Geophysical Research Abstracts
Vol. 19, EGU2017-16337, 2017
EGU General Assembly 2017

1-hour time resolution data of PM2.5 composition and gaseous precursors in background Milan: pollution sources and atmospheric processes, and their implications for air quality.

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Aim of this study is the investigation of processes leading to atmospheric pollutants formation and ageing in Milan, Po valley, i.e. one of the main hotspot region in Europe. Few 1-hour time resolution campaigns were accomplished in Milan urban area and none of these dealt with simultaneous characterization of atmospheric pollutants in both gas and particle phase. The present study is based on a thorough analysis of hourly data of atmospheric pollutants and of main PM2.5 compounds, and it includes several soluble inorganic aerosols (Cl-, NO_2-, NO_3-, SO42-, K+, Mg2+, Ca2+, Na+, NH4+), gases (HCl, HNO_2, HNO_3, NH3, NO, NO_2, O_3, SO_2) organic, elemental and black carbon and meteorological parameters. The data proceed from an intensive sampling campaign in urban background Milan in summer 2012 (Bigi et al., 2017).
Data analysis methods used include mean diurnal pattern on weekdays and Sundays, pollution roses, bivariate polar plots and statistical models using backtrajectories.
Results show how nitrous acid (HONO) was mainly formed heterogeneously at nighttime, with a dependence of its formation rate on NO_2 consistent with observations during the last HONO campaign in Milan in summer 1998, although since 1998 a drop in HONO levels occurred following to the decrease of its precursors. Nitrate showed two main formation mechanisms: one occurring through N2O5 at nighttime and leading to nitrate formation onto existing particles; another occurring both daytime and nighttime following the homogeneous reaction of ammonia gas with nitric acid gas. Air masses reaching Milan influenced nitrate formation depending on their content in ammonia and the timing of arrival.
Notwithstanding the low level of SO_2 in Milan, its peaks were associated to point source emissions in the Po valley or shipping and power plant emissions SW of Milan, beyond the Apennines. A distinctive pattern for HCl was observed, featured by an afternoon peak and a morning minimum, and best correlated to atmospheric temperature, although it was not possible to identify any specific source.
The ratio of primary-dominated organic carbon and elemental carbon on hourly PM2.5 resulted 1.7. Black carbon was highly correlated to elemental carbon and the average mass absorption coefficient resulted MAC= 13.8 $\pm$ 0.2 m2 g^{-1}. It is noteworthy how air quality for a large metropolitan area, in a confined valley and under enduring atmospheric stability, is nonetheless influenced by sources within and outside the valley.

References

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