Mobile Doppler Radar Observations of a Tornadic Supercell near Springfield, Illinois, on 15 March 2016 Brittany Welch and Jeffrey Frame

Introduction and Motivation

On 15 March 2016, a Doppler on Wheels (DOW) radar collected data on a tornadic supercell thunderstorm near Springfield, Illinois. The supercell produced an EF-1 tornado at 0044 UTC 16 March (7:44pm CDT). The tornado tracked through rural areas west of Springfield before crossing I-72 and causing significant roof and structural damage to a home. This damage was rated EF-1 on the Enhanced Fujita Scale with estimated wind speeds of 100-105 mph. The tornado dissipated in a field west of Springfield at 0052 UTC. The tornado occurred at distance of 20-25 km from the DOW.



Map depicting the track of the tornado and damage indictors from a National Weather Service damage survey. Credit: NWS, Lincoln, IL



Photograph of the tornado from the DOW deployment site. Photo Credit: Jessie Choate



A surface cold front extended southward from a low over NW IL East of this front, the air mass was characterized by SSE winds and temperatures in the lower 70s with dewpoints in the upper 50s.



Synoptic Background

Illinois was Central Aloft, located downstream of 2 negatively-tilted 300 mb trough over the Northern Plains and in the left-exit region of a 125-knot jet streak over the Central Plains.

- \star Sounding location
- \star Tornado location



0000 UTC sounding from The Lincoln, IL, (\star) exhibited 1500 J kg⁻¹ of mixed-layer CAPE in an environment characterized by 55-60 knots of 0-6 km shear and 0-1 km storm-relative helicity around 200 $m^2 s^{-2}$.

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Storm-Scale Overview

thunderstorm isolated supercell The intercepted by the DOW radar is circled in white on the WSR-88D base reflectivity imagery from 0044 UTC (left). This was an isolated supercell thunderstorm, while a cluster of other storms, some of which were also tornadic supercells, persisted farther northwest.

A zoomed-in view (right) reveals two thin hook echoes on the right-rear flank of the storm. The westernmost of these was associated with a weak circulation that produced the tornado from 0044-0052 UTC (circled in white on image to right). A tornado warning was issued for this storm at 0026 UTC.

Mobile Doppler Radar Observations





At the beginning of the analysis period (0034 UTC), the pretornadic circulation broadened with height. The circulation at 1.0° and below remained relatively unchanged through 0039 UTC, while it weakened and broadened considerably above this level. Curiously, the circulation in the lowest elevation scans still remained unchanged through the time of tornadogenesis (0044 UTC) while the circulation aloft strengthened and retightened by this time. The circulation intensified slightly by 0049 UTC at all levels. Beam blockage by trees prohibited further detailed analysis after tornado dissipation (0052 UTC).









Damage Survey and Circulation Track Comparison

There was excellent agreement between the tornado track from National Weather Service damage survey and the track of the lowest level (0.5°) circulation.



Low-Level Track



Circulation Intensity and Diameter Analysis

The pretornadic circulation ΔV (m s⁻¹) vs. Time on the lowest scans at 0035 UTC was curiously as strong than stronger the circulation immediately after ■ ΔV_1.0 Degrees tornadogenesis (right). The **Δ**V_1.5 circulation weakened with 0037-0042 between time UTC, but strengthened just after this time, culminating in tornadogenesis at 0044 UTC (dotted line). Throughout this period, the circulation generally weakened with height, except for during the period of weakening. The circulation dissipated rapidly by 0052 UTC.

The diameter of the circulation, defined here as the distance between the maximum wind speeds on either side of the circulation, broadened as the pretornadic circulation weakened around 0037 UTC. The circulation tightened at all levels, but most notably aloft, in the



- tornadogenesis, 0044 UTC.
- weakened with height.

Results





before minutes tornadowith the genesis, consistent of conservation angular The (left). momentum diameter of the circulation remained less than 200 m during the time of the tornado and broadened as the tornado dissipated at 0052 UTC.

Conclusions

The circulation at 0034 UTC was very similar to that at the time of

The circulation was generally strongest on the 0.5° scan and

There was good agreement between the National Weather Service damage survey and the radar-determined circulation track.

The circulation was generally stronger when it was smaller in size.