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

I. America

ilja.america@wur.nl

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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.

General comments:

This study investigated if it is possible to achieve simulations that can be truly useful for contingency planning and prevention when limited data is available with large uncertainties. In order to answer this, an investigation which combines RRMs, hydraulic models and post-event data within an uncertainty analysis framework has been done for the extreme flood-event of 1998 in Tegucigalpa, Honduras. The models that have been used, TOPMODEL, MCT-routing, LISFLOOD-FP hydraulic model and GLUE, simulate the runoff and river flows very good within a very good uncertainty-analysis framework. For this investigation high water marks of the event in 1998 were gathered via interviewing residents who experienced the event at specific cross-sections in the area. The parameters within the hydraulic model are based on the degree of belief at each observation point. These parameters were used to generate a fuzzy likelihood water level profile and map the maximum flood extension during the Mitch event. This investigation could be very interesting for flood areas where limited data is available. Because the uncertainties of the different models, parameters and the data itself have been included. Therefore the results should be more realistic and more useful for contingency planning and prevention. However, the model evaluation shows its shortages and gives therefore not the wanted results. Therefore I suggest major revisions for this manuscript that should incorporate : the formulation of an alternative hypothesis and a critical analysis of the model and the uncertainties that are used in this investigation. My suggestions for this paper are explained further in the text.

Major arguments:

Hypothesis

The aim of this investigation is to know if it is possible to achieve simulations that can be truly useful for contingency planning and prevention when limited data is available with large uncertainties (P2, L25; P3, L6). The hypothesis that is stated in the paper gives only a part of a bigger investigation, analyzing extreme floods to prevent such extreme events, which is more interesting and needed. Therefore a new hypothesis should be formulated or added. Suggestions to reformulate the hypothesis can be found in the paper by Beven (2001). He formulated an hypothesis: 'The fast response of a catchment is dominated by surface runoff derived from rainfall' which can be used to compare different models which have required components and parameters for hydrograph simulation. Another suggestion for a new hypothesis is : 'This 'new' flood inundation method which incorporate uncertainty in its model and (post-event) data give more reliable results than other flood inundation methods'.

Model evaluation

In order to answer the hypothesis, an investigation which combines RRMs, hydraulic models and post-event data within an uncertainty analysis framework has been done (P3, L29 to P4, L3). Other, more easily, investigations which could also give an flood-inundation map are however not given. The model has not been compared with other models, while this is very important (Beven 2001). Some suggestions (many other approaches are possible, I just named two new approaches):

1) test if the same results would occur if uncertainty has been added to the results of JICA (P12, L14-18)

2) asses the spatial likelihood of flooding hazard using naïve Bayes and GIS (Liu et al. 2015)

3) asses the uncertainty in distributed model predictions using observed binary pattern information within GLUE (Aronica et al. 2001-2016)

A main subject in this investigation is the uncertainty of the different models, parameters and the data itself (P1, L21-26). A logic reasoning would be to test the combination of the different models that has been used on real existing data, which is present at the moment (Mastin, 2002). Only then the uncertainty of the model is tested in a trustworthy way for normal and extreme events. Therefore I would like to see the test-results

when the model has been tested with existing data to proof that the model outputs give reliable results with less data. Overall, I would recommend to evaluate the model with real existing data and to test if the approach that is described by the paper is better than other approaches. If so, the paper can contribute to the prevention of floods in a large part of the world.

Uncertainty

As I already stated the uncertainty of the different models, parameters and the data itself is a very important subject in this investigation(P1, L21-26). However these uncertainties in the parameters and data have not explicitly been analyzed in the manuscript. Some suggestions:

1) The comparability between the different post-event data should be checked. This holds for the peak discharge estimates and for the high water marks. Peak discharges at points 1 and 2 were estimated using the width contraction analyses, at point 3 the discharge was estimated by the slope-area analyses and the discharges at points 3, 5 and 7 were estimated by a rainfall-runoff analysis (P5,L25 to P6,L5). These discharges cannot be seen as equivalent values and need therefore different and (larger) uncertainties. The high water marks data should be analysed on their comparability with each other and by their corresponding discharge. The description of high water marks (location and number) should also be added in the manuscript (annexes). A calibration with real existing data is therefore needed as described above.

2) There are a lot of parameters used in this analysis which have a large number and range of possible values. This could be limited by, for example, a sensitivity analysis (Griensven, 2006). The correlations between the different parameters could also be described more clearly. A specific point that can be made here, is the water level – discharge relation which is locally controlled by roughness coefficients (P8, L12-16 ; P10, L8-9). Uncertainties in both, can influence each other. Smaller uncertainties can be obtained through specific calibration with existing data, as mentioned before.

Minor arguments:

The assumed uncertainty range for the peak discharge, assuming all predications within the fuzzy set equally good was $\pm$ 50

The fuzzy set values of a and b for evaluating the simulated peak, time of the peak and water levels were set to 20

The values of the degree of beliefs of water level data varies between 0.46 and 0.75 with relaxed criteria are quite acceptable (P14, L6-8). I would like to know why this is acceptable and why this would give trustworthy results.

The TOPMODEL parameter sets from Grande and Chiquito River sub-catchments were used to simulate the hydrographs at Salada creek and Las Lomas creek sub-catchments (P11, L10-13). The reason for this is missing.

Minor issues:

Abstract : Tegucigalpa is the capital of Honduras, is missing.

Methods : The combination of the different models (TOPMODEL, MCT-routing, LISFLOOD-FP hydraulic model) and the models independently, within the GLUE uncertainty analysis framework, are not clearly explained for a broader public. This could maybe be done by a sketch of the combination of the different models.

P10, L19-24 : Reference is done to Table 1. In my opinion the main point of this reference is to show where points 3 or 6 are positioned. This could be better done if the reference is to Figure 2.

P11, L19-20 + Fig 6: ‘five out of eight parameters were sensitive (Fig 6)’ It would be better to show the eight parameters. The sensitivity of the different parameters can then be observed.

P14, L18 : ‘rainfall data played an important role’ is not further explained or referenced.

P19, L7-9 : ‘JICA: On flood control and landslide prevention in Tegucigalpa metropolitan area of the republic of Honduras, Pacific consultants International and Nikken consultants, Tegucigalpa, Honduras., 2002.’ This report cannot been found on the internet.

P25, Fig 1 : Implement Tegucigalpa is capital of Honduras and show this on a bigger ‘world’ map.

P26, Fig 2 : Figure is not detailed enough. Show the different catchments as has been done in the right figure of Figure 1.

P27, Fig 3 : The figure is not very valuable for understanding the story. Therefore it is not needed.

P35, Fig 11 : The figure is very unambiguously. If there is a likelihood of inundations than this likelihood is mainly 0.8-1. This is very peculiar.

References:

Aronica, G., P. D. Bates, and M. S. Horritt. "Assessing the uncertainty in distributed model predictions using observed binary pattern information within GLUE." Hydrological Processes 16.10 (2002): 2001-2016.

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