Evaluation of the Relationship between NSSL MRMS Rotation Tracks and Tornadoes in Iowa

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Goals

Evaluate the relationship of rotation tracks to the initiation point of tornadoes.

- Where do tornadoes typically initiate relative to the track?
- How long after a track develops does a tornado form?
- Is there a relationship between observed shear magnitude and tornado EF-scale rating?
- What is the shear distribution for observed tornadoes?
- Broaden forecaster perspective of rotation tracks from only a storm survey tool to warning decision tool.
Data

• 186 tornadoes in Iowa from 2008 - May 2014
• WSR-88D-based MRMS 0-2 km rotation tracks

• Error sources
  – Reported location of tornado
  – Reported time of tornado
  – Missed tornado or false id
  – EF scale +/- 1
  – Lead time methodology is somewhat subjective (based on rotation tracks maxima)
  – Standard radar limitations
Iowa Tornadoes 2008-2014

EF-scale Distribution

- EF5: 56.5%
- EF4: 1.6%
- EF3: 2.2%
- EF2: 10.8%
- EF1: 29.0%
- EF0: 0.0%
Iowa Tornadoes 2008-2014

Tornado Report Source (%)

- NWS Storm Survey: 53%
- Trained Spotter: 3%
- Emergency Manager: 3%
- Law Enforcement: 5%
- Public: 3%
- Storm Chaser: 3%
- Fire Department/Rescue: 10%
- Broadcast Media: 19%
- Amateur Radio: 10%
- Newspaper: 5%
- State Official: 5%
- Other Federal Agency: 3%
- Airplane Pilot: 3%
- NWS Employee: 3%
- Unknown: 3%

Unknown
Defined Locations Relative to Tracks

• Tornado was associated with nearest maximum at or upstream of the tornado initiation point.

• HIT
  – In
  – Near
  – End

• MISS
  – Outside
  – None
Supercell vs. QLCS track
94.6% of Tornadoes Associated with Tracks

**Tornado Location Relative to Rotation Track**

- **In**: 86.0%
- **Near**: 5.4%
- **Outside**: 3.2%
- **End**: 2.7%
- **None**: 1.6%
Lead Time Calculation

• Begin at shear = 0.002 \(s^{-1}\)
• 2 minute interval between maxima
• NOT to be confused with NWS tornado warning lead time
• Subjectivity
Cumulative Shear Frequency

Shear Cumulative Frequency for Tornadic Storms
Shear Distribution for Tornadic Storms

Values from top to bottom: maximum, 90th percentile, 75th, median, 25th, 10th, minimum
Conclusions

• MRMS rotation tracks data should prove useful as an operational tool for anticipating and tracking tornadoes in real-time warning operations.

• Operational experience suggests data should be monitored in concert with single radar data, especially with the advent of SAILS.

• Low-level rotation tracks should also monitored with respect to mid-level data, particularly for supercell events where traditional downward development of rotation tends to occur. This is not as critical for QLCS events.
Future work

• Expand to Missouri and Illinois – cold season events

• Evaluate potential relationships with storm mode

• Frequency of tracks with straight-line wind damage and no tornadoes?

• Frequency of tracks with no tornadoes?