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Aerosol mass closure and reconstruction of the light scattering coefficient over the Eastern Mediterranean Sea during the MINOS campaign

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Abstract. As part of the Mediterranean Intensive Oxidant Study (MINOS) performed during August 2001 in the Eastern Mediterranean Region, intensive measurements of chemical and radiative properties of atmospheric aerosols were performed at two remote sites on Crete Island, located in the marine boundary layer (MBL), and in the lower free troposphere (FT), respectively. Gravimetric particulate mass, as well as chemically-derived masses of water soluble ions, organic and elemental carbon, and tracer elements for dust aerosols were measured for fine (<1.2 µm) and coarse (>1.2 µm) particles at the two sampling sites. Although strongly bound water, mainly associated with inorganic species, could have slightly altered our results (10% of the reconstructed mass), chemical mass closure was achieved most of the time for the fine and coarse size fractions and at both sites. Our conversion factor of 2.1 for organic carbon (OC) to particulate organic matter (POM) is at the upper end of those reported in the literature, but fits with the aged smoke particles collected during the campaign. The results indicate that this conversion factor changed during the campaign along with the BC/TC ratio. The particulate mass (PM) concentration for fine aerosols at the MBL and FT sites averaged 17.4±4.7 µg/m^3 and 11.2±3.2 µg/m^3, respectively, and is among the highest reported in the literature for remote sites; more than 90% of this PM was composed equally of ammonium sulfate and carbonaceous aerosols. Comparison between the MBL and FT sites showed a slight vertical gradient for PM that was not observed for dust aerosols, which averaged 10.5±4.8 and 11.7±5.0 µg/m^3 for the MBL and FT sites, respectively.

The results were used to reconstruct the ambient light scattering coefficient (σ_{sp}) that was measured at ambient Relative Humidity (*RH*) for fine particles at the MBL site. Reconstruction of σ_{sp} was achieved using ratios of wet to dry scattering, *f*(*RH*), that depend on *RH* for ammonium sulfate, but are kept equal to 1 for POM. This results in a low water adsorption for our organic-rich carbonaceous aerosols, although these aged biomass smoke aerosols are supposed to be highly oxidized. Mass scattering efficiencies of the main aerosol components were obtained by

multivariate regression analysis, and were 2.66 and 4.19 m^2/g (at the 95% confidence level) for dry ammonium sulfate and POM, respectively. The calculations indicate that one third of the reconstructed σ_{sp} was due to water uptake by ammonium sulfate aerosols, demonstrating their major role in the radiative aerosol properties in the eastern Mediterranean.

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