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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Bromide and other ions in the snow, firn air, and atmospheric boundary layer at Summit during GSHOX" *by* J. E. Dibb et al.

Anonymous Referee #2

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This discussion paper describes observations of bromide in the gas, aerosol particle, and snow phases at Summit Greenland. It is a nice contribution to the literature of halogens, particularly in relationship to polar regions. Novel aspects of the work are the observation that snow surface bromide co-varies with aerosol radionucleides, indicating ventilation of the boundary layer may be bringing free tropospheric bromine down to the snowpack. The observation of significant enrichment of the bromide to sodium ratio as compared to sea water ratios appears to be in agreement with similar observations seen during sea-ice related ozone depletion events, possibly implicating active Br chemistry in the Arctic basin. The observation of enhanced soluble bromide in firn air as compared to ambient near midday at Summit is also very intriguing and indicative of active bromine chemistry in the snowpack.

Generally, the manuscript is well written and referenced. The field sampling and analysis are well described and appear to yield good results in both a challenging field location and at very trace analysis levels.

==========Minor points==========

A number of the references are listed as "in preparation, 2010". I believe that it is the style of ACP/D to use footnotes for unpublished references.

p13619 around line 20. A number of past studies have investigated Br-/Na+ ratios in snow and found enrichment of Br-/Na+ for low salinity snow. Two references are:

Toom-Sauntry, D., and L. A. Barrie (2002), Chemical composition of snow- fall in the high Arctic: 1990–1994, Atmos. Environ., 36, 2683–2693.

Simpson, W. R., L. Alvarez-Aviles, T. A. Douglas, M. Sturm, and F. Domine (2005), "Halogens in the coastal snow pack near Barrow, Alaska: Evidence for active bromine air-snow chemistry during springtime", GRL, 32, L04811, doi:10.1029/2004GL021748.

p13620 line 10 – "Rapidly" is misspelled

p13622 line 25. When I do the calculation, I find that there is only an order of magnitude more Br- in the top 0.5cm of snow. Possibly the top 0.5 meters of snow was meant? My quick calculations are:

Snow: Typical concentrations are 10 nmol kg-1, which converts to 1e-11 mol per gram of snow. If the density is 0.3 g/cm3, then we have 3e-12 mol / cm3. The top 0.5cm then contains 1.5e-12 mol / cm2, which converts to 9e11 molecules / cm2, or on the order of 1e12 molecules/cm2.

Gas phase: Typical mixing ratios are 0.5 ppt, or about 1.2e7 molecules / cm3. Times 100 meter height = 1.2e11 molecules / cm2, or on the order of 1e11 molecules/cm2.

Thus, the top 0.5cm of snow has only an order of magnitude more Br-. If this reservoir were a lot larger, then one would expect that the gas phase could not make it vary, and

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there are significant variations seen in the surface snow bromide content.

Overall, this is a well done an interesting paper that should be published in ACP.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 13609, 2010.