Identification of the main sources of PM_{10} impacting the north of France: a comprehensive source apportionment study with PMF5 at five sampling sites

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Aerosols have a strong impact on human health due to theirs ability to penetrate the respiratory system. Specifically, particles with aerodynamic diameter smaller than 10 µm (PM_{10}) are heavily emitted in the North of France due to the constant presence of urban and industrial sources.

In order to identify and allocate these sources, PM_{10} samples were collected at 5 sampling sites spread geographically in the northern part of France over an 18 month period (Jan 2013 – Jun 2014). These sites, included in the CARA program (Chemical Characterization of Particles) managed by the French reference laboratory for air quality monitoring (LCSQA), present different typologies (3 urban, 1 traffic and 1 remote).

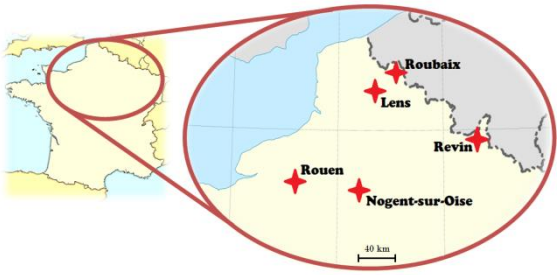

Figure 1. Geographical location of the 5 sampling sites studied across the north of France.

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 (EC and OC) and organic tracers. The same analytical methodology was followed for the 5 sites, resulting in comparable results.

A Positive Matrix Factorization (PMF) approach (Paatero and Taper, 1994) has been applied to each database using PMF5. The results obtained showed the critical importance of the typology of the different sampling sites, i.e. the nature of the surrounding sources of particles.

At first, each dataset was approached individually, in order to find the optimal PMF solution, to study the seasonal variability and to assess the importance of exceedance episodes at each site.

Results show a strong influence of secondary aerosols on the PM_{10} total mass, which represent one of the major pollution sources in the area, in accordance with previous studies (Waked et al. 2013).

Local sources have an important impact as well, notably biomass burning sources associated with residential heating can be one of the major causes of exceedance episodes during cold periods, particularly in urban environments.

In a second step, datasets for each sampling site were recalculated in order to contain the same chemical species. This allows a full intercomparison between the PMF results for each case and the possibility of identifying the chemical composition of common factors – mainly the ones with regional influence. The complete methodology that allowed the intercomparison of PMF solutions will be presented.

All results are validated with external data, such as meteorological information available at each site and correlation with gas pollutants (when available).

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