WAVE-CURRENT ACTIONS ON THE TRANSPORT OF SEDIMENT IN DEEP BAY, HONG KONG

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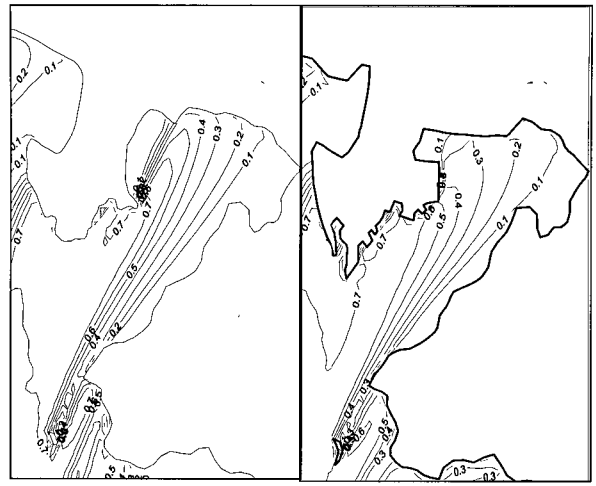
Deep Bay is a semi-enclosed shallow basin with intertidal silt flats lying on the border between Hong Kong and Shenzhen. The bay contains a wetland of internationally recognized ecological importance (the Maipo Marshes Nature Reserve, a declared habitat under the International Ramsar Convention); it is also a locally important commercial fishing ground and a traditional oyster culture area. In many coastal and estuarine regions such as Deep Bay, waves and currents often coexist together creating a very effective agent for resuspending and transporting sediment in the water. It is necessary to consider the coexistence of waves and currents when simulating the transport of sediment in large coastal areas. A 3-dimensional (3D) split-operator finite element model developed by Lu and Wai (1998) has been applied to simulate the wave-current induced transport of cohesive sediment in Deep Bay. The wave climate is calculated by the conservation of wave action equation and the eikonal equation (Chen et al., 2003) that take into account of wave refraction-diffraction and time varying non-uniform currents (Wai et al., 2004). The wind action has also been incorporated in the wave climate calculation. The wave model is directly coupled with a tidal flow model through a wave-current bottom boundary layer model and vertical eddy viscosity coefficients. The model was calibrated and verified against a set of 16-hour field measurements including water elevations, flow velocities, suspended sediment concentration, wind conditions, and swell properties collected in 1986 during a spring tidal period and a neap tidal period. The calibrated/validated model was then applied to simulate the sediment transport process in Deep Bay with the present coastline and bathymetry. The computed significant wave height distributions using the 1986 coastline and the present coastline are illustrated in the figure below. The wave distributions in the bay are essentially the same under both coastline configurations except in the north side of the bay where the wave height is smaller in the present situation. It is found that the suspended sediment concentration can increase by 20 times if wave actions are in comparable magnitude with the flow current. The general trend of the residual sediment transport flux was weakly ebb-oriented in the major axis of the bay implying that the sediment is slowly convecting out of the bay along the south-west direction. The results are useful for shore and environmental protection and coastal project management in the bay.



Significant wave height distribution (in meters) in Deep Bay
(a) 1986 coastline; (b) 1997 coastline.

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