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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 #1

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This paper describes airborne observations of clouds and aerosol particles made during July, 2013 as part of the Aerosol-Cloud Coupling And Climate Interactions in the Arctic (ACCACIA) campaign. The observations were conducted from a BAS Twin Otter, based out of Longyearbyen, Svalbard. The instrumentation emphasises cloud microphysics a little more than aerosol microphysics. The paper is an overview of observations from eight science flights.

The results presented in this paper will likely be of value to the modelling community in terms of data for evaluation. It may be able to offer some useful scientific perspectives, but currently it reads more like a project summary or narrative of a field study. It is a mix of many observations that needs more focus. I suggest emphasis on two aspects: 1) ice processes, including INP, and 2) connections of the aerosol observations with

the cloud droplet number concentrations where feasible.

Specific comments:

1. Table 1 and Figure 1 are missing the Canadian NETCARE aerosol and cloud observations conducted near Resolute Bay in the Canadian Arctic archipelago during July, 2014, as described by Leaitch et al. (ACP, 2016).

2. Section 4.3 discusses the switch from mostly liquid to mostly ice, but fails to refer to Figure 7. According to Figure 7, M191 exhibited more glaciation than M193, yet the 2DS ice concentrations given in Table 4 are about two times higher for M191 than M193. Please discuss these differences. Are you suggesting ice multiplication for M191, M193 or both?

3. Section 4.4 is unable to say anything about INP sources. It brings up the observations from the Grimm OPC, but the discussion is brief and qualitative. Why is there no attempt to correlate number concentrations from the Grimm with the 2DS 'ice' cns? A comparison of Tables 3 and 4 suggests there may be some association. Whether there is or not, it would offer more information and something with a little more rigour than the current presentation. It could be linked to DeMott et al. (PNAS, 2010).

4. The second last paragraph of Section 4.4 that discusses CCN and new particle formation should be a separate section that draws connections between the CPC, Grimm and CDP number concentrations. Presently, the aerosol and cloud droplet number concentrations are discussed independently. The aerosol numbers with the standard deviation give us no perspective on the aerosol concentrations that influenced the clouds. Profiles of the CPC and Grimm number concentrations should be included with the CDP number concentrations shown in Figure 10. How is the below-cloud aerosol linked with the cloud? Were you level in cloud long enough to estimate updraft speeds from your gust measurements?

5. Define ACCACIA when it is first written.

6. Page 1, Line 30 – which, which

7. Page 1, Line 32 – IPCC reference needed.

8. Page 6, line 23 - Canadian Arctic Archipelago rather than Northern Canadian islands.

9. Page 9, lines 16-20 - The comparison between the Grimm and CAS is fine, but what is the purpose of it here?

10. Page 10, lines 15-16 – Indicate where this is evident - Figure 8?

11. Page 10, lines 18-19 – To what do you attribute the difference between M191 and M193 in Figure 7?

12. Page 10, Lines 20-28 – What is the importance of these details?

13. Rather than leaving it until the caption of Figure 9, mention in Section 2 that the flights were based out of Longyearbyen.

14. I don't find the 3D aspect of Figure 9 to be helpful. If all you are trying to say is that "the stellar crystal regions were co-located at different heights", is not a 2D representation sufficient and clearer?

15. Page 15, line 14 – "INP"

16. Page 16, lines 16-18 - "Cloud droplet diameters. . ." Add why you think the droplets are smaller than for other studies? Is it because of the presence of ice?

17. Page 16, lines 19-20 – What are the potential implications for "no consistent relationship of ice crystal number concentration with altitude"?

18. Page 16, lines 23-25 - "The exact sources. . ." This is not a conclusion. Essentially, it says that nothing has been determined and everything is possible.

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