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The relation between spatial and temporal mesoscale wind fluctuations

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The amount of produced wind energy is rising and this energy is due to the wind characteristics highly fluctuating. The safe integration of wind energy into the transmission grid requires high-quality wind power predictions. To develop new prediction models, the atmospheric processes and conditions which lead to strong wind fluctuations have to be understood and a suitable measure for wind fluctuations has to be defined.

The focus of our work is on mesoscale wind fluctuations with a duration of one minute to several hours. We analyse wind field measurements and numerical simulations at an offshore site with a size of several kilometres. An offshore site was chosen because in an offshore wind park, a large installed power is built on a small geographical area. Thus many turbines are effected by local wind fluctuations and large power fluctuations are expected.

Firstly, meteorological data for Germany were analysed, which were generated by dynamical downscaling with the Weather Research and Forecasting (WRF) model. As initial and boundary conditions the Modern Era Reanalysis for Research and Application (MERRA) was used. The resulting WRF data have a spatial resolution of 1.75 km and a time step of 10 min. This allows the investigation of both, the spatial pattern of wind fluctuations and the wind time series. Furthermore it is possible to examine the interaction of the spatial and the temporal wind fluctuations. Apart from the wind components, six additional meteorological variables are available to find interdependencies between the wind fluctuations and meteorological situation. Furthermore, Lidar measurements of the inflow of an offshore wind park and point measurements of different meteorological variables are available. These measurements were used to verify the results obtained from the WRF data.