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Atmospheric Measurement Techniques Discussions

Interactive comment on "Ozone Comparison between Pandora #34, Dobson #061, OMI, and OMPS at Boulder Colorado for the period December 2013–December 2016" *by* Jay Herman et al.

Jay Herman et al.

jay.r.herman@nasa.gov

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 Interactive comment on "Ozone Comparison between Pandora #34, Dobson #061, OMI, and OMPS at Boulder Colorado for the period December 2013–December 2016" by Jay Herman et al. R. Chatfield (Referee) Robert.B.Chatfield@nasa.gov Received and published: 30 June 2017 Review of Herman et al.

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Discussion paper

Reply: I will incorporate the replies into the paper after the second review (if any).

This is a good basic publication which just needs clarity and precision. Conclusions regarding trends in retrieved ozone need more modest standard error estimates, I believe The authors appear to make two assumptions: (a) That “significance” means a 5% (? not stated) chance of Type 1 error (false acceptance) with a Gaussian distribution of errors.

Reply:The error estimates given are 1 standard deviation STD estimated from the least squares linear fit process. The error of the individual points was described in the previous paper as 1% with a precision of 0.1%. Most of the variation seen in the data is “natural” variation”. It is clear that the error bars are large enough to make the statistical significance of some of the slopes marginal (see OMPS vs Pandora; 0.19 +/- 0.1). Some of the others are significant (see OMPS vs Dobson: -0.4 +/- 0.09) at the 2 STD level.

(b) That the “number of relevant samples” is the number of individual observations, apparently as averaged for 80 seconds for the PANDORA, the number of individual observations (averaged over 8 minutes, or once daily?) of observation recorded for the Dobson, and the number of days of observation (maximum once per day?) for OMI and OMPS.

Reply: Each Pandora data point is an average of 4000 measurements obtained during 20 seconds. All data for this study were clear-sky within the instrument’s field of view based on the Dobson criteria for A-pair direct-sun clear sky. In addition, the Pandora data are averaged over a period of +/- 8 minutes surrounding the Dobson time of measurement (2 to 3 times per day). Pandora measurements are obtained every 80 seconds that means there were an additional 10 Pandora data points averaged together to compare to each Dobson measurement. The net averaging of Pandora is 40,000 (4x104) measurements for each comparison. The same procedure was used for comparisons with OMI and OMPS, where they measure once or twice per day over

Boulder, Colorado.

For some comparisons, "data were selected for scenes that are clear-sky conditions as determined from the Dobson A pair" For all?

Reply: All Dobson vs Pandora, OMI, or OMPS scenes were clear-sky A-pair using the Dobson criterion Reply: All Pandora vs OMI and OMPS were clear sky using the Pandora criterion âĂČ How many days? Each of these numbers should be stated in the relevant context .

Reply: Dobson vs Pandora has 1326 points with 1 to 3 points per day OMI vs Pandora has 637 points with 1 -2 points per day OMPS vs Pandora has 956 points with 1 – 2 points per day OMI vs Dobson has 636 points with 1 – 2 points per day OMPS vs DOBSON has 833 points with 1 - 2 points per day

There are many statistics quoted where the reviewer was confused. Please describe each. The appropriate statistic to quote is the p-value (0.05 ??) with the number of observations used in each statistic, and one- or two-sided calculation, where there could be confusion. For example, a p–value of 0.10 would suggest to the reviewer that there was something worth further investigation. The point of maximum confusion for the reviewer was the discussion of drift. What number of samples was used? The eye sees that “independent” observations seem to occur often due to some rapidly changing condition: experimental error in one or both instruments, or rapid weather variation?

Reply:There is weather variation in ozone – see the first paper on Boulder Colorado – that is mostly day to day variation. Averaging over a week removes most of the weather variation.

Lowess(0.1), reference, explain “0.1)”?) Reply: Lowess(0.1) means that 10% of the total data were least squared averaged to form a smooth curve. It is the same as a “running average” except in the use of least squares instead of a linear average.

Lowess(1) would give a tradition linear least squares. This was explained in the original referenced paper.

The smoothed lines (which smoothing for Figure 3 as Figure 2. suggest that “weather” variation has a substantial impact on the smoothes and indeed the trends, especially in Figure 2. The smoothes for Figure 2 appear somewhat more convincing, but the uncertainty of 0.1% seems to be based on number of all samples rather than some partial contribution from “weather variability.” One could guess a synoptic value of “five days per synoptic episode” and calculate a debatable approximate “number of samples” but the more appropriate value would be derived from a time series analysis which allowed for longer time-scales in that algorithm. In fact, there is enough excellent data here for most series to justify a more careful time-series analysis. For this publication, a disclaimer saying that “weather variability” could allow for a larger uncertainty in the apparent divergence is acceptable. In this case, “weather” is longer than one day but probably shorter than three years. Similar comments apply to the +/- 0.002 in Figure 1.

Reply: Since this paper is supposed to closely follow a 15 minute presentation at QOS, I will state that there is some weather variation and leave detailed statistical analysis for the future.

(minor points: explain acronym CCMI; Reply:CCMI is Chemistry–Climate Modelling Initiative

Reply: The acronyms for OMI and OMPS are given in the opening paragraph “Additional comparisons are made with satellite overpass data from OMI (Ozone Measuring Instrument on board the AURA spacecraft) and OMPS (Ozone Mapping Profiler on board the Suomi NPOESS satellite).”

perhaps OMI and OMPS are named on web pages, but could explained) This will be a nice addition to the description of stratospheric (and tropospheric) change and tropospheric change (TOAR). We may hope that the advent of many PANDORA instruments will add to a better discrimination of the variability and secular change of ozone as a

function of altitude. Minimal re-review is expected.

1. Does the paper address relevant scientific questions within the scope of AMT? Yes 2. Does the paper present novel concepts, ideas, tools, or data? Yes, Data 3. Are substantial conclusions reached? Yes, sufficient when they are qualified as noted 4. Are the scientific methods and assumptions valid and clearly outlined? Correctable. See notes above 5. Are the results sufficient to support the interpretations and conclusions? Ditto 6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? Ditto 7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? Yes 8. Does the title clearly reflect the contents of the paper? Yes 9. Does the abstract provide a concise and complete summary? Yes 10. Is the overall presentation well structured and clear? Yes 11. Is the language fluent and precise? Yes, but see 4. 12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? Yes, minor additions needed for abbreviations, see above for e.g. “significant” and “Lowess(0.1)” 13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? No 14. Are the number and quality of references appropriate? Yes 15. Is the amount and quality of supplementary material appropriate? Yes

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