AEOLUS calibration and validation activites at SPU Lidar Station - Brazil

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Background and objectives

The SPU Lidar Station, which belongs to Latin America Lidar Network (LALINET) (Guerrero-Rascado et al, 2016), installed at the Center for Laser and Applications (CELAP – IPEN), has been monitoring the vertical distribution of particles optical properties since 2001 using a Raman lidar system, developing a database of vertical distribution of aerosols and other atmospheric components such as water vapor and clouds, over Metropolitan area of São Paulo - Brazil. The SPU Lidar Station also provides quality assurance data for satellite missions such as CALIPSO (Lopes et al., 2013), and ESA's mission AEOLUS and EarthCARE.

The ADM-AEOLUS mission was successfully launched on August 22, 2018 and since November 4, 2018 the SPU Lidar Station has initiated correlative measurements, focusing on validation and comparison with the ALADIN instrument. ADM-AEOLUS satellite overpasses São Paulo site twice a week, every Sunday, in two different orbits, the descending trajectory at 08:49 UTC and the ascending trajectory at 21:29 UTC. The main objectives of our efforts in the ADM-AEOLUS validation and calibration process is to compare L2A AEOLUS products of aerosol and cloud profiles of backscatter and extinction coefficients and also lidar-ratio.

Methodology

In order to achieve these points we have performed measurements using a multi-wavelength lidar system, which is a coaxial ground-based system operating with a pulsed Nd:YAG laser, emitting radiation at 355 nm, 532 nm, and 1064 nm; a laser repetition rate of 10 Hz; and a laser beam pointing to zenith direction. The pulse energy (and stability) of each wavelength is 225 mJ (2 mJ) at 355 nm, 400 mJ (4 mJ) at 532 nm and 850 mJ (6 mJ) at 1064 nm. The SPU Lidar Station detects three elastic channels at 355 nm, 532 nm and 1064 nm and three Raman-shifted channels at 387 nm, 408 nm (shifting from 355 nm by N_2 and H_2O) and 530 nm (corresponding to the rotational Raman shifting from 532 nm by N_2).

Quality Assurance and Quality Control (QA/QO) program based on the EALINET standards were implemented in SPU Lidar Station to provide quality assured particle backscatter and extinction profiles (Guerrero-Rascado et al, 2016). We performed a four hours measurement centered at the time-period of the closest approach of AEOLUS satellite over SPU Lidar Station and from measurements we applied the Klett-Fernald-Sasano (klett, 1985; Fernald, 1984; Sasano et al., 1985) and Raman (Ansmann et al., 1990) inversion techniques in order to derive the backscatter and extinction profiles.

Results

The SPU Lidar Station accomplished so far, a total of 43 correlative measurements with AEOLUS satellite, from a total of 122 overpasses. From this total, 22 measurements were in acceptable atmospheric conditions to make correlative analysis.

During August 18, 2019 São Paulo city atmosphere experienced an intrusion of a long-range layer of aerosol coming from the Central-Western part of Brazil, from Bolivia and the Amazonia basin. Figure 1 shows the backscatter profiles at 355 nm retrieved by the AEOLUS L2A SCA (standard correct algorithm) product and the SPU Lidar Station. The SPU Lidar Station detected three different aerosol layers. The first one between 0.3 km to 1.0 km of altitude, the second one between 2 km and 3 km, and the third one and

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more intense around 4 km of altitude. We can observe a good agreement for both system for the layer detected at 4 km of altitude.
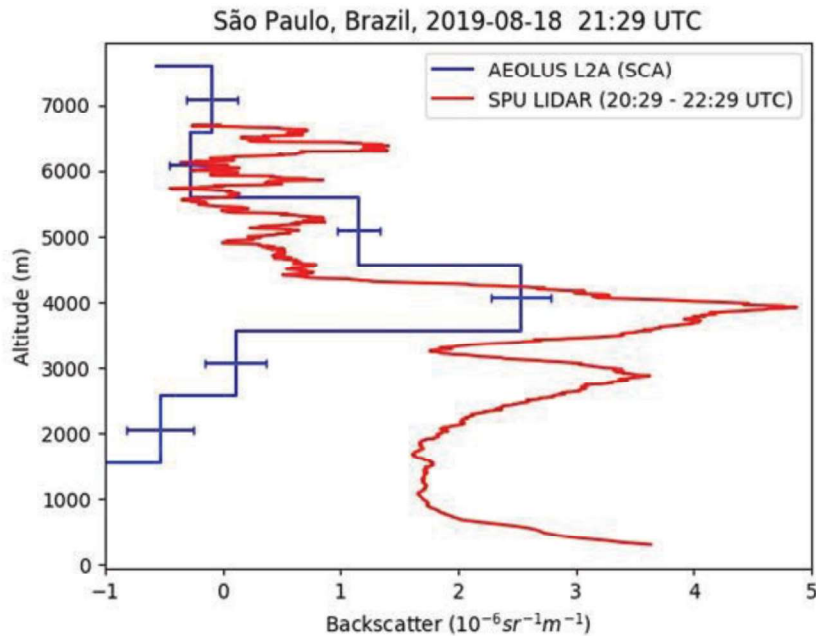

Figure 1. The backscatter profile at 355 nm retrieved by SPU Lidar Station and AEOLUS satellite over São Paulo-Brazil at 21:29 UTC during August 18, 2019.

For the biomass burning detection on August 2019, AEOLUS retrieved lidar ratio values between 76 sr to 81 sr, which agree with the lidar ratio retrieved by the SPU Lidar Station that was around 60 sr to 80 sr.

This preliminary result shows an indication that for higher aerosol layers detached from aerosol boundary layer, the AEOLUS satellite measurements are in good agreement with SPU Lidar Station retrievals.

Disclaimer and Acknowledgements

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