

WIND-WAVE-SURGE INTERACTION SIMULATION IN SHALLOW WATER: COMPUTATION OF THE STORM SURGE BY T9918

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1. Coupling System

Waves play a critical part in a coupled air-sea system. To this end several initial studies were undertaken to test the impact of waves in various components of a complete coupled air-sea system. It is generally accepted that a coupling of the atmospheric boundary layer and the wind waves yields increased surface drag coefficients, especially during the early stages of storms or ahead of fronts. It is obvious that in a simple feedback mechanism the stress, which generates the waves, is enhanced and hence increases the momentum flux into the waves. This increase in momentum also affects the current distribution and the surge, which in turn may also influence the evolution of the wave field in coastal regions. The synchronous coupled wind-wave-surge model was developed and verified in the Linux Beowulf parallel system. It was applied to the storm surge simulation caused by Typhoon Bart (T9918) in the Yatsushiro Sea. The mesoscale atmosphere model (MM5) was hired to compute the wind condition during typhoon event, and the full spectral third-generation wind-wave model (WW3) compute wave status and wave breaking stress. The storm surge successfully simulated with wind-wave-surge interaction using the coastal ocean model (POM).

2. Research Area

The tide of the Ariake Sea is characterized by very large difference of tidal height between ebb and full and strong tidal current. In recent years, the Ariake Sea has encountered serious environmental problems typified by the seaweed damage which may be caused by serious prediferation of phyto planktons due to environmental chages, such as tidal transformation by coastal development. In this study, characteristics of the tide and tidal current in the Ariake Sea was investigated with the numerical experiment by a parallel three-dimensional primitive s-coordinate model for sea water circulation. The parallel linux

system was used to calculate and predict the Ariake Sea tide. The computed results were compared with the existing charts and coastal tidal observations. The influence of Isahaya Dike on the changes in tidal environment in the Ariake Sea was also examined.

3. Computational Results

Since Typhoon Bart (T9918) landed on Kyushu with maintaining its strength, a serious storm surge calamity occurred at Matsuai, in the Yatsushiro Sea. According to the field survey performed later, in the Yatsushiro Sea, the maximum of tide anomaly was presumed to exceed about 3.5m. The developed system was applied to the storm surge simulation caused by T9918 in the Yatsushiro and Ariake Seas.

An additional sea surface stress, the whitecap wave breaking stress, was introduced to consider the effects of energy transfer from wind to current through wave breaking in the air-sea interaction system. The conducted hindcast of storm surge in this study clearly showed the importance of energy transfer path via whitecap dissipation of wind waves in the generation mechanism of mean current in the extremely shallow water. The maximum sea level elevation of 450 cm was observed at Matsuai by the survey after the storm surge event. Simulated surge height at Matsuai is 410 cm.

4. Future Research Plan

The model built by this research is the next generation typhoon and storm surge model which actually it makes use of the reappearance of the high precision of the storm surge and high wave in the shallow water area where has complex land geographical features and in Japan. This research will be expected system of a expanded numerical model for flood in the river basin as a material transport model, river mouth problem, seashore erosion, disaster prediction of storm surge or high wave using the coupled model with the atmosphere, land surface and water circulation.

