Large-scale intensive study of light absorption by urban aerosol in the Athens Metropolitan Area

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Keywords: CAPS PMssa, absorption, wood-burning, black carbon.
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Air pollution is a very important environmental concern in Athens. Because of its high population and the concentration of urban activities in a relatively small area, as well as its complex topography with its surroundings mountains acting as physical barriers, severe environmental degradation are taking place characterized by high loadings of atmospheric pollutants. In the last decade, a growing use of biomass for domestic heating has been observed, resulting in an increase in the emission of soot particles.

In that context, the aim of this study was the characterization of anthropogenic aerosol pollution in the urban environment of Athens, focusing on the "smog" phenomenon caused by wood-burning for heating purposes.

For that purpose, the intensive measurement campaign "ACTRIS JRA1" took place during winter 2016 at the Thissio urban background sampling site in the premises of the National Observatory of Athens in the centre of Athens. Simultaneous measurements were performed at the "Demokritos" monitoring station, located in a vegetated area, and representative of the atmospheric suburban background of Athens. At both sites, surface in-situ measurements of absorption and scattering coefficients were continuously performed using multi-wavelength aethalometers, CAPS PMssa, MAAP and nephelometers.

Intercomparisons between the different instrumental techniques were performed in order to reduce the uncertainties in the determination of the aerosol light absorption and scattering measurements.

Ambient measurements of the absorption, scattering and extinction coefficients are presented in Figure 1. Absorption coefficients exhibited values up to 100 Mm^{-1} and up to 20 Mm^{-1} at the central and the suburban stations of Athens respectively, revealing a highly polluted atmosphere in Athens during wintertime. Overall, the atmospheric load of absorbing aerosols was 3 to 6 times lower in the suburban monitoring site compared to the centre of Athens.

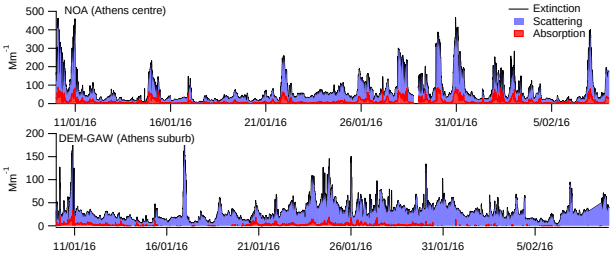

Figure 1. Time Series of absorption, extinction and scattering coefficients measured by CAPS PMssa at 780 nm at NOA and Demokritos stations

As illustrated in Figure 2, the diurnal variability of equivalent BC concentrations led to a bimodal pattern, with higher levels early in the morning and just after sunset. This behaviour is explained by the combination of enhanced emissions and a shallow boundary layer during these hours of the day. Preliminary results showed that biomass burning contributed to the eBC levels at around 40% during nighttime at the suburban site.

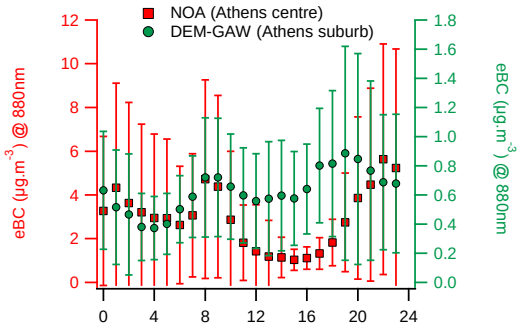

Figure 2. Diurnal cycle of equivalent BC concentrations measured by AE33 aethalometers at 880 nm at NOA and Demokritos stations

Support by the ACTRIS JRA1, the EnTeC FP7 Capacities (REGPOT-2012-2013-1, FP7, ID:316173) and ERC-CoG 615922-BLACARAT programmes is acknowledged.