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Hydrology and Earth System Sciences Discussions

Interactive comment on "A past discharges assimilation system for ensemble streamflow forecasts over France – Part 1: Description and validation of the assimilation system" *by* G. Thirel et al.

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General remarks:

This very solid paper addresses a topic which is of high interest for any kind of effort towards generating skillful discharge predictions for large river basins and their tributaries.

As the authors acknowledge in the introduction the topic "data assimilation" has been

recently discovered in the hydrology community. The knowledge-gap with regards to the community of the meteorologist is large and this paper is surely an important step ahead for hydrology.

The most fascinating aspect of the proposed aspect is that Thirel et al. provides a well documented guideline on how to handle (real-time) discharge assimilation from systems with nested basins (up-to 34!). Approaches for headwater basins have been presented before (e.g. Wöhling et al., 2006), but the BLUE approach combined with the step-wise solution of the Jacobian matrix sets a new standard in this kind of assimilation experiments.

The results (proof-of-concept) are well selected. For instance it is very interesting to learn that the assimilation procedure can very quickly react and "correct" unrealistic initial conditions. This will be particular useful in operational mode when for instance a weather radar is down during an event and not enough rain is given to the model.

Minor comments:

1) In the first part of the introduction you give some statements that could be supported by some references: (a) LSMS in Hydrology on line p 2414 lines 20-23; (b) use of data assimilation in other disciplines p 2415 lines 17-20.

2) You give a clear statement on the reasons why the procedure fails to improve the discharge simulations in the dry period following the antecedent wet period. From Figure 2 we learn that there is drainage leaving the third level is going to MODCOU/SIM where it is transformed in discharge. My question is if you have thought about applying the assimilation procedure also to MODCOU/SIM, and this as soon as the root and deep layers approaches field capacity. You give some comments on that in the conclusion suggesting the assimilation of aquifer levels. It seems you mean "observed" aquifer levels. I wonder if you don't have the possibility to perturb (adjust) the SIM storages as you can adjust the W2/W3 layers in ISBA

3) Again from Figure 6 we see that apart from the biggest events, where there is a clear correction in one direction, there is a general "fluctuation" of the adjustment factor very close 1.0. Do you plan to make a long-term statistic on this adjustment factor and try to reduce it by re-tuning the free parameters of SIM/MODCOU?

4) In this respect is there any way to estimate how good the skill of the assimilation routine is if you assume 1 or 2 days persistence of the adjustment factor.

5) I can imagine that unrealistic initial condition might also occur at the beginning and at the end of the snowmelt season. Do you have some comments on the quality of the assimilation routine in basins with rainfed regime and in basins where snowmelt governs runoff generation in spring?

Technical Issues:

The quality of Figure 4 and 6 should be improved. The difference in grey-level between IS5/IS6 and REF is not very clear.

Final considerations:

This is a very solid manuscript and represents a high quality contribution to HESSD and HESS. The skill demonstrated in this conceptual part of the two companion-papers let raise large optimism. Thirel et al. is a needed and most interesting baseline work for later application in operational (ensemble) discharge forecasts.

References:

Wöhling T, Lennartz F, Zappa M. 2006. Technical Note: Updating Procedure for flood forecasting with conceptual HBV-Type Models. Hydrology and Earth System Sciences. 10:783-788.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 2413, 2010.