Biogeosciences Discussions

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Comment on bg-2021-311

Anonymous Referee #1

Referee comment on "Exploring the role of bedrock representation on plant transpiration response during dry periods at four forested sites in Europe" by César Dionisio Jiménez-Rodríguez et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-311-RC1, 2022

Paper summary: In response to a growing body of research indicating that plants routinely use water from bedrock, these authors asked the question: what happens to modeled plant transpiration if, instead of relying exclusively on soil water, they are allowed to access a deeper bedrock bucket? They found that having access to more water improved the accuracy of transpiration in a widely used land surface model (when compared to actual sap flow data) in places with pronounced dry seasons. The authors suggest that this provides additional motivation for the better inclusion of plant-available bedrock water in land surface models. The manuscript is well written and easy to read.

I am supportive of the goals of this manuscript and would like to see it published, but I would also appreciate the authors considering how they could address what I perceive are two shortcomings:

- The study illustrates transpiration dynamics using field data for sapflow at four sites, but no actual local field information about the storage dynamics of the bedrock underlying soil, local rooting profiles, etc. is provided. So, there is little meaningful context regarding the subsurface properties at the sites (properties that are the primary focus of the paper). This means the study essentially looked at the effect of varying a model parameter (water storage bucket size) on T and found that the default model configuration could be improved upon. Other default model parameters could have also been varied (the PFT properties, for example), and modeled transpiration

might have been improved as well. So, while the authors have shown that changing a model parameter from the default can improve model performance (larger storage buckets *can* improve T representation [and I don't doubt that this is the likely reason]), without any actual data showing that plants use deeper water from bedrock at these sites it has not been demonstrated that this is mechanistically why T has improved for these particular sites. Is any of this context available at the four study sites, and could it be added to the paper? Based on the findings of the paper, what should be done by the modeling community? Should the water storage bucket just be freely calibrated instead of prescribed? What exactly is the goal of changing this parameter? To improve accuracy of historically observed T, or to better predict T under non-stationary climate, etc?

- Other studies have already shown that increasing the size of the storage bucket accessible to plants can improve modeled T patterns in seasonally dry (e.g., Mediterranean) climates (e.g., Ichii, K., Wang, W., Hashimoto, H., Yang, F., Votava, P., Michaelis, A. R., & Nemani, R. R. [2009]. Refinement of rooting depths using satellite-based evapotranspiration seasonality for ecosystem modeling in California. *Agricultural and Forest Meteorology*, *149*(11), 1907-1918.). Yes, these studies do this by changing rooting depths, or adding deeper soil (rather than calling it bedrock), but isn't the fundamental result the same: more stored water accessible to plants? What exactly is the novel finding in this study in relation to what these other studies have done (which is to change a model parameter that ultimately allows for more water storage for plants, thereby resulting in a better T or ET estimate)?

Other items:

Table 1: Is the p50 correct for the Russian site? I am surprised it would be such a low water potential in such a cold climate.

- I understand the goal of Figure 4: compare modeled to actual sapflow patterns by time (note that nowhere in the figure or caption is this stated, however). This figure is extremely difficult to comprehend, even after quite a few minutes of study. It is also worth noting that a continuous variable is reported as an area (circle area) rather than a length, leading to potential interpretation ambiguities. Can these not be plotted as regular time series points, whose values vary along a continuous rather than categorical y-axis?

Figures 5 and A2-A5 are not legible when printed on standard paper and need to be reformatted so that they can be read.

Line 165: It is reported that in order to mimic the hydraulic behaviour of fractured bedrock, it is modeled as a pile of sand (90% sand, 10% clay). This model choice is not supported by any reference to literature on bedrock hydraulic properties, and surprised me as it is not how I would conceive of bedrock hydraulic properties.