

Interactive comment on “Sun-induced Fluorescence and Near Infrared Reflectance of vegetation track the seasonal dynamics of gross primary production over Africa” by Anteneh Getachew Mengistu et al.

Anonymous Referee #2

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1 Overview:

Review of “*Sun-induced Fluorescence and Near Infrared Reflectance of vegetation track the seasonal dynamics of gross primary production over Africa*” by Mengistu *et al.*

My sincere apologies for the delay in my review.

Mengistu *et al.* present an analysis of SIF, NIRv, EVI, and NDVI over the African con-

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continent. They compare these remote-sensing products to flux towers across multiple ecosystems. They find soil moisture to be the dominant driver for much of their data. They also find both SIF and NIRv do a better job of reproducing GPP than EVI or NDVI. Overall, the study is both interesting and useful. My main comments relate to quantitatively assessing the claim that SIF and NIRv are performing better. The figures are reasonably easy to follow and the text is quite well written. I would recommend minor revisions.

2 Major comments:

Both of my main comments relate to the claim that SIF and NIRv are performing better than NDVI and EVI.

2.1 Are SIF and NIRv actually performing demonstrably better?

In the conclusions, the authors state: “*The mean climatology of SIF and NIRv agrees widely with the MPI-BGC GPP products in large parts of Africa, confirming their values as a more robust GPP proxy than the commonly used MODIS vegetation indices.*” However, it’s not clear to me that 1) agreement with the MPI-BGC GPP estimate is the metric by which to justify that statement and 2) that the differences between some of the products is not within the noise. The latter statement implies to me that SIF and NIRv are both performing comparably well while NDVI and EVI are performing measurably worse. From examination of Figure 2, it’s not clear that is the case. I would certainly agree that NIRv and SIF are performing better than EVI at CG-Tch, but NIRv and EVI seem nearly identical at GH-Ank while SIF seems to show no real correspondence with the EC data.

I’m wondering if it would be possible to set up some hypothesis test to quantify this.

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Or maybe it could be done via bootstrapping. For example the authors could randomly sample the different datasets and compare them to the EC data and the MPI-BGC data then report an uncertainty on the R values. Or report the fraction of times the different remote-sensing products performed better than each other.

2.2 Are SIF or NIR_v capturing those downregulation effects due to water availability?

As the authors note, the MPI-BGC and other models (e.g., VPRM) include terms for water availability. The authors show that root zone soil moisture is both important for GPP across Africa and strongly coupled to SIF/NIR_v. Does this mean that SIF and NIR_v are responding to changes in water availability? If so, are they responding in a manner that better approximates GPP than NDVI or EVI? Related to this, does this mean that models using SIF or NIR_v would not need a water availability term? Or do they still require one?

The authors mention that the rapid decrease at CG-Tch starting in June is due to water availability, I would be interested to see a timeseries for individual years that show SIF and NIR_v tracking this decrease and some measure of water availability. This could be a supplemental figure, but it would be nice to see that it's actually occurring on individual years.

3 Minor comments:

3.1 Wang et al study?

The authors may want to discuss the Wang et al. (2020; doi:10.1029/2020JG005732) paper. They provide a nice discussion of what these different remote-sensing measures are telling us.

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3.2 Choice of regions?

In Section 2.1 the authors mention that they split ecosystems across hemispheres (i.e., NH shrubs and SH shrubs). This reviewer is confused about why this decision was made. The precip and insolation will be out of phase, sure, but wouldn't we expect the response to be similar? Or should we expect a different functional relationship?

3.3 Use of multiple MODIS products?

I see the authors used MCD43C4 for NIR_v, but MOD13C2 for EVI and NDVI (Page 6, Line 5)? I'm curious why they didn't use the same set of reflectances and then compute the various indices in a consistent manner?

3.4 LUE models

Not all of the photons emitted will escape the canopy. Shouldn't there be some canopy escape term in the SIF relationship? If I recall, the Dechant et al. (2020; doi:10.1016/j.rse.2020.111733) paper argued that this canopy escape term is where much of the information is coming from (that we're learning something about structure).

3.5 Flux tower comparison

Presumably the flux towers can be influenced by different types of vegetation within the footprint of the tower, why do the authors remove those pixels from the satellite data: *"The flux towers have a footprint of about 1 km² and it is hard to compare them to areas that are 200 km² centering the tower which includes many vegetation types. However, we use the vegetation mask to exclude grid cells with different vegetation from the tower's vegetation"*. Seems like it would be more appropriate to keep all of the

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pixels within the region because they are not systematically removing airmasses that come from certain wind directions.

3.6 Discussion of COS and $\Delta^{17}\text{O}$

The timing of this discussion seems weird. The authors mention that these measurements exist but do not actually employ them. As such, I don't feel like this paragraph really adds much value. I'd suggest either removing this paragraph or putting it in the intro.

3.7 Colorscheme

As someone who is mildly colorblind, I would prefer the authors use a different color scheme for Figure 1. There's a great discussion on color schemes here: <https://personal.sron.nl/~pault/> and examples of how the rainbow color scheme can distort data (see "Good and bad colour schemes compared" near the end). It appears that the authors are using Matlab, I think the "parula" scheme is fairly safe and should be easy to change to. It should just be a matter of adding `colormap(parula)` to the code.

4 Specific Comments:

Page 2, Line 25: Typo, should be "Congo basin".

Page 3, Line 10: Typo? Sentence is confusing: "there is a clear contribution of soil moisture is stress for short vegetation".

Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2020-242>, 2020.