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Real Scale Wind Turbine Wake Comparisons Applying LES-IB Simulations

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ABSTRACT

Numerical modeling has been employed for wind power projects to solve the properties of the turbulent flows in detail. In the present study, LES and IB methods have been coupled to model turbulent flows around single and coupled wind turbines. The simulations aim to describe the dynamics of the turbulent flows in detail and the interactions of the wind with the turbine structures. The simulation scenario was based on the real scale case of NREL 5 MW. The LES simulations are performed in a dynamically adaptive mesh refinement environment. The present work provides an accurate yet affordable methodology for predicting wind structures and the design of wind turbines. This work contributes to a range of aspects: (i) leading MFSim platform to applications in the wind industry branch, real scale wind turbine, as the measurements by met towers and other equipment provide results only for specific points or at most small regions of the flow; (ii) comprise a full rotor simulation applying LES-IB, for real scale wind turbine; (iii) evaluating the dynamic adaptive meshing tool by vorticity criteria already implemented in the MFSim code to capture turbulent structures and vortices in the downstream wake region of the turbine. In order to compare the results obtained by the MFSim simulation, the results are compared with the TOSCA platform developed, which is crucial to verify and validate our work due to the lack of wake results available for the large scale NREL 5 MW experimental measurements.

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