PM$_{10}$ physical and chemical characterisation using high-time resolved samplings in an air pollution "hot-spot" area in Europe

R. Vecchi[1], G. Valli[1], V. Bernardoni[1], D. Cricchio[1], A. D'Alessandro[1], P. Fermo[2],
A. Piazzalunga[2], C. Rigamonti[2], S. Nava[3], F. Lucarelli[4], F. Mazzei[5], P. Prati[5]

[1]Inst. of Applied General Physics, University of Milan, and INFN-Milan, 20133, Milan, Italy
[2]Dep. of Inorganic, Metallorganic and Analitical Chem., University of Milan, 20133, Milan,Italy
[3]National Inst. of Nuclear Physics, Sesto Fiorentino, 50019, Florence, Italy
[4]Dep. of Physics, University of Florence, and INFN-Florence, 50019, Florence, Italy
[5] Dep. of Physics, University of Genoa, and INFN-Genoa, 16146, Genoa, Italy

In this paper high-time resolved compositional analysis, aiming at PM10 physical and chemical characterisation as well as at the identification of different aerosol sources and processes involving atmospheric particles, is shown. High-time resolved measurements of aerosols are necessary to have insights on phenomena like production, deposition, transport and chemical reactions in atmosphere, which can not be generally identified by standard 24-hours integrated filter-based methods.

Two intensive measurement campaigns have been performed in Milan (Italy), located in the Po valley, one of the largest air pollution "hot-spots" in Europe. PM10 was sampled with 4-hours resolution and the aerosol mass concentration was determined by gravimetric analyses. The filters were analysed for elemental composition by ED-XRF technique, for soluble components by ion chromatography and for EC/OC fractions by TOT method. Fine and coarse PM fractions were also collected with hourly resolution obtaining the elemental composition by PIXE analysis. Particles number size distributions were measured by an Optical Particle Counter and the dataset was correlated with chemical components. Finally, the assessment of atmospheric dispersion conditions by means of Radon and meteorological parameters measurements was performed.

Beside the complete physical and chemical characterisation of PM10, these measurements allowed the identification of peculiar phenomena, like long-range transport events, and the evaluation of the impact of local and/or fugitive sources on atmospheric aerosol concentration and composition.

After particles removal due to a huge thunderstorm, the particles accumulation time was assessed; it varied from less than 3 hours for particles in the finest fractions to about 12 hours for bigger particles. Differences in the removal efficiency for different size ranges were also observed with experimental results in agreement with modelling previsions.

Chemical mass closure was carried out for each time interval during the day and in both season. Significant differences during daytime were observed for the crustal component and sulphates, while increases in nitrates percentages were registered during the night especially during summertime. Considering adjacent time intervals only slight differences in composition were generally observed as particles residence times also play a relevant role.
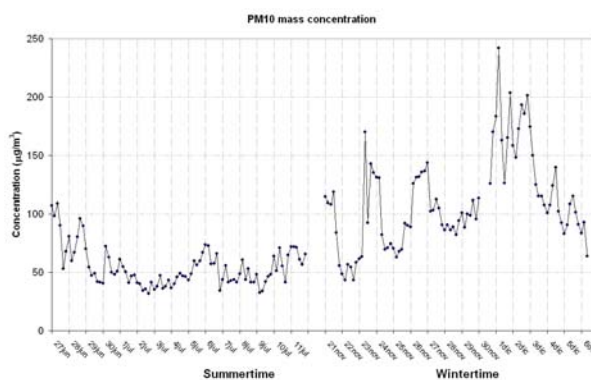

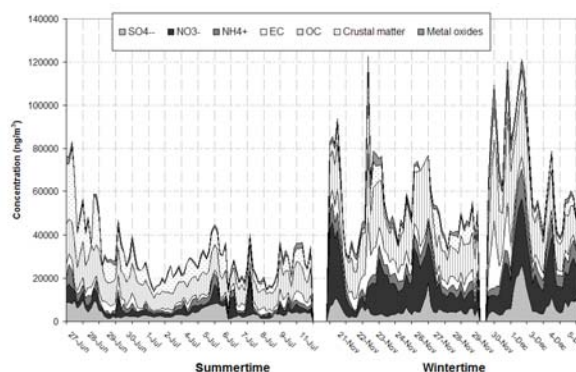**Figure 1:** 4-hours resolution mass concentration

Figure 2: 4-hours resolution chemical composition

The whole data-set was analysed using Positive Matrix Factorization (PMF2) resolving 6 different sources: "nitrates", "sulphates", "resuspended soil dust", "construction works", "traffic (primary emissions)" and "industry". The high-time resolved analyses give evidence to the variation in the contribution of the sources during the different parts of the day.