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On the Improvement of Numerical Weather Prediction by Assimilation of Hub Height Wind Information in Convection-Resulted Models

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Determining the amount of weather dependent renewable energy is a demanding task for transmission system operators (TSOs). In the project EWeLiNE funded by the German government, the German Weather Service and the Fraunhofer Institute on Wind Energy and Energy System Technology strongly support the TSOs by developing innovative weather- and power forecasting models and tools for grid integration of weather dependent renewable energy.

The key in the energy prediction process chain is the numerical weather prediction (NWP) system. With focus on wind energy, we face the model errors in the planetary boundary layer, which is characterized by strong spatial and temporal fluctuations in wind speed, to improve the basis of the weather dependent renewable energy prediction. Model data can be corrected by postprocessing techniques such as model output statistics and calibration using historical observational data. On the other hand, latest observations can be used in a preprocessing technique called data assimilation (DA). In DA, the model output from a previous time step is combined such with observational data, that the new model data for model integration initialization (analysis) fits best to the latest model data and the observational data as well. Therefore, model errors can be already reduced before the model integration.

In this contribution, the results of an impact study are presented. A so-called OSSE (Observation Simulation System Experiment) is performed using the convective-resoluted COSMO-DE model of the German Weather Service and a 4D-DA technique, a Newtonian relaxation method also called nudging. Starting from a nature run (treated as the truth), conventional observations and artificial wind observations at hub height are generated. In a control run, the basic model setup of the nature run is slightly perturbed to drag the model away from the beforehand generated truth and a free forecast is computed based on the analysis using only conventional observations. In a second run forecasts start from an analysis including the artificial wind information. A comparison between those two free forecasts shows the potential of hub height wind information for NWP. The spatiotemporal impact of the artificial wind observations is discussed on the basis of 68 representative wind farm sites located in Germany.