



Analysis of an acute PM event over northern Italy: The case study of 24th January- 4th February 2017

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Abstract

This work describes the analysis of an acute PM event, which took place between the ending of January and the beginning of February 2017. Our findings point out the impact of the meteorological conditions on the secondary particles formation processes which resulted in extremely high PM levels in Emilia Romagna region

Aim

The purpose of this study is to address the acute pollution events by investigating the emission/formation processes of primary and secondary particles in the lower atmospheric layer over the Emilia Romagna region

Method and data

We performed analysis of the of concomitant atmospheric conditions:

- subsidence into the lower troposphere due to high pressure over the continental scale
- thermal inversion at few hundred meters above the ground
- stagnant conditions in the mixing layer
- starting from the 30 January, warm air masses coming from south-west resulted in further air subsidence from above associated with an enhanced trapping of pollutants near the ground

The following information were used for this study:

- PM measured at 47 stations of Arpae Emilia Romagna observational network
- PM₁, PM_{2.5} and PM₁₀ as well as the organic and the elemental carbon and secondary inorganic aerosols at station called MainSite in Bologna (BO)
- atmospheric radio-soundings and wind speed and direction measurements observed at rural background station of San Pietro Capofiume
- ECMWF operational products provided over the continental area of Mediterranean basin

Results

A very acute PM₁₀ event was registered by the observational network of Emilia Romagna region (law threshold is 50 ug m⁻³)

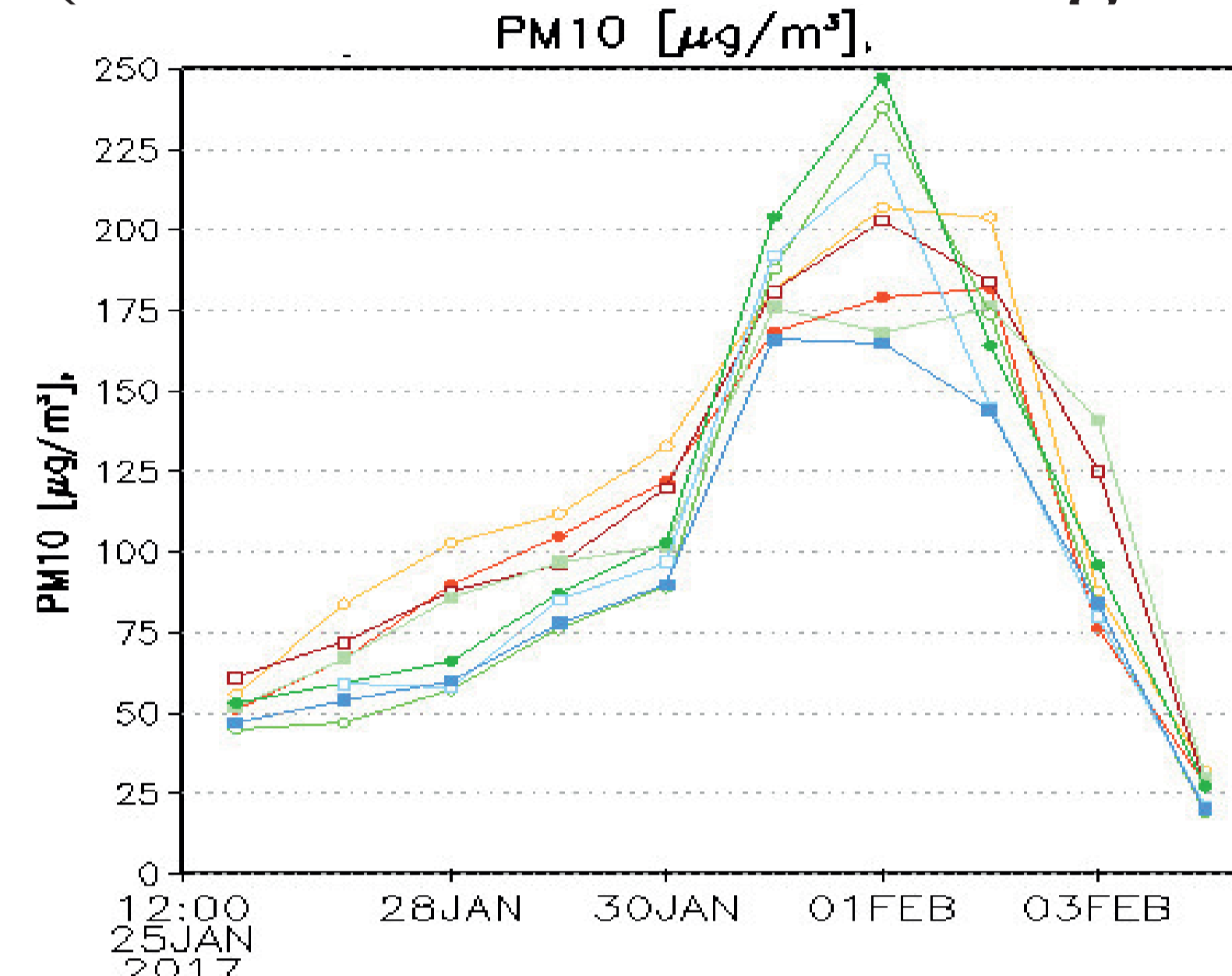


Figure 1. Time serie of daily PM₁₀ concentrations [ug m⁻³] measured between 25th January and the 4th February of 2017 at the air quality stations belong to Modena and Bologna district.

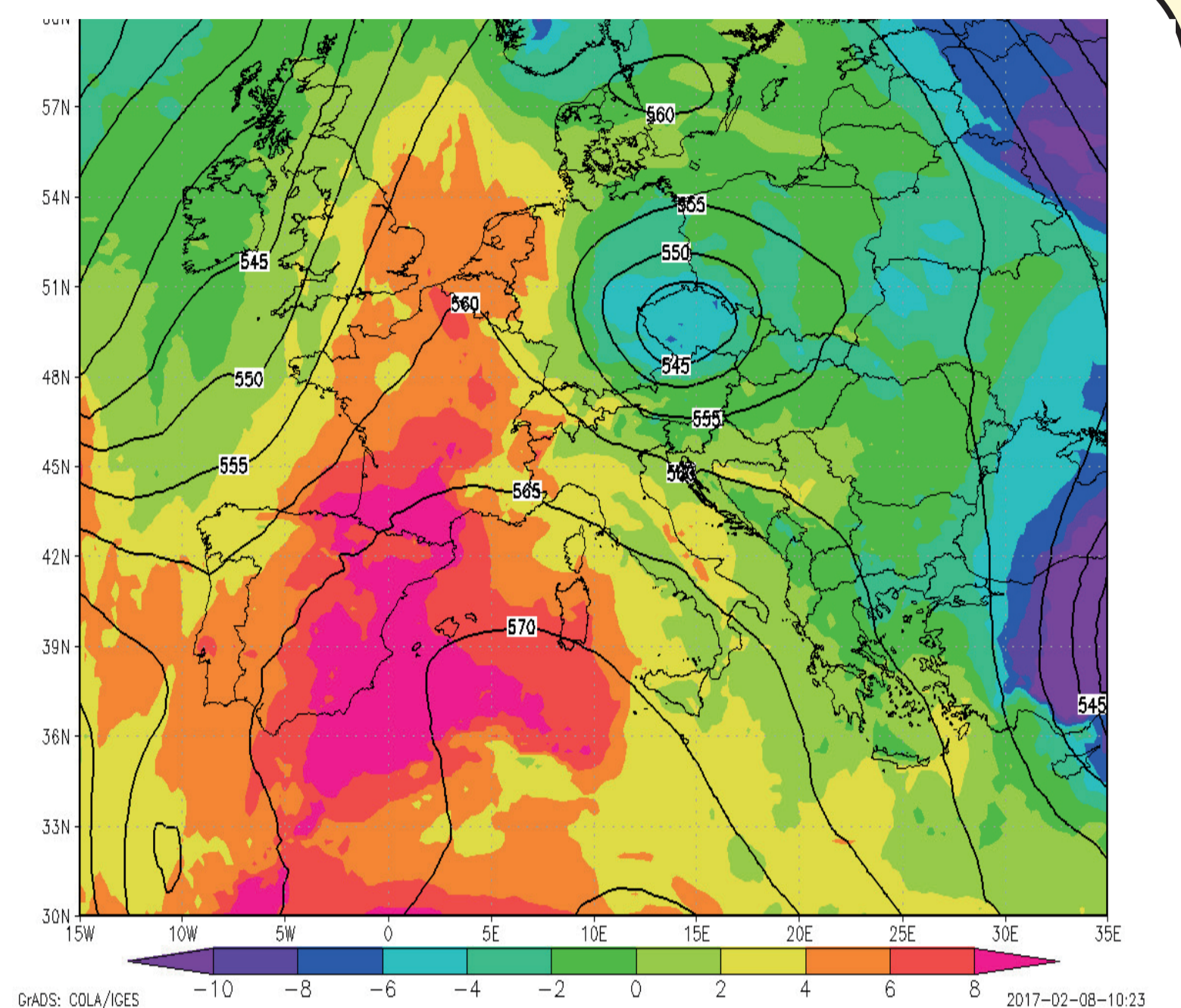


Figure 2. The synoptic situations as calculated by ECMWF IFS model over the Mediterranean basin. Geopotential at 500 hPa and air temperature at 850 hPa are shown.

High pressure situation over the northern Italy resulted in very low depth of atmospheric mixing layer

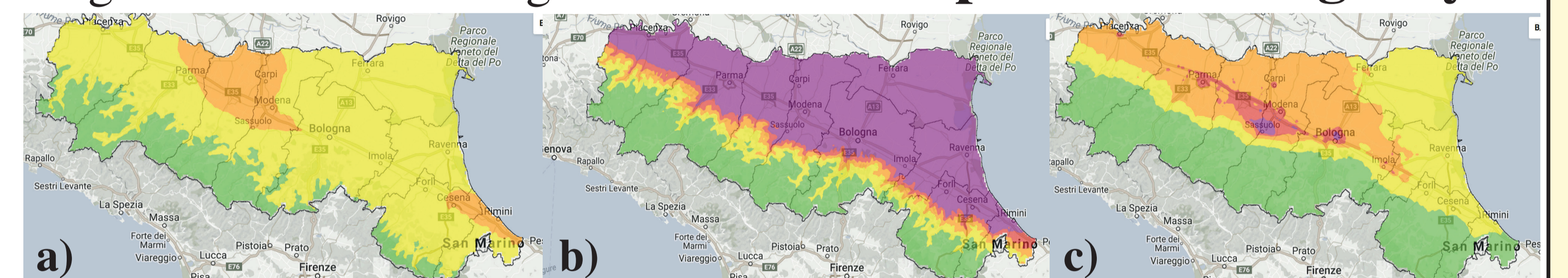


Figure 3. Daily PM₁₀ concentrations as produced by the spatial analysis system PESCO before (panel a), during (panel b) and after (panel c) the PM acute event which took place between 31 January and 2 February 2017.

During the acute event the PM were almost homogeneously distributed overall the plain of the region

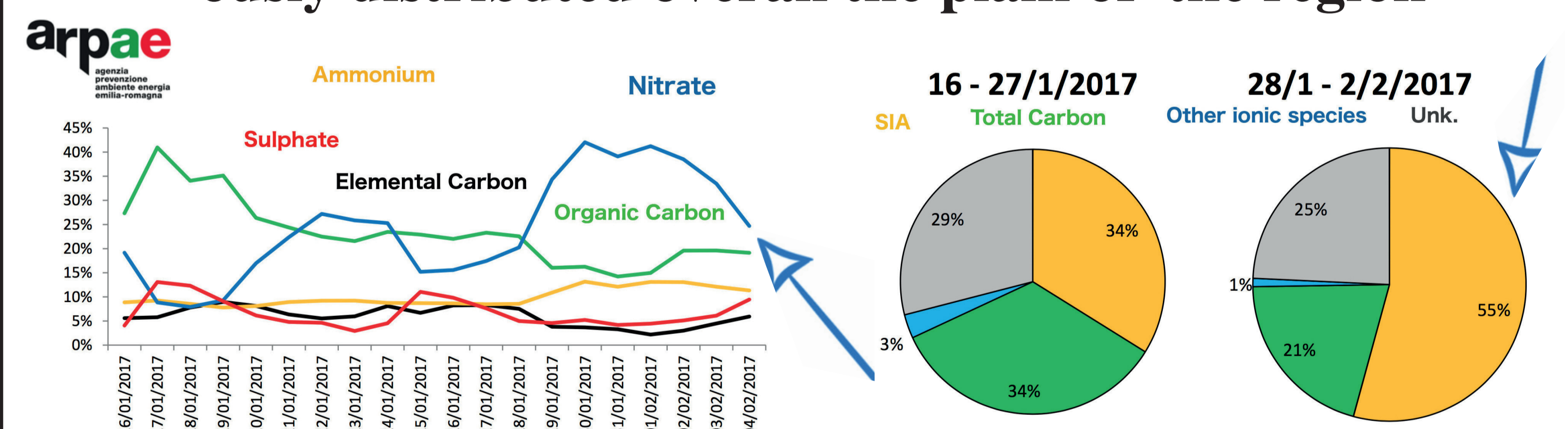


Figure 4. Time series of secondary inorganic aerosols and organic and elemental carbon and pie chart of the mass closure of PM_{2.5} before and during the event.

Nitrate concentrations mostly contribute to increase the PM_{2.5} levels during the acute event

Conclusions

In this study analysis of PM₁₀, PM_{2.5} and PM₁ ratios suggested that the major contribution to the high levels of total suspended matter can be ascribed to secondary aerosols formations over large part of Emilia Romagna region

Pietrogrande, Maria Chiara, et al. "Characterization of atmospheric aerosols in the Po valley during the supersito campaigns—Part 3: Contribution of wood combustion to wintertime atmospheric aerosols in Emilia Romagna region (Northern Italy)." Atmospheric Environment 122 (2015): 291-305.

Stafoggia, Massimo, et al. "Estimation of daily PM10 concentrations in Italy (2006–2012) using finely resolved satellite data, land use variables and meteorology." Environment international 99 (2017): 234-244.