

Atmos. Meas. Tech. Discuss., author comment AC2
<https://doi.org/10.5194/amt-2021-66-AC2>, 2021
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Reply on RC2

Lu Yao et al.

Author comment on "Retrieval of solar-induced chlorophyll fluorescence (SIF) from satellite measurements: comparison of SIF between TanSat and OCO-2" by Lu Yao et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-66-AC2>, 2021

General comment

The manuscript of Yao et al. presents a DOAS-like retrieval algorithm to estimate the amount of solar-induced chlorophyll fluorescence (SIF) from TanSat measurements. For a technical paper, the actual retrieval algorithm is insufficiently well explained and results would not be reproducible. The SIF retrieval strategy including Eq. (2) is well documented in the literature. However, it remains unclear how the only novelty, that is the surface pressure to model residual O₂ absorption, is incorporated and affects the retrieval. Perhaps a Figure and sensitivity analysis could illuminate the importance and necessity of this state vector element.

There is some confusion as to when the official OCO-2 data set (IMAP-DOAS) and when the IAPCAS data are used. While I think it is a good idea to compare the performance of the proposed retrieval algorithm (Sect. 2.4) based on OCO-2 L1B data, it is inappropriate to use the IAPCAS OCO-2 data in Fig. 3 (where it is not clear which OCO-2 SIF data has been used), 4, and 5 (again not clear which OCO-2 data set has been used). In fact, it may even disguise shortcomings. For example, the difference maps in Fig. 4 suggest that there is considerably less coverage for OCO-2, while I am certain that the official data provides a better coverage. For Figs. 3, 4 & 5, the official OCO-2 data is urgently needed to evaluate the retrieval performance objectively.

Reply: The algorithm part was modified in the revision. The retrieved OCO-2 SIF data and official OCO-2 SIF data were clarified before usage in the revision. We used both the two OCO-2 SIF data in section 2.4 for the algorithm test. The official OCO-2 SIF data was used in the orbit comparison with TanSat. The retrieved OCO-2 data was compared with the TanSat SIF data on the global scale, which was shown in Figure 3. However, the official OCO-2 SIF data was used as a reference for global SIF validation and it was not shown in the manuscript. In the comparison of SIF-GPP the official OCO-2 SIF data was used for correlation estimation. The global distribution of the SIF difference represents the gridded TanSat and OCO-2 observation data pairs, which are affected by the data volume and distribution of the two satellites, and the actual effective data pairs are less than the OCO-2 data volume which leads to limited coverage.

As the authors cite Yao et al., 2021 with the same topic and a substantial overlap in co-

authors, it is unclear to me what would justify another publication, especially when considering the shortcomings of the present manuscript.

Reply: The previous paper mainly introduced the TanSat SIF product and made a comparison between the two TanSat SIF products by different algorithms. The result shows a regional bias between the two SIF products in different seasons. This article details the IAPCAS/SIF algorithm implementation process and tests the consistency of the retrieval results with OCO-2 data products by data comparison on different scales, focusing on the collaboration observation of different satellite missions and comprehensive usage of multi-satellite products. The physical-based SIF retrieval method is

Minor comments:

L43: Middle □ Medium

Reply: it was modified.

L90: spectrum -> spectral

Reply: it was modified.

L143 What is "side radiance"?

Reply: it was modified in the revision and it means the radiance outside the absorption features in the micro-window.

L149: significant □ systematic

Reply: it was modified.

L184 Point 2: I believe the opposite is meant here, continuum level radiances outside the range of 15-200 W/m²/μm/sr

Reply: it was modified in the revision.

L196 & Table 1: The authors mention that there is a small bias between the official OCO-2 product and the results of their own retrieval algorithm. I suggest to add the intercept and slope to Table 1, so that the reader can come to their own judgement as to how well the retrieval algorithm performs.

Reply: The intercept and slope were added to Table 1.

L256-259: The described quantity should not be referred to as "retrieval uncertainty". In fact, this is the standard error of the mean and is a measure of retrieval error plus natural variability.

Reply: it was modified in the revision.