Review for manuscript by acpd-14-17857-2014 by Fernandez et al.,

The present paper reports on a modelling study of inorganic bromine and its partitioning in the tropical tropopause layer. Consequences for the injection of bromine into the stratosphere are discussed. In the manuscript, the relevance of bromine atoms for the photochemistry and budget of bromine in the tropical tropopause layer (TTL) are correctly emphasized. The manuscript thus constitutes a valuable and original contribution to improve our understanding of the TTL photochemistry and physics.
My minor concerns with the present study addresses the robustness and permanence of the postulated ring of Br atoms located within the TTL around globe (e.g. in the abstract it is written: We propose the existence of a "tropical ring of atomic bromine" located approximately between 15 and 19 km and 30^{o} N to 30^{o} S). In fact, as correctly indicated in the discussion at various places in the manuscript, due to its strong T and ozone dependence of the Br/BrO ratio, the ring of Br atoms might be much more variable in space and time (ergo patchy) than the sentence in the abstract is indicating. Therefore, I recommend to change this notion ' of ring of Br atmos' in a manner which more correctly expresses its patchiness.

Further recommendations:

1. The definition of the vertical extent of the TTL (as given on page 17860 line 21 to 25 in the paper) is not compatible with more recent definitions of the TTL, as for example given in the studies of Fueglistaler et al., (2009), or even more recently in the paper of Randel and Jensen (2013). Both studies are not mentioned in the manuscript. In these studies and mich more other studies addressing TTL dynamics and/or radiation, the TTL is defined by the layer between the level of zero radiative heating (LZRH at 150 hPa/355 K/14 km) and the cold point (CP) tropopause (at 70 hPa/425 K/18.5 km) (see the abstract of the Fueglistaler et al., 2009 paper), somehow in contradiction with the definition (12 to 17 km) preferred in the present study.
2. Previous ozone measurements within the TTL (e.g., SHADOZ, Thompson et al., 2003, cited in the paper), as well as more recent measurements within the TTL of the West Pacific indicate that in most cases (> 90 %) the ozone concentrations were larger than for example indicated by Figure 4 and 5. Accordingly since the modelled Br/BrO ratio largely depends on TTL ozone, digging-into the statistics of measured within the TTL would certainly reveal the patchiness of this postulated ring of Br atmos.
3. Since non-methane hydrocarbons (NMHC) are known to rapidly react with Br atoms, I wonder why the role NMHC may play in the TTL bromine photochemistry (i.e. by forming HB in fresh outflow or vs by efficiently destroying NMHC) is not even mentioned in a single paragraph in the manuscript.
4. Correction to the text and missing references:

4.1 On page 17856, line 27: Since the idea that brominated VSLS significantly contribute to stratospheric bromine budget was mentioned earlier than the cited studies, please add the following references where appropriate:

- Pfeilsticker K., W.T. Sturges, H. Bösch, C. Camy-Peyret, M.P. Chipperfield, A. Engel, R. Fitzenberger, M. Müller, S. Payan, and B.-M.Sinnhuber, Lower stratospheric

organic and inorganic bromine budget for the arctic winter 1998/99, Geophys. Res. Lett., 27, 3305-3308, 2000.

- Van Roozendael, M., Wagner, T., Richter, A., Pundt, I., Arlander, D., Burrows, J. P., Chipperfield, M., Fayt, C., Johnston, P. V., Lambert, J.-C., Kreher, K., Pfeilsticker, K., Platt, U., Pommereau, J.-P., Sinnhuber, B.-M., Tornkvist, K. K., and Wittrock, F.: Intercomparison of BrO measurements from ERS-2 GOME, ground-based and balloon platforms, Adv. Space Res., 29, 1661-1666, 2002.
-

4.2 On page 17859, line 8 and …. , add the following reference:
Liang, Q., Atlas, E., Blake, D., Dorf, M., Pfeilsticker, K., and Schauffler, S.: Convective transport of very short lived bromocarbons to the stratosphere, Atmos. Chem. Phys., 14, 5781-5792, doi:10.5194/acp-14-5781-2014, 2014.

4.3 Page 17866, line 28: Reformulate the sentence (With the exception of the ozone sensitivity study (Sect. 3.3.1), all box-model simulations had been performed with an ambient O3 concentration of 25 ppbv, which is the expected ozone value existent in the TTL.), or skip the second part since this is certainly not true. In particular the insert in Figure 8 is rather honest (TTL O3 near convective outflow) and implicitly confirms the statement made in comment 2.

4.4 Page 17868, line 11: Inspect and the VSLS measurements of Laube et al., (2014) in the WP and then put study with a sentence (following line 11) into the context of our results.

4.5 Page 17870, lines 1- 5: With respect of the patchiness of this ring of Br atoms, you may wish to reformulate this paragraph.

4.6 Page 17874, line 15 and elsewhere: Add the reference of Mébarki et al., (2010) to Marcy et al., (2004), since they report on HCl measurements performed within the TTL over Brazil. Also discuss their findings with respect to the potential of reactivating bromine (your reaction R2).

4.7 Page 17877, line 27. Add a point after (Williams et al., 2009)

4.8 Page 17879, line 10: Check as to whether you are fine with the statement, considering that eventually large amounts of NMHC (which efficiently react with Br atoms) are also transported by strong convection.

4.9 Figures: Rethink if the lower horizontal dashed line is useful with respect to comment 1. In fact, the line irritated me a lot, before I realized that your TTL definition largely departs from the more recent TTL definition and that all your statements regarding Br atoms concentration et cetera refers to and eventually are only valid for the more modern definition of TTL.

4.10 Useful references

- Fueglistaler, S. et al. Tropical tropopause layer. Rev. Geophys. 47, 1–31 (2009).
- Randel W.J, and E. J. Jensen, Physical processes in the tropical tropopause layer and their roles in a changing climate, Nature Geoscience 6,169–176, (2013).
- Sala, S., Bönisch, H., Keber, T., Oram, D. E., Mills, G., and Engel, A.: Deriving an atmospheric budget of total organic bromine using airborne in situ measurements from the western Pacific area during SHIVA, Atmos. Chem. Phys., 14, 6903-6923, doi:10.5194/acp-14-6903-2014, 2014.
- Ashfold, M.J., N.R.P. Harris, E.L. Atlas, A.J. Manning, and J.A. Pyle, Transport of short-lived species into the Tropical Tropopause Layer, Atmos. Chem. Phys., 6309–6322/doi:10.5194/acp-12-6309-2012.
- Mébarki, Y., Catoire, V., Huret, N., Berthet, G., Robert, C., and Poulet, G.: More evidence for very short-lived substance contribution to stratospheric chlorine inferred

from HCl balloon-borne in situ measurements in the tropics, Atmos. Chem. Phys., 10, 397-409, doi:10.5194/acp-10-397-2010, 2010.

-

-