HINDCASTING OF WAVES AND STORM SURGE - A COMPARISON OF TWO TECHNIQUES

Z.S.Tarapore, R.R. Patra, Ajay Pradhan
DHI Water and Environment, K-71, Hauz Khas Enclave
New Delhi – 110016, India

ABSTRACT

Coastal erosion and inundation is caused mainly due to cyclonic storms in the ocean. In order to maintain a safe estate level for any coastal development such as Ports, coastal power stations and other human settlements, it is necessary to determine the enhanced water levels under the effects of cyclonic storms and the waves generated by storm winds blowing over large water bodies. This technique, which is known as hindcasting of storms, is dependent on the wave energy transmitted to the water body under the effects of the cyclonic winds.

By far, the majority of wave energy is contained in the 0.1 to 10 Hz frequency range. Hence, the practical problem is to predict the growth and subsequent behavior of gravity waves under wind excitation. In general, the larger the wind velocity and the longer its duration, the higher and longer will be the waves generated. In addition the distance over which the wind blows over the water surface, known as the fetch, also governs the energy transfer from the air to the water medium.
Waves in the region of transfer of energy are called " seas" and tend to have a more random and peaked appearance. Waves traveling out of the storm area, tend to decay with travel, and are called "swell." There are prediction techniques for generation of seas and also for the decay of these "seas" as they filter out various frequencies, after leaving the area of generation to form what is known as " swell" . Since gravity waves are dispersive, the long waves will move out ahead and the short waves will fall behind. There is constant group activity, and the spectrum of a packet of wind-generated waves is constantly changing during its run across the ocean (Schenck, 1975). There are many methods for determining the wave height and period.. There are basically two types of wave prediction methods: (1) analysis of gross average values—the "significant wave" method; and (2) analysis of statistical distributions—the "wave spectra" methods.

The first one more commonly known as the Bretschneider (1959) method was very widely used all over the world for prediction of wave height and period. This is an established method which gives good estimates of the resulting waves. However, with the advent of numerical simulation techniques, actual simulation of the cyclonic storms over large water bodies is possible. This technique is used in MIKE SW, which is a fully spectral wave model based on unstructured mesh.
A global model is the norm when storm simulation is carried out, for both the generated wave height and storm surge.
This paper utilizes the Orissa, super cyclone of 1999, for which the entire Bay of Bengal was modeled in order to predict the storm surge and wave heights nearshore. This Global model gives the basic input for a Flow model on the flexible mesh, to carry to the resulting surface elevation at the point of interest. In this technique, the nearshore wave modifications are also taken in to account.

The results of prediction by the Bretschneider method and the global model are given in the paper.

This paper seeks to explore the difference in wave heights and surface elevations computed and by both the above methods.