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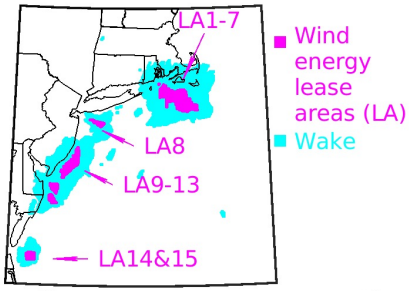
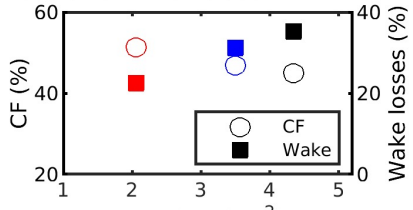
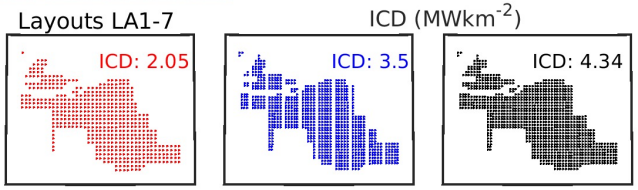
HYPERFACETS

A Framework for Improving Analysis and Modeling of Earth System and Intersectoral Dynamics at Regional Scales







Many countries are planning development of very large offshore wind farms to aid decarbonization of the energy sector. High-resolution numerical simulations are performed for the domain shown upper right, to quantify power production (capacity factors [CFs], high CF means higher efficiency of power production and lower wake losses) and the spatial scale and effects of downstream wakes (areas of disturbed flow) from lease areas that are under development along the U.S. east coast for different layouts (installed capacity density, ICD).

Pryor S.C., Barthelmie R.J. and Shepherd T.J. (2021): Wind power production from very large offshore wind farms. *Joule* **5** 2663-2686 doi: 10.1016/j.joule.2021.09.002

Scientific Achievement

We develop a modeling framework comprising; (a) new methods for efficiently developing robust assessment of power production from offshore wind turbines with WRF, (b) new metrics to quantify the spatial extent and intensity of wind turbine wakes, (c) generalized first-order scaling rules that describe how “wake shadows” from large offshore wind farms scale with prevailing meteorology and wind turbine installed densities.

Significance and Impact

The excellent wind resource and proximity to large markets along the U.S. east coast mean it is the focus of America’s first-phase offshore wind projects. The scale of these installations raises questions regarding potential reductions of electrical power production efficiency due to operation of wind turbines in disturbed flow (wakes) from upwind wind turbines and wind farms. It requires detailed and robust numerical tools.

Research Details

Very high-resolution simulations are performed with the WRF model and analyzed for the current generation of wind energy lease areas along the US east coast.