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Discussions

Interactive comment on "An assessment of Ozone Mini-holes Representation in Reanalyses Over the Northern Hemisphere" *by* Luis Millan and Gloria Manney

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We thank the reviewer for his/her comments. Below is our response.

Reviewer comments:

This is a quality study of the ability of meteorological reanalyses to simulate ozone miniholes. Most of the conclusions are well supported by the presented results. In particular, it is inferred that the dynamics of the reanalysis models at synoptic scales is deficient and that this is the main reason why the reanalyses do a poor job of simulating ozone mini-holes. My only real negative comment concerns the last paragraph of the Conclusions section on page 9. It states that: "In general, MERRA-2 seems

to represent mini-holes more accurately than the rest of the reanalyses." I don't understand where this statement is supported in the rest of the text. For example, it is noted several times that ERA-Interim underestimates the number of mini-hole events the least among the reanalyses (34 per cent). Figure 4 shows that the number of events per month is underestimated less by ERA-Interim than by MERRA-2. Only in Figure 6 is there any indication that MERRA-2 might do slightly better in identifying specific mini-holes found in the OMI measurements (238 matches as compared to 214 for ERA-Interim). So, I think this last paragraph needs to be modified to at least say that ERA-Interim does about as well as MERRA-2. ERA-Interim also assimilates the OMI and MLS ozone data. Overall, the final paragraph of the conclusions section and the data availability section 7 sound a little too much like an advertisement for using reanalysis data to study ozone variability on short time scales. It mentions that "Independent comparisons performed by Wargan et al. (2017) suggest that MERRA-2 upper tropospheric and stratospheric ozone are of sufficient quality for studies requiring high-frequency, highly resolved global ozone maps and variability consistent with dynamics." This sentence needs to be removed in this reviewer's opinion. The results of this study clearly show that none of the reanalyses is of sufficient quality for this purpose. Any future studies of ozone mini-holes, for example, must use actual satellite ozone measurements such as OMI. This should be the main conclusion of the paper. Please revise the text.

Response:

The last paragraph in the conclusion will be modified to:

In general, MERRA-2 seems to represent mini-holes marginally better than the rest of the reanalyses (see Figure 6 and 7), likely because MERRA-2 assimilates OMI and MLS ozone throughout the comparison period. CFSR assimilates only SBUV/2 ozone, and performs similarly well to ERA-Interim, which assimilates OMI and MLS ozone during 2008 and after mid-2009. This suggests that the dynamics produced by the reanalyses are more important than the assimilated ozone fields in reproducing mini-

holes.

Because of the mismatch between the mini-holes found in OMI and the mini-holes found in the reanalysis fields, careful attention needs to be paid to ensure that the regions used to study them coincide with regions where the reanalysis fields display mini-hole conditions. That is to say, it is insufficient to identify the mini-hole position in the data and then see what the reanalysis fields do at those exact locations. Rather, one should find the nearby mini-holes in the reanalysis fields, see whether their characteristics (magnitude, timing) are similar to those in the OMI data, and if they are, study the meteorological conditions at those locations. Because none of the reanalyses fully captures mini-hole features and distributions, the satellite data remain an essential tool for studying ozone mini-holes.

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