EGU23-664, updated on 01 Dec 2023
https://doi.org/10.5194/egusphere-egu23-664
EGU General Assembly 2023

Comparison of extreme value distributions for significant wave heights in the Mediterranean Sea

Tahsin Görmüş[1,2], Burak Aydoğan[1], and Berna Ayat[2]
[1]Gebze Technical University, Department of Civil Engineering, Kocaeli, Türkiye (tgormus@gtu.edu.tr)
[2]Yıldız Technical University, Department of Civil Engineering, Istanbul, Türkiye (bayat@yildiz.edu.tr)

The investigation of extreme sea conditions is of great importance regarding to the design and survivability of marine and offshore structures. Accurate quantification of the storm events in terms of the n-year return levels is needed. Extreme value distributions are used to analyze the extreme waves in the interested location, but the comparison of the distributions is usually ignored. This comparison is important, since a small deviation could mean much higher differences in the design parameters of the structures. This study evaluates the extreme wave conditions in the prescribed locations located in the Mediterranean Sea by quantitatively comparing different statistical distributions. The recent ERA5 dataset is used for the analysis. Statistical distributions of Generalized Extreme Value (GEV), Gumbel, Weibull and Lognormal are used based on the Annual Maximum Series (AMS); Weibull and Generalized Pareto Distribution (GPD) are used based on the Partial Duration Series (PDS). Peak-over-threshold method is used with 99.5th percentile threshold of the hourly 42-year long time-series after careful considerations of the alternatives found in the literature regarding to the threshold selection. The return levels of the significant wave height ($H_{m0,N}$) for each of the selected location is computed using the relation $H_{m0,N}=F^{-1}(1-1/\lambda N)$ in where F denotes the cumulative distribution function of the used statistical distribution, N is the return period in years, and λ is the yearly frequency of the extreme events in the extracted time-series. The distribution parameters are acquired using the maximum likelihood approximation. The comparison of the distributions is made using the Anderson-Darling (AD) test. Mediterranean Sea exhibits diverse sea conditions. 12 spatially distributed locations are selected to represent the wave climate in the basin. The analysis clearly depicts the importance of the statistical distribution model selection. In the Gulf of Lion, 100-year return level $H_{m0,100}$ ranges between 9.5 m (Weibull/AMS) and 11.3 m (Gumbel/AMS). Inter-model uncertainty increases with the increasing return period. It is evaluated that the characteristics of the extreme wave series are determinative over the fitting accuracy of the distributions. Considering the best-fitting distributions among the 12 selected locations throughout the basin, the $H_{m0,100}$ values range between 4.9 m and 9.8 m. GEV distribution is selected as the best-fitting AMS distribution in five of those locations by the AD test, where for PDS models, Weibull distribution is outperformed the GPD in 11 points. This research is a part of a project supported by The Scientific and Technological Research Council of Turkey (TÜBİTAK) under grant number 122M279, and the first author is also supported by TÜBİTAK 2211 PhD scholarship programme.