

Reply to the review reports

Dear Editor,

Thank you very much for your time and discussion on this manuscript. We also thank the referees very much for their constructive comments. We have revised the manuscript accordingly. The replies are follows:

Referees' comments:

Referee #1:

1. Should the geographical distribution of the raingauges be taken into the consideration?

Reply: The raingauges is sparse in study area due to desert and mountainous, and many observation stations are located at low elevation. missing data is a common problem in alpine. These factors are contributed the trend, So we choise stations which observed data have long-time and missing less.

2. it might be even better to discuss what the indices defined in the paper.

Reply: According to the referee's suggestion, we have reviewed other literature so that descripte the indices clearly so that understand easily to people.

3. The method of averageing some indices may need a bit more explanation.

Reply: In this manuscript, We want to detect the entire region trend used the average indices so that ignore limited within a subregion. According to the referee's suggestion, we have given bit explanation.

4. A small amount of extra revision efforts might be to further substantialise the conclusion.

Reply: According to the referee's suggestion, we have given some discussion due to data scarcity.

Referee #2:

1. The manuscript is very difficult to read because of poor struture and grammar.

Reply: According to the referee's suggestion, we have checked the structure and grammar and revised it.

2. Referee can not see a proper citation of their work.

Reply: Sure, the idea that we used method is derive from the article that Mishra et al(2009) and including the reference in 319 line.

3. *the figure do not have all the information required to easily follw discussion..*

Reply: According to the referee's suggestion, we have change the figure 1 and identity important mountains and basins.

4. *Referee is very interesting the strong correction between mean entropy and PCI and this can be conclusion.*

Reply: Thanks for the referee's suggestion, We have add this to conclusion.

5. *What does "point of trend" mean?*

Reply: Thanks for the referee's comments, "point of trend" may be "change point of trend", it is meaning than trend turned. We have revised the "mutation of trend" so that understand it easily.

6. *What is the added value of having the entropy-based variability if the mean rainfall distribution is already known?*

Reply: Thanks for the referee's comments, the value is calculated using the Eq(2), and interpolated data used kriging.

7. *Referee missed the explanation about how the probabilities for the entropy calculation are extimated. Referee presume that these preobabilities were estimated as the relative frequency of the occurrence of rainfall events in a particular month over the complete set of years. If this correct, then these probabilities are based on binary time series(event /no event) and therefore n=2 in Eq(1). Am I right?*

Reply: Sure, because entropy method is derive from information theory.

8. *In section 3.4 it is stated that a value of PCI<20 indicates significant seasonality in precipitation distrubution and extraordinary monthly variability otherwise. How do the authors come up with this vallue of 20 to define this threshold?*

Reply: Thanks for the referee's comments, the threshold is given by Olive(1980).
Reference:

Oliver J.E. 1980. *Monthly precipitation distribution: a comparative index. The Professional Geographer*, 32(3): 300-309.

9. *I found confuing the use of the variable n in Eq(1), Eq(2) and Eq(3). Form the text, I presume that in Eq(1), n=2=number of occurrence states (event /no event). For Eq(2), n=number of years, and for Eq(3), and forEq(3), n=number of records. If I am correct, I suggest using different variables, if not, a better explanation is needed.*

Reply: you are right, and we have given explanation that used in manuscript.

10. *Table 1 does not include units and its caption is not understandable.*

Reply: Thanks for the referee's comments, the entropy is no unit.

11. *It is not clear what the colour bar scale represents in Fig 1.*

Reply: Thanks for the referee's comments, it represents the elevation of study area.

12. *How Fig 2 was obtained? It seems to be a linear interpolation of the annual mean precipitation of the 54 stations, but this is not explicitly stated, neither its units(mm).*

Reply: Thanks for the referee's comments, it was obtained by using inverse distance weighted.

13. *Figures 5 and 6 make sense only if the station IDs are provided in Fig 1.*

Reply: Yes, only these stations data can be used to analyse.

14. *Figure 9 is presented to discuss the "change point test" but no description is given about what is $u(t)$ and $u'(t)$. Section 3.5 explains only what the dashed horizontal lines are.*

Reply: Thanks for the referee's comments, we have given the explanation in revised manuscript.

14. *Tarim, Turpan and Hami are basin names that are mentioned in the text but there is no map where the reader can see where they are located.*

Reply: Thanks for the referee's comments, we have identified these basins names in Fig 1.

15. *Some authors are listed but not referenced in the text.*

Reply: Thanks for the referee's comments, we have checked the reference and revised.

16. *There are a lot of typos along the manuscript.*

Reply: Thanks for the referee's comments, we have checked the manuscript and revised the typos to improve its quality.

Referee #3:

1. *How the author deal with the missing values in the data sets?*

Reply: Thanks for the referee's comments. Missing data is a common problem in mountainous. The data sets used in manuscript are from 1951, but some stations have missed data, so we chose the data sets from 1961.

2. *there is a need on discussion about how the author deal with the 'uncertainties' occurring due to the change in the bin size for the entropy calculation..*

Reply: The data sets is monthly precipitation, the uncertainties of entropy is due to the uncertainties of precipitation, so we did not discuss the uncertainties.

3. The author should use a kernel-density based for other nonparametric methods for estimating the PDF and therefore the entropies.

Reply: Thanks for the referee's comments. In this manuscript, We want to detect the mutation of trend.

4. Several major discussions resembles to Mishra et al. (2009) published in J Hydrology, however the author did not gave proper credit to their article..

Reply: Sure, the idea that we used method is derive from the article that Mishra et al. (2009) and including the reference in 319 line.

5. Page 2980:Calcutaion of entropy values: It is not clear.

Reply: According to the referee's suggestion, we revised and given explanation.

6.The title of the paper says 'long-term', however the length of data is less than 50 years, the title is needs to be changed..

Reply: Thanks for the referee's comments, the series is nearly 50 years, only few station records started 1951. So we think the series is long-term for the study areas. But We change the title as "Analysis of precipitation variability based on entropy over Xinjiang nearly 50 years, northwestern China".

Yours sincerely,

Chuan-cheng Zhao