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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The contribution of anthropogenic bromine emissions to past stratospheric ozone trends: a modelling study" *by* B.-M. Sinnhuber et al.

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We thank all the referees for their detailed and helpful comments. We have now revised our manuscript taking into account the specific reviewer comments. In particular we have repeated the model calculations with the now available JPL-06 reaction rate recommendations, as suggested by the referee Ross Salawitch. We also have modified the technical details of how to calculate alpha: calculations are now performed with increased chlorine and bromine loadings of 10, 30 and 50%. With the new calculations the values of alpha have slightly changed (annual averaged alpha is now calculated as 64, in contrast to a value of 69 from our earlier calculations). Below we give a detailed reply to Referee #4's comments.

Reply to the detailed points:

1. As noted in also our reply to Referee #3, it is true that our 2D model has a relatively coarse vertical and horizontal resolution. However, improving the resolution is beyond what is feasible for this study.

2. Absolute total ozone columns from our 2D model are larger than observed columns. E.g., modelled total ozone averaged over 60S-60N is around 340 DU for 1980, about 50 DU higher than the TOMS/SBUV observations. However, this is well within the range of values calculated by other models (2D models and 3D chemistry climate models) used in the 2007 WMO/UNEP Ozone Assessment (see Chapter 3 of WMO 2007).

3. The 2007 WMO/UNEP Ozone Assessment includes a comparison of modelled ozone trends from our 2D model with other models and with observations, both for total columns and for profiles. We have included a reference in the text.

4. In contrast to our own preliminary calculations and in contrast to the recommendations, we have now not switched off the tropospheric washout. We believe that this is more realistic and also avoids possible problems in the model. As a result, not all of the bromine from VSLS enters the stratosphere; for the scenario used here this results in an increase of stratospheric Bry by about 4 pptv, with a somewhat smaller increase in the lowermost stratosphere where the VSLS are not yet fully degraded. We have modified the text accordingly.

5. The finding of a 11-year solar cycle in tropical total ozone is indeed well known; we have added a reference to WMO 2007.

6. The different behavior of the Pinatubo eruption on ozone in the NH and SH has been noted before (e.g., it is discussed in some detail in the previous 2002 WMO/UNEP Ozone Assessment) and is not specific to our model. As it stands, we don't have an explanation for it and addressing this issue would be beyond the scope of the present study.

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7. We agree that one should not expect a 2D model to reproduce all aspects of inter-annual variability seen in observations. Clearly there are significant differences between the modelled ozone trends and observed trends, as we note in the text. Still, we believe that overall the modelled trends agree "reasonably well with observed trends" so that we have a reasonable basic state of the model from which the sensitivity calculations are performed.

p. 6499, l. 14: We have now removed the word "converse"

p. 6500, Sec. 2: The model uses potential temperature as vertical coordinates in the stratosphere. We have now included this in the text.

p. 6502, l. 6: We have now cited the range and most likely value as assessed by the 2007 WMO/UNEP Ozone Assessment.

p. 6508, l. 17: The "effective alpha column" is defined in Sec. 3.2.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 6497, 2006.

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