

## ***Interactive comment on “Global observations of tropospheric BrO columns using GOME-2 satellite data” by N. Theys et al.***

**Anonymous Referee #3**

Received and published: 26 January 2011

The manuscript gives a detailed description of a novel algorithm to improve the determination of tropospheric BrO column densities from UV - spectra recorded by nadir viewing satellite instruments. Some applications on GOME-2 data are presented and some interesting conclusions regarding polar BrO ?hot spots? and BrO in the free troposphere are drawn. The described algorithm builds on an earlier publication with the same first author (Theys et al. 2009), which describes a central part of the new algorithm, i.e. the global stratospheric-BrO climatology. Moreover, the new algorithm presented here appears to improve over a similar algorithm described in a very recent publication by Salawitch et al. 2010 in several points, for instance it uses NO<sub>2</sub> to correct for photochemical effects, employs a wider spectral range less susceptible to O<sub>3</sub> interference, and it gives a convincing error analysis of the derived tropospheric BrO columns.

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Overall, this appears to be a very important and thorough piece of work which should be of great interest to the scientific community. There are only few major questions that should be answered by the authors before the manuscript is ready for publication: (a) A central element of the algorithm is the correlation of BrO with the total O<sub>3</sub>-column. How does strong chemical loss of stratospheric O<sub>3</sub> (e.g. the ozone hole) affect the results? This question is not discussed in the manuscript despite its great importance for the precise determination of tropospheric BrO hot-spots, which tend to occur in nearly the same area and time as stratospheric O<sub>3</sub> loss (polar springtime). (b) Four of the authors of the present manuscript are also co-authors on Salawitch et al. 2010, however there are major differences in the approach, in particular the spectral range used for BrO evaluation in this manuscript is 332-359 nm while Salawitch et al. 2010 analyse much shorter wavelengths (320-347.5 nm), moreover in the work presented here a modified DOAs approach is used. What is the rationale for such a drastic change and how does it affect the results? (in fact it is hard to believe that the choice of the spectral range should not affect the resulting BrO columns and ? in particular ? possible interferences from O<sub>3</sub>). (c) A prominent result of Salawitch et al. 2010 is the possibility that short lived organic Br-species make a major contribution to BrO in the polar lower stratosphere, it would therefore be interesting to know whether the present study confirms this result.

There are a number of minor questions the authors might want to consider:

- 1) Page 28637, lines 20-24: This sentence appears to be incomplete, also the statement made here is not in contradiction to BrO being present in the free troposphere.
- 2) Page 28638, line 14: Perhaps the publication ?Hollwedel, J. et al. (2004), Year-to-year variations of spring time polar tropospheric BrO as seen by GOME, Adv. Space Res. 34, 804-808.? would be more easily accessible than Hollwedel 2005.
- 3) Page 28638, line 20: What is the meaning of ? ... a negligible impact of the tropospheric BrO content on the stratospheric correction ...?
- 4) Page 28639, lines 2-4: Does this mean that the limb-correction approach is only

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applicable to tropical latitudes (where the tropopause height exceeds 15km) ?

5) Page 28642, lines 9-11: What are the implications of this statement for the retrieval used in Salawich et al. 2010?

6) Page 28642, line 26: Give literature reference describing BASCODE.

7) Page 28643, lines 1-3: Give literature references supporting this statement.

8) Page 28643, line 7: Give details how is the strat. BrO profile ?calculated??

9) Page 28643, line 19: 1 PVU equals 10-6 m2 s?1K kg?1.

10) Page 28643, line 24: How large is the ?small effect??

11) Page 28644, line 1: ?ensure consistency? with what?

12) Page 28646, line 7: Give definition (formula) of capital Phi.

13) Page 28648, line 5: ?This pragmatic choice ...? of what?

14) Page 28648, lines 6-9: What is the source of the surface albedo?

15) Page 28649, line 16: Does ?adding in quadrature? refer to sum of squares?

16) Section 4: What is actually gained by the comparison with SCIAMACHY results?

17) Page 28650, Lines 1-29: this section appears to belong into the experimental section (section 2).

18) Page 28652, line 11: Is there snow in Lauder in winter (August)?

19) Page 28652, lines 23-25: Is the derived tropospheric BrO column (ca. 1.5E13 cm-2) actually a significant result in view of the (1 sigma!) error amounting to (0.8-1.5)E13 cm-2?

20) Page 28653, lines 14-15: Could the sea ice effect be an effect of different albedo between ice and water?

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21) Comment of figures: Generally the print on the axes and in particular on the colour scales (Figs 8, 9, 10, 13) is too small and therefore very hard to read. In Fig. 12 (lower panel) the label covers part of the curves.

In summary I recommend publication after minor revisions.

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Interactive comment on Atmos. Chem. Phys. Discuss., 10, 28635, 2010.

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