Multi-site Concentration Field method applied to the outputs of a comprehensive source apportionment study (PMF) in the north of France

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Northern France is a region strongly affected by high concentrations of atmospheric pollutants, especially particulate matter, which is directly linked to human health issues such as respiratory related diseases (Pope et al., 2009). The region is known for often exceeding the daily limit value of 50 µg/m^3 on PM_{10} mass concentration, which, according to the directive 2008/50/EC, should not occur more than 35 times per year.

Primary sources of PM_{10} such as industry, dense urban areas, traffic and agriculture, along with particle long-range transport (enhanced here in a context of rather flat topography), have proven to be the main sources of high concentration episodes in Lens (Waked et al., 2014).

Five sampling sites were selected over the region, with different typologies (3 urban, 1 traffic and 1 remote), in order to account for the wide range of possible sources expected.

Samples were collected using sequential HVS filters (Digitel DA80) operating at 30m^3/h. Pre-baked 150 mm diameter quartz filters were used and samples were selected every three days. The samples correspond to a 24-hour collection period and the PM_{10} mass concentration was measured by TEOM-FDMS. The final database comprises the concentrations of ~35 different chemical species, from ions to metals, elemental and organic carbon and organic tracers. The same analytical methodology was implemented for the 5 sites, resulting in comparable results.

A Positive Matrix Factorization (PMF) approach using PMF5 (Paatero and Taper, 1994) has been applied to each database, first individually then using harmonized databases with the exact same number of chemical species in order to allow a full intercomparison of the results. This work is described in more details in a companion abstract.

Local and regional sources were identified for each sampling site, with major ones being local sources identified are: traffic or traffic related and biomass burning for local sources, whereas regional sources often seen at the sampling sites were sea salt related and secondary aerosols, including ammonium nitrate, ammonium sulfate and organic material.

Using the capability of PMF5 to constrain factors, results for each site were optimized in order to obtain stable solutions and similar chemical profiles for regional factors. This allows to fully consider the regional presence of these pollutants and apply the Concentration Field (CF) method with a multi-site approach (Seibert et al., 1994). This method consists in redistributing given concentrations along back-trajectories in order to identify the geographical origins of some remote sources impacting the sampling site.

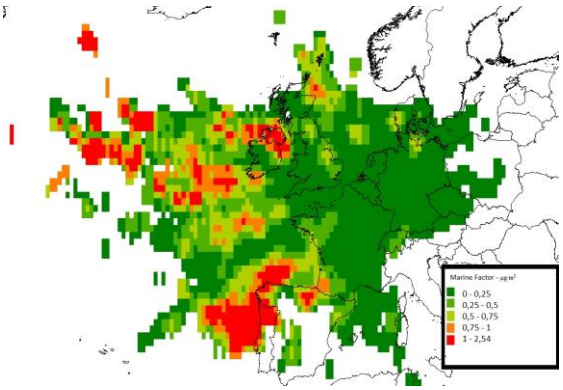

Figure 1 – Concentration field map for the marine factor obtained in the PMF of a urban site (Nogent-sur-Oise)

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