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PLENARY SPEAKER

QUANTIFYING THE HEALTH EFFECTS OF AIR POLLUTION GLOBALLY

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Globally, roughly 4.5 million people die prematurely each year because of exposure to ambient particulate matter and ozone pollution – 1 in 12 deaths globally. How do we know that air pollution affects health and how do we quantify deaths? Here I will discuss the how we learn from atmospheric sciences and health effects sciences to understand air pollution health effects and challenges these communities face going forward. I will also present examples of assessments of health impacts based on atmospheric modeling from my lab – estimating the global burden of disease, the contributions of emission sectors, trends in air pollution-related deaths, deaths attributable to climate change, and the air quality and health co-benefits of global greenhouse gas reductions.

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LECTURERS

TROPOSPHERIC CHEMISTRY OF REACTIVE GASES

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In this introductory talk, we will describe the importance of understanding the role that key reactive gases play in the chemistry of the atmosphere. These compounds, including surface ozone (O_3), carbon monoxide (CO), volatile organic compounds (VOCs), oxidized nitrogen compounds (NOx, NOy), ammonia (NH_3) and Sulphur dioxide (SO_2) are heavily involved in inter-relations between atmospheric chemistry and climate, either though control of ozone and the oxidizing capacity of the atmosphere, or through the formation of aerosols. We will review how changes in atmospheric abundances of these species can affect human health and the ecosystems. It is particularly interesting to differentiate the natural variability in the abundances of these gases from the perturbations caused by the various human activities. The biogeochemical cycles in which they are involved need to be understood, as well as their main sources, sinks and production/removal mechanisms. This talk will include advances and limitations in our current understanding of these processes.

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MEASUREMENTS OF REACTIVE GASES (O_3, CO, NO_X, VOCS)

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Reactive gases have a wide array of natural and human sources in the atmosphere. Because of their reactive nature most reactive gases (with the exception of carbon monoxide and some volatile organic compounds) cannot be sampled and stored in sampling containers such as flasks or canisters. Therefore, most measurements are conducted with real-time monitoring approaches that require deployment and operation of instrumentation at the monitoring site. This presentation will review fundamental monitoring approaches, instrumentation, quality control, and calibration approaches for the monitoring of O_3, CO, NOx, and VOCs in the background atmosphere.

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INTRODUCTION TO TROPOSPHERIC AEROSOLS

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Aerosol particles impact human health and the World Health Organization recommends that countries not surpass a certain level. The different standards within Latin America and the Caribbean and current observations will be presented. Students will learn briefly about the physics and chemistry of aerosol formation, discussing primary versus secondary formation and the link to sources as well as their lifetimes. Other parameters that characterize aerosol particles such as their morphology, number, area and mass/volume size distributions and composition, their vertical profiles and removal processes will be presented. Students will learn briefly about the chemical and physical transformations that aerosol particles experience in the atmosphere during their lifetimes, as they are adverted from their sources. Aerosols play a role in the atmosphere in terms of their interaction with, primarily, solar radiation. The lecture will briefly cover aspects of this interaction, noting the role of size, morphology, and composition on local and regional visibility. This interaction also plays a role in the radiative balance of the Earth system, and, given the large variability observed in aerosol particles, it is a source of uncertainties in the global estimates of the IPCC. Students will learn that cloud droplet and ice particles in the planet form over a sub-group of aerosol particles. We will briefly discuss their characteristics and how they can impact cloud characteristics such as their albedo, lifetime and precipitation formation and the uncertainties that aerosol-cloud interactions introduce in the global radiative balance. Long-range transport of aerosol particles and deposition far away from their sources can lead to pollution and also to phenomena such as ocean and land fertilization, thus affecting their natural ecosystems. Students will briefly learn about his topic, through examples such as transatlantic Saharan dust transport and anthropogenic particles affecting more pristine areas, such as the Arctic.

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ATMOSPHERIC AEROSOL PHYSICS, PHYSICAL MEASUREMENTS, AND SAMPLING

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These lectures will provide fundamental and applied knowledge about aerosol physical properties, physical aerosol instrumentation as well as recommendations for aerosol sampling. The lectures will be given in an interactive way that there is continuous communication between lectures and the audience. We expect that people can understand and speak English to follow the course and to contribute the lectures with questions and own experiences. The content of the lectures is the following: General Definitions, Particle Diameter Definitions, Mechanical Properties, Artifact-free Sampling, Online Mass Monitors, General Sampling Considerations, Particle Counters, Particle Size Spectrometers, & Mass Closure.

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OBSERVING THE CHANGING ATMOSPHERE FROM THE GROUND: REQUIREMENTS FOR GLOBAL NETWORKS FOR SHORT-LIVED ATMOSPHERIC SPECIES

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Atmospheric aerosol particles continue to contribute to the largest uncertainty in estimates and interpretations of the Earth's climate. In substance, the magnitude of aerosol forcing is assessed to be –0.45 (–0.95 to +0.05) W m–2 for aerosol alone and –0.9 (–1.9 to –0.1) W m–2 when aerosol/cloud feedbacks are accounted for, both with a medium confidence level. The uncertainty is still very high although substantial progress has been made to understand climate-relevant aerosol processes, such as new particle and secondary organic aerosol formation mechanisms, or aerosol source attribution. While the benefit of improved monitoring capabilities developed in the last decades, both from satellites and ground-based has been clearly assessed for the production of more reliable data records, the need for maintaining and enhancing the capacity of the observing system to provide the additional constraints, in particular for the derivation of trends is still essential in climate change predictions. It is the goal of the Global Atmosphere Watch (GAW) programme to ensure long-term measurements atmospheric parameters relevant to the climate in order to detect trends in global distributions in the air and the potential effectiveness of emission-control policies. With respect to aerosols, the objective of GAW is to determine the spatiotemporal distribution of aerosol properties related to climate forcing and air quality on multi-decadal time scales and on regional, hemispheric and global spatial scales. One major difficulty for the programme is the multi-variable aspect of aerosol forcing on climate: optical properties of an aerosol population are closely linked to chemical, physical and hygroscopic properties and also to the altitude-dependency of these parameters. The implementation of observing networks from the ground is however not as straightforward as it seems. Ensuring long-term operation with skilled operators worldwide, controlling and improving data quality and enhancing use by the scientific community are complex and expensive actions when considered at a global scale. GAW is an essential pillar. The course will discuss the strategy for implementing monitoring networks from the ground, evidencing the regional initiatives and presenting results from the last decade of operation with the Global Atmosphere Watch program. It addresses and discusses the most effective solutions for observation activities to be pursued and further developed in a sustainable manner.

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DATA SUBMISSION PROCEDURES AT GAW-WDCA, GAW-WDCRG AND THE EBAS DATA CENTRE

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The overall goal of the GAW World Data Centre for Aerosol (WDCA) and World Data Centre for Reactive Gases (WDCRG) is to integrate information and measurement from all parts of the globe to obtain new information and facilitate easy access to atmospheric research data. The lecture aims to give first- hand information and training in data formatting and data submission procedures to current and future station managers, project leaders and data submitters. The systems and services implemented at the data center, ranging from data formatting templates, the online format checker and the submission tool, to the database web pages will be discussed in detail. Further, the lecture will cover relevant topics such as the importance of data reporting, the value of sharing data and data policies

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ENVIRONMENTAL DATA HANDLING

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Quality control of environmental data is closely linked to the entire air quality monitoring process, from the choice of site, choice of instrumentation, calibration and maintenance processes, data storage, and retrieval and analysis systems. For air quality monitoring, quality control is used to ensure that the final product (ambient air quality monitoring data) is consistent and reliable. The data validation process involves a critical review of all information relating to a particular data set in order to verify, amend or reject the data. A robust and reliable handling of environmental data is especially important nowadays given that the amount of monitoring data available worldwide is substantial and increasing mostly thanks to the establishment of international monitoring networks (e.g. ACTRIS – the European Research Infrastructure for the observation of Aerosol, Clouds, and Trace gases, GAW – WMO Global Atmosphere Watch, EMEP – The European Monitoring and Evaluation Programme, NOAA/ESRL Federated Aerosol Network, among others). Here we mostly focus on different approaches to handling, process and present environmental data and we will go through the steps of the data validation process which include for example: the correct application of check and calibration factors, multi-data (contaminants and meteorology) analysis to highlight anomalies, removal of data known to be spurious or collected during calibration and maintenance, treatment of negative or out-of-range data, among others. With this aim, we will use ambient data collected with different instruments widely used to study the aerosol particle properties important for air quality and climate. Moreover, for a reliable quality control of data, it is important to have access to specialist software that might be necessary to carry out all but the simplest types of analysis. Here we will also present some useful software packages to handle environmental data.

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QUALITY CONTROL OF THE TRACE GASES OBSERVATIONS

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The lecture on *Quality Control of Trace Gases Observations* will introduce the Global Atmosphere Watch Quality Management Framework and the role of the individual Central Facilities, will show the importance of traceability of the observations to common references, the significance of regular quality assurance and quality control measures, and the assessment of measurement uncertainties. It will also include an overview of the Swiss activities in data sparse regions such as the Latin America and Caribbean region.

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SHORT TALKS

ST-01

REACTIVE GASES IN THE LATIN AMERICAN AND CARIBBEAN REGION: A PERSPECTIVE OF GLOBAL ATMOSPHERE WATCH (GAW)

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The Reactive Gases group (RG) is one of the eight Focal Areas of the Global Atmosphere Watch Program (GAW) of the World Meteorological Organization (WMO). They comprise the compounds Volatile Organic Compounds VOC, Carbon Monoxide CO, Nitrogen Oxides NOx (NO and NO2), ozone O3, and Sulphur Dioxide SO2. Currently, GAW coordinates network observations of atmospheric measurements at 31 global stations, more than 400 regional stations, and around 100 contributing stations. Network data compatibility implies a living quality management frame work (QMF) in place since more than 15 years. Key elements of the QMF are parameter specific data quality objectives (DQOs), quality assurance and control processes (QA/QC) and training. RG data for Latin America and the Caribbean area currently available for two global stations (Arembepe, Brazil; Ushuaia, Argentina), 12 regional stations, and one contribution station. Thus, there is still room for increasing the network density for RG measurements - e.g. upgrading existing regional stations - for better representing the Latin American and Caribbean region in assessments of the regional and global atmosphere.

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ST-02

GROUND-BASED PASSIVE UV-VIS REMOTE SENSING OF AIR QUALITY: SETTING THE STAGE FOR SATELLITE VALIDATION AND ENHANCED ENVIRONMENTAL MONITORING FOR LATIN AMERICA AND THE CARIBBEAN

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Technological advances have led to the development of affordable, compact ground-based UV-Vis hyperspectral instruments known as the Pandora Spectrometer System (Pandora). With spectral range of 280 to 530 nm (at 0.6nm resolution) and the ability to make direct sun/lunar observations approximately every 3 mins, the Pandora produces total column O_3, NO_2 and near surface NO_2 data in near real time (~10 minutes dependent upon the host's ability to transmit the observations to a centralized processing location). Research-grade products include total column HCHO and SO_2 and O_3profiles . These observations support air quality monitoring and provide a means to tie surface/near surface activities to satellite observations of air quality polar orbiting satellites/instruments including: AURA (OMI), MetOp-A (GOME-2), S-NPP (OMPS), MetOp-B (GOME-2), DSCOVR (EPIC), Sentinel 3A (MWR, OLCIS, LSTR), Sentinel 5P (TROPOMI), GaoFen-5 (EMI), NOAA-20 (OMPS-N) and Sentinel 3B (MWR, OLCIS, LSTR). We believe that this compact, innovative approach to sun/lunar/sky photospectrometry provides an opportunity for the Latin American AQ/AC community to leverage the considerable scientific knowledge of both context and in-situ functioning of their systems while contributing to the larger global scientific community of environmental observations. Furthermore, the observations and data from ground-based instruments such as the Pandora may better position host institutions to derive information that will help their nations inform the UN Sustainable Development Goals. Opportunities for Latin American institutions, scientists and students to participate in a global network of Pandora instruments are also presented.

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ST-03

OBSERVING THE CARBON CYCLE OF THE AMERICAS WITH DAILY OBSERVATIONS FROM GEOSTATIONARY ORBIT: THE GEOCARB MISSION

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Launching in 2022, the Geostationary Carbon Observatory (GeoCarb) will make daily observations of CO2, CO, and CH4 over North and South America. As the first geostationary greenhouse gas targeted mission, GeoCarb will have the unique ability to map the Americas on a daily basis, allowing for disaggregation of surface flux and atmospheric transport. The co-located CO2, CO and CH4 observations will allow attribution to processes, for example biomass burning and combustion versus natural biotic sources and sinks. In this presentation we will introduce the mission and instrument, and discuss the science questions that motivate GeoCarb's design as well as some simulation studies.

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ST-04

AERONET AEROSOL MEASUREMENTS IN LATIN AMERICA AND THE CARIBBEAN (LAC): INSTRUMENTATION, DATABASE, QUALITY CONTROLS, AND APPLICATIONS

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With growing interest in air quality due to biomass burning smoke, Saharan dust, urban pollution, and volcanic ash, the Aerosol Robotic Network (AERONET) continues to expand within the LAC region. Multispectral Cimel radiometers measure solar irradiance from the UV to the NIR and allow for the determination of aerosol optical depth (AOD). In combination with the AOD, multispectral angularly distributed radiances using the almucantar or hybrid sky scans are inverted to compute aerosol properties such as the volume size distribution, complex index of refraction, and single scattering albedo. Lunar measurements in the visible and NIR are performed by the most recent generation of Cimel radiometers and occasionally provide AOD for both the diurnal and nocturnal periods depending on the moon phase. Further, advances in instrument design lead to improved geolocation and time correction, robot operation, and data storage increasing the availability, reliability, and precision of AERONET measurements. The new Version 3 (V3) AOD database, released in January 2018 on the AERONET web site, provides higher quality data than Version 2 database in near real-time (NRT) due to improved automated cloud screening and robust data quality controls. The V3 cloud screening removes most cirrus-contaminated data and yet retains highly variable biomass burning smoke compared to Version 2. Further V3 quality controls remove additional cloud and instrument anomalies in the NRT AOD database previously removed by an analyst in Version 2. The V3 quality assured data set (Level 2.0) is now available within 30 days of the final instrument calibration. The AERONET web site provides web service tools allowing for quick and unfettered data access. In addition to a description of instrumentation, database, and quality controls, AERONET data are presented for sites in the LAC region.

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ST-05

MPLNET MEASUREMENTS IN THE LAC REGION

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The NASA Micro Pulse Lidar Network (MPLNET) has grown to 24 sites worldwide since 2000, with ~5 more in planning stages. MPLNET lidars run continuously day/night, providing data on the heights of clouds, aerosols, and the planetary boundary layer as well as cloud and aerosol properties. All data are acquired in near real time, processed and available on our public website within < 1.5 hours. All sites except those in polar regions are co-located with AERONET and several others are co-located with in-situ sampling stations as well. MPLNET is now running our Version 3 processing system, including polarized lidars and a greatly expanded data product suite. We present the current status of MPLNET and an overview of Version 3 capabilities, especially with respect to Caribbean Aerosol Health Network (CAHN) and WMO SDS-WAS collaborations. We will also discuss MPLNET sites and planned deployments in the Caribbean and Latin America using existing partnerships with LALINET and other GAW Aerosol Lidar Observation Network (GALION) partners to provide greater coverage.

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ST-06

CARIBEAN AEROSOL HEALTH NETWORK (CAHN) PROGRAM – REVIEW OF AIMS AND OBJECIVES AND CURRENT STATUS

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An initial objective of the CAHN concept is to build on existing air quality programs in the region and to encourage the expansion of measurement sites and protocols. At present our efforts are focused on making use of existing sites and to see how we can best use the data acquired at such sites to characterize aerosol impacts with a focus on African dust. To this end I will present some recent examples of this strategy showing how African dust has impacted three sites in the region: Cayenne, French Guiana; Miami, Florida; and Houston Texas. The impact of dust at these sites is clearly demonstrated from measurements of PM2.5 and PM10. This attribution is buttressed by other measurements made at these sites. These examples support the strategy upon which CAHN is based.

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ST-07

THE ACTIVITIES OF THE WMO SDS-WAS PAN-AMERICAN NOD

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Over ten years ago, the World Meteorological Organization (WMO) took the lead in working with international partners to implement a Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS). This initiative addressed the need for international coordination of the many countries that are impacted by sand and dust storms. The mission of SDS-WAS is to enhance the ability of countries to deliver timely and high- quality sand and dust storm forecasts, observations, information and knowledge to users through an international partnership of research and operational communities. SDS-WAS operates as an international hub of researchers, operational centers and end-users and is organized through regional nodes. Three nodes are currently in operation- Regional Node for Asia, coordinated by a Regional Center in Beijing, China, hosted by the China Meteorological Administration; Regional Node for Northern Africa, Middle East and Europe coordinated by a Regional Center in Barcelona, Spain, hosted by the State Meteorological Agency of Spain (AEMET) and the Barcelona Supercomputing Center (BSC); and Regional Node for Pan-America, coordinated by a Regional Center in Bridgetown, Barbados, hosted by the Caribbean Institute for Meteorology and Hydrology.This presentation will focus on the Regional Node for Pan-America, its structure, activities to date and the way forward.

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ST-08

IMPROVING HEALTH THROUGH EARLY WARNING OF AIR QUALITY EVENTS

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A multidisciplinary team of universities, agencies and non-governmental organizations located in the Caribbean region will characterize the periodic trans-Atlantic dispersal of African Dust and its impacts on the health of people in small islands states (SIS) of the region. We propose to characterize the distribution pattern and variability of dust in these annual events using synoptic Earth observations from satellites and ground stations and quantify the impact on respiratory diseases using detailed time histories of medical records from Caribbean SIS. The goal is to develop a forecasting ability for hazardous conditions for human populations in SIS, disaggregated by gender, age group, and socio-economic indicators. The long-term objective is to increase the use of NASA satellite sensors and ground aerosol observations to guide surveillance, early warning, and risk assessment of potential public health issues. Natural scientists, social scientists, including public health practitioners, and atmospheric scientists will co-develop solutions and create a Public Health Early Warning System that integrates the various environmental and public health data.

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ST-09

AN OVERVIEW OF LATIN AMERICA LIDAR NETWORK – LALINET AND THE NEXT PROJECTS APPLIED TO SATELLITE VALIDATION

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Latin America Lidar Network is a federative fully operative lidar for aerosol research in South and Central America. Its operational cycle concerns probing the atmosphere on regular basis to retrieve vertically and temporally resolved aerosol optical and microphysical properties. Most of the instruments based in the network were customized and produced configurations suitable for the aerosol observation task. The network was officially established in 2013 by recognition as being part of GAW-GALION programs under the supervision of World Meteorological Organization. The present goals in the short terms of LALINET are based on the following propositions: 1 – Consolidation of at least two mandatory measurements per week following data acquisition protocols developed based on the European Lidar Network – EARLINET. 2 - Establish a quality assurance (QA) and quality control (QC) routine tests among all stations. 3 - Improve and establish an unified data analysis routine common to all stations. 4 - Create a scientifically significant distributed database and, e.g., lidar ratio, particle extinction, backscatter, angstrom exponents and particle depolarization regional values, and a scientific repository accessible to all participant stations. 5 - Guarantee the continuity of LALINET's biannual workshops by the intensification its role as a mechanism of transfer of knowledge, evaluation of joint actions conducted and agreements on how to continue under the new evolving situations. LALINET measurement protocol follows an twice a week measurements on Mondays and Thursdays, even though each station can operates continuously and focus on other schedules for other proposes. The main products obtained are aerosol backscattering and extinction profiles, Lidar ratios (average and profiles when Raman channels are operative). Since the vast majority of stations have collocated AERONET sunphotometers it is possible to obtain microphysical products. Some of the station also have polarization-sensitive channels which allows information on shape and identification of aerosols. Currently LALINET is seeking its expansion to better cover up a region roughly twice the size of EARLINET and therefore a region where more circulation patterns take place. A careful establishment of a regional distributed aerosol optical parameter database poses a challenge which could be tackled with the network expansion. In this matter 2 stations were deployed recently. One in Natal, Brazil, which should be focused in long-range aerosol transport from Saharan dust. The other in Punta Arenas in Chile, which is also part of SAVERNET which merges the efforts of LALINET and Asian Dust and Aerosol Lidar Observation Network–ADNET. All the measurement protocols and QA/QC tests an analysis implemented at LALINET stations will guide us to set up the most suitable methodology and strategy to participate at the AEOLUS and EARTHCare satellite missions as official station for validation measurements.

POSTERS

P-01

RELATION BETWEEN PM10, PM2.5 AND BLACK CARBON IN LIMA, PERÚ: INFLUENCE OF THE METEOROLOGY CONDITIONS

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In the city of Lima, Perú, there is an automatic network for monitoring air quality, where six pollutants are monitored daily. PM10 and PM2.5 are critical pollutants that continuously exceed the Environmental Quality Standards. Have to consider the meteorological conditions of this city: located in arid coastal zone, where weak winds blow whose predominant direction goes of the south towards north and with lest precipitations throughout the year, predisposes a potential risk for the health of the population. Black carbon is a short-lived climate pollutant that is identified as one of those responsible for climate change due to its ability to absorb solar radiation and influence the world's climate. In Peru black carbon is not regulated, but taking the Canadian standard as reference, we exceed 8 µg/m3. Black carbon was measured with by a Multiangular Absorption Photometer (MAAP) in two points of the city with the highest contamination, one in the south zone of Lima (Villa María del Sur). April 17 to May 3, 2015, and another in the northern zone (Puente Piedra) from May 16 to June 11, 2015, both in urban areas with high vehicular traffic due to the circulation of light and heavy vehicles. Significant associations were found between black carbon, PM10 and PM2.5, being clearly influenced in hours of high vehicular traffic mainly from 06:00 to 10:00 hours. In addition to a relationship with the wind and seasonal periods related to the mixture layer.

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P-02

DETERMINATION OF THE EMISSION SOURCES OF PARTICULATE MATTER IN QUERETARO (MEXICO)

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Queretaro is located in the center of Mexico, 270 km north of the City of Mexico Metropolitan Area and is one of the cities with highest economic development in recent years, coupled with rapid population growth (30% in the last 15 years) and an expansion of industrial areas within and near the city. As a result, there has been an increase in the amount of pollutants emitted into the atmosphere, including particulate matter (PM). Given that PM is one of the pollutants with greatest impact on human health, it is important to identify its sources in order to implement regulations to control its ambient concentration PM 10 and PM 2.5 were collected at three sites in Queretaro during 2014 and 2017. The concentration of trace elements in the samples was determined using Inductively Coupled Plasma Mass Spectrometry (ICP-MS). The results were analyzed using the EPA´s Positive Matrix Factorization (PMF) model in order to identify the main PM sources in the city of Queretaro. Preliminary results show that PM 10 has a cortical origin, while the PM 2.5 is mainly of anthropic origin, as expected. A more detailed analysis will be presented showing the characteristics, relative contributions, and time series of the source identified. Comparison of the data at different periods and sites will be used to describe the temporal and spatial variability of the PM and trace elements concentrations.

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P-03

TRENDS IN OZONE POLLUTION AND ITS IMPACT ON SECONDARY PARTICLES IN SANTIAGO, CHILE

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In spite of the decline in partially (PM10) and fully (PM2.5) observed over the last 20 years in Santiago, the capital city of Chile, it is still high in the rank of polluted urban areas of the world. Attainment plans implemented since 1997 have emphasized measures aimed at curbing primary and secondary particles, and little attention has been paid so far to photochemical pollution. However, ozone (O3) mixing ratios regularly exceed 110 ppb in summer, while in winter maximum mixing ratios often reach 90ppb. Moreover, the sum (Ox) of O3 and nitrogen dioxide (NO2), i.e., Ox=O3+NO2, shows an increasing trend of more than 4 ppb per decade at 7 out of 11 stations in Santiago, which appears to be driven by increasing NO2 possibly linked to growing motorization rates in Santiago. Using carbon monoxide (CO) as a proxy of primary particles, and ozone anomalies in excess of 20 ppb as a proxy of secondary particle formation, we estimate the fraction of secondary particles in PM2.5. We show evidence of an increasing contribution of secondary particles associated with the growing mixing ratios of Ox.

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P-04

PM2.5 CHEMICAL COMPOSITION IN BUENOS AIRES BY AN ENSEMBLE OF ANALYTICAL TECHNIQUES.

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In the framework of a 4-years cooperation project funded by the International Atomic Energy Agency, that aims at enhancing the knowledge about atmospheric aerosols in the Latin America and the Caribbean (LAC) region, a database of radiative and health related aerosol properties for the main urban areas of 14 countries will be built. Using agreed monitoring and analytical methodologies among the participating countries, inorganic and organic compounds and optical properties of the aerosols collected will be determined, and the contribution of local and regional PM2.5 sources will be identified 1.013 combining receptor modeling techniques with satellite analysis. The project includes the PM2.5 collection with a high-volume sampler using quartz filters for PAHs, EC, OC and ions determinations, and a medium sampler using Teflon filters for elemental analysis and BC measurements. In Argentina the project will focus on Buenos Aires where metals and metalloids will be measured by neutron activation analysis and atomic fluorescence spectrometry; ions and PAHs by High-performance liquid chromatography-mass spectroscopy (HPLC-MS) with UV and fluorescence detection; BC using a smoke stain reflectometer and a spectral reflectometer. The main drawback for our research group is the lack of thermo-optical equipment for OC and EC determinations. To overcome this situation, a double strategy was explored: (1) sending part of the high-volume filter to an external laboratory and (2) complementing the BC measurements with total carbon determinations with other thermal techniques available in our labs (a LECO TOC analyzer, TGA-DTA, controlled atmosphere oven). OC charring was studied measuring reflectance of quartz filters before and after different thermal treatments. In the workshop the results of this analysis will be presented, as well as the protocols prepared for aerosol monitoring.

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ANALYSIS OF THE SPATIAL AND TEMPORAL VARIABILITY OF CONCENTRATIONS OF GASES AND AOD IN THE METROPOLITAN REGION OF SAO PAULO AND ITS TRANSPORTATION TO OTHER REGIONS USING SATELLITE IMAGES AND WRF-CHEM

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One of the main problems of urban areas is air pollution and is mainly caused by the emission of polluting gases produced by fossil fuels, which are generated by transport and industries (Mayer, 1999). Air pollution threatens the health of the urban population, in the metropolitan region of Sao Paulo (MRSP), there were 9,700 deaths per year due to this problem (Miranda et al., 2012). For this problem, in Brazil, it has focused much more on-air quality by studying the behavior of the atmospheric concentration of various gases such as carbon monoxide (CO), oxides of nitrogen (NOx), ozone (O3) and (PM10), from the emission by mobile sources in the MRSP. The urban population of South America grew at a rate of 1.05% per year, from 2000 to 2013 (Perez-Martinez et al., 2014). In addition, the increasing number of vehicles causes negative impacts on the environment due to sound and atmospheric pollution (Fiziola, 2004). One way to reduce air pollution is to control emissions. Ground observations have been made to provide the spatial and temporal information of the concentrations of pollutant particles and atmospheric composition. However, due to the highly variable concentration in space and time and high operating costs, in situ observations are insufficient to capture, in high temporal and spatial resolution, the concentration of pollutant particulate concentrations, especially at the regional scale. Therefore, remote sensing can intervene in regional air quality monitoring where ground monitoring is not available or poorly distributed (Wang et al., 2013). Therefore, in this project, the main objective is to analyze the spatial and temporal variability of the anthropic concentrations of anthropogenic gases and AOD in the MRSP and its transportation to other regions using satellite images and WRF-Chem model.

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PRELIMINARY ANALYSIS OF THE SAHARAN DUST TRANSPORT PATTERNS ACROSS THE CARIBBEAN.

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There are notable advances in weather, climate and several atmospheric modelling. However, the numerical simulation of aerosols emission, transport and deposition has serious limitation. Therefore, more research is required in this subject to identify and characterize the patterns of emission, transport and deposition. Here, we report an ongoing research to determine the pattern of Saharan dust transport across the Caribbean. We used temporally matched data from four Caribbean AERONET stations (Camaguey, Guadeloupe, La Parguera and Ragged Point), in the period 2008 to 2016. The MODIS dataset was not used because there was very few temporally matched data of these four stations and also, the Angstrom parameter from MODIS has serious limitations to classify the aerosol types. Highest values of AOD are showed in summer season (JJA) in these four stations with monthly mean values of AOD between 0.22 and 0.27 and the lowest values between 0.09 and 0.13 are showed in winter season (DJF). There is a predominance of marine aerosols in all stations, with more than 50% of case, followed by dust aerosols. Only Camaguey station shown an important number of cases of continental aerosols. The mean back trajectories have a predominance towards the east. The dust episodes have a direct relationship with these back trajectories and are related with the eastern waves pattern and the associated wind flow.

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CLIMATOLOGY OF AEROSOL OPTICAL PROPERTIES MEASURED WITH SUN PHOTOMETER AT CAMAGUEY, CUBA.

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We report the climatological values of the main aerosol optical properties of aerosols: the aerosol optical depth (AOD) at eight wavelengths and the Angstrom Exponent (AE), for the unique AERONET station located in Cuba. The statistics for Camagüey site were calculated at daily, monthly, annual and interannual scales using the AERONET level 2.0 data for the station (2008-2016). The AOD (500 nm) mean value for the entire period was 0.15 ± 0.05, while the AE (440-870 nm) mean value was 0.80 ± 0.20. Aerosols load increases during the summer, because of the Saharan dust reach the Caribbean region where Cuba is located, transported across the Atlantic from Africa. Aerosols were classified using the relation between the daily means of the AOD and AE. Maritime aerosols predominate at the site the year around, with frequent presence of desert dust in summer due to the arrival of the Saharan dust already mention. Finally, back trajectories analysis is shown to identify the geographical regions that are the source for the aerosols reaching Camagüey site.

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TEMPORAL AND SPATIAL VARIABILITY OF AEROSOLS AND CARBON MONOXIDE IN SOUTH AMERICAN CITIES

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Natural, but primarily anthropogenic atmospheric emissions, pose a threat to public health in two interconnected ways: the direct risk of air pollution and the indirect but merciless action of climate change. Natural fires and photosynthetic activity are important contributors to the quality of the air we breathe. However, levels of human activity such as transport, industry, agriculture, etc. are the main cause of air quality deterioration and of the indubitable climate disruption. In terms of air pollution, nearly 7 million people die each year, primarily of developing countries. Conversely, air quality monitoring in South America is still scarce, even in big cities in which there is a tendency to concentrate the economic resources of a country. For example, (i) Buenos Aires (Argentina) has 13 million inh. but only 3 air quality monitoring stations, (ii) Asunción (Paraguay) and Montevideo have more than 2 million inh. but no air quality monitoring and (iii) Córdoba (Argentina), with almost 2 million inh. since 2003 air pollution levels have not been monitored. In this work, we characterize the temporal and spatial variability, using satellites sensor information, of two contaminants relevant to public health: atmospheric aerosols and carbon monoxide (CO). We employed information from 2000 to 2017 covering the southern area of South America acquired by the EOS-TERRA satellite. The highest values of CO and Aerosol Optical Depth occurred in the period from August to October. The correlation between CO and active fires (AF) product was very high (0.89, $p<0.05$), associated to biomass burning and the dominance of the dry season. However, it was not the case of AOD and AF, indicating the incidence of urban emission. Although it is necessary to have continuous measurements of air quality, the use of satellite data could be useful to establish causality when analyzing the degradation of air quality.

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LAECESS: LATIN AMERICA EARLY CAREER EARTH SYSTMEN SCIENTIST NETWORK

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The LAECESS (Latin America Early Career Earth System Scientist) Network was created in 2016 as an iLEAPS (Integrated Land Ecosystem Atmosphere Processes Study) regional network. During the 2016 International Global Atmospheric Chemistry (IGAC) Conference (Breckenridge, USA), LAECESS was restructured and since then it has continuously growing as an open network for Latin America. The main goals of LAECESS network are to promote (i) integrated science, (ii) networking and (iii) leadership skills.

Promoting integrated science

The main motivation to do research in different areas of the natural sciences is to increase our understanding of terrestrial systems and the potential effects that human activity can have on them. It is in order to contribute to human knowledge and its dissemination that LAECESS offers a basis for sharing and integrating research related to this area of research.

Promoting networking

One of the most enriching and at the same time motivating events for sciences is the exchange of ideas and the discussion about the challenges, questions and problems. In addition and given that the systems and processes studied cover such broad fields, networking is essential to connect new ideas, generate new knowledge and its application for the benefit of humanity. The nucleus to create those connections and keep them through time are conferences, workshops and scientific meetings, in which LAECESS collaborates more and more. In addition, LAECESS makes use of modern means such as its website and social media (Facebook, Instagram, Twitter, etc.) to manage, maintain and communicate collaborative works.

Promoting leadership skills

Since doing science goes far beyond the publication of novel results in scientific papers, it also includes managing important resources such as time, meeting the demands of our boss, solving technical problems, among others. For this reason, LAECESS collaborates in the development of skills such as communicating ideas correctly, positively influencing work teams and executing actions to achieve objectives through meetings, courses and talks.

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QUANTIFICATION OF PRIMARY AND SECONDARY SOURCES OF ORGANIC AEROSOLS IN DIADEMA, SÃO PAULO, BRAZIL

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The São Paulo Metropolitan Area (SPMA), a megacity with 20 million inhabitants and 7 million vehicles, experiences frequent air pollution episodes. The Diadema city is one of the 39 SPMA municipalities. An aerosol and trace gas monitoring station were operated at Federal University of São Paulo campus, in Diadema, from November 15th, 2016 to March 15th, 2017, spring to summer in south hemisphere. Near real time size distribution, number and mass concentration, and chemical composition of submicron particles (PM1) were determined using SMPS, MAAP and Aerodyne ACSM instruments. Moreover, 24h-Filter sampling provides organic and elemental carbon (Sunset), mass concentration and elemental composition (XRF) of PM2.5. Optical properties, gas phase and meteorological information integrates the data set. Average PM1 concentration during campaign was 10.6 µg m-3. Chemical composition showed a large dominance of organic aerosols, accounting for 56% of PM1 aerosol. Inorganic aerosol account to 15%, 8% and 6% (SO4, NO3 and NH4, respectively), and eBC average contribution was 15% for the whole campaign. Positive Matrix Factorization (PMF) identify 4 OA components and showed that formation of SOA was very strong accounting to 2.6 µg m-3 (44% of total of organics). The secondary contribution to OC was also estimated but using the minimum OC/EC ratio method and accounted to 42% of the total OC on average. Five components of PM2.5 were identified by Principal Component Analysis (PCA) and confirms that fine particles are impacted mainly by industrial and vehicular sources (35% and 27%, respectively). Source apportionment of Organic Carbon fractions shows that while traffic emission accounts for almost 90% of primary OC, the photochemistry component have dominated (52%) the impact on secondary OC formation. Principal Component Analysis (PCA) of Particle Number Size Distribution (PNSD) allowed the identification of distinct particle size modes that represents distinct sources and aerosol processes.

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INTERCOMPARISON OF PARTICLE-SOOT ABSORPTION PHOTOMETER (PSAP) SAMPLE FILTER MEDIA

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Changes in Earth's climate (i.e., higher temperatures and severe or prolonged droughts) are occurring because of anthropogenic emissions of both gaseous and particulate matter (aerosols) into the atmosphere. Whereas many gaseous species are known to be warming agents, particles can scatter and/or absorb solar radiation, exerting radiative forcing that may provide a cooling or heating effect on Earth's climate. To better quantify the impacts of aerosols on Earth's radiative balance, many measurement campaigns have deployed the Particle-Soot Absorption Photometer (PSAP), an instrument that measures light extinction by aerosol particles collected on a filter. Although in use for over twenty years, the filter medium (E70) used for this instrument's measurements is no longer produced, necessitating a replacement to maintain continuity with the historical record. To this effect, a laboratory-based measurement study, sponsored by the Department of Energy's Atmospheric Radiation Measurement (ARM) program, is being undertaken at Brookhaven National Laboratory with several PSAP units to evaluate four candidate filter materials (Azumi, WhatmanGF10, Savillex and EMFAB), with the goal of selecting the one that provides the response that most closely mimics the current filter medium. Characterization of the PSAP performance metrics (e.g., the LED wavelengths and flow calibrations), leak testing and software updating were conducted to ensure un-biased data collection indicative solely of the filter media differences. Linear regressions of absorption coefficients using original and candidate filters showed high positive correlations in all cases, but the regression slopes reveal that out of the four candidates, the Savillex filter comes closest in signal response to the E70.

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HYDROCARBONS INTERACTING WITH AIR POLLUTANTS AND METEOROLOGICAL PARAMETERS IN URBAN FORESTS

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Metropolitan area of Sao Paulo (MASP) is one of the main megacities worldwide with more than 22 million inhabitants. Its densely urbanized area is characterized by some green park's representative of the Brazilian tropical forests, surrounded by intense vehicular traffic. The main objective of my project is to evaluate the interactions of hydrocarbons (HC) with air pollutants and meteorological parameters in urban forests. HCs have been sampled and analyzed from both natural and anthropogenic sources, among which the fuel combustion is the main from anthropogenic sources in urbanized regions. Natural sources, such as biogenic emissions, are globally bigger than anthropogenic emissions. Isoprene is the main biogenic HC, presenting large amounts of emissions and important implications for the atmospheric chemistry. Green parks in urban regions, in general, are associated to various benefits for air quality, but also can contribute to the production of ozone in the atmosphere because hydrocarbons emissions from trees. Thus, while HC emissions can protect plants against oxidative stress, they can also substantially alter the ozone interactions between the atmosphere and biosphere and influence the formation of other pollutants. The sampling has been manually carried out with Tenax cartridges and analyzes by gas chromatography-flame ionization detector (CG-FID) coupled to thermal desorber (ATD). Meteorological data are from stations installed at the same sampling points. The urban forests average and standard deviation mixing ratios for isoprene were 0.17±0.06, 0.14±0.12 and 0.09±0.05 ppb in Matão-USP, PEFI and Morro-Grande, respectively, during winter (June, July and August) 2018. Daily peaks were identified from 10am to 2pm, after maximum the day temperature.

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THE VEHICULAR EMISSIONS IMPACT ON THE FORMATION OF OZONE AND FINE PARTICLES IN URBAN AREAS IN BRAZIL

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Most of air pollution studies are concentrated in large urban centers. Studies in small/medium sized cities and surrounding cities these major centers are also important. These cities can receive all the pollution load coming from the large cities bringing consequences to population's health. Besides, there is a deficiency not only in the air quality monitoring but also in determining the sources of air pollution and elemental composition of particulate matter, especially in medium sized cities, which makes it difficult to develop inventories or to confirm them. In this way, the present study aims to evaluate urban emissions impact in four areas of different dimensions (two large and two medium sized) and under the influence of different atmospheric pollutants, assessing their sources and the air quality of these regions. To obtain this data, the cities to be studied will be monitored for a period from a mobile station. The pollutants to be studied will be the fine particulate matter (PM2.5), ozone (O3), nitrogen oxides (NOx), carbon monoxide (CO) and hydrocarbons (HC). To complement surface monitoring of aerosol data, remote sensing data (MODIS and AERONET) will be used, increasing the coverage area of this pollutant. Regarding polluting sources, these will be determined from principal component analysis (PCA) and positive matrix factorization (PMF). Thus, at the end of this research the information will be organized with the purpose of evaluating the air quality as well as the determination of the main pollutant sources present in each region.

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SYNOPTIC FORCING OF EXTREME CONCENTRATIONS OF FINE PARTICULATE MATERIAL (PM2.5) IN A PATAGONIAN CITY

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The city of Coyhaique (45o34'19 "S, 72o4'15"W, at 300 m.a.s.l.), located in the Chilean Patagonia, has a population of 62,265 inhabitants. This city shows the highest concentrations of fully inhalable particles (PM2.5) in the country, reaching emergency levels (> 180 ug/m3) every winter. Wood burning for heating and cooking is the main source of particles. In this work, we identify synoptic configurations associated with extreme particle pollution, in particular surpassing pre-emergency (> 110 ug/m3) and emergency levels. Identifying these synoptic configurations may provide a basis for robust air quality forecasting to avoid extreme pollution, particularly long-lasting episodes. Preliminary results suggest that long-lasting (> 5 days) extreme episodes of PM2.5 would be associated with blocking conditions over southern Patagonia.

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THE RUOA NETWORK IN MEXICO

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The University Network of Atmospheric Observatories (RUOA in Spanish) comprises ten observatories and five meteorological stations installed in different academic institutions scattered throughout Mexico. The main purpose of the network is to produce reliable atmospheric information relevant to topics such as air pollution, climate change, hydrological resources, food security among others. The network started in 2014 as an effort to increase inter-institutional collaborations in Mexico and includes the participation of various institutes from UNAM, several state universities and government agencies. We present some characteristics of the network including the progress made on the development of a quality assurance and quality control workflow, database structures and metadata implementation as well as the incorporation of new sites. All the information generated by the network is made public and can be consulted and downloaded free of charge at www.ruoa.unam.mx. A focus is made on the benefits of making the data available for stimulating multidisciplinary collaborations and supporting existing educational programs in different levels (high school, undergraduate and graduate programs, research, state agency reports, etc. We to present a general outlook of the range of projects that are using RUOA data in science and technology issues and think it can serve as a model for other Latin American countries who are planning to develop similar programs that can later link one with the other.

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CHARACTERIZATION OF THE SPATIO-TEMPORAL VARIATION OF ATMOSPHERIC POLLUTION. WRF-CHEM SIMULATIONS AND ANALYSIS POTENTIAL SOURCES CONTRIBUTION ON THE CENTRAL ANDES

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The Central Andes are an area located in South America, between latitudes 30 ° and 40 ° south. It is important because it contains the largest metropolitan area in Chile, Santiago and the fourth largest city in Argentina, Mendoza. According to climate predictions, this region would be very affected by climate change, which would cause an alteration of the relationships between liquid and solid precipitation, albedo variations, changes in the seasonal distribution of Andean fluvial spills and overtaking in runoff peaks. Due to the possible socioeconomic impacts in the region, it is necessary to design and implement adaptation strategies for these anticipated changes. An accurate prediction requires a correct representation of atmospheric conditions, their development and evolution. Recent studies conducted by our research group show that the presence of atmospheric aerosols would be related to the negative trend variations of albedo in the snow during the last 17 years, which leads to an increase in the thaw rate. Even so, there is a high degree of uncertainty about the identification and characterization of the sources of origin of the aerosols that contribute most to the darkening of the snow. In addition, the particulate material, depending on its size, quantity and chemical composition, could modify the constitution of the clouds, reducing the precipitation of rain or snow and increasing the formation of hail. The physics and dynamics of this type of events can be understood through the use of mesoscale models. In this work, inventories of regional anthropogenic emissions of own elaboration are incorporated to the simulations carried out with the WRF-Chem model to study the relationships: aerosols-albedo and aerosols-precipitations. The objective is to recognize the retro-trajectories that indicate potential sources of contamination, and to improve the modeling with own measurements, made for the criteria pollutants: PM, BC, OC and dust.

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ENHANCEMENT OF THE PARTICLE LIGHT ABSORPTION COEFFICIENT DUE TO COATING OF NON-ABSORBING MATERIAL

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With the purpose of analyzing the influence of aerosol particle mixing state on the enhancement of the aerosol particle light absorption coefficient, measurements of optical and physical properties of aerosol particles were performed at an urban site located at the Institute for Tropospheric Research (TROPOS, Leipzig-Germany) between October 2016 and February 2017. Light absorbing aerosol particle properties were obtained using two Continuous Light Absorption Photometers (CLAPs), operating in parallel. Furthermore, they have been compared to a Multi-Angle Absorption Photometer (MAAP), which was also operated at the same time and is considered to be a reference instrument for eBC (equivalent Black carbon). The two CLAPs were operated to determine the particle light absorption of the a) directly sampled ambient aerosol particles and b) of the aerosol particles passing an aerosol thermodenuder, operating at 300°C. The light absorption coefficients for ambient and denuded aerosol particles were measured for consecutive periods. They were then compared among them in order to account for the effect of mixing state. Likewise, the correspondent particle number size distributions have been measured, using a mobility particle size spectrometer to account for the mixing state of the samples. The average particle light absorption amplification factor related to mixing state for this period was 2.0 ± 0.6. This value presented a large fluctuation between 1 and 4 related to different volume fractions and climatological conditions. It is considered that these results may help improve modeling the impact of the particle light absorption of BC particles in Central Europe. Regarding the performance of the newly developed photometers, their measurements presented a linear correlation against the measurements of reference eBC, with correlation factors $R2 > 0.99$ and slopes close to the one-to-one line when using quartz-fiber filters. The observed unit to unit variability among them was of the order of 10%.

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OPTICAL PROPERTIES OVER AN URBAN SITE IN CITY AND PERI-URBAN SITE IN QUERETARO

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Measurements of aerosol optical properties, black carbon, PM2.5, NOx and ozone were obtained in two sites: urban and peri-urban, the first within Mexico City, and the second in the city of Queretaro. Observations of the meteorological parameters (relative humidity, solar radiation and wind speed) were used to explain the daily and seasonal behavior of the optical properties of particles and gaseous pollutants. The measurements were made from November 1, 2014 to July 31, 2016. The concentrations of O3 and NOx fell in the VOC-limited region (Mexico City) and between the NOx-limited region and the transition region (Queretaro). This result suggests that ozone in Mexico City would be formed photochemically; while in Queretaro would be linked to transport and photochemistry. In Mexico City; the average values of the scattering coefficient (Bscat) were: 35.8, 27.1 and 31.3 Mm-1, during the cold dry, warm dry and rainy seasons, respectively, while in Queretaro 10.9, 11.9 and 15.0 Mm-1. The average values of the absorption coefficient (Babs) in Mexico City during the cold dry, warm dry and rainy seasons were: 14.5, 12.7 and 12.7 Mm-1, respectively; and for Queretaro 4.9, 4.7 and 3.9 Mm-1. During the three seasons, the Bscat and Babs maxima coincide in Queretaro; while in Mexico City, during the dry seasons the Bscat maxima are delayed three hours from the Babs maxima, and five hours during the rainy season. This difference of phase arises from the difference in the formation processes of the aerosol particles. In Mexico City, no difference was observed between the seasonal values of single scattering albedo (SSA); while in Queretaro, the rainy season has the highest value of SSA (like Bscat). Mexico City has a much stronger secondary aerosol formation rate than Queretaro. Wind speeds in Mexico City are generally lower than in Queretaro, giving more time for secondary aerosol formation and larger pollution buildup.

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AUTOMATIC OPEN HARDWARE SUN PHOTOMETER FOR AOD MONITORING IN DENSE CITY-SCALE NETWORKS.

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Nowadays ground-based AOD measurements are performed by global Sun Photometers Networks such as AERONET or CARSNET. These networks provide useful information, but often the high cost of the required instruments limit the possibilities of monitoring AOD within small but sometimes highly relevant areas, such as cities. Measuring AOD at city scale can provide data useful to improve high-resolution air quality models and to validate satellite AOD products of fine spatial scale, as already shown by previous research (e.g. Toledo et al, (2018)). The method so far, however, relies on the use of handheld Sun Photometers, which do not allow the retrieval of high-density AOD measurements for extended periods of time. This situation motivates the development of a new type of instrument, that is both low cost and easy to manufacture. In this work, we describe an automatic, low-cost and open hardware LED-based Sun Photometer developed by our team. We present the main components of the instrument, the calibration methodology and preliminary results of the city scale AOD network implementation. Finally, we present possible future applications and steps to follow in the development of this instrument.

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AMBIENT CONCENTRATION AND PERSONAL EXPOSURE TO SHORT-LIVED POLLUTANTS IN MARITIME PASSENGER TRANSPORT

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The maritime transportation is considered a cleaner transportation mode in terms of CO2emitted per travel (0–60 tonne-kilometre) compared to rail (20–120 tkm) or road transportation (80–180 tkm). However, it contributes largely to the global emission of air pollutants, such as particulate matter and Sulphur oxides. The emissions come from the burning of diesel used for fueling the engines. Given that maritime diesel is dirtier than the diesel for on-road vehicles, its effects on air quality can be worse than the latter. In Brazil, the Sulphur (S) content of maritime diesel is 5,000 ppm, whilst the S content in the diesel for on-road vehicles ranges from 10 to 500 ppm. The megacity of Rio de Janeiro (Brazil) hosts a unique maritime mass transit system, connecting the city center with the neighboring city of Niterói. It operates catamarans with passenger capacities between 1,300 and 2,000 and ranks fourth in the world in number of commuters, transporting 20 million passengers annually. Despite the advantages of mobility and fast transit, the pollutants emitted by the vessels can pose serious short- and long-term risks to commuters and staff. Exposure studies on maritime commute modes are scarce in South America and, to the best of my knowledge, information on pollutant concentrations aboard vessels is non-existent. Thus, I have conducted a pioneering research aiming to characterize the concentrations of PM2,5, black carbon, particle number and volatile organic compounds aboard catamarans between Rio de Janeiro and Niterói. I used portable high-response instruments operated continuously to capture fine spatio-temporal features during the transit and in different seat positions. The preliminary results unveiled sharp gradients with outstanding concentrations during docking. This pioneering study will provide the first estimates of personal exposure to harmful air pollutants in a maritime transit system in a megacity in Latin America.

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INFLUENCE OF MINERAL DUST AND BIOMASS BURNING IN THE AIR QUALITY OF MERIDA (YUCATAN) IN 2017

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Several studies suggest that the air quality of Merida city may be influenced by mineral dust from the Saharan Desert and by biomass burning emissions from Central America and Southern Mexico. To verify this phenomenon X-ray fluorescence (XRF) analysis was performed on samples of PM2.5 collected at the chemistry department of the UADY (Universidad Autónoma de Yucatán), located in Merida. The collection of particulate matter was conducted in the periods where the biomass burning plumes (April-May 2017) and mineral plumes (July 2017) likely arrive to Merida. In addition to the chemical characterization, the data collected by the PM10 and PM2.5 analyzers of the RUOA station (Red Universitaria de Observatorios Atmosféricos) of Merida were analyzed in order to determine some peaks of interest in the periods mentioned above. After identifying them, back trajectories were carried out with the help of NOAA's HYSPLIT program to infer their potential sources.

It was found that from April 5 to 7 and from May 27 to 29, biomass burning emissions from Southern Mexico likely impacted the Merida's air quality, generating an increase of 600% and 200% in PM10, and PM2.5 concentrations, respectively. It was also found that from July 22 to 24 and from July 27 to 28, air masses that arrived in Merida were able to transport mineral dust from Africa. The levels of PM10 and PM2.5 increased between 200% and 500% with respect to the baseline. It is possible that in addition to impact on Merida´s air quality, these aerosol particles could also affect the formation of clouds, and therefore, the regional hydrological cycle.

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A LOW-COST, AEROSOL MONITORING NETWORK DESIGN TO EMPOWER STUDENTS AND CITIZENTS IN BOGOTA, COLOMBIA

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A strong commercialization of low-cost air quality sensors has begun, becoming a field of rapid growth and evolution. It is considered that the availability of this type of technologies will continue to increase both in types and numbers in the coming years. Its operation in general terms consists of converting into an electrical signal the presence of a relevant gas or particle pollutants, depending on its concentration. The use of these innovative technological tools allows to increase and significantly improve the monitoring capacity, breaking the current paradigms where monitoring is restricted to that done by the governmental entities. In addition to the low cost of these sensors, their small dimensions, low weight and low energy consumption give them a great versatility of operation. Of the main advantages of this low-cost monitoring equipment is the possibility of monitoring near specific sources for a better characterization at the local level and increase the extension of the monitored area for better spatial and temporal identification of trends. Bogota is an excellent stage for the massification of this technology as it is a vast metropolis that only has 13 fixed monitoring stations managed by the Air Quality Monitoring Network of the City's Secretary of Environment, leaving extensive areas of the city without any monitoring of the actual concentrations of pollutants to which the public is exposed. Besides, the use of these low-cost instruments has the potential to become highly effective tools to encourage and motivate students and the community at large in matters of air quality. We try to develop a local low-cost network around Universidad Central to assess the real exposition of the academic community to particulate matter as a way to motivate students to the study of air quality and its related health
impacts.

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LEVELS OF PARTICULATE MATTER IN CITIES OF LATIN AMERICA AND THE CARIBBEAN

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Temporal and spatial trends of particulate matter smaller than 10 micrometers (PM10) in different cities of Latin America and the Caribbean are analyzed in this study. Annual averages of PM10 were obtained from the World Health Organization (WHO) database related to outdoor air pollutants in cities. The cities included in the study were Kingston (Jamaica), Medellín (Colombia), Guatemala City (Guatemala), Lima (Peru), Mexico D.F. (Mexico), Rio de Janeiro (Brazil), Santiago (Chile), Sao Paulo (Brazil), Quito (Ecuador) and Buenos Aires (Argentina). According to the principal component analysis it has been determined that the first two components account for 91% of the information variability of the PM10. It was possible to identify 3 groups among the 10 cities based on the PM10 data for the years 2011, 2014, 2016 and 2018. The first one is characterized for having high concentrations of PM10 during 2014, decreasing in the following years, as in Rio de Janeiro and Mexico DF, it may be due to the fact that during 2014, the aforementioned cities implemented some measures to reduce this pollutant. The second group includes cities that showed high concentrations of PM10 throughout the four years of the study, these cities are Lima, Santiago and Medellín. Finally, there are the cities of Kingston, Quito, Buenos Aires and Sao Paulo with low concentrations during the analysis period. The cities with the highest average concentration of PM10 are Santiago and Lima (68 and 72 μg/m3 respectively), while those with the lowest average concentration are Buenos Aires and Sao Paulo (30 and 34 μg/m3 respectively).

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NITROUS ACID (HONO) AND PM2.5 MEASUREMENTS IN SAN SALVADOR, EL SALVADOR

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The nitrous acid (HONO) is an important source of hydroxyl radicals (OH) produced via photolysis [1]. The OH radicals promotes the oxidative capacity of the atmosphere [2] which boost the increasing of tropospheric O3 and atmospheric pollutants such as PM2.5 [3]. This relationship between the HONO and PM2.5 has been already reported, suggesting that the addition of HONO sources favors an increase in PM2.5 and O3 concentrations during the day [4]. One of the main HONO sources is the direct emission in the troposphere by combustion processes such vehicle exhaust among others [3]. In this work we report on the diurnal variation of HONO and PM2.5 levels measured using the MAX-DOAS technique and ambient particulate monitoring instruments, respectively. An increase in the values of HONO can be observed during daytime when traffic flow is high. This behavior seems to be similar to the diurnal variation of PM2.5 concentration values. These results will be further discussed.

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EFFECTS OF AFRICAN DUST IN THE NUTRIENT, RADIATION, AND WATER BUDGET OF A TROPICAL FOREST

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African dust travels thousands of kilometers and can reach the Americas and the Caribbean. Dust particles interact with radiation, by directly scattering and absorbing it, or indirectly by serving as cloud condensation nuclei (CCN) or ice nuclei (IN). These particles can also affect the water budget by altering the normal precipitation patterns of an ecosystem. Through dry and wet deposition, they can alter the nutrient budget of a system. As part of the Luquillo Critical Zone Observatory, field campaigns were held during the summers 2013, 2014, and 2015 at Pico del Este, a tropical montane cloud forest in the Caribbean island of Puerto Rico. Cloud microphysical properties, which include liquid water content, droplet concentration, and droplet size, were measured. Cloud and rainwater samples were collected and analyzed for chemical composition. Properties analyzed include pH, conductivity, concentration of ions and trace metals, and concentration of total and dissolved organic carbon and nitrogen. Radiation, visibility, precipitation (total and intensity) and meteorological state variables (temperature, relative humidity, wind direction and wind speed) were also measured at this station. Samples were separated between high and low dust concentration samples using products from models and satellites. Results suggest that some African dust serves as a CCN, increasing by 44% the droplet concentration and by 33% the liquid water content under high dust events, which could be affecting the radiation and water budgets. Chemical analyses showed an overall increase in the concentration of ions, trace metals, and total and dissolved organic carbon and nitrogen under high dust influence (e.g., Ca trace metal in cloud water was 4x higher). An increase in the concentration of ions and trace metals could alter the nutrient budget of the ecosystem by injecting nutrients like nitrogen, phosphorous and calcium into the ecosystem

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LOW-COST SENSORS IN THE STUDY OF AIR QUALITY IN SAN JUAN METRO AREA FOLLOWING HURRICANE MARIA

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After the impact of Hurricane Maria, the electric grid in Puerto Rico was devastated, with over 90% of the island without electricity. Still six months later, the service was unstable and more than 10% of the population was without grid electricity. The main objective of this project is to analyze how the air quality (AQ) of the island has been affected with the increase in the use of power generators post hurricane María and to evaluate how AQ changes when electrical power is restored. Four different sampling locations were selected in the San Juan Metro Area (SJMA). Low-cost sensors were key in monitoring air quality of the SJMA. Since November 2017, Real-time Affordable Multi-Pollutant monitors (RAMPs) were deployed at the four different locations to monitor CO, SO2, and optical particulate matter (PM2.5) concentrations. A microaethalometer to monitor black carbon (BC) and a Microtops sunphotometer to monitor aerosol optical thickness (AOT) were rotated among some of the locations. A black carbon (BC) monitor and a particle counter (OPC) were deployed at the super site location of the University of Puerto Rico-Rio Piedras Campus. Results up to now show that, in the first weeks of sampling, SO2 often exceeded the National Ambient Air Quality Standards (75ppb/hr). After four months of sampling and as the power is restored and fewer generators are used, concentrations of CO, SO2 and BC were found ca. 50% lower. Detailed results regarding variations in the concentrations of BC, CO, PM2.5, SO2, and AOT during daytime/nighttime and for the different locations studied in the SJMA will be presented at the conference. We will also present the case 2.008 study of January 1, 2018, which might have been affected by the excessive ignition of fireworks in this period.

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RESEARCH USES OF BROADBAND AEROSOL OPTICAL DEPTH

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The broadband aerosol optical depth (BAOD) derived from pyrheliometer solar radiation measurements at Camagüey meteorological station, for almost half a century have been used to conduct scientific research on aerosol and solar radiation. Recently the validation of the BAOD with satellite and ground-based aerosol optical depth measurements (AOD) has been conducted showing good results. The results of the validation will be mention briefly as an introduction to the posters to be presented by members of GOAC. The applications for aerosols climatological studies and for the identification of the decreasing aerosols trends between 1981 and 2010 as the main cause of occurrence of the solar radiation brightening under clear sky condition at the site will be more broadly shown and discussed.

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TEMPORAL RELATIONSHIPS BETWEEN AFRICAN DUST AND CHLOROPHYLL-A IN THE EASTERN CARIBBEAN BASIN.

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Seasonal African Dust (AD) transports soluble iron to oligotrophic Caribbean waters, and when bioavailable, it could increase marine primary productivity (PP). Recently, the region has experienced the proliferation of unusually high quantities of Sargassum, an iron-absorbing macroalgae inhabiting the air-sea interface, which possess ecological and economic challenges and whose driving factors are still uncertain. AD events reach Puerto Rico (PR) mostly during boreal summer months, also the season when chlorophyll-α (CHL) concentrations are highest, when the algae starts to bloom, and when sediment plumes from the Orinoco River (ORP) reach nutrient discharge maxima. This study seeks to better understand the temporal relationships between increases in CHL and the presence of AD events in the region. Aerosol data collected at the Cabezas de San Juan Atmospheric Observatory was used to identify AD events between January 2005 and December 2015. Light scattering coefficients were measured with a integrating Nephelometer, while light absorption coefficients were obtained from either the Particle Soot/Absorption Photometer (PSAP) or the Continuous Light Absorption Photometer (CLAP). Spectral properties suggesting AD events were cross-referenced with surface dust concentration image models and source-attributed air masses corresponding to dusty periods using Hybrid Single-Particle Lagrangian Integrated Trajectories (HYSPLIT). For all years with spectral data, modelled monthly wet dust deposition was correlated (R^2= 0.64) with mean CHL concentrations from NASA's Moderate Resolution Imaging Spectroradiometer (MODIS). Daily dust mass column densities from NASA's MERRA-2 model were also correlated (R^2= 0.53) to sea surface iron concentrations from NASA's Ocean Biogeochemical Model. Our 2010 case study coincides with the start of the Sargassum bloom and shows CHL peaks occurring a month before ORPs but during the AD season, suggesting the AD role in enhancing PP. Other possible influencing climatic and oceanographic variables could be associated to these observations.

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AN AEROSOL AND CLOUD ANALYSIS SYSTEM (ACAS) IN THE CARIBBEAN REGION

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We are developing a tightly integrated, multi-sensor instrument (the Aerosol and Cloud Analysis System – ACAS) that will remain permanently operational at the Pico del Este (PDE) tropical montane cloud forest site in El Yunque National Forest (Puerto Rico) year-round for ongoing research and educational outreach. The PDE site has been used by a number of international research groups in past measurement programs because of its unique, sub-tropical island location. Depending on the time of the year and the origin of the air masses, the aerosols may consist of sea salt, black and organic carbon (BC, OC), sulfates, bioaerosols or dust. The ACAS will provide users with a measurement system that will address multiple questions of how droplets form, grow and process aerosols over a large range of environmental conditions. The development will integrate specialized sensors that detect the chemical (inorganic and organic species, black carbon, cloud condensation nuclei), bioaerosol and microphysical properties of the particles and cloud droplets.

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INCREASE IN THE OUTDOOR LEVELS OF FUNGAL SPORES IN SAN JUAN, PUERTO RICO IN THE AFTERMATH OF HURRICANES IRMA AND MARIA

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The effect of hurricanes on the calendars of fungal spores and pollens have not been studied. Hurricanes Irma and Maria hit Puerto Rico on September 6 and 20, 2017 respectively and allowed us to determine their impact on the San Juan, PR fungal spore and pollen calendars. In San Juan, PR peaks of fungal spores occur during April and May and from September through November. In contrast, tree pollens, the most abundant in PR, are present all year long but at lower levels during the summer (June-August).We use the Burkard air sample to take daily air samples on a glass slide to count and identify the fungal spores and pollens a week after Maria hit PR, just at the beginning of the fungal spore season. We observed a significant decrease in the levels of fungal spores and the 2017 fungal spore's season was severely affected. Nevertheless, the fungal spores rapidly rebound reaching unexpected record high levels during January through March 2018 and the April and May season is the highest on record. Several days of very high fungal spores levels (red alerts) and very rapid release of fungal spores were observed. This could be due to the accumulation of biomass for the fungal growth and an unusual rainy season at the beginning of 2018. In contrast to the fungal spores, and due to the devastation of the vegetation after the hurricanes, the tree-pollen levels reached very low levels during the beginning of 2018. Hurricanes may be an important factor in the increase of outdoor fungal spores. As we described that high levels of fungal spores are significant triggers of asthma and allergies in PR, we will expect an increase in the use of asthma and respiratory medical services for 2018 in the aftermath of hurricanes Irma and Maria.

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FIFTEEN-YEAR TREND IN AFRICAN DUST OUTBREAKS ACROSS THE EASTERN CARIBBEAN

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Dust days across the eastern Caribbean between 13° and 23° North latitude, and the 61° and 71° West longitude were identified by defining a threshold value in the midvisible Aerosol Optical Depth (AOD) retrieved from the MODerate Resolution Imaging Spectroradiometer (MODIS). The Lognormal and Weibull distributions, which have been widely applied to characterize the statistical properties of atmospheric variables including AOD, were analyzed to determine those threshold values. Based on Chi Square Goodness of fit, the 90th and 99th percentiles within the lognormal distribution were used as the point at which all subsequent values were considered dust day (D90) (AOD 0.34) and extreme dust day (D99) (AOD 0.59), respectively. Dust days and threshold values were validated using the Aerosol Optical Depth (AOD) and the Extinction Angstrom Exponent (EAE) retrieved from the AErosol RObotic NETwork (AERONET) at Cape San Juan (CSJ) in Fajardo, Puerto Rico. Although there is no trend in frequency and magnitude of dust days during June – July - August, the years with highest number of dust days across the eastern Caribbean were associated with positive North Africa Dipole Intensity (NAFDI). The analysis described above is also in progress for the eastern Atlantic and western Africa.

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INITIAL ASSESSMENT OF ENVIRONMENTAL FACTORS AFFECTING NIGHT SKY BRIGHTNESS MEASUREMENTS IN PUERTO RICO

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The population growth and urban sprawl in Puerto Rico has resulted in a widespread increase in nighttime light pollution during the last decades. The excessive and inappropriate use of unshielded artificial light sources has been linked to detrimental impacts to wildlife and human health. Measurements of night-sky brightness can be used as reliable indicators to monitor the relative intensity of light pollution. In this study, measurements of night sky brightness were collected across Puerto Rico using the Sky Quality Meter photometers (Unihedron, Inc.). These measurements are essential to characterize the night sky quality and establish targeted baseline values at selected sites, both natural and urban, across the Island. In addition to these local efforts, the Puerto Rico's Working Group on Light Pollution is collaborating in the validation of the NASA's Black Marble nighttime lights product suite, which relies on measurements from the Visible Infrared Imaging radiometer Suite (VIIRS) onboard the Suomi National Polar-orbiting satellite platform. We show that night sky luminance measurements in Puerto Rico are influenced by a confluence of environmental factors such as the presence of clouds, relative humidity and intrusion of mineral dust form Africa. The influence of aerosols, in particular, result in the scattering of light that might contribute to increased sky glow and to uncertainties in the satellite-derived measures. This work presents the results of a scoping study, supported by NASA and other federal agencies, to evaluate the impact of aerosols and relative humidity to night sky brightness. SQM measurements collected between 2009 and 2019 at various sites in Southwestern Puerto Rico are being correlated to Aeronet's Aerosol Optical Depth (at 870 and 550 nm) and the Angstrom Exponent. The latter is part the NOAA Center for Atmospheric Sciences and Meteorology (NCAS-M) Aerosol and Radiation Network at the Isla Magueyes Field Station.

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LONG TERM MONITORING OF MINERAL "AFRICAN" DUST CONCENTRATIONS IN PUERTO RICO

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Every year, over 40 million tons of African dust are transported from the Saharan and Sahel regions by the trade winds to the Caribbean. Mineral dust particles affect air quality (visibility), climate (by influencing the Earth's radiative budget), ecosystems and human health. Many aspects of those effects remain poorly understood showing the need for more research. To better understand the impact of African dust on the Caribbean it is necessary to study the temporal and spatial distribution of dust over the region. For this reason, total suspended particle (TSP) aerosol samples are collected at the Atmospheric Chemistry and Aerosols Research's Cape San Juan Atmospheric Observatory (ACAR's CSJ) and at the Facundo Bueso Building (ACAR's FB), Puerto Rico, using a High-Volume Sampler. Dust concentrations are determined by gravimetric analysis. Dust concentrations in Puerto Rico together with optical measurements of aerosol scattering and absorption coefficients and aerosol chemical composition were studied during years 2017 and 2018. Results of mineral dust concentrations obtained during the summer months of 2017 and under the influence of African Dust incursions were on average five times higher for high dust days than for low dust days, with maximum concentrations up to 15 μg/m3. Detailed results will be presented at the meeting.

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IMPACT OF AFRICAN DUST INCURSIONS TO FUNGAL CONTENT AND AEROSOL COMPOSITION AT THE CARIBBEAN REGION

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African Dust (AD) particles reach the Caribbean region during the summer months, from May to August. AD is one of the most important natural sources of mineral particulate matter at the global scale. During AD incursions at the Caribbean region an increase in particulate matter have been observed exceeding the exposure limit of 50 μg/m³ 24-hour mean established by the World Health Organization (WHO) affecting the air quality and public health. The relationship between AD incursions and the concentration of fungal spores (FS), a major component of primary biogenic aerosol particles in the atmosphere, in the Caribbean region is poorly understood. Here we present a resume of the data obtained of fungal spore concentrations vs AD incursions from a montane rain forest and an urban station. In order to have a better understanding of the impact of AD incursions on FS emissions, fungal spore concentrations were monitored using a Burkard spore trap at the tropical montane cloud forest of Pico del Este at El Yunque National Forest in Río Grande Puerto Rico and at the School of Medicine of the University of Puerto Rico in San Juan Puerto Rico. AD concentrations were measured at the University of Puerto Rico Río Campus in San Juan Puerto Rico and compared with the FS obtained. Preliminary results showed that Basidiospores and Ascospores comprised the major components of the total spore's concentrations at the montane rain forest and urban station, up to a maximum of 98%, during both AD incursions and background days. A considerably decrease in the concentration of fungal spores during AD events was observed at both stations. Preliminary results of dust concentration and ionic speciation will be presented at the conference.

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BACKGROUND AEROSOL CONCENTRATION DETERMINATIONS FROM VENEZUELA

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Long term measurements of aerosols background concentration and particle number size distribution in the tropics are important for validation of regional and global aerosol-climate models. Despite recent efforts to enhance monitoring of aerosols in tropical troposphere, the data from the tropics continues to be significantly scarce. In Venezuela the only continuous data available of aerosol concentration in the free troposphere (FT) were done from March 2007 to 2009 at Sierra Nevada mountain ridge at 4765 m.a.s.l. in the Venezuelan Andes. These results showed a seasonal trend with larger concentrations of aerosols in the free troposphere (FT) during the dry season. That seasonality was regulated by the migration of the inter tropical convergence zone (ITCZ) and the enhancement of biomass burning during this season. Unfortunately, background aerosols concentrations continuous measurements are difficult to maintain for both economic constraints and difficulty in access to these remote sites. We proposed to use our continuous measurements of aerosol aerosols at Altos de Pipe Air Quality Station (APAQS) (1740 m.a.s.l.) located at a tropical montane ecosystem in the Coastal Mountain Range of Venezuela to test if by using the average aerosol concentration values obtained between 12:00-15:00, period of maximum solar irradiance in the tropics, our values could be used as representative of the background tropospheric aerosol concentration from northern South America. Preliminary measurements during the dry season of 2017 show an average similar than those reported for background aerosol concentrations from other tropical sites. Further diurnal cycles and air masses influences will be discussed.

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COMPARISON OF TOTAL SUSPENDED PARTICULATES (TSP) MEASUREMENTS AT A SUBURBAN SITE IN BARBADOS TO MODEL PREDICTIONS AND OBSERVATIONS

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Atmospheric particulate matter that has diameter less than 10 micrometers and 2.5 micrometers (PM10 and PM2.5) from Saharan Dust impacts the concentration of Total Suspended Particulates (TSP) in the Eastern Caribbean. Using the Weather Research and Forecasting model coupled with chemistry (WRF-Chem) the transport of Saharan Dust from its source to the Eastern Caribbean was used to identify possible dust episodes for the study. Aerosol optical depth (AOD) data from the Aerosol Robotic Network (AERONET) site on the southeast coast of Barbados at Ragged Point were used to confirm the predicted dust episodes. During the summer (July) and winter (February to March) of 2017, TSP samples were collected at the CIMH located in Husbands, St. James, Barbados which is a suburban area close to the capital city of Bridgetown. The daily mass concentrations ranged from 5.1 to 1475.2 µg m-3 in the winter and 1.2 to 1781.0 µg m-3 in summer. Comparative analysis of the WRF-Chem and the TSP concentrations indicated that low concentrations were collected during most of the winter period. During this same period, the WRF-Chem predicted little to no Saharan dust was affecting the Eastern Caribbean. During the summer period many of the daily TSP concentrations far exceeded the model's predictions. This difference in collected particulates and model outputs suggests that the primary source of dust may not originate from the Saharan during the observed summer period.

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AEROSOLS MEASUREMENT AS PRODUCT OF BIOMASS BURNING ONC CRYOSPHERE IN THE CENTRAL ANDES

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The cryosphere on the Central Andes between Argentina and Chile is an important water reservoir; therefore, it is important to ensure the sustainability of this resource for the ecosystem and millions of people in this region. Then, the knowledge about hydrological cycle and the different phenomena that are affecting its radiative balance caused by absorbing aerosols of solar radiation, some of these aerosols can be generated by large burning of biomass, a practice that occurs during crop changes in the austral spring in South America. For this reason, it has been analyzed in several basins uses remote knowledge data for 17 years (2000 - 2016) and the analysis of variations on snow albedo, aerosol optical depth (ODA) and land surface temperature of several water basins of that region. The partial results indicate a negative tendency in the snow albedo decrease related to the AOD variations. The next step will be collect snow samples to measure levoglucosan, mannosan and galactosan to establish if there is on snow presence of aerosol from the biomass combustion and the type of biomass source.