Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC3
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# Comment on amt-2021-61

Anonymous Referee #1

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Referee comment on "Total ozone column from Ozone Mapping and Profiler Suite Nadir Mapper (OMPS-NM) measurements using the broadband weighting function fitting approach (WFFA)" by Andrea Orfanoz-Cheuquelaf et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-61-RC3, 2021

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## General Comments

The authors have implemented a total ozone algorithm for the Ozone Mapping and Profiler Suite (OMPS) Nadir Mapper (NM) based on a technique they call the Weighting Function Fitting Approach (WFFA). The purpose of the algorithm is to estimate total ozone from OMPS NM coincident with OMPS LP stratospheric column ozone, and compute the tropospheric column by taking their difference. As such, the algorithm has been applied only near nadir and in cloud free conditions. The authors explain the WFDOAS approach is not the optimal to retrieve total ozone (TO) from OMPS NM due to the relatively low spectral resolution of the instrument which negatively impacts analysis of the differential spectrum. In the WFFA method the primary algorithmic changes increase the width of the fitting window and reduce the low order polynomial to a constant term. With these modifications, the WFFA method fits the spectral slope of the ozone absorption in addition to higher order structure. The first half of the paper describes the algorithm. The second half details validation of the total ozone retrievals using other datasets that are well known in the field. The total ozone results presented in the second half of the paper look quite good and therefore I feel this algorithm is very promising. However I have some questions about the algorithm and how it has been presented. I recommend the authors address the following to significantly strengthen the paper.

## Specific Comments

1. The authors have made an unusual accommodation to get good results from their OMPS NM retrievals - they have achieved their results using only alternating pixels in the OMPS NM spectra. Oddly, this works when odd-numbered pixels are used in the retrieval. When even-numbered or all pixels are used, the results are unstable from one retrieval to the next and a bias is observed. I think it is important in this paper to provide further information on this instability. The issue raises questions about the performance of the algorithm, the instrument, or both. Do the authors have an idea why the WFFA method gives reasonable results in the one specific case? Perhaps the fitting of the spectral slope to determine TO is affected by end-point sensitivity of the fit? The authors use a fitting

window of 316-336 nm in their algorithm. Does an adjustment of this window to include/exclude 1-2 spectral points at the window edges produce a more stable retrieval when all spectral pixels are used? Are there any particular spectral features at the edges of the fitting window that complicate a reliable spectral slope determination that might show as a noticeable pattern in fitting residuals? If the authors think the issue is related to quality of OMPS NM spectra, this should be stated. It is worth nothing that colleagues at BIRA have successfully retrieved total ozone from OMPS NM with the GODIFT v4 algorithm to produce data consistent with the GTO-ECV record. I am aware of no similar issues with processing OMPS NM data.

2. The explanation of the insensitivity of the WFFA algorithm to absorbing aerosols and other broadband contributions should be explained better. The WFFA approach fits the spectral slope to estimate the ozone absorption signal, but several other geophysical effects may also affect spectral slope. The authors assume an aerosol-free atmosphere in their forward model and retrieve an effective scene albedo at 377 nm using the LER approach, so albedo wavelength is 40 - 60 nm from the edges of the fitting window region. Absorbing absorbing aerosols can produce several percent in spectral dependence in the radiance signal in this spectral region. The authors state the aerosol effect is largely accounted by the effective scene albedo, but I feel given the nature of the algorithm this may be an oversimplication. How can we be better assured of this? It is true that results shown later there are no significant ozone anomalies in regions of high aerosol load. But I cannot explain why. The WFFA algorithm may well be as insensitive as authors claim, but it would be useful for the reader to know the reason(s), and clarify circumstances where residual error may grow to be significant. Absorbing aerosols are common in the tropical regions and these are regions where tropospheric ozone is of particular interest. Since tropospheric column is a relatively small fraction of the total column, small errors for TO can be non-negligible for tropospheric ozone determination.

3. The sensitivity of the algorithm to tropospheric ozone is not discussed in the paper. This should be addressed in some fashion given the goal of the algorithm.

4. Some discussion of algorithm uncertainty and sources of error would strengthen the paper considerably.

5. It is unclear why S5P/TROPOMI results from different satellite algorithms are compared. How do these comparisons relate to the OMPS-NM WFFA TO algorithm in the present manuscript?

6. The title is very general. A more specific title will help readers distinguish this work from that of others.

**Techincal comments:**

Line 2: its -> the

14: delete "characterizes the stratosphere. In turn,"
15: remove "On the other hand,"
19: remove "Among others,"
20: "1970's, have provided"
23: specify Suomi NPP OMPS
22: change 1994 to 2005
24: named -> known
24: (all) -> (all instruments)
29: giving -> which is useful to establish
32: this -> that
57: sensor (no s)
58: radiation instead of radiances?
64: 150 km wide swath
95: "linearly"
101: remove comma
Eqn. 1: is this C or C_i?
113, 137: same comment as for Eqn. 1
118: please revise statement in light specific comments above
127,128: readouts -> pixels
140: define RTM
149: this first sentence seems out of place; can safely remove.
174: may be V8.6
203: "from the" -> "reported with"
212: Is this the IGACO3 recommendation?
221: Fig. 5 shows ozone lower over Antarctica than tropics during SON.
250: "OMPS-L2" does not indicate a specific product. Please clarify which product.
284-286: cloud contaminated scenes would generally have low bias, not high
291: define TOCS
305: th -> the
327-328: more should be said to justify this statement. What are requirements for retrieving tropospheric ozone from the limb-nadir matching technique?

Fig. 5: striping in these TO maps seems large for a 150 km wide swath.
Fig. 10: cannot find a reference to this figure in the text. Please define what the shaded areas represent. What is the difference between the grey and the very light green shaded areas?

* Minor editing note: the use of plural nouns is not needed in a number of places.