Modified version of the cross-correlation function to measure drought occurrence time-delay correlation

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ABSTRACT

According to the importance of assessing the presence of time delay between the occurrence of various hydrological and meteorological phenomena, the study aim is to introduce a new method (with high ability and non-sensitivity to the abnormality of datasets and the existence of outliers) for determining the time delay in mentioned data series. In this research, a new measure to detect the time delay between two stationary time series (Non-Parametric Cross-Correlation Function or NCCF, called Spearman's CCF or SCCF) is introduced, which has very low sensitivity to abnormality of data series and also the existence of outliers in the data series. The numerical studies verify the ability of the proposed measure. In standard uniform and exponential (with mean 1) time series, at 100% of numerical analyses and in standard Gaussian time series at more than 60% of numerical studies, the ability of SCCF was more than the CCF. The applicability of the proposed measure in practice was also studied using the Reconnaissance Drought Index (RDI) data series of 20 stations over Iran during 1967–2019 in 1, 3, and 12-month time scales. The results of the practical study also proved the appropriate performance of the proposed model in all time scales.

Key words: cross-correlation, drought, non-parametric, stationary, time-delay, time series

HIGHLIGHTS

- A modified version of the cross-correlation function was presented.
- Output of this research is a new measure to detect the time delay between two stationary time series.
- In this research, data series of 20 stations with various climate conditions was used.
- The results are usable in better understanding the behavior of climatic parameters (especially drought).