

Interactive comment on “Hybridizing Bayesian and variational data assimilation for robust high-resolution hydrologic forecasting” by Felipe Hernández and Xu Liang

Anonymous Referee #1

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I really enjoyed reading the paper, which deals with the important issue of improving model updating techniques for better flood predictions. This manuscript proposes a new data assimilation procedure which combines Bayesian and variational approaches. I believe this is an important contribute to DA research field and of notable interest and modernity, especially for the HESS readership. However, I still have some comments regarding method, structure, and readability of the paper. Below you can find some major comments:

- Results of this research are not well described in the abstract and it is somehow difficult to grasp the main advantage of this approach.

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- From the introduction, it is not really clear the difference between OPTIMIST and other hybrid 4D approaches. Novelty has to be better explained in order to further appreciate the added value of such method.
- Nowadays, there are many DA methods with varying complexities and accuracies. However, few of these methods are used in early warning system to improve flood predictions. Did the authors investigate the way to easily implement OPTIMISTS by water authorities for flood forecasting in any existing early warning system? Is there any advantage in terms of computational time if compared to PF and 4D-Var?
- Page 1, lines 14-16: Is this sentence related to the watershed's location or to the use of different models for different case studies? Authors should clarify this point.
- Page 3, lines 8-9: The authors mentioned that “a hybrid data assimilation algorithm that incorporates the most valuable features from both Bayesian and variational methods “. Which ones are these valuable features?
- Description of Table 1 should be better included within the paper. Right now it looks quite disconnected from the other part of the introduction.
- I found very difficult to follow the flow of thoughts of the authors in describing the DA method. I think it will be beneficial for the readability of the paper to include in section 2 a figure representing the structure of OPTIMISTS. In addition, authors tend to use complex terms for non-DA expert. I suggest revising the description of the paper in order to make it “accessible” to everyone and increase its impact on the scientific community.
- At this point, results are valid only for the 5 considered flood events and 2 basins obtained. As expected, results largely depend on the features of the flood events and quality of rainfall data. I am afraid that the small number of events makes results rather random. I suggest to increase the number of flood events to make more general conclusions for this study.

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- A crucial component in each DA application is the proper definition of model and observational error. While model error is accurately described, I could not see a clear definition of the observations error (standard deviation in Eq.10). The authors have to include more information and references about it.

- Are you using actual meteorological forecasts or are you using the observations as perfect forecasts? Please specify

- I suggest the authors to split results and discussions in two different sections, this would make reading the text so much easier.

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