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Do dam constructions in a Vietnamese river basin result in change points in hydrologic regime and how reliable are different methods?

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The damming of rivers causes one of the most considerable impacts of our society on the riverine environment. More than 50% of the world's streams and rivers are currently impounded by dams before reaching the oceans. The construction of dams is of high importance in developing and emerging countries, i.e. for power generation and water storage. In the Vietnamese Vu Gia – Thu Bon Catchment (10,350 km^2), about 23 dams were built during the last decades and store approximately 2,156 billion m^3 of water. The water impoundment in 10 dams in upstream regions amounts to 17 % of the annual discharge volume. It is expected that impacts from these dams have altered the natural flow regime. However, up to now it is unclear how the flow regime was altered. For this, it needs to be investigated at what point in time these changes became significant and detectable. Many approaches exist to detect changes in stationary or consistency of hydrological records using statistical analysis of time series for the pre- and post-dam period.

The objective of this study is to reliably detect and assess hydrologic shifts occurring in the discharge regime of an anthropogenically influenced river basin, mainly affected by the construction of dams.

To achieve this, we applied nine available change-point tests to detect change in mean, variance and median on the daily and annual discharge records at two main gauges of the basin. The tests yield conflicting results: The majority of tests found abrupt changes that coincide with the damming-period, while others did not. To interpret how significant the changes in discharge regime are, and to which different properties of the time series each test responded, we calculated **I**ndicators of **H**ydrologic **A**lteration (IHAs) for the time period before and after the detected change points. From the results, we can deduce, that the change point tests are influenced in different levels by different indicator groups (magnitude, duration, frequency, etc) and that within the indicator groups, some indicators are more sensitive than others. For instance, extreme low-flow, especially 7- and, 30-day minima and mean minimum low flow, as well as the variability of monthly flow are highly-sensitive to most detected change points.

Our study clearly shows that, the detected change points depend on which test is chosen. For an objective assessment of change points, it is therefore necessary to explain the change points by calculating differences in IHAs. This analysis can be used to assess which change point method reacts to which type of hydrological change and, more importantly, it can be used to rank the change points according to their overall impact on the discharge regime. This leads to an improved evaluation of hydrologic change-points caused by anthropogenic impacts.

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