

Geosci. Model Dev. Discuss., referee comment RC1
<https://doi.org/10.5194/gmd-2022-148-RC1>, 2022
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Comment on gmd-2022-148

Anonymous Referee #1

Referee comment on "Modeling the topographic influence on aboveground biomass using a coupled model of hillslope hydrology and ecosystem dynamics" by Yilin Fang et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2022-148-RC1>, 2022

Hydrological mortality influences water availability and biomass. In this manuscript, the authors present the results of a study designed to incorporate the ELM, FATES, and Farflow to show the importance of lateral subsurface in above-ground biomass. The WTD, AGB, and Bowen ratio could be varied after using the three-dimensional hydrology model. This paper is valuable because it is the first to apply the three-dimensional hydrology model to the Earth System model. This work could be helpful for the researchers using ELM, FATES (or ED2). However, model explanation, design of experiments, and the results need more detail, and analysis is ambiguous in several places.

Major comments

- In section 2.1.3, while explanations of different hydraulic failure models are well described, the explanation of the biomass equation is insufficient. Clarify it (Equations calculating the above-ground biomass should be needed in this chapter).
- The meteorological data which are employed in the model are from tower measurements. So, the same meteorological forcing is used in all grids? Is it a reasonable method? Moreover, which variables are used in this study (for example, temperature, precipitation, radiation).
- Before starting the experiments, parameter tuning of the FATES model should be done because the FATES model has large uncertainties yet. The above-ground biomass in ELM-F1-M1, ELM-F1-M2, which are basic models (figure4 e) is quite underestimated because the parameter tuning was not done. After the parameter tuning was done, the results all could be different. (The effect of the 3-dimensional model on biomass may be reduced or increased.)
- With the 3-dimensional model, the AGB and GPP were simulated bigger at lowland than at highland. Do you have observation or reference? Does the fact that the simulated

wetter soil in lowland using a three-dimensional model show the improving model performance or just model comparison?

- In section 3.2, while the results of ELM-PF-FL-M1 are well written, the explanation of ELM-PF-F2-M1 was quietly insufficient. Moreover, what is difference between F1 and F2? This explanation could be added in section 2.4.
- With F2, the AGB increases, but GPP decreases. In general, the AGB is positive correlated with GPP, but it is not in this case. This could be discussed with a trait of plants. (Line 476). And it would be better to think about it the direct impact of plant trait on AGB and the indirect impact (plant trait -> WTD -> AGB)
- In-Line 479~484, I was confused that the experiment with adjusting the VCMAX was shown suddenly. There is no experiment in Table 1 and in Section 2.4. And why did you multiply 1.9? Is there any reference?
- In section 3.3. it is very interesting about the response of AGB, VWC, Water table depth, H mortality and C mortality to M1, M2 and M3 model. In Line 514, you mentioned that M2 simulates wetter soil in the dry season compared to M3. But it seems likely that simulated AGB in M3 is more than M2 (Figure 6 (a), (b)). Could you add the results of AGB in M2 and M3 in dry seasons and discuss that why is AGB in M3 is more than M2? To my knowledge, the vegetation in wetter soil makes more carbon, especially in dry seasons.
- In section 3.4, the description of variable importance of AGB, WTD was written. How did you calculate the importance? It should be added in section 2.5.
- It is necessary to first show the performance of how well AGB and WTD are predicted by the random forest method. It is necessary to show the importance after presenting the results and discussing them. Moreover, why did you select elevation, slope, convexity, and vwc using the random forest? Is this sufficient to explain the importance of AGB and WTD?
- This paper has novelty because a three-dimensional model is incorporated with Earth system modeling. In this paper, the domain is very small, while the domain and spatial resolution of research using the Earth system model are still large. Using a three-dimensional model may have inaccurate results or no significant impact with large resolution. It would be good to add a discussion on using a three-dimensional model in a global scale.

Minor comments

Contracted words are inappropriate in a science paper.

Line 103 during1983 -> during 1983

Line 198 The words of leaf area index are repeated

Line 293~295 The sentence about ET could be deleted

Line 318~319 and 321~322 These sentences should be rearranged (-> in section 2.3)

Line 333 2)->1)

Line 349~357 The explanations about spin up and experimental design are quietly hard to understanding. The case 3 was run 200 years and after that additionality runs for 16 years was done due to the comparing case 6 and case 7. It would be nice to show this in Table 1. And did you run the CASE 5 after case 4?

VWC is already shown in Figure 6, but there is no description of VWC in section 3.3. The first introduction of VWC is in section 3.4

Line 610 adds the discussion why the results of test data was not good.