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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Sensitivity of stratospheric Br_y to uncertainties in very short lived substance emissions and atmospheric transport" *by* R. Schofield et al.

R. Schofield et al.

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We thank the reviewer for improving our manuscript with their careful and insightful review. We highlight the original review text in bold and provide our response as normal text below.

This study uses a simple conceptual model to investigate the sensitivity to key parameters controlling the contribution of very short lived substances (VSLS) to stratospheric bromine loading. This is an interesting new approach compared to previous studies and provides important contributions to the ongoing discussion in this field. Overall the paper is well written and I recommend publication

in ACP after a few, mostly minor, changes.

General Comments

While I really like the approach used here, I feel that some of the assumptions made need to be better motivated, discussed and a bit more detail should be given. Table 2 with the VSLS scenarios is really useful, but I am slightly uneasy with it as there is the risk that future studies may refer to it, without fully recognizing its limitations. Therefore I suggest to give a bit more information how these numbers were extracted from the references given (Yokouchi et al. and Kerkweg et al.) and to discuss in a bit more detail the uncertainties in these estimates. E.g. Carpenter et al. (2009) give quite different values, possibly indicating that there is a larger uncertainty in these numbers than the difference between Scenario 1 and 2 suggests.

Thank you for this suggestion we include now specific details of how the numbers in table 2 are derived from the original literature as footnotes to table 2. We also include a cautionary note including the Carpenter et al. reference as an alternative scenario.

A critical value for the CPT washout is the fraction of soluble versus insoluble bromine gases. Here a reference to the modeling study of Yang et al. (2005) is given, stating that 85% of inorganic bromine in the TTL is in the form of HBr and HOBr. However, I couldn't find this result for the TTL in the Yang et al. paper (maybe I just overlooked it)

We derived this from figure 4 of Yang et al.

but I remember having seen other model results that showed much less HBr and HOBr in the TTL. (However, unfortunately I can't find any published figures right now.)

We would be interested in these studies if you can refer us to them (via the editor for example).

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While this is not really critical in the current study as any uncertainty here can be lumped into the washout efficiency gamma, one should clearly avoid giving numbers that future studies may use in a wrong context.

Indeed, however we believe that the Yang et al. study figures do support 85% partitioning of soluble Br_y.

Specific Comments

p.24177,l.4: please be specific if you mean detrainment rate or divergence. Both may have the same units, but they are not the same.

This has been clarified, we now include an explicit definition for the detrainment rate in the paper.

p.24179, Sect. 2.4: I'm having problems with the "concentration weighted lifetime". It is not obvious to me that such a step is equivalent to calculating the evolution of the individual gases.

This is of course an assumption and not equivalent to calculating the evolution of the individual gases. But it provides a computationally fast method that corrects for the younger speciation that the convective outflow supplies.

p.24179,l.24: "CH_3Br is usually treated as a long lived species within chemistry-climate and transport models": What does that mean? Isn't CH_3Br explicitly modeled in such models?

We modify this statement – we were referring to models that simply introduce CH_3Br to the stratosphere (or have too rapid TTL transport), and thereby do not adequately account for loss of this species to soluble product gases in the TTL that then undergo washout.

p.24180,l.16: Hossaini et al. show that the difference in lifetime for CH_2Br_2 is huge between the mid-troposphere and the TTL! How would the much longer

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lifetimes in the TTL affect the conclusions of the current study?

We expect that the results will be similar to what we see when we use the Kerkweg emission scenario which introduces more very long-lived CH_3Br – that produces a narrower distribution at 400K. Determining the spatial variation of OH fields in the TTL will be vital in answering this question of TTL lifetime comprehensively.

p.24185, l.25: "Changing the BL to outflow convection efficiency": This is an awkward phrase.

This has been altered.

p.24194, Table 2: Are the numbers given ppt of CH_2Br_2 and $CHBr_3$ or ppt of bromine?

These are in ppt of CH_2Br_2 and $CHBr_3$.

I.e., are these numbers already multiplied by the number of bromine atoms?

No. To avoid this confusion and following the request made by Referee 4 a line is included showing Br_y total values.

Technical Corrections

p.24173,l.2: "i.e." -> "e.g."

This has been changed.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 24171, 2010.