

***Interactive comment on* “Evaluating and Improving the Community Land Model’s Sensitivity to Land Cover” by Ronny Meier et al.**

Anonymous Referee #1

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Well written manuscript. The subject is relevant and timely. I would recommend publication in Biogeosciences after the following revisions are made.

From the stylistic point of view, in my opinion the paper would read better if it is moderately restructured. The description of the sensitivity experiment (section 3.2) should be located in the methodology section before the result. This would avoid the feeling of jumping back and forth from results to methods, and would help justify the presence of CLM-PLUS results in the earlier figures (before its description). I know this may feel awkward as the CLM – PLUS simulation is seen as a response to the problems (i.e. results) identified in section 3.1, but with some effort I am confident the restructuring can be done. I would introduce this idea (that a CLM – PLUS simulation is done as a response to the first results) in the last paragraph of the introduction, and then describe

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it in the last section of the methods, saying you are anticipating (in the text) the results that will be presented thereafter.

Another restructuring point I would strongly recommend is to try to separate Results from Discussion. The combined section currently works quite well for 'Results', as such a section should not be just a description of results but also an interpretation of them. But some parts can be moved to a more general 'discussion' section in which the whole approach is discussed in a broader sense, providing more insight of the caveats and advantages of the whole experiment, and how it relates to the broader picture in Earth System Science.

Deforestation is more complex than a simple transition from forest to open land described in the Li et al 2015 MODIS dataset, as different types of forest (e.g. evergreen or deciduous) would have different effects (on snow masking and albedo for instance), and different kind of open lands will also behave differently (management would arguably have a strong influence). With the GETA data, the authors do explore this variability for ET to some extent. In my opinion a more thorough discussion is warranted, even if further analyses are not required within this study. Could anything be said on PFT specific differences for albedo and LST? Are there other field-based datasets such as GETA that could be used for these variables? Could other datasets from remote sensing that differentiate amongst forest types be used? If not, mentioning this need could justify and stimulate the development of such products in the future.

There are some doubts on how comparable the deltas that are extracted from GLEAM are with respect to the Li MODIS dataset and to the CLM sub-grid simulations. If I understand correctly, GLEAM provides separate values for tall canopies and low vegetation over the same 0.25 dd pixels, and to obtain a change between 'forest' to 'open-land', one makes the difference a pixel level between the value for tall canopies and for low vegetation. However, to understand better the possible repercussions this may have on the analysis, it would be necessary to have more information on how the distinction between tall canopies and low vegetation is made in GLEAM. What land cover

maps are used (if any)? How do these match with the CLM distribution of PFTs?

The MODIS Li et al. 2015 dataset depends on setting a threshold on the percentage of forest/trees that there are in a pixel so as to consider it 'forest' or 'openland'. They also show in their supplementary material that the choice of the threshold does have some effect of the results. How does this affect the comparison with CLM sub-grid results, for which the signal is fully 'un-mixed'? In my understanding this has the effect that the MODIS delta will often relate to a comparison from a 'not-so-full-forest' to a 'not-so-treeless-openland', while the simulations are from a 'full-closed forest' to a 'treeless openland'. How does this impact the results? Can something be done about it? Regarding the discussion on T2M vs LST in both the models and observations, an important point that is not completely clear is whether T2M is considered as 2m above the canopy or above the soil (i.e. within the forest). Note that in studies like Alkama & Cescatti (2016), the techniques to obtain T2M from satellite LST require weather stations, which typically use WMO definitions by which temperature is measured above a standard grass canopy, even if it is surrounded by forest. This means that the T2M obtained is not that which is observed within the canopy (i.e. under the trees) nor the one above the trees. In the model, and hence in this analysis, what temperature are we speaking about and how can the comparability between observations and models be ensured?

Other punctual remarks include:

Page 6, Line 3: Style: avoid starting sentence with a number

Page 9, Line 21: You need to specify that you are speaking of the MODIS instrument on-board of the the AQUA satellite. There is also a MODIS instrument on-board of the TERRA satellite for which the overpass time (at the Equator) is approx. 10:30 am and 10:30 pm. The choice of AQUA is sound as those times are actually not that far from the maximum and minimum

Page 9 Line 31, Could you speculate on why the model would have this behaviour?

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Page 11, Line 19... Could you add some info on whether this shallower root distribution is closer to what is observed, perhaps based on information from the references cited (Fan2017 & Canadell1996)? Ideally it would be good to have a line in Fig 6 for the observations over 'openland'.

Fig 1, 2, How do you calculate the confidence interval in MODIS? Do they come from the original product of Li et al. 2015? If so, do explain a bit more how they are calculated and how should the reader interpret it?

For all plots like that of figure 1, I am not too sure how much we gain in insight by having the fine 1dd resolution. I would recommend using broader latitudinal bins (e.g. 2.5 or perhaps even 5 dd) so as to have larger boxes in which the points of the t-test are larger and clearer.

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