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High-frequency Mobile Radar Measurements of Tornado Boundary Layer Flow

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Since 2009, the Texas Tech University Ka-band (TTUKa) radars have been deployed on a number of supercell thunderstorms in the United States Central and Southern Plains. One objective of these deployments, owing to the narrow half-power beamwidth (0.33 deg) of these systems, is to obtain high-resolution measurements of flow within the tornado boundary layer (TBL), the depth of which can be as shallow as $\sim$10 m. It is understood that this region of the tornado has significant bearing on the maintenance mechanisms of tornadoes. However, there is a relative paucity of such boundary layer measurements available to corroborate past findings from simulation and theory.

This presentation will focus on measurements of the TBL for at least two specific cases. The 18 May 2013 case near Rozel, Kansas featured a slow-moving EF4 tornado. One TTUKa radar was deployed for this event, revealing a robust vertical secondary circulation with a boundary layer depth of approximately 50 m at the range of the diameter of maximum wind (DMW), increasing with range beyond the DMW. The slope of the inferred TBL top varied dramatically between the near (east) and far (west) sides of the tornado.

The 14 April 2012 case near Cherokee, Oklahoma shows a rather different depiction of tornado core flow, where the expected convergent flow within the friction layer is positioned above diffluence in the lowest 200 m above ground level (AGL). As the tornado appeared to be weakening during the time of this range-height indicator (RHI) sample, it is possible that the resolved structure was indicative of a disruption in typically identified tornado maintenance mechanisms (e.g., the convergence of angular momentum near the surface).

If time permits, supplementary results from the 2015 TTU field study will be presented.