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Vertical distribution of ozone, aerosols and nitrogen oxides over Athens during late summer in the frame of the STAAARTE Project

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Air pollution is a major issue for the authorities, especially near significant urban centers or industrial parks, as it has a strong impact on human health or other living organisms and the environment. Among the most important air pollutants are ozone, aerosols and nitrogen oxides. In the troposphere, ozone formation results from the photochemical oxidation of volatile organic compounds (VOC) and carbon monoxide in the presence of nitrogen oxides ($\mathrm{NO_x} = \mathrm{NO} + \mathrm{NO_2}$). Aerosols enter the atmosphere as primary particles (e.g. maritime, dust), or they are produced chemically from a variety of compounds including organics, $\mathrm{SO_2}$ and $\mathrm{NO_x}$. Nitrogen oxides are produced mainly from combustion processes, lightning and biogenic activities in the soil. The nitrogen compounds emitted in the atmosphere are essentially in the form of NO, but NO is rapidly oxidized into $\mathrm{NO_2}$ and for this reason are grouped into $\mathrm{NO_x}$.

Athens is the capital of Greece with about 4 millions inhabitants in its larger urban zone, being one of the largest urban agglomerations in the Mediterranean region. Athens is characterized by (i) high concentrations of primary and secondary pollutants, frequently exceeding the air quality standards, emitted from high density pollution sources (traffic, industrial, domestic), (ii) high levels of solar irradiation and temperature throughout the year stimulating the photochemical production, and (iii) a topography which facilitates the accumulation of pollutants. In addition, as Athens is located in the eastern Mediterranean region is affected by the transport of high concentrations of ozone and aerosols, the former associated with polluted air masses from northern directions and the latter with air masses mostly from southern directions.

During September 19-26, 1996, the STAAARTE 96 *Hellen* airborne campaign was organized over the Greek territory, in order to characterize the distributions of ozone and aerosols in the lower troposphere. To this purpose the French research aircraft ARAT was instrumented with the lidar ALTO operating in the nadir-looking mode measuring ozone and the aerosols scattering ratio at 316 nm, as well with in situ instruments on board measuring ozone, aerosols (scattering coefficient at 550 nm) and $\mathrm{NO_x}$. The aircraft was based in Athens, which permitted to sample the lower troposphere (0.5-3 km) around Athens during 12 take offs and landings using the in situ observations. In addition, 2 flights were realised near Athens in order to reveal the vertical distribution of ozone and aerosols from the lidar observations at regional scale.

Results show that ozone over Athens varies from 25 to 70 ppb during the different flights, with the mean value of 45 ppb being almost constant with altitude. The aerosols scattering coefficient varies from 30 to 110 $\mathrm{Mm^{-1}}$, with higher values inside the boundary layer, except in one case with dust aerosols from Sahara. The same holds for $\mathrm{NO_x}$, ranging from 250 to 2500 ppt and even higher concentrations in the boundary layer for two cases. The mean profiles are compared with the simulations from the chemistry-transport model CHIMERE. While, the influence of the long-range transport above the boundary layer is examined with the Lagrangian dispersion model FLEXPART.