

Vertical profiles of aerosol physico-chemical and optical properties measured along Italy over basin valleys

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Aerosols physico-chemical and optical properties are fundamental for climate change (IPCC, 2007; Kaufman et al., 2002) as well as for remote sensing applications (Wang et al., 2010; Di Nicolantonio et al., 2009); for the latter their 3D knowledge, especially along the whole atmospheric column is required (Levy et al., 2007; Wang et al., 2010).

For the reasons above, vertical profiles measurements of aerosol properties were conducted in winter 2010 along Italy over the cities of Terni (Central Appenine Valley), Milan (Po Valley) and Merano (Alpine Valley).

A tethered balloon was fitted with an instrumentation package consisting of: 1) a tandem-OPC system (2 OPCs GRIMM 1.107; 31 size classes between 0.25 to 32 μm : one dried, the other one at ambient RH), 2) a novel micro-Aethalometer (AE51, Magee Scientific), 3) a miniaturized cascade impactor (Sioutas SKC with 2 impaction stages: $<1 \mu\text{m}$, $>1 \mu\text{m}$), 4) a meteorological station.

OPCs tandem system data allowed us to determine the aerosol humidigraphs along height following the method reported in Snider et al. (2008) (Figure 1). Hygroscopic growth (Gf) was found to be not uniform along the vertical profiles (Figure 2) evidencing how the use of simple parameterizations of Gf along the atmospheric column in remote sensing applications can be a source of uncertainty in the results.

Micro-Aethalometer data enabled us to estimate black carbon (BC) concentration and absorption coefficient profiles. BC profiles clearly identified the mixing height (MH), which was characterized by a strong vertical concentration gradient. Over Milan BC profiles also showed a shallow layer of increased concentrations close to the ground (+24% compared to the whole MH), due to the proximity of combustion sources. The BC fraction of aerosol volume fell to 50-70% above the MH, compared to ground-level data. This caused a change in the optical absorption properties of the aerosol at different heights. Fairly constant values of absorption coefficient were found above the MH for each location, between 5-20% ($2-15 \text{ Mm}^{-1}$) of those measured within the mixing layer.

PM samples collected with the cascade impactor were analysed by ion chromatography (Dionex ICS90 and ICS2000) system. The chemical speciation (Ions and BC) allowed to estimate a aerosol refractive index, and aerosol optical

properties along height were calculated from OPC data using a Mie code (Bohren and Huffman, 1983): vertical optical properties were useful to improve the satellite retrieval of particulate matter at ground-level.

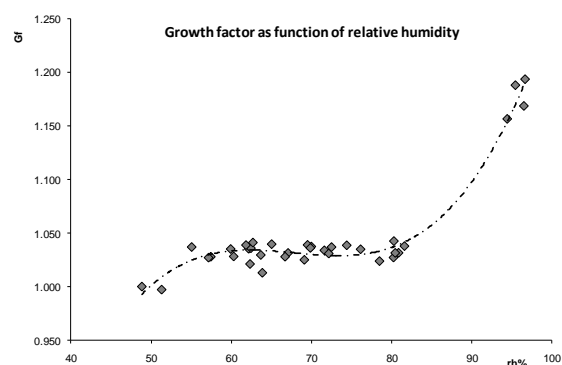


Figure 1. Humidograph along vertical profiles.

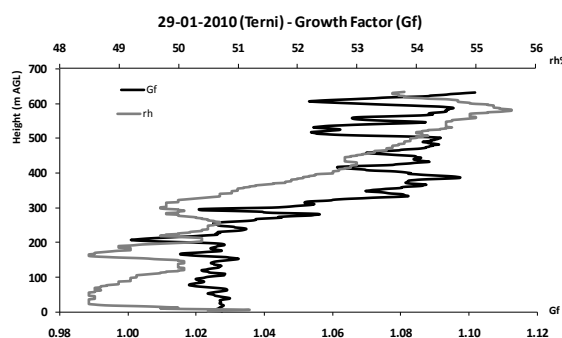


Figure 2. An example of Gf vertical profile.

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