Study of the aerosol elemental composition with high time resolution: preliminary results from the AIRUSE LIFE+ Project

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Atmospheric aerosols are of great concern because they can have negative effects both on environment and on human health. In Europe, the current policy efforts have not fully delivered the expected results and many urban areas still do not meet the air quality standards (2008/50/EC Directive). This is especially true for Southern Europe, where both anthropogenic and natural (Saharan dust, marine aerosols, etc.) sources give important contributions to particulate matter (PM).

The AIRUSE project, which involves public and private institutions of Spain, UK, Portugal, Italy and Greece, aims at testing existing and future mitigation measures and to develop new strategies for the improvement of air quality in Southern European countries (www.airuse.eu). The project includes PM sampling in four urban sites in Barcelona (Spain), Athens (Greece), Porto (Portugal), and Florence (Italy), for long periods (~1 year), on a daily basis. It will allow us to obtain a time-extensive data set, which is mandatory in order to get an overall representative picture of the PM composition in these urban sites.

However, it should be noted that most particulate emissions as well as atmospheric transport and dilution processes change within a few hours and daily samples are not capable of tracking these rapid changes. High-time resolved detailed characterisation allows a better insight on processes such as formation, transport, removal, deposition and chemical reactions in the atmosphere. Moreover, high-time resolution allows a direct comparison with meteorological parameters and gaseous pollutants, which are generally monitored on hourly basis. High-time resolved samplings can also give further information about source emissions: these can heavily impact on air quality with very high emission loadings of elements or compounds during a few hours in a day, and the knowledge about the timing and intensity of specific episodes may be important to assess human exposure. Furthermore, source apportionment receptor models need a series of samples containing material from the same set of sources in differing proportions and increasing the time resolution of the measurements typically provides samples that have greater between-sample variability in the source contributions than samples integrated over longer time periods.

For these reasons, intensive high time resolution PM samplings are also included in the AIRUSE project. The fine (< 2.5 μm) and coarse (2.5-10 μm) fractions of particulate matter are collected with hourly time resolution by means of ''streaker'' samplers (PIXE International Corporation). PIXE analyses, performed with a 3 MeV proton beam from the 3 MV Tandetron accelerator of the INFN-LABEC laboratory, allow the assessment of the concentrations of several elements (Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Br, Sr and Pb), including important source tracers, with hourly time resolution (Fig. 1).

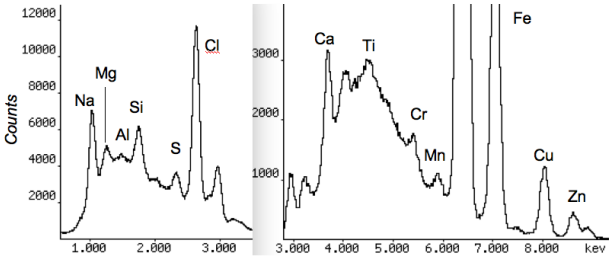

Figure 1. Example of X-ray spectra obtained by PIXE analysis of the aerosol (coarse fraction) collected during one hour sampling in Porto.

Two wintertime intensive sampling campaigns, of about 3 weeks each, have been carried out in Florence and Porto. Summertime campaigns are scheduled in all the AIRUSE sampling sites, while wintertime campaigns in Barcelona and Athens will be carried out next winter.

In this work preliminary results will be shown. In particular, hourly data will be used to investigate:

- the impact of industrial emissions, which produce short intense pollution peaks;
- the effects of road transport: exhaust and not-exhaust emissions and dust resuspension (which is particularly important in South European urban environments due to the lower precipitation and higher solar irradiation);
- the impact of biomass burning (hourly resolution daily patterns of fine K, fine Cl, and other elements may help in disentangling this source).

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