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A "Cyber Wind Facility" for HPC Wind Turbine Field Experiments JAMES BRASSEUR, ERIC PATERSON, SVEN SCHMITZ, ROBERT CAMPBELL, GANESH VIJAYAKUMAR, ADAM LAVELY, BALAJI JAYARAMAN, TARAK NANDI, PANKAJ JHA, ALEX DUNBAR, JAVIER MOTTAMENA, BRENT CRAVEN, Penn State U., SUE HAUPT, NCAR — The Penn State "Cyber Wind Facility" (CWF) is a high-fidelity multi-scale high performance computing (HPC) environment in which "cyber field experiments" are designed and "cyber data" collected from wind turbines operating within the atmospheric boundary layer (ABL) environment. Conceptually the "facility" is akin to a high-tech wind tunnel with controlled physical environment, but unlike a wind tunnel it replicates commercial-scale wind turbines operating in the field and forced by true atmospheric turbulence with controlled stability state. The CWF is created from state-of-the-art high-accuracy technology geometry and grid design and numerical methods, and with high-resolution simulation strategies that blend unsteady RANS near the surface with high fidelity large-eddy simulation (LES) in separated boundary layer, blade and rotor wake regions, embedded within high-resolution LES of the ABL. CWF experiments complement physical field facility experiments that can capture wider ranges of meteorological events, but with minimal control over the environment and with very small numbers of sensors at low spatial resolution. I shall report on the first CWF experiments aimed at dynamical interactions between ABL turbulence and space-time wind turbine loadings. Supported by DOE and NSF.

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