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Study on optical and microphysical properties of mixed aerosols from lidar during the EMEP 2012 summer campaign at 45^{o}N 26^{o}E

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Aerosols optical and chemical properties in the upper layers of the atmosphere and near ground are variable, as function of the different mixtures of aerosol components resulting from their origin and transport over polluted areas. Due to a complex dynamics of air masses, the Romanian atmosphere has strong influences from dust and biomass-burning transported from South, West or East Europe. The dominant transport, and consequently the dominant aerosol type, depends on the season. As a result of the transport distance from the source and depending on the chemical and physical characteristics of the particles, tropospheric aerosols detected at Magurele, Romania, show different optical and microphysical properties than at the originating source. The differences are caused by the mixing with local particles, and also by the ageing processes and hygroscopic growth during the transport.

This paper presents a statistical analysis of tropospheric aerosol optical properties during the EMEP (European Monitoring and Evaluation Programme) summer campaign (08 June - 17 July 2012), as retrieved from multiwavelength Raman and depolarization lidar data. Three elastic (1064, 532 and 355 nm), two Raman (607 and 387 nm) and one depolarization channel (532 nm parallel / 532 nm cross) are used to independently retrieve the backscatter coefficient, extinction coefficient and linear particle depolarization ratio of aerosols between 0.8 and 10 km altitude. Intensive optical parameters (Angstrom exponent, color ratios and color indexes) and microphysical parameters (effective radius, complex refractive index) from multiwavelength optical data inversion of the layer mean values are obtained.

During the campaign, aerosol profiles were measured daily around sunset, following EARLINET standards. An intensive 3-days continuous measurements exercise was also performed. Layers were generally present above 2 km and bellow 6 km altitude, but descent of air masses from the free troposphere to the ground was also possible in favorable meteorological conditions.

Long-range transport of mineral dust originating from Sahara region was dominating the 3 - 5 km layers for the entire period. The presence of non-spherical particles was assessed based on high particle depolarization values measured by the lidar and confirmed by the HYSPLIT backtrajectories. Only 7 out of the 22 layers carrying mineral dust particles were found to have optical properties of pure Saharan dust. The mixing of Saharan dust with continental polluted aerosols results in a modification of both intensive (AE, SSA) and extensive (AOD) optical properties.

Three cases of biomass burning were also observed and analyzed: 8, 14 and 24 June, 2012. Microphysical inversion was performed for the lofted layers, and results were compared to the measurements at ground, using a C-ToF Aerosol Mass Spectrometer. The spectrometer provides real-time size resolved composition analysis of particulate matter, with 0.002 μg/m3 detection limit and mass range up to 800 m/z. Mixing with local aerosols but also changes in the chemical properties due to ageing processes and hygroscopic growth were found to strongly influence the optical and microphysical properties of long-range transported biomass burning particles.