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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Variational assimilation of remotely sensed flood extents using a two-dimensional flood model" *by* X. Lai et al.

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Comments from G. J.-P. Schumann (Referee)
This paper proposes to assimilate a direct observable flood variable from satellites, namely flood extent, in 2D flood models using a 4-D var method. I reviewed I think all of the previous versions of this research work by the authors and I have to say that this one is a great improvement from the previous versions in which the authors actually addressed most of the reviewers' comments very carefully. Introduction to the problem as well as description of methods and result analysis has much improved. I believe that after addressing some relatively minor concerns, this paper may be published.

Re: Thanks for your comments and time for this manuscript.

Comments: - Please explain the alpha scaling parameter better when you talk about stage and velocity being assimilated together. I can't really follow on page 6935.

Re: α is the scaling parameter (weight coefficient) that weights different kinds of cost functions. It can be considered as a normalized parameter. When other types of observations (e.g. water depth or flow velocity data) are assimilated together, the component of cost function for flood extent observations should be properly scaled in Eq. (9) to respect an initial balance between different components of total cost function. The α in Eq. (9) and the words are superfluous for this manuscript. We will drop α and remove these words.

- Figure 10. I think this figure is a bit confusing and unclear at the moment. It would be helpful to plot the MODIS flood extent at thr = 126 on there as shown in figure 9.

Re: We will insert MODIS flood extent at b=126 into Figure 9.

- I still have two major points of concern regarding the results: 1) The RMSE in water depth are extremely low, we are talking less than mm. Am I reading these numbers correctly? If so, how can this be physically meaningful and why should we care then? Sorry if I misunderstood these RMSE numbers (Table 3 for example). Please explain

Re: Sure, the absolute value of RMSE in water depth is low for both small-scale test cases. In fact, the simulated water depths are just several cm or few 10 cm in both cases. Thus, the relative magnitude is not so small. The difference of flood extents before and after assimilation can more clearly show the improvements of our model, e.g. results shown in Figure 3. We use these test cases mainly for verifying the algorithm in more challenge situations, such as dam break flood wave routing. Results must have shown that the model decreased RMSE significantly.

2) To my knowledge the obtained floodplain roughness after assimilation is really high. Is this realistic, physically? Maybe it's worth describing what the floodplain vegetation is but given that MODIS observed flooding the vegetation cannot be completely dense

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forest for example.

Re: It is true that the identified Manning's n is high. This area is mainly covered by corn fields. Also, there are tens of villages with a population of 148 000. As stated in our manuscript, the high Manning's n may be caused by the loss of accuracy from the low resolution MODIS data and uncertainties in the domain topography, etc. Nevertheless, the Manning's n, in certain cases (low water depth), may reach this magnitude (0.04 0.25) for over-bank flows in the floodplain, as suggested by Maidment (1992). For example, the suggested Manning's n for overland flow over short grass prairie and dense grasses are 0.15 and 0.24 respectively (Engman, 1986)

Reference

Maidment, D.R.: Handbook of hydrology. McGraw-Hill, New York, 1992.
Engman, E.T.: Roughness coefficients for routing surface runoff. Journal of Irrigation and Drainage Engineering 112 (1): 39-53, 1986.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 6923, 2014.