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Reply on RC2

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Author comment on "Hydrological Drought across Peninsular Malaysia: Implication of Drought Index" by Hasrul Hazman Hasan et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2021-249-AC4, 2021

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The origin of hydrological droughts is usually a climatic drought, but the quantification of hydrological droughts as an independent phenomenon has also received much attention in the scientific community. This is because there is usually no direct spatial or temporal relationship between climate and hydrological droughts (Vidal et al. 2010). Moreover, the analysis of hydrological droughts allows for a direct quantification of deficits in usable water sources.

However, a reduction in flows during high flow periods can have negative impacts on natural systems adapted to a specific flow regime. For example, the unusually low flows during high flow duration can reduce the storage of downstream reservoirs and affect the availability of water resources for certain uses a few months later. For these reasons, in addition to using low-flow analysis through run theory (see reviews in Smakhtin 2001; Tallaksen and Van Lanen 2004), it would be beneficial to develop a standardised hydrological drought indicator that would allow comparisons of drought severity over time and space, including in catchments with different characteristics in terms of regime, flow variability and magnitude. Such an indicator could be calculated using the same theoretical approach as the climatic drought indices.

In contrast to climatic drought, the quantification of hydrological drought is usually not based on indices but on the theory of runs. These indices have the same theoretical background, as they derive the hydrological drought index by converting monthly streamflow into z-scores. The problem with this approach is that the selection of the most appropriate probability distribution for calculating the index and the impact of the selection on the final series have not been thoroughly tested.

River flow tends to have greater spatial variability than the climate variables used to derive drought indicators. This is due to the influence of a number of factors, including topography, lithology, vegetation and human management. It is also a consequence of the spatial aggregation of runoff, which alters the statistical properties of the series downstream (Mudelsee 2007). Therefore, there is a high degree of spatial variability in the probability distributions that best fit the monthly streamflow data, making it difficult to select the most appropriate distribution for calculating a drought index for a large area.

To further corrected paper will investigate the statistical properties of observed samples of hydrological variables, the relationship between the sampling uncertainty resulting from limited observed flow series and the corresponding sample size based on the bootstrap method. By reconstructing a large number of bootstrap samples from the original flow series, the effects of different data lengths on the estimation of the parameters of PDF and SDI for Peninsular Malaysia were analysed.

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