

MONTHLY MEAN WAVE HEIGHT FORECASTS USING THE STATISTICAL WAVE MODEL BASED ON PCA ANALYSIS

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INTRODUCTION

Wave forecasts are used in various fields such as fishing, surfing, ship navigation, and maritime construction. In addition, mild wave conditions are necessary during construction on the sea. Therefore, the accuracy of wave forecasting greatly influences marine construction management. In order to make a construction plan for marine construction, it is desired to estimate the wave height and frequency of construction several months ahead. The concern with long-term predictions has been growing because most wave forecasts are short-term predictions. In this study, a monthly ensemble mean wave height prediction was carried out using the statistical wave model, and the prediction accuracy was verified.

METHODOLOGY

The monthly mean wave predictions are developed using a statistical wave model based on grid value and principal component analysis results of the North Pacific using the JRA-55 atmospheric reanalysis data (Kishimoto et al., 2017). The statistical wave model has a low computational cost compared to the spectral wave model. Computational flow of the statistical wave model shows in Figure 1. The mean wave height (MWH) is estimated from a combination of grid point wind velocities, sea-level pressures, gradients, and time series of modes of principal component analysis for the Pacific pressure patterns. Thus, it contains both local and remote information, corresponding to wind-sea and swell information. Based on the weather forecasts, we have evaluated the forecast model for MWH. The atmospheric prediction is used by ensemble forecasts of the Japan Meteorological Agency (JMA). The meteorological forecasts by JMA have been distributed once every 5 days, and the MWH forecasts were virtually simulated from the meteorological data averaged for 30 days at the beginning of the month.

RESULTS

The monthly ensemble mean wave heights from October 2021 to March 2022 were calculated and compared with the observed waves. The monthly mean wave heights were compared with the ensemble mean calculation and observation by observation (NOWPHAS) in October 2021. NOWPHAS system is the wave information network in Japan conducted by the following organizations. Although the difference between the observation and calculation waves can be confirmed at some points on the Pacific side, the ensemble mean wave prediction results generally agree with the observed wave. The difference in the wave predictions is probably caused by swell propagating from the Pacific side and the topography. Figure 2 shows the correlation between estimation wave

height and observation wave. Circles indicate the ensemble mean, and vertical lines indicate the spread of the ensemble. It is found that the correlation is higher on the Japan sea side than on the Pacific side. In addition, the tendency for the ensemble to be wide was remarkable on the Japan sea. This is because the wave height on the Sea of Japan side in winter is greatly affected by the strong winter wind. Therefore, it depends almost on the local wind at the Japan seaside. These results indicate that the prediction wave is in good agreement with the observed wave.

REFERENCES

Kishimoto, R., T. Shimura, N. Mori and H. Mase (2017): Hydrological Research Letters, Vol.11(1), pp.51-57.

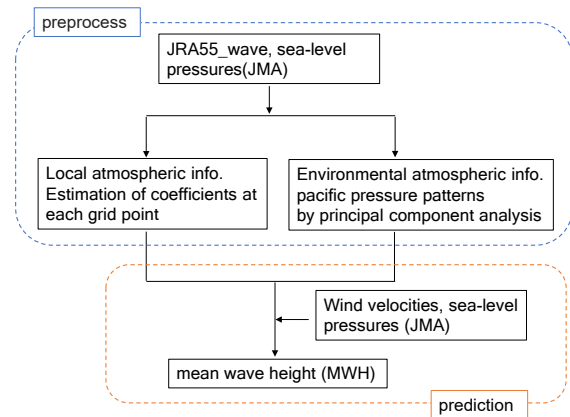


Figure 1 - Computational flow of forecast model.

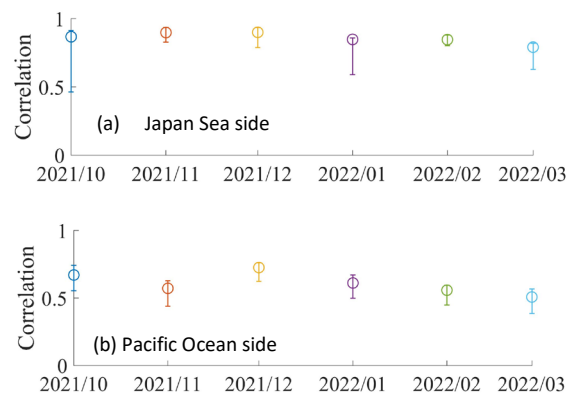


Figure 2 - Correlation between wave height forecasts and observation data along the Japanese coast.