Abstract Submitted
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LES studies of wind farms including wide turbine spacings and comparisons with the CWBL engineering model[1] RICHARD STEVENS, Johns Hopkins University; Twente University, DENNICE GAYME, Johns Hopkins University, JOHAN MEYERS, University of Leuven, CHARLES MENEVEAU, Johns Hopkins University — We present results from large eddy simulations (LES) of wind farms consisting of tens to hundreds of turbines with respective streamwise and spanwise spacings approaching 35 and 12 turbine diameters. Even in staggered farms where the distance between consecutive turbines in the flow direction is more than 50 turbine diameters, we observe visible wake effects. In aligned farms, the performance of the turbines in the fully developed regime, where the power output as function of the downstream position becomes constant, is shown to primarily depend on the streamwise distance between consecutive turbine rows. However, for other layouts the power production in the fully developed regime mainly depends on the geometrical mean turbine spacing (inverse turbine density). These findings agree very well with predictions from our recently developed coupled wake boundary layer (CWBL) model, which introduces a two way coupling between the wake (Jensen) and top-down model approaches (Stevens et al. JRSE 7, 023115, 2015). To further validate the CWBL model we apply it to the problem of determining the optimal wind turbine thrust coefficient for power maximization over the entire farm. The CWBL model predictions agree very well with recent LES results (Goit & Meyers, JFM 768, 5-50, 2015).

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Richard Stevens
Johns Hopkins University; Twente University

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