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Comment

## ***Interactive comment on “Longpath DOAS observations of surface BrO at Summit, Greenland” by J. Stutz et al.***

**Anonymous Referee #2**

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Review of the paper “Longpath DOAS observations of surface BrO at Summit, Greenland” by J. Stutz et al.

In this paper, the authors report on long-path DOAS measurements of BrO and O<sub>3</sub> on Greenland during two periods in 2007 and 2008. Unexpectedly high levels of BrO were observed throughout the measurements, both during episodes of long-range transport of marine air to Greenland and in local airmasses. In 2008, a clear diurnal cycle of BrO was observed which can in part be explained by changes in boundary depth and photolytic release of BrO from a snow source.

The paper is generally well written and reports on a very interesting and surprising data set which certainly deserves publication in ACP. However, in my opinion, the analysis and discussion in the paper is somewhat incomplete and disappointing, and more work

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is needed to make this a convincing analysis. This is in part related to the fact that the model based analysis of the same measurements is presented in several companion papers, leaving little room for interpretation in this manuscript.

### Major Points:

- I was surprised not to find any reference to the CIMS measurement of BrO which were also taken during the campaigns. I understand that this is not a comparison paper but the existence of this other data set should be mentioned, and some basic information been given (Are the overall values comparable? Is the variability comparable? Are the differences between the years comparable? Is the diurnal cycle comparable?). I think this is relevant as the BrO values observed are unexpectedly high and confirmation of the observations by an independent technique adds confidence to the results.
- The four most striking features of the BrO time series are
  - the large difference between the two light paths in 2007
  - the large variability of the values over short time periods
  - the systematically lower values in 2008
  - the difference in diurnal variation between the two years

I think that all these points should be addressed in more detail. Were there instrumental differences between the years other than the improved pointing? Are the results from the shorter path as reliable as those from the longer path? Do the authors think the variability is real, or could this be linked to observational problems?

- The analysis of the diurnal cycle of BrO makes sense as boundary layer depth and photochemistry should both contribute to BrO levels. However, the results

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are not really conclusive as a) there was no such diurnal cycle in 2007 (assuming that all points shown in Fig. 6 are statistically meaningful), b) the statistical analysis is based on hourly values averaged over several days, and for the same time of the day, photolysis and boundary layer depth can vary, and c) there is a lot of short-term variability in the data which must have other reasons.

- The big question in general is: Where does the bromine come from? The authors try to address this point by looking at time periods with different air mass origin, but do not directly compare the results from these different situations. I would have expected an analysis of how the observed BrO depends on parameters such as wind direction, temperature, wind speed, actinic flux or time of last contact to the open ocean using all the data and not just a subset of hourly averaged values. I'm sure that such an analysis was performed on the measurements, and strongly recommend adding it to the paper.
- I'm not familiar with the "footprint sensitivities" shown in Figs. 4 and 8, and with the little information given in the text, I do not understand what the colours shown represent. Please explain in more detail what is shown and why in some cases there is high values all over the ocean and in others not.
- I'm not convinced that the steady state considerations presented in the conclusions add relevant information. They are not directly linked to the observations reported, are based on very simplified assumptions and much more detailed chemical analysis is presented in other papers of the special issue.

### Minor Points:

P 6711, I 1: The Dibb et al. (2010) paper can hardly have been the motivation for the measurement campaign – it actually reports on results from this campaign.

P 6715, I5: accompanied with => accompanied by

P 6715, I7: varied approximately a factor => varied approximately by a factor

P6723, I15: surface => surfaces

Fig. 4 and 8: Circles are not visible on standard printout. As far as I can see, they are not coloured but grey shaded. Please try to improve on the clarity of this display

Fig. 5: remove black line connecting measurement points

Fig. 7: Add the year used (2008) to the caption

Fig. 8: What is the difference between panels A and B?

Fig. 9: Remove black line connecting measurements.

Fig. 9: What are the black line and the green points in the third panel of this figure?

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 6707, 2011.

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