

## ***Interactive comment on “Evaluation of modeled global carbon dynamics: analysis based on global carbon flux and above-ground biomass data” by Bao - Lin Xue et al.***

**Anonymous Referee #1**

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This study uses IBIS in a calibration then validation study to examine AGB, GPP, and ET. This is not a very novel contribution but has the potential to be a solid iteration. My main concerns are (1) the lack of detail on calibration, (2) the lack of a pre-calibration baseline, (3) the lack of variable tau even though this is known and has already been done for this model, (4) the relevance of ET, (5) the lack of detail on the flux data, and (6) language issues. These are all detailed in the specific comments below. Assuming these are addressed this study could be suitable for publication in Biogeosciences.

L24: You go from “the simulation of carbon dynamics on regional and global scales” to biomass. But carbon dynamics are more than biomass! Also, later in the paper you look at ET, this is not mentioned in the abstract until you get to “Independent validation”

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(L31).

L40: I'm having a hard time with your: “The conclusions of our research highlight the necessity of considering the heterogeneity of key model physiological parameters in modeling global AGB.” This is not a new insight. What have you added here? How has the body of knowledge on this point been expanded? And I think the community knows that getting fluxes and stocks correct is a good idea to enhance predictive skill. More generally, I am struggling with the novelty of this study. I feel like I've read dozens of such papers before. . .

L54: One of many language issues: “The large carbon stock in the terrestrial ecosystem indicates the need for a reliable description of its current distribution and prediction of future variations”. This is a non sequitur as written. I think I know what you want to say here but I should not have to divine intent and meaning. But please have this edited by a native speaker.

L57: Is not the main reason it is hard to get global scale carbon stocks a lack of good observations?

L73: Try “alter global biomass”. The full sentence here (L72) is also a non sequitur as written.

L87: Here you only mention potential whereas above you also had present-day. Please be careful! Trivially we are nowhere near some idealized potential state such that a model might be more concerned with getting present-day correct.

L100: Starting here in this paragraph I feel you have already made these points. Also, where is ET. It's thrown in at seemingly random times and is not part of the story. Why do you even include ET?

L116: I need more detail on how you calibrated IBIS parameters. It's not explained to sufficient detail anywhere in the text.

L122: You mean hydrological?

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L125: Remove “In detail,”.

L143: Remove both uses of “the”.

L191: Is not there a more recent version of CRUTS?

L197: “The Princeton...” reads awkwardly. Maybe “The Princeton forcing data...” is better.

L207: If IBIS can’t do croplands why perform any comparison?

L214: Same awkward “In detail, ...”. Perhaps you want “In brief, ...” instead.

L216: A minor point but you might want to capitalize Random Forest as you use forest as a PFT/biome in many places.

L219: I am still unsure if you are doing global runs here? The preceding text references the Amazon. Also, despite your description I am unclear how “plot-level AGB data from the literature” was used to tweak IBIS out-of-the-box parameters. That is, how was Objective (2) satisfied?

L221: Break into 2 sentences please.

L228: no “the” before GPP.

L232: a rho of 0.6 means 36% variance explained. And this is a lower bound? Can you elaborate here? How can you reconcile the lower bound you use in the text with your “the model can simulate the energy balance well” (L236) statement.

L245: How does a small value have a large intercept?

L247: Try “When GPP was below...”

L248: Try “simulated GPP was. . .” GPP is not used as a plural. Fix this throughout the paper.

L251: How does a tower focus on high-production ecosystems when it’s sited in a

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marginal system? This makes no sense.

L252: I found this section rather hard to read. One example: “the model simulation results are around 100 mm year<sup>-1</sup> smaller than those from Jung et al. (2011), especially for low ET areas (Fig. 4).” The “especially” fragment makes no sense. And why “model simulation results” as opposed to just “simulated results”? I would encourage you to look at the full manuscript for clarity and flow.

L254: Remove the comma.

L277: Your “scale difference” argument here is not clear. Please elaborate.

L279: What is “plot accuracy”?

L286: In this section you overuse the word “shows”.

L292: What is “below -30°S”? The minus sign is redundant here.

L294: How did you pick the bounds for your latitudinal regressions? And why is this relevant here? In general, the writing has a tendency to walk the reader through the figures. That’s not bad per se but it’s overly verbose as is. Let the figures do some of the talking. I would recommend less length here.

L312: Language again, the hanging fragments of “according to the two meteorological datasets” and “with large heterogeneities in different areas” simply do not add value, only volume.

L325: “Comparisons of carbon densities have the advantage over AGB comparisons that they eliminate the uncertainties induced by global vegetation areas used in different studies.” Not sure I buy this. It seems you are assuming that density is the same across vegetation gradients. And we know this is not the case. And your L336 goes against this anyway.

L361: There has been more work on tau beyond the IBIS work. And if this is known as the “most important parameter in determining the spatial variance” why was it not

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addressed here?

L374: "The interannual variations in the GPP were mainly caused by different meteorological drivers." This is an odd sentence. How is IAV "caused" by different forcings? And drop "the" before GPP.

L379: Figure 8 does not show this. There is no "transfer function" from GPP to AGB (or vice versa) shown in the figure!

L422: "The research also shows that to simulate large-scale carbon dynamics, both carbon flux and AGB data are necessary to constrain the model." Fine, I think we knew this before this study was executed. But why not extend this. Add results using the out-of-the-box parameter values, so pre-calibration. What is that effect size? How does parameter-induced spread compare with forcing data-induced spread and spatial heterogeneity. Your second question (L116) is: "Can a single set of calibrated parameters accurately map the patterns of GPP and AGB?" It strikes me that to answer this query we need a baseline without calibration.

Table 2: Please add time period so we have a better sense of sample size. How did you navigate the La Thuile fair use data policy? I'm assuming that's where you harvested the FLUXNET data.

Figure 1: Label x-axis. What are the 20, 40, 60, 50, 100, 150 values for?

Figure 2: Add labels for y- and x-axis. Get rid of the "or". Make sure inset text does not overplot.

Figure 3: Minor point but the use of the same colormap in both plots (one inverted, one not) makes this harder to read than needed. A third panel showing relative differences ( $100 \cdot b/a$  in effect) would be a good add. Fix subscripts on colorbar units.

Figure 4: Same comments as for Figure 3.

Figure 5: Same comments as for Figure 2.

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Figure 6: Fix subscript. I'd like to see (b) flipped so that the lat bands match how one would read map. Why not add a mean zonal vector for both forcing cases?

Figure 7: The (c) panel occupies a bit too much space. It's really not that exciting anyway, you could drop it. Also, ylabel is misspelt. Or, map the relative differences as I've suggested in preceding figures.

Figure 8: Same comment as for Figure 7.

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