Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2021-1090

Anonymous Referee #2

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-RC2, 2022

General comments:

Materials presented in the manuscript are interesting and well suited to the scope of the current journal. The authors seem to have successfully operated a chain of models to present the simulation results, but their argument needs improvements and additional calculations may be required. Thus, the manuscript should be accepted in the journal, only after the authors revise the manuscript by reflecting the following general and specific comments.

- The title says "regional impacts of ARI". The authors only presented ARI at several grid points, but the regional mean ARI should be presented and discussed. Without the presentation of regional ARI, the current study is not comparing US and China, but comparing a few fire grids in US and a few urban grids in China.
- There are several types of BC-ARI, but the differences are not clearly stated. For example, the authors mentioned 1.1 W m^{-2} for global mean BC-ARI (Bond et al., 2013), but actually the value is "total climate forcing". It is totally different from the authors' BC-ARI, that is "clear-sky direct affect". For every ARI value in the manuscript, please be aware which types of ARI you are siting.
- There are clear-sky and all-sky ARI. All-sky ARI is more popular and meaningful. There are also instantaneous ARI and ARI with rapid adjustment. The reviewer understands that the authors' simulation setup cannot derive ARI with rapid adjustment (though they are using WRF-Chem), but all-sky instantaneous ARI can be readily calculated. Impacts of morphology on all-sky ARI should be of interest for readers, too.
- The reviewer does not understand why impacts of morphology on EAE and AAE are important. Presentations of impacts of morphology on regional mean (or regional maximum) clear-sky and all-sky ARI should be much more meaningful.

Specific comments:

- Abstract: many important information is missing: "simulation period: season and duration", "clear-sky", "external mixture assumption".
- Lns. 53-56, WRF-Chem, FlexAOD, and libRadtran: reference is missing.
- Section 2 and 3 should be combined to one section, "Method".
- Sect. 2: Which meteorological analysis used for the simulation of China?
- Lns. 125-128: The reviewer does not fully understand why size distribution of WRF-Chem is not directly used for the optical and radiative transfer calculations.
- Sect. 3: Equations 4-10 are too general and thus you don't need to describe them in the paper. Rather, descriptions or equations describing how to directly calculate the optical properties of fractal agglomerates by MSTM should be elaborated in this section.
- Ln. 143: What are "the pmom code"? Avoid model-specific terms in a paper.
- Ln. 158: FlexAOD
- Ln. 200: What do you mean by "standard atmosphere background"? Instead of using standard atmosphere, the authors should use the atmospheric conditions predicted by WRF.
- Ln. 201: Double periods ".."
- Ln. 212, "PM2.5": 2.5 is lowercase here and elsewhere.
- Ln. 217, It is a very good idea to compare simulated AOD and AAOD against AERONET in Beijing. Why not other sites in China and US, rather than to compare surface $PM_{2.5}$ only?
- Ln. 224, "400 ug/m3": it seems the nighttime concentration which does not affect ARI. Please show shortwave and longwave ARI, separately. Longwave ARI could be negligibly small. You may see the phrase "which should have a strong impact on the aerosol radiative effects" is totally wrong. Also, it is just a surface concentration, but the column amount matters for ARI. Reorganize the discussion here.
- Acknowledgement: please remove FlexAOD here because code availability is in different section.
- Figures: please clearly state if the authors use UTC or local time for all time series panels.
- Caption of Fig. 12: probably EAE, not AAE. Probably not lambda=450-850 nm, 850 nm pair but lambda = 450 nm, 850 nm pair.
- Code availability: code availability should be also stated for WRF-Chem, libRadtran, and MSTM.
- Data availability: "athour"-> "author". The statement "the data can be requested from the corresponding author" may not be allowed by ACP.
- Table S1: please remove (mp_physics), …, (bl_pbl), as those are model-specific terms. Explain acronyms, RRTMG and YSU. Better to include references of each option.
- Table S2: avoid model specific terms. What do a01, a02, a03, and a04 indicate? If it indicates size bins, define the sizes. Same for Table S3. What are those acronyms, for example, orgalk1j?
- Fig. S1: boarders (national, province, land/ocean) and symbols are hardly legible. Probably, better to use "white" color for tiny values, instead of "blue".