Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2020-337-RC1, 2020


Atmospheric Measurement Techniques Discussions



# *Interactive comment on* "Determination of black carbon mass concentration from aerosol light absorption using variable mass absorption cross-section" *by* Weilun Zhao et al.

**Anonymous Referee #1**

Received and published: 12 October 2020

A new method by considering the variation in MAC is developed to obtain BC mass size distribution and then bulk BC mass concentration from size-resolved light absorption measurements. Size-resolved MAC calculated on the basis of core-shell Mie model is mainly discussed, which is determined by Dp-dependent DBC and coating thickness. However, there are many assumptions in calculation processes, e.g., same DBC and coating thickness at each selected mobility size, a constant number fraction of BC-containing particles, etc. Meanwhile, measurements were not described clearly.

The significance of this study should be also strengthened. In my point of view, compared to BC mass loading, the light absorption measurements are more required to



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evaluate the influences of BC particles on solar radiation. Thus, MAC is likely to be more important for converting bulk BC mass loading, which can be directly measured by using chemical method (e.g., Thermo Optical Reflection-EC) or laser-induced incandescence techniques (e.g., SP2-rBC), to light absorption in climate research. The current study is more important for obtaining BC mass size distribution from size-resolved absorption measurement. BC mass size distribution obtained from the DMA-AE51 measurement based on the new method is also suggested to compare with that obtained from the direct measurement from DMA-SP2 system, which has used in the field campaign.

Furthermore, the Mie model is likely to not suitable for the calculation of BC aggregates with large sizes. For a small BC particle (core), the mass equivalent diameter of the assumed BC sphere is much smaller than the wavelength (880 nm) resulting in a less effect of morphology to absorption. In this case, the Mie model is somewhat feasible for absorption estimation. However, for a large BC particle (core), its mass equivalent diameter is close to the wavelength (i.e., large size parameter); thus, the absorption is largely influenced by the morphology. Moreover, large BC particles are more likely to exhibit loose fractal aggregates with thin coating, thus, is likely much different from core-shell structure. MAC in this case cannot be well depicted by using Mie model.

In general, some improvements are necessary before the manuscript can be accepted for publication.

Specific comments: 1. Wavelength should be addressed when the absolute value of MAC is mentioned. 2. Line 13, what do the ‘different core-sell structures’ mean? Different core size and shell thickness? 3. Line 57–58, Bond and Bergstrom (2006) just suggested a consistent MAC for fresh (uncoated) BC particles. 4. Line 73, a more detailed but clear description of BCPMSD measurement should be addressed. From my understanding, major results and discussion presented in this study are based on the BCPMSD measurements (using DMA-AE51?) at Zhangqiu site. DMA-SP2 measurements at Taizhou, and comparisons of AE33 with PASS-3 at Taizhou and Beijing are





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mostly used to provide essential parameters (e.g., number fraction of BC-containing particles, multi-scattering correction factor for AE33, etc.) for the BCPMSD retrieval. 5. Line 112–115, the method to determine the size-resolved number fraction of BC-containing particles should be introduced briefly. How to deal with the effect of multi-charged particles in the DMA-SP2 system. Why the number fraction of BC-containing particles at Taizhou can be used to represent that at Zhangqiu? 6. Line 120, why absorption coefficients measured by AE33 are 2.9 times those measured by PASS-3? Does this ratio mean the multi-scattering effect of the filter loading method? However, as mention in line 106, a compensation factor of 2.6 has been introduced to mitigate multiple scattering effect. Was the PASS-3 well calibrated before the measurement? 7. Line 147, although the mantle chemical species would not influence largely the results presented in this study, BC/OM mixtures are more likely existed in the atmosphere of studied regions.

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-337, 2020.



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