Characterization of particulate nitrate in Barcelona during DAURE 2009 winter campaign

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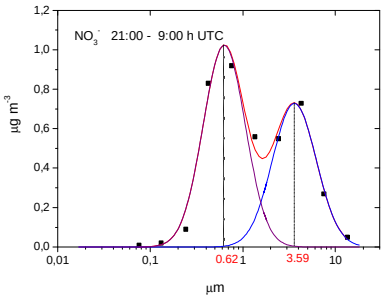
The DAURE (Determination of the sources of atmospheric Aerosols in Urban and Rural Environments in the western Mediterranean) winter campaign took place from 2009/02/25 to 2009/03/26. The objective was to characterize the sources of fine aerosols in the Barcelona region. Inorganic pollutants account for a significant fraction of the atmospheric aerosol. In order to characterize this fraction, especially the particulate nitrate, two different types of instrumentation were deployed in an urban site in the centre of Barcelona city.

Particle size distribution was obtained by means of a micro-orifice deposit impactor (MOUDI) (Marple *et al*., 1991). This impactor collected ten size fractions on aluminium substrates that were chemically analyzed by IC for soluble ions, thus obtaining a size distribution for each of the ions (sulphate, nitrate, ammonium, calcium and others). Samples were taken from the 24th of February to the 12th of March on a 12 hour basis. The first sampling period (21:00 to 9:00 UTC) comprised night time aerosol together with the morning emission period. The second sampling period (9:00 to 21:00 UTC) comprised daytime aerosol. The mass concentration averaged for each ion, size fraction and period during the whole campaign was fitted to a multi-modal log-Gaussian distribution. The particulate nitrate case can be found in figure 1. Night time distribution fit shows an accumulation mode near 0.6 µm and a coarse mode near 3.6 µm. The day distribution shows two modes near 0.75 and 3.9 µm. This slight displacement can be seen as a sign of ageing. Ion balances show that nitrate and sulphate are neutralized by the ammonium in the accumulation mode. In the coarse mode the nitrate is neutralized by the calcium ion. This suggests that some of the gaseous nitric acid reacted with the crustal calcium carbonate present in this coarse fraction.

Particulate nitrate time series on the fine fraction were measured by means of an R&P 8400N monitor with a 10 min time resolution (Long and McClenny, 2006). Comparisons of this time series with meteorological variables and gases series allowed determining the meteorological influence on the particulate nitrate concentration. Two stagnant periods enhanced the accumulation of pollutants and made that fine nitrate reached levels above 25 µg/m^3. Transport from nearby emission areas was identified as another relevant factor on the rise of the concentration.

(a)



(b)

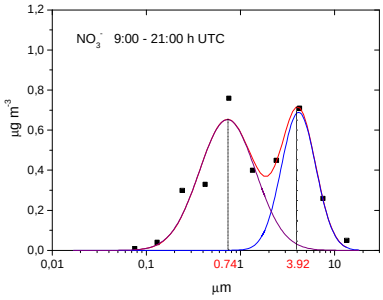


Figure 1. Log-Gaussian fits of the size distribution of the nitrate average. (a) Night and morning emission period. (b) Day period.

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