Optical and chemical properties of PM10 and PM1 samples over south eastern Italy

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Aerosol effects on the environment depend on particle size, chemical composition, and optical properties (e.g. scattering and absorption) which are highly variable in time and space. Then, long-term measurements are regularly performed worldwide to obtain statistical significant data sets. Integrating nephelometers are currently used to characterize the aerosol scattering properties. Nephelometer measurements combined with simultaneous PM10 and PM1 mass concentration measurements, and chemical speciation analyses have been used in this study to investigate the relationships between particle scattering properties, chemical composition, and mass concentrations of PM10 and PM1 samples. Measurements have been performed from December 2011 to November 2012 at a Central Mediterranean site (40.33°N; 10.11°E) affected by anthropogenic pollution from the industrialized European Countries, dust particles from the African deserts, and marine particles from the Mediterranean Sea. A LED-based integrating nephelometer (model Aurora 3000, ECOTECH, Australia) was used to measure particle scattering and hemispheric backscattering coefficients at 450, 525, and 635 nm, respectively. A low volume (2.3 m^3 h^{-1}) HYDRA-FAI dual sampler was used to simultaneously collect 24-h PM10 and PM1 samples on quartz fibre filters. Organic and elemental carbon, inorganic ions, and selected metals were measured in the collected samples to characterize the composition of the PM10, PM1, and (PM10-PM1) fractions. The thermal optical transmittance technique by means of the Sunset Carbon Analyzer Instrument was used to determine EC and OC mass concentrations in a 1.5 cm^2 punch of the filter sample. Soluble ions (SO_4^{2-}, NO_3^-, NH_4^+, Cl^-, Na^+, K^+, Mg^{2+} and Ca^{2+}) were analyzed via High Performance Ion Chromatography. Eight trace elements (Ni, Cu, V, Mn, As, Pb, Cr, Sb) were analyzed via Graphite Furnace Atomic Absorption Spectroscopy (Perkin Elmer Analyst 600 System). Four trace elements (Fe, Al, Zn and Ti) were analyzed by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES, Varian Liberty 110 spectrometer). The Positive Matrix Factorization technique and the mass closure analysis have been applied to the chemically speciated PM10 and PM1 samples to identify main natural and anthropogenic sources. Analytical back trajectories combined with a statistical cluster analysis have been used to determine the contribution of long range transported air masses. Figure 1 shows the 24-h scattering coefficient at 450 nm, retrieved from nephelometer measurements, versus *a*) PM10 and *b*) PM1 mass concentrations for the main airflow types reaching the study site at 271 m above sea level. Different symbols and colours have been used for data and corresponding fitting regression lines associated with different airflows. North-East (NE), slow North-West (slowNW), North North-West (NNW) and West (W) indicate some of the main airflows, according to *Perrone et al* (2014). Linear correlation coefficients (R) and slopes (σ_{PM}) of the fitting regression lines are also provided in the Figure. Note that σ_{PM10} represents the PM10 mass scattering cross section. Figure 1a shows that σ_{PM10} varies significantly with airflows as a consequence, of the change of the main particle sources. In fact, σ_{PM} on average decreases with the increase of the particle size as the value of σ_{PM1} (Fig. 1b) clearly reveal. Results on the relationships between mass scattering cross sections and chemical speciation of PM1 and PM10 sample will also be provided.

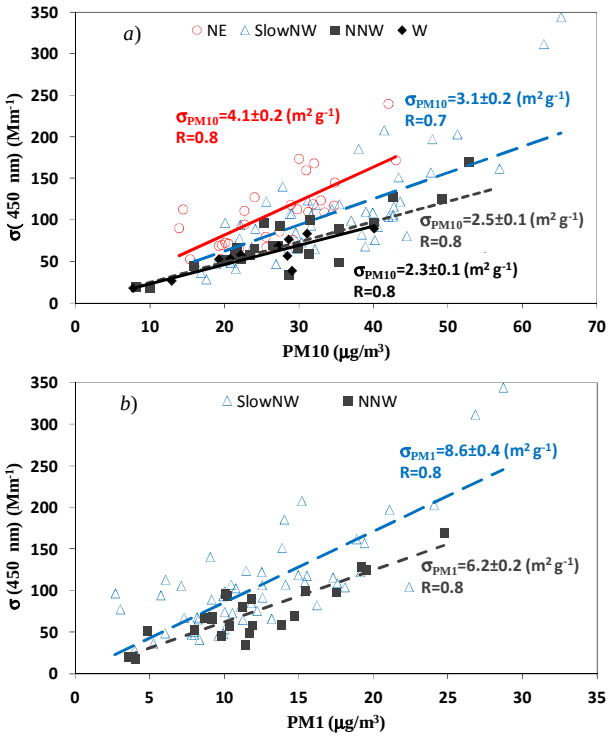

Figure 1. Scattering coefficient versus *a*) PM10 and *b*) PM1 mass concentrations.

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