Low-Level Jet Characteristics as Determined by High-Resolution Doppler Lidar During CASES-99

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As surface heating reverses to cooling in the evening, the winds above the surface decouple from frictional effects at the ground and accelerate into a low-level jet (LLJ). The CASES-99 dataset represents a unique opportunity to study this phenomenon with a variety of instrumentation, including NOAA/ETL's High-Resolution Doppler Lidar (HRDL). During CASES-99 over the prairie of south-central Kansas, these evening accelerations produced LLJ's with peaks in the wind speed profiles at levels between 50 and 150 m AGL, based on analysis of HRDL scan data over 12 nights during CASES. The present study has two parts. The first part is a summary of LLJ characteristics determined by HRDL over the 12 study nights. Characteristics include timing of onset and peak jet speeds through each night, and time series of the height, speed, and direction of LLJ maxima. The analyses show considerable variability in location and timing of these characteristics from night to night. The second part is a study of two individual case-study nights. Time-height cross sections of mean wind and streamwise velocity variance from HRDL vertical-slice scan data are used to locate regions of high variance and their relationship to LLJ evolution. Regions of high variance, and therefore enhanced vertical mixing, are further probed by examining individual vertical scans to determine the mechanisms responsible for the high fluctuation values. For example, on one of the nights a period of enhanced mixing is clearly produced by overturning Kelvin-Helmholtz-type billows, and on the other, high-amplitude coherent turbulence structures generate the high variance values. The ability both to profile mean and fluctuating wind properties and to inspect the spatial details of individual events is a unique capability of Doppler lidar.