CHAPTER 74

Comparison of Wave Hindcast Methods for Lower Gulf of Thailand

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Abstract

The practical wave hindcast methods namely, SMB (Sverndrup-Munk-Bretchneider), PM (Pierson-Moskowitz) and SPM 1984 (Shore Protection Manual) were evaluated and accessed for their accuracy using the one year recorded of the available oceanographic data at the lower gulf of Thailand in 1987. It was found that all models show the comparable accuracies of significant wave height (H_S) and significant wave period (T_S) but SPM (1984) rather gave the lowest root mean square error when H_S exceeds 1 m. The empirical formulae of land-wind velocity relationship was simply established in a exponential form. The value of constants in the expression between the 5 meteorological stations on land in the southern part of Thailand and the offshore platform were obtained as well. Using the land-wind velocity empirical formulae and a selected wave hindcast method to predict H_S and T_S , the better result was obtained by the low RMSE value.

Introduction

In developing countries, long term wave record is always lacked due to the high cost of instrument used. This make the unrealiable of wave forecasting from the limited number of data for planning and design of coastal projects. A wave hindcast model utilizing local wind velocity will provide more quantitative data of wave climate. The design parameters of two large ports in Thailand is also obtained from the result of wave hindcast models. The selection of appropriate models is quite important and it will govern the project cost. In this study, the result of practical wave hindcast models were compared with the real field measurement to access their accuracy. The empirical relationships of land-wind velocity were established in order to improve the wave hindcast

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procedure at specific sites. The better result was obtained and shown with the lower root mean square error for both wave height and period.

Procedure

A comparison of three wave hindcast models was carried out using the oceanographic information recorded at the offshore platform at the lower gulf of Thailand during a period of one year in 1987. The available data were significant wave height, period, wind velocities and their direction respectively. Fig.1 shows the location of offshore platform. The conventional Sverndrup-Munk-Bretchneider (SMB) model was compared with the Pierson-Moskowitz (PM) model and with the relatively new model from shore protection Manual (SPM, 1984).

The SMB wave hindcast model was used as the standard method for wave prediction and its procedure was published and referred to SPM (1977). The PM wave hindcast model was an accepted method and Silvester (1977) and Muangman (1973) described the detail for hindcast deep water wave height and period including the energy transfer concept from the previous wind velocity. Pecently, the standard method for wind wave prediction in Shore Protection Manual (1984) was changed. The simplifying equation was based on the parametric approach of Hasselmann et al (1976). This method will refer to as SPM (1984) and it will be tested for its accuracy as well.

The significant data for wave hindcast method was wind direction and velocity overwater or oversea. The problem in wave hindcast method in practical is that how to transform the available recorded overland wind velocity to the overwater wind.

In this study, land-wind velocity relationship was empirically formulated using the Meteorological information abserved at the 5 stations at the southern part of Thailand and the offshore wind velocity data. Since the altitude of the meteorological station was not much higher than the sea level, the data between overwater and overland wind velocity was related instead of using pressure gradient. Lag time of wind data was also taken into considered and computed by measuring the distance between the platform and each land station in different wind direction and divided by average velocity. The lag time was used to select the over land data which corresponded to over water wind.

Results

The significant finding from the study will be highlighted associated with the example results herein.

Comparisons of Wave Hindcast Models

The results of all three wave hindcast models were shown by



comparing predicted and observed values of significant wave height and period. In Thailand, there are 3 seasonal clasified by wind direction. The wind from North East Monsoon always blow from period of December to March. The South West Monsoon start from June to September. Finally the transition period is from April to May and October to November. Examples taken from March, July and December 1987 were depicted in Figs.2 to 4. The predicted values from SPM (1984) were rather overestimated when wave height exceeds approximately 1 m. while the rest is underestimated. The wave period showed the same trend while that from SMB and PM were understimate. The accuracy of each models were accessed using the root mean square error (PMSE). Figure 5 showed PMSE of wave height and period. SPM (1984) has the less RMSE of wave height compared with the rest when its value exceeds 1 m. while the wave period show scatter RMSE for and model. However, the accuracies in predicting wave height and wave period were comparable for all models. In addition, It was found that most of the time wave condition was duration limited case independent of method used.

Land-Wind Velocity Pelationship

Relation of over water wind velocity, i.e at the offshore platform, and that of over land, i.e at the nearby 5 meteorologinal station on land, were simply established and expressed as

$$R_{T} = a + b. exp (c. U_{T})$$
(1)

Knowing over land wind velocity (U_L) , the over water wind velocity (U_W) can be computed using the ratio $R_L = U_W / U_L$ in the obove equation. Fig.6 shows land-wind velocity relationship. Table 1 summaries the constants, a, b and c, of each stations. It was found that the ratio $R_{\rm T}$ increased as the station more away from shorelind.

A better result of wave hindcasting, using the over land wind data and the above equation, are depicted in Fig.7. The RMSE reduced from 0.595 m. to 0.383 m. and 6.676s to 5.025s for both significant wave height and period. The improved accuracy are 55% and 33% respectively.

Conclusions

Wave climate at a specific site in the study area can be predicted using the empirical formulae of land-wind velocity relationship and a selected wave hindcast model. Any models give the comparable accuracies of the wave hight prediction but SPM (1984) rather give the high value when wave height exceeds 1 m. with the less RMSE compared with the rest and most of the time the wave period is somewhat lower than the measured one. The procedure described above is useful and practical for engineering application in developing countries which deal with coastal problems since local wave climate is necessarily and basically needed when few field date is available.





References

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Table	1	Constants of	Over	1and	and	Over	water	wind	velocity
		Relationship							

Station	Distance from	a	b	Ċ
	shoreline (m)		_	
Ko samui	300	0.819	9.196	-0.436
Songkhla	900	0.935	6.921	-0.411
Narathiwat	1,800	0.762	7.985	-0.418
Suratthani	6,100	1.062	8.818	-0.421
Pattani	8,300	0.969	20,189	-0.696
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