Doctoral Dissertation Defense Announcement

MODELING THE VULNERABILITY OF A HIGHLY INDUSTRIALIZED ESTUARY TO STORM SURGE WITH A COUPLED ADCIRC, SWAN, AND EFDC SYSTEM

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ABSTRACT

Environmental and economic losses from hurricanes have emerged as an important topic due to the extensive damages from recent hurricanes Katrina, Rita, Ike, and Sandy on the Gulf and Eastern Coasts of the United States. Loss models developed to date fall short of modeling losses from industrial activities in coastal areas, especially economic losses from facility damage and environmental losses due to spills into waterways and ecosystems. This dissertation defines the vulnerability of industrial complexes, develops a framework for modeling environmental and economic losses due to storm surge, and develops a water and sediment quality model with storm surge boundary conditions to simulate the relative amount of pollution that would reach an open bay from a spill within an industrial facility. The developed framework, simulation tools, and models are applied to the Houston Ship Channel Industrial-Corridor (HSC-IC) using Hurricane Ike to generate three hurricane scenarios representing Hurricane Ike, Hurricane Ike landing further south along the coast, and the relocated Hurricane Ike with 30% higher winds. Data defining facility scale vulnerability are stored in a Geographic Information Systems database; the data are used to estimate inundation under surge using SWAN+ADCIRC simulations of Hurricane Ike completed by others. The resulting inundation projections are used in conjunction with infrastructure and environmental damage relationships in the developed FEDERAP loss estimation tool to estimate facility losses. Pollutant transport is simulated by coupling the SWAN+ADCIRC and EFDC models. A conservative tracer is simulated in the resulting model, known as EFDC-SS, to examine the effects of spill location and timing relative to peak surge on pollution extent and mass released to Galveston Bay. Results from FEDERAP indicate facility level losses ranging from $10 to $25 billion based on 12 facilities that were analyzed in detail and projected losses for the HSC-IC ranging from $10 to $90 billion for all facilities. The EFDC-SS results show a significant dependence between the time of the spill and the distribution of pollutants in the HSC-IC system. Modeling results also indicate that at least half the spilled mass will reach the open bay waters within 10 days of being spilled under surge.