

## **Authors' Response to Interactive comment on "Three-dimensional model evaluation of the Ozone Depletion Potentials for n-propyl bromide, trichloroethylene and perchloroethylene" by James Franklin**

We thank James Franklin for his consideration of our article. With regard to the comments and additional information (shown in italics):

*I concur with the remarks made by the two anonymous reviewers regarding the values of the atmospheric emissions fluxes adopted in this paper for TCE and PCE. While the absolute magnitude of the fluxes should not affect the calculated ODPs, it would be appropriate to adopt more realistic values. To that end, the following additional information may be useful:*

- *As stated on page 17900 of the Wuebbles et al manuscript, the Reactive Chlorine Emissions Inventory (see the McCulloch et al 1999 and Keene et al 1999 references of the manuscript) gave the 1999 global annual atmospheric releases of TCE and PCE as 0.146 and 0.387 Tg, respectively.*
- *These values should be compared to the much greater emissions of 12.9-51.7 and 3.91 Tg/year, for TCE and PCE, respectively, adopted in the Wuebbles et al manuscript.*
- *While recent industry data on global emissions of these two solvents is apparently not publicly available, the overall picture is one of steady decline in releases over the past several decades. Thus, for example, according to recent data from the European Chlorinated Solvent Association [1], sales of TCE in Western Europe were 0.025 Tg in 2006 (the latest year for which data are available), while those of PCE reached 0.044 Tg in 2009. These values should be compared to those for the 1974-1979 timeframe, which averaged 0.257 Tg and 0.280 Tg for TCE and PCE, respectively [2].*
- *Measurements of tropospheric PCE levels at the remote Mace Head site in Ireland support a continuing decline in European emissions after 2000 [3]. When used as input to a 12-box model, they lead to considerably lower emission values than the reported industry sales data [3]. Global modeling (incorporating input data from Cape Grim, Tasmania, as well as from Mace Head) for the period 1999-2003, gave an average annual global emission of 0.228 Tg [3].*

*The adoption of more realistic emission fluxes would lead to correspondingly more accurate atmospheric levels. Thus, for example, the Wuebbles et al manuscript refers (on page 17899) to "tropopause PCE mixing ratios, which range from 100 ppt at the North Pole to 50 ppt at 40°S", while actual atmospheric measurements carried out over Costa Rica in 2007 led to a mixing ratio close to 1 ppt at the tropopause [4].*

The primary purpose of the TCE and PCE component in this study was to obtain the Ozone Depletion Potential of those two chloroalkenes, not to attempt realistic modeling of TCE or PCE distributions in the global atmosphere. For this, we require an ozone perturbation large enough to be numerically significant in MOZART-3. If we had attempted to run MOZART-3 with the RCEI

data base TCE or PCE emissions, not to mention the more recent (lower) emissions pointed to by this comment, we would not have had a numerically significant ozone loss to use in this study. The text is being revised to clarify the choice of emissions used.

*Finally, the authors of the manuscript state (in the Abstract) that “For the first time, ODPs for TCE and PCE are also evaluated”, despite the fact that they cite a reference to a prior modeling study (Kindler et al, 1994) in which ODPs were calculated for TCE (0.00049-0.00070) and PCE (0.0057-0.0070). These values are in fair agreement with those reported by Wuebbles et al.*

Agreed; we should have said "... evaluated in a three-dimensional, global atmospheric chemistry-transport model.", and this correction is made in the revised manuscript.