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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Evaluating the strength of the land–atmosphere moisture feedback in earth system models using satellite observation" *by* P. A. Levine et al.

Anonymous Referee #2

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General comments:

This paper describes a new methodology for the analysis of land-atmosphere coupling that focuses on the seasonal time scale and that addresses both the widely-studied impact of the land surface on the atmosphere and the somewhat less often considered (in this context) sensitivity of the land surface to atmospheric forcing. This methodology is applied to remote-sensing data of terrestrial water storage (TWS), the CESM Large Ensemble (LENS) and a few CMIP5 models.

Although many methodologies to quantify land-atmosphere coupling already exist, the focus on seasonal time scales and the investigation of both the forcing and feedback loop of land-atmosphere coupling make this methodology valuable. The use of LENS

is also valuable and in particular is useful to consider potential impacts of internal variability on the metrics.

The manuscript is very well written and very clear. The authors have done a good job at keeping the text relatively short and straightforward despite substantial analyses. Most of my comments below are minor and I think the manuscript can be published after considering these.

Specific comments:

- Page 4, line 16-17: "Until recently, studies using remote sensing data to look for evidence of land–atmosphere coupling relied on data products that provide information about surface soil moisture." There are some exceptions and some remote-sensing products also estimate soil moisture in the whole root zone (for instance, I recall that Guillod et al. (2015) used such estimates).

- Section 3.3: These results on the role of internal variability are interesting. Another source of discrepancy between a single model run and observations can be observational error combined with short record (e.g., Findell et al., 2015), which may artificially decrease the coupling found in observations. Together, this effect and internal variability probably tell us something about the data length required to robustly assess land-atmosphere coupling.

- Page 8, line 24 and Page 11, line 5: Supplementary figures references could be more specific. I think that the first mention on page 8 refers to Fig. S3 while the second mention (page 11) refers to Figs. S1 and S2. The order of the supplementary figures could also be adapted so they are cited in sequence.

- Page 13, line 20-29: The authors write that overestimating ET would lead to excessive land-atmosphere coupling. This is a bit confusing: if the coupling is strongest in transitional regions between wet and dry climate, why would a too high ET in an already wet region lead to an increase in coupling? I agree that model errors with re-

spect to the distribution of water between storage reservoirs can be an issue; however I do not think that this necessarily leads to stronger coupling, but maybe I am missing something here.

Technical corrections:

- Page 11, line 23: I assume that “Introduction” should in fact be “Discussion”.

- Page 12, line 22: “(Guo et al., 2006) explain. . .” should be “Guo et al. (2006) explain. . .”.

- Page 13, line 13: “and underestimation of and remote SST forcing” should be “and underestimation of remote SST forcing” (?).

- Page 16, line 11: “Regions of strong coupling metrics”: I think the authors mean “Regions of strong response metrics” here.

References:

- Findell, K. L., et al., 2015. Data Length Requirements for Observational Estimates of Land-Atmosphere Coupling Strength. J. Hydrometeorol. 16, 1615–1635.

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