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Impact of increasing spatial Model Resolution on the Accuracy of Wind Power Forecasts

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In some European countries peak penetration of wind power has reached shares of up to 30-40% of demand, in particular during night times. The average penetration is 5.7, 8.8, and 20% for Germany, Spain and Denmark, respectively. Wind power forecasting system became an essential tool for Transmission System Operators (TSOs) to savely integrate fluctuating wind power into the grid. However, it is increasingly important to cut down costs for regulative power regarding the economic value of wind power.

Fighting CO_2 emissions the shares of renewable energy sources (RES) shall reach 20% of total energy use in Europe by 2020 following political targets. It is expected that wind energy capacities in Europe will be increased by a factor of 6 in 2030 totalling 300 GW. Higher accuracy of wind forecasts provided from global or regional numerical weather prediction models will be the key driver to improve wind power forecasts. While these improvements can be changes to the data assimilation system, new and revised physical processes, this paper will investigate the impact of the spatial model resolution on aggregated wind power forecasts for entire Germany.

Long timeseries of forecasts that are based on the same model and that are only different in the horizontal and vertical resolution are available from the European Centre for Medium-Range Weather Forecasts (ECMWF). Forecasts of the latest deterministic forecast model version running T799 resolution with 91 vertical levels are compared with the control forecasts of the Ensemble Prediction System (EPS). The control forecasts are computed with T399 and 62 vertical levels. In order to make results comparable both forecasts are used on the same 0.5×0.5 degree grid.

The used wind power forecasting model is based on principle component regression techniques of the wind speed over Germany. It is shown that 6 to 8 eigenvectors are sufficient to describe the forecasted wind speed field. The time dependent principle components are predictors to estimate the total wind power in Germany.

The average wind power forecast error for all lead-times up to 72 hours is 7.5% (root mean square error normalized with the rated wind power capacity) using the lower resolution control forecast and 7.0% using the deterministic forecast. The verification period is one year. The ability to predict extreme events will be compared in the presentation.