

Interactive comment on “Three-dimensional model evaluation of the Ozone Depletion Potentials for n-propyl bromide, trichloroethylene and perchloroethylene” by D. J. Wuebbles et al.

Anonymous Referee #2

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Wuebbles et al. presented a 3-D modeling estimate of the Ozone Depletion Potentials (ODPs) for three short-lived ozone depleting substances (ODS), n-propyl bromide, trichloroethylene and perchloroethylene. The results are interesting and provide useful information to quantitatively understand how these short-lived ODS impact ozone. I recommend this article to be published after the following concerns are addressed.

1. On page 17891-17892, the authors mention that results from an earlier study (Wuebbles et al., 2001) suggests about half of the bromine from nPB enters the stratosphere in the form of inorganic bromine (Bry), with direct transport of nPB and transport of BrAc accounts for the 33% and 19%, respectively. Thus the troposphere-to-stratosphere

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transport of Bry plays the most important role in understanding how nPB impacts stratospheric bromine and ozone. In section 2, the authors explain how degradation of nPB is treated in the model ($\text{nPB} + \text{OH} \rightarrow \text{BrAc}$), however I couldn't find any further explanation on how BrAc is converted to Bry subsequently. Also Bry is highly soluble. Recent modeling works suggest that Bry has a lifetime of ~ 10 -15 days against wet deposition (e.g. Warwick et al., 2006; Hossaini et al., 2010; Liang et al. 2010) and about 30% Bry produced in the troposphere are removed by wet scavenging before entering the stratosphere (Liang et al. 2010). How is wet deposition of Bry treated in MOZART-3? How is the lifetime and washout efficiency of Bry against wet scavenging in MOZART-3 compared to these studies?

2. Section 3. How do the authors decide on the magnitude of emission fluxes used for nPB (2.48 Tg/yr), PCE (3.91 Tg/yr) and TCE (51.7 Tg/yr)? Why not choose an emission flux rate that corresponds to the current emission strength or a flux rate that will yield $\sim 1\%$ reduction in ozone (which seems to be a more conventional choice)? I understand ODP is in general independent of the choice of the emission strength, but it would be good to explain the rationale of the choice of these emission rates and also to clarify in the text that the magnitude of emission fluxes has little impact on the calculated ODP.

Minor comments:

Page 17890, line 18-19: It would be helpful to add the chemical formula for TCE (C_2HCl_3) and PCE (C_2Cl_4) here in the parentheses.

Page 17897, line 19-20, “and the resulting change in the distribution of tropospheric and stratospheric O₃ as scaled to 1% decrease in global O₃ burden”. I don't understand what you mean by “scaled to 1% decrease in global O₃ burden”. Please clarify.

Page 17898, line 1-2: “the minimum Bry perturbation in the tropics suggests that much of the Bry crosses north of 20°N”. Convective lofting through the tropical tropopause layer has long been suggested to be the most important pathway of air entering the

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stratosphere (e.g. Sinnhuber and Folkins, 2006; Fueglistaler et al., 2009). Your result seems to contradict the above suggested pathway. What's the explanation? If much of the cross-tropopause transport of nPB and its degradation products do occur north of 20N, what are the transport mechanisms? In addition, is Bry subject to washout in the model? If so, could this minimum Bry perturbation in the tropics simply reflect more efficient washout in deep convective up-lofting in the tropics?

Page 17899, line 11-13: I would suggest moving this sentence to somewhere in the first paragraph in Introduction.

References:

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