

Geosci. Model Dev. Discuss., referee comment RC1  
<https://doi.org/10.5194/gmd-2022-1-RC1>, 2022  
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## Comment on gmd-2022-1

Anonymous Referee #1

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Referee comment on "LPJ-GUESS/LSMv1.0: a next-generation land surface model with high ecological realism" by David Martín Belda et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2022-1-RC1>, 2022

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This paper describes a land surface model hooked on a well-developed vegetation dynamics model, LPJ-GUESS, mainly including the energy fluxes and radiation transfer processes of vegetation canopy and soil. Since the LPJ-GUESS model was designed to simulate vegetation dynamics at daily and yearly time steps, it requires many adaptations to simulating the sub-daily processes, such as soil temperature, ground heat flux, latent heat flux, transpiration, stomatal conductance, canopy bulk temperature, etc., as described in detail in this paper. I appreciate the efforts of transforming a traditional vegetation model (which is a very successful one) to a land surface model, where the original vegetation model plays a role of boundary conditions for the fast biophysical processes. I also like the idea of coupling the fast biophysical processes into the detailed vegetation structure, instead of the other way around, i.e., calculating the mean states of vegetation for coupling a vegetation model into land models.

The authors tested this model at 8 sites across the globe with vegetation types ranging from grasses (C3 and C4) to shrubs, woodland, and forests. They also tested different formulations of leaf conductance and soil water uptake functions. To me, the model behavior is well tested in this paper, because this paper is to show if these biophysical processes, when organized together on top of LPJ-GUESS, work reasonably well in different climate zones and vegetation types. And, these formulations have been used widely and tested extensively in other models.

As for the water (and latent heat) fluxes issue, the authors invested a lot of efforts to look

for reasons with different stomatal conductance models and water uptake functions. I think an expanded discussion about the interactions between vegetation settings from the LPJ-GUESS model and physical environments derived from the new biophysical processes would be helpful. This would also be helpful for understanding the differences in productivity between the original LPJ-GUESS and it coupled with LSM. Extensively tuning the parameters is unnecessary in this paper though.

Minor comments:

1. Line 146: the unit of lambda. I think "C-1" is not necessary. The number of  $2.44 \times 10^6$  has included an assumption of normal water temperature

2. Lines 380 and 388: How do the vegetation conditions vary with the actual vegetation? I think the vegetation and soil states (equilibrium or not) may affect NEE, as shown in Fig. 14 that the simulations are close to equilibrium state.

3. Line 506 section Ecosystem structure and function: They are related to the settings of the vegetation model since the structure is highly dynamic. How to make them consistent with each case and the measurement data?

4. Lines 572: measured NEE is more negative than those simulated. I think it is related to how far the vegetation is from its theoretical equilibrium state. Disturbances also play a role here. For example, at equilibrium state, an ecosystem will have a zero NEE (or fluctuated around zero) if the system has no disturbances. However, if it is equilibrated with a particular disturbance regime (e.g., a given fire frequency distribution), the system must have a negative NEE that is to counter the carbon release at disturbance events. In long-term, it is still carbon neutral. This is the pattern this paper showed in this section that observations have higher carbon sink (more negative NEE) than the simulated (with 500 years of model run).

5. Time steps of and growth (yearly) and SOM (daily): how LAI dynamics and heterotrophic respiration are calculated? Usually, LAI should be updated daily and Rh hourly (or half hourly). Are they connected with plant growth and SOM dynamics at each step, respectively? This just need to clarify. I may miss the description.

6. In discussion, for the water uptake functions and C4 grass carbon assimilation simulations, they are phenomenological equations in the model that directly link soil water availability to leaf functions. A discussion of actual plant-soil hydraulics would be helpful

for understanding why they happen and why we don't have to spend much time to tune these functions.

7. I just realized the codes of LPJ-GUESS are still not publicly available. Maybe, this question should be asked by the handling editor. Does it comply with the journal's policy?