Response to reviewer #1

We thank reviewer #1 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.

This is the first review of the paper "Global, regional and seasonal analysis of total ozone trends derived from the 1995–2020 GTO-ECV climate data record" by Melanie Coldewey-Egbers et al.

This paper is focused on updates of the trends derived from the extended GTO-ECV satellite total ozone record. The dataset was recently updated by including new satellite records (i.e. TROPOMI) and by extending previously used satellite records. The dataset is homogenized by using the same processing algorithm for all satellite records.

In the paper, the authors apply a statistical model to the GTO-ECV record to detect ozone changes over a wide range of latitudes (70S-70N). The regional and seasonal patterns in both Hemispheres are identified and linked to the chemical and dynamical processes that contribute to ozone recovery.

This paper is an extension to the previously published analyses by Coldewey-Egbers et al. (2014), however in this paper statistical model also includes additional explanatory parameters (AO and AAO), which improve the model fit to the data, especially at high latitudes, thus suggesting a significant contribution of the changes in the Brewer-Dobson circulation to the apparent ozone recovery in some regions.

Among new findings, authors report that positive trends in the 50-70 S region are highly significant in many regions. Since the AAO controls the transport of ozone to high latitudes, did you check if the AAO contribution to the ozone variability has significantly increased over the last 25 years?

→ We checked if the AAO contribution to ozone variability has changed using two options:

1. Keep the start date of the regression at 1997 and vary the end date of the regression, i.e. vary the length of the time series
2. Vary the start and end date of the regression using a fixed length of 16 years.

→ We did not find an increase in the AAO contribution and did not see a change in the spatial pattern.

This paper provides a strong contribution to the understanding of the drivers of ozone recovery.

The figures are clear and support the discussion and main conclusion points of the paper.

Comments:

Line 30, “(though not statistically significant)” I recall that Ball et al. 2018 claimed a statistically significant ozone decrease in the lower stratosphere. He stated that the models did not support this finding. Please clarify if you are discussing total stratospheric ozone or low stratospheric ozone changes. I believe Ball et all (2019) has reassessed the significance of observed and modeled changes in the datasets extended to 2018, but still found high probability (90 % in NH mid-latitudes, 95 % in tropics, and 80 % in the SH middle latitudes) that the lower stratospheric ozone declined by 2018 as compared to the 1998 levels. I think it might be good to state in this paragraph that analyses were done using broad latitude bands and zonal averages, while your paper has assessed zonally resolved data for trends.
→ We have deleted the statement “(though not statistically significant)” since this is not correct as pointed out by the reviewer. We have added the reference Ball et al., 2019 here and mention that the cited studies mainly use zonally averaged data in contrast to our study.

Line 35, “changes in the tropospheric amount do not indicate a clear global pattern” – this paper was published back in 2018. Should a more recent assessment of tropospheric ozone trends be used here (i.e. Ziemke et al. 2019) that found regional patterns in TOR trends?
→ We have replaced the reference Gaudel et al., 2018 with Ziemke et al., 2019, as suggested and adapted the text accordingly:
“On a global scale ozone in the troposphere has increased during the past decades. However, the enhancement is highly regional (Ziemke et al., 2019).”

Line 45, you mentioned “focusing on different questions”. Please indicate how this paper’s focus is different from other papers.
→ Since referee #2 raised a similar comment, we rephrased the sentence:
“… focusing on various questions such as the consistency of trends and their uncertainties derived from different data sets, as well as the dependence of the trends on latitude, altitude, or season.”

Line 64 “inter-relation” vs correlation: please clarify what it means.
→ We meant “correlation”.

Lines 122-124. Do you introduce seasonal variability in the trend term only or also in coefficients of other proxies?
→ We introduce seasonal variability only in the trend term, but not in the other explanatory variables. We now explicitly mention this in the text.

Line 167, you can also add Appenzeller et al, 2000 and Rieder et al (2010) papers to the references.
→ We added Rieder et al., 2010 in the discussion of the impact of the AO/NAO (line 176).

Line 175 “over Iceland” – the anomaly pattern in the figure is not centered on Iceland. Should the description be altered to describe the are (i.e. geographical coordinates of the region).
→ We altered this sentence to:
“The corresponding lower tropopause altitude leads to an increase in total ozone (i.e. a positive correlation between AO and ozone, which is centered over the Labrador Sea),...”

Lines 261-263. Have you considered the change in the position of the subtropical and polar jets that can contribute to regional changes in the total ozone (i.e. Seasonal and Regional Variations of Long-Term Changes in Upper-Tropospheric Jets from Reanalyses by Gloria L. Manney and Michaela I. Hegglin in J of Clim, 2018)?
→ Thank you very much for pointing to this study. We did not consider changes in the jets in our study.

Line 271-272, please explain what you mean by the “maximum values of the trends”.
→ This is just the trend value for that grid cell which shows the maximum trend in the respective region.

Lines 286-289, Can the total ozone trend over Siberia be offset by an increase in tropospheric ozone due to wildfires? It might be interesting to investigate seasonal differences in the tropopause height trends.
→ An increase in tropospheric ozone can contribute to the trend. Unfortunately we could not find a study providing robust tropospheric ozone trend estimates for Siberia. However, according to Ponomarev et al. (2016) the number of wildfires over Siberia steadily increased over the past decades which supports your hypothesis.
→ Regarding the trend in tropopause height, we did not find a seasonal dependence.
Ponomarev, Evgenii I., Viacheslav I. Kharuk, and Kenneth J. Ranson. "Wildfires Dynamics in Siberian Larch Forests" *Forests* 7, no. 6: 125. https://doi.org/10.3390/f7060125, 2016.

Figure 6. since the differences are hard to discern, would it make sense to make plots of the seasonal differences from the annual trends?
→ Thank you for this suggestion. We created these plots, but in our view they would lead to more confusion instead of clarity. Thus, we would prefer to leave Fig 6 as is.