

## ***Interactive comment on “A new data assimilation approach for improving hydrologic prediction using remotely-sensed soil moisture retrievals” by W. T. Crow and D. Ryu***

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The authors introduce a new method that uses soil moisture observations to correct model soil moisture (state estimation) and precipitation forcing in a data assimilation system. The authors demonstrate that the new method yields improved runoff estimates (when compared to traditional state estimation) as well as improved soil moisture estimates. The new approach grows naturally out of the authors' previous work and offers many new and important insights.

The manuscript is technically sound, generally well written, and should be of great

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interest to HESS readers. Nevertheless, I have one major comment (see below) that should be addressed (along with the minor comments) before the manuscript can be accepted as a peer-reviewed publication.

Major comment:

It is not clear to me why the API model is needed in Case 5. Running the EnKF or EnKS already produces soil moisture increments for SAC. Perhaps I am missing something fundamental, but why can precipitation increments not be computed from the SAC soil moisture increments? There does not seem to be a need for running an API model. Admittedly, the fudge factor  $\lambda$  of equation (9) would be different in this case (that is, it could not be used directly from previous work, so a re-calibration would be required). An added benefit of this modified procedure (without API model) would be to eliminate Case 4 as obviously pathetic (as you rightly explain at length in the manuscript).

Before I can fully endorse publication of the manuscript as peer-reviewed, I would ask that the authors seriously consider replacing Cases 4 and 5 with the modified procedure suggested above (or just add the modified procedure to Cases 4 and 5). If I am wrong about the modification, please explain (in the manuscript) why this is cannot be done. I suspect that many others might have the same question.

Note that on Page 2029, lines 6-9 you point out the identical v. fraternal character of the twin experiment w.r.t. to soil moisture and precipitation corrections. The modified approach would unify the experiments in this regard.

Minor comments:

1.) Page 2008, lines 24-27: Why does this opportunity "only" exist for systems with near-real time precip forcing? Is it because they are of poor enough quality for the procedure to have a measurable positive impact? It is not clear that "rainfall forecasts from a NWP model" would be any better. Perhaps you wanted to say "gauge-corrected

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reanalysis precip"?

2.) Equations (10), (16), and (18): This may sound silly, but please consider changing the symbols for the "max" capacity parameters. At first reading, I did not see that eg. UZFWC was different from UZFWM, because the acronyms differ only in the fifth letter. How about something like  $UZFWC_{max}$ ?

3.) Page 2017, line 28: The phrase "they are re-applied" could use some clarification and elaboration. Presumably, you first run a single ensemble member with all perturbations turned that serves as the OpenLoop. Next, you use the perturbed forcings as inputs into an ensemble integration in which the forcings and the state variables are again perturbed with the same perturbation parameters that were used in the OpenLoop. Does that make sense?

4.) Page 2018, lines 15-20: These lines are redundant and can be deleted.

5.) Page 2020, line 23: Replace "you can" with "one can" (or change the sentence to the passive voice).

6.) Page 2023, line 9: Replace reference to "Fig 2" with reference to "Fig 1"?

7.) Page 2024, line 13, also Figure 9 (graphic \*and\* caption): Are SER and SIR the same? Please clarify and/or correct accordingly.

8.) Page 2028, line 20: delete "for approach" from Section heading

9.) Page 2030, line 24: It would seem that flood forecasts (as opposed to retrospective runoff estimation) \*must\* use precipitation forecasts (rather than near-real time satellite rainfall) from at least the time of the production of the forecast out to the forecast lead time. The precipitation inputs up to the production time may be from a variety (or hierarchy) of precipitation data of various quality and latency.

10.) Figure 2: Red and black curves are not labeled (which is model streamflow, which is USGS obs?)

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11.) Figure 2: It would be good to provide lat/lon information within the Figure or in a separate map or Table about the location of the five basins.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 2005, 2008.

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