

Interactive comment on “New Aura Microwave Limb Sounder observations of BrO and implications for Br_y” by L. Millán et al.

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We thank the reviewer #4 for his thoughtful comments and suggestions that have helped to improve the paper. In addition to enacting changes he suggested, as detailed below, we have also made some additions and updates to the paper to improve clarity and underscore areas where our product represents a significant improvement on earlier versions.

In the course of making our modifications, we recognized that the averaging kernel plot (figure 3) was incorrect in the submitted draft. The earlier version indicated the new product had more sensitivity to the lower stratosphere than is in fact the case. In the light of this we have revised our estimate of the valid vertical range of the product to 10–4.6 hPa. We note that our estimate of total Br_y is unaffected by this update.

C623

However, the vertical range over which the new MLS observations usefully overlap with the other sensors is narrower, restricting the range of interest for the analysis shown in the comparison with other datasets.

Reviewer comments:

The paper reports about MLS satellite measurements and a new inversion algorithm for the retrieval of BrO down to lower altitudes compared to previous versions.

Unfortunately not true anymore, but we are terribly sad for this, but the data is the data and there is nothing we can do about it, although we really try.

Although the paper is well written, I recommend publication only after some major revisions.

Like indicated in the title already, the paper wants too much at the same time, i.e. good observations of BrO and a reliable estimate of Br_y. As I understand, AMT is meant for the first task, i.e. the more technical part of a robust BrO retrieval. Here the paper lacks a proper validation of the BrO observations. All comparisons with models and other satellite observations are qualitative only. Some of these shortcomings are even mentioned by the authors themselves, e.g. on page 334, line 17 ff, or page 336, line 14. A reliable and quantitative validation is necessary though, in order to convince the readers of the robustness of the MLS BrO observations.

To make the comparisons less qualitative a tabulated photochemical model was used to map a balloon, SCIAMACHY and OSIRIS datasets to the MLS local time. The section 5.1 of the new version of the paper will explained the details.

The second topic of the paper, i.e. the estimate of total Br_y and therefore the contribution of brominated VSLS to total stratospheric Br_y, is handled vaguely too. The error of plus minus 4.5 ppt for the VSLS contribution seems to be underestimated. Most of the errors sources are mentioned in the text, but not handled adequately - see e.g. page 335, line 17 ff.

C624

All the errors were discussed further and included in the new estimate.

I want to encourage the authors to revise the manuscript. So far, the scientific community mainly relies on estimates of B_{ry} from BrO based on the DOAS (Differential Optical Absorption Spectroscopy) technique - see e.g. WMO 2011, table 1.14 - therefore an independent method is highly appreciated.

Specific comments: Page 326, line 13: What year does this result of total B_{ry} refer to.

For the year 2005 (mention in the new draft)

Page 326, line 21: 'The fact that bromine depletes stratospheric ozone 45 to 66 times more efficiently than ...' is this true throughout the stratosphere, or which part of the stratosphere are you referring to?.

It is true throughout the stratosphere.

Page 327, line 7: 'current estimates for the B_{ry} loading from VLS vary from 3 to 8 pptv WMO (World Meteorological Organization, 2010, Chapt. 1)'. The wording is a bit misleading, since individual estimates actually vary much larger than 3 to 8 ppt. Also it is not clear which method is referenced, i.e. the estimate of the VLS contribution to B_{ry} from BrO , or the estimate based on VLS source gas and product gas measurements/modelling - see e.g. page 1.3 in WMO 2011.

It was specified that this range is for B_{ryVLS} derived from stratospheric BrO measurements.

Page 327, line 17: Please define B_{ryVLS} .

Defined

Page 332, line 16: How would the use of the latest JPL recommendations change the SLIMCAT output? And why does SLIMCAT use JPL 2002, while WACCM uses JPL 2006 (page 333, line 3), i.e. how would the intercomparison between the two models change?.

C625

The only relevant reaction for BrO chemistry missing from the JPL2002 catalog is the one added ($\text{BrONO}_2 + \text{O} \rightarrow \text{BrO} + \text{NO}_3$). This reaction was added to the JPL2006 catalog, hence no difference is expected.

Page 335, line 7: From Figure 10 and the text, it is actually not clear to me how you end up with these errors, i.e. plusminus 4.5 ppt.

We particularly thanks this comment which pointed out to a mistake in the computation of the error, although when including all the sources of error it turned out to be roughly the same.

An estimate of the error can be computed as $\text{square_root}(2.5^2 + 2^2 + (18 \cdot 0.18)^2)$ where 2.5 and 2 corresponds to the random and systematic errors and where 18 is the estimated yearly BrO and 0.18 is the assumed kinetic error.

Technical comments: 1. Page 341 ff: Capitalise all captions in the Figures for unification. Like, Radiance in Fig.1, or Pressure in Fig.2

I did not find any AMT requirements for capitalizing the captions in the figures, and personally I like them better in lower case.

2. Page 337, line 1: The reference Bovensmann et al. (1999) is not used in the text.

Corrected

3. Page 337, line 26: The reference Lamarque et al. (2011) is not in alphabetical order.

Corrected

References: WMO (2011), Scientific assessment of ozone depletion: 2010, World Meteorological Organization Global Ozone Research and Monitoring Project, Report 52.

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C626