Factors driving intra-day variation of submicron aerosols in Barcelona

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It is well known that ambient aerosols have adverse effects on human health and affect climate. Fine particulate matter (PM_1, particles with an aerodynamic diameter <1 µm) are mainly comprised of secondary inorganic compounds and carbonaceous aerosols, the latter reaching up to 90% of the mass.

The city of Barcelona is located in the Western Mediterranean Basin, characterized by unique atmospheric dynamics which control the concentration, composition and transport of PM, with enhanced regional accumulation of pollutants in summer. Barcelona has a high road traffic density in comparison to other European cities, with a large proportion of diesel vehicles. Several studies on the air quality of Barcelona have been carried out (e.g. Pérez *et al*, 2010). Nevertheless, the intra-day variation and the organic sources have not been studied for long-term periods. Therefore, the present study aims at assessing the submicron aerosol chemical composition and organic sources in Barcelona during one year period by using on-line measurements.

An aerosol chemical speciation monitor (ACSM, Aerodyne Research Inc.) was deployed at the urban background site of Palau Reial in Barcelona (PR, 41°23'14" N, 02°06'56"E, 78 m a.s.l.) from May 2014 to the present (and ongoing) to measure real-time submicron inorganic (nitrate, sulphate, ammonium and chloride) and organic aerosol (OA) concentrations. Real-time black carbon (BC) and PM_1 concentrations were measured using a multi-angle absorption photometer (MAAP) and an optical particle counter (OPC, GRIMM 180), respectively. 24-h PM_1 samples were collected on filters and subsequently chemically analyzed. The organic mass spectral data matrix from the ACSM was used to carry out the source apportionment of OA applying Positive Matrix Factorization (PMF) using the Multilinear Engine (ME-2) with the toolkit SoFi (Canonaco *et al*, 2013). The results shown in this abstract comprise data from May 2014 to February 2015.

The ACSM + BC concentrations agreed with the PM_1 measurements, and strong correlation was found between the concentrations of ACSM species and the off-line measurements of the same species, especially for sulphate and ammonium (squared Pearson correlation coefficient R^2=0.91).

The PM_1 was dominated by OA both in the warmer period (May to September) and in the colder period (October to February), accounting for 40% of the PM_1 (calculated as ACSM + BC concentrations). The contribution of BC reached 16% in the warmer period and 20% in the colder period.

The intra-day variations of OA and BC concentrations track each other and show clear peaks at traffic rush hours, which indicates that they may have common sources. It is especially true in the colder period, when the correlation between OA and BC is relatively strong (R^2=0.61), as opposed to that in the warmer period (R^2=0.45), which points to additional sources of OA in summer. The source apportionment to the OA fraction will further confirm the existence of these sources and will quantify their different contributions.

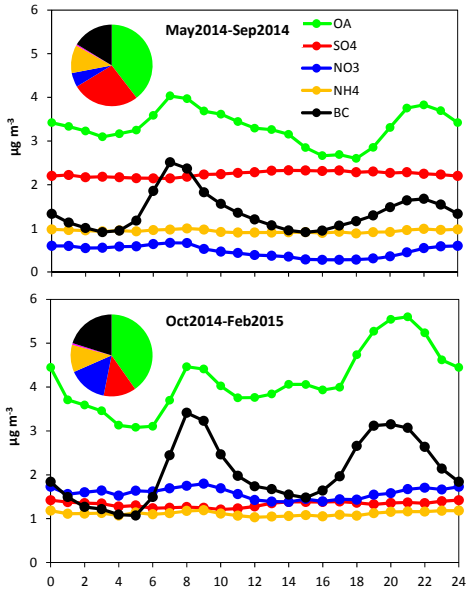

Figure 1. Average composition and average daily pattern of organic aerosol (OA), nitrate (NO3), sulphate (SO4), ammonium (NH4), and black carbon (BC) for the warmer and the colder periods.

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