Assessment of emission sources in an industrial area using instrumental and biomonitoring techniques

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The objective of this study was to assess the air quality and the contribution of emission sources in the vicinity of an industrial area placed in the North of Spain, which is affected by a steelwork, a cement factory and a power plant. For that complementary tools were used:

1) Metal concentrations were mapped in the surroundings of the industrial area using passive biomonitors;
2) Geographic Information System was used to evaluate the relations between the spatial distribution of the elements, contamination factors, land use and topography and to identify the sources and processes associated with the pollutants' formation;
3) PM_{10} was sampled in the industrial area and a temporal database of aerosol species was built to evaluate the seasonal variations of metal concentrations;
4) Receptor models were used to identify and quantify the contributions of the industrial operations to metal concentration in the local ambient air.

The spatial distribution of the chemical elements assessed by the biomonitors showed an increase of Al, Ca, Cl, Cu, Fe, I, Mn, Na, Sb and V in the industrial area. Elements associated with the soil also presented increased concentrations in this area probably due to re-suspension caused by the heavy traffic of trucks (Fig.1).

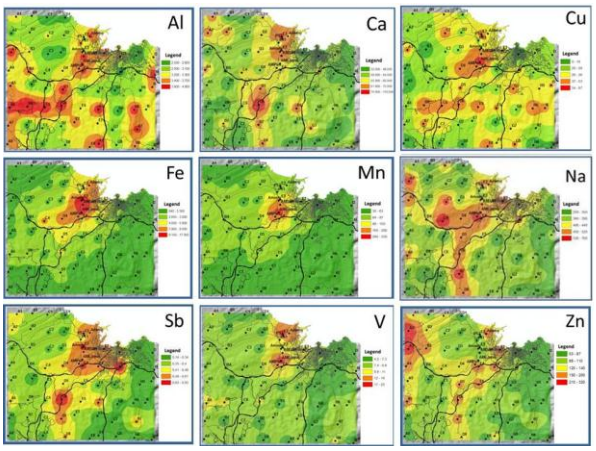

Figure 1. Spatial distribution of the Al, Ca, Cu, Fe, Mn, Na, Sb, V and Zn concentrations measured in the exposed biomonitores.

PMF applied to the PM_{10} compounds identified 7 emission sources. The first source clearly reflected the sea-spray composition, having high shares of Cl and Na, and contributed on average to 22% of the PM_{10} mass. The second source, which contributed on average to 11% of the total PM_{10} mass, was mainly composed of As, Cr, Cu, Ni, Pb, Sb and Zn and was attributed to mixed combustion processes and traffic. The third source contained high percentages of NH_4^+ that derives from gas to particle conversion processes. The contribution of this factor to PM_{10} mass was on average 12%. The fourth factor is made of Br and contributed for 1.8% of the total PM_{10} mass. The fifth source is dominated by NO_3^- and SO_4^{2-} and contributed on average for 19% of the PM_{10} mass concentration. The sixth source carries high percentages of Al, Ca, La, Si, Ti and V and account for 14% of the PM_{10}. These are the major constituents of soil and point out the fingerprint of mineral dust. The seventh factor was associated with steel production as it is defined by Fe and Mn. This source accounted for 21% of PM_{10} mass concentration (Fig.2).

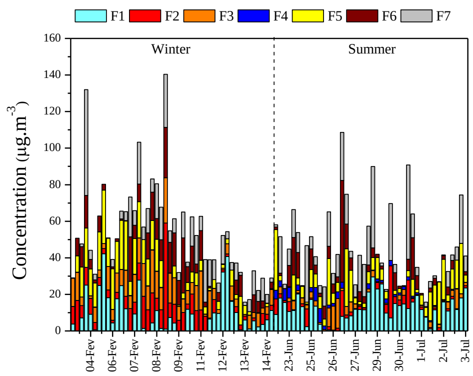

Figure 2. Source contribution for PM_{10} total mass concentration time series (µg.m^3).

This work showed that the use of complementary tools is essential in the assessment of the air quality. Atmospheric particles are usually measured instrumentally. However, particles sampling and characterization is necessarily performed by a limited number of sampling stations due to the associated high costs. As a result, vast areas are not covered by any monitoring system. Therefore, in one hand biomonitoring offers unique advantages - the ability to perform high-density sampling at any spatial scale at low cost and the measurement of a wide range of pollutants. In the other hand, instrumental measurements inform about the absolute air concentrations and the temporal trend of the pollutants.

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