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LES of turbulent flow past axial flow turbines and turbine arrays: Model development and validation[1] FOTIS SOTIROPOULOS, SEOKKOO KANG, XIAOLEI YANG, LEONARDO CHAMORRO, CRAIG HILL, University of Minnesota — We present recent progress towards the numerical simulation of turbulent flows past axial-flow wind and hydrokinetic turbines and farms. For simulating multi-turbine arrays, we combine turbine parameterization approaches (actuator disk and actuator line models) with our curvilinear-immersed boundary (CURVIB) LES model. Simulations are carried out both for aligned and staggered wind farms and the computed results are compared with wind tunnel experiments carried out at the St. Anthony Falls Laboratory (SAFL) atmospheric boundary layer wind tunnel. Turbine geometry resolving simulations also employ the CURVIB-LES solver with a wall model and very fine computational grids. Simulations are reported for a complete model marine turbine mounted at the bottom of a straight open channel and the computed results are compared with laboratory experiments obtained in the SAFL Main Channel. The simulated flowfields are analyzed to elucidate the structure of the turbine wake, identify large-scale instabilities, and quantify the mechanisms of turbulence production in the near and far wakes.

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