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Carbonaceous aerosol measurements at the GAW-DEM urban background site in Athens, Greece – Concentration levels and potential sources

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Carbonaceous material constitutes a major component of suspended particulate matter (PM) and plays an important role in radiative transfer, atmospheric chemistry and air pollution health effects. Particulate carbon consists mainly of elemental carbon (EC) and various organic compounds (OC), and may be of primary or secondary origin. Under certain meteorological conditions (such as during Sahara dust events) inorganic or carbonate (CC) carbon may also contribute significantly to total particulate carbon, especially in the coarse fraction.

The aim of the present work was to examine EC, OC and CC concentration levels at an urban background site at the city of Athens. Seasonal and diurnal trends were studied, in order to reveal potential aerosol carbon sources in the atmosphere. In addition, elemental carbon (EC) concentrations and aerosol absorption coefficient obtained in parallel were compared.

The results presented cover measurements conducted at the N.C.S.R. "Demokritos" urban background site (GAW-DEM), in the periphery of the Athens Metropolitan area, during 1 year (October 2009 – September 2010). PM2.5 elemental, organic and carbonate carbon concentrations were measured in a 3-hr basis by thermal/optical methodology (Semi-Continuous OCEC Field Instrument, Sunset Laboratory Inc.). In addition, aerosol absorption coefficient was measured continuously by an aethalometer (Model AE31, Magee Scientific).

Mean 24-hr OC and EC concentrations were measured equal to 2.40 ± 0.92 μg m-3 and 0.67± 0.30 μg m-3, respectively. The corresponding CC concentrations were much lower (0.07 ± 0.09 μg m-3). Nevertheless during certain days CC contributed significantly to total carbon concentration, reaching up to EC concentration levels. Back-trajectory analysis revealed that part of these high CC concentration events corresponded to days with air masses transport from North Africa, linking the measured CC with Sahara dust transferred across the Mediterranean basin. No significant seasonal variation was observed on EC and OC concentrations, indicating the presence of constant carbon sources in the area for these two species. Elemental carbon diurnal variation suggested vehicular traffic from the metropolitan area as a major source of EC; organic carbon seems mostly related to secondary aerosol formation and long range transport.

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