Center for Environmental & Applied Fluid Mechanics

& Co-hosted with ROSEI

"Enabling Renewable Energy Growth by Addressing Challenges in the Atmospheric Science of Wind Energy"

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As the world moves away from fossil fuels and towards more renewably-generated electricity, interdisciplinary challenges become more prominent. In the wind energy arena, the intersection of atmospheric science, engineering, and applied mathematics offer several interesting areas of research. In this talk, I will first survey some of the "Grand Challenges" of wind energy and then delve into details of specific areas of my research. These challenges include approaches for turbulence modelling, assessing the impacts of wind turbine wakes in the US East Coast wind resource areas, and quantifying uncertainty in those wakes.

At the most fundamental scale, the representations of atmospheric turbulence in numerical weather prediction models require revision, especially given that our simulation capabilities have outstripped some of the theoretical underpinnings. New observational approaches have let us measure the dissipation rate of turbulence kinetic energy in a broad range of circumstances so that we can document the inadequacies of current model parameterizations. I will present our observational methods and the variability of dissipation rate, and suggested machine-learning-based approaches for improving representation of dissipation rate in numerical weather prediction models.

At a larger spatial scale, an individual wind turbine will create a wake downwind. This wake region of slower wind will undermine power production of neighbouring turbines. The wake itself will vary with atmospheric conditions, and so predicting wake variability becomes critical for integrating large amounts of renewably-generated electricity into power grids. I will survey approaches for representing approaches for representing wakes in numerical weather prediction models and share some recent results of wake variability in the US East Coast wind resource areas, including some surprising insights into how those wakes affect meteorological phenomena like sea breezes.

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https://wse.zoom.us/j/93762992307

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