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Reply on CC1

Anna Ryś and Lucyna Samek

Author comment on "Measurement report: Determination of Black Carbon concentration in PM2.5 fraction by Multi-wavelength absorption black carbon instrument (MABI)" by Anna Ryś and Lucyna Samek, Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-766-AC1, 2021

This study (acp-2021-766) reported a one-year eBC measurement study in Poland using a multiwavelength absorption black carbon instrument (MABI). MABI is a newly developed offline filter-based absorption photometer that provides more wavelengths (7λ) than the existing OT-21 (2λ) and MWAA (3λ). The application of MABI could provide more information to study the spectral characteristics of light-absorbing aerosols. However, the following concerns need to be addressed.

Reply: We would like to thank for valuable feedback. Please see attached for our response to comments.

- Line 105. The assumption of the multi-scattering correction factor C_{ref} =1 is arbitrary. C_{ref} is not only filter type specific (Presler-Jur et al., 2017), but also site specific (Coen et al., 2010). Teflon filter usually has a C_{ref} value smaller than the quartz filter (Pandey et al., 2019). The exact value of C_{ref} can only be determined through co-located field comparisons with a reference instrument (e.g. photo-acoustic spectrometry).

Reply: Based on "Summary of Light Absorbing Carbon and Visibility Measurements and Terms" (Cohen, 2020), the authors assumed C_{ref} = 1. This paper (Cohen, 2020) provides deeply discussion about C_{ref} for different type of filters and sizes of particulate matter, among other on page 10. Moreover very similar research, to the present in current manuscript, was conducted during a comparble period in Poland (Zioła et al., 2021) The condition and type of location were very similar, but measurement was conducted by different instrument (a modern Aethalometer AE33). This study presents comparable results with shown in the manuscript, which was expected. They have annual average of eBC concentration equal to 3.22±2.81µg/m^3 compared with our study 3.5±1.5µg/m^3. As of today, our research group does not have possible to performe co-located field comparisons with reference instrument .

- The MAE_{eBC} used in this study (6.036 m^{2}g^{-1} @ 639 nm) lacks scientific evidence. Neither the MABI manual nor the recent MABI paper (Manohar et al., 2021) had shown how MAE_{eBC} was derived. The key question is that for the MAE_{eBC} used in MABI, which EC protocol is aligning with? For example, the MAE_{eBC} used in the aethalometer was aligning with EC determined by Lawrence Berkeley Laboratory evolved gas analysis (EGA) protocol (Gundel et al., 1984). The MAE_{eBC} used in MAAP was aligning with EC determined by VDI part 1 protocol (Petzold and Schonlinner, 2004). How MAE_{eBC} was derived was not clear in the current manuscript.

Reply: The MAE_{eBC} used in this study was recommended by the Australian Nuclear Science and Technology Organisation (ANSTO) in ANSTO External Report ER-790 (Cohen, 2020). In this report -"Summary of Light Absorbing Carbon and Visibility Measurements and Terms", you can find discussion about results of research and analysis which have done over the years. The aspect raised in this point described among other on page 11, and 15 – 17. The comparison of the results of MABI measurements and Aethalometer was presented by Manohar (Manohar et al., 2021).
The article aimed to present the method of calculating the results obtained by MABI based on the paper provided particular by ANSTO. Moreover, authors wanted to show the result for BC by MABI, which can show general BC situation in Krakow and give opportunity to compare BC result in the future.

- The use of the delta-C approach for BB-derived eBC was questionable. A study in the UK has shown that the delta-C approach derived BC_{bb} is unreliable (Harrison et al., 2013). The Aethalometer AAE model has its limitations for resolving BC from BB, which is only valid when the variability of AAE is dominated by primary brown carbon. The study by Lack and Langridge (2013) had shown that a transparent coating on BC can also lead to an increase of AAE of BC up to 1.5. As a result, the Aethalometer model/delta-C method is only valid when the primary brown carbon contribution is much higher than the lensing effect. The BC_{bb}/eBC ratio found in this study was lowest in winter, which is unreasonable. Since BB emissions were active during winter, BC_{bb}/eBC ratio is expected to be higher than other seasons. The authors should provide more evidence (e.g. a good correlation between delta-C and levoglucosan or potassium) to prove that this method is suitable for the samples used in this study.

Reply: Our comprehensive study provides that potassium is the highest in winter, and the lowest in summer. Please take a look, on Table 1, that the values for BC_{BB} shows similar relation, the highest value is in winter (0.4±0.3 μg/m^3) and the lowest is in summer (0.2±0.1 μg/m^3). Moreover, the values for eBC are also the highest in winter (5.3±1.8 μg/m^3), what is expected. The relative contribution of biomass (BC_{BB}) to eBC, present in this table for winter, shows that the higher excess of eBC contribution from fossil fuels than biomass burning was observed during winter. Our results for BC_{BB} annual average concentration is 0.25±0.15 μg/m^3 and it is lower than in Zabrze (Poland) (0.93±0.76. μg/m^3) (Ziola et al., 2021). It can probably be connected with introduction in September 2019 of ban of burning wood and coal in Krakow.

Period	K (ng m^{-3})	u(K) (ng m^{-3})
Spring	117	2
Summer	65	1

Autumn	159	4
Winter	197	3

Reply: Bibliography:

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