Downstream effects from contemporary wind turbine deployments - DTU Orbit (26/01/2019)

Downstream effects from contemporary wind turbine deployments

High-resolution regional simulations of the downstream effects of wind turbine arrays are presented. The simulations are conducted with the Weather Research and Forecasting (WRF) model using two different wind turbine parameterizations for a domain centered on the highest density of current wind turbine deployments in the contiguous US. The simulations use actual wind turbine geolocations and turbine specifications (e.g. power and thrust curves). Resulting analyses indicate that for both WT parameterizations impacts on temperature, specific humidity, precipitation, sensible and latent heat fluxes from current wind turbine deployments are statistically significant only in summer, are of very small magnitude, and are highly localized. It is also shown that use of the relatively recently developed new explicit wake parameterization (EWP) results in faster recovery of full array wakes. This in turn leads to smaller climate impacts and reduced array-array interactions, which at a system-wide scale lead to higher summertime capacity factors (2-6% higher) than those from the more commonly applied ‘Fitch’ parameterization. Our research implies that further expansion of wind turbine deployments can likely be realized without causing substantial downstream impacts on weather and climate, or array-array interactions of a magnitude that would yield substantial decreases in capacity factors.

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