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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Variational Assimilation of Streamflow Observations in Improving Monthly Streamflow Forecasting" *by* Amirhossein Mazrooei et al.

Anonymous Referee #1

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The paper "Variational Assimilation of Streamflow Observations in Improving Monthly Streamflow Forecasting" aims at proposing a scheme that applies Variational Data Assimilation (VAR DA) in VIC Land Surface Model (LSM) in order to correct the initial state conditions and improve 1-month ahead streamflow forecast by using observed streamflow information. The authors analyzed also the role of VAR DA in Improving Streamflow Simulation and Forecasts. I really enjoyed reading the paper, which I found well written, properly structured and easy to understand despite the complexity of the assimilation approach. Because of this, I recommend a minor revision. However, I still have a few comments which may help the authors to improve their manuscript.

- One of my main concern is the use of an LSM. In particular, besides for the fact that (to the best of authors knowledge) this is the first study that uses LSM and VAR DA together, why did the authors use a semi-distributed model instead of a more simple conceptual lumped model? Because of the complexity of the integration between VAR DA and LSM, the authors introduced some important assumptions (e.g. the use of a constant multiplier) which may affect the final assimilation performances. Therefore, VAR DA (or sequential data assimilation) algorithm could be implemented lumped model in an easier way, and the computational time of the simulation (which is a problem underlined by the authors in the paper) could be reduced.

- How can the proposed assimilation scheme be extended in case of assimilation of distributed streamflow observations?

- As the authors properly stated, the skill of VIC in predicting low flows are particularly lower than normal. As a consequence, a strong improvement in low flow predictions is achieved. What could be the impact of calibrating the VIC model separately for low and high flows? How this will affect the assimilation performances?

- In all assimilation applications, it is important to provide adequate information regarding the estimation of model and observation error and their spatial correlation. These aspects can drastically affect the assimilation performance. Could the authors elaborate more on the assumption of daily observational error equal to 0.05% of the variance of observed daily flows over 62 years (1949-2010)?

- Can the authors provide more detail about the calibration method used with the VIC model? In addition, which range of model parameters is considered during calibration?

- I suggest to include the dimension of the matrices of the VAR DA method (e.g. [nstate,nobs]). This will help the reader to better understand how to implement VAR DA in a generic hydrological model

- Besides the simplification of the minimization function of Eq1, what are the other

limitations of the current study and recommendations for future ones?

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