Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2021-214

Anonymous Referee #1

Referee comment on "Comparing black-carbon- and aerosol-absorption-measuring instruments – a new system using lab-generated soot coated with controlled amounts of secondary organic matter" by Daniel M. Kalbermatter et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-214-RC1, 2021

Review of:

Response of black carbon and aerosol absorption measuring instruments to laboratory-generated soot coated with controlled amounts of secondary organic matter

Comments:

- Page 1. Title. It seems that the title captures only a part of the accomplishment of this work. As stated in the conclusions, one outcome is the demonstration of the aerosol generation system. Perhaps the title could be revised to reflect this.
- Page 5, paragraph starting at line 145. One goal of this study seems to be to evaluate new instruments with existing instruments. Since the 'PAS' is a new instrument, it would be good to give more details and a schematic. It seems that operation at such a high frequency (around 23 kHz) would result in a low pass filter response to light absorption, that heat transfer from the aerosol to the surrounding air would not all occur within the acoustic period so that the measurements would be strongly a function of aerosol size. Additional details about the motivation for, and design of, the prototype PAS would be useful, perhaps given in the supplemental section. The additional detail could explain how the instrument 'modulation frequency adapts…' (what measurements or theory are used to accomplish this).
- Page 6, line 180. It's unclear to me how the babs values were normalized by total number concentration. Total number concentration seems potentially fraught with issues since light absorption of course depends on particle diameter in a complicated way.
- Page 8, line 215. Was electron microscopy performed to investigate soot core restructuring?
- Page 9, line 247. It seems that there is a contradiction in this paper to use the AE33

derived AAE to move the babs for other sensors (PAX for example) values all to 532 nm since the AE33 data is also described as being likely incorrect. What is the justification for doing this and what uncertainty enters the conclusions as a consequence?

- Page 9, lines 254-257. Which instrument(s) is(are) being considered reference methods for evaluating the results of these measurements? Which instruments provide the most and least correct measurements and how is that known?
- Page 9, line 257, and later in the paper, page 10, lines 264-267. It still is not clear why the PAX 870 nm absorption measurements show no sensitivity to coatings. At what wavelengths are the coatings expected to be light absorbing to various degrees? It seems that the authors could readily evaluate the insensitivity to coating at 870 nm by using the core/shell model for light absorption as a function of wavelength to theoretically evaluate light absorption enhancement at various wavelengths to confirm these results. Mass transfer is known to affect photoacoustic/photothermal measurements when the aerosol (or coating) has a high vapor pressure.
- Collectively the results shown in Figures 3b and 4b indicate that common aerosol light absorption measurement methods disagree by a factor of two, even in this case of laboratory-generated aerosol. If the measurements were given error bars that indicate precision and accuracy, would they overlap? It seems that the AE33 results are farthest from the rest, and that may be due to the choice of factors used to convert from filter-based to in situ light absorption. Assuming that the photoacoustic/photothermal measurements are closest to reality, can these measurements provide a suggested correction strategy for the AE33 light absorption calculation as a contribution to a growing literature on the subject?

Minor issue:

- Page 15 line 333, 'of' is repeated.