Large-eddy simulations of the Lillgrund wind farm

The power production of the Lillgrund wind farm is determined numerically using large-eddy simulations and compared with measurements. In order to simulate realistic atmospheric conditions, pre-generated turbulence and wind shear are imposed in the computational domain. The atmospheric conditions are determined from data extracted from a met mast, which was erected prior to the establishment of the farm. In order to allocate most of the computational power to the simulations of the wake flow, the turbines are modeled using an actuator disc method where the discs are imposed in the computational domain as body forces which for every time step are calculated from tabulated airfoil data. A study of the influence of imposed upstream ambient turbulence is performed and shows that higher levels of turbulence results in slightly increased total power production and that it is of great importance to include ambient turbulence in the simulations. By introducing ambient atmospheric turbulence, the simulations compare very well with measurements at the studied inflow angles. A final study aiming at increasing the farm production by curtailing the power output of the front row turbines and thus letting more kinetic energy pass downstream is performed. The results, however, show that manipulating only the front row turbines has no positive effect on the farm production, and therefore, more complex curtailment strategies are needed to be tested. Copyright © 2014 John Wiley & Sons, Ltd.