

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

### **Anonymous Referee #1**

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#### Overall recommendation

This paper is well-written and overall very clear. The concept of applying a simple data assimilation technique to account for variations in parameters over time is interesting. The simplicity of the method is unique. It is easy to see how all versions of P-SEDA could be applied and interpreted operationally, except for constraining the parameter and preceding streamflow feature. This paper is close to being publishable as-is. My concerns are minor and can be addressed with writing.

#### Major concerns

1) I had to go back to the methods sections several times to interpret what methods

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were covered by “P-SEDA” and how the method was applied. Algorithm 1 is extremely helpful, but I would suggest a second algorithm or a flow chart that is specific to the P-SEDA method applied, and perhaps specific to the 3-day moving window application presented in the manuscript. The manuscript should be more explicit about how P-SEDA is different from Algorithm 1.

2) I cannot tell from the description in the methods section if the filters are applied sequentially or if they always draw from the same set of 10,000 simulations. This is stated more clearly in the conclusions. Because the majority of particle filters are applied sequentially, it should be clear early on that this is not the case in this paper.

3) I would not expect three days of streamflow to be enough to determine reasonable streamflow parameters. The parameters that produce good baseflow are rarely the same parameters that produce good flood peaks. Please provide more justification for testing this method.

## Minor concerns

1) Tables 4 5, lines 10-25, p. 13, and Figure 8, Conclusions: terminology suddenly changes. “Projection methods” were never defined; previously the four P-SEDA methods were all referred to as “filters”. It is unclear which is the “3-day filter” and which are projections. I assume they correspond to the previously defined filters as follows, but I am not certain:

- a. 3-day filter = minimized uncertainty filter
- b. 3-day projection = preceding streamflow filter
- c. bulk projection = bulk calibration filter
- d. 3-day projection with constrained parameters = parameter and preceding streamflow filter.

2) Line 21, p. 6: Instead of saying “ensemble data assimilation filters”, say “P-SEDA” filters. Otherwise, it is not clear that P-SEDA encompasses all 4 filter approaches.

3) Lines 30-31, p. 13: I assume that you do not use the bulk calibration filter here because it performed poorly, but it is probably worth stating that.

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- 4) Line 32, p. 17: The reason you chose to focus on 2014 should be stated in methods.
- 5) How do the authors propose to implement the parameter and preceding streamflow filter? Operationally, one would not extract parameters for all days during a year's precipitation events before setting the parameter range for this filter. Would it be based on the previous year's filter or would the parameter prior distribution be updated based on the days leading up to the current date? How would that impact the result? This is touched on in the conclusions, and it is probably beyond the scope of this study, but it would be helpful if this limitation were mentioned in the methods section.
- 6) Line 8, p. 19: Shouldn't it be the minimized uncertainty filter that shows the model is capable of simulating streamflow for any 3-day period.

Typos, grammar, etc.

- 1) Line 23, p. 9: "eror" -> "error"
- 2) Line 25, p. 13: I'm pretty sure you mean 4c to 4e and 7.
- 3) Lines 20-21, p. 15: "...including the state of basin storage in the assessment of equifinality clearly shows that the parameter-state sets are not equal." I'm not sure what is meant by "assessment of equifinality." Also, please refer either to a figure, a table or a citation that supports this.
- 4) Figure 1: Color of lakes and rivers in legend should match their color in Fig. 1c.
- 5) Figure 2: The toolbar at the top should be removed.
- 6) Figure 5: Plot storage on the same scale in a and b. I'm guessing the solid black line is precipitation and the dots are storage simulated by the best 10 parameter sets. A legend would help.
- 7) Table 4: "assessement" -> "assessment"

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