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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Reactive bromine in the low troposphere of Antarctica. Estimations at two research sites" *by* Cristina Prados-Roman et al.

Anonymous Referee #2

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General Comments

This manuscript gives an overview of the retrieval of BrO vertical profiles and column densities from ground-based MAX-DOAS measurements at 2 locations on the Antarctic coast. They examine the impacts of meteorology, aerosols, and ozone on the observed BrO, as well as doing some simple modeling to determine ozone lifetimes due to BrO_x at each site. They find differences in BrO between the two sites and suggest these differences could be linked to differing sea ice condions between the two sites. They also find that BrO enhancements occur under low wind speed conditions and that blowing snow is not needed for substantial enhancements, but rather that surface emissions and vertical mixing can be responsible for the observed enhancements. This work is

well presented, within the scope of ACP, and merits publication after addressing some minor issues with the MAX-DOAS interpretation and analysis that I discuss below.

Specific Comments

MAX-DOAS analysis

The authors claim that BrO is not present in significant amounts above 2 km based on their ground-based measurements, where they retrieve BrO vertical profiles from 0-6 km. I am skeptical that ground-based MAX-DOAS measurements can be used to make this claim. For what it is worth, I am skeptical that the prior studies cited could actually observe BrO at those altitudes as well. The information content outside of the lowest elevation angle measurements simply isn't high enough. The authors should present averaging kernels showing that the measurements are sensitive to changes in BrO above 2 km if they are going to make this claim. I also think the presented vertical profiles should also be limited to 2 km unless the averaging kernels show that a higher altitude is merited.

Sea ice conditions between the two sites

I think the author's points about needing to examine the sea ice conditions at both sites and the heterogeneity being potentially linked to sea ice differences is a good one. However, I think simply describing the sea ice around Marambio as seasonal without providing further detail is potentially misleading, as the ice toward the outside edge of the sea ice in the Antarctic is often the oldest sea ice (excluding the "permanently" sea iced sections surrounding Belgrano) (Nghiem et al., 2016). This older sea ice is likely lower salinity than the newer sea ice regions closer to the coast. These differences

may impact the overlying snowpack, which is the likely source of the reactive bromine. Of course the proximity of this older ice to open water may also lead to enhanced snow salinity due to sea spray aerosol deposition (e.g. May et al., 2016). In any case, I'd like to see the authors add a more detailed discussion of the sea ice conditions at the two sites.

Page 1, Line 41

This sentence should have references for these impacts of atmospheric halogens.

Page 5, Line 32

What percentage of the retrievals has a DOF larger than 1?

Page 5, Line 40

A summary of the degrees of freedom for the BrO retrievals should be presented here as well.

Page 6, Line 39

Can you state the differences in AOD between the two sites more quantitatively?

Page 7, line 11

0.8×10^{13} molec cm^{-2} isn't a range as presented. Please clarify, is this a standard deviation?

Suggested Figure Modifications

1. Figures 3,4: I don't really think it is necessary to shade regions without data. It gives the figure a cluttered look.
2. I think just showing Fig. 6 is sufficient, and the timeseries of wind speed (Fig. 5) isn't really needed.
3. Fig. 7: Consider plotting both ozone series on the same panel so one can clearly see the differences between the two sites.
4. Fig. 8,9,10: As I suggest above, the portion above 2 km should be cut unless you can demonstrate that your retrieval is sensitive to the true atmospheric state at higher altitudes.

References

May, N. W., Quinn, P. K., McNamara, S. M., and Pratt, K. A.: Multiyear study of the dependence of sea salt aerosol on wind speed and sea ice conditions in the coastal Arctic, Journal of Geophysical Research: Atmospheres, 121, 9208–9219, doi:10.1002/2016JD025273, http://doi.wiley.com/10.1002/2016JD025273, 2016.

Nghiem, S. V., Rigor, I. G., Clemente-Colón, P., Neumann, G., and Li, P. P.: Geophysical constraints on the Antarctic sea ice cover, Remote Sensing of Environment, 181, 281–292, doi:10.1016/j.rse.2016.04.005, http://www.sciencedirect.com/science/article/pii/S0034425716301481, 2016.

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