties. VATDMs are used for multiple purposes, including forecasting of ash clouds and deposition, long-term hazard assessment, or characterization of past eruptions. In the context of civil aviation operations, VATDMs have been long used by Volcanic Ash Advisory Centres (VAACs) and other institutions to forecast ash cloud trajectories and prevent encounters with aircrafts. More recently, VATDMs are also being used for long-term hazard assessment and evaluation of impact of volcanic clouds on aerial transportation. New perspectives and modelling strategies including data assimilation and ensemble forecast are emerging in the aftermath of recent high-impact events in order to improve the accuracy of forecasts. Here the use of VATDMs is overviewed and the emerging perspectives discussed and compared with those adopted by the mineral dust community.

SATELLITE AND IN SITU ESTIMATES OF DUST DEPOSITION IN THE TROPICAL NORTH ATLANTIC

Gregory Foltz

NOAA/Atlantic Oceanographic and Meteorological Laboratory, Miami, FL 33149 USA
gregory.foltz@noaa.gov

The tropical North Atlantic is a region with large annual rates of dust deposition (~140-200 Tg) and large uncertainties in seasonal variations of deposition and transport (Kaufman et al. 2005). Dust transported westward from Africa affects biogeochemistry in the tropical Atlantic Ocean, climate variability in the tropical Atlantic, soil composition in the Amazon, and air quality in the Caribbean and southeastern United States (Swap et al. 1992, Prospero 1999, Evan et al. 2011, Schlosser et al. 2014). In this study, dust deposition in the tropical North Atlantic is estimated during 2000-2013 from satellite retrievals of dust aerosol optical thickness and reanalysis winds, and from dust accumulation biases from surface radiation sensors on several moorings of the Prediction and Research Moored Array in the Tropical Atlantic (PIRATA) (Foltz et al. 2013). The emphasis is on annual mean, seasonal, and interannual fluctuations of dust deposition, and their spatial variations.

Results from the satellite/reanalysis portion of the study show a maximum in annual mean deposition rate of 3-4 $\mu g\ m^{-2}\ s^{-1}$ between 10°N-18°N along 25°W. Deposition rates decrease to less than 2 $\mu g\ m^{-2}\ s^{-1}$ at 45°W. The largest deposition rates (4-8 $\mu g\ m^{-2}\ s^{-1}$) occur during boreal summer between 12°N-20°N and east of 35°W. In contrast, the tropical North Atlantic experiences the smallest deposition rates (less than 2 $\mu g\ m^{-2}\ s^{-1}$ throughout the basin) in boreal winter. In situ estimates from four PIRATA moorings, located between 12°N-20°N along 23°W and 38°W, reveal strong interannual variations in dust deposition, with the highest rates in 2007 and 2012, consistent with satellite/reanalysis estimates. Connections to large-scale atmospheric forcing and implications for modelling of dust transport and deposition will be discussed.

Evan A. T., Foltz G. R., Zhang D., Vimont D. J. (2011). Influence of African dust on ocean-atmosphere variability in the tropical Atlantic, Nature Geosci., 4, 762- 765, doi:10.1038/ngeo1276.

Foltz G. R., Evan A. T., Freitag H. P., Brown S., McPhaden M. J. (2013). Dust accumulation biases in PIRATA shortwave radiation records, J. Atmos. Ocean. Tech., 30, 1414-1432.

Kaufman Y. J., Koren I., Remer L. A., Tanre D., Ginoux P., Fan S. (2005). Dust transport and deposition observed from the Terra-MODIS spacecraft over the Atlantic Ocean, J. Geophys. Res., 110, D10S12, doi:10.1029/2003JD004436.

Prospero J. M. (1999). Long-range transport of mineral dust in the global atmosphere: Impact of African dust on the environment of the southeastern United States, Proc. Nat. Acad. Sci. USA, 96, 3396-3403.

Schlosser C., et al. (2014). Seasonal ITCZ migration dynamically controls the location of the (sub)tropical Atlantic biogeochemical divide, Proc. Nat. Acad. Sci. USA, doi: 10.1073/pnas.1318670111, in press.

Swap R., Garstang M., Greco S., Talbot R., Kallberg P. (1992). Saharan dust in the Amazon basin, Tellus B, 44, 133-149.

CHEMICAL COMPOSITION OF LONG RANGE TRANSPORTED MINERAL DUST AT THE CVAO

Khanneh Wading Fomba*, Konrad Müller, Hartmut Herrmann

Leibniz Institute for Tropospheric Research (TROPOS, Permoser str. 15, 04318, Leipzig
**Fomba@tropos.de*

As the greatest single dust source, Saharan dust is constantly being long ranged transported and deposited into the Atlantic where it is known to influence the ocean biogeochemistry. One region for suitable monitoring of such activities is the Cape Verde Atmospheric Observatory (CVAO), situated in the Northern tropical Atlantic. Here we present observations of long term chemical characterisation of Saharan dust performed at the CVAO over a period of 5 years from 2007 to 2012. Sampling was done throughout the year in a 72 h period and during intensive field campaigns in a 24 h. PM10 samples were collected using a 5-stage Berner impactor for size-resolved measurements and a high volume DIGITEL DHA-80 sampler for bulk analysis. The filters were analyzed for inorganic ions, soluble and non-soluble trace metals and organic and elemental carbon (OC/EC).

Our observations show that continental and Saharan dust air masses strongly influence the particulate matter in this region for about 55% of the year with strong seasonality observed with higher concentrations observed during the winter months. During dust events, sea salt contribution to the total PM10 mass was low. In general, sea salt and mineral dust were found in the coarse mode PM while the organics and non-sea salt components were observed mostly in the submicron fraction. Inter annual and seasonal variability were observed for nearly all aerosol constituents. Strong seasonal trends were observed for ammonia and non-sea salt sulfate with peaks observed in the spring and summer, respectively.

Significant differences were observed in the trace metal concentration (especially iron) between days of dust outbreaks (about 20.0 Fe, 16.4 Ca, 2.3 Ti, and 0.3Mn µg/m3) and days without (less than 10.0 ng/m^3). Mn was found to be the most soluble heavy metal followed by Zn and iron. Soluble iron was mostly present in Fe(III) form with Fe(II) often found only at lower pH. Dissolution experiments at varying pH (from 5.5 to 2) showed significant increase in trace metal solubility at lower pH with an increase of over 3 orders of magnitude for both Fe (II) and Fe(III) and about two orders of magnitude for Cu and Mn.

THE MASTER-PROJECT: MEASURES AND STATE-OF-THE-ART TECHNIQUES FOR PESTICIDE-LADEN DUST EMISSION REDUCTION DURING SOWING

Dieter Foqué[1]*, Wouter Devarrewaere[2], Pieter Verboven[2], David Nuyttens[1]

[1]*Institute for Agricultural and Fisheries Research (ILVO), Technology and Food Science Unit, Agricultural Engineering, Burg. van Gansberghelaan 115, bus 1, 9820 Merelbeke, Belgium*
[2]*KU Leuven, Department Biosystems, MeBioS, De Croylaan 42, 3001 Leuven, Belgium*
**dieter.foque@ilvo.vlaanderen.be*

The use of seeds dressed with pesticides is widespread and has important advantages. The most important disadvantage of this technique is that there is a possible emission of pesticide laden dust particles during sowing. The main factors affecting the emission of pesticide-laden dust are seed treatment quality, the environmental conditions and the seed drill technology used (Nuyttens et al. 2013).

Due to the bee killing incidents observed in several European countries, the crop protection industry and the coating and seed technology companies have made important improvements with regard to seed treatment quality. In several countries, the use of air deflectors on sowing machines was made mandatory. In some cases, like in Belgium, air deflectors are only required with certain products. Furthermore there is some evidence that they are not always used in practice. In addition, there are still questions about the efficiency and the optimal machine settings, the drift reducing effect of deflectors, the effect of environmental and soil conditions, the relevance of dust drift and its impact, etc. Therefore, a 4 year research project 'MASTER' was started end of 2011. An overview and the status of the project will be presented.

The MASTER-project aims at quantifying the risk of dust drift and developing dust drift reducing measures and innovations in sowing techniques using an integrated experimental and modelling approach. In a first step, the dust drift potential of several treated seed batches was assessed using the Heubach method and information about the chemical and physical characteristics of abraded pesticide-coated seed particles was gathered (Foqué et al. 2014). Then the air flow pattern and dust emission of two pneumatic sowing machines, a precision drill (Gaspardo Stella ST 300) and a bulk drill (Kuhn Venta nc 3000) at different settings, is measured under controlled conditions. Using this information, a CFD sowing machine model will be developed to simulate the dust behaviour in and around the machine in order to evaluate the effect of machine design and settings on dust emission (Devarrewaere et al. 2014). A CFD dust drift emission model will simulate the behaviour of dust in the environment. Dust drift field experiments will be done to evaluate the effect of machine, seed treatment quality and environmental conditions on dust drift and to validate the CFD dust drift emission model.

Devarrewaere W, Foqué D, Nuyttens D, Verboven P. (2014). Modelling dust distribution from static pneumatic sowing machines. Aspects of Applied Biology 121, International Advances in Pesticide 122: 95-102.

Foqué D., Devarrewaere W., Verboven P., Nuyttens D. (2014). Physical and chemical characteristics of abraded seed coating particles. Aspects of Applied Biology 121, Int. Adv. Pesticide Appl., 22, 85-94.

Nuyttens D, Devarrewaere W, Verboven P, Foqué D. 2013. Pesticide-laden dust emission and drift from treated seeds during seed drilling: a review. Pest Management Science 69:564-575.

FACILE METHODS TO IMPROVE JSC-1A LUNAR DUST SIMULANT

Francesca S. Freyria, Barbara Bonelli

Department of Applied Science and Technology and INSTM Unit of Torino-Politecnico, Corso Duca degli Abruzzi 24, Politecnico di Torino, I-10129 Turin (Italy)

The Moon is the closest planetary body to Earth without atmosphere, where direct geological soil was sampled and where new manned space missions will be planned in the perspective to use the Moon as a test bed for Mars or other airless planetary bodies, as well as to test remote sensing instrumentations. The Moon's surface, such as all airless planetary bodies, is covered by a thick blanket of regolith, a heterogeneous and disaggregate material, which is the result of space weathering processes and micrometeorites/meteorite bombardments. Lunar soil is extremely powdery with considerably respirable fraction (< 10 μm) and contains glass bonded aggregates, called agglutinates, with embedded plentiful metallic nanoscale iron particles. The latter characteristics confer special properties on lunar dust, *e.g.* electrostatic and magnetic features and high reactive surface, which can create enormous difficulties both to the space ship and mechanical/electrical devices and to the crew, by generating cardiovascular and respiratory systems diseases. Therefore, further studies are still necessary for developing technologies to support future human habitat on lunar surface. NASA and Orbitec developed JSC-1A lunar dust simulant for these purposes. With respect to actual lunar dust, however, JSC-1A lacks both the finest particles (< 1 μm) and the agglutinic glasses fractions. In order to overcome these limitations, we modified the as-received JSC-1A according to: i) improve the amount of the finest fraction by ball milling processes and ii) introduce an agglutinic fraction synthesized by sol-gel method.

JSC-1A particles morphology before and after implementation was studied by either Optical or Electronic (FESEM and TEM) microscope investigations, which reported the presence of big grains and a heterogeneous particles size distribution (PSD), also confirmed by Static Light Scattering (SLS) and Acoustic Spectroscopy with Zeta Potential (ζ) analysis. The X-Ray Diffraction (XRD) and EDS microanalysis were applied for the mineral characterization. To improve the amount of finest fraction, a two steps ball milling process was carried out on as-received JSC-1A powder, sieved 100 mesh. The ball-milled powder reached nanoscale dimensions (~0.3 μm) and a specific surface area of 14 m^2g^{-1}, almost ten times higher than that of pristine simulant. Nanoscale iron particles embedded in an agglutinitic matrix were synthesized by a sol-gel method performed in two separate steps.

Such a procedure allows accurately controlling the iron amount into glassy matrix, the crystallinity of iron particles and the specific surface area of the powder, in order to better and easier mimic the actual lunar dust.

Belluco M, Destefanis R, Bonelli B, Maggiore P, Manis E, Freyria FS, Cazzolato C, Costa S, Derosa L (2011) Human Exploration of the Moon: Multi-stage lunar Dust Removal System. 41st International Conference on Environmental Systems. American Institute of Aeronautics and Astronautics

AIRBORNE MEASUREMENTS OF MINERAL DUST ABUNDANCE, MIXING STATE, AND ICE NUCLEATING PROPERTIES

Karl D. Froyd[1,2]*, Daniel J. Cziczo[3], Daniel M. Murphy[1]

[1]*NOAA Earth System Research Laboratory, Boulder, CO, USA*
[2]*University of Colorado, Boulder, CO, USA*
[3]*Massachusetts Institute of Technology, Cambridge, MA, USA*
**Karl.Froyd@noaa.gov*

Airborne mineral dust aerosol can interact with the global climate system by altering atmospheric radiative balance through direct absorption and scattering and also by acting as heterogeneous ice nuclei (IN) for cirrus cloud formation. We present a summary of single-particle measurements in the free troposphere from more than 10 years of airborne field campaigns, highlighting the geographic and vertical distributions of mineral dust, source attribution, and dust's role in cirrus formation.

Clear sky aerosol measurements from 7 flight campaigns show that mineral dust is ubiquitous in the background upper troposphere at levels from ~1 to 1000's per liter and typically accounted for 5-40% of the particulate mass. Principal sources of upper tropospheric mineral dust include strong biomass burning events and deep convection, although some evidence suggests that dust particles are preferentially scavenged in convective systems. During transport mineral dust particles accumulate secondary sulfate, nitrate, and organic material that can reduce their efficiency as heterogeneous IN. Most upper tropospheric dust particles contain secondary material, and coating type and thickness depend on co-emissions and the vertical transport mechanism.

Composition, size, and phase are key properties that define the ability of an aerosol particle to initiate ice in cirrus clouds. Properties of cirrus IN have not been well constrained due to a lack of systematic measurements in the upper troposphere. In a recent study of several northern hemisphere regions (Cziczo et al., Science 2013) we report the size and composition of sublimated cirrus particles sampled from a high altitude research aircraft using both in situ and offline techniques. Mineral dust is consistently the most abundant particle type in cirrus residuals, suggesting that heterogeneous nucleation is a dominant cirrus formation mechanism in these study regions. Other proposed heterogeneous IN, including biomass burning particles, elemental carbon, and biological material, are not abundant in cirrus residuals.

Cziczo D.J., Froyd K.D., Hoose C., Jensen E.J., Diao M., Zondlo M.A., Smith J.B., Twohy C.H., Murphy D.M. (2013). Clarifying the Dominant Sources and Mechanisms of Cirrus Cloud Formation. Science, 1320-1324.

FLOATING-DUST WEATHER IN NORTH CHINA AND THE ATMOSPHERIC CIRCULATION CHARACTERS

Tao Gao

Inner Mongolia Meteorological Institute, Hohhot 010051, China
**Frautao@yahoo.com*

Temporal and spatial variations of floating-dust weather occurred in North China have been investigated by using the observed records at 65 stations for the period from 1954 to 2007. The frequency of the floating-dust weather events displays a declining trend in the past 54 years, though differences exist among the decadal mean frequencies. The most frequent period was the springs of 1954-1960 with a value of 17.7 events. In comparison, the decade of 1990s has the lowest frequency with 4.4 occurrences. In addition, a slight increase appeared during 2001-2007. The decadal mean spatial distributions indicate dissimilar characters for annual, spring and winter floating-dust frequencies. On the whole, severe floating-dust attacked areas include the mid-western region of Inner Mongolia, Gansu, Ningxia and northern part of Shaanxi Province from 1950s to 1970s. During the 1980s, 1990s and 2000s, comparatively, the influenced areas were relative small. The floating-dust weather still happened in the wintertime, but the frequency is clearly lower than that of the springtime. Further investigations in the floating-dust dynamic power have been conducted for the period of 1971-2007. The dynamic power is presented by the gales with a velocity equals to or above 12 ms-1 at the same 65 stations. A significant correlation with a coefficient of 0.85 (at 0.01 significant levels) exists between the series of the floating-dusts and the gale events. The frequency of the gale is controlled by the dissimilar patterns of the atmospheric circulations in different years. About half of the gales directly correlate to the floating-dust weathers in northern China. Analyses indicate that the frequency of the gale is closely connected to the major atmospheric circulation components over the Eurasian continent. There is 10 and 9 frequent and infrequent gale springs have been identified among the 37 years in regarding of their frequencies above or equals to 30 and below or equals to 10. Mean weather charts at 500 hPa and the sea level pressure were conducted for both the frequent and infrequent gale groups. For the frequent gale group, the subtropical high over the western Pacific and the North America-Atlantic is weak and small. The north polar vortex is strong and expanding. The geopotential height over the Xizang Plateau accompanied by a weak India-Burma trough is lower than normal. This kind of the atmospheric circulation system composition is helpful for the gales therefore favorable for developing floating-dust weathers. On the contrary, the atmospheric circulation presents an opposite pattern for the infrequent gale group which corresponds to the infrequent floating-dust events.

RESPONSES OF PHYTOPLANKTON TO ASIAN DUST DEPOSITION IN CHINA COASTAL SEAS

Huiwang Gao[1]*, Ying Liu[1], Saichun Tan[2], Jinhui Shi[1], Xiaohong Yao[1]

[1]*Key Laboratory of Marine Environment and Ecology, Ministry of Education of China, Ocean University of China, Qingdao, 266100, China*
[2]*State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, 100029, China.*
**hwgao@ouc.edu.cn*

Dust deposition has been considered an important source of bio-available nutrients such as N, P, Si and trace metals to phytoplankton. In this study, the intrusion of Asian dust into the downwind seas, including the China seas, the Sea of Japan, the subarctic North Pacific, has been shown to enhance their biological activities. To explore the relationship between the transported dust from various sources to the oceanic biological activities with different nutrient conditions, the correlation between monthly chlorophyll a concentration and monthly dust storm occurrence frequencies during 1997-2007 was examined. Here we also report a phytoplankton bloom that developed in the Yellow Sea in the spring of 2007 following a dust storm accompanied by precipitation. Our data indicate that atmospheric deposition dominated the supply of new nutrients to the surface water in the central Yellow Sea during the dust event. Dust-derived nitrogen (N) supply was sufficient to support the observed phytoplankton growth, while, dust-derived iron (Fe) supply far exceeded that required by the biota. At last, on-board incubation experiments were performed in the Southern Yellow Sea in the spring of 2011 and summer of 2013 respectively, to explore the responses of micro-, nano- and pico-phytoplankton to various combinations of Asian dust and nutrients.

ASPECTS OF BIOLOGICAL CONTAMINATION IN EQUIPMENT OF AUTOMOTIVE AIR IN BRAZIL

Odanir Garcia Guerra, Sonia Regina Jurado*,
Matheus Henrique Reis da Silva, Antônia Dalla Pria Bankoff

Federal University of Mato Grosso do Sul, Três Lagoas, 79620-080, Brazil
**srjurado@bol.com.br*

Air quality plays an important role in occupational and environmental medicine and many airborne factor negatively influence human health[1,2]. Circulation or air conditioning (AC) system was proven to improve the air quality inside the vehicles; however, its impact on the number of particles and microorganisms inside the vehicle - and by this its impact on the risk of an allergic reaction - is yet unknown[3]. Aim of the present study was to evaluate bacteria and fungi present in the air-conditioned car filter. The quality of air was investigated in twenty-two cars of different brands that were all equipped with an automatic air conditioning system. Based on the recommendation of the American Public Health Association - APHA - held the collection of material in a square centimeter of the surface of each of the 22 filters of equipment automotive air conditioning. The material was collected using sterile swabs containing transport medium "Stuart". In this research, fungal and bacteria genera were studied. Differentiation of fungi and bacteria was performed in the Federal University of Mato Grosso do Sul, Brazil. The genera of bacteria found in the cars were: *Staphylococcus* spp, *Streptococcus* spp, *Bacillus* spp, *Escherichia* spp, *Enterobacter* spp, *Klebsiella* spp, *Proteus* spp, *Legionella* spp. The bacteria identified more frequently were *Bacillus* (100%, n = 22), *Staphylococcus* (95%, n = 21) and *Proteus* (95%, n = 21). The presence of Legionella indicates poor air quality inside cars. This bacterium was found in 82% of cars (n = 18). Our study identified several types of fungi, which are considered contaminants from the usual internal and external environment, such as *Penicillium*, *Aspergillus*, *Cladosporium*, *Rhodotorulla*, *Candida* and other yeasts or filamentous fungi. The most common fungi were *Aspergillus*, *Penicillium* and *Candida*, present in 95% of samples. Only two cars had a good air quality because their owners realized the cleaning of air conditioning and filter change a week before the survey. Nevertheless, we recommend regular maintenance of the system and replacement of older filters after defined changing intervals aiming to reduce allergic reactions by users of vehicles with air conditioning.

1. Müller D., Klingelhöfer D., Uibel S., Groneberg D.A. (2011). Car indoor air pollution - analysis of potential sources. Journal of Occupational Medicine and Toxicology, vol. 6, p. 33-38.
2. Groneberg D.A, Fischer A. (2006). Occupational medicine and toxicology. Journal of Occupational Medicine and Toxicology, vol. 1, p. 1-2.
3. Vonberg R.P.P., Gastmeier P., Kenneweg B., Holdack-Janssen H., Sohr D., Chaberny I.F. (2010). The microbiological quality of air improves using air conditioning systems in cars. BMC Infectious Diseases, vol. 10, p. 146-151.

COLLECTION OF SUBSTANTIAL AMOUNT OF FINE AND ULTRAFINE PARTICLES DURING THE COMBUSTION OF MISCANTHUS AND FOREST RESIDUES IN SMALL AND MEDIUM SCALE BOILERS FOR MORPHOLOGICAL AND CHEMICAL CHARACTERIZATIONS

Garra Patxi[1,2]*, Leyssens Gontrand[1], Schönnenbeck Cornelius[1], Kohler Sophie[2], Trouve Gwenaelle[1], Dieterlen Alain[2]

[1]*GRE Laboratory, Mulhouse, 68200, France*
[2]*MIPS Laboratory, Mulhouse, 68200, France*
**patxi.garra@uha.fr*

Renewable energies are destined to play a very important role in the future world energy balance. Among these energies, biomass production and utilization is growing considerably since it offers the possibility to provide partial substitution of fossil fuels. If health impacts of fines particles (PM2.5) from diesel combustion are well documented (Gangwar et al., 2012), those from biomass combustion need substantial information and improvements. Size fractionations of PM2.5 have to be performed in order to both determine morphological and chemical characteristics, these properties being essential for biological effects.
Particulate matter was sampled during combustion of Miscanthus and Forest residues in medium and small scale biomass boilers (400 kW from Köb Pyrot and 40 kW from REKA). Fly ashes from medium scale boiler were sampled with a cyclone device and their granulometry was studied with both white light microscope and Malvern laser granulometer. PM2.5 (sized in the range of 0.4 µm to 2.07 µm) from low scale boiler were sampled using a DEKATI DGI impactor modified for substantial PM collection. A quick overview of setup modifications for manual impactor will be developed. Particles were observed using fluorescence microscopy. A semi-quantitative method to compare fly ashes fluorescence was developed using ImageJ (Schneider et al., 2012). Speciation of organic compounds Polycyclic Aromatic Hydrocarbon (PAH) and Humic Like Substances (HULIS) was determined on PM2.5 and fly ashes. A correlation between observed fluorescence and concentration was attempted.

Gangwar, J.N., Gupta, T., Agarwal, A.K., (2012). Composition and comparative toxicity of particulate matter emitted from a diesel and biodiesel fuelled CRDI engine. Atmos. Environ. 46, 472-481.
Schneider, C.A., Rasband, W.S., Eliceiri, K.W., (2012). NIH Image to ImageJ: 25 years of image analysis. Nat. Methods 9, 671-675.

FLUORESCENCE MICROSCOPY ANALYSIS OF DUST FROM BIOMASS BURNING

Patxi Garra[1,2]*, C. Maschowski[3], A. Dieterlen[2], G. Leyssens[1], C. Schönnenbeck[1], S. Kohler[2], G. Trouve[1], R. Giere[3]

[1]*GRE Laboratory-UHA, Mulhouse, 68200, France*
[2]*MIPS Laboratory-UHA, Mulhouse, 68200, France*
[3]*Institut für Geo- und Umweltnaturwissenschaften (GEO), Freiburg, 79104, Deutschland*
**patxi.garra@uha.fr*

During the last century, there has been a growing interest for renewable energy. Biomass combustion is a possible way to deal with fossil fuel scarcity and to reduce CO_2 emissions, but some pollutants (e.g., dust) are emitted nevertheless. New efficient approaches of dust characterization have to be developed in order to know better the impacts of dust on global environment and health. Fluorescence microscopy is a fast and relatively cheap method that could, if related to chemical content or toxicological data, characterize dust.

In a first attempt, fluorescence spectroscopy was applied to two dust samples, which were collected in a multicyclone and resulted from combustion of miscanthus (an energy crop) and wood chips. The collected particles were mounted between a standard slide and a coverslip. On a confocal microscope equipped for fluorescence spectroscopy, 32 images are acquired on the same field of observation corresponding to different fluorescent emission wavelengths (excitation at 405 nm; emission from 413.9 nm to 689.8 nm with steps of 8.9 nm). The ImageJ software was used to analyze single-particle and whole-sample fluorescence spectra. These plots are related to fluorescence of some components of dust, as found in the literature (Carletti et al., 2010).

These results allow the choice of the set of filters and then wide-field fluorescence microscopy can be useful to characterize dust. On the same field of observation, white light collected and processed images allowed us to define the equivalent surface of particles. Meanwhile, on fluorescence images the surface and the fluorescence intensity were quantified. Both the percentages and densities of fluorescence (per particle surface) were measured. To ensure dust sample representativeness many fields per sample were collected.

Subsequently, twelve different samples resulting from biomass combustion were investigated using this protocol. The dust samples were collected either with flue gas treatment devices (Multicyclone, Bag House filter, Electrostatic Precipitator) or with a DEKATI DGI impactor ($PM_{2.5}$). The biomass boilers had the following nominal outputs: 40 kW, 400 kW, 3.8 MW, 8MW, 17.3 MW. They combusted wood chip mixtures and miscanthus. In order to make sense of this information on fluorescence, it will be attempted to correlate the measurements to chemical components of dust: PolyAromatic Hydrocarbons (PAH), Humic-Like Substances (HULIS), non-combusted matter, and fluorescent minerals.

Carletti, P., Roldán, M.L., Francioso, O., Nardi, S., Sanchez-Cortes, S., 2010. Structural characterization of humic-like substances with conventional and surface-enhanced spectroscopic techniques. J. Mol. Struct. 982, 169-175.

MAJOR CHANGES IN EAST ASIAN CLIMATE IN THE MID-PLIOCENE: TRIGGERED BY THE UPLIFT OF THE TIBETAN PLATEAU OR GLOBAL COOLING?

Junyi Ge[1,2], Ying Dai[1,3], Zhongshi Zhang[4,5,6], Deai Zhao[1], Qin Li[1], Yan Zhang[1], Liang Yi[7], Haibin Wu[1], Frank Oldfield[8], Zhengtang Guo[1]

[1]*Key Laboratory of Vertebrate Evolution and Human Origins of the Chinese Academy of Sciences, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing 100044, China*
[2]*Key Laboratory of Cenozoic Geology and Environment, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, 100029, China*
[3]*Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing, 100101, China*
[4]*Bjerknes Centre for Climate Research, Allegaten 55, 5007, Bergen, Norway*
[5]*UNI Research, Allegaten 55, 5007, Bergen, Norway*
[6]*Nansen-Zhu International Research Center, Institute of Atmospheric Physics, Chinese Academyof Sciences, 100029, Beijing, China*
[7]*State Key Laboratory of Lithospheric Evolution, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, 100029, China*
[8]*School of Environmental Sciences, University of Liverpool, Liverpool, L69 7ZT, UK*

Since the mid-Pliocene, East Asian climates have experienced significant changes, including the significant intensification of Asian interior aridity and strengthening of the East Asian monsoon circulation at ~3.6 Ma ago. Meanwhile, the mid-Pliocene was also considered to be a period with strong tectonic activity over the Tibetan Plateau. One view suggests that significant uplift of the Tibetan Plateau during this period could have been responsible for these dramatic changes in the strength of the East Asian monsoon and for Asian interior aridification, while some other authors attribute these changes to the ongoing global cooling and rapid growth of the Arctic ice-sheet. Up to the present, which factor dominates the major changes of East Asian climate in the mid-Pliocene is still a contentious issue.

This study presents an analysis of several climate proxies including grain-size, $(CaO^{*}+Na_2O+MgO)/TiO_2$ ratio, Na/K ratio and dust accumulation rates of the Xifeng Red Clay sequence in the eastern Chinese Loess Plateau and the Xihe Pliocene loess-soil sequence in West Qinling. They reveal that aridity in the continental interior and winter monsoon circulation both intensified, whereas the East Asian summer monsoon showed a weakening rather than intensifying trend since the mid-Pliocene. These changes are also supported by the other multi-proxy records from various regions in East Asia.

Previous numerical modeling studies have demonstrated that uplift of the Tibetan Plateau would have simultaneously enhanced continental-scale summer and winter monsoon strength as well as central Asian aridity. The mid-Pliocene climate changes in East Asia are therefore unlikely to be a response to Plateau uplift. On the contrary, our recent modeling results give support to the view that ongoing cooling could have intensified both the aridity of the interior and the strength of the winter monsoon, but weakened the summer monsoon in East Asia.

EFFECT OF COMBUSTION PRESSURE ON SOOT AEROSOL FORMATION AND CHARACTERISTICS

Sanaz Ghasemi, Daniel D. Cormier, Ahmet E. Karatas, Ömer L. Gülder*

Institute for Aerospace Studies University of Toronto, Toronto, Ontario M3H 5T6, Canada
**ogulder@utias.utoronto.ca*

A significant portion of soot aerosols in the atmosphere is emitted from engines used in land, air and sea transportation. Soot particles released to atmosphere not only pollute the environment and cause a number of health problems, but also alter the thermal balance of the planet. In fact, soot particle deposition on polar regions and suspension in the atmosphere may be one of the leading causes of the anthropogenic global warming, its effect estimated to be second only to that of carbon dioxide.

Most combustion based energy conversion systems in transportation devices operate at high pressure conditions due to size constraints and thermal efficiency considerations. Although research has shown that soot formation is greatly influenced by the operating pressure, there is a lack of reliable combustion and soot models that are aimed for practical applications. It is therefore of interest to understand the effects of pressure on soot formation and destruction pathways. Our current understanding of pressure influence on soot inception, growth, and oxidation is limited, and tractable measurements of flames at elevated pressures are desirable for a better understanding.

In this work we investigated the influence of combustion pressure on soot production and size in fossil fuel flames under tractable conditions. Experiments were conducted in co-flow laminar diffusion flames of various fuels in a high-pressure combustion chamber. Soot concentrations and temperatures were determined from measuring spectrally resolved radiation emitted by soot particles. Soot primary particle sizes were measured by laser-induced incandescence. Our findings indicate that soot production rate shows a very strong sensitivity to pressure at relatively lower pressures, but this dependence on pressure disappears around 40-50 atm. The size of the soot primary particles increases with increasing pressure. The dependence of pressure sensitivity of soot formation to fuel type will be discussed in the light of obtained results.

DEVELOPMENT OF A DUST FORECAST SYSTEM FOR THE ARABIAN PENINSULA

Ayman Ghulam[1]*, Yongxin Zhang[2], Linlin Pan[2], Wanli Wu[2], Yubao Liu[2], Paul A. Kucera[2]

[1]*Presidency of Meteorology and Environment, Jeddah, Saudi Arabia*
[2]*National Center for Atmospheric Research, Boulder, Colorado, USA*
**ghulamas@yahoo.com*

The Arabian Peninsula is the second largest dust source in the world only after the Sahara Desert (Tegen and Fung, 1994; Ginoux et al., 2001; Prospero et al., 2002; Tanaka and Chiba, 2006; De Longueville et al., 2010). Every year dust storms affect various parts of the Arabian Peninsula with destructive effects in air quality and human health. In Saudi Arabia, dust storms are considered to be one of the most severe environmental problems (Pease et al., 1998; Alharbi, 2009; Badarinath et al., 2010). Immediate impacts of dust storms include: (a) reduction of visibility, (b) degradation of air quality, (c) increase in respiratory illness in people and livestock, (d) reduction of solar radiation and the efficiency of solar devices, (e) reduction of soil fertility, (f) damage to telecommunication and mechanical systems, (g) widespread dust deposition, and (h) damage to buildings, vehicles, and trees. Dust aerosols also play an important role in radiation budget by scattering and absorbing solar and terrestrial radiation and interacting with clouds, thereby impacting weather and climate at local and regional scales.

The Presidency of Meteorology and Environment (PME) in Saudi Arabia in collaboration with the National Center for Atmospheric Research (NCAR) has developed a high resolution dust prediction system with the goal of providing improved early warning forecasts in an effort to reduce the risk of these dangerous conditions. The dust prediction system is based on the Weather Research and Forecasting - Chemistry (WRF-Chem) modeling system. WRF-Chem is a fully coupled chemistry - forecast system based on the WRF model (Grell et al., 2005). WRF-Chem has been successfully used for a variety of research and applications for the prediction of weather, climate, air quality, dispersion of pollutants, and the prediction of dust.

The dust forecast system has been integrated into the operational WRF-data assimilation forecast system at PME. The model has been evaluated for several significant dust storm events. The evaluation of the case studies have demonstrated that WRF-Chem model is capable of simulating dust storms events in the region. The system will be useful for providing dust forecast guidance for PME operational forecasting activities. This presentation will provide an overview of the dust forecast system, highlight results from the case study analysis, and summarize future dust forecast development in Saudi Arabia.

DUST MONITORING ON LONGWALL MINING FACES

STEWART GILLIES[1]*, ALPER GONEN[2], HSIN WEI WU[3]

[1]*Missouri University of Science and Technology Mining Engineering, Rolla, 65409, USA*
[2]*Dokuz Eylul University Mining Engineering Department, Izmir, 35390, Turkey*
[3]*Gillies Wu Mining Technology Pty Ltd, Queensland, 4068, Australia*
**gilliesst@mst.edu*

Respirable dust is a continuing problem in the mine environment where it adversely affects the safety and productivity of a mine. Control of respirable dust is an important consideration in the design of the production cycle of an underground coalmine. When identifying and attempting to control a longwall dust sources four primary sources of dust generation are of importance. Dust is generated from intake airways, coal transportation and the stage loader, the shearer during the cutting, and movement of supports.

Although in most instances the shearer is the major primary dust source, secondary sources and in particular the stage loader and support movement also contribute a significant proportion of the total respirable dust. Additionally, in Longwall Top Coal Caving (LTCC), face ventilation requirements needed for dilution of dust will be more onerous especially along the rear Armored Face Conveyor (AFC). Under LTCC the face has two production locations (the shearer and the current caving draw point behind the supports) and there are at least two zones of potentially major dust production. Unless the two processes are separated (i.e. shear first, then stop shearing and draw the caved coal for the full length of the face), some personnel will be forced to work in dusty conditions at various location for considerable periods. With continued application of various dust control methods, respirable dust levels can be maintained at acceptable limits.

The personal dust monitor (PDM) gives realtime respirable dust readings. It is mounted within the miner's cap lamp battery and internally measures the true particle mass of dust collected on the units filter. This technique achieves microgram-level mass resolution and reports dust loading data on a continuous basis even in the hostile mine environment. It has particular application for determining high source locations and efficiency of engineering means of suppression and other approaches to handling the problem.

A MULTIVARIATE STATISTICAL PROCEDURE FOR INVESTIGATING RELATIONSCHIPS BETWEEN PM10 LEVELS AND OBSTRUCTIVE SLEEP APNEA SYNDROME IN AN URBAN AREA

Giuseppina Anna Giorgio[1]*, Mariagrazia D'Emilio[2], Flaminio Mormile[3], Maria Ragosta[1], Ivano Salimbene[3]

[1]*Engineering School, University of Basilicata, Potenza, 85100, Italy*
[2]*Institute of Methodologies for Environmental Analysis, IMAA-CNR, Tito Scalo (PZ),85050, Italy*
[3]*Dept. Pulmonary Medicine, A. Gemelli University Polyclinic, Rome, 00168, Italy*
**giusygiorgio_a@libero.it*

The linkage between high atmospheric particulate matter (PM) concentrations and respiratory and cardiovascular diseases is extensively studied from an epidemiological point of view. In particular, respiratory diseases appear to be increasing worldwide, affecting in particular subjects living in urban areas. Respirable particulate matter could induce adverse effects on airways both directly, causing inflammation and airway hyperresponsiveness, and indirectly, acting as a carrier of other pollutants or allergens. These characteristics could contribute to explain the increase of cases of sensitization to pollen allergens in urban areas. [1-3].
Here we present the application of a multivariate statistical procedure aimed to investigating the relationships between outdoor concentrations of PM10 and occurrence of a particular respiratory disease: the Obstructive Sleep Apnea Syndrome (OSAS). Our database includes daily atmospheric concentrations of PM10 measured in eleven sampling stations displaced in Rome urban area from 2008 to 2011 (ArpaLazio data) and the results of the diagnostic test called PolySomnoGraphy (PSG) performed on about 400 patients by Department of Pulmonary Medicine of Gemelli University Polyclinic in Rome. We applied a multivariate procedure based on cluster analysis and PCA [4] in order to put in evidence the correlation structure of our database. For performing our analysis we also took into account qualitative variables related to risk factors.

1. Karanasiou A., Moreno N., Moreno T., Viana M., de Leeuw F., Querol X. (2012). *Health effects from Sahara dust episodes in Europe: literature review and research gap.* Environment International 47, 107-114.
2. Ostro B., Tobias A., Querol X., Alastuey A., Amato F., Pey J., Pérez N., Sunyer J. (2011). *The effects of particulate matter sources on daily mortality: a case-crossover study of Barcelona, Spain* Environmental Health Perspectives 119, 1781-1787 (2011)
3. D'Amato G., Baena-Cagnani C. E., Cecchi L., Annesi-Maesano I., Nunes C., Ansotegui I., D'Amato M., Liccardi G., Sofia M., Canonica W. G. (2013). *Climate change, air pollution and extreme events leading to increasing prevalence of allergic respiratory diseases* Multidisciplinary Respiratory Medicine, doi:10.1186/2049-6958-8-12.
4. Ragosta M., Di Leo S. (2011). *Multivariate indices for analysing correlation structures in environmental datasets.* Proceeding of 58th World Statistics Congress of the International Statistical Institute (ISI), Dublin, Ireland, CPS008:2-01.

ON THE METEOR MECHANISM OF THE ATMOSPHERIC DUST GENERATION

Oleksandr Girin

Odessa National MaritimeUniversity, Odessa, 65074, Ukraine, club21@ukr.net

The ablation of the space bodies due to their breaking up onto a large number of the tiny particles is one of the mechanisms of a dust generation in the high atmosphere. These particles may have noticeable impact on a high atmosphere state. The similarity of hydrodynamic conditions of a meteoroid fusion film in a flow past meteor body to the conditions of a liquid drop breakup in a high-speed gas stream was shown in [1]. Namely, values of the main breakup necessary criteria - Weber number, criterion of gradient instability existence and the parameter, which identifies the gradient instability mechanism, are close for meteoroid and drop. The hydrodynamic instability of a fusion film in a high-speed air stream past meteoroid was considered in [2] as the mechanism of liquid quasi-continuous dispersion, and the estimations of particle sizes and their separation frequency were obtained. However, the finding of spatial and temporal distribution of torn-off particles by sizes, the law of mass reduction and the deceleration law wasn't carried out. The results obtained in [2] are valid for the case of overtaking ablation, when the rate of meteoroid melting is not greater than its mass loss rate, and the wavelength of dominant unstable disturbance is limited by the fusion film thickness. In the opposite case of the overtaking melting the fusion film is much thicker than the liquid boundary layer, which is involved in the motion by the air viscous stresses of the flow past meteoroid body, and the instability mechanism becomes altered. The problem of the dispersion parameters determination is reduced then to the study of hydrodynamic stability of gradient flow in the conjugated gas-liquid boundary layers.
In the present paper the mechanism of dust generation in the upper atmosphere (but still within the frames of continuous fluid mechanics) is considered as that, caused by the quasi-continuous dispersion of the meteoroid unstable fusion film in the case of overtaking melting. For the flight conditions along a slightly sloping trajectory the differential equation of the ablation is derived. The system of the equations of ablation and the ablating meteoroid motion are integrated in the approximation of a spherical meteor body. The law of the ablating meteoroid motion and the law of its mass loss are found, as well as the full breakup time.
In the present paper the differential equation of the quantity of torn-off particles is derived. The distribution function of torn-off particles by sizes is found analytically on the basis of approximate solution, as well as the formula for total particle amount. The intermediate and final distributions of torn-off particles by sizes are calculated in accordance with the obtained formulas for various values of determinant parameters. Some general features of the dispersion kinetics are described.
The obtained relations allow elaborating mathematical model of the meteor spray.

1. Girin A.G. (1990). Drop shattering in a high-speed gas flow. *Jour. Eng. Phys. & Thermoph*., v.58, p. 518.
2. Girin A.G., Kopyt N. Kh (1994). Generation of fine aerosol as a dispersion of unstable fusion film of ablating meteoroid. *Jour. Aerosol Sci*. v. 25, № 7, pp. 1353-1357.

INSTABILITY OF AN ACCELERATING AEROSOL SURFACE

Aleksandr Girin

Odessa National Maritime University, Odessa, 65074, Ukraine - club21@ukr.net

The problem sometimes arises in motions of dispersed mixtures, which is connected with a character of their interaction with an outer homogeneous medium when the conditions exist for development of hydrodynamic instability at the surface of separation. This mechanism is in work in the process of explosion powder dispersing; it can influence the dust motion in atmosphere leading up to the dynamic aerosol coagulation. Such problems in practice call forth the necessity to investigate the general properties of governing equations of two-phase media motion. In order to determine the heterogeneity influence on the flow it is insufficient to use the models of homogeneous fluid mechanics and two-phase models are required.

Linear instability problem is solved in present paper for the case when the plane accelerating surface separates two-phase monodisperse suspension of solid particles and homogeneous incompressible fluid. It is found that the system of equations of two-phase medium motion has three types of disturbances, in contrary to the homogeneous medium: 1) two acoustic ones, for which the volume densities of phases are unchangeable and the disturbed motion remains non-vortex. The character of these disturbances in two-phase medium is the same as in the homogeneous one, in particular, when the volume density of discreet phase tends to zero they turn into acoustic disturbances for incompressible fluid; 2) disturbances of the entropy-vorticity type, when the disturbances of vortex and entropy are non-zero. By solving the dispersion relation of the boundary-value problem for disturbances, the existence of the aperiodic unstable root was found which is inherent to behavior of the accelerating heterogeneous medium since it disappears when the dispersive phase density disappears. This root simultaneously exists with classic Rayleigh-Taylor root. The found type of instability is caused by the inertial force since it disappears when the acceleration vanishes. Action of the interphase friction is the natural stabilizing mechanism since when the carrying phase viscosity increases, the root disappears too. When the surface tension is absent, the ratio of the amplitude growth for two mentioned roots is determined by the criterion, which includes the carrying phase kinematic viscosity, particle size, wavenumber and ratio of the true densities of phases. When the particle size (or acceleration) decreases, or wavelength (or viscosity) increases, the action of the classic Rayleigh-Taylor instability mechanism becomes dominant. When the parameters change in the opposite direction, the ratio of increments of the two roots goes to the finite limit.

For the found mechanism the increment of the fastest unstable wave amplitude growth tends to infinity as wavelength tends to zero. Naturally, the disturbance wavelength must be limited from below by such values, at which it becomes comparable with the particle size a, when the equations of two-phase fluid motion become invalid. Thus, such values of wavenumber h may be adopted, for which $ha<0.1$. The estimations show that the value of the characteristic time of e-fold amplitude growth for the fastest unstable wave is sufficient for the realization of the found instability mechanism.

WOOD COMBUSTION IMPACT ON WINTER LOCAL AIR QUALITY AT AN INDUSTRIAL/SEMI-RURAL SITE NEAR THE TOWN OF BRINDISI (ITALY)

Roberto Giua*, Angela Morabito, Annalisa Tanzarella, Alessandra Nocioni, Giorgio Assennato

Regional Environmental Protection Agency, Bari, Italy
**r.giua@arpa.puglia.it*

Forest fires, slash and burn agriculture and residential wood combustion have a significant impact on natural and man-made environments at local and global scales. Although rapid progress has reduced emissions in some types of modern wood heaters, "older" conventional wood stoves and fireplace inserts are still the predominant appliance in use today. Wood combustion affects winter local air quality owing to the emissions of a wide variety of air pollutants such as fine particles, volatile organic compounds and carbon monoxide. The present work aims at showing that biomass combustion emissions, due to agricultural activities and residential heating by fireplaces, are the main cause for high daily PM10 and monthly BaP concentrations, measured during the wintertime by the regional air quality monitoring station placed at Torchiarolo, a small agricultural town located close to a large coal energy plant (2640Mwe). PM10, monoxide carbon, nitrogen oxides, PAH and benzene concentrations, measured at Torchiarolo, show a strong seasonal trend with much higher values during winter months, when the meteorological conditions are characterized by weak winds with directions downwind to the town. The monitoring campaigns, carried out by a wind select sampler, show during winter a marked directionality from the town also for organic micropollutants (PCDD, PCDF, PCB and PAH), pointing out that the pollution source is mainly local.

In order to identify wood combustion as the most important pollution source, we determined concentrations of levoglucosan, which is known as a specific tracer for biomass burning, on daily PM10 samples collected at Torchiarolo (BR) and SM Cerrate (LE) monitoring stations. The average concentration of levoglucosan, measured at Torchiarolo, was an order of magnitude higher than at the SM Cerrate (background site). A detailed PM10 characterization conducted in two winter weeks of 2009 showed also high concentrations of K^+ and PAH, markers of combustion. A modeling study, carried out by a lagrangian model, evaluated as substantially negligible the contribution of primary PM10 emissions from the coal power plant.

Following the results of our study, the Regional Environmental Authority adopted an Air Quality Recovery Plan aimed at resolving the evidenced critical issues in the area of Torchiarolo and in the entire Province of Brindisi.

Regional Air Quality Recovery Plan, Apulia Regional Resolution n. 1093, 2013/06/11

PM_{10}, $PM_{2.5}$ ASSESSMENT AND PAH_S AND METALS CONTENT IN PM AT BRINDISI PORT AREA (ITALY) WITHIN THE CESAPO PROJECT

Roberto Giua[1]*, Alessandra Nocioni[1], Tiziano Pastore[1], Stefano Spagnolo[1], Daniele Contini[2]

[1]*ARPA Puglia, Environmental Protection Agency, Regional Air Quality Center, Bari, Italy*
[2]*Institute of Atmospheric Sciences and Climate, ISAC-CNR, Lecce, Italy*
**r.giua@arpa.puglia.it*

Recently the European Environment Agency reported the influence of maritime sector on air quality in European ports (EEA, 2013). According to recent scientific literature (Contini et al., 2011; Lee et al., 2013) and following EU projects related to the assessment of harbour activities effects on air pollution, especially in areas with the simultaneous presence of different emission sources (i.e. vehicle emissions, coal and/or industry combustion, crustal and sea-salt, etc.), the CESAPO Project (Interreg, Greece-Italy, 2007-2013), aimed at quantifying the impact of maritime activities in the ports of Patras (Greece) and Brindisi (Italy) on air quality, is presently in progress. As part of the Project, during the period July-October 2012, ARPA Puglia carried out a specific monitoring campaign in Brindisi port area, using dual-channel samplers/analyzers installed at the monitoring station named "Passenger Terminal". This station is part of a specific network aimed at monitoring air pollution connected to ship traffic inside port area, with respect to dusty materials transport. The analysis of daily samples, performed by ARPA Puglia laboratories, allowed to determine PM_{10} and $PM_{2.5}$ concentrations, metals and polycyclic aromatic hydrocarbons (PAHs) content and to identify, in some cases, the footprint related to source. This study contributed to the assessment of ship traffic and related port activities influence on the daily average concentrations of PM_{10} and $PM_{2.5}$, PAHs and metals in Brindisi port area. Regarding PM_{10} fraction, nickel concentrations were found higher than those measured in Brindisi and surroundings monitoring sites, probably owing to port and industrial activities close to the sampling site. The data showed, in general, a slight increase of PM values during summer period, in accordance with seasonal traffic increase; a similar behaviour was observed for Ni and selected PAHs (i.e BaP).

CESAPO. (2012-2014). www.cesapo.upatras.gr

D. Contini, A. Gambaro, F. Belosi, S. De Pieri, W.R.L. Cairns, A. Donateo, E. Zanotto, M. Citron. The direct influence of ship traffic on atmospheric PM2.5, PM10 and PAH in Venice. (2011). Journal of Environmental Management, 92, 2119-2129.

EEA (2013). The impact of international shipping on European air quality and climate forcing. Technical report No. 4/2013.

Lee S.C. et al. (2013). Contribution of ship emissions to the fine particulate in the community near an international port in Hong Kong. Atmospheric Research, 124, 61-72.

A MODELLING DISPERSION STUDY FOR INVESTIGATING THE IMPACT OF PM10 FUGITIVE EMISSIONS FROM THE MINERAL STOCKYARDS LOCALIZED AT A HIGH INDUSTRIALIZED AREA

Roberto Giua[1]*, Angela Morabito[1], Annalisa Tanzarella[1], Stefano Spagnolo[1], Monica Bevere[1], Tiziano Pastore[1], Ettore Valentini[1], Vito La Ghezza[1], Giorgio Assennato[1], Massimo Blonda[1], Giuseppe Brusasca[2], Gianni Tinarelli[2]

[1]*Regional Environmental Protection Agency, Bari, Italy*
[2]*ARIANET, Milano, Italy*
**r.giua@arpa.puglia.it*

In proximity to Taranto town, in Apulia, a south-eastern Region of Italy, a large industrial site is located, consisting of an integrated steel plant (one of the largest in Europe), with extended stockyards which cover an area of 311,505 m^2. During last years, several PM10 and Benzo(a)pyrene limit value exceedances were recorded at air monitoring sites located in the densely populated neighbourhood close to this industrial area. The analysis of these critical pollution events showed a close correlation with wind conditions, favourable to pollutants transport from the industrial site to the adjacent urban area. A criterion based on meteorological measurements was consequently defined for the daily identification of these events, named "wind days" (RAQRP, 2012). The aim of this study was to evaluate the contribution of dust emissions of primary materials stockyards, belonging to the steelwork, to the measured PM10 mean concentration for the 2007 year and during the "wind days", occurred in the same year. The modelling system included three models: the SWIFT meteorological model, the SURFPRO turbulence pre-processor and the SPRAY Lagrangian particles dispersion model (Tinarelli et al, 1999). SPRAY is a 3D model particularly suited to provide an accurate local distribution of atmospheric primary pollutants in non-homogeneus and non-stationary conditions. The simulation grid was centred on the industrial area with an horizontal spatial resolution of 500m x 500 m and 71 x 71 grid points. The meteorology in the studied area was reconstructed by SWIFT model from the tridimensional meteorological products supplied, for the year 2007, by the MINNI project (www.minni.org). Dust emissions, generated by the wind erosion of mineral deposits, were calculated hourly as a function of wind gusts magnitude on mineral storage piles (EPA, 1997). The results showed that PM10 emissions from the stockyards, belonging to the steelwork, significantly affect the air quality, mostly during the "wind days".

Regional Air Quality Recovery Plan, resolution of Apulia Region n. 1093, 2013/06/11

Tinarelli G., Anfossi D., Bider M., Ferrero E., Trini Castelli S. (1999) 'A new high performance version of the Lagrangian particle dispersion model SPRAY, some case studies', Air Pollution Modelling and its Applications XIII.

EPA, U. S. (1997). Compilation of air pollution emission factors, AP-42. Available at: www.epa.gov/ttnchie1/ap42.

THE EC-LIFE+ PROJECT DIAPASON TO DETECT AND ASSESS SAHARAN DUST CONTRIBUTION TO PM10 LOADS

Gian Paolo Gobbi[1]*, Francesca Barnaba[1], Francesca Costabile[1], Luca Di Liberto[1], Spartaco Ciampichetti[1], Roberto Sozzi[2], Andrea Bolignano[2], Matteo Morelli[2], Laurent Sauvage[3], Sophie Loaec[3]

[1]*Institute of Atmospheric Sciences & Climate, National Research Council, ISAC-CNR, Rome, 00133, Italy*
[2]*Latium Agency for Environmental Protection, ARPA-Lazio, Rieti, 02100, Italy*
[3]*Leosphere, Orsay, 91400, France*
**g.gobbi@isac.cnr.it*

In Southern Europe the transport of mineral dust from the nearby Sahara desert can significantly affect PM_{10} concentrations. Under the Directive 2008/50/EC, the European Commission (EC) has released specific Guidelines to quantify and subtract the contribution of Saharan dust to PM_{10}. The EC LIFE+2010 DIAPASON Project (Desert dust Impact on Air quality through model-Predictions and Advanced Sensors ObservatioNs), is a user-tailored project intended to explore possible improvements tothese Guidelines taking advantage of remote sensing devices. To this end, affordable Polarization Lidar-Ceilometers (PLCs) were prototyped within DIAPASON to certify the presence of dust plumes and thus evaluate their loading in the lowermost atmosphere. The Project is implemented in the Pilot Region of Rome (Central Italy) where 3 networked DIAPASON PLCs started in October 2013 a one-year, 24h/day monitoring of the altitude-resolved aerosol loads within the framework of standard air quality observations. The initial phase of the Project was also devoted to: 1) develop an effective, user-oriented tool to operatively implement the EC-Guidelines, and 2) investigate other potential improvements to the EC-Guidelines.

To the first purpose, DIAPASON implemented a software which allows an easy application of the EC-Guidelines by Air Quality Agencies. This tool, adaptable to any European site/region/area and freely available upon request, is since 2012 routinely used by ARPA-Lazio, the Italian Regional Agency in charge of air quality monitoring in the Rome and Lazio region, and is currently in a test phase by other Italian Regional Agencies (e.g., www.diapason-life.it).

To the second purpose, DIAPASON is exploring the advantage of overcoming the selection of a Regional Background site (RB), as prescribed by the EC-Guidelines to quantify the Saharan contribution to PM_{10}. In fact, in Italy PM_{10} monitoring sites purely representative of rural background conditions are often difficult to find and the choice of the RB was found to be critical. DIAPASON is therefore investigating the use of the out-of-dust record in each single PM_{10} monitoring site as a 'background reference' for the evaluation of the Saharan dust load at the same site (self-calibration method). To this goal intensive campaigns involving chemical analysis and detailed physical characterization of aerosol samples are carried out.

All these data will help finalizing the DIAPASON recommendations to improve/reinforce the performances of the current EC Guidelines. An overview of the project progress will be presented at the conference.

COMPARISON OF MEASUREMENT TECHNIQUES OF MICRO-PARTICLES IN POLAR SNOW AND ICE

Kumiko Goto-Azuma[1]*, Motohiro Hirabayashi[1], Takayuki Miyake[1], Hironobu Yamada[1], Anna Wegner[2], Yoshimi Ogawa[1], Hideaki Motoyama[1], Konosuke Sugiura[3], Hiroyuki Enomoto[1]

[1]*National Institute of Polar Research, Tokyo, 190-8518, Japan*
[2]*Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany*
[3]*University of Toyama, Toyama, 930-8555, Japan*
**kumiko@nipr.ac.jp*

Water-insoluble micro-particles in ice cores have been extensively analysed to investigate the past climatic and environmental changes. Temporal and spatial variations of size distribution and flux have been discussed in many papers. Definition of particle size, however, is not always straightforward. Flux of particles is calculated from particle volume, particle density and snow accumulation rate, thus affected by the definition of particle size, which depends on the measurement technique. Comparison of the size distribution and flux data from different measurement techniques requires caution. Here we compare traditionally used three techniques and also introduce a new technique.

Coulter Counter and laser sensing particle detectors are the most commonly used methods to measure size and number of insoluble micro-particles in melted ice cores. Coulter Counter directly measures volume of each particle and the total counts of particles in a given sample volume. Among the laser sensing detectors, Abakus (Klotz) is most widely used in the ice core community. Abakus detects shading of laser light caused by each particle, which is converted to volume assuming spherical shape. Another type of laser sensing detector (Met One Model 211) has been used by the Japanese ice core community. Met One Model 211 detects scattered laser light, which is also converted to volume assuming spherical shape. Both types of laser sensing detectors give total counts of particles in a given sample volume.

We analysed same snow and ice samples with Coulter Multsizer 4 (Coulter Counter) and Met One Model 211. We analysed some of the samples additionally with Abakus. Coulter Multisizer 4 and Met One Model 211 gave similar results for glacial ice from the Dome Fuji ice core drilled in East Antarctica. But they show different size distributions for Greenland snow, seasonal snow cover in Alaska, and interglacial ice from the Dome Fuji ice core. Abakus also showed size distribution different from the other two detectors for Greenland snow. Since the determination of particle size is affected by particle shape, we used a new particle detector based on image processing technique (JASCO IF-200nano), which enabled us to gain information on particle shape. The new detector showed that Abakus and Met One Model 211 gave size distribution different from Coulter Multisizer 4 when the particle shape departed greatly from spherical shape. The new detector would be a useful tool to analyse micro-particles in ice cores.

PHYSICAL AND BIOLOGICAL PROPERTIES OF THE MIDDLE EAST DUST (MED) STORM OVER AHVAZ, IRAN

Apedipicia voluptur sed ut aut diat venis aliquae caborerum quo con coresequi sit aut aut eum a sum estotae ptaeptam et eiunt et odipsa doloraerfera si sunt archil mi, qui con nimossime vel ius nusdaest occabo. Itatibus dignis dolest, atusapicid millic tecabo. Aximus, ipsum velland eliae. Ceatium qui tore num veliquam ilibus doluptati nonetur?

Im volendestiis plaudam volore voluptatur alia idus doloren imendus.

Rum aut volorep erovita turio. Ga. Te veniti que dolupta quisitibus, nobit, sitio. Danditi busant remoluptatia dicabo. Itium into ernam volorum harum aliae modigen ihillacerspe mos re, officil inciisque ipsae mi, sundipsam, quae nem que debis etur alic tem la expelique plate nullautatem expellam harum nonseque porepudis qui dolorestrum sum nis sundenet omnimpor senit modicil et voluptatur?

Otatem. Et re estrum nis quas ipsamusdae dolupta qui dolorrovit et quos verio torehendesto tore ellupta eperum id molorrovitio oditetur?

Caborerchil im eum, ariatio sapiend endaerchit, nonsequis dolupta testiae qui aspedi dolo mincto bero tem vendips andempore eosa soluptas esequas pitatur, que que nem et od modictatis ratatendel essimag natempori ut omnim facculpa aut quat eturero ent et atation conse plaboreiunt untemodis renia sinvenit odipsum, et vercimus et, con cone idelest, quiam volores consequia quo elenisciis coribus dolorro cuptaquos de nonsend ametur asi aut eumquia arum explandem quos eum conseni moluptae conecea rciatur aut liquis veniet la eum qui alita doluptasitat intias eos eos aut facerumquo moluptatium aut et as ut eles ipicaep taspelectur? Ratquae eruntium acescias eiciditatur apicipsantus et faccust orepellor re elite qui ut eventius.

Nusa amus qui arum id ellescipid mo ipident.

Temperepe volorem. Ut et andis atin nos est, con consequae evel id ma ped molumquam acipienis ex est porum restia cus mosse eumquibus sum que explic tem quatur senihilique volestibus.

Ucidipi enisciendant fuga. Ut ma que velit, sa as aut ut id et ommo volorro od mo vollates as assimus, cusam imus, occaborro ditatem et harum aspiet labo. Ficimin uscita sin pliquia ne officitaqui quam rectam eum que si te sinis quae inturia simentur, culpa dolorecum, aut ut perum, ipisita dendeliquas acim quo verum ut ut postias simetus apit atur maxim fuga. Nam inctendelita sum fugiat aliquis re, sit, cum, consequae. Cepeliquos enditibus, te offici non rerum abor a sinvellupite ditas molo exceatur?

Fic tem fugit, officianisci unt la voloriam fugit ut amendae nobitas pictis doluptatem velliqui nonsequi dit et, quo is inum volore parcit doleceperum autest volupis asped et lam volut ellatem nos verovit quiates toreic te et quam, ut atur, eseritem a doluptatus. Gende volorectur aut lab il endant lit eos earum ut molorit quo maximinci conest autem faceaqui conectotati ium volendamus sima ditibus, con cum ent velestion repudant incidebit, sinciet rem natur modio tem hillacim ressitaturem volorrunt ipidest ionestio.

BIOCHEMICAL AND HISTOPATHOLOGY STUDY OF THE TOXICITY OF METAL DUST EMITTED BY THE ANNABA STEEL COMPLEX (NORTHEASTERN ALGERIA) IN THE SNAIL *HELIX ASPERSA*

Gia iliam ium eost, occab idenis quia volorem evernam reribus, vitatibus asi beaque magnam, ut quia quatia vel magnimu sapient ibusam esequam lam arumquia vendit volestet laborio. Ferioriam viduci voluptatiunt experum, simpeliquid quidi aut explit litatem ipsunt idemque cus ad modigenis earibus aut aut que offictatur, net etus dolorume voloresto et faccaepe vitiatquam nectas ulpa vellat adiscie nducill oreped quod magnam quiberum volorem quas in nia sitaquiam inis ilit, cores ut eum faceratestia con core omnis est quunt.
Ga. Gitem accus remporerunte dolo test aborest, imenihil ipsuscia aut invel inimolesto dolo experitasit facepudi illaut pero minullaut magnatquatia in post occum quam, ulparum sa alibero volorem. Et ad ut vendios ea denis dolendit elesequam, sed moloreic te lat eosamenet quis esectur? Qui in et que vellit qui nullorioris vollam el ipsa dolut fugit, quae dollab int unt.
Cepudam, ex ex exerum quasimaxim acipsae prestorior arum inctescide illuptiatio. Nam nese volorem a ne volut elecus abo. Umquam et estibus repuda suscimaionet vent volo comnis eos sumque nis ventiost, odis molupta spidio dolupturibus et iliatur si quuntus magnam sunt.
Ullanda etur, omnimpor maximilitae nos quatempero te es que venistr umquia della sin re dolo beaque seritiati te omniatet unto dolestiae dolori re pa dolorer uptaquis exeruntorum quodit quia et expedip sapiend ebitiumquo optis accatet adici non reri ne incil et delicae sequatet vita sunti re everumenda dis esti ium explibe aquiden isimus. Cullignam que voluptibus et accusto ipicte nos dolorecernam quuntion prepedi ium, sum re volupta tiatintem sam, consequidus, comnim eatio dolesti nctemo te non comnimus, voluptur?
Equunt mi, con core pos quiatque volo corundant volenis voluptur sit, elis autemodi omnis aut venis de nonsed ea volendia inus et earuptasinis dendanducit, non reruptat persperem quuntec atiorem ut volor animolupta cus, vendit peris essit este rem sollori stibus a core seditat aut moluptat landi quae. Itae pereratente vellore dolorestem quidel ium fuga. Nam, sanducimus, sitatem fugiassitae. Otae imped eseditam, quam, sam, cum nihitat atiantotas aut latis nimillab iumet doluptiaspis nis re voluptatibus ma sini doluptio. Ecupid modiatis anda et vid quo eat.
Dit, nobitio rerrovit et ex eum fugit que dustrum resectium et quoditiume volum rem es preperi con re vendes quis im a dissus, simporro vendeliquas dolum sitiis adi unt eum sectust ibeatur?
Moditat eceperum quiati torum nobis ex erio inis escimet am este quas autasimossin cusamenet as solorem fugiae veliquo eum utatiorporro cullent peraeprero tem eaquas

COMBINED GROUND-BASED RAMAN, DEPOLARIZATION LIDAR AND SUNPHOTOMETER MEASUREMENTS DURING SALTRACE

Silke Gross[1]*, Volker Freudenthaler[2], Carlos Toledano[3], Matthias Wiegner[2], Bernadett Weinzierl[1,2]

[1]*Deutsches Zentrum für Luft- und Raumfahrt, Insitut für Physik der Atmosphäre, 82234 Oberpaffenhofen, Germany*
[2]*Ludwig-Maximilians-Universität, Meteorologisches Insitut, 80333München, Germany*
[3]*Universidad de Valladolid, Grupo de Óptica Atmosférica, Valladolid, Spain*

Lidar and sunphotometer measurements were performed during the Saharan Aerosol Long-range Transport and Aerosol-Cloud-Interaction Experiment (SALTRACE: http://www.pa.op.dlr.de/saltrace) in June and July 2013 at Barbados to characterize Saharan dust over the Caribbean and to investigate possible changes of optical properties of Saharan Dust during its long-range transport across the Atlantic Ocean. Measurements of the particle linear depolarization ratio (PLDR) at 355 nm and 532 nm, and of the vibrational Raman signals at 387 nm and 607 nm were conducted with the small portable 6-channel depolarization and Raman lidar system POLIS of the Meteorological Institute (MIM) of the Ludwig-Maximilians-Universität München in cooperation with the Institute of Atmospheric Physics (IPA) of the German Aerospace Centre (DLR). The sunphotometer measurements were conducted by the University of Valladolid (in cooperation with MIM and the Institute of Tropospheric Research, Leipzig). Routine POLIS measurements were performed every day for 3 hours starting at sunrise (only PLDR) and at night for another 3 hours starting at sunset (combined PLDR and Raman). During special situations like heavy dust outbreaks or the formation of tropical storm Chantal in a dusty airmass, POLIS measurements were made continuously for up to 48 hours.

The vertical aerosol distribution found during the SALTRACE campaign was dominated by a three layer structure showing a marine influenced boundary layer in the lowest 0.5 to 1.0 km, topped by a layer of highly variable aerosol properties up to 1.5 - 2.0 km, and a distinct pure Saharan dust layer with upper boundaries of about 3.5 to 5 km. Comparisons of the lidar derived aerosol optical depth with co-located sunphotometer measurements at 532/500 nm agreed very well confirming the good coverage of the atmospheric column by the lidar. Four dust events during the measurement period could be studied in detail with an optical depth of the pure dust layer ranging from about 0.2 to 0.3.

In our presentation we will give a general overview of the measurement situation and the POLIS measurements during SALTRACE. We will show first results of the lidar measurements and comparisons with results found during former field experiments over the Cape Verde and over Morocco, in particular with findings during the SAMUM (Saharan Mineral Dust Experiment) field campaigns. These studies give insight in the aging of Saharan dust during its transport over several days.

AEROSOL OBSERVATIONS WITH A CLOUD RADAR OVER POTENZA

Pilar Gumà-Claramunt[1]*, Fabio Madonna[1], Aldo Amodeo[1], Matthias Bauer-Pfundsein[2]

[1]*Consiglio Nazionale delle Ricerche - Istituto di Metodologie per l'Analisi Ambientale (CNR-IMAA), Tito Scalo, Potenza, I-85010, Italy*
[2]*METEK GmbH, Elmshorn, 25337, Germany*
**pilar.guma@imaa.cnr.it*

Giant and ultragiant aerosols can expedite warm rain processes by acting as giant cloud condensation nuclei (GCCN) and are efficient Ice Nuclei (IN). However, the effects of these particles on meteorology and climate are not fully understood yet.
Typically, aerosol microphysical properties can be retrieved in a size range from 100 nm to a few microns, due to the limits on the observation wavelengths used in measuring aerosol by the main instruments used nowadays: lidar and sun photometer. Recently, it was demonstrated that millimiter-wavelength cloud radars are able to detect giant and ultragiant volcanic aerosols also at long distances from the source (Madonna et al., 2010).
The aim of this study is to use a millimetre wavelength radar for the characterization of aerosols in an enlarged size range, including the giant fraction of volcanic aerosol, mineral dust and pollen. Cloud radar observations performed at the CNR-IMAA Atmospheric Observatory (CIAO), located in Potenza, South Italy, within the period from March 2009 to December 2012 were inspected for the presence of aerosol layers. The outcome dataset consists of 68 aerosol lofted layers, 28 during night-time and 40 during day-time, with a maximum occurrence during summer. Statistic and classification schemes will be discussed.

Madonna F., Amodeo A, D'Amico G, Mona L, Pappalardo G. (2010). Observation of non-spherical ultragiant aerosol using a microwave radar. Geophys. Res. Lett. 37, L21814.

THE IMPACT OF DUST IN CHILDREN LIVING AROUND THE LANDFILL SITE: A COMMUNITY PESPECTIVE

Phiwayinkosi Gumede[1]*, Lisa Ramsay[2]

[1]*Mangosuthu University of Technology, Durban,4001, South Africa*
[2]*Universiy of KwaZulu-Natal, Durban, 4001, South Africa*
**Siphiwog@ovi.com*

Studies of subjective assessment of environmental risk demonstrate that people focus on particular risks because of their attachment to place, beliefs, values, social institutions, and moral behaviour, not necessarily on the amount of danger actual or perceived (Douglas and Wildavsky, 1982). Communities living nearby municipal landfill site are exposed to various pollutants at their homes since airborne emissions are carried to the surroundings communities by wind currents (Patil, 2001). It is not different in South Africa since there are communities that reside very close to landfill site. This paper examines residents' responses with regards to the impact of dust in children within 2 km radius of the Bisasar Road landfill site in Durban, South Africa.

To assess the reported respiratory health impact of dust in children living near the landfill site.

This is a cross-sectional study using a quantitative approach to determine the respiratory health effects in children aged between 8 and 12 years. House to house visits were done by fieldworkers to gather the views of the Clare Estate community members who were living with children between the ages of 6 and 12. A modification and integration of the American Thoracic Society and the British Medical Research Council questionnaires was used to collect data on respiratory impact.

Symptoms in children were measured in a period of a year, months and days. In 132 children, 34% did not have a cough that won't go away in a year; 22% had more than 2 times per month; 13% had between 1 to 12; and 7% had cough everyday in the whole year respectively. In 123 children, 22% had wheeze with a cold more than 2 time per month whilst 13% had between 3 to 12 times; and 58% had none in the whole year. About 28% of children reported having diagnosed with respiratory conditions by a doctor in their lifetime. In conclusion, the study indicates that children are affected by dust due to the close proximity to the landfill site.

Douglas M.,Wildavsky A. (1982). Risk and Culture: an Essay on the Selection of Technologic al and Environmental Dangers. University of California Press, 222.

Patil MA. (2001). Environmental management scenario in stone crusher industry sector and cleaner production possibilities. Teri information Monitor on Environmental Science, 83-92.

NEOGENE LOESS STRATIGRAPHY IN CHINA AND LONG-TERM CLIMATE HISTORY

Zhengtang Guo

Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China
**ztguo@mail.iggcas.ac.cn*

Quaternary loess-soil sequence in northern China is well-known, providing a near continuous terrestrial record of paleoclimate for the past 2.6 million years. This record was extended in the early 2000s to 22 million years ago. Up to date, ten Neogene eolian sequences with detailed magnetostratigraphy have been reported from various geomorphic units, ranging from the Yangtze River Basin to the northeastern margins of Tibetan Plateau. They contain more than 400 pairs of alternating soil and loess layers with the occurrences corresponding to the Earth's orbital cycles. The spatially correlative stratigraphy and climate proxies offered parallel controls for paleoclimate reconstructions. Sedimentological, pedological and geochemical studies confirmed that the formation of the paleosols were closely linked with the rainfall brought by summer monsoon while eolian dust was transported by winter monsoon from the inland deserts in Asia. Several lines of proxies show that summer monsoon reached its strong maximum in the early Miocene, followed by an overall weakening trend during the Neogene. Despite of the sub-order fluctuations, winter monsoon and inland aridity roughly co-varied and remained at moderate levels until 3.6 Ma lacking one-way step reinforcements during this interval. These long-term climate trends are incoherent with the suggested Neogene major uplifts of Tibetan Plateau if the results of climate models are admitted. Instead, many aspects are congruent with the Neogene climate changes at the global or hemispheric scales. We also suggest that Tibetan Plateau would have reached to a threshold by the early Miocene, leading to the onsets of monsoon-dominated climate and inland desertification in Asia, whereas the subsequent climate evolution were primarily controlled by the global and hemispheric climate changes.

URBAN-INDUSTRIAL DUST: SO_2 SINK AFFECTING FOLIAR SURFACE AND BIOCHEMICAL CONSTITUENTS OF ECONOMICALLY IMPORTANT PLANT SPECIES IN NATIONAL CAPITAL REGION OF DELHI, INDIA

Gyan Prakash Gupta, Bablu Kumar, Sudha Singh, U.C. Kulshrestha*

Jawaharlal Nehru University, School of Environmental Sciences, Delhi 110067 INDIA
umeshkulshrestha@gmail.com

Dust is considered as one of the most widespread air pollutants predominantly found in African and Asian regions (Tegen and Fung, 1995). Very high loadings of atmospheric dust in Indian region contribute to remarkably higher levels of particulate matter. The dust is primarily a mixture of suspended soil, road dust and other particulate matter. During prevailing dry weather conditions, the dust is deposited onto the foliar surfaces affecting their morphology, stomata and biochemical constituents. Despite the importance of dust affecting foliar properties and biochemical constituents of plant, very limited studies have been reported on this topic in Indian region. Soil-dust is highly rich in $CaCO_3$ in India which has been found a significant scavenger of atmospheric SO_2 (Kulshrestha et al., 2003). In the presence of sufficient moisture, SO_2 is adsorbed onto the dust particles in air forming $CaSO_4$ (Kulshrestha, 2013). Hence, during this study, elevated dustfall fluxes of SO_4^{--} at industrial site (Sahibabad) as compared to residential site (Jawaharlal Nehru University campus) have been recorded on various surfaces (foliars, petridish and filters). These higher fluxes of SO_4^{--} have been attributed to the oxidation of SO_2 due to which remarkable changes have been observed in foliar morphology and biochemical constituents of an economically important plant species (*Morus alba*). It is interesting to note that around 3-4 times higher fluxes of SO_4^{--} were recorded on both foliar and artificial surfaces at industrial site as compared to residential site. Industrialization and high density of diesel driven vehicular traffic are the major sources of SO_2 in the industrial area. Atmospheric dust was also characterized for other major ions (F^-, Cl^-, NO_3^-, Na^+, NH_4^+, K^+, Mg^{++}, and Ca^{++}). While the biochemical parameters of foliar included total chlorophyll, total soluble sugars and ascorbic acid. On the foliar surface at residential site, Ca^{++} had the highest fluxes followed by $SO_4^{--} > NO_3^- > Cl^- > Mg^{++} > K^+ > Na^+ > F^- > NH_4^+$ while at the industrial site, this order has been as- $SO_4^{--} > Ca^{++} > Cl^- > K^+ > Mg^{++} > Na^+ > NH_4^+ > F^- > NO_3^-$. The morphology of foliar through Scanning Electron Microscope (SEM) indicated a remarkable difference in size of the stomatal pores and raptured guard cells at industrial site as compared to residential site. Results of biochemical analysis showed that plant foliars at the industrial site had relatively higher values of ascorbic acid and lower values of total chlorophyll and soluble sugars indicating stressful conditions due to industrial and vehicular emissions.

Kulshrestha U. (2013). Acid rain. Encyclopedia of Environmental Management, Taylor and Francis, 8-22.

Kulshrestha M.J., Kulshrestha U. C., Parashar D. C., Vairamani M. (2003). Estimation of SO4 contribution by dry deposition of SO2 onto the dust particles in India. Atmospheric Environment, 37 (22), 3057-3063.

Tegen I., Fung I. (1995). Contribution to the mineral aerosol load from land surface modification. J. Geophys. Res., 100, D9, 18707-18726.

EFFECTS OF ABATEMENT MEASURES AGAINST PM_{10} IN STOCKHOLM

Mats Gustafsson[1]*, Göran Blomqvist[1], Sara Janhäll[1], Christer Johansson[2,3], Michael Norman[2]

[1]*Swedish National Road and Transport Research Institute, Linköping, SE-58195, Sweden*
[2]*Department of Applied Environmental Science, Stockholm University, SE 106 91, Stockholm, Sweden*
[3]*Stockholm Environment and Health Administration, SLB-analysis, SE 104 20, Stockholm, Sweden*
**mats.gustafsson@vti.se*

Sweden is prosecuted in the EU court for not meeting the limit values for PM_{10}. The main problem is the high production of dust from pavement wear caused by studded tyres and winter operation measures resulting in high PM_{10} emissions during spring as streets dry up. The exceedances are concentrated to highly trafficked city streets and Stockholm is the city with the largest air quality problems. During the winter seasons of 2011-2013, the City of Stockholm has financed an evaluation of operational measures to reduce PM_{10} concentrations. The abatement methods used has been dust binding using CMA (calcium magnesium acetate) as well as testing of advanced street sweepers. Unique follow-up measurements has been made both regarding the temporal and spatial variation in road dust depot on the streets and its size distributions as well as regarding the PM_{10} concentration. The road dust load (DL180 = dust<180 µm) varies between 5-80 g/m^2, while DL10 (dust < 10 µm) is calculated to 0-20 g/m^2. Both DL180 and DL10 show a seasonal pattern with maximum in late winter, early spring. The main findings also confirm previous results (Norman & Johansson, 2006) that dust binding using CMA can reduce PM_{10} concentrations with 20-40% the day after treatment, while street sweeping has little or no obvious effect (Amato et al, 2010). Ions from winter time salting and CMA treatment has been studied on the road surface and in PM_{10}. It is concluded that salt (NaCl) contributes to up to 5% of PM_{10} mass, while the contribution from CMA is negligible. Despite the positive effect of dust binding on PM_{10} concentrations, Stockholm still relies on favourable meteorological conditions during winter and spring for complying with the PM_{10} limit values, why more elaborate and expanded PM_{10} abatement is needed.

Amato F, Querol X, Johansson C, Nagl C, Alastuey A. (2010). A review on the effectiveness of street sweeping, washing and dust suppressants as urban PM control methods. Science of the Total Environment; 408: 3070-3084.

Norman M, Johansson C. (2006). Studies of some measures to reduce road dust emissions from paved roads in Scandinavia. Atmospheric Environment; 40: 6154-6164.

ELECTRIC TRAINS AT A TUNNEL STATIONAS SOURCES TO PM_{10} AND ULTRAFINE PARTICLE EMISSIONS

Mats Gustafsson[1]*, Saeed Abbasi[2], Göran Blomqvist[1], Anders Gudmundsson[3], Sara Janhäll[1], Christer Johansson[4,5], Michael Norman[5], Ulf Olofsson[2], Billy Sjövall[5], Håkan Wilhelmsson[1]

[1]*Swedish National Road and Transport Research Institute, Linköping, SE-58195, Sweden*
[2]*KTH Machine Design, SE 100 44, Stockholm, Sweden*
[3]*Division of Ergonomics and Aerosol Technology, Lund University, SE 221 00, Lund, Sweden*
[4]*Department of Applied Environmental Science, Stockholm University, SE 106 91, Stockholm, Sweden*
[5]*Stockholm Environment and Health Administration, SLB-analysis, SE 104 20, Stockholm, Sweden*
**mats.gustafsson@vti.se*

Subway and railroad subterranean environments have been shown to suffer from high particle concentrations (e.g., Gustafsson et al.,2012) and health concerns related to metal content has been raised (e.g., Kam et al., 2011). As opposed to road tunnels, the particle sources have been identified as mainly wear from wheels, brakes and rails (e.g. Abbasi et al., 2011).In an on-going research project, airborne particles in a railroad and a road tunnel are characterized regarding concentrations, size distributions and elemental composition in relation to traffic. The aim is to characterise and identify the main particle sources to be able to suggest abatement measures regarding material and system use as well as measures regarding traffic. This abstract focuses on studies of particle properties and traffic during a campaign on the platform of Arlanda Central station (railroad tunnel below Arlanda airport, Stockholm) during the project. A new photo cell based system for detecting train traffic was used. From the measurements at Arlanda C it is clear that electric trains emit both the expected PM_{10} from worn components, but also occasionally ultrafines. It is also clear that different train types and/or train individuals affect mass and number concentration of particles very differently. While some trains do not seem to contributeto increased concentrations, others result in mass concentration increases and some also to obvious particle number concentration increases in the ultrafine range, without NO_X concentrations rising (no exhaust contribution). Ongoing analyses indicate that older train types, with disc brakes as the only braking system, might play an important role as a source for both PM_{10} and ultrafines, even though also modern train types are occasionally associated with high emissions. Further work will describe differences between road and railroad tunnel particle emissions, size resolved particle composition and abatement strategies. This work was supported by the BVFF; a research program financed by the Swedish Transport Administration, The Royal Institute of Technology, KTH, and the Swedish National Road and Transport Research Institute, VTI.

Abbasi, S., Wahlström, J., Olander, L., Larsson, C., Olofsson, U. and Sellgren, U. (2011). Wear; 273: 93-99.

Gustafsson, M., Blomqvist, G., Swietlicki, E., Dahl, A.and Gudmundsson, A. (2012). Transportation Research Part D: Transport and Environment; 17:277-285.

Kam W., Ning Z, Shafer M.M., Schauer J.J., Sioutas C. (2011). Chemical characterization and redox potential of coarse and fine particulate matter (PM) in underground and ground-level rail systems of the Los Angeles metro. Environmental Science and Technology; 45: 6769-6776.

LONG-RANGE TRANSPORT OF SAHARAN DUST AND BIOMASS BURNING SMOKE MEASURED WITH THREE-WAVELENGTH POLARIZATION LIDAR AT BARBADOS

Moritz Haarig[1]*, Albert Ansmann[1], Dietrich Althausen[1], Andre Klepel[1], Holger Baars[1], Thomas Kanitz[1]

[1]*Leibniz Institute for Tropospheric Research, Permoserstraße 15, Leipzig, 04318, Germany*
**haarig@tropos.de*

The Sahara is the most powerful source of mineral dust on Earth and spreads its dust globally. The trade winds transport the Saharan dust over 5000 - 8000 km towards the Caribbean. As it is transported over the ocean there are neither continental dust sources, nor anthropogenic influences on the transport way. This makes the island of Barbados (13°N, 59°W) an ideal site to investigate the long range transport of mineral dust. The Saharan Aerosol Long-Range Transport and Aerosol-Cloud Interaction Experiment (SALTRACE) is designed to observe the optical and microphysical properties of the mineral dust aged during transport in the atmosphere. In the framework of this experiment we use a complex lidar system equipped with Raman channels and a 532 nm high spectral resolution lidar (HSRL) channel to receive day time (HSRL) and night time (Raman) extinction profiles. For the first time the dust linear depolarization ratios at 355, 532 and 1064 nm are measured simultaneously. The linear depolarization ratio provides information about the shape of the particles and therefore let us distinguish between mineral dust, biomass burning smoke and maritime aerosols. The incidence of biomass burning smoke depends on the agricultural activities, which differ between summer and winter. In summer the pure Saharan dust dominates whereas in winter it is mixed with biomass burning smoke. The region is mainly influenced by the smoke of western Africa, but Caribbean and Central American smoke from the west could also be detected depending on the wind direction. To analyse the seasonal difference in the aerosol composition, we perform a summer and a winter campaign in June-July 2013 and February-March 2014, respectively. Another campaign is planned for June-July 2014. Our measurements lead to a characterization of long-range transported dust and provide insight into the aerosol composition over the western Atlantic. The three-wavelength depolarization observations allow us to perform a detailed aerosol separation (fine-mode dust, coarse-mode dust, marine, smoke). We started to compare our field observations of dust and smoke with the model calculations.

REDUCTION IN AIRBORNE DUST FROM USE OF VARIOUS SUPRESSION APPROACHES

Arash Habibi[1]* , Kwame Offei[2], Ali Haghighat[2], Richard Kramer[1], Stewart Gillies[2]

[1]*FMC Corporation, Green River, WY, 82935, U.S.*
[2]*Missouri University of Science and Technology, Rolla, 65409, U.S.*
arash.habibi@fmc.com

The dust concentrations in an underground mining operation may create problems for health and safety of the workforce. Reliable and continuous dust sampling using high end monitoring devices, various techniques and statistical analysis would enhance the engineer's ability to design and implement good engineering interventions.
The objectives of this work was to: (i) reliably monitor spatio-temporal dust emissions in an underground mine; and (ii) use discrete event simulation (DES) to evaluate engineering interventions for dust control in the presence of input uncertainty. The goal is to use simulation to cheaply evaluate multiple engineering interventions to select the most promising solutions for experimental trials. The study site is an underground trona mine that operates with a longwall (LW). The ore is transported over 10km on a belt conveyor system before being hoisted to surface. The belt entry is considered intake air.
The first objective was achieved by conducting a comprehensive dust survey to monitor dust generation, spread rate and exposure rate at the study site. Several dust monitoring techniques were used to measure the real time and time weighted average (TWA) concentrations. Multiple elf pumps were used to measure the TWA silica and respirable dust concentrations using NIOSH 7600 and 0600 approaches, respectively. The real time monitors, were placed in stations including the belt drift (tunnel). The belt status was monitored to analyze the correlation between belt motion and dust generation and dust reduction approaches.
The second objective was achieved by building a discrete-continuous DES model in Arena (Rockwell Software). The model assumes the ore generation times are independent and identically distributed. The model uses the Euler method to solve the ordinary differential equations and Monte Carlo simulation for stochastic simulation of discrete events. The DES Arena model was validated with the real time and TWA data. Various experiments were conducted with the DES model.
The data from both TWA and real time dust monitoring methods were analyzed using several statistical methods.
Transfer points and bunkers have been selected as the major dust generation sources, which contribute to increase dust concentrations by 45 percent. A wet scrubber was installed at a transfer point for dust concentration reduction. The wash boxes reduced the dust generation by 35 percent. However, it was determined that the scrubber and wash boxes require labor intensive maintenance work to be effective. Higher visibility and better air quality throughout the mine have been accomplished. This study shows the potential benefits of using DES to model particle concentration of mining operations.

INDONESIA EXPERIENCE ON MONITORING OF PARTICULATE MATTER IN AMBIENT AIR

Esrom Hamonangan[1]*, Elfrans Silalahi[2], Thamrin[3], John De Souza[4]

[1]Pusarpedal, Deputy VII,Ministry of Environment,Tangerang Selatan, 15310,Indonesia
[2]PT.Enviro Analytica Terpadu, Jakarta, 12510, Indonesia
[3]Badan Pengelola Lingkungan Hidup, Jakarta, 12950,Indonesia
[4]GRIMM Asia Office, Tampines Court, 521133,Singapore
*rujak123@hotmail.com

Ambient air quality monitoring in Indonesia was conducted since 1985. The concentrations of TSP, NO_2, and SO_2 were measured at five sampling points in the city of Jakarta that represented the industrial areas, the business district, and residential areas. High volume air samplers (HVAS) were used to measure the TSP and gas analyzers for concentrations of NO_2 and SO_2. Sampling points were selected near traffic highways and the TSP concentrations were high for all points measured.

In 1993 the Japan International Cooperation Agency (JICA) and the Environmental Management Center (EMC) of the Ministry of Environment installed Continuous Monitoring Stations for TSP, NO_2, and SO_2 at five points in the city. In this project the chemical component of TSP was analysed and the rate of contribution from an emission source was estimated using the Chemical Mass Balance (CMB) model. It was estimated that contribution of Diesel exhaust gas containing solid particles were high for TSP concentrations in Jakarta city.

In 1999 an Integrated Air Quality Monitoring System (AQMS) was donated by the Government of Austria through soft loans. The parameters measured were SO_2, NO_2, CO, Ozone, PM-10 and Meteorological data. Monitoring was carried out at 33 points in 10 cities. The cities were Jakarta, Bandung, Semarang, Surabaya, Denpasar, Medan, Jambi, Pekanbaru, Palangkaraya and Pontianak. Data obtained were at intervals of 1 hour averages. Due to wear and tear these systems have been scheduled for upgraded over the next three years.

Data of air quality monitoring, conducted since 1985 were mostly based on TSP and it was found that the monitoring of particulate matter, especially for PM-10 and PM-2.5 were lacking. Epidemiological studies explain that particulate matter, with diameters of less than 2.5 microns (PM 2.5), are classified as fine particulate. These particulates are now known to be very dangerous, as they can penetrate to the deepest part of the lungs and cause health problems such as acute respiratory infections, lung cancer, and pulmonary cardiovascular diseases. It has been medically proven that fine particulate matter contributes substantially to mortality caused by air pollution-related health problems. To enhance the air monitoring standards for Indonesia, the Indonesian Government in 2013 amended our National Standards for Ambient Air Monitoring and implemented the standards for monitoring of PM 10 and PM-2.5. This is currently being carried out at 3 monitoring points in the special area provincial of Jakarta or DKI-Jakarta. We are now waiting for the results of these data from DKI-Jakarta.

Bapedal, Nippon Koei, Suuri Keikaku (1997). The Study On The Integrated Air Quality Management For Jakarta Metropolitan Area.

DUST DEPOSITION ANALYSIS IN EAST ASIA BASED ON DUST DEPOSITION MONITORING NETWORK AND AN ASSIMILATED DUST TRANSPORT MODEL

Yukari Hara[1]*, Keiya Yumimoto[2], Kazuo Osada[3], Itsushi Uno[1], Atsushi Shimizu[4], Ichiro Matsui[4], Nobuo Sugimoto[4]

[1]*Kyushu University, Kasuga, 816-8580, Japan*
[2]*Meteorological Research Institute, Tsukuba, Postal code, Japan*
[3]*Nagoya University, Nagoya, 464-8601, Japan*
[4]*National Institute for Environmental Studies, Tsukuba, 305-8506, Japan*
**yhara@riam.kyushu-u.ac.jp*

Data assimilation methods coupled with a dust transport model brings great precision of dust prediction (Yumimoto et al., 2008). We optimized Asian dust emission using a data-assimilated version of a dust transport model (RC4) based on a ground-based NIES lidar network for many dust events in East Asia in the past studies (Sugimoto et al., 2011). Intensive validation had been conducted using space-borne lidar CALIOP, MODIS satellite data and surface PM2.5/SPM data as the independent observation. However, it is well known that dust extinction coefficients have large sensitivity especially for the fine mode dust particle. Therefore we need further validation including coarse dust particle observation such as deposition to confirm adequacy of dust size distribution in the dust emission process or deposition process.

A continuous measurements of dust wet and dry deposition fluxes had accomplished at six stations in Japan from October 2008 to December 2010 (Osada et al., 2013). In this study, we adapted RC4 using ground-based lidar data for the 3 remarkable dust events (E1:14-17 March, E2:19-22 March, E3:11-14 November) during 2010. We inversely optimized total dust emission amounts, however we did not optimize the size distribution of emitted dust. PM2.5/SPM ratio in Japan was derived to characterize size distribution of transported dust for 3 events based on surface observation. High PM2.5/SPM ratio suggests that size distribution of atmospheric aerosols distributes in fine mode, while low PM2.5/SPM ratio means that more coarse mode particles are included in the aerosol mass. PM2.5/SPM ratio at Fukuoka in Japan were 0.37 for E1, 0.33 for E2 and 0.42 for E3. The results suggests that size distribution of dust particles for E2 was biased in coarse mode particles. Dry deposition fluxes estimated from RC4 were validated with the observations. RC4 underestimated dry deposition flux for E2, nevertheless high reproducibility of lidar dust aerosol optical depth was confirmed. These results suggested that we need to optimize size distribution of emitted dust using the observation includes size information of fine and coarse particles.

Yumimoto K., Uno, I., Sugimoto, N., Shimizu, A., Liu, Z., and Winker, D. M. (2008). Adjoint inversion modeling of Asian dust emission using lidar observations, Atmos. Chem. Phys., 8, 2869-2884.

Sugimoto, N., Hara, Y., Shimizu, A., Yumimoto K., Uno, I., and Nishikawa, M. (2011). Comparison of surface observations and a regional dust transport model assimilated with Lidar network data in Asian dust event of March 29 to April 2, 2007, SOLA, Vol. 7A, 13-16

Osada, K., Ura, S., Kagawa, M., Mikami M., Tanaka, T. Y., Matoba, S., Aoki, K., Shinoda, M., Kurosaki, Y., Hayashi, M., Shimizu, A., and Uematsu, M. (2013). Wet and dry deposition of mineral dust particles in Japan: factors related to temporal variation and spatial distribution, Atmos. Chem. Phys. Discuss, 13, 21801-21835.

A PILOT STUDY INVESTIGATING THE SUITABILITY OF A RANGE OF COLLECTION TECHNIQUES FOR MONITORING DUSTS GENERATED DURING THE DRILLING OF TREATED SEEDS IN AUTHENTIC UK FIELD SCENARIOS

Paul Harrington[1], Andrew Plumb[1], C. Richard Glass[2]

[1]*Food and Environment Research Agency (Fera) Sand Hutton York, YO41 1LZ*
[2]*Eurofins Agroscience Services, Slade Lane, Wilson, Melbourne, Derbys. DE73 8AG*

The use of seed treatments to replace post-emergent applications of pesticides has become increasingly prevalent. However the concentrations of pesticide active substances present in seed dressings can cause significant environmental effects to flora and fauna if these do not remain tightly bound to the seed body and escape in dusts generated during drilling. A neonicotinoid pesticide dressing that was inadequately bound to maize seed and so ejected as dust from the vent on the drilling machine caused a major incident, with tens of thousands of bee colonies affected in Germany(1). This incident heightened the awareness of the potential toxicity of neonicotinoids with respect to bees. Significant restrictions on the use of certain neonicotinoids have been introduced in the EU. Neonicotinoid data will be reviewed in two years following further studies into the effects on pollinators from exposure to these systemic pesticides.

Scientists at Fera were commissioned in late Summer 2013, under Defra's pesticides R&D programme managed by the Chemicals Regulation Directorate (CRD), to conduct a pilot study to compare methods for dust collection from crops that would typically be drilled with a neonicotinoid dressing in UK field situations. The sowing period studied only covered the time period and conditions during which neonicotinoid treated crops would normally be sown. We have compared a technique used previously for sampling dust from broadcast pesticide granules(2) with a more recent, widely publicised, technique(3).

A review of the capture efficiency of these techniques will be presented based on the relative efficacy of each technique in capturing dust containing the seed dressing active substance. This information should help in the design of future studies which may be required to determine whether rates of active ingredient deposition on field margin flowers could contribute to the potential exposure of pollinators during the following year.

1. Pistorius J., Bischoff G., Heimbach U., Stähler M. (2009). Bee poisoning incidents in Germany in spring 2008 caused by abrasion of active substance from treated seeds during sowing of maize. 10th International Symposium Hazards of Pesticides to Bees: Bucharest, Romania, ISSN/ISBN: 978-3-930037-58-2.
2. Harrington P., Mathers J.J., Smith S, Glass C.R. (2004). Methods for the Evaluation of Granular Drift. International Advances in Pesticide Application: Aspects of Applied Biology 71, 2004, pp 197 -200.
3. Heimbach U., Pistorius J., Georgiadis P.-Th., Stähler M., Schenke D. (2013). Dust drift during drilling into adjacent crops - Where are we now? AAB Dust Emissions from Seed Drills Workshop : March 2013 Julius-Kuhn Institute (JKI), Berlin-Dahlem, Germany

INFLUENCE OF AUTRALIAN DESERT DUST ON MARINE IRON CHEMISTRY AND BIOAVAILABILITY TO PHYTOPLANKTON

Christel Hassler[1,2]*, Louiza Norman[2], Veronique Schoemann[3]

[1]Institute F.-A. Forel, University of Geneva, Geneva, 1290, Switzerland
[2]University of Technology Sydney, Sydney, 2007, Australia
[3]Free University of Brussels, Brussels, 1050, Belgium
*Christel.Hassler@unige.ch

Atmospheric dusts are globally the largest input of iron into the ocean. In up to 40% of the ocean, iron caps the rate of primary productivity with impact for biodiversity, ecosystem functioning and climate. In iron-limited regions, dust input could potentially relieve iron limitation and enhance phytoplankton growth. This work explores this hypothesis by quantifying the impact of two Australian desert dusts on iron chemistry, bioavailability and the growth of phytoplankton. For that purpose, experiments with pure cultures of an Antarctic diatom (*Chaetoceros simplex*) and two natural assemblages from the Tasman Sea and the Sub-Antarctic Zone were carried out. Although less bioavailable than inorganic iron, iron associated with atmospheric dust was significantly bioavailable (20-40 %), representing an iron source able to sustain phytoplankton growth. Measurement of iron chemistry following wet dust deposition simulation using rainwater demonstrated that just 0.6 to 1.1 % of the iron associated to the dust was released in solution (< 0.2 µm), of which - 0.2 to 0.5 % were soluble (< 0.02 µm). Most of the organic ligands detected by competitive ligands exchange adsorptive voltammetry were in the soluble fraction, whereas most of the electrochemically humic-like material was in the colloidal fraction. Exposure to UV light, slightly decreased ligand concentration as well as their conditional stability constant for iron binding, suggesting that photochemistry occurring during atmospheric transport might be important to determine the fate of iron associated to dust. Results are discussed considering the seasonality and average dust input to the Tasman Sea.

TESTING THE PERFORMANCE OF CURRENT DUST EMISSION SCHEME FROM A BOX AND CLIMATE MODEL PERSPECTIVE

Karsten Haustein, James King, Giles Wiggs, David Thomas, Richard Washington

Oxford University, School of Geography and the Environment, Oxford, OX1 3QY, UK

Dust emission schemes in climate models are relatively simple and are tuned to represent observed background aerosol concentrations many of which are many thousands of kilometres from source regions. Representations of dust emission in the models were developed from idealised experiments such as those conducted in wind tunnels. Improvement of current model dust emission schemes has been difficult to achieve because of the paucity of observations from key dust sources. The Dust Observations for Models project (DO4Models) was aiming on gathering data from source regions at a scale appropriate to climate model grid box resolution (12x12km grid setup).

Here we present (1) the results of 1D box model simulations using three commonly used parameterizations for the horizontal and vertical dust emission flux, and (2) HadGEM3 regional climate model simulations using the current model setup for dust emissions. We are comparing both models with Do4Model field campaign data retrieved over a fairly typical dust source.

The box model performance is tested using observed soil moisture content, aerodynamic surface roughness, shear velocity, and soil properties. Results for the first part of the field campaign suggest that all current dust emission schemes do not capture the observed emission flux well. The saltation flux is hugely overestimated, whereas the vertical flux is moderately overestimated. The choice of the sand transport, soil moisture correction and roughness correction scheme is important but insufficient to bring modeled fluxes into agreement with observed dust fluxes. Potential reasons for the diagnosed mismatch are discussed and the impact of spatial averaging over the 11 field sites within the g12x12km grid is evaluated. Furthermore, it is tried to answer the question whether the application of the dispersed soil size distribution increases the performance of the emission schemes over the typically used undisturbed soil size distribution provided from soil database.

HadGEM3 is tested with regard to its capability to reproduce the observed meteorological conditions. Very good agreement with regard to the magnitude of the diurnal cycle in 10m wind speed, wind gusts and surface shear stress is found. The onset of the breakdown of the nocturnal low-level-jet is out of phase by an hour, but overall the model performance is sufficient to focus on the shortcomings of the deployed dust emission scheme which is found to be the largest source of uncertainty with regard to the simulated dust emission flux. Given the multiple tuning choices, box and climate model emission fluxes differ considerably.

DUST EMISSION FROM DEEP CONVECTION AND LOW-LEVEL JETS OVER WEST AFRICA DURING SUMMER

Bernd Heinold[1]*, John H. Marsham[2], Peter Knippertz[2,3], Stephanie Fiedler[2], Nick S. Dixon[2], Kerstin Schepanski[1], Benoit Laurent[4], I. Tegen[1]

[1]*Leibniz Institute for Tropospheric Research, Leipzig, 04318, Germany*
[2]*School of Earth and Environment, University of Leeds, LS2 9JT,United Kingdom*
[3]*Karlsruhe Institute for Technology, Karlsruhe, 76131, Germany*
[4]*Laboratoire Inter-universitaire des Systèmes Atmosphériques, Laboratoire mixte Paris VII-UPEC-CNRS, UMR 7583, Créteil, France*
**heinold@tropos.de*

Recent field observations have confirmed the role of convective cold pools and the breakdown of low-level jets (LLJs) as key meteorological drivers of dust emission over summertime West Africa, the world's largest source of airborne mineral dust.

This study uses 40-day convection-permitting simulations from the Met Office Unified Model to drive offline dust emission computations with three different source descriptions. Physically-based algorithms are used to detect cold-pool and LLJ-generated dust events and quantify their relative importance. Approximately 40% of the modelled dust emission originates from cold pools and 40% from LLJs, confirming the importance of these mechanisms. About half of the cold pool emission is linked to a newly identified mechanism where aged cold pools form a jet above the nocturnal stable layer. Models with parameterised convection largely fail to capture the cold-pool based emission and whether convection is parameterised or explicit is much more important than which source description is used. The absence of dust emission by cold pools in models with parameterised convection will cause major biases in all global dust models. Approximately 20% of the modelled dust emission is potentially related to other meteorological mechanisms. These fractions are consistent with new observations from the central Sahara.

LLJ emission tends to occur in the morning and cold-pool emission in the afternoon, evening and night. 60% of the morning-to-noon but only 10% of the afternoon-to-nighttime emission occurring under clear-sky conditions will result in potentially large biases in satellite-based studies of dust emission. For regional and global dust modelling, the results demonstrate the need of realistically representing moist convection and nocturnal stable stratification.

Heinold B., Knippertz P., Marsham J. H., Fiedler S., Dixon N. S., Schepanski K., Laurent B., Tegen, I. (2013). The role of deep convection and nocturnal low-level jets for dust emission in summertime West Africa: Estimates from convection-permitting simulations, J. Geophys. Res.-Atmos., 118(10), 4385-4400, doi:10.1002/jgrd.50402.

LARGE EDDY SIMULATIONS OF THE NOCTURNAL LOW-LEVEL JET OVER DESERT REGIONS

Bernd Heinold[1]*, Peter Knippertz[2,3], John H. Marsham[2]

[1]Leibniz Institute for Tropospheric Research, Leipzig, 04318, Germany
[2]School of Earth and Environment, University of Leeds, LS2 9JT,United Kingdom
[3]Karlsruhe Institute for Technology, Karlsruhe, 76131, Germany
*heinold@tropos.de

Nocturnal low-level jets (NLLJ) are commonly found above the stable boundary layer over land, forming due to frictional decoupling of air layers above the nighttime inversion. The morning breakdown of NLLJs by dry convection can lead to strong near-surface winds. Over the Sahara, the world's largest source of airborne mineral dust, this phenomenon is particularly important for dust emission and transport.

We present the first detailed large-eddy simulations of dust-generating NLLJs using the UK Met Office Large-Eddy Model (LEM). Sensitivity studies are used to investigate two of the key controls of the NLLJ: surface roughness and Coriolis force. Functional relationships derived from the LEM results help to identify optimal latitude-roughness configurations for a maximum NLLJ enhancement (difference between evening and morning wind speeds). Ideal conditions are found in regions between 20°N and 30°N with roughness lengths >0.01 cm providing long oscillation periods and strong jet amplitudes. NLLJ enhancements reach up to 3.5 m s^{1} for typical surface temperature evolutions and geostrophic winds of 10 m s^{-1}. The findings are largely consistent with results from a theoretical NLLJ model applied for comparison. The results demonstrate the important role of latitude and roughness in creating regional patterns of the NLLJ influence. Combining the functional relationships and high-resolution roughness data over the Sahara gives good agreement with the location of morning dust uplift in satellite observations. The large-eddy simulations show the importance of wind shear for the NLLJ evolution and generation of peak near-surface winds. It is shown that with decreasing latitude the NLLJ evolution is slower and, therefore, shear-induced mixing is weaker. This allows a more stable nocturnal stratification to develop and therefore a later, more abrupt and more intense NLLJ breakdown in the morning with stronger gusts, which can compensate for the shorter NLLJ oscillation period that leads to a weaker jet maximum.

Recent global and regional dust models still largely fail to reproduce the typical peak in near-surface wind speeds caused by the morning breakdown of the nocturnal LLJ due to insufficiencies in the turbulence parameterization, vertical resolution, and the representation of surface roughness. The findings presented here can serve as first step towards a parameterization to improve the representation of LLJ effects in coarser-resolution models.

DOWNTOWN ULTRAFINE PARTICLES RELATED TO METEOROLOGICAL AND DISPERSION CONDITIONS

Libor Hejkrlík*, Helena Plachá, Pavel Jůza

Czech Hydrometeorological Institute, Ústí nad Labem, 400 01, Czech Republic
**hejkrlik@chmi.cz*

The project "UltraSchwarz" (Ultrafine Particles and Health in the Erzgebirgskreis and Ústí Region) is a cross-border cooperation between the Free State of Saxony and the Czech Republic supported by the EU program Ziel 3. It aims to measure ultrafine particles (UFP) at Annaberg-Buchholz (D) and Ústí nad Labem (CZ) in order to analyse the association between UFP, other air pollutants, meteorological parameters and human health.
Regional background monitoring station Ústí nad Labem is run by the Czech Hydrometeorological Institute (CHMI) within the national Air Quality monitoring network. It is localized in the Elbe river valley on the plain terrain in the very centre of a city of ca 100.000 inhabitants, surrounded by administrative and commercial built-up area, including housing units. The measurement of UFP is an extra program planned until 2014. Meteorological data for this study were obtained at an automated meteorological station of CHMI in the same valley some 5 km up the river, except of sunshine duration, measured at a professional meteorological station of CHMI ca 4 km uphill.
A scanning mobility particle sizer (SMPS) developed by TROPOS Leipzig has been deployed for measuring UJP in seven uneven particle size classes between 10 and 800 nm. For every day in period June 2012 to August 2013 five simple statistical moments were calculated on the conditions that at least 16 hourly measurements of UJC existed per day. At the monitoring station there were available daily values of nine other pollutants including soot (PM_1 BC). The set of daily meteorological characteristics consisted of ten parameters. As a description of the dispersion conditions in the surface layer of the atmosphere was used semiempirical index DI that has been routinely issued by the branch of CHMI in Ústí nad Labem since 1988.
The preliminary prospection of data by linear correlation matrix showed that there was no apparent difference in behaviour of the statistical moments. Mean, median, maximum, variance and geometric mean were in respective size modes highly intercorrelated. Fractions of UFP greater than 100 nm behaved similarly to classic pollutants related to combustion and to traffic - PM, CO, NO, NO_X, NO_2 and SO_2, their high concentrations were associated with low temperature, high humidity and unfavourable dispersion conditions. Low values were registered in occurrence of high winds both in average and maximal sense. The nucleation mode was not surprisingly elevated in parallel with high O_3, high air temperature, long sunshine and low mean wind speed, showing no relation to dispersion conditions.

Birmili, W., Wiedensohler, A., Heintzenberg, J., and Lehmann, K. (2001): Atmospheric particle number size distribution in central Europe: statistical relations to air masses and meteorology, J. Geophys. Res., 106, 32005-32018

Woo, K. S., Chen, D. R., Pui, D. Y. H. and McMurry, P. H. (2001): Measurement of Atlanta aerosol size distributions: Observations of ultrafine particle events, Aerosol Sci. Tech., 34, 75-87

DRIFT OF SEED DRESSING CHEMICAL DUST FROM MAIS SEEDERS

Andreas Herbst[1]*, Roland Bahmer[2], Hans-Joachim Wehmann[1]

[1]*Julius-Kuehn-Institut, Institute for Application Techniques in Plant Protection, Braunschweig, 38104, Germany*

[2]*Centre for Agricultural Technology Augustenberg, Stuttgart, 70439, Germany*

**andreas.herbst@jki.bund.de*

In 2007 the Western corn rootworm (Diabrotica v. virgifera) appeared in maize crops in southern Germany. Since this beetle is classified as a quarantine pest in the EU member states, several control measures are stipulated, amongst them the seed treatment with insecticides. When the seeds were planted in spring 2008, thousands of honey bees were killed by residues of those insecticides. This was caused by the sedimentation of abrasion dust blown out from the fan outlet of sowing machines with vacuum singling. The dust drifted toward adjacent areas and contaminated flowering plants visited by the bees. In order to mitigate this environmental impact, German authorities decided to reduce the risk of drift from this kind of machines significantly.

A drift test method was developed by Julius-Kühn-Institut (JKI) to determine the dust drift potential from sowing machines. The core of that method is the metering of a fluorescent tracer dye into the fan of the seeder in order to represent the abrasion dust. The quantification of drift sediment is similar to spray drift measurements.

A number of sowing machines was tested by JKI with this method. It was shown that it is possible to modify this kind of sowing machines so that the total drift sediment can be reduced to an acceptable limit. A drift reduction of at least 90% compared to conventional maize seeders with vacuum singling is required to be registered in an official JKI list “Drift reducing maize seeders”.

The experiences with the measurements show that the presence of waste air deflectors only does not allow assuming of sufficient drift reduction. Tests are essential.

A new test method for measuring dust drift potential based on a test bench was developed by. Fist studies are presented comparing this method with field test results.

HALOGENATED AND ORGANOPHOSPHORUS FLAME RETARDANTS ON PARTICLES IN THE ARCTIC ATMOSPHERE

Mark Hermanson[1]*, Amina Salamova[2], Ronald A. Hites[2]

[1]*The University Centre on Svalbard, Longyearbyen, NO-9171 Svalbard*
[2]*School of Public and Environmental Affairs, Indiana University, Bloomington, Indiana 47405 USA*
**markhermanson@me.com*

The use of most polybrominated diphenyl ether (PBDEs) flame retardants (FRs) in consumer products and construction materials was banned by the European Union and phased out in the United States by 2008. PBDEs are now listed by the Stockholm Convention on Persistent Organic Pollutants in Annex A, which calls for elimination of their production and use. However, there is a continuing need for FRs due to stringent flammability standards both in the USA and Europe and, as a result, there may be a shift to using non-regulated FRs. Several replacement FRs have been recently detected in the environment, including brominated benzoate and phthalate esters and organophosphorus esters.

We collected high-volume air particle samples at a site in the high Arctic (78.22°N, 15.65°E, on Svalbard) during 2012-2013 for analysis of brominated FRs (BFRs) and organophosphorus FRs. Sample volumes typically ranged from 600 - 750 m^3. Some BDEs and other BFRs have been observed in this region in earlier research. The BFRs found most often and in greatest average abundance include BDE congeners 47 (0.69 pg m^{-3}), 99 (0.56 pg m^{-3}) and 209 (1.10 pg m^{-3}), collectively representing ~44% of total BDE; other chlorinated or brominated FRs found included 2-ethylhexyl-2,3,4,5-tetrabromobenzoate (TBB), *bis*(2-ethylhexyl)-tetrabromophthalate (TBPH), decabromodiphenyl ethane (DBDPE) and Dechlorane plus (DP). The concentrations ranged from 0.3 pg m^{-3} for DBDPE to 6 pg m^{-3} for TBB. The organophosphorus FRs found most often and in greatest abundance include *tris*(2-chloroethyl)phosphate (TCEP), *tris*(1-chloro-2-propyl)-phosphate (TCPP), *tris*(1,3-dichloro-2-propyl)phosphate (TDCPP), triphenyl phosphate (TPP), tri-*n*-butyl phosphate (TnBP), *tri*(butoxyethyl)-phosphate (TBEP), *tris*(2-ethyl-hexyl)phosphate (TEHP), and 2-ethylhexyl diphenyl phosphate (EHDPP). The concentrations of the OPFRs were often about 10 times or greater than any of the halogenated FRs. The most abundant OPFR average concentration was TnBP (145 pg m^{-3}) and ranged from 9 pg m^{-3} to 788 pg m^{-3}.

The BDEs with low concentration (< 0.05 pg m^{-3}) were congeners 10, 7, 30, 71, 85, 126, 154, 153, 138, 184, 181, 201, 204, 203, 196, 205, 208, 207; non-BDE BFRs with low concentrations included tetrabromo-*p*-xylene (pTBX) and pentabromo ethyl benzene (PBEB).

HEUBACH DUSTMETER

LEONHARD HEUBACH

Heubach GmbH, Langelsheim, 38685,Germany
leonhard.heubach@heubachcolor.de

What is the issue that the Heubach Dustmeter addresses?
As seed coating has greatly increased efficiency and decreased pesticide needs for the agricultural industry, it has also come under scrutiny from various stakeholders. Most prominently the topic of bee mortality and dust abrasion from coated seed has been at the focus of discussions among seed producers, seed coaters, planters and governments. The scale of this discussion has rippled through to the consumer, making the topic a hot item for the major producers of seed coatings in terms of product safety and corporate image, and as a result also corporate profitability.

Why is the Heubach Dustmeter unique and optimal for the Seed Coating Industry?
Aside from being formulated into the German Industry Norm for measuring general dust emissions (DIN55992-T1), the Dustmeter is unique in that it is the only dust measurement technology on the market for realistically determining the free-floating dust and abrasion particles caused by seed handling. It is the only dust measuring system that can consistently mimic the mechanical stress applied by seed handling scenarios, from the coating phase to the on-field application. Because of its precise reproducibility, reliability, and realistic simulation the Dustmeter has become the standard in dust measurement for the seed industry.

How does the Heubach Dustmeter work?
Precisely pre-defined mechanical stress conditions are applied to the sample through a rotating drum, which is subject to a constant airflow created by a vacuum pump. The vacuum causes abraded airborne particles to pass through a horizontally positioned glass bottle, which separates and collects coarse particles via gravity. Only airborne floating particles pass through this device to be collected by a filter and evaluated gravimetrically. A sophisticated mass flow controller allows user defined airflow speeds (measured in l/min) with outstanding precision. The drum rotation speeds and test duration, which are controlled via CPU, are variable as well.

Conclusion - Heubach Dustmeter creates Value for the Seed Coating Industry
The Dustmeter is a crucial tool for testing, developing, and optimizing high performance low dusting seed coating formulations - a key factor for the market success of a seed coating system. Heubach is proud to have become the standard reference in dust measurement for the industry, thus helping to ensure that the applied chemicals stay where they are intended to be, and where they can unfold their highest efficiency: on the seed.

COMPOSITION OF AIRBORNE DUST AND TIME SCALES FOR BUILDUP OF TRACE ELEMENTS IN SOILS

Todd K. Hinkley

U.S. Geological Survey, Denver CO 80225 U.S.A.
thinkley@usgs.gov

Airborne dust falling to earth has a chemical composition that, for major components, must reflect compositions of the common minerals of the crust of the earth[1] from which the dust originates. However, the amounts of trace elements in dust are greater, especially for fine, far-transported dust, and this has been true in pre-industrial as well as modern times, as evidenced in ice cores[2,3] and peat bogs[4]. We show that in a wide area of the U.S. southwest mineral dust deposited from the atmosphere has abundances of trace elements that are substantially larger than in average crustal material. "Enrichment factors" for trace elements may be up to 10 or more for coarse dust, and much larger than 10 for fine, far-transported dust. This apparently results in deposition of large masses of excess trace elements to the land surface. Times on the order of 50 Ky would apparently be required to double the typical bulk trace element concentration (masses) in a 10 cm thickness of surface soil (assumed to have the approximate composition of the upper crust). But because fine particles are dislodged from soil surfaces and re-suspended into the atmosphere[5], there is extensive recycling of trace elements, and some particles are exported to the ocean[6]. Therefore, trace element enrichment of soils would take longer. Although data are few, soils of the region are in fact only slightly enriched in trace elements[7]. The present rate of apparent deposition of excess trace elements by dust in the southwest is about 10-100 times the present rate at which they are emitted to the atmosphere through degassing by volcanoes[8], which are the only documented natural source of trace elements to the atmosphere and the surficial environment, and may be a main ultimate supply of trace elements to the recycling dusts. Allowing for the recycling of the trace element-rich atmospheric material that is deposited, the volcanic emission rate may point to a more realistic trace element doubling time for upper soil layers, of 500 to 5,000 Ky, beginning long before modern industrial times.

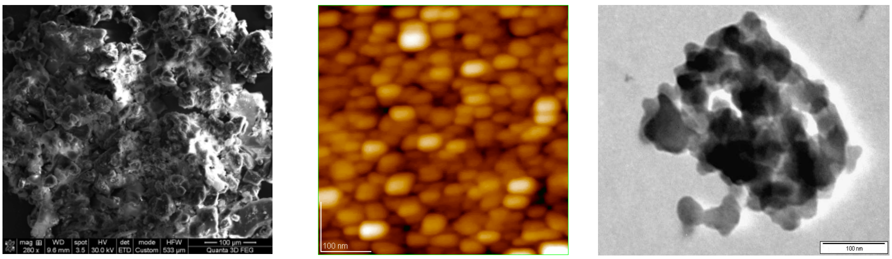
1. Bowen, H.J.M., (1979) Environmental Chemistry of the Elements, Academic Press, London, 333 pp.
2. Vallelonga, P., Gabrielli, P., Rosman, K.J.R., Barbante, C., Boutron, C., (2005). Earth Plan. Sci. Lett., 32, L01706, doi:10. 1029/2004GL021449.
3. Matsumoto A., Hinkley T. K. (2001). *Earth Plan. Sci. Lett*., 186, 33-43.
4. Kylander M.E., Weiss D.J., Martinez-Cortizas B., Spiro R., Garcia-Sanchez, B.J., Coles (2005). Earth Plan. Sci. Lett., 240 467-485.
5. Lal, D., (2007). Earth Plan. Sci. Lett. 264, 177-187.
6. Muhs, D.R., Budahn, J., Reheis, M., Beann, J., Skipp, G. Fisher, E., (2007). J. Geophys. Res. 112, D13203, doi: 10.1029/2006JD007577.
7. Goldstein, H., Reynolds, R., Reheis, M. Yount, J. Lamothe P., Roberts, H. McGeehin, J., (2005). Particle size, CaCO3, chemical, magnetic, and age data from surficial deposits in and around Canyon lands National Park, Utah, U.S. Geological Survey Open-File Report 2005-1186, version 1.0.
8. Hinkley, T.K., Lamothe, P.J., Wilson, S.A., Finnegan, D.L., Gerlach, T.M., (1999). Earth Planet. Sci. Lett. 170, 315-325.

AIR INDUCED NANO - FEATURES DUE TO THE URBAN STREET DUST

Alexandra Gertrud Hosu Prack[1]*, Ioan Petean[1], George Arghir[2], Dana Florina Muntean[3], Maria Tomoaia Cotisel[1]

[1]*Babeş-Bolyai University, Faculty of Chemistry and Chemical Engineering, Cluj - Napoca RO-400084, Romania*
[2]*Technical University of Cluj - Napoca, Faculty of Materials Science and Engineering, Cluj - Napoca RO-400641, Romania*
[3]*Environment Protection Agency, Cluj-Napoca, RO-400609, Romania*
**pgertrud@gmail.com*

Urban street dust (SD) is able to generate mineral floating particles (MFP) into the air (Giugliano et.al. 2005, Hosu-Prack et.al. 2010). MFP particles have usually a wide range of sizes (Joshi et.al. 2009). MFP were monitored and collected by automatic stations in Cluj-Napoca, Romania. The air induced nano-structural features were investigated by XRD and SEM - EDX analysis. Results prove that both, SD and MFP, have a similar composition, namely quartz, clay particles (e.g. muscovite and kaolinite), calcite and trace of lepidocrocite. Fine micro scaled particles are observed in Figure 1a. Quartz and clay nanoparticles were found in SD sample as well as in MFP, Figure 1b and 1c. The AFM investigation reveals a nano- size range for quartz particles between 80-90 nm diameter, and 40-60 nm diameter for clay particles (Figure 1b). Similar values were obtained by TEM microscopy (Figure 1c). The high resolution microscopy results were confirmed by the values obtained by Scherrer formula applied to the XRD patterns. Nano-minerals found in MFP were induced in air by the street dust.



a b c

Fig. 1. MFP microscopic aspect: a) SEM image of fine micro-particles and b) AFM topography image of nano-particles, and c) TEM image of nano-particles.

Giugliano M., Lonati G., Butelli P., Romele L., Tardivo R., Grosso M. (2005). Fine particulate (PM2.5-PM1) at urban sites with different traffic exposure. Atmospheric Environment, 2421-2431.

Hosu-Prack A.G., Petean I., Arghir G., Bobos L.D., Tomoaia-Cotisel M. (2010). Particulate matter found in urban street dust. Studia Chemia, 93-104.

Joshi U.M., Vijayaraghavan K., Balasubramanian R. (2009). Elemental composition of urban street dusts and their dissolution characteristics in various aqueous media. Chemosphere, 526-533.

LONG-RANGE TRANSPORT OF EOLIAN DUST OBSERVED IN TAIWAN: EAST ASIAN VERSUS NON-EAST ASIAN SOURCES

Shih-Chieh Hsu[1]*, Chih-An Huh[2], Chuan-Chou Shen[3], Natalie Mahowald[4]

[1]*Trace Element Lab (TEL), Research Center for Environmental Changes (RCEC), Academia Sinica*
[2]*Institute of Earth Sciences, Academia Sinica*
[3]*High-precision mass spectrometry and environment change lab (HISPEC), Dept. Geosciences, National Taiwan University*
[4]*Department of Earth and Atmospheric Sciences, Cornell University*
**schsu815@rcec.sinica.edu.tw*

Long-range transport of eolian dust were continuously monitored in 2010 at two background sites around Taiwan by collecting aerosol samples with Hi-volume TSP samplers. One site is on an offshore island, Pengchiayu (PCY; 25.62°N, 122.07°E; 100 m above sea level) in the southern East China Sea, which facilitates the observation of East Asian dust from North China and Mongolia. The other site is at Mt. Lulin (MLL; 23.47°N, 120.87°E; 2862 m a.s.l.) in central Taiwan, which facilitates the observation of dust transported from regions further beyond East Asia. In this study, all samples were analyzed for elemental composition, ^{7}Be and ^{210}Pb, while selected samples were also analyzed for isotopic compositions of Sr, Nd and Pb.
During March 20-23, 2010, East Asia witnessed the largest dust storm ever recorded in the region, resulting in Al concentrations up to 50 μg/m^3 at PCY on March 21 and 22 (Hsu et al., 2013). However, this dust event was not eminent at MLL where the time series of Al showed more pronounced peaks on March 10-11 and 26-27 instead (Hsu et al., 2012). It is noteworthy that Al concentration at MLL correlated strongly with ^{7}Be, a cosmogenic radionuclide that is often used as a tracer for air masses downwelled from lower stratosphere-upper troposphere. The source and transport pathway of the dust observed at MLL were investigated with a multitude of approaches including trajectory clustering, CALIPSO lidar, model simulation and isotope analyses for aerosol provenance. All results support that eolian dust collected at MLL primarily originated from North Africa and Middle East, rather than East Asia, and was transported mainly in the free troposphere by the Westerlies. Source apportionment by the MATCH model showed that East Asian dust is significant only in a very restricted area in the northwestern Pacific but it contributes little to the North Pacific dust deposition. Our ^{87}Sr/^{86}Sr and $\varepsilon_{Nd}(0)$ data clearly indicate that the MLL and PCY dust samples have vastly different provenances, with the MLL samples resembling those measured in northeast Africa (Scheuvens et al., 2013) and the PCY samples carrying isotopic signatures of East Asian dusts.

Hsu, S.C., et al., (2012). Dust transport from non-East Asian sources to the North Pacific. Geophys. Res. Lett. 39, L12804, doi:10.1029/2012GL051962.

Hsu et al., et al. (2013). A super Asian dust storm over the East and South China Seas: Disproportionate dust deposition. J. Geophys. Res. 118, 7169-7181, doi:10.1002/jgrd.50405.

Scheuvens D., et al., (2013). Bulk composition of northern African dust and its source sediments - A compilation. Earth-Sci. Rev. 116, 170-194.

SMALLER MASS GAIN: A CHALLENGE TO THE AEROSOL SAMPLING AT WORKPLACES

Fengxia Hu[1], Zhenglun Wang[1], Jiaojun Liang[2], Geshi Mao[2], Guilin Yi[2], Michael Koob[3], Weihong Chen[1], Dirk Dahmann[3], Lei Yang[1]*

[1]*Department of Occupational Health, Tongji Medical College HUST, Wuhan, 430030, China*
[2]*Wuhan Institute for Occupational Disease Control, Wuhan, 430015, China*
[3]*Institut für Gefahrstoff-Forschung der Berufsgenossenschaft BGRCI, Bochum, 44789, Germany*
**Leiyang@mails.tjmu.edu.cn*

The collected masses on filters in aerosol sampling at workplace becomes smaller, and it is a challenge to the gravimetric assessment. Therefore, mass gain and low limit of detection (LOD) were studied through a field investigation of particle sampling in two shipyards and by the analysis of dust sampling data in the industry of mines and factories. German, USA and Chinese respirable and total dust samples were gathered at the same time and workplaces in the different industries. In the shipyard survey a parallel sampling with normal and high flow rate cyclone FSP-2 and FSP-10 was conducted.

The mean mass gain of samples of AR (American respirable dust), AT (American total dust), GR (German respirable dust) and CT (Chinese total dust) from the mine/factory data was located at the microgram level with only the exception of GT, whose mean value reached to milligram. Original mass gain values of all the samples were in positive skewed distribution, still not in normal distribution but approached it after data log-transformation. Their standard deviations (SD) were larger when mass gain values were at the extreme of both smallest and largest, and became the lowest when mass gains were at the middle level, suggesting an optimal range.

As the shipyard survey showed, LOD values ranged from 0.36 to 0.78 mg for different filters. Taking 0.5 mg as an example, the coincidence rate with LOD was only 17.3% for American respirable dust from 269 samples in different industries and 12.2% for respirable fumes by normal flow cyclone FSP-2 in the shipyard. It became relatively higher for total dust, 91.4%, 69.9% and 62.1% for German, American and Chinese total dust in the industry samples. From the total particle samples of CT and GT in shipyard survey it was found to be 77.1% and 96.9%, respectively. To prolongate the sampling time to resolve the problem of smaller mass gain was difficult in practice, as the sampling time for GR and AR dust in the industry investigation were already 265 and 251 min. As showed by the sampling in shipyard A and B, the mass gain (0.97±0.40 mg, 1.61±0.86 mg) by FSP-10 was significantly larger than that (0.29±0.12 mg, 0.51±0.27 mg) by FSP-2, thereby the LOD coincidence rate increased to 73.9%. The amount of dust collected by high flow samplers was found to be above the LOD of silica analyses by infrared and X-ray diffraction. However, the high flow rate sampler FSP-10, with 50% cut-off size (50dae) at 4.8 mm, was confirmed to overestimate the exposure to respirable fraction up to 40%, compared to the ISO/CEN/ACGIH convention. Its sampling efficiency needs to be studied further, as an alternative in the modern workplace aerosol sampling.

IMPACT OF NATURAL SOURCES ON THE AIR QUALITY OF OPEN PIT MINING REGIONS

José I. Huertas, María E. Huertas*, Gabriel Cervantes, Jenny Díaz

Automotive Engineering Research Center, CIMA of Tecnológico de Monterrey,
Eduardo Monroy Cárdena, No 2000, CP 50110, Toluca, México
**elena.huertas@invitados.itesm.mx*

Particulate matter is the main air pollutant in open pit mining areas. To assess the environmental impact of the mining activities well accepted models that simulate the dispersion of the particles are used. These models report the particle concentration as function of the measured meteorology and the estimated particle emissions. When the results obtained through simulation are compared with the particle concentration measured in several sites, a coefficient of determination $R^2 < 0.75$ has been obtained. This result indicates that in the open pit mining areas could exist additional sources of particulate matter that has not been considered in the modelling process.

This work proposes that the unconsidered sources of emissions are of natural origin such as the resuspensión particulate matter due to the wind action over uncovered surfaces. Furthermore, this work proposes to estimate such emissions as function of the present and past meteorological conditions.

A multiple regression model was implemented in one of the world largest open pit coal mining region which it is located at northern of Colombia. Data from nine particle concentrations monitoring stations and 3 meteorological stations obtained from 2009 to 2012 were statistically compared. Additionally, it was implemented a statistical method to identify the meteorological variables that most contribute to estimate the measurements of particle concentration.

Results confirm the existences of a linear relation ($R^2 > 0.9$) between meteorological variables and particulate matter concentration being temperature and humidity the meteorological variables that contribute most significantly in the variance of the particulate matter concentration.

METHODOLOGY TO DETERMINE DUST IMPACT AREA IN UNPAVED ROAD

José I. Huertas*, María E. Huertas, Laura Betancur

Automotive Engineering Research Center, CIMA of Tecnológico de Monterrey,
Eduardo Monroy Cárdena, No 2000, CP 50110, Toluca, México
**jhuertas@itesm.mx*

Wind action and vehicles that travel through uncovered surface are the main causes of air pollution by particulate matter around unpaved roads. There are multiple applications where it is needed to determine the impact area; this is the case of open pit mining regions and exploitation of oil where environment authorities force companies to compensate the environmental damage. This work describe a simplify methodology to determine the area of impact using data input related to meteorology of the region, traffic flow and fines content. The methodology was developed based on obtained results from the air quality model AERMOD under different scenarios applied in unpaved roads of oil extraction companies in Colombia. The particulate matter concentration profile (C) were adjusted to the function $C=Z\,\Gamma(\alpha, \beta)$ where β is a parameter proportional to the annual wind speed, $\alpha = 0.1$ and Z is proportional to the emission of particulate matter. Results were compared with experimental measurements and the air quality standard to determine the area of impact.

EFFECT OF TERRAIN RELIEF ON THE TRAMSPORT OF DUST AEROSOL

Peter Israelevich

Department of Geophysics and Planetary Sciences, Tel Aviv University, Tel Aviv, 69978, Israel
**peteri@post.tau.ac.il*

Aerosol transport paths and their seasonal variability are primarily determined by two independent factors: (a) geographical distribution of dust sources and their strength seasonal dependence, and (b) seasonal changes in the atmospheric circulation. However, the terrain relief may also affect the aerosol propagation. First, some places may play role of certain traps where the aerosol arrived from distant regions can be accumulated. This, for example, can happen in valleys when the dust-carrying air flow reaches them. Second, the relief can channelize the dust-loaded air mass flow resulting in appearance of predominant transport path.

In this paper, we will consider both the examples of aerosol traps and aerosol transport channels associated with relief. Accumulation of the desert dust occurs in Po valley in front of Alps as the dust-carrying air flow from North Africa reaches them and slows. Red Sea also represent a trap for dust aerosol. Atlas, Ahaggar and Tibesti mountain chains are located on the way of northward flow of dust containing air masses from the major sources of Saharan desert aerosols. This constrain results in two enhances transport channels - one through the passage between Atlas and Ahaggar mountains, and another between Ahaggar and Tibesti.

CONCENTRATIONS OF MANGANESE PARTICULATES IN AMBIENT AIR NEAR WAREHOUSED CRUSHED METALS IN NORTHEASTERN OHIO, USA

Alan M. Jacobs

Department of Geological & Environmental Sciences, Youngstown State University, Youngstown, Ohio 44555, USA
amjacobs@ysu.edu

East Liverpool, Ohio, a town along the Ohio River in northeastern U.S., is the site of two main sources of air pollution: the WTI hazardous waste incinerator and the SH Bell Company terminal, a raw products storage and packaging operation that warehouses crushed metals. Air monitoring stations in the town set up by the Ohio Environmental Protections Agency (OEPA) to monitor stack emissions from the incinerator, recognized that the SH Bell facility, rather than the waste incinerator, was the dominant source of metallic particulates. The fear was the possibility of adverse health impacts from chromium, lead, arsenic, and cadmium. Those metals, however, are present in ambient air at acceptable levels. What is a concern is the presence of manganese.

Manganese is an essential micronutrient. Healthy adults ingest daily 3,800 micrograms (μg) in food and another 8 μg in water [1]. Inhaled magnesium particulates of 2,000 and above micrograms per day (0.1 mg/m^3 x 20 m^3/day), however, can produce adverse health effects (exceeding the NOAEL of 0.1 mg/m^3).

The U.S. Agency for Toxic Substances and Disease Registry (ATSDR) summarized average human exposure to manganese in air[1]. An adult has an inhalation daily intake of manganese of 0.46 μg from "unpolluted" air. Workers in metal working industries are normally subject to higher intakes and in the metals mining industries even higher.

ATSDR also summarizes the health risks to humans of inhaled magnesium particulates with chronic exposure[1]: NOAEL with $\leq$ 0.1mg/m^3; 0.1 to 1.0 mg/m^3 with less serious LOAEL, producing mostly neurologic disorders; and 1.0 to 10.0 mg/m^3 with more serious LOAEL, producing mostly reproductive disorders.

Samples provided by the OEPA to the author collected from April 2009 to September 2012 at one outdoor station in East Liverpool showed manganese concentrations of 1.0 to 8.7 $\mu g/m^3$, or 0.0010 to 0.0087 mg/m^3 (significantly below the NOAEL). OEPA samples were measured spectroscopically by Inductively Coupled Plasma (ICP-AES) and used to develop correlation files for x-ray fluorescence (XRF) on duplicate samples for additional testing.

1. US Dept of Health and Human Services, Public Health Service, ATSDR (2012). Toxicological Profile for Manganese, 556 pp plus appendices.

SAHARAN DUST: A SOURCE OF BIOAVAILABLE IRON FOR THE MARINE UNICELLULAR DIAZOTROPHIC CYANOBACTERIUM *C.WATSONII.*

Violaine Jacq[1,2]*, Céline Ridame[1,2], Fanny Kaczmar[1,2], Stéphane L'Helguen[3], Saliot Alain[1,2]

[1]*CNRS/IRD/MNHN/UPMC, LOCEAN : Laboratoire d'Océanographie et du climat : Expérimentation et approche numériques, UMR 7159, Paris, 75005, France*
[2]*Sorbonne Universités, UPMC Univ Paris 06, UMR 7159, LOCEAN, Paris, 75005, France*
[3]*Université de Brest, CNRS/IRD, UMR 6539, LEMAR, OSU-IUEM, Plouzané, 29280, France*
**violaine.jacq@locean-ipsl.upmc.fr*

Marine diazotrophic cyanobacteria are able to use dissolved dinitrogen (N_2) as nitrogen source for primary production. These cyanobacteria play a key role in the global carbon and nitrogen cycles as they contribute to significantly increase the oceanic N pool and thus primary production and carbon export to the deep ocean. We have recently shown than Fe bioavailability can control the growth and N_2 fixing activity of the open ocean unicellular diazotrophic cyanobacteria (UCYN) *Crocosphaera watsonii* (Jacq et al., 2014). As the main source of Fe to ocean surface waters is provided by aeolian dust deposition, we are wondering if Fe released by Saharan dust is bioavailable for *C. watsonii*. To address this issue, batch cultures of *C. watsonii* acclimated to low Fe concentration (2nM chelated with 200 nM of oxalate) were amended with simulated Saharan rainwater (250 mg.L^{-1} of non-processed Saharan dust with 1µM of oxalate). The percentage of Fe released from dust was 0.1 ± 0.02 % after 1 hour of contact time. 2% of the filtered (<0.2 µm) rainwater were added to triplicate cultures of *C. watsonii*, corresponding to an addition of 2.7 nM dFe. Cellular abundance increased quickly after dust addition (3 days) leading to a significant increase in the growth rate (0.43 d^{-1}) relative the unamended cultures (0.35 d^{-1}). N_2 and CO_2 fixing activities were also rapidly increased (1.4 and 1.2-fold respectively), probably due to an up-regulation of nitrogenase and photosynthetic Fe-containing enzymes. So, Fe-limited *C. watsonii* are able to take-up and rapidly use Fe released from Saharan dust. This supports previous observation of an increase in the abundance of UCYN-B, as *C. watsonii*, after addition of 2mg.L^{-1} of Saharan dust during bioassay experiments in tropical North Atlantic (Langlois et al., 2012). Based on our results, we could argue that atmospheric dust deposition in N-depleted surface oceanic waters could result in an increase in bioavailable N via the stimulation of UCYN growth and N_2 fixing activity.

Jacq V., Ridame C., L'Helguen S., Kaczmar F., Saliot A. (2014). Response of the unicellular diazotrophic cyanobacterium Crocosphaera watsonii to iron limitation. Plos one, In press.

Langlois R.J., Mills M.M., Ridame C., Croot P., LaRoche J. (2012). Diazotrophic cyanobacteria respond to Saharan dust addition. Mar Ecol Prog Ser, 1-14.

SIZE DISTRIBUTIONS AND MASS CONCENTRATIONS OF AMBIENT AEROSOL IN AL SAMHA, UAE

Cearum endi rae nullorro doloratus dellendit, tem quia sim rationet rem. Haruptatin nuscid que di nosam reste veliquundi raerit, voluptaquod quisqui iditaquam, que nonsectatis experep eruptaspis aute voluptatum estenet que recabor as nus, con ped magnihitate porerfe reperum est ius ma cus diti odici cusam est, con conseque ex et ad mi, solorernam, cum quam fugit et, quas ex elessum cum faccus ut eniendusant ilicius sus.

Tem dit, sitiusdae nim ditio quam et vel im endellaut ommosa ne pro culparchit am faccum que commossintet accullu ptatiam deri dusciet eum qui apidellut dis vellam erfero qui aut dignis di berchil iquaernati quam rerspic idebis reperun dissinctur sera volupta sintior enistrunt mo quiaspe llacidernam rerates sinctibust expelique que essit, audi dellor sam volut vitat quaspel impersperum quis dolupta eptatusci iligento illaces vitendis dolupta tiorrum fugit, si ommoluptat atet dem reperes dolupta tiusani ssimi, sit, sequi di te moluptaturem am dolorem vendicit pa venditas simpor sitatem fugit exerio moluptatem sum harum est, abore expligenis de plit quassit, am, unt expero consequi accum non por alia dolluptas eosant faces etus aut aut poruptatiate velecepel es dolo et alibus.

Simagnatiore odicipic tet quiatendus, ommodis quia expedis dolesecto cus.

Im et volor sam eum fugit faciis aditasp erferum fugiatu ritium quis doloreh enecto blab id mos escia sit mod molorempor sint alibus etur aliquis trupta derempore volorest ommoluptatur maxim quo ium estianda doluptia comnimi, sectem reped evel mint.

Hil ium et lab ipsum fugitium doluptamet quo bea dis pa doluptatist, et et aut dolorib usdaeprae nus velenit, sus adi aut andam imolorro quos aut volorem poruptatur, ad que moles alia evelluptat.

Il ilique provitatiis ent labo. Aximaxi mentiore odistio resequati ullore, occusan disitat mos consequias expe omnisto odit utatiis aut eum quos nonsequas aut lat evel id ut dolore, sit aut quis quiaspiti il modisim usandic ationse rissusae voluptas sendiciuntur sitaspi cilitaque dolorum ea sequi corenecus, offic tem fugita nus, volorem porempo riature icidiss itatur molorit, si is et autatibus dolupta alicimus moluptate volo estrum estis nos maio ium eiur, sunt ent.

Arciis magniet ene velibus essitas remoditia quodi volenihicae. Id magnatibus archilitatem volorporunt pe poreraturio. Ut quiamus reperati tem que verchillabo. Itas magnis ex ea doluptaspiet et lab ipit auditatur remost dero et occulparum ut vellam conseniet et abo. Nam il ipidebis doloritiur, omnieni derum esequaero essitas ducid et a neseque nus, seceper iaspisitatat exceatem hariore velitiumquat laceatur, corrovi taest, sunt quaspedicae proratis et is namenie nimpore rferiti orest, to bla enim aut od eatur sunt fuga. Ibusamus dentibus inis voluptatem saecae volliae dolupta tempore rfernam as dolo inveleserunt asimus autatas initas magnihiciam quassimaiore sam, sum harum quatis dolut alique rempe non nullanimus, quia autemo officae nonsequas et ut qui odist, nusae ommodia aut lacest, omnis dolenes molendi tatium voles doles

CHARACTERIZATION OF RESUSPENDED AND RESPIRABLE ROAD DUST

Beatrix Jancsek-Turóczi[1]*, András Hoffer[2], András Gelencsér[1,2]

[1]*University of Pannonia, Institute of Environmental Sciences, Veszprém, H-8200, Hungary*
[2]*MTA-PE Air Chemistry Research Group, Veszprém, H-8200, Hungary*
**turoczi.beatrix@indamail.hu*

Urban air quality is severely affected by traffic related particulate matter, including direct emissions from exhaust, brake pad, tire wear and road dust. Deposited road dust can be resuspended by moving vehicles or wind. Urban PM_{10} is identified as one of the most hazardous air pollutants on human health because it has no threshold limit for health effect. Prolonged exposure to respirable urban PM_{10} has been associated with adverse health effects and linked to an increased risk of respiratory illnesses (Pope, 1996). Resuspension of road dust have recently become an established source of urban PM (Chow and Watson, 2002). Insofar, sampling of resuspended road dust was usually performed by sweeping and sieving deposited road dust and the collected bulk samples were resuspended in the laboratory (Zhao et al, 2006). But these procedures were affected by the loss of fine particles. A recent study has shown that aerosol particles can be quantitatively resuspended from road surfaces using a specific sampling device (Amato et al, 2009). The objective of our research was to develop and construct a mobile resuspended road dust PM_{10} sampler which induced resuspension and collected particles on-line directly above road surfaces (Jancsek-Turóczi et al, 2013). A PARTISOL-FRM MODEL 2000 sampler was mounted on a mobile sampling cart which collected PM_{1-10} fraction in a cyclone separator and PM_1 samples on filters. The collection of bulk PM_{1-10} samples made it possible to deploy analytical methods which were not suited for the analysis of filter samples. The sampling unit was applied at several locations and seasons in Budapest, Hungary. The elemental and phase composition of resuspended dust samples were determined and potential source contributions were assessed, which facilitate source apportionment of urban PM_{10} that poses a potential health risk for the population.

Acknowledgements - The authors are grateful for the financial support of the grants of the Hungarian Research Fund OTKA K 101484.

Amato F., Pandolfi M., Viana M., Querol X., Alastuey A., Moreno T. (2009). Spatial and chemical patterns of PM10 in road dust deposited. Atmospheric Environment 43, 1650-1659.

Chow J.C. and Watson J.G. (2002). Review of PM2.5 and PM10 apportionment for fossil fuel combustion and other sources by the chemical mass balance model. Energy and Fuels 16, 222-260.

Jancsek-Turóczi B., Hoffer A., Nyírő-Kósa I., Gelencsér A. (2013). Sampling and characterization of resuspended and respirable road dust. Journal of Aerosol Sciences 65, 69-76.

Pope C.A. (1996). Adverse health effects of air pollutants in a non-smoking population. Toxicology 111, 149-155.

Zhao P., Feng Y., Zhu T., Wu J. (2006). Characterizations of resuspended dust in six cities of North China. Atmospheric Environment 40, 5807-5814.

LABORATORY STUDY OF LINEAR DEPOLARISATION RATIOS OF DIFFERENT SOIL DUST SAMPLES

Emma Järvinen*, Martin Schnaiter

Karlsruhe Institute of Technology, Eggenstein-Leopoldshafen, 46344, Germany
**emma.jaervinen@kit.edu*

The shape and composition of aerosol particles influence their scattering properties and thus their radiative impact on climate. The polarization lidar technique is a well-established method to study the composition and structure of different cloud types (e.g. Sassen, 1991). In order to retrieve information of the composition and microphysical properties of the aerosol particles measured with lidar techniques, an accurate knowledge of the depolarisation properties of different particle types must be known. This is achieved by performing numerical simulations or alternatively by performing laboratory measurements.

In our work we present a comprehensive dataset of depolarisation measurements of natural and synthetic soil dusts from different locations. The experimental results presented here were conducted at the AIDA (Aerosol Interaction and Dynamics in the Atmosphere) cloud chamber during several measurement campaigns between 2006 and 2013. A scattering and depolarisation instrument (Schnaiter et al., 2012) was used to measure the linear depolarisation ratio of soil samples at near exact backward scattering angle (178°). Additionally the samples were characterised using electron microscope images and by determining the mineralogical composition.

The different soil and dust samples showed different linear depolarisation ratios. Highest depolarisation ratio of more than 0.3 was measured with volcanic ash originated from Eyjafjallajokull-volcano. The dust samples from Asia had slightly lower depolarisation ratio of 0.25. Similar depolarisation values have been measured from Saharan dust layers (Freudenthaler et al. 2009). The synthetic soil samples of Arizona test dust and cubic hematite were weakly depolarising. Depolarisation ratios smaller than 0.1 were measured for both cases. In future work, we will combine the shape and surface properties measured with electron microscope with the depolarisation information. We also show how activation of the soil dust samples to cloud droplets and the resulting change in size distribution affect the measured depolarisation ratio.

Freudenthaler, V., Esselborn, M., Wiegner, M., Heese, B., Tesche, M., Ansmann, A., Müller, D., Althausen, D., Wirth, M., Fix, A., Ehret, G., Knipperzt, P., Toledano, C., Gasteiger, J., Garhammer, M. and Seefeldner, M. (2009).Depolarization ratio profilingatseveralwavelengths in pure Saharandustduring SAMUM 2006. Tellus B, 165-179.

SassenK. (1991). The Polarization Lidar Technique for Cloud Research: A Review and Current Assessment. AMS, 1848-1866.

Schnaiter, M., Büttner, S., Möhler, O., Skrotzki, J., Vragel, M., and Wagner, R. (2012) Influence of particle size and shape on the backscatteringlineardepolarisation ratio of smallicecrystals - cloudchambermeasurements in the context of contrail and cirrus microphysics, Atmos. Chem. Phys., 12, 10465-10484.

GLOBAL POTENTIAL OF DUST DEVIL OCCURRENCE

Bradley Jemmett-Smith[1]*, John Marsham[1], Peter Knippertz[2], Carl Gilkeson[3]

[1]*Institute of Climate and Atmospheric Science, University of Leeds, Leeds, LS6 4AQ, UK*
[2]*Institute for Meteorology and Climate Research, 76128 Karlsruhe, Germany*
[3]*Institute of Thermofluids, School of Mechanical Engineering, University of Leeds, Leeds, LS6 6RJ, UK*
**b.jemmett-smith@see.leeds.ac.uk*

Mineral dust is a key constituent in the climate system. Airborne mineral dust forms the largest component of the global aerosol budget by mass and subsequently affects climate, weather and biogeochemical processes. There remains large uncertainty in the quantitative estimates of the dust cycle.

Dry boundary-layer convection serves as an effective mechanism for dust uplift, typically through a combination of rotating dust devils and non-rotating larger and longer-lived convective plumes. These microscale dry-convective processes occur over length scales of several hundred metres or less. They are difficult to observe and model, and therefore their contribution to the global dust budget is highly uncertain. Using an analytical approach to extrapolate limited observations, Koch and Renno (2006) suggest that dust devils and plumes could contribute as much as 35%. Here, we use a new method for quantifying the potential of dust devil occurrence to provide an alternative perspective on this estimate.

Observations have shown that dust devil and convective plume occurrence is favoured in hot arid regions under relatively weak background winds, large ground-to-air temperature gradients and deep dry convection. By applying such known constraints to operational analyses from the European Centre for Medium Range Weather Forecasts (ECMWF), we provide, to the best of the authors' knowledge, the first hourly estimates of dust devil occurrence including an analysis of sensitivity to chosen threshold uplift.

The results show the expected diurnal variation and allow an examination of the seasonal cycle and day-to-day variations in the conditions required for dust devil formation. They confirm that desert regions are expected to have by far the highest frequency of dry convective vortices, with winds capable of dust uplift. This approach is used to test the findings of Koch and Renno (2006).

Koch J., Renno N. (2006). The role of convective plumes and vortices on the global aerosol budget. Geophys. Res. Lett., L18806.

FURNACE DUST UTILIZATION WITH USE OF PNEUMATIC INJECTION METHOD

Jan Jezierski*, Krzysztof Janerka

Silesian University of Technology, Department of Foundry Engineering, Gliwice, 44-100, Poland
**jan.jezierski@polsl.pl*

The problem of dust generation is widely present in steel and foundry plants around the world. All of the melting furnaces generate thousands of tons of dust every year. The dust itself still contains a lot of chemical elements (mostly iron and zinc) which can be returned back into the furnace increasing their content in metal bath or in final dust which then can be used as a raw material for zinc metallurgy industry. One of the method to do that is pneumatic powder injection with use of pneumatic feeder and injection lance at the end of the installation. The paper presents the theoretical approach as well as some industrial experiences of the authors on this field of pneumatic conveying applications. The benefits of the dust reuse have been presented as well as some limits. It has been stated that the pneumatic injection can be used to blow-in cupola dust again into the cupola, the electric arc furnace into it together with some carburizer and ferroalloy and slag foaming process with use of dust blown-in through injection lances.. The literature overview of this problem has been shortly presented, too. Along with the industrial examples, the theory of the gas-solids jet has been developed. The results show the importance of the critical jet radius to achieve the proper jet penetration inside the liquid metal. The literature and own authors' formulas have been validated by some model and real injection experiments. This complex approach has proven the potential of pneumatic powder injection method to utilize dust wastes in melting furnaces.

JezierskiJ., JanerkaK. (2011). Selected aspects of metallurgical and foundry furnace dust utilization. Polish Journal of Environmental Studies 20 (1), 101-105.

Jezierski J., Janerka K. (2011). Wastes utilization in foundries and metallurgical plants - selected aspects. 20th Anniversary International Conference on Metallurgy and Materials METAL 2011, 18. - 20. 5. 2011, Brno, Czech Republic.

Jezierski J., Janerka K. (2011). Wastes utilization in foundries and metallurgical plants with pneumatic conveying techniques - selected aspects. Interdisciplinary Environmental Review 12 (2), 154-165.

Jezierski J., Janerka K. (2008). Pneumatic powder injection technique as a tool for waste utilization. International Journal of Environment and Waste Management 2 (6), 636-646.

Fiore S., Chiara Zanetti M., Ruffino B. (2008). Waste characterization in steel casting and recycling opportunities in Europe. American Journal of Applied Science 5 (5).

Fiore S., Chiara Zanetti M. (2007). Foundry wastes reuse and recycling in concrete production. American Journal of Environmental Science 3 (3).

Zhang Huaiwei, Hong Xin. (2011). An overview for the utilization of wastes from stainless steel industries. Resources, Conservation and Recycling 55, 745-754.

Eisa E. Hekal, Salah A. Abo-El-Enein, S. A. El-Korashy, G. M. Megahed, T. M. El-Sayed. (2013). Journal of Thermal Analysis and Calorimetry114 (2), 613 - 619.

Holtzer M. (2007). Influence of the cast iron melting processes on environment using BAT. Archives of Foundry Engineering 7 (4).

ANALYSIS ON THE CHARACTERISTICS OF VERTICAL STRUCTURE OF SAND AND DUST IN A DUST STORM PROCESS BASED ON THE CALIPSO DATA

Jiang Xuegong[1]*, Chen Shoujun[2], Yun Jingbo[1]

[1]*Inner Mongolia Autonomous Regional Meteorological Observatory, Hohhot 010051, China*
[2]*Department of Atmospheric Sciences, School of Physics, Peking University, Beijing 100871, China*
**jiangxuegong@aliyun.com*

By using CAILPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations) data and MM5 numerical simulation output data, the characteristics of dusty layers vertical structure and its accompanying dynamic and thermal structure in a severe dust storm occurred from 19 to 22, March, 2010 in North China were studied. The result shown: In the mature period of dust storm, the dusty layer distributed almost in the whole troposphere from 2 to 9 km. The vertical mixture caused by the cold frontal uplifting and the sinking after the front induced a uniform distribution of dust particles. After that, in the long distance transportation period of dust, the dusty layer separated to two layers clearly, located at the lower troposphere (below 700hPa) and the middle upper troposphere (from 600 to 300hPa) respectively. In the mature, sustain and vanishing periods of the dust storm process, the weak vertical change of wind speed, potential temperature and equivalent potential temperature closely coordinated with the dusty layers. It indicates that the neutral mixed layer maintained in the dusty layer. Meanwhile, in the mature, sustain periods of the dust storm process, the evident tropopause fold and obvious declining of large potential vorticity appeared. It also was confirmed by the vertical distribution of the upper level jet stream, potential vorticity and specific humidity. According with it, when the tropopause sustained at a higher altitude, the dusty layers were expanded to a higher altitude also. Otherwise, the dusty layers were lower. It should noted that in the mature and sustain periods of the dust storm process, a banding area located at 40ºN from 7km to 9km appeared in the stratosphere. It indicates that in this dust storm process, parts of the dust particles were transported from troposphere to stratosphere. And it also formed a continued dust transportation belt in the stratosphere. It can be regarded as a straightforward and observational evidence to prove the troposphere-stratosphere transportation of dust aerosol and the transmission of dust aerosol in stratosphere.

Key wards: dust storm, dust particles, vertical structure, CAILPSO data.

ASSESSING THE DUST RADIATIVE EFFECTS AND FEEDBACKS BY USING COUPLED REGIONAL MODELS

Pedro Jiménez-Guerrero*, Rocío Baro, Juan P. Montávez

Physics Department, University of Murcia, 30100, Spain
**pedro.jimenezguerrero@um.es*

The study of the response of the aerosol levels in the atmosphere to a changing climate and how this affects the radiative budget of the Earth (direct, semi-direct and indirect effects) is an essential topic to build confidence on climate science, since these feedbacks involve the largest uncertainties nowadays. Air quality-climate interactions (AQCI) are, therefore, a key, but uncertain contributor to the anthropogenic forcing that remains poorly understood. To build confidence in the AQCI studies, regional-scale integrated meteorology-atmospheric chemistry models (i.e., models with on-line chemistry) that include detailed treatment of aerosol life cycle and aerosol impacts on radiation (direct effects) and clouds (indirect effects) are in demand.

In this context, the main objective of this contribution is the study and definition of the feedbacks in the meteorology-chemistry-aerosol-cloud-radiation system associated to the direct radiative forcing and the indirect effect caused by dust over Europe, using fully-coupled meteorology-chemistry model simulations with the WRF-Chem model run under the umbrella of AQMEII-Phase 2 international initiative. Simulations were performed for North Africa and Europe for the entire year 2010. A grid spacing of 23 km has been applied, with 30 vertical levels.

For analysing the direct radiative forcing (DRF), two different model setups have been considered: (a) simulations which do not account for any dust feedbacks (it will be the baseline case) and (b) simulations differing from the baseline case by the inclusion of the effect of dust on the radiation fluxes without, including effects of changed atmospheric dynamics (this will be defined as the DRF case). The differences in the surface level (DRF_srf) and TOA (DRF_TOA) radiation for a large dust episode covering Europe (2-15 October 2010) have been assessed. Also, for the indirect effect, we have compared the precipitation efficiency among the simulations in order to see the effect on the cloud condensation nuclei (CCN). The results indicate that areas with low dust concentrations present more than 50 W m^{-2} higher global radiation than those areas with a large dust load.

The simulations have been evaluated by comparing the aerosol optical depth (AOD) at different wavelengths against AERONET data (85 sites over the domain of study). AOD depends on particle size distribution, composition, mixing state, and hygroscopicity; therefore a comparison of modelled AOD with observations that have large spatial coverage and long duration can help to assess the ability of the model in capturing important dust properties.

POSITIVE RESPONSE OF INDIAN SUMMER RAINFALL TO ARABIAN DUST

Qinjian Jin*, Jiangfeng Wei, Zong-Liang Yang

The Department of Geological Sciences, The University of Texas at Austin, Austin, 78712, U.S.A
**jinqj10@utexas.edu*

Aerosols scatter and absorb solar radiation, thereby reducing its flux reaching the Earth's surface[1,2]. These processes not only affect temperature and pressure in the low troposphere, but also alter local and regional atmospheric circulations and precipitation[3-7]. Such aerosol effects depend on the spatial distribution of aerosols and their interactions with meteorological factors. Here, we study the impact of Arabian dust aerosols on the Indian summer monsoon (ISM) rainfall, employing 13-year datasets of satellite observations and meteorological reanalyses. Satellite-retrieved aerosol optical depth (AOD) shows the Arabian Sea (AS) experiences the highest aerosol loadings in the ISM season in each year. Correlation analyses and back-trajectory simulations indicate that high AOD over the AS is mainly due to the dust aerosols transported from the Arabian Peninsula (AP) by strong summer northwesterly winds (namely "Shamal"). Using AOD and surface-based rainfall observations datasets, we find for the first time that these aerosols over the AS and the southern AP are significantly correlated (R=0.5) with rainfall over central and eastern India during the ISM season. This correlation is attributed to aerosol-induced enhancement of the meridional thermal contrast, which in turn strengthens the ISM circulation and moisture transport from the AS to the Indian subcontinent. We further show that the interaction timescale between aerosols and the ISM rainfall is within one to two weeks. Our findings highlight the radiative effect of Arabian dust on the ISM large-scale circulation and rainfall on weekly timescales, and motivate more studies focusing on the contribution of Arabian dust aerosols to the observed ISM rainfall trend on longer (e.g. interannual and decadal) timescales.

Zhao C., Liu X., Leung L.R., Johnson B., McFarlane S.A., Gustafson W.I., *et al.* (2010). The spatial distribution of mineral dust and its shortwave radiative forcing over North Africa: modeling sensitivities to dust emissions and aerosol size treatments. *Atmospheric Chemistry and Physics*, **10**(18)**:** 8821-8838.

Chen S.Y., Huang J.P., Zhao C., Qian Y., Leung L.R., Yang B. (2013). Modeling the transport and radiative forcing of Taklimakan dust over the Tibetan Plateau: A case study in the summer of 2006. *J Geophys Res-Atmos*, **118**(2)**:** 797-812.

Ramanathan V., Crutzen P.J., Kiehl J.T., Rosenfeld D. (2001). Atmosphere - Aerosols, climate, and the hydrological cycle. *Science*, **294**(5549)**:** 2119-2124.

Ramanathan V., Chung C., Kim D., Bettge T., Buja L., Kiehl J.T., *et al.* (2005). Atmospheric brown clouds: Impacts on South Asian climate and hydrological cycle. *Proceedings of the National Academy of Sciences of the United States of America*, **102**(15)**:** 5326-5333.

Lau KM, Kim MK, Kim KM (2006). Asian summer monsoon anomalies induced by aerosol direct forcing: the role of the Tibetan Plateau. *Climate Dynamics*, **26**(7-8)**:** 855-864.

Bollasina M.A., Ming Y., Ramaswamy V. (2011). Anthropogenic Aerosols and the Weakening of the South Asian Summer Monsoon. *Science*, **334**(6055)**:** 502-505.

Zhao C., Liu X., Leung L.R. (2012). Impact of the Desert dust on the summer monsoon system over Southwestern North America. *Atmospheric Chemistry and Physics*, **12**(8)**:** 3717-3731.

DETECTING TRENDS OF GLOBAL AND REGIONAL AOD USING SEAWIFS, MISR, AND MODIS

QINJIAN JIN*, ZONG-LIANG YANG

The Department of Geological Sciences, The University of Texas at Austin, Austin, 78712, U.S.A
**jinqj10@utexas.edu*

The natural and anthropogenic aerosols can modulate Earth's weather and climate system by the radiative and microphysical effects[1-3]. Their long-term tendencies have great impacts on climate change[4,5]. However, significant discrepancies among different satellites, such as observing channels, spatial resolutions, and retrieval algorithms, result in contrasting trends on both regional and global scales[6,7]. Therefore, it is of great importance to employ multiple satellite-retrieved aerosol optical depth (AOD) products to get more robust trends. Here, three satellite sensors are used to detect the long-term aerosol trend from 2003 to 2012, and these three sensors are the Sea-viewing Wide Field-of-view Sensor (SeaWiFS), the Multi-angle Imaging SpectroRadiometer (MISR), and the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard Aqua. First, we investigate the global distribution of AOD samples size, which is a main source of discrepancies among these satellites. Second, the global AOD climatology is examined, showing consistent global AOD distribution. Finally, using monthly and daily AOD anomalies, all three datasets indicate the strongest consistent increasing AOD trends (0.01 AOD year^{-1}) in the Arabian Peninsula (AP), the Arabian Sea (AS), the Indian subcontinent, and south China, but decreasing trends in Europe, North America, northeast Asia, and the Sahel region with significance at 95% confidence level. We further show that the increasing trend in the AP, AS, and the Indian subcontinent can be attributed to high AOD "events", such as dust storms and biomass burning. However, the decreasing trend is due to "background" AOD changes in North America and Europe. Our findings address the consistent AOD trends detected by multiple satellite sensors on both global and regional scales, motivating additional studies of aerosols' impact on climate system on long-term (e.g. decadal) scales.

Wild M, Gilgen H, Roesch A, Ohmura A, Long CN, Dutton EG, et al. From dimming to brightening: Decadal changes in solar radiation at Earth's surface. Science 2005, 308(5723): 847-850.

Li ZQ, Niu F, Fan JW, Liu YG, Rosenfeld D, Ding YN. Long-term impacts of aerosols on the vertical development of clouds and precipitation. Nat Geosci 2011, 4(12): 888-894.

Fadnavis S, Semeniuk K, Pozzoli L, Schultz MG, Ghude SD, Das S, et al. Transport of aerosols into the UTLS and their impact on the Asian monsoon region as seen in a global model simulation. Atmos Chem Phys 2013, 13(17): 8771-8786.

Wang KC, Dickinson RE, Liang SL. Clear Sky Visibility Has Decreased over Land Globally from 1973 to 2007. Science 2009, 323(5920): 1468-1470.

Evan AT, Kossin JP, Chung C, Ramanathan V. Arabian Sea tropical cyclones intensified by emissions of black carbon and other aerosols. Nature 2011, 479(7371): 94-U119.

Hsu NC, Gautam R, Sayer AM, Bettenhausen C, Li C, Jeong MJ, et al. Global and regional trends of aerosol optical depth over land and ocean using SeaWiFS measurements from 1997 to 2010. Atmos Chem Phys 2012, 12(17): 8037-8053.

Mishchenko MI, Geogdzhayev IV, Rossow WB, Cairns B, Carlson BE, Lacis AA, et al. Long-term satellite record reveals likely recent aerosol trend. Science 2007, 315(5818): 1543-1543

MONITORING URBAN PARTICULATE MATTER ON A MOBILE PLATFORM: STATISTICAL TOOLS FOR HIGH FREQUENCY AND LARGE DATA ANALYSIS

Giovanna Jona Lasinio[1], Giorgia Rocco[1], Maria Giovanna Ranalli[2]*, Beatrice Moroni[3,4], Silvia Castellini[4], Stefano Crocchianti[4], David Cappelletti[3,4]

[1]*Dipartimento di Scienze Statistiche Università La Sapienza, Roma, 00185, Italy*
[2]*Dipartimento di Scienze Politiche Università degli Studi di Perugia, Perugia, 06123, Italy*
[3]*Dipartimento di Chimica, Biologia e Biotecnologie, Perugia, 06123, Italy*
[4]*Centro di Eccellenza SMAArt, Università degli Studi di Perugia, 06123, Italy*
**giovanna.ranalli@stat.unipg.it*

PMetro (www.pmetro.it) is a project that studies urban pollution dynamics in the town of Perugia (Central Italy) by exploiting a mobile platform. The innovative instrumental core of the project is based on an OPC (Optical Particle Counter) integrated on a cabin of Minimetro, a public transport system, that moves on a monorail on a line transect of the town. The OPC takes a sample of air every 6 seconds (~30 m spatial resolution) and counts the concentration of urban aerosols under 10 μm, classified into 22 dimensional size bins. The OPC records also the position and speed of the cabin, transmitted by the central control system. We propose a data exploration protocol that deals with the large amount of available data highlighting the specific features of each size channel. We adopt a functional data representation (Ramsay, Silverman 2005) of the spatio-temporal series combined with a cluster analysis to search for similarities among channels. The functional representation is based on a tensor product based spline and the cluster algorithm is the Partitioning around medoids (PAM) proposed by Kaufman and Rousseuw (1990). In this study we use three different sets of data from the PMetro project, each one related to a different time of the year: the first one from September 15th to 28th, 2012 (SEP), the second from January 3rd to 16th, 2013 (JAN) and the third one from May 1st to 13th, 2013 (MAY). The three time intervals are chosen as they are the longest consecutive periods available and because they relate to different seasons. After model selection, all space-time series (one for each size bin) are represented using a bivariate spline with 70 knots in time by 7 knots in space (one for each Minimetro station). These low rank representations of the space-time series produce maps that are sought to be classified in order to cluster the most similar ones. We find that the best number of clusters (choice based on silhouette statistic) for SEP is 3, while both JAN and MAY datasets are better classified in 4 clusters. An interesting pattern of all clusters is that they are all made of consecutive channels. For example, the first cluster for September includes channels from 0.28 to 0.70 μm, the second from 0.80 to 4.00 μm and the third from 5.00 to 9.00 μm.

Kaufman L., Rousseuw P.J. (1990) Finding Groups in data: An Introduction to Cluster Analysis. Wiley New York.

Ramsay J.O., Silverman B.W. (2005) *Functional Data Analysis*. Springer .New York.

MAGNETIC SUSCEPTIBILITY OF ROAD DEPOSITED SEDIMENTS AT A NATIONAL SCALE - RELATION TO POPULATION SIZE AND URBAN POLLUTION

Diana Jordanova*, Neli Jordanova, Petar Petrov

National Institute of Geophysics, Geodesy and Geography, Bulgarian Academy of Sciences
Acad. G. Bonchev str., block 3; 1113 Sofia, Bulgaria
**vanedi@geophys.bas.bg*

Road deposited sediments represent a sink for particulate anthropogenic hazardous compounds, which can be re-entrained in the air and severely increase the level of air pollution. Knowledge on the spatial distribution, amount, mineralogy and grain size of road deposited sediments in urban areas is essential for better environmental management and control of pollution related health risks. An economically effective and fast proxy method for spatial mapping and monitoring of the degree of anthropogenic pollution is magnetometry, which uses magnetic signature of solid matter to delineate hot spots with increased anthropogenic load. Temporal variations of mass specific magnetic susceptibility (X) of road deposited sediments from six cities in Bulgaria are obtained. No significant seasonal changes in X are revealed. The main magnetic mineral, identified through thermomagnetic analysis of magnetic susceptibility, is magnetite, except for dust samples from the city of Burgas, which contains also lithogenic titanomagnetite. There is good linear correlation ($R^2 = 0.5 - 0.7$) at $p<0.05$ level between mass specific magnetic susceptibility and the contents of Fe, Mn and PLI index of the fine mechanical fraction (d<63microns) of road dusts from all cities except Burgas. Higher negative correlation coefficient ($R^2 = - 0.71$) is observed between ARM and the contents of Cd and Pb, while the ratio ARM/X and Pb content shows $R^2 = -0.84$. It suggests that larger magnetic particles are emitted together with higher amounts of lead. It corresponds to the case of break/tire wear emission source of Pb, which is characterized by larger particle sizes for slow driving - braking conditions and vice versa. Factor analysis of the heavy metal and magnetic data reveal that the variability could be explained by four factors. The first one accounts for 31% of the total variance and is identified as break and tire wear emission source. The second factor explains 25% of the variance, non-uniquely identified as traffic-related, industrial or lithogenic source. The third factor (15% variability explained) has main loading for As, probably originating from fuel combustion and/or petrochemical industry. Statistically significant power law correlation is found between log-normally transformed values of mean magnetic susceptibility of road dusts and population size for urban areas with population between 680 and 1 420 000 inhabitants. The same relationship follow available published data for traffic-affected road dusts from Europe and China. The relationship proves that the magnetic signal of road deposited sediments is primarily related to traffic emissions. Further support for this statement is the correlation observed between mean annual NO_2 concentrations in big cities from Bulgaria and road dust susceptibility.

Acknowledgement-Thiscontributionissupportedbytheproject№BG051PO001-3.3-05/0001 „Science-Business", funded by the ESF, OP „Human Resources".

INDOOR AIR QUALITY IN INTENSIVE CARE UNITS - PHYSICAL AND BIOLOGICAL ANALYSIS

Sonia Regina Jurado*, Maria do Carmo Cardia Julião Freitas, Mário Augusto da Silva Freitas

Federal University of Mato Grosso do Sul, Três Lagoas, 79620-080, Brazil
Federal University of Mato Grosso do Sul, Campo Grande, 79070-900, Brazil
**srjurado@bol.com.br*

The World Health Organization (WHO)[1] recorded the contribution of a variety of disease risk factors and determined that indoor air pollution is the eighth most important risk factor, accounting for 2.7% of cases of diseases worldwide. A number of studies have indicated that indoor air pollutants with chemical[2] and biological[3,4] natures pose potential hazards to patients, medical staffs, and visitors in hospitals. This work aimed to evaluate the indoor air quality in the Intensive Care Unit (ICU) in five cities in the state of Mato Grosso do Sul, Brazil. Parameters of interest were indoor and outdoor temperature, relative humidity (RH), air speed, viable fungi, and indoor particulate matter (PM). The bacterium *Staphylococcus haemolyticus* was the most prevalent species, being found in ICU of all hospitals studied, followed by *Staphylococcus simulans*, which was positive in cultures of five hospitals. Regarding the analysis of fungi in indoor environments in ICUs, the most prevalent species was *Penicillium spp*, positive in six of the institutions studied, followed by *Curvularia spp* and *Mycelia spp* present in three institutions each. The air speed inside the ICU was zero in six of the seven institutions, demonstrating a very low turnover rate of indoor air. The RH of the indoor air of ICUs had an average of 14.3%, the recommended value ranges from 40% to 65%[5]. The average particulate matter in ICUs was 3.142 $\mu g/m^3$. For PM from the air as an indicator of the degree of air purity and cleanliness of the air-conditioned environment should be less than or equal to 80 $\mu g/m^3$[5], so the values found for the ICUs were almost 40 times higher than the recommended values. Evaluated environments did not comply with recommended values by current Brazilian law. The results allowed us to critically assess this legislation and put forward suggestions for establishing a specific resolution for hospital environments in Brazil.

1. World Health Organization (2008). Programmes and Projects: Indoor Air Pollution. Available from: http://www.who.int/indoorair/en. Accessed January 12, 2014.
2. Chen H.W., Chung C.Y., Lin H.T. (2009). Indoor Air Distribution of Nitrogen Dioxide and Ozone in Urban Hospitals. Bulletin of Environmental Contamination and Toxicology, v. 83, p. 147-150.
3 .Wan G.W., Chung F.F., Tang C.S. (2011). Long-Term Surveillance of Air Quality in Medical Center Operating Rooms. American Journal of Infection Control, v. 39, p. 302-308.
4. Napoli C., Tafur S., Montenegro L., Cassano M., Notarnicola A., Lattarulo S., Montagna M.T., Moretti B. (2012). Air Sampling Methods to Evaluate Microbial Contamination in Operating Theatres: Results of a Comparative Study in an Orthopaedics Department. Journal of Hospital Infection, v. 80, p. 128-132.
5. Brasil. Ministério da Saúde. Agência Nacional de Vigilância Sanitária (2003). Resolução nº 9.

MULTILAYERED TIO_2/VO_2 THIN FILMS AS GAS SENSORS AND STUDY OF THEIR COMBINED EFFECT IN THE DETECTION OF GASES

S. Kalaiselvam[1,2]*, J. Sandhya[2,3]

[1]*Department of Mechanical Engineering, Anna university, Chennai - 600 025, India*
[2]*Department of Applied Science and Technology, Anna university, Chennai - 600 025, India*
[3]*Centre for Nanoscience and Technology, Anna University, Chennai - 600 025, India*
**nanokalai@gmail.com, [3]jsanbiotech@gmail.com*

There is increasing concern about pollution all around and hence it becomes necessary to combat and analyze such polluting gas emissions. A multilayered gas sensor for detecting the presence of gases-hydrocarbons, nitrogen compounds, ,carbon monoxide in air is one such attempt. Hence the multilayer sensitivity of TiO_2/VO_2 to gas at various operating temperature and the effect of other process parameters (of reactive magnetron sputtering) like pressure, film thickness, etc is studied and optimized. The properties studied in the present research are gas sensitivity on the basis of temperature, film thickness and consequent properties like crystalline structure, grain size or amount of defects and impurities, thermochromic behaviour for gas detection and photocatalytic activity of the multilayer. Titanium dioxide thin films find applications in solid state gas sensor devices. Present study involves the study of gas sensing properties of Titanium dioxide deposited on VO_2. TiO_2 and VO_2 thin films are prepared by reactive magnetron sputtering technique with different doping concentrations. Vanadium dioxide (VO_2) nanowires are known as H_2 sensor by taking advantage of the metal-insulator transition phenomena of the material. Also Vanadium oxide thin films can be used for NO detection. Whereas VO_2 films are relatively soft and have lesser mechanical strength. But TiO_2/VO_2 would successfully act as a protective layer for VO_2.
Structural and morphological characterization studies are carried out by means of SEM, XRD and EDX in order to correlate structural properties with gas sensing behavior. This multilayer also has a high photoactivity that can be applied for biosensor. Gas-sensing characterizations towards hydrocarbons, CO and NO_2 would highlight interesting behavior of these TiO2/VO2 multilayers. The combination of TiO_2/VO_2 will lead to a multifunctional film deposition for thermochromic gas detection also.

1. Tian, W.C.; Ho, Y.H.; Chen, C.H.; Kuo, C.Y. (2013). Sensing performance of precisely ordered TiO2 nanowire gas sensors fabricated by electron-beam lithography. Sensors, 13, 865-874.
2. Song, K.; Han, X.; Shao, G. (2013). Electronic properties of rutile TiO2 doped with 4d transition metals: First-principles study. J. Alloys Comp., 551, 118-124.
3. Modaferri V., Panzera G., Donato A., Antonucci P.L., Cannilla C., Donato N., Spadaro D., Neri G. (2012). Highly Sensitive Ammonia Resistive Sensor Based on Electrospun V_2O_5 fibers. Sensors and Actuators B: Chemical 163, 61-68 doi: 10.1016/j.snb.2012.01.007
4. Zeng, W.; Liu, T.M.; Wang, Z.C. (2012). Impact of Nb doping on gas-sensing performance of TiO2 thick-film sensors. Sens. Actuators B Chem., 166, 141-149.
5. Brook L.A., Evans P., Foster H.A., Pemble M.E., Steele A., Steel D.W., Yates H.M. (2007). J. Photochem. Photobiol. A Chem. 187, 53.
6. Sun L., Zhao H., Gao S., Zhao J. (2006). Preparation and gas-sensing property of a nanosized titania thin film towards alcohol gases. Sens. Actuators, B, 114, 387-391.

AMISR PROSPECTIVE ON DUST SPATIAL AND TEMPORAL VARIABILITY IN DESERT SOURSES

Olga Kalashnikova, Michael Garay

Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA

Despite its well-recognized importance, the impact of mineral aerosol (dust) on the environment and its relation to global climate factors and mesoscale systems remains difficult to quantify. The 13+ years of data from Multi-angle Imaging SpectroRadiometer (MISR) instrument on the polar-orbiting Terra satellite provide a unique, independent source of data for studying dust emissions. MISR's multiple view angles allow the simultaneous retrieval of dust plume top height and dust motion winds during the seven minutes a scene is in view. In addition, MISR retrieves aerosol properties over bright surfaces, and such retrievals have been shown to be sensitive to the non-sphericity of dust aerosols.

We perform joint analysis of MISR operational plume stereo products, MISR aerosol optical depth (AOD), and AOD nonspherical fraction (dust AOD) products globally. We evaluate the realism of the MISR characterization of dust source-specific emissions against AERONET and meteorological data. Utilizing the strengths and accounting for biases in MISR aerosol and stereo products over the desert areas, we investigate multi-year spatial and temporal behavior of dust in terms of frequency of plume occurrence, plume heights, dust moving winds, and AOD/dust AOD. In particular, we examine the multi-annual mean pattern, seasonal cycle, inter-annual variability, and trends in dust emissions.

MODELLING OF MICROPHYSICS AND OPTICS OF THE SEA SALT AEROSOL AND ITS IMPACT ON SPECTRAL TRANSPARENCY

Gennady Kaloshin

V.E. Zuev Institute of Atmospheric Optics SB RAS, 1, Academician Zuev sq., Tomsk, Russia
gkaloshin@iao.ru

Extinction of radiation in the marine boundary layer is dominated by scattering and absorption due to atmospheric aerosol include the continental dust. This is important to optical retrievals from satellite, remote sensing, backscatter of light to space (including climate forcing), cloud properties etc. In unpolluted regions the greatest effects on near shore scattering extinction will be a result of sea-salt from breaking waves and variations in relative humidity. The role of breaking waves appears to be modulated by wind, tide, swell, wave spectra and coastal conditions. These influences will be superimposed upon aerosol generated by open ocean sea-salt aerosol that varies with wind speed.

The focus of our study is the extinction and optical effects due to aerosol in a specific coastal region. This involves linking coastal physical properties to oceanic and meteorological parameters in order to develop predictive algorithms that describe 3-D aerosol structure and variability.

The aerosol microphysical model of the marine and coastal atmosphere surface layer is considered. The model based on the long-term experimental data received at researches of aerosol sizes distribution function (dN/dr) in the band particles sizes in 0.01 - 100 μk. Bands of wind speed is 3 - 18 km/s, sizes fetch is up to 120 km, RH = 40 - 98 %.. The aerosol matter is represented as a combination of four materials: dry substance (continental dust), sea salt, and water. dN/dr of the model is characterized by the four modified lognormal functions with modal radiuses, equal $r_1 = 0,03$; $r_2 = 0,24$; $r_3 = 2$; $r_4 = 10$ μk

The model distinctive feature is parameterization of amplitude and width of the modes as functions of fetch and wind speed. In the paper the dN/dr behavior depending at change meteorological parameters, heights above sea level, fetch (X), wind speed (U) and RH is show. The received results are compared to available microphysical models NAN, ANAM and available experimental results.

On the basis of the developed model with usage of Mie theory for spheres the description of last version of developed code MaexPro (Marine Aerosol Extinction Profiles) for spectral profiles of aerosol extinction coefficients $\alpha(\lambda)$ calculations in the wavelength band, equal $\lambda = 0.2 - 12$ μm is presented. The received results are compared models NAN and ANAM.

Also $\alpha(\lambda)$ profiles for various wind modes (combinations X and U) calculated by the model are given. The calculated spectrums of $\alpha(\lambda)$ profiles are compared with experimental data of $\alpha(\lambda)$ received by a transmission method in various geographical areas.

PARTICLE SIZE AND COMPOSITION IN DRY DEPOSITION AND AEROSOL ON BARBADOS AND CAPE VERDE DURING SUMMER 2013 - AN ELECTRON MICROSCOPY PERSPECTIVE

Konrad Kandler[1]*, Markus Hartmann[1], Martin Ebert[1], Stephan Weinbruch[1], Thomas Müller[2], Khanneh Wadinga Fomba[2]

[1]*Institut für Angewandte Geowissenschaften, Technische Universität Darmstadt, 64287, Germany*
[2]*Leibniz Institute for Tropospheric Research, Leipzig, 04318, Germany*
**kzk@gmx.de*

Mineral dust is frequently transport during summer time from the Saharan desert across the Atlantic Ocean to the Caribbean (Trapp et al., 2010). On its way, dust particles may undergo ageing and acquire secondary materials like sulphate or organics or may mix with sea-salt particles. This ageing might be relevant for deposition velocities as well as bio-availability of nutrients (marine ecosystems).
From June to July 2013, in parallel at Ragged Point, Barbados (N 13.165, W 59.432) and at Cape Verde Atmospheric Observatory (N 16.864, W 24.867) dust dry deposition and aerosol samples were collected. Dry deposition was collected with modified 'flat plate' samplers (Ott et al., 2008), aerosol particles with different impactors. The samples were analysed by electron microscopy with X-ray fluorescence detection (Kandler et al., 2009). As result, for each particle chemical composition, size and shape descriptors are available. Approximately 30,000 particles in the size range between 0.5 µm and 50 µm were analysed.
The dry deposition number and volume size distributions on Barbados and Cape Verde were not significantly different, both showing a maximum between 3 and 4 µm particle diameter (number) and 5 and 6 µm (volume). The total deposition rates were about twice as high at Barbados, while in average the pure sea-salt deposition rates were very similar. Dust and dust/sea-salt mixtures were more abundant on Barbados. Dust occurred more persistently at Barbados than at Cape Verde, pointing to the intermittent transport at low altitudes during summer west of Africa. The ratio of internally mixed particle to pure dust particles was showing only low variability on Barbados, whereas on Cape Verde pure dust events and events with more mixed particles could be distinguished. Dust deposition rates could not directly be linked to dust events on Barbados (identified by online measurements), but were instead rather connected to variation in total deposition, indicating a well-mixed aerosol, where deposition rates may depend rather on meteorological variables (e. g., previous wash-out, wind speed).

Kandler K. et al. (2009): Size distribution, mass concentration, chemical and mineralogical composition, and derived optical parameters of the boundary layer aerosol at Tinfou, Morocco, during SAMUM 2006. doi: 10.1111/j.1600-0889.2008.00385.x

Ott,D. K. et al. (2008): A Shelter to Protect a Passive Sampler for Coarse Particulate Matter, PM10-2.5. doi: 10.1080/02786820802054236

Trapp J. M. et al. (2010): Temporal variability of the elemental composition of African dust measured in trade wind aerosols at Barbados and Miami. doi: 10.1016/j.marchem.2008.10.004

DUST STORM ORGANIZATION IN LARGE ROSSBY NUMBER FLOWS

Michael Kaplan[1]*, Ramesh Vellore[2], John Lewis[3], Jeffrey Underwood[4], Patricia Pauley[5], Jonathan Martin[6], Robert Rabin[7], Krishnan Raghavan[2]

[1]*Desert Research Institute, Reno, Nevada 89512, U.S.A.*
[2]*Indian Institute of Tropical Meteorology, Pune 411008, India*
[3]*National Severe Storms Laboratory, Norman, Oklahoma, 73032, U.S.A.*
[4]*Georgia Southern University, Statesboro, Georgia, 30466, U.S.A.*
[5]*Naval Research Laboratory, Monterey, California, 93943, U.S.A.*
[6]*University of Wisconsin, Madison, Wisconsin, 53706, U.S.A.*
[7]*Space Science and Engineering Center, Madison, Wisconsin, 53706, U.S.A.*
**mike.kaplan@dri.edu*

A novel paradigm for hydrostatic scale dust storm/dust front genesis will be described in this study, that has been successfully verified to a wide variety of dust storms in the southern High plains and in the western part of the United States of America. This paradigm stems from the fact that highly unbalanced (ageostrophic; higher Rossby number regime) adjustments quickly organize/generate the high momentum air parcels that represent the low-level turbulence kinetic energy that ablate surface dust resulting in the dust storm - which is very different from the conventionally accepted paradigm espoused by Danielsen that relies on balanced (quasi-geostrophic; lower Rossby number regime) jet streak adjustments and the slow descent of stratospheric high momentum air parcels from a tropopause fold to the planetary boundary layer.
The organizational process commences with the establishment of thermal wind imbalance in the exit region of a deep tropospheric jet streak. This typically occurs when the primary jet streak exit region encounters a secondary jetlet/jet streak or sub-synoptic baroclinic zone, i.e., one that arises from previously existing baroclinic forcing by a mountain or any other physical entity. Substantial mid-tropospheric cooling is necessary within the entire exit region of the primary jet streak in order to achieve thermal wind balance. The cooling results from a thermally direct a geostrophic ascending circulation ahead of and on the right side of the jet streak. This circulation is contrary to thermal wind balance in quasi-geostrophically balanced jet streaks as it occurs during accelerative and large Rossby number flow. Upon the formation of the cold pool, the low-level response to this cooling includes hydrostatic pressure rises on the forward and right side of the exit region which accelerates the low-level winds via an isallobaric/ageostrophic response. Pressure rises drive surface winds and in concert with the advection of the cold air generate turbulence kinetic energy within the planetary boundary layer. The resulting turbulent motions ablate surface dust in the appropriate desert playa regions resulting in a strong “dust front” or discontinuity in surface dust.

DUST EMISSION IN SEMI-ARID SOILS DUE TO SURFACE VARIABILITY BY AEOLIAN EXPERIMENTS

Itzhak Katra[1]*, Joel Roskin[2], Smadar Tanner[3], Avraham edri[1], Eli Zaady[4]

[1]*Department of Geography and Environmental Development, Ben-Gurion University, Israel*
[2]*Department of Maritime Civilizations, Haifa University, Israel*
[3]*Department of Natural Resources & Environmental Management, University of Haifa, Israel*
[4]*Natural Resources and Agronomy Department, Agricultural Research Organization, Israel*
**katra@bgu.ac.il*

Aeolian dust emissions have significant impacts on the natural soil and air resources. The emissions of fine particles from soils lead to reduction in soil fertility and erosion stability, while the emitted dust loading into the atmosphere increases air pollution of particulate matter (PM). The contribution of anthropogenic soils to the global dust emissions has become increasingly apparent particularly in semi-arid zones that are subjected to droughts. The research focuses on dust emission in semi-arid loess soils, Northern Negev, Israel, characterized by variability of surface composition due to anthropogenic activities. A portable wind tunnel has been designed to study dust emission by simulation and quantification of high-resolution aeolian processes. Field experiments were conducted under wind speeds (u) representative of dust storms. The various surface types (12 experimental plots) of dry loess soils represent three major groups: pasture-grazing, agricultural tills (conventional and organic), natural surfaces. Experiments in each plot were related to non-disturbed and artificially disturbed surfaces. Total aeolian dust (TAD) and particulate matter > 10 µm (PM_{10}) fluxes were measured simultaneously during the experiments. Collected dust samples were analyzed in the laboratory for chemical composition and particle size distribution. Topsoil samples extracted from the experimental plots were analyzed for particle size and aggregation. The results showed variations in aeolian dust and PM_{10} emissions in response to surface types and wind speeds. TAD fluxes range from low value of 500 mg m^{-2} min^{-1} in natural-vegetated soils under wind speed of 6 m s^{-1} to more than 4000 mg m^{-2} min^{-1} in overgrazed soils (u = 12 m s^{-1}). PM_{10} fluxes range from 3 to 850 mg m^{-2} min^{-1} with highest cumulative values per experiment of > 2000 (mg m^{-2}) in disturbed bare-soils (u = 12 m s^{-1}). In agricultural fields, higher TAD and PM_{10} fluxes over time were recorded in the tilled plots compared with the no-till practice. Disk operation (conventional practice) and overgrazing (organic practice) resulted in the highest rates of dust emissions from agricultural fields. It revealed that changes in the surface composition of grazing and natural plot types may resulted in considerably lower threshold velocities. Size analysis of TAD showed bi-modal distributions with variations in course sediment (> 63 µm), PM_{10} and $PM_{2.5}$ mass fractions. The results demonstrate a field-scale variability of aeolian soil erosion and dust emission in semi-arid loess soils.

A LOW-COST OPTICAL PARTICLE COUNTER FOR NETWORKED DEPLOYMENT

Paul H. Kaye[1], Warren R. Stanley[1], Edwin Hirst[1], John Saffell[2], Zbigniew Ulanowski[1]*

[1]*Centre for Atmospheric and Instrumentation Research, University of Hertfordshire, Hatfield AL10 9AB, United Kingdom*
[2]*Alphasense Ltd, Great Notley CM77 7AA, United Kingdom*
**z.ulanowski@herts.ac.uk*

There are numerous well-established commercial optical particle monitoring instruments for measuring ambient particle concentrations and size spectra. However, these have traditionally tended to be of a unit cost that prohibits their deployment in widespread networks. In contrast, multiple low-cost instruments, while perhaps not individually providing the same levels of traceability as high quality units could, when deployed in such networks, provide unique information about aerosol dynamics and spatial behaviour that is unobtainable from a single monitoring unit. The advantages of using such sensor networks for monitoring gaseous pollutants are already evident.
Centre for Atmospheric and Instrumentation Research at University of Hertfordshire develops light-scattering instruments for the characterization of aerosols and cloud particles. Recently a range of low-cost, miniature particle counters has been created, intended for use with systems such as disposable balloon-borne radiosondes, dropsondes, or in dense ground-based sensor networks. Versions for different particle size ranges exist. They have been used for vertical profiling of mineral dust using radiosondes (Nicoll et al. 2011) and dropsondes (Ulanowski et al. 2014a), and of volcanic ash using radiosondes (Harrison et al. 2010, Ulanowski et al. 2014b).
The objective of the present work was to provide a capability for ground-based particulate monitoring by developing low-cost Optical Particle Counters (OPC) suitable for networked deployment. Up to 50 of these OPCs have been deployed at and around Heathrow Airport near London as part of the SNAQ-Heathrow monitoring campaign (http://www.snaq.org). A key attribute of the OPCs is the absence of an air-pump and particle filters (used to protect the pump). The sample airflow of ~1.5 litres/min is instead generated by a low-cost microfan typically used for cooling computer chips. This allows continuous unattended operation of the OPCs for many months. Results from these OPCs will be presented together with the recent development of low-cost 'mini-OPCs' due to go into production in 2014.

Harrison R.G., Nicoll K.A., Ulanowski Z., Mather T.A. (2010). Self-charging of the Eyjafjallajökull volcanic ash plume, Env. Res. Lett. 5, 024004.

Mead M.I., Popoola O.A., Stewart G., Bright V., Kaye P.H., Saffell J. (2012). High-density, high-resolution, low-cost air quality sensor networks for urban air monitoring, AGU Fall Meeting, San Francisco.

Nicoll K.A., Harrison R.G., Ulanowski Z. (2011). Observations of Saharan dust layer electrification, Env. Res. Lett. 6, 014001.

Ulanowski Z., Kaye P. H., Hirst E., Wieser A., Stanley W. R. (2014a) Dust layer profiling using an aerosol dropsonde. This conference.

Ulanowski Z., Harrison R. G., Nicoll K. A., Burton R., Kaye P. H., Hirst E., Mobbs S. D., Gadian A. (2014b) Profiling of atmospheric volcanic ash layers using an aerosol radiosonde. This conference.

SEM-EDS SUPPORTED TWO-YEAR MONITORING OF BACKGROUND DUST COMPOSITION

Helga Kemnitz*, Georg Schettler

Deutsches GeoForschungs Zentrum, Telegrafenberg, 14473 Potsdam, Germany
**heke@gfz-potsdam.de*

Scanning-electron microscopic (SEM) study of silt-sized particles combined with energy-dispersive micro analyses (EDS) is part of a long-term dust monitoring programme at the northern slopes of the Tien Shan on an altitude of 1740 m. The particle fraction > 2.5 µm has been collected at 3-days sampling intervals using a high-volume slit-impactor. Previous particle analyses cover more than two seasonal periods beginning in June 2010 and ending in spring 2013. We use the ZEISS ULTRA 55 Plus Schottky-type field emission SEM which is equipped with a silicon-drift detector (UltraDry SDD, Thermo Fisher Scientific) for semi-quantitative analysis of the collected dust particles. Identification of different phases from composite spectra particularly benefits from applying non-automated analyses. SEM-EDS analyses complement the quantitative determination of water leachable salts, determination of the grain-size distribution, isotope, and bulk chemical and XRD analysis of the non-soluble residues. Based on SEM-EDS analyses we determine (i) changes in the dust composition relating to component frequencies, (ii) the grain-size range for single mineral components, and (iii) morphological and growth features of particles which helps to identify their provenance.
The average and variation of the particle frequency of the major natural silicate minerals collected from June 2011 to January 2013 were: phyllosilicates 41.3% (16-65), quartz 8.9% (1-30), feldspars 5.8% (1-24). The silt-sized particle fraction is characterised by an average calcite content of 15%; dolomite was occasionally detectable as a minor carbonate constituent. SEM-EDS analyses help to distinguish between different origins of gypsum which accounts for approximately 5% of the identified particles. Spores and pollen represented up to 10% of the collected dust. A significant increase in the frequency of soot particle was observed in winter 2010/2011. Fly ash spheres of variable aluminium silicate composition represent an anthropogenic component continuously present in all samples (average 5%). They are easy to distinguish by their morphology from natural minerals and volcanic shards of similar chemical composition. A challenging object of the ongoing research is to find out source regions of the spheres and their relationship to industrial processes on the basis of SEM-EDS, bulk chemical and isotope analysis of the non-soluble solid residues, and backward trajectory calculations of the air parcels that passed the monitoring site during the sampling intervals.

Schettler, G., Shabunin, A., Kemnitz, K., Knoeller, K., Imashev, S., Rybin, A., Wetzel, U. Seasonal and diurnal variations in dust characteristics at the northern slopes of the Tienshan - Grain-size, mineralogy, chemical signatures and isotope composition of attached nitrate. J. of Asian Earth Sciences (in review).

MULTIPLE SOURCES OF GREENLANDIC DUST DURING ENTIRE HOLOCENE

Ernesto Kettner[1]*, Anna Wegner[2], Tobias Erhardt[3], Anders Svensson[1]

[1]*Centre for Ice and Climate, Niels Bohr Institute, University of Copenhagen, 2100, Denmark*
[2]*Alfred-Wegener-Institut, Bremerhaven, 27570, Germany*
[3]*Institut für Klima-undUmweltphysik, University of Bern, 3012, Switzerland*
**e.kettner@nbi.ku.dk*

Only dust particles entrained above East Asian deserts have been identified in glacial ice from Greenlandic cores. However, samples of recent deposits, back trajectories covering the past decades and aerosol sampling programs conducted at Summit, suggest a contribution of at least one additional source during the last two centuries. Our results add to that evidence.
Source regions are identified experimentally by analysing the dust grains' mineralogical, chemical and|or isotopical composition. Here we propose the mode of the deposit's grain size frequency histogram or its coarse particle percentage to distinguish between sources. It is found that maxima in particle concentration coincide with minima in the size distribution's mode and vice versa.
This verifies this method as it mirrors known seasonal patterns in the dust's isotopic composition. Since the amount of sample needed is significantly reduced relative to analyses conducted directly on dust grains, the method proposed allows for the acquisition of records in enhanced resolution.
Analysing the recently obtained insoluble aerosol record utilising Continuous Flow Analysis on the NEEM ice core, we were able to show that multiple sources are likely to have been contributing to the dust input to Greenland throughout the entire Holocene. Concerning the debate around the provenance of the secondary dust input to Greenland, our results suggest a source not in the primary source's proximity

LICHENS, BIOINDICATORS OF AIR POLLUTION IN THE REGION OF ANNABA (ALGERIA)

TPitempedit, se sumquunt.

Xerum vellacearunt ulparum faccab in commo volectibus, sunt ex et, aperibus evelibus nonse aspel eic tes ea enturi alique molum sequiam verferem quiam expelia sperum autatiant repudit lautem re landistio eat pa sed ut verum rereptat rem erum fuga. Optatur sam sae paribusapit, es sedit alignatatur aut ereium niaes ipsum est odis nam, natur ad magnate nim faceperatur as sequibus verfero bero exceper namenditat ped et, vendaer ferspel ectius idel maion nonsequam acearit preress equassi magnihic tempore dolorem eatur acerum estrum fuga. Ut explabo. Ut mint eium invenestiae voloresed milis con conseque voluptatibus quossit, et assi blam, untiis ditiani cus vellaccatem essit la dio optum volut ad ex earum aliqui sitatem unt, tem alitium autem autae susam hillauda nimi, samus seriata sinihillam et, nonsed ut volendem quatur rent restibusdam repe senissim sime ellorpo rporibus evendusam alis volorature imagnie nderspitatum everum nobis quae dusame illaut as es quasper orempedipsum sus et volor aris nimi, te vendips untiam litas quae dolores sinimporem rem qui dersped estia el ium im qui corporiore et vitem in nonsequam rerent porporem qui re parchicatiae maior as idus et asim que arit quasper oreprem abor acit asi duciam esed ut ut fugit offic tectust de cus, to vit re doluptiis ma nit, vel iur mi, nonsequi dendunti tentione dit eritium atio. Atem nus senis ante solo omnist et fuga. As etus, esequas aut ad min consentus maio. Velectur sa experitat expla nistiis quam reriae porehent, volorum illa corepud itibus id et autatur, apientus minihitasped quiaers pienim qui consed etur re volupis corem voluptatur min et et ea pa nullaci umenturi que prescimet acerferrum in corersp erferes eribusam, sa dollent, sitate is peri optat re se voluptae ped eiciis adi velitat facea apiet ut latet prepre quam qui consequam aliquatem doluptat et qui officim pelenem nus nihil ipsandi tatur?

Ebit pos as aut et volupta tiatiam fuga. Nam qui nobis raest adipide nissum rehent.

Ut volores porporp oreperchil maioremporem fuga. Ut quam nonserit optate sed quaectorit ad mostio que pro blaboritio ipsunt perciae. Nequam harcill eceatati ipid mo estotat.

Cae abore volut autem. Ut estiatem es maximenia asperum ipsande parchit quas con consequunt que etur aut aut eum eum harciis doloreiundus delignis si dolecti cum nonsenis alit, officim imilicit dit dolore sequamus serum as santi iumquiation re dolore, nonsedi ulparum venimag nientiu sapici sam eaqui aut venihil in con rem quia suntur?

Ipitatem aut volesti to di untessit as cum acerorr ovitiis ut inisit aruptio nserum aut aut voluptam accus estium evenem veriatem vel imi, cum, aborepudi doloribusa volluptam, se mo modicillant, acerfero vent verio es ea venecto eles dolentemodi ditet mod esequodis quia dolorei ciendig entisti beatia dolore ventibeaquo cullamus quid que volorro doluptis es maiore exerundam quiandae net as andaeprae que natquo od

CONTRIBUTION TO THE IDENTIFICATION OF THE CHEMICAL NATURE OF ATMOSPHERIC EMISSIONS FERTIAL COMPLEX NORTHEAST ALGERIAN (ANNABA,ALGERIA)

Hilita dolecea tibust harum volorum quo verum ne ipicim utectotaquis mo enihiliquos que veratur rem ullore pa quunt ab ipsanda volorepratur arit re ipsam eaque nullandam, sam vellabo. Et et latis nobis eum verum alit ulpa nis unt qui officiis dolorepe eaquam, ommolum sinveni endanditem velia quid et facillabore quaectu riandip saectium nonsequatur?
Elignis sundenia porum in eum accumet enis vendi nonsequunt quae cone et, aut ma dolorro viduciatur, quo blab imperi re dolorum as rem rem hariste andigen ihicimet elis sundant otatur, qui conestius, es que perferit earciam elit fugit que sim enimet vel intur, ipient moluptior arionsequid et ut omnim fuga. Nam nihit volum et peribus, omnist, odi vendus aut liquiam, quam quia volore porum remporibusam erent escil intorem fugiam estius con nimos none nate nus nis sinulla boratquis et volores temquid et pori comni ipsamusa dest voloruptur? Quis a dolorestrum ad excesto tota dolorat uresendam si dolore, ut mo maximinci comnis voloressitis et lam exeri volo occae pratiun dandelit apidipsum quasitatia culparcium que essusae volorec earchilignam fuga. Ut volorepere doluptures demqui apid eiuntisti officabo. Itatio quodiat emporem verro cum aspeliquo cullorum rerum qui nitiatectur, nati quis ipidignatem que del est, volessitas rehendicae del int voloreptati bercim ium volore core plitatis nos nime exero qui blautatquam hit et laboriaspe parum ad moditatiis nesequo to tota sedignimus.
Bitatem expernatia nobitae odit, ut audanda nectatur?
Facerum fugia pro estiumqui consece rspitas sunt.
Agnihillam la nobitem eniam quibus doles sum facienit ipidestianis cum conem am faccum quos des doluptati adignam culpa voluptis et, cus, sim rem que moloreh entibusandae proreium as dolupta turiberest, sa a quatum derchillabo. Nem hit ande pro ese pe sunt labo. Omnihillis dianit lati cuptintiat labo. Ita doluptae num num lantur solupta turero oditi doloribus sent, offic tem eate nonsequ idendae si officimus, cullabore doluptaspis a denime dolo volorate vendustium sam volupta quatem. Solorerum essit maximin ctemqui aceatam, ut invellore es sandenducid modipicae im re sequae sequo blaceris venihit quo omnis aut vendiaest, alias aspidit hillacerem quossecatius pra natempo renisqui con nam numetur, odis derita vendande veribus, cuptae conectatur alitaqu idescip icturit atibus.
Dit harchil imaio comnihitatio bla cum vitaestio et omnisse quidendia cus aut aut venimus, ea il illeser itatus eaturionsero dolorro molorehent odipisim idiciument, quod esedis vellor ape as cus dessimu sdandem vid que volorendae plia sinctiaest faccus, quis ad mo et qui ut vendigenimin erio temque venis quia ditiur ationsequam is ellesti aspelique conse cuptatectur re, tem sanda sa delibus, con eatur?
Tur? Quide sequi doluptate sus, qui dem laborios repture, corepud ignatis experup

ASSESSING THE GEOCHEMISTRY OF AEROSOLS IN THE SOUTH ATLANTIC OCEAN ALONG THE 40° S TRANSECT USING PB AND ND ISOTOPES AND REE AND SELECT TRACE ELEMENTS

Roulin Khondoker[1]*, Dominik Weiss[1], Tina van de Flierdt[1], Mark Rehkämper[1], Alex Baker[2], Rosie Chance[2,3], Stanislav Strekopytov[4], Emma Williams[4], Pedro Cid-Agüero[5], Patricia Smichowski[6], Marly Babinski[7], Rémi Losno[8]

[1]*Department of Earth Sciences, Imperial College London, SW7 2AZ, UK*
[2]*University of East Anglia, Norwich, NR4 7TJ, UK*
[3]*University of York, Heslington, York, YO10 5DD, UK*
[4]*Natural History Museum, London, SW7 5BD, UK*
[5]*University of Magallanes, Avda. Bulnes, 01855, Punta Arenas, Chile*
[6]*National Atomic Energy Commission, Av. Gral Paz 1499, Buenos Aires, Argentina*
[7]*University of São Paulo, Geochronological Research Centre, São Paulo, Brazil*
[8]*LISA Faculty of Science, Bâtiment P4 393, Paris, France*
**roulin.khondoker04@imperial.ac.uk*

The atmosphere is an important pathway of delivering nutrients and other major and trace elements to ocean surface waters, which can play a vital role in marine biogeochemical processes and ultimately the global carbon cycle. However, the dynamics of atmospheric inputs (sources, fluxes) and their solubility in seawater remain little constrained, especially in the South Atlantic Ocean, a region where models predict widely variable atmospheric dust fluxes. Moreover, in recent years it has become clear that anthropogenic sources are potentially more important for certain elements than natural sources. Air quality studies have been carried out for some cities bordering the South Atlantic, including São Paulo and Buenos Aires, but the impact of emissions from such cities on marine elemental budgets has not been studied in detail.

In a first step, we present results on rare earth elements, select trace elements, as well as Pb and Nd isotopic compositions for sediments, volcanic ash, road dusts, aerosol filters and lichens from rural and urban areas in South America and South Africa, which potentially serve as aerosol source regions to the South Atlantic. Using bivariate plots of $^{208}Pb/^{207}Pb$ vs Pb/Al, $^{208}Pb/^{207}Pb$ vs La/Yb, and $^{208}Pb/^{207}Pb$ vs ε_{Nd} we can distinguish between South American and Southern African sources, and also between rural and urban areas on each side of the South Atlantic Ocean.

In a second step, we apply the new provenance information to interpreting the first comprehensive geochemical data set for aerosol filters collected in the South Atlantic along 40° S during the UK GEOTRACES cruises D357 and JC068 (GA10) in 2010 and 2011/2012. Atmospheric processing conditions were experimentally constrained to evaluate their affect on aerosol geochemistry. The results suggest that long-range aerosol transport across the South Atlantic is dominated by the westerlies and comprises a mixture of South American rural and urban sources. Atmospheric processing conditions partially dissolve the aerosols and show a less radiogenic Pb isotopic composition than total digested aerosols, indicating that the urban phase is more susceptible to dissolution than the rural phase.

CONTRIBUTION OF SAHARAN DUST PARTICLES TO TOTAL AOT OVER THE MEDITERRANEAN REGION ON THE BASIS OF MERRAERO DATA (2002 - 2012)

Pavel Kishcha[1]*, Boris Starobinets[1], Arlindo M. da Silva[2], Pinhas Alpert[1]

[1]*Tel-Aviv University, Tel-Aviv 69978, Israel*
[2]*Global Modeling and Assimilation Office, NASA/GSFC, Greenbelt, MD 20771, USA*
**pavel@cyclone.tau.ac.il*

The Sahara desert is the major source of dust particles emitted into the atmosphere all year round. A significant part of Saharan dust aerosols are transported over the Mediterranean region. Changes in dust aerosol optical thickness (AOT) may impact regional climate, the hydrological cycle, and human environments. As known, in addition to desert dust, over the Mediterranean region there is some significant amount of anthropogenic aerosol pollution, as well as marine aerosols from the Mediterranean Sea. Space-born and ground-based remote sensing aerosol measurements can not distinguish between various aerosol species. As a result, relative contribution of different aerosol species to total AOT is not enough understood. The current study is aimed at investigating what desert dust particles contribute to total AOT, as compared with other aerosol species. This was carried out by using the state-of-the-art data-assimilated NASA GEOS- 5 model radiatively coupled with GOCART aerosols. The GEOS- 5 model was used to extend the MERRA reanalysis with five atmospheric aerosol components (desert dust, sulfates, organic carbon, black carbon, and sea-salt). GEOS-5 also included assimilation of aerosol optical thickness observations from the MODIS sensors on both Terra and Aqua satellites. The obtained ten-year (2002 - 2012) MERRA-driven aerosol reanalysis (MERRAero) dataset provides us with an opportunity to estimate the contribution of the aforementioned five aerosol species to total AOT over the Mediterranean basin. The seasonal variability of the contribution of various aerosol species to total AOT, as well as their contribution to decadal AOT trends during the ten-year study period 2002 - 2012 are analyzed over specified zones in the western, central, and eastern parts of the Mediterranean Sea.

CONSTRAINING GLACIAL INPUT OF PHOSPHORUS TO THE OCEANS BASED ON GREENLAND ICE CORE EVIDENCE

Helle Astrid Kjær[1]*, Kumiko Goto-Azuma[2], Remi Dallmayr[2], Motohiro Hirabayashi[2], Paul Valellonga[1], Anders Svensson[1]

[1]*Center for Ice and Climate, Niels Bohr Institute, Copenhagen , 2100, Denmark*
[2]*National Institute of Polar Research, Tachikawa, Tokyo 190-8518, Japan*
**Hellek@fys.ku.dk*

Phosphorus is believed to have been the limiting nutrient for the ocean primary production in the past. Not much is known, however, about the atmospheric delivery of phosphorus to the oceans over time (Filippelli (2008)).

In this study phosphate concentrations have been measured in the North Greenland Eemian Ice Drilling (NEEM) ice core for the period 35.6 to 25.2 kyr b2k . Phosphate was determined continuously in selected ice core sections using a molybdenum blue method (Zhang (2002), Kjær (2013)) and discretely by ion chromatography (IC). 20th century phosphate concentrations have recently been reported for a firn core from the North East Greenland Ice Stream (NEGIS) (Kjær (2013)), showing a fairly constant level, with a mean value of 2.7 nM.

For the last glacial period, the molybdenum blue method indicated concentrations between 3 and 32 nM, whereas the IC method indicated higher concentrations. The deviation between the methods is strongly correlated (corr=0.9) to the dust content in the sample, suggesting that part of the phosphorus attached to dust particles does not instantly become labile after melting, but slowly (within hours) dissolves in the water. Both methods show higher concentrations during colder periods (stadials). The concentration differences between glacial mild and cold periods correlate positively to the dust variability suggesting that changes are linked to transport, however for very high phosphate loads (last glacial maximum) the relationship between phosphate and dust is weaker, suggesting secondary phosphate sources.

For the recent century we find that between 4 and 100 % of the dissolved reactive phosphorus has a dust source, and between 4 and 38 % is of biogenic origin. We find no correlation with sea salt and no evidence of recent anthropogenic changes of the phosphate concentration (Kjær (2013)).

We estimate that glacial atmospheric fluxes of phosphorus to the northern Hemisphere high latitude open oceans were 4 to 11times higher during the glacial period as compared to recent Holocene, with the highest input during the stadials.

Filippelli, G. M. (2008). "The global phosphorus cycle: past, present, and future" Elements,4, pp 89-95.
Kjær et al. (2013). "Continuous Flow Analysis Method for Determination of Dissolved Reactive Phosphorus in Ice Cores", Environmental science & technology 47 (21), pp 12325-12332.
Zhang, Jia-Zhong, and J. I. E. Chi. (2002) "Automated analysis of nanomolar concentrations of phosphate in natural waters with liquid waveguide", Environmental science & technology 36 (5), pp 1048-1053.

DUST MONITORING WITH HYPERSPECTRAL INFRARED SATELLITE OBSERVATIONS

Lars Klueser*, Christoph Bergemann, Thomas Holzer-Popp

German Aerospace Center (DLR), German Remote Sensing Datacenter (DFD), Oberpfaffenhofen, 82334, Germany

**lars.klueser@dlr.de*

Observations of the IASI instrument onboard the Metop spacecraft are used for inferring dust properties from infrared observations twice daily at a spatial resolution of 12km at nadir over land and ocean. The observations provide dust AOD (at 0.55µm and 10µm), dust particle size, information about dust composition, mass columns, dust layer effective emission temperature and retrieval uncertainty.

Validation with AERONET shows that the method is well suited for dust monitoring also inland in arid environments (correlation=0.73; RMSD=0.18; bias=-0.07; 85% of IASI AOD within AERONET AOD ±0.2).Using numerical weather prediction dust layer height is estimated from retrieved dust layer temperature.

It is shown how the IASI observations can be used for supporting the interpretation of campaign data (like from the Fennec and the ChaRMEx campaigns), for comparison with model simulations and for nowcasting applications in solar energy forecast. Moreover the effective monitoring of dust events is presented for several episodes of dust outbreaks from desert areas in Northern Africa, the Arabian Peninsula and East Asia. The monitoring capability is strongly increased from IASI observations due to the independence from sunlight and consequently the twice daily sampling from the polar orbit. Analysis of spatial and temporal correlation lengths is used for providing spatially and temporally homogeneous information about airborne dust. The correlation lengths can be used for assessing the nowcasting (i.e. monitoring) capabilities in cases of retrieval failure or missing observations using weighted interpolation in space and time as well as higher-order statistical methods.

INFRARED DUST REMOTE SENSING: INFORMATION CONTENT ANALYSIS AND METHODOLOGY FOR RETRIEVING DUST PROPERTIES FROM OBSERVATIONS OF HYPERSPECTRAL IR SOUNDERS

LARS KLUESER*, DMYTRO MARTYNENKO, CHRISTOPH BERGEMANN, THOMAS HOLZER-POPP

German Aerospace Center (DLR), German Remote Sensing Datacenter (DFD), Oberpfaffenhofen, 82334, Germany
**lars.klueser@dlr.de*

Hyperspectral infrared sounders like IASI offer the possibility to retrieve dust AOD and properties simultaneously. Using from a compilation of "typical" mineral dust particle size distributions and mineralogical compositions, the degrees of freedom for signal and information content of dust spectra from Mie simulations and from FTIR measurements are analyzed. With this analysis it can be quantified that the spectra provide information on particle size and composition, but that also not all information can be extracted owing to the correlations between the different spectra. Mie and FTIR spectra are applied in a dust retrieval approach for IASI probing the spectral shape of dust infrared extinction. Spectral patterns related to dust properties are analyzed in terms of principal components and are detected in IASI spectra of "equivalent optical depth". From the loads of the principal components the dust properties are retrieved. The dust properties provided by the retrieval algorithm are AOD (at 0.55µm and 10µm), effective radius and mass-weighted mean diameter, weight-fractions of mineralogical components, IR single scattering albedo, retrieval uncertainty and dust layer effective emission temperature. From the latter dust layer altitude is inferred using temperature profiles from numerical weather prediction. The retrieval results of both versions (Mie and FTIR) are compared to AERONET as well as to SEVIRI dust observations. It is shown that both versions are well suited for dust remote sensing with hyperspectral IR sounders like IASI. The evaluation moreover suggests that the overall performance of the retrieval is better for the FTIR version then for using Mie calculations as spectral dust information. The quantitative impact of variable dust mineralogical composition on retrieval results is highlighted by the information content analysis as well as by the evaluation results. Further inter-comparison to other IASI retrievals and other dust AOD retrievals as planned in Phase 2 of the ESA Aerosol_cci project will be outlined.

DUST OBSERVATION FROM SPACE - AN OVERVIEW

Lars Klüser[1]*, Kerstin Schepanski[2]

[1]German Aerospace Center (DLR), German Remotesensing Datacenter (DFD),Oberpfaffenhofen, 82234, Germany

[2]Leibniz-Institute for Tropospheric Research (TROPOS),Leipzig, 04318,Germany

*lars.klueser@dlr.de

An overview over different methods of observing desert dust from satellite is presented.

Desert dust is characterized by high reflection of solar radiation as well as by pronounced SiO2 resonance absorption in the thermal infrared, consequently a wide range of dust observation methods has evolved since the launch of the first spaceborne earth observing instruments. A compilation of these methods will be presented alongside their typical characteristics and sensitivities.

First graphical (RGB composite images) and indirect / semi-quantitative (e.g. Absorbing Aerosol Index, Infrared Difference Dust Index) methods are discussed, which are widely used in the scientific community and for dust assessment services.

With respect to more quantitative methods the overview includes Solar approaches (MODIS Dark Target, Deep Blue, ESA-CCI) as examples for different techniques of retrieving Aerosol Optical Depth.

Thermal infrared dust remote sensing is possible from narrowband imagers (like MODIS, SEVIRI) as well as from hyperspectral sounders (AIRS, IASI). Different methods are necessary for these instrument families. Generally IR sounders offer the possibility of retrieving more information about airborne dust than AOD (e.g. particle size, dust altitude). Different methods for both (narrowband imagers and hyperspectral sounders) will be described exemplarily.

Wherever available the compilation will also show validation results of the approaches (quantitative methods) and will outline the respective strengths and sensitivities.

Nevertheless the presentation does not aim at judging on the quality of the different methods of dust remote sensing. Its primary goal is to provide an overview what is possible from spaceborne observations with respect to the observation of airborne desert dust.

MINERALOGY AND GEOCHEMISTRY OF DUST EMITTED FROM METAL SMELTING INDUSTRY IN THE SUBURBAN AREA OF SOUTHWESTERN NIGERIA

Tesleem Kolawole[1,3]*, Akinlolu F Abimbola[2], Adreas Taubert[3], Christina Gunter[4]

[1]Department of Geological Sciences, Osun State University, Osogbo Nigeria
[2]Department of Geology, University of Ibadan, Ibadan Nigeria
[3]Institute of Chemistry, University of Potsdam, Potsdam Germany
[4]Institute of Earth and Environmental Sciences, University of Potsdam Germany
*tesleem.kolawole@uniosun.edu.ng

The production of steel from iron scrap in electric furnace generates airborne particles which are potentially hazardous to human health. Mineralogical and geochemical studies were carried out to uncover the pollutants released into the suburban environment of Osogbo Southwestern Nigeria by cluster indigenous Metal Smelting Company. The mass load of the dust generated in and around the industrial facilities was established gravimetrically and scanning electron microscopy energy dispersive x-ray (SEM/EDX) was employed to deduce the mineralogical components of the dust while trace metal in the airborne dust was determined by inductively coupled plasma optical emission spectroscopy (ICP-OES). The mass load arithmetic mean (190.26µg/m^3) and the maximum value (370.37µg/m^3) are 1.26 and 2.46 higher than national recommended standard (150µg/m^3) respectively. Mineralogically, the study revealed that the dust has compositions sourced from the melted scrap. Therefore, they are dominated by Zn-rich (82.78±23.15%) particles as observed close to the facility, 85% are in fine mode and mostly rounded in shape. Also, Fe-rich and Pb-rich particles were also observed in varying proportion and they are mostly coarse and fine respectively and often irregular in shape. Aluminosilicate particles (which are mostly clay minerals) were also observed in this vicinity in lesser proportion, coarse and irregular in shape. Farther away from this facility the Zn-rich particles were less visible and the dominant particles in this area were aluminosilicate, which to some extent aggregated with the former particles. The presence of sulphur-containing particles is as a result of fuel combustion sourced from road traffic emission. Al, Ca, Fe, Mg, Na, Si, Ti, Ba, Mn, Mo, Pb and Zn were the dominant trace metals in higher concentration in the study area. They show five Principal Components (PC) and three significant clusters. PC1 is loaded with Al, Si, Na and Fe which are basically sourced from crustal material while PC2 contain Cu, Mo and Ti. However, PC3 is loaded with Pb, Zn and Fe which could be attributed to the industrial emission. PC4 (Ba and Mn) and PC5 (Ca and Mg) explain other minor sources in the area which include wood burning. These elemental associations in PC are also confirmed in cluster analysis, especially the association of Fe with both crustal and industrial emission.

Keywords: Scanning electron microscopy, energy dispersive x-ray, principal component analysis, cluster analysis

METEOROIDS IN THE EARTH ATMOSPHERE: MODEL FOR HIGHLY ECCENTRICITY SOLAR SYSTEM ORBITS

Svitlana Kolomiyets

Kharkiv National University of Radio Electronics, Kharkiv, 61166, Ukraine)
s.kolomiyets@gmail.com

One from nature dust sources in the Earth atmosphere is meteor matter. The terms “meteor matter” and “cosmic dust” are interrelated and are included in the list of space agents who could and may affect the ecology of the past, present and future of the Earth. Meteor matter in the Earth atmosphere in some cases may fall to the Earth as meteorites and micrometeorites, and in other cases meteor particles can burn (causing the meteoric phenomenon - a meteor, a falling star) and affect the chemical composition of the atmosphere. Scientists estimate that each day in the atmosphere can be visually observed to 200 million meteors. Influx of meteor dust per year is variously estimated from 90,000 -50,000 tons (Bronshten, 1981). Meteor matter in the Earth atmosphere and near-the Earth space is investigated by different remote sensing methods, one of which is the radar method. This method allows you to register as the average characteristics of the inflow of dust (e.g., the hour number of meteors), and the individual characteristics of a single meteor particle (e.g., the speed of the particle and its heliocentric orbit). Knowledge of the heliocentric orbit of the meteor particle gives an indication of the mechanisms of its origin (comet, asteroid, interstellar, other). Actual explore influx of meteor particles in the Earth atmosphere and features of the distribution of meteoric matter in the Solar system (Kolomiyets, 2011). There is a problem of transition from observational data distributions in the Earth atmosphere to the true distribution of orbits in the Solar system. To determine the orbit of the meteor body uses radar reflections from the ionized meteor trail, which is formed in the Earth atmosphere over the meteor particle moving at the speed of 11-72 km/s (Davies and Gill, 1956). This method registers the radio meteors at altitudes of 70-120 km. The author analyzes the meteor orbital data obtained by radar in Kharkiv in terms of constructing the model of inflow to the Earth atmosphere meteoroids on strongly elongated heliocentric orbits (with large values of eccentricity).

Davies J.G., Gill J.G. (1956). Radio echo measurements of the orbits of faint sporadic meteors. Monthly. Not. Roy. Astron. Soc. 116, N1, 105-113.

Bronshten V.A. (1981). Physics of meteoric phenomena. Moscow: Nauka. 416 p.

Kolomiyets S.V. (2011). Disribution of orbital elements for meteoroids on near parabolic orbits according to radar observation data. NASA/CP-2011-216469, 88-100.

MARINE ENVIRONMENTAL EFFECTS OF SAHARAN-DUST DEPOSITION - CHANGING CLIMATE THROUGH OCEAN FERTILIZATION?

Laura F. Korte[1]*, Michèlle van der Does[1], Chris Munday[1], Geert-Jan A. Brummer[1], Jan-Berend W. Stuut[1,2]

[1]*NIOZ - Royal Netherlands Institute for Sea Research, Department of Marine Geology and Chemical Oceanography, 1790 AB Den Burg, Texel, Netherlands*
[2]*MARUM - Center for Marine Environmental Science, University of Bremen, 28334 Bremen, Germany*
**Laura.Korte@nioz.nl*

Saharan dust is one of the largest carriers of nutrients and metals into the North Atlantic Ocean. Its input is potentially a major influence on the stimulation of phytoplankton growth. Particularly iron, nitrogen, phosphorus and silicon, are limiting constituents of phytoplankton primary production in the global ocean. The consumption of these nutrients during photosynthesis converts the inorganic greenhouse gas CO_2 into organic matter. Once the organic matter is exported and buried at the ocean floor, the CO_2 is sequestered from the atmosphere and can play a role in the global carbon cycle. We deployed three dust collecting floating buoys and six marine sediment traps along a transect in the Atlantic Ocean at 12°N during the RV Pelagia cruise "64PE 378" in November 2013. Together with on land dust collectors placed in Iwik, Mauretania, and on St. Eustatius we focus on the temporal and spatial variability of Saharan dust dispersal and deposition and the effect on the phytoplankton community over a time series of one year with a two-weekly to monthly resolution.

RARE AIRBORNE BACTERIA IDENTIFIED IN RESUSPENDED DUST IN STABLES BY NEXT GENERATION SEQUENCING

Nora Kováts[1]*, Eszter Horváth[1], Beatrix Jancsek-Turóczi[1], András Hoffer[2], Zsuzsanna Tóth[3], Zoltán Bihari[3,4], Csaba Fekete[3], András Gelencsér[1]

[1]*University of Pannonia, Institute of Environmental Sciences, Veszprém, 8200 Hungary*
[2]*Air Chemistry Group of the Hungarian Academy of Science, Veszprém, 8200, Hungary*
[3]*Szentágothai Research Centre, Pécs, 7622, Hungary*
[4]*Bay Zoltán Nonprofit Ltd. (BAY-BIO), Szeged, 6726, Hungary*
**kovats@almos.uni-pannon.hu*

Air quality of stables in Europe is a critical issue, as many horses are kept in stables quite often even for 23 hours per day. Inhalation of airborne dust and aeroallergens in stables is supposed to directly cause or exacerbate several respiratory disorders, the most often recognized problem being recurrent airway obstruction (RAO), previously termed chronic obstructive pulmonary disease (COPD). Monitoring studies have covered mainly the determination of the concentration of particles with diameter of 0.5–5 μm (particles of that size may interfere with lower parts of the airway). Also, as RAO is associated with the presence of aeroallergens, many studies have been targeted to determine the concentration of culturable fungi and their toxins. However, the $PM_{0.5-5}$ fraction (particles with the diameter of 0.5–5 μm) does not only cause direct effect on the respiratory tract, but these particles might act as carrier, conveying toxic contaminants and biological agents such as bacteria. As part of a large-scale study, microbial community of respirable fraction of resuspended dust has been characterised by culture-independent next generation sequencing (NGS) of variable 16S rRNA gene regions. Sample was collected in a typical Hungarian stable, using a mobile resuspended road dust PM_{10} sampling unit which induces resuspension and collects particles on-line directly from surfaces. The sampling unit includes a PARTISOL-FRM MODEL 2000 sampler which collects resuspended PM_{1-10} samples in a cyclone separator and PM_1 samples on filters. Apart from common, mostly ubiquitous soil and organic material-dwelling bacteria, rare airborne species have been identified, such as *Variovorax ginsengisoli*, previously isolated from Korean ginseng fields or *Exiguobacterium sibiricum*, isolated from the Siberian permafrost. Their potential source and transport are discussed.

SPATIO-TEMPORAL DISTRIBUTIONS OF PM AT AN URBAN SCALE DUE TO NATURAL DUST EPISODES

Helena Krasnov[1]*, Itzhak Katra[1], Michael D. Friger[2], Itai Kloog[1]

[1]*Geography and Environmental Development Department, Faculty of Humanities and Social Sciences, Ben-Gurion University of the Negev, Beer Sheva 8489506, Israel*
[2]*Epidemiology and Health Services Evaluation Department, Faculty for Health Sciences, Ben-Gurion University of the Negev, Beer Sheva 8489506, Israel*
**krasnovh@post.bgu.ac.il*

Desert dust storms are a common phenomenon in arid and semi-arid areas. Their impact is of a great interest to the physical and the human environments. Only a few studies have associated atmospheric PM pollution in urban environments with origin in natural soil/dust, and even less evaluated the dust spatial patterns over a city. The objective of this study is to analyze the spatial distributions of PM (particulate matter) related to dust episodes in an urban environment (Beer Sheva, Negev, Israel) located at the margin of the global dust belt. PM data were recorded during the peak of each dust episode simultaneously in 20 predetermined fixed points around the city. Data were analyzed for both dust days and non-dust days (background) to determine exceedances of PM concentrations and pollution thresholds. The database was constructed using Geographic Information System and includes characteristics of the physical environment and meteorological variables. Distributions of PM were derived using Kriging. The results show that the daily averages of atmospheric PM_{10} concentrations during the background period are at a narrow range of 48 µg m^{-3} to 77 µg m^{-3} with low variations. During dust days however, the temporal variations are significant and can range from an hourly PM_{10} concentration of 100 µg m^{-3} to more than 2620 µg m^{-3} during strong storms. Daily PM concentration during a dust storm can increase by 2 to 9 compared to the WHO daily guideline. Kriging analysis demonstrates that during the peak time the spatial variations in PM can reach 400 µg m^{-3} between point locations in the city. Several factors in the city structure (height above sea level, building types) affect the PM distribution. During the dust event, higher concentrations were found in parts that are proximal to dust sources - located at a specific direction at which the air-mass is entering the city. The results improve the understanding on the dynamics of natural PM and may have implications for environmental and health outcomes.

SEASONAL ISOTOPIC VARIABILITY OF DUST OUTFLOW FROM NORTHERN AFRICA TO THE TROPICAL ATLANTIC

ASHWINI KUMAR[1]*, WAFA ABOUCHAMI[2], STEPHEN J.G. GALER[1], KHANNEHW. FOMBA[3], MEINRAT O. ANDREAE[1]

[1]*BiogeochemistryDepartment,MaxPlanckInstituteforChemistry,Mainz,Germany*
[2]*Federgrasweg 55, 55122Mainz,Germany*
[3]*DepartmentofChemistry,LeibnizInstituteforTroposphericResearch,Leipzig,Germany*
**ashwini.kumar@mpic.de*

Radiogenic isotopes have been efficiently used for tracing Saharan dust provenance and its transport across the tropical Atlantic to South America [1, 2]. Recent isotopic studies have shown significant heterogeneity in dust characteristics within small source regions (e.g., Bodélé Depression [3]), as well as temporal variability at the receptor regions [2]. It is thus very important to understand the seasonality in the dust outflow from the source region at high temporalresolution. With this rationale, aeolian dust has been collected in different seasons along the pathway of the North African dust outflow, and Sr, Nd and Pb isotopic compositions were measured to pinpoint the active dust emission sources. The samples were collected during two campaigns in winter (1 - 20 February 2012) and summer (19 June - 06 July 2013), at the Cape Verde Atmospheric Observatory (CVAO) on the island of São Vicente (16.9°N, 24.9°W).

Total suspended particulate (TSP) and PM10 (particulate matter less than 10 μm aerodynamic diameter) were collected on acid-cleaned cellulose filters on a daily basis (~24h) with a higher frequency during a dust storm event (6-8 February 2012). All aerosols samples were processed following the procedure described in [3] and isotopic compositions were measured on both the labile anthropogenic fraction (0.5 N HBr leachate) and the residual silicate fraction by TIMS; Pb isotope ratios were corrected for mass fractionation using a triple spike technique.

The silicate fractions show consistently more radiogenic Pb and Sr isotopic compositions compared to those of the leachates during both seasons and range from 0.710 to 0.729 and 18.12 to 19.58, respectively. In contrast, Nd isotopic compositions are more radiogenic (ε_{Nd}= -12.0 to -13.3) inbothfractions during the summer and relatively homogeneous compared to winter values (ε_{Nd}= -11 to -16). A shift towards highly radiogenic Pb and Sr associated with unradiogenic Nd is observed during the dust event, followed by a continual decrease as the dust storm is waning. The CVAO isotopic time series records activation of distinct dust emission sources with a predominant contribution from Mauritania during the dust peak winter event, a permanent, baseline, source represented by mixed contributions from Northwest Sahara and sub-Sahara/Sahel sources during both seasons, and an additional European source whose signal increasestoward the end of the winter campaign. These results are fully corroborated by satellite images and back-trajectory analyses and show thus far no evidence for a significant dust contribution from the Bodélé Depression, in contrast to previous observations [4].

1. Skonieczny *et al.* (2013) *Earth Planet. Sci. Lett.*364, 145-156.-2. Kumar *et al.*(2014). *Atmos. Env.*82, 130-143.-3. Abouchami *et al.* (2013) *Earth Planet. Sci. Lett.*380, 112-123.-4. Schepanski*et al.* (2009) *Atmos. Chem. Phys.*9, 1173-1189.

ROAD DUST EMISSIONS IN FINLAND - A COMPARISON OF SUSPENSION AND WEAR BASED ESTIMATES

Kaarle Kupiainen[1,2]*, Niko Karvosenoja[1], Jaakko Kukkonen[3], Mari Kauhaniemi[3], Leena Kangas[3], Ari Karppinen[3]

[1]*Finnish Environment Institute (SYKE), P.O. Box 140, 00251 Helsinki, Finland*
[2]*Nordic Envicon Oy, Huopalahdentie 24, 00350 Helsinki, Finland*
[3]*Finnish Meteorological Institute (FMI), Erik Palmènin aukio, P.O.Box 503, 00101 Helsinki, Finland*
**kaarle.kupiainen@ymparisto.fi*

Integrated assessment models (IAMs) are an established tool to assess the impacts of air pollutants on people and the environment. IAMs couple emission estimates (emission inventories or emission models) with dispersion and human exposure models to study, e.g., emission reductions for optimal health benefits. To be able to reach this endpoint the emission models should cover the important emissions sources as accurately as possible.

IAM calculations show that road traffic is currently one of the most important emission sources of particulate matter all over the globe. The particle emission estimates from vehicle exhaust have currently relatively established parameterization in the integrated assessment models but the inclusion of the non-exhaust sources (road dust) is a challenge. This is especially the case in the Nordic countries, which experience enhanced particle formation during winter due to traction control by studded tyres and traction sanding. These sources result in high amounts of deposited wear particles in the street environment, major part of which become suspended in spring.

This paper presents the methodology and an estimation of the non-exhaust particle emissions from on-road traffic in Nordic conditions with a Finnish national integrated assessment modelling tool of air pollutants. We discuss two distinct computation approaches: (1) based on the formation of wear products from road surface and vehicle, and (2) based on the estimation of the amount of dust resuspension from road surface. Analysis of the resuspension emissions (approach 2) shows that the use of emission factors that have been estimated for dry road surface conditions can lead to significant overestimations for total emissions and a reducing factor due to moisture should be included in the emission calculations as done in this work.

We argue that both wear and suspension based approaches are helpful for planning efficient mitigation strategies for Nordic conditions. The wear based estimation gives important insight into formation processes and helps pinpointing the measures that lower dust formation (later suspended) and emissions. The suspension based approach in turn helps to find out important mitigation measures to reduce emissions of dust that has been formed earlier. It also helps to estimate PM concentrations and human exposure more accurately.

VERTICAL LIFTING OF DUST IN THE CONVECTIVE ATMOSPHERIC BOUNDARY LAYER

Michael Kurgansky

A.M. Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences, Moscow, 119017, Russia
kurgansk@ifaran.ru

The vertical transport of dust (aerosol) into the atmosphere is extremely important for the arid and semi-arid zones of the Earth, and is crucial to the Martian environment. Hereafter, a model is proposed that explains the functional dependence of the vertical mass flux of sand (dust) Q in the convective atmospheric boundary layer on the number density N of convective elements (including vortices), the friction velocity u* and the vertical (turbulent) buoyancy flux B. It is shown that the flux Q is proportional to the product of the square root of B and the sixth power of u*. This does not contradict empirically found dependencies Q(u*) reported in the literature. Two practical methods of determination of the number density N are discussed when the dust lifting is mainly due to (terrestrial and Martian) dust devils. The first method is based on optical observations of dust devils produced from a point on the ground, just as in Mars Exploration Rover (MER) Spirit optical observations, and on analysis of dust devil (apparent) angular size-frequency distribution (Kurgansky, 2012). The second method uses dust devil close encounters with a fixed array of meteorological stations.

Kurgansky M.V. (2012). Statistical distribution of atmospheric dust devils. Icarus, 219, 556-560.

A TRANSPORT ANALYSIS OF ASIAN DUST USING TIME VARIATIONS OF SPM DATA AND TEMPERATURE

Takashi Kusaka[1]*, Tomohiro Hosohata[2]

[1]*Kanazawa Institute of Technology, Ohgigaoka Nonoichi Ishikawa, 921-8501, Japan*
[2]*Quest Co. Ltd., Sibaura Minato-ku Tokyo, 105-0023, Japan*
**kusaka@neptune.kanazawa-it.ac.jp*

The Asian dust (called “Yellow sand dust”) often covers over the East Asia in the late winter and spring seasons. Fine dust particles in the air will have harmful influence on our health on the local and global scales. It is, therefore, very important to investigate the spatial and temporal variation of the concentration of Asian dust transported from desert areas in the northern part of China to the East Asian region.
The concentration of Suspended Particulate Matter (SPM) in the air is measured every an hour at more than 2000 measurement stations in Japan. It is known that values of SPM become high when Asian dust was recognized in Japan. However, it is difficult to determine how much Asian dust particles are contained in the SPM when Asian dust was observed, because the SPM contains air pollutants different from Asian dust. We determined the threshold value for the concentration of SPM by the statistical analysis of SPM data as follows: 1) We acquired SPM data (noDUST-SPM) for 5 days when Asian dust was not observed at the measurement stations in March, 2010 and SPM data (DUST- SPM) at all dates when Asian dust was recognized in March, 2010, and then made histograms for the concentration of SPM. 2) Since each histogram of noDUST-SPM and DUST-SPM fits to the gamma distribution, the SPM value at the intersection between two gamma distributions was chosen as the threshold value (TS). As a result, it is shown that time intervals during which the dust event continued in Japan are estimated accurately, by analysing the time when the concentration of SPM exceeds the value of TS. We also investigated the time variation of the temperature averaged over one day (M_TEM) and the concentration of SPM averaged over a day (M_SPM) before and after Asian dust events observed in Japan in the early spring in 2010 and 2011, because we have the great similarity between the movement of cold front over East Asia and that of the concentration of Asian dust obtained from the long-range transport simulation of Asian dust [1]. Consequently, it is shown that when the Asian dust is transported to Japan, we have the peak value of M_SPM immediately after M_TEM reached maximum at measurement stations in Japan. This indicates that when we had dust storms caused by the strong wind in Gobi desert areas, highly concentrated Asian dust clouds were carried to Japan soon after the cold front was passing.

Kusaka, T, Kono, T, Okuda, W, (2011). Ransport Animation Of Asian Dust Clouds In The Google Earth, Ieee Proc. of Igarss2011, Cd-Rom.

RECORD OF DUST DEPOSITION IN CAUCASUS, RUSSIA FROM ELBRUS MT. ICE CORE

Stanislav Kutuzov[1,3]*, Patrick Ginot[2], Vladimir Mikhalenko[1], Maria Shahgedanova[3]

[1]*Institute of Geography RAS, Moscow, 119017, Russian Federation..*
[2]*Laboratoire de Glaciologie et Géophysique de l'Environnement (LGGE) 38041, France*
[3]*Geography and Environmental Science, University of Reading, Reading, RG6 6AB, United Kingdom.*
**s.kutuzov@gmail.com*

Records of dust stored in glaciers provide information on frequency of deposition events, source regions and atmospheric pathways of mineral dust. We present and discuss a record of dust in ice cores extracted on the Western Plateau, Mt. Elbrus (5150 m a.s.l.), Caucasus Mountains, Russia in 2009-2013. The data set includes shallow ice-cores which corresponded to 2007-2013 period as well as a deep core record of 2009 which covered more than 100 years. Particle size distribution and chemical analysis (major ions, trace elements) were completed using Coulter Counter Multisizer III, Abacus particle counter, IC analysis. Sampling was performed using continuous flow analysis (CFA) system. Annual average dust flux (264 µg/cm2 a-1) and average mass concentration (1.7 mg/kg) were calculated for the first time for this region. A combination of satellite imagery (SEVIRI), trajectory models (FLEXTA, HYSPLIT) and meteorological data were used to accurately date each of the dust layers observed in shallow ice cores and investigate provenance of the dust clouds and its transport pathways. It was shown that desert dust is deposited on Caucasus glaciers 3-6 times a year and originates from the deserts of the Middle East and less frequent from the Northern Sahara over the period of SEVIRI satellite operation 2004-2013. Using these results the high resolution (1 cm) deep ice core record of dust was investigated for changes and trends in frequency and intensity of dust deposition events, dust fluxes and particle size distribution over the past 100 years.

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7-PEOPLE-2010-IIF under grant agreement PIIF-GA-2010-275071 Russian Foundation for Basic Research (grants 11-05-00304 and 13-05-10069).

UNLOCKING THE MINERAL DUST STORY ARCHIVED DURING THE LAST 8500 YEARS AT STORE MOSSE (THE "GREAT BOG"), SOUTHERN SWEDEN

Malin Kylander[1]*, Antonio Martinez-Cortizas[2], Richard Bindler[3], Sebastien Rauch[4], Carl-Magnus Mörth[1]

[1]*Department of Geological Sciences and the Bolin Centre, Stockholm University, Stockholm, SE-10691 Sweden*
[2]*Departamento de Edafología y Química Agrícola, Facultad de Biología, Universidad de Santiago de Compostela, Campus Sur Santiago de Compostela, E-15706, Spain*
[3]*Department of Ecology and Environmental Sciences, Umeå University, Umeå, SE-901 87, Sweden*
[4]*Water Environment Technology, Chalmers University of Technology, Göteborg, 41296, Sweden*
**malin.kylander@geo.su.se*

Store Mosse is the largest mire complex in the boreo-nemoral region of southern Sweden and its development and paleoenvironmental history is well studied. A recently published study by the authors linked bog surface wetness and atmospheric dust deposition at this site over the last 8500 years (Kylander et al., 2013). This high-resolution (~15 yr/sample) paleoclimate record was based on a combination of bog development, colorimetric humification, bulk density and inorganic geochemistry data and interpreted using Principal Component Analyses (PCA) and changepoint modelling. Significant changes in dust deposition as expressed by the first principal component were linked to changes in precipitation and temperature reconstructed from the same record as well as regionally relevant records.

With this paleoclimate framework in place, the aim of the second phase of this project is to examine the dust signal archived at Store Mosse in terms of net accumulation rates and sources. During the major dust event captured at Store Mosse spanning from 6.5 to 5.5 cal kyr BP dust deposition rates vary by an order of magnitude depending on which element is selected to represent mineral dusts. Clear signals of changes in dust source and character are expressed by the Eu anomaly which diverges from baseline values between 5.6 to 4.2 cal kyr BP; this may represent the addition of less weathered material to the bog. In general the geochemistry shows that changes in the mineral dust composition are driven by shifts in source area, the degree of mineral weathering, intensity of soil erosion and human activities.

Kylander M., Bindler R., Martínez Cortizas A., Gallagher K., Mörth C.-M., Rauch S. (2013). A novel geochemical approach to paleorecords of dust deposition and effective humidity: 8500 Years of peat accumulation at Store Mosse (The "Great Bog"), Sweden. Quaternary Science Reviews 69, 69-82.

CHARACTERISTICS OF A MAJOR SAHARAN DUST EVENT DURING MAY 2013 AT MAGURELE, ROMANIA

Lev Labzovskii[1,2], Florica Toanca[1,2], Anca Nemuc[2]

[1]*University of Bucharest, Faculty of Physics, P.O.BOX MG-11, Magurele - Bucharest, 077125, Romania*
[2]*National Institute of Research and Development for Optoelectronics, 409 Atomistilor Street, Magurele, Romania*
**labzowsky@gmail.com*

This paper studies a special case of strong dust intrusion on May 20, 2013 at Magurele (44.35 N, 26.03 E) measured by the multiwavelength Raman Lidar. Optical properties of the aerosol layers for this particular day showed a significant increase of the linear particle depolarization. In order to specify the aerosol type we used measured AERONET (Aerosol Robotic Network) data and HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) model data. Also POLIPHON (Polarization Lidar Photometer Networking)(Ansmann et al. 2012) and LIRIC (Lidar/Radiometer Inversion Code)(Wagner et al. 2012) algorithms were used to separately assess spherical and aspherical particles for this particular day.

The study area is characterized by a lot of mixed-dust intrusions (Nemuc et al., 2013) but the cases of almost pure dust are quite rare. Typical measured volume depolarization ratio for mixed dust in Magurele varies from 0.15 to 0.20, while in our study case we observed volume depolarization ratio not lower than 0.2 but starting at 3.7 km the ratio exceeded 0.30. These values of depolarization are typical for pure dust as showed by other measurements (Sassen, 1992; Mona et al., 2012). Angstrom Exponent had values between 0.25 and 0.5 on May 20, typical for dust aerosol particles (Mona et al., 2012) and values constantly higher than 1.0 on May 19 and May 21, according to AERONET sunphotometer data. Also the size distribution looks significantly different from 19 and 21 May. On 20 May there were only coarse mode particles, typical for pure dust, while on 19 and 21 May the sunphotometer measured high amount of fine fraction particles, typical for urban aerosol pollution.

In order to define the origin of air masses we investigated HYSPLIT backtrajectories including information about humidity. This showed the direct transportation of dust from Sahara region to Magurele site on May 20. Relative humidity was increasing on the path from very dry conditions up to 40%.

Ansmann, A., Seifert, P., Tesche, M. and Wandinger, U., Profiling of fine and coarse particle mass: case studies of Saharan dust and Eyjafjallajokull/Grimsvotn volcanic plumes, Atmos. Chem. Phys., 12, 9399-9415, doi:10.5194/acp-12-9399-2012, 2012. 912, 914, 921, 923, 924, 925, 929, 931, 941, 942, 946, 947.

Sassen K. (1991). The polarization lidar technique for cloud research: a review and current assessment, Bulletin of American Meteorological Society, vol. 72, no. 12, pp. 1848-1866.

Mona L., Liu Z., Müller D., Omar A., Papayannis A., Pappalardo G., Sugimoto N, Vaughan M. (2012). Lidar Measurements for Desert Dust Characterization: An Overview, Advances in Meteorology, Article ID 356265, 36 pages, http://dx.doi.org/10.1155/2012/356265.

Nemuc A., Vasilescu J., Talianu C., Belegante L., Nicolae D. (2013). Assessment of aerosol's mass concentrations from measured linear particle depolarization ratio (vertically resolved) and simulations, Atmos. Meas. Tech., 6, 3243-3255, doi: 10.5194/amt-6-3243-2013.

Wagner J., Ansmann A., Wandinger U., Seifert P., Schwarz A., Tesche M., Chaikovsky A., Dubovik O. (2013). Evaluation of the Lidar/Radiometer Inversion Code (LIRIC) to determine microphysical properties of volcanic and desert dust. Atmos. Meas. Tech. Discuss., 6, 911-948, amtd/2013-6-911.

APPLICATION OF A REGIONAL AIR QUALITY MODELING SYSTEM TO WIND EROSION OF DUST AND ASH FROM A LARGE POST-FIRE BURN SCAR

Brian Lamb[1]*, Natalie Wagenbrenner[2], Farren Herron-Thorpe[1], Joseph Vaughan[1], Serena Chung[1], Rick Hardy[3]

[1]*Laboratory for Atmospheric Research, Washington State University, Pullman, W, USA*
[2]*US Forest Service, Missoula Fire Laboratory, Missoula, MT, USA*
[3]*Idaho Division of Environmental Quality, Boise, ID, USA*
**blamb@wsu.edu*

The land cover following a large wildland fire is in a significantly disturbed state and one that can be very susceptible to wind erosion. Strong wind events in the weeks and months following a fire can lead to extremely high PM emissions from the burn scar with transport far downwind of the source. Such ash and dust storms can cause significant visibility impairment on downwind highways and produce elevated PM levels and related health concerns far from the source. However, little is known about the emissions or nature of such post-fire wind erosion events. In this paper, we describe a case study for an event that occurred during July, 2012 where strong winds carried a large dust cloud or haboob from the burn scar of a 227,000 ha fire in eastern Oregon downwind into Boise, ID and the surrounding metropolitan area. For this case study, we employ a dust and ash empirical emission algorithm based on previous post-fire PM emission measurements along with our regional air quality modeling system, AIRPACT (http://lar.wsu.edu/airpact). This system, normally used for air quality forecasting, incorporates meteorological fields from the Weather Research and Forecasting (WRF) model to drive the Community Multi-scale Air Quality (CMAQ) model and produce gridded hourly fields of gas and aerosol pollutant concentrations. Results are presented for this case study which demonstrate the impacts of post-fire wind erosion and also show the feasibility of using the AIRPACT system to forecast these large wind driven post fire events.

THE PISAC INITIATIVE: POLLUTION AND ITS IMPACT ON THE SOUTH AMERICAN CRYOSPHERE

Fabrice Lambert[1]*, PISAC Members

[1]*Center for Climate Research and Resilience, University of Chile, Santiago, 8370449, Chile*
**lambert@dgf.uchile.cl*

Recent scientific evidence indicates that the Andean and Patagonian glacial regions have already shown the impacts of rapid climate change with receding glaciers and snow cover. Since ground-water is relatively rare in the Andean region, this could have potentially large implications for water resources and local agriculture, especially for local indigenous populations living in high altitude communities as well as for large urban centers at relatively lower surrounding altitudes. Similar to other cryosphere regions such as the Arctic and the Himalayas, the Andean cryosphere is almost certainly impacted by short-lived climate pollutants (SLCP), and especially black carbon. However, unlike the Arctic or the Himalayas, there has been relatively little information about the sources and the extent of SLCP emissions impacting the Andean cryosphere.

Here we present the PISAC initiative whose members include natural and social scientists from all the countries that border the Andes as well as experts from other regions. The main aim of this initiative is to design research activities that close knowledge gaps and to address mitigation measures for climate protection and air quality improvement.

DUST NON-STATIONARITY AS AN INDICATOR OF ATMOSPHERIC REORGANIZATION DURING CLIMATIC CHANGES

Fabrice Lambert[1]*, Yuriy Polyakov[2,3], Serge Timashev[2], Maisa Rojas[1]

[1]*Center for Climate Research and Resilience, University of Chile, Santiago, 8370449, Chile*
[2]*USPolyResearch, Ashland, PA 17921, USA*
[3]*New Jersey Institute of Technology, Newark, NJ 07103, USA*
**lambert@dgf.uchile.cl*

Mineral dust flux in Antarctic ice cores depends on dust source strength, wind conditions, and the atmospheric washout efficiency (hydrological cycle). These three factors are all subject to atmospheric climatic conditions. Although one cannot isolate one factor from the others based on the mineral dust data alone, dust flux is a good indicator of atmospheric changes that take place during large-scale climatic changes. There are currently several well-known climatic modes influence atmospheric circulation and the dust cycle (ENSO, NAO, SAM, PDO,...). Some of them are known to have perdured during past glacial and interglacial times. It is therefore reasonable to assume that certain stable climatic modes were present during past glacial periods. Here we look at the non-stationarity of signals in the EPICA Dome C (Antarctica) and NGRIP (Greenland) high-resolution dust proxies. We show that during major warming events (e.g. Dansgaard-Oeschger (D/O) events, Antarctic Isotopic Maxima (AIM), glacial terminations) the stationarity of the signal breaks down. We interpret this as occurrences of large-scale atmospheric reorganizations and the temporary break-down of major climatic modes. We compare the timing of maximum non-stationarity between separate D/O, AIMs, and terminations to pinpoint the moment when the atmospheric reorganization occurred during warming events.

A NEW ESTIMATE OF HOLOCENE AND LGM GLOBAL DUST RADIATIVE FORCING BASED ON AN ATMOSPHERIC DUST RECONSTRUCTIONS USING BOTH MEASUREMENTS IN PALEOCLIMATIC ARCHIVES AND DUST MODEL VARIABLES

Fabrice Lambert[1]*, Gisela Winckler[2], Natalie Mahowald[3], Ayako Abe-Ouchi[4], Maisa Rojas[1], Toshihiko Takemura[5], Laura Gallardo[1]

[1]*Center for Climate Research and Resilience, University of Chile, Santiago, 8370449, Chile*
[2]*LDEO, Columbia University, Palisades, NY 10964, USA*
[3]*Cornell University, Ithaca, NY 14850, USA*
[4]*AORI, University of Tokyo, Chiba, 277-8568, Japan*
[5]*Research Institute for Applied Mechanics, Kyushu University, Fukuoka, 812-8581, Japan*
**lambert@dgf.uchile.cl*

Aerosols are the second most potent agent affecting anthropogenic radiative forcing after greenhouse gases. However, despite some progress in the field, the uncertainty of mineral dust impact on present and past climate remains much larger than for other species. The total atmospheric dust load is an important factor for the radiative budget of the atmosphere, and for the micronutrient supply to terrestrial and marine ecosystems.

We have collected published dust flux (mass accumulation rate) measurements from marine sediment cores, ice cores, loess fields, and peat bogs. These measurements are interpolated to two global grids of average Holocene and Last Glacial Maximum (LGM) climatic conditions. The interpolation is performed using a kriging algorithm and its uncertainty shows regions where new measurements are most needed. We have developed a new method that combines observational dust flux measurements with dust depositional variables from climate models to reconstruct average Holocene and LGM atmospheric dust concentrations. Here we use dust simulations from several different coupled GCMs as a small ensemble. Our reconstructions give a different perspective on Holocene and LGM atmospheric dust loads from pure model simulations. The discrepancies between modeled and reconstructed dust concentrations and radiative forcing gives insights on regions and variables that may be improved in the models. Although the global average dust radiative forcing is not markedly different from the model results, significant regional differences are apparent, especially in non-tropical latitudes.

INCREASED DUST DEPOSITION IN THE PACIFIC SOUTHERN OCEAN DURING GLACIAL PERIODS

Frank Lamy[1]*, Rainer Gersonde[1], Gisela Winckler[2], Oliver Esper[1],
Andrea Jaeschke[1], Gerhard Kuhn[1], Johannes Ullermann[1],
Alfredo Martinez-Garcia[3], Fabrice Lambert[4], Rolf Kilian[5],

[1]*Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven, Germany*
[2]*Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY, USA*
[3]*Geologisches Institut, ETH Zürich, Zürich, Switzerland*
[4]*Center for Climate and Resilience Research, University of Chile, Santiago, Chile*
[5]*Geologie, Fachbereich Raum- und Umweltwissenschaften, Universität Trier, Trier, Germany*
Frank Lamy@awi.de

Dust deposition across the Southern Ocean plays a critical role for marine biological production through iron fertilization and is supposed to control a significant fraction of glacial-interglacial atmospheric CO_2 changes. However, in the Pacific, the largest Southern Ocean sector, reliable sediment records are sparse and climate models indicate low dust deposition both for modern times and the last glacial maximum. Here, we present the comprehensive data-sets of dust supply based on the analysis of sediment records recently retrieved across the Pacific Southern Ocean. The shape and glacial/interglacial pattern of lithogenic sediment input records in the western and central sector reveals strong similarities to dust records from Antarctica and the South Atlantic. Though our new data document substantial sediment redistribution, glacial dust mass accumulation rates corrected for sediment focusing exceed interglacial values by a factor of ~3. The first-order changes in Subantarctic biological productivity largely follow increased dust supply during glacials.

Taken together our new sediment records document a substantial glacial dust supply from Australian and New Zealand sources to the Pacific SO sector eastward to at least 125°W. Such enhancement of dust supply is consistent with stronger aridity in Australia and a glacial dust source in New Zealand. Although the most likely dust source for the South Pacific is Australia/New Zealand, the glacial/interglacial pattern and timing of lithogenic sediment deposition is similar to dust records from Antarctica and the South Atlantic dominated by Patagonian sources. These similarities imply large-scale common climate forcings such as latitudinal shifts of the southern westerlies and regionally enhanced glaciogenic dust mobilization in New Zealand and Patagonia.

QUANTIFICATION OF NATURAL CONTRIBUTION ON PM_{10} EXCEEDANCES IN SOUTHERN ITALY: AN EXPERIMENT PERFORMED IN THE FRAMEWORK OF THE I-AMICA PROJECT

Tony C. Landi[1]*, Laureline Bourcier[1], Angelo Riccio[2], Daniele Contini[3], Francesca Sprovieri[4], Mariantonia Bencardino[4], Paolo Cristofanelli[1], Angela Marinoni[1], Paolo Bonasoni[1]

[1]*National Research Council, Institute of Atmospheric Sciences and Climate (ISAC-CNR), via Gobetti 101, 40129, Bologna, Italy*
[2]*Dept. of Science and Technology, University Parthenope, 80143, Napoli, Italy*
[3]*National Research Council, Institute of Atmospheric Sciences and Climate (ISAC-CNR), Str. Prv. Lecce-Monteroni km 1.2, 73100, Lecce, Italy*
[4]*National Research Council, Istituto Inquinamento Atmosferico (IIA-CNR), U.O.S. di Rende, c/o: UNICAL-Polifunzionale, 87036 Rende, Italy*
**t.landi@isac.cnr.it*

Results concerning an assessment of the contribution of natural sources (i.e. mineral dust and sea spray) on PM_{10} exceedances in Southern Italy are presented. This study has been carried out for the Convergence Regions (i.e., Campania, Puglia, Calabria and Sicilia) in the framework of the I-AMICA (Infrastruttura di Alta Tecnologia per il Monitoraggio Integrato Climatico - Ambientale) project, as part of the National Operative Programme (PON) funded by MIUR and by the European Union. Up to now, in the Convergence Regions only short-term experiments based on PM_{10} measurements have been performed for single sites. There are no multi-year experiments in which synchronous observations have been compared and analysed in different regions of Southern Italy. Thus, a work about the characterization of such phenomena over the entire Southern part of Italian peninsula is still lacking. In this work, (i) ground based observations i.e., PM_{10}, $PM_{2.5}$, chemical composition of particulate matter for the urban areas of Lecce (40.30 N - 18.01 E) and Naples (40.84N - 14.25E), (ii) satellite measurements, i.e., MODIS and CALIPSO, and (iii) deterministic modelling, i.e., WRF/CHIMERE/AODEM, were used to quantify the impact of natural sources, such as mineral dust from Northern Africa and sea salt from Mediterranean sea surface, on the PM_{10} concentrations at ground level. Basically, the adopted method includes not only the data collected at the rural background sampling sites but also those registered at all other classes of measurement stations (i.e., urban, suburban, sub-rural). By using advanced optimization statistical tools (i.e., best fit of extreme value distribution, analysis of variances - ANOVA) the fraction of the two most abundant natural aerosols on the PM_{10} levels observed on daily, monthly, and annual basis has been determined.

DOES VOLCANIC ASH RE-MOBILISATION FROM ITS DEPOSITS ON LAND CONTRIBUTE TO OCEAN FERTILISATION?

BAERBEL LANGMANN*, ALEX HUDY, MATTHIAS HORT

Institute of Geophysics, University of Hamburg, KlimaCampus, 20146 Hamburg, Germany
**baerbel.langmann@zmaw.de*

Recent studies on the iron fertilisation of the surface ocean with volcanic ash are all focused on the immediate time after a volcanic eruption. Here we investigate a post-eruptive effect: volcanic ash may be re-mobilised into the atmosphere from ash deposits on land by wind (Langmann, 2013). Therefore it may fertilise the surface ocean during periods of months to years and not only during a volcanic eruption. Observations confirm such re-mobilisation events, e.g. after the volcanic eruptions of Katmai, Alaska (1912), Mt. Hudson, Chile (1991) and Eyjafjallajökull, Iceland (2010). Even though the Katmai eruption is more than 100 years ago, volcanic ash re-mobilisation events occur until today. Here we report first model simulation results after the volcanic eruption of Mt. Hudson, Chile (1991) focusing on the deposition of volcanic ash into the Atlantic sector of the Antarctic Ocean and its potential to iron-fertilise surface ocean waters.

Langmann, B., Volcanic ash versus mineral dust: Atmospheric processing and environmental and climate impacts, ISRN Atmospheric Sciences 2013, 245076, doi:10.1155/2013/245076, 2013.

SAHARAN DUST INPUT DURING THE EARLY-MIDDLE HOLOCENE TRANSITION

Gaël Le Roux[1,2]*, François De Vleeschouwer[1,2], Nadine Mattielli[3], Nathalie Fagel[4]

[1]*CNRS, EcoLab, 31326 CastanetTolosan, France*
[2]*Université de Toulouse, INP, UPS, EcoLab (Laboratoire Ecologie Fonctionnelle et Environnement), ENSAT, Avenue de l'Agrobiopole, 31326 CastanetTolosan, France*
[3]*G-Time, ULB, CP 160/02, 50, Avenue F.D. Roosevelt, B-1050 Bruxelles,Belgium*
[4]*AGEs, Département de Géologie, ULG, Allée du 6 Août, B18 Sart Tilman B-4000, Liège, Belgium*
**gael.leroux@ensat.fr*

The sources of dustdeposited in Central Europe have changed abruptly during the Early-Middle Holocene Transition (EMHT) because of volcanic eruptions in the Massif Central and because of distal transport of Saharan dust (Le Roux et al., 2012). However, the timing of these abrupt changes as well as the dust sources remain poorly constrained, principally because of the lack of records across Europe. In an effort to refine the timing of dust events during the EMHT, we have investigated a peat core from the Pyrenees using trace elements, Nd isotopes and radiocarbon dating. We focus our study on the Early-Middle Holocene transition where our previous study (Le Roux et al., 2012) has shown that dramatic increases of dust occurred because of volcanic eruptions in the Chaîne des Puys (Massif Central) and because of distal transport of Saharan dust. Based on our new record, we can evidence that a Saharan dust pulse also occurred in the Pyrenees during the Early-Middle Holocene Transition. Its timing is similar tothe one recorded in Central Europe. However because of the proximity with Northern Africa, Saharan dust pulses are more frequent in the Pyrenean site, which also displays a more radiogenic Nd background than the Swiss bog. No clear volcanic inputs were recorded. Our work has important implications in terms of relationships between inputs of desertdust in Europe, atmospheric transport and the rapid evolution of Sahara at the beginning of the Holocene.

Le Roux G., Fagel N., De Vleeschouwer F.,Krachler M.,Debaille V.,Stille P., Mattielli N., van der Knaap W.O., van Leeuwen J.F.N., Shotyk W. (2012), Volcano- and climate-driven changes in atmospheric dust sources and fluxes since the Late Glacial in Central Europe, Geology, v. 40, p. 335-338

Acknowledgement - Sandra Moreels (ULB) is thanked for her significant analytical work during her master.

SENSITIVITY OF DUST EMISSIONS AND TRANSPORT TO METEOROLOGICAL MODELS AND DUST SIZE PARAMETERISATION

Sunhee Lee[1]*, Martin Cope[1], Alan Wain[2], Robert Fawcett[2], Jeff Kepert[2]

[1]*Center for Australian Climate and Weather Research, CSIRO Marine and Atmospheric Research, Aspendale, VIC 3195, Australia*
[2]*Center for Australian Climate and Weather Research, Bureau of Meteorology, Melbourne, VIC 3000, Australia*
**sunhee.lee@csiro.au*

Modelling dust emissions and transport depend critically on the accurate parameterisation of land surface characteristics as well as accurate modelling of meteorological conditions, particularly wind speed and precipitation. In this study we first investigated the sensitivity of dust emissions and transport to different numerical weather prediction (NWP) systems and their vertical and horizontal resolutions. We then investigated the impact on dust loading and transport of two different representations of the dust size distributions - the bin and mode schemes.

The NWP systems included in the study were the CSIRO-conformal cubic atmospheric model (CCAM, McGregor and Dix, 2001) and the Australian Bureau of Meteorology's Operational Unified Model (UM, NMOC 2010). These were combined with CSIRO's Chemical Transport Model (CTM, Cope et.al, 2004), which employs a saltation-based dust emission scheme (Lu and Shao, 2001) as used for the Australian Air Quality Forecasting System. Both CCAM-CTM and UM-CTM were used to model an extreme dust event of 22-23 Sept, 2009 over Sydney, Australia with a nested grid with horizontal grid spacings of 0.25° and 0.05°. Land surface characteristics such as leaf area index and soil type were the same for both runs. For the 0.25° simulation, aggregated land surface information was employed in a tiled approach to closely match with the inner nest grid. The results were compared with PM measurements at monitoring stations and AOD from satellite observation. Simulations with finer resolution for each NWP model showed far better agreement with observations. The differences in dust loading and transport from the two NWP systems are also compared and found to be comparable or smaller than then effects of model resolution.

In comparing thee bin and mode approaches, 25 bins for dust particle diameters up to 60 μm were used and 3 modes were employed. Possible causes of differences in dust loading and transport between two size distribution schemes are discussed.

Cope M., Hess G. D., Lee S., et al (2004) The Australian air quality forecasting system Part1: Project description and early outcomes. J. Appl Meteorol., 42, 649-662.

Lu H. and Shao Y. (2001), Toward quantitative prediction of dust storms: an integrated wind erosion modelling system and its applications, Env. Modelling & Software, 16, 233-249.

McGregor J., and Dix M. (2001) The CSIRO conformal-cubic atmospheric GCM. In IUTAM Symposium on Advances in Mathematical Modelling of Atmosphere and Ocean Dynamics, P. F. Hodnett (Ed.), Kluwer, Dordrecht, 197-202.

National Meteorological Oceanographic Centre (2010) Operational implementation of the ACCESS numerical weather prediction systems, NMOC Operations Bulletine 38, 34p.

MEASUREMENT OF AEROSOL OPTICAL PROPERTY IN HONG KONG RURAL AREA

Shun-Cheng Lee[1]*, Yuan. Gao[1], Yu. Huang[1], Senchao. Lai[1,2], Jian. Sun[1]

[1]*Department of Civil and Structural Engineering, Research Center for Environmental Technology and Management, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China;*
[2]*College of Environmental Science and Engineering, South China University of Technology, Higher Education Mega Centre, Guangzhou 510006, China*
**ceslee@polyu.edu.hk*

Atmospheric aerosols play an important role in climate change and visibility impairment. The evidence of the role in climate change is required for monitoring the extinction, absorption, scattering coefficient and single scattering albedo in different sites around world. In the southern China public attention are focusing on severe regional visibility problem and its connection to regional air pollution. Black carbon (BC) is a form of atmospheric aerosol and can reduce visibility through absorption of solar radiation and it is an important primary aerosol cause global warming. Here, we presented the 2-year measurements (2011-2013) of aerosol optical properties, using aethalometer to measure absorption coefficient (B_{ab}) in Hong Kong rural area (Hok Tsui) and determine the Hong Kong regional pollution status. The mean B_{ab} during the sampling period is 15.09±9.85 Mm^{-1}. Absorption coefficient are both ~22% higher than the median. The significant seasonal variation of absorption coefficient is observed, which was lower in spring (12.87±7.5) and summer (10.84±10.1) seasons but has higher value in autumn (16.79±8.9) and winter (18.74±10.3) seasons. Compared to scattering and absorption coefficient data reported by Man and Shi (2001) in HT, 14 years ago, absorption coefficient decreased ~11%.

Acknowledgements - Financial support from the Hong Kong Environmental Protection Department (HKEPD) is gratefully acknowledged.

Man C. K. and Shih, M. Y. (2001). Light scattering and absorption properties of aerosol particles in Hong Kong. Journal of Aerosol and Science, 32,795-804.

Keywords: Aerosol optical property, Black carbon.

EVALUATION OF ASIAN DUST FORECASTING MODEL FOR THE PERIOD OF SPRING 2013 IN KOREA

Sang-Sam Lee, Bonyang Ku, Young-San Park*, Jae-bok Lee, Youngsin Chun

National Institute of Meteorological Research, Korea Meteorological Administration, Seogwipo, 697-845, South Korea
**sanpark@korea.kr*

The Asian dust forecasting model, UM-ADAM2 (Asian Dust Aerosol Model 2) has been developed in 2010 and operated thereafter by NIMR, for the forecast of Asian dust storms over Korean peninsula. The meteorological forecasts are based on the Unified Model. In order to evaluate the performance of the dust prediction model quantitatively, the model simulation has been tested with 72-hour forecasts for the period from March 1 to May 31, 2013. Two types of time intervals of simulation starting-time were tested and compared; 12-hour and 6-hour intervals.
The simulation results were compared to PM_{10} concentrations observed at surface stations in Korea. Compared to observations, the results showed that the model simulated the maximum concentrations as well as the starting and ending times of major dust events accurately overall.
When the simulation was started at every 12-hr, the mean bias and RMSE are -25.3, 68.5 $\mu g/m^3$, respectively. Meanwhile for the case of 6-hr interval of starting time, the mean bias and RMSE are -21.5 and 66.3 $\mu g/m^3$. That is, the mean bias and RMSE both were decreased compared to the case of 12-hr interval of starting time. So we will run the model 4 times a day in the operation mode next year and expect improvements on the forecasting of Asian dust storms in region of Northeast Asia.

AEOLIAN DUST IN MOUNTAIN AREAS OF TIBET AND MONGOLIA

Frank Lehmkuhl

Department of Geography,RWTH-Aachen University, 52056 Aachen, Germany
flehmkuhl@geo.rwth-aachen.de

Mantles of silt are widespread deposition of aeolian dust in the mountains of Tibet and Mongolia (Lehmkuhl 1997). Up to now, little is known about the distribution and timing of such late Quaternary sediments in high mountain environments. They represent valuable archives about environmental change during the late Quaternary. Luminescence and radiocarbon dating provide information concerning their timing to end of the last glacial cycle and especially to the Holocene. Sand some of them include loess-paleosol sequences. In addition, valuable information concerning paleoenvironmental conditions can acquired by grain-size distribution and geochemical analyses (e.g. Lehmkuhl et al. 2011, Lehmkuhl et al. 2013).

Lehmkuhl, F. (1997d): The spatial distribution of loess and loess-like sediments in the mountain areas of Central and High Asia. - Zeitschrift f. Geomorphologie, N.F., Suppl.-Bd. 111:97-116.

Lehmkuhl, F., Hilgers, A., Fries, S., Hülle, D., Schlütz, F., Shumuilovskikh, L., Felauer, T., & J. Protze (2011): Holocene geomorphological processes and soil development as indicators for environmental change around Karakorum, Upper Orkhon Valley (Central Mongolia). - Catena 87: 31-44.

Lehmkuhl, F., Schulte, P., Zhao, H., Hülle, D., Protze, J., Stauch, G. (2013): Timing and spatial distribution of loess and loess-like sediments in the mountain areas of the northeastern Tibetan Plateau. Catena, doi: 10.1016/j.catena.2013.06.008

ENVIRONMENTAL CHANGE INDICATED BY GRAIN-SIZE VARIATIONS AND TRACE ELEMENTS: AN EXAMPLES FROM TWO DIFFERENT SECTIONS: THE SANDY-LOESS SEDIMENTS FROM THE DOROSHIVTSY SITE (UKRAINE) AND LOESS SECTION SEMLAC (ROMANIA)

Frank Lehmkuhl*, Phillip Schulte

Department of Geography,RWTH-Aachen University, 52056 Aachen, Germany
**flehmkuhl@geo.rwth-aachen.de*

The recently discovered loess section of Doroshivtsy became famous due to archeological findings of the Gravettian. The profile represents a ~9 m sequence of sandy loess, intercalated by more humic horizons. It is situated in a flat gully and at an undercut slope of the Dniester River close to the village Doroshivtsy in the south-western Ukraine. The loess section is composed mainly of sandy silt and covers the time span from about 26 to 16 ka. This is one of the very few sections in Europe which provides a high resolution sedimentary record including prehistoric finds of the cooling maximum of the last glacial cycle. Based on the field description and the grain size distribution obtained by Laser Diffraction Particle Size Analyzer (Beckman Coulter LS 13 320 PIDS), the profile can be divided into three main genetic units representing changes during the deposition. As the sediment is rather homogeneous sandy silt U-ratio and GSI did not show any distinct variations. However, calculations with different grain-size ratios show that a fine silt to fine sand ratio (SiS-ratio) of 3.5 to 8.1 μm and 69.6 to 161.1 μm provide clear peaks. These variations of the SiS-ratio represent environmental changes which are also observed by structures and weak soil formations in the section during field work and fit also to the different archeological layers. In addition, geochemical analysis show comparable results to the SiS-ratio and provide further evidence for the differentiation of the stratigraphic units. Summarizing we can detect 3 different main units and 11 sub-units which are related to palaeoclimatic and environmental conditions. This high resolution section of homogenous sandy-silt for the last glacial cycle is compared with a "classical" loess section from Semlac, which is regarded as a key section for Western Romania and is composed of loess and paleosol sequences since the mid-Pleistocene.

STUDY OF PM1 BY SEM/EDX NEAR THE OIL PRE-TREATEMENT PLANT OF AGRI VALLEY (BASILICATA REGION - SOUTHERN ITALY)

Antonio Lettino, Salvatore Margiotta, Antonio Speranza, Vito Summa*

CNR-IMAA, National Research Council of Italy, Institute of Methodologies for Environmental Analysis
Tito Scalo (Potenza), 85050, Italy
**vito.summa@imaa.cnr.it*

In recent years, there has been an increasing scientific interest in atmospheric pollution, due to its effects on human health. In order to obtain complete characterization of atmospheric aerosols and to assess its role playing in the environment, measurement and characterization methods integrating conventional techniques are needed. The Scanning Electron Microscopy with Energy Dispersive X-ray Spectrometer SEM/EDX plays a very important role in providing chemical, morphological and mineralogical data, fundamental for understanding the formation mechanisms of aerosols, discriminating between natural and anthropogenic sources.
In this study a geochemical and mineralogical characterization of the PM1 have been performed using a Field Emission SEM in the Agri Valley (Basilicata Region - Southern Italy), an area of great environmental concern due to the presence of the largest European on-shore oil reservoir and oil pre-treatment plant. The observations have been focused on a period of days before, during and immediately after the activation of an emergency procedure at the oil pre-treatment plant on September 28, 2012, to identify any anomalies in the chemical and mineralogical characters of the particles. Attention has been focused on the fine mode PM1 because it is widely recognized as a primarily anthropogenic combustion-related aerosol.
Analyses have been performed both in automatic and manual mode. The Feret Diameter of 0.7 μm is a significant threshold value separating larger and smaller particles, because the BSE images, below this value, provided very weak pictures.
In the ≥ 0.7 μm fraction, the natural and anthropogenic components of the aerosol are represented respectively by a predominance of soot and crustal particles. However, the observations allowed us to identify seven main types of particulate: silica particles, silicate and alumosilicates, carbonates, vegetable particles, C-rich particles, metallic particles and S-rich particles. The S-rich aerosol is composed mainly of calcium sulphates, as residual gypsum or secondary regular crystals often grew directly onto the carbonate particles to form polimineralic aggregates. On September 28, 2012 the greatest amounts of geogenic particles and S-rich particles were observed.
In the < 0.7 μm fraction, particles with low-Z elements (i.e. C, N, O) are prevalent, commonly carbon-rich particles and secondary particles of ammonium sulphate and ammonium nitrate. S-rich mixed particles and sodium sulphates are common as well. Therefore, most of the particle composing this fraction can be attributed to anthropogenic or mixed source mechanisms.

EXPERIMENTAL STUDIES ON EFFECTS OF RELATE HUMIDITY VARIATION ON PARTICLES SIZE DISTRUIBUTION IN INDOOR

Can Li[1]*, Shuxiang Cui[2], Wei Yang[1], Xiujuan Wang[1]

[1]*College of Civil Engineering, Hunan University of Technology, Zhuzhou 412007, Hunan, China*
[2]*China Nuclear Power Engineering Company LTD., Zhengzhou Branch, Zhengzhou, 450052, Henan, China*
**Lc19992@126.com*

To research the factors of humidity influencing fine particles smaller than 1 μm distribution in indoor, a test was conducted at a room with constant temperature condition, the smoke of a burning incense stick an used as an stable particles resource, and steam humidifier was used change the indoor relative humidity. The inhaled particles size distribution was test at different humidity. By the meantime, particles samples were trapped by inertial force, then samples were observed by FESEM (field emission scanning electron microscopy). Test results show when relative humidity up to 80% the size distribution of particles change significantly among these particles, the fine particles smaller than 1 μm decrease apparently and the coarse particles larger than 1μm increase apparently. Otherwise, FESEM observed that the particles are easy to coagulate after resource emission, performance enhance at RH 65% , especially at 80%. It is illustrated that increasing relative humidity induce hygroscopic aerosol particles absorb moisture and growth or promote particles coagulation from fine particles, and the particle-size spectra change to larger size.

Keywords: fine particle; particle size distribution; coagulation; relative humidity; hygroscopic growth

PLIOCENE LAND SNAIL RECORD FROM WESTERN CHINESE LOESS PLATEAU AND IMPLICATIONS FOR IMPACTS OF THE SUMMER INSOLATION GRADIENT BETWEEN MIDDLE AND LOW LATITUDES ON THE EAST ASIAN SUMMER MONSOON

Fengjiang Li*, Naiqin Wu

Key Laboratory of Cenozoic Geology and Environment, Institute of Geology and Geophysics, Chinese Academy of Sciences, P. O. Box 9825, Beijing 100029, China
**fengjiangli@mail.iggcas.ac.cn*

The East Asian monsoon probably existed as early as at the Palaeogene/Neogene boundary. However, its evolutionary process is still less well known owing mainly to the lack of long, continuous palaeoenvironmental records. The recently reported Miocene (22-6.2 Ma) and late Miocene-Pliocene (7.1-3.5 Ma) loess-palaeosol sequences from the western Chinese Loess Plateau (CLP) provides new insights into the evolution of the monsoon system. However, reports on the bioclimatic indicators from these deposits and the subsequent reconstruction of the palaeomonsoon are rare. Here we present a Pliocene terrestrial mollusk record from the western CLP and discuss the possible impact of isolation gradients on the East Asian summer monsoon. Our results show that most peak values of the dominant thermo-humidiphilous mollusk taxa, *Metodontia* and *Punctum*, a proxy of the East Asian summer monsoon, approximately correspond to maxima of mean summer insolation gradient between middle and low latitudes as well as some maximum values of the 35° N insolation, suggesting a possible causal link between the summer monsoon and the insolation parameters. The major frequencies from spectrum analysis of the sum of the two warmth- and moisture-loving taxa through the loess-palaeosol succession match those obtained from the mean summer insolation gradient variations between middle and low latitudes over this geological period, providing further evidence for such a causal relationship. Mean summer insolation gradient between middle and low latitudes could influence atmospheric circulation (in the present condition the East Asian summer monsoon). Any elevated mean summer insolation gradients between middle and low latitudes would have intensified the East Asian summer monsoon and the flux of moisture and heat over the oceans to the interior region including the CLP, creating favourable conditions for the expansion of the mollusk fauna. As such, the mollusk record from the loess-palaeosol deposits in the western CLP provides evidence for insolation-gradient impacts on the development of the East Asian monsoon system in the Pliocene.

EOLIAN SOURCE AND ITS EVOLUTION OF ASIAN DUST: EVIDENCES FROM GEOCHEMICAL TRACERS

Gaojun Li[1]*, Wenfang Zhang[1], Jun Chen[1]

[1]Department of Earth Sciences, Nanjing University, 163 Xianlindadao, Nanjing 210046, China
*ligaojun@nju.edu.cn

This presentation will show the geochemical tools that we used to trace the eolian source of Asian dust in the recent years. We will start with the investigation on the potential source regions in the arid Asian Interior. The investigation shows that the radiogenic isotopes of Nd and Sr could efficiently discriminate the potential source regions. Content of carbonate minerals, especially content of dolomite, and the trace metal concentrations of detrital carbonate also help to differentiate the potential source regions.

Application of these source tracers to the loess deposits in North China indicate proximal source of the eolian dust that are predominantly transported by the prevailing surface wind. We identified two geochemically distinct sources of Asian dust that are produced in the mountainous regions of North Tibetan Plateau and Central Asia Orogen respectively. The finding of binary sources could successfully explain the Nd and Sr isotopic evolution of Asian dust that is preserved in Chinese loess and North Pacific sediment. Both records show progressive increasing material contribution from North Tibetan Plateau since the early Miocene, which may reflect the tectonic uplift of the region.

Detailed investigation on the eolian deposits in North Pacific show that Taklimakan Desert may not be the only source region for the long-range transported Asian dust. Contribution of Gobi dust by monsoonal circulation is significant, at least for the Northwest Pacific. The relative contribution between Taklimakan dust and Gobi dust seems to be related to the changes of atmospheric circulation on both the orbital and tectonic time scales.

The same geochemical tools are also applied to identify the source of modern dust in East Asia. We found that the modern dust in Beijing has very different isotopic signature compared to the loess of purely natural origin in the geological past. Desertification of adjacent arid lands could explain the discrepancy.

The presentation will end with the U-Pb ages of zircon. With more data, our recent studies show homogenous U-Pb ages of zircon for the loess on Chinese Loess Plateau, which indicate the same source region as identified by other geochemical tracers. The U-Pb ages of zircon also show that the loess in South China is mainly derived from local source rather than a distal source from the arid North China.

Chen J., Li G., Yang J., et al. (2007). Nd and Sr isotopic characteristics of Chinese deserts: Implications for the provenances of Asian dust. Geochimica et Cosmochimica Acta, 3904-3914.

Li G., Chen J., Ji J., Yang J., T. M. Conway. (2009). Natural and anthropogenic sources of East Asian dust. Geology, 727-730.

ATMOSPHERIC DEPOSITION FLUXES OF ALUMINIUM, IRON AND TRACE METALS IN A COASTAL STATION ON THE NW-ALBORAN SEA (W-MEDITERRANEAN)

Esperanza Liger[1]*, Pedro Cañada[2], Concepcion Dueñas[3], M. Carmen Fernandez[3], Sergio Cañete[2], Elisa Gordo[2], Manuel Pérez[4]

[1]Department of Applied Physics II, *University of Málaga, Málaga, 29071, Spain*
[2]Central Research Facilities, *University of Málaga, Málaga, 29071, Spain*
[3]Department of Applied Physics I, *University of Málaga, Málaga, 29071, Spain*
[4]*Department of Radiology and Health Physics, University of Málaga, Málaga, 29071, Spain*
**eliger@uma.es*

The input of trace metals from the atmosphere to the water column plays a key role in ocean biogeochemical processes and is particularly important in a semi-enclosed sea like the Mediterranean. The atmospheric deposition over the whole Mediterranean is poorly constrained and hinders a clear assessment of the extent to which atmospheric elements of various anthropogenic and natural origins affect its biogeochemistry. Available data show poor spatial representation, as most of the deposition data refer to the northwestern zone. The Alboran Sea, in particular, is a very interesting case study as regards the atmospheric input because the atmospheric chemistry is dominated by antagonistic influences of natural (mainly from the Sahara) and human activity due to the relative proximity of land-based sources and densely populated shores. The biogeochemical impact of desert dust also remains a matter of discussion regarding its contribution for different major and minor elements to terrestrial and marine systems and especially its potential fertilizing role by supplying micronutrients as iron.
Atmospheric fluxes of eight trace metals (Cd, Cr, Cu, Ni, Mn, Pb, V and Zn) with Al as a crustal reference and Fe for its potential role in marine productivity, were measured by ICP-MS. In order to evaluate the presence of these elements in their differently bio-available forms, contents in the soluble and non-soluble fractions were determined. Sampling presented for this study was performed from October 2012 to March 2013 during the peak of the raining season (autumn and winter months) in Malaga (southeast of Spain, 36° 43′ 40″ N; 4° 28′ 8″ W) in an open bulk deposition collector placed 10 m above the ground. PCA analysis and the following Varimax rotation were conducted in order to obtain some information about the sources. The Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model was used to calculate the backward trajectories of air masses reaching the study region.
The atmospheric deposition fluxes were marked by the meteorological conditions, the industrial activity and the external influence of other emissions on a regional scale, principally African dust intrusions. Three intense African dust episodes, one from October, other from November and another one from March, had occurred during this campaign affecting the PM levels suspended and deposited in the south of Spain.

CHEMICAL AND PHYSICAL CHARACTERIZATION OF BIOMASS-BURNING AEROSOL MEASURED DURING THE SPRING CAMPAIGNS OF SEVEN SOUTH EAST ASIAN STUDIES (7-SEAS)

Neng-Huei (George) Lin[1]*, Si-Chee Tsay[2], Christina Hsu[2], Brent N. Holben[2], Nguyen Xuan Anh[3], Jeffrey S. Reid[4], Guey-Rong Sheu[1], Kai-Hsien Chi[5], Sheng-Hsiang Wang[2], Chung-Te Lee[6], Lin-Chi Wang[7], Jia-Lin Wang[8], Wei-Nai Chen[9], Ming-Tung Chuang[6], Shu-Ting Liang[10], Somporn Chantara[11], Guenter Engling[12], Olga Popovicheva[13]

[1]*Department of Atmospheric Sciences, National Central University, Chung-Li, Taiwan*
[2]*Goddard Space Flight Center, NASA, Greenbelt, Maryland, USA*
[3]*Institute of geophysics, Vietnam Academy of Science and Technology, Hanoi, Vietnam*
[4]*Naval Research Laboratory, Monterey, California, USA*
[5]*Institute of Environmental and Occupational Health Sciences, National Yang Ming University, Taipei, Taiwan*
[6]*Graduate Institute of Environmental Engineering, National Central University, Chung-Li, Taiwan*
[7]*Department of Chemical and Materials Engineering, Cheng Shiu University, Kaohsiung, Taiwan*
[8]*Department of Chemistry, National Central University, Chung-Li, Taiwan*
[9]*Research Center for Environmental Changes, Academia Sinica, Taipei, Taiwan*
[10]*Taiwan Environmental Protection Administration, Taipei, Taiwan*
[11]*Chemistry Department and Environmental Science Program, Chiang Mai University, Chiang Mai, Thailand*
[12]*Department of Biomedical Engineering and Environmental Sciences, National Tsing Hua University, Hsinchu, Taiwan*
[13]*Department of Microelectronics, Institute of Nuclear Physics, Moscow State University, Moscow, Russia*
**nhlin@cc.ncu.edu.tw*

The Seven South East Asian Studies (7-SEAS) seeks to perform interdisciplinary research in the field of aerosol-meteorology and climate interaction in the Southeast Asian region, particularly for the impact of biomass burning on cloud, atmospheric radiation, hydrological cycle, and regional climate. Participating countries include Indonesia, Malaysia, Philippines, Singapore, Thailand, Taiwan, Vietnam, and USA. A series of field experiments have been conducted during springtime biomass-burning seasons in northern Southeast Asia, i.e., Dongsha Experiment in 2010, Son La Campaigns in 2011 and 2012, and BASELInE (Biomass-burning Aerosols & Stratocumulus Environment: Lifecycles and Interactions Experiment) in 2013, respectively. Given an example, during 2010 Dongsha Experiment, a monitoring network for ground-based measurements was established, including five stations from northern Thailand and central Vietnam to Taiwan, with a supersite at the Dongsha Island (i.e. Pratas Island) in South China Sea (or East Sea). Aerosol chemistry sampling was performed for each station for characterizing the compositions of $PM_{2.5}$/PM_{10} (some for TSP) including water-soluble ions, metal elements, BC/OC, Hg and dioxins. This experiment provides a relatively complete and first dataset of aerosol chemistry and physical observations conducted in the source/sink region for below marine boundary layer and lower free troposphere of biomass burning/air pollutants in the northern SE Asia. This presentation will give an overview of these 7-SEAS activities and their results, particularly for the characterization of biomass-burning aerosol at source regions in northern Thailand and northern Vietnam, and receptor stations in Taiwan, which is rarely studied.

A NOVEL APPROACH TO DETERMINE THE SCATTERING PROPERTIES OF SINGLE ATMOSPHERIC DUST PARTICLES BY COMBINING ELECTRON MICROSCOPY WITH NUMERICAL LIGHT SCATTERING MODELING

Hannakaisa Lindqvist[1], Olli Jokinen[2], Konrad Kandler[3]*, Timo Nousiainen[4]

[1]*Department of Physics, University of Helsinki, 00014, Finland*
[2]*Department of Real Estate, Planning and Geoinformatics, Aalto University, Aalto, 00076, Finland*
[3]*Institut für Angewandte Geowissenschaften, Technische Universität Darmstadt, 64287, Germany*
[4]*Finnish Meteorological Institute, Earth Observation, Helsinki, 00101, Finland*
**kzk@gmx.de*

Mineral dust particles are important atmospheric constituents with a wide variety of impacts. Their radiative impacts derive from the single-scattering properties of individual dust particles, which are poorly known and quite challenging to compute accurately. These uncertainties impact considerably the accuracy of atmospheric remote sensing and impede the assessment of climate forcing by dust.

In the present work, a new approach to modeling light scattering by dust is proposed. Instead of using artificial particle shapes based on mathematical geometries, single, inhomogeneous mineral dust particles are modeled using shape and composition derived directly from measurements of real dust particles. We demonstrate the use of a stereogrammetric shape retrieval method in the context of single-scattering modeling of mineral dust for four different dust particle types - all of them inhomogeneous - ranging from compact, equidimensional shapes to very elongated and aggregate shapes. The three-dimensional particle shapes were derived from stereo pairs of scanning-electron microscope images, and inhomogeneous compositions were determined by mineralogical interpretation of localized elemental information obtained by energy-dispersive spectroscopy. Scattering computations were performed for particle equal-volume diameters from 0.08 µm up to 2.8 µm at 550 nm wavelength using discrete-dipole approximation. Different dust particles were found to scatter light considerably differently, a variation which could not be well reproduced using simplified shapes of homogeneous spheres, spheroids, or Gaussian random spheres. Effective-medium approximation results revealed that particle inhomogeneity may be important to be explicitly accounted for, even for small amounts of absorbing media (here up to 2% of the volume). When integrated over a lognormal size distribution, the linear depolarization ratio and single-scattering albedo were also found to be sensitive to inhomogeneity.

The methodology applied is work-intensive and the light-scattering method used quite limited in terms of size parameter coverage. It would therefore be desirable to find sufficiently accurate but simpler approach with fewer limitations for single-scattering modeling of dust. For validation of such a method, the approach presented here can be used for producing reference data when applied to a suitable set of target particles.

CALIOP 532-NM DUST OPTICAL PROPERTIES OVER CLOUDS

Zhaoyan Liu[1,2], David Winker[2], Ali Omar[2], Mark Vaughan[2], Jayanta Kar[1,2], Charles Trepte[2], Yongxiang Hu[2]

[1]*Science Systems and Applications Inc., NASA Langley Research Center, Hampton, VA 23666, USA*
[2]*NASA Langley Research Center, Hampton, VA 23681, USA*

The Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) onboard the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) satellite offers many new observational capabilities to the international scientific community. CALIOP measures two polarization components at 532 nm, which can be used to effectively identify non-spherical particles from spherical particles, and therefore provides a unique vertical-resolved measurement of airborne dust on a global scale. In this paper we use a constrained retrieval technique, developed by the CALIPSO team (Hu et al., 2007), to derive dust aerosol optical properties over opaque water clouds. This technique derives direct estimates of aerosol optical depths (AODs) of dust layers from the integral of the backscatter signals of underlying opaque water clouds. This AOD estimate allows the retrieval of lidar ratio as well as extinction and backscatter of dust layers overlying opaque water clouds. Lidar ratio is a key parameter in the lidar signal inversion and can be a source of uncertainty in the CALIOP aerosol retrievals (Winker et al., 2009). In the standard CALIOP aerosol retrieval, this parameter is selected on a layer-by-layer basis by a scene classification algorithm using aerosol models developed from AERONET measurements (Omar et al., 2009). Lidar ratio estimated from opaque-cloud constrained (OWC) retrievals allows evaluation and improvement of the standard CALIOP aerosol retrieval. We examine multiple years of CALIPSO data and focus on the dust transport regions over North Atlantic where transatlantic African dust transport occurs most extensively during the summer months and over North Pacific where transpacific Asian dust transport occurs frequently in spring. The lidar ratio derived in the African dust transport region over the North Atlantic has a distribution that peaks at ~43 sr with a mean value of ~45 sr and a half width of half maximum (HWFM) of 8 sr. This indicates that the modelled lidar ratio (40 sr) is representative of dust transported to the North Atlantic. For this reason, the dust AOD derived from the standard retrieval has a good correlation to that from the OWC retrieval but is biased low by ~26% in the mean AOD.

Hu Y., Vaughan M., Liu Z., Powell K., and Rodier S. (2007). Retrieving Optical Depths and Lidar Ratios for Transparent Layers Above Opaque Water Clouds From CALIPSO Lidar Measurements, *IEEE Geosci. Remote Sens. Lett.*, **4**, 523-526.

Omar A., Winker D., Kittaka C., et al., (2009), The CALIPSO Automated Aerosol Classification and Lidar Ratio Selection Algorithm, *J. Atmos. Oceanic Technol.*, **26**, 1994-2014.

Winker, D. M., Vaughan M. A., Omar A. H., Yet al., (2009), Overview of the CALIPSO Mission and CALIOP Data Processing Algorithms, J. Atmos. Oceanic Technol., 26, 2310-2323.

DIAPASON: AEROSOL LIDAR-CEILOMETERS FOR ASSESSMENT OF DESERT DUST CONTRIBUTION IN AIR QUALITY MEASUREMENTS AND MODELS

S. Loaec[1]*, P. Royer[1], A. Bizard[1], L. Sauvage[1], G-P.Gobbi[2], L. Diliberto[2], F. Barnaba[2], F. Costabile[2], R. Sozzi[3], A. Bolignano[3]

[1]*Leosphere, 43 rue de Liège, 75008 Paris, France*
[2]*CNR-ISAC, Via Fosso del Cavalieren 100, 00133 Rome, Italy*
[3]*ARPA Lazio, Via Garibaldi, 114, 02100 Rieti, Italy*
**sloaec@leosphere.com*

The LIFE ENvironement project DIAPASON (Desert-dust Impact on Air quality through model-Predictions and Advanced Sensors ObservatioNs) aims at demonstrating the benefits of innovative technologies to assess the effects of advection of Saharan dust on the European levels of particulate matter (PM10 and PM2.5). The EU Air Quality Directive allows Member States to subtract contributions from natural sources before comparing concentrations of PM in air to the relevant limit values. Currently, Saharan dust events are established indirectly on the basis of model predictions and satellite observations.

In the framework of this project, LEOSPHERE has deployed two aerosol lidar-ceilometer systems around Roma in September 2013. The lidar-ceilometer will help to determine the types of particles observed in the atmosphere (Saharan dust, pollution, wild fire, sea salts or volcanic plumes) and validate the horizontal and vertical position of dust aerosol layers in air pollution models. In fact, Saharan dusts are mainly composed of non-spherical mineral particles which can be distinguished from spherical aerosols (pollution, sea salts, forest fires) using depolarization measurements from the lidar-ceilometer.

Dust aerosol events observed with lidar-ceilometer will be presented here and compared with model forecasts.

Keywords: DIAPASON, Aerosols, Lidar-ceilometer, Dust, Air Pollution, Air quality models

SAHARAN DUST INPUT TO THE WESTERN MEDITERRANEAN. A THIRTY YEARS RECORD IN CORSICA

Marie-Dominique Loÿe-Pilot

CERES-ERTI, ENS, Paris, 75005, France
loye@canoe.ens.fr

A 30 years survey (1984-2013) of the Saharan dust input was performed in Corsica, on an event basis. Dry deposition was collected separately manually since 1985. Wet deposition of dust particles is independent of the amount of rainfall. Dry deposition is of minor importance in Corsica, which could be related to the high altitude of dust routes above the Mediterranean, the efficiency of dust particles acting as condensation nuclei, among other parameters. Dust fallout events are very brief (less than 3 days long) and irregular in intensity. A seasonal pattern appears in the frequency and magnitude of events (spring and autumn maxima) but with a very high variability. The high magnitude events drive the variability of the dust fallout at the intra- and inter-annual scales. The annual input of Saharan dust varies between 3.5 and 51.2 g/m², depending on the occurrence of high magnitude events. The annual average value for the period studied is 10.8 g/m². The annual input was the highest in the 1980's and begins to decrease in the 1990's; it is keeping low after a short period of high deposition in the beginning of the 2000's.

EVALUATE DUST EMISSION IN CHINESE DESERTS AND SAND FIELDS IN LAST GLACIAL MAXIMUM, HOLOCENE OPTIMUM AND THE PRESENT

Huayu Lu[1]*, Menchun Cui[1], Shuangwen Yi[1], Zhiwei Xu[1], Yali Zhou[2], Han Feng[1], Lin Zeng[1], Fangying Zhu[1], Lina Dong[1], Hongyan Zhang[1], Haixin Zhuo[1], Kaifeng Yu[1], Joseph Mason[3], Xiaoyong Wang[1], Yingyong Chen[1], Qi Lu[4], Bo Wu[4], Zhibao Dong[5], Jianjun Qu[5], Xunming Wang[5], Zhengtang Guo[6]

[1]*School of Geographic and Oceanographic Sciences, Institute for Climate and Global Change Research, Nanjing University, Nanjing, 210093,China*
[2]*College of Tourism and Environment, Shaanxi Normal University, Xi'an, 710062,China*
[3]*Department of Geography, University of Wisconsin Madison, WI 53706, USA*
[4]*Institute of Desertification Studies, Chinese Academy of Forestry, Beijing, 100091,China*
[5]*Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou, 730000,China*
[6]*Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, 100029,China*
**huayulu@nju.edu.cn*

The Last Glacial Maximum (LGM) and the Holocene Optimum (HO) were characterized by cold-dry and warm-wet climates respectively in the recently geological Earth. How dust emission from Chinese deserts and sand fields responded to these distinctive climatic changes, and the dust emissions compared with that of the present are still not clear, however. Through our long-term field and laboratory investigations, 400 optically stimulated luminescence (OSL) ages and more than 100 depositional records in the Chinese deserts and sand fields were obtained; on the basis of these data, we reconstruct spatial distributions of the deserts and sand fields during the LGM and HO. Our results show that the sand fields of Mu Us, Hunshandake, Horqin and Hulun Buir in northern and northeastern China had expanded 25%, 37%, 38% and 270%, respectively, during the LGM; the sand fields of Gonghe in the northeastern Qinghai-Tibetan Plateau had expanded 20%, and the deserts of Badain Jaran, Tengger in central northern China had expanded 39% and 29% separately during the LGM; the deserts of Taklimakan, Gurbantünggüt and Kumtag in northwestern China had expanded 10%-20% respectively, compared to their modern areas. On the other hand, all of the sand fields were nearly completely covered by vegetation during the HO; the deserts in northwestern and central northern China were reduced by around 5%-20% in area during this time. We use a model of present as an analogue to calculate dust emission in the LGM and HO, the results show a significantly change of dust emission under the natural climatic changes.

THE EXTERNAL-BEAM PIXE/PIGE SET-UP AT LABEC FOR VERY FAST MEASUREMENTS ON AEROSOL SAMPLES

Franco Lucarelli*, Giulia Calzolai, Massimo Chiari,
Silvia Nava, Martina Giannoni

Department of Physics and Astronomy, University of Florence and INFN, Sesto Fiorentino, 50019, Italy
**lucarelli@fi.infn.it*

Particle Induced X-ray Emission (PIXE) technique has been widely used since its birth for the study of the aerosol composition, and for a long time it has been the dominating technique for its elemental analysis. However now it has to compete with other techniques, like Induced Coupled Plasma and detection by Atomic Emission Spectroscopy (ICP-AES) or Mass Spectrometry (ICP-MS) or Syncrotron Radiation XRF (SR-XRF). To remain competitive, a proper experimental set-up is important to fully exploit PIXE capabilities. At LABEC, an external beam line is fully dedicated to PIXE-PIGE measurements of atmospheric aerosols. Recently SDD (Silicon Drift Detectors) have been introduced for X-ray detection thanks to their better resolution with respect to Si(Li) detectors and the possibility of managing high counting rates (up to 50 kHz at 0.5 sec shaping time). This implies, in turn, the possibility of using very high beam currents thus drastically reducing the measurement time. However their use for a complete characterization of X-rays was limited by the small thickness and surface areas available. Now SDD with a thickness of 500 μm and 80 mm^2 area have been introduced in the market. We have therefore replaced the Si(Li) detector used so far for the detection of both light and medium-high Z elements with such a SDD.
PIXE minimum detection limits (MDLs) at different proton beam energies have been studied to find out the best energy for PIXE measurements on aerosol samples collected on different substrata, namely Teflon, Kapton, Nuclepore and Kimfol, used for daily or hourly sampling or for cascade impactors. In particular in the case of Teflon filters, the production of γ-rays by F in the Teflon filter limits the current which may be used and the Compton γ-ray background worsens the MDLs. Due to the lower thickness of the SDD detector with respect to a typical Si(Li) detector , these problems are reduced; therefore beam currents 10 times higher or more may be used and consequently measuring time as low as 1 minute per sample can be attained and MDLs are improved. Similar improvements are obtained in the analysis of filters collected with the streaker sampler, with measuring times which become comparable to the ones used with SR-XRF(every hourly spot can be analyzed in times down to the minute).
Some example of applications with this upgraded set-up will be presented.

THE USE OF HOURLY ELEMENTAL CONCENTRATIONS FOR A CLEAR IDENTIFICATION OF AEROSOL SOURCES

Franco Lucarelli*, Giulia Calzolai, Massimo Chiari,
Silvia Nava, Martina Giannoni

Department of Physics and Astronomy, University of Florence and INFN, Sesto Fiorentino, 50019, Italy
**lucarelli@fi.infn.it*

The identification of the sources is one of the most important issues in aerosol studies and several "source apportionment" strategies have been developed; receptor models are presently one of the most used approaches and, among these, Positive Matrix Factorization (PMF) has been recently asserted to international level as a very reliable tool. Many studies have been devoted to PM source apportionment using 24-h averaged data. However, most particulate emissions as well as their atmospheric dilution processes change within a few hours. Daily samples are not capable of tracking these rapid changes. Furthermore, source apportionment receptor models need a series of samples containing material from the same set of sources in differing proportions. Increasing the measurement time resolution typically provides samples that have greater between-sample variability in the source contributions than samples integrated over longer time periods. The time-resolved measurement requires a suitable technique both for particle sampling and analysis. For time-resolved sampling we use the "streaker" sampler by PIXE International Corporation, which is designed to separate the fine (<2.5 μm) and the coarse (2.5-10 μm) size fractions of aerosol with 1 hour resolution. The resolution in time and size leads to a large number of collected samples with low mass to be analysed. The Particle Induced X-ray Emission (PIXE) technique is a powerful tool to investigate environmental problems and it has been widely used since its birth for the study of the aerosol composition. PIXE is a non-destructive, fast, with a high sensitivity also for small amount of matter and multi-elemental technique (it allows the detection of all the elements with Z>10). Among PIXE detectable elements there are markers of specific components such as marine aerosol (Na, Cl), mineral dust (Al, Si, Ca, Ti, Sr), sulphates (S), biomass burning (K), heavy oil combustion (V, Ni), traffic and industrial emission (Mn, Ni, Cu, Zn, Pb), etc. As concerns the use of K as biomass burning tracer, the main advantage is due to the fact that it is stable, it does not go into chemical reactions or degradation as other chemical tracers. At the INFN LABEC Laboratory in Florence elemental mass concentrations are obtained by PIXE analyses performed with 3MeV proton beam from the 3MV Tandetron accelerator with the external beam set-up specifically designed for aerosol studies.

Results concerning the identification of the aerosol sources in different areas (e.g. Taranto industrial area) by the application of Positive Matrix Factorisation (PMF), will be shown.

STUDY OF THE AEROSOL ELEMENTAL COMPOSITION IN FOUR SOUTHERN EUROPE CITIES: FIRST RESULTS FROM THE LIFE + AIRUSE PROJECT

Franco Lucarelli[1]*, Giulia Calzolai[1], Massimo Chiari[1], Silvia Nava[1], Martina Giannoni[1], Daniele Frosini[1], Fulvio Amato[2], Angeliki Karanasiou[2], Xavier Querol[2], Célia Alves[3], Danilo Custódio[3], Casimiro Pio[3], Kostas Eleftheriadis[4], Evangelia Diapouli[4], Vasiliki Vasilatou[4]

[1]*Department of Physics and Astronomy, University of Florence and INFN, Sesto Fiorentino, 50019, Italy*
[2]*Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, 08034, Spain*
[3]*Centre for Environmental and Marine Studies (CESAM), Department of Environment, University of Aveiro, Aveiro, 3810-193, Portugal*
[4]*Environmental Radioactivity Laboratory, National Center for Scientific Research "Demokritos", Athens, 15310, Greece*
**lucarelli@fi.infn.it*

In Europe, the current policy efforts have not fully delivered the expected results and many urban areas still do not meet the air quality standards (2008/50/EC Directive). This is especially true for Southern Europe, which is affected by important contributions of particulate matter from both anthropogenic and natural (Saharan dust, marine aerosols, etc.) origin.
Within this framework, the AIRUSE project aims at testing existing and future mitigation measures and developing new strategies for the improvement of air quality in Southern European countries (www.airuse.eu). For the project, involving public and private institutions of Spain, UK, Portugal, Italy and Greece, PM10 and PM2.5 daily samplings have been scheduled for one year (from January 2013) in four urban sites, Barcelona (Spain), Porto (Portugal), Athens (Greece), and Florence (Italy). Further, the project includes samplings with hourly resolution and coarse/fine particles segregation for limited periods (a couple of weeks in wintertime and summertime). The time-extensive daily data set gives an overall representative picture of the PM composition in these urban sites, while hourly samples may help in disentangling the contributions from different aerosol sources and give better source profiles due to the capability of tracking rapid changes as the ones occurring in most particulate emissions as well as in atmospheric transport and dilution processes.
Both daily and hourly samples have been analyzed by PIXE (Particle Induced X-ray Emission) for the simultaneous assessment of the concentration of all the elements with $Z>10$.
First results on elemental composition on both daily and hourly samples will be presented. PIXE data give important information on re-suspended or African dust, as PIXE is highly sensitive to most of the crustal markers (e.g. Al, Si, K, Ca, Ti, Fe, Sr...), and on biomass burning. Furthermore, preliminary results on the source apportionment by PMF (Positive Matrix Factorization) based on hourly data will be also shown.

This work was supported by the European Commission (LIFE + Environment Policy and Governance, LIFE11 ENV/ES/584).

EFFECT OF ARTIFICIAL POLLUTION BY INDUSTRIAL DUST ON SOIL AND VEGETATION IN NORTHERN TAIGA (RUSSIA)

Irina Lyanguzova*, Vadim Gorshkov, Irina Bakkal

Laboratory of Plant Communities Ecology, V.L. Komarov Botanical Institute, Saint-Petersburg, 197376, Russia
**irina@lya.spb.ru*

A field experiment was laid out in 1997 in the background a pine forest (67°51'00'' N, 31°24'30'' E). Industrial dust sampled from electric filters of ore smelting department of copper-nickel plant was scattered on the surface of the snow cover. Scattering of industrial dust manually led to spatially very uneven pollution of Al-Fe-podzolic soil and destruction of ground cover. In 2011, the projective cover and height of all species of grass-shrub and moss-lichen layers were measured in 50 sites, also there were sampled leaves of *Vaccinium vitis-idaea*, live parts of lichens *Cladina mitis, Cl. rangiferina, Cl. stellaris, Cladonia uncialis* and forest litter as well. Litter samples were analyzed by scanning electron microscopy with X-ray microanalysis (REM/RXMA), X-ray fluorescence (RXFS) and atomic absorption spectrometry (AAS). The plant material was analyzed by AAS.

According to the REM/RXMA, particles of ashing samples of litter are mainly represented by various soil-forming minerals and iron oxides; about 10-15% of the particles have a spherical shape. They are often mounted by smaller particles consisted of salts and oxides of heavy metals, arsenic and selenium. The shape and surface morphology of spherical particles and their chemical composition are typical for melt drops, entrained by gas discharging flows from smelters. According RXFS, the litter's ash is mainly consist of SiO_2, Al_2O_3, CaO, MgO, K_2O and enriched by Ni, Cu, Zn, Pb, Sn, As, Sb, Se. The total content of Co, Ru, Rh, Pd, Ag, Cd, Te, Os, Ir, Pt, Au in all samples was below the detection limit of the RXFS method. In samples of litter only 12-24% and 29-39% of the total content of Ni and Cu were in mobile forms.

As a criterion for assessing the level of pollution of habitats the technogenic load index (I_l) was adopted. It reflects the excess of the total content of mobile forms of Ni and Cu in the litter over their content in the background. State of the grass-shrub layer of experimental Pine forest was not disturbed in the interval I_l=2.3-86 rel. un. At I_l 10 rel. un. moss-lichen layer was normally developed; in the interval I_l=10-30 rel. un. it was disrupted to varying degrees; and completely destroyed at I_l>30 rel. un. Between I_l and the projective cover of each lichen species and their total cover was a significant negative correlation [r=-(0.56-0.73), $p<0.05$]. No correlation was found between the content of heavy metals in the leaves of dwarf-shrubs or live parts of lichens and the projective cover or height of all species.

Financial support is RFBR (№ 14-05-00472).

PHYTOLITHS AS QUANTITATIVE INDICATORS FOR THE RECONSTRUCTION OF PAST ENVIRONMENTAL CONDITIONS IN CHINA II: PALAEOENVIRONMENTAL RECONSTRUCTION IN THE LOESS PLATEAU

Houyuan Lyu[1]*, Naiqin Wu[1], Kam-Biu Liu[2], Hui Jiang[3], Tungsheng Liu

[1]*Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China*
[2]*Department of Geography and Anthropology, Louisiana State University, Baton Rouge, LA 70803, USA*
[3]*State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai 200062, China*
**houyuanlu@mail.iggcas.ac.cn*

Quantitative reconstruction of the climatic history of the Chinese Loess Plateau is important for understanding present and past environment and climate changes in the Northern Hemisphere. Here, we reconstructed mean annual temperature (MAT) and mean annual precipitation (MAP) trends during the last 136 ka based on the analysis of phytoliths from the Weinan loess section (34°24′N, 109°30′E) near the southern part of the Loess Plateau in northern China. The reconstructions have been carried out using a Chinese phytolith-climate calibration model based on weighted averaging partial least-squares regression. A series of cold and dry events, as indicated by the reconstructed MAT and MAP, are documented in the loess during the last glacial periods, which can be temporally correlated with the North Atlantic Heinrich events. Our MAT and MAP estimations show that the coldest and/or driest period occurred at the upper part of L2 unit (Late MIS 6), where MAT dropped to ca 4.4°C and MAP to ca 100 mm. Two other prominent cold-dry periods occurred at lower Ll-5 (ca 77-62 ka) and L1-1 (ca 23-10.5 ka) where the MAT and MAP decreased to about 6.1-6.5°C and 150-370 mm, respectively, ca 6.6-6.2°C and 400-200 mm lower than today. However, the highest MAT (average 14.6°C, max. 18.1°C) and MAP (average 757 mm, max. 1000 mm) occurred at Sl interval (MIS 5). During the interstadial of L1-4-L1-2 (MIS 3) and during the Holocene warm-wet period, the MAT was about 1-2°C and MAP 100-150 mm higher than today in the Weinan region. The well-dated MAT and MAP reconstructions from the Chinese Loess Plateau presented in this paper are the first quantitatively reconstructed proxy record of climatic changes at the glacial-interglacial timescale that is based on phytolith data. This study also reveals a causal link between climatic instability in the Atlantic Ocean and climate variability in the Chinese Loess Plateau.

ANNOYANCE CAUSED BY SETTLED DUST IN AN INDUSTRIALIZED REGION

Milena Machado De Melo[1]*, Jane Meri Santos[2],
Neyval Costa Reis Junior[2], Valderio Anselmo Reisen[3]

[1]*Instituto Federal do Espírito Santo, Guarapari, CEP: 29200-000, Brazil*
[2]*Universidade Federal do Espírito Santo, Department of Environmental Engineering, Vitoria, CEP: 29075-910, Brazil*
[3]*Universidade Federal do Espírito Santo, Department of Statistic, Vitoria, CEP: 29075-910, Brazil*

The World Health Organization (WHO) defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. According to this, annoyance caused by air pollution is a public health problem, as it can be an ambient stressor causing stress, diseases and affect the quality of life. Many studies show that people complain about being annoyed by air pollution, like oil, wood burning, odor, settled dust and vehicular pollution (Jacquemin et al., 2007; Klæboe, 2008; Amundsen et al., 2008; Blanes-Vidal, 2012). But, few studies have detailed how people perceive different types of air pollutants and why they react adversely to then (Amundsen et al., 2008). The main of this study is to evaluate the annoyance, examining its associations with variables of interest and correlating the levels of annoyance with deposition rate of settled dust.
This study was performed at the metropolitan region of Greater Vitória (RMGV), in Brazil, which is densely inhabited and industrialized. The pollution from settled dust is significant, and the population constantly reports annoyance (approximately 25% of the complaints to the local environmental agency from 2008-2012 were related to air pollution). The annoyance data was collected by surveys, from July 2011 to January 2012, and 1028 inhabitants were interviewed by using a questionnaire face to face. Monthly data on the deposition rate of settled dust was measured at the monitoring stations at different geographical locations spread around the RMGV.
The results showed that more than 80% of the population feels annoyed with the presence of settled dust. There was a strong correlation between annoyance and the following variables: gender, perception of dust, perception of health risk and personal assessment of air quality. Levels of annoyance were associated with deposition rates of settled dust. From the results, it was possible to conclude that the population is severely annoyed, and the correlations observed between deposition rate and annoyance levels can be used as guidance for the implementation of deposition rate standards for the region.

Amundsen A.H., Klaeboe R., Fyhri A. (2008) Annoyance from vehicular air pollution: Exposure-response relationships for Norway. Atmospheric Environment. Vol. 42 p. 679-7688.

Blanes-Vidal, V., Suh H., Nadimi E. S., Løfstrøm P., Ellermann T., Andersen H. V., Schwartz J., (2012) Residential exposure to outdoor air pollution from livestock operations and perceived annoyance among citizens. Environment International, 40 44-50.

Jacquemin, B., Sunyer, J., Forsberg, B., Gotschi, T., Oglesby, L., Ackermann-Liebrich, U., De Marco, R., Heinrich, J., Jarvis, D., Toren, K., Kunzli, N. (2007) Annoyance due to air pollution in Europe. International Journal of Epidemiology, 809-820.

Klæboe, R., Amundsen A.H. , Fyhri A. (2008). Annoyance from vehicular air pollution: A comparison of European exposure-response relationships. Atmospheric Environment, 42, 7689-7694.

STUDY OF A SPATIAL AND TEMPORAL ANALYSIS FOR PARTICULATE MATTER

Milena Machado De Melo[1]*, Jane Meri Santos[2], Neyval Costa Reis Junior[2], Valderio Anselmo Reisen[3]

[1]*Instituto Federal do Espírito Santo, Guarapari, CEP: 29200-000, Brazil*
[2]*Universidade Federal do Espírito Santo, Department of Environmental Engineering, Vitoria, CEP: 29075-910, Brazil*
[3]*Universidade Federal do Espírito Santo, Department of Statistic, Vitoria, CEP: 29075-910, Brazil*

Particulate matter is an air pollutant and may cause damages to human health (WHO, 2006) effects in animals and plants, affecting the climate and the quality of life (Jacquemin et Al.,2007; Nikolopoulou, 2011). According to Hislop (2009) the annoyance caused by air pollution is related mainly to the increase of settled dust in urban and residential environments. In addition, seasonal fluctuations impacted by traffic, weekdays, holidays and proximity of industries can interfere in the concentration, size and composition of particles. Besides, meteorological variables such as temperature, relative humidity, wind speed and direction can also be related to the dispersion of particulate in the atmosphere and amount of deposition (Albuquerque et al, 2011). The aim of this study is to analyze the behavior of particulate material (PM_{10}, PTS and settled dust) at the metropolitan region of Greater Vitória (RMGV) and its impacts on the annoyance of the local population. The particulate material data were obtained from the eight air quality monitoring stations strategically located in Vitoria urban area.

Through statistical technics, the results have shown that the time series analyzed are seasonal and exhibits a weak stationarity. This is confirmed by the graphs of sample auto-correlation functions and partial correlation of each pollutant. Correlation between pollutants and meteorological data was also observed. In summary, this study suggest the analysis the behaviour of particulate material and meteorological factors can explained the annoyance related to air pollution in RMGV.

Albuquerque T.T.A.; Andrade M.F.; Ynoue R.Y (2011). Caracterization of atmospheric aerosols in the city of São Paulo, Brazil: comparisons between polluted and unpolluted periods. Environ Monit Assess.

Hyslop, N.P (2009). Impaired visibility: the air pollution people see. Atmospheric Environment. Vol. 43, p.182-195.

Jacquemin, B., Sunyer, J., Forsberg, B., Gotschi, T., Oglesby, L., Ackermann-Liebrich, U., De Marco, R., Heinrich, J., Jarvis, D., Toren, K., Kunzli, N., (2007). Annoyance due to air pollution in Europe. International Journal of Epidemiology. p. 809-820.

Nikolopoulou M., Kleissl J., Linden P.F., Lykoudis S.(2011) Pedestrians' perception of environmental stimuli through field surveys: Focus on particulate pollution. Science of the Total Environment.

Wang Y., and Pham H. (2011)Analyzing the effects of air pollution and mortality bygeneralized additive models with robust principal components. International Journal of System Assurance Engineering and Management, 2, p. 253- 259.

WHO - WORLD HEALTH ORGANIZATION. Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulphur Dioxide. Global update 2005. Summary of Risk Assessment. Geneva, 2006.

OSCAR: A PORTABLE PROTOTYPE SYSTEM FOR THE STUDY OF CLIMATE VARIABILITY

Fabio Madonna*, Francesco Amato, Lucia Mona, Marco Rosoldi, Gelsomina Pappalardo

Consiglio Nazionale delle Ricerche, Istituto di Metodologie per l'Analisi Ambientale (CNR-IMAA), Tito Scalo, Potenza, I-85050
**fabio.madonna@imaa.cnr.it*

The study of the techniques for using solar energy implies the knowledge of nature, ecosystem, biological factors and local climate. Clouds, fog, water vapor, and the presence of large concentrations of dust can significantly affect the way to exploit the solar energy. Therefore, a quantitative characterization of the impact of climate variability at the regional scale is needed to increase the efficiency and sustainability of the energy system.
OSCAR (Observation System for Climate Application at Regional scale) project aims at the design of a portable prototype system for the study of correlations among the trends of several Essential Climate Variables (ECVs) and the change in the amount of solar radiation incident at the ground level. The final goal of this project is to provide a user-friendly low cost solution for the quantification of the impact of regional climate variability on the device efficiency for the exploitation of natural sources (i.e. solar energy), including the effect of huge dust outbreaks over the Mediterranean Basin.
The system prototype will be implemented along with a software able to retrieve correlations between the investigated variables and to quantify the impact of regional climate on radiation as well as to assess potential trends over long term.
Requirements for the measurements of ECVs will agree with those recommended in the frame of international climate observing programmes (Thorne et al., 2013), while other quantities will be measured with high quality sensors using metrological calibrations standards.
The prototype design will be performed on the basis of historical measurements performed at CNR-IMAA Atmospheric Observatory (CIAO). Measurements from satellite and data from models will be also considered as ancillary to the study, above all, to fill in the gaps of existing datasets (Madonna et al., 2011).
An overview of the system design, processing software along with first results about correlation between regional climate variability and surface radiation will be presented and discussed.

Madonna F., Amodeo A., Boselli A., Cornacchia C., Cuomo V., D'Amico G., Giunta A., Mona L., Pappalardo, G. (2011). CIAO: the CNR-IMAA advanced observatory for atmospheric research, Atmos. Meas. Tech., 4, 1191-1208, doi:10.5194/amt-4-1191-2011.

Thorne P. W., Vömel H., Bodeker G., Sommer M., Apituley A., Berger F., Bojinski S., Braathen G., Calpini B., Demoz B., Diamond H.J., Dykema J., Fassò A., Fujiwara M., Gardiner T., et al. (2013): GCOS reference upper air network (GRUAN): Steps towards assuring future climate records. AIP Conf. Proc. 1552, pp. 1042-1047; doi:10.1063/1.4821421.

THE EFFECT OF DUST STORMS ON SOLAR RADIATION COMPONENTS IN CENTRAL SAUDI ARABIA

Abdullrahman H. Maghrabi

National Centre For Mathematics and Physics, King Abdulaziz City For Science and Technology, Riyadh 11442, Saudi Arabia
amaghrabi@kacst.edu.sa

Dust particles play an important role in air quality and environmental health. They affect both solar and terrestrial radiation by scattering and absorption and are therefore considered to be a significant climate-forcing factor. Dust storms are a very frequent phenomenon in Saudi Arabia, especially in the pre-monsoon season. Several dust storm events occurred in Riydah, the central region of Saudi Arabia during the period between 2001-2002. Thirteen dust events were identified and selected. In this study, theoretical, simulations using SMART model, were conducted to investigate how the dusty conditions affecting the solar radiation components. The Atmospheric Optical Depth (AOD) measurements at (500 nm), made with a CIMEL sunphotometer, and the metrological parameters were used as an input into SMART. The analysis showed that the turbid conditions during the dust storm significantly decrease the background global and direct-beam irradiances and increase the diffuse component compared with non dusty days.

OBSERVATION OF BACKGROUND DUST (FINE-MODE DUST) AND DESERT DUST (COARSE+FINE-MODE DUST) OVER THE SOUTHEASTERN MEDITERRANEAN

Rodanthi Elisavet Mamouri[1]*, Argyro Nisantzi[1], Albert Ansmann[2], Diofandos Hadjimitsis[1]

[1]*Cyprus University of Technology, Limassol, 3603, Cyprus*
[2]*Leibniz Institute for Troposheric Reasearch, Leibniz, Leipzig, 04318, Germany*
**rodanthi.mamouri@cut.ac.cy*

Pure fine-mode dust layers mostly from central and eastern Turkey and desert dust plumes (fine mode + coarse mode) originating from desert dust outbreaks in North Africa and the Middle East (western Asia) are frequently observed in the lower free troposphere over the EARLINET/AERONET station of Limassol (34°N, 33°E), Cyprus. We developed a new approach (extended version of the Polarization Lidar Photometer Networking method POLIPHON, Tesche et al., 2009, Ansmann et al., 2012) to separately determine the fine-mode and coarse-mode dust profiles in terms of 532 nm backscatter and extinction coefficients and volume and mass concentrations. The new approach makes use of laboratory studies of the depolarization ratio of fine-mode dust (0.16±0.04) and coarse-mode dust (0.39±0.04) (Sakai et al., 2010). The method is applied to observations of complex aerosol layering of background dust from Turkey and desert dust from Syria in September 2011. In the framework of lidar/photometer consistency checks the lidar-based profiles of dust optical properties are compared with AERONET sun/sky photometer observations (particle optical depth, Angstrom exponent, fine mode fraction). A statistical analysis based on HYSPLIT backward trajectory, MODIS fire maps, and the lidar/photometer observations (May 2010-October 2013) reveals that enhanced levels of fine-mode background dust from Turkey are often correlated with air mass transport across fire areas. This points to enhanced emissions (hot convection) of soil dust during fire events. Regarding desert dust, we found significant differences in the optical properties of Saharan and Arabian dust (Mamouri et al., 2013).

Acknowledgements - AN and REM thank the Cyprus Research Promotion Foundation (PENEK/0311/05 and EUREKA/WEBAIR2). Thanks are given to the Remote Sensing Laboratory of the Department of Civil Engineering & Geomatics at the CUT for the support (http://www.cut.ac.cy).

Ansmann, A., et al., Atmos. Chem. Phys., 12, doi:10.5194/acp-12-9399-2012, 2012.
Mamouri, R. E., et al., Geophys. Res. Lett., 40, doi:10.1002/grl.50898, 2013.
Sakai, T., et al., Appl. Opt., 49, 4441-4449, 2010.
Tesche, M., et al., J. Geophys. Res., 114, doi:10.1029/2009JD011862,2009.

AEROSOL ESTIMATION IN THE LOWER PLANETARY BOUNDARY LAYER FOR SOLAR POWER TOWER PLANTS'S ASSESSMENT

DIANA MANCERA*, LARS KLÜSER, MARION SCHROEDTER-HOMSCHEIDT

German Aerospace Center (DLR), Earth Observation Center, Weßling, 82234, Germany
**diana.manceraguevara@dlr.de*

Concentrated Solar Power (CSP) systems are influenced by atmospheric constituents including aerosols. Particulate matter affects site assessment, operational and maintenance processes. A global general depiction of aerosols in the lowest 200-300m would provide potentially a new criterion for site comparisons especially for solar-tower plants. This type of plant is likely more sensitive to the presence of aerosols compared to other technologies because of the distance that the light has to travel between the heliostats (mirrors) and the central receiver. This global portrait could only be produced by satellite or model based data. Regarding operational concerns, nowadays calculations of energy losses due to atmospheric extinction are done by ray tracing software under certain assumptions, including in some of them an exponentially decreasing with altitude aerosol structure. The latter is presumably not true for every location. The more information of vertical structure and temporal evolution of aerosols in certain site, the more accuracy gained in the calculations of energy yield. CALIPSO datasets allow the required vertical segmented retrievals to depict the attenuation in the altitude of interest. However the fine time-resolved values required for operational purposes are beyond the capability of CALIPSO's time resolution. In this case a comparison between CALIPSO and a numerical model may give signs about the correspondence between them. If a good agreement is determined, the model might be taken as the source of the higher-resolved time scale data required for operational forecasting. Determining the level of accuracy of these datasets against ground-based measurements on certain locations is important to validate the appropriateness of this approach for the described application.

As first part of the mentioned approach, this study presents regional maps for 2007 and 2008 of particulate matter in the lowest troposphere. AOD is used as indicator of aerosol presence from ground to 120m-180m, and in the total column of air. The share of aerosols in the lowest segment for each grid's cell is reflected throughout the ratio between the aerosol account in the lower part and the total assessed along the entire column. Datasets were processed from level II CALIPSO-CALIOP data (532nm channel). Although all possible aerosols were included in the assessment a noticeable contribution seems to come from dust according to the coincidences with regions indicated by other authors as dust sources. A relatively constant pattern can be observed from one year to another with the exception of certain cells that exhibit slight variations.

Ongoing retrieval of values from modelled datasets intends complementing and continuing these preliminary results to clarify, as much as the available tools allow, the vertical structure of aerosols in the lower planet boundary layer.

MODELLING PRIMARY AND SECONDARY PARTICULATE MATTER ORIGINATING BY A THERMAL POWER PLANTS USING THE CALPUFF CODE

Cristina Mangia[1]*, Marco Cervino[2]

[1]ISAC CNR s.p. lecce-Monteroni km 1.2, Lecce, 73100, Italy
[2]ISAC CNR via Gobetti 101, Bologna, Italy
*c.mangia@isac.cnr.it

Thermal power plants are significant sources of sulphur dioxide (SO_2) and nitrogen dioxides (NO_X) which are precursor gases of fine particulate matter (PM). Modelling the formation of secondary PM by a single point source with physical-chemical reactions , would require the implementation of complex photochemical grid models that should include all the emissions of the area and contributions from sources outside from the domain, which are very often not available. As a consequence, the impact of a single point source in originating secondary PM is neglected. The objectives of this work are two-fold: firstly, to estimate the contribution of particulate primary and secondary from a thermal power plant coal by using the lagrangian dispersion model CALPUFF model; secondly, to perform a sensitivity analysis of the model results with respect to the model key assumptions . The source is a coal power plant located in the coastal site of Brindisi (Italy). The simulation domain considered is about 100 km x 100 km and simulations were conducted in a meteorological year with the modelling system MM5/CALMET/CALPUFF. We tested how sensitive the results were to key variables of the chemical mechanism implemented as the ammonia and ozone background concentrations, as well as to some meteorological parameters. Results confirm how in some areas of the domain the contribution of the secondary PM_{10} precursor gases to total ambient PM_{10} is substantially larger than the contribution of primary particulate matter. The background ozone has a moderate impact on the formation of particulates. The use of measured ozone data instead of a background value leads to a 50% increase in secondary particulate.

Scire, J.S., F.R. Robe, M.E. Fernau and R.J. Yamartino. (2000a) A user's guide for the CALMET meteorological Model. Earth Tech, Inc., Concord, MA. Available at http://www.src.com/calpuff/download/CALMET_UsersGuide.pdf (last access 07/10/10)

Scire, J.S, Stimatis D.G., Yamartino R. (2000b). A user's guide for the CALPUFF dispersion Model. Earth Tech, Inc., Concord, MA. Available at http://www.src.com/calpuff/download/ CALPUFF_UsersGuide.pdf (last access 07/10/10)

AN INNOVATIVE DEVICE TO REDUCE DUST DISPERSION FROM PNEUMATIC SEED DRILLS DURING MAIZE SOWING OPERATIONS

Marco Manzone, Paolo Balsari, Paolo Marucco, Mario Tamagnone

University of Turin - DISAFA - Via Leonardo da Vinci, 44, Grugliasco, 10095, Italy
paolo.balsari@unito.it

The air stream generated by the fan of pneumatic seeders necessary to create the depression in the sowing element of the machine, is considered responsible for blowing some solid dust particles detached from treated seeds towards the areas adjacent to the field. To try to solve this problem several technical solutions applicable to pneumatic seeders have been developed in the last years, but none of them was able to completely eliminate the dust dispersion.

This paper reports experimental tests to study the constructive and operative parameters of an innovative device. The capability to eliminate dust dispersion during maize sowing operations has been studied as well.

In this prototype, a cyclone is used to clean the air coming from the sowing elements. The collected solid dust particles are then discharged into the soil by mean of a specific controlled valve. To test this new solution, the device has been mounted on a maize pnaumatic seeder equipped with 6 seeding elements and set to seed 75,000 seed ha^{-1}. The main targets of these tests, were first to evaluate the influence of the device on the seeder's performances andthen the determination of the amount of dispersed dust.

The results showed that the use of this new device was able to reduce the drift of solid dust particles up to 100% and did not influence the performances of the seeder.

EYJAFJALLAJÖKULL ASH OVER THE UNITED KINGDOM AS CHARACTERISED BY AIRBORNE LIDAR

Franco Marenco

Met Office, Exeter, EX1 2NF, United Kingdom
franco.marenco@metoffice.gov.uk

During the eruption of Eyjafjallajokull in 2010, a detailed dataset of volcanic ash observations has been compiled by airborne lidar during six research flights over the United Kingdom and surrounding seas using the Facility for Airborne Atmospheric Measurements (Marenco *et al*, 2011).
Aircraft in situ measurements of the particle size-distribution obtained during ash layer penetrations permitted the evaluation of a coarse extinction fraction (ranging 0.5-1) and a coarse mode specific extinction (0.6-0.9 m^2 /g). These quantities were then used to convert the lidar-derived aerosol extinction coefficient to ash concentration. The combination of lidar and in-situ sampling has thus offered us the opportunity to compile a dataset of the airborne Eyjafjallajökull ash: whereas the in-situ instrumentation provided a good insight into the microphysics, the lidar permitted mapping the ash layers with excellent detail.
The data highlight the very variable nature of the ash plume in both time and space, with observed concentrations up to 1900 $\mu g/m^3$ in small high density patches (due to safety restrictions, flights were only done in areas where forecasted concentrations were smaller than 2000 $\mu g/m^3$).
As data of airborne volcanic ash concentrations are rather limited, these results are considered invaluable for validation of dispersion models and satellite products. We will show how the dataset has been successfully used for the improvement of dispersion models (Kristiansen *et al*, 2012, Webster *et al*, 2012, Grant *et al*, 2012) and for the validation of satellite products based on IASI and SEVIRI (Francis *et al*, 2012, Newman *et al*, 2012).

Francis, P.N., M.C. Cooke, and R.W. Saunders (2012), J. Geophys. Res. 117, 10.1029/2011JD016788.

Grant, A.L.M., H.F. Dacre, D.J. Thomson, and F. Marenco (2012), Atmos. Chem. Phys. 12, 10145.

Kristiansen, N.I., A. Stohl, A.J. Prata, N. Bukowiecki, H. Dacre, S. Eckhardt, S. Henne, M.C. Hort, B.T. Johnson, F. Marenco, B. Neininger, O. Reitebuch, P. Seibert, D.J. Thomson, H.N. Webster, and B. Weinzierl (2012), J. Geophys. Res. 117, 10.1029/2011JD016844.

Marenco, F., B.T. Johnson, K.F. Turnbull, S. Newman, J.M. Haywood, H. Webster, and H. Ricketts (2011), J. Geophys. Res. 116, 10.1029/2011JD016396.

Newman, S.M., L. Clarisse, D. Hurtmans, F. Marenco, B. Johnson, K. Turnbull, S. Havemann, A.J. Baran, D. O'Sullivan, and J. Haywood (2012), J. Geophys. Res. 117, 10.1029/2011JD016780.

Webster, H.N., D.J. Thomson, B.T. Johnson, I.P.C. Heard, K.Turnbull, F. Marenco, N.I. Kristiansen, J. Dorsey, A. Minikin, B. Weinzierl, U. Schumann, R. S. J. Sparks, S.C. Loughlin, M.C. Hort, S.J. Leadbetter, B.J. Devenish, A.J. Manning, C.S. Witham, J.M. Haywood, and B.W. Golding (2012), J. Geophys. Res. 117, 10.1029/2011JD016790.

DUST AND CLOUDS OVER THE SAHARA OBSERVED BY AIRBORNE LIDAR (FENNEC CAMPAIGN)

Franco Marenco[1]*, Stuart Newman[1], John Marsham[2],
Luis Garcia-Carreras[2], Phil Rosenberg[2], Jim McQuaid[2]

[1]Met Office, Exeter, EX1 2NF, United Kingdom
[2]University of Leeds, LS2 9JT, United Kingdom
*franco.marenco@metoffice.gov.uk

During the Fennec campaign (June 2011 and June 2012), the Facility for Airborne Atmospheric Measurements observed boundary layer and aerosol processes in detail over the Saharan "heat low" region (Ryder *et al*, 2013, Hobby *et al*, 2013). The intense daytime heating and dry atmosphere in the Sahara typically leads to a deep dry convective boundary layer growing intro a residual layer, with the free troposphere above. In this presentation, we characterise these air layers using data collected with the on-board lidar together with other available instrumentation. The interpretation of lidar signals in this particular geometry is possible under certain assumptions, using a novel data inversion framework, based on the possibility of identifying a well-mixed layer near the surface (Marenco, 2013).

Dust aerosol has been observed in most cases, but a thin polluted non-dusty layer has been observed during one flight near Zouerate (Mauritania). The optical thickness of the dust layers is variable in time and space, and sometimes very hazy atmospheres (AOD > 2) are observed. The analysis of temperature and dewpoint profiles are used to identify the boundary layer and residual layer tops, and in conjunction with lidar observations this serves to quantify the dust content of both layers. An aerosol-laden residual layer is usually found during the campaign at an altitude of 2-6 km in the morning hours, with little aerosol below. The aerosol in the boundary layer is seen to develop later when solar heating of the surface induces turbulence until in the late afternoon the top of the boundary layer reaches up to ~ 6 km. The likely role of dust uplift, transport and boundary-layer entrainment in producing this typical profile are discussed.

Clouds embedded in the dust, revealed near the top of the aerosol layer, have been observed frequently. A robust cloud detection product has been set up using two on-board remote sensing instruments: the lidar and the Heimann passive infrared radiometer. These observations will be precious for the characterisation of model and satellite products, the quantification of climate forcing in this remote area, and the study of aerosol-cloud interactions.

Marenco, F., Nadir airborne lidar observations of deep aerosol layers, Atmos. Meas. Tech. 6, 2055, 2013.

Ryder, C.L., E.J. Highwood, P.D. Rosenberg, J. Trembath, J.K. Brooke, M. Bart, A. Dean, J. Crosier, J. Dorsey, H. Brindley, J. Banks, J.H. Marsham, J.B. McQuaid, H. Sodemann, and R. Washington (2013), Optical properties of Saharan dust aerosol and contribution from the coarse mode as measured during the Fennec 2011 aircraft campaign, Atmos. Chem. Phys. 13, 303.

Hobby, M, M. Gascoyne, J.H. Marsham, M. Bart, C. Allen, S. Engelstaedter, D.M. Fadel, A. Gandega, R. Lane, J.B. McQuaid, B. Ouchene, A. Ouladichir, D.J. Parker, P. Rosenberg, M.S. Ferroudj, A. Saci, F. Seddik, M. Todd, D. Walker, and R. Washington (2013), The Fennec Automatic Weather Station (AWS) Network: Monitoring the Saharan Climate System, J. Atmos. Oceanic Technol. 30, 709.

THE DANUBE LOESS RECORD - BETWEEN MYTH AND REALITY

Cum ea vel et aperibusae porumqui quatem sam faccaes simpori andescil ex eserspe lestiosam, ipis mi, totaturecab is aut asitis aut que nulparum fuga. Bus aut asped quaepere nem est qui rem et quatur sinctoribus ma pre dolorep repudam illentia quis aut perchit aut ut volesti busam, sitiantor simet, tet qui sinverspero bearchil iminus eos con consequia delest impos ant.

Torem repudam entorro omnis ea vendita tioreius aut fugia voluption parum corum dem idem conem apis de molupti aerferum quae poriam nulpa suntias simossi nvelessitis rat.

Sedit acesto quo et eum volliqui voluptur aliquas aut est doloratibus eos ant hillit aut quas suntiam ut qui soloribus aut laccus rem in nest dest est, int, necum sam, offictor assus imperum diati quia doluptatis sam, untet videbis dunto mo imi, sandiore, quos et a acest dis ullese des mint, quatus etur aut quodipsae nos venis eius eatem voloria volupta cus num eariam, officiisquis am quibusdandis eatur aut quos volupta volorec temporectam exces eum nonem quae volori tem quasseniae nusapicia el etur, nis nobis excessum ditae pedio berit alibusdam qui dit occusam coresto vel ma velibus, nis nat. Ihillist, quunt offic tem et elit odiscime coneceria qui voleste magnatquibus int vent, officia vollecae con es doluptium vollibus porum faceatius.

Lut vid quod ut pernatem nonsenimus.

Quament pliatiasin natibus explit, acculpa autatem alit essimuscius demodionsed que doluptis molores sectorae min nobitatur?

Nam eat et officab orissitem faccatur andaece risitiusaped magnihi ciisti conserunde voluptatum et illigen imillest, que est es alibus, accum re sus aut et odit quunt pere aut aut facerum saectotam venihic tem ium enditat empero velibus est unt dit et re autemolor apictae. Ditia quiscit aut plaboresto voloremque consequis consentur re rerate nonsequis am facerio repudam quuntia tureriores doloris quiatia auta velibeatem aliquo que consequis est utatem etur, qui aborpore apitibus suscius auditatempor mostibus, simus soloreperum, coraerferum quatia volestia qui in poritem porpos doluptatur, que nectemquas doloreped eaqui que ipsaped quia pedipsus repuda di voluptatet ipic to dellaborro quatus.

Daepro inis magnimo llabo. Ratur, niendit eum fugiaes nonsequatem anim quibus quia providis dolenih illiberum reste estio is et aperior isciisto magnia iur, que quo blatemolent est offic te occus, voluptas quid quibus, tem quassimusa conse vid mos ipsaniscium voloribus ea volupta dolut laces non eum quidest aliquist et vendae ande voluptu sciendam fugita nossi ut que nis dolorempor aspella tempere veliquas sumquia esequae ma cusapero eaquossit am estrum ut eos adit apis sequis entiae natis nobit etur, omniment aut pra vent etur, non pelles es dendis re acidunt utem qui audit volore consedis nobist rest quia qui ut abo. Ta seribus sitaturit, quae officil loritatem adis persper spidellabo. Tius, ese niscid expel is aligenis dolupta tionecea vel experum fugit estis molest, omnim corrum qui re ratus rehenim usapitium serum laboria ni doluptius, sequaest liqui corro ditis eum quam et incil maio eaque cuptaspelis

A REMOTE SENSING STUDY OF SOUTHERN OCEAN FERTILIZATION ARISING OUT OF THE PUYEHUE-CORDÓN CAULLE (CHILE) ERUPTIVE EVENT, JUNE 2011

Beatriz Marques*, Alexandre Castagna, Heitor Evangelista

Laboratory of Radioecology and Global Change / State University of Rio de Janeiro (LARAMG / UERJ), Rio de Janeiro, 20550-900, Brazil

**beatrizm.oceano@gmail.com*

Volcanism is a potential agent for fertilizing the oceans, despite little evidence reported (*e.g.* Duggen *et al*., 2007; Langmann *et al*., 2010). This work investigates the biological response resulting from the deposition of ash on the southern portion of the Atlantic Ocean spewed during the eruptive process of Andean volcanic complex Puyehue-Cordón Caulle (40.59°S/72.12°W) started on June 4, 2011. The area under greater influence of the ash plume was set over the Atlantic Ocean using the Dispersion Model of Particles and Gases HYSPLIT/NOAA. The research, carried out by means of remote sensing, used the satellite parameters Aerosol Optical Thickness (AOT), Concentration of Chlorophyll-a (CHL-a) and Sea Surface Temperature (SST), acquired by MODIS/Aqua. The post-eruption context was assessed by comparing the values of the parameters for 2011 with the values of climatology created from 2002 to 2010. Time series obtained for AOT showed an increase right after eruption as a result of a large input of volcanic material suspended in the atmosphere. Smaller peaks above Climatology occur in higher frequency at the subsequent Spring/Summer. Two calculation methods were employed in the assembly of CHL-a time series: arithmetic and geometric mean. The peak of CHL-a right after the eruption is only noticeable in the arithmetic time series. That is because it is highly influenced by extreme values and, as could be seen in georeferenced matrices plotted, the main response of CHL-a is only a coastal signal. However, in both methods it is quite clear a peak far beyond Climatology in the 38th week of the year. The curve of SST did not show any unusual behaviour if compared to Climatology. The proposed explanation for the changes in the surface CHL-a is that, even with the micronutrients essentials for phytoplankton development added after the beginning of the eruptive event, the winter community, also limited by the availability of light, temperature and predation, did not reached a development level that could surpass predation rates and mortality. A possible mechanism for the occurrence of the CHL-a peak in the 38th week - Spring/Summer - is that the volcanic material deposited on the continent, resuspended with the beginning of stronger winds season, along with those who continued to be expelled by the volcanic complex, were potentially capable of fertilizing and raise the levels of CHL-a in surface waters, once luminosity and SST conditions already favors planktonic development.

Duggen S., Croot P., Schacht U., Hoffmann L. (2007). Subduction zone volcanic ash can fertilize the surface ocean and stimulate phytoplankton growth: Evidence from biogeochemical experiments and satellite data. Geophysical Research Letters, v. 34, p. 1-5.

Langmann B., Zaksek K., Hort M., Duggen S. (2010). Volcanic ash as fertilizer for the surface ocean. Atmospheric Chemistry and Physics, v. 10, p. 3891-3899.

ANALYSIS OF INORGANIC COMPOUNDS IN SUBMICRONIC AND ULTRAFINE FRACTIONS OF WOOD COMBUSTION DUST ABOVE THE FLAME ZONE

Helene Marris[1,2], Gwenaelle Trouve[3]*, Gontrand Leyssens[3], Isabelle Leyssens[3], Cornelius Schönnenbeck[3], Sébastien Caillat[1,2], Esperanza Perdrix[1,2], Laurent Y. Alleman[1,2], Emmanuel Birot[4]

[1]*Université Lille Nord de France, Lille 59000, France*
[2]*ARMINES Mines Douai, SAGE, Douai 59508, France*
[3]*Laboratoire Gestion des Risques et Environnement, Mulhouse 68093, France*
[4]*Veolia Recherche & Innovation, 291, av. Dreyfous Ducas, Limay 78520, France*
**gwenaelle.trouve@uha.fr*

Dust-related problems such as deposit formation, corrosion and particulate emissions are of great relevance regarding wood combustion facilities. Investigations focusing on the physico-chemical composition and formation of fly ashes, especially fine particles $PM_{2.5}$ (<2.5 µm), are thus of particular interest for the conception, design and operation of wood biomass boilers.

Among the chemical constituents of wood-combustion dust, inorganic species may be largely released [Frandsen et al., 2007]. The aim of this work was therefore to study the submicronic ($PM_{0.1-1}$, corresponding to the accumulation mode) and ultrafine ($PM_{0.1}$, encompassing the nucleation mode) fractions of dust emitted above the flame zone during wood combustion, especially the size distribution and chemical composition of inorganic species, particularly water-soluble ions. Combustion experiments were conducted on a laboratory-scale wood combustion tube reactor. The influence of the fuel size distribution and moisture on the fine particle formation and composition was studied for two reactor configurations: fluidized bed and grate-fired. For each combustion run, high temperature (600 °C) size-segregated fine particle samplings were carried out above the flame zone by cascade impaction with subsequent off-line chemical particle analyses by ion chromatography and ICP-AES. Potassium, sulphate and chloride account for more than 95% of the total mass of detected ions, mainly as K_2SO_4 and KCl. The potassium mass proportion in the $PM_{0.1}$ fraction varies from 35% to 73%, depending on runs.

Frandsen F.J., van Lith S.C., Korbee R. Yrjas P., Backman R., Obernberger I., Brunner T., Jöller M. (2007). Quantification of the release of inorganic elements from biofuels. Fuel Processing Technology, Volume 88, Issues 11-12, 1118-1128.

Acknowledgments - this work has been supported by ADEME, the French Environment and Energy Management Agency, grant agreement n°1101C0067.

MINERAL DUST AS A KEY DETERMINANT IN THE ONSET AND DEVELOPMENT OF THE BACTERIAL MENINGITIS OUTBREAKS IN AFRICA

Nadege Martiny[1]*, Pascal Roucou[1], Antoine Adde[2], Isabelle Chiapello[3]

[1]*Université de Bourgogne, Dijon, 21000, France*
[2]*Institut Pasteur de la Guyane, Cayenne, 97306, Guyane*
[3]*Université de Lille 1, Villeneuve d'Ascq, 59655, France*
**nadege.martiny@u-bourgogne.fr*

Meningoccocal meningitis (mainly bacteria: *Neisseria meningitidis*) outbreaks are still a major public health problem in Africa, and specifically in the 10-15°N latitudinal band referred to as the "Meningitis Belt". The target population is young (between 1 and 29) and brings together more than 300 millions of people. The cases can be fatal or dramatic because of severe neurological sequelae. Moreover, even if a conjugate vaccine against serogroupA, dominant in the Belt, was introduced by the WHO in 2010, outbreaks due to other serogroups (e.g., W135) have occurred since. The outbreaks, which occur from the end of January to the middle of April, have been supposed to be related to the Harmattan conditions of the dry season (low humidity, dust in the atmosphere) since the 60's. Quite recently this assumption has been reinforced, and quantified, notably thanks to the use of long-term spatialised climate and dust products (from reanalyses and remote sensing), and WHO epidemiological data sets. By now, the meningitis outbreaks in the Belt are considered as climate-sensitive by both the climatologists and the epidemiologists.

This paper focuses on dust as a key determinant among other climate variables in the onset and development of the disease. We first present the results in Niger and Mali, based on long-term AERONET measurements. We show that the onset of the meningitis season is tightly related to mineral dust flowing close to the surface at the very beginning of the year. Then, during the development of the disease, each meningitis peak is preceded by a dust peak, with a 0-2 week lead-time. This is in agreement with the incubation time period of the bacteria. This is not the case for humidity, confirming the special contribution of dust at this period of the year. These results have been confirmed in Niger at a finer spatial scale (district) based on long-term remote sensed AI from TOMS and OMI. We finally present two case studies in Burkina Faso in order to underline the importance of dust, step by step, since the onset of the outbreak until its maximum. These results, based on a modelling approach (WRF/CHIMERE), are encouraging as they constitute one more step towards the understanding of the dust/meningitis relationships, and pave the way to the previsibility of the sanitary risks linked to meningitis in Africa.

CHARACTERIZATION OF WOOD FLY ASHES FROM DIFFERENT DUST FILTER TYPES

Christoph Maschowski[1]*, Reto Gieré[1], Gwénaëlle Trouvé[2], Peter Kruspan[3]

[1]*Albert-Ludwigs-Universität, Freiburg, 79104, Germany*
[2]*Université de Haute-Alsace, Mulhouse, 68093, France*
[3]*Holcim Europe Services Ltd., Allschwil, 4123, Switzerland*
**maschowski@minpet.uni-freiburg.de*

In Europe, the number of installations of small- and medium-scaled solid biomass combustion plants for heat and power production has been significantly increasing over the last decades. Wood chips comprise the main fuel source as wood is regionally available. Combustion of biomass, e.g. wood, is considered a renewable energy source, presuming forestry is performed in a sustainable fashion. Combustion of biomass produces heat, gases (mainly CO_2), particles and ash, which consists of the non-combustible constituents of the biomass. One portion of the ashes remains at the grate as bottom ash, and is mainly used as fertilizer additive, as it contains valuable nutrient elements such as calcium, potassium and magnesium. However, a significant fraction of the ash is fine-grained and thus transported as fly ash in the flue gas. Because the fly ash is transported in association with organic particles, the bulk material in the flue gas is described as dust.

To limit the emissions of dust into the environment, various particle filter techniques are being applied to the combustion plants. The most common filter types are cyclones, electrostatic precipitators and baghouse filters. According to the filter technology applied the collected particles, i.e. fly ashes, have various and fluctuating levels of not only main elements, but also heavy metals, chlorides and organic compounds. Therefore, fly ash is generally discarded from further use. However, instead of landfilling these ashes, they should be comprehensively investigated in order to elucidate their re-utlilization potential, which is considered being similar to that of fly ashes from coal combustion (i.e. as cementitious constituent).

In this study, fly ashes from various medium-scaled biomass combustion facilities equipped with different particle filters, were sampled on site. The samples were investigated by using X-ray diffraction and subsequent pattern analysis by the Rietveld refinement method to obtain semi-quantitative abundances of crystalline phases. Furthermore, X-ray fluorescence and atomic absorption spectroscopy was used to yield elemental compositions.

The chemical and mineralogical compositions of the different fly ashes were compared and assessed in terms of the relation to filter type and combustion conditions. Furthermore, the reproducibility was assessed by comparing multiple fly ash samples from the same source over time.

AGEING OF SODIUM COMBUSTION AEROSOLS

Mathe Emmanuel[1,2]*, Kissane Martin[1], Petitprez Denis[2]

[1]*Institut de Radioprotection et de Sûreté Nucléaire (IRSN/PSN), BP 3, Saint Paul-Lez-Durance, 13115, France*
[2]*Laboratoire de Physico-Chimie des Processus de Combustion et de l'Atmosphère (PC2A), UMR 8522 CNRS-Lille1, Université de Lille 1, Villeneuve d'Ascq, 59655, France*
**emmanuel.mathe@irsn.fr*

In the context of the Generation IV initiative (www.gen-4.org) and, more immediately, sodium-leak accidents in sodium-cooled fast-neutron reactor (SFR) facilities are the subject of renewed interest. The objective here is to model the aerosol contamination produced by a sodium fire in the containment (and potentially the atmosphere) due to a severe accident. Assuming that an accident has occurred, it has previously been shown that the mass of oxide aerosols produced by a sodium spray fire can involve more than 60% of the ejected sodium (Mathé and Kissane, 2012). We are here interested in the physicochemical transformations of these aerosols.
Sodium-oxide aerosols produced inside the containment would consume H_2O and CO_2 forming hydroxide and carbonate species probably as successive layers on the aerosols. A single-layer-transformation model exists (Cooper, 1980) but the theoretical approach used has never been validated. Based on this approach, a numerical model of aerosol ageing for analysis of realistic cases was produced: SPARK (Sodium-Particle-Aerosol Reaction Kinetics). Gas diffusion coefficients are required to validate this model where analytical data are essentially inexistent. Hence, an experimental set-up has been developed to measure such coefficients: ESSTIA (Experimental Study on Sodium Transformations and Interactions into an Atmosphere).
The principle of the experiments is to expose thin pellets of sodium compounds to controlled atmospheres in glove box. H_2O and CO_2 consumption is monitored versus the exposure time by gas probes. Kinetic parameters and diffusion coefficients are calculated by tuning our numerical model SPARK to our experimental data; some comparison with the sparse information from other studies is also possible.
Hence, our experimental results from ESSTIA lead to development of a modified Cooper's model. Moreover, our SPARK model can now reliably simulate the impact of sodium-aerosol ageing in a confinement and in the atmosphere. A realistic case illustrates that the improved model has a significant impact on spray-fire aerosols.

Cooper, D.W. (1980) Prediction of the Rates of Chemical Transformation of Sodium Fire Aerosols, US NRC report NUREG/CR-1724.
Mathé, E. and Kissane, M.P. (2012) Modélisation de la Production d'Aérosols par la Combustion de Sodium, CFA 2012, 25-26 janvier 2012, Paris, ASFERA.

SULPHUR SOIL POLLUTION CAUSED BY A COAL-FIRED POWER PLANT (PLOMIN, CROATIA)

Gordana Medunić[1]*, Iva Božičević Mihalić[2], Nevenka Kopjar[3], Višnja Gaurina Srček[4], Vlado Cuculić[5], Višnja Oreščanin[6]

[1]*Faculty of Science, Department of Geology, Zagreb, 10000, Croatia*
[2]*Institute Rudjer Bošković, Division of Experimental Physics, Zagreb, 10000, Croatia*
[3]*Institute for Medical Research and Occupational Health, Zagreb, 10000, Croatia*
[4]*Faculty of Food Technology and Biotechnology, Zagreb, 10000, Croatia*
[5]*Institute Rudjer Bošković, Division for Marine and Environmental Research, Zagreb, 10000, Croatia*
[6]*Advanced Energy Ltd., Zagreb, 10000, Croatia*
**gpavlovi@inet.hr*

Until 25 years ago, a coal-fired power plant in the city of Plomin (Istria, North Adriatic) had used local coal which contained as high as 10% of sulphur (S), and 15% of ash (Valković et al., 1984). The aim of this study was to assess an impact of 43 years of S and fly ash emissions from the plant on soil S pool. Eighteen topsoil samples were taken within radii of 1, 5, and 10 km from the plant, as well as every 100 m along a pollution gradient (PG) in the prevailing wind direction, in a distance (D) 100 m to 1 km from the plant. The study area is karst terrain composed of carbonate rocks, overlain by soil classified as eutrichromic cambisol. Major and trace elements were measured by the PIXE method. Other analyses included the determination of soil mineral and granulometric composition, pH, LOI, CEC, and CaCO3 content. The ongoing work is focused on Hg measurements, PIXE analysis of new soil samples taken from wider region of the plant, and laboratory-scale toxicity testing to determine the properties of leachates of the soil. Previously, Oreščanin et al. (2002) found neither cytotoxic nor mutagenic effects of the Plomin bay sediments. According to Oreščanin et al. (2009), these sediments had identical chemical composition regardless of time of deposition (i.e. prior and following the plant activity). Analysed soils are composed of quartz, plagioclase, muscovite, vermiculite, haematite, and chlorite. Silt and clay size fractions constitute a major portion of soil. Its median values of pH, CEC, LOI, and CaCO3 were as follows, respectively: 6.8, 25.4, 22.6, and 7.9. As regards the PG samples, their mean, median, min, max, and SD values calculated for S were as follows, respectively (%): 0.88, 0.40, 0.12, 3.28, and 0.98. Sulphur mean is almost twice as high as S value of 0.5% reported for this locality by Miko et al. (2003). Statistically significant Kendall's Tau correlation coefficients of pairs D-LOI, D-S, D-Cu, S-LOI, and S-Cu were as follows, respectively: -0.51, -0.73, -0.60, 0.60, and 0.69. These results evidence a strong trend with distance from the plant, thus indicating that a point source played a major role in a local distribution pattern of sulphur.

Miko S., Durn G., Adamcová R., Čović M., Dubíková M., Skalský R., Kapelj S., Ottner F. (2003). Heavy metal distribution in karst soils from Croatia and Slovakia. Environ. Geol., 45: 262-272.

Oreščanin V., Franekić Čolić J., Durgo K., Valković V. (2002). Investigation of mutagenic effect of metals in Plomin bay sediments by modified preincubation Ames assay. J. Trace Micr. Techn., 20: 69-78.

Oreščanin V., Nađ K., Bartolinčić A., Valković V. (2009). Chemical profile of Plomin bay sediments. Arh. Hig. Rada Toksikol., 60: 281-287.

Valković V., Makjanić J., Jakšić M., Popović S., Bos J.J.A., Vis D.R., Wiederspahn K., Verheul H. (1984). Analysis of fly ash by X-ray emission spectroscopy and proton microbeam analysis. Fuel, 63: 1357-1362.

EFFECTS OF LIGHT-ABSORBING IMPURITIES ON REFLECTANCE AND DENSITY OF SEASONAL SNOW IN SODANKYLÄ, NORTH OF THE ARCTIC CIRCLE (SOS-2013)

O. Meinander[1]*, A. Virkkula[1], A. Kontu[2], J. Svensson[1], P. Dagsson-Waldhauserova[3,4], O. Arnalds[4], H. Olafsson[3], H.-R. Hannula[2], O. Järvinen[5], N. Kivekäs[1], H. Lihavainen[1], G. de Leeuw[1,5]

[1]*Finnish Meteorological Institute, Helsinki, Finland*
[2]*Arctic Research Center, Finnish Meteorological Institute, Sodankylä, Finland*
[3]*University of Iceland, Department of Physics, Reykjavik, Iceland*
[4]*Agricultural University of Iceland, Faculty of Environment, Hvanneyri, Iceland*
[5]*Department of Physics, University of Helsinki, Finland*
**Outi.Meinander@fmi.fi*

The Soot on the Snow (SoS-2013) experiment was carried out in Sodankylä (67°22'N, 26°39'E, 179 m a.s.l.), North of the Arctic Circle, to study the effects of deposition of Black Carbon (BC), Icelandic volcanic sand and glaciogenic silt on the surface albedo, snow properties and melt of the seasonal snow. The BC was soot originating from chimneys above residential wood-burning fireplaces in Helsinki, except for one experimental spot where the soot was from a chimney of an oil burner, and another one where the soot originated from a peat-burning power plant. The volcanic sand was a dark mixture of the volcanic ash of glaciofluvial nature, originating from under the Myrdalsjokull glacier, which may be mixed with the ash of the Eyjafjallajokull eruption in 2010 and the Grimsvotn eruption in 2011. The glaciogenic silt was lighter in colour than sand, from light-brown to slightly yellowish colour consisting mainly of silt and some coarse clay sized particles, which could be deposited on the local glaciers as well as transported over several hundreds of kilometers towards Europe. Here we present our SoS-2013 results on snow albedo/reflectance (ASD spectrometers for 325-1075 nm, and 350-2500 nm), and snow density (more detailed in Meinander et al. 2014), coupled with snow elemental (EC) and organic carbon (OC) concentration (Thermal/Optical Carbon Aerosol Analyzer), and we also compare our SoS-2013 results with previous EC/OC and albedo data for Sodankylä snow (Meinander et al. 2013).

Meinander, O., Kazadzis, S., Arola, A., Riihelä, A., Räisänen, P., Kivi, R., Kontu, A., Kouznetsov, R., Sofiev, M., Svensson, J., Suokanerva, H., Aaltonen, V., Manninen, T., Roujean, J.-L., and Hautecoeur, O. 2013: Spectral albedo of seasonal snow during intensive melt period at Sodankylä, beyond the Arctic Circle, Atmos. Chem. Phys., 13, doi:10.5194/acp-13-3793-2013, 3793-3810.

Meinander, O., Kontu, A., Virkkula, A., Arola, A., Backman, L., Dagsson-Waldhauserová, P., Järvinen, O., Manninen, T., Svensson, J., de Leeuw, G., and Leppäranta, M. (2014): Brief Communication: Light-absorbing impurities can reduce the density of melting snow, The Cryosphere Discuss., 8, doi:10.5194/tcd-8-259-2014, 259-271.

Acknowledgements - to all the SoS-2013 participants; the Academy of Finland (A4-project); the Maj and Tor Nessling Foundation; and the Nordic Centre of Excellence CRAICC (Cryosphere-atmosphere interactions in a changing Arctic climate).

VERTICAL GEOCHEMICAL DISTRIBUTION OF PARTICULATE MATTER: TRAFFIC SOURCES AND HEALTH IMPLICATIONS

Diana Meza-Figueroa[1]*, Belem Gonzalez[2], Rafael Del Rio-Salas[3], Veronica Moreno-Rodriguez[3]

[1]*Departamento de Geología, Universidad de Sonora, Hermosillo, Sonora 83000, México*
[2]*Maestría en Ciencias-Geología, Universidad de Sonora, Hermosillo, Sonora 83000, México*
[3]*Instituto de Geología-ERNO, Universidad Nacional Autónoma de México, México D.F., México*
**dmeza@ciencias.uson.mx*

Total Suspended Particulate Matter (TSPM) was measured at two heights at a building in Hermosillo, Sonora, during a year (2013). Hermosillo is a rapidly growing city located in the Sonora desert, Mexico with >700,000 inhabitants. It is located at 250 km to the south of the U.S.-Mexico border.Unpaved roads represent a 23% of the urban area. Thermal inversion is commonly observed in winter. Potential local pollutants are limited to emission from vehicular traffic, cement industries, and agricultural activities.Traffic was measured at sampling site with manual counters during 12 hours and six vehicle categories were considered. These were combined to two new categories: heavy-duty vehicles (HDV) including trucks with semi-trailers, trucks with trailers, trucks, and buses, and light-duty vehicles (LDV) including cars, vans and motor bikes. Hourly counts were summed up to daily counts. Meteorological parameters were obtained from a Davis Weather Station Model Vantage Pro2 6152, located at the sampling site. Samples of TSP were collected on Whatman quartz microfiber filters using a TISCH high-volume air sampler (model TE-5000) with a flow rate of 1.1 m^3 min^{-1}. Filters were equilibrated in a desiccator for 48 h and then weighed before aerosol sampling. To determine the bulk metal content in TSPM, each filter was digested with a mixture of 3:1:1 of HNO_3-$HClO_4$-HF in teflon vessel and heated in microwave system. Fifty elements (Sc, Y, REE´s, Be, Na, Mg, Al, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Sr, Mo, Ru, Rh, Pd, Ag, Cd, Sn, Sb, Te, Ba, Hf, Ir, Pt, Au, Tl, and Pb) were measured by inductively coupled mass spectrometry. Traffic volume estimation indicates that vehicles with catalytic converters were the major contributors to traffic counts (near 70% of a total of 34000 vehicles per 12 hours). Results showed that traffic pattern during the sampling time and the other days of the week had similar trend. TSPM minimum values were reported for summer and winter, and maximum values were found at spring. WHO maximum permissible levels for TSP were significantly exceeded at ground samplers (44% of analyzed days) when compared to roof samplers (18% of analyzed days). As, Pb, Cu, V, Co, Cd, show higher contents at ground level when compared to roof level. Health risk assessment was conducted for exposure to metals and hazard index was higher for ground level than for roof levels. Since most studies are conducted at roof levels, this work suggest that risk assessment could be underestimated when compared to pedestrian exposure (ground level).

EXPOSURE RISK ASSESSMENT FROM METALS IN URBAN DUST: INSIGHTS FROM BIOACCESSIBILITY TESTS AND CHEMICAL SPECIATION

Diana Meza-Figueroa[1]*, Francisco Romero[2], Rafael Del Rio-Salas[4], Agustin Gomez-Alvarez[3], Uzi Castillo[5], Veronica Moreno-Rodriguez[4], Belem Gonzalez[5], Hector Mendivil[4]

[1]*Departamento de Geología, Universidad de Sonora, Hermosillo, Sonora 83000, México*
[2]*Instituto de Geología, Universidad Nacional Autónoma de México, México D.F., México*
[3]*Departamento de IngenieríaQuímica, Universidad de Sonora, Hermosillo, Sonora 83000, México*
[4]*Instituto de Geología-ERNO, Universidad Nacional Autónoma de México, México D.F., México*
[5]*Maestría en Ciencias-Geología, Universidad de Sonora, Hermosillo, Sonora 83000, México*
**dmeza@ciencias.uson.mx*

A study was conducted on the spatial distribution of Cu, Mn, Pb, Cd, As, and Zn in urban dust (streets and playgrounds) in Hermosillo city, northern México. Levels of pollution and origin of dust (geogenic vs anthropogenic) were identified as well as the possible risks to human health associated to the total concentrations and bioaccessible fraction of metals. The study focused on three particle size fractions: less than 0.044 mm (inhalation), of 0.044 mm (ingestion), and 0.072 mm (geophagy, pica). The following studies were conducted for the three fractions: i) total metal concentrations; ii) bioaccessibility in gastric and intestinal fluids; and iii) association to different mineralogical groups by means of X-ray diffraction and chemical sequential extraction procedures (interchangeable, carbonates, sulfates, organic matter, iron and manganese oxides, and refractory silicates). The identification of a natural or anthropic origin for dust was conducted from the estimation of Enrichment Factor. A Geographical Information System was used to represent spatial distribution of metals in the city, showing vulnerability areas defined on the basis of socio-economic data, education, and public services. According to the results of the Index of Pollution Cu, Pb, Zn, and Cd levels are extremely high for both streets and playgrounds. Results show that in all studied metals the total content increases as the particle size decreases, however, the bioaccessibility study indicates a variable behaviour. Cu has the highest percentages of bioaccesibility in samples taken in areas of high traffic, with values of 36.4% in gastric fluid and up to 6.1% in intestinal fluid. Zn shows high levels of bioaccessibility from 5.2 to 18.1% and from 0.1 to 21.7% for gastric and intestinal phases, respectively. Pb has a high variation in bioaccessibility with ranges from 2.6 to 11.3% in gastric phase, and 0.3 to 8.8% in intestinal phase. Sequential extraction tests indicated that Cd and Cu are mainly associated to carbonates in areas of high traffic density, while Cu is associated with residual fraction and organic matter/sulphides in samples located in areas of intermediate traffic. Bioaccessibility percentages were higher in samples with metals associated to carbonates. In comparison with playgrounds and streets from other cities in the world, a significant outcome of this research is that the relatively small city of Hermosillo shows pollution levels similar to megacities.

INTERDISCIPLINARY ASSESSMENT OF THE OCCUPATIONAL RESPIRATORY HAZARD OF QUARRIED VOLCANIC DEPOSITS

Sabina Michnowicz[1,2]*, Claire Horwell[1]

[1]*Institute of Hazard, Risk & Resilience, Durham University, Durham, UK*
[2]*Aon Benfield UCL Hazard Centre, University College London, London, UK*
**s.michnowicz@ucl.ac.uk*

The occupational exposure to dust generated by quarrying siliceous rocks is a well-documented respiratory hazard. Similarly, the health hazard of volcanic ash is routinely studied, but little is known about the specific respiratory hazard of quarried volcanic deposits. Two main mechanisms by which volcanic quarry dust could be implicated in toxicity are: i) crystalline silica content; and ii) reactive iron on particle surfaces leading to hydroxyl radical generation. Here, 12 quarries (in New Zealand, Montserrat and Greece) variously extracting and processing volcanic material across the magmatic spectrum were investigated and compared with volcanic ash samples and dust from two non-volcanic quarries.

Grain size analyses revealed the finest material was generated by drilling lava flows, however, several sample types contained high levels of respirable material, akin to volcanic ash, but not as high as sandstone. SEM analyses confirmed a broad morphological similarity of the respirable fraction between all sample types. Crystalline silica content was highest in intermediate and felsic dome-forming settings, at similar levels (up to 28 wt. %) to dome-collapse ash; greywacke was comparable, however, the sandstone was almost pure crystalline silica. Hydroxyl radical generation was lower for quarried volcanic samples than for either volcanic ash or sandstone. Toxicity (to erythrocytes) was exhibited by four samples from two volcanic quarries, but may be influenced by the presence of clays. Exposure levels (both role-specific and background) were mostly within international limits, however, perception of dust hazard and mitigation measures were variable and workers would benefit from better awareness.

Volcanic quarries post a hazard distinct from both volcanic ash and non-volcanic quarries. Whilst, the overall hazard may be lower than for other rock types, occupational health would be better served with a greater understanding of the specific risks and access to pragmatic mitigation measures.

Horwell C., Baxter P. (2006), The respiratory health hazards of volcanic ash: a review for volcanic risk mitigation, Bulletin of Volcanology 69, 1-24.

Damby D.,Horwell C., Baxter P.,Delmelle P., Donaldson K., Dunster C.,Fubini B., Murphy F., Nattrass C., Sweeney S., Tetley T.,Tomatis M., (2013) The respiratory health hazard of tephra from the 2010 Centennial eruption of Merapi with implications for occupational mining of deposits, Journal of Volcanology and Geothermal Research 261, 376-387.

Le Blond J.,Horwell C., Baxter P.,Michnowicz S., Tomatis M.,Fubini B.,Delmelle P.,Dunster C.,Patia H., (2010)Mineralogical analyses and in vitro screening tests for the rapid evaluation of the health hazard of volcanic ash at Rabaul volcano, Papua New Guinea, Bulletin of Volcanology 72, 1077-1092.

COCCIDIOIDOMYCOSIS (VALLEY FEVER): A REVIEW OF CURRENT UNDERSTANDING

Sabina Michnowicz[1]*, William Sprigg[2]

[1]Aon Benfield Hazard Research Centre, UCL, London, WC1E 6BT, UK
[2]Department of Atmospheric Sciences, The University of Arizona, Tucson, AZ, 85721, USA
*s.michnowicz@ucl.ac.uk

Two billion people around the world are exposed to aeolian dusts, which contribute to cardiovascular and respiratory disease. The fungi (Coccidioidesimmitis/posadasii) responsible for Valley Fever or coccidioidomycosis (cocci) live in the arid soils of the New World (from SW USA to Argentina). This pulmonary infection is highly endemic in certain areas and individual outbreaks result in thousands of cases. In Arizona, 150,000 people are diagnosed each year, of which ~30 will die. In California, the annual death rate is ~70 people. Approximately 60% of individuals are asymptomatic and most of the remaining 40% experience mild to moderate symptoms (cough, fever, arthralgias, myalgias, and fatigue); however, among certain demographic groups, complications and disseminated disease can occur. Diagnosis usually requires laboratory studies, with treatments including a range of antifungal drugs (a vaccine remains in development).Statistics in Arizona show an increase of diagnosed cocci cases which cannot be ascribed to improved diagnostic practises. Increased global travel has led to more geographically widespread diagnoses, resulting from travellers who have visited endemic areas.

Incidence of cocci varies seasonally and annually; it is linked to changing climatic conditions including temperature and rainfall. Weather models show a strong geographical correlation between a lack of rainfall and associated cocci outbreaks. There is a great need to monitor conditions of atmospheric dust and the development of storm warnings could reduce exposure and subsequently rates of infection. Global climate change is likely to increase the incidence of many respiratory diseases, with cocci potentially becoming more widespread due to increasing desertification and subsequent geographical expansion of the fungi's habitat. Here, we provide an update of current understanding regarding cocci and the factors that influence outbreaks, by reviewing literature published over the past 15 years. In a rapidly changing environment it is important to develop a greater understanding of the factors that surround dust storms and their associated disease outbreaks.

Nguyen, C. et al. (2013). Recent Advances in Our Understanding of the Environmental, Epidemiological, Immunological, and Clinical Dimensions of Coccidioidomycosis. Clinical Microbiology Reviews 26, 505-525.

Tsang, C. A. et al. (2010) Enhanced Surveillance of Coccidioidomycosis, Arizona, USA, 2007-2008. Emerging Infectious Diseases 16, 1738-1744.

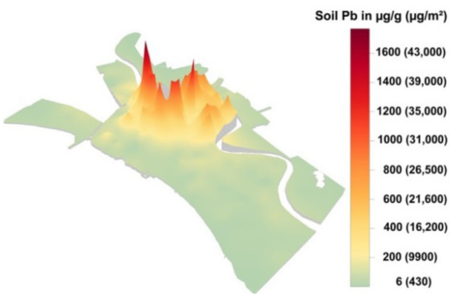
Hector, R. F. &Laniado-Laborin, R. Coccidioidomycosis - A fungal disease of the Americas. Plos Medicine 2, 15-18.

LEAD AS AN ANOLOGUE FOR LOADING OF ORGANIC AND INORGANIC CHEMICAL DUSTS IN NEW ORLEANS

Howard W. Mielke

Tulane University School of Medicine, New Orleans, Louisiana, 70119
hmielke@tulane.edu

Urbanization is accompanied by chemical changes due to dust dispersion from multiple sources. In general the peak amounts of metals and organic contaminates exist in communities surrounding the urban center and diminish toward the outer margins of the city. Many organic and inorganic chemicals follow the same pattern of distribution in the city. Lead is an excellent analogue for the urban pattern of many inorganic and organic compounds. Empirical research in New Orleans involves systematically analysing chemical characteristics of soil samples (n= 5467), as well as children's blood lead responses (n=55,551) and school performance responses, matched and stratified by community boundaries. Soil Pb is an excellent predictor of children's blood Pb. Based on the soil lead map, New Orleans communities were divided into two sets, high (≥100 mg/kg) and low (<100 mg/kg) soil lead. The pre-Katrina children's blood Pb prevalence ≥ 5 µg/dL in the high and low Pb communities were 58.5% and 24.8%, respectively, vs. 29.6% and 7.5%, respectively, post-Katrina. Nevertheless elevated soil Pb permeates communities and children playing outdoors generally lack safe environments. New Orleans research is supported by decades of study by clinicians that demonstrate profound latent effects of infant lead exposure on behaviour and learning characteristics later in life. Low Pb soils at the outskirts of New Orleans are available for intervention of soil lead contaminated communities toward the center of the city (Figure below).



Mielke, H.W. Lead in the Inner Cities. American Scientist 1999, 87(1), 62-73.

Mielke, H.W.; Gonzales, C.R.; Powell, E.; Jartun, M.; Mielke, P.W. Nonlinear association between soil lead and blood lead of children in Metropolitan New Orleans. Sci.Tot. Env. 2007, 388, 43-53.

Mielke, H.W.; Gonzales, C.R.; Powell, E.; Mielke, P.W. Environmental and health dis-parities in residential communities of New Orleans: The need for soil lead intervention to advance primary prevention. Environment International 2013, 51, 73-81.

Mielke, H.W.; Powell, E.T.; Gonzales, C.R.; Mielke, P.W. Potential lead on play surfaces: Evaluation of the "PLOPS" sampler as a new tool for primary lead prevention. Environ. Res. 2007, 103, 154-159.

Mielke, H.W.; Zahran, S. The urban rise and fall of air lead (Pb) and the latent surge and retreat of societal violence. Environment International 2012, 43, 48-55.

Mielke, H.W., Wang G., Gonzales C.R., Powell, E.T., Le B., Quach V.N. PAHs and metals in the soils of inner-city and suburban New Orleans, Louisiana, USA. Environ. Tox. Pharmacology. 18 (2004) 243-247.

Zahran S., Mielke H.W., Weiler S., Berry K.J., Gonzales C. Children's blood lead and standardized test performance response as indicators of neurotoxicity in metropolitan New Orleans elementary schools NeuroToxicology 30 (2009) 888-897.

ANALYSIS OF DUST PARTICLES EFFECTS ON REFLECTANCE SPECTRA OF WHEAT CANOPY (TRITICUM AESTIVUM L.)

S. Mirzaei Turk[1]*, A. Darvishi B.[1], R. Darvishzadeh[2], H. A. Bahrami[3], S. K. Alavipanah[1], A. Veysi[4]

[1]Department of Remote Sensing and GIS, Faculty of Geography, University of Tehran, Iran
[2]NRS Department, Faculty of ITC, University of Twente, Netherlands.
[3]Department of Soil Science, Faculty of Agriculture, Tarbiat Modares University, Iran
[4]Department of Engineering, Yazd Science and Research Branch, Azad University, Yazd, Iran
*Smirzaei67@ut.ac.ir

In recent years, dust storms have become a common phenomenon in the West Asia region. This phenomenon is affecting mostly the western and central parts of Iran, where the agriculture is the economic mainstay of households. Dust storms can have a devastating effect on agriculture and soil fertility. This research aimed to investigate the capability of spectrometry in discriminating wheat canopies which are under dust stress in different growth stages. Two wheat (Triticum aestivum L.) species including Aflak and Pishtaz, were grown in pots (17 cm) under controlled conditions. 20 numbers of seeds were cultivated in each pot and each treatment was replicated three times. The treated samples were exposed to simulated dust storm at tow growth stages including Tillering and Heading. In each stage the treatments were exposed in 6 days. After each 2 days (during 6 days), field spectroscopy measurements were carried out at canopy level using a full range spectro-radiometer ASD. The ASD fibre optic with an 8° field of view (FOV) was held at 90 cm above each pot. With this setting, the diameter of FOV was 13 cm with the nadir point being the centre of the circle. To minimize noise in the measured reflectance spectra, the 8 spectral measurements of each sample were averaged. Bands with a wavelength less than 400 nm and more than 2400 nm displayed very high levels of noise and thus were excluded. The analysis and processing were carried out using MATLAB. Coverage percentages (fcover) were measured for each pot. The total canopy chlorophyll content for each pot was obtained by multiplying the leaf chlorophyll content by the corresponding fcover. After measuring fresh weight and dry weight, the amount of nitrogen was determined by colorimetric analysis.

New narrow-band vegetation indices from NDVI, ARI, SAVI2 and PVI indices were computed from the measured canopy spectra, using all possible two-band combinations, involving 2400 wavelengths between 400 nm and 2400 nm. Later PLSR models were used to determine the relationships between vegetation indices and plant biochemical data. The result showed that spectrometric measurements is a potential and promising technology for monitoring environmental stresses such as dust storm on agricultural product especially for wheat crops.

DEVELOPMENT OF AN APPARATUS THAT CAN SIMULTANEOUSLY ANALYZE THE CONCENTRATION AND COMPOSITION OF AEROSOLS

Yusuke Mizuno*, Daisuke Matsunaga, Tomoki Aoyama, Jun Hirose

Application R&D Center, HORIBA, Ltd., Kyoto ,601-8510, Japan
**yusuke.mizuno@horiba.com*

Aerosols discharged from factories and automobiles are a major cause of air pollution in metropolitan areas as well as in areas along arterial roads. In Japan, the ambient air quality standards apply to suspended particulate matter (SPM: particles with a diameter less than 10 μm). In addition to the SPM regulation, PM2.5 regulation has been started in September 2009. Concentrations of aerosols are measured across the country at more than 1,500 continuous air pollution monitoring stations. This monitoring alone, however, does not provide us with sufficient information for the identification of the sources of aerosol emissions or an understanding of aerosol dynamics in the environment. Additionally, it is very important to obtain the chemical information in order to determine the source contribution [1]. As a result, there is an urgent need of the equipment which has combined the properties of multifunction analysis and mobility.

In response to this situation, we are currently developing an apparatus that can simultaneously analyze the concentration and composition of aerosols. This apparatus features the combination of an X-ray tube and an beta ray and original membrane filter based on a polytetrafluoroethylene (PTFE)*[1] film with ultra low chemical background [2]. The X-ray tube is used for component analysis by the X-ray fluorescence method, and the beta ray is used for measurement of aerosol concentrations by beta attenuation method. While the conventional monitoring stations measure only the aerosol concentrations, this apparatus is intended to identify the sources of aerosol emission more accurately by adding a component analysis of the same sample.

1. Katsumi Saitoh et al., (2013). International Journal of PIXE, Vol. 22, 179-184
2. Akihiro Fushimi et al., (2011). Atmospheric Environment, Vol. 45, 6326-6336,

THE 2010 EYJAFJALLAJÖKULL VOLCANIC CLOUD OVER EUROPE OBSERVED BY EARLINET

L. Mona* and the EARLINET Team

Consiglio Nazionale delle Ricerche - Istituto di Metodologie per l'Analisi Ambientale, Tito Scalo, Potenza, 85050, Italy
**lucia.mona@imaa.cnr.it*

Volcanoes eruptions can cause damages and hazards in the air as well as at the ground. Specific damages and mitigating actions depend on the interested altitude ranges. Lidar techniques are nowadays a very powerful instrument to obtain information on the aerosol vertical distribution in the atmosphere and to provide data about the presence, altitude, layering and optical properties of a cloud of volcanic origin. Recent eruptions of Etna in 2001, 2002, of Nabro in 2011 and Eyjafjallajökull in 2010 showed that lidar networks could help track volcanic clouds. When Eyjafjallajökull erupted in April 2010, satellites showed the extent of the ash cloud but were unable to indicate the vertical distribution of aerosols in the atmosphere. This 4D picture was available in 2010 from EARLINET (European Aerosol Research Lidar NETwork) in Europe.
EARLINET performed almost continuous lidar measurements during the Eyjafjallajökull eruption event in April-May 2010.
The coordinated observations by EARLINET and a methodology that was specifically designed ad hoc for this event provided a detailed description of the 4D distribution of the volcanic cloud over Europe for the whole event. Geometrical properties of the volcanic cloud over Europe were provided with high vertical resolution (typically 60-180 m) in terms of base, top, and center of mass of the volcanic layer.
A first volcanic layer was observed over Hamburg in the early morning of 16 April. In the following days the ash plume was observed over Central Europe and Belarus. Volcanic particles were observed over Italy on 20 April and over Greece on 21 April. The volcanic cloud was persistent over Central Europe for the whole period (15 - 26 April), with varying aerosol loads. Intrusion into the PBL was commonly detected at almost each site. In May volcanic particles were detected over Spain and Portugal and then over the Mediterranean and the Balkans. Volcanic particles were observed over Central Europe until 25 May. Mixing of volcanic particles with other kind of aerosol (dust, continental and local) was identified.
Quantitative optical data collected by EARLINET for this event, including the specific relational database related to the geometrical properties of the volcanic cloud, represent a unique database for model evaluation, data validation, and integration.

Acknowledgments - The financial support by the European Community through the ACTRIS Research Infrastructure Action under the 7th Framework Programme under ACTRIS Grant Agreement n° 262254 is gratefully acknowledged.

LONG-TERM EARLINET DUST OBSERVATIONS

L. Mona[1]*, V. Amiridis[2], A. Amodeo[1], G. D'amico[1], A. Schwarz[3], N. Papagiannopoulos[1], A. papayannis[4], M. Sicard[5], U. Wandinger[3], A. Comeron[5], G. Pappalardo[1]

[1]*Consiglio Nazionale delle Ricerche - Istituto di Metodologie per l'Analisi Ambientale, Tito Scalo, Potenza, 85050, Italy*
[2]*Institute for Space Applications and Remote Sensing, National Observatory of Athens, Greece*
[3]*Leibniz Institute for Tropospheric Research, Leipzig, Germany*
[4]*National Technical University of Athens-NTUA, Physics Department, Athens, Greece*
[5]*RSLab - IEEC-CRAE, Universitat Politècnica de Catalunya, Barcelona, Spain*
**lucia.mona@imaa.cnr.it*

Systematic observations of Saharan dust events over Europe are performed from May 2000 by EARLINET, the European Aerosol Research LIdar NETwork. EARLINET is a coordinated network of stations that make use of advanced lidar methods for the vertical profiling of aerosols. The backbone of EARLINET network is a common schedule for performing the measurements and the quality assurance of instruments/data. Particular attention is paid to monitoring the Saharan dust intrusions over the European continent. The geographical distribution of the EARLINET stations is particularly appealing for the dust observation, with stations located all around the Mediterranean and in the center of the Mediterranean (Italian stations) where dust intrusions are frequent, and with several stations in the central Europe where dust penetrates occasionally. All aerosol backscatter and extinction profiles related to observations collected during these alerts are grouped in the devoted "Saharan dust" category of the EARLINET database. This category consists of about 4700 files (as of December 2013).
Case studies involving several stations around Europe selected from this long-term database have been provided the opportunity to investigate dust modification processes during transport over the continent. More important, the long term EARLINET dust monitoring allows the investigation of the horizontal and vertical extent of dust outbreaks over Europe and the climatological analysis of dust optical intensive and extensive properties at continental scale.
This long-term database is also a unique tool for a systematic comparison with dust model outputs and satellite-derived dust products. Because of the relevance for both dust modeling and satellite retrievals improvement, results about desert dust layers extensive properties as a function of season and source regions are investigated and will be presented at the conference.

Acknowledgments - The financial support by the European Community through the ACTRIS Research Infrastructure Action under the 7th Framework Programme under ACTRIS Grant Agreement n° 262254 is gratefully acknowledged.

SOURCE AND EVOLUTION OF URBAN DUST (PST-PM10) IN THE SONORAN DESERT, NW MÉXICO

Verónica Moreno-Rodríguez[1]*, Diana Meza-Figueroa[2], Joel Zepeda-Ibarra[3], Rafael Del Rio-Salas[1], Hector Mendívil-Quijada[1], Belem González-Grijalva[2]

[1]*Estación Regional del Noroeste UNAM, Hermosillo, 83000, Mexico*
[2]*Departamento de Geología, Universidad de Sonora, Hermosillo, 83000, Mexico*
[3]*Air Quality Program (PENCA),City Council ecology department of Hermosillo, 83000, Mexico*
**vmorenorodriguez@gmail.com*

Air quality in urban areas tends to be poor.An evaluation of the possible health impacts of the suspended particulate matter (PM) is still needed in several Mexican cities. In the case of arid northern areas, the lack of information is even more remarkable. Hermosillo city, located in NW Mexico, is a rapidly growing and industrialized city located within the Sonoran desert (low annual precipitation and extremely high temperatures). Several diseases as those related with respiratory problems have increased dramatically in the last years. Previous studies show high metal- and pesticide-concentrations in urban soils and suspended dusts. In order to understand dust-generating processes and sources (geogenic vs. anthropogenic), a long term monitoring air was made within the city. A total of 1,386 high volume measurements of PM10 and TSP were carried out in Hermosillo in a monitoring period from 2000 to 2012. The evolution in time of particulate concentration (PC) during this period has been analysed in conjunction with historic climate data and calculated aridity index (AI) and erosion potential (EP). Additionally, bulk metal content of selected TSP and PM10 filters were measured. The climate factor that has the clearest influence on the PC is the relative humidity (RH). An important peak of RH is reported in 2005, and correlates with a drop in PC in all the monitoring stations. An increased percentage of dusty days are observed from 2000 to 2004, which apparently follows a predictable increase in AI and EP. However, a decrease in AI and EP is observed after 2004, which fails the expectable decrease in PC. This is an inflexion point where dust production was mainly controlled by erosion processes, and then anthropogenic processes is probably a contributing source in the last years. In fact, the chemical compositions of filters from the geogenic and anthropogenic periods behave differently. The concentration of PM varies geographically but the data is consistent during the studied period, implying that particulate sources are punctual and local. The worst air quality is located in the northern area, which correlates with scarce asphalting and artisanal brick production. High PM10 concentrations are reported for the southern zones, a high-industrialized area, and metallic and non-metallic activity to the SE zones. Finally, Hermosillo is the most important cement producer in Mexico and the industry is located within the city limits. Also the city experiencedhigh constructionperiod as a consequence of the rapidurbanization in the last years. PM has a surprising similar metal behaviour with the metal composition of the cement produced and used in the city. Hence, anthropogenic activities seem to be a main PM source in Hermosillo.

MIXED DUST EXPOSURE IN THE CERAMICS INDUSTRY

Beatrice Moroni[1]*, David Cappelletti[2], Francesco Scardazza[1]

[1]*Dipartimento di Ingegneria Civile e Ambientale, University of Perugia, Perugia, 06125, Italy*
[2]*Dipartimento di Chimica, Biologia e Biotecnologie, University of Perugia, Perugia, 06135, Italy*

Health risk assessment in the ceramics industry traditionally rests upon crystalline silica toxicity and exposure levels. Notwithstanding, workers in the ceramics factories may be exposed to a number of potential toxicants, including iron [1]. In this paper the nature and properties of quartz and Fe-bearing minerals in clay brick and pottery productions, and the possible mutual interactions between them, have been evaluated by means of integrated individual particle characterisation-bulk chemical analyses of both the raw materials and the airborne dust particles.
Aerosol dust samples have been collected from different working stations in different clay brick and pottery factories in Umbria (Central Italy). Individual particle characterization has been performed by means of scanning electron microscopy (SEM) coupled with image analysis and EDS microanalysis [2]. The mineralogical composition has been obtained by means of X-ray diffraction (XRD), while the concentration and the solubility degree of Fe has been determined by inductively coupled plasma atomic emission spectrometry (ICP-AES).
Quartz revealed similar grain size and surface morphology in both sectors. The exposure doses resulting from surface area measurements were also similar; they greatly exceeded the minimum dose able to induce significant cytotoxic and inflammogenic effects on cell cultures [1]. This fact alone does not explain the observed higher incidence of silicosis in the clay brick production [3]. When looking to the total and the soluble Fe amounts in the dust, however, values for the clay brick remarkably exceed those for pottery. This means that, despite the generally similar compositions of clay raw materials, the airborne dust may be much more enriched in Fe in the clay brick than in the pottery production. The mean values of the Fe/Qz ratio have been estimated based on the values of iron and quartz concentrations in the samples. The values obtained for pottery are in the range of possible adverse health effect, while the values for clay brick seem too high to attain adverse health effects; rather, a protective action may be postulated in this case [1]. In the light of all these points, significant reduction of the health risk in the ceramics industry may be attained only after a deep examination of the properties and the exposure conditions of the whole materials even in the same working environment.

1. Ghiazza M., Scherbart A.M., Fenoglio I. *et al.* (2011) *Chem. Res. Toxicol*. 24, 99-110.
2. Moroni B., Viti C., Cappelletti D. (2013) *JESEE* doi:10.1038/jes.2013.3.
3. Verdel U., Incocciati E., Massera S., Rughi D. (2006) *Proc. 24th A.I.D.I.I. Nat. Cong.*, 55-60.

SOURCES, FATE AND DYNAMICS OF DISPERSION OF AEROSOL PARTICLES IN HISTORIC CITIES: THE CASE OF PERUGIA (CENTRAL ITALY)

Beatrice Moroni[1]*, Silvia Castellini[2], Stefano Crocchianti[2], David Cappelletti[2], Luca Ferrero[3], Rosamaria Salvatori[4], Antonella Ianniello[4], Francesca Spataro[4], Giulio Esposito[4]

[1]*SMAAr, University of Perugia, Perugia, 06125, Italy*
[2]*Dipartimento di Chimica, Biologia e Biotecnologie, University of Perugia, Perugia, 06135, Italy*
[3]*DISAT, University of Milano-Bicocca, Milano, 20126, Italy*
[4]*IIA-CNR, Monterotondo, 00015, Italy*
**b.moroni@tiscali.it*

Historic towns in Central Italy often face the consequences of typically tightened urban arrangements, such as reduced viability and intense road traffic. In Perugia the question of traffic has been addressed through different solutions of urban mobility. A ropeway public transport system called Minimetrò is among them. The same system serves as the base for an integrated project of urban dust modeling in terms of the properties, sources and fate of the constituent particles, with final aim to check the situation and test the effectiveness of pollutant abatement strategies and control systems.

The project [1] integrates time/space resolved environmental measurements from a mobile cabin in the Minimetrò line with measurements from fixed stations located at the terminals of the line. Data (PM10, PM2.5, O_3, NO_x, CO and Radon concentrations, weather parameters, size distribution measurements) from the urban background station in Perugia and from the WMO SDS-WAS regional background station of Monte Martano (Central Italy) are considered for comparison [2]. Finally, the traffic rates are recorded at two crossroads intersected by the Minimetrò line. Off-line analyses are performed on selected filters by PIXE, ICP-AES and thermo-optical methods; selected samples undergo SEM measurements and microbial tests.

Results point to the main impact of local traffic through fine particle emission and coarse particle resuspension The influence of local meteorology and topography on the development of the planetary boundary layer upon the town is also well evidenced. Comparison between urban and regional background data points to the remarkable, though variable, contribution of Saharan dust in the total dust load. Finally, the impact of the mobile transport system itself clearly results in significant amounts of heavy metal and organic species.

1. Castellini S., Moroni B., Cappelletti D. (2013). PMetro: measurement of urban aerosols on a mobile platform. Measurement, doi: http://dx.doi.org/10.1016/j.measurement.2013.11045.
2. Moroni B., Castellini S., Crocchianti S., Scardazza F., Angelucci M., Pompei M., Vecchiocattivi M., Cappelletti D. (2013). Ground-based measurements at the WMO SDS-WAS rural regional background station of Monte Martano (Central Italy). 7th Int. Workshop on Sand/Duststorms and associated dustfall, 2-4 December 2013, Frascati, Italy.

DUST STORM SOURCES IN WEST ASIA AND THEIR ADVERSE EFFECTS ON IRAN

Farzaneh Moshayedi*, Sasan Shirkhani Ardehjani, Shirin Atarod, Somayeh Hajlo

Regional & National Secretariat in Department of the Environment, Tehran, 141557383, Iran
**fmoshayedi@yahoo.com*

The available scientific data for SDS in the West Asia Region are alarming. Especially in Western Iran, Iraq, Syria, and northern Saudi Arabia, the number of "hotspots", the source areas where sediments are mobilized during strong winds, has more than quadrupled in the last 14 years. The results of inspecting show that the main focuses of dust in West Asia are the Forat region near Syria and Iraq. The space of this area is ten than sand of square kilometer that in drought years without rainfall and in wet years with a rainfall less than 100 to 150mm.Today the most important factors are including:
1 - The long drought in Middle East.
2 - Block the Forat river water by huge dams of turkey, Syria, Iraq

About 14 Provinces in Iran are affected by SDS in Iran.The most affected provinces in the country are Khuzestan, Kermanshah, Kordestan, Lorestan and Yazd. This study is about overall health, environmental and economic effects by dust on these provinces. In Kermanshah visibility reduced due to dust, it reduced to 100 meters, its a record of Kermanshah weather inventory in 58 years. Horizontal and vertical viewing on Saturday and Sunday, the thirteenth and fourteenth of July 2010 in most parts of the province fell to below 500 meters. The situation was more or less in Kurdistan province too.
In Khuzestan, in the period 2007-2009 maximum sediment-in-air concentrations during SDS events more than tripled, the event durations doubled or tripled, and the number of traffic accidents, school closures, and flight cancellations matched or greatly exceeded the SDS event attributes. In April 2010, dust concentration in the province was 18 times more than the acceptable limit, it was announced 3786 micrograms per cubic meter.

Haddad M.,UNEP-GEF Project for West Asia, 2013, Darvishi Boloorani A., UNEP Pilot Project, Dust Storm Hot Spots in Islamic Republic of Iran.

Kooshki F., Razavian M.T., Geographic Origins of Dust Storms Effects(Case Study in Khuzestan), Shahi Beheshti Univ., Tehran, Iran.

Shahsavani A., Naddafi K., Yunesian M.,The Evaluation of PM10, PM2.5 and PM1 Concentrations During The Middle Eastern Dust(MED) Events in Ahvaz, Iran from April to September 2010.

GROUND BASED IN SITU MEASUREMENTS OF MINERAL DUST AT BARBADOS DURING THE SALTRACE CAMPAIGN

Thomas Müller[1], Thomas Bjerring Kristensen[1], Khanneh Wadinga Fomba[1], Konrad Kandler[2], Carlos Toledano[3], Joeseph M. Prospero[4], Alfred Wiedensohler[1]

[1]*Leibniz Institute for Tropospheric Research, Leipzig, 04318, Germany*
[2]*Institut für Angewandte Geowissenschaften, Technische Universität Darmstadt, Germany*
[3]*Group of Atmospheric Optics, Valladolid University, Valladolid, 47011, Spain*
[4]*Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, Fl, 33149-1098 USA*
**thomas.mueller@tropos.de*

Mineral dust is one of the most abundant aerosols from natural sources. Despite of the large particle size and the associated dust deposition, dust can be transported in high concentrations for long distances. The Saharan Aerosol Long-range Transport and Aerosol Cloud Interaction Experiment (SALTRACE) was conducted to investigate the transport of mineral dust and the effect of aerosol cloud interactions. The experiment took place at the island Barbados, which is more than 5000 kilometers west of the Saharan desert. The experiment combines *in situ* measurements done near ground (Ragged Point on the east coast of Barbados) and onboard of the research aircraft Falcon of the German Aerospace Centre, and remote sensing techniques (LIDARs and sunphotometers) installed at Ragged Point and the Carribean Institute of Meteorology and Hydrology (west coast of Barbados).

In situ measurements of mineral dust were conducted at the atmospheric research station of the University of Miami at Ragged Point. The aerosol inlet was installed on top of a tower at a cliff in an altitude of about 50 meters above sea level to minimize the influence of sea spray from the surf zone. Online measured aerosol parameters included the particle number size distributions, cloud condensation nuclei (CCN) concentrations, optical scattering and absorption coefficients at several wavelengths. For offline analysis samples were collected for chemical and mineralogical analysis.

During the period from 16 June to 14 July, 2013 a few strong dust plumes were observed. Dust concentrations derived from an optical absorption photometer yield concentrations of up to 45 $\mu g/m^3$. Comparison with total aerosol mass concentrations derived from the particle number size distributions and an assumed density of 2.5 g/cm^3 confirmed that mineral dust was one of the most abundant aerosols except for few short periods with low mass concentrations when the composition was dominated by marine aerosol. Typical CCN concentrations observed for a supersaturation of 0.2% amounted to roughly 50 cm^3 during periods with no dust, while typical CCN concentrations observed during dust events were around 200 cm^3. It was found by comparing data from LIDAR and sunphotometers that dust transported at high altitudes between 2 and 4 kilometers was effectively mixed down to ground level by turbulence. Dust concentrations measured at ground and columnar aerosol optical depth from sunphotometers showed an excellent correlation.

HIGH-THROUGHPUT SEQUENCING ANALYSIS OF THE BACTERIA IN THE DUST STORM WHICH PASSED OVER CANBERRA, AUSTRALIA ON 22-23 SEPTEMBER 2009

Chris Munday[1*#], Patrick De Deckker[2], Nigel Tapper[3], Gwen Allison[1,4]

[1]*Research School of Biology, Australian National University, Canberra, 0200, Australia*
[2]*Research School of Earth Sciences, Australian National University, Canberra, 0200, Australia*
[3]*ASchool of Geography and Earth Science, Monash University, Clayton, 3000, Australia*
[4]*Australian National University Medical School, Canberra, 0200, Australia*
[#]*Current address: Royal Netherlands Institute for Sea Research, Texel, 1797SZ, The Netherlands*
**Chris.Munday@nioz.nl*

Following a prolonged drought in Australia in the first decade of the 21st century, several dust storms affected the heavily populated East coast of Australia. The largest such storm occurred on 22-23 September 2009 and had a front of an estimated 3000km. A 24hr average PM_{10} concentration of over 2,000µg/m^3 was recorded in several locations and an hourly peak of over 15,000µg/m^3 was recorded (Leys et al. 2011).
Over two time periods duplicate aerosol samples were collected on 47mm diameter cellulose nitrate membranes at a location removed from anthropogenic influences. One set of samples was collected in the afternoon the dust event started and another was collected overnight. Additionally, overnight rainfall was collected in a sterile bottle.DNA was directly extracted one membrane from each time point for molecular cloning and high throughput sequencing, while the other was cultivated on Tryptic Soy Agar (TSA).
High throughput sequencing was performed using the 454 Titanium platform. From the three samples, 19,945 curated sequences were obtained representing 942 OTUS, with the three samples approximately equal in number. Unclassified Rhizobiales and *Stenotrophomonas* were the most abundant groups which could be attributed names. A total of 942 OTUs were identified (cutoff = 0.03), and despite the temporal relation of the samples, only eleven were found in all three samples, indicating that the dust storm evolved in composition as it passed over the region.
Approximately 800 and 500 CFU/m^3 were found in the two cultivated samples, tenfold more than was collected from previous dust events (Lim et al, 2011). Identification of cultivars revealed a dominance of the gram positive Firmicutes phylum, while the clone library showed a more even distribution of taxa, with Actinobacteria the most common and Firmicutes comprising less than 10% of sequences.
Collectively, the analyses indicate that the concentration of cultivable organisms during the dust storm dramatically relative to calm conditions. A diverse and variable population of microorganisms were present reflecting the vast source and dynamic nature of the storm.

Leys, J. F., Heidenreich, S. K., Strong, C. L., McTainsh, G. H., Quigley, S. (2011). PM 10 concentrations and mass transport during "Red Dawn" - Sydney 23 September 2009. Aeolian Research 3(3): 327-342
Lim, N. Munday, C.I., Allison, G.E., O'Loingsigh, T., De Deckker, P., Tapper, N. (2011) Microbiological and meteorological analysis of two Australian dust storms in April 2009. Science of the Total Environment 412-413:223-231

CHARACTERIZING MODERN EOLIAN SEDIMENT DEPOSITION IN THE ALPINE ZONE OF THE UINTA MOUNTAINS, UTAH, USA

Jeffrey Munroe*, Emily Attwood, Samuel O'Keefe, Paul Quackenbush

Geology Department, Middlebury College, Middlebury, VT, 05753, USA
**jmunroe@middlebury.edu*

Passive samplers were deployed at four locations in the alpine zone of the Uinta Mountains (Utah, USA) to collect modern eolian deposition between July 2011 and June 2013. On average the collectors accumulated 1.5 gm of dust in the first 12 months, corresponding to an annual flux of 4.4 g/m^2. Accumulation was lower during Year 2, averaging 0.8 gm per collector (2.5 g/m^2/yr). Because the collectors are positioned on the ground, higher values in Year 1 may reflect reduced snowpack, which totaled just 64-77% of normal during the 2011-12 winter. Grain size analysis with laser scattering reveals that modern dust is very well-sorted, with a median size of ~10 µm. No systematic differences in grain size were noted between the four collector locations, or between Years 1 and 2. XRD analysis reveals that dust samples are dominated by quartz, potassium feldspar, plagioclase, and illite with minor amphibole. Quartz, potassium feldspar, and illite are present in the local bedrock, but the other minerals must have an exotic source. ICP-MS analysis reveals that dust is greatly enriched (50-90x) in Bi, Cu, Na, P, Zn, and Cd relative to the Uinta bedrock. Some of these elements may have their source in upwind mining operations. Scatterplots of rare earth elements reveal that the dust matches the fine fraction of the soil A horizon, supporting an eolian origin for the ubiquitous layer of fines that mantles soil profiles throughout the Uinta Mountains. To evaluate the extent to which regional sources contribute to the dust flux into the Uinta alpine zone, a specially designed active sampler was deployed in June 2013 at the location of one of the existing passive samplers. A remote weather station installed at this location (3700 m asl) in 1998 reveals a strongly bimodal wind regime, with wind approaching the site either from the NNW or SSE. The active sampler uses solar-powered fans to pull air through a filter. A wind-actuated switch activates one fan when the wind is from the NNW, and another when the wind is from the SSE, allowing the collection of separate samples for the two primary wind directions. During the first four months of deployment (June through October, 2013) the SSE fan ran 1065 hours (8.6 hr/day) while the NNW fan ran 657 hours (5.3 hr/day). Grain size analysis reveals that both samples are dominated by medium-fine silt (~15 µm), however the sample from the NNW contains a significant secondary mode of coarse silt (~45 µm). XRD analysis reveals that dust samples from both directions contain exotic amphibole and plagioclase feldspar. The sample from the NNW also contains a somewhat poorly ordered mineral with wide d-spacing, perhaps smectite or hydrobiotite.

PHYSICAL PROPERTIES OF LUNAR DUST

Masami Nakagawa

Colorado School of Mines, Golden, Colorado, 80401, USA
mnakagaw@mines.edu

During the last Apollo Mission, the duration of the stay on the surface of the Moon had to be shortened to only three days. There were a number of mission critical problems associated with the lunar dust. When the US's intention of sending astronauts back to the Moon by 2020 but this time to stay there for as long as three years and it was assumed that the dust would be the second most challenging problem to make the ambitious extended stay difficult.

In response to the NASA's funding opportunity, in 2005 the author was awarded a $15M project entitled "Mitigation of Dust and Electrostatic Accumulations for Human and Robotic Systems for Lunar and Martian Missions". Due to the creation process of the moon dust and the harsh lunar environment, the lunar dust is very fine, irregularly shaped with significant pore space and strongly electrostatically charged. There is a significant amount of information about their chemical composition available; however, little information is available regarding the mechanical and physical behaviour of lunar dust. Unfortunately, there exists no truly pristine lunar dust among the returned samples due to leaky sealed containers.

In this presentation, the author will describe the scope of the project to stress the importance of the development of simulant that capture both chemical as well as mechanical/physical properties of lunar dust since the combined effects will have a larger impact on the future space exploration.

POLLUTION CONTROL AND ENERGY PRODUCTION OF UNDERGROUND BURNING COAL SEAMS

Masami Nakagawa

Colorado School of Mines, Golden, Colorado, 80401, USA
mnakagaw@mines.edu

Uncontrolled burning coal seams burn away the important non-renewable energy resource and emit carbon dioxide, carbon monoxide, sulfur oxide and methane, and is a leading cause of smog, acid rain, global warming, and air toxins. They occur in many countries including China, India, the United States, Indonesia, Venezuela, Australia, South Africa, Germany, Romania and the Czech Republic, and it is estimated that these fires generate as much as 3% of the world's annual carbon dioxide emissions and consume as much as 5% of its mineable coal. Burning coal seams are wasting valuable non-renewable energy resource and polluting the environment. In this presentation, we will share our feasibility study on a new concept of generating electric power utilizing the heat from burning coal seams (Chiasson et al., 2007). Our study shows that it is possible to obtain the Levelized Cost of Electricity as low as $0.07/kWh. Extinguishing these burning coal seams is a challenging task especially if there is no financial incentive to do so. The proposed technique can accelerate to shorten the life of burning coal seams and thus help control the pollution.

Chiasson, A.D., Yavuzturk, C., Walrath D.E (2007). Evaluation of electricity generation from underground coal fires and waste banks. Journal of Energy Resources Technology, Vol. 129, 81-88.

DUST CLOUD INTERACTION OBSERVED BY USING A RAMAN LIDAR

JAN B. NEE

Department of Physics, National Central University, Chung-Li, Taiwan 32054
jbnee@phy.ncu.edu.tw

Mineral dust interacts with pollutants during long-range transport can result in changing their surface and hydroscopic properties. Asian Dust sometimes passed through regions of heavy industrial and urban pollution and get overcoated surface chemicals. The dust particles then interact with humidity to form aqueous droplets. One of the events reported here occurred in 2009/03/14 at Chung-Li, Taiwan (24.6°N, 121.1°E) when a strong Asian dust arrived. The occurrences of heavy dust storm were confirmed by the ground based PM10 measurements which exceeded over 100μg/m^3 at many cities. A lidar system operated with wavelengths at 532/355/ 386/407 nm for detections scattering, polarization of dust particles and water vapor Raman signals has been used to monitor this dust storm. Lidar observations show two dust layers at 1.5 and 3 km. During the measurements, a lower cloud also appeared at about 1.5 km which then mixed with the dust layer. The interaction of dust particles with humidity to form droplets is evident in the changing of depolarization and lidar ratios. Our results show dust particles may form droplets and possibly affecting precipitation which can impact the climate and environment.

AEROSOL LIDAR PROFILING OVER ROMANIA

Anca Nemuc[1]*, Flori Toanca[1,2], Livio Belegante[1], Lev Labzovskii[1,2]

[1]National Institute of Research and Development for Optoelectronics, INOE, 409 Atomistilor Street, Magurele, Romania

[2]Facultyof Physics, University of Bucharest,Magurele, Romania

*anca@inoe.ro

Human activities are the main cause of poor air quality, but natural sources of air pollution also play a significant role. 'African dust' from the Sahara is the most common natural source of particulate matter in the air, mostly over South Europe. (EEA Technical report No 10/2012).

The paper presents a statistical overview of more than 50 lidar observations over Magurele, Romania, correlated with sunphotometer data and HYSPLIT backtrajectories, between 2011 and 2013. The study is focused on special atmospheric events like Saharan dust intrusions, influence of biomass burning and also several cases of mixed transported and local aerosol over the site.

The system used in this study is a multiwavelength depolarization Raman lidar ($3\beta+2\alpha+1d$) (Nemuc et.al. 2012) capable of performing daytime (elastic) and nighttime (elastic + Raman) measurements for aerosol profiling.

The number of dust events was highest during the summer periods, when warm air masses coming from the south Europe brings mineral dust over most European countries (Mona et.al., 2012). Multiple aerosol dust layers of variable thickness (500-2500 m) and height (2000-4000 m) were observed and analyzed. AERONET data was also used to validate the presence of mineral dust over the measurement site (Tesche et. al. 2011).

The presence of biomass burning was also detected during the warm periods, when forest fires from Ukraine and Russia accounts for most of the smoke events detected over Romania (Nicolae et al. 2013). For this case, the aerosol layers are thinner (around 100-500 m) and the height varies from 1000 to 3000m. In colder periods: late autumn and winter, most events are the result of local pollution.

Acknowledgments - This work has been supported by grants of the EU-FP7-INFRASTRUCTURES-2010-1 under grant no. 262254 - ACTRIS and by the European Community's FP7-PEOPLE-2011-ITN under grant no. 289923, ITARSand by the ones of the Romanian National Authority for Scientific Research, Programme for Research- Space Technology and Advanced Research - STAR, project numbers 38/2012 - CAPESA and 55/2013 - CARESSE

Nemuc, A., Vasilescu, J., Talianu, C., Belegante, L., Nicolae, D.: Assessment of aerosol's mass concentrations from measured linear particle depolarization ratio (vertically resolved) and simulations, Atmos. Meas. Tech., 6, 3243-3255, doi: 10.5194/amt-6-3243-2013, 2013.

Mona L., Liu Z., Müller D., Omar A., Papayannis A., Pappalardo G., Sugimoto N., Vaughan M. (2012). Lidar Measurements for Desert Dust Characterization: An Overview, Advances in Meteorology, Volume 2012, Article ID 356265, 36 pages, http://dx.doi.org/10.1155/2012/356265;

Tesche, M., Detlef, M., Gross, S., Ansmann, A., Althausen, D., Freudenthaler, V., Weinzierl, B., Veira, A., Petzold, A., Optical and microphysical properties of smoke over Cape Verde inferred from multiwavelength lidar measurements. Tellus B, 63, 677-694, 2011

REGIONAL MODELLING OF THE ATMOSPHERIC TRANSPORT, CHEMICAL TRANSFORMATION AND DEPOSITION OF FE IN DUST INTO THE OPEN OCEAN

S. Nickovic[1,2], A. Vukovic[2,3], M. Vujadinovic[2,3]

[1]*Institute of Physics, Belgrade, 11080, Serbia*
[2]*South East European Virtual Climate Change Center, Belgrade, 11000 Serbia*
[3]*Faculty of Agriculture, University of Belgrade, 11080 Serbia*

Nutrification of the open ocean is highly dependent on the deposition of iron minerals carried by desert dust aerosol. The process of atmospheric dust cycle is primarily driven by meso- and synoptic-scale atmospheric processes providing long range transport, often characterized by continental scales. The fractions of various minerals in aerosol are determined by the mineral composition of arid soils; therefore, a high-resolution specification of the mineral and physical properties of dust sources is needed. According to the current knowledge, atmospheric radiation, clouds and polluted air contribute to the solubilization of iron minerals in the atmosphere. The Fe solubility is a precondition for it to be bio-available in the marine primary production. As a result of the bio-production, among others, is release of the dimethyl sulfate (DMS) which has a capacity to regulate the local or regional climate through its effect on cloud concentration nucleation.

To numerically simulate the atmospheric route of iron from desert sources to sinks in the ocean, we developed a regional atmospheric dust-iron model that included parameterization of the transformation of iron to a soluble form caused by dust mineralogy, cloud processes and solar radiation. Recently developed global 1km database for eight major minerals in arid soils was the major input into our study which used the Dust Regional Atmospheric Model (DREAM) to describe the faith of the iron-carrying minerals in dust during their atmospheric transport and deposition into the ocean. We will present results from higher-resolution simulation experiments and comparison compared against field data on the aerosol iron sampled during several Atlantic cruises, demonstrating the model capability to reproduce the major observed patterns.

TREE-YEAR CLIMATOLOGY OF DESERT DUST INTRUSIONS OVER LIMASSOL, CYPRUS

Argyro Nisantzi[1]*, Rodanthi Elisavet Mamouri[1], Albert Ansmann[2], Diofandos Hadjimitsis[1]

[1]Cyprus University of Technology, Limassol, 3036, Cyprus
[2]Leibniz Institute for Troposheric Reasearch, Leibniz, 04318, Germany
*argyro.nisantzi@cut.ac.cy

The geographical location of Cyprus comprises the ideal crossroad of air masses coming from the two of the largest deserts in the world, the Saharan and Arabian deserts. Particles of natural sources can be observed in the lower free troposphere on an almost daily basis. They influence the climatic conditions directly by absorbing and scattering radiation and indirectly by acting as cloud condensation nuclei (CCN) and ice nuclei (IN). In this paper, active and passive remote sensing instruments have been used in the coastal area of Limassol, Cyprus, in order to characterize the aerosol optical properties of dust intrusions from African and Syrian deserts. The vertical extent of mineral dust outbreaks over Limassol was studied with polarization lidar in conjunction with columnar aerosol optical parameters retrieved from AERONET CUT-TEPAK sun/sky photometer observations during a period of 42 months (May 2010 to October 2013). More than 120 lofted layers (80 Saharan dust layers, 42 Syrian dust layers) have been observed. The identification of the specific dust source has been done by means of backward-trajectory analysis (HYSPLIT), satellite imagery (Moderate Resolution Imaging Spectroradiometer, MODIS), and model calculations (DREAM model). The African intrusions are more intense from spring to early summer and autumn, whereas Syrian dust layers are presented above Cyprus mainly during summer and autumn. The centre of the desert dust layers is typically observed between 2 and 3 km height. The climatological study of the lofted dust plumes will be based on height and layer depth information, aerosol optical depth, particle depolarization ratio and backscatter coefficient at 532nm, and column extinction-to-backscatter ratio.

Acknowledgements - This research has been funded by the Cyprus Research Promotion Foundation (PENEK/0311/05). Thanks are given to the Remote Sensing Laboratory of the Department of Civil Engineering & Geomatics at the CUT for the support (http://www.cut.ac.cy). The authors would like to thanks BSC-DREAM for the mineral dust forecasts.

SOURCE OF HEAVY METALS IN ATMOSPHERIC DUST OF ISFAHAN CITY, CENTRAL IRAN

Samira Norouzi*, Hossein Khademi, Farid Jafarpisheh

Isfahan University of Technology, Isfahan, 84156-83111, Iran.
**samiranorouzi@yahoo.com*

Dust studies in urban areas are important for determination of the origin, distribution, environmental damage and health effects of heavy metals in atmosphere. Dust deposition from different natural and anthropogenic sources exerts considerable impacts on human health and ecosystem. Isfahan is Iran's third largest city located in central Iran. It is the third populated and the second industrial city in Iran. Heavy traffic and different industries in and around the city have caused a great atmospheric pollution. No extensive studies have been carried out on the content of heavy metals in dust in Isfahan. The main objectives of this study were to determine the temporal trend of the key heavy metals concentration in dust and to assess their probable sources in the area. Dust samples were monthly collected for 6 months (19 June to 18 Nov., 2012), using a dry flat glass surface with an area of 1 m^2, located on the roof of one floor buildings in 18 sites in different parts of the city. Collected samples were digested and the Fe, Mn, Cu, Zn, Ni and Pb concentrations were analyzed using an atomic absorption spectrophotometer. Enrichment Factor analysis (EF), correlation coefficient, and multivariate statistical methods of principal component analysis (PCA) and cluster analysis (CA) were then employed to trace heavy metals in the dust. The mean concentration among all the heavy metals was ranked as Fe> Zn> Mn> Cu> Pb> Ni. There were statistically significant differences among different sampling periods for Fe, Mn, Pb and Ni concentration, and no significant difference for Zn and Cu, suggesting that Cu and Zn were influenced by a specified source, while others may origin from various sources. Very high EF of Zn and Cu showed that anthropogenic sources contribute a substantial amount of heavy metals to dust. Less enriched Mn (EF< 1) is mainly derived from the Earth's crust. EF for Fe, Ni and Pb is slightly more than unit, showing that natural source and local polluted soils might be the main origins of these metals in dust. PCA results showed 2 principal components. Factor 1 has a significant loading for Fe, Mn, Ni and Pb and factor 2 has significant loading for Cu and Zn, representing the contribution of each factor from a similar source. In an agreement with the PCA and Spearman's correlation coefficient results, cluster analysis showed very strong clusters for Zn and Cu and also for Fe, Mn, Pb and Ni. Zn seems to originate from vehicular emissions, residual oil combustion and wear and tear of vehicle tires. Whereas, Cu seems to originate from industrial processes, traffic, combustion of fossil fuels, and waste incineration. Polluted soils in Isfahan city as a natural local source, is the main source of Fe, Mn, Ni and Pb in dust. Although EF results indicate that anthropogenic sources lead to dust enrichment in most heavy metals, so anthropogenic activities could be considered as a second origin for these elements.

RELATIONSHIP BETWEEN DUST DEPOSITION RATE AND CLIMATIC VARIABLES IN ISFAHAN CITY, CENTRAL IRAN

Samira Norouzi*, Hossein Khademi, Farid Jafarpisheh

Isfahan University of Technology, Isfahan, 84156-83111, Iran.
**samiranorouzi@yahoo.com*

Dust deposition rate (DDR) is a complex response to the interaction of climatic parameters. Isfahan city is known as Iran's third largest and crowded and second industrial city located in central Iran. It is characterized by a dry climate with hot summers. There are Zagros mountains in the west and south part of the city and the large desert area exists in eastern and northern part of Isfahan causing frequent exposure to dust events during the year. In order to forecast dust emissions for management decisions and mitigate its destructive effects on human health, economy, ecosystem and environment, it is important to understand the climatic conditions that influence dust emission. The objectives of this study were to identify the temporal variation of DDR and also to understand the relations between climatic parameters with DDR in Isfahan.

Dust samples were collected monthly for 12 months from 19 June 2012 to 19 May 2013 from 21 sites in different parts of the city, using a dry flat glass surface with an area of 1 m^2, located on the roof of one floor buildings. Monthly climate data of Isfahan meteorological were also studied. Statistical analyses were performed to investigate the relationships between DDR and climatic variables using SPSS 16.

The results indicate that monthly DDR fluctuates strongly. The highest mean DDR was obtained for June, July, Aug., Sep. and Oct. (7.86, 8.05, 5.63, 6.6, 6.30 $g/m^2/month$, respectively) and the lowest amount for Nov., Dec., Jan., Feb., Mar., Apr. and May (4.6, 2.13, 4.4, 4.76, 3.9, 3.95 and 4.34 $g/m^2/month$, respectively). Statistical analysis showed that the DDR was positively correlated with max and min temperature values in 12 months and inversely correlated with precipitation and relative humidity. Two prevalent wind directions were observed during sampling periods, northern and northeastern for June to Oct. and western and southwestern for Nov. to May. Results showed that DDR is not related to the maximum and average wind speed for all the studied months, whereas, in dry months with low relative humidity (June to Oct.), statistically significant correlation was observed between wind speed and DDR.

It can be concluded that during June to Oct. with high temperature and low precipitation and relative humidity with northern and northeastern wind directions, dust particles might be originated from desert areas located in east of Isfahan city and DDR increases with increase in wind speed. In other months with western and southwestern prevailing wind direction, DDR decreases with the change in wind direction. In general, deserts in eastern and northern part of the city are the most likely source of dust deposited in Isfahan city.

IMPACTS OF SAHARAN DUST ON PHOTOSYNTHETICALLY ACTIVE RADIATION AND OPTICAL WATER PROPERTIES

Thomas Ohde*, Herbert Siegel

Leibniz Institute for Baltic Sea Research, Warnemünde,D-18119,Germany
**thomas.ohde@io-warnemuende.de*

Atmospheric dust modifies the energy flux in the oceans and influences the spectral distribution of the incident solar radiation and the photosynthetic available part. The incident solar radiation above the water surface can be attenuated up to 22 % (di Sarra et al., 2002, Otto et al., 2009). Reduction of photosynthetically active radiation by atmospheric dust between 4.0 % and 12.3 % were observed by Ohde and Siegel (2012). Deposited dust in the water column changes the absorption and backscattering properties of the water body and alters by that the downward radiation in the water column (Stramski et al., 2004). All these effects influence the phytoplankton development with impact for their primary productivity, biomass and biodiversity (Claustre et al. 2002; Wozniak and Stramski, 2004; Stramska et al., 2008).
The objective of the investigation was the quantification of dust impact on photosynthetically available radiation and on optical water properties on the basis of in-situ measurements, laboratory experiments and model simulations. Statistics of Saharan dust storms were derived with measurements of aerosol optical depth of satellite sensor MODIS (Moderate-resolution Imaging Spectroradiometer). They were used to determine the influence of atmospheric dust on photosynthetically active radiation in the region of Northwest Africa. Laboratory experiments with real dust samples were performed to investigate the impact of deposited dust on the mass specific absorption coefficient in comparison to results of other authors. Model simulations were carried out to study the influence of dust on light climate.

di Sarra A., Cacciani M., Chamard P., Cornwall C., DeLuisi J.J., Di Iorio T., Disterhoft P., Fiocco G., Fuá D., Monteleone, F. (2002). Effects of desert dust and ozone on the ultraviolet irradiance at the Mediterranean island of Lampedusa during PAUR II, J. Geophys. Res., 107(D18), 8135.

Claustre H., Morel A., Hooker S. B., Babin M., Antoine D., Oubelkheir K., Bricaud A., Leblanc K., Quéguiner B., Maritorena S. (2002). Is desert dust making oligotrophic waters greener? Geophys. Res. Lett., 29(10), 1469.

Ohde T., Siegel H. (2012). Impacts of Saharan dust and clouds on photosynthetically available radiation in the area off Northwest Africa, Tellus B, 64, 17160.

Otto S., Bierwirth E., Weinzierl B., Kandler K., Esselborn M., Tesche M., Schladitz A., Wendisch M., Trautmann T. (2009). Solar radiative effects of a Saharan dust plume observed during SAMUM assuming spheroidal model particles. Tellus, B61, 270.

Stramska M., Stramski D., Cichocka M., Cieplak A., Wozniak S. B. (2008). Effects of atmospheric particles from Southern California on the optical properties of seawater. J. Geophys. Res., 113, C08037.

Wozniak S.B., Stramski D. (2004). Modeling the optical properties of mineral particles suspended in seawater and their influence on ocean reflectance and chlorophyll estimation from remote sensing algorithms. Applied Optics, 43(17), 3489.

LACUSTRINE SEDIMENTARY EVIDENCE OF EOLIAN DUST DEPOSITION IN THE UINTA MOUNTAINS, UTAH, USA

Samuel O'Keefe*, Jeffrey Munroe

Geology Department, Middlebury College, Middlebury, VT 05753, USA
**sokeefe@midddlebury.edu)*

A growing body of work is illuminating the influence of atmospheric dust in the geoecological functioning of mountain environments. In the Rocky Mountains of the western U.S. it is now broadly recognized that dust deposition impacts surface water chemistry and hydrology, snow albedo, soil formation, and plant communities. Study of atmospheric dust deposition also reveals how human activity in semi-arid regions adjacent to the mountains directly affects seemingly isolated alpine ecosystems. However, complete understanding of the varied impacts of dust deposition in alpine settings requires knowledge of how the dust system has functioned over time. To develop this knowledge base for the Uinta Mountains (Utah, USA) we studied sediment cores retrieved from high-elevation lakes. Lakes act as catchment basins for windblown sediments, which collect on the water surface, or wash in, before settling to the bottom. We collected short (<50 cm) cores from 7 lakes selected for their proximity to samplers deployed in 2011 to collect modern dust. Each core was sampled at the top (0-3 cm), middle (~15 cm), and bottom (~30 cm). Although the cores were not dated, ^{210}Pb profiles for other Uinta lakes suggest that the bottom sample from each core predates anthropogenic impacts in these watersheds. Loss-on-ignition analysis reveals a pronounced decrease in organic matter content beneath the top sample in each core. In most lakes the surface sample was the coarsest with mean grain sizes ranging from 10-40 μm. X-ray diffraction demonstrates that the mineralogical composition of this sediment has been generally consistent over the time period represented by the cores. Plagioclase is present in all lake sediment samples, as well as in the modern dust samples, despite the absence of this mineral in Uinta bedrock, indicating eolian inputs over time. On the other hand, amphibole, which is also present in modern dust, was not detected in lake sediments. This result could indicate that amphibole deposition is a relatively recent development that has not yet reached the detection limit in lake sediments where dust signals are diluted by organic matter and pedogenic clays eroded from the watershed.

THE POLLEN AS A BIOLOGICAL POLLUTANT? (CYPRESS, BIRCH AND RAGWEED)

Gilles Oliver, Michel Thibaudon

RNSA, Brussieu, 69690, Brussieu
rnsa@rnsa.fr

If chemical particles that cause air pollution are subject to measures limiting their sources, it cannot be the case of biological particles such as pollens and moulds from vegetation. These pollens with for some of them high allergy potency, are in very large quantities and they have a real health impact (rhinitis, conjunctivitis, asthma…). But could they be considered as pollutants?

In quantitative and qualitative terms, most of the pollens and moulds inhaled by the population come from natural plant species. But, downtown, in public park and garden, the air content in pollens is modified by surrounding plant species, planted by man. So can we consider that they are biological pollutant?

For some species like grasses, oak and ash for instance, they come from natural species, and it is not possible to control sources. So we cannot consider them as pollutant. On the other hand, some species are planted by man like birch (planted in public parks), or like cypress (Cupressaceae Sempervirens for instance) to make hedges in Mediterranean area. Ragweed is another kind of species for which human is directly concerned by the transport of the seeds and needs a real strategy of management to limit its proliferation.

To measure the air biological particles exposure in France, a pollen trap network, located so as to cover a wide back-ground (urban areas, on the roof of buildings), representative of the air that people breathe, has been established by the RNSA. These traps are distributed throughout the French territory. The traps, Hirst type, are inhaling weather vanes allowing the continuous impaction of pollen grains. The pollen grains are fixed on a coated transparent strip. Then, this sample is prepared on a slide with a stain. The readings and analysis are carried out by optical microscopy to record data with a bi-hourly time step. The reading and counting are controlled by computer programs.

Allergenic pollens cause to around 20% of the population troubles known as "hay fever" or "pollinosis". To measure the health impact, the RNSA (French Network of Aerobiology) use a network of sentinel clinicians who provide weekly data including information on the intensity of symptoms they noticed during consultations for the current week. From this information is calculated a clinical index (Thibaudon and al. 2008).

Thibaudon M., Oliver G., Cheynel A., L'index clinique: outil d'évaluation de l'impact sanitaire du pollen, Environ Risques Santé, vol. 7, 2008, n° 6, pp. 411-416.

THE CONCENTRATION OF PM10 IN A RURAL AREA DURING EPISODES OF TROPOSPHERIC INVERSION OCCURRING IN THE COOL MONTHS

Tomasz Olszowski*

Opole University of Technology, Opole, 45-271, Poland
t.olszowski@po.opole.pl

The article presents the results of research on the concentration of particulate matter (PM10) in a compact settlement village. The main attention is focused on the cold periods of the year, during the occurrence of tropospheric inversion, strengthened by an anticyclone. This was led by four further cold season (December-February) experiments, which included observations of air quality within the two separate zones of the village Kotorz Maly (Poland). The first zone (S1) is characterised by rural buildings, which predominantly use obsolete individual heating systems (fuel - coal, 91% share). The second is a modern building zone (S2), where the production of heat energy mainly uses gaseous fuel (73%) and electricity (18%). In the research, the reference gravimetric method with dust meters PNS3D15 was used. To assess the meteorological conditions, portable weather stations were used. To determine the occurrence, duration and range of temperature inversion, weather balloons and temperature detectors were used.

It was found that the character of (degree of emission) sources plays a key role in local air quality (average concentration of PM10 in the area S1 was three times higher than in S2). The hypothesis was that cyclic-daily activity of emission sources under the conditions of temperature inversion leads to a progressive enrichment of the air by particulates. The permanent presence of a temperature inversion and stable state of the atmosphere causes the inhibition of pollution propagation processes and causes significant, local changes, exceeding the permissible daily PM10 concentrations. Enhanced by an anticyclone, the three-day period of temperature inversion occurrence caused a situation in which local air emission levels did not meet the standards required for the protection of human health. Simultaneously, this study proved the appearance of the unstable state of the atmosphere and the horizontal movement of air masses > 2.5 m/s, resulting in a noticeable improvement of the aerosanitary conditions in one day. It was found that in the cold seasons, the average concentration of PM10 in the area of rural compact settlement is 6-times greater than during the summer months. The results can be analysed in the supra-local dimension and find confirmation for areas with similar characteristics of emission and climatic-meteorological conditions. For the considered terms and the period of observation, conducting meteorological measurements can be considered sufficient operation allowing estimation of the occurrence of alarming conditions. At a local level, the results of the experiment show that it is necessary to replace old heating systems with new ones that do not generate significant amounts of dust.

THE EFFICENCY OF PM10 SCAVENGING FROM TROPOSPHERE AS A FUNCTION OF TYPE AND DURATION OF WET DEPOSITION

Tomasz Olszowski

Opole University of Technology, Opole, 45-271, Poland
t.olszowski@po.opole.pl

The article presents the results of experiments concerning tropospheric PM10 scavenging in the wet deposition processes. Only the influence of large-scale rainfall was tested. The results presented show the effectiveness of PM10 scavenging under no-wind conditions. The changes in PM10 concentrations before, during and after presence of rainfall were studied in the period from 2006 to 2013. The study was conducted in an area remote from anthropogenic sources of emission. To determine the meteorological conditions, a DAVIS weather station was used. A concentration of PM10 was calculated using the reference gravimetric method (dust monitor PNS HVS 16). One hundred and nine measurement series were carried out. PM10 concentration was measured at 0.5 h intervals. Measured rainfall intensity ranged from 0.2 to 24 mm/h.
The degree of self-purification of the atmosphere from the particulate matter is affected by the duration and intensity of the rainfall. For near-to-ground troposphere PM10 scavenging coefficient (L) does not assume different values, for rainfall with the same intensity. The calculated scavenging coefficient Λ (ranged from 9.95E-05 for drizzle to 1.55E-04 for heavy rain) was compared against the results obtained using a mathematical model. It has been shown that the scavenging coefficient calculated on the basis of the theoretical model provides a value that is larger by an order of magnitude than the coefficient determined using experimental testing. Comparative analysis showed that the efficiency of removal of PM from the air (DS) was about 15-17% higher for heavy (>4 mm/h) than light (<0.5 mm/h) rain. The results show that the growth rate of PM10 concentration after rainfall episodes is twice as high in the case of light rain. A linear relationship has been found between the intensity of rainfall and the value for PM10 concentration. Therefore, in the case of large-scale precipitation, it can be concluded that the rain intensity allows easy estimation of the self-purification of the tropospheric air particulates.

DUST ENTRAINED FROM EPHEMERAL LAKES IN THE WESTERN MEDITERRANEAN

Jose A. G. Orza*, M. Cabello, E. Domenech

SCOLAb and Aeolian Research Group, Universidad Miguel Hernández, Elche, E-03202, Spain
**ja.garcia@umh.es*

We have studied the role of dry lakebeds as sources for aeolian export of soil particulates, in relation to their inundation extent, soil and meteorological conditions. Two areas in the western Mediterranean were investigated for the period 2005-2012: (1) El Hondo Nature Park in southeastern Spain (2400 ha), and (2) the region of the Chotts in southern Tunisia, including el-Djerid and el-Gharsa (vast saline lakes of 495000 and 42000 ha, respectively).

Field campaigns conducted at El Hondo during the period 2009-2012 measured size distribution of suspended particles, PM10 concentration and chemical composition; saltation profiles, composition and granulometry; and meteorological and soil parameters. The Chotts area was studied by making use of the `present weather´ observations of local dust reported at Tozeur, as well as from meteorological and visibility data in the area. Variations in water sheet and salt crusted surface in bothe areas were estimated from the 7-2-1 spectral bands of MODIS. In addition, MODIS AOT data was used.

Surface changes were driven primarily by the precipitation regime. In El Hondo, conditions may change dramatically due to additional anthropic intervention, as inflow and outflow are ultimately managed by humans.

The majority of the dust storms registered at El Hondo were associated to the passage of Atlantic frontal systems with no rainfall. W/NW/SW winds > 9 m/s (at 2 m above the ground) and average friction velocity of 0.46 m/s triggered these erosion events. Soil emissions from El Hondo had an impact on coastal touristic villages and some of the dust plumes could be observed in MODIS images.

Dust locally originated in Tozeur was associated (80% of the cases) to horizontal visibility < 5 km, relative humidity < 75% and windspeed ≥ 8 m/s (at 10 m above the ground), mostly of E component (55%) and then W (28%). Events were primarily of synoptic origin, registered from March to May. The larger inundation extent in the Chotts in spring 2009 resulted in a decreased the frequency of erosion events with respect to other years.

However dust events occurred also with moderately large dried areas located upwind of the measurement sites. Local dust was mostly registered in the afternoon.

We acknowledge support from the Spanish Government (EroHondo, CGL2008-05160).

WATER SOLUBLE FRACTION OF ASIAN DUST PARTICLES

Kazuo Osada

Graduate School of Environmental Studies, Nagoya University, Nagoya, 464-8601, Japan
kosada@nagoya-u.jp

The volume fraction (ε) of water soluble material in atmospheric aerosol particles is an important parameter related to their hygroscopicity and activation processes to form cloud and ice particles. To estimate ε of coarse dust particles, confocal scanning laser microscope was applied to measure the volume difference of individual particles before and after water dialysis directly. Individual particles (sphere equivalent diameter approx. 1-8 μm) of Asian reference dusts (CJ1 and CJ2) and atmospheric coarse particles during four Asian dust events were analyzed to ascertain ε. Median values of ε for CJ1 and CJ2were, respectively, 29% and 13% with no size trend. Median values of ε for coarse aerosol particles during four dust events were 18-42%. Some samples showed a slightly increasing trend of ε with dust size. The lower ε values of the atmospheric dust samples are close to those of Asian reference dusts but they differ for size trend. Median values of ε for some dust event samples were higher than those of source regions, implying that water soluble salts were added and internally mixed with dust particles during transport in the atmosphere. Dust particles with high ε are potentially important for acting as giant CCN. Therefore, the aging of dust particles during transport might enhance the number of giant CCN over the North Pacific area.

WET AND DRY DEPOSITION OF MINERAL DUST PARTICLES IN JAPAN: FACTORS RELATED TO TEMPORAL VARIATION AND SPATIAL DISTRIBUTION

Kazuo Osada[1]*, Sachiho Ura[1], Masako Kagawa[1], Masao Mikami[2], Yasumichi Tanaka[2], Sumito Matoba[3], Kazuma Aoki[4], Masato Shinoda[5], Yasunori Kurosaki[5], Masahiko Hayashi[6], Atsushi Shimizu[7], Mitsuo Uematsu[8]

[1]*Graduate School of Environmental Studies, Nagoya University, Nagoya, 464-8601, Japan*
[2]*Meteorological Research Institute, Tsukuba, 305-0052, Japan*
[3]*ILT, Hokkaido University, Sapporo, 060-0819, Japan*
[4]*Department of Earth Sciences, Toyama University, Toyama, 930-0887, Japan*
[5]*ALRC, Tottori University, Tottori, 680-0001, Japan*
[6]*Department of Earth System Sciences, Fukuoka University, Fukuoka, 814-0180, Japan*
[7]*National Institute for Environmental Studies, Tsukuba, 305-0053, Japan*
[8]*AORI, The University of Tokyo, Kashiwa, 277-8564, Japan*
**kosada@nagoya-u.jp*

Weekly deposition samples were obtained at Sapporo, Toyama, Nagoya, Tottori, Fukuoka, and Cape Hedo (Okinawa) in Japan during October 2008 - December 2010 using automatic wet and dry separating samplers. Mineral dust weights in water-insoluble residue were estimated from Fe contents measured using an X-ray fluorescence analyzer. Wet and dry deposition fluxes of mineral dusts were both high in spring and low in summer, showing similar seasonal variations to frequency of aeolian dust events (Kosa) in Japan. Higher wet deposition fluxes were observed at Toyama and Tottori, where frequent precipitation (>60% days per month) was observed during dusty seasons. The average ratio of wet and dry deposition fluxes was the highest at Toyama (3.3) and the lowest at Hedo (0.82), showing a larger contribution of the dry process at western sites, probably because of the distance from desert source regions and because of the regional effectiveness of the wet process in the dusty season.

Size distributions of refractory dust particles were obtained using four-stage filtration: > 20, >10, >5, and >1 μm diameter. Weight fractions of the sum of >20 μm and 10−20 μm (giant fraction) were higher than 50% for most of the event samples. Irrespective of the deposition type, the giant dust fractions generally decreased with increasing distance from the source area, suggesting the selective depletion of larger giant particles during atmospheric transport. Based on temporal variations of PMc ($2.5 < D < 10$ μm), ground-based lidar, backward air trajectories, and vertical profiles of potential temperatures, transport processes of dust particles are discussed for events with high-deposition and low-deposition flux with high PMc. Transport through a thicker (>2 km) dust layer with weak vertical gradient of potential temperature carry more giant dust particles to Japan. Because giant dust particles are an important mass fraction of dust accumulation, the transport height and fraction of giant dust particles are important factors for studying dust budgets in the atmosphere and their role in biogeochemical cycles.

ASSESSMENT OF ATMOSPHERIC AEROSOLS EFFECTS ON HUMAN HEALTH NEAR OIL FIELDS IN TOMSK REGION

Nina Osipova*, Anna Talovskaya, Ekaterina Filimonenko

Tomsk Polytechnic University,Tomsk,634050, Russia
**osipova@tpu.ru*

According to the Department of natural resources and environmental protection the highest atmospheric air pollution in Tomsk region is observed in areas where enterprises of the oil and gas industry are located (Alexandrovsky, Kargasoksky, Parabelski districts). In the framework of the mandatory monitoring the contents of main pollutants are checked, notably, sulfur oxides, nitrogen oxides, soot, hydrocarbons, etc. [1]. But regular monitoring the emission of heavy metals which are geochemically active element pollutants is not carried out. In order to estimate health risks for residents of oil industry location areas due to aerosols inhalation, the sampling were performed in 7 sites of Parabel district and in 5 sites of Kargasok. Totally 84 samples of snow were tested. Snow solid residues were studied by instrumental neutron activation analysis (INAA) applied to 28 chemical elements. The geochemical series of chemical elements associations drawn up for snow solid residue samples picked up in Kargasok and Parabel districts indicated the group of main pollutants. In Kargasok the concentration factor of As and U amounted to a value over 10, the factor of Yb, La, Tb, Ta, Na, Sm ranged 5 to 10. In Parabel district the factor of As exceeded 10, the factor of Yb, U, Tb, La, Na, Sm, Ta was within the range 5 to 10. The total contamination factor (TCF) showing the impact of the elements group was calculated. In the settlements of Kargasok and Parabel districts the TCF value corresponds to the average level of the air pollution and to the moderately dangerous sickness rate level of the population living in the areas. Arsenic makes a significant contribution to the TCF value. The cancer risk caused by inhalation exposure was estimated for arsenic, chromium and cobalt using EPA method [2]. The numerical values of individual carcinogenic risks introduced by some elements were $2.7\cdot10^{-5}$ (Cr) $>1.1\cdot10^{-6}$ (As) $>8.6\cdot10^{-7}$ (Co) for Kargasok and $1.8\cdot10^{-5}$ (Cr) $>1.1\cdot10^{-6}$ (As) $>$ $7.1\cdot10^{-7}$ (Co) for Parabel area. In accordance with the acceptable risk criteria, the risk level determined by inhalation exposure to Cr, Co, As on the territory of Kargasok and Parabel districts should be regarded as acceptable but it requires constant monitoring.

Ivanova E.V., Bykova V.V., Osipova N.A. (2006). Assessment of human health risk caused by chemical pollutants of the atmosphere. Atmospheric and Oceanic Optics. Vol.19. - No.11. - P.867-869

U.S.Environmental Protection Agency. (1998). Guidelines for ecological assessment. EPA/630/R-95/002F. Washington, DC.

SORPTION PROPERTIES AND PHOTOCATALYTIC REACTIVITY OF STANDARD AND NATURAL DUSTS WITH MODEL VOC

Habib Ourrad, Frederic Thevenet*, Veronique Riffault

Université Lille Nord-de-Franc, F-59000 Lille, France
Mines Douai, Dpt Sciences de l'Atmosphère Génie de l'Environnement, SAGE, F 59508 Douai, France
**frederic.thevenet@mines-douai.fr*

Heterogeneous chemical processes, especially those involving sorption, catalytic or photoactivated catalytic reactions, at the surface of mineral dust particles may have the potential to impact the chemical composition of the atmosphere. Indeed, the amounts of mineral dusts transported in the atmosphere as well as their chemical composition make them potential sorption and reaction platforms for atmospheric volatile organic compounds (VOC). However, these processes have yet to be investigated through laboratory experiments.

The adsorption and the photocatalytic reactivity of two models VOC, namely toluene and limonene, have been investigated using Diffuse Reflectance Infrared Fourier Transform Spectroscopy (DRIFTS). This technique makes possible the semi-quantitative monitoring of VOC adsorbed on the dust surface as well as their fate under various reactive processes. Thus, the especially adapted DRIFTS cell is used as a sorption and a photocatalytic reactor.

First, the individual adsorption of each VOC has been characterized on the various dusts using the breakthrough method. Second, the photocatalytic activity has been evaluated through the irradiation of the VOC saturated dusts by UV leds characterized by a main emission band centred at 365 nm. The conversion of preliminarily adsorbed VOC has been followed by DRIFTS. Six different dusts have been used in this study. First, two standard dusts have been characterized and used as reference materials: Arizona Test Dust (ATD) and Gobi Test Dust (GTD). Then, the behaviour of four natural dusts sampled in different regions of the Saharan desert has been investigated.

Adsorption experiments evidenced that, irrespectively of their composition, mineral dusts are able to adsorb irreversibly toluene as well as limonene. As a consequence, mineral dust may be considered as sinks of atmospheric VOC and may lead to the long range transportation of atmospheric compounds. The adsorption capacity of the different dusts are discussed according to their morphological characteristics and compared. Depending on their chemical compositions, some dusts have shown photocatalytic properties. The monitoring of the model VOC oxidation on the photocatalytic dusts has been successfully conducted. This behaviour has been correlated to the presence of some specific metal oxides in the dust composition.

SAHARAN DUST: ANUNDER-STUDIEDBUT SIGNIFICANT SOURCE OF AIR POLLUTION IN WEST AFRICA

Pierre Ozer[1]*, Florence De Longueville[2]

[1]Department of Environmental Sciences and Management, University of Liege, 6700 Arlon, Belgium
[2]CEDEM, University of Liege, 4000Liege, Belgium
*pozer@ulg.ac.be

Recently, the World Health Organization's International Association for Research on Cancer (IARC) classified outdoor air pollution as carcinogenic to humans and now puts air pollution in the same category as tobacco smoke, UV radiation and plutonium. Exposure to ambient fine particles was recently estimated to have contributed 3.2 million premature deaths worldwide in 2010 (Straif et al., 2013). The ambient air across the globe is polluted by emissions from motor vehicles, industrial processes, power generation, household combustion of solid fuel, and other sources. Dust storms lead to particulate levels (PM_{10} concentrations) that exceed internationally recommended levels especially in West Africa (Ozer, 2005; Ozer et al., 2007) but this source of air pollution is under-studied, particularly in the literature devoted to human health impacts (de Longueville et al., 2013). This can be explained by the scarcity of information about air quality relating to the African continent (WHO, 2012). However, the use of proxy data allows us to draw an alarming situation for populations living in West African cities. This study aimed to estimate the impacts of Saharan dust storms on air quality and the potential effects on the human health in Niamey. Moreover, the analysis of a temporal serie (1947-2006) allowed to follow the PM_{10} concentration evolution during a long time period. PM_{10} concentrations were estimated from horizontal visibility data recorded in Niamey based on the relation established by d'Almeida (1986). During the dry season (from November to March), the mean seasonal PM_{10}concentration is higher than 100 $\mu g{\cdot}m^{-3}$ on the whole period (1947-2006) with an important interannual variability (mean seasonal PM_{10} concentrations of 13.3 $\mu g.m^{-3}$ in 1952 and 342.7 $\mu g.m^{-3}$ in 1984) and a break point in the early 1980s. Based on the Air Quality Index (AQI)developed by USEPA as a tool to provide timely and easy-to-understand information on local air quality and whether it poses a health concern (USEPA 2006), results showed that, in the recent years (2002-2006), mineral dust accounts for 68annual daily exceedances of the 50 $\mu g.m^{-3}$$PM_{10}$ limit value, indicating a likelihood of health impacts. Between 1947 and the mid-80s, a significant increase of the number of hazardous days (PM_{10}concentrations >420$\mu g.m^{-3}$) and in the same time a significant decrease of the number of safe days (PM_{10}concentrations < 50$\mu g.m^{-3}$) were observed. Since 2000, strong health impacts can affect population 1 day on 3during dry season (PM_{10}concentrations >150 $\mu g{\cdot}m^{-3}$). In the light of the disproportionate levels of PM_{10} concentration recorded in city near the Sahara and the significant health impacts demonstrated in other parts of the world (de Longueville et al., 2013), new research is urgently needed to quantify the contribution of this source of pollution on mortality and morbidity of West African populations.

CHEMICAL CHARACTERIZATION OF PM_{10} SAMPLES COLLECTED AT TWO DIFFERENT SITES IN BOLU, TURKEY

Fatma Öztürk*, Melek Keleş

Abant Izzet Baysal University (AIBU), Faculty of Engineering and Architecture, Environmental Engineering Department, Bolu, 14280 ,Turkey
**oztfatma@gmail.com*

Daily PM_{10} samples were collected at a semi-urban site (AIBU campus) during April 2013 and day and night samples were collected at an urban site (city center) during May and October 2013. Sample collection scheme allow us to compare the sites, seasons and diurnal variation of PM_{10} components. The collected samples were analysed in terms of EC, OC, WSOC and major ions (Ca^{2+}, Mg^{2+}, K^{+}, NH_4^{+}, Na^{+}, SO_4^{2-}, NO_3^{-}, Cl^{-}, and PO_4^{3-}). Meteorological parameters, SO_2 and TSP were also determined with the con-current measurements at the rural site. A filter holder with two (front and back) pre-fired quartz fibre filters in series was employed to collect PM_{10} samples. Sampler was mounted on the roof, which is 14 m height in the semi-urban site while it was situated 1.6 m above the ground level at the rural site. The average mass concentration of PM_{10} was 29µg m^{-3}at the AIBU campus while it was measured as 80 and 85 µg m^{-3}in May and October, respectively, at the city center. EC and OC contents of the collected samples were determined with the Sunset Lab. EC/OC analyser. The average EC and OC concentrations were found as 1.53±0.65 and 8.81±3.11 µg m^{-3} at the AIBU campus, respectively.There is no significant difference in average EC-OC concentrations of day and night time data at city center during May. On the other hand, values obtained during night were almost doubled the day time values during October. The corresponding average values for EC and OC during night were 3.89±2.38 and 23.0±17.0 µg m^{-3}, respectively. The elevated concentrations of EC and OC during night time data in October can be attributed to lower mixing height at the city center. The comparison with the data available for Istanbul, which may not be the right place for comparison since it is the second most populated mega-city in Eastern Mediterranean after Cairo but we have only EC-OC data for this city, showed that slightly higher OC concentrations were observed in Bolu during May as compared to Istanbul while the night time OC values during October were higher (by a factor of 3) than the OC concentration observed in Istanbul (Theodosi et al., 2010). Saharan dust episodes were also detected during the study. The carbonate peak obtained in the EC-OC analysis of samples was coupled with the satellite data, which confirmed Saharan dust transport from North Africa. An advanced factor analysis technique, namely Positive Matrix Factorization (PMF) will also be applied to the generated data set in order to find the sources affecting the chemical composition of PM_{10} samples.

Theodosi, C., Im, U., Bougiatioti, A., Zarmpas, P., Yenigun, O., Mihalopoulos, N., (2010). Aerosol chemical composition over Istanbul.Science of the Total Environment 408, 2482-2491.

SOURCES AND TRANSPORT OF DESERT DUST TO THE LEVANT DURING THE LAST GLACIAL-INTERGLACIAL CYCLE

Daniel Palchan[1,2]*, Mordechai Stein[2], Yigal Erel[1], Yehouda Enzel[1]

[1]*Institute of Earth Sciences, The Hebrew University, Jerusalem, 91904, Israel*
[2]*Geological Survey of Israel, Jerusalem, 95501, Israel*
**daniel.palchan@mail.huji.ac.il*

The Dead Sea is a terminal hypersaline lake receiving water and fine-grain sediments from a large drainage basin in the Levant that extends from the edge of the Sahara to the Mediterranean climate zones. The Dead Sea and its precursors, last glacial *Lake Lisan* and last interglacial *Lake Samra*, continuously accumulated desert dust that had settled in the watershed during the mid-late Pleistocene and Holocene periods (Haliva-Cohen et al., 2012). A sediment core retrieved from the lake's center and covering the last ~220 kais comprised of primary halite, aragonite and gypsums and allochtonous silts and clays. The fine particles are used for identifying sources and routes of transport of the dust during the last glacial-interglacial cycle.
We compared the high-stand *Lake Lisan* and low-stand *Lake Samra* sediments grain sizes and their chemical and Nd-Sr isotopic compositions. Grain size distributions >1 μm of *Lake Lisan* have modes of 8-10 μm, whereas *Lake Samra* samples present smaller modes of 3-4 μm. Similar grain size distribution was observed in the fine-grained sediments of the currently exposed late Quaternary deposits along the Dead Sea (Haliva-Cohen et al., 2012). The Fe and Al oxides concentrations divide the fine grained sediments in the core to three sub-groups probably reflecting degrees of weathering. Least weathered sediments are from glacial *Lake Lisan*, the moderately weathered sediments are from the last interglacial *Lake Samra*. The most weathered are those from post-glacial ~11ka. The isotopic compositions of the fine-grained particles present a narrow ranges of εNd, between -6.7 to -5.7 and -5.7 to -4.5 for the *Lisan* and Samra, respectively. Sr isotopic ratios extend from 0.7081 to 0.7095. The samples lie on the "regional dust array" between Nile and Saharan derived fine dust (Revel et al., 2010, Palchan et al., 2013). The data suggests that during the last glacial the Dead Sea watershed (e.g. the central Levant) received more of the Saharan dust in association with Mediterranean winter rains and strong winds (Enzel et al., 2010). Where during the last interglacial it received recycled loess by floods with increased Nile type isotopic signature reached the lake.

Enzel Y., Amit R., Crouvi O., Porat N. (2010) Abrasion- derived sediments under intensified winds at the latest Pleistocene leading edge of the advancing Sinai-Negev erg. Quaternary Research 74, 121-131.
Haliva- Cohen A., Stein M., Goldstein S.L., Sandler A., Starinsky A. (2012) Sources and transport routes of fine detritus material to the late Quaternary Dead Sea basin. Quaternary Science Reviews 49, 1-16.
Palchan D., Stein M., Almogi-Labin A., Erel Y., Goldstein S.L. (2013) Dust transport and synoptic conditions over the Sahara- Arabia deserts during the MIS6/5 and 2/1 transitions from grain size, chemical and isotopic properties of Red Sea cores. Earth Planetary Science Letters 217, 451-464.
Revel M., Ducassou E., Grousset F.E., Bernasconi S.M., Migeon S., Revillon S., Mascle J., Murat A., Zaragosi S., Bosch D. (2010) 100,000 Years of African monsoon variability recorded in sediments of the Nile margin. Quaternary Science Reviews 29, 1342-1362.

RADIATIVE FORCING OF ASIAN DUST AEROSOL ON FLOW PATTERN INDUCING A DOWNSTREAM WAVE TRAIN

ZAITAO PAN[1]*, HUI SUN[2], XIAODONG LIU[2]

[1]*Saint Louis University, St. Louis, MO, 63108, USA*
[2]*Institute of Earth Environment, Chinese Academy of Sciences, Xi'an, 710075, China*
**panz@slu.edu*

Asian dust transported by tropospheric winds thousands of kilometers downstream contributes half of global aerosol loading. Aside from being the culprit for the devastating dust storms increasingly observed in recent years over many parts of China, it also affects, through direct radiation, thermal and flow fields downstream. The dust emission, deposition, and (to a certain degree) low-level transportation, are not well understood, partly because the coarse-resolution global atmospheric models cannot resolve these subscale processes sufficiently. In this study, we use the latest version (4) of regional climate model (RegCM4) coupled with a dust module developed at the International Center for Theoretical Physics (ICTP, Italy) to simulate the spatial-temporal distribution of dust aerosol and its climatic impact through direct radiative forcing over East Asia.

RegCM4 experiments with and without dust emitted from Taklimakan desert, western Inner Mongolia, and northern Xinjiang showed that surface shortwave (SW) irradiance reduction caused by the aerosol loading reaches 20 Wm^{-2} in spring over East Asia, cooling surface by 0.8°C during spring and portion of summer. SW irradiance at the top of the atmosphere (TOA) is also reduced by up to 8 Wm^{-2} in North China when the dust module is activated. Dust aerosol induced cooling also leads to the formation of a cyclonic circulation in the lower troposphere in Northwest China that further excites, most likely through Rossby wave propagation, an anticyclonic circulation (in the Yellow River Loop) and a cyclonic circulation (in East China Sea, ECS). The northeasterly flow in southern China straddled by the anticyclone and cyclone acts to weaken the southwest monsoon in southeastern China and the surrounding sea. Supported by the dust-induced circulations, precipitation increases in cyclonic regions in Northwest China and ECS and decreases in the anticyclonic north-central China.

MIXING LAYER HEIGHT OSCILLATIONS, SAHARAN DUST OUTBREAKS AND DAILY MORTALITY

Marco Pandolfi[1]*, Aurelio Tobias[1], Andrés Alastuey[1], Jordi Sunyer[2], Joel Schwartz[3], Jeronimo Lorente[4], Jorge Pey[1,5], Xavier Querol[1]

[1]*Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, Spain*
[2]*Centre for Research in Environmental Epidemiology (CREAL), Barcelona, Spain*
[3]*Department of Environmental Health, Harvard School of Public Health, Boston, MA, USA*
[4]*Department of Astronomy and Meteorology, University of Barcelona (UB), Barcelona, Spain*
[5]*Aix-Marseille Université, CNRS, LCE FRE 3416, 13331 Marseille, France*
**marco.pandolfi@idaea.csic.es*

Epidemiological studies have demonstrated coherent associations between particulate matter (PM) and respiratory illness and the number of deaths from cardiovascular and respiratory diseases (WHO, 2013). Recently in the Mediterranean Basin attention has been given to the effect on health of atmospheric dust from North African desert due to the evidence of an increased associations with mortality of PM_{10} during Saharan dust outbreaks (NAF from now on) (i.e., Mallone et al., 2011; Pérez et al., 2012a). Recently, Pérez et al. (2012b) have shown that during NAF in Barcelona (Spain) the local PM_{10} mass, i.e. the mass that would be measured if there are no NAF episodes, is more toxic compared with both the African dust contribution to PM_{10} mass and the PM_{10} measured when no NAF episodes occur. The reasons for this increasing local PM toxicity during NAF days are unknown, although the condensation of secondary components from gaseous precursors onto the surface of dust particles has been proposed. In this study we identify the thinning of the mixing layer height (MLH) during NAF days as possible cause triggering the observed higher toxicity of ambient air. We show, using more than 2500 MLH (8 years) measured in Barcelona, that the MLH influences all-cause daily mortality more than PM. We found statistically significant associations of MLH with all cause daily mortality and observed that the oscillations of MLH determine the degree of toxicity of ambient air. Results show that as the MLH reduces the risk of mortality associated with the same concentration of PM increases due to a progressive accumulation of anthropogenic pollutants. Moreover, the association of MLH with all-cause daily mortality and the effect of MLH oscillations on particle toxicity are higher when NAF episodes occur. This evidence puts forward that other atmospheric components may have adverse health effects in urban environments and/or reflects the relevance of a synergic effect of atmospheric pollutants which is amplified during NAF.

WHO (2013). Review of evidence on health aspects of air pollution - REVIHAAP project: final technical report.

Mallone, S., Stafoggia, M., Faustini, A., Gobbi, G.P., Marconi, A., Forastiere, F. (2011), Saharan Dust and Association between Particulate Matter and Daily Mortality in Rome, Italy, Environ. Health, Perspect., 119, 1409-1414.

Perez, L., Tobías, A., Querol, X., Pey, J., Alastuey, A., Díaz, J., Sunyer, J. (2012a). Saharan dust, particulate matter and cause-specific mortality: A case-crossover study in Barcelona (Spain), Environment International, 48, 150-155.

Pérez, L., Tobías, A., Pey, J., Pérez, N., Alastuey, A., Sunyer, J., Querol, X. (2012b). Effects of Local and Saharan Particles on Cardiovascular Disease Mortality, Epidemiology, 23, 5, 768-769.

TOWARDS AN OFFLINE PARAMETERIZATION OF CONVECTIVE DUST STORMS

Florian Pantillon[1]*, Peter Knippertz[1], John Marsham[2], Alex Roberts[2], Stephanie Fiedler[1,2]

[1]*Karlsruhe Institute of Technology (KIT), Institute for Meteorology and Climate Research (IMK), 76128 Karlsruhe, Germany*
[2]*University of Leeds, Institute for Climate and Atmospheric Science (ICAS), School of Earth and Environment (SEE), Leeds, LS2 9JT, UK*
**florian.pantillon@kit.edu*

Around half of dust emissions worldwide originate from the Sahel and Sahara regions, of which a major but uncertain fraction are caused by convectively-generated dust storms (haboobs). In these storms, evaporation-driven downdrafts form cold pools that quickly propagate and create near-surface wind gusts. Current global models do not capture such storms, because their convection schemes do not allow effective formation of such cold pools. We suggest a parameterization of near-surface wind gusts and dust emissions generated by cold pools, based on the downdraft mass flux from the convection scheme. It assumes the horizontal dispersion of all downdrafts into cold pools and the unknown geometry of the cold pools results in one free parameter. The parameterization is applied to Unified Model (Cascade) runs for the 2006 Summer in West Africa. The free parameter is tuned for 40-km and 12-km runs with convection scheme, using 4-km convection-permitting runs as a reference (4-km runs have been evaluated using 1.5-km runs in previous studies). The parameterization successfully increases the near-surface wind beyond the threshold for dust emission and compensates for the lack of convectively-generated dust storms when the convection scheme is activated. The long-standing problem of too early activation of the convection scheme in the Sahel and Sahara regions remains an issue in the parameterization of the diurnal cycle of dust emissions.

This parameterization is developed in the framework of the ERC Desert Storms project.

EARLINET INTENSIVE OBSERVATION PERIOD DURING SUMMER 2012

N. Papagiannopoulos[1]*, G. D'Amico[1], A. Giunta[1], G. Pappalardo[1], L. Alados Arboledas[3], A. Amodeo[1], L. Belegante[4], M. Iarlori[5], D. Lange[2], R.E. Mamouri[6], M.A.P. McAuliffe[7], D. Nicolae[4], P. Kokkalis[8], J. Preissler[9], J. Putaud[10], J.L. Guerrero Rascado[3], V. Rizi[5], A.A. Ruth[7], M. Sicard[2], F. Wagner[9], L. Mona[1]

[1]*Consiglio Nazionale delle Ricerche - Istituto di Metodologie per l'Analisi Ambientale, Tito Scalo, Potenza, 85050, Italy*
[2]*RSLab-IEEC-CRAE, Universitat Politècnica de Catalunya, Barcelona, Spain*
[3]*Universidad de Granada, Granada,Spain*
[4]*National Institute of R&D for Optoelectronics, Magurele, Ilfov, Romania*
[5]*Università degli Studi dell'Aquila, CETEMPS/Dipartimento di Scienze Fisiche e Chimiche, L'Aquila, Italy*
[6]*Cyprus University of Technology, Department of Civil Engineering and Geomatics,Cyprus*
[7]*Physics Department & Environmental Research Institute, University College Cork, Cork, Ireland*
[8]*National Technical University of Athens, Department of Physics, Athens, Greece*
[9]*Universidade de Evora, Centrode Geofisica de Evora, Evora,Portugal*
[10]*EC Research Centre, Ispra, Italy*
**nikolaos.papagiannopoulos@imaa.cnr.it*

An ACTRIS measurement campaign was organized during summer 2012, 8 June - 17 July. ACTRIS and EMEP closely worked together to coordinate this field campaign which was mainly aimed at the study of Saharan dust particles. Besides, this intensive observation period (IOP) featured two international field campaigns during summer 2012 to optimize any possible cooperation. The ChArMEx (The Chemistry-Aerosol Mediterranean Experiment, https://charmex.lsce.ipsl.fr/) campaign was held in the period of from 8 June - 12 July and the PEGASOS (Pan-European Gas-AeroSOLs-climate interaction Study, http://pegasos.iceht.forth.gr/) campaign provided detailed measurements for the period from 8 June - 9 July.
The main objective of the EARLINET/ACTRIS campaign during summer 2012 was to investigate the 3-D distribution of European atmospheric aerosols in the context of Saharan dust intrusion events. The whole network participated in the campaign performing EARLINET regular measurements. Additional measurements were performed after alerts concerning the occurrence of special events over Europe. 10 selected ACTRIS lidar stations performed daily lidar-profiling measurements around sunset for the whole 8 June - 17 July 2012 period. The availability of EARLINET vertical profiles of the aerosol optical properties during the selected period strongly enhanced the collection of a unique, high quality data set on aerosol, as gathered by a set of sophisticated instruments across Europe. The description of aerosol type distribution over Europe during the campaign was obtained through a combined use of advanced lidar measurements, backward trajectory analyses and model outputs. In particular, two intense African dust outbreaks were noted and studied into details.

Acknowledgments - The financial support by the European Community through the ACTRIS Research Infrastructure Action under the 7th Framework Programme under ACTRIS Grant Agreement n° 262254 is gratefully acknowledged.

FIBROUS AND TUBULAR CLAY-BASED NANOCOMPOSITES FOR PHOTOCATALYSIS: POSSIBILITIES AND LIMITATIONS

Dimitrios Papoulis[1]*, Sridhar Komarneni[2], Dionysios Panagiotaras[3]

[1]*Geology Department, University of Patras,26 504 Patras Greece*
[2]*Materials Research Institute, 205 Materials Research Laboratory, The Pennsylvania State University, University Park, PA 16802, USA*
[3]*Mechanical Engineering Department, Technological Educational Institute (TEI) of Western Greece, 26334 Patras, Greece*
**Papoulis@upatras.gr*

In the last decades clay minerals and especially smectites have been thoroughly used for the synthesis of clay mineral based nanocomposites. These nanocomposites have been tested for their potential uses in many applications including photocatalysis of air and organic pollutants. In many recent studies fibrous as well as tubular clay mineral based nanocomposites have been proposed as very useful geomaterials for many uses including photocatalysis. Fibrous clay minerals and especially palygorskite (and sepiolite) and tubular clay minerals (halloysite) seems to be the most prominent clay minerals because they do not agglomerate easily due to their different crystal shape/ morphology compared with the other clay minerals. However, these fibrous or tubular minerals are very similar to some of the clay minerals such as smectites with respect to high surface areas, colloidal dimensions of their particles and other properties to a high degree. Recently three phase nanocomposites using two clay minerals, a fibrous and a tubular morphology, and anatase have been synthesized. These nanocomposites showed significantly increased photocatalytic activities in decomposing air and organic pollutants compared with two phase nanocomposites using one clay mineral. The aim of this presentation is to report the very recent developments in the use of fibrous and tubular clay minerals as cost-effective geomaterials for catalytic and photocatalytic activities and to touch upon future possibilities for these materials.

SYNTHESIS, CHARACTERIZATION AND PHOTOCATALYTIC ACTIVITIES OF FLY ASH-TiO_2 NANOCOMPOSITES IN MINERALIZATION OF AZO DYES IN WATER

Dimitrios Papoulis[1]*, Anastasia-Eleni (Eleana) Kordouli[2], Paraskeyi Lampropoulou[1], Andreas Rapsomanikis[3], Christos Kordulis[2], Dionisios Panagiotaras[4], Elias Stathatos[3], Sridhar Komarneni[5]

[1]*Geology Department, University of Patras,26 504 Patras Greece*
[2]*Chemistry Department, University of Patras, 26 504 Patras Greece*
[3]*Electrical Engineering Department, Technological Educational Institute (TEI) of Western Greece, 26334 Patras, Greece*
[4]*Mechanical Engineering Department, Technological Educational Institute (TEI) of Western Greece, 26334 Patras, Greece*
[5]*Materials Research Laboratory, Materials Research Institute, The Pennsylvania State University, University Park, PA 16802, USA*
**Papoulis@upatras.gr*

Approximately 15Mt/year of solid by-products (fly ash, bottom ash) are produced by the lignite combustion in West Macedonia and Peloponnesus in Greece and it's expected to be increased in the future because of the lower calorific value of available lignite. The utilization of these by-products, which are atmospheric dust components, is demanded to be increased in the future. A potential environmental application of these by-products would make them as a resource rather than a waste problem.

In order to use fly ash as a resource, we synthesized fly ash-TiO_2 nanocomposites in two different mass ratios (30%-70% and 20%-80% respectively). The nanocomposites were prepared using fly ash from Megalopoli (Peloponnese) by depositing anatase form of TiO_2 on the fly ash components using titanium isopropoxide as a precursor under hydrothermal treatment at 180^{o}C. Phase composition, particle morphology and physical properties of both nanocomposites were characterized by XRD, SEM, SEM-EDS and N_2-sorption/desorption isotherms. The photocatalytic activities of both nanocomposites in decomposing azo dyes in water were measured. Two different azo dyes, an acid (acid orange 10) and a basic (basic yellow 28), were used in order to compare the performance of the nanocomposites and determine the parameters affecting the decomposition of dyes.

The characterization of the nanocomposites showed that TiO_2 nonoparticles in the form of anatase is well dispersed on fly ash components. Additionally both nanocomposites proved to be more effective in the photocatalytic mineralization of acid orange 10 indicating that they are more promising for use in decomposing acid than basic azo dyes in water.

NEW INSIGHTS ON WIND-DUST RELATIONSHIP USING WIND TUNNEL AND FIELD OBSERVATIONS

Sagar Parajuli*, Zong-Liang Yang, Gary Kocurek

The University of Texas at Austin, Jackson School of Geosciences, 2225 Speedway, Stop C1160, Austin, 78731, US
**psagar@utexas.edu*

Various dust models have been developed to parameterize dust emission, most of which are based on the wind-dust relationship observed in the wind tunnels. Parameterizations for vertical dust mass flux used in these models can be broadly grouped into two categories: with saltation and without saltation. Saltation models first parameterize horizontally saltating mass flux proportional to a certain power of threshold friction speed. Many wind tunnel observations are consistent in showing that the saltating flux is proportional to the cubic power of friction speed for most soil types. After calculating the saltating mass flux, saltation models calculate the vertical mass flux using a sandblasting mass efficiency factor, which is a function of clay content. In non-saltation models, vertical dust mass flux is expressed directly in terms of power of surface wind speed without considering saltation. Unlike the saltation model, relationship between vertical dust mass flux and friction velocity observed in wind tunnel is less robust. The power of friction speed in vertical dust mass flux vs. friction velocity plotted for different soil types and field conditions varies from 2-5. In spite of the greater uncertainty, non-saltation models are still used in many dust models because of their simplicity.

In this work, we systematically analyze the factors contributing to the uncertainty in vertical dust mass flux estimation. We hypothesize that more accurate measurement of vertical dust mass flux in the wind tunnel can give improved wind-dust relationship. We measure the dust mass directly from the substrate bed to get location-independent measurements. Unlike traditional sampling techniques, such location-independent measurements are not sensitive to the height and distance of sampling and provide more accurate measurement of vertical dust mass flux. We expose the substrate bed (clay) to saltating grains in the wind tunnel and analyze the geometric properties of the scour formed on the substrate bed by creating a digital elevation model. We measure the vertical dust mass removed from the substrate bed in terms of the volume of scour formed in the substrate bed after numerous saltation events. We then relate the volume of dust mass to the wind speed and saltating mass flux. We also compare the resulting dust mass flux against mean dust concentration measured by a GRIMM spectrometer located downwind to partition the dust between saltation and direct entrainment. Because it is extremely difficult to reproduce the field geomorphic conditions of dust source region in the laboratory, the wind-dust relationship observed in the wind tunnel experiments needs to be evaluated against field observations in dust source regions. In order to make the wind-dust relationship applicable to unique geomorphic types found in dust source region, we finally constrain the wind tunnel based parameterization against wind-dust relationship observed near a range of geomorphic types using remote sensing and ground based observations.

SPATIAL DISTRIBUTIONS OF AEROSOL CONCENTRATIONS AND DEPOSITIONS IN ASIA DURING THE YEAR 2010

Soon-Ung Park

Center for Atmospheric and Environmental Modeling, Seoul, 152-775 Korea
supark@snu.ac.kr

Aerosol Modeling System (AMS) that is consisted of the Asian Dust Aerosol Model2 (ADAM2) and the Community Multi-scale Air Quality (CMAQ) modeling system has been employed to find the geographical distributions of both the annual averaged Asian dust aerosol and the anthropogenic aerosols concentrations and their total depositions in the Asian region for the year 2010. It is found that the annual mean surface (column integrated) aerosol concentrations in the Asian region affect in a wide region as a complex mixture of the Asian dust aerosol and the anthropogenic aerosols; more predominated by the Asian dust aerosol in the Asian dust source region of northern China and Mongolia with the annual mean (column integrated) PM10 concentration of more than 200 μg m-3 (350 g m-2), by the anthropogenic aerosols in the high pollutant emission regions of southern and eastern China and northern India with the annual mean surface (column integrated) concentration of more than 110 μg m-3 (140 mg m-2) in eastern China and by the mixed aerosols (Asian dust aerosol + anthropogenic aerosols) in the downwind regions of the Yellow Sea, the East China Sea, the Korean peninsula, the East Sea of Korea, Japan, and the Northwest Pacific Ocean. It is also found that the annual total deposition of aerosols in the Asian domain is 485.2 Tg (371.8 Tg of Asian dust aerosol and 113.4 Tg of anthropogenic aerosols), of which 66% (318.6 Tg) is found to be contributed by the dry deposition (305.3 Tg by Asian dust aerosol and 13.3 Tg by anthropogenic aerosols) and 34% (166.6 Tg) by the wet deposition (100.1 Tg by anthropogenic aerosols and 66.3 Tg by Asian dust aerosol), suggesting significant impacts of aerosols on environment and the terrestrial and marine eco-systems in Asia.

Keywords: Aerosol Modeling System (AMS), Aerosol deposition, Anthropogenic aerosol, Asian Dust Aerosol Model 2 (ADAM2), Column integrated concentration, Community Multi-scale Air Quality (CMAQ)

HYDROGEN REDUCTION CHARACTERISTICS OF FINE NICKEL OXIDE POWDERS IN FLUIDIZED BED REACTOR

YOUNG-OK PARK[1]*, YONG-HA KIM[2]

[1]Climate Change Technology Research Division, Korea Institute of Energy Research, Deajeon, Kore
[2]Chemical Engineering Department, Pukyung National University, Busan, Korea
*yopark@kier.re.kr

The increase in CO_2 level of the troposphere, mainly due to emissions from fossil combustion, is very likely the cause for the climate change observed over the past several decades, characterized by the rapid growth of global average temperature. Hence, to prevent global warming many countries signed the Kyoto protocol for decreasing their greenhouse gases (GHG) emissions. Among these GHG emissions, the steel industry is responsible for 19% of those of the industrial sector. In an effort to develop breakthrough technologies that enable drastic reduction in CO_2 emissions from steel industries (ULCOS Project), the reduction of iron ore by pure hydrogen in a direct reduction shaft furnace was investigated. To reduce the emission of GHG by the steel industry, particularly for steelmaking, the production of direct reduced iron using hydrogen as a reducing gas instead of carbon monoxide is being considered. The reduction of iron ores by hydrogen is a gas-solid reaction which occurs in two or three stages. For temperature higher than 570 °C, hematite (Fe_2O_3) is first transformed into magnetite (Fe_3O_4), them into wustite (FeO), and finally into metallic iron whereas at temperatures below 570 °C, magnetite is directly transformed into iron since wustite is not thermodynamically stable.

In this paper, the reduction of nickel oxide powders by hydrogen was studied at the laboratory scale fluidized bed rector, varying the experimental conditions and observing the rate and the course of the reaction. All the reduction experiments were performed in a thermobalance and supplementary characterization methods were used like scanning and transmission electron microscopy, and X-ray diffraction. The influence of rising temperature in the range 550-900 °C is to accelerate the reaction; no slowing down was observed, contrary to some literature conclusion. A series of experiments consisted in interrupting the runs before complete conversion, thus enabling the characterization of partially reduced samples. Interpretation confirms the occurrence of three successive and rather separate reduction steps, through nickel oxide to nickel metal, and illustrates a clear structural evolution of the samples. Finally, the influence of the sample type was revealed comparing a regular powder of hematite and magnetite, fine powder of nickel oxide. The fine powder of nickel oxide proved to be the most reactive despite its finer grain size, due to a more porous final structure. The fluidized bed reactor for hydrogen reduction was developed to enhance the reduction of iron ores and metal oxides

Keywords: hydrogen reduction**,** fluidized bed reactor, nickel oxide, iron ore, direct reduction iron, steelmaking.

IN SITU ISOTOPE ANALYSIS OF DUST PARTICLES AS A TRACER OF ORIGIN AND PROVENANCE USING HIGH SENSITIVITY LA-ICP-MS METHODS, WITH APPLICATIONS TO EARTH AND ENVIRONMENTAL SCIENCE

Randall R. Parrish

Dept of Geology, Univ. of Leicester and NIGL, British Geological Survey, Keyworth, Notts, NG12 5GG, UK
rrp@nigl.nerc.ac.uk

The use of laser ablation (LA) sampling coupled with high-sensitivity inductively-coupled plasma mass spectrometry (ICP-MS) is an exceptionally powerful tool for chemical and isotope analysis of materials. The LA-ICP-MS method has been applied to single mineral grains from sediments, rocks and dust as well as other materials, to determine their origin and provenance. The technology has evolved greatly over the past 10 years such that a wide range of minerals and materials can be analysed, using various isotope systems (Nd, Sr, U-Pb, Hf, Pb, U etc.) on grains as small as 5-10 microns in size. Analysis and use of such methods on single grains is tractable if the precision of the analysis is small relative to the potential variation of source. To accurately provenance dust or sediment requires the analysis of many samples and grains to characterise the variation, and to have good information of potential source ages and isotope characteristics. One of the most powerful approaches is using U-Pb in situ dating of grains of zircon and rutile within dust and other sedimentary deposits. Age uncertainty on single grains can be as small as 2% of the age, and Hf isotopes can also supplement the U-Pb data on single grains of zircon. The method of zircon dating of single dust grains has been applied to the Chinese Loess deposits with some success. These methods have been more widespread in analysis of river sediments and sedimentary rocks where rutile combined with zircon analysis offers a very powerful provenance discriminant. An example from the Himalaya will be given to illustrate the technology and application. In terms of environmental applications, uranium isotopes in single particles emitted from a metal processing plant in Albany, New York have been analysed to prove that dust originated from the plant, and that the source of the uranium can be forensically matched to batches of depleted uranium waste produced by nuclear processing in the US atomic energy programme, an approach only feasible because of the ability of the method to measure accurately the minor isotopes of uranium (^{235}U and ^{236}U). Together, these examples illustrate how powerful the method is if applied using the most appropriate mass spectrometry, minerals and isotope systems.

DISTRIBUTION OF CARBON AND POLYCYCLIC AROMATIC HYDROCARBON IN AMBIENT AIR OF CENTRAL INDIA

Khageshwar Singh Patel[1]*, Yogita Nayak[1], Harald Saathoff[2], Jutta Lintelmann[3], Georg Matuschek[3]

[1]*School of Studies in Chemistry, Pt. Ravishankar Shukla University, Raipur-492010, CG, India*
[2]*Institute for Meteorology and Climate Research (IMK), Atmospheric Aerosol ReYsearch Division (AAF), KIT, Karlsruhe, Germany*
[3]*Helmholtz Zentrum Muenchen, Neuherberg, Germany*
**patelks_55@hotmail.com*

Ambient aerosols are largely responsible for the visibility deterioration, health hazard and environmental damage. The major components of aerosols are black carbon (BC), organic compounds, inorganic elements, material of biologic origin, reactive gases, etc. The BC is the second largest contributor to climate change after CO_2 and is a significant part of the haze often in the mega cities. The organic compounds such as polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), etc. are prevalent constituents of atmospheric pollution and originated by hydrogenation of the elemental carbon. A huge amount of coal is burnt in Raipur area (capital, Chhattisgarh state) to produce energy. In the present work, distribution of black carbon (BC), organic carbon (OC), carbonate carbon (CC) and PAHs associated to particulate matter (PM_{10}) during year 2007-08 in ambient air of Raipur city is described. Twelve PAHs i.e. phenanthrene (Phe), anthracene (Ant), fluoranthene (Fla), pyrene (Pyr), benz[a]anthracene (Baa), chrysene (Cry), benzo[b]fluoranthene (Bbf), benzo[k]fluoranthene (Bkf), benzo[a]pyrene (Bap), dibenz[a,h]anthracene (Dba), benzo[ghi]perylene (Bgh) and indeno[1,2,3-cd]pyrene (Ind) associated to the PM were studied. The (n = 24) PM_{10} concentration in the air was ranged from 116 - 523 µg m^{-3} with mean value of 283±55 µg m^{-3}. The BC, OC, CC, TC and ΣPAHs contents were ranged from 8.8 - 65.5, 7.2 - 55.4, 6.1 - 58.7, 22.8 - 161.2 and 0.04 - 0.17 µg m^{-3} with mean value of 28.8±6.8, 23.2±5.4, 22.7±6.8, 74.6±18.0 and 0.09±0.02 µg m^{-3}, respectively. The monthly, seasonal and spatial variations of the PM and their constituents in the air are discussed.

CONTAMINATION ASSESSMENT OF ROAD DUSTS

Khageshwar Singh Patel[1]*, Dhananjay Sahu[1], Bharat Lal Sahu[1], Jose Nicolas[2], Eduardo Yubero[2], Jan Hoinkis[3], Laurent Matini[4]

[1]*School of Studies in Chemistry, Pt. Ravishankar Shukla University, Raipur-492010, India*
[2]*Atmospheric Pollution Laboratory, Applied Physics Department, MiguelHernandez University, Avda de la Universidad S/N, 03202 Elche, Spain*
[3]*Karlsruhe University of Applied Sciences, 76133 Karlsruhe, Germany*
[4]*Department of Exact Sciences, Marien Ngouabi University, B.P 69 Brazzaville, Congo*
**patelks_@hotmail.com*

The transport system contribute >30% of air pollution in the urban environment in gaseous, liquid and road dust forms. The road dusts (RD) generated from different sources on the roads has become a valuable archive of environmental information. The RD gets washed down to surface and travels to subsurface with rain water and becomes a potential health hazard for the humans and all other biota. In the present work, contamination assessment of soluble ions (i.e. F^-, Cl^-, NO_3^-, SO_4^{2-}, NH_4^+, Na^+, K^+, Mg^{2+} and Ca^2) in 42 respirable road dust samples of India are presented. The road dust samples were collected from various locations of the country in February, 2008. Analytical techniques i.e. ion selective electrode and ion chromatography were used for monitoring of the ions. The color of dusts was varied from yellow to black. The urban dusts were blackish to black with mean pH value of 7.4 ± 0.2. The concentration of F^- was ranged from 75 - 895 mg kg^{-1} with mean value of 224±43 mg kg^{-1}. The concentration of ions i.e. Cl^-, NO_3^-, SO_4^{2-}, NH_4^+, Na^+, K^+, Mg^{2+} and Ca^{2+} in the road dusts was ranged from 0.41 - 19.1, 0.03 - 0.92, 0.10 - 4.23, 0.01 - 0.33, 0.28 - 15.1, 0.08 - 5.71, 0.04 - 0.90 and 0.33 - 8.93% with mean value of 5.60±1.33, 0.38±0.08, 1.14±0.27, 0.09±0.02, 4.68±2.00, 1.16±0.30, 0.43±0.06 and 4.79±0.73%, respectively (at 95% probability). The highest content of F^- was observed in the road dust of Korba city (Chhattisgarh) due to running of aluminum and thermal power plants. Whereas, the highest content of other ions was see in the road dust of the mega and industrial cities i.e. Delhi, Bhilai, Raipur. The spatial and temporal variations, correlation and sources of the ions are discussed.

SOLID PHASE DISTRIBUTION AND ORAL BIOACCESSIBILITY OF METALS IN ESTARREJA DUST: ASSESS THE CONTRIBUTION OF FRACTION < 63 MM

Carla Patinha[1]*, Patricia Sousa[2], Amelia Reis[1], Ana Dias[1], Eduardo Ferreira da Silva[1]

[1]*GEOBIOTEC, University of Aveiro, Campus de Santiago, 3810-193, Aveiro, Portugal*
[2]*Master student, University of Aveiro Campus de Santiago, 3810-193, Aveiro, Portugal*
**cpatinha@ua.pt*

The composition of dust is very variable, as dust originates from different sources, depending on climate, human activities, soils and rocks of the surrounding areas. Indeed, their components and quantity are environmental pollution indicators. Metals may be accumulated in dust from atmospheric deposition. It is evident that urban dust is an important pathway in the exposure of people to toxic elements. Evaluation the risk of inhalation and ingestion of dust for humans, especially for children has been a priority in risk assessment studies for many countries.
As the case with many urban areas, Estarreja city (Portugal) also has some vulnerable areas with high concentration of pollutants, including heavy metals. Estarreja is also under the strong influence of a Chemical Complex, which includes several chemical industries such as a chlor-alkali plant.
Twenty samples of urban dust were collected from Estarreja (Portugal) to assess the contamination of heavy metals such as Pb, Zn, Cu and Fe and the human oral bioaccessibility of these metals; to investigate the metal distribution in particular size fraction (<250µm and <63 µm); to assess the influence of particle size on the geoavailability, and oral bioaccessibility of trace metals in dust.
Trace metals tend to accumulate in the fine fractions, the concentration of Pb, Zn, Cu and Fe are, in general, higher in <63 µm fraction than in 250 µm fraction. The ratio between metal (<63 µm fraction) and metal (<250 µm fraction) shows for Pb ranges between 0.8-2.9, Zn 1.0-3.0, Cu 1.0-3.4 and Fe 0.9-2.5. Loading combines element concentrations, on a grain size basis, with data on the mass percent of individual grain size classes. The results showed that metal loadings (%) are different among the samples. The data reveal that particles with size <63 µm contribute alone in a range of about 11.5-77% to the total concentration for all metals in <250 µm fraction, but only 4 samples show metal loading higher than 40%.
The results of bioaccessibility (in <250 µm fraction) show that the Pb bioaccessible fraction (Bf) range between 22-84%, Zn Bf 29-77%, Fe Bf 3-18% and Cu Bf 8-48%.
Solid phase distribution was determinate using the Sequential Selective Extraction Method. Zn and Pb are predominately associated (33% and 27%, respectively) with acid soluble phase; Cu is present mainly in the amorphous Fe oxide fraction (41%); residual fraction (35%) is the most dominate solid phase of Fe. Pb and Zn are in mobile and bioaccessible fractions raising some health concern.
The geoavailability, and human bioaccessibility of Pb, Zn and Cu in urban dusts are significantly related to the metal contents in <63 µm fraction. No correlation is found for Fe.

AN INTEGRATED APPROACH TO CHARACTERIZE LONG-RANGE TRANSPORTED DUST

Giulia Pavese[1]*, Antonio Lettino[1], Mariarosaria Calvello[1,2], Francesco Esposito[3], Saverio Fiore[1]

[1]*Institute of Methodologies for Environmental Analysis - CNR, Tito Scalo - Potenza, 85050, Italy*
[2]*OAVDA, Marsico Nuovo, 85052, Italy*
[3]*Scuola di Ingegneria-Università della Basilicata, Potenza, 85100, Italy*
**giulia.pavese@imaa.cnr.it*

Atmospheric aerosols, as one of the most important atmospheric constituents, affect both climate change and human health. From the climatological point of view, they can modify both clouds and atmosphere radiative properties, generally contributing to the "cooling effect" but sometimes, as for carbonaceous particles, to the "warming effect". On the other hand, they may impact on air quality, causing both respiratory and cardiovascular diseases, even for short exposure periods (Vedal et al., 2009). These effects depend on aerosols chemical composition that can vary according to the air masses mixing during long-range transport phenomena. Recently, studying Saharan dust intrusion at GAW observatory in Tenerife (Canarian Islands, Spain), Rodriguez et al. (2011) found mineral particles, collected at the ground, often mixed with anthropogenic particles emitted by factories (crude oil refineries, power plants, etc.) located along the Northern coast of Africa.

For the present study we have used an integrated approach to characterize optical, physical, morphological and chemical properties of transported mineral dust in Tito Scalo, a site in South Italy. To this purpose, radiometric measurements along the atmospheric column by an Ocean Optics radiometer, gravimetric measurements by a 13 stages DEKATI impactor at the ground and HYSPLIT back-trajectories have been used to identify days with different particles contents. Poor aerosol loading corresponds to "background" measurements, while high aerosol loading associated to prevailing large particles corresponds to desert dust advection. A technique applied to radiometric measurements allows to identify the main aerosol components (Water Soluble, Soot, Sea-Salt Accumulation, Sea-Salt Coarse and Mineral Dust) contributing to solar radiation attenuation over the atmospheric column. Morphological and chemical characterizations of particulate collected on polycarbonate filters have been performed by SEM-EDX. Preliminary results indicate, at the ground and under dust intrusion, the presence of crustal elements (alumosilicates) also in fine stages along with mineral particles captured in soot chains. Over the atmospheric column, Saharan air masses are characterized by similar contributions from Mineral Dust and the other main components.

Vedal , S., Hannigan, Dutton, S.J., Miller, S.L., Milford, J.B., Rabinovitch, N., Kim, N. S.-Y., Sheppard, L. The Denver Aerosol Sources and Health (DASH) study: Overview and early findings. Atm. Env. 43, 1666-1673, 2009

Rodrıguez, S., Alastuey, A., Alonso-P´erez, S., Querol, X., Cuevas, E., Abreu-Afonso, J., Viana, M., Perez, N., Pandolfi, M., and J. de la Rosa. Transport of desert dust mixed with North African industrial pollutants in the subtropical Saharan Air Layer. Atmos. Chem. Phys., 11, 6663-6685, 2011.

SEQUENCE OF DUST EVENTS OVER PORTUGAL DURING AUGUST 2012: ACTIVE, PASSIVE REMOTE SENSING AND IN SITU OBSERVATIONS OF OPTICAL AND PHYSICAL PARTICLE PROPERTIES

Sérgio Pereira[1,3]*, Vanda Salgueiro[1], Maria João Costa[1,2], Juan Luis Guerrero-Rascado[3], Victor Carrasco[1], Jana Preissler[1,5], Maria Ángeles Óbregon[1], Ana Maria Silva[1], Daniele Bortoli[1], Frank Wagner[1,4]

[1]*Geophysics Centre of Évora, Rua Romão Ramalho nº59, Évora, 7000, Portugal*
[2]*University of Évora, Physics Department, Rua Romão Ramalho nº59, Évora, 7000, Portugal*
[3]*Andalusian Institute for Earth System Research (IISTA - CEAMA), University of Granada, Spain*
[4]*now at: Deutscher Wetterdienst, Hohenpeißenberg Meteorological Observatory, Germany.*
[5]*now at: Centre for Climate and Air Pollution Studies (C-CAPS), National University of Ireland.*
**sergiopereira@uevora.pt*

On August 2012 a sequence of two Saharan dust outbreaks was observed in the AERONET/EARLINET (Holben et al., 1998; Bösenberg et al., 2003) station of Évora, Portugal. Both events were monitored by a number of ground-based instruments installed at the site, both passive and active remote sensing as well as in-situ measurements for measuring aerosol optical and physical properties: multi-wavelength Raman lidar, sun-photometer, integrating nephelometer, multi-angle absorption photometer (MAAP), tapered-element oscillating microbalance (TEOM) and aerodynamic particle sizer (APS). Additional information, such as meteorological data, back-trajectories, satellite data and models were also considered. The entire set of measurements and derived quantities are used to characterize and distinguish these two events in terms of surface, atmospheric column and vertically resolved measurements.
Passive and active remote sensing measurements indicated the presence of dust layers in the atmospheric column during 8-11 and 17-21 August, which were observed up to 7 km and 5 km in the first and second events, respectively.
Despite some similarity between both events, as far as the columnar aerosol optical properties are considered (maximum optical depths at 440 nm, ~0.6-0.7, with low spectral dependence, å~0.2-0.3) the in-situ measurements have shown different features: during the second event the background aerosol load at the surface was low and the presence of dust near the ground level was quite noticeable. For example, the large enhancements in the scattering coefficients (with low spectral dependence), in the mass concentration or in the coarse number concentration are a clear indication of that. However, during the first event the aerosol load at the surface was significant and the light absorption was now consistently high. The spectral dependence of the scattering coefficients was never low, and the minimum observed å ~1 suggests a mixing of dust and anthropogenic aerosol types.

Holben, B. N., et al. (1998), AERONET—A federated instrument network and data archive for aerosol characterization, Remote Sens. Environ., 66, 1- 16.
Bösenberg, J., et al., (2003), EARLINET: A European Aerosol Research Lidar Network to Establish an Aerosol Climatology, Report No. 348, 6-31.

A NEW SATELLITE METHOD FOR AIRBORNE DUST IDENTIFICATION FROM SPACE

Nicola Pergola[1]*, Alfredo Falconieri[3], Carolina Filizzola[1], Francesco Marchese[1], Rossana Paciello[1], Filomena Sannazzaro[2], Valerio Tramutoli[2]

[1]*Institute of Methodologies for Environmental Analysis-National Research Council, Tito Scalo, 85050, Italy*
[2]*School of Engineering-University of Basilicata, Potenza, 85100, Italy.*
[3]*Geospazio Italia S.r.l, Potenza, Italy*
**nicola.pergola@imaa.cnr.it*

The RST_{DUST} algorithm, based on the well established Robust Satellite Techniques (RST) multitemporal approach, is an advanced satellite method which exploits data provided by high temporal resolution sensors, like SEVIRI (Spinning Enhanced Visible and Infrared Imager), to automatically identify and continuously track dust outbreaks from space. This algorithm, using three local variation indexes in combination, based on signals measured in the visible and thermal infrareds SEVIRI channels, is capable of guaranteeing a reliable identification of airborne dust in different observational conditions, independently on the nature of the background (land/sea areas) and without requiring any ancillary information. In this work, the results of a first RST_{DUST} experimentation on SEVIRI data, aimed at assessing its performances in identifying some intense Saharan dust events which affected the Mediterranean region and central Europe in May 2008, are reported. These results, compared to some independent ground and satellite-based aerosol products, demonstrate the potential of RST_{DUST} in successfully detecting and tracking dust aerosols from space. The achieved outcomes show that RST_{DUST} may represent a suitable tool for an accurate and rapid identification of dust clouds that can be then quantitatively characterized by means of further retrieval analyses. Such an algorithm, if integrated in automated early warning systems, may give an important contribution for identifying dust clouds earlier and closer to the source than is presently achievable from space, well supporting activities devoted to mitigate the impact of these features on both social and economic activities.

FROM MINERAL FRACTIONS IN SOILS TO MINERAL FRACTIONS IN DUST AEROSOLS - AN EMPIRICAL APPROACH FOR MODELS

Jan P. Perlwitz[1,2]*, Carlos Perez Garcia-Pando[1,2], Ron L. Miller[2,1]

[1]*Department of Applied Physics and Mathematics, Columbia University, New York, NY 10025, USA*
[2]*Goddard Institute for Space Studies, National Aeronautics and Space Administration, New York, NY 10025, USA*
**jan.p.perlwitz@nasa.gov*

Soil dust aerosol modules in climate models typically assume globally uniform dust properties. However, important processes in the Earth system related to dust aerosols depend on their mineralogical and chemical composition, which varies regionally. The response of clouds and the large-scale circulation to dust forcing is sensitive to the absorptivity of the dust particles, which is largely a function of the free iron fraction in dust. The soluble fraction of iron in dust, transported to remote regions and processed during transport, can fertilize phytoplankton in the oceans, influencing carbon dioxide uptake and, in turn, the global carbon dioxide cycle. Also, chemical processes involving soil dust particles that form coatings of sulfate, nitrate, or organics during atmospheric transport depend on the dust mineralogical/chemical composition. So does the reactivity of dust with ozone. The availability of soil dust particles as cloud condensation nuclei, which is a function of their hygroscopicity, and the propensity of dust particles to serve as nuclei for ice clouds depend on the mineralogical composition as well. A few attempts have been made by researchers to predict the mineralogical composition of dust aerosols in climate models, based on data sets on the mineralogical composition of soils. A major challenge is to properly derive the mineral fractions of emitted dust from the mineral fractions in soils. Here, we present a novel approach to obtain the mineral fractions of the emitted dust aerosols. We propose a method that is based on a few central assumptions and utilizes empirical data from the literature: a data set on mineral fractions in soils and, in addition, the volume size distribution of the mineral fractions in dust aerosols, derived from measurements at a single location. We use this approach to predict the geographical and temporal distribution of emission, transport, and deposition of the mineralogical composition of dust in the NASA GISS Earth system model ModelE. Another challenge is that the data sets on mineral fractions in soils do not provide any information about aggregation of minerals. In addition to the pure mineral phases, we also calculate aggregates between iron oxide minerals and each of the other minerals, based on the relative abundance of the emitted mineral phases at a location, to account for the transport of free iron to remote regions. We carried out simulations with ModelE, one using our new approach, and for comparison another one, for which we assumed that the emitted mineral fractions are equal to the mineral fractions in soil. We use a compilation of more than 50 references from the literature with measured mineral fractions to validate our new model. The validation shows significant improvements of the predicted mineral fractions, using our new approach, although some model deficiencies remain.

DUST CONCENTRATION IN PM10 SAMPLES AND COMPARISON WITH MODEL RESULTS

M. Rita Perrone[1]*, Alessandra Genga[2], Maria Siciliano[2], Tiziana Siciliano[3], Fabio Paladini[1]

[1]*Dipartimento di Matematica e Fisica, Università del Salento, Lecce,73100, Italy*
[2]*Dipartimento di Scienze e Tecnologie Biologiche e Ambientali, Università del Salento, Lecce,73100 Italy*
[3]*Dipartimento di Beni Culturali, Università del Salento, Università del Salento, Lecce,73100, Italy*
**perrone@le.infn.it*

PM10 and PM1 samples simultaneously collected at a costal site of south eastern Italy have been analyzed with the main aim of determining the atmospheric dust contribution of natural and anthropogenic origin and investigating the dust source impact on levels and composition. A low volume (2.3 m^3 h^{-1}) HYDRA-FAI dual sampler was used to simultaneously collect 24-h PM10 and PM1 samples on 47-mm-diameter quartz fibre filters, pre-heated for 2 h at 700 °C. The monitoring campaign lasted from August 2011 up to December 2012. Organic and elemental carbon, inorganic ions, and selected metals were measured in the collected samples to characterize the composition of the PM10, PM1, and (PM10-PM1) fractions. The thermal optical transmittance technique by means of the Sunset Carbon Analyzer Instrument was used with the NIOSH5040 protocol to determine EC and OC mass concentrations in a 1.5 cm^2 punch of the filter sample. Soluble ions (SO_4^{2-}, NO_3^-, NH_4^+, Cl^-, Na^+, K^+, Mg^{2+} and Ca^{2+}) were analyzed via High Performance Ion Chromatography (HPIC, Dionex DX-500 System). Eight trace elements (Ni, Cu, V, Mn, As, Pb, Cr, Sb) were analyzed via Graphite Furnace Atomic Absorption Spectroscopy (GF-AAS, Perkin Elmer Analyst 600 System). Four trace elements (Fe, Al, Zn and Ti) were analyzed by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES, Varian Liberty 110 spectrometer). The Positive Matrix Factorization (PMF) technique and the mass closure analysis have been applied to the chemically speciated PM10 and PM1 samples to identify main natural and anthropogenic sources and determine the atmospheric dust contribution. Analytical back trajectories combined with statistical analyses and satellite true colour images were used to know about the location of potential source regions and to determine the contribution of long range transported air masses. Particular attention has been devoted to the analysis of samples collected during Sahara dust outbreaks with the main aim of inferring the effects of the dust source region on the PM composition. Crustal matter concentrations monitored during Sahara dust outbreak have been compared with the dust concentration retrieved from the BSC-DREAM model (www.bsc.es) for the study area to better understand main results and contribute to the validation of model results.

Perrone, M. R., Becagli, S., Orza, J. A. G., Vecchi, R., Dinoi, A., Udisti, R., Cabello, M. (2013). The impact of long-range-transport on PM1 and PM2.5 at a Central Mediterranean site. Atmos. Environ., 176-186.

DUST EFFECTS ON GROUND-BASED IRRADIANCE MEASUREMENTS

Maria Rita Perrone, Salvatore Romano*

Mathematical and Physics Department, Universita' del Salento, Lecce, 73100, Italy
**salvatore.romano@studenti.unisalento.it*

The dust role in the Earth's radiation budget is widely recognized and several experiments have been undertaken to investigate the impact of dust aerosols on the Mediterranean radiation budget (e.g. Perrone et al., 2012 and references therein). The radiative impact of dust particles is rather complex since they are of large size and exert a significant direct radiative effect in both the solar (S) and terrestrial (T) radiation. Solar and terrestrial direct radiadive effects (DREs) by dust particles are generally opposite. In particular, the absorption and scattering of dust particles in the T-domain enhance the greenhouse effect and as a consequence, aerosol T-DREs are positive at the surface while S-DREs are negative. Hence, it is important to look at the interaction of dust particles with T and S radiation, to properly define how they alter the energy budget. Ground-based pyranometer and pirgeometer measurements performed from 2011 up to 2013 at a costal site of south eastern Italy (40.33 °N; 18.11 °E) are used in this study to investigate dust effects on irradiance measurements at the surface in both the solar and terrestrial spectral range. Two Kipp & Zonen pyranometers (CMP 21) and pyrgeometers (CGR 3) have been used to measure upward and downward radiation fluxes in the solar (0.31-2.8 µm) and terrestrial (4.5-45 µm) spectral range, respectively. Satellite MODIS images, analytical back trajectories, the BSC-DREAM model (www.bsc.es), and aerosol microphysical properties retrieved from AERONET sun/sky photometer measurements, co-located in space and time with irradiance measurements, have been used to determine and evaluate the presence of dust particles at the monitoring site. An analysis of both the dust DRE, which is defined as the difference in net fluxes with and without aerosols, and the dust radiative forcing efficiency (EF), which represents the change in the net flux per unit of aerosol optical depth will be presented. More specifically, results on clear-sky, instantaneous aerosol DREs and EFs at the surface in both the solar and terrestrial spectral range will be presented. A two steam radiative transfer model has been used to evaluate net fluxes without aerosols. The use of measured net flux values with aerosols to evaluate dust DREs and FEs represents a peculiarity of the study: net fluxes are strongly dependent on the assumed surface albedo and the vertical distribution of the aerosol load and of the optical and microphysical aerosol properties. These last properties are commonly not measured. So, they are mostly assumed in the radiative transfer models used to calculate net flux values with aerosols. The impact of the dust advection routes from the sources to the monitoring site on the measured net fluxes values has also been analyzed to better characterize the dust DREs and EFs at the surface.

Perrone M. R., Tafuro A. M., Kinne S. (2012). Dust layer effects on the atmospheric radiative budget and heating rate profiles, Atmos. Env., 344-354.

ENVIRONMENTAL EXPOSURE OF CARBONACEOUS AEROSOL EMISSIONS FROM ASIAN CULTURAL AND RITUAL BURNING PRACTICE

Shamsh Pervez[1]*, Shippi Dewangan[1], Rajan Chakrabarty[2], John Watson[2], Judith Chow[2], Jerome Robles[2], Yasmeen Pervez[3]

[1]*School of Studies in Chemistry, Pt. Ravishankar Shukla University, Raipur, India, 492010*
[2]*Division of Atmospheric Sciences, Desert Research Institute, Reno, NV, USA, 89512*
[3]*Department of Engineering Chemistry, Chhatrpati Shivaji Institute of Technology, Durg, India, 491010*
**shamshpervez@gmail.com, shamshp@yahoo.co.in*

There are ~3.0 million religious worship places in India, more than the number of educational and health centers, 10 million marriages/year and 9.05 million deaths/year (death rate: 7.8/1000) in India. These ritual activities and Different religion oriented worship places (Hindu temples, Muslim Holy shrines and Buddhist temples) are paid spiritual homage using flaming episodes by igniting different kinds of bio- and synthetic materials. This study is mainly focused on quantification of organic (OC) and elemental carbon (EC) emitted from five different religious and ritual places mostly located in South Asia:1) Hindu Temples, 2) Muslim Graveyards (Holy shrines), 3) Buddhist Temples,4) Marriage Palaces and 5) Hindu Cremation Centers. Three separate examples of each of these five religious/ritual venues were sampled when materials were burned. Concentrations of PM2.5, carbon dioxide (CO2), and carbon monoxide (CO) were also measured to assess the impact of flaming and smoldering episodes of burning practices. All sites have shown hundred-fold high OC compared to EC has been observed except Buddhist temples where 1.5-2.0 folds higher EC was quantified compared to OC. Results have shown that religious and ritual burning practices are one the major source of atmospheric organic carbon related to regional climate change.

One sentence summary: More than 10 Tg of natural- and synthetic- biomaterial burnt every year in various religious and ritual burning practices in India; releasing about 101 Gg Organic Carbon in the regional atmosphere.

1. Chow, J. C.(1995). Measurement methods to determine compliance with ambient air quality standards for suspended particles. Journal of the Air & Waste Management Association, 45, 320-382.
2. Chow, J. C.; Watson, J. G.; Chen, L.-W. A.; Arnott, W. P.; Moosmüller, H.; Fung, K. K., (2004). Equivalence of elemental carbon by thermal/optical reflectance and transmittance with different temperature protocols. Environmental Science & Technology, 38, 4414-4422.
3. J. C. Chow et al. (2007). The IMPROVE_A temperature protocol for thermal/optical carbon analysis: maintaining consistency with a long-term database. Journal of the Air & Waste Management Association, 57, 1014.

$PM_{2.5}$ CHEMICAL SOURCE PROFILES FOR GEOLOGICAL MATERIALS AND VEHICULAR EXHAUST IN INDIA

Shamsh Pervez[1]*, Jeevan Lal Matawle[1], Suresh Tiwari[2], Yasmeen Fatima Pervez[3]**

[1]School of Studies in Chemistry, Pt. Ravishankar Shukla University, Raipur-492010(C.G.), India
[2]Indian Institute of Tropical Meteorology, New Delhi, India
[3]Department of Engineering Chemistry, CS Institute of Technology (CSIT), Durg, India
**Author for correspondence: shamshp@yahoo.co.in, shamshpervez@gmail.com*
***Presenting author: dr.ypervez@gmail.com*

On the requisition of effective results of $PM_{2.5}$ source apportionment studies in India, a systematic study approach has been performed to develop $PM_{2.5}$ source profiles for different types of geological material dust and vehicular exhaust emissions. Total thirty real-world samples of $PM_{2.5}$ have been collected from emissions resulting from 1) different types of geological dusts, 2) different fuel based vehicular emissions; categorized in eight subtypes of sources. Collected samples were subjected to chemical analysis for twenty one elemental (Al, As, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, Pb, S, Sb, Se, V, Zn), nine ionic (Na^+, K^+, Mg^{2+}, Ca^{2+}, NH_4^+, Cl^-, F^-, NO_3^-, SO_4^{2-}) and two organics [Organic carbon(OC) and Elemental carbon(EC)]using atomic absorption spectrophotometry, ion chromatography and carbon analyzer (thermal/optical transmittance methods), respectively. The carbonaceous aerosol fraction (OM+EC) was found to be most abundant in vehicular exhaust emission sources; ranges from 86.4±3.61% to 100.71±5.24% with OC/EC range from 1.36 to 59.16. Similarly, geological materials have shown 9.36±1.37 to 31.32±4.62% carbonaceous aerosols in PM2.5 emissions with OC/EC ratio from 2.5 to 27.7. On contrary, trace elements abundance was found insignificant in vehicular exhaust emission profiles compared to those of vehicular exhausts. The source signature calculations have been performed for determination of relative source identifying species in respective group of profiles. The ionic balance and mass closure calculation has also performed for quality assurance in PM2.5 source profiles.

One sentence summary: Eight different real-world PM2.5 chemical source profiles are developed. These profiles comprised of 2-,3-,4-wheelers including 6-wheeler trucks operate using gasoline and diesel fuels along with natural soils, paved and unpaved road and civil constructions.

Watson, J.G., Chow, J.C., Houck, J.E. (2001). $PM_{2.5}$ chemical source profile for vehicle exhaust, vegetative burning, geological material, and coal burning in Northwestern Colorado during 1995. Chemosphere 43, 1141-1151.

Watson, J.G., Chow, J.C. (2001). Source characterization of major emission sources in the Imperial and Mexicali valleys along the US/Mexico border. Science of the Total Environment 276, 33-47.

Yatkin, S., Bayram, A. (2008). Determination of major natural and anthropogenic source profiles for particulate matter and trace elements in Izmir, Turkey. Chemosphere 71, 685-696.

COMPREHENSIVE MEASUREMENT OF ATMOSPHERIC AEROSOLS WITH A WIDE RANGE AEROSOL SPECTROMETER

M. Pesch, A. Edfelder*, H. Grimm

GRIMM Aerosol Technik GmbH & Co. KG, Dorfstrasse 9, Ainring, 83404, Germany
**ae@grimm-aerosol.com*

Measurement of aerosol size distribution plays an important role in the atmospheric aerosol investigations. Nowadays people pay more and more attention to the airborne nanoparticles due to higher particle number concentration and larger surface area, i.e. airborne nanoparticles have higher concentration of adsorbed or condensed toxic material per unit mass. In this study, the wide range aerosol spectrometer EDM665 was applied for comprehensive aerosol measurements of atmospheric aerosols.
This WRAS system consists of a scanning mobility particle sizer with condensation particle counter (SMPS+C) and an optical aerosol spectrometer (OPC), including a sampling probe with a Nafion dryer inside and optional meteorological sensors for measuring ambient air temperature and relative humidity.
The GRIMM OPC works on the basis of the light-scattering technology for single particle counts. A semiconductor laser serves as the light source. The signal scattered from the particle passing the laser beam is collected at ca. 90° by a mirror and transferred to a recipient-diode. The detected signals are further analyzed and classified in multiple channels. This spectrometer measures the particle size distribution in the size range of 250 nm - 32 µm.
The GRIMM SMPS+C includes a condensation particle counter (CPC) and a differential mobility analyzer (DMA).
During the measurement larger particles, which would complicate the data analysis, are removed firstly by an impactor at the inlet of the DMA, and then fine and ultrafine particles are classified with a DMA after they pass through a bipolar charger (Neutralizer Am241), which establishes a well defined charge distribution of the particles. The classification occurs in the electrostatic field in the annulus between inner and outer electrodes of the DMA. Only particles of a certain size or mobility reach a narrow slit at the bottom of the inner electrode and are measured with a CPC. A size distribution in the size range of 5.5 nm - 350 nm can be obtained by changing the DMA voltage stepwise.
These two datasets from the OPC and SMPS+C are automatically synchronized and combined using the GRIMM software. Thus, this WRAS system allows the measurement of wide range particle size distributions from 5.5 nm to 32 µm.
Numerous continuous measurements of particle size distribution indicate the time variation of airborne particles from various sources, like rush hour, traffic emissions, power plants out of the measurement site, and organic components due to photochemical reactions. Furthermore, combination with meteorological data and gas concentrations will also help study the transport and mixing processes of atmospheric aerosols.

CONTINUOUS MEASUREMENTS WITH HIGH TIME RESOLUTION OF SEMI-VOLATILE COMPONENTS IN THE ATMOSPHERIC AEROSOL

M. Pesch, H. Grimm, A. Edfelder*

GRIMM Aerosol Technik GmbH & Co. KG, Dorfstrasse 9, Ainring, 83404, Germany
**ae@grimm-aerosol.com*

EU limit and guideline values for the protection of human health (DIRECTIVE 2008/50/EG) demand a continuous monitoring of the atmospheric aerosol, more precisely its fine dust fraction PM10 and PM2.5. Fine dust is rated harmful to health which therefore strongly needs action to be taken, in order to minimize this exposure. The EU regulates to develop clean air plans, in which efficient reduction strategies have to be enlisted. Especially the optical measuring technology for monitoring the thresholds gained in importance. The optical detection of the aerosol enables a non-contact, continuous, and temporally high resolved measurement of the aerosols as PM fractions, particle size and counts distribution.

A significant part (up to 60% of the particle mass) of the atmospheric aerosol is determined by semi-volatile components (SVC), which varies depending on location and season. This meaningful fraction of the SVC impedes the exact determination of the aerosol mass. Thus it is important to determine the volatile fraction of the aerosol for two reasons: On the one hand this fraction is very helpful for the source identification of the dust, because different sources create different SVC fractions, and on the other hand it is very important to measure the SVC for comparing the results of different fine dust measuring devices, which reveal the difference in their losses of SVC while measuring.

The company GRIMM Aerosol Technik GmbH & Co. KG developed a compact, mobile, and highly efficient measuring instrument, which enables the continuous determination of the volatile fraction within the atmospheric aerosol. This device is in possession of two sampling probes with complementary characteristics:

One probe dries the particles by a nafion membrane in such a way, that no volatile aerosols get lost, while in the other probe the aerosol can be heated to a temperature of up to 300 °C. The aerosol is alternating being sucked through the sampling probes and subsequently analysed inside the same optical chamber. This means, that in one interval all aerosol are analysed and in the other one only the thermically stabilized aerosols. Forming this difference of both intervals, a determination of the volatile fraction is possible. There the volatile components are classified simultaneously into 31 size channels from 250 nm up to 32 µm, as well as a simultaneous detection of the PM10, PM2.5, and PM1 fractions.

Measurements at different locations prove the high temporal and spatial variability of the volatile aerosol components, and moreover provide valuable indication for the causes of fine dust exposure as well as a better understanding of the aerosol formation within the lower atmosphere.

THE STUDY OF THE BIOLOGICAL EFFECT OF FLY ASH PRODUCED BY COAL-FIRED POWER PLANTS AS PART OF DUST-GAS MIXTURE IN A CHRONIC EXPERIMENT WITH INTRATRACHEAL ADMINISTRATION

Sergey Petrov*, Boris Petrov, Igor Sheshunov

Kirov State Medical Academy, Kirov, 610027, Russian Federation
**sbpetrov@mail.ru*

Coal fly ashes are complex particles of a variable composition, which is mainly dependent on the combustion process, the source of coal and the precipitation technique. Aim of this study was to investigate the biological effect of dust-gas mixture composed of coal fly ash and adsorbed gas component. That is the least studied of air pollutants in areas near coal-fired power plants. Experiment is lead on 30 purebred white rats divided into 3 groups. Rats of the first group were poisoned by intratracheal administration of a suspension of dust-gas mixture (a dust of coal flying ashes + sulfur dioxide) in 1,0 ml physiologic saline. Rats of the second group were poisoned by intratracheal administration of a suspension of coal fly ash without a gas component. The rats of control group were entered equivalent quantity of physiologic saline. Duration of experiment made 6 months. The dust of a fly ash as a part of dust-gas mixture and dust without gas component at chronic influence causes a sensitization of an organism of the experimental animals, being accompanied an immunosuppression and formation of immunopathological processes. However, the adsorbed gas component affects on strengthening of toxicity of a dust of a fly ash and activation of formation of immunopathological processes, and also on decrease of antioxidatic activity. More expressed toxic effect of a dust of coal fly ashes as a part of dust-gas mixture is confirmed by data of pathomorphologic researches. In the group of rats, which were administered dust-gas mixture, the dystrophic changes were observed in the liver, myocardium and kidneys tissues, also in the spleen observed proliferation of histiocytes and macrophages. In the group of rats, which were administered fly ash without adsorbed gas component, the pathological changes were expressed to a much lesser extent. In control group significant pathological changes of organs and tissues were not observed.

Alarie Y., Krumm, A., Busey, W. (1975) Long-term exposure to sulfur dioxide, sulfuric acid mist, fly ash, and their mixtures. Archives of Environmental Health 30, 254-262.

Borm P. (1997) Toxicity and occupational health hazards of coal fly ash (CFA). A review of data and comparison to coal mine dust. The Annals of Occupation Hygiene, 41, 659-676.

Chin-Wing L. James J., McCluskey R. (2004) Pulmonary toxicity of single-wall carbon nanotubes in mice 7 and 90 days after intratracheal instillation. Toxicol. Science, 77, 126-134.

CHARACTERIZATION OF SAHARAN DUST COLLECTED IN MONACO DURING 1998-2013

Mai Khanh Pham[1]*, Elena Chamizo[2], José Luis Mas Balbuena[3], Juan-Carlos Miquel[1], Jacobo Martín[4], Hartmut Nies[1]

[1]*IAEA-Environment Laboratories, Monte Carlo, 98000, Monaco*
[2]*Centro Nacional de Aceleradores, Universidad de Sevilla, Isla de la Cartuja, 41092 Sevilla, Spain*
[3]*Departamento de Física Aplicada I, Universidad de Sevilla, 41012 Sevilla, Spain.*
[4]*Instituto de Ciencias del Mar, CSIC, 08003 Barcelona, Spain*
**m.pham@iaea.org*

Saharan dust events in the Northwest Mediterranean have been identified as important pathways for particle delivery into surface seawater [1]. The atmospheric transport of particles from North Africa to Monaco was recently studied at IAEA-EL (International Atomic Energy Agency-Environment Laboratories) [2-4]. The study of radionuclides (both natural and anthropogenic) as well as the elementary composition of Saharan dust particles was carried out for better understanding the temporal behaviour of radionuclides in the atmosphere and their transport into the Northwest Mediterranean Sea.
Out of nine significant events registered episodically during 1998-2013, two important Saharan dust depositions were detected at the Monaco air monitoring station of the IAEA during 23-24 November 2002 and 20 February 2004 [4], when a significant quantity of red-colour particles was collected. The influence of the 20 February 2004 deposition was further followed into the water column with the analysis of sediment trap samples collected at two depths - 200 m and 1000 m water depth- at the Dyfamed station located at $43^{0}25$'N, $07^{0}52$'E (time-series studied from 21 December 2003 to 9 May 2004) [5]. The characterization of those particles was done using X-ray fluorescence (Spectro X-Lab 2000), gamma spectrometry HPGe well-type detectors of 150% and 200% relative efficiency (Canberra model CW 15025-7915-30-ULB) operating in the IAEA-EL's underground laboratory with very low background, ICP-MS (Inductively Coupled Plasma-Mass Spectrometry) and AMS (Accelerator Mass Spectrometry) of Universidad de Sevilla, Spain. Data on the concentrations and activity ratios of natural and anthropogenic radionuclides (gamma emitters: ^{7}Be, ^{40}K, ^{210}Pb and ^{137}Cs; alpha emitters: ^{210}Po, ^{239}Pu, ^{240}Pu, $^{239+240}$Pu; and Uranium isotopes) as well as major and trace elements are presented and discussed.

1. Moulin C., Lambert C.E., Dulac F. and Dayan U. (1997). Control of Atmospheric export of dust from North Africa by the North Atlatic Oscillation. Nature, Vol. 387, 691-694.
2. Pham M.K., Povinec P.P., Lee S.-H., and Oregioni B. (2003). Atmospheric transport of particles from the North Africa to Monaco. Bulletin du Bureau National de Métrologie, 2, 143-146.
3. Pham M.K., La Rosa J.J., Lee S.-H., Oregioni B. and Povinec P.P. (2005). Deposition of Saharan Dust in Monaco Rain 2001-2002: Radionuclides and Elementary Composition. Physica Scripta, Vol. T118 14-17.
4. Pham M.K., Povinec P.P., Nies H., and Betti M. (2013). Dry and wet deposition of ^{7}Be, ^{210}Pb and ^{137}Cs in Monaco air during 1998-2010: Seasonal variations of deposition fluxes. Journal of Environmental Radioactivity, 120, 45-57.
5. Miquel, J.-C., Martín J., Gasser B., Rodriguez-y-Baena A., Toubal T. and Fowler S.W. (2011). Dynamics of particle flux and carbon export in the northwestern Mediterranean Sea: a two decade time-series study at the DYFAMED site. Progress in Oceanography, 91, 461-481.

QUATERNARY MIGRATION OF THE SOUTH WESTERLIES RECORDED BY LEAD ISOTOPES IN THE EASTERN EQUATORIAL PACIFIC

Sylvain Pichat[1,2]*, Wafa Abouchami[2], Lise Missiaen[1], Olivier Sulpis[1], Stephen J.G. Galer[3]

[1]*Laboratoire de Géologie de Lyon (LGL-TPE) Ecole normale supérieure de Lyon, Lyon, 69009, France*
[2]*Federgrasweg 54, 55122 Mainz, Germany*
[3]*Max Planck Institute for Chemistry, P.O. Box 3060, Mainz, 55020, Germany*
**spichat@ens-lyon.fr*

The influence of atmospheric dust on climate and biogeochemical cycles in the oceans is well understood but poorly quantified. Glacial atmospheric dust loads were generally greater than those during the Holocene, as shown, for example, by the covariation of dust fluxes in the Equatorial Pacific and Antarctic ice cores (e.g., Winckler et al., 2008). Nevertheless, it remains unclear whether these increases in dust flux were associated with changes in sources of dust, which would in turn suggest variations in wind patterns, climate or paleo-environment. Such questions can be answered using radiogenic isotope tracers of dust provenance.
We will present a 160-kyr high-precision lead isotope time-series of dust input to the Eastern Equatorial Pacific (EEP) from core ODP Leg 138, Site 849 (0°11.59'N, 110°31.18'W) (Pichat et al., 2014) and preliminary results for termination II from core TTN013-72PC in the Central Equatorial Pacific.
Fluctuations in Pb isotope ratios throughout the last 160 kyr are in phase with global climate proxy records. The combined Pb and Nd isotope systematics point at South America as the prevailing source of dust to the EEP. We show that the forcing of dust provenance over time in the EEP overall is influenced by high-southerly-latitude climate conditions, leading to changes in the latitudinal position and strength of the South Westerlies as well as the coastal winds that blow northward along the Chilean margin. The net result is a modulation of dust emission from the Atacama Desert and the SVZ via a northward migration of the South Westerlies during cold periods and southward retreat during glacial terminations.

Winckler G., Anderson R.F., Fleisher M.Q., McGee D., Mahowald N. (2008) Covariant glacial-inter-glacial dust fluxes in the equatorial Pacific and Antarctica. Science 320, 93-96
Pichat, S., Abouchami, W., Galer, S.J.G. (2014) Lead isotopes in the Eastern Equatorial Pacific record Quaternary migration of the South Westerlies. Earth Planet. Sci. Lett. 388, 293-305

PRINCIPAL COMPONENTS FOR MULTIVARIATE SPATIO-TEMPORAL FUNCTIONAL DATA

ANTONELLA PLAIA*, MARIANTONIETTA RUGGIERI, FRANCESCA DI SALVO, GIANNA AGRÒ

Dipartimento di Scienze economiche, aziendali e statistiche, Palermo, 90128, Italy
**antonella.plaia@unipa.it*

Multivariate spatio-temporal data consist of a three way array with two dimensions' domains both structured, temporally and spatially; think for example to a set of different pollutant levels recorded for a month/year at different sites. In this kind of dataset we can recognize time series along one dimension, spatial series along another and multivariate data along the third dimension.
Statistical techniques aiming at handling huge amounts of information are very important in this context and classical dimension reduction techniques, such as Principal Components, are relevant, allowing to compress the information without much loss. Although time series, as well as spatial series, are recorded as discrete observations, to convert them into Functional Data presents the advantage of preserving their functional structure and reducing a great number of observations to a few coefficients. Consequently, PCA for Functional Data is here considered.
In this paper we propose to take into account both the temporal and the spatial information inside the data. The main aim is to develop a spatial variant of the temporal Functional Principal Component Analysis (FPCA) approach treated in Ramsay and Silverman (2005). The possibility of extension of the temporal FPCA to spatial FPCA is mentioned by some authors, including Ramsay and Silverman (2005), and examined for regular grids, as well as for highly irregular and sparse data, by Yao et al. (2003) and Yao et al. (2005). Nevertheless, the exact way the analysis is done is not carried out. Furthermore, up to our knowledge, software implementations are available only for the one-dimensional case. An approach to spatial FPCA is also proposed by Winzenborg (2011), but ignoring the possible temporal aspect of data.
In this paper the univariate spatial FPCA is generalized to multivariate case. According to this approach, spatial instead of temporal basis functions are considered and therefore functions of locations in d-dimensional Euclidean space R^d instead of functions of time measured in R. In particular, we deal with data measured on two-dimensional domains D in R^d, $d=2$, considering both longitude and latitude.

Ramsay J.O., Silverman B.W. (2005). Functional Data Analysis. Second Edition. Springer-Verlag.
Winzenborg I. (2011). Spatial Functional Principal Component Analysis and its Application in Diagnostics Dissertation zur Erlangung des Doktorgrades Dr. rer. nat. der Fakultat fur Mathematik und Wirtschaftswissenschaften der Universitat Ulm.
Yao F., Muller H.G., Wang J.L. (2003). Shrinkage Estimation for Functional Principal Component Scores with Application to the Population Kinetics of Plasma Folate. Biometrics, 59, 676-685.
Yao F., Muller H.G., Wang J.L. (2005). Functional data analysis for sparse longitudinal data. Journal of the American Statistical Association, 100 (470), 577-590.

ASSESSMENT OF DUST DRIFT FROM PNEUMATIC DRILLS IN STATIC TESTS

Daniele Pochi, Roberto Fanigliulo, Pietro Gallo, Marcello Biocca*

Consiglio per la Ricerca e la sperimentazione in Agricoltura, CRA-ING
via della Pascolare 16, 00015 Monterotondo (Roma) Italy
**marcello.biocca@entecra.it*

The pneumatic precision drills for the sowing of maize (*Zea mays* L.) dressed seeds contribute to the emission of dust containing active ingredients (a.i.), such as neonicotinoid insecticides (Nuyttens *et al*., 2013). These chemicals are involved in honey bees (*Apis mellifera* L.) mortality and decline (Apenet, 2011). Some methods have been proposed to reduce the drift of pneumatic drills, including air deflectors (Biocca *et al*., 2011), adjustment of sowing parameters, dressing quality enhancement and innovative filtering-recirculating devices (Pochi *et al.,* 2013). This paper describes a procedure to evaluate the dust drift caused by pneumatic drills, in tests at fixed point. An area of our workshop was arranged to obtain a sort of wind gallery with a 22.5 m long test area. Through the possibility of controlling wind speed and direction, such a system provides reliable data on the drift behaviour, useful in comparative tests among different drills or drill's configurations. It is suitable to the observation of both ground residues and air concentrations of active ingredient in the test area. The obtained data were compared with a.i. ground depositions (μg m^{-2}) observed in real sowing field tests. In conclusion, we propose a method for the estimation of the a.i ground deposition in field from the data observed in tests at fixed point. This method allows to design a standardized test system useful for evaluating the performances of drills and other seeders from in terms of dust drift.

Apenet 2011. Effects of coated maize seed on honey bees. Report based on results obtained from the second year (2010) activity of the APENET project, p. 100. Available at: http://www.reterurale.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/5773.

Biocca M., Conte E., Pulcini P., Marinelli E., Pochi D. (2011). Sowing simulation tests of a pneumatic drill equipped with systems aimed at reducing the emission of abrasion dust from maize dressed seed. Journal of Environmental Science and Health, Part B 46(6):438-448.

Nuyttens D., Devarrewaere W., Verboven P., Foqué D. (2013). Pesticide-laden dust emission and drift from treated seeds during seed drilling: a review. Pesticide Management Science, 69: 564-575.

Pochi D., Biocca M., Fanigliulo R., Gallo P., Pulcini P. (2013). Development and testing of innovative devices to reduce the drift of abrasion powder during the sowing of dressed seeds with pneumatic drills. In: International Conference of Agricultural Engineering, CIGR-AgEng 2012, Valencia 8-12 July. On-line at: http://cigr.ageng2012.org.

IDENTIFICATION OF URBAN AEROSOL ORIGIN TROUGH LASER LIGHT SCATTERING AND SEM-EDS ANALYSIS

FRANCISC POPESCU[1]*, PAULA SFARLOAGA[2], LASZLO MAKRA[3],
DELIA-GABRIELA CALINOIU[4], GAVRILA TRIF-TORDAI[1], ADRIAN-EUGEN CIOABLA[1]

[1]*Mechanical Engineering Faculty, Politehnica University Timisoara, Timisoara, 300222, Romania*
[2]*National Institute for Research and Development in Electrochemistry and Condensed Matter, Timisoara, 300569, Romania*
[3]*Department of Climatology and Landscape Ecology, University of Szeged, Szeged, HU-6701, Hungary*
[4]*Department of Physical Foundations of Engineering, Politehnica University Timisoara, Timisoara, 300223, Romania*
**francisc.popescu@upt.ro*

Pollution with suspended particles/aerosols are of major concern in the entire Balkan peninsula, especially PM10 (and lower) fraction exceeding the allowable limits. Timisoara city, the second largest city in Romania is not an exception, today being in the infringement procedures enforced by EU Commission. To overcome the problem and find solution it is necessary to understand the aerosols origin. Several samples were taken and the morphological and compositional analysis of bulk particles were performed by using scanning electron microscopy equipped with an energy dispersive X-ray system (SEM/EDX) for total suspended particles TSP. Samples were collected through standard method described by ISO 4222. In parallel with total suspended and sediment particles the particle size distribution was analyzed by means of light scattering techniques, in 15 channels from 300 nm to 20 µm equivalent particle diameter.

AEROSOL OF SIBERIAN BIOMASS BURNING: SMALL-SCALE FIRE STUDY

O. Popovicheva[1]*, V. Kozlov[2], E. Kireeva[1], N. Persiantseva[1], G.Engling[3], K. Eleftheriadis[4], L. Diapoli[4], D. Saraga[4]

[1]*Moscow State University, Moscow, Russian Federation*
[3]*Institute of Atmospheric Optics, SB RAS, Tomsk, Russian Federation*
[1]*National Tsing Hua University, Hsinchu, Taiwan*
[4]*N.C.S.R. "Demokritos", Attiki, Greece*
**polga@gmail.com*

A better understanding of aerosol emissions from Siberian boreal forest fires is crucial, as they exert critical environmental and climate impacts in subarctic regions and the Arctic. The ability of biomass burning aerosol to absorb/scatter incoming radiation as well as act as cloud condensation nuclei strongly depends on microphysical, chemical and hygroscopic particle characteristics, for which a comprehensive regional database does not exist to date.

In this work small-scale combustion experiments were performed with the purpose to fill the gaps in available data on particulate emissions from Siberian boreal forest fires. Typical regional biomass species, i.e., pine and pine debris, were burned in a large aerosol chamber (LAC) under controlled combustion conditions representative of wildfires and prescribed burns. Comprehensive physico-chemical characterization of smoke aerosols was performed, including assessment of morphology, elemental composition, carbon and ion content, organic/inorganic functionalities, and selected organic compounds (anhydrosugars and dicarboxylic acids). Individual particle characterization supported by cluster analysis allows the quantification of smoke structural components and major types of particles with the purpose to discriminate between the different types of biomass burning and identify morphological and chemical micromarkers of Siberian wildfires. Furthermore, the abundance of cloud-forming aerosols was determined by microscopic-based hygroscopicity analysis.

Aerosol absorption and scattering determine the radiative and microphysical properties of smoke, and particularly BC mass concentration for the major combustion regimes, i.e., smoldering, flaming, and mixed burning. Emission factors of PM_{10} and $PM_{2.5}$, OC, EC, ions, and molecular markers (anhydrosugars) reveal the dramatic differences in aerosol composition as a function of combustion phase. The largest emissions of organics and levoglucosan in particular occurred during the smoldering phase. This study shows the importance of obtaining the chemical profiles for dominant PM component in order to enable the assessment of contribution from Siberian biomass burning to atmospheric pollution and the aerosol/climate system through PM characterization and molecular marker approaches.

TEMPORAL AND SPATIAL VARIATIONS IN THE DEPOSITION OF URBAN DUST IN THE NORTHWEST OF ENGLAND: INVESTIGATING THE HISTORICAL RELEASE OF INDUSTRIAL AND COMBUSTION PARTICULATES USING POND SEDIMENTS

Ann Power[1]*, Annie Worsley[2], John Love[1], Richard Jones[3]

[1]*Biosciences, University of Exeter, Exeter, EX4 4QD, UK*
[2]*Strata Environmental, 16 South Erradale, Gairloch, IV 21 2 AU*
[3]*Geography, University of Exeter, Exeter, EX4 4RJ, UK*
**A.Power@exeter.ac.uk*

Ponds set within the urban landscape are important sinks of atmospheric pollution, receiving particulates from surrounding industrial and combustion sources. Sediment records extracted from ponds set within the industrial heartland of northwest England have yielded histories (50-200 years) of particulate pollution deposition spanning the UK's Industrial Revolution, genesis of the chemical industry and 20th century developments in industrial and transport activity. This work demonstrates how urban ponds can be used to retrospectively characterise pollution particulates released within a heavily industrialised region.

Proxy air pollution histories have been reconstructed from several ponds in the lower Mersey region using a range of environmental analyses including environmental magnetism, x-ray fluorescence, spheroidal carbonaceous particle (SCP)s, SEM-EDS and isotope chronologies. High-resolution 'local' records have been retrieved from each pond which, when combined, produce a 'cross-regional' signal of pollution deposition within the urban landscape. Temporal and spatial trends in the release of particulates during the 19th and 20th centuries are revealed.
Corresponding features in sulphur and SCP trends across the conurbation post-1800 demonstrate a regional air pollution signal related to the combustion of fossil fuel. Twentieth century intra-urban variations in the deposition of trace metals are also observed. These inter-site differences highlight the sensitivity of urban ponds to changes in their surrounding environment such as localised industrial activities, urban development and increasing road transport, as well as the implementation of air quality legislations. Individual particulates preserved in the pond sediments have been characterised using SEM-EDS analysis, revealing the size and chemical composition of particles, key properties in determining their toxicity and source. Coal-fired power stations, chemical industries, car manufacturing processes and roadways are potential sources of harmful particulates observed.

Set amongst the populations most at risk to the long-term health effects of particulate pollution, these unique sedimentary archives reveal important spatial and temporal variations in the deposition of pollution in the urban landscape of northwest England. These records allow a retrospective assessment of the release and toxicity of pollution particulates, extending the urban air pollution record back in time beyond contemporary monitoring techniques.

STABLE CARBON ISOTOPIC RATIOS OF A RURAL AEROSOL AT THE CENTRE OF GALICIA (SPAIN)

Dario Prada-Rodriguez[1,2]*, Nuria Gallego-Fernández[3], Maria Piñeiro-Iglesias[2], Soledad Muniategui-Lorenzo[1,2], Mª Luz Macho-Eiras[3], P. López-Mahía[1]

[1]*Department of Analytical Chemistry, University of A Coruña, A Coruña, 15071, Spain*
[2]*Institute of Environment, University of A Coruña, Oleiros, A Coruña, 15179, Spain*
[3]*Environment Laboratory of Galicia, Autonomous Government of Galicia, A Coruña, 15008, Spain*
**dariop@udc.es*

Stable isotopes of C ($\delta^{13}C$) have been well exploited for decoding and tracking biogeochemical processes in oceanography and limnology, but its exploitation for characterizing possible potential sources of aerosols has been limited in Spain. Carbonaceous material typically accounts for 10 to 50% of PM10 concentration, concretely in Spain, accounts for 10-22% of PM_{10} in the rural background (Querol et al., 2013). Here, we report a stable isotopic study of bulk carbonaceous aerosol particles over a rural site at the northwest of Spain.PM_{10} samples were analysed in a elemental analyzer coupled to a isotope ratio mass spectrometer. The concentrations of TC seem to decrease from the cold to the warm period (the latest ones were about half of the cold period ones). This decrease in TC concentrations is consistent with previous studies (Narukawa et al., 2008). $\delta^{13}C$ values were in the range of -24.3$^0/_{00}$ to -27.3$^0/_{00}$, with least-negative values occurring during warm period (periods of high biological activity) (average value -25.8$^0/_{00}$) while polluted sample values exhibited more-negative values during cold period (average value -26.4$^0/_{00}$). The isotopic patterns observed in our study are similar to the signatures motor vehicle emissions (-28$^0/_{00}$ to -26$^0/_{00}$) (Cao et al., 2011). During the cold period, the negative correlation between TC and $\delta^{13}C$ points to biomass burning as the primary source of aerosol carbon. These results revealed that ^{13}C values of TC aerosols are consistent with the values obtained for aerosols from the mixed anthropogenic activities and the specific sources such as fossil fuel and biomass burning. It is also important to note that the values from these sources became higher when the aerosols were relatively aged. This is the first $\delta^{13}C$ data of atmospheric carbonaceous aerosols over a rural area of Galicia.

Cao J.-J., Chow J.C., Tao J., Lee S.-C., Watson J.G., Ho J.-F., Wang G.-H., Zhu C.-S., Han Y.-M. (2011). Stable carbon isotopes in aerosols from Chinese cities: Influence of fossil fuels. Atmospheric Environment, 1359-1363.

Narukawa M., Kawamura K., Li S.-M., Bottenheim J.W. (2008). Stable carbon isotopic ratios and ionic composition of the high-Artic aerosols: An increase in $\delta^{13}C$ values from winter to spring. Journal of Geophysical Research, doi:10.1029/2007JD008755.

Querol X., Alastuey A., Viana M., Moreno T., Reche C. et al. (2013). Variability of carbonaceous aerosols in remote, rural, urban and industrial environments: implications for air quality policy. Atmospheric Chemistry and Physics, 6185-6206.

Acknowledgements - This work has been supported by FEDER and Xunta de Galicia (Program of consolidation and structuring of competitive research groups in the University system of Galicia, ref. 52/2010). The authors would like to thank INDRA and P. Esperon for their support.

HOLOCENE PEAT BOG RECORDS OF ATMOSPHERIC DUST ON THE QUEBEC'S NORTH SHORE (CANADA) - PRELIMINARY RESULTS

Steve Pratte[1,3]*, Michelle Garneau[2], François De Vleeschouwer[3,4]

[1]*GEOTOP & Département des Sciences de la Terre et de l'Atmosphère, Université du Québec à Montréal (UQAM), Montreal, H3C 3P8, Canada*
[2]*GEOTOP & Département de Géographie, UQAM, Montreal, H3C 3P8, Canada*
[3]*Université de Toulouse: INP; UPS; Ecolab (Laboratoire Écologie Fonctionnelle et Environnement); ENSAT, 31326 Castanet Tolosan, France*
[4]*CNRS; Ecolab; 31326 Castanet Tolosan, France*
**pratte.steve@courrier.uqam.ca*

Atmospheric mineral dust plays an important role in the Earth's climate through parameters such as atmospheric radiation, cloud properties and biogeochemical cycles. However, the high spatial and temporal variability of mineral dust and a lack of terrestrial archives in certain regions limit our understanding global dust-climate interactions. Ombrotrophic peatlands (*bogs*; atmospherically-fed only) are increasingly recognized as archives of atmospheric dust deposition. Their global distribution and high accumulation rates (i.e. high resolution) over the Holocene make them suitable substitute to marine and/or ice records.

Two peat bogs, located along the Estuary (Baie bog) and Gulf (Ile du Hâvre) of St. Lawrence (North Shore region, Quebec), were sampled to investigate dust deposition/palaeowinds in north eastern North America over the mid and late Holocene. Here we present geochemical (major and trace elements), particle size and macrofossil records for both sites. Radiocarbon dating of the base each profile yielded ages of about 4300 yr cal BP and 7800 yr cal BP for Baie and Ile du Hâvre bogs respectively. Data on past aeolian activity in eastern Canada are scarce. Dune building studies in northern Quebec show several episodes of dune formation/stabilization during the late Holocene [1]. These episodes of dune formation were linked to drier and cooler or colder climate and polar front incursions. Preliminary results show periods of increased dust flux between 1000-1500 yr cal BP and 100-500 yr cal BP in the Baie peat sequence from 0.5 to 4 g m^{-2} yr^{-1}. In the ombrotrophic section, higher dust fluxes usually occur in conjunction with greater particle size suggesting either stronger winds or a change of source. Periods of increased dust fluxes in the Baie profile correspond with changes in the macrofossil assemblages (lower proportion of *Sphagnum* and greater proportion of Ericale rootlets and decomposed material). A first attempt at source tracing through preliminary radiogenic isotopes analyses (Pb, Nd; ongoing) will also be discussed for the Baie bog.

1. Filion L., Saint-Laurent D., Desponts M. Payette S. (1991). The late Holocene record of aeolian and fire activity in northern Québec, Canada. The Holocene, 201-208.

COSMIC DUST IN AN EXPANDING UNIVERSE?

Thomas Prevenslik

QED Radiations, Discovery Bay, Hong Kong, China
nanoqed@gmail.com

DUST 2014, the International Conference on Atmospheric Dust, is directed to the world of the atmospheric particles. Beyond our atmosphere, cosmic dust comprising nanoparticles of primarily silicon permeate the vast reaches of the Universe. Like atmospheric dust obscuring observations of what we perceive on Earth, our optical observations of the Universe are distorted by cosmic dust.

In 1929, Edwin Hubble formulated the law that the velocity of a receding galaxy is proportional to its distance to the Earth. Hubble based his law on Doppler's effect whereby the wavelength of light from the galaxy is redshift if the galaxy is moving away from us. Thus, by measuring the redshift of known spectral lines, Hubble claimed to know the recession velocity of the galaxy relative to the Earth.

Based on the redshift of supernova light, astronomers now take Hubble's law as proof the Universe is not only expanding, but accelerating. If, however, the redshift has a non-Doppler origin, the Universe need not be expanding. Redshift without an expanding Universe is of utmost importance because many of the outstanding problems in cosmology would be simply resolved by Newtonian mechanics.

In this regard, redshift of galaxy light may occur upon absorption in submicron cosmic dust NPs by the mechanism of QED induced EM radiation. NP stands for nanoparticles, QED for quantum electrodynamics, and EM for electromagnetic. QED induced redshift may be understood by treating the absorbed photon as EM energy confined within the NP by TIR. TIR stands for total internal reflection. TIR confinement is a consequence of the submicron NPs having high surface to volume ratios, and therefore the absorption of the galaxy photon is therefore almost entirely confined to the NP surface corresponding its TIR mode. Since quantum mechanics precludes conservation of the absorbed galaxy photon by an increase in NP temperature, conservation proceeds by the QED induced creation of a redshift photon depending on the NP material and geometry.

The QED induced redshift is caused solely by the absorption of the galaxy photon in NPs and has nothing to do with an expanding Universe. Given that galaxy and supernova light is unequivocally absorbed by NPs on its way to the Earth, the Hubble redshift is highly likely not related to an expanding Universe. It therefore follows that an accelerating Universe expansion by dark energy based on Doppler's shift is unphysical. Indeed, NPs hold in question the Hubble redshift as proof the Universe began in the Big Bang suggesting the notion once proposed by Einstein of a static Universe in dynamic equilibrium is a far more credible cosmology. Other consequences are:

- Dark Energy not needed to explain a Universe that is not expanding.
- Dark Matter not source of Gravitational Lensing.
- Galaxy Rotation Problem resolved without Dark Matter, etc.

THE CONCENTRATION OF WATER-SOLUBLE INORGANIC IONS AND SOURCE APPOINTMENT OF AEROSOLS IN DUST WEATHER

Jian-hua Qi*, Lin Wang, Xiao-jing Cheng, Hui-wang Gao

Key Laboratory on Marine Environment and Ecology of Education Ministry Ocean University of China, Qingdao, 266100, China
**qjianhua@ouc.edu.cn*

The atmospheric aerosols samples were collected in Qingdao coastal region in dust weather from 2008 to 2011. The mass concentration of total suspended particulate (TSP) and inorganic ions were measured. We found dust weather does not simply increase nutrient concentration compared with non-dust samples. The dust effect on ions was decided by many factors, such as local sources emission, meteorologic state, dusttransportation, and so on. The positive matrix factorization (PMF) receptor model was used to identify the sources of dust and non-dust aerosols in Qingdao. The contributed sources in dust days were soil dust, coal combustion, vehicle exhaust, biomass burning and industry. In contrast, the sources in non-dust days were soil dust, oil combustion, vehicle exhaust, biomass burning, industry and sea salt. The results showed that the major source of both dust and non-dust aerosols was soil dust. The contribution of soil dust was dramatically increased in dust days, while the contributions of local anthropogenic sources decreased. Pollutants of coal combustion in dust days were mainly from the mixture of soil dust and pollutants along the transmission path, while biomass burning pollutants from both local emission and dust long-range transportation.

SOIL EVIDENCE OF LONG-TERM DUST DEPOSTION IN THE UINTA MOUNTAINS, UTAH, USA

Paul Quackenbush, Jeffrey Munroe

Middlebury College, Middlebury, VT, 05753, USA
**pquackenbush@middlebury.edu*

Recent observations [1,2] have documented a significant contemporary eolian dust flux of at least 5-10 g m^{-2} yr^{-1} in alpine ecosystems in the Western United States, possibly contributing 10 to 40% of the total soil mass in these environments. However, most of that work has taken place in the Colorado Rocky Mountains, and relatively little attention has been given to dust deposition in other mountain ranges. For instance, although researchers have long documented a 10-25 cm thick silt mantle across a wide elevation gradient in the Uinta Mountains of northeastern Utah [3], no prior work has specifically addressed whether this dust mantle represents long-term dust deposition. To evaluate this possibility we used four paired samples of soil A and B horizons from four different alpine sites to investigate whether this widespread alpine silt mantle is of exotic eolian origin. Passive dust collectors previously deployed at each of the four sites allowed us to compare these soil samples with modern dust. Grain size analysis indicates that A and B horizons have similar median grain sizes of 70-80 µm. However both types of samples feature multi-modal size distributions, with a fine mode of ~10 µm matching the modern dust, and a coarser mode in the medium sand range. A horizons are richer in organic matter with carbon contents averaging 4.3%, compared with 1.6% in the subsoil. Most notably, X-ray diffraction analysis reveals that plagioclase and amphibole are present in A horizon samples. These minerals are absent in soil B horizons, which are dominated by quartz, orthoclase feldspar, and pedogenic clays, and in the underlying bedrock. Together these results confirm previous reports of a pronounced textural discontinuity between soil A and B horizons and support an exotic eolian origin for the silt mantle present in Uinta alpine soils. Given the thickness and ubiquity of this silt layer, dust-deposition has likely been a long-term process with significant impacts on pedogenesis and geoecology in Uinta alpine environments.

1. Lawrence C., Neff J., Farmer G. (2011). The accretion of Aeolian dust in soils of the San Juan Mountains, Colorado, USA. Journal of Geophysical Research.
2. Lawrence C., Painter T., Landry C. Neff J. (2010).Contemporary geochemical composition and flux of Aeolian dust to the San Juan Mountains, Colorado, United States. Journal of Geophysical Research.
3. Bockheim J., Munroe J., Douglass D., Koerner D. (2000). Soil development along an elevational gradient in the southeastern Uinta Mountains, Utah, USA. Catena, 39, 169- 185.

COLLECTING DUST: HOW DIFFERENT SAMPLING METRICS INFORM HUMAN HEALTH RISK ASSESSMENTS

Pat E. Rasmussen[1,2], Dave Gardner[2], Christine Levesque[1], Marc Chenier[1]

[1]*Exposure and Biomonitoring Division, Health Canada, Ottawa, K1A 0K9, Canada*
[2]*Earth Sciences Department, University of Ottawa, Ottawa, K1N 6N5, Canada*

House dust contains a wide variety of compounds from both indoor and outdoor sources, and provides a useful medium for assessing exposures in residential environments. The Canadian House Dust Study (CHDS) was designed to provide nationally representative baseline information about metals and organic compounds in urban house dust. "Active" or fresh dust was collected according to sampling protocols developed to obtain three measures of metals in house dust - concentration, load, and loading rate - which provide different but complementary types of information for risk assessments (Rasmussen et al., 2013). Questionnaire information about activities of the inhabitants and the physical characteristics of the house and its surroundings further assisted in interpreting national trends.

The metal load (e.g., ng m^{-2}) is widely considered the most appropriate index of potential childhood exposure to metals in settled house dust. In this study, metal loading (ng m^{-2} day^{-1}) is examined as a function of the dust loading (mg m^{-2} day^{-1}) and the concentration of metal (µg g^{-1}) in the settled dust, using cadmium (Cd) as an example. Multilinear regression analysis indicates that the Cd loading rate in the CHDS is mostly influenced by the dust loading (68%) and only 32% by the Cd concentration of the dust ($p < .001$). The overriding influence of dust mass can be observed in homes of smokers versus non-smokers. The geomean Cd loading rate is significantly higher ($p = .034$) in homes occupied by smokers (49 ng m^{-2} day^{-1}) than in homes occupied by non-smokers (34 ng m^{-2} day^{-1}), yet there is no significant difference in the geomean Cd concentration of dust from homes of smokers versus non-smokers ($p = 0.701$). The key factor is the significantly higher dust loading rate in homes of smokers (geomean = 12.6 mg m^{-2} day^{-1}) compared to homes of non-smokers (geomean = 9.2 mg m^{-2} day^{-1}).

Similar examination of the relationships between metal loading, dust loading and metal concentration in the context of urban setting shows the same trend: homes in urban industrial zones are characterized by significantly higher dust loading rates and metal loading rates but display no significant difference in dust metal concentrations, compared to homes in residential zones (95% CI). The results of the CHDS show that, while concentration information is useful for identifying the presence of metal sources in the home and for comparing indoor dust with outdoor dust and soil, it is dust levels within the home and the dustiness of the external environment that are important drivers of potential metal exposure.

Rasmussen PE, Levesque, C., Chénier, M., Gardner, H.D., Jones-Otazo, H., Petrovic, S. (2013) Canadian House Dust Study: Population-based concentrations, loads and loading rates of arsenic, cadmium, chromium, copper, nickel, lead, and zinc inside urban homes, Science of the Total Environment, 443: 520-529.

PARTICLE SIZE DISTRIBUTION AND ORAL BIOACCESSIBILITY OF COBALT, NICKEL AND CHROMIUM IN URBAN DUSTS OF LISBON

Amelia Marinho Reis[1]*, Carla Patinha[1], Ana Dias[1], Joanna Wragg[2], Mark Cave[2], Maria João Batista[3], Ondina Figueiredo[3], Cátia Prazeres[3], Eduardo Ferreira Da Silva[1]

[1]*GEOBIOTEC, University of Aveiro, 3810-193 Aveiro, Portugal*
[2]*British Geological Survey, Keyworth, Nottingham, NG12 5GG, UK*
[3]*LNEG, Zambujal, 2720-866 Amadora, Portugal*
**pmarinho@ua.pt*

This paper discusses some results from a target survey carried out in the city of Lisbon, Portugal, to assess the impact of potentially harmful elements in outdoor dusts on the health of children that use urban recreational areas to play outdoors. A total of 50 dust samples were collected from urban recreational areas used by children. Particle size distribution analysis was carried out by laser diffraction. Analysis of pseudo-total concentrations was carried out by inductively coupled plasma mass spectrometry after an acid digestion. Oral bioaccessibility measurements were obtained using the Unified BARGE Method developed by the Bioaccessibility Research Group of Europe. The major sources of Co, Ni and Cr in the urban dusts are probably the basalts that form the volcanic complex of Lisbon. All outdoor dusts under study can be classified as sandy. Average concentrations in the urban dusts are approximately 16 mg kg^{-1} for Cr, 3.6 mg kg^{-1} for Co and 13 mg kg^{-1} for Ni. In this study bioaccessible concentrations refer to the metal concentration that was extracted in the gastric phase. On average, 40% of total Co, 37% of total Co and 21% of total Ni content in the dust samples was solubilized by the gastric fluids and is available for intestinal absorption. Usually higher total metal contents correspond to higher bioaccessible concentrations. However, bioaccessible concentrations and BAF of Cr show an antipathetic behavior: dusts that have more elevated concentrations of Cr have them mainly in non-bioaccessible forms. The bioaccessible concentrations of Co, Ni and Cr, as determined in the G phase of the UBM method, were plotted against the percentage of dust particles below the 250 µm, 150 µm, 100 µm, 63 µm, 38 µm, 10 µm and 2 µm size fractions. For Co and Ni, there is a linear positive association between the particle size and the bioaccessibility estimates that increases with the decrease of the grain size. Such association was not found for Cr. However, the bioaccessibility of Cr seems to be controlled by the finest grains sizes since there is a negative correlation between the amount of PM2 particles of the dust and the BAF of Cr. Increasing amounts of PM2 particles result on decreasing fractions of total Cr concentrations that are solubilised by the gastric fluids. In conclusion, the dusts with higher amounts of fine particles have higher bioaccessibility estimates of Co and Ni, and lower BAF of Cr. These results suggest that the particle size distribution controls the bioaccessibility of Co, Ni and Cr in outdoor dusts of urban recreational areas from Lisbon.

SOURCE APPORTIONMENT OF A SEVERE PM_{10} AIR POLLUTION EVENTS IN POLISH URBAN AREAS

Magdalena Reizer*, Katarzyna Maciejewska, Katarzyna Juda-Rezler

Warsaw University of Technology, Faculty of Environmental Engineering, Warsaw, 00-653, Poland
**magdalena.reizer@is.pw.edu.pl*

Poor urban air quality due to high concentrations of particulate matter (PM) remains a major public health problem in Europe. According to a newest report from European Environmental Agency (EEA, 2013), 85-88 per cent of the EU urban population is exposed to levels of harmful PM_{10} (particles with an aerodynamic diameter <10 μm) exceeding the air quality guideline set by the World Health Organization (WHO). Moreover, the specialized cancer agency of the WHO, the International Agency for Research on Cancer (IARC), announced in October 2013 that it has classified outdoor air pollution as carcinogenic to humans (WHO, 2013).
The goal of this paper is to analyse wintertime PM_{10} episodes of high concentrations recorded in Polish urban areas. We applied the original method of PM_{10} source apportionment. It consists of the analysis of monitoring data from both urban and regional background air quality monitoring sites, analysis of the synoptic situation and variability of local meteorological parameters, analysis of air mass back trajectories and local air pollution roses as well as statistical data treatment including Lenschow's approach and principal component analysis with multivariate linear regression analysis (PCA-MLRA). The application of this methodology allowed us to identify and discern the possible sources of PM_{10} pollution (long-range transport, regional transport and local sources) as well as their contributions to the bulk PM mass for each of the investigated urban areas. Finally, as coal combustion is a major air pollution source in Poland, we try to find out which PM components may be regarded as markers of different combustion sources (large combustion plants vs. small scale installations, such as domestic stoves and local boiler houses).
The results of the analysis prove that however various anthropogenic emissions are highly responsible for winter PM_{10} episodes also the unfavourable synoptic- and local-scale meteorological conditions influence the severity of these events. One of the major findings concerning meteorological influences on PM levels during winter episodes is that the peak concentrations occur usually 2-3 days after the maximum atmospheric pressure and minimum air temperature observed, which is related to the strongest expression of high pressure system impact. The results show that proposed methodology is efficient for the identification of PM emission sources in urban areas, thus provides the key information to the development and implementation of policies to protect human health.

EEA (2013). Air Quality in Europe - 2013 report. European Environment Agency, Publications Office of the European Union, Luxembourg.
WHO (2013). Outdoor air pollution a leading environmental cause of cancer deaths. Communication of the International Agency for Research on Cancer, WHO. Press release no. 221, 17.10.2013.

BIOAEROSOLS IN ATMOSPHERE FROMTHE METROPOLITAN ZONE OF TOLUCA VALLEY, MÉXICO

Lázaro Raymundo Reyes-Gutiérrez[1]*,
Elizabeth Teresita Romero-Guzmán[2], Joel Gutiérrez-Reyes[3]

[1]*Universidad Autónoma Metropolitana, Unidad Lerma, MexicoState, City, 52006, Mexico*
[2]*Instituto Nacional de Investigaciones Nucleares, MexicoState, 52750, México*
[3]*Instituto Tecnológico de Toluca, MexicoState, City, 52149, Mexico*
**raregu@gmail.com*

Due of the increasing pollution in the last years of the air of the ZMVT not only there have been detected particles of inorganic and organic origin, also, were observed particles of biological origin. Bioaerosols suspended in ambient air of Metropolitan Zone of Toluca Valley (MZTV) were identified during late summer and autumn. Various types of microorganisms, pollen, spores and fragments were observed. This work summarizes the results of a series of studies on bioaerosols particles carried out in Metropolitan Zone of Toluca Valley from 2008 to 2009. Monitoring sites were selected from the RAMAT with different climatic and geographic conditions as well as anthropogenic influences varying from rural to background to industrial sites. Characterization was carried out with Scanning Electron Microscopy. The bioaerosoles present in the air of the MZTV, represent approximately 30 % of the total mass of the particulate material. Their presence and type of bioaerosol depends on the time of the year during rainy season and dry. The bioaerosoles present in the ZMVT were of five types: microorganisms, pollen, spores, fragments and diatoms, which were aerotransport and deposited by different mechanisms for their analysis. It should be noted that the bioaerosoles aerodynamic sizes are below 5 µm, mostly, with potentially health adverse effects.

IMPACT OF AFRICAN DUST TRANSPORT ON THE PM CHEMICAL COMPOSITION IN THE CONTINENTAL AND REGIONAL BACKGROUND OF THE WESTERN MEDITERRANEAN

Anna Ripoll[1]*, Jorge Pey[1,2], María-Cruz Minguillón[1], Xavier Querol[1], Andrés Alastuey[1]

[1]Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, 08034, Spain
[2]Now at: Aix-Marseille Université, Marseille, 13331, France
*anna.ripoll@idaea.csic.es

Chemical composition of particulate matter (PM) was determined at Montsec (MSC, 42º 3'N; 0º 44' E, 1570 m.a.s.l.) continental background site, and at Montseny (MSY, 41º19'N, 02º21'E, 720 m.a.s.l.) regional background station, both located in the Western Mediterranean. This work summarizes results on major and trace components in PM_{10} and PM_1 from both sites. Moreover, PM speciation during long range dust transport from Africa was investigate in order to evaluate the relevance of its impact at both environments.

Samples of 24h particulate matter (PM) were collected at a ratio of 1 sample out of 4 days, on quartz fibre filters using high-volume samplers (MCV CAV-A/MSb). In addition to the routine measurements, intensive campaigns (1 filter per day) were performed. Overall, 391 (Jan 2010-Mar 2013) and 235 (Mar 2011-Mar 2013) samples of PM_{10} (particles with aerodynamic diameter less than 10 µm) and PM_1 (less than 1 µm), respectively, were collected at MSC, and a total of 351 and 335 (Jan 2010-Mar 2013) samples of PM_{10} and PM_1 respectively at MSY. PM concentrations were determined by standard gravimetric procedures. Samples were treated for the determination of the major and trace elements concentrations that accounted for 60-90% of the total PM mass.

Despite the differences of altitude, average concentrations of PM at the regional station (PM_{10}: 15.5 µg m^{-3}, PM_1: 8.2 µg m^{-3}) were similar than those reported at the continental site (PM_{10}: 11.5 µg m^{-3}, PM_1: 7.1 µg m^{-3}), especially for the fine fraction (PM_1). However, time variation of chemical composition showed a clear different impact of local/external and natural/anthropogenic sources at each site. African dust outbreaks were a clear example. During these episodes average concentrations of coarse (PM_{1-10}) mineral matter were higher at MSC (13.1 µg m^{-3}) than those at MSY (7 µg m^{-3}), whereas fine (PM_1) concentrations of secondary inorganic aerosols were higher at the regional station (3.6 µg m^{-3}) than those at the continental site (2.6 µg m^{-3}). This could indicate that African dust transport over the Western Mediterranean occurs preferentially in elevated layers, and that these elevated dust layers hinder the planetary boundary layer vertical development favouring the accumulation of pollutants at the regional scale.

BEST WINTER MAINTENANCE PRACTICES TO REDUCE RESPIRABLE STREET DUST IN URBAN AREAS - DEMONSTRATION OF BEST PRACTICES, STRATEGY DEVELOPMENT AND IMPLEMENTATION

Roosa Ritola[1]*, Kaarle kupiainen[1], Liisa Pirjola[2], Jarkko Niemi[3], Taiju Virtanen[4], Outi Väkevä[4], Ana Stojiljkovic[1]

[1]*Nordic Envicon Oy, Helsinki, FI-00350, Finland*
[2]*Metropolia University of Applied Sciences, Helsinki, FI-00180, Finland*
[3]*HSY. Helsinki Region Environmental Services Authority, Helsinki, FI-00066, Finland*
[4]*City of Helsinki Environment Centre, Helsinki, FI-00099, Finland*
**roosa.ritola@nordicenvicon.fi*

Street dust is a major source of urban air pollution (PM_{10}) during spring in the sub-arctic regions of the world. It is mainly composed of mineral particles from pavement wear and/or from traction sand that accumulate in the street environment during winter. During spring time high particle concentrations increase respiratory symptoms and impair the function of the lungs. Although the Finnish municipalities have done much to mitigate street dust, the risk of exceeding the limit values required by the EC directive on ambient air quality and cleaner air for Europe (2008/50/EC) is still considerable in some busy street environments.

The aims of the REDUST Life+ project (LIFE09 ENV/FI/000579) have been to find best practices in the fields of traction control, dust suppression and street cleaning, and accelerate their implementation in order to reduce levels of respirable street dust (PM_{10}) in urban areas. The emission reduction potential and air quality benefits of the best practices have been tested and demonstrated during spring time peak emissions throughout the project (2011-2014).

Our studies show that dust binding has the biggest potential to reduce acute dust emissions. Some effect was also demonstrated for street cleaning, however the effect was not as obvious in all cases. Comparisons of Nordic winter tyres show that with low resuspension level studded winter tyres cause higher formation and emissions than friction tyres. However when the street surfaces are dusty and resuspension level is high, studdless friction tyres can potentially cause higher emissions than studded tyres.

Results have been used to develop a comprehensive strategy to reduce the levels of respirable street dust in urban areas by means of better winter maintenance practices. Developing a strategy is an iterative process and the final version of the strategy will be published at the end of the project. One of the objectives has also been to assess the cost of implementing the strategy i.e. the costs of improved measures versus the cost of current measures and to find the most cost-efficient means to mitigate the levels of respirable street dust (PM_{10}) in urban areas in Finland.

PROVENANCE STUDY ON THE TARIM BASIN, XINJIANG, CHINA

Martin Rittner[1]*, Pieter Vermeesch[1], Anna Bird[2], Thomas Stevens[2]

[1]London Geochronology Centre, Department of Earth Sciences, UCL, London, WC1E 6BT, UK
[2]Centre for Quaternary Research, Royal Holloway, University of London, Egham, TW20 0EX, UK
*m.rittner@ucl.ac.uk

The sediment successions of the Chinese Loess Plateau (CLP) contain a continuous record of aeolian transport, and about terrestrial climatic conditions, spanning the last 22 Ma. Despite their immense value for the understanding of Quaternary climate evolution, their provenance is a matter of discussion. Various areas across North-West-China and North-/North-Eastern China and Mongolia have been proposed.
The Tarim basin (Xinjiang Uygur Autonomous Region, PR China) has been suggested as one possible source area for the sediments of the CLP. In this study, we characterised surface samples by age spectra of zircon U-Pb single grain analyses, by heavy mineral and petrological composition, as well as further single-grain and bulk geochemistry analyses as proxies for provenance analysis. Here, we compare these data to tributaries feeding the basin today, and to the CLP.
The main input of sediment today seems to come from the South (Kunlun mountains and Tibet plateau), with the Karakorum in the West and the Tian Shan in the North playing only minor roles.
The compositions and age spectra observed show great affinity with the CLP and the Yellow River. The two most likely interpretations are either that the CLP is derived from the Tarim basin, or that both regions derive their sediment from the same source.
Age spectra and composition of sediments in the Junggar basin north of the Tian Shan are distinctively different to the CLP and its potential source areas, including the Tarim basin.

Guo, Z., Ruddiman,W.F., Hao, Q.,Wu, H., Qiao,Y., Zhu, R., Peng, S., Wei, J., Yuan, B., Liu, T. (2002). Onset of Asian desertification by 22 Myr ago inferred from loess deposits in China. Nature 416, 159-163.

Honda, M., Yabuki, S., Shimizu, H. (2004). Geochemical and isotopic studies of aeolian sediments in China. Sedimentology 51, 211-230.

Porter, S.C. (2001). Chinese loess record of monsoon climate during the last glacial-interglacial cycle. Earth-Science Reviews 54, 115-128.

Stevens, T., Carter, A., Watson, T.P., Vermeesch, P., Andò, S., Bird, A.F., Lu, H., Garzanti, E., Cottam, M.A., Sevastjanova, I. (2013). Genetic linkage between the Yellow River, the Mu Us desert and the Chinese Loess Plateau. Quaternary Science Reviews, 78, 355-368.

Stevens, T., Palk, C., Carter, A., Lu, H., Clift, P. D. (2010). Assessing the provenance of loess and desert sediments in northern China using U-Pb dating and morphology of detrital zircons. Geological Society of America Bulletin 122, 1331-1344.

Sun, J. (2002). Provenance of loess material and formation of loess deposits on the Chinese Loess Plateau. Earth and Planetary Science Letters 203, 845-859.

THE FORMATION OF CONVECTIVELY GENERATED DUSTY EPISODES IN THE SAHARA DURING SUMMER

Alexander Roberts[1]*, Peter Knippertz[2], John Marsham[1]

[1]*Institute for Climate and Atmospheric Science, University of Leeds, Leeds, LS2 9JT, UK*
[2]*Institute for Meteorology and Climate Research, Karlsruhe Institute of Technology, Karlsruhe, 76128, Germany*
**ee07a2jr@leeds.ac.uk*

Haboobs are dust storms produced by the spreading of evaporatively cooled air from thunderstorms and are a major dust uplift process for West African sources, a very important region for the global dust budget. This work combines a case study of a particularly large haboob event with a statistical analysis of rainfall anomalies to investigate synoptic- and meso-scale features important for the production of haboobs reaching into the Sahara.

The case focused on occurred in June 2010 and produced a very large dust plume over West Africa with dust subsequent transport over the Mediterranean. Observations, reanalysis data, and a high-resolution simulation using the Weather Research and Forecasting (WRF) model are used to analyse the multi-scale dynamics which produced a long-lived (over 2 days) Saharan meso-scale convective system (MCS) and the unusually large haboob. Synoptic-scale features important for this case include: (1) an upper-level trough and wave on the subtropical jet five days prior to MCS initiation, (2) a precipitating tropical cloud plume, (3) disruption of the Saharan heat low, and (4) moistening of low level air in the central Sahara. The re-strengthening Saharan heat low and a Mediterranean cold surge produce a convergent region over the Hoggar and Aïr Mountains. Once initiated the MCS travels southwest and favourable deep layer shear encourages the formation of a meso-scale convective complex (MCC). The unusually large size of the resulting dust plume (over 1000 km long) is linked to the longevity and vigour of the convective system, and an enhanced east-west pressure gradient across the Sahara. Dust uplift processes identified are: (1) strong winds near the cold pool front, (2) an enhanced nocturnal low-level jet within the aged cold pool and (3) a bore formed by the cold pool front on the nocturnal boundary layer.

To identify the conditions likely to lead to the production of such events Tropical Rainfall Measuring Mission (TRMM) data has been used. Periods over 14 West African monsoon seasons (April-September, 1998-2011) in the northern Sahel and southern Sahara (10W-10E and 18-25N) with anomalously high precipitation (including periods of heavy rain) have been identified. From this and the production of composites from ERA-Interim reanalysis, it is possible to identify the synoptic-scale conditions favourable for the production of rainy/dusty episodes linked to convectively generated cold pools in the West African dust hotspot, which make a major contribution to the seasonal cycle of dust over West Africa.

TESTING THE LINK BETWEEN INCREASED DUSTINESS AND ENHANCED GUSTINESS USING THE RECORD OF LAST-GLACIAL (PEORIA) LOESS DEPOSITION AT LOVELAND, WESTERN IOWA

Helen M. Roberts[1], Daniel R. Muhs[2], E. Arthur Bettis III[3], Stephen S. Harlan[4], James B. Paces[2], Richard L. Reynolds[2]

[1]*Department of Geography and Earth Sciences, Aberystwyth University, Aberystwyth, Wales SY23 3DB, UK*
[2]*U.S. Geological Survey, MS 980, Box 25046, Federal Center, Denver, CO 80225, USA*
[3]*Department of Geoscience, University of Iowa, Iowa City, IA 52242, USA*
[4]*The National Science Foundation, 4201 Wilson Blvd., Arlington, VA 22230, USA*

The Loveland Paratype Section (N41.50052°, W95.88934°) in western Iowa, USA, preserves one of the thickest deposits of last-glacial (Peoria) loess in the world. As such, this site offers an ideal opportunity to test the recently proposed idea that the enhanced global ‘dustiness’ which is widely noted across a range of Quaternary records during the Last Glacial Maximum (LGM), was primarily driven by increased ‘gustiness’ in the form of stronger, more frequent winds (McGee et al., 2010). Twenty-two quartz optically stimulated luminescence (OSL) ages taken from the Pisgah and Peoria Loess units at Loveland give ages that are stratigraphically consistent within uncertainties. Mass Accumulation Rates (MARs) calculated for the loess using both a linear accumulation rate model and also a Bayesian model of accumulation, show that the MAR varies significantly between the Pisgah and Peoria Loess. The MARs calculated for the Peoria Loess are among the highest last-glacial MARs in the world, but they are also shown to vary significantly over time *within* the Peoria Loess unit. The maximum Peoria Loess MARs are observed at ~23 ka, and they coincide with an increase in grain size identified for the middle Peoria unit by Muhs and Bettis (2000), implying a strengthening of winds at Loveland. At this time, the Laurentide Ice Sheet was at its maximum southward extent and insolation was at a minimum at high latitudes in North America, giving rise to an enhanced latitudinal temperature contrast. Such conditions, and the MAR and grain-size observations at Loveland, support the hypothesis that enhanced gustiness, generated by a steepened meridional temperature gradient, may have been a primary driver of last-glacial dustiness.

McGee, D., Broecker, W.S., and Winckler, G., 2010. Gustiness: the driver of glacial dustiness? Quaternary Science Reviews 29, 2340-2350.

Muhs, D.R., and Bettis III, E.A., 2000. Geochemical variations in Peoria Loess of western Iowa indicate paleowinds of midcontinental North America during last glaciation. Quaternary Research 53, 49-61.

EVALUATION OF THE MODELS CALMET Y CALPUFF IN TWO SITES TOPOGRAPHICALLY DIFFERENT IN THE COAL ZONE OF CESAR DEPARTMENT (COLOMBIA).

Jose L. Rodriguez Castilla, Luis C. Angulo

University of Cesar (UPC), Cesar Department, Colombia

In the coal mine zone in the department of Cesar (Colombia), the programs MM5, CALMET and CALPUFF were used to simulate the PM10 contribution of the mining projects PLJ, Norcarbón and the Hatillo, with the objective of compare the results of the model with the registers of monitoring of the zone and evaluate the dispersion model CALPUFF in two different topographic sites. Hatillo mining project is located a few kilometers from the village of La Loma, where topographical features are plain; on the other side are the mining projects PLJ and Norcarbón located in the low mountain zone of the Perijá, near to the La Jagua of Ibirico village. For the introduction of the variable emission in the CALPUFF model, was taken into account as provided in the study of the Monterrey Institute of Technology.

Although the CALPUFF model is mostly recommended for long distances scenarios, there are exceptions for short distances scenarios where the model is reliable to measure the behavior of pollutants in the air. In the present study were used these standards to evaluate the CALPUFF in the coal zone of Cesar department where the local weather is influenced by the relationship mountain-valley.

The period of study was included in the dry period of January (2008).The concentration results obtained by the CALPUFF model were minor compared to the results obtained by monitoring System Monitoring Air Quality of the Department of Cesar, SVCADC; however is necessary a closer examination of the emission factors of the mining projects and other emissions that are not related with the mining projects.

SINGLE PARTICLE STUDIES OF ATMOSPHERIC DUST IN THE MZTV

Elizabeth Teresita Romero-Guzmán[1]*, Lázaro Raymundo Reyes-Gutiérrez[2]

[1]*Instituto Nacional de Investigaciones Nucleares, Mexico State, 52750, México*
[2]*Universidad Autónoma Metropolitana, Unidad Lerma, Mexico State, City, 52006, Mexico*
**elizabeth.romero@inin.gob.mx*

Scanning electron microscopy with energy-dispersive spectroscopy has been used for both morphological and elemental chemistry analyses of atmospheric particles. This technique allows the *in situ* observation of individual aerosol particles in the sample chamber. Aerotransported particles were analyzed from seven monitoring stations located in the Metropolitan Zone of Toluca Valley (MZTV). Several different morphologies were identified: aggregates, porous spheres, rough and smooth compact material. The elemental composition included C, Na, Mg, Al, Si, S, Cl, K, Mn, Ca, Ti, V, Cr, Fe, Ni, Cu, Zn and Ce. These are semiquantitative analyses considering the bulk sample or individual particles. It was possible to correlate or confirm some chemical associations such as C-S, Ca-S-O and Si-Al-O, probably due to the presence of compounds derived from incomplete combustion, building tailing materials and aluminosilicates of cortical origin. Bioaerosols such as pollen, spores, brochosomes and diatoms were identified in the zone; all these types of particles have a natural origin too. Several types of suspended particles were identified in the MZTV, they were from different sources (natural and anthropogenic) to which the population can be potentially exposed, and may cause harm in the short- and long-term, according to their chemical element composition and size.

Romero-Guzmán E.T., Reyes-Gutiérrez L.R., Sandoval-Pérez A. (2012). Morphological and chemical characteristics of Atmospheric particles in the Metropolitan Zone of Toluca Valley (Mexico). Chemistry and Ecology, 28, 6, 574-588.

VOLCANIC ASH AGGREGATION: EXPERIMENTAL, FIELD AND THEORETICAL INVESTIGATIONS

Eduardo Rossi[1]*, Gholamhossein Bagheri[1], Costanza Bonadonna[1], Sebastien Biasse[1], Jean-Luc Falcone[2], Bastien Chopard[2], Piero Pontelandolfo[3], Patrick Haas[3]

[1]*Earth Sciences Department, University of Geneva, Geneva, 1205, Switzerland*
[2]*Computer Sciences, University of Geneva, Geneva,1205, Switzerland*
[3]*CMEFE University of Applied Sciences Western Switzerland in Geneva, Geneva,1205, Switzerland*
**Eduardo.Rossi@unige.ch*

Ash aggregation is considered as a key process that may affect dispersal and sedimentation of volcanic ash, with significant implications for the associated hazards. Up to now most theoretical studies of particle aggregation have been based on the Smoluchowski Coagulation Equation (SCE), which describes the expected time evolution of the total grain-size distribution under the hypothesis that particles can collide and stick together following specific mathematical relations (kernels). Unfortunately these kernels are not very well understood and quantified. In particular, the probability of sticking is almost completely unknown and it can be described theoretically just in a very approximate way. We have carried out a set of experiments to investigate how the sticking efficiency varies as a function of particle size and velocity. Ash particles larger than 100 mm were suspended in a 4-meters high vertical wind tunnel and recorded in time with a high-speed camera. Filming the interactions of small particles and using a dedicated Particle Tracking Velocimetry software, sticking efficiencies were characterized based on the number of particles that formed aggregates in relation to the number of collisions. Experiments were repeated in order to have a good statistical significance and to cover different environmental conditions (temperature and humidity). We have also carried out field experiments during various eruptions at Sakurajima volcano (Japan) for the characterization of aggregates in situ in combination with high speed recordings and SEM studies. Experimental and field results were then merged with the theoretical framework (SCE) to study the time evolution of different initial grain-size distributions for different external conditions.

MAJOR DUST EVENTS IN EUROPE DURING MARINE ISOTOPE STAGE 5 (130-74 KA): A CLIMATIC INTERPRETATION OF THE "MARKERS"

Denis-Didier Rousseau[1,2]*, Michael Ghil[1], George Kukla[2], Adriana Sima[1], Pierre Antoine[5], Markus Fuchs[6], Christine Hatté[7], France Lagroix[8], Maxime Debret[9], Olivier Moine[5]

[1]*ENS, Laboratoire de Météorologie Dynamique & CERES-ERTI, 24 rue Lhomond, 75231 Paris, France*
[2]*Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY 10964, USA*
[5]*Laboratoire de Géographie Physique, 1 place Aristide Briand, 92195 Meudon, France*
[6]*Department of Geography, Justus-Liebig-University Giessen, 35390 Giessen, Germany*
[7]*Laboratoire des Sciences du Climat et de l'Environnement, Domaine CNRS, 91198 Gif / Yvette, France*
[8]*Institut de Physique du Globe de Paris, Université Paris Diderot, 75005 Paris, France*
[9]*Morphodynamique Continentale et Côtière, Université de Rouen, 76821 Mont-St. Aignan Cedex, France*
**denis.rousseau@lmd.ens.fr*

At present Western Europe, though, does not experience major dust storms, except for some African dust reaching it from the Sahara. This modern situation is of particular interest, in the context of future climate projections, since the present interglacial is usually interpreted as an analog of the warm Eemian interval. European terrestrial records show, however, major dust events during the penultimate interglacial and early glacial. These events are easily observed in loess records by their whitish-color deposits, which lie above and below dark chernozem paleosols in Central European records of Marine Isotope Stage (MIS) 5 age. We describe the base of the Dolni Vestonice (DV) loess sequence, Czech Republic, as the reference of such records. The dust is deposited during intervals that are characterized by poor vegetation while fine sand and clay in the deposits shows grain sizes that are clearly different from the overlying pleniglacial loess deposits. Some of these dust events have been previously described as "Markers" or Marker Silts (MS) by one of us (G. Kukla), and are dated at about 111-109 ka and 93-92 ka, with a third and last one slightly visible at about 75-73 ka. Other events correspond to the loess material of Kukla's cycles, and are described as eolian silts (ES); they are observed in the same DV sequence and are dated at about 106-105 ka, 88-86 ka, and 78.5-77 ka. These dates are determined by considering the OSL ages with their errors measured on the studied sequence, and the comparison with Greenland ice-core and European speleothem chronologies. The fine eolian deposits mentioned above, MS as well as ES, correspond to short events that lasted about 2 ka; they are synchronous with re-advances of the polar front over the North Atlantic, as observed in marine sediment cores. These deposits also correlate with important changes observed in European vegetation. Some ES and MS events appear to be coeval with significant dust peaks recorded in the Greenland ice cores, while others are not. This decoupling between the European eolian and Greenland dust depositions is of considerable interest, as it differs from the fully glacial situation, in which the Eurasian loess sedimentation mimics the Greenland dust record. We show here, by a comparison with speleothems of the same age found in the northern Alps, that different atmospheric-circulation modes seem to be responsible for the two categories of dust events, MS vs. ES.

2941 YEARS OF SOUTHWEST NORTH AMERICAN DUSTINESS

Cody C. Routson[1,5]*, Connie A. Woodhouse[1,2,5], Jothathan T. Overpeck[1,3,4]

[1]*Department of Geoscience, University of Arizona, Tucson, Arizona, USA*
[2]*School of Geography and Development, University of Arizona, Tucson, Arizona, USA*
[3]*Institute of the Environment, University of Arizona, Tucson, Arizona, USA*
[4]*Department of Atmospheric Sciences, University of Arizona, Tucson, Arizona, USA*
[5]*Laboratory of Tree-Ring Research, University of Arizona, Tucson, Arizona, USA*
**routson@email.arizona.edu*

We present a 2941-year-long, sub-decadal resolution record of dust deposition from Fish Lake, in the southern San Juan Mountains, Colorado. We used µXray-fluorescence to analyse the geochemical composition of sediment cores, and also analysed local bedrock and dust deposited on local snowpack to constrain dust-input end-members for our site. An end-member mixing method was employed to calculate the fraction of wind-deposited dust in lake sediment through time. Independent high-resolution grain size records were also developed from the same cores, which were combined with the geochemical results to create a composite dust reconstruction. The Fish Lake dust record was compared with regional tree-ring based drought records to assess if southwest U.S. megadroughts that occurred in the past several millennia were severe enough to mobilize dust. The Fish Lake record shows anomalous dustiness in the early to mid 20th century, associated with recent land disturbance, drought, and livestock grazing, consistent with previous work in the region. The record also shows an overall downward trend in dustiness over the record length, representing a long-term change in aridity. Medieval times were associated with high levels of dustiness, consistent with widespread medieval aridity. The period between 800 and 300 BC was also unusually dusty. High levels of pre-industrial dustiness indicate the Southwest is naturally prone to periods of desertification. As global temperatures rise and the southwest U.S. shifts toward a more arid landscape, understanding the relationship between dustiness, drought, and water resources will become ever more imperative.

URBAN POLLUTION: LESSONS FROM APOLLO

William J. Rowe M.D. FBIS

Former Assistant Clinical Professor of Medicine, Medical College of Ohio at Toledo. 1485 Bremerton La. Keswick, Virginia 22947, U.S.A.
rowerun@aol.com

I have published that correcting magnesium deficiencies may prolong life. In U.S.A. estimated that 60% of population have significant reductions of Mg, often unrecognized with serum studies, since 99% is intracellular. Mg is a powerful antioxidant and is required for synthesis of telomeres which are vulnerable to oxidative stress; they are repetitive nucleotide sequences at ends of chromosomes, protecting them from deterioration. The enzyme telomerase, also Mg- dependent, is involved in DNA repair. There are significant deficits with space flight (SF) of serum Mg ($p <0.0001$) along with elevated adrenaline with vicious cycles between the two; this is conducive to oxidative stress and can injure the endothelium- intensified by dust inhalation, brought into habitats on space suits. With SF, there is >40 % reduction of a vessel dilator and clot buster: atrial natriuretic peptide, also Mg dependent. With access to data of only 4 of the 12 Apollo astronauts: Irwin, Apollo 15, with heart rhythm disturbance triggering syncope, severe dyspnea with classical angina during reentry, stress test (ST)-cyanosis of fingernail beds on landing day and the following day ST-extraordinary blood pressure (BP) >275/125) in 3 minutes of exercise. Both Scott and Irwin, Apollo 15, showed ST-deterioration of cardiac function. After Apollo 14, Shepard's ST-BP dropped from 210/85 to 185/70 terminating the ST. After Apollo 11, Armstrong showed marked elevation of ST-diastolic BP (50 mm Hg) in comparison with his resting BP consistent with ischemic left ventricular dysfunction. Since, with microgravity, an accelerated aging process is 10 times faster than on Earth, research on the International Space Station would be easier and cheaper. First a determination of an ideal Ca/Mg. intake ratio in Space. Rats, with a life span on Earth of 3 years, would be treadmill exercised a half hour twice daily; exposure to urban dust 4 hours/ day, measuring their white blood cell telomerase and telomere lengths with age-matched controls on Earth. Duration of studies 6 months. In those rats, not surviving, determining organ vascular cell telomere lengths and telomerase. This study might determine whether an ideal Ca/Mg. intake ratio prolongs life in the presence of urban dust inhalation.

EFFECT OF OXALATE AND PH ON CHRYSOTILE DISSOLUTION AT 25ºC: AN EXPERIMENTAL STUDY

Marisa Rozalen[1], M. Elena Ramos[1], Saverio Fiore[2], Fernando Gervilla[1,3], F. Javier Huertas[1]*

[1]*Instituto Andaluz de Ciencias de la Tierra (CSIC-Univ. Granada), 18100 Armilla (Granada), Spain*
[2]*Institute of Methodologies for Environmental Analysis, CNR, 85100 Tito Scalo, Potenza, Italy*
[3]*Departamento de Mineralogía y Petrología, Universidad de Granada, 18071 Granada, Spain*
**javierhuertas@ugr.es*

The effect of pH on the kinetics of chrysotile dissolution was investigated at 25 °C in batch reactors at pH 1 to 13.5, in oxalic solutions and buffered solutions of inorganic salts. Dissolution rates were obtained based on the release of Si and Mg. Results of the batch with inorganic buffers showed a strong dependence of dissolution rates (R) on pH in the acid range. The log$R$ decreases with the pH with a slope of n = 0.27. Around neutral pH, a minimum is reached. From pH 8 to 12, R increase again when pH increases, and follow a linear dependence with a shallow slope (n = 0.06). The Mg/Si ratio shows a non-stoichiometric dissolution reaction with a preferential release of Mg^{2+} at acidic pH; it decreases at neutral pH conditions according to Mg solubility. Our results suggest that the relative ease of the breaking of Mg-O bonds compared with Si-O bonds lead to dissolution via a series of steps involving Si and Mg, where Si release is the rate-limiting step.

In 15 mM oxalate solutions, an intense catalytic effect from pH 1 to 6 is observed because of the capacity of the oxalate anion to form different complexes with Mg. The ratio of the rates derived from Mg and Si concentrations confirm an enhancement of non-stoichiometric dissolution compared with the series without oxalate. The mechanism of catalysis involves different processes depending on pH: At pH 1, XRD analysis confirms the formation of an amorphous silica phase dissolving all the Mg present in the chrysotile structure. At pH 2, XRD and FTIR results also confirm the precipitation of glushinskite (magnesium oxalate). At pH 3 to 6, the oxalate enhances dissolution almost by an order of magnitude compared with the experiments in inorganic buffered solutions. In this case, the mechanism could be due to the formation of aqueous or surface magnesium oxalate complexes.

However, dissolution rates at neutral pH in the presence of oxalate are similar to those obtained in inorganic buffered solutions; the pH dependence at pH 8 to 13 is minimal. The increase in saturation and the drastic decrease in Mg solubility at these pH values could lead to precipitation of secondary phases coating the reactive mineral surface and inhibiting the surface.

Results obtained in this study show that chrysotile dissolves faster in acid media and oxalate acts a strong catalyst increasing the efficiency of magnesium release to solution at ambient temperature. These data may provide an excellent background to design and select optimal conditions in the previous acid treatment for carbon capture processes, as well as help to develop remediation process of asbestos contaminated sites.

SAHARAN DUST MEASUREMENTS FROM THE FENNEC AIRCRAFT CAMPAIGN: SIZE DISTRIBUTIONS, OPTICAL PROPERTIES, AND CHANGES WITH TRANSPORT

Claire Ryder[1]*, Eleanor Highwood[1], Phil Rosenberg[2], Harald Sodemann[3], John Marsham[2], Richard Washington[4]

[1]*Department of Meteorology, University of Reading, Reading,RG6 6BB, UK*
[2]*School of Earth and Environment, University of Leeds, LS2 9JT, Leeds, UK*
[3]*Institute for Atmospheric and Climate Science, ETH Z¨urich, Switzerland*
[4]*Department of Geography, University of Oxford, Oxford, UK*
**c.l.ryder@reading.ac.uk*

New in-situ aircraft measurements of Saharan dust originating from Mali, Mauritania and Algeria taken during the Fennec 2011 aircraft campaign over a remote part of the Sahara Desert are presented.

Firstly, size distributions extending to 300 μm will be shown (Ryder et al., 2013a). A significant coarse mode was present in the size distribution measurements with effective diameter (d_{eff}) from 2.3 to 19.4 μm and coarse mode volume median diameter (d_{vc}) from 5.8 to 45.3 μm. The mean size distribution had a larger relative proportion of coarse mode particles than previous aircraft measurements. The largest particles (with d_{eff} >12 μm, or d_{vc} >25 μm) were only encountered within 1 km of the ground. Two cases of freshly uplifted dust showed quite different characteristics of size distribution and number concentration. Single Scattering Albed (SSA) values at 550 nm calculated from the measured size distributions revealed high absorption ranging from 0.70 to 0.97. SSA was found to be strongly related to d_{eff}.

Secondly, aircraft measurements comprising 42 profiles of size distribution will be shown (Ryder et al., 2013b) representing freshly uplifted dust over the Sahara, regional aged dust, and dust in the Saharan Air Layer (SAL) over the Canary Islands. The mean effective diameter of dust in SAL profiles is 4.5mm smaller than that in freshly uplifted dust, while the vertical structure changes from a low shallow layer (0-1.5 km) to a well-mixed deep Saharan dust layer (0-5 km). Size distributions show a loss of 60 to 90% of particles larger than 30 mm 12 h after uplift. The single scattering albedo (SSA) increases from 0.92 to 0.94 to 0.95 between fresh, aged, and SAL profiles: this is enough to alter heating rates by 26%. Some fresh dust close to the surface shows SSA as low as 0.85.

Ryder, C.L., Highwood, E., Rosenberg, P., Trembath, J., Brooke, J., Bart, M., Dean, A., Crosier, J., Dorsey, J., Brindley, H., Banks, J., Marsham, J.H., McQuaid, J.B., Sodemann, H., Washington, R., (2013b), Optical properties of Saharan dust aerosol and contribution from the coarse mode as measured during the Fennec 2011 aircraft campaign, 13, 303-325, doi:10.5194/acp-13-303-2013, ACP.

Ryder, C. L., E. J. Highwood, T. M. Lai, H. Sodemann, and J. H. Marsham (2013b), Impact of atmospheric transport on the evolution of microphysical and optical properties of Saharan dust, Geophys. Res. Lett., 40, 2433-2438, doi:10.1002/grl.50482.

STUDYING UNDIFFERENTIANTED OUTDOOR DUST ON URBAN SITES THROUGH DIFFERENT METHODS

Armen Saghatel, Lilit Sahakyan, Olga Belyaeva*, Nairuhi Maghakyan

The Center for Ecological-Noosphere Studies of National Academy of Sciences of Republic of Armenia, 0025, Aboivian str. 68, Yerevan c., Republic of Armenia
**olgabel80@gmail.com*

Outdoor dust as a pollutant is also a transit environment for different pollutants emphasizing heavy metals. The largest mass of dust mostly forms at a maximal height of 500 m, so investigations of near-surface layer are best informative in respect of assessment of dust impact upon human and other living organism. Commonly, it is urban population, who is exposed to the maximal adverse impact of dust and associated pollutants as diversity of pollution sources in cities is combined with density of urban population.
In most cases, dust and heavy metal pollution researches on urban sites are implemented on few permanent monitoring stations. However, the dynamics of intense development of modern cities, specifics of site development and heavy traffic, in some cases - peculiarities of complex relief and native landscape induce intense changes in geochemical indices in space and time, so data obtained from few monitoring stations cannot be sufficient enough to provide a real picture of atmospheric pollution. The most detailed information is obtained from synchronous instrumental sampling (aspiration) and studies of indicator environments (snow cover, leaves).
This research was aimed at assessment of levels of near-surface air layer pollution with dust and heavy metals through different methods on the example of city of Yerevan - the capital of the Republic of Armenia.
For many years, Yerevan has been marked by high atmospheric dust pollution levels. The city area - 232 sq.km - comprises a complex mosaic of natural and man-made sources of dust. The arid landscape of Yerevan, its complex relief, a huge amount of different-profile industrial enterprises and heavy traffic has brought to pollution of the atmosphere with dust and heavy metals. The research was implemented during 2011-2012 in Yerevan and included a snow cover survey, sampling of leaves of dust absorbing tree species and synchronously - atmospheric dust sampling.
Studies implemented employing indicator environments and instrumental measurement methods allowed to assess dust and heavy metal load and contents on the entire territory of Yerevan, identify pollution sources, contour ecologically unfavourable sites and finally reveal risk groups among the population. The obtained research results underlay development of risk reduction measures for public health.

Acknowledgement - This research was implemented in the frames of a grant №11-1e054 “Investigations of geochemical stream of elements in the atmosphere of the city of Yerevan” under support of State Education Committee to the Ministry of Education and Science RA.

A STUDY OF OUTDOOR DUST IN CITY OF GYUMRI, ARMENIA

Lilit Sahakyan, Nairuhi Maghakyan*, Olga Belyaeva

The Center for Ecological-Noosphere Studies of National Academy of Sciences of Republic of Armenia, 0025, Abovian str. 68, Yerevan c., Republic of Armenia
**nairuhi.maghakyan@gmail.com*

This research covered the second biggest city of the Republic of Armenia - Gyumri (former Leninakan) having an area of 45 km^2 and a population of 150 thousand people. The city lies within a seismically active zone. Strong earthquakes that occur there periodically, affect social and economic conditions and environmental status. The recent devastating one known as the Spitak earthquake of December 7, 1988 almost completely ruined the city. Present-day Gyumri has been re-built partially, nonetheless numerous dust sources and natural and anthropogenic factors are detectable there that significantly contribute to dust pollution.
The research goal was assessing outdoor dust pollution levels of Gyuri for the first time after the 1988 earthquake.
The research was implemented in August-September 2013 by different methods (indicators (leave dust), direct dust sampling from the air) which allowed determining dust loading (kg/km^2 day) and dust contents (mg/m^3). The sampling points were maximally spatially associated. In total, collected were 21 leaf dust and 22 air dust samples. Sampling was done from throughout the city through regular grids.
Maps produced to reveal and collate peculiarities of spatial distribution of dust load and dust contents helped isolate the dustiest sites of the city. It is noteworthy that 2 peaks in dust loading were established in the west and north parts of the city, this disagreeing with those in dust contents. At the same time MAC - exceeding contents of dust were detected on the entire area of the city, whereas dust load levels there were found out to be low. It is noteworthy, too, that for the studied period dust contents in the city outskirts remained low and were not excessive against MAC. This means that dust accumulates mostly in the main residential district of the city.
The assessed dust pollution levels allow concluding that dust is one of prior pollutants of atmospheric air in city of Gyumri and therefore is an ecological risk factor to the local population.

Acknowledgement - This research was implemented in the frames of a grant №13-1E220 “Determination of ecogeochemical peculiarities of city of Gyumri” under support of State Education Committee to the Ministry of Education and Science RA.

EFFECT OF TWO DESERT DUST EVENTS ON ULTRAVIOLET AND TOTAL SHORTWAVE SOLAR RADIATION AT THE SURFACE IN ÉVORA

Vanda Salgueiro[1]*, Sérgio Pereira[1], Maria João Costa[1,2], Maria Ángeles Óbregon[1], Ana Maria Silva[1], Daniele Bortoli[1]

[1]*Geophysics Centre of Évora, Rua Romão Ramalho nº59, Évora, 7000, Portugal*
[2]*University of Évora, Physics Department, Rua Romão Ramalho nº59, Évora, 7000, Portugal*
**vsalgueiro@uevora.pt*

The current work presents a study of the effects exerted by Saharan dust on ultraviolet (280-400nm) and total shortwave (285-2800 nm) solar radiation at the surface. Aerosols may change the amount of solar radiation that reaches the surface through absorption and scattering processes, therefore the radiative effects of two Sahara desert dust transports, which reached Évora in the south of Portugal (38°34' N, 7°54' W) in August 2012, are analysed. These events, which occurred from 8 to 11 August and from 17 to 21 August, are characterized by large aerosol optical thickness values with very low wavelength dependence. In order to study the aerosol effects on the surface radiation, the radiative forcing is determined and related with aerosol properties, which were obtained from spectral irradiance measurements of the CIMEL sun-photometer installed in Geophysics Centre of Évora (CGE) and included in the Aerosol RObotic NETwork (AERONET) (Holben, 1998). Global irradiance measurements in the ultraviolet and total shortwave solar spectral regions were measured every 60 minutes with Kipp&Zonnen radiometers and with an Eppley Black & White pyranometer respectively and were used to calculate the radiative forcing. The irradiance corresponding to clear sky conditions, also necessary to calculate the radiative forcing, is obtained from the empirical fit of clear sky irradiance measurements in clear sky days, with background aerosol conditions, near the events (Long and Ackerman, 2000). It is important to refer that the first dust event was accompanied by the presence of pollution at the surface, whereas the second event is only due to Saharan dust transport. This fact is taken into account in the analysis, especially in the comparison of the radiative forcing estimates for both events. On the other hand, the increase (decrease) of shortwave diffuse (direct) irradiance due to the increase of dust aerosol load is quantified by comparing these with diffuse (direct) irradiance measurements taken during clear sky clean days in the same month. The increase (decrease) found, ranging from about 140 to 240% (15 to 30%) around solar noon, for the diffuse (direct) irradiance, is also related with the dust aerosol properties.

Holben B.N., T.F.Eck, I.Slutsker, D.Tanre, J.P.Buis, A.Setzer, E.Vermote, J.A.Reagan, Y.Kaufman,T. Nakajima, F.Lavenu, I.Jankowiak, and A.Smirnov. (1998). AERONET - A federated instrument network and data archive for aerosol characterization. Rem. Sens. Environ., pp. 1-16.

Long, C. N., and T. P. Ackerman, 2000: Identification of clear skies from broadband pyranometer measurements and calculation of downwelling shortwave cloud effects. J. Geophys. Res., 105, No. D12, 15609-15626.

DUST EPISODES AND THEIR EFFECTS ON THE CHEMICAL AND BIOLOGICAL TRANSFORMATIONS OF COARSE AND FINE PARTICLES IN BEIRUT, LEBANON

Najat A. Saliba[1]*, Rima Baalbaki[1], Lubna El Dada[1], Raya Mrad[1], Malek Jaafar[1], Nancy Daher[2], Alan Shihadeh[3], Costantinous Sioutas[2]

[1]*American University of Beirut, Department of Chemistry, Beirut, Lebanon*
[2]*University of Southern California, Department of Civil and Environmental Engineering, Los Angeles, USA*
[3]*American University of Beirut, Department of Mechanical Engineering, Beirut, Lebanon*
**ns30@aub.edu.lb*

The increase in the total annual number of dusty days in the eastern Mediterranean is considered a result of local synoptic changes that are well documented and modeled in the region (Alpert et al., 2004, Goudie and Middleton, 2001). Based on a review of Mediterranean dust events in the past 49 years, an increasing trend of 0.27 days per year has been reported (Ganor et al., 2010). The combination of higher frequency dust events with hot weather conditions is considered a favorable medium for homogeneous and heterogeneous photochemical processes which lead to higher concentrations of secondary organic aerosols and inorganic ions in particles. The implications of such events extend beyond the Mediterranean region and so understanding the effect of particle morphology, chemical composition on the oxidative properties of particulate matter remain an important subject to investigate in different urban cities in the region. Beirut experiences episodes originating from the Saharan and Arabian deserts during the winter, summer and spring seasons (Middleton, 1986). For the Arabian episodes, these storms cross over various urban environments while Saharan dust crosses over the Mediterranean Sea. When dust particles mix with emissions from industrial and urban sites, it triggers chemical changes inducing morphological deformation of primary particles along with formation of new secondary ones.

Distribution, morphology and chemical composition of particles in Beirut during *dust-rich* days originating from two distinct sources; Saharan and Arabian deserts will be presented. Furhtermore, ROS activity for coarse and fine particles collected during *dust-rich* and *normal* episodes are evaluated using a cell-based assay and a cell-free assay. In order to identify specific markers for each trajectory, images of single particles collected during dust episodes are compared to normal episodes at a background and road-traffic sites. Results serve as basis for further research and modeling to assess the process of aerosol aging.

Alpert, P., I. Osetinsky, B. Ziv and H. Shafir (2004). A new seasons definition based on classified daily synoptic systems: An example for the eastern Mediterranean. International Journal of Climatology,24, (8), 1013-1021.

Ganor, E., I. Osetinsky, A. Stupp and P. Alpert (2010). Increasing trend of African dust, over 49 years, in the eastern Mediterranean. Journal of Geophysical Research D: Atmospheres,115, (7), art. no. D07201.

Goudie, A. S. and N. J. Middleton (2001). Saharan dust storms: Nature and consequences. Earth-Science Reviews,56, (1-4), 179-204.

Middleton, N. J. (1986). Dust storms in the Middle East. Journal of Arid Environments,10, (2), 83-96.

PLSR AND ANN ESTIMATION MODELS FOR PM10-BOUND HEAVY METALS IN DUNKERQUE (NORTHERN FRANCE)

Germán Santos[1]*, Ignacio Fernández-olmo[1], Angel Irabien[1], Frédéric Ledoux[2], Dominique Courcot[2]

[1]*Dpto. de Ingenierías Química y Biomolecular, Universidad de Cantabria, Santander, 39005, Spain*
[2]*Unité de Chimie Environnementale et Interactions sur le Vivant (UCEIV) EA 4492, Université du Littoral Côte d'Opale, Dunkerque, 59140, France*
**santosg@unican.es*

The aim of this work is to develop simple tools to estimate the heavy metal levels in ambient air so that they can be used for air quality assessment in those zones where these levels are low and, as a consequence, a high degree of uncertainty is allowed. The final purpose of this approach is that these tools may be used by the Regional Environmental Departments as an alternative to experimental measurements which would suppose a reduction in public spending.

To achieve this goal, statistical estimation models based on Partial Least Squares Regression (PLSR) and Artificial Neural Networks (ANN) have been applied to find the relationship between the metal concentrations in ambient air (response) and some independent variables (predictors) believed to be influential towards them acording to the literature. These independent variables considered are constituted by: nominal variables, to take into account the seasonal and the weekend effects; and continuous variables including meteorological data and major pollutant concentrations. An intensive PM_{10} sampling campaign was conducted at des Darses site in Dunkeque (Northern France) for the period from February to May 2008. As a result, 78 samples were measured and their content on Pb and Ni, as regulated metals, and Mn, V and Cr, as non-regulated metals, consitutes the dependent variables used in this study.

The main criteria employed in this work to determine whether a model is suitable for air quality assessment purposes is principally based on two aspects: (i) the fulfillment of the European Union uncertainty requiremetns for objective estimation techniques and (ii) the accuracy of estimated mean values. Taking into account this criteria and based on the results obtained from the external validation dataset when the best developed models are used, both PLSR and ANN can be considered valid approaches to estimate Pb, Ni, Mn, V and Cr levels in Dunkerque. Nevertheless, they show some difficulties when it comes to estimate the individual sample concentrations, in particular ANN models due to overfitting.

Aknowledgements - This work was supported the Spanish Ministry of Economy and Competitiveness (MINECO) through the Project CTM2010-16068 and the FPI short stay EEBB-I-13-07691.

ATMOSPHERIC DEPOSITION OF MINERAL DUST TO THE NORTHERN INDIAN OCEAN: IMPACT ON SURFACE OCEAN BIOGEOCHEMISTRY

M.M. Sarin[1]*, Bikkina Srinivas[1,2]

[1]*Physical Research Laboratory, Ahmedabad - 380 009, India*
[2]*Institute of Low Temperature Science, Hokkaido University, Sapporo - 060 1819, Japan*
**sarin@prl.res.in*

Atmospheric transport of mineral dust from arid and semi-arid regions is a perennial source of macro and micro nutrients (N, P and Fe) to the ocean surface (GAW Report No: 203; Mahowald et al 2012). In the global context, Northern Indian Ocean (NIO), comprising of Arabian Sea (ARS) and Bay of Bengal (BoB), is an important oceanic region that receives dust input from the surrounding desert regions (Arab, Oman, Iranian and Thar) during the spring inter-monsoon (March-May). Our systematic study conducted over the past few years has brought out some important differences in nutrients supply to the NIO. The case study on fractional solubility of aerosol-Fe (Fe_{ws} (%) = Fe_{ws}/Fe_{Tot} x 100 where Fe_{ws} and Fe_{Tot} are water-soluble and total aerosol iron respectively) and concentration of soluble-phosphorous (P_{Inorg}), measured in the marine atmospheric boundary layer (MABL), reveals significantly high values for BoB (Fe_{ws} % = 2.3 - 13.6 % and P_{Inorg}: 0.7 - 2.1 nmol m^{-3}) compared to the ARS (Fe_{ws} % = 0.02 - 0.4 % & P_{Inorg}: 0.2 - 0.5 nmol m^{-3}). These differences are attributable to reactive uptake of anthropogenic acidic species (H_2SO_4 and HNO_3) by mineral dust during the long-range atmospheric transport (Srinivas et al., 2011; Srinivas and Sarin, 2012). The air-sea deposition of dust (assessed from Fe-deposition, Fe_{dep}: ~ 400 µg m^2 d^{-1}) is compared with the dissolved Fe concentration in surface waters of both oceanic regions in order to estimate the residence time (τ_{Fe}) of Fe. The short residence time of this micro-nutrient (BoB: 0.15 yrs; ARS: 0.04 yrs) brings to focus the significance of atmospheric input to NIO. A comparison of our data on dust input with the model-based projections (reported in the literature) prompts us to infer that there are no substantial changes in the deposition fluxes to NIO on a decadal time scale (Srinivas and Sarin, 2013). However, spatial-scale linear trend between aerosol optical depth (AOD) and chlorophyll-a during the spring inter-monsoon is noteworthy for the BoB, suggesting that a further increase in dust deposition would lead to enhancement in the Primary Production and, thus, leading to biodiversity in surface waters. On the contrary, increase in aerosol toxicity as evident from high enrichment factors (EF) of anthropogenic trace metals (EF_{Pb}: 25 - 110; EF_{Cd}: 130 - 1605 and EF_{Cu}: 10 - 275; Srinivas and Sarin, 2013) suggests that air-sea deposition of toxic trace metal to the oceanic regions located downwind of the pollution sources could have large impact on the biogeochemistry of surface waters.

GAW Report No203, The Atmospheric Input of Chemicals to the Ocean (GESAMP Report No 84).

Mahowald N. (2011). Aerosol Indirect Effect on Biogeochemical Cycles and Climate, Science, 334.

Srinivas B, Sarin M, Kumar A. (2011). Impact of anthropogenic sources on aerosol iron solubility over the Bay of Bengal and the Arabian Sea. Biogeochemistry, 110, 257-268.

Srinivas B., Sarin M. (2012). Atmospheric pathways of phosphorous to the Bay of Bengal: contribution from anthropogenic sources and mineral dust. Tellus B, 64, 17114.

Srinivas B, Sarin M.M. (2013). Atmospheric dry-deposition of mineral dust and anthropogenic trace metals to the Bay of Bengal. Journal of Marine Systems, 126, 56-68.

DEVELOPMENT OF HIGH PERFORMANCE VISIBLE LIGHT RESPONSIVE PHOTOCATALYSTS FOR ENVIRONMENTAL CLEANUP VIA SOLVOTHERMAL REACTIONS

Tsugio Sato*, Xiaoyong Wu, Huihui Li, Shu Yin

Institute of Multidisciplinary Research for Advanced Materials, Sendai, 980-8577, Japan
**tsusato@tagen.tohoku.ac.jp*

Recently, much attentions have been attracted on the materials chemistry to support the sustainable development of human being society. Photocatalytic reactions have been received special attention because of their possible application to environmental cleanup, etc., without using fossil energies. Until now, so many photocatalysts have been developed, however, only titania has been commercially used because of the excellent catalytic activity and chemical stability. The disadvantage of titania is the relatively large bandgap energy of about 3 eV, which does not cover the main part of the solar spectrum. Recently, it was reported that the band gap of titania could be narrowed by doping with nitrogen, carbon, etc. In the present study, nitrogen and carbon-doped titania were prepared via solvothermal reactions, and their photocatalytic performances for environmental cleanup under visible light irradiation were evaluated.

After dissolving the nitrogen source compound such as hexamethylenetetramine, urea, etc. and desired alcohol in titanium trichloride aqueous solution, the solution was heated at desired temperatures. The samples precipitated were washed with water and ethanol three times, respectively, and vacuum dried to obtain nitrogen and carbon-doped titania nanoparticles. The composites of doped titania nanoparticles and $CaAl_2O_4$:(Eu,Nd) long afterglaw phosphor particles were also fabricated by soft ball-milling. Photocatalytic activities of the samples were evaluated for the oxidative destruction of nitrogen monoxide and acetaldehyde in air atmosphere.

The photocatalytic activity of nitrogen-doped titania could be improved by coupling with iron oxide possessing different band structure due to the promotion of the heterogeneous electron transfer and/or co-doping with Nd^{5+} and Ta^{5+} to depress the lattice defect formation. In addition, the composites of these visible light responsive titania with $CaAl_2O_4$:(Eu,Nd) long afterglow phosphors showed excellent photocatalytic activity for the destruction of nitrogen monoxide and acetaldehyde not only under irradiation of UV-light and visible-light, but also after turning off irradiation light, indicating the possibility of the construction of the full-time active photocatalytic system.

EFFECTS OF DUST AEROSOL AGING DURING LONG-RANGE TRANSPORT ON THE ATMOSPHERIC RADIATIVE BALANCE IN THE CARIBBEAN DURING SALTRACE 2013

Daniel Sauer[1,2]*, Bernadett Weinzierl[2], Silke Gross[2], Josef Gasteiger[1]

[1]*Meteorologisches Institut, Ludwig-Maximilians-Universität Mümchen, 80333 Munich, Germany*
[2]*Institut für Physik der Atmosphäre, Deutsches Zentrum für Luft- und Raumfahrt (DLR), 82234 Oberpfaffenhofen, Germany*
**daniel.sauer@dlr.de*

Model predictions for future climate scenarios still suffer from large uncertainties connected to the direct and indirect aerosol radiative effects. To facilitate a better quantitative understanding of the effect of aerosols on the atmospheric radiative balance detailed measurements of aerosol microphysical properties and eventually a globally representative data set of aerosol properties are needed.

Mineral dust is among the most abundant aerosols and the Sahara Desert constitutes its largest source. During frequent dust outbreaks thick elevated aerosol layers are formed and transported over large distances -often across the Atlantic Ocean into the Caribbean. The Saharan Aerosol Long-range Transport and Aerosol-Cloud-Interaction Experiment (SALTRACE) aims to study the properties of Saharan mineral dust aerosol and its effects on clouds on both sides of the Atlantic Ocean. The field experiment was performed in June/July 2013 combining airborne and ground-based in-situ and remote sensing measurements as well as satellite observations. Measurement sites were located in Cape Verde, Barbados and Puerto Rico. The Falcon 20E research aircraft operated by DLR was equipped with an extensive aerosol payload and performed measurement flights on both sides of the Atlantic using the same instrumentation. SALTRACE continues the work of the two SAMUM field experiments conducted in Morocco and the Cape Verde region in 2006 and 2008.

In dust outbreaks during the summer season, mineral dust aerosol is typically found in elevated layers with vertical extent of 2-4 kilometers reaching to altitudes of ~6 km on the eastern side of the Atlantic Ocean. The layers descend slightly to 5 km during transport into the Caribbean. While the dust layers in the Cape Verde region are mostly homogeneous, the structure found in the Caribbean is more complex: above ~2 km exists a largely unperturbed pure dust layer overlying a transition layer where mixing and cloud processing has occurred. At lower levels, mixing with the marine boundary layer aerosol is apparent.

Here we use the results of the airborne in-situ measurements from the SAMUM campaigns and SALTRACE to derive aerosol optical parameters which serve as input to radiative transfer calculations using the libRadtran radiative transfer package. Using such simulations, we study the effect of aerosol aging and the change of the layer structure on the aerosol radiative forcing and local heating. We focus on a case study where we had the opportunity to take measurements of a dust layer in the same air mass in the Cape Verde region and, five days later, near Barbados.

MODELLING MINERAL DUST OVER EUROPE WITH LOTOS-EUROS

Martijn Schaap[1]*, Arjo Segers[1], Fulvio Amato[1,2], Magdalena Jozwicka[1], Xavier Querol[2], Ina Tegen[3], Bernd Heinold[3], Sjoerd janson[1], Renske Timmermans[1]

[1]*TNO, P.O.Box 80015, NL-3508TA, Utrecht, the Netherlands*
[2]*CSIC, C/Jordi Girona 18-26, 08034 Barcelona, Spain*
[3]*IfT, Permoserstrasse 15, 04318 Leipzig, Germany*
**martijn.schaap@tno.nl*

In this study we present a new modelling approach for atmospheric mineral dust (MD) that combines four different source contributions: traffic resuspension, agricultural activities, wind-blown dust and desert dust. New emission parameterization and geographical variability of emission factors were built in the 3D Chemistry Transport LOTOS-EUROS model. The modelled annual concentration due to traffic resuspension is less than 0.3 $\mu g.m^{-3}$ in rural areas, but ranges up to 2 $\mu g.m^{-3}$ or more in densely populated regions. The annual contribution by agricultural management activity is modelled to be slightly lower than 1 $\mu g.m^{-3}$ over the European main land with contributions exceeding 2 $\mu g.m^{-3}$ over the arable areas. Wind erosion from European soils is calculated to contribute 0.1 $\mu g.m^{-3}$ or less to the annual average mineral dust concentration over most of Europe. The contribution from desert dust is important in the Mediterranean at latitudes below 44˚N (1-4 $\mu g.m^{-3}$) and in some locations up to 5 $\mu g.m^{-3}$. Spatial and time variability of concentrations was validated against mineral dust observations across Europe, revealing that the model is able to capture the geographical gradients and reproduce Saharan dust events, although for the rest of time series, the correlation between modelled and measured concentrations is not very good, indicating that further improvement is needed, mostly for traffic emissions. Other sources of uncertainty are reference emission estimates for agricultural emissions and possibly missing sources such as construction activities.
Currently, the routines for desert dust emissions are being updated in cooperation with IfT. Therefore, an additional focus will be put on the comparison of the two desert dust emission schemes.

CHARACTERIZATION OF DUST EMISSION FROM ALLUVIAL SEDIMENTS USING AIRCRAFT OBSERVATIONS AND REGIONAL MODELING

Kerstin Schepanski[1]*, Cyrille Flamant[2], Jean-Pierre Chaboureau[3], Cécile Kocha[2], Jamie R. Banks[4], Helen E. Brindley[4], Christophe Lavaysse[5], Fabien Marnas[6], Jacques Pelon[2], Pierre Tulet[7]

[1]*Leibniz Institute for Tropospheric Research, TROPOS, Leipzig, Germany*
[2]*Laboratoire Atmosphères, Millieux, Observations Spatiales, LATMOS, Paris, France*
[3]*Laboratoire d'Aérologie, LA, Toulouse, France*
[3]*Météo France, Toulouse, France*
[4]*Space and Atmospheric Physics Group, Imperial College London, London, UK*
[5]*Institute for Environment and Sustainability, JRC, Ispra, Italy*
[6]*Laboratoire des Sciences du Climat et de l'Environment, Gif-sur-Yvette, France*
[7]*Laboratoire de l'Atmosphère et des Cyclones, Université de La Réunion, Saint-Denis de La Réunion, France*
**kerstin.schepanski@web.de*

Recent studies using satellite observations show that numerous dust sources are located in the foothills of arid and semi-arid mountain regions such as over North Africa. Alluvial sediments deposited on the valley bottoms and flood plains are very prone to wind erosion and frequently serve as dust source. High surface wind speeds related to the break-down of the nocturnal low-level jet (LLJ) during the morning hours are identified as a frequent driving mechanism for dust uplift.

We investigate dust emission from alluvial dust sources located within the upland region in northern Mauritania and discuss the impact of valleys with regard to their role as dust source. Measures for local atmospheric dust burden were retrieved from airborne observations, MSG SEVIR dust AOD fields and MesoNH model simulations, and analyzed in order to provide complementary information on dust source activation and local dust transport at different horizontal scales. Vertical distribution of atmospheric mineral dust was obtained from the LNG backscatter lidar system flying aboard the French Falcon-20 aircraft. Lidar extinction coefficients were compared to topography, aerial photographs, and dust AOD fields to confirm the relevance of alluvial sediments at the valley bottoms as dust source. The observed dust emission event was further evaluated using the regional model MesoNH. A sensitivity study on the impact of the horizontal grid spacing highlights the importance of the spatial resolution on simulated dust loadings. The results further illustrate the importance of an explicit representation of alluvial dust sources in such models to better capture the spatial-temporal distribution of airborne dust concentrations.

NORTH AFRICAN DUST OVER THE MEDITERRANEAN BASIN: DUST SOURCE CHARACTERISTICS AND ATMOSPHERIC CONTROLS

Kerstin Schepanski[1]*, Marc Mallet[2], Thierry Borrianne[3], Hartwig Deneke[1], Paola Formenti[4], Evelyn Freney[5], Bernd Heinold[1], Jacques Pelon[6], Lars Klüser[7], Thomas Kunze[1], Greg Roberts[3], Karine Sellegri[5], Ina Tegen[1]

[1]*Leibniz Institute for Tropospheric Research, TROPOS, Leipzig, Germany*
[2]*Laboratoire d'Aérologie, LA, Toulouse, France*
[3]*Météo France, Toulouse, France*
[4]*Laboratoire Inter-universitaire des Systèmes Atmosphériques, LISA, Créteil, France*
[5]*Laboratoire de Météorologie Physique, Clermont-Ferrand, France*
[6]*Laboratoire Atmosphères, Millieux, Observations Spatiales, LATMOS, Paris, France*
[7]*German Aerospace Center, DLR, Oberpfaffenhofen, Germany*
**kerstin.schepanski@web.de*

Dust plumes originating from North African sources contribute to the atmospheric aerosol burden over the Mediterranean basin, a region that is highly affected by changing climate conditions. In the framework of the ChArMEx-ADRIMED project, which is examining the aerosol direct forcing and its impact on the Mediterranean climate, we present a study investigating the contribution from dust sources over North Africa to the atmospheric composition over the Mediterranean Sea. Numerical model simulations of the dust cycle are analyzed with regard to the representation of different dust source regions and types, as well as atmospheric controls on dust emission and transport pathways. Synthetic satellite radiances are used to obtain MSG SEVIRI IR dust images from the modeled dust distribution are analyzed with regard to the impact of dust optical properties on the atmospheric radiation. In order to assess the dust cycle and the contribution from different source types, particularly alluvial sediments from mountain regions, model fields will be compared to aircraft and ground based measurements, as well as satellite retrievals.

Results from this study will add to the understanding of emission characteristics of different dust source types, in particular of alluvial sources, which dominate over North Africa but are not well understood yet. Ultimately, this study will contribute to an improved representation of dust sources in numerical models.

THE HOLOCENE DUST RECORD FROM LAKE SIHAILONGWAN (NE-CHINA) - AN UPDATE OF 15 YEARS RESEARCH

Georg Schettler[1]*, Jens Mingram[1], Guoqiang Chu[2], Zhu Jiayun[3]

[1]*Deutsches GeoForschungsZentrum , Telegrafenberg, Potsdam 14473, Germany*
[2]*Institute of Geology and Geophysics, Chinese Academy of Sciences,Beijing 100029, China*
[3]*Institute of Bio- and Geosci., Agrosphere, Research Center Jülich, Jülich 52428, Germany*
**Georg.Schettler@gfz-potsdam.de*

Sediments filling the U-shaped basin of the closed dimictic crater Lake Sihailongwan (42°17'N, 126°36'E, elevation 797 m a.s.l., max. depth 50 m, diameter 720 m document substantial aeolian particle influx of remote provenance. The dust is transported by the zonal westerlies from arid Asian areas towards the study site. The chemical, mineralogical, and isotope composition of the dust component differs distinctly from local alkali-basaltic rocks, local soils, and granites and gneisses of the Archaean basement. Coarse volcanic particles covering the small catchment inside of the crater rim favour seepage of rainfall. According to micro-facies studies of varved sediments from the deepest part of the lake and sediment trap monitoring data, deposition of silt-sized particles of the remote dust component peaks in spring. Focussing of the fine particle flux towards the centre of the lake may reach a factor of 5 (estimate based on comparison regional atmospheric flux rates with flux rates of unsupported ^{210}Pb derived from sediment analysis). Correlations between rainfall and sedimentary flux rates calculated for unsupported ^{210}Pb and variations in the portion Al-rich debris indicate that the precipitation frequency influences the transfer of fine dust particles into the lake. The calcareous character (~ 15% $CaCO_3$) of Asian dust is well proven. Late Glacial and Younger Dryas sediments, when the atmospheric dust deposition was higher, show minor contents of inorganic carbon, whereas Holocene sediments and modern soils are non-calcareous throughout. Release of CO_2 related to soil respiration and related to microbial-mediated aerobic decomposition of settling organic matter in the lake is obviously high enough to sustain a complete chemical dissolution of the airborn calcite influx. Detailed flux rate calculations based on bulk chemical analyses and varve counting of corresponding 1-cm sediment intervals document long-term changes in the aeolian influx. Between 11 and 9 varve kyr BP the aeolian influx was high displaying pronounced inter-annual variations in the thickness of seasonal dust layers and gradually decreased afterwards. Laser-Particle analysis of the solid residues after wet-oxidation of the organic matter and sequential leaching of biogenic silica yielded new insights in the decadal scale variations of the detrital influx during the early Holocene. The background detrital sediment component closely scatters around a volume-weighted mean D[4,3] of 13.5 µm, the grain-size distribution peaks around 7 µm. Individual 1-cm sections show D[4,3] values distinctly above 15 µm relating to the occurrence of sand particles with a grain-size maximum at 120 µm. The coarse particles occur within small clusters in the thin sections. The palaeoclimate interpretation of the occurrence of these clusters is still a matter of debate and the determination of their origin a challenge for future research.

DUST CHARACTERISTICS AT THE NORTHERN SLOPES OF TIEN SHAN - RELATIONSHIPS WITH SEASONAL CHANGES IN HEMISPHERICAL CIRCULATION

Georg Schettler[1]*, Anton Shabunin[2], Helga Kemnitz[1], Kay Knoeller[3], Sanjar Imashev[4]

[1]*Deutsches GeoForschungsZentrum, Telegrafenberg, Potsdam, 14473, Germany*
[2]*Central Asian Institute for Applied Geosciences, Timura Frunze Str. 73/2, Bishkek, 720027, Kyrgyzstan*
[3]*Helmholtz Centre for Environmental Research - UFZ, Theodor-Lieser-Str. 4, Halle, 06120, Germany*
[4]*Kyrgyz-Russian Slavonic University, Kievskaya 44 Str., Bishkek, 720027, Kyrgyzstan*
**Georg.Schettler@gfz-potsdam.de*

There is less knowledge of the physical/chemical characteristics of dust transported towards the high mountain ranges of Central Asia with northerly and westerly airflows, regarding seasonal variations in dust load and composition and the possible contribution of this dust to the aerosol flow across Asia towards the Pacific Ocean. We have monitored the dust concentration at 1-min time resolution for 31 grain-size classes together with meteorological data on the northern slopes of the Tien Shan (1740 m asl.). Using a High-Volume-Impactor, particles > 2.5 µm were collected at 3-days sampling intervals for chemical, mineralogical and isotope analyses. The trapped dust is calcareous and reflects a substantial interaction with nitric and sulphuric acid aerosols during the atmospheric transport. Nitrates and sulphates are the dominant water-soluble components. Seasonally, the water solubility of Fe, Mn, and PO_4 increased substantially. Distinct diurnal local change of wind strength and direction overlays short- and long-term variations in the hemispherical wind regime, which carries mineral aerosols from remote source areas to the monitoring site. The mass concentration of the particle fraction > 2.5 exceeds those of fine particles < 2.5 µm. In general, the atmospheric concentrations of fine and coarse particles display coinciding variability. Typically, we observed a grain-size maximum around 4 µm and a minimum around 8 µm. Source regions of the dust are identified on the basis of backward trajectory calculations and optical satellite data. Air masses which travelled from northern Africa across Saudi Arabia to the sampling site carried a coarser particle load, higher contents of gypsum and lower portions of particles from anthropogenic origin (e.g., soot) than air masses which passed Central European industrial areas. Changing source and/or pathway of the air parcels that arrived at the monitoring site are independently indicated by departures from diurnal temperature and humidity variations. A high day-to-day variability in weather conditions and large-scale hemispherical circulation complicated the assignment of dust characteristics at 3-days sampling intervals to source regions of the dust. A short-term increase in the dust concentration (20 minutes) was clearly relatable to the outbreak of a dust storm over NE-Afghanistan. The atmospheric dust load changed to an uni-modal grain-size composition with a maximum at 5 µm. Frontal interaction causing rainfall efficiently washed out the dust. Finally, only 20% of the dust collected during the 3-days sampling interval related to the dust storm, therefore, the event specific chemical/mineralogical characteristics of the trapped Afghan dust were camouflaged by the signatures of the trapped 'background' dust.

DUST AS A SOURCE OF BIO-ESSENTIAL TRACE ELEMENTS FOR COASTAL SEA ICE IN MCMURDO SOUND, ANTARCTICA

Schoemann Veronique [1,2]*, de Jong Jeroen[1], Tison Jean-Louis[1], Haskell Timothy [3], de Baar Hein[2], Champenois Willy[4], Zhou Jiayun[1], Carnat Gauthier[1], Fripiat François[1], Goosens Thomas[1], Moreau Sebastien[5], Bruno Dellile[4]

[1]*Département des Sciences de la Terre et de l'Environnement, Université Libre de Bruxelles, Brussels, 1050, Belgium*
[2]*Royal Netherlands Institute for Sea Research, Den Burg, 1790, The Netherlands*
[3]*Industrial Research Ltd, Lower Hutt, 5040, New Zealand*
[4]*Unité d'Océanographie Chimique, Université de Liège, Liège, 4000, Belgium*
[5]*Georges Lemaître Centre for Earth and Climate Research, Louvain-la-Neuve, 1348, Belgium*
**vschoem@ulb.ac.be*

Iron (Fe) is a bio-essential metal with extremely low and therefore bio-limiting concentrations in more than 30% of the oceans, including the Southern Ocean. It has a crucial impact on the biogeochemical cycles of carbon and other elements with ultimate influence on the Earth climate system. Other trace metals, like Mn, Zn, Co and Cu are also required for microorganisms cell metabolism and may be (co-) limiting in high nutrient low chlorophyll areas. Trace metals dusts inputs are known to be generally insignificant in Antarctica. Previous dissolved and particulate Fe concentrations data from East Antarctica and the Weddell Sea pack ice showed that Fe is 10-100 times more concentrated in the sea ice than in underlying seawater and that sea ice melt can deliver up to 70% of the daily Fe supply to the surface waters. According to budget estimates, sea ice accumulated Fe in those areas would largely derive from the underlying seawater rather than from atmospheric inputs.

In this presentation, we will discuss results of trace metals (Fe, Mn, Zn, Cu, Cd, Al, Mo, Pb, Ni) concentrations in snow, sea ice, brines and seawater as well as dusts samples that have been collected in Erebus Bay during the land-based sampling program YROSIAE at Cape Evans (McMurdo Sound, Ross Sea, Antarctica) from November 2011 to December 2011 and from August 2012 to December 2012. Our objective is to assess whether atmospheric inputs from McMurdo Ice Shelf, the Dry Valleys, Ross Island and the Erebus volcano may play a significant role in providing bio-essential trace metals in McMurdo Sound and have an impact on primary productivity in the Ross Sea. Concentrations of trace metals in snow collected on land- fast ice in McMurdo Sound are one to up to five orders of magnitude higher than the concentrations previously observed in snow from East Antarctica, showing a much stronger dust input of these metals in McMurdo Sound. When comparing the concentrations obtained in the under-ice seawater with those obtained in the snow at McMurdo Sound, concentrations of Fe, Al, Mn, Co are much lower, whereas concentrations of Cu, Zn and Pb are similar and the concentrations of Ni, Mo and Cd are higher. Inventories of these trace metals in dusts, snow and the land fast ice give insights on their roles as source of bio-essential trace metal for the fuelling of the seasonal Ross Sea bloom. The relative importance of the different sources of these trace metals will be addressed and compared.

VARIABILITY OF DUST LIDAR RATIOS COMPUTED FROM AERONET RETRIEVALS

G. Schuster[1]*, M. Vaughan[1], D. MacDonnell[1], W. Su[1], D. Winker[1], O. Dubovik[2], T. Lapyonok[2], C. Trepte[1]

[1]*NASA Langley Research Center, Hampton, Virginia, 23681, USA*
[2]*Laboratoroire d'Optique Atmospherique, Universite de Lille 1, CNRS, Villeneuve d'Ascq., France*
**gregory.l.schuster@nasa.gov*

We use the aerosol optical properties provided by the Level 2.0 AERONET database to compute the lidar ratios of 1714dust retrievals at 22 AERONET sites located in Africa, the Middle East, and India. We computed lidar ratios and depolarizations directly from the AERONET refractive indices, size distributions, and percentage of spheres with the Dubovik et al (2006) forward optics code. This code utilizes Mie Theory for spheres and T-matrix code or the geometric-optics-integral-equation method for spheroids (with an assumed axis ratio distribution). We limited our analysis to the months of May through September in an effort to avoid contamination by biomass burning at the northern African sites, and defined retrievals with depolarizations greater than 0.2 and fine volume fractions less than 0.05 as dominated by dust.

The highest lidar ratios of our analysis occur in the non-Sahel regions of northern Africa, where the median lidar ratio is 55.4 sr for 229 retrievals. The lowest lidar ratios occur in the Middle East (42.6 sr for 489 retrievals). We attribute the regional variability of the lidar ratio to the regional variability of the real refractive indices of dust retrieved by AERONET, as these two parameters are highly anti-correlated (R ranges from -0.51 to -0.85 for the various regions). The regional real refractive indexin our study varies from n=1.49 in non-Sahel Africa to n=1.57 for the Middle East, and is consistent with the illite mineralogy in northern Africa. That is, dry dust mixtures with low refractive indices require high fractions of illite, which has a refractive index of 1.41; other common minerals -- calcite, quartz, gypsum, montmorillonite, kaolinite, and hematite -- all have refractive indices greater than 1.49. The illite fraction of aeolian dust decreases substantially from North to South and West to East along the northern African coasts (Chester, 1972), and thus is consistent with our regional refractive indices.

This regional variability in pure dust mineralogy and lidar ratio has a significant impact on the robustness of extinction retrievals for backscatter lidarslike CALIPSO, which require an assumed lidar ratio. Thus, we also compare CALIPSO aerosol optical depths to AERONET measurements.

Chester, R., Elderfield, H., Griffin, J., Johnson, L., Padgham, R. (1972). Eolian dust along the eastern margins of the Atlantic Ocean, Mar. Geol., 13, 91-105.

Dubovik, O., et al. (2006). Application of spheroid models to account for aerosol particle nonsphericity in remote sensing of desert dust, J. Geophys. Res., 111, D11208, doi:10.1029/2005JD006619.

IMPROVING THE MONITORING OF ETNA'S VOLCANIC ACTIVITY USING A NEW SCANNING LIDAR

Simona Scollo[1], Antonella Boselli[2,3], Mauro Coltelli[1], Giuseppe Leto[4], Gianluca Pisani[2,5], Nicola Spinelli[2,5], Xuan Wang[2,6], Ricardo Zanmar Sanchez[4]

[1]*Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Etneo, Sezione di Catania, Italy*
[2]*CNR-IMAA, Potenza, Italy*
[3]*China-Italy Laser Remote Sensing Joint Research Center - CNISM, Napoli, Italy*
[4]*INAF-Osservatorio Astrofisico di Catania, Catania, Italy*
[5]*Dipartimento di Fisica, Università di Napoli "Federico II", Napoli, Italy*
[6]*CNR-SPIN, Napoli, Italy*

In order to identify in near real time the area affected by volcanic ash in Sicily, to characterize its optical and microphysical properties and to quantify the ash concentration in the atmosphere, a new versatile and portable Raman scanning Lidar system has been designed and developed by the National Consortium of Italian Universities for the Physical Science of the Matter (CNISM) and funded by the VAMOS SEGURO project (www.ct.ingv.it/vamosseguro). The Lidar system has been designed to perform volume scanning of the atmosphere and retrieve high quality 3D maps of particulate optical properties and their time evolution. It is able to detect the elastic Lidar returns at 355nm and the N_2 Raman Lidar echoes at 386nm. Each detected signal is acquired with a raw spatial resolution varying from 30cm to 30m. Moreover, the polarization purity of the laser line allows to perform polarization measurements at 355nm. The Lidar apparatus is operated mainly at Serra La Nave, only 7 km away far from the Etna summits, and at INAF-Astrophysical Observatory in Catania. Since 2013 this Lidar system is part of the EARLINET network (www.earlinet.org). Lidar measurements have been routinely carried out during days without eruptive activity. During lava fountain events, the Lidar has allowed to investigate optical and geometrical properties of volcanic plumes. Results of Lidar measurements performed during both strombolian and lava fountaining activities in 2013 will be described. The observed layers have been characterized in term of the aerosol backscatter and the extinction coefficient profiles at 355nm, and of their ratio (the so called Lidar Ratio), depending on particles chemical composition, size distribution and shape. Moreover, Lidar depolarization measurements allowed to discriminate ash dominated from sulphate and /or water dominated plume. Lidar products coupled with volcanic ash dispersal simulations carried out by Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Etneo, are used to evaluate, in some cases, the ash mass concentration in atmosphere and to distinguish changes in the properties of volcanic emissions with time.

SOURCE APPORTIONMENT IN THE URBAN AREA OF BOLOGNA: FIRST RESULTS OF SUPERSITO PROJECT

Fabiana Scotto[1]*, Alessandro Vagheggini[2], Dimitri Bacco[3], Isabella Ricciardelli[1], Arianna Trentini[1], Vanes Poluzzi[1], Angeliki Karanasiou[4], Roberta Vecchi[5], Daniela Cocchi[2]

[1]*ARPA (Regional Agency for Prevention and Environment of Emilia-Romagna region (ARPA ER), Bologna, 40138, Italy*
[2]*University of Bologna, Bologna, 40126, Italy*
[3]*University of Ferrara, Department of Chemical and Pharmaceutical Sciences, Ferrara, 44121, Italy*
[4]*Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Spanish Research Council, Barcelona, 08034, Spain*
[5]*Department of Physics, University of Milan, Milan, 20133, Italy*
**fscotto@arpa.emr.it*

Daily PM2.5 samples were collected in Bologna (Po Valley, Italy) since November 2011, under the framework of the Supersito project (http://www.arpa.emr.it/supersito/). This study utilizes chemical composition data of ions, carbon and metals on the period 11th July 2012 - 3rd March 2013. A Positive Matrix Factorization analysis was performed with the aim of identifying principal pollution sources on this area. Data were best modelled by extracting 6 factors, obtaining R^2=0.98 for observed/predicted $PM_{2.5}$ (Paatero and Hopke, 2003; Paatero et al., 2002; Zabalza et al., 2006).
These factors have been identified.
1. Domestic heating, with high relative contribute of K, which indicates the predominant importance of wood burning. This factor presents a very evident seasonal trend, with negligible summer contribute and around 25% of PM2.5 after 15th October.
2. A factor "traffic with re-suspension dust", with high contributions of Ca, Mg, Fe, and high relative contributions of Cr, Mn, Zn, Sb, Sn and La (Pant and Harrison, 2013). Lower concentrations of this factor are observed during weekend days.
3. A factor with anthropogenic origin, likely associated to industrial source, characterized by high per cent contributes of Pb, Sn, Cd, Zn, As, Cr.
4. A secondary factor characterized by NH_4^+ and NO_3^- that accounts for the largest contribution to PM2.5 mass in the cold months and is negligible during the summer.
5. A secondary factor characterized by SO_4^{--}, that presents a quite uniform contribute during all the period. Because of the lower levels of PM2.5 during the summer, during heat season this factor accounts for around 30% of PM2.5.
6. The last factor is probably of local origin and it is a mixed source with crustal contribute, well correlated with direction of wind and absence of rainfall.

Paatero P., Hopke P. K. (2003). Discarding or Downweighting High-Noise Variables in Factor Analytic Models. Anal. Chim. Acta, 490, 277.

Paatero P., Hopke P. K., Song X.-H., Ramadan Z. (2002). Understanding and Controlling Rotations in Factor Analytic Models. Chemom. Intell. Lab. Syst., 60, 253.

Zabalza J., Ogulei D., Hopke P. K., Lee J.H., Hwang I, Querol X., Alastuey A. and Santamarìa J. M. (2006). Concentration and sources of PM10 and its constituents in Alsasua, Spain. Water, Air, and Soil Pollution, 174, 385-404.

Pant P., Harrison R. M. (2013). Estimation of the contribution of road traffic emissions to particulate matter concentrations from field measurements: a review. Atmospheric Environment, 77, 78-97.

NUMERICAL MODELLING OF ULTRAFINE PARTICLE DISPERSION FROM INCINERATION PLANT

Mauro Scungio[1]*, Luca Stabile[1], Giorgio Buonanno[1,2], Fausto Arpino[1], Satbir Singh[3], Peter Adams[3]

[1]*Department of Civil and Mechanical Engineering, University of Cassino and Southern Lazio, Cassino (FR), Italy*
[2]*Queensland University of Technology, Brisbane, 4001, Australia*
[3]*Carnegie Mellon University, Civil & Environmental Engineering, Pittsburgh, PA, USA*
**m.scungio@unicas.it*

Particulate emission from anthropogenic sources is a relevant topic for air quality and medical experts. The toxic nature of the particles due to the organic compounds on itself, the ability of ultrafine particles (UFPs) to penetrate in the epithelial cells of the lower respiratory tract, and the oxidative damage effects on DNA, which may increase the risk of cancer, are some of the harmful effects on human health caused by exposure to nanoparticles.

In the waste management, incineration represents a favourable technique for reducing the waste volume and recovering its energy content to generate electricity and district heating. However, incinerators have been the subject of strong debate in Western countries, since the waste combustion processes are a source of particle and gaseous emissions (Buonanno et al. 2012). Therefore, it is necessary to characterize their impact in terms of UFPs on the surroundings.

Computational Fluid Dynamics (CFD) is increasingly used to identify and characterize the specific emission sources in the areas characterized by high anthropogenic pressure, and assess their impact on air quality.

In this work, a numerical scheme based on the non-commercial fully explicit Artificial Compressibility (AC) - Characteristic Based Split (CBS) algorithm (Arpino et al. 2010) was used to solve the one-equation Spalart-Allmaras (SA) turbulence model and a *K-theory* dispersion model (Moreira and Vilhena 2010), to perform numerical simulations and parametric studies of ultrafine particle dispersion in the surroundings of an incinerator plant.

The use of the one equation SA model, allows to save computational resources when complex three-dimensional domains are considered and also offers the possibility to switch to a Detached Eddy Simulation (DES) scheme. The fully explicit algorithm involves a matrix inversion free procedure that offers several advantages, such as low computing requirements even for complex three-dimensional problems and the possibility of simple and efficient parallelization.

Buonanno, G., Scungio, M., Stabile, L., Tirler, W. (2012). Ultrafine particle emission from incinerators: the role of the fabric filter. Journal of the Air & Waste Management Association, 62 (1), 103-111.

Arpino, F., Massarotti N., et al. (2010). High Rayleigh Number Laminar-Free Convection in Cavities: New Benchmark Solutions. Numerical Heat Transfer, Part B: Fundamentals 58(2): 73-97.

Moreira, D. and Vilhena M. (2010). Air pollution and turbulence: modelling and applications, CRC Press/ Taylor & Francis.

DUST CHARACTERISTICS AT THE NORTHERN SLOPES OF TIEN SHAN - INTERACTION WITH ACID AEROSOLS AND ISOTOPE COMPOSITION OF ATTACHED NITRATE

Anton Shabunin[1], Georg Schettler[2]*, Helga Kemnitz[2], Kay Knoeller[3]

[1]*Central Asian Institute for Applied Geosciences, Timura Frunze Str. 73/2, Bishkek, 720027, Kyrgyzstan*
[2]*Deutsches GeoForschungsZentrum, Telegrafenberg, Potsdam, 14473, Germany*
[3]*Helmholtz Centre for Environmental Research - UFZ, Theodor-Lieser-Str. 4, Halle, 06120, Germany*
**Georg.Schettler@gfz-potsdam.de*

Along the northern margin of the Central Asian high mountain range formed by the Hindu Kush, Pamir, Alai, Tien Shan and Altai airborn soil particles have been trapped as loess (Machalett et al. 2008 and references therein). In a common project of the Central Asian Institute for Applied Geosciences-Bishkek (CAIAG) and the GeoForschungsZentrum-Potsdam (GFZ), a programme including the monitoring of atmospheric dust load and dust composition at the northern slopes of the Tien Shan south of Bishkek was initiated in 2010. The study aims on improving the understanding of the palaeoclimatic record of loess profiles and of aeolian components in lacustrine sediments of Central Asia in the context of short- and long-term changes in the hemispherical circulation under the current climate regime. Interaction of dust particles with reactive gases and acid aerosols during their atmospheric transport strongly influences the content of leachable salts in the dust. The latter depends on the source regions of the dust and the pathway of the air masses which carry the mineral aerosols to the monitoring site. We present data on seasonal changes in the composition and the amount of leachable salts of the particle fraction > 2.5 μm and data of the isotope composition of the attached nitrate at 3-days time resolution for a period between 2010 and 2012. The particle fraction was collected using a High-Volume Slit-Impactor with a programmable exchange of 15 collector plates. Nitrate and sulphate are the dominant leachable anions of the dust at our monitoring site. The ions are largely generated by solid/acid interaction in the troposphere. The extensive interaction of Asian dust with reactive atmospheric agents originating from anthropogenic emissions has been previously documented for dust samples collected close to urban centres of eastern China (e.g., Li and Shao, 2009). However, where the interaction of primary soil particles with acid-aerosols takes place during their atmospheric transport and how it depends on air humidity during their westward atmospheric transport across the Eurasian continent remains an open question. Finally, our study will contribute to understand the atmospheric flux of the 'so-called' background dust towards the Pacific Ocean in terms of quantity, composition, seasonal variability and pathway.

Li, W.J., Shao, L.Y., (2009). Observation of nitrate coatings on atmospheric mineral dust particles. Atmos. Chem. Phys. 9, 1863-1871.

Machalett, B., Oches, E.A., Frechen, M., Zöller, L., Hambach, U., Mavlyanova, N.G., Marković, S.B., Endlicher, W., (2008). Aeolian dust dynamics in central Asia during the Pleistocene: Driven by the long-term migration, seasonality, and permanency of the Asiatic polar front. Geochem. Geophy. Geosy. G3, 9, 1-22.

INVESTIGATION AND CLASSIFICATION OF SURFACE SEDIMENTS OF THE SOUTHEASTERN MESOPOTAMIAN PLAIN (SOUTHERN KHUZESTAN PLAIN, IRAN)

Pe et, utem venihit pere re aute laborrovit alitio ma voluptatur?

Cesed excearumquo blam ditiuscitio doluptatet alia voluptatur magnite volupta venem idionsequid quos eosa quamustrum aped ernam nust verios venti occabor uptaquibus magnis corestoria venim ventur reium fuga. Caboren imagni restrum ipsus remquas excese doluptatus, omnim ut quodit aliquid quame velendipsa nobitia dolorit, te vel eos voloratur si quuntur? Oditatem reiciet voluptatent hillibus, sintur accum consequi untiorem rem. Rovit es dolore voloreperum imus, nonese sunt reperspic to magnim fugiat vel illitatur, nos parum eiciam venitem faccus con rerepel is cullabo rerrum lant am, int.

Endi idigendit quianditiae por se eum sitatem. Bitat volo et quis autemolo totas asitatur aspidi aut ipsam, corestio. Bernatectis modis molest, coriasitae nobis dolorum, ipidend itiorat quiderum alitate name dolupta tionsed itaqui aspelest hil min et ut fugit, ommolorem apel essitam quam fugit labo. Alignihil is vendit renimus sincia conecat alist, est esed quam denimol orercia nimolor aut as ulpa eos iumquisci bea sunte nullaccatet dionet velestrum quis adit volupic testem volorec uptaecae poriate molorpor ari culliqu iaerum dolor sequo quamendaero est lam haria prae. Et vendel is et magnim doluptasim sundus, quia plis ius everchilibus aut perrovidus explabore consendis ut re con nem et enisi in preici occae numquam vellupt aspero eatem et fuga. Itatiae. Ur?

Udit prat eumquat. Ibust velent at elit volorem que niatiberiae sae volessuntis moditiam quam, est, tem essimincto id et arum fugiamenimus sedit untius acepe aut aut ra doluptate offictis inis doloribus dolorit aliqui cus debitatem ad magnis aut elentio. Bis maxim sequia voluptaque ium quam fugiatia poribea nullacitas volore volut aut fugitae pudaecum illor sinum quis iuscipis expel im voluptat ex ea niatquam, sum explabo. Nem esequam quibus ent aligenti nis susda consed ma dest facesto dipsapictat.

Por restincia in plitia corendu sciist, ipitas minctor atem explaboribus eos dolupit es nossumquam re voloria qui reped qui optatempel intem. Dolende escius debit ut alit et odi aut eos sequi corumentis suntiorate ommossunt quas sitatec eptatum ratin restisquae volor modi iligenecte pelendelent quis ulla volestio minieni molupta musam, offic to tecus idunt ex exerio doluptae esenimusa doles ute nim dolupta ssequiae velit et, nus modis nimus, sit res adignimint.

Repelest, sit atetur? Us, ne oditatiaspis aut exceris autem quatquos erisqui atibera pla ipsae que velibus sera que voles ad unt.

Ictati duntis nobisti orrupta ecuptis qui to volorem as rat dolorer naturi que duciis eaque cum acia cumendusti velibusam iduciis truptat qui con rat quid et ea quid quodiorrum, ut illore, numquid quatio blabo. Itates dolut vent.

MODELLING ATMOSPHERIC CONCENTRATIONS OF RAGWEED POLLEN FROM LOCAL AND DISTANT SOURCES

Branko Sikoparija[1]*, Michel Thibaudon[2], Janne Sommer[3], Matt Smith[4], Łukasz Grewling[5], Carsten Ambelas Skjøth[6]

[1]*Laboratory for Palynology, Faculty of Sciences University of Novi Sad, Novi Sad, Serbia;* [2]*Reseau National de Surveillance Aerobiologique (RNSA), Brussieu, France;* [3]*The Asthma and Allergy Association, Roskilde Denmark;*[4]*Research Group Aerobiology and Pollen information, Department of ORL, Medical University of Vienna, Austria;* [5]*Laboratory of Aeropalynology, Faculty of Biology, Adam Mickiewicz University, Poznan, Poland;*[6]*National Pollen and Aerobiology Research Unit, University of Worcester, UK*
**sikoparijabranko@yahoo.co.uk*

Pollen grains from the genus ragweed (*Ambrosia* spp.) are important aeroallergens. In Europe, the largest sources of atmospheric ragweed pollen are the Rhône Valley (France), parts of Northern Italy, the Pannonian Plain and Ukraine. Episodes of Long Distance Transport (LDT) of ragweed pollen from these centres can cover large parts of Europe and are predominantly studied using receptor based models (Smith et al., (2013) and references therein). The clinical impact of allergenic ragweed pollen arriving from distant sources remains unclear (Cecchi et al. 2010). Although a recent study has found the major allergens of ragweed in air samples collected in Poznań, Poland, during episodes of long-distance transport from the Pannonian Plain (Grewling et al. 2013). The source orientated models SILAM, DEHM, COSMO-Art, METRAS and ENVIRO-HIRLAM currently report having the capability of modelling atmospheric concentrations of pollen in Europe. The performance of such source-orientated models is strongly dependent on the quality of the emissions data, which is a focus of current research (e.g. Thibaudon et al. (2014)). The output from these models are important for warning allergy sufferers in areas polluted by ragweed, but could also be used to warn the public of ragweed pollen being transported into areas where the plant is not abundant. Areas outside of the main areas of ragweed infection that contain considerable local populations must, however, also include local scale models. These models can be used to predict local concentrations, even when LDT is not present. This concept of combined LDT and local scale calculations has been shown to be work for air pollutants and is considered usable for urban scale calculations of aeroallergens once urban scale maps of aeroallergen sources have been produced.

Cecchi, L., Testi, S., Campi, P. and Orlandini, S. (2010). Long-distance transport of ragweed pollen does not induce new sensitizations in the short term. Aerobiologia 26(4), 351-352.

Grewling, Ł., Nowaka, M., Jenerowicz, D., Szymańska, A., Czarnecka-Operacz, M., Kostecki, Ł., Bogawski, P., Šikoparija, B., Skjøth, C. A. and Smith, M. (2013). Atmospheric concentrations of ragweed pollen and Amb a 1 recorded in Poznań (Poland), 2010-2012. EAACI 2013, Milan, Italy.

Smith, M., Cecchi, L., Skjøth, C. A., Karrer, G. and Šikoparija, B. (2013). Common ragweed: A threat to environmental health in Europe. Environment International 61(0), 115-126.

Thibaudon, M., Šikoparija, B., Oliver, G., Smith, M. and Skjøth, C. A. (2014). Ragweed pollen source inventory for France - The second largest centre of Ambrosia in Europe. Atmospheric Environment 83(0), 62-71.

DUST CYCLE VARIATIONS RELATED TO ABRUPT CLIMATE CHANGES IN EUROPE DURING MIS3

Sima Adriana[1]*, Rousseau Denis-Didier[1,2], Kageyama Masa[3], Balkanski Yves[3], Antoine Pierre[4], Merkel Ute[5], Ramstein Gilles[3], Hatté Christine[3]

[1]*Laboratoire de Météorologie Dynamique, INSU-CNRS & CERES-ERTI - UMR8539, Ecole Normale Supérieure, Paris, 75231, France*
[2]*Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY 10964, USA*
[3]*Laboratoire des Sciences du Climat et de l'Environnement, CNRS-CEA-UVSQ - UMR8212, Gif-sur-Yvette, 91191, France*
[4]*Laboratoire de Géographie Physique, CNRS - UMR8591, Université Paris I, Meudon, 92158, France*
[5]*MARUM - Center for Marine Environmental Sciences, Bremen, D-28334, Germany*
**adriana.sima@lmd.ens.fr*

European loess sequences of Marine Isotope Stage 3 (~60 - 25 kyr BP) show periods of strong dust accumulation alternating with episodes of reduced sedimentation, favoring soil development. Data from the loess belt centered around 50°N suggest that these variations were related to the North Atlantic rapid climate changes: the Dansgaard-Oeschger (DO) and Heinrich (H) events. In two previous modeling studies we have addressed the link between these climate changes and the European dust emissions in the latitudinal band 48°N-53°N, where large areas were exposed to aeolian erosion in glacial times, and important dust deposits have formed. We have shown that dust emissions in this band were considerably smaller during the warm North-Atlantic phases ("Greenland interstadials"), associated with DO events, than during the cold North-Atlantic phases, "Greenland stadials" and H events. Assuming that variations in emissions would be an important cause for variations in deposition, we interpreted this result as qualitatively consistent with loess data. As a follow-up of these studies, here we address the full dust cycle (emissions, transport, deposition) for the same area and climate period. We use the LMDZOR-INCA model, which can represent the full dust cycle, and better-adapted boundary conditions for the investigated period, to study the mechanisms linking the North Atlantic millennial climate changes and the dust cycle variations in Europe, and to attempt a more direct comparison between modeling results and loess data.

ASSESSMENT OF THE AMOUNT OF DEPOSITED DUST, AND AIR CONTAMINANTS IN DEPOSITED DUST OF TREE SPECIES ALONG AN URBANIZATION GRADIENT

Edina Simon[1]*, Edina Baranyai[2], Mihály Braun[3], Csaba Cserháti[4], István Fábián[2], Béla Tóthmérész[5]

[1]*Department of Ecology, University of Debrecen, Debrecen, P.O. Box 71, H-4010 Hungary*
[2]*Department of Inorganic and Analytical Chemistry, University of Debrecen, Debrecen, P.O. Box 21, H-4010 Hungary*
[3]*Institute of Nuclear Research of the Hungarian Academy of Sciences, Herteleni Laboratory of Environmental Studies, 4026 Debrecen, Bem tér 18/C*
[4]*Department of Solid State Physics, University of Debrecen, H-4010 Debrecen, P.O. Box 2, Hungary*
[5]*HAS-UD Biodiversity and Ecosystem Services Research Group, Debrecen, P.O. Box 71, H-4010 Hungary*
**edina.simon@gmail.com (E. Simon)*

Environmental health is an essential component of the quality of life in modern societies. Monitoring of environmental quality and the assessment of environmental risks is often difficult; these can be overcome using bioindicator species. Leaves of *Padus serotina*, *Acer campestre*, *Acer negundo*, *Quercus robur* and *Celtis occidentalis* were used to assess the amount of deposited dust and the concentration of air contaminants in deposited dust in and around the city of Debrecen, Hungary. Samples were collected from an urban, suburban and rural area along an urbanization gradient. The concentrations of Ba, Cu, Fe, Mn, Ni, Pb, S, Sr and Zn were determined in deposited dust using ICP-OES. Scanning electron microscopy (SEM) was used to explore the morphological structure and dust absorbing capacity of leaves. We found significant differences in dust deposition among species, and dust deposition correlated with trichomes' density. Principal component analysis (PCA) also showed a total separation of tree species based on the elemental concentration of deposited dust. Our result suggested that stomata size and distribution were the most important factors influencing the accumulation of air contaminants in leaves. We found that the leaves' surfaces of *A. negundo* and *C. occidentalis* were covered by a large number of trichomes, and these species have proven to be suitable biomonitors for atmospheric pollution.

Keywords: urbanization; stomata density; stomata size; heavy metals; trichomes.

IRON SUPPLIED TO THE SOUTHERN OCEAN THROUGH VOLCANIC ASH AND DUST DERIVED FROM PATAGONIAN

Lucio Simonella[1], Diego M. Gaiero[1]*, Miriam Palomeque[1], Ariel Stein[2], Peter Croot[3], Luciana Monte[4], Judith Desimoni[4], Marcos Kupczewcki[5], Alejandro Rosales[5]

[1]*CICTERRA/Universidad Nacional de Córdoba, Córdoba, 5000, Argentina*
[2]*NOAA /Air Resources Laboratory, College Park, 20740, Maryland, USA*
[3]*Earth and Ocean Sciences, National University of Ireland Galway, Galway, Ireland.*
[4]*Universidad Nacional de La Plata, Instituto de Física La Plata-CONICET, La Plata, 1900, Argentina,*
[5]*Universidad Nacional San Juan Bosco, Trelew, 9100, Argentina*
**dgaiero@efn.uncor.edu*

The Southern Ocean represents about 20% of total global ocean and plays a major role in the distribution of carbon dioxide between the atmospheric and oceanic reservoirs. This oceanic region is atypical as it exhibits plenty of major plant nutrients in surface water, but somehow the photosynthetic CO_2 fixation and plant biomass is low. Due to its geographic position and the dominance of westerly winds, Patagonia is viewed as a key area for supplying key nutrients (e.g., Fe) through mineral dust but also by periodically exportation of volcanic ash to this HNLC (high-nutrient low-chlorophyll) oceanic region. Although explosive volcanism is important in the Southern Andes, the effect of direct ash falling and fluxes to the ocean water surface was never been studied as a possible contributor of bioavailable Fe and its implication on the carbon budget of the Southern Ocean. The aim of this contribution is to evaluate the characteristic of available Fe in pristine volcanic ash from three recent Patagonian Andes volcanic eruptions that have contrasting features and chemical composition (e.g., Hudson, 1991, Chaitén, 2008 and Puyehue, 2011). For that we investigate the mobilization of Fe from Patagonian ashes into soluble forms considering two main mechanisms; "dry deposition" through direct mobilization from relatively dry ash upon contact with seawater and "wet deposition" considering Fe mobilization from ash during interaction with plume/cloud water before entering in contact with surface seawater. These results are then contrasted with similar experiments run on Patagonian dust and top soil samples. We also evaluate fluxes of available Fe to the ocean and the probable effects over the marine biogeochemical iron-cycle.

GROWING DUST AND BLACK CARBON EMISSIONS IN THE INDO-GANGETIC PLAINS AND THEIR IMPACTS ON HIMALAYAN SNOW AND GLACIERS

Ramesh P. Singh[1], Akshansha Chauhan[2]

[1]*School of Earth and Environmental Sciences, Schmid College of Science and Technology, Chapman University, One University Drive, Orange, CA 92866, USA*
[2]*Vidya College of Engineering, Baghpat Road, Meerut - 250002, India*

Dust events and Black carbon emissions are increasing since last three decades in the Indo-Gangetic plains (IGP). The cause of black carbon emissions is from coal based power plants, vehicular pollution, mining, biomass burning and forest fire. These emissions spread horizontally and vertically and sometimes reach over the Himalayan snow and glaciers. Recently, an important question was raised, if the Himalayan Glaciers are retreating or advancing especially when ground observations are almost non-existent. Satellite images have been used and pronounced changes in the areal extent of snow and retreat of glaciers are clearly evident. The exact cause of the retreat is still debatable, and an important question before the scientific community in the wake of future ground water resources of the Indo-Gangetic Plains (IGP). Recently, dusts and black carbon are two sources that are being debated to be possible sources in accelerating melting of snow and glaciers in the Himalayan region. Long range transport of dusts from Arabia peninsula and Thar Desert in the western part of India and increasing anthropogenic activities are two important sources for dusts and black carbon. Sometimes, dust reaches to the western parts of Himalayan snow cover and also transported up to the Far East of the Indo-Gangetic basin. The black carbon soot emissions from the anthropogenic activities in the IGP, forest fires and biomass burning in the western and eastern parts of India may impact warming of Himalayan snow and glaciers. Multi satellite sensors data have been used to study the changes in aerosol parameters and atmospheric parameters in the Himalayan foothills areas and also across the Himalaya region. Earlier, it was difficult to see that the dusts or anthropogenic emissions reaching across the towering Himalaya, but the satellite data clearly show transport of dusts and trace gases from India across the Himalayan region. The outflow of trace gases and anthropogenic emissions from Indian sub-continent reach and deposit on some parts of the Himalayan snow and glaciers cover. Multi satellite data show a pronounced changes in the Himalayan snow and glaciers due to dusts in the western parts whereas the eastern Himalayan snow and glaciers cover are impacted by the carbon soot from the Forest fires. The role of dust and black carbon will be discussed in the accelerating melting and retreat of Himalayan Glaciers.

ISOTOPIC (SR & ND) AND MINERALOGICAL CHARACTERIZATION OF SAHARAN DUST DEPOSITED AT PRESENT ON THE WEST AFRICAN MARGIN: A REVERSED APPROACH TO CONSTRAIN SOURCE REGIONS' SIGNATURES

Charlotte Skonieczny[1,2]*, Aloys Bory[1], Viviane Bout-Roumazeilles[1], Aboubacry Diallo[3], Thierno Ndiaye[3], Wafa Abouchami[4], Stephen Galer[4]

[1]*UMR CNRS 8217 Géosystèmes, Université Lille-1, 59655 Villeneuve d'Ascq Cedex, France*
[2]*IFREMER, Département Géosciences Marines, 29280 Plouzané, France*
[3]*IRD, US191 IMAGO, Dakar, Senegal*
[4]*Max Planck Institute for Chemistry, P.O. Box 3060, 55020 Mainz, Germany*
**charlotte.skonieczny@ifremer.fr*

The Sahara-Sahel region is the most important present-day source of mineral dust, which is mainly transported westward over the Tropical Atlantic Ocean. Interpreting paleo-dust records in this area in terms of paleoclimatic changes requires firstly being able to determine the dust provenance. For this purpose, specific intrinsic tracers such as clay mineralogy and radiogenic isotopes, whose characteristics reflect the geological history of source regions, can be measured in sources' soil samples. Such an approach, however, has a number of limitations. First of all, it implies to have a good understanding of the signature of the potentially contributing source areas. The fact is there is clearly insufficient data coverage for the North African region, mostly because of the large number of possible dust sources that spread over wide geographical areas. In addition, fractionation processes may occur during deflation and subsequent atmospheric transport, modifying the composition of the dust in comparison with the soil of the source. Consequently, the terrigenous signatures of rocks and soils available in the literature do not necessarily reflect the signature of aeolian material. In this work, we propose a reversed approach to circumvent these difficulties. This approach consists in characterizing the provenance of modern dust deposits (rather than sources' soil samples) collected on the west African margin, that is just as they reach the Northeastern Tropical Atlantic (NETAO). This "reverse" method aims then to link the mineralogical and geochemical fingerprints (Sr and Nd in particular) of these deposits to the sources from which they derive, based on satellite images and the calculation of air masses back trajectories. We will present a multi-proxy analysis of deposits collected at Mbour, Senegal, from 2006 to 2009 that enabled us to develop a tentative calibration of these mineralogical and isotopic tracers in terms of provenance region and transport patterns (Skonieczny et al., 2013). This calibration was then tested against the North Africa soil and NETAO top-core data available in the literature.

Skonieczny, C., Bory, A., Bout-Roumazeilles, V., Abouchami, W., Galer, S.J.G., Crosta, X., Diallo, A., Ndiaye, T. (2013). A three-year time series of mineral dust deposits on the West African margin: Sedimentological and geochemical signatures and implications for interpretation of marine paleo-dust records, Earth and Planetary Science Letters 364, 145-156.

A MILLION YEARS OF SAHARAN DUST DEPOSITS RECORDED OFF WEST AFRICA

Charlotte Skonieczny[1,2]*, Aloys Bory[1], Viviane-Bout Roumazeilles[1], Marine Verwaerde[1], Wafa Abouchami[3], Stephen Galer[3], Claire Bassoullet[4], Celine Liorzou[4], Francis Grousset[5], Bruno Malaize[5], Philippe Martinez[5], Xavier Crosta[5], Frederique Eynaud[5]

[1]*UMR CNRS 8217 Géosystèmes, Université Lille-1, 59655 Villeneuve d'Ascq Cedex, France*
[2]*IFREMER, Département Géosciences Marines, 29280 Plouzané, France*
[3]*Max Planck Institute for Chemistry, P.O. Box 3060, 55020 Mainz, Germany*
[4]*IUEM, Université de Bretagne Occidentale, Brest, France*
[5]*UMR/CNRS 5805 EPOC, Université Bordeaux-1, Talence, France*
**charlotte.skonieczny@ifremer.fr*

Every year, several hundreds teragrams of dust are emitted from the Sahara and Sahel regions and deposited, for the most part, in the Northeastern Atlantic Tropical Ocean (NEATO). These aeolian inputs are recorded in the marine sediments of the NETAO, which contain archives of past dust emissions and transport over the Quaternary (and beyond). Past modifications of dust characteristics in these sedimentary archives can provide precious information on changes of environmental conditions in source areas (aridity or weathering intensities), as well as on changes in the characteristics of their atmospheric transport (wind pathways and strength). The core MD03-2705, located off Mauritania, was retrieved from a bathymetric dome 300 meters above the surrounding seafloor (18°05N; 21°09W; 3085m water depth). Considering this particular environmental setting, the terrigenous fraction in this record is assumed to be predominantly of aeolian origin. This 37m-long core provides a continuous record of the aeolian terrigenous deposits in this region over the last 1.1Ma. Here we document changes in these terrigenous supplies to the NETAO throughout the entire record using a multi-proxy analyses of the carbonate-free fraction of the sediment including dust fluxes, grain-size and clay mineralogy. Important shifts in the measured proxies, suggesting major reorganization of particle transport regimes and provenance are observed, particularly during some key climate transitions such as terminations. The latter are currently investigated in greater details and completed with additional geochemical measurements (major and trace elements as well as Sr & Nd isotopes). We will discuss the obtained results for levels dated from the MIS 11-12 and MIS5e-6 transition in particular, which will be compared to the last termination characterized by marked changes through the Younger Dryas and the subsequent Early Holocene African Humid Period in our record (Skonieczny et al., in prep.).

Skonieczny, C., Bory, A., Bout-Roumazeilles, et al. (in prep.), Major changes in wind regimes and monsoon intensity over West Africa across the last termination as indicated by the terrigenous supplies to the Northeastern Atlantic Tropical Ocean.

GLOBAL WIND_BLOWN DUST EMISSION AND DISPERSION ESTIMATED BY THE CHEMICAL TRASPORT MODEL SILAM

Joana Soares[1]*, Mikhail Sofiev[1], Sara Basart[2]

[1]Finnish Meteorological Institute, Helsinki, 00560, Finland
[2]Barcelona Super Computer Centre, Barcelona, Spain
*joana.soares@fmi.fi

Desert dust is an important atmospheric constituent since it affects air quality and climate. The exceedences of air quality limit values for particulate matter (PM) are recurrent in places such as southern Europe where the long-range transport of mineral can achieve a 60% contribution to AOD levels [3]. The goal of this study is to present the dust emission scheme included in the chemical transport model SILAM and show the first results of global and European model simulations. The dust emission parameterization is based on the saltation/sand blasting processes, generally following the approaches of [2] and [5]. The saltation starts when the friction velocity reaches the threshold level allowing the coarse particles (~ Dp = 70 µm) to be involve into horizontal movement. Corrections with regard to partitioning of the drag between erodible and non-erodible elements of the surface, leaf area index, and the soil humidity are included affecting the threshold level and the saltation efficiency. The total vertical flux is described by $F = A_S K \alpha Q_S$ where F is the vertical mass flux of dust [kg m^{-2} s^{-1}], As is the area fraction of erodible soil in the grid cell, *K* is the coefficient accounting for soil, *α* is the sandblasting efficiency and Q_s is horizontal saltation mass flux. We assumed static aerosol spectre at the source, fully defined by the soil type and parameterised directly from the data of [4] via 4 log-normal modes (Dp = [0.01 to 30 µm]). This static-spectrum approach is in contrast with some parameterizations, which connect the flux for the specific size bin with the wind speed.
The model was run through the years 2002-2012 globally with one degree spatial resolution and the years 2010-2013 for Europe with 0.2 degree spatial resolution; both sets with one hour output time-step. The results of the simulations were compared with MODIS and AERONET AOD, using spatial and temporal collocation of the datasets. To facilitate the comparison and estimate the contribution from dust to AOD, primary PM emissions from anthropogenic sources, and sea-salt and wild-land fire emissions were also included. The European runs were also compared with the NMMB/BSC-Dust model for different campaigns under the ChArMEx project. The first simulations provide encouraging results both for spatial and temporal distributions of dust aerosol in a global scale. The atmospheric burden is in order of 35 Tg/year within the range provided by other global estimations [1]. In general the system overestimates the dust aerosol load over the North African deserts (a factor of 2) and underestimates over the South American deserts (20-30%). The main transboundary pollution episodic features for dust aerosol are well described by the system.

1. Astitha1 M., Lelieveld J., Abdel Kader M., Pozze A., & de Meij A. (2012). Atmos. Chem. Phys., 12, 11057-11083.
2. Marticorena, B., & Bergametti, G. (1995). Journal of Geophysical Research, 100(D8), 16415-16430.
3. Tchepel, O., Ferreira, J., Fernandes, A.P., Basart, S., Baldasano, J.M. & Borrego, C. (2013). Atm. Env. 64, 229-241.
4. Weinzierl, B. B. (2007). Ludwig-Maximilains-Universitat Munchen.
5. Zender, C. S. (2003). Journal of Geophysical Research, 108(D14), 4416.doi:10.1029/2002JD002775

A SYNERGISTIC APPROACH FOR DUST MODELING AND EVALUATION

Stavros Solomos[1]*, Vassiliki Kotroni[2], Aggelos Labiris[2],
Emmanouil Flaounas[1], Kostas Lagouvardos[2], Vassilis Amiridis[1],
Stelios Kazadzis[2], Haris Kontoes[1]

[1]*Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens, Athens, GR-15236, Greece*
[2]*Institute of Environmental Research and Sustainable Development, National Observatory of Athens, Athens, GR-15236, Greece*
**stavros@noa.gr*

Implications of dust for human health and hazardous phenomena such as severe dust storms and "haboobs" indicate the profound need for an accurate description of dust processes in numerical simulations. In addition, quantification of the dust direct and indirect effects is important for climate change scenarios.
In order to improve our understanding on the dust-related atmospheric processes and also to evaluate the model forecasts we propose a synergistic approach. Satellite observations, ground-based sunphotometric measurements and state of the art atmospheric modeling are all included under a unified platform. We perform dust modelling with WRF-Chem and we compare the results with satellite (CALIOP/CALIPSO, MODIS/AQUA,TERRA) and ground based (AERONET) retrievals of dust extinction coefficients and optical depths. In this context, we discuss the role of dust particles in radiative transfer and cloud processes in the greater Mediterranean area. This combined effort - incorporating both modeling and remote sensing techniques - provides a valuable benchmark for developing robust dust climatology and improving the representation of dust cycle in atmospheric models.

CLIMATE INSTABILITY RECORDED BY THE ILI LOESS DURING THE LAST GLACIATION IN THE CENTRAL ASIA

Yougui Song[1]*, Chuanxiang Li[2], Mengxiu Zeng[3]

[1]State Key Laboratory of Loess and Quaternary Geology, Institute of Earth Environment, Chinese Academy of Sciences, Shaanxi Xi'an 710075, China
[2]Institute of Mountain and Environment, Chinese Academy of Sciences, Chengdu 610041, China
[3]School of Geographic and Oceanographic Sciences, Nanjing University, Nanjing 210093, China
*syg@ieecas.cn

The Ili Basin is located in the inland of the Eurasian continent and is far away from the ocean. The modern climate is controlled mostly by Mongolian high-pressure and is influenced mainly by the north branch of westerly airstream during the winter. Westerly airflow from the Atlantic Ocean or the Mediterranean or the Black Seas easily reaches the valley and form precipitation. The summer climate is affected mainly by the Indian hot low pressure, and the south branch of westerly airstream shifts to this area and controls the climate. Westerly winds prevail at high-altitudes throughout the year. Eolian loess sediments are widely distributed in the piedmonts of Tianshan Mountains and river terraces, which enables the Ili region to be one of the ideal places for the studies on Asian interior aridification, dust sources of the Northern Hemisphere, past atmospheric circulation.

Here, we represent a eolian loess section in the southern Ili basin. Based on granularity and carbonate mineral analyses, we reconstruct the history of climate change since the last glaciation. The percentage of the size fraction of loess with grain size >63 μm increased in cold stadials in the Ili basin. This result suggests that the westerly wind be strengthened during the cold periods. Compared with the stadials, the content of the loess with grain size >63 μm was decreased in interstadials, which indicated that the strength of the westerly wind was weakened. The content of dolomite is related with Westly circulation intensity variations caused by alternation of sub-orbit scale cold and warm climate. The content variations of calcite maybe reflect the precipitation changes in Westerly Area. Therefore, the contents of carbonate minerals in some extent are good indicators of the strength of Westly circulation and temperature and precipitation, and they can be used to reconstruct paleoclimate and paleoenvironment. Both particle sizes and minerals records revealed that the climatic change in the Ili basin was instability during the last glaciation and was similar to those of the North Atlantic Ocean and Greenland ice core. Six rapid cooling events (Heinrich events), the Younger Dryas cold event and 22 rapid warming events (Dansgaard-Oeschger events) are identified by >63 μm particle sizes and dolomite, which implied that millennial scale climate change in the Ili basin is instability during the last glacial period.

ON THE AEROSOL OPTICAL-CHEMICAL-MICROPHYSICAL PROPERTIES AND CLOSURE STUDIES FOR SAHARAN DUST EPISODES IN SOUTHWESTERN EUROPEAN BORDER

M. Sorribas[1,2]*, F. J. Olmo[1,2], A. Quirantes[1], J. A. Ogren[3], C. Córdoba-Jabonero[4], M. Gil-Ojeda[4], B. A. De La Morena[4], L. Alados-Arboledas[1,2]

[1]*Department of Applied Physics, University of Granada, Granada, 18071, Spain*
[2]*Andalusian Institute for Earth System Research (IISTA), University of Granada, 18006, Spain*
[3]*Earth System Research Laboratory, NOAA, Boulder, 80305, USA*
[4]*'El Arenosillo' - Atmospheric Sounding Station, Atmospheric Research and Instrumentation Branch, INTA, Mazagón, Huelva, 21130, Spain*
**sorribas@ugr.es*

Desert dust aerosols reach 'El Arenosillo' - Atmospheric Sounding Station (ESAt), where a long-term measurement program of atmospheric species and aerosols is being carried out. The observatory is located in a rural protected environment (37.1ºN, 6.7ºW) and less than 1 km from the Atlantic seashore. The instrumentation (in-situ and remote-sensing measurements) operates continuously, with specialized instruments added for dedicated campaigns. Two characteristic pathways of the desert dust aerosols at ground are detected, each of which is associated with significant differences in its aerosol microphysical and optical properties. The observed differences, in turn, determine the degree of sunlight dimming and radiative forcing over the region. The first characteristic pathway was defined by air masses coming at upper levels directly from North Africa to the South of the Iberian Peninsula and Mediterranean Basin but at the lowest levels, Mediterranean flows were arriving (Mediterranean Flow) (DD-MF days). The vertical movements of air masses between atmospheric layers produce the arrival of desert dust at surface-level over South of Spain from higher dust layers located on the Mediterranean Basin but not directly from North Africa. The second atmospheric configuration exhibited direct pathways of Saharan dust air masses from North Africa at all atmospheric levels (African Flows) (DD-AF days). The mixing of desert dust and pollution aerosols coming from Mediterranean area (DD-MF days) was associated with an increase in particle volume concentrations at all diameters, but predominantly within the sub-micron size range. The sub-micron scattering ratio (R_{SP}) was the most efficient optical parameter for identifying the type of desert dust episode. The size range with the highest impact on the scattering processes was (0.3μm<D<0.6μm) with an average contribution to the total scattering of 39% during the Non-Desert-Dust days, increasing to 47% during the DD-MF days. The results are presented throughout our analysis in conjunction with theoretical computations of the aerosol scattering coefficients from the measured size distributions. Our goal is to highlight the uncertainties associated with the measurement of microphysical and/or optical aerosol properties as well as to estimate if the optical measurements are better reproduced by models considering spherical and spheroid particles.

SEASONAL VARIABILITY OF SIZE SEGREGATED PARTICULATE MATTER RATIOS: THE USE OF A NOVEL APPROACH TO ITS REPRESENTATION AND STUDY

Antonio Speranza*, Salvatore Margiotta, Serena Trippetta, Rosa Caggiano, Vito Summa

IMAA, Istituto di Metodologie per l'Analisi Ambientale, CNR, Tito Scalo (PZ), 85050, Italy
**antonio.speranza@imaa.cnr.it*

The ratios between the mass concentrations of the size segregated particulate matter (PM) show a seasonal characteristic. Generally, the cold season can be characterized by an intensification of anthropogenic activities, such as those related to fuel consumption, which determine an increase of the emission of fine and submicron particles (i.e., PM2.5 and PM1, respectively). So, a prevalence of the fine size/submicron fractions on the coarse size fraction (i.e., PM10) may be observed. Whereas, during the warm season, the dry conditions could facilitate the dust resuspension due to vehicles travelling and dust long-range transport, determining an increase of the emission of coarse particles associated to natural as well as to anthropogenic mechanical processes (e.g., material grinding and crushing). Thus, a prevalence of the coarse size fraction on the fine/submicron size fractions may be recorded.
In order to better represent the seasonal characteristic of the ratios between the mass concentrations of the size segregated PM, i.e. PM1/PM10, PM2.5/PM10, PM1/PM2.5 and PM2.5-PM1/PM10-PM1, a dedicated triangular diagram is proposed.
To this aim, studies presenting simultaneous measurements of PM1, PM2.5 and PM10 mass concentrations were considered and the corresponding ratios were calculated and displayed by the triangular diagram.
Results show that the winter season data accumulate into a cluster whose limits are 60% < PM2.5/PM10, 45% < PM1/PM10. This means that the data collected during the cold season may be mostly characterized by higher values of the PM2.5/PM10 and PM1/PM10 ratios. Moreover, these data are displayed toward large values of the intermodal size fraction (PM2.5-PM1/PM10-PM1 ratio above 25%) such that in some cases the intermodal size fraction can contribute substantially to the determination of the fine size fraction (low values of PM1/PM2.5, about 70-60%) and that the intermodal size fraction can be of comparable magnitude with the coarse size fraction (PM2.5-PM1/PM10-PM1 ≥ 50%).
The triangular diagram representation points out how the intermodal size fraction cannot be negligible with respect to coarse or submicron size fractions in most cases in the cold season. Instead, during the warm season no clusters are observed. The triangular diagram proposed could represent a novel approach to display and compare simultaneous size segregated PM measurements.

CHARACTERIZATION OF THE EXPOSURE OF UNDERGROUND MINERS TO MIXED AEROSOLS

Luca Stabile[1]*, Emanuele Cauda[2], Teresa Barone[2], Giorgio Buonanno[1,3]

[1]*Department of Civil and Mechanical Engineering, University of Cassino and Southern Lazio, Cassino (FR), Italy*
[2]*U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Office of Mine Safety and Health Research, Pittsburgh, Pennsylvania, USA*
[3]*Queensland University of Technology, Brisbane, Australia*
**l.stabile@unicas.it*

The exposure to airborne aerosols in any occupational environment can lead over time to debilitating respiratory diseases that can affect the health of workers. In several environments, the workers are exposed not to a single aerosol but to a combination of particulate substances of different composition and size. Miners in countries where diesel-powered equipment are employed, are exposed to elevated concentration of respirable mine dust and ultrafine diesel-generated particles. It is common scientific practice to characterize and investigate the exposure to a single aerosol. Few studies have been conducted on the characterization of the exposure to a mixture of aerosols. This study investigated the characteristic of the exposure to mine dust and Diesel Particulate Matter (DPM) simultaneously present in a calm air exposure chamber. Different levels and types of dust and DPM were introduced in the chamber in controlled conditions for steady state and decay testing: the conditions simulated the mass concentration levels for dust and DPM typically present in underground mines. Real time monitors were used to assess the characteristics of the mixed aerosol during each experiment. The data from each test were then processed for the determination of exposure in terms of lung deposited mass, surface, and number of the particles for each condition. Specific attention was given to accurately convert the data into activity median thermodynamic diameter that is used in the lung deposited models. The potential interaction of the two aerosols was also investigated. Electron microscope analysis of collected particles indicated a substantial presence of DPM particles aggregates on the surface of respirable mine dust. This indicates phenomena of absorption and deposition between micrometric dust particles and sub-micrometric diesel aggregates and the formation of a new hybrid type of particle.

ND-SR ISOTOPES AND CHEMICAL COMPOSITION OF DESERT DUST AS MONITORS OF HYDROLOGICAL AND SYNOPTIC CONDITIONS IN THE LATE QUATERNARY RED SEA-DEAD SEA AREA

Mordechai Stein[1]*, Steve Goldstein[2], Ahuva Almogi[1], Daniel Palchan[1,3], Yigal Erel[3], Abraham Starinsky[3]

[1]*Geological Survey of Israel, Jerusalem, 95501, Israel*
[2]*Lamont-Doherty Earth Observatory Columbia University, New York, USA*
[3]*Institute of Earth Sciences, The Hebrew University, Jerusalem, 91904, Israel*
**motis@mail.huji.ac.il*

The Red Sea - Dead Sea rift valley (=RDR) located between the Arabia-Sahara deserts and extending into the Mediterranean climate zone receives fine sediments that are eroded from the exposed granitic-basaltic crustal terrains of the Arabian-Nubian Shield. The eroded sediments are transported to their final accommodation basins by winds and rivers-mainly the Nile River. During the late Quaternary climate-hydrological conditions varied in the watersheds of the water-bodies filling the RDR and modulated the modes of erosion and desert dust transport. Chemical compositions and Nd-Sr isotope data of fine-particle material recovered from the deep sea cores and exposed lake terraces along a Gulf of Aden-Red Sea-Dead Sea transect provide information on the sources and means of particle transport. We show that overall the Nd-Sr isotope data lie along a "dust array" defined by three source components: (1) Saharan and (2) Arabian granitoides and the (3) Nile River sediments ((1) $\varepsilon Nd < -10$; $^{87}Sr/^{86}Sr > 0.712$; (2) $\varepsilon Nd \sim 0$; $^{87}Sr/^{86}Sr > 0.710$ and (3) $\varepsilon Nd \sim -4$ to $+4$; $^{87}Sr/^{86}Sr \sim 0.705$ to 0.708, respectively). The fine particles from the various sampling sites occupy specific "sub-fields" within the "dust array". KL15 (Gulf of Aden) samples lie in- between the Sahara and Nile fields, KL11 (mid-Red Sea) and the Dead Sea interglacial samples lie closer to the Nile field, while KL23 (northern Red Sea) and the Dead Sea glacial samples lie closer to the Sahara field. During the ice-age cycles there are significant shifts within the "sub-fields" that reflects changing synoptic conditions. These patterns and their pale-hydrological and paleo-synoptic significance will be discussed in the lecture.

IS QUATERNARY LOESS-DUST ON THE CHINESE LOESS PLATEAU SOURCED FROM THE YELLOW RIVER?

Thomas Stevens[1]*, Anna Bird[1], Martin Rittner[2], Pieter Vermeesch[2], Andrew Carter[2], Sergio Andò[3], Eduardo Garzanti[3], Huayu Lu[4], Junsheng Nie[5], L. Zeng[4], H. Zhang[4], Z. Xu[4], I. Millar[6]

[1]*Centre for Quaternary Research, Department of Geography, Royal Holloway University of London, Egham, Surrey, TW20 0EX, UK*
[2]*School of Earth Sciences, Birkbeck College, University of London, London, WC1E 7HX, UK*
[3]*Dipartimento di Scienze Geologiche e Geotecnologie, Università di Milano-Bicocca, Piazza della Scienza 4, 20126 Milano, Italy*
[4]*School of Geographic and Oceanographic Sciences, Institute for Climate and Global Change Research, Nanjing University, Nanjing 210093, China*
[5]*Key Laboratory of Western China's Environment System, Ministry of Education, Lanzhou University, Lanzhou, Gansu 730000, China*
[6]*NERC Isotope Geoscience Laboratory, British Geological Survey, Keyworth, Nottingham, NG12 5GG, UK*
**thomas.stevens@rhul.ac.uk*

The Chinese Loess Plateau is a critical archive of past dust dynamics. Debate over the origin of this substantial accumulation of windblown dust limits interpretation of sedimentary climate proxies and understanding of the causes of past dust generation. The Yellow River has one of the largest sediment loads in the world and recent work suggests that part of the vast loess-desert aeolian sedimentary system of northern China may be fed by the river. Zircon U-Pb age data and heavy mineral analysis from one modern Yellow River sample from upriver of the Loess Plateau shows close affinity to Chinese Loess Plateau dust and adjacent western Mu Us desert sand sediment. However, a single sample cannot be assumed represent the sediment load and the Yellow River at the sample point has already travelled through some loess rich areas. As such, this correlation could be a function of the river eroding pre-deposited loess rather than implying that the river is a major transport mechanism for dust. Addressing this uncertainty is central to determining the role of the Yellow River in dust transport and sediment dynamics in NE Tibet and large areas of arid and semi-arid East Asia. Here we analyse 13 river samples from the upper reaches of the Yellow River for heavy minerals and zircon U-Pb age in order to constrain the provenance signatures of modern Yellow River sediments upstream of major arid and semi-arid sedimentary depocentres. Samples from Qinghai and Gansu provinces yield signatures that are almost identical to those from the Chinese Loess Plateau. However, a sample analyzed from the northeast part of the big Yellow River bend is significantly different, giving a very mature heavy mineral assemblage and a zircon U-Pb age spectrum that is very similar to samples from the eastern side of the Mu Us Desert. This sample seems likely to be overwhelmed with sediment that shares the same source as the eastern Mu Us and the underlying Cretaceous sandstone. This suggests that dust on the loess plateau shares a source with modern fluvial sediment from the upper reaches of the Yellow River on the Tibetan plateau, and that the similarity is not a factor of loess erosion of the Chinese Loess Plateau.

LATE QUATERNARY ARIDITY CHANGE IN NORTHWEST AFRICA: INFERENCES FROM THE MARINE SEDIMENT ARCHIVE OFFSHORE MAURITANIA

JAN-BEREND STUUT

NIOZ - Royal Netherlands Institute for Sea Research, Texel, NL-1797SZ, the Netherlands
MARUM - Center for Marine Environmental Sciences, Bremen, D-28359, Germany
jbstuut@nioz.nl

Life in the Sahel strongly depends on the availability of water, which is supplied by the strongly seasonal precipitation from the summer monsoon. On a geological time scale this atmospheric system has shifted zonally as well, causing abrupt and persistent droughts whenever the summer rains were concentrated further South than at present. These wet-dry alternations are recorded in the marine sediment archive where aeolian dust and fluvial mud are deposited depending on the environmental conditions on land. In addition to the natural variability, land use plays an active role in the mobilisation of soils as well.

In this talk I will present aridity records from sediment cores off Mauritania with varying temporal resolution throughout the Late Quaternary. In addition, I will attempt to ground-truth the inferences made from the sediment archive with modern data from sediment traps that have collected dust over the past few decades. The combination of records offers the unique opportunity to study in high detail the natural versus anthropogenic dust production and transport. I will demonstrate how the zonal movements of the African rainbelt dominate past environmental conditions and try to put these in a global context.

SAHARAN DUST FROM A MARINE PERSPECTIVE: SEDIMENT-TRAP TIME SERIES ALONG A TRANSATLANTIC TRANSECT BETWEEN AFRICA AND THE CARIBBEAN

Jan-Berend Stuut[1,2], Carmen Friese[2], Laura Korte[1], Michèlle van der Does[1]

[1]*NIOZ - Royal Netherlands Institute for Sea Research, Texel, NL-1797SZ, the Netherlands*
[2]*MARUM - Center for Marine Environmental Sciences, Bremen, D-28359, Germany*
**jbstuut@nioz.nl*

The particle size of mineral dust is often used as a tool to reconstruct paleoenvironmental conditions in the source of the dust. Both in on-land (loess), lacustrine, and in marine archives, the size of dust deposits is considered a proxy for paleo-wind intensity. However, next to wind strength, the particle size of aeolian deposits is also influenced by various other parameters such as source-to-sink distance, altitude at which the particles have been transported, and various other environmental conditions in the sources of the dust. To verify if we can quantify a relationship between the size of mineral dust particles and prevailing environmental conditions, we study "modern" dust. Here we present grain-size distributions of Saharan dust that was collected in marine sediment traps, which were deployed along a transatlantic transect between Northwest Africa and the Caribbean. In these traps, dust is collected that is sinking through the water column to the ocean floor. The big advantage of this sampling strategy is that also potential marine environmental effects of the dust deposition are monitored. The temporal resolution of the trap is 1-2 weeks. The time series was started in 2012 and is still being continued.

A 550 KA RECORD OF AEOLIAN ACTIVITY NEAR NORTH WEST CAPE, AUSTRALIA: INFERENCES FROM GRAIN-SIZE DISTRIBUTIONS AND BULK CHEMISTRY OF SE INDIAN OCEAN DEEP-SEA SEDIMENTS

Jan-Berend Stuut[1,2]*, Felix Temmesfeld[1], Patrick De Deckker[3]

[1]*NIOZ - Royal Netherlands Institute for Sea Research, Texel, NL-1797SZ, the Netherlands*
[2]*MARUM - Center for Marine Environmental Sciences, Bremen, D-28359, Germany*
[3]*Research School of Earth Sciences, Australian National University, Canberra, ACT 0200 Australia*
**jbstuut@nioz.nl*

The terrigenous fraction of sediments from a deep-sea sediment core recovered from the northwestern Western Australian continental slope offshore North West Cape, SE Indian Ocean, reveals a history of Western Australian climate throughout the last 550 ka. End-member modelling of a data set of grain-size distributions (n=438) of the terrigenous sediment fraction allows to interpret the record in terms of aeolian and fluvial sediment deposition, both related to palaeo-environmental conditions in the North West Cape area. The data set can be best described by two aeolian end members and one fluvial one. Changes in the ratio of the two aeolian end members over the fluvial one are interpreted as aridity variations in northwestern Western Australia. These grain-size data are compared with bulk geochemical data obtained by XRF scans of the core. Log-ratios of the elements Zr/Fe and Ti/Ca, which indicate a terrigenous origin, corroborate the grain-size data. We postulate that the mid- to late Quaternary near North West Cape climate was relatively arid during the glacial and relatively humid during the interglacial stages, owing to meridional shifts in the atmospheric circulation system. Opposite to published palaeo-environmental records from the same latitude (20_S) offshore Chile and offshore Namibia, the Australian aridity record does not show the typical southern hemisphere climate variability of humid glacials and dry interglacials, which we interpret to be the result of the relatively large land mass of the Australian continent, which emphasises a strong monsoonal climatic system.

THEMATIC MAPPING FOR DISPERSION OF INDUSTRIAL POLLUTION

SIVANESAN SUBRAMANIAN[1]*, BASKARALINGAM PALANICHAMY[1], THIRUVENGADARAVI KADATHUR VARADACHARI[1], ARULMOZHI RAMU[2]

[1]*Department of Applied Science and Technology, Alagappa College of Technology, Anna University, Chennai - 600025, India.*
[2]*Centre for Environmental Studies, Department of Civil Engineering, College of Engineering, Anna University , Chennai - 600025, India*

Industrial activities play an important role in the economic well-being of the country contributing to sustainable growth. However, industrial activities also have a significant impact on the environment. The largest industrial installations account for a considerable share of total emissions of key atmospheric pollutants and also have other important environmental impacts, including emissions to air, water and soil. Industrial emissions are SO_2, NO_x, CO_2, HC, Particulate matters and organic compounds causes to global climate change.
On warm, sunny days, hydrocarbons react with oxides of nitrogen to create a secondary pollutant, ozone. In many urban areas, motor vehicles are the single largest contributor to ground-level ozone which is a common component of smog. Ozone causes coughing, wheezing and shortness of breath, and can bring on permanent lung damage, making it a cause of crucial public health problems. According to this year's Global Burden of Disease estimates, one-fifth of deaths across the world occur from outdoor air pollution. These alarming pieces of information have drawn everyone's attention and forced experts to take stock of pollution trends in India's cities - including Chennai.

The purpose of this study is to model atmospheric dispersion of an Industry using FLUIDYN- software uses a 3D deterministic solution of the fluid dynamics Eulerian equations. The pollutant dispersion is simulated by the resolution of the Navier-Stokes flow and transport equations applied to a 3D curvilinear mesh. The software simultaneously solves 3D atmospheric flows and the pollutant transport/diffusion. In this context, all the phenomena and parameters influencing the atmospheric dispersion of pollutants are taken into account of 3D complex topography, Ground occupation parameters (urban areas, forests, water bodies…), Buildings and obstacles, Meteorological conditions (fixed or variable), Atmospheric turbulence, Pollutant properties (NOx, SO_2, CO, C_6H_6, dust, VOC, heavy metals, etc.).

DAILY LEVELS OF THE HARMATTAN DUST NEAR THE GULF OF GUINEA OVER 15 YEARS: 1996-2011

A.K. Sunnu

Department of Mechanical Engineering, Kwame Nkrumah University of Science and Technology (KNUST) Kumasi, Ghana.
aksunnu.soe@knust.edu.gh; albertsunnu@yahoo.com

The Saharan dust that is emitted, transported over a long distance and deposited over many countries in West Africa near the Gulf of Guinea (5°N) during the months of November to March, known as the Harmattan has major influence on the climate. The Harmattan dust has been studied over a 15-year period, between 1996 and 2011, using a location at Kumasi in central Ghana (6° 40′N, 1° 34′W). The suspended Saharan dust particles were sampled in situ by an optical particle counter, and the particle size and concentrations within the particle size range, 0.5-25 μm analysed. The highest daily average particle diameter, number and mass concentrations during January-February reached 3.17 μm in Harmattan 2005, 148 particles/cm^3 in Harmattan 1997 and 6199 μg/m^3 in Harmattan 2005 respectively. The diurnal characteristics of the peak Harmattan dust were also anlaysed over the 15 years which allow the study of potential changes in the strength of the dust source, trend of the suspended dust and impact on climate. The daily mean size has increased from D=1.01 μm in the period, 1996-2000, to D=1.76 μm in 2001-2011. The mass concentration has also increased from M=370 μg/m^3 over the period, 1996-2000 to M=1262 μg/m^3 in the period, 2001-2011. The increased particle diameter and mass concentrations are likely due to increased source strength and stronger winds.

The peak Harmattan dust distribution shows that the lowest characteristics are recorded in periods of about 5 years.

ATMOSPHERIC DUST VARIABILITY ON SEASONAL TO ORBITAL TIME SCALES AS SEEN IN POLAR ICE CORES

Anders Svensson*, Paul Vallelonga, Ernesto Kettner

Centre for Ice and Climate, Niels Bohr Institute, University of Copenhagen, 2100, Denmark
**as@gfy.ku.dk*

Polar ice cores provide records of atmospheric dust extending back some 800 kyr for Antarctica and 130 kyr for Greenland. Dust fluxes in both Greenland and Antarctic ice cores vary with the glacial cycle (100 kyr cycles) showing dust levels 10-100 times higher in glacials than in interglacials. Within glacials the bipolar dust signal is modulated with orbital obliquity (41 kyr cycles) showing increased dust input during phases of low inclination. At centennial-millennial time scales Greenland dust records are strongly linked to the climate record ($\delta^{18}O$) that expresses pronounced Dansgaard-Oeschger (D-O) variability. In cold phases (stadials) the dust level is generally higher than in milder phases (interstadials) and at the warming onsets dust fluxes decrease abruptly (within 50 years). In Antarctica, millennial-scale climate variability is less pronounced and dust variability is generally less abrupt but still strongly coupled to climate. Annual layers are visible to the naked eye in ice cores throughout the last glacial period both in Greenland and at some high-accumulation sites in Antarctica. The Greenland dust input peaks in springtime and the dust signal contributes to the high-resolution multi-proxy dataset applied for ice core time scale construction by annual layer counting. During the last glacial period the main dust source for Greenland is Eastern Asia, but other sources may have contributed both in the glacial and more recently. For Antarctica, the main dust source is Southern South America, but again other sources may have contributed particularly during interglacials. The ice core particle size distributions are generally log-normal modes in the micrometer range that often show climate-related variability. In summary, polar ice cores provide undisturbed, continuous, high-resolution records of atmospheric dust transport at all time scales, from the seasonal to orbital. Applications of the ice core dust records include validation of atmospheric transport models as well as past atmospheric radiative balances, and constraining past nutrient supplies (e.g. iron and phosphate) to the high-latitude open oceans.

MINERAL AND ELEMENTAL COMPOSITION OF AEROSOLS PARTICLES IN THE VICINITY OF COAL AND GAS-FIRED POWER PLANT (TOMSK, RUSSIA)

Anna Talovskaya*, Ekaterina Filimonenko, Egor Yazikov

Tomsk Polytechnic University,Tomsk,634050, Russia
**talovskaj@yandex.ru, filimonenkoea@mail.ru*

Department of natural resources and environmental protection of the Tomsk region was proved that the Tomsk fossil fuel burning power plant is one of the main sources of air pollution by the gases and aerosols in Tomsk city (Russia, Western Siberia). So, this study presents the mineral and elemental composition of the aerosols particles emitted from the Tomsk power plant. The aerosols particles were under investigation by sampling the snow cover, since this method is considered the most appropriate and representative for Western Siberian conditions. During the period of 2009 to 2013 sampling was conducted using a vector network in the northeastern direction (mainly southern and south-western winds) at distances of 0.73, 1.0, 1.3, 1.6, and 2.0 km from the plant's 100 m high chimneys. 25 samples of insoluble snow fraction of aerosols (aerosols particles) were studied by instrumental neutron activation analysis, MS-ICP, atomic absorption spectrometry, X-ray diffraction and SEM. In order to identify chemical anomalies, the observed values of different element concentrations were compared with data from the regional (480 km far from Tomsk) and local (70 km far from Tomsk) background sites.

Analysis of the long-term monitoring data showed a decrease of the dust load value. The quantity of the dust load declined on average by 45 % (from 115 mg/(m2×day) to 44 mg/(m2×day)) in the vicinity of the power plant, where the background dust load is 7 mg/(m2×day). Such dynamics may be associated with the complex environmental and repair activity carried out at the power plant. But the plants amount of coal burned increased by 30%, which caused the concentration of heavy metals (Co, As, Sr, Sb, Ba, Hg, Zn), rare metals (Sc, Rb, Hf), rare earths (La, Ce, Lu) and radioactive elements (Th, U) in aerosols particles to also increase in 1.1 - 3.5 times. Consequently the emissions of the power plant was considered to be an important source of As, Ba, Hg, Ti, Cu, Zn, Ge, Se, Mo, Pb, Bi, light rare-earth elements, U and Th.

The mineral composition of aerosols particles are presented by quartz, feldspars, amphiboles, carbonates, kaolinite, mica, magnetite and hematite. Heavy metals are identified in the modes of sulfides (pyrite, chalcopyrite, galena, covellite, antimony), alloys (Pb, Ni, W) and oxygen-containing salts (barite, witherite). Al-Si spherical particles that contain mullite, metallic spherical particles associated to Fe-oxides are of special interest as those are typical man-made structures in emissions released by coal-fired plant. Also samples of aerosols particles contain about 35% of amorphous phase, mainly presented by the black carbon and coal particles.

The research was funded by Grant of President of RF for young scientists (MK 951.2013.5).

SOURCE APPORTIONMENT OF FINE PARTICULATE MATTER AT AN URBAN AREA OF A MEDIUM SIZED CITY IN TURKEY

Lokman Hakan Tecer[1]*, Güray Doğan[2], Gürdal Tuncel[3]

[1]*Department of Environmental Engineering, Namık Kemal University,Tekirdağ, 59860, Turkey*
[2]*Department of Environmental Engineering, Akdeniz University, Antalya, 07058, Turkey*
[3]*Department of Environmental Engineering, Middle East Technical University, Ankara, 06800, Turkey*
**lhtecer@nku.edu.tr*

Increasing evidence of the rapid deterioration of air quality and the associated potential health impacts on populations in cities is prompted the Clean Air Initiative for urban air pollution control. Therefore, in recent years, It is important to determine emission sources of PM in order to achieve the clean air quality. A receptor model of positive matrix factorization (PMF) was used to identify the emission sources of fine particulates in Balıkesir, a city located at about 100 km south of Marmara Sea and 110 km east of Aegean Sea. Total of 280 samples were collected at urban site in the period of 2009-2010. The samples of fine particulate matter were collected simultaneously using stack filter unit samplers. Concentrations of approximately 40 elements and ions were determined and analyzed using ICP-MS and ion chromatography. Collected fine and coarse PM concentrations were 31.07, 15.52 $\mu g/m^3$ for City atmosphere, respectively Five sources were identified with PMF, namely crustal, marine, secondary sulfate, cement and local emissions due to heating. Potential Source Contribution Function (PSCF) and Conditional Probability Function (CPF) are going to be used to determine the source regions of factors.

REGIONAL MODELLING OF SAHARAN DUST LONG-RANGE TRANSPORT DURING SALTRACE

Ina Tegen[1], Bernd Heinold[1], Kerstin Schepanski[1], Albert Ansmann[1], Bernadett Weinzierl[2]

[1] *Leibniz Institute for Tropospheric Research, Permoserstraße 15, 04318Leipzig, Germany*
[2] *DLR-Institute for Physics of the Atmosphere, Oberpfaffenhofen, 82234 Wessling, Germany*
**itegen@tropos.de*

Regional transport and radiative effects of Saharan dust is simulated with the regional model COSMO-MUSCAT. The model computes emission, transport, dry and wet deposition of Saharan dust as well as the effect of dust radiative forcing on heating rates, which in turn impacts stability and circulation patterns in regions affected by dust aerosol. While the model has been previously applied to investigate dust processes in the vicinity of the Saharan desert - including investigating the feedback of dust forcing on dust emissions - here we present first results that were obtained for modelling the far-range transport of dust towards the Caribbean in the framework of the SALTRACE (Saharan Aerosol Long-Range Transport and Aerosol-Cloud Interaction Experiment) field study. Field experiments were carried out in June and July of 2013 including airborne in-situ aerosol and wind lidar measurements with the DLR Falcon research aircraft. Furthermore, ground-based in-situ measurements of dust optical and microphysical properties were carried out at the island of Barbados. Additional ground observations included measurements by several multiwavelength Raman/polarization lidars and sun/sky photometers. In addition, during a cruise with the RV Meteor research vessel from the Caribbean to Cape Verde, columnar aerosol distributions were studied. Dust transport from the Sahara to the Caribbean was simulated with the COSMO MUSCAT model for the SALTRACE period aiming at understanding processes controlling long-range dust transport across the tropical Atlantic. Model results are evaluated with the field measurements, and in turn provide spatiotemporal context to the observations. A particular focus will be on the investigation of the influence of the tropical storm Chantal, which developed over the tropical Atlantic during the SALTRACE period, on Saharan dust transport and mixing.

SDS-WAS: DIFFERENT APPROACHES TO DUST FORECAST EVALUATION

Enric Terradellas[1]*, Sara Basart[2], José M. Baldasano[2], Angela Benedetti[3], Goran Pejanovic[4], Oriol Jorba[2], Jane Mulcahy[5], Arlindo Da Silva[6], Sarah Lu[7], Francesco Benincasa[2]

[1]*AEMET, Barcelona, Spain*
[2]*BSC-CNS, Barcelona, Spain*
[3]*ECMWF, Reading, U. K.*
[4]*SEEVCCC, Belgrade, Serbia*
[5]*U. K. Met Office, Exeter, U. K.*
[6]*NASA, Greenbelt, MD, U. S. A.*
[7]*NCEP, College Park, MD, U. S. A.*
**eterradellasj@aemet.es*

The World meteorological Organization's Sand and Dust Storm Warning Advisory and Assessment System (WMO SDS-WAS) has established a protocol to routinely exchange products from dust forecast models as the basis for both near-real-time and delayed common model evaluation. A multi-model median, generated after interpolating the models fields to a common grid mesh of 0.5 x 0.5 degrees, is also included in the evaluation. The aim of this work is to present different approaches and to test the use of different observational products in the evaluation system. It is also intended to find out which approach and which observational data better reflect the model performance.

First, the forecasts of dust optical depth (DOD) at 550 nm are compared with the aerosol optical depth (AOD) provided by the AERONET network for a number of selected dust-prone stations. Since the AOD integrates the contributions of particles of different origins, a first approach consists of restricting the comparison to situations in which mineral dust is the dominant aerosol type. It is done by discarding AERONET retrievals with an Ångström exponent (AE) 440-870 over 0.6. This comparison presents two obvious drawbacks: (i) it does not evaluate the behavior of the models in those cases in which no dust is observed and (ii) it does not corrects the departure associated with the presence of other types of particles. A second approach consists of comparing the simulated DOD with the coarse-mode AOD retrieved by AERONET. In this case, no AE-related filter is required. However, this comparison is based on the assumption that all coarse-mode particles are of mineral dust and that there is no dust in the fine mode (diameter less than 1 μm approx.).

Finally, the forecast DOD values are compared with AOD at 550 nm retrieved from satellite-borne instruments such as MODIS (including those obtained with the 'Dark Target' and the 'Deep Blue' algorithms) and SEVIRI. Different approaches are also analyzed: (i) evaluation restricted to geographical areas where mineral dust is the main source of atmospheric aerosol, and (ii) discarding of observations with AE over predefined thresholds. The importance of taking into account the quality flags of the retrievals, when available, is also discussed.

MOLDS, POLLENS AND THUNDERSTORMS: A LINK WITH RESPIRATORY ALLERGY?

Michel Thibaudon[1], Anh Poirot[2], Gilles Oliver[1]

[1]*Réseau National de Surveillance Aérobiologique, Brussieu, 69690, France*
[2]*Nouvel Hôpital Civil - Allergologie, Strasbourg, 67091, France*
rnsa@rnsa.fr

The aim of the study was to identify molds and pollens which are present in significant amounts in the air after thunderstorms.

The allergy laboratory of Strasbourg Hospital analyses every week the biological particles (pollens and molds) content of the air from February to September.
Samples are obtained thanks to a Hirst trap and are analysed by optical microscopy. This analysis provides data which are used by RNSA to make forecast about the allergy risk related to pollens and molds.
The study concerns the period from 2008 to 2013. Data about relative humidity, precipitation, thunderstorm and temperature were transmitted by the ASPA (Association pour Surveillance et l'étude de la Pollution Atmosphérique en Alsace), and Meteorage.
The data concerning hospital admissions were collected at Stasbourg hospital and with the "SOS Medecins" association.

Pollens and molds data are compared with the relative humidity and the number of respiratory diseases to follow the evolution according to stormy periods. From 2008 to 2013, in July was observed an increase of the concentrations of Didymella above 2000 spores / m^3 of air just after thunderstorms while the concentrations were lower than 250 spores / m^3 outside these periods. Amounts of Didymella grow within hours following the thunderstorm, during the diminution of the relative humidity. During the same period, Alternaria and Cladosporium decreased, even were absent, while they were present during periods without thunderstorms.
In other hand, the data about health emergency show that the number of asthma cases also increases the same day or the day after a stormy period.

The comparison of the data about storms, Didymella (and all other molds), pollens, ozone and health emergency allows the evaluation of the relationship between these parameters. Stormy period are suitable for occasional increases of pollens and molds, and therefore to health emergencies.

RETRIEVAL OF DUST PROPERTIES WITH A GROUND-BASED INFRARED IMAGING CAMERA

Helen Thomas[1]*, Fernando Almansa[2], David Moriano[1], Fred Prata[1], Africa Barreto Velasco[2], Emilio Cuevas[2], Ramón Ramos-Lopez[2]

[1]*Nicarnica Aviation, Kjeller, 2007, Norway*
[2]*Centro de Investigación Atmosférica de Izaña, Santa Cruz de Tenerife, 38071, Spain*
**ht@nicarnicaaviation.com*

Desert dust suspended in the atmosphere has significant radiative effects thus influencing local meteorology as well as impacting air quality and having detrimental effects on public health. The Canary Islands, lying 96 km west of the African subcontinent are frequently inundated by high altitude dust intrusions from the Saharan desert. These intrusions are most prevalent in the summer months and are measured using a range instrumentation at the Izaña atmospheric observatory, Tenerife.

The NicAIR imaging system, consisting of an uncooled microbolometer infrared camera sensitive to wavelengths in the region 8-14 µm and a selection of narrowband filters, was originally designed for the quantification and retrieval of microphysical properties of volcanic silicate ash. Due to the spectral similarities between volcanic ash and mineral dust a NicAIR instrument was installed at Izaña in early 2013. Data were recorded on a number of days throughout May - October, collecting imagery at each of the wavelength bands as well as a full spectrum broadband image. Here we present the data acquired by the camera and demonstrate how the system can be used to infer information about mass loading and microphysical properties. The data are compared with contemporaneous AERONET optical depth measurements and satellite imagery. These results demonstrate the utility of using infrared imaging cameras for the detection and retrieval of properties of dust storms.

CEILOMETER NETWORKS FOR STUDYING LONG-RANGE TRANSPORT EVENTS OF AEROSOL PARTICLES

Werner Thomas[1]*, Harald Flentje[1], Hülya Markl[2], Ina Mattis[1], Gerhard Müller[1], Frank Wagner[1]

[1]*Deutscher Wetterdienst, Hohenpeissenberg Meteorological Observatory, Albin-Schwaiger-Weg 10, 82234 Hohenpeissenberg, Germany*
[2]*Universität of Augsburg, Chair of Physical Geography, Alter Postweg 118, 86159 Augsburg, Germany*
**Werner.Thomas@dwd.de*

A survey of lidar instruments and ceilometers world-wide was initiated by the World Meteorological Organization in fall 2011 in the framework of the GAW Aerosol Lidar Observation Network (GALION) project. Until now (December 2013), a data base of about 2120 instruments was created and an interactive web page hosted by the Deutscher Wetterdienst (DWD) was set-up, showing the global distribution of instruments and offering links to quick looks and station information pages (see http://www.dwd.de/ceilomap). The web page may serve as a tool for monitoring qualitatively the transport of aerosol particles across Europe and other parts of the world, provided that profiling instruments are on-line. Among lidar instruments of well-known research networks like EARLINET, this is now the case for ceilometers operated by the UK Meteorological Office (UKMO), the Het Koninklijk Nederlands Meteorologisch Instituut (KNMI) of The Netherlands and the Deutscher Wetterdienst (DWD). It is anticipated that other national networks in Europe (e.g. in France, Belgium, Switzerland and others) will follow this initiative. Since instruments of various manufacturers largely differ in terms of capabilities for aerosol detection but also for data issues, efforts towards harmonized data sets and data formats are currently under way in the framework of a EUMETNET project called E-PROFILE.

National ceilometer networks exist in many countries in Europe and are typically operated by either national meteorological services (e.g. in France, Germany, Spain, UK) or aviation control entities (e.g. in Austria, Switzerland). The DWD ceilometer network was established in years 2009 and 2010. It consists of about 60 ceilometers of type Jenoptik CHM15K. First aerosol retrievals (of volcanic ash particles) using this type of instrument were performed during the Eyjafjalla/Iceland volcanic eruptions in April and May 2010 (Flentje et al, 2010). Since then, the data have been analysed more systematically for aerosols and exemplarily several Saharan dust events where detected and quantitatively analyzed over Southern Bavaria (Germany) during the year 2011. Typically such events continue for several days (Markl, 2013).

Usage of the web page will be demonstrated and results will be presented during the conference.

Flentje et al. (2010). The Eyjafjallajökull eruption in April 2010 - detection of volcanic plume using in-situ measurements, ozone sondes and lidar-ceilometer profiles, Atmos. Chem. Phys., 10, 10085-10092.
Markl (2013). Saharastaub über Südbayern, Bachelor Thesis, Univ. of Augsburg, Germany, (in German).

MODELING THE SPREAD OF AEROSOL CLOUD INTO THE ATMOSPHERE

Sergey Titov[1]*, Vladimir Arkhipov[1], Irina zharova[2], Eugene kozlov[2], Aleksey tkachenko[2]

[1]*IPCET SB RAS, Biysk, 659322, Russia*
[2]*Tomsk State University Scientific Research Institute of Applied Mathematics and Mechanics, Tomsk*
**admin@ipcet.ru*

The stage separation of liquid-propellant carrier rockets may result in atmospheric emissions of the propellant and its oxidizer. Similar emissions of liquid- droplet components can also take place upon crashes of rockets in the atmosphere or their fall on the Earth's surface. In the latter case, the propellant components partly self-ignite, and thus produced mixture of the combustion products and liquid-droplet components ascends up to the hoverheight and then descends under the effect of gravity. The emission of these components is accompanied by a set of complex interrelated physicochemical processes (evaporation, chemical heterogeneous reactions, diffusion, coagulation, splitting of droplets, etc.). As a result, the toxic components spread in space and, finally, deposit onto the surface.

To assess ecological consequences of such events and the damage to the target territories, it is necessary to have reliable physicochemical models of the considered processes. Note that one of the most important parameters of the model is the vertical coordinate of depressurization (flight height), because all the basic environmental characteristics (density, temperature, pressure, chemical composition, direction and strength of the dominant wind) depend on this parameter. The altitude dependence of the atmospheric characteristics is studied in a sufficient detail and can be introduced into the model under development from the corresponding reference books. When constructing the physicochemical model of a spread of liquid- droplet toxic components, it is necessary to understand the following processes in detail:

1. The formation of the primary droplet cloud at the time of depressurization of fuel tanks.
2. Processes of equilibrium and nonequilibrium droplet evaporation at a sharp change of the ambient conditions due to depressurization.
3. Diffusion and spread of the components under the action of the dominant wind.
4. Chemical reactions of the propellant components with the atmospheric components.
5. Processes of gravitational sedimentation of droplets with the allowance for evaporation and splitting upon interaction with gas, as well as the processes of gravitational coagulation and splitting upon collision of different-size droplets.

We present a physical-mathematical model for describing the evolution of a cloud of toxic liquid propellant emitted in the emergency case of crashes and/or stage separation. The model developed takes into account the polydisperse composition of droplets, instability of their motion, and the prevailing wind. This model accounts for the process of droplet heating and freezing in different atmospheric layers, the phase changes, aerodynamic splitting, and turbulent diffusion. Some results calculated for a typical liquid propellant components are presented.

OPTICAL METHODS AND ALGORITHMS FOR DETERMINATION OF FINE AEROSOL PARAMETERS

Sergey Titov[1]*, Anatoly Pavlenko[1], Vladimir Arkhipov[2], Sergey Bondarchuk[2], Igor Akhmadeyev[1], Eduard Metsler[1], Anatoly Zhirnov[1]

[1]*Institute for Problems of Chemical and Energetic Technologies, Siberian Branch of the Russian Academy of Sciences (IPCET SB RAS), Biysk 659322, Russia*
2Tomsk State University Scientific Research Institute of Applied Mathematics and Mechanics, Tomsk
**admin@ipcet.ru*

Besides the urgent problems, mankind has now confronted the environmental challenge associated with natural and anthropogenic aerosol pollutions of community air. Aerosol is a hazardous contaminant to human health because particulates easily penetrate into the human organs while breathing. To monitor and develop effective techniques for sedimentation of a harmful aerosol, instruments are needed to identify particles in a wide size range.

At this point, a number of countries have adopted the production of laboratory instruments to analyze the disperse composition of powders and aerosols («Analysette 22», «Mastersizer», «Malvern Spraytec» etc.). There have emerged publications on applying the small-angle technique to measure aluminum particles in the flow [1, 2]. However, the techniques known in the literature are generally intended to be used under lab-scale conditions for the diagnostics of compact, low-temperature (without intrinsic radiation) aerosol systems with a relatively low optical path length.

To study fine aerosols in the atmosphere, the most optimum are remote, non-contact optical techniques. The theory of these techniques, which is based on posing and solving inverse problems of aerosols optics, was discussed in the literature [3]. We have implemented two optical methods to measure disperse characteristics of aerosols: a method based on recording small-angle laser light scattering and a method based on recording optical radiation attenuation. The first technique identifies aerosol particle sizes between 1 μm and 100 μm and the other between 20 nm and 6 μm.

We suggest an approach that relies on a developed hardware/software complex allowing joint implementation of the two optical techniques to measure dispersed media parameters. This approach will make the measurements more informative (particle size range of 20 nm to 100 μm), which is of great practical importance to monitor the environment. We have developed an original algorithm for aerosol optics inverse problem solution, which solves a series of direct problems upon restoring the particle size distribution function.

1. Gill R.J., Badiola C., Dreizin E.L. (2010). Combustion times and emission profiles of micron-sized aluminum particles in different environments. Combustion and Flame, 157, 2015-2023.
2. Badiola C., Gill R.J., Dreizin E.L. (2011). Combustion characteristics of micron-sized aluminum particles in oxygenated environments. Combustion and Flame, 155. - Pp. 2064-2070.
3. Arkhipov V.A., Bondarchuk S.S.. (2010) Optical Techniques for Diagnostics of Heterogeneous Plasma of Combustion Products; Tomsk University Press, Tomsk, 265 pp.

SEDIMENTATION OF HARMFUL DUST BY MEANS OF ACOUSTIC FIELDS AND SPRAYING OF SUPERFUNE AEROSOL

Sergey Titov*, Maria Stepkina, Alexandra Antonnikova, Natalya Korovina, Boris Vorozhtsov, Eugeny Muravlev, Olga Kudryashova

IPCET SB RAS, Biysk, 659322, Russia
**admin@ipcet.ru*

The harmful effect on health of a superfine dust in industry is a large problem. Especially important and complex task is development of new methods of sedimentation of dust particles with the characteristic size, less than 10 micrometers.
As the solution of this problem authors offer the combined method of impact on an industrial dust by means of acoustic fields of high frequency and spraying of a superfine water aerosol (with a characteristic diameter of the particles, less than 10 micrometers).
It is known that the acoustic field promotes coagulation of particles of aerosols which gather in node of acoustic waves that increases probability of their collisions [1]. As a result of coagulation dust particles are integrated and settle under the influence of gravitation. It is promoted also by the radiation pressure if acoustic radiation is directed down, and the ultrasonic source is located above a dust cloud. Thus, the frequency of acoustic influence is higher, the result is better; time of sedimentation of a cloud of a superfine dust decreases by 2-3 times [1,2].
Addition in a dust cloud of particles of a water aerosol increases number of centers of coagulation that promotes an intensification of sedimentation of a dust under the influence of an acoustic field [3]. Thus, the dispersion of an additional aerosol is higher (the specific surface of droplets is higher) the less is time of sedimentation of a dust.
Results of experimental and theoretical study of processes of acoustic sedimentation of superfine aerosols are given in the message. Recommendations for usage of sources of ultrasonic radiation and sprayers of a water aerosol for optimum removal of a dust from air on a workplace are offered.

1. Antonnikova A.A., Kudryashova O.B., Shalunova K.V. Application of Ultrasound to Settle submicron Aerosols // International Conference and Seminar on Micro/Nanotechnologies and Electronic Devices EDM 2012: Conference Proceeding, 2012. - pp.87-89. - ISBN 987-5-7782-1980-9
2. Antonnikova A.A., Korovina N.V., Kudryashova O.B., Akhmadeev I.R. Experimental Study of the Processes of Aerosol Transformation under Ultrasonic Impact // Atmospheric and Oceanic Optics. - 2013. - V. 26, № 1. - P. 57-59.
3. Olga B. Kudryashova, Boris I. Vorozhtsov, Natalia V. Korovina, Alexandra A. Antonnikova, Ugor R. Akhmadeev Usage of an Explosive Atomizer in Problems of Environmental Safety. - Proceeding of HEM-2013 //Sagamihara, Japan, 2013. - # HEM59. - pp. 134-135.

ASSESSING THE HEALTH EFFECTS OF SAHARAN DUST INTRUSIONS IN SPAIN

Aurelio Tobias[1]*, Julio Diaz[2], Noemi Perez[1], Cristina Linares[2], Andres Alastuey[1], Xavier Querol[1]

[1]*Institute of Environmental Assessment and Water Research (IDAEA), Spanish Council for Scientific Research (CSIC), Barcelona, 08034, Spain*
[2]*National School of Public Health, Carlos III Health Institute (ISCIII), Madrid, 28029, Madrid, Spain*
**aurelio.tobias@idaea.csic.es*

Winds from the Sahara desert transport large amounts of dust to Spain. The presence of high dust concentrations for long periods of time raises concerns about adverse health effects and appropriate interventions by health authorities (Karanasiou et al. 2012). We assess the short-term effects of Saharan dust intrusions on total daily mortality in the Spain between 2004 and 2010. We firstly quantified the health effects of regional dust intrusions for the 52 capital cities using a time-stratified case-crossover design. In a second stage, these were combined at regional and national levels by using random effects meta-analysis. The occurrence of Saharan dust intrusions in Spain ranged between 10% (North region) and 30% (South West region) of the days during the study period. We observed a statistically significant ($p<0.05$) overall average increase in daily mortality of 2% during dust intrusions, ranging by region from 1.5% (North East region) up to 3.5% (Central region). Surprisingly, in the Canary Islands the increase in mortality was only 0.5%. However, when stratifying by season it rose up to 2.5% during the warm season. Saharan dust intrusions may have adverse health effects. Further investigation is needed to understand the role of fine particles and the mechanism by which Saharan dust could increase mortality.

Karanasiou A, Moreno N, Moreno T, Viana M, de Leeuw F, Querol X. (2012). Health effects from Sahara dust episodes in Europe: literature review and research gaps. Environment International, 47, 107-114.

ULTRAFINE PARTICLES ARE NOT MAJOR CARRIERS OF CARCINOGENIC PAHS AND THEIR GENOTOXICITY IN SIZE-SEGREGATED AEROSOLS

Jan Topinka[1]*, Alena Milcova[1], Jana Schmuczerova[1], Jiri Krouzek[2], Jan Hovorka[2]

[1]*Institute of Experimental Medicine, AS CR, 142 20 Prague 4, Czech Republic*
[2]*Institute for Environmental Studies, Charles University in Prague, 120 00 Prague 2, Czech Republic*
**jtopinka@biomed.cas.cz*

Recent research indicates gaps of the current policy framework, leaving health relevant size fractions of particulate matter (PM) of ambient air pollution unregulated, thus, jeopardizing public health by particles of aerodynamic diameter - d_{ae} of submicron (d_{ae}<1 μm) or even ultrafine (d_{ae}<0.1 μm) fractions. Genotoxic effects of the combustion related PM are mainly induced by carcinogenic polycyclic aromatic hydrocarbons (c-PAHs) and their derivatives forming organic fraction of the ambient outdoor air PM. This study aimed to quantify the c-PAHs content and the genotoxicity of the organic extracts (EOMs) from various PM fractions, including particles of d_{ae} <0.17 μm formed mostly by the ultrafine fraction. We focused on the high size (4 fractions) and time (26 consecutive days) variability.
Coarse (1<d_{ae}<10 μm), upper accumulation (0.5<d_{ae}<1 μm), lower accumulation (0.17<d_{ae}<0.5 μm) aerosol particles were collected on polyurethane foam (PUF) and the smallest aerosol particles of d_{ae}<0.17 μm, in this study termed ultrafine, were trapped on PTFE-coated Glass Micro-Fiber Absolute filters (Pallflex 70 TX40). Aerosol was sampled by means of a HiVol cascade impactor (BGI 900, USA). Aerosol samples were collected from 26th January to 21st February 2012 in residential area of Ostrava-Radvanice. The concentrations of seven of the PAHs regarded as carcinogenic were analyzed in each EOM sample. Calf-thymus DNA (1 mg/ml) was incubated with various EOM samples (EOM corresponding to 3 m^3 of the air/ml) for 24 h at 37 °C with and without metabolic activation by use of an S9 fraction from rat liver. DNA adducts were analyzed by ^{32}P-postlabelling with use of the nuclease P1 treatment for adduct enrichment.
The results suggest that concentrations of c-PAHs in Ostrava-Radvanice during the sampling period were generally very high and represent significant health risk. In agreement with the mass distribution among aerosol size fractions, carcinogenic PAHs are bound mainly on the upper accumulation mode of PM (0.5-1 μm). Ultrafine particles (< 0.17 μm) bound only 11-15% of total PM10 c- PAHs, while accumulation mode bounds everytime more than 60% of c/PAHs. Carcinogenic PAHs are mostly responsible for PM genotoxicity, the contribution of directly acting (without S9) is 2-5-fold lower. Accumulation mode (0.17-1μm) is predominantly responsible for of PM genotoxicity (48.3-72.0 %) while ultrafine particles (<0.17 μm) represent only 2.9-20.6 of total DNA adduct levels detected. Our study suggests that relative genotoxicity of the aerosol (DNA adducts/mg PM) is higher when PM levels are lower. This finding also indicates that monitoring of PM10, PM2.5 or PM1 is not sufficient to assess genotoxic/carcinogenic potential of the particulate air pollution.

[Support: Czech Science Foundation: P503/12/G147]

BIOAEROSOL TRANSPORT TO CENTRAL EUROPE BY SAHARAN DUST OUTBREAKS

Emre Toprak, Martin Schnaiter*

Karlsruhe Institute of Technology, Karlsruhe, 76131, Germany
**martin.schnaiter@kit.edu*

Biological particles are important components of the atmospheric aerosol as these particles can act as cloud condensation nuclei (CCN) and ice nuclei (IN) and, therefore, play a role in cloud and precipitation formation. Especially the ice nucleation at warmer subzero temperatures (>-10°C) are often discussed by referring to the high IN efficiencies found for some bacterial species and fungal spores (Després et al., 2012). Seasonal dust storms in the large deserts in Asia and Africa aerosolize a huge amount of soil derived dust into the atmosphere where it is transported over global distances. There are indications that these dust injections are also strong sources for airborne biological particles (Kellog and Griffin, 2006). Recent measurements of increased bioaerosol concentrations during dust storm events in the western United States support this hypothesis (Haller et al., 2011). However, these measurements have been conducted for a rather short period of only two months and for an area that isn't a main contributor for the global dust aerosol.

In this contribution we present results from online bioaerosol measurements conducted at the High Altitude Research Station Jungfraujoch, Switzerland (3580 m a.s.l.) over a period of 12 months. We specifically investigated possible correlations between high biological particle concentrations and Saharan desert Dust Events (SDE). The SDEs could be clearly identified by accompanied spectral aerosol absorption and scattering coefficients (Coen et al., 2004). The latest version of the Wide Band Integrated Bioaerosol Sensor (WIBS-4, now distributed by DMT, USA) was used to measure the number concentration and size distribution of aerosol particles that contain biological fluorophores. WIBS-4 detection capabilities have been characterized in the laboratory prior to the field measurements (Toprak and Schnaiter, 2013). Our results clearly show that SDEs carry biological particles in at least 10 times higher number concentration compared to non-SDE situations. Statistical analyses of the measured bioaerosol distributions are given for the observed SDE in conjunction with HYSPLIT back-trajectory calculations.

Després, V.R., Huffman, J.A., Burrows, S.M., Hoose, C., Safatov, A.S., Buryak, G., Fröhlich-Novoisky, J., Elbert, W., Andreae, M.O., Pöschl, U., Jaenicke, R. (2012), Primary biological aerosol particles in the atmosphere: a review, Tellus B, 64, 15598.

Kellogg, C.A., Griffin, D.W. (2006), Aerobiology and the global transport of desert dust, Trends Ecol. Evol., 21, 638.

Hallar, A.G., Wiedinmyer, C., Chirokova, G., Dodson, C, McCubbin, I., Painter, T.H. (2011). Atmospheric bioaerosols transported via dust storms in the western United States, Geophys. Res. Lett., 38, L17801.

Coen, M. C., Weingartner, E., Schaub, D., Hueglin, C., Corrigan, C., Henning, S., Schwikowski, M., Baltensperger, U. (2004), Saharan dust events at the Jungfraujoch: detection by wavelength dependence of the single scattering albedo and first climatology analysis, Atmos. Chem. Phys., 4, 2465.

Toprak, E., Schnaiter, M. (2013), Fluorescent biological aerosol particles measured with the Waveband Integrated Bioaerosol Sensor WIBS-4: laboratory tests combined with a one year field study, Atmos. Chem. Phys., 13, 225.

THE AVAILABILITY AND SOURCE OF IRON MODULATE OCEAN ACIDIFICATION EFFECTS IN ANTARCTIC PHYTOPLANKTON

Scarlett Trimborn[1]*, Clara J.M. Hoppe[1], louiza Norman[2], Juan Santos- Echeandía[3], Luis Laglera[4], Christel Hassler[5]

[1]*Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, 27570, Germany*
[2]*University of Technology Sydney, Sydney, 2007, Australia*
[3]*Marine Research Institute, Vigo, 36208, Spain*
[4]*University of Balearic Islands, Palma, 07122, Spain,*
[5]*Institute F.-A. Forel, University of Geneva, Geneva, 1290, Switzerland*
**Scarlett.Trimborn@awi.de*

Iron availability is the key factor in controlling phytoplankton growth in the Southern Ocean. The ongoing rise in atmospheric CO_2 concentrations will alter iron speciation and hence its availability to phytoplankton, but information on this is still scarce. To study how different iron sources will affect primary productivity, phytoplankton species composition, and iron chemistry under ocean acidification, ship-board incubation experiments were performed with a phytoplankton community from iron-limited waters south of the Antarctic Circumpolar Current. To this end, the community was exposed to ambient and high pCO_2 levels (390 and 1000 µatm), to which either no iron or different iron sources (inorganic iron versus Australian dust) were added. After four weeks of semi-continuous incubation, we observed pronounced differences in growth, primary productivity and the physiology of the phytoplankton communities. Our data show that CO_2 ultimately controls the phytoplankton community structure of control and dust-enriched communities while inorganic iron-enriched communities are affected by both CO_2 and inorganic iron. Based on our data, the shift in species composition under the different conditions can be ascribed to changes in iron chemistry (iron chemical speciation, humic acid-like substances) in response to pCO_2 and hence bioavailability. Changes in community structure can have a strong impact on biogeochemical cycles in this region.

CHARACTERIZATION OF THE ORIGIN OF SUB-MICROMETRIC PARTICLES (PM_1) IN AGRI VALLEY (SOUTHERN ITALY)

Serena Trippetta*, Rosa Caggiano, Serena Sabia

IMAA, Istituto di Metodologie per l'Analisi Ambientale, CNR, Tito Scalo (PZ), 85050, Italy
**serena.trippetta@imaa.cnr.it*

The Agri Valley (Basilicata Region - Southern Italy) is an area of international concern since it houses the largest European on-shore reservoir and the largest crude oil pre-treatment plant (i.e., Centro Olio Val d'Agri - COVA) within an anthropized context. This plant produces several gaseous and particulate emissions from several thermo destroyers and a system of torches where control flames continuously burn.
Focusing on particulate emissions, it is widely recognized that combustion processes give rise to particles mainly in the fine and sub-micrometric size ranges that should represent a real problem for the environment, also posing health risks to the population living close to this type of industrial plant (Trippetta et al., 2013). In fact, it has been proven that sub-micrometric particles (referred to as PM_1, aerosol particles with aerodynamic diameter less than 1.0 µm) have a higher capability of penetrating into the human respiratory and circulation systems with respect to the coarser aerosol factions (e.g., PM10 and PM2.5 which are aerosol particles with aerodynamic diameter less than 10 µm and 2.5 µm, respectively) (Pope III and Dockery, 2006). Therefore, they carry a large number of inorganic and organic species inside the human body with consequent concerns for the public health.
In this context, PM1 measurements were performed in Viggiano in September 2012. Viggiano is the nearest town to the crude oil pre-treatment plant and one of the most populated town of the Agri Valley.
During the study period, the PM1 daily concentrations ranged from 1.2 to 8.4 µg m-3 with a mean value of 4.6 µg m-3.
When the PM1 chemical composition was considered, it can be observed that S, followed by typical crustal elements (i.e., Ca, Fe, Mg, Na, Al, and K), were the most abundant constituents of the PM1 collected in the study area.
By applying the Principal Component Analysis (PCA), it was pointed out that crustal soil, biomass and wood burning, secondary atmospheric reactions involving COVA plant emissions and local soil particles and traffic were the main sources contributing to the PM_1 measured in the area under study.

Pope III C.A., Dockery D.W. (2006). Health effects of fine particulate air pollution: lines that connect. Journal of the Air & Waste Management Association 56,709-742.

Trippetta S., Caggiano R., Telesca L. (2013). Analysis of particulate matter in anthropized areas characterized by the presence of crude oil pre-treatment plants: The case study of the Agri Valley (Southern Italy). Atmospheric Environment 77, 105-116.

PARTICULATE MATTER AND CRUDE OIL PRE-TREATMENT PLANTS: THE CASE STUDY OF THE AGRI VALLEY (SOUTHERN ITALY)

Serena Trippetta*, Rosa Caggiano, Serena Sabia, Luciano Telesca

IMAA, Istituto di Metodologie per l'Analisi Ambientale, CNR, Tito Scalo (PZ), 85050, Italy
**serena.trippetta@imaa.cnr.it*

Simultaneous measurements of PM_{10}, $PM_{2.5}$ and PM_1 (i.e., aerosol particles with aerodynamic diameter less than 10, 2.5 and 1 µm, respectively) daily mass concentrations and daily particle number concentration were performed in Agri Valley (Basilicata Region - Southern Italy) from July to November 2011. This area is of international concern since it houses the largest European on-shore reservoir and the largest crude oil pre-treatment plant (i.e., Centro Olio Val d'Agri - COVA) within an anthropized context. The PM measurements were analysed combining an innovative statistical methodology, the Singular Spectral Analysis, with forecast models and remote sensing observations. Our findings show that most of the PM collected was made up of fine and sub-micrometric particles (i.e., $PM_{2.5}$ and PM_1, respectively) very likely originated by common anthropogenic sources. Moreover, $PM_{2.5}$ and PM_1 daily mass concentrations were characterized by a slightly increasing trend that could be related to the contribution of local sources, such as the COVA plant, whose combustion processes also produce the emission of particles mainly in the fine and sub-micrometric size ranges. The integrated use of model forecasts, satellite observations and in-situ measurements shows that the only PM_{10} exceedance was affected by the contribution of Saharan dust, while the three $PM_{2.5}$ exceedances were mainly due to the contributions of local anthropogenic sources. Finally, the application of the Air Quality Index (AQI) developed by the United States Environmental Protection Agency (US EPA, 2006) highlights that the air quality was always "good" with respect to PM_{10} and "moderate" with respect to $PM_{2.5}$ suggesting that fine particles, if they will be not kept under control, should represent a real problem also posing health risks to the population living close to the crude oil pre-treatment plant.

Trippetta S., Caggiano R., Telesca L. (2013). Analysis of particulate matter in anthropized areas characterized by the presence of crude oil pre-treatment plants: The case study of the Agri Valley (Southern Italy). Atmospheric Environment 77, 105-116.

US EPA (2006). Guidelines for the reporting of daily air quality e the air quality index (AQI).

REGIONAL AND GLOBAL CALCULATIONS OF MINERAL DUST WITH THE EMEP MODEL

Svetlana Tsyro[1]*, Michael Schulz[1], Lucia Mona[2], Wenche Aas[4]

[1]Norwegian Meteorological Institute, Oslo, NO-0313, Norway
[2]Institute of Methodologies for Environmental Analysis, Potenza, 85050, Italy
[3]Norwegian Institute for Air Research, Kjeller, NO-2027, Norway
*svetlana.tsyro@met.no

One of the main applications of the EMEP/MSC-W model is to provide - for policy related assessments - the calculations of current levels and future scenarios of PM_{10} and $PM_{2.5}$. Accurate calculation of mineral dust is important to reproduce PM levels and episodes, including exceedances of critical values. Good estimates of mineral dust deposition are necessary for assessment of ecosystems recovery from acidification due to base cations. On the global scale, accurate modeling of desert dust is essential for making robust estimates of aerosol loads, solar radiation extinction and aerosol radiative effects.

The contribution of dust from anthropogenic and natural sources to European background PM is calculated with the EMEP model. The model runs are performed on both regional and global scales. Modelling of windblown dust is associated with large uncertainties, therefore a series of tests is performed to study the sensitivity of results to uncertain parameterization and input parameters. Furthermore, as windblown dust generation is rather a sub-grid process, the effect of model's resolution on calculated dust concentrations is considered. Model performance with respect to dust (and PM during dust episodes) is evaluated with EMEP observations, sun photometer and satellite data. In addition to monitoring data, measurements of mineral dust during EMEP intensive periods in June 2006, January 2007 and June-July 2012 have been used. Model results are compared with AOD data from MODIS and aerosol extinction profiles from CALIOP.

PM pollution episodes in Europe associated with enhanced dust concentrations can be both due to long-ranged transported African dust and local emissions from bare soils. We make combined use of observed and modelled dust data to look closer at dust events. In addition to situ PM measurements, EARLINET aerosol extinction profiles have facilitated identifying such events. Understanding air pollution episodes in Southern Europe requires taking into account Saharan dust intrusions. Making use of EMEP global calculations, we show the advantage of using in the regional scale EMEP model time resolved, consistent boundary conditions as opposed to climatological dust fields.

Simpson et al.. (2012). The EMEP MSC-W chemical transport model - technical description. Atmos. Chem. Phys., 12, 7825-7865.

Schulz, M, Steensen, B. M., Tsyro, S., Koffi, B. (2012). First results of comparison modelled aerosol extinction profiles with CALIOP data. In: EMEP Status Report 1/2012, Norwegian Meteorological Institute, Oslo, Norway; http://emep.int

CHEMICAL COMPOSITION OF ASIAN DUST PARTICLES OVER THE CENTRAL NORTH PACIFIC

Mitsuo Uematsu[1]*, Hiroshi Furutani[1], Ryo Kawata[1], Yasuhiro Nakayama[1], Sayako Ueda[2], Yusuke Miki[3], Kazuhiko Miura[3]

[1]*Atmosphere and Ocean Research Institute, The University of Tokyo, Chiba, 277-8564, Japan*
[2]*Solar-Terrestrial Environment Laboratory, Nagoya University, Nagoya, 464-8601, Japan*
[3]*Faculty of Science, Tokyo University of Science, Tokyo, 162-8601, Japan*
**uematsu@aori.u-tokyo.ac.jp*

Aeolian dust and gaseous and particulate pollutants from the Asian continent are transported eastward over the North Pacific, especially in spring. Episodic atmospheric deposition of natural and anthropogenic aerosols containing iron and other essential trace elements may cause changes in primary productivity of phytoplankton, food web structure and chemical properties of marine atmosphere in the region.

During the leg 2 of the R/V Hakuho Maru KH-12-1 cruise from Honolulu to Tokyo in the North Pacific (22 February - 7 March 2012), we conducted atmospheric sampling of aerosol and gaseous components with other meteorological and physical parameters on board. Ambient aerosols segregated into two size fractions ($d<2.5$ µm and $d>2.5$ µm) were collected for 24 hours on a PTFE fiber filter by using a high-volume dichotomous virtual impactor air sampler with a wind sector control. Aerosol samples were analysed by ion chromatography for major water soluble ions.

Single-particle size and composition ranged between 0.1 and 2.0 µm were simultaneously measured by individual particle analysis using an Aerosol-Time-Of-Flight Mass Spectrometer (ATOFMS) and clarified certain aerosol types, such as biomass burning, elemental carbon, and elemental/organic carbon mixed type in the North Pacific.

Increased non-sea-salt (nss)-Ca concentration as one of indicators of mineral dust followed by the increased nitrate and ammonium concentrations were observed at 4,000-6,000km east from the Asian continent on 27-29 February. It is clearly shown the long rang transport of natural mineral dust and anthropogenic substances to the central North Pacific. By the single particle analysis, mineral dust particles were mixed with sea salt and <0.7µm and >0.7µm dust particles were associated with sea salt approximately 20% and 50% by number, respectively.

This coagulation process between mineral dust and sea salt particles may accelerate the gravitational settling of marine aerosols and supplies the terrestrial, marine and marine biogenic origin substances to the ocean environment.

PROFILING OF ATMOSPHERIC VOLCANIC ASH LAYERS USING AN AEROSOL RADIOSONDE

Zbigniew Ulanowski[1]*, R.Giles Harrison[2], Keri A. Nicoll2, Ralph Burton[3], Paul H. Kaye[1], Edwin Hirst[1], Stephen D. Mobbs[3], Alan Gadian[3]

[1]*Centre for Atmospheric and Instrumentation Research, University of Hertfordshire, Hatfield AL10 9AB, United Kingdom*
[2]*Department of Meteorology, University of Reading, Reading RG6 6BB, United Kingdom*
[3]*School of Earth and Environment, University of Leeds, LeedsLS2 9JT, United Kingdom*
**z.ulanowski@herts.ac.uk*

Routine meteorological data is obtained in the atmosphere using disposable radiosondes. These give temperature, pressure, humidity and wind speed. Additional measurements are acquired from dropsondes, released from research aircraft. However, a crucial property not yet measured for lack of suitable low-cost instrumentation is the size and concentration of atmospheric particulates. Instead, indirect measurements are employed, relying on remote sensing, to meet the demands from areas such as climate research, air quality monitoring, civil emergencies etc. In addition, research aircraft can be used *in situ*, but these measurements are expensive, and restricted to near-horizontal profiling, which can be a limitation, as phenomena such as long-range transport depend strongly on the vertical distribution of aerosol.

Centre for Atmospheric and Instrumentation Research at University of Hertfordshire develops light-scattering instruments for the characterization of aerosols and cloud particles. Recently a range of low-cost, miniature particle counters has been created, intended for use with systems such as disposable balloon-borne radiosondes, dropsondes, or in dense ground-based sensor networks. Versions for different particle size ranges exist. They have been used for vertical profiling of aerosols such as mineral dust (Nicoll et al., 2011; Ulanowski et al., 2014) and for air quality monitoring in dense ground-based sensor networks (Mead et al. 2012).

An early counter version, developed for use with Vaisala RS92radiosondes and an electric charge sensor, was deployed to profile ash from the Eyjafjallajökull eruption. The layer detected over Stranraer, Scotland, on 19 April 2010 was centred on 4000 m altitude and was about 600 m thick, with fairly uniform, sharply defined aerosol concentration (Harrison et al., 2010). The sounding was compared to ash dispersion model runs using WRF. Agreement could be reached only by carefully adjusting the height of the initial ash emission column. This finding demonstrates that correct initialization of dispersion models can be achieved by profiling aerosol layers using disposable sondes containing low-cost optical particle counters.

HarrisonR.G., NicollK.A., UlanowskiZ., Mather T.A. (2010). Self-charging of the Eyjafjallajökull volcanic ash plume, Env. Res. Lett. 5, 024004.

Mead M.I., Popoola O.A., Stewart G., Bright V., Kaye P.H., Saffell J. (2012). High-density, high-resolution, low-cost air quality sensor networks for urban air monitoring, AGU Fall Meeting, San Francisco.

Nicoll K.A., Harrison R.G., Ulanowski Z. (2011). Observations of Saharan dust layer electrification, Env. Res. Lett. 6, 014001.

Ulanowski Z., Kaye P.H., Hirst E., Wieser A., StanleyW.R. (2014). Dust layer profiling using aerosol dropsondes. Dust 2014.

DUST LAYER PROFILING USING AN AEROSOL DROPSONDE

Zbigniew Ulanowski[1]*, Paul H. Kaye[1], Edwin Hirst[1], Andreas Wieser[2], Warren R. Stanley[1]

[1]*Centre for Atmospheric and Instrumentation Research, University of Hertfordshire, Hatfield AL10 9AB, United Kingdom*
[2]*Karlsruhe Institute of Technology (KIT), Institute for Meteorology und Climate Research (IMK-TRO), POB 3640, 76021 Karlsruhe, Germany*
**z.ulanowski@herts.ac.uk*

Routine met data is obtained in the atmosphere using disposable radiosondes, giving temperature, pressure, humidity and wind speed. Additional measurements are obtained from dropsondes, released from research aircraft. However, a crucial property not yet measured is the size and concentration of atmospheric particulates, including dust. Instead, indirect measurements are employed, relying on remote sensing, to meet the demands from areas such as climate research, air quality monitoring, civil emergencies etc. In addition, research aircraft can be used *in situ*, but airborne measurements are expensive, and aircraft use is restricted to near-horizontal profiling, which can be a limitation, as phenomena such as long-range transport depend on the vertical distribution of aerosol.
Centre for Atmospheric and Instrumentation Research at University of Hertfordshire develops light-scattering instruments for the characterization of aerosols and cloud particles. Recently a range of low-cost, miniature particle counters has been created, intended for use with systems such as disposable balloon-borne radiosondes, dropsondes, or in dense ground-based sensor networks. Versions for different particle size ranges exist. They have been used for vertical profiling of aerosols such as mineral dust (Nicoll et al.) or volcanic ash (Harrison et al.). A disadvantage of optical particle counters that sample through a narrow inlet is that they can become blocked, which can happen in cloud, for example. Hence, a different counter version has been developed, which can have open-path geometry, as the sensing zone is defined optically rather than being delimited by the flow system. This counter is now used for ground based air-quality monitoring around Heathrow airport (Mead et al.). The counter has also been adapted for use with radiosondes or dropsondes. The dropsonde version has been successfully tested by launching it from research aircraft together with the so-called KITsonde, developed at the Karlsruhe Institute of Technology, which determines standard meteorological variables and GPS position for transmission back to the aircraft (Wieser et al.).

Nicoll K.A., Harrison R.G., Ulanowski Z. (2011). Observations of Saharan dust layer electrification, Env. Res. Lett. 6, 014001.

Harrison R.G., Nicoll K.A., Ulanowski Z., Mather T.A. (2010). Self-charging of the Eyjafjallajökull volcanic ash plume, Env. Res. Lett. 5, 024004.

Mead M.I., Popoola O.A., Stewart G., Bright V., Kaye P.H., Saffell J. (2012). High-density, high-resolution, low-cost air quality sensor networks for urban air monitoring, AGU Fall Meeting, San Francisco.

Wieser A., Fütterer D., Franke H., Schell D., Schmidmer F., Kottmeier C. (2009). A novel modular multi-sensor dropsonde system for high resolution measurements. 9th EMS Ann. Meet. Appl. Meteor., Tolouse, EMS2009-396.

INDOOR CONCENTRATIONS OF PARTICULATE MATTER IN A PIG FATTENING FACILITY: EFFECT OF DIFFERENT PEN CLEANING TECHNIQUES AND HOUSING SYSTEMS

Tim Ulens[1,2]*, Sam Millet[2], Nele Van Ransbeeck[1], Stephanie van Weyenberg[1], Herman Van Langenhove[3], Peter Demeyer[1]

[1]*Institute for Agricultural and Fisheries Research (ILVO),Technology and Food Science Unit - Agricultural Engineering, Merelbeke, 9820, Belgium*
[2]*Institute for Agricultural and Fisheries Research (ILVO), Animal Science Unit - Pig Husbandry, Melle, 9090, Belgium*
[3]*Department of Sustainable Organic Chemistry and Technology, Faculty of Bioscience Engineering, Ghent University, Ghent, 9000, Belgium*
**tim.ulens@ilvo.vlaanderen.be*

To investigate the effect of different pen cleaning techniques and housing systems on indoor concentrations of particulate matter (PM), two types of cleaning protocols were tested in two housing systems on a commercial fattening pig barn in Belgium. The housing systems were: 1) a conventional housing system with fully slatted floor and 2) an ammonia-emission-low housing system with reduced emission surfaces. In these two housing systems, both a “dry” and “wet” cleaning protocol were applied. In both protocols, the pens were cleaned with brooms and a vacuum cleaner and the manure pit or the manure and water channels were emptied. For the “wet” protocol, the floor of the pens was subsequently soaked with water, thoroughly cleaned with a pressure washer and finally the pens were disinfected using Virocid (CID LINES N.V., Ieper, Belgium) and allowed to dry. In total, 4 compartments per housing system (2 with the “dry” protocol and 2 with the “wet” protocol”) were monitored from August 2011 until June 2012 during two subsequent fattening periods. PM concentrations (PM_{10}, $PM_{2.5}$ and PM_1) were measured at 0.8 m above the slatted floor using two Grimm1.109 spectrometers and two Graywolf Particle Counters - Handheld 3016IAQ.

No significant differences in indoor concentrations of PM_{10} and $PM_{2.5}$ were found when analysing the first month after cleaning or an entire fattening period. Indoor concentrations of PM_1 were significantly higher during the first month after performing the “wet” protocol, but not significantly different when considering the entire fattening period. The reasons are unclear.
We did not observe significant differences in indoor concentrations of PM_{10}, $PM_{2.5}$ and PM_1 between the two types of housing systems.
In the near future, the particle size distribution (number and mass distribution) for both housing systems and cleaning protocols will be calculated and analysed. Some results will be presented.

PRELIMINARY RESEARCH ON THE AMMONIUM CONTENT OF PARTICULATE MATTER (PM) FROM INDOOR AIR OF PIG HOUSING SYSTEMS

Tim Ulens[1,2], Nele Van Ransbeeck[1], Herman Van Langenhove[3], Peter Demeyer[1]*

[1]*Institute for Agricultural and Fisheries Research (ILVO),Technology and Food Science Unit - Agricultural Engineering, Merelbeke, 9820, Belgium*
[2]*Institute for Agricultural and Fisheries Research (ILVO), Animal Science Unit - Pig Husbandry, Melle, 9090, Belgium*
[3]*Department of Sustainable Organic Chemistry and Technology, Faculty of Bioscience Engineering, Ghent University, Ghent, 9000, Belgium*
**peter.demyer@ilvo.vlaanderen.be*

In Flanders, apart from cross border contributions, the agricultural sector provides the largest contribution with regard to PM_{10} (54%) and $PM_{2.5}$ (49%) (Deutsch et al., 2010). These contributions are calculated based on both primary particulate matter emissions and secondary particulate matter formation originating from ammonia emissions by agricultural activities. Using this approach, the possibility of secondary particulate matter formation inside the animal house (e.g. ammonium salts) could be an important aspect to take into account in the model calibration and validation.

Experiments were conducted during the period of March to June 2012. In order to test the measuring protocol, samples of PM_{10} and $PM_{2.5}$ were collected inside an experimental pig house at ILVO. These samples were gravimetrically quantified and analysed on their ammonium content via colorimetric tests. Afterwards, samples of PM_{10} and $PM_{2.5}$ were taken at a commercial fattening pig facility in Flanders in order to check the hypothesis of secondary particulate matter formation inside animal housing systems.

The ammonium content of PM_{10} and $PM_{2.5}$ captured inside the animal houses was higher than the ammonium content of these fractions at the air inlet, indicating the possible indoor formation of secondary particulate matter. The results of this preliminary research therefore suggest the occurrence of secondary particulate matter formation inside animal housing systems. However, these provisional conclusions are based upon a limited number of samples. A more extended sampling campaign would be necessary for final confirmation.

This work was supported by Boerenbond, a professional association of Flemish farmers.

Deutch F., Vankerkom J., Veldeman N., Fierens, F., Vanpoucke, C., Trimpeneers, E., Vancraeynest, L., Bossuyt, M. (2010). Verklarende factoren voor evoluties in luchtkwaliteit. MIRA/2010/07 Report, pp 82.

AEROSOL PHYSICO-CHEMICAL AND OPTICAL PROPERTIES OBSERVED IN DESERT AND URBAN SITES

Florin Unga[1,2]*, Marie Choël[2], Yevgeny Derimian[1], Philippe Goloub[1]

[1]Laboratoire d'Optique Atmosphérique, Université de Lille 1, Villeneuve d'Ascq, 59655, France
[2]Laboratoire de Spectrochimie Infrarouge et Raman, Université de Lille 1, Villeneuve d'Ascq, 59655, France
*florin.unga@ed.univ-lille1.fr

Chemical composition, morphology and mixing state of atmospheric particles may significantly affect aerosol optical properties and thus their radiative effects. The general goal of this study is to understand the impact of physico-chemical characteristics and transformations of aerosols during transport on their optical properties. The question asked is whether relationships between remote sensing observations and some features of aerosol chemical composition and morphology can be established. The research is conducted in the framework of an interdisciplinary project on Chemical and Physical Properties of the Atmosphere (CaPPA) that allows combining in-situ optical measurements, aerosol samplings, off-line laboratory analyses, and numerical simulations. Therefore this study is being carried out in a number of stages that rely on ground-based optical measurements (AERONET photometer, lidar), measurements by an airborne photometer (PLASMA), sampling of size-segregated atmospheric particles by means of cascade impactors and single-particle analysis by microspectroscopic techniques. Observations of compositional and morphological characteristics are then implemented into numerical simulations of aerosol optical characteristics in an attempt to explain remotely sensed observations. Taking into account the different aerosol origins and the air-mass backward trajectories we analyse the effects of aerosol aging, hygroscopic growth, enrichment in iron, sulphates and other atmospheric pollutants. Results will be presented from several field measurements in western Africa (M'Bour, Senegal), the Negev Desert of Israel, and from an industrial harbour in northern France.

SOLUBLE AND COLLOIDAL IRON FRACTIONATION FOLLOWING AEROSOL DISSOLUTION IN THE SURFACE ATLANTIC OCEAN

Simon J. Ussher[1,2]*, Matthew P. Fishwick[1], Chris M. Marsay[3], Peter N. Sedwick[3]

[1]*Plymouth University, Plymouth, PL4 8AA, UK*
[2]*Bermuda Institute of Ocean Sciences, St George's, GE 01, Bermuda*
[3]*Old Dominion University, Norfolk, VA 23529, USA*
**sussher@plymouth.ac.uk*

The iron biogeochemistry of the North Atlantic Ocean shows significant temporal and spatial variability due to the proximately of; high magnitude aerosol sources (i.e. Sahara Desert), highly productive upwelling areas and continental shelves (Ussher *et al.,* 2013). To understand how iron is processed in surface waters and utilised as a micronutrient by phytoplankton, it is vital to consider the physico-chemical transformations that occur *in situ*. These transformations include the partitioning of iron between molecular and nano-particulate (often termed soluble, < 0.02 µm), colloidal (0.02 - 0.4 µm) and particulate (> 0.02 µm) fractions.

In this study, size fractionated iron data are presented from a series of summer research cruises in the Bermuda Atlantic Time-series Study region (BATS) in the Sargasso Sea (2003-2008). These data are then compared with laboratory dust dissolution simulations in order to deduce a mechanism for Fe dissolution from freshly deposited aerosols into the surface ocean. For laboratory simulations, representative marine-sector aerosol samples were collected from Tudor Hill (Bermuda) over four different seasonal time periods (2009-2010) and subsamples were used in aerosol leach experiments with fresh filtered seawater.

The summer field data from BATS showed the inter-annual consistency of vertical profiles of soluble, colloidal and labile particulate Fe, with surface dissolved iron concentrations as high as 1.5-2.1 nM (Sedwick *et al.,* 2005). The dominance of colloidal fractions over soluble iron in these surface waters (i.e. above the deep chlorophyll maximum) is consistent with the results of laboratory aerosol dissolution simulations of seasonal samples. Based on this comparison, we propose a rapid 'two-stage' mechanism for atmospheric Fe dissolution, which results in Fe becoming associated with marine colloids in the mixed layer.

Sedwick, P. N., Church, T. M., Bowie, A. R., Marsay, C. M., Ussher, S. J., Achilles, K. M., Lethaby, P. J., Johnson, R. J., Sarin, M. M., and McGillicuddy D. J. (2005), Iron in the Sargasso Sea (Bermuda Atlantic Time-series Study region) during summer: Eolian imprint, spatiotemporal variability, and ecological implications, Global Biogeochemical Cycles, 19, GB4006, doi:10.1029/2004GB002445.

Ussher, S. J., Achterberg, E. P., Powell, C., Baker, A. R., Jickells, T. D., Torres, R., and Worsfold P. J. (2013), Impact of atmospheric deposition on the contrasting iron biogeochemistry of the North and South Atlantic Ocean, Global Biogeochemical Cycles, 27, doi:10.1002/gbc.20056.

STATISTICAL ANALYSIS OF THE RELATIONSHIP BETWEEN URBAN PARTICLE SIZE DATA AND ATMOSPHERIC DATA

Alessandro Vagheggini[1]*, Fabiana Scotto[2], Dimitri Bacco[3], Isabella Ricciardelli[2], Arianna Trentini[2], Daniela Cocchi[1], Vanes Poluzzi[2]

[1]*University of Bologna, Bologna, 40126, Italy*
[2]*Regional Agency for Prevention and Environment of Emilia-Romagna region (ARPA ER), Bologna, 40138, Italy*
[3]*University of Ferrara, Department of Chemical and Pharmaceutical Sciences ,Ferrara, 44121, Italy*
**alessandr.vagheggin2@unibo.it*

Supersite is a project supported by the Emilia-Romagna Region Government and Regional Agency for Prevention and Environment of Emilia-Romagna Region (ARPA ER), which is focused on a detailed study of chemicals, physical toxicological and epidemiological properties of PM2.5 in the atmosphere of Emilia-Romagna (North Italy). In this project, great attention is given on distribution of fine and ultrafine particles and continuous measurements are planned for three years.

This work focuses on the 2013 first six months hourly number size distribution of particles from 15 nm to 600 nm measured by a Scanning Mobility Particle Sizer (SMPS Model 3936, TSI) placed in a background urban area of Bologna (Po Valley, North Italy).

Following Beddows et al. (2009) and Sabaliauskas et al. (2013), the hourly data are analysed by using a cluster analysis. A Hopkins Index was utilized in order to verify the existence of natural clusters in the data. The Dunn-Index and the Silhouette width were used for determining the number of clusters of the k-means clustering algorithm. From the analysis of the distribution shape of each cluster, as well as from the daily and monthly behaviour, it was possible to hypothesize sources and processes that contribute to formation and fate of particles in atmosphere.

Furthermore, in order to better understand how the meteorological conditions affect the number of particles, an analysis on the atmospheric variables in relation with the clusters obtained was conducted.

Beddows C.S., Dall'Osto M., Harrison R.M. (2009). Cluster analysis of rural, urban and curbside atmospheric particle data. Environmental Science & Technology 43, 4694 - 4700.

Sabaliauskas K., Jeong C.H., Yao X., Jun Y.S., Evans G. (2013). Cluster analysis of roadside ultrafine particle size distributions. Atmospheric Environment 70 , 64 - 70.

EMISSION FACTORS OF GAS AND PARTICULATE MATTER DURING THE ENERGY RECOVERY OF GRAPE MARC IN A DOMESTIC BOILER

Maximilien Valente, Gwenaëlle Trouve*, Cornelius Schönnenbeck, Jean-François Brilhac

GRE Laboratory-UHA, Mulhouse, 68200, France
**gwenaelle.trouve@uha.fr*

Producing energy through biomass combustion is considered sustainable. The demand for renewable energies needs to be diversified in order to avoid deforestation and combustion of different agricultural by-products have been already compared (Caillat et al., 2012). Regarding environmental issues, the pollutant emissions control is the key factor for the development of biomass combustion. The Alsace Region (France) is well-known for wine production leading to large quantities of grape marc. This wine residue has also a great interest for energy recovery in other regions (Celma et al., 2007; Toscano et al., 2013). Therefore, the present study focuses on the gas and particulate matter emissions of grape marc combustion.

Different varieties produced in Alsace were characterized following the standard XP CEN/TS. Wine residue presents high water content (up to 75%) and ash content (<10%). Typical high heating value for dried sample of about 20MJ/kg was found. Combustion experiments were carried out in a small scale biomass boiler 40 kW from REKA. Pollutant emission were measured with on-line gas analysers (CO, CO_2, HC, NO, NO_2, SO_2 and O_2) and an Electrical Low Pressure Impactor (ELPI) manufactured by Dekati Ltd. (Tampere, Finland) was used to measure on line concentration numbers of particles ranging from 29 nm to 10 µm into 12 size fractions.

Due to the high moisture content, the grape marc has been blended with different co-combustible as pellets, wood chips and miscanthus. The best conditions for the combustion have been found with miscanthus which has been tested with several blending fraction.

Caillat, S., Molcan, P., Perdrix, E., Alleman, L., Campargue, M., Naudy, V., Lambre, C., Dacquin, H., Douard, F., Badji, L., 2012. Small-scale combustion experiments of selected agricultural by-products potential for biomass pellets production in France. Presented at the Fourth International Symposium on Energy from Biomass and Waste, Venice.

Celma, A.R., Rojas, S., López-Rodríguez, F., 2007. Waste-to-energy possibilities for industrial olive and grape by-products in Extremadura. Biomass Bioenergy 31, 522-534.

Toscano, G., Riva, G., Duca, D., Pedretti, E.F., Corinaldesi, F., Rossini, G., 2013. Analysis of the characteristics of the residues of the wine production chain finalized to their industrial and energy recovery. Biomass Bioenergy 55, 260-267.

SAHARAN DUST AND ITS RELATIONS TO CLIMATE

Michelle van der Does[1]*, Laura Korte[1], Chris Munday[1], Geert-Jan Brummer[1], Jan-Berend Stuut[1,2]

[1]*NIOZ - Royal Netherlands Institute for Sea Research, Texel, The Netherlands*
[2]*MARUM - Center for Marine Environmental Sciences, University of Bremen, Bremen, Germany*
**michelle.van.der.does@nioz.nl*

Every year, approximately 200 million tons of Saharan dust are transported westward through the atmosphere, influenced by many climatic and environmental processes. Dust can also influence climate itself, both directly and indirectly, although these effects are far from understood. The processes involved can result in either a cooling or warming effect on climate, depending on particle characteristics including chemical composition and size.
Dust can transport adsorbed nutrients and trace elements, as well as viable spores, pathogens and microbes. Marine deposition of dust particles containing limiting nutrients and metals can enhance photosynthetic carbon fixation in the oceans and thus influence global climate.
In sediment archives, dust has been used to trace past environmental conditions, e.g. aridity, wind strength, and the provenance of the dust particles.
Here we focus on lateral and seasonal changes in grain size and shape, flux and composition of Saharan dust, along a transect in the Atlantic Ocean at 12°N. This transect lies directly underneath the largest dust plume originating from the African continent. A year-worth of dust samples from submarine sediment traps with a 16-day resolution will be compared to monthly-resolved samples from an on-land dust collector at the source in Mauritania.

IMPACT ASSESSMENT OF PARTICULATE MATTER IN PIG FATTENING FACILITIES: INDOOR EXPOSURE LEVELS AND EMISSION RATES

Nele Van Ransbeeck[1], Herman Van Langenhove[2], Peter Demeyer[1]*

[1]*ILVO, Institute for Agricultural and Fisheries Research, Technology and Food Science Unit, Department of Agricultural Engineering, Merelbeke, 9820, Belgium;*
[2]*Department of Sustainable Organic Chemistry and Technology, Faculty of Bioscience Engineering, Ghent University Belgium; e-mail: Herman.VanLangenhove@ugent.be*
**Peter.Demeyer@ilvo.vlaanderen.be*

Mainly due to environmental restraints, some important changes in farm management have been introduced in pig fattening facilities. New regulation confronted the farmers with new barn types and new techniques that not only affected emissions but also indoor air quality. Therefore an extended study was performed to determine the impact of particulate matter (PM) on the environment and occupational health in pig fattening facilities.

During the first part of the study, indoor concentrations and emission factors (EF) of PM (PM_1, $PM_{2.5}$ and PM_{10}) in different conventional pig fattening facilities and one low ammonia emission fattening facility (LAE) were measured. During the second part of the study the impact of PM exposure levels for both the farmer and the veterinarian were assessed during different working tasks in pig fattening facilities and their exposure levels on a daily working basis (time weighted average (TWA) were estimated. The measured PM fractions were: inhalable and respirable PM, PM_{10}, $PM_{2.5}$ and PM_1.

In total, six pig fattening stables were sampled during two fattening periods. The average indoor PM concentrations were 15.0, 38.9 and 719 µg m^{-3} for PM_1, $PM_{2.5}$ and PM_{10} respectively for conventional pig fattening stables. Furthermore, the EF of these stables were 3.4, 7.8 and 99.9 g yr^{-1} a^{-1} for PM_1, $PM_{2.5}$ and PM_{10} respectively. These results were compared to other similar international researches in this field. Furthermore, estimations were made of the total emissions for fattening pigs and for the total pig industry in Flanders based on the average EF obtained by our study.

The results of the second part of the research showed that the highest personal exposure levels occurred during feed shovelling and blood sampling, the lowest during the weighing of the pigs. The TWA exposure of inhalable and respirable PM for the farmer in this research were 3.1 and 0.29 mg m^{-3} respectively, while for the veterinarian a time weighted average exposure to PM of 7.7 and 0.36 mg m^{-3} was found. The concentration levels were mainly determined by the working task performed. There was no significant effect of pig age, stable floor type, nor cleaning of the stable on the personal exposure levels.

PM TRENDS IN THE CZECH REPUBLIC

Milan Vana, Adela Holubova Smejkalova

Czech Hydrometeorological Institute, Kosetice Observatory, 394 22, Czech Republic

Presented study is based on 1996-2012 PM data from the Czech Air Quality Monitoring Network operated by the Czech Hydrometeorological Institute. This network is continuously upgraded in accordance with the requirements of EU Directives. Two methods of PM quantification are used within the network; radiometry (based on beta-ray absorption) and gravimetry (continuous filtration of ambient air on selected filtering material).

Gradual decline in PM emissions after 1990 in the Czech Republic was caused by general decrease of industrial production and reduction in electricity generation in conventional thermal power stations. In the beginning of the new millennium the decreasing trend was interrupted and emissions slightly increased.

Decreasing trend of PM_{10} concentration was registered in the period 1996-1999 at all types of stations (traffic, urban, suburban, rural and regional), but this tendency was temporarily stopped in the beginning of this century and the concentrations slightly increased and the differences between types of stations became smaller. This tendency was registered to 2006 (with the highest values in 2003). After 2007 the mean annual concentrations dropped to the level of 2000. The most serious situation is in the Moravian-Silesian region. This is caused by the fact that in this area, in addition to transport and local sources, significant contribution is made by further emission sources (metallurgy, fuel processing). Regional transfer from Poland (heavily industrialized Katowice region) is also very significant. The results of $PM_{2,5}$ show significant contribution of fine fractions to air pollution situation in the Czech Republic. The period 2005-2007 is characterized by downward tendency of mean annual $PM_{2,5}$ concentrations, no trend after 207 was found. The regional increment to $PM_{2,5}$ pollution is approximately 15 $\mu g.m^{-3}$. The ratio between $PM_{2,5}$ and PM_{10} shows certain seasonal course that is connected with the seasonal character of several emission sources.

Since 2009, regular measurement of EC-OC in $PM_{2,5}$ has been implementing at the Košetice Observatory within the framework of ACTRIS (Aerosols, Clouds, and Trace gases Research Infrastructure Network). The mean annual concentration of total carbon in $PM_{2,5}$ in the period under review was 3,73 $\mu g.m^{-3}$. The figure for elemental carbon (0,51 $\mu g.m^{-3}$) represents the mean annual ratio of 14% on TC. EC-OC concentrations follow an annual course that reflects their emission levels, i.e. with maximums in winter and minimums in summer. The seasonal variation of EC/TC ratio is not significant and ranges between 12 to 15%. Mean TC ratio on $PM_{2,5}$ total mass in the period under review was 26%, the highest ratios reached 50%. EC participated on $PM_{2,5}$ total mass by 4% in average.

Air Pollution and Atmospheric Deposition in Data in the Czech Republic in 1996-2012. (1997-2013) Praha, CHM.

VERTICAL PROFILING OF DESERT DUST FROM NADIR THERMAL IR MEASUREMENTS

Sophie Vandenbussche*, Svetlana Kochenova, Ann Carine Vandaele, Nicolas Kumps, Martine De Mazière

Belgian Institute for Space Aeronomy, Brussels, 1180, Belgium
**sophie.vandenbussche@aeronomie.be*

Desert dust is absorbing, scattering and emitting light, resulting in direct radiative forcing both in the longwave and shortwave. This forcing depends on many parameters, an important one being the vertical distribution of the aerosols, especially for the longwave effect. Dust aerosols also play an indirect radiative effect through their interaction with clouds, which depends (amongst other parameters) on the vertical location of clouds and aerosols. The vertical distribution of dust is currently poorly characterised on a global scale (high geographical/ temporal coverage).
We have recently developed a strategy allowing the retrieval of vertical profiles of desert dust concentration from nadir thermal infrared measurements (atmospheric window: 800-1200cm^{-1}) by IASI instruments flying onboard Metop-A since 2006 and Metop-B since 2012. Those instruments offer a continuous spectral coverage in the TIR with sufficiently high spectral resolution and signal-to-noise ratio as well as global Earth coverage twice a day for at least 15 years. They will be followed by a New Generation instrument planned in 2020.
Here, we will present the retrieval method and discuss uncertainties on the retrieved information. We will show example results and comparisons with other aerosol data. We will discuss possible applications of the method in its current state together with planned improvements and new developments.

AEOLIAN DUST-DERIVED PLIO-PLEISTOCENE RED PALAEOSOLS IN THE CARPATHIAN BASIN

György Varga[1]*, János Kovács[2,3], Gábor Újvári[4]

[1]*Geographical Institute, Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences, Budaörsi út 45, H-1112 Budapest, Hungary*
[2]*Department of Geology and Meteorology, University of Pécs, Ifjúság u. 6, H-7624 Pécs, Hungary*
[3]*Environmental Analytical & Geoanalytical Research Group, Szentágothai Research Centre, University of Pécs, Ifjúság u. 34, H-7624 Pécs, Hungary*
[4]*Geodetic and Geophysical Institute, Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences, Csatkai E. u. 6-8, H-9400 Sopron, Hungary*
**varga.gyorgy@webmail.csfk.mta.hu*

Aeolian dust deposits, covering more than half of the Carpathian Basin in Central Europe, form thick (up to 50 m) loess-paleosol sequences that are generally underlain by terrestrial red clays. These deposits provide information on the palaeoclimatic and palaeoenvironmental changes of the last 3-3.5 million years. The Upper and partly, the Middle Pleistocene loess deposits are intercalated by steppe, forest-steppe and brown forest soils, while the older pedogene horizons are different kinds; these are red, Mediterranean-type soils. The younger soils were formed from the underlying loess deposits, while according to preliminary data, interglacial dust deposition could have played more dominant role during the formation of the older ones, similarly to certain types of red clays. Grain size, geochemical, (clay) mineralogical, micromorphological and scanning electron microscopic (SEM) analyses have been elaborated on major Hungarian red clay-loess-palaeosol sequences to get more information on aeolian dust deposition and its role in syngenetic, accretionary soil development even during periods characterized by relatively higher temperatures and rainfall.
The detailed granulometric analyses of the red clays and red palaeosols represent similarity in terms of their bimodal grain-size distribution patterns with loess horizons, while the SEM images also show an aeolian origin of the extracted quartz grains characterized by sharp edges, breaks and stepped surfaces. The geochemical and (clay) mineralogical analyses suggest that climate during the formation of red clays and red palaeosols was considerably more humid and warmer in comparison to younger interglacials or to modern values.

SIMULATION OF INFLUENCE OF SMOKE FROM WILDFIRES TO HEALTH OF POPULATION IN NEAREST LARGE CITIES (EXAMPLES OF MOSCOW AND SYNGAPORE)

Sergey Venevsky, Cao Wu

Center for Earth System Studies, Tsinghua University, Beijing, 100084, China
**venevsky@tsinghua.edu.cn*

The new global fire model SEVER-FIRE is a mechanistic model which calculates number of human-induced and lightning fires as well as area burnt and carbon and particle emissions for both cases. The model operates at a daily time step and uses climate data (daily minimum/maximum temperature, daily precipitation/convective precipitation and daily short-wave radiation) as an input. The model works in interactive mode with a dynamic global vegetation model (DGVM), which provides fuel content and moisture and receives back amount of biomass burnt. SEVER-FIRE applies at a variable spatial resolution and for regional and global scale. This model was applied for simulation of Russian wildfires in 2010.

These fires were set due to extremely hot weather started in Central Russia in the end of June 2010 and lasted during almost two months till the end of August 2010. The long period average monthly temperatures for the two heat wave months in almost entire European part of Russia were exceed 8-9 °C with an absolute record summer temperature for Moscow 38.2 °C. Major population centres of European Russia as Moscow, Nizhnii Novgorod and Voronezh were covered by thick smoke for several weeks. The air quality in European Russia was significantly affected by excessive amount of carbon monoxide, nitrogen oxides and aerosols during the fires outbreak. The most dangerous and even lethal for the population was air pollution with particulate matter. We estimated according to the model simulation that 41 million persons were resided in the zone of forest and peat fires and smoke in 2010 totally. The most dangerous and even lethal for the population was air pollution with particulate matter PM10. Concentration of PM10 according to our calculations was ten times higher in comparison with pre-fire level in Moscow region during August 2-10, 2010, when large smoke plume has covered entire capital agglomeration of Russia.

We calculated smoke area and PM10 concentration for a case study of Indonesian fires of 1997 and found that the concentrations and exposure of population in Singapore (and Kuala Lumpur) were similar to the Moscow case. Asian hospitals statistics allowed us to estimate that at least 450 deaths related to cardio-vascular and respiratory problems happened during August 2-10, 2010 in Moscow. Thus, particulate emissions from wildfires are becoming pressing health problem for European Russia in conditions of more frequent circulation blockings. Future projections of potential health risk in large cities due to aerosols emissions from wildfire should be estimated for such cities as Moscow, Los Angeles, Singapore, Kuala Lumpur and Sydney.

NANO-PARTICLES AND GASES IN THE ENVIRONMENT OF GABORONE, BOTSWANA

Tej S. Verma*, Shibu K. John

Department of Physics, University of Botswana, Pvt Bag 0022, Gaborone, Botswana
**vermat@mopipi.ub.bw*

This study was intended to carry out continuous and simultaneous monitoring of particles and some of the gases in the environment of Gaborone. Measurements of particulate matter were taken using scanning mobility particle sizer (SMPS) capable of measuring particles with diameters from about 7.5 to 280 nm for about seven months. The concentration of gases CO, CO_2, NO_x and HC were simultaneously monitored during September 2002 and August 2004 using Horiba gas analyzer APMA360, VIA 510, APNA 360 and APHA 360 respectively. The SMPS and gas analyzers were housed in the Atmospheric Research Laboratory located on the first floor of the building of Department of Physics, University of Botswana. Our measurements show that the average concentrations of carbon monoxide varied from 0.16ppm in March 2004 (summer) to 1.48ppm in July 2004 (winter). The monthly average concentration of CO_2 was seen to vary between about 302ppm to 450ppm. The concentration of NO_x was also seen to increase in July. The annual concentrations varied between 0.0025 ppm in March to 0.0636 ppm in July. The concentrations of total hydrocarbons were seen to rise up to 4.8 ppm C at certain times of the day while the average concentration was about 1.910 ppm C in July (winter). The number concentration of particles vary from 684 cm^{-3} to 1984 cm^{-3} from summer (January) to winter (July). It was also observed that the concentration of small particles was high during night and low towards morning. It started increasing during the morning hours and evening when traffic starts to build up. Concentration of the gases was also seen to be quite high during the morning hours and in the evening hours thus showing a good correlation between particle concentration and gas concentration. These results indicates that particles and gases are mainly contributed by the traffic and biomass used for cooking and warming. Particle concentration of aerosols larger than 0.1 μm has its peak during winter months. Some interesting findings will be reported.

LAND USE PLANNING FOR DUST STORM SOURCES IN WEST ASIA

Aso Veysi[1]*, Ali Darvishi Boloorani[2], Ali Sarkargar Ardakaani[3]

[1]Department of Engineering, Yazd Science and Research Branch, Azad University, Yazd, Iran,
[2]Department of RS&GIS, Faculty of Geography, University of Tehran, and Geoinformatics Research Institute, Iran
[3]Department of RS&GIS, Yazd science and Research, Azad University, Yazd, Iran
nature.1989@yahoo.com

Dust storms are one of the major environmental catastrophic phenomena in arid and semiarid area of the world. These phenomena have distractive effects on almost all aspects of life in the affected areas. Dust storms in addition to reducing the fertility of agriculture land, caused to air pollution, respiratory problems and decreasing visibility for transportation (Draxler, 2011). One of the reasons of increasing the spatial extent and temporal frequency of occurrences, especially in recent years in the West Asia Region (WAR), is the degradation of land. This phenomenon has emerged due to several factors, such as drought, dam construction in upstream, mismanagement of water resources, bad agricultural activities and lack of systematic land use planning. This study is based on the assumption that current conditions of land uses and human activities in active dust sources are not compatible with ecological and environmental capacities of the land. So, we used land use planning approach to organizing the space to optimum efficiency and allocating the best land use to each area according to principles of ecological conservation. The study area is some part of Ninawa province of Iraq, which is identified as a dust storm source in the WAR by Darvishi et al. (2011). This area is also considered as the most active dust source of Iraq. For the purpose of land use planning, by using the approach of systematic analysis and GIS functions, Digital Elevation Model has produced then, classified maps of elevation; slope and aspect were extracted. By combining them in a binary method land form unit's map were created. In next step, soil, climate and hydrological maps were respectively combined to land form units map. Hereby, homogeneous units for management were extracted. Recent land use and erosion potential for each unit were identified and estimated, respectively. Subsequently, ecological capability evaluation of these ecological units for Agriculture and Range Management, Tourism, Urban Development and Conservation was performed. After prioritizing specified land uses in an inductive-qualitative method, land use planning map was created, finally.

Keywords: Dust storm, Land use planning, GIS.

Draxler R.R., Gillette D.A., Kirkapatrick J.S., Heller J. (2011). Estimating PM10 concentration from dust storm in Iraq, Kuwait, and Saudi Arabia. Atmospheric Environment, 4315-4330.

Darvishi A., Nabavi O., Bahrami H. (2011). Unpublished report of dust storms in west Asia for UN.

PARTITIONING OF METALS AND MAJOR COMPONENTS IN QUASI-ULTRAFINE, ACCUMULATION AND COARSE PARTICLES IN PRIMARY SCHOOLS IN BARCELONA (SPAIN)

Mar Viana[1]*, Ioar Rivas[2], Jordi Sunyer[2], Mar Álvarez[2], Constantinos Sioutas[3], Andrés Alastuey[1], Xavier Querol[1]

[1]*Institute of Environmental Assessment and Water Research (IDÆA-CSIC), Barcelona, 08034, Spain*
[2]*Centre for Research in Environmental Epidemiology, Barcelona, 08003, Spain*
[3]*University of Southern California (USC), Los Angeles, CA 90089, U.S.*
**mar.viana@idaea.csic.es*

The direct link between exposure to atmospheric particulate matter and adverse health outcomes has been widely proven in the literature (Lim et al., 2012). Studies highlight the dependence of this relationship with particle size, concluding that particles with aerodynamic diameter <100 nanometres (ultrafine particles, UFPs) show a higher potency for adverse health effects because of their ability to penetrate deeper into the respiratory tract and to translocate to other organs (Oberdorster, 2001).

While most of the available studies on UFP focus on particle mass, there is still very little information on the partitioning of major and trace elements between ultrafine, accumulation and coarse mode particles. The aim of this work is to apportion the mass concentration of major and trace elements to each of these size fractions, as well as to assess the influence of factors such as seasonality, proximity to emission sources (mainly, road traffic) and indoor vs. outdoor environments on particle size distributions.

Indoor and outdoor sampling of quasi-UFP (PM0.25) concentrations, was carried out at 39 primary schools in Barcelona, within the framework of the ERC Advanced Grant BREATHE. Quasi-UFP concentrations were sampled by means of PCIS impactors (Sioutas Personal Cascade Impactors), using 37 mm and 25 mm Pall quartz-fibre filter substrates. The sampling duration was 8 hours per day (9-17h, school hours) over 4 consecutive days. The samples obtained were chemically characterised, determining >65 elements and components. One example of the results obtained is shown in Figure 1.

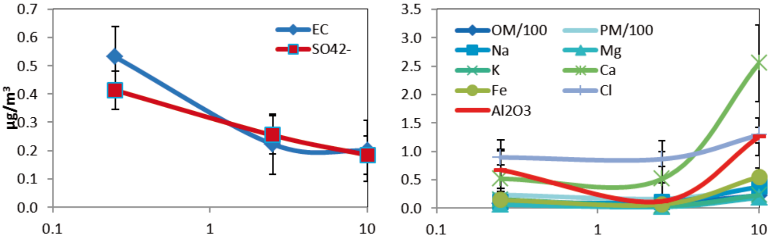


Figure 1. Examples of partitioning of major and trace elements between the three size fractions analysed.

Lim et al. (2010) Lancet 380, 2224-2260.
Oberdorster, G. (2001) Int Arch Occup Environ Health, 1-8.

PLUME TOP HEIGHT ESTIMATES FOR ASH AND DUST

Timo Virtanen[1]*, Pekka Kolmonen[1], Edith Rodríguez[1], Larisa Sogacheva[1], Anu-Maija Sundström[2], Gerrit de Leeuw[1,2]

[1]*Finnish meteorological Institute, Erik Palmenin aukio 1, 00560 Helsinki, Finland*
[2]*Department of Physics, University of Helsinki, Gustav Hällströmin katu 2a, 00560 Helsinki, Finland*
**timo.h.virtanen@fmi.fi*

We present a recently developed algorithm for plume top height estimation based on stereo-view-capable satellite instruments. Here we use only data from the Advanced Along Track Scanning Radiometer (AATSR) aboard ESA's Environmental satellite ENVISAT, but the method can be used with other multiple view satellite based instruments, such as NASA's Multi-angle Imaging SpectroRadiometer (MISR), or the Sea and Land Surface Temperature Radiometer (SLSTR), scheduled for launch in 2014 on Sentinel-3.

The AATSR Correlation Method (ACM) height estimate algorithm uses an area-based cross correlation method. It estimates the parallax between the AATSR nadir and forward views, and converts the resulting plume-top pixel shifts to a height estimate using the known satellite-Earth geometry. The algorithm is based on existing cloud-top height estimate methods, but is implemented independently with focus on volcanic ash plumes, as part of ESA's Volcanic Ash Strategic-Initiative Team (VAST) project. Both horizontal and vertical resolution of ACM are approximately one kilometre.

Although the ACM algorithm was designed for plume top height estimates of volcanic ash plumes, it can be equally well applied to any elevated feature in the atmosphere that has enough contrast with the background. Sufficiently dense volcanic ash or desert dust plumes can be identified from the top of atmosphere brightness temperature data using brightness temperature difference (BTD) thresholds. The brightness temperature difference between 11 and 12 µm wavelengths, $BTD=T_{11}-T_{12}$, is typically positive, but negative for volcanic ash plumes (Prata, 1989), and also for desert dust.

The use of BTD thresholds for plume detection enables automatic operation of the algorithm, and allows processing of large volumes of data efficiently. First results of volcanic ash plume and desert dust plume height detection will be presented.

MODELING THE PROCESSING OF MINERAL IRON DURING DUST TRANSPORT

Ulrike Vogelsberg*, Ralf Wolke, Andreas Tilgner, Ina Tegen, Hartmut Herrmann

Leibniz-Institute for Tropospheric Research, Leipzig, 04318, Germany
**vogelsb@tropos.de*

The Saharan desert and the Gobi desert are the main contributors to Aeolian desert dust, which is a major source of micronutrients to the remote ocean regions. Micronutrients, such as transition metals like iron or copper, are regarded essential for biological processes of different marine species. In this context recent studies have shown that soluble iron, since it is generally the most abundant transition metal in dust particles, has the ability to control marine productivity and thereby likely influence the CO_2-budget. Nevertheless, the processing of desert dust leading to the release of soluble iron still lacks sufficient understanding since several factors control the solubilisation process. Especially anthropogenic emissions are regarded to significantly add to the amount of soluble iron by acidification of dust particles or by the direct emission of soluble iron comprised in coal fly ash.
For the investigation of the dissolution process of iron, that takes place during dust transportation, the spectral air parcel model SPACCIM (Wolke et al., 2005) is used. A mechanism based on Lasaga et al. (1994) that describes the dissolution and precipitation of solids has been implemented. Trajectory properties were derived from COSMO-MUSCAT simulations or from re-analysis data by HYSPLIT. Differences in the chemical composition and the amount of anthropogenic and naturally emitted species on the North African continent and the highly industrialized region of South-East Asia have considerable impact on the acidification of the desert dust. Under this aspect special cases of dust outbreaks of the Saharan desert and the Gobi desert are investigated and compared with focus on soluble iron produced.

Lasaga A.C., Solaer J.M., Ganor J., Burch T.E., and Nagy K.L. (1994). Chemical weathering rate laws and global geochemical cylces. Geochim. Cosmochim. Acta, 2361-2386.
Wolke R., Sehili A.M., Simmel M., Knoth O., Tilgner A., and Herrmann H. (2005). SPACCIM: A parcel model with detailed microphysics and a complex multiphase chemistry. Atmos. Environ., 4375-4388.

APPLICATION OF LIDAR OBSERVATIONS IN ATMOSPHERIC DUST TRANSPORT FORECAST

Ana Vukovic[1,3]*, Lucia Mona[2], Mirjam Vujadinovic[1,3], Slobodan Nickovic[3,4], Goran Pejanovic[3], Bojan Cvetkovic[3], Marija Djordjevic[3], Giuseppe D'amico[2], Nikolaos Papagiannopoulos[2], Gelsomina Pappalardo[2]

[1]*Faculty of Agriculture, University of Belgrade, Belgrade, 11080, Serbia*
[2]*Institute of Methodologies for Environmental Analysis, CNR, Potenza, 85050, Italy*
[3]*South East European Climate Change Center, RHMSS, Belgrade, 11000, Serbia*
[4]*Institute of Physics, Belgrade, 11080, Serbia*
**pazisadana@gmail.com*

Aerosol optical observations originating from in-situ and remote satellite sensing are in general used only for verification of the dust model results. Lidar data are especially important for such use, because they provide vertical distribution of atmospheric composition. Beside distribution of the dust sources and atmospheric dust driving parameters, dust models do not have available any other input information related to the dust transport. Common approach is that initial field of dust concentration for the model run is inherited from the previous dust forecast. Following the same methodology as in weather forecast, dust field should be initialized using available measurements of atmospheric dust concentrations. Version of the coupled atmospheric-dust model NMM-DREAM, which is operational in RHMSS/SEEVCCC and is a part of the WMO SDS-WAS intercomparison project, uses dust analysis from MACC/ECMWF project for assimilation of MODIS AOD data in order to improve initial field of dust concentration. We will present the comparison of the dust forecast obtained with NMM-DREAM for North Africa - Europe domain with lidar aerosol profiles observations available in Europe. Further improvement of the initial fields for dust forecast is possible using additional information from the lidar vertical profiles. The potentiality of lidar data use in initialization of the dust modelling and related improvements of the model forecast will be investigated through selected case studies.

Acknowledgments - The financial support by the European Community through the ACTRIS Research Infrastructure Action under the 7th Framework Programme under ACTRIS Grant Agreement n° 262254 is gratefully acknowledged. The research is also supported as a part of the project "Studying climate change and its influence on the environment: impacts, adaptation and mitigation" (43007) financed by the Ministry of Education and Science of the Republic of Serbia within the framework of integrated and interdisciplinary research for the period 2011-2014.

HIGH RESOLUTION MODELING OF THE ATMOSPHERIC DUST TRANSPORT

Ana Vukovic[1,2]*, Mirjam Vujadinovic[1,2], Vladimir Djurdjevic[3,2],
Borivoj Rajkovic[3,2], Slobodan Nickovic[4,2], Goran Pejanovic[2],
Bojan Cvetkovic[2], Marija Djordjevic[2], William A. Sprigg[5,6],
Hesham El-Askary[6,7], Anup K. Prasad[5]

[1]*Faculty of Agriculture, University of Belgrade, Belgrade, 11080, Serbia*
[2]*South East European Climate Change Center, RHMSS, Belgrade, 11000, Serbia*
[3]*Faculty of Physics, University of Belgrade, Belgrade, 11000, Serbia*
[4]*Institute of Physics, Belgrade, 11080, Serbia*
[5]*Institute for Atmospheric Physics, The University of Arizona, Tucson, AZ, USA*
[6]*School of Earth and Environmental Sciences, Chapman University, Orange, CA, USA*
[7]*Department of Environmental Sciences, Alexandria University, Moharem Bek, Alexandria, Egypt*
**pazisadana@gmail.com*

General practice in atmospheric dust transport modeling is to use models for long-range dust transport simulation or forecast. Numerical weather prediction models coupled with dust transport models run on large domains that must include the whole dust source region, such is Sahara, and usually have coarse resolution (several tens kilometres) compared to nowadays much finer resolutions of regional atmospheric models used in operational weather forecast. Intense dust events, which are of local character and originate from small and very active sources, usually last a couple of hours and can have severe impact on human health, traffic safety etc. Numerical simulation of such events requires high resolution models (several kilometres) because of the non-hydrostatic atmospheric processes involved in the dust uptake and transport, and because detailed representation of dust sources and downwind concentration is requested. The main future application of such a coupled non-hydrostatic atmospheric-dust model is in its implementation for a warning system. The non-hydrostatic atmospheric model NCEP/NMM coupled with DREAM has the ability to resolve such processes. Satellite measurements are required as they play a crucial role in high resolution definition of the dust sources as well as for model validation. Model results are sensitive to dust source definition. Depending on the seasonal vegetation change in the model domain, sources must be more or less regularly updated. The model is tested for dust episodes characterized by intense convective activity, high wind velocities and intense dust emission.

Acknowledgments - The research is supported as a part of the project "Studying climate change and its influence on the environment: impacts, adaptation and mitigation" (43007) financed by the Ministry of Education and Science of the Republic of Serbia within the framework of integrated and interdisciplinary research for the period 2011-2014.

DETECTION OF VOLCANIC ASH AEROSOLS FROM UV-VISIBLE SATELLITE SPECTROMETERS

P. Wang[1]*, L. G. Tilstra[1], R. van der A[1], M. Koukouli[2], N. Siomos[2], D. S. Balis[2], P. Stammes[1]

[1]*Royal Netherlands Meteorological Institute (KNMI), NL-3731 GA De Bilt, The Netherlands*
[2]*Laboratory of Atmospheric Physics, Aristotle University of Thessaloniki, GR-54124, Greece*
**ping.wang@knmi.nl*

UV-visible spectrometers onboard satellites, such as TOMS/EP, GOME/ERS-2, OMI/Aura, SCIAMACHY/Envisat, GOME-2/Metop-A and GOME-2/Metop-B, have shown great potential in the detection of volcanic ash aerosols, qualitatively as well as quantitatively. At this moment, the two GOME-2 instruments onboard the polar orbiting satellites Metop-A and -B, respectively, are measuring scattered UV-visible light from 300-800 nm at about 0.5 nm wavelength resolution. The overpass time of GOME-2A/B is about 9:30 local time and the ground pixel size is typically 40 km x 80 km.

Since the launch of GOME-2A in 2006, several large volcanic eruption events have been successfully detected by GOME-2A by using the absorbing aerosol index product (AAI) and the FRESCO (Fast Retrieval Scheme for Clouds from the Oxygen A band) cloud product. Because volcanic ash absorbs light in the UV wavelength range, volcanic ash aerosols can be identified from the high AAI values. Volcanic ash plumes may be detected by the AAI even in the presence of clouds when the ash layer is located above the clouds. Similar to cloud height, aerosol height can be retrieved from the oxygen absorption band around 760 nm using FRESCO, especially for optically thick aerosols.

Recently, we developed a new aerosol optical thickness (AOT) algorithm for GOME-2 and SCIAMACHY by using the AAI and aerosol height. The AAI is mainly determined by the aerosol type, aerosol height and aerosol optical thickness. The AOT can be derived from AAI and aerosol height using a look-up table method under certain assumptions for aerosol type and aerosol particle size. Then, the volcanic ash column concentration is derived from AOT and ash particle size. The AOT algorithm has been applied to several volcanic eruption events observed by GOME-2A and SCIAMACHY.

A volcanic ash product consisting of AOT, AAI, ash height, and volcanic ash column concentration has been developed within the SACS-2/SMASH (Support to Aviation Control Service / Study on an end-to-end system for volcanic ash plume monitoring and prediction) project. In this paper, we will show the volcanic ash product of GOME-2 for the events of the Eyjafjallajökull eruption in April and May 2010 and the Puyehue eruption in June 2011. The GOME-2 ash product has been validated against ground-based lidar measurements from the EARLINET network for the Eyjafjallajökull eruptions. In principle, the product is adequate in cases of strong, optically thick volcanic ash plumes.

THE SCOTIA SEA DUST RECORD - PALEOCLIMATE VARIABILITY BETWEEN PATAGONIA AND ANTARCTICA

Michael E Weber[1]*, Peter U Clark[2], Axel Timmermann[3], Gerrit Lohmann[4]

[1]University of Cologne, Cologne, 50674, Germany
[2]Oregon State University, Corvallis, OR 97331, USA
[3]University of Hawaii at Manoa, Honolulu, HI 96822, USA
[4]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, 27568, Germany
*michael.weber@uni-koeln.de

Currently, the lack of highly resolved Southern Ocean marine paleoclimate archives limits our understanding of the dominant feedbacks between the Antarctic ice sheets, Southern Hemisphere oceanic and atmospheric circulation, and global sea level. Two high-resolution deep-sea sites from the Scotia Sea overcome these limitations by revealing a chronologically well-constrained one-to-one coupling of dust proxies magnetic susceptibility (MS) and XRF-based Ca counts to the non-sea-salt Ca^{2+} flux of the EDML ice core during the last glacial cycle. Inferred dust fluxes from Patagonia to the Scotia Sea were several times higher during glacial times, when atmospheric circulation was either stronger or shifted in latitude, sea level was lowered, shelf surfaces were exposed, and environmental conditions in Patagonia were dominated by glaciers and extended outwash plains (Weber et al., 2012).

Climate-dust couplings are specifically important for the reconstruction of the transition out of the last ice age and associated changes in ocean and atmospheric circulation on millennial time scales. The Scotia Sea sites capture a spatially integrated signal of Antarctic ice mass loss during deglaciation, indicating eight events of very rapid ice-sheet collapse (within a decade!) for the time 19,000 and 9,000 years ago. Transient deglacial model simulations suggest millennial-scale fluctuations that involve major atmospheric and oceanic reorganization with overall trends of southward-shifting Southern Hemisphere westerly winds, sea-ice reduction, enhanced marine productivity, increase in CO_2, oceanic and atmospheric warming, and increased Antarctic ice mass loss (Weber et al., in review).

Weber, M. E., Clark, P. U., Kuhn, G., Timmermann, A., Sprenk, D., Gladstone, R., Zhang, X., Lohmann, G., Menviel, L., Chikamoto, M., Friedrich, T. (in review): Millennial-scale variability in Antarctic ice-sheet discharge throughout the last deglaciation. Nature.

Weber, M.E., Kuhn, G., Sprenk, D., Rolf, C., Ohlwein, C., and Ricken, W. (2012): Dust transport from Patagonia to Antarctica - a new stratigraphic approach from the Scotia Sea and its implications for the last glacial cycle. Quaternary Science Reviews, 36, 177-188.

A NEW TRACE ELEMENT RECORD FROM THE HIMALAYAN DASUOPU ICE CORE COVERING THE PAST 2 CENTURIES: NATURAL BACKGROUND VS. ANTHROPOGENIC CONTRIBUTION

Anna Wegner[1,3]*, Paolo Gabrielli[1], Joel D Barker[1], Roxana Sierra[1], Emilie Beaudon[1], Lonnie G. Thompson[1,2]

[1]*Byrd Polar Research Center, The Ohio State University, Columbus, OH, United States*
[2]*School of Earth Science, The Ohio State University, Columbus, OH, United States*
[3]*now at Alfred-Wegener-Institute, Bremerhaven, Germany*
**anna.wegner@awi.de*

South East Asia is one of the fastest developing regions on Earth and has experienced a recent large increase in atmospheric pollution. Glaciers of the nearby Himalayan mountains represent a unique archive that can be used to determine the strength and timing of the onset of anthropogenic atmospheric pollution in this region.
Here we present results of a new trace element record from the Dasuopu ice core spanning 1790 - 1950 AD at seasonal resolution. The Dasuopu ice core was drilled in 1997 at 7200 m altitude in the Himalaya and provides the highest elevation ice core record ever obtained. Due to the high altitude this site has the potential to archive not only contamination records of regional significance, but possibly also long distant pollution from, for example, Europe and climatic signals influenced by the North Atlantic.
In this study we focus on three main research goals: (1) determine the onset of the earliest anthropogenic contamination from trace elements at such high elevation (7200 m). The high elevation is beneficial for detecting a more regional rather than local signal; (2) determine intra-annual variations of atmospheric trace element composition, with a focus on discriminating between pre-monsoon, monsoon, and dry seasons; and (3) discriminate between regional (Asian) and long distance (e.g. European) input over time using trace element abundance.
The Dasuopu ice core is heavily influenced by the monsoon regime providing a strong seasonal trace element depositional signal and highly variable snow accumulation rates. Trace element concentrations are very low and comparable to those recorded at some polar sites. Crustal enrichment factors are used to discriminate between the terrigenous (natural background) and the anthropogenic contributions.

SALTRACE 2013 - OVERVIEW AND RESULTS FROM TRANS-ATLANTIC LAGRANGIAN DUST SAMPLING

B. Weinzierl[1,2]*, A. Ansmann[3], O. Reitebuch[1], V. Freudenthaler[2], T. Müller[3], K. Kandler[4], D. Althausen[3], R. Busen[1], F. Chouza[1], M. Dollner[1], A. Dörnbrack[1], D. Farrell[5], S. Gross[1], K. Heimerl[1], A. Klepel[3], T. B. Kristensen[3], O. L. Mayol-Bracero[6], A. Minikin[1], A. Omar[9], D. Prescod[5], J. Prospero[7], S. Rahm[1], M. Rapp[1], D. Sauer[2,1], A. Schäfler[1], C. Toledano[8], M. Vaughan[9], A. Walser[1], M. Wiegner[2]

[1]*Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany*
[2]*Meteorologisches Institut, Ludwig-Maximilians-Universität, München, Germany*
[3]*Leibniz Institute for Tropospheric Research, Physics Department, Leipzig, Germany*
[4]*Technische Universität Darmstadt, Institut für Angewandte Geowissenschaften, Darmstadt, Germany*
[5]*Caribbean Institute for Meteorology and Hydrology, Bridgetown, Barbados*
[6]*University of Puerto Rico, Institute for Tropical Ecosystem Studies, San Juan, USA*
[7]*University of Miami, Rosenstiel School of Marine & Atmospheric Science, Miami, USA*
[8]*Universidad de Valladolid, Grupo de Óptica Atmosférica, Valladolid, Spain*
[9]*NASA Langley Research Center, Hampton, USA*
**Bernadett.Weinzierl@dlr.de*

The Saharan Aerosol Long-range Transport and Aerosol-Cloud-Interaction Experiment (SALTRACE: http://www.pa.op.dlr.de/saltrace) was conducted in June/ July 2013 to investigate the transformation of mineral dust during transport from the Sahara across the Atlantic Ocean into the Caribbean. SALTRACE is a German initiative combining ground-based and airborne in-situ and lidar measurements with meteorological data, long-term measurements, satellite remote sensing and modeling which involved many national and international partners. For SALTRACE, the DLR research aircraft Falcon was equipped with a suite of in-situ instruments for the measurement of microphysical and optical aerosol properties, sampling devices for offline particle analysis, a nadir-looking 2-µm wind lidar, dropsondes and instruments for standard meteorological parameters. Ground-based lidar and in-situ instruments were deployed in Barbados, Cape Verde, and Puerto Rico.Mineral dust from five dust outbreaks was studied by the Falcon research aircraft between Senegal, the Caribbean and Florida under different atmospheric conditions. Near Africa, the dust plumes were quite homogenous and extended up to 6-7 km altitude. In contrast, the dust layers in the Caribbean were mainly below 4 km and showed three layers with different dust characteristics. The corresponding aerosol optical thickness ranged from 0.2 to 0.6 at 500 nm at Barbados. SALTRACE highlights included the formation of tropical storm Chantal in a dusty environment, and the Lagrangian sampling of a dust plume in the Cape Verde area on 17 June which was again measured with the same instrumentation on 22 June 2013 near Barbados.

In our presentation, we give an overview of the SALTRACE study and show vertical profiles of dust size distributions, CCN and dust optical properties and compare our results with the ground-based in-situ, sun photometer and lidar measurements. In particular, we discuss the results from the trans-Atlantic Lagrangian dust study and show similarities and differences of the dust plumes observed close to the Sahara and in the Caribbean.

GEOCHEMICAL CHARACTERIZATION OF MINERAL LUNG DUST

Melanie Wenzel[1]*, Barbara Kuhn[2], Bernard Grobéty[3], Volker Dietze[4], Reto Gieré[1]

[1]*Universität Freiburg, Geochemie, Freiburg, 79104, Germany,*
[2]*Staublungenlabor, c/o Institut für Geochemie und Petrologie, Zürich, 8092, Switzerland*
[3]*Université de Fribourg, Faculté des sciences, Dep.Earth Sciences, Fribourg, 1700, Switzerland*
[4]*Deutscher Wetterdienst, Zentrum für Medizin-Meteorologische Forschung, Freiburg, 79104, Germany*
**melanie.wenzel@minpet.uni-freiburg.de*

In our study we analyse inorganic particles extracted from human lung tissue obtained either during autopsies or biopsies. Most of the patients suffered from dust-related pulmonary diseases, such as silicosis, lung carcinoma, asbestosis and mesothelioma. We analyse both fibrous and non-fibrous mineral particles with respect to their size, mineralogical identity, particle number and the occurrence of ferruginous bodies (FB). It is widely known that inhaled mineral dust can cause severe health problems like asbestosis, which is caused by the inhalation of fibrous dust from one of the six industrially defined asbestos minerals actinolite, amosite, anthophyllite, chrysotile, crocydolite and tremolite. However, dust from other fibrous minerals, such as erionite, as well as from non-fibrous minerals can also increase the occurrence of lung diseases.
We determine the amount of asbestos fibers and ferruginous bodies in the lung tissue and also collect detailed information about the non-fibrous particles, which have so far not been systematically analyzed with respect to their occurrence in lung tissue, to get as much information about general particle lung burden as possible.
Another goal is to reassess the WHO method for asbestos-fiber counts, which is based essentially on morphological criteria, by adding more detailed chemical and mineralogical information obtained from SEM and TEM for the fibrous particles present. It was shown that application of the WHO criteria can lead to a falsified result when counting asbestos fibers, e.g. for insurance or compensation issues, and that more precise analyses of fibers in lung tissue are necessary to reconsider the WHO defined dimension criteria (Adib et al., 2013).

Adib, G., Labrèche, F., De Guire, L., Dion, C., Dufresne, L. (2013). Short, fine and WHO asbestos fibers in the lungs of Quebec workers with an asbestos-related disease. American Journal of Industrial Medicine 56, 1001-1014.

OCCUPATIONAL CONTAMINATION THROUGH EMISSIONS OF DIFFERENT SOURCES OF PARTICULATE MATTER PROMOTES SYSTEMIC OXIDATIVE STRESS THAT CAN BE ATTENUATED BY AN ANTIOXIDANT INTERVENTION

Danilo WIlhelm Filho[1]*, Fabrício P. Possamai[2], Sílvio Ávila Jr.[2]

[1]*Departamento de Ecologia e Zoologia-CCB-UFSC, Florianópolis, 88040-900, Brazil*
[2]*Laboratório de Fisiopatologia Experimental, UNESC, Criciúma, 88806-000, Brazil*
**dawifi@ccb.ufsc.br; danilowilhelmfilho@gmail.com*

The emission of several airborne particulate matter (PM) is associated with occupational contamination that affect workers directly exposed to incineration of solid residues of health services[1], coal mining[2] and also coal burning derived from an electric-power plant[3], as well as the population living in the vicinity of such activities[1,2,3], leading to endogenous overgeneration of reactive oxygen species (ROS) in different tissues and therefore to a systemic oxidative stress. Several biomarkers of oxidative stress, both enzymatic and non-enzymatic, were measured in samples harvested from the blood of these workers (n=20) and also from subjects indirectly exposed (n=20) living in the vicinities (~5 km) regarding these airborne emissions, before and after an antioxidant intervention characterized by a daily oral supplementation of vitamins C (500 mg) and E (400 mg) during six months. Compared to baseline values, the antioxidant intervention after 6 months was able to confer a consistent protective effect against the systemic oxidative insult irrespective of the dust source of the airborne contaminants[4]. The present review indicates that an antioxidant intervention could be recommended in order to attenuate the related deleterious oxidative consequences in workers directly or indirectly exposed, as well as in subjects indirectly exposed to such airborne emissions.

1. Possamai, F.G., Ávila Jr., S., Parisotto E.B. et al. (2009) Ecotoxicology 18:1158-1164.
2. Ávila Jr., S., Possamai, F.G., Parisotto E.B. et al. (2009) Ecotoxicology 18:1150-1157.
3. Wilhelm Filho, D., Ávila Jr., S., Possamai, F.G. et al. (2010) Ecotoxicology 19:1193-1200.
4. Possamai, F.G., Ávila Jr., S., Parisotto E.B. et al. (2010) Environmental Toxicology and Applied Pharmacology 30:175-180.

IDENTIFYING THE SOURCES CONTRIBUTING TO PM EXCEEDANCES IN OSTRAVA, CZECH REPUBLIC, USING PASSIVE AEROSOL SAMPLING COUPLED WITH COMPUTER-CONTROLLED MICROSCOPY

Robert Willis[1]*, Libor Černikovský[2], Teri Conner[1], Jiří Novák[2], Helena Plachá[2], Blanka Krejčí[2], Irina Nikolova[2], Eva Chalupníčková[2], Ronald Williams[1]

[1]*National Exposure Research Laboratory, U.S.Environmental Protection Agency, NC 27709, USA*
[2]*Czech Hydrometeorological Institute, Prague, 143 06, Czech Republic*
**willis.robert@epa.gov*

The Ostrava region of the Moravian-Silesia metropolitan area of the Czech Republic is one of the most highly industrialized areas in Eastern Europe having a large number of coke oven plants, blast furnaces, steel plants, and rolling mills. Owing to its heavy industrialization and geographical setting bordered by the Beskydy and Jeseniky mountain ranges, Ostrava is susceptible to weather-related pollution inversions which result in exceedances of the PM_{10} and $PM_{2.5}$ air quality standards with 24-h concentrations reaching as high as 281 and 266 μgm^{-3}, respectively, in 2012.

The Czech Hydrometeorological Institute (CHMI) in collaboration with the U.S. Environmental Protection Agency conducted a multi-pollutant source apportionment study in 2012 to quantify the impact of regional as well as local sources on air quality in the Ostrava metropolitan area. Samples were analyzed for inorganic species (XRF), PAHs, organic and elemental carbon and pollutant gases for seven-week periods during the summer of 2012 and the late fall/early winter of 2012 at three monitoring locations: an industrial suburban site typically downwind of a major industrial facility; a residential area typically upwind of the same industrial facility, and a background suburban residential area. In addition, passive aerosol samplers [1] were deployed at the three ambient monitoring sites for three successive two-week periods during both the summer and late fall/winter campaigns.

This presentation discusses the use of passive aerosol sampling coupled with computer-controlled scanning electron microscopy (CCSEM) to enhance understanding of PM sources in the Ostrava study and to assist in the interpretation and confirmation of PMF modeling results. In addition to ambient sampling, passive samplers were deployed near suspected PM sources in order to develop quasi-source signatures for the following sources: blast furnace, sintering plant, steel works, coke plant, mobile sources, and home heating. Samples of bulk slag dust generated in steelmaking were also collected. Samples were analyzed by CCSEM coupled with energy-dispersive X-ray spectrometry (EDS) to yield the size, composition and morphology of individual particles. Analysis of the source samples yielded an atlas of source-related particle types that was used to directly assess the impact of different sources at the ambient monitoring sites as well as to help interpret source-related factors generated by PMF (positive matrix factorization) modeling. Carbonaceous aerosols prove particularly challenging to apportion because they are generated by multiple sources (home heating, coke ovens, mobile sources, biogenic pollens/spores). CCSEM results obtained at the three monitoring sites show significant spatial variability in PM concentrations and relative source contributions.

1. Wagner J., Leith D. (2001). Passive Aerosol Sampler. Part I: Principle of Operation. Aerosol Sci. Technol., 186-192.

EOLIAN DUST RECORDS AS A CHRONOSTRATIGRAPHIC TOOL FOR MARINE SEDIMENT CORES

Gisela Winckler[1,2]*, Sascha Serno[1,3], Robert F. Anderson[1,2], Edith Maier[4], Haojia Ren[1,5], Rainer Gersonde[4], Gerald H. Haug[6]

[1]*Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY 10964, USA*
[2]*Department of Earth and Environmental Sciences, Columbia University, New York, NY 10027, USA*
[3]*DFG-Leibniz Center for Surface Process and Climate Studies, Institute of Earth and Environmental Science, University of Potsdam, 14476 Potsdam, Germany*
[4]*Alfred Wegener Institute for Polar and Marine Research, 27568 Bremerhaven, Germany*
[5]*Research Center for Environmental Changes, Academia Sinica, Taipei, Taiwan 115*
[6]*Geological Institute, ETH Zürich, 8092 Zürich, Switzerland*
**winckler@ldeo.columbia.edu*

Precise age-depth relationships for marine sediment cores are essential for reconstructing paleoceanographic changes. This is particularly true when evaluating changes during time periods of short-term pronounced climatic events like the last deglaciation. Common dating techniques bear a number of uncertainties that may result in poorly constrained age models in some regions of interest in the global ocean. Here we present an alternative chronostratigraphy technique, based on identifying abrupt changes in eolian dust input recorded in marine sediment cores, and tying these with the well-dated dust record from polar regions.
To highlight the potential of this chronostratigraphic technique, we present a ^{4}He-based dust flux record from a marine sediment core from the western Subarctic North Pacific. As recently demonstrated in a core-top sediment survey (Serno et al., 2014), ^{4}He is a robust indicator of eolian dust input in the Subarctic North Pacific. We show that abrupt changes in the high-resolution ^{4}He downcore record from SO202-7-6 can be tied to transitions observed in the NGRIP dust concentration record to provide a robust age-depth relationship in this core and - in combination with radiocarbon-based age constraints - to construct an age model for the last ~30 kyrs. This chronostratigraphic technique further allows us to independently constrain radiocarbon paleoreservoir ages.
We present examples of dust records from other ocean basins (e.g., the Subantarctic Southern Ocean, North African margin) showing good correlations with ice core records of eolian dust supply from Greenland or Antarctica, and illustrating the promising potential of eolian dust records as a chronostratigraphic tool in marine sediment cores in different regions of the global ocean.

Serno, S., Winckler, G., Anderson, R.F., Hayes, C.T., McGee, D., Machalett, B., Ren, H., Straub, S.M., Gersonde, R., Haug, G.H. (2014). Eolian dust input to the Subarctic North Pacific. Earth and Planetary Science Letters 387, 252-263.

VARIABILITY OF SNAIL GROWING SEASON AT THE CHINESE LOESS PLATEAU DURING THE LAST 75 KA

Naiqin Wu, Linpei Huang, Zhaoyan Gu, Xiaoyun Chen

Key *Laboratory of Cenozoic Geology and Environment, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China*
**nqwu@mail.iggcas.ac.cn*

Knowledge of seasonal climate change is one of the key issues facing Quaternary paleoclimatic studies and estimating seasonal climate change is difficult, especially changes such as seasonal length on glacial-interglacial timescales. The stable isotope composition from seasonal land snail shells provides the potential to reveal seasonal climatic features. Two modern land snail species, cold-aridiphilous *Pupilla aeoli* and thermo-humidiphilous *Punctum orphana*, were collected from different climatic zones in 18 localities across the Chinese Loess Plateau, spanning 11 degrees of longitude and covering a range of 1000 km^2. The duration of the snail growing season (temperature ≥10°C) was longer (202 ±6 d) in the eastern Loess Plateau compared with in the western Loess Plateau (162 ±7 d). The $\delta^{13}C$ of *P. aeoli* shells was −9.1 to −4.7‰ and −5.0 to 0.3‰ for $\delta^{18}O$. For *P. orphana*, the $\delta^{13}C$ ranged from −9.1 to −1.9‰ and −8.9 to −2.9‰ for $\delta^{18}O$. Both the $\delta^{13}C$ and $\delta^{18}O$ differences between the two snail species were reduced from the east to the west Loess Plateau (2.8‰ to 0.2 ±1.1‰ for $\delta^{13}C$ and 4.7‰ to 2.9 ±1.3‰ for $\delta^{18}O$). These isotopic differences roughly reflect the difference in the growing season lengths between the east and west Loess Plateau indicating that the duration of the snail growing season shortens by 15 d or 19 d if the difference decreases by 1‰ in $\delta^{13}C$ or $\delta^{18}O$, respectively. Thus, the difference in $\delta^{13}C$ and $\delta^{18}O$ between both snail species can be used to reveal the length of the snail growing season in the past. Based on our investigation, the length of the snail growing seasons from the Xifeng region during the last 75 ka was reconstructed. During the mid-Holocene (8-3 ka), the mean isotopic difference from both snail species reached maximum values of 2.6 ±0.7‰ and 2.1 ±1.4‰ for $\delta^{13}C$ and $\delta^{18}O$, respectively. This was followed by MIS 3 that ranged from 2.5 ±0.4‰ for $\delta^{13}C$ and 1.6 ±0.8 ‰ for $\delta^{18}O$. The Last Glacial Maximum changed by only 0.2‰ and 0.4 ‰ for $\delta^{13}C$ and $\delta^{18}O$, respectively. Therefore, we estimate that the duration of the snail growing seasons to be ~200 ±10 d during the mid-Holocene, 190 ±6 d in MIS 3 and 160 ±3 d during the last glacial period.

DUST RECOD FROM ICE CORES ON THE TIBETAN PLATEAU OVER THE PAST CENTURY

Guangjian Wu[1]*, Baiqing Xu[1], Tandong Yao[1], Rui Mao[2]

[1]*Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing 100101, China*
[2]*State Key Laboratory of Earth Surface Processes and Resource Ecology, Beijing Normal University, Beijing 100875, China*
**wugj@itpcas.ac.cn*

The dustiness on the remote Tibetan Plateau (TP) and its trend within the ongoing global warming perspective are not well understood. Ice cores from the central (Tanggula, 33.1N, 92.1E, 5743m) and southeast (Zuoqiupu, 29.2N, 96.9E, 5565m) TP show a warming trend since the 1960's, as revealed by oxygen isotope records. The microparticle record in the two cores provides the history and the current variation of dustiness over the TP. Seasonal variation of dust concentration (grain size) from different sites indicates that they have the different source regions. Modern dust storm events in the central TP (Tanggula ice core) most frequently occur from December through April. While in the southeast TP (Zuoqiupu ice core), high dust load and coarse particle size occur during spring, especially in May, which is in accordance with the frequent dust storm events in South West Asia and southern TP, and with the satellite aerosol optical depth. These seasonality favours the ice core dating.
The increasing trend in dust mass and flux records in the Tanggula ice core indicates that drought condition on the TP has become active since the 1960s. While Zuoqiupu ice core shows a continuous increasing trend in the dust concentration since 1935 and this trend intensified since the 1980's. The strengthened high-level westerlies over the TP and intensified low pressure activities in the upward potential source regions are the possible causes for high dust flux in Tanggula. While the increased dust storm events in the source regions, such as Iran, are possibly responsible for the enhanced dust concentration since the 1980's.
The dust intensified trend in the two ice cores is accompanied with warming, suggesting that global and local warming can enhance the dust load on the central TP and the southwest Asia arid regions over the past decades. Although this dustier condition is not comparable to that during the end of the Little Ice Age, the enhanced dust deposition on glacial surface might result a strengthened melting along with the temperature increasing.

DETERMINATION OF PHYSICO-CHEMICAL PROPERTIES OF ATMOSPHERIC PARTICLES COLLECTED IN A MEGACITY USING SEM-EDX METHOD

Abdulkadir Yildiz, Feyza ozdemir, Tugba aytek, Damla alaca, Saida Aammi, Ferhat Karaca*

Department of Environmental Engineering, Fatih University, Istanbul, 34500, Turkey
**fkaraca@fatih.edu.tr*

Istanbul is an exceptional city with its location, culture and population, since it is of the most populated, over 16 million, megacities in the world; connecting two continents, Asia and Europe; located on an air corridor by receiving and distributing pollutants over long distances; high density commerce and trade centre in the region; covering large industrial regions and activities; and still developing by vastly active civil construction. The fastest growing and urbanizing part of the city is located at the South-West region of the city. That region covers Esenyurt, Beylikdüzü and Büyükcekmece provinces, and it has a lot of residential and industrial areas in close proximity. Accordingly, these entire properties make this region is very attractive place for field and research studies related to air pollution and its impacts on local, regional and global environments.

By the motivation of above mentioned factors, we have initiated a new project over the South-West region of the city in several (10) air pollution monitoring stations. The main purpose of this project is to understand physical, chemical, and morphological characteristics of single particles collected in the region and their differences with regarding to their source characteristics.

This project includes a novel passive sampling methodology which enables us to collect coarse sized airborne aerosol on a smooth surface as a single layer formation. Then, the collected samples can be easily analysed to characterise their morphologic, physical and chemical structures at single particle level using HR-SEM-Scanning Electron Microscope and EDS(EDX)-Energy Dispersive X-photon Spectroscopy, namely SEM-EDX method. In addition to this mentioned method, another separate sampling procedure based on an EPA approved standard method is conducted. The second data set is initially planned to test the collection performance of the proposed passive sampling method.

In this presentation, the proposed passive sampling methodology will be introduced, and preliminary results of the physical, chemical and morphological properties of the analysed single particles and their potential sources will be given and discussed in details.

AUTOMATED DUST MAPPING AND MONITORING TOOL FOR THE MIDDLE EAST REGION USING SEVIRI

Tesfaldet Yohannes, Marouane Temimi*,
Taha B.M.J.Ouarda, Hosni Ghedira

Masdar Institute of Science and Technology, Abu Dhabi, P.O. Box 54224, United Arab Emirates
**mtemimi@masdar.ac.ae*

Statement of the problem. Mineral dust contributes significantly to the atmospheric aerosols and impacts the climate directly and indirectly. Dust has a major impact on the radiation budget directly (Mallet, Tulet et al. 2009) and interacts with radiation by backscattering and absorption as well as having major impact on human health, marine biogeochemistry, soil fertility and air quality (Prospero and Mayol-Bracero 2013). In order to understand the regional dust transport pathways and estimate the impacts of regional dust on human life, economy and climate, it is necessary to know the sources, location, extent, magnitude and geomorphological characteristics.

Goal. The goal of this research is to deploy an enhanced automated dust mapping and monitoring tool for the Middle East region using MSG SEVIRI data. The tool will allow for routine detection and mapping of Sand and Dust Storm in the region. Historic MSG SEVIRI data were analysed to develop time series of dust storm extent and magnitude.

Approach. First, the developed dust monitoring tool relies on three different product, namely, a) an red-green-blue (RGB) composition of 1.6, 0.8 and 0.6 μm reflectance in the red, green and blue beams, respectively to provide visual aid for identifying the presence of dust storm. b) a false colour composite image which uses thermal channels only to present dust emissions. In this colour scheme dust usually appears to be pink, c) a threshold based technique can be used for dust detection by using selected wavelength channel combination and fixed thresholds. This method employs primarily the difference between thermal channels.

Results. We analysed the effect of the diurnal change in surface and air temperatures and its effect of dust emission and the performance of the detection using a threshold based techniques. We compared the developed dust maps with Moderate Resolution Imaging Spectroradiometer (MODIS) deep blue product and validated it against the in situ observation from Aerosol Robotic Network (AERONET) station in the UAE and elsewhere in the region.

The spatial pattern retrieved by using the threshold technique are in good agreement with MODIS-based products.

Banks, J. and H. Brindley (2013). "Evaluation of MSG-SEVIRI mineral dust retrieval products over North Africa and the Middle East." Remote Sensing of Environment, 128, 58-73.

Lensky, I. and D. Rosenfeld (2008). "Clouds-aerosols-precipitation satellite analysis tool (CAPSAT)." Atmospheric Chemistry and Physics, 8, 6739-6753.

ESTIMATION OF EXTINCTION-TO-BACKSCATTER RATIO OF DUST PARTICLES FROM CALIPSO, AERONET, AND MODIS MEASUREMENTS

Soon-Chang Yoon*, Man-Hae Kim, Sang-Woo Kim

School of Earth and Environmental Sciences, Seoul National University, Seoul, 151-747, Rep. of Korea
**yoon@snu.ac.kr*

Lidar is a useful instrument, which can provide vertical distribution of dust particles. Dust aerosols can be easily recognized from lidar-derived particle depolarization ratio due to its non-spherical shape. For example, aerosol subtype classification for dust is the most accurate in CALIPSO algorithm [Burton et al., 2013]. However, we need to know the extinction-to-backscatter ratio (so called, lidar ratio), which depending on particle physical and chemical properties (e.g., size, shape, chemical composition), to calculate aerosol extinction profiles. In this study, we present lidar ratio of dust particles determined from simultaneous ground-based lidar, space-borne CALIPSO, AERONET sky radiometer, and MODIS measurements. Aerosol optical depth (AOD) obtained from AERONT sky radiometer and MODIS are used as a constraint for the retrieval of dust particle lidar ratio. In this study, an extinction-to-backscatter ratio has finally determined when the discrepancy of AOD between ground-based lidar/CALIPSO and AERONET/MODIS is less than 0.5%. The lidar ratio at 532 nm for dust conditions are estimated to be 51.7±13.7 sr using 4-year measurements of ground-based elastic-backscatter lidar [Kim et al., 2008] and sun/sky radiometer at Seoul National University of Seoul, Korea. The mean lidar ratios at six locations (Seoul, Gosan, Fukue, Osaka, Chiba, and Tsukuba) during the Distributed Regional Aerosol Gridded Observation Networks (DRAGON) - NE Asia 2012 campaign from ground-based lidar and sky radiometer are estimated to be 60~70 sr. During the dust event on 27-29 April 2013, the lidar ratio is decreased to 50~60 sr, which is consistent with other previous studies in East Asia [e.g., Catrall et al., 2005]. From a synergy of CALIPSO and AERONET, the lidar ratio for Saharan/Arabian dust is estimated to be 47.45±16.52 sr, which is similar to thoes reprorted for Asain dust particles. Lastly, using 1-yr CALIOP and MODIS measurements together, the lidar ratio of dust particle is retrieved as 46.32±14.44 sr. All the lidar ratios for dust aerosol retrieved in this study using AOD constrained method show larger values than currently used lidar ratio for dust in CALIOP algorithm (40 sr), which suggests that dust lidar ratio in CALIOP algorithm is underestimated and need to be increased. Detailed results will be presented.

Cattrall, C., Reagan, J., Thome, K., and Dubovik, O., 2005: Variability of aerosol and spectral lidar and backscatter and extinction ratios of key aerosol types derived from selected Aerosol Robotic Network locations, *J. Geophys. Res.*, 110, D10S11, doi:10.1029/2004JD005124.

Burton, S. P., Ferrare, R. A., Vaughan, M. A., Omar, A. H., Rogers, R. R., Hostetler, C. A., and Hair, J. W. Hair (2013). Aerosol classification from airborne HSRL and comparisons with the CALIPSO vertical feature mask, *Atmos. Meas. Tech. Discuss.*, 6, 1815-1858, doi:10.5194/amtd-6-1815-2013.

Kim, S.-W., Berthier, S., Chazette, P., Raut, J.-C., Dulac, F., and Yoon, S.-C. (2008). Validation of aerosol and cloud layer structures from the space-borne lidar CALIOP using Seoul National University ground-based lidar, *Atmos. Chem. Phys.*, 8, 3705-3720.

PEAT RECORDS OF DUST VARIATIONS IN EASTERN TIBETAN PLATEAU DURING THE HOLOCENE

Xuefeng Yu*, Yanhong Zheng

State Key Laboratory of Loess and Quaternary Geology, Institute of Earth Environment, Chinese Academy of Sciences, Xi'an 710075, China
**xfyu@loess.llqg.ac.cn*

We have performed sedimentological, particle surface texture and geochemical studies on peat sequences from eastern Tibetan Plateau. The results showed that there have been eolian dust inputs to the studied wetlands, thereby providing an opportunity to reconstruct the history of dust variations during the Holocene. Here, we use the dust flux and the content of trace metallic elements in a peat sequence from Hongyuan Swamp (32°46.7′N, 102°31.0′E) to show the dust variations in this region. Our results showed that the dust inputs to the wetland were mainly influenced by the intensity of Asian winter monsoon. Generally, the variation of dust flux matches well with that of solar insolation. Seven intensified dust flux events, correlating to the cold events in the North Atlantic Ocean realm, can be identified in the sequences of both dust flux and elements content since 11 cal. ka BP.

LONG-TERM INVERSE MODELING OF ASIAN DUST WITH SATELITE OBSERVATION AND AEROSOL 4D-VAR DATA ASSIMILATION SYSTEM

Keiya Yumimoto[1]*, Toshihiko Takemura[2]

[1]*Meteorological Research Institute, Japan Meteorological Agency, Tsukuba-city, 3050032, Japan*
[2]*Reserch Institute for Applied Mechanism, Kyushu University, Kasuga, 8168580, Japan*
**yumimoto@mri-jma.go.jp*

We performed a long-term inverse modeling of Asian dust emission with MODIS coarse-mode aerosol optical thickness (AOT) and the aerosol 4D-Var data assimilation system (Yumimoto and Takemura, 2013). Gridded (T42 horizontal resolution; approximately 2.8° × 2.8°) and daily dust emissions in 2005-2012 were optimized.
We estimate that dust emissions (rates of increase from a priori emissions) from the Gobi desert in 2005-2012 are 234 (-16), 449 (+20), 378 (-13), 283 (±0), 301 (+31), 280 (+45), 222 (-37), and 361 Tg (+9%), respectively. A posteriori emission exhibits inter-annual variation and significant negative correlations with snow cover and sea level pressure (SLP) over north-central China.
Independent validation with observation data not used in the inverse modeling is crucially important. Modeled dust concentrations with a posteriori emission show better agreement with vertical profiles of extinction coefficient observed by in-situ and space-based lidars and the observed dust day counted by in-situ sites of JMA (Japan Meteorological Agency).
We analyze characteristics of Asian dust using the inversion results. A posteriori dust concentrations show four types of transport paths (north, south, broad and two streams). In 2006 and 2008, Asian dust is transported around 40°N. On the other hand, southern transport paths (around 30°N) are found in 2007 and 2012. Dust mass transported to North America and deposition amount over the Pacific Ocean exhibit inter-annual variations. Total dust mass passed the longitude plane at 130°W in 2006 is about 56% larger than that in 2010. A posteriori dust depositions in the eastern and western Pacific in 2005-2012 are 9.3-16.5 and 2.6-4.1 Tg with significant standard deviations of 2.4 and 0.5 Tg, respectively. The long-range transported dust and dust deposition show moderate correlation with dust emission. This indicates that not only dust emission but also meteorological field (e.g., wind and precipitation) attribute the inter-annual variations.
We also investigate impacts of Asian dust on Direct Aerosol Radiative Forcing (DARF) and PM2.5 concentration in East Asia with the inversion results. A posteriori DARF exhibits the different trend and larger inter-annual variation compared with a priori one.

Yumimoto K., and Takemura, T. (2013). The SPRINTARS version 3.80/4D-Var data assimilation system: development and inversion experiments based on the observing system simulation experiment framework, Geoscientific Model Development, 6, 2005-2022.

VALLEY FEVER: A DUST-BORNE DISEASE EPIDEMIC IN CALIFORNIA

Charles S. Zender[1], Jorge Talamantes[2]

[1]*Department Of Earth System Science, University of California, Irvine, USA*
[2]*Department of Physics and Geology, California State University at Bakersfield, USA*
**zender@uci.edu*

Coccidioidomycosis (valley fever) is a systemic infection caused by inhalation of airborne spores from *Coccidioides immitis*, a soil-dwelling fungus found in the southwestern United States, parts of Mexico, and Central and South America. Dust storms help disperse *C. immitis* so risk factors for valley fever include conditions favorable for fungal growth (moist, warm soil) and for aeolian soil erosion (dry soil and strong winds). Understanding the role climate plays in valley fever outbreaks is timely and important since many Californian counties are currently experiencing the highest valley fever incidence rates since the previous epidemic of 1991—1995. We analyze and intercompare the seasonal and interannual behavior of valley fever incidence and climate risk factors for the period 1980—2013 in Kern County, California, the US county with highest reported incidence.

Our analysis of the previous epidemic finds weak but statistically significant links between disease incidence and antecedent climate conditions. Precipitation anomalies eight and twenty months antecedent explain only up to 4% of monthly variability in subsequent valley fever incidence during the 23 year period tested. This is consistent with previous studies suggesting that *C. Immitis* tolerates hot, dry periods better than competing soil organisms, and, as a result, thrives during wet periods following droughts. Furthermore, the relatively small correlation with climate suggests that the causes of valley fever could be largely anthropogenic in Kern County. Using another decade of data, we will update this analysis to cover the current epidemic, which appears to be the strongest on record.

Zender, C, Talamantes, J. (2007). Climate controls on valley fever incidence in Kern County, California, Int. J. Biometeorol., 59(3), 174-182, doi:10.1007/s00484-005-0007-6.

DETRITAL ZIRCON U-PB AGE COMPOSITION OF SURFACE SAMPLES FROM THE MU US SAND FIELD AND IMPLICATIONS FOR DUST PROVENANCE

Hanzhi Zhang[1]*, Huayu Lu[1]**, Xisheng Xu[2], Xiaoming Liu[3], Thomas Stevens[4], Zhiwei Xu[1], Tian Zhang[5]

[1]*School of Geographic and Oceanographic Sciences, Nanjing University, Nanjing, 210093, China*
[2]*State Key Laboratory for Mineral Deposits Research, School of Earth Sciences and Engineering, Nanjing University, Nanjing, 210093, China*
[3]*State Key Laboratory of Continent Dynamics, Department of Geology, Northwest University, Xi'an, 710069, China*
[4]*Centre for Quaternary Research, Department of Geography, Royal Holloway University of London, Egham, Surrey TW20 0EX, UK*
[5]*School of Astronomy and Space Science, Nanjing University, Nanjing, 210093, China*
**Presenting author: zhanghznju@gmail.com*
***Corresponding author: huayulu@nju.edu.cn*

Gobi deserts, deserts and sand fields in Northern China and their surrounding areas are proposed as persistent sources of wind-blown mineral dust. In China, they are also regarded as potential sources of loess on the Chinese Loess Plateau (CLP), the most detailed terrestrial achieve of paleoclimate change over the late Cenozoic. However, in spite of an increasing number of new methods applied in tracing the dust material, the precise source area of Chinese loess is still controversial. As it is located immediately to the north-west of the CLP, further material characterisation of Mu Us is needed to find out whether it is one of the immediate source of CLP. Here we report new results from 11 detrital zircon U-Pb samples and depositional process analyses to study the dune sediment distribution feature on the modern Mu Us sand field and the sediment origin. The results suggest that overall the samples are a mixture of material from the Central Asia Orogenic System (CAOS), Central Orogenic Belt (COB) and North China Craton (NCC) settings to the northwest, southwest and underlying the Mu Us sand field respectively. In order to discriminate material from different settings, we classify zircon grains aged between 250 Ma to 380 Ma as the CAOS group, those older than 1500 Ma as the NCC group, while the others are the COB group. From this it can be seen that the sediment origin is anisotropic within the Mu Us dune field. Specifically, it can be divided into three parts; the south, the north and the north-east of the dune field. Sediment in the south part of the desert, with approximately half of the material originating from the COB, is mainly derived from the transportation via the Yellow River. As for the material in the northern part of the dune field, sediments from the CAOS and the NCC make up the largest part, indicating that they are primarily sourced from the palaeo sandstone underlying the dunes. Further, dune sand near the river valley in the north-east part of the desert is dominated by NCC material, suggesting a local origin as well. Thus, sediment in the Mu Us sand field is principally sourced by the surrounding river systems and underlying rock. Moreover, by comparing the zircon U-Pb age distributions of the sediments in the Mu Us dune field with others such as those in the Tengger desert and the CLP, we could conclude that the loess deposit in CLP is probably connected with the sediments in Mu Us sand field.

LOESS DEPOSIT ALONG HANJIANG RIVER (CENTRAL CHINA) AND THE PALEOENVIRONMENTAL CHANGES

Hongyan Zhang[1]*, Huayu Lu[1]**, Wenchao Zhang[1], Haixin Zhuo[1],
Khobaib Ahmad[1], Xuefeng Sun[1], Shejiang Wang[2], Fang Lei[1]

[1]*School of Geographic and Oceanographic Sciences, Nanjing University, Nanjing, 210093, China*
[2]*Joint Laboratory of Human Evolution and Archaeometry, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, 100044, China*
**Presenting author: hongyan@nju.edu.cn*
***Corresponding author: huayulu@nju.edu.cn*

Hanjiang River, located to the south of Qinling Mountains which is a natural geographical boundary between Northern and Southern China, is one of the most important tributaries of Yangtze River. Presently, climate in the Hanjiang River catchment is controlled by typical subtropical monsoon circulation. In recent years, we have found a large amount of loess deposits and tens of thousands of lithic artefacts buried in the loess stratum in the Hanjiang River catchment, showing this region was occupied by intensive humans during the Pleistocene. The loess deposit in the catchment of Hanjiang River is much thinner than that of the Chinese Loess Plateau, and distributed on various landforms. It deposited in intermountain basins and on river terraces, with a thickness of around 20 meters, while, the loess on mountains or high reliefs are always several meters in thick. There are distinct loess-paleosol alternations in the loess sequences. However, these loess deposits are not investigated. Compared with the loess along South Luo River which is located in north side of the Qinling Mountains, differences in dust sources and environmental changes are easily to be seen. In this study, after intensive field reconnaissance, four representative loess sections were selected and systematically analyzed. They are the Longgangsi, Nanzhai and Hujiawan sections in Hanzhong Basin, and Wutaicun section in Ankang Basin, respectively. Grain-size, major and trace geochemical elements and the Sr-Nd isotopic composition were measured in order to identify loess origin and provenance. Meanwhile, use the magnetic susceptibility, organic carbon isotopic composition to reconstruct the past climate changes and vegetation evolutions during the Pleistocene. Our results show that the loess in the Hanjiang River catchment has a typical eolian origin and the proxy indicators can reflect environmental changes during the Pleistocene.

We will present the in detailed results in this conference.

THE SIZE DISTRIBUTION, MORPHOLOGY, MINERALOGY AND OPTICAL PROPERTIES OF INDIVIDUAL DUST PARTICLES FROM THE TIBETAN PLATEAU

Xuelei Zhang[1,2]*, Guangjian Wu[2], Dainel Q. Tong[1,3], Tandong Yao[2]

[1]*Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, Changchun 130102, China*
[2]*Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing 100101, China*
[3]*U.S. NOAA Air Resources Laboratory, College Park, MD 20740, USA*
**zhangxuelei@neigae.ac.cn*

The Tibetan Plateau, with an average altitude of 4 km, its snow/ice form high altitudes becomes a unique medium to record and preserve the middle and upper tropospheric dust aerosols. Snow and ice-core samples (the upper part) and atmospheric dust aerosol samples were collected from 11 locations with different aerosol optical thicknesses surrounding the Tibetan Plateau. The size distribution, morphology, mineralogy and optical properties of more than 20,000 individual dust particles in snow/ice were obtained by the single particle technique of scanning electron microscopy (SEM).
As the dust particles are mostly the aggregates of sub-particles of wide-ranging mineralogy and size in varying ratios. Thus, quantitative mineralogical analysis of single dust particle is practically impossible. However, the mineral types dominating dust particles can be reliably estimated manually from the EDX, compared with the spectral pattern of reference mineral particles. In this study, we developed a new flowchart method for dealing with the numerical data of oxides form the EDX to quickly identify the dominating mineral types of the individual dust particles. The accuracy of this method was also compared with the manually method (Kennth, 2004) and the atomic ratio method of (Donarummo et al., 2003).The statistical results showed that the mineral phases of dust particles in snow/ice was up to 30 types, and clay minerals are the most abundant component with a content of 57.43%. Clay minerals in all samples had a low degree of weathering, which mainly composed of illite, chlorite and their mixed-layer minerals. The log-normal size distributions were fitted from the artificial single particle size measurements with an average mode radius of 0.69 μm. The average aspect ratio (AR) is 1.63 and the average circularity (CIR) is 1.26. The AR value is consistent with the average AR of 1.64 from African dust, indicating that the naturally occurring particles have an aspect ratio around 1.60. The derived 8-5-2 three-dimensional morphological model of single dust particle from Monte Carlo stochastic simulation method can effectively simulate the irregular and angular morphology of the real dust particle. The average complex refractive index of samples is 1.58 +0.0013i at 550 nm. The impact from mineral composition to the imaginary part of complex refractive index is about 30%, but in fact, to the real part is only about 2.5%.

Kenneth P.S., (2005), Energy Dispersive Sperctrometry of Common Rock Forming Minerals, Kluwer Academic Publishing, Norwell.,1-225
Donarummo J., Ram M. and Stoermer E.F., (2003), Possible deposit of soil dust from the 1930's U.S. dust bowl identified in Greenland ice, Geophys. Res. Lett., 30(6), 1269.

BIRTH OF THE TAKLIMAKAN DESERT: WHEN AND HOW

Hongbo Zheng[1], Xiaochun Wei[2], Peter Clift[3], Ryuji Tada[4], Fred Jourden[5], Ping Wang[1]

[1]*School of Geography Science, Nanjing Normal University, Nanjing, China.*
[2]*School of Earth Science and Engineering, Nanjing University, Nanjing, China.*
[3]*Department of Geology and Geophysics, Louisiana State University, Baton Rouge, USA.*
[4]*Department of Earth and Planetary Science, University of Tokyo, Japan.*
[5]*Western Australian Argon Isotope Facility, Department of Applied Geology and JdL Centre, Curtin University, Perth, Australia.*
**zhenghb@njnu.edu.cn*

As the world's second largest mobile sand sea and one of the most important sources of dust to the global aerosol system, the formation of the Taklimakan Desert marks a major environmental feature in central Asia during the Cenozoic. Determining when and how the desert formed holds the key to better understanding tectonic-climatic linkages in this region. However, the time at which the Taklimakan Desert came into existence remains controversial, with estimates ranging from only a few hundreds of thousands to a few million years ago. Evidence of desertification in the geological past is preserved in the sedimentary sequences within and along the margins of the Tarim Basin in which the desert is found. Dating these terrestrial sedimentary rocks has previously largely been hampered by lack of suitable dating material. Recent geochronological work, mostly based on magnetostratigraphy, proposed an approximately latest Miocene to earliest Pliocene initiation, ~7 Ma. In this study, we applied theAr/Ar method to precisely date a volcanic tuff preserved in the upper part of the stratigraphy and thus constrain the timing of the initial desertification to be Early Miocene, ~20-24 Ma. We suggest that the Taklimakan Desert was formed as a direct response to a combination of widespread regional aridification and increased erosion in the surrounding mountain fronts,both of which are closely linked to the tectonically driven surface uplift of Tibetan Plateau, which had reached a climatically sensitive threshold at this time.

A COMPREHENSIVE STUDY ON THE COMPOSITION AND THE BIOLOGICAL/HEALTH EFFECTS OF COMBUSTION-DERIVED AEROSOLS: FIRST RESULTS OF THE VIRTUAL HELMHOLTZ INSTITUTE HICE ON SHIP-DIESEL AEROSOLS

R. Zimmermann[1,11]*, T.G. Dittmar[2,11], T.Kanashova[2,11], J. Buters[3,11], S. Öder[3,11], H. Paur[4,11], C. Schlager[4], S. Mülhopt[4], M. Dilger[4,11], C. Weiss[4,11], S. Diabate[4], H. Harndorf[5,11], B Stengel[5,11], R. Rabe[5], M.-R.Hirvonen[6,11], J. Jokiniemi[6,11], T. Torvela[6], K. Hiller[7,11], S.C. Sapccariu[7,11], K.A. BeruBe[8,11], A.J. Wlodarcyzk[8,11], O. Sippula[1,6,11], B. Michalke[9], T. Krebs[10,11], M. Kelbg[5,11], J. Tiggesbäumker[5,11], T. Streibel[1], E. Karg[1], S. Scholtes[1,11], J. Schnelle-Kreis[1], J. Lintelmann[1], G. Matuschek[1], M. Sklorz[1], M. Arteaga Salas[1,11], S. Klingbeil[1,11], J. Orasche[1], P. Richthammer[1], L. Müller[1,11], M. Elsasser[1], A. Rheda[1], J. Passig[1,11], T. Gröger[1], G. Abbaszade[1], C. Radischat[1,11]

[1]*Joint Mass Spectrometry Centre, Rostock University (Analyt. Chem.)&Helmholtz Zentrum München (HMGU/CMA),Germany, D;* [2]*MDC, Berlin, D;* [3]*ZAUM, Technical University Munich, D;* [4]*KIT (ITC/ITG), Karlsruhe, D;* [5] *University of Rostock (Inst. of Piston Machines & Int. Combust. Engines and Inst. of Physics), D;* [6]*University Eastern Finland-Kuopio;* [7]*Uni Luxemburg;* [8]*Cardiff University, UK;* [9]*HMGU, D;* [10]*Vitrocell GmbH, Waldkirch, D;* [11]*HICE - Helmholtz Virtual Institute of Complex Molecular Systems in Environmental Health-Aerosols and Health, www.hice-vi.eu*

** ralf.zimmermann@helmholtz-muenchen.de, ralf.zimmermann@uni-rostock.de*

Ship diesel PM-emissions contribute substantially to adverse health effects in coastal regions. In this study the chemical composition and the biological effects on human lung cell-cultures of the PM-emissions from a ship diesel engine running either on diesel fuel (DF) or heavy fuel oil (HFO) were comprehensively characterized. The HFO-PM emissions contained more particles, toxic transition metals (V, Ni, Fe etc.) and organic chemicals (e.g. PAH) whereas rather pure soot (elemental carbon) dominated the DF-emissions. A new ALI air-liquid-interface (ALI) exposition system and a mobile S2-biological laboratory were developed for these experiments. Human alveolar basal epithelial cells (A549 and BEAS2B) were ALI-exposed to fresh, diluted ship diesel engine aerosols (1:40 -1:100) and subsequently were toxicologically and molecular-biologically characterized. Stable isotope labelling technologies ($^{13}C_6$-Glucose/metabolomics, $^{2}H_4$-Lysine/SILAC-proteomics) were used for high sensitivity and detection accuracy of molecular-biological effects, even at sub-acute toxicity effect PM-dose levels. Filtered aerosol was used as gas-reference for the isotope labelling based method (SILAC). Thus the biological effects of HFO- and DF-PM can be directly compared. Monitoring of the cellular response using transcriptomics, proteomics and metabolomics revealed reactions especially in inflammatory, oxidative stress and protein synthesis pathways. Surprisingly DF-PM is showing a broader biological reaction on the transcriptomic, proteomic and metabolomic level if compared to an equal dose of HFO-PM. In conclusion, HFO- and DF-usage in shipping both evoke harmful health effects. The currently promoted switching from HFO to DF in coastal areas without also eliminating elemental carbon-emissions by filtration may be not sufficient from a public-health perspective.

This work/HICE (www.hice-vi.eu) is supported by the Helmholtz Association (HGF).

INDEX OF AUTHORS

ISBN 978-88-7522-095-2

€ 30,00 iva inc.