

Responses to reviews for manuscript **Global Evaluation of the Ecosystem Demography Model (ED v3.0)**

To Reviewer #1:

The manuscript compared global evaluation of water and carbon fluxes, vegetation dynamics such as leaf area index and canopy height reasonably to a series of global observations shown in table 1. As a whole, the manuscript seems carefully prepared and concise, and is thus suitable for the publication in GMD. At present, The improved ED-v3.0 model is a potential used as one of benchmark models for evaluating globally ecosystem responses to the climatic variations in the future. Using the model simulations, the authors showed spatio-temporal variations in GPP and AGB that were comparable to global observations well, including the effects of eccentric atmosphere-oceanic events like El nino/La nina on terrestrial carbon productivity. However, I suppose, in Discussion and Conclusions, you need to somehow modify the manuscript to more clearly show the importance and advantage of use of four modifications that has been never handled into the previous developed ED model. In particularly, the discrepancy between the present model and observations for evaluating global annual evaporation shown might be related to a lack of unknown terrestrial hydrological processes. Additional simulations were no longer required, while more discussions are to be indicated if the application of other new submodules also derived realistic products compared to those from the original ED. The manuscript will be thus accepted after covered moderately with these minor revisions. I will give several bullet points below.

Response: Thank you very much for your constructive comments which have improved the manuscript. We have revised the manuscript accordingly. Specifically, we added a new paragraph to the Discussion section to point out the qualitative benefits of the four key modifications (page 13, line 420-429). We also added more discussion on the potential causes of low ET (page 14, line 485-489).

Method line245: Make clear net biome productivity (NBP) here, and delete this in line260.

Response: We have revised it.

Results line 368-374: ED-evaluated annual evapotranspiration seems consistently smaller than FLUXCOM observations not only in dry regions you mentioned but across all the latitudinal ranges. Could you describe more detail what mechanisms regulated annual values in the model to explain the discrepancy between model and observational estimations. Additionally, how did the new hydrology submodule incorporated operate for the annual estimation associating with evaporation from soil and canopy? Or, Is this due to evaluations from Penman-Monteith big-leaf model? If so, for instance, Bonan et al.(2021) in Agri.For.Meteorol may help more discussion of the model work.

Response: This paper introduced evaporation estimation to the hydrology submodule, which is missing in previous regional versions of ED. In the Hydrology submodule, the ET is the sum of evaporation from soil, evaporation from canopy, and transpiration from canopy. The evaporation calculation follows the Penman-Monteith equations (Mu et al 2011) with further detail provided in the Supplement S9.

We agree that the ET underestimation appears not only in dry land but also other areas. There may be several causes of ET underestimation, but these were not explicitly identified in this study. We have added some discussion of these potential causes on page 14, line 485-489:

... Third, ED estimates of ET were lower than reference across all latitudes. One reason for this difference could be the parameterization of Penman-Monteith equations in the Hydrology submodule, as the value of aerodynamic resistance used in this study was higher than reported in Mu et al 2011. A second potential cause could be the scaling of evapotranspiration (Bonan et al 2021), which combines cohort scale transpiration with patch scale evaporation and currently omits vertical variation of evaporation ...

Discussion and Conclusions: line 408-417: Make the discussion started first. Move the first paragraph to the late part of this chapter and arrange then.

Response: We have revised this paragraph as suggested.

line 457: Delete the first sentence.

Response: Agreed. It has been revised.

line 459-465: The author stated here ED overestimated tree height in three particular regions like S.China, SE asia and SE Brazil. From Fig.17, the canopy height estimation from ED seems to be so smaller than observations over northern hemisphere, including the former two regions. Rather, ED-derived LAI from Fig.12 is larger over whole latitudes.

Response: ED-estimated height is indeed higher than GEDI over S. China and SE Asia; however, there is also underestimation in other areas at the same latitudes such as in Myanmar and Tanzania. Thus, this underestimation leads to overall lower height at these latitudes as shown in the Fig. 17d. Additionally, LAI in Fig.12 includes a contribution from grass shrub type of PFTs which lowers canopy height significantly.

line 478-483: Move these to the top of this chapter and arrange then.

Response: We have revised the Discussion section as suggested.

Other: Figure 5: In (c) and (d), symbols and captions in legend are too small.

Response: Agreed. We have redesigned it.