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Time resolved characterization of urban aerosol

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Particulate matter (PM) in urban atmosphere has been proposed as a major factor in producing adverse health effects. Since PM is complex mixture of chemical species and can originate from different sources its composition may vary temporally and spatially. Time resolved composition is a basic information to characterize the PM: in urban areas hourly data are often required to single out the PM sources (D'Alessandro et al., 2003).

We present here results of some campaigns carried out in the city of Genoa (Italy) collecting and analyzing "hourly resolved" data. Three different instruments were contemporary put in operation: two-stage streaker sampler, aethalometer and optical particle counter (OPC). The streaker consists of a pre-impactor that removes the particles with aerodynamic diameter greater than 10 μm, a kapton foil that intercepts the coarse PM and finally a nuclepore filter that collects the fine particles. The sampling produces a circular continuous deposit on the two stages. The deposits can be analyzed by Ion Beam Analysis (PIXE, in particular) to deduce the elemental concentrations. PIXE analysis was performed on streaker deposits, using the external beam facility of the new I.N.F.N. Tandem accelerator at the Florence University. PIXE spectra were fitted for 25 elements using the GUPIX software package (Maxwell et al., 1995) and the elemental concentrations were obtained via a calibration curve measured with a set of thin standards of known areal density. The aethalometer is an optical device (Hansen et al., 1984) which measures the black carbon (BC) concentration in PM collected on a quartz tape. Light attenuation through the tape is converted in BC concentration assuming a constant attenuation coefficient. Size segregated particles number distribution was measured by a Grimm 1.108 optical counter (OPC): it divides PM grains with diameter D_p between 0.25 μm and 32 μm in 31 size bins and with a 30-minutes time resolution.

Concentration time series of the measured species provided some direct information. Indeed, we generally observed a clear correlation between BC and Cu (coarse + fine fraction) suggesting a common origin for the two species. An example is given in Figure 1. Cu is usually acknowledged as a good tracer of traffic (Salma and Maenhaut, 2006) and the correlation with BC turned out to be particularly strong in traffic sites (Figure 1).

PM sources were identified by Positive Matrix Factorization (PMF). We considered in the PMF analysis the time series of hourly elemental concentrations (obtained by streaker + PIXE) and the BC (measured by the Aethalometer). A multi-linear regression of size-segregated number of particles (measured with the OPC) versus the sources resolved by PMF, made possible the apportionment of size-segregated particles number according to a methodology previously tested (Mazzei et al., 2007).

The results obtained in the frame of a large PM sampling campaign in several sites in the city of Genoa will be presented.

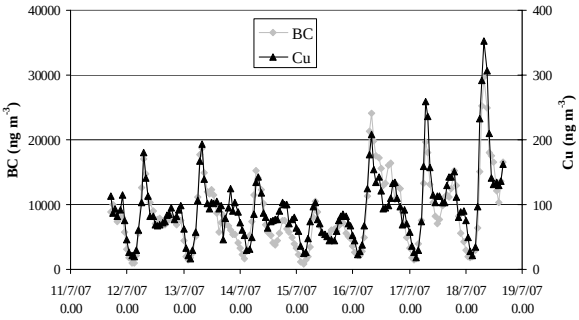

Figure 1. BC and Cu (coarse + fine fraction of PM10) concentration time series measured at a traffic site near the harbour in July 2007 concentration (R^2 = 0.81).

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