

***Interactive comment on “State updating of a distributed hydrological model with Ensemble Kalman Filtering: effects of updating frequency and observation network density on forecast accuracy” by O. Rakovec et al.***

**Anonymous Referee #1**

Received and published: 29 March 2012

In this paper, the authors update the states of a distributed hydrologic model through the assimilation of discharge data. Generally, the paper is well written, and interesting. What I would like to see is a more in-depth discussion on a number of results.

Major comments:

- One *\*HUGE\** issue that needs more discussion is the routing. Basically, the authors employ a kinematic wave model. This implies, as the authors correctly note, that one can avoid the need to update the states of the model in the past in order to assimilate

C605

the discharge in the present. However, physically (no hydrologist in the world is going to dispute this), runoff is determined by the soil moisture in the past. The consequence of this fact, combined with the routing model that avoids this, is that the modeled discharge is going to be much more sensitive to the state of the routing model than to the state of the hydrologic model. This also becomes evident in the results in the paper. As the modeled runoff is much more sensitive to the state variables of the routing model, the Kalman filter will mainly update the routing model state variables (thus  $H$  and  $Q$ ). Thus, which is confirmed in the paper, the results of the hydro logic model are hardly going to change at all through the assimilation of the discharge.

In the model description, the authors need to discuss the time-delay issue, the fact that they avoid it (and how), and the consequences this is going to have on the results. In the abstract, the results, and the discussion and conclusion, this really needs to be brought more forward (thus that the states of the routing model are updated, rather than the states of the hydrologic model, and why).

- Another issue that also needs more discussion is the setup of the synthetic experiment. The authors retain one ensemble member as the synthetic truth. No parameters or initial conditions are changed to generate the ensemble, only the rainfall was changed. Essentially, noise is added to the rainfall. This implies that the authors assume that the only cause of uncertainty is the rainfall, and that for example model parameters and formulation are not a source of error. Most synthetic experiments that I know about, use different model parameters to generate the synthetic truth. This will introduce more differences between the model results and the observations, which is (arguably) closer to reality. I would recommend the authors to justify more the approach that they have used (thus not disturbing parameters to generate the synthetic truth).

Some minor comments:

- P 3962 L 20: most hydrologic forecasting systems employ lumped models ? I would rephrase this as "most hydrologic discharge assimilation systems ...". There are actu-

C606

ally quite a number of papers where distributed models are used for data assimilation (soil moisture).

- P 3963 L 8-10: Sequential assimilation methods ... sequentially. Rephrase (sequential twice in the sentence).

- Same page L 17: Better to refer to Evensen (1994) when discussing the EnKF.

- Same page line 25: I would argue that discharge measurements are the most widely used OPERATIONALLY FOR FLOOD FORECASTING. Again, there are quite a number of papers that use other data (for example soil moisture or temperature data for weather prediction).

- P 3967: Please provide a more detailed explanation on the Broersen and Weerts error correction method.

- P 3968: Please provide some more explanation on how google maps is used for channel width estimation. I also do not understand why for non-channel cells, the channel width is equal to the cell width. If a cell is not in the channel, then perhaps the channel width should be zero?

- Page 3975, L 2: DA "machinery"... Please use another term.

Overall, if the authors provide a satisfactory response to these questions and remarks, the paper should be publishable.

---

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 3961, 2012.