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Atmospheric Chemistry and Physics Discussions

Interactive comment on "On the importance of small ice crystals in tropical anvil cirrus" *by* E. J. Jensen et al.

Anonymous Referee #3

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Overview

The paper contributes to the long standing problem of the existence of small ice particles in ice clouds and their impact on the radiation transfer. The entire consideration is based on the comparisons of the in-situ measurements of two probes SPEC 2D-S and DMT CAS obtained during the TC4 project. In the absence of the standards of ice measurements the present study still leaves room for doubts regarding the existence small ice particles and the accuracy of the measurements of small ice. The paper is worth publishing in the ACP after addressing the comments below.

Major comments:

1. I did not find any mention of the particle size corrections (e.g. Korolev 2007). The

measured particle size in the imaging probes increases with the distance from the object plane. At the same time the sample area is reversely proportional to the squared particle size. Therefore, applying the size corrections will decrease the concentration of large particles and may significantly increase the concentration of small ice particles. This may affect the final conclusions in the paper. The size corrections should be included.

2. The inter-arrival time filter is based on the assumption that the shattered particles form a cluster of the fragments with a small spatial separation and that some number (N>1) of the particle fragments intercepts the sample volume of the probe. In other words, if only one particle from the ensemble of shattered fragments (i.e. N=1) passes through the sample volume of the probe, then the inter-arrival filter will not identify the shattering event. The authors silently assumes that N>1 always, and that, therefore, all shattering events can be identified. I have serious doubts that the condition N>1 is always true. I would like to see some discussion of the accuracy of the inter-arrival time filter applied in this paper.

3. The sizing and concentration measurements in the imaging probes, in the first four size bins are highly unreliable due to image digitization problems and errors related to the definition of the depth-of-field (e.g. Korolev et al. 1998). Since the 2D-S concentration measured in the first four bins plays a crucial role for the analysis and conclusions of this study I would expect that, as a first step, the authors would attempt to convince a reader that both 2D-S and CAS provide adequate measurements in liquid clouds, where shattering or splashing does not play any significant role, and that the size distributions measured by both instruments are in a good agreement. And after that they would proceed with the analysis of ice clouds. Besides the problems with the 2D-S first size bins, one may also argue that the disagreement between two probes, demonstrated in the paper, may be caused by some sort of malfunctioning of the CAS, e.g. optical misalignment, noise issues, etc.

4. The results would be more convincing if the CIP measurements were included here.

Minor comments:

1. The CIP pixel resolution used in this study should be indicated.

2. The inter-arrival time filter was originally suggested by Cooper (1977). This work should be acknowledged in the text.

3. What is the size-to-mass conversion parameterization used in this study?

4. The word "arctic" should start from capital thought the text.

5. page 5333, line 17. Delete extra "about".

6. page 5338, line 11-16. This sentence should be edited.

7. page 5339, line 25. Delete extra "during".

8. page 5340, eq.1. Numerous studies indicate that ice particle density, on average, decreases with decrease of the particle size. The assumption that the ice density is constant and equal to 0.9g/m3 implies that all particles have a compact quasi-spherical shape. Could you please comment on how does this assumption affects the calculation of the erective radii?

9. page 5346, line 1. "There is no reason to expect that an undercounting of small-particles by the 2D-S probe would result in such a correlation with large-crystal mass". This statement sound too subjective. I would say: "There is no known reason...".

10. page 5348, line 16. Correct the units "10 s cm-3"

11. Fig.6, bottom diagram. Units "L-1" should be corrected to "g/m3".

12. Fig. 11. Did you assume a spherical ice growth here?

13. Fig.16. The entire diagram should be rotated 90 degrees counterclockwise to make it consistent with the figure caption.

Otherwise, change "left-right" to "top-bottom".

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 5321, 2009.