Proceedings of

RICTA 2015
Elche

3rd Iberian Meeting on Aerosol Science and Technology

Elche
29 June - 1 July

Edited by J.A.G. Orza

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Welcome

On behalf of the Organizing Committee, I would like to welcome you to the 3rd Iberian Meeting on Aerosol Science and Technology, RICTA 2015. Following on from the success of previous RICTA and RECTA Conferences since 2007, I expect to bring at least the same level of excitement and information content.

This event is a valuable opportunity to learn about new discoveries, approaches and challenges in the aerosol science and technology field. It is also an opportunity to exchange views and meet again. One of the aims of the conference is fostering interaction among the Portuguese and Spanish communities, while being open to other nationals. Participants of RICTA2015 are coming from seven countries: Spain, Portugal, Poland, Italy, France, United Kingdom and Greece. Thanks to the effort of the invited speakers, authors and reviewers, the program consists of 4 invited talks, 23 talks and 65 posters.

This year, a session for presenting your poster in one or two minutes has been scheduled. Additionally, all posters should be displayed throughout the conference. We hope this will give more visibility to you and your poster presentation.

I would like to thank all the participants and the members of the Scientific and Organizing Committees for putting this conference together. Welcome to Elche!

J. A. Garcia Orza
3rd Iberian Meeting on Aerosol Science and Technology
Elche (Alicante), 29 June-1 July 2015

Proceeding Index RICTA 2015

RICTA 2015 Elche

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Invited Lectures & Talks

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SOURCES AND PROCESSES AFFECTING URBAN AEROSOLS WITH A FOCUS ON UNREGULATED SOURCES AND NANOPARTICLES

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An initial overview will be given of the major component composition and sources of particulate matter in the urban atmosphere. This will be illustrated primarily with case study data from Europe and from far eastern countries, contrasting the very different source contributions. As well-recognised sources such as road vehicle exhaust decline in magnitude, some of the main challenges from a policy perspective in reducing urban concentrations of particulate matter relate to unregulated sources such as woodsmoke, non-exhaust particles from road vehicles and cooking emissions. There is evidence that burning of biomass fuels such as wood has increased during the economic recession, but data on its contribution to air pollution remain scarce. Cooking emissions have been quantified primarily through Aerosol Mass Spectrometry, but this technique may be overestimating contributions. Non-exhaust emissions from road traffic include particles generated from wear of the brakes, tyres and road surface, and by resuspension of road surface dusts. Some of the latest data relating to these sources will be considered in the context of source apportionment estimates for $PM_{2.5}$.

There is currently a high level of interest in nanoparticles in the urban atmosphere arising largely from concerns over their greater surface area per unit mass of particles and potential toxicity. Knowledge of the sources of nanoparticles in urban atmospheres will be reviewed and major sources highlighted. In most situations, the largest contributors to urban nanoparticle concentrations are road traffic on the one hand and regional nucleation on the other. Evidence relating to these sources will be described and results of recent studies of nanoparticles from traffic will be considered. Traffic particles affect all urban areas, but regional nucleation is far more prevalent in sunnier southern climates, and the two sources may be differentiated using traffic marker elements. Areas of particular concern which will be described include studies of the hydrocarbon composition of diesel exhaust particles in the context of its semi-volatility and the contribution of desorbed compounds to secondary pollutant formation including secondary organic aerosol. There is also concern over the transition metal content of the nanoparticle fraction due to its possible role in causing oxidative stress subsequent to inhalation. Recent measurement and modelling studies of metallic nanoparticles in the atmosphere will be described with a view to better understanding their sources.

AN INCURSION INTO ATMOSPHERIC DUST POLLUTION: CHARACTERIZATION, LEVELS AND SOURCES

C. PIO AND THE ATMOSPHERIC CHEMISTRY GROUP

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Dust produced by anthropogenic, or natural, mechanical processes over the continents is an important part of the atmospheric aerosol, dominating aerosol loading in the super micrometre size range.

Anthropogenic dust is formed as result of agricultural, mining, industrial, construction and road transport activities, having an important negative effect on corrosion, soiling and health in populated areas, principally in urban conglomerations with semi-arid or arid climates.

The natural action of the wind over desert and semi-desert regions is one of the largest sources of atmospheric aerosol at planetary level, together with the formation of sea salt spray over the oceans. Dust emission from the desert surface, with special relevance in the Sahara and the Sahel, introduces huge amounts of particles into the atmosphere polluting large areas of North Africa and neighbouring regions such as the Mediterranean and south Europe where they influence air quality in episodic periods of the year. Dust emissions from deserts, as the Sahara, also have relevant impacts on regional weather and global climate, and on the biogeochemical cycles of nutrients such as iron and phosphorous over central north Atlantic and the Amazonas region.

This presentation is an incursion into the field of atmospheric dust aerosol, both anthropogenic and natural, founded on published bibliography and, mainly, on the long experience in aerosol studies of the Atmospheric Chemistry Group of the University of Aveiro. Sampling methodologies and results from aerosol measurements in urban, rural and remote areas in Portugal and Europe will be used to infer about atmospheric contamination and source apportionment of atmospheric dust, either anthropogenic or natural.

Most of this presentation is based on a recent field campaign of aerosol measurements and transport modelling, at the island of Santiago, Cape Verde, off the west of North African coast, integrated in the Project CVDUST. In this one year campaign, aerosol was continuously measured with optical instrumentation and size selectively collected over membrane and quartz filters for posterior analysis. Mass, size distribution, inorganic water soluble compounds, elements, minerals, carbon and organic species and viable species were analysed and determined. As a summary it can be concluded that desert dust contamination in Santiago is an episodic annual phenomenon occurring during the "bruma seca" period between October and April, when PM10 levels reach concentrations of hundreds μg m^{-3}, being a serious hazard to local population. Applied emission/transport modelling is in agreement with measuring experiments, showing a continuous transport of Sahara dust to the Atlantic region, at low altitude levels during "bruma seca" season and in the upper troposphere during the rest of the year. Source apportionment using receptor modelling permit to infer quantitatively the sources and processes contributing to the local aerosol loading in the different seasons of the year.

MECHANISMS OF AEROSOL TRANSPORT

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Aerosol particles are entrained by the motion of the carrier gas, where they are immersed, due to resistance forces that produce drag and lift on the particles. Thus aerosols are usually subjected to differential forces that compel them to depart from the streamlines of the surrounding gas. Furthermore, the density of the particles (or droplets) forming the aerosols is typically three orders of magnitude larger than air density and this mass disparity produces inertial accelerations that lead to additional migration phenomena.

These effects are combined in Newton's second law of mechanics whose integration provides the solution to the aerosol motion problem. The computation of aerosol pathlines requires the knowledge of the net force acting on each individual aerosol particle which constitutes the basic problem of aerosol mechanics. This problem will be reviewed here, accounting for the most significant mechanisms that contribute to aerosol transport.

A rough but useful classification of the forces acting on aerosol particles can be related to its size and shape. In general, for particle sizes in the micron range and larger, inertial effects are dominant, whereas for submicron particles phoretic effects (thermophoresis, diffusiophoresis, ...) provide the main aerosol transport mechanisms, and finally nanoparticles undergo an intense Brownian diffusion. On the other hand, regarding aerosol shape, the common assumption of spherical particle turns out to be more than just a simple canonical example as it is a good representation of droplet aerosols and high temperature solid aerosols among others. However, in most applications aerosol particles with strongly non-spherical shapes appears, often as a consequence of coagulation, and this loos of rotational symmetry leads to important orientation dependent properties affecting their transport.

In addition to these forces, aerosol motion may be driven by external fields, as gravity, electrostatics or magnetostatic forces, leading to settling, focusing or deposition phenomena.

Finally, regarding the mathematical modelling of these motions, Lagrangian or Eulerian descriptions can be used advantageously depending on the case. Examples of both approaches will be discussed in the light of some characteristic flow configurations leading to aerosol deposition and resuspension.

Work supported by research funding agencies in Spain: Ministerio de Economia y Competitividad (grant ENE2011-26868, and Program Consolider-Ingenio 2012 grant CSD2010-00011). This presentation compiles the results of years of discussions and works in collaboration with J.L. Castillo, D.E. Rosner, A.G. Konstandopoulos, A. Perea, M. Arias-Zubasti and many other colleagues and friends, to all of them my appreciation and gratefulness.

Friedlander, S.K. (2000). Smoke, Dust and Haze (2nd ed.). Oxford Univ. Press (Oxford).
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Proceedings of RICTA 2015, Elche (Alicante), 29 June-1 July 2015

DUST VERSUS CLIMATE VARIABLES AS DETERMINANTS OF THE ONSET OF THE MENINGITIS OUTBREAKS IN NIGER, MALI AND BURKINA FASO

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Outbreaks of bacterial meningitis are still today a major public health problem in West Africa. Beyond the role of social determinants on the spread of the outbreaks, recent studies have highlighted the importance of climate and dust. The intensity of the outbreaks appears to be related to specific conditions in the atmospheric circulation a few months before the onset of the outbreaks. The onset of the outbreaks coincides with the winter maximum and the arrival of the first huge dust events brought by the Harmattan winds.

The establishment of early warning systems for epidemiological risks requires then a more detailed understanding of the climate-dust-meningitis relationships. Are they similar everywhere in the meningitis Belt? At which spatial scale? Is dust a specific case compared to climate variables? If yes, which key dust parameter(s) do we have to consider?

The results presented here concern three countries affected by the outbreaks (Niger, Mali, Burkina Faso). They are notably based on the exploitation of a new-built multidisciplinary database that includes epidemiological surveys, climate reanalyses, remote sensing products, regional climate modeling outputs and in-situ measurements.

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3rd Iberian Meeting on Aerosol Science and Technology
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Oral Session I: Atmospheric Aerosols

EFFECT OF LOCAL TRAFFIC POLICIES ON AIR QUALITY IN TWO CITIES: LJUBLJANA AND GRANADA

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Atmospheric pollution represents a risk factor for respiratory and cardiovascular diseases and for cancer (e.g. Pope and Dockery, 2006). Traffic emissions are of particular concern in urban areas, since traffic-related pollutants have been associated with overall mortality increase. Transport regulation at local level for the abatement of air pollution has gained significant traction in the European Union lately. In this work, we analyze the effect of different transportation changes on air quality in two similarly sized cities: Granada (Spain) and Ljubljana (Slovenia). Several air pollutants were measured at three sites in each city before and after the implementation of the air quality plans. The Ljubljana municipality closed a 400 m section of a major street through the city center 22 September 2013 for all traffic except public buses and taxis as an abatement measure. This measure resulted in a 72% reduction of local black carbon (BC), reducing concentrations from 5.6 to 1.6 μg/m3. On the other hand, the municipality of Granada implemented a new bus transportation system on 29 June 2014. This new scheme has reduced the overlap between bus lines in downtown and introduced brand-new buses with higher passenger capacity and lower emissions. The overlap between bus lines was reduced by replacing around 10 bus lines with identical routes when crossing the Granada downtown by a single bus line. This re-organization of the public transport resulted in a statistically significant reduction of 1.3 μg/m3 (37%) in BC and of 15 μg/m3 (33%) in PM10 concentrations. At both cities, the improvement observed in air quality was very local since only the areas directly affected by the changes experienced a decrease in air pollutants. Closing streets to private traffic, renewal of the bus fleet and re-organization of the public transportation to reduce overlap between lines significantly benefit air quality and human health, possibly more than 80% for primary pollutants. The effect of the policies has the potential to greatly reduce the exposure to air pollution of the population commuting through the regulated zones.

This work was supported by the Andalusia Regional Government through projects P10-RNM-6299 and P12-RNM-2409, by the Spanish Ministry of Economy and Competitiveness through projects CGL2011-13580-E/CLI, CGL2011-16124-E and CGL2013-45410-R; and by EU through ACTRIS project (EU INFRA-2010-1.1.16-262254). The authors would like to thank Air Quality Service from Junta de Andalucía (Consejería de Medio Ambiente y Ordenación del Territorio) and Vicerrectorado de Política Científica e Investigación from the University of Granada. G. Titos was funded by the program FPI of the Spanish Ministry of Economy and Competitiveness – Secretariat of Science, Innovation and Development under grant BES-2011-043721. Part of the work described herein was financed by the Municipality of Ljubljana. The Ljubljana campaign has been made possible by collaboration with Slovenian environmental agency.

Pope CA, Dockery DW.: Health effects of fine particulate air pollution: lines that connect. J Air Waste Manage Assoc; 56:709–42, 2006.

ABL AND OZONE-AEROSOL INTERACTIONS UNDER SAHARAN DUSTY CONDITIONS AT "EL ARENOSILLO" (SW SPAIN)

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A research campaign was performed under the AMISOC (Atmospheric Minor Species relevant to the Ozone Chemistry) project at El Arenosillo atmospheric observatory (southwest Spain) in May-June 2012. The campaign was focused on the impact of Saharan dust intrusions in both the Atmospheric Boundary Layer (ABL) and ozone-aerosol interactions. In-situ and remote-sensing techniques for gases and aerosols were used in addition to modelling analyses. Meteorology features, ABL structures and evolution, aerosol profiling distributions and aerosol-ozone interactions on the surface were analysed. Two four-day periods were selected according to non-dusty (clean conditions) and dusty (Saharan dust) situations. In both scenarios, sea-land breezes were observed in the lower atmosphere, but differences were found in upper levels. Results show that surface temperatures and humidity values were higher and lower, respectively, under dusty conditions than those found under non-dusty conditions. Thermal structures on the surface layer (as estimated by instrumentation placed at different levels in a 100 m tower) show differences, mainly marked during nocturnal periods with less intense inversions under dusty conditions. The mixing layer during dusty days was 400-800 m thick, less than observed on non-dusty days. Dust also disturbed the typical daily ABL evolution. Stable conditions were observed during the early evening during dust intrusions. Back-trajectory analyses confirmed the African origin of dust arrivals. Aerosol extinction on dusty days was 2-3 times higher, and the dust was confined between 1500 and 5500 m height. On surface, the particle concentration was approximately 3.5 times higher during dusty events, but the local ozone did not exhibit any change. The arrival of Saharan dust at upper levels impacted the meteorological surface, inhibited the daily evolution of the ABL and caused an increase in aerosol loading both on the surface and at higher altitudes; however, no dust influence was observed on the surface ozone levels.

This work was supported by the Spanish Ministerio de Economía y Competitividad (MINECO) under grant CGL2011-24891 (AMISOC project). We acknowledge the NOAA Air Resources Laboratory for the provision of the HYSPLIT model. The authors thank the AEMET (Spanish State Meteorological Agency) and European Centre for Medium-Range Weather Forecasts (ECMWF) for the access to the input meteorological fields, EUMESAT for the provision of the satellites images, BSC-DREAM (Barcelona Supercomputing Center) for the DREAM images and WMO Sand and Dust Storm Warning Advisory and Assessment System (http://sds-was.aemet.es) for the netCDF files.

Proceedings of RICTA 2015, Elche (Alicante), 29 June-1 July 2015

AIRUSE-LIFE+: MITIGATION OF ROAD AND SOIL DUST RESUSPENSION IN SOUTHERN EUROPE

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Resuspension is an important air quality issue in Southern Europe. PM emissions from road dust and soil dust resuspension increase considerably the levels of PM10 in urban atmosphere and in industrial settings, hampering the attainment of EU limit values and WHO guidelines. In Scandinavian and Alpine regions, where studded tires and road sanding are used, dust binders. No information is available for the Mediterranean countries, where the high road dust loadings and climatic conditions make a very specific scenario for resuspension emissions and need to be evaluated exhaustively. AIRUSE-LIFE+ tested the efficiency of street cleaning (washing and sweeping), CMA, MgCl2 and nano-polymer, at diverse environments in Spain namely: Urban road, Industrial paved road, Industrial unpaved road, Unpaved urban park. Street washing (combined with a preliminary sweeping) was found to be the most effective measure in all tested roads: urban paved, industrial paved and unpaved. Reduction on mean PM10 levels was estimated at 7-10% (daily mean), 18% (daily mean) and >90% (in the first hour after washing) for urban paved, industrial paved and unpaved road respectively, as measured at kerbside monitoring sites. CMA and MgCl2 were not found to reduce PM10 levels with statistically significance and, in any case, reduction was lower than that of water only (e.g. 8% for CMA versus 18% for water at the industrial paved road). The low or null effectiveness of CMA and MgCl2 in Southern Europe (in contrast with Central and Northern Europe) is attributed to the high solar radiation, rapid evaporation of road moisture and consequently to the lower capacity of CMA and MgCl2 to keep a high road moisture and bind road dust particles. A side-effect of CMA spraying was found consisting in the stripping of NH3 from road surface due to the sensible (CMA induced) increase of pH. The nanopolymer was efficient in reducing resuspension in a park in Barcelona where the application of a 3 L/m^3 dosage was found to reduce PM10 levels by 2.9 μg/m^3 on a daily mean. AIRUSE recommends the use of a tandem operation, where the streets are first vacuumed-swept and then washed with water, since street sweeping alone resulted ineffective in reducing PM concentrations in the short term. The effectiveness of street washing is proportional to the magnitude of road dust contribution to total PM10. The higher the share of PM10 due to road dust, the higher the effectiveness of street washing. Street washing should be performed at the early morning (5-6 h am), before the rush traffic hour. This is due to the fact that the effectiveness of street washing is related to the higher road humidity and being generally short-lived (few hours). Street washing should be prioritized at roads with medium-high vehicle intensity (>10,000 vehicles per day), during dry periods (for example after 15 days without precipitations) and right after African dust intrusion events, when road dust emissions are sensibly higher. Non-drinking phreatic water should be preferred. For urban unpaved areas such as public parks, unpaved parking lots and access to construction sites, the use of the tested nano-polymer is recommended. Before planning street washing, the local authorities should support research studies aimed at:

1. Selecting those streets more critical for the road dust emissions
2. Estimating the accumulation rate of road dust, and
3. Determine the most effective cleaning criteria (frequency, timing, etc.). In this context, analysis of rainfall statistics are also important.

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Oral Session II: Instrumentation & Fundamentals

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NEW TECHNOLOGY FOR DETECTION AND REAL-TIME TRACKING OF AEROSOL PLUMES

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A new mechanism for the detection and real-time tracking of atmospheric aerosols is presented. The principle of operation is detection of scattered light from a narrow band light source, as in LIDAR, but using a modulated infrared signal and simpler, cheaper, and lower power consumption hardware. The emitted light is backscattered by the aerosol plume and captured by the system's optics.

The system operates with an LED emitter with 940 nm peak wavelength, in the near infrared. While this wavelength is close to absorption peaks for both liquid water and water vapour giving a high atmospheric absorption coefficient, it allows reducing interference from other sources. The wavelength is also chosen such that the scattering is dominated by Mie scattering for most of the aerosols of interest (0.1 to 10 μm), giving an optimum scattered signal. The total emitted optical power is slightly above 3 W.

The emitted light is modulated with a pseudo-random code which allows discrimination of the signal from interference and noise, and also further reduces the detectability of the signal by external equipment. The use of an incoherent source at relatively low power, and relatively long wavelength, as well as beam-spreading optics means that the optical power density is low enough to be eye-safe. The detection is performed by a Si photodiode, with standard analog electronic signal conditioning followed by sampling for digital signal processing. The signal is detected repeatedly to improve the signal to noise ratio.

Initial processing by a cross-convolution of the detected signal with the original emitted code gives the received signal as a function of distance (time). The distance resolution is dependent on the bandwidth of the detector and the sampling frequency used. The bandwidth is primarily dependent on the size of the photodetector, giving an inverse relationship of sensitivity and resolution.

It is demonstrated that even in apparently clear air the scattering is dominated by signals from close to the equipment <75 m, and therefore considerable distance resolution is important in distinguishing remote targets from the nearby signal. The position resolution is then increased by a deconvolution of the signal in the time domain using a novel iterative deconvolution algorithm able to produce good results when the signal is at, near, or even below, the noise level, given the detected signal and the system transfer function as inputs. Again this trades off resolution against sensitivity as the deconvolution increases bandwidth at the cost of raised noise.

An automated version of the system has been manufactured which performs a 360^{o} scan in approximately 3 minutes, detecting smoke to a distance farther than 3 km, and using less than 15 W total system average power.

NEW APPROACH FOR THE EFFICIENT COLLECTION OF AIRBORNE PARTICLES DOWN TO 6 nm FOR CHEMICAL AND TOXICOLOGICAL CHARACTERIZATION

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There is a need for new aerosol collection systems that allow more accurate measurements of the chemical and toxicological properties of ambient aerosols. Commonly used filter-based systems are relatively inexpensive and robust for field deployment; however their time resolution is inadequate, and laboratory analyses are costly, limiting their use for routine data collection. In addition, long collections and extraction procedures may alter the physical, chemical and toxicological properties of particles, which may lead to inaccurate assessment of exposure and health effects.

A new particle collector developed by our group is capable of collecting concentrated samples of airborne particles. The "three-stage growth tube" uses temperature-moderated water condensation technology (Hering et al., 2014) to enlarge and collect particles as small as 6 nm (Figure 1). Collection efficiencies >90% have been obtained for particles between 6 nm and 10 μm, with no particle bounce. The moderated temperatures minimize loses of semivolatiles reducing artifacts. This system can be run in two configurations to collect samples as: 1) concentrated dry spots or 2) concentrated liquid suspensions.

The Sequential Spot Sampler (S3) enables time-resolved (from minutes to hours) characterization of the chemical composition of particles at multiple locations by providing uninterrupted collection as concentrated dry deposits ($\sim$ 1 mm) into small wells within a single multi-well plate. This plate can be directly placed into an autosampler for automated extraction and analysis of several chemical species, including anions and organics. Several field campaigns have shown good correlation between the S3 and the Particle into Liquid Sampler (PILS) and the conventional URG-filter packs.

The Aerosol into Suspension Collector (ASC) collects both soluble and insoluble particles into a liquid suspension. Samples are concentrated into a small liquid volume that can be stored and later used for chemical characterization and/or toxicological studies. An in-vitro study conducted at Michigan State University showed an increase in IL-6 and IL-8 production after BEAS-2B cells were stimulated with a 3-hr sample collected using ASC.

Figure 1: Three-stage growth tube collector (*Courtesy of Aerosol Devices Inc.*)

This work was supported by NIH Grants: RC3 ES019081-01 & R43-ES022523.

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USE OF HIGH-VOLUME OUTDOOR SMOG CHAMBER PHOTO-REACTORS FOR STUDYING PHYSICAL AND CHEMICAL ATMOSPHERIC AEROSOL FORMATION AND COMPOSITION

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The atmospheric particulate matter has a large impact on climate, biosphere behaviour and human health. Its study is complex because of the large number of species at low concentrations and the continuous time evolution, being not easily separable from meteorology, transport, dispersion, and other processes. Closed reaction systems have been proposed by isolating specific reactions, pollutants or products and controlling the oxidizing environment. High volume simulation chambers, such as EUropean PHOtoREactor (EUPHORE), are an essential tool used to simulate atmospheric photochemical reactions minimizing reactor-wall effects. Furthermore, the use of natural solar light permitting the simulation of quasi-real conditions and the integration of high performance equipment, allows the accurate monitoring of particulate matter and the rest of atmospheric pollutants. In the last years, relevant advanced knowledge of the physical and chemical processes has been reached.

This communication describes the last results about the reactivity of prominent atmospheric pollutants and the subsequent particulate matter formation. Specific experiments focused on organic aerosols have been developed at the EUPHORE smog chambers. The use of on-line instrumentation, supported by off-line techniques, has provided well-defined reaction profiles. Together physical properties, about 325 different volatile organic compounds have been determined in aerosols.

The application fields include the degradation of biogenic and anthropogenic pollutants under several atmospheric conditions. For instance, the particulate matter formation from most commonly used pesticides in the Mediterranean Area has been studied, together with the contribution of their degradation products on the formation of secondary organic aerosols (SOA). In addition, polycyclic aromatic hydrocarbons from light diesel engine emissions have been extensively evaluated. Furthermore, multi-oxygenated compounds from the photo-oxidation reactions of vegetal pollutants (isoprene and monoterpenes) and aromatic compounds (benzene and toluene) have been analysed. The obtained information has been correlated with seasonal variations of SOA and sources of pollution in outdoor sampling campaigns.

In conclusion, the studies performed at the EUPHORE reactors have improved the mechanistic studies of atmospheric degradation processes and the knowledge about the chemical and physical properties of atmospheric particulate matter formed during these processes.

The research leading to these results received funding from the Spanish Ministry of Economy and Competitivity (project IMPLACAVELES: CGL2013-49093-C2-1-R), and Generalitat Valenciana for the DESETRES-Prometeo II project.

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VAPORIZATION OF A SPRAY OF SMALL FUEL DROPLETS IN A HOT GAS COFLOW

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Liquid hydrocarbons have an energy density much larger than conventional batteries, which has spurred interest in small scale power sources for portable equipment based on combustion and subsequent thermal-to-electric energy conversion. One of the challenges presented by these systems, apart from the increased heat losses that accompany large surface-to-volume ratios and set a lower limit to the combustor dimensions, is the need to atomize the fuel into very small droplets that must rapidly vaporize and generate a uniform fuel-air gas mixture before the fuel is catalytically oxidized. The electrospray has been identified as an ideally suited atomizer for miniaturized liquid fuel combustors, since it is one of the few devices that can disperse the low flow rates of interest into small, nearly monodisperse droplets. Gomez et al. (Proc. Combust. Inst. 31, 2007) used multiplexed electrospray sources working in the cone-jet mode, or a single source working in a novel stabilized multijet mode, to atomize fuel mass flow rates on the order of 10 g/h into droplets smaller than 20 microns. These authors also proposed several air supply configurations intended to enhance fuel vaporization and mixing, including heat recuperation and swirl.

We have carried out numerical simulations of the dispersion and vaporization of a spray of electrically charged droplets in a a coflow of hot air. The spray is injected axially through a central orifice at one of the bases of a cylindrical chamber 3.8 cm in height whose opposite base is a porous plug that mimics the interface with a catalyzer. A Lagrangian particle-in-cell description of the disperse phase is combined with an Eulerian description of the gas and the electric field, in which the spray of vaporizing droplets acts as a continuous distribution of charge and a continuous source/sink of mass, momentum, and energy. This approach is justified when the mean distance between droplets is large compared with the diameter of the droplets and small compared with the characteristic macroscopic size of the spray. Simple models of the heat and momentum transfer between the gas and individual droplets are used that are appropriate for moderate Reynolds number of the slip flow. The temperature of each droplet is spatially uniform, and vaporization begins when this temperature reaches the boiling temperature of the fuel, which are approximations valid for large values of the liquid-to-air conductivity ratio and the ratio of latent heat of vaporization to thermal energy. Coulomb explosions of the vaporizing electrically charged droplets are approximately represented as mass and charge losses of droplets that reach the Rayleigh's limit to daughter droplets, although the subsequent evolution of the daughter droplets is ignored.

The numerical results show that full vaporization of the spray in the available space, and uniformity of the gas mixture entering the catalyzer, depend very much on the initial mean diameter of the droplets and the inlet temperature of the gas. Thus, for a fuel with the physical properties of heptane, a mass flow rate of 12 g/h, and droplets and gas inlet velocities of 10 m/s and 1 m/s, respectively, full vaporization is achieved when the initial mean droplet diameter and inlet gas temperature are 18 microns and 200^{o}C but some liquid is left at the end of the chamber when the initial droplet diameter increases to 25 microns or the inlet gas temperature decreases to 150^{o}C. The effect of a high electric voltage applied between the bases of the chamber on the residence time of the droplets is investigated.

This work has been suppoted by Spanish MINECO through projects DPI2013-47372-C02-02 and CSD2010-00010.

MEASUREMENT METHODS OF AEROSOL AND REFRACTORY CARBON CONCENTRATIONS AT HIGH SAMPLING FREQUENCY: DEKATI® HR-ELPI + (HIGH RESOLUTION ELECTRICAL LOW PRESSURE IMPACTOR) AND ARTIUM® LII300 (LASER INDUCED INCANDESCENCE)

ISMAEL SETIEN

SolMa Environmental Solutions, S.L.

The aerosol morfology, chemical composition, size, number density, mass concentration measurements are a complex matter that requires different procedures and different instruments. At the same time, monitoring several combustion process implies very high signal sampling frequency and high sensitivity.

Aerosol Electrical Charging is the most used basic procedure for accomplishing fine and ultrafine particle analytical tests: sizing, density number, mass concentration, surface area, mobility and net charge.

Electrical Low Pressure Impactor (ELPI) is one of the solutions for providing results that correspond to the above parameters that characterize an aerosol. ELPI carries out another interesting task: used as a conventional impactor it collects 15 particle sizes class to realize gravimetric and chemical analysis.

Refractary carbon is a combustion product that is the target of several works. Until the moment, most of the procedures provide non continuous measurements or require of large periods of time to provide results. Low Fluence Laser Induced Incandescence, overcome those shortcomings by heating the soot at a close to sublimation temperature (around 4000 ^{o}K) and then measuring the emitted radiation at two different wavelengths, during the darkness period of the pulsed laser. The system is calibrated against a NIST standard, not against another aerosol analyzer. The most prominent features of this technology are wide dynamic range (from 1 ppt to ppm), high sampling frequency of the signal (20 Hz) and direct emission measurements without sampling and conditioning.

RICTA 2015 Elche

3rd Iberian Meeting on Aerosol Science and Technology
29 June - 1 July

Oral Session III: Atmospheric Aerosols & Radiation

IMPACT OF ATMOSPHERIC AEROSOLS ON SOLAR RADIATION FORECASTS

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Meteorological forecast models do not incorporate predictions of atmospheric aerosol content at the present time. They use climatological values, so they cannot predict changes due to aerosols. However, the importance of including this information to improve the predictions of the meteorological variables is recognized. One such variable that has been recently begun to extract is solar radiation. The reason is the demand for this information, mainly by the solar industry. AEMET is working in the development of a solar irradiance forecasting system using and comparing different tools.

Aerosol loading has been found to be the most critical parameter in the Mediterranean and northern Africa, causing 30% of total direct normal irradiance (DNI) extinction (Wittmann et al, 2008), reaching even 100% on dust outbreak events. However, the other aerosol major components cannot be neglected. Significant improvements in irradiance forecasts have been found when including forecasts considering more complete aerosol descriptions compared to the dust alone.

Three days with North African dust contribution were chosen for study in 8 sites of the Central, Southern and Eastern parts of the Iberian Peninsula. Differences in the range 4-15% have been found at noon when we considered forecasts of dust and all aerosol components included in the MACC predictions. The largest differences have been registered in the Southern and Eastern stations, in spite of being the regions most affected by African outbreaks. Figure 1 shows the results for Murcia on the 22nd of August 2013.

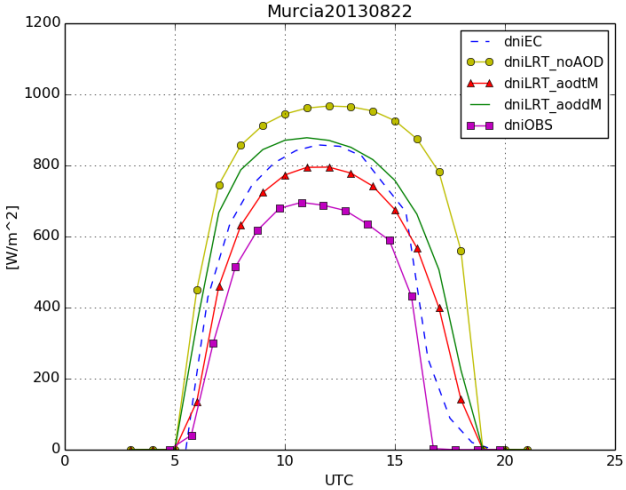

Figure 1: DNI at Murcia, 22/08/2013. Yelow circles: libRadtran without aerosols. Green line: libRadtran with MACC dust forecast. Blue dashes: forecast by ECMWF model. Red triangles: libRadtran with MACC total aerosol forecast. Pink squares: DNI observed

The libRadtran developers are acknowledged. The MACC project and the BSC-DREAM8b provided aerosol forecasts. The ECMWF provided forecasts of meteorological variables. AERONET and the Red Radiométrica Nacional provided observational data.

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STUDY OF THE AEROSOL-CLOUD INTERACTIONS OVER THE IBERIAN PENINSULA

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The study of the aerosol radiative effects and the feedbacks with the climatic system is nowadays one of the most important topics in climate science. Air quality-climate interactions (AQCI) are, therefore, a key, but uncertain contributor to the anthropogenic forcing that remains poorly understood. To build confidence in AQCI studies, regional-scale integrated meteorology-atmospheric chemistry models (i.e., models with on-line chemistry) that include detailed treatment of aerosol life cycle and aerosol impacts on radiation (aerosol-radiation interactions) and clouds (aerosol-clouds interactions) are in demand.

In this context, the main objective of this contribution is the study and definition of the aerosol-cloud interactions on the climate-chemistry-cloud-radiation system over Spain, using WRF-Chem model simulations run under the umbrella of AQMEII-Phase 2 international initiative and COST Action ES1004 EuMetChem. The selected period was a Portuguese forest fires period occurred from 25 July to 15 August 2010. A number of variables have been studied, that are directly affected by the aerosol-cloud interactions, namely cloud condensation nuclei, cloud water mixing ratio, cloud droplet number, droplet number mixing ratio, cloud optical depth, cloud water liquid path, effective radius and convective/large scale precipitation.

Results indicate that the on-line representation aerosol cloud interactions increase the cloud condensation nuclei in the coupled model, as well as cloud droplet number over the Portuguese area, where high levels of aerosols are found. There are also important changes in the cloud cover over northern Spain. High aerosols concentrations also lead to an increase of the cloud water liquid path. Precipitation over the Atlantic Ocean is enhanced when predicted aerosol concentrations were accounted for cloud droplet formation.

These simulations have been carried out under the umbrella of the EuMetChem COST ES1004 Action and the AQMEII-Phase 3/HTAP initiatives. This work was also supported by the Spanish Ministry of Science and Technology/Economy through project CGL2013-48491-R.

MULTI-WAVELENGTH AEROSOL LIDAR SIGNAL PRE-PROCESSING: PRACTICAL CONSIDERATIONS.

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LIDAR (Light Detection And Ranging) systems are powerful tools to monitor the atmosphere with range resolution. They can provide information about atmospheric aerosol content, polluting gases or wind-speed distribution[1,2].

The Barcelona lidar station has developed and operates regularly an aerosol multi-wavelength Raman LIDAR since 2007.

The LIDAR return signals need a great amount of pre-processing to be ready to be inverted in order to provide the information about the atmospheric area being probed. The information provided by the auxiliary instruments is crucial to perform a good pre-processing task.

This contribution will deal mostly with practical considerations about the following pre-processing sequences and techniques:

1. Dark measurement subtraction to avoid systematic errors. Those systematic errors are generally associated with the presence of ground loops that capture interference signals produced by the high current values needed to drive the laser flash-lamps.

2. Rayleigh-fit: to calibrate the signal, to correct for the signal offset and to define the contribution of the atmospheric molecules. If available, a Rayleigh-fit can be realized with temperature and pressure data obtained from collaborating radio-sounding probes. It can also be performed by using standard atmospheric models.

3. Signal-averaging: to improve the Signal-to-Noise Ratio.

4. Dead-time correction: in photon-counting receivers, the time response to individual detected photons results in a saturation-like effect on the extracted data[3].

5. Analogue and photon-counting signal "gluing"[3]: when analogue (immune to saturation effects) and photon-counting data are available for the same channel, both data sets can be combined to further improve the Signal-to-Noise ratio. The possible time differences between the laser light pulse emission and the respective triggers, for both the analogue and photon-counting data acquisition, must be considered and corrected

6. When an estimation of the overlap function has been previously made[4], it can be used to correct the signal of the overlap effect in the first hundreds of meters of the profile.

The theoretical foundations of these techniques will be used as a starting point and its practical consequences will be presented.

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HOW GOOD ARE AEROSOL RADIATIVE FEEDBACKS REPRESENTED IN ON-LINE COUPLED MODELS? AN ASSESSMENT OVER THE IBERIAN PENINSULA

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Atmospheric aerosols affect human health, ecosystems, materials, visibility and Earth's climate. These effects are produced mainly by their optical, microphysical and chemical properties and how affect the radiative budget of the Earth. The radiative effects can be divided into direct and semi-direct effects, produced by the aerosol-radiation interactions (ARI); and indirect effects, produced by aerosol-clouds interactions (ACI). In this sense the objective of this work is to assess whether the inclusion of aerosol radiative feedbacks in the on-line coupled WRF-Chem model improves the modelling outputs over the Iberian Peninsula.

For that purpose, the methodology bases on the evaluation of modelled aerosol optical properties under different simulation scenarios. The evaluated data comes from three WRF-Chem simulations for the Iberian Peninsula with a resolution of 0.1^{o}, differing in the inclusion (or not) of ARI and ACI. The first simulation, base case, does not take into account any aerosol feedbacks (BC); the second simulation includes the aerosol-radiation interactions (ARI); while the third adds the aerosol-cloud interactions to the previous modelling setup (ACI). The case studies cover two important aerosol episodes over the Iberian Peninsula in the year 2010. One of these episodes consists on a Saharan desert dust outbreak (simulations from 28 June to 12 July) and a forest fires episode over the Iberian Peninsula (simulations from 25 July to 15 August). The evaluation uses observational data from AERONET stations over the Iberian Peninsula, precisely aerosol optical depth (AOD) at different wavelengths (AOD440, AOD675, AOD870 and AOD1020), single scattering albedo (SSA) at the same wavelenghts, Angström exponent (AE440-870) and asymmetry parameter (g) at 440, 675, 870 and 1020 nm. Moreover the MODIS sensor has been used to evaluate AOD550 and the Angström exponent (AE550-860 over ocean and AE470-670 over land). Moreover, the evaluation also uses experimental data of aerosol vertical distribution from EARLINET stations in the Iberian Peninsula (e.g. Granada, Barcelona, Madrid or Evora), in particular particle extinction coefficient (night time), particle backscatter coefficient (both day and night time) and particle Angström exponent profiles using signals at 355, 532 and 1064 nm.

The results indicate that the inclusion of direct and indirect aerosol effects reduces the bias and improves correlations for some stations and regions. However, the domain and time averaged performance statistics do not indicate a general improvement when aerosol feedbacks are taken into account. Pronounced feedback effects are found for the summer 2010 Portuguese wildfire episode, where the ARI lower the mean solar radiation by up to 20 W m^{-2} and seasonal mean temperature by 0.25^{o}C. The most pronounced and persistent feedback due to the ACI is found for regions with very low aerosol concentrations.

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AEROGUI: UNA INTERFAZ GRÁFICA PARA LAS PROPIEDADES ÓPTICAS DE LOS AEROSOLES

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Los aerosoles atmosféricos tienen un efecto incierto en el clima, y un impacto serio en la salud humana. La incertidumbre en el papel de los aerosoles en el clima tiene varias fuentes. Primero, los aerosoles presentan una gran variabilidad espacial y temporal. La variabilidad espacial se debe a que los aerosoles son emitidos en un lugar pero pueden viajar miles de kilómetros arrastrados por el viento y modificar el clima de la región a la que lleguen. También los aerosoles están heterogéneamente distribuidos en la dirección vertical, lo cual puede llevar a un efecto diferente en el balance de energía dependiendo de la altura en la que se encuentran los aerosoles. Por otra parte, los aerosoles experimentan transformaciones físicas y químicas en el tiempo que pasan en la atmósfera, generalmente conocido como envejecimiento, que modifican sus propiedades ópticas. Estos factores hacen necesario el uso de dos enfoques en el estudio del impacto de los aerosoles en el clima: modelos globales de aerosoles y, por otro lado, medidas desde satélite y a nivel del suelo. El desacuerdo entre las estimaciones de ambos enfoques es la mayor causa de la incertidumbre en el clima.

Una manera de reducir la incertidumbre en el clima es crear nuevas herramientas para simular escenarios de aerosoles más realistas. Presentamos una interfaz gráfica para calcular las propiedades ópticas de los aerosoles: coeficientes de extinción, dispersión y absorción; albedo de dispersión simple; factor de asimetría y espesor óptico. La herramienta puede utilizarse para obtener las propiedades ópticas de la mezcla externa e interna de varios componentes de los aerosoles.

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Oral Session IV: Atmospheric Aerosols

THE ROLE OF PRESSURE ANOMALY AND INTER-TROPICAL CONVERGENCE ZONE ON MODULATING DUST OUTBREAKS IN SOUTHWEST ASIA: THE 1-3 JULY 2014 CASE

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The present work examines the dust-plume characteristics (source regions, pathways, vertical profiles) as well as the meteorological conditions and the role of Inter-Tropical Convergence Zone (ITCZ) in dust transport over southwest (SW) Asia and Arabian Sea. The examined case is that of 1-3 July 2014, when a long-range dust storm originated from the southern Turkmenistan basin and reached the northernmost part of the Arabian Sea intermingled with a second one coming from the Arabian Peninsula. A synergy of NCEP/NCAR reanalysis data, ground-based meteorological observations along with satellite remote sensing (MODIS, Meteosat, CALIPSO) data is utilized. The major dust storm (AOD550 up to 1.5-2.0) was generated in the southern Karakum desert as a result of intense north winds (Levar), due to enhanced pressure gradient between Caspian Sea and Hindu Kush Mountains. The dust plume was vertically extended up to 5 km over the arid terrain of SW Asia, as a consequence of the deep mixing layer and increased convection, while over northern Arabian Sea it was vertically mixed with dust coming from Arabia and marine aerosols due to strong monsoon winds within the boundary layer. The regional topography, monsoon circulation and the position and movement of the ITCZ play a decisive role in the modulation of the wind field, dust-storm pathways and mixing processes in the atmosphere. This study sheds light on the atmospheric circulation and processes responsible for dust exposure and transport over SW Asia and Arabian Sea in linkage to the north Levar wind and SW Indian summer monsoon. Enhanced knowledge of these meteorological processes is essential for improving dust forecasts and simulations over the region. The examined case is quite representative of the atmospheric circulation and meteorological regimes that are associated or even favour the dust exposures over SW Asia, which will be also discussed.

Analyses and visualizations used in this paper were produced with the Giovanni online data system, developed and maintained by the NASA GES DISC. We acknowledge the MODIS mission scientists and associated NASA personnel for the production of the data used in this research effort. CALIPSO scientific team is gratefully acknowledged for providing high quality CALIOP data. The NCEP/NCAR Reanalysis team is gratefully acknowledged for providing the meteorological maps. Authors also gratefully thank the NOAA Air Resources Laboratory (ARL) for the provision of the HYSPLIT transport and dispersion model and/or READY website (http://www.ready.noaa.gov) used in this publication and the technical and scientific staff of the 10 Iranian Meteorological stations that have been used in the current work.

AEROSOL MODELLING WITH THE GLOBAL ONLINE NMMB/BSC CHEMICAL TRANSPORT MODEL

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The Barcelona Supercomputing Center (BSC) does research on atmospheric chemistry, mineral dust transport and air quality. The center is working on the development of a chemical weather forecasting system based on the NCEP/NMMB multiscale meteorological model, namely NMMB/BSC Chemical Transport Model (NMMB/BSC-CTM). A gas-phase chemistry module and a multi-component aerosol scheme have been coupled online with the NMMB.

In this contribution, we describe and evaluate the fully online-coupled aerosol module simulating the lifecycle of the most relevant global aerosols (i.e. mineral dust, sea-salt, black carbon, primary and secondary organic aerosols, and sulfate) and their feedbacks upon atmospheric chemistry and radiative balance. Following the capabilities of its meteorological core, the model has been designed to simulate both global and regional scales with unvaried parameterizations: this allows detailed investigation on the aerosol processes bridging the gap between global and regional models. Since the strong uncertainties affecting aerosol models are often unresponsive to model complexity, we choose to introduce complexity only when it clearly improves results and leads to a better understanding of the simulated aerosol processes.

We evaluate our simulations using a variety of observations and measurement techniques. Surface concentration of black carbon, organic carbon, and sulfate are compared with observations from the IMPROVE, EMEP, and EANET continuous measurement networks covering anthropogenic hotspot regions (such as United States, Europe, and Eastern Asia). Global aerosol transport is evaluated also by comparing aerosol concentrations with worldwide observations from the University of Miami Network and AMS measurements. The simulated aerosol optical depth is evaluated against global AERONET sun-photometer measurements and MODIS satellite retrievals. Additionally, we discuss our results in comparison to other global models within AEROCOM and ACCMIP.

This work is supported by the project CGL2013-46736 and Severo Ochoa (SEV-2011-00067) programme of the Spanish Government.

ATMOSPHERIC AEROSOL MEASUREMENTS AT THE WMO-GAW STATION OF MT. CIMONE (2165 M A.S.L., ITALY)

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Particulate matter is one of the main atmospheric pollutants with a great chemical-environmental relevance. Improving knowledge of the sources of particulate matter and of their apportionment is needed to handle and fulfill the legislation regarding this pollutant, to support further development of air policy as well as air pollution management.

Various instruments have been used to understand the sources of particulate matter and atmospheric radiotracers at the site of Mt. Cimone (44.18º N, 10.7º E, 2165 m asl), hosting a global WMO-GAW station and located on the highest peak of the Northern Apennines. Thanks to its characteristics this location is suitable to investigate the regional and long-range transport of polluted air masses on the background Southern-Europe free-troposphere (Marinoni et al., 2008).

The PM_{10} time series sampled at the station in the period 1998-2011 is characterized by a strong seasonal fluctuation with a winter minimum and a summer maximum, attributed to the seasonal fluctuation of the mixed layer height as well as to the intense vertical exchange occurring in the warm season at this latitude (Tositti et al., 2013). Source regions of particulate matter were revealed comparing time series of PM10 and fine and coarse particles number densities, as well as applying a receptor model based on back trajectories. In summary, PM10 peaks at the site can be attributed to three classes of events:

- Saharan dust transports;
- Uplift of polluted air masses from the Italian areas north of the Apennines range;
- Advection of PM_{10} enriched air masses from the European continent North and East of the Italian peninsula.

The seasonal behavior and the source areas of the crustal radionuclide 210Pb, originated by ^{222}Rn decay and travelling attached to fine particulate matter, resulted largely similar to that of PM_{10}. Both PM_{10} as well as ^{210}Pb time series show a decreasing trend analogous to what has been observed for PM_{10} and $PM_{2.5}$ at other remote European stations (Brattich et al., in preparation).

A severe PM10 episode was also observed at Mt. Cimone in the period of 13th-15th March 2004; during the event PM10 reached the maximum concentration recorded between 1998 and 2011 (80 μg m^{-3} against an average of 8.8 $\pm$ 8.0 μg m^{-3}) (Brattich et al., submitted). Meteo-synoptical analysis allowed to ascribe this event to a long lasting and highly coherent Saharan dust outbreak. The analysis of data acquired by optical counting enabled to detect the inception and development of the event through a steep and simultaneous increase of both coarse and fine particle number densities, much less frequently documented for Saharan Dust events.

We acknowledge: ISAC-CNR for providing data, as well as infrastructural access at the WMO-GAW Global Station Italian Climate Observatory "O. Vittori" at Mt. Cimone; NOAA (http://www.esrl.noaa.gov/) for providing the HYSPLIT trajectory model (available at http://ready.arl.noaa.gov/HYSPLIT.php) and the NCEP/NCAR reanalysis data used in this study; the Italian Air Force (CAMM Monte Cimone) for the valuable co-operation at the CMN station. The Italian Climate Observatory "O. Vittori" is supported by MIUR and DTA-CNR throughout the Project of National Interest NextData.

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3rd Iberian Meeting on Aerosol Science and Technology
29 June - 1 July

Oral Session V: Aerosols&Health/Bioaerosols

EXPOSURE TO BIOAEROSOL AT WASTE SORTING PLANT

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INTRODUCTION In the European Union (EU), an average of 524 kg of municipal waste per inhabitant per year is produced. The Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 promotes the idea of "recycling society", which seeks to avoid generation of wastes and, if they are collected, to re-use them as a resource. A key element of this strategy is separate collection of wastes and, if it was not possible, their comprehensive segregation. The aim of this study was to assess the exposure to harmful microbiological agents present as bioaerosol at waste sorting plants.

METHODS The study was carried out at 3 manual waste sorting plants during summer season. The bioaerosol was sampled using 6-stage Andersen impactor. The bioaerosol measurement was done at height of 1.4 m above the ground level to simulate the human breathing zone. Standard Petri dishes filled with blood trypticase soy agar and malt extract agar were used for bacterial and fungal sampling, respectively. Quantitative analyses of isolated colonies were supplemented by qualitative identification of microbial strains.

RESULTS The results showed that average microbial concentrations in the examined processing facilities were from 1.3 CFU/m^3 to 2.2×10^3 CFU/m^3 for bacteria and from 0.2×10^3 to 1.9×10^4 CFU/m^3 for fungi. The most numerous bacteria in the air were Gram-positive species including cocci and endospore-forming rods. The most common fungal species were those from *Penicillium* (mainly *P. rugulosum*), *Aspergillus*, *Paecilomyces, Stachybotrys, Scopulariopsis, Sporotrichum, Mucor* and *Cladosporium* genera. Among the isolated microorganisms were those classified into risk group 2 including *B. subtilis, Proteus mirabilis*, species of *Streptomyces, Actinomycetes* and *Streptococcus* genera, and *Aspergillus fumigatus*. The results of the size distribution revealed that the most common microorganisms were present mainly as single cells/spores (3.3–4.7μm) and large aggregates (>7μm). As such they can easily penetrate the human respiratory tract, may be deposited within the oral and nasal cavities as well as trachea and secondary bronchi and, by that, be responsible for adverse health effects such as nose and eye irritation as well as asthmatic reactions.

CONCLUSIONS The study showed that waste sorting plants are an active source of microbial contaminants. As workers of the manual waste sorting plants are exposed to pathogenic microorganisms that can cause human diseases, highly effective preventive measures should be introduced to protect their health and safety. To reduce exposure derived from microbial hazards, the S.T.O.P. philosophy (covering systemic, technical, organisational and personal measures) may be applied.

This work was funded by the Polish Ministry of Labour and Social Policy from the Multiannual Program "Improvement of safety and working conditions (2014–2016)" through the grant no. 2.Z.21.

1. Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives. O. J. No. L 312, 3-30.
2. Directive 2000/54/EC of the European Parliament and of the Council of 18 September 2000 on the protection of workers from risks related to exposure to biological agents at work. O. J. No. L 262, 21-45.

FORECASTING THE START OF THE POLLINATION PERIOD FOR SOME TAXA IN CATALONIA (NE IBERIAN PENINSULA)

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Airborne pollen grains constitute part of the biological component of the atmospheric aerosol. Pollen concentration in the air, as well as other parameters such as the date of the start, the end and the length of the pollination period vary depending on the pollen taxa, the meteorological conditions and the characteristics of the sampling stations.

Here we explore the effect of climatic variability on the start of the pollination period (SPP) for the airborne pollen series of 22 taxa collected at 6 aerobiological stations in Catalonia (NE Iberian Peninsula) during the 18 year-period 1994-2011.
First, we have analyzed the relationship between the SPP and the phases of the North Atlantic Oscillation (NAO), the Western Mediterranean Oscillation (WeMO) and the Arctic Oscillation (AO) in their annual and winter dynamics. Climatic indices showed significant negative correlations with the SPP for most of the taxa, especially for *Artemisia*, Cupressaceae, *Pinus*, *Pistacia*, *Platanus* and Urticaceae. We also have explored the relationship between the SPP and the annual and winter precipitation. These correlations were positive or negative depending on the taxa and the station, being *Alnus*, *Artemisia*, *Olea*, *Plantago*, *Platanus* and *Quercus* deciduous type the most significant ones.
Taking into account the significant correlations showed above and the observed timing of the pollination period, we have chosen 6 of the 22 pollen taxa (*Olea*, *Pinus*, *Pistacia*, *Plantago*, *Platanus* and *Quercus* deciduous type) in order to predict the SPP.
We have applied two traditional forecasting models. Taking into account that temperature is one of the primary factors affecting blossoming, the first method consists on the cumulative sum of the daily average temperatures from a statistically determined date and above a thermal threshold. The second method consists in a multiple regression using the climatic variables: rainfall and temperature (daily average, maximum and minimum) for 10-day periods.
The different parameters needed to predict the SPP have been computed using 2001, 2005, 2008, 2009, 2010 and 2011 data. The SPP has been forecasted for the above years and 2006 and 2007, have been used as control data to test the method.
The forecasting models have been tested computing the discrepancy between the predicted and the observed values by means of different quantitative metrics commonly used to test the behavior of models.
The results show a high variability depending on the pollen taxa and the sampling station. The root mean square error (RMSE) ranged from 0.7 days for *Pistacia* in Manresa by the multiple regression model, up to 10 days for other taxa and stations. *Platanus* was the taxon showing the best results for all the stations.

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SCREENING AND ADVANCED INSTRUMENTATION FOR ON-SITE DISTINCTION OF THE BACKGROUND AND RELEASE SIGNALS IN A NANO-SIO2 PRODUCTION PLANT

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The definition of a suitable strategy for the on-site distinction between the background and release of NOAAs is still far from a sound consensus regarding real industrial environments (Lopez de Ipiña et al. 2015; Price et al., 2014; Vogel et al, 2014). Thus, the motivation for this case study is the assessment of the performance of the so-called screening and advanced instruments, from the signals simultaneously obtained.
In the frame of SCAFFOLD project (2014), here are presented the results of a case study, regarding both the standards of occupational exposure assessment (ISO 2011; ISO 2012) as well as the quasi-real time records from aerosol analyzers along the batch production of nano-SiO2 (average primary particle size 10-15 nm) as produced by TECNAN, et a rate of 0.5 kg/hour. The nanoparticles synthetized have a high purity, low aggregation and small particle size, which can be controlled depending on the production conditions. The product is collected directly from the hopper of a bag filter.
This instrumental inter-comparison encompasses a comprehensive suite of both metrics and temporal resolutions. Off-line analysis of time-integrated samples include microscopic techniques, as well as selective elemental methods, specifically Raman spectroscopy.
The batch production can be broken down in the following single tasks: production by Flame Spray Pyrolysis, weighing and packing, and the cleaning and removal of the product-dedicated bags.In order to assess the implications of the experimental results, the following reference values have assumed as guidelines: PCN 40000 particles cm^{-3} as NRV (TWA) proposed by IFA (2009), and 0.1 mg m^{-3} as OEL(TWA) proposed in SCAFFOLD (2014). Remarks should be addressed to the PCN reference valueregarding the procedure in obtaining the net PNC and the implications of the potential dynamic background (Lopez de Ipiña et al. 2015).
Result will be shown on: comparison of instruments and metrics, distinction of background signal and then tracking of potential releases of NOAA. Possibilities of monitoring will be discussed.

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Oral Session VI: Atmospheric Aerosols

SIMULTANEOUS OBSERVATIONS OF AEROSOL AND RAIN WATER CHEMICAL PROPERTIES IN A KERBSIDE SITE IN OPORTO, PORTUGAL

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$PM_{2.5}$ aerosol samples and wet-only rain water samples were collected from January 2013 to January 2014 on the kerbside of a major arterial route (Fernão de Magalhães Avenue) in the city of Oporto, and later analyzed for carbonaceous fractions and water soluble ions. The objective of this study was to gain understanding of sources and seasonal variation of aerosol and rain water chemical constituents and of how particles interact with precipitation in a kerbside environment.

The average concentrations of organic carbon (OC), elemental carbon (EC) and water soluble organic carbon (WSOC) in the aerosol were 6.3 μg/m^3, 5.0 μg/m^3 and 3.9 μg/m^3, respectively, and fit within the range of values that have been observed close to major roads. The three carbon fractions exhibited a similar seasonal variation with high concentrations in late autumn and in winter and low concentrations in spring. SO_4^{2-} was the dominant water soluble ion in aerosols, followed by NO_3^-, Cl^-, NH_4^+, Na^+, K^+, oxalate, Ca^{2+}, Mg^{2+}, formate, methanesulfonate and acetate. Some of these ions exhibited a clear seasonal trend during the study period.

The volume-weighted concentrations of water insoluble organic carbon (WIOC), EC and WSOC in rain water were 218 μg/L, 37 μg/L and 481 μg/L, respectively, which are typical of urban atmospheres. Cl^- was the dominant water soluble ion in rain water, followed by Na^+, SO_4^{2-}, NO_3^-, Mg^{2+}, NH_4^+, Ca^{2+}, K^+, acetate, formate, oxalate and methanesulfonate. No obvious seasonal trend was evident for the chemical species in rain water.

Possible sources and formation pathways of chemical species were explored by correlation analysis and mass concentration ratios. Finally, wet deposition fluxes were determined and the tendency of a species to be removed from the atmosphere by wet deposition was estimated by the calculation of scavenging ratios.

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ANALYSIS OF ATMOSPHERIC VERTICAL PROFILES IN THE PRESENCE OF DESERT DUST AEROSOLS

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Desert dust aerosols from North Africa are frequently transported towards the Iberian Peninsula, particularly during spring and summer seasons. This sorts Iberia as a privileged location to study desert dust aerosols and the interaction of these particles with radiation and clouds.

The present work aims at studying very recent episodes of desert dust transports detected over Évora, where a varied set of instrumentation for aerosol measurements is installed, including: a CIMEL sunphotometer integrated in AERONET, a ceilometer, a microwave radiometer (profiler), a TEOM monitor, an hemispheric spectral nephelometer, an aerodynamic particle sizer spectrometer and a multi angle absorption photometer.

The aerosol transports occurring over Évora site are detected and characterized using the columnar, vertically-resolved and in situ measurements. Subsequently, the tropospheric vertical profiles of humidity and temperature obtained with the passive microwave (MW) radiometer are analyzed in order to distinguish the possible influence of desert dust layers. The MW profiles examined are also compared with corresponding numerical simulations obtained with a mesoscale atmospheric model over the region of interest. This is done in order to test the ability of using atmospheric vertical profiles to vertically trace desert dust aerosol (elevated / near-surface) layers, under cloud-free conditions.

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ULTRAFINE AND NANOPARTICLE EMISSIONS FROM ATMOSPHERIC PLASMA SPRAYING

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It is well known that a significant number of indoor workplaces in the industry are potentially affected by worker exposure to harmful airborne particles. However, much less is known about the unintentional nanoparticle emission (<100 nm in diameter) and its occupational exposure, especially if non-nano sized materials are processed. The Atmospheric Plasma Spraying (APS) is a high-energy process used in a wide variety of industries to obtain enhanced coatings properties which are required to protect and/or functionalize materials, having high potential for nanoparticle formation and release by bottom-up mechanisms. The present work aimed to identify and quantify particle emissions to indoor air from APS with special interest in airborne nano-sized particles (<50 nm in diameter) generation when a micrometric ceramic suspension or powder is sprayed. For this purpose, particle number, mass concentrations, alveolar lung deposited surface area concentration and size distributions in the 10-20000 nm size range were simultaneously monitored at emission source, in the worker breathing zone and outdoor air by using different particle monitoring instrumentation (NanoScan SMPS, Grimm optical particle counter 1108, DiscMini and CPC). Airborne samples were also collected to characterize the particles by transmission electron microscopy (TEM) coupled with energy-dispersive X-ray spectroscopy.

The results evidenced that ultrafine and nano-sized airborne particles were generated and emitted into workplace air during APS on statistically significant level (higher than the background concentrations plus three times the standard deviation of the background concentration; NanoGEM, 2012). Overall, average particle number concentrations during APS were 134 times higher than background concentrations as shown in Figure 1a and b. A maximum of 8.4 x 10^6 particles·cm^{-3} with mean particle diameters of 38 $\pm$ 1.6 nm was detected. Furthermore, the size distribution measurements showed that a proportion of 33.9% of the new particle emissions (by subtracting the background from the total particle number concentration) was attributable to particles at nucleation mode (<30 nm in diameter) while 64.7% of the particles were in the 30-100 nm size range (Figure 1a and c). The results from this study evidence the risk of occupational exposure to ultrafine and nanoparticles during APS and raise a need to develop mitigation strategies in order to reduce the worker exposure.

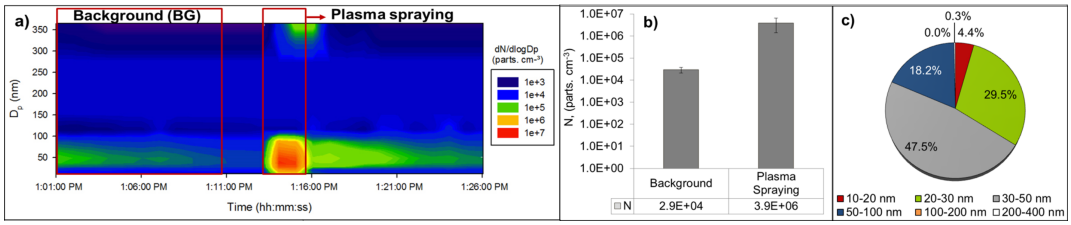

Figure 1: *(a) Time series of the particle size distribution (10-420 nm) at emission source. (b) Total particle number concentration at background and during the plasma spraying activity. (c) Contribution of particle number concentration (%) in different size ranges.*

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NanoGEM, SOP for assessing exposure to nanomaterials, following a tiered approach (2012)

BARCELONA DUST FORECAST CENTER: THE FIRST WMO REGIONAL METEOROLOGICAL CENTER SPECIALIZED ON ATMOSPHERIC SAND AND DUST FORECAST

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The World meteorological Organization's Sand and Dust Storm Warning Advisory and Assessment System (WMO SDS-WAS, http://sds-was.aemet.es/) project has the mission to enhance the ability of countries to deliver timely and quality sand and dust storm forecasts, observations, information and knowledge to users through an international partnership of research and operational communities. The good results obtained by the SDS-WAS Northern Africa, Middle East and Europe (NAMEE) Regional Center and the demand of many national meteorological services led to the deployment of operational dust forecast services. On June 2014, the first WMO Regional Meteorological Center Specialized on Atmospheric Sand and Dust Forecast, the Barcelona Dust Forecast Center (BDFC; http://dust.aemet.es/), was publicly presented. The Center operationally generates and distributes predictions for the NAMEE region. The dust forecasts are based on the NMMB/BSC-Dust model developed at the Barcelona Supercomputing Center (BSC-CNS). The present contribution will describe the main objectives and capabilities of BDFC.

One of the activities performed by the Center is to establish a protocol to routinely exchange products from dust forecast models as dust load, dust optical depth (AOD), surface concentration, surface extinction and deposition. An important step in dust forecasting is the evaluation of the results that have been generated. This process consists of the comparison of the model results with multiple kinds of observations (i.e. AERONET and MODIS) and is aimed to facilitate the understanding of the model capabilities, limitations, and appropriateness for the purpose for which it was designed. The aim of this work is to introduce different evaluation approaches and to test the use of different observational products in the evaluation system. It is also intended to find out which approach and which observational data better reflect the model performance.

The authors acknowledge all the participants that make possible all the activities of the WMO BDFC and SDS-WAS NAMEE regional node. The authors also thank calibration efforts from AERONET-Europe TNA supported by the PHOTONS and RIMA networks. We also acknowledge the MODIS mission scientists and associated NASA personnel for the production of the data used in this research effort.

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Posters Session - Atmospheric Aerosols

BIOMASS BURNING AEROSOLS DURING WINTERTIME IN GRANADA URBAN ENVIRONMENT

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Absorption of solar radiation due to aerosol particles is mainly caused by carbonaceous particles and mineral dust. The Absorption Ångström Exponent (AAE) describes the wavelength dependency of the absorption coefficient and it can give information about the type of aerosol related to its composition or its source (Cazorla et al., 2013). In this sense, black carbon (BC) follows a λ-1 spectral dependency, yielding an AAE equal to 1, and organics substances and mineral dust have a higher contribution to absorption in the ultraviolet and blue spectral regions yielding an AAE greater than 1 (Kirchstetter et al., 2004).

In this study, we analyze data from an Aethalometer AE31 that measures the aerosol light-absorption coefficient at 7 wavelengths (370, 470, 520, 590, 660, 880, 950 nm) installed in Granada, an urban city in the southeast of Spain. The period of study comprises one year of measurements from September 2012 to September 2013. Additional measurements of the aerosol light scattering coefficient and its spectral dependence were also performed by means of a TSI 3563 nephelometer. The chemical composition of 24h samples was also investigated including elemental and organic carbon, levoglucosan, potassium and inorganics compounds content. The Aethalometer data was corrected using a collocated Multi-Angle Absorption Photometer (Collaud-Coen et al., 2010). Afterwards, the model proposed by Sandradewi et al. (2008) was applied to the Aethalometer data in order to calculate the contribution of biomass burning and traffic sources to the measured BC. Variations of the Sandradewi et al. (2008) model have been explored in order to better understand BC sources at our urban environment. Results reveal an enhancement in the absorption coefficient in the UV range during winter time in coincidence with an increase contribution of levoglucosan, potassium and organic carbon, evidencing the influence of biomass burning aerosols during the cold season. On the other hand, the contribution of road traffic to BC concentrations exhibits high values all year round.

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AEROSOL OPTICAL PROPERTIES AND HYGROSCOPIC GROWTH OVER GANGETIC-HIMALAYAN REGION DURING GVAX CAMPAIGN

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In-situ measurements of optical and physical properties of near-surface aerosols were carried out at Manora Peak, Nainital, India in the Gangetic-Himalayan region in the frame-work of Ganges Valley Aerosol Experiment (GVAX) during June 2011–March 2012. GVAX aimed at investigating the contribution of Ganges valley to aerosol plume formation, development and transformation over Himalayas, which in turn play a pivotal role in the physical processes of aerosol-aerosol and aerosol-cloud interactions and their impacts on regional climate. Multiple instruments were used via the Aerosol Observing System (AOS) for measurements of optical and physical properties of aerosols, such as aerosol light absorption (σ_{ap}) and scattering (σ_{sp}) coefficients, number concentration of condensation nuclei (N_{CN}) and cloud condensation nuclei (N_{CCN}) for two different size fractions ($D_{1\mu m}$, D <1 μm and $D_{10\mu m}$, D <10 μm, where D is diameter of aerosol particle).

The results show enhanced aerosol scattering and absorption coefficients along with high NCCN and NCN in November to March period, possibly due to transported smoke plumes from agricultural burning in northwestern India (November), uplift of urban-anthropogenic aerosols from the Ganges Valley, local biofuel burning and influence of transported dust in March. In contrast, during monsoon, aerosol concentrations are significantly lower due to cloud-scavenging and rain-washout. The single scattering albedo (SSA) varies from 0.90 to 0.95 for $D_{10\mu m}$ and from 0.87 to 0.93 for $D_{1\mu m}$ aerosol particles, while the N_{CN}, N_{CCN} and activation ratio (AR = N_{CCN}/N_{CN}) range from 1606 to 4124 cm^{-3}, 684 to 2065 cm^{-3} and 0.38 to 0.60, respectively, suggesting large heterogeneity in aerosol transformation/transport properties, types and sources/sinks. Furthermore, the light scattering enhancement factor [f(RH)] and its dependency with relative humidity (RH) was investigated by means of a two-parameter fit equation for both size fractions of 1 and 10 μm. During the study period, the mean $\pm$ standard deviation values of f(RH) are found to be 1.33 $\pm$ 0.17 and 1.38 $\pm$ 0.35 for $D_{10\mu m}$ and $D_{1\mu m}$, respectively, while the mean values for the rate of change of f(RH) as a function of RH are 0.21 ($\pm$ 0.08) and 0.28 ($\pm$ 0.12) for $D_{10\mu m}$ and $D_{1\mu m}$ size fractions. In synopsis, the results show the influence of aerosol size on optical and hygroscopic aerosol properties over Gangetic-Himalayan region and reveal a significant effect of transported plumes from the Ganges Valley and neighboring regions, boundary-layer dynamics and meteorology on the aerosols in the study region.

This study is carried out under the GVAX (https://www.arm.gov/sites/amf/pgh/) project in collaboration with the DoE, IISc, SPL, ISRO and ARIES. We would like to thank the participants of the campaign for their valuable help and cooperation. The support of
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HETEROGENEOUS AND MULTIPHASE REACTIVITY OF INTERNALLY MIXED ORGANIC/INORGANIC AEROSOL PARTICLES WITH OZONE

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Sea salt aerosols generally consist of inorganic species with a wide variety of organic compounds, which is extremely susceptible to atmospheric oxidation. Chemical aging of aerosol particles generally changes their composition, decreases their reactivity, increases their hygroscopicity and cloud condensation activity, and can change their optical properties.

In the present work we study the ozonolysis of sodium halide aerosols (NaX, X=Cl, Br, I) internally mixed with maleic acid (MA). Fourier-transform infrared spectroscopy has been used to characterize particle composition, phase and gas-phase composition. We provide information about the reaction rate and mechanism of the ozonolysis of MA in presence of salt ions and the influence of relative humidity (RH) upon reactivity. In addition, we have studied the morphology of the particles by Scanning Electron Microscopy before and after the ozonolysis.The results indicate that formic acid, generated as a product in the gas phase, is produced at higher rate under high RH conditions; and the presence of NaX enhances the reaction under high RH conditions, whereas at low RH, the ozonolysis is inhibited. The apparent pseudo-first order velocity constants of the ozonolysis of internally mixed MA particles have been determined.(Pöschl et al. 2007)

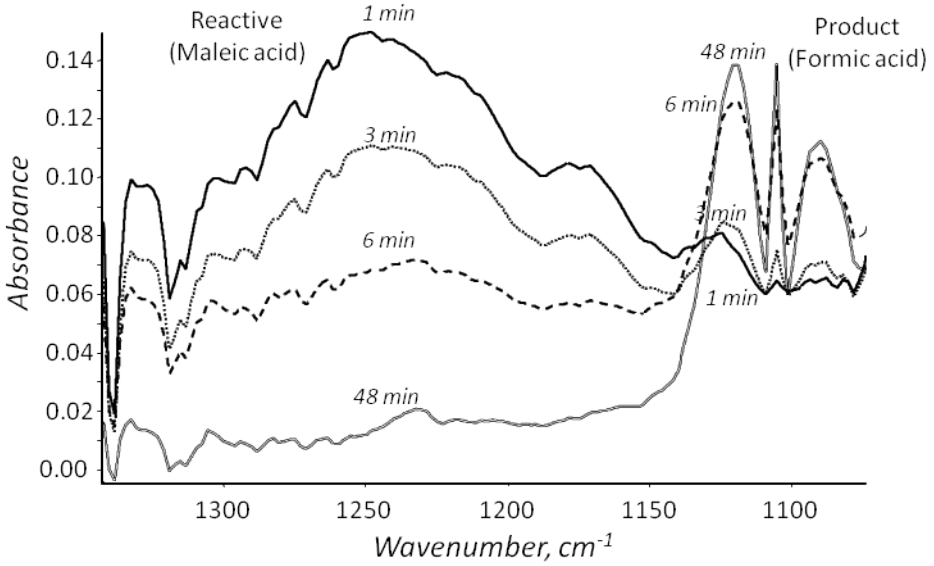

Figure 1: Time evolution of infrared spectra of MA particles exposed to O_3, showing the decrease of maleic acid signal and the increase of formic acid product signal.

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CLIMATOLOGICAL STUDY ABOUT COLUMNAR AND SURFACE AEROSOL LOAD IN THE IBERIAN PENINSULA

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The climatology of atmospheric aerosols over the Iberian Peninsula (IP) has been analyzed using PM_{10} and AOD_{440nm} data from AERONET and EMEP networks, respectively, in the 2000s. This kind of analysis leads to a classification of five different sectors (as shown in Figure 1). The PM_{10} annual cycles in five Iberian sectors show a main maximum in summer and a secondary in spring, which is only observed in the southern area for the AOD climatology. In the remaining sectors, the AOD cycle is close to a bell shape (see Figure 1). The characteristics of PM_{10}-AOD annual cycles of each geographical sector are explained by the different climatology of the air mass origins and their apportioning (Mateos et al., 2015). The polar maritime and Arctic air masses are proved as the main responsible of the aerosol climatology in the North and Central regions. The eastern coast presents a dominant role of the Mediterranean air masses which cause different aerosol climatology. And finally, African air mass intrusions loaded with desert dust strongly modulate the annual cycle shape in the southern area.

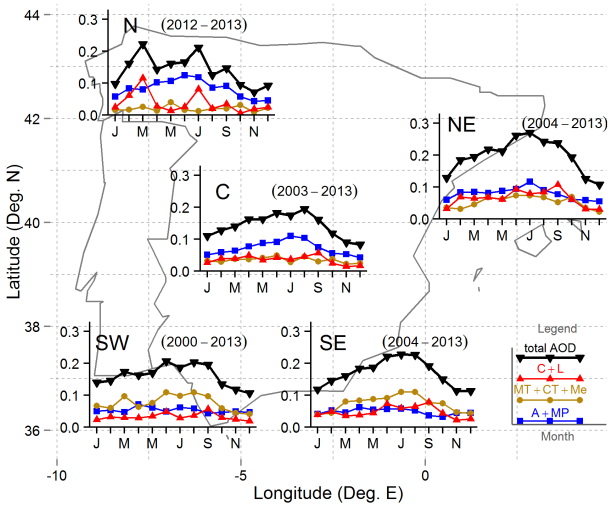

Figure 1: Annual cycle of aerosol optical depth (AOD) and the apportioning of seven air masses: A (Arctic), MP (polar maritime), MT (tropical maritime), CT (continental tropical), Me (Mediterranean), C (continental), and L (local) for the five Iberian sectors.

The authors are grateful to: AERONET and EMEP networks; FP7/2007-2013 program under 262254 [ACTRIS] agreement; Spanish MINECO (projects of ref. CGL2011-23413, CGL2012-33576); and Environmental Council of the "Castilla and León" Regional Government (AERQUA project).

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ANGULAR CORRECTION FOR THE TSI 3563 INTEGRATING NEPHELOMETER: RESULTS FROM OBSERVED SIZE DISTRIBUTIONS AND MIE AND T-MATRIX CODES

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Natural and anthropogenic particles in the atmosphere alter the Earth's energy budget and are drivers of climate change. In studying scattering properties of atmospheric particles, two important facts should be considered: (a) the uncertainties associated with instruments for measuring the scattering aerosol properties and (b) the particle's non-sphericity, which is know to have a great impact in the description of the particle-radiation interaction (Sorribas et al., 2015). In this study was carried out an investigation of an instrument widely used to measure the scattering and backscattering properties, the TSI's integrating nephelometer —Model 3563— (Anderson et al., 1996; Müller et al., 2011). The dry ambient sub-micron and super-micron size distributions were monitored by a Scanning Mobility Particle Sizer (SMPS) and an Aerodynamic Particle sizer (APS), respectively.

Ideally, the nephelometer should integrate light scattered in a volume of air over a 0^o-180^o angular range. But in reality the light scattered in the near-forward (0^o-7^o) and near-backward (170^o-180^o) directions cannot be measured. Additionally, the illumination function of the light source deviates from a sine function, meaning that it is not a Lambertian radiant source. Anderson and Ogren (1998) presented a correction (Cts – for scattering and Cbs – for backscattering), considering both deviations (non-Lambertian illumination and the angular truncation), which is called in our work as 'angular correction'. The correction factor for particle scattering was defined as, $Cts=\sigma_{SP}{}^{TRUE}/\sigma_{SP}{}^{NEPH}$, where $\sigma_{SP}{}^{TRUE}$ was the Mie-calculated 0^o-180^o and $\sigma_{SP}{}^{NEPH}$ was the calculated scattering using the Mie Code, for a broad range of aerosol populations. In our work, the $\sigma_{SP}{}^{NEPH}$ was calculated using experimental particle size distributions measured by the SMPS and APS particle spectrometers. The Mie Code has been used to calculate the optical parameters for spherical particles and the T-matrix theory for non-spherical particles.

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SEASONAL VARIATION OF PM_1 AEROSOLS AT A REGIONAL BACKGROUND SITE IN SOUTHEASTERN SPAIN

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Between February 2011 and September 2012, 161 daily PM_1 samples were collected at Mt. Aitana (38^0 39' N; 0^0 16' W; 1558 m a.s.l.) using a high-volume sampler (MCV, 720 m^3/day). Samples were analysed by ion chromatography and by a themal-optical method for the determination of major ions (SO_4^{2-}, NO_3^- and NH_4^+) and carbonaceous species (organic and elemental carbon), respectively.

The PM_1 concentration averaged for the whole study period (4.3 $\mu g/m^3$) was of the same order than that found at another Spanish regional background site, Mt. Montsec, which is located at a similar altitude, but at a higher latitude (5 $\mu g/m^3$ three-year average; Ripoll et al., 2014). However, it was lower than the value obtained at Mt. Montseny (8 $\mu g/m^3$), a Spanish station located closer to urban areas than Montsec and at a considerably lower altitude (720 m a.s.l.). Therefore, this station is most of the time under the planetary boundary layer (PBL).

Organic matter (calculated by multiplying OC concentrations by a factor of 2; Marenco et al., 2006) was the principal constituent of PM_1, accounting for 42% of the total mass. The second major component was ammonium sulfate, which contributed 28% to the total PM_1 concentration. The sulfate to ammonium ratio (2.6) indicates that all sulfate was neutralized by ammonium. EC concentrations (0.07 $\mu g/m^3$) were extremely low, as expected from its exclusively anthropogenic origin. Regarding nitrate levels (0.10 $\mu g/m^3$), these were lower than those measured at other high altitude sites like Mt. Cimone (0.26 $\mu g/m^3$, summer average; Marenco et al., 2004). A possible explanation is that Mt. Cimone is often under the influence of emissions in the Po Valley, one of the highest industrialized areas in Europe.

The seasonal cycle of PM_1 concentrations at Mt. Aitana was characteristic of a high altitude location (Marenco et al., 2004; Ripoll et al., 2014). The highest values were recorded during summer (5.8 $\mu g/m^3$) while the minimum levels were measured in winter time (2.7 $\mu g/m^3$). Some of the reasons are: (1) during winter, the top of the mountain is frequently above the PBL and precipitation rates are higher; (2) the increase in temperature and solar radiation intensity during summer months favors biogenic emissions and the formation of secondary aerosols; (3) in summer there is a higher frequency of occurrence of Saharan and recirculation episodes that contribute to increase PM levels in the western Mediterranean Basin. OC, sulfate and ammonium, the main constituents of PM_1, also showed a marked increase from winter to summer.

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VALIDATION OF LIBRADTRAN AND SBDART MODELS UNDER DIFFERENT AEROSOL CONDITIONS

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This study is aimed at analyzing the performance of the radiative transfer models libRadtran (Mayer and Kylling, 2005) and SBDART (Ricchiazzi et al., 1998) for estimating the shortwave (285-2800 nm) irradiance under different aerosol conditions. For that purpose, measurements of downward irradiance at the earth's surface in Évora (38.6º N, 7.9º W, 293.0 m a.s.l), Portugal, and the corresponding model simulations have been compared for six selected days. Version 1.7 of the libRadtran and version 2.4 of the SBDART radiation transfer codes were applied to estimate the global solar irradiance at ground level. The inputs of the radiation codes were the same for the two models. Level 2.0 AERONET (Aerosol Robotic NETwork) aerosol optical properties were used in the simulations. Total ozone column was provided by the Ozone Monitoring Instrument (OMI). Surface albedo values were obtained from the Surface and Atmospheric Radiation Budget (SARB) working group (http://snowdog.larc.nasa.gov/surf/index.html). Radiation was measured by an Eppley pyranometer installed at Évora Geophysics Center Observatory in Évora. Only measurements corresponding to solar zenith angles lower than 80º have been considered in this study.

The comparison between measured and simulated values shows a highly significant correlation, with a correlation coefficient over 0.999 for both models and slopes very close to unity (libRadtran between $0.992/pm0.004$ and $1.017/pm0.003$ and SBDART between $0.997/pm0.004$ and $1.024/pm0.002$), supporting the validity of the models in the estimation of irradiance in the shortwave spectral range. Relative differences between the simulated and measured irradiances with respect to the measured values have also been calculated, being most of the differences lower than 0.1 % for the six days. These small differences could be associated with experimental errors in the measurements as well as uncertainties in the input values given to the models, particularly those related with the aerosol properties. Also, relative differences between the models have been calculated, obtaining values lower than 0.02 %. The SBDART model slightly overestimates the libRadtran simulations. The notably good agreement between simulated and measured irradiances indicates that both models can be used to estimate solar irradiance, provided that the models are fed with high-quality data.

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EFFECT OF WATER VAPOR IN THE SW AND LW DOWNWARD IRRADIANCE AT THE SURFACE DURING A DAY WITH LOW AEROSOL LOAD

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The aim of this study is to analyze the effect of the water vapor content on the downward irradiance measured at the earth's surface. For that purpose, different estimations of downward irradiance using the radiative transfer model libRadtran (Mayer and Kylling, 2005) with different water vapor content and spectral ranges: shortwave (SW: 285-2800 nm) and longwave (LW: 3500-50000 nm). These simulations have been conducted for the location of Évora (38.6º N, 7.9º W, 293.0 m a.s.l), Portugal, the August 4, 2012. This date was selected as a good example of a cloud-free day with low aerosol optical depth. LibRadtran Version 1.7 was used to estimate the downward irradiance at ground level, with inputs of total water vapor content and aerosol from Level 2.0 AERONET (Aerosol Robotic NETwork). Total ozone column was provided by the Ozone Monitoring Instrument (OMI). Surface albedo values were obtained from the Surface and Atmospheric Radiation Budget (SARB) working group (http://snowdog.larc.nasa.gov/surf/index.html). The simulations for the study day have been made each 10 minutes and for solar zenith angles lower than 80º. The values of the total water vapor content used in the simulations are: the true value (corresponding to August 4, 2012), the true value –2 mm, the true value –5 mm and the true value – 10 mm.

The comparison between the simulated irradiance obtained with different water vapor content shows differences in both spectral ranges. For SW, the irradiance reaching the earth's surface increases when the water vapor content decreases. For LW, the behavior is the opposite, the irradiance decreases when the water vapor content decreases. Relative differences between the simulated irradiances with lower water vapor content, with respect to the simulated irradiances with the true water vapor content have also been calculated, obtaining an increase for the SW irradiance of up to 4 %, 2 % and 1% respectively for the three cases studied, and the LW irradiance decreases up to 10 %, 4 % and 2 %, corresponding the largest decreases to the smallest values of water vapor. The effect of water vapor in the aerosol radiative forcing (ARF) has also been analysed, obtaining relative differences between the ARF calculated with low water vapor content with respect to the ARF calculated with the true water vapor content, of up to 2.5 % for SW and 35 % for LW. This study shows the significant influence of water vapor content on the SW and LW irradiance measured at the earth's surface, being more important in the LW. Therefore, it is concluded that, in order to obtain accurate estimations of the irradiance, the model must be fed with highly reliable values of the water vapor content.

This work was partially supported by FCT (Fundação para a Ciência e a Tecnologia) through the grant SFRH/BPD/86498/2012, the project PDTC/CEO-MET/4222/2012 and the research project CGL2011-29921-C02-01/CLI granted by the "Ministerio de Economía y Competitividad" of Spain. The authors acknowledge the funding provided by the Évora Geophysics Centre, Portugal, under the contract with FCT (the Portuguese Science and Technology Foundation), PEst-OE/CTE/UI0078/2014 and the Institute of Earth Sciences. The authors also acknowledge Samuel Bárias for maintaining instrumentation used in this work. Thanks are due to AERONET/PHOTONS and RIMA networks for the scientific and technical support. CIMEL calibration was performed at the AERONET-EUROPE GOA calibration center, supported by ACTRIS under agreement no. 262254 granted by European Union FP7/2007–2013.

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CHARACTERIZATION OF AFRICAN DUST OUTBREAKS IN SOUTHERN SPAIN

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North Africa is widely considered as the largest dust producing source, identifying the Sahara desert as one of the major source areas of windblown dust in the Northern Hemisphere. Due to the proximity to the African continent, Spain is especially affected by those dust plumes. Thus, a number of works have been devoted to the influence of African dust on health, ecosystem dynamics or climatic change, as well as to the study of its properties and the mechanisms of dust transport.

Even the huge amount of studies concerning African dust outbreaks, there are still questions to be answered. The aim of the present work is to characterize these episodes and their influence on the air quality in southern Spain to try to contribute to a better understanding.

The study area is located in Málaga (southern Spain). Days affected by African dust outbreaks during 2009-2011 were identified using the DREAM and NAAPS dust models. Daily concentrations of air pollutants and meteorological data, as well as Absorbing Aerosol Index (AAI) and Aerosol Optical Depth (AOD) data from satellite data were used to try to find out the influence of the African dust transport toward Spain on the air quality. Moreover, 96-hour back-trajectories were computed at 00, 06, 12 and 18 UTC each day during the study period arriving at the receptor point at different heights from 500 to 5000 m above sea level (m a.s.l.) in 250 m increments by the HYSPLIT dispersion model.

In the period 2009-2011, 101 African dust events were identified in the study area, accounting for a total of 403 days (on average 34 events and 134 days per year) mainly occurring in summer (more than 40%). During these events, PM_{10} values range from 13 to 166 μg m^{-3} and more than 30% of them present exceedances of the daily limit value of EU air quality directive. Likewise, AOD and AAI records range from 0.038 to 1.603 and -3.3 to 2.7 respectively. On days affected by African dust, the trajectories reaching Málaga at low heights do not pass over Africa, but over the Mediterranean; trajectories arriving between 1500 and 2500 m a.s.l. passed over the African continent and at high altitude they reach from the Atlantic.

Levels of PM_{10} and gaseous pollutants show a clear seasonal pattern. NO_2 and CO present a maximum during winter, while O_3 and PM_{10} show higher records in summer. For PM_{10}, SO_2 and O_3 significant differences were found between days affected and non-affected by African dust outbreaks, however, NO_2 and CO do not show these differences.

For PM_{10}, SO_2 and O_3 significant differences were found between days affected and non-affected by African dust outbreaks, however, NO_2 and CO do not show these differences.

The correlation between the time which backtrajectories have lasted over the African continent versus PM_{10} and AAI, were the highest for altitudes between 2250 to 3500m. For AOD the best correlations are found for 2250 to 5000 m a.s.l.

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TRENDS IN THE AEROSOL LOAD PROPERTIES OVER SOUTH EASTERN ITALY

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The long term analysis of aerosol properties is of peculiar importance to investigate the changes of natural and anthropogenic aerosol contributions and to better evaluate the aerosol impact on the surface radiation balance. Aerosol optical thickness (AOT) measurements performed from 2003 to 2013 at a southeastern Mediterranean site within the Aerosol Robotic Network (AERONET), have been analyzed to investigate the long term trend of the AOT at different wavelengths and of the particle mean size by mean of Ångstrom exponents (AE) referring to different wavelength pairs.

Non-parametric procedures based on the Mann-Kendall test were considered for the assessment of monotonic trends in combination with the Theil-Sen slope estimate, in the time series of monthly mean, median, 10th and 90th percentile values. The Mann-Kendall test allows working with non-normal data and in situations with many missing values, and it is resistant to extreme cases. It, however, requires independence between observations; therefore, short-term persistence and seasonality alter the significance levels and may lead to wrong conclusions about the presence of a trend. The seasonal Kendall test (Hirsch et al., 1982), as well as the trend-free pre-whitening (TFPW) procedure (Yue et al., 2002) applied over the seasonally adjusted monthly series, were used. The deseasonalized time series used as input for the TFPW method were obtained from a seasonal-trend decomposition of the series based on LOESS (locally weighted low-degree polynomial regression) applied recursively to the seasonal and trend components (Cleveland et al., 1990).

According to both tests there exist significant downward trends in all the AOT time series, at least at the 90% confidence level, while no trend is found in the AE calculated at the 440 and 870 nm wavelength pair. These results suggest that the aerosol load has decreased while the mean particle size likely remained unchanged from 2003 to 2013.

The AOT (negative) trend is stronger at lower wavelengths. For each AOT, the strongest trends are found for the time series of the 90th percentile and the weakest are found for the 10th percentile values. The 10th percentile AOT decrease may clearly indicate a lowering in the background aerosol levels. Trends in the 90th percentile of the AOT at 1020 nm (which is more sensitive to coarse mode particles) and of the AOT at 340 nm (more sensitive to fine mode particles) would indicate that both coarse and fine mode particles are decreasing over time. Results on the AOT and AE relationships with the frequencies of occurrence of the large-scale advection patterns are also reported.

In the same time period, the monthly AOT mean values at 550 nm (Land and Ocean aerosol products) from the MODerate resolution Imaging Spectroradiometer (MODIS) on board the Terra and Aqua satellite show a downward trend of smaller magnitude. A decrease over time is also observed in the monthly mean, median, 10th and 90th percentile values of PM10 concentrations (2005-2013) measured at the ground level.

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DIFFERENCES BETWEEN THE MONTHLY AVERAGES OF WATER VAPOUR COLUMN DERIVED FROM SATELLITE AND GPS INSTRUMENTS IN THE IBERIAN PENINSULA

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Water vapour plays a key role in the climate, exchanging heat into the atmosphere and changing atmospheric aerosol properties due to hygroscopicity. Therefore, the knowledge of the atmospheric water vapour amount, well represented by the total column water vapour column (WVC), is a relevant topic within the atmospheric sciences. A satisfying way to obtain WVC in any place of world is through satellite retrievals since they give a global spatial coverage of the atmosphere. This is the case of GOME-2 (Global Ozone Monitoring Instrument 2), currently on board two satellite platforms (MetOp-A and MetOp-B) which provides WVC values worldwide with a pixel resolution of 80 km x 40km. However, this kind of remote sensing data needs be validated against high quality data in order to assure their reliability.

In this framework, the main objective of this study is to inter-compare the WVC from GOME-2 (on board MetOp-A satellite) data with WVC measurements derived from GPS devices at the Iberian Peninsula. To this end, the WVC measured by GPS instruments at 21 Spanish locations were used in order to obtain the monthly WVC average of each place. Moreover, the WVC data provided by GOME-2 at the same places were also monthly averaged. The standard deviations of these monthly means were also calculated in order to obtain information about intra-monthly variability. Finally, the monthly means and standard deviations of GOME-2 observations were compared against GPS values in each station and each month.

The obtained data shows four well defined climatological areas. From the results, it can be seen that the monthly WVC of GOME-2 fits better with the GPS for summer months. The absolute differences are usually lower than 10% in spring and summer months for all zones, showing an underestimation of GOME-2 in spring and an overestimation of GOME-2 in the remaining months. North-Atlantic zone show the lowest differences while the South-Western zone is the area that shows in general the highest differences in the summer months, indicating that GOME-2 predicts a worse climatology in this zone. Regards the standard deviation comparison, the highest differences usually appear for North-Atlantic zone followed by Mediterranean zone. Most of the months present differences between -10% and 10% for Continental and South-Western regions. For all zones together (using all available data) the standard deviation obtained from GOME-2 fits well the obtained by GPS in spring, but it strongly overestimates GPS in winter. Overall, the zones with lowest differences between the GOME-2/GPS monthly averages present the highest values of the difference between the GOME-2/GPS standard deviation.

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ANGSTRÖM EXPONENT AND FINE MODE FRACTION OVER TWO SITES IN SOUTHERN SPAIN

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One of the fundamental atmospheric columnar aerosol properties is their size distribution. Ångström exponent (α) is known to give information about aerosol size distribution, and the fraction of the optical depth contributed by the fine mode (fine-mode fraction) (FMF) can be used to identify and quantify the extent and the role of anthropogenic particles in climate. In this work we have compared these parameters and its relationships at two locations in Southern Spain (Granada and Málaga), an urban and a coastal site, respectively. This analysis uses measurements gathered during three years (2010, 2011 and 2012). The spectral behaviour of the AOD is used to compute the AOD fine mode fraction (FMF). Measurements were obtained by a CIMEL sun/sky photometer, which is the standard used in the AERONET network (Holben et al., 1998). This instrument is within RIMA (http://www.rima.uva.es/RIMA/), Iberian network of sun-photometers included in AERONET.

FMF showed a clear seasonal pattern, with maximum in winter and minimum in summer for both localities (0.71 ± 0.18 and 0.42 ± 0.14 at Granada; 0.61 ± 0.17 and 0.46 ± 0.13 at Málaga), thus prevailing the fine particles in winter and coarse particles in summer, and the presence of more fine particles in Granada in comparison to Málaga is detected. A similar pattern have also found for α. There is a good linear relationship between FMF and α for both localities, with the determination coefficient (R^2) higher than 0.94. This result suggests a high sensitivity to fine fine/coarse mixtures. Also, it was detected a high dispersion for α values greater than 1, suggesting that for a given α value there is a wide range of FMF values. This is largely the result of differences in fine mode particle size and the reduction in α magnitude as in fine mode particles grow from aging and/or hygroscopic growth.

INFLUENCE OF SEA-LAND BREEZE PATTERNS ON ^{210}PB ACTIVITY CONCENTRATIONS IN SOUTHERN IBERIAN PENINSULA

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The meteorological impact in the temporal and spatial variability of natural radionuclides, particularly ^{210}Pb, is often oriented to synoptic-scale studies. Nevertheless, mesoscale processes, as sea-land breezes, play a key role in its temporal variability in complex areas.

The aim of this work is to analyse the role of sea-land breezes circulations on the temporal variability of ^{210}Pb activity concentrations on surface aerosols in southwestern Iberian Peninsula. With this target, we have taken as reference the ^{210}Pb database at El Arenosillo station (southwestern Iberian Peninsula) during 2004-2011 (128 periods of 48h).

The analysis of surface winds during each period has revealed that two sea-land breeze patterns (pure and non-pure) have a positive impact on ^{210}Pb activity concentrations. Pure breezes show the typical behaviour of coastal areas, where flows run perpendicular to the coastline. Non-pure breezes occur under synoptic forces, causing a nocturnal regime with fair flows not perpendicular to the coastline. The mean concentrations were 0.80 ± 0.09 Bqm^{-3} for the pure pattern (34 days) and 0.54 ± 0.09 Bqm^{-3} for the non-pure pattern (23 days), while for the rest (71 days) is 0.46 ± 0.04 Bqm^{-3}. The pure pattern favours the accumulation process and the non-pure is associated with regional transport.

One representative period of each pattern has been also analysed based on 1) hourly surface wind observations, 2) the wind field simulated by the Weather Research and Forecasting (WRF) mesoscale meteorological model and 3) the hourly database of sub-micron-particle size range. These particles are used to represent the impact of sea-land breezes circulations on hourly pattern of ^{210}Pb due to the rapid association of ^{210}Pb onto this type of particles and on the high correlation obtained in the present work between ^{210}Pb activity and particles in the accumulation mode (NACC) ($r = 0.90$). The analysis suggests the previous transport of particles by Mediterranean flows along the Guadalquivir valley in the case of the pure pattern, and the arrival of winds coming from the continental areas of the western Iberian Peninsula in the case of non-pure, as the reasons of these high activity concentrations.

These results reveal the necessity to consider mesoscale meteorological conditions and the use of NACC in the hourly temporal analysis of ^{210}Pb concentrations.

SPECTRAL BEHAVIOR OF CARBON AEROSOL PARTICLES IN A HIGH MOUNTAIN SITE

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Between March 2014 and December 2014, a radiative forcing study of aerosols was held at Mt. Aitana (38º39' N; 0º16' W; 1558 m a.s.l.). Absorption measurements were obtained every 5 min at seven different wavelengths (370, 470, 520, 590, 660, 880 and 950 nm) using an Aethalometer (model AE31, Magee Scientific, USA). Attenuation of light through filter paper at 880 nm channel is considered standard for calculating BC concentration as there is no other major aerosol species which exhibits absorption at this wavelength (Hansen et al, 1984).

BC concentrations at 880 nm are plotted in Figure 1(a). Daily and monthly mean were calculated showing higher values in summer than in other seasons. The biomass smoke aerosols has a strong wavelength dependence. On the contrary, light absorption by the motor vehicle aerosols show relatively weak wavelength dependence (Kirchstetter et al, 2004). The absorption Ångström exponents (AEE) were calculated and its daily mean is shown in Figure 1(b). The AAE are lower in summer and it could be indicative of less biomass burning in comparison to the rest of the year. In summer the BC concentrations were higher compared to winter, however the lowest AAE was observed in summer.

Thus, the BC measured in summer had mainly a fossil origin. Conversely, in winter average AAE up to around 2 were measured indicating the importance of biomass burning aerosol in the region under study.

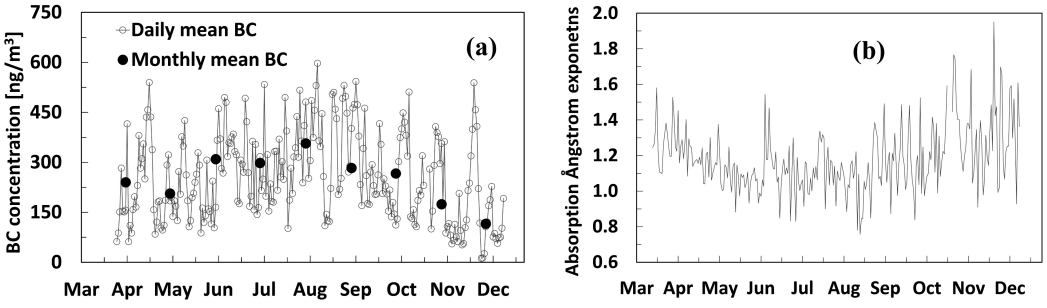

Figure 1: Seasonal evolution of BC concentration (a) and daily mean AAE (b)

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RETRIEVAL OF AEROSOL PROPERTIES WITH GRASP USING COLOCATED SUNPHOTOMETER AND CEILOMETER DATA

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Aerosol optical properties play an important role in the radiative budget and energy balance of the Earth. However, there are still large uncertainties in their characterization and therefore in the assessments of climate effect produced by atmospheric aerosols. In this study, we focus on ground based measurements, which among different techniques, are used to retrieve aerosol properties. Specifically, we analyze the possibility of combining sun photometer and ceilometer measurements in a joint retrieval.

During the last years, spectral measurements of direct Sun radiation and angular distribution of diffused sky radiation obtained by sun-photometer measurements have been successfully used to retrieve aerosol properties like single scattering albedo (SSA) and aerosol size distribution (SD) (e.g. Nakajima et al., 1996; Dubovik and King, 2000). The aerosol properties retrieved from this procedure are columnar due to the measured information which is used in the inversion algorithms. However, the aerosol vertical distribution remains unknown and its form needs to be assumed by the retrieval algorithms. This approximation can have some consequences on the retrieval products depending on the observation geometry and the characteristics of the vertical distribution (Torres et al., 2014).

The idea of the present study is to make use of the information about aerosol vertical distribution provided by a ceilometer co-located together with the sun-photometer and see how the retrieved aerosol properties are improved with this addition. To this end, vertical profiles of range corrected backscatter at 1064 nm from a ceilometer were used in an inversion algorithm together with an AERONET Cimel Sun photometer. Both instruments (ceilometer CHM15k from Jenoptik, CE318 Sun photometer form Cimel Electronique) are installed on the roof of the Science Faculty at Valladolid (Spain). Combination of sunphotomer measurements with vertical profiles were carried out before by other authors (e.g., Lopatin et al., 2013) using Lidar systems. Lidars provide aerosol vertical profiles with more preciseness and accuracy, and usually in more wavelengths, than ceilometers; however a ceilometer is more robust and automatic system, which makes that ceilometers and sunphotometers together can create the synergy needed to retrieve the searched aerosol properties

The inversion algorithm used in this study is the "Generalized Retrieval of Aerosol and Surface Properties" (GRASP), which is the first unified algorithm developed for characterizing atmospheric properties gathered from a variety of remote sensing observation, and is based on several generalization principles with the idea of developing a scientifically rigorous, versatile, practically efficient, transparent, and accessible algorithm (Dubovik et al., 2014). Using the commented method, two aerosol events over Valladolid were studied: A biomass burning episode and a desert dust intrusion. Both events were identified by means of air mass back-trajectory analysis and synoptic conditions. As preliminary results of this study, the AOD, SSA and volume SD obtained by GRASP using Sun photometer (spectral AOD, sky radiances) and ceilometer profile, were compared to the retrieval using only sun photometer. Finally, the aerosol extinction vertical profile for each event was obtained.

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AUTOMATIC RETRIEVAL OF AEROSOL BACKSCATTER COEFFICIENT WITH CEILOMETER

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The interest on vertical resolved aerosol characterization with ceilometers has increased in the last few years with the development of more sensitive ceilometers. The main advantage of the use of ceilometers for aerosol characterization is, on one hand, the automatic and much simpler operation compared to lidars and, on the other hand, their spatial distribution, providing backscatter profiles 24 hours a day and distributed over large areas. Several thousands of ceilometers are in operation over the world. The main disadvantage is the reduced signal to noise ratio, making difficult to extract the aerosol information such as the aerosol backscatter coefficient.

The estimation of the aerosol backscatter coefficient with elastic lidars requires several steps:

1. The Rayleight fit is used to find the height at which only molecular scattering is detected (reference height)

2. The Klett-Fernald retrieval (Klett, 1981; Fernald 1984) uses that reference height and assumes a relationship between the extinction and backscatter coefficients (lidar ratio, LR) to estimate the aerosol backscatter coefficient.

Thus, the calculation of the reference height requires the manual inspection of the backscatter profile and molecular backscatter profile and the Klett-Fernald retrieval requires the selection of a lidar ratio.

Given the large amount of data provided by ceilometers, a manual analysis is not possible. In this study we present an automatic Rayleight fit method based on the comparison of the slopes of the backscatter profile and the molecular backscatter derived for an atmospheric profile tuned to surface meteorological conditions. Due to low signal to noise ratio the automatic Rayleight fit is not always successful. When the reference height can be retrieved, we apply the Klett-Fernald retrieval procedure. For this purpose a fixed lidar ratio (LR = 50 sr) has been assumed for 1064 nm.

In order to check the goodness of the retrieval, we compare available aerosol optical depth (AOD) measurements from a sun-photometer with integral of the estimated extinction coefficient profiles (backscatter coefficient profile multiplied by the lidar ratio).

Results reveal that it is possible to automatize the process of inversion of backscatter profiles and makes this an excellent tool for the selection of cases for comparison of ceilometer retrievals with lidar retrievals. In addition, this process minimizes the uncertainty on the calibration constant for ceilometers if cases are restricted to good inversion retrievals.

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VERTICAL ESTIMATE OF SAHARAN DUST MASS CONCENTRATIONS DERIVED BY GROUND-BASED REMOTE SENSING OBSERVATIONS IN SYNERGY WITH AIRBORNE IN-SITU MEASUREMENTS

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The vertical distribution of Saharan dust plays a significant role in climate-related issues, in particular those associated to its atmospheric radiative forcing. In addition, height-resolved information of the dust properties is also required for both aerosol transport modelling (i.e., BSC/DREAMS) and satellite data validation (i.e., CALIPSO/CALIOP). Moreover, a general effort is being made by the ESA Earth Observation programs, EarthCARE and Sentinels missions, focused on the vertical monitoring of aerosols and clouds and the retrieval of the their macro/microphysical and optical properties for radiative forcing considerations.

The AMISOC-Tenerife (AMISOC-TNF) campaign was planned, in particular, as a multi-instrumented campaign carried out from 01 July to 11 August 2013 (42 days in summertime) over Tenerife area (Canary Islands), to study the dust impact in climate-related issues, focused on dust profiling characterization. This study reflects the synergy of airborne in-situ instrumentation (PCASP aerosol sonde) and ground-based remote sensing (LIDAR and MAXDOAS-spectroscopy) techniques to derive both the vertically-resolved microphysical and optical properties of Saharan dust particles. The aim of this work is to illustrate the potential of combined MAXDOAS, lidar and airborne observations for estimating their vertical Mass Concentration.

Dusty (DD) conditions taking place during AMISOC-TNF campaign corresponded to a progressively arriving Saharan dust intrusion over Tenerife area on 31 July (weak incidence, AOD=0.2) and 01 August (strong incidence, AOD=1.5) 2013. Vertical profiles of dust mass concentration as derived from both LIDAR and MAXDOAS extinction retrievals and airborne particle number size distributions (at three particular size ranges) were analysed. A good agreement is found between the optical and microphysical properties showing dust particles confined in a wide layer of 4.3 km thickness from 1.7 to 6 km height. LR values ranged between 50 and 55 sr, showing typical values for Saharan dust. Dust incidence mostly affected the FT altitudes. In general, under DD conditions, the dust impact on mass concentration was enhanced due to the increase of larger particles, affecting both the BL and FT, but showing differences depending on the dusty case.

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AIRBORNE POLLEN (API, START, END AND LENGTH) AND ITS RELATIONSHIP WITH METEOROLOGICAL PARAMETERS IN CATALONIA (NE IBERIAN PENINSULA)

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The aim of this work is to explore the effect of some meteorological factors on the airborne pollen series recorded in Catalonia (NE Iberian Peninsula). In this sense, the relationship between precipitation / insolation (Sánchez-Lorenzo et al. 2007) and the pollen parameters has been studied for 22 pollen taxa considered of interest for its abundance, landscape importance and/or allergenic significance. The pollen was collected at 6 aerobiological stations: Barcelona and Bellaterra for the period 1994-2011, and Girona, Manresa, Lleida and Tarragona for the period 1996-2011. The pollen parameters studied are: Annual Pollen Index (API, sum of the mean daily pollen concentrations along a year), the dates of Start and End of the Pollination Period and the Length, number of days between the Start and the End.

The Spearman rank correlation coefficients were computed to obtain the relationships between precipitation amount (monthly, annual and winter), sunshine duration (monthly and annual) and the pollen parameters. The relationship between the main climatic indices affecting Western Mediterranean regions: NAO, WeMO and AO, and precipitation / insolation at the monitoring sites was also explored for the study periods.

Significant correlations were obtained between winter precipitation and winter NAO, WeMO and AO in most of the stations. Montly and yearly correlations were in general weaker, and only significants for WeMO.

Annual rainfall presented low correlations with the API, but the relationship between winter rainfall and API showed high positive correlations. On the other hand the correlation between annual rainfall and Start was positive for most of the taxa. In general, correlations with Length and End were low but negative, evidencing the cleaning effect of the rain. With sunshine duration, in general, the correlations were weaker, being significant only for a few taxa.

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THE INFLUENCE OF URBAN WINTER POLLUTION EPISODES ON REGIONAL BACKGROUND SITE

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During late autumn and winter, the western Mediterranean basin is often affected by severe pollution episodes (SPEs) caused by stagnant weather conditions that produce a notable increase in particulate matter (PM) levels. The objective of the present study is to evaluate the impact of these episodes on PM1 concentrations at an urban (US) and a high mountain station (MS) in the western Mediterranean.

The site representative of a regional environment was located on top of Mt. Aitana (38º39'N; 0º16'W; 1558 m a.s.l). The station was situated in a military area (EVA no. 5) belonging to the Spanish Ministry of Defense. The second monitoring site (an urban site) was a station located on the outskirts of the city of Alicante (335.000 inhabitants; 38º21'N; 0º30'W; 20 m a.s.l.) close to an access road approximately 2 km from the coast. PM1 concentrations were continuously measured by means of two optical counters Grimm 190.

The route from US to MS runs through valleys and mountains that rise as we approach the regional site. Although the complex orography of the terrain complicates the transport of pollutants from the coast inland, under certain conditions polluted air masses could reach the top of the mountain range (Pey et al., 2010).

Seven SPEs were identified during the study period. We considered that PM1 levels were "affected" by the accumulation process associated with the stagnant meteorology when the daily average concentration at US and MS was higher than the average value obtained for the entire study period at each site (10.5 and 3.6 μg m^{-3}, respectively).

From the seven episodes identified during the measurement period, only three registered significant increases in PM1 concentrations at MS. During these three events the following conditions were fulfilled: a) a light coastal sea-breeze was developed; b) a high positive increment of the CBL (convective boundary layer) height between MS and the coastal area was recorded (this increment would favor a good development of mountain breezes and therefore would make the transport of pollutants to the mountain summit more effective); c) the value of the CBL height was not too low. Otherwise, recirculation of air masses may occur due to the complex orography of the terrain preventing pollutants from reaching the mountain top.

The PM1 hourly evolution at both sites during these episodes was different. While at US PM1 concentrations remained high during the night, PM1 levels at MS fell to background values. During the night, down-slope winds prevail at MS within a fully formed valley temperature inversion. Therefore, pollutants are swept away from the monitoring station.

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STATISTICAL CHARACTERIZATION OF METEOROLOGY AT NATAL, NORTHEASTERN BRAZIL

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This study is conceived to statistically characterize the meteorological conditions over Natal (Rio Grande do Norte, Brazil, 5.84^o S, 35.20^o W), where a new LALINET station (Latin American Lidar Network) [Guerrero-Rascado et al., 2014] has been recently installed. To this aim, GDAS information (Global Data Assimilation System) covering the period August 2006 to July 2014 have been the inputs in the HYSPLIT model (Hybrid Single Particle Lagrangian Integrated Trajectory model) (version 4.9) to generate daily backward trajectories at six standardized height levels. The clustering analysis allowed for identifying the main air mass paths arriving to Natal and distinguishing wet/dry season features. Moreover, a complementary, statistical analysis of the main meteorological variables (including temperature, pressure, relative humidity and wind speed and direction) has been performed to provide a comprehensive characterization of atmospheric scenarios in the region. The results obtained in this work are expected to contribute to future atmospheric studies conducted over Northeastern Brazil, in particular those related to long-range transport of Saharan dust and African biomass burning episodes and aerosol-cloud interactions.

This work was supported by FAPESP (Fundação da Amparo à Pesquisa do Estado de São Paulo) through the visiting professor grant ref. 2013/21087-7 and projects 2011/14365-5 and 2008/58104-8; by the program Ciências sem Fronteiras through project PVE-400430/2014-2 by the University of Granada through the contract "Plan Propio. Programa 9. Convocatoria 2013"; by the Spanish Ministry of Economy and Competitiveness through projects CGL2010-18782 and CGL2013-45410-R; and by the Andalusian Regional Government through projects P10-RNM-6299 and P12-RNM-2409.

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PM TEMPORAL EVOLUTION IN A MOUNTAIN STATION IN SOUTH-EASTERN SPAIN

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From the beginning of 2014 the aerosol concentrations in the PM_{10}, $PM_{2,5}$ and PM_1 fractions were measured at a high mountain station by means of an OP counter (Grimm 190). The station is situated on top of Mt. Aitana (38^{o}39'N; 0^{o}16'W; 1558 m a.s.l), in a military area (EVA no. 5) which belongs to the Spanish Ministry of Defense.

The PM_{10} fraction is characterized by higher concentrations during summer and autumn. In summer the CBL (convective boundary layer) is usually higher, allowing the transport of pollutants from cities situated near the coast. In autumn and spring some African outbreaks reach the station increasing the PM_{10} concentration (peaks in the figure). These episodes are short in time but can reach concentrations of more than 150μg/m^3. In contrast, during the winter the station is almost always over the CBL and the concentrations are very low in the three fractions.

The behaviour of the $PM_{2.5}$ and PM_1 fractions is quite similar. The maximum concentrations are reached during summer due to the transport of pollutants from the coast, aided by the presence of the sea breeze. The arrival of dust from North Africa does not increase the concentrations in the same proportion as in the PM_{10} fraction, suggesting the coarse nature of the aerosol present in these African episodes.

In Figure 1 a CPF plot for the PM1 concentrations is shown. The days influenced by the arrival of air masses from Africa were removed. As can be seen, the plot shows that the high PM concentrations are found in the wind direction of the big cities along the coast confirming the anthropogenic origin of the aerosol reaching the mountain station.

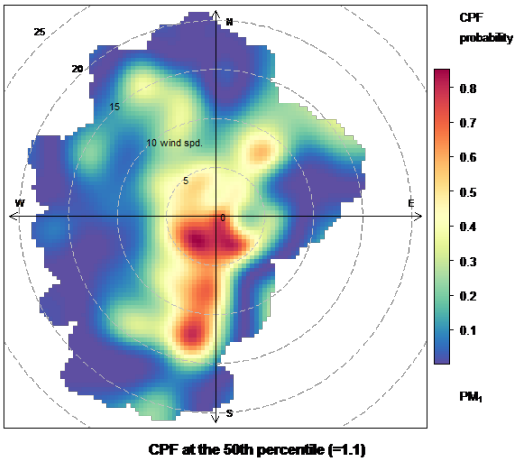

Figure 1: CPF plot for PM_1 (Carslaw et al.,2012)

This work was supported by the Spanish Ministry of Science and Innovation under the CGL2009-08036 (PASSE) and CGL2012-39623-C02-2 (PRISMA) projects. We would like to thank the military base (EVA no. 5) for allowing access to its facilities.

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MONITORING OF A LONG-RANGE TRANSPORTED SMOKE EVENT OVER SOUTHERN SPAIN

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This work aims to describe a smoke event over the Southern Iberian Peninsula in terms of particle optical and microphysical properties. Several aerosol plumes were detected over the EARLINET (European Aerosol Research Lidar Network) Granada station (37.º N, 3.61º W, 680 m asl) in the period from 10th to 17th July 2013. Backward trajectories generated with HYSPLIT model (Hybrid Single Particle Lagrangian Integrated Trajectory model, version 4.9) showed that the air masses affecting the studied layers came from certain regions in North America. At these regions, some active forest fires were observed according to the information provided by MODIS global fire maps. The multi-wavelength lidar technique was applied to retrieve optical properties, namely backscatter (β) and extinction (α) coefficients, lidar ratios, Angström exponents (AE) and linear particle depolarization ratios (δ_P). Column-integrated microphysical properties retrieved with AERONET code were also analyzed during this period. From the combination of the lidar data and the AERONET products, vertically-resolved volume concentration profiles were obtained for three modes (fine, coarse spherical and coarse spheroid) applying LIRIC algorithm.

The results highlight at least three different layers containing biomass burning particles, arriving at the study station on 10^{th}, 14^{th} and 15^{th} July respectively. The first layer, detected on 10^{th} July at more than 8 km asl was not very strong (β around $3{\cdot}10^{-7}$ $m^{-1}sr^{-1}$ at 532 nm), but AE around 2 and δ_P less than 0.05 confirmed the presence of small, spherical particles. High β values (more than $3{\cdot}10^{-6}$ $m^{-1}sr^{-1}$ at 532 nm) were obtained for the layers on 14^{th}-15^{th}, which were found around 6 and 4 km asl respectively, and exhibited similar AE and δ_P values than those on 10^{th} of July. The retrieval of volume concentration profiles showed in all cases a clear predominance of fine mode in the smoke layers, with values up to 20 $\mu m^3/cm^3$ for the strongest layers. Such results evidence that the air masses observed contained high concentrations of fine particles, arriving after a long-range transport from North American forest fires.

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ATMOSPHERIC DYNAMICS AND LONG RANGE TRANSPORT OF BIRCH (*BETULA*) POLLEN RECORDED AT CATALONIA AND BASQUE COUNTRY (2004-2014)

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Airborne pollen is produced and released into the atmosphere by anemophilous plants and can induce allergic symptoms in the atopic population. Studies of dispersion and source identification of pollen grains have been developed, being an important tool for the diagnosis and prevention of allergies. This is particularly important in the case of birch pollen, since it has a huge pollen production and it is one of the most important causes of respiratory allergy in Northern and Central Europe. In addition, it has been reported that birch pollen levels are increased by long distant transport.

Birch trees (*Betula* sp.) are abundant in Central, North and Eastern Europe, while scarce in the Mediterranean territories, especially in Spain, where they only grow in mountains in the northern regions. We analyze the dynamics of the *Betula* pollen in the atmospheric spectra of 2 Spanish localities, one in Catalonia (Bellaterra-Barcelona) and the other in Basque Country (Vitoria-Gasteiz), using annual series of Hirst daily data, corresponding to the period 2004-2014. Our aim is to provide information about the long range transport (LRT) of this bioaerosol through the Pyrenees, which is considered a natural border between the Iberian Peninsula and the rest of Europe. In this work, *Betula* pollen transport is investigated also as a measure of the dispersion capacity of the plants. As the territory studied constitutes a southern limit of the distribution area of birch trees, the information obtained could have important biogeographical implications.

The date of the significant concentration peaks in the pollen time series of the period March to May for the years 2004-2014 were identified and the atmospheric back-trajectories for each date calculated. Then, source-receptor methodologies were applied to the complete set of daily pollen data and back-trajectories for March, April and May between 2004-2014 to determine the likely provenance regions. On the other hand, in order to isolate LRT from regional/local pollen sources, the synoptic flux for the days with simultaneous peaks in the two monitoring stations was analyzed by means of back-trajectories.

In the localities studied, the source-receptor results of *Betula* pollen established that the presence of this pollen in the atmosphere depends on the LRT from source areas in Central and North Europe.

We acknowledge the financial support from the Spanish Government (CGL2012-39523-C02-01 and CGL2012-39523-C02-02)

TROPOSPHERIC OZONE, UV RADIATION AND AEROSOLS DURING HIGH INTENSITY PYROTECHNIC DISPLAYS

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Several festivals worldwide are celebrated with pyrotechnic displays that are responsible for a significant increase in air pollutant concentrations (Crespo et al., 2012; Moreno et al., 2007; Vecchi et al., 2008). A few previous studies have reported the generation of tropospheric O_3 in the absence of sun radiation attributed to fireworks displays even when NO_2 is not present. Attri et al (2001) suggested that ozone is formed from the photolysis of molecular oxygen following a process equivalent to that occurring in the stratosphere.

O_3, NO, NO_2, aerosols and radiation were continuously monitored very close to the launch area of high intensity pyrotechnic events, the so called Mascletàs, which take place every year during the Hogueras de San Juan Festival in the city of Alicante (southeastern Spain).

During the whole event, which lasted approximately 9 minutes, an opposite variation in ozone and particle concentrations was found ($r = -0.69$, p-value <0.05).

A sudden increase in aerosol concentration occurred just after the Mascletà started, accompanied by a rapid drop in ozone concentration from approximately 74 μg m^{-3} to less than 10 μg m^{-3}.

The maximum O_3 concentration (150 μg m^{-3}) was detected when a high number of fireworks explosions occurred very close to the sampling site. The ozone maximum was registered immediately after that of UV radiation, suggesting that O_3 was formed from the photodisociation of O_2.

Our experimental data suggest that tropospheric ozone was unlikely formed from reactions involving nitrogen oxides. Instead, the photolysis of oxygen molecules by absorption of UV radiation emitted by firework displays, and the subsequent combination of atomic and molecular oxygen, is the most plausible mechanism to explain ozone formation. This reaction sequence corresponds to the process of ozone production in the stratosphere.

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CHARACTERIZATION OF DESERT DUST AEROSOL PROPERTIES OVER CASTILLA Y LEÓN IN 2003-2013

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Based on a desert dust (DD) inventory over North-central Spain in the period 2003 to 2013 developed by means of columnar sun-photometers (AOD_{440nm} and $Alpha_{440-870nm}$) and surface (PM_{10}) measurements from AERONET and EMEP networks respectively, the characterization of desert dust aerosol properties has been carried out in this study. The days composing the inventory have been separated in two subsets corresponding to: the purer desert dust days (named D and characterized by Alpha values lower than 1.0), and those days showing a mixture of desert dust with other type of aerosol (DC, Alpha >1.0). Alpha for DC subset, that could be considered relatively high, reflect the presence of desert dust in our study area, bearing in mind the long path followed, the distance to the source and the mixture with local or another type of aerosols that are representative of our region.

Figure 1 shows the monthly means of AOD, Alpha and PM_{10}. The annual cycle of desert dust aerosols present two maxima, one in March (0.32 and 33.6 μg m^{-3}, for AOD and PM_{10}, respectively) and another one in summer (with values of 0.32 and 31.8 μg m^{-3}, for AOD and PM_{10} respectively, in the month of August). The two subsets considered, D and DC, follow the mentioned behavior in a greater or lesser extent. The thresholds values to detect a DD day are 0.18 for the (instantaneous) values of AOD (which allow to thorough observe the evolution of an episode) and 13 μg m^{-3} for (daily) values of PM_{10}. A day can be considered as DD day if just one of the magnitudes AOD or PM_{10} overcomes its threshold value, although the other one remains close but below its corresponding threshold, due to the detailed analysis of a wide range of supplementary information. This fact leads to the minimum value of AOD (0.15) in January.

The analysis of the frequency histograms of AOD and PM_{10} shows that our criteria to detect desert dust episodes were relatively moderate, which give rise to the consideration of a high number of events of middle or low intensity. Hence, the maximum number of DD days occurs for values around 0.2 in AOD and 20 μg m^{-3} in PM_{10}, respectively.

The characterization of the particle size distribution, volume concentration and effective radius (as representative quantities for microphysical properties) and single scattering albedo and asymmetry parameters (for the optical properties) have also been carried out. Results show the well-known desert dust aerosol characteristics with a lower or weaker desert character, as it was expected due to the distance between the emission source and our region of study.

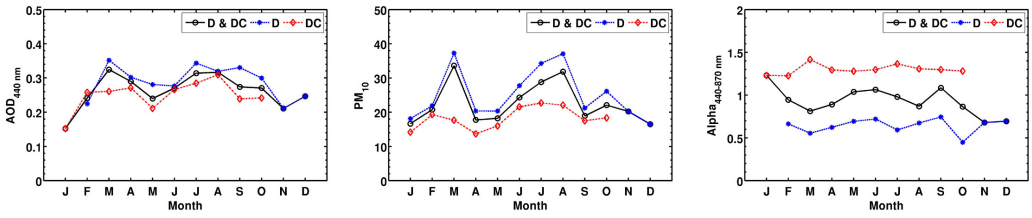

Figure 1: Annual cycles of AOD_{440nm}, PM_{10} and Alpha for D, DC and D+DC days.

Authors are grateful to Spanish MINECO for the FPI grant BES-2012-051868 and projects of ref. CGL2011-23413, CGL2012-3356. Special thanks to EMEP and AERONET-PHOTONS-RIMA for providing observations and to the European Union Seventh Framework Programme (grant agreement Nr. 262254 [ACTRIS]). We also thank the Consejería de Medio Ambiente de la Junta de Castilla y León for supporting this research.

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ATMOSPHERIC PARTICLE SIZE DISTRIBUTIONS IN THE SPANISH NETWORK OF ENVIRONMENTAL DMAS (REDMAAS)

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Within the framework of the Spanish Network of Environmental DMAs (REDMAAS) two measurement campaigns on the submicron aerosol fraction have been carried out during a summer period (1-30 June 2012) and a winter period (13 December 2012-15 January 2013). Measurements were simultaneously made at seven monitoring stations located all over the Spanish territory and belonging to six Spanish research groups (A Coruña: urban background station; Barcelona and Montseny (Barcelona): urban and rural background stations respectively; El Arenosillo (Huelva): rural background station; Izaña (Tenerife): free troposphere station; Granada: urban traffic station and Madrid: urban background station). More detailed information on the REDMAAS network stations can be found at http://www.redmaas.com.

The aim of this study was to characterize, for the first time in Spain, the influence of the strong climate variability in its territory on the features of submicrometer atmospheric aerosol.

A combination of the influence of pollution emission sources on the measurement sites and the meteorological conditions determined the characteristics of the atmospheric aerosol in each measurement station.

The highest particle number concentrations were registered during the winter period at those measurement stations with a direct influence of anthropogenic emissions, oscillating between 38040$\pm$ 29333 cm^{-3} (Granada: urban traffic station) and 3145$\pm$2729 cm^{-3} (A Coruña: urban background station). On the opposite, the lowest particle number concentrations were recorded in the Izaña (Tenerife) (free troposphere station), with mean values of 520$\pm$1037 and 900$\pm$1624 cm^{-3} in the winter and the summer periods, respectively.

During the summer period, both the low particle concentrations and favourable meteorological conditions led to new particle formation (NPF) in all the measurement stations. In addition, aerosol shrinkage processes were also identified at the Madrid (urban background) and El Arenosillo (Huelva) (rural background) stations in the presence and absence of NPF.

This work has been financed by the Ministry of Science and Innovation (CGL2011-15008-E, CGL2010-1777 & CGL2011-27020), Xunta de Galicia (GRC2013-047 potentially cofounded by ERDF) and the European Union Seventh Framework Programme (FP7/2007–2013) ACTRIS under grant agreement no. 262254.

HYGROSCOPIC PROPERTIES OF ATMOSPHERIC AEROSOL MEASURED WITH AN HTDMA IN AN URBAN BACKGROUND SITE IN MADRID

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One of the most important properties to understand the aerosol behavior in the atmosphere is its ability to absorb water. The changes that suffer the aerosol size due to its hygroscopicity affect both the processes involved on climate change and human health (IPCC, 2013; Varghese and Gangamma 2006).

During the winter of 2014, aerosol growth factor (GF) measurements at a RH of 90% for five particle sizes (50, 80, 110, 190 and 265 nm) have been conducted with an HTDMA in an urban background area located at CIEMAT facilities (40º 27' 23.2" N, 03º 43' 32.3" E), in the north-northwest of Madrid. In addition, the weather data registered in a meteorological tower and the chemical composition of submicrometer aerosol (organics, NO^{3-}, $SO4^{2-}$, NH^{4+} and Cl^{-}) provided by Aerosol Chemical Speciation Monitor (ACSM) in the measurement station have complemented this study.

The primary sources of pollutants in the city are emissions from traffic and domestic activities, conditioning the aerosol composition to be predominantly of carbonaceous nature, and consequently its hygroscopicity. As a result, the growth factor distribution under normal meteorological conditions is bimodal, being the concentration of particles corresponding to the less-hygroscopic mode higher than the hygroscopic mode. The smaller particle size measurements (50 and 80 nm) have an average growth factor (GF_{avg}, average GF of the less-hygroscopic and hygroscopic modes of each measure provided by the $TDMA_{inv}$ program (Gysel et al., 2009)) between 1.0 and 1.11 (freshly emitted black carbon particles), while that for larger particles (110, 190 and 265 nm) a GF_{avg} higher than 1.11 (particles with higher degree of oxidation) (Alonso-Blanco et al., 2014).

However, not only the aerosol genesis is important but the meteorological conditions play a crucial role on its hygroscopicity. For instance, during a period of atmospheric stability on December 2014 (from 14 to 28), under the meteorological influence of a strong thermal inversion, the NO^{3-} formation were high. The PM_1 composition was 62% of organics and 25% of NO^{3-}. This composition increased the aerosol hygroscopicity.

During the episode, the aerosol growth factor distribution was also bimodal for the five particle sizes measured, with an average GF_{avg} between 1.2 and 1.3. Nevertheless, the particle fraction corresponding to the hygroscopic mode was higher than under normal atmospheric conditions. A possible explanation for this might be that the strong atmospheric stability during the episode led to a high degree of aerosol external mixing in all measured particles size.

This work has been supported by the Spanish Ministry of Science and Innovation funding the projects: PHAESIAN (CGL2010-1777) and MICROSOL (CGL2011-27020) and Ramón Areces Foundation, the AEROCLIMA project (CIVP16A1811) and Autonomous Community of Madrid, the TECNAIRE project (P2013/MAE-2972). The authors are grateful to Martin Gysel for the development of $TDMA_{fit}$ algorithm to invert HTDMA data and allowing free use within the scientific community. E. Alonso-Blanco acknowledges the FPI grant to carry out the doctoral thesis/PhD at the Research Center for Energy, Environment and Technology.

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AIR QUALITY IN PORTUGAL: 1995-2013 ASSESSMENT

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Current EU Directive on air quality (2008/50/EC) sets out a number of targets framed within the Thematic Strategy on Air Pollution [COM(2005)446] to improve human health and environmental quality, establishing target dates for reducing atmospheric concentrations of several pollutants. In this context, each Member State must evaluate and predict air quality, as well as to estimate human exposure to inform the public and protect their health by conducting emission inventories, action plans, monitoring systems and air quality modeling. During the study period 1995-2013 the temporal and spatial evolution of several air pollutant concentrations (CO, NO, NO_2, O_3, SO_2, $PM_{2.5}$ and PM_{10}) was analyzed in the most populated areas of Portugal, where the density of the air quality monitoring network is higher. Exceedances of the limit values for several pollutants such as PM10 (Fig. 1) were very frequent during this period in Lisbon, Oporto and the south coastal area.

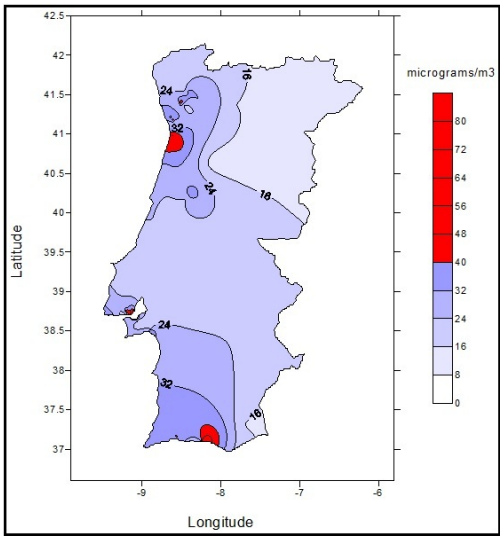

Figure 1: Portugal areas where PM_{10} limit value was exceeded during the study period.

A FUN WAY TO APPROACH ATMOSPHERIC STUDIES TO KIDS AND THE IMPORTANCE OF THEIR KNOWLEDGE

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The importance of the atmospheric sciences is well known. However, these topics are usually missing in the curricular activity of elementary schools. Since kids should know the environment and the conditions surrounding them, the non-profit association "Physics League" has managed a workshop with different experiments about the atmosphere. What are the atmospheric aerosols? This concept is introduced by a simple experiment with a laser and a glass of water where sugar is going to be added bit by bit. Kids can understand scattering phenomena and how solar radiation is trapped in the atmosphere. A particular mention about desert dust aerosols is also be performed. With a hairdryer, sand can be transported in a big box built for this workshop simulating the mineral dust transport from the Sahara desert to the Iberian Peninsula (in particular, to Valladolid city). Photographs with very intense desert dust intrusions can also illustrate this interesting phenomenon. Several characteristics about these events are detailed to highlight their relevance over our region. Convection phenomena related to temperature inversion in the atmosphere and its consequences can be explained with a really impressive experiment. Two jars with cold and warm water (preferably tinted with different colors) are overlapping. When the warm water is below all the water is mixed, but when it is above nothing happens. This process of great relevance in high pollution environments may result very interesting for kids. The role of aerosols as cloud condensation nuclei are also investigated solving the simple question: How are clouds formed? The atmospheric conditions are simulated in a jar with a temperature gradient (warm to cold), and the use of hairspray can introduce aerosols acting as cloud condensation nuclei. Other experiments about the atmospheric pressure to realize that the air exists can also be performed during the workshop.

The non-profit association Physics League is composed by 30 members, all of them dedicated to outreach activities. Economical funding from European Physical Society (Young Minds Project) [ref. EPSYM2015G24; EPSYM2015G25; and EPSYMIYL2015-15], Optical Society of America [Universidad de Valladolid OSA chapter], and American Physical Society [APS outreach mini grant] are strongly grateful.

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MODULATION OF URBAN ATMOSPHERIC ELECTRIC FIELD MEASUREMENTS WITH THE WIND DIRECTION IN LISBON

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Atmospheric electric field measurements (potential gradient, PG) were taken in the urban environment of the city of Lisbon (Portugal). The measurements were taken using a Benndorf electrograph at the Portela Meteorological station in the suburbs of the city (NW from the centre). The period of 1980 to 1990 is considered here. According to wind direction, different content and types of ions and aerosols arrive at Portela causing significant variations to the PG. To the south there are significant pollution sources, and no such sources exist to the north. The Iberian Peninsula is to the east of the station and to the west, the Atlantic Ocean. Wind directions are divided in four sectors: i) NW: $270^o \leq \theta \leq 360^o$; ii) NE: $0 \leq \theta \leq 90^o$; iii) SE: $90 \leq \theta \leq 180^o$; iv) SW: $180^o \leq \theta \leq 270^o$. Analysis of the weekly cycle, caused by anthropogenic pollution related with urban activity, was undertaken for each wind sector. A boxplot method and Lomb-Scargle spectra are used to that end. NW sector has been shown to be least affected by this cycle, which is attributed to the effect of marine air. The daily variation of NE sector for weekends reveals a similar behaviour to the expected daily behaviour imposed by the Global Electric Circuit and is known as Carnegie curve (minimum around 03UTC and maximum around 19UTC). This implies that the NE sector in the weekends has very low pollution levels.

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TRANSPORT OF THE SMOKE PLUME FROM CHIADO'S FIRE IN LISBON SENSED BY ATMOSPHERIC ELECTRIC FIELD MEASUREMENTS

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The Chiado's fire that affected the city centre of Lisbon (Portugal) occurred on 25th August 1988 and had a significant human and environmental impact. This fire was considered the most significant hazard to have occurred in Lisbon city centre after the major earthquake of 1755. A clear signature of this fire is found in the atmospheric electric field data recorded at Portela meteorological station about 8 km NE from the site where the fire started at Chiado. Measurements were made using a Benndorf electrograph with a probe at 1 m height. The atmospheric electric field reached 510 V/m when the wind direction was coming from SW to NE, favourable to the transport of the smoke plume from Chiado to Portela. Such observations agree with predictions using Hysplit air mass trajectory modelling and have been used to estimate the smoke concentration to be 0.4 mg/m^3. It is demonstrated that atmospheric electric field measurements were therefore extremely sensitive to Chiado's fire.

This result is of particular current interest in using networks of atmospheric electric field sensors to complement existing optical and meteorological observations for fire monitoring. In this perspective, this urban fire that occurred in Lisbon city centre represents a unique opportunity to study the effect of smoke particles on PG, as such measurements were made in the suburbs of Lisbon and no other reports in the literature exist of such a clear signature.

Portuguese Science and Technology Foundation (FCT) funded this research through the research program Pest/OE/CTE/UI0078/2014 and the grants SFRH/BPD/63880/2009 (HGS), SFRH/BD/89218/ 2012 (MM), SFRH/BPD/81132/2011 (SP) and FCT/COMPETE project FCOMP-01-0124-FEDER-029197 PTDC/GEO-FIQ/4178/2012. The authors are grateful to Claudia Serrano, Samuel Bárias, and Doctor Mário Figueira in recording and preparing the data.

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AEROSOL HYGROSCOPIC GROWTH AND THE DEPENDENCE OF ATMOSPHERIC ELECTRIC FIELD MEASUREMENTS WITH RELATIVE HUMIDITY

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A simple formulation is developed to model the influence of the aerosol hygroscopic growth in the dependence of the atmospheric electric field measurements with relative humidity. The formulation uses the Petters and Kreidenweis's model for the hygroscopic growth factor of aerosols with relative humidity and assumes that the ion-aerosol attachment coefficient is linearly proportional to the particle radius according to Gunn's calculation. A formula which describes the atmospheric electric field increase with relative humidity in the regime expected for the aerosols to grow hygroscopically is found; between 60 % to 90 %. It also relates the microphysical parameter of aerosol hygroscopicity, k, with the macrophysical measure of the atmospheric electric field. Historical data of atmospheric electric field and relative humidity recorded in the meteorological station of Portela (near Lisbon airport, Portugal) are used to fit the model. The electrical measurements were done with a Benndorf electrograph and the 1980-1990 period was considered. Due to the high pollution levels the atmospheric electric field measurements were divided in four wind sectors, NW, NE, SE, and SW. The sector least affected by pollutant aerosols, NW, was used in the fitting and the goodness found is $r^2 \approx 0.97$, the aerosol concentration number is ≈ 3280 cm^{-3} and the hygroscopic growth parameter k ≈ 0.094. These are very reasonable values consistent with an urban environment, which typically has high aerosol number concentration with small hygroscopicity. The limitations of the model are presented throughout the sections.

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EVALUATION OF SEASONALITY OF PM_{10} CONCENTRATIONS IN WESTERN EUROPEAN ATLANTIC AREAS

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The atmospheric levels of PM_{10} in many areas are characterized by a lack of a well-defined seasonal cycle, which, in contrast, is apparent for other pollutants such as ozone and nitric oxide. In this work we investigate the seasonal variations of PM_{10} concentrations at three areas of similar Atlantic climate in Western Europe: the Basque Country, Portugal and the United Kingdom. Similarities and differences between these regions are highlighted, and the association of PM_{10} seasonal variations with meteorological and anthropogenic factors is explored.

Hourly PM_{10} data from 99 stations of rural, urban background, industrial and traffic characteristics from the air quality monitoring networks (AQMNs) of the Basque Country, Portugal and United Kingdom in the period 2005-2012 were collected and processed in order to remove anomalous data, calculate daily PM_{10} concentrations and obtain monthly averages.

Seasonality in meteorological conditions was evaluated by examination of the precipitation records and the frequency of occurrence of the characteristic advection patterns. They were obtained by k-means clustering of back trajectories computed with HYSPLIT at three heights (500, 1500 and 3000 m above sea level), four times a day, for the period 2005-2012. Meteorological fields from the European Centre for Medium-Range Weather Forecasts (ECMWF) reanalysis (ERA)-Interim data set were used. Monthly averages of column-integrated aerosol properties from MODIS (aerosol optical depth at 550nm, Ångström exponent (470nm, 660nm), small-mode fraction and cloud fraction) were also analysed to further interpretation of PM_{10} levels.

Clear differences between the annual courses of PM_{10} in the three regions were observed. Furthermore, differences were also found between stations of different type within a region. For instance, rural background stations in the Basque Country showed maximum values in summer, whereas the common behavior for the anthropic-influenced stations exhibited minimum values in August.

The observed seasonal variations were related with the seasonal patterns of precipitation, Saharan dust outbreaks and advection paths.

ANALYSIS OF DERIVED OPTICAL PARAMETERS OF ATMOSPHERIC PARTICLES DURING A BIOMASS BURNING EVENT

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On the afternoon of 26th November of 2014, the instruments of an in situ measurement station located on site 40º16'30"N, 7º30'35"W, 704 m a.s.l. (campus of the University of Beira Interior) recorded a biomass event. The episode started around 16:00 and ended around 18:00, local time. In fact, this type of event delivers many particles to atmosphere and consequently, the aerosol optical properties change. Our study aims characterize the evolution of the aerosol properties during the biomass burning event.

The optical parameters as well as their derived proprieties are analyzed in this work. All direct parameters were collected with specific equipment: a nephelometer (model 3563, TSI), a 3λ particulate soot absorption photometer (Radiance Research), a condensation particle counter (model 3022A, TSI) and an aerodynamic particle sizer (model 3321, TSI). Scattering and absorption Ångström exponents, as well as single scattering albedo were derived and fully analyzed.

The scattering and absorption coefficients and the number of particles counted increased dramatically during the event. The temporal evolution of this parameters is presented in figure 1. The scattering and absorption Ångström exponents also increased throughout event, however, the single scattering albedo presented an inversion of the spectral behavior.

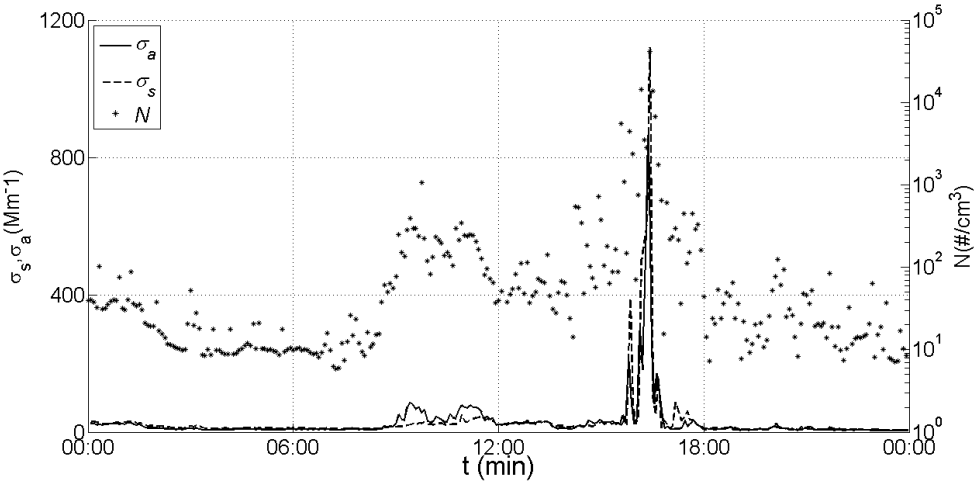

Figure 1: Temporal evolution of the optical parameters and the number of particles.

RETRIEVAL OF THE AEROSOL OPTICAL THICKNESS FROM UV GLOBAL IRRADIANCE MEASUREMENTS

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Although ultraviolet (UV) radiation accounts for less than 10 % of the solar radiation, the UV irradiance reaching the surface has particular significance within the solar spectrum due to its potential harmful effects, constituting a hazard for several life forms on Earth. For this reason UV radiation is being monitored since several years in regions with high insolation values. In the absence of clouds, aerosols are the major regulators of the Earth radiation budget and play a central role in modulating UV radiation. Therefore, UV irradiance measurements may be used to estimate the atmospheric aerosol load under cloud-free conditions, constituting a useful tool to estimate aerosol optical thickness in regions where only the UV radiation is monitored but no aerosol information is available.

The UV irradiance is measured at Évora since several years, where a CIMEL sunphotometer integrated in AERONET is also installed. In the present work, measurements of UV A (315 – 400 nm) irradiances taken with Kipp&Zonen radiometers, as well as satellite data of ozone and NO2 total column values, are used in combination with radiative transfer calculations, to estimate de aerosol optical thickness (AOT) in the UV. The retrieved UV AOT in Évora is compared with AERONET AOT (at 340 and 380 nm) and the accuracy of the method estimated. The methodology is then used to estimate the UV AOT in a site on the Atlantic coast, where the UV irradiance is being monitored but no aerosol information is available.

Acknowledgements

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PM_{10} METAL COMPOSITION AND AIR MASS ORIGIN AT A COASTAL INDUSTRIAL SITE

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Chemical composition of atmospheric particulate matter at a given site is mainly determined by local emissions and meteorological conditions. However, consideration regarding the influence of pollutant advection associated to the arrival of different air masses should be taken. By segregating the measured species by air mass origin after calculating and classifying back-trajectories, such influence can be determined.

A three-year characterisation of the metal composition of PM_{10} at a coastal industrial location in the Basque Country was carried out. The influence of the air mass origin was investigated.

PM_{10} samples were collected during 24 h periods twice a week, on quartz fibre filters and were analysed for metal composition (As, Cd, Co, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Sr, V, Zn) by ICP-MS. In addition, the concentrations of the major pollutants (carbon monoxide, nitrogen oxides, ozone, suspended particulate matter (PM_{10}) and sulphur dioxide) were monitored in an hourly basis by two stations of the Air Quality Monitoring Network managed by the Basque Government.

The back-trajectories of air masses reaching the study area were calculated in order to evaluate their effect on pollutant concentrations. They were classified by k-means clustering of back trajectories computed with HYSPLIT at three heights (500, 1500 and 3000 m above sea level), four times a day, for the period 2005-2012. Meteorological fields of 1.5 deg resolution from the European Centre for Medium-Range Weather Forecasts (ECMWF) reanalysis (ERA)-Interim data set were used.

Wind direction analyses resulted in Na and Mg being related to marine influence; a larger industrial and traffic pollutant load was associated to southerly winds, which increased Fe, Mn, Zn, Pb, Cu, Sb, As, Cd and Co levels.

The analyses of back-trajectories revealed that the most polluted air masses were those arriving from continental Europe, enriched in anthropogenic metals (Fe, Zn, Pb, As). Also, short back trajectories (i.e., slow advections) were associated with high pollutant loads, which were related to local pollution events, and enriched in V and Co from an oil refinery. On the contrary, fast air masses arriving from the Atlantic Ocean showed the lowest levels of pollutants while they were enriched in Na and Mg.

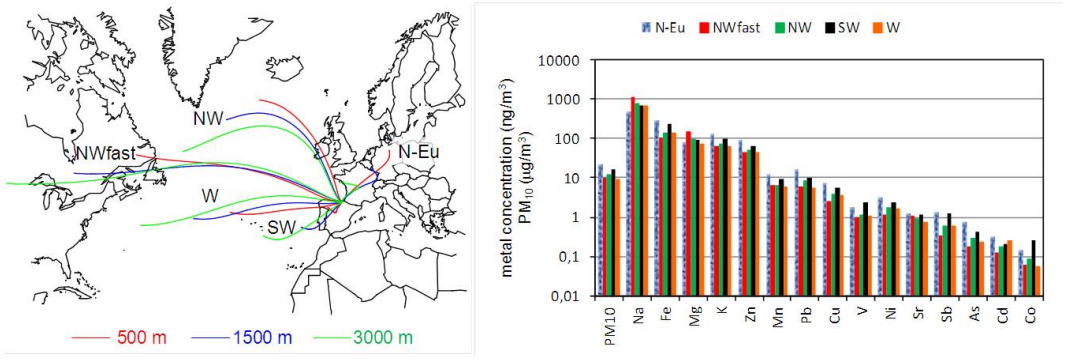

Figure 1: Figure 1. Left: Major air masses arriving to the study area. Right: Average concentrations of PM_{10} and trace metals by air mass.

VALIDACIÓN DE PRODUCTOS DE AEROSOLES DE MODIS NIVEL 3 DE LAS COLECCIONES 5.1 Y 6 EN VALENCIA, ESPAÑA

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El estudio de los aerosoles es de gran importancia ya que, debido a su alta variabilidad temporal y espacial, constituyen una de las mayores fuentes de incertidumbre en diferentes procesos que ocurren en la atmósfera y que afectan tanto al clima, como a la visibilidad, la calidad del aire y la salud humana. El estudio de sus propiedades puede realizarse empleando diferentes técnicas de medida, todas ellas complementarias. Por un lado existen métodos de medida in-situ con gran resolución temporal en la obtención de las propiedades de los aerosoles, aunque con escasa o nula representatividad en columna. Por otro lado existen técnicas de teledetección que permiten medir desde el espacio o desde la superficie las propiedades de los aerosoles en columna.

En la última década, se han puesto en marcha diferentes misiones enfocadas a la medida de aerosoles mediante teledetección, en la que se emplean sensores como, por ejemplo, MODIS. MODIS mediante sus satélites Terra y Aqua ofrece productos en varios niveles debidamente procesados de ciertos componentes, entre ellos los aerosoles. Los niveles se diferencian, entre otros detalles, por la resolución especial de los datos. El producto de nivel 3 es un producto de valor agregado que se deriva de las variables geofísicas de niveles inferiores, especialmente del nivel 2. Contiene diferentes parámetros atmosféricos entre ellos el espesor óptico de aerosoles (AOD) a una resolución espacial de 1^o x 1^o.

La caracterización de las propiedades de aerosoles de la columna atmosférica se realiza a nivel de suelo con fotómetros solares, específicamente CIMEL CE318 de la Red Robótica de Aerosoles (AERONET), instrumentos sencillos de medida precisa. Por lo tanto, pueden ser utilizados para validación de los productos MODIS (Segura et al., 2015). Los fotómetros solares miden radiación directa, y difusa en diferentes longitudes de onda (440, 500, 675, 870, 1020 nm) y permiten obtener el espesor óptico de aerosoles en estas longitudes de onda.

En este estudio realizamos la validación de los productos MODIS de aerosoles de nivel 3 (de la anterior colección 5.1 y la nueva colección 6) especialmente el espesor óptico de aerosoles (AOD) a 550nm. Para la validación se comparan los productos de MODIS con los de CIMEL, y se analizan no solo las diferencias sino también el cumplimiento de las incertidumbres estimadas por diversos autores (Remer et al., 2005; Ruiz et al., 2013).

Este trabajo ha sido financiado conjuntamente por el Ministerio de Economía y Competitividad (MINECO) y el Fondo Europeo de Desarrollo Regional (FEDER) a través de los proyectos CGL2011-24290 y CGL2012-33294, así como por la Generalitat Valenciana gracias a los proyectos PROMETEO (PROMETEUII/2014/058) y de Grupos Emergentes (GV/2014/046).

Remer L., Kaufman Y., Tanré D., Mattoo S., Chu D. Martins J., Li R., Ichoku C., Atmos. Sci., 62, 947–973 (2005).Ruiz J., Dudhia J., Gueymard C., y Pozo D., Atmos. Chem. Phys., 13, 675–692 (2013)Segura, S., Estellés, V., Esteve, A. R., Tena, F., Utrillas, M. P., and Martínez-Lozano, J. A. Atmos. Res., 157, 66-73 (2015)

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MICROSCALE VARIATIONS OF AMBIENT PARTICLE CONCENTRATION LEVELS IN AN URBAN TRAFFIC HOT SPOT

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The TECNAIRE project (Técnicas innovadoras para la evaluación y mejora de la calidad del aire urbano) aims to develop new techniques, able to diagnose the problems of air quality in urban environments and evaluate strategies for their resolution. Within this framework, a campaign was designed and performed during the winter period 13 February-2 March 2015 in a traffic hot spot (Plaza de Fernández Ladreda) in Madrid. This is an example of traffic influenced site, which frequently experiences the highest pollution levels for particles and gases of the city. From the point of view of an air quality study, it represents a site of enormous complexity in terms of interaction of sources, complex urban geometry and intense presence of pedestrian activities.

In this campaign, the ambient particle concentration levels (PM10, PM2.5 and PM1) were measured at different sites representative of different ambient conditions. Short time and space variations were assessed from measurements at different locations taking into account possible influences of factors such as meteorological variables and turbulence, traffic sources, pedestrian activities, and height of measurement, among others. Several optical instruments (OPCs) were deployed in the study area. A Grimm 1107 was installed in the South of the square, close to a transport station, and a Grimm 365 in the North side. These instruments were previously intercompared between them and also against the reference gravimetric method by performing filter measurements with high volume devices for the three size fraction. Intercomparison with the TEOM instrument, operating in the Madrid air quality monitoring network station at the same site, was also performed. Particle measurements were complemented with meteorological variables from two stations located in the study area, one of them measuring microturbulence parameters.

A TSI Dust-Track instrument, measured the particle levels at a number of points around the experimental area. In this case, the measurement strategy was different from that of the static points instrumented with GRIMMs. A dynamic measurement pattern was designed by moving the instrument around the square measuring at 14 points in total. Two different speeds were used: a slow case where two hours were needed to walk around the place and a fast case where twenty minutes were needed. These last measurements almost allowed characterizing the square in a frozen way, almost like a snapshot. Some points had a special attention like bus stops, where high particle concentrations were measured, and traffic lights. At the same time, the pedestrian flows were characterized to obtain their exposure to particles in this square.

All these results are currently under analysis and they will be shown in this paper.

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CARBONACEOUS AEROSOL IN A KERBSIDE SITE IN OPORTO, PORTUGAL

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During one year (January 2013 – January 2014) fine and coarse particles were collected in quartz filters on the kerbside of a major arterial route (Fernão de Magalhães Avenue) in the city of Oporto. A high volume sampler, operating at 1.13 m^3 min^{-1}, with PM_{10} selective inlet and a single stage impactor attached to the equipment enabled the particle collection into 2 fractions: $PM_{2.5}$ and $PM_{2.5-10}$ samples. A total of 131 pairs of $PM_{2.5}$ and $PM_{2.5-10}$ samples were collected. PM mass concentration was quantified applying the gravimetric method. Elemental carbon (EC) and organic carbon (OC) components of particles were measured by the thermal–optical method developed by the University of Aveiro. The present method applied to the OC/EC quantification (DAO method) is described in Alves *et al.* (2011). Secondary organic aerosol (SOA) was estimated using the OC/EC minimum ratio tracer described in Pio *et al.* (2011) and the samples were organized in two groups: cold season, group of samples collected between 15^{th} November to 15^{th} March, period of domestic wood heating, and warm season performed by the samples collected between 16^{th} March to 14^{th} November. Fifty of the total $PM_{2.5}$ samples were selected to perform as well the OC and EC quantification using the EUSAAR protocol. Black carbon (BC) was also quantified with a seven wavelength Aethalometer (Magee Scientific, model AE31) and the sampling period was set to 5 min. The quantification of carbonaceous content in PM samples through different methods was investigated.

The average concentrations of OC and EC in $PM_{2.5}$ were 6.3 $\mu g.m^{-3}$ and 5.0 $\mu g.m^{-3}$, respectively, accounting together for more than 40% of the $PM_{2.5}$ mass. The contribution of $PM_{2.5}$ to PM_{10} mass concentration was very high (slope = 0.88 and r^2= 0.971, linear regression of $PM_{2.5}$ vs. PM_{10}). The carbonaceous fraction represented, on average, 30.3% of the total mass of PM_{10} (13.4% and 16,9% for EC and OC, respectively). EC was found mainly in the aerosol fine fraction. Spring season exhibited, on average, lower concentration of carbonaceous matter. The highest concentrations of OC and EC were observed in winter season and in some days of summer when several forest fire events were reported.The percent contribution of SOA to TC ($PM_{2.5}$) in the warm season (39.8 $\pm$ 15.2) is almost twice that observed in the cold season. The minimum OC/EC ratio for the cold and warm seasons was 0.3 and 0.7, respectively. This last ratio is very close to the OC/EC ratio found in a Portuguese traffic tunnel (Pio *et al*., 2011). In cold season the higher OC/EC could be explained by domestic heating with biomass burning. The quantification of OC and EC with the EUSAAR protocol showed that organic carbon tends to be underestimated and EC overestimated in relation to DAO protocol. This is a critical point and the comparison of carbonaceous content in aerosol samples obtained with different methods and protocols must be done with precaution. Attending to the good correlation found with EUSAAR and DAO protocols, the obtained equation could be very usefull in the future when trends of OC, EC and OC/EC will be evaluated.The highest BC carbon concentrations were observed in winter months and the daily pattern variation is driven by local traffic. The hourly average concentrations of BC in some occasion exceeded more than 20 $\mu g.m^{-3}$. The comparison of EC and BC showed a good agreement although EC tends to be higher than BC concentrations.

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MODIFICATION OF SOLAR SPECTRAL IRRADIANCE DUE TO ATMOSPHERIC AEROSOL: A MODELLING APPROACH

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This study investigates the modification of the clear-sky spectral irradiance components (direct beam and diffuse), as well as the spectral diffuse-direct beam ratio (DDR) as a function of the solar zenith angle (SZA) and aerosol properties, like Aerosol optical Depth (AOD), Single Scattering Albedo (SSA) and Ansgtrom wavelength exponent (α). The solar spectrum under different atmospheric conditions is simulated via the SMARTS radiative transfer model (Gueymard, 1995, 2005), using ideal urban and continental aerosol models and/or via changing the aerosol loading, scattering and absorption capabilities of particles. The model simulations are also compared with experimental data taken from multi-filter rotating shadowband radiometer (MFRSR) in Athens, Greece. The aerosol optical properties strongly affect the scattering processes in the atmosphere, thus modifying direct and diffuse spectra, as well as DDR, especially in the ultraviolet band (Kaskaoutis et al., 2007). More specifically, the DDR wavelength distribution can be simulated by a decreasing exponential curve, while the correlation between spectral DDR and spectral AOD can be represented precisely by an exponential function. The constant terms of the fitting functions depend strongly on SZA and aerosol properties (AOD, SSA, α) and are in accordance with those obtained from the experimental data when the urban aerosol model is used in the SMARTS code. Comparison between measurements and model estimates of the DDR for same SZA and AOD is able to provide SSA estimates which are not given via MFRSR.

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CHANGES IN SOURCES CONTRIBUTING TO THE PM10 COMPOSITION CLOSE TO A CEMENT PLANT (2005-2013).

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The evolution of PM10 levels and chemical composition from 2005 to 2013 in the University of Alicante is discussed. The university is located in a semi-arid industrial environment where a number of industries related with construction as cement, ceramic and crushed stone or construction waste recycling have had a decrease in production as a consequence of the economic crisis. Annual average levels of PM10 have decreased from 40,5 mg/m^3 in 2005 to 17,0 mg/m^3 in 2013. This decrease implies a generalized decrease in most important sources as crustal and secondary aerosols. SIC (Secondary Inorganic Compounds) decrease from 7,5 mg/m^3 in 2005 to 3,4 mg/m^3 in 2013 and crustal from 17,4 mg/m^3 in 2005 to 4,2 mg/m^3 in 2013. However carbonaceous compounds do not show a decrease being their concentrations (OM+EC) 2,9 mg/m^3 in 2005 and 3,3 mg/m^3 in 2013. Even more important is the relative increase (from 7% in 2005 to 19% in 2013) that these compounds present with respect to the PM10 mass, becoming now one of the principal constituents of the aerosol.

A first estimation of (OM + EC) or organic matter plus elemental carbon were obtained by applying a 1,2 factor to the OC + EC concentrations for urban sites (Querol et al.2008). The OC + EC fraction was obtained after subtracting the CC (C–carbonate) to the total carbon TOC.

Two common techniques were used to measure TOC from 2005, depending on availability: a LECO analyzer for the samples collected during 2008-2009 and 2011 and a SUNSET analyzer (OC+EC) for the period 2005-2006. In 2013, both techniques were used to study their comparability and a possibility to discern OC and EC in the years were only TOC was measured.

A good correlation (r2=0,98) between the concentrations obtained by both methods for the TC is found. Also the correlation (0,69) between the Sunset EC and the Leco-TC is significant. This allows to estimate the EC concentrations for the past years were only TC-Leco was measured and therefore a better estimation of organic fraction based only in OC/OM ratios (Escudero et al., 2015).

Inorganic Carbon is usually calculated stoichiometrically from Ca and Mg concentrations. It accounts for 15% of TC (min 3%-max 30%). However, when IC is discounted from TC the correlation between OC and EC does not present significant changes.

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PARTICULATE MATTER FORMATION FROM PHOTOCHEMICAL DEGRADATION OF ORGANOPHOSPHORUS PESTICIDES

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Pesticides are most widely used chemical compounds and actually, they are emerging chemical pollutants precursors of particulate matter. Today's agriculture involves heavy use of synthetic pesticides, including herbicides, fungicides, acaricides, insecticides and avicides. Their entry into the atmosphere occurs during application or subsequent processes such as volatilization and resuspension (Gil et al., 2005). The number of patented pesticides is very high and many families belong authorized, prohibited or banned - CE 1107/2009 - due to the restricted regulations about human and environmental safety. As consequence, the scientific knowledge about the behaviour of pesticides in the atmosphere is highly demanded due to their use in Mediterranean agriculture in a broad range of applications. However, there is a relative lack in the scientific knowledge about the behaviour of pesticides in the atmosphere.

The major routes of degradation of pesticides in the troposphere involve photolysis, ozonolysis and reactions with hydroxyl and nitrate radicals. The result is a reduction of their concentration in air. However particulate matter (PM) is formed and it could have a toxicity, residence time and atmospheric chemical stability different than the original molecule. Relevant information for several of the most Mediterranean Area world-wide used organophosphorous insecticides has been obtained in a high volume atmospheric simulation chambers – EUPHORE - with an extensive instrumentation for monitoring the particulate matter formed. Thus, several experiments were performed in these facilities for organophosphorus pesticides such as, chlorpyrifos, chlorpyrifos-methyl, diazinon and pirimiphos-methyl (Muñoz et al., 2011,2014; Borrás et al., 2015). The mass concentration yields obtained (Y) were in the range 5 – 44 % for the photo-oxidation reactions in the presence and the absence of NOx. These results confirm the importance of study pesticides as significant precursors of atmospheric particulate matter due to the serious risks they can generate. Also, several degradation products were identified, allowing us to propose degradation mechanism pathways.

The studies, based on the use of EUPHORE photoreactor, provide useful data about atmospheric degradation processes of organophosphorus pesticides to the atmosphere. Knowledge of the specific degradation products, including the formation of secondary particulate matter, could complete the assessment of their potential impact. In fact, the fingerprint chemical composition analysis has indicated that they are a relevant source of multi-oxygenated molecules. The formation of those types of degradation products is important because they play a significant role in the atmospheric chemistry, global climate change, radiative force, and are related to health effects.

The research leading to these results received funding from the Spanish Ministry of Economy and Competitivity (project IMPLACAVELES: CGL2013-49093-C2-1-R) and, Generalitat Valenciana for the DESETRES-Prometeo II project.

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THE EFFECT OF METEOROLOGICAL CONDITIONS ON PARTICULATE MATTER GENERATION ALONG THE TURIA RIVER (SPAIN): SIMULATIONS AT THE EUPHORE SMOG CHAMBER

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Within the MODELISMOS project (Modelling and analysis of mesometeorological processes on transport and accumulation of pollutants in the Western Mediterranean and their influence on chemical degradation mechanisms) two different campaigns, the first one in winter (February 2012) and the second one in summer (September 2012), were carried out at the EUPHORE simulation chambers to study the influence of the meteorological conditions (temperature, relative humidity and radiation) on the secondary particulate matter (PM) formation and the chemical reaction mechanisms in the atmosphere, recreating atmospheric environments under controlled experimental conditions. The reactants and experimental conditions used were based on the field measurements performed along the Turia river (Valencia-Western Mediterranean). Results obtained in both campaigns regarding of secondary pollutants formed are presented.

With the aim of characterizing the main air pollutants (anthropogenic, biogenic and secondary reaction products) present in the Mediterranean coast of the Iberian Peninsula under different meteorological conditions (summer and winter), two smog chamber campaigns were designed and performed. The study presented in this communication deepens on the knowledge of the chemical characterization processes that generate secondary pollutants such as secondary organic aerosols (SOA), under different weather conditions by atmospheric degradation of VOCs. In this sense, the EUropean PHOtoREactor (EUPHORE, Valencia-Spain) is one of the major outdoor simulation chambers (2x200 m^3) on investigation into the photochemical degradation of atmospheric pollutants and generated products. These simulation chambers are fully equipped with a broad number of analytical instruments in order to analyze most relevant contaminant species under controlled oxidative conditions.

A mixture of 6 most relevant VOCs (3 Biogenics + 3 Anthropogenics) was used to represent urban and rural scenarios based on the field measurements previously done along the Turia basin. A total of 20 urban and rural base scenarios were established, and from them, the effect of increasing anthropogenic, biogenic or NOx concentration under winter and summer conditions was studied. Accordingly, VOCs, NOx and humidity were introduced into the chamber and exposed to sunlight during several hours to measure generation rates of particulate matter. Different VOCs/NOx ratios representing urban and rural scenarios under winter and summer conditions were simulated at EUPHORE chamber. This ratio is higher in summer scenarios than in winter, and among urban and rural, VOCs/NOx ratio is higher in rural than in urban conditions. In general, maximum secondary PM concentration was higher in urban (VOCs limited) scenarios than in rural (NOx limited), but there is not a direct relationship between rural and urban scenarios and PM generation when changing biogenic, anthropogenic or NOx concentration in winter and summer. As a main conclusion, the fact of implementing different reduction strategies (i.e. anthropogenic, biogenic and NOx emissions) could be strongly affected by the prevailing meteorological conditions (winter or summer considered as extreme climatic conditions throughout the year) and its effects would be different if the reduction strategies were implemented on rural or urban scenarios.

The research received funding from the Spanish Ministry of Economy and Competitivity (project MODELISMOS) and, Generalitat Valenciana for the DESETRES-Prometeo II project.

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CHARACTERIZATION OF AFRICAN DUST OUTBREAKS IN SOUTHERN SPAIN

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North Africa is widely considered as the largest dust producing source, identifying the Sahara desert as one of the major source areas of windblown dust in the Northern Hemisphere. Due to the proximity to the African continent, Spain is especially affected by those dust plumes. Thus, a number of works have been devoted to the influence of African dust on health, ecosystem dynamics or climatic change, as well as to the study of its properties and the mechanisms of dust transport.

Even the huge amount of studies concerning African dust outbreaks, there are still questions to be answered. The aim of the present work is to characterize these episodes and their influence on the air quality in southern Spain to try to contribute to a better understanding.

The study area is located in Málaga (southern Spain). Days affected by African dust outbreaks during 2009-2011 were identified using the DREAM and NAAPS dust models. Daily concentrations of air pollutants and meteorological data, as well as Absorbing Aerosol Index (AAI) and Aerosol Optical Depth (AOD) data from satellite data were used to try to find out the influence of the African dust transport toward Spain on the air quality. Moreover, 96-hour back-trajectories were computed at 00, 06, 12 and 18 UTC each day during the study period arriving at the receptor point at different heights from 500 to 5000 m above sea level (m a.s.l.) in 250 m increments by the HYSPLIT dispersion model.

In the period 2009-2011, 101 African dust events were identified in the study area, accounting for a total of 403 days (on average 34 events and 134 days per year) mainly occurring in summer (more than 40%). During these events, PM_{10} values range from 13 to 166 μg m^{-3} and more than 30% of them present exceedances of the daily limit value of EU air quality directive. Likewise, AOD and AAI records range from 0.038 to 1.603 and -3.3 to 2.7 respectively. On days affected by African dust, the trajectories reaching Málaga at low heights do not pass over Africa, but over the Mediterranean; trajectories arriving between 1500 and 2500 m a.s.l. passed over the African continent and at high altitude they reach from the Atlantic.

Levels of PM_{10} and gaseous pollutants show a clear seasonal pattern. NO_2 and CO present a maximum during winter, while O_3 and PM_{10} show higher records in summer. For PM_{10}, SO_2 and O_3 significant differences were found between days affected and non-affected by African dust outbreaks, however, NO_2 and CO do not show these differences.

For PM_{10}, SO_2 and O_3 significant differences were found between days affected and non-affected by African dust outbreaks, however, NO_2 and CO do not show these differences.

The correlation between the time which backtrajectories have lasted over the African continent versus PM_{10} and AAI, were the highest for altitudes between 2250 to 3500m. For AOD the best correlations are found for 2250 to 5000 m a.s.l.

THE "A5-UNIBO" EXPERIMENT ON-BOARD BEXUS 18 STRATOSPHERIC BALLOON

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Aerosols are able to affect climate in two major ways, namely direct and indirect process. The direct effect is the one exerted by aerosols themselves on the radiative balance of the Earth through a combination of scattering and absorption of radiation. The indirect effects are a suite of possible impacts on aerosols through the modification of cloud properties interaction of aerosols on clouds (IPCC, 2013). Clouds and aerosols still contribute the largest uncertainty to the correct assessment and understanding of "climate change" (IPCC, 2013).

Ion-induced nucleation has been proposed to act in addition to the classical homogeneous nucleation (Iida et al., 2006; Hirsikko et al., 2007; Laakso et al., 2007). In particular, possible links between cloud formation processes and the ionization of atmospheric particles caused by Cosmic Rays have been proposed. The most widely studied mechanism proposed to explain the possible influence of the cosmic ray flux on cloudiness is the "ion aerosol clear air" mechanism (Carslaw et al., 2002; Usoskin and Kovaltsov, 2008). Our current understanding of these phenomena remains very low, mostly due to the reduced number of conclusive observations and our dependence on model simulations of these phenomena.

The "A5-Unibo" experiment flown in BEXUS18 stratospheric balloon has been developed by the University of Bologna to this aim. The primary objective of the experiment was to collect vertical profiles of different atmospheric parameters involved in the above-mentioned processes, while the secondary one was the sampling of stratospheric aerosols for a post-flight analysis.

In fact, A5-Unibo experiment measured profiles of particles size distribution with an innovative aerosol counter (LOAC "Light Optical Particle Counter", MeteoMODEM,), positive and negative ion densities (Air Ion Counter, AlphaLab. Inc.), together with key atmospheric parameters (such as temperature, humidity, and pressure).

In this way, a correlation between ionization and aerosol formation processes has been investigated through a rather simple multi-instrument approach. Our preliminary results have identified a possible role of positive ions in condensation, as well as a larger importance of humidity with respect to temperature.

This work was designed and developed within the collaboration of the Flight Mechanics Laboratory and the Department of Chemistry of the University of Bologna as main supporters. We also acknowledge: a) institutional supporters: DLR, Rymdstyrelsen, SSC, ESA, EuroLaunch, ZARM; b) private companies and associations: AlphaLab Inc., Boxer, Iacobucci HF Aerospace, Icos, CNA Forlì-Cesena, Dogcam, Gruppo SDS, Società Italiana di Medicina Generale, Plastica Panaro, Bustaplast, Bellini Tiziana, Mascherpa.

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STUDY OF THE BIOGENIC N-ALKANES CONTRIBUTION FROM A PALM TREE URBAN GARDEN TO THE AEROSOL LEVELS IN THE CITY OF ELCHE

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A wide variety of organic compounds, that can be distributed between both the gas and particulate phases, is present in the atmosphere as a result of a mix of biogenic and anthropogenic sources and the photochemical degradation of their emissions.

The aliphatic fraction of particulate matter comprises n-alkanes, n-alkenes, the unresolved complex mixture of cyclic branched and unsaturated hydrocarbons and acyclic isoprenoids. n-Alkanes usually represent the most abundant group among the aliphatic fraction (Alves et al., 2012) and can be emitted from both anthropogenic and natural sources. Gasoline and diesel vehicles, coal, biomass and natural gas burning, cigarette smoke, unburnt heating oils, etc. are the most general anthropogenic sources of this kind of hydrocarbons. But nature, in the form of contemporary epicuticular plant wax emissions and direct suspension of pollens, microorganisms and insects is also a major contributor to the atmospheric concentrations of n-alkanes.

Organic compounds can be found in both the coarse (PM10-PM2.5), the fine (PM2.5-PM1) and the sub-micron (PM1) fractions of atmospheric PM, although the higher concentrations are usually associated to the finer fractions, which are also the most dangerous ones because they can reach the human lung alveoli (Gerde et al., 1991).

The campaign was carried out from October 2008 until August 2009. Twenty four hours samples of PM1, PM2.5 and PM10 were collected on teflon-impregnated glass-fibre filters by means of low volume samplers at two sampling points. The first (CHO) was located on one of the city centre palm tree gardens existing in Elche, and the other point was placed on the roof of a building adjacent to a major city avenue (UMH).

In the CHO location, n-alkane associated to PM1 reached up to 61% of total hydrocarbon concentration, 30% related to the PM2.5-1 fraction and 9% associated to the coarse fraction. Homologue C31 was the major contributor in the different fractions, followed by C29. . Surprisingly, anthropogenic hydrocarbons C20-C23 showed higher concentration values than those observed at the UMH sampling point, which was expected to be more influenced by traffic emissions.

Remarkable differences were observed for C36-C40 alkanes. During the warm season, long chain n-alkane concentrations at CHO exceeded those observed during the cold period. However, the same was not observed at the UMH location, proving the major contribution of biogenic sources to n-alkane concentration during the spring-summer period.

CPI values were slightly higher for the sampling point located inside the palm tree garden, suggesting a higher proportion of natural emissions with respect to the UMH site. The PM10 fraction was the most influenced by biogenic emissions, recording higher CPI values, both in spring-summer and autumn-winter periods, than PM2.5 and PM1.

Slightly higher values were obtained for wax n-alkanes percentage (%WNA) at CHO with respect to those at UMH, as expected from its location in a garden.

This work was supported by the Spanish MINECO under the CGL2012-39623-C02-2 (PRISMA-AITANA) projects.

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DETERMINATION OF SELECTED POLYCYCLIC AROMATIC COMPOUNDS IN PARTICULATE MATTER: A VALIDATION STUDY OF AN AGITATION EXTRACTION METHOD FOR SAMPLES WITH LOW MASS LOADINGS USING REDUCED VOLUMES

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This work presents the results obtained for validation of a simple sample treatment procedure to analyze selected polycyclic aromatic compounds by agitation extraction using reduced volumes of solvent. The main focus was the analysis of PACs in particulate matter with low mass loading, such as impactor substrates used to determine the nano and submicron size distribution.

The development of the proposed analytical method was performed on one hand from comparison with pressurized fluid (PSE) and microwave (MC) extraction techniques and on the other one by estimating intermediate precision associated to analytical measurements. Twelve ambient air samples (PM10) were used for analysis. In particular, four sub-samples of each one were treated and analyzed separately based on different extraction procedures to evaluate analytical results including the associated intermediate precision.

Extractions by agitation with 8 mL of dichloromethane yielded recoveries between 80-135% compared to those obtained from PSE extraction. Regarding intermediate precision results, values between 10-20% were reached showing increases of dispersion for compounds with high volatility and low levels of concentration. Within the framework of the INTA/CIEMAT research agreement for the PM characterization in gas turbine exhaust, the method was applied for analysis of aluminum foil substrates and quartz filters with mass loading ranged from 0.02 to 2 mg/sample.

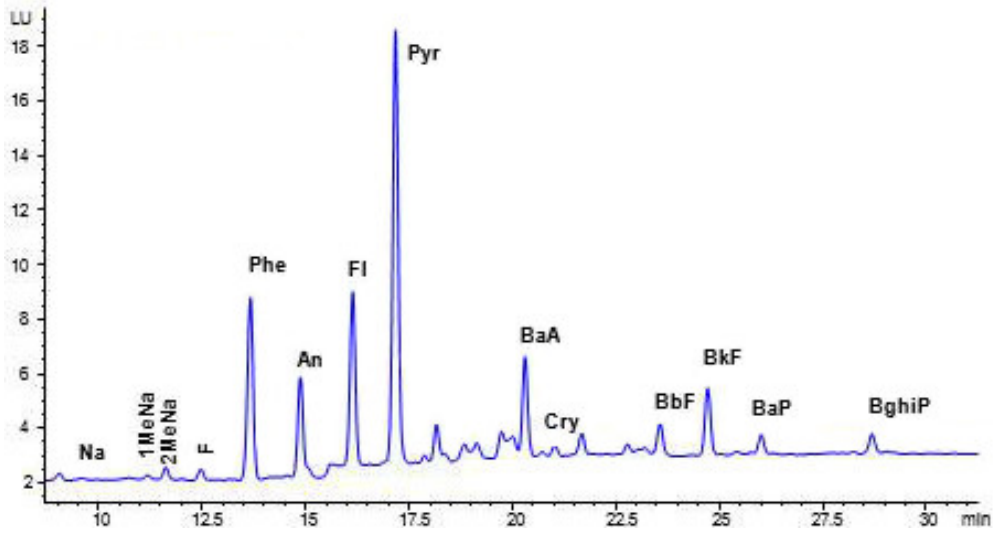

Figure 1: Representative chromatogram obtained from analysis (100 μL of final extract) of a quartz filter collected by a Low Pressure Impactor during assays from turbofan engine exhaust (mass load around 2 mg/filter).

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IDENTIFICATION AND QUANTIFICATION OF MARKERS IN EMISSIONS AT AN URBAN BACKGROUND SITE

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In this study, a comprehensive assessment of PM composition has been carried out including numerous organic substances such as levoglucosan (marker of wood burning), water soluble organic carbon (WSOC), short chain organic acids, PAHs, alkanes, phthalates, terpenes, fatty acids, paraffins and hopanes (Turlington et al., 2010; Alves, 2008). In particular, a new more rapid methodology has been set up for the quantification of most of these substances by GC-MS. Levoglucosan and WSOC have been determined according to analytical procedure previously described (Piazzalunga et al., 2013).

The WSOC importance is that they can potentially alter the hygroscopic properties of aerosol particles making them more effective cloud condensation nuclei, being important in regulating aerosol indirect radiative effects. In the present study, the absence of a significant difference between the two seasons indicates that both primary and secondary sources contribute to WSOC emissions. The presence of levoglucosan allows to estimate the contribution of wood combustion to PM emission. The correlation levoglucosan/WSOC during winter indicates an important contribution of BB (biomass burning) to WSOC during this season.

Organic acids sources comprise direct anthropogenic and biogenic emissions. In this study oxalate, acetate, formiate and methansolphonic (MSA) acids have been quantified. The high correlation between acetate and formiate during wintertime indicates a common origin which has been identified as wood combustion.

The contribution of the major emission sources to regional particulate pollution can be identified by using specific molecular markers (Alves, 2008). Some of the fatty acids identified (myristic, palmitic, oleic, etc.) are considered markers of cooking. A season variability has been also observed, fatty acids with C>20 (associated to emission from biological sources) show higher concentrations during winter which can be associated to the leaves fall. For alkanes, there is a predominance of homologous with a high molecular weight and an odd carbon number that are attributed to plant waxes. Among terpenes, limonene, farnesol, eucalyptol and caryophellene are linked to biogenic emissions from plants. Hopanes have been also identified and their presence has been associated to traffic exhaust.

Some of the organic compounds present play an important role in PM health effects due to their toxicological potential impacts (e.g. PAH identified as carcinogenic by IARC). Seventeen species belonging to this class have been quantified paying attention in particular to PAH with 5 or 6 rings. Their presence could be due to combustion processes including wood combustion.

This data will be included in the dataset of previously made analysis in Joint Research Center at Ispra (OC/EC measurements, elemental analysis) to run source apportionment models.

The project is supported by ABC-IS group.

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DETECTION AND MOLECULAR TYPING OF BACTERIAL PATHOGENS AT WORKPLACES IN POWER PLANT

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Introduction: A vast majority of the hitherto published reports regarding molecular detection and typing of microbial species in the occupational environments has been focused on the high-risk pathogens in health-care settings. A little attention has been so far given to microbial source tracking in other working environments [1,2]. In this study, the ways of environmental transport of the most common bacterial species isolated from different human and workplace sources of their origin were characterized.

Methods: The study was carried out at 5 workplaces of the energy production line in power plant utilizes biomass. At each of the workplaces, bioaerosol particles were collected as on sterile teflon filters using conical inhalable samplers (CIS) and biomass samples were taken to analyze their microbial load. Swab samples from hands of 10 workers and their used respiratory mask were also collected after the work-shift to evaluate microbial contamination. In all types of the collected samples, total bacterial concentrations were assessed and the most common microbial isolates were identified to the species level using both biochemical (API tests) and molecular (PCR-RAPD) methods.

Results: The mean concentrations of culturable bacteria in the air and in biomass samples at workplaces were high, i.e. 1.4×10^6 CFU/m^3 and 4.3×10^4 CFU/g, respectively. The number of bacteria in swab and mask samples also reached a high level of 1.5×10^4 CFU/ml and 2.4×10^3 CFU/ml, respectively. Among the most frequently isolated bacteria from all types of samples were species of the genus *Bacillus* (*B. pumilus* and *B. subtilis*). The genomic similarity within 15 *B. pumilus* and 4 *B. subtilis* isolated strains was showed by PCR-RAPD method. At 80% similarity, four distinct clusters for *B. pumilus* (I-IV) and one for *B. subtilis* were detected. The clusters of *B. pumilus* contained isolates from: I – mask and air samples; II – biomass and hands; III – biomass, mask and hands; IV – hands and mask. Only 4 strains of *B. pumilus* showed a very high similarity coefficient (>92% – isolated from biomass and mask; >85% – isolated from biomass and hands). In case of *B. subtilis*, cluster I grouped 3 strains isolated from biomass and hand samples, and two of them showed a high similarity coefficient (>90%).

Conclusion: The results demonstrated that biomass is the primary source of bacteria at the power plant workplaces. The biomass-associated bacteria can easily be airborne and, as such, transferred to human hands and mask during working activities. The PCR-based methods seems to be an efficient tool for a fast and precise typing of bacterial strains isolated from different sources in the occupational environment. Such methods may help to implement appropriate prophylactic procedures and minimize transmission of infectious agents at workplaces.

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THORACIC AND INHALABLE FRACTIONS OF SULFURIC ACID AEROSOL AT THE WORKPLACES AIR

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The common use of sulfuric acid(VI) can cause a serious hazards to workers health in many branches of the economy. This acid is used in fertiliser, petroleum refining and metallurgy industries as well as during the production of among others different kinds of chemicals, synthetic rubber, plastics, paints, paper, soap and detergents. Sulfuric acid is not very volatile and therefore workplace inhalation exposures are primarily limited to aerosols. The particle size and the amount of particles depends on the type and conditions of the manufacturing process and acid strength. Due to determine an Indicative Occupational Exposure Limit Value (IOELV) of 0.05 mg m^{-3} for sulfuric acid aerosols only for the thoracic particle fraction by the Commission Directive 2009/161/EU and because of many the many gaps in occupational exposure to different fractions of sulfuric acid aerosol and epidemiological studies on their health effects, as indicated review of literature, new research findings in this area are high demand. The main aim of presented studies is to compare of the thoracic fraction contents in the inhalable fraction of aerosol emitted in different technologies with sulfuric acid.

The measurements of fraction of sulfuric acid aerosol in the workplaces air were carried out in three enterprises during production concentrated acid and titanium dioxide. For air sampling membrane filters placed in impactors PPI (Parallel Particle Impactor) for thoracic fraction and in sampler IOM (Institute of Occupational Medicine) for inhalable fraction was used. Sulfuric acid is eluted using 10 ml of distillated water. The obtained solutions were analyzed with ion chromatography with conductometry detection. For analysis DionexIonPac® AS22 (4x250 mm) column with pre-column DionexIonPacAG22 (4x50mm) and eluent composed of 4.5 mM NaHCO3 and 1.4 mM Na2CO3 in isocratic flow 1.2 ml min^{-3} were used. The range of measurement is 0.01 to 0.1 mg m^{-3} for a 480 l air sample. The detectability of method is 1.02 μg m^{-3}. Depending of the location of air samplers the concentrations of thoracic fraction were: 0.002—0.004 mg m^{-3} in enterprise A, 0.003—0.010 mg m^{-3} in enterprise B and 0.006—0.036 mg m^{-3} in C. While concentration of inhalable fraction sampling in the same locations were in enterprises A - C respectively: 0.010—0.018 mg m^{-3}, 0.038—0.059 mg m^{-3} , 0.027—0.16 mg m^{-3}. The results of the investigation indicated that thoracic fraction of sulfuric acid(VI) constitutes from 26% to 96% of inhalable fraction, depends mainly of the process type and the sampling site.

The paper was prepared based on the results obtained within the National Programme: "Improvement of Safety and Working Conditions" (2014–2016). The Central Institute for Labour Protection-National Research Institute is the coordinator of the programme.

THE STUDY OF POLYCYCLIC ORGANIC SUBSTANCES IN THE FINE PARTICLES FRACTIONS EMITTED FROM DIESEL AND GASOLINE ENGINES.

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The natural phenomena and human activities are the main reason for fine particles generation. An important role in the environmental pollution by fine particles factions of aerosol, particularly in the centers of big agglomeration as well as in the working environment play a different machines and equipment with diesel engines and automotive. The nanoparticles represent a significant part of the fine particles fraction of the exhaust combustion fumes. They have different properties and performance as well as other capacity to accumulate in the human respiratory system compared with larger particles of the same chemical composition. Despite of many research there are still many unsolved issues in the area of particulate emissions from motor vehicles and their impact on human health.

This paper presents the results of the determination of polycyclic aromatic hydrocarbons (PAHs) in the fraction of fine particles emitted from two types of fuels used in diesel engines and gasoline. Samples of exhaust combustion fumes were generated at the reference station which consisted which consisted of a diesel engine - Diesel 2.0 TDI in 2007 and VW 1.4 four-cylinder petrol engine of 2009. Personal Cascade Sioutas Impactor (PCSI) with Teflon filters was used for sampling of ultrafine particles from exhaust fume. PAHs adsorbed on particulate fractions were analyzed by high performance liquid chromatography with fluorescence detection (HPLC/FL). Phenanthrene, fluoranthene, pyrene present the highest concentration in the particulate matter emitted by a Diesel engine. Benzo(a)pyrene, was present in the particles emitted during operation of the diesel engine and maximum concentration in the fraction -1. In the fraction of 0.25 μm—10 μm emitted from a gasoline engine and in the fraction -1 and 22 μg g^{-1}, respectively. Dibenzo(a,h)anthracene was determined only on the particulates emitted from diesel fuel in the fraction -1.

The obtained results indicate that the highest concentrations of PAHs are present in the fraction of exhaust particles smaller than 0.25 μm, regardless of the fuel used.

The paper was prepared based on the results obtained within the National Programme: "Improvement of Safety and Working Conditions" (2014–2016). Te Central Institute for Labour Protection-Nationalis the coordinator of the programme.

SOURCES OF AIRBORNE OLIVE TREE POLLEN IN ALICANTE (SPAIN)

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The olive tree pollen is highly allergenic, but not all varieties of olive trees have the same content of molecular allergens (Alché et al., 2007). In the province of Alicante (eastern Spain), there are varieties of olive trees different from those that grow in southern Spain. Our main goal was to determine the origin of air masses when peak concentrations of pollen were recorded in our study area between 2009 and 2012 by means of back-trajectories (Draxler et al., 2013; Fernández-Rodriguez et al., 2014).

We analyzed data on pollen counts in the urban area of Elche, located 20 km south of the city of Alicante. Pollen counts were obtained with a Burkard type collector and those days with peak concentrations were selected each year. In order to identify the origin area of pollen for the selected sampling days, 3-day back-trajectories of air masses arriving to Elche in spring were calculated. We used the HYSPLIT 4 transport model (NOAA Air Resource Laboratory) at three different levels above the ground (100, 500 and 1000 m).

We found an average of 5 or 6 peaks per year of high concentrations of olive pollen, with variations in the onset of the first peak from March to May. The maximum pollen concentration did not exceed 700 pollen grains per cubic meter of air (gn/m^3), far away from the value of 2500 gn/m^3 usually observed in Jaén and Seville, located in southern Spain.

Back-trajectory analysis showed that some high pollen concentrations were recorded when air masses came from southern Spain, especially Jaén and Seville (Cultivars: Picual, Hojiblanca, Verdial de Huevar, etc). The first concentration peaks coincided with the blooming of the local community (Cultivars: Alfafara, Blanqueta, Changlot Real, Rojal de Alicante and Villalonga).

The study of the origin of air masses allows us to know source areas of pollen. Thus, we can improve the knowledge of the different allergens of olive tree pollen that reach our study area.

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CHEMICAL AND PHYSICAL EMISSIONS PM CHARACTERIZATION FROM AIRCRAFT TURBOFAN ENGINES

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Aircraft transport is growing rapidly and so are the engine particle emissions, which may affect negatively to air quality and lastly to human health. Smaller particles have a greater penetration in the respiratory system, and therefore, it is not only important to study the total concentration, but also the size distribution. Moreover, the chemical speciation is also of great relevance, as the toxicity depends of each compound. In this point, there are gaps in the knowledge of polycyclic aromatic hydrocarbons (PAH) aircraft emissions composition.

In order to assess the environmental impact of aircraft emissions, multiple air samples were collected during the engine tests that are carried out in the turbojet testing centre located at INTA, using a probe located at the stack. Particle number concentration and size distribution were measured using an ELPI+, a CPC (TSI 3775) and a SMPS (TSI 3934). Particles were also collected in parallel with a flow splitter on aluminum substrates using a Berner low pressure impactor (BLPI) for PAHs composition determination. At the same time, ambient PM samples were captured outside the facility using a high-volume air sampler (CAV-A/M) to compared data with atmospheric background levels.

The results show an increase in the total particle concentration with increasing engine power level, with a clear predominance of ultrafine particles. Size distribution shape also changes, with a single mode at low power conditions and a bi-modal distribution for higher levels, which is attributed to the increased of the non-volatile particles diameter. From the PAHs analysis, we found that the main compounds of the engine exhaust were methylnaphthalenes, followed by other semi-volatile compounds such as phenanthrene, fluoranthene and pyrene.

EXPOSURE OF THE GENERAL POPULATION TO PM2.5, POLYCYCLIC AROMATIC HYDROCARBONS, QUINONES, BLACK CARBON AND VOLATILE ORGANIC COMPOUNDS

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This study aims to quantity the concentrations of PM2.5 and associated PAHs and quinones, BC and VOCs at the personal exposure level and also present in typical indoor environments, such as homes and offices.

Subjects were recruited among the general population (N=48). Aerosol samples were collected onto Teflon filters at 3L/min for 24-h using a PM2.5 URG cyclone (URG-2000-30EQ) attached to a bespoke personal sampler for gravimetric analysis and chemical characterisation of PAHs and quinone content (Delgado-Saborit et al, 2013). VOCs were concurrently collected into sorbent tubes at 40 mL/min for 24-h (Delgado-Saborit et al, 2009). Additionally, subjects were issued with one microaethalometer AE-51 (Magee Scientific Ltd) to collect BC concentrations every 5-min for 24-h. Samples were concurrently taken at the personal level, home and workplace of the subjects.

Geometric mean PM2.5 concentrations measured at the personal exposure level (34 μg/m^3, range: 10-145 μg/m3), at home (31 μg/m^3, 8-151 μg/m^3) and workplace (39 μg/m^3, 11-125 μg/m^3) were close to the limit concentrations reported by the World Health Organisation (25 μg/m^3). However the range of concentrations measured indicate that some subjects are exposed to considerably high levels of PM2.5. Geometric mean concentrations of PAHs in the population of study are lower compared with a previous study performed in Birmingham (Delgado-Saborit et al, 2009). The differences might be attributed to a lower percentage of subjects exposed to environmental tobacco smoke in the current study (6% v. 12% in earlier study). Geometric mean concentrations of quinones measured at the personal level and at the subject's main indoor microenvironments are reported for the first time in this study, to the knowledge of authors. The concentrations are higher than those reported in a trafficked roadside in Birmingham (UK) and urban background locations elsewhere (Delgado-Saborit et al, 2013). Concentrations measured by the microaethalometer were combined with information provided by the time-activity diaries of the subjects and geometric means at the most visited microenvironments were calculated. The lowest concentrations were measured at subject's homes (634 ng/m^3), followed by the workplace (866 ng/m^3). Highest concentrations were recorded in-transit (1,813 ng/m^3). Home and workplace were however the microenvironments that accounted for the highest contribution to the daily exposure of the subjects. VOC concentrations measured in this study where generally lower than those reported for an earlier study in Birmingham, e.g. benzene mean 1.6 μg/m^3 (Delgado-Saborit et al, 2009). However, toluene, styrene and naphthalene concentrations were higher in the current study (e.g. toluene mean = 49 μg/m^3).

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DETERMINATION OF COOLING TOWER EMISSIONS (DRIFT AND PM10). EXPERIMENTAL PROCEDURE AND DISCUSSION OF THE STANDARDS

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Cooling towers are evaporative heat removal devices. Their principle of operation requires spraying water over a surface across or through which a stream of air is passing. The atmospheric air cools the water (direct contact between them) by evaporating part of the water. Chilled water falls into the tower basin while the removed heat leaves the device as warm air. As a result, water droplets are incorporated in the air stream and will be taken away from the unit. This is known as drift.

Cooling tower drift is objectionable for several reasons, but mainly because the emission of chemicals or microorganisms to the atmosphere. Undoubtedly, regarding to microorganisms, the most well-known pathogens are the multiple species of bacteria collectively known as legionella. Numerous legionella outbreaks have been linked to cooling towers in the southeast of Spain (Murcia 2001, Torrevieja 2005, Alcoy 2002-2014). Because of that fact, local authorities tend to replace cooling towers by less efficient devices.

Cooling tower emissions also include solid emissions. Since drift is not pure water, when the water from the drops evaporates, the impurities present in the droplets will remain in the air and possibly deposit onto the ground. This is known as particulate matter emissions, PMx. In the literature several methods with the aim of calculating PMx emissions can be found (AP42 EPA, 1995 or Reisman and Frisbie, 2002). Unfortunately, the results predicted by the methods do not agree well.

The main objective of this paper is to describe the experimental procedure to measure the emissions of a cooling tower: drift and PM10. This objective is met by carrying out several tests in a pilot plant using the sensitive paper method. This technique has been selected because is the only method included in the relevant international standards which is capable to provide drop size distribution data.

The results obtained have been discussed according to the relevant international standards and it has been found that these values are significantly higher than typical present-day manufacturers' guaranteed drift rates. In light of this, a revision of the standards is recommended.

Regarding PM10 emissions determination, two of the methods described in the literature have been compared. The AP-42 (EPA, 1995) method overestimates the PM10 emitted by the tower. It is therefore recommended a more realistic calculation of the PM10 emissions based on measurements, including factors such as the drift rate or the Total Dissolved Solids in the facility where the drift is measured.

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ANALYSIS OF ATMOSPHERIC POLLEN CONCENTRATIONS OVER EVORA IN RELATION WITH METEOROLOGICAL CONDITIONS

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Airborne pollen is an important fraction of the bioaerosol component in ambient air, particularly during the spring time where pollination peaks.

Airborne pollen concentration is regularly measured in Évora from January to June since several years using a stationary Hirst-type volumetric sampler (Burkard 7-day trap) situated at a height of 18 meters above the ground. The daily samples obtained from the samplers were analysed using the standard methodology proposed by the Spanish Aerobiology Network [1] and the hourly and daily pollen concentration was determined.

The meteorological conditions play a central role in the transport, dispersion and deposition of atmospheric pollens, thus strongly modulating the daily cycle of the concentration of these particles in the atmosphere. The aim of the present study is to analyze several years of pollen data in combination with key meteorological variables such as temperature, wind, humidity and solar radiation, as well as precipitation, which is closely linked with pollen atmospheric scavenging.

A diurnal cycle in atmospheric pollen, showing maximum values between 10h and 15h and minimum values from 0h to 6h, was observed. The cycle in pollen concentrations followed daily variation in wind velocity and was inversely correlated with relative humidity. Pollen concentration steadily increased with wind velocity from 0.4 m/s to 2m/s reaching a plateau that was maintained in the interval of 2m/s to 4m/s. Wind direction did not correlated with pollen concentration. Relative humidity in the interval 30-60% did not significantly affected pollen counts, however, above 70% a declining trend was observed.

In this work existing correlations and time lags between both time series data (pollen and meteorological variables) were explored. The correlations observed between pollen counts and meteorological data may constitute important hints to establish predictive models for alert purposes.

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INFLUENCE OF METEOROLOGICAL CONDITIONS ON POACEAE AND OLEA POLLEN LOADS IN THE CITY OF EVORA: A COMPARATIVE STUDY

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Due to different species requirements, the meteorological conditions may differentially affect production, transport and dispersion of diverse pollen types. The aim of this study is to perform a comparative study of the effect of key meteorological variables on airborne poaceae and olea pollen in the city of Evora.

Airborne pollen concentrations is regularly measured in Évora from January to June since several years using a stationary Hirst-type volumetric sampler (Burkard 7-day trap) situated at a height of 18 meters above the ground. The daily samples obtained from the samplers were analysed using the standard methodology proposed by the Spanish Aerobiology Network [1] and the hourly and daily grass and olive pollen concentration were determined. Existing species-specific correlations and time lags between both time series data (pollen and meteorological variables) were explored with comparative purposes.

Both grass and olive pollen concentration positively correlated with temperature in the beginning of the pollen season. Relative humidity (30-90%), temperature (5-35^{o}C) and wind velocity (1-4 m/s) affected pollen concentration in the air similarly irrespectively of the pollen type. Wind direction did not correlate with pollen counts from either olive or grass. Unlikely grass pollen, isolated events of olive pollen were observed outside the main pollen season. Back trajectories suggest that these isolated peaks might originate from long range transport of olive pollen to the capture site.

In summary, these two pollen types are similarly affected by most of the meteorological factors. Long range transport, however, might differentially affect the pollen types and, due to its putative health impact, is worth to further characterize.

Pollen counts were kindly supplied by the Rede Portuguesa de Aerobiologia, Sociedade Portuguesa de Alergologia e Imunologia Clínica. A special acknowledgment to Prof. Rui Brandao, deceased, for his dedication to the present work and to Aerobiology.

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ASSESSMENT OF THE SPECIFIC CONTRIBUTIONS TO OCCUPATIONAL EXPOSURE OF NANO-ALLOYING OF TIO2 TO SPECIAL STEELS

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Nano-reinforced steels are now considered for applications at severe conditions of radiation and high temperature due to their intrinsic resistance to radiation damage and high creep strength. Oxide Dispersion Strengthened (ODS) alloys are the most known of the nano-reinforced alloys. The development of industrial production of such new products has raised issues about their specific contribution to occupational exposure during the production process. This work presents the results of a comprehensive experimental campaign focused on the assessment of occupational exposure (inhalation and dermal) to nano-TiO2 tablets as alloying element to the molten steel, covering three case studies along the life cycle of nanoenabled steel: preparation of the tablets, mounting and incorporation to the molten steel. The tablets were made up by cold-compressing of commercial bulk powderAEROXIDE TM TiO2 P25 (Evonik) The typical BET area, according to the manufacturer is of 50 ± 15 m^2/g.

The measurements have been done in a full-scale production line, thus subjected to the constraints in measurement precision described in (Lopez de Ipina, 2015).The exposure inhalation assessment strategy followed NIOSH 63 (NIOSH, 2011). Samples at the personal breathing zone have been collected for ICP-MS and SEM/EDX. Aerosols released in the activities have been characterized using on-line devices following the tiered approach established by Asbach et al. (2012).Occupational exposure limit used for nano-TiO2 are 0.3 mg/cm^3 (NIOSH, 2011). Currently there is no limit value available for dermal exposure to nano-objects.

Results will encompass the concentration at the PBZ (mg/m^3) with regard to the proposed value for TiO2 (NIOSH), as well as on the total particle concentration number. It will be shown displays the high variability in the total particle number concentration in the periods without contribution from these tasks (1.9E+4-8.4E+4 particles/cm^3), does not allow to identify potential releases from the processes differentiated from other sources in the industrial environment. Data on dermal exposure showed very low concentration on the hands of the operators, which may be due to contamination during sampling. Nevertheless, the results showed that the occupational exposure to nano-TiO2 was below the selected OEL for all scenarios. The characterization of the aerosol released presented difficulties in some scenarios due to the strong influence of background in multi source industrial scenario MSIS. (L de Ipina et al, 2015).

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COMPARABILITY BETWEEN PORTABLE AND STATIONARY INSTRUMENTS FOR URBAN AIR QUALITY MONITORING

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Recent research recommends that current air quality monitoring networks should have a stronger link to health-effects monitoring (AirMonTech, 2013; Snyder et al., 2013). The need for exposure monitoring has been evidenced by numerous works (Gehring et al., 2013, among others). Portable monitors and sensors are currently being developed to enable a move towards exposure monitoring (as opposed to background concentration monitoring). One added value of these monitors is that they may also be used in indoor air.

US-EPA advocates a tiered system for different types of air monitors based on cost, application, and end user (US-EPA, 2013): near-reference, monitors/sensors intended for indicative use, and sensors intended for educational use. Their performance must be tested against reference instrumentation, or against the most widely used instruments in the case of unregulated parameters (e.g., ultrafine particle number concentration, black carbon) for which no reference is available. The present work focuses on near-reference instruments measuring parameters such as particle number concentration (N), mean particle diameter, lung-deposited particle surface area (LDSA), black carbon (BC) concentration, and particle mass concentration (PM10, PM2.5, PM1). The final goal is to evaluate whether the portable instruments under study are comparable to their reference (or widely accepted) stationary counterparts, for outdoor and indoor air quality studies.

To this end, five units of each of the near-reference instruments tested (DiscMini, Microaeth AE51, and Dusttrak DRX) were co-located inside the IDAEA-CSIC air quality monitoring station in Barcelona (Spain), connected to an inlet to monitor outdoor (urban background) air. Intercomparison exercises were carried out for at least 2 consecutive days (with a 5- or 10-minute time resolution) for each type of instrument. For each of them, 4 such intercomparison exercises were carried out, with a 2-3 month period between each exercise to identify potential drifts. As a result, for each parameter (e.g., BC), the dataset available consisted of 4 sets of 2-3 day intercomparisons between 5 units of the Microaeth AE51 and one MAAP instrument (considered as reference).

Results evidenced that the performance of portable monitors DiscMini and Microaeth AE51 may be considered comparable to that of their stationary counterparts (CPC, SMPS and NSAM for DiscMini, and MAAP for AE51), with R2 values >0.80 for BC, 0.>85 for N and >0.90 for LDSA. This analysis allowed us to quantify the mean uncertainty of each instrument as 9% for BC, 15% for N, and 12% for LDSA. The performance of Dusttrak DRX regarding particle mass concentration was lower (R2 with respect to reference >0.65, with values as low as 0.20), which was due to the unpredictable re-basing of the instrument on random occasions. This results in a mean uncertainty >20%.

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SMPS AS AN INDUSTRIAL MONITOR: REQUIREMENTS AND FIRST INTERCOMPARISON

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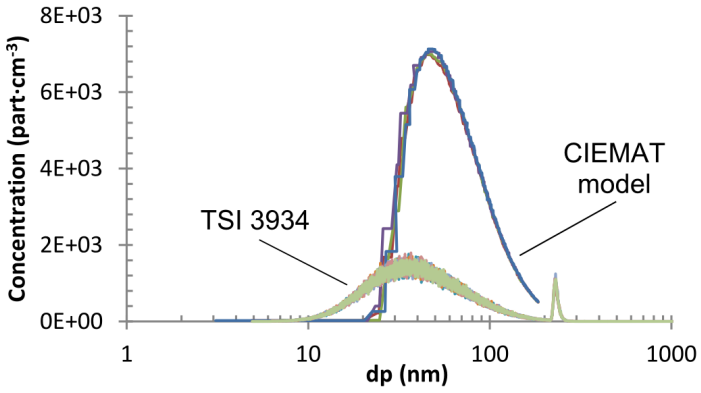
The submicron size range is becoming increasingly relevant in diffferent industrial contexts. High particle concentrations in this range are present in characteristic workplace situations. Highly concentrated submicron aerosols during the cooling down of process streams can lead to severe corrosion, abrasion and deposition. Its role as pollution precursors implies a new emission control strategy. Consequently, continuous monitoring systems can help to implement new process control systems and make feasible new technological requirements.

Among the available techniques, SMPS (Scanning Mobility Particle Sizing) is the most suitable one due to its high resolution and versatility. However, current devices show several critical issues in industrial or harsh environments. Here is presented the initial progress on the setting up of the first version of a custom-made SMPS (Rojas et al., 2011) featuring a stable operation against external vibrations. It includes an enhanced protection of the Kr85-based bipolar charger, a Vienna-type DMA with a long inner electrode that allows measuring particle sizes up to 300nm and a commercial CPC (3022A, TSI Inc.). The SMPS runs under a custom software which allows configuring the measurement and monitor the most relevant parameters, namely flows and applied voltage. Preliminary performance assessment was divided into three sequential steps: calibration of flowmeters and voltage testing, CPC and DMAs comparison with co-located commercial versions, and SMPS performance comparison with a commercial model (TSI 3934).

Latest results of trials with NaCl aerosol (Figure 1) reveal close resemblance between both distributions (TSI mean mode: 38nm; CIEMAT mean mode: 47nm). Higher particle concentration is detected by CIEMAT model. Although there is still room for improvement (voltage stability, size resolution, response delay,...), this first version of CIEMAT model shows good performance.



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SIMULATION OF THE TRANSFER FUNCTION OF A PLANE DMA RUN AT HIGH REYNOLDS NUMBER WITH DIFFERENT AEROSOL INLET-TO-OUTLET FLOW RATE RATIO

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The use of DMAs (differential mobility analyzers) to characterize submicron and even nanometric airborne particles is widely spread within the aerosol community. Actually, there is an intense research on the performance of such instruments with particles as small as one nanometer or even smaller, with the aim of develop some special designs that may act as truly analytical tools, that could compete with other well–established techniques but that require either special environments or very costly peripherals (Maiser, 2011).

In this scenario, new designs of DMA have been recently developed to classify entities as small as air ions. The main problem limiting the DMA performance resides on the large diffusivity of those entities, which smears out the otherwise sharp transfer functions. A heavy body of work has already been done in optimizing the geometrical design and the running conditions to reduce the diffusive broadening. Generally speaking, to resolve such small particles the DMA column must be short and also small to be able of running at very large Reynolds number with a moderate pumping requirements, and also use very thin injection/extraction slits for the aerosol (Fernández de la Mora, 2013). The problem with small instruments is that they require very tight fabrication tolerance, so numerical modeling of those complex combinations of flows together with electrode geometries could help to reduce prototyping expenses and also to optimize running conditions.

We present the preliminary results of the numerical modeling of the flow field inside a parallel–plate DMA and the dynamics of nanoparticles within. In particular, we analyze the effect that varying the aerosol input-to-output ratio has upon the transfer function and, particularly, on the resolution of the instrument. We use a commercially available code (FLUENT) for solving the Navier–Stokes equations within the instrument. The code allows seeding the flow with charged particles, whose electrical mobility is selected to match those of small singly charged ions in air. Combination of the aerodynamic drag with the electric drift causes the particles to move across the DMA channel.

To check the computations we have focused in situations where the resolution is limited by the "slits width"–to–"DMA length" ratio, so that the "aerosol–to–sheath" flow rate ratio, is much smaller than the former and such that the particle's Peclet number is large enough. Therefore, non–diffusive particles have been used in the calculations, although diffusion will also be included. When the aerosol inlet–to–outlet ratio, is kept equal to one, as usually done in most of the real measurements, the width at half height of the dimensionless transfer function, turns out to be of the order of regardless of the flow Reynolds number, as expected from theory. When is increased over one, decreases, so that the resolution (the inverse of dimensionless transfer function) increases. This effect is due to the reduction of the suction brought about by the decrease aerosol flow at the output slit (Knutson and Whitby, 1975).

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DYNAMICS OF PERIODIC ELECTRIC MICRODRIPPING EMISSIONS

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We investigate the formation of monodisperse droplets and ligaments from an electrified meniscus of a low viscosity, highly conductive liquid in the periodic electric microdripping mode, termed Axial Spray Mode II by Juraschek & Röllgen (1998).

The meniscus is attached to the tip of a metallic capillary tube of diameter D, is fed with a flow rate Q, and is connected to a voltage ϕ relative to a flat counterelectrode at a distance L in front of the tube. Within a certain range of flow rates and in a narrow range of applied voltages, the meniscus sets in the microdripping mode, in which its tip periodically elongates forming a ligament that ultimately detaches as a droplet. This mode produces monodisperse droplets whose diameter depends on the flow rate and may be one tenth of the diameter of the capillary tube.

The process is governed mainly by two dimensionless parameters: the dimensionless flow rate $q = \rho^{1/2} Q/(\gamma D^3)^{1/2}$, where ρ and γ are the liquid density and surface tension, and $B_E = \varepsilon_0 \phi^2/[\gamma D \ln^2(4L/D)]$ the electric Bond number , where ε_0 is the permittivity of the air surrounding the meniscus. Parameter q is small but can be varied by a factor of about 100 within the microdripping mode, whereas B_E is bound to a narrow range of order unity.

High speed video has been used to analyze the dynamics of the meniscus, and the electric charge carried by the emitted droplets has been measured.

At very low flow rates, the period of the meniscus oscillation is of the order of the capillary time $t_c = (\rho D^3/\gamma)^{1/2}$. After reaching its maximum elongation, the meniscus recedes with a velocity of the order of the capillary velocity $v_c = D/t_c$, except for a region around its tip that is pinned by strong electric stresses and develops into a ligament. The life time of this ligament is of the order of its pinch-off time $t_s = (\rho D_s^3/\gamma)^{1/2}$, where D_s is the characteristic width of the developed ligament, whose length is therefore $L_s \sim v_c t_s$. This condition, together with the condition that the volume of the ligament at detachment should be equal to the volume of liquid injected during a cycle of the oscillation, $D_s^2 L_s \sim Q t_c$, determines powers laws for the ligament length, $L_s/D \sim q^{3/7}$, and width, $D_s/D \sim q^{2/7}$.

These power laws fail at higher flow rates, when L_s ceases to be small compared to D. Then the balance of dynamic pressure, electric stress and surface tension stress, $\rho v_E^2 \sim \varepsilon_0 E^2 \sim \gamma/D_s$, relates the characteristic velocity (v_E) and time ($T = L_s/v_E$) of the ligament, and the characteristic electric field at its surface (E). These conditions, together with the volume conservation condition $D_s^2 L_s \sim QT$ and the condition that, according to our experimental results, the electric charge at the ligament surface (which ends up in the detached droplet) is of the order of the Rayleigh's limit charge, $\varepsilon_0 E D_s L_s \sim (\varepsilon_0 \gamma V_d)^{1/2}$ where $V_d \sim D_s^2 L_s$ is the volume of the droplet, determine new power laws for the ligament size, $L_s/D \sim D_s/D \sim q^{1/2}$. The period of the oscillation increases as the square root of the flow rate $T/t_c \sim q^{1/2}$.

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OPTIMIZATION OF CATALYTIC LAYERS PREPARED FROM THE DEPOSITION OF ELECTROSPRAYED INKS

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Catalytic processes require the availability of materials with a large effective surface area together with a proper distribution of the active sites on this surface. To achieve these requirements, the use of nanoparticles partially covered with catalyst as building blocks for these materials has several advantages. Thus, the dynamics of nanoparticle arrival to the collector can be used to control the porosity and surface roughness of the resulting granular material (Castillo et al, 2014). Moreover, nanoparticles doped with different amounts of catalyst may be used to prepare porous materials with similar morphological features but different catalytic content. The catalytic performance of this material depends on the layer thickness and on the catalyst distribution.

In previous works, the electrohydrodynamic atomization of catalytic inks (Martin et al, 2012) was used to grow highly porous materials with very low catalyst loadings resulting in extremely efficient fuel cell electrodes (Martin et al, 2013). The technique has been recently scaled-up to market size electrodes suitable for commercial applications where larger active areas are needed (Martinez-Vazquez et al, 2015).

Moreover, an analytical description of the catalytic activity of a porous layer coupled to a fuel diffusion region leads to establish the optimal layer depth required to accomplish the complete fuel consumption.

The analytical model is combined with the experimental results to assess the observed fuel cell performance.

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SCALING OUT OF ELECTROHYDRODYNAMIC SOURCES FOR THE PRODUCTION OF PARTICLES

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Electrospray is a liquid atomization technique which forms electrically charged microdroplets. Reaching industrially relevant microdroplet production rates by electrospraying requires the simultaneous operation of many electrospray emitters (Bocanegra et al., 2005; Deng et al., 2006). In this work, we aim to develop robust one-dimensional (1D) linear arrays of electrospray "needles". We have characterized -as a function of the geometrical parameters of the arrays- the conditions leading to stable cone-jet mode and spray plume behavior. The figure shows how electrostatic repulsion among all emitters and charged sprays actually influence the spreading of the collected particle spots. As the needle number increases from N= 3 to 5 to 7 at equal inter-needle pitch (P) the sprays become more compressed. On reducing P from 4.6 to 2.3 mm (for N=7), the spots compress along the array direction, although their distance in units of P increases slightly. A key factor is the applied voltage, which must be increased when either P is reduced or N is increased,in order to offset the greater electrostatic shielding. For instance, for P= 2.3 mm, the applied voltage is 19% higher in order to sustain stable electrospraying. Consequently, the sprays' residence times, thus their electrostatic expansions, are reduced (smaller collected spots).

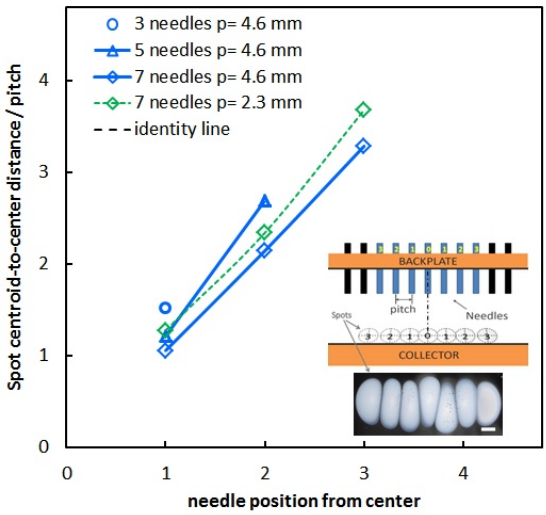

Figure 1: Distance from the centroid (center-of-area) of each collection spot to the array center plane, normalized by inter-needle pitch (P), versus needle position Two blind needles are on either end ("end electrodes") (Rulison and Flagan, 1993; Hubacz & Marijnissen, 2003). Inset: Spots scale bar 2mm

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IDENTIFICACIÓN DE PARÁMETROS CRÍTICOS EN DEPURACIÓN DE EMISIONES DE COMBUSTIÓN DE BIOMASA.

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La combustión de biomasa produce diferentes tipos de contaminantes gaseosos (CO, SO2, CxHy, N2O, NOx, HCl), de materia particulada (PM), hidrocarburos policíclicos aromáticos (HAP), dioxinas y furanos (PCDD/F) y metales traza (Cu, Pb, Zn, Cd,. . .).

Alcanzar una elevada eficiencia en la combustión (medidas primarias) reduce significativamente las concentraciones alcanzadas para ciertos contaminantes. Normalmente, el contenido en azufre de las biomasas no da lugar a emisiones de SOx que requieran equipos de depuración de emisiones (medidas secundarias) para cumplir con la normativa. Respecto a NOx, si es preciso, se pueden aplicar medidas primarias. Así pues, PM es el principal contaminante que requiere de medidas secundarias para la limitación de sus emisiones. Otras categorías de contaminantes regulados como los metales pesados, PCDD/F o los HAP, se presentan frecuentemente en fase sólida o asociados a ella, razón por la cual las mismas medidas secundarias implementadas para PM resultan relevantes para estos contaminantes.

El proyecto CLEANBIOM pretende posibilitar la gestión y operación sostenible, de unidades a media escala (<50MW), para la combustión de biomasa residual agroforestal característica de la cuenca mediterranea. El objetivo general del proyecto es desarrollar una estrategia integral, para la prediccion, control y minimizacion de los contaminantes generados en el proceso de combustion.

Entre las tareas del proyecto, se incluye identificar, determinar y evaluar desde una perspectiva de análisis de ciclo de vida, los parámetros y/o características que pueden influir sobre la formación de precursores de corrosión y de contaminantes a lo largo del proceso de combustión de biomasa (procesado del combustible, combustión y depuración de emisiones), definiendo a partir de técnicas estadísticas cuales son los experimentos necesarios para poder estudiar la influencia de las variables identificadas así como sus interacciones.

La depuración de emisiones tiene un papel fundamental en la transformación de contaminantes existentes y en la formación ex-novo de algunos contaminantes. Variaciones en las caracteristicas de la corriente de gases provocadas por las condiciones de funcionamiento de los sistemas de depuracion, pueden afectar de forma significativa sobre el rendimiento de dichos sistemas.

Los sistemas más factibles de usar para la depuración de este tipo de emisiones serían: electrofiltro (ESP), filtro de mangas (FM) y scrubber. Por tanto, en este estudio los parámetros de funcionamiento en la depuración están referidos a ellos. Entre los mismos, atendiendo a los fundamentos de las técnicas de retención utilizadas y la evolución de las propiedades fisico-químicas de los aerosoles, se pueden citar los siguientes:

- Caudal de gas tratado (tiempo de residencia o velocidad del gas) (ESP y FM).
- El potencial eléctrico aplicado (ESP).
- Área de colección (ESP).
- Espesor y permeabilidad del medio textil (FM).
- Método de limpieza (por sacudidas, por flujo inverso y por pulsos) (FM).
- Ciclo de limpieza y presión de aire de limpieza (por flujo inverso o pulsos) (FM).
- Temperatura del gas (ESP y FM).

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MICROSCALE VARIATIONS OF AMBIENT PARTICLE CONCENTRATION LEVELS IN AN URBAN TRAFFIC HOT SPOT

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The TECNAIRE project (Técnicas innovadoras para la evaluación y mejora de la calidad del aire urbano) aims to develop new techniques, able to diagnose the problems of air quality in urban environments and evaluate strategies for their resolution. Within this framework, a campaign was designed and performed during the winter period 13 February-2 March 2015 in a traffic hot spot (Plaza de Fernández Ladreda) in Madrid. This is an example of traffic influenced site, which frequently experiences the highest pollution levels for particles and gases of the city. From the point of view of an air quality study, it represents a site of enormous complexity in terms of interaction of sources, complex urban geometry and intense presence of pedestrian activities.

In this campaign, the ambient particle concentration levels (PM10, PM2.5 and PM1) were measured at different sites representative of different ambient conditions. Short time and space variations were assessed from measurements at different locations taking into account possible influences of factors such as meteorological variables and turbulence, traffic sources, pedestrian activities, and height of measurement, among others. Several optical instruments (OPCs) were deployed in the study area. A Grimm 1107 was installed in the South of the square, close to a transport station, and a Grimm 365 in the North side. These instruments were previously intercompared between them and also against the reference gravimetric method by performing filter measurements with high volume devices for the three size fraction. Intercomparison with the TEOM instrument, operating in the Madrid air quality monitoring network station at the same site, was also performed. Particle measurements were complemented with meteorological variables from two stations located in the study area, one of them measuring microturbulence parameters.

A TSI Dust-Track instrument, measured the particle levels at a number of points around the experimental area. In this case, the measurement strategy was different from that of the static points instrumented with GRIMMs. A dynamic measurement pattern was designed by moving the instrument around the square measuring at 14 points in total. Two different speeds were used: a slow case where two hours were needed to walk around the place and a fast case where twenty minutes were needed. These last measurements almost allowed characterizing the square in a frozen way, almost like a snapshot. Some points had a special attention like bus stops, where high particle concentrations were measured, and traffic lights. At the same time, the pedestrian flows were characterized to obtain their exposure to particles in this square.

All these results are currently under analysis and they will be shown in this paper.

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