Authors responses:
The authors thank the Reviewer for taking time to provide the valuable comments and suggestions.

Reviewer 1 comments
Review of “Ozone trends in homogenized Umkehr, Ozonesonde, and COH overpass records” by Irina Petropavlovskikh et al.

Summary and General Comments:

The authors demonstrate improvements to the LOTUS MLR ozone trends model through addition of dynamical proxies applied to ground-based (Dobson Umkehr, ozonesonde) and satellite (NOAA COH overpass and zonal) ozone datasets. Ozone trends for the lower to upper stratosphere are first presented with the “standard” Reference LOTUS model (excluding the AOD proxy) for 2000-2020, after which individual additional proxies including tropopause pressure, Eddy Heat Flux, Equivalent Latitude, etc., are added to the model to determine the best choices for a “full” model trends calculation.

The authors find that, with a few exceptions in the lower stratosphere, the trend values are mostly unchanged in the full model. However, improvements to the model adjusted R2 values and p-values indicate that the addition of proxies specifically chosen for various stations and altitudes will lead to more confidence in trend detection, as well as the possibility of detecting trends smaller in magnitude compared to a base MLR with limited proxies (i.e., as would be used with zonally averaged data).

The paper is written exceptionally well, is highly detailed, and the decision-making process for choice of additional proxies in the model and other topics are carefully explained in the text and in extensive Appendices.

I have no major concerns with this manuscript, but I do wonder if the authors explored using the Payerne ozonesonde record in addition to the Hohenpeissenberg record for the Arosa/Davos station. The Payerne record is also extremely dense, Payerne is only 50 km farther in distance from Arosa/Davos, and that is an ECC record that does not have a correction factor applied as with the Hohenpeissenberg Brewer-Mast type ozonesondes. The inclusion of Payerne sonde trends could be illuminating.

Authors’ response:
We considered performing trend analyses of the Payerne ozonesonde records available from the HEGIFTOM archive (which contains ECC sondes only datasets). However, the shortness of the record (homogenization was applied to the data starting in 2002 after the Brewer-Mast to ECC sondes transition) prohibits using the LOTUS multi-linear regression method on the same time range as the other datasets. Specifically, we used the independent linear trend (ILT) approach which requires data starting a few years before 1996. The record downloaded from the NDACC archive has a step change in 2002 when Payerne station switched from the Brewer-

Mast version of ozonesondes to the ECC sondes as long as the Dobson normalization factor is not applied on the ECC timeseries (Stuebi et al, 2008). The HOH dataset is however a Brewer-Mast based time series on which the Dobson normalization factor is applied. We discussed Payerne record use with the PI, coauthor of this paper, and decided that it was hard to interpret the results of the trend analysis when it is impacted by a step change in the 1996-2020 time range. Once a new record would become available we would be happy to repeat trend analyses.
Stuebi, R., G. Levrat, B. Hoegger, P. Viatte, J. Staehelin, and F. J. Schmidlin (2008), In-flight comparison of Brewer-Mast and electrochemical concentration cell ozonesondes, J. Geophys. Res., 113, D13302, doi:10.1029/2007JD009091.

Recommendation:
I recommend publication of this paper and have only minor and technical comments below.

Specific and Line-by-Line Comments:

Line 117 and 118: It looks like there are some extra parentheses on these lines.

Response: We corrected the parenthesis in the text.

Line 127: SHADOZ is “Southern Hemisphere Additional Ozonesondes”

Response: We corrected the text.

Line 133: The vertical resolution of ozonesonde data is a factor of the time response of the instrument, not altitude.

Response: We corrected the text “depending on the balloon accent velocity and the time response of the instrument”.

Table 1: If using the OHP ozonesonde data from NDACC, I am assuming you are using the homogenized “Corrected Ozone partial pressure” ozone values in those files, correct?

Response: Thank you for making us aware of the additional column available in NDACC files for the OHP record. We selected the corrected ozone partial pressure and repeated our trend analyses. Please find updated results for the OHP ozone sonde data in the revised paper.

Table 2: NOAA 11 appears twice in this Table.
Response: This is correct. NOAA 11 is used in two separate time periods, first on the ascending orbit, then again when it emerges from darkness and we use the data from the descending orbit. We now make changes in the table

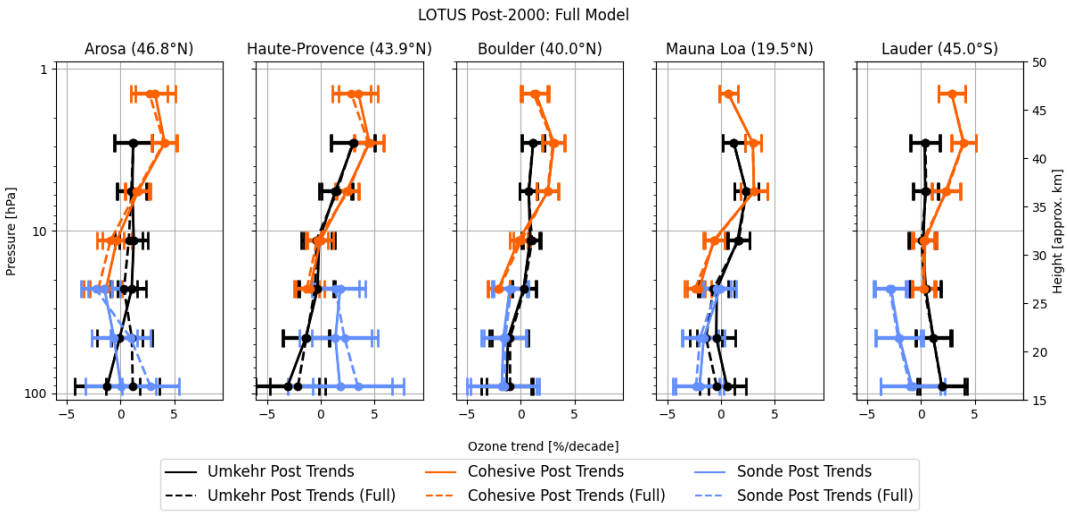
Line 263: I think you are missing a “m =” here
Response: we added m constant to the text.

Line 362: Change “interannual” to “interannually”

Response: we made a change to the text.

Line 413: The OHP sonde and Umkehr trend differences look quite large for all Layers 3-5 (not just 4), although always within the 2 standard errors.

Response: After replacing the uncorrected OHP ozonesonde data with a homogenized record, we found that trends became less positive. Therefore, their difference from the Umkehr trends became smaller (see updated Figures). The updated ozonesonde trend uncertainties were also reduced but continue to overlap with Umkehr trend uncertainties. Additional efforts are ongoing to improve OHP ozonesonde homogenization but a new version is not yet available (private communications with PI). We updated Figures, Tables and discussion in the text.



Figures 3 and 5: Suggest changing “Height (hPa)” to “Pressure (hPa)”

Response: We made the requested change.

Line 528: I’m not sure I would say the results point to the inability of the model to detect non-zero trends. At this point we really don’t know and probably cannot say that trends are non-zero here in Layer 6.

Response: we changed the text to “Therefore, the statistical trend model cannot separate trends from zero due to unexplained high ozone variability in this layer”.

Line 606 and 794: “lower” stratospheric ozone records…

Response: we made requested changes to the text.

Table 13: A plot similar to Figure 7 with the adjusted R2 values, but for the p-values for the Ref and Full models could be helpful and would keep the reader from having to flip back and forth between the two Tables 6 and 13.
Response: we replaced Table 13 with Figure 7c. This is an updated Figure (10/20/2024)

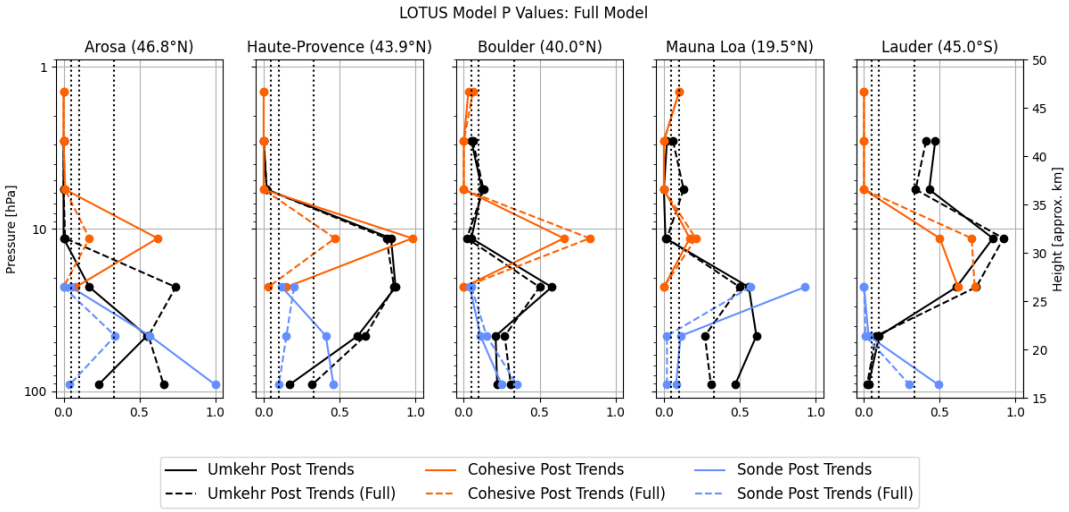


Figure 7 c) P Value of the Full (dashed lines) and Reference (solid lines) model. The vertical dashed lines at 0.05, 0.1, 0,33 indicate: high certainty of trend detection (below 0.05), medium (between .05 and 0.1), low (between 0.1 and 0.33), and very low certainty or no evidence of trend detection (above 0.33).

Lines 866-869: I think it would be useful to put these questions in the intro as well (or just move them there) to very clearly motivate this study.

Response: Thank you for the suggestion to clarify the motivation of the paper in the introduction section. We outlined motivations in lines 89-100 that should cover the questions and the goals of the paper. Therefore, we decided to keep the question in the Conclusion section. We also added the following sentence after line 100.

Ability of the ground-based and ozonesonde records in capturing semi-global ozone changes is evaluated by comparing trends derived from the satellite overpass and zonally averaged records

Line 901: Change “in case of” to “for”
Response: We made requested change to the text,