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Stochastic Flood Frequency Analysis Using the SCHADEX Method in Slovakia

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Methods for derived flood frequency analysis often use a stochastic weather generator to derive a continuous rainfall runoff model in order to simulate long series of artificial flows. Time series of synthetic precipitations generated by a weather generator should have the same statistical properties than an observed time series. This is true if the weather generator is properly set up which is not an easy task. The rainfall-runoff modelling in mountainous regions also requires a time series of temperatures to simulate snow melting processes, which must be generated alongside the precipitations. A French method SCHADEX avoids these problems and is the only one combining the advantages of continuous rainfall-runoff modelling and event-based synthetic precipitations. This work presents results of the application of the SCHADEX probabilistic method for extreme flood estimation. SCHADEX has been developed at Electricité de France (EDF) for dam spillway design. The method uses a continuous rainfall-runoff model for simulation of catchment responses to synthetic precipitation events generated by a stochastic rainfall model. The rainfall model utilizes a Multi-Exponential Weather Pattern (MEWP) distribution to account for both seasonal variation and the type of weather pattern. The application of the SCHADEX method is illustrated with the example of the River Hron at Banská Bystrica (1768 km2). The daily (from 1981 to 2010) and hourly (from 1988 to 2002) datasets were used to estimate 24 and 1 hour floods with various return periods. The uncertainty of the whole methodology has been assessed by using 100 various hydrological models, where parameters of each model were obtained by using different period for model calibration. The hydrological models were then used to simulate synthetic rainfall events generated by the same stochastic rainfall model. As expected the variation of the estimated floods was substantial especially in the high return periods. The difference between minimum and maximum estimated flood spread from 80 m3/s (from 166 to 232 m3/s) for a 10-year flood to as much as 600 m3/s (from 644 to 1391 m3/s) for a 10000-year flood. Despite of this uncertainty the SCHADEX method gives better results than traditionally used flood estimation methods used in Slovakia which was demonstrated by comparing estimated with reconstructed historical floods.