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Turbulence characteristics around a staggered wind farm configuration: A wind tunnel study LEONARDO CHAMORRO, ROGER ARNDT, FOTIS SOTIROPOULOS, University of Minnesota — Turbulent flow around a wind farm is characterized by the coexistence and superposition of multiple wind turbine wakes. The understanding of the momentum transport and velocity fluctuations at different locations in the wind farm is essential to improve energy production and the structural stability of the different turbines. In this study, a staggered model wind farm was placed in the boundary layer wind tunnel of the Saint Anthony Falls Laboratory at the University of Minnesota. The staggered wind farm consisted on 10 rows in the streamwise direction by 2–3 columns. A cross-wire anemometer was used to obtain high-resolution measurements of 2 velocity components (streamwise and vertical) inside and above the model staggered wind farm. Full characterization of the turbulent flow was obtained at a vertical plane parallel to the flow direction through the entire wind farm and at 4 spanwise vertical planes (located at 5 rotor diameter behind the 4th, 6th, 8th and the 10th row). Special emphasis is placed on the description of the enhancement of the turbulence levels in the wind farm as a function the number of rows of the wind farm as well as the growth of the internal boundary layer induced by the wind farm. The results are being used to develop new parameterizations of wind turbines for high-resolution and large-scale numerical models.

Leonardo Chamorro
University of Minnesota

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