

Review of “Contribution of stratospheric intrusion to tropospheric hydroxyl radical” by Wang et al.

Wang et al. present a discussion of the role of stratospheric ozone intrusions on tropospheric OH production. They use the GFDL AM3 model and compare the results to HIRDLS and output from other CCMs. My two main comments are: 1) it's clear what we learn from this work that hasn't been shown before and 2) the presentation of the work needs to be cleaned up. It's clear the authors did a lot of work with many comparisons, but in my opinion they need to do a better job of detailing how this goes beyond previous work (including some uncited papers) mentioned below. Additionally, the figures need to be redone. They are not in a publishable state. I would recommend major revisions for the manuscript.

Major Comments

1) Not entirely clear what we learn

The authors need to do a better job of explaining what is actually new here. There is quite a bit of work discussing the role of STE for OH going back 20+ years (e.g., Crutzen et al., *Telus* 1999). Other papers describing the controls on OH seem to be missing such as Murray et al. (2014; <https://doi.org/10.5194/acp-14-3589-2014>), Murray et al. (2021; <https://doi.org/10.1073/pnas.2115204118>), Bourgeois et al., (2021; <https://doi.org/10.1073/pnas.2109628118>), and Zhang et al., (2024; <https://doi.org/10.1126/science.adn2961>). Many of the conclusions stated in the abstract are things that have been known for a while.

The text does a decent job of describing differences, but many of the differences they do describe have already been seen for many years in these models.

2) Cleaned up

The manuscript needs to be cleaned up. All of the figures need to be improved and/or cleaned up.

It's not totally clear which figures go with each caption. For example, it seems like Figure 1 is split across 3 pages and is made up of 12 separate panels but only labeled a-d. I initially thought the text on Page 9 was the caption for 2 separate figures. I eventually realized that the paragraph is part of the main text, not a caption. The current panel “(a)” should be its own figure. This is showing the same thing. The authors should group figures together that are showing similar results instead of stringing 12 panels together.

Figure 2 is similar. It is comprised of 6 panels and there is only one label (b). The (a) label seems to be missing. Although each subpanel has a label, so there are technical 3 panel “(b)”.

Figure 3 is similarly missing a label (a), the caption is on a separate page, and it is comprised of 24 panels.

This may result in far more figures than the authors would like. If so, they should consider moving some to an SI, particularly if they are not important to the story.

Minor Comments

1) Abstract contradicts their numbers

The abstract seems to contradict their own numbers. The abstract says the “*contribution of stratospheric intrusion can reach the 12% over the Tibetan Plateau, northern South America and South Africa, and 20% over the subtropical oceans*”. This seems to disagree with the Conclusions (Section 4.1):

- Tibetan Plateau: -11% to 7.5%
- Subtropical oceans: 22%

2) Simulation timeline doesn't make sense

Section 2.1 (Lines 142-145) state that the simulation ran from January 1, 1979 to November 31, 2004. It then ran four more years with daily output. First, November should only have 30 days. Second, this would take their simulations to the end of 2008. The analysis is supposedly from July 2005 to December 2010 (Lines 143-145). This doesn't make sense to me.

3) Figure contradicts their numbers

The text states that the tropospheric OH from AM3 is 10.10×10^5 molec/cm³. However the text on Figure 2a (top left panel) lists a value of 9.06×10^5 molec/cm³.

Specific comments

Abstract (Lines 11-12): Typo, should be “revealed” and “variability”. Confusing sentence using “and” 3 times.

Lines 34-43: Should include Murray et al., (2014; <https://doi.org/10.5194/acp-14-3589-2014>) and Murray et al., (2021; <https://doi.org/10.1073/pnas.2115204118>)

Lines 46-50: Citations needed.

Lines 59-75: Other recent papers that should be mentioned:

- Bourgeois et al., (2021): <https://doi.org/10.1073/pnas.2109628118>
- Zhang et al., (2024): <https://doi.org/10.1126/science.adn2961>

Line 98: Weird reference style. Mao, Paulot, et al. (2013) is not in reference list.

Lines 104-105: Typo, missing “convection”

Line 116: Is this the stratospheric ozone tracer from Michael Prather that was implemented by Meiyun Lin in AM3? Needs citations if so. In either case, these need to be defined better. It’s not clear what the subscripts mean or what each is supposed to represent.

Figure 2: Citations for the models used?