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Development of an integrated and interdisciplinary flood risk assessment instrument: the River Unstrut study

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Modern flood control concepts have to be based on interdisciplinary approaches, i.e. coupling of hydrologic and hydraulic analyses with socio-economic assessment and decision theory to identify the risk. For this purpose, the flood control system of the River Unstrut watershed, located in the mid-eastern part of Germany, with an area of 6343 km2, is evaluated considering multiple objectives. Hydrological loads are generated with a stochastic rainfall generator. These precipitation time series are used as input for a hydrological model. The hydrographs are routed through dams within the watershed by a reservoir model. It has been ascertained that the hydrological loads encompass a broad range of scenarios, with flood events of different recurrence intervals, hydrograph shapes and volumes, providing a scenario space that allows for probabilistic evaluation. These hydrological loads serve as input for a combined 1-D/2-D hydrodynamic model, which allows for accurate determination of inundation areas, flow velocity, stage and flood duration. To evaluate the system, six system states are investigated. First the current state is considered. Next the existing structural flood control system is improved and in the four remaining steps the structural flood control system is extended. For all system states non-structural measures such as variations in polder and dam operation are analyzed. The hydrodynamic model hence provides a set of inundation scenarios, categorized in terms of probability, which forms the

basis of the socio-economic assessment, considering direct and indirect benefits and costs. To integrate the results a decision support system (DSS), based on an activity and object model, was developed. The DSS provides tools for different interactive analyses within a participatory negotiation process. If-then analyses can be used to reduce the set of measures and/or scenarios according to the preferences of the users, e.g. local focus points, administrative units or summer flood events. These tools can contribute to the solution of conflicts between groups with different interests such as upstream/downstream or rural/urban stakeholders. The results for the River Unstrut watershed proved particularly interesting, as the watershed encompasses two states, hence adding political involvement to the “upstream protects downstream” goal of integrated flood management. By means of this new approach it became feasible to determine the level of flood protection ensured for the study watershed for various scenarios, hence providing decision makers with a multi-criteria instrument, including risk assessment.