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Discussions

Interactive comment on "Reproducing an extreme flood with uncertain post-event information" *by* Diana Fuentes-Andino et al.

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"Note to the editor and authors: As part of an introductory course to the Master programme Earth & Environment at Wageningen University, students get the assignment to review a scientific paper. Since several years, students have been reviewing papers that are in open online discussion for HESS, and they have been asked to submit their reports to the discussion in order to help the review process. While these reports are written as official reviews, they were not requested for by the editor, and we leave it up to the editor and authors to use these reports to their advantage. While several students were asked to review the same paper, this was not done to provide the authors with much extra work. We hope that these reports will positively contribute to the scientific discussion and to the quality of papers published in HESS. This report was supervised by dr. Ryan Teuling."

This paper answers the question to whether it is possible to achieve simulations of extreme floods, with limited data availability and large data uncertainties and can this simulation be truly useful for contingency planning and prevention. To answer this question information on discharge, extent of inundation and water level dynamics are required. However, hydrometric measurements of discharge and water levels during an event are often lacking or highly inaccurate, for example during the flooding caused by hurricane Mitch in Tegucigalpa, the capital city of Honduras. Instead of hydrometric measurements, information about water levels and discharges are inferred from post-event surveys.

In this study, post-event data have been used to calibrate hydraulic models. The GLUE framework has been used to account for uncertainty in hydraulic models and for the coupling of a Rainfall Runoff Model (TOPMODEL), with a hydraulic model (LISFLOOD-FP), using during-event measured data. Comparison of simulations and evaluations of these simulations were done by using a membership function of a fuzzy set to obtain a grade of degree of belief for each parameter set. Behavioural parameter sets were those for which all evaluation variables fell within the support of a fuzzy set defined by the uncertainty range associated with the post-event estimated evaluation data. These behavioural parameter sets were used to generate a fuzzy likelihood water level profile and map of the maximum flood extension during the Mitch event. The paper concludes that it is possible, considering the uncertainty in post-event data, to reasonable reproduce the extreme Mitch flood in spite of no hydrometric gauging during the event.

The paper fits well in the scope of the journal by addressing a new interesting modelling approach to reproduce floods with post-event data. The paper gives a clear overview of the already existing methods and approach in literature. The structure of the method is well thought through by first introducing the modelling framework where after the used models are discussed. However the paper is very interesting, some improvements should be made concerning the relevance, the added value of the used modelling framework and the validation of the model. So, the idea of the paper is nice although some improvements should be made, to make the paper more convincing.

Although, the introduction of the paper gives a broad picture of the already existing methods and models, the objective does not become clear from the introduction. The objective could be to reproduce the large ungauged flood event by using post data. However the objective could also be to reproduce the water level dynamics of extreme events in order to improve model structures, which corresponds to the main research question. The main research question was “To whether is it possible to achieve simulations that can be truly useful for contingency planning and prevention?” However this question is not answered in the conclusion. From the conclusion, the objective seems to be to reproduce the flood. If that is the case, the question arises: what can you do with this information? Horrit et al (2002), Papenberg et al. (2006) and Ciervo et al. (2015) suggest using the flood inundation area to improve flood forecasting systems. So maybe this can also be the case in Honduras. Is there a flood forecasting system in Honduras which can benefit from this knowledge or can such a system be developed? Some additional information about the applications of the produced inundation model should strengthen the social relevance of the paper.

In the discussion, the authors give a good explanation of what is done and what are the results of the TOPMODEL and the LISFLOOD-FP. Also, they compare the results with the results of Bonnifait et al. (2009). Bonnifait et al. (2009) use a combination of TOPMODEL and LISFLOOD-FP but without the GLUE network. They found discharges $\pm$ 10%, while the paper found discharges in a range between 2708 and 4619 ms-1 with a 90% confidence interval. In my opinion the results of Bonnifait et al. (2009) and Fuentes-Andino are more or less the same. So the question arises what is the added value of the GLUE framework to the modelling approach of combining a RRM with a hydraulic model. Since both approaches give more or less the same result. Smith et al. (2002) did also research about the peak discharges caused by Mitch. Using standard USCG techniques, he found discharge value within the range proposed by Fuentes-Andino for the same reaches. So why using model techniques while standard USCG

techniques give more or less the same result concerning the discharge.

A third weakness of the model development is the lack of validation of the model. All the model runs with different parameters are evaluated against a fuzzy membership. However the valid parameter sets are not validated against other data. Since discharge is only evaluated against one point and time of peak against two points in the river, validation is necessary. Papenberg et al. (2006) suggest that the prediction of current flood models is the subject to errors in input data, model structure and the observations used in model evaluation. This statement proves the importance of validation. Probably the authors have decreased these errors due to the GLUE framework. However it would be nice if they prove this by doing some validation. Validation can be easily done against pictures (Papenberg et al. (2006) or remote sense maps (Horrit et al. (2002). Another possibility is to calibrate the model against discharge measurements and validate the same model to its prediction of flood extent. A good model should be give accurate prediction of both, discharge and flood extent (Horrit et al. 2002). Another possibility is to calibrate the model against regular runoff events and validate it against the extreme flooding as is done by Grillaskis et al (2010). Adding validation to the proposed method can prove the added value of the approach.

Furthermore there are some minor issues which need some more explanation. In the article is often referred to the JICA report (2002) but this report is nog public assessable. Since quit a lot of data are used from this report, more explanation of the findings from the report will be desirable. For example, peak discharges at different locations were estimated by JICA (2002) and also the maximum water levels were surveyed post-event by JICA (2002). However, the exact approach to obtain these data remains unclear.

Page 1, 4 and 25: In the abstract, the area description and the caption of Figure 1 Honduras is not mentioned. It would be nice if this can be added to these sections. Most people are not familiar with Tegucigalpa.

Page 6, line 13: The statement “Propagation of the water level uncertainty in the flood extent was more evident at highly dense urban areas” is made. However, it does not become clear how you can conclude this from a likelihood map for inundation.

Page 8 lines 9-13: In this section six model parameters are mentioned. However it is more easily understandable if the model for which the parameters are used, is mentioned as well.

Page 22 table 1 gives estimations of time of peak, but not for all the points. Why is this the case? Furthermore points 8 and 9 which are visible in figure 1 and 2 are not described in the table.

Page 25 and 26: The caption of figure 1 and 2 should be referred to the points in table 1 and 2. Without referencing in the caption it is not clear what the numbers indicate.

Page 25: Figure 1 shows the study area. However, the topography and the course of the river outside the study area are not shown. Expanding the figure a bit will give more knowledge about how the river continues outside the study area. Expanding the figure will also help to place the study area somewhere in Honduras.

Page 30, figure 6 shows only the sensitive parameters. Why does this figure not show all the parameters? Showing all the parameters will convince people with the result.

Page 34: Figure 10 is unclear. The symbols of the likelihood of high-water-marks are too small and cannot be distinguished from each other. This figure should definitely be improved to be able to draw conclusions or observations from it.

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