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Reply on RC1

Huimin Wang et al.

Author comment on "Development of a novel daily-scale compound dry and hot index and its application across non-arid regions of China" by Huimin Wang et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-217-AC1, 2022

We express our great appreciation for your constructive comments on improving the manuscript. We will revise our manuscript according to your comments. The answers to your concerns are as follows:

(1) There are so many indices for characterizing compound hot and dry events, such as Hao et al., 2019 and Wu et al. (2021). The authors claimed that these previous indices cannot monitor short-term events. Absolutely, monitoring the compounding events at a daily scale is important. Numerous studies have explored the extreme heat events by using daily indices, such as wet-bulb temperature and lethal heat stress index. The most challenge is to characterize the drought in a daily scale and then transform to the compounding events. This study used the existing drought indices by only changing the input from monthly to a daily scale. I am not persuasive that this is a great novelty in hydrological community. The authors should fully clarify this issue.

Response:

Thanks for your comments. Yes, there are some indices in monitoring daily heat events. Therefore, we changed the sentence to 'these previous indices cannot monitor short-term compound dry and hot events. In addition, we will add some sentences about daily heat events indices (e.g., wet-bulb temperature and lethal heat stress index). We agree that the most challenge is to characterize the drought on a daily scale and then transform it into compound dry and hot events.

In the current study, we first extended the monthly SZI to a daily scale and then combined it with daily STI to monitor short-term compound dry and hot events. Although SZI is an existing drought index with good performance in drought monitoring across different climatic regions, we don't know whether it can monitor short-term drought events, which occur more frequently in recent years due to climate change. Therefore, we should develop the daily SZI and verify its applicability.

Li et al. (2021) developed a short-term compound dry and hot events by combing SPEI and STI. We agree that SPEI is also a commonly used drought index, however, some studies (Ayantobo et al. 2020; Zhang et al. 2015, 2019, 2021) have reported that it always overestimates drought, especially across non-humid

regions. The SPEI measures climatic water balance anomalies by incorporating the difference between precipitation (P; available water supply) and potential evapotranspiration (PET; atmospheric water demand). While PET is a good indicator for characterizing climate aridity, using it as a measure of atmospheric water demand for drought analysis leads to misrepresentation of droughts, especially over water-limited (non-humid) regions where the actual evapotranspiration is primarily dominated by water availability rather than energy (or PET) (Zhang et al., 2019). Compared to SPEI, SZI, using climatically appropriate precipitation for existing conditions as the atmospheric water demand metric, is physically more reasonable in reflecting surface water-energy balance over both humid and non-humid regions and can monitor different types of droughts in different climatic regions (Ayantobo et al. 2020; Zhang et al. 2015, 2019, 2021).

In addition, we will extend our research regions from non-arid regions of China to the whole regions of China and verify the applicability of daily SZI in drought monitoring across different climatic regions of China by comparing correlation distributions of SPEI-SM and 1 (Figs. R1 and R2).

Fig. R1 Correlations for SPEI-SM and SZI-SM at 3- and 6-month scales across China (Supplement Figure R1)

Figure R2 Boxplots of correlations for SPEI-SM and SZI-SM at 3- and 6-month scales at seven climatic regions of China (Supplement Figure R2)

(2) The authors claimed that they calculated the Standardized Temperature Index (STI) following the SPI estimation procedures. They fit the daily temperature data by using a normal distribution function; the normal assumption is OK. As the precipitation (temperature) in different months have large variations, the SPI (and STI) should be fitted in each month. Unfortunately, the authors fail to consider such seasonal variations in the present work.

Response: Actually, we calculated daily SZI and STI considering seasonal variations by fitting the daily WSD and temperature using log-logistic and normal distribution functions. For SZI, the daily difference (WSD) between precipitation and climatically appropriate precipitation was calculated, and then the daily WSD was fitted to the log-logistic distribution function for each calendar day. For example, the WSD of January 1st for all years was extracted and fitted to the log-logistic distribution, and the cumulative probability (P) was obtained and transformed to SZI. And we obtained SZI values for all calendar days with the same procedure. Finally, we rearranged these SZI values according to time orders and obtained daily SZI time series.

(3) The main methods in this study (e.g., both using WSD, root-zone soil moisture, STI, copula, run theory, and the same study region) is very similar with Li et al. (2021). The main differences may be just the input data, i.e., from sub-monthly to daily data. These issue should be fully clarified.

Response: In the current study, we first extended the monthly SZI to a daily scale and then combined it with daily STI to monitor short-term compound dry and hot events. Although SZI is an existing drought index with good performance in drought monitoring across different climatic regions, we don't know whether it can monitor short-term drought events, which occur more frequently in recent years due to climate change. Therefore, we should develop the daily SZI and verify its applicability.

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and STI. We agree that SPEI is also a commonly used drought index, however, some studies (Ayantobo et al. 2020; Zhang et al. 2015, 2019, 2021) have reported that it always overestimates drought, especially across non-humid regions. The SPEI measures climatic water balance anomalies by incorporating the difference between precipitation (P; available water supply) and potential evapotranspiration (PET; atmospheric water demand). While PET is a good indicator for characterizing climate aridity, using it as a measure of atmospheric water demand for drought analysis leads to misrepresentation of droughts, especially over water-limited (non-humid) regions where the actual evapotranspiration is primarily dominated by water availability rather than energy (or PET) (Zhang et al., 2019). Compared to SPEI, SZI, using climatically appropriate precipitation for existing conditions as the atmospheric water demand metric, is physically more reasonable in reflecting surface water-energy balance over both humid and non-humid regions and can monitor different types of droughts in different climatic regions (Ayantobo et al. 2020; Zhang et al. 2015, 2019, 2021).
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We will revise the manuscript according to your all comments (including minor comments), and ask native speakers to polish the language.

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10.1016/j.ejrh.2021.100898, 2021.

Please also note the supplement to this comment:
https://hess.copernicus.org/preprints/hess-2022-217/hess-2022-217-AC1-supplement.pdf