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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The Impact of Non-uniform Sampling on Stratospheric Ozone Trends Derived from Occultation Instruments" *by* Robert P. Damadeo et al.

Anonymous Referee #1

Received and published: 1 September 2017

The manuscript "The Impact of Non-uniform Sampling on Stratospheric Ozone Trends Derived from Occultation Instruments" by Damadeo et al. describes a newly developed version of a regression analysis to determine ozone trends in the stratosphere. With this method three different satellite data sources (SAGE II, HALOE and ACE-FTS) are fed into the regression model independently, but are then analyzed together. There is no previous homogenization of the data sources necessary, and offsets and drifts between the different data sources, and effects of non-uniform temporal, spatial and diurnal sampling, are taken into account within the regression model directly. The derived trends from this method are then compared to results from more traditional regression model approaches, and the differences in trends and basis function

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responses are described and discussed.

The structure of the manuscript is clear, and it is well written. In principle the storyline is easy to follow, however, in some paragraphs I was missing some details about the methodology or about some results. This made it sometimes complicated to understand what exactly had been done in the analysis and how exactly the different results vary. That said, I think the analysis is sound, and it is just a matter of rephrasing and rewording some things to improve the manuscript sufficiently for publication.

I would recommend the manuscript for publication, after the following suggestions/comments have been taken into account:

General suggestions/comments:

- The manuscript describes a new version of a regression model, but the model is nowhere described, neither briefly nor in detail. Much of it might be described in detail in Damadeo et al. (2014), however, it now is used for the first time to not just use SAGE II measurements, but simultaneously also HALOE and ACE-FTS measurements, and I think that should definitely be described mathematically.
- As mentioned before, I was sometimes missing details about the methodology description and during the result discussion. I would recommend that the authors read through the manuscript again with this in mind (after considering the more specific comments below) to clarify any remaining items that are described too briefly.

Specific suggestions/comments:

- Section 2: I would recommend to remove the description of the data sets that are not used in the analysis that is described here in detail (POAM II, POAM III, SAGE III), as well as the description of their filtering. The results of the STS

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regression with all six data sources are only mentioned briefly once, and therefore the detailed description of those data sources seems unnecessary. It is always possible to refer to their description in the literature.

- Page 4, line 11-12: Was the analysis done for more unit systems than just number density versus altitude? If yes, this should be mentioned in more detail. If no, I don't think the information about other unit systems is relevant here.
- Page 4, line 11-12: What vertical resolution is used for the different regression analyses? 1km?
- Page 4, line14: What is the spatial resolution of the daily means (for the STS)?
- Page 5, line 32 to page 6, line 16: Here is a detailed description of the correlated residuals that is not shown in a graph. It is very hard to follow the discussion without being able to look at something. I would recommend to either drop the paragraph, or add a figure that shows the correlated residuals.
- Page 7, line 33 to Page 8, line 2: The discussion about the SAGE II data filtering and the conclusion about the HALOE filtering is not clear. This section would benefit from some more details (how the conclusion was drawn) or some rephrasing.
- Section 4.4: How do the results from Maycock et al. (Maycock, A. C., Matthes, K., Tegtmeier, S., Thiéblemont, R., and Hood, L.: The representation of solar cycle signals in stratospheric ozone – Part 1: A comparison of recently updated satellite observations, Atmos. Chem. Phys., 16, 10021-10043, https://doi.org/10.5194/acp-16-10021-2016, 2016.) compare to the findings described here?
- Page 9, line 3-4: How much did the trends change in Millan et al. (2016) between considering the sampling bias and not considering it?

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- Page 9, line 7-15: It is not clear to me what that calculated bias is based on. It is given in percent, but is it percent of ozone? Or percent of something else? If it is ozone, how was the difference between the biased value and the "centered" MZM value (middle of the month and middle of the latitude band) calculated? More details would be helpful here.
- Page 10, line 17: The latitude band "20S-20N" should be "15S-15N" here? At least Figure 8 shows the results for "15S-15N".
- Page 11, line 5-17: It would be good to be a bit more detailed in the description of the different methods here. It is not very obvious from the text that there are indeed 4 different regression models discussed.
- Page 11, line 18-23: It was not clear from the supplementary material how the text would change here with the updated way of calculating the uncertainties on the trends.
- Page 11, line 33: The increase of about 1%/decade in the NH mid-latitudes is not very obvious in the updated plot. Is this a remnant description of the old plot? If not, I would recommend to adjust the description to ensure the reader knows where exactly the 1%/decade increase takes place.
- Page 13, line 6-8: It is referred here to the "recovery trend results in Fig 11", however it is not specified which results exactly. STS results? MZM? For all four results shown in Figure 11, I am not sure I see the pattern that is supposed to match the ACE-FTS drift pattern. Should this be Figure 12? If not, could you explain in more detail here where the similarities in the figures are?
- Page 13, line 14: Where exactly are the results changed by up to 2%/decade?
- Page 13, line 17: "limitations in these regression techniques" -> which regression techniques are referred to here? The ones used in this analysis? All four of them

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have the same limitations?

- Page 13, line 25-26: “only a single uniform seasonal cycle should be used for these analyses” -> which analyses exactly are referred to here? Any regression model? Only the ones used here?
- Page 14, line 1: “This study also highlights the limitations inherent in these techniques. . .” -> which techniques are referred to here?
- Page 14, line 8-9: “With sufficient overlap. . .” -> does MLS provide a sufficient overlap with SAGE II and HALOE to allow the suggested analysis?
- Page 23: Maybe add “filtering” in the last line of the figure caption, “. . ., though results with filtering are similar”

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