

We thank the two anonymous reviewers for their valuable comments and constructive suggestions on the manuscript. Below, we explain how the comments and suggestions are addressed and make note of the revision in the revised manuscript.

Reviewer #1

In this paper, the authors evaluate cloud properties as simulated with the Community Atmosphere Model Version 5 (CAM5) against observations for the HIAPER Pole-to-Pole Observations (HIPPO). To conduct a direct comparison, the model was nudged to be more representative in respect to the reanalysis. The authors show that underestimation of water vapor is responsible for most of cloud occurrence biases. They also discuss the sensitivity of autoconversion of ice to snow and ice nucleation to the modeled cloud microphysical properties as compared against observations. This paper is well written and of scientific relevance. I have a few minor comments/suggestions I would like to be addressed before publication.

Reply: We thank the reviewer for constructive review and encouraging comments. The text and figures are revised as the reviewer suggested.

Introduction: Page 3, line 51. I would start the introduction with: “Cirrus clouds, located at high altitudes and composed of ice crystals, are one of the key components in the climate system. They cover about 30%.....”

Reply: Done.

Page 4, line 75: I suggest replace “higher” with “high” (since there are no mention yet what nucleates at lower supersaturations), and the give a typical range of supersaturations.

Reply: We changed the text “Homogeneous nucleation generally requires higher supersaturation” to “Homogeneous nucleation generally requires high ice supersaturation typically of 40%-60%” in the revised manuscript.

Page 4, line 83: Replace “ice microphysics” with “ice microphysical processes”

Reply: Done.

Page 5, line 110: What is meant by fast measurements? High frequency measurements?

Reply: Yes, we meant high frequency measurements. We changed “fast measurements” to “high frequency measurements” in the revised manuscript.

Page 67, line 140. What about observations of water vapor? Since much of the analysis is in regard to the relative humidity and supersaturation, I think the observations of water vapor should be included as well.

Reply: Thank the reviewer for this comment. We included “water vapor” in describing “measurements of ambient environmental conditions” in the revised manuscript.

Page 12, line 248: Replace “the” with “for”

Reply: Done.

Page 12, line 256, add “a” between “includes version”, so that “includes a version”

Reply: Done.

Page 16, line 340. “Reword CAM5 is able to better simulate cloud systems”

Reply: Done.

Page 21, line 465. I suggest to rewrite: “The model is capable to simulate the occurrences of ice” i.e. remove the reference to comparison with observations, since the model does a poor job in simulating supersaturation in clear sky.

Reply: Done.

Page 568, line 568 (or figure 8F). The point of DCS75 and PRE-ICE can produce $N_i > 50 \text{ L}^{-1}$ is hard to see because the figure is too small.

Reply: Thank you for pointing out this. We added an inset with rescaled axes in Figure 8f to illustrate the frequency of N_i when $N_i > 50 \text{ L}^{-1}$. From the inset, it is clear that DCS75 and PRE-ICE can produce $N_i > 50 \text{ L}^{-1}$.

Page 31, line 678: Replace “which nudge the” with “with nudged”. Page 32, line 688. Remove “and” before 86.1% Page 32, line 691: Remove “of” Page 32, line 705: Add “to” so that “The model is mostly able to reproduce...” Page 34, line 735. Suggest adding “global” such that “...future global model....”

Reply: All the suggested revisions are done in the revised manuscript.

Page 34, line 746. A recently published paper by Eidhammer et al. (2017) describes the implementation of the single ice category in CAM5. I suggest including this citation on line 746.

Eidhammer, T., H. Morrison, D. Mitchell, A. Gettelman, and E. Erfani, 2017: Improvements in Global Climate Model Microphysics Using a Consistent Representation of Ice Particle Properties. J. Climate, 30, 609–629, doi: 10.1175/JCLI-D-16-0050.1.

Reply: We thank the reviewer for pointing us to the work of Eidhammer et al. (2017), which is very relevant to our study. We have cited their study for references in the revised version.