



One-year systematic measurements of tropospheric ozone profiles over the city of Athens, Greece using a ground based DIAL system

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Ozone and aerosol vertical profiles have been measured simultaneously over the city of Athens (37.9°N, 23.6°E) during the last 12 months (2004-2005). The Differential Absorption Lidar system (DIAL) is based on the 4th harmonic (266 nm, 20 mJ) frequency of a pulsed Nd:YAG laser, which is used to pump a 60 cm long Raman cell filled with a mixture of 3.5 bar H₂ and 11.5 bar D₂ (Ancellet et al., 1989; Tzortzakis et al., 2004). The Raman cell is fitted with two-convex-concave quartz lenses (30 cm focal length) as entrance and exit windows. The Raman shifted frequencies from H₂ (289 nm) and D₂ (299 nm) are emitted into the atmosphere, with output energies of the order of 5 mJ. The receiving system consists of a 150 mm diameter Cassegrainian telescope with 700 mm focal length. The signals detectors (PMTs) are operated both in analog (20 MHz, 12 bit) and photon-counting mode (250 MHz) for maximum efficiency at near and far ranges. The spatial resolution of the detected raw lidar signals is 15 m.

The ozone DIAL measurements are corrected using simultaneously obtained aerosol profiles at 299 nm, in combination with a modified Klett inversion algorithm (Klett, 1985) using as input the mean lidar ratio data profiles obtained from N₂-Raman lidar measurements at 387 nm (Papayannis et al., 1990; Ansmann et al., 1992).

Routine measurements have been performed twice per week to obtain ozone and aerosol profiles over the city of Athens under various meteorological conditions. The range of the ozone/aerosol profiles varies from 300 m up to 4000 m above sea level (asl). The ozone profiles are inter-compared to simultaneous measurements obtained by ozonesondes launched from the University of Athens (Laboratory of Meteorology).

The DIAL data at the lowest point (300 m asl.) are also compared to nearby ground measurements obtained by the Greek Ministry of Public Works, Urban Planning and Environment at the Agia Paraskevi air pollution station (250 m asl.) located at a 4 km distance from our site.

In total 80 ozone DIAL profiles have been obtained during the period 2004-2005. The estimated ozone concentration varies from 45-50 ppbv during the winter period, while these values range between 55-80 ppbv during the summer period. Good correlation has been found between ozone profiles obtained by the DIAL technique and the ozonsondes launched over the city of Athens. Also good correlation ($R^2=0.92$) has been found between ground-based measurements and the DIAL data at 300 m asl. The ozone concentration has been found to be approximately 1.5 times higher at the top of the Planetary Boundary Layer (PBL), than at ground level. Aerosol layers are usually found aloft near the top of the PBL, which lies between 2 – 2.5 km during summer period.

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1 References

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