We thank the reviewer for the thoughtful and useful comments. Our responses to the comments are provided below, with the reviewer's comments italicized.

I only have two substantive comments. Firstly, I would encourage the authors to include some discussion on the implications of their findings for stratospheric ozone depletion. This need only be citing previous works tying additional bromine to ozone loss (typically considered most important in the lower stratosphere I believe), I'm not suggesting additional calculations or model runs.

We have added a discussion on the implications of our finding for stratospheric ozone depletion as suggested (section 5). In addition, we would like to mention that a detailed analysis on how the enhanced Br_y from VSLS will impact stratospheric ozone depletion is currently in preparation. The results will be submitted to ACP in the near future.

Secondly, I was a little surprised to learn that this study showed little impact of convective scavenging on stratospheric BryVSLS (I guess I follow 'conventional wisdom'). A little more discussion of this point would, I feel, help make this clearer to the reader. Am I correct in presuming scavenging of the organic bromine species is negligible? It would be helpful (to me, at least) in the discussion at the end of section 5 to be more specific, and underscore that we are not talking about scavenging of the organic precursor species. Can the authors cite studies and/or model runs that demonstrate that the scavenging scheme in their model is robust. For example, have people looked at model depiction of the behavior of other soluable species such as nitric acid?

To address the comments from Reviewers #1 and #2 on convective scavenging of Br_y from VSLS, we have expanded the discussion on the importance of convective transport and dehydration during troposphere-to-stratosphere transport (section 1), how we set up wet deposition in the model (section 2.2), and the implication of our results (section 5). Yes, the reviewer is right. Organic bromine species are in general insoluble and not subject to wet scavenging. We assume all inorganic bromine is highly soluble and is completely scavenged when condensation occurs in convective updrafts. However, a fraction of the dissolved Br_y is released back to the atmosphere when re-evaporation occurs. When release associated with re-evaporation occurs above the level of neutral buoyancy in the tropical tropopause layer, Bry can escape to the stratosphere through radiative ascent. Our results suggest that net dehydration during troposphere-to-stratosphere transport occurs slowly so that most of the Br_y lofted in convective updrafts is released back to the atmosphere during evaporation, subsequently escaping to the stratosphere. We adopted our wet deposition scheme from the well-developed GOCART (Goddard Chemistry Aerosol Radiation and Transport) model. This wet scavenging scheme has been applied in many atmospheric modeling studies of soluble aerosols, e.g. sulfate, sea salt, dust, and the simulated concentrations compare well with surface observations at many observation sites around the globe (e.g. Chin et al., 2000, 2007; Ginoux et al., 2001). The same scavenging scheme is also used in many global chemistry transport models, e.g. the GEOS-Chem (Bey et al., 2001) and the GMI (Global Modeling Initiative) (Duncan et al. 2007) models.

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Ginoux, P., Chin, M., Tegen, I., Prospero, J., Holben, B., Dubovik, O., and Lin, S.-J.: Sources and distributions of dust aerosols simulated with the GOCART model, J. Geophys. Res., 106, 20 225–20 273, 2001.

Bey, I., Jacob, D. J., Yantosca, R. M., Logan, J. A., Field, B. D., Fiore, A. M., Li, Q., Liu, H. Y., Mickley, L. J., and Schultz, M. G.: Global modeling of tropospheric chemistry with assimilated meteorology: Model description and evaluation, J. Geophys. Res., 106, 23,073-23,096, 2001.

Duncan, B. N., Strahan, S.E., Yoshida, Y., Steenrod, S. D., and Livesey, N. J.: Model Study of the Cross-Tropopause Transport of Biomass Burning Pollution, Atmos. Chem. Phys., 7, 3713-3736, 2007.

Minor comments ————

—— Page 23629
Line 14: ’2-dimensional’ typo.

Corrected.

Line 24/25: Why is ’transported as an individual tracer’ in quotes? Is this some standard modelling terminology and quoted as such?

The quotes were added due to a mistake during format editing. We have deleted the quotes in the revised manuscript. We apologize for the confusion that may have caused.

—— Page 23630
Line 8-14: It is not clear to me how the ’lifetimes’ discussed here relate to those shown in figure 1. Some description would help. Are the single values quoted some kind of global/seasonal average? If so, the values are not immediately obvious from the two figures in column three. For the ’average’ for $CHBr_3$ to be 20 days seems at odds with how high the values are at higher latitudes (though weighting by area might account for that).

The single values for atmospheric lifetimes are calculated as the global atmospheric burden divided by the global-integrated loss and annual averaged. Though local lifetime of VSL bromocarbons is highly variable, their global-integrated atmospheric lifetimes are heavily weighted by the tropical lower atmosphere where emissions are high and loss is rapid. We have modified the text for a clear explanation.

Line 27: Again the quotes for ’atmospheric lifetime Bry’ are unexplained.

The quotes were added due to a mistake during format editing. We have deleted the quotes in the revised manuscript. We apologize for the confusion that may have caused.

—— Page 23634
Lines 6-10: I found this discussion a little unclear. Are the authors interpolating the model in space and time to each aircraft location (do they have model outputs with sufficient temporal resolution for that)? Or are they taking model mean files for a large time window and interpolating them in space? Fundamentally I’m not quite clear what’closest point in MAM and JAS’ means.

We apologize for the unclear and misleading explanation. We have changed the text to the following-"We separate aircraft observations into two periods, February-May and June-October, which approximate the boreal spring and summer seasons, respectively. Since more than 95% of the observations are made between March-May (MAM) and July-September (JAS), we compare the spring and summer observations with the simulated mean MAM and JAS $CHBr_3$ concentrations, respectively. Both the observed and simulated CHBr3 are regridded to a horizontal resolution of 10º×8º for easy comparison. In addition, we have added two panels (Figure 4, middle column) showing simulated $CHBr_3$ at locations where there are observations available for clear side-by-side comparison."

—— Page 23635
Line 17: I'd suggest a 'The' before 'mixing ratio of ...'

Added as suggested.

—— Page 23636
Lines 1-5: It would be good to mention if other tracers of biomass burning (e.g., CO, HCN, CH_3CN) show similar disagreements between model and observations in this case (assuming the model includes them).

The model used in this study includes all tracers that are important for stratospheric ozone chemistry, but does not include any tracers that are commonly used to track biomass burning, e.g. CO, HCN, CH_3CN.

—— Page 23639
Line 20: Might it be good to add 'near the Earth's surface' after 'gradient', just to be totally clear we're not talking about any gradients in the mid or upper troposphere.

Added as suggested.

—— Page 23640
Line 1: For clarity it would be good to add '(organic and inorganic)' after 'bromine' (first word) - assuming that this is a correct interpretation.

Added as suggested.

—— Figure 7: Why are the observations shown as black symbols with error bars here while in figure 6 black lines with shading were used?

We have modified Figure 7 to be consistent with Figure 6.

—— Figure 12:
Caption line 1: Should one not add 'due to VSLS' after 'bromine'? Also, it would be good to repeat '(organic and inorganic)' here for the readers who skim the text and concentrate on the figure.

Revised as suggested.