Single and Dual-Doppler Radar Observations of a Nontornadic Supercell Thunderstorm on 6 June 2010

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Introduction

This study examines a nontornadic supercell thunderstorm near Ogallala, NE, on 6 June 2010. Two Doppler on Wheels (DOW) radars intercepted the storm during VORTEX2. The close proximity of the radars to the cell allows for relatively high-resolution analyses of the reflectivity and radial velocity fields near the mesocyclone, which are presented here. We hope that our analysis, along with the work of others, will help to make significant strides in determining the differences between tornadic and nontornadic supercells.

Data and Methodology

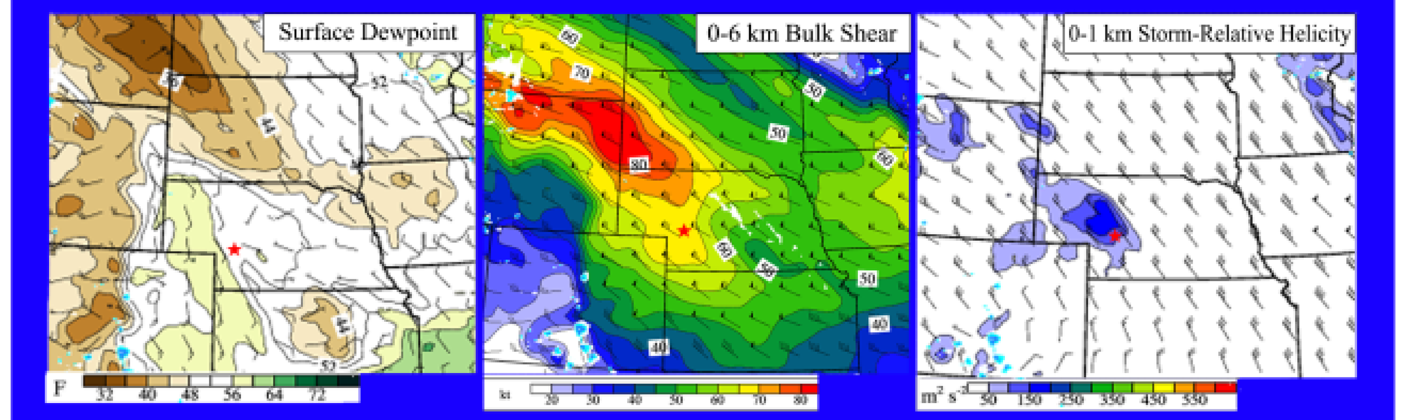
The DOW radars are both X-band (3 cm) wavelength radars, which employ dual-polarized beams 0.95˚ in width.

Data were edited using SoloII software and mapped to a Cartesian grid using a one-pass Barnes analysis. The grid spacing is 100 m, the radius of influence is 720 m, and the weighting parameter is 0.1019 km^2.

All objective analyses presented are at 100 m above ground level.

Synoptic Setup

NSSL WRF - 22-hour Forecast - Initialized at 00:00 UTC 6 June 2010



★ Approximate Location of DOW Intercept

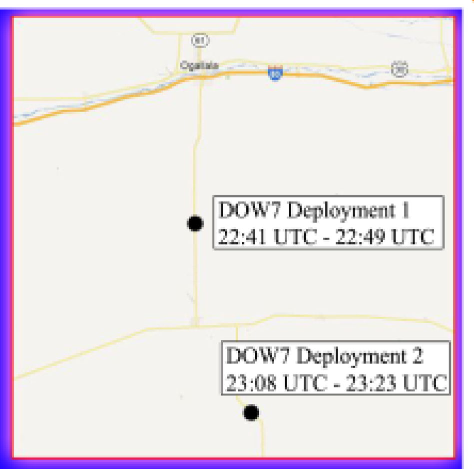
The cell initiated in a region of moist upslope flow east of a lee surface trough (left).

The 0-6 km bulk shear was in excess of 60 kts, more than sufficient for supercell development (center).

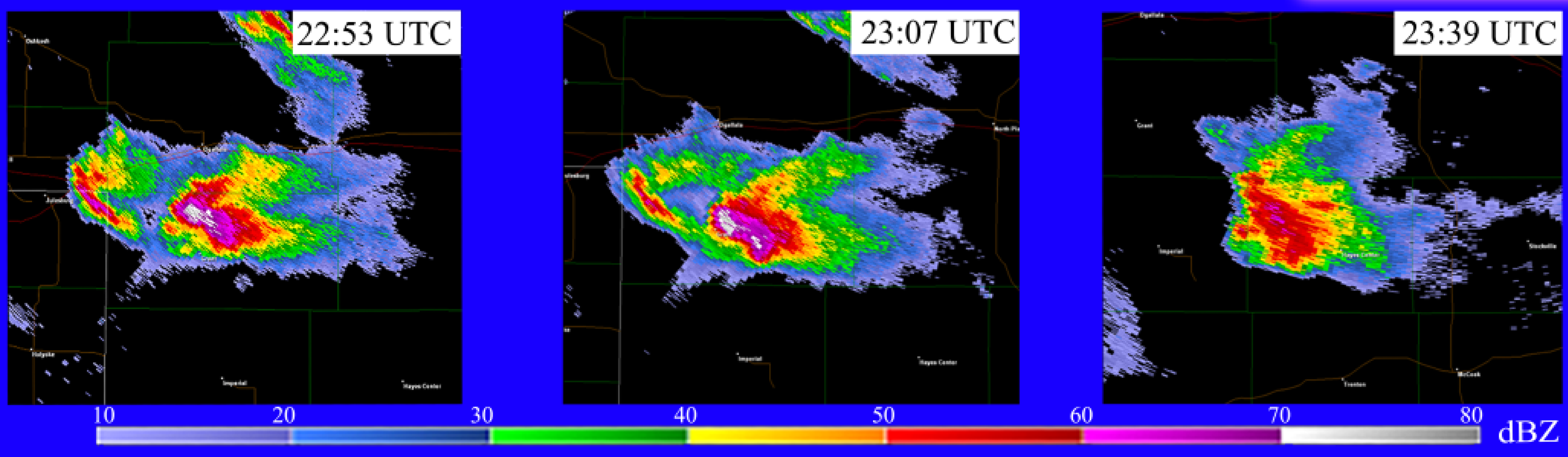
The storm moved eastward into a region with 0-1 km storm-relative helicity near 200 m^2 s^{-2} (right).

Observations

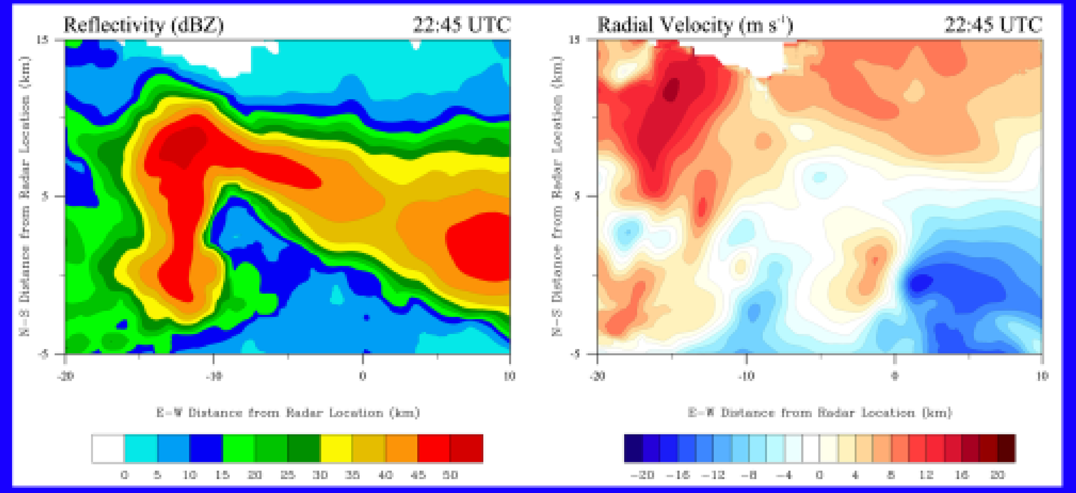
These data were obtained during two seperate radar deployments (right). The data void is due to the southeastward relocation of DOW7 to follow the storm southeastward between 22:50 UTC and 23:08 UTC.



KLNX WSR-88D Imagery

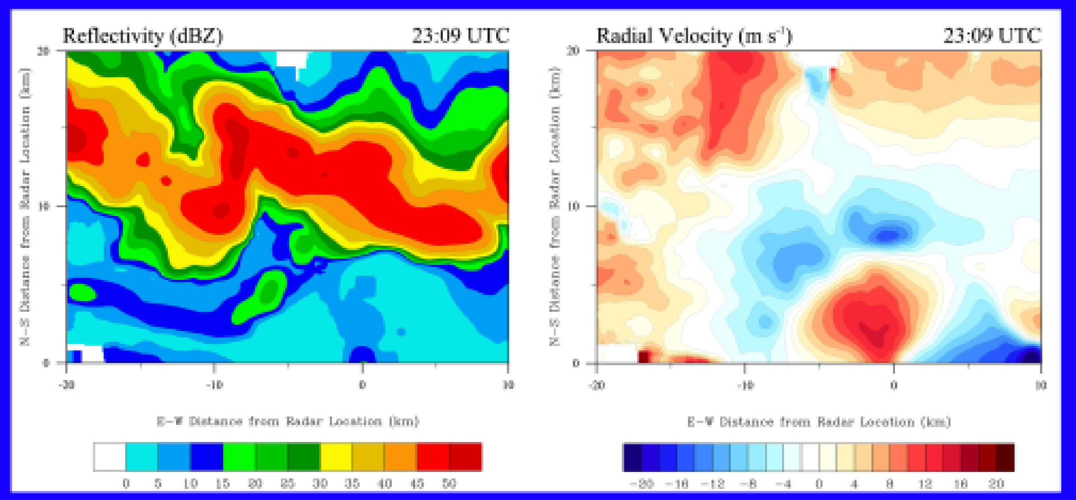


- At 22:53 UTC, the maximum reflectivity within the storm is about 75 dBZ and a "flying eagle" signature is present within the forward flank (left).
- Through 23:07 UTC, the reflectivity maximum persists while additional convection nears the rear flank of the cell (center).
- By 23:39 UTC, the reflectivity values in the core decrease and the hook echo begins to dissipate (right).



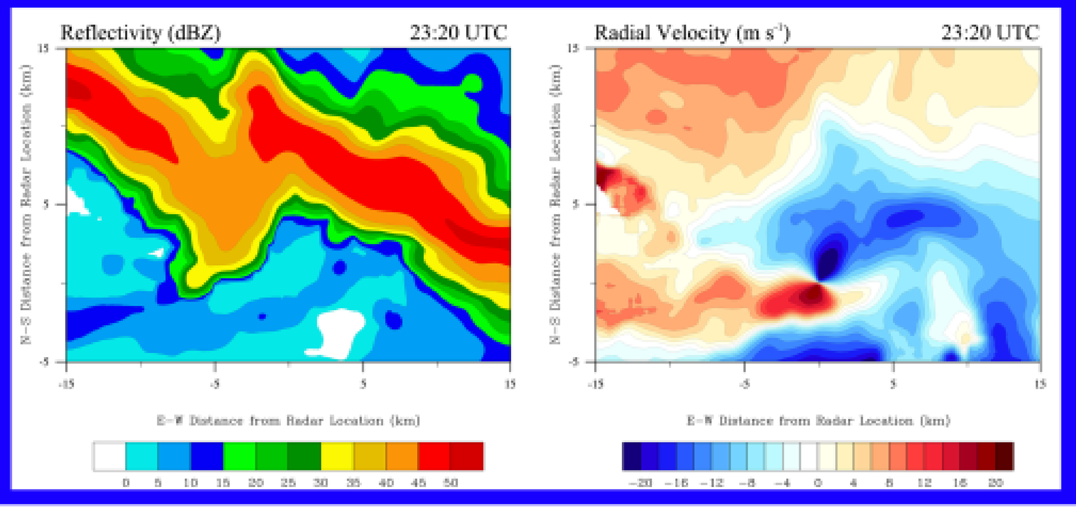
The initial DOW scan at 22:45 UTC displays a well-defined hook echo. An outflow boundary is located along the line of enhanced reflectivities east of the hook.

The radial velocity image depicts a couplet with Δv = 24 m s^{-1} near the back of the hook.



As the cold pool strengthens, the rear-flank gust front begins accelerating southeastward at speeds of 12-16 m s^{-1}.

By 23:09 UTC, no low-level rotation exists within the storm, likely due to the surging cold pool.



Reflectivities within the precipitation core of the storm, and especially within the hook echo, decrease by 23:20 UTC.

The rear-flank gust front continues to surge south-eastward and is now southeast of the radar location.

Conclusions

These single-Doppler analyses indicate that the rapid weakening of the low-level mesocyclone was likely due to the surging cold pool. This acted to isolate the updraft and mesocyclone from the warm, moist inflow leading to the weakening of the storm.

Future Work

- Analyze NOAA X-Pol radar data
- Perform dual-Doppler wind syntheses
- Calculate low-level trajectories and vorticity budgets
- Examine in-situ thermodynamic data from mobile mesonets and sounding units to determine the relative buoyancy within the forward-flank and rear-flank downdrafts.

Acknowledgements

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