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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

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Reviewer #3 raises a number of questions regarding the employed methods and the structure the manuscript. In the following we provide point by point answers to these questions. For the sake of clarity we first repeat the reviewer's comments (*in italic*) and then provide our response.

Comment 1: *The paper analyses the impact of large-scale atmospheric drivers versus land parameters for modelling the terrestrial water systems over Europe. It is concluded that substantial parts of terrestrial water dynamics are controlled by atmo-*

spheric forcing which dominates over land parameters. The manuscript discusses in its first part the scale separation between small- and large scale phenomena and consequently proposes the "Constant Land Parameter Hypothesis" (CLPH) which assumes, based on runoff observations in Europe, that one single set of model parameters is valid at every location in space. The CLPH has been tested against several alternative hypotheses.

Reply 1: We appreciate this concise summary of our research.

Comment 2: *While I do appreciate the scale separation discussion in Section 2, the tests of the CLPH are not very convincing. It is not clear enough which explicit and implicit assumptions are made with CLPH and thus which of them allow the conclusions presented as results, in particular in relation to the discussed small and large scales.*

Reply 2: Please note that the CLPH is developed in detail in Section 3, where the important assumptions (including effect of scales) are introduced. The CLPH is formally introduced with Equation 8. We restructured the revised article, aiming at communicating the assumptions of our analysis more clearly.

Comment 3: *Instead, a lot of technical detail in the appendix does not necessarily contribute to a better understanding of the main testing strategy.*

Reply 3: We address this issue in the revised manuscript and now include more details in the main body of the article.

Comment 4: *For which years has the CLPH been tested?*

Reply 4: Thank you for spotting that we forgot to state that the 1963 - 2000 time period was considered in the analysis. This time window corresponds to previous investigations (e.g. Gudmundsson et al., 2012a,b). This is corrected in the revised version of the manuscript.

Comment 5: *What was the training data set and what the independent verification data?*

Reply 5: The skill of the statistical models (Equations 9 and 10) was quantified using cross validation (p. 13203, l. 8-16, Bishop, 2006; Hastie et al., 2009). As cross validation and its implications for the presented study were not explained sufficiently we will expand the related section.

Comment 7: *What is the reference model used in the skill score estimates?*

Reply 7: "... the mean annual cycle of monthly runoff observations is used as reference [model]." as stated on p. 13203, l. 3-4.

Comment 8: *As I am not an expert in land surface modelling and thus am not able to substantially comment on the physical aspects of terrestrial water dynamics, a my criticism also concerns the methodological approach used in the study. The skill of monthly water dynamics estimates over Europe are purely based on deterministic skill measures which to me seems to be in stark contrast to the unavoidable uncertainties related to land surface modelling parameters and observations. Why do the authors not consider probabilistic measures of performance which explicitly take into account the uncertain nature of the subject?*

Reply 8: While we agree that probabilistic measures of model skill can be superior to deterministic measures, we would like to point out that a proper probabilistic treatment is not possible for the data at hand. The reason for this is that the LSM/GHM ensemble from the WATCH project does not provide measures of uncertainty. Consequently the properties of the predictive distributions cannot be estimated, which prevents the application of probabilistic scores such as the CRPS. One might argue, that the predictive distribution could be estimated from the LSM/GHM ensemble, by averaging over all ensemble members. This however, would contradict the premiss of the analysis which assumes that each LSM/GHM is an alternative hypothesis to the CLPH.

Comment 9: *I was surprised to see the parameters in Table 1 where the fraction of variance explained by the small and large temporal and spatial scales are equal. How does this fit to the main results of the dominance of the large-scale atmospheric*

forcing?

Reply 9: The reason for the high fraction of variance explained by small spatiotemporal scales in Table 1 is related to the fact that this analysis has been conducted without preprocessing the data. The analysis of scales was conducted using streamflow from different catchments at daily resolution (p. 13196, l. 15 - 22). The investigation of the CLPH is based on monthly data with a 0.5° spatial resolution (see p. 13200, l. 19-23 and p. 13201, l. for further arguments). At monthly resolution, the variance stemming from daily variations is filtered out.

Comment 10: *The topic of the paper is an interesting one but I doubt that the manuscript can shed much convincing light on the subject. The paper is not particularly well structured, see comments above. Some of the graphics are too small for me to be meaningful (Figures 3 and B1) and could perhaps be improved.*

Reply 10: We acknowledge that some parts of the manuscript have to be restructured to convey our arguments more clearly. However, we disagree with the reviewer that the results do not provide new light on the topic. The main motivation for the article is related to assumptions used in land surface modeling, which give a strong weight to land parameters, although we find that they have no identifiable relevance at the considered spatial and temporal scale.

Please note that the size of the graphics (Figures 1 and B1) is related to the typesetting of HESS-Discussions. In the final format of HESS these figures will cover the full page width and will be consequently more readable.

References

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