Evaluation on Storm Surge along Suo-nada Sea, Japan

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ABSTRACT

The Suo-nada Sea in Japan has a vulnerability to storm surges. However, investigations of storm surges are few, though the intensity of typhoons approaching the sea will be more intense due to global warming in the future. For the future coastal disaster prevention, this study verified the accuracy of storm surge simulations in the Suo-nada Sea. Additionally, the characteristics of the future typhoons passing through the region were investigated by using the large ensemble data of climate projections. Ultimately, storm surges which can occur under the future climate were estimated with the data, and disasters in the sea were evaluated.

KEY WORDS: Suo-nada Sea; storm surge; FVCOM; future typhoon; d4PDF; damping effect on typhoon intensity; climate change

INTRODUCTION

Japan is an island nation and lies in an area frequently hit by typhoons, while many city functions are located in lowlands of coastal areas. Thus, Japan has experienced lots of storm surge disasters up to the present. The Suo-nada Sea, which is surrounded by several islands such as Kyushu, Shikoku and the west part of Honshu Island (See Fig. 1), has a vulnerability to storm surges. In the past, typhoons BART in 1999, CHABA and SONGDA in 2004 made remarkable damages at the surrounding areas of the Suo-nada Sea. Furthermore, due to global warming, there are growing concerns that typhoon intensity will be greater than the present and the related disasters will be more serious. Hence, it is necessary to accurately estimate future storm surges, and then coastal disaster prevention under the future climate needs to be considered. The Suo-nada Sea, however, has some topographical factors which make storm surge estimations difficult (Matoba et al., 2006). Besides, there are fewer investigations of storm surges in the area compared to the major bays in Japan, for example, Tokyo, Osaka and Ise Bays or the Ariake-Sea which is located near the Suo-nada Sea.

In this study, numerical simulations for storm surges around the Suo-nada Sea were performed by using the coastal circulation model FVCOM (Finite Volume Community Ocean Model version 3.2) developed by Chen et al. (2003). FVCOM employs an unstructured grid system so as to accurately compute ocean currents even in complicated inner bays. First, in the model, an appropriate computational domain size was found. Then the influences of various input data (atmospheric pressure and wind), which is estimated by an empirical typhoon model, Weather Research and Forecasting (WRF) Model and meteorological reanalysis data, on the accuracy of simulations were examined. Moreover, the accuracy of simulated storm surges dependent on the typhoon path was also studied. Subsequently, the future changes of typhoon characteristics around the Suo-nada Sea were investigated on the basis of the Database for Policy Decision making for Future climate changes (d4PDF). From this investigation, some possible changes of typhoon trends in the Suo-nada Sea were clarified.

Fig. 1 Object sea area and computational domains