Responses to Reveiwer 2

Comments: In this paper, extreme precipitation statistics are examined for Ganjiang river basin in China. This work contains interesting results in the field of risks of extreme events in a changing climate, though, in my opinion, there are significant problems that need to be addressed. Thus, I would recommend a major revision of the manuscript according to the following comments, which I hope the authors will find useful.

Response: We sincerely thank Reviewer 2 for the time in effort on reviewing our manuscript with many insightful comments. We used more than 20 days and try our best to revised it. We believe that we have addressed each of the comments carefully and properly. The quality of paper was also improved significantly. We hope that the changes listed below are acceptable.
All the changes made were highlighted using "Track Changes" mode of Microsoft Word in the revised manuscript attached.

Major Comments:

- Firstly, I would like to point out that the manuscript is poorly prepared with many errors and elusive points (that are described in the specific & minor comments below).

Response: Sorry for the language problems,we tried our best to revised them one by one and highlighted the revised part in the revised paper.

- Moreover, the results of the statistical procedures are not discussed/explained in terms of their physical meaning, which is critical when dealing with demanding concepts.

Response: Thanks. We revised the discussiong and conclusion and tried to make it more clear in the revised manuscript. We hope that the revised part could be acceptable.

- In addition, the intensity of the precipitation events is not examined, at least explicitly, which I think it's quite crucial when dealing with floods.

Response: Thanks. The manuscript focused on extreme precipitation, which is defined as events over 99 percentiles.Table 5 shows the mean values of the the thresholds which are more than 14mm per 12 hours. These rainfall values belong to heavy or even violent precipitation accord to *Flood Control Manua*l published by Office of the National Flood Control Department in China, that is, they are high-intensity precipitaion. Therefore the intensity of the precipitation events is not the main topic and we just discussed it in Section 4.2 with the parameters of the gamma distribution to show their charactristics and changes.

- Finally, in the manuscript, there are many grammar and syntax errors. Many sentences/phrases are incomprehensible, and this may obscure the findings.

Response: Sorry for the language problems. We tried to correct them in the revised paper and checked them again and again. We hope it will be OK.

Specific Comments

1. Abstract: It should be completely revised or rewritten in terms of scope, results, and language.

Response: Thanks. We tried our best to revised the abstract as below:

"Climate warming increases flood risk and the intensity of extreme precipitation. Studying extreme precipitation patterns and changes is vital to reducing flood risk. This paper investigates thresholds, changes and time scales for extreme precipitation using sub-daily records from meteorological stations in the Ganjiang River basin. We use the gamma distribution and select the L-moment method to estimate the parameters α and β. Results show that (1) events of 1-4 runs occurred most commonly and events of 1-10 runs contributed the most to total precipitation; (2) Extreme precipitation has the characteristics of high intensity and occasional occurrence in summer. The intensity and the occasional probability of extreme precipitation will increase in spring in the future in stations like Yifeng, Zhangshu and Ningdu; (3) flood risk shows signs of increasing as elevation increases in the northern lowland and Jitai Basin in the mid-stream region, while risks in the southern mountainous region decreasing with elevation increasing. These findings will facilitate emergency preparedness, including risk management and disaster assistance in flood-prone areas."

2. Line 10: Which parameters you refer to?

Response： Thanks. They refer to α and β, We revised this sentence as:”We use the gamma distribution and select the L-moment method to estimate the parameters α and β.”

3. Lines 15-16: How the results help in planning and management? This also affects the discussions and coclusions as well.

Response: Thanks. We revised this sentence as: “These findings will facilitate emergency preparedness, including risk management and disaster assistance in flood-prone areas.”

4. In Introduction and the rest of the paper: A great number of the cited papers are missing from the reference list or there are not cited properly (e.g., Asadieh & Krakauer, 2015; Westra et al., 2013; Fischer et al., 2013; O’Gorman & Schneider, 2009; Pendergrass & Hartmann, 2014; Sillmann et al., 2013; Wu et al. (2014); Brunetti, Maugeri et al. 2004; López-Moreno and Beniston 2009; Fernández-Montes, Seubert et al. 2014; Merino,Fernándezâ Vaquero et al. 2016; Xu, Ma et al. 2014; Chen 2015; Shan, Zhang et al. 2001 and more). This largely downgrades the quality of the paper.

Response: Sorry for these errors. We checked all the references and corrected them one by one. Some of them are: (Rodrigo, 2010)，(Asadieh et al., 2015; Westra et al., 2013)，(Fischer et al., 2013; O'gorman et al., 2009; Pendergrass and Hartmann, 2014; Sillmann et al., 2013)，(Li et al., 2014)(Xu et al., 2014; Chen, 2015).

The changed records are highlighted in the revised paper.

5. Lines 104-105: What is the meaning here?

Response: Sorry. The sentences cause ambiguity. We revised them as: “Regional differences often indicate whether extreme precipitation can cause flooding. For example, daily precipitation of 50mm may have a low impact on human society in flat or humid areas. However, it can lead to flash floods and even landslides and debris flows in mountainous or arid areas.”

6. Line 127: According to the relief description above, the higher precipitation should be distributed to the south. Thus, why it is mentioned here that the

highest precipitation is found to the NW? In addition to the above, I strongly suggest including the spatial distribution of the precipitation in the basin or at lease include a table with the annual and seasonal totals.

Response: Thanks for your kind advice. According to the records, more precipitation are found in NW stations like Jgx, Yf, Lh, Yc,Yof, Zs, more than 1600mm. The station in the south have less precipitation but more floods. We add a table （Table 2）in Section 3.1 to show seasonal and annual average precipitation and revised in the end as: "Seasonal and annual average precipitation was calculated for each station and listed in Table 2, which shows that the highest precipitation in most stations is in spring, followed by summer, autumn and winter. The stations located in the windward mountains have more annual precipitation, while the stations located in the plain areas have less precipitation. Jgx in the west has the highest annual precipitation."

The newly added table is:

Table 2 Seasonal and annual average precipitation in stations (mm)

station	spring	summer	autumn	winter	annual
Yf	667.1	588.2	252.9	249.2	1757.4
Lh	627.4	512.8	228.8	236.7	1605.6
Yc	624.4	522.3	242.2	237.9	1626.8
Ja	604.5	490.2	221.3	211.3	1527.4
Jgs	578.4	774.5	336.4	207.9	1897.2
Sc	494.6	501	273.9	188.2	1457.6
Gx	570.2	458.4	208	209.2	1445.9
Nc	626	556	196.5	214.7	1593.4
Zs	665.4	542.6	215.5	243.7	1667.2
Yof	656.1	550.5	227.3	234.7	1668.6
Nd	706.9	614.7	234.5	224.8	1781
Ln	597.6	544.4	205	196.5	1543.5

7. Line 129: Please provide more info about these weather systems/patterns. What is this quasi-stationary front? Monsoons and typhoons can affect this area, taking also under consideration the high relief of the southern areas.

Response: Thanks for your kind advice. We corrected quasi-stationary front to near-stationary front, which is a kind of stationary front result in the high precipitation from April to June.

This conclusion is from the reference: *Statistical assessment and hydrological utility of the latestmulti-satellite precipitation analysis IMERG in Ganjiang River basin. The original sentences are* Over 70% of the total rainfall is concentrated in the period from April to June, which is the plum rain season, because of the convergence of cool and warm air masses and the existence of surface quasi-stationary front over the basin. Furthermore, due to local topography and monsoon climate, maximum precipitation usually occurs in the northwest and east of the Ganjiang River basin during the rainy season.

8. Lines 142-143: The temporal intervals of the raw observations are not mentioned. Are sub-daily observations (and with what time interval)? What "sliced with the purpose to keep data consistency" means? Sliced from daily? If yes, which is the point? If not, please clarify the followed procedure.

Response: Sorry for the misunderstanding. The original data include precipitation records from 8:00 to 20:00 during days, precipitation from 20:00 to 08:00 the following day during nights, and daily precipitation from 20:00 to 20:00 the following day. We just selected the records from 1959-1-1 and 2016-12-31 in each station to keep uniformity of observation time and consistent number of observations. We revised the sentences to make them more clearly:

"The original data include precipitation records from 8:00 to 20:00 during the days, precipitation from 20:00 to 08:00 the following day during the nights, and daily precipitation from 20:00 to 20:00 the following day. The data precision is 0.1 mm. Twelve hourly (12-H) precipitation was defined as precipitation records from 8:00 to 20:00 during days or precipitation from 20:00 to 08:00 the following day during nights and sliced from the original data between 1959-1-1 and 2016-12-31 with the purpose of keeping the data consistency."

9. Line 145: More discussion/explanation in needed regarding verification and correction.

Response: Thanks for the advice. The verification and correction were carried out station by station with R programmed developed by Wang et al. In 2010, The reference is *New techniques for the detection and adjustment of shifts in daily precipitation data series*.

One sentences was revised as: "PParticular attention has been paid to problems such as changing points arising from inhomogeneities of data series, which were validated and corrected according to the methods supposed by Wang in 2008 (Wang, 2008) station by station. "

10. Line 171: Please provide info about the flood records.

Response: Sorry for the misunderstanding. We revised the expression as "According to this threshold, 0-4 extreme precipitation events can be found in a year, which is close to the number of floods observed in China."

11. Line 174: What does this mean?

Response: Thanks. We revised this sentence as "How to accurately estimate the return period of extreme precipitation is an information science problem "

12. Line 175: "only 59 years"- This is the point of statistical analysis; to estimate parameters of a population bases on a sample.

Response: Thanks. We corrected the number and revised it as "In this study, there are 58 years of rainfall records, which forces us to use limited samples to estimate events with a chance of 1 in 100 years or even more, i.e., exceedance probabilities of one percent or more. The addressed problem is solved in practice by estimating probability distributions, which can estimate parameters of a population bases on samples."

13. Lines 201-208: Please revise the mathematical description of the L-moments. In my opinion, there are some mistakes and omissions. Specifically, β is usually called "inversed scale"; how aL is calculated and how it is an estimate of α; what is a1?

Response Thanks for your advice. The description of L-moments was from referrence: *L-moment estimators as applied to gamma drop size distributions and L-moments: analysis and estimation of distributions using linear combinations of order statistics*. The parameters α_L are estimated by iteration using recursion. We added the reference which introduced it.

In the paper we calcualted them with lmoments.py, which is revised fromthe Fortran from the IBM Corperation. The library was developed by WILLIAM ASQUITH. The was developed by WILLIAM ASQUITH. The Python translation was conducted by:

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Sorry for the error of α_l It should be α_L， we corrected it in the revised paper.

14. Lines 227-228: Please elaborate on that. What is the purpose of this procedure?

Response Sorry for the vague expression. This procedure is to show the methods to get spatial features of flood risk. We revised them asbelow:

“Spatial distribution of precipitation hazards is analyzed using a GIS method. Extreme precipitation is the main disaster-causing factor of floods in the study area. The extreme precipitation thresholds of different probabilities are used to evaluate the flood risk. The number of events above the thresholds are calculated at each meteorological station. The inverse distance weighted method (IDW) is then used to interpolate and zone the number after validation with observations, with the purpose to show the spatial characteristics of the flood risk”

15. Lines 231-232: The term “run” firstly appears here without a previous explanation. I assumed it refers to the 12-h intervals of precipitation and under this assumption I read the rest of the paper (I hope I got it right). Moreover, the sentence is confusing: What do the phrases “on the standard of an event” and “with the purpose to keep independent for time series analysis” mean? In any case, the choice to work with 12-h values is not justified. Please elaborate more on this choice.

Response Sorry for the confusine. Yes. Run means number of durations for precipitation in this pape,, we revised this partas:

“Runs of 12-H precipitation in each station were calculated with records of precipitation >0.1mm. Runs are defined as consecutive precipitation events for time series analysis in this paper. 1-run refers to a precipitation event recorded in 12 hours. 2-run refers to an event with precipitation recorded in two consecutive 12-hour intervals, and so on. If no precipitation is recorded at an interval greater than 12 hours, precipitation is defined as discontinuous and divided into two runs. This definition helps keep the calculated events independent.”

16. Lines 247-248: Why is this important?

Response Sorry for the language bugs. As revsied above, a run means a consecutive precipitation event. 1-run refers to precipitation lasting for 12 hours, 2-run refers to precipitation lasting for 24 hours, and so on. Figure 2 shows, high frequency of a run does not mean high contribution to total precipitation. This draw the conculsion that “3-run precipitation events contributed the most precipitation but with lower frequency and would be key events for flood monitoring.”, which is important for flood risk analysis. Thanks.

17. Line 254/Figure 3: In line 239, it is mentioned that only one station has 28-runs, so whys this value appears in every plot (every station)? The numbers on the plots, I suppose that refer to each station. Please add the name of the station on each plot instead of these arbitrary for the reader numbers.

Response Sorry for the errors. We checked the programme and find the figures was plotted with the slided added data fro 1 to 28, not the real runs of precipitation. We correct them and replotted the figures in the revised paper. For station number, we also add the station code in Table 1.

18. Line 263: What is the meaning of this phrase?

Response: Thanks. Do you mean "uniformly rigorous and systematic approach"? Sorry for the confusing. We revised it as "providing smooth changes and long-term projection"

19. Line 267-254: The physical meaning of β is not given. What in terms of precipitation distribution a large or small value of β provides as information? What does this mean about the events? How the conclusions about atmospheric circulation are drawn from this analysis from the values of α and β? It seems that the authors jump to conclusions without the necessary support from the findings.

Response: Thanks. The analysis of α and β were done follow the conclusion from literature Changes in the probability of extreme daily precipitation observed from 1951 to 2002 in the Iberian Peninsula, which shows that the shape parameter α was ≤1, which indicates that events with small amounts of rainfall account for a substantial large proportion while events with large amounts of rainfall account for very small proportion, The β parameter characterizes the scale of intensity of the precipitation. The higher β is, the higher the intensity is. We rephrase these analysis and add the references as below:

"Related research shows that when the shape parameter α was ≤1, the distribution has a asymmetric J-shaped probability density function (Loucks et al., 2005), which indicates that events with small amounts of rainfall account for a substantial large proportion, while events with large amounts of rainfall account for very small proportion (Rodrigo, 2010). This case is common for the four seasons, especially in summer and autumn when α is ≤0.1, indicating that these two seasons are characterized with occasional and sudden extreme heavy precipitation in all stations. The β parameter characterizes the scale of the gamma distribution. When β increase, the distribution curve squeezes leftward and upward, indicating high intensity of precipitation (Rodrigo, 2010). "

20. Lines 276-289: The same comments as above stand for the discussion about trends of gamma parameters. What these changes mean in terms of observed precipitation?

Response: Thanks. This part is a MK analysis of α and β in. As previous researhes and the above revised part. When α become smaller in the future, there will be more events with small amounts of rainfall which will account for a substantial large proportion. When β becomes bigger, the distribution curve will squeeze leftward and upward, indicating high intensity of precipitation. Then this analysis shows the future trend of α and β, representing the changing characteristics of the observed precipitation. The result shows that precipitation would occur more occasionally with higher intensity in spring, winter and autumn.

If we analysis the trend directly with the observed data, it will just shows the precipitation increase or decrease in the future, we can not find more information indicating flood risk.

21. Line 294: Are the differences between percentiles and gamma distribution any meaningful/important? Why are they mentioned?

Response: Thanks. Yes. It is too sudden for readers. We revised it as "As defined in Section 3.2, the 99% percentile of the 12-H precipitation data and their gamma distribution estimates were first calculated as extreme precipitation thresholds."

22. Lines 304-305: How a change in threshold will help the risk management? How lower values of Gamma function help reduce risk?

Response: Thanks. Lower threshold will increase the predicted number of the floods, which will help raise the awareness of government managers about flood risk and thus reduce risk. We explaint it by " A slightly lower threshold for extreme precipitation will increase flood risk, which allows risk managers to improve risk management before storm floods occur. Therefore, the lower values from the Gamma function would help reduce risks. The 99th percentile estimates are maintained as the threshold values to obtain the risk analysis"

23. Lines 325-344: Please explain why you selected two different stations to compare percentiles of one station with gamma distribution results of the other. In addition, why only 5 years of data?

Response: Thanks. It is the reason of insufficient data. Floods are hydrological events. But hydrological observations is not easy for us to collected in the study area. We only collected 6 years data (2009-2014) in Halinqiao hydrological observation station. Therefore the validation and comparative analysis was limited in the two station from 2009 to2014. We revised Line 340 as "Events between 2009-2014, which is the period of the available hydrological data at Hanlinqiao station." We selected Gx, the meteorological station near Halinqiao, which is one of 12 stations analyzed above. We replace it with Gx to avoid ambiguity in the revised paper.

24. Line 340: Where this selection is mentioned in the text and how it is justified?

Response: Thanks. We revised it as "Events between 2009-2014, which is the period of the available hydrological data at Hanlinqiao station." as well as Line 336 in the revised paper as "we selected Gx, a meteorological station and Hanlinqiao because of the available data" to explain the reasons why we selected them.

25. Lines 345-354: As above, I don't understand how these two tables compare to each other. Why didn't you use the same station with and without Gamma fitting?

Response: Thanks. As analyzed in the paper. the gamma fitting only used in Gx, the meteorological station, with the purpose to estimate the intensity and return periods of precipitation. Yet the final purpose is to project likely floods with precipitation. Hence we do not fit the hydrological data and culclated how many flood events occurred with the observed hydrological data.

Table 6 shows the number of exteme precipitation events predicted under 5 scenarios (0.5-0.02, that one in two years to one in 50 years). Table 7 shows the number of real flood events in Halinqiao hydrololgical station.

26. Lines 349-350: Which was the actual rain of these flood events?

Response: Thanks. The actual rain were not calcuated. The first reason is that precipitation happend not at the same time as floods. They often occurs before floods. But How long before the flood? 12 hours? one day? two days? There is no agreed standard and we can not calcualted them . We talk about the case with the findings of literature (Merino et al., 2018) in section 4.4.2. The other reasons is the topic of the paper. We just focused on analysing extreme precipitation risk, not forcasting them and flood risk.

27. Line 353: What is “underestimated”? The number of events or the precipitation amounts? And why this happens?

Response: Yes. We revised it as “low estimated”. We think the reason might be the higher thresholds under Scenarios 3, 4 and 5 from the gamma fit.

28. Line 360: It is quite expected to have more flood events for short-time precipitation with high intensity. Here, it is obvious that an intensity analysis should be added to shed light on these findings.

Response: Thanks for your kind advice. As description above, we did not collected more hydrological data. If more data available,it will be much more interesting to research into such findings. We will further to find more ways to solve the data collection problems later. Thanks again.

29. Line 361: How the events are “predicted”? Please explain or rephrase.

Response: Thanks. They are predicted with gamma distribution. We added the phrase in the revised paper: “events predicted with the gamma distribution from precipitation”

30. Lines 377-389: How the risk maps were created? Please provide the methodological steps and the data/layers that have been used to create the maps.

Response: Thanks. The risk maps are created with the number of events of extreme precipitation in the analyzed 12 stations. We described the method with 3 step：

1) “The observed precipitation was 12-H precipitation from the 12 meteorological stations. The 99th percentile was selected as thresholds in each season.
2) A gamma function was used to fit the observed data. Thresholds were calculated at a given probability of 0.2 from the gamma curves. Events bigger than the threshold were considered as the extreme precipitation events and calculated for risk map.
3) The number of events in all the station was further interpolated with an inverse distance method. The results were mapping and stretched from low to high according to number of the events.”

31. Lines 390-395: It is not clear how the durations and amounts are connected. Which are the combinations of amount and duration leading to flood events? In other words, the intensity is needed. In addition, how robust are the conclusions with such a small number of events? Which is the uncertainty of the results?

Response: Thanks. This paragraph is used to discuss the likely reason result in high flood risk in the risk map. This part do not analyse the duration and amounts of precipitation. We just use events of precipition to represent flood risk, following the result of comparative analysis in Section 4.3.2. The numbers of lengend in Figure 6 are the numbers of events of extreme precipitation in the past 58 years. The higher the numbers are, the higher the flood risk are. Then we find highest risk center in the west and south. Literature Zhang et. al (2001) shows that the soutwestward and uplifted monsoons in spring and tropic ocean cyclones might resulted in the findings.

32. Discussion: In this section, the results along with a literature review should be discussed. In contrast, the results are mentioned vaguely, and the rest of the section refers to the other works. Please completely revise this part in line with the above comment.

Response: Thanks for your advice. We carefully talked about your suggestion about the discusssion and found the big problem might be the languages. We tried our best to revised this section and make the results clearer. The revised discussiong is:

“**4.4.1 Time scales of precipitation**

Precipitation events, especially occasional extreme precipitation events, is highly variable in time (Beck et al., 2015) and intermittency is a core characteristic (Trenberth et al., 2017). This paper investigated the time scales of precipitation with 12-H data and found 3-run precipitation events contributed the most precipitation but with lower frequency. The study area was mainly characterized with short duration precipitation events and events greater than 10 runs occurred very rarely. Hence short duration precipitation events would be a key hazard factor for extreme precipitation forecasting, flood and disaster risk management analysis. Section 4.2 further analysed the trend of short duration precipitation and found they would occur more occasionally but with higher intensity in future. Other associated studies have yielded similar results. Cheng et al. investigate the precipitation Intensity-Duration-Frequency (IDF) in a changing climate and find that climate-induced changes on heavy rainfall events are non-uniform. The shorter precipitation events have been changed more in the past decades, while longer events have not changed substantially (Cheng and Aghakouchak, 2014). Hosseinzadehtalaei et al. find the frequency of sub-daily extreme precipitation events of 50- and 100-year return periods will be tripled under the high-end RCP8.5 scenario in the future climate change, which will increased the risk of flooding (Hosseinzadehtalaei et al., 2020). Similar cases are also found in China. Ren at al. analysed the data from 2,300 stations across China. Their research shows that the frequency of trace precipitation (precipitation with a daily rainfall of less than 0.1 mm) has shown a more significant downward trend than the frequency of light rain events in the eastern monsoon region. The frequency of light precipitation in the eastern monsoon region has shown a very obvious downward trend(Ren et al., 2016). The Ganjiang river basin is located in the south of the east Asian monsoon region. Changes in short-duration precipitation events caused by climate warming will cause higher risk of flooding, which are certainly the key indicator for further study on climate change, floods and other extreme weather disasters.

4.4.2 Extreme precipitation and Flood risk

In fact, most precipitation events bring us necessary beneficial freshwater resources. Only few events, especially extreme precipitation events, cause disasters and losses. Yet what extreme events will result in flooding is not very clear. Researchers should consider how extreme precipitation is defined and carefully choose the data for their analysis of extreme precipitation (Pendergrass, 2018). We compared the extreme precipitation events from 1-10 runs of 12-H data with the flood records in hydrological observation station and found that the number of events from 1, 2, 3 and 4 runs were close to the number of flood records. The number of diagnosed extreme events decreases as precipitation runs of 12-H increase, i.e, precipitation of more than 5 runs would low estimate the flood risk. Similar case are also found in the literature Merino et al. (Merino, Fernández-González et al. 2018), who select 29 floods between 2000 and 2014 in Spain and compare them with the extreme precipitation events calculated with hourly and daily precipitation data in order to find their capability of identifying major flood events. The result shows that no extreme precipitation events are identified in eight of the flood events using definition based on daily precipitation but events based on sub-daily data permit much more accurate identification of events posing hydrologic risks (Merino et al., 2018). Obviously it would be better to use short-duration data, for example, sub-daily precipitation, in extremely events analysis to avoid underestimation potentially dramatic consequences they caused such as flooding. In practice, daily precipitation seris are commonly used to analyse extreme precipitation events with their sufficient quantities and few homogeneity problems. The reason might be that high time resolution precipitation data are not provided or recorded in most regions. Therefore remotely sensed data from satellites or rain radar would be used to replace sub-daily precipitation in follow-up researches (Müller and Kaspar, 2014)."

33. Lines 398-399: Here, the precipitation intensity is discussed without any previous analysis of it.

Response: Sorry for the expression. We revised the sentence as:

"Precipitation events, especially occasional extreme precipitation events, is highly variable in time (Beck et al., 2015) and intermittency is a core characteristic"

34. Line 400: Correlation is not calculated in the analysis, thus, how its statistical significance is deduced?

Response: Sorry for my language bugs. We revised the expression with the findings in Section 4.1 “This paper investigated the time scales of precipitation with 12-H data and found 3-run precipitation events contributed the most precipitation but with lower frequency. The study area was mainly characterized with short duration precipitation events and events greater than 10 runs occurred very rarely.”

35. Line 452: Again, correlations are not calculated between any of the parameters. Please calculate correlations and then discuss on the findings.

Response: Sorry for the inappropriate words. We revised it as:

“Flood risk shows signs of increasing as elevation rises in the northern river-lake plain area and the Jitai Basin in the midstream area while risk in the southern hilly area were the opposite, decreasing with elevation.”

36. Conclusions: This section should be re-written after a thorough revision of the manuscript. Most importantly, the take home message for the end users is totally missing from the conclusions.

Response: Thanks. We revised this part as:

“In this study we investigated the frequency and contributions of precipitation events using sub-daily records in meteorological stations in the Ganjiang river basin; identified their changes and time scales using gamma distribution and M-K test; and explored the definition, thresholds of extreme precipitation events and the flooding risk. We further spatially mapped flood risk across the entire study area and analysed the distribution characteristics. Based on the analyses presented in this study, the following conclusions can be drawn:

(1) For frequency and contributions, it was found events of 1 to 4 runs occurred most commonly and events of 1-10 runs contributed the most to total precipitation. Frequency of events ≤4 runs accounted for as high as 83.5% of the total events. Events greater than 10 runs only accounted for 1.4% of the total. Cumulative contributions of events with 1-10 run counted for 92.6% while events greater than 10 runs counted for only 7.4%. 3-run precipitation events contributed the most precipitation but with lower frequency and would be key events for flood

monitoring.

(2) The gamma parameters analysis shows that extreme precipitations have the characteristics of high intensity and occasional occurrence in summer in all the station. In summer, the shape parameter α is ⩽0.1 and the scale parameters β is the highest. The highest β values indicate that stations in mountainous area and the transition areas from mountains to plains such as Ningdu, Longnan Nanchang, Zhangshu and Yongfeng are characterized with high-intensity precipitation in spring. Suichuan, Yongfeng, Ningdu and Longnan often have high-intensity precipitation in autumn. Temporal trends analysis of α and β shows the intensity and occasional probability of precipitation events will increase in spring in the future in Yifeng, Zhangshu and Ningdu, which will in turn increase the risk of storm floods.

(3) Flood risk shows signs of increasing as elevation increases in the northern river-lake plain area and the Jitai Basin in the midstream area while risk in the southern hilly area were the opposite, decreasing with elevation. Elevation and weather systems such as medium-to-low--level shear lines, low-level jet, the southward route of typhoons are the key disaster-pregnant factors for flood risk management"

Minor comments

1. Title: The name of the studied area is wrong or misspelled.

Response: Sorry for the error. We corrected it in the revised paper.

2. The citations in the text do not follow the proper format.

Response: Thanks. We checked and corrected them again.

3. Figures: All have too small fonts and very low resolution/quality, and they need to be redrawn.

Response: Thanks for your kind advice. We redrew Figure 1, 3, 4, and enlarged the fonts and the quality.

4. Line 23-24: The citation is not valid.

Response: It is from a website from Baidu. We remove it in the revised paper.

5. Line 50: CMIP5 is not one model. If they used one model, please mention it otherwise rephrase.

Response: Thanks. We revised it as: “CMIP5 data”

6. Lines 53-54: Check syntax

Response: Thanks. We checked it and revised the sentence as:

“Extreme precipitation can be defined in a variety of ways. Pendergrass thinks that extreme events can be considered if precipitation falls more than those which are often appreciated”

7. Line 123: What means “is the major inflows”?

Response: Sorry for the language, it is main stream

8. Line 134: Which flood is considered “big”?

Response: Thanks. We deleted “big” in the revised paper.

9. Line 165: Hurricanes are hazards not impacts.

Response: Thanks. We revised it as:

“EOT is characterized by physical expected hazards, such as floods or hurricanes.”

10. Line 209-210: Reference is needed.

Respones: Thanks. We added the reference (Kliche et al., 2008) in the revised paper.

11. Lines 331-332: If the names of these rivers are mentioned on the map, then they are not readable, thus, you should increase the fonts along with the quality of the map.

Respones: Thanks. Yes. The two rivers are in the map. We enlarged the fonts in Figure 1 in the revised pictures.

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