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Size distribution of airborne particulate matter concentration without multi-stage cascade impactors

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The characterization of atmospheric aerosols requires much information, such as the temporal behaviour of Particulate Matter, PM, and its compounds on a short time basis, the size segregated distribution of PM and its components as well as the particles number distribution with high-time resolution. All these features help both in the source characterization through receptor models and in the assessment of health effects.
We have developed a methodology to extract both the size-segregated apportionment of atmospheric aerosol particles concentration and the size distribution of each detected element. This is based on the contemporary use of a standard low-volume PM sampler and of a Particle Counter a Grimm 1.108, in this case). The approach is complementary to size-segregated PM sampling, and it was first tested versus a 12 stage cascade impactor (SDI-Dekati). Samples were collected in one site inside the urban area of the city of Genoa (Italy) and their elemental composition was measured by Energy Dispersive X-Ray Fluorescence (ED-XRF). Time series of elemental concentration values were inputs for a Positive Matrix Factorization (PMF, Paatero and Tapper, 1994) analysis. Major PM sources were identified by the statistical analysis and both PM mass concentration and size-segregated particle number concentration were apportioned (Mazzei et al., 2007). Source profiles extracted by PMF were used together with the OPC data to obtain the size distribution of several elements. The new methodology proved to be reliable both in the PM apportionment and in providing the elemental concentration fraction in PM10, PM2.5, PM1. The elemental size distributions are in fair agreement with those given by the cascade impactor for several elements with some discrepancies, in particular for composite sources as those related to traffic emissions (Cuccia et al.).
To extend the new methodology to the ionic and carbonaceous fraction of PM we have conducted a further PM10 and PM2.5 sampling campaign in a urban background site in Genoa, with the determination of ion and OC/EC (Organic/Elemental Carbon) concentrations in PM2.5 too. OC and EC were measured with a SUNSET thermo-optical analyzer adopting the EUSAAR2 protocol while major ionic compounds were identified by a standard chromatography.
Test samplings with a 13 stage cascade impactor (NanoMOUDI®) were carried out during the campaign in the background area. The data reduction is in progress and it will be completed before the EGU conference.
The new methodology has two main advantages: it only requires standard semi-automatic sampling equipment and compositional analysis and it provides size segregated information averaged over quite long periods (typically, several months). This is particularly important since the laborious campaigns with standard multi-stage cascade impactors are normally limited to short times.

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