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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Spatiotemporal analysis of flash flooding events in mountainous area of China during 1950–2015" *by* Nan Wang et al.

Anonymous Referee #2

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This study uses a very interesting data set about flood event across China for the last 75 years. It analyses spatio-temporal patterns and attempts to link them to rainfall and soil moisture. Although I think that this data set may offer a great opportunty and that the research question is of high importance, the manuscript contains flaws, does not given the information to understand the methods and results and is not written in a concise way.

Major Comments:

(1) Manuscript lacks conciseness: The manuscript is hard to understand as it lacks conciseness. For example, sentences like ". . .Precipitation anomalies and soil moisture were detected to have a close correlation with FFEs, however, the interplay of climatic variations and anthropogenic activities may impose greatly impacts on the occurrence

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and evolution of the flash flooding disasters on a large extent. . .” leave the reader with an uneasy feeling as it is not completely clear what is meant by this sentence and by some of its parts (such as “. . . on a large extent. . .”). On many locations, the reader knows what is meant, but still it is not concise. An example (Line 42): “. . .driven by increasing precipitation and atmospheric circulation. . .”: I assume that it is not increasing atmospheric circulation but changes in the frequency and persistence of flood-related circulation patterns. Another example is Line 77: “. . .including temporal variation, temporal mutation, temporal periodic, and temporal clustering. . .”: Is temporal variation different from the 3 other terms? What is meant by temporal mutation and temporal periodic? The manuscript also contains statements that are not substantiated and may mislead the reader. For example: “. . .Our research has shown that currently there is not strong enough evidence to support whether climate change will do good or harm to the flash flooding disaster in the future. . .” I would rather argue that this manuscript has not addressed this question. There is a large body of literature and very elaborated methods on attributing changes (for example in rainfall or flooding) to climate change. Hence, saying that an important question cannot be answered as there is not enough evidence is inappropriate, when the research has not even attempted to address the attribution question. Another example for unconcise wording: “. . . Besides, the results suggest that the temporal variations were closely related to the climatic variations and anthropogenic activities in China. . .”: Anthropogenic activities are mentioned in a very general way, and the manuscript does not contain any analyses or specific statements about anthropogenic activities. Unfortunately, these are only a few examples.

(2) Manuscript contains a number of errors: An example is the caption of Figure 1: (b) is the trend and not the intra-year series, and (c) is the intra-year distribution and not the inter-year series. Another example: Sections 4.4.1 and 4.4.2 have exactly the same title (Intra-annual clustering), but have different contents.

(3) The English is poor, and often very difficult to understand.

(4) Structure of the manuscript: The discussion chapter takes up a new issue and

introduces additional data (precipitation and soil moisture). I strongly recommend to rearrange the contents such that all data, methods and results are reported in the data, methods and results sections, respectively, and that the discussion section only discusses the findings.

(5) Abstract: The abstract cannot be fully understood since terms are used which can have different meanings, but are not explained.

(6) I am confused by the use of the term “Flash Flooding”. Flash floods are different from river floods. In the introduction, several “flash flood” studies are cited, but these studies actually discuss river floods and not flash floods. First, I thought that the authors had not carefully read the literature they were citing, but later I got very confused as they speak about large watershed (“. . . 133 watersheds, with the watershed area ranged from 0.3 to 60 $\times$104 km2 . . .”). Is this paper about flash floods or river floods? I also propose that they introduce their definition of flash flood events early in the paper.

(7) Selection of Events and FFE database (Section 2.1): The criteria when an event has been counted/documented in the database are not given. The data set needs to be described in detail. For example, has been taken care of the reporting bias? Without a detailed describtion, the reader cannot really interpret the results of the study.

(8) Division into regions (Section 2.2): The justification for dividing the country into these 6 regions is not given. Why these 6 regions? Are 6 regions detailed enough for such a large country?

(9) Description of data is incomplete (Section 2.4): A much more detailed description of the data used is necessary. For instance, how many rainfall stations are available? What is the (grid) resolution of the simulated soil moisture?

(10) Section 2.4: Rainfall data is only available for 1980–2010, but the event FFE analysis is carried out for 1950-2015. What is done for the periods where rainfall data is missing?

(11) Figure 1: It is not clear what Figure 1c shows. What is the meaning of the blue polygone?

(12) Methods: Different methods are used but only for the trend analysis with Sen's slope, the significance is calculated. I feel that it is absolutely necessary to provide significance statements also for the other analyses (reported in 4.1, 4.3, 4.4).

(13) Methods/results: Figure 2 shows "... trend line based on the least-squares linear regression...". This is inconsistent with the Methods Section where it is stated that the trend is estimated by Sen's slope.

(14) Methods/results: The grey, yellow and blue lines seem to decrease to 0 at the end of the time series. I guess that this is not a real decline in the occurrence of floods (then the red line would not increase), but is an artefact of the method/presentation used. This needs to be clarified.

(15) Method (Line 192): The sentence "The statistic results presented an overall agreement between MK testing and Sen's slope estimator..." is unclear (as MK tests the significance and Sen provides the slope of the trend).

(16) Section 4.1 and 4.2: Both sections present trend analyses. Why are there 2 sections with different methods looking at the trend? I rather feel that the reader is confused by these 2 sections (in particular as the section titles are not understandable).

(17) Figure 3: The value of the trend (Sen's slope) should be given in relation to a certain quantity, e.g. X% per decade in relation to average value. Otherwise, these numbers do not give any information. Similarly, I wonder whether the reader can interpret the Z-statistics of the MK test. I would rather report the p-value which is typically used.

(18) Figure 4/Figure 5: The wavelet results look quite different to the many wavelet results I have seen in other studies. I propose to use the setup of the seminal paper on wavelets of Torrence and Compo (1998). Further, one needs to add the cone of

influence to understand where the results are not reliable. In addition, I wonder why 3 wavelet diagrams are shown (Fig. 4, 5a, 5b). Why do they differ?

(19) Wavelet results: I wonder why the annual scale is not prominent. Figure 1c seems to suggest that there is a very strong seasonality in the occurrence of FFEs; then this should show up in the wavelet results. (But maybe I misinterpret Figure 1c, because it is not explained what this figure (blue polygone) means).

(20) Figure 7: I understand that Figure 7 shows a transects at the main periods (10a, 5a) through the wavelet diagram (Figure 4), but I cannot understand at all the explanation of this figure (Lines 233-238).

(21) Methods: Intra-annual clustering (Section 4.4.2): It is not clear what is shown and discussed in Figure 10 and in section 4.4.2. For example, the calculation of D requires selecting the aggregation period T; this information is not given. What exactly is meant by intra-annual clustering? Further, significance of clustering derived by the index of dispersion method is sensitive to the selection of the starting time point of the aggregation window (see Merz et al., 2016). This issue should be considered.

(22) Figure 11 and 12: I assume that 'number of FFEs' means the total number of documented FFEs within each year (from Jan to Dec). This needs to be said. More disturbing is that the x-axis of Figure 11 seems to have wrong labels as the numbers are 2 orders of magnitude smaller than Figure 12.

(23) Figure 13: The text does not contain a hint to and discussion of Figure 13. However, this is necessary, as it is not that obvious from Figure 13 that FFEs occurrence and high positive anomalies match.

Minor Comments:

(24) Line 19: Please relate the growth rate ("... with a growth rate of 23.62 per year...") to the average number per year or give the growth rate in %. Otherwise its relevance cannot be understood.

(25) Line 20, 21: Please specify what is meant by "... large scale...", "... small scale...".

(26) Line 22: The sentence: "... intra-annual frequency distribution of FFEs can be divided into three types, right-skew, left-skew and symmetry;..." cannot be understood; at this point it is not clear what is meant by intra-annual frequency distribution.

(27) Line 23: Again, it is unclear what is meant by "... inter-annual clustering ..." and "... under-dispersions...".

(28) Line 35: "...impacts of global change on climate, severe weather in the form of heavy rainfall and river discharge conditions ...": What exactly is meant here? Are the second and third causes not consequences of the first cause? Or do you mean that surface processes change (independent of the climate)?

(29) Line 39: This sentence is unclear: "...Most previous studies related to the multivariate frequency analysis of extreme events assumed temporal stationarity...." Firstly, I do not understand what is meant by multivariate frequency analysis; secondly, I think that there are many papers meanwhile that have not assumed stationarity.

(30) Line 49: "...However, few studies have been focused on the spatiotemporal changing of flash flooding on the national scale in China...": Please list these studies here.

(31) Line 58: What is meant by "...of the flash flooding intra annual clustering..."?

(32) Line 59: What is meant by "...most probable flash flooding generation processes can therefore assist in the identification of homogeneous regions with a dominant flash flooding season..."?

(33) Line 67: What are "...geomor-regions..."?

(34) Line 127: What exactly is meant by "... Sen's slope is tested by a two-tailed test at α confidence..."? Is this sentence related to the Mann-Kendall test mentioned earlier?

(35) Table 4: Please explain in the caption the meaning of the colours in the table.

(36) Line 337: Please explain the term ‘El Niño Modoki’.

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