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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Investigating the yield of H_2O and H_2 from methane oxidation in the stratosphere" *by* Franziska Frank et al.

Anonymous Referee #2

Received and published: 26 March 2018

Frank et al. present a thorough investigation into stratospheric methane oxidation, and challenge a long-hold assumption in GCMs without online chemistry, namely that one molecule of CH4 produces exactly two molecules of H2O. Using three separate methods, they show that this assumption is incorrect over many altitudes. I find the study design well thought through and well presented, and suitable for publication in ACP.

One I idea I had around improving the manuscript, is that the authors encourage the use of comprehensive parametrizations in GCMs – but I am not clear on what exactly these parametrizations should be? I wondered if it could be worth adding a subsection near the end called 'recommendations for GCMs without online chemistry,' or similar.

I'm also aware of more recent parametrizations for methane oxidation, e.g. as dis-

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cussed in Oman et al. (2008), whereby the rate of methane oxidation takes into account pressure, latitude and age-of-air. I think that discussing these more recent parametrizations would round out the discussion nicely.

Minor comments: - The paper will benefit from copy editing for English, and the authors might want to find a native English speaker or two to help with that when they resubmit the final version.

- P1L18: how about at polar latitudes?

- P3L20: I guess you mean it's not vertically well mixed, c.f. zonally.

- P3L25: please state what sort of model you use in (3).

- P3L27 and elsewhere: note the correct spelling of 'explicitly.'

- P3L28-30: it wasn't clear to me what you mean by this sentence.

- P4L24: can you list the simulated intermediates here (if practical)?

- P4L30: please define acronyms, e.g. NMHCs, HCFCs

- P4L30: how do you define HOx? H+OH+HO2?

- P5: Please also define NOx, ClOx and BrOx

- P5L28: I'd like to know more about your RC1SD-base-10 EMAC simulation. E.g., from the name, can it be inferred that dynamics are specified to a reanalysis?

- Fig.2: where is H2O being lost to in the mesosphere?

- Table 2: the authors might want to consider adding an extra column stating whether the simulation is a box model or CCM simulation.

- P15L21-23: Can you comment on what in particular is important regarding chemical composition of the box?

- P24L13: I think it's now fairly well recognised that online chemistry is necessary in

many respects, e.g. the Southern Hemisphere circulation response to CO2 via O3 changes (Chiodo and Polvani, 2017).

References: Chiodo, G., and L. M. Polvani (2017), Reduced Southern Hemispheric circulation response to quadrupled CO2 due to stratospheric ozone feedback, Geophys. Res. Lett., 44, 465–474, doi:10.1002/2016GL071011.

Oman, L., Waugh, D.W., Pawson, S., Stolarski, R. and Nielsen, J. E., Understanding the changes of stratospheric water vapour in coupled chemistry-climate model simulations, J. Atmos. Sci., 65, 3278-3291, 10.1175/2008JAS2696.1, 2008.

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