Forecasting ocean wave energy: A Comparison of the ECMWF wave model with time series methods

Recently, the technology has been developed to make wave farms commercially viable. Since electricity is perishable, utilities will be interested in forecasting ocean wave energy. The horizons involved in short-term management of power grids range from as little as a few hours to as long as several days. In selecting a method, the forecaster has a choice between physics-based models and statistical techniques. A further idea is to combine both types of models. This paper analyzes the forecasting properties of a well-known physics-based model, the European Center for Medium-Range Weather Forecasts (ECMWF) Wave Model, and two statistical techniques, time-varying parameter regressions and neural networks. Thirteen data sets at locations in the Atlantic and Pacific Oceans and the Gulf of Mexico are tested. The quantities to be predicted are the significant wave height, the wave period, and the wave energy flux. In the initial tests, the ECMWF model and the statistical models are compared directly. The statistical models do better at short horizons, producing more accurate forecasts in the 1–5 h range. The ECMWF model is superior at longer horizons. The convergence point, at which the two methods achieve comparable degrees of accuracy, is in the area of 6 h. By implication, the physics-based model captures the underlying signals at lower frequencies, while the statistical models capture relationships over shorter intervals. Further tests are run in which the forecasts from the ECMWF model are used as inputs in regressions and neural networks. The combined models yield more accurate forecasts than either one individually.

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