Abstract Submitted
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Large Eddy Simulation study of the fully developed wind-turbine array boundary layer[1] CHARLES MENEVEAU, Johns Hopkins University, MARC CALAF[2], Ecole Polytechnique Federale de Lausanne, Switzerland, JOHAN MEYERS, Katholieke Universiteit Leuven, Belgium — When wind turbines are deployed in large arrays, their efficiency decreases due to complex interactions among themselves and with the atmospheric boundary layer (ABL). For wind farms whose length far exceeds the height of the ABL, a fully developed flow regime can be established. Such a fully developed wind-turbine array boundary layer may be studied computationally using periodic boundary conditions in the horizontal direction. A suite of Large Eddy Simulations in which wind turbines are modeled using the classic "drag disk" concept are performed, in order to quantify the vertical transport of momentum and kinetic energy across the boundary layer. LES for various wind turbine arrangements, loading factors, and surface roughness are performed. Horizontally averaged statistics are documented. Results are compared with models for effective roughness length scales experienced by the ABL. This scale is often used to parameterize wind turbine arrays in models of atmospheric flow at regional or global scales. Based on the observed trends, a modified model is proposed showing improvements in the predicted effective roughness heights.

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