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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Physical properties of High Arctic tropospheric particles during winter" *by* L. Bourdages et al.

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Below is our response to the detailed comments of Referee #2 (R2). The referee's comments are quoted, and our response follows. Please also see our "General Response" thread.

R2: "The authors present a new cloud property data set from a high-latitude Arctic site. The data set is of obvious importance to climate research, particularly given the potential sensitivity of the arctic climate system to changes in cloud cover. While the data set is of great importance to climate research, the authors do very little beyond presenting the cloud properties as retrieved from the various remote sensing instrumentation. These retrievals are more or less established algorithms. The results constitute new information, and are therefore of value to the general climate community. However, the

manuscript reads a bit more like a technical report. Much more could be done with this data set before publication in ACPD."

We agree that the data set is important and that our results constitute new information. The retrievals, however, are not "established algorithms" given that we have a unique combination of instruments and measurement conditions. This is explained further in our "General Response" to the reviews. There is still considerable debate in the community on how to best retrieve particle optical properties, and a schism between those that would assume some particular habit versus a spherical geometry. We believe that we are the first to make the interpretation of lidar-derived effective radii in terms of minimum particle dimension.

R2: "For example, the authors raise some interesting questions that could be (at least partially) addressed with the data set at hand (e.g. whether or not clouds are responsible for limiting the minimum temperature in the Arctic). This data set could be used to assess the radiative impact of clouds, rather than just their occurrence, properties, and/or 'type'. Could the data set be composited for the occurrence of warm air advection with cloud, warm air advection without cloud, cold air advection with cloud, and cold air advection without cloud? Which events bring certain 'types' of clouds? What is the cloud frequency at Eureka? How does the cloud frequency differ between the different retrievals? In fact, table 1 indicates that there was an AERI at the site. The AERI data would be very useful in assessing the radiative impact of clouds. I can only assume that broadband radiation measurements are also made at Eureka. Analyses from ECMWF or something similar could be used to classify weather regimes and composite the cloud data. If ECMWF data becomes involved, why not assess ECMWF over the site?"

These are excellent suggestions, but are for future work that is far outside the scope of our current manuscript. There is considerable extra study with unknown outcomes in what is proposed, and this would delay the release of our important new results for some time.

Please note that our study is not a “process” study like the comments above recommend. We have provided data on the nature of particles in the wintertime High Arctic troposphere for which there is no previous information. Process studies are hampered without a sound understanding of the basic phenomenology that we provide. It make sense to us to separate the two.

R2: “The cloud ’type’ is a particularly troublesome issue in the work. The authors should clearly explain how they set each threshold. The authors should present some sort of timeline (or freq. dist.) of when the data were collected. The contour plots are for the entire period of Dec-Mar. However, the reader is left wondering whether the data sets represent December-only conditions, or March-only conditions, or some fraction of the three months... I don’t think the three months are equivalent climatologically.”

The categorization issue is explained in our "General Response" to the reviews. The lidar operates continuously, and the high number of hours (7772 h) show that the data was evenly distributed over the months in question. The climatology of Lesins et al. (2009b) shows that Dec-Mar are equivalent climatologically for Eureka, and we would include this information in any revision of our manuscript.

R2: “I hope that this paper is published in some format very soon. However, in its current state, I recommend rejection.”

We appreciate the Reviewer’s acknowledgment of the importance of our study, and hope they agree it can be published with the revisions we have proposed.

R2: “-remove figure 3, along with the distracting introduction to section 3.”

Figure 3 is used to establish our classification scheme, and so is an essential component of our manuscript. As described on the first page of this manuscript, we would expect to clarify its use in our revisions.

R2: “-many figures can be presented as black and white contours, rather than in color.”

Much of the detail apparent when using a gradient between many colours would be

lost in reducing down to a gradient between two (black and white).

R2: “-I recommend removing OPAL instrumentation from Table 1 that is not used to produce data presented in the work. This is not an advertisement for OPAL (although I think OPAL is a very important site in the Arctic Observatory).”

The table is not meant as an advertisement, but was included for reference by other papers from the PEARL Laboratory. It can be removed, but does not detract from the paper as presented.

R2: “-The authors should revisit their vertical averaging algorithm, because some of the step changes (Fig 7, for example) are quite large, yet the contours seem continuous within each km averaging bin. This juxtaposition seems fishy to me.”

We trust that the discussion of the data masking on the first page of this response clarifies this issue. The data are indeed obtained and presented at high resolution. The discontinuities apparent in Figure 7 are in regions of relative low statistics, and the fact that aerosols are ubiquitous in the Arctic winter atmosphere. Separating the different cases will always lead to such discontinuities in the aerosol data.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 7781, 2009.