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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Diurnal variations of $BrONO_2$ observed by MIPAS-B at mid-latitudes and in the Arctic" *by* Gerald Wetzel et al.

Anonymous Referee #1

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General comments:

This paper discuss temporal variations of $BrONO_2$, the nighttime main reservoir of Bry, in the polar and mid-latitude stratospheres. They clearly showed different behaviors of $BrONO_2$ in nighttime: the amounts of $BrONO_2$ revealed more than 20 pptv in the absence of PSCs and less than 14 pptv in the presence of PSCs. These values were well reproduced by CTM for which the averaging kernel matrix of MIPAS-B was applied. Thus, temporal behaviors of $BrONO_2$ during sunset/sunrise are thought to be understood by conventional chemical reactions involving radicals such as ClOx etc. With this knowledge, they estimated the amount of Bry to be 21-25 pptv in the lower stratosphere. I would suggest that this paper should be published in ACP; however, some messages to the reader would be desired or clarified before the acceptance of

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Discussion paper

this manuscript.

1. Which is better for estimating Bry: daytime BrO or nighttime $BrONO_2$?

I would suggest to add some discussion about the estimate of Bry. If we select a condition where no heterogeneous reactions occur, is the measurement of $BrONO_2$ in nighttime a better way? The authors state comparison with previous studies in "Conclusion" without any discussion about it in "Results and discussion". Thus, I suggest to add a subsection, e.g., "Comparison with other studies", then discuss about studies on BrO measurements, the estimation of Bry, and the advantage of $BrONO_2$ in the estimation, if so.

2. Are heterogeneous reactions on sulfate not important for the destruction of $BrONO_2$ in nighttime under volcanically quiescent periods and temperatures observed?

Under conditions where no PSCs were evident in the Arctic March and the mid-latitude September, significant enhancements of $BrONO_2$ up to 21-22 pptv were measured by MIPAS-B. This may suggest that any heterogeneous reactions (or hydrolysis) of $BrONO_2$ on sulfate is not important, at least, under such a low aerosol surface area density and temperatures.

Minor points:

1. page 5, line 130: What is instrumental offset? The authors mention that continuum could be separated from individual spectral lines.

2. page 6, Figure 6: What is a cause of difference in peak altitudes? Namely, 24 km in nighttime and 22 km in daytime. This feature is also seen from the model result, so that the authors can provide some explanation for that. In connection with this, additional figures from model computations are useful, if the authors provide figures showing difference in the partitioning of Bry species at day and night with and without PSCs. Then, add some discussion on that.

3. page 7, line 209: is it right for this calculation, because the model grid ($x - x_a^*$) is

larger than that of MIPAS-B (x_a)?

4. page 9, line 274: The authors state "starts earlier". What is the difference in time? I suggest to write: e.g., "The $BrONO_2$ increase stats at XXXXUT in the measurement, whereas the model $BrONO_2$ increase starts at YYYYUT."

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