

# UMASS-XPOL

*Vortex-2*

## SCIENTIFIC MISSION SUMMARY

### PRINCIPAL INVESTIGATORS

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**2009/05/12**

Two deployments :

1) ~8 km WSW of Silverton (Ranch Rd 284 and County Rd I.) - 2313-2338 UTC. Operated ~120 degree sector scans from 1 to 17 degrees at 2 degree increments (in elevation). Some light precipitation was observed at the deployment location, though the blowing dust and strong winds were much more notable.



2) ~12 N of Paducah (Hwy 62 and Ranch 3256; ~35 km S of CDS) - 0143-0225 UTC. Apparent (relatively high-based) supercell was observed at close range (i.e. under updraft at times) after radar inadvertently sampled soft <1" hail between Paducah and Childress. Operated with several different scanning strategies, including 1 to 17 degrees (2 deg increments) and 2 to 42 degrees (4 deg increments). KFDR WSR88D data indicated likelihood for at least large hail with the storm, so focused primarily on polarimetric, volumetric collection. Attenuation was very severe, such that the signal was lost at ranges of less than 9 km. Interpretation of polarimetric signatures aloft may be tricky owing to having to scan at very high elevation angles as a result of our close proximity to the storm.



**2009/05/13**

Four deployments in the afternoon and evening :

1) Location: 13 km W of Hennessey; 3 km E of Lacey

Coordinates: 36.1165 N, 98.0342 W

Time: 2314-2317 UTC

Direction: Scanned WNW through NE

Comments: Very brief deployment on developing convection along the front to our west through northeast. Reposition was requested as a result of new convection developing rapidly to our W and WSW.

2) Location: 14 km W of Okarche; 22 km E of Greenfield

Coordinates: 35.7253 N, 98.1336 W

Time: 0023-0034 UTC

Direction: WSW through NNE

Comments: From the previous position, we had to head east to get a south road that would cross a nearby river. As such, we were consistently too far east of the "business end" for the net southward motion. A wall-cloud developed very shortly after we undeployed (approaching rain made us weary of staying on a red dirt road). Unanticipated storm motion complicated any attempts for us to get southwest far enough to participate in the X-band network. Out of radio range for most of the chase.



3) Location: 13 km SE of Geary; 13 km NE of Hinton

Coordinates: 35.5325 N, 98.2335 W

Time: 0106-0130 UTC

Direction: SW though NNE

Comments: Couldn't make it to Hwy 281 S toward Hinton by the time the core reached I40. As such, we deployed near the Love's at exit 108 (Hwy 281 Spur) along I40. Observed small hail at deployment location.

4) Location: Norman; Max Westheimer airport (immediately SE of Exit 112 on I35)

Coordinates: 35.2537 N, 97.4806 W

Time: 0354-0430 UTC

Direction: NNW through E (then SE)

Comments: Tornadoic supercell approached OUN from the north, but we weren't able to deploy until after Lake Stanley Draper tornado lifted (per OUN NWSFO). Scanning strategy: [2:1:16] every 2 minutes.

**2009/05/15**

Two deployments on the afternoon and evening of 5/15/09, both as the northeastern-most radar along the line of X-band (and SR) radars; UMXP was ~22 km NE of SR1.

1) Location: ~4 km NNE of Renfrow, OK

Coordinates: 36.9561 N, 97.6348 W

Time: 2140 - ~2200 UTC and 2255 - 0015 UTC

Direction: W through NE and WSW through NNE

Comments: Initial convection along the front developed well beyond the maximum unambiguous range (30 km), but a few 2nd-trip volume scans were collected. We then waited until the convection approached 30 km NW of the radar before resuming again. Shelf cloud and outflow moved above and through deployment location; heavy rain approaching our red dirt road location forced us to find a new deployment location along a paved road (such locations were either too close to a major roadway or too sloped to allow for leveling). Radar was synced to start new lowest-elevation scan at multiples of 3 minutes after the hour.

2) Location: ~2 km SSW of Renfrow, OK

Coordinates: 36.920 N, 97.956 W

Time: 0024-0048 UTC

Direction: SSE through ENE

Comments: Couldn't level the truck owing to excessive slope, but pitch and roll were recorded. The dirt and gravel roads were too wet or soft to deploy on; we had concerns of getting stuck in the mud on the dirt roads, and the gravel sections were too soft for the levelers to work properly. At any rate, we collected volumetric sector scans to the SE (in DD lobe with nearby SR) before collecting a few RHIs and vertically-pointing scans in the light stratiform precipitation at the rear of the squall line / bow echo. Scanning strategy: [2:2:24] degrees every 90 seconds.



**2009/05/19**

A single deployment this afternoon on weak convection that developed across northeastern Colorado and adjacent portions of the southern Nebraska panhandle.

1) Location: ~12.5 km ESE of center of Sidney, NE; south of intersection of Rd 16 and Rd 127

Coordinates: 41.10183 N, 102.838700 W

Time: 2203-2300 UTC

Scanning strategy: SSW-WNW with [2:1:9] degrees elevation angle set every 1 minute

Discussion: We sampled some weak, extremely high-based convection in environment characterized by 40-50 F dewpoint depressions. A lot of virga, some precipitation reaching the surface, and blowing dust noted to our southwest through west-northwest. No precipitation or enhanced wind experienced at deployment location.



**2009/05/20**

UMXP deployed once today, with a slight reposition eastward to clear some low-level beam blockage issue experienced when the we had to change sectors as the storm moved eastward:

1) Location: ~15-16 km N of Alliance, NE, off Hwy 87

Coordinates: 42.237533 N, 102.86500 W (adjusted to 42.23773 N, 102.860750 W)

Time: 2348-0000 UTC ; 0006-0038 UTC (end time approximate)

Scanning strategy: NW through NE with [2:1:13] / 90 sec; NNW through E with [2:1:26]/~110 sec (not synced)

Discussion: Thunderstorm looked to undergo "supercellgenesis" as it passed to the N of Alliance, NE. As we were setting up to scan, we saw at least 3 gustnadoes at close proximity along SSEward-moving leading edge of the outflow (it was in the spot where you'd expect an RFD, but we were a little south of the storm - far enough where I wouldn't expect that the strongest RFD would pass). The gustnadoes passed within 100 yards of the radar. Strong and cold northerly and northwesterly winds experienced for the duration of the deployment.



## **2009/05/23**

Two deployments :

1) Location: ~4 km E of Madrid along Hwy 23 (~20 km E of Grant)

Coordinates: 40.849623 N, 101.49334 W

Discussion: Attempted to deploy ahead of the northward-moving convection, but didn't get set up much before precipitation was observed at location. Scanned E through S through W; adjusted sector to NE through SE through SW.

2) Location: ~22 km N of Wallace just west of Hwy 25 (~12 km S of I80)

Coordinates: 41.032700 N, 101.155183 W

Time: 2256-2303 UTC and 2308-2341 UTC

Discussion: Scanned SSW through NW at a location 10-15 km S of NOXP. Collected from 2 degrees to 24 (later to 28) degrees in elevation. At end of official deployment time, took a few RHIs to the west and a few vertically-pointing ZDR calibration check scans.

## **2009/05/24**

Travel day. Uncoordinated scans for Zdr Calibration.

**2009/05/25**

Two deployments on one dissipating "storm" and one weakening supercell:

1) Location: West side of Hollis, OK

Coordinates: 34.683820 N, 99.92977 W

Time: 2133-2150 UTC

Scanning strategy: Starting at 2 degrees, every 1 degree, to 17 degrees every 2 minutes

Discussion: Captured weakening convection. Nothing else to say, really.

2) Location: 12.5 km E of Rocky/Hwy 183 on Rte 55, or 5.3 km W of Rte 54 (WSW of Lake Valley)

Coordinates: 35.160705 N, 98.922223 W

Time: 2340-2346 UTC

Scanning strategy: 2 degrees to 17 degrees in elevation (every 1 degree) every 2 minutes

Discussion: Weakening supercell observed to the north. Some banding noted in low-levels of updraft before deployment, but the cell began to rapidly weaken just after deployment. We soon undeployed to target another cell (which too rapidly weakened upon nearing it) NW of Sweetwater, OK.



**2009/05/26**

One deployment on a left-moving, anticyclonic supercell NNW of Ft. Worth:

- 1) Location: On FM 455 ~6.5 km SE of Forestburg, TX, or ~40km WSW/SW of Gainesville, TX  
Coordinates: 33.479190 N, 97.527075 W  
Time: 0112-0220 UTC  
Scanning strategy: 2 degrees to 17 degrees every 1 degree every 2 minutes; scanned SSW through NNE  
Discussion: Nice anticyclonic supercell with excellent anticyclonic hook and good mesoanticyclone structure noted to our S during initial stage of deployment. Features appeared to devolve with time.



**2009/05/29**

One deployment today as target storm was dissipating :

1) Location: 24 km NNW of Taylor, NE, or 23 km SSE of Rose, NE, on Hwy 183

Coordinates: 41.985551 N, 99.425643 W

Time: 0044 - 0050 UTC

Scanning strategy: 2 to 24 degrees ever 2 degrees; scanned N through E and NE through SE

Discussion: The target storm was dissipating by the time we deployed between Taylor and Rose, NE, off Hwy 183. More vigorous, multicell convection was sustaining itself to the S through ESE of the deployment location.



## 2009/05/31

Two deployments on convection that initiated in extreme southeastern NE and moved into extreme southwestern Iowa during the late afternoon and early evening hours:

1) Location: ~3 km NNE of Sidney, IA (or ~22 km NE-ENE of Nebraska City, NE)

Coordinates: 40.77045 N, 95.63287 W

Time: 0024 - 0043 UTC (scanned W through N); 0044 - 0050 UTC (scanned W through NE)

Scanning strategy: 1 to 16 degrees every 1 degree every 120 s

Comments: Minor RFI noted during first part of deployment; more severe RFI observed during latter periods of deployment. Significant RFI was noted though much of the latter half of the deployment. The rather light RFI in the first part of the deployment time had limited impact on the polarimetric quantities (e.g.  $\rho_{hv}$ ); by the second half of the deployment, RFI became more prominent and significantly reduced  $\rho_{hv}$ .

2) Location: ~5 km SW of Shenandoah (or ~3 km W of US 59 - Rte 2 intersection)

Coordinates: 40.742855 N, 95.421890 W

Time: 0117 - 0130 UTC (scanned S through W through N)

Scanning strategy: 2 to 32 degrees every 2 degrees every ~120 s

Comments: Brief data collection after official coordinated operations ended. Convection was very close to radar, so we scanned to very high elevation angles.

## 2009/06/01

No formal deployments as a result of a problem in which the computer was unable to control fully the antenna.

## 2009/06/04

Four deployments today (the last two were essentially the same location, but we had to turn the truck around):

1) Location: I80 at exit 386 (south of Egbert, NE of Carpenter, ESE of Burns)

Coordinates: 41.156828 N, 104.253503 W

Time: 2313-2315 UTC

Scanning strategy: 1 degrees to 24 degrees every 1 degree every 180 s; scanned W through NE

Discussion: Collected data of the weakening stage of a supercell that passed N and NE of Cheyenne, WY.

2) Location: ~8 km W of Carpenter, WY, along CR 203 (or ~30 km ESE of US 85 - I80 interchange)

Coordinates: 41.03475 N, 104.46630 W

Time: 0048-0101 UTC

Scanning strategy: 2 degrees to 22 degrees every 1 degree every 180 s; scanned W through NE

Discussion: Collected data on strong convection that passed very near Cheyenne. Had to undeploy sooner than desired owing to our location on a dirt road relative to approaching heavy precipitation

3) Location: ~7 km SSW of Hereford, WY, at Weld County Rd 77 and CR 128 (or ~10 km NW of Grover, WY);

Coordinates: 40.915990 N, 104.335065 W

Time: 0129-0134 UTC

Scanning strategy: 2 degrees to 22 degrees every 1 degree every 180 s; scanned WNW through NE  
Discussion: Collected data on convection to our immediate NW through NE. Had to turn the truck around to allow for better sectors. I really wanted to deploy the radar with the rear of the truck facing northward, but I couldn't safely do so.

4) Location: ~7 km SSW of Hereford, WY, at Weld County Rd 77 and CR 128 (or ~10 km NW of Grover, WY)

Coordinates: 40.916033 N, 104.33534 W

Time: 0139-0151 UTC

Scanning strategy: 2 degrees to 23 degrees every 1 degree every 180 s; scanned NNW-SSE

Discussion: Weakening convection to our N through E

## 2009/06/05

Four deployments today on supercells in extreme eastern Wyoming and western Nebraska :

1) Location: 16.5 km E of Meriden, 13 km SSE of LaGrange, 12.4 km N of Albin, WY

Coordinates: 41.527684 N, 104.12266 W

Time: 2208-2259 UTC

Scanning strategy: 2 degrees to 16 degrees every 1 degree every 120 s

Discussion: Owing to inability to find a good deployment spot, we missed tornadogenesis by a few minutes. Note that our SASSI position was NOT updating after we went N of Albin! We finally found a clear deployment spot in a broad valley (so we have partial beam blockage problems on the lowest one or two elevation angles) and scanned through the majority of the tornadoes life (and some time thereafter). Polarimetric data appear to indicate rho<sub>hv</sub> half-ring in the mid-levels to the NW of the location of the tornado (at the low-levels) with ~55 m/s inbound winds on the south side. Note that max unambiguous velocity is approx +/- 40 m/s. Closer to the surface, the tornado is evident by a collocation of a velocity couplet, rho<sub>hv</sub> "hole", Zdr "hole", and local minimum in reflectivity factor. The tornado was located ~15-19 km to our WNW.





2) Location: 15 km S of Harrisburg, NE; 27 km E of Albin, WY (9 km W of 71 along CR 6)  
Coordinates: 41.423574 N 103.767901 W  
Time: 2350 - UTC  
Scanning strategy: 2 degrees to 9 degrees every 1 degree every 60 s  
Discussion: Interesting wall-cloud and lowerings on the supercell to our N-NE. An LP also appeared to our NW/WNW. Note that we took a few volumes while moving eastward on CR6 E of Albin.

3) Location: 22 km ESE of Dalton, NE; 21 km ENE of Gurley, NE (1 mi N of Rd 46-139 intersection)  
Coordinates: 41.337087 N, 102.724428 W  
Time: 0150-2230 UTC  
Scanning strategy: 2 degrees to 13 degrees every 1 degree every 2 minutes  
Discussion: Outflow-heavy, HP supercell was scanned to our NW through NE.

4) Location: 2 km S of Paxton, NE; ~0.5 km S of I-80 exit 145 (along SR 51)  
Coordinates: 41.107055 N, 101.356584 W  
Time: 0438-0457 UTC  
Discussion: Large HP supercell to our far east; tornado-warned storm to our north. Cold, northerly outflow experienced south of updraft at deployment location. The eastern cell was too far to our E, and the convection to our N and NE was not particularly interesting.

## 2009/06/06

Two deployments today :

1) Location: ~5 km S of Mullen, NE (SE of SR 97 - Rte 2108 intersection)  
Coordinates: 41.995819 N, 101.045921 W  
Time: 2258-2319 UTC  
Scanning strategy: 2 degrees to 24 degrees every 2 degrees every 90 s  
Discussion: Combination of wanting to scan high yet maintain rapid scanning of low-levels as the supercell progressed very close to deployment site necessitated a 90 s volumetric sector interval (i.e. 2 volumes every 3 minutes). Golfball-sized hail was experienced at deployment site before radar was forced to abandon northward (into the FFD).

2) Location: 2~ km SE of Thedford, NE (1.5 km S of US 83 - SR 2 intersection)  
Coordinates: 41.965610 N, 100.56074 W  
Time: 0000-0013 UTC  
Scanning strategy: 2 degrees to 24 degrees every 2 degrees every 90 s  
Discussion: Supercell became undercut by cooler outflow to its north and began to weaken. Data were collected in close proximity to the KLNK WSR-88D in Thedford, NE.

## 2009/06/07

Three deployments today :

1) Location: Southwest side of Forest City, MO  
Coordinates: 39.976620 N, 95.201575 W

Time: 2252 - 2340 UTC

Scanning strategy: 2 degrees to 16 degrees every 1 degree every 2 minutes

Discussion: Intensifying, non-tornadic (at least at the time of scanning) supercell scanned to the west. The supercell took a right turn that eventually brought the mesocyclone over the deployment location. Eward advancing precip at south end of hook echo noted ~1-2 km to our south. We waited as long as possible in an attempt to catch tornadogenesis, but that never came. We experienced hail of approximately baseball size in Forest City, and hail larger than baseballs in Oregon. I vividly remember at least two hailstones on the lawns of two houses in Oregon that are certainly the largest hailstones I have ever seen; I would not be surprised if these stones were larger than 4.25" in diameter. A storm chaser (per a report on Stormtrack) measured a 5.25" diameter hailstone in Oregon, and there are several accounts by other chasers in and around Oregon of hail well beyond baseball size. Unfortunately, being on the very north side of the meso, I was not concentrating much on collecting hail, as we were trying to make a hasty exit from under the storm. The only thing I can say with relative certainty is that the stones were at least as large as 3.5" in diameter. We did take some scans as we were driving under the north side of the meso, with the hook echo to our immediate south. This should be a very good polarimetric case of a largely non-tornadic, significant supercell that produced gargantuan hail.



2) Location: Exit 61 at I-35 and Hwy 69 approximately 3.5 km SW of Winston, MO

Coordinates: 39.853990 N, 94.174742 W (~100' Eward reposition mid-deployment)

Time: 0118 - 0215 UTC

Scanning strategy: 2 degrees to 17 degrees every 1 degree every 2 minutes

Discussion: Not a terribly good deployment spot, with a tall gas station sign to our N, and a set of trees to our W. However, it was the best we could find in the area. Apparently, at least one or two tornadoes were reported to our WNW, though the first (near Amity) likely occurred before we began data collection. We noted several low-level, rain-wrapped meso occlusions with the storm as it moved to our NW through NE, and it should have been in a dual-Doppler lobe with at least one other Xband radar. Extremely large hail (4.0") was reported to our NE during our deployment, and there were several other reports of >2" hail throughout the deployment time. New convection developed after we undeployed, and a large tornado was reported to have caused damage ~10 km S through E of our deployment location approximately 45 minutes after we left the location (approximately 90 minutes after we ended data

collection). We repositioned the truck slightly to the east (~100-150 feet) so we could scan to the ENE - NE without significant beam blockage issues.



3) Location: ~9 km E of Hiawatha, KS (Hwy 36 - Prairie Rd intersection)

Coordinates: 39.841915 N, 95.435748 W

Time: 0411 - 0417 UTC

Scanning strategy: 2 degrees to 17 degrees every 1 degree

Discussion: Decaying storm to our NW; possible heat burst experienced.

## **2009/06/09**

Three deployments today :

1) Location: 12 km NE of Ford, KS; 9 km S of Windthorst; 34 km ESE of DDC (along 132 Rd and Outlaw Rd)

Coordinates: 37.704454 N, 99.635900 W

Time: 2307-2322 UTC (synced to the even minute)

Scanning strategy: 1 degree to 16 degrees every 1 degrees every 120 s

Discussion: Intense supercell to our west was scanned at relatively close range. Supercell structure was fantastic, and baseball-sized hail was reported in the core during the deployment. We could not level the truck since the soft sand road resulted in the failure of the levelers to work properly; pitch and roll were measured and recorded, however.



- 2) Location: ~2 km NE of Greensburg, KS (~1 km N of US 54)  
Coordinates: 37.616242 N, 99.272139 W  
Time: 0003 - 0012 UTC (synced to the even minute)  
Scanning strategy: 2 degrees to 17 degrees every 1 degree every 120 s  
Discussion: Extremely impressive supercell updraft structure continued to be observed with this supercell. A tornado was reported approximately 10 minutes prior to deployment. The updraft structure changed rather markedly during the course of the deployment, and reflectivities aloft rapidly decreased.



- 3) Location: ~9.7 km W of PTT; 5.3 km ENE of Cullison, KS; NE of US 54 - SW 60th Ave  
Coordinates: 37.639442 N, 98.846280 W  
Time: 0040 - 0050 UTC  
Scanning strategy: 2 degrees to 17 degrees every 1 degree every 120 s  
Discussion: Weakening LP supercell observed to the west.

## 2009/06/10

Four deployments :

1) Location: 24 km SE of Johnson City, KS; 16 km S of Big Bow, KS  
Coordinates: 37.417533 N, 101.557788 W  
Time: 2309 - 2358 UTC  
Scanning strategy: 2 degrees to 25 degrees every 1 degree every 180 s

2) Location: ~21 km E of Hugoton, KS; 21 km NW of Liberal, KS (near Rd 27-SR 51)  
Coordinates: 37.164655 N, 101.103521 W  
Time: 0103 UTC  
Scanning strategy: 2 degrees to 21 degrees every 1 degree every 180 s

3) Location: 19 km NW of Liberal, KS; SR 51 - CR A  
Coordinates: 37.170010 N, 101.067262 W  
Time:  
Scanning strategy: Not coordinated.

Discussion: An interesting, organized lowering behind the gust front that contained rapid upward motion. This blocky lowering was much more organized than the transient areas of rotation that are often seen along and immediately behind gust fronts. In addition, it wasn't anything like the lowerings seen earlier in the evening/afternoon (i.e. during coordinated operations); the most fascinating feature of blocky lowering was the persistence of very rapid upward motion along periphery of lowering. The truck couldn't level here, and we had some problems with the lowering behind too forward of the truck, so we made this a brief deployment.

4) Location: 17 km NNW of Liberal, KS; SR 51 - CR C  
Coordinates: 37.170194 N, 101.032931 W  
Time:  
Scanning strategy: Not coordinated

Discussion: Similar to deployment #3, except focusing on a subsequent organized lowering. We noted a snaky funnel that extended ~60% of the way to the ground and persisted for ~20-30 seconds immediately after we undeployed.

## 2009/06/11

One short deployment :

1) Location: ~5 km S of La Junta, CO; near SR 109 - San Juan Ave  
Coordinates: 37.939318 N, 103.539635 W  
Time: 2358-0004 UTC  
Scanning strategy: 2 degrees to 18 degrees every 2 degrees

Discussion: Deployed to scan two supercells to the north and northwest. Several minutes into the deployment, electrical problems arose, and data collection was forced to stop.

**2009/06/13**

One deployment :

1) Location: 12 km W of Panhandle, TX; W of Ranch 293 - CR H intersection

Coordinates: 35.352136 N, 101.493015 W

Time: 0026 - 0048 UTC

Scanning strategy: 2 degrees to 15 degrees every 1 degree

Discussion: Deployment near time of interaction between left-moving anticyclonic supercell coming up from the SSW and a cyclonic supercell coming from the north side of Amarillo. Severe clutter was noted in the lower elevation angle scans as a result of a nearby wind farm. After the storm passed our longitude, we undeployed to move eastward. The updraft dissipated before we could deploy a second time.