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Review of the manuscript "A Global Ozone Profile Climatology for Satellite Retrieval Algorithms Based on Aura MLS Measurements and the MERRA-2 GMI Simulation" by J.R. Ziemke

Anonymous Referee #2

Referee comment on "A global ozone profile climatology for satellite retrieval algorithms based on Aura MLS measurements and the MERRA-2 GMI simulation" by Jerald R. Ziemke et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-159-RC2>, 2021

The manuscript "A Global Ozone Profile Climatology for Satellite Retrieval Algorithms Based on Aura MLS Measurements and the MERRA-2 GMI Simulation" by J.R. Ziemke describes a new atmospheric ozone profile climatology built from Aura MLS data in the stratosphere and MERRA-2 Global Modeling Initiative (GMI) simulation data in the troposphere. It replaces a climatology that was based on MLS observations and ozone soundings. The new climatology (12 months, based on the period 2004-2016) is available in 5-degree latitude bands from 90S-90N, and covers the altitudes from the Earth's surface to 80km in about 1km increments. Additionally, a time-dependent climatology of monthly zonal-mean profile ozone anomalies was developed, based on a rotational EOF analysis of Aura MLS observations. These are very useful climatologies and therefore the manuscript provides scientifically interesting analyses and results. The manuscript is very well written, mostly well structured, and the topic lays within the scope of the AMT journal. However, there are a few things that I think would help to improve the manuscript, and that I would suggest the author to consider while revising the manuscript. These comments are outlined below.

I recommend the publication of the manuscript after minor revisions.

General comments:

- Abstract: It is mentioned that the MLS measurements were filtered so only the daytime measurements of MLS were used for the climatology which is beneficial because of the diurnal cycle in ozone in the upper stratosphere and mesosphere. However, that fact is mentioned again in the description of the used MLS observations, but not the results section. Is it then necessary to be mentioned so prominently in the abstract?
- In Section 2.1 the time period of the used MLS data is given as August 2004-December 2016. Does that mean that the climatology is not based on full years only? If so, is the difference in number of data points for calculating the climatology reflected in the climatology somehow?
- In Section 2.2 the abbreviation "MOD" is given as "merged ozone dataset". However, when it is mentioned in the section there are normally additional identifiers given when "MOD" is mentioned, e.g. line 105 "MOD total ozone dataset". I recommend checking the instances where "MOD" is used to make sure that the abbreviation is correctly used.
- In Section 2.3 there is, in my opinion, not enough information given about the ozone sounding database that is used. How many stations are included? How many stations are there per latitude band? And how many soundings per month per latitude band are available? I understand that the ozone soundings are only used for validation purposes in this analysis, but some more information about the number of stations and soundings would be very helpful.
- The structure of Section 4 made it hard to understand the content of the section. The first paragraphs feel almost like an introduction to the section without any specific content which raise all kinds of questions that are answered only a few paragraphs further along. I think it would really help this section to be better understandable if it would be restructured and if in some cases paragraphs would be merged/rephrased/reorganized.

More specific comments:

- Page 5, line 126: It might be good to be more specific about the ozone database, e.g. rephrase to "The used ozone database..."
- Page 5, line 130/131: I think the term "The ozonesondes provide daily ozone profile concentrations..." is misleading. Ozone soundings are on most stations not performed on a daily basis, but only a few times a week. I suggest rephrasing this.
- Page 7, line 187: What does the phrase "have been space-time co-located at the sonde station sites" mean with respect to comparison to M2GMI tropospheric column ozone? Were the M2GMI data used directly for the coordinates of the different sounding stations or the soundings used in latitude bands? Were the M2GMI data used for the specific days when the soundings happened or were monthly means calculated from the soundings and then compared to the M2GMI? Please rephrase and be more specific.
- Page 10, line 236: there are two "." at the end of the sentence.
- Page 11, line 284/285: Maybe it would be worth also to mention what the reasons for the lowest ozone amounts in the different seasons around 20km are?
- Page 12, line 301/302: Should the phrase "Year-round negative differences in the tropics in Fig. 4..." rather be "Year-round positive differences in the tropics in Fig. 4..."? The tropical signal in Figure 4 in the lower and middle troposphere is positive.
- Page 14, line 329: What would be other reasons for the seasonal biases? The text says

“Part of the reason...”.

- Page 17, line 423: “The bottom panel in Fig. 7b...” should be “The bottom panel in Fig. 7a...”, I guess.
- Page 19, line 454-456: I find this sentence a little misleading. You mention in the very last sentence of the summary that long-term trends are not included in the REOF climatology. But how would you use the climatology then as baseline for model and observation comparisons without considering this long-term evolution?
- Page 19, line 469: Here the time period of MLS data used for the REOF analysis is given as “August 2004 – December 2016”, however, on page 17, line 371 it is given as “between January 2005 and December 2016”. Which one is correct?