

Interactive comment on “Investigating the yield of H₂O and H₂ from methane oxidation in the stratosphere” by Franziska Frank et al.

Anonymous Referee #1

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This is an interesting study which is certainly appropriate for publication in ACP. As the title says, the primary motivation is to investigate the oxidation of methane in the stratosphere, to determine how much water vapor and H₂ is produced, and to the sensitivity of this production to certain geophysical parameters.

My most serious concern is that this study fails to provide any discussion and comparison to the obviously relevant study by Wrotny et al. (“Total hydrogen budget of the equatorial upper stratosphere”; JGR 2010). Some appropriate discussion should therefore be added. While it seems clear that this manuscript will disagree with some of the high yield values found in the Wrotny study, the upper stratosphere/lower mesosphere does appear to be the one region where this study shows a yield greater than 2 (Figure 10).

Page 5 line 12 – “The equator is chosen for its negligible seasonal cycle.” While the equator is a reasonable choice because some seasonal cycles are smaller, the change in H₂O entering the stratosphere at the equator is, among other things, certainly not “negligible”.

Page 5 line 29 – “is not known” should be “are not known”

Page 7 line 6 – “once” should be “at a time”.

Figure 5 – The order of the lines in the legend is a bit strange and confusing, being neither high to low nor low to high OH. Please make this easier for the reader.

Page 13 line 3 – This short summary paragraph is confusingly written, especially given the use of the phrase “on the other hand”. Unless I’m missing something, increasing OH concentration simply increases the yield of H₂O by both the direct and effective measures with the difference between direct and effective being largest at the highest altitudes.

Figure 6 – Perhaps I am missing some important point, but it seems to me that this figure and the accompanying text on page 12 is in the section “Sensitivity with respect to OH”. Wouldn’t it be much more appropriately placed right after the introduction of equation (3), which forms the basis of the terms being plotted?

Figure 12 – This is an extremely important figure, yet it is plotted on a log scale which makes it difficult to quantitatively determine many of the values of interest. The species could all be put on the same scale with appropriate offsets and multipliers. In particular, it would be interesting to see the H₂ variation with altitude in the stratosphere on a linear scale. It is not necessary to show the decrease in water vapor with increasing altitude in the troposphere, so this figure could certainly be started at 100 hPa.

Page 21 line 1 – “explicitely” should be “explicitly”.

Page 23 line 16 – “Yet, we see it critical to use the results of le Texier et al. (1988) to justify the approximation of H₂O=2 at lower altitudes.” I don’t understand this sentence.

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Figure S2 – This figure would be much more informative if the colors were not all red. It seems to me that the color scale could be run from ~ 1 to just over 2.

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