Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-419-RC2, 2017

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 #2

Received and published: 31 August 2017

The paper of Wetzel et al. presents the first stratospheric measurements of BrONO2 at mid- and polar latitudes under twilight conditions. These measurements were carried out using the balloon-borne MIPAS-B instrument launched from Kiruna (68°N, Sweden) in January 2010 and March 2011, and from Timmins (49°N, Canada) in September 2014. Observed BrONO2 vertical profile temporal variations are compared to multi-year simulations performed by the EMAC CTM and the latter is found to capture well the 14 and 20 pptv of BrONO2 measured in the 22-25 km altitude range in the presence and absence of PSCs, respectively. Total inorganic bromine (Bry) amount is then derived by combining MIPAS-B BrONO2 concentrations with modelled BrONO2/Bry ratios. The estimated Bry values are about 21-25 pptv in the lower stratosphere, i.e. at the upper limit of the already published estimates calculated from BrO DOAS observa-

tions.

The manuscript is well written and clearly structured. I recommend its publication in ACP after addressing the following comments:

General comments:

1/The comparisons between measured and modelled BrONO2 mixing ratios are discussed in a too qualitative way and therefore it is very difficult for the reader to have a quantitative view about the level of agreement (or discrepancy) between MIPAS-B and EMAC. To improve this, I suggest to add in the manuscript 2D colorplots of EMAC minus MIPAS-B BrONO2 VMR relative differences for the three balloon flights and for both smoothed and unsmoothed model profiles. Those plots would also help to better characterize and discuss the impact of the smoothing of model profiles by MIPAS-B averaging kernels on the comparison results (see e.g. page 9, lines 255-261).

2/As Anonymous Referee #1, I strongly recommend to discuss the pros and cons of using nighttime BrONO2 for estimating Bry, instead of daytime BrO.

Specific comments:

1/Page 6, lines 169-171: The authors should briefly described here how the vertical resolution of the MIPAS-B BrONO2 observations is estimated (FWHM of the averaging kernel matrix). I think that showing typical averaging kernels could be also useful to see in which altitude range the maximum sensitivity of the MIPAS-B BrONO2 measurements is located.

2/Page 8, lines 223-227: It is stated that the sensitivity study of Kreycy et al. (2013) about the BrONO2 photolysis rate is not relevant here because it was conducted for mid-latitude conditions. If this is true for the two Kiruna flights, this is not the case for the third flight, which was launched from Timmins (49°N, Canada), i.e. at mid-latitude. For the latter, I would suggest to also perform model simulations using the Keycy et al. BrONO2 photolysis rate and see how it impacts (1) the MIPAS-B versus model

comparison, and (2) the Bry estimate.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2017-419, 2017.