

Numerical Simulation on Effect of Typhoon to Water Level and Velocity Field in the Ariake Sea

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I. Introduction

In Japan each year a typhoon passed over the island and the sea frequently. Ariake Sea is located in the Kyushu Island and it is surrounded by Kumamoto, Fukuoka, Saga and Nagasaki Prefecture. In 2004 typhoon Songda and Chaba passed across Kyushu Island. They have large wind speeds. In 2005 the prophet typhoon crossed the same area with winds of nearly the same. Saga plain is a low land and the Ariake Sea is an enclosed bay, and they are often crossed by a typhoon. It was deemed necessary to see how large the effects of the typhoon on the water level and velocity field in this area.

II. Study area

The measurement point of water level and velocity are as follows.

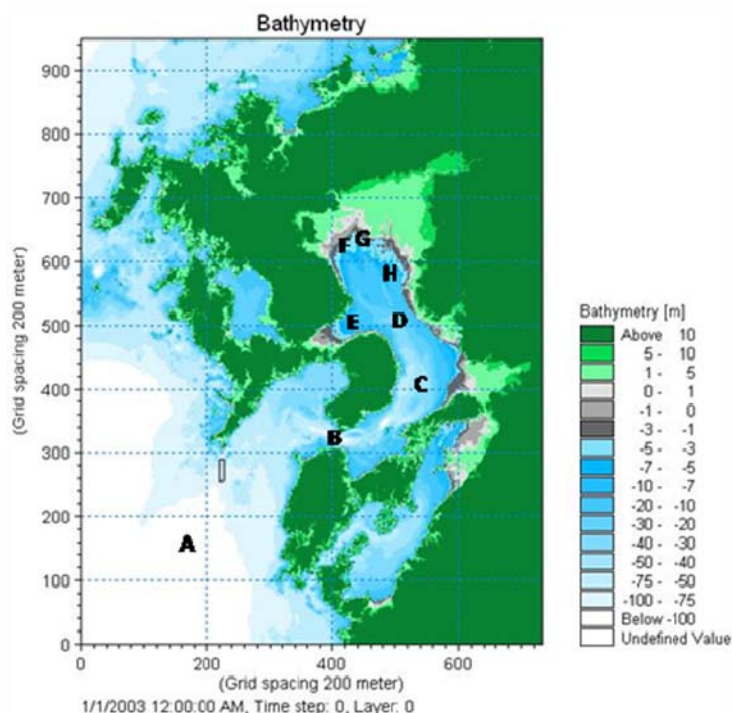


Fig. 1 Study area and Bathymetry

A : At the front of the mouth of Ariake Sea
B : Mouth of Ariake Sea
C : Around the front of Kumamoto port
D : At the front of Arao City
E : At the front of Isahaya dyke
F : Around the front of Shiroishi
G : Around the front of Kawasoe, Saga
H : Around the front of Tamana

III. Numerical simulation

In this study MIKE 3 Flow Model Software version 2009 developed by DHI is used. It is a general three dimensional modeling tool for oceanographic, coastal and estuarine applications.

Wind data taken beginning on 9/4/2004 1:00:00 PM and ends on 9/9/2004 12:00:00 PM used by Chikugo River Office at Synthetics tower at coordinate 33.07638889 N and 130.3008333 E. The study period is from 07/09/2004 5:00:00 PM and to 08/09/2004 06:00:00 AM. A time step is 60 minutes and the result is taken every 30 minutes

In Fig.2 the time series of wind speed and direction are shown. In Fig. 3 the typhoon Songda track is shown.

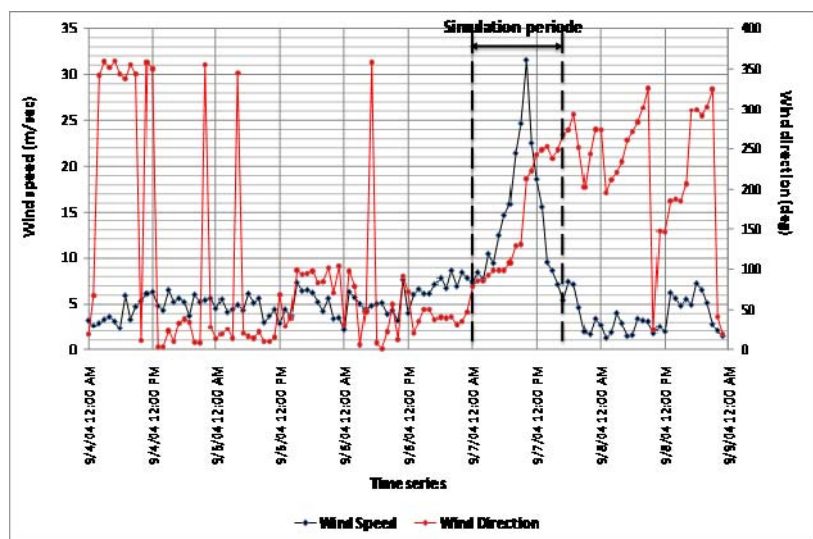


Fig 2 Wind speed, direction at the Synthetic Tower and simulation period

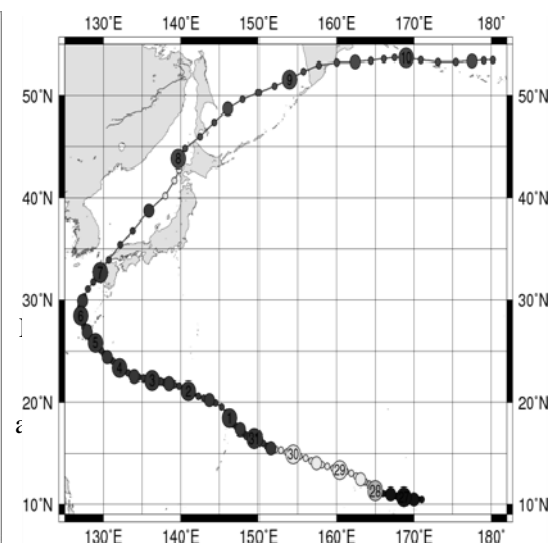


Fig 3 Typhoon Songda track

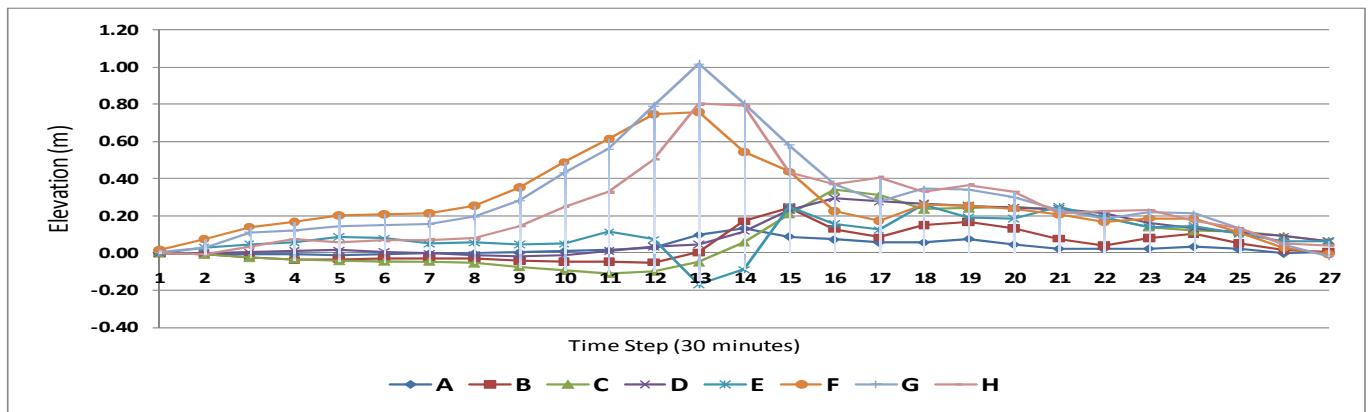


Fig. 4 Water levels at measurement points for each time step

In this graph it can be seen that the maximum water level 1.018 m occurred in time step 13 at point G where is near the front of Kawasoe, Saga, while the lowest -0.168 m occurred at the time step 13 at the point E where is near the front of Isahaya Dyke. As for the velocity it can be seen in Fig. 5 that the largest value 0.90 m/sec of velocity component occurs at the time step 15 at point B where is mouth of the Ariake Sea and and Fig. 6 it can be seen the pressure of the water surface that the largest pressure value is Pa occurs at the time step 15 where is near the front of Kawasoe, Saga.

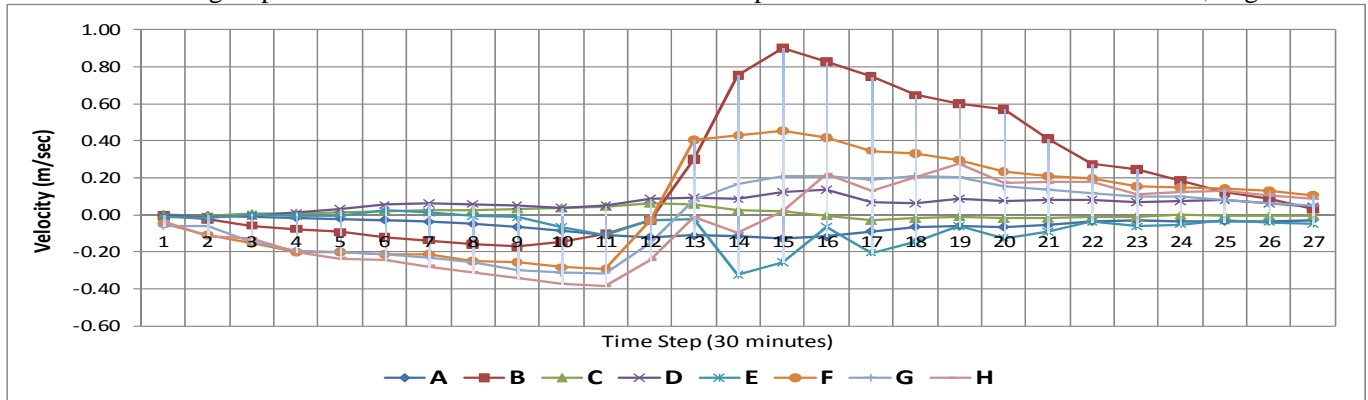


Fig. 5 Velocity at measurement points for each time step

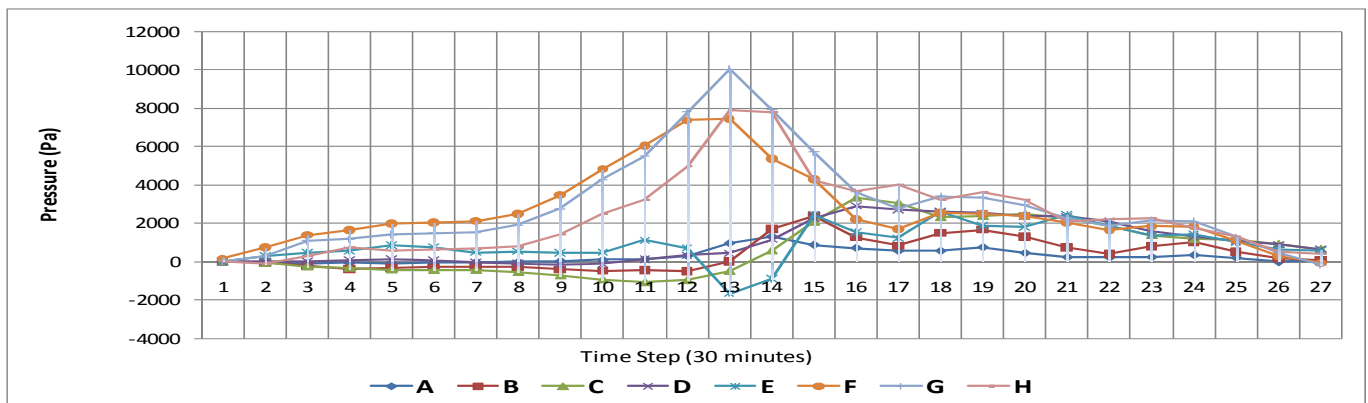


Fig.6 Pressure of the surface layer

V. Conclusions

From the numerical simulation results, it can be concluded that the typhoon, with winds as typhoon Songda do not much affect to the water level and velocity in the Ariake Sea, where the highest water level occurred in front of Kawasoe, Saga. The highest velocity occurred at the mouth of Ariake Sea and the highest pressure of water surface in near the front of Kawasoe, Saga.

References

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- (2) DHI, 2001, MIKE3 Flow Model, Hydrodynamic Module, User Guide.
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- (4) <http://agora.ex.nii.ac.jp/digital-typhoon/summary/wnp/1/200418.html.ja>