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Hydrology and Earth System Sciences Discussions

Interactive comment on "Estimating geostatistical parameters and spatially-variable hydraulic conductivity within a catchment system using an ensemble smoother" *by* R. T. Bailey and D. Baù

Anonymous Referee #1

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General

This paper is interesting and presents a contribution for data assimilation in a surface-subsurface flow system. Not only states, but also parameters and meta-parameters (geostatistical parameters) are updated.

The paper is in general well written and the contribution is novel. There are, however, some weak points of the study, in my opinion. One is that river discharge is included in the state vector, whereas it should have been assimilated as observation, and the states should have been updated through a linearized relation between states and

discharge flux. I believe that that would be the more correct way to proceed. Further comments follow below. I think that the paper can be published after revisions have been made.

Detailed comments

Page 9592, Line 3. EnKF instead of EnFK.

Page 9594, L 2-5. This is a limitation of this work, as correlation scale has the highest impact on weighting in the EnKF (more than sill, for example). As other scientists had problems to estimate the correlation scale, I can imagine that the authors also tried this and were not successful here. It would be good to indicate this in the paper and provide further details on possible attempts the authors made to estimate the correlation scale.

Page 9595, L 7-8. This seems not the most appropriate reference for the groundwater flow equation.

Page 9596, L 13. This is not a state, but a flux, and should therefore not be included in the state vector. Instead, a relation between the flux and state variable should be derived (using a linearization for example). Details on how to assimilate observed discharge data can for example be found in Pauwels and De Lannoy (2009, WRR). It is true that also in other papers discharge was included in the state vector, but this is not correct in my opinion.

Page 9601, L 24. "updated" instead of "update".

Page 9603, L 5. What about ET? It seems the authors applied net infiltration instead of precipitation. This should be clarified.

Page 9603, L 17. Change to: "an isotropic, homogeneous aquifer."

Page 9604, L 8- L12. Is it necessary to repeat this? I think it could be skipped.

Page 9605, L 25-L 29. Why are not more assimilation times used?

Page 9609, L 20- L 22. How can the final values be so low? Could the authors further comment this? Is it related to the set-up of the verification experiments?

Page 9610, L 12- L15. Rewrite and split sentence.

Table 1. The small number of layers does not seem to be suited to model unsaturated flow.

Figure 2. What is the motivation to use everywhere no flow boundary conditions? Is this realistic?

Figure 4. The effect of cultivated vs non-cultivated fields is difficult to detect because of the random structure of the fields. Why does a line appear from Northwest to Southeast on the right map (B)?

Figure 8. This is unclear to me. Why is the variance so large (unrealistically large)? Do you mean simulated WT values? Or is it correct that these are perturbed observed WT values? But why is the variance so large then?

Figure 12. Too many lines, unclear in black-white.

Figure 15. The AE for Fig. D is larger than for Fig. C. Does AE increase further for more iterations?

Figure 15, caption. What are the starting values?

Figure 16. Too many lines, unclear in black-white. “updated” instead of “update”.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 9587, 2011.