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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Large surface radiative forcing from surface-based ice crystal events measured in the High Arctic at Eureka" *by* G. Lesins et al.

Anonymous Referee #1

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Comments on Lesins et al, 2008. Large surface radiative forcing from surface-based ice crystal events measured in the High Arctic at Eureka

Overall Assessment

This is an important set of observations about the radiative impacts of ice crystals in the high Arctic and their effects on the infrared radiative transfer back to space. The work follows on discussions of diamond dust dehydration implications of such crystals in the work of Blanchet and Girard as well as some limited observations during the SHEBA campaign in the Beaufort Sea.

The paper is well written with few errors and probably can be accepted substantially as is. This reviewer will note the lack of reference to some early work using lidar in the 1980's where ice crystal precipitation was observed by lidar and the relationship of low visibility (i.e. attributions of Arctic haze) were related to number densities of ice crystals in the 4-300 um range (Trivett et al., 1988; Hoff et al., 1988: Leaitch et al, 1989). In that Arctic haze experiment, it was clear that horizontal visibilities of less than 30 km were likely to contain significant numbers of ice crystals.

It is interesting that the ice crystal events in this paper do not involve significant involvement of ice crystal showers as seen in the Hoff study. In that paper, it was mentioned that wave activity can lead to significant ice supersaturation which can nucleate the crystal showers.

In this paper, the ice crystals are attributed to blowing snow. This is a different mechanism than homo or heterogenous nucleation of ice crystals and therefore one would expect significantly different morphological differences in the crystals. In the 1980's studies quoted above, rosettes of very small diamond dust were seen (4-12 um) but were relatively rare compared to the larger hexagonal column crystals which ranged up to over 100 um in size. Presumably blown snow would be more irregular less well defined crystals due to weathering. There is little discussion of the crystal morphology (other than SBDART was run with spherical scatterers) and of the retrieved crystal size from the SBDART calculation and the lidar/AERI data. It would be interesting to see the retrieved mean sizes of the crystals in the Tables.

Figures 12-16 show the radiosonde profiles with the RH presumably above water? If so, can the soundings also show the saturation with respect to ice? It may very well be that the attribution of crystals due to blowing snow off the ridges is correct, but precluding nucleation of new crystals would be important to this conclusion.

The homogenous nature of the layer if these are indeed plumes from the ridges is curious. Can there be some discussion of why more structure is not seen the boundary

ACPD

8, S7703–S7705, 2008

layer below the inversion? The MODIS IR images do not obviously show the plumes of snow claimed by the authors. I would suggest annotating the images to show these features rather than have an extended figure caption.

Finally, the implications of high warmings in the Arctic would have more impact if this were not a local event. If, in fact, the crystal source is the ridges near Eureka, then the impact is fairly localized in extent and does not have the same import as it would if this were a widespread phenomenon such as Blanchet and Girard's dehydration hypothesis. Can the authors give some "big picture" statements of how this is to be viewed in the overall radiative budget of the Arctic?

Trivett, N. B. A., L. A. Barrie, J. P. Blanchet, J. Bottenheim, R. M. Hoff, and R. E. Mickle, An Experimental Investigation of Arctic Haze at Alert, N.W.T., March 1985. Atmosphere Ocean, 26, 341 376, 1988.

Hoff, R. M., Vertical Structure of Arctic Haze Observed by Lidar, J. Appl. Met. 27, 125 139, 1988.

Leaitch, W. R., R. M. Hoff and I. MacPherson, Airborne and Lidar Measurements of Aerosol and Cloud Particles in the Troposphere over Alert Canada in April 1986, J. Atmos. Chem., 9, 187 211, 1989.

Pg 17692 : line 21: Meteorological Service of Canada is misspelled

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Interactive comment on Atmos. Chem. Phys. Discuss., 8, 17691, 2008.