Warning Challenges and Successes of the June 16-17 Southern Wisconsin Nocturnal QLCS

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Motivation?

Goals

Answer the questions:

- Why was the tornadic nature of these storms so poorly forecast?
- How was the impact of these under-forecast tornadoes so small?
- What could have been done differently to improve the service provided by the NWS?
Outline

• Step into the warning desk!
• Walk through radar data & warning decisions.
• Discuss what went **wrong**.
• Discuss what went **right**.
• **What can we do to get better?**
June 17 0100Z Day 1 Convective Outlook

- Tornado
- Hail
- Wind
Tornado Watch 306
Valid from 2250Z to 0600Z

Severe Thunderstorm Watch 308
Valid from 0225Z to 0800Z

PRIMARY THREATS INCLUDE...
SCATTERED DAMAGING WIND GUSTS TO 70 MPH POSSIBLE ISOLATED LARGE HAIL EVENTS TO 1.5 INCHES IN DIAMETER POSSIBLE

WELL-DEVELOPED MCS WILL CONTINUE ESEWD ALONG INSTABILITY GRADIENT WITH A CONTINUING RISK FOR DAMAGING WINDS AND ISOLATED LARGE HAIL WITH THE STRONGER EMBEDDED STORMS.
SPC Mesoanalysis Summary

<table>
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<th>0200Z</th>
<th>0300Z</th>
<th>0400Z</th>
<th>0500Z</th>
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<tr>
<td><strong>ML CAPE</strong></td>
<td>2000 J kg(^{-1})</td>
<td>2500 J kg(^{-1})</td>
<td>1500 J kg(^{-1})</td>
<td>1000 J kg(^{-1})</td>
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<tr>
<td><strong>ML CIN</strong></td>
<td>~25 J kg(^{-1})</td>
<td>~25 J kg(^{-1})</td>
<td>~50 J kg(^{-1})</td>
<td>~75 J kg(^{-1})</td>
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<tr>
<td><strong>0-1 km SRH</strong></td>
<td>200 m(^2) s(^{-2})</td>
<td>250 m(^2) s(^{-2})</td>
<td>300 m(^2) s(^{-2})</td>
<td>400 m(^2) s(^{-2})</td>
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<tr>
<td><strong>0-3 km SRH</strong></td>
<td>300 m(^2) s(^{-2})</td>
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<td><strong>0-1 km Shear</strong></td>
<td>30 kts S</td>
<td>30 kts S</td>
<td>35 kts S</td>
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<td><strong>0-6 km Shear</strong></td>
<td>55 kts W</td>
<td>55 kts W</td>
<td>50 kts SW</td>
<td>50 kts S</td>
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0-3 km Shear ~ 35 kts WSW
Tornadoes 1 - 3

- **EF-1** at 0400Z, 1 minute long.
- **EF-1** at 0410Z, 1 minute long.
- 0 spotter reports of tornadoes.

- All associated with **bookend vortex**.
- **EF-1** from 0400Z-0411Z (4.35 mi).
Tornadoes 4 & 5

- Classic QLCS tornadoes on bow echo, north of apex.
- Both 1 minute long; 1
  st at 0436Z, 2
  nd at 0445Z.

- Both rated EF-1.
- TDS on both tornadoes.
- Still no spotter reports.
Warning issued at 0451Z.

South of bookend circulation.
- Attempt to capture TDS detection.
- Don’t often expect to see tornadoes with bookend vortex.
- 0 spotter reports of tornadoes so far on bookend vortex.

Main circulation on bookend vortex begins to strengthen right at time of issuance.
Tornadoes 6 - 8

- Warning expired at 0514Z, EF-2 hit at 0515Z with marginal TDS.
- New warning at 0520Z.
- EF-1 hits at 0521Z, within warning.

- All associated with bookend vortex.
- EF-3 hit Verona at 0508Z, just north of warning. TDS detection but 0 reports.
Verona EF-3
Madison EF-2
What Went Wrong?

- Did not anticipate favorable QLCS tornado risk in advance of event, despite strong low level shear values and warm front in area.
- Nocturnal tornadoes in WI are rare.
- Tornadoes were very short-lived.
  - By the time warning could be issued, tornado would have dissipated.
- Many tornadoes far from radar.
- 0 spotter reports of tornadoes as the event was unfolding.
- The first tornado warning missed circulation in bookend vortex, and did not remain in effect long enough.
What Went Right?

• All **Severe Thunderstorm Warnings** mentioned threat of brief tornadoes (TORNADO POSSIBLE tag).

• **Tornado Warnings** were communicated effectively through **Wireless Emergency Alerts**.
  – Most people we spoke to near Tornado Warnings got the warning through these messages and had plenty of time to shelter.

• **Madison** sounded sirens **city-wide**.

• Most tornadoes in **rural areas**.

• **Recently upgraded radar technology**:  
  – Dual-Pol showed **Tornadic Debris Signature**, our only confirmation.  
  – **SAILS** scanning strategy allowed for more rapid radar updates.
How Do We Improve Our Service?

- **Anticipate the favorable QLCS tornado risk!**
  - When you have **very strong** low level shear values, **persistent** low to mid level rotation and a **surface boundary**, pull the trigger on a **Tornado Warning**!

- **If a Tornado Warning** is issued, be sure to include all possible tornado sources (environment, TDS, spotter reports, etc…).

- **Make sure to keep warnings large enough, and long enough in duration**, to cover re-generating tornadic circulations within QLCS.

- **QLCS Tornadoes – Warning Decisions w/Polygons:**
  - **Severe Thunderstorm Warning** with TORNADO POSSIBLE tag?
  - **Tornado Warning** describing several brief tornadoes within line of severe storms?
  - Several smaller **Tornado Warnings** within larger **Severe Thunderstorm Warning**?
The End

Questions?