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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Do land parameters matter in large-scale terrestrial water dynamics? – Toward new paradigms in modelling strategies" *by* L. Gudmundsson and S. I. Seneviratne

Anonymous Referee #5

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The original premise of this manuscript aligns with the conceptual versus physical model paradigm. However, there are too many underlying assumptions and failed evaluation that lead to at least major revisions and probably a complete rethinking of the manuscript, its assumptions and conclusions.

Below are the main issues that need to be addressed:

1. Time scale – The entire premise of this manuscript is based on the assumption that the monthly time step and 0.5 degree spatial resolutions describe the need for heterogeneous land parameters. However, it is quite clear that there are many im-

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portant processes (surface runoff, evapotranspiration,. . .) that although at the monthly time step will average out a lot of the daily and sub-daily signal, does not mean that heterogeneous parameters do not matter.

2. Comparison to LSMs – The authors compare a machine learning algorithm (purely statistical) to semi-physical based LSMs. From the manunscript, it appears that no prior calibration was performed on the LSMs and instead the trained random forest was directly compared to the LSMs. This is quite misleading. For this comparison to be "fair", the LSMs should also be trained.

3. Paper Structure – The only sections that seem ok are the abstract and introduction. The section on scaling takes up too much space for a subject that could be discussed in a sentence instead of a significant part of the manuscript. The results in the figures are not adequately discussed and instead just simply stated. Finally, the appendix it too convoluted and with too much information. The paper would need to be re-synthesized for publication.

Abstract -Unclear which processes and parameters to include? I don't think that is accurate. I think it is more appropriate to emphasize that we don't fully understand the underlying processes and are unable to accurately define the parameters to include line 11-12 -This might be true at the monthly time step over a coarse grid, but it really depends on the objective.

Introduction line 25 - I don't think that "relate" is the appropriate verb here. I would replace it with simulate. Relate implies an empirical relationship which is not what most land surface models actually do. line 14-15 - I would be very careful in stating the exact grid cell dimensions. Land surface models are not specific to a certain resolution. As long as you incorporate the appropriate processes, you can use land surface models at multiple scales. Given that in this study you are mainly concerned with coarse grid, I would just make sure you emphasize the "macro scale" component of the land surface modeling you are discussing in this paper.

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Separation of Scales - It is unclear when you read the paper for the first time why this section even exists. The main emphasis of this paper is to determine the need for spatially heterogeneous land parameters but yet you spend time discussing the time scaling of soil moisture? Please explain.

4.1.1 - Althougth the monthly time scale might work to understand the impact of land parameters on GCMs, it definitely does not explain the sub-monthly time scale. For example, LSMs act as boundary conditions for numerical weather models at the hourly scale. You state that this is an assumption, however you fail to go into detail on how this assumption drives all your conclusions. This needs to be addressed.

4.2.1 - Again, it is not surprising that the model does well at the monthly time step against evaporation from LandFlux. At these scales, the daily and sub-daily processes are averaged out and you are relying on seasonal and annual variability. Given that at these scales, net radiation and rainfall will be the main drivers (atmospheric forcing), this result is not surprising.

4.2.2 - This comparison is misleading. The purpose of heterogenous LSMs is to include available datasets to depict the heterogeneity of the processes and not need calibration. I understand that available datasets make this a large challenge. However, you are making a comparison of physical based LSMs to a pure machine learning algorithm. While they both have positives and negatives, they also have different purposes. Not stating those different purposes and instead doing a 1 to 1 comparison sends the wrong message.

5 - page 13206, lines 1-12 - I agree that the absolute values of the water balance equation will be highly correlated to the monthly atmospheric forcing. However, this is rarely (if ever) true at the sub-monthly time step. Although, I agree that the monthly average will only be affected by variables that depend at large time scales on the heterogeneous land properties, this still does not address the problem that we still need to depict the signal at the finer time scales to account for important hydrologic processes

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such as flooding, sensible heat, and latent heat at the daily to sub-daily scale. - page 13206, lines 13-22 - Actually, the land parameters used in macro scale LSMs come from upscaled (mainly by spatial averaging) of higher resolution product. This means that many processes in LSMs (e.g. richards equation) make sense at fine resolutions but are misleading at the coarse resolution. Combining high resolution modeling with available high resolution datasets (e.g. gSSURGO) will make the processes in current and upcoming LSMs more appropriate. - page 13207, lines 5-12 - I don't think that this statement says anything new from previous work. It is well known that an appropriate black-box model (i.e. random forests) when appropriately trained with enough data from representative regions will indeed beat in many cases physically based LSMs. However, this will only be applicable at the monthly time step and will fail to account for the evolution of the land surface over time and take account for variable climates. It is not surprising that the trained random forest worked well in this study, given that the climates used are similar. Taking this model and applying it over tropical regions would most likely lead to very different results.

Figure 6 - Were the LSMs used in this comparison trained against the data? Given that you are using a trained random forest, it is only fair to train appropriate LSM parameters for the comparison. If not, at least making this assumption very clear is an absolute necessity.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 13191, 2013.