PM10 sources identification by means of PMF and CPF

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The concentrations of trace metals, ionic species and carbonaceous components in PM10 (particulate matter with aerodynamic diameters smaller than 10 µm) were measured from samples collected near an industrial complex, primarily composed of cement plants, in southeastern Spain, from September 2005 to August 2006. Positive matrix factorization (PMF) and conditional probability function (CPF) were applied to this data set to identify different types of sources. Six significant sources were identified: crustal matter, traffic, aged sea-salt, industrial emissions, secondary aerosol and sea salt. The difficulty of separating anthropogenic sources from those of natural origin is highlighted in this study; in particular, the crustal source can be connected with both natural (African outbreaks, wind resuspension) and man-made emissions, like fugitive emissions in an industrial environment.

Table 2. Brief summary of annual and seasonal PM10 concentrations. Units of PM10 in µg m^{-3}.

	Fall	Winter	Spring	Summer	All
Mean	40.4	40.6	41.5	39.7	40.5
Median	34.6	38.3	35.7	37.5	37.0
SD	21.1	16.0	19.7	13.0	17.5
Min	15.9	17.3	20.4	21.7	15.9
Max	120	85.5	110	82.6	120
N	30	30	31	30	121
SDE*	0	0	11	8	19

*Saharan dust event

The interpretation of PMF results has been improved by the study of the CPFs, i.e. by connecting the source contributions with meteorological factors (wind direction and velocity): in particular, it allowed us to understand which sources are connected to the industrial emissions coming from the NW direction.

The main contribution to PM10 (34%) is due to the crustal source, which may have different origins: Saharan intrusions, fugitive emissions escaping the cement plant installations or quarries, local dust resuspended by the wind or traffic. However, the combined use of PMF and CPF highlighted a predominant contribution from the industrial pole.

As a consequence, the cement plants' contribution to PM10 concentration levels are not solely represented by the cement plant combustion of petroleum coke, but in great measure by a crustal component as well. Therefore, in order to reduce PM10 levels, the application of reduction techniques to lessen fugitive emissions would be additionally necessary.(Fig. 1)

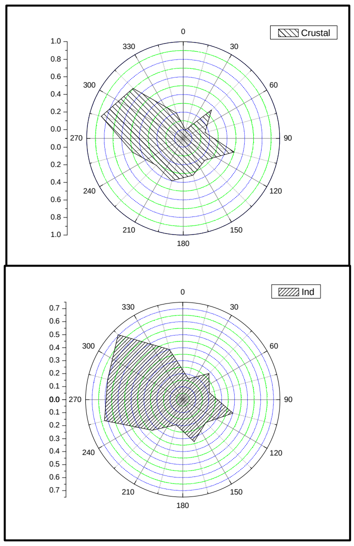

Figure 1. CPFs for the crustal and industrial sources, pointing out the same wind direction.

The traffic source, which gives an average contribution of 20%, is a result of both vehicle exhaust and emissions from tire and break wear. Secondary sulphates accounts for 8% of PM10 concentration.

Finally, two sea-salt sources have been identified (with a global average contribution of 7 %): a fresh marine aerosol and an aged one, characterised by a Cl depletion (and an SO_4^{-2} and NO_3^- enrichment) due to chemical reactions taking place in the atmosphere.

Concerning seasonability, sources such as aged sea-salt and secondary aerosol present elevated values in summer, while others like traffic and industrial were highest during winter. For the former this is due to photochemical reactions being favoured during this time of year that form this type of aerosol; for the latter group, meteorological situations occur in fall and winter which allow the accumulation of contaminants.

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