Hydrology and
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Discussions

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Interactive comment on "Parameter-state ensemble data assimilation using Approximate Bayesian Computing for short-term hydrological prediction" *by* Bruce Davison et al.

Anonymous Referee #3

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In this paper the authors present the application of Approximate Bayesian Computation (ABC) to joint parameter and state estimation of a watershed model using a simplified particle filter. The authors consider various case studies with known/unknown streamflow and/or known/unknown precipitation. The paper presents interesting results, nevertheless, I think it requires a major revision before it can be judged to making a significant contribution to the field of hydrological data assimilation. Main issue I have with the paper is that I cannot always follow the implementation the authors are using. I will list some examples of this in my comments below. This lack of clarity downplays readability and makes it difficult to understand what has been done, and comprehend the results. I also have some more theoretical questions regarding the application of

ABC.

COMMENTS:

1. Section 2.1: The first few sentences describe briefly how the P-SEDA filter works. States and parameters are drawn from some multivariate initial distribution - and then analyzed for use in a projection period. How is this analysis done? I think a Figure may really help to communicate to readers how the P-SEDA method is implemented. The two sentences, "The analysis is completed and the process repeated for the next appropriate time-step in the continuous simulations" and "In this manner, both the parameters and states are drawn from the entire M simulations for the projection period". Not clear to me.

2. Line 10: so you are talking here about the normalized weights. A particle filter uses three different weights: incremental weight (for current datum only), unnormalized weight (normalized weight prior to datum x incremental weight -> summarizes weight of entire trajectory) and normalized weights -> normalization of unnormalized weights before moving on to the next datum.

3. Line 12: Resampling is the crux to an efficient implementation of the particle filter. Otherwise, many trajectories will receive a negligible weight and the PF does not approximate closely the target PDF.

4. Line 14 - 16 "The approach presented here is the same, but without resampling and always returning to the original particles as updated by the model and assigning a weight of zero or one to each particle based on the filter (i.e. using a rectangular filter)." is unclear to me. This goes back to my earlier comment. From what is presented, I do not understand how the authors implement such approach. Thus, no resampling is done? How do you return to the original particles. As with comment 1 above, can you give a detailed example, in text or in Figure that explains how this works. For example, at a time, t, we have the state forecast and associated parameter values + an incoming observation. What does the filter do then? How does it return to the original particles?

How are the weigts assigned? How is resampling avoided? etc.

5. Algorithm 1: How is s(y_i) computed? And how do you find the theta's from the k_m nearest neighbors of s0?

6. I do not understand where ABC comes in. Is this in the selection of s0? and the s_y's? And how is the likelihood function formulated? This is done by simulation, yet, I miss the details necessary to understand and comprehend what has exactly been done.

7. Latin Hypercube sampling is argued as being highly inefficient. That is true if you want to approximate a target PDF, nevertheless, if you just want to sample the parameter space, then this may be one of the best methods you can use.

8. In Section 2.7 the authors describe how they construct the ensemble. None of the four approaches listed are described in detail. Hence, I do not understand what is being done. "minimized uncertainty filter". Need a detailed explanation, step by step how we go about initial states and parameters to a minimized uncertainty filter. Same holds for the other three listed methods. Without this the results in this paper will not be understood, nor are impossible to be reconstructed by the reader.

I'll leave it with this for now. I believe the authors should clarify their methodology. Otherwise the results of this paper cannot be understood by a large audience. This would be unfortunate, as what the authors are doing has lots of potential.