

## ***Interactive comment on “Ecosystem physio-phenology revealed using circular statistics” by Daniel E. Pabon-Moreno et al.***

**Anonymous Referee #1**

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In "Ecosystem physio-phenology revealed using circular statistics", Pabon-Moreno et al. have analyzed how the timing of maximum gross primary productivity is related to climate variables such as air temperature, solar radiation, precipitation, and VPD. They have analyzed 52 FLUXNET sites with more than 7 years of data and applied a circular regression method to (a) understand which environmental variable best predicts the timing of GPPmax and (2) measure the sensitivity of the response to each variable and (c) evaluate the method for different plant functional types. The topic is interesting, and the questions are relevant.

The authors have also performed a simulation analysis to compare linear and circular regression methods, in particular given that some of the sites are in the southern hemisphere and hence may not be on the same calendar year as the northern hemisphere

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sites, the authors have justified circular regression methods are more appropriate than linear regression methods.

The manuscript is generally well written and presented, however I have a couple major concerns related to the methods and conclusion that I strongly recommend being addressed by the authors.

1) I am not sure how finding shortwave radiation is related to the annual trend of GPP is surprising. Especially with the not particularly high correlation values from the model outputs. My concern is that what the model predicts may be actually the average seasonality of the site, which is generally represented/regulated by the annual variation of solar radiation. I think it would have been more convincing if the model could predict “weird years” rather than normal years. So, one might argue that the model is tuned to track the seasonality of the sites with an average predictability power. See my next comment which is related.

2) My other concern is that DOY values were directly used in the model as response variables. However, to analyze the inter-annual variability of the response, the anomalies should be used in the model. This is somehow related to the previous comment, as using site-specific model and absolute response values may result in obtaining the average annual trend and not the year-to-year variabilities. I think it would be best if the authors could use anomalies for each site as “y” in equation 2. Note that using absolute values in a consolidated model (all sites together) is another potentially good idea but that would detect the spatial (or site-by-site) patterns in the data rather than the temporal trends (which is the main question here).

There are also a few minor comments that I came across:

1- There is extensive use of parenthesis in the paper that sometimes make the narrative hard to follow. I suggest avoiding unnecessary parentheses in the manuscript.

2- The authors have used present tense throughout the manuscript at many places

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where past tense verbs are recommended.

3- line 141, “closed parenthesis” that was never opened

4- the narrative of the Results section can be improved, especially because the reader has to go back to the method to remember the terminologies and acronyms related to the method.

5- line 277: “Although the sensitivity of the DOYGPPmax to the climate drivers is site specific, it is possible to extrapolate the circular regression model for different sites with the same vegetation type and similar latitudes.” That’s a big claim. I’m not sure if the manuscript has provided convincing evidence with only 52 sites to support this.

6- What are the temporal windows for each predictor variable?

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I hope the authors find this review helpful in improving their manuscript.

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