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Atmospheric Chemistry and Physics Discussions

Interactive comment on "What do we learn on bromoform transport and chemistry in deep convection from fine scale modelling?" *by* V. Marécal et al.

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General comments

Referee#1 found the paper poorly written. The revised version has been improved in this respect since it was corrected by a native English speaker. The abstract has been significantly modified for improvements. The Appendix has been shortened for clarity. The main corrections of the paper appear in red in the revised version.

Specific comments

- Confidence in, and sensitivity to, the calculated Henry's constants The uncertainties

in the calculated Henry's constants for hydroperoxide, aldehyde and ketone bromine organic products have been evaluated by taking into account two types of uncertainties: 1. the maximum difference between the measured and calculated Henry's constants for species of the same family for which the Henry's constants have been determined experimentally and 2. the maximum uncertainty on the measurement of the Henry's constants. Using this approach, the estimation of the uncertainty for bromine aldehydes and ketones is 44%. For hydroperoxides it is 70%. This information is now given in section 2.2, page 9 of the revised version. Sensitivity tests of the impact of these uncertainties are presented in section 3.2.1, page 15.

- Confidence in the model OH field The mean OH profile at the location where the convective event develops has been compared to an OH climatology at the same latitude and season and to measurements made under similar atmospheric conditions. These comparisons have shown that our OH concentration is in fairly good agreement with these data. This is now discussed in section 3.1, page 13.

- On the use of 40 ppt for intitial bromoform mixing ratio The 40 pptv initial value used for bromoform is very large but realistic since it was measured in the Eastern Pacific. This is written in the revised version in section 2.3. Simulations assuming the mean measured value of 1.6 pptv proposed in WMO (2010) have been added to test the impact of the initial mixing ratio on the results. In the revised version there are now two background simulations (BG1 and BG2) and two simulations in which convection occurs (PERT1 and PERT2). BG1/PERT1 runs correspond to 40 pptv initial bromoform and BG2/PERT2 to 1.6 pptv. Results of the BG2 and PERT2 simulations are discussed in sections 3.1, pages 13-14 and 3.2.3, page 21, respectively. We found that BG2 results are the same as BG1 results in a ratio for all species mixing ratios equal to 1.6pptv/40pptv. Conclusions of the PERT2 simulation are different from PERT1. We show that the release of Br2 in the gas phase by aqueous reactions is less efficient in PERT2 than in PERT1. This is due to the intensity of the modelled bromine explosion phenonenom.

- Bry profiles and partitioning of Bry Horizontally averaged profiles of Bry and organic PGs are now shown in figure 12 at the end of the convective event and discussed in section 3.2.1, pages 16-17. We agree that a direct comparison with the results of Hossaini and Aschmann is not appropriate since their simulations are very different from ours. Nevertheless a discussion on the difference between PGs in the TTL computed by Hossaini and in our work is added in section 3.2.1, page 18. From their Figs. 7 and 9, it is possible to calculate that approximately 2% of bromine atoms are present as less soluble organic PGs (2*CBr2O+CHBrO) compared with atoms present as CHBr3 (3*CHBr3) at 100 hPa ($\sim$16 km) at tropical latitudes while we compute more than 13% in our simulations. In our study we compute organic PGs lifted above a convective system. The partition between the less soluble organic PGs and CHBr3 observed in the TTL is therefore mostly representative of the chemistry in the lower troposphere since the non soluble species are rapidly transported from the lower troposphere to the TTL. In the study by Hossaini et al. (2010), the partition between organic PGs and CHBr3 results not only from convective transport from the lower troposphere but also from the chemistry in the TTL. In this layer the OH concentration is lower than in the lower troposphere. CBr2O is therefore produced in a much lower amount in the TTL than in the lower troposphere. This leads to a shorter mean lifetime for all organic PGs in the TTL. Thus, the impact of the chemistry in the TTL is to reduce the ratio of bromine atoms present as organic PGs to those present as CHBr3. This is partly why our simulations, that only take into account the convective effect, give a higher ratio. It is also partly related to the fact that the results shown in Hossaini et al. (2010) in Fig. 9 are tropical annual and zonal mean profiles while our calculations are made for high sunlight conditions and therefore have higher modelled OH concentrations. It is not possible to make a similar comparison on ratios with Aschmann's results because there is no profile presented of PGs together with CHBr3.

All technical corrections have been taken into account.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 29561, 2011.