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Intercomparison of state-of-the-art models for wind energy resources with mesoscale models:

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1. Introduction
Mesoscale models are increasingly being used to estimate wind conditions to identify perspective areas and sites where to develop wind farm projects. Mesoscale models are functional for giving information over extensive areas with various terrain complexities where measurements are scarce and measurement campaigns costly. Several mesoscale models and families of models are being used, and each often contains thousands of setup options. Since long-term integrations are expensive and tedious to carry out, only limited comparisons exist. To remedy this problem and for evaluating the capabilities of mesoscale models to estimate site wind conditions, a tailored benchmarking study has been co-organized by the European Wind Energy Association (EWEA) and the European Energy Research Alliance Joint Programme Wind Energy (EERA JP WIND). EWEA hosted results and ensured that participants were anonymous. The blind evaluation was performed at the Wind Energy Department of the Technical University of Denmark (DTU) with the following objectives: (1) To highlight common issues on mesoscale modelling of wind conditions on sites with different characteristics, and (2) To identify gaps and strengths of models and understand the root conditions for further evaluating uncertainties.
2. Approach
Three experimental sites were selected: FINO 3 (offshore, GE), Høvsore (coastal, DK), and Cabauw (land-based, NL), and three other sites without observations based on . The three mast sites were chosen because the availability of concurrent suitable time series of vertical profiles of winds speed and other surface parameters. The participants were asked to provide hourly time series of wind speed, wind direction, temperature, etc., at various vertical heights for a complete year. The methodology used to derive the time series was left to the choice of the participants, but they were asked for a brief description of their model and many other parameters (e.g., horizontal and vertical resolution, model parameterizations, surface roughness length) that could be used to group the various models and interpret the results of the intercomparison.
3. Main body abstract
Twenty separate entries were received by the deadline of 31 March 2015. They included simulations done with various versions of the Weather Research and Forecast (WRF) model, but also of six other well-known mesoscale models. The various entries represent an excellent sample of the various models used in by the wind energy industry today.
The analysis of the submitted time series included comparison to observations, summarized with well-known measures such as biases, RMSE, correlations, and of sector-wise statistics, e.g. frequency and Weibull A and k. The comparison also includes the observed and modeled temporal spectra. The various statistics were grouped as a function of the various models, their spatial resolution, forcing data, and the various integration methods. Many statistics have been computed and will be presented in addition to those shown in the Helsinki presentation.
4. Conclusions
The analysis of the time series from twenty entries has shown to be an invaluable source of information about state of the art in wind modeling with mesoscale models.
Biases between the simulated and observed wind speeds at hub heights (80-100 m AGL) from the various models are around ± 1.0 m/s and fairly independent of the site and do not seem to be directly related to the model horizontal resolution used in the modeling. As probably expected, the wind speeds from the simulations using the various version of the WRF model cluster close to each other, especially in their description of the wind profile.