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Point-Specific Wind Forecasting using the HARMONIE Mesoscale Forecast Model with Bayes Model Averaging for Fine-Tuning

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Two distinct elements seem to be required to make accurate wind-speed forecasts for wind-farms: the first is deterministic output from a weather forecast model, and the second is some probabilistic or statistical post-processing to account for local biases, or systematic errors in the model. A variety of statistical post-processing schemes are available, and are generally worthwhile since they are cheap and at worst do no harm. More typically, they demonstrably improve the accuracy of the deterministic forecast.

Gridded output from the operational HARMONIE mesoscale weather forecast model has been interpolated to forecast winds at the precise (3-dimensional) location of the met-mast of a wind farm in southwest Ireland. A sequence of 48-hour forecasts run at 6-hourly intervals for over one year have been validated against winds recorded at turbine height on the mast. All the interpolated deterministic forecasts are also post-processed using Bayesian Model Averaging (BMA) to remove systematic local bias, and to provide forecasts in a calibrated probabilistic format.

Three variants of the HARMONIE model were also run during October 2010 and validated against the winds recorded at the met-mast. The HARMONIE variant with the most advanced physics and the larger domain was the most accurate in forecasting met-mast windspeed, with mean average error (MAE) of 1.5 ms-1 (i.e. about 10% of mean wind speed). The BMA analysis for this short period (using a 25-day training period) did not change the MAE for the best HARMONIE configuration, but did improve the MAE of the other two by about 15%. The most advanced HARMONIE configuration proved more accurate than an ensemble of all three. There was negligible degradation in the skill of the hourly forecasts, at least out to 24 hours (i.e. 24-hr forecasts were only marginally less accurate than 0-hr analyses or 1-hr forecasts).

Results are presented from the operational 48-hr HARMONIE forecasts collected during Jan.-Mar. 2012, as compared with recorded winds at the met-mast. The added value of BMA post-processing (using a moving 25-day training period) is quantified.

Forecasts from an experimental extra high-resolution HARMONIE (1km resolution, on a 1,000 x 1,000 km domain) are available for a continuous 30-day period starting 10 Nov. 2012, and the extra skill provided by this for the specific wind-farm site is also quantified.