Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

The Fluid Physics Challenges of Atmospheric Flow Relevant to Wind Turbines JULIE LUNDQUIST, University of Colorado, Boulder — Our recent paper highlighted three grand challenges to drive innovation to meet future demand and functionality of wind energy. The first of these challenges, improved understanding of the physics of atmospheric flow and wind power plant flow physics, requires collaboration between the atmospheric science and wind energy engineering communities to enable improved wind energy forecasting, operations, and wind turbine/wind plant design. Wind turbines reside in the lower levels (e.g. 300 m) of the atmosphere, and so experience not only global meteorological phenomena, manifested as pressure gradient and Coriolis forces, but also localized friction and buoyant forces from the surface. This presentation will highlight advances and gaps in our knowledge of flows in complex terrain, varying stability conditions, and in the offshore environment. We also highlight recent developments in coupled mesoscale-microscale modeling, so that design and operations of wind plants can incorporate both weather and localized forcing. Finally, wakes from individual turbines and from wind plants themselves exert impacts on downwind turbines as well as local micrometeorological environments. Recent advances in wake modeling, prediction, measurement, and manipulation will be presented.

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Date submitted: 03 Aug 2020 Electronic form version 1.4