Analyzing Supercell Intensity Changes in a Heterogeneous Environment in the VORTEX2 Supercell Pair in Southeastern Colorado on 11 June 2009

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Introduction

Much of what we understand about supercell thunderstorms comes from idealized simulations containing homogeneous environments. However, determining how a supercell will respond to changes in their environment, such as heterogeneity due to boundaries, the transition from day to night, or interactions with other storms, is much more challenging. Our current understanding of how supercells evolve given those complexities is somewhat limited. The present study seeks to fill this gap by examining the 11 June 2009 VORTEX2 case in southeastern Colorado, wherein two supercells were within proximity of each other and a nearby surface boundary. In conjunction with these complexities, the supercell pair also occurred within a low CAPE, high-shear environment, as well as during the nocturnal transition. This study aims to investigate how this supercell pair evolved in response to these environmental complexities.

Data and Methods

- Observations
    - Radar data were obtained from available VORTEX2 mobile radars (DOW6, DOW7, and SR1) and the local WSR-88D (KPUX) between 0000 UTC and 0300 UTC on 12 June 2009
    - A series of near-inflow soundings were launched between 2300 UTC on 11 June and 0300 UTC on 12 June (Fig. 1)
        - A number of thermodynamic and kinematic parameters were computed for each sounding to assess the temporal and spatial variability of the environment (Fig. 2)
    - Associated storm reports from the Storm Prediction Center

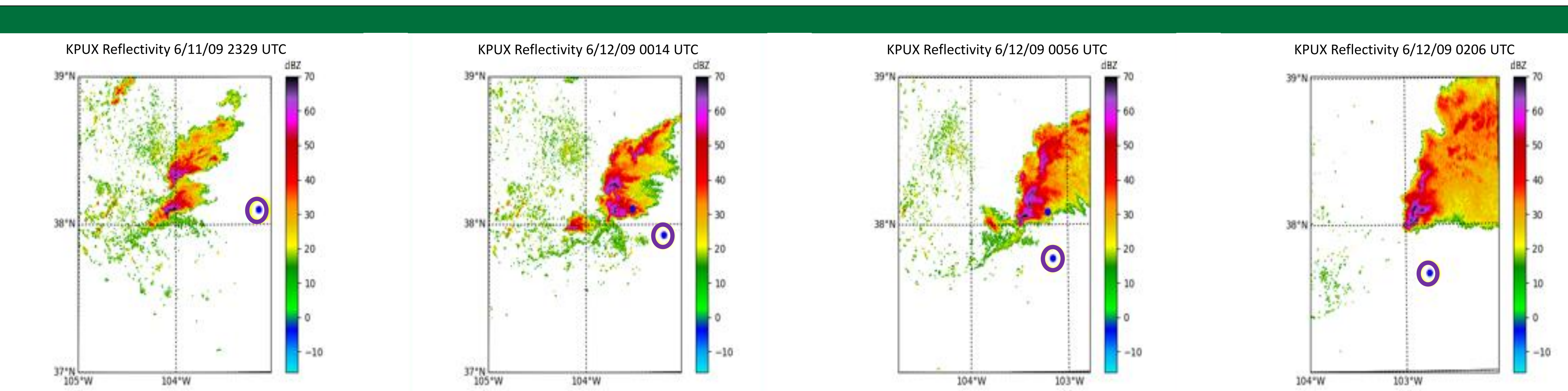


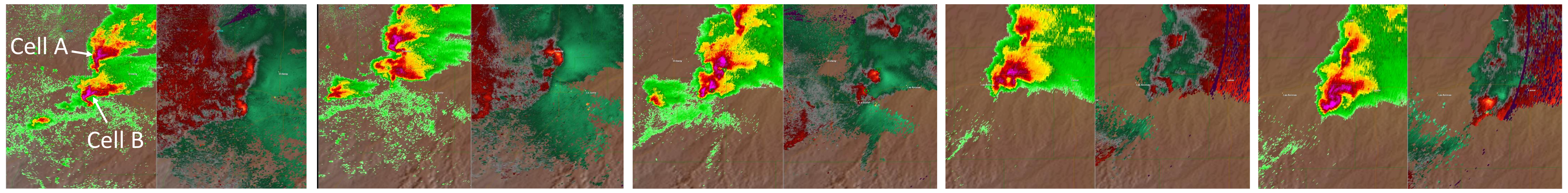
Figure 1: Locations of the soundings (indicated by blue dots) overlaid on base reflectivity from KPUX. The near-inflow sounding utilized at each time is circled in purple.

Time (UTC)	SB/MUCAPE J/kg	SB/MUCIN J/kg	0-1km SRH m²/s²	0-3km SRH m²/s²	Eff. SRH m²/s²	SBLCL feet	LI	SCP	Fixed STP	SHIP	PWAT inches
2329	1805	-2	28	129	114	1275	-5	3.0	0.2	0.5	1.07
0014	1581	-56	130	202	185	1254	-8	5.9	1.0	0.8	0.96
0056	1251	-106	270	261	264	1666	-7	6.6	0.8	0.8	0.81
0206	1035	-86	140	363	171	926	-3	3.5	1.0	0.2	0.88

Table 2: Kinematic and thermodynamic parameters calculated from the 4 near-inflow soundings (see Fig. 1)

Results

- **Radar Summary (Fig. 3)**
    - Cell A formed around 2030 UTC on 11 June
    - Cell B initiated off of Cell A's outflow boundary around 2250 UTC
    - The two supercells strengthen and merge between 2300 UTC and 0200 UTC, completing the merger by 0210 UTC
- **Near-Inflow Environment**
    - CAPE decreased over time, while CIN increased (Table 2)
    - Low-level and elevated parcels stabilized over time (Fig. 4)
    - Effective SRH, 0-1km SRH and 0-3 km SRH all increased through approximately 0100 UTC; only 0-3 km SRH continued to increase (Table 2)
- **Storm Timeline (Fig. 5)**
    - The concentration of warnings and LSR's is fairly evenly distributed
    - MDA and TVS signatures are most concentrated between 0030 UTC and 0130 UTC, after the storms began to merge
        - Coincides with max lifted index, SCP, and helicity parameters (Table 2)
    - Both the low- and mid-level mesocyclones strengthen when the storms began to merge; only the mid-level shows intensification when the mesocyclones merge
        - 0-1 km, 0-3 km, and effective layer SRH values all increase during this time frame



2337 UTC: Cells A and B show very clear supercellular characteristics.

2346-0018 UTC – Cell A and B's 50 dBZ regions merge, and become Cell A' and Cell B', (SS @ 0005 UTC)

0028-0056 UTC: Both cells contain MDA's at several points, and Cell A' even has a TVS (SS @ 00:47 UTC)

0147 UTC: BWER between Cell A' and Cell B', and mesocyclones are close to a full merger

0210 UTC: Cells A' and B' have now completely merged, and have one complete mesocyclone

Figure 3: KPUX base reflectivity (left) and velocity (right) over time, illustrating the evolution of the pair of supercells on 11-12 June 2009.

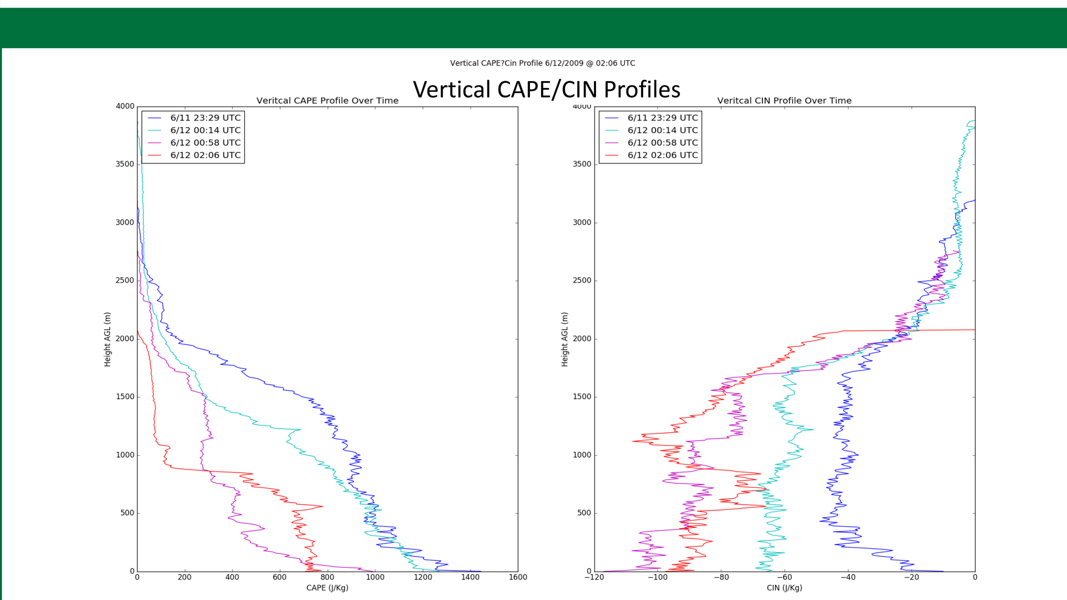


Figure 4: Vertical CAPE/CIN Profiles

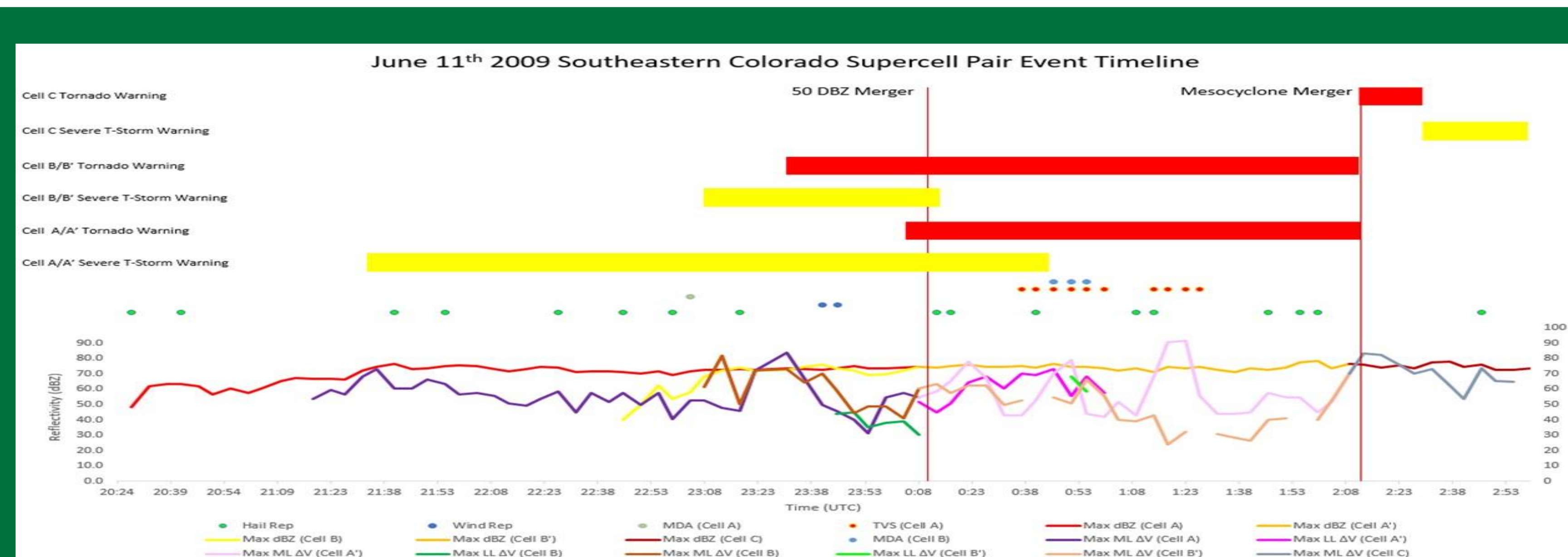


Figure 5: Timeline of velocity differential, max reflectivity, storm reports, and warnings.

Summary and Future Work

- The near-inflow environment evolved into high shear/low CAPE as CAPE decreased and SRH strongly increased (Table 2; Fig. 4)
- As Cell A and Cell B merged, the storms intensified, based on low- and mid-level velocity differentials, as well as MDA and TVS signatures (Fig. 5)
    - Strengthening also coincided with increases in SRH and SCP (Table 2)
- The storms interacted for quite some time without inhibiting the other
- Future work will focus on performing a dual-Doppler analysis of the supercell pair, using mobile radar data from VORTEX2 to quantify changes in updraft strength, vertical vorticity, etc.