

ACD MODELLING OF WAKE INTERACTIONS IN HORNS REV WIND FARM

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ABSTRACT

Large eddy simulations of the Navier-Stokes equations are performed to simulate the Horns Rev off shore wind farm 15 km outside the Danish west coast. The aim is to achieve a better understanding of the wake interaction inside the farm. The simulations are performed by combining the in-house developed computer code EllipSys3D with the actuator-disc methodology. In the actuator-disc method the blades are represented by a disc at which body forces representing the aerodynamic loading are introduced. The body forces are determined by computing local angles of attack and tabulated aerofoil coefficients. The advantage of using the actuator-disc technique is that it is not necessary to resolve blade boundary layers since the computational resources are devoted to simulating the dynamics of the flow structures.

In the present study approximately 13.6 million mesh points are used to resolve the wake structure in the park. The park contains 80 wind turbines distributed over an area of about 20 km². Since it is not possible to simulate all turbines, the 2 central columns of turbines have been simulated with periodic boundary conditions. This corresponds to an infinitely wide farm with 10 turbines in downstream direction. Simulations were performed within plus minus 15 degrees of the turbine alignment, making the wide farm approximation reasonable.

The results from the CFD simulations are evaluated and the downstream evolution of the velocity field is depicted. Special interest is given to what extent the production is dependent on the inflow angle and turbulence level.

The study shows that the applied method captures the main production variation within the wind farm. The result further demonstrates that levels of production correlate well with measurements. However, in some cases the variation of the measurement data is caused by variation of measurement conditions with inflow angles.

References

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