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DEM based approach for modelling coastal urban floods: A case study

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Abstract

Coastal urban areas are vulnerable to flooding due to high tide and runoff. Modelling and simulation is an important tool for flood assessment. Easy availability of high resolution Digital Elevation Model (DEM) has led to develop simplified or reduced complexity flood models. Literature review indicates DEM based flood models are capable of simulating rain induced flooding in urban areas. In the present study the overland flow is simulated using mass balance approach, channel network flow is simulated using one-dimensional dynamic wave approximation solved using finite element method. The spill over from the channel and its subsequent routing on the adjacent floodplain is simulated using DEM based quasi two-dimensional approach. In this approach DEM serves as a platform to water depths at each time interval using continuity equation and Manning's equation for all pixels in the domain. The developed integrated model has been applied to a coastal urban catchment of Navi Mumbai viz: Airoli which, has steep hilly region on its upstream of channel and is subjected to semi-diurnal tidal variations on the downstream side joining Thane creek. The data pre-processing like generation of overland flow grids, channel details etc., has be carried out in GIS software and forms input to the model. High resolution DEM has been generated from pair of stereo imagery Cartosat-1 (2.5 m pixel resolution) using photogrammetric software. The model has been applied to two non-flooding rainfall events and compared with observed stages and are found to be satisfactory. Subsequently, the model is applied to an extreme event of July 26, 2005 with cumulative rainfall depth of 744 mm occurring over 24 hours. The discharge and stage hydrographs are plotted at certain chainages and the generated flood maps are discussed. Thus, the study has attempted to present an integrated flood model utilizing DEM based approach for flood simulation.

Biography

A T Kulkarni has completed Masters in Water Resources Engineering from IIT Bombay. With four and half years of professional experience he has worked in diverse areas from water and electricity regulation to construction services. At present he is a research fellow for DST sponsored project on integrated flood assessment modelling, at IIT Bombay.