Application of Statistical methodology for air quality data evaluation, characterized by a strong seasonal variability series

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Environmental pollutants concentrations are characterized by daily and seasonal variability, due to different atmospheric dispersion conditions of planetary boundary layer (PBL) and different activations of emission sources.

In the current study we examine periodical occurrences and eventual trends of historical air quality data series. We consider particulate matter (PM_{10}), a primary and secondary pollutant, and nitrogen dioxide (NO_2) a secondary pollutant, produced by nitrogen oxide NO and peroxide radicals complex reactions, both characterized by seasonal behaviour and in particular by more significant levels in winter than in summer.

When we have long historical data series and an evident seasonal component, the data series can be statistically broken down in three variability components: seasonal, trend and residual. In normal conditions, the residual component presents random variability. In this contest, seasonal and residual components could be used to assess the air quality data.

In this connection we analyze two case studies. The first one is about the evaluation of PM_{10} and NO_2 concentrations, measured by a mobile station, located in the town of Vinchio (AT) during a 34 days monitoring campaign conducted in May and June 2014, in correlation to air quality historical data series, measured in the last five years by a near air quality station.

The second case study is related to the comparison between PM_{10} e NO_2 concentration data of the year 2014 with the historical data series of the last ten years, available from same air quality stations.

It is useful mentioning that a statistical approach was used, summarized in the following steps: screening analysis of historical data series by time-plot representation, identification of a clear seasonal component and consequent elaboration for each pollutant and air quality station.

The seasonal component was taken away from air quality data to highlight eventual significant trend, with a procedure similar to the one used to determine seasonal component. Historical data series and the compared monitoring data are furtherly cleaned by trend component to get the random residual one. Variability range of residual component is described by upper thresholds, essential to evaluate monitoring air quality data.

We used validated and certified data, from three air quality monitoring stations of "ARPA Piemonte" measured in the Province of Asti, a territory that extends for 1500 Km^2 in the southwest of Piedmont.

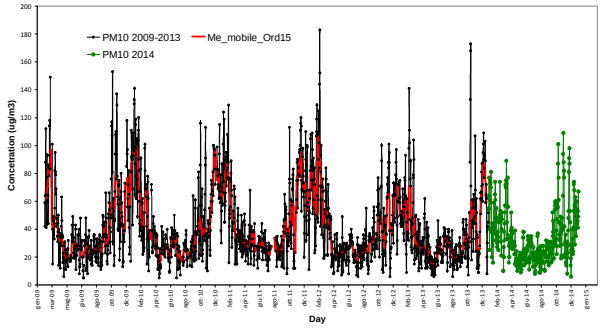

Figure 1. Time plot PM_{10} concentration measured in Asti-Baussano: black and red historical data series from 2009 to 2013 (respectively daily data and moving average), green monitoring data of 2014.

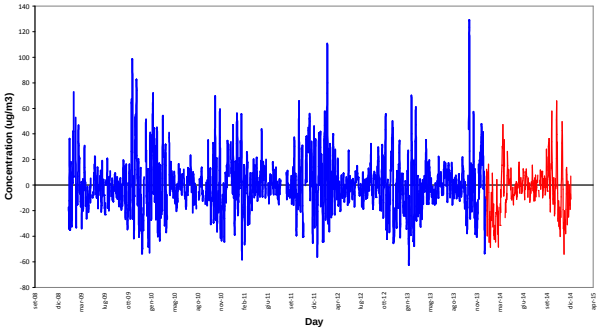

Figure 2. Residual component PM_{10} measured in Asti-Baussano: blue historical data series from 2009 to 2013, red Residual component for 2014.

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