Hydrology and Earth System Sciences Discussions

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Interactive comment on "Assimilating in situ and radar altimetry data into a large-scale hydrologic-hydrodynamic model for streamflow forecast in the Amazon" *by* R. C. D. Paiva et al.

Anonymous Referee #1

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Review of the paper by R. Paiva et al 'Assimilating in situ and radar altimetry data a large-scale hydrologic-hydraulic model for streamflow forecast in the Amazon'

The paper presents assimilation of water levels and discharge from gauges and altimeter derived into a hydrologic hydraulic model for improving streamflow forecast.

This is a very timely research topic since (1) the field of assimilation of hydraulic variables is not well advanced but research in this area is picking up quickly and (2), as noted by the authors as well, the potential NASA/CNES SWOT mission and also other altimetry missions could benefit from assimilation approaches that make use of river

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hydraulic parameters.

The paper is well written and follows a clear structure. The technical description and equations are sound and the results are encouraging and in my opinion this paper is worth publishing after some major concerns are addressed.

These relate primarily to the setup of the design, including the use of the EnKF, to estimate Q.

In particular I have some concerns regarding the following points:

- In the introduction the authors should mention other research on assimilation of water level data in hydrodynamic or coupled hydrology-hydrodynamic models that use variational techniques (Hostache, 2010) or particle filter methods (Matgen et al, Giustarini et al.):

Hostache et al, JoH, 2010, Assimilation of spatially distributed water levels into a shallow-water flood model. Part II: Use of a remote sensing image of Mosel River

Matgen et al, HESS, 2010, Towards the sequential assimilation of SAR-derived water stages into hydraulic models using the Particle Filter: proof of concept

Giustarini et al, HESS, 2011, Assimilating SAR-derived water level data into a hydraulic model: a case study

Hostache et al., SPIE Proc. Remote Sens. for Agric. and Ecosys., 2011, Tracking, sensing and predicting flood wave propagation using nomadic satellite communication systems and hydrodynamic models

- Also there should be an explanation why the EnKF is preferred over VAR or Particle-based assimilation

- In section 2, what's the effect of log-transforming Q and levels before assimilation vs. using the untransformed data?

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- The experimental design seems appropriate to me. Although I'm not an assimilation expert, I assume the main reason that results (particularly in terms of Q) are improving is that the authors have used perturbations in precip. to get ensembles of Q through their hydrology model which makes the ensemble mean quite different from the 'truth', both in timing and magnitude. This is absolutely fine but I wonder if Q estimates of an ensemble were slightly better, maybe the degradation in Q when assimilating water levels would have been much larger and maybe not even show minor improvements in some places at all.

I say this since I imagine Q is correlated with water depth, which cannot be assimilated since it is not known but Q has much lower correlations with h, esp. in space

- I think the improvements in results make a lot of sense but some aspect could do with more explanation. For example assimilating h to retrieve h, or Q to retrieve Q can be expected to work but assimilating h to get Q is a very different problem as illustrated well by your results since h for Q only gives very minor improvements and in most cases degradation.

So, in this respect, there should be some suggestions how this retrieval of Q with just levels (h) might be improved; maybe another assimilation technique is required or an extension or simultaneous assimilation of different variables and including both space and time is an option that could be explored.

Although the authors discuss some possible alternative to solve this problem (e.g. sub-basin scale based assimilation), it would be useful to have a more elaborate discussion on this 'Q issue'.

- Figures are of good quality

- Please update the reference by Alfieri et al

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 2879, 2013.