

Interactive comment on “An analyses of long-term precipitation variability based on entropy over Xinjiang, northwestern China” by C. Zhao et al.

Anonymous Referee #2

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General Comments

The paper addresses a very important topic for water resources management which is the analysis of the spatial variability of precipitation over monthly, seasonal and annual timescales in the region of Xinjiang. The use of Information Theory concepts to perform this analysis is of scientific interest.

Unfortunately, I find the paper very difficult to read, mainly because of poor structure and grammar. For this reason, it is not so clear to me what the authors want to show. In principle the paper is about using entropy for analysing variability of rainfall. However, the paper discusses also, without a clear structure, topics such as "precipitation concentration index", and a "change point analysis" without a proper explanation of how

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they relate with the entropy approach. In particular, Section 2 - Materials and Methods is not well structured, since the description of the case study and the data is followed by formulations of entropy, entropy-based variability, precipitation concentration index and change point analysis, without a clear line of reasoning. Section 2.7 explains how entropy is used, but it does not say how the other formulations complement / support the use of entropy.

Additionally, I feel that the authors try to replicate a part of what Mishra et al (2009) developed, using a different case study. However, I cannot see a proper citation of their work. For instance, the "Entropy-based variability" they introduce happens to be exactly the same introduced by Mishra et al (2009), but it has no reference. If this is the case, the authors should state explicitly that the originality of the manuscript relies on data and not on methods.

The discussion about the annual, seasonal and monthly variability is interesting. Unfortunately, the figures do not have all the information required to easily follow such discussion. For example, the Tianshan Mountains and Altai Mountains are frequently mentioned, but a map is not provided. Also, the discussion can lead to more elaborated conclusions.

Regarding the conclusions, the first one states that the annual rainfall distribution depends on topography, which is something we can expect. Besides, the authors do not provide a figure of the topography of the region, so this conclusion cannot be verified by the reader. Conclusions 2 - 4 can be interesting for local weather agencies but do not answer specific scientific questions. Conclusion 5 states that significant trend changes occurred in the 1980s but the authors do not explain what can be the reasons for these changes. I find very interesting the strong correlation between mean entropy and PCI in Fig 8. With a bit of elaboration this can become another conclusion provided a good description on how probabilities were assessed.

Specific comments

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1. What does "point of trend" mean?
2. It is somewhat clear what the problem is, but it is not clear how the authors want to solve it. What is the added value of having the entropy-based variability (Fig. 3) if the mean rainfall distribution (Fig. 2) is already known? It seems to be that the first conclusion can be drawn from Fig. 1 alone.
3. I missed the explanation about how the probabilities for the entropy calculation are estimated. I presume that these probabilities were estimated as the relative frequency of the occurrence of rainfall events in a particular month over the complete set of years. If this is correct, then these probabilities are based on binary time series (event / no event) and therefore $n=2$ in Eq (1). Am I right?
4. In section 3.4 it is stated that a value of $PCI < 20$ indicates significant seasonality in precipitation distribution and extraordinary monthly variability otherwise. How do the authors come up with this value of 20 to define this threshold?
5. No units for entropy quantities are included. Eq (1) to Eq (4) are entropy-related quantities calculated with logarithms in base 2, so their units are bits.
6. I found confusing the use of the variable n in Eq (1), Eq (2) and Eq (3). From 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), n =number of records. If I am correct, I suggest using different variables. If not, a better explanation is needed.
7. Table 1 does not include units and its caption is not understandable.
8. It is not clear what the colour bar scale represents in Fig 1.
9. 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).
10. The second and third graphs of Figure 4 do not add any value to the discussion, since they show exactly the same as the entropy map in Fig 3. Why the authors decided

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to break it down into lat, long, elevation? If it was to show the correlation between DI and latitude, this is evident from Fig 3.

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

12. 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.

13. 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.

14. Some authors are listed but not referenced in the text. For instance: Daly, C. Smith, L. C., Turcotte, D. L., and Isacks, B. L.

15. There are a lot of typos along the manuscript, some of them are: page 2976, line 7: kendall (Kendall) page 2980, line 2: accurrence (occurrence?) page 2980, line 9: baed (based) page 2987, line 20: Luis or Luìs (as in the text)? page 2988, line 21: Oliver or Olive (as in the text)? Caption of Fig. 3 baed (based) Caption of Fig. 8 prcipitation (precipitation)

Reference

Mishra, A. K., Ozger, M., and Singh, V. P. (2009). An entropy-based investigation into the variability of precipitation, *J. Hydrol.*, 370(1–4), 139–154.

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