

## ***Interactive comment on “Assessing the large-scale plant-water relations using remote sensing products in the humid subtropical Pearl River Basin in south China” by Hailong Wang et al.***

### **Anonymous Referee #1**

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The manuscript evaluates regional scale plant-water relations in the Pearl River Basin. The authors find a strong inter-annual correspondence between NDVI and GRACE-derived TWS, suggesting water limitation in an area where rainfall is generally higher than the potential evapotranspiration. This is an interesting result, but the underlying mechanism remains unclear.

The introduction touched on a few important topics such as water limitation and plant water use, but the scientific hypothesis/questions are not clearly defined. “Quantifying the plant-water relations at different temporal scales under different dryness conditions” is a good starting point, but the specific questions to address need to be defined.

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The choice of vegetation data needs justification. NDVI is known to saturate in the forest ecosystem. MODIS GPP poorly represents soil moisture limitation on productivity which is directly relevant to the main theme of this study. There are many other vegetation metrics available that are not or less affected by these issues (e.g., SIF and EVI). LAI has also been used in a similar domain (Tong et al., 2018). I suggest the authors adopt these other datasets in the analysis.

The strong inter-annual correspondence between NDVI and TWS is interesting, given how humid this area is. It would be of interest to see if this correspondence changes across different biomes (e.g. crops vs. forests) or regions with different levels of aridity, which may be done at mascon resolution. On the other hand, the monthly-scale correlation analysis needs clarification. Is the trend and seasonality removed from the monthly time series?

The discussion session lacks a clear focus and sometimes reads like a literature review (e.g. Line 280-294). The discussion should be centered on clearly defined research questions and based directly on the results of this study.

Detailed comments:

Lines 72-73. This statement needs clarification. Is it to question if water limitation prevails in the humid ecosystems in the long term?

Line 105. I think it is better to define the TWS anomaly using the entire analyzed period as a baseline (by removing the mean calculated over the entire period), unless there are specific reasons to believe that the 2004-2009 period better represents a “normal” condition.

Lines 129-132. The mean annual TWSA depends on the choice of the reference period. The trend analysis is a better way to illustrate wetting/drying information. Are all the trends significant in Fig 2d?

Fig 2e. Please clarify how the basin average and the associated errors (measurement

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and leakage) are calculated. This should be included in the Method session.

Line 145. What is the trend in space? Note that here the trend in time does not have an error bar.

Figs 3-5. Please change the color scheme to improve the readability of the figures. For example, a sequential colormap is ideal for the aridity index. For the anomaly and trends, it is better to use a diverging colormap with a symmetric scale.

Line 153. Please label the significant trends in the map.

Lines 159-161. This reads like discussion, not actual results.

Lines 169-170. Needs other proxies for plant productivity to confirm this. MODIS GPP directly accounts for the limitation from VPD but not from soil moisture supply.

Fig 7. Please either label the areas with significant correlations or mask the insignificant ones. Trends can inflate the correlation results. Have you de-trended the time series?

Line 182. It is unclear how the monthly scale regression is calculated. Note that to quantify water limitation, the seasonality should be removed from the monthly time series.

Lines 189-190. It is unclear what this means. How are the water restriction and water consumption quantified and compared? In fact, quantifying the amount and timing of plant water consumption (e.g. ET in wet and dry years) might be helpful to understand why there is an apparent water restriction in such a humid area.

Line 196. How is the span of the growing season defined in this area?

Lines 212-220. This should go to the Data and Method session.

Line 230. The uncertainty of the trend needs to be evaluated.

Lines 232-241. This should go to the Data and Method session. The authors present examples where MODIS GPP shows consistency with other vegetation data, but in this

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study, the analysis based on the two datasets (MODIS GPP and NDVI) shows different plant-water relations. It is unclear if the difference is physical (e.g. due to the different responses of vegetation state and vegetation productivity) or caused by data accuracy issues. In this case, other vegetation metrics are needed to justify the results.

Line 257. Note that this is an active area for ecological restoration, including the Grain to Green project (Tong et al., 2018).

Lines 272-275. This point seems important but is not fully developed. Are there results in this study showing enhanced or perhaps near-normal productivity under drier than normal condition?

Reference: Tong, X., Brandt, M., Yue, Y., Horion, S., Wang, K., Keersmaecker, W. De, ... Fensholt, R. (2018). Increased vegetation growth and carbon stock in China karst via ecological engineering. *Nature Sustainability*, 1(1), 44–50. <https://doi.org/10.1038/s41893-017-0004-x>

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