

Atmos. Chem. Phys. Discuss., referee comment RC2  
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## Comment on acp-2021-208

Anonymous Referee #2

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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-RC2>, 2021

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General comment:

This paper addressed the important problem about the modeling capability of ice cloud radiative forcing in climate simulations. An irregularly shaped Voronoi ice cloud particle model which was proven to be effective and efficient in satellite remote sensing retrieval purposes has been implemented in the RRTMG RTM and CAM5 climate model. Comparisons of modeling results with the Voronoi model along with the other four previously proposed ice cloud models are carried out. Further comparison between model results and the CERES SYN1deg radiative fluxes indicates that the Voronoi model provides the closest cloud radiative forcing to observation. This study could be a good supplement to understand the influence of ice cloud optical properties on simulated cloud radiative effects. The topic of this paper is within the scope of the journal of Atmospheric Chemistry and Physics. But unfortunately, the paper is not acceptable in the present form due to various issues.

Major questions:

- Overall, the quality of this paper does not meet the standard of ACP. The problem is all-round, from simple wording and sentence expressions to the quality of figures and tables, data analysis, conclusions, and so on. There are so many things to be improved to make the paper better (please see details below).
- The authors should be cautious about the definition and the use of abbreviations. Several abbreviations are defined again and again. While some other abbreviations are defined and never used again. Abbreviations like AGCM are used without definition. This may be just subtle issue but it could be an indicator of how the paper is carelessly prepared ...
- The authors need to pay more attention to the way to cite papers. Some of the names of the authors are wrong! For example, Line 47, "Hulst" should be "van de Hulst"; Line 68, "Labonnote" should be "C.-Labonnote". Incorrect citation formats also exist, for

example, at Line 61, 63, 83, 86, etc. This is another indicator that the paper undergoes insufficient examination before submission.

- It looks like the “Baum-Yang” scheme in this paper is different from the “Baum-Yang” scheme in Wang et al. (2018). It may be better to rename the schemes to avoid confusion when the readers are comparing the two studies.
- Among the various schemes, Fu scheme actually has different definitions of effective diameter (see Fu et al., 1997). So the question is how can the Fu scheme be compared directly with the other schemes?
- Line 89-92: What’s the point of mentioning CIESM at this point? Since CIESM is no different from CESM regarding the ice cloud scattering properties, there seems no need to mention it at all. After all, the authors are actually using the original CAM5, isn’t it?
- I don’t like the way the authors organized the figure panels. It’s strange to me to use panel a1, a2, ... and b1, b2, ... in a same figure. Please consider following the conventional panel naming habit of (a), (b), (c), ...
- I don’t like the organization of section 3 either. Particularly, Line 140-159 is a mess. It may not be a good idea to briefly referring to something you will mentioned in detail later. It makes no sense and just add to the confusion of the reader.
- More details about the particle size distributions should be given. The authors may add a figure to show how the PSD looks like.
- Why do the authors choose to use CERES\_SYN1deg\_Ed4A products for comparison with GCM modeling results? What is the temporal range of data used? Usually the CERES EBAF dataset is a better choice for this purpose. Since the authors’ choice will apparently affect the evaluation results, it is quite necessary for the authors to elaborate the reasons more convincingly.
- The authors should do a better job of relating the optical properties of different ice cloud models with the simulated SWCF and LWCF. It is still confusing to me that why the Voronoi model possesses the lowest asymmetry factor in the SW but however exhibits the lowest SWCF compared with the other models? In short, why the Voronoi model could be the better choice?
- Many grammar mistakes and sentence errors could be found in the manuscript. The authors should pay more attention to polish the English language. Several captions of figures and tables also need to be rephrased. For example, Table 3 and Figure 9 all miss the units. While caption of Figure 5 is too complicated to understand.

Minor questions:

- Line 17-18: “While abundant irregularly shaped ice particle habits present a challenge for modelling ice clouds.” – please be clear about what challenge is the authors referring to.
- Line 24: There may be no need to express the names of the other four schemes since they are not used again in the abstract, and the readers still could not understand what the names are referring to.
- Line 25, 27, 30: RRTMG, CERES, SW and LW are never used again in the abstract. May not need to define the abbreviations.
- Line 91: “CAM5 in CIESM was modified with several new schemes”- what are the changes which relate to this study?
- Line 101-105: Very complicated sentence which contains error.
- Line 109: “has proven” should be “has been proven”
- Line 138: It’s very odd to see equation (1) here without any explanation.
- Line 148: What is the temperature used in the Planck function?
- Line 157: “to validate the cloud radiative properties” – do you mean “cloud radiative

forcing”?

- Line 166-167: Sentence error.
- Line 197-198: What is “standard tropics”? How are the 60 vertical levels distributed? Please give a reference.
- Line 201: “the same with” should be “the same as”
- Line 242: should be Zhao et al. (2018)?
- Line 264-266: Please change a way to express the range of values since the present form easily cause confusion.
- What is the version of RRTMG used?
- Line 320: The authors may need to specify the contribution of all authors.
- Line 513: “Ice particle effective size” – please be specific. Is it diameter or radius?