Geoscientific
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Discussions

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Interactive comment on "Identification of key parameters controlling demographicallystructured vegetation dynamics in a Land Surface Model [CLM4.5(ED)]" *by* Elias C. Massoud et al.

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Received and published: 15 February 2019

Vick,

Thank you very much for the comments. Please see below a short response before our final revision.

1) The entire parameter space of the model was not explored so how can this be even called a global sensitivity analyses? You looked at 87 parameters in this study. How much uncertainty you have in your existing results for the parameters that you have ignored?

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[Discussion paper]

Response: There are two types of analysis for models. One is the sensitivity analysis, which is used to explore the sensitivity of model outputs to parameter changes. They normally change the parameter by an equal amount/percentage to understand the model behaviors. A second type is the uncertainty analysis, which is used to understand how much uncertainty or variability is in the model outputs and what contributes to the uncertainty. It is possible that an output is very sensitive to parameters but has less uncertainty contributions if we have a good estimate of the parameter. Both analyses will be useful for model development with the sensitivity analysis focusing on understanding the baseline of model behaviors and the uncertainty analysis focusing on guiding field and laboratory measurements.

Our study is the sensitivity analysis. The "global" here is refer to that we change all the parameters at the simultaneously for understanding the impact of parameter of model outputs. There is confusion on how we define "global" sensitivity analysis. A sensitivity analysis is considered to be global when all the input factors are varied simultaneously and the sensitivity is evaluated over their entire range of interest (https://link.springer.com/referenceworkentry/10.1007%2F978-0-387-35973-1_538). From methodological perspective, it is mainly that we change the parameters simultaneously. From the scientific perspective, the question is what the entire range of interests is. For sensitivity analysis studies, the entire range of interest could be a certain percentage of default values of parameters. For uncertainty analysis, the entire range of interest could be the uncertainty or ranges in the measurements and observations.

2) How does these results of CLM4.5(ED) compare with the other versions of CLM e.g. with CLM-DGVM or CLM-FATES?

Response: This version of model [CLM4.5(ED)] is the initial version of CLM-FATES. We changed the name from ED to FATES about 2 years ago. We will make this clear for the revision to avoid confusions. As far as we know, we have no studies for CLM-CNDV, which is an original version of the dynamic vegetation for CLM. We did compare

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our results with ED in the manuscript.

3) The model simulations are performed for 1 deg x 1 deg (approximately at 100 km). This resolution is quite coarse. If you are trying to understand the large-scale vegetation responses to changes in parameter values, then I think that needs to be made clear (at-least in the abstract as well as in the introduction). If not, then you need to address how much your results will change if you did the sensitivity analyses at the local scale using local weather conditions.

Response: We will make this clear for our revised manuscripts.

4) This simulation is only carried out at one site. Why was this specific site chosen? Isn't this already a bias? Will you get similar results at other biomes?

Response: This a good question. We chose this site because CLM(ED) is already set up for this site and is common test site for the tropical biome. We will expect to see different results for other biomes but we will expect the main results will maintain valid. This is our first sensitivity of the model and we will see other research groups working on different sites to improve our understanding of the model at different locations.

5) The climate data was recycled, which might be okay, but you used climate data from 1942 to 1972? I don't think you can compare your modeled results with observations unless you believe that the climate at your studied site didn't change much or if your measurements were carried out around 1972? Further, isn't CLM4.5(ED) sensitive to climate forcing?

Response: Yes, CLM4.5 is sensitive to climate forcing. We understand your concern about the climate driver and I agree with you of the potential bias. However, because we are more on the qualitative comparison using different data at different periods of times, we feel that the bias could be small.

6) The simulation was carried out for about 130 years, where the changes in parameter values (+/- 15%) was relatively small compared to the default value. This % change

was fixed for all parameters. Isn't there any parameter out of 87 that has a wider range in reality. If so, how can one be really sure about these results then?

Response: As I pointed out at beginning of response, this study is a sensitivity analysis focusing understanding of the model behaviors. Ongoing studies of uncertainty analysis will help us understand the uncertainty contributions.

7) The authors should quantify the relative impacts on the carbon fluxes or vegetation stocks due to parameter changes, and state whether these impacts are statistically significant or not. At present, it is unclear how much the identified parameters control the carbon fluxes or stocks.

Response: We do have the standard errors of estimated sensitivities based on the delta method. See details from Chonggang Xu & George Zdzislaw Gertner (2011) Reliability of global sensitivity indices, Journal of Statistical Computation and Simulation,81:12, 1939-1969, DOI: 10.1080/00949655.2010.509317. We will update the p-values for the revision. We do plots the proportion of contributions in the sensitivity figures.

Yours Chonggang

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Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2019-6, 2019.