Aerosol climatology of tropospheric aerosol profiles over Athens, Greece using an elastic-RAMAN lidar system (2000-2006)

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Tropospheric aerosols play an important role in earth’s radiation budget through the scattering and absorption of the incoming and outgoing radiation. This can yield to local radiation balance and climate changes (local cooling or heating effects) depending on the aerosol chemical composition (Houghton et al., 2001). Therefore, monitoring the optical properties of the aerosol particles is of crucial importance in studies of climate change, atmospheric modelling and satellite image correction.

Six-years of systematic measurements of aerosol backscatter, extinction, integrated backscatter, lidar ratio and optical depth using an elastic-Raman lidar system, at 355, 387 and 532 nm have been performed over Athens [37.9° N, 23.6° E, 200 m above sea level (asl.)], Greece. All lidar data were obtained in the frame of the EARLINET project (2000-2003) and also beyond (PENED-2003 Project), up to April 2007.

The lidar profiles were obtained in the lower troposphere typically from 500 m to 5000 m asl. The high quality of the lidar data has been previously assured by extensive inter-comparison at software (Böckmann et al., 2004) and hardware level, within the frame of the EARLINET project (Bösenberg et al., 2003). A large amount of the aerosol profiles has been recorded by the elastic lidar system during daytime and by the Raman lidar system during nighttime.

A statistical analysis has been performed to evaluate the optical properties of aerosol over Athens and observe their seasonal variations (Matthias et al., 2004). Mean values and variances of the aerosol backscatter ($\beta_{aer}$) and extinction ($\alpha_{aer}$) profiles, integrated backscatter (IB), and optical depth (AOD) have been evaluated.

The corresponding seasonal cycle of these quantities shows highest values during the summer period and secondary maxima during the autumn/spring period. Small fluctuations have been found only during the winter months.

High aerosol integrated backscatter values were found during the summer period, due to larger dust concentrations in the lower troposphere linked to long-rang transport activity of dust from the Saharan desert region.

Additionally, the seasonal variation of the lidar ratio (LR) at 355 nm was evaluated. Air mass back-trajectory analysis, along with a cluster analysis, related the lidar ratio and aerosol optical thickness values to air masses of different origin (i.e, Saharan dust, biomass burning, marine or continental aerosols). Thus, higher lidar ratio values in the free troposphere are generally correlated with air masses coming from southerly directions and this could be related to aerosols originating from the Saharan dust region and also from the NW directions (central Europe).

This lidar ratio climatology could also be useful for satellite data retrieval applications and for calibrating elastic backscatter lidar systems.

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