Long term measurements of carbonaceous aerosol in PMx in Barcelona, Spain - Influence of African dust

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Keywords: elemental carbon, organic carbon, carbonate, African dust.
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Atmospheric aerosol represents a complex mixture of inorganic substances and hundreds of different organic compounds. Carbonaceous material may be broadly divided into three categories: organic carbon (OC), elemental carbon (EC) and inorganic carbon (IC), present as carbonate carbon (CC). OC can be of both primary and secondary origin, i.e. emitted directly into the atmosphere or formed by the condensation of compounds produced in the atmosphere by photo-oxidation of volatile organic precursors. In contrast, EC is exclusively of primary origin (incomplete combustion of C containing fuels). CC is mostly present in natural ground and building/demolition dust which can be resuspended (Karanasiou et al., 2011). The inorganic content of PM includes major soluble ions and metals of both natural and anthropogenic origin. Natural events, such as dust transport from North Africa, can significantly influence (up to 80%) the levels of measured particulate matter, PM (Pey et al., 2013). To establish appropriate abatement strategies long-term measurements of aerosol chemical composition are necessary.

Long term measurements of PM10, PM2.5 and PM1 were conducted in an urban background monitoring station in Barcelona, Spain covering the period 2007-2014. All particle measurements were obtained using the gravimetric method. All PMx samples were analyzed for water-soluble ions (SO_4^{2-}, NO^{3-}), major elements (Al, Ca, K, Mg, Fe, Na) and 46 trace elements by inductively coupled plasma atomic emission and mass spectrometry respectively. A section of 1.5 cm^2 of the filter was used for the determination of organic (OC) and elemental carbon (EC) by an OC/EC analyzer (Sunset Laboratory thermal optical transmittance method) using the NIOSH protocol for the period 2007-2010 and later on the EUSAAR-2 temperature protocol.

The occurrence of African dust transport and its contribution in PM levels in Barcelona site was determined by the methodology described in Escudero et al. (2007).

We firstly investigated the distribution of carbonaceous aerosol in PM10, PM2.5 and PM1 during the period 2007-2014. As it was expected most of the mass of EC and OC was found in the fine fractions PM2.5 and PM1. The influence of the African dust transport on the distribution patterns of EC and OC was also studied.

CC concentrations are significant during African dust events. The decomposition temperature of carbonate may vary depending on a number of factors such as: the chemical composition of the carbonate compound, the presence of other minerals, the crystal form, the grain size and the temperature protocol used. To investigate the interference in OC and EC determination caused by CC we carefully studied all thermograms of the OC/EC analyser during African dust intrusions for the period 2007-2014. The last peak in the inert mode was compared with the CC concentrations calculated from Ca concentrations (as if all CC comes from $CaCO_3$). The results revealed that the last peak in the inert mode correlates well with CC concentrations. The non-quantification of existing CC may significantly bias thermal OC determination increasing its uncertainty.

This work was supported by the Spanish Ministry of Economy and Competitiveness and FEDER funds under the project CGL2012-39623-C02-1); the Spanish Ministry of Agriculture, Food and the Environment; the H2020 project ACTRIS-2 (grant agreement 654109); and the Generalitat de Catalunya (AGAUR 2014 SGR33).

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