

## Comments to the Authors

Review of “Nonlinear Quantitative Relationship Between the Duration and Occurrence Frequency of Droughts” by Yan et al., submitted to *Nonlinear Process in Geophysics*.

The study addresses the nonlinear quantitative relationship between the duration and the frequency of droughts. The authors analyzed the daily meteorological drought composite index (MCI) data, and found that shorter drought durations were associated with higher occurrence frequencies, while longer durations corresponded to lower frequencies. In addition, the authors pointed out that the parameter  $k$  aligned well with precipitation isolines, which could effectively distinguish arid, semi-arid, and humid regions.

The paper is interesting and well written, and provides critical insights for optimizing water resource management, agricultural planning, and disaster mitigation strategies. However, some revisions are needed for this work. It can be recommended to publish after the following issues have been well responded. Detailed comments are below.

(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.

(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?

(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?

(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"(line 155) which appears counterintuitive (as one might expect more frequent droughts in arid regions). Clarification is requested.

(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.*

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”.