

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

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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 NO_y 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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