Abstract Submitted
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Properties of wind turbine wakes under various atmospheric stability conditions SHENGBAI XIE, CRISTINA ARCHER, University of Delaware — Large-eddy simulations (LES) are performed to study the properties of wind turbine wakes under various atmospheric stability conditions. The Wind Turbine and Turbulence Simulator (WiTTS), a 4^{th}-order finite-difference LES code is used for stable, neutral, and unstable conditions. The Coriolis forcing is also considered. Three cases are studied: isolated turbine, finite-size turbine array, and infinite wind farm. The results show strong correlations with stability. For the stable condition, the power extraction by an isolated turbine is highest, but the wake is also longest, thus the relative performance inside the array is lowest. In contrast, although the single-turbine power extraction is low for the unstable condition, the performance of downstream turbines is improved due to faster wake recovery. The wake shape is distorted by the stability-related wind veering. Therefore, the self-similar Gaussian wake deficit is not accurate. Here, a new wake model is proposed for correction. The infinite wind-farm case shows that the temperature near the ground is warmed by about 1 K for the stable condition, but the influence is almost negligible for the unstable and neutral conditions. For all conditions, the near-ground shear stress is reduced.

Shengbai Xie
University of Delaware

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