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Meteorological factors for PM10 concentration levels in Northern Spain

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Atmospheric particulate matter (PM) is made up of a mixture of solid and aqueous species which enter the atmosphere by anthropogenic and natural pathways. The levels and composition of ambient air PM depend on the climatology and on the geography (topography, soil cover, proximity to arid zones or to the coast) of a given region.

Spain has particular difficulties in achieving compliance with the limit values established by the European Union (based on recommendations from the World Health Organization) for particulate matter on the order of 10 micrometers of diameter or less (PM10), but not only antropogenical emissions are responsible for this: some studies show that PM10 concentrations originating from these kinds of sources are similar to what is found in other European countries, while some of the geographical features of the Iberian Peninsula (such as African mineral dust intrusion, soil aridity or rainfall) are proven to be a factor for higher PM concentrations.

This work aims to describe PM10 concentration levels in Cantabria (Northern Spain) and their relationship with the following meteorological variables: rainfall, solar radiation, temperature, barometric pressure and wind speed. Data consists of daily series obtained from hourly data records for the 2000-2010 period, of PM10 concentrations from 4 different urban-background stations, and daily series of the meteorological variables provided by Spanish National Meteorology Agency.

The method used for establishing the relationships between these variables consists of several steps: i) fitting a non-stationary probability density function for each variable accounting for long-term trends, seasonality during the year and possible seasonality during the week to distinguish between work and weekend days, ii) using the marginal distribution function obtained, transform the time series of historical values of each variable into a normalized Gaussian time series. This step allows using consistently time series models, iii) fitting of a times series model (Autoregressive moving average, ARMA) to the transformed historical values in order to eliminate the temporal autocorrelation structure of each stochastic process, obtaining a white noise for each variable, and finally, iv) the calculation of cross correlations between white noises at different time lags. These cross correlations allow characterization of the true correlation between signals, avoiding the problems induced by data scaling or autocorrelations inherent to each signal. Results provide the relationship and possible contribution to PM10 concentration levels associated with each meteorological variable. This information can be used to improve PM10 concentration levels forecasting using existing meteorological forecasts.