Identifying trends in hydrological data: using integrated indicators to identify non-stationary behaviour

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We present a method to detect changes in the mean and variance of hydrological time series. This enables multiple change points to be identified, assigns a significance level to each, and provides a detailed description of how changes in the time series are manifested. This approach has the following useful characteristics:

(1) Unlike conventional parametric tests, the method is independent of temporal context (i.e. starting or finishing point);
(2) The technique is highly sensitive and vastly increases our ability to detect trends compared with non-parametric (i.e. Mann-Kendall) and parametric (i.e. conventional time series analysis) techniques;
(3) Where change points or trends are identified, these can be traced to particular forms of driver (i.e. continuous, or discrete) and the time at which these drivers operated.

We also show how the method can be used to explore fundamental process drivers of non-stationary behaviour in hydrologic time series, and the ways in which these may be transferred into improved model structures or water resource decision-support tools.