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Hydrology and Earth System Sciences Discussions

Interactive comment on "Towards the sequential assimilation of SAR-derived water stages into hydraulic models using the Particle Filter: proof of concept" *by* P. Matgen et al.

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The paper by Matgen et al. proposes a useful framework to assimilate SAR-derived water stages into hydraulic models. Data assimilation is performed using the Particle Filter (PF). Synthetic data, representing SAR-derived water stages, are used to present and test the data assimilation framework.

I did enjoy reading and reviewing this paper. Given the increasing availability of satellite flood images and their capability to support hydraulic modeling, the topic of the paper is extremely relevant and within the scope of HESS.

However, I believe that some improvements are needed. My main concern is that

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neither the assumed error structures nor the temporal frequencies of the synthetic data reflect the actual characteristics of SAR-derived water stages. I therefore recommend a revision of the manuscript before publication. A list of specific comments is reported below.

SPECIFIC COMMENTS

(1) The frequency of the observations used in the paper (down to 12 h) seems to be too optimistic. I agree with the fact that we might have lower repeat times in the future, but I think that, for the time being, it is better to (also) consider conditions that are more realistic. In particular, most of the study presents results assuming the error of the SAR-derived water stages as a white noise with a standard deviation of 0.3m. This might be realistic in some ideal conditions. However, given the strong inverse relationship between spatial resolution and revisit time of satellite images (e.g. Schumann et al., Rev. Geophys., 2009; Di Baldassarre et al., Hydrol. Processes, 2009), SAR-derived water stages with standard deviations of 0.3m are difficult (if not impossible) to obtain every 12-24 hours. I am aware that this work does require a low temporal frequency because of the hydrological response of the catchment under study (Fig. 5). Thus, given that low revisit times are currently achievable only with coarser resolution imagery (Schumann et al., Water Resou. Res., 2010), this paper should focus more on the results obtained assuming a higher standard deviations (e.g. 1-2m), which reflect more the errors expected using coarser resolution imagery.

(2) 1790; 24-26: SAR-derived water stages are likely to be affected by non-Gaussian and/or correlated errors. I do understand that a proof of concept can be based on simplified assumptions, but then the description of the research work should be more precise. For instance, I would not emphasize that the error structure is realistic. A clarification and justification of the assumptions (given their important effect on the results) are necessary here. Moreover, the conclusive sentence (1803; 16-17) should be reformulated.

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(3) Figure 4 presents the water stage histograms for different standard deviations. The results obtained with standard deviations of 1-2m are reasonably good. It seems to me that this outcome indicates that the information content in water stages with standard deviations of 1-2m is valuable. I therefore recommend presenting (also) the results of the data assimilation exercise using a higher standard deviation (1 or 2m). As mentioned above, this may show that coarse resolution images (that are more frequent than high resolution images) can be efficiently used to update a flood model.

(4) 1788; 14-16: The authors may refer to: Bates, P.D., Horritt, M.S., Aronica, G., Beven, K., 2004. Bayesian updating of flood inundation likelihoods conditioned on flood extent data. Hydrological Processes 18, 3347–3370.

TECHNICAL CORRECTIONS

(a) 1789; 16: can be achieved

(b) I would merge Tables 1 and 2 (the caption is longer than each table).

(c) Fig. 5-8. Although HESS does publish colored figures I would suggest making them readable when printed in black and white.

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