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Causes of daily cycle variability of atmospheric pollutants in a western Mediterranean urban site (DAURE campaign)

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The 2009 DAURE Aerosol Campaign (23-February-2009 to 27-March-2009 and 1-July to 31-July) (see Presentation: Pandolfi et al., section AS3.2) had the objective of characterising the main sources and chemical processes controlling atmospheric pollution due to particulate matter in the Mediterranean site of Barcelona (Spain). An urban and a rural background site were selected in order to describe both kinds of pollution setting. Several parameters were taken into consideration, including the variability of mass concentration in the coarse and fine fractions, particle number, amount of black carbon and the concentration of gaseous pollutants (SO2, H2S, NO, NO2, CO, O3) present. Comparisons between the chemical composition of ambient atmospheric particles during day versus night were made using twelve-hour PM samples. The data shown here are focused on results obtained for the urban site where two main atmospheric settings were distinguishable in winter, namely Atlantic advection versus local air mass recirculation. During the warmer months Saharan dust intrusions added a third important influence on PM background. The data demonstrate that superimposed upon these background influences on city air quality are important local contributions from road traffic, construction-demolition works and shipping. There is also a major local contribution of secondary aerosols, with elevated number of particles occurring at midday (and especially in summer) when nucleation processes are favoured by photochemistry.

Concentrations of SO2 peak at different times to the other gaseous pollutants due to regular daytime on-shore south-easterly breezes bringing harbour emissions into the city. Road traffic in Barcelona also has a great impact on air quality, as demonstrated by daily and weekly cycles of gaseous pollutants, black carbon and the finer fraction of PM, with peaks being coincident with traffic rush-hours (8-10h and 20-22h), levels of pollution increasing from Monday to Friday, and a pronounced “weekend effect” diminution. An additional factor produced a previously undocumented PM2.5-10 peak between 11.00 and 14.00h and is attributed to the enormous quantity of construction and demolition works taking place in the metropolitan area during 2009. At the beginning of the year there were around 300 new work sites already in operation, maximum levels of emissions from which are favoured by the presence of the sea breezes which are at their strongest around midday.

Chemical analyses of the PM show a predictable domination of the coarser fraction by mineral matter and sea salt, while the finer PM contains more organic matter, elemental carbon, SIA (secondary inorganic aerosols: sulphate, nitrate and ammonia) and trace elements. Not many chemical differences are detected by comparing day and night samples, excepting SIA (the concentrations of which are higher at night) and mineral matter (higher during the day). With regard to trace metal concentrations there were higher than average levels of metals typically associated with mineral matter (Li, Se, Hf) and non-exhaust traffic emissions (Ba, Sn).
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