Response to reviewer #3

We thank reviewer #3 for her/his valuable comments. Please find below the reviewer's comments (in black), our responses (in blue), and changes or additions to the text (in red). All page / line numbers refer to the old version of the manuscript.

GENERAL

The paper is dedicated to the updated GTO-ECV total ozone climate data record, and to evaluation of global, regional and seasonal ozone trends.

The paper is well-organized and written, and it contains important information. Please find my minor comments below.

MAIN COMMENTS

For reporting trends with uncertainty interval (x +-y%), please make clear that uncertainties are 2-sigma (I believe, they are 2-sigma). It can be done with the first such trend reporting.
→ We added the information in the abstract and in Sec. 4.1.

In addition to Figure 1, I would suggest adding a figure (maybe in appendix) showing the percent of variability explained by each proxy. For such analysis, 2 QBO components can be combined into one source. Such figure would be useful in visualization of relative contribution of each proxy to observed ozone variability.
→ As suggested, we added this Figure in the appendix. We provide the contributions for QBO30, QBO50, Solar Flux, and MEI in Fig. A2 (a)-(d), respectively. In order to be consistent with Figure 1, we show the contributions for QBO30 and QBO50 separately. We refer to this Figure in Sec. 3.
The contribution of the AO/AAO proxy is already indicated in Figure 2(b), which shows the difference between the MLR without and with AO/AAO. Therefore, we do not show this contribution in Fig. A2 again.

The analyses presented in the paper show pronounced dependence of ozone trends on tropopause altitude. The tropopause altitude can be also used as a proxy in regression. It would be interesting to assess the influence of using tropopause height as a proxy on estimated ozone trends.
→ As suggested, we used the tropopause height as a proxy in the regression (replacing the AO/AAO proxy). The spatial trend pattern did not change, but the trend estimates in particular in the Northern Hemisphere became smaller and remained non-significant. The areas, for which the trend was significant (North Atlantic and SE Europe), became also slightly smaller. The fit coefficient for tropopause pressure is positive for the entire globe and about 0.5DU/hPa in the middle latitudes of the Northern Hemisphere, which corresponds to about -15DU/km (at tropopause altitude). This is in good agreement with Steinbrecht et al. (1998), who assumed a value of about -16DU/km.

DETAILED COMMENTS

L. 30-31, Ball et al. (2018) reported statistical significance of the lower-stratospheric trends. It is worth to mention also recent studies - (Ball et al., 2019, 2020; Orbe et al., 2020; Dietmuller et al., 2021).
→ Additional studies have been added.

L.65 “inter-relation” – do you mean correlation?
→ Yes, we meant correlation. Changed.

L.88, 97: Please provide quantitative measures of “a very good quality”, “very good overall agreement”, “” excellent long-term stability”.
→ We now provide numbers for all statements:

L.88 → “...evidences a very good quality. The mean bias between the individual level-2 products and ground-based measurements is within 1.5±1.0% (Garane et al., 2018, 2019).”

L.89 → “...the inter-sensor consistency of the selected instruments is overall extremely high (within 1.0% between 50°N and 50°S (Garane et al., 2018)).”

L.97 → “...reveals a very good overall agreement (i.e., similar to the validation of the level-2 data and with 0.5% to 1.5% peak-to-peak amplitude) and an excellent long-term stability (Garane et al., 2018). The drift with respect to ground-based data is well below 1% decade^{-1}.”

L. 100- 103: This sentence suits better for the discussion section.
→ We moved this sentence to the end of the discussion section.

L. 205-209: The comparison with height-resolved trends at different altitudes looks strange. In (Arosio et al., 2019) and (Sofieva et al., 2021), the longitudinal difference in trends between Scandinavia and Siberia are observed at all altitude levels in the stratosphere.
→ Reviewer #2 raised a similar comment and we rephrased this part.

L. 237 – this paragraph. Compared to Coldewey-Egbers et al. (2014), this paper uses not only the updated dataset, but also a different MLR. This is worth to note.
→ We have added this information in L238.

L.265-270. Reanalyses data can be not optimal for trend analyses, since changing number of assimilated datasets with time can introduce artificial steps in data (for example, Simmons et al., 2014). Is it checked that the NCEP trends in tropopause height are in good agreement with those from experimental data?
→ Using the NCEP/NCAR tropopause height was motivated by two studies (Santer et al., 2003a, 2003b), who used this reanalysis data set for the same purpose, i.e. the derivation of trends. Santer et al. (2003a) found a good agreement with changes obtained from radiosonde data, and the agreement with other reanalysis data set was also found to be reasonable.

Santer, B.D., R. Sausen, T.M.L. Wigley, J.S. Boyle, K. AchutaRao, C. Doutriaux, J.E. Hansen, G.A. Meehl, E. Roeckner, R. Ruedy, G. Schmidt, and K.E. Taylor: Behavior of tropopause

height and atmospheric temperature in models, reanalyses, and observations: Decadal changes. *J. Geophys. Res.*, **108**, no. D1, 4002, doi:10.1029/2002JD002258, 2003a

Santer, B. D., Wehner, M. F., Wigley, T. M. L., Sausen, R., Meehl, G. A., Taylor, K. E., Ammann, C., Arblaster, J., Washington, W. M., Boyle, J. S., & Brüggemann, W.: Contributions of Anthropogenic and Natural Forcing to Recent Tropopause Height Changes. *Science*, *301*(5632), 479–483. http://www.jstor.org/stable/3834678, 2003b

L.291. How many terms were used for characterization of seasonal dependence?
→ We use only one term (N_b=2) to account for annual variations.

I think that Figure 8 does not bring essential information – this is the summary of previous figures. Furthermore, the Hemispheres cannot be directly compared, as the latitude bands are different. I suggest placing this figure in Appendix.
→ Maybe the label/caption of Fig. 8 was a bit misleading. Reviewer #2 also points this out. We do not show absolute numbers of grid cells indicating a significant trend, but the percentage of significant grid cells in the respective latitude band. We changed the label/caption accordingly. We think that the three latitude bands can be compared and we would prefer to keep this Figure in Sec. 4.2.

L. 358-359. The last sentence of this paragraph contains technical information and can be omitted in Summary.
→ We have deleted this sentence.

L. 367 Please add “statistically” before “significant”
→ Done.

REFERENCES

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