Below-cloud scavenging of fine particles by convective precipitation events in Milan's metropolitan area

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Wet deposition of aerosol particles is a key removal mechanism of self-purification of atmosphere from natural and anthropogenic pollutants. This is especially true in metropolitan areas, as Milan, that are characterized by high suspended fine aerosol concentrations, causing short and long-term health problems (Pope, 2000). In the metropolitan area of Milan, the flat conformation of the territory and the scarcity of winds imply very low dry deposition, making the issue even more vital. In this context, wet deposition becomes fundamental, being almost the only mechanism to clean the air. The main goal of this study is to determine how efficient is the convective precipitation, which is characterized by high rainfall intensities, in scavenging aerosol particles.

Measurement campaigns of particle concentration have been performed during 2011 and 2012 years at a monitoring site in downtown Milan (Pascal-Città Studi station, property of ARPA Lombardia), that can be considered a metropolitan background site, representative of the urban environment. Particle data have been collected as number of particles per liter with 1 minute time resolution, with 31 size bins between 0.25 to 32 µm using an OPC-Grimm (Optical Particle Counter). Nevertheless, only the results related to the smaller interval 0.25-0.28 µm have been reported here, due to the characteristics of the two main local emission sources, namely vehicular traffic and domestic heating, (Andronache et al., 2006; Laasko et al.,2003, Chate and Pranesha, 2004).

Precipitation has been analyzed both in terms of rainfall intensity and in terms of raindrop size distribution. The rainfall intensity has been collected by a rain-gauge located at Milano-Lambrate station (ARPA Lombardia), while the drops size has been measured by a THIES disdrometer, located on the roof of the DICA department. The three measurements sites can be included in a circle with 500 m radius, see Fig. 1.

The results of the study show high percentages of aerosol reduction during the selected convective events (reaching a maximum of 90%) and demonstrate the important role of drop size in this mechanism.

Figure 1. Study area with localization of the instruments: disdrometer (1), OPC (2), rain gauge (3).

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