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Development of flood hazard maps by considering future projections of daily streamflows obtained using support vector regression based downscaling approach

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Changes in global climate over the past few decades are having a significant influence on water resources planning and management. One challenging aspect is the predicted changes in flood patterns and associated flood hazards in the future. Identification of areas that are at the greatest risk for flooding in the future is therefore necessary for planning and development of cities and to prevent loss of life and damage to structures. This research focuses on the identification of communities in Ireland at an increased risk of flooding in the future through the use of the Hazus-MH software developed by US Federal Emergency Management Agency. This uses flood hazard mapping techniques to prepare floodplain maps using historical flood data. Hence, this approach may under-represent the risk and exposure to flood-prone communities in the future, as it does not specifically account for future changes in the climate. This study however, uses the Soil and Water Assessment Tool (SWAT) model to obtain future projections of streamflows at several river catchments in Ireland corresponding to different climate change scenarios, which are subsequently used for identification of flood prone areas. SWAT is a physically based, deterministic, continuous, catchment-scale, distributed simulation model that can represent the hydrologic system with sufficient accuracy by considering the spatial variability of model parameters and inputs. The SWAT model subdivides the catchment into smaller sub-basins and utilizes soil and land use data for each of those sub-basins as model inputs. Simulation of future projections of streamflow require future projected values of several meteorological variables including rainfall, temperature, wind speed, relative humidity and solar radiation. Generally, SWAT uses a weather generator to simulate those meteorological variables, which affects the model performance. This study however, has developed a support vector regression (SVR) based downscaling models to obtain future projections of each of the meteorological variables at monthly scale. The downscaling model develops a nonlinear regression relationship between the meteorological variable and a set of predictors, termed large scale atmospheric variables (LSAVs), which were obtained from European reanalysis data. The developed regression relationship were then subsequently used to arrive at future projections using General Circulation Model data. The projected values were then disaggregated to daily scale by using a k-nearest neighbour disaggregation technique, which were subsequently used to obtain the future projections of streamflow. The study indicated changes in flood pattern in several basins in Ireland, which is helpful in performing flood hazard analysis. These predicted changes in flood hazard can be used for better decision making and the development of more incisive water management policies.