Hydrological modeling of streamflow approaching the new Hintze Ribeiro bridge

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Abstract

The present work aims to provide reliable estimates of extreme discharge flows and their probability of occurrence. Such estimates are important for the assessment of the associated hydrological risk of hydraulic infrastructures, such as bridges and dams, in the design process as well as during their operations. The hydrological modeling herein developed was applied to estimate the design floods approaching the new Hintze Ribeiro bridge, in the north of Portugal. It proposes a statistical analysis of the maximum annual streamflow data by using a flood frequency analysis technique. The data series were subject to a reliability analysis and the specific modeling assumptions, required for the study, were appropriately given and tested. An extrapolation technique of the missing instantaneous discharge data was herein derived. Such technique was validated by two distinct methods. The estimations are accurate with a mean deviation of 7.2% relative to the observed data. A set of probabilistic models were considered and the models' performance verified by the goodness-of-fit tests and Q-Q plots. The model and the parameter uncertainties were taken into account. Model uncertainties were addressed by comparing the estimated design floods through selecting the best fitting probability model (MS) with the approach that considered the distribution functions which fit well the data (MM). On the other hand, the computed flow rates were estimated with 95% of confidence to reduce the inherent parameter uncertainties. An additional accuracy assessment of the parametric approaches was performed through a comparative analysis of such design floods with the ones retrieved by application of the non-parametric Kernel density estimate (KDE). The MM approach showed a lower discrepancy (18.5%) to KDE estimates, when compared with the MS results. A sensitivity analysis of the associated hydrological risks was also undertaken.

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