Comparison of particle number concentration and $PM_{2.5}$ chemical species in urban and rural sites in Po Valley (I) during measurement program in the Supersito project

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Under the framework of the Supersito project, continuous monitoring of physical and chemical parameters takes place in two sites located in the Po Valley (Northern Italy): an urban background site (BMS) situated in Bologna, a big town in the Valley near Apennines mountains, and a rural background site (SPC) located in the countryside 40 km North East of Bologna.

This work has the purpose of assessing differences between two environmental conditions from a statistical point of view. This approach allows the achievement of size segregated information on the aerosol main chemical components, useful for source attribution, without performing additional analysis on size fractionated aerosol samples.

Aerosol number concentration and size distribution data of three months in fall-winter 2011/2012 are analyzed. Data are collected by an Optical Particle Counter (FAI OPC Multichannel Monitor) that classifies particles in 8 size bins in the 0.28 – 10 µm size range.

PM_1 and $PM_{2.5}$ daily concentrations are monitored in both sites and a complete characterization of $PM_{2.5}$ composition is achieved by the determination of ions (NH_4^+, NO_3^-, SO_4^{2-}, K^+, Na^+, Ca^{2+} and Cl^-), total carbon and metals (As, Fe, Ni and Zn).

Daily patterns of total particle concentration in the two sites in the whole period reveal a good correlation coefficient (r=0.91). The total particle concentration mean values in the two sites are clearly similar (BMS=773 cm^{-3}, SPC=763 cm^{-3}).

Mean $PM_{2.5}$ levels in BMS and SPC are, respectively, 47 and 40 µg m^{-3} while PM_1 are 26 and 24 µg m^{-3}.

Concerning the chemical composition of $PM_{2.5}$, the aerosol mass closure on the chemical species for the analyzed period is presented in Figure 1.

Particle number size ranges and chemical species are examined using correlation matrices to study the partitioning of species in the different size classes and to analyze time trends of aerosol constituents, in order to identify similarities or differences between the two sites.

PM_1 and, mostly, $PM_{2.5}$ in BMS show high correlations with size channels up to optical diameter d_o<2 µm while in SPC these good correlations are observed only up to d_o<0.7 µm.

High correlations (r>0.80) are observed between NH_4^+ and NO_3^- with fine particles channels (d_o<1.1 µm) both in BMS and SPC. Conversely, SO_4^{2-} presents only in BMS a good correlation (r>0.70) with particle number d_o<0.7.

Ca^{2+} shows a good correlation with the largest fraction of particles (d_o>5 µm) both in BMS (r=0.83) and in SPC (r=0.81). Other ions (K^+, Na^+ and Cl^-) have a fairly good correlation, only in SPC, with greater particle size.

Total carbon concentration (sum of organic and elemental carbon) doesn't show a clear association with a single particle size range but, anyhow, its correlations with each size bins are higher in BMS than in rural site.

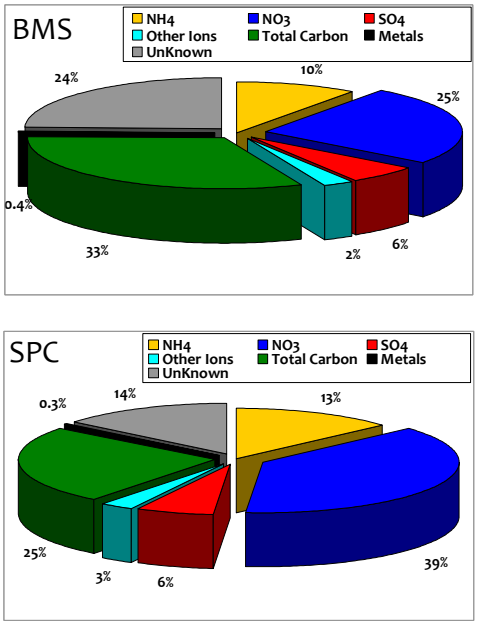

Figure 1. $PM_{2.5}$ mass closure on chemical species

Among metals, As and Fe show better correlations with coarse particles (d_o>1.1 µm), in SPC than in BMS. Conversely the correlations of the same metals with fine particles (d_o<1.1µm) are higher in BMS than in SPC.

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