Response to referee comments on manuscript amt-2022-129

First of all, we would like to thank referee #1 for his/her constructive comments, which helped us to improve the manuscript. We replied all comments and questions as follows. The referee's comments are coped in blue text.

Anonymous Referee #1

General Comments:

Referee:

The authors report on the combination of two successful efforts: First, the calibration model was re-derived to account for nonlinear response, polarization sensitivity, and other features. Second, the spectral radiances were validated against three other instruments.

The new model is presented with 27 equations, which is both an advantage (very complete work) and a disadvantage (difficult to follow).

When possible, it would be beneficial to provide context for these reprocessed data products and validation activities by citing requirements, performance of other satellites, or accuracy thresholds linked to scientific goals. Also, the significance of the improved model could be highlighted by comparing accuracy & precision metrics between older and newer versions.

Author's reply:

Thank you very much for reviewing our manuscript. We revised our manuscript with changes tracked.

In the revised version, we added the additional explanation for the equations and symbols with consistency between the equations and text.

TANSO-FTS-2 and TANSO-FTS are unique instruments for observing both SWIR and TIR radiance spectra, simulatively. It can provide both the total and partial column concertation of GHG. In other words, they can provide the near surface (0 to around 4km above from ground) GHG concentration, globally. Those products have advantage for understanding the global carbon cycle. To retrieve the accurate partial column concentration, the angle depended or scene brightness temperature depended bias in radiance spectral domain is undesirable. As for TIR sounder, the radiometric and spectral consistency among other sounders is important. Then, we developed new estimation method for 2-orthogonal simultaneous off-nadir overpass, updated the calibration procedure for spectral radiance and improved the spectral quality in off-nadir observations.

To clarify for this science objective, we add the following sentences in the section 1.

"Simultaneous spectral radiance observation for SWIR and TIR supports retrieving new partial column concentration of CO_2 and CH_4 as well as the total column concentration which are conventional products. The partial column concentration has sensitivities for the near surface (ground to around 4 km altitude) and upper troposphere (between 4 and around 12 km altitude) of CO_2 and CH_4 concentrations. These products lead to new applications for local emission estimation (Kuze et al., 2022). "

"To provide the radiometric and spectral consistency among the TIR sounders as well as the accurate partial column concentration, the angle dependent or scene radiance dependent bias in radiance spectral domain is undesirable. Then, we showed that the spectral radiance for TANSO-FTS-2 TIR bands is consistent with the intercalibration data of the other TIR sounders mentioned above, with time-series, wavenumber, and the incident angle dependencies."

As for other satellite performance, we added the overview of characterization results for other sensors are implemented in session 4 with additional references.

The key messages are as follows;

"Aumann et al. 2019 have studied the long-term stability of AIRS spectra as compared with calculated spectra over Tropical Ocean at night and found that the trend of all AIRS longwave channels in the surface sensitive channels was quite small (2 mK/yr). In addition, AIRS and IASI are well characterized and the bias of these sensors are reported less than 0.2 K (Jouglet et al., 2014). Then, our calibration target is to provide the consistent spectral radiance among the TIR sounder for full coverage of TANSO-FTS-2 observation angless."

Also, the comparison results between previous (old) and new products are highlighted in table 2 and section 4.1.

Specific Comments and Technical Corrections:

Referee:
Finally, the authors are encouraged to make a number of minor English corrections:

Line 12: $0.2cm^{-1}$ -> separate number & unit

Author's reply:

We corrected the word "$0.2cm^{-1}$" to "$0.2\ cm^{-1}$" in the revised manuscript.

Referee:
Line 39: the earth -> Earth

Author's reply:

We changed a small letter of "earth" to capitalized "Earth".

Referee:
Line 45: Characterization of these spectral radiance is essential (reword)

Author's reply:

We modified the word "Characterization of these spectral radiance is essential" to "The calibrated spectral radiance is essential"

Referee:
Line 204: contamination -> combination

Author's reply:

We changed the word "contamination" to "combination" in the revised manuscript.

Referee:
Line 311 & 579: grided -> gridded

Author's reply:

We corrected the word "grided" to "gridded" in line 311 and to "angular bin" in line 579 in the revised manuscript, respectively.

Referee:
Line 387: Table.3.

Author's reply:

We corrected the word "Table.3" to "Table 3" in the revised manuscript.

Referee:
Line 394: orthogoanl -> orthogonal

Author's reply:

We corrected the word "orthogoanl" to "orthogonal" in the revised manuscript.

Referee:
Line 401: TANO -> TANSO

Author's reply:

We corrected the word “TANO” to “TANSO” in the revised manuscript.

Referee:
Line 403: bias exceeds 0.5 K bias (redundant)

Author’s reply:
We removed the redundant word “bias” in the revised manuscript.

Referee:
Line 510: fig 2 legend - "vicalrous" -> "vicarious

Author’s reply:
We corrected the word “vicairous” to “vicarious” in the revised manuscript.

Referee:
Line 539: fig 4 caption - "londitude" -> "longitude"

Author’s reply:
We corrected the word “londitude” to “longitude” in Fig 4 in the revised manuscript.

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