Black carbon contribution to the particle matter in Madrid City during a local winter episode

E. Coz[1], M. Becerril[1], Z. Chang[2], J. Pérez-Guldris[2], A.S.H. Prévôt[3], G. Ramos[2], B. Artiñano[1]

[1]Department of the Environment, CIEMAT, Madrid, ES-28040, Spain
[2]Department of Analytical Chemistry and Chemical Engineering, University of Alcalá de Henares, Alcalá de Henares, ES-28801, Spain
[3]Laboratory of Atmospheric Chemistry, PSI, Villigen-PSI, CH-5232, Switzerland
Keywords: black carbon, thermal inversion
Presenting author email: esther.coz@ciemat.es

Black carbon (BC), a product of inefficient combustion from fossil fuel and/or biomass burning, is considered a major contributor to global warming (Ramanathan and Carmichael, 2008). In a highly populated urban metropolis, such as Madrid, with no industry nearby and where traffic and domestic activities are the dominant sources, BC can be regarded as one of the most important components within the chemical atmospheric pool. Thus, BC monitoring has become an urgent challenge to achieve for the city.

For the first time, PM_{10} BC concentrations have been recorded through aerosol light absorption using a 7 multi-wavelength Aethalometer (Magee Sci. mod. AE33, Aerosol d.o.o.) during a small thermal inversion period (Fig.1) -typical meteorological scenario from the winter season in Madrid-, at the CIEMAT urban background site (Plaza et al., 2011). The instrument took part in an ACTRIS intercomparison showing extremely good agreement with the other instruments (same and previous model, AE31) and the MAAP used as reference.

Results showed that the evolution of the BC concentrations during the sampling tests conducted at CIEMAT were in good agreement with the averaged $PM_{2.5}$ and PM_{10} concentration levels of all the stations from the city Authority air quality monitoring network (http://www.mambiente.munimadrid.es/svca/index.php?lang=en), confirming the site as representative of the atmospheric aerosol composition within the urban limits during this type of events. Hourly BC concentrations, which reached more than 20 $\mu g \cdot m^{-3}$ in part of the period, represented, on average, 40% of the network averaged $PM_{2.5}$ during the episode in comparison with 10% during the previous and subsequent days.

A first evaluation of the responses at the ultraviolet (UVPM, 370nm) and near-infrared (nIR-BC, 880nm) wavelengths (Sandradewi et al., 2008), suggests there was no important contribution from biomass burning origin to these high BC concentrations during the event. The mean UVPM/n-IR-BC ratio was 1.07±0.05. Relatively higher concentrations of the UVPM signal are expected from the derived organic compounds when the contribution of wood smoke aerosols becomes important. Nevertheless, further analysis ^{14}C analyses and further data analyses need to be done to quantitatively estimate each contribution.

This finding is of special importance since biomass burning seems to be a significant source in most of the European highly populated cities, giving Madrid a unique position regarding atmospheric aerosol /BC sources at least in this time of the year.

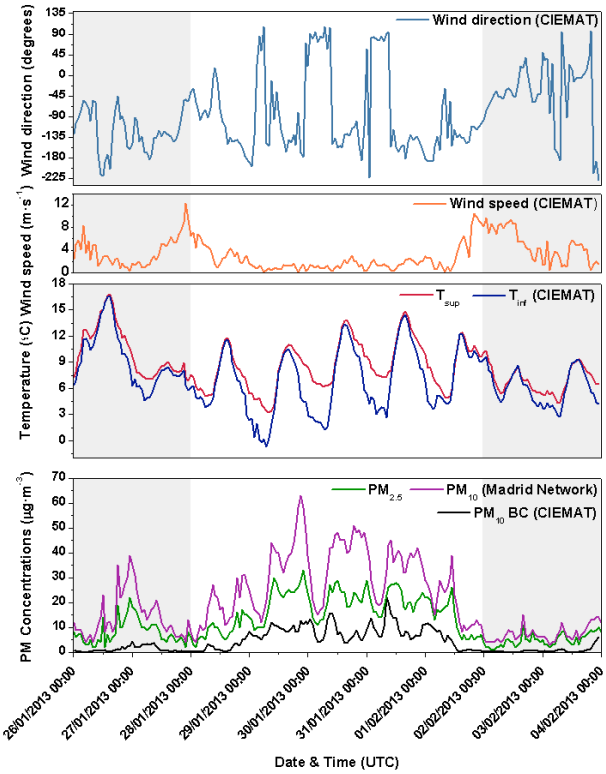

Fig 1. Meteorological parameters and BC concentrations during the thermal inversion in the station at Ciemat. T_{sup} and T_{inf} are temperature at high and low levels of the CIEMAT tower. Averaged PM_{10} and $PM_{2.5}$ concentration levels from the stations in the local Authority network.

The authors especially acknowledge Dr. Müller and the participant team in the ACTRIS WP3 Absorption Photometer and Nephelometer Workshop in February 2013. This work has been funded by the AEROCLIMA project (CIVP16A1811, Fundación Ramón Areces) and the MICROSOL project (CGL2011-27020).

Plaza et al. (2011). *Atmos. Environ.* **35 (11)**, 2496–2506.
Ramanathan, V. and Carmichael, G. (2008). *Nature Geosci.* **1**, 221–227.
Sandradewi et al. (2008), *Atmos. Environ.* **42**, 101-112.