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Discussions

Interactive comment on "Brominated VSLS and their influence on ozone under a changing climate" *by* Stefanie Falk et al.

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To acp-2017-34-RC1-supplement (31 March 2017): The authors thank the anonymous referee #2 for his constructive comments regarding our paper. We will answer his specific questions in detail in the following. Accordingly, we will provide comprehensive discussions and additional numbers in a revised version of the paper where further clarifications are needed.

- Specific comments:
  - Sensitivity of VSLS emissions wrt. water concentrations/wind/SST: No simulation study has been conducted in the regard of changing water concentrations of VSLS *and* a change in climate. Therefore no assessment can be

made. At present, global mean CH_2Br_2/$CHBr_3$ concentrations in ocean water are close to equilibrium with atmospheric concentrations which is causing a high sensitivity of ocean–atmosphere fluxes to changes in the atmosphere (Lennartz et al., 2015). There are different potential future scenarios. The current scenario could be interpreted as an increase in production in response to increased fluxes to compensate a detrainment. Increased fluxes and decreasing production at the same time may lead to decreasing concentrations and in turn decreasing fluxes. Regarding a dependency of VSLS fluxes wrt. SSTs and wind, our data show a strong correlation between VSLS fluxes and former ($\Phi_{VSLS}(SST) \propto SST$), but a much weaker (or even anti-) correlation to latter.
  - Emission perturbation's influence on ozone: Unfortunately, our long-term simulations do not allow for an assessment of ozone changes induced through VSLS emission perturbations. SC_free does not include interactive ozone chemistry, whereas RC2-base-05 incorporates prescribed fluxes based on scenario five by Warwick et al. (2006).
  - Chlorine moderation of bromine influence on ozone: Future projections of stratospheric chlorine loading are shown, e.g., in IPCC - Intergovernmental Panel on Climate Change (2013, Chap. 12) or Global Ozone Research and Monitoring Project (2014, Chap.2). Stratospheric Cl_y peaks in 2000. Assuming an adherence to the Montreal protocol, stratospheric volume mixing ratios of Cl_y will decay exponentially in the course of the 21st century. From Global Ozone Research and Monitoring Project (2014, Chap.2, Fig. 2–21), a decrease of Cl_y loading at 1 hPa of about 2 ppbv between 2000 and 2080 can be deduced. We will provide numbers of peak and end of 21st century values for the Cl_y load in the stratosphere in accordance to our simulations. We acknowledge, the combined effect of chlorine and bromine is not negligible. However, it can not be assessed with our simulations. RC2-base-05 is not accompanied by a sensitivity study with no VSLS emission. RT1a/RT1b

have the same chlorine load and do not include present day. The moderation of differing chlorine loading on bromine influence on ozone has been studied in detail by Yang et al. (2014) and Sinnhuber and Meul (2015). Yang et al. (2014) show for two stratospheric Cl_y loadings (3 ppb, 0.8 ppb) corresponding to 2000 and 2100 values and differing VSLS contribution to stratospheric bromine loading, the more chlorine the stronger ozone is affected by increasing bromine mixing ratios from VSLS. Between the two Cl_y scenarios a ΔO_3 of about 0.5–0.6 ppmv (80° S) and 0.3–0.4 ppmv (80° N) has been found.

P1 L1: The sentence has been changed in accordance to the comment: *Very short-lived substances (VSLS) contribute as source gases [...]*

P2 L4: Accordingly, the acronym definition has been changed and moved to the proper sentence: *Minor brominated very short-lived substances (VSLS) include [...]. The tropospheric lifetime of these gases lies between several days to weeks.*

P2 L6–7: The definitions at this point have been removed since they are, indeed, redefined later on.

P5 L12–15: In accordance to the comments a specification of temperature and transfer velocities has been added: *The transfer velocity depends largely on temperature T_{air} and surface wind speed which is taken into account by distinguishing between water- and air-side transport velocities (k_w, k_{air}).*

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