

Response to Reviewer #1:

Short resume

This paper presents the development of a vertically resolved ozone climatology based on the merging of MLS measurements with model simulations. The presented data set is compared with a previously developed climatology and independent observations. In addition, the authors present an inter-annual ozone profile climatology, which is also compared with satellite observations. Improvements and advantages w.r.t. previous climatologies are well discussed. This paper fits the scope of AMT, it is well written and scientifically sound. From my side, I only have some minor comments on specific aspects and technical corrections.

Specific comments

1. Introduction

I find that the introduction of the paper could be slightly expanded. The authors properly explain the improvements w.r.t. the ML climatology but I would expand if possible the part concerning the usage of this climatology and the issues it tackles, which are mostly already present in the paper but in different sections. Some paragraphs in the paper could better fit in my opinion to the introduction rather than in their current section. For example, the end of section 2.1 where you introduce the studies regarding diurnal ozone variations, with the justification of using only MLS daytime data, should rather be collocated in the introduction than in the data section. Also section 3, first paragraph, when the usage of climatological ozone variability is explained, could also go to the introduction.

Very good point – the Introduction was short, and we have now expanded it discussing applications using the climatologies. Sections 2.1 and 3 discuss some details such as relating to diurnal variability that we thought would be better to discuss in those sections rather than in the Introduction. The ML climatology was based on daytime/nighttime averages and an earlier version of MLS. Also, the ML climatology only went up to 65 km and used ozonesondes for troposphere.

2. General idea/possible additional data set

You show in Fig.2 the zonal asymmetries in the ozone field at 5 km and explain the bias in the ML climatology at the end of Section 3.1. Since you have a high spatial resolution both with MLS and GMI, why not providing also a longitudinally resolved climatology, specially for tropospheric ozone or total column?

We decided to limit this paper to zonal-mean climatologies as in our previous ML climatology papers. Inclusion of longitudinal variability invokes additional uncertainties in mean profile numbers due to non-stationary inter-annual changes in the ozone fields. This especially applies to both the MLS/GMI seasonal climatology and REOF climatology due to large year-to-year regional changes in stratospheric ozone. The paper by Ziemke et al. (2011) produced a gridded

tropospheric and stratospheric (and thus total) column ozone 12-month seasonal climatology based on combined Aura OMI and MLS satellite measurements. Once we do more validation of the GMI model in the lower troposphere, we will consider adding the longitudinal component to the profile climatology.

3. Section 4

I found the description of this section (particularly until beginning of page 16) rather confused with some repetitions and lack of flow. For example, the third paragraph could go at the end as a conclusion of the work done (maybe starting with 'We demonstrated that'. The fourth paragraph could be incorporated into the fifth one, where the step-by-step procedure is introduced. The term 'REOF' is introduced in the second paragraph as acronym but only explained in the fifth one.

Thanks – we have extensively re-written Section 4 under your suggestions. The Section 4 is a general overview with details remaining in the Supplementary Materials.

4. Merging procedure

A simple remark: it is implicitly meant but, I think, never clearly stated that the merging of the profiles occurs on L3 data, i.e. monthly zonal mean MLS data are merged with monthly mean GMI data. I think this could be more clearly stated at the beginning of Section 3.2 or you can say in the MLS data section that you prepared MLS L3 data as you did for M2GMI.

Good point – we describe this now in section 3.2. Yes, merged after monthly means were created.

Technical corrections

P2, 152: I would insert the acronym: 'We have generated a new ozone profile seasonal climatology (MLS/GMI) based...'

Done.

P4, 1105: section→Section

Done.

P4, 1109: Now→currently or presently

Done.

P5, 1134: I would write '...for both sonde measurements and GMI TCO was...'

Done.

P5, 1136: Most all of the→Most

Done.

P5, 1136-138: please move the last sentence of this paragraph to line 131, before explaining the post-processing of the ozonesondes.

Done.

P5, 1141: I would remove 'in its construction' at the end of the sentence.

Done.

P6, 1163: provides→provide

Done.

P6, 1177:

I find the term 'difference standard deviations' not so clear, maybe better 'standard deviation of the differences' of 'RMS of differences'.

Done.

P7, 1193: The section in the supplementary material is S3, not S1.

Done.

P9, 1245: 'similar to the satellite TCO patterns during May'→'similar to the TCO May pattern from satellite records.'

Done.

P12, 1299: 'MLS/GMI minus ML' is opposite to what the title in Fig.4 says. I would also rephrase as 'Figure 4 shows the difference between ML and MLS/GMI zonal-mean column ozone...'

Done.

P12, 1311: I would change to 'the model in this region over-determines the ozone column in DJF by about 2 DU.'

Done.

P13, 1317: I would delete the explanation 'with blue/dashed contours meaning negative, and pink to red solid etc..'

We rephrased this sentence for the color scheme.

P15, 1354: '. The time period for this climatology is 1970-2018...'→', and it corresponds to 1970-2018...'

This has been rewritten in the revision.

P15, 1369: 'The EOF analysis was applied to monthly zonal mean anomalies derived by removing seasonal cycles in MLS...'→'In detail, we removed the seasonal cycle from MLS...'

This has been rewritten in the revision.

P16, 1408: delete 'based on'

Done.

P17, 1424: 'Figure 7b is the same as Fig.7a but for the lower altitude range'.

Done.

Supplementary Material

P13: The comparison with Lidar is in Fig.S11 not S12.

Done.