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Real-time Japanese nearshore wave prediction for one-week later using GMDH and global wave forecast data

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The present study addresses how one-week later nearshore wave heights and periods are predicted by using a machine learning technique and global wave forecast data. For the machine learning technique, Group Method of Data Handling (GMDH) is used. The GMDH uses computer-based mathematical modeling of multi-parametric regression characterized by fully automatic structural and parametric optimization first introduced by Ivankhnenko (1971). The algorithm of GMDH can be described by a self-selecting procedure deriving a multi-order polynomial to predict an accurate output. Since its procedure is similar to a feed-forward transformation, the algorithm is called a Polynomial Neural Network (Onwubolu, 2016).

For the global wave forecast data, the datasets released by the Japan Meteorological Agency (JMA), National Oceanic and Atmospheric Administration (NOAA), and European Centre for Medium-Range Weather Forecasts (ECMWF). The global wave forecasts are generally available every 6 hours, with forecast out 180 hours in the future. However, since timely available forecasts are produced on synoptic scaled calculation domains, a consistent level of predictive accuracy at specific locations along Japanese coasts cannot be expected from the viewpoint of spatial resolution.

The present study aims to aid harbor and marine construction by establishing a nearshore wave prediction model for 14 stations around Japan that forecast up to one week in the future.

When the GMDH-based wave model uses the input data of global wave data by NOAA and ECMWF, the estimations of significant wave heights agreed well with observations. On the other hand, a combination of JMA and ECMWF wave data gave a good performance for significant wave periods. Since the present method transforms global wave prediction data into local nearshore waves by GMDH, it is possible at any concerned location where the nearshore wave observations can be obtained for the training of GMDH.