Reply on RC2

Xiaodan Zhang et al.

Response to reviewer 2

We greatly appreciate the valuable comments and suggestions. Below are our responses to the comments, with the comments colored in blue, and responses in black:

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or short time period (line 121-124), to my knowledge, this was not totally true because Chinese scholars have utilized historical documents to study the extreme events and their socioeconomic impacts (e.g. Yin et al. 2015, Ren et al. 2013).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 planed revision of the manuscript, we will further integrate the earlier research results on climate change in the Hanjiang River basin during the historical period and then compare the results of this study with the earlier research results in terms of the temporal and spatial patterns of the extreme droughts/floods. The publications will include, but not limited to, the follows: Central Meteorological Bureau, 1981; Ding and Zheng, 2020; Yin and Huang, 2012; Ren et al., 2013; Ren et al., 2014; Zhao et al., 2020; Chen et al., 2006; Yin et al., 2010; Zhao et al., 2009; Gao and Gao, 2010; Su et al., 2006; Xu et al., 2010; Yang et al., 2016; Hao et al., 2019.

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 will add topographic information to Figure 1 and label the corresponding names included in each representative site. All place names covered in this manuscript will be labeled.

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. Five 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 three more sites to the original five sites of CMB. In the revised manuscript, the difference will be clarified, and the five representative sites ever assigned by CMB in Figure 1 will be marked and the comparative analysis of the results of this manuscript and the results of CMB will be added.

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 planed revision, we will clarify these, including mentioning in (line 177-182) the specific time range of the instrumental data (the instrumental data started in 1951).

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; Gong et al., 1983; Zhang, 1983). 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). We will add some sentences like these in the method section of the planed revision to explain the merging method of historical and instrumental data.

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 this manuscript to delineate the time nodes of the historical period are as follows：

The time uniformity of the historical documentary sources within the study period (1426-1950) was first analyzed to determine whether there were systematic deviations in the sources, and the sources were divided into different time phases according to their temporal changes. It was then determined whether the data in each phase met the data documentation rate required for the study (i.e., the ideal frequency criterion of 20% was required for extreme events). 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, the "record only disasters but not normal conditions" character of the historical literature leads us to believe that even the period with the lowest average documentation rate in this study

(42.6% of the Ankang site during 1426-1812) is still sufficient for the study because it reaches greater than 20%.

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 will be further addressed in the method and discussion sections of the revised manuscript. Meanwhile, we will also increase the citations of English literature across the board to increase the diversity of literature citations.

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 will add a comparative analysis of the results of this manuscript with those of previous studies in the Hanjiang River basin. The publications will include, but not limited to, the follows: Central Meteorological Bureau, 1981; Ding and Zheng, 2020; Yin and Huang, 2012; Ren et al., 2013; Ren et al., 2014; Zhao et al., 2020; Chen et al., 2006; Yin et al., 2010; Zhao et al., 2009; Gao and Gao, 2010; Su et al., 2006; Xu et al., 2010; Yang et al., 2016; Hao et al., 2019.

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 planed revision, we will add topographic information to Figure 1 and label the corresponding area names included in each representative site. All place names mentioned in this manuscript will be 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 will make the following changes：

"(1) In the 15th-17th century, the monsoon was generally weak, with 24 extreme drought events and 22 extreme flood events occurring in the Hanjiang River basin, 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 Hanjiang River basin. 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 20 extreme flood events occurring in the Hanjiang River basin. 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 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 (Ren et al., 2014; Ye and Zhao, 1995).”

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 next version of the manuscript, we decided to move these contents to the discussion section and replace section 3.2 with an analysis of the spatial pattern of extreme droughts and floods in the Han River basin, and to supplement some discussions of the relationship between extreme droughts/floods in the Hanjiang River basin and the East Asian summer monsoon in discussion section. Thus this paper will focus 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 will simplified, and will not be summarized in the abstract.

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