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Hydrology and Earth System Sciences
Discussions

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 #2 Received and published: 29 October 2018 This paper presents some simulations of flood in a karst catchment in China, based on the weather satellite rainfall data. However, (at present) I cannot recommend publication, but after the following concerns are addressed. Main comments: 1 From reading this paper, it is unclear what the real novel contribution is. The rainfall variety does not seem to have a direct relationship with the karst landform or geology. But I think the distributed model should be the main scientific contribution in this article. However, the authors paid more attention to the rainfall accuracy rather than the karst model. 2 The authors inform the

reader that in Yangbo Chen et al. (2009), the distributed model was developed in previous work, by integrating the karst flow progresses. However,some key issues have not been clearly explained in the model description. For example, the exchange between the 'rapid fissure' and 'slow fissure' in the epikarst zone, the hydrological function of the sinkholes. Obviously, the authors are aware of these important influence on the flow in karst aquifer, but I cannot find the corresponding explain in the model. 3 For such a complex model, with a lot of parameters, only several flood events are used for parameter calibration and model variation. So I don't think it can give a confident results or reasonable conclusions. The uncertainty should be analyzed in this work. 4 There is no detailed geological information of study basin in the paper. I do not think the authors can get good results without these information in karst area. Detailed comments 1 Line 251-254: I do not understand this description. 'After all the pores are full-filled,means the macro crack is saturated.' But the authors also say 'ignore the regulation and storage hydrological process of the macro crack'. What does it mean? And how to deal with the unsaturated flow in macro crack? 2 Line 255: Is there a flow exchange between rapid and slow fissure? 3 Line 263-267: These confuse me. Whether 'the epikarst zone' in these sentences indicate the slow fissure in epikarst? It is not clear. 4 Line 269: What is 'the superficial karst fissure system'? epikarst? 5 Line 316 and 356: Hydrogeology is the most important influence on hydrological processes in karst. However, there is no geology information of this catchment in this paper. I do not know how the authors deal with the distribution of hydrological function of the study catchment in a distributed model. 6 Line 450: In the model, '.... rapid ïňĄssure ïňĆow will go directly into the underground river....' Where is the distribution of underground river? Is there a connection between surface and underground river? 7 Line 493: Only one ïňĆood event was used to calibrate so many parameters. What is the uncertainty? 8 Line 574: Why only evaluate the parameters related to rainfall? The catchment properties may be more effective.

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 1. From

reading this paper, it is unclear what the real novel contribution is. The rainfall variety does not seem to have a direct relationship with the karst landform or geology. But I think the distributed model should be the main scientific contribution in this article. However, the authors paid more attention to the rainfall accuracy rather than the karst model. ACs1. 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.This is also the first time that Liuxihe model has been used in flood simulation and prediction in karst basin as an attempt in this study. The comment pointed out it is unclear what the real novel contribution in this paper due to lack of the descriptions for scientific contribution. The description of the improved structure and function for Liuxihe model will be added in the abstract and the introduction in the revision. 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. Also recalibrate the coupling model parameters is a novelty in this study, it can largely improve the performace of model in flood prediction The comment pointed out the rainfall variety does not seem to have a direct relationship with the karst landform or geology, but the authors paid more attention to the rainfall accuracy rather than the karst model. Because in most cases, there is no enough rain gauges in karst basins, and it is hard to build a hydrological model without typical rainfall data. The PERSIANN CCS QPEs could offer a reasonable and high-resolution rainfall data in karst basins, and coupling the PERSIANN CCS QPEs with a physically based distributed hydrological model has far reaching application potential in karst flood simulation and prediction. So the authors paid attention to the rainfall accuracy based on the PERSIANN CCS QPEs. The comment pointed out the distributed hydrological karst model have a direct relationship with the karst landform or geology. It is right, the authors agree with this opinion. And in the revision, the information on the karst landform, geology and the hydrogeology will be added in the revised paper. Also, the improvement of the struc-

ture and function for Liuxihe model by adding karst mechanism will be added in the revised abstract and the introduction as well as the section 4.2 The improvement of the Liuxihe model in the revision. In addition, the structure of the paper will be modified in the revision. The original paper structure was :1 Introduction- 2 Methodology- 3 Study area and data- 4 PERSIANN-CCS QPEs and its post-processed results- 5 Model set up- 6 Results and discussions- 7 Conclusion. In consideration of some contents in the part-4 PERSIANN-CCS QPEs and 5 Model set up should belong to the part 2 –Methodology, so the structure of the paper will be modified to make it easy to understand the sequence and the logical relationship. And the whole structure of the paper will be changed to 1 Introduction- 2 Study area and data - 3 PERSIANN-CCS QPEs and its post-processed results - 4 Hydrological model - 5 Model set up- 6 Results and discussions- 7 Conclusion. Comment 2. The authors inform the reader that in Yangbo Chen et al. (2009), the distributed model was developed in previous work, by integrating the karst flow progresses. However, some key issues have not been clearly explained in the model description. For example, the exchange between the 'rapid fissure' and 'slow fissure' in the epikarst zone, the hydrological function of the sinkholes. Obviously, the authors are aware of these important influence on the flow in karst aquifer, but I cannot find the corresponding explain in the model. ACs2. There are some syntax errors and unclear sentences throughout the paper, which makes it hard to understand the descriptions of the improvement for Liuxihe model, and some key issues on the distributed model was developed with the karst mechanism have not been clearly explained in the model description. It will be down in the revision. And a native English speaker will help to carefully proofread the whole paper in the revision. Also the descriptions of the improvement for Liuxihe model with the karst mechanism will be added in the revision to make the model structure and function clearer. The comment pointed out the exchange between the 'rapid fissure' and 'slow fissure' in the epikarst zone, and the hydrological function of the sinkholes are not clear in model. The description of the exchange between the 'rapid fissure' and 'slow fissure' in the epikarst zone, and the hydrological function of the sinkholes will be added in the section 4.2

The improvement of the Liuxihe model in the revision. And there is a mistake in word spelling in 255 line, the original sentence in the paper is"The rest of the water content will enter the tiny pores in the surface karst zone, and the water content of rapid fissure flow could be described as the following equation:" In fact, the word 'rapid fissure flow' should be changed to 'slow fissure flow', and it will be modified in the revision. Comment 3. For such a complex model, with a lot of parameters, only several flood events are used for parameter calibration and model variation. So I don't think it can give a confident results or reasonable conclusions. The uncertainty should be analyzed in this work. ACs 3. It is a pertinent comment. There are a lot of parameters in the distributed hydrological karst model, and only 5 flood events used for parameter calibration and model variation are not enough. In fact, in the first draft, there are 30 flood events from 1982-2013 have been collected, among them, 3 flood events are used to optimize model parameters, at last, we choose a flood process with the best parameter evolution result for parameter calibration, and the rest of flood events are used to validate the model performance. In consideration of the article is too long, only 5 flood events are used finally. Since it is necessary to collect enough flood events for parameter calibration and model variation. The 30 flood events simulation and prediction results will be added in the revision, which can give a confident results or reasonable conclusions. Comment 4 . There is no detailed geological information of study basin in the paper. I do not think the authors can get good results without these information in karst area. ACs 4. It is a pertinent comment. I agree with that 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.

Detailed comments: Detailed comments 1. Line 251-254: I do not understand this description. 'After all the pores are full-filled, means the macro crack is saturated.' But the authors also say 'ignore the regulation and storage hydrological process of the macro crack'. What does it mean? And how to deal with the unsaturated flow in macro

crack? Detailed ACs1. The sentence 'After all the pores are full-filled, means the macro crack is saturated.' is not complete. In the revision, it will be replaced by"When the rainfall enters the superficial karst water system of the epikarst zone. The macro crack will be filled firstly. This part of saturated water content named rapid fissure flow will go directly into the karst conduit through the macro crack. Because this rapid fissure flow will pass quickly through the karst conduit system without stopping, and the water regulation and storage function is weak, so ignored the regulation and storage of the rapid fissure flow in this study." The stored-full runoff was the main pattern of runoff yield in the study area. During the heavy rain, the macro cracks are always saturated firstly, the runoff only happened when the aeration zone is saturated, so we assume the macro crack is saturated during the rain, and the water regulation and storage function of the macro crack is weak, so ignored the regulation of the unsaturated flow within it.

Detailed comments 2. Line 255: Is there a flow exchange between rapid and slow fissure? Detailed ACs2. There is a flow exchange between rapid and slow fissure indeed, the flow exchange between rapid and slow fissure has an important influence on the hydrological process in the internal karst water-bearing medium. However, its influence on the hydrological process outlet of the basin is weak, so in the flood simulation, the flow exchange between rapid and slow fissure is ignored. Detailed comments 3. Line 263-267: These confuse me. Whether 'the epikarst zone' in these sentences indicate the slow fissure in epikarst? It is not clear. Detailed ACs 3. Yes, the epikarst zone in these sentences indicate the slow fissure in epikarst zone , and it will be replaced by the slow fissure in epikarst zone in the revision . Detailed comments 4. Line 269: What is 'the superficial karst fissure system'? epikarst? Detailed ACs 4. Both of the superficial karst fissure system and the conduit system are existed in the epikarst zone, in order to make the description clearer, in the revision, this sentence "The linear reservoir model is employed to calculate the regulation process of the superficial karst fissure system"will be replaced by "The linear reservoir model is employed to calculate the regulation process of superficial karst fissure system in the epikarst zone" Detailed comments 5. Line 316 and 356: Hydrogeology is the most important influ-

ence on hydrological processes in karst. However, there is no geology information of this catchment in this paper. I do not know how the authors deal with the distribution of hydrological function of the study catchment in a distributed model. Detailed ACs 5. It is right, the hydrogeology is the most important influence on 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 . Also, there are some descriptions in the section 4.2 The improvement of the Liuxihe model in the revision will help to better understand the structure and function of the distributed model. Detailed comments 6. Line 450: In the model, '.... rapid ïňĄssure ïňĆow will go directly into the underground river....' Where is the distribution of underground river? Is there a connection between surface and underground river? Detailed ACs6.

This sentence '.... rapid ïňĄssure ïňĆow will go directly into the underground river....' is not complete, it should be '.... rapid fissure flow will go directly into the karst conduit through the macro crack. and ignores the regulation and storage hydrological process of the rapid fissure flow in this study', and it will be modified in the revision.

The distributions of underground rivers are existed in the whole basin, but most of them are distributed in the southwest and near the outlet of the basin. The underlying surface are dominated by the alluvium , diluvium and the katatectic layer due to the fluviraption of the liujiang river and karst geological background, where the thickness is about 10-20 meters. There is a connection between surface and underground river indeed. The surface river will replenish ground river during floods, but in the dry season, the ground river will replenish the surface water through the regulation of karst fissures. And in this study, we study on the karst flood events, so only the hydrological process of the surface river replenish ground river is concerned, and this is the hydrological process of rainfall-runoff in the model. Detailed comments 7. Line 493: Only one ïňĆood event was used to calibrate so many parameters. What is the uncertainty? Detailed ACs 7. This comment was mentioned in comment 3, and it is right, only one ïňĆood event used to calibrate so many parameters is not enough, so

in the revision, the 30 flood events will be collected, and 3 flood events are used to optimize model parameters, the rest are used for model variation. Detailed comments 8. Line 574: Why only evaluate the parameters related to rainfall? The catchment properties may be more effective. Detailed ACs 8. It is a pertinent comment, the catchment properties may be more effective to evaluate the parameters, so in section 5.2 Parameter optimization of coupling model, 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.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2018-438/hess-2018-438-AC2-supplement.pdf

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