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Reply on RC2

Hasrul Hazman Hasan et al.

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-AC1>, 2021

Comment on nhess-2021-249

Anonymous Referee #2

The manuscript investigates drought conditions on the Peninsula Malaysia in between 1978 and 2018 based on monthly discharge data in 42 stations. The manuscript is well organized, even if it requires additional effort to improve the structure of the writing; it mainly presents a case study regional application, which might be improved. Indeed, the innovative contribution to the literature appears to be weak; the Authors should better motivate their work and describe how they are contributing in terms of new methods. Some specific comments follow; I hope that they will be useful for manuscript improvement.

The structure of the text needs some additional efforts from the Authors; specifically, in the Introduction Section there are many repetitions that can be avoided and the arguments presentation should be easier to follow.

L 170-172. I understand that the availability of discharge data is a positive, not so frequent condition. I was wondering if the use of rainfall data together with discharge data might provide a deeper analysis of drought condition with respect of using only the discharge data. I expected a comment on this from the Authors.

L 175, 279-282. The motivation to investigate different temporal resolution appears to be weak; I suppose that different temporal resolution could be of interest depending on the characteristic temporal scale of the storage/supply system. Since this is the main motivation of the proposed work, apart from analyzing the drought condition in Peninsula Malaysia, I believe that the Authors should better explain this issue and justify their choices.

L 476-477. The conclusion that the 3-months SDI better describes the variability of the process in time is almost expected, and does not depend on the results of the analysis.

Response: We thank the reviewers for their time and suggestions, which helped to improve the manuscript.

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.