The intense PM pollution episode in France during March 2015: multi-site approach and near real time data

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The understanding of atmospheric particulate pollution represents one of the most important scientific challenges of our time, due various effects on climate and public health. These impacts are regularly highlighted during pollution episode occurring in densely urbanized areas. In Northern Europe, and more particularly in France, most intense and persistent episodes usually occur during spring, and are characterized by a large-scale pattern, covering most of the territory. Specific episodes are generally investigated from a single measurement point, describing the synergy between sources, chemical composition and meteorological conditions over a local to a regional scale. In this context, the development of aerosol mass spectrometry measurements greatly improved our knowledge of pollution (trans-)formation. Yet, this approach conceptually fails to get the bigger picture of large-scale pollution episodes, as multi-site characterization is needed.

The presented work focuses on the investigation of the intense PM pollution episode that occurred in March 2015 from multi-site observations and near real time data. Aerosol Chemical Speciation Monitor (ACSM, Ng et al., 2011) and 7-wavelength aethalometer (AE33, Drinovec et al., 2015) measurements were carried out in Lyon, Metz, Creil and at SIRTA (Fig. 1).

Figure 1. Localisation of sampling sites.

Results

A climatology approach showed that this episode is associated at all sites with clear rain shortage compared to normal values. When looking back until 2007, unusually high PM concentrations are always associated to pronounced rain shortage. If this trend become confirmed, this could be an illustration of the regional impact of climate change, and its link with air quality issues.

Despite a clear dominance of secondary species, singularities from site to site are observed (Fig. 2). Indeed, while high amplitudes are observed in the Paris Basin, concentrations stayed fairly stable in Lyon and Metz, highlighting different transformation processes linked to different meteorology.

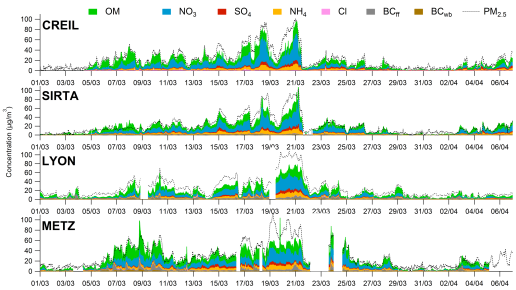

Figure 2. Chemical composition timeseries at all 4 sites.

Combined with cluster analysis, the statistical distribution of BC/SO_4 values confirms the rather advected pattern of the episode at all sites. It also shows that absolute values are geographically specific, especially regarding the intensity of BC emissions. Then, trajectory analyses highlighted that despite this demonstrated advected pattern, the Paris Basin, Metz and Lyon are influenced by different long-range emission zones, and thus potentially different sources. This is of primarily importance to settle mitigation policies, coordinated over large geographical scales.

Finally, real time data are a unique opportunity to evaluate model performance. Simulated PM_1 chemical composition by CHIMERE shows satisfying consistency for secondary pollutants, but exhibits high discrepancies for OM and BC, underlining the need of refined emission inventories and/or emission factors.

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