Estimation of Extreme waves in Asaluyeh Using SWAN model

Mohammad Hadi Moeini* **Amir Etemad-Shahidi*** **Vahid Chegini****
***Iran University of Science and Technology** ****Iranian National Center for Oceanography**

mhmoeini@iust.ac.ir *etemad@iust.ac.ir* *v_chegini@inco.ac.ir*

Abstrct

The design of coastal and offshore structures requires estimation of the significant wave height corresponding to a certain return period, obtained by collecting short-term data. Instrumentally measured, visually observed or numerically simulated wave data can be used for this purpose. In this study a third generation numerical model, i.e. SWAN, was employed for reproducing time series of wave data in Asaluyeh in the Northern coasts of the Persian Gulf. The SWAN model was forced with Dayyer synoptic wind data. The extreme value analysis was conducted based on the measured and hindcasted wave data. The peak over threshold method was used for determination of extreme waves. It was found that although there were some inconsistencies between recorded and simulated data mainly due to the quality of wind source influenced by the orography effects, the differences between design wave heights obtained from measured and simulated data were not significant in any direction. The results of this study also showed that the Weibull distribution is better compared to other distributions for both measured and simulated data in this region. The shape parameter for Weibull distribution was found to be 1.6 for both measured and modeled data. In addition, the effect of threshold value on the extreme wave height was less than 10 percent for all return period.

Keywords: *Persian Gulf, SWAN, third generation, extreme wave height.*

Introduction

Wave characteristics are one of the most important factors in design of coastal and marine structures. The design of coastal and offshore structures requires estimation of significant wave height corresponding to a certain return period. The design wave height is obtained by collecting short-term, .e.g. 3-hourly, data at the given location. Instrumentally measured, visually observed or numerically simulated wave data can be used for this purpose (Goda, 2000). Ocean engineers generally use these data associated with statistical methods to characterize wave climate at a desired probability. Due to the lack of measurements and observations in many regions, and development of numerical wave models, nowadays numerically simulated wave data are widely used as the data bank for extracting design wave characteristics. The quality of wind forcing is the most important factor affects the results of numerical wave models. Therefore, investigation of the effect of wind source on both wave hindcasting and calculation of extreme waves is very important.

A large number of scientists have researched around the extreme value analysis of winds and waves. As an example, Gumbel (1953) was the first who has evolved a statistical method for extracting extreme values of natural events such as winds and waves that have a random essence. Some more details about extreme value analysis can be found in Goda (1992) and Mathiesen et al. (1994). Also Goda (2000) and Kamphuis (2000) have presented the procedure for extreme value analysis of random seas and estimation of the design wave characteristics.

Neelamani et al. (2007) have estimated design wave characteristics for Kuwaiti territorial waters based on 12yr simulated data with WAM model on a 0.1° × 0.1° grid and 0.5° × 0.5° ECMWF wind forcing. They have used POT method to extract storm data and employed Weibull and Gumbel distribution to estimate extreme wave characteristics. According to their findings, the Weibull distribution is better fitted to the storms compared with Gumbel distribution in Kuwaiti territorial waters. Since they validated their results against the measurements in Kuwaiti waters, the validity of their findings along Iranian coasts should be proved. In addition, they have not presented any idea about the effect of modeling results on the extreme value analysis of wave data in the Persian Gulf. Iranian National Center for Oceanography (2005) has used MIKE21 SW forced with ECMWF wind