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Boundary layer heights determinate from Raman multiwavelengths lidar and microwave radiometer measurements

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Planetary boundary layer (PBL) is the lowest part of the troposphere that is directly influenced by friction and solar heating from earth's surface. Accurate determination of the boundary layer heights is critical in understanding the regional air quality.

Lidar systems have been widely used to examine the structure and variability of the boundary layer (BL) heights (Brook et al 2000, Talianu et al 2006, Madonna et al, 2011). This paper aims to develop a method of assessing the PBL heights using Raman multi-wavelengths lidar – RALI measurements. RALI system has three elastic (1064nm, 532nm, 355nm) and two Raman (607nm, 387nm) channels. This method is based on the vertical gradient accurate calculation of the ratio between signal collected from elastic and inelastic channels. From 500m up to 10 km this will give information about vertical distributions of aerosols layers. We have chosen to use as method for validation the one described by Stull (Stull 1988) based on virtual potential temperature. The vertical gradient of the virtual potential temperature gives also information about the stability of stratification. Temperature, pressure and humidity profiles provided by the microwave radiometer (collocated with the lidar system) have been used to determine virtual potential temperature profiles. The PBL heights calculated from virtual potential temperature have been compared with PBL heights determinate from lidar data collected before and after sunset measurements, in Magurele (Longitude: 26.029 E, Latitude: 44.348 N, a.s.l: 93m), near Bucharest, June to August 2011.

Results from lidar data showed the breakdown of the boundary layer after sunset and is visible on almost every day of measurements. The height of the boundary layer has been determined and lies between 700 and 800 meters during 2011 summer time. These results have been similar with the outputs of the virtual potential temperature method and a good correlation of the two methods has been found. Therefore we validated the method based on Raman multi-wavelength lidar measurements to calculate PBL heights as a reliable and useful tool.