

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2021-1090

Anonymous Referee #1

Referee comment on "Regional impacts of black carbon morphologies on shortwave aerosol–radiation interactions: a comparative study between the US and China" by Jie Luo et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-1090-RC1>, 2022

The authors investigated ARI of BC and some other radiative properties with a modified BC-model, as the fractal-like structure is more realistic. The authors found some biases in the traditional sphere BC models in AOD, AAOD and AAE. For ARI, the more realistic BC model produces higher ARI forcing compared with sphere model. The method of this study is solid and the results are well presented, providing some new insights of BC ARI to the community.

However, this paper needs some revisions before the acceptance for publication.

Major comments:

- It looks like a *discussion* section is missing. A more detailed discussion is needed (e.g., limitations, interpretation of the results, comparison with previous studies).

- I was wondering in the current generation of GCMs or ESMs such as CMIP5/6, is the BC model sphere or fractal-like? Or maybe some of them are sphere/fractal. I suggest authors provide some more information on this in the *introduction* section. If most of

the current models use simplified sphere BC models, then the contributions of this study would be more significant and the authors should add some discussions in the *discussion* section.

- In line 254, the authors provided an explanation why different structure may lead to different AAOD. However, such explanation is missing in some other analyses. I suggest the authors add similar explanations like line 254 in the descriptions of other results (e.g., why fractal structure produces higher ARI, maybe more solar radiation is reflected by sphere-structure?).

- The authors cited several BC forcing values at the beginning of *section 4.4*. Is there any value could be used to compare with the simulation from this study? There are four ARI values for each location in this study, is there any value that is more realistic?

- It is confusing to see the “relative variations” of 10.4%-15.3% in the *abstract*. What is the relative variation? Day-to-day variation? Please define it. In *section 4.4*, there is “relative uncertainty”, are they the same? In the *conclusions*, it is switched to “relative variations” again.

Minor comments:

- The writing needs some polishing (e.g., Line 48, contribute to...)
- Line 95, with a larger Df ?
- Figure 3, lower panel, the four lines are overlapped. You may try to use thicker lines underneath and use thin lines above to make them clearer. It is the same for Figure 6 and 8.

