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Analysis of Tip Vortices Identified in the Instantaneous Wake of a Horizontal-Axis Model Wind Turbine Placed in a Turbulent Boundary Layer AKASH JAIN, FARAZ MEHDI, JIAN SHENG, Texas Tech University — The near-wake field, a short region characterized by the physical specifications of a turbine, is of particular interest for flow-structure interactions responsible for asymmetric loadings, premature structural breakdown, noise generation etc. Helical tip vortices constitute a distinctive feature of this region and are dependent not only on the turbine geometry but also on the incoming flow profile. High-spatial resolution PIV measurements are made in the wake of a horizontal-axis model wind turbine embedded in a neutrally stratified turbulent boundary layer. The data is acquired over consecutive locations up to 10 diameters downstream of the turbine but the focus here is on the tip vortices identified in the instantaneous fields. Contrary to previous studies, both top and bottom tip vortices are clearly distinguishable in either ensemble fields or instantaneous realizations. The streamwise extent of these vortices stretches from the turbine till they merge into the expanding mid-span wake. The similarities and differences in the top and bottom tip vortices are explored through the evolution of their statistics. In particular, the distributions of the loci of vortex cores and their circulations are compared. The information will improve our understanding of near wake vortical dynamics, provide data for model validation, and aid in the devise of flow control strategies.

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