Biogeosciences Discussions

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Comment on bg-2021-311

Anonymous Referee #2

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-RC2, 2022

Summary:

The authors manipulate existing CLM 5 soil texture and depth to bedrock (DTB) parameters to account for plant-accessible moisture stored in fractured bedrock beneath soils. They compare simulated to actual transpiration across four sites in Europe with different climate conditions and find that the two simulated bedrock scenarios (one with 1.5 m of simulated “bedrock” and another with additional “fracturing”) better match observed transpiration during the summer for the sites with a pronounced dry season.

This work motivates further exploration of how bedrock water is accessed by plants and how this process is represented in hydrologic and ecophysiological models. The manuscript is exceptionally well motivated and contextualized, and was easy to follow. The conclusions are well reasoned and of interest to a number of communities engaged in biogeosciences research. Comments are shared to increase clarity.

Comments and questions for the authors:

Why are the rooting profiles illustrated as linear but described as exponential?

Is there an expectation that model agreement should be improved during energy limited periods or in energy limited sites (e.g. line 303, 405). Limitations outside of water availability could be better quantified and described in the results and discussion.

Are the default parameters reported in line 145 site specific and if so, are they reported?

A statement on the rationale behind the specific three model configurations would benefit the reader. Why these three and not other possibilities? Additionally, in line 167, how does the 90% sand and 10% clay mimic fractured bedrock? Justification is needed here.

The Pelletier et al 2016 dataset is a model output and not reflective of local site conditions per se. As far as I understand, it is only validated for depth to bedrock in the US using groundwater well data (which is rarely available in uplands areas like the sites in this study.) The language around use of the dataset should be couched to reflect that the dataset does not provide DTB at the four sites.

In line 80, what does "fully developed" mean in this context?

In line 75, an additional possibility is that belowground biomass distributions may change over time in response to water stress (e.g. Liu et al, 2019).

Is there site specific subsurface information (from e.g. the papers cited in the site descriptions) that could be added to contextualize the DTB increase needed to improve model performance?

The overprediction of transpiration during spring and rapid drying of the root zone is a very interesting result that models representing deeper water stores will have to grapple with. The discussion of plant hydraulics in L420-440 is thorough and very well done, but are there perhaps other additional factors that could be considered as well? For example, dynamic belowground biomass, fungi, or the role of multi-porosity systems (e.g. Schwinning, 2020).

Is it necessary to have well developed soil to access groundwater (Line 355)?

The definition of bedrock within the paper is a bit inconsistent, specifically in the caption of Figure 1. For example, bedrock in CLM5 is considered impermeable but bedrock is represented as a combination of sand and clay. Clarification is needed here.

Some comments about figures:

Figure A1: Is this a boxplot? It seems like a timeseries. A description of the points vs.

lines is needed in the caption.

Figure 2: Is there a legend label missing (corresponding to pink or orange)?

Figure 3: This is the most impactful figure but it is very difficult to tell the different model configurations apart. The caption says boxes but there don't seem to be boxes in the figure.

Figure 4: Some of the concepts in this figure could potentially be better represented by scatterplots for specific times or model configurations that are most significant to the results. Including a simple illustration of how model-data agreement is improved with bedrock water storage under specific conditions could make the paper potentially more impactful and approachable to non-CLM experts.

References cited:

Li, H., Si, B., Wu, P. and McDonnell, J.J., 2019. Water mining from the deep critical zone by apple trees growing on loess. *Hydrological Processes*, *33*(2), pp.320-327.