

Biogeosciences Discuss., referee comment RC2
<https://doi.org/10.5194/bg-2021-348-RC2>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on bg-2021-348

Anonymous Referee #2

Referee comment on "A convolutional neural network for spatial downscaling of satellite-based solar-induced chlorophyll fluorescence (SIFnet)" by Johannes Gensheimer et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-348-RC2>, 2022

This manuscript presents a downscaled SIF product 'SIFnet' (x10 improvement to 500m) based on combining TROPOMI native low resolution gridded SIF, climate products, and remotely sensed gridded products using a convolutional neural network approach. The method development and product verification are well laid out and justified, with a comparison to a recent downscaled SIF product nicely incorporated. I am not a ML expert, so cannot comment on the specifics of the algorithm chosen, apart from that a substantial and commendable effort was made by the authors to: check model sensitivity to the input parameters (including developing a feature importance metric), overfitting, multicollinearity, validation, and intercomparison to other products.

My main suggestions are to: i) incorporate more information on data filtering and quality assurance, including data coverage and missing values and their impact on final product values, ii) incorporating a more physiological perspective on what SIF is, and outline the implications of how choices in the methodology affect the interpretation of SIFnet SIF, iii) include a more detailed explanation for the apparent low correlation of TROPOMI SIF with OCO SIF and the implications for those using SIF products for GPP proxies, and iv) detailing why solar radiation at surface level was not included as an input as one of the main drivers of SIF and APAR (i.e. taking into account clouds). These general comments and more specific minor comments are found below.

General comments

Data filtering: the information provided is severely lacking. First, be specific about what data filtering methods and thresholds were applied for each dataset, and then specify the amount of data that was filtered (or available) after filtering. This is important on many fronts, especially as filtering will be non-uniformly distributed across space and time (e.g. cloudiness in the tropics, snow affected regions in winter etc.). Also, there will be a strong bias towards clear sky conditions as the reflectance indices won't produce valid data with clouds, yet SIF may still be retrievable through some clouds.

Physiology perspective: Missing a more detailed explanation of what SIF is. Also, a physiology perspective (on the implications of method choices) beyond the intro is lacking seeing the emphasis of the downscaled SIF product is to monitor veg dynamics (e.g. GPP).

TROPOMO vs OCO SIF: Can you explain why the r^2 values are reasonably low (0.56-0.61) for TROPOMI vs OCO SIF? (Fig. S19 in S7)? This is important because they are both a measurement of the same metric and has implications for interpreting SIF. Is this purely time of day mismatch and spatial heterogeneity? This is especially important for putting into context the r^2 values achieved in this study. Is the difference due to anything physiologically related, i.e. is OCO SIF more sensitive to GPP than TROPOMI (I cannot see why, but maybe the retrieval algorithms play a role)? A detailed comparison will be beyond the scope of this paper, but a figure and some stats and more explanation are warranted seeing OCO SIF is used as verification.

Inputs: why not use incoming solar radiation at surface level from a gridded climate product rather than a clear sky flux equivalent? This would factor in cloudiness and is closer to the first driver of SIF magnitude in veg (PAR or APAR).

Minor

Figure 1: what function was fit for each subplot to get the goodness of fit? Add info to figure caption.

L 120 remove 'In' before Figure 2.

L 123: any explanations offered as to why TROPIMI SIF and GOME-2 SIF show different behaviors of correlation with NIRv to Camps-Valls et al. (2021)?

L130: expand 'NN' (first usage)

L136: check grammar of sentence beginning 'As such'

L161: remove 'are' after 'we'

L 166: perhaps explain the implication of setting missing values and to zero, especially over vegetated regions.

Fig. 4: add SIF units to subplots

L 199: remove 'did' before 'yielded'. Also a double full stop evident.

L225: add space after 'notably,'

L223: remove 'do' after 'approach'

L276: both high res SIF products performing poorly in urban areas suggest they should be treated separately in a model and/or point to the requirement for even higher spatial res products (e.g. 5 or 10m).

L317: check grammar 'us to spatial'

L322: repeated point of less training data – suggest removing or consolidating with the previous mention in the conclusion.

Supplementary Minor

L29: remove 'is' after 'Australia'

L51: see question mark

Fig 6S: can remove one upper or lower diagonal as the plot is mirrored. Should subplots c & d have 1SD error bars seeing they represent a feature group?

L80: 'similar' to 'similarly' and be quantitative (provide a range).

Fig S11c: can you comments on the mean value of rho_NIR compared to the equivalent plot in the main body for mean NIRv? Is the second feature (rho_NIR) more important than the second feature NIRv for the different input parameterisations? This point is worthy of another sentence or two in the main text.