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Quantifying state dependent change in a paired catchment experiment

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We develop and test a new approach for the assessment of hydrological effects of land-use change based on a non-parametric direct mapping of rainfall-runoff relationships. Reference periods, characterized by sufficiently long record and quasi-stationary conditions, are partitioned into similar predictor configurations using a regression tree algorithm. As predictors we use linear combinations of the variables characterizing the climatic forcing, and, in the paired catchment setting, also the response of the 'control' to help condition for climate variability. Non-parametric tests on a statistic characterizing the response in each partition are constructed by re-sampling entire years from the reference periods and assessing whether the responses in 'test' periods are within the confidence intervals for the reference periods. The presented methodology allows the modelling of complex nonlinear relationships with a minimal set of assumptions, a reduction of interference in model estimation, and the emulation of a complex error structure. The proposed method is applied on the HJ Andrews Experimental Forest Watershed by using 45 years of data for WS1 (treatment) and WS2 (control). Results show highly significant increase in flow immediately after clear-cut, with highest relative effects on low flows and highest absolute effects on medium and high flows. About 15 years later, below median discharges return to pre-treatment levels, while flows above the median are still significantly higher than the pre-treatment period.