MOBILE SOUNDING MEASUREMENTS OF THE NEAR-STORM ENVIRONMENT DURING VORTEX2

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I. INTRODUCTION

The first field campaign of the Verification of the Origins of Rotation in Tornadoes Experiment 2 (VORTEX2) was held from 10 May - 13 June 2009 in the central U.S. VORTEX2 is a fully nomadic project targeting in-storm and near-storm measurements of tornadoes and supercellular thunderstorms. Among approximately 50 instrumented vehicles fielded for VORTEX2 are four mobile GPS advanced upper air sounding (MGAUS) systems. During the 2009 field phase, we made 217 successful launches on 21 different operations days, including 69 pre-convective soundings and 148 soundings in the vicinity of mature storms. Quality control and initial processing of the data are currently underway; the conference poster provides a first look at several deployments from the 2009 campaign.

II. DEPLOYMENT STRATEGIES

A. Pre-storm Environment

A primary MGAUS aim is to characterize the pre-convective environment within which storms develop. These data are used in real time for forecast refinement, and will be used in retrospective analysis of the VORTEX2 cases. The higher temporal and spatial resolution of the MGAUS observations (when compared to the routine operational soundings) provides an excellent depiction of environmental variability and evolution. For example, on 13 June 2009, an impressive capping inversion was present during much of the day (Fig. 1, left), but had been removed by the time of convective initiation in the region (Fig. 1, right).

B. Near-storm environment

Another primary MGAUS aim is to characterize the near-storm environment for target storms that are sampled by the VORTEX2 armada.

Primary deployment plan

Many missions focused on documenting environmental variability and baroclinity in the storm's inflow, forward flank, rear flank, and anvil shading zones. Fig. 2 summarizes the frequency with which various parts of target supercells were sampled by the MGAUS teams. An example of an optimal MGAUS deployment is shown in Fig. 3, wherein the inflow zone, upshear/rear flank zone, and the forward flank baroclinic zone were all sampled with simultaneous launches from our four vehicles. This launch occurred shortly after the dissipation of a tornado that was sampled by the VORTEX2 armada. The inflow sounding (Fig. 4) reveals very large vertical wind shear and CAPE, with a nearly adiabatic lapse rate extending up through 500 hPa (for more, see Parker 2009, elsewhere in this volume).

Secondary and ad hoc deployment plans

If storms are fast-moving, in a sparse road network, or clearly non-supercellular, other near-storm deployments are used, such as a mesoscale box (Fig. 5) or picket fence (Fig. 6). Although such strategies do not sample the storm-scale variability as well, they are safer and also often provide a depiction of mesoscale heterogeneity that is startling. For example, the black and green soundings in Fig. 6 were launched within 5 minutes and roughly 20 km of one another. Even so, they reveal very different inflow environments, with the temperature inversion and associated convective inhibition (CIN) being completely absent from the eastward member of the pair (Fig. 7).

III. LESSONS LEARNED AND FUTURE PLANS

MGAUS teams became quite adept at near-storm sampling during the 2009 campaign; MGAUS systems are well-suited to depicting variability of the storm-scale environment. However, preliminary analyses suggest that soundings are often lost or compromised in the forward flank of supercells, possibly because of icing and/or lightning.

In the coming months, we will complete quality control procedures for the 2009 MGAUS data. The next step will then be integration of the sounding data with the other VORTEX2 datasets collected in 2009. We will undertake the second observing phase during the window of 1 May - 15 June 2010. Going forward, we plan to amend the MGAUS operations plan for the forward flank of supercells, wherein we often lose soundings pre-maturely and data quality appears to be compromised. One possibility is to sample the inflow environment more heavily, since there appears to be significant mesoscale variability in storms' inflow sectors.

IV. ACKNOWLEDGMENTS

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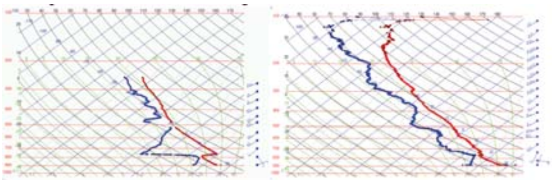

FIG. 1: MGAUS soundings from Dumas, Texas on 13 June 2009 from 1959 UTC (left) and 2303 UTC (right).

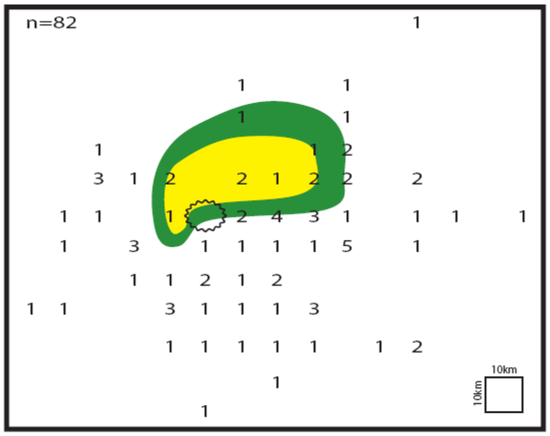

FIG. 2: Storm-relative MGAUS launch positions for 82 near-supercell soundings from VORTEX2 in 2009.

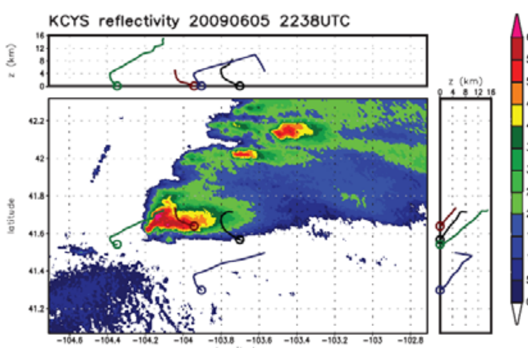

FIG. 3: Launch locations and trajectories for MGAUS deployment on 5 June 2009. Sounding positions are converted to be storm-relative with respect to radar image from Cheyenne, Wyoming.

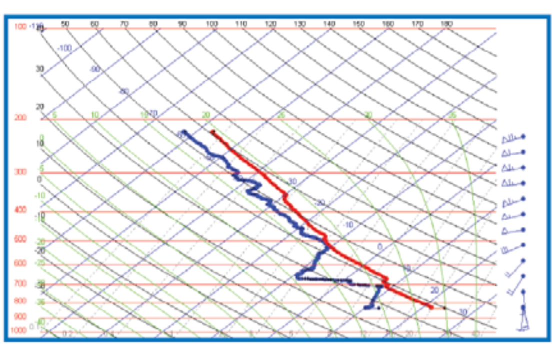

FIG. 4: MGAUS sounding from 2240 UTC on 5 June 2009. Launch location and trajectory are in blue in Fig. 3.

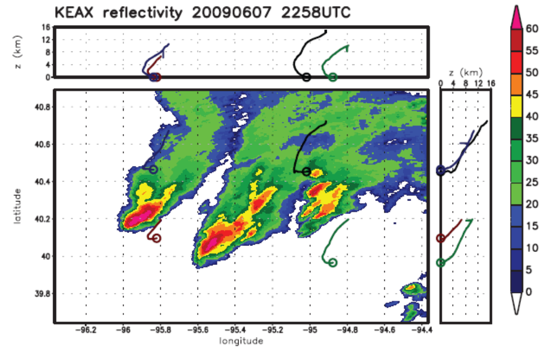

FIG. 5: Same as Fig. 3, except for 7 June 2009, with radar image from Kansas City, Missouri.

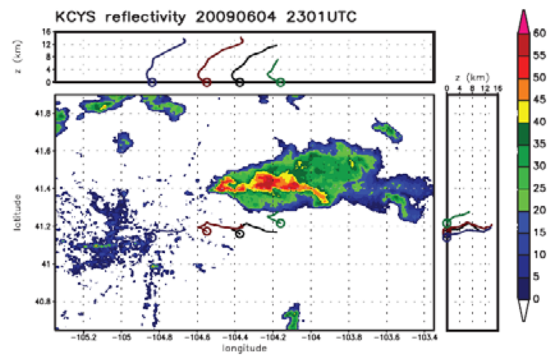

FIG. 6: Same as Fig. 3, except for 4 June 2009.

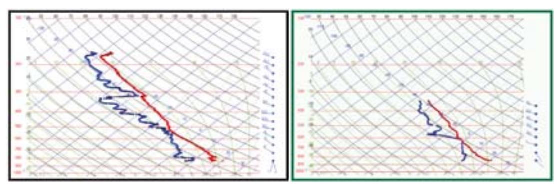

FIG. 7: MGAUS soundings on 4 June 2009 from 2303 UTC (black) and 2308 UTC (green). Launch locations and trajectories are color-coded with Fig. 6.