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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Deriving tropospheric ozone from assimilated profiles" *by* Jacob C. A. van Peet and Ronald J. van der A

Anonymous Referee #2

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This is an interesting paper on determining tropospheric ozone from the assimilation of satellite measurements. The assimilation of satellite measurements is an important modern concept in determining global daily fields of trace constituents, one of those being tropospheric ozone. I suggest publication of this paper with mostly minor comments/changes listed below.

There are two main points to this paper and they are (1) testing TM5 assimilation versus TM5 free-running simulation, and (2) testing the quality of measuring 0-6 km column ozone from direct vertical integration, versus a "residual" difference from independent product/assimilation. Neither of these are particularly strong science points by themselves, but certainly fine to include in this study.

Two TM5 CTM simulations are compared, one simulation including assimilated METOP

GOME-2 and Aura OMI satellite measurements, and the other simulation being free-running that does not include assimilation of these measurements. A conclusion made, perhaps not all that surprising, is that the TM5 assimilated run which includes satellite measurements does better than the free-running TM5 model run. A question is why would we expect that a free-running simulation could compare better with ozonesondes than using TM5 with assimilated measurements?

Part of the analysis also involves comparing integrated ground-to-6 km column ozone (FAT column) from TM5 with a "residual" ground-to-6 km ozone calculated by differencing MSR total ozone minus TM5 modeled ozone column (from 6 km to top of atmosphere). If I understand correctly, the MSR total ozone is an assimilated data product for 1970-2017 that is independent of the TM5 modeled/assimilated ozone fields in the current study. MSR total ozone is derived from a composite of several satellite ozone measurements. (Line 4 page 4 actually says "from all available satellite measurements".)

The 0-6 km residual column ozone for comparison is derived by taking MSR DOAS total ozone and subtracting from this UV/VIS assimilated column ozone lying above 6 km. These are two very large column measurements

Differencing two large and independent column ozone measurements will be noisy due to basic statistics involving their inherent precision and accuracy numbers. It is not surprising that directly integrated 0-6 km FAT column ozone will be less noisy and will compare better with the ozonesondes. Are there any estimates for accuracy and precision for these two large independent columns that can be stated in the paper, or maybe better yet, an estimate of the accuracy and precision of the final derived 0-6 km residual ozone from their differences?

Also, directly integrated 0-6 km FAT column ozone ingests satellite UV/VIS measurements in the assimilation run; these satellite measurements have largely reduced sensitivity in detecting column ozone in the 0-6 km low-troposphere, perhaps up to 40%

or more. The DOF of ∼1.2 in the tropics for GOME (line 14, page 9) as stated is a very good number, but it doesn't indicate how much real ozone variability is lost below 6 km due to insensitivity to ozone in the satellite retrievals. It may be that a lot or most of the 0-6 km column amount is coming from CTM modeling and retrieval climatology (for the UV/VIS assimilation run) rather than real measurement. It would be important to at least give some numbers for OMI and GOME-2 retrieval sensitivity for directly integrated 0-6 km column ozone, even if only qualitative.

SPECIFIC MINOR COMMENTS:

Line 6 in Abstract: "assimilated"

Paragraph starting Line 26, page 2: Should include reference(s) for TES/IASI IR retrieved ozone.

In the paper I'm assuming that RMS refers to standard deviation everywhere.

In Figure 2 and Figure 3, how actually are the uncertainty bars calculated? Are they all plotted as +/- one-sigma?

I was hoping that there were some more FAT comparisons with ozonesondes in the Figure 6 time series. The current Figure 6 compares only three sites, at latitude -70.7 deg, +19.4 deg, and +60.1 deg, but nothing for mid-latitudes. Including a couple of sites in mid-latitudes would help this figure and conclusions.

There are several typos in the manuscript that the authors may have already found and corrected.

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