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Scanning of wind turbine upwind conditions: numerical algorithm and first applications MARC CALAF, GERARD CORTINA, Mechanical Engineering, University of Utah, VARUN SHARMA, MARC B. PARLANGE, School of Architecture, Civil and Environmental Engineering, EPFL — Wind turbines still obtain in-situ meteorological information by means of traditional wind vane and cup anemometers installed at the turbine's nacelle, right behind the blades. This has two important drawbacks: 1-turbine misalignment with the mean wind direction is common and energy losses are experienced; 2-the near-blade monitoring does not provide any time to readjust the profile of the wind turbine to incoming turbulence gusts. A solution is to install wind Lidar devices on the turbine's nacelle. This technique is currently under development as an alternative to traditional in-situ wind anemometry because it can measure the wind vector at substantial distances upwind. However, at what upwind distance should they interrogate the atmosphere? A new flexible wind turbine algorithm for large eddy simulations of wind farms that allows answering this question, will be presented. The new wind turbine algorithm timely corrects the turbines' yaw misalignment with the changing wind. The upwind scanning flexibility of the algorithm also allows to track the wind vector and turbulent kinetic energy as they approach the wind turbine's rotor blades. Results will illustrate the spatiotemporal evolution of the wind vector and the turbulent kinetic energy as the incoming flow approaches the wind turbine under different atmospheric stability conditions. Results will also show that the available atmospheric wind power is larger during daytime periods at the cost of an increased variance.

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