ABSTRACT

The present thesis work emphasize on diverse aspects in developing a near-shore wave forecasting system for coastal Kalpakkam, located in the east coast of India. Efforts were made to investigate various physical processes that can influence near-shore waves, and thereby provide a better framework of modeling components for operational application to the decision support system (DSS), at Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam. The modeling system comprises a suite of state-of-art atmospheric, wave and hydrodynamic models, viz; WRF, WAM, SWAN and coupled ADCIRC-SWAN models. A comprehensive study using the JTWC best cyclone track archive from 1945-2009 was made to construct the most probable cyclone track. Several synthetic experiments with various combinations of maximum sustained wind speed, and radius of maximum winds was investigated with this probable track to assess the maximum significant wave height, that can occur at various coastal destinations surrounding Kalpakkam. The study has led to development of coastal and social vulnerability index for the northern belt of Tamil Nadu coast, which revealed Kalpakkam is a moderate risk zone. The role of distant Southern Ocean swells that travels over the hemisphere into the north Indian Ocean, and their influence to modulate and modify the local wind-waves off Kalpakkam was studied. The role of non-linear wave-wave interaction in the energy re-distribution process was notable and quantified. The inclusion of background swells from multi-scale modeling approach revealed that swell effects are significant in an operational wave forecasting system. The sensitivity of model resolution and bottom slopes in computation of wave induced setup has been studied in detail. The knowledge obtained from sensitivity experiments, was then translated to quantify the wave setup that resulted from Category-4 'NARGIS' cyclone which occurred in the Bay of Bengal. The performance of a coupled ADCIRC+SWAN model for the recent December 2011 'THANE' cyclone which had its landfall in the northern Tamil Nadu coast was investigated. Predicted cyclone track, landfall locations and wind fields from WRF model was then used to assess the performance of coupled model. Knowledge obtained from these modeling components, was then integrated into the DSS system operational at IGCAR, Kalpakkam.

Key words: Wave Forecast, Coastal Vulnerability, Social Vulnerability, Wave Setup, Swells, Coupled Model, Decision Support System