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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Summertime Arctic Aircraft Measurements during ACCACIA" *by* Hazel M. Jones et al.

Anonymous Referee #2

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Summary:

The objective of this paper appears to be tabulation of some of the aerosol and cloud measurements made during each flight of the ACCACIA campaign. The authors list the instrumentation (section 2), describe the meteorology, aerosol and cloud conditions encountered during each flight (section 3), and offer some quite vague discussion relative to some other literature (section 4). Any tabulation of in situ cloud microphysics measurements over the Arctic and Antarctic is valuable. However, the manner in which measurements are partially shown without experimental uncertainty falls below minimum methodological requirements and claims as to active processes are insufficiently supported.

Comments:

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1. Re methodology, basic limitations of the measurements reported here such as detection limits and experimental uncertainty are never mentioned, which is not acceptable. For instance, the abstract reports that ice crystals "when present" were at concentrations of "0.42 - 0.88 L-1". This is a very narrow range of ice number concentrations. There is never any value between 0 and 0.42 L-1? Depending on the size range to which the authors are referring here, I would expect the uncertainty in the number concentrations to be much higher than a factor of two. What is the uncertainty in total ice number concentration reported? To give another example, what is the uncertainty in the number concentration of 10-micron aerosol measured by the CAS shown in Figure 4 without error bars? This is a persistent omission throughout the manuscript. One option is to report the experimental uncertainty in section 2 with the instrumentation (I think this should be mandatory). Another option is to report it in Table 3. Another option is to show it in figures. Ideally all should be done.

2. I don't believe that sufficient evidence is provided to support the contention about glaciation (last conclusion and last sentence of second paragraph of the abstract). What is the evidence for this? If the liquid phase cloud is not fully overcast and the boundary layer is suffused with slow-falling ice, that doesn't mean that the ice glaciated what the authors refer to as "pockets." If the liquid cloud base or top are variable, and sedimenting or detrained ice is present, that also doesn't mean that any ice present is controlling the cloud parcel phase. I basically just don't believe that the authors have shown support for their last conclusion: "However, intermittently there are sufficient IN to initiate secondary ice processes which then dominate the glaciation process, sometimes producing a totally glaciated cloud in small pockets." IN were not measured. Uncertainties are not reported. The cloud structure is not well illustrated or sampled. I'm open to being convinced, but what is shown here does not convince me.

3. There is a lack of quantitative analysis. For instance, the authors report that CIP-25 and 2D-S "generally compare well" but sometimes "2D-S numbers were much higher." There is no way for a reader to make a robust comparison of such terms with their

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own analyses. I will not try to find all such occurrences; please avoid such imprecise quantifications throughout.

4. Some figures appear not to be called out (5 an 6?). It's not clear to me what Figure 6 is intended to illustrate. Similarly, why is Figure 7 shown?

5. Averaging times are never discussed. For instance, what is the time frequency and rough flight length used to generate Figure 7? Is it the same for all aerosol and cloud measurements shown in the paper?

6. I don't understand the point of Figures 8 and 9. What is the authors' hypothesis for the presence and absence of stellar crystals and why does it matter? If they occur at cloud top and did not sublimate between cloud top and surface, why aren't they observed in between?

7. Figure 1: colors in legend and figure don't match.

8. The yellow lines in many figures are illegible (e.g., Figure 4h).

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