Comment on essd-2022-136
Yao Zhang (Referee)


Mapping the dynamics of Vcmax at global scale is important for the improvement of the model performance in predicting GPP and to understand the driving factors for its spatial and temporal variations. Recent studies have developed multiple methods to retrieve Vcmax based on satellite observations. This paper by Chen et al. summarized these approaches and provide a direct comparison between these datasets, the one predicted by optimality theory (EOT) as well as in situ observations. The satellite-based datasets generally show good consistency with the EOT and observations. The authors also evaluate the difference between the satellite observations and EOT and suggest that the difference can be explained by irrigation, soil PH, and nitrogen content. This is a solid paper and the developed datasets should be published. However, I still have some comments for the improvement of the manuscript.

In the abstract, the authors mentioned that they use a data assimilation technique to combine the SIF generated Vcmax and LCC generated Vcmax to get an optimized Vcmax, I did not find the description of this data assimilation method. Later in the results, I feel that the authors are referring the TROPOMI SIF based Vcmax as the assimilated Vcmax. If this is the case, the presentation in the abstract should be revised. In the abstract, the authors suggest that the data assimilation technique is to combine “two types” of remote sensing dataset, one is SIF based, the other is LCC based. Clearly, TROPOMI SIF Vcmax, based on its names, should still be considered as SIF based. This naming system is misleading to the readers. I would suggest the authors to reconsider this naming system or revise the abstract.
The authors suggested that irrigation may be the reason to explain the difference between satellite observed Vcmax and EOT predicted ones. I would argue that the improvement in the crop industry ("green revolution"), mostly better seeds, fertilization usages to be the plausible cause. This is based on the fact that the difference in satellite and EOT predicted Vcmax is large over all cropland regions, no matter it is irrigated or not (e.g., irrigation cannot explain the difference in Africa and south America). Second, irrigation would provide enough water which tends to reduce Vcmax based on the optimality theory, this is different than what we see in this comparison.

The manuscript mostly focuses on the comparison of the spatial variation of Vcmax from different datasets. Based on my understanding, all three remote sensing-based Vcmax have seasonal variations. Previous studies have highlighted the importance of correctly representing the seasonal variation of Vcmax to the improvement of seasonal GPP simulations. This seems to be an advantage of the dataset. But I did not see much stress on this temporal variation throughout the manuscript, this is also no cross comparison of these datasets at temporal scales.

Detailed comments:

L31, why three? LCC, SIF and the optimized one?

L32, the link provides two SIF based Vcmax, which is not described here.

L48, it would be good to briefly describe how Vcmax can be derived from SIF, you did this for LCC later but not here.

L64, and SIF is quite noisy.
L69, ... to produce a global Vcmax time series dataset? Single time series may refer to only one vector.

L98, the SIF-photosynthesis relationship is only linear at longer time scales (weekly or monthly), you may want to specify this. This sentence can be misleading considering you use "instantaneous".

L100, “sunlit leaves are the predominant sources of SIF” a reference would be helpful here.

L150, were these obtained from sunlit leaves only? The remote sensing datasets are for the sunlit leaves, right?

L165, I was expected to see the equation here.

L224, also plant genetic engineering. I think this may be a more plausible reason to explain the difference between TROPOMI and EOT. Human selections are producing much more productive crops that the optimality theory cannot predict. It happens that the much of croplands have irrigation. In Fig. 4b, the different is obvious in almost all croplands across the globe.

L228, but the optimality theory predicts lower Vcmax at regions with abundant water resource.

L258, I think you mean biome level Vcmax here.

L259, not sure if TROPOMI is the dataset obtained from data assimilation. This needs to be clarified in the method.