We sincerely thank the reviewer for their valuable comments and suggestions. Please find our response below in blue. The proposed revisions of the manuscript are quoted in *red italics*, with their corresponding sections and line numbers in the original manuscript marked in **bold red**.

[RC1-1] The paper by Wen et al. examines the performance of in-situ and satellite-derived solar-induced fluorescence (SIF) and vegetation indices in tracking intra-seasonal vegetation dynamics in an African dryland ecosystem. Overall, the paper is well-written and conveys an important finding: TROPOMI SIF aligns well with in-situ SIF measurements in the Horn of Africa (HoA), while other reflectance-based vegetation indices may overlook certain subseasonal vegetation dynamics. These findings have potential implications for understanding dryland carbon fluxes. Given the good shape of the manuscript, I have a few comments to further improve the paper.

[AR1-1] We thank the reviewer for appreciating our work and providing constructive comments that helped to improve this manuscript. Please find below our point-by-point response and revisions.

Introduction:

[RC1-2] The authors provide an insightful introduction to the importance of drylands and the role of SIF and vegetation indices. However, there is limited discussion on the existing literature concerning SIF applications for tracking dryland GPP or drought/heat stresses. I suggest the authors expand this to provide a more comprehensive background on SIF use in dryland ecosystems.

[AR1-2] We appreciate this suggestion. While we have already described SIF's mechanistic advantages over VIs in general in **Line 65-67**, we propose to add more specific descriptions on the applications of SIF in monitoring for dryland ecosystem dynamics, as this reviewer suggested. We will revise the original text in **Line 68-70** as: "*In addition, since SIF signal comes only from active vegetation, it is less susceptible to the brightness of soil background, unlike reflectance-based VIs (Huete et al., 2002). These characteristics make SIF a unique observational signal for inferring photosynthetic dynamics for dryland ecosystems. For example, SIF has demonstrated a superior capability in accurately depicting dryland ecosystem phenology (Wang et al., 2019) as well as capturing seasonal variations (Wang et al., 2022c) and interannual variations (Smith et al., 2018) of in situ gross primary production (GPP). Furthermore, it has facilitated many applications in drought detection and ecosystem restoration in drylands (Robinson et al., 2019; Mengistu et al. 2021, Constenla-Villoslada et al., 2022).*"

Huete, A., Didan, K., Miura, T., Rodriguez, E. P., Gao, X., and Ferreira, L. G.: Overview of the radiometric and biophysical performance of the MODIS vegetation indices, Remote Sens Environ, 83, 195–213, https://doi.org/10.1016/S0034-4257(02)00096-2, 2002.

Wang, C., Beringer, J., Hutley, L. B., Cleverly, J., Li, J., Liu, Q., and Sun, Y.: Phenology Dynamics of Dryland Ecosystems Along the North Australian Tropical Transect Revealed by Satellite Solar-Induced Chlorophyll Fluorescence, Geophys Res Lett, 46, 5294–5302, https://doi.org/10.1029/2019GL082716, 2019.

Wang, X., Biederman, J. A., Knowles, J. F., Scott, R. L., Turner, A. J., Dannenberg, M. P., Köhler, P., Frankenberg, C., Litvak, M. E., Flerchinger, G. N., Law, B. E., Kwon, H., Reed, S. C., Parton, W. J., Barron-Gafford, G. A., and Smith, W. K.: Satellite solar-induced chlorophyll fluorescence and near-infrared reflectance capture complementary aspects of dryland vegetation productivity dynamics, Remote Sens Environ, 270, https://doi.org/10.1016/j.rse.2021.112858, 2022c.

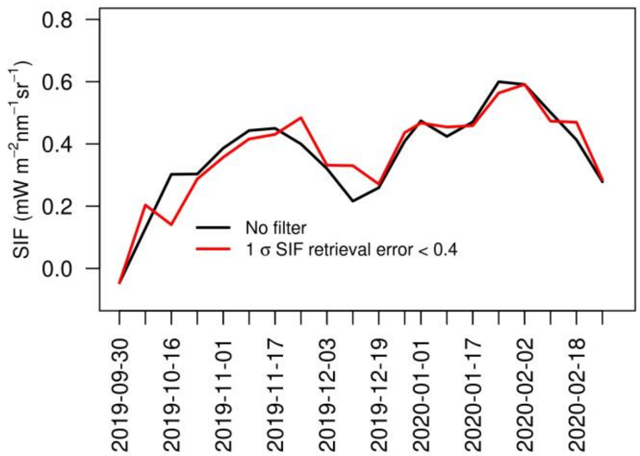
[RC1-3] Line 78: The IPCC reference can be more specific

[AR1-3] We appreciate this suggestion and propose to specify details for this reference. We propose to change it to *"IPCC Working Group II, Chapter 9, 2022"* in **Line 78**.

Method:

[RC1-4] When filtering satellite SIF measurements, it is unclear whether the authors account for the uncertainties in SIF retrievals (e.g., standard deviations of SIF) provided by the products.

[AR1-4] Thank you for this constructive comment. We did not account for the uncertainties of SIF retrievals in our original submission, as previous studies have rarely used the SIF retrieval uncertainty for quality control. In the revision, we tested the robustness/sensitivity of our results to SIF retrieval uncertainties. While the retrieval error for TROPOMI_ESA (743–758 nm fitting window) is typically 0.5 mW m^{-2} sr^{-1} nm^{-1}(Guanter et al., 2021), we tested with a stricter threshold (0.4 mW m^{-2} sr^{-1} nm^{-1}) and found that the temporal pattern remains largely unchanged, as shown in the figure below.



We have added this panel to **Fig S3** along with descriptions to the corresponding text in the main manuscript (**Line 251**).

"This double-peak pattern in TROPOMI SIF held, regardless of sources of TROPOMI data, fitting windows used for SIF retrievals, or quality filtering criteria (e.g., SZA, CF, and retrieval error) (Fig. S3a-S3d)."

Results:

[RC1-5] There are negative SIF values in both the in-situ observations and the TROPOMI SIF retrievals, as shown in Fig. 2. Since SIF should theoretically be positive, the authors should explain the source of these negative values, such as measurement errors or retrieval limitations.

[AR1-5] This is a great point, but we have to argue that negative SIF values should be retained in the analysis, a practice that is commonly used in the SIF community (e.g., Sun et al., 2018; Doughty et al., 2022) and suggested for TROPOMI SIF applications (Guanter et al., 2021). This is because negative SIF values are mainly a consequence of measurement and retrieval noises, even though theoretically SIF should be positive. If removing these negative values during spatial/temporal aggregation, one would introduce artificial positive biases. In principle, if the noises are random, the average of SIF value in a non-vegetated area should be zero, i.e., average of both positive and negative values.

Doughty, R., Kurosu, T. P., Parazoo, N., Köhler, P., Wang, Y., Sun, Y., and Frankenberg, C.: Global GOSAT, OCO-2, and OCO-3 solar-induced chlorophyll fluorescence datasets, Earth Syst. Sci. Data, 14, 1513–1529, https://doi.org/10.5194/essd-14-1513-2022, 2022.

Sun, Y., Frankenberg, C., Jung, M., Joiner, J., Guanter, L., Köhler, P., and Magney, T.: Overview of Solar-Induced chlorophyll Fluorescence (SIF) from the Orbiting Carbon Observatory-2: Retrieval, cross-mission comparison, and global monitoring for GPP, Remote Sens Environ, 209, 808–823, https://doi.org/10.1016/j.rse.2018.02.016, 2018.

To clarify this point, we propose to add descriptions in **Section 3.1** after **Line 226**: *"Note that some negative values appear in FloX SIF and TROPOMI SIF especially during the time periods with weak SIF signals, as a result of measurement and retrieval noise (Guanter et al., 2021). These negative values are retained in the evaluation to avoid an artificial positive bias in spatial and temporal aggregation."*

[RC1-6] Fig. 1(h): The legend with dotted lines does not match the lines in the figure.

[AR1-6] Thanks for pointing this out. We propose to revise the legend to match the lines in the figure.

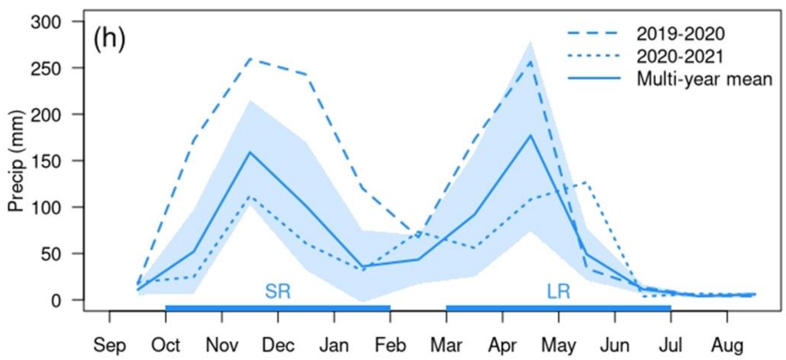


Figure 1h. *Time series of precipitation at Kapiti during 2019-2020 (dashed) and 2020-2021 (dotted), when in situ SIF was collected, compared to the multi-year mean (2011-2020, solid). The shade denotes one standard deviation of monthly precipitation during 2011 and 2020. The lengths of SR and LR seasons are marked on the x-axis in light blue.*

[RC1-7] Fig. 7: It might be useful to include a scatter plot showing SIF yield against variables like VPD, soil moisture, or Tair to illustrate how much environmental factors drive variation in SIF yield.

[AR1-7] Thanks for this constructive feedback. We propose to include scatterplots between TROPOMI SIF yield and environmental factors in **Fig. 7 (d) - (f)**.

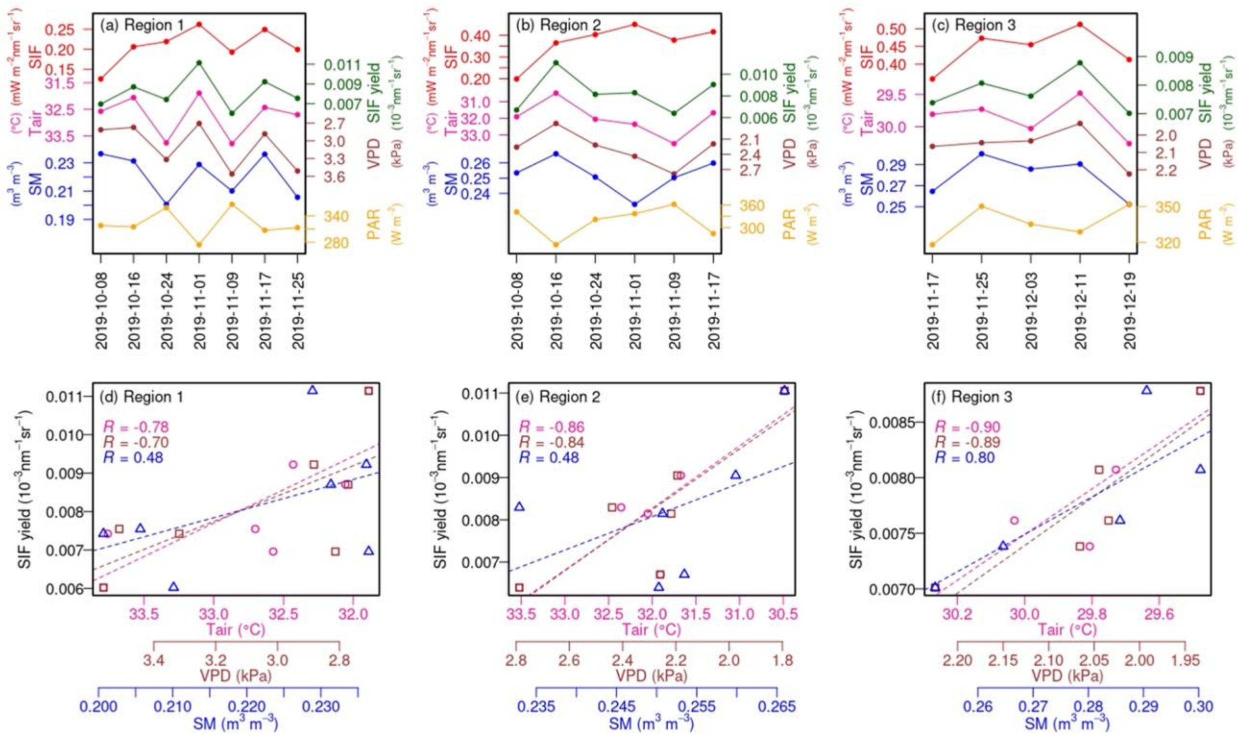


Figure 7: (a) – (c) Intra-seasonal variations of TROPOMI SIF, TROPOMI SIF yield, Tair, VPD, SM and PAR for the three sub-domains during the selected time windows (Fig. 4). The y axes for Tair and VPD are reversed for visual clarity. The x axis labels represent the starting date of each 8-day interval. (d) – (f) Scatterplots between TROPOMI SIF yield and Tair (pink circle), VPD (brown square), and SM (blue triangle) for the three sub-domains during the selected time windows. The dashed lines represent fitted linear regression lines, with correlation coefficients (*R*) noted in the upper left of each panel.

We propose to add text descriptions after **Line 352**: *"The environmental effect on vegetation function is further demonstrated by the strong correlation between SIF yield derived from TROPOMI and meteorological variables, especially Tair and VPD (Fig. 14d – 14e)."*

Discussion:

[RC1-8] The authors could further discuss the performance of SIF in tracking dryland vegetation dynamics as reported in previous studies. For instance, Wang et al. (2022) found that NIRv performed better than SIF in capturing GPP in western U.S. drylands due to noise in SIF signals. The results of this study appear to differ somewhat from those of previous studies.

Wang, X., Biederman, J.A., Knowles, J.F., Scott, R.L., Turner, A.J., Dannenberg, M.P., Köhler, P., Frankenberg, C., Litvak, M.E., Flerchinger, G.N. and Law, B.E., 2022. Satellite solar-induced chlorophyll fluorescence and near-infrared reflectance capture complementary aspects of dryland vegetation productivity dynamics. *Remote sensing of environment*, *270*, p.112858.

[AR1-8] This is a great point. Indeed, we fully agree that the mechanistic advantages of SIF over VIs may be offset by its large measurement/retrieval noise, as we discussed in **Section 4.2 Line 386-387**, *"On the other hand, SIF has its practical limitations (e.g., comparatively coarser spatial and temporal resolutions, and higher measurement/retrieval noise) relative to the greenness-based VIs that are much easier to retrieve."*

In addition, we propose to explicitly compare and discuss the different conclusions drawn from their and our studies. We plan to add a new paragraph in the end of **Section 4.2**: *"A recent study by Wang et al. (2022c) evaluated the ability of satellite SIF and NIRv in capturing the seasonal variation of GPP in dryland ecosystems, and found that NIRv performed better than SIF for low-productivity sites, likely because of the low signal-to-noise ratio of SIF retrievals. This does not necessarily contradict the findings of our study. First, Wang et al. (2022c) examined the performance of SIF and NIRv at the seasonal scale over about two years, when SIF may have only marginal advantages in inferring function-related variations that are overwhelmed by structure-related variations. In contrast, our study focused on intra-seasonal variations, when functional changes have a stronger impact. Second, our evaluation is conducted on a relatively wet period when vegetation signals are strong, therefore the data noise has less influence on the retrieved vegetation signals."*