

Atmos. Chem. Phys. Discuss., referee comment RC4  
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## Comment on acp-2021-208

Anonymous Referee #4

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Referee comment on "Investigation of ice cloud modeling capabilities for the irregularly shaped Voronoi ice scattering models in climate simulations" by Ming Li et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-208-RC4>, 2021

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The paper by Li et al. presents an analysis of a proposed broadband ice cloud scheme based on the Voronoi ice cloud particle model. The comparisons of model simulations using RRTMG and CAM5 between Voronoi and other four ice cloud schemes were carried out, indicating that the Voronoi scheme is superior to the other conventional schemes and should be sufficient for ice cloud modeling. I believe this study can be valuable to the relevant community, and it helps to better understand the ice cloud optical properties and their impact on cloud radiative effects modeling.

Overall, the study established a straightforward objective and was done in a comprehensive way. The employed scheme seemed valid and the extensive comparison was performed and discussed properly. The drawn conclusions are in line with the experimental results. From my point of view, the paper is suitable for Atmospheric Chemistry and Physics, although I do have some concerns that need to be responded. To enhance the potential of the proposed scheme, I would encourage the authors to submit a revised manuscript by addressing my specific comments below:

- As pointed out by the other reviewers, the English language of the current manuscript requires a substantial improvement. There are a number of grammatic and wording errors (not described here as most of them have been noted by the other reviewers) in the article. A careful proofreading throughout the manuscript would be necessary.
- Please check Equation (1) at line 138 since the current layout seems weird.
- Please consider to revise Figure 2 as the flowchart does not look very helpful to me. If possible, please also include a short overview of Figure 2 in the beginning of Section 3 or reorganize this section, particularly the first paragraph. Here, you do not have to provide equation indices since you will detail them in the following subsections anyway.
- Line 151: In Section 1, you actually only introduce the four conventional ice cloud schemes without sufficient (mathematical/technical) details. Readers would expect more details from Section 3. So this could be another point to reorganize Section 3.
- Section 3.1: I am okay with the contents. However, I would like to see a clearer structure. Each equation should normally follow the corresponding text.

- Line 269: It sounds unclear to me based on what quality criteria the authors ranked the five models.
- Lines 293-296: Please explain Figure 9 in detail, more explicitly, why the Voronoi model performed the best. So far I am not convinced by the statement in the current manuscript "...differences box of Voronoi scheme are most concentrated on the zero ...".
- An additional appendix including all acronyms and abbreviations used in the manuscript would be useful to readers.