Atmos. Chem. Phys. Discuss., 8, S9958–S9960, 2008
www.atmos-chem-phys-discuss.net/8/S9958/2008/

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.

G. Lesins et al.

Received and published: 17 December 2008

Response to Anonymous Referee #1

The following is our response to each of the issues raised.

1. We thank the referee for pointing out important measurements done in the 1980s on Arctic haze and ice crystals. We have added Trivett et al., 1988, Hoff et al., 1988 and Leaitch et al., 1989 to our reference list, and have referred to these papers in our Introduction section. A brief summary of the ice crystal measurements of Trivett et al., 1988 and Leaitch etr al., 1989 has been added in the Discussion section.

2. We agree that the ice crystal morphology for a blowing snow source will likely be very

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

different from an atmospheric nucleation source. We did emphasize in the Conclusions section that our study is not considering the classic diamond dust phenomenon. We have added a statement about the likelihood of different ice crystal morphology in the Discussion and Conclusions sections. We have added a reference to Walden et al (2003) who did ice crystal measurements but in the Antarctic winter at much colder temperatures.

3. We did report on the results of a simple sensitivity study using SBDART by varying the effective radius but found less than 1 W/m2 change in the radiative forcing. We feel that Table 4 is already overloaded with information (as pointed out by another referee) and so decided to keep this result in the Discussion section.

4. In the caption to Figure 13 to 16 the referee asked for the relative humidity to be plotted with respect to ice saturation. We agree this is a good idea and have changed the plot. Note that Figures 13 to 16 are now Figures 12 to 15 in the revised manuscript. The air layer containing the ice crystals are close to or exceed ice saturation suggesting that significant modification of the ice crystals occurred between the source at the ridges and Eureka. We have added sentences to this point in the Discussion section.

5. A question was raised about the apparent lack of small scale structure in the ice crystal layer in the boundary layer. Examination of lidar backscattering shows that there is a large variation in the degree of heterogeneity for the four case studies that originated as blowing snow from the surrounding ridges. The time windows used for the radiative forcing calculations were chosen to be as uniform as possible to reduce large fluctuations in the measurements that would not be possible to reproduce in the SBDART calculation and hence this is likely the reason for the uniformity issue raised by the reviewer. This is pointed out in Section 4.1 when discussing the choice of the averaging time window for radiative calculations and comparisons. It is not accurate to think of these events as being homogeneous.

6. The referee asked for annotations on the MODIS IR images to indicate the locations

ACPD

8, S9958–S9960, 2008

of the snow plumes. We have added a circle in Figure 16 (used to be Figure 13) indicating the important plume that is over Eureka.

7. The referee asked us to comment on the big picture aspect of our results in the context of the overall radiative budget of the Arctic. This study was not intended to address that issue since our observations are based on one station. However we believe that the effect of blowing snow from ridges is not as local as one might think. The MODIS IR images showed that warm plumes formed off many ridges around Eureka. Furthermore the Arctic Archipelago consists of islands with rugged terrain which can also serve as a source for elevated blowing snow. However since much of the Arctic consists of sea ice away from topography and also that these events are episodic rather than continuous we cannot conclude that the strong radiative forcing we measured will have a large impact on the overall Arctic radiative budget climatology. We added a clarification on this point in the Conclusions section.

8. We corrected the misspelling of the ‘Meteorological Service of Canada’.

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