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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Evaluating uncertainty in estimates of soil moisture memory with a reverse ensemble approach" *by* D. MacLeod et al.

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We thank the reviewer for their insightful comments. The first comment made is that the analysis should be extended to show how variations in soil moisture memory matter, for example how they impact models' weather forecast.

This is a good point and we agree in principle. However the analysis we have done is based on an uncoupled land-surface model, and to look at the impact on the output of weather forecasts would mean running the land surface coupled to an atmospheric model, which is not a trivial task for two reasons. One; the setup of the experiment is not a simple job and two; the number of simulations carried out in the same setup (15,625 per start date) would be prohibitive, both in terms of computer time and data storage.

We are certainly interested in the impact of memory on weather forecasts, however in addition to the reasons listed above we believe that the experimental design would be qualitatively different enough from the current analysis to render the investigation out of scope of the current focus. We are however intending to pursue this idea in future and are open to collaboration and would welcome further discussion with the reviewer if they are interested in this.

The second point raised by the reviewer refers to the November initialized simulations, suggesting we should better motivate analysis of hindcasts initialized in November and raising the question about why we should worry about uncertainty in soil moisture memory in winter if snow isolates soil hydrology from the atmosphere and prevents soil moisture-atmosphere interactions.

Our response is twofold. Firstly we use November forecasts as we wanted to focus on the two standard contrasting seasons, boreal summer and winter and many regions for November initializations are unaffected by snow. Secondly, whilst it is true that the snow will insulate the soil from the atmosphere, over the course of the season snow can melt and ultimately restore interaction between the land surface and the atmosphere. At this point initial soil moisture memory anomalies can influence the atmosphere, thus the variations in memory can still be important despite an absence of soil moisture-atmosphere interaction for part of the season. However it is true, that smaller variations in memory are less important when memory itself is long, as shown in the COV plot for the November start date in figure 4.

Naturally we plan to address the main reviewer comments in any future versions of the manuscript, along with including the minor revisions suggested by the reviewer.

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