

SAFL SPECIAL SEMINAR

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ST. ANTHONY FALLS LABORATORY ~ AUDITORIUM



Enabling the expansion of wind energy with atmospheric science

Dr. Julie Lundquist

Staff Scientist

Atmospheric Earth and Energy Dept.

Lawrence Livermore National Laboratory

Wind energy offers the promise of a robust and inexhaustible domestic energy source. Not only do wind turbines provide power with minimal greenhouse gas emissions, but virtually no fresh water is required for power production. Wind energy capacity in the U.S. now produces enough electricity to power the equivalent of approximately 7 million households (American Wind Energy Association, 2009). Despite impressive recent growth, wind energy still constitutes less than 2% of US electricity sources. Several attainable technical challenges must be surmounted if electricity generated by wind is to provide a significant source of domestic power – recall that the Obama administration has defined a goal of 25% renewables by 2025.

This presentation will highlight some of these challenges, focusing on those that could be addressed through atmospheric science research. Then we will discuss an approach for providing accurate predictions of flow in complex terrain in order to support optimized wind farm siting, to enable efficient wind farm operations, to quantify impacts of wind farms on local climates, and to facilitate the integration of large quantities of renewable energy into power grids. Large-eddy simulation, which explicitly resolves the effects of atmospheric stability and terrain features on atmospheric turbulence, is required for capturing the complexities of turbulence and its effects on wind turbines. However, changing weather conditions also affect flow, and therefore accurate and flexible mesoscale models are needed to provide boundary conditions for the large-eddy simulations. Multi-scale simulations, where LES is nested into a mesoscale model, require nuanced representations of turbulence. This presentation will highlight results of nested large-eddy simulations within mesoscale simulations for wind energy applications.

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