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Interactive comment on "Life time of soil moisture perturbations in a coupled land-atmosphere simulation" *by* T. Stacke and S. Hagemann

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We thank the referee for the positive review of our manuscript. In the following we will repeat the referee comments before answering them.

1. The experimental setup implies that the atmospheric model is coupled only with the land surface model not the ocean or other earth system components. However the introduction appears to suggest that this study aims to address the issues related to the use of ESMs for decadal and seasonal predictions. Please reword the first paragraph of the introduction suitably. Please provide a description of the prescribed SSTs in the experiment setup and replace "AMIP-type" in the abstract with "prescribed ocean" or appropriate words.

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Reply: Indeed, we used a coupled land-surface model with prescribed ocean and thus focus on a limited aspect of the full Earth System. While we acknowledge there might be some impact of an interactive ocean on land surface memory, we expect the major process interactions to take part between land and atmosphere. Thus, we omitted the ocean simulation thereby significantly reducing the computation costs for the ensembles. In order to make readers aware of this, we used the phrase "prescribed ocean" in the abstract and repeated this fact in the experiment setup section together with the references (Taylor et al., 2000) for the ocean fields.

2. The authors find that the strength of soil moisture memory depend on dynamically changing land atmosphere interactions rather than static soil or land cover properties. However the analyses only focus on the bringing out the interactions of soil moisture with land surface state variables. The analyses of the induced anomaly and memory statistics in near surface air temperature and humidity would have added more insight to how the favorable climate states contribute to persistent soil moisture anomalies.

Reply: In terms of our experiment setup and method, we don't expect to gain much additional information by analyzing induced anomaly and memory in the atmospheric fields. Already at the surface, the variability of humidity is very high and much more ensemble members are probably required to derive a significant signal in the lower atmosphere. With increasing height variability likely increases e.g. due to advection. Thus, a more physical approach like a tracking scheme would be needed to explicitly follow the pathways of soil memory – atmosphere interaction.

3. Please include a discussion on how much the conclusion that the 'soil moisture initialization has potential for decadal and seasonal predictions using ESMs' will be dependent on the atmosphere-land coupled modeling framework used in this study.

Reply: We agree that our results are, of course, model dependent. However, we cannot quantitatively conclude on how much our results would change in a different model framework, without actually testing it. However, we expect that a framework including

the most critical parametrization, namely the existence of a root zone soil layer and a deep zone soil layer below, would show similar memory characteristics. We added to following paragraph to the discussion:

"Furthermore, it has to be noted that the results are, of course, model dependent and the exact numbers will differ for individual modeling frameworks. Nonetheless, as long as critical land surface parametrizations are existent, namely the separation of the soil column into several layers containing a root zone and a deep soil layer, we expect similar soil moisture memory characteristics to emerge. Thus, the potential for improved climate predictions should exist for all state of the art modeling frameworks."

4. Please describe all the acronyms used in the manuscript e.g. ECHAM6, JSBACH etc.

Reply: In the very beginning, the acronym ECHAM was combined from the ECMWF (where the model originated from) and Hamburg, the place where its parametrization was developed. JSBACH stood as acronym for "Jena Scheme for Biosphere-Atmosphere Coupling in Hamburg". However, both acronyms became obsolete and the terms ECHAM and JSBACH are used as individual names by now. Thus, no description of the name will be provided in the manuscript. The explanations for the remaining acronyms, MiKlip (Mittelfristige Klimaprognosen), SPECS (Seasonal-to-decadal climate Prediction for the improvement of European Climate Services), and CMIP5 (Coupled Model Intercomparison Project Phase 5) have been added to the manuscript.

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