



Comparison of Large-Eddy Simulation and Engineering Wake Model Results for Offshore and Onshore Sites

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With the help of Large-Eddy Simulations (LES) wake deficits in velocity and power output behind wind turbines can be simulated with high resolution and with the possibility to consider many significant effecting parameters. But LES in general take a long time to simulate even only short periods of time and are therefore expensive, especially if the actuator line method is used as wind turbine parameterization. However, for many applications, such as planning the layout of a new wind farm, it is necessary to get valid results pretty fast. For this reason much simpler and faster engineering wake models were developed and are still used by many wind turbine manufacturers or wind energy project developers. Our comparison of results of both types of models shall highlight differences in results between those models and expose how engineering wake models can be improved.

We compared results of wake situations simulated with the parallelized LES-Model PALM and with our engineering wake model (Wind) Farm Layout Program FLAP. In FLAP both models, one based on Ainslie (1988) and the other based on Jensen (1983) and Katic (1986), are used for this comparison. Simulations of two different sites – Alpha Ventus as example for an offshore and a wind farm in Schleswig-Holstein for an onshore wind farm – are done with both models. Furthermore, different meteorological situations are considered. Additional, results of both models are compared to measurements (met mast and SCADA-data) to verify both models.

At first differences (e.g. in time step, resolution etc.) between PALM and FLAP results had to be neglected otherwise the comparison would have given slurred results. After averaging PALM and weighting FLAP results velocity and power output deficit, turbulence intensity, wake width and other parameter were compared. This comparison will for example be used to calibrate parameters for wake width calculations in FLAP.