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Forecasting the weather
- ensemble techniques
in probabilistic weather prediction

Assessment of ECMWF's 100m EPS winds in probabilistic Wind Power Forecasting

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For many years wind power deployment is increasing rapidly and has become a very important market in terms of business and energy production. The current perspective of the European Wind Energy Association states that around 400 GW of installed wind power capacity (250 GW onshore and 150 GW offshore) will supply 30% of Europe's electricity consumption in 2030.

Increasing wind power capacities require very good predictions of wind power production to enable save grid integration while keeping the very high level of reliability of the European power supply system.
Continuous improvement is indispensable and is requested by all stakeholder of the electricity market (Transmission System Operators (TSOs), energy traders, wind farm operators). The day-ahead (24- 48h) deterministic prediction of wind power is nowadays an established product and is in general of very good quality. However, end-users of wind power predictions start to request additional information on the uncertainty of wind power forecasts when scheduling power reserves or marketing wind energy. Thus, more and more wind power forecast products with prediction intervals on confidence are offered for commercial use. However, research is still ongoing to make best use of Ensemble Prediction Systems (EPS) that are operational at various NWP centers.

The special interest of this paper is to assess the benefit of ECMWF's EPS wind speeds at hub height (∼100m) of wind turbines over the usage of 10m wind speeds in probabilistic wind power forecasting. In January 2010 ECMWF started operationally to generate a wind speed product in 100m height tailored to wind energy applications since archiving of EPS model levels is too costly. This request for 100m winds was brought forward by the wind energy community within the EU-Project SafeWind.
A very efficient wind power prediction model is used to process all 50 ensemble members to compute probabilistic wind power forecasts for Germany and Denmark. The wind power prediction model is based on principle component regression techniques of the wind speed to reduce the degrees of freedom. Using 100m winds overcome the known disadvantage that the usage of 10m winds is almost irrelevant for non-neutral atmospheric conditions. In stable stratification wind speeds at hub height of wind turbines are underestimated while wind speeds are overestimated in non-stable situations. Hence, the diurnal cycle of wind speeds at hub height over land can not be captured very well by 10m winds, because extra information on thermal stability while extrapolating 10m winds to hub height is not available in the EPS.

The evaluation is done using a range of probabilistic skill scores like Brier Skill Score, ROC Area, Reliability Diagram, and Ignorance Score.