10.2 Sensitivity of wind turbine array downstream effects to the parameterization used in WRF.

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High-resolution numerical simulations are conducted with the Weather Research and Forecasting (WRF) model using two different wind turbine (WT) parameterizations; (1) the Fitch parameterization that is included in WRF releases, and (2) the recently developed Explicit Wake Parameterization (EWP) scheme. The key difference between these two WT parameterizations is that while the Fitch scheme applies a (local) drag force and additional turbulent kinetic energy (TKE) to all model grid cells that intersect the turbine rotor, the EWP scheme parameterizes the unresolved wake expansion within the grid-cell and applies a grid-cell averaged drag force and additional TKE is introduced solely from the enhanced vertical shear due to the WT wake(s). Simulations reported herein are for a domain centered on the highest density of current wind turbine deployments in the contiguous US. In order to directly compare the two WT schemes, three identical inner domains (resolved at 4 km) (no WT, WT Fitch, WT EWP) are within the same coarse domain (12 km) run with no WT parameterization operating. Pairwise analyses are then applied to diagnose the downstream effects from the WT. It is shown that on average use of the EWP nested results in faster recovery of full WT array wakes. This in turn leads to smaller climate impacts and reduced array-array interactions, which at a system-wide scale lead to summertime capacity factors (i.e. the electrical power produced relative to nameplate installed capacity) that are 2-6% higher than those from the more commonly applied ‘Fitch’ parameterization.