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Atmospheric Chemistry and Physics Discussions

Interactive comment on "New insights into aerosol and climate in the Arctic" *by* Jonathan P. D. Abbatt et al.

Anonymous Referee #1

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This is an overview paper that summarizes key findings from the large NETCARE research campaign focused on aerosols and clouds in the Arctic. The paper is slightly unusual in that it only lightly touches on a wide variety of research findings that are described in other NETCARE papers, but I find synthesis papers of this nature to be useful because they serve as a starting point for informing on the campaign and as a gateway for readers to locate more detailed studies and place them in the broader context of the campaign and outstanding research questions. As a standalone, this paper is also useful in highlighting recent advances in Arctic aerosol research and key outstanding questions that persist today. The paper is clearly written and organized. I recommend publication after minor issues are addressed.

One statement that requires investigation, however, is on p.17, line 1: "GEOS-Chem-

Tomas yields a pan-Arctic average springtime DRE ranging from -1.65 W/m2 for entirely externally mixed BC to -1.34 W/m2 for entirely internally mixed BC." - The top-of-atmosphere DRE of Arctic BC is most certainly positive (See, e.g., Table 1 of Samset et al 2013, doi:10.5194/acp-13-2423-2013, showing positive global and Arctic BC DRE from all models). Do the cited estimates perhaps refer to DRE by all aerosols? Or do the numbers perhaps include indirect BC effects that are negative? Please clarify. If the DRE estimate is for all aerosols, please communicate which anthropogenic and natural aerosol groups are included in the estimate. It would also be helpful to include the isolated DRE of BC if possible, since BC is the focus of this paragraph.

Minor issues:

Abstract: It would be helpful to see more concrete or quantitative findings presented in the abstract, where possible. In particular: (1) line 24: "a significant fraction of the new particles grow..." - What was the actual (range of) fraction that was found? Or... how 'significant' is this fraction? (2) line 30-31: "... measurements were used to better establish the BC source regions that supply the Arctic..." - And which source regions were found to be important? Was there a change in our general understanding of the important source regions?

p.4, line 3: References cited in this manner should, I believe, be: "Quinn et al (2006)" instead of "(Quinn et al, 2006)".

p.8, line 13: Please provide a reference or link for "PMEL database".

p.8, line 25: Why are the DMS dynamics so different between multi-year and first-year ice? Even speculation on this would be useful.

p.9, line 14: "Biogenic DMS oxidation products were also prevalent in the marine boundary layer" - The relevance of this statement is not immediately clear. It would be helpful to connect it better with the rest of the paragraph.

p.10, line 14: "... tundra could act as a source of ammonia..." - The abstract and con-

clusions highlight sea birds as an important and underappreciated source of ammonia. It would be helpful if you can link the different NETCARE studies together to draw conclusions on the relative importance of the tundra soil and sea birds as sources of ammonia in different environments and/or seasons.

p.11, line 11: "Furthermore, the simulated response of the mean cloud radiative forcing in the Arctic is proportional to the mean surface seawater DMS concentration in the Arctic" - Do you have any explanation for why? It is not immediately clear to me why this should be the case, but perhaps it is intuitive and I am not reading it correctly.

p.12, line 19: Regarding the relative importance of European and Asian sources to Arctic BC at different altitudes: One study that has explored this via modeling is Jiao et al (2016, doi:10.1002/2015JD023964).

p.15, line 16: Why is the dome boundary ("north of 66-68.5") expressed as a range? Does the boundary vary with longitude in your analysis? With time?

p.15, line 29: What is the meaning of "sensitivity to the surface"?

p.16, line 9-10: This sentence is a bit unclear. By "changes", do you mean seasonal changes? And by "time period" do you you mean winter to spring? Please clarify.

p.19, line 8: "... still debated in the literature" - Please provide references that communicate this debate.

Figure 7: Please explain this figure more thoroughly, including the legend description and meaning of dashed lines.

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