Preliminary Study on Statistical Characteristics of Waves and Surges over Taiwan Waters

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ABSTRACT

We here investigate the statistical characteristics of ocean waves and surges over Taiwan waters by cluster and return period analysis. The results of cluster analysis show the data records from neighbor stations would not always fall into the same cluster due to the influence of topography around wave stations. In addition, the wave height of the specified return period is significant related to the probability distribution of the data set. Because of the extreme wave record in Gueishandao sea area around Taiwan, the suitable probability distribution cannot be well determined in this area. It would affect the wave height analysis of the return period. We would continue the study to discuss the suitable probability distribution, so as to determine the accurate wave height in different situations of the specified return period.

KEY WORDS: Surge; wave height; cluster analysis; return period.

INTRODUCTION

Ocean waves and surges have attracted considerable attentions throughout history. The mechanism of wave and surge is still not fully understood in the present day. Statistical analysis of the wave and surge data is a quite popular and practical way to understand the characteristics of these ocean phenomena. It is also possible to predict the sea states by some statistical methods (Liu et al., 1998; Tsai et al., 2002; Lee et al., 2007).

Taiwan, located between the tropics and the subtropics, lies on the border between the largest land mass and the largest ocean in the world. The marine and atmospheric environments here are complex and sensitive. Due to the island of Taiwan is situated on typhoon tracks; typhoons always bring severe sea states. Thus Taiwanese coasts receive direct impacts by huge waves especially in the eastern part of the island as well as large surge heights in the western part. In the past 100 years, there were average 3.5 typhoons attacking Taiwan per year. However, the number of typhoon is increasing recently (Fig. 1). Therefore, coastal flooding events happen very often in the past 10 years. Lives and properties lost very much within every year. The flooding events in Taiwan are always happened in the coastal area. The causes of coastal flooding are from two directions. One is because of the high water level in the river which the other reason is because of the high sea level elevation and high waves. In addition, direct coastal flooding will be probably happened if the sea level rises by storm surge or by the overtopping of huge waves or their joint effects. To mitigate the damages induced by typhoons, it is necessary to understand the ocean phenomena.

Fig. 1 The numbers of typhoon attacked Taiwan since 1967.

Measurement always plays an important role on evaluating and describing wave and surge phenomena and characteristics. Since 1998, the government organizations in Taiwan have established a coastal monitoring network around Taiwan coast. The coastal monitoring network as shown in Fig. 2 was jointly established by Central Weather Bureau, Water Resources Agency and Tourist Bureau (Kao et al., 1999). To obtain the surge data, the harmonic analysis is applied to separate the astronomical tide and surge from the water level records around Taiwan. Due to the numerous stations and long-term data over Taiwan waters, it should be possible to understand well the sea state characteristics in this area. We here investigate the statistical features of ocean waves and surges. The cluster and return period analysis, which should be able to derive the spatial features from the whole Taiwan sea area, are applied here to reveal the characteristics of wave height and surge.