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Evaluation of probabilistic forecasting of atmospheric and ocean conditions on the Southern North Sea using the ECWMF Ensemble Prediction System

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To reduce the cost for development of large offshore wind farms, design, installation and planning of large scale wind farms should be approached using probabilistic methods. In meteorology, probabilistic weather forecasts are usually derived from the Ensemble Prediction System (EPS),in which a number of separate weather forecasts is produced by launching an ensemble of weather forecasting models which differ from each other with respect to the applied initial conditions for atmospheric fields. In this study, we have verified the 50 member EPS of the European Center for Medium-Ranged Weather Forecasts (ECMWF) on a forecast range of 10 days against observed atmospheric and ocean conditions during 2013 and 2014 over the southern part of the North Sea. The forecasts have been compared to re-analyses from the KNMI wind (KNW) atlas and to deterministic forecasts produced by the High-Resolution ECMWF forecasting system, and the operational regional scale Harmonie model. Observations include wind speed profile observations up to 300 m heights at the IJmuiden measurement tower, which is located 75 km out of the coast of North Holland. The skill of the ECMWF EPS for forecasting lateral variations of wind speed, significant wave heights and wave periods is evaluated using observations that are taken at or in the vicinity of oil drilling platforms in the Southern North Sea. For wind speed, it appears that the ECMWF EPS has a negative bias, especially for high wind speeds. This negative bias results in forecasts that have a relatively low reliability with rank histograms that are skewed to the right. Note that the Mean Absolute Error of the ensemble mean is similar to the deterministic forecasts by HRES ECMWF and the operational Harmonie model, while biases (forecast minus observation) are comparable the HRES ECMWF forecast and somewhat higher than the overall biases of the operational Harmonie model. For waves, reliability diagrams and rank diagrams indicate a relatively low reliability, while for short lead time wave forecasts, the performance of the ECMWF EPS is also hampered by the fact that no perturbations are applied to the ocean state fields.