

Geosci. Model Dev. Discuss., referee comment RC1  
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## Comment on gmd-2021-383

Anonymous Referee #1

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Referee comment on "Impact of changes in climate and CO<sub>2</sub> on the carbon storage potential of vegetation under limited water availability using SEIB-DGVM version 3.02" by Shanlin Tong et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-383-RC1>, 2022

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This paper reports a set of factorial simulations of global vegetation biomass responses to changes in atmospheric CO<sub>2</sub>, temperature, precipitation, and radiation based on a well-developed dynamic vegetation model, SEIB-DGVM. The purpose of this study is to "systematically determine the long-term variability of carbon-sequestration potential and understand its response mechanisms, and estimate trends in partitioning of potential biomass carbon-stocks of vegetation biomass".

However, after reading through this paper a couple of times, I do not think these questions are answered. The authors should keep it in mind that these results are simulations from a model. One cannot just run the model and tell us what they are. The simulations must be correctly evaluated before taken as conclusions. A detailed analysis of simulation results, model formulation, and uncertainty evaluation is necessary either in Results or in Discussion.

I also had a hard time in following the description of model description (Section **2.3 Carbon-stock of vegetation biomass partitioning**). Please improve this section.

I put my detailed comments below:

Line 89: "Large gaps in our knowledge of the effects of various drivers on the partitioning of carbon-stocks in vegetation biomass remain."

Through this paper, the definition of "carbon-stock" is confusing. If it is referred to as the biomass, you do not have to use it. Just use "biomass".

Lines 123~124 "Neither the CRU nor NCEP datasets included downward shortwave and longwave radiation." I used these data and I know they have downward shortwave and longwave radiation at 6-hourly time step. Go to TRENDY site, where you can find the links to these data.

Line 177: "**Carbon-stock of vegetation biomass partitioning**" I think it does not have to say "carbon-stock" if it means carbon content of biomass. Biomass can be defined as unit of carbon (e.g., kg carbon per unit of land)

Line 194: I am not clear about this equation.

Does "( $\frac{\partial C_{veg}}{\partial t} = \sum_i \frac{\partial C_{veg,i}}{\partial t} + \frac{\partial C_{veg}}{\partial t}$ )" have any physical meaning?

L<sub>Amax</sub> seems to be a maximum leaf area. However it is said to be "maximum leaf area of PFTs per unit biomass (m<sup>2</sup> m<sup>-2</sup>)," per unit biomass of what? Why is the unit m<sup>2</sup> m<sup>-2</sup>?

Line 204: "Grass leaf biomass is supplemented"? stop to grow?

Line 206: Any scientific basis for this equation? Why is it like this?

Lines 214~215: This sentence is funny "When total woody biomass is more than 10 kg DM, which defines the minimum tree size for reproduction, 10% of non-structural carbon is transformed into litter."

The authors are talking about "reproduction" limit of biomass, and then they tell you if this requirement is met, some NSC will be converted to litter. Then, what is reproduction? Is it "10% of non-structural carbon is transformed into seeds"?

Lines 216: "the remaining structural carbon is allocated to sapwood biomass" What is "structural carbon"?

Line 222 "Terrestrial water availability represents a significant source of variability in the ecosystem carbon cycle" This sentence is not necessary.

Line 232 "According to the flexible allocation scheme, SEIB-DGVM allocates and stores the biomass carbon ..." the phrase "According to the flexible allocation scheme," is not needed.

Lines 236~238 This sentence disrupts the description of model formulation. Reword it.

Lines 253~254: "The plant functional types are favored for establishment by the environmental conditions in each grid cell." Reword this sentence. I could not understand what it wants to say. Does it mean the environmental conditions will select out PFT(s) in each grid cell.

Lines 260~268: section "**Factorial simulation scheme**" Clarify this section please. It is really difficult to understand it.

Lines 260: What are "Other drivers" in Table 1? You only listed "atmosphere CO<sub>2</sub>, precipitation, temperature, and radiation". Specify them please.

Line 265: What is "carbon-stocks trend"?

Lines 295: I don't understand "In terrestrial vegetation biomes, there is a high correlation between biomass carbon-stock density and NPP per unit (Erb et al., 2016; Kindermann et al., 2008)". Why does it need "In terrestrial vegetation biomes"? per unit of what?

This is supposed to be the results. Why does it have citation here?

Lines 295~302: If this paragraph is to describe another dataset, it should be Method and Data section.

Lines 303~314: Same for this section. Move it to the data analysis method section

Lines 331~332: Move to Method section.

Lines 335~336: I am confused by the definition of "carbon-stock". Is it new growth of biomass or the biomass a plant has?

Line 349 "a conclusion consistent with prior knowledge (Erb et al., 2018; Schimel et al., 2015)" should be in discussion.

Lines 355~357 "Based on the carbon-stock partitioning method, we found that the integrated carbon-stock as well as the above- and belowground carbon-stocks over the period of 1916–2015 exhibited a remarkable spatial heterogeneity. " This sentence does not have information. Say it directly: What the spatial pattern is.

Lines 369~372: "Biomass carbon allocation between above- and belowground vegetation organs reflect the changes in individual growth, community structure and ecosystem function, which are important attributes in the investigation of carbon-stocks and carbon cycling within the terrestrial biosphere (Hovenden et al., 2014; Fang et al., 2010; Ma et al., 2021)" this sentence should be in discussion. Present your own results.

Throughout the results section, this type of evaluations to their own results should go to discussion.

Line 466 "**4 Conclusions and discussions**" Change it to "4 Discussion and conclusion".

For a modeling paper, the uncertainty of simulations should be evaluated. One cannot pretend these simulations to be the sure thing and "offer perspectives" based on them directly. Many patterns are just artifacts from model assumptions and model response equations, which are highly uncertainty.

For example, in line 495, the authors found "the long-term change in carbon-stocks is tightly coupled to terrestrial water availability". Then, it should be talked about that how the model simulates water effects on vegetation and to what extent this formulation can be trusted.