

Interactive comment on “Snow-sourced bromine and its implications for polar tropospheric ozone” by Xin Yang et al.

Anonymous Referee #1

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General comments

This manuscript describes modelling calculations aimed at simulating bromine explosion events observed during polar spring. The authors do this by modelling sea salt generation during blowing snow events, which then act as an additional bromine source. They further include heterogenous reactions on background aerosol to reactivate Br radicals from HBr reservoir. The authors carry out a logical suite of experiments, making a number of reasonable assumptions during their calculations, and then exploring some of these assumptions in sensitivity tests. The results clearly demonstrate the significance of blowing snow for influencing the polar troposphere, while acknowledging that more work is needed to develop details of the parameterisation. The paper is well written and clearly presented and should be published in ACP.

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Specific comments

Page 8142, line 19: Am I right that the recycling reactions only occur on background aerosol and not on the additional aerosol generated from blowing snow? If so, the authors might like to add a comment somewhere that the additional aerosol from blowing snow will further enhance the recycling.

Page 8145/8146 and Figure 4: I can see why it's tempting to make comparisons at specific locations, especially ones where ODEs and BEs are regularly observed. But I wonder if it's asking too much of the experiment to do regressions on these? The comparison at Barrow works fairly well and r^2 is (surprisingly) good. But there are clearly issues with comparisons at many of the locations shown in Figure 4, where neither the agreement in timing nor magnitude of BrO are particularly well captured. This isn't really surprising given that a model grid box is being compared with a satellite pixel, and that the system is highly dynamic and sensitive to a wind speed threshold that might be smoothed out over an averaged grid box. The most important point I take from these diagrams is that the Ocean run doesn't get close to giving bromine explosions, whereas the blowing snow run really does. I'd take that as the conclusion, and not push into regression analyses for these other locations, unless more discussion is given as to why differences in detail (and hence reduced r^2) can be expected.

Page 8146, line 3: "during Julian days 80-90, and 120-130" – or is there a reason why the latter is not mentioned?

Page 8146, around line 15: Neumayer and Arrival Heights (4e and f) are not inland stations, they are coastal sites, Summit, on the other hand (4b) is in central Greenland, and Harestua (4d) is some considerable distance from the coast.

Page 8147, line 20: Figure 6 shows that emissions of Br associated with blowing snow contribute significantly to BrO at mid-latitudes. This is an important finding and should be included in the Conclusions section.

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Page 8159, Figure 4: It's noticeable that in the Arctic, the model consistently underestimates GOME trop column throughout the non-spring periods of the year. Do you have any suggestions as to why this might be?

Page 8147, line 13: do the differences in BrO distribution reflect different meteorology in the two polar regions?

Page 8147, line 18: do the different percentages arise because of the different salinities between the Arctic and Antarctic used in the model?

Page 8149, line 10: Blowing snow events are never dry. Within blowing snow, relative humidity will be 100%. What matters, in terms of climatic influence, is the windiness. Please clarify this in the text.

Page 8158, Fig 3: given the discussion in the text about wind speed at Barrow, it might be interesting to see wind speed data for Barrow compared with that in the model for the spring period.

Page 8158, Fig 3: As the largest BE occurs between days 50-60, it would be nice to see GOME trop column data for this period as well – are there any?

Page 8160, Figure 4: Could you define what you mean by “over Weddell Sea” and “over Ross Sea”? Are the data averages across these regions..?

Technical comments

Page 8138, line 13: Amend title to “Main features of the blowing snow scheme”

Page 8142, line 15 and 16: can you provide a reference for the uptake coefficients used?

Page 8143, line 12: “Earth” should be upper case

Page 8144, line 21: “boreal” and “austral” should be lower case (adjectives)

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 8135, 2010.

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