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Organized convection and mesoscale vortices: Observations from BAMEX (2003)

C. Davis (1), S. Trier (1), D. Jorgensen (2), J. Tuttle (1) and H. Murphey (3)

(1) National Center for Atmospheric Research, Colorado, USA (2) National Severe Storms Laboratory, Oklahoma, USA, (3) UCLA, California, USA (cdavis@ucar.edu / Fax: 303-497-8181 / Phone: 303-497-8990)

The Bow Echo and MCV Experiment (BAMEX) took place during the late spring of 2003 over central North America. One of the two primary objectives was to observe the formation and mature structure of mesoscale convective vortices (MCVs) and their relation to deep, moist convection. MCVs form within nocturnal mesoscale convective systems, and often survive as quasi-balanced remnants of convection. In many cases, they persist into the heating cycle of the next day and can focus new convection, sometimes culminating in a multi-day sequence of causally linked convective systems with attendant heavy rainfall. Observations of developing MCVs from airborne Doppler radars will be presented, as will mature MCVs using dropsonde and wind profiler data.

Analysis of three formative MCVs will be presented, showing that these circulations initially develop as part of a line of deep convection, preferentially on the poleward end of the line. Initially, MCVs have horizontal diameters of 50-100 km, and are confined to the lowest 5 km of the troposphere. The cyclonic circulation around these vortices appears to reinforce the descending rear-inflow jet and accentuates the bowing of the leading-line of convection.

Five mature MCVs were sampled with dropsondes and wind profilers. We present analysis of the kinematic and thermodynamic structure of each MCV, including an assessment of the degree of dynamical balance. Vertical motion within the circulation of each vortex is computed and used to interpret thermodynamic variations that promote new convection downshear. Horizontal advection of temperature induced by the MCV was significant in some cases, leading to the structures resembling extratropical

cyclones, but with length scales of only a few hundred kilometers. The MCVs themselves had diameters between 200 and 300 km and nearly all maximized near 4 km MSL.

Vortices spanning a considerable range of size, intensity and structure were observed. The longest-lived case, 11 June 2003, was part of a multi-day vortex that transitioned from elevated circulation to a deep cyclone extending through the troposphere. Although the MCVs formed in vertical wind shears of varying strengths, only the 11 June case occurred in shear that was less than 5 m/s over the depth of the vortex. In two of the cases, the mesoscale kinematic and thermodynamic modification due to the MCV promoted severe weather in an environment that would be otherwise considered benign.