A full characterization of the carbonaceous component of the aerosol in near-real-time in a coal region

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Keywords: air quality, aethalometer, elemental carbon, organic carbon, total carbon analyzer.
Associated conference topics: 2.9, 3.2.
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Air pollution in urban sites is one of the main problems of humanity in the 21st century. Linked to this, carbon emissions represent a serious environmental problem, compounded by the combustion of coal as fossil fuel used for heating purposes. Coal combustion is still a major source of atmospheric pollutants in several areas of the world, such as Asia or some European countries, e.g. Poland (Smołka-Danielowska et al., 2021). The main aim of this study is to provide, in near-real-time, a full characterization of the carbonaceous component of the aerosol (organic carbon -OC-, black carbon -BC- and total carbon -TC) in a coal-burning area, with medium-high traffic intensity. Furthermore, the contribution of fossil fuel, biomass burning and coal combustion to BC will be estimated.

The sampling campaign was carried out on the terrace of an official building, at a height of around 20 m above street level, in León city centre (NW Spain; 844 m a.s.l) between 03/12/2021 and 03/05/2022. Three sampling instruments were used: i) a Total Carbon Analyzer (Model TCA08) to measure TC, OC and elemental carbon (EC)-; ii) an aethalometer AE33 for measuring BC concentration, connected to TCA (using a slope EC:BC of 1) and; iii) a weather station to monitor some meteorological variables. The contribution of the main sources of BC, fossil fuel and biomass burning can be estimated by applying the Sandradewi et al. (2008) approach, using an Ångström Absorption Exponent (AAE) of 1.0 for fossil fuel and 2 for biomass burning.

The preliminary results indicate that the mean hourly concentrations of TC and BC were 8.34 and 1.70 μg m^{-3}, respectively (Figure 1). The maximum hourly concentration was registered on 15/12/2022 at 1700 UTC, with a concentration of TC and BC of 40.77 and 19.45 μg m^{-3}, respectively. Along sampling (cold months), there was a good correlation between hourly BC-TC concentrations (r=0.77; p<0.05). The aethalometer model application showed a mean contribution of biomass burning to the total BC of 22 % with a mean AAE of 1.30.

The weekly evolution showed that during weekdays, the TC and BC concentrations were 8.66 and 1.85 μg m^{-3}, higher than during weekend days (7.52 and 1.34 μg m^{-3}, respectively) due to the lower activity in the city (Figure 2). Besides, January was the month with the highest TC and BC concentrations (10.20 and 2.42 μg m^{-3}, respectively), related to the lower temperatures (5.1 °C) and low precipitation (8.25 mm) registered.

The study of the evolution of carbon pollutants in the NW of the Iberian Peninsula will allow to improve air quality models and this will help to apply mitigation/corrective measures in the use of coal. The next step in this study will be the application of the model of Blanco-Alegre et al. (2022) to estimate the contribution of coal combustion to total BC.

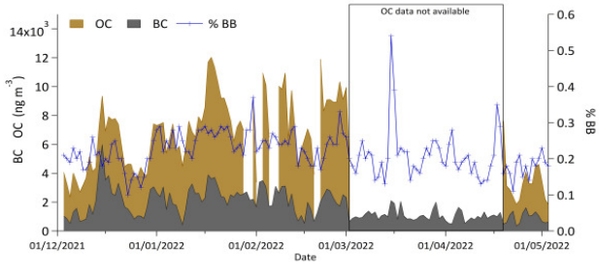

Figure 1. Evolution of BC, OC and biomass burning percentage (% BB) along sampling campaign.

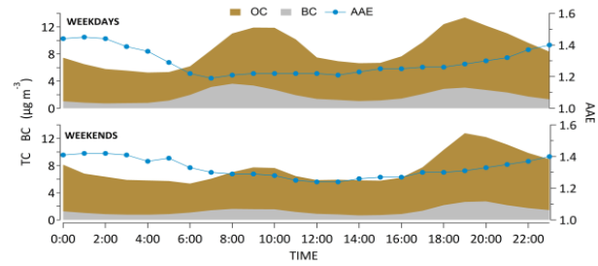

Figure 2. OC and BC concentrations and AAE during weekdays and weekends along sampling campaign.

This work was partially supported by the Junta de Castilla y Leon co-financed with European FEDER funds (Grant LE025P20). It was also in part supported by the AEROHEALTH project (Ministry of Science and Innovation, co-financed with European FEDER funds. Grant PID2019-106164RBI00). Furthermore, it is part of the project TED2021-132292B-I00, funded by MCIN/AEI/10.13039/501100011033 and by the European Union “NextGenerationEU”/PRTR.

Blanco-Alegre, C., Fialho, P., Calvo, A.I., Castro, A., Coz, E., Oduber, F., Prévôt, A.S.H., Močnik, G., Alves, C., Giardi, F., Fraile, R., 2022. Atmos. Res. **267**, 105980.
Sandradewi, J., Prévôt, A.S.H., Szidat, S., Perron, N., Alfarra, M.R., Weingartner, E., Baltensperger, U.R.S. (2008) Environ. Sci. Technol. **42**, 3316–3323.
Smołka-Danielowska, D., Jabłońska, M., Godziek, S. (2021) Minerals 11:1155.