LIMITED AREA FORECASTING FOR WIND ENERGY SCHEDULING

CITIES
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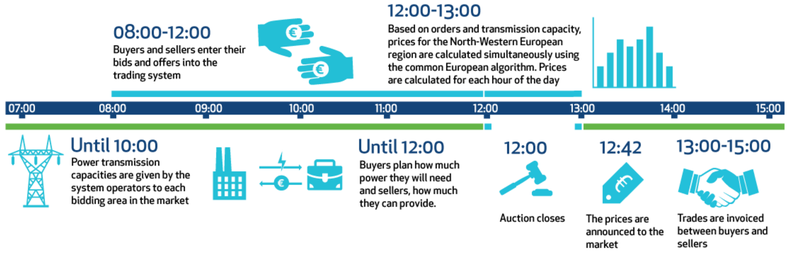
MOTIVATION

For any energy system relying on wind power detailed knowledge of near-future wind fluctuations is essential for efficient utilisation in the power grid. To this end, accurate weather forecasts constitute vital input and this study concerns assessment of the value added by increasing the resolution of global weather forecasts using a specific configuration of a limited area weather forecast model (the Weather Research and Forecasting model; WRF).

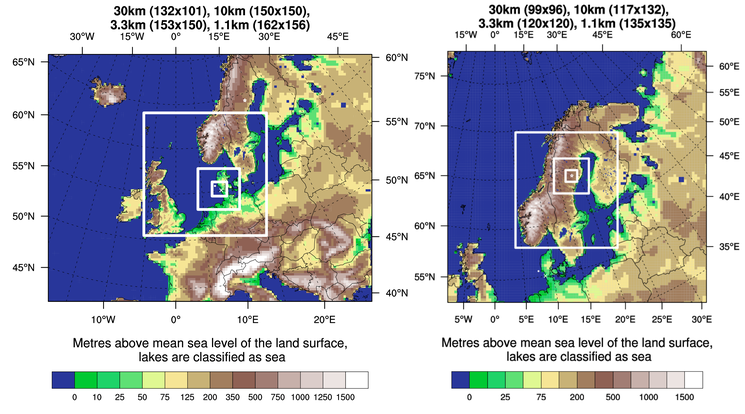
Objective:

Quantify the extent to which WRF predictions can add value, relative to Global Forecast System (GFS) predictions, to day ahead wind power scheduling for efficient Elspot market trading.



THREE WIND FARM FORECAST CASES

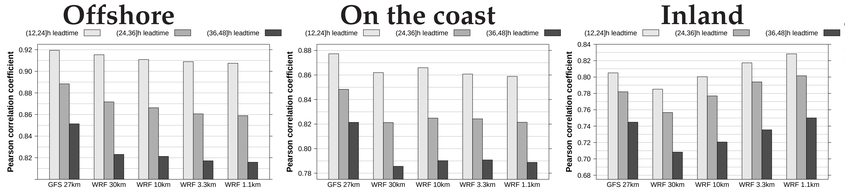
The forecast dataset consists of twice-daily (0000 and 1200 UTC) 48-hour WRF model forecasts, generated for the time period May 2012 to May 2013, for three wind farms offshore, on the coast and inland, respectively. The forecast reference is farm-averaged wind turbine nacelle anemometer measurements.



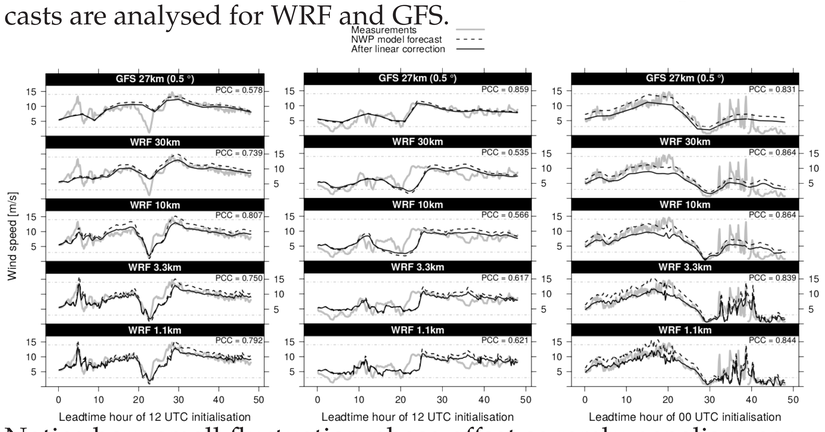
WRF grid values are tricube-weighted according to wind farm radius and GFS grid values are bilinearly interpolated to wind farm centre coordinates.

RESULTS

Performance in terms of PCC is shown below (MAE and RMSE are sensitive to model bias, which can be corrected for)

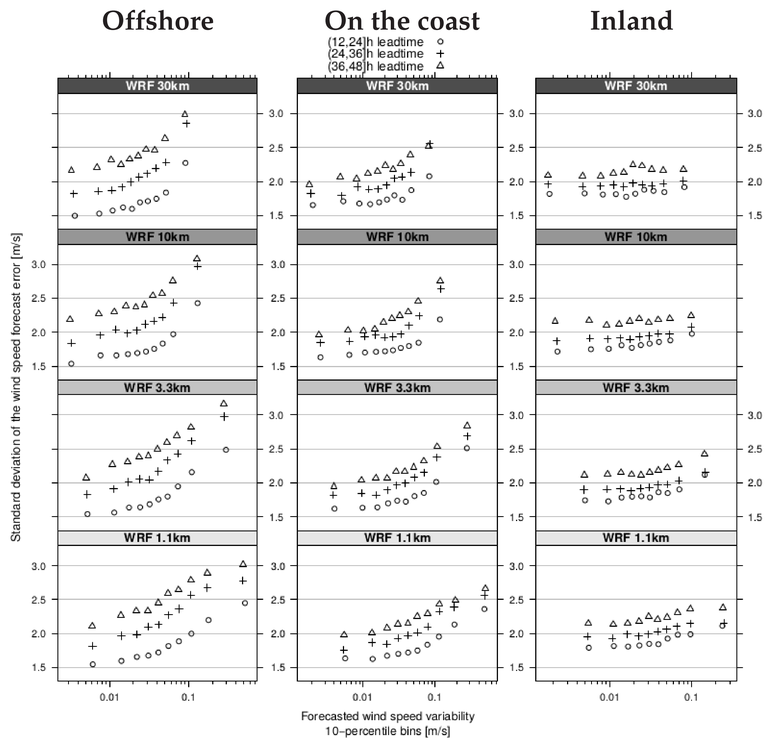


WRF improvement for inland site where the global model cannot resolve topography in sufficient detail. Near-ocean WRF predictions are inferior to GFS predictions in terms of scalar accuracy metrics. In order to understand why, individual wind speed forecasts are analysed for WRF and GFS.



Notice how small fluctuation phase offset severely penalises performance in terms of scalar accuracy metrics (PCC value in upper right corner). Temporal smoothing improves WRF performance in terms of scalar accuracy metrics (not shown) and prediction of wind speed ramp objects is more accurate at high WRF model resolution (not shown).

GFS forecasts are @ three-hour resolution, WRF resolution may be as fine as the integration time step. Wind speed variability added to WRF output; *can this quantity predict wind farm production uncertainty?*



Forecasted wind speed variability is a feasible predictor for wind power uncertainty **near the ocean**. Over land the explanatory effect severely diminishes.

CONCLUSION

WRF model performance in terms of scalar accuracy metrics is deteriorating with model resolution offshore and on the coast, while improvement relative to the GFS forecasts is achieved inland. The forecast examples illustrate how close-to-correct wind speed simulations subject to slight phase errors and/or temporal dilation are severely penalised in terms of PCC.

However, in terms of wind speed ramp objects a nearly consistent improvement in the Critical Success Index is observed across a range of different ramp widths (not shown). Finally, forecasted wind speed variability may serve as predictor for wind speed prediction uncertainty – and hence also wind power prediction uncertainty.

ACKNOWLEDGEMENT

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