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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Snow optical properties at Dome C, Antarctica – implications for snow emissions and snow chemistry of reactive nitrogen" *by* J. L. France et al.

Anonymous Referee #2

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Snow Optical Dome C

J.France et al.

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Snow optical properties at Dome C, Antarctica – implications for snow emissions and snow chemistry of reactive nitrogen

27 June 2011

The manuscript presented by France et. al. (this study) returns to the Wolff et. al., 2002 manuscript examining the influence of snow opitcal properties on nitrate loss in Antarctic snowpacks due to photolysis. This is an area of research with a long history in ice core interpretation, yet to date, lacking a conclusion.

The France et. al. work contributes significantly to the discussion by providing a more detailed model investigation of the photolytical properties of the snow pack and using more recent and reliable field data than that of the Wolff et. al. study.

While the work presents an advance in our understanding of the processes, there is still an open ended conclusion, with photochemical loss of nitrate in the snow pack being unable to account for the high losses recorded in observations.

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1 Scientific Significance

The manuscript is highly signficant and makes a positive contribution to the field of snow pack radiative transfer and ice core interpretation.

2 Scientific Quality

The largest flaw in the manuscript is a lack of comprehensive literature review. The citations are largely 'in house' British Antarctic Survey manuscripts, and the authors failed to include prior investigations into the topic and furthermore to discuss some of the limitations in their methods that are highlighted by some recent radiative transfer studies of snow pack. In particular, the limitations and challenges of accurately measuring and modeling reflectance from polar snow packs as discussed in the following manuscripts should be provided at a minimum:

Aoki, T. (2003), Effects of snow physical parameters on shortwave broadband albedos, Journal of Geophysical Research, 108(D19), 1-12, doi:10.1029/2003JD003506. [online] Available from: http://www.agu.org/pubs/crossref/2003/2003JD003506.shtml (Accessed 13 February 2011)

Munneke, P. K., C. H. Reijmer, M. R. V. D. Broeke, P. Stammes, and W. H. Knap (2008), Analysis of clear-sky Antarctic snow albedo using observations and radiative transfer modeling, Analysis, 113, 1-11, doi:10.1029/2007JD009653.

Picard, G., L. Arnaud, F. Domine, and M. Fily (2009), Determining snow specific surface area from near-infrared reflectance measurements: Numerical study of the influence of grain shape, Cold Regions Science and Technology, 56(1), 10-17, doi:10.1016/j.coldregions.2008.10.001. [online] Available from: http://linkinghub.elsevier.com/retrieve/pii/S0165232X08001602 (Accessed 13 Febru-

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ary 2011)

On the matter of review of nitrate photochemistry and the preservation and loss of nitrate in the snow pack, the authors fail to cite the following important contributions:

Burkhart, J. F., R. C. Bales, J. R. McConnell, M. a Hutterli, and M. M. Frey (2009), Geographic variability of nitrate deposition and preservation over the Greenland Ice Sheet, Journal of Geophysical Research, 114(D6), 1-15, doi:10.1029/2008JD010600. [online] Available from: http://www.agu.org/pubs/crossref/2009/2008JD010600.shtml

Burkhart, J. F., M. Hutterli, R. C. Bales, and J. R. Mcconnell (2004), Seasonal accumulation timing and preservation of nitrate in firn at Summit , Greenland, Methods, 109(1), 1-9, doi:10.1029/2004JD004658.

Hastings, M. G., Steig, E. J., and Sigman, D. M.: Sea- sonal variations in N and O isotopes of nitrate in snow at Summit, Greenland: Implications for the study of nitrate in snow and ice cores, J. Geophys. Res., 109(D20), D20306, doi:10.1029/2004JD004991, 2004.

Aside from these omissions, the manuscript reads clearly the english is good and few changes are suggested. These are highlighted in the next section.

3 Presentation Quality

The authors should return to the draft and review their use of acronyms, and the introduction of the acronyms. Clearly, due to their familiarity with Antarctic research, they fail to properly present a few key locations:

Dome C, introduce as Dome Concordia and explain
EPICA, introduce and explain

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EAIS, introduce and explain

Also, the following are either not defined, or defined later and the definition should be moved forward:
TUV-snow
DISORT
HULIS

Some other inconsistencies:
page 11971, the range of BC is provided as 0-13 ng g-1, whereas in the discussion is is 2-6 ng g-1
page 11976, define and provide a reference to ISCAT
Table 2, the headings in the last two columns are illegible.

Lastly, the discussion of uncertainties of the irradiance measurements themselves lacks detail. At a minimum, the values presented in Fisher (2005) should be presented again for reference. Furthermore, some more details regarding the data aquistion would be important for repeatability. For instance, on page 11965 it is not important that a Panasonic Toughbook was used, but it would be interesting to know more about the integration time of the measurements, and overall aquistion parameters. What Ocean Optics spectrometers were used? How was the data post-processed?

The manuscript should be accepted for publication with minor revisions.

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