Review of "Cloud-scale modelling of the impact of deep convection on the fate of oceanic bromoform in the troposphere: a case study over the west coast of Borneo" by Hamer et al.

The paper describes a cloud-scale modeling study to investigate convective transport of bromoform ($CHBr_3$) and its product gases. The model is applied to a case study along the west coast of Borneo that was sampled with aircraft measurements, which provide a means to evaluate the model. The major findings are that there is good agreement of $CHBr_3$ mixing ratios between model and observations in the boundary layer and reasonable agreement in convective outflow regions. Analysis of the bromine speciation in convective outflow shows ~85% of the Br is from $CHBr_3$, < 10% from inorganic product gases (HBr, BrO, HOBr, Br, Br_2, $BrONO_2$), ~2% from organic product gases (brominated peroxides and carbonyls). The paper finds that the inorganic product gases are dominated by HBr, which is highly soluble and quickly removed by the convection. The paper suggests that the high HBr is a result of the low O_3 environment (O_3 < 20 ppbv) that favors production of HBr from Br + HCHO and Br + HO_2 over production of BrO from Br + O_3. Without BrO production, HOBr also has low mixing ratios. Further, aqueous phase reaction between HOBr and HBr is fast, further limiting HOBr within convection.

This study provides fundamental knowledge on the processing of Br compounds in tropical convection, which is important to apply to global models that examine pathways of Br compounds to the stratosphere where Br plays a critical role in ozone chemistry. The paper covers several topics without fully justifying why each topic is addressed. My main concern is that the main points are not concisely given (e.g. in the abstract or results section) but are written along with other points that cause a loss of clarity in the story. For example, why do we need to know the convective transport efficiency? Secondly, why is it important to know if $CHBr_3$, HBr, BrO, or organic Br is the bromine compound transported to the upper troposphere?

In addition, the discussion focuses on the regional chemistry that the convection forms in. The discussion makes sense but is not supported with figures showing rates of reactions.

Specific Science Comments

1. The abstract needs to be improved by making the existing text be more concise, stating more clearly that low O_3 levels lead to HBr gas-phase production, and adding comments on the role of aqueous chemistry.
2. Line 102 in Introduction. I do not think it was explained what the limitations are of the previous studies. There should be a few sentences clearly stating these limitations in the Introduction and again in the Discussion.
3. Line 153 states that the $CHBr_3$ measurements were performed by the GHOST instrument. Please add information on what the technique for these measurements is, as well as its detection limits and uncertainties.
4. Since the GHOST instrument is a GC/MS technique, are there other trace gases that it measured that are useful for this analysis, such as other Br-containing trace gases?

5. Line 223. I noticed that the chemistry listed in the supplement does not include Br-Cl reactions, e.g. Cl + $CHBr_3$ → HCl + CBr_3. What impact would Cl chemistry have on the results provided in this paper?
6. Does the model include direct uptake of Br compounds onto ice? It may not be important for the species considered (except $BrONO_2$; Fernandez et al., 2014, ACP), but I suggest mentioning this process.
7. Lines 245-249. Could you provide a little more information on the emissions? Do the emissions vary temporally? If not, what time-span is the average for?
8. Line 298. What is the vertical resolution of the model in the upper troposphere? Does the vertical resolution affect the cloud top height estimate? Since the results show a fairly good comparison, I guess not, but I suggest thinking about the uncertainties in the model cloud top height if dz > 500 m.
9. Line 328. Are there any temporal uncertainties to consider? I imagine the statistical approach removes effects of poor timing of the convection, but does it also reduce uncertainties in relation to timing of emissions (if there is a diurnal profile) or photochemistry?
10. Line 330. I first saw the equation given on line 333 in Cohan et al. (1999) JGR (please cite them). This equation assumes that there is no mixing of air at different altitudes between cloud base and cloud top, i.e. it is a two-component mixture model. During the past decades, others have used modified versions of this type of equation. For example, Borbon et al. (2012) JGR applied a three-component mixture model, while Yang et al. (2015) JGR applied a four-component mixture model, and Fried et al. (2016) JGR applied a 10-layer mixture to account for entrainment of air between cloud base and cloud top. The multi-layer approach is useful for conditions when the vertical profiles vary with altitude in the clear air. It would be good to see the clear-sky vertical profile for $CHBr_3$ to show its variability with altitude. Is $CHBr_3$ sufficiently close to zero or non-varying with altitude such that entrainment of air between cloud base and cloud top can be ignored?
11. Lins 388-395. Could you specify where the vertical cross section is located. Is it an average across the anvil, or a line down the center of the anvil?
12. Section 4.3.2. Figures 9 and 10 show values based on Br pptv and percent contribution to total Br. Somehow the text gets a bit confusing. Is it possible to organize the text a little differently, such as by region, which would better align with the Conclusions section. For example, In the UT convective outflow $CHBr_3$ contributes 85%, inorganic PGS < 10%, and organic PGs ~2% to total Br. In the boundary layer, $CHBr_3$ contributes ….. In the 1-4 km layer, $CHBr_3$ contributes …..
13. Line 488. It is suggested that reactions 2 and 3 could be important routes for HBr formation. Reaction 2 is Br + HCHO. Does HCHO come from CH_4 or are there VOCs, such as isoprene, contributing to its mixing ratio? What is the typical reactivity for reactions 1 to 3 for the study area? It would help to see reaction rate constants and typical O_3, HCHO, and HO_2 mixing ratios.
14. Line 505. Again, it would help to know the reaction rate constant and reactivity of reaction 7. Marecal et al. (2012) report 1.6×10^{10} M^{-1} s^{-1}, which is indeed high but is the rate high as well when compared to competing gas-phase reactions? It would be good to see figures of reaction rates supporting the discussion on what reactions dominate.

15. Line 521. It mentions the very short residence time due to falling hydrometeors. Can you calculate the residence time? I would suggest looking at Bela et al. (2018) JGR who discuss time an air parcel spends in contact with liquid water in convection (ranging from weak convection to severe convection). They also showed via vertical profiles that highly soluble trace gases (like H_2O_2) are depleted rapidly below the freezing level, whereas less soluble gases will be lofted higher.
16. Lines 524-557 discuss how the current results compare to those by Marecal et al. (2012). Could the authors make clear what are the differences between the model configuration by Marecal et al. and this paper? I found two comments on the differences, 1) running real meteorology (and thus global model generated initial conditions) and running ideal meteorology, and 2) running a case for Darwin versus Borneo where emissions, photolysis rates, OH mixing ratios can be different. Are there other differences? What about the information in the "new chemistry" section?
17. Line 542. For the discussion of differences due to Darwin and Borneo settings, the lifetime of $CHBr_3$ is discussed. These lifetimes are > 15 days. How do the changes in chemical lifetime affect the results of convective transport, which occurs in < 1 hour and is the topic of the paper?
18. Line 557. Isn't O_3 low in both Darwin and Borneo? I do not see why low O_3 would cause differences between the results from Marecal et al. and this paper.
19. Section 4. How do the results from this paper fit in the context of findings from the CONTRAST field campaign? I am not sure it is possible to have a thorough discussion, but noticed that Chen et al. (2016) JGR discuss convective transport (or not) of BrO and HOBr + Br_2.
20. Section 5. Can results from global model studies (e.g. from TOMCAT, or other CCMI models) help identify other tropical regions that should be studied?

Organization, Clarity, Technical Comments

1. Line 60, I suggest starting the sentence as, "Bromoform ($CHBr_3$), with 3 Br atoms …."
2. Line 589, Suggest: Fuhlbrugge et al. (2016) who showed that ….
3. Line 505, Could you make the negative ion sign more obvious. Perhaps via a symbol or equation editor.
4. I recommend that the Appendix be placed in the supplement.

Figures and Table

1. In Table 1, is the H_x for Br_2 correct? A positive value is given for a_H yet H_x is less than H_{298}.
2. Is the vertical cross section in Figure 8 in a different location than the other vertical cross sections?