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LES of wind turbine wakes: Evaluation of turbine parameterizations FERNANDO PORTE-AGEL, University of Minnesota, YU-TING WU, LEONARDO CHAMORRO — Large-eddy simulation (LES), coupled with a wind-turbine model, is used to investigate the characteristics of wind turbine wakes in turbulent boundary layers under different thermal stratification conditions. The subgrid-scale (SGS) stress and SGS heat flux are parameterized using scale-dependent Lagrangian dynamic models (Stoll and Porte-Agel, 2006). The turbine-induced lift and drag forces are parameterized using two models: an actuator disk model (ADM) that distributes the force loading on the rotor disk; and an actuator line model (ALM) that distributes the forces on lines that follow the position of the blades. Simulation results are compared to wind-tunnel measurements collected with hot-wire and cold-wire anemometry in the wake of a miniature 3-blade wind turbine at the St. Anthony Falls Laboratory atmospheric boundary layer wind tunnel. In general, the characteristics of the wakes simulated with the proposed LES framework are in good agreement with the measurements. The ALM is better able to capture vortical structures induced by the blades in the near-wake region. Our results also show that the scale-dependent Lagrangian dynamic SGS models are able to account, without tuning, for the effects of local shear and flow anisotropy on the distribution of the SGS model coefficients.

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