

Interactive comment on “A new formulation of equivalent effective stratospheric chlorine (EESC)” by P. A. Newman et al.

P. A. Newman et al.

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Thank you for the helpful suggestion.

First, we have made more specific references where possible. In particular, we have narrowed the references down to the individual chapters of the WMO assessments.

Second, with respect to the relative reactivity of chlorine and bromine. Most chlorine is found in the reservoir species: HCl and ClONO₂, while in daytime most bromine is found in the more active species: BrO, Br, and HOBr. BrONO₂, and BrCl are readily photolyzed in daylight, while HBr is only a minor species (mainly controlled by HOx reactions). Hence, BrO is the dominant daytime specie for bromine, while ClO is not the dominant daytime specie. Since bromine is primarily found in reactive forms, while Cl is mainly in reservoir species (HCl and ClONO₂), an individual bromine atom is a

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much more efficient ozone depletion agent than Cl. A detailed explanation of alpha is beyond the scope of this paper. We have added a reference to the Daniel et al. (1999) and Sinnhuber et al. (2007) papers.

Third, based upon the comments of the other referees, we have deleted the discussion of the lifetimes.

With regard to the faster circulation and the fractional release values. Indeed, a faster circulation does increase the fractional release values. CFCs that move upward through the stratospheric tropical pipe are almost completely photolyzed after reaching the tropical mid-stratosphere. This upward advection is relatively slow, such that the age of air near 10 hPa at the tropical tropopause is approximately 3-years. Any air parcel that reaches this altitude in the tropics will have its CFCs almost fully photolyzed. This is why fractional release curves are both functions of latitude and altitude. From our CCM, we see that the deviations from standard fractional release curves mainly occur in the tropical mid-to-upper stratosphere. This fractional release value at this location changes only slightly if the circulation becomes faster (i.e., as the mean age decreases). The photolysis rates change only weakly as a function of time (mainly because of overhead ozone changes). Hence, if you cycle material through the mid-to-upper stratosphere faster (i.e., you reduce the mean age of air), but the fractional release value remains almost the same, effectively increasing the release value for a “fixed” age. Hence, fractional release values increase as the circulation accelerates and age becomes younger at a fixed point. Also see our discussion in response to Reviewer #3.

We’ve added the two sentences: “For example, increasing vertical motion in the stratospheric tropical pipe will decrease the mean age, but the CFC photolysis rates in the mid-to-upper stratosphere are only modestly affected. Hence, for a fixed mean age, the fractional release will tend to increase.”

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