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Development of a wind turbine wake in the infinite turbine array characterized via wall-normal-spanwise planes and cylindrical coordinates
RAÚL BAYOÁN CAL, NICHOLAS HAMILTON, Portland State University — A wind turbine wake was investigated experimentally through a wind tunnel experiment. Velocity fields oriented normal to the mean convective flow were measured using stereo-PIV every half-rotor diameter (6cm) in the wake. The full Reynolds stress tensor is available through SPIV measurements and shows that very near to the turbine the presence of the mast has a large influence over the stress fields. Further downstream gradients in the mean velocity soften and the stress fields become roughly axisymmetric. In the far wake of the wind turbine, the flow is well mixed and becomes more homogeneous, with vertical and spanwise velocities an order of magnitude less than inlet velocity. Previous research indicates that the flux in the vertical direction is the dominant contributor to the flux tensor in a plane aligned with the hub of the turbine. Data from the current experiment indicate that spanwise components of the flux tensor make a significant contribution at the edges of the wake. In polar-cylindrical coordinates, flux is considered radially inward from outside of the wake. In this frame of reference turbulence phenomena are assessed in a more natural sense. In a polar coordinate system, the production and flux tensors show a single dominant component, emphasizing the suitability of the current analysis.

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