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Instationarity in runoff distributions

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Instationarities in runoff time series are ubiquitous. However, simple trend analyses are often obscured by the presence of long-term correlations, and some instationarities are not simply changes in the mean or periodicities. Thus, wherever feasible, instationarities should be based on the full frequency distribution, or the cumulative distribution function (cdf), of the series. In this paper, we investigate the time-dependence of the empirical cdfs of 97 runoff datasets from the upper Danube basin applying a new pairwise test statistic, KSSUM, based on integrated differences of the cdfs. This is an improvement to the Kolmogorov-Smirnov (KS) test and was applied on different time scales, i.e. windows of varying size. If desired, the influence of drifts in the mean as well as heteroscedasticity can be excluded via z-transformations. The resulting time series of the KSSUM variable, either within a runoff series for different windows, or across series for the same period, is then subjected to the detection of spatiotemporal patterns with different methods. For most of the time series the underlying distributions move towards higher values in the long run. We also observed a periodic drift in the mean across all analysed gauges. It is furthermore possible to separate exceedingly variable runoff series from those with intermediate or small changes in value distribution on a regional basis, and thus to separate overall trends from local deviations at individual gauges. It is demonstrated that KSSUM is a sensitive method to investigate instationarities in sets of time series based on pairwise comparisons. An extension to a proper multivariate comparison is a possible further development.