



národní  
úložiště  
šedé  
literatury

## **Source apportionment of equivalent black carbon (ebc) at a regional background site in central europe**

Mbengue, Saliou  
2019

Dostupný z <http://www.nusl.cz/ntk/nusl-409688>

Dílo je chráněno podle autorského zákona č. 121/2000 Sb.

Tento dokument byl stažen z Národního úložiště šedé literatury (NUŠL).

Datum stažení: 27.09.2024

Další dokumenty můžete najít prostřednictvím vyhledávacího rozhraní [nusl.cz](http://nusl.cz) .

## SOURCE APPORTIONMENT OF EQUIVALENT BLACK CARBON (EBC) AT A REGIONAL BACKGROUND SITE IN CENTRAL EUROPE

Saliou Mbengue<sup>1\*</sup>, Norbert Serfozo<sup>1</sup>, Jaroslav Schwarz<sup>2</sup>, Nadezda Zikova<sup>2</sup>, Adéla Holubová Šmejkalová<sup>1,3,4</sup>, Ivan Holoubek<sup>5</sup>

<sup>1</sup>*CzechGlobe CAS, Brno, 60300, Czech Republic*

<sup>2</sup>*ICPF CAS, Prague, CZ-18000, Czech Republic*

<sup>3</sup>*CHMI, Košetice Observatory, Košetice, 394 22, Czech Republic*

<sup>4</sup>*IES, Charles University, Prague, 128 01 Czech Republic*

<sup>5</sup>*RECETOX, Masaryk University, Brno, 62500, Czech Republic*

\*Presenting author email: [mbengue.s@czechglobe.cz](mailto:mbengue.s@czechglobe.cz)

Keywords: equivalent black carbon, source apportionment, biomass burning, fossil fuel

Black carbon (BC) is a primary carbonaceous aerosol playing an important role on public health and the Earth's climate system (Bond et al., 2013). It is the most efficient light-absorbing aerosol species in the visible spectrum. The wavelength dependence of light absorption has been widely used to investigate the influence of fossil fuel (traffic emissions) and biomass burning (Sandradewi et al., 2008; Vaishya et al., 2017). There are relatively scarce studies reported in Eastern Central Europe using real-time BC measurements. This study focuses on a 5-year measurement of equivalent BC (EBC) at a regional background site in Central Europe. Our aim is to identify the potential sources of EBC, especially fossil fuel (ff) and biomass burning (bb).

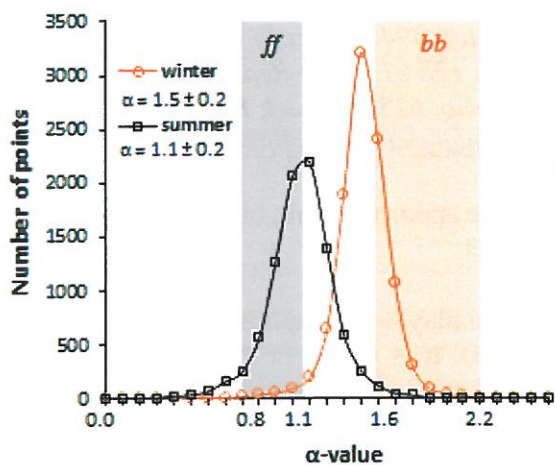
The campaign was conducted from September 2012 to December 2017 at NAOK (National Atmospheric Observatory Košetice, 49°35' N, 15°05' E), central Czech Republic. The measurements of EBC in PM<sub>10</sub> were performed at 4 m above the ground with a 7-wavelength aethalometer (AE31, Magee Scientific). The EBC data have been corrected for loading effect (Virkkula et al., 2007) and the aethalometer model, based on the wavelength dependence of light absorption (Angstrom coefficient), has been used to estimate EBC<sub>bb</sub> (EBC from biomass burning) and EBC<sub>ff</sub> (EBC from traffic). The locations of local and distant sources have been investigated using the Conditional Probability Function (CPF) and Backward Trajectories Cluster Analysis (BTCA).

The results show clear seasonal, diurnal and weekly variations of EBC that could be related to the sources fluctuations and transport characteristic. The higher concentrations of EBC were measured during winter ( $1.00 \pm 0.87 \mu\text{g m}^{-3}$ ) in comparison with summer ( $0.44 \pm 0.29 \mu\text{g m}^{-3}$ ). The Angstrom coefficient ( $\alpha$ -value) measured in summer ( $1.1 \pm 0.2$ ) was consistent with reported value for traffic (Figure 1), while the highest value ( $1.5 \pm 0.2$ ) was observed in winter due to increased EBC<sub>bb</sub> accounting for 40% of total EBC. This result is in agreement with the strong correlation ( $R > 0.85$ ) between EBC<sub>bb</sub> and biomass burning tracers (levoglucosan and mannosan) in winter. The measured levoglucosan/mannosan ratio ( $4.8 \pm 0.7$ ) was consistent with reported values for softwoods burning.

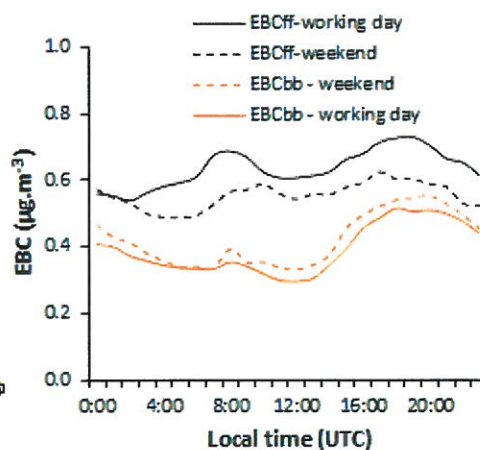
The EBC diurnal pattern (Figure 2) displays a typical morning peak that could be attributed to the morning traffic rush hour. The EBC<sub>ff</sub> peak corresponds well to the other combustion-related elements behaviour (NO<sub>x</sub>, NO<sub>2</sub>, SO<sub>2</sub>, and CO). The concentrations of EBC<sub>bb</sub> and Delta-C (proxy for biomass burning) reached a maximum in the evening, especially during winter that could be attributed to the increasing emissions of wood burning from the domestic heating devices (woodstoves / heating system). The diurnal profile of EBC<sub>ff</sub> suggests a reduced emission of EBC from traffic during weekends due to lower commuting in the rural area. On the contrary,

the contribution of  $EBC_{bb}$  is slightly higher during the weekend due to the increased operation of domestic heating devices.

The CPF and BTCA reveal that  $EBC_{bb}$  and  $EBC_{ff}$  concentrations over 75<sup>th</sup> percentile are dominated by regional air masses recirculating over the Czech Republic and neighbouring countries.



**Figure 1:** Distribution of  $\alpha$  value measured at NAOK for various seasons in comparison to the values reported in the literature.



**Figure 2:** Diurnal variations of total  $EBC_{bb}$  and  $EBC_{ff}$  during working day and weekend for winter season.

### Acknowledgement

This work was supported from European Regional Development Fund-Project “ACTRIS CZ RI” (No. CZ.02.1.01/0.0/0.0/16\_013/0001315), European Union’s Horizon 2020 research and innovation programme under grant agreement No 654109 and is supported by Ministry of Education, Youth and Sports of the Czech Republic within project for support of national research infrastructure ACTRIS – participation of the Czech Republic (ACTRIS-CZ - LM2015037).

### Reference

- Bond, T.C., Doherty, S.J., Fahey et al: Bounding the role of black carbon in the climate system: A scientific assessment. *Journal of Geophysical Research: Atmospheres* 118, 5380–5552 (2013).
- Sandradewi, J., Prévôt, A.S.H., Szidat, S. et al., Using aerosol light absorption measurements for the quantitative determination of wood burning and traffic emission contribution to particulate matter. *Environmental Science & Technology* 42, 3316-3323 (2008).
- Vaishya, A., Singh, P., Rastogi, S. and Babu, S.S. (2017). *Atmos. Res.* 185, 13-21. Vaishya, A., Singh, P., Rastogi, S. and Babu, S.S., Aerosol black carbon quantification in the central Indo-Gangetic Plain: Seasonal heterogeneity and source apportionment. *Atmospheric Research* 185, 13-21 (2017).
- Virkkula, A., Mäkelä, T., Hillamo, R. et al., A simple procedure for correcting loading effects of aethalometer data. *Journal of the Air & Waste Management Association* 57, 1214-1222 (2007).