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Atmospheric Measurement Techniques Discussions

Interactive comment on "Sensitivity of the OMI ozone profile retrieval (OMO3PR) to a priori assumptions" *by* T. Mielonen et al.

Anonymous Referee #1

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The paper Sensitivity of the OMI ozone profile retrieval (OMO3PR) to a priori assumptions by Mielonen et al presents a series of sensitivity studies performed on the operational OMI retrieval schemes in order to improve the quality of the retrievals and reduce systematic biases found by Kroon et al (2011), particularly in the troposphere. These sensitivity studies are done by comparison of ozone retrievals from the operational and modified schemes from OMI measurements of one or several orbits. The paper is well written in general and mostly clear in the text. However, captions and legends of the figures need to be more explicit and better explained for sake of clarity. The general approach is interesting and the assumptions that are tested (radiance corrections, surface albedo, a priori profiles, constraint matrix) sequentially are indeed very important for the quality of the ozone retrievals. However, the improvement of the

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modified scheme is only commented in relative terms with respect to the operational approach and in average for all pixels. The comparison with ozone sondes is only briefly explained in the text and reader needs to see the paper by Kroon et al (2011) for understanding the biases as a function of altitude that are intended to be reduced. Additionally, the comparison with IASI retrievals is an interesting approach for verifying the regional consistency of the retrieval, although explanations and figures lack of important information for a complete understanding of the comparison.

In order to be publishable, my main recommendations for the paper are the following:

(1) In the current paper, clearly show as a function of altitude the results of the comparison of the operational ozone retrievals against ozone sondes from Kroon et al (2011), and compare them with the results of the new modified scheme. I suggest doing this in a detailed dedicated table or if possible, in a panel of a new figure that would also show in another panel the comparison between ozone retrievals of the operational and the new modified schemes.

(2) Comparison with IASI retrievals: the differences between the IASI and OMI ozone retrievals in terms of sensitivity as a function of altitude should be clearly presented. I recommend adding new figures showing the differences in terms of degrees of freedom in the lower troposphere and the altitude of maximum sensitivity within this layer. In the comments of these results, it should be clearly stated whether the improvement of the results from OMI are obtained only in the background values of ozone or it corresponds to regional differences (with ozone plumes or lower ozone abundances) and the link with the modifications in the OMI scheme. Moreover, I suggest commenting these regional/background differences by showing explicit figures with the lower troposphere ozone distribution over Europe (not only differences) from IASI and OMI (at least from the modified version). Another aspect that should be mentioned in the comparison is the difference between IASI and OMI in the overpass local time and how this would affect the lower tropospheric ozone abundances.

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(3) Clarity of figures and captions: a significant effort is to be done in order to complete the captions of the figures clarifying the datasets that are used, the units and what is the quantity that is shown. Each figure with its caption is to be clear and explicit by itself with no need to read the main text to understand it. In many figures (1, 2, 4 and 6) the legend included “mod” and “orig” is used, which is not clear for the reader. I suggest using clearer terms and not generic ones, and clearly indicate in the caption what they are. This applies as well to the term “differences in O3” used in many other figures. Which unit is used for O3 concentration? Differences from what with respect to what? In many cases (figures 3, 5 and 8), much more curves are shown that are not detailed in the legend, thus they are difficult to understand. All curves should be included in the legend.

(4) Sensitivity to the surface albedo: Since it depends on surface properties, I recommend showing this sensitivity test as a function of latitude/altitude. As comments are already given in the text, figures should show these regional differences.

(5) The previous remark also applies for the sensitivity test with respect to the ozone climatology. Regional and latitude-dependent changes are also expected when changing the ozone climatology. I suggest adding a new figure comparing the operational and the modified version (the best one) as a function of latitude/altitude.

Other detailed aspects are the following:

(6) Page 1836, Line 15: I suggest adding “AS EXPECTED, we found that the a priori covariance . . .”

(7) Page 1836, Lines 17-19: Please clarify “equally”. What about mean biases of the retrieval? Do they depend only on the assumed a priori errors?

(8) Page 1836, Line 26: please clarify at which altitudes tropospheric ozone is a greenhouse gas and where it acts as a pollutant.

(9) Page 1837, Line 2: indicate the typical lifetime of ozone

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(10) Page 1837, Lines 7-23: The capability of TIR sensors (IASI and TES) for retrieving ozone and tropospheric ozone should be introduce in this section.

(11) Page 1837, Line 15: The statement on the fine horizontal resolution applied also for IASI, whose pixels are comparable to those of OMI.

(12) Page 1838, Lines 15-18: Other validation papers of this IASI ozone retrieval should be cited: Keim et al., 2009 ACP and Dufour et al., 2012, AMT.

(13) Page 1839, lines 29: the consequences of not modeling clouds in the retrieval should be explained. What is the lost of precision for partially cloudy pixels? Are cloud fractions used in the retrieval? How? From which source?

(14) Page 1840, lines 12-17: Please better explain, fitting is done between what and what? What is done within the ozone retrieval scheme?

(15) Page 1843, lines 18-19: Please, explain why there is an improvement for ozone precision with a linear fit of albedo with respect to a second order polynomial fit.

(16) Page 1848, line 1: “shows shows”, Please correct.

(17) Page 1848, lines 17-18: Please, justify this modification with minimum a priori errors of 10% or 20%. What does it represent? Why we would do this modification to climatological values?

(18) Page 1849, line 11: The formula is not clear, please correct.

(19) Page 1849, lines 25-27: It does not seem very clear, please clarify.

(20) Page 1850, lines 21 and elsewhere in this section: Please better identify the regions that are mentioned (e.g. where is the Bay of Biscay? which outskirts of Europe?)

(21) Section 4: The location of pixels with partial cloud cover should also be considered in the analysis. Please add a corresponding figure of cloud cover that might explain differences in ozone abundances.

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(22) Figure 9: Squared structures (of 5x5 or 6x6 degrees in latitude and longitude) are evident in the differences of the ozone retrieved by the differences schemes. Please, clarify why these structures is present.

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