During the spring of 2013, attempts were made to deploy DOWs and in-situ Tornado Pod instrumentation near and in several violent tornadoes during a reduced experimental season consisting of only a few IOPs. These include the EF-3 El Reno tornado, the EF-4 Rozel, Kansas tornado, the EF-4 Bennington, Kansas tornado, and the EF-2 Wichita, Kansas tornado. Very fine-scale radar observations, including rapid-scan (7-second volumes) and quick-scan (7-second sweeps) radar data reveal quickly-evolving structures, low level winds, and relationships with damage.

**El Reno, OK:** A large and violent tornado/multiple vortex mesocyclone (MVMC) tracked south and east of El Reno, Oklahoma on 31 May 2013, causing 8 fatalities, including stormchasers/researchers attempting to deploy in-situ instrumentation. Transient and persistent sub-vortices moving within and near the MVMC were documented, some moving in trochoidal-like patterns inside the tornado/MVMC, with ground-relative translational velocities ranging from near zero to 79 m/s, the fastest ever documented. Winds measured by a DOW radar in one of these sub-vortices exceeded 115 m/s at 134 m AGL. If assumptions concerning radar-unobserved components of the velocity vector are made, peak wind speeds of 130-150 m/s are implied, comparable to the strongest ever measured. However only Enhanced Fujita Scale 3 (EF-3) damage was documented, likely due to a paucity of well-built structures in the path of the small, most-intense portions of sub-vortices and because the regions of most intense winds were very small, and translating extremely rapidly, resulting in 100 m AGL winds exceeding 120 m/s occurring for perhaps < 1 s over particular locations. The region enclosing the maximum winds of the MVMC extended ~2 km. DOW-measured winds >50 m/s (>30 m/s) extended outward from the radius of maximum winds (RMW) to cover a cross-track region exceeding ~3 km (7mi), comparable to the widest ever documented.

**Rozel, KS:** EF-4*

**DOW-Measured winds of 78-83 m/s**

**Wichita, KS:** EF-2*

**DOW-Measured winds of 60-64 m/s**

* DOW-Influenced Preliminary Ratings

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**ROTATE 2013 TORNADOES**

**Rozel, KS (18 May 2013)**

**Wichita, KS (19 May 2012)**

**El Reno, OK (31 May 2013)**

**Bennington, KS (28 May 2013)**

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**Bennington, KS: Quasi-Stationary, EF-4 Tornado**

Above. Looping track of tornado from 2247-2347 UTC. Tornado formed before 2247, but DOW-base locations are less precise since the DOW was in motion. Tornado was nearly stationary from 2308-2113, moving less than 80 m over 300 s, and traced multiple loops during that and other periods, remaining within a 2.5 km diameter circle (orange) for 2000 s.

Above. Doppler Velocity (left) and Received Power (right) showing Discontinuous debris ring echo (DRE) as tornado passes over region with trees. In Bennington, Kansas tornado on 28 May 2013. Winds exceeded 118 m s⁻¹ at 47 m AGL. Black lines indicate two ATO surges.

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