Refining the identification of potential source areas impacting the PM_{10} concentrations in northern France

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Particulate matter with aerodynamic diameters smaller than 10 µm (PM_{10}) is harmful to human health, notably due to their capacity to penetrate the human respiratory system (Arden et al., 2002). The struggle to reduce high concentrations of particulate matter is then a major public health issue.

The directive 2008/50/EC on ambient air quality and cleaner air for Europe demands to each European member states to ensure that in all their territory, the level of PM_{10} does not exceed a daily limit value of 50µg m^{-3} more than 35 days per year. This daily limit value is often exceeded in the Nord-Pas de Calais region (Waked et al., 2014) which is located at the extreme north of France.

In northern France, primary sources of PM_{10} are related to a heavy industry sector, dense urbanization, heavy traffic and intensive agriculture. In addition to primary sources, particulate matter observed in Nord-Pas de Calais region may come from source areas outside the region (Favez et al., 2012) and from secondary formation during long-range transport. Therefore, PM_{10} concentrations measured within the region by the Regional Network for Air Quality Monitoring (Atmo Nord-Pas-de-Calais) may be due to both local and long-range sources.

This study aims at helping regional policy-makers to take efficient measures against particulate matter air pollution, by determining the origin of atmospheric particles observed in the Nord-Pas de Calais region. To do so, this work relies on five years (2009-2013) of hourly measurements of PM_{10} all over the region through a dense monitoring network (27 stations, cf. Fig. 1).

Figure 1: Location of the 27 monitoring stations (red circles) of the regional monitoring network.

We will first present the methodology developed to distinguish the different classes of stations based on daily percentiles of PM_{10} mass concentrations. We will then discuss the results from a multi-site concentration field analysis (Seibert et al., 1994). This statistical method, based on a large set of data, consists in redistributing the PM_{10} concentrations along the 72 hours back-trajectories in order to identify potential source areas impacting the receptor sites. In particular, the influence on the localization of potential source areas, due to precipitation events and based on the altitude of the air masses along the back trajectories will be presented.

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