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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Exploring the variability of aerosol particle composition in the Arctic: a study from the springtime ACCACIA campaign" *by* G. Young et al.

Anonymous Referee #1

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"Exploring the variability of aerosol particle composition in the Arctic: a study from the springtime ACCACIA campaign" by Young et al. focus on the chemical composition observed during six flights conducted in spring 2013.

Reading the manuscript it is clear that the authors worked with a limited set of data. Nevertheless, any airborne observations of aerosol properties should be shared with the community, as we still lack some fundamental understanding on this topic. As pointed out, models are not yet able to fully reproduce details in the variation of the Arctic aerosol properties. Unfortunately, the authors chose to focus on low-level data, and in my opinion the most interesting conclusion was based on comparing two levels

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in the vertical. The conclusion about the origin of the air in FL764 and the ubiquitous presence of minerals in all flights, are sufficient to warrant the publication of these data.

Before any publication I have a few comments that might improve the manuscript.

To begin, I think the title must be revised. The "variability of aerosol particle composition" implies some statistical representation of a larger data set than is actually presented here. In total I calculated about 1.5 hours of sampling time and less than 10 cubic meters or air. Besides some mean values, there are few statistical measures on the variability presented in the manuscript. I propose a more direct approach, where the title reads something like: Observed size dependent chemical compositions of aerosols in the sub-Arctic during six measurement flights during the ACCACIA campaign. Far from perfect suggestion, but I hope the point is made.

On the topic of variability, may I suggest the reference by Tunved et al. 2013 (ACP) for a climatology of physical properties observed at the Zeppelin station to include in your introduction. Also pertinent to this study are references from the ASTAR 2007 campaign, i.e. Hara et al.

2.2. Filter collection Line 20-25 My understanding is that sub-isokinetic sampling is not the trick for removing large particles or droplets. It is the virtual impactor at the bend (where the inlet direct the sample flow through the fuselage) that gives this positive effect. This design in itself generates a blunt cut-off in the sampling of particles, which is not addressed in this manuscript. When sampling sub-isokinetic with a forward facing probe, this introduces a size dependent sampling efficiency which favors larger particles. How much, this effect influences depends on the ratio between the sampling flow and the volume swept through by the opening area of the inlet as the plane moves forward. How large is this ratio, and how does this potentially influence the size dependent sampling for the filter substrates?

Even with a tapered tip (as I believe is used on the FAAM platform) there is a potential risk of drops shattering on the probe tip, or more so, inside the probe if the probe is not

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aligned with the streamlines of the surrounding air. That is, the probe is of axis during low speeds with high aircraft attack angles or in turns etc. These problems could cause spurious effects in the data during cloud traverses. Where any such observed, or was this problem considered in the analysis somehow?

2.3 Page 29411 Line 11 What does 4 pixels correspond to in um?

Page 29412 Last line "The number. . ." what is the fraction?

2.4.5 Page 29417 Line 25 The word "present", is this meant to be "originated"? If not I don't get the logic of the paragraph. Surely such aerosol may be present in the Arctic.

3.1 Page 29418 Line 22 Strike "monotonically" as this is not always true and especially not for all trajectories.

3.2 Figure 4. This figure is somewhat central to the manuscript as it is used both to corroborate different measurement technics as well as in the interpretation of the data. I understand that the probe data are means from each flights for the corresponding period of the filter samples. However, it is not clear if these are arithmetic or geometric means. Also, there are no indications of variability (some call it uncertainty) for each size bin or at least size range. The ESEM data is unclear to me. Can a similar line be produced as for the probes? What does each marker represent, fixed size range or number of particles? Presumably, these must represent some sort of histogram if they are to be dN/dlog Dp values.

I think I got that both filters are uses for each data point (if I'm wrong correct me).

My main request is that the authors include meteorology and ambient conditions to the manuscript. It is not reported and could fit very well into a table with average T and RH for each sampling period for instance. The result of this could enter the discussion of figure 4. If the RH is high (i.e. >80%) this will significantly change the ambient vs dry aerosol apparent sizes. In some cases, the probe data could be shifted as much as a factor of 2, or more (towards smaller particles) comparing ambient and dry conditions.

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Later this figure is used in connection of “comparable” in section 5, it is important to note over what size ranges this is true and under what conditions (after the difference between ambient and dry conditions are considered).

4.3 This section is too verbose and contain much background information which is more pertinent into the introduction. Cut what is not essential to the findings of this study. In my opinion there is information about minerals, but nothing about their IN potential, which would potentially reduce this section a lot.

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Conclusions 1 Page 29431 Line 7-8 Ok until “;”, after that can be striked).

Page 29432 Line 2 To make my point, meteorology is used as an argument, but not reported in the manuscript. Please, include some info on T and RH at least.

In general it would be nice if dates for flights where used and flight numbers where referred to in the table and not vice versa. It makes much more sense to other people not specifically involved in the campaign.

Given the relatively short sampling times, the trajectory analysis could be greatly simplified by fewer trajectories over the actual sampling time. The 30s interval brings no additional information and only clutters the graphs. Trajectory at start and at end would probably be more than sufficient for the analysis and conclusions.

It took me some time to understand the samples available. First I thought it was six, then an extra showed up. It is also not clear how many particles were analyzed per filter. Can these things be made clearer in the text/tables perhaps?

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 29403, 2015.