

## ***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 #3**

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Black carbon is a very important component in estimation of aerosol's optical properties, which lead to much bias in estimation of its radiation forcing in climate modelling. Because BC is of strong absorption in the solar lights, the share of BC in aerosol is also a reason of uncertainties of remote sensing from radiance-like observation, such as CO<sub>2</sub> from satellite measurement in the shortwave infrared wavelength. BC measured by AE51 or other optical instrument, which is easy in operation and used in common, is given under assumption of a constant coefficient of MAC. To correct the differences induced by this assumption, the authors proposed a new method and variant MAC coefficient related to the particles size is used to derive BC. As far as I know, this work is original and very important to derive an accurate BC, and the results from

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field measurements and comparisons from different instruments showed here is reasonable, the method may be a good reference in future measurement of BC in the atmosphere. Therefore, I strongly recommend the publish of this work after revision.

My major concern is: 1. As the authors pointed, for the new BC, its shape is chain-like, not a spherical one, so how do you know this method is applicable for the measurement. How many parts of BC is new generated and how many is old one, is there a guess for that? Do you have some samples measured ASAP and others saved and wait some time to let them to be old one? Other minor concerns are related to language and logistics: 2. Line 16, “with in” should be “within” 3. Line 58, what's mean of “degree of MAC” 4. “...Mie model incorporated with core-shell configuration hypothesis was applied in this study to assess the limitation of the constant “ should be simplified as “...Mie model with assumption of core-shell particles was .....” 5. Line 68, “Based on the detailed...” The word “the” should be deleted. 6. Line 73, “The measured BC particle mass size distribution (BCPMSD) was obtained from the field campaign conducted at the Zhangqiu Meteorology Station (36°42'N, 117°30'E), Shandong Province. This field campaign lasted for about 1 month, from July 23, 2017 to August 24, 2017. The Zhangqiu observation site is located in the North China Plain (NCP) and is surrounded by farmland and residential areas, representing regional background conditions of the NCP.” Should be rewrite as ” The BC particle mass size distribution (BCPMSD) was measured at Zhangqiu Meteorology Station (36°42'N, 117°30'E), Shandong Province, surrounded by farmland and residential areas and a typical site for regional background conditions of North China Plain (NCP). The field campaign lasted for about 1 month, from July 23, 2017 to August 24, 2017.” 7. Line 76, the last word “system” should be deleted 8. Line 77, “measurements to determine ....” Should be “ is used to determine ....” 9. Line 78, “The suburban measurement site” , the word “measurement” should be deleted 10. Line 79, the word “the” before “Jianghuai Plain” should be deleted 11. Line 86 and 87, “All the measurements in the three sites were conducted in containers where ambient temperature was controlled within 24 ± 2 °C with a particle pre-impactor to remove particles larger than 10 μm

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from the input air stream. “ should be rewritten as “All the measurements in the three sites were conducted in temperature( $24 \pm 2$  °C) controlled containers, and a particle pre-impactor is used to remove particles larger than  $10 \mu\text{m}$  from the input airflow.” 12. Line 92, “developed by (Ning et al., 2013). The instrument setup was further improved by Zhao et al. (2019b).” should be “developed by Ning et al. (2013) and improved by Zhao et al. (2019b)” 13. Line 101, “that were used to represent air pollution conditions” should be deleted 14. Line 105, the variables of k and ATN should be italic 15. Line 108, “in this study” should be deleted 16. Beginning of line 115, word “from” should be “at” and the same for line 117 17. Line 117 and 118, “ with a measurement flowrate of ” should be “with flowrate of” 18. Line 123, “.... through a constant MAC value” should be “under assumption of a constant MAC” 19. Line 130, “an appropriate model simulation is needed for representing a single BC particle’s optical properties.” What’s meaning of this sentence. 20. Line 131, “ There are three widely employed mixing states that are used to represent the structure of BC-containing aerosols” should be “Three widely employed mixing states are used to represent the structure of BC-carried aerosols” 21. Line 133, “....chain-like aggregates composed of small spheres” should be “chain-like aggregates of small spheres” 22. Line 139, “the spherical core and shell favor the Mie model” should be deleted. 23. Line 140, “in this study” should be deleted. 24. Line 143, could you use other words for the section title ? 25. Line 147, the word “frequent” should be replace by “common” 26. Line 150, “.... at the wavelength of 880 nm, calculated using the Mie theory, has been presented” should be “.... at wavelength of 880 nm are simulated with Mie scattering method.” 27. Line 151, “reported to vary with incident light wavelength” should be “dependent on light wavelength” 28. Line 152~153, “ as BC particles can be emitted from different fuels and conditions, RI cannot be observed directly, with both real and imaginary part of RI varying over a significantly wide range” should be “due to different source of BC, both the real and imaginary part of RI varies over a significantly wide range” 29. Line 157, “averaged values are illustrated ....” Do you mean “mean values.....” 30. Please rewrite paragraph between line 168 and 173 to make it simple and clear. 31.

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Line 174, the first sentence “The detailed iterative procedure is illustrated in Fig. 2.” Should be reposition to the end of last paragraph, and the word “detailed” should be “deleted” 32. Line 175, “represented” should be replace by “shown” 33. Line 175, “a simplified algorithm for deriving BCPMSD was proposed by considering Fig. 1 as a look-up table.” Should be rewritten as “a simplified algorithm was proposed to derive BCPMSD through a pre-calculated a look-up table.” 34. Line 195 and 196, words “finer mode” and “coarser mode” should be replace by “fine mode ” and “coarse mode”, please read through the whole draft to replace other similar words. 35. Line 198, “The results indicate that with the boundary of 280 nm, two opposite deviation tendencies exist. “ should be replaced by “the results show that there exist two opposite deviation trend before and after the turning point around 280nm” 36. Line 247, “The variations in on...” should be “The variation of ....” 37. Line 247, “all MACs in the look-up table in Fig. 1 are the mean values as the imaginary part and real part of BC RI varied over a wide range.” What’s the meaning of this sentence mean, please rewrite. 38. Please rewrite the whole paragraph between line 247~260 to make it clear and simple. 39. Line 454 to line 459, please rewrite caption for Figure 3 and make it easy to read. The same the caption of figure 4

Please also note the supplement to this comment:

<https://amt.copernicus.org/preprints/amt-2020-337/amt-2020-337-RC3-supplement.pdf>

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

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