

The paper entitled by 'Improved estimate of global gross primary production for reproducing its long-term variation, 1982-2017' proposed a new light use efficiency model (rEC-LUE) by integrating part of the Farquhar's model (a process model for leaf-scale photosynthesis of C3 plant) into EC-LUE model, which showed an obvious improvement of the simulation performance. Based on the simulations of this new model, the authors produced a new global GPP data very correlated to FLUXCOM GPP on annual scale. According to some of the Reviewer #2's comments, the authors also have provided adequate figures and revisions. However, I have the same opinion as the second one of Reviewer #2, which the authors didn't accept:

**In addition, it is necessary to closely look into a few specific sites (through selection of flux sites considering climate and other environmental factors) using time-series data. I guess the proposed model would work well for some sites, and not for others. Additional discussion should follow regarding that. When simply looking at Figure 8, the proposed model appears to somewhat underestimate GPP compared to the existing ones, which implies more validations are required on spatially and temporally detailed domains.**

It's very necessary that the authors could provide the time series result for some specific sites (can be one low-r<sup>2</sup> site, one median -r<sup>2</sup> site and one high-r<sup>2</sup> site) and give some analysis about the bias between models against observations.

Furthermore, I think the authors should also address following questions in their paper:

To build this model:

1. The authors were using part of Farquhar's model (Equation 5) to represent the CO<sub>2</sub> effect on GPP and embedding it into the EC-LUE model directly. However, this part of Farquhar's model only includes the limitation from the electron-transport efficiency (or J<sub>max</sub>) which is a super much simplification. The explanation should be given on why the limitation from Rubisco carboxylation rate (or V<sub>cmax</sub>) and non-linear effect of J<sub>max</sub> which also include the CO<sub>2</sub> effect were ignored.
2. In the introduction, the authors only talked about on the environmental factors they considered in their model, but didn't look into the other factors, for example: soil moisture, which is considered much more important than VPD in many other light use efficiency models (e.g. VPM, CASA, Horn's model and even the original EC-LUE model). The state of art on choosing the environmental factors should be investigated.

To force the models:

1. Because of weather impact, the EC sites also produce very bad quality data, which could not represent the CO<sub>2</sub> exchange under real condition. To some extent, the bad quality data could be filtered out by the quality flag. To calibrate the parameters, only the good quality data should be used for all these models.
2. It's better to keep the observed GPP and simulated GPP on the same time scale when calibrating the parameters.

To evaluate the models:

1. Besides giving some examples for specific sites, the site-specific R<sup>2</sup>, RMSE and bias for each model should also be given either in a plot (a scatter, histogram or boxplot) or in a table (the

R<sup>2</sup>/RMSE/bias of the best model and rEC-LUE model for each site). The statistical hypothesis test between different models could help to find the best model.

2. Figure 3: the highest slope is still under 0.5, does it mean the GPP is underestimated for most sites?
3. Figure 4: most of the GPP are close to 0. Please check the data quality, if data is good, could try data only in growing season.
4. Could you give a reason why the r<sup>2</sup> of FLUXCOM GPP is lower than their paper (Jung et al., 2017)?
5. Figure 6: it seems the negative GPP trend happen in the region where the uncertainty is relatively big. This should be discussed.
6. Figure 8: it's incredible that the GPP sensitivity to VPD is so much higher than to air temperature. Can you compare this with the sensitivity derived from other LUE model or GPP products?
7. Some letters in this paper look weird: 'v', 'x', 'z' and '%' are extremely small comparing other letters, please check the format before upload.