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Combining PBL and Free Troposphere Lidars to improve the retrieval of aerosol optical properties

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In recent years, the scientist from the field of the atmosphere sciences concluded that climate and climate changes depend on atmospheric composition and the physical processes induced by green house gases and aerosols.

Laser remote sensing is a useful tool used to provide systematic monitoring of the temporal evolution of atmospheric parameters in order to understand the radiative, physical, chemical and dynamic processes in the lower and upper atmosphere.

Depending on the system design, its can measure the backscatter and extinction due to aerosols and clouds, water vapor mixing ratio, molecules concentration or wind velocity. Methods that are more complicated allow automatic detection of the layers in the lower atmosphere, the Planetary Boundary Layer (PBL) dynamics, but also calculation of Angstrom coefficients, Single Scattering Albedo (SSA), particle depolarization and Aerosol Optical Depth (AOD). The knowledge of these parameters allows to quantify the impact of aerosols on climate and to assess, in turn, the feedback of climate change on atmospheric composition.

This paper presents recent studies of aerosol characteristics using PBL (elastic backscatter) lidar and Free Troposphere (Raman multiwavelength) lidars data from Bucharest-Magurele and during field campaign.

The retrieval of aerosol optical parameters from lidar is limited of the instrument's capability and inversion algorithm. In the PBL lidars (low range detection), the calibration in far-range is difficult due to the SNR (Signal to Noise Ratio). In the FT lidars (high range detection), the assumptions made for the "blind" region introduce large error when computing integrated column or PBL parameters. In order to optimization optical proprieties of aerosols provided by those lidars, the low range (LR) and high lidar (HL) data have been gluing in some fashion to create a single backscatter profile for each channel. The gluing procedure has applied to identical products, in our case to data describing the same atmosphere and free of instrumental dependencies. The usual way is to glue the optical products but in our case, this product is directly dependent on a correct calibration and a proper choice of the lidar ratio for the LR lidar. The HR lidar, on the other hand, can provide lidar ratio and can be calibrated with a higher accuracy, since it is a multiwavelength lidar.

Applying the gluing procedure for the time-averaged signal, the dynamic range is considerably increased and the relative error in computing AOD is reduced. The combination of ground instruments (like sun photometer) and lidars using AOD as common parameter leads, therefore, to an improved accuracy in the determination of aerosol's optical and microphysical parameters.

Lidars have proved their ability in providing real time information on atmosphere's structure, dynamics and density.

Using of lidar observations with in situ measurements and models provides a unique opportunity to conduct long-term inter-calibrations and complementary or simultaneous monitoring of different atmospheric parameters over various space-time scales.