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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of very short-lived halogens on stratospheric ozone abundance and UV radiation in a geo-engineered atmosphere" *by* S. Tilmes et al.

Anonymous Referee #2

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General Comments

This paper presents results from a chemistry climate model (CCM) study examining the impact of bromine and chlorine-containing very short-lived substances (VSLS) on stratospheric ozone (O_3), in a future geo-engineered atmosphere. The authors use the WACCM CCM and artificially increase stratospheric inorganic bromine (Br_y) with an assumed contribution from VSLS (Br_y^{VSLS}) of 0 ppt, 6 ppt and up to 10 ppt, in a sulphur injected geo-engineered atmosphere. Similarly, assumptions are made regarding the contribution to stratospheric inorganic chlorine from VSLS (Cl_y^{VSLS}) . In my view, a stratospheric Br_y^{VSLS} contribution of 10 ppt is somewhat large

and I wonder what WACCM would show if VSLS were treated explicitly (i.e. VSLS emissions, tropospheric degradation etc.). Nevertheless, explicit VSLS treatment is not required here and the authors justify their experiment design well in the main text and also the supplement. The paper is a nice addition to current literature and contains some novel results. The conclusions of this paper reinforce the notion that VSLS halogen sources need to be considered in CCMs for stratospheric O_3 and also geo-engineering studies. I recommend publication in ACP but ask the authors to consider the mostly minor comments below.

Specific Comments

The introduction is lacking adequate background on VSLS. Given they are clearly central to the focus of the paper, I would expect more than just the citation to WMO (2003) on page 21926 (line 14). In fact, a citation to the most recent WMO assessment is probably more appropriate in order to be up-to-date on VSLS literature. At the very least it should be mentioned that bromine-containing VSLS, such as bromoform ($CHBr_3$) and dibromomethane (CH_2Br_2), are predominately of natural biogenic/oceanic origin (e.g. Quack and Wallace, 2003). This is mentioned in the supplementary material but should also be included in the main text. What are the important chlorine-containing VSLS? Do they have a biogenic source also? A few more sentences should be included.

Page 21926 (line 15): Feng et al. (2007), using a 3-D model, also showed the impact of VSLS on stratospheric O_3 to be larger during periods of high aerosol loading. A reference to this study should also be included.

Page 21927 (line 1): The authors correctly note that halogen loading from VSLS will gain (relative) importance as the contribution from long-lived gases declines in coming years (under the terms of the Montreal Protocol). The authors should also

note here that the contribution from VSLS to stratospheric halogen loading may increase in absolute terms. The recent CCM study of Hossaini et al. (2012) shows enhanced $CHBr_3$ in the lower stratosphere, relative to present day, under future climate projections. A reference to this new work is relevant here and should be included.

Page 21927 (experimental design): WACCM is well known but a few more simple details of the runs would be appropriate here (e.g. resolution, vertical domain and levels).

Technical Comments

Page 21927 (line 16): Has UTLS been defined?

Page 21927 (line 25): Sulfur dioxide (SO_2).

Page 21927 (line 26): tropics, state latitude range.

Page 21944 (Figre 3 caption): First sentence is too long. Please split or include punctuation.

References

Feng, W., Chipperfield, M. P., Dorf, M., Pfeilsticker, K., and Ricaud, P. (2007), Mid-latitude ozone changes: studies with a 3-D CTM forced by ERA-40 analyses, Atmos. Chem. Phys., 7, 2357-2369, doi:10.5194/acp-7-2357-2007.

Hossaini, R., Chipperfield, M. P., Dhomse, S., Ordonez, C., Saiz-Lopez, A., Abraham, N. L., Archibald, A., Braesicke, P., Telford, P. J., Warwick, N. J., Yang, X., and Pyle, J. (2012), Modelling future changes to the stratospheric source gas injection

of biogenic bromocarbons, Geophys. Res. Lett., doi:10.1029/2012GL053401, in press.

Quack, B. and Wallace, D. W. R. (2003), Air-sea flux of bromoform: Controls, rates, and implications, Global Biogeochem. Cycles, 17(1), 1023, doi:10.1029/2002GB001890.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 21923, 2012.