September 5, 2004 Tornadoes

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Information from storm surveys conducted by Karl Jungbluth, Craig Cogil, and Rodney Donavon was included in this report.

A late season tornado outbreak occurred across Iowa during the early evening hours of Sunday September 5, 2004. The environment suggested little potential for large hail and minimal chances of damaging straight-line winds. The greatest severe weather threat was actually tornadoes, and that turned out to be the case. There were eight tornadoes in the Des Moines National Weather Service Forecast Area, all F0 or F1, no reports of hail, and only one straight-line wind report.

The environment reflected high values of both shallow and deep layer shear with only weak to moderate instability. **Figure 1** shows the modified LAPS sounding for DSM at 23z, while **Table 1** lists several of its severe weather parameters.

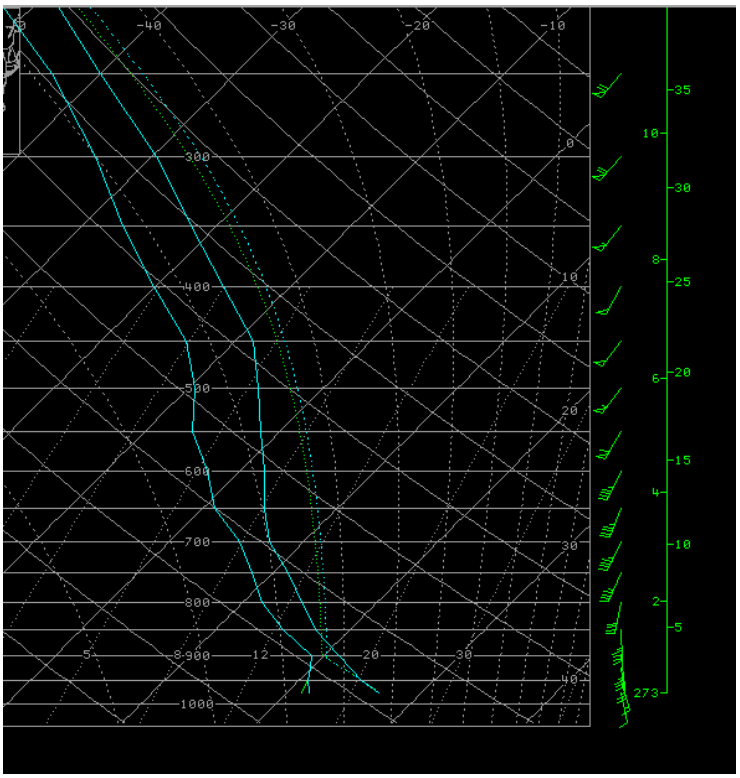

Figure 1 – DSM Modified 23z LAPS sounding

MLCAPE (50mb)	1036 j/kg
0-3km CAPE	168 j/kg
MLCIN (50mb)	-7 j/kg
EL	12342m (40492 ft)
LCL	816m (2677 ft)
LFC	977m (3205 ft)
Freezing Lvl	14700 ft
Wet Bulb Zero	13017 ft
VGP - 4km	0.23
EHI – 1km	1.4
EHI – 3km	2.0
SRH 3km	310 m^2/s^2
SRM 1km	222 m^2/s^2
0-1km shear	32 kts
0-6km shear	48 kts

Table 1 – 23z Modified LAPS Severe Weather Parameters

Although the shear was more than adequate for supercells and organized systems, marginal instability and low normalized cape would keep parcel accelerations relatively weak. This combined with high freezing levels and web bulb zeros made large hail production highly unlikely, and diminished the chances for downbursts or widespread straight-line wind events.

The environment was much more conducive for tornado development however. Several parameters including 0-3km CAPE and its relatively high percentage of MLCAPE (16%), and

intense 0-1km shear made conditions favorable for rapid shallow parcel accelerations and rotation. This intense low level stretching and shear, as well as accompanying low LCLs and LFCs, were nearly ideal for mini-supercells whose mesocyclones would be low enough to aid tornadic development.

The first tornado events the Des Moines forecast area occurred in Greene County at 604 pm CDT, just south and east of Cooper, and 2 miles west of Jefferson (F0) . The strongest radar signature was with the Cooper storm, and is shown in **Figure 2**. Storm Relative Velocity (SRM) is noted in the right hand image while Reflectivity is displayed on the left. Recall that green is motion toward the radar and red away from the radar in the SRM display, with the radar to the southeast. Notice that reflectivities are rather low, with only a slight hint at a "hook" echo.

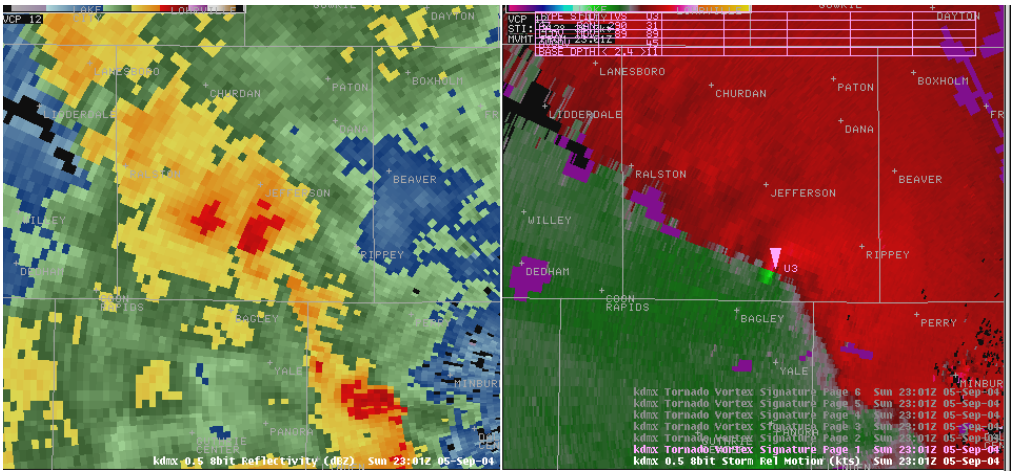

Figure 2 - WSR-88D 0.5° 2301Z Reflectivity (left) and Storm Relative Velocity (right). Cooper tornado.

The same storm that produced the tornadoes in Greene County then traveled northeast toward Hamilton County. Another brief tornado then occurred with the storm 4 miles northwest of Webster City at 715 pm CDT (F0). The radar signatures were much more subtle by this time, with **Figure 3** showing the same information as **Figure 2**. Notice the rather innocuous looking reflectivity and SRM images. Only a minor circulation is noted in the SRM data. The reflectivity would cause little or no concern at first glace with returns below 50dBZ.

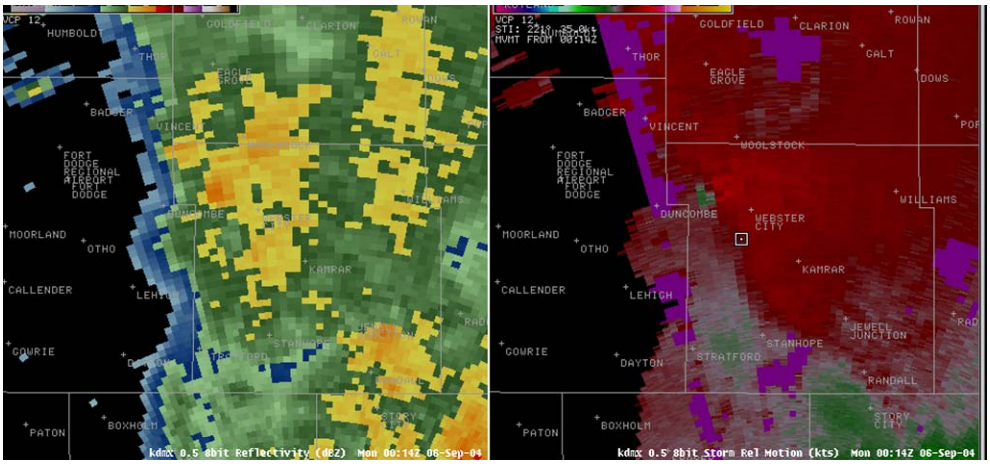

Figure 3 - WSR-88D 0.5° 0014Z Reflectivity (left) and Storm Relative Velocity (right). Tornado 4 NW Webster City.

Another long track mini-supercell moved across Union and Madison Counties, and prompted several tornado warnings. The storm eventually produced a weak, brief tornado in northwest Warren County at 752 pm CDT, 5 miles southwest of Norwalk near Prole (F0). **Figure 4** again shows rather innocuous looking reflectivity and SRM images with this storm.

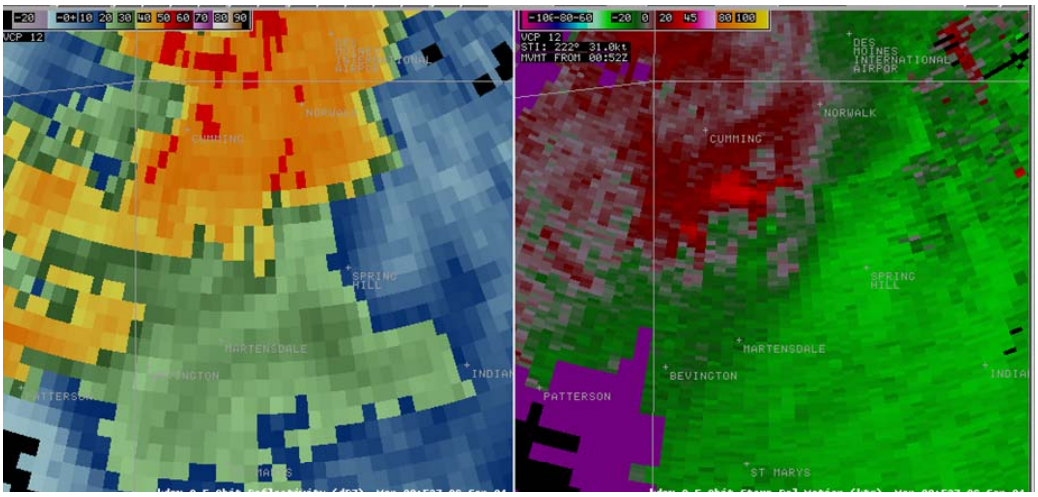

Figure 4 - WSR-88D 0.5° 0014Z Reflectivity (left) and Storm Relative Velocity (right). Tornado near Prole.

About an hour later another stronger storm crossed northwest Lucas County into southern Warren County with a very intense circulation noted in velocity data. National Weather Service staffers conducted a storm survey and the only apparent and conclusive tornado damage occurred 5 miles northwest of the town of Lucas at 848 pm CDT. **Figure 5** shows a very intense circulation with a more organized reflectivity signature as well. However again note that the reflectivity image exhibits no hook echo, and only a slight hint of an inflow notch.

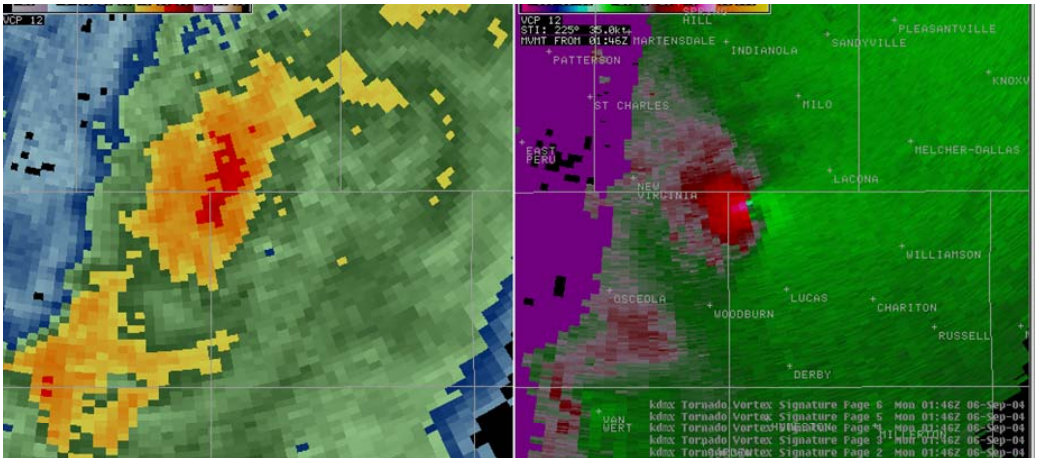

Figure 5 - WSR-88D 0.5° 0146Z Reflectivity (left) and Storm Relative Velocity (right). Tornado 6 NW Lucas.

This storm weakened, but the Prole storm continued to display moderate to strong indications of a circulation in the lowest slice of radar data as it entered Polk County with tornado warnings in effect. A post-event storm survey did discover tornado damage in northeast Polk County, 8 miles east of Elkhart at 851 pm CDT (F0). Figure 6 shows similar features with this storm circulation.

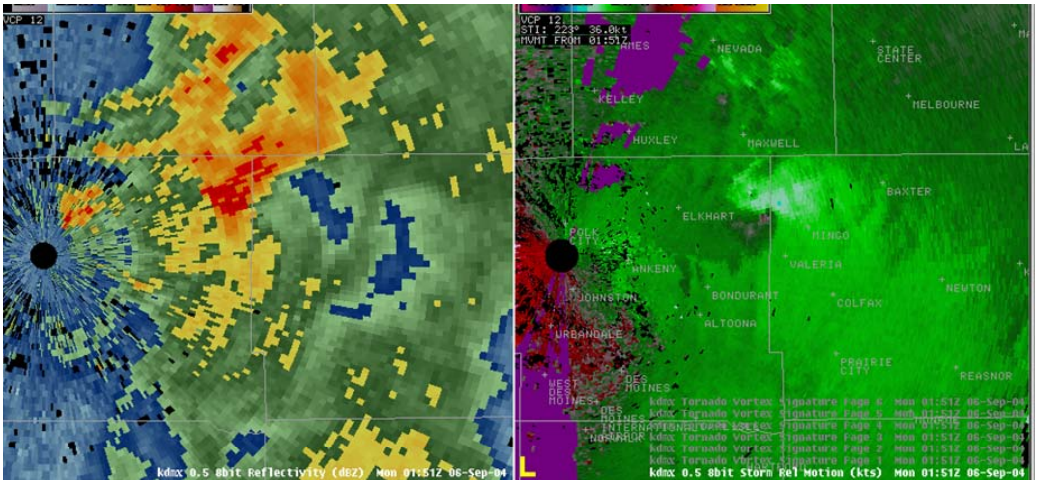

Figure 6 - WSR-88D 0.5° 0152Z Reflectivity (left) and Storm Relative Velocity (right). Tornado 8 E Elkhart.

This storm maintained intensity as it crossed into southeast Story County, continuing its track all the way across Union, Madison, Warren, Polk and Jasper Counties. Although conclusive tornado damage was not evident in far northwest Jasper County, the storm produced another and slightly stronger F1 tornado just south and east of Collins at 906 pm CDT. The radar circulation at this time was very similar to what occurred near Elkhart (**Figure 7**). Reflectivity data was more organized during both of these tornado occurrences and resembled signatures similar to what you would typically see in larger supercells.

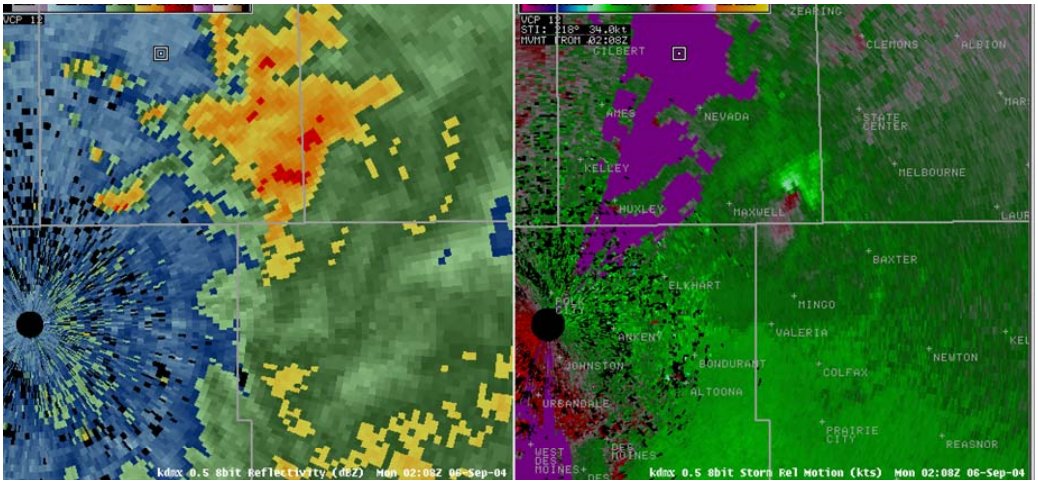

Figure 7 - WSR-88D 0.5° 0208Z Reflectivity (left) and Storm Relative Velocity (right). Tornado just SE of Collins.

The last tornado track of the day, and surprisingly most significant, occurred just after the storm entered Marshall County. Although there was some evidence of minor crop damage, it was insufficient to assume that the Collins tornado remained on the ground into Marshall County, and the track shifted more to the north as well. A more pronounced 3 mile long tornado track started about 3 miles southwest of State Center at 927 pm CDT, ending about 3 miles north-northwest of State Center 7 minutes later. Damage was F1 at its peak. The damage path looked to be about a 100 feet wide and destroyed several sheds and grain bins with numerous trees snapped. Damage pictures gathered from the National Weather Service survey and trained spotter Jason Dodd showed distinct paths through the corn (**Figures 8 and 9**). Most of the structure and tree damage had already been cleaned up before the photos were taken. Notice that

the storm had weakened considerably in both the reflectivity and velocity imagery at the time of the tornado, but the storm continued to produce significant damage (**Figure 10**). The storm ended at 929 pm CDT and was the last tornado reported for the day.

Figure 8 - 1 mile south of Highway 30, looking north (Justin Dodd)

Figure 9 - 3/4 mile east of Arney Ave, looking south from Highway 30 (Justin Dodd)

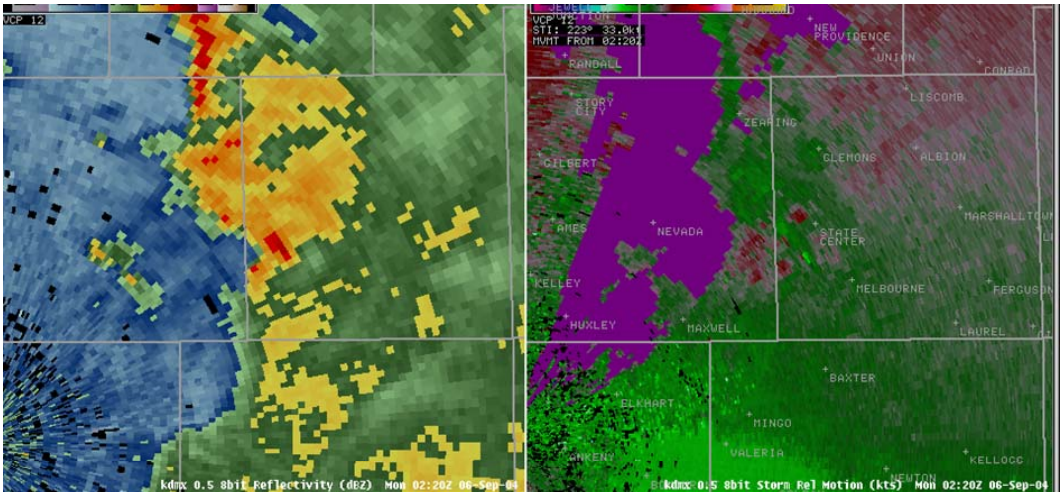

Figure 10 - WSR-88D 0.5° 0226Z Reflectivity (left) and Storm Relative Velocity (right). Tornado 3 W State Center.

The events of Sunday September 5, 2004 should be noteworthy for several reasons. First off, remember that tornadoes can occur in nearly any month of the year, even in September well after what is typically known as the peak of severe weather season in Iowa. Eight different tornadoes occurred in what could be defined as a late season outbreak (**Figure 11**). Secondly, tornadoes can and do occur at night when visual identification is difficult. The NWS only received tornado reports with two of the storms while they were in progress, with the remaining reports based on damage which was correlated to radar signatures well after the event. Also, conditions on this day were mainly conducive for storms producing either tornadoes or no severe weather at all. Spotters and the general public should not be lulled into complacency because the storms lacked large hail and substantial straight-line winds. Lastly, several of these tornadoes occurred with less than impressive radar signatures, especially a significant track across Eastern Marshall County, while other more impressive storms produced little or no damage at the surface.

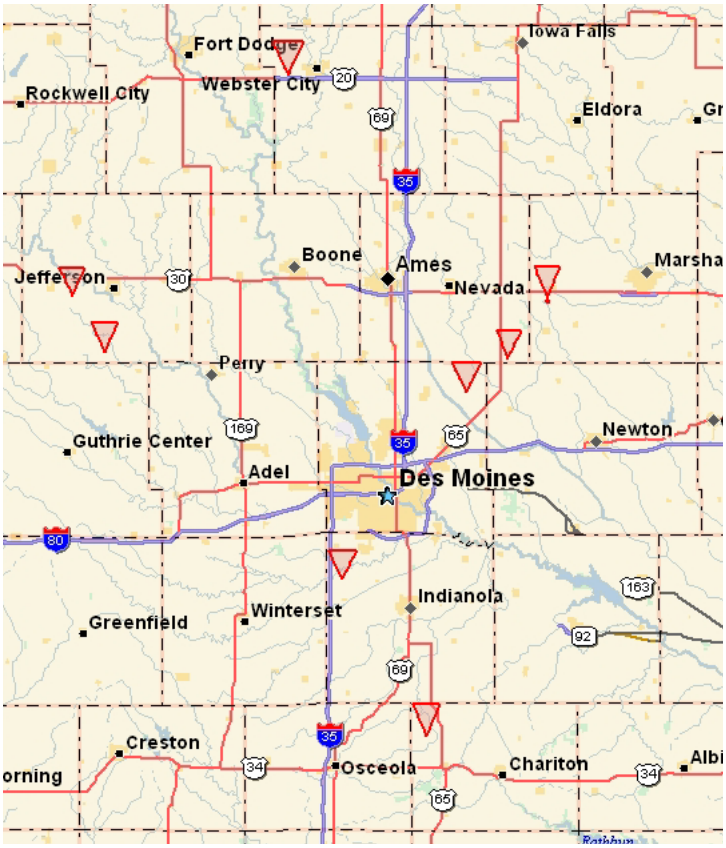

Figure 11 – Graphic of 8 tornado locations from Sunday, September 5, 2004 in the Des Moines NWS area of responsibility (red triangles).