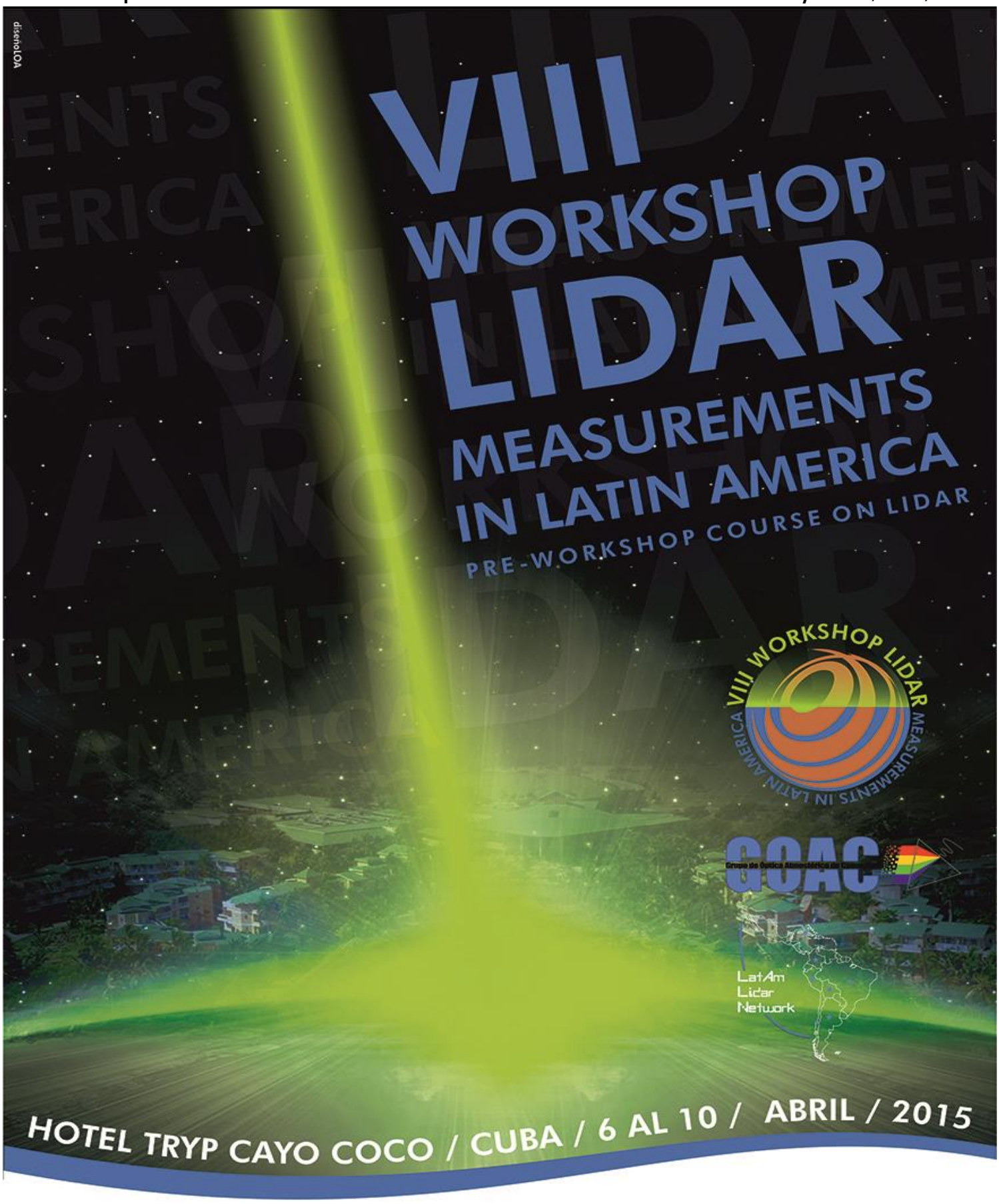
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Oral Presentations

Aerosol Identification by Lidar: A Comparison of Results from CALIPSO and AERONET

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Abstract: Aerosols have important effects on human health, the environment, and climate. It is well known that aerosols represent the largest unknown factor in models for predicting future climate. Numerous space-borne instruments, such as the lidar on CALIPSO and the instruments on MODIS, POLDER, MISR, and many other satellite systems give us an excellent picture of aerosol geographic distribution and, in the case of CALIPSO, the vertical extent of aerosol. Analyses of the data from all of these instruments have been used to estimate aerosol type, but it is safe to say that none of these systems gives a definitive identification of the type of aerosol being observed. Omar and co-workers carried out intercomparisons and concluded that "One size fits none."

We describe a new technique for determining aerosol type using a limited number of optical properties, which can be obtained with space-borne instruments. The method is based on an evaluation of the Mahalanobis distance from five different "reference" aerosol types. The reference types are denoted Urban-Industrial, Biomass, Dust, Maritime and Mixed. To develop the technique we used the AERONET data set values for the following parameters: Extinction Angstrom Exponent, Absorption Angstrom Exponent, Single Scattering Albedo, Real Index of Refraction and Imaginary Index of Refraction.

The Mahalanobis distance is a statistical technique that allows one to determine the "distance" from a particular measurement to each of a set of reference clusters. If the measurement is closest to a specific reference cluster, the measurement is assumed to belong to that cluster. An advantage of this method is that one can use as many parameters as desired to evaluate the distance. We can evaluate the Mahalanobis distance of any particular aerosol observation to the five reference clusters using all of the parameters listed above, and thus determine the type of aerosol being observed. We find that our scheme is quite robust, being able to identify aerosol types under a wide range of conditions. We present results showing the various aerosol types and their seasonal dependence at numerous locations, as well as a global aerosol climatology.

The CALIPSO lidar in space experiment measures the backscatter ratio at 532 and 1064 μm wavelength, and the depolarization ratio at 532 μm, both as functions of altitude. The CALIPSO aerosol classification scheme uses these data as well as additional information, namely: the nature of the surface (snow, desert, ocean) and the height of the aerosol layer. Using this information, CALIPSO then classifies the aerosol as belonging to one of the following types: Smoke, Desert Dust, Polluted Dust, Polluted Continental Aerosol, Clean Continental Aerosol and Maritime Aerosol.

We compare the aerosol type classifications obtained with the Mahalanobis distance calculation with the CALIPSO classifications. Although this comparison might be considered a validation of either one or the other scheme, it should be kept in mind that any method for classifying aerosols should be supplemented by in-situ observations.

Keywords: AERONET, lidar, mahalanobis distance, CALIPSO, reference aerosol types

VIII WLMLA Topic: Remote Sensing applications

Cloud impact study in solar surface radiation using the R2-SOLAR network in Argentine territory

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Abstract: In the framework of the international project named SAVER.Net (South American Environmental Risk Network), the CEILAP's Lidar Division was established a new ground based radiation monitoring network in the Argentine territory. This project has the main goal to develop an atmospheric environmental risk-management system in South America that create a bridge between the primary data generators and the national authorities that disseminates public warming in case of atmospheric event likes volcanic ash eruption, Patagonian dust storms, high UV radiation sunbathing, among others. The increase in the instrument capabilities offers the opportunity to make scientific studies of different atmospheric events in several spatial and time scales. The radiation monitoring network is constituted with moderated narrow band radiometers GUV 2511, broadband pyranometers in the visible (Kipp&Zonen CMP21) and UVA and UVB (YES) installed at the moment in 5 sites in the Argentine territory, four of them in Patagonia region. Synergy of radiometer measurements with model allow to determine UV Index, cloud optical depth, total ozone column, and to quantify the impact of different aerosols and cloud event over solar radiation at ground surface. In this work we present preliminary results of cloud impact in the surface solar radiation at different time scale that is to short time rates (minutes) to seasonal variation. The results show that the clouds reduce the visible daily solar irradiance between 30-40% in average without a defined seasonal influence. Instead, the partially cloud cover when solar disk is unblocked can produce solar UV enhancements up to 20% but in shorted time scales (5-10 minutes).

Keywords: solar radiation, radiometers, network

VIII WLMLA Topic: Remote sensing application

Recent Advances in the Cubatão Scanning Lidar to Monitor Industrial Flares

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Abstract: This study present the recent advances made on a multiwavelength elastic scanning lidar placed at the industrial area of Cubatão in the State of São Paulo (Brazil). Special attention has been paid to the characterization of the instrumental performance of this lidar system, in particular regarding to its electronic subsystem. To this aim, the quality assurance tests, regularly applied in well-established lidar networks such as LALINET and EARLINET, were applied to the Cubatão scanning lidar in order to improve the knowledge of its performing itself and to design protocols for correcting lidar signal for undesirable instrumental effects. In particular, the trigger delay was assessed by means of zero-bin and bin-shift tests for analog and photo-counting signals, respectively. Dark current test is also performed to detect potential range-dependency that could affect lidar products. The application of the results derived from these tests together with the state-of-the-art methodologies to characterize the particle optical and microphysical properties inside industrial flares demonstrate the potential of this lidar for the study and measurement of industrial emissions.

Keywords: EARLINET protocols; dark current; instrumental tests; LALINET protocols; lidar; trigger delay; flame optical properties; flame microphysical properties

VIII WLMLA Topic: Remote Sensing applications

Characteristics of Cirrus Clouds in the Central Amazon region during the Intensive Observational Period in the dry season 2014 as part of the GOAMAZON experiment

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Abstract: Using three lidar systems around the city of Manaus, the behavior of the cirrus clouds in the region was investigated. The measurements were conducted during the second GoAmazon 2014/5 Intensive Operating Period (IOP2), from August 15 to October 15, in the dry season of 2014. The three systems were operated continuously at the sites T3, downwind and 60 km to the west of Manaus; T2 (3.21 ºS 60.60 ºW), also downwind of Manaus but just across the Negro river to the west; and T0e (2.89 ºS 59.97 ºW), an upwind site east of Manaus located in campus of Embrapa. These different sites were selected for GoAmazon 2014/5 to measure the effects on aerosols and clouds of different levels anthropogenic pollution, in an otherwise pristine tropical rainforest environment. From the analysis of individual 5-min backscatter profiles, we investigate the statistical distribution of cirrus clouds base and top altitude characteristics; and also the cloud optical depth for the three sites. Mean characteristics for the cirrus clouds measured in the three sites are discussed and the relations between these results are investigated. The cirrus clouds are frequent cloud in the three sites during the dry season. Comparisons with cloud optical depth from sun-photometer in T0e and T3 sites and base height from ceilometer in T3 site were conducted.

Keywords: cirrus clouds; Lidar; Central Amazon Region

VIII WLMLA Topic: Lidar applications in environmental sciences

Subtropical and polar Cirrus clouds characterized by ground-based lidars and CALIPSO/CALIOP observations

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Abstract: Cirrus clouds are product of weather processes, and then their occurrence and macrophysical/optical properties can vary significantly over different regions of the world. Since Cirrus clouds usually are located from 7 km height up to tropopause altitudes, active remote sensing techniques, mainly lidar systems, are usually used for detection of Cirrus clouds from ground-based and space observations. Lidars can provide height-resolved measurements with a relatively good both vertical and temporal resolutions, making them the most suitable instrumentation for high-cloud observations. The aim of this work is to show the potential of lidar observations on Cirrus clouds detection in combination with a recently proposed methodology to retrieve the Cirrus clouds macrophysical and optical features. In this sense, a few case studies of cirrus clouds observed at both subtropical and polar latitudes are examined and compared to CALIPSO/CALIOP observations. Lidar measurements are carried out in three stations: Sao Paulo (Brazil, 23.6°S/46.8°W) and Sta. Cruz de Tenerife (Spain, 28.5°N/16.3°W), being both subtropical sites, and the Belgrano II base (Argentina, 78ºS/35ºW) in the Antarctic continent. Local radiosounding profiles are also used for cirrus-temperature correlation analysis. Optical (COD-cloud optical depth and LR-Lidar Ratio) and macrophysical (top/base heights and thickness) properties of both the subtropical and polar cirrus clouds are reported. This study is focused on the classification of the daily cloud features into three Cirrus COD-related categories: svCi-subvisual (COD < 0.03), stCi-semitransparent (COD: 0.03 - 0.3), and opCi-opaque (COD > 0.3) clouds. In general, subtropical Cirrus clouds present lower LR values and are found at higher altitudes than those detected at polar latitudes. Additionally, a higher svCi presence is observed over the polar station along the day, since svCi clouds are formed at lower temperatures. A good correlation agreement is also achieved between groundbased lidars and space-borne CALIOP measurements.

Keywords: CALIPSO, Cirrus clouds, LIDAR observations; Polar and subtropical regions

VIII WLMLA Topic: Lidar applications in environmental sciences

Saharan dust event over Colombia detected in the LALINET Lidar Observatory Atmosphere - LOA-UNAL

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Abstract: Passive and active remote sensing techniques are well suited for understanding the optical and microphysical characteristics of aerosol layers. Lidar systems has the ability to monitoring the vertical structures of the atmosphere and determine the concentrations of aerosol, either local and those transported for long-ranges, through the evaluation of the optical properties such as backscatter and extinction coefficients. Inversion products from CIMEL (part of AERONET) data give information about size distribution, Single Scattering Albedo (SSA), aerosol fine- coarse modes, and Angstrom exponent (AE). The singular event of Saharian dust over Medellín, Colombia was detected in the LALINET Lidar Observatory Atmosphere – LOA-UNAL, Colombia (6.26°N, 75.58W, 1471 a.g.s.l). We report here some analysis results of the Saharan dust event observed on 27 June 2014 from the synergy of Lidar, sun photometer (CIMEL, NASA-AERONET), and global mass transport models: NAPPS and MACC, and back trajectories representations.

Keywords: LOA LALINET, Elastic Lidar and Saharan dust particles

VIII WLMLA Topic: Lidar applications in environmental sciences

Lidar measurements validation under coastal condition

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Abstract: New challenges are faced with the increasing use of lidar technology in wind energy applications, more specifically in resource assessment and power performance measurements. This study aims to validate measurements of a wind lidar profiler installed in a wind farm at the coastline. An experimental setup was deployed in Pedra do Sal site, located inside a 18MW wind farm in the northeast coast of Brazil. The site is 300m away from the sea shore at a flat terrain. The objective is to use wind data from a 100m meteorological mast as reference and to correlate wind profile lidar data to analyze deviations and site-specific effects. The met tower and the 500m Windcube8 lidar are installed 565m away from each other and positioned 100m upwind from the turbines. The measurement campaign covered a one-year period, from August 2013 to July 2014. Tower data presented a recovery rate of 99.97%. The database used only lidar data with availability of 100%. Five wind speed levels (40m, 60m, 80m, 98m and 100m) are correlated, where the highest level is validated with a 3D sonic anemometer. Results show a good correlation between lidar and tower, with an average R^2=0.97. However, there is a systematic error (bias) for all analyzed levels, with an increasing tendency for larger wind speed values. The calculated bias is confirmed with a negative skewness and high kurtosis for the five levels. It is also observed a non-linear behavior of the bias along the wind speed range. In conclusion, the studied lidar profiler presented a good correlation with the reference data, but with significant deviations for wind energy applications. The source of the observed non-linear behavior is still to be better understood.

Keywords: Wind energy; Wind lidar; Windcube8; Validation; Bias analysis

VIII WLMLA Topic: Lidar applications in environmental sciences

Angular Aerosol Profiling over the city of La Paz, Bolivia

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Abstract: Multiangle aerosol profiling measurements were carried out with an elastic scanning lidar system over the city of La Paz, Bolivia(3420 masl). The goals of these measurements were to study the temporal evolution of the boundary layer over La Paz city, to estimate the aerosol loading over this city, and the amount of these aerosols that could be transported to the Chacaltaya GAW station (5240 m asl). The first results of this study are shown here.

Keywords: Lidar; Multiangle; Aerosol; Boundary layer

VIII WLMLA Topic: Lidar applications in environmental sciences

Vertical estimate of Saharan dust mass concentrations derived by ground-based lidar observations in synergy with airborne in-situ measurements

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Abstract: The vertical distribution of dust plays a significant role in climate-related issues, in particular those associated to its atmospheric radiative forcing. Canary Islands offer a suitable site for dust monitoring as located downwind of the Sahara desert. Hence, the arrival of dust plumes are frequent in this area, mainly in summertime and extended up to high altitudes, forming the Saharan Air Layer (SAL). The AMISOC-Tenerife (AMISOC-TNF) campaign was planned as a multi-instrumented campaign carried out from 01 July to 11 August 2013 over Tenerife area (Canary Islands) to study, in particular, the dust impact with a special emphasis focused on dust profiling. This study reflects the synergy of multi-platform in-situ and remote sensing techniques to derive both the verticallyresolved optical and microphysical properties of the SAL. Among those characteristics are examined vertical aspects (layered structure, top height) of the dusty episodes, as well as other dust features (Free-Troposphere dust contribution, Lidar Ratio frequency, particle fine/coarse mode predominance). In addition, the Mass Concentration of dust particles, in relation with their radiative impact factor, can be estimated in terms of the Mass Extinction Efficiency (MEE), a measure of the aerosol effectiveness on solar radiation, relating both optical and microphysical properties. A previous work (Reid et al., J. Geophys. Res., 2003) showed the study of vertical profiling of dust during the PRIDE campaign, devoted to the long-range transcontinental transport of Saharan dust particles over the Caribbean region. Our study is mainly focused on the first detection of Saharan dust particles over Tenerife after their short-range transport from Africa. The aim of this work is twofold: (1) to discuss lidar retrievals of optical properties and airborne in situ measurements of microphysical properties, and (2) to illustrate the potential of combined lidar and airborne observations to estimate the height-resolved Mass Concentration of Saharan dust particles.

Keywords: Airborne measurements, LIDAR, Saharan dust

VIII WLMLA Topic: Synergy between lidar and others instruments

Wind LiDAR profiler performance in the northeast coast of Brazil

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Abstract: The increasing use of wind lidar profilers for wind energy applications is noticeable as turbines are reaching up to 200m height, where meteorological towers are no longer cost-effective. Several lidars have been validated with standard cup anemometers around the world, both at on-shore and offshore sites. This work uses a lidar profiler installed in the northeast coast of Brazil. The database covers a one-year measurement campaign, from September 2013 to August 2014. High environmental temperature, strong marine condition over the coast and the poor aerosol content from ocean fetch were some of the challenges faced in this experiment. The present paper aims to analyze the performance of middle-range lidar wind profiler, up to 500m, in Pedra do Sal Wind Farm. The results shows that the poor aerosol content in the local atmosphere affects strongly the heights above 400m. The data recovery is 66% up to 400m. In the other hand, above 400m the recovery rate reduces to 28.7 % for the one-year data. The rain season also affects the measurements along the year, where the data recovery varies from 99.8% in the dry season to 50.8% in the rainy season at 220m height, which is the laser focal point. In conclusion, the lidar performance is limited by site-specific conditions such as rain, dust and poor aerosol content in order to attend the MEASNET recommendations, where at least 90% of one-year data available is required for wind energy assessment.

Keywords: Wind Energy; Wind Profiler, Doppler LiDAR, Validation, Data filtering

VIII WLMLA Topic: Lidar applications in environmental sciences

Observation and characterization of the transcontinental aerosol transportation from Africa to South America continent – Introducing a new Lidar system to LALINET

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Abstract: Saharan mineral dust can affect the environment and climatic processes from the Western Africa, Europe and the Eastern region of Americas due the large carrying processes of dust aerosol. This type of aerosol can interact with the incoming energy from the Sun and alter radiation budget of the Earth-atmosphere system. Dust particles can also change the cloud lifetime and albedo; they can induce precipitation and indirectly influence the convective clouds height. Several studies have been conducted to understanding the physical and optical properties of dust particles, using systems onboard satellites, airborne or ground-based instruments. However, most of the studies were focused on African, European or North America regions. In order to fill the "scientific knowledge gap" in the South America region it has been developed a new lidar system to study the transcontinental transportation of dust aerosols from Sahara region to South America. The project has as objectives monitoring the dust aerosols transportation seasonality, their vertical distributions in the atmosphere, their physical and optical properties and their influences on the radiative budget. For this task, a four-channel ground based lidar for aerosol profiling, including polarization, is being deployed at the city of Natal, in the North-Northeast region of Brazil. In this study, we present a review of the project current instrumental status, instrument technical specification, the potential results to be obtained and the entire performance test to be done in order to introduce the new lidar system into Latin American Network – LALINET according to procedures developed by Guerrero-Rascado et al 2014.

Keywords: lidar, dust aerosol, transportation, technical specifications, LALINET

VIII WLMLA Topic: Special Section on Aerosol long-range transport

The Caribbean Test-bed for Saharan Dust Long and Short Range Transport

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Abstract: Every year, hundreds of Tera-grams of dust are transported from Africa across the Atlantic to the Caribbean/Central America and neighbors South and North America regions. That amount of aerosols, commonly known as Saharan dust, impacts the climate, weather and human activity. Notable progress have been achieved recently in the characterization of the large spatio-temporal scale main features of the Saharan dust long range transport to the Americas, making use of instruments onboard satellites (ex. MODIS and CALIOP). However, several key scientific questions remain to be answered at that large spatio-temporal scale and much more at medium and lower spatio-temporal scales. Based in the experience acquired during the last decade in the build-up of LALINET (Latin America Lidar NETwork) and in the knowledge and scientific capacity that it has been accumulated, here we propose to create "The Caribbean Test-bed for Saharan Dust Long and Short Range Transport". It will be established based in the regional and international cooperation. However, in its first stage it could be developed making use of the local existing scientific instruments, personnel and expertise, mainly using sun photometers and direct solar radiation instruments located in the Caribbean region. Further steps will include setting up new sun photometers and lidars, in cooperation with LALINET, RIMA and AERONET. Examples of the existing local resources for research at different scales and its potential use will be demonstrated to support the proposed test-bed.

Keywords: lidar, dust aerosol, transport, LALINET, RIMA, AERONET

VIII WLMLA Topic: Special Section on Aerosol long-range transport

Use of WRF model for aerosols transport simulations originated by biomass burning inside and outside of Cuba

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Abstract: In order to simulate the transport of aerosols produced by biomass burning within and outside Cuba, the WRF-CHEM Model has been employed. The model was configured with two domains, for the Caribbean region and for Cuba. Emission data are taken from the site http://web3.acd.ucar.edu/acresp/dc3/finn-data.shtml (Fire Inventory of NCAR Data) and meteorological data are taken from the site http://nomads.ncep.noaa.gov/, (GFS Model, NOAA). Two case studies are shown that reflect the advection of aerosols produced by burning vegetation on Cuba.

Keywords: aerosols; transport; emission

VIII WLMLA Topic: Special Section on Aerosol long-range transport

Intercomparison of the Lidar systems operated during GoAmazon 2014/15 experiment

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Abstract: The main goal of the GoAmazon 2014/15 experiment is to measure and understand the factors affecting aerosol particles over a tropical rain forest, especially the effects of anthropogenic pollution plume from Manaus as a perturbation to natural state of the pristine forest surrounding the city. A combination of in-situ and remote sensing measurements, both ground and air-borne based, is being used for this purpose. During the second intensive operating period (IOP2), from 15-Aug to 15-Oct-2014 three lidar systems operated simultaneously in different experimental sites. The first is the UV Raman lidar from IF-USP , which is running operationally since 2011 at site T0e (2.89ºS 59.97ºW) 30 km upwind of Manaus. The second is the IR Micropulse Lidar (MPL) of the ARM mobile facility installed at site T3 (3.21°S; 60.59°W) 80 km downwind of Manuas and measuring polarized elastically backscattered light since 1-Jan-2014. The third was the mobile visible Raman lidar system from IPEN operated during IOP2 at site T2 (3.13°S, 60.13°W), just across the Negro river 5 km downwind of Manaus. The mobile lidar system was brought to operate side by side with the other two lidar systems for two days in each site. This allowed for an intercomparison between the instruments measuring the same atmospheric profile and for accessing the differences in the measurements of these systems. In this paper, we show the results from this intercomparison for the range-corrected raw signals, backscattering coefficient profiles and cloud properties, taking into account the different laser wavelengths, and instrumental characteristics.

Keywords: lidar, aerosol particles, backscattering coefficient

VIII WLMLA Topic: Lidar technologies and methods

Comparison of atmospheric optical properties retrieved by CMAX-DOAS and LIDAR measurements at Concepcion, Chile

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Abstract: The LIDAR-CEFOP Observatory is operating with complementary instrumentation for measuring atmospheric aerosol optical properties, e.g. elastic and Raman Lidar system, sunphotometer and CMAX-DOAS (Concurrent Multi AXis Differential Optical Absorption Spectrometer). The CMAX-DOAS technique uses the differential absorption structures of the oxygen collision complex (O_2-O_2 or O_4) in the visible wavelength region to derive aerosol information and due to no absolute radiometric calibrations are generally needed, the CMAX-DOAS is suitable for conducting long-term automated measurements, providing further information of aerosols and trace gases. In this work, the aerosol extinction coefficients (α_a) retrieved at 532 nm by the CMAX-DOAS and elastic Lidar systems measurements at Concepcion (Chile) are presented. The comparison of α_a profiles was done from measurements performed at November 11th, 2014, a clear sky day at the end of austral spring. The Lidar system has the overlap height at 170m, the results obtained shows that the CMAX-DOAS provides an efficient information about aerosol properties in the lower troposphere closer to ground level. Moreover, this work shows the good agreement and complementarity between both remote-sensing systems.

Keywords: aerosol properties, lidar, differencial absorption, spectrometry

VIII WLMLA Topic: Lidar Technologies and methods

Active-Passive Instrument Package Definition for Advanced Earth Resources Monitoring

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Abstract: Climate changes occurring at global scale are severely affecting the Earth resources. Increasing occurrence of unpredicted extreme meteorological events and natural disasters are raising increasing concern on health and evolution of Earth Biosphere and in particular Earth food resources and state and distribution changes of vegetation. Today more than ever there is an increasing need for an efficient and world-wide coordinated effort to monitor, study and predict these changes and their impact on life. Ground-based, airborne and Spaceborne observations play a crucial role for this effort. Taking into account recent understanding and updated observational requirements, in this paper it is proposed an instrument package consisting of a multi-spectral high resolution lidar operating with a multi-frequency Nd:YAG/ OPO transmitter, and a multi-spectral imaging spectrometer receiver operating in the UV-VIS, NIR and SWIR atmospheric channels. The paper will provide the design definition of this instrument suite together with the observational capabilities for Biosphere vegetation study and monitoring. This package can operate self-standing in support to local resource planning and management or be part of an international, coordinated campaign.

Keywords: vegetation lidar; spectrometry, climatology

VIII WLMLA Topic applicable: Lidar Technologies and methods

Disentangling the Manaus pollution plume from the biomass burning plume during the second GoAmazon 2014/5 Intensive Operating Period (IOP2)

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Abstract: The Green Ocean Amazon experiment (GoAmazon2014/5) seeks to understand how aerosol and cloud life cycles are influenced by pollutant outflow from a large industrial city in the tropical rain forest, particularly the susceptibility to cloud-aerosol-precipitation interactions and the feedbacks among biosphere and atmosphere functioning and human activities. For this purpose, six research sites were setup at different distances upwind and downwind from Manaus, in the central Amazon forest, and three of these have vertical profiling capabilities. A micropulsed lidar (MPLnet) from DOE/ARM is being operated at T3 site (3.21°S 60.59°W), 60 km downwind to the west of Manaus. A portable Raymetrics aerosol raman lidar from IPEN/SP was operated T2 site (3.21 ºS 60.60 ºW, 5 km downwind) during the second Intensive Operating Period (IOP2), and measures directly the emissions from Manaus. The third system is the UV Raman lidar from the University of Sao Paulo, continuously operated since 2011 at T0e (2.89 ºS 59.97 ºW), an upwind site 10 km to the east. T0e serves as a reference station, as the air masses there are not influenced by the local urban emissions. Using these three lidar systems and the AERONET stations at T3 and T0e, the scattering and absorption properties of the Manaus and biomass burning plumes were investigated. The measurements were conducted during the biomass-burning season, from August 15 to October 15 2014. Scattering aerosol optical thickness varied from 0.1 to 1.5, with a regression coefficient of 0.980.02, showing similar scattering properties at T0e vis-à-vis T3 and thus little influence of the Manaus plume. For the absorption AOD, however, values ranged from 0.05 to 0.8 and the regression coefficient was 2.2(2), indicating a much more absorbing aerosol at T3. A similar result was observed in the vertical. The aerosol backscatter profiles from T2 and T0e were remarkably similar, and even small-scale vertical structures of about ~100m inside the biomass burning plume were not destroyed as the air mass travels 36 km over the city and the river. The night-time aerosol extinction profiles, however, showed substantially more absorption at T2 then at T0e although not enough to justify the different absorption AOD. Possible reasons will be explored and discussed.

Keywords: Anthropogenic pollution plume; Biomass Burning; Lidar Ratio; GoAmazon

WLMLA Topic: Lidar technologies and methods

Homogenizing spaceborne lidar missions by addressing depolarization ratio spectral dependence

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Abstract: Under the homogenization concept between CALIPSO, ADM-Aeolus and EarthCARE time series of aerosol datasets, the European Space Agency has conducted studies addressing the wavelength dependence of extinction and backscatter (ESA-CALIPSO, LIVAS, ICAROHS), where multi-wavelength measurements from ground-based networks like EARLINET and AERONET were used. However, none of these studies managed to tackle correctly the depolarization wavelength dependence issue due to the limited datasets available for this purpose. So far, none of the EARLINET stations provides polarization observations at more than one wavelength on a regular basis. Sparse multi-wavelength measurements are available from ground-based lidars mainly during experimental campaigns, coming however from different measurement techniques and systems with mostly large uncertainties (Groß et al., 2011). Moreover, ground-based lidar systems only measure the linear particle depolarization ratio. This gap will be filled by analyzing high-quality dual-depolarization measurements collected in Charadmexp and apply conversions to CALIPSO data in order to derive a global climatology at 355 nm as this has been defined in ESA-LIVAS.

Key words: spaceborne lidar missions, depolarization, lidar, aerosol

WLMLA Topic: Lidar technologies and methods

Comparison of the hygroscopic behavior of aerosols obtained by Raman LIDAR and nephelometry – the NASA Discover-AQ experience

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Abstract: The hygroscopic behavior of aerosols is of great interest in the recent decades because of the importance in computing the radiative forcing of aerosols in the energy balance of the planet. The last report of the IPCC in 2013 shows that the uncertainty associated to the interactions between aerosols and clouds is high, and more research in this area is needed in order to give more information about the indirect effect of aerosols.

The LIDAR (Light Detections and Ranging) is a technique that can be used to study the hygroscopic growth of aerosols under varying relative humidity conditions, and the main advantage of the technique is the possibility of studying the hygroscopicity next to the saturation in an unperturbed atmosphere.

During the NASA Discover-AQ in 2011, a Raman LIDAR operated at the Howard University in Beltsville, United States, at the same time a nephelometer inside an airplane was sampling the same aerosol population. Then, the hygroscopic growth factor of the aerosols was computed using both instruments, and the results are now being compared.

In this work, the result obtained by the LIDAR will be shown and compared to the nephelometer results obtained by Ziemba et al (2013) for 05 July 2011. The different methodologies adopted are explained and discussed. The good agreement between both instruments shows LIDAR is a promising technique in this field of study.

Keywords: hygroscopicity; Lidar; Nephelometer

VIII WLMLA Topic: Lidar applications in environmental sciences

Comparison and merging of ozone profile data from lidar and other measurement techniques at NDACC Alpine station

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Abstract: Within the Network for the Detection of Atmospheric Composition Changes (NDACC), various remote sensing techniques are used in addition to in situ ozone sounding measurements for the long-term evaluation of the ozone vertical distribution. These techniques, using e.g. microwave spectrometers, Fourier Transform Infrared spectrometers or laser radiation (lidars), are very different in terms of vertical distribution, time sampling and precision, which can present some difficulties for the validation of satellite data or the products of the European Monitoring atmospheric composition & climate Service (MACC). Within the European NORS project, we developed a methodology for the integration of profile ozone data from various sources in order to provide consistent ozone vertical distribution time series as well as tropospheric and stratospheric ozone partial columns at various NDACC stations. This methodology was applied for measurements performed in the stations forming the Alpine station (e.g. Haute-Provence Observatory OHP – France, Bern – Switzerland, Jungfraujoch – Switzerland). Ozone measurements from the lidar at OHP, the microwave spectrometer at Bern and the FTIR spectrometer at the Jungfrauch station were used for this purpose.

Keywords: ozone; merging profiles; monitoring

VIII WLMLA Topic: Synergy between lidar and other instruments

Radiative Forcing Effects on Planetary Boundary Layer Evolution in the Tropical Andean Zone, Medellín – Colombia: Synergy Lidar and Sun Photometer

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Abstract: Atmosphere monitoring in the tropical Andean zone, Medellín – Colombia, (6.26 N, 75.58 W, 1471 m.a.s.l.), by using LOA-UNAL station infrastructure: lidar and sun photometer operation since December 2012. The solar radiation affect this urban zone generating fast atmospheric phenomena involving exchange of aerosol until to reach a well-mixed layer, with effects on variability of the PBL heights. The behavior of the PBL heights and its correlation with the effects of the solar radiation is shown in this work, involving products from both elastic lidar and sun photometer NASA-AERONET.

Keywords: Radiative forcing; PBL; Lidar

VIII WLMLA Topic: Synergy between lidar and others instruments

Synergy between multichannel Raman Lidar system and spaceborne remote sensing platforms applied to study aerosol optical properties at Metropolitan Area of São Paulo – Brazil

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Abstract: In the last decades, several remote sensing platforms, i.e., spaceborne, aircraft and ground-based measurement systems have been developed or improved to conduct studies of aerosol and cloud optical properties on local and global scales, as well as to provide the scientific basis for understanding the Earth's climate system. The combination measurements between spaceborne sensors and ground-based instruments can helps to provide a better understanding about the impact of aerosols on air quality and in the climate changes inside large cities. The Metropolitan Area of São Paulo (MASP), one of the largest megacities in the world, frequently suffers with problems related to the air quality. Concerned with the pollution scenario of MASP, several measurement campaigns were conducted since 2012, specially, during the South hemisphere winter, period when the low temperatures and the low level of precipitation contribute to the poor dispersion of aerosols. A multichannel Raman Lidar system and air quality monitoring stations from University of São Paulo and Environment Agency of São Paulo State (CETESB) were employed in order to monitor the increasing of aerosol load in the atmosphere. Satellite data from CALIPSO and AQUA were applied to draws the pollution scenario and the most frequent aerosol type at MASP. This study intend to present how the synergy between ground-based monitoring and satellite data can helps to improve the studies the effects of particulate matter concentration in the air quality of MASP and the influence of aerosol from biomass burning advected from large range distance of South American continent.

Keywords: Lidar; air quality; particulate matter, AOD, CALIPSO, MODIS

VIII WLMLA Topic: Synergy between lidar and others instruments

Multi-wavelength Depolarization and Raman lidar and High Spectral Resolution Lidar setup and modelization at the Argentinean Aerosol Monitoring Stations

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Abstract: The Argentinean Aerosol Monitoring Network Project in which several lidars for aerosol research were installed, started on February 2012. The grant MD31554/11 provided by the Ministry of Defense gave the opportunity to design, build and transport these systems to their final locations. Since their operation they have been providing valuable information about the presence of volcanic ashes, dust and other kind of aerosols to the civil aviation while being operated by the National Weather Service. The stations are composed by a multi-wavelength lidar and several aerosol-monitoring instruments as sun-photometers, nephelometers and radiometers, and they have been growing in number reaching 5 stations in 2014. These stations are placed at the main international airports in Patagonia and in Buenos Aires. In addition to these stations high spectral resolution lidars are being designed in close collaboration with the National Institute for Environmental Studies from Japan which is related to CEILAP and Universidad de Magallanes, Chile by the first tri-national research program of Japan of "Science and Technology Research Partnership for Sustainable Development" (SATREPS). This work describes the lidar instrumentation, models the behavior of the optical design in normal operating conditions but also studies the effects of any possible misalignments of the units. Finally it also shows how the effects of these misalignments affect the lidar observations and the results of the proposed tests requested in the frame of the system validation of the Latinamerican Lidar Network.

Keywords: Lidar Network; Lidar Modelling; Volcanic Ash, HSRL

VIII WLMLA Topic: Lidar Networking, Regional and international cooperation in lidar technologies

Contribution of EARLINET/ACTRIS to the summer 2013 Special Observing Period of the ChArMEx Project

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Abstract: In the framework of the ChArMEx (Chemistry-Aerosol Mediterranean Experiment, http://charmex.lsce.ipsl.fr/) initiative, a field campaign took place in the western Mediterranean Basin between 10 June and 5 July 2013 within the ADRIMED (Aerosol Direct Radiative Impact on the regional climate in the MEDiterranean region) project. The scientific objectives of ADRIMED are the characterization of the typical "Mediterranean aerosol" and its direct radiative forcing (column closure and regional scale). At three sites, in Ersa (Corsica Island, France), Granada (Spain) and Lampedusa Island (Italy), a complete set of instruments were operated to measure in-situ aerosol physical, chemical and optical properties. Aerosol mixing state and vertical distribution, as well as radiative fluxes were also measured. At a third site, in Menorca (Spain), aerosol optical properties and vertical distribution were measured. The ground observations were supported by airborne measurements: the ATR-42 (10 June – 5 July) and the Falcon-20 (17 June – 5 July) equipped with a lidar. Whenever it was possible, extra measurements were carried out by the EARLINET/ACTRIS (European Aerosol Research Lidar Network / Aerosols, Clouds, and Trace gases Research InfraStructure Network, http://www.actris.net/) lidar stations. In several occasions corresponding to aerosol loads of different types (including desert dust, sea salt, smoke and pollution) the aircraft flew near EARLINET/ACTRIS lidar stations: near Barcelona and Granada on 16 and 17 June, near Barcelona on 18 and 27 June, near stations in southern Italy (Potenza, Naples, Lecce, Serra La Nave) on 22, 23, 28 June and 2 July. After a general description of the ChArMEx project, the presentation will focus on the cases covered simultaneously by ChArMEx airborne and EARLINET ground-based lidar measurements

Keywords: international field campaign; aerosol optical and radiative properties; Mediterranean region

VIII WLMLA Topic: Lidar Networking and Regional and international cooperation in lidar technologies

LALINET a.k.a. Activities

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Abstract: The LALINET network activities will be given focusing on the lidar station characterization in the network, the efforts given to standardize the algorithms as weel the main scietific drives for data collection.

Keywords: LALINET, network, lidar

VIII WLMLA Topic: Regional and international cooperation in lidar technologies

Posters

Evaluation of the Atmospheric Boundary Layer behavior

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Abstract: We will show the results obtained from backscatter profiles taken with a lidar system located at Cota-Cota, La Paz-Bolivia (16.5ºS, 68.1ºW, 3420masl). The profiles were processed with the algorithm developed for determining the thickness of the Atmospheric Boundary Layer (ABL). This algorithm use wavelet transforms to estimate the thickness and location of the ABL. The results correspond to profiles taken every Monday for two hours over the last two years (2013-2014). They show the behavior of the ABL in different seasons and different weather conditions. In addition, to improve the understanding of the behavior of the boundary layer in this region, wind profiles, potential temperature and specific humidity obtained from radiosondes released at the time that lidar was in operation is shown.

Keywords: lidar, radiosonde, Atmospheric Boundary Layer (ABL)

VIII WLMLA Topic: Lidar applications in environmental sciences

Algorithm for the Determination of the Optical Depth and Lidar Ratio of Cirrus Clouds by Elastic Lidar Measurements

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Abstract: We present an algorithm for determination of cloud optical depth and average extinction-tobackscattering ratio (lidar ratio) of cirrus clouds from the elastic backscatter vertical profiles measured by lidar systems. The cirrus optical depth can be obtained from the transmission factor of the lidar equation for elastic backscattering by the evaluation of the attenuation caused in the lidar signal due to cirrus cloud. This method is known as the transmittance method, and requires no previous information of the lidar ratio of the cirrus cloud. An average value for the lidar ratio of this cloud can then be estimated by comparing the optical depth obtained by the transmittance method and the optical depth obtained by integrating the cloud extinction coefficient profile obtained by Klett-Fernald method, assuming that the optical depth by the two methods are equal when the true value of the lidar ratio of the cirrus cloud is used as input to the Klett-Fernald method. In order to validate the methodology, we performed computer simulations os cirrus clouds with COD varying from 0.01 to 0.4, and LR varying from 10sr to 40sr. The RMS error of the retrived COD and LR depends mostly on the lidar signal-to-noise ratio. As an application, we will present and discuss COD and LR obtained when applying the algorithm to cirrus clouds measured by a ground based lidar system in the Amazon forest region.

Keywords: Klett-Fernald method, lidar ratio, cloud extinction coefficient

VIII WLMLA Topic: Lidar applications in environmental sciences

Comparing CALIPSO and ground-base measurements of clouds at Camagüey

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Abstract: The Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) aboard the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) satellite provides a new view of cloud properties data with high resolution around the World, especially semitransparent and optically thin clouds. Assessment of this useful data comparing with data from ground-base measurements is very important for increasing the knowledge about clouds and their representation in climate models.

In this paper Cloud Optical Depth (COD) lower than 5 from level 2 version 3.01 cloud profile data of CALIPSO [2006-2014] measurements is compared with COD <5 obtained from AErosols RObotic NETwork ground-base sun photometer (AERONET)[2010-2014]. Cloud frequency was also computed for each datasets as a ratio between cloud measurements and all possible measurements made for each instrument.

Coincident and general comparison using CALIPSO COD values falling within 20 km and 100 km respectively of maximal distance from AERONET sun photometer was conducted. For Coincident (20 km) comparison visual clouds reports were used. We look for cirrus clouds with long time duration because of the time lag between AERONET and CALIOP measurements.

Both COD distributions have differences especially in the bins centered at 0.1 and 0.2 of COD values. Monthly characteristics were compared for both datasets, showing there are differences between all months, April has the best agreement. Annual Cloud occurrence cycle agrees between both datasets, showing the pattern of the cloudiness characterizing the region and seasonality, being stronger from CALIPSO data. Only two coincident cases for both datasets were found showing higher COD values for AERONET.

Keywords: CALIPSO; AERONET; Cloud Optical Depth

VIII WLMLA Topic: Lidar applications in environmental science

Angular Response Calibration System for Solar Radiation Instruments coupled to a Digital Galvanometer

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Abstract: With the objective to determine the correction sun altitude factor for the pyranometers used in the measurements of Solar Radiation Diagnostic Service for Cuba (SDRS, htpp://www.goac.cu/actino/), an Angular Response Calibration System, for solar radiation sensors, has been installed in the Atmospheric Optics Group of Camagüey (GOAC). The installation of this system, unique of its kind in the country, has been possible through a collaboration project with the Atmospheric Optics Group of Valladolid University (GOA-UVA). For the use of this system, has been necessary design and construct both, a power source for the halogen lamp used in the calibration procedure, as well as a digital galvanometer to collect data measurements. The last one instrument is coupled to the sensors during the calibration process, and will be replicated in order to substitute their analogic homologues in the SDRS.

Keywords: Angular Response; solar radiation sensors; correction sun altitude factor; pyranometer; calibration; digital galvanometer

VIII WLMLA Topic: Remote Sensing applications

Determination of the Broadband Aerosol Optical Depth Baseline and comparison with sunphotometer data

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Abstract: The Broadband Aerosol Optical Depth (BAOD) was calculated for Camagüey Actinometric Station (EAC) using the methodology described by Gueymard (1998). The main source of data used was the Solar Radiation Database of EAC (for 1981-2013 period). The BAOD calculation was performed for observations with total cloud coverage equal or less than one tenth of sky (Clear Sky, HCD) and for actinometric observations with *Squared Sun* solar disk. To determine the BAOD Baseline the periods of *El Chichón* and *Pinatubo* volcanic eruptions were eliminated. The average value of BAOD for the entire period and for aerosol background conditions is 0.115 (± 0.075) with a decreasing trend equal to -1.20×10^{-6} day^{-1}. The results were compared with spectral AOD values obtained from a sunphotometer near the station. The highest correlation values were obtained for the wavelengths of 500 and 675 nm, with an $R^2 = 0.45$ for both cases.

Keywords: aerosol optical depth; solar radiation; sunphotometry; actinometric station; clear sky

VIII WLMLA Topic: Remote Sensing applications

Cloud camera design using a Raspberry Pi

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Abstract: The design and assembly of low cost all-sky camera for clouds detection is presented. The instrument comply with all the requirements currently established for this type of instrument. Under the conditions of Cuba it is impossible to acquire such a device which costs between $ 600 and $ 3500 USD. Using a Raspberry Pi, its camera module with a CCD sensor and a unipolar stepper motor (recovered from a discontinued matrix printer) we have built a sky camera for less than $ 300 USD. The Raspberry Pi, using free software and hardware, will control and conduct the operation of the camera, the image capturing, the processing and the transmission of the latter results. Among the advantages provided for this device stand objectively determining the percentages of sky covered by clouds, the ability to archive images taken for potential future reprocessing, the classifications of clouds according to the attenuation of solar radiation they produce, among others. All this advantages will be achieved with an instrument of very low cost, allowing access to this technology for both research networks and meteorological services in poor countries.

Keywords: all-sky camera, raspberry pi, cloud camera

VIII WLMLA Topic: Remote Sensing applications

Surface albedo Climatology at actinometrical Camagüey Station

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Abstract: Employing 30 years of solar radiation dataset from Camagüey Actinometric Station, the surface Albedo Climatology was determined for two solar disk state (Sun and Squared Sun). The obtained mean value for all period is 0.211 with a median 0.209 and standard deviation of 0.0422. To determine this climatology has been employed the WMO Guide to Climatological Practices. The employed dataset has been subjected to a meticulous quality control process, taking into accounts the criteria of Baseline Surface Radiation Network (BSRN). The annual and multiannual means was established, as well as, the monthly and hourly mean values for all sample. The frequency distribution was determined for different combination of active Surface and their relation with albedo values.

Keywords: Surface albedo, solar radiation, BSRN, actinometric stations

VIII WLMLA Topic: Remote Sensing applications

Assessment and improvements of STRAT applied to ceilometer measurements for non-supervised atmospheric classification

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Abstract: Identification of different layers affected by clouds or aerosols in the atmospheric column is relevant in the atmospheric research. Lidar and ceilometer systems can be used to this aim. In this sense, *Morille et al.* [2007] developed the STRucture of ATmosphere (STRAT) software for classifying the atmosphere in a non-supervised way using single-wavelength vertical backscatter signal from lidar or ceilometer. In this work, an assessment of STRAT using ceilometer measurements is performed and some improvements are checked. Measurements were performed with a Jenoptik CHM 15k ceilometer at the Granada EARLINET station (Granada, Spain). First, the appropriate values of the user-defined STRAT thresholds were optimized through the comparison of STRAT results with correlative lidar measurements. Second, some improvements were included in order to solve misclassification problems associated the low signal-to-noise ratio of ceilometer data. Our results show that the use of automatic algorithm for atmospheric classification is very useful to retrieve atmospheric structure information in ceilometer networks with affordable cost.

Morille, Y., M. Haeffelin, P. Drobinski and J. Pelon (2007), STRAT: An automated algorithm to retrieve the vertical structure of the atmosphere from single-channel lidar data, *J Atmos Ocean Tech*, *24*(5), 761-775.

Keywords: atmospheric classification; ceilometer; atmospheric aerosol

VIII WLMLA Topic: Lidar applications in environmental sciences

First Attempt to Assess Aerosol-Cloud Interaction by Elastic Lidar at the EARLINET Granada Station

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Abstract: As the recently published IPCC 2013 claims, aerosol-cloud interaction (ACI) is still far from being completely understood. Among other reasons this is due to the intrinsic complexity of the involved atmospheric components and also instrumental limitations, such as the absence of temporal and/or spatial coincidence of aerosol and clouds datasets. To overcome this traditional drawback, elastic lidar technique is used in this work. Here we focus on quantifying the influence of the relative position between aerosol and cloud layers on ACI. For this aim, the pre-existing database of lidar profiles recorded at the EARLINET Granada station (Spain) between 2007 and 2014 has been considered. The aerosol/cloud integrated backscatter coefficient retrieved from elastic lidar signals at two wavelengths, namely 532 and 1064 nm, has been used as the proxy to investigate ACI. In spite of the difficulty to distinguish between cloud and aerosol boundaries in the so-called twilight zone, significant correlation between aerosol and cloud proxies (0.86 and 0.76 at 532 and 1064 nm, respectively) is still observed when aerosol and cloud layers are relatively close to each other (distance < 250m). Even though a wide period was considered, our study highlights the need for specific protocols to measure ACIs.

Keywords: aerosol; clouds; EARLINET; elastic lidar; interaction; interaction distance

VIII WLMLA Topic: Lidar applications in environmental sciences

Retrieval of particle microphysical properties for different aerosol types with LIRIC algorithm

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Abstract: This work presents a characterization of three different aerosol types in terms of their microphysical properties, for several events registered at the EARLINET Granada station (37.16º N, 3.61º W, 680 m asl) during July 2013. A preliminary analysis of the aerosol optical properties, presented in previous works, has been used to make a classification of the aerosol types forming the detected plumes. Backward trajectories analysis with HYSPLIT model to identify the origin of the air masses arriving at our station and modeling tools as NAAPS and BSC-DREAM8b have been used as ancillary information. According to those data, the presented cases correspond to mineral dust particles coming from Sahara Desert, biomass burning particles transported from Canadian forest fires, and mixed layers containing anthropogenic pollution. The study has involved lidar data processing for both Raman and elastic lidar signals and also combined analysis of sun-photometer AERONET data and elastic lidar signal using LIRIC algorithm. The results evidence a large concentration of fine mode particles in the biomass-burning aerosol layers, whereas for Saharan dust layers, the largest concentration values were obtained for the coarse mode, in particular for the non-spherical fraction. Layers with anthropogenic or with mixed aerosol layers were found to exhibit a hybrid behavior.

Keywords: AERONET; Anthropogenic; Biomass Burning Particles; EARLINET; Lidar; LIRIC; Saharan Dust; Sun-Photometer

VIII WLMLA Topic: Synergy between Lidar and others instruments

Continuous observations with multi-parameter lidars in Asian Dust and aerosol lidar observation Network (AD-Net)

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Abstract: Asian Dust and aerosol lidar observation Network (AD-Net) is a lidar network for continuous observations of dust and other aerosols in East Asia. A two-wavelength (532 nm and 1064 nm) polarization-sensitive (532 nm) Mie-scattering lidar is operated at 20 stations as the standard lidar system of AD-Net. Using the backscattering coefficient and depolarization ratio, extinction coefficients are estimated for non-spherical (dust) and spherical aerosols. In several years, continuous observations with advanced multi-parameter lidar systems are conducted for better estimation of aerosol optical properties. A Nitrogen vibrational Raman scattering channel (607 nm) was additionally set to the standard lidar system at primary 6 stations to obtain extinction coefficients at 532nm during nighttime. At Tsukuba in Japan, we started continuous observation with a three-wavelength (1064 nm, 532 nm, and 355 nm) polarization-sensitive (532 nm and 355 nm) lidar. This lidar has a high-spectral-resolution receiver with an iodine filter at 532 nm and a Raman channel at 387 nm. Furthermore, continuous observation with a multi-wavelength Raman lidar was started at Okinawa and Fukuoka in Japan. The multi-parameter lidar data will be used for aerosol component analysis and data assimilation in chemical transport models.

Keywords: lidar network; aerosol; high-spectral-resolution lidar

VIII WLMLA Topic: Lidar Networking, Regional and international cooperation in lidar technologies

Development Atmospheric Spectro-radiometry as a Support Technique to the LOA-UNAL Activities

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Abstract: Remote sensing systems have the ability to obtain information from a far object. This concept may be applied to atmospheric study related to air quality, aerosols transport, and the climate. In the LOA-UNAL has development a singular automatic Spectroradiometer (EPR-LOA) system, which has been incorporated to the LOA-UNAL activities. In this paper, we shown the first results of solar spectrum registered over Medellín city (6.26°N, 75.58W, 1471 a.g.s.l) covering range from 250 nm to 700 nm, and the first attempt for obtain the AOD for the two lidar wavelengths: 355 nm and 532.

Keywords: Spectroradiometer; Aerosol optical depth; Lidar

VIII WLMLA Topic: Synergy between lidar and others instruments

Intercomparison of wind data observed with Wind Doppler LIDAR and SODAR at Ressacada, Florianópolis-Brazil

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Abstract: Nowadays, remote sensing equipment has long been used for various studies related to atmosphere. When wind speed issues are discussed, the Wind Doppler LIDAR and SODAR deserve to be highlighted due to high vertical resolution of both and the high data acquisition rate. This equipment has been very applied in academic studies for environmental issues and also in the industry as wind power projects and airport security. Though each has its limitation, they enable different types of studies, which range from the observation of the vertical wind profile until the detection of turbulent phenomena. The main objective of this work is to do an intecomparison between these two technologies. For this study one measurement campaign was conducted in Florianópolis (Santa Catarina State - Brazi) and a case study will be presented, where were employed a Wind Doppler LIDAR WL70 Leosphere operating with wavelength of 1.5 μm and maximum range of 1,500 meters and a SODAR MFAS SCINTEC with maximum range of 800 meters. It will be held: a statistical analysis in relation to the wind velocity and wind direction values, analysis of the turbulence and detection of PBL (planetary boundary layer) height. Both devices will be validated by atmospheric sounding data from the airport near the study area. From the results of this work are expected to find consistent values of correlation between the two devices and demonstrate its wide applicability, although each one have your different limitations, in the various areas of knowledge.

Keywords: Wind Doppler Lidar, planetary boundary layer, turbulence

VIII WLMLA Topic: Synergy between lidar and others instruments

Strong temperature gradients in the MLT region associated to an instability source

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Abstract: Na Lidar temperature measurements, covering the range 82 – 105 km, have been made since 2007 at Sao Jose dos Campos (23.1 ° S, 45.9 °W). We have studied vertical wind shear related to atmospheric tides, inferred by meteor radar, with the aim of analyzing instability generation. We have found that wind shear alone is not enough to trigger an instability. A strong temperature gradient of at least -8K/km is required concomitantly with the wind shear in order to generate the instability. We have used two years of data from 2007 to 2008 with 28 days of simultaneous wind and temperature, totalizing 148 hours of observation. We observe several cases of strong temperature gradients and tidal wind shear. This is evidence of a possible local Gravity Wave source in the Mesosphere Lower Thermosphere region.

Keywords: Na Lidar temperature measurements, instability

VIII WLMLA Topic: Lidar applications in environmental sciences

Development of a Multispectral Raman and Fluorescence lidar to study the atmospheric aerosols chemical composition

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Abstract: The Lidar Division of CEILAP is developing a lidar (Light Detection and Ranging) to study the chemical composition of atmospheric aerosols in Argentinean Lidar Network. The instrument works with fluorescence, elastic and inelastic scattering in order to characterize the atmospheric particles in real time and with high spatial, temporal and spectral resolution. The transmission system is implemented by a Nd:Yag laser which emits in its first three harmonics (1064, 532 and 355 nm) at 10Hz. Reception is performed with two Newtonian telescopes. The main telescope has 50 cm diameter area and it is used to collect the fluorescence and Raman backscatter in coaxial arrangement with the laser beam. The second telescope has 20 cm diameter and it is used to recover Rayleigh and Mie backscatter in biaxial setup, with 532 nm orthogonal polarization. The Raman and fluorescence signals generated by laser interaction (532 or 355 nm) with the molecules composing atmospheric aerosols are processed with a multispectral acquisition system. The multispectral device consists of a Crossed Czerny-Turner spectrometer, a 32 channels hybrid photomultiplier and a photocount detection system which works at 15 m spatial and 4.5 nm spectral resolutions. This method allows to recover Raman and fluorescence spectrum within the atmospheric boundary layer and the first kilometers of the free atmosphere with temporal resolution better than an hour. The instrumental setup and the first aerosol studies in Buenos Aires region are presented and discussed.

Keywords: aerosol, Raman, fluorescence, lidar

VIII WLMLA Topic: Remote Sensing applications

Retrieval of the Temporal and Spatial Aerosol Dynamics Onshore and Inland Using Continuous Ceilometers Data

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Abstract: Continuous Ceilometers measurements of aerosol vertical profiles were performed at two sites in Israel (onshore and 7 km inland) as part of a planned network. Israel is on the Mediterranean eastern side (29-33°N) close to southern desert belt. It has winter & summer with short passage periods. The Ceilometer is a microLidar developed to measure clouds base installed in most air fields and bases. Using their data the international scientific community develops methods to analyze both clouds and less thick layers in high temporal and vertical resolution. Part of the effort is focused on the diurnal and seasonal evolution of the Mixing layer height, since within this layer major part of the pollution is trapped. Measurements show the typical daily patter during the summer, when the growth of the layer due to earth warming in the morning is stopped before noon due to the Mediterranean Sea breeze penetration inland. When the breeze weakens during the afternoon the layer either grows again or remains constant depending on ground temperature. Therefore, the typical "Parabola" behavior of growth and decrease during nights does not exist. This behavior is slightly different in the two sites, due to the higher level of clouds near the shore that suppress the morning and afternoon growth. In contradiction, during dry winter days when easterly winds prevails, there is no sea intervention and the full "Parabola" pattern exists. Dust enters Israel as a dense narrow layer 1 km above sea level and lasts a few hours. Then, due to mixing it decays and forms a thick layer starting from ground with a few higher lobes. This temporal and spatial behavior is important to civil and military authorities. The measurements can be a useful both as and operational tool to test and improve dust model predictions.

Keywords: Micro Lidar, Ceilometer network, vertical aerosol profiles, temporal MLH evolution

VIII WLMLA Topic: Lidar applications in environmental sciences

Long-term inventory of desert dust outbreaks in Palencia site (north-central Spain)

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Abstract: With the aim of knowing the impact of desert dust aerosols over the well-known climatology in the north-center region of the Iberian Peninsula, an inventory of desert dust events has been carried out. The time period of this study covers more than one decade (Jan/2003-Dec/2013), and the two databases used are: the instantaneous values of sun photometric measurements provided by the site of Palencia (Aerosol Robotic Netowork) and the daily values of the particulate matter (PM) provided by the site of Peñausende (European Monitoring and Evaluation Programme network). The inventory of desert dust intrusions includes, mainly: information of each episode and its associated days; the daily values of aerosol optical depth at 440nm (AOD), Alpha exponent and PM under 10 µm (PM_{10}) among others; cloudiness, synoptic scenarios, and origin of air masses back-trajectories.

The methodology employed here is similar to that documented in Toledano et al. (2007), which is based on threshold values of the AOD-Alpha diagram (adapted to the particularity of this region of study, governed by continental clean aerosols), but it has been complemented with the analysis of the PM_{10} (surface data). It has also been taken into account supplementary information as air masses back-trajectories (calculated with Hybrid Single Particle Lagrangian Integrated Trajectory model), synoptic scenarios and Moderate Resolution Imaging Spectroradiometer images. Thereby, the thorough supervision of this information results in this detailed inventory.

As a rule, the detection of a desert dust intrusion is not complicated since background values of AOD, Alpha and PM_{10} change substantially. However, it can be difficult to determine the exact number of days, mainly at the end of the episodes which correspond to mixed aerosols. The classification of pure desert days (D) and mixed aerosol days (DC, Desert-Continental) is also performed in this study.

Once the inventory is established, the monthly climatology, inter-annual variability and desert dust contribution to mean AOD and PM_{10} values have been established for D+DC, D, and DC days. The most relevant aspect of this analysis is the evaluation of desert dust contribution to AOD and PM_{10} values. The contribution climatology shows a bimodal pattern, peaked in March and August, while the desert dust contribution shows a negative trend rate in the period 2003-2013 with pronounced minimums in 2009 and 2013 for both PM_{10} and AOD data.

Keywords: Inventory, Desert dust aerosols, AOD

VIII WLMLA Topic: Remote Sensing Applications

Total water vapour column on the Iberian Peninsula: Satellite vs ground measurements

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Abstract: Total water vapour column (WVC) plays a key role in global warning and climatic change since water vapour is the main greenhouse gas. In order to obtain a global observation of WVC at world-scale, some instruments on board satellites retrieve WVC from their measurements. This is the case of GOME-2 (on board MetOp-A satellite), which provides the GDP-4.6 version of WVC with a pixel resolution of 80 km x 40km. These WVC data present a high coverage, but need validation against reliable ground-based WVC observations.

To this end, the GOME-2 data have been compared with WVC measured at ground by GPS instruments at 21 Spanish locations, covering a big part full Iberian Peninsula. The comparison between satellite and ground measurements has been developed using, among others, the Mean Bias Error (MBE) and Mean Absolute Bias Error (MABE). As a conclusion, and using all available data, the GOME-2 overestimates the ground measurements, obtaining a MBE about 10% and a MABE of 24%. The values of MBE and MABE are found to depend on other variables retrieved by GOME-2 like cloud fraction (CF), solar zenith angle (SZA); therefore these statistical estimators have been also calculated for different CF and SZA conditions. As a result, the best agreement between satellite and ground is found for low SZA values and cloud-free conditions.

Finally, a monthly WVC climatology has been obtained at each location using GOME-2 data, and then it has been compared with the same climatology calculated with GPS data. The monthly WVC climatology of GOME-2 fits better with the GPS climatology for summer months, which have low SZA values and frequently present cloud-free conditions.

Keywords: water vapour, satellite, GPS

VIII WLMLA Topic: Remote Sensing applications

Differences and similarities between surface and columnar aerosol climatology in the Iberian Peninsula

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Abstract: The atmospheric aerosols play a notable influence on Earth's climate and radiative budget, air quality, and human health, among others. Two different techniques have been taken to study and monitor the atmospheric aerosols: remote sensing and "in situ" measurements which do not always evolved together. The primary element to account for the impact of aerosols is its load in the atmosphere, represented by the mass concentration of particulate matter (PMx) at the surface or by the aerosol optical depth (AOD) in the entire column. The aerosol load in the atmosphere depends on both natural and anthropogenic emissions, atmospheric synoptic circulation patterns which govern long-range transport, local meteorology, and topographical characteristic, among others. In order to evaluate the climatology of PMx and AOD for the last decade in the Iberian Peninsula, high quality observations from the European Monitoring and Evaluation Programme (EMEP) and the Aerosol Robotic Network (AERONET) databases are used in this study. Daily PMx and AOD data are analyzed in a large number of sites which are split in five different sectors attending their geographical positions and their aerosol climatology characteristics. The air mass retro-trajectories calculated with the Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) model complete the analysis. Some characteristics are common for the two variables, e.g., larger values during summer and an early minimum in spring. However, there are differences between surface and columnar aerosols which are explained by the climatology of the air masses achieving each sector. The maritime polar and arctic air masses are proved as the main responsible of the aerosol climatology, but the eastern Iberian coast presents a dominant role of the Mediterranean Sea which causes different aerosol climatology. Finally, the southwestern area is clearly governed by desert dust intrusions from North Africa. A linear relationship between PMx and AOD is proved, although this relationship is clearly affected by the meteorological and synoptic conditions. Overall, both variables are correlated by a simplified factors ranging between 20 and 90 for the different sectors of the Iberian Peninsula.

Keywords: Aerosol Optical Depth, Particulate Matter, Air mass retro-trajectories

VIII WLMLA Topic: Remote sensing applications

On the meteorological scenarios and main air mass paths at the LALINET Natal station (Northeastern Brazil)

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Abstract: To continue the effort in understanding the role of aerosol particles on continental scale, the Latin American Lidar Network (LALINET) [Guerrero-Rascado et al., 2014] will spread its activities to the North-eastern part of South America in the near future. A new LALINET station will be deployed at Natal (Rio Grande do Norte, Brazil, 5.84º S, 35.20º W) with the aim of characterizing the transcontinental transport of aerosol particles from Africa to South America, mainly Saharan dust and biomass burning, before their potential contamination with local particles. This study is conceived as a preliminary characterization on the atmosphere over Natal based on meteorological features including air mass clustering. On one hand, this work will allow to identify periods with the largest frequency of Saharan dust outbreaks and biomass burning episodes over Natal. On the other hand, it will provide a statistically detailed characterization of meteorological conditions in this region. To this aim, GDAS information (Global Data Assimilation System) will be the inputs in our analyses and HYSPLIT model (Hybrid Single Particle Lagrangian Integrated Trajectory model) (version 4.9) will be used to generate daily backward trajectories at six standardized height levels.

Keywords: air masses, LALINET, meteorology, transcontinental transport

VIII WLMLA Topic: Special Section on Aerosol long-range transport