Long-term Variability and Trends of Wave Climate in the Southern East China Sea and Northwestern Pacific Ocean from 1958 to 2009 – Wave Modeling Validation

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**ABSTRACT**

Typhoon waves play a major role in engineering and environmental problems. Our long-term goal is to investigate variability and trends of typhoon waves over past 62 years. However, the parameters in numerical wave models need to be calibrated before a model can be applied to a specific region. In this paper, we selected the 3 most important parameters from the source term of the SWAN wave model and subjected them to sensitivity analysis to determine which parameter is the most sensitive. After sensitivity analysis, we adopted the ARS method to find the optimal value of the parameter to which the SWAN wave model is the most sensitive by comparing modeling results with observed data at three buoys off the northeastern coastal waters of Taiwan; the aim being to find optimal value of the parameter for improved modeling of wave development. The procedure adopting the optimal parameter in wave simulations did improve the accuracy of the SWAN wave model in comparison to default runs based on field observations at three buoys.

**KEY WORDS:** Typhoon waves, Sensitivity analysis, SWAN wave model, Adaptive random search

**INTRODUCTION**

Taiwan is located between the continental shelf of China and the northwestern Pacific. It is often subject to severe sea states induced by typhoons, resulting in terrible losses of human life and property in the coastal areas of Taiwan. Statistical number from Central Weather Bureau (CWB) of Taiwan shows that there are in average 3.5 typhoons approaching Taiwan per year (1895-1995). Therefore, analysis of typhoon waves and long-term changes of typhoon wave climate are of great importance to the operation and safety of coastal development.

The paths of typhoons are divided into 9 categories. Ou et al. (1999) revealed that the most disaster in the northeastern coast zones of Taiwan is expected to be due to typhoons of paths 1, 2, 3, and 6, which bring more than 50% of the occurrences in the past 10 decades. Ou et al. (2002) simulated typhoon waves by the SWAN wave model. The results have shown that waves due to typhoons of paths 3, 4, 5, 6 and 7 can be reasonably simulated on east coastal waters of Taiwan. The study aim at long-term variability of wave climate in the southern East China Sea and northwestern Pacific Ocean is to investigate the trends of waves due to typhoons of paths 2 over past 62 years. Unfortunately, the long observational records are hardly available. Therefore, hindcasts by the wave models become a common tool to complement the limited observational record.

Before the model can be applied to the specific region, we have to calibrate the parameters of the wave model. There are many empirical and tunable parameters in the equations of the model, the setting of these parameters bring a great influence on the results of the model. Consequently, it is important to determine the most crucial parameters and then find their optimal values to improve the result of simulations.

In this paper, firstly, we decided the parameters which are the most important during the process of wave decay. Secondly, we ranked the parameters by sensitivity analysis; i.e., to know which parameter is the most sensitive. After sensitivity analysis, we adopted the ARS method to find the optimal value of the most important parameter. Finally, the results of our analysis are used for simulating typhoon waves by the SWAN wave model, and compared with actual buoy observations and default simulation of the SWAN wave model (using default parameter settings) in the coastal waters off northeastern Taiwan.