Secondary particulate matter formation during foggy days

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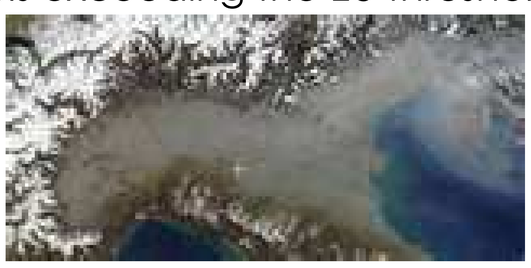
Introduction

In Milan, one of the largest cities in Italy, strong atmospheric stability conditions cause prolonged periods with high pollution levels exceeding the EU threshold limits.



During wintertime **secondary aerosol** often prevails on primary aerosol (Vecchi et al., 2009).

Formation path?

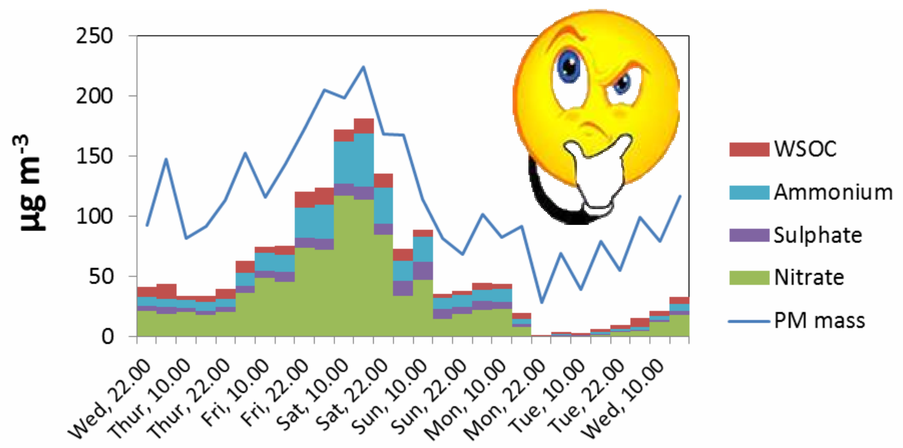


Fig.1: secondary inorganic ions, WSOC and PM mass trends in the period 21-28 February 2007

Focus

The data analysis presented here is mainly focused on the **secondary aerosol formation occurring during misty or foggy days**.

Experimental

Two **PM10** sampling campaigns (Nov-Dec 2006, Feb 2007).

Sampling: carried out in **parallel** on **quartz fibre and PTFE filters** with 4 hour and 8 hour time-resolution.

Chemical characterisation: elements, inorganic ions, OC/EC fractions, WSOC (water soluble organic compounds), and levoglucosan

Further measurements: particle size distribution by OPC, meteorological parameters (including global solar radiation and visibility), ^{222}Rn (marker for atmospheric stability conditions).

Results – First campaign (21 Nov- 6 Dec 2006)

Hydroxymethanesulfonate **(HMS): tracer for heterogeneous chemical reactions** (Dall'Osto et al., 2009). Product of the aqueous reaction between dissolved SO_2 and HCHO.

HMS was detected **in more than 90% of our samples** in the first campaign (range 12 - 3500 ng m^{-3}) **increased during the mist/fog events** (figure 2).

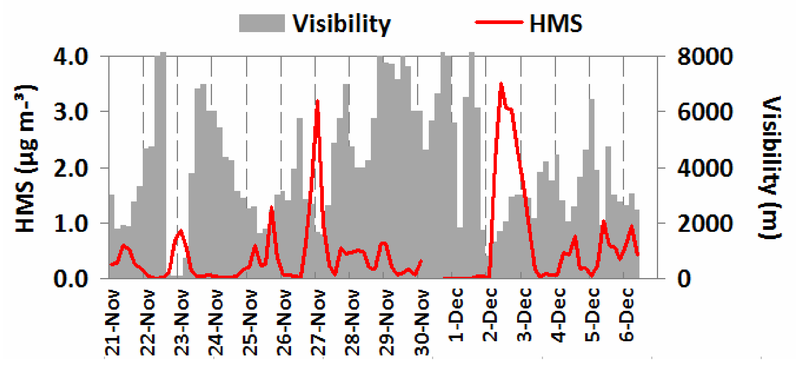


Fig.2: Visibility and HMS trends during the first campaign

Good correlation HMS-sulphate-particle number concentration in the range 0.6-0.7 µm (accumulation mode) (figure 3).

Vs.

No strict correlation between nitrate and particle number in a specific size-bin could be detected (figure 4).

=> **different formation path/ hygroscopic growth**

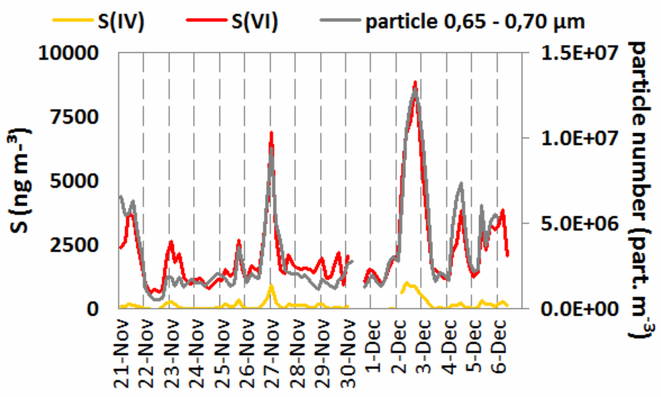


Fig.3: sulphate, sulphite, and particle number concentration in the range 0.65-0.7 µm during the first campaign

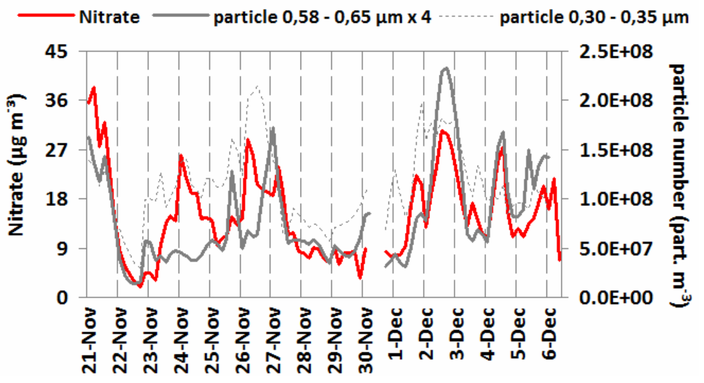


Fig.4: nitrate and particle number concentration in two size bins during the first campaign

Fig.3 confirms the possible sulphate formation by heterogeneous reactions which can occur in cloud droplets (Choularton and Bower, 2001).

Results – Second campaign (21-28 Feb 2007)

Characterised by a **2-days mist/fog event** (Friday-Saturday, Figure 5).

Nitrate: strongly related to particles in the range 0.58-0.65 µm (fig.6), possibly indicating a specific formation/growth path, opposite to the first campaign.

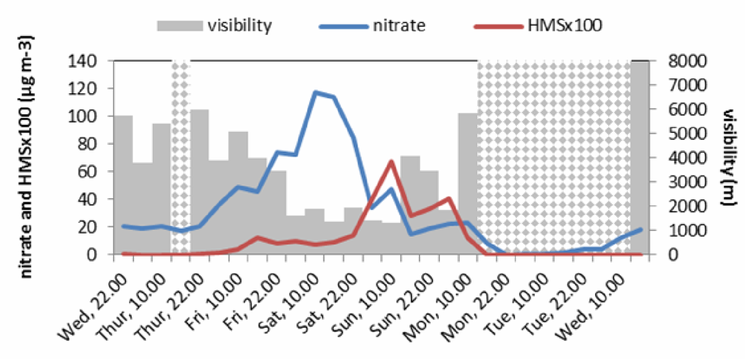


Fig.5: Visibility, HMS, and nitrate trends during the second campaign

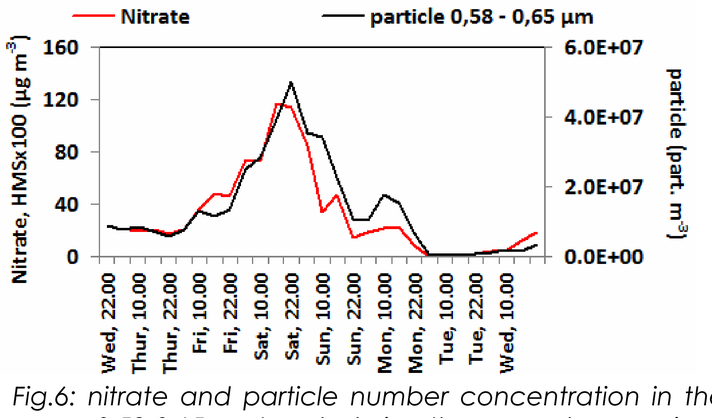


Fig.6: nitrate and particle number concentration in the range 0.58-0.65 µm trends during the second campaign

HMS: increased **only on Sunday** (figure 7).

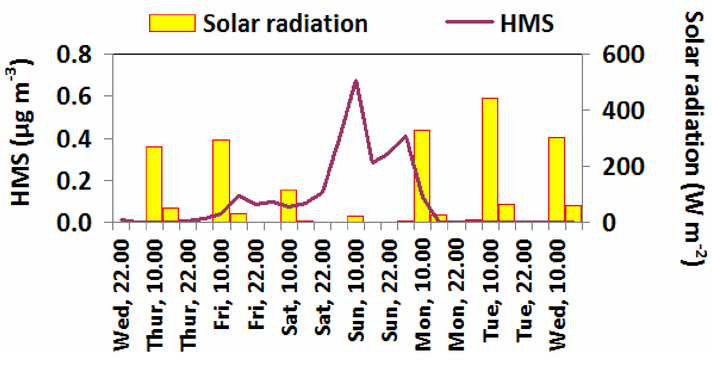


Fig.7: HMS and solar radiation during the second campaign

As shown in figure 1, **during the fog episode most of the PM10 mass can be ascribed to secondary components**.

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