Review of: Oh, Jenny, The atmospheric fate of 1,2-Dibromo-4-(1,2-dibromoethyl)cyclohexane (TBECH…) (egusphere-2023-1151)

This is an outstanding paper that examines in detail the concentrations and phase distribution of TBECH in air and water of the Canadian Environment. The sampling coverage in QC, BC and Toronto is very thorough, a lot of time went into designing and implementing the sampling networks and performing the subsequent analysis. The presentation of results and discussion of pathways and implications is also thorough and informative.

Here we have a flame retardant that is not used in Canada, but is nevertheless abundant in the environment, and must therefore have arrive by air transport. Enantiomeric analysis reveals that the TBECH has been subjected to degradation processes that deplete one enantiomer, thus pointing to "secondary sources". An unanswered question is from where? My guess is the U.S., and a comment has been made about this near the end of the review.

Below are some points that could use a bit of clarification. Overall, I support publication with minor revisions.

Line 54. Would be good to state the percentages of the four TBECH isomers in the technical mix. Relevant also for Section 4.1.2.

Line 217. How do the ratios in air compare with those in the technical mix, and in other locations where TBECH in air has been reported?

Looking for Saturna Island and Tadoussac on the maps, but can't find them. Possible to label the appropriate dots on the map?

Line 326. Section 3.3. Interesting that TBECH was prominent in Saturna Island precipitation, whereas concentrations in the AAS were quite low. The dimensionless scavenging ratios, SR = Cprecip/Cair, are on the order of 10^6 - 10^7 (Fig. S17). As the authors note in Section 4.1.2, such SRs are much higher than commonly encountered for gaseous chemicals and they are even on the high end of SRs for particle-bound chemicals. The authors discuss possible reasons for this in Section 4.1.2. Not mentioned is the possibility that a differences in air masses might account for this. On page S31 the authors state: "In the studied region, summer air comes from the Pacific Ocean and winter air from the continent." Could there also be a vertical influence at this coastal site? Warm continental air with higher TBECH at the cloud level (scavenged by precip.) overriding cooler clean ocean air underneath (sampled by AAS)?

Line 332, Section 3.4. The enantiomer elution order is not specified here. In Supplementary Text 4, this statement is made: "To determine enantiomer fraction (EFs) for α-TBECH, the elution order was used and calculated as E1/(E1+E2), since the correspondence between optical signs and chromatographic elution is unknown for the TBECH (Wong et al., 2012)." Could the authors also state that EF = E1/(E1+E2) in Section 3.4?

Line 409, Section 4.2. The title of the paper says "…atmospheric fate"…, and "fate" is partly accounted for through discussions of deposition and air-water exchange. However, degradative fate is not discussed, and this section would be a good place for it. Can some simple statements be made about predictive OH radical degradation (AOPWIN)? My guess is that the model will not differentiate among the TBECH isomers, but at least would provide information to balance against deposition removal.

Line 437, Section 4.3.
It seems that the “elephant in the room” has been ignored in this discussion – the possibility of air transport from the U.S.! Especially since the sampling sites are not far from the border. What is known about TBECH use south of the border?