3D Simulation Model for Nearshore Bathymetric Change : NeCST System

Beach topography is affected by incident waves, coastal current, tide, long period wave, adjacent bathymetry of sea bottom and coastal structures. The bathymetric change also affects mutually the characteristics of wave and current. Beach bathymetry and each sea condition are be closely-linked by each other. **NeCST** (Nearshore Circulation and Sediment Transport Model) has been developed by ECOH CORPORATION with introducing these effects with each other. NeCST can input various external forces. The factors of wave, current and bathymetric change are affected mutually for reproduction of bathymetric change. Through 3D simulation, the basic data due to implementation of coastal structures can be provided. For example, it can be applied for various problems of littoral drift, the examinations for arrangement of coastal structures for beach erosion and the assessments of impacts to surrounding environment.

1. Component and Characteristics of NeCST

NeCST is composed of 3 parts, such as numerical simulation method of wave transformation, current and topographic change. By computing each part in order repeatedly, time evolution change of wave, current and topography are predicted.

●Part 1: Numerical Simulation of Wave Transformation

By phase mean model where energy balance equation including diffraction term is a fundamental equation, wave height, period, wave direction and radiation stress are calculated.

Shallow water deformation, wave refraction, wave diffraction, reflected wave against coastal structures, dissipation due to wave breaking with wave reformation and wave transformation by current are estimated adequately.

●Part 2: Numerical Simulation of Current Condition

Tidal current, nearshore currents and wind driven current are calculated. The complicated currents occurred in coastal zone are calculated in the condition of external force change over time. The boundary between the land and sea is treated as a moving boundary, and wet and drying ground by tide excursion is estimated.

●Part 3: Numerical Simulation of Bathymetric Change

Magnitude of the morphological change in the visinity is calculated by estimating the shearing stress in bottom and sediment transport rate according to the characteristics of sediment resulted from Part 2 of wave and current calculation.

To calculate sediment transport rate, the both of the bed load and the suspended load by waves are considered. The sand transport model and mud transport model are used properly according to the characteristics of bottom sediment. And if the effect of sea-bottom slope and submerged rocks exists, the sediment transport rate is estimated adequately.

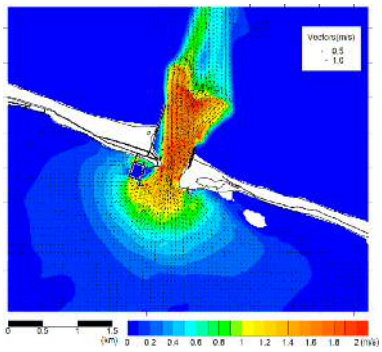

Figure 1: Example of Current Pattern Reproduced in Lagoon Breach (Ebb Tide)

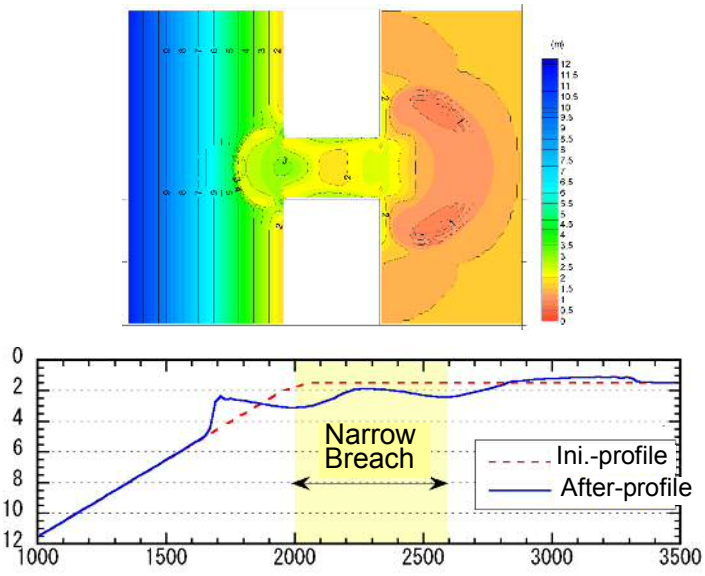

Figure 2 :Example of Bathymetric Change Adjacent to Narrow Breach of Lagoon by Tidal Current

2. Applicability to Bathymetric Change around River Mouth

It is important that stream flow and nearshore current are solved simultaneously in the river mouth, because the various currents are formed by superposition of the two flows. Figure 1 shows an example of simulation of bathymetric change around the river mouth. (a): In the case of simulation by using only wave effect, river mouth bar is formed by the current toward center of river mouth. (b): By adding the effect of river flow, the bar is flushed by strong river flow affecting on the river mouth, and the terrace bathymetry is spread to offshore. NeCST model can represent the process of topographical change in the both cases at the time of flood condition and normal stage of river discharge.

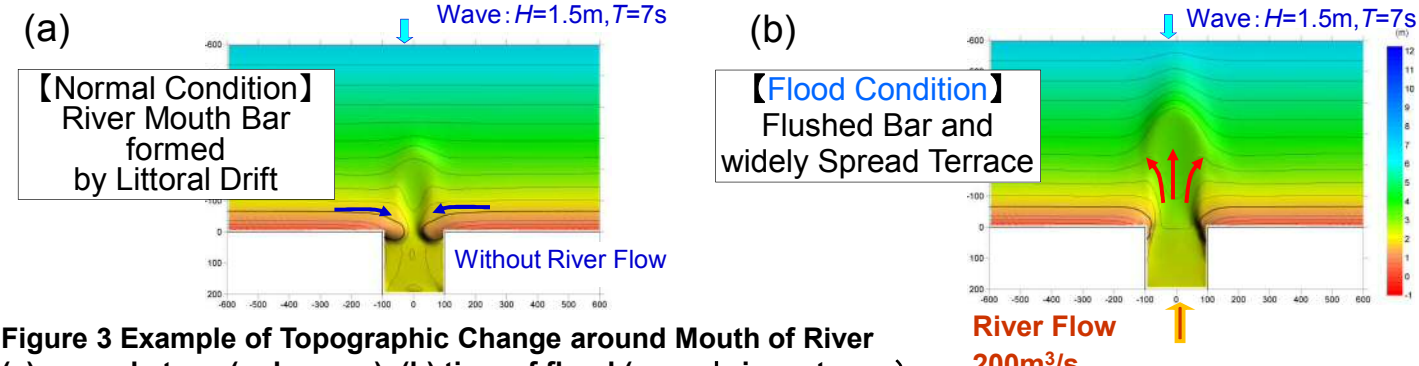

Figure 3 Example of Topographic Change around Mouth of River (a) normal stage (only wave) (b) time of flood (wave＋river stream)