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Atmospheric Measurement Techniques Discussions

AMTD

Interactive comment

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

Wannan Wang et al.

wang_wannan@163.com

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

Comment 1: Line 44: The BAMS SOTC report also includes annual updates every year beginning 2013 of tropospheric ozone including trends and effects from El Nino.

Response 1: We have added: "The Bulletin of the American Meteorological Society (BAMS) annually publishes its "State of the Climate", which includes tropospheric O3 trends and effects from El Nino-Southern Oscillation (ENSO)".

Comment 2: Lines 56-58: Central to your analysis is the assumption that true diurnal variability of atmospheric ozone affects mostly just the BL and the upper stratosphere/mesosphere, neither of which contributes much to either AIRS total column ozone or MLS stratospheric column ozone. This seems to be a valid assumption. In the Introduction you discuss details driving diurnal variability, especially for stratospheric and mesospheric ozone where you give some numbers. For tropospheric ozone diurnal variability, a study by Strode et al. (2019, Atmos. Env.) using a photochemical transport model indicated that diurnal variability in global tropospheric column ozone appears very small, at most only ∼1-2 DU in some regions such as central Africa, India, and east Asia (their Figure 11). Strode et al. provides at least some estimated numbers in DU for global tropospheric ozone diurnal variability that you might include for your paper. These are small diurnal changes in tropospheric column ozone which further reinforce your conclusion that the main issue seems to be an over determination of day-night differences in AIRS total ozone. I.e., as you discuss in Section 3.3, your Figure 5 for 60S-60N shows much larger inferred day-night AIRS minus MLS (TOR) differences of about 5 DU, with most of it coming from AIRS total ozone.

Response 2: We have added: "Strode et al. (2019) simulated the global diurnal cycle in the tropospheric O3 columns, their results indicated that the mean peak-to-peak magnitude of the diurnal variability in tropospheric O3 is approximately 1 DU". Results reported by Strode et al. (2019) supported our results in Figures S3 to S6 in the supplement that AIRS TCO retrieval artefacts dominate the day/night variability of tropospheric O3 residuals (TOR = AIRS TCO – MLS SCO).

Comment 3: Line 215: More specifically for MLS it is mostly for the SH Antarctic region and it seems to be very large. The abrupt change of about 30 DU in 2015 for MLS in Figure 5e for the Antarctic region suggests that something changed significantly with the MLS v4.2 retrieval (and for the better). In addition, there are huge day-night differences for MLS in Figure 5f that are greatest in September-October during the Antarctic ozone hole with numbers of 60-70 DU. It is also noteworthy that AIRS day versus night total ozone differences appear smaller at ∼2-3 DU in both polar regions

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compared to ~5 DU for 60S-60N. (I may not have inferred these numbers very precisely since vertical scales are all different for the three regions.) In your paper you mention AIRS day-night differences associated with ocean scenes via cloud patterns and also mostly over dry land areas likely related to surface emissivity issues. This seems to be consistent with AIRS in Figure 5. Your Figure 5 is very interesting and you might discuss more about the features.

Response 3: We have added more discussion about Figure 5 as follows "AIRS SCO retrievals show smaller day-night differences in the polar zones (1-2 DU) than in 60°S-60°N (4-5 DU). This is related to clouds and the surface type which affect the AIRS O3 retrievals as mentioned above. Figure 5b shows monthly 14-year average daytime AIRS SCO and MLS SCO in 60°S-60°N for 2005-2018. Seasonal or random changes of clouds and the surface emissivity issues have more significant impact on each monthly AIRS SCO retrieval than on the MLS SCO retrieval. Compared with 60°S-60°N region, surface types in the polar zones are less diverse (snow or ice). Therefore, the monthly 14-year average daytime AIRS SCO and MLS SCO in Figure 5d and 5f show similar patterns. Figures 5c to 5f also confirm that MLS SCO has a polar bias when compared with AIRS SCO at high latitudes. In addition, for MLS SCO in Figure 5f, the biggest day-night differences (50-60 DU) occur in September and October during the Antarctic O3 hole."

Comment 4: Line 140: "...accuracy was estimated at ~40 or ppbv +5% (~20 140 ppbv or +20% at 215 hPa)." Please clarify sentence.

Response 4: We rephrased this sentence as follows "Livesey et al. (2008) estimated the MLS O3 accuracy as ~40 ppbv ± 5% (~20 ppbv ± 20% at 215 hPa)".

Comment 5: Line 255: "... (< 1 DU for the upper atmospheric SCO), expect in the upper stratosphere and mesosphere." Please clarify sentence. There are other typos and wording/sentence issues throughout the paper that you will find upon re-reading the current manuscript.

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Response 5: We rephrased this sentence as follows “MLS day-night differences in SCO and O3 profiles show that day-night differences are only small (< 1 DU) and likely to be in the upper stratosphere and mesosphere”. Besides, we have revised other grammar issues throughout manuscript including text and figures.

Please also note the supplement to this comment:
https://amt.copernicus.org/preprints/amt-2020-194/amt-2020-194-AC2-supplement.pdf

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