Review of ar-2024-12: "The applicability and challenges of black carbon sensors in dense monitoring networks"

The paper elaborates on the applicability of BC sensors in dense monitoring networks. The figures are clear and easy to understand and the topic is of high interest especially in the frame of the upcoming EU regulations. I still have some minor comments listed below.

## **General comments:**

To me, the word "dense" is a little misleading since the focus of the work is on BC small-scale sensors. I would remove the word dense. Because: What are the specific challenges with this BC sensors in the frame of a dense network over a stand-alone device included in a nation-wide network? Why is this emphasized?

Regarding the "Results and Discussion" section: For the intercomparison, to check whether or not the offset in the orthogonal fit is real, please elaborate whether or not a sufficient zero test was conducted within the intercomparison period. Also, please provide statistically backed estimates on the validity of the coefficients of the orthogonal regression. If yes and successful, why the calibration curve was not forced through zero?

Also, the text needs a revision in terms of interpunctuation and harmonization of how units are given (with or without space).

And last but not least, the paper would highly benefit from a more statistical analysis on the significance of the results (see below).

Please also set your work in context to other work like (Wu et al, 2023, <u>https://doi.org/10.1016/j.jes.2023.05.044</u>. who also checked the performance of protable BC monitors in field measurements

## Specific comments:

p. 2 l. 50: space between number and unit. Please also harmonize along the text.

p. 2 l. 56: small-scale versions of? Word missing

p. 2 l. 58: In previous studies – add a comma there (check missing comma)

p. 3 l. 70: Please elaborate on the assumed performance of the MAAP. How you know, that this device can act as a reference?

p. 3 l. 79: An Aethalometer<sup>®</sup> is a device (and please use the registered trademark sign), not a method. Please rephrase.

p. 3 I. 84: "The measured variable by the instrument is the attenuation coefficient bATN( $\lambda$ ) [m-1] calculated from the measured attenuation" – if it's calculated its not measured.

p. 6 l. 155: According to Müller et al. (2011), the MAAP LED differs from the manufactures given wavelength and is 637 nm.

p. 7 Table 1: The given detection limit is given for a defined sampling period. Please elaborate. E.g., MA200 is "30 ng BC/m 3, 5 min timebase., 150 ml/min flow rate, SingleSpot<sup>TM</sup>" according to the technical specifications.

p. 12 l. 228: Please provide details on how the intercomparison was set up, e.g., whether or not the sensors sampled through the same inlet etc.

p. 22. L 368 and 369: "At all the locations, Mon and Tue had higher concentrations than Wed and Thu, and at most sites the highest concentrations were observed on Fri." Are these differences statistically significant – please add and/or comment within the text. This also expands to the later following analysis regarding the differences along sensors and weekdays.

p. 23 l. 387: I assume that the planetary boundary layer is thicker this time and the dilution of the emissions is enhanced. Please check.

p. 23 and p 24. Fig 12 and 13: The shown temperature clearly exceeds the operational temperature range given by the manufacturer. The question is whether or not the data is reliable.

Also, the 880 nm channel is near IR and hence sensitive to temperature changes. Please provide insights, if the bias was also visible in the other channels of the MA200. To me, a MAAP at 637 nm wavelength indicates that the 625 nm channel of the MA200/MA350 would also be suitable to determine the eBC mass concentration. Since the MAs provide multiple wavelengths, and the question of applicability of those sensors in a dense network is stated, also other channels should be considered. The effect of BrC should be negligible still.

Also, since the change rates of environment are of important I'd like to see also the change of the sample RH within the figure.

In a supplementary material I'd like to see the time series, showing that Observair sensors is significantly less affected by environmental changes.

p. 27 Table A1. I am missing the respective information on the MAAP at SMEAR III ground station.