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Simulating rainfall-runoff dynamics of selected flash flood events in Slovakia using the KLEM hydrological model

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The HYDRATE project (Hydrometeorological Data Resources and Technologies for Effective Flash Flood Forecasting) objective is to improve the scientific basis of flash flood forecasting by extending the understanding of past flash flood events and developing a coherent set of technologies and tools for effective early warning systems. To understand rainfall-runoff processes during selected extreme flash floods occurred in the past in Slovakia, runoff responses during selected major events were examined by using the spatially distributed hydrologic model KLEM (Kinematic Local Excess Model (Borga et al., 2007)). The distributed hydrological model is based on availability of raster information of the landscape topography, the soil and vegetation properties and radar rainfall data. In the model, the SCS-Curve Number procedure is applied on a grid way for the spatially distributed representation of runoff generating processes. For representing runoff routing a description of the drainage system response is used. In Slovakia, 3 extreme events selected from the HYDRATE flash-flood database were simulated by the model. Three selected major flash floods occurred 20th of July 1998 in the Malá Svinka and Dubovický creeks, 24th of July 2001 in the Štrbský Creek (both with more than 1000-years return period) and 19th of June 2004 in the Turniansky Creek (with 100-years return period). Rainfall-runoff characteristics of the floods in the Malá Svinka, Dubovický and Štrbský creek basins were similar and the floods had a similar progress. A value of runoff coefficient varied from 0.39 to 0.56. Opposite to them, the highest runoff coefficient in the Turniansky Creek Basin only reached a value equal to 0.26. The simulated values by the KLEM model were comparable with maximum peaks estimated on the base of post event surveying. The consistency of the estimated and simulated values by the KLEM model was evident both in time and space and the methodology has shown its applicability for practical purposes. It was concluded that for short duration of the storm events temporal variability seems to be less important than the spatial variability.