Biogeosciences Discussions

Biogeosciences Discuss., referee comment RC1
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Comment on bg-2021-49

Anonymous Referee #1

Referee comment on "Extreme events driving year-to-year differences in gross primary productivity across the US" by Alexander J. Turner et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-49-RC1, 2021

This study presents a GPP estimate over the conterminous US using TROPOMI SIF calibrated against eddy-covariance sites, with MODIS-based downscaling to 500 m spatial resolution. The methods used here are an extension of the previous work of Turner et al. (2020). This GPP estimate is then employed to examine interannual variations in GPP between 2018 and 2019, finding that differences between years are strongly impacted by four large precipitation-driven climate anomalies. This paper is well written, and I believe that this analysis is a significant scientific contribution and will be of interest to the readership of Biogeosciences. I feel that this paper is suitable for publication after generally minor revisions.

However, as a potential user of this datasets, I feel that the impact of this work would be significantly increased if a comparison with existing (particularly MODIS-based) GPP estimates was presented. Over the past several years, there have been a number of gridded GPP products developed, including the FLUXCOM GPP (Jung et al., 2020) and FluxSat v2 GPP (Joiner et al., 2020) that estimate GPP from MODIS data trained on eddy-covariance observations. A clear advantage of the MODIS-based GPP estimates is that they cover 2001-present, while the advantages of this TROPOMI-based GPP product are less clear. In particular, some questions that I have after reading this manuscript are: (1) Would the MODIS-based GPP estimates similarly find that 2018-2019 differences in GPP to be <4% with 28% of the variations explained by these four events? (2) Do MODIS-based GPP estimates show less IAV for forest ecosystems, as suggested by NIRv? (3) SIF and NIRv may underestimate drought-induced GPP reductions (e.g., He et al., 2020), what are the differences in drought-induced GPP reductions for TROPOMI-based and MODIS-based GPP? I encourage the authors to provide a comparison of the GPP estimated in this analysis with MODIS-based estimates.

The manuscript does not provide much discussion of the uncertainties associated with these GPP estimates, and it is unclear if the GPP product provided with this analysis has associated uncertainties. I encourage the authors to include an uncertainty estimate with the data product and explain these uncertainties in the text. Presumably, an uncertainty estimate could be obtained from the uncertainty in the SIF-GPP regression.

Specific comments

P2 L18-20: Please re-word this sentence. Drought and flooding are drivers of IAV but seasonal redistribution is a response.

P2L19: Check citation format. Many instances where "Author (year)" should be "(Author, year)"

P3L6: "partitioned by the group operating the site". Is this always nighttime partitioning? Or does it vary between sites?

P3L8: It is not clear what product is being used to define the IGBP product and version number (note that there are large changes in v6 of MODIS product).

P4L4: "small signal" is "small SIF signal"?

P4L7-16: A little bit more detail could be given in this paragraph. Are you performing the cluster analysis on the 500 m gridcells?

P4L15: "most robust" – how is this determined?

Figure 2: The colors for mixed forest and deciduous broadleaf are hard to distinguish and the histograms largely overlap. I suggest switching these to more contrasting colors.

P7L11: "(500 mm vs 1000 mm)" – I could not find where the precipitation dataset is described. Please check that the precipitation dataset is described and cited.

P7L30: "toto"

References

He et al. (2020). Tracking seasonal and interannual variability in photosynthetic downregulation in response to water stress at a temperate deciduous forest. Journal of Geophysical Research:Biogeosciences, 125, e2018JG005002.https://doi.org/10.1029/2018JG005002

Joiner, Joanna, and Yasuko Yoshida. "Satellite-based reflectances capture large fraction of variability in global gross primary production (GPP) at weekly time scales." *Agricultural and Forest Meteorology* 291 (2020): 108092. https://doi.org/10.1016/j.agrformet.2020.108092

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Turner, A. J., Köhler, P., Magney, T. S., Frankenberg, C., Fung, I., and Cohen, R. C.: A double peak in the seasonality of California's photosynthesis as observed from space, Biogeosciences, 17, 405–422, https://doi.org/10.5194/bg-17-405-2020, 2020.