Storm Surges Congress, Hamburg, Germany
13–17 September 2010
SSC2010-10-1

Coupled tide-surge-wave modelling in shallow water under extreme storm conditions

J. Brown, J. Wolf, and A. J. Souza

Proudman Oceanographic Laboratory, Joseph Proudman Building, 6 Brownlow Street, Liverpool, L3 5DA, UK
(jebro@pol.ac.uk, +44 (0) 151 795 4971, Fax: +44 (0) 151 795 4801)

An extreme storm event on the 18th January 2007 is use to set up an accurate model hindcast of tide-surge-wave interaction within Liverpool Bay, UK. Two projects: the Coastal Flooding by Extreme Events (CoFEE) project, and Morphological Impacts and COastal Risks induced by Extreme storm events (MICORE) project, are assessing past, present and future flood risk for a range of coastal environments due to extreme events in this region. To aid coastal planning state-of-the-art regional model simulations are required. An assessment of the WAve Model (WAM) and the Simulating WAves Nearshore (SWAN) model is made. Following modification to the numerical methods implemented in WAM the model performs as well, if not better, than SWAN in shallow estuarine environments when coupled to a hydrodynamic model. We use the Proudman Oceanographic Laboratory (POL) Coastal Ocean Modelling System (POLCOMS) to provide the tide-surge hindcast for this period. The 180m Liverpool Bay model hindcasts are compared with wave and surge observations within the Dee Estuary in this study area. Both wave and surge external boundary conditions are provided by the 1.8km coupled POLCOMS-WAM Irish Sea model. The external surge for this model is provided by the $\sim$12km operational Continental Shelf surge model, run at POL. Mesoscale ($\sim$12km) wind and pressure forcing from the UK Met Office model are used to generate the local surge and wave conditions. For correct tide-surge-wave prediction in very shallow water (<18m) a coupled wave-hydrodynamic model is required, to include 2-way interaction between the wave field and hydrodynamic fields. This is achieved here through: a wave-current bottom stress, a wave dependent surface drag to generate the surge, wave refraction due to the presence of time varying depth and current fields and the inclusion of radiation stresses in the hydrodynamics to generate wave-induced currents and wave-setup. We find that, in the estuary environment, tidal elevation plays an important role in the modulation of the wave height, while wave-setup has a significant impact on resulting peak surge elevation.