Experimental characterization of aerosol properties during the DAURE 2009 campaigns

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The DAURE (Determination of the sources of atmospheric Aerosols in Urban and Rural Environments in the western Mediterranean) campaigns took place in two periods: from 2009/02/25 to 2009/03/26 and during July 2009. The objective was to characterize the sources of fine aerosols in the Barcelona region in two different sites: an urban one at Barcelona city and a rural background site at the Montseny Natural Park. The campaign was hosted by the IDÆA-CSIC who co-organized it with the University of Colorado-Boulder (USA). A number of Spanish (CREAF, Barcelona Supercomputing Centre, UPC, UB and CIEMAT) and international (PSI (Switzerland), CEH (UK), University of Innsbruck (Austria) and Aerodyne Research (USA)) groups collaborated in the DAURE campaigns.

During the winter one, CIEMAT participated with a continuous particulate nitrate monitor (R&P 8400N) (Long and McClenny, 2006), a micro-orifice deposit impactor (MOUDI) (Marple *et al*., 1991) and a Sierra 220 cascade impactor for SEM analysis (Coz et al., 2009) that were installed at the Barcelona city site. An SMPS, the MOUDI and the Sierra impactors were also used at the Montseny site. During the summer campaign, the R&P 8400N monitor was installed at Barcelona site.

Analysis of particulate nitrate time series along with meteorological variables and gases allowed determining the main features influencing the evolution patterns of particulate nitrate concentrations.

The MOUDI allowed studying the particulate soluble ion size distribution. Samples were taken on a 12 hour basis, attempting to collect night time aerosol and morning emissions in the first sampling and daytime aerosol in the second one. The mass concentration averaged for each ion, size fraction and period during the whole campaign was fitted to a multi-modal log-Gaussian distribution. Ion balances were performed to observe the aerosol neutralization. Results showed that particles were neutral, except those bellow 56 nm, where the sulphate ion produced acidity.

The SEM analyses focused on the relative contribution and some specific physico-chemical properties of soot, mineral dust, metals and primary biogenic organic aerosols (PBOA) in the $PM_{2.5}$. Samples were taken at four different times of the day during one of the strong atmospheric stability periods. Results showed that condensation onto soot does not allow the structure to collapse (as it has been documented in Mexico DF) forming some stable complex mixtures of organic and nitrate matter covering the surface (possibly organonitrites). There was a constant background of mineral dust and PBOA in the fine range. The contribution of anthropogenic industrial mineral dust to the total mineral dust in the $PM_{2.5}$ ranged from 20 to 70%.

At the Montseny site, two different types of events were characterized, coinciding with the arrival of air masses, along the main axis of the valley. In one case the air mass coming from SE transported aged aerosol which had grown up by condensation and oxidation and produced a high number of particles recorded with the SMPS. The analysis of MOUDI samples showed a significant amount of Ca^{2-} in all sizes that is not present in the PM1 fraction when air comes from NW. In that case much smaller particles close to the SMPS instrument detection limit were recorded , what meant that new particle nucleation could have occurred just before arriving to the sampling point.

There was not a strong difference for sulfate and nitrate in relation with air mass origin. Sulfate was found in the accumulation mode and below 56 nm, while nitrate also appeared in the coarse mode.

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