

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

Anonymous Referee #1

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The manuscript ‘Life time of soil moisture perturbations in a coupled land-atmosphere simulation’ by T. Stacke and S. Hagemann aims to evaluate whether the initialization of soil moisture has the potential to improve the prediction skill of coupled climate models at seasonal to decadal time scales by designing soil moisture initialization experiments using the atmospheric component of the MPI-M Earth System Model (ECHAM6) coupled to the land surface model (JSBACH). This evaluation is focused on a global analysis of the life-time (memory) of soil moisture perturbations distribution as well as a comparison of its characteristics for different regions and seasons.

The authors employ a quantitative methodology with the experiment setup by generating an ensemble that considers the internal variability within the model and accounts for inter-annual climate variations. The analysis uses a signal to noise ratio based on the

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ensemble statistics to derive metrics for period of memory and peak anomaly during these memory periods for soil moisture and related land surface state variables.

The analysis provides useful insight into the possible pathways of the soil moisture interactions with other land surface states at different time scales, though they are generally model dependent due to the formulation of the different parameterization schemes used in this model to represent the important physical processes within the atmosphere, land surface and sub surface hydrology. Hence many of them need further evaluation using different modeling framework.

Overall the paper is well written, structured and referenced. The abstract reflect the content of the paper and provide a clear and complete summary. I recommend its publication after the following minor issues are addressed.

Specific comments:

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.
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.
3. Please include a discussion on how much the conclusion that the ‘soil moisture

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initialization has potential for decadal and seasonal predictions using ESMs' will be dependent on the atmosphere-land coupled modeling framework used in this study.

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

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