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Interactive comment

Interactive comment on "Flood forecasting in large karst river basin by coupling PERSIANN CCS QPEs with a physically based distributed hydrological model" *by* Ji Li et al.

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Anonymous Referee #3 Received and published: 5 November 2018 "Flood forecasting in large karst river basin by coupling PERSIANN CCS QPEs with a physically based distributed hydrological model" by Ji Li et al. This paper has two research elements. The first stage of the study involves in adopting the existing 'Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks (PERSIANN) Cloud Classification System (CCS)' (Hsu et al., 1999; Hoang et al., 2004) approach to estimate hourly precipitation at Liujiang river basin. The authors then compared the estimated precipitation with rain gauges and found that the distribution of precipitation

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generated from PERSIANN-CCS approach is similar, but quantity values are smaller. To make predicted rainfall from PERSIANN-CCS approach comparable with rain gauge measurement, they have introduced a postprocessed method. The second part of the study involves in feeding the estimated rainfall from PERSIANN-CCS into the existing Liuxihe hydrological model (Chen, 2009) for flood simulation in Liujiang Karst River Basin. Integrated Quantitative Precipitation Estimation (QPE) with distributed hydrological modelling could be useful to understand the behaviour of Karst catchment for a range of rainfall events and possibly use as a flood forecasting tool. However, I find difficult to see what the main contributions from this study to existing knowledge. There is a potential risk, this study seems to be nice applications of existing methods without having enough novelty and appear as a journal paper in HESS. 1) Lack of details on how authors have modified Liuxihe model to suit Karst landscape. Muskingum model parameters K and x varies with flow conditions. Please refer Ahilan et al (2012) study. The karst catchment behaves like flashy catchment for the large flood event. It is relatively difficult to generalise K and x parameters in the hydrological model. 2) Lack of details on field survey to obtain hydraulic conductivity and aquifer transmissivity properties of the study catchment. 3) Authors dealt the large catchment (58,270 km2) as a whole. It should be more appropriate to break the Liuijiang catchment into several sub-catchments and explore mass balance relationship between rainfall and flow. 4) Uncertainty analysis in QPE and Liuxihe models are largely left unexplored. This is essential to uncertain confidence of the model prediction. 5) Some of the references which were used in this study are outdated. For instance, L335 Davis (1912) L453: Strahler method (Strahler, 1957) L485: Saxton (Saxton et al.,1986) 6) There is a number of syntax errors throughout the paper. The paper should be carefully proofread and edited by a native English speaker. 7) Figures (1 – 4) seem to be borrowed from other previous papers. The resolution is relatively low. 8) Figures (5 – 9) need to be modified. X-Axis should be rain gauge precipitation and Y – Axis should be PERSIANN-CCS QPE. The 45-degree line should be used to compare them. 9) Figures (5-9) rainfall should be converted into mm/hr. 10) L618: Error in time to peak is considerably

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high. Hydrological model structure need to be re-examined. References: Ahilan et al. (2012) Influences on flood frequency distributions in Irish river catchments. Hydrology and Earth System Sciences.

Authors reply: Firstly, thanks very much for the referee for reviewing this manuscript. Following are responses to the reviewer's comments one by one. Comment: The comment pointed out the novelty of this study is not enough. ACs: The main novelty of the paper is to improve the structure and function of physically based distributed hydrological model-Liuxihe model by adding karst mechanism. For instance, the sub-basins are divided into many karst hydrology respond units (KHRUs) in this paper to ensure the model structure is refined enough to suit the karst landforms. In addition, the karst hydrological process including the 'rapid fissure' and 'slow fissure' in the epikarst zone is considered a lot in the model structure. The descriptions of the improved structure and function for Liuxihe model are not enough in the original article, and more details on the improvement of the model will be added in the abstract and the introduction as well as the section 4.2 The improvement of the Liuxihe model in the revision. Also recalibrate the coupling model parameters is a novelty in this study, it can largely improve the performace of model in flood prediction. Although Liuxihe model has achieved many good results in flood forecasting. However, all the applications are in non-karst basins, and this is the first time that Liuxihe model has been used in flood simulation and prediction in karst basin as an attempt in this study. And the main novelty of the paper is the improvement of model structure and function. There is lack of typical rainfall data to build a hydrological model in karst basins, the PERSIANN CCS QPEs could offer a reasonable and high-resolution rainfall data, and coupling the PERSIANN CCS QPEs with a physically based distributed hydrological model has far reaching application potential in karst flood simulation and prediction.

Comment 1. Lack of details on how authors have modified Liuxihe model to suit Karst landscape. Muskingum model parameters K and x varies with flow conditions. Please refer Ahilan et al (2012) study. The karst catchment behaves like flashy catchment for

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the large flood event. It is relatively difficult to generalise K and x parameters in the hydrological model. ACs1. It will be done in the revision, and more details on the Liuxihe model improvement to suit karst landscape will be added in the section 4.2 The improvement of the Liuxihe model in the revision , which can help to better understand the improvement of the model structure and function. In the original Liuxihe model, the confluence mode of underground runoff is a linear reservoir model, in view of the karst water-bearing medium is nonlinear, and the Muskingum model was used for the confluence of the underground river to test its applicability. It is hard to generalise the parameters K and x of Muskingum model in the hydrological model due to their variability with flow conditions. In the revision, more karst flood events (a total of 30) will be collected to validate the performance of the Muskingum model in study area. And Ahilan et al (2012) made a good research example for this aspect, this article will be added in the references in the revision. Comment 2. Lack of details on field survey to obtain hydraulic conductivity and aquifer transmissivity properties of the study catchment. ACs2. It will be done in the revision, more details on hydraulic conductivity and aquifer transmissivity properties will be added in the section 5.2 Parameter optimization of coupling model. Including the hydrogeology parameters , the parameters of the epikarst zone, soil type and the rainfall infiltration coefficient of different karst landforms will be evaluated in the revision, and listed in Table 2. The parameters of the model. In view of the geological information is very important to hydrological processes in karst areas. So in the section 2 study area and data, the section 2.2 Landform, tectonics and hydrogeology information will be added in the revision to better understand the geological background for model building in the study catchment.

Comment 3. Authors dealt the large catchment (58,270 km2) as a whole. It should be more appropriate to break the Liuijiang catchment into several sub-catchments and explore mass balance relationship between rainfall and flow. ACs 3. In fact, the whole karst river basin has been divided into many small karst sub-basins by using the high-resolution DEM data in the paper, and furthermore, the karst sub-basins were divided into many karst hydrology respond units (KHRUs) to ensure the model structure is refined enough to suit the karst landforms. The whole studied area was divided into 1,469,900 grid cells named the karst sub-basins in this study (section 5.1hydrological model setup). And the confluence calculation of these sub-basins will be accumulated to the outlet of basin, this is the mechanism of the distributed hydrological model, it's not like that dealt the large catchment as a whole.

Comment 4 . Uncertainty analysis in QPE and Liuxihe models are largely left unexplored. This is essential to uncertain confidence of the model prediction. ACs 4. It is a pertinent comment. There are a lot of parameters in the distributed hydrological karst model, and only 5 flood events in the original paper used for parameter calibration and model variation is uncertain. So in the revision, 30 flood events from 1982-2013 will be collected, among them, 3 flood events are used to optimize model parameters, and the rest of flood events are used to validate the model performance, which can give a confident results or reasonable conclusions.

Comments 5. Some of the references which were used in this study are outdated. For instance, L335 Davis (1912) L453: Strahler method (Strahler, 1957) L485: Saxton (Saxton et al.,1986) ACs 5. Some of the references are outdated in the paper, and they will be replaced or deleted in the revision. For instance, the references Davis (1912), Strahler method (Strahler, 1957) will be deleted, and Saxton (Saxton et al.,1986) will be replaced by Ren(2006).

Comments 6. There is a number of syntax errors throughout the paper. The paper should be carefully proofread and edited by a native English speaker. ACs6. There are some syntax errors and unclear sentences in the paper, which makes it hard to under the meaning of some information. It will be down in the revision. And a native English speaker will help to carefully proofread the whole paper in the revision.

Comments 7. Figures (1 – 4) seem to be borrowed from other previous papers. The resolution is relatively low. ACs 7. It will be done in the revision. Figures (1 – 4) will be redraw with a high resolution in the revision. Comments 8. Figures (5 – 9) need to be modified. X-Axis should be rain gauge precipitation and Y – Axis should be PERSIANN-CCS QPE. The 45-degree line should be used to compare them. ACs 8. It will be done in the revision. Figures (5 – 9) will be modified in the revision, the 45-degree line will be used to compare the rain gauge precipitation(X-Axis) and the PERSIANN-CCS QPE (Y-Axis).

Comments 9. Figures (5-9) rainfall should be converted into mm/hr. ACs 9. Figures (5 – 9) will be modified in the revision, the unit of rainfall will be converted into mm/hr. Comments 10. L618: Error in time to peak is considerably high. Hydrological model structure need to be re-examined. ACs 10. There is a considerably high error in time to peak in the flood simulation results. So the Liuxihe model will be re-validated by adding more flood events, 30 floods will be used for parameter calibration and model variation in the revision, which can reduce the uncertainty of the model and offer a confident flood simulation and prediction results.

References: Ren,Q.W.: Water Quantity Evaluation Methodology Based on Modified SWAT Hydrological Modeling in Southwest Karst Area. China University of Geoscience, Wuhan ,China, 2006.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2018-438/hess-2018-438-AC3-supplement.pdf

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