

Interactive comment on “The Yale Interactive terrestrial Biosphere model: description, evaluation and implementation into NASA GISS ModelE2” by X. Yue and N. Unger

Anonymous Referee #1

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This paper describes a new model for terrestrial biosphere processes that can be run in offline mode and coupled to an atmospheric chemistry-climate model. Aside from the model description, the authors show substantial validation of the model (YIBs) in three different configurations. The model performs well compared to the observations presented and to other more established terrestrial biosphere models. Compared to other models it also has a fairly mature treatment of ozone damage and BVOC emissions. This represents a substantial contribution to the earth system science community, as evidenced by the fact that YIBs has already been used in previously published work. The paper is well structured and well written, and the abstract is clear and concise. It is appropriate for GMD and I recommend it for publication in this journal. However I do

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have recommendations as outlined below.

1. Model spin up: Why are different periods used for each of the experiments? In the supplement, it is stated that 80 years was long enough to get a net land sink of 2 PgC yr⁻¹. Was this initial condition only used for the global offline simulations? Why was only 60 years used for the online simulations?

For the site simulations, 30 years is a very short spin-up period, and it's likely that the respiration fluxes are still a function of the initial soil carbon. A longer spin-up would affect both the annual total and seasonal cycles of ecosystem respiration, and would therefore alter the NEE results. Since it is unknown to what level the soil carbon is in equilibrium at each site, I recommend removing the discussion of site simulated NEE. It could warrant a whole paper on its own, but as it stands this does not substantially add to the paper.

2. GPP: Please state where the GPP data comes from: was it downloaded from a website? Processed by the authors from NEE? Also, there is uncertainty associated with the flux tower GPP, as it is calculated from the measured NEE, which is itself uncertain (e.g. Papale et al. 2006, or see biome-dependent uncertainty estimates in Luyssaert et al. 2007, both attached). It would be useful to know the ability of the model in light of the uncertainty. For example, in Figure 4: a relative bias of 50% in GPP would be very high if the uncertainty in the GPP is around 20%. It would be useful to include uncertainty in the Flux Tower analysis – for example, the standard deviation of measured GPP could be used as a proxy for uncertainty in the flux, or general guidelines for biome-level uncertainty in Luyssaert et al. 2006.

3. Judging from Table 1, the tundra PFT is most like a shrub but with reduced productivity. Does phenology apply to the tundra PFT?

4. Model description: A few questions about the model formulation:

- In Equation 19, $(1-\lambda)NPP$ is allocated toward the different vegetation carbon pools.

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What happens to the rest of the carbon assimilated through NPP (λ NPP)? - Nitrogen in wood: From equation 23c, it looks like all wood respire. Is it accurate to assume that all wood respire? In TRIFFID there is an additional parameter for calculating N in stems that approximates the respiring stemwood based on height (e.g. Friend et al. 2003). - Is this model available for people to use? Is there a website?

5. As explained in Section 5.1, there is a high correlation between modelled and observed GPP at the ENF sites. Is this definitely due to the frost hardening? Was the correlation evaluated with and without frost hardening? There are many other temperature dependencies in the photosynthesis equations so it seems possible that other factors are affecting the GPP in winter.

6. Table 3 and related text in Section 5.2: This section of text is difficult to follow, mainly because the text explains carbon fluxes for large regions (ie: All tropics) in terms of % of the global total, while the table shows actual fluxes for smaller regions – this makes it cumbersome to cross-reference the table. One suggestion is to add columns for All Tropics and All Temperate regions.

Also, is 46% meant to refer to both the NPP and Rh?

The final sentence about the NEE differences between the tropical and temperate biomes needs some further evidence or explanation: If the warmer biomes have a higher dark respiration, this implies that they also have higher V_{cmax} and possibly GPP, which would contribute to a more negative NEE in the tropics (unless tropical GPP is limited by radiation, J_e , which in some regions is likely the case – in this case higher V_{cmax} would result in increased R_{dc} but not higher GPP). Was dark respiration output by the model?

7. Figure 6: It would help to have a legend showing the color-coding for the seasons.

8. Conclusions and discussion: I disagree with the statement that “The vegetation parameters, V_{cmax25} , m , and b are not well calibrated for the tropical forest rainforest

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biome due to the limited availability of tropical site measurement data (Fig. 1).” While it is true that relative to other biomes, there is a lack of data for tropical forest biomes, this is not what is shown in Figure 1. This figure shows there is only 1 flux tower used in this study (not the authors fault, there is a lack of flux towers in the Tropics especially ones with enough data to calculate GPP from the NEE). However, there is a fair amount of data which could be used to calculate photosynthesis parameters in the Tropics, see for example Figure 2 in Kattge et al. 2011.

9. Why was the MTE from Jung et al. 2009 used, instead of the MTE described in the 2011 paper? The 2009 product was made to reproduce a model (LPJmL), using fPAR simulated in LPJmL.

Technical comments: Abstract: An opinion: I'm not sure if the word “inextricably” is the best choice for beginning a paper attempting to explain these connections. Perhaps “intricately” is a better word?

Dark respiration is referred to as R_d in equation 5 and R_{dc} in Equation 22.

Page 3164, Line 20: remove “vs. higher”

References: Kattge et al., 2011: TRY - A global database of plant traits. *Global Change Biology*, 17, 2905–2935, doi: 10.1111/j.1365-2486.2011.02451.x

Papale et al., 2006: Towards a standardized processing of Net Ecosystem Exchange measured with eddy covariance technique: algorithms and uncertainty estimation. *Biogeosciences*, 3, 571–583, www.biogeosciences.net/3/571/2006/

Luyssaert et al., 2007: CO₂ balance of boreal, temperate, and tropical forests derived from a global database. *Global Change Biology*, 13, 2509–2537, doi: 10.1111/j.1365-2486.2007.01439.x

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