



EGUsphere, referee comment RC1
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Comment on egusphere-2022-640

Mukund Palat Rao (Referee)

Referee comment on "Synergy between TROPOMI sun-induced chlorophyll fluorescence and MODIS spectral reflectance for understanding the dynamics of gross primary productivity at Integrated Carbon Observatory System (ICOS) ecosystem flux sites" by Hamadou Balde et al., EGUsphere, <https://doi.org/10.5194/egusphere-2022-640-RC1>, 2022

October 7, 2022

Dear Dr. Rotenberg,

Thank you for the opportunity to review the manuscript "*Synergy between TROPOMI sun-induced chlorophyll fluorescence and MODIS spectral reflectance for understanding the dynamics of gross primary productivity at integrated carbon observatory system (ICOS) ecosystem flux sites*" by Balde et al. I have now completed my review of the manuscript. In their study, Balde et al. first evaluate the strength of the linear relationship between gross primary productivity (GPP) and solar induced chlorophyll fluorescence (SIF) at a number of ICOS eddy covariance flux tower sites. They find that in general, SIF exhibits a linear relationship between GPP (or productivity), though they find that this relationship depends on the plant functional type, site, and other variables. In the second half the study they authors attempt to develop statistical models to predict productivity/GPP using SIF, and remotely sensed vegetation reflectance and vegetation index data. They find that generally their models can predict between 75-85% percent of the variance in GPP. Overall, the manuscript is well written, the analyses can be followed easily, and the science presented is of good quality. I do not have any major concerns with the manuscript. I only have one question that I would like the authors to address. Do the RF-R style models (RF-F, RF-SIF-R, RF-SIF-R-PFT) outperform the RF-SIF-VI model just because they have more predictor variables (14 vs 4). Perhaps you can present some analysis on how these models perform on 'validation' data that the models have not been calibrated on? Instead of presenting just the overall R². Generally, the validation R² results in a less biased estimate of performance since more number of predictor variable that can inflate the overall R².

Some other minor suggestions below.

Page 1, Line 15: "Earliest" studies, based could be "earlier" studies or prior studies?

Page 1, Line 17: "plant functional type" should be plant functional types.

Page 2, Line 14: "which is the amount of flux carbon taken up by vegetation." The word 'amount' is not needed since the work flux assumes an amount.

Page 2, Line 53: "Remote sensing is widely used to upscale canopy GPP to landscape, regional, and global scales and at daily scale using reflected sunlight measured by satellite sensors". The "and at daily scale" addition seems a bit awkward. Maybe remote sensing is widely used to upscale daily GPP to landscape.....

Page 2, Line 60: "and biochemical canopy characteristics (Dechant et al., 2020; Pabon-Moreno et al., 2022). Although, they suffer." The way the sentence is framed, I think it would flow better as a continuous sentence.

Page 3, Lime 83: "Early studies relied on ground-based", should be Earlier studies relying on...

Page 3, Line 96: "which is on board Sentinel 5-Precursor, represents a novel (???) for understanding:". A missing word after novel? Tool maybe?

Page 3, Line 97: "it provides a quiet high temporal resolution at daily". Quite instead of quiet. However, the word quite is not needed either.

Page 3, Line 104: "comprehensively addressed. Owing to most". This should be once sentence, or the second sentence should start of as, This is due to the fact or This is because....

Page 4, Line 8: "data products is given in Supplementary Materials in Tab S2.". the Authors don't need to do this, but might consider including a column for the spectral band (i.e. visible (R/G/B), NIR, etc. in the table)..

Page 6, Line 230-232: "Overall, SIFd was significantly related with tower-based GPP at the site level and at the daily timescale (as p<0.0001 was statistically highly significant), except for *IT-Cp2* site of which GPP and SIFd relationship was insignificant and weak (R^2

= 0.001, p≤0.60)".

This is of course quite subjective, but despite some of the sites being statistically significant I would not call these relationships as being strong. The reason for the statistical significance and p-value is being driven by the high sample size. In particular, I would add GF-Guy to the list of sites where there is no relationship between GPP-SIFd. The correlation needed to get an R² of 0.2 is around 0.15 which is still quite weak. I would also then add FR-Mej, FR-EM2, and FI-Var to the list of sites with a weak relationship. I know this is mentioned a bit later, but maybe an easier way to frame it would be to not mention the weak relationship at IT-CP2 in the beginning, but then mention all these sites together at the end of the paragraph?

Page 7, section 4.1.2 I like the progress from the site level (Section 4.1.1) to PFT level SIFd-GPP relationships. However, the way the PFT level relationships are presented, don't seem to actually allow us to closely examine within PFT spread in the R2's, slopes, and intercept. For example, in Table 2, all sites of a PFT are lumped together. If the authors wish to highlight the within PFT spread, one option could be to include boxplots by PFT for the R2, slope, and intercept for the SIFd-GPP relationships.

Page 9, Section 4.5, Line 284, Supplementary Fig. S1: I would recommend changing the figure to have a diverging colourbar. The gradient colourbar from ~-0.65 to 1 is not intuitive to me and hard to visualize.

Page 12, Table 3: would benefit from a vertical line separating RF-R, RF-SIF-R, and N, and other similar vertical line in the lower panel

Page 15, Line 431: "it can be avoided", maybe better phrased as "we don't need to rely on land cover type....and meteorological data"?

Page. 16, Line 465: ERA5 instead of ERAS?