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Intercomparison of lidar and ceilometer retrievals for PBL and aerosol profiling over Athens, Greece

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This paper presents an intercomparison of two active remote sensors (lidar and ceilometer) in determining the structure of the Planetary Boundary Layer (PBL) and atmospheric aerosol vertical profiles, in the troposphere over Athens, Greece. This intercomparison is performed during a 2-day period of coincident and co-located lidar/ceilometer measurements to monitor the temporal evolution of the PBL structure. The portable lidar was provided by Raymetrics S.A. (Greece) and the ceilometer by Vaisala (Finland). Based on a 2AP positioner from Kipp & Zonen B.V. (Holland) Raymetrics S.A. Greece has developed a fully automated 3D scanning eye safe lidar system equipped with a 200 mm diameter telescope (LB11 ESS D-200 model) which can work 24-hours per day, outdoor, under unattended operation under almost any weather condition. Vaisala CL 31 operates at 910 nm and its measurements range goes up to 7.5 km. The methodology followed was based on the determination of the mixing layer height using suspended aerosols as indicator of the PBL structure, in conjunction with available radiosonde data. The limitations of each instrument are also examined. The capability of Vaisala CL31 ceilometer to detect aerosol structures in the free troposphere is additionally evaluated against quality assured lidar profiles. The variability of the aerosol backscatter profile at 355 nm taken with lidar found to be in a good agreement with the ceilometer retrievals, in altitudes higher than 2000 m. That fact indicates that despite its low energy laser and simplicity in transmitter and receiver optical design, a ceilometer can provide qualitative description of the vertical aerosol structures, under the assumption of suitable aerosol loads. The quantitative performance of a ceilometer in regard to the accuracy of the calculated backscatter profiles is finally examined and the improvements on the retrievals are shown when coincident sunphotometric measurements are available.