Major sources of carbonaceous $PM_{2.5}$ in Emilia Romagna Region (Northern Italy) from four–year observations.

M.C. Pietrogrande[1], D. Bacco[2], S. Ferrari[2], I. Ricciardelli[2], F. Scotto[2], A. Trentini[2], M. Visentin[1]

[1]Department of Chemical and Pharmaceutical Sciences, University of Ferrara, Ferrara, I-44121, Italy.
[2] Regional agency for prevention, environment and energy of Emilia-Romagna, Bologna, 40122, Italy.
Keywords: carbonaceous aerosols, secondary organic carbon, wood combustion, PAHs, traffic.
Presenting author email: mpc@unife.it

Organic and elemental carbon (OC–EC) were measured in nearly 1000 $PM_{2.5}$ samples collected from November 2011 to Maj 2014 at two sites (urban site in Bologna city and rural site at San Pietro, SP) in the Emilia Romagna region (Po Valley, Northern Italy) in eight monitoring campaigns conducted in different seasons in the framework of the Supersito project. In addition, 40 specific chemical markers were quantified, to determine the factors affecting the carbonaceous aerosol variations, namely low-molecular-weight carboxylic acids − to investigate the contribution of secondary organic aerosol −, anhydrosugars − to quantify primary emissions from biomass burning –, bio sugars – to qualitatively estimate biogenic sources – and Polycyclic Aromatic Hydrocarbons – to differentiate among different combustion emissions (Pietrogrande *et al* (2015).

Strong seasonality was observed with the highest OC concentrations during the cold periods (≈ 5.5 $\mu g\ m^{-3}$) and the lowest in the warm months (≈ 2.7 $\mu g\ m^{-3}$) as well as with higher EC levels in fall/winter (≈ 1.4 $\mu g\ m^{-3}$) in comparison with spring/summer (≈ 0.6 $\mu g\ m^{-3}$). These results suggest that the stable atmosphere and lower mixing play important role for the accumulation of air pollutant and hasten the condensation or adsorption of volatile organic compounds over the Emilia Romagna region (Pietrogrande *et al* (2016).

Concerning spatial variability, OC data show homogeneous values at both sampling sites in each campaign, while the EC concentrations show nearly twofold higher levels at the urban site than those at the rural one.

The contribution of wood smoke to atmospheric OC concentration was computed using the levoglucosan tracer method. Wood burning accounts for 33% of OC in fall/winter and for 3% in spring/summer (Pietrogrande *et al* (2014a).

A clear seasonal trend is observed for the impact of secondary processes with higher contribution in the warm seasons (≈ 63%) in comparison with that in colder months (≈ 33%), that is consistent with enhanced solar radiation in spring/summer (Pietrogrande *et al* (2014b).

In order to investigate the impact of the two main sources to ambient PAHs, i.e., traffic and wood combustion, a profile-based source apportionment was applied by comparing the abundance distributions of the measured PAHs to those obtained from literature. The obtained results (Figure 1) suggest that measured PAHs distributions are composite profiles of the 2 investigated sources, with higher contribution of biomass burning in the cold seasons. In summer the direct impact of traffic emissions, associated with vehicle transport, is stronger inside Bologna city and decreases by moving away from the city to SP.

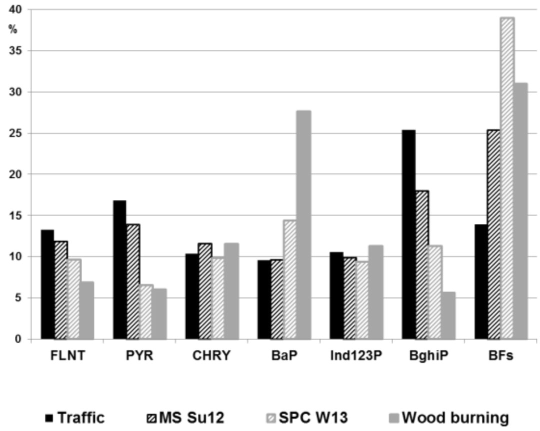

Figure 1. PAH distribution profiles: Full black bars: traffic emission profile; full grey bars: wood burning emission profile; dashed bars: experimental PAHs distributions.

Finally, the principal component analysis (PCA) was applied to the obtained data for $PM_{2.5}$ source appointment, focusing on chemical markers of specific sources, such as some dicarboxylic acids, representative for SOA contribution, anhydrosugars, which account for biomass burning, primary bio sugars and even alkanes mainly emitted from biogenic activities, BaP and PAHs representative for combustion sources, and lighter alkanes (C_{14}-C_{24}) representative for vehicular emissions.

This work was conducted as part of the "Supersito" project, which was supported and financed by Emilia-Romagna Region and the Regional Agency for Prevention and Environment under the Regional Government Deliberation n.428/10.

Pietrogrande, M.C., Bacco, D., Visentin, M., Ferrari, S., Poluzzi, V. (2014a) *Atmos. Environ.* **86**, *164–175.*

Pietrogrande, M.C., Bacco, D., Visentin, M., Ferrari, S., Casali, P., (2014b) *Atmos. Environ.* **97**, *215–225.*

Pietrogrande, M.C., Bacco, D., Ferrari, S., Kaipainen, J., Ricciardelli, I., Riekkola, M-J., Trentini, A., Visentin, M. (2015) *Atmos. Environ.* **122**, *291-305.*

Pietrogrande, M.C., Bacco, D., Ferrari, S., Ricciardelli, I., Scotto, F., Trentini, A.,Visentin, M. (2016) *Sci. Tot. Environ*. in press.