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Large-eddy simulations of the Lillgrund wind farm KARL NILSSON, KTH Mechanics, SIMON-PHILIPPE BRETON, Uppsala University Campus Gotland, STEFAN IVANELL, DAN HENNINGSON, KTH Mechanics — Large-eddy simulations using the EllipSys3D Navier-Stokes solver developed at DTU/Risø combined with an actuator disc (ACD) method for rotor modeling are performed to compute the power production of the turbines in the Lillgrund wind farm. The ACD method models the rotor with body forces determined from drag and lift coefficients which are tabulated as functions of the angle of attack. As the boundary layer over the blades is not resolved, this approach greatly reduces the computational costs compared to simulations involving the modeling of the full blade geometry. The simulations are performed both with a recently implemented power controller, which forces the turbines to adapt their rotational speed to the conditions they are operating in, and without any controller, where all turbines are given a fixed rotational speed. The atmospheric conditions are modeled using pre-generated turbulence and a prescribed boundary layer. Only a marginal difference is found between the results from the simulations with and without the controller. The simulation results show a very good agreement with measured production from the real farm. Therefore, it can be concluded that the simulation method realistically predicts the power production of the Lillgrund wind farm.

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