

Ultrafine particles and PM1 measurements in a hot-spot pollution area: size distribution, mass closure and source apportionment.

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Keywords: sub-micron sized particles, size distributions, chemical characterisation, source apportionment

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In urban areas, ultrafine particles and PM1 are of great concern because can deeply enter the respiratory system strongly affecting human health.

Hot-spot pollution areas are peculiar sites where source emissions and meteorological conditions foster particulate matter accumulation and very high aerosol concentrations are often registered. The Po Valley is one of the main hot-spot pollution areas in Europe, especially during wintertime. Despite the high levels of PM registered in the area, little knowledge on PM1 and ultrafine particles composition and sources is available, apart from a couple of studies carried out by our group in 2002 and 2004 in the same area.

This work aimed at a detailed physical and chemical characterisation of PM1 and ultrafine particles and at singling out major sources contributing to the high concentrations observed in the urban area. A critical comparison to the results obtained during the previous PM1 campaigns will be also shown.

PM1 was sampled at an urban background station in Milan, Italy, during winter 2011-2012. Parallel PM1 sampling was carried out twice a day (07-16, 19-04) on PTFE and quartz fibre filters using two low-volume samplers for a total of about 300 samples. Mass concentration was determined by the gravimetric technique and all the PM1 samples were chemically characterised for elements, inorganic ions, levoglucosan, EC/OC and water soluble organic compounds. BC determination was also carried out on both PTFE and quartz fibre filters by a polar photometer (Vecchi et al., 2010; Vecchi et al., 2012). Moreover, BC concentrations in PM1 were monitored with a 5 minute resolution by a MAAP.

The ultrafine fraction was characterised for number size distribution by an optical particle counter (range 0.25-32 μm in 31 size bins) and a differential mobility particle scanner (8-700 nm in 31 size bins). Moreover, parallel samplings using multistage cascade impactors (Dekati-SDI and nanoMOUDI) were collected on different substrates (polycarbonate membranes and quartz fibre filters) to gain information on the size-segregated chemical composition (elements, ions, and carbonaceous components). It is noteworthy that the detailed characterisation of size-segregated PM required the optimisation of the analytical techniques because of

the small quantities of material to analyse and of the peculiarities of the PM deposits.

Ancillary information on atmospheric dispersion conditions was available by ²²²Rn measurements and the main meteorological parameters (temperature, pressure, RH, solar radiation, wind speed and direction) were also monitored at the sampling site.

PM1 data will be used to resolve the main sources in the area using Positive Matrix Factorization. This is important to develop suitable and efficient abatement strategies in an area heavily affected by high PM levels.

Results obtained for size-segregated samples will be analysed using the MICRON inversion model aiming at the identification of the size-distribution modes for the different chemical components. These modes can track different formation processes adding useful information to the results obtained by PMF on the PM1 samples.

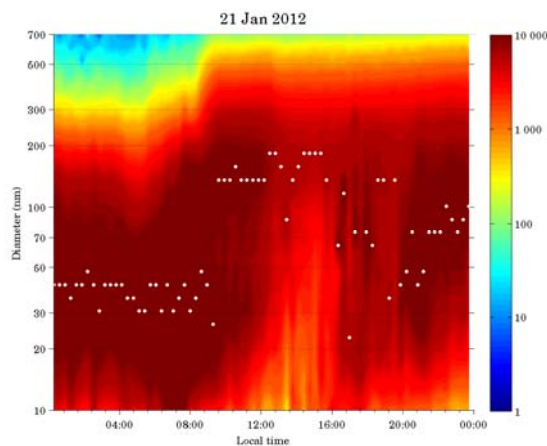


Figure 1: example of DMPS data (Milan, 21 Jan 2012)

Vecchi, R., Bernardoni, V., Broccoletti, S., Canepa, P., Cuccia, E., Massabò, D., Paganelli, C., Piazzalunga, A., Prati, P., and Valli, G. (2010). *Abstract 11E2, International Aerosol Conference 2010*, Helsinki, August 29 - September 3, 2010.

Vecchi, R., Valli, G., Bernardoni, V., Paganelli, C., and Piazzalunga, A. (2012). *Abstract, European Aerosol Conference 2012*, Granada, 2 – 7 September, 2012.