

Atmos. Meas. Tech. Discuss., referee comment RC2
<https://doi.org/10.5194/amt-2022-281-RC2>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on amt-2022-281

T. E. Taylor (Referee)

Referee comment on "Update on the GOSAT TANSO-FTS SWIR Level 2 retrieval algorithm" by Yu Someya et al., Atmos. Meas. Tech. Discuss.,
<https://doi.org/10.5194/amt-2022-281-RC2>, 2022

The paper provides updates on the NIES L2 Full Physics algorithm used to retrieval XCO₂ and XCH₄ from short-wave GOSAT measurements. A number of important updates have been made to increase the physical representation of the algorithm; treatment of cirrus clouds, solar model, instrument degradation model, and spectral absorption coefficients. The paper is well written and well organized and provides a useful update on the state of the algorithm. However, the results are very underwhelming and the level of detail in the analysis and discussion is lacking. Most of the conclusions in Section 4 (Results) do not show any supporting quantification. For example, line 162 claims "the fitting accuracies of V3 are found to be better than those of v2.9" This claim needs some fitting statistics to validate.

Figures 1-4 (spectral residuals) need statistics. Also recommend writing out the name of each spectral band to each panel as a title or legend. Maybe adding a horizontal "zero" line would be helpful too. It could be informative to generate some "zoomed in" versions of the plots that focus on very specific spectral ranges so that the reader can get a better sense of the differences between the v2.9 and v3. Is it possible to change the vertical scale from absolute radiance units to percent of the continuum? Generally that is more intuitive and informative. Might be illustrative to list the XCO₂ value from the retrievals for these specific cases in a legend. It would be somewhat interesting to see how much the XCO₂ changed from v2.9 to v3.

Does the NIES retrieval algorithm use EOFs to help account for mis-fitting the spectra caused by errors in absorption coefficients? If not, then perhaps it should be investigated.

In Section 4.2, I would recommend that the authors show either a scatter plot of XCO₂ from V3 vs v2.9 for matched soundings. Then apply a linear fit and report the statistics to demonstrate the difference. Alternatively, the delta XCO₂ between the two versions could be plotted as a time series heat map. Are there differences in time?

The maps in Fig 5 would be more useful if separate maps were made for land and ocean using different color scales. Are the current plots showing individual soundings or are these gridded values? I'm pretty sure that they are individual values, which means that there is probably a lot of overplotting in these figures, making them not all that useful. An alternative idea is to only plot a single year of soundings to reduce the amount of soundings overlap. Or plot seasonal maps (DJF, MAM, JJA, SON).

Table 5 presents the statistics of the retrieved XCO₂ for v2.9 and v3 as compared to TCCON measurements with the loose collocation requirements. These results essentially suggest that v3 XCO₂ for landH is slightly worse compared to TCCON than it was for v2.9. It is probably worth investigating if this is driven by some of the TCCON sites in particular. Maybe a table showing the N/bias/scatter for v2.9 and v3 for each station individually would be useful. I notice that for the tighter collocation criteria, the overall statistics are slightly improved for v3 as compared to v2.9, which is good.

I'm not really sure what to make out of the huge XCO₂ bias in v3 over Ocean. It seems like some effort needs to go into the NIES L2FP to fix this by making the treatment of the ocean surface more complicated. Clearly the retrieval is unable to make a proper fit. Because of the delta XCO₂ scale and the overplotting on Fig 5, it is impossible to tell what the large negative bias really looks like. Again, recommend making the maps separate for land/ocean with appropriate color scale. And probably more useful to show data for a single year/season at the beginning and end of the date record, e.g., 2010 vs 2020.

Fig 7. Some fitting statistics are needed to support the discussion.

Fig 8: the shading of the land is too light. Increase the contrast between land and ocean.

Fig 9: Recommend plotting these as density heat maps, and making into 4 panels for Land/Ocean and v2.9/v3. Also needs fitting statistics to support discussion.

Fig 10: Recommend separating into 2 panels for land/ocean. The current delta xco₂ range of +/-10 ppm makes this plot very uninformative.

Sec 4.4 Evaluating the long term trend using in situ measurements. This section needs some corresponding plots to support the discussion. There is a lot of good work here, but the authors do not show any of it. The paper is very short, so it wont hurt to add a few more interesting plots. Some plots of the calculated CO₂ growth rate are definitely needed since that was one of the big motivations for the changes to the L2FP code.

Sec 4.5 Bias correction. This section also needs one or two interesting plots to support the discussion.

Line 55 in Introduction: please cite [Taylor, ESSD, 2022] for the ACOS L2FP retrieval as applied to GOSAT.

Line 61/62. the sentence beginning with "However, the systematic structures..." should be split into 2 separate sentences for clarity.

Line 92: how large is the expected increase in throughput due to this change? Did the change roughly meet expectations?

Line 121; In the sentence "Although the new degradation model..." do you mean "Although the results from the new degradation model..."

Line 176: "The temporal differences are possibly due to the contributions by the other components..." What other components specifically?

Line 204; "...seems to correspond to that of the difference in XCH4 shown in Fig 5." Would be useful to generate and show a correlation plot to support this claim.

Line 229: "There are no substantial changes...although the biases are different between v3 and v2.9 in some cases". Unfortunately the results are actually slightly worse for v3.

Line 245/246: No statement about XCO2, which unfortunately is actually worse for v3 than v2.9 compared to TCCON.

Line 319: "...a gap in the spectral baseline..." I dont understand this comment.