Towards a Lidar Federation in Latin America

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ABSTRACT

Coordinated actions by the Latin American lidar community have been conducted during almost a decade with the aim of creating a Latin American Lidar Network. Although that final goal has not been reached, there are several other achievements resulting for the actions conducted. We describe the evolution of such efforts highlighting the progress and difficulties, discussing the strategy applied during these years. In the process of adapting to the complex economic situation worldwide, new short term goals have been set to maintain the achievements already reached and to continue the capacity building process already in course.

1. INTRODUCTION

From the year 2000 to the present the few Latin America lidar teams have been engaged in a joint effort to create a Latin American Lidar Network. The first approach to reach that goal was conducting a Workshop on Lidar Measurements in Latin America (WLMLA). The workshop specific goals were "*… to promote cooperation between the members of the scientific community engaged in LIDAR research in Latin America, and to plan future lidar research projects in Latin America*" [1]. The first workshop was held on 6-8 March 2001 in Camagüey, Cuba with the support of the INSMET, IAI, WCRP and SPARC [1, 2]. The two initial goals were complemented by a third, "*… to facilitate the education and scientific capacity building of students and young scientists related to lidar research in Latin America*" [3].

That successful first workshop has been followed by a set of four more regular workshops every 2 years including the last one, the V WLMLA, which took place in Buenos Aires, Argentina, at the end of 2009.

The present paper is intended to discuss and evaluate the progress and difficulties confronted during all these years and to describe the changes introduced in the working strategy of the lidar community in Latin America.

2. LATIN AMERICAN LIDARS: CURRENT CONDITIONS

The geographical extent of Central and South America guarantees a maximum regional latitudinal-longitudinal coverage in both hemispheres and with coasts facing the major oceans, the Atlantic and the Pacific. This maximum regional coverage extends in latitude from

55°S in Chile to 30°N in Mexico and longitude from 34°W Brazil to 81°W in Peru.

There are existing or under development lidar teams in Argentina, Bolivia, Brazil, Colombia, Cuba, Chile and Puerto Rico. The majority of the most important atmospheric variables are already being measured by Latin American teams. These include aerosols (both tropospheric and stratospheric, biomass burning, industrial pollution and Saharan dust), ozone (both tropospheric and stratospheric), temperature (stratospheric and mesospheric), water vapour (tropospheric) and the mesospheric sodium layer.

Such a diverse set of measurements is possible because the lidar teams have accumulated the know-how (via in-house development or by technology transfer from lidar teams in other parts of the world). These teams have also developed the local scientific and technological capabilities necessary for keeping the lidar systems operating and for conducting measurements. There are cooperative activities with lidar teams in Europe, Japan and the US, as well as with ESA, JICA and NASA,

Latin America is the only region in the world which maintains a regular series of workshops on lidar applications, including an important educational component with student attendance, participation in lectures and presentations. Both regional and international experts participate as lecturers in the sessions dedicated to the students and young researchers.

3. 5th WLMLA

The 5th WLMLA was the most recent event conducted by the lidar community in Latin America. It was organized by the División Lidar-CEILAP (CITEFA-CONICET) [4]. Sessions were held at the Instituto Tecnológico de Buenos Aires (ITBA), from November 30 to December 3, 2009. Information about the numbers of attendees and presentations for the five workshops already held is shown in Table 1. The total number of attendees and presentations at the 5th WLMLA maintained the general increasing trend already evident in the former workshops. Table 1 also shows that the number of attendees from the rest of the world continues to rise, demonstrating the increasing interest of the international scientific lidar community in lidar activities in Latin America. Another important indicator is the number of students attending, constituting an average of around one third of the attendees.

In table 1 oral and poster presentations also show an increasing tendency. This trend could also be associated in some degree to the fact that beginning with the III WLMLA, held in Popayan, Colombia, July 11th-15th, the publication of papers presented at the workshop has been made possible, after a peer review process. Both the oral and poster presentations, elaborated as papers by the authors, are submitted to a committee, in charge of conducting a peer review process. All the papers accepted are being published in Pure and Applied Optics (OPA, Óptica Pura y Aplicada), the official journal of the Spanish Optical Society. This achievement has been possible thanks to the financial support of the Atmospheric Optics Group of the University of Valladolid, through the personal effort and engagement of Dr. Angel de Frutos Barajas, leader of this group. This important contribution was recognized and acknowledged at the Open Session of the V WLMLA.

Table 1: Attendees and presentations at each of the WLMLAs. LA: Latin America; RW: Rest of the World; ST: Students; OR: Orals; PO: Posters. (Oral presentations include lectures.)

WLMLA	Attendees				Presentations	
	LA	RW	Total	ST	OR	PO
I	9	14	23	5	14	5
II	13	12	25	13	25	2
III	25	6	52	26	25	6
IV	30	12	42	20	29	16
V	42	23	65	21	31	31

Also at the cited Open Session the permanent financial support from the II to the V WLMLA provided by the European Space Agency (ESA) was acknowledged. In particular the role played by Dr. Errico Armandillo in guaranteeing such support was highlighted. In addition it was recognized that Dr. Armandillo has also been the only non-Latin-American scientist to have attended all the five workshops already conducted. He has also cooperated in several of the WLMLA International Organizing and Awards Committees. Morover he has been a permanent source of advice and suggestions on how to promote the advance of the lidar community in Latin America.

Finally in the open session Dr. Francesco Zaratti, leader of the Laboratorio de Física de la Atmósfera, Universidad Mayor de San Andres (LFA-UMSA), La Paz, Bolivia, offered his institution to host the VI WLMLA. The general consensus was to hold it in La Paz, Bolivia in 2011, with the Local Organizing Committee led by the Dr. Zaratti and composed by

personnel of LFA-UMSA. This Workshop will mark the 10th anniversary of this enterprise, consequently pioneers in the organization and implementation of the first workshops will be specially invited to attend.

The V WLMLA was highly successful and achieved all the goals proposed.

3. ACTIONS IMPLEMENTED

The evolution of the series of WLMLAs has been described at several International Laser Radar Conferences (ILRC), explaining the adaptation strategies adopted according to the changing situations confronted during over the years [3, 5, 6].

Several attempts have been made to find funding to support the organization of the Lidar network, all unsuccessful. Among these attempts were contacts with the Programa Iberoamericano de Ciencia y Tecnologia para el Desarrollo (CYTED) in particular in the networking section. The research lines proposed during the last 3 program calls did not allow our network to be included.

Following the IV WLMA, held in Ilhabela, Brazil, in June 2007, an attempt was made to organize a Lidar summer school, but because the lack of funding sources it was also unsuccessful.

Because of the international recognition reached by the Lidar Community in Latin America one of the lidar team leaders was selected as a member of the International Coordination group on Laser Atmospheric Studies (ICLAS), this being the first time ever that a Latin-American is present in this group [7]. It is expected that upon the ending of his term another Latin-American scientist will be included in the group. Also a Latin-American contribution was present at the Meeting of WMO Experts for the design and implementation of GALION (GAW Aerosol Lidar Observation Network). The lidar sites from our region were included in the design of the Global Network and particular attention was paid to the capacity building effort been conducted in Latin America [6, 8].

4. ACTIONS UNDERWAY

Although much of the world is building lidar networks, both at regional and global levels; we do not envisage that possibility for Latin American lidar teams in the near future. The reasons: very few lidar stations, very different instruments measuring different parameters at each site, but mainly the lack of funds. In this context our goal is to maintain and increase the level of exchange and capacity building actions and to keep exploring all opportunities for creating a network.

In this sense, at the 5th WLMLA the possible affiliation to ALAGE (Asociación Latinoamericana de Geofísica Espacial) was proposed. This option is under evaluation by the team leaders.

Participation in GALION is also an important activity for our lidar community. It will take place both by individual lidar teams' affiliations to GALION, once the project has been implemented, as well as by contributing with our experience in capacity building. In the last case, the series of Workshops we have conducted during the past decade, could serve as an option for facilitating the capacity building activities in regions of the world with low scientific and technical expertise in lidar.

Several measures are being taken to increase the cooperation and exchange between the Latin American lidar teams and with other groups all over the world.

The División Lidar from CEILAP (CITEFA-CONICET), consists of two experimental sites: one in Río Gallegos, Santa Cruz province and the other in Villa Martelli, Buenos Aires province, in the metropolitan area of Argentina's capital. The first has been the subject of an optimization of its electronics for all the channels of the DIAL system for ozone measurements, increasing its precision, with the partial financial support of JICA (Japan International Cooperation Agency). Active cooperation with NIES (Japan) and with the Service d´Aeronomie, CNRS (France) continues. A new spectrometric box for three elastic and three inelastic channels is being implemented, for a better characterization of the aerosols. In Villa Martelli a new mobile Raman lidar is being built for measurements at different sites. The lidar is being built in cooperation with NIES. Also, the six mirror lidar for the future Cherenkov Telescope Array Observatory (CTA), is being designed. This instrument will be installed in a country to be selected by the consortium in charge of the whole project, in which Argentina participates.

The IPEN lidar team (São Paulo, Brazil) and the Camagüey Lidar Station (Cuba) are drafting a joint proposal for studying the latitudinal distribution of Saharan aerosols arriving in our region. The IPEN lidar team also plans to upgrade their instrument to a 6 channel Raman system, with Nitrogen and Water vapor channels at 532 and 355 nm wavelengths. In addition, it will begin an indirect aerosol hygroscopic growth project; continue the Raman lidar water vapor system calibration study and the tropospheric aerosol and biomass burning tracking measurements as well.

The INPE lidar team (São José dos Campos, Brazil) plans to install an aerosol channel in its sodium resonance lidar. This will enable the lidar to measure

upper tropospheric and stratospheric aerosols from volcanic and biomass burning sources, in addition to its main purpose of measuring temperatures between 80 and 100 km.

The Atmospheric Physics Laboratory at La Paz Bolivia, with the collaboration of the Raman LIDAR group at NASA-GSFC, is implementing an aerosol backscatter LIDAR for monitoring the aerosols mainly produced by tropical biomass burning. The implementation of the project is in an advanced phase and the first experimental results are expected to be delivered soon.

In Colombia, the Lasers and Spectroscopy Group, Universidad Nacional de Colombia, Sede Medellín, has designed and built an elastic backscattering LIDAR. The objective of this project is to study aerosol optical properties in the Medellín troposphere, (Longitude 75º 34' 05" West, Latitude 6º 13' 55" North), a strategic location in South America to derive quantitative information on optical parameters of the tropical region.

The first LIDAR campaign in Colombia will begin in May of 2010 with the development of a project financed by the local government. The LIDAR data will be used to help our understanding of local, regional, and global atmospheric dynamics.

The goal of the Colombian Group is to establish a synergy between the Latin American lidar teams and with other groups in the world, aiming at standardization of instruments, calibration, and data processing.

6. SUMARY

Although the implementation of the Latin American Lidar Network is still not possible, our lidar community remains committed to the main goals agreed upon almost ten years ago. We will maintain the series of workshops every two years, paying particular attention to the participation of students and young scientists from our region. The development of capacity building actions is another direction in which we will concentrate our efforts. Joint research projects and cooperation agreements, both with Latin American teams and with the rest of the world will continue to be promoted. The association of as many as possible of the Latin-American lidar teams to the GALION project is another goal to be aimed at.

Acknowledgments: The core of this work was supported by the Cuban National Climate Change Research Program grant 01301204.

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