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Hydrology and Earth System Sciences
Discussions



# *Interactive comment on* "Spatial and temporal Trend Analysis of Long Term rainfall records in data-poor catchments with missing data, a case study of Lower Shire floodplain in Malawi for the Period 1953–2010" *by* Rabee Rustum et al.

**Anonymous Referee #3**

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This paper shows a trend analysis of some rainfall time series in Malawi. As detailed below, it is my opinion that: 1) The assumptions made and the analyses performed by the Authors are questionable: many of the points made by the Authors have already been thoroughly discussed and questioned in the literature. 2) The paper seems indeed to suffer from a poor literature review: the Authors should demonstrate to the HESS readership how their research fits into the larger field of study. 3) The Authors make strong claims that may well be incorrect and theoretically ungrounded. Consequently, my recommendation to the Editor is to reject this paper. If the Authors wish



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to resubmit, I think the amount of required changes goes well beyond a major revision, hence my recommendation of rejection. In the following, I give further details on my major concerns. a) Data gaps are ubiquitous in hydrological time series, and filling these values remains a challenge. The Authors should investigate the influence of their gap filling method on their analysis and provide cautionary remarks for maximal gap allowance. This is especially so for the paper case study, where “several records are missing” (see paper p. 7). b) Hydrological data are commonly characterized by temporal dependence. All trend tests involving the iid hypothesis (such as the Mann-Kendall test used in the paper) should be corrected for the effect of autocorrelation. Neglecting this aspect usually leads to contradictory results further discussed by Khaliq et al. (2009), Bayazit (2015), Serinaldi and Kilsby (2016), Serinaldi et al. (2018) and Tyralis et al. (2018). c) The Authors use the Mann-Kendall test to detect monotonic trends in the observational data, and then quantify their magnitude by the so-called Sen’s method, which assumes a linear trend. However, this is not justified. The Mann-Kendall test (MK) refers to monotonic changes that can be either linear or nonlinear. Reducing the indication of possible monotonic trends given by MK to that of a linear trend is too restrictive and somewhat arbitrary, and does not reflect the rationale and outcome of MK test (Serinaldi et al., 2018). d) Based on the Authors’ claims (see the paper introduction), a trend of true interest (which also is the focus of the largest part of hydro-meteorological literature on the topic) is related to a form of nonstationarity. However, handling (or even detecting) nonstationarity merely from data may be difficult, if not impossible. I endorse herein the following statement by Koutsoyiannis and Montanari (2015): “To establish a deterministic function of time, as required in order to claim nonstationarity, we need at least both of the following conditions to hold: (a) deductive reasoning in order to establish the deterministic function of time; (b) validation of the deterministic function by data which were not used in the model construction”. Hence, testing trends on observed time series can easily be inconclusive and/or misleading because of the intrinsic difficulty, if not impossibility, of detecting nonstationarity (of a process) solely from data without exogenous information (Serinaldi et al., 2018). e)





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Based on the considerations above, the following statement in the paper conclusions (p. 9) is misleading and theoretically ungrounded: “Thus, coherent and significant increases in rainfall was observed over wet seasons with obvious decreases found over dry seasons. The cause of these changes, requires further investigation to establish a linkage between climate variability and observed trends”. As a trend is a systematic change reflecting a time-dependent process, the mathematical rule describing the evolution of this change should be established a priori (see e.g., Poppick et al., 2017).

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