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Estimation of design floods for ungauged basins in an alpine watershed

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Small tributaries in alpine watersheds are mostly ungauged or data are available only for short observation periods. For a comprehensive flood risk assessment estimates of design flood hydrographs for such basins are required. This case study of the Ill watershed in the Western Austrian Alps presents a methodology for obtaining such estimates by applying a continuous hydrologic model for a larger basin and transferring model parameters from gauged to ungauged subbasins. Statistical extreme value analysis of observed discharges in the Ill catchment provided first approximations of the magnitudes of peak discharges. Implementing a semi-distributed, continuous rainfall-runoff model the watershed of 1300 km^2 was divided into subbasins with areas ranging from 10 to 200 km^2. Then, the subbasins were divided into homogenous hydrological response units (HRU) which were obtained by intersection of elevation bands, soil maps and land use data. For each HRU with a mean area of about 1.6 km^2 an initial set of parameters was estimated. These initial estimates were calibrated and validated based on observed discharge hydrographs of 6 years with continuous daily records and hourly records for 16 flood periods. The calibrated parameters of gauged subbasins were transferred to neighbouring ungauged subbasins and modified according to the size of the catchment area. Moreover the different characteristics of runoff separation into surface flow, interflow and base flow in different altitudes were considered. Subsequently the rainfall-runoff model was applied to simulate flood events. Extreme storm precipitations of various depths and durations provided by a meteorological convective storm event model were used as input. As resulting flood discharges vary considerably depending on the applied storm event features, most appropriate design storm events were selected by comparing simulated peak discharges with the results of

the statistical analysis for gauges with long records. Different initial catchment conditions were chosen from simulated state variables of the calibration and validation flood periods. Uncertainty related with the assignment of model parameters for ungauged basins was assessed by varying the parameters that determine the shape of the hydrograph. This combination of statistical analysis, continuous simulation and event-based methods yields design flood hydrographs for ungauged basins within moderate margins of possible peaks and shapes. The various sources of uncertainty associated with the determination of design floods are displayed and communicated to end users and water resources decisionmakers.