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Carbonaceous content of atmospheric aerosols in Lisbon urban atmosphere

Fátima Mirante (1), C. Oliveira (1), N. Martins (1), C. Pio (1), A. Caseiro (1), M. Cerqueira (1), C. Alves (1), C. Oliveira (2), J. Oliveira (2), F. Camões (2), M. Matos (2), and H. Silva (2)

(1) CESAM, Department of Environment and Planning, Aveiro University, Portugal (fmirante@ua.pt), (2) CCMM/DQB – Sciences Faculty from Lisbon University, Lisbon, Portugal

Lisbon is the capital city of Portugal with about 565,000 residents and a population density of 6,600 inhabitants per square kilometre. The town is surrounded by satellite cities, forming together a region known as "Lisbon Metropolitan Area" with about 3 million inhabitants. It is estimated that more than one million citizens come into the Lisbon area every day from the outskirts, leading to elevated traffic densities and intense traffic jams. Airborne particulate matter limit values are frequently exceeded, with important consequences on air pollution levels and obvious negative impacts on human health.

Atmospheric aerosols are known to have in their structure significant amounts of carbonaceous material. The knowledge of the aerosols carbon content, particularly on their several carbon forms (as TC, EC and OC, meaning respectively Total, Elemental and Organic carbon) is often required to provide information for source attribution.

In order to assess the vehicles PM input, two sampling campaigns (summer and winter periods) were carried out in 2008 in Lisbon in two contrasting sites, a roadside and an urban background site. Particulate matter was collected in two fractions on quartz fibre filters using Hi-Vol samplers (coarse fraction, 2.5μm<Dp<10μm and fine fraction, Dp<2.5μm). To complementing this study, an atmospheric aerosol sampling campaign was also performed inside an open and a closed tunnel on four size fractions (PM0.49, PM0.49-0.95, PM0.95-2.5 and PM2.5-10). Road dust was also collected in each sampling site. Samples were analysed for elemental carbon (EC) and organic carbon (OC) concentrations by a thermal-optical method.

The urban site presented the highest aerosol PM concentrations for the two size ranges, with PM10 average values of about 48 μg.m-3 and 27 μg.m-3 respectively for the roadside and urban background sites in the summer period, and about 44 μg.m-3 and 27 μg.m-3 in the winter season. In general, the concentrations of TC were higher at the roadside site, reflecting the input of EC from traffic. The OC presented a lower gradient, presumably due to the substantial secondary organic component. Both EC and OC showed higher concentrations in summer than in winter, with average values more elevated at roadside than those detected at the urban background site.
The finest fraction presented similar OC/EC ratios (about 0.8) for both sampling sites and seasons, with the exception of the summer period in the urban background site, were this ratio was about 1.9 due to the OC increase by secondary production. In contrast, the coarse fraction had similar values in both seasons within the same location; with the urban background site presenting ratios half than those of the roadside site. This trend suggests in each site the presence of similar carbon sources between both sampling seasons.
Inside the closed tunnel were vehicles emissions are the main source of pollution the OC/EC ratios for PM2.5 were about half the ones detected in the outside of the tunnel in the roadside station, where other emission sources are present. This fact suggests that vehicles carbon emissions are mostly composed by EC, whereas the OC has significant contributions from other sources.

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