

**Review: “GTDI: a gaming integrated drought index implying hazard causing and bearing impacts changing” by Zhao et al.**

**RC6: 'Comment on nhess-2024-45', Anonymous Referee #1**

We would like to express our gratitude for your valuable comments and suggestions. In response to your Major suggestion #4, we have further supplemented its corresponding modification example to improve our response to your suggestion.

**Major suggestion:**

4. The conclusion section could be more concise, focusing on the key findings and their implications.

**Answer 4:** Thank you for highlighting shortcomings in our manuscript. We will proceed as suggested and further condense the conclusion section to highlight the main findings and points. For example:

*“This study integrated the SPEI (meteorological index and drought hazard-causing index) and SSMI (agricultural index and drought hazard-bearing index) to propose a game theory-based drought index (GTDI). The integration performance and weight allocation of the GTDI were demonstrated by evaluating the correlations with SPEI and SSMI, and comparing the integrated weight to the ETDI (entropy theory-based drought index); the reliability of the GTDI was confirmed by the Leaf Area Index (LAI) data; and the advancedness of the GTDI was examined by contrasting the temporal trajectories and spatial evolution characteristics of GTDI, SPEI, and SSMI. The following are the primary conclusions:*

*The single-type drought indices (SPEI and SSMI) and the integrated drought index (GTDI) exhibit dependable spatial consistency. The entropy theory-based drought index ETDI performs worse than the GTDI, particularly when it comes to the regional distribution of correlation coefficient homogeneity. Specially, the game theory technique provides an integrated weight geographic distribution in the integrated index GTDI that is consistent with the precipitation-dominated natural drought pattern, as there is a strong negative spatial relationship between the weight ratio of SPEI to SSMI and the average annual precipitation in the Wei River Basin. The ETDI, on the other hand, has a very weak connection with the annual mean precipitation. This indicates that the GTDI's weight distribution of SPEI and SSMI is more logical and trustworthy.*

*The GTDI has superior efficacy for identifying drought when compared to the ETDI, SPEI, and SSMI, as the GTDI efficiently captures drought with an efficacy ratio of over 70% in all validation months, whereas the ETDI, SPEI, and SSMI catch it with an efficacy ratio of approximately 50%. Thus, GTDI is expected to replace single-type drought indices to provide a more accurate portrayal of actual drought.*

*The GTDI merges SPEI and SSMI via their game relationship rather than simply putting them together, making it a superior technique to represent the spatial and temporal evolution of droughts. Specially, it has a higher overlap with SSMI in drought trajectory, implying changes in the hazard-bearing body during the dry period, while being closer to SPEI in drought seasonal allocation, responding to the fluctuation of hazard-causing factors.*

*Additionally, it has been discovered that GTDI exhibits the gaming feature of the drought hazard-causing and bearing index, having a distinct benefit in monitoring changes in their impacts. The hazard-causing index SPEI dominates the early stages of a drought event, whereas the hazard-bearing index SSMI dominates the later stages.”*

We express our gratitude for your valuable input, and we assure you that all of your comments and concerns will be carefully considered and incorporated into the revised manuscript.