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Estimation of Extreme Storm Water Level in Japanese Bays by Using Stochastic Typhoon Model and Tide Observation Data

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ABSTRACT

In Japan long storm surge defense has been constructed for the deterministic design storm water level based on the storm surge by Typhoon Vera in 1959. Yet storm water level may exceed the current design one in small probability. This study, therefore, estimated the extreme storm surge and storm water level in Japanese major bays, by using a stochastic typhoon model and tide observation data. The result shows that the return period of the current design storm water level at three major locations, Tokyo, Nagoya, and Osaka, is a few hundred years or more.

KEY WORDS: Typhoon; storm surge; storm water level; return period; stochastic typhoon model; storm surge defense.

INTRODUCTION

Each year, several typhoons or more affect Japan and some of them cause significant storm surge in some bays. For instance, Typhoon Vera in 1959, named Typhoon Isewan in Japan, triggered terrible storm surge disaster with 5,000 victims on the coast of Ise Bay. After the disaster, the Japanese Government simulated the storm surge of the standard typhoon based on Typhoon Isewan and began the construction of storm surge defense on the coast of major bays having dense population and expensive properties. These efforts obviously decreased storm surge disaster in frequency and magnitude. But storm surge disaster repeated in 1999 and 2004 with a loss of lives.

The current design storm water level was determined deterministically through the storm surge simulation with the standard typhoon. It is believed that such the high storm water level appears extremely rarely and the discussion on the return period of the current storm water level is still insufficient. The history of typhoon and tide observation is so short in Japan that it is difficult to estimate the return period which may be a few hundred years or more. In such the situation, a stochastic typhoon model, simulating typhoon parameters with the Monte Carlo method, based on typhoon statistics, is known as one of the useful tools to breakthrough the difficulty.

That is the reason why we computed the storm surge in the numerous typhoons which were given by a stochastic typhoon model, and then estimated the extreme storm water level in Japanese major bays. This procedure is similar to the previous research for Seto Inland Sea, Japan (Kawai et al. 2006, 2007). This paper will introduce briefly the current design storm water level in Japan before the main story.

BACKGROUND OF CURRENT DESIGN STORM WATER LEVEL FOR STORM SURGE DEFENCE IN JAPAN

Disastrous Typhoons between 1930's and 1950's

Japan has suffered from coastal disaster due to a typhoon. Fig. 1 shows the track and the central pressure at the landfall time, of three major disastrous typhoons which appeared between 1930's and 1950's.

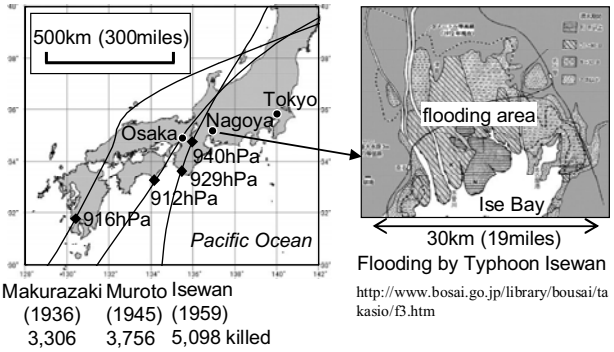

Fig. 1. Major disastrous typhoons (left) and the flooding area by Typhoon Isewan (right)