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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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Again, we thank Prof. Dirmeyer very much for the review of our revised manuscript and the helpful criticism. In the following we comment on every point of the review.

Comment: The authors have addressed my comments satisfactorily, and I appreciate the thoroughness of their responses. As I read the responses, I thought again about alternative sources of memory and realized there is another possible memory mechanism in this model: SST/ocean heat content anomalies. It is possible that these are not cause-effect relationships in the land surface, but effect-effect where the atmosphere is delivering the signal (via circulation-induced precipitation anomalies) of the actual cause, which is a multi-year ocean anomaly. This could happen in both coupled and

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AMIP-style simulations. This possibility needs to be checked, to be sure the ocean is not a culprit here.

Reply: Thanks for this advice. For the atmosphere we tried to avoid this effect by spreading our ensemble over 12 years in order to sample a multitude of different circulation states. Of course, for the ocean the life time of oscillations is much longer. Thus, we analyzed the time series of SST anomalies in our ocean forcing to investigate whether persistent anomalies exist that might bias our results. The anomalies were computed by subtracting the 30-years climatology from our forcing data. We then identified the anomalies with the longest, consecutive duration. For the majority of the ocean, anomalies of a given direction do not occur more than three consecutive years in a row and almost all regions are below six years of persistent anomaly length (see attached figure). Only the North Atlantic is dominated by a prominent warm anomaly lasting longer than nine, consecutive years. Thus, we conclude that the number of years over which our ensembles spreads, is sufficient to account for the effect of oceanic oscillations for most regions. However, the North Atlantic oscillation might have an additional impact on our results that cannot be estimated from our simulations. For this reason we will consider a longer time period for any follow up studies.

In order to acknowledge this limitation we added a comment to our model description section: "[...] This is also true for the majority of state variations in our ocean-surface forcing except for small parts of the North Atlantic region. There, our experiment cannot sample the full state variations and a tendency towards warm surface temperature anomalies remains."

Comment: 1. Fig 9: The scale on the right panel is quadratic, not exponential.

Reply: Corrected for Fig. 3 and 9. Thanks.

Comment: 2. Table 1: What is before/after the semicolon? Also, please don't use what look like computer code variable names - write out the full names of the variables.

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Reply: The semicolon separates the minimum and maximum values occurring for different seasons and hemispheres. We added this information to the captions of Tab. 5 and 6 (formerly Tab. 1 and 2). Also we change the variable names.

Comment: 3. Section 5 is very interesting and the discussion is thought-provoking. The notion of short-lived shallow anomalies filtering into longer-term deep anomalies is reminiscent of the theory behind the old force-restore soil schemes (cf. Dickinson 1988; J Clim. 1086-); also see Fig 2 in Entekhabi et al. (1992; J. Climate 798-), so there is precedent for this notion.

Reply: Thanks for pointing us to these publications. We included the references into our manuscript and added the following sentence to our summary:

“Examples for similar processes of interaction between short-term shallow and longer-term deep anomalies exist from earlier studies. These are in particular the transition of temperature signals through several soil layers in the framework of force-restore soil schemes (Dickinson, 1988) as well as the propagation from precipitation perturbations into groundwater anomalies (Entekhabi et al., 1992).”

Interactive comment on Earth Syst. Dynam. Discuss., 6, 1743, 2015.

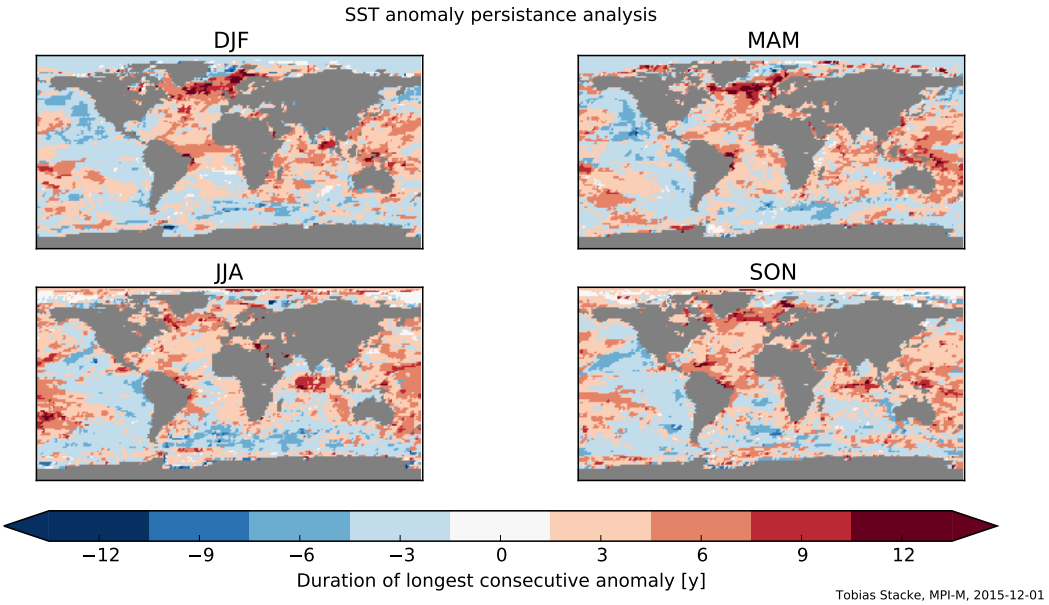

Fig. 1. Maximum duration of consecutive years with SST anomalies for a given season. Warm anomaly durations use positive numbers while cold anomaly durations are multiplied with -1.

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