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Scattering and absorption of solar light by mixtures of mineral dust and urban aerosol

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The aim of this work is to quantify the alteration of scattering and absorbing properties resulting from mixing of mineral dust with anthropogenic aerosols. For doing this, results collected during the spring of 2005 intensive observation period of the Cairo Aerosol Characterization Experiment (CACHE) are analyzed. This period includes two major dust events, during which real-time PM10 and black carbon mass concentrations were measured with a TEOM microbalance and a spectral Aethalometer, respectively. Concentrations in major elements were determined by X-ray fluorescence analysis of filter samples. A 3 wavelength-Nephelometer and the Aethalometer were used to determine the aerosol mass scattering (MSE) and mass absorption (MAE) efficiencies from which the Single Scattering Albedo was derived. We show that the proportions of the aerosol mixture can be parameterized by the means of the Black Carbon (BC) mass fraction (% BC) and that this parameter conditions the optical properties. The MSE decreases linearly with % BC from between 2 and 4 m2/g to 0.6 m2/g. At the same time, Angström's exponent for scattering decreases from 1 to -0.31. The linearity of the decrease might indicate that the type of mixing is external rather than internal. The MAE also decreases during the dust events, but due to iron oxides that absorb specifically at short wavelengths, this decrease is spectrally dependent. This particularity is also reflected by the single scattering Albedo whose spectral dependence is completely modified by the presence of dust: it decreases slightly with wavelength in urban-pollution dominated conditions whereas it increases in presence of dust.