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

C. Blanco-Alegre, A.I. Calvo, C. Gonçalves, E. Vicente, and R. Fraile
Department of Physics, Universidad de León, Campus de Vegazana, 24071, León, Spain.
Keywords: air quality, aethalometer, elemental carbon, organic carbon, total carbon analyzer.
Presenting author email: cblaa@unileon.es

EAC 2023
European Aerosol Conference
Malaga (Spain) – September 3–8, 2023

INTRODUCTION

Urban air pollution is one of the major problems facing humanity in the 21st century. Related to this, carbon emissions are a serious environmental problem, exacerbated by the combustion of coal as a fossil fuel for heating. 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 objective 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** (Figure 1)**,** with medium-high traffic intensity. Furthermore, the contribution of fossil fuel (eBC$_{ff}$) and biomass burning (eBC$_{bb}$) to BC will be estimated.

MATERIAL AND METHODS

A Total Carbon Analyzer (Model TCA08) to measure TC, OC and EC.

An aethalometer AE33 for measuring BC concentration, connected to TCA (using a slope EC:BC of 1).

A weather station to monitor meteorological variables.

Cold months

03/12/2021   03/05/2022

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 2.0 for biomass burning.** The model of Fialho et al. (2006) has been applied to Saharan intrusion events.
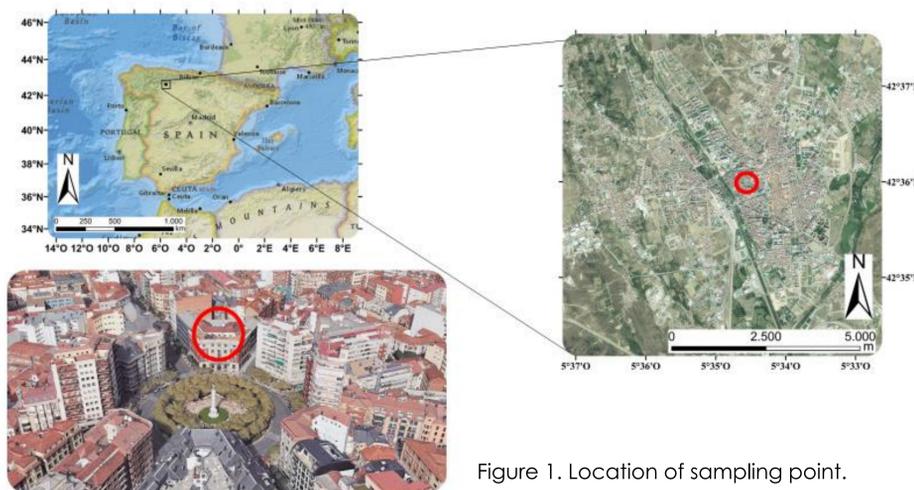

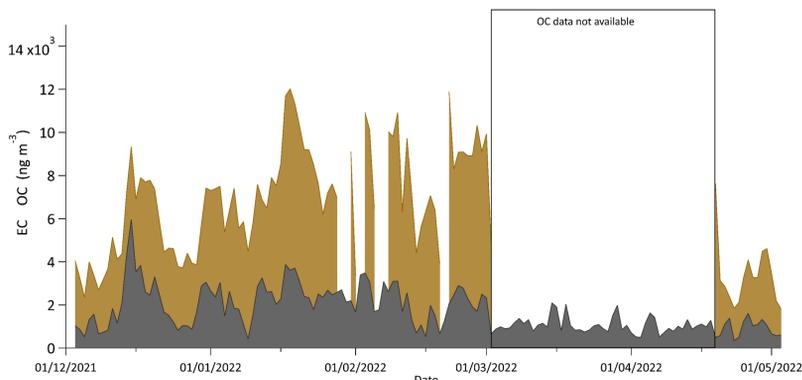Figure 1. Location of sampling point.

RESULTS

Figure 2. Evolution of EC and OC along sampling campaign.

- The mean hourly concentrations of **TC and EC** were **8.3 and 1.7 µg m^{-3}**, respectively. The **maximum hourly concentration** was registered on 15/12/2022 at 1700 UTC, with a concentration of **TC and EC of 40.8 and 19.5 µg m^{-3}**, respectively (Figure 2).

- Along sampling (**cold months**), there was a **good correlation** between hourly **BC-TC** concentrations (r=0.77; $p<0.05$).

Figure 3. Evolution of eBC$_{ff}$, eBC$_{bb}$ and AAE along sampling campaign.

- The aethalometer model application showed a mean **contribution of biomass burning** to the total eBC of **22 %** with a **mean AAE of 1.30** (Figure 3).

- The weekly evolution showed that during **weekdays**, the TC and BC concentrations were 8.7 and 1.9 µg m^{-3}, **higher than during weekend** days (**7.5 and 1.3 µg m^{-3}**, respectively) due to the lower activity in the city (Figure 4).
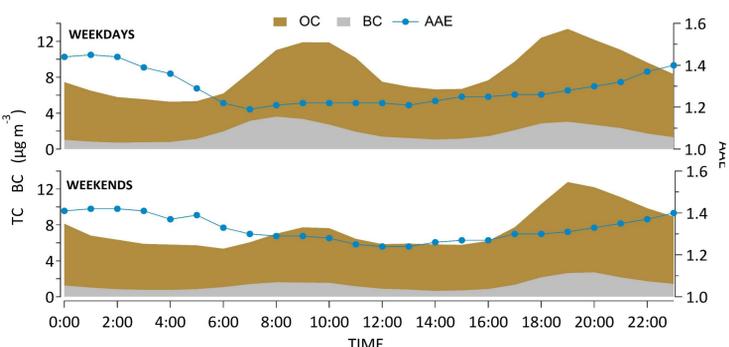

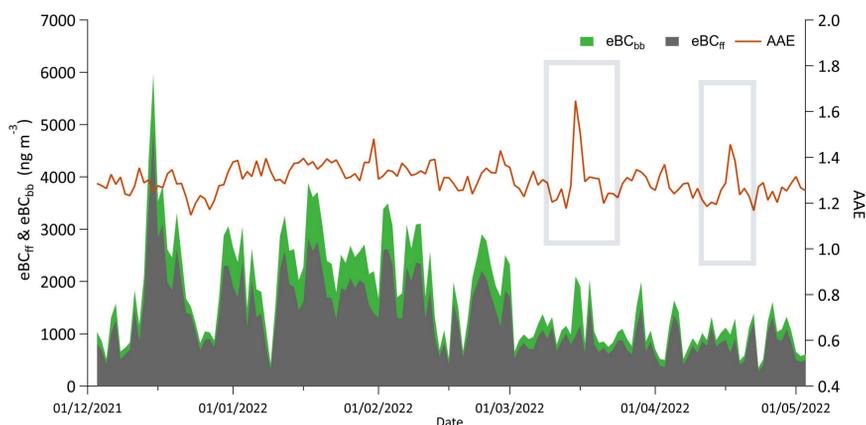Figure 4. OC and EC concentrations and AAE during weekdays and weekends along sampling.

- **January was the month with the highest TC and BC concentrations (10.2 and 2.4 µg m^{-3}**, respectively), related to the lower temperatures (5.1 °C) and low precipitation (8.25 mm) registered.

- The boxes in Figures 3 and 5 **indicate Saharan intrusion events**. These events complicate real-time analysis by adding another source of eBC.
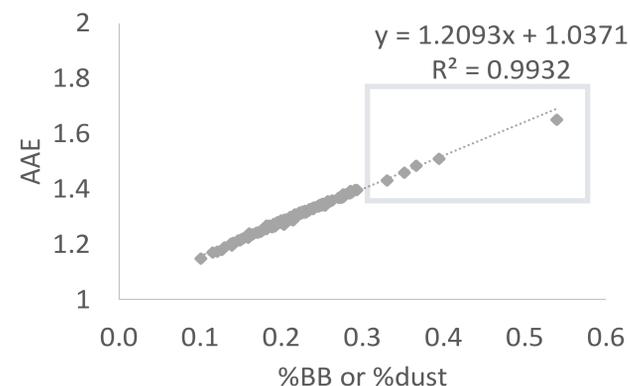

$y = 1.2093x + 1.0371$
$R^2 = 0.9932$

Figure 5. Relationship between AAE and % BB or % dust values.

CONCLUSIONS

- 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 traffic and in the use of coal and biomass.
- 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, using chemical compositions of aerosols.

References

- 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.
- Fialho, P., Freitas, M.C., Barata, F., Vieira, B., Hansen, A.D.A., Honrath, R.E., 2006. J. Aerosol Sci. **37**, 1497–1506.
- 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.