Local geological topsoil dust in the area of Rome: linking mineral composition, aerodynamic size and optical properties

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Airborne mineral dust plays a key role in energy exchange processes of the Earth's system. Understanding these phenomena requires deep knowledge of physical, chemical, morphological and size properties of mineral aerosols. However, large knowledge gap is currently recognized about these issues, e.g. the scatter and absorption of solar and terrestrial radiation by mineral dust, affecting also the reliability of modelling estimates (Hansell *et al*., 2011). In this view, an effort has been made in this study to link the aerodynamic behaviour and the optical properties of a suspended PM_{10} purely crustal dust. Topsoil mineral dust samples representative of major geological domains (Volcanics, Siliciclastic, Travertine) in the area of Rome (Italy) were collected from selected outcropping rocks. Chemical profiles of dust were previously obtained (Pietrodangelo *et al*., 2013). A micro-analytical approach based on Scanning Electron Microscopy and Energy Dispersive X-ray microanalysis (SEM-EDX) has been then applied, leading to define at once mineralogical composition and morphological features of more than 500 individual dust particles per sample. These were quantified by EDX microanalysis and X-ray spectra were matched with mineral EDX spectra of geochemical archives. Quantified particles were thus assigned to different mineral groups. Aerodynamic size distributions of each mineral groups and of major geological domains were finally built up by means of mineral densities (site-related) and of individual particle morphological data. Consistency of this approach was assessed by comparison with results of X-ray Diffraction (XRD) analysis of the same samples. In figure 1 the number size distribution of Volcanics and Travertine is reported.

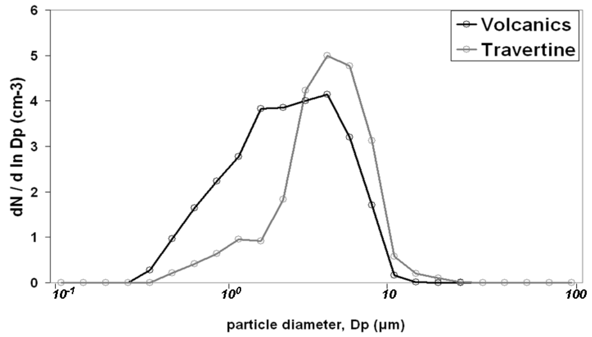

Figure 1. Number size distribution of Volcanics and Travertine PM_{10} with respect to aerodynamic diameter.

Awareness of mineralogical features of dust aerosols is also crucial in evaluating their optical and radiative behaviour. In this study, the optical properties of crustal dust were simulated by the 6SV atmospheric radiative transfer code (Kotchenova *et al*., 2008; Vermote *et al*., 1997), which computes aerosol optical properties (single-scattering albedo, asymmetry parameter, extinction coefficient, scattering coefficient and phase function) by the Mie Theory. Volume size distributions and refractive indexes related to dust samples of this study were used as model input data, respectively representing dust micro-physical and chemical properties. Conditions of dryness and of spherical particle shape were applied to all parts of this work, as this choice meets requirements both of SEM-EDX microanalysis and of the 6SV code to estimate particle scattering and absorption of the electromagnetic waves. In figure 2 the single-scattering albedo and the extinction coefficient of the Volcanics and Travertine PM_{10} is reported.

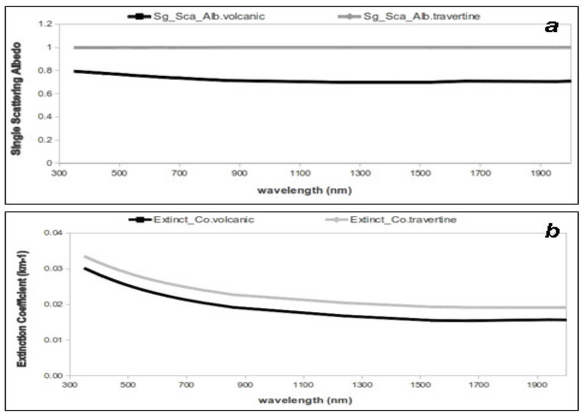

Figure 2. Single-scattering albedo (a) and extinction coefficient (b) of Volcanics and Travertine.

The single-scattering albedo highlights the weak absorption of Travertine along the visible and near-infrared spectral domain. The extinction coefficient shows a similar spectral dependence of Volcanics and Travertine on the extinction of electromagnetic waves with respect to the direction of propagation.

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