RIGC, Yokohama, Japan

November 16, 2010

Dear Anonymous Referee 2,

Thank you for your comments on the paper *"Emission location dependent ozone depletion potentials for very short-lived halogenated species"*.

We have addressed your concerns about the assumptions we made related to stratospheric chemistry on our calculations of ODPs. We agree that the use of a fixed alpha factor to scale loss from bromine to chlorine is an approximation, and that the amount of ozone destroyed by chlorine/bromine will not just depend linearly on the time spent in the stratosphere. However, the mean value theorem ensures that a value exists that represents the total depletion for every individual parcel, and also for the whole ensemble. A linearisation is indeed possible. The benefits of such a linearised, simplified approach are manifold, allowing rapid low-cost calculations for different VSLSs. In the particular in our estimates of an ODP for nPB we have made more explicit the assumptions related to the factors modelling the dependency of the calculation on the actual distribution of the active/inactive halogen throughout the stratosphere (see also reply to Referee 1).

We have modified the paragraph in the discussion related to that:

"The assumptions related to stratospheric chemistry also introduce limitations for the accurate calculation of ODPs and may also explain some of the differences between our estimates and other numbers found in the literature. Another possible cause is an underestimation of the total ozone destroyed by CFC-11. In fact, CFC effect in the stratosphere is estimated using a full description of the stratospheric turnover of the injected masses yielding an expected residence time depending on the latitude and height, rather than a simple global mean residence time. CFC–11 is modelled as being activated above 30 mb, but at this height the expected residence estimated is rather a lower boundary since we have used a 20 year trajectory calculation and at this height trajectories may remain in the stratosphere for longer periods. A full assessment of the stratospheric expected residence time and age of stratospheric air would be advisable to address such an uncertainty. Eulerian model studies such as Wuebbles (2009,2010) may not have made such approximations of the stratospheric chemistry. In the real stratosphere, the amount of ozone destroyed by chlorine/bromine will not just depend linearly on the time spent in the stratosphere. If an air parcel reaches a high altitude, where the photochemical lifetime of ozone is short then ozone will reach equilibrium. In addition, bromine chemistry is not so efficient at these altitudes (WMO 2007, Salawitch 2005). In our approach, the different activation heights of chlorine from CFC-11 (above 30 mb) and bromine from VSLSs (above 400 K) aims to represent the inhomogeneous distribution of active species and other factors influencing the depletion reactions. The chlorine from CFC–11 and bromine from VSLSs released is then modelled as remaining active along the transit through the stratosphere until the parcel under consideration is expelled

back into the troposphere. This approximation largely neglects effects arising from the inhomogeneous distribution of active (radical) and inactive (reservoir) halogen; instead, only a mean efficiency factor α published in the literature (WMO 2003,WMO 2007) was assumed. This assumption could be relaxed in future studies but would add significant computational costs from running box models along the stratospheric trajectories. "

In addition, we would like to remark that the method presented here is intended to be complementary to others such as Eulerian global modeling and not to supersede them.

Specific comments:

p. 16278. Line 12. OK

p. 16278, l.14: OK

p. 16278. Lines 19/20. OK

p. 16279. Lines 1-3. OK

P. 16279. Line 13-14. "halogen-containing" has been hyphenated throughout the document.

P. 16279. Lines 18-20. The reference to Dorf et al. has been added.

p. 16279, l.25: The value has been added.

p. 16279, l.25: The passage has been rephrased.

p. 16280, l.11: OK

p. 16287, l.13: OK

p. 16290. Line 25. OK

p. 16291. Line 13. OK

p. 16295. Line 6. OK

p. 16295. Line 8. OK

p. 16295. Line 16. We have changed the statement to to "we believe".

p. 16295. Line 17. OK

The Figures 1 and 4 have been modified as well as the corresponding captions.

Yours sincerely,

The authors