An integrated hydrological modelling approach for flood forecasting using GIS: An example of Gottleuba Catchment, Saxony, Germany

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Hydrological modelling is a powerful tool for hydrologist and engineers involved in the planning and development of integrated approach for the management of water resources. With the recent advent of computational power and the growing availability of spatial data, it is possible to accurately describe watershed characteristics in particularly when determining runoff response to rainfall input. The main objective of this study is to improve the spatial input parameters which were used to generate a precise hydrological modelling tool. For the spatial database creation, high resolution 2 m laser scanning digital elevation model (DEM), soil map, and land use map were used. Rainfall records were transformed into a runoff through hydrological parameterization of the watershed and the river network for rainfall-runoff simulation. The soil conservation services curve number (SCS-CN) method was selected to calculate the rainfall losses as it relates the precipitation losses to the land use and soil type. Additionally, the effect of soil moisture was taken into consideration during modeling phase. Soil moisture was derived using the BROOK90 model for evaporation, soil water, and stream flow simulation. Finally, the developed integrated hydrological model was applied to the test site of the Gottleuba catchment area which covers approximately 250 km2 in southern Pirna, Saxony, Germany. Model runs were carried out using gridded precipitation data for 10 and 30 years return periods. Further, the model was calibrated and optimized against the observed runoff data, which was measured in the studied area during a storm flood event recorded between the 11th and the 13th of August, 2002. The simulation results showed a reasonable match between the simulated and the observed hydrographs. Quantitatively the paper concluded that based on forecasted meteorological data, the model could be used as a tool for flood forecasting system.