

Reviewer 2

This study presents an integrated approach between vegetation modeling and Earth observations to derive the hydraulic trait, a crucial parameter to better understand the impact of droughts on vegetation. This new approach is likely to improve the parameterization of vegetation in land surface models. The manuscript is well organized and written, the approach is well described, the results are convincing. It also fits the scope of the journal. I just have a few minor comments:

Authors: We thank the reviewer for providing positive and constructive comments. The response to each individual comment, along with associated edits to the manuscript text, are listed below in black.

1) In the abstract and other parts of the manuscript, you write: "VOD is proportional to vegetation water content and therefore closely related to leaf water potential". You should specify that you choose a high-frequency VOD, X-band instead of L-band for instance, as the high frequencies are more sensitive to the leafy component of the vegetation and the lower frequencies to the woody component (see Frappart et al., C1 HESSD Interactive comment Printer-friendly version Discussion paper Remote Sensing, 2020 for a recent review on VOD).

Authors: In the methods (lines 141-142), we noted that X-band VOD was used. It is also specified that "This dataset is based on observations at X-band frequency (10.7 GHz), which is primarily sensitive to water content of the upper canopy layers (Frappart et al., 2020)." We have now added the following sentence for clarity (lines 142-144): "Here, we used an X-band record rather than lower microwave frequencies to reduce errors associated with potential sensitivities of these lower frequencies to xylem water potential, which might deviate from leaf water potential".

2) Why did not you include the equatorial and boreal forests in this study? It would have been interesting to see the results in Amazonia to compare them with the gradient observed by Jones et al., Environmental Research Letters, 2014, who identify adaptation to both water and light availability from west to east.

Authors: While we agree that the described comparison would have been interesting, parts of equatorial and boreal forests were removed if the long-term average VOD exceeds 0.8. We filtered such pixels to remove the effect of high retrieval uncertainty in these regions - at high VOD, there is little signal expected from the soil, but some soil signal is still assumed in the retrieval algorithm. This can have the effect of adding noise to the VOD. This filtering criterion is explained in the Methods section (lines 221-225): "Pixels where VOD is below 0.15 or above 0.8 were also excluded to remove sparsely vegetated pixels and extremely dense vegetation areas, respectively. The most densely vegetated areas were removed because low microwave transmissivity significantly reduces the accuracy of VOD and soil moisture retrievals there (Kumar et al, 2019), and low VOD pixels were removed to reduce inaccuracies due to ground volume scattering and low vegetation density."

3) Why did you choose LPRM VOD and soil moisture products instead of LPDR? In a recently published study (Li et al., Remote Sensing of Environment, 2021) one of you is co-author, LPRM

X-VOD was found to be more correlated to vegetation indices (NDVI, EVI, ...) than the other X-VOD products including LPRM.

Authors: Our application here is primarily interested in those components of the VOD timeseries that vary as a result of changes in water stress and associated leaf water potential changes. Thus, a greater correlation between VOD and optically-based vegetation indices representing canopy greenness and structure (e.g., canopy height) are not necessarily indicative that that particular dataset is a better fit for this particular application. Our choice to use LPRM instead of LPDR here was based on the fact that, as written in its documentation files, the LPDR product pre-applies a 30-day moving window average to the dataset to smooth out variability. This is much coarser than the 5-day moving window we applied to LPRM data and has the possible effect of reducing meaningful variations due to water stress.

However, we agree with the reviewer that there may be other differences between the algorithms that can affect the hydraulic traits derived here - for example, LPDR's use of a dynamic single-scattering albedo vs. LPRM's constant values. We had previously noted uncertainty associated with the choice of VOD dataset (lines 445-446): "the exact values of hydraulic traits depend on the specific data and model representation used here and therefore are subject to model and data uncertainties" (lines 386-387). To emphasize this point more, we have now added more text in the Discussion Section 4.1 to encourage further investigation on the impacts of different VOD products (lines 397-399): "However, additional research is needed to understand the effect of the choice of retrieval algorithm and specific VOD product (Li et al, 2021) on any inferred VOD- ψ_l relationships. For this reason, any such efforts would also benefit from explicit uncertainty quantification."