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Temporal evolution of the planetary boundary layer over Athens, Greece - Statistical analysis based on coincident lidar and radiosonde data in the frame of EARLINET (2002-2012)

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The focus of this paper is to study the temporal evolution of the Planetary Boundary Layer (PBL) height over the basin of the megacity of Athens, Greece for a 10-years period: 2002-2012. This study is based on a statistical analysis of PBL heights derived from coincident laser remote sensing (lidar) and radiosonde data, obtained in the frame of the European Aerosol Research Lidar network (EARLINET). To this end, the systematically obtained data (in terms of the lidar signals) by the EOLE Raman-elastic lidar system of the Laser Remote Sensing Unit (LRSU) of the National Technical University of Athens (NTUA), in conjunction with the radiosonde data obtained by the Hellenic National Meteorological Service (HNMS), have been statistically analyzed.

The NTUA EOLE lidar system is able to provide the vertical aerosol backscatter (at 355, 532, 1064 nm), aerosol extinction (at 355 and 532 nm), as well as water vapor mixing ratio profiles, from about 700 m up to 10000 m, with high temporal ($<$ 5 min.) and spatial (7.5 m) resolution. The calculation of the first and second derivative of the Range-Corrected Lidar Signal (RCLS) permits the calculation of the PBL height, with a spatial resolution of about 15-30 m, in the range height 700-10000 m, respectively. Radiosonde data are collected daily by HNMS radiosoundings at midnight (00:00 UTC) and midday (12:00 UTC) at the site of Hellenikon, approximately 10 km SW from the NTUA lidar station. The atmospheric parameters calculated from the radiosonde data to provide the PBL height are the potential temperature and the Richardson number.

Our data analysis was based on hourly-averaged lidar RCLS measurements, obtained in a time window starting 30 min before and ending 30 minutes after the radiosounding launching time. A good correlation coefficient value ($R^2 > 0.8$) between the aforementioned lidar – radiosonde dataset ensured the accurate derivation of the PBL height. A statistical analysis based on the spatial and temporal variation of PBL height was also introduced, as the PBL height differentiates on a diurnal and seasonal scale. Our results have been compared with previous studies and conclusions are finally drawn.

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