ANIV-G Live Talks

Mesoscale simulations for wind energy applications

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Wednesday 14 January 2026, 16.00 (CET)

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Abstract

Wind turbines cause a reduction of wind speed and an increase of turbulence kinetic energy (TKE) in their wakes, thus they can alter the boundary layer wind and temperature distributions. As wind power expand worldwide, due to its environmental and economic benefits, concerns arise about the magnitude, spatial extent, and duration of such potential effects. High-fidelity simulations of wind flows around wind turbines (typically Large-Eddy Simulations, LES) assume constant meteorological conditions and therefore cannot properly account for the effect the wind turbines on the atmosphere around them. Mesoscale models, such as the Weather Research and Forecast (WRF) or the Model for Predictions Across Scales (MPAS), cannot simulate these effects directly either, because their coarse spatial resolution (order of a few kilometers) cannot resolve the wind turbines aerodynamics. Thus, the only way to simulate these effects is via a parameterization, which is basically a model, within the mesoscale model, of the sub-grid effects of the wind turbine wakes, not of the wakes themselves. In this seminar, I will review past and recent wind farm parameterizations and their applications, from the global to the regional scales, including potential effects of wind farms on hurricanes and a new parameterization of added TKE by wind turbines developed by my research group.

Short CV

Dr. Cristina L. Archer is a Professor in the Department of Geography and Spatial Sciences and in the Department of Mechanical Engineering at the University of Delaware. Dr. Archer is the Director of the Center for Research in Wind (CReW), which focuses on wind energy, in particular offshore, and its integration in the electric grid. She earned a B.S. in Civil and Environmental Engineering from the Politecnico di Milano (Milan, Italy) in 1995, an M.S. in Meteorology from San Jose State University in 1998, and a Ph.D. in Civil and Environmental Engineering from Stanford University in 2004. She was a Postdoc there in 2004-2005 and then worked as an Atmospheric Modeler in the air quality district of San Francisco in 2005-2007. Dr. Archer joined the Carnegie Institution for Science in 2007 as a Research Associate. She was an Assistant Professor in the Department of Geological and Environmental Sciences of the California State University Chico during 2008-2011 and then joined the University of Delaware in 2011. Dr. Archer's research interests include wind power, meteorology, air quality, climate change, numerical modeling, and computational fluid dynamics.