

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2021-880

Anonymous Referee #1

Referee comment on "Upper stratospheric ClO and HOCl trends (2005–2020): Aura Microwave Limb Sounder and model results" by Lucien Froidevaux et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-880-RC1>, 2021

This is an excellent paper, using results both from MLS measurements and the WACCM model to obtain trend estimates of ClO and HOCl over the ~15 years for which MLS has been making measurements. With the exception of requiring a better explanation for a line used in two of the figures, this manuscript is certainly publication worthy in its present form.

However, I do have to express disappointment with this study because almost all of the analysis of this wonderful MLS dataset and the sophisticated modeling study that accompanies is reduced to plots of linear trends. Beyond some lines drawn through two figures (which are dominated by annual cycles) the reader is left with no sense of how well a linear trend actually fits this data. The authors use a quite complicated regression fit that includes some quite long-period terms such as ENSO and 11-year solar cycle terms. Before comparing the trend fits between model and measurement, it would be good to know how well these agree or whether they are significant, since differences in these terms could influence the calculated trends. If they don't make a difference please say so.

A few simple measurement (and possibly model) timeseries plots of annual ClO and HOCl anomalies (without ENSO, F10.7, or QBO fits) or something similar from 50S to 50N at a few of the altitudes shown in Figure 10 would be of great interest. It would visually help the reader to understand how easy it is to identify a linear trend in this data, would help to answer the question of the importance of the multi-year terms in the fit, and would provide some indication of the importance of endpoints. At present, only Figures 2 and 8 provide any timeseries information, and these are very cluttered and difficult to read, dominated by the annual cycle, and given only for very specific (for some reason different for the 2 species) locations.

Figure 2 and Figure 8 – I'm afraid that I don't understand the meaning of "the model fit to MLS data". Is this just WACCM minus MLS? The authors seem to be using "fit" to refer to

the regression. Line 246 seems to suggest that the pink line is just a difference: "WACCM time series actually fit the MLS data better than the regression fits do". I indeed hope that this line is just a model minus MLS difference with the bias removed, since this would seem to be the most useful and basic thing to plot.

Minor points:

Line 138 – "only" is an unnecessary word here. Also, somewhere in this paragraph it should be mentioned that additional details about the standard HOCl retrieval are included in the MLS data quality document (i.e. Livesey et al. 2020). I realize that is mentioned in 3.2.

Lines 178-193, or thereabouts- I'm pretty sure that "the model" is always referring to WACCM, but it would be nice to spell that out somewhere in this long paragraph.

Line 211 – Just curious as to why here the fitted component apparently follows a different solar model than that mentioned in 2.2.

Line 216 – "year-long blocks". I agree that this is probably a reasonable choice, but I'm just curious if the authors have any particular reason for this choice. I certainly don't insist on any change in the manuscript.