EMS Annual Meeting Abstracts
Vol. 12, EMS2015-213, 2015
15th EMS / 12th ECAM

Benefits of an ultra large and multiresolution ensemble for estimating available wind energy

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The stochastic nature of weather imposes wind power as an uncertain source of electrical energy. With the rapid growth of installed capacity, stable power grid management and energy trade on stock markets call for improvement of probabilistic wind power forecasts. It is generally agreed that the major potential lies in the improvement of the underlying weather forecast.

In some European countries during low-load periods, power plants already form a major fraction of the electricity supply. In the short- and medium-range, current wind power forecast systems rest in general on NWP models. As Ensemble Forecasting is known to reduce the forecast error significantly, it is already applied to generate probabilistic power forecasts, but in a limited manner.

Only calibrated ensembles from meteorological institutions serve as input so far, with limited spatial resolution ($\sim 10-80$ km) and member number (~ 50). Perturbations related to the specific merits of wind power production are yet missing. Thus, single extreme error events which are not detected by such ensemble power forecasts occur infrequently.

Therefore, we investigate the benefit of a short-term (1 to 48 hour) balanced and multiresolution (up to ~ 1 km) meteorological ensemble using an ultra large ensemble size with up to 1000 members. The numerical forecast model used in this project is the Weather Research and Forecasting Model (WRF). To generate ensemble members, model uncertainties are represented by stochastic parametrization of sub-grid processes via stochastically perturbed parametrization tendencies and in conjunction via the complementary stochastic kinetic-energy backscatter scheme already provided by WRF. We perform continuous ensemble updates by comparing each ensemble member with available observations using a sequential importance resampling filter to improve the model accuracy while maintaining ensemble spread. Additionally, we use different ensemble systems from global models (ECMWF and GFS) as input to capture different synoptic conditions.