Kinematics, Thermodynamics, and Microphysics of the 25-26 June 2015 Kansas MCS during PECAN

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Introduction:

This is a preliminary analysis of a nocturnal mesoscale convective system (MCS) that was observed in northeast Kansas on 25-26 June 2015 (IOP 16). The environment was characterized by almost zonal flow at 500 mb downstream of ridging over the Pacific Northwest and a weak E-W boundary near the KS/NE border. Since bores, convection initiation (CI), and an MCS were all forecast in different parts of the domain, it was decided that IOP 16 would be a Bore mission. This lead to a mobile radar configuration of two vertically stacked diamonds as opposed to the usual hexagon set-up for MCS missions.

Over the course of the observational period, a broken line of nocturnal convective cells initiated around 0230 UTC (all times are Universal) on the cool side of a surface cold front and subsequently merged into a quasi-linear MCS that later matured and developed strong outflow and a trailing stratiform region. Additional convective cells developed in the warm inflow region of the convective line.

Methods:

Preliminary quad-Doppler radar analyses were conducted at 0430, 0500, and 0530 UTC using data from SR1, SR2, NOXP, and DOW7 that were heavily edited with Soloii. Individual radars were interpolated onto a Cartesian grid with a 500 m spacing using a 2-pass Barnes scheme. Wind synthesis was effected using an over-determined (normal eqn.) dual-Doppler method via iterative solution, downward integration of the anelastic mass continuity equation, and a variational integral constraint.

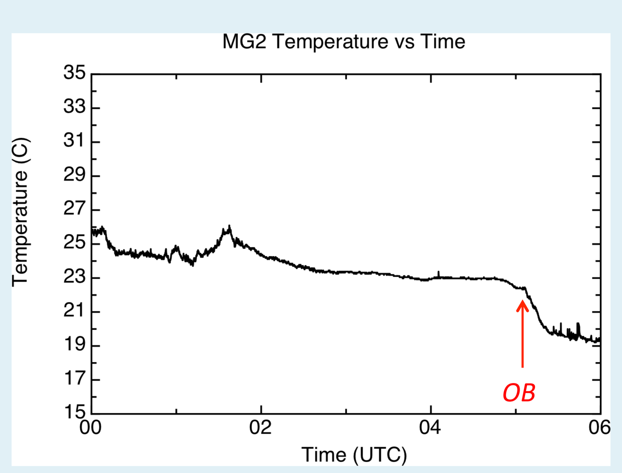

Fig. 1. Temperature (C) vs. time during MG2's transects of the MCS.

MCS Forecast Verification

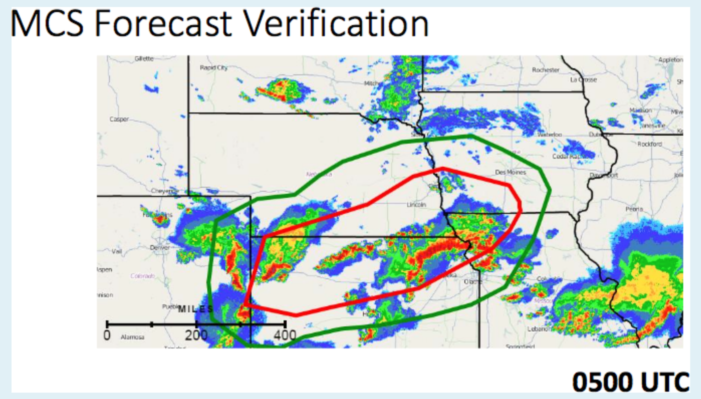

Fig. 2. Plot of WSR-88D radar reflectivity overlaid with MCS probability from the Day 1 PECAN forecast.

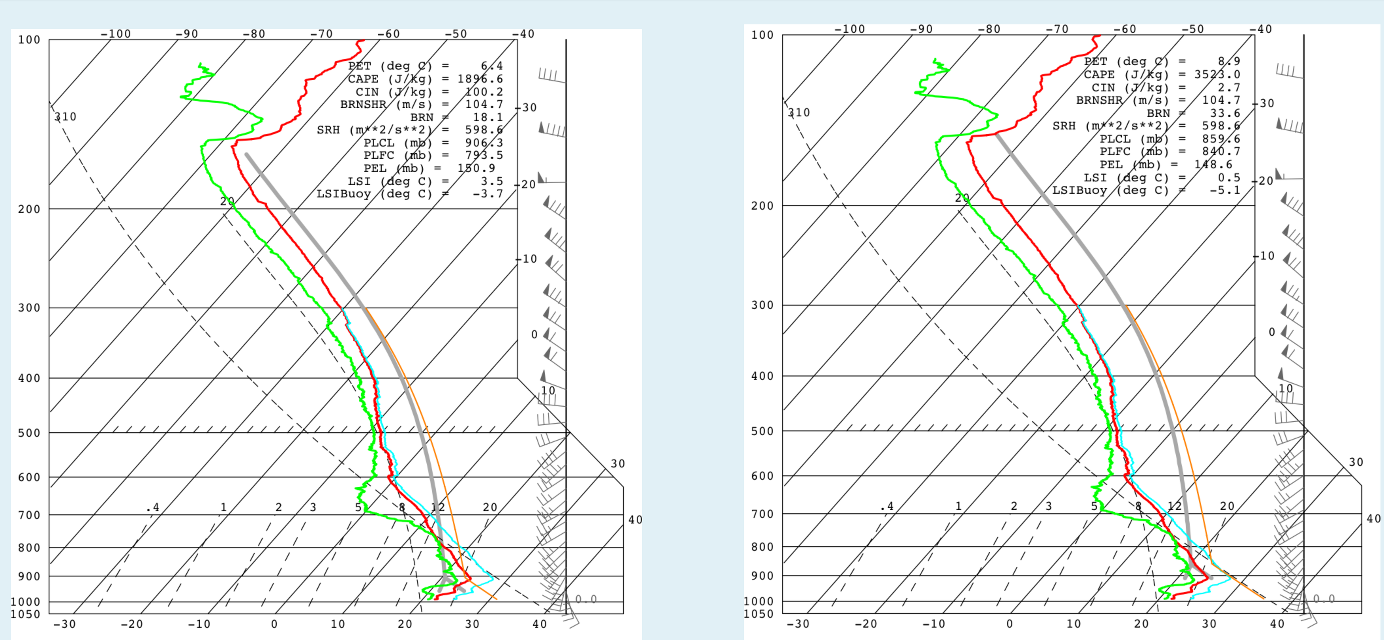

Fig. 3. MG3 sounding at 0428. The gray line represents the path of a lifted parcel with the left and right soundings showing surface-based and elevated most-unstable parcels respectively. The surface temperature in the strongly stratified NBL is ~ 22 C.

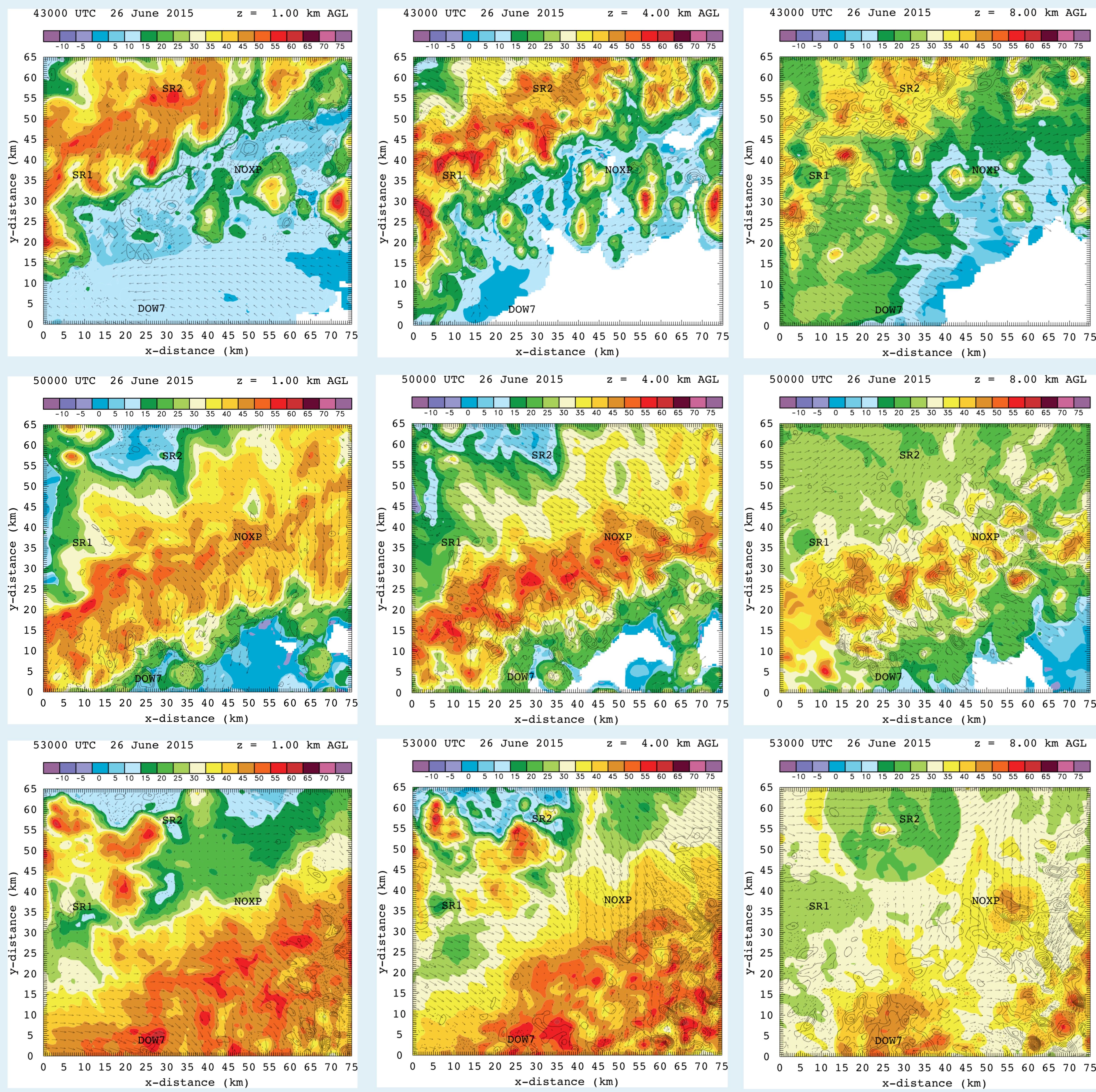

Fig. 4. Quad-Doppler radar analysis performed at 0430 (top row), 0500 (middle row), and 0530 (bottom row) UTC at 1 (left column), 4 (middle column), and 8 (right column) km. Color shading is radar reflectivity (dBZ) and arrows are wind velocity (m/s). Updrafts are contoured in solid black lines every 5 m/s and downdrafts are contoured with dotted black lines every -5 m/s.

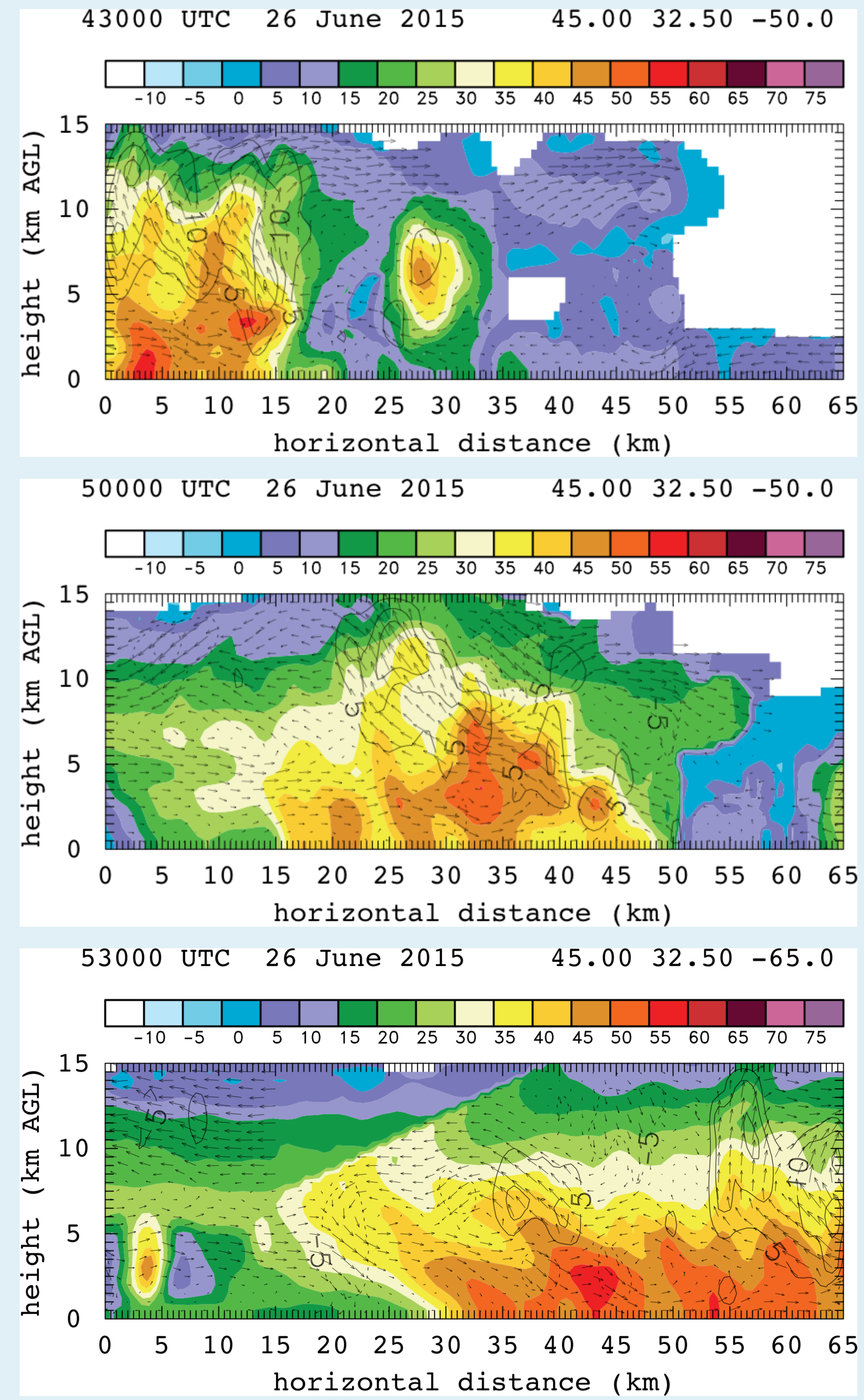

Fig. 5. NW-SE vertical cross-sections normal to the outflow boundary and CL at 0430, 0500, and 0530 UTC. Shading, contours, and arrows are the same as in Figure 4.

Conclusions:

The 0430 analysis reveals a CL with an inferred surface-based cold pool leading to the development of elevated cells along the edge. Environmental air is ascending over the cold pool to feed the convective updrafts and create the front-to-rear flow. By 0500, the stratiform region has developed and a deep rear inflow jet (RIJ) is descending behind the CL which has alternating updrafts and downdrafts normal to the cold pool. CI has occurred by 0530 in the rear area of the stratiform region. The RIJ has strengthened near the surface in a rotor region and oscillates as it descends. Future analysis will include calculating backward trajectories to determine whether the parcels ascending into the convective line are surface-based or from an elevated layer. Diabatic Lagrangian analyses will be effected to retrieve the hydrometeor and perturbation virtual buoyancy fields and determine how air parcels' thermodynamic properties change as they process through the MCS.