

Referee report to the revised version of the “Joint spectral retrievals of ozone with Suomi NPP CrIS augmented by S5P/TROPOMI” manuscript by Edward Malina et al.

The revised manuscript is significantly shortened and much easier to read. All major issues are fixed. Some minor issues are still to be dealt with. The manuscript can be published after minor corrections listed below.

Detailed comments

- Line 98: I am wondering why OMPS-LP instrument is not mentioned here.
- Line 60 -26: ”In the UV, Sentinels 4 and 5 (Ingmann et al., 2012), Tropospheric emissions: Monitoring of pollution (TEMPO) (Zoogman et al., 2017) and the Geostationary Environmental Monitoring Spectrometer (GEMS) (Nicks et al., 2018) will augment this record.” - the sentence seems to be grammatically incorrect and should be reworded.
- Line 144 -147: ”Chemical reanalysis datasets, which provide global and consistent ozone, can be constrained by multiple satellite observations including precursor data, (e.g., NO_x emissions). These cross-comparisons provide insight into how the retrievals are capturing chemical processes. Their data fields use a more stringent co-location criteria owing to their higher data abundance.” - this text seem to refer to the removed comparisons and has to be removed as well.
- Fig. 2: It is fine to cite previous studies for a detailed description but all basic terms has to be defined within the paper. Please provide a definition for ”Noise Equivalent Spectral Radiance (NESR)” in the text.
- Line 303: ”... while TROPOMI has a more constant bias.” - Is it really the case? Standard deviation of the bias (absolute residual radiance mean) is largest for TROPOMI.
- Lines 303 -304: ”These quality of fit parameters form a part of the MUSES quality assurance procedure (described in 3.6).” - the statement is unclear.
- Line 305: The paragraph starting at this line does not seem to have any connection with the previous text and with the ”quality of fit” subsection in general.
- Line 305: ”show greater sensitivity in the UV to stratospheric ozone.” - with respect to what?
- Line 307: ”in the 9.6 and 10.43 micron bands” - the text discusses wavelengths in microns while x-axis is given in wavenumbers. Please use the same units in the figure and in the text.

- Lines 358-359: " For example, focusing on the Atlantic Ocean, there are regions with clearly improved DFS values from CrIS-TROPOMI, as opposed to CrIS." - I cannot identify the discussed feature. Are you referring to Fig. 5 of Fig B1?
- Lines 367-368: "... with the most reduction above the tropopause (100 hPa)." - I would rather say the most reduction occurs just below 100 hPa.
- Lines 373-375: "The key difference is that the variability of the total uncertainty is smaller than that of CrIS, and the total/smoothing error is slightly smaller. Suggesting that the inclusion of the TROPOMI radiances reduces the uncertainty of the CrIS retrievals slightly." - looking at the plot it is impossible to say if this statement is true. To my opinion the variability is the same for CrIS-TROPOMI and CrIS-only.
- Line 389: The text "chemical reanalysis datasets and" should be removed as it refers to the removed comparison
- Line 393 and line 394: "the chemical reanalysis or" - same as above
- Fig. 7: the plot has an extremely bad resolution
- Lines 406-407: "The Asian monsoon has been found to enhance tropospheric ozone concentrations (Worden et al., 2009), as can be seen in the spatial maps, as well as the profile plots (Fig. C1)" - for a clear illustration plots outside the monsoon season should be provided
- Lines 411-412: "Both the 316 and 68 hPa pressure levels identify an interesting significant ozone enhancement (roughly double the surrounding regions) in the southern Indian ocean (60°S)." - It is unclear what is meant here, I do not see anything special at 60°S in the Indian ocean.
- Line 422: "in the middle row" - which figure you are talking about?
- Line 445: Here you should provide the reason why comparisons for longer periods are not feasible (as you did in the replies).
- Line 447: You should make a statement whether the profile comparisons for MLS and AIRS-OMI shown below are done with or without AK convolution.
- Lines 450 - 452: "This co-location criterion (along with AIRS-OMI) is the least stringent of all the comparisons shown in this study, due to the reduced coincidences from different satellite orbits and the relative low variability in stratospheric ozone." - I think this statement refers to the deleted comparisons and should be removed as well.
- Line 482: "Differences of between 10-40% are seen" - I think the difference are rather below 20% below 1 hPa.

- Fig. 10: CrIS-TROPOMI retrieval shows a significant jump after June 2020, this needs to be discussed.
- Fig. 10: Suboptimal placement of the legend covering the data points
- Line 523: "For the tropospheric trends ..." - I guess you mean "columns" not "trends".
- Line 536 - 540: "The low information content of TROPOMI in the troposphere means the application of Eq. 8 yields the TROPOMI precision." and the following 3 sentences. - I do not think this is true. With zero precision Eq. 8 gives $H = x_a$, which has nothing to do with the precision and the retrieval in general.
- Lines 544 - 545: "Suggesting CrIS-TROPOMI/CrIS-only have comparable or improved performance in the troposphere." - This might be also the case if the sensitivity is significantly lower.
- Line 558: "...in this paper and the supplementary material..." - is there still a supplementary material?
- Lines 616 - 617: "The MUSES CrIS-TROPOMI ozone data set is a valuable new product for characterising the variation of ozone in the atmosphere." - This was already said in the first sentence of the Conclusions.
- Lines 617: "Future developments and refinements to the MUSES algorithm, will improve the product,..." - I suggest to replace "will" by "are expected" as you cannot know it for sure now.

Technical corrections

- Line 124: remove line break in the link
- Caption of Fig. 9: "The three subplots ..." → "The four subplots ..."
- Line 502: Remove "while" at the end of the sentence.
- Line 561: "Comparisons with satellite data and reanalysis in the troposphere" → "Comparisons with satellite data in the troposphere"
- Line 607: "Resulting in substantially larger data volumes in the final retrieval products." - Incomplete sentence.
- Line 612: "MUSES quickly be able" → "MUSES will quickly be able".