Reply to revision suggestions and comments from Referee #2

Anonymous Referee #2

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The manuscript by Hu et al. investigates changes of flood disasters in China using statistical disasters data and also hourly rainfall data at 2420 stations during 19842007. The spatiotemporal pattern of rainstorm-related flood disasters was analyzed with respect to trends. They also use GeoDetector method to analyze the driving factors behind flood disasters and the trend during 1984-2007. The work is original and is conducted a systematic way by assessing the trend of the flood disasters in both temporal and special characters. It gets some interesting results but it looks more like a report of flood disaster. The investigation on the driving factors of flood disaster is a bit weak and lacks a more scientific and theoretical method. I have some comments listed below. Further, I highlight some typos and possible inaccuracies. I hope my suggestions can help the authors to further improve the paper.

Reply: Thank you for your insightful review and professional suggestion. Besides, your positive comments on our work and your generous kindness will be taken as the great encouragements for us to push our work forward. Actually, we did quantitative analysis between flood disaster and relevant driving factors. Here I briefly introduced Geodetector. At first, spatial stratified heterogeneity (SSH) refers to the phenomena that within strata are more similar than between strata, such as well known landuse types and climate zones and those yet to be known, is ubiquitous in universe. As a set of information or patterns, *SSH has been a window for humans to recognize the nature and to understand its mechanisms behind since Aristotle time*. Geographical detector (or simply GeoDetector) used in this current study is a novel tool to identify SSH and to attribute the spatial patterns: (1) measure and find SSH of a variable Y; (2) *test the association between two variables Y and X*, according to the coupling between their *spatial distributions*, without assumption of linearity; and (3) *investigate interaction between two explanatory variables X1 and X2 to a response variable Y*, without any specific form such as assumed product in econometrics. Therefore, we used *novel quantitative analysis* method in our current study.

Specific comments: L 148-150: "this current study is theoretically and scientifically significant in development of human knowledge of flood disasters in a changing environment at regional and global scales ": the study did some

analysis on the spatial distribution of flood disasters and its trend during 1984-2017, but I can't see much from the work which is "theoretically significant in development of the knowledge of flood disasters in a changing environment : : :".

In general, the study lacks a more scientific and theoretical method to investigate the driving factors of flood disasters. Some part of the results is missing a clarification on "why is it".

Reply: Thank you for your insightful review, professional suggestion and your rigorous scientific attitude. We have to clarify that we used the GeoDetector in our current study and this method is just a quantitative analysis method and was widely used in attribution analysis from spatial pattern perspective. The list of the references introducing and/or using GeoDetector is as follows for your reference. Thank you for your professional comments.

Wang, J., Hu, Y.: Environmental health risk detection with GeogDetector. Environ Modell Softw., 33, 114-115, 2012.

Onozuka, D., Hagihara, A.: Extreme temperature and out-of-hospital cardiac arrest in Japan: A nationwide, retrospective, observational study. Sci Total Environ., 575, 258-264, 2017.

Li, X., Xie, Y., Wang, J., Christakos, G., Si, J., Zhao, H., Ding, Y., Li, J.: Influence of planting patterns on fluoroquinolone residues in the soil of an intensive vegetable cultivation area in northern China. Sci Total Environ., 458, 63-69, 2013.

L 218 and L 235: h denotes the band width in equation 1 and is the stratum in equation 2. Do those 'h' represent the same thing? If not, should avoid use the same label in the manuscript.

Reply: Thank you for your insightful review, professional suggestion and your rigorous scientific attitude. Based on your kind suggestion, the h in Equ. (2) was changed to w to avoid potential misunderstanding. Thank you so much for your kindness.

Fig 3: First, the watershed division is missing in the subfigures on the left side pane. Second, the subfigures in the right pane are not clear. It will be appreciate that authors add a table to clarify those numbers of missing rate.

Reply: Thank you for your insightful review, professional suggestion. It is done based on your suggestion, i.e.

improvement of the figures you pointed out here and also a new table was added as Table 1.

L 256-279: A table will be appreciated for the station numbers with respect to the change trend during L 256 -279.

Reply: Thank you for your insightful review, professional suggestion. It is done based on your suggestion.

L264: "rainfall duration" is firstly mentioned here in the paper and this term used as an important index in analysis, which needs a clear definition in the manuscript.

Reply: Thank you for your insightful review, professional suggestion. It is done based on your suggestion.

L266-270: "When it comes to spatial pattern of trends in rainfall duration, lengthening rainfall duration was found mainly in southern China and in the lower Yellow River basin, and in the Huai River basin as well. Shortening rainfall duration was observed mainly in the lower Yangtze River basin and northeastern China." : It would be great that authors can add a bit explanation on why it is?

Reply: Thank you for your insightful review, professional suggestion. While, in this current study, we focused on changes of flood disasters in both space and time, and precipitation extremes are taken as one of the driving factors. Investigation of physical mechanisms behind precipitation changes is not the major objective of this current study. Besides, we did this analysis in our previous researches and some are listed here for your reference:
Qiang Zhang, Vijay P. Singh, Jianfeng Li, Xiaohong Chen, 2011. Analysis of the periods of maximum consecutive wet days in China. Journal of Geophysical Research, Vol. 116, D23106, doi: 10.1029/2011JD016088.
Qiang Zhang, Vijay P. Singh, Juntai Peng, Yongqin David Chen, Jianfeng Li, 2012. Spatial-temporal changes of precipitation structure across the Pearl River basin, China. Journal of Hydrology, 440-441, 113-122.
Qiang Zhang, Jianfeng Li, Vijay P. Singh, Chong-Yu Xu, Yungang Bai, 2012. Changing structure of the precipitation process during 1960-2005 in the Xinjiang, China. Theoretical and Applied Climatology, 110(1-2), 229-244.
Here we would like to ask you for your kind understanding and also the major objective of our current study you are reviewing. Thank you so much for your generous kindness.

L283: "We used a range of spatial interpolation methods in spatial interpolation analysis : : :" : can remove the first "spatial".

Reply: Thank you for your insightful review, professional suggestion. It is done based on your suggestion.

L283: "(figures now shown here)"? where are the figures? Or do you mean "not shown here"?

Reply: Thank you for your insightful review, professional suggestion. Your professionally right. It is "not shown here". It was modified in the main text. Many thanks for your kindness.

L293-298: "While, shrunk regions with less rainstorm amount were found in northwestern China during 1991-2000. Meanwhile, regions with larger rainstorm amount during 1991-2000 were found mainly in the middle and lower Yangtze River basin and also in the Pearl River basin. However, regions with larger rainstorm amount during 2001-2007 were found mainly in the Pearl River basin. These results may imply amplification of droughts across China over the time with higher drought risks" I don't understand what the authors try to interpret in this part. It is not clear. Do you mean the "shrunk region with less rainstorm amount" and "larger rainstorm amount in some river basin" imply 'droughts" or "higher drought risk" in China? I don't agree with it.

Reply: Thank you for your insightful review, professional suggestion. You are right. We deleted this part to avoid potential misunderstanding because we only concern flood disaster but not drought. Thank you so much for your professional suggestions.

L302-305: What do you mean here? "shrinking region with longer duration" imply "higher intense precipitation"? I think "longer rainstorm duration together with higher intense precipitation at the same region" will imply "higher probability of flood or flood disaster". Actually, it would be interest to overlay the plots from the left side pane and the plots from the right side pane in the figure 5. Find out the regions/counties where have both "increase of cumulative rainfall" and "shortening rainstorm duration", those regions/counties could have the "higher probability of flood disaster".

Reply: Thank you for your insightful review, professional suggestion. You are right. We further checked the results and the results we published in JGR in 2011. Based on these results and also your suggestions, we modified the sentence you pointed out here. The reference we cited was:

Zhang, Q., V.P. Singh, J. Li, X. Chen.: Analysis of the periods of maximum consecutive wet days in China. Journal of Geophysical Research, 116, D23106, doi: 10.1029/2011JD016088, 2011.

L328-331: There is a repeat sentence. Please remove "It can be seen from Fig. 7 that Three time intervals with higher flood frequency were analyzed to calculate the annual average frequency, mortality (per million people), the flood-affected rate (%) and the economic loss per capita (unit: RMB converted into 2007 price) (Figs. 7, 8)"

Reply: Thank you for your insightful review, professional suggestion. It is done based on your suggestion.

L334: "While, higher flood frequency during 1991-2000 was significantly higher than that during 1984-1990." In the whole China? In northeastern China?

Reply: Thank you for your insightful review, professional suggestion. It is done based on your suggestion. It is "In northeastern and southeastern China". Thank you for your careful review.

L 334-339: "While, higher flood frequency during 1991-2000 was significantly higher than that during 1984-1990" : : : "Comparatively, reduced flood frequency can be found in northern and northeastern China during 1991-2000 when compared to that during 1984-1990". It seems a bit contradictory.

Reply: Thank you for your insightful review, professional suggestion. It is done based on your suggestion and our further check of the results by removing "Comparatively, reduced flood frequency can be found in northern and northeastern China during 1991-2000 when compared to that during 1984-1990".

L339-341: Can authors clarify a bit on why there is a larger flood frequency during 1991-2000 than 1984-1990?

Is the dam impact included in the data for the flood frequency analysis? There were certainly more dam regulation after 90th than before in China.

Reply: Thank you for your insightful review, professional suggestion. This result is reasonable and similar was observed in the Pearl River basin. During 1991-2000, there occurred many huge flood such as 1998 flood. Besides, here we referred to flood disasters but not flood processes. Of course, there are close relations between flood events and flood disasters. Here I show you the results we published in HESS for flood disasters in the Pearl River basin, which may further corroborate the results by our current study.
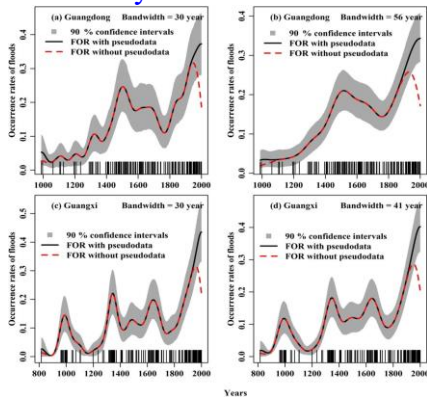
Temporal variations of frequency of flood hazards during the past 1000 years in Guangdong and Guangxi provinces (the Pearl River basin).
Due to statistical analysis of flood disasters within slightly different areas, the curves for flood disaster changes are a little bit different.

L364: remove "(: : :)"

Reply: Thank you for your insightful review, professional suggestion. It is done based on your suggestion

L390: This is still a part of results instead of discussion.

Reply: Thank you for your insightful review, professional suggestion. It is done. We just want to use this results to draw out valuable discussion. Many thanks for your kind suggestion.

Fig 9: "duration of counties"? Please rewrite the caption. Also it would be nice to add the watershed division in the figure.

Reply: Thank you for your insightful review, professional suggestion. New figure was done and this one was deleted from the figures. Thank you so much for your professional suggestion and thoughtful help.

Fig 10: What do the labels mean, for example, ELE, SLP, etc. The figure should be read as stand alone.

Reply: Thank you for your insightful review, professional suggestion. Meanings of these labels were added in the caption. I totally agree with you that the figure should be read as stand alone. Thank you so much for your generous kindness.

Your professional suggestions and your insightful review greatly help to improve the quality of our manuscript. Thank you again for your hard work, your valuable time and your patience in reviewing our manuscript.