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Optical properties of anthropogenic pollution and Saharan dust aerosols over the North-Western Mediterranean basin: airborne observations during the TRAQA 2012 campaign

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The Mediterranean basin is a very complex area where high concentrations of atmospheric aerosols of different origin and types may be found.

The North-Western part of the Mediterranean basin, due to its closeness with high polluted industrialized areas (such as the Po Valley and the Fos/Berre region) and coastal high populated cities (such as Barcelona, Marseille, Nice, or Genes), is frequently affected by severe pollution episodes. The strength of these episodes is particularly intense during summer when stable meteorological conditions favour the accumulation of pollutants in the lower-most atmospheric layers. In addition to these phenomena, also the export of Saharan dust aerosols, which is more favoured during summer in this part of the basin, strongly contributes to the high aerosol load.

An intensive airborne campaign (TRAQA, TRansport and Air QuAlity) was conducted in June-July 2012 over the North-Western Mediterranean basin with the SAFIRE ATR-42 aircraft. Observations performed during TRAQA have given the opportunity to analyse the microphysical and optical properties of atmospheric aerosols in a large area of the western Mediterranean basin (Gulf of Genes, western Corsica, Gulf of Lion, north-eastern Spain). During the campaign the western Mediterranean basin was interested by different synoptic conditions which lead to the export of anthropogenic plumes from different polluted source regions (northern Italy and the Po Valley, Marseille and the Fos/Berre region, and Barcelona), as well as to a strong Saharan dust intrusion.

Measurements of the aerosol optical properties (scattering and backscattering coefficients at 450, 550, and 700 nm with a TSI nephelometer; absorption coefficient at seven wavelengths between 370 and 950 nm with a Magee Sci. aethalomether), size distribution (PCASP, 0.1 μm<D_p <3.0 μm), and total particle number concentration (TSI Condensation Particle Counter, 4 nm<D_p <3.0 μm) were obtained during flights; aerosol particles were also collected on polycarbonate and quartz membranes in order to derive the bulk aerosol composition and mass concentration. Particles were sampled through the AVIRAD system, specifically developed for airborne operations. Lidar profiles (backscatter at 355, 532, and 1064 nm, and depolarization at 355 nm), meteorological parameters, upward and downward shortwave and longwave radiative fluxes, and atmospheric composition (H_2O and CO_2 with Li-Cor7500, CO and $O_3$with the MOZART analyzer, and VOCs with a PTR-MS) were also measured from aircraft instrumentation.

A detailed analysis of the microphysical and optical properties obtained for pollution events and the Saharan dust intrusion will be presented. Results suggest a large variability of the aerosol absorption properties as a function of the source region for pollution particles. The single scattering albedo (ω) obtained between 370 and 950 nm for the different episodes, is lowest for aerosols from the Marseille-Fos/Berre area (0.85-0.70 at 370-950 nm), thus indicating high absorption capability, whereas the pollution from Barcelona and the northern Italy-Po Valley is characterized by higher values (0.89-0.84 and 0.97-0.92, respectively), thus indicating a less absorbing aerosol. For Saharan dust particles the single scattering albedo varies between 0.81 (370 nm) and 0.98 (950 nm), in agreement with estimations reported for this aerosol type in the Mediterranean basin.