Prediction of extreme values of the wave characteristics in Persian Gulf considering 100-yearly effects of climate change-Part 1

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Abstract

Prediction of extreme values of the wave characteristics for various return periods is required for design and locating the marine structures. The accuracy of this prediction increases if the long-term data are available. In addition, the selected method for extreme value analyzing influences on the results. Regarding the fact that a small change in wave characteristics results in a considerable change in extreme values, the assessment of climate change impact on wave extreme values is of great importance. This project was defined in two phases in order to estimate the extreme waves and climate change impact on them.

In the first phase of this project, the effect of data availability duration, distribution and fitting methods on extreme value analysis are investigated. The extreme value analysis was carried out using data obtained from ISWM II and after the validation of the utilized methods, the extreme values of the wave characteristics were obtained for 2, 5, 10, 20, 25, 50, 100 years return periods using Weibull, Gumbel and Log-Normal distributions and using Maximum Likelihood, Method of Moments and Method of L-Moments fitness methods.

Spatial distribution of the extreme waves showed that the maximum extreme wave occurs in Strait-of-Hormuz and the central parts of the Persian Gulf and the lowest extreme values exist in north-west and south of the domain. Comparison of standard deviation and Probability Plot Correlation Coefficient for various distributions indicated that Gumbel distribution using the maximum likelihood fitness method has the lowest standard deviation and the highest Probability Plot Correlation Coefficient which mean the higher accuracy. In addition, the bias, which was calculated by comparing the results with those of previous studies, was found to be the least value in

Gumbel distribution using maximum likelihood fitness method. It must be noted that the bias is positive in eastern and central parts while it is negative in north-western and southern parts of the Persian Gulf.

In order to compare the results with the previous studies, ten points were selected in the Persian Gulf based on the bias distribution. The results illustrated that the difference increases by increasing the return period. Moreover, the obtained results are underestimated in points located in north-west and overestimated in other points. Extreme peak periods were also calculated using a linear regression between significant wave height and peak period. Furthermore, for assessing the climate change impact on extreme wave conditions, wind data obtained from a global climate model (CGCM3.1) verified in comparison to ECMWF local winds. The statistical analysis showed that the standard deviation is lower in ECMWF data and ECMWF wind speed values are higher in most of the points. Comparison of wind roses also shows some difference between these two wind sources. Climate change impact on extreme waves will be carried out in the second phase of this study.

Keywords: Wave modeling, Extreme value analysis, climate change, Persian Gulf