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A study of two subgrid-scale models and their effects on wake breakdown behind a wind turbine in uniform inflow[1] LUIS MARTINEZ, CHARLES MENEVEAU, Johns Hopkins University — Large Eddy Simulations (LES) of the flow past a single wind turbine with uniform inflow have been performed. A goal of the simulations is to compare two turbulence subgrid-scale models and their effects in predicting the initial breakdown, transition and evolution of the wake behind the turbine. Prior works have often observed negligible sensitivities to subgrid-scale models. The flow is modeled using an in-house LES with pseudo-spectral discretization in horizontal planes and centered finite differencing in the vertical direction. Turbines are represented using the actuator line model. We compare the standard constant-coefficient Smagorinsky subgrid-scale model with the Lagrangian Scale Dependent Dynamic model (LSDM). The LSDM model predicts faster transition to turbulence in the wake, whereas the standard Smagorinsky model predicts significantly delayed transition. The specified Smagorinsky coefficient is larger than the dynamic one on average, increasing diffusion thus delaying transition. A second goal is to compare the resulting near-blade properties such as local aerodynamic forces from the LES with Blade Element Momentum Theory. Results will also be compared with those of the SOWFA package, the wind energy CFD framework from NREL.

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