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A comparative quadrant analysis of canopy turbulence based on LES and field-PIV data WUSI YUE, WEIHONG ZHU, RENE VON HOUT, CHARLES MENEVEAU, Johns Hopkins University, Baltimore, Maryland, MARC PARLANGE, The Federal Institute of Technology at Lausanne, Switzerland, JOSEPH KATZ, Johns Hopkins University, Baltimore, Maryland — Based on the conditional sampling technique of Lu and Willmarth (1973), a detailed quantitative quadrant-hole analysis is presented of canopy turbulence data, comparing computational and field data. The computational data are obtained from large-eddy simulation (LES) of a corn canopy that resolves coarse features of individual corn plants and uses the Lagrangian, scale-dependent dynamic subgrid model. The field data are obtained using PIV. The quadrant hole analysis shows that around the canopy top, ejections are the most frequently occurring events (longest duration) while sweeps are the biggest contributors (largest fraction) to the Reynolds shear stress. Sweeps also contribute the most to the turbulence kinetic energy (TKE), vorticity and dissipation rate around the canopy top. However, the magnitudes of the vorticity (at the LES/measurement resolution) and dissipation rate are the highest in the first quadrant (the outward interactions events). With few exceptions, there is excellent agreement between the quadrant-hole analysis results from the LES and the field data confirming the applicability of LES for fundamental studies of canopy turbulence.

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