Modelling $PM_{2.5}$ chemical composition with CAMx in southwest Spain

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Keywords: aerosol modelling, $PM_{2.5}$, chemical composition.
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Background $PM_{2.5}$ concentrations (rural) are rather high in the southwest region of Spain (Andalusia). The region has high anthropogenic emissions including substantial industrial emissions (e.g. power plants, petrochemical refineries, fertiliser industry), on-road traffic, shipping traffic passing through the Gibraltar strait, agricultural emissions and also biogenic emissions. It also experiences a high frequency of African dust intrusions and its low rainfall, dry soils and high photochemical activity plus the availability of aerosol precursors all contribute to the enhanced concentration of atmospheric aerosols.

As a result of these factors the AER-REG project was initiated to study the formation and transport of atmospheric aerosol in western Andalusia. It involved intensive measurement campaigns at two rural sites and one urban site in 2008 and 2009. Chemically speciated $PM_{2.5}$ measurements of all major aerosol components (sulphate, nitrate, ammonium, total carbon, black carbon, sea-salt, dust) plus trace elements were made during daytime and nighttime with high volume samplers (30 m^3 h^{-1}) using quartz micro-fibre filters. In addition highly time resolved (15 minute mean) measurements of Black Carbon (BC) were made at one of the rural sites and the urban site using a Multi-Angle Absorption Photometer, see Fernández-Camacho *et al* (2010) for more details. Gaseous measurements of O_3, SO_2, NO and NO_2 were also conducted.

In parallel to the chemically speciated measurements the three-dimensional eulerian photochemical model CAMx v4.51 (Environ) was implemented to investigate the complex dynamics of aerosol formation and transport in this region and their spatial and temporal resolution. CAMx was run with three nested domains with 18 km, 6 km and 2 km resolution. The outer domain covers the Iberian Peninsula while the inner domain covers the southwest region of Spain (western Andalusia). The non-hydrostatic mesoscale meteorological model (MM5) v3.7 was used to drive the photochemical model.

Emissions in the inner domain are based on Castell *et al* (2010) and include industrial point and area sources; on-road and shipping traffic; NH_3 emissions from fertiliser application to agricultural land and biogenic sources of non-methane volatile organic compounds (NMVOC). Emissions in the outer domains are from EMEP plus biogenic NMVOC emissions.

The combination of the high quality chemically speciated measurement dataset and the modelling system is now being utilised to explore the seasonal differences in both primary and secondary chemically speciated aerosol. The model performs well for ammonium in both summer and winter periods (although tending to underestimate the magnitude of concentrations) while for sulphate the performance is better during the summer period. The highly resolved measurements of $PM_{2.5}$ BC and CAMx simulated $PM_{2.5}$ primary elemental carbon (PEC) at the urban site in Huelva in winter and summer (Fig. 1) show that the model captures the diurnal and seasonal variability of this primary aerosol. Peak concentrations are observed during a winter anticyclonic episode in the first half of the March campaign and these are well captured by the modelling system (Fig. 1a), although the model underestimates concentrations in the latter half of the campaign. During the summer campaign, concentrations are generally much lower reflecting enhanced dispersive conditions (Fig 1b).

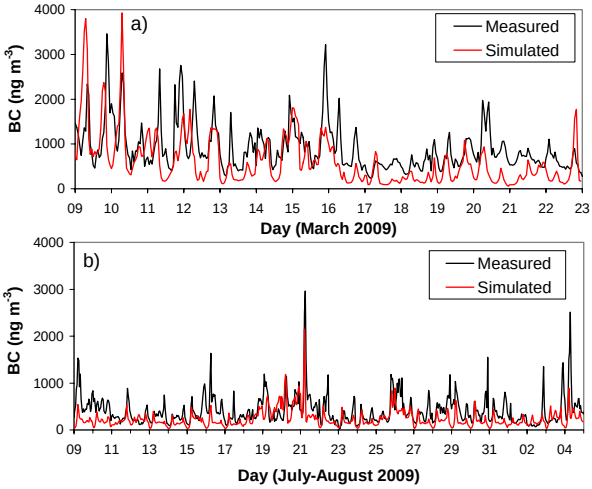

Figure 1. Measured BC ($PM_{2.5}$) and simulated $PM_{2.5}$ PEC concentrations at University Campus, Huelva.

The authors gratefully acknowledge funding from the Department of Innovation, Science and Enterprise (Andalusia Government) through the projects AER-REG (P07-RNM-03125) and SIMAND (P07-RNM-02729).

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