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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A global stratospheric bromine monoxide climatology based on the BASCOE chemical transport model" *by* N. Theys et al.

Anonymous Referee #2

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Review of 'A global stratospheric bromine monoxide climatology based on the BASCOE chemical transport model' by Theys et al. submitted to ACP.

This paper presents a new approach to design a global climatology of stratospheric BrO specifically intended for the retrieval of tropospheric BrO columns from satellite nadir instruments but will also be available for other applications. The parameterization used for this climatology is evaluated in the manuscript based on 3 years of output from the BASCOE chemical transport model. The dynamics impacting on the stratospheric BrO distribution is accounted for by a parameterization based on ozone columns, the effect of photochemistry on stratospheric BrO is determined by using NO2 columns

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and the SZA. Both ozone and NO2 outputs from BASCOE used to build the BrO climatology have been extensively validated within this paper as well as in other previous publications and the authors found that the important changes in stratospheric ozone and NO2 are consistently reproduced by the model (except for SH ozone hole conditions). They conclude that the overall uncertainty on stratospheric BrO is lower than 30%.

General comments:

1) I find the research described in this publication to be of great interest but it leaves me rather confused re the actual purpose of this publication: The authors go through quite some trouble to show that BASCOE can model observed BrO well (section 3.2, also: abstract: 'the model simulations have been optimized for bromine chemistry and budget') but then they don't use the actual BASCOE BrO output to build up the climatology. Instead they build the climatology based on ozone and NO2 output - this is very well motivated and convincing as a method but why not use straight the BrO output from BASCOE - would that not make more sense? This really also begs the questions how would this 'straight out of the model' BrO climatology compare to the BrO that is 'built' based on NO2 and ozone? If the actual climatology is the important message here, then why not use the BASCOE BrO fields straight? Or is a simplified parameterization based on ozone and NO2 the main message which can also be used if no straight BrO output would be available but then the validation of BASCOE BrO is a little confusing (good to see though that it works ok). I think it really would be important to get this message straightened out - or please do tell me what I am missing here, I am having a bit of a head cold at the moment, so hope that this is not impacting on my understanding.

2) No doubt such a global stratospheric BrO climatology is a very useful tool but it certainly has to be applied with a lot of care specially when used to retrieve tropospheric BrO from satellite observations. The authors discuss briefly e.g. in section 4.1 that 'misrepresentation of important patterns of stratospheric BrO will lead to artefacts on

ACPD

8, S9414–S9416, 2008

the retrieved tropospheric BrO columns'. So, although this will be quite a powerful method I strongly believe that a thorough validation of the resulting tropospheric BrO columns by either balloon observations, ground-based retrievals or in-situ observations will be a very important reality check.

3) Given that the overall uncertainty in this BrO climatology could be as large as 30%, will this be of sufficient quality so that the climatology can be used for its main design purpose, i.e. to pull out tropospheric BrO from satellite columns? I do understand that this will be discussed in detail in a future paper (as stated in the conclusions) but since this is also the main motivation for this paper, it would be helpful if the authors could elaborate on this a little.

4) Another minor comment: Under section 3.2.1 the authors provide some background on the BrO measurements used for the comparison. Stratospheric BrO profiles retrieved at 80 SZA are used to compare with the model e.g. in Fig 4. That is all looking good but they then say that the BrO profiles can be converted to any SZA by using a photochemical model. Certainly also true, but that then would not work anymore as a measurement to model (BASCOE) comparison but a photochemical box model to BASCOE comparison, right? Do I understand this right that there is only one independent value, e.g. for 80 SZA retrieved from the observations? I just felt it could potentially sound a bit misleading as is in the text.

Specific comments:

Page 17593: Hendrick et al., 2008b paper cited only under preparation, might have to be removed if not submitted in time.

Figure 8: Suggest to swap the 2 top plots so the 30-40N is displayed above the 30-40S plot (or swap the 2 bottom plots).

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 17581, 2008.