Source contributions to PM_{10} levels in a coastal area in northern France: a one year study

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The Hauts-de-France Region is one of the most concerned areas in France by exceedances of the PM_{10} daily mean limit value (50 $\mu g.m^{-3}$). For a better understanding of these phenomena, the identification as exhaustive as possible of sources contributing to PM_{10} concentration is an essential step. Numerous studies were performed on the identification of particles from terrestrial sources. The objective of this work is to fill the lack of knowledge about the impact of emissions resulting from the marine compartment. It includes natural emissions such as sea salts [1] and anthropogenic emissions linked to the marine traffic especially in the English Channel, that forms a narrow corridor with one of the greatest concentrations of shipping in the world (up to 800 vessels sailing per day) [2].

PM_{10} sampling and measurement campaign were performed continuously during one year in 2013 at Cape Gris-Nez, a coastal French site located in front of the Straits of Dover. PM_{10} levels were measured using MP101 analyzer (Environment SA®) and collected using the DA80 sampler (Digitel®, 30 m^3/h) on a daily basis. The characterization of PM_{10} was performed considering major and trace elements, water soluble ions, EC/OC as well as tracers of biomass burning (levoglusan), primary biogenic emissions (arabitol, mannitol) and marine biogenic emissions (methanesulfonate ions). These chemical parameters were used to explain PM_{10} levels on the coastal site, identify PM_{10} sources and estimate their contributions.

Sources profiles were identified from the use of a Constrained Weighted non Negative Matrix Factorization (CW-NMF) model [3,4]: fresh sea-salts, aged sea-salts, secondary nitrates, secondary sulphates, crustal, biomass combustion, primary biogenic emission, marine traffic, combustion, metal source. The monthly evolution of their contribution evidenced different behaviours between the sources: secondary nitrates were predominant during the cold season and appeared to be the most involved in the PM_{10} concentration peaks. The impact of marine traffic and a high proportion of aged sea-salts versus fresh sea-salts were mainly evidenced during the summer season. For the year 2013, the mean contribution of the different sources were 37% for sea salts and aged sea-salts, 43% for the secondary inorganic aerosols, 7% for biomass combustion, 5% for marine traffic. This distribution varies highly depending on the period and more particularly during exceedances of daily PM_{10} limits values.

Keywords: source apportionment, receptor modelling, seasonal variations

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