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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A model study of the impact of source gas changes on the stratosphere for 1850–2100" *by* E. L. Fleming et al.

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We thank the reviewer for their comments and suggestions. The reviewer has a few minor comments, and we present these along with our responses.

1) Abstract. Line 10 on. You could briefly state the mechanisms by which the GHGs and ODSs are impacting O3. In particular, make it clear that the impact of CO2 is via cooling.

Response: This is a good idea. We have added a few sentences to this point.

2) Introduction Line 7. 'leadingtotal'?

Response: The phrase "total chlorine and total bromine loading" was inserted here by

mistake and has now been deleted.

3) Introduction Line 8' 'Increase in N2O and the odd nitrogen..'. This makes it sound like they are two separate processes. The increase in N2O causes the increase in NOy which then affects O3...

Response: This sentence has been modified to read: "Increases in N2O and the subsequent increase in odd nitrogen species...."

4) Page 11213. Line 18. Is the radiative cooling impact of CH4 important at all?

Response: We ran an additional sensitivity simulation with only the radiative impacts of CH4 included, both directly and indirectly via H2O, with no chemical CH4 impact. This resulted in a maximum cooling of 0.7K globally at 30-60 km from 1850-2050. The accompanying ozone increase in this region was 1-1.5% from 1850-2050, with a corresponding 1.5DU increase in total ozone. Compared to the CO2 cooling effect and the CH4 chemical impact on ozone, this is a small but not insignificant effect. We have added a few sentences to the text to this point, and have added an additional curve to the ozone time series in the upper stratosphere (Fig. 5) and total column (Fig. 6).

5) Page 11216. Line 11. The experiments with perturbed CH4 affecting only a subset of the chemistry are interesting but I am not clear on how this was done. Please give more details. Does the model run have two CH4 tracers? If so are both of these destroyed by the full chemical terms?

Response: These experiments used only one CH4 tracer, which was subjected to the perturbed CH4 boundary conditions (2.25 ppmv) for all three experiments. In the case that used perturbed CH4 for the reactions with O(1D) and OH (green curves in Fig. 9), these reactions were computed as usual. However in this case, the CH4 +Cl reaction at all model grid points was computed using the perturbed CH4 multiplied by the ratio of the unperturbed/perturbed CH4 boundary conditions (1.75/2.25 ppmv). Therefore the CH4 +Cl reaction was evaluated essentially using the unperturbed CH4. The anal-

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ogous methodology was used for the case of perturbed CH4 used in the reaction with Cl (red curves in Fig. 9). We have added a few sentences to the text to clarify these points.

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