

The Wave Climate Variation around Taiwan Waters

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Abstract

The historical hourly wave fields of the northwest Pacific are reconstructed using SWAN model driven by NCEP 1948 to 2008 re-analysis data. The computation domain covers E110~E160, N5~N35 with spatial resolution of 0.1 degree. Results of numerical simulations are compared and validated with buoy data from 1997 to 2007. The assessments of model errors demonstrate the consistency of numerical outputs to the field measurements during both extreme conditions such as strong winter monsoons and typhoons and the annual variations. Statistic analyses are then applied to the 60-year wave data bank to investigate the trend and oscillation features of wave height, wave period, steepness, dominating direction and the wave power.

It is found that there is a slightly decreasing trend of wave heights about 0.42cm/yr from 1948 to 2008 around Taiwan waters. However, significant oscillations with three different temporal scales can be identified, i.e. the seasonal, inter-annual and decadal oscillations. Both the observations and numerical hindcasts show that the average wave energy at the northeast coast of Taiwan reaches to the peak about 22kW/m during winter, which is about 300% the magnitude of the summer. On the other hand, the inter-annual oscillation has medium to high correlation to the Southern Oscillation Index (SOI). The annual average wave height in La Nina year is 20% larger than in El Nino year. Furthermore, it is also found that the annual maximum of wave energy and wave height occurs in the late November in El Nino years, which is about 4.5 weeks earlier than in La Nina years. Using the Empirical Mode Decomposition method (EMD), the long-term oscillation can be extracted from the 60 years hourly wave records. This decadal oscillation has negative correlation to the Pacific Decadal Oscillation (PDO) index.

In addition, the extreme wave events are retrieved from the data bank. Due to the weakened strength of Siberia High, it is shown from the result that the occurrence probability of extreme wave events during winter season decrease rapidly and since the late 80's the occurrence probability during summer increases.

Keyword: Wave climate, Numerical wave hindcast