Geophysical Research Abstracts
Vol. 16, EGU2014-11014, 2014
EGU General Assembly 2014

Optical properties and vertical distribution of pollution aerosols in the Mediterranean basin in summertime: airborne observations from the Charmex SOP0, SOP1, and SOP2 campaigns

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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 and coastal high populated cities, 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 lowermost atmospheric layers.
Three intensive airborne campaigns (TRAQA, TRansport and Air QuAlity, June-July 2012), ADRIMED (Aerosol Direct Radiative Impact on the regional climate in the MEDiterranean region, June 2013) and SAFMED (Secondary Aerosol Formation in the MEDiterranean, July 2013) have been conducted over the North-Western and Central Mediterranean basin with the SAFIRE ATR-42 aircraft in the framework of the ChArMex Special Observing Periods 0 and 1. During the different campaigns the ATR-42 was equipped with a large set of instruments for the measurements of the aerosol physico-chemical (GRIMM, SMPS, PCASP, USHAS, FSSP for size distribution, and three lines for filter sampling on polycarbonate and quartz membranes in order to derive the bulk aerosol composition) and optical properties (TSI nephelometer, Magee Sci. aethalomether, and CAPS for scattering, absorption, and extinction coefficients at several wavelengths in the visible). Lidar backscatter profiles at 355, 532, and 1064 nm, meteorological parameters, upward and downward shortwave and longwave radiative fluxes, and atmospheric composition (H_2O, CO_2, CO, and O_3) were also measured from aircraft instrumentation.
In this work we present data on the aerosol physico-chemical and optical properties obtained during the 25 scientific flights of TRAQA, ADRIMED, and SAFMED performed in correspondence of pollution episodes. During the campaigns 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). The differences in terms of physico-chemical and optical properties for the different cases will be investigated and the variability of optical properties will be discussed in term of aerosol origin and airmass history.