Dear Editor,

Thank you so much for handling our manuscript, and the reviewers for their comments and suggestions. We have made a major revision of the manuscript, addressing all of the concerns raised by the reviewers. We have submitted the revised manuscript on to the editorial system. Below are our responses to the comments by the reviewers, with the original comments in **blue** and the responses in **black**.

If you have any questions and other instructions, please let me know.

Best regards,

Guoyu Ren

Response to reviewer 1

Reviewer 1: comment 1

The Introduction is too long and has no focus. This section should write based on the first words in Abstract. Some paragraphs are not related to the topic of this paper, and some could be moved to the Discussion. For example, the sixth paragraph just give some results of previous studies, and has no meaning. The second to the last paragraph should be put in the front of the Introduction. Generally, this part should be organized based on the logic of your Abstract.

Author: response to comment 1

Thank you for pointing this out. In the revised manuscript, we reduced the contents of the entire introduction section. We streamlined lines 46-48 and 76-92 of the original manuscript, which is located in the 45-47 and 74-76 line of the revised manuscript, respectively, and moved some contents related to the results of previous studies to the discussion section in the version of our revised manuscript, as you suggested (the factors influencing extreme droughts and floods in the Hanjiang River basin were discussed). Furthermore, we have deleted lines 93-106 from the original manuscript.

Reviewer 1: comment 2

Line 145-146: how do you get this result, it is from previous studies or you're your own analysis? I suggest the authors to give some analysis of extreme droughts and floods based on the instrumental data. It is important to support your results obtained from historical records, especially when you make comparisons between your series with ENSO events. Is there significant relationship between instrumental extreme events and ENSO events?

Author: response to comment 2

Thank you for this comment, and apology for the lack of clarity. In the revised version, we added citations for this conclusion as follows: *"Since the 1990s, the HRB has been experiencing continuous drought, severely impact the ecological environment, the rational allocation of water resources, and water supply in the basin (Chen et al., 2006; Wang and Guo, 2010; Yin et al., 2015)."* This increased sentance is located in the 120-122 line in the revised manuscript.

Furthermore, in the revised manuscript, we calculated and plotted the precipitation anomaly percentages from May to September in the Hanjiang River basin since 1951, applying the instrumental data, and then compared with the drought and flood rating spacing maps in this period to verify the applicability of the procedure used in this study. The results showed that the correlations between precipitation data and the drought and flood grades passed the significance test of 0.01. The applicability of the procedure was also confirmed in previous studies (Wang and Zhao, 1979; Fang et al., 2014). This change is located in the 236-241 line in the revised manuscript (Figure 3).

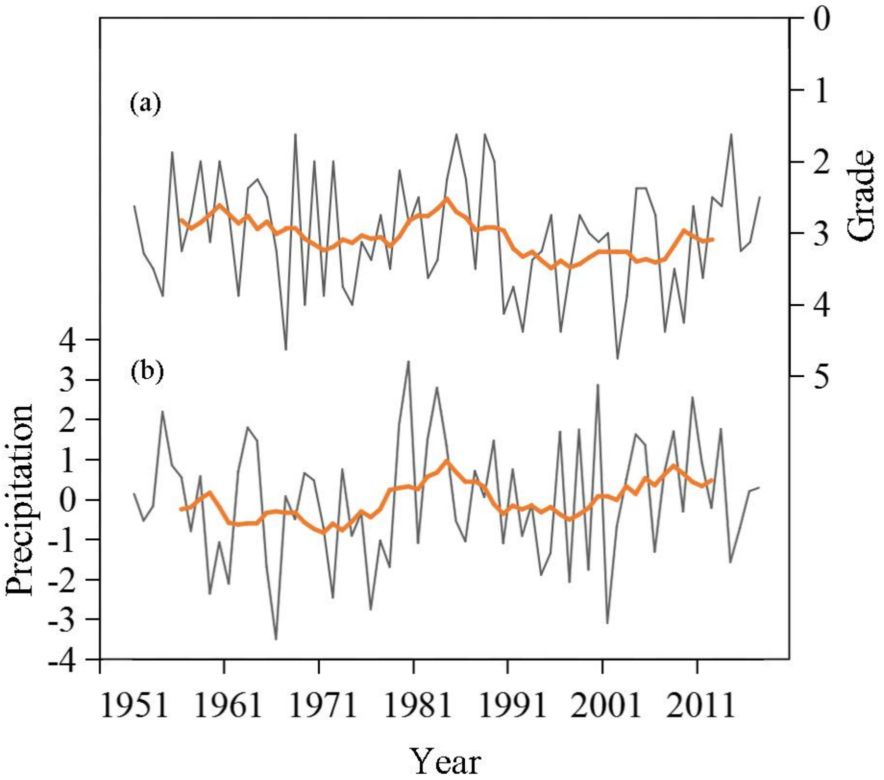

Figure 3: A comparison of drought and flood grades (a) and precipitation anomaly percentage (b) in the HRB during 1951-2017.

However, because another reviewer indicated that the arguments in section 3.2 on ENSO and volcanoes are not very convincing, so in the revised manuscript, we moved this section to the discussion section and discussed them only as possible influential factors without performing a specific analysis. Due to the length limit of this manuscript, we will not provide a specific analysis of the relationship between extreme drought/flood events and ENSO during the instrumental measurement period, so that we can focus more on the in-depth analysis of historical change in reconstructed extreme drought/flood events. Meanwhile, the previous studies on changes of precipitation in instrumental period and their association with ENSO (e.g., Zhu, 1934; Niu et al., 2004; Hao et al., 2008; Wang et al., 2020; Su, 1981; Yin et al., 2015; Ye and Zhao, 1995; Huang et al., 1999; Lu, 2002; Liu and Ding, 1995) have been cited in discussing the possible influence of ENSO on extreme drought/flood events on inter-annual to decadal scales in the basin in the discussion section.

Reviewer 1: comment 3

Figure 2: from this figure, it is obvious that drought and flood records in early periods are fewer than recent periods, and this may result from the fewer documents in early periods. Do you consider some correction method or give different weight for different periods?

Author: response to comment 3:

Thank you for this comment. We explained the method to address this issue in the revised manuscript, lines 216-231. The contents are as follows:

"*On this basis, the homogeneity test of the number of available data at 95% confidence level was performed to determine whether there was systematic bias in the available records. It was revealed that there was a significant abrupt change in the number of records in 1812, indicating a significant increase in the number of local records and archival materials in the 1810s. Furthermore, after 1951, with the construction and development of the modern meteorological observation network, the number of meteorological observation stations in the HRB increased significantly, and precipitation observation began to enter the period of instrumental measurement, which represents a radical change in data category. Therefore, 1812 and 1951 were regarded as the time nodes of discontinuity in the temporal distribution of the data, respectively. The whole period of 1426-2017 were thus divided into three time stagess: 1426-1812, 1813-1950, and 1951-2017. The eight sites' average recording rates during these three time periods were 61.11%, 91.28% and 100%, respectively (Figure 2). The key to this method is a phased evaluation approach, which constructs a platform for comparison between historical periods, and historical and instrumental data. That is, because of the nature of "concerning only disasters but not normal conditions" in the historical documents (Zheng et al., 2014), the average recording rates suggest that a significant proportion of drought and flood events were recorded in the HRB from 1426-1950. Even in the period when the average rate of data recording at a single site was lowest (42.6% of the Ankang during 1426-1812), it was greater than 20% and therefore still met the needs of the study*".

In addition, we added a discussion of the limitations of this method in the discussion section, in the 525-530 line of the revised manuscript. The increased contents are as follows:

"*Secondly, the method of dividing time points according to the number of historical period materials also suffers from the unavoidable uncertainty of using proxy data for reconstruction work. In this study, the uncertainties are mainly in the subjective description of historical information, which is unavoidable in grading. Because historical materials include a variety of information, there are complex relationships between different carriers and different records, which may lead to subjectivity and ambiguity. This cannot be avoided entirely even if we do not base the grading on the linguistic descriptions of historical materials alone when selecting the available historical materials (Yang and Han, 2014).*"

Reviewer 1: comment 4

Section 3.2.2: this section is difficult to read. It is better to give a table presenting the corresponding ENSO and droughts/floods events in history. ENSO is a complicated phenomenon, and its interaction with Asia monsoon is also complicated, the discussion in this part is too simple.

Reviewer 1: comment 5

Line 445-448: "However, the correlation between extreme droughts/floods and large volcanic eruptions are not significant in the other eras.", Why? Are there any other factors influencing the extreme droughts/floods? Why the large volcanic eruptions influence extremes at the 1430s-1450s and 1640s-1660s? I think the authors should carefully consider this section, you can not compare for the sake of compare.

Author: response to comment 4&5

Thank you for the comments. After considering your and another expert's comments on section 3.2, we decided to move this section to the discussion section and replace section 3.2 with an analysis of the spatial distribution of extreme droughts and floods in the Hanjiang River basin. We also added some words in the discussion section to analyze the relationship between extreme droughts/floods in the Hanjiang River basin and decadal to multi-decadal variability of East Asian summer monsoon.

Response to reviewer 2

Reviewer 2: comment 1

Hanjiang River is one of the most important tributaries of the Yangtze River and the basin is well-known for its geographical attribute and cultural heritage in history. This paper thus presents the merit to study the important topic building flood and drought chronologies for the region. Given so, there were already several previous studies researching extreme flood and drought in the region. Although the authors declared that those papers were proxy-based, low-resolution, focusing on upper stream or short time period (line 121-124), to my knowledge, this was not totally true because Chinese scholars have utilized historical documents to study the extreme events and their socioeconomic impacts (e.g. Yin et al. 2015, Ren et al. 2013). It's a pity that the authors did not make further connections with the earlier studies for example to compare the trends and consistencies of the timing and zoning of the extreme events. I therefore urge them to make a comprehensive review and benefits of integrating knowledge from previous and present papers.

Author: response to comment 1

Thank you for this constructive suggestion.

In the revision of the manuscript, we further integrated the earlier research results on climate change in the Hanjiang River basin during the historical period and then compared the results of this study with the earlier researches in terms of the temporal and spatial patterns of the extreme droughts/floods. The cited publications included the follows: Guo et al., 2020; Yin et al., 2010; Yin et al., 2013; Yin and Huang, 2012;Institute of Geography, Chinese Academy of Sciences, 1957; Mao et al., 2016; Peng et al., 2013; Wang et al., 2021; Wang and Guo, 2010; Zhou et al., 2014; Zhou et al., 2016; Chen et al., 2006; Ankang City Local History Compilation Committee, 2004; Department of Geography, Shaanxi Normal University, 1986; Zhang and Yin, 2012.

Reviewer 2: comment 2

Firstly, there are many place names in the paper, and most of the places are not shown on the map (figure 1) so it adds a lot of difficulties to follow and understand where and why the authors are referring to the locations. Also, topography information should be added in Figure 1.

Author: response to comment 2

Thank you for your valuable comment. In the revised version, we added topographic information to Figure 1 and labeled the corresponding names included in each representative site. All place names mentioned in this manuscript are labeled. The modification figure is as follows:

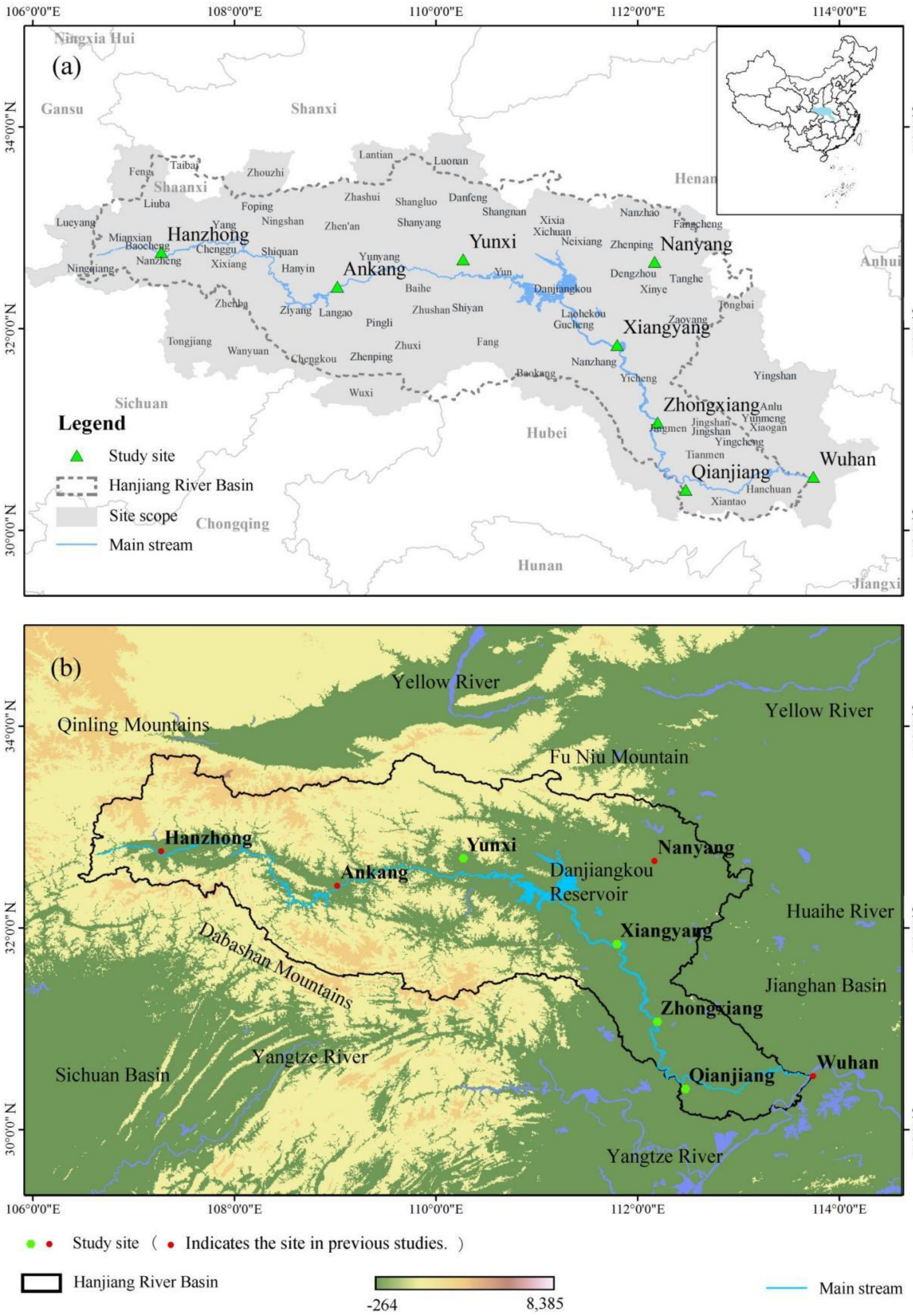

Figure 1: Study area and locations of the eight prefecture capitals used for reconstruction of drought and flood (a, b). Study sites in previous work (Central Meteorological Bureau, 1981) are marked as red points in (b). The inset in (a) indicates the relative location of the study area in China.

Reviewer 2: comment 3

Secondly, method part is unclear. Now the way the authors presented the data and method looks like they were building the flood and drought index series by themselves. But to my knowledge those index series were built by the CMB (1981). So, it's more appropriate and fairer that the authors directly refer to CMB (1981) for the data source (5 geographical sites), and 3 new sites were added by themselves by using the same criteria. CMB sites and new sites can be marked on the map along with the number of records to improve the clarity.

Author: response to comment 3

Thank you for this comment, and apology for the lack of clarity.

The historical data used in this manuscript to reconstruct the historical drought and flood sequences in the Hanjiang River Basin have all been re-collected and re-organized by the authors. Four (the five sites with the same name in the original manuscript were incorrect; they were actually four sites with the same name as the CMB (1981), which have been corrected in the revised manuscript) out of the eight representative sites in the Hanjiang River Basin reconstructed by ourselves have the same site names as the representative sites reconstructed by the CMB, but the historical data and the surrounding administrative areas in each representative site are not the same. In other words, the drought/flood grades of the eight representative sites in this manuscript were reassigned by us, not only adding four more sites to the original four sites of CMB.

In the revised manuscript, we added cited references to sections that could easily lead to confusion and refactored the statements to represent the methods' sources more clearly. Meanwhile, the difference is clarified in the revised manuscript (in the 188-195 and 203-210 line in the revised manuscript). The four representative sites ever assigned by CMB in Figure 1 are also marked (Figure 1).

However, the drought and flood grades in the CMB were identified uniformly from the meteorological data of 120 sites in China, their spatial resolution of drought and flood series is relatively low, so they are only applicable to reflect the spatial distribution characteristics of droughts and floods on a large scale in China and have many limitations for the analysis of small and medium scale scales (Chen, 2020). Therefore, we finally decided not to compare the results of this study with the drought and flood series of the Hanjiang River basin in the CMB. We chose to count the drought and flood grades of North China in the CMB and compared them with the results of this study to verify whether the correlation between drought in the Hanjiang River basin and North China is significant. In the revised manuscript, this section is in the 161-164 and 403-407 line.

Reviewer 2: comment 4

Table 1 needs to be referred to CMB, and also some info needs to be checked: criteria for modern precipitation for the grades is not consistent, is it or ? Also, it needs some explanation of why and is adopted in theory or practice? In addition to historical data, the authors also used instrumental data (lin177-182) but no context were provided to explain the time range used in the analysis and how the two very different types of data, i.e. historical and instrumental, can be merged for analysis.

Author: response to comment 4

Thank you for noting this. We are sorry for the vagueness. In the revised manuscript, we modified this section as follows: "*The instrumental data (started in 1951) comes from the monthly precipitation dataset "China National Ground Meteorological Station Homogenized Precipitation Data Set (V1.0)*". In the revised manuscript, this change is in the 153 line.

The quantitative criteria of the five-grade drought and flood classification method (including historical period and instrumental measurement period) used in this manuscript were determined in the 1970s (Central Meteorological Bureau, 1981). A comparative analysis revealed that the drought and flood grades obtained by this method for the historical period and the types of drought and flood distribution analyzed from the instrumental period data were highly consistent, and therefore fully articulated for analysis (Wang and Zhao, 1979). Meanwhile, because the hierarchical classification method applies to almost all historical climate records, Chinese scholars have widely used it to reconstruct regional climate changes during historical periods (Ge et al, 2016; Wan et al., 2018).

In the revised manuscript, we calculated and plotted the precipitation anomaly percentages from May to September in the Hanjiang River basin since 1951, applying the instrumental data, and then compared them with the drought and flood rating maps in this period to verify the applicability of the procedure used in this study. The results showed that the correlation between precipitation data and the drought and flood grades passed the significance test of 0.01. The applicability of the procedure was also confirmed in previous studies (Wang and Zhao, 1979; Fang et al., 2014). The newly added explanation is in the 236-241 line in the revised manuscript (Figure 3).

Reviewer 2: comment 5

Line 238-250 writes that using Yang and Han (2014) method to evaluate the non-uniformity of the number of records and then 1812 and 1951 were regarded as time nodes of discontinuity. This paragraph seems important but the method and contribution to the study is unclear. This also brings to another point; the authors used a lot of Chinese papers in the reference (some marked with in Chinese, some not). While this can be understandable in the context, it inevitably raises justification issues. It's important that authors review papers from more diversified sources including a rich quantity of paper in English related to monsoon, ENSO, and volcanic forces on climates.

Author: response to comment 5

Thank you for this comment. The methods and explanations used in revised manuscript to delineate the time nodes of the historical period are as follows:

"*On this basis, the homogeneity test of the number of available data at 95% confidence level was performed to determine whether there was systematic bias in the available records. It was revealed that there was a significant abrupt change in the number of records in 1812, indicating a significant increase in the number of local records and archival materials in the 1810s. Furthermore, after 1951, with the construction and development of the modern meteorological observation network, the number of meteorological observation stations in the HRB increased significantly, and precipitation observation began to enter the period of instrumental measurement, which represents a radical change in data category. Therefore, 1812 and 1951 were regarded as the time nodes of discontinuity in the temporal distribution of the data, respectively. The whole period of 1426-2017 were thus divided into three time stagess: 1426-1812, 1813-1950, and 1951-2017. The eight sites' average recording rates during these three time periods were 61.11%, 91.28% and 100%, respectively (Figure 2). The key to this method is a phased evaluation approach, which constructs a platform for comparison between historical periods, and historical and instrumental data. That is, because of the nature of "concerning only disasters but not normal conditions" in the historical documents (Zheng et al., 2014), the average recording rates suggest that a significant proportion of drought and flood events were recorded in the HRB from 1426-1950. Even in the period when the average rate of data recording at a single site was lowest (42.6% of the Ankang during 1426-1812), it was greater than 20% and therefore still met the needs of the study.*" This part is in the 216-231 line in the revised manuscript.

Of course, the method itself suffers from uncertainties that are unavoidable in reconstruction work using surrogate sources. In the study of this manuscript, the uncertainties are mainly in the subjective description of historical information that is unavoidable in grading. Because historical materials include a variety of information, there are complex relationships between different carriers and different records, which leads to subjectivity and ambiguity that cannot be avoided entirely even if we do not base the grading on the linguistic descriptions of historical materials alone when selecting the available historical materials. The limitations of the methodology used in this study further addressed in the method and discussion sections of the revised manuscript. This part is in the 525-530 line in the revised manuscript.

Meanwhile, we also increased the citations of English literature across the board to increase the diversity of literature citations. In the revised manuscript, the newly added English references are as follows: Aiken and Rauscher, 2019; Chen et al., 2012; Fenby and Gergis, 2013; Gao et al., 2017; Krysanova et al., 2008; Liu et al., 2018; Liu et al., 2010; Machado et al., 2011; Mei et al., 2019; Mao et al., 2016; Tan et al., 2018; Vicente-Serrano et al., 2003; Wang et al., 2021; Wang et al., 2020; Wan et al., 2018; Zhou et al., 2016.

Reviewer 2: comment 6

Thirdly, the result part which identifies extreme flood and drought in history is fine, although it would be even better if the authors can compare the results with previous studies in the Hanjiang River watershed instead of comparing to the whole Yangtze River or Northern China.

Author: response to comment 6

Thank you for this helpful comment. In the revised manuscript, we added a comparative analysis of the results of this manuscript with those of previous studies in the Hanjiang River basin. We also added the contents to compare the variation of the HRB to those occurred in the mid- and lower reaches of the Yangtze river and northern China. The increased publications in the revised manuscript include: Wang and Guo, 2010; Chen et al., 2006; Yangtze River Water Resources Commission, 2010; Yin and Huang, 2012; Guo et al., 2020; Yin et al., 2010; Institute of Geography, Chinese Academy of Sciences, 1957.

Reviewer 2: comment 7

Also, many places mentioned in the section are very hard to be understood because of the lack of locational identification on the map.

Author: response to comment7

Thank you for this helpful comment. In the revised manuscript, we added topographic information to Figure 1 and labeled the corresponding area names in each representative site. All place names mentioned in this manuscript are labeled.

Reviewer 2: comment 8

For the section 3.2, I appreciate the authors' endeavor trying to examine the extreme flood and drought trends with other important factors like monsoon index, ENSO and volcanic eruptions. However, I also found the interpretation can be arbitrary and sometimes not convincing. For example, in line 355-360, it says '15th-17th century, the monsoon was generally weak, and extreme drought events were relatively more likely to occurred. And 18th-19th century, the monsoon gradually strengthened, and there were more extreme flood events than extreme drought events.' I couldn't agree with that for Table 1 showing, among all, most importantly only 2 extreme floods in the 18th century and 10 times each for the 16th, 17th, and 19th centuries. The correlations between extreme events and ENSO and volcanic eruption are not robust or statistically significant. Also, it is important to notify that ENSO, monsoon, and volcanic eruption represent multi-annual scale variations, so it can fall into scale mismatch when authors trying to explain the correlations at multi-decadal or centennial scale. Overall, I suggest authors to further clarify the scientific contribution of the paper by improving the data and method section, and comprehensively reframing the results, discussions, conclusion parts.

Author: response to comment 8

Thank you for the comments and suggestions. In the revised version, we made the following changes regarding the influence of monsoon:

"(1) In the 15th-17th century, the monsoon was generally weak, with 24 extreme drought events and 22 extreme flood events occurring in the HRB, and extreme drought events were relatively more likely to occur. (2) In the 18th-19th century, the monsoon gradually strengthened, and there were 6 extreme drought events and 12 extreme flooding events in the HRB. Specifically, there were relatively few extreme events in the 18th century and an increase in extreme events in the 19th century, with 10 extreme floods and 3 extreme droughts in the 19th century, more than 3 times as many extreme floods as extreme droughts. This phenomenon further illustrates the complexity of the mechanisms by which extreme drought and flood events occur. (3) The second half of the 19th century and the 20th century saw a monsoon's significant strength and a marked increase in extreme drought and flood events, with 14 extreme drought events and 21 extreme flood events occurring in the study region. As revealed by other studies (Huang et al., 1999; Lu, 2002; Niu et al., 2004), in the second half of the 20th century, abrupt changes in global atmospheric circulation and an unusual weakening of the summer monsoon led to an increase in extreme drought events, with a total of 8 extreme drought events and 6 extreme flood events. Therefore, extreme droughts and floods in the 20th century have broadly evolved through a process of main floods, followed by a shift from floods to droughts, which is consistent with the results of previous analyses (Ye and Zhao, 1995)." This part is in the 459-472 line in the revised manuscript.

We appreciate your comments and agree with your suggestions about the influence of ENSO and the volcano on extreme droughts/floods occurrence. Because the correlation analysis of extreme droughts and floods with ENSO and volcanoes is performed without de-trending in this manuscript, the relationship with ENSO and volcanoes can also reflect impact of inter-decadal trends at low frequencies (Wilson et al., 2010), but it does have insufficient convincing power. Therefore, in the version of the revised manuscript, we simplified this section and moved these contents to the discussion section (this change is in the 445-510 line in the revised manuscript) and replaced the original section 3.2 with an analysis of the spatial pattern of extreme droughts and floods in the Hanjiang River basin (this part is in the 353-438 line in the revised manuscript), and to supplement some discussions of the relationship between extreme droughts/floods in the Hanjiang River basin and the East Asian summer monsoon in the discussion section. Thus this study focused on the reconstruction of extreme droughts/floods and their temporal and spatial pattern. The analyses of the association of the extreme droughts/floods with influential factors are greatly simplified, and not be summarized in the abstract.

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