

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

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General Comment:

This paper applies the Fourier Amplitude Sensitivity Test (FAST) to a land surface model that accounts for vegetation demography. In particular, the authors try to conduct a comprehensive assessment of the sensitivity in the simulated vegetation dynamics to over 80 input parameters that describe plant biochemical, allometric, and demographic traits. The analysis is performed for a tropical rainforest region in the Amazon, where model bears large uncertainty. Limited by data and computational cost, the paper only included one plant functional type and found that model results are very sensitive to

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allometric parameters across all time-scales.

Generally, I feel the study is somewhat interesting for GMD in the sense that it introduces FAST to vegetation demography and ecosystem modeling, and that it includes allometric parameters. However, I think the paper can be improved in several aspects to be more useful to the community.

Scientific Comments

1. [P6L32-33] I understand the challenge to include trait-covariation in such analysis. However, the current assumption of absolute orthogonality between parameters makes it hard to interpret the results. For instance, Diaz et al. 2015 shows that the actual ecophysiologicaly-viable trait space might only be 2% of the total N-dimensional parameter space. It would be helpful to include some more discussions to help interpret the results

Díaz, S., Kattge, J., Cornelissen, J.H.C., Wright, I.J., Lavorel, S., Dray, S., Reu, B., Kleyer, M., Wirth, C., Colin Prentice, I., Garnier, E., Bönlisch, G., Westoby, M., Poorter, H., Reich, P.B., Moles, A.T., Dickie, J., Gillison, A.N., Zanne, A.E., Chave, J., Joseph Wright, S., Sheremet'ev, S.N., Jactel, H., Baraloto, C., Cerabolini, B., Pierce, S., Shipley, B., Kirkup, D., Casanoves, F., Joswig, J.S., Günther, A., Falczuk, V., Rüger, N., Mahecha, M.D. & Gorné, L.D. (2015) The global spectrum of plant form and function. *Nature*

2. Since the analysis uses a vegetation demography model, one interesting question is how parameters influence ecosystem demography/structure. I like the results showing the sensitivity for different size groups. An additional interesting diagnostic is how the fraction of small/large trees change with parameters. This information can help future modeling practices to diagnose biases in ecosystem structures. In addition, a theoretical analysis by Falster et al. 2018 suggests that the trait influence on growth can change non-linearly with size. It would be interesting to see whether the results of this study are consistent.

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Falster, D.S., Duursma, R.A. & FitzJohn, R.G. (2018) How functional traits influence plant growth and shade tolerance across the life cycle. *Proceedings of the National Academy of Sciences*, 115, E6789–E6798.

3. Of course, allometry can influence the results by a lot. But is a 15% change in the stem allometric coef  $c$  (the exponent in the allometric equation) justifiable? This is actually linked to the limitation that no parameter distribution is included. But I would suggest including some discussion for the most sensitive parameters.

4. The most sensitive parameters (e.g. target storage carbon) seems to be a rather model-specific one. What does this imply for other models or ecophysiology?

5. I feel the manuscript can benefit from some re-organization of figures to condense the scientific finding. Most importantly, it seems the sensitivity does not change much with time after a few years, which is expected to me given that only one PFT is included. In this case, I would suggest not to show the changes in sensitivity with time. Instead, just pick two time frame (early succession  $\sim$  5-10 years, and late succession  $\sim$  80-100 years, just like Figure 9) and use bar plots to show how variance is partitioned into different parameters grouped by category shown in Table D1 (Allometry, Photosynthetic, Regrowth, Mortality, etc.).

Stylistic comments: I noticed quite a few typos and inaccurate descriptions over the text. Here I name a few. I would suggest an overall editorial check of the manuscript.

Title missing space between demographically and structured

P1L2 'aimed' to 'that aims'

P3L23 allometry

P7L8 'bare ground', usually it is called near-bare ground since the model assumes a certain seed bank/seedlings to start with.

Figure 9, please make the last panel the same size.

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

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