A C-Band, Dual-Polarimetric Radar Analysis of a Tornadic Mesoscale Convective System: The 25 May 2011 Northern Illinois and Indiana Tornado Event

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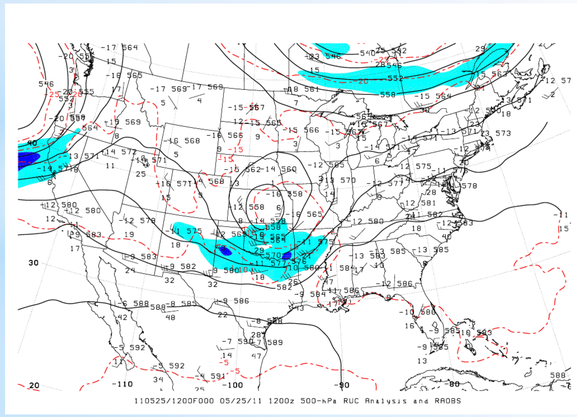
Motivation

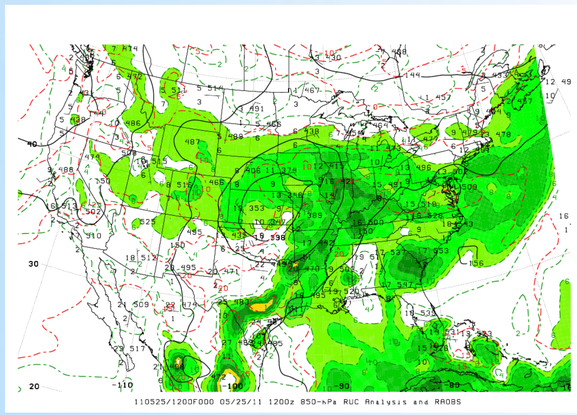
- All tornadoes occurred without severe thunderstorm or tornado warnings
- Tornadoes occurred in excess of 65 km to over 100 km from the nearest NEXRAD radar sites; extremely difficult to detect
- Tornadoes occurred 50-75 km from VU radar

Synoptic and Mesoscale Background

- Vertically-stacked low located over central Plains
- WAA regime across Illinois and Indiana ahead of 850 hPa low
- Remnant QLCS from devastating 24 May tornado outbreak progressed northeast across Missouri and Illinois during overnight and early morning hours, reaching NE Illinois mid-morning
- QLCS became tornadic across E Illinois and NW Indiana
- 8 total tornadoes were produced, with 6 tornadoes in NE Illinois and NW Indiana
- Four tornadoes were studied, 1 EF0 (Morocco, IN), 2 EF1s (NW of Rensselaer and on the SE side of Rensselaer, IN), and 1 EF2 (near Mt. Ayr, IN), with path lengths up to 10 km and path widths up to 275 m

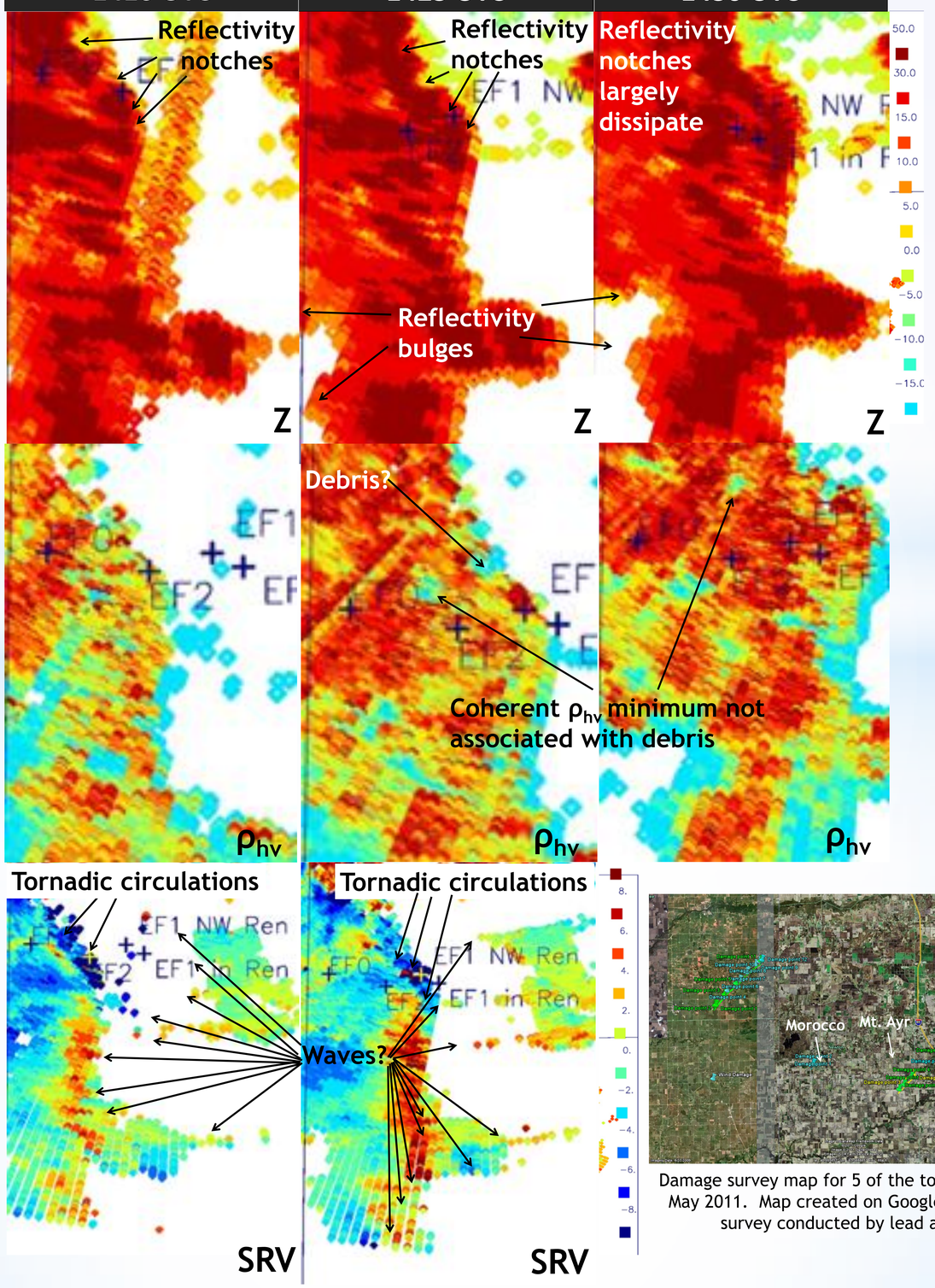


500 hPa analysis 1200 UTC 25 May 2011; solid heights, shaded isotachs, dashed isotherms



850 hPa analysis 1200 UTC 25 May 2011; solid heights, shaded and green dashed mixing ratio, red dashed isotherms

0.5 Z, ρ_{hv}, and SRV Signatures Associated with NW Indiana Tornadoes

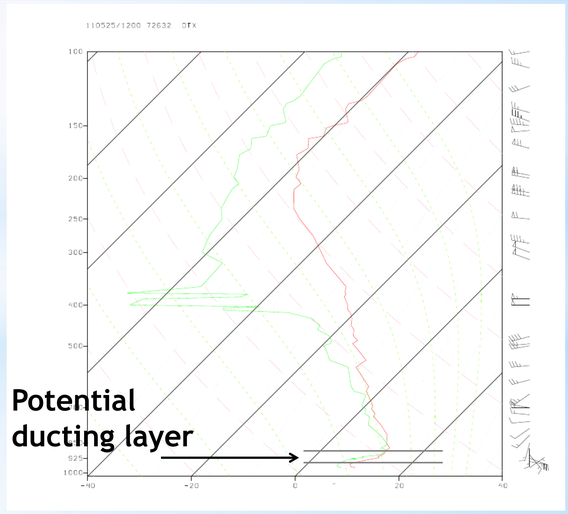


Reflectivity (Z) Observations

- Reflectivity "notches" occurred along the leading edge of the QLCS
- Notches maintained appearance well after tornado dissipation
- Reflectivity "bulges" occurred behind QLCS
  → Bulges associated with past QLCS tornado events (Barker 2006)

Storm-Relative Velocity (SRV) Observations

- Circulations were detected on storm relative velocity PPI plots
- Strongest circulation with EF1 tornado NW of Rensselaer, IN
- Numerous east-west oriented bands appear on Z, SRV, and ρ_{hv} plots, moving from S to N nearly perpendicular to QLCS motion
  → Bands may be associated with ducted gravity waves, with evidence of potential ducting layer on 1200 UTC DTX sounding and favorable location with respect to low (Koch and O'Handley, 1997)



DTX sounding from 1200 UTC 25 May 2011.

Cross-Correlation Coefficient (ρ_{hv}) Observations

- Minimum in ρ_{hv} associated with reflectivity notch of EF2 tornado near Mt. Ayr, IN, on 1423 UTC plot
- Marginally low ρ_{hv} values, other noise, and rather significant distance from radar preclude reaching conclusion of the source of the minimum in notch
- Additional coherent minimum in ρ_{hv} appears behind QLCS leading edge at1423 UTC and 1430 UTC
  → Minimum ρ_{hv} associated with reflectivity weakness
  →Given no circulation or tornado associated with feature, cause of ρ_{hv} minimum is unclear

Damage survey map for 5 of the tornadoes on 25 May 2011. Map created on Google Earth, with survey conducted by lead author.

Acknowledgements/References

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