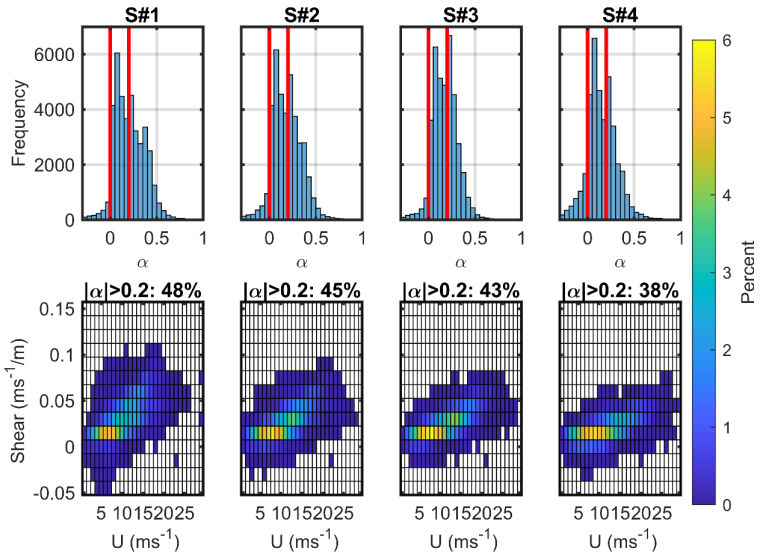
Reaching-up to power-up

U.S. Department of Energy | Office of Science
HYPERFACETS
A Framework for Improving Analysis and Modeling of Earth System and Intersectoral Dynamics at Regional Scales



Histogram of shear exponent (α) across the rotor plane for 4 different wind turbines (*H in m, D in m*); WT1:100,100. WT2:134,165. WT3:150,240. WT4:168,248. The red lines indicate the two thresholds for extreme shear exponent (α = 0 and 0.2). The bottom sub-panels show the joint probability distribution of the 10-min values of shear magnitude across the rotor plane and hub-height wind speed for each WT scenario. The title above each of these frames indicate the fraction of 10-min periods when the absolute value of α exceeded 0.2.

Barthelmie R.J., Shepherd T.J., Aird J.A. and Pryor S.C. (2020): Power and wind shear implications of large wind turbine scenarios in the U.S. Central Plains. *Energies* **13**(16) 4269 https://doi.org/10.3390/en13164269.

Scientific Achievement

Analyses of high-resolution WRF simulations indicate deployment of larger wind turbines in the US Great Plains yields considerable net benefits for both increased wind resources and has the co-benefit of reductions in fatigue loading related to vertical wind speed shear.

Significance and Impact

Increases in wind turbine dimensions are being driven in part by the desire to harness higher wind speeds aloft (increasing *hub-heights*) and to increase rotor-swept area (via increased *rotor diameters*). Concerns have been voiced that extending higher in the atmosphere might lead to increased wind loading and reduced wind turbine lifetimes. This research indicates this penalty is not realized over Iowa.

Research Details

We present and analyze simulations with Weather Research and Forecasting and realistic next generation wind turbines.