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Comparison between Vertical-Axis Wind Turbine Arrays and Plant Canopies[1] MATTHIAS KINZEL, DANIEL ARAYA, JOHN DABIRI, California Institute of Technology — We present experimental results from three different full scale arrays of vertical-axis wind turbines (VAWTs) under natural wind conditions. One array consists of a row of four single turbines while the other two are made up of nine counter rotating turbine pairs. The wind velocities throughout the turbine arrays are measured using a portable meteorological tower with seven, vertically-staggered, three-component ultrasonic anemometers. Furthermore, the power output of each turbine is measured simultaneously with the free stream wind velocity and direction. These measurements yield detailed understanding of the aerodynamics inside the VAWT arrays and the resulting power productions. Quadrant hole analysis is employed to gain a better understanding of the vertical energy transport at the top of the VAWT array. Results comparing the energy transport and the responsible mechanisms between the larger turbine arrays and the four single turbines configuration will be presented. Furthermore, results are compared to the flow in urban and plant canopies. Emphasis is given to the flow physics in the adjustment region of the canopy, i.e. the region where the flow transitions from an atmospheric surface layer to a canopy flow.

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