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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Bromine in the tropical troposphere and stratosphere as derived from balloon-borne BrO observations" *by* M. Dorf et al.

M. Dorf et al.

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Author comment on review comment #1 for manuscript acpd-2008-0290

We are grateful to the referee's overall positive comments and suggestions. Please find below our point-to-point reactions in italic.

General comments:
The measurements of the organic source gases by Laube et al. were performed 10 days earlier than the BrO measurement described here. As the chemical lifetime of most of the relevant VSLS is only a few days and deep convective transport is

typically very sporadic in nature, I don8217;t think these two measurements should be called "quasi- simultaneous" (e.g., p.13006). Is there any evidence for a change in meteorological conditions, e.g., intensity and frequency of deep convection, between the two balloon flights, that could explain any differences in Bry?

We agree that the intensity and frequency of deep convective events, which were not investigated, play a major role and might strongly influence the Br_y *derived from SG measurements. Many more observations are needed to capture the potential variability of the VSLS and PG injection. One has to keep in mind that the PG injection derived from the BrO and SG measurements holds only true for a 'locally balanced' bromine budget. With currently available measurements, that is the best estimate we can do at the moment. That's why we state on page 13004, line 26 to page 13005, line 3, that '...Stronger convection in combination with areas of stronger VSLS sources on the ground, could lead to higher* Br_y*. Furthermore, the whole-air-sampler VSLS concentrations represent a local budget for the probed area and time in the tropical tropopause layer. In contrast,* Br_y^{in} *is based on measurements of 4.5 year old air in the longitudinally well mixed middle stratosphere and might comprise a different VSLS contribution.'*
On page 13006, line 13 and page 13001, line 1 'quasi-simultaneous' was replaced by 'temporally close'
Page 13001, line 1 changed as follows: 'The temporally close observations of the major PG (BrO) and SGs Laube et al., (2008) at the same location attempt to overcome these limitations of past studies.'

Could you be more specific in the discussion of potential reasons for the discrepancy on page 13004? How much of the differences could be attributed to differences in the SG calibration scales?
It is hard to give absolute numbers here. Laube et al. (2008) state that: 'their observations and calculations are mainly based on the NOAA calibration scale and

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that, e.g., the other large global monitoring network AGAGE found 0.72 ppt higher bromine from H1211 and H1301 in 2004, probably reflecting differences in absolute calibration scales.'
Different inter-calibration studies are currently ongoing and have to be done for all species, to resolve this issue, especially for the VSLS.
The word 'absolute' has been added on page 13004, line 25 - '...the SG absolute calibration scales...'

An important finding of this paper is the observation of very low amounts of BrO in the tropical troposphere. It is stated that observed BrO is below detection limit. It would be good to give a bit more information here on the precise value and nature of the detection limit.
Due to the nature of the observations it is difficult to give a precise standard value for the whole troposphere, e.g. for lower altitudes the optical density of BrO is larger in the DOAS retrieval, but less measurements contribute to a profile point. Strong winds can cause larger oscillations of the balloon gondola, making the sun-tracking less precise and in turn having an influence on the DOAS retrieval. The choice of the altitude grid and other factors in the profile inversion etc. - All these factors would make it necessary to give a different detection limit for each altitude (see error bars in Figure 1).
On page 13002, line 23 we changed the sentence as follows: '...concentrations are compatible with zero within the uncertainties (around 1 ppt, depending on altitude – see Fig.1).'

Specific comments:
p.13001/2 comment: in the tropical tropopause region the concentration of O_3 probably plays a more important role for the bromine partitioning than NO_2.

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Yes - you are right. That's why we also scaled O_3 to our observations in the model comparison.

p.13002, l.24: what precisely do you mean with "suggesting that reactive bromine is small there"? Couldn8217;t it be that under low O_3 conditions atomic Br concentrations are even larger than BrO concentrations?

We agree with your comment. Under low O_3 conditions Br concentrations in the UT can even be higher than BrO, see e.g., Salawitch, R. J. and Wennberg, P. O., Biogenic bromine and atmospheric chemistry, AGU Fall Meeting, 2006. Unfortunately, to our knowledge, these results have not been published in a peer-review journal yet, since they could strengthen our suggestion of a significant PG injection.
We removed '...suggesting that reactive bromine is small there'.

Technical comments:
p. 13006, l.10: Remove "In order to explain our observations"
done

p.13009, l.6: The title of the Laube et al. paper is "Contribution of very short-lived organic substances to stratospheric chlorine and bromine in the tropics - a case study". M. Dorf and K. Pfeilsticker should be removed from the author list and K. Grunow need to be included.
changed

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