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Efficiency of model selection criteria in flood frequency analysis

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The estimation of high flood quantiles requires the extrapolation of the probability distributions far beyond the usual sample length, involving high estimation uncertainties. The choice of the probability law, traditionally based on the hypothesis testing, is critical to this point.
In this study the efficiency of different model selection criteria, seldom applied in flood frequency analysis, is investigated. The efficiency of each criterion in identifying the probability distribution of the hydrological extremes is evaluated by numerical simulations for different parent distributions, coefficients of variation and skewness, and sample sizes.
The compared model selection procedures are the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), the Anderson Darling Criterion (ADC) recently discussed by Di Baldassarre et al. (2008) and Sample Quantile Criterion (SQC), recently proposed by the authors (Calenda et al., 2009).
The SQC is based on the principle of maximising the probability density of the elements of the sample that are considered relevant to the problem, and takes into account both the accuracy and the uncertainty of the estimate. Since the stress is mainly on extreme events, the SQC involves upper-tail probabilities, where the effect of the model assumption is more critical. The proposed index is equal to the sum of logarithms of the inverse of the sample probability density of the observed quantiles. The definition of this index is based on the principle that the more centred is the sample value in respect to its density distribution (accuracy of the estimate) and the less spread is this distribution (uncertainty of the estimate), the greater is the probability density of the sample quantile. Thus, lower values of the index indicate a better performance of the distribution law. This criterion can operate the selection of the optimum distribution among competing probability models that are estimated using different samples. The need to select an optimum distribution among various models, calibrated using different samples, was prompted by the complex behaviour observed in flood samples, that can be ascribed to different identifiable processes contributing to the generation of the data series.

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