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Atmospheric Measurement Techniques Discussions

Interactive comment on "PHIPS-HALO: the airborne Particle Habit Imaging and Polar Scattering probe – Part 2: Characterization and first results" *by* Martin Schnaiter et al.

Anonymous Referee #1

Received and published: 20 September 2017

Review of "PHIPS-HALO: the airborne Particle Habit Imaging and Polar Scattering probe – Part 2: Characterization and first results" by Schnaiter et al.

Recommendation: Accept with minor revision

This paper characterizes the response of the PHIPS-HALO probe that was introduced in the Part 1 paper published last year. In addition to the laboratory characterization of the light scattering detection system, imaging system and electronics, some first results from two field campaigns in the Arctic and in the vicinity of Colorado during the ARISTO 2017 field campaign are presented. I find that the probe does offer a unique way of looking at data from having stereoscopic images and from having scattering

phase functions of individual particles coincident with the scattering properties, and will likely allow some fundamental questions describing the relation to cloud microphysics and radiation to be answered in the near future. Thus, I think its publication in AMT is appropriate. However, I am recommending a few minor revisions that I think will improve the quality and readability of the paper.

1) The paper discusses the PHIPS-HALO in isolation from any other imaging probes and scattering probes that are currently available. It would be nice to compare the advantages and disadvantages of PHIPS-HALO with some of these other probes. Perhaps a table could be constructed where some parameters of different probes that image particles and scattering phase functions could be compared (e.g., sample area, number of crystals imaged in given time period, range of particle sizes, sizes of particles detected, data volume, etc.). This would be helpful for future users of the probe.

2) I think that the authors should exhibit more caution in some conclusions that they make out of a very limited set of data. I think the current paper is very powerful at showing the types of questions the probes can answer, but less powerful at actually answering these questions given the very limited amount of data that are presented. Some of the conclusions in Sections 3.2 and 3.3.1 are especially problematic. For example, the authors claim that the images in Fig. 13 show that a highly structured crystal (b) gives flat and featureless phase functions, whereas less structured crystals (a) exhibit peaks at two specific angles. I found this less than convincing: when I compare the (a) and (b) images I only see that the image in (b) is darker, as later commented on by the author. If the b particle is indeed more structured, the authors need to show the specific places on the crystals (perhaps circled) where this structure is seen. I am also not convinced that the particles in (a) and (b) are similarly oriented. They look to me that they could be oriented with different angles. Can the authors do some simple scattering simulations to show how different orientations of the same particle affect the scattering phase function? If there is a difference in 10 degrees, for example, is this sufficient to show different scattering functions? Over what angles would

the scattering patterns be similar, and how close do the scattering functions need to be in order to be classified as similar? Similarly, I am concerned with the analysis in Section 3.3.1 where the authors make the overarching claim that "particle ensembles composed of ice crystals that show a significant complexity on a single particle basis possess similar flat and featureless average angular scattering function even if their basic crystal habit differ (columnar vs. plate-like in this case)." I think a much more thorough analysis needs to be done, including using scattering models to see how different orientations of crystals and different constructions of bullet rosettes with varying numbers of rosettes and orientations, affect the scattering properties before making such a conclusion. The authors themselves seem to explicitly acknowledge this when they stated that the "above examples have demonstrated that this question can be addressed by measurements with PHIPS-HALO, [but] further detailed analyses with larger data sets are necessary to come to statistically significant conclusions." I would recommend toning down the earlier statements, and supplying some scattering simulations, to better justify the discussions in the earlier part of the paper.

Minor Comments:

Page 3, line 1: How does the sample area (and other parameters) compare with other probes? See major comment 1.

Page 8, line 21 bits not bit

Page 8, line 26: lose not loosing

Page 9, line 19, was not were

Page 9 line26: Remove was

Page 10, line 3: I don't think ARISTO was designed to test instrumentation from SOCRATES, even though many of the experiments used in ARISTO will ultimately be used in SOCRATES

Page 10, lines 15-16: I don't think it is true that there are always portions of the particle

in other imaging probes that are out of focus. While I think it is true that some portions of the particles imaged that are out of focus, but there are individual particles that are entirely in focus. I'm not sure if this is a misinterpretation of the English that is written, but it should be noted that entire particles are in focus in other probes (though some particles are entirely out of focus).

Page 13, line 32: missions not mission

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