

Dear reviewers and editors:

Thank you very much for the suggestive comments. We reply to them one by one as follows and modify our manuscript. These comments have significantly enhanced the scientific rigor of the manuscript. Black text is reviewer's comments and blue text is the reply.

Best wishes,

The authors

(1) The introduction lacks a clear articulation of the core research question, specifically the rationale for investigating the relationship between duration and frequency. This should be supplemented.

REPLY: Thanks a lot for the suggestion. We have added more information about the articulation of the core research question in section 1(Line 45-51).

(2) While the paper focuses primarily on establishing statistical relationships, the physical mechanisms underlying the double-logarithmic relationship remain insufficiently explained. Does this relationship reflect certain characteristics of scale invariance or self-organized criticality?

REPLY: This study utilized more refined daily indices to investigate the nonlinear characteristics during drought persistence processes, revealing a double-logarithmic linear relationship. Furthermore, through research on all China stations, we demonstrated the spatial universality of this nonlinear feature. This indicates that the double-logarithmic linear relationship exhibits certain self-organization characteristics on daily-scale drought events. In section 4, we expanded the discussion on this aspect.

(3) Regarding the results, the lowest R^2 values (<0.4) observed in Kashgar, Xinjiang—could this be attributed to sparse station coverage or particular climatic characteristics of the region?

REPLY: The spatial values of R^2 in the northwest region are significantly smaller than those in the southeast region, with the core reason being the prolonged duration

and low frequency of droughts in arid zones, resulting in a low sample size for individual drought events. This is particularly evident in Xinjiang's Kashgar region. Notably, such stations are rare, and there are 98.31% stations with the value of R^2 exceeding 0.6.

(4) In section 3, it states that “ the occurrence frequency of droughts in humid and semi-humid regions is much higher than that in arid and semi-arid regions ” (line155) which appears counterintuitive (as one might expect more frequent droughts in arid regions). Clarification is requested.

REPLY: This conclusion is highly intriguing. In conventional theories, more frequent droughts are observed in arid regions. In fact, when considering shorter time scales, short-duration droughts are more frequently detected, characterized by brief duration and high frequency. Consequently, from a frequency distribution perspective, they appear more pronounced.

(5) This study points out that the nonlinear relationship is present in the drought duration and the frequency. I am wondering whether this nonlinear relationship is time-dependent? This is, the nonlinear relationship exhibit interannual or interdecadal variability? In addition, whether the nonlinear characteristic of the relationship between the drought duration and the frequency could be quantified by some indices, such as the Lyapunov exponent (References are listed below) or other methods? Please clarify and give some discussion.

Reference:

Li, X., et al., 2020: Quantitative comparison of predictabilities of warm and cold events using the backward nonlinear local Lyapunov exponent method.

Li X., et al., 2023: Estimating the local predictability of heatwaves in south China using the backward nonlinear local Lyapunov exponent method.

Li X., et al., 2026: Investigating the predictability limit and forecast error dynamics of summer air temperatures over East Asia using the ensemble forecast dataset from ECMWF.

REPLY: Indeed, an intriguing question arises as to whether the nonlinear relationship between drought duration and frequency exhibits temporal stability or

evolves over longer time scales. However, robust statistical characterization of drought frequency necessitates sufficient sample sizes; consequently, shortening the observation period inevitably compromises the significance of identified patterns. Future investigations may benefit from extended observational sequences or paleoclimate reconstructions to elucidate long-term variations in this nonlinear relationship. Notably, complementary nonlinear indices — such as those capturing drought intensity dynamics or compound event characteristics — could collectively advance our understanding of these evolving patterns. We have expanded our discussion of this research frontier in Section 4 (Discussions), and more introduction about the exploration of nonlinear research in section 1(Introduction).

Additional minor issues:

- (1) Figure 9 caption: “Severe drought (a)” should be “(b)”;
- (2) Figure 10 caption: the "2" in "R2" should be formatted as a superscript (R^2);
- (3) “Extraordinary drought” is recommended to be changed to “extreme drought”.

REPLY: All above mistakes have been modified.