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Hydrology and Earth System Sciences Discussions

Interactive comment on "The impact of land model structural, parameter, and forcing errors on the characterization of soil moisture uncertainty" *by* V. Maggioni et al.

Anonymous Referee #3

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Review of the paper "The impact of land model structural, parameter, and forcing errors on the characterization of soil moisture uncertainty," by Maggioni et al. This paper proposes to investigate the errors , be it observational or model, associated with soil moisture data assimilation, using the well-known Catchment Land Surface Model (CLSM). The basis of this paper is the use of the General Likelihood Uncertainty Estimator (GLUE), which here provides the tool to estimate the sensitivity of parameters and perturb the variables.

As a first point, let me say that the paper is very well structured and written. It uses a clear and concise language which leaves little to criticize. However, I do have some

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points to raise on the technical aspects of the submission. For instance, there are a number of model runs, but little in the way of quantification of these results or an assessment of the processes influencing those in the background. The use of the efficiency and uncertainty scores is a first step, but in my eyes does not give a full and clear picture of the system performance. Moreover, the paper lacks a more detailed description of the model itself and a discussion on using a Topmodel-like model such as CLSM on a 25km scale and the issues arising with this. I have a number of more detailed comments below. This paper may be published after major revisions.

Major:

1. A detailed model description is required (eg. as a Section 3). Without such a description, an assessment of the model structure is not possible, as the reader lacks the background needed for a full appreciation of the issues at hand. Eg. the three soil moisture stores in CLSM are not independent and have interactions with other states, too. Is the fact that vegetation is prescribed causing a feedback, when perturbing soil moisture states, while still forcing with the same radiation data set?

2. Are the parameters identified really the most sensitive? There are techniques to assess the sensitivity of parameters relative to their state (eg. see Baffaut et al., 1996). Is the chosen approach the best? The sensitivity of the parameters may change as a function of the parameter or variable state (eg. Rudiger et al., 2010). I suggest the authors looked into this, as well, may it be with their approach or another one. You may find that under different conditions, the parameter selection may change.

3. Following on from this, I would suggest to undertake a sensitivity study in the scaling issues of the model. Eg. has the scale an effect on the compound topographic index within CLSM? If so, what are the issues for the model parameters and associated errors?

4. Numbers of ensembles: I understand that Reichle et al have shown in the past that CLSM could be run with 10 or so ensemble members. However, this would also have to

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be assessed for this particular case. Also, it is necessary to provide more detail on the way the ensembles were created here. Not only are the parameters preselected, but it is also unclear as to how the ensemble spread was determined, and how the individual ensembles were selected. It should be a random effect, but I get the impression that this was not the case.

5. p. 2299, line 3-4: can you explain why this happens. This is not explicitly being picked up in the discussion. It would be interesting (and worthwhile) to know what causes this shift.

Minor:

1. p. 2286, line 10-12: are you referring to spatial or temporal uncertainties?

2. P. 2296, line 19-20: why not? Just exclude some of the field sites within the OK Mesonet and analyze them independently.

References

Baffaut, C., Nearing, M.A., Ascough II, J.C. and Liu, B. (1996). The WEPP Watershed Model: II. Sensitivity Analysis and Discretization on Small Watersheds. Transactions of the ASAE, 40 (4), 935-943.

Rudiger, C., C. Albergel, J.-F. Mahfouf, J.-C. Calvet, and J.P. Walker (2010), "Evaluation of the Observation Operator Jacobian for Leaf Area Index Data Assimilation with an Extended Kalman Filter," Journal of Geophysical Research – Atmospheres, 115, D09111, doi:10.1029/2009JD012912.

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