World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:16, No:01, 2022

Application of Hydrological Engineering Centre – River Analysis System (HEC-RAS) to Estuarine Hydraulics

Authors : Julia Zimmerman, Gaurav Savant

Abstract : This study aims to evaluate the efficacy of the U.S. Army Corp of Engineers' River Analysis System (HEC-RAS) application to modeling the hydraulics of estuaries. HEC-RAS has been broadly used for a variety of riverine applications. However, it has not been widely applied to the study of circulation in estuaries. This report details the model development and validation of a combined 1D/2D unsteady flow hydraulic model using HEC-RAS for estuaries and they are associated with tidally influenced rivers. Two estuaries, Galveston Bay and Delaware Bay, were used as case studies. Galveston Bay, a bar-built, vertically mixed estuary, was modeled for the 2005 calendar year. Delaware Bay, a drowned river valley estuary, was modeled from October 22, 2019, to November 5, 2019. Water surface elevation was used to validate both models by comparing simulation results to NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) gauge data. Simulations were run using the Diffusion Wave Equations (DW), the Shallow Water Equations, Eulerian-Lagrangian Method (SWE-ELM), and the Shallow Water Equations Eulerian Method (SWE-EM) and compared for both accuracy and computational resources required. In general, the Diffusion Wave Equations results were found to be comparable to the two Shallow Water equations sets while requiring less computational power. The 1D/2D combined approach was valid for study areas within the 2D flow area, with the 1D flow serving mainly as an inflow boundary condition. Within the Delaware Bay estuary, the HEC-RAS DW model ran in 22 minutes and had an average R^2 value of 0.94 within the 2-D mesh. The Galveston Bay HEC-RAS DW ran in 6 hours and 47 minutes and had an average R^2 value of 0.83 within the 2-D mesh. The longer run time and lower R^2 for Galveston Bay can be attributed to the increased length of the time frame modeled and the greater complexity of the estuarine system. The models did not accurately capture tidal effects within the 1D flow area.

Keywords : Delaware bay, estuarine hydraulics, Galveston bay, HEC-RAS, one-dimensional modeling, two-dimensional modeling
Conference Title : ICEHEH 2022 : International Conference on Environmental Hydraulics and Engineering Hydrology
Conference Location : New York, United States
Conference Dates : January 28-29, 2022