A Look at the August 23, 2012, Severe Storms and EF-0 Tornado using Dual-Pol Radar Products

Event Synopsis

During the early evening hours of August 23, 2012, a few severe thunderstorms developed in far eastern South Dakota. These storms produced up to golf ball size hail as they crossed the border into Lincoln and Lyon counties in southwest Minnesota. The storms weakened below severe thresholds as they continued eastward, but one storm intensified again as it crossed the Minnesota River into Renville and McLeod counties. This prompted additional severe thunderstorm warnings, with the main threat being wind instead of hail (Fig 1). The cause for concern was a "rear inflow jet," which is an area of strong wind that begins aloft on the back side of the storm and eventually descends down to ground level in the front of the storm (Fig 2). When the rear inflow jet reaches the ground, it can cause extensive wind damage. In fact, after the storms had moved through, there were reports of trees down in Stewart and roof damage near Glencoe.

As the storm passed over Glencoe, the air flowing into the storm's updraft began to intensify. The combination of the easterly winds flowing into the updraft, and westerly winds of the descending rear inflow jet, caused a low level circulation to form (Fig 3). This circulation ended up producing a short-lived EF-0 tornado that tracked just northwest of Norwood Young America in western Carver County (Fig 4).

Recently, the Twin Cities National Weather Service Radar was upgraded to dual-pol technology. This allows the radar's receiver to separate the reflected energy into both the horizontal and vertical parts. This technology produces several new products, one of which is Correlation Coefficient, or CC. When the Correlation Coefficient is low, it is an indication that the particles in the atmosphere may not be rain, hail, nor snow. In other words, something may have been lifted up into the atmosphere that shouldn't be there. This signature is called a "tornadic debris signature," and it can be used to identify small objects such as leaves of corn, wood, insulation, and so on that have been lofted into the storm by the tornado (Fig 5,6). Fortunately this was a short-lived weak tornado, so the damage was mainly confined to trees and crops. Unfortunately however, there was one barn that was destroyed by this storm (Fig 7-11).

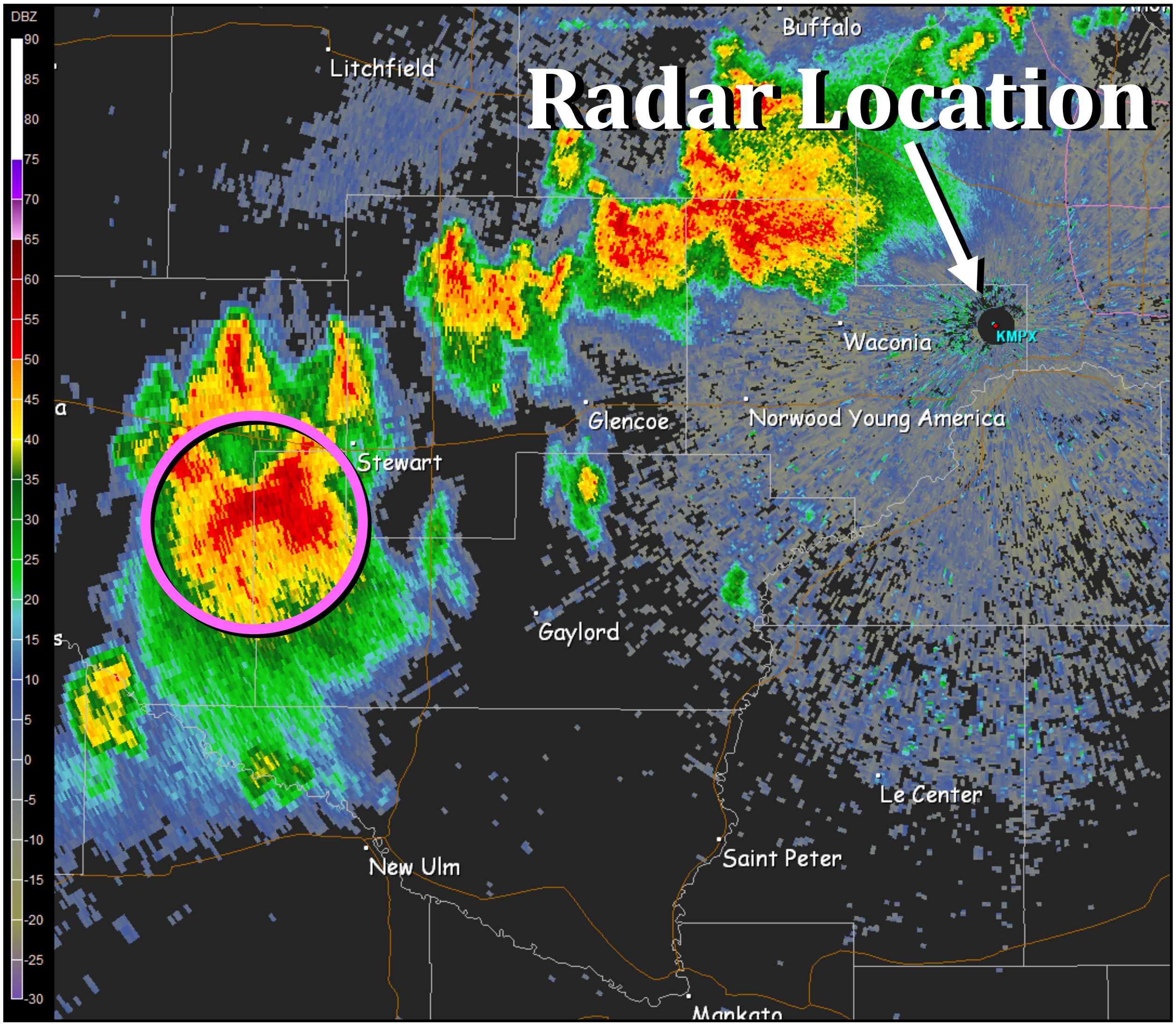

Figure 1: The image above is from August 23, 2012. It shows the radar base reflectivity (0.5°) at 807 pm CDT. The strongest storm is identified by the pink circle. This was the storm that produced wind and hail damage from Stewart to Waconia, as well as a weak tornado northwest of Norwood Young America.

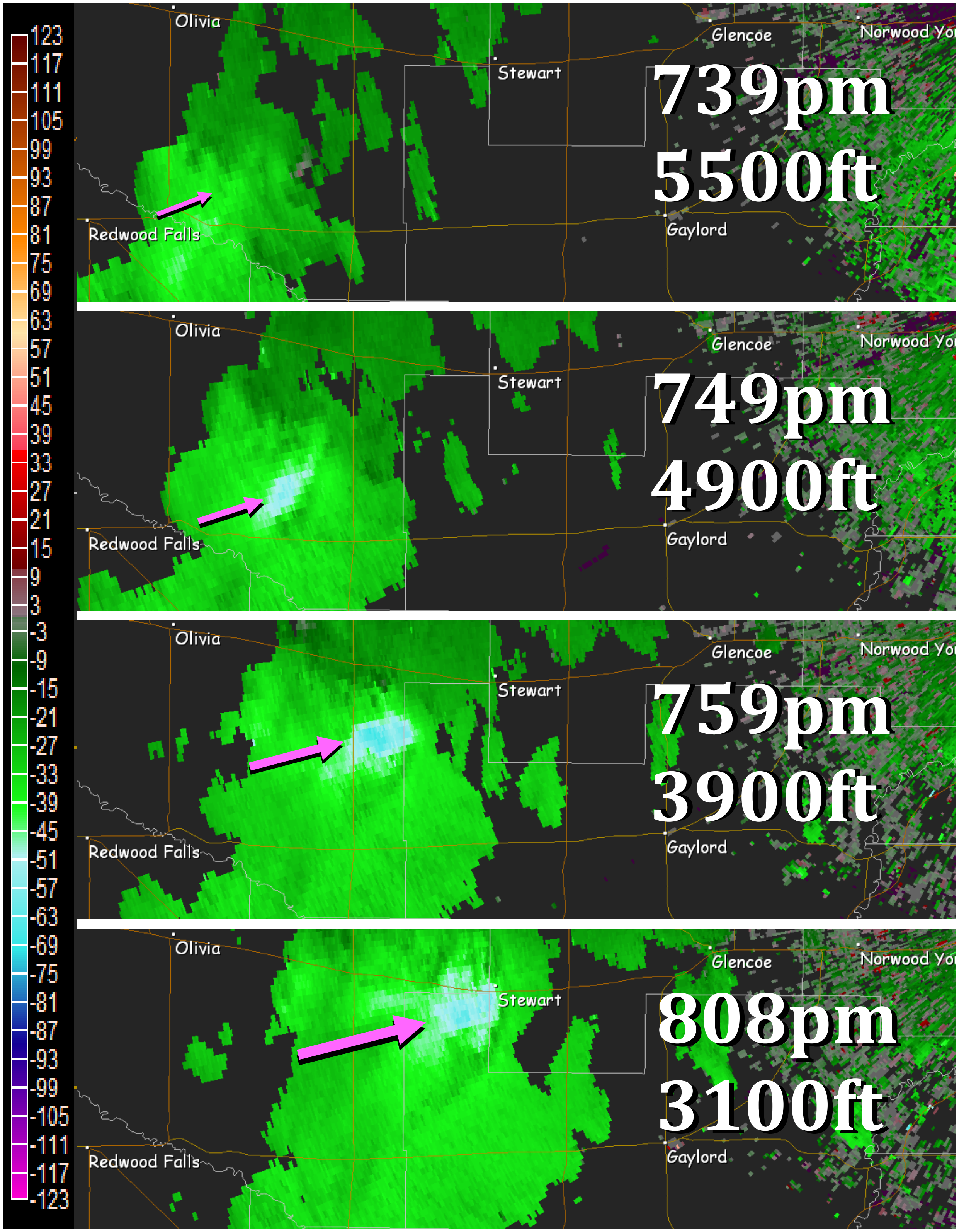

Figure 2: The radar images above show the base velocity (0.5°) as the storm crossed the Minnesota River valley and headed northeast. The green/blue colors show the descending "rear inflow jet," where the air was accelerating toward the radar from about 40kts at 5500 ft above ground (top) to about 65kts at 3000ft above ground (bottom). This rear inflow jet is highlighted by the pink arrows.

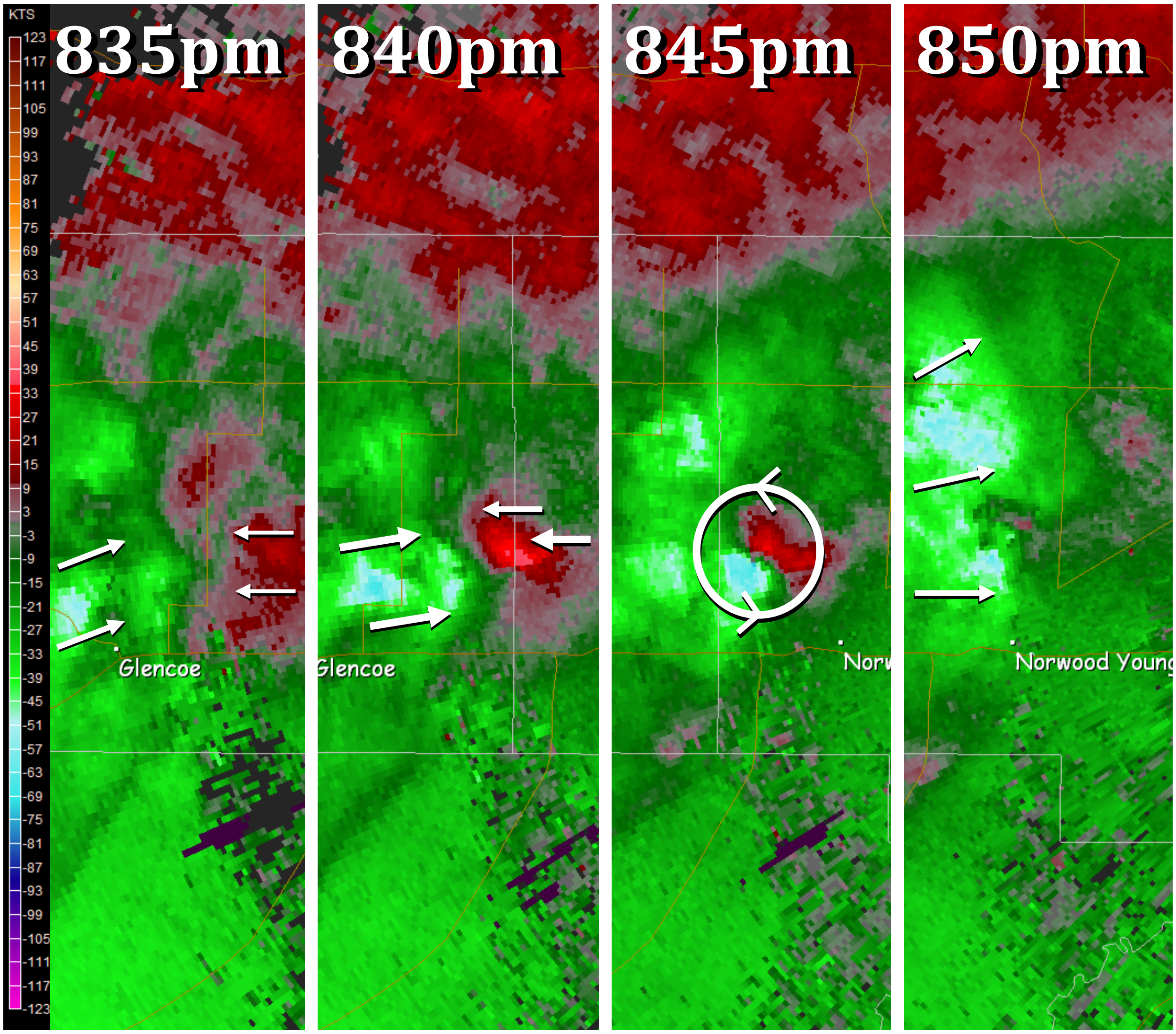

Figure 3: The images above follow the leading edge of the storm and show how the base velocity (0.5^o) changes over time during the few minutes prior to and after the tornado. The green/blue colors show where the air is moving northeast towards the radar, while the red/orange colors show where the air is moving westward away from the radar. The legend on the left is in knots. This set of images follows the formation and eventual dissipation of the circulation as it moves across western Carver County (white arrows/circle).

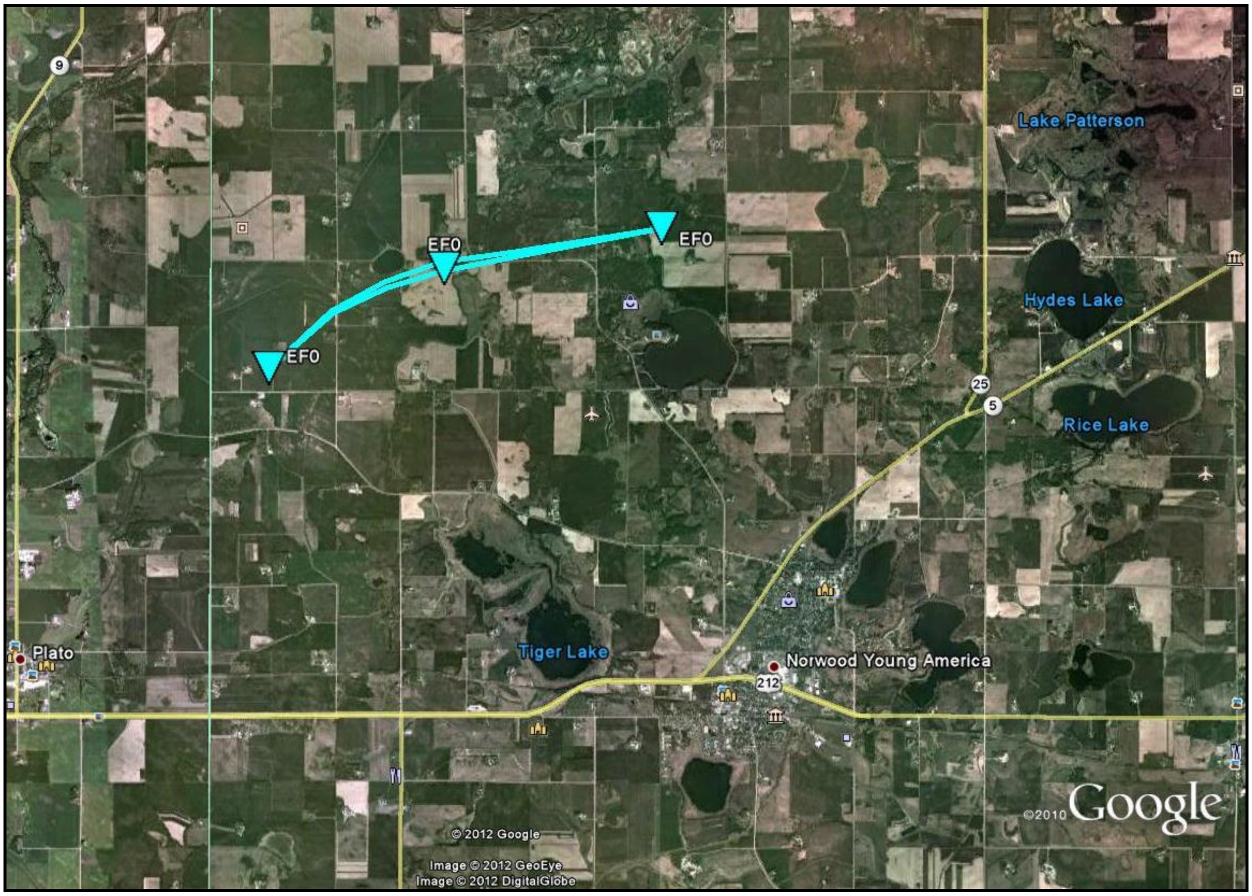

Figure 4: The image above shows the track of the tornado as it travel an estimated 3.2 miles with a maximum width of 100 yds and was on the ground for approximately 7 minutes.

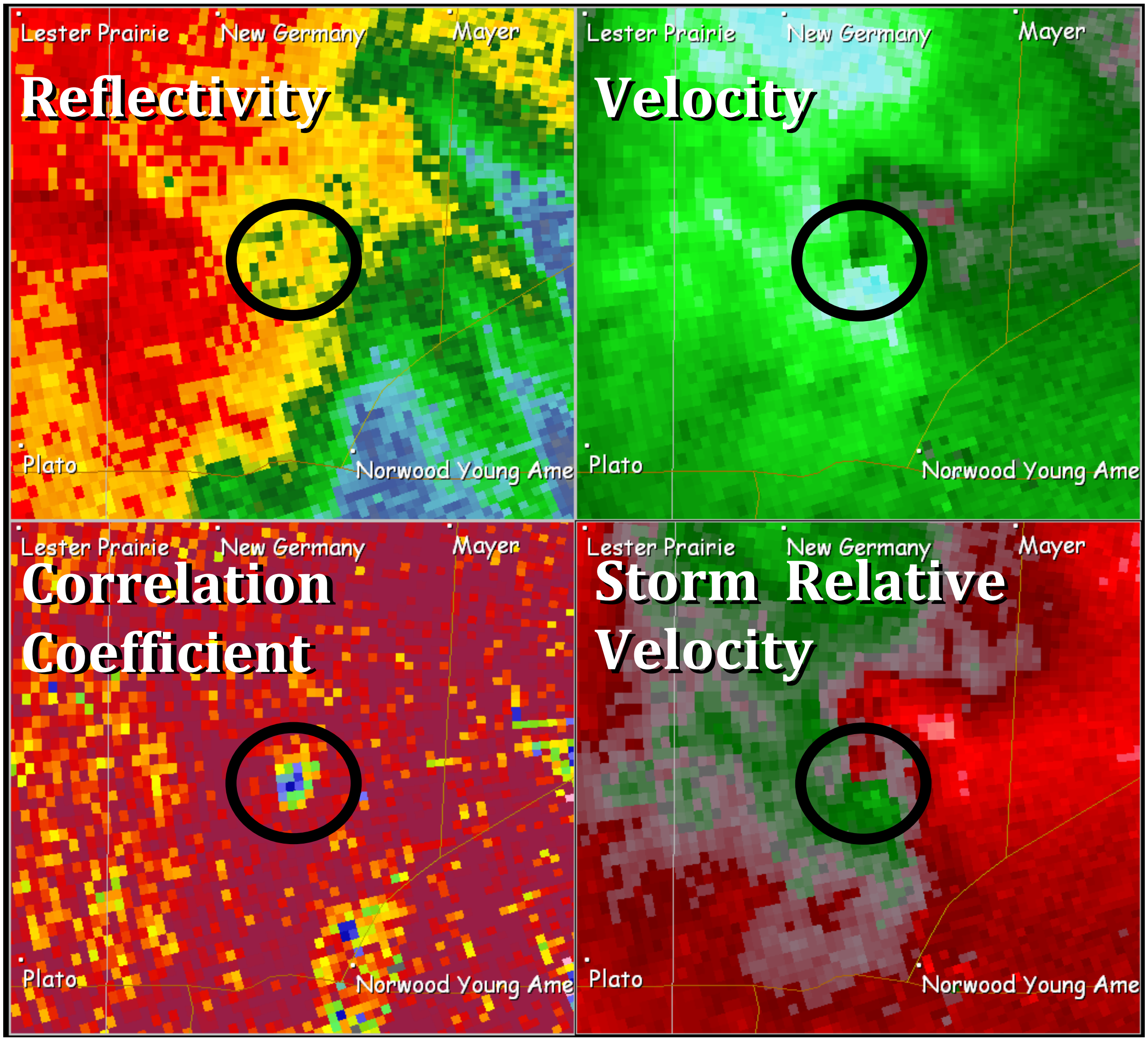

Figure 5: The 4-panel image above shows the 0.5º radar scan at 849pm CDT. The different images are reflectivity (top left), velocity (top right), storm relative velocity (bottom right), and correlation coefficient (bottom left). The black circle highlights the tornadic debris signature which is indicated by the blue pixels in the correlation coefficient (see Fig 6 for legend). Notice how the circulation has weakened in the right-hand panels. This is about the time the tornado had dissipated.

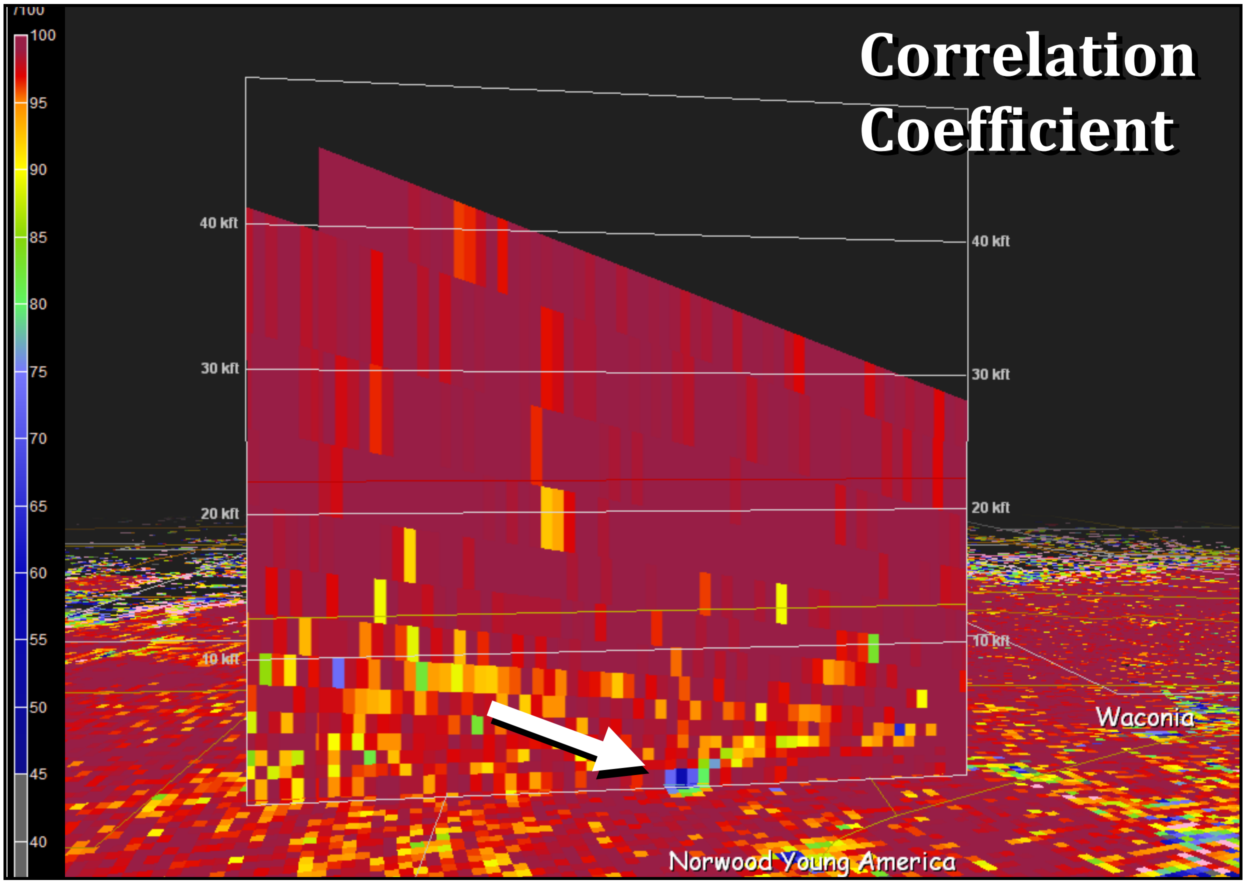

Figure 6: An east/west oriented cross section through the Correlation Coefficient minimum at 849pm CDT. The tornadic debris signature is identified by the white arrow. As the legend on the left shows, the blue values indicate areas of low correlation coefficient. In this case the tornado was weak, and the debris was not lofted very high into the storm.

Figures 7, 8: The pictures above illustrate the damage that was caused to a farmstead in western Carver County by this EF-0 tornado The top image shows the remnants of a barn that was blown over, and the bottom image shows a piece of the barn that was driven into a pile of mulch.

Figures 9, 10: Several trees were damaged at a neighboring farmstead. The top image shows a pine tree that was blown down toward the northeast, and the bottom images shows a cottonwood tree that fell on a fence and was pointed toward the southeast. This convergent damage pattern is a key indication of a tornadic circulation.

Figure 11: The picture above shows a grove of trees that were damaged with the limbs oriented in different directions. This offered additional supporting evidence of a tornadic circulation.