REPORT

X Workshop on Lidar Measurements in Latin America

November 19 - 23, 2018

X Workshop on Lidar Measurements in Latin America

Universidad Nacional Sede Medellín

Medellín, Colombia

December 28, 2018

Summary

Between November 19th and 23rd the X Workshop on Lidar Measurements was held in Univesidad Nacional Sede Medellín, Medellín, Colombia. This edition gave continuity to an ongoing process of gathering lidar and atmospheric science scientists devoted to carry their studies over South America. The WLMLA is a biannual meeting, where the Latin American's lidar researchers and students join together to share knowledge among them as well as with researchers worldwide.

Participants

Scientists involved with lidar technology and correlated areas from over the world were present at X WLMLA. In total XX people were present at this event. Geographically there were present from Latin America: Argentina (2), Bolivia(1), Brazil (16), Chile(1), Colombia(27), Cuba(2). From Europe: Spain(2). From North America: USA(3). From Asia: Japan(1).

Sponsors and Supporters

The X WLMLA sponsors were European Space Agency (ESA), Optical Society of America (OSA), Instituto de Pesquisas Energéticas e Nucleares (IPEN), and the companies LICEL Gmbh., . The organization of the Lidar School was made with support from University of São Paulo, University of Granada and University of Michigan, the latter helped in the web design. The event management was made with and Fundação de Apoio e Fomento à Inovação Tecnológica, Pesquisa e Ensino (FAFITPE). The event was hosted in the premises of Universidad Nacional Sede Medellín - Medellín which provided some logistics on the event organization.

Scientific Venue

In WLMLA there were 36 presentations, 13 oral presentations and 23 posters displayed. An award committee selected the best student presentations, in both formats, i.e., oral and poster. The evaluation committee was composed of: Omar Torres, Judith Hoelzemann and David Winkler on November 21, the latter being replaced by Henrique Barbosa on the second day of the poster evaluations on November 22.

Poster Presentations

The posters were equally divided for evaluation by the committee members.

Winners on November 21 poster session

- Amanda Vieira dos Santos (Poster 9) - US$ 50,00
- Manuela Hoyos Restrepo (Poster 7)
- Carlos Cuervo (Poster 15)

Winners on November 22 poster session

- Daniela Boñalo Marín (Poster 15) - US$ 50,00

- Renata Sammara da Silva Santos (Poster 5)
- Andrés E. Bedoya Velásquez (Poster 10)

Oral Presentations

The evaluation committee was composed of: Nobuo Sugimoto, Claudio Mazzoleni, and Omar Torres.

Winners of oral session

- Laura Herrera Best Oral Presentations (Student) - US$ 100,00
- Maria Fernanda Sanchez - Souvenirs for US$50 and Certificate for special recognition of their work.

Program

The workshop run on a program starting with School on Lidars followed by the main event itself witha day break.

School on Lidars

- November 17th, 2018 Lidar Technique and atmospheric Introduction for students at beginner level.
- November 18th, 2018 Lidar Systems and Lidar signal processing for students at middle and advanced level.

The event was offered by 6 instructors, the topics were:

- Prof. Henrique Barbosa - Lidar Data Processing
- Prof. Jose Antonio Bravo Aranda -Optical properties of aerosols
- Prof. Eduardo Landulfo - Lidar Quality Assurance
- Prof. Nobuo Sugimoto - Lidar methods and hardware systems
- Prof. Claudio Mazzoleni -Aerosols: Effects on clouds and climate
- Dr. David Winker -CALIPSO
- Prof. Pablo Ristori -Data processing

- Prof. Omar Torres - Measurement Techniques

Yet the event counted with three invited speakers:

- Dr. David Winker - A decade of global Lidar cloud and aerosol profiling
- Prof. Claudio Mazolleni - Monitoring automotive emission with lidar
- Prof. Juan Antonio Bravo Aranda - Lidar depolarization technique
- Dr. Eduardo Landulfo - AEOLUS LA2 and LALINET Earthcare CAL/VAL Projects
- Prof. Nobuo Sugimoto - Chemical Compositions and mixing state of dust particles
- Prof. Henrique Barbosa - Optical properties and radiation forcingof cirrus clouds
- Prof. Judith Hoelzemann - IGAC Activities
- Prof. Omar Torres - Monotoring of pollution
- Prof. Juan Carlos Antuña - Comparison of aerosol optical depth from satellite and ground based observations in Cuba

The followed schedule during the Workshop is presented in the Appendix.

Topics

- Lidar technologies and methods
- Lidar applications in environmental sciences
- Lidar Neworking
- Synergy between lidar and others instruments
- Regional and international cooperation in lidar technologies
- Remote Sensing applications

X WLMLA Organizing Committee

International committee

Dr. Eduardo Landulfo	IPEN, Brazil
Dr. Eduardo Quel	CEILAP, Argentina
Dr. Henrique Barbosa	LFA, Brazil
Dr. Ricardo Forno	LFA-UMSA, Bolivia
Dr. Alvaro Bastidas	UNALMED, Colombia
Dr. Rene Arredondo	GOAC, Cuba
Dr. Angel de Frutos	U. de Valladolid, Spain
D. Barclay Clemesha	INPE, Brazil
Dr. Georgios Tzeremes	ESA-EU
Dr. Errico Armandillo	ESA-EU

Local committee

Dr. Alvaro Bastidas	UNALMED
Dr. Daniel Nisperuza	Instituto Tecnológico de Antioquia
MSc. Dairo Alegría	Universidad del Cauca
Dr. Juan Vélez	UNALMEDl
Phys. Eng. Student Duban Medina	LOA, GLEO, UNALMED
Phys. Eng. Student Maribel Vallejo	LOA, GLEO, UNALMED
Phys. Eng. Student Camila Melo	LOA, GLEO, UNALMED-Colombia
Phys. Eng. Student Sebastian Lpez Arroyave	LOA, GLEO, UNALMED
Phys. Eng. Student Mariana Maya	LOA, GLEO, UNALMED
Chemical Eng. Student Estefania Vergara	LOA, GLEO, UNALMED

Financial Report

The administration of the funds was in charge of the conference chairs and the local organizing committee. The list of institutions that supported and sponsored the X WLMLA is:

Table 1: Financial Support

Internal		
Source	Amount	Purpose
UNALMED	R$ 5,067.35	TG
SIATA	R$ 4,318.01	L
TdeA	R$ 1.943,60	L
External		
ESA	€1.500,00	TG
OSA	US$ 2,400.30	TG
LICEL	US$ 2.623,30	L/TG
IPEN(FAFITPE)	US$ 10.545,00	L/TG

TG=Travel Grant;L=Logistics

LALINET Session

The LALINET meeting occurred on November 11th, 2018. Representatives from all stations were present. Some points to highlight are:

- About 50% of all stations are under maitenance
- There are 2-3 new stations to be deployed next year
- Creation of a Technical Board for discussing technical issues in the network
- 2 new stations were added to Colombia in Calí and Medellín
- Put some ancillary equipment in the network to allow complimentary data to the network
- Improve the use of mechanisms to have student exchage,e.g., TNA in ACTRIS
- Imporve the use of data processing such as SCC
- Improve and increase the use of communication tools such as emailing list
- Start making WC/QA tests for all stations new and current ones
- Establish a culture to publish WLMLA work and LALINET joint efforts
- Next WLMLA should be held at Punta Arenas , and Local chair will Boris Barja

AEOLUS & EARTHCARE Project

LALINET is a leading network in quantitative aerosol profiling performing a schedule of routine measurements and presently consists of 07-09 stations distributed over South America. The construction of an un-biased spatio-temporal database of vertical profiles of aerosol optical properties on a regional scale for climate and air quality research is the main objective of LALINET and is accomplished by the application of Raman lidars. Raman lidars, like HSRL, are capable of providing vertically resolved aerosol and cloud backscatter and extinction profiles as well as the lidar ratio without critical assumptions. The perspectives from space observations and ground based measurements are complementary: from space a global overview is obtained, built up from snap-shot like observations over different locations, while a temporal development over one place is obtained

from a ground based station. A network of ground-based stations, therefore, has the ability to provide spatio-temporal development of aerosol fields and offers a unique opportunity for validation of observations from space. These notions are the basis for this proposal. The main objectives of this proposal are: 1) Validation of AELOUS products of aerosol and cloud profiles of backscatter, extinction and lidar-ratio, 2) Assessment of spatio-temporal representativeness of AEOLUS aerosol and cloud products. The objectives will be accomplished through correlation between ground based lidar data from LALINET stations. For this, data will be used from: 1) The (historical) LALINET database, 2) Correlative measurements performed by selected LALINET stations during close proximity AEOLUS overpasses. LALINET stations perform regular lidar measurements simultaneously at three fixed instances a week, guaranteeing unbiased data collection: one daytime measurement around noon, when the boundary layer is well developed, and two night-time measurements per week, in low background-light conditions, to perform Raman extinction measurements. Since the launch of CALIPSO in April 2006, LALINET maintains a correlative measurement schedule that takes advantage of the network structure. This is done so that close overpasses are captured by a particular station and also by its nearest-neighbour stations to capture the spatio-temporal variability. It is proposed to use a similar strategy for the validation of AEOLUS & EARTHCARE space mission. Deliverables are: 1) Vertical profiles of aerosol optical properties (backscatter, extinction and lidar ratio) obtained from routine network observations, 2) Vertical profiles of aerosol optical properties obtained from correlative observations. 3) Report The routine LALINET measurement programme is run on National/Institutional funding obtained by the individual partners and is secured by individual stations. Since most of the LALINET lidar instruments cannot measure unattended, substantial effort is involved in special and additional/correlative measurements, for which additional funding is needed. National/internationalagencies will be approached to cover these costs.

Abstracts & Posters

The abstract list (oral + poster) is presented in the Appendix.

*Conference Budget Detail_X-WLMLA (Medellín)

SUPPORT		Air Tickets	PerDiem	Meals	
UNALMED					
Dr	**Juan Carlos Antuña M.**	US$787,14			
St	**Frank García Parrado**	US$787,14			
Dr	**David Winker**			US$60.00	
Dr	**Omar Torres**			US$60.00	
Dr	**Nobuo Sugimoto**			US$60.00	
	Claudio Mazzoleni			US$60.00	
	Henrique Barbosa		US$220.78		
	Judith Hoelzemann		US$220.78		
	Lodging for Students (31)				**US$950.00**
	Meals for Students (31)				**US$490.42**
	Transport Local				**US$480.66**
	Logistic				**US$890.43**
		US$1,574.28	**US$441.56**	**US$240.00**	**US$5,067.35**
SIATA					
	David Winker	US$730.82	US$220.78		
	Omar Torres	US$730.82	US$220.78		
	Nobuo Sugimoto	US$1,242.43	US$220.78		
	Claudio Mazzoleni	US$730.82	US$220.78		
		US$3,434.89	**US$883.12**		**US$4,318.01**
TdeA					
Dr	**Pablo Ristori**	US$678.42	US$220.78		
Dr	**Juan Antonio Bravo**	US$823.60	US$220.78		
		US$1,502.02	**US$441.56**		**US$1,943.6**
OSA					
St	Maria Fernanda Sanchez	US$658.90	US$196,78	US$0.00	
St	Milagros Estefania Herrera	US$883.75	US$0.00	US$0.00	
St	Ignacio Andres Toro	US$660.87	US$0.00	US$0.00	
	Prize				**US$250**
		US$2,203.52	**US$196.78**	**US$0.00**	**US$2,400.3**
LICEL					
Dr	**Eduardo Landulfo**	US$800.00	US$220.78	US$60.00	
Dr	**Juan Carlos Antuña M.**		US$220.78	US$60.00	
St	**Frank García Parrado**		US$220.78	US$60.00	
St	**Milagros Estefania Herrera**		US$220.78	US$60.00	
St	**Ignacio Andres Toro**		US$220.78	US$60.00	
Dr	**David Winker**			US$60.00	
Dr	**Omar Torres**			US$60.00	
Dr	**Nobuo Sugimoto**			US$60.00	
Dr	**Pablo Ristori**			US$60.00	
Dr	**Juan Antonio Bravo**			US$60.00	
Dr	**Henrique Barbosa**			US$60.00	
Dr	**Judith Hoelzemann**			US$60.00	
		US$800.00	**US$1,103.9**	**US$720.00**	**US$2,623.9**
ESA					
St	**Jose Benavent Oltra**	US$998.43			
	Registration Students (x9)				**US$578.04**
		US$998.43			**US$998.43**

X WORKSHOP ON LIDAR MEASUREMENTS IN LATIN AMERICA

PROGRAM

MEDELLÍN

COLOMBIA

November 19th to 23rd, 2018

Monday, November 19th

08:20 - 09:00	***Registration***
09:00 - 09:40	***Opening*** Alvaro E. Bastidas G.; Eduardo Landulfo; Juan Carlos Antuña
09:40 - 10:40	*Lidar school basics 1* Juan Antonio Bravo, "Optical properties of aerosols"
10:40 - 11:00	***Coffee break***
11:00 - 12:20	*Lidar school basics 2* Claudio Mazzoleni, "Aerosols: Effects on clouds and climate"
12:20 - 14:00	***Lunch***
14:00 - 15:20	*Lidar school basics 3* Nobuo Sugimoto "Lidar methods and hadware systems"
15:20 - 15:40	***Coffee break***
15:40 - 17:00	*Lidar school basics 4* Eduardo Landulfo, "Lidar signals"
17:00 - 19:00	***Welcome Cocktail***

Tuesday, November 20th

08:20 - 09:00	*Talk 1* David Winker, "A decade of global Lidar cloud and aerosol profiling"
09:00 - 10:20	*Lidar school advanced 1* Omar Torres, "Measurements technicals"
10:20 - 10:40	***Coffee break***
10:40 - 12:20	*Lidar school advanced 2* David Winker, "CALIPSO".
12:20 - 14:00	***Lunch***
14:00 - 15:20	*Lidar school applied 1* Pablo Ristori, "Data processing"
15:20 - 15:40	***Coffee break***
15:40 - 17:00	*Lidar school applied 2* Henrique M. J. Barbosa, "Lidar data processing"
17:00 - 19:00	***Poster session*** P1.01: Manuela Hoyos Restrepo P1.02: Elaine Cristina Araújo P1.03: Marcos P. Araújo da Silva P1.04: José A. Benavent Oltra P2.01: Santiago Jaramillo Gil P2.02: Cristina T. de Sousa Rae P2.03: Fernanda de Mendonça M. P2.04: Maria Helena G. de Andrade S. P2.05: Thaís Corrêa P4.03: Hernán Antonio Ramírez Yañez

Wednesday, November 21st

08:20 - 09:00	*Talk 2* Claudio Mazzoleni, "Monitoring automotive emissions with lidar"
09:00 - 09:40	*Talk 3* Juan Antonio Bravo Aranda, "Lidar despolarisation technique"
09:40 - 10:00	***Oral presentation*** O1.01: Anderson G. Guedes
10:00 - 10:20	O1.02: Maria Fernanda Sánchez
10:20 - 10:40	***Coffee break***
10:40 - 11:00	O1.03: David Ricardo Vivas
11:00 - 11:20	O1.04: Jonnathan Cespedes Rojas
11:20 - 11:40	O2.01: Milagros Estefanía Herrera
11:40 - 12:00	O2.02: Carlos Andrés Melo Luna
12:00 - 13:40	***Lunch***
13:40 - 14:00	O3.01: Juan Diego Areiza Cardona
14:00 - 14:20	O3.02: Andrés E. Bedoya Velasquez
14:20 - 14:40	O3.03: Renata Samara da Silva Santos
14:40 - 15:00	O4.01: Frank García Parrado
15:00 - 15:20	O4.02: Laura Herrera
15:20 - 15:40	***Coffee break***
15:40 - 18:00	***Poster session*** P3.01: Antonio A. Gómes P3.02: Andrés E. Bedoya Velásquez P3.03: Andrés E. Bedoya Velásquez P3.04: Manuel García Reyes P4.01: Marco Aurélio Franco P4.02: Cássia Maria Leme Beu P4.04: Leidy Karina Vásquez Londoño P4.05: Sindy Tatiana Morales García P4.06: Daniela Boñalos Marín P4.07: Elena Montilla Rosero P4.08: Daniel Nisperuza Toledo
18:00 - 19:00	**LALINET MEETING**

Thursday, November 22nd

08:20 - 09:00	Talk 4 Eduardo Landulfo, "AEOLUS LA2 and LALINET earthCARE CAL/VAL projects"
09:00 - 09:40	Talk 5 N. Sugimoto, "Chemical compositions and mixing state of dust particles"
09:40 - 10:20	Talk 6 Henrique Barbosa, "Optical properties and radiation forcing of cirrus clouds"
10:20 - 10:40	***Coffee break***
10:40 - 11:00	***Oral presentation*** O4.03: Daniel C. Fortunato dos Santos O.
11:00 - 11:20	O4.04: Amanda Vieira dos Santos
11:20 - 11:40	O4.05: David Alejandro Collazos
11:40 - 12:00	O4.06: Andrés E. Bedoya Velásquez
12:00 - 13:30	***Lunch***
13:30 - 14:00	Transfer
14:00 - 17:00	***Tour***
17:00 - 18:00	Transfer
18:00 - 20:00	**DINNER**

Friday, November 23rd

08:20 - 09:00	Talk 7 Omar O. Torres, "Monitoring of pullution"
09:00 - 09:40	Talk 8 Juan C. Antuña, "Comparison of aerosol optical depth from satellite and ground-based observations in Cuba."
09:40 - 10:20	Talk 9 Pablo Ristori, "Lidar monitoring of volcanic emissions"
10:20 - 10:40	***Coffee break***
10:40 - 12:20	***CLOSURE***
12:20 - 14:00	***Lunch***


SIATA
Área Metropolitana Valle de Aburrá
LALINET
Latin American Lidar Network
OSA
The Optical Society
esa
CIBioFi
Universidad del Valle
licel
Red Colombiana de Óptica
Tecnológico de Antioquia
Institución Universitaria
UNIVERSIDAD NACIONAL DE COLOMBIA
GLE
X WORKSHOP ON LIDAR MEASUREMENTS IN LATIN AMERICA

XW

Photos with captions X-WLMLA (Medellín)

X WorkShop Lidar Measurements in Latin America

(X-WLMLA)

November 19th to 23rd, 2018

Medellín, Colombia

1. Lidar Technologies and Methods

Determination of the Atmospheric Boundary Layer top in the presence of multiple aerosol layers.

Maria Fernanda Sánchez

Laboratorio de Física de la Atmósfera, Universidad Mayor de San Andrés, La Paz-Bolivia.

La Paz city situated inside a canyon and surrounded by the Altiplano flatland and mountains in the Andean Region of Bolivia gives a perfect scenario for the formation of multiple aerosol layers within and above the Atmospheric Boundary Layer (ABL). Data obtained with the lidar system located in Cota Cota-La Paz (16.5ºS, 68.1ºW, 3420 masl) were used to study the ABL complexity in this region under different weather conditions. In order to improve the detection of the ABL top in presence of multiple aerosol layers a method was developed applying basic statistics onto Haar wavelet profiles. The presentation pretends to show the method developed and its application on a set of data.

WCT parameters determination by a machine learning algorithm.

David Ricardo Vivas Ordoñez

CIBioFi

The Planetary Boundary Layer (PBL) top is one of the most dynamical troposphere regions in climatology since it has a response to variables such as temperature, precipitation, topography, and human activity. As a consequence, the identification of PBL top pattern behavior requires the constant monitoring and the application of methods for its detection and analysis. One of the most powerful methods to retrieve the PBL top is the Wavelet Covariance Transform (WCT); however, this well-known method depends on the choice of the so-called **a** and **b** parameters for dilation and translation, respectively,

that is usually a non-trivial task. In this work, we propose an alternative novel solution to the selection of these parameters, by employing a machine learning algorithm to detect the transition between the well-mixed PBL that contains the meaningful aerosols load, and free troposphere due to change in backscattering signal LiDAR.

First measurement of optical properties of aerosols in Cali, Colombia: Results from Ground-based LiDAR-CIBioFi station.

Jonnathan Cespedes

CIBioFi

The monitoring of aerosols impact in Colombia, on a regional or local scale, is usually limited by the infrastructure and the instrumentation capability. The main source of data about the temporal and spatial dynamics of aerosols are the ground-based stations established by local governments for monitoring the air quality at ground level. However, these ground-based stations do not measure profiles of atmospheric properties, so they are not able to retrieve parameters such as the vertical distribution and temporal evolution of the aerosol extinction coefficient or the daytime evolution of the atmospheric boundary layer. As a consequence of this, there is a lack of information about the vertical dynamics of the atmospheric constituents as well as their interaction with sunlight. To address this issue, we have implemented the Ground-based LiDAR-CIBioFI station that allows us to perform measurements of the backscatter returns. In this work, we report data related to Planetary Boundary Layer top observations using the Wavelet Covariance Transform detection method. We also retrieve backscattering and extinction coefficients by means of Klett-Fernald algorithm. All this information has been retrieved using the LiDAR-CIBioFI in elastic mode at 532 nm. This study shows the first observations of the vertical transport of aerosols with our lidar with the aim of studying the impact of the aerosols on the radiative forcing over the city of Cali.

Improvement of Lidar depolarization measurements: assessment of the polarizing-optic influence

Manuela Hoyos Restrepo

Departament of Physical Sciences, EAFIT University

Mulhacen is a multiwavelength Raman lidar belonging to the EARLINET Granada station, whose volume linear depolarization ratio (δ') retrievals were improved by means of the correction of the effects of the optical components on its depolarization measurements. To this aim, the □90 calibration method (Freudenthaler, 2016) was applied to several calibration measurements performed in the period from September to December 2017. This enabled the determination of the most critical optical parameters inducing errors in the depolarization measurements, including the misalignment angle of the plane of polarization of the laser regarding the plane of incidence of the Polarizing Beam Splitter (PBS). Moreover, the temporal stability of the calibration measurements was analyzed through the determination of their statistical variables, and the total uncertainty of the volume linear depolarization ratio was established via the combination of the Stokes–Müller formalism and a complete sampling of the error space using the lidar model presented in Freudenthaler, 2016.

Characterization of the temporal and spatial distribution of inhalable particles in the city of Cubatao

Elaine Cristina Araújo

Instituto de pesquisas energéticas e nucleares, Sao Paulo, Brazil

Air pollution is a topic that has been discussed in scientific circles for many years. There are several elements that together or separately can be precursors of poor air quality.

Among the various pollutants that cause air pollution, Particulate Matter is one of the main agents of this phenomenon. The levels of air pollution, global and in Brazil, especially in large metropolis such as São Paulo is high. Other Brazilian cities and capitals the air pollution is over that is expected for good air quality. One of the Brazilian cities that became known nationally and even worldwide by the high levels of Particulate Material is Cubatao, located in the state of Sao Paulo, 57 km from the state capital. Among the classifications of particulate matter there are two main categories, inhalable particles (PM10) and fine inhalable particles (PM2,5), these are thus classified according to their aerodynamic diameters. Considering the facts mentioned above, this work proposes to characterize the inhalable particles of the city of Cubatão - SP, for this was carried out an análisis of data from remote sensing techniques, such as Light Detection and Ranging – LIDAR , what work with three wavelengths; 355 nm, 532 nm and 1064 nm and MODIS from the Goddard Interactive Online Visualization and Analysis Infrastructure (GIOVANNI) platform, where was obtained information of Aerosol Optical Depth (AOD) and Angström Exponent. Finally, data from the Air Quality Information System - QUALAR, which retrieved information on the concentration of the inhalable particles, were used.

The DUSTER Cloud-Free Filter to Remove LIDAR Profiles with Clouds

Marcos Paulo Araújo da Silva

Federal University of Rio Grande do Norte

Especially low clouds can disturb the signal above them turning a detected ground-based LIDAR profile not useful for obtaining products such as aerosol backscattering and extinction profiles. For this reason, the DUSTER Cloud-Free Filter (DCF) was developed to automatically separate cloudy and cloud-free profiles as well as identify invalid files caused by occasional errors during data logging. The DCF was developed using the

database of the elastic depolarization DUSTER LIDAR, operational since January of 2016 in Natal, Rio Grande do Norte, Brazil (5°50'29.58" S; 35°11'57.79" W). The DUSTER system is located approximately 2 km away from the ocean and is strongly influenced by the Intertropical Convergence Zone (ITCZ), thus it is very common to detect very low clouds during data acquisition. In the altitude where a cloud is detected the signal gets saturated, mainly on photon counting channels that are more sensible than the analogue ones. The DCF inputs are the raw data files, a saturation limit for the investigated channel and a vertical investigation range. First of all, the filter checks which files are valid, identifying if there are null files or files with shorter duration of acquisition than the standard duration. Sometimes the transient recorder (an electronic device used to organize the detected signal in binary files) generates this kind of invalid files while logging the data, therefore it is very important to perform this initial check-up. By means of the input parameters the filter analyses all the valid files, altitude by altitude in the investigation range, comparing the raw signal intensity with the respective saturation limit. If in only one altitude the signal intensity is above saturation limit the profile is considered as a cloudy profile, else it is considered as a cloud-free profile. Therefore, the choices of the investigation range as well as the saturation limit are fundamental for obtaining good results. After classifying the profiles, the filter separates cloudy and cloud-free files in two different folders, creating copies, without modifying the original data. When the processing finishes it informs the user how many valid files have been processed, the directories of the invalid files, how many cloudy and cloud-free files were detected, and the processing time. The DCF has shown good results, separating hundreds of profiles in a few minutes, performing automatically a task that could demand lot of manual work. In the near future it is planned to extend the use of the DCF to other LALINET station's data processing routines.

GRASP: statistical analysis of aerosol properties in São Paulo (Brazil)

Jose Antonio Benavent Oltra

Andalusian Institute for Earth System Research (IISTA-CEAMA). University of Granada

Atmospheric aerosols particles play an important role in the atmospheric radiation budget. Depending on the particles properties, they can absorb or scatter the incoming and outgoing radiation, leading to a warming or cooling of the Earth–Atmosphere system. Aerosol profiling with high spatial and temporal resolution provided by lidar techniques is an indispensable tool to study the vertical structure of the aerosol particles and its temporal and spatial evolution.

In this work, a statistical study of aerosol properties retrieved by GRASP code (Generalized Retrieval of Atmosphere and Surface Properties) has been performed at the LALINET (Latin American Lidar NETwork) station of São Paulo, Brazil, from May 2015 to October 2017. GRASP combines the AOD and sky radiances at 440, 675, 870 and 1020 nm measured by CIMEL photometer and the 30-min lidar RCS (range corrected signal) at 355 and 532 nm averaged in a ±15 min window centered at the time of CIMEL measurements.

During AW (autumn-winter season), most of particles are confined to the first kilometers above the surface, while a major presence of aerosol particles at higher altitudes is observed during SS (spring-summer season). The largest values of aerosol extinction (α) are observed at the lowest altitudes analyzed, being the values for AW and SS very similar. A clear exponential decrease is observed for the α-mean in both seasons. Scale heights of 0.7 and 1.0 km a.g.l. have been obtained for AW and SS, respectively. This parameter indicates the altitude where most of the aerosol particles resides.

The fine concentration mode is highest for all seasons. The differences between fine and coarse mode are higher in the AW season and AOD440<0.2 conditions, where to coarse

mode is very low. However, for SS and AOD440>0.2 retrievals the values of coarse mode are higher, with values around 10 μm3/cm3.

Evaluation of the Transport of Atmospheric Aerosol on Natal-RN (Brazil) through the LIDAR Technique of Depolarization

Anderson G. Guedes

Federal University of Rio Grande do Norte, Brazil. Andalusian Institute for Earth System Research,University of Granada. Physical Sciences Department, EAFIT University.

The objective of this work is describe some results of the Natal LIDAR system (DUSTER), an integrating station of The Latin America Lidar Network (LALINET), aimed to detect and evaluate the transcontinental transport of Sahara dust (SD) and other aerosols to the Brazilian territory during the aerosol Monitoring campaign Long-range Transportation Over Natal ZERO and I (MOLOTOV ZERO, MOLOTOV I) which occurred from February 2016 to July 2016 and December 2016 to February 2017, respectively. The city of Natal is located in northeastern Brazil and is one of the continental points closest to the African continent, an important fact to observe the entry of SD in the South American continent. The DUSTER system allows the detection of signals at wavelengths of 355 nm, 532 nm (parallel), 532 nm (perpendicular) and 1064 nm. To detect and characterize SD aerosols and other particles in the atmosphere, DUSTER uses the ability of suspended aerosol particles to change the polarization state of light. The data retrieved by DUSTER allow calculate fundamental parameters in the characterization of atmospheric aerosols such as linear volume depolarization ratio (δ^{v}) and particle linear depolarization ratio (δ^{p}). Campaign data showed that on a few days the value of δ^{p} varied between 0.07 and 0.40 at a transport altitude within the range of 1-4 km above sea level indicating in some cases probably a mixture of SD with other types

of aerosols such as marine particles, anthropogenic pollution or biomass burning smoke. The data obtained with DUSTER have allowed verify the seasonality of this transport, the altitudes of detected particles and study its optical properties. Their data were correlated using other data sources such as CIMEL (AERONET), Cloud-Aerosol Transport System (CAST), CALIPSO and HYSPLIT model.

2. Lidar applications in enviromental sciences

Space - temporal evolution of the planetary boundary layer height from Lidar signals during the periods 2012 - 2013 in Concepcion, Chile

Ignacio Andrés Toro Zanetta

Universidad de la frontera, Chile

The Planetary Boundary Layer (PBL) is the lowest thermodynamic layer of the troposphere. This layer is directly influenced by the contact with the surface of the Earth so obtaining the height that reaches this layer is relevant as a parameter for the study of tropospheric aerosols. Generally, above the PBL (free troposphere), the concentration of aerosols is much lower than under it. These abrupt changes in the concentration of aerosols can be observed from the signals of a Lidar system, which measures the intensity of backscattered light coming mainly from the aerosol particles as a function of the height at which they are found. In this way, significant changes in the Lidar signal are associated with the top height of the PBL. Different methods were applied for the detection of the PBL top height using the Lidar signal: First Gradient, Second Gradient, Wavelet Covariance Transform and Modified Wavelet Technique. The techniques of the First and Second Gradients, determines the first and second derivatives of the normalized and range-corrected signal to find a local minimum value which indicates an abrupt change in the signal. The Wavelet Covariance Transform produces a convolution between the normalized and range-corrected Lidar signal, with a step function known as the Haar function. This last method describes a continuous form of the transform. Finally, the Modified Wavelet Technique describe a discrete version of this transform, considering a threshold value that is used for the detection of first maximum of the Wavelet vertical profile above the surface. For both methods associated with the Wavelet transform, a maximum value located in its vertical profile is associated with a significant change in the Lidar signal. The Lidar signals were obtained by the Lidar Cefop System during the periods 2012 - 2013 in the city of Concepción, Chile (36° 47' S, 73° 1' W). In this work, the space - temporal evolution of the PBL top height obtained by an Elastic and Tropospheric Lidar System is presented and discussed. The results of the different methods for obtaining the top height of the PBL are compared with the space - temporal

evolution of the Lidar signal. Also, a statistical analysis of the PBL height obtained from the Lidar signal data processed with the Modified Wavelet Technique method is presented.

Properties of the atmospheric aerosol over Argentina retrieved from combination of lidar and sun-photometer measurements.

Milagros Estefanía Herrera

Laser and Applications Research Center (CEILAP)

We have implemented two different inversion algorithms to obtain aerosol properties from simultaneous collocated lidar and sun photometers in Argentina. The first is the GARRLiC (Generalized Aerosol Retrieval from Radiometer and Lidar Combined data) / GRASP program, used as a benchmark, and the second one was Python implementation of an algorithm done at the Defense Institute of Scientific and Technological Research (CITEDEF) following the basic guidelines of the LiRIC (Lidar-Radiometer Inversion Code). Both methods combine lidar and sun photometer observations, providing aerosol properties as vertical profiles and integrated columnar values. The results obtained allow the study of similarities and differences between both algorithms and are a valuable tool to analyze the possible improvements that can be done to the local version of LiRIC to increase its degree of precision on its aerosol discrimination capabilities.

Surface layer and max-DOAS column measurements of ozone in center of the agriculture-intensive Cauca River Valley in Colombia

Carlos Andrés Melo Luna

CIBioFi

In contrast to the stratospheric ozone layer, which acts as a natural protection from UV solar radiation, even slightly elevated ozone concentrations at ground level are known to be harmful to human health and ecosystem productivity. Tropospheric ozone is produced by an usually complex system of photochemical reactions that drive the photo-oxidation of volatile organic compounds (VOCs) "catalyzed" by nitrogen oxides (NOx). Hence, the monitoring of ozone and the understanding of its vertical distribution are of high value for public health and environmental management purposes. Sunlight exposed biomass burning products generate photochemical pollution. Prescribed sugarcane pre-harvest burning is widespread in the highly productive Colombian Cauca Valley region. Here we report measurements of ozone in the surface layer with a standard photometric point monitor, and of the ozone column with a multiaxial Differential Optical Absorption Spectroscopy (max-DOAS) system located at the Universidad Nacional de Colombia - Palmira Campus (3.5380° N, 76.2972° W) during the CACIQUE measurement campaign, which aims at quantifying air pollution in the Cauca Valley and understanding its sources, including intensive agriculture.

Development of a microfluidic circuit “microreactor” to atmospheric analyses

Antonio A. Gómes

Nuclear and Energy Research Institute. Universida de de São Paulo, Escola Politécnica

The Earth atmosphere is composed by several gases, which are distributed in layers and plays a fundamental role in the life cycle of the different ecosystems. The troposphere is the layer that has the highest concentration of these gases and their species. The alpha-

carbonyls are among the most prevalent species in atmospheric air, so that the more significant are: glyoxal (GLY) and methylglyoxal (MGLY), both generated by photo-oxidation processes of volatile organic compounds (VOCs), which come from biogenic and anthropogenic sources (FU et al., 2008). The main atmospheric controller of GLY and MGLY is the photolysis, which in the presence of OH, SO_X and NO_X favors the formation and increase of tropospheric ozone and secondary organic aerosols (SOA), causing several health and environmental problems (VOLKAMER et al., 2007; FU et al., 2008). Studies performed in the last decade (FU et al., 2008; BIKKINA et al., 2014) demonstrate the GLY and MGLY as markers for the decomposition of VOCs and as precursors in the formation of tropospheric ozone and SOA. The derivatization technique is the process by which a compound is chemically modified, yielding a novel derivative compound of similar structure through the functional group of the substance of interest (ORATA, 2012). This technique favors greater stability to the analyte, so that it can be subjected to analytical methods, such as gas chromatography coupled to the mass spectrometer (GC-MS), which requires a chemically stable and sufficiently volatile sample for the GC-MS injection patterns. This consequently enables the chemical analysis, as well as, its identification and quantification. In recent decades, microfluidics has proved to be a powerful technology in almost every field of science. However, it has begun to develop increasingly significant roles in the participation of the development of methods and analytical techniques, and significant creation of new technologies that allow the detection and studies of air pollutants compared to other methods and equipment (PANG, 2013). The present work aims to develop a microreactor through the new femtosecond laser workstation, using the derivatization technique, allowing the detection and analysis of GLY and MGLY in the air of the tropospheric region.

Preliminary studies of aerosol hygroscopic growth using automatic remote sensing instrumentation at the SIATA stations in Medellín (Colombia)

Andrés Esteban Bedoya-Velásquez

Andalusian Institute for Earth System Research (IISTA-CEAMA), University of Granada

Hygroscopic growth is the capacity of some atmospheric aerosol particles to pick up water from the environment and increase their size. In addition to size change, wet particles have different refractive indices and angular scattering properties than their dry counterparts. At present, studies combining in-situ and remote sensing instrumentation have increased the possibility to investigate aerosol hygroscopic growth under unmodified atmospheric conditions. In this work, we combine remote and in-situ instrumentation operated by the "Sistema de Alerta Temprana de Medellín y el Valle de Aburra" (SIATA) in Medellín to chase potential hygroscopic growth cases over two stations (East-Center: Torre SIATA and East-south: Concejo de Medellín). The synergy between temperature and relative humidity (RH) profiles from radiosounding (RS) and MWR with attenuated backscatter coefficient profiles from a Vaisala CL51 ceilometer and in-situ instrumentation are used. On this regard, we firstly performed an error estimation of the MWR (temperature and RH profiles), determining the trustworthy regions of these variables, using the mean-bias and standard deviation calculation between MWR and RS. Secondly, we propose a methodology based on strict criteria to find potential hygroscopic growth cases in the Valley.

Remote sensing and in-situ instrumentation synergy for studying aerosol hygroscopic growth: case from SLOPE I campaign

Andrés Esteban Bedoya-Velásquez

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This study focuses on the analysis of aerosol hygroscopic growth by using the synergy of active and passive remote sensors. The measurements were performed during the Sierra Nevada Lidar Aerosol Profiling Experiment (SLOPE I) campaign in which observations at the ACTRIS Granada station and at a mountain station (Sierra Nevada, SNS), both located in south-eastern of Spain, were combined. The methodology is based on simultaneous measurements of aerosol profiles from multi-wavelength Raman lidar (RL) and relative humidity (RH) profiles obtained from a multi-instrumental approach. The combination of calibrated water vapour mixing ratio (r) profiles from RL and continuous temperature profiles from a microwave radiometer (MWR) is used for obtaining RH profiles with a reasonable vertical and temporal resolution. The accuracy of this method is evaluated against co-located radiosounding (RS) measurements, obtaining differences in hygroscopic growth parameter (γ) lower than 5% between the RS and the methodology presented here. Additionally, the results of an aerosol hygroscopic growth case using remote sensing were compared with the ones obtained using Mie theory and in-situ measurements of particle number size distribution and submicron chemical composition measured at SNS. This work summarizes the recent study published by Bedoya-Velásquez et al. (2018).

Retrieving Cloud Properties from Solar Background Signal by Ground-Based Lidar Measurements over the Southeastern Spain

Manuel García Reyes

Andalusian Institute for Earth System Research (IISTA-CEAMA). University of Granada.

We present a first attempt to develop a database of cloud properties retrieved by a lidar in the period 2016 – 2017 at the Andalusian Institute for Earth System Research (IISTA-CEAMA) in Granada (37.16º N, 3.61º W, 680 m a.s.l.), located in southeastern Spain. A method based on high temporal resolution (1 min) solar background lidar signals has been used.

When lidar is pointing to the zenith, the solar background signal is proportional to the solar zenith radiance and can be calibrated. Thus, we used measurements of solar zenith radiance from a collocated Sun-photometer in coincidence with lidar data to derive calibrated solar zenith radiances. From this lidar-based radiance database, we used the SBDART (Santa Barbara DISORT Atmospheric Radiative Transfer) software tool to retrieve the cloud optical depth of liquid water clouds. In addition, data provided by a collocated microwave radiometer and a ceilometer have been used to complete the characterization of the cloud properties, excluding ice, multilayered precipitating clouds from our database.

Cloud optical depth database obtained from lidar is compared with cloud optical depth data obtained by AERONET in cloud mode retrieval, which are taken when clouds completely block the Sun, making the measurements inappropriate to retrieve aerosol optical properties.

Cloud properties measurements from a high temporal resolution instrument like lidar will allow us monitoring the aerosol-cloud interactions with an accurate and continuous database of both aerosol and cloud particles.

Retrieval of aerosol optical properties using Vaisala CL51 ceilometer corrected data.

Juan Diego Areiza Cardona

Department of Physical Sciences, EAFIT University

The Early Warning System of Medellin and Aburra Valley (SIATA) has a network of three Vaisala CL51 Ceilometer stations. These remote sensing devices measure the vertical distribution of clouds up to 15,400 m with 10 m resolution. The laser in the ceilometer is a semiconductor laser (InGaAs diode laser) with 910 nm wavelength. The measured signals are integrated 16 s and calibrated by the manufacturer. The commercial Ceilometer provides a range-corrected attenuated backscatter coefficient, but the raw data are not available to the user. In this work, we present the results obtained from noise and water vapor corrections applied to the Ceilometer data measured in the SIATA tower (Medellin downtown), during identified clear-sky days of 2015, to retrieve optical properties of local urban aerosols.

3. Synergy between lidar and others instruments

Investigating aerosol hygroscopic enhancement factor by combination of automatic remote sensing and chemical analysis

Andrés Esteban Bedoya Velázquez

Andalusian Institute for Earth System Research (IISTA-CEAMA), University of Granada

Many studies have investigated the effect of aerosol hygroscopic growth on the scattering coefficient using in-situ techniques (e.g. nephelometers tandem), including the effect of aerosol chemical composition and particle size distribution in the hygroscopic enhancement factor. However, it is difficult to provide results above 90% relative humidity (RH) with tandem nephelometers, besides they also modify the environmental conditions. In this sense, other studies have combined lidar and radiosondes to analyze changes in particle backscatter coefficient under relative humidity up to 90% inside a well-mixed aerosol layer. However, the main drawback of this approach is the lack of radiosondes and continuous lidar measurements.

In this work, we study the aerosol hygroscopic growth in SIRTA station (Palaiseau, France) by combination of (1) a ceilometer that provides continuous measurements of high temporal resolution aerosol attenuated backscatter with low full overlap height (Vaisala CL31) and (2) a hygrometer installed in a co-located tower (30-m height). This unique experimental layout provided us more than 100 potential cases in a 4.5-year database (2012-2016). After the application of several strict criteria that include (i) checking the simultaneous increase/decrease of attenuated backscatter and relative humidity, (ii) then the aerosol origin is studied, and (iii) finally, we use in-situ data concentration to evaluate the impact of the organic and inorganic compounds over the 8 final cases selected. Finally, co-located measurements of aerosol chemical composition and particle size distribution allowed us to identify links between the hygroscopic growth observed and aerosol type such as the correlation between gamma parameter and the organic/inorganic mass fractions.

Study of Cirrus clouds physical properties over Natal using the Lidar-DUSTER system and radiosounding data

Renata Sammara Da Silva Santos

Federal Universiry of Rio Grande do Norte

Cirrus clouds are the highest clouds in the atmosphere occurring generally from 7 to 18 km altitude, having necessarily ice crystals in their composition. They still have an uncertain influence role in climate, therefore are seen as important atmospheric elements to be studied. Lidar systems (LIght Detecting and Ranging) have shown efficiency in the collection of cirrus cloud characteristics which can help in its better parameterization in climatic and atmospheric models. In this work a collection of physical characteristics of cirrus clouds was carried out, for January and February of 2017 and 2018, in Natal's atmosphere using Lidar DUSTER data (5.84 S 35.20 W), a partnership of UFRN and IPEN-SP. Tenuous clouds with thinner depths are observed at the top regions of troposphere, around 16.0 km. Clouds with bigger vertical extensions are found around 12.0 km. Cirrus height of occurrence varied at a minimum of 7.0 km and a maximum of 16.0 km and most frequently occurred at an average height of 12.0 km. Those clouds had a considerable representativeness over the region corresponding to 67% of measured days. Using radiosounding data the behavior of the meteorological variable relative humidity was analyzed for the regions in which cirrus clouds were found by the Lidar DUSTER. A significant increase of humiditywas observed in the region reinforcing the presence of cirrus. The Lidar DUSTER demonstrated to be effective identifying cirrus clouds over the city's atmosphere and can be used for future studies contributing to a better comprehension of their behavior and role within the region.

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4. Remote sensing applications

Climatology of aerosol optical properties measured with sun photometer at Camagüey, Cuba.

Frank García Parrado

(GOAC), Geophysical Institute of Peru

We report the climatological values of the main aerosol optical properties of aerosols: the aerosol optical depth (AOD) at eigth wavelengths and the Angstrom Exponent (AE), for the unique AERONET station located in Cuba. The statiscs 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 clasified 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, backtrajectories analysis are show to indetify the geographical regions that are the source for the aerosols reaching Camagüey site.

Characterization of the Atmospheric Boundary Layer over Aburrá Valley region (Colombia), using remote sensing and radiosonde data

Laura Herrera

SIATA

The Aburrá Valley is a narrow complex mountainous terrain located in the Colombian Andes. In recent years this region has experienced critical air quality episodes, with daily concentrations reaching over 100 μg/m3. Meteorological and climate variability modulates the occurrence of these episodes. The presence of low-level clouds and the structure of the Atmospheric Boundary Layer (ABL) are critical factors for the understanding of the behavior of aerosols. Scanning LIDARS (Light Detection and Ranging devices) are versatile tools to assess ABL dynamics in an urban environment, allowing aerosol characterization and spatio-temporal evaluation. In this work, we study vertical profiles of attenuated backscatter and depolarization ratio derived from a ground-based scanning LIDAR, and simultaneous profiles obtained from the space-borne CALIOP Lidar instrument onboard CALIPSO satellite to characterize the spatio-temporal variability and structure of the Aburrá Valley ABL. The profiles are also contrasted with backscatter measurements from three lidar ceilometers operating within the valley. The results suggest that both ground-based remote sensors identify similar variability of the atmospheric vertical structure, aerosols, and ABL height. In the case of CALIPSO, we do not intend to validate or calibrate the retrievals using ground-based instruments; several authors have reported aerosol profile disagreements due to random and systematic sources. Instead, we consider CALIPSO and ground-based retrievals as complementary leading to a better understanding of the atmospheric profile, and the implications of aerosol-cloud interactions feedbacks for the surface radiative balance. While the amount of data is not yet sufficient for statistically significant conclusions, the preliminary aerosol and cloud characterization and discrimination allow the clustering of four cases with different consequences for incoming solar radiation and turbulent fluxes. The cases include (i) cloud-free and low aerosol load, (ii) cloud- free and high aerosol load, (iii) cloudy skies and low aerosol load, and (iv) cloudy skies and high aerosol load scenarios.

Obtaining the vertical distribution of aerosol in Central Amazon from the measurements of a ceilometer during GoAmazon IOP1 (February-March 2014)

Amanda Vieira dos Santos

Laboratory of Atmospheric Physics, University of São Paulo, USP

The Amazon is under constant change, and this has important climatic implications. The forest affects the global hydrological cycle as well as the global carbon balance. The local convection together with meteorological systems on a large scale are responsible for the formation of clouds in the region. The cycle of deforestation and biomass burning causes great variation in the aerosol concentration. The area also suffers the impact of urban pollution from nearby cities such as Manaus. In this study, we use ceilometer data from the experimental site T3-Manacapuru of the GoAmazon2014/15 experiment, and our main goals are to identify the profiles that contain clouds and investigate the vertical distribution of aerosols in the central Amazon region in a period when there was no contribution from biomass burning. The experimental site is located downwind of the city of Manaus, and alternatively receives clean air masses from the forest and polluted air masses from the city. The study period is IOP1 (February-March 2014) of the experiment. The profiles that contained clouds were identified using an algorithm developed in our laboratory. Those profiles were removed from the analysis and the Klett method (Klett, 1981)[1] is applied to the elastic backscatter signal measured by the ceilometer to obtain the vertical distribution of the aerosol backscatter coefficient. The thermodynamic profiles measured by radiosondes at the experimental site are used as reference for the molecular scattering. We found that it is possible to calculate the vertical distribution of aerosol using a ceilometer if the profiles containing clouds are correctly identified and removed from the analysis and a suitable temporal average is applied to the data.

Measurement of mechanical properties in vegetable tissue and solid materials by non-contact opto-acoustic techniques - preliminary results.

David Alejandro Collazos-Burbano

Universidad del Valle

Non-contact sensing is a promising technique to reliably, and in a fast way, extract properties of crops, leaves, materials, particles and molecules, to name but a few. Among the several non-contact options available nowadays, acoustic propagation using laser-ultrasonics and air-coupled ultrasound are of current interest because of their capacity to provide information about the mechanical behavior of the samples. Depending on the strategy to generate acoustic waves, we can retrieve information either in the thickness direction or in the plane of the sample. Besides, dispersive properties of the medium can also be extracted to experimentally characterize the samples under study. In this work, we report experimental results on the inspection of solid materials and the characterization of vegetable tissue. In particular, we analyze dispersion properties to detect changes in materials engineering, such as through-holes and notches. Furthermore, we use laser induced acoustic waves to estimate the mechanical properties and relative water content in coffee leaves (*coffea arabica*). Finally, we present a discussion on the use of these results to calibrate current remote sensing measurements used in smart agriculture.

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Many studies have investigated the effect of aerosol hygroscopic growth on the scattering coefficient using in-situ techniques (e.g. nephelometers tandem), including the effect of aerosol chemical composition and particle size distribution in the hygroscopic enhancement factor. However, it is difficult to provide results above 90% relative humidity (RH) with tandem nephelometers, besides they also modify the environmental conditions. In this sense, other studies have combined lidar and radiosondes to analyze changes in particle backscatter coefficient under relative humidity up to 90% inside a well-mixed aerosol layer. However, the main drawback of this approach is the lack of radiosondes and continuous lidar measurements. In this work, we study the aerosol hygroscopic growth in SIRTA station (Palaiseau, France) by combination of (1) a ceilometer that provides continuous measurements of high temporal resolution aerosol attenuated backscatter with low full overlap height (Vaisala CL31) and (2) a hygrometer installed in a co-located tower (30-m height). This unique experimental layout provided us more than 100 potential cases in a 4.5-year database (2012-2016). After the application of several strict criteria that include (i) checking the simultaneous increase/decrease of attenuated backscatter and relative humidity, (ii) then the aerosol origin is studied, and (iii) finally, we use in-situ data concentration to evaluate the impact of the organic and inorganic compounds over the 8 final cases selected. Finally, co-located measurements of aerosol chemical composition and particle size distribution allowed us to identify links between the hygroscopic growth observed and aerosol type such as the correlation between gamma parameter and the organic/inorganic mass fractions.

Determinación de índices de variabilidad climática en el departamento del Cesar implementando sensores remotos

Donoban Areválo

Universidad Popular del Cesar

En el departamento del Cesar, la minería a cielo abierto se ha consolidado como la actividad económica de mayor importancia; a pesar de esto, los beneficios económicos que genera son empañados por el gran impacto ambiental causado en su zona de influencia, poniendo en riesgo áreas de gran importancia ambiental. La zona minera del departamento cuenta con una red de monitoreo que tiene como función registrar la cantidad de material particulado (PM) presente en el aire. Sin embargo, estos datos solo permiten determinar el índice de calidad de aire de la zona de influencia a partir de muestras puntuales; dejando a un lado la estimación de variables que permitan la evaluación de la calidad de la vegetación y el estudio del suelo. Estos impactos ambientales son agravados con la influencia que ejerce el cambio climático sobre la región. Por estas razones es necesaria la estimación de variables ambientales especiales que permitan el monitoreo del estado de la vegetación, el aire, el agua y el suelo del departamento del Cesar en una línea de tiempo. Partiendo de esto, en el presente estudio se implementan herramientas tecnológicas que aplican técnicas existentes en el campo del análisis visual para la determinación y seguimiento de variables ambientales de cambio climático en el Departamento del Cesar. A partir de imágenes satelitales se calcularán índices de evaluación del estado de la calidad ambiental como lo son: NDVI, SAVI, NSI y TS en zonas de posible afectación. De esta manera se busca abrir la puerta a su aplicabilidad en los municipios adyacentes a la zona de influencia directa y de todo el departamento, y en un futuro plantear la elaboración de un mapa que registre los valores de las variables estimadas a nivel departamental y regional, con la posibilidad del establecimiento de una comparación multitemporal de la calidad de los recursos naturales.

Seasonal analysis of temperature and relative humidity profiles and integrated water vapor from microwave measurements over Granada (Spain)

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Profiles of meteorological variables such as temperature, relative humidity (RH) and integrated water vapor (IWV) derived from a ground-based microwave radiometer (MWR, RPG-HATPRO, G2) are continuously monitored at Granada station (Southeastern Spain) since the end of 2010. In addition, the radiosondes (RS) are launched mostly on field campaigns scheduled from May to September. In this work, a 5-year period corresponding to 2012-2016 is studied in order to characterize the performance of the MWR to provide trustable products. In this sense, the MWR performance is evaluated analyzing the mean-bias and standard deviation. From this analysis, 55 coincident cases were studied. This analysis has been separately performed for all-weather conditions (AWC) and cloud-free conditions (CFC), and also distinguishing between daytime and night-time scenarios. The analysis of the time series of IWV reported a good correlation between RS and MWR. The correlation fits better for CFC (R2= 0.96) respect to AWC (R2= 0.82), presenting a lower mean bias error for CFC (-0.80 kg/m2) than AWC (-1.25 kg/m2). This work reveals the good performance of MWR in terms of temperature and IWV for further applications like weather forecasting, atmospheric boundary layer height (ABLH) studies, aerosol hygroscopicity growth, among others. On the other hand, the whole period with continuous measurements was used to analyze the seasonal variability along the years of temperature, RH, IWV and ABLH derived from MWR, in order to thermodynamically characterize the atmosphere over Granada.

Statistical approach to assess the impact of polluted regions on the Aerosol Optical Depth. measured by AERONET photometers

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Urban pollution has been the focus of several studies in many regions of the world, since their health impacts are highly significant. NASA's AERONET project has been one of the world's leading tools to provide direct access to concentrations and physical properties of aerosols from polluting anthropogenic action. This study proposes the use of statistical tools such as correlation matrices and temporal autocorrelation to access the impact of polluted regions on the Aerosol Optical Depth (AOD) measured by AERONET photometers at different wavelengths. For comparison purposes, 9 sites located in both South and North America were selected, which were distributed among little and highly impacted by pollution. The selected sites were São Paulo, Rio Branco, Manaus, Alta Floresta, Ascension Island, Arica, Canberra, La Paz and Mexico City. Correlation matrices were constructed with the AOD at 8 different wavelengths and they were able to discriminate, through graphic visualizations, sites highly impacted by the pollution of those less impacted, since the most impacted ones had correlations between different wavelengths much smaller than in the case of less impacted sites. The temporal AOD autocorrelations were calculated for each site through the AOD of a given day with that spaced between 1 and 365 days. The results showed that in low contamination sites autocorrelation for all AOD wavelengths has a clear seasonal behavior, with minimum and maximum spacing approximately every 6 months. On the other hand, highly impacted sites, autocorrelation rapidly falls to zero within the first 10 days and fluctuates around this value throughout the study period. This indicates that highly polluted sites present their AOD completely dominated by local anthropogenic processes. Therefore, temporal autocorrelation can be used as a marker for highly polluted sites, and, together with the correlation matrix, provide reliable qualitative information on how significant local anthropogenic impacts are on the AOD seasonality.

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The Low-Level Jet (LLJ) is being studied at Ipero, a municipality into the southeastern part of Brazil. Although Ipero is a predominantly rural place, it already hosts the technological center for nuclear development of the Brazilian Naval and is the future site for a new nuclear reactor. The nuclear activities require a good understanding of atmospheric dispersion, as for normal operation conditions as for accidental emissions. The LLJ (a strong current of winds) is a natural phenomenon that may occur within the Planetary Boundary Layer (PBL) and plays an important role for the atmospheric dispersion. The LLJ hinders the vertical mixture, causing high impact to the hazard material concentration close to the surface. Knowing the LLJ characteristics (as frequency, height, mechanical turbulence generation, cleaner air entrainment, for example) are essential to evaluate the performances of the weather forecast models (input for the atmospheric transport and dispersion models). As an autonomous instrument, the doppler lidar allows the high frequency sampling and extended sampling campaigns, features that are very important considering the fast dynamic of the LLJs and PBL. This work shows the results of a 6 months field campaign in which the doppler lidar operated continuously. This high sampling rate provides an excellent tool for the next steps of this PhD project: the evaluation and adjustment of the weather forecast models and the implementation of atmospheric transport and dispersion models for the 2 nuclear facilities at Ipero. The field campaign results showed that the LLJs occur with high frequency at Ipero and that the Stable Boundary Layer (SBL) is shallow. The results obtained until now raised some questions, as: can the synoptical condition impact the LLJ development? Can the LLJ be stronger or develop faster under no synoptical disturbances or under a post-frontal condition? These questions should be answered with further case studies.

Episodios de contaminación en la ciudad de Bogotá de enero de 2015 a diciembre de 2017

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Antecedentes: Las partículas contaminantes del aire se conocen como material particulado, que puede manifestarse como polvo y humo, aunque también como aire limpio a la vista. Exposición a largo plazo de estos contaminantes se relaciona con alteración en la calidad de vida, aumentando en ciertos casos la mortalidad y morbilidad cardiovascular. El material particulado de tamaño fino (2.5 μm o menores) y ultrafino (0,1 μm o menores) son capaces de alcanzar los alvéolos terminales y en algunos casos la circulación vascular. El estudio de estas concentraciones de material particulado en el año, permiten entender su comportamiento y los diferentes fenómenos que favorecen o dificultan la elevación de estas concentraciones en el aire de Bogotá.

Método: A partir de los datos de la red de monitoreo de aire (RDMCA) del sitio web de la secretaria de ambiente de Bogotá, se establecen los episodios de pico exposiciones en la ciudad de Bogotá durante los periodos comprendidos entre enero de 2015 a diciembre de 2017. Se comparan los periodos de bajo movimiento vehicular en la ciudad Semana santa, diciembre – enero y periodos intersemestrales con el resto de los días.

Resultados: Existe un cambio en los periodos de receso de 2015 y 2017 en relación con fenómenos asociados al flujo vehicular menos marcado en estos periodos. El año 2016, presenta una variación diferente al resto de los años. Para PM2.5, en esos tres años la métrica establecida por la OMS es superada, alcanzando un pico máximo de 20,3 μg/m3 en 2016 (DS 11,8, máximo diario de 99,5 μg/m3 y un mínimo de 2,2 μg/m3). Asimismo, para PM10 se superaron las métricas establecidas por la OMS, alcanzando un pico máximo de 45,2 μg/m3 en 2016. (DS 22,4, máximo diario de 161,9 μg/m3 y un mínimo de 10,8 μg/m3).

Tropospheric O3 modeling from both satellite and in-situ data analysis in the Aburrá valley - Colombia

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Ozone (O_3) is among the most commonly investigated species in dirty atmospheres. The tropospheric O_3 concentration has received much attention over the last decades due to its formation as a byproduct of the photooxidation of hydrocarbons in topographically constrained areas where photochemical smog prevails like in the urban zone of Aburrá valley – Colombia (6°15′N, 75°36′W). In the next few years, O3 should be brought under control as it is classified as a pollutant when found at surface. O_3 measurements from both the "*Sistema de Alerta Temprana del valle de Aburrá*" - SIATA project and NASA AURA satellite were analyzed in the urban area of Aburrá valley in Colombia in order to obtain simple mathematical models describing the behavior of this trace gas during sunny and rainy seasons. Procedures and methodologies applicable to any location are reported.

Atmospheric Aerosols classification at Aburrá valley from both satellite and in-situ data analysis

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Areas like urban zone of Aburrá valley – Colombia (6°15′N, 75°36′W) have been strongly affected from several contaminant sources both natural and anthropogenic, which had caused an increasing of the extreme pollution occurrence. In these regions is important to study and understand the physical and chemical information from atmospheric pollutants

in order to influence on the definition of environmental policies. In this vein, global efforts are being carried out by implementation of air quality monitoring networks both grounds based and airborne platforms. That was one of the reasons why the "*Sistema de Alerta Temprana del valle de Aburrá*" - SIATA project born as a regional risk management strategy. SIATA has many ground stations widely located into the valley in order to continuously monitoring parameters related to air quality and climatology. In other hand, NASA airborne platforms like CALIPSO satellite also monitor air quality and climatology parameters in this region. Therefore, first attempting of correlation between both CALIPSO satellite and SIATA measurements in order to classify the atmospheric aerosols in the urban zone of Aburrá valley is reported.

T-Matrix computation of light scattering to obtain volume linear depolarization ratio of local atmospheric aerosols: Preliminary results

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During the last years in the Aburrá Valley – Colombia, has been a growing interest to identify, quantify and reduce sources of air polluting particles. In this way, is very important the implementation of methods and instruments that contribute to identify different kind of atmospheric particles. Associated to laser remote sensing, one of these methods uses changes in the polarization state of the scattered light for aerosol typing. To identify the shape of particles using the depolarization studies, the calibration and uncertainties related are fundamental. In this work, using algorithms based on the T-Matrix method, reference values of volume linear depolarization ratio produced by different kind of aerosols found in the Aburrá Valley have been retrieved; these values are compared with those obtained by experimental methods.

Depolarization system to identify atmospheric aerosols: laboratory study

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Observations and characterization of aerosol microphysical properties are fundamental to contribute at reducing the largest uncertainty of the Earth's changing energy budget, among these aerosol properties, the aerosol shape information allows the identification of different aerosol types. The polarization Lidar is used to retrieve the particle linear depolarization ratio due to it is often used to discriminate between spherical and non-spherical aerosols. Although many Lidar campaigns have reported depolarization values for tropospheric aerosols, larges uncertainties associated to the instrument and calibration method remains. In the Applied Optics Group of EAFIT University, a polarimetric system integrating an aerosol generator has been developed to perform depolarization measurements of atmospheric aerosols under controlled laboratory conditions, the main aim is to provide reference values to compare in-situ and Lidar measurements. In this work, we present the first results of aerosol backscattering depolarized signals retrieved at controlled temperature and relative humidity conditions.

Characterization of Aerosol Optical Properties in the Atmosphere of Natal/Brazil by a Sun Photometer of the AERONET Network

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Atmospheric aerosols contribute as radiative forcing to global warming and influence in visibility, can provoke acid rain, affect human health and alter precipitation patterns. Since 2016, Natal, capital of the state of Rio Grande do Norte, Brazil, has a sun

photometer (Cimel) of the RIMA/AERONET network installed that can identify the presence of aerosols in the atmosphere and characterize them. The data of the AERONET, at level 1.5, Version 3, provide information on some microphysical characteristics such as Aerosol Optical Depth (AOD), Ångström coefficient, Single Scattering Albedo, Asymmetry factor, Complex refractive index, Volume Size Distribution and precipitable water that were analyzed during the period from August 2017 to February 2018. The data was compared with satellite data from CALIPSO and ground-based DUSTER Lidar measurements at UFRN in Natal. In addition, the backward trajectories of the measured air masses was modeled with the HYSPLIT model The first results of this research showed that the properties were characterized and classified as marine aerosols, mixture between marine and dust, and dust. The case study for January 8, 2018 displayed the presence of a layer of aerosols, a trimodal volume size distribution and backward trajectories coming from the Atlantic Ocean and Africa.