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Atmospheric Measurement Techniques Discussions

Interactive comment on "Tropospheric ozone and ozone profiles retrieved from GOME-2 and their validation" *by* G. M. Miles et al.

Anonymous Referee #2

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The paper by Miles et al. titled "Tropospheric ozone and ozone profiles retrieved from GOME-2 and their validation" describes the process of the new retrieval algorithm for ozone profile product from satellite GOME-2 measurements. Special emphasis is given to determine an accuracy of the derived tropospheric ozone global field. The paper describes details of GOME-2 measurements, spectral resolution, methods of the spectral fitting, limitation of the remotely sensed information, process for error analysis, averaging kernels and approach for validation of the retrieved product. Results of the paper are very detailed and the paper is well written. Summary includes proposed steps to address remaining spectroscopic issues in the tropospheric ozone retrieval. I suggest the paper for publication after minor revisions are made to address the following comments.

Comments.

p. 7927, lines 19 and p. 7928 line 20. There are two descriptions of band 1 and band 2. In the earlier section Band 1 is described as (240-315 nm), while in the second section it is defined as "<307 nm". The same discrepancy is found for band 2 (310-403 nm vs 323-335nm). It is understandable that not all of the spectrum can be used in the retrieval. However, it should be mentioned in the text, may be band 1a, 1b and 2b?

p. 7928, line 19-21. Not sure about the point you are trying to make by referring to albedo derived from the longer spectral wavelength of band 1 as being inappropriate for use in band 2. Why did you specify the use of the long wavelength from Band 1? It is stated earlier in the text that the derived albedo is spectrally independent. Unless you want to emphasize that surface albedo should be spectrally dependent in the band 2 retrievals, and this is an error in the retrieval scheme. It is not discussed later in the text, thus I do not see the reason to emphasize it. Just say that the albedo derived from the band 1 cannot be used in retrieval in band 2.

p.7931, line 2. "a priori error covariance matrix (Sa). May be it is even better to rewrite this sentence to make it more clear, such as: For the Band 2 retrieval the ozone profile derived from the Band 1 data is used as the a priori profile. In addition, the a priori error covariance matrix Sa is modified in the region of the UTLS by using an 8km Gaussian correlation length to further stabilize the Band 2 ozone retrieval.

p. 7938, lines 10-24. This section is dedicated to the discussion of the AK results. Figure 3 is referenced. However, there are 4 panels shown in Figure 3,with only second panel from the top to represent AK as function of altitude and latitude. You should give panels a reference (a-d) to help with discussion in section 3.2 Then you can say Figure 3a shows ozone cross section,. . ., 3d shows an improvement of the retrieved error as compared to the a priori. It is actually very well written in the Figure 3 caption, but it is hard to understand from the discussion. "The largest improvement (it is expected that result of Fig 3d are discussed here) upon prior uncertainty in the example given here is

found in the UTLS region at mid to high latitudes, where it is reduced in places to less than 20% of the prior error (so, it is Fig. 3c that is discussed, right?)."

Also, please specify UTLS altitudes.

If authors would like to discuss the "improvement" in the retrieved errors, then the a priori variance should be given as a reference (possible to include the a priori variance as additional panel in Figure 3?). But then it might be better to use panel d (bottom panel) that clearly shows relative change in the retrieved variance. Moreover, I would not use the "improvement" but rather "reduction in retrieved variance". It is possible that the algorithm underestimates the retrieved errors, or it could be too conservative to capture true variability as defined by a priori. Thus, it is not an "improvement". The accuracy of the retrieval is further assessed in the validation from comparisons with other measurements, which is a good place to use the word "improvement".

p.7939. line 10 . Reference to Fioletov etl (2008) paper is inappropriate here. Paper only discussed the total ozone column comparisons against satellite ozone column measurements. Also in the list of references Fioletov name is misspelled. You can use either the web site of the WOUDC (www.woudc.org) and NDACC (www.ndsc.ncep.noaa.gov, ozone and aerosol sondes working group) or find another paper that can be a good reference to the ozone sonde measurements taken by multiple stations around the world . It may be useful to provide the number of ozone-sonde stations per latitude band (30S-30N, 30-60 S/N, and 60-90N) used in this analysis. If it is less than 20 – it can be listed in the table. Otherwise it is not clear which part of the geographical domain this validation mostly represents. It is possible to add number of sounding stations (or profiles used in the comparison) to Figure 6.

p.7942 lines26-27, p. 7943, lines1-2. The large bias for 60-90 S is probably not because of the wrong a priori, but rather due to poor sensitivity in the AK between 10 and 25 km altitude.

p.7944-7945. section 2.3.2. It is not clear what the colors represent in the bottom two

panels of Figure 8 (scatter plot of TOMRAD and GOME 2, AKGome2). Can you please add explanation? This section could benefit from providing the reason for including comparisons with the model. If GOME 2 is used to validate TOMRAD, please indicate it in this section.

p.7945 Figure 9 – The correlation coefficients for China region are higher between TOMCAT and a Priori than between TOMRAD and GOME 2. Is it correct?

p. 7946, last line of Summary: "We would also wish to remove the retrieval of an ozone absorption cross-section shift which should add significant information." Please give more explanation as it is not clear what you are planning to do and why it is important.

Technical corrections: p.7930, line24. "month and latitude" p.7930, line 25. a priori error covariance matrix (Sa) – you can introduce Sa for further reference here. p.7931, line.20. change to Visible/InfraRed p.7931, line 24. replace "little" with "limited" p.7942, line 13. The meaning of the sigma should be explained, i.e. . . . σ (see discussion of Eq. 6, and Figure 3, panel c) . . . p. 7942, line 14. Should be Eq. 15 p. 7942, lines 21-22. Appears that the panels in the Figure 6 are mislabeled (AK and RT). I would also keep Figure 6 in altitude pressure coordinates rather than in pressure. It is confusing to have it compared with other earlier plots.

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