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Atmospheric Measurement Techniques Discussions

Interactive comment on "Verification of the AIRS and MLS ozone algorithms based on retrieved daytime and nighttime ozone" *by* Wannan Wang et al.

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We thank the reviewer for their constructive comments and useful suggestions.

Comment 1: Line 25-26: significant threat of CFCs and other . . . (remove 2 'the's). Line 47: Remove the leading 'The'. Line 48: is the most used method. . . (add 'method'). Line 49: . . .occultation method. . . (add 'method'). Line 60: . . .day and night or issues with. . . (add "issues with"). Line 63: I suggest: "daytime values have a low bias due to errors in the retrieval method". Line 65: Change profile to profiles. Line 71: upper or lower stratosphere? Line 72: add "the" to Chapman cycle. Line 87: Hydrogen and molecular what? Line 149: efficiency. Line 220: replace 'that is why O3 low over" with

"causing low O3 over". Line 222: use "loss due to photochemical mechanisms". Line 271-272. It is necessary . . . This sentence is confusing. Please rewrite.

Response 1: We agree with these grammatical changes. Besides, we have revised other grammar issues throughout manuscript including text and figures.

Comment 2: Line 99: A reference to the recent Frith et al paper on diurnal changes in ozone would be useful.

Response 2: Results reported by Frith et al. (2020) are meaningful. We have added this paper in manuscript.

Comment 3: Lines 124-129. Why is version 5 being discussed? In line 200 you discuss the different MLS versions and state that there in not much difference. But there is no discussion of AIRS V5 vs V6 in the paper. Either add a discussion on those differences between V5 & V6 or remove all references to V5. BTW, V7 is coming out sometime soon. Lines 162-165: see question from Line 124. Line 248-250. Ah ha! There is the discussion about V5 AIRS. Please move up to Line 124 and add more information on where/when/why the ozone values were different and by how much. Or just drop the discussion all together.

Response 3: We generally introduced AIRS ozone retrievals accuracy in 'Data' section 2.1 (Lines 120-129 in original manuscript) and discussed improvements between versions in 'Result' section 3.1 (Lines 162-170 in original manuscript) and summarized in 'Conclusions' section 4 (Line 248-250 in original manuscript). And do the same for MLS in section 2.2 and 3.2. In order to make it more clear, we removed accuracy introduction of AIRS V5 specifically in 'Data' section 2.1 as you suggested.

Comment 4: Figure 1. Why were the scales changed in plot E? It is better to keep the same scale for all plots.

Response 4: We have changed Figure 1e scales to be the same as the others.

Comment 5: Figure 5 & section 3.3: By far, the most interesting feature in these plots

has gone unnoticed (or undiscussed). Why does the difference between MLS and AIRS look so different in figure 5b and so similar in all the others?

Response 5: The differences of the monthly 14-year average daytime AIRS SCO and MLS SCO in 60°S-60°N (Figure 5b) have greater amplitudes than in the polar zones (Figure 5d and 5f). This associates with clouds and the surface type which affect the AIRS ozone retrievals. Seasonal or random changes of clouds and surface emissivity have more significant impact on each monthly AIRS SCO retrieval than on the MLS SCO retrieval. Compared with the 60°S-60°N region, surface types in polar zones are less diverse (snow or ice) and more stable. Therefore, the monthly 14-year average daytime AIRS SCO and MLS SCO show in the polar zones similar patterns. We have added this discussion for Figure 5b in the revised manuscript.

Comment 6: Figure 6 is interesting but confusing. How do you define “low ozone” for AIRS and MLS? There are not many points in fig 6d leading this reviewer to wonder if the MLS lines in 6f are meaningful. Could you please explain a bit more what you are trying to point out with these plots?

Response 6: According to the WMO, the Antarctic ozone hole is defined geographically as the area where the total columns of ozone are less than 220 DU (Fahey and Hegglin, 2011). Generally, the ozone hole is well known to appear in Antarctica. However, there also exist well-known low ozone regions outside of Antarctica. We used this phenomenon to illustrate the importance of the small biases in AIRS and MLS.

Figure 6b shows for MLS, the low ozone regions appear in large areas at night besides in tropical western Pacific. However, Figure 6d shows the occurrence frequency and intensity of daytime low ozone regions by MLS SCO retrievals drastically reduces and exists mainly in tropical western Pacific. The yearly and monthly averaged AIRS TCO and MLS SCO of the low ozone regions show no consistency and regularity in Figure 6e and 6f. The analysis of daytime MLS SCO of the low ozone regions is based on only a few observations. The evaluation of day-night differences in both

MLS and AIRS has revealed the existence of biases in the satellite data. We cannot distinguish whether it is an algorithm problem or a chemical mechanism that caused this phenomenon. Therefore, our results show that maintaining the quality of the satellite observations of stratospheric ozone is highly relevant.

Please also note the supplement to this comment:
https://amt.copernicus.org/preprints/amt-2020-194/amt-2020-194-AC1-supplement.pdf

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