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1D HEC-RAS Hydrodynamic Modeling of River Flow Simulation Using DEM Extracted River Cross-Sections - A Case of Sabarmati River, Gujarat, India

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The river cross sections are the main inputs in any type of hydrodynamic modeling to generate river geometry. Field measurement of river cross sections is time-consuming, labors and expensive activity. Availability and accuracy of measured river cross sections in developing countries are scared, therefore it is difficult to simulate the river flow and discharge using a hydrodynamic modeling. In the present study, a methodology is proposed to extract the river cross section from Shuttle Rader Topographic Mission DEM (SRTM DEM) of a 1-arc second (30 m grid interval) and HEC-GeoRAS 10.1 software. A total of 144 cross sections, i.e. at every 300 m interval for entire study reach of 43 km, is prepared using HEC-GeoRAS 10.1. The extracted cross section of Sabarmati river, starting from Chiloda Bridge to Vasana barrage is used to prepare the 1D Geometry in HEC-RAS 5.0.3. To simulate the flow in river geometry, Flood hydrograph of 2006 is considered as an upstream boundary, whereas normal depth at Vasana barrage is considered as a downstream boundary. The flow is simulated under the unsteady flow condition. The model is calibrated for the year of 2006 and validated for the year of 2015. The Manning's roughness coefficient for the past flood event of the year 2006 is selected using a trial-and-error method. The model validation results showed a close agreement between the simulated and observed stage hydrograph. The calibrated values of Manning's n were found to vary within the range of 0.020 and 0.035. Therefore, the present study revealed that extracted cross section from 1 arc SRTM DEM could be applicable in 1D HEC-RAS based hydrodynamic modeling to simulate the stage and discharge hydrographs with considerable accuracy under the scarcity of measured cross-sections data in developing countries.