

Geosci. Model Dev. Discuss., author comment AC2  
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## Reply on RC1

Ensheng Weng et al.

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Author comment on "Modeling demographic-driven vegetation dynamics and ecosystem biogeochemical cycling in NASA GISS's Earth system model (ModelE-BiomeE v.1.0)" by Ensheng Weng et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2022-72-AC2>, 2022

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Reviewer 1 asks us to re-arrange the description of GISS ModelE, and improve the presentation of the model and results. We will do this if we are asked to submit a revised version. Detailed responses are below:

*This manuscript by Weng et al reported a model improvement. I am happy to read it and know many great improvements. However, there are some unclear things that need improve before publication.*

Thanks!

*Line 47-49: this sentence is not necessary.*

Removed

*Line 86-99: should this paragraph be moved to model introduction section?*

Agreed. We will move it to the model description section if we are asked to submit a revised version.

*Line 213-214: how to determine soil moisture threshold is quite important. However, it is difficult to understand how to determine this threshold. the authors need introduce more about this.*

In this paper, we just slightly tuned this parameter. We will parameterize it with data for different PFTs in future. A plant hydraulic module is being developed. It is not necessary to tune it too much. We will add some explanations for it.

*Line 219: what is structural biomass? What are the parameters of  $a_c$ ,  $a_z$ ,  $\theta_c$  and  $\theta_z$ .*

Sapwood plus heartwood. We will add the notation to these parameters in the text.

*For Eq. (5), the most important thing is how to simulate  $D$ ?*

Yes.  $dD/dt$  (and its integral  $D(t)$ ) is the process that links carbon fluxes to plant structure. It also bridges the traditional BGC model (fluxes and pools) to the demographic models that explicitly simulate three-dimensional growth of trees.

We have a paragraph to explain it after Eq (7). We will clarify the meaning of predicting  $D$  in revised paper.

*Line 231: is that correct to keep a minimum growth rate of stems? Why do the authors set the equation like this?*

Yes. The purpose is to keep the consistency of the vascular system in leaves, sapwood and roots, though they are separated into three pools. We discussed this assumption in Weng et al. 2015 and Weng et al. 2019. A brief explanation will be added in the revised version.

*Line 232-235: it is difficult to understand how the authors simulate carbon allocation. Carbon allocation is quite hard to simulate indeed, and especially for demo-type model, the authors should pay more attention to impacts stand age on carbon allocation. Please refer the Xia et al. 2019.*

We will explain it clearly and put it in the background of other models, including Xia et al. 2019.

*Line 246 "Reproduction and Mortality". They are very important and hard to simulate. I am happy to see the authors made great contributions.*

Thanks!

*Line 258: cannot understand "U-shape" curve?*

"U-shape" means high mortality rates at seedling and old trees. We will reword this sentence.

*Eq. (9) it will be better to introduce the basic principle.*

This equation delineates the mortality rate that changes with social status (crown layers), shade effects, and tree sizes. We will add this to the revised version.

*Figure 2. it will be helpful to give name of each vegetation type in the figure caption. Did you include cropland?*

Will do as suggested. Cropland is not included. We only simulated potential vegetation as represented by the 9 PFTs.

*Line 355: what do you mean "The interpolation of radiation"?*

The forcing data is at six-hour time step. We interpolate them into hourly/half-hourly time step. We will clarify it.

*Figure 4. can you explain why there are sharp decreases of simulated height? I am also confused why the crown area index increased first and then decrease?*

The sharp decrease in critical height indicates the transformation from even aged trees to mixed trees in canopy. "Critical height" is the shortest tree in canopy layer.

We will clarify this model behavior in the revised version.

*Figure 5. simulated LAI is not good enough, but I totally understand it is very hard task. You may discuss this issue, and especially point out how we should improve LAI simulations in the further studies.*

Will do as suggested.

*Figure 7. how did the authors treat cropland? If the model scheme impacts this global comparison?*

We don't include croplands in this study. We assumed the land is covered by potential vegetation that is represented by the 9 PFTs.

*Figure 8. these results are surprised for me. I thought the model can simulate plant carbon better than soil carbon. But it seems that I am not correct. Would you like please to explain the reason for large uncertainties of plant carbon simulations?*

We simulated the potential vegetation biomass. However, the data of biomass include effects of land use and disturbance. Soil carbon is disturbed too. From our simulations, biomass was far more away from equilibrium state. We will clarify it in the revised version.