Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2020-348-RC1, 2020

Geoscientific Model Development Discussions
Open Access
EGU

Interactive comment on "Effects of black carbon morphology on the brown carbon absorption estimation: from numerical aspects" *by* Jie Luo et al.

Anonymous Referee #1

Received and published: 26 November 2020

The authors conducted theoretical calculations to quantify the effect of BC particle morphology on inferring brown carbon absorption based on three commonly used AAE methods. The BC morphology issue has been investigated a lot in the past 10 years, particularly for its impact on BC absorption. This study provides a relatively new perspective to look at the BC morphology effect on deriving brown carbon absorption through spectral/AAE methods. The implication for the advantages and disadvantages of those common AAE methods could be important to guide future measurements and retrieval of BrC absorption. However, the presentation in a number of places in the text is quite confusing to me and requires further clarification and more explanations, particularly in the methodology part. Please see my specific comments below.

Printer-friendly version

Discussion paper

Major Comments:

1. Section 2.1: More descriptions are needed for the algorithm and model used to generate bare BC aggregates and coated BC particles. At least the key steps and elements involved in the algorithm and model need to be presented in addition to simply citing the references.

2. Equation (3): I am not quite convinced that this is the best way to compute the absorption cross section of BC with irregular shapes. Would it be better to use the projected area (averaged cross all directions) than pi/4 * Dvˆ2 (volume-equivalent geometric cross section)? Besides, can MSTM and DDA methods directly output the absorption cross sections? If so, why did the authors need to use equation (3)? Based on lines 109-110, it seems that DDA can directly compute absorption cross section for the entire particle with irregular shapes. Why not using DDA for both external and internal mixing cases? Did the MSTM and DDA can produce exactly the same results for the same case? If not, then using two different methods could further introduce differences between external and internal results.

3. Lines 137-147: This part is not clear to me. How could delta_MAC represent the deviation between the "True" and inferred BrC MAC? What if this delta_MAC can be affected by the additional absorption from BrC, which interacts with BC physical properties? Currently, delta_MAC is only calculated from the difference between "True" and the estimated BC absorption by assuming BC is mixed with non-absorbing materials. Why not directly compute the difference between "True" and the estimated absorption for BC mixed with BrC?

4. Section 3.2: The way to infer BrC absorption is also not very clear to me. For example, (1) Line 157, “estimate the BrC absorption at 440 nm based on Equation 1”, should it be based on Equation (4)? (2) Line 159: “AAE of Mie calculation”. Could the authors be more specific about how did they compute this AAE using Mie calculation? Assuming core-shell structure for BC coated by BrC? (3) How did the delta_MAC in

Equation (10) fit into the analysis?

5. A number of assumptions used in this study could affect the results and conclusions. For example, the assumed BrC density, how much uncertainty would this bring into the final results?

Minor Comments:

1. The language needs to be further polished particularly to correct grammatic issues. Just to name a few: Line 31: “divide BC and BrC” should be “separate BC and BrC”. Line 34: “exclude the dust” should be “excluding dust”. Line 65: it should be “BC AAE”, right? etc. I suggest the authors carefully check the entire text again.

2. Could the authors give some comments on how their results/conclusions could help future measurements of BrC absorption?

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2020-348, 2020.