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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Meteorological controls on the vertical distribution of bromine monoxide in the lower troposphere" *by* P. K. Peterson et al.

Anonymous Referee #2

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This paper describes an approach to retrieve the vertical columns (200 meters, 2 km) of BrO at Barrow Alaska during BROMEX. The paper focuses on the vertical destruction of BrO in the polar troposphere during spring, an important topic, which is clearly appropriate for ACP. I concur with the first reviewer's comments and agree that the paper should be accepted after addressing the following additional comments:

1. The paper focuses on two possible meteorological controls for BrO vertical distributions: wind speed and temperature. Analysis of temperature (stability) and wind speed is not sufficient considering the particularities of the Barrow research site where air that arrives can be influenced different histories (originated from snow, ice, the city of Barrow, etc). As pointed out by the first reviewer, the issues of airmass origin must also be considered in this analysis. For example, what is the influence of wind direction on

BrO VCD,200m and BrO VCD,LT?

2. It is concerning that in Figure 6 all of the area in gray is excluded from the correlation presented in Figure 7. Is there a known reason for the horizental gradient in BrO during this period? A more in depth analysis (including airmass history) may provide insight onto these differences, which should be discussed in the paper.

3. Figures 10 and 11 show the BrO VCD 200m as a function of temperature (Figure 10) and wind speed (Figure 11). However, other controlling factors (e.g. available sunlight and ozone mixing ratios) have not been considered as possible driving factors controlling BrO VCD,200m and VCD,LT. Although the influence of ozone has somewhat been taken into account by excluding very low ozone airmasses, it does not seem a fair comparison to consider all measurements together, without considering also cloud cover and/or time of day in order to consider the amount of available sunlight in these correlations.

4. In Figure 12, the authors show that BrO in the lowest 200m peaks at the beginning and end of the day. What does it mean that BrO peaks when there is no longer enough available sunlight to make MAX-DOAS measurements? Does it mean, that there is still enough available sunlight to drive Br2 <-> BrO photochemistry, but not enough to measure? Is this a real feature?

5. It is interesting that the VCD,LT-VCD peaks at a different time of day than the BrO VCD,200m. This may have to do with the combination of available sunlight and mixing processes. Has the balloon sounding data been used to look at the temperature profiles above 200 m in order to investigate the amount of vertical transport occurring at mid-day? Is the peak in the lowest 2 km from a surface source of reactive bromine, or is it from bromine already in the free troposphere? Airmass histories (FLEXPART or HYSPLIT) and additional balloon sounding data are needed to suggest the origins of the measured BrO within the VCD,LT.

6. These type of diurnal profiles in BrO (peak in the morning and afternoon) along

with a dip at mid-day have been observed already at Summit (See Figure 6 of Stutz et al., 2011). This was used in part to suggest a small snow source of reactive bromine even far from the coast. The authors should discuss if the same type of diurnal profile in their VCD,200m (albeit at a different site and time of year) is similar evidence for a snow source of bromine.

7. The conclusions section of the paper should be expanded to include a better perspective on what this paper adds to our understanding of bromine sources and chemistry. In comparison to the paper, the conclusion is much too brief and should include a better synthesis of the science results and their context.

8. The title of the paper should be changed to "Temperature and wind speed controls" unless further analysis of the meterology during the campaign is presented in the paper.

9. The statements about using bromine source parameterizations based on wind speed in 3D models are currently not totally supported by the data presented in the paper. Specifically - I object to the text which states, "BrO may show an apparent relationship to wind speed" on Page 23969. The authors have not done enough analysis to determine how bromine gets out of the boundary layer into the free troposphere, where it is likely to be detectible by satellites, which may very well correlated with wind speed. The authors should be more careful in their wording, because this may not be just an apparent, but an actual correlation of BrO in the free troposphere with surface wind speeds. Although, wind speed may not represent the first step in the bromine release process.

References

Stutz, J., et al.: Longpath DOAS observations of surface BrO at Summit, Greenland, Atmos. Chem. Phys., 11, 9899-9910, doi:10.5194/acp-11-9899-2011, 2011.

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