8th International Workshop on Sand/Duststorms and Associated Dustfall

1st-4th May 2016 - Lisbon, Portugal

BOOK OF ABSTRACTS

Instituto Superior Técnico
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FOREWORD

The DUSTworkshop8 National Organizing Committee from the C^2TN - Centro de Ciências e Tecnologias Nucleares (Instituto Superior Técnico, Universidade de Lisboa) and from CESAM - Centre for Environmental and Marine Studies from University of Aveiro will hold the 8th International Workshop on Sand/Duststorms and Associated Dustfall (DUSTworkshop8). The event will take place in the Pavilion of Knowledge - Ciência Viva (Lisbon) between 1st and 4th of May 2016.

The series of Dust Workshops started in 2002 and, in 2016, Portugal has the pleasure to be the host country of this important international workshop for the first time. C^2TN - Centro de Ciências e Tecnologias Nucleares (Instituto Superior Técnico, Universidade de Lisboa) and CESAM - Centre for Environmental and Marine Studies (University of Aveiro) have the honor to organize such an important meeting of researchers, policy makers and practitioners from all over the world, which theme is the advances on research and knowledge on sand and dust storms and their impacts on environment, weather and climate.

The goal of DUSTworkshop8 is to bring international research activities/outcomes together and to discuss how to enhance our understanding of dust storm mechanisms and their links and feedbacks between desert dust, air quality, radiation, clouds, water budget and health impacts. One of the major objectives is to bring together scientists working on dust from Europe, Asia and USA, exchange information on hot research topics and to promote international collaborative efforts between research groups, institutions and agencies.

Therefore, the Organizing Committee is pleased to announce an exciting innovative congress, with scientific presentations covering a wide range of topics.

The Organizing Committee looks forward to your presence and participation to continue the Excellency of the previous DUSTworkshop series.

Lisbon, 1st May 2016.

The National Organizing Committee

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PROGRAM

8th International Workshop on Sand/Duststorms and Associated Dustfall

1st-4th May 2016 - Lisbon, Portugal

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11:00 - 11:15		S3-O2	S5-O2	
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Session 2	ENVIRONMENT IMPACT ASSESSMENT
Session 3	DUST AND CLIMATE INTERACTIONS + AEROSOL-RADIATION-CLOUD-PRECIPITATION INTERACTIONS
Session 4	DUST TRANSPORT, MIXING WITH ANTHROPOGENIC POLLUTANTS AND AGING
Session 5	MODELING AND PREDICTION
Session 6	SOURCE DEFINITION AND PROPERTIES OF DUST
Poster Session	
Opening cerimony | Closing cerimony	

ABSTRACTS

SESSION 1

DUST PARTICLE SIZE AND COMPOSITION

S1 PLENARY SESSION

Review of Fugitive Dust Emission Processes and Control Measures

J.G. WATSON[1], X.L. WANG[1], S.D. KOHL[1], J.C. CHOW[1]

[1]Desert Research Institute, 2215 Raggio Pkwy, Reno, Nevada 89511, USA; john.watson@dri.edu

Minerals from fugitive dust constitute important fractions of PM10 and PM2.5. These emissions result from both mechanical- and wind-generated forces. Fugitive dust emission factors are inaccurate, and emission inventories commonly overestimate these emissions. Practical emission control measures include paving surfaces, decreasing trackout from unpaved to paved surfaces, minimizing surface disturbances, applying suppressants, and constructing wind barriers. Mining pits, open fields and parking lots, paved and unpaved roads, agricultural fields, construction sites, unenclosed storage piles, and material transfer systems are the major sources of fugitive dust. Large dust plumes are often noticed over these sources when wind speeds are high or when vehicles are moving. Fugitive dust emissions depend on particle sizes, surface loadings, surface conditions, wind speeds, atmospheric and surface moisture, and dust-suspending activities. Emission rates and control measures are also closely related to these properties. Little is known about the PM10 and PM2.5 in surface dust deposits as these fractions are too small to be determined by simple sieving methods. Modern technology allows these emissions to be better characterized Portable wind tunnels can be equipped with continuous PM size monitors to obtain real-time measurements as a function of wind speed for various surfaces. The monitors can also be mounted in a vehicle with the inlet next to the tire to evaluate mechanical suspension potential on roadways as a function of vehicle speed. This technique identifies hot-spots, such as trackout from unpaved areas onto paved roads. Trackout is a major fugitive dust source, as the traffic grinds this dust to smaller particles, and transports it down the roadway via vehicle wakes. Mitigation measures include: 1) reducing suspendable dust reservoirs, 2) preventing its deposit, 3) stabilizing it, 4) enclosing it, and 5) reducing the activities that suspend it. These methods are applied with various degrees of effectiveness and diligence. Surface watering is often applied on disturbed land such as construction sites or unpaved surfaces to reduce particle resuspension by vehicles. The application of chemical suppressants and vegetation to unpaved surfaces is effective under some circumstances, but not under others. Increasing the surface roughness reduces wind shear at the surface, which also lowers suspension potential. Normal brush sweepers often raise more dust than they collect. Vacuum sweepers are more effective for dust control, and several U.S. air quality districts have specified collection efficiency tests that are required for emission reduction credits.

Keywords: Fugitive Dust, Suppressants, Suspended Particulate Matter, Mining, Air Quality Management

Session 1

S1-O1

Long-term variations of sandstorms and associated dustfall observed in central Korea

Y.S. CHUNG[1], H.S. KIM[2]

[1]Korea Centre for Atmospheric Environment Research; 164-37 Jeosan- Koonghyon, Khangnae, Cheongju, Choongbook 28177, Korea; chungys22@gmail.com

[2]Korea National University of Education; 250 Taeseong-Tabyeon, Khangnae, Cheongju, Choongbook 28173, Korea; envir007@knue.ac.kr

Session 1

Large-scale transport of duststorms originating from Mongolia and northern China have been observed by using satellites and surface measurements from a background site in central Korea from 1997 to 2015. The air quality standards have applied since 1997 to dustfall cases are TSP (≥250 $\mu gm^{-3}hr^{-1}$), PM10 (≥190 $\mu gm^{-3}hr^{-1}$) and PM2.5 (≥85 $\mu gm^{-3}hr^{-1}$), based on the measurement of mass concentrations. Dustfall cases associated with sandstorms generally load coarse (TSP and PM10) particulates in the atmosphere in Korea. Furthermore, high mass concentrations caused by dustfall cases in spring and winter have contributed a large portion of the annual TSP and PM10 average. During the last 19 years, the annual rate of dustfall cases in central Korea has decreased by -0.4±0.1 case yr^{-1}. Changes in sandstorm occurrences from Mongolia and northern China caused variations in the measurements of dustfall cases and mass concentrations at the central Korean site, which is located in the leeward side of China. A noticeable decrease of mass concentrations in spring and winter in central Korea has directly resulted in the annual decreasing rates of TSP and PM10 with -1.3±0.4 $\mu gm^{-3}yr^{-1}$and -1.6±0.4 $\mu gm^{-3}yr^{-1}$, respectively.

Keywords: Dustfall Case, Sandstorm, TSP, PM10, PM2.5

S1-O2

Impact of Saharan dust events on PM in the urban area of Bologna (Po Valley, Italy)

A. TRENTINI[1], D. BACCO[1], F. SCOTTO[1], A. MARINONI[2], T. LANDI[2], C. ZIGOLA[1], V. POLUZZI[1]

[1]Emilia-Romagna Agency for Prevention, Environment and Energy; Largo Caduti del Lavoro, 6 - Bologna (Italy); atrentini@arpa.emr.it

[2]National Research Council, Institute of Atmospheric Sciences and Climate; via Gobetti, 101 - Bologna (Italy); a.marinoni@isac.cnr.it

Session 1

In the framework of the Supersito Project (www.supersito-er.it), continuous measurements of $PM_{2.5}$ and its chemical composition (nitrate, sulphate, ammonium, organic and elemental carbon) have been carried out, since 2011, at Bologna, one of major cities of Po Valley. Furthermore, Particle Number Concentration from 0.28 µm to 10 µm were measured with an Optical Particle Counter (developed by FAI Instruments, Italy). PM_{10} data were available from air quality monitoring network (www.arpae.it). In the present study, the changes of the aforesaid parameters values were analyzed for the days before and after a dust event detected at high mountain (2165 m asl) Climate Observatory "O. Vittori" (www.isac.cnr.it/cimone), from March 2012 to February 2015. Only dust events longer than a day were taken into account. Due to the lack of data about specific dust tracers like Al or Si, Saharan dust events in Bologna were estimated by observing an increase of PM_{10} values associated with a decrease of $PM_{2.5}/PM_{10}$ ratio, an increase of the $PM_{2.5}$ unknown fraction (likely due to the enhanced contribution of crustal components) and an increase of the particles with diameter >5µm. Despite about 75% of the events recorded on Apennines coincide with an increase of PM levels in the urban area of Bologna, only about 50% seems to be due to a direct impact of dust on particle values.

Keywords: Dust, $PM_{2.5}$, Po Valley, Particles

Geochemical Composition of Dust Outbreaks in Europe: Time and Spatial Variation During the 2012-2013 EMEP IMPs

A. ALASTUEY[1], X. QUEROL[1], W. AAS[2], F. LUCARELLI[3], N. PEREZ[1], T. MORENO[1], F. CAVALLI[4], K.E. YTTRI[2] and the 3rd EMEP IMP TEAM

[1]Institute of Environmental Assessment and Water Research (IDAEA-CSIC); C/ Jordi Girona, 18-26, ES-08034 Barcelona, Spain; andres.alastuey@idaea.csic.es

[2]NILU-Norwegian Institute for Air Research; P.O. Box 100, NO-2027 Kjeller, Norway; Wenche.Aas@nilu.no

[3]Dipartimento di Fisica e Astronomia and National Institute of Nuclear Physics (INFN); Via Sansone,1, I-50125, Sesto Fiorentino (Firenze), Italy; lucarelli@fi.infn.it

[4]European Commission – DG Joint Research Centre, Institute for Environment and Sustainability Air and Climate Unit - TP 123, Via E. Fermi, 2749, I-21027 Ispra (VA), Italy; fabrizia.cavalli@jrc.ec.europa.eu

Session 1

During the third intensive measurement period (IMP), organised by the European Monitoring and Evaluation Programme (EMEP), PM_{10} filter samples were concurrently collected at 20 regional background sites across Europe in summer 2012 and winter 2013. Mineral dust was determined using the same or a comparable methodology. Throughout the summer 2012 IMP, two Saharan dust events (SDE) originated in South Algeria and Mali. Dust concentration increased first at the south-western sites, and subsequently the plume moved northwards spreading to distant areas such as Germany and towards the eastern Mediterranean region. Observations in the Iberian Peninsula demonstrated a higher impact of mineral dust at the mountain sites during these SDEs, reflecting the transport of dust at high altitudes in summer. Short but intense dust episodes blew off the coast of Libya during the winter 2013 IMP, affecting mainly the Eastern Mediterranean. The comparison between average mineral loads for the whole period and for non-SDE days at each site permitted the estimation of Saharan dust contribution, ranging 0.1-0.4 µg m^{-3} at the northern sites affected by SDE, and 0.5-5 µg m^{-3} at the southern sites. The composition of African dust was quite homogeneous over the different regions of Europe, showing that changes during dust transport were not very significant. However, for similar SiO_2/Al_2O_3 ratios, the contribution of CaO was higher during winter events, reflecting differences in the source areas. During the summer SDEs, a higher content on CaO and MgO, and a relatively lower content on K_2O and Fe_2O_3, was determined at the southern sites compared to central and northern Europe. This could be attributed to the different composition of local dust or to the preferential settling during transport of specific minerals.

Keywords: Saharan dust; chemistry, PIXE, ICPs, EMEP

S1-O4

Winter Particulate Pollution and Source Apportionment over Central India (Raipur)

K. S. PATEL[1], N. K. JAISWAL[1], H. SAATHOFF[2], S. NAVA[3], F. LUCARELLI[3], J. F. NICOLAS[4], E. YUBERO[4], M. VIANA[5], M. PANDOLFI[5]

[1]School of Studies in Chemistry, Pt. Ravishankar Shukla University, Raipur, CG, India; patelks_55@hotmail.com, nitinkjaiswal@hotmail.com
[2]Institute for Meteorology and Climate Research, Research Centre, Karlsruhe, Germany
[3]Department of Physics, University of Florence and INFN, Florence, Italy
[4]Atmospheric Pollution Laboratory, Applied Physics Department, Miguel Hernandez University, Avda de la Universidad S/N, 03202 Elche, Spain
[5]Institute for Environmental Assessment and Water Research, IDAEA-CSIC, C/ Jordi Girona 18, 08034 Barcelona, Spain

Session 1

Winter particulate pollution is severe in several urban parts of India. Therefore, the aim of the present work is to characterize the concentration, composition and sources of winter particulate matter (PM_{10}) in the most industrialized part of central India: Raipur city. Fifteen coarse particulate matter (PM_{10}) and three suspended particulate matter (SPM) samples from 15 different locations of Raipur city during period, (December, 2006 - February, 2007) were collected. The concentration of organic carbon (OC), elemental carbon(EC) and elements associated to PM in the air is described. The concentration of PM_{10} and SPM in the ambient air was ranged from 221 - 760 and 1150 - 1577 µg m^{-3} with mean value of 435±85 and 1331±250 µg m^{-3}, respectively. The mean concentration of OC, EC, Al, Ti, Mn, Fe, Cl^-, NO_3^-, SO_4^{2-}, Na^+, K^+ and Ca^{2+} associated to the PM_{10} in the air was 51±17, 41±15, 10.9±1.9, 1.7±0.3, 1.2±0.3, 27.5±8.0, 4.7±1.8, 8.2±1.9, 17.4±4.1, 5.9±1.0, 4.2±1.9 and 20.6±3.5 µg m^{-3}, respectively. The variations, correlation and sources of the aerosols are discussed.

Keywords: Particulate Matters; Elemental Carbon; Organic Carbon; Metals: Sources

SESSION 2

ENVIRONMENT IMPACT ASSESSMENT

S2-O1

Potential for Dust Suspension in Industrial Operations

J.C. CHOW[1], X.L. WANG[1], S.D. KOHL[1], J.G. WATSON[1]

[1]Desert Research Institute, 2215 Raggio Pkwy, Reno, Nevada 89511, USA; judith.chow@dri.edu

Session 2

Industrial operations, especially mining, have large potential to emit dust from activities on unpaved roads, movement of overburden and ore, storage piles and conveyors, and tailings pond dikes. This study characterizes the generation of windblown dust from various sources in the Athabasca Oil Sands Region (AOSR) in Alberta, Canada. The *P*ortable *I*n-*S*itu *W*ind *E*rosion *L*aboratory (PI-SWERL) was equipped with two real-time dust monitors and nine-channel filter packs to simulate wind-driven erosion and measure emissions. Sixty four sites were measured, including oil sands mining facilities, quarry operations, and roadways in the vicinity of Ft. McMurray and Ft. McKay. Key parameters related to windblown dust generation were characterized including: threshold friction velocity, reservoir type, and particle size-segregated emission potential. The threshold wind speed for particle suspension varies from 11-21.5 km/h (u_{10}^+; measured at 10 m above ground level), and saltation occurred at higher speeds of $u_{10}^+ > 32$ km/h. All surfaces had limited dust supplies at lower wind speeds of <27 km/h, but have unlimited dust supplies at the highest wind speed tested (56 km/h). Unpaved roads, parking lots, or bare land with high abundances of loose clay and silt materials along with frequent mechanical disturbances are the highest dust emitting surfaces. Paved roads, stabilized or treated (e.g., watered) surfaces with limited loose dust materials are the lowest emitting surfaces. Surface watering proved effective in reducing dust emissions, with potential emission reductions of 50-99%. Surface disturbances by traffic or other activities were found to increase PM_{10} emission potentials 9-160 times. Similar studies can be performed at other industrial locations to improve the accuracy of emission inventories, dust dispersion, transport, and source apportionment models. These measurements are being used to design and evaluate dust control strategies, with priority given to those areas with the highest dust suspension potential.

Keywords: Fugitive Dust, Suppressants, Suspended Particulate Matter, Mining, Air Quality Management

S2-O2

Saharan dust impact in central Italy: comparison of the EU method with quantifications based on the particulate elemental composition and PMF analysis

F. LUCARELLI[1], S. NAVA[1], G. CALZOLAI[1], M. CHIARI[1], M. GIANNONI[1], S. BECAGLI[2], R. TRAVERSI[2], R. UDISTI[2], F. AMATO[3], X. QUEROL[3]

[1] Dep. of Physics and Astronomy, Università di Firenze and INFN-Firenze, Sesto Fiorentino, 50019, Italy; lucarelli@fi.infn.it

[2] Dep. of Chemistry, Università di Firenze, Sesto Fiorentino, 50019, Italy

[3] Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, 08034, Spain

In southern Europe, Saharan dust may give a significant contribution to PM. The European legislation allows the subtraction of natural aerosol to fulfill the PM10 standards; different approaches have been proposed to assess this contribution, by both model-based methods and PM time series analysis. Specific EU Guidelines provide the Member States a common protocol: it first requires the identification of all days affected by Saharan intrusions; the net African dust contribution is then calculated from the PM10 concentration values measured in rural background sites during Saharan-days by subtracting a regional background level. However, as the impact of desert dust is characterised by an increase of all soil-related elements and changes in elemental ratios, field campaigns followed by elemental analysis can be very accurate and reliable methods to assess the real contribution of these episodes at the ground level. In this context, the detection with very high sensitivity of all the crustal elements makes Particle Induced X-ray Emission (PIXE) a very effective tool. Since 90s, several sampling campaigns were carried out by the authors in Tuscany (central Italy), and long time series of elemental concentrations were obtained by PIXE. A review of these data was accomplished with the aim of identifying the occurrence of Saharan dust transport episodes over long periods and characterising them in terms of composition and impact on PM concentration, tracing back their contribution to the exceedances of the PM10 limit value. The Saharan dust net contribution was assessed following the approach described in Nava et al. (2012): the mineral dust component is first calculated using the oxide formula (corrected for sea salt and possible anthropogenic contributions); the net African dust contribution is then calculated on the identified Saharan episodes by subtracting an estimated soil dust background. As collected samples were analysed by several techniques, thus obtaining an extended chemical speciation, receptor modelling (namely PMF, Positive Matrix Factorisation) was also applied to identify aerosol sources and quantify their contributions. In most of the cases, PMF successfully separated the Saharan dust factor from the local dust one, thus allowing the quantification of the impact of desert dust on PM10 concentration. In this work, results obtained by different approaches (EU method, elemental composition + oxide formula with soil dust background subtraction, extended chemical speciation + PMF) are discussed and compared. It is worth noting that the EU method has been tuned, validated and widely applied in Spain, but its “exportability” to other regions is still under debate. In particular, one key point of this approach, i.e. the selection of a proper network of rural background stations, is particularly critical in Italy where many rural stations are “near-city” stations and may be affected by different anthropogenic contributions. In this context, the comparison with different methods, based on PM elemental composition, is particularly useful and may be used to tune (selection of the best regional background network, choice of the best percentile), improve and validate the EU procedure.

Keywords: Saharan dust, elemental composition, PIXE, PMF

Using intensive optical properties for near real-time detection of Saharan dust events in the northwestern Mediterranean

M. EALO[1,2], A. ALASTUEY[1], A. RIPOLL[1], N. PÉREZ[1], M. C. MINGUILLÓN[1], X. QUEROL[1], M. PANDOLFI[1]

[1]Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, Spain; marina.ealo@idaea.csic.es

[2]Department of Astronomy and Meteorology, Faculty of Physics, University of Barcelona

Session 2

Saharan Dust Events (SDE) are important pollution episodes affecting air quality and health in Southern Europe. More than 70 % of the exceedances of the PM_{10} daily limit value at most regional background sites of Spain have been attributed to dust outbreaks. Mineral dust also influences significantly the climate system through direct and indirect effects causing important impacts on climate radiative budget. Therefore, a better understanding of the physicochemical and optical properties of mineral dust is strongly required in order to reduce uncertainties on climate models and evaluate the potential impacts on air quality and climate. In the present work we demonstrate the potential of in situ aerosol optical measurements, from both Nephelometer and Aethalometer instruments, for near real-time detection of SDE in the Western Mediterranean Basin (WMB). Intensive aerosol optical parameters such as scattering and absorption Ångström exponents (*SAE* and *AAE*), asymmetry parameter (*g*) and single scattering albedo Ångström exponent (*SSAAE*) were retrieved from measurements performed since 2010 at two sampling sites in NE Spain, representative of the middle-altitude regional (Montseny station (MSY); 720 m a.s.l.) and high-altitude continental (Montsec station (MSA); 1570 m a.s.l.) backgrounds in the WMB. Mineral dust induces significant changes on the spectral dependence of aerosol scattering and absorption, leading to low values of *SAE*, as a consequence of the predominance of coarse particles, and an increase of *AAE* due to the enhanced absorption in the ultraviolet spectral range by iron oxides contained within the mineral dust. On average *SAE*, *AAE* and *g* parameters ranged between -0.7 and 1, 1.3 and 2.5, and 0.5 and 0.75, respectively, at both stations during dust outbreaks. We show that the feasibility of detecting SDE by means of the aerosol intensive optical parameters depended on both the altitude of the measurement station, which determined the distance from anthropogenic sources of fine PM, and on SDE intensity. In fact around 85% of SDE were detected at MSA station by means of the *SSAAE* parameter, compared to 50% of SDE identified at MSY, where the closer proximity to anthropogenic sources of fine PM compared to MSA gave rise to a mixture of aerosols which hindered the optical effect of mineral dust on the aerosol optical properties during less intense SDE. Another interesting atmospheric process detected using the calculated intensive aerosol optical properties took place when regional atmospheric circulations, often occurring after SDE, favoured the resuspension of mineral dust at regional level in the WMB. Thus, mineral dust can remain in the atmosphere for a few days after the end of SDE, thus also contributing to the exceedances in the PM_{10} daily limit value.

Keywords: Saharan Dust Events, Intensive Optical Properties, Mineral Dust Resuspension, Air Quality

S2-O4

The Effects of Airborne Bacteria within Asian Duststorm (Kosa bioaerosols) on the Forest Ecosystem: Wood Decay and Growth of Pinewood Nematode by Kosa Bioaerosol

F. Kobayashi[1], D. Akaishi[2], T. Maki[3], M. Kakikawa[4], A. Matsuki[5], Y. Iwasaka[6\]

[1]Faculty of Natural system, Institute of Science and Engineering, Kanazawa University; Kakuma-machi Kanazawa, Ishikawa 920-1192, Japan; fumihisa@se.kanazawa-u.ac.jp

[2]Satoyama Satoumi Nature School, Institute of Nature and Environmental Technology, Kanazawa University; Misaki-machi Kodomari 33-7, Suzu, Ishikawa 927-1462, Japan; daicha5@gmail.com

[3]Faculty of Chemistry, Institute of Science and Engineering, Kanazawa University; Kakuma-machi Kanazawa, Ishikawa 920-1192, Japan; makiteru@se.kanazawa-u.ac.jp

[4]Faculty of Electrical and Computer Engineering, Institute of Science and Engineering, Kanazawa University; Kakuma-machi Kanazawa, Ishikawa 920-1192, Japan; kakikawa@ec.t.kanazawa-u.ac.jp

[5]Institute of Nature and Environmental Technology, Kanazawa University; Kakuma-machi Kanazawa, Ishikawa 920-1192, Japan; matsuki@se.kanazawa-u.ac.jp

[6]The University of Shiga Prefecture;Yasaka-machi2500, Hikone, Shiga 522-8533, Japan; iwasaka@mti.biglobe.ne.jp

Airborne bacteria, Biaerosols are particle or large molecules that carry living organisms or are released from living organisms (*e.g.*, bacteria and fungi). On the other hand, mineral or soil particles that are blown into the atmosphere by winds in arid and semi-arid areas such as the Taklamakan Desert, Gobi Desert and Loess Plateau in inland China are transported by the westerly winds and often reach Japan. The phenomenon called Asian duststorm, Kosa, describes the entrainment of mineral and soil particles from atmosphere, diffusion on a global and/or regional scale and their deposition in a distant area. Recently, the frequency and the associated damage have been increasing. In our previous study, we pioneered the investigation of microorganisms within Kosa particles by sampling and bioanalysis using a tethered balloon in Dunhuang City, western China, which was the source region of Kosa in 2006. We have investigated Kosa bioaerosols in the atmosphere using a tethered balloon and an airplane in Japan and have detected many kinds of microorganisms. On May 2008, Kosa bioaerosols were sampling using a tethered balloon on the Noto Peninsula and *Nocardiopsis* sp. BASZUN0801, *Nocardiopsis* sp. BASZUN0802, *Nocardiopsis* sp. BASZUN0803, *Nocardiopsis* sp. BASZUN0804, *Bacillus* sp. BASZUB0801, *Streptmyces* sp. BASZB0802, *Bjerkandera* sp. BASZUP0801, *Bjerkandera* sp. BASZS0801 were isolated (Kobayashi et al., 2010). *Bacillus* sp. BASZHN0901 was isolated at an altitude of 3,500 m over Noto Peninsula using the airplane, Cessna 404 (Kobayashi et al., 2011). Furthermore, *Bacillus* sp. BASZHR1001 was isolated as Kosa bioaerosol at 2,900 m over the Noto Peninsula using airplane on March, 2010 (Kobayashi, 2015). In order to discuss the environmental impact of the forest ecosystem, the wood decay experiments of Japanese red pine, Japanese oak, and Japanese cedar cut down a forest in the Noto Peninsula were performed using the Kosa bioaerosol, *Bjerkandera* sp. BASZUP0801. This Kosa bioaerosol decomposed these wood as the same amount by famous wood rotting fungus, *Phanerochate chrysosporium* ATCC34541. Kosa bioaerosol, Bacillus sp. BASZUB0801 enhanced the growth of *Bursaphelenchus xylophilus* as pinewood nematode caused pine wilt disease. It was suggested that a part of Kosa bioaerosols affected the forest ecosystem.

Keywords: Asian duststorm (Kosa), Bioaerosol, Forest ecosystem, Wood decay, Pinewood nematode

S2-O5

Source apportionment studies of particulate matter in China

Y. GAO[1], S.C. LEE[1*]

[1] Department of Civil and Environmental Engineering, Research Center for Environmental Technology and Management, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong SAR;
ceslee@polyu.edu.hk

Many source identification models are used in the world, such as, diffusion model, receptor model and satellite method. Because of limited database in China and Hong Kong area, the statistics calculation theory model was popular used in the areas. Seven Chinese cities were selected for the source apportionment studies review and the cities are located in northern, eastern, southern, western and central China. Based on simulated PMF model, there are 6 sources of $PM_{2.5}$ are commonly observed, which including soil/fugitive dust, coal combustion, industrial emission, vehicle emission, biomass burning and secondary aerosol. The contribution of each sources are varied in different cities, because of varied anthropogenic activities, but in general, the secondary formation aerosol the fraction is over 30% on average to $PM_{2.5}$ mass. But in many major cities, which surrounded many industries, the contribution on industrial emission has relative high contribution, such as Beijing and Nanjing cities. The amount of coal consumption in Xi'an and Wuhan cities are relatively high, increased contribution on coal combustion emission. In Hong Kong, traffic emission and secondary aerosol has comparative contribution to fine particulate matters, which due to the high traffic loading. While, in recent stage, many issues related with $PM_{2.5}$ is still unclear. The characteristics of fine particulate matters need to have further discussion. In addition, the uncertainty on single model simulation remains high, and multi-model combination model can reduce its uncertainty and more accurate source profiles can be identified in China. The accurate source profiles are provide useful information for Chinese government build effective and efficient air pollution control program in China.

Session 2

Keywords: PMF, Source Identification, Secondary Aerosol

S2-O6

Automated Dust Monitoring Web Map Service and Impact Assessment Based on Meteosat Second Generation Images

P. MARZIALETTI[1], L. FUSILLI[2], G. LANEVE[3]

[1] DIAEE. Sapienza Universita di Roma; Via Salaria 851. Rome; pablo.marzialetti@uniroma1.it
[2] DIAEE. Sapienza Universita di Roma; Via Salaria 851. Rome; lorenzo.fusilli@uniroma1.it
[3] SIA. Sapienza Universita di Roma; Via Salaria 851. Rome; giovanni.laneve@uniroma1.it

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In recent years, the frequency of dust storms has increased. In particular, desert areas are considered vulnerable to climate change and face a unique set of environmental challenges. Rising environmental degradation coupled with the increasing frequency and intensity of extreme weather events, take an enormous toll on socioeconomic life, human development, and air quality across entire regions, causing numerous negative impacts on aviation safety, health, ground transport, agriculture and climate. These events are usually sparsely distributed in space and time. Thus the processing of a large number of satellite images is required to carry out an effective monitoring system; this raises the problem of the development of automated procedures. Within the framework of MyGEOSS project, the Earth Observation Satellite Application Laboratory (EOSIAL) of the University of Rome "La Sapienza", developed a web map service (WMS) that provides near real time georeferenced maps of dust features with statistics of the area and roads impacted, with a temporal resolution of 15 minutes. The area of interest analysed for this prototype application and first release was set to Algeria. This Dust Monitoring and Impact Assessment WMS provides accessibility to valuable information derived from complex satellite image processing and geographic information system procedures. The dust feature extraction algorithm is based on brightness temperature (BT) thresholds (from Meteosat Second Generation-SEVIRI channels 4, 7, 9 and 10) taking into account among others the differences recommended by EUMETSAT, capable to discriminate dust-contaminated pixels and to remove other features as desert sand, land, clouds etc. The algorithm was validated on several real dust storms occurred in the Middle East and North Africa. The results were compared to dust features extracted from MODIS satellite images and with the dust forecast maps provided by the Barcelona Dust Forecast Centre to evaluate its performance. Finally, dust features are intersected with an Open Street Map (OSM) layer (grouped by highway types), generating a map of affected roads and a report which details the area covered and the amount of kilometers impacted. This monitoring system provides a useful tool to track and assess the impact of dust storms, generating maps with high temporal resolution and complementary data to climate monitoring and management agencies devoted to early warning activities. Added value products could help to locate potential health effects in the communities affected, and identify roads and cities recurrently affected.

Keywords: Dust Storm, MSG-SEVIRI, Satellite Image, Earth Observation, Monitoring System

Spatio-temporal Monitoring of a Moderate Saharan Dust Event Affecting Southern Europe by Ground-based and Air- and Space-borne Lidars

R. BARRAGAN[1,2], M. SICARD[1,2], J. TOTEMS[3], J.-F. LÉON[4], F. DULAC[3], M. MALLET[4], J. PELON[5], L. ALADOS-ARBOLEDAS[6,7], A. AMODEO[8], P. AUGUSTIN[9], A. BOSELLI[8,10], J. A. BRAVO-ARANDA[6,7], P. BURLIZZI[11], P. CHAZETTE[3], A. COMERON[1], G. D'AMICO[8], M. J. GRANADOS-MUÑOZ[6,7], G. LETO[12], J. L. GUERRERO-RASCADO[6,7], F. MADONNA[8], L. MONA[8], C. MUÑOZ-PORCAR[1], G. PAPPALARDO[8], M. R. PERRONE[11], V. PONT[4], F. ROCADENBOSCH[1,2], A. RODRIGUEZ[1], S. SCOLLO[13], N. SPINELLI[9,14], G. TITOS[6,7], X. WANG[9,15], R. ZANMAR SANCHEZ[12]

[1]Remote Sensing Laboratory, Universitat Politècnica de Catalunya, Barcelona, Spain
[2]Ciències i Tecnologies de l'Espai - Centre de Recerca de l'Aeronàutica i de l'Espai / Institut d'Estudis Espacials de Catalunya (CTE-CRAE / IEEC), Universitat Politècnica de Catalunya, Barcelona, Spain
[3]Laboratoire des Sciences du Climat et de l'Environement (LSCE), CEA-CNRS-UVSQ, Gif-sur-Yvette, France
[4]Laboratoire d'Aérologie, Université de Toulouse / CNRS, Toulouse, France
[5]Laboratoire Atmosphères, Milieux, Observations Spatiales (LATMOS), Université Pierre et Marie Curie, Paris, France
[6]Dpt. Applied Physics, Faculty of Sciences, University of Granada, Fuentenueva s/n, 18071, Granada, Spain
[7]Andalusian Institute for Earth System Research (IISTA-CEAMA), Avda. del Mediterráneo s/n, 18006, Granada, Spain
[8]Consiglio Nazionale delle Ricerche - Istituto di Metodologie per l Analisi Ambientale (CNR-IMAA), Potenza, Italy
[9]Laboratoire de Physico-chimie de l'atmosphère (LPCA), Université du Littoral Cote d'Opale, Dunkerque, France
[10]Consorzio Nazionale Interuniversitario per le Scienze Fisiche della Materia, Naples, Italy
[11]Dipartimento di Matematica e Fisica, Università del Salento, Lecce, Italy
[12]INAF - Osservatorio Astrofisico di Catania, Italy
[13]Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Etneo, Sezione di Catania, Italy
[14]Dipartimento di Scienze Fisiche, Università di Napoli "Federico II", Naples, Italy
[15]Consiglio Nazionale delle Ricerche – Istituto Superconduttori, Materiali Innovativi e Dispositivi (SPIN-CNR), Italy

Session 2

During the ADRIMED (Aerosol Direct Radiative Impact on the regional climate in the Mediterranean region) field campaign conducted in June 2013 in the framework of the ChArMEx (Chemistry Aerosol Mediterranean Experiment) project a moderate Saharan dust event swept the Western and Central Mediterranean Basin (WCMB) from west to east during a 10-day period (between 15 and 25 June). This event was monitored from the ground by six EARLINET/ACTRIS (European Aerosol Research Lidar Network / Aerosols, Clouds, and Trace gases Research InfraStructure Network) lidar stations (Granada, Barcelona, Naples, Potenza, Lecce and Serra la Nave) and two ADRIMED/ChArMEx lidar stations specially deployed for the field campaign in Menorca and Corsica Islands. The first part of the study consists in showing the spatio-temporal monitoring of the dust event during its transport over the WCMB with ground-based lidar measurements and co-located sun-photometers in terms of the dust layer optical depth, Ångström exponent, coarse mode fraction and dust layer height. The second part of the study is focused on the characterization of the multi-intrusion aspect of the event by complementing the dataset with airborne lidar measurements performed from the French Falcon 20 research aircraft deployed during the field campaign, spaceborne lidar measurements from the CALIOP (Cloud-Aerosol Lidar with Orthogonal Polarization) instrument, satellite images from SEVIRI (Spinning Enhanced Visible and Infrared Imager) and MODIS (Moderate Resolution Imaging Spectroradiometer) instruments and backtrajectories performed with the FLEXible PARTicle dispersion model (FLEXPART).

Keywords: Mineral Dust, Lidar, Sun-Photometer, Multi-Intrusion, Western and Central Mediterranean Basin

S2-O8

Megabarchans' black sand (khnifiss national park, SW of Morocco): Composition, Origin and Transport pathways

M. ADNANI[1], M.A. AZZAOUI[1], H. ELBELRHITI[2], M. AHMAMOU[1], L. MASMOUDI[1]

[1] Faculté des Sciences de Rabat, Université Mohammed V-Agdal, 4 Avenue Ibn Battouta B.P. 1014 RP, Rabat, Maroc - adnani.manar@gmail.com, azzaoui.m.amine@gmail.com, lhmasmoudi@gmail.com

[2] Département des Sciences Fondamentales et Appliquées. Institut Agronomique Vétérinaire Hassan II. BP 6202, 10101 – Rabat, Maroc - helbelrhiti@gmail.com or h.elbelrhiti@iav.ac

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We propose to study the red megabarchans located in Tarfaya basin in the South-west Moroccan desert. In the present work, we aim to achieve an understanding of the megabarchans sand provenance, interplay of transport mechanisms and conditions of deposition. Preliminary analysis revealed non-coherent sand, with a mixture of sand types. This indicates that we have multiple potential sand sources and competing transport agents, resulting in the sand deposition. The data used for this study comes from the samples taken at the megabarchans and at nearby beach located in 4 Km towards the north east of the studied dunes. Landsat 8 satellite images were also used to complement the analysis. Heavy minerals and geochemical characterization was carried out for sand samples. The results showed a similar composition between the heavy fraction from the megabarchans samples and the beach's black sand samples. Therefore, wind is probably remobilizing sediment from the beach through the direction NNE – SSW and deposing it on the mega-barchans windward side. 4/2 Landsat 8 image band ratio showed a signature of iron oxide concentration over the megabarchans. Mineralogical analysis also revealed a high grade of oxides and opaque minerals: "Ilmenite, Magnetite, Titano-magnetite", in addition to silicates: "Pyroxenes" and carbonates: "Calcite". Sand's composition supposes the interference between different origins: i) A Quaternary Calcareous cliff for carbonate material as a proximal source, ii) Paleozoic and pre-Cambrian formations (granite and igneous rocks) in Anti-Atlasic domain derived by Drâa valley as distal sources for iron oxides and silicates.

Keywords: Black Sand, Landsat 8, Iron oxide, Mineralogy, Mega barchans, Akhefnir beach

S2-O9

Mediterranean Desert Dust Outbreaks' Direct Radiative Effects based on Regional Model Simulations

A. GKIKAS[1], V. OBISO[1], L. VENDRELL[1], S. BASART[1], O. JORBA[1], C. PEREZ GARCIA-PANDO[2,3], N. HATZIANASTASSIOU[4], S. GASSO[5], J.M. BALDASANO[1,5]

[1]Earth Sciences Department, Barcelona Supercomputing Center, Barcelona, Catalonia, 08034, Spain
[2]Department of Applied Physics and Mathematics, Columbia University, New York, New York, 10027, USA
[3]NASA Goddard Institute for Space Studies, New York, New York, 10025, USA
[4]Laboratory of Meteorology, University of Ioannina, Ioannina, Epirus, 45110, Greece
[5]Environmental Modelling Laboratory, Technical University of Catalonia, Barcelona, Catalonia, 08034, Spain

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The present study focuses on the determination of intense Mediterranean desert dust outbreaks' direct effect on the Earth-Atmosphere's radiation budget, based on regional model numerical simulations. To this aim, 20 dust outbreaks have been selected, over the period 2000-2013, through an objective and dynamic algorithm, which utilizes as inputs daily retrievals derived by passive satellite sensors. Dust outbreaks' selection was made according to their spatial coverage (number of 1º x 1º grid cells undergoing dust episode) and intensity (in terms of aerosol optical depth at 550 nm). For each outbreak, two simulations of the NMMB/BSC-Dust model were made for a forecast period of 84 hours with activated (RADON) and deactivated (RADOFF) dust-radiation interactions. Each forecast cycle starts at 00 UTC of the day when a dust outbreak has been ignited. The simulation domain comprises the Northern Africa, the Middle East and the European continent at 0.25° x 0.25° horizontal resolution, for 40 hybrid sigma pressure levels up to 50hPa. The direct radiative effects (DREs) are calculated at the top of the atmosphere (TOA), into the atmosphere (ATMAB), and at surface, for the downwelling (SURF) and the absorbed (NETSURF) radiation, for the shortwave (SW), longwave (LW) and NET (SW+LW) radiation. According to our results, the instantaneous NET DRE_{ATMAB} values can reach up to 150Wm^{-2} indicating a strong atmospheric warming, while a reduction is found for the downwelling (DRE_{SURF}) and absorbed ($DRE_{NETSURF}$) radiation at the surface by up to 300 Wm^{-2} and 250 Wm^{-2}, respectively, indicating a strong surface cooling. At TOA, DRE values are as large as -150 Wm^{-2} (planetary cooling) over the Mediterranean areas affected by dust outbreaks, while positive values (planetary warming) up to 50 Wm^{-2} are encountered over the Saharan and Middle-East desert areas. The regional NET DREs, averaged for the whole simulation domain under clear-sky conditions, vary between -10 to 2 Wm-2, -3 to 25 Wm-2, -35 to 3 Wm^{-2} and -22 to 3 Wm^{-2} for TOA, ATMAB, SURF and NETSURF, respectively. Due to the interaction of dust particles with the SW and LW radiation, the temperature at 2 meters above ground is locally decreased by up to 4 ^{o}C during daytime, while an opposite tendency of similar magnitude is recorded at night. Negative feedbacks on dust emissions and dust aerosol optical depth are obtained when dust interacts with the radiation. The evaluation of the model performance to reproduce the downwelling SW and LW radiation against ground measurements from 6 Baseline Surface Radiation Network (BSRN) stations reveals a better agreement for the RADON compared to the RADOFF configuration. Moreover, the consideration of the dust radiative effects improves the ability of the model to reproduce the temperature fields at 2 meters as well as at lower tropospheric layers. These findings are obtained through comparison of model outputs against ERA-Interim reanalyses datasets and weather stations observations (Integrated Surface Database, ISD). From the present analysis, it is apparent that the inclusion of dust radiative effects in numerical simulations improves the forecasting efficiency of a regional model, at short time scales.

Keywords: Mediterranean, dust, satellites, regional modelling, direct radiative effects

S2-10

The Effect of Dust Lifting Process on the Electrical Properties of the Atmosphere

F. ESPOSITO[1], R. MOLINARO[1], C. I. POPA[1], C. MOLFESE[1], F. COZZOLINO[1], L. MARTY[1], K. TAJ-EDDINE[2], G. DI ACHILLE[3], S. SILVESTRO[1], G. G. ORI[4,2]

[1]INAF - Osservatorio Astronomico di Capodimonte; 80131, Napoli, Italy; francesca.esposito@na.astro.it
[2]Ibn Battuta Centre - University Cadi Ayyad, 40000, Marrakech, Morocco
[3]INAF-Osservatorio Astronomico di Teramo, 64100, Teramo, Italy
[4]IRSPS Università G. D'Annunzio, Pescara, Italy

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Airborne dust and aerosol particles affect climate by absorbing and scattering thermal and solar radiation and acting as condensation nuclei for the formation of clouds. For this reason, they strongly influence the thermal structure, balance and circulation of the atmosphere. On Earth and Mars, this 'climate forcing' is one of the most uncertain processes in climate change predictions. Moreover, wind-driven movement of sand and dust largely contributes to the reshaping of planetary surfaces through processes like the erosion of rocks, the formation of sand dunes and ripples, and the creation and transport of soil particles. These processes are not confined to Earth, but also occur, for example, on Mars, Venus and Titan. The knowledge of the atmospheric dust properties and of the mechanisms for dust settling and lifting into the atmosphere is important to understand planetary climate and surface evolution. On Mars the physical processes responsible for dust injection into the atmosphere are still poorly understood, but they likely involve saltation as on Earth. Saltation is a process where large sand grains are forced by the wind to move in ballistic trajectories on the soil surface. During these hops they hit dust particles, that are well bound to the soil due to interparticle cohesive forces, thus transferring to them the required momentum to be entrained into the atmosphere. It is known that this process is capable of generating strong electric fields in the atmosphere up to 100-150 kV/m. This enhanced electric force acts as a feedback in the dust lifting process, lowering the threshold of the wind friction velocity (u*) required to initiate sand saltation. The effect of the electric field is an important aspect of dust lifting process that needs to be well characterized and modelled. Although the literature reports several measurements of E-fields during dust devils events, there is only a limited number of measurements of atmospheric electric properties during dust storms or isolated gusts. To solve some of the issues raised above we carried out a series of field campaigns in South-eastern Morocco during the 2013 and 2014 dust storm seasons. Here we show for the first time that, depending on relative humidity conditions, electric fields contribute to increase the amount of particles emitted into the atmosphere. This means that electrical forces and humidity are critical quantities in dust emission process and should be taken into account in climate and circulation models to obtain a more realistic estimation of dust load in the atmosphere.

Keywords: Electric Field, Dust Lifting

SESSION 3

DUST AND CLIMATE INTERACTIONS + AEROSOL-RADIATION-CLOUD-PRECIPITATION INTERACTIONS

S3 PLENARY SESSION

Impact of African Dust Long-Range Transport on PM Concentration and Chemical Composition in the Athens Metropolitan Area, in Greece

E. DIAPOULI[1], N. TSAMI[1], V. VASILATOU[1], D.SARAGA[1], C. ALVES[2], F. LUCARELLI[3], X. QUEROL[4], K. ELEFTHERIADIS[1]

[1] Institute of Nuclear & Radiological Sciences & Technology, Energy & Safety, N.C.S.R. "Demokritos", 15310 Agia Paraskevi, Athens, Greece; elefther@ipta.demokritos.gr

[2] Department of Environment, University of Aveiro, 3810-193 Aveiro, Portugal; celia.alves@ua.pt

[3] Department of Physics and Astronomy, University of Florence, 50019 Sesto Fiorentino, Florence Italy; lucarelli@fi.infn.it

[4]Institute of Environmental Assessment and Water Research, CSIC, 08034 Barcelona, Spain; xavier.querol@idaea.csic.es

Particulate matter (PM) concentrations over the Mediterranean Basin are often influenced by long-range transport of African dust. These events are more frequently observed in the Eastern Mediterranean region and may lead to exceedances of EU air quality guidelines. The aims of the present work were: (i) to quantify the contribution of African dust to the recorded PM_{10} concentration levels and relevant exceedances, for sites of different urbanization characteristics in the Athens Metropolitan area and (ii) to assess the impact of African dust on the aerosol chemical composition and identify PM species that may serve as tracers of African dust transport events. PM_{10} sampling was conducted at a suburban and an urban traffic site in the Athens Metropolitan Area (AMA), on a 24-hr basis. The suburban site (SUB) was monitored during March 2013-February 2014, while two monthly campaigns during warm and cold season were performed at the urban traffic site (UB). All samples were analysed for major PM constituents: elemental, organic and carbonate carbon, major ions and major and trace metals and elements. Long-range transport of African dust was identified through the following prediction models: Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT), Barcelona Supercomputing Centre (BSC) - DREAM8b v2.0 Atmospheric Dust Forecast System, Skiron and Flextra. Contribution of the net dust to PM_{10} concentration levels was calculated based on the EC methodology (SEC 2011.208, 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, 2011). 24-hr PM_{10} concentration data were also obtained by the National Monitoring Network for all stations of the AMA. Mean annual African dust contribution to PM_{10} concentrations was calculated equal to 19.6 μg m^{-3} (20% f PM_{10} concentration on average), with peak values reaching up to a 24-hr concentration of 127 μg m^{-3} during a 15-day dust transport event on May 2013. The contribution of African dust during days with exceedance of the PM_{10} 24-hr EU limit value was found equal to 79% at the suburban site and 45% at the urban traffic site. As expected, African dust long-range transport caused significant increase in PM constituents related to crustal material, such as carbonate carbon, Ca, Al, Si, Fe and Ti. In addition to these species, ions of secondary origin (SO_4^{2-} and NO_3^-), sea salt components (Na^+, Cl^- and Mg^{2+}) and some trace metals (Ni, V, Ba) exhibited elevated concentrations during dust episodes. Analysis of the data pointed towards specific elements, as well as elemental ratios as potential good tracers of African dust long-range transport. In addition, the comprehensive characterization of aerosol chemical composition in the presence and absence of dust events provided insight into the enrichment of African dust with anthropogenic aerosol components during its transport to European receptor sites. The chemical profile of African dust presents significant

implications for population exposure risk assessment, given the very high dust loads during strong dust episodes, such as the ones often observed in the Southern European countries.

Keywords: Long-range transport of African dust; PM_{10}; chemical speciation; Southern Europe

S3-O1

Amplification of dust variability by dynamic vegetation changes

P. GINOUX[1], S. EVANS[2,] S. MALYSHEV[3], E. SHEVLIAKOVA[4]

[1]NOAA Geophysical Fluid Dynamics Laboratory, 201 Forrestal Road, Princeton, NJ 08540, USA;
Paul.Ginoux@noaa.gov
[2]Princeton University, Department of Ecology and Evolutionary Biology, Princeton, NJ 08544, USA;
Suart.Evans@noaa.gov
[3]Princeton University, Department of Ecology and Evolutionary Biology, Princeton, NJ 08544, USA;
Malyshev@princeton.edu
[4]NOAA Geophysical Fluid Dynamics Laboratory, 201 Forrestal Road, Princeton, NJ 08540, USA;
Elena.Shevliakova@noaa.gov

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Over the last decade dust models have been significantly improved. However, comparison with long-term observations indicates a lack of variability in model results. We suggest that this drawback is related to the treatment of vegetation cover over the dust sources. Because vegetation and its characteristics are affected by both direct anthropogenic changes (e.g. deforestation) and by climate change (e.g. die-back due to drought), it is important to include vegetation dynamics as one of the predictors of dust emission to accurately simulate past and future dust loading. In this presentation, we will analyze the results of implementing dust emission and deposition within the dynamic land model (LM3Dust), terrestrial component of the Geophysical Fluid Dynamics Laboratory climate models. We will show that low frequency dust variability is related to soil moisture and vegetation changes, which follow modifications of the hydrological cycle. This will be illustrated over Australia as it provides clear example of atmospheric dust loading modulates by El Nino and the Southern Oscillation (ENSO) through changes of vegetation and soil moisture. We will show similar behavior in other regions. Finally, we will discuss how such long-term variability of dust may translate in radiative forcing and ocean productivity.

Keywords: Dust, Climate, Vegetation, Australia, ENSO

S3-O2

Sandblasting Mass Efficiency as a Function of Soil Clay Contents: A comparative modelling study

J. KUSHTA[1], C. SPYROU[1], P. PATLAKAS[1] AND G. KALLOS[1]

[1]University of Athens; School of Sciences, Faculty of Physics, University campus, 15771, Athens, Greece;
kousta@mg.uoa.gr; cspir@mg.uoa.gr

The production of small dust aerosols in the atmosphere is controlled by the saltation and sandblasting mechanisms. Saltation refers to a soil layer moving with the wind right above the surface. Sandblasting is the disaggregation and ejection of clay (diameter less than 2.5 μm) and silt (diameter 2.5-60 μm) particles by saltating sand-sized particles (diameter larger than 60 μm). Sandblasting mass efficiency is the ratio of the vertical mass flux of dust aerosols to the saltating mass flux. Empirical parameterizations have been used to estimate the sandblasting mass efficiency, as a function of soil characteristics, and particularly clay content. The basic size and drag independent function is based on the work of Marticorena and Bergametti (1995) but it is often modified in different applications mostly depending on the spatiotemporal resolution (local-regional-global applications). We have tested different combination of the sandblasting mass efficiency functions for clay content values above and below 0.2 (either functions or constants) and we propose a new function for clay content above 0.2. The comparative modelling study is performed with the use of the online model RAMS/ICLAMS for the Saharan desert.

Keywords: Sandblasting Mass Efficiency, Dust Production, Clay Content

Session 3

S3-O3

Merged Dust Storm Climatology over the Western United States: Analysis and Climate Impacts

J.X.L. WANG[1], H. LEI[2], D.Q. TONG[3], T.E. GILL[4], P. LEE[5]

[1]NOAA Air Resources Laboratory, 5830 University Research Ct., NCWCP, College Park, MD 20740, USA, Julian.wang@noaa.gov

[2]Environmental Modelling Centre/NCEP/NOAA, 5830 University Research Ct., NCWCP, College Park, MD 20740, USA, hang.lei@noaa.gov

[3]NOAA Air Resources Laboratory, 5830 University Research Ct., NCWCP, College Park, MD 20740, USA, Daniel.tong@noaa.gov

[4]University of Texas at El Paso, Texas 79968, USA, tegill@utep.edu

[5]NOAA Air Resources Laboratory, 5830 University Research Ct., NCWCP, College Park, MD 20740, USA, pisu.lee@noaa.gov

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Based on three data sources including regular meteorological records, in-situ air quality measurements, and satellite remote sensing observations, a merged climatology of dust storm activities over the western United States was generated, which provided a consistent and continuous record suitable for climate studies. In this presentation, the detailed description of data merging methods will be shown including uncertainty discussions. A preliminary analysis of the merged data will be presented to exhibit its linkages with climate variables, particularly, dust activity as a catalytic agent in climate change environment. This presentation is based on several articles that have been and/or are being published.

Keywords: Dust Climate Record, Merged Climatology of Dust Activities, Climate Impact on Dust Storms

S3-O4

Modelling the effects of desert dust on the atmospheric water content on the Arabian Peninsula

C. SPYROU[1], G. KALLOS[2], S.J. KOUSTA[3], E. DRAKAKI[4]

[1]University of Athens; School of Sciences, Faculty of Physics, University campus, 15771, Athens, Greece; cspir@mg.uoa.gr

[2]University of Athens; School of Sciences, Faculty of Physics, University campus, 15771, Athens, Greece; kallos@mg.uoa.gr

[3]University of Athens; School of Sciences, Faculty of Physics, University campus, 15771, Athens, Greece; kousta@mg.uoa.gr

[4]University of Athens; School of Sciences, Faculty of Physics, University campus, 15771, Athens, Greece; elenidrakaki@mg.uoa.gr

Session 3

The Arabian Peninsula is one of the world`s largest source of atmospheric mineral dust, following the Sahara and Gobi desert. The large amounts of natural particles injected into the air, has profound effects on the radiative budget and energy distribution of the atmosphere. By absorbing and scattering solar radiation aerosols reduce the amount of energy reaching the surface. In addition aerosols enhance the greenhouse effect by absorbing and emitting longwave radiation towards the ground. Desert dust forcing exhibits large regional and temporal variability, due to its short lifetime and diverse optical properties. Through this energy redistribution of the atmospheric column, changes in the evaporation and precipitation rates are observed, especially during the wet season and the transitional periods. In an effort to quantify this semi-direct effect of desert dust particles the SKIRON/Dust model coupled with the RRTMG module was used. The model was setup over the Arabian Peninsula and two sets of simulations were performed: One where the dust particles were inert and one where they interacted with solar and terrestrial radiation. The study period was from October 2013 to March 2015, in order to include at least two wet seasons included in the calculations. The two sets of simulations were evaluated against relative humidity station data and the effects of the direct radiative effect on the atmospheric water content were examined. In general dust tends to suppress precipitation, especially over water bodies (like the Red Sea), while at the same time there is an increase to the evaporation rates, mostly related to the increase of the surface temperature from the “greenhouse” effect of dust. However the changes in the total atmospheric water content are closely related on which of the two effects is stronger and highly depends on the weather conditions of the area in question.

Keywords: Desert Dust, Radiative Feedbacks, Precipitation

S3-O5

Combination and post-processing of aerosol and NWP models to improve DNI forecasts

J.L. CASADO-RUBIO[1], M.A. REVUELTA[2], M. POSTIGO[3], I. MARTINEZ-MARCO[4]

[1]AEMET; Leonardo Prieto Castro 8, 28071 Madrid, Spain; jcasador@aemet.es
[2] AEMET; Leonardo Prieto Castro 8, 28071 Madrid, Spain; mrevueltam@aemet.es
[3] AEMET; Leonardo Prieto Castro 8, 28071 Madrid, Spain; mpostigog@aemet.es
[4] AEMET; Leonardo Prieto Castro 8, 28071 Madrid, Spain; imartinezm@aemet.es

Direct normal irradiance (DNI) is a key physical variable for the solar industry. It mainly depends on two factors: clouds and aerosols. Although many numerical weather prediction (NWP) models already predict DNI, they do not forecast aerosol content, using instead seasonal climatological values to calculate DNI. This can affect the accuracy of the forecasts, specially in regions where there are many cloudless days and the aerosol content is significant, such as the Mediterranean and Northern Africa. We have developed a post-processing method which runs 1D radiative transfer model libRadTran with aerosol forecasts from an aerosol model as input data to get DNI forecasts, and combines them with cloud and direct radiation forecasts from a NWP model to improve their accuracy. This method allows to identify the contribution of each factor to the DNI, and measure the relative effect of dust in DNI compared to other aerosols. We have used cloud and direct radiation forecasts from European Centre for Medium-Range Weather Forecasts (ECMWF) model, and dust or total aerosol forecasts from Barcelona Supercomputing Center (BSC-DREAM8b) dust model and Monitoring Atmospheric Composition & Climate (MACC) project aerosol model. The DNI forecasts calculated have been verified against observations from AEMET radiation network in Spain. Results show an improvement of DNI forecasts in cloudless days, and it has been found that both dust and other aerosols have a strong effect on DNI in the region studied.

Keywords: Aerosol, DNI, LibRadTran, Post-Processing, Verification

SESSION 4

DUST TRANSPORT, MIXING WITH ANTHROPOGENIC POLLUTANTS AND AGING

Decoupling of air masses in the western Mediterranean: Simultaneous African dust outbreaks and Mediterranean polluted contributions in southern/south-eastern Spain

J.A.G. ORZA[1], M. CABELLO[2],
[1]SCOLAb, Física Aplicada, Universidad Miguel Hernández; Avda. de la Universidad, s/n. 03202 Elche (Spain); ja.garcia@umh.es
[2]Department of Applied Physics I, Faculty of Sciences, University of Málaga; 29071 Málaga (Spain); mcabello@uma.es

Dust-laden African air masses reach frequently the Iberian Peninsula. We show that during most African dust outbreaks, southern/south-eastern Spain is under the influence of Mediterranean air masses at the lowermost heights, while African flows arrive above the boundary layer primarily with southwestern pathways. The local and regional accumulation of aged pollutants in the western Mediterranean during the central months of the year, associated to recirculations within the coastal breezes reinforced by the local orography, contributes with anthropogenic aerosols and O_3. In particular, ozone concentrations are significantly higher under African episodes than on days with no episode; and concentrations increase when flows are traced-back along the Spanish coast to the Gulf of Lyon, which points out the contribution of continental polluted outflows. However, the maximum concentrations are found with no African episode, probably due to ozone depletion by dust particles. We have made an analysis of back-trajectories at multiple heights over the southern and eastern Spanish coast for the period 2004-2012, to analyse the decoupling between the lowest troposphere and upper levels, and its influence during African dust events. Though mesoscale processes are not well represented in the calculated single-particle trajectories, and consequently they cannot be reproduced, the short Mediterranean trajectories are a clear signature of the low synoptic forcing associated to daily recirculations in the western Mediterranean. Similarly, the influence of the Atlas Mountains, which act in most of cases as a barrier, can be ascertained. The study is done in combination with meteorological data from the ERA-Interim database and operational radiosoundings from Gibraltar and Murcia, PM_{10} and O_3 concentrations at the ground level from the stations located near the coast in southern and south-eastern Spain belonging to the regional air quality networks, and column-integrated aerosol properties and O_3 data from satellite retrievals. This work provides insight on the vertical transport of African dust to the Iberian Peninsula. The findings also highlight the importance that the studies of adverse health outcomes of the African dust events (not the focus of this work) consider that, in addition to the presence of African dust particles, Mediterranean polluted air masses are concurrently found in many African events.

Session 4

Keywords: African Dust Outbreaks, Western Mediterranean, Aged Air Masses, Back-Trajectories

S4-O2

Seasonal Trends of Natural and Anthropogenic Sources Contributions to PM2.5 and PM10 in Southern Italy

D. CONTINI[1], G.E. DE BENEDETTO[2], P. BONASONI[3], M. BUSETTO[3], D. CESARI[1], D. CHIRIZZI[2], M. CONTE[1,4], P. CRISTOFANELLI[3], A. DINOI[1], A. DONATEO[1], F.M. GRASSO[1], A. MARINONI[3], A. PENNETTA[2]

[1]Istituto di Scienze dell'Atmosfera e del Clima, ISAC-CNR, Str. Prv. Lecce-Monteroni km 1.2, 73100 Lecce, Italy; d.contini@isac.cnr.it, d.cesari@isac.cnr.it, m.conte@le.isac.cnr.it, a.dinoi@le.isac.cnr.it, a.donateo@isac.cnr.it
[2]Dipartimento di Beni Culturali, Università del Salento, Str. Prv. Lecce-Monteroni, 73100 Lecce, Italy; giuseppe.debenedetto@unisalento.it, antonio.pennetta@unisalento.it, daniela.chirizzi@unisalento.it
[3]Istituto di Scienze dell'Atmosfera e del Clima, ISAC-CNR, Via Gobetti 101, 40129 Bologna, Italy; p.bonasoni@isac.cnr.it, p.cristofanelli@isac.cnr.it, a.marinoni@isac.cnr.it, m.busetto@isac.cnr.it
[4]Dipartimento di Matematica e Fisica, Università del Salento, Via per Arnesano, Lecce, 73100; marianna.conte@unisalento.it

Session 4

A one-year (July 2013-July 2014) dataset of $PM_{2.5}$ and PM_{10} was collected at the Environmental-Climate Observatory (regional station of the Global Atmosphere watch – GAW-WMO), recently built in an urban background area in Lecce (SE Italy, 40°20'8''N-18°07'28''E, 37 m asl) within the I-AMICA project (PON R&C 2007-2013). Roughly, one sample every three days was chemically analysed for a total of 226 simultaneous samples (113 for each size fraction). Elemental and organic carbon were determined via thermo-optical method (Sunset OC/EC analyser, NIOSH5040 protocol), major ions Cl^-, NO_3^-, SO_4^{2-}, $C_2O_4^{2-}$, Ca^{2+}, Na^+, K^+, Mg^{2+} via IC and 23 metals via ICP-MS (Li, Al, Ti, V, Mn, Fe, Co, Cu, Zn, As, Se, Rb, Sr, Nb, Cd, Sb, Ba, La, Ce, Nd, Dy, Pb, Th). The dataset was analysed using mass closure stoichiometric calculations for sea-spray, secondary inorganic aerosol (SIA) and crustal matter and using Positive Matrix factorization model (PMF5) to investigate the seasonal trends of eight particle sources (sea-spray, nitrate, sulphate, biomass burning, crustal, crustal carbonates, traffic, and industrial). Several cases of sea-spray events were observed with an average contribution of 16% to the coarse fraction ($PM_{10-2.5}$) and 3% to $PM_{2.5}$. Larger contributions were observed in autumn and winter and in high winds periods. Sea-spray interacted with nitric acid with a consequent chloride depletion, 60% on average for both $PM_{2.5}$ and PM_{10}. The Cl^- depletion was significantly larger at high temperature during spring and summer with a trend opposite to that of secondary nitrate that was lower during spring and summer due to its thermal instability. Secondary nitrate had larger concentration in the coarse fraction at high temperature, instead at lower temperature the fine fraction of nitrate dominated. Organic matter was evaluated as OM=1.6xOC and represented 31% (PM_{10}) and 43% ($PM_{2.5}$), EC represented 2.7% (PM_{10}) and 3.1% ($PM_{2.5}$). Carbonaceous species were higher during autumn and winter with OC well correlated with K^+ supporting the relevant contribution of biomass burning found with PMF5. Secondary organic carbon, evaluated with the minimum OC/EC ratio, was entirely segregated in $PM_{2.5}$ accounting for 80% of total OC. Two crustal contributions were found, one characterised by metal oxides representing long-range transport of dust including Saharan dust advection, and the other characterised by crustal carbonates (mainly calcium carbonates) compatible with the local soil composition (limestone). Secondary sulphate was mainly ammonium sulphate/bisulphate entirely segregated in $PM_{2.5}$, however, during intense cases of Saharan dust advection, a coarse component of $CaSO_4$ was observed.

Keywords: $PM_{2.5}$, $PM_{10-2.5}$; Sea-Spray, Dust Sources, Source Apportionment

S4-O3

Polar Dust 'Hot Spot' - Iceland

P. DAGSSON-WALDHAUSEROVA[1,2,3], O. ARNALDS[2], H. OLAFSSON[1,4,5]

[1]University of Iceland; Departments of Physical and Earth Sciences; Reykjavík; Iceland; IS 101; pavla@lbhi.is

[2]Agricultural University of Iceland; Faculty of Environmental Sciences, Hvanneyri; Borgarnes; IS 311; Iceland; oa@lbhi.is

[3]Czech University of Life Sciences Prague; Faculty of Environmental Sciences; Department of Ecology; Prague; 160 00; Czech Republic

[4]Icelandic Meteorological Office; Bústaðavegi 9; Reykjavík; IS 150; Iceland; haraldur@vedur.is

[5]Bergen School of Meteorology; Geophysical Institute; University of Bergen; 5007; Norway

Emissions of particulate matter from the natural sources account for a significant part of the total particulate air pollution. Iceland is the largest European desert located at the edge of the Arctic region. Frequent strong winds make the long-term dust frequency in Iceland, based on the meteorological data from 30 weather stations in period 1949-2011, similar to the major desert areas of the world (Mongolia, Iran, USA, China). However, volcanic eruptions with the re-suspension of volcanic materials and dust haze increase the number of dust events fourfold, resulting in 135 dust days annually. The Sea Level Pressure oscillation controlled whether dust events occurred in NE or in southern part of Iceland. The Arctic dust events (NE Iceland) were typically warm and during summer/autumn (May-September) while the Sub-Arctic dust events (S Iceland) were mainly cold and during winter/spring (March-May). A total of 32 severe dust storms (visibility < 500 m) was observed. Dust deposition of 31 – 40 million tons influences areas of > 500,000 km^2, while some dust plumes are spanning > 1000 km at times. These results confirm that Icelandic dust sources are the most active in the Arctic/sub-Arctic region. Dust is also distributed over glaciers (about 4.5 million t annually) and oceans (6 – 14 million t annually). Our reflectance measurements showed that Icelandic dust deposited on snow lowers the snow albedo and reduces the snow density as much as Black Carbon, the most powerful absorbing aerosol. This indicates that climate forcing of Icelandic volcanic dust is different to that concluded for mineral dust in climate change predictions. Icelandic volcanic dust tends to act as a positive climate forcing agent, both directly and indirectly. The high frequency, severity and year-round activity of volcanic dust emissions suggest that Icelandic dust contributes to Arctic warming. The dust has a marked influence on Icelandic ecosystems. The oceanic deposition of the iron-rich dust can potentially affect the primary productivity in oceans around Iceland, especially in spring and late summer. The investigations of physical properties of volcanic dust reveal major differences in mineralogy, geochemical compositions, shapes, sizes and colour, compared to the crustal mineral dust. Icelandic dust is of volcanic origin, dark in colour with sharp-tipped shards and large bubbles. About 80 % of the particulate matter is volcanic glass rich in heavy metals, such iron and titanium. Suspended dust measured at the glacial dust source consists of extreme numbers of close-to-ultrafine particles with a similar numbers as reported during the active eruptions. However, giant Icelandic particles (50 – 100 µm), can travel long distances. Suspended grains > 2 mm were captured during the severe dust storm after the Eyjafjallajokull eruption in 2010, when the aeolian transport exceeded 11 t of materials over one meter wide transect. This places Icelandic dust storms among the most extreme wind erosion events recorded on Earth.

Keywords: Volcanic Dust, Cold Glacial Deserts, Snow-Dust Storms

S4-O4

Trends in the Saharan Air Layer Composition Observed at Izaña - Tenerife

S. RODRIGUEZ[1]

[1]Izaña Atmospheric Research Centre, AEMET, La Marina 20, planta 6, Santa Cruz de Tenerife.
srodriguezg@aemet.es

The Saharan Air Layer (SAL), i.e. the warm and dry airflow that expand from North Africa to the Americas, influences on climate. This is in part due to the desert dust aerosols regularly transported within this airflow, which scatter and absorb radiation, participates in cloud formation and influences on the ocean – atmosphere CO_2 exchange by marine fertilization. Involvement of dust on climate related processes also depends on dust composition, size distribution and mixing with pollutants. Decades of observation (1980s-2010s) of dust and aerosol chemistry at Izaña mountain observatory (Tenerife, the Canary Islands) are contributing to understand the variability of dust and aerosol composition. Of special interest is the summertime, when dust emissions and impacts on the North Atlantic are at maximum and the SAL occurs at altitudes 1-5 km above sea level (km.a.s.l.) off the North African coast. The location of Izaña, at ~2.4 km.a.s.l. off the North African coast, allows collecting samples of aerosols directly into the SAL, allowing to characterise the fresh dust particles recently exported from the Sahara. Along three decades, summer mean dust concentrations at Izaña have oscillated within the wide range of 17 - 140 µg/m^3. Satellite observations indicate that dust variability at Izaña is associated with large-scale processes. Summer-to-summer variability observed in dust concentrations is associated with latitudinal shifts of the SAL that are modulated by variability in large-scale meteorology in North Africa. Observations at Izaña also show that there is significant long-term inter-annual variability in size distributions of dust, which is connected to the intensity of the North African outflow. Dust composition also changes significantly. The ratio of some elements to aluminium in the dust samples collected within the SAL at Izaña, experiences important changes connected to the air mass origin and the spatial variability in mineralogy and composition of soil dust across the Sahara. In the SAL, dust is frequently mixed with pollutants. Industrial areas of North Africa and Europe appear as important source regions of these contaminants. Different types of (external and internal) mixing of sulphate, nitrate, ammonium and dust are observed. Studies on course find evidences of the influence of this dust-pollutants mixing on climate related aerosol properties. The Izaña record shows that some pollutants in the SAL have long term trends correlated to that of the emission rates of pollutants in some regions upwind of the Sahara. This points that international environmental policies modulate the influence of the SAL on climate related processes.

Keywords: Saharan Air Layer, Dust, Aging, Size Distribution

Session 4

S4-O5

Heterogeneous Interaction of Isopropanol with Gobi Mineral Dusts under Simulated Atmospheric Conditions

M. N. ROMANIAS[1,2], M.N. ZEINEDDINE[1,2], V. GAUDION[1,2], V. RIFFAULT[1,2], F. THEVENET[1,2]

[1] Mines Douai, SAGE, 941 rue Charles Bourseul, F-59508 Douai, France
[2] Université de Lille, F-59000 Lille, France

Dust surfaces may provide the seedbed for specific interactions with atmospheric trace gas molecules, and therefore, could play a key role in the fate of many atmospheric species. In the current study, the heterogeneous interaction of isopropanol (IPA) with natural Gobi desert mineral dusts is investigated under simulated atmospheric conditions using synthetic dry air as a bath gas. Experiments are carried out with the smallest sieved fractions of the dusts, i.e. inferior to 100 µm. N_2 sorption measurements, granulometric analyses, X-ray Fluorescence and Diffraction (XRF and XRD) measurements are preliminarily conducted to determine the morphological properties of the particles. The kinetic adsorption/desorption studies are performed using a novel experimental setup combining long path Fourier-Transform InfraRed spectroscopy and Selected-Ion Flow-Tube Mass Spectrometry for the detection of the gaseous species. The initial uptake coefficients, γ, of isopropanol are determined as a function of several environmental parameters (IPA concentration, temperature, relative humidity, mineral dust mass). Furthermore, adsorption isotherms of isopropanol are determined within an extended temperature range, results are fitted using Langmuir model to assess dust surface maximum coverage and equilibrium constants. The impact of H_2O to the adsorption isotherms was also determined in the relative humidity range of 0-50% at room temperature. Beside the kinetic study, series of experiments are conducted to investigate the degradation of isopropanol (a) under UV light conditions and (b) in presence of O_3. This is the first quantitative laboratory study reporting the heterogeneous interactions of isopropanol with natural mineral dust.

Keywords: Gobi Dust; Up-Take; Adsorption Isotherm; Volatile Organic Compound; Isopropanol

S4-O6

Assessment of Sandstorms to Develop an Accelerated Ageing Test for Solar Power Materials

F. WIESINGER[1], F. SUTTER[1], N. HANRIEDER[1], F. WOLFERTSTETTER[1], A. FERNÁNDEZ-GARCÍA[2], R. PITZ-PAAL[3]

[1]DLR German Aerospace Center, Institute of Solar Reasearch, Plataforma Solar de Almería, Ctra. Senés, km 4, P.O. Box 39, 04200 Tabernas, Almería, Spain, Florian.Wiesinger@dlr.de

[2]CIEMAT-Plataforma Solar de Almería, Ctra. Senés, km 4, P.O. Box 22, 04200 Tabernas, Almería, Spain, Afernandez@psa.es

[3]DLR German Aerospace Center, Institute of Solar Reasearch, Linder Höhe, 51147 Cologne, Germany Robert.Pitz-Paal@dlr.de

Concentrating Solar Power (CSP) systems are ad key technology for the future energy generation mix. Due to their ability to store energy thermally they are predestined to assure the uninterrupted supply with electrical energy even in times when other renewable power plants like photovoltaic or windmills do not have any significant power output. However, the long-term efficient operation of CSP plants depends heavily on the durability of the components. Especially optical materials like reflectors and absorbers of the solar radiation are prone to erosion by wind-blown particles during sand storms. At the current state of the art, there is no suited standardized test to assess the resistance of those optical materials against sand storms. The assessment of optical materials for particular plant sites is often carried out by standardized corrosion tests like the salt spray test according to ISO 9227 standard for marine environments, the ISO 11507 standard for long-term UV-radiation and cyclic condensation or the IEC 61215 standard for the simulation of thermal cycles. Though, the threat of sandstorms has not yet been dealt with within the framework of standardization testing. Since CSP plants are mostly situated in arid and semi-arid areas, erosion is a serious issue and both manufacturers and plant operators seek for methods to assess their materials. The hindering step towards the development of an accelerated laboratory test at the moment is the lack of field data about sandstorms. Preliminary testing of different groups in various laboratory setups gave rise to the most important parameters to be erosion determining. From current literature only very few of these parameters can be acquired satisfactorily. Therefore field campaigns need to be undertaken to give reliable information about wind speeds, particle concentration, particle size distribution, particle properties (hardness, roundness) at altitudes from one to five meters above the ground. By now the DLR has collected two years of data for total suspended particle concentration and wind velocity in Missour (Morocco). Furthermore the erosion damage caused by particle impact was analysed on exposed mirror samples in Missour and several other sites. Especially in Zagora (Morocco) the erosion effects on these mirror samples were significantly pronounced compared to samples from other sites. It is concluded, that in this area sandstorms are quite common. Therefore it was decided to achieve a more detailed view on the ongoing aeolian particle movement in Zagora by exposing a high volume air sampler in the course of 2016. Furthermore soil samples of different areas were analysed by sieving and microscopy and the results are presented in this work.

Session 4

Keywords: CSP technology, Solar Mirror, Sand Erosion, Accelerated Ageing, Standard Test Method

S4-O7

Biodiversity and Chemical Speciation of Long Range Transported Desert Dust Particles

C. PETROSELLI[1], E. MONTALBANI[1], S. CASTELLINI[1], C. CASAGRANDE[1], E. CECI[1] , S. CROCCHIANTI[1], E. FEDERICI[1], A. FRANZETTI[3], B. MORONI[1,2], B. SEBASTIANI[1], R. SELVAGGI[1] and D. CAPPELLETTI[1,2]

[1]Dipartimento di Chimica, Biologia e Biotecnologie, Università degli Studi di Perugia; via Elce di Sotto 8, 06123 Perugia, Italy; david.cappelletti@unipg.it

[2]centro di eccellenza SMAArt, Università di Perugia

[3]Dipartimento di Scienze Ambiente e Territorio e Scienze della Terra, University of Milano-Bicocca, Milan; andrea.franzetti@googlemail.com

Desert dust storm can transport over great distances in the atmosphere the uplifted particles. These include microorganisms that may survive to the long-range transport. African desert air masses can further mix with polluted air from the anthropized African coastal cities, cross the eastern Mediterranean and inject a large pulse of particles and bacteria into the European air, expanding the biogeographical range of the biota and elevate substantially the local particulate matter concentration. Herein, we studied the bacterial diversity and physico-chemical characteristics of aerosol from a series of Saharan dust transport events registered in central Mediterranean basin at the Monte Martano sampling site (MM), a rural background site in central Italy setup at 1100 m. asl in the 2009 (Moroni et al., 2015 *Atmos. Res.* **155**, 26-36). The site, particularly suited for monitoring long-range transport of pollutants, participates to the observation net of the SDS (Sand and Dust Storm) warning alarm system of the WMO. Aerosol samples have been collected with a high volume PM10 sampler (TISCH) on quartz filters. A routine protocol has been followed to sterilize and handling the filters. Samplings lasted in average 12 h during the dust events. Typically, filters have been collected also before and after the events to characterize the background values. More than ten different and clear desert dust intrusion episodes have been clearly individuated in the 2014-2015 period with the help of back trajectories analysis and complementary OPC measurements carried out continuously at the MM site. The present study has been complemented with a similar number of non Saharian or local aerosol samples in order to enlight differences and trends. Aerosol bacterial communities have been investigated both with a molecular approach, using Illumina next generation sequencing (NGS) of amplified 16S rRNA gene fragments, and also by a cultivation approach followed by counting, screening and metabolic activity tests. Chemical characterizations included PAH and alkanes (GC-MS), metals (ICP-AES), principal inorganic ions (IC) and EC/OC (thermo optical analyser). Main results of the present study, to be discussed at the meeting, are *(i)* a quantification of the airborne bacteria abundance during the Saharan advections (which has been found in same cases comparable with urban aerosol) *(ii)* the demonstration of the high biodiversity of the bacterial communities associated with desert dust, *(iii)* the large variability of bacterial communities for dust events along the year, *(iv)* the individuation of common core microbiota, *(v)* the individuation of possible relationships with aerosol chemistry and *(vi)* the individuation of culturally and metabolically active (potentially) pathogens. This last aspect has a particular relevance when considering the impact on human health of Saharan dust intrusions.

Keywords: Saharan Dust, Biodiversity, Long Range Transport, Health Impacts

Session 4

S4-O8

Aerosol Characterization at Columnar and Surface Levels Based on a Long-term Desert Dust Inventory in North-central Iberian Peninsula

M.A. BURGOS[1], V.E. CACHORRO[1], D. MATEOS[1], C. TOLEDANO[1], A.M. de FRUTOS[1]

[1]Grupo de Óptica Atmosférica, Facultad de Ciencias, Universidad de Valladolid, Paseo Belén 7, CP 47011, Valladolid, Spain

The aim of this study is to perform a detailed analysis of aerosol optical and microphysical properties during desert dust (DD) episodes identified in the North-central long plateau of the Iberian Peninsula for a long-term period (2003-2014). This study is based on a long-term DD inventory obtained by the joint interpretation of Aerosol Optical Depth (AOD), surface mass concentrations of different sizes (PM_{10} and $PM_{2.5}$), Ångström exponent (AE), PM ratio ($PM_{2.5}/PM_{10}$) and other ancillary information (air mass trajectories, model forecast, and meteorological products, among others), which allows a classification of the DD episodes in two different categories (purer and mixed). Aerosol columnar properties such as aerosol optical depth, Ångström exponent, volume size particle distribution, effective radius for the fine and coarse modes, volume concentrations for total, fine and coarse modes (VC_T, VC_F, and VC_C, respectively), single scattering albedo and asymmetry factor are analyzed. Some of these properties are also investigated as a function of surface PM_{10} and $PM_{2.5}$ quantities. The mean intensity of the DD episodes exhibits an AOD of 0.28 (at 440 nm) and a PM_{10} of 24 µg m^{-3}, being the strongest events beyond 0.6 and 40 µg m^{-3}, respectively. Overall, there is a correlation between DD fingerprints at the surface and the entire atmospheric column. However, further research should be performed about how well surface and columnar properties are correlated. Annual cycles describe the behavior of DD outbreaks, with maximum intensity values in March and summer months and minima in May and winter months. Three well established zones of DD events are determined in the analysis of the VC_F/VC_T ratio. Coarse-mode-dominated cases ($VC_F/VC_T \leq 0.2$) present a clear mineral dust character, with similar aerosol properties to nearby Saharan sites: e.g., maximum concentration of particles around 2 µm, non-sphericity, stronger absorption power at shorter wavelengths, among others. The relevance of the fine mode is also noticeable in mixtures with a predominance of particles around 0.2-0.3 µm. Those conditions showing $0.2 < VC_F/VC_T < 0.45$ and $VC_F/VC_T \geq 0.45$ present a larger variability in all studied aerosol properties because of the mixture of aerosols over the study area. The total volume concentration during DD events correlates very well for $V_F/V_T < 0.2$ with PM_{10} and AOD. All the reported aerosol properties at the surface and columnar levels highlight that both measurement techniques are complementary and required for a reliable characterization of DD episodes.

Keywords: Desert Dust, Aerosol Optical Depth, Particulate Matter, Volume Particle Concentration

SESSION 5

MODELING AND PREDICTION

S5 PLENARY SESSION

Microorganisms Transported Long-range in the Free Atmosphere over North-East Asia: Mixing State of Dust Particles

Y. IWASAKA[1], T. MAKI[2], F. KOBAYASHI[3], M. KAKIKAWA[4], A. MATSUKI[5]

[1]The University of Shiga Prefecture; Hikone 522-8533 Japan; iwasaka@mti.biglobe.ne.jp
[2]College of Science and Technology, Kanazawa University; Kakuma, Kanazawa 920-1192 Japan; makiteru@se.kanazawa-u.ac.jp
[3]College of Science and Technology, Kanazawa University; Kakuma, Kanazawa 920-1192 Japan; fumihisa@t.kanazawa-u.ac.jp
[4]College of Science and Technology, Kanazawa University; Kakuma, Kanazawa 920-1192 Japan; kakikawa@ec.t.kanazawa-u.ac.jp
[5]College of Science and Technology, Kanazawa University; Kakuma, Kanazawa 920-1192 Japan; matsuki@se.kanazawa-u.ac.jp

Kosa particles (Dusty sky and/or Dust particles transported from Asian continent are called Kosa in Japan) are frequently transported long range from desert areas in Asian continent, and Taklamakan desert has large potential to produce the background Kosa, which are found in the free atmosphere in every seasons, due to his effective geographical conditions and structures to rift up the dusty air masses in the free troposphere. Westerly easily transports those air masses containinh lots of particles from the Asian continent to Korea peninsula, Japan islands, and the Pacific ocean, sometimes to Hawaii islands and the American continent. The mixing ratio of dust particle-microorganism mixture is about 10-20% of dust particles (number concentration base) on the basis of field measurements made at Taklamakan desert suggesting strongly that the atmospheric microorganisms effect on climate and environment in regional and/or global through long-range transportation of dust-microorganisms mixture. The analysis of bacteria community found in the particulate matter diffusing long-range strongly suggested that bacteria of *bacillus* group frequently dominates and possibly effects on atmospheric processes such as cloud formation and snow/rain fall. We made direct sampling of atmospheric bacterial material at Suzu of Noto peninsula in Japan with tethered-balloon. This observational site is facing the Japan sea and contamination from the local sources is considered to be in very low levels. According to the analysis of the community of bacteria collected at 3000m, 1000m, and 10m heights, the phylotypes belonging to the class *Bacilli* accounted for high relative abundances ranging from 28.6% to 49.9% and were, concerning with air mass at 3000m which is considered to be transported from the desert area of Asian continent with few severe distarbances, mainly composed of members of the families *Bacillaceae* and *Stapylococcaceae*. The ratio of number concentration of bacterial cells and mineral dust particles, according to measurements made at Kanazawa during Kosa events, is about 1.5- 3.0 and the cell number concentration is apparently larger than dust particle concentration. Considering that the ratio of dust-microorganism mixture to dust particle number concentration, this observation strongly suggests that each Kosa-microorganism mixture contain lots of cells and sometimes cells belonging to various kind of phylotypes. Mixing ratio of microbial aggregates were suggested to be about 30% of the particles (larger than 5μm) from analysis of snow layer on Mt Tateyama and *Bacillus subtilis* group were frequently found in snow layer suggesting Kosa particle effects. Detail analysis of Kosa-microorganism mixture is desired to clarify the effects of Kosa on environment and climate.

Keywords: Kosa (Asian Dust) Particle, Dust-Microorganism Mixture, Long-Range Transport

S5-O1

Mineral dust aerosol distributions, its direct and semi-direct effects over South Africa based on regional climate model simulation

M. TESFAYE[1], G. MENGISTU TSIDU[2], J. BOTAI[1], V. SIVAKUMAR[3], C.J. DEW. RAUTENBACH[1]

[1]South African Weather Service, Pretoria, South Africa; mela20062@gmail.com
[2]Department of Earth and Environmental Sciences, Botswana International University of Technology and Science, Botswana
[3]Discipline of Physics, School of Chemistry and Physics, University of KwaZulu Natal, Westville, Durban 4000, South Africa

The present contribution investigates the seasonal mean mass distributions, direct and semi-direct climatic effects of desert dust aerosols over South Africa, using the 12 year runs of Regional Climate Model (RegCM4). The essential steps and mechanisms which are considered in developing the desert dust production scheme and its implementation into RegCM are described in detail by Zakey et al. (2006). Size dependent dust Short-Wave (SW) optical properties used in RegCM radiation scheme and a sensitivity study performed on dust single scattering albedo values are given in Solmon et al. (2008). The dust Long-Wave (LW) emissivity and absorptivity which are calculated using prognostic dust bin concentrations are discussed in Solmon et al. (2008). The results of the present study have shown that the desert dust particles which burden the western and southern regions of South Africa are predominantly produced from the Kalahari and Namib Desert areas. At the surface and within the atmosphere, the SW and LW radiative forcing (RF) of dust showed contrasting effects. However, due to the dominant influence of dust SW-RF, the Net-RF of dust causes a reduction on the net radiation absorbed by the surface via enhancing radiative heating in the atmosphere. In addition, the desert dust aerosols in South Africa reduce the net radiative flux at the top of the atmosphere (up to -8 W/m^2). The radiative feedbacks of desert dust particles mainly result in a positive response on net atmospheric radiative heating rate, Cloud Cover (CC) and cloud liquid water path. The CC enhancement and net surface RF of dust, cooperatively, induce reduction in surface temperature (up to -1.1 K) and surface sensible heat flux (up to -24 W/m^2). The presence of desert dust aerosol also causes boundary layer height reduction, surface pressure enhancement and dynamical changes. Overall, the present contribution (i.e., Tesfaye et al., 2015), underscores the importance of including the effects of wind-eroded dust particles in climate change studies over South Africa.

Keywords: Desert Dust, RegCM4, Dust Direct Climate Effects, Dust Semi-Direct Climate Effects, South Africa

References

Solmon, F., et al., 2008. Dust aerosol impact on regional precipitation over western Africa, mechanisms and sensitivity to absorption properties. Geophys. Res. Lett. 35 (L24705) http://dx.doi.org/10.1029/2008GL035900.
Tesfaye, M., et al., 2015. Mineral dust aerosol distributions, its direct and semi-direct effects over South Africa based on regional climate model simulation. J. Arid Environ. 114: 22–40, doi: 10.1016/j.jaridenv.2014.11.002.
Zakey, A.S., et al., 2006. Implementation and testing of a desert dust module in a regional climate model. Atmos. Chem. Phys. 6, 4687e4704. http://dx.doi.org/10.5194/acp-6-4687-2006.

S5-O2

A Process-oriented Evaluation of Dust Emission Schemes in CESM: Simulation of a Typical Severe Dust Storm over East Asia

Z. LIN[1], C. WU[1], J. HE[1], M. ZHANG[2]

[1]Institute of Atmospheric Physics, Chinese Academy of Sciences; 40# Hua Yan Li, Qi Jia Huo Zi, Chao Yang District, P. O. Box 9804, Beijing 100029, China; lzh@mail.iap.ac.cn.cn, wuchenglai@mail.iap.ac.cn, hejx@mail.iap.ac.cn

[2]School of Marine and Atmospheric Sciences, Stony Brook University, State University of New York; Stony Brook, New York 11794-5000, USA; minghua.zhang@stonybrook.edu

Dust cycle is an important component of the earth system and has been explicitly represented in the current earth system models (ESMs). However, there are still large uncertainties in the models' representation of dust emission processes. Therefore it is desirable to identify the model bias and thus improve it. Dust emission parameterizations in ESMs are generally evaluated by long-term (one-year or multi-year) simulations of the model in which biases in dust aerosol cannot be easily attributed to the meteorological states or the parameterizations themselves. This study presents a complementary process-oriented evaluation of dust emission parameterizations in the Community Earth System Model (CESM) by applying the model to simulate an observed severe dust storm during 19–22 March 2010 over East Asia. The different parameterizations accounting for the effect of land-surface characteristics are assessed through sensitive experiments with different roughness correction factor (f_λ) and source erodibility index (S). The simulation results are compared with each other and evaluated with dust events (i.e., Dust in Suspension, Blowing Dust, Dust Storm, and Severe Dust Storm) recorded by about 1000 surface synoptic stations over East Asia, including more than 800 stations in China. The simulated results are also quantitatively evaluated with PM10 observations at six stations and visibility-derived TSP concentration at three stations near the source regions in South Mongolia and northern China. We show that generally this model can capture the main dust emission regions and the evolution of main dust plumes in Mongolia and northern China, even without considering the constraint of roughness elements (i.e., f_λ set to 1). With the constraint of f_λ taken into account, dust emission scheme effectively alleviates or eliminates the overestimation of dust emission over the vegetated area and consequently the model mostly captures better the magnitude of surface dust concentrations at its nearby and downwind stations. Besides, time variation of dust concentration is also closer to the observation at most stations. The incorporation of a geomorphic S (S_g) tends to concentrate the dust emission over the low-lying basins including terrain depressions and river-valleys, thereby producing hot spots of dust distribution which are much stronger than observation. It also shifts some dust emission regions and thus could not capture the evolution of surface dust concentration at stations of Dalanzadgad and Wulatezhongqi, and these biases could be ascribed to the deficiencies of S_g in representing the potential ability of land surface for wind erosion. Overall the inclusion of f_λ on the threshold friction velocity could satisfactorily provide realistic representation of the effect of land surface characteristics for the severe dust storm.

Keywords: Earth System Model, Dust Emission Parameterizations, Severe Dust Storm, Land Surface Characteristics, Source Erodibility

S5-O3

Analysis of mineral dust over Portugal using different modelling approaches

A.P. FERNANDES[1], J. FERREIRA[2], C. BORREGO[3], O. TCHEPEL[4].

[1]CESAM & Department of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal, apsfernandes@ua.pt

[2]CESAM & Department of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal, jferreira@ua.pt

[3]CESAM & Department of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal, cborrego@ua.pt@ua.pt

[4]CITTA, Department of Civil Engineering, University of Coimbra, 3030 - 788 Coimbra, Portugal, oxana@uc.pt

Over the last decade, air pollution has become a major problem in Portugal. The high concentrations of particulate matter (PM), exceeding the daily limit values, is one of the main concerns for air pollution management. The concentrations of aerosols vary strongly in space and time because the residence time of particles in the atmosphere is only in the range of hours to weeks, depending mainly on the particle size and meteorological conditions. An abundant type of natural atmospheric aerosol is related with the suspension and long–range transport of mineral dust from North Africa deserts. Over Portugal, the mineral dust average concentrations are significantly higher during the spring months. The main objective of this work is to assess the contribution of mineral dust over Portugal using the Comprehensive Air Quality Model (CAMx) under two different approaches to process mineral dust data. The first approach uses the mineral dust outputs of NMMB/BSC-Dust model (http://www.bsc.es/earth-sciences/mineral-dust/catalogo-datos-dust) and a CAMx simulation to compute AOD based on total particulate sulphate (PSO4), total primary and secondary organic aerosols (POA + SOA), and total primary elemental carbon (PEC) . In the second approach, the AOD is calculated based on a CAMx with initial and boundary conditions for Europe provided by the Model for OZone and Related chemical Tracers (MOZART). For this approach the obtained results were grouped by size bin into PSO4, POA + SOA, PEC and the primary inert material per four size bins (0.1µm-1µm; 1µm-2.5µm; 2.5µm-5µm; 5µm-10µm) for the AOD quantification. The AOD was calculated by the integration of aerosol extinction coefficient (Qext) over the vertical column from the surface level to the top of the modelling domain. Results of both approaches were compared with the measured aerosol data provided by four AERONET stations (Cabo da Roca, Évora, Huelva and Caceres). The results from both approaches were analysed for May 2011 in terms of temporal and spatial variations over Portugal, focusing on aerosol optical depth (AOD) at 550 nm. It was concluded that the highest concentrations and AOD are obtained in the south of Portugal as result of the long-range transport of mineral dust from the north of Africa. The comparison between measured and modelled data returned a correlation coefficient of 0.71 for the first approach and 0.28 for the second one. Other statistical parameters were analysed confirming the better performance of the CAMx+NNMB/BSC-Dust modelling approach.

Keywords: Aerosol Optical Depth, Mineral Dust, Chemical Transport Model, AERONET.

S5-O4

Impact of Trans-Eurasian Dust Aerosol Transport on East Asian Atmosphere

T.L. ZHAO[1], J.H. LIU[1], Y. LIU[2], Y.X. HAN[1], J. XIONG[3]

[1] CAM Key Lab of Aerosol-Cloud-Precipitation, Nanjing University Information Science & Technology, Nanjing 210044 China, tlzhao@nuist.edu.cn (TLZ), liujianhui219@126.com (JHL), han-yx66@126.com (YXH)

[2] Institute of Atmospheric Composition, Chinese Academy of Meteorological Science, Beijing 100081 China, liuyu@camscma.cn

[3] Hubei Provincial Weather Bureau, Wuhan, Hubei, 430074 China, xiongjie8707@sina.com

Based on the evaluation of global soil dust aerosols simulated by global climate model CAM3.0 during 2 years (2002-2003), a sensitivity experiment with removing East Asian deserts was conducted to explore the contribution of dust aerosol emission sources over African, Arabian and central Asian deserts to the atmospheric environment in East Asian region through Trans-Eurasian dust aerosol transport. Under the impact of Trans-Eurasian transport on East Asian atmosphere, the foreign dust emission sources contribute the dust aerosol to the Tibetan Plateau with the largest rate, to the arid and semi-arid regions in northern China with the lowest rate, and to Sothern China and Korean Peninsula, Japan and the adjacent northwest Pacific region with the moderate rate. The contribution rates of foreign dust aerosols presented seasonal variations in the East Asian region; Autumn and winter are respectively the season with the weakest and strongest influences of the foreign dust aerosols on East Asia with the contribution rates of about 5% in autumn and of about 30% in winter over northern China as well as the contribution rates of 20-60% in autumn and of 60-80% in winter over the Tibetan Plateau. The seasonal patterns of the foreign dust contribution to tropospheric loading and surface concentrations are generally similar, but the contribution rate to dust loading is 10-40% higher. The influences of foreign dust aerosol controlled by the trans-Eurasian dust aerosol transport are vertically concentrated at 2-6km in the free troposphere with larger contribution rate at higher elevation. Annually, the Tibetan Plateau with the regional averages of 62-81% contribution rate of foreign dust aerosol to the tropospheric atmosphere is regarded as the highest impact region in East Asia.

Keywords: Dust Aerosol, East Asia, Modelling, Trans-Eurasian Transport

S5-O5

Assessing the size distribution of dust emissions in the NMMB/BSC-Dust model

C. GAMA[1], S. BASART[2], J.M. BALDASANO[2], C. PIO[1], C. BORREGO[1], O. TCHEPEL[3]

[1]CESAM & Department of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal;
carlagama@ua.pt; casimiro@ua.pt; cborrego@ua.pt

[2]Earth Sciences Department, Barcelona Supercomputing Center, 08034 Barcelona, Spain;
sara.basart@bsc.es; jose.baldasano@bsc.es

[3]CITTA & Department of Civil Engineering, University of Coimbra, 3030-788 Coimbra, Portugal;
oxana@uc.pt

The size distribution of mineral dust aerosols is one of the key modeling factors in order to correctly assess the atmospheric life cycle of the eroded desert dust and its impacts across the globe. This work aims to evaluate the originally implemented size distribution of dust emissions in the NMMB/BSC-Dust model, and to implement and test a new emission scheme, derived from Kok's brittle fragmentation theory. The new methodology to redistribute the total vertical dust flux by the 8 size bins of the model is developed without changing the computation of the total dust emissions. Two high resolution simulations were performed for the year 2011, the first with the originally implemented size distribution scheme (REF) and the second with the newly implemented one (KOK). Results are evaluated against surface concentrations measured in Praia, Cape Verde, in the scope of the CV-DUST Project, and against AERONET direct-sun observations. Kok's size distribution function leads to lower emissions in the fine bins of the model and higher emissions in the coarser ones. As expected, this has an impact in the modeled downwind concentrations and optical parameters. In Cape Verde, the results obtained with KOK show lower dust concentrations than with REF. In addition, KOK shows mass dominance of particles with equivalent aerodynamic diameter between 3 and 5 µm, which is in better agreement with observations. Comparison between simulations and AERONET observations shows that, for most of the sites, AOD fine fraction is in better agreement with observations using KOK. Nevertheless, KOK underestimates total AOD. This work allowed the development of a new dust size distribution scheme of emissions and provides a preliminary assessment of the results. Further evaluation will be done, addressing as well the impact of the new size distribution scheme on the dust deposition.

Keywords: Dust Particle Size, Modeling, NMMB/BSC-Dust, Cape Verde, AERONET

S5-O6

WMO SDS-WAS: towards continuous evaluation of dust models in Northern Africa

S. BASART[1], G. GARCÍA-CASTRILLO[2], E. CUEVAS[3], AND E. TERRADELLAS[2]

[1]Earth Sciences Department, Barcelona Supercomputing Center, Barcelona, Catalonia, 08034, Spain
[2]State Meteorological Agency of Spain, AEMET, Barcelona, Spain
[3]Izaña Research Atmospheric Center-State Meteorological Agency of Spain, CIAI-AEMET, Barcelona, Spain

One of the most important activities of the Regional Center for Northern Africa, Middle East and Europe of the World Meteorological Organization's Sand and Dust Storm Warning Advisory and Assessment System (WMO SDS-WAS, http://sds-was.aemet.es) is the dust model intercomparison and forecast evaluation, which is deemed an indispensable service to the users and an invaluable tool to assess model skills. Currently, the Regional Center collects daily dust forecasts from models run by nine partners (BSC, ECMWF, NASA, NCEP, SEEVCCC, EMA, CNR-ISAC, NOA and UK Met Office). A multi-model ensemble has also been set up in an effort to provide added-value products to the users. The first problem to address the dust model evaluation is the scarcity of suitable routine observations near the Sahara, the world's largest source of mineral dust. The present contribution presents preliminary results of dust model evaluation using new observational datasets over Nothern Africa. The current routine evaluation of dust predictions is focused on total-column dust optical depth (DOD) and uses remote-sensing retrievals from sun-photometric (AERONET) and satellite (MODIS) measurements. However, most users of dust forecasts are interested in the concentration near the surface (in the air we breathe) rather than in the total column content. Therefore, evaluation of the predicted surface concentration is also necessary. In this context, the initiative of the African Monsoon Interdisciplinary Analysis (AMMA) International Program to establish permanent measuring stations in the Sahel is extremely important. Data from Tapered Element Oscillating Microbalance (TEOM) monitors that continuously record PM10 in M'Bour (Senegal); Cinzana (Mali) and Banizoumbou (Niger) were first used to evaluate the predicted surface concentration in the Sahel. Then, the evaluation has been extended to the Canary Islands, Spain, with the use of PM10 observation from the Air Quality Control and Monitoring Network (AQCMN). The Canary Islands are located in the sub-tropical Eastern Atlantic (roughly 100 km west of the Moroccan coast), in a region that is frequently affected by intrusions of Saharan dust. Additionally, since the data sets of weather records have an excellent spatial and temporal coverage, observations of horizontal visibility included in meteorological reports are used as an alternative way to monitor dust events in near-real-time (NRT) and to qualitatively evaluate the dust forecasts. Recently, a visibility product that includes data released by more than 1,500 stations has been implemented and is daily available on the Regional Center website. Moreover, the Regional Center started working in the evaluation of vertical profiles. The free troposphere contribution to aerosol optical depth (AOD) and the altitude of lofted layers are provided thanks to the vertical profiling capability of the lidar/ceilomenter technique. Currently, a lidar located in Dakar (Senegal) and a ceilometer in Santa Cruz de Tenerife (Canary Islands, Spain) provide near-real-time (NRT) vertical profiles of aerosols, which are compared with those simulated by models.

Keywords: Mineral Dust, Dust Modelling, Evaluation, Northern Africa

SESSION 6

SOURCE DEFINITION AND PROPERTIES OF DUST

S6-O1

Ionic and Mass Balance of Cape Verde Atmospheric Aerosol during CVDUST

C.A. PIO[1], J.G. CARDOSO[1,2], S. M. ALMEIDA[3], P. SALVADOR[4], T.V. NUNES[1], M. CERQUEIRA1, C.A. ALVES1, M.A REIS, M. ALMEIDA-SILVA3, P.C CHAVES[3], B. ARTINANO[4]

[1]CESAM & Dep Environ, Aveiro University; 3810-193 Aveiro, Portugal; casimiro@ua.pt
[2]Cape Verde University; Campus do Palmarejo, Praia, Cape Verde; cardoso31@hotmail.com
[3]C[2]TN, Inst Super Téc, Lisbon University, 2686-953 Sacavém, Portugal; smarta@ctn.ist.utl.pt
[4]Environ Dep, CIEMAT; Av Complutense 40, 28040 Madrid, Spain; pedro.salvador@ciemat.es

Under the research project CVDUST, atmospheric aerosol was collected, as PM10, during one year, at Santiago Island, Cape Verde, located 600 km off-coast of West Africa in the north-east tropical Atlantic Ocean, a region under the effect of dust transport emitted by the Sahara desert. Approximately 150 aerosol events were sampled and analysed for carbon, elements and water soluble ions. Ten events were sampled with impactors, permitting the size differentiated distribution of composition. During winter, Cape Verde was heavily affected by Sahara dust transport with PM10 concentration peaking at more than 500 $\mu g.m^{-3}$. The high input of soil dust affected the concentrations of all elements and ions, even those usually only associated with sea spray emission such as Na^+ and Cl^-. The major sources and formation processes of the collected aerosol were determined by a material and ionic compound balance, based in commonly accepted reaction processes and source compositions. Because of the unusual high contamination with dust, balances for non-dust sources had to take into account contaminations by elements and ions originated from dust, employing auxiliary information such as line edges in graphics relating compounds with elements exclusively from dust such as Al, Si and Fe, and common ratios for groups of elements in Sahara dust and soil, obtained from previous studies. The size distribution patterns of measured compounds in samples collected with the impactors were also used to help in the interpretation of the relative importance of competing formation processes and sources. With these methodologies a source and process formation distribution could be obtained for the various seasons of the sampled year, which compares relatively well with other source apportionment methodologies, such as Positive Matrix Factorization, PMF, study already published in Atmospheric Environment, vol 127, pages 326-39 (2016).

Keywords: Ionic Balance; Mass Balance; Source Apportionment; African Dust; Cape Verde

S6-O2

Remote sensing of desert dust physico-chemical properties within Aerosol_cci

L. KLÜSER [1], C. BERGEMANN[1], T. POPP[1]

[1]German Aerospace Center (DLR), Münchener Straße 20, 82334 Wessling, Germany, lars.klueser@dlr.de

Within the Aerosol_cci project of the European Space Agency (ESA) measurements of the Infrared Atmospheric Sounding Interferometer (IASI) operated on board of the Metop satellite series are used for observations of desert dust. Being a hyperspectral infrared spectrometer, IASI offers a huge amount of information about the atmospheric state as well as about the observed dust. With the IMARS (Infrared Mineral Aerosol Retrieval Scheme) method it is possible to not only retrieve dust AOD, but also physico-chemical properties of the dust from the observed spectra. These properties include information about particle size as well as mineralogical composition of the dust. From the thus acquired characterization the derivation of dust AOD (Aerosol Optical Depth) at visible wavelengths but also of dust mass column is possible. Coupling the retrieved information with model output from Numerical Weather Prediction furthermore allows for obtaining information about dust layer height. Examples of derived dust properties will be shown and how they can be used for increasing our understanding of atmospheric processes related to desert dust.

Keywords: Mineral dust, IASI, Metop, Climate Change Initiative, Dust Properties

S6-O3

Red-Ox speciation and Coordination of Iron in Saharan Dust

C. PETROSELLI[1], B. MORONI[2], F. D'ACAPITO[3], D. CAPPELLETTI[4]

[1]Dipartimento di Chimica, Biologia e Biotecnologie, Università degli Studi di Perugia; via Elce di Sotto 8, 06123 Perugia, Italy; petrosellichiara@gmail.com

[2] SMAArt centre, Dipartimento di Chimica, Biologia e Biotecnologie, Università degli Studi di Perugia; via Elce di Sotto 8, 06123 Perugia, Italy; b.moroni@tiscali.it

[3]CNR-IOM-OGG c/o ESRF LISA CRG; 71 Av. Des Martyrs, F-38043 Grenoble, France; dacapito@esrf.fr

[4]Dipartimento di Chimica, Biologia e Biotecnologie, Università degli Studi di Perugia; via Elce di Sotto 8, 06123 Perugia, Italy; david.cappelletti@unipg.it

Atmospheric aerosol can affect climate and human health thanks to its physico-chemical properties such as mass concentration, size distribution and chemical composition. The interaction with biota is ruled mainly by particles' solubility but this parameter can change during the permanence in atmosphere due to several photochemical and ageing processes. Iron, in particular, is a micronutrient for phytoplankton in oceans but it can also affect human health through ROS (Reactive Oxygen Species) production when it interacts with lung biological fluids. The most suitable technique for the determination of the valence state of heavy metals such as iron is XAS (X-ray Absorption Spectroscopy). In this study we analysed the chemical state of Fe in aerosol samples with X-ray Absorption Spectroscopy (XAS) at the LISA beamline of the European Synchrotron Radiation Facility (ESRF) of Grenoble, France. This technique has recently been applied to aerosol samples but, as regards Saharan dust, only samples collected in Africa near to the source regions have been analysed and no information are currently available on long range transported dust. Several aerosol filter samples have been analysed in order to determine the valence state and the local order of Fe comparing Saharan dust with other types of aerosol of different origin. Leaching tests and diffraction (XRD) analysis have also been performed on all the samples analysed in this study. The rural regional background site of Monte Martano is particularly suitable for the characterization of long range transport events such as Saharan dust outbreaks, and since 2013 it has joined the WMO-SDS WAS (World Meteorological Organization-Sand and Dust Storms Warning Advisory and Assessment System) international network. The Saharan dust outbreak that reached Central Italy between November 30th and December 1st 2014 has been chosen as a case study because it has been a really intense and sharp event. During these days, PM_{10} reached values eight times the mean annual value for the site, and these values allowed us to consider the aerosol sampled during the event as pure long range transported Saharan dust. XAS data analysis evidenced for all the samples (Saharan dust and non Saharan aerosol) the presence of Fe^{+3} and the spectrum shape suggested that Fe was mainly present as an (oxy-hydr)oxide. Both the Fe-O bond distance and the coordination number are lower for non Saharan samples suggesting a higher coordination (octahedral) for Saharan dust and lesser oxidized compounds (penta-coordinated, tetrahedral Fe^{+3}) for other samples. In conclusion, Saharan dust showed peculiar XAS features that differentiate it from local aerosol. The results of the present work can be used as a fingerprint of Saharan dust from the red-ox and local order point of view.

Keywords: Saharan dust, Fe speciation, XANES, EXAFS, synchrotron radiation

Session 6

S6-O4

Building a time series of Saharan dust chemical composition on the West African margin

A. BORY[1], C. SKONIECZNY[1], Q. LOUIS[1], D. PONLEVE[1], V. BOUT-ROUMAZEILLES[1], S. PHILIPPE[1], A. DIALLO[2], T. NDIAYE[2]

[1] Université de Lille, CNRS, Université du Littoral Cote d'Opale, UMR 8187 LOG, Laboratoire d'Océanologie et de Géosciences, F-59000 Lille, France; aloys.bory@univ-lille1.fr

[2] IRD, US191 IMAGO, Dakar, Senegal

The Sahara-Sahel region is by far the largest mineral dust source in the world, sending as much as 800Tg of crustal material in the atmosphere every year. This vast arid and semi-arid area stretches over a ~4000km x ~2000km area at present from the Atlantic to the red sea and encompasses numerous dust emission "hot spots" spread over diverse geological settings. As a result, our knowledge of the Saharan dust composition variability is incomplete. Improving our understanding of the Saharan dust composition variability is essential to assess the dust influence on the ocean biogeochemistry, to enhance qualitative and quantitative information retrieved by remote sensing (as mineralogical and elemental composition of the dust affects its absorption and diffusion properties), to track the dispersion of Saharan dust in the atmosphere and thus further its impact at the scale of the Northern Hemisphere, and to reconstruct past changes in the dust cycle (variations in the contributing sources for instance) as recorded in environmental archives such as marine sediments and polar ice sheets. This was the main rationale for launching a continuous sampling of dust deposition on the Senegalese margin (at Mbour, ~80 km south of Dakar) 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. Dust deposits have been collected for nearly a decade at a weekly (or better) resolution. Pilot investigations, carried out on the <30µm calcium carbonate-free fraction, reveal a marked seasonal variability in the dust elemental composition (measured by ICP-OES and ICP-MS). Ca/Al and Ti/Al ratios, for example, are higher during the dry winter-spring season, which is when most of the dust is deposited at our site, while K/Al and Na/Al, among other ratios, increase during the wet summer monsoon season. This variability reveals changes in dust provenance linked to the seasonal migration of the ITCZ and associated shift in wind patterns over West Africa. The observed geochemical variations likely reflect, to a large extent, the higher degree of chemical alteration of the Sahel source terrains (activated only during the winter, when the ITCZ lies at lower latitudes) compared to the northern Saharan dust sources. This is supported by earlier investigations based on clay mineralogy measurements [Skonieczny et al., EPSL 364, 2013]. Part of the observed chemical variability, however, reflects the contrasting original lithology of the various contributing sources: dust derived from the Atlantic coastal region of the Western Sahara, for instance, is enriched in phosphorus. The extent to which data obtained so far (including trace elements concentrations and a few Sr-Nd isotopic ratios) enables us to typify the mineralogical and geochemical signatures of the other major dust source regions "feeding" the tropical Atlantic will be discussed.

Keywords: Saharan dust, West African margin, major and trace elements, clay mineralogy, source

Session 6

S6-O5

Saharan Dust Measurements in Évora, Portugal, Using Lidar Techniques

S.N. Pereira[1], D. Bortoli[1], P. S. Kulkarni[1], M. Potes[1], M.J. Costa[2], A. M. Silva[1]

[1]Instituto de Ciências da Terra - Polo de Évora, Departamento de Física, Instituto de Investigação e Formação Avançada, Universidade de Évora, Évora, Portugal

[2]Instituto de Ciências da Terra - Polo de Évora, Departamento de Física, Escola de Ciências e Tecnologia, Universidade de Évora, Évora, Portugal

The presence of mineral dust aerosols transported to Portugal is regularly detected at the Atmospheric Physics observatory of the Institute of Earth Sciences (ICT) in Évora. Here, active and passive remote-sensing, as well as in-situ techniques and modeling, are used in the research of aerosol optical properties, including the characterization of dust aerosols. This work is focused in the active remote-sensing approach, which has the advantage of providing height-resolved information on the aerosol optical properties. To do so, a Raman lidar, PAOLI (Portable Aerosol and Cloud Lidar), is installed at the ICT facilities, at Évora, Portugal; this system, providing unique measurements in Portugal, is also part of the European lidar network (EARLINET). It displays three elastic channels in the UV-VIS-IR range (355 nm, 532 nm and 1064 nm), two inelastic (Raman) channels (387 nm, 607 nm) and a further polarization channel which detects the cross polarized component at 532 nm. The basic products retrieved with this system include three backscatter coefficients, at 355 nm, 532 nm and 1064 nm, two extinction coefficients at 355 nm and 532 nm, and the depolarization ratio at 532 nm. The later is particularly useful in discriminating the presence of mineral dust particles as they are typically characterized by their irregular shape; therefore they can significantly change the polarization state of the lidar emitted radiation. The particle linear depolarization ratio, δ_P, is the parameter which quantifies this change. These lidar measurements, unique in Portugal, are here presented during Saharan dust outbreaks, whilst its depolarization features are highlighted. Profiles of particle linear depolarization ratios were retrieved during different episodes and during different days of an episode, and average depolarizing properties of the Saharan dust plumes were obtained. These average features have shown that the dust particles are usually transported aloft, at altitudes up to about 5 km and or they mix with the polluted aerosols produced near the surface.

Keywords: Raman Lidar Measurements, Saharan Dust, Optical Properties, Depolarization

S6-O6

Object, Thing and Event: New Ontological Approaches to Dust Storms and Dust Source Suitability Distribution Modeling

C.P. JACKSON[1]

[1]Department of Geography, New Mexico State University; Las Cruces, USA; charliej@nmsu.edu

The many ontological constraints and metaphysical theories prevalent in our disciplines have left dust storms with a rather questionable ontological status. Are they discrete and determined objects, or are they vague and indeterminate events? Do they exist at all? Do they exist only for us? Here I attempt to explain how dust storms can simultaneously be things, objects *and* events. In 2015, I introduced a novel and geographically scalar approach for modeling the distributions of suitable conditions for dust sources during major synoptic dust events in the Lake Palomas basin of North America's Chihuahuan Desert. Graham Harman's Object-Oriented Philosophy provides the basis for taking dust storms to be vague and ephemeral objects with component parts. More importantly, Harman's ontology is what allows us to generate maximum entropy "species" distribution models (SDMs) from small numbers of dust source presences in the same way that we would for any biotic taxon. By replacing the geographically uncertain point sources located in satellite imagery with multiple geoecologically relevant terrain objects, it was demonstrated how the suitability distributions can then be projected to the lower object and pixel levels. I discuss in more detail the ontology used so as to clarify what are two kinds of objects and qualities, *real* and *sensual*. Objects, according to Harman, remain "partially indeterminate with respect to their exact properties, and therefore are incommensurable with any concrete event." A 'concrete event', such as the translation of a dust storm by satellite sensors, is what produces the specific contiguous profiles of objects within a containing relation-object. Therefore, pixels as objects, and not ontologically defective artifacts as they are commonly understood to be, then become the components of larger objects. These still contiguous profiles of geographically scalar objects both emerge as new spatio-temporal *sensual objects* with their own unique qualities and acquire meaning *interobjectively* within new containing relation-objects, and may even be translations of *real objects*, or *things*, that withdraw from all direct access and causation. However, to simply put forward an ontology would be remiss, if not altogether misguided, no matter how effective it might seem to be in a given scientific application; we would run the risk of having it dismissed as a mere philosophical exercise. Therefore, I also introduce Tristan Garcia's *Form and Object: A Treatise on Things* and Markus Gabriel's Ontology of Fields of Sense (OFS). For Garcia, "[o]bjects and events exist in the universe. Objects are things in other things. Events are presences of things or presences of objects." Not only will Garcia's *formal* system of things and *objective* system of events and objects help explain what is meant by presence and absence in the context of the SDMs explained here, they will also serve to shed light on what precisely is at stake when we consider dust storms as objects, things and events. Finally, Gabriel's OFS, where objects appear in a given field of sense, is introduced to concisely show how each of these systems effectively avoids the scientism and constructivism prevalent in our respective disciplines.

Keywords: Fields of Sense, Maximum Entropy, Object-Oriented Philosophy, Ontology, Species distribution models

Session 6

S6-O7

Chemical and Pb-isotope Characteristics of Modern Dust from the Northern Slopes of the Tien Shan – a Multi-annual Record of Dust collected at 3-day Sampling Intervals

G. SCHETTLER[1], Y. WANG[2], M. SIPS[1], B. MOLDOBEKOV[3], K.W. FOMBA[4], K. MÜLLER[4]

[1] Helmholtz Centre Potsdam, German Research Centre for Geosciences, Telegrafenberg, 14473 Potsdam, Germany, schet@gfz-potsdam.de, sips@gfz-potsdam.de

[2] Chinese Academy of Meteorological Sciences (CAMS), 4, Zhong-Guan-Cun Avenue, Beijing, 100081, China, yaqiang.wang@gmail.com

[3] Central Asian Institute for Applied Geosciences, Timura Frunze Str. 73/2, 720027 Bishkek, Kyrgyzstan, b.moldobekov@caig.kg

[4] Leibniz-Institute for Tropospheric Research, Permoser Str. 15, 04318 Leipzig, konrad@tropos.de, khanneh-wadinga.fomba@tropos.de

We run a ground-based dust monitoring program at an altitude of 1740 m asl. on the northern slopes of the Tien Shan since summer 2010. The program includes the collection of dust particles > 2 µm using a High-Volume-Slit Impactor at 3-day sampling intervals, particle counting for 31 grain-size classes and recording of meteorological parameter at 1-min time resolution. Temporarily, we detected soil particles that were deflated during dust storm events in remote deserts (Northern Africa, Middle East, and Central Asia). The mineral aerosols were transferred with westerly air-flows along the Northern Margin of the Central Asian High Mountain Belt.

Concentration data of water-soluble dust components and their frequency distribution for a sampling interval between summer 2010 and summer 2014 are presented. Mean concentrations values of the major leachable ions based on 205 dust samples are: NO_3= 32.0, SO_4= 21.0, Cl= 3.3, Ca= 18.9, Na= 5.9, K= 2.5, Mg= 1.1, Sr= 0.121 mg/g. Furthermore, we determined the chemical and Pb isotope composition of the non-soluble dust residue. Mean concentration values of selected trace elements based on 215 dust samples are: Pb= 139, Cu= 67.6, Cd= 5.7, Tl= 0.94, Bi= 1.1, Mo= 2.3 µg/g. We infer the source areas of dust with exceptional high soluble salt contents, and compare dust transported by westerly airflows with dust arriving from NW-China in terms of their heavy metal contamination. The relative trace element enrichment versus average upper continental crust (UCC) and local pre-industrial Quaternary loess due to anthropogenic contaminations increases in the following order: Bi – Tl – Mo – Cu – Ni(Zn) – Pb – Cd. On average, the absolute anthropogenic dust contamination, calculated using normative chemical mass budgets, are highest for Zn (256 µg/g), Pb (123 µg/g) and Ni (180 µg/g). The isotope composition of the dust-Pb showed the following variation $^{207}Pb/^{206}Pb$ (0.85 – 0.87), $^{208}Pb/^{206}Pb$ (2.08 – 2.12) and displayed a weak positive correlation between the Pb concentration and $^{207}Pb/^{206}Pb$. The geogenic dust characteristics is similar to UCC, but displays enrichment of LIL elements (Ba, Rb, Cs) and depletion in Na that are characteristics of highly weathered substrates that may have experienced repeated alteration cycles. Finally, we briefly compare anthropogenic contaminations of dust from Central Asia and Middle Germany for selected heavy metals.

Keywords: Central Asian Dust, Chemical and Pb-Isotope Composition

Determination of PM10 sources and properties in the Central Mediterranean from long-term measurements at Lampedusa

G. CALZOLAI[1], S. NAVA [1], S. BECAGLI[2], F. LUCARELLI[1], M. CHIARI[1], M. GIANNONI[1], R. TRAVERSI[2], D. FROSINI[2], M. SEVERI[2], R. UDISTI[2], A. DI SARRA[3], G. PACE[3], D. MELONI[3], C. BOMMARITO[4], F. MONTELEONE[4], F. ANELLO[4], D. SFERLAZZO[5]

[1]Dept. of Physics and Astronomy, University of Florence, and INFN-Florence, Via G. Sansone 1, 50019 Sesto Fiorentino (Florence), Italy; calzolai@fi.infn.it

[2] Dept. of Chemistry, University of Florence, Via della Lastruccia 3, 50019 Sesto F.no (Florence), Italy

[3] ENEA Lab. for Earth Observations and Analyses, 0012, S. Maria di Galeria, Roma, Italy

[4] ENEA, Laboratory for Earth Observations and Analyses, 90141 Palermo, Italy

[5] ENEA, Laboratory for Earth Observations and Analyses, 92010 Lampedusa, Italy

Strong natural and anthropogenic aerosol emissions, as well as important climatic forcings, affect the atmosphere of the Mediterranean Basin. This area has been identified as one of the "Hot-Spots" in future climate change projections. In this framework, the Station for Climate Observations was installed by ENEA (Italian Agency for New Technologies, Energy and Sustainable Economic Development) on the island of Lampedusa (35.5° N, 12.6° E, 45 m a.s.l.) far from continental pollution sources (the nearest coast, in Tunisia, is more than 100 km away). At the station, continuous observations of greenhouse gases concentration, aerosol properties, total ozone, ultraviolet irradiance, and other climatic parameters are routinely carried out. PM_{10} samples have been collected on a daily basis since 2007 in order to study the chemical properties of the aerosol and to gain information on the aerosol sources and their contributions.

After mass gravimetric measurements, samples are measured using a wide set of analytical techniques. This allows a comprehensive chemical characterization of the samples, including ionic content by Ion Chromatography (IC), soluble metals by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES), total (soluble + insoluble) elemental composition by Particle Induced X-ray Emission (PIXE), and carbonaceous component (elemental and organic carbon, EC and OC) by Thermo-Optical Transmittance (TOT) analysis. Source apportionment was performed by exploiting the Positive Matrix Factorization (PMF) model on data from 2007-2008 and 2012-2014. Despite the remoteness of the sampling site, several episodes with PM_{10} reaching levels of more than 100 $\mu g/m^3$ were observed (minima were found to be around 10 $\mu g/m^3$). Seven sources were resolved for the 2007-2008 data-set: sea-salt, mineral dust, secondary nitrate, secondary sulphate, primary particulate ship emissions, biogenic emissions and combustion emissions. Source contributions to the total PM10 mass were estimated to be about 40% for sea-salt, around 25% for mineral dust, 10% each for secondary nitrate and secondary sulphate, and 5% each for primary particulate ship emissions, biogenic emissions, and combustion emissions. Using a literature approach, about one third of the total contribution of secondary sulphate was estimated to originate from ship emissions. Large variations in absolute and relative contributions of the different sources were found, depending on the season and on transport episodes.

Preliminary results from the 2012-2014 dataset confirm the main sources impacting the Central Mediterranean area. Further, they improve the study by adding important information on the aerosol carbonaceous component thanks to the availability of EC and OC data for this 3-year-long period.

Keywords: Mediterranean Basin, aerosol sources, PM10, PMF

POSTER SESSION

P1

Characterization of Limonene and Toluene Adsorption Properties on Saharan Dusts

M. N. ROMANIAS[1,2], H. OURRAD[1,2], V. RIFFAULT[1,2], F. THEVENET[1,2]

[1] Mines Douai, SAGE, 941 rue Charles Bourseul, F-59508 Douai, France
[2] Université de Lille, F-59000 Lille, France

The heterogeneous interaction of limonene and toluene with Saharan dusts was investigated under dark conditions, pressure of 1 atmosphere, and temperature 293K. The mineral dust samples were collected from six different regions along the Sahara desert, extending from Tunisia to the western Atlantic coastal areas of Morocco, and experiments were carried out with the smallest sieved fractions, i.e. inferior to 100 µm. N_2 sorption measurements, granulometric analysis, and X-ray Fluorescence and Diffraction (XRF and XRD) measurements were conducted to determine the physicochemical properties of the particles. The chemical characterization showed that dust originating from mid-eastern Sahara has significant higher SiO_2 content (~82%) than dust collected from the western coastal regions where the SiO_2 relative abundance was ~50%. A novel experimental setup combining Diffuse Reflectance Infrared Fourier Transform spectroscopy (DRIFTS), Selected-Ion Flow-Tube Mass Spectrometry (SIFT-MS) and long path transmission Fourier-Transform InfraRed spectroscopy (FTIR) allowed following both the adsorbed and gas phases. The kinetic adsorption and desorption measurements were performed using synthetic dry air as bath gas exposing each dust surface to 10 ppm of the selective Volatile Organic Compound (VOC). The adsorption of limonene was independent of the SiO_2 content, given the experimental uncertainties, and the coverage measurements ranged between (10-18) × 10^{13} molecule cm^{-2}. Experimental results suggest that other metal oxides that could possibly influence dust acidity may enhance the adsorption of limonene. On the contrary, in the case of toluene, the adsorption capacities of the Saharan samples increased with decreasing SiO_2 content. However, the coverage measurements were significant lower than those of limonene and ranged between (2-12) × 10^{13} molecule cm^{-2}. Flushing the surface with synthetic dry air showed that VOC desorption is not a completely reversible process at room temperature. The reversibly adsorbed fraction and the rate coefficients of desorption, k_{des}, depended inversely on the SiO_2 relative abundance for both VOCs.

Keywords: Mineral Dust; Volatile Organic Compounds; Sahara; Adsorption; Desorption

Poster Session

P2

IASI Dust Algorithm Inter-Comparison within ESA's Climate Change Initiative

L. KLÜSER [1], S. VANDENBUSSCHE[2], V. CAPELLE[3], L. CLARISSE[4], T. POPP[1]

[1]German Aerospace Center (DLR), Münchener Straße 20, 82334 Wessling, Germany, lars.klueser@dlr.de
[2]Belgian Institute for Space Aeronomy (BIRA-IASB), 3 Avenue Circulaire, 1180 Bruxelles, Belgium, sophie.vandenbussche@aeronomie.be
[3]Laboratoire de Météorologie Dynamique (LMD), 91128 Palaiseau Cedex 24, France, virginie.capelle@lmd.polytechnique.fr
[4]Université Libre de Bruxelles (ULB), Avenue F.D. Roosevelt 50, 1050 Bruxelles, Belgium, lclarisse@ulb.ac.be

In the Aerosol_cci project of the Climate Change Initiative of the European Space Agency (ESA) it is envisaged to produce a full-mission (~10 years) dataset of dust AOD from IASI (Infrared Atmospheric Sounding Interferometer) with four different algorithms, which are based on different retrieval techniques. A major task within the project is the first inter-comparison of those IASI dust retrieval algorithms on the basis of a large set of observations. For this purpose one year of IASI observations (2013) over the major dust belt of the Northern hemisphere, including the Northern Atlantic Ocean, the Sahara desert, the Arabian Peninsula as well as the Central Asian desert regions, is consistently processed with all four algorithms and similar retrieval output (visible and infrared AOD, AOD uncertainty, retrieval quality, cloud flags) is generated in order to facilitate the comparison of results. The retrieval inter-comparison, called Round Robin exercise, consists of an analysis of the different sensitivities of the four algorithms to dust and environmental conditions. The retrieval methods are based on different retrieval strategies such as look-up tables, optimal estimation, neural network and singular value decomposition. The sensitivity analysis will reveal the major uncertainties of infrared dust remote sensing from space as well as specific strengths and weaknesses of the different retrieval approaches under varying environmental conditions and can be used to identify and/or mix the best-suited approach for specific conditions (for example atmospheric moisture or surface characteristics). The Round Robin exercise includes the evaluation of retrieval results from the four different algorithms with external data. AERONET sun photometers are used for evaluation as well as observations from the German SALTRACE campaign over the tropical Atlantic Ocean in summer 2013. Evaluation of subsets will thus allow for an improved understanding of the feasibility of hyperspectral infrared dust remote sensing with different approaches under varying conditions.

Poster Session

Keywords: Mineral dust, IASI, Climate Change Initiative

P3

Influence of Air Masses on ^{210}Pb Aerosols in the South-East of Iberian Peninsula

E. CHHAM[1], F. PIÑERO-GARCÍA[2], P. GONZÁLEZ-RODELAS[3], M.A. FERRO-GARCÍA[3]

[1]Radiochemistry and Environmental Radiology Laboratory; Inorganic Chemical Department, Faculty of Sciences, University of Granada, 18077 Granada (Spain); saidchham@gmail.com

[2]Radiochemistry and Environmental Radiology Laboratory; Inorganic Chemical Department, Faculty of Sciences, University of Granada, 18077 Granada (Spain); franciscopigar@ugr.es

[3]Departamento de Matemática Aplicada, Universidad de Granada, ETS de Ingeniería de Caminos, Canales y Puertos; C/ Severo Ochoa, s/n. 18071 Granada (Spain); prodelas@ugr.es

[4]Radiochemistry and Environmental Radiology Laboratory; Inorganic Chemical Department, Faculty of Sciences, University of Granada, 18077 Granada (Spain); ferro@ugr.es

This research studies the influence of the dust transported by air masses together with the local meteorological fluctuations on the radioactivity levels of ^{210}Pb detected in aerosols at surface air of the south eastern of Iberian Peninsula. It is important to know the role of air masses origin in the behaviour of radioactive aerosols since the currents of air masses are the responsible of the transport, concentration and dilution of them. For that reason, in our study, the role of air masses influence by Saharan desert deserves special attention since Saharan Intrusions are the major mineral dust source in the southeast of Iberian Peninsula. The aerosols samples were weekly collected from January-10 to December-14 in the Faculty of Sciences in the city of Granada (Spain) (37º10`50''N, 3º 35'44''W, and 687 m above sea level). The monthly activity concentration of ^{210}Pb (Bq/m^3) has been determined by gamma spectrometry (Photopeak 46.55 KeV; Yield 4.25%). Furthermore, decay correction was carried out considering the mid-point of the collection period and the half-life of ^{210}Pb, 22.26 years. To identify the origin and the pathway of the air masses arriving to Granada during the sampling period, 72-h kinematic 3D daily back-trajectories, from January-10 to December-14, were computed using the Hybrid Single Particle Lagrangian Integrated Trajectory (Hysplit, version 4.9). The backward trajectories were calculated four times each day (00 UTC, 06UTC, 12UTC and 18UTC) at three different altitudes: 500 m, 1500 m and 3000 m. Then, we developed a method of clustering of air trajectories using the backward trajectory of HYSPLIT program, to classify the origin of the air masses over Granada for each altitude independently. For that purpose, we carried out a complete clustering analysis of exclusive partitional K-means type, using the Euclidean distance of the three spherical coordinates of the points in the trajectories. Finally, Multiple Regression Analyses (MRA) was used to identify the influence of the air masses over ^{210}Pb aerosols. In conclusion, the results of the current research demonstrate that re-suspended mineral dust from Northern Africa together with continental aerosol transported by Mediterranean air masses (1500 m) and Local air masses (500 m) favour the increase of the radioactivity levels of ^{210}Pb detected in the south-east of Iberian Peninsula, especially during the anticyclone situations since it reduces the possibility of the dispersion of the aerosols producing an accumulation of suspended particles in the surface atmosphere.

Keywords: ^{210}Pb; Atmospheric radiotracers; Backward trajectory; Saharan Intrusion; Multiple Regression Analyses (MRA)

Poster Session

P4

Long-term recovering of aerosol optical depth from 1941 to 2013 at the Izaña Atmospheric Observatory

R.D. GARCÍA[1,2] O.E.GARCÍA[1], E. CUEVAS[1], S. RODRÍGUEZ[1], V.E. CACHORRO[3], A. BARRETO [1,4], C. GUIRADO[1,3], N. KOUREMETI[5], J.J. BUSTOS[1], P.M. ROMERO-CAMPOS[1], A.M. DE FRUTOS[3]

[1]Izaña Atmospheric Research Center (IARC), Agencia Estatal de Meteorología (AEMET), rgarciac@aemet.es

[2]Air Liquide S.A.

[3]Atmospheric Optics Group, Valladolid University (GOA-UVA), Valladolid, Spain.

[4]Cimel Electronique, Paris, France.

[5] Physikalish-Meteorologisches Observatorium, Davos, World Radiation Center, Davos, Switzerland.

A 73-year time series of the daily aerosol optical depth (AOD) at 500 nm has been reconstructed at the subtropical high-mountain Izaña Atmospheric Observatory (IZO) located in Tenerife (The Canary Islands, Spain). For this purpose, we have combined AOD estimates from neuronal networks (ANNs) from 1941 to 2001, and AOD measurements directly performed with Precision Filter Radiometer (PFR) between 2003 and 2013. The analysis is limited to cloud-free conditions (oktas = 0) and to the summer season (JAS: July-August-September), where the largest aerosol load is observed at IZO (Saharan mineral dust particles). The ANNs were trained with PFR data between 2003 and 2009 and *in situ* measured meteorological parameters (horizontal visibility, relative humidity and sunshine duration). The experimental quality assessment has been performed by comparing the ANN AOD to coincident AOD-500nm data measured with AERONET Cimel Sun Photometers between 2004 and 2009 and with AOD-770 nm from the solar spectrometer Mark-I between 1984 and 2009. The observed agreement between ANN estimates and measurements is rather good, with Pearson correlation coefficients (R) > 0.90%. In addition, we have analysed the long-term consistency between ANN AOD time series and long-term meteorological records identifying Saharan mineral dust events at IZO (synoptical observations and local wind records). Both analyses provide consistent results, with correlations > 85 %. Therefore, we can conclude that the reconstructed AOD time series captures well the AOD variations and dust-laden Saharan air mass outbreaks on short-term and long-term timescales and, thus, it is suitable to be used in climate analysis.

Poster Session

Keywords: Aerosol Optical Depth, Artificial Neural Networks, Visibility Horizontal, Sunshine Duration, Time Series

P5

Impact of meteorological factors on PM2.5 below-cloud scavenging processes – a case study from Wrocław (Poland)

A. DRZENIECKA-OSIADACZ[1], T. SAWIŃSKI[1], M. KORZYSTKA-MUSKAŁA[1], P. MUSKAŁA[1]

[1]University of Wroclaw, Institute of Geography and Regional Developnent, Department Of Climatology and Atmosphere Protection, ul. Kosiby 6/8, 51-621 Wrocław, Poland;
anetta.drzeniecka-osiadacz@uwr.edu.pl, tymoteusz.sawinski@uwr.edu.pl,
magdalena.korzystka-muskala@uwr.edu.pl, piotr.muskala@uwr.edu.pl

The main objective of the presented work was to determine the variability of particulate matter with aerodynamic diameter less than 2.5 µm, with assessment of the seasonality of washout effects and efficiency for removal of pollutants from the atmosphere by wet deposition. Data used in this study were obtained in Wrocław – a city in SW Poland with population of about 600 000 and strong degree of air pollution, especially particulate matter. The whole series covers a 5-year measurement period (May 2010 - June 2015) and was collected in Meteorological Observatory of University of Wroclaw, located in a residential area on the border of the city center. The data contain information about the variability of $PM_{2.5}$ concentration and precipitation as well as background meteorological conditions. The time resolution of the measurements was 1 min. $PM_{2.5}$ measurements were conducted with use of automatic dust concentration monitor TEOM 1400a. Pecipitation was measured by optical disdrometer PARSIVEL, enabling i.e. measurements of precipitation intensity in high temporal resolution and identification of precipitation types according to SYNOP categories. The analysis was based on the scavenging coefficient λ, calculated for precipitation episodes on the basis of difference between c_0 - initial cocnentration in time t_0 and c_1 –final concentration in time t_1. The time step between t_0 and t_1 used in the calculations was 600 seconds. The obtained results show a clear variability of the scavenging process depending on precipitation characteristics – its intensity, size of precipitation particles and type of precipitation. At the same time it can be seen that other meteorological parameters, such as wind speed during the precipitation episode also strongly influence the process. According to the authors, such variation is caused by genetic characteristics of precipitation observed in Wrocław, which is primarily related to the frontal weather with advection of fresh air masses, caused by movement of low pressure systems mainly from the sectors: NW – W – SW. Situations with limited air mass exchange, when removing of pollutants depends mainly on pure scavenging are quite rare, and they are associated most often with slight precipitation of low scavenging effectiveness. The results indicate that in Central European conditions the potential effectiveness of particulate matter scavenging should be assessed not only with respect to physical parameters of the precipitation, but also in the context of the whole "weather complex", including genetic determinants of precipitation, intensity of the advection, type of inflowing air mass etc. Results of the study will be applied in the forecast system for Lower Silesia region, which is now developed within the project "Air Pollution and biometeorological forecast and Information System" (LIFE-APIS/PL), co-financed by European Union, under the Financial Instrument LIFE+ and The National Fund for Environmental Protection and Water Management.

Poster Session

Keywords: $PM_{2.5}$, Scavenging, Weather Complex, Precipitation

P6

Aerosol radiative effects during two desert dust events in August 2012 over the Southwestern Iberian Peninsula

M.A. Obregón [1], S. Pereira [1], V. Salgueiro [1], M.J. Costa [2], A.M. Silva [2], A. Serrano [3], D. Bortoli [1]

[1]Departamento de Física, Centro de Geofísica, Instituto de Investigação e Formação Avançada, Universidade de Évora, Évora, Portugal, nines@unex.es
[2]Departamento de Física, Centro de Geofísica, Escola de Ciências e Tecnologia, Universidade de Évora, Évora, Portugal, mjcosta@uevora.pt
[3]Physics Department, University of Extremadura, Avd. Elvas, s/n, 06006 Badajoz, Spain, asp@unex.es

This study provides an analysis of desert dust aerosol radiative effects in the shortwave solar spectrum. For this purpose, the aerosol radiative forcing (ARF) at the earth's surface was calculated during two desert dust events that occurred during August 2012 over Badajoz (Spain) and Évora (Portugal), both stations are located in southwestern Iberian Peninsula. Aerosol properties from these two AERONET stations have been employed to feed the libRadtran model used to simulate irradiances in the shortwave range at the surface under cloud-free conditions. In addition, simulated irradiances for Évora have been compared with Eppley pyranometer measurements. Simulated irradiance values have been used to calculate ARF values at both sites. The overall mean simulated ARF values for Évora and Badajoz during the first event are −43.03 and−43.76 Wm−2, respectively, while, for the second event, the overall mean values are−19.73 and −26.07 W m−2, respectively, indicating that the first event has a greater regional radiative impact than the second one, causing a more pronounced radiate cooling at the surface. The ARF per unit of aerosol optical depth (AOD), called the aerosol radiative forcing efficiency (ARFE), is also evaluated for this shortwave spectral range. The ARFE values obtained for Évora and Badajoz during the first event are−112.93 ± 6.60Wm−2 and −101.63 ± 10.73Wm−2 per unit of AOD (500 nm), respectively, and, for the second event, −92.44 ± 9.82 W m−2 and −87.85 ± 10.19 W m−2 per unit of AOD (500 nm), respectively. These values also confirm the previous results, i.e., the first event causes a greater radiate cooling than the second one in both stations, although the second desert dust event is more intense, i.e., with higher aerosol optical depth and PM10 aerosol mass concentration. The presence of absorbing aerosols, together with dust, near the surface during the first event may explain the greater efficiency of this aerosol mixture to reduce the downward shortwave irradiance reaching the surface, inducing a greater radiative cooling than the second event.

Poster Session

Keywords: Dust Aerosols, Radiative Forcing, LibRadtran Model

P7

Texture Segmentation of Barchans Dunes in High Resolution Satellite Images

M.A. AZZAOUI[1], M. ADNANI[1], H. ELBELRHITI[2] , I.E. CHAOUKI[3], L. MASMOUDI[1]

[1]Faculté des Sciences de Rabat, Université Mohammed V-Agdal, 4 Avenue Ibn Battouta B.P. 1014 RP, Rabat, Maroc - azzaoui.m.amine@gmail.com, adnani.manar@gmail.com, lhmasmoudi@gmail.com

[2]Département des Sciences Fondamentales et Appliquées. Institut Agronomique Vétérinaire Hassan II. BP 6202, 10101 – Rabat, Maroc - helbelrhiti@gmail.com or h.elbelrhiti@iav.ac

[3]Ecole Nationale des Sciences Appliquées d'Agadir, Maroc. B.P. 1136 - b.chaouki@uiz.ac.ma

Barchans dunes are crescent-shaped dunes that are known to move rapidly in deserts when compared to other sand dunes types. In order to understand their dynamics in the field, we developed an analytical approach for defining their potential positions automatically by using textural segmentation in high resolution satellite images. Our work consists of classifying the image into barchan dunes sand, and flat-bed surroundings of barchan dunes. We started by using image enhancement techniques, then we proceeded with a segmentation based on a supervised learning method coupled with a coarse to fine approach to refine the borders of barchan dunes sand. Our results were satisfying and our procedure could be used as a basis for further quantitative evaluations of sand volume in such deserts.

Keywords: Barchan Dunes, Desert, Classification, Texture Segmentation, High Resolution Satellite Image

Poster Session

P8

Aerosol Deposition in the Westward Saharan Dust Transport Region: Examples from Tenerife, Cape Verde, and Barbados

K. KANDLER[1], M. HARTMANN[1], A. GRUHN[1], M. EBERT[1], S. WEINBRUCH[1], T. MÜLLER[2], K. W. FOMBA[2], L. MENDES NEVES[3]

[1]Institut für Angewandte Geowissenschaften, Technische Universität Darmstadt, Germany
[2]Leibniz-Institut für Troposphärenforschung, Leipzig, Germany
[3]Instituto Nacional de Meteorologie e Geofisica, Mindelo, Cape Verde

Mineral dust is one of the dominating aerosol species in the atmosphere. Particularly, the tropical North Atlantic Ocean is heavily affected by dust, changing for instance cloudiness, precipitation, nutrient fluxes into the ocean and radiation balance. Wet deposition and dry deposition are the two major pathways of desert aerosol removal during westward transport from Africa. In particular in the northern tradewind region, dry deposition is dominating the mass removal. In the present work, dust dry deposition was measured for a period of one month at Izaña, Tenerife; Praia airport, Santiago, Cape Verde; Cape Verde Atmospheric Observatory (CVAO), Sao Vicente, Cape Verde; and Ragged Point, Barbados. Samples were collected for one to four days periods with different dry deposition samplers on carbon adhesive substrates. Electron microscopy with energy-dispersive X-ray fluorescence analysis (SEM-EDX) was performed for 800 to 2000 single particles from every sample, determining the particle size and chemical composition for each particle in the size range of 1 µm to 50 µm diameter. Size-resolved particle compositions were determined, and size-resolved particle fluxes were calculated. The measurement periods at Izaña in summer and Praia in winter were dominated by dust outbreaks, while at CVAO in summer dust occurred in lower 'background' concentration. At Barbados, dust presence was connected to the dry phases of the tropical easterly waves. Non-dust aerosol composition is dominated by sea-salt at Barbados, and by sulfate and sea-salt as function of particle size in the Eastern Atlantic Ocean. While the dust component composition in the Eastern Atlantic Ocean shows variation as function of dust source, at Barbados the dust composition is very homogeneous. In general, a size-dependency of the mineral dust composition was observed; e.g., iron-rich particles were more frequently observed for particles smaller than 3 µm, and calcium-rich particles in the Eastern Atlantic Ocean were observed mainly between 2 µm and 6 µm. Determination and comparison of absolute dust fluxes between the locations was hampered by use of different types of dry deposition samplers, leading to considerable uncertainties (unknown bias) as function of wind speed. In particular for larger particles (> 20 µm diameter), low particle numbers are the largest source of error for dust flux determination. For future analyses, new deposition samplers – less influenced by wind speed or at least having known dependencies – have to be constructed, and in particular the large particle fraction will need special attention.

Poster Session

Keywords: mineral dust deposition, electron microscopy, size distribution, chemical composition

P9

Sun Photometer Retrievals of Saharan Dust Properties During SALTRACE Campaign

C. TOLEDANO[1], B. TORRES[2], D. FUERTES[2], C. VELASCO[1], D. ALTHAUSEN[3], S. GROß[4], V. FREUDENTHALER[5], M. WIEGNER[5], B. WEINZIERL[4, 5], J. GASTEIGER[5], T. MÜLLER[3], R. GONZÁLEZ[1], V. CACHORRO[1].

[1]Universidad de Valladolid, Grupo de Óptica Atmosférica, Valladolid, Spain
[2]GRASP-SAS, Bachy, Nord Pas de Calais Picardie, France
[3]Institut für Trophosphärenforschung, Leipzig, Germany
[4]Deutsches Zentrum für Luft- und Raumfahrt, I. Physik der Atmosphäre, Oberpfaffenhofen, Germany
[5]Ludwig-Maximilians-Universität, Meteorologisches Institut, München, Germany

The Saharan Aerosol Long-range Transport and Aerosol-Cloud-Interaction Experiment (SALTRACE) was devoted to the investigation of Saharan dust properties after the long-range transport across the Atlantic. For this 5-week campaign in June-July 2013, a large set of ground-based and airborne aerosol instrumentation was used. Several Sun photometers were deployed at Barbados Island during this campaign: two AERONET Cimel sun photometers and the Sun and Sky Automatic Radiometer (SSARA). The sun photometers were co-located with the ground-based multi-wavelength lidars BERTHA and POLIS. The time series of aerosol optical depth allows identifying up to five dust events separated by short periods in which marine background conditions were observed. Moderate aerosol optical depth in the range 0.3 to 0.6 was found during the dust periods. Sky radiance measurements (almucantar and principal plane geometries) have been used to retrieve the aerosol optical and microphysical properties using the GRASP algorithm by Dubovik et al. The sun photometer infrared channel at 1640nm was used in the retrieval to investigate possible improvements and expected larger sensitivity to coarse particles. The synergy between sun photometer and lidar measurements has been exploited to investigate dust properties within the Saharan Air Layer. The comparison between column (AOD) and surface (dust concentration) properties demonstrates the connection between the Saharan Air Layer and the boundary layer in the Caribbean region, as shown by the synchronized detection of successive dust events in both data sets.

Poster Session

Keywords: Saharan dust, sun photometer, lidar, surface concentration, GRASP inversion

P10

Trans-Atlantic African Dust Transport Under El Niño 2015 Scenario

M.I. GARCIA[1,2], J.M. PROSPERO[3], S. RODRIGUEZ[2], P. ZUIDEMA[3], E. SOSA[2], A. ALASTUEY[4], F. LUCARELLI[5], G. CALZOLAI[5], J. LOPEZ-SOLANO[2]

[1]Department of Chemistry (T.U. Analytical Chemistry), Faculty of Science, University of La Laguna; Avda. Astrofísico Francisco Sánchez s/n. 38071, Tenerife, Spain; mig.aerosol@aemet.es

[2]Izaña Atmospheric Research Centre, AEMET; C/ La Marina 20, 6 floor, 38001, Tenerife, Spain; srodriguezg@aemet.es

[3]Rosenstiel School of Marine and Atmospheric Science, University of Miami; 4600 Rickenbacker Causeway, Miami, FL 33149, USA; jprospero@rsmas.miami.edu, pzuidema@rsmas.miami.edu

[4]Institute of Environmental Assessment and Water Research, CSIC; C/ Jordi Girona 18-26, 08034, Barcelona, Spain; andres.alastuey@idaea.csic.es

[5]Department of Physics and Astronomy, University of Florence and I.N.F.N.; Via Sansone 1, 50019 Sesto Fiorentino, Italy; lucarelli@fi.infn.it

This study focus on the desert dust export from North Africa across the Canary Islands and the subsequent changes in dust properties during trans-Atlantic transport to the Caribbean. The research is centered on summertime when dust emissions and impacts throughout the North Atlantic are at a maximum. During July and August 2015, samples of aerosols were collected every day at three sites: at Izaña mountain observatory (~2400 m.a.s.l. in Tenerife, Canary Islands) off North African coast, at Barbados (~50 m.a.s.l.) in the eastern Caribbean, and at Miami (~25 m.a.s.l.). Samples at Izaña were collected within the high altitude Saharan Air Layer; they are representative of the fresh dust recently exported from the Sahara. In contrast, samples collected at Barbados and Miami are representative of aged dust, after about a week of transport across the Atlantic. The characterization of these samples includes analysis of bulk dust concentrations (ashed-filter method), SO_4^{2-}, NO_3^-, NH_4^+, Cl^-, K^+, Ca^+ and Na^+ (flame photometry, ion chromatography and colorimetry) and elemental composition (PIXE). These data have been complemented and interpreted by using meteorological reanalysis, output of model forecasts used during the campaign, and satellite observations. The observed features of dust transport during summer 2015 are associated to the influence of El Niño – ENSO 2015. Dust export tended to occur in dust export pulses that frequently can be tracked from North African coast to the Caribbean. This trans-Atlantic transport may last about a week to Barbados and more than a week to Miami. The identification of these dust pulses allows assessing how size distribution, dust composition and dust mixing with pollutants may change during trans-Atlantic transport. El Niño - ENSO 2015 is among the strongest since 1950s; results of this study allow assessing the sensitivity of dust export from North Africa to climate variability related large-scale changes of meteorology.

Poster Session

Keywords: Saharan Dust, El Niño, ENSO, Dust Aging, Climate.

P11

Impact of Desert Dust Outbreaks in the Aerosol Load Levels of a Rural Background Environment between 2003 and 2014

D. MATEOS, M.A. BURGOS, V.E. CACHORRO, C. TOLEDANO, C. VELASCO-MERINO, R. GONZALEZ, A. CALLE, A.M. de FRUTOS

Grupo de Óptica Atmosférica, Facultad de Ciencias, Universidad de Valladolid, Paseo Belén 7, CP 47011, Valladolid, Spain; mateos@goa.uva.es

The desert dust (DD) intrusions are a key player in the Earth's planetary system and, therefore, their influence is an interesting topic for the atmospheric science community. It is worth mentioning the complexity of the terminology used to refer the change caused by DD events. The terms "contribution", "intensity", and "impact" do not mean the same concept, but they are related in greater or lesser extent. The contribution quantifies the fraction of the total aerosol load caused by DD events, the "impact" is similar but it means the produced change in a time window used as reference (e.g., moving 30-day averages, etc.). The intensity uses the daily values of aerosol load for DD event days. In this study, the impact of DD episodes is addressed using the average daily variations (δX) of AOD and PM_{10} with respect to their inter-annual monthly mean using a long-term database of 12 years (2003-2014) in the North-central Iberian Peninsula. The DD inventory used is evaluated with the joint interpretation of columnar and surface aerosol loads and other ancillary information. Those intrusions strongly/weakly modifying the aerosol behavior in the study area are highlighted, since the influence of background levels and other episodes of high turbidity are minimized in our results. With respect to the aerosol load, three months highlight by a strong impact (>0.3 and >30 μg m^{-3}) both at the surface and entire column: March-2004, July-2004, and August-2010, which are in line with previous findings reported in the Iberian Peninsula of strong desert dust case studies. On the contrary, the least intense events, simultaneously observed at the surface and the entire column, occur on June-2009, January-2012, and August-2013, with an impact close to zero on both magnitudes. However, there are other events with large δAOD but with a weaker impact on PM_{10}: July-2003, August-2003, August-2004, and October-2008. In these months, whereas δAOD is always larger than 0.25, δPM_{10} barely reaches 20 μg m^{-3}. The opposite situation (large δPM_{10} and a weaker AOD impact) takes place in: November-2003, March-2005, April-2005, August-2005, and June-2012. Other remarkable characteristic is the notable impact (e.g., δAOD between 0.1 and 0.25) of the low number of DD events occurring in December because of their high load with respect to the mean levels during winter. In spite of the large aerosol load of the annual cycle occurring in March, there are four years with zero DD events meanwhile in summer (June, July and August) there are just two gaps in August-2006 and August-2014. The concentration of the strongest DD events seems to be larger at the beginning of the analyzed period, together with a reduction of the number of events at the ending. Therefore, the high inter-annual variability of DD impact is remarked together with the complexity of the characterization process and the necessity of long-term datasets.

Keywords: Desert dust outbreaks; Aerosol Optical Depth; Particulate Matter; Monthly Impact; Seasonal cycle

Poster Session

P12

Contamination of Building Roof Dust in India

K. S. PATEL[1], M. RAJAK[2], N. K. JAISWAL[3], G. AGNIHOTRI[4], B. BLAZHEV[5], L. MATINI[6], E. YUBERO[7], W. CORNS[8]

[1]School of Studies in Chemistry, Pt. RavishankarShukla University, Raipur-492010, CG, India; patelks_55@hotmail.com

[2]Chhattisgarh Groundwater Board, 2nd Floor, Reena Apartments, Pachpedi Naka, Raipur-492001, India

[3]Department of Chemistry, ITM University, Uparwara, Raipur-493661, India; nitinkjaiswal@hotmail.com

[4]Defence Research Organization, Jagdalpur – 494001, CG, India

[5]Central Laboratory for Chemical Testing and control, 1330-Saofia, Bulgaria

[6]Department of Exact Sciences, E.N.S., MarienNgouabi University, B.P 69 Brazzaville, Congo

[7]Atmospheric Pollution Laboratory, Miguel Hernandez University, 03202 Elche, Spain

[8]PS Analytical Ltd, Arthur House, Unit 3 Crayfields Industrial Estate, Orpington, Kent, BR5 3HP, UK

The ambient air quality in Raipur city, Chhattisgarh state, India is poor during the winter season due to the lowest wind speed and temperature inversion. The whole buildings in city are covered by the black fugitive dust. They are allergic in nature and degraded the building life. In addition, they influence the quality of harvested rainwater. In this work, characterization and source apportionment of contaminants i.e. carbons, Al, As, Cr, Mn, Fe, Ni, Cu, Zn, Pb, Cd, F^-, Cl^-, SO_4^{2-}, NO^{3-}, NH_4^+, Na^+, K^+, Mg^{2+} and Ca^{2+} in the building roof dust of Raipur area, central India are described. Various analytical techniques i.e. thermal method, ion selective electrode, ion chromatography, atomic fluorescence spectrometry, and induced coupled plasma-atomic emission spectrophotometry were used for monitoring of the contaminants. Significant concentration of black carbon(BC), SO42-, Ca2+, Al, Fe and Mn in the dusts were recorded, ranging from 8.7 – 21.9, 0.5 – 2.1, 1.8 – 2.9, 2.1 – 4.8, 6.2 – 13.4 and 0.34 – 0.95% with mean value of 14.1±2.6, 1.2±0.3, 2.3±0.2, 3.3±0.4, 9.4±1.2 and 0.64±0.11%, respectively. The concentration of heavy metals i.e. As, Cr, Ni, Cu, Zn, Cd and Pb was ranged from 13.8 – 47.3, 57 – 187, 36 – 89, 31 – 177, 208 – 472, 0.11 – 0.53 and 93 – 366 mg kg^{-1} with mean value of 21.5±6.0, 111±22, 59±9, 102±23, 306±48, 0.28±0.08 and 176±48 mg kg^{-1}, respectively. The cluster and factor analysis were used to determine sources of elements linked to several anthropogenic activities in the study area. The concentration variations, pollution indices and toxicities of the contaminants are discussed.

Poster Session

Keywords: Characterization, Building Roof Dust, Pollution Indices, Factor Analysis

P13

Experimental study of dust effect on photovoltaic power generation for different climatic regions

S. SEMAOUI[1], K. ABDELADIM[1], A. HADJ ARAB[1], S. BACHA[2], B. AZOUI[3]

[1]Centre de Développement des Energies Renouvelables, B.P. 62, Route de l'Observatoire, Bouzaréah, 16340, Alger, Algérie.
[2]Grenoble Electrical Engineering Laboratory, G2Elab, 38402 St Martin d'Hères - France.
[3]Faculté de Technologie, Université Hadj Lakhdar, 05000 Batna, Algérie.

The Algerian program for electricity production has an objective to insert renewable energies, with a share of 40% by year 2030, using photovoltaic (PV), solar thermal and wind generators. This program will install approximately 13 GW_p of photovoltaic modules in an estimated area of 65 km² distributed over the national territory. The PV systems choice is justified by the low investment costs and the availability of a great solar potential that exceeds 3000 hours per year in Saharan areas, with an average incident energy between 1700 and 2650 kWh/m²/year on more than 80% of the total surface of the country. Nonetheless, frequent sandstorms occur in the Algerian desert regions and exhaust emissions from motor vehicles characterize Northern regions. This air pollution creates serious problems from carbon particles or from sand particles stirred by wind. These phenomenons affect the energetic productivity of PV generator by dirt accumulation on PV modules glazing. Experiments have been conducted on clean and dirty photovoltaic modules glazing. These tests were performed using the PVPM 2540C device, in natural conditions at different locations to determine the power characteristics and the resulting efficiency. It was found that dirt on PV module glazing can significantly minimize electric power production with maximum losses during the day of about 8.77 % in desert regions and 8.43 % in coastal regions after an average exposure period of a half month from the last rainfall. These tests show that dirt affects the irradiance incident on photovoltaic modules. Our studies show as well that irradiance losses are not constant throughout the day and are strongly dependent on the sunlight incident angle.

Poster Session

Keywords: Dust Effect, PV Power Generation, Desert Climate, Air Pollution

P14

Air temperature data analysis using Fourier series for sites across Algeria

K. ABDELADIM, S. BOUCHAKOUR, A. RAZAGUI, S. SEMAOUI, S. OULD AMROUCHE, A. HADJ ARAB, F. BOUKHTOUCHE CHERFA

Centre de Développement des Energies Renouvelables, B.P. 62, Route de l'Observatoire, Bouzaréah, 16340, Alger, Algérie.

Algeria is considered as one with the highest solar potential in the Mediterranean basin, as indicated in several studies. Sunshine duration on almost all the country is over 2000 hours per year and can reach 3900 hours in the Highlands and the Sahara. However, the knowledge of the climatic conditions of the site is crucial for sizing different solar systems before their installation at a particular location. In this study, an analysis using Fourier series was conducted based on measurements of air temperature parameter. The estimation was performed for 37 sites over the country. An updated typical year for air temperature parameters was obtained for the all considered locations. The treatment has taken into account data measured for a step of 30 minutes. A sample of 5 year was analyzed for the period 2011-2015.

Keywords: Fourier Series; Modelling; Air Temperature; Measured Data

Poster Session

P15

Boundary Layer dynamics and relationship with particulate matter PM2.5 concentrations in Wrocław (SW Poland)

A. DRZENIECKA-OSIADACZ[1], T. SAWIŃSKI[1], P. MUSKAŁA[1], M. KORZYSTKA-MUSKAŁA[1], M. KOWALCZYK[1]

[1]University of Wroclaw, Institute of Geography and Regional Developnent, Department Of Climatology and Atmosphere Protection, ul. Kosiby 6/8, 51-621 Wrocław, Poland;
anetta.drzeniecka-osiadacz@uwr.edu.pl, tymoteusz.sawinski@uwr.edu.pl, piotr.muskala@uwr.edu.pl
magdalena.korzystka-muskala@uwr.edu.pl, marek.kowalczyk@uwr.edu.pl

The main aim of this study was to assess the particulate matter ($PM_{2.5}$) variability with respect to the dynamics of atmospheric boundary layer (ABL) estimated with use of SODAR (SOund Detection And Ranging). The study concerns the episodes with high $PM_{2.5}$ concentrations during radiative weather. Dispersion and concentration of particulate matter depend strongly on the local ABL structure and its dynamics. Moreover the parameters of ABL are used as a basic input characteristic in meteorological and air pollution modeling. The $PM_{2.5}$ concentration and sodar data were collected at the Meteorological Observatory of University of Wrocław in years 2010-2014. $PM_{2.5}$ mass concentration was measured by means of an automatic dust concentration monitor TEOM 1400a and the structure of ABL, mixing height and vertical wind velocity were retrieved form trimonostatic Doppler SODAR. Basic meteorological data were used as a background. All data were collected with time resolution of 1 minute. In radiative weather conditions the ABL structure is characterized by well marked periodicity. After evening transition period (before the sunset) the process of creating a stable boundary layer starts with radiative inversion ranges from about 50 to 200 m a.g.l (above ground level). Air mixing at this layer is weak and air subsidence dominates where the vertical velocity does not exceed 0.75 ms^{-1}. In such conditions the concentration of pollutants increases and reaches the state of dynamic equilibrium. A change in weather conditions associated with an increase in ventilation index leads to a decrease of $PM_{2.5}$ concentration also during stable situation. A second, weaker, maximum, is marked in some cases during the morning transition period. During the day, the concentration decreases due to the development of with vertical air movement exceeding 1 ms^{-1}. In addition, strong air mixing contributes to the fact that we observe strong minute-to-minute variations of concentrations. Data form field measurements showed obvious differences in ABL structures and vertical wind velocity and relationship to $PM_{2.5}$ concentration variability. The obtained results will be applied in the forecast system for Lower Silesia region, which is now developed within the project "Air Pollution and biometeorological forecast and Information System" (LIFE-APIS/PL), co-financed by European Union, under the Financial Instrument LIFE+ and The National Fund for Environmental Protection and Water Management.

Poster Session

Keywords: $PM_{2.5}$, SODAR, Atmospheric Boundary Layer, Air Quality

P16

Study of a Saharan Haboob using the NMMB/BSC-Dust Model

L. VENDRELL[1], S. BASART[1], O. JORBA[1], J.M. BALDASANO[1,2]

[1]Earth Sciences Department, Barcelona Supercomputing Center, Barcelona, Catalonia, 08034, Spain
[2]Environmental Modelling Laboratory, Technical University of Catalonia, Barcelona, Catalonia, 08034, Spain

Haboobs are convective dust storms characterized by walls of blowing dust of hundreds of meters in height that move quickly and sharply drop visibility in their path. Observational and modelling studies suggest that during the wet season, haboobs largely contribute to dust emissions in the Sahara Desert, the world's main dust source. During the wet season, high vertical thermic gradients and moist air inflows over the Saharan thermal low allow for the formation of thunderstorms, which in their mature stage can produce cold pools, the meteorological driver of haboobs. Cold pools are downdrafts of cold air mass formed under thunderstorms that rapidly descend and reach the ground. Haboob formation involves several small-scale processes (less than 5 km) such as moist convection which are usually not well-reproduced by dust models (most of them with coarser horizontal resolutions). The present contribution aims to better understand the generation and development of small-scale dust storms and to explore the potential of dust models to more accurately simulate such extreme events. In this study, a haboob that occurred on 14-15 July 2011 over southern Algeria is analysed using a set of observational datasets and a high-resolution simulation (at 0.03ºx0.03º grid spacing) based on the NMMB/BSC-Dust model. This dust model is operational in the Earth Sciences Department of the Barcelona Supercomputing Center (BSC-CNS; http://www.bsc.es/earth-sciences/) and in the World Meteorological Organization Barcelona Dust Forecast Center (WMO BDFC; http://dust.aemet.es). The studied haboob was initiated by a massive cold pool from a mesoscale convective system. The resulting dust cloud eventually covered a large part of southern Algeria and quickly moved towards the northwest, which was captured by satellite products. Two consecutive half-hourly (14:00-14:30 UTC on 14 July 2011) METAR reports from the Tamanrasset site (southern Algeria) recorded surface changes such as decreasing the temperature by 13 ºC (from 33 to 20 ºC); changing the wind direction from southwest at 10.3 m/s to variable at 12.3 m/s with gusts up to 27.3 m/s; increasing mean sea level pressure 2 hPa (from 1017 to 1019 hPa) and relative humidity from 30 to 83 %; and lastly, it began to rain heavily. These METAR data showed the initial stages of a haboob and how much the meteorological parameters under a cold pool can vary over a short period (less than an hour). On basis of the simulated fields, the model was able to reproduce the typical stages involved in the haboob formation such as strong updrafts of warm air, downdrafts of cold air that gave rise to a sharp increase of the surface winds above 10 m/s uplifting a dust cloud with concentrations upwards of 3000 µg/m^3. This simulated haboob propagated during 12 hours in the shape of an arc towards the west across hundreds of kilometers and up to 2 km in height.

Poster Session

Keywords: Mineral Dust, High-Resolution Dust Modelling, Haboob

P17

Modeling Saharan Desert Dust Radiative Effects on Clouds

D. SANTOS[1,2], M. J. COSTA[3], A. M. SILVA[2], R. SALGADO[3]

[1]Instituto Português do Mar e da Atmosfera – IPMA, Faro, Portugal; dinas@uevora.pt
[2]Instituto de Ciências da Terra - Polo de Évora, Departamento de Física, Instituto de Investigação e Formação Avançada, Universidade de Évora, Évora, Portugal
[3]Instituto de Ciências da Terra - Polo de Évora, Departamento de Física, Escola de Ciências e Tecnologia, Universidade de Évora, Évora, Portugal; mjcosta@uevora.pt

The objective of this work is the analysis of Saharan desert dust storm effects on clouds. This is done through the investigation of possible modifications that mineral desert dust aerosols may exert on clouds, modifying their properties and also through the estimation of the cloud radiative forcing in the presence of this type of aerosols, during strong desert dust events that occurred in the end of May 2006 and in the beginning of September 2007. The assessment of the cloud radiative forcing is made at a regional scale both at the top of the atmosphere (TOA) and at the surface levels. The results are obtained from numerical simulations with a mesoscale atmospheric model (MesoNH) over Portugal area and nearby Atlantic Ocean. From the results obtained it is possible to observe that, for all days under study, a cooling effect is always found both at the TOA and surface levels. Also, for these two levels and for clouds developing in a dusty atmosphere, a more pronounced cooling effect (more negative cloud radiative forcing values) is found compared with the corresponding cloud radiative forcing values for clouds developing in a dust free atmosphere.

Keywords: Mesoscale Modelling; Clouds; Dust Aerosols

Poster Session

P18

Chemical Characterisation of Total Suspended Particulate Matter from a Remote Area in Amazonia

C. ALVES[1], C. GONÇALVES[2], B. FIGUEIREDO[2], A. A. CARDOSO[3], R. da SILVA[4], S. H. KANZAWA[2], A. VICENTE[1]

[1]CESAM, University of Aveiro, 3810-193, Aveiro, Portugal; celia.alves@ua.pt; anavicente@ua.pt
[2]Department of Geology and Natural Resources, Institute of Geosciences, University of Campinas, 13083-870, Campinas - SP, Brazil; catiagoncalves@ige.unicamp.br; berna@ige.unicamp.br; simoneknzw@gmail.com
[3]Department of Analytical Chemistry, Institute of Chemistry, Júlio de Mesquita Filho State University of São Paulo, 14800-900, Araraquara – SP, Brazil; acardoso@iq.unesp.br
[4]Institute of Engineering and Geosciences, Oeste do Pará Federal University, 68040-470, Santarém – PA, Brazil; rodrigo.silva@ufopa.edu.br

This research had as study object the total suspended particulate matter collected in the Alenquer region, a remote area in the Pará state. The city of Alenquer was chosen to carry out this study because of its remote location and low anthropogenic influence, which makes it a suitable place to understand the natural characteristics of the region. It may be considered a natural laboratory for understanding the effects of anthropogenic pollution on the aerosol life cycle in the tropics. The main objectives were the characterisation of the inorganic and organic chemical composition of the aerosol, looking for seasonal patterns and the identification of probable emission sources and formation processes. Two sampling campaigns were carried out: the first campaign took place between April 20 and May 5 of 2014, coinciding with the rainy season; the second campaign was conducted between August 18 and September 2 of 2014, coinciding with the dry season. A total of 30 samples were obtained. The particulate material was collected on quartz fibre filters with a high volume sampler for 24 h periods. The analytical methods included gravimetric analysis, water-soluble ions analysis by ion chromatography (IC), elemental analysis by inductively coupled plasma mass spectrometry (ICP-MS) equipped with collision cell technology, carbonaceous content determination with a thermal-optical system and organic speciation by gas chromatography–mass spectrometry (GC–MS). The average concentrations of particulate matter ranged from 14 ± 1.3 μg/m^3 to 31 ± 7.8 μg/m^3, in the rainy and dry season, respectively. The carbonaceous content represented, on average, approximately 27% and 21% of the particulate matter in the rainy and dry season, respectively. The water-soluble ions accounted for an average of 7%, during the rainy season. In the dry season they represent on average 18% of the TSP. Na^+, Cl^-, SO_4^{2-}, NO_3^- yield the highest concentrations in both seasons. Na was the dominant element, reflecting the transport of air masses from the Atlantic. An increase in concentrations between the rainy and dry seasons was especially noted for the terrigenous elements Mn, Fe and Al. The chromatographically resolved organics included n-alkanes, n-alkenes, PAHs, n-alkanoic acids, n-di-acids, resin acids and some phenolic compounds. The chemical characterisation along with the backward trajectory cluster analysis suggest a great influence from natural sources such as marine aerosol, mainly in the rainy season. In the dry season, the region is also affected by soil dust re-suspension and some forest fires.

Keywords: Water-Soluble Ions, Elements, Organic Speciation, TSP, Amazonia.

Poster Session

P19

Measurement Of The Optical Properties Of Aerosols Observed During A Desert Dust Event Registered In Covilhã, Portugal

S. MOGO[1,2,3], V. CACHORRO[2], A. DE FRUTOS[2], M. MEDEIROS[1], R. MARTINS[1], L. NEVES[1], E. CONCEIÇÃO[1]

[1]University of Beira Interior, Dep. of Physics; Covilhã, Portugal; smogo@ubi.pt
[2]Universidad de Valladolid, Grupo de Óptica Atmosférica; Valladolid, Spain
[3]Instituto Dom Luiz, Lisbon, Portugal

In this work we present the evolution of the optical properties of aerosols during a desert dust event registered in Covilhã, center of Portugal, on November 2014. The peak of the event occurred on the 22nd November. The measurements took place in a kerbside site (40°16'30"N, 7°30'35"W, 704 m a.s.l.) located on the campus of the University of Beira Interior, nearly 1 km from city center, in Serra da Estrela downhill. The region is dominated by forest and agriculture in small farms. All the data presented were collected on the facilities of the GOA-UVa in situ measurement station. This station is the result of the collaboration between the Group of Atmospheric Optics of the Universty of Valladolid (GOA-UVa) and the University of Beira Interior (UBI). The station includes a 3-wavelength nephelometer (model 3563, TSI) and a 3-wavelength particulate soot absorption photometer (Radiance Research), allowing the measurement of the scattering coefficients (σs) and the absorption coefficients (σa) in the blue, green and red regions of spectrum. The derived parameters, single scattering albedo (ω0), Ångström alpha exponent of scattering (αs), Ångström alpha exponent of absorption (αa) and Ångström alpha exponent of single scattering albedo (αω0), are also presented and fully analized. The wavelength dependence of scattering, absorption and single scattering albedo is studied and related with the size of the particles and theire chemical composition. High values for scattering and absorption coefficients were registered during the event, leading to low values for the single scattering albedo. The rate of decrease of the scattering coefficient led to small values of αs, compatible with the large particles expected during a dust event. The desert event was confirmed by other techniques, as air mass back trajectories observation and measurement of the particulate matter (PM). A condensation particle counter (model 3022A, TSI) and an aerodynamic particle sizer (model 3321, TSI) are available in the station, allowing to determine the number of particles and the size distribution of aerosols.

Poster Session

Keywords: In Situ, Absorption, Scattering, Single Scattering Albedo, Ångström Alpha Exponent

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Chemical and Colorimetric Characterization of Dust and Soils, Kuito, Central Angola

M.M.S. CABRAL PINTO[1], E.M.C. GOMES[2], J.C. OLIVEIRA[2], M.M.V. SILVA[3], L.G. CATARINO[4], E.A. FERREIRA SILVA[1]

[1]GeoBioTec, University of Aveiro, 3810-193 Aveiro, Portugal; marinacp@ci.uc.pt
[2]Department of Earth Sciences, University of Coimbra, 3030-790Coimbra, Portugal; egomes@dct.uc.pt
[3]CEMUC, Department of Earth Sciences, University of Coimbra, 3030-790 Coimbra, Portugal
[4]CGEO, Department of Earth Sciences, University of Coimbra, 3030-790 Coimbra, Portugal

This study was carried out in the city of Kuito, Bié province, central Angola. The main objectives were to characterize and compare the colour and chemical composition of dust and soil samples and identify possible sources of atmospheric particles in the city of Kuito. There were two dust sampling campaigns in 2015, with 60-day accumulation periods: the first in the rainy season, from February 18th to April 19th, and the second in the dry season, from June 5th to August 4th. Ceramic collection containers were used. Five representative samples of regional soil and 5 representative samples of urban soils were collected on May 5, 2015. The colour of the samples of dust and soil was determined by colourimetry using CIE colour space with parameters L*, a* and b*. These values are all positive, and it can be concluded from the plot x, y, z that the sample colour is close to grey and yellow shades and that the soils, especially the regional ones, are darker than the dust. The chemical composition of the samples was determined by X-ray fluorescence. Student's t-test was used to compare the means of chemical elements analysed in the samples studied, and to determine that the differences are statistically significant at a 0.05 significance level. A comparison was made of the dust in the two campaigns, the regional soils and dust, the urban soils and dust and the regional soils and urban soils. It may be concluded that the chemical composition of the dust from the two campaigns presents significant differences depending on the season for most elements, except for Mo, Sr, Pb, Bi, Al and Si, which, with the exception of Pb, represent geogenic contribution. It can also be concluded that the regional soils are distinct from the dust and that in urban soils the elements Pb, Fe and Cr show levels similar to those of the dust. As Fe is an abundant geogenic element in the lytic units of the region, these elements may be considered as representing an anthropogenic contribution associated with road traffic. Finally, regional and urban soils also show significant differences in composition, with identical levels for the elements Mo, W, Cr and Nb. The colour and chemical composition of the samples studied allow identify the lytic units and soils of the region and road traffic as possible sources of atmospheric particles in the city of Kuito.

Poster Session

Keywords: Colourimetry, X-ray Fluorescence, Dust, Soils, Kuito

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Particulate and gaseous emissions from the combustion of certified and non-certified pellets

C. A. ALVES, E. D. VICENTE, R. T. CARVALHO, D. CUSTÓDIO, L. TARELHO

Centre for Environmental and Marine Studies, Department of Environment, University of Aveiro, 3810-193 Aveiro, Portugal; celia.alves@ua.pt

The biomass market for domestic heating has been in strong growth in order to meet the heat demand by households and also to promote the use of renewable sources. The development of new combustion technologies allowed the provision of improved, automated and cleaner heating systems. One of the reasons for the better performance of such systems is the use of standardized fuels. The use of densified biomass fuels in automatic heating systems, such as pellets, showed an increasing trend over the years (Cocchi et al. 2011) and proved to be advantageous since these fuels require less space for storage, are ready to use (the fuel is already dry) and in Europe there are wood pellet regulations ensuring their quality. Furthermore, the use of pellets as fuel in domestic heating systems has been pointed out as suitable in order to reduce the emissions from this sector (e.g. Pettersson et al. 2010). However, some wood pellets commercially available have no certification and even between certified pellets the differences regarding the emissions can be noticeable. Three types of pellets (certified pellets I and II and non-certified pellets) were tested in an automatic pellet stove (9.5 kW) in order to determine the emission factors of gaseous compounds and particulate matter (PM_{10}). PM_{10} sampling was performed in a dilution tunnel, under isokinetic conditions, using a TCR TECORA (model 2.004.01) instrument operated at a flow of 2.3 $m^3\ h^{-1}$. The carbonaceous content (OC/EC) in the particulate samples was analysed by a thermal optical transmission technique. The flue gas composition was determined using an online Fourier Transform Infrared Gas analyser (FTIR Gasmet, CX4000). The certified pellets I and II have the ENplus quality label and comply with the Class ENplus A1. The third type was purchased from a local supplier and has no certification. Gaseous emissions are greatly affected by the biofuel type. The CO emission factor from the certified pellets I (13.0±3.60 $g.kg^{-1}$) was 5-fold higher than the one recorded for the certified pellets II (2.42±0.31$g.kg^{-1}$). The NO and NO_2 emission factors were higher for the combustion of the commercial non-certified pellets. The variation in NOx emissions may be related to different nitrogen contents of fuels. Fuel-NO is the main mechanism of NO formation in this type of appliance. The temperatures recorded in the combustion chamber are typically too low for the onset of the NO thermal mechanism. Regarding hydrocarbons, certified pellets I generated a higher emission factor than other fuels. Low HF, HCl, NH_3 and SO_2 emissions were recorded indicating low N, S and Cl contents in the fuels. The PM_{10} emission factors ranged from 0.56±0.09 (certified pellets II) to 1.34±0.74 (non-certified pellets) g kg^{-1}.

Poster Session

Keywords: Residential combustion, Pellet Stove, PM_{10}, OC/EC, Gaseous Emissions

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Cocchi, M., Nikolaisen, L., Junginger, M., Goh, C. S., Hess, R., Jacobson, J., Ovard, L. P.,Thrän, D., Hennig, C., Deutmeyer, M., Schouwenberg, P. P., Marchal, D., 2011. Global Wood Pellet Industry. Market and Trade Study. IEA Bioenergy.

Pettersson, E., Lindmark, F., Ohman, M., Nordin, A., Westerholm, R., Boman, C., 2010. Design changes in a fixed-bed pellet combustion device: Effects of temperature and residence time on emission performance. Energy & Fuels 24, 1333-1340.

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Particulate emissions from biomass combustion in a fluidised bed reactor

C. A. ALVES[1], E. D. VICENTE[1], J. P. RIBEIRO[1], X. QUEROL[2], F. AMATO[2], L. TARELHO[1]

[1]Centre for Environmental and Marine Studies, Department of Environment, University of Aveiro, 3810-193 Aveiro, Portugal; celia.alves@ua.pt

[2]Institute of Environmental Assessment and Water Research, IDAEA, Spanish Research Council (CSIC) 08034, Barcelona, Spain

Fossil fuel reserves are finite and diminishing from year to year leading to a growing interest in renewable energies in order to decrease the dependence on fossil fuels. Current EU policies incentives the use of biomass as renewable source of energy since it allows self-sufficiency and reduction of the greenhouse gas emissions. The technology of fluidised bed combustion applied to solid biomass is one of the most used in industrial processes since it presents several advantages, including high combustion efficiency with a very broad range of solid fuels, clean operation, high heat transfer rate between the solids bed and immersed surfaces, uniform temperature distribution, among others (e.g. Chirone et al., 2008; Scala and Salatino, 2002). Despite the advantages, the combustion process generates considerable gaseous and particulate emissions. The particulate matter emissions have gained increasing attention due to the potential health and environmental hazardous effects associated mainly with their chemical constituents and size (Bølling et al., 2009). Combustion of three typical Portuguese species of biomass has been performed in a pilot-scale bubbling fluidised bed reactor. The species of biomass burnt were eucalypt, pine and golden wattle. Total suspended particles (TSP) were collected directly from the inlet and outlet cyclone and baghouse filter ducts using a TCR TECORA instrument. The samples were analysed for organic (OC) and elemental carbon (EC), carbonates and 57 elements. The lowest TSP emissions were registered for the pine combustion experiment, which can be related to the more stable feeding of chipped pine. The cyclone separator showed low removal efficiency due to the small size of the particles released. Collection efficiencies ranging from 94 to 99% were registered for the baghouse filter system. At the exhaust duct, the TSP emissions were mainly composed of inorganic matter, while organic compounds represented a higher fraction at the baghouse filter outlet duct. Only a few percent (1 to 5 wt.%) of the TSP mass consisted of organic matter before and after the cyclone. The OM fractions in particulate matter from pine and golden wattle combustion before the dust separator were 7 to 9 times lower than those obtained after the baghouse. For eucalypt, the difference was much higher. The carbonate content in TSP samples was always lower than 2%wt. The dominant inorganic species in TSP samples showed fluctuations depending on the fuel. The main components in particles were K, Ca and Na. Baghouse filter decreased significantly the inorganic species in the particulate emissions.

Poster Session

Keywords: Biomass Combustion, Fluidised Bed, Particulate Matter, OC/EC, Inorganic Species.

Acknowledgments: This work was funded by the Life+ project AIRUSE (ENV/ES/000584).

Bølling et al., 2009. Health effects of residential wood smoke particles: the importance of combustion conditions and physicochemical particle properties, Part. Fibre Toxicol. 6 29.

Chirone et al., 2008. Fluidized bed combustion of pelletized biomass and waste-derived fuels, Combust. Flame 155 21-36.

Scala F., Salatino P., 2002. Modelling fluidized bed combustion of high-volatile solid fuels, Chem. Eng. Sci. 57 1175-1196.

P23

Variations in the structure of airborne bacterial communities in Gobi desert area during a dust event

T. MAKI[1], Y. KUROSAKI[2], K. ONISHI[3], N. YAMANAKA[2], M. SHINODA[4], F. KOBAYASHI[1], Y. IWASAKA[5]

[1] College of Science and Engineering, Kanazawa University; Kakumamachi, Kanazawa, Ishikawa, 920-1192, Japan; makiteru@se.kanazawa-u.ac.jp

[2] Arid Land Research Center, Tottori University; 1390 Hamasaka, Tottori, 680-0001, Japan; kuro@alrc.tottori-u.ac.jp

[3] Faculty of Medicine, Tottori University; 86 Nishi, Yonago, Tottori, 683-8503, Japan; issey@med.tottori-u.ac.jp

[4] Graduate School of Environmental Studies, Nagoya University; Furocho, Chikusaku, Nagoya, 464-8601, Japan; shinoda.masato@g.mbox.nagoya-u.ac.jp

[5] Community Research Service Group, University of Shiga Prefecture; 2500 Yasakamachi, Hikoneshi, Shiga, 522-8533, Japan; iwasaka@mti.biglobe.ne.jp

Microorganisms associated with mineral particles in Chinese desert regions are transported up to atmospheric area and disperse to downwind environment by Asian dust (Kosa) events, significantly impacting biological ecosystems, human health, and ice-cloud formation in downwind areas. However, the composition and population dynamics of airborne bacteria have rarely been investigated in desert areas during dust events. In this study, air samplings were sequentially performed at a 2-m high above the ground within the desert sampling site (Tsogt-Ovoo of Gobi Desert, Mongolia) from in March 16 to 19, 2014 when a dust event (TOMKOJ) caused. The particle concentrations of bacterial cells and mineral particles were ten-fold higher during the dust event days than on non-dust event days. MiSeq sequencing targeting 16S ribosomal DNA revealed that the air samples contained bacterial sequences, which were composed of more than eleven classes of bacterial populations, suggesting the high diversities of airborne bacteria in desert areas. The airborne bacterial communities in desert area mainly belong to the classes *Acidobacteria, Actinobacteria, Bacteroidetes, Chloroflexi, Bacilli, Alpha-, Beta-* and *Gamma-proteobacteria*. During the first phase of the dust event, the bacterial communities in the air sample included 6 classes at similar relative abundances ranging from 5% to 20%. In particular, the members of *Bacteroidetes*, which are known to attach with organic matters, occupied more than non-dust days. At the end stage of dust events, the sequences from *Alpha-* and *Gamma-proteobacteria* increased their relative abundances, closely relating to *Xanthomonas* spp. and *Sphingomonas* spp., which are reported to associate to the leaf surfaces of plants. Withered plants and animal feces can be observed on ground surfaces in the Gobi desert and are expected to be origins of airborne organic matters associating with bacterial populations. The members of *Alpha-*, *Gamma-proteobacteria* and *Bacilli* were predominant after the dust event had finished. The members of *Bacilli* are known to form endospore resisting again environmental stressor and predominate in the atmosphere at high altitudes above the Chinese desert and in downwind area during dust events. After dust events transported several kinds of bacteria from ground surfaces to atmosphere, some bacterial populations belonging to *Alpha-*, *Gamma-proteobacteria* and *Bacilli* are though to maintain resisting to atmospheric stressors. Our results suggest that airborne bacterial communities at the ground level in dust source areas change their species compositions during a dust event.

Keywords: Asian Dust, Dryland, Airborne Bacteria, Bioaerosol

Poster Session

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Distribution and Sources of Ambient Carbonaceous Aerosol in India

N. K. JAISWAL[1], K. S. PATEL[2], H. SAATHOFF[3]

[1]School of Studies in Chemistry, Pt. Ravishankar Shukla University, Raipur; nitinkjaiswal@hotmail.com
[2]Department of Chemistry, ITM University, Raipur, India; patelks_55@hotmail.com
[3]Institute for Meteorology and Climate Research, Research Centre, Karlsruhe, Germany

Carbons i.e. elemental carbon (EC) and organic carbon (OC) are formed mainly as a result of incomplete combustion or high temperature pyrolytic process during burning of fossil fuels, organic materials, as well as in natural processes such as carbonization. The EC and some fraction of OC are optically active and known as black carbon(BC). 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 dark color of BC attracts and absorbs heat from sunlight, causing atmospheric temperature to rise. This is particularly dangerous in the Arctic where BC settles on snow and ice, causing these surfaces to heat up and melt. The melting of glaciers and other large ice masses not only contributes to the rise of global sea levels, but also adds significant amounts of fresh water to salty oceans, which could shift the ocean circulation patterns that affect the climate. Black carbons are so small that they can infiltrate the deepest recesses of the lungs and cause significant damage to the respiratory system including irritation, chronic bronchitis, aggravated asthma and difficulty breathing. The complex environmental and health issues are appeared in the central India due to running of several sponge iron and other coal based industries. The aim of the proposed work is to describe concentrations, variations, composition and source of carbonaceous particulate pollution in the city of Raipur, central India, surrounded by heavy industries. The carbonate carbon (CC), organic carbon (OC) and elemental carbon (EC) are main components of coarse (PM_{10}) and fine ($PM_{2.5}$) particulates, and the annual (i.e. October, 2005 - September, 2006) concentration of PM_{10}, $PM_{2.5}$, CC_{10}, OC_{10}, EC_{10}, $CC_{2.5}$, $OC_{2.5}$, and $EC_{2.5}$ in the ambient air was ranged between 66 - 759, 24 - 311, 0 - 29.8, 2.2 - 56, 0.9 - 74.9, 0 - 9.1, 0.1 - 52.1 and 0.5 - 64.7 µg m^{-3} with mean value of 220±42, 95±19, 8.4±2.0, 14.0±3.4, 16.9±2.9, 3.8±0.8, 11.9±3.0 and 13.4±4.0 µg m^{-3}, respectively. The annual mean concentration of CC_{10}, OC_{10}, EC_{10}, $CC_{2.5}$, $OC_{2.5}$ and $EC_{2.5}$ in the PM was found to be 4.1, 6.3, 7.1, 4.9, 11.8 and 13.1 %, respectively. The seasonal, spatial and temporal trends in distribution of carbonaceous aerosol in ambient air of the central India are discussed. The origin of secondary organic carbon and impact of black carbon in the soil are discussed. The potential source contribution function (PSCF) analysis model was used to apportion the distant sources.

Poster Session

Keywords: Carbonaceous aerosol, Ambient air, Distribution, Sources

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Characterization of process fugitive emissions in a steel integrated site

S.M. GARCIA[1], S.M. ALMEIDA[2]

[1]Instituto de Soldadura e Qualidade; Av. Prof. Dr. Cavaco Silva, 33, 2740-120 Porto Salvo; smgarcia@isq.pt
[2] C2TN, Instituto Superior Técnico; Estrada Nacional 10, ao km 139,7 2695-066 Bobadela LRS; smarta@ctn.ist.utl.pt

The EU Air Quality Framework Directive (Directive 2008/50/EC) emphasises the need to achieve improved air quality standards in order to improve the health and longevity of citizens living in the EU. It is, therefore, imperative that industry plays its part in ensuring that the required targets are achieved, by enabling the best cost-effective abatement measures. This work attempt to investigate operations and processes occurring in a steel integrated site regarding it fugitive emissions, which are difficult to characterise and therefore to contain, as opposed to stationary point emissions which are generally well studied and controlled. Therefore, fugitive emissions from sources such as coke oven batteries, blast furnace slag granulation, iron ore stockyard and coke handling have been characterised in terms of particulate size, mass and chemical composition. Two separate joint sampling trials (winter and summer) were performed. In each case two monitoring points were selected according to predictable predominant wind direction on each source site. In those trials the following evaluation was made: (i) real time measurements of PM10 performed jointly on both monitoring points and (ii) chemical composition of PM segregated by size (PM1, PM1-2.5 and PM2.5-10) at a downwind point. As expected, meteorological conditions had a strongly influence on the results obtained, showing that slightly variations in wind directions can often result in the sampling the background air or other vicinity sources instead of emissions from the targeted source. By correlating wind direction with time measurements it was therefore possible to assessed the real contribution of the aimed source during the sampling trails. Particle size class with the highest presence was PM1 with a contribution of 41 to 53% in all sources. Regarding chemical composition, Fe, Ca, Ni and K were the elements with more relevance in all sources and among all size distribution. This approach allowed estimating mass releases from fugitive emissions of the investigated processes, putting them in perspective when compared to point emissions. Using the experience collected it is also possible to plan measurements that could provide deeper, broader and more reliable characteristics of emission sources on a steel plant.

Poster Session

Keywords: Fugitive Air Emissions; Steel Industry; Particle Size Distributions; Particle Composition Characterization

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Characterization of Fugitive Emissions from a Harbor, Setúbal, Portugal

A.V.SILVA[1,2], S. M. ALMEIDA[1], A.I.MIRANDA[2], F.MARTIN[3]

[1]Centro de Ciências e Tecnologias Nucleares, Instituto Superior Técnico, Universidade de Lisboa, Estrada Nacional 10, Km 139.7, 2695-066 Bobadela LRS, Portugal; alexandra.silva@ctn.tecnico.ulisboa.pt; smarta@ctn.tecnico.ulisboa.pt

[2] CESAM & Department of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal; miranda@ua.pt

[3]CIEMAT, Atmospheric Pollution Unit. Avda. Complutense, 22. 28040 Madrid, Spain fernando.martin@ciemat.es

The fast urbanization of the cities and the concentration of industrial and principally road traffic activities resulted in increased levels of air pollution and consequently have relevant impacts in the environment, climate and human health. Harbour activities such as loading, unloading and transport of materials may be an important source of Atmospheric Particulate Matter (APM). Fugitive dust emissions from harbours can cause nuisance in residential areas due to APM transport and deposition. Notwithstanding the availability of some emission factors specifically addressing harbours activities, they are mainly empirically-based and thus these fugitive emissions are difficult to characterize and to quantify. This work aims to characterize the emission of dust providing from operations associated with differently materials handling in the harbour, applying a methodology to estimate this type of activity's emission factors using a simple source-apportionment methodology. The harbour of Setúbal, in Portugal, was selected as case study, because it is located in a very densely populated area and also because of its proximity of a natural and protected areas. The model used to estimate the emission factors from Setúbal's harbour was the reverse dispersing modelling (RDM), which is a high-resolution lagrangian puff-model. Two field campaigns were designed and performed to characterize the emissions used as input in the RDM. Results show that manipulation of materials during harbour operations produce high emissions of particles, especially from the coarse fraction (PM2.5-10). PM10 concentrations discriminated by wind direction confirmed that the location of the sampling stations in relation to the wind direction is essential to evaluate the impact of fugitive emissions. The proposed methodology allowed determining diffuse PM emission factors associated with dust handling material at the Setúbal's harbour, but it is applicable to other harbours. The use of the estimated emission factors is an added value when assessing the Best Available Techniques (BATs) to reduce emissions in the harbours.

Poster Session

Keywords: Fugitive Emissions, Emission Factors, Metals, Harbour, Particles

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PM10 Air pollution in Portugal between 2001 and 2011

T. FARIA[1], M. ALMEIDA-SILVA1, S.M. ALMEIDA[1]

[1] Centro de Ciências e Tecnologias Nucleares, Instituto Superior Técnico, Universidade de Lisboa, EN 10, km 139.7, 2695-066 Bobadela LRS, Portugal; tiagofaria@ctn.ist.utl.pt

The good quality of the air we breathe is considered a basic need for human health and well-being. During last three decades special efforts have been made in Europe aiming to reduce air pollution and more important, to reduce the adverse impacts of atmospheric pollutants. Although these efforts led to a reduction of risks and effects, air pollution in Europe is still a matter of concern. The aim of this study was to study the air pollution by PM10 in Portugal between 2001 and 2011. Data were collected from 60 stations of air quality monitoring throughout mainland Portugal, divided by 5 regions – 1) North, 2) Centre, 3) Lisbon and Tejo Valley, 4) Alentejo and 5) Algarve. Each station was divided into 5 different types, namely: a) Traffic, b) Industrial, c) Background - Urban, d) Background - Sub-Urban and e) Background - Rural. These data were provided by the Portuguese Environment Agency, with contribution from the Committee for Coordination and Regional Development (CCDR). The results showed that the average PM10 concentrations in Portugal declined from 57 $\mu g/m^3$ in 2001 to 27 $\mu g/m^3$ in 2011 and that the annual averages since 2004 were below the current limit value of 40$\mu g/m^3$. This data are in agreement with the European Environment Agency who showed, in 2012, that Portugal was the country with main reported reduction between 2000 and 2010 (29%). This decrease may be related with the implementation of the Best Available Technologies in the industry, with the development of low emission vehicles and with the crisis experienced in recent years that is associated with the decrease of consumption and production. It is possible to observe that monitoring stations located along the high traffic areas had higher concentrations of PM10. The stations near the industries and sub-urban areas were the second type of station that presented higher particles concentration. The largest and most important cities of Portugal were the ones with the largest pollution outbreaks and where levels were still below the European targets. Between 2001 and 2011 the annual levels of PM10 decreased in Portugal. However, both the annual and the daily limit values, defined by the Portuguese Legislation, were still exceeded principally in urban and industrial areas. Moreover, the levels were also far from the narrower limit value of 20$\mu g/m^3$ defined by the WHO. The HYSPLIT (Hybrid Single-Particle Lagrangian Integrated Trajectory) model was used to perform 3-day backward trajectories, ending in Lisbon, Oporto, Estarreja and Sines. It is fundamental to continue with efforts reducing emissions of these pollutants, in order to protect public health, since it is well known that particles may promote serious diseases upon human health.

Poster Session

Keywords: PM10, Air pollution, Portugal

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Effect of Desert Dust on Ultraviolet Solar Radiation at the Surface in Évora

V. SALGUEIRO[1,*], S. PEREIRA[1], M. J. COSTA[1,2], M. A. ÓBREGON[1], A. M. SILVA[1], D. BORTOLI[1]

[1] Departamento de Física, Centro de Geofísica de Évora, Instituto de Investigação e Formação Avançada, Universidade de Évora, Rua Romão Ramalho nº59 7000 Évora, Portugal; vsalgueiro@uevora.pt

[2] Departamento de Física, Centro de Geofísica de Évora, Escola de Ciências e Tecnologia, Universidade de Évora, Rua Romão Ramalho nº59 7000 Évora, Portugal

The current work presents a study of the effects exerted by Saharan dust on ultraviolet solar radiation (280-400nm) 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 ultraviolet 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 the Institute of Earth Sciences (ICT) and included in the Aerosol RObotic NETwork (AERONET) (Holben, 1998). Global irradiance measurements in the ultraviolet spectral region were measured every 60 minutes with Kipp&Zonnen radiometers 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, and using the method proposed by (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 comparison of the radiative forcing estimates for both events showing that the first event, due to its characteristics, had a greater radiative impact than the second one which was demonstrated by the aerosol radiative forcing and forcing efficiency (aerosol radiative forcing per unit of aerosol optical thickness).

Keywords: Desert Dust, Aerosol Optical Thickness, Ultraviolet Radiation, Aerosol Radiative Forcing, Aerosol Radiative Forcing Efficiency

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The new sun-sky-lunar Cimel CE318-T multiband photometer. New calibration methods, and a comprehensive performance evaluation

A. BARRETO [1,2], E. CUEVAS[1], M. J. GRANADOS-MUÑOZ[3], L. ALADOS-ARBOLEDAS[3], P. M. ROMERO[1], J. GRÖBNER[4], N. KOUREMETI[4], A. F. ALMANSA[1,2], T. STONE[5], C. TOLEDANO[6], R. ROMÁN[6], M. SOROKIN[7], B. HOLBEN[7], M. CANINI[2], M. YELA[8]

[1]Izaña Atmospheric Research Center (IARC), Agencia Estatal de Meteorología (AEMET), 38001, Santa Cruz de Tenerife, Spain; [2]Cimel Electronique, 75011, Paris, France; [3]Department of Applied Physics, University of Granada, 18001, Granada, Spain; [4]Physikalisch-Meteorologisches Observatorium Davos and World Radiation Center (PMOD/WRC), 7260, Davos, Switzerland; [5] US Geological Survey, 86001, Flagstaff, USA; [6]Grupo de Óptica Atmosférica, Universidad de Valladolid, 47002, Valladolid, Spain; [7]NASA/Goddard Space Flight Center, 20771, Greenbelt, USA; [8]Instrumentation and Atmospheric Research Department, National Institute for Aerospace Technology (INTA), 28850, Madrid, Spain.

The new photometer CE318-T, able to perform daytime and nighttime photometric measurements using the Sun and the Moon as light source, is introduced in this work. This photometer provides information on aerosols and water vapor, day and night, whenever the sun and moon are visible, enhancing atmospheric monitoring. We have proposed four different calibration methods for CE318-T nocturnal calibration: the Lunar-Langley method for absolute calibration, the Ratio Moon method, to transfer the nocturnal calibration from a master to a secondary instrument using nighttime ratios master vs. secondary, and two new methodologies which involve only daytime measurements to infer nighttime calibration. These two new techniques are: 1) the Sun Ratio method,which requires a reference instrument nighttime calibrated; and 2) the Sun-Moon gain factor method, which requires a reference instrument daytime calibrated and an integrating sphere (not necessarily calibrated), not dependent on any lunar irradiance model. The differences of AOD values obtained from these two new calibration techniques are very small (i.e. <0.02 for 500-1020 nm wavelength range), confirming that both techniques are consistent. These two new techniques reduce significantly the previous calibration complexities inherent to nocturnal calibration (changing moon illumination conditions and the limitation of having only a few days around full moon to perform the instrument calibration). A quantitative estimation of Aerosol Optical Depth (AOD) uncertainty by means of error propagation theory revealed similar CE318-T AOD uncertainties at daytime (uDAOD) than those expected for standard AERONET (Aerosol RObotic NETwork) sunphotometers, while AOD uncertainties at nighttime (uNAOD) depends strongly on moon's illumination conditions and also on the calibration technique, ranging between 0.011 and 0.018 for reference instruments, and between 0.012 and 0.021 in case of field instruments. In this study we have assessed the CE318-T performance at daytime by comparing its measurements with those of collocated independent reference instruments. Daytime AOD evaluation, encompassed measurements from a reference CE318-T, a CE318-AERONET master, a Precision Filter Radiometer (PFR) and a Precision SpectroRadiometer (PSR) prototype, reporting very low AOD discrepancies between the four instruments (up to 0.006). These results demonstrate that CE318-T provides measurements, at least of the same quality than those provided by the current standard AERONET sun photometer. AERONET team has accepted the new CE318-T henceforth in AERONET, suggesting the replacement of CE318-N instruments by the new photometer as far as possible. The nocturnal AOD

evaluation of the CE318-T was performed using a collocated star photometer and also by means of a day/night coherence transition test using the master CE318-T and daytime data from a CE318-AERONET master. Very low discrepancies with star photometer were found at 870 nm and 500 nm channels (≤ 0.013), as well as very low differences with AERONET daytime data (1-h after and before sunset and sunrise) in agreement with the estimated uNAOD values at all illumination conditions in case of channels within the visible spectral range, and only for high moon's illumination conditions in case of near infrared channels. Precipitable water vapor (PWV) nocturnal data from CE318-T showed a good agreement Global Navigation Satellite System (GNSS) PWV values for all moon illumination conditions, within the expected precision for sun photometry.

Keywords: Sun-photometer, Lunar-photometer, AOD, Uncertainty, PWV.

FAMILY PHOTO OF THE DUSTWORKSHOP8 PARTICIPANTS!

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