2.4 THE TWIRL PROJECT: FINE-SCALE MOBILE RADAR AND IN SUTU OBSERVATIONS OF TORNADO STRUCTURE

KAREN A. KOSIBA[1], JOSH WURMAN[1], HOWARD BLUESTEIN[2]
[1]Center for Severe Weather Research, USA
[2] University of Oklahoma, USA
kakosiba@cswr.org

During the spring of 2016, The Center for Severe Weather Research (CSWR) fielded three Doppler on Wheels (DOW) mobile radars, three mobile mesonets, and 15 rapidly deployable Tornado Pods to quantify the wind structure in and around tornadoes. DOWs 6 and 7 have gating resolution of 12.5 m, and the Rapid-Scan DOW has resolution of 11.2 m. The Rapid-Scan DOW has a 0.8x-0.9-degree beam width and 7-second volumetric resolution, permitting matched fine-scale 4D resolution of small and quickly evolving sub-tornadic features.

On 09 May 2016 the University of Oklahoma RAXPOL and CSWR DOW7 mobile radars deployed near and in front of a large and intense tornado in southern Oklahoma, establishing an unprecedentedly short 3.5 km dual-Doppler baseline. The tornado, exhibiting a complex wind field structure, moved through the dual-Doppler lobes of the radars and crossed between them at a range of < 2 km to each radar. Sweep update rates are 2 s for RAXPOL and 7 s for DOW7, resulting in the shortest time-scale dual-Doppler observations ever in a tornado. Gating is 12.5 m in DOW7 and 75 m for RAXPOL, with ˜1-degree beam widths. The result is 4D temporal-spatial resolution of 2 s (7 s) x 27 m x 27 m x 75 (12.5) m = 109,000 (64,000) m3s for RAXPOL (DOW7) at the tornado's closest approach.

Dual-Doppler analysis with volumetric gridding as small as ˜60 m x 60 m x 60 m, at 7-second intervals, capable of revealing the vector-wind structure of sub-tornadic structures, is possible for the first time. Rotational space-time conversion will be implemented to accurately retrieve features spinning about the tornado. RAXPOL and DOW7 are both dual-polarimetric, DOW7 with two independent dual-polarimetric systems, providing unique fine-scale and intercomparable ZDR and rho-HV observations of tornadic debris lofted by the tornado and its sub-vortices.

RAXPOL and DOW data revealed a large tornado with a core flow diameter of ˜500 m, exhibiting a complex and rapidly evolving structure including intense sub-vortices. Preliminary dual-Doppler vector wind syntheses, dual-polarimetric analysis will be presented, documenting the evolution of the near-ground wind field and debris structure in this tornado.

Additionally, on 09 May 2016, a tornado pod was deployed in the tornado path just north of the core flow region – well within the subsequent damage swath – and measured peak winds of about 45 m/s. DOW7, which was < 2 km range, observed winds at 20 m AGL, over the tornado pod. Peak DOW winds during this tornado were 97 m/s. Combined DOW-damage analyses indicated that the strongest winds and greatest damage occurred in association with multiple vortices. Then, on 24 May 2016, two tornado pods, with contemporaneous DOW data at 40 m AGL, sampled the core region of a tornado in southwest Kansas. The peak DOW-measured winds during this event exceeded 80 m/s. Observations from both the 09

May and 24 May indicated that the 1-meter AGL wind speeds were ˜60%-70% of the DOW-measured winds at 20-40 m AGL. The wind-height-damage relationship as a function of tornado structure will be discussed on the context of these and past DOW-in situ observations.