



Comparison of stationary and non-stationary frequency models for assessing design discharges in variable climate: north-west England case study

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Successive occurrence of floods across north-west England over the course of the past few years has resulted in the need for the local authorities and decision makers to (re-) assess several flood management schemes. However, ongoing decision-making on how flood control measures are constructed, is frequently still made on the basis of the assumption that the flood characteristics of catchments have remained constant over time (i.e., stationarity). To verify the validity of this assumptions, non-parametric tests alongside change-permitting flood frequency frameworks based on Generalized Logistic distribution model (as the recommended model in the UK catchments) have been applied to a dataset of extreme peak river flow measurements across the region (39 catchments with up to 75 years of records). Allowing the location parameter of the model to change linearly with time, cumulative annual rainfall and cumulative annual temperature as covariates, one stationary as well as six non-stationary models have been introduced. The regional non-stationary frequency results indicate a notable improvement over the stationary predictions, estimating design flood quantiles (i.e., 100-year events) up to 75% larger than classic stationary estimates. Moreover, the vast majority of rivers demonstrate statistically significant changes (mainly driven by cumulative annual rainfall), specifically in the late 1990s. This indicates that non-stationary models should be taken into consideration, along with the traditional stationary ones to help understanding the changes in the peak river flow regimes across the north-west England.