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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Direct comparisons of ice cloud macro- and microphysical properties simulated by the Community Atmosphere Model version 5 with HIPPO aircraft observations" *by* Chenglai Wu et al.

**Anonymous Referee #2**

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The Community Atmosphere Model Version 5 (CAM5) is evaluated using HIPPO measurements in this study. It shows that CAM5 can reproduce most of the observed cloud systems. This study also pointed out that the missing cloud occurrences in the model simulations are mostly attributed to the discrepancies in water vapor, and further improvements to RH variability are needed in the model.

The manuscript is overall well-written and delivers the necessary information concisely. Some revisions are needed to address the following questions before the acceptance of this manuscript:



1. Lines 269-271: Please check grammar.

2. Lines 271-272: This study uses horizontal resolution of 1.9 degree x 2.5 degree. CAM5 can be run at much higher resolution, such as 0.23 degree x 0.31 degree, which may be more appropriate for comparison with HIPPO aircraft observations and help address the over-sample issue that the authors also mentioned (lines 293-311). Please justify why a higher resolution is not used in this study.

3. Figure 1: Different colors for HIPPO observations (especially for ice clouds and warm clouds) should be used to distinguish the modeled results and observations.

4. Lines 525-526: Why there are more large ice particles at higher temperature? Is it because that it is more likely for heterogeneous nucleation (formation of larger ice crystals) to occur at higher temperature that homogeneous nucleation (formation of smaller ice crystals)?

5. Line 581-586: When all sulfate aerosol particles are available for homogeneous nucleation, it seems to me that more ice crystals with smaller size should be formed, and Ni (number of particles larger than 75 um) should decrease.

6. Lines 649-652: In previous section (Section 4.1), it is shown that the missing cloud occurrences in the model simulations are primarily ascribed to the fact that the model cannot account for the high spatial variability of observed relative humidity (RH), and that model RH biases are mostly attributed to the discrepancies in water vapor. Here it shows that when nudging both T and Q together with U and V, the model performance is even worse in terms of cloud simulations. Since the model produces clouds based on RH values, is it possible that the worse simulation of clouds in the NUG_UVTQ experiment is related to the RH threshold values used in the model?

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