

July 1, 2011 Eastern South Dakota and southwest Minnesota High Precipitation Supercell

A supercell thunderstorm is a thunderstorm in which there is strong rotation within the storm. While most thunderstorms will only last 30 to 60 minutes, supercell thunderstorms can last several hours. High Precipitation (HP) supercells are some of the most prolific producers of severe weather. While tornadoes with HP supercells are generally short lived, these supercells have the potential to produce very large hail, sometimes over 4 inches in diameter, torrential rainfall rates in excess of 4 inches an hour, and straight line winds around 100 mph. Fortunately, these storms are fairly rare.

The following are a few references to HP Supercells:

http://cimms.ou.edu/~doswell/Conference_papers/SELS93/pakwash.html

The April 10, 2001 Interstate 70 HP

http://www.crh.noaa.gov/lax/?n=04_10_2001

On July 1, an HP supercell moved across southeast South Dakota into southwest Minnesota. This storm produce 2 tornadoes, hail up to the size of tennis balls (2.5 inches) and wind speeds well in excess of 80 mph. There was significant damage to trees and some buildings in Wentworth and Flandreau in South Dakota and to Marshall, Balatin, and Lake Benton in Minnesota. There were also two tornadoes with the storm – an EF2 tornado that hit Tyler, Minnesota and an EF1 tornado that hit Ruthton, Minnesota. Below are images of the storms from the WSR-88D radar in Sioux Falls, South Dakota.

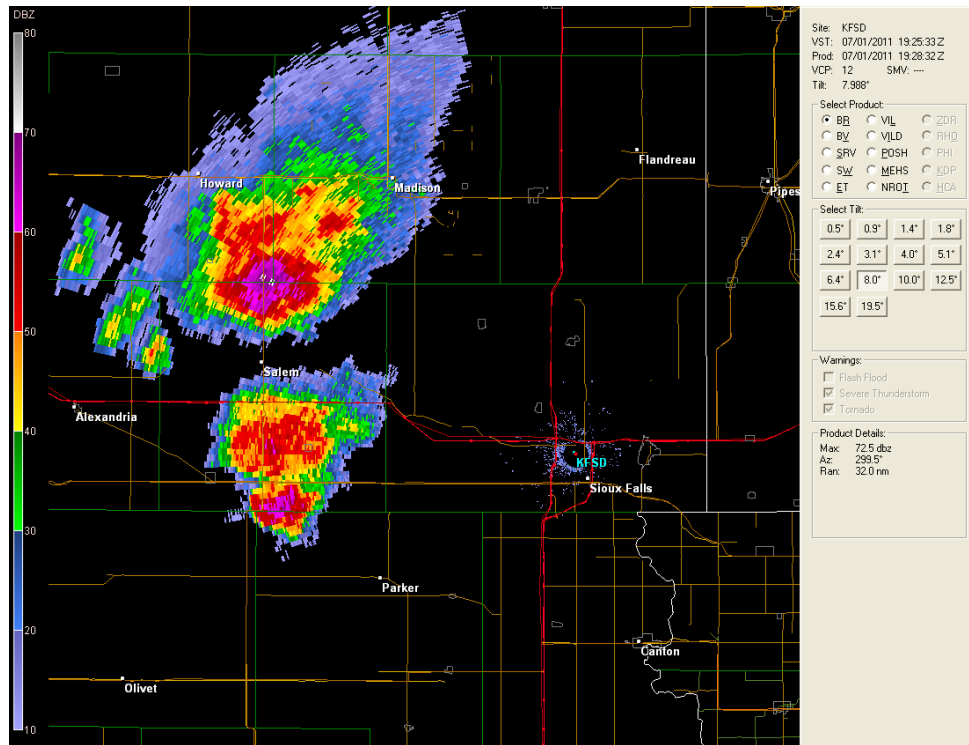


Image 1. Reflectivity at 225 pm CDT as initial storms developed. Note three strong updrafts at this time with the strongest northwest of Sioux Falls. The storms in this image are seen at about 25000 feet.

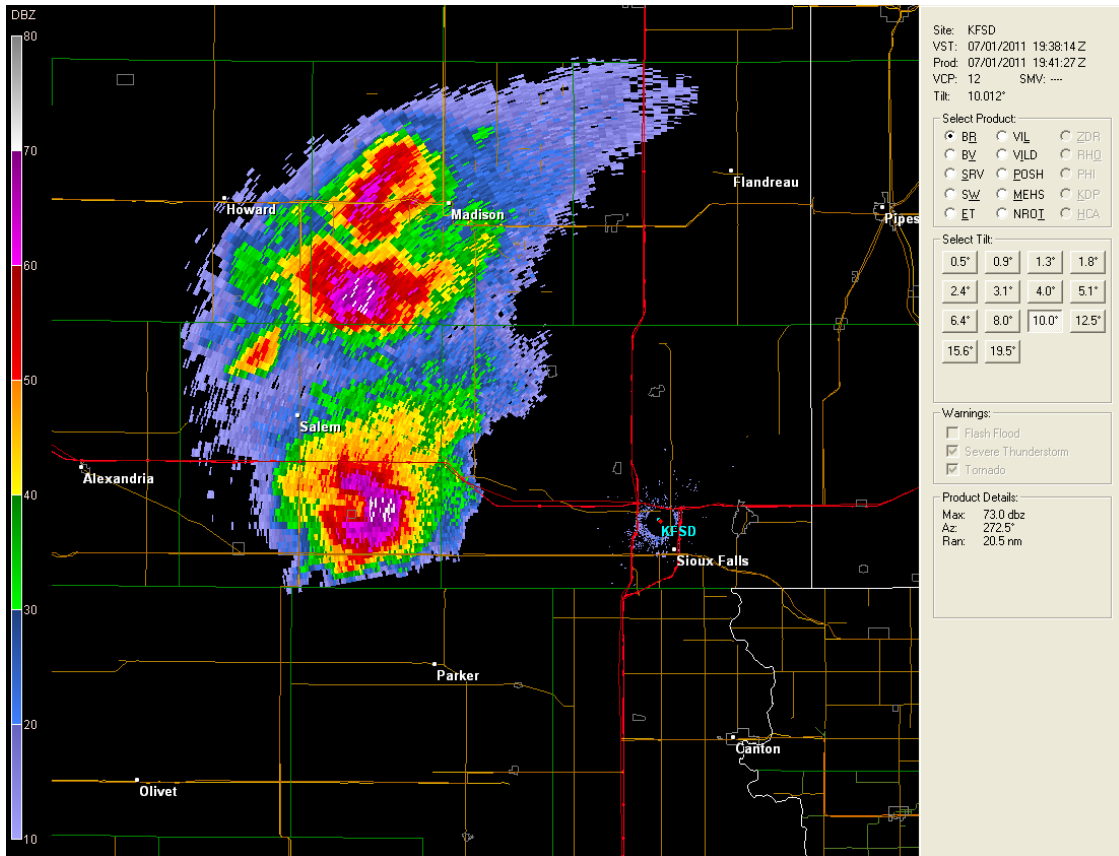


Image 2. Reflectivity at 238 pm CDT around 30000 feet. The cells in the south have merged at this point and have begun producing hail and strong winds. Tennis ball size hail was reported in Canistota, South Dakota at this time. The northern cell has split with the southern portion remaining the strongest.

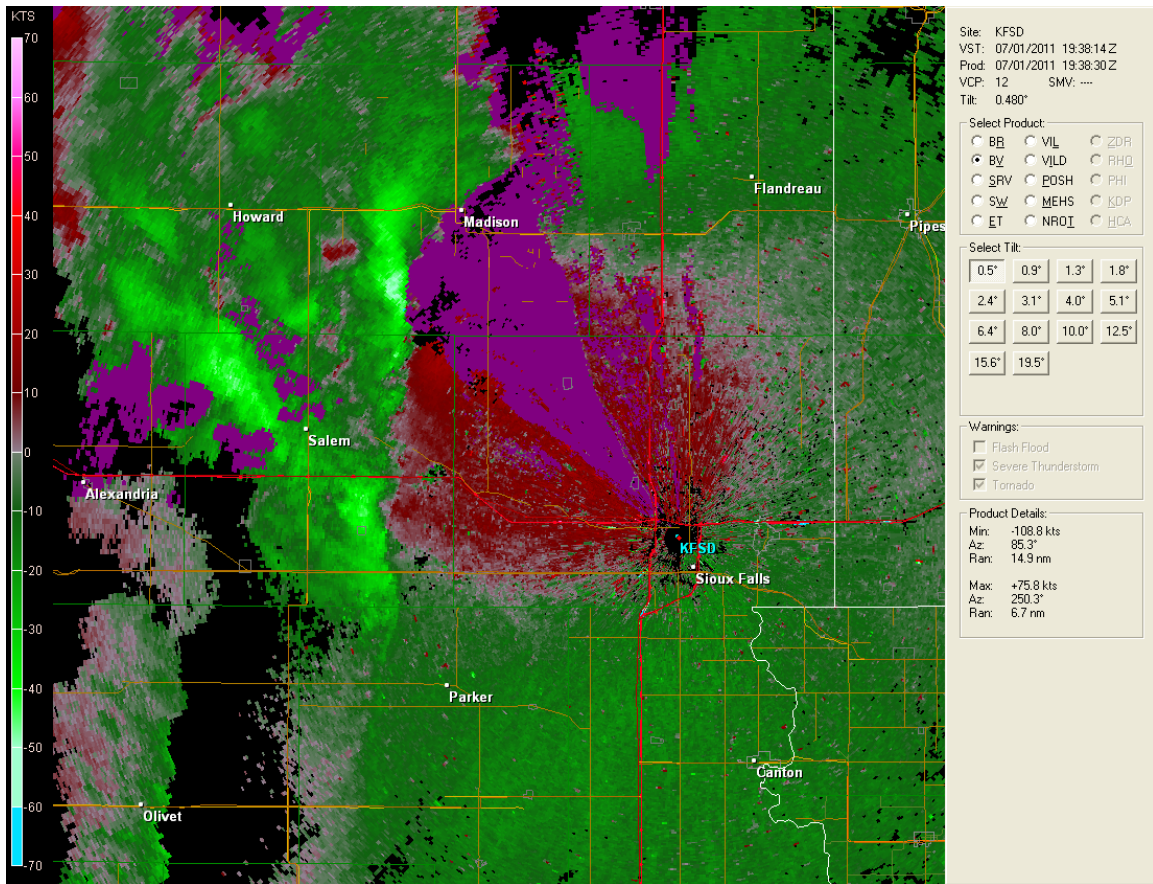


Image 3. Velocity at 238 pm CDT. Inbound velocities towards the radar (shown in the bright green) southwest of Madison are beginning to increase rapidly, indicating the threat for strong straight line winds. The small red area (outbound velocities) just northwest of the strongest inbound velocities is also a hint of strong downburst.

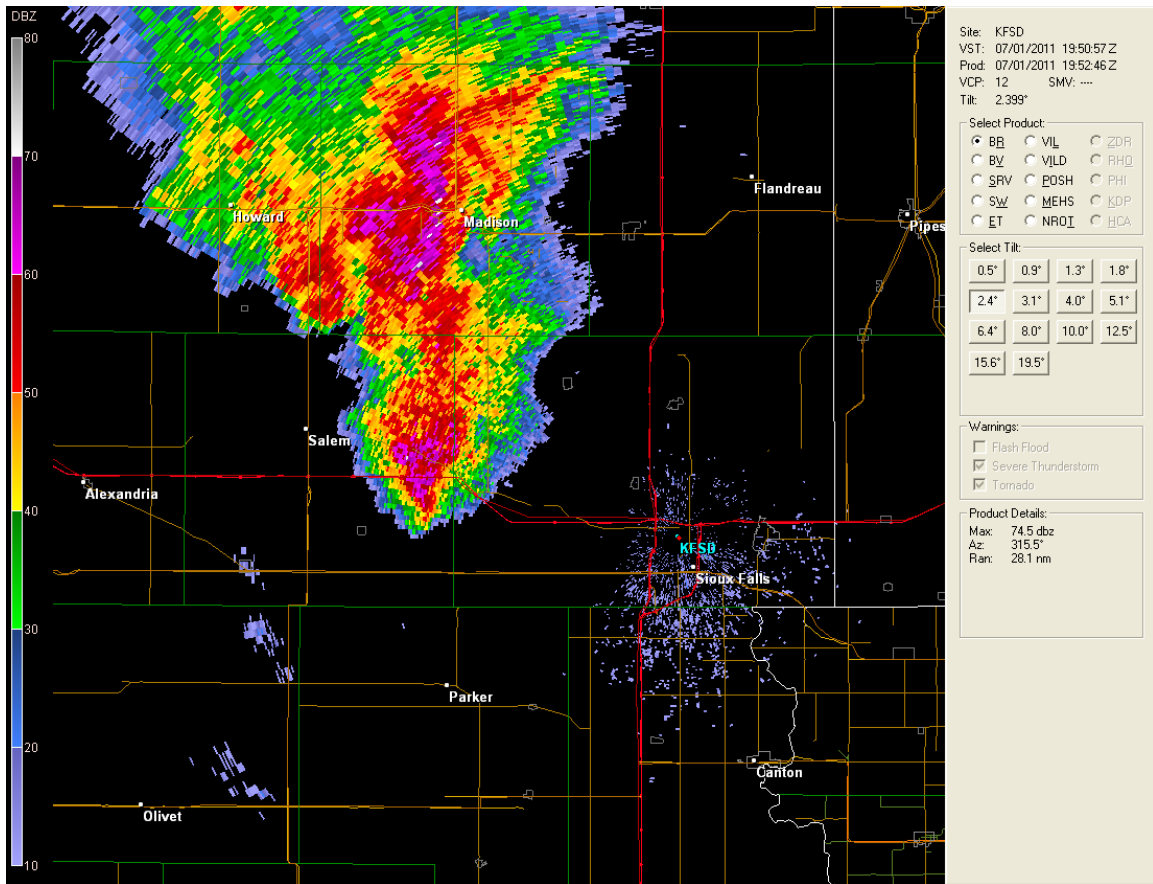


Image 4. Reflectivity at 250 pm CDT around 15000 feet. The storms at this time are beginning to merge into one organized supercell. One interesting feature at this point is just south southeast of Madison where there was a lack of reflectivity detected by the radar. This is the location of the strongest updraft within this storm.

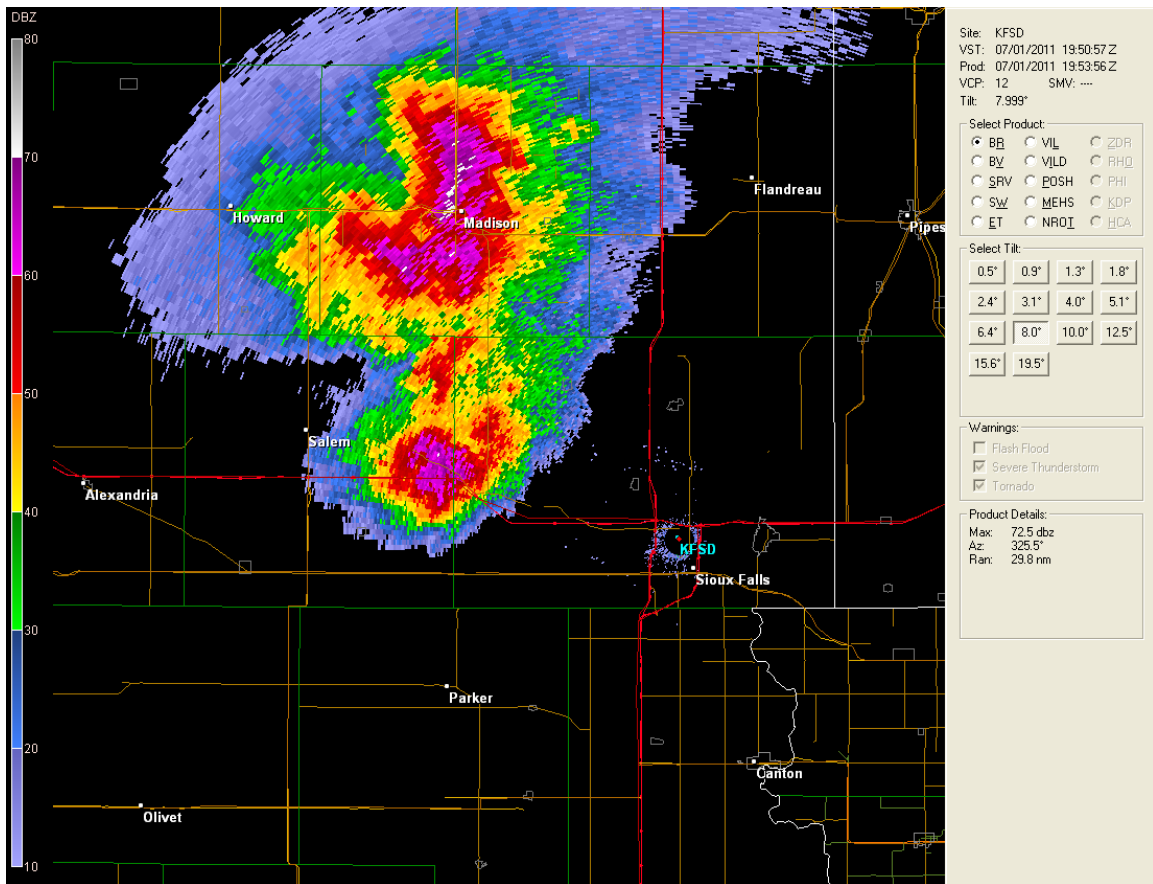


Image 5. Reflectivity at 250 pm CDT around 25000 feet. Note the area south southeast of Madison had very high reflectivity, likely rain and very large hail are being lofted and re-circulated within the updraft of this powerful thunderstorm not yet reaching the ground.

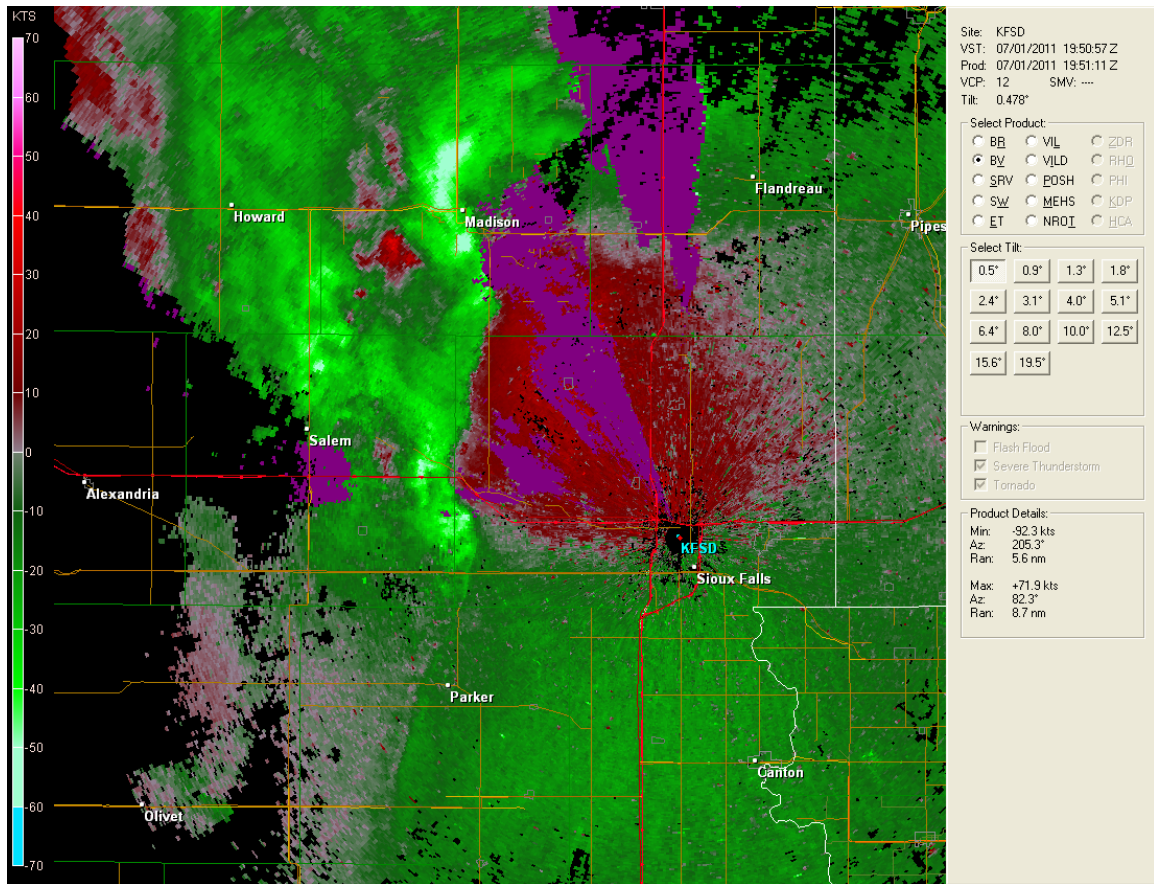


Image 6. Velocity near the surface at 250 pm CDT. Strong outflow has now moved into Madison. The storm to the south also indicated some strong winds, but the storm was not as organized as the storm near Madison.

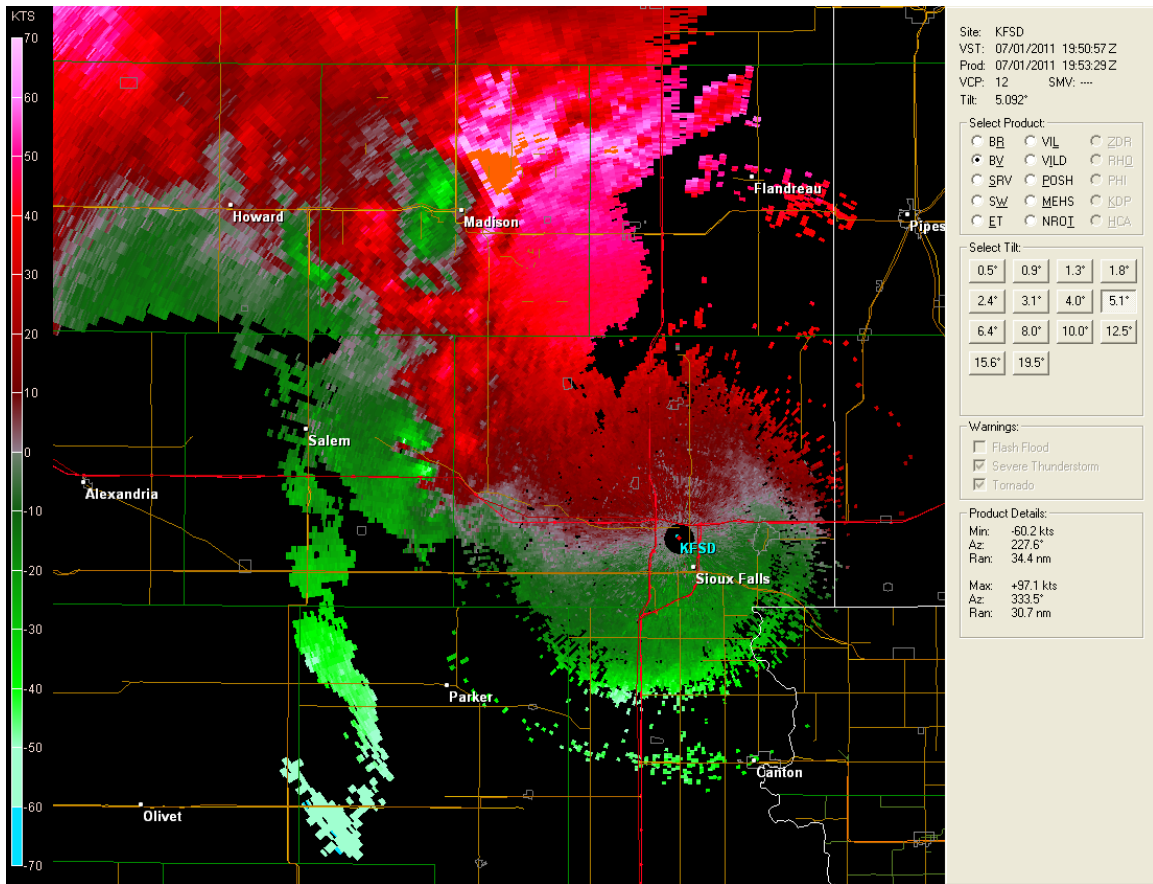


Image 7. Velocity around 25000 feet. Note the strong outbounds (shown in bright red/orange) just east of the fairly strong inbounds (shown in green) near Madison which is a rapidly developing area of rotation aloft.

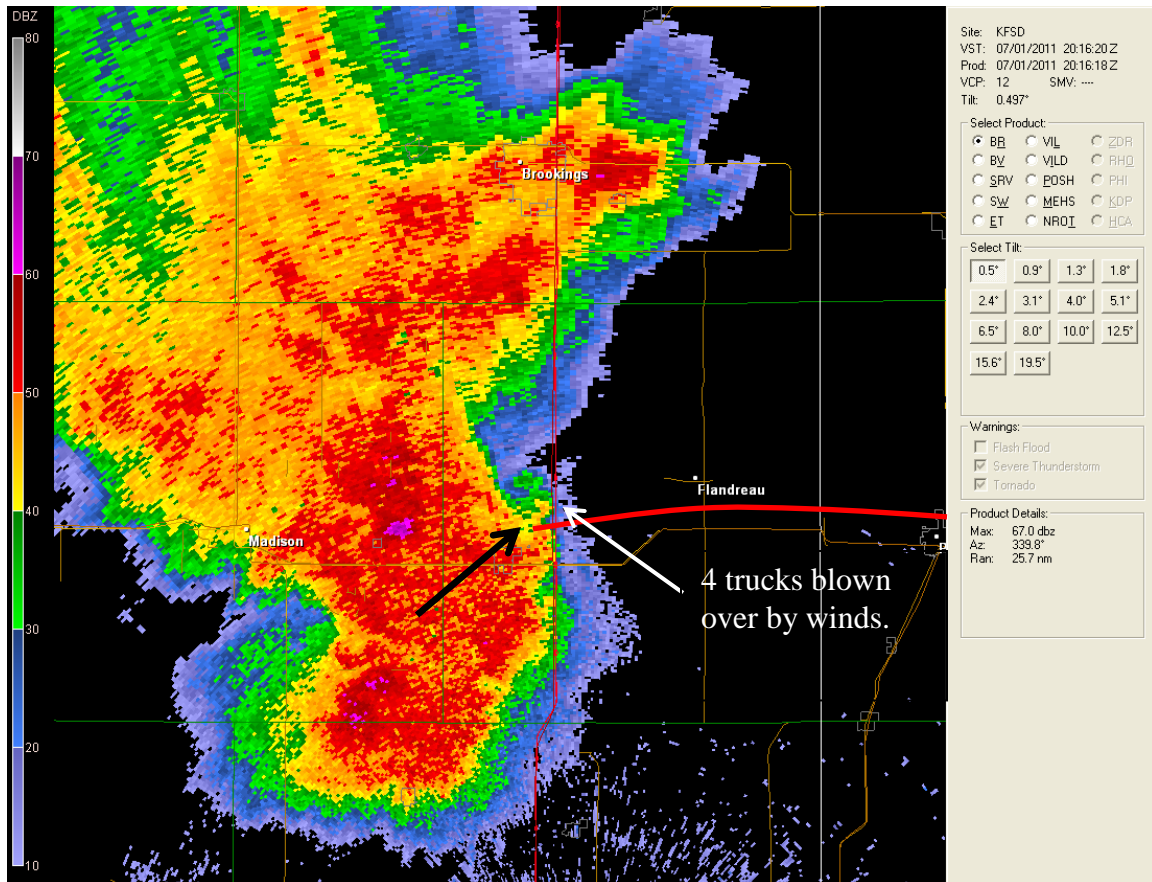


Image 8. This is the 316 pm CDT 0.5 degree reflectivity. A warm front at the surface was in place from near Pipestone to just south of Flandreau (red line on map). The small curl in the reflectivity west of Flandreau indicated strong rotation near the surface. To the south of this curl is where the strongest straight line winds are located. Approximately 5 minutes later, at least 4 semi-tractor trailer trucks were overturned by winds from the storm at the Flandreau exit on Interstate 29.

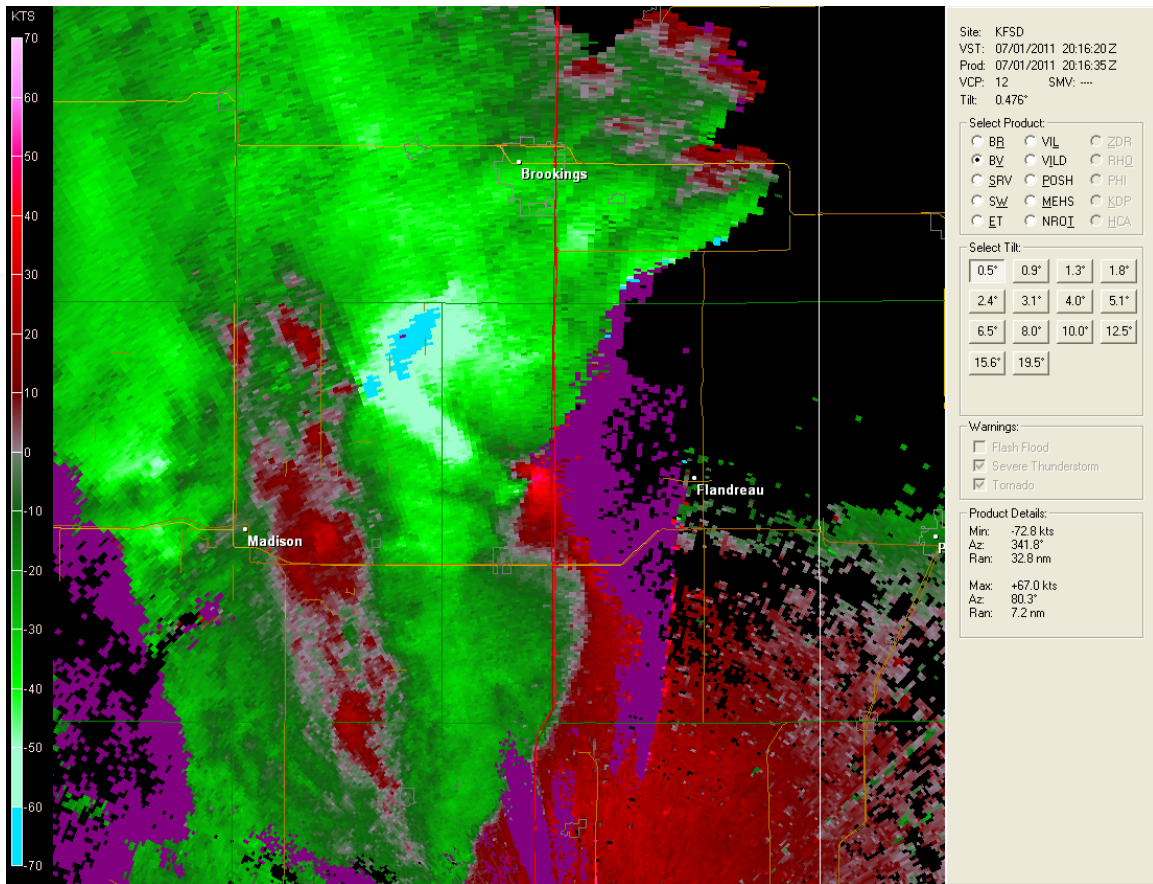


Image 9. The 316 pm 0.5 degree velocity supports the rotation with a tight velocity couplet (inbound (green) directly next to outbound (red) velocity) west of Flandreau near Interstate 29 (red line). While there was no indication of a tornado, this type of circulation indicates the potential for very strong and damaging winds.

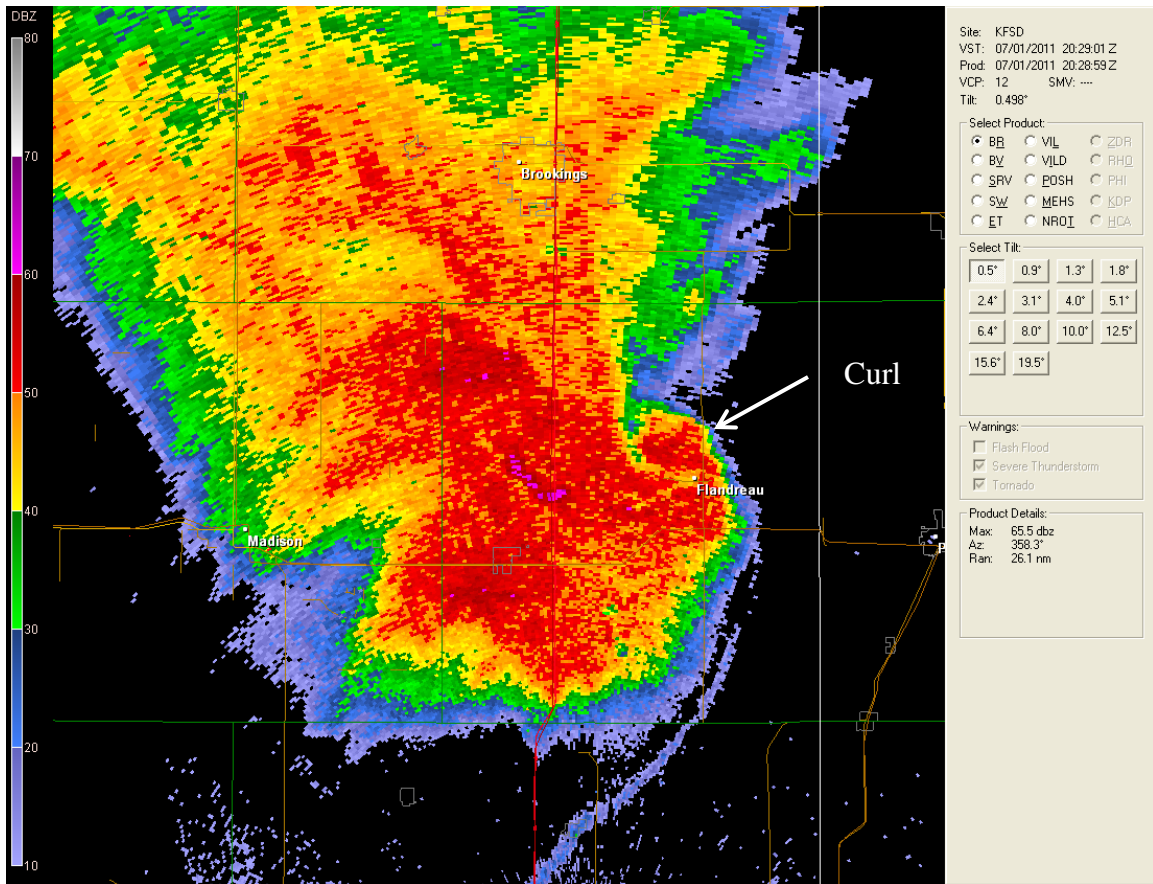


Image 10. The 0.5 degree reflectivity at 329 pm CDT as the storm blew through Flandreau. Note that the curl has wrapped up and the higher reflectivities have surged eastward.

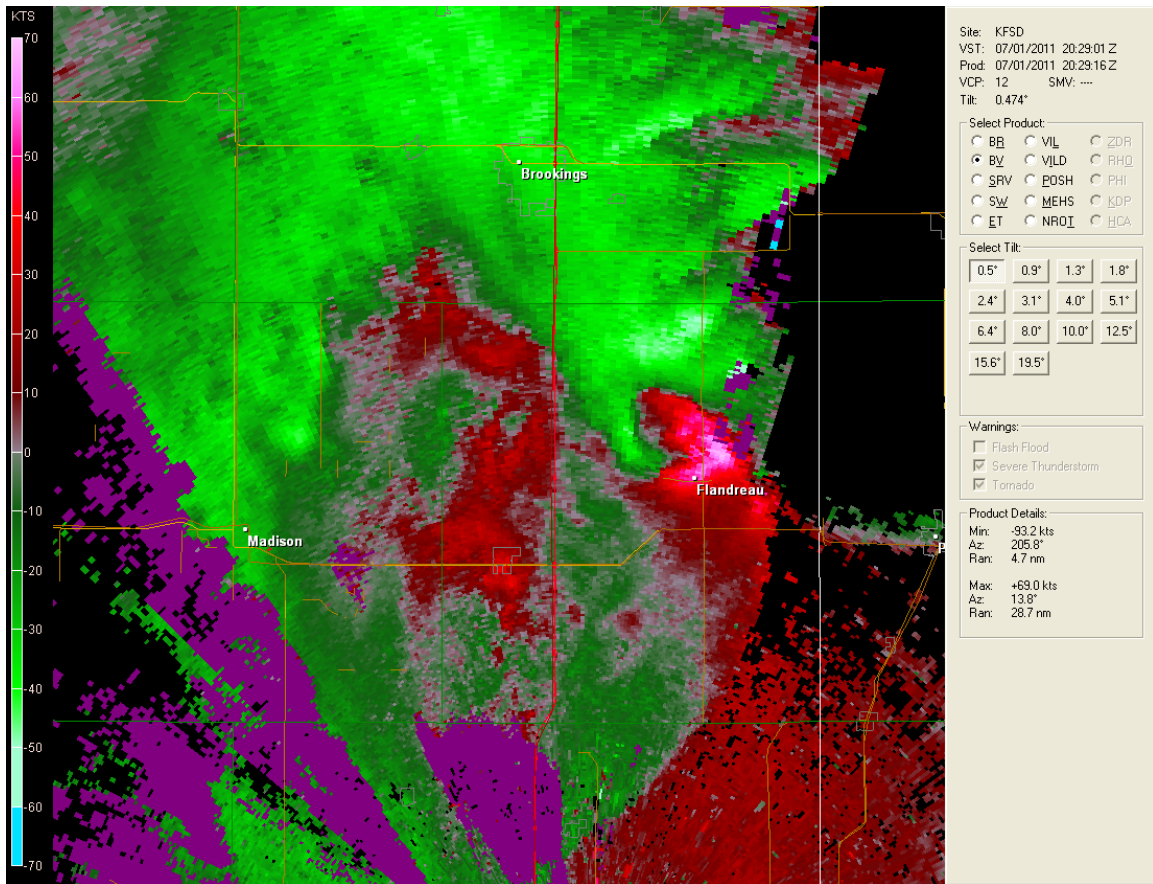


Image 11. The 0.5 degree velocity at 329 pm CDT. Strong outbound velocities (shown in bright red) have developed over Flandreau as straight line winds move through the Flandreau area. A wind sensor near Flandreau recorded a wind speed of 64 mph. Numerous trees and power lines were taken down by the winds.

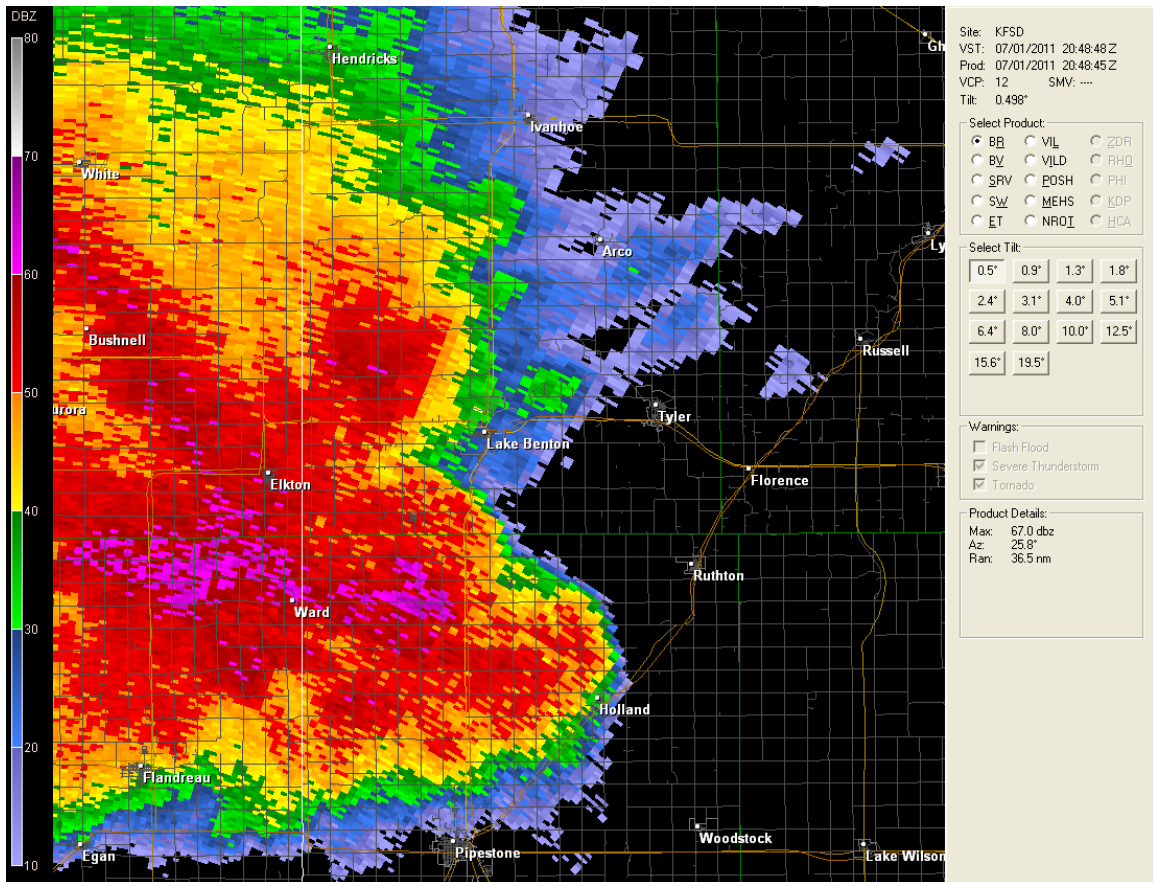


Image 12. This is the 0.5 degree reflectivity at 348 pm CDT. This image was taken right before the town of Tyler, MN was hit by an EF2 tornado. The main curl in the reflectivity is just west of Ruthlon while a curl associated with a new circulation is developing near Lake Benton.

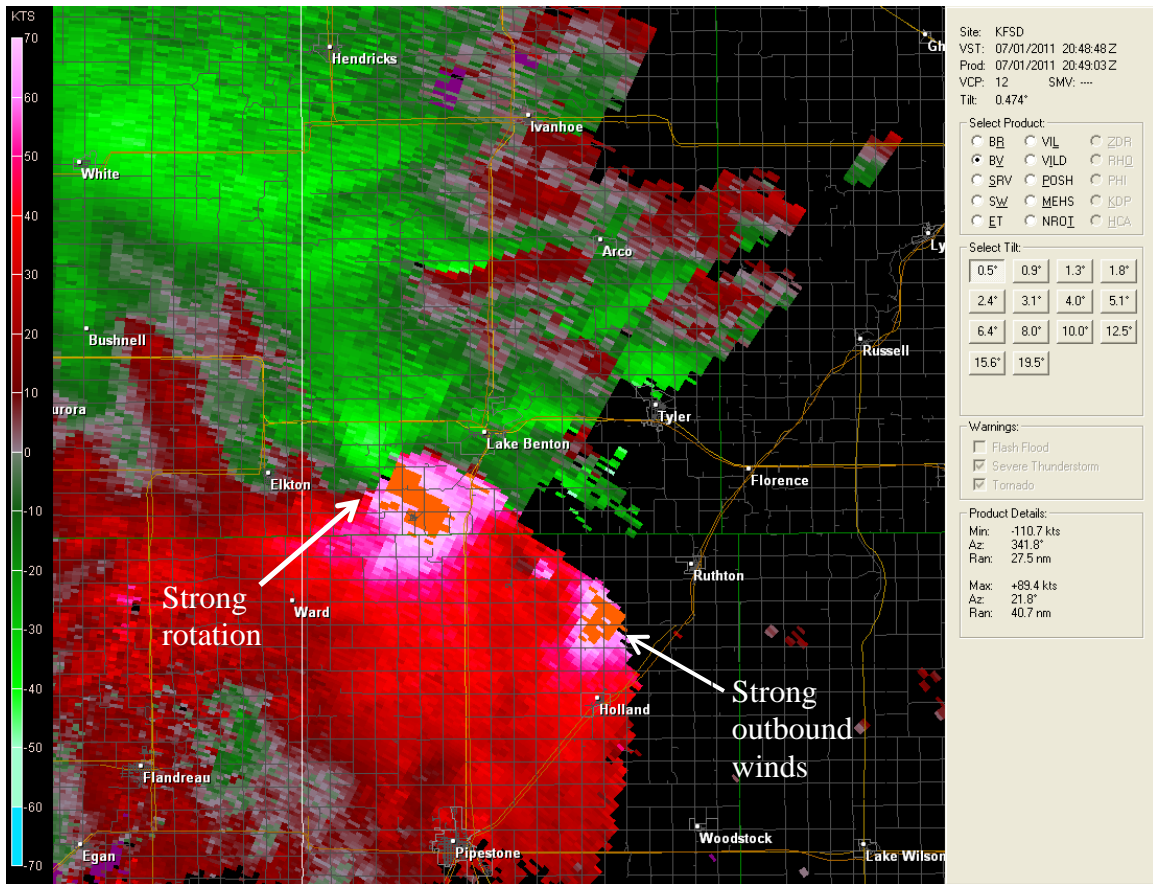


Image 13. The 0.5 degree velocity image at 348 pm CDT. A very strong rotational couplet developed just west of Lake Benton, denoted by the strong outbounds (shown in bright orange and pink) near the strong inbounds (shown in bright green). Numerous trees and power lines were reported to be down west of Lake Benton. Another enhanced area of outbounds (southwest of Ruthton), where another tornado occurred shortly after this. Wind damage was reported from west of Holland up to Florence. This damage was caused by both very strong winds over 60 mph and an EF-1 tornado that went through Ruthton approximately 5 minutes after this image.

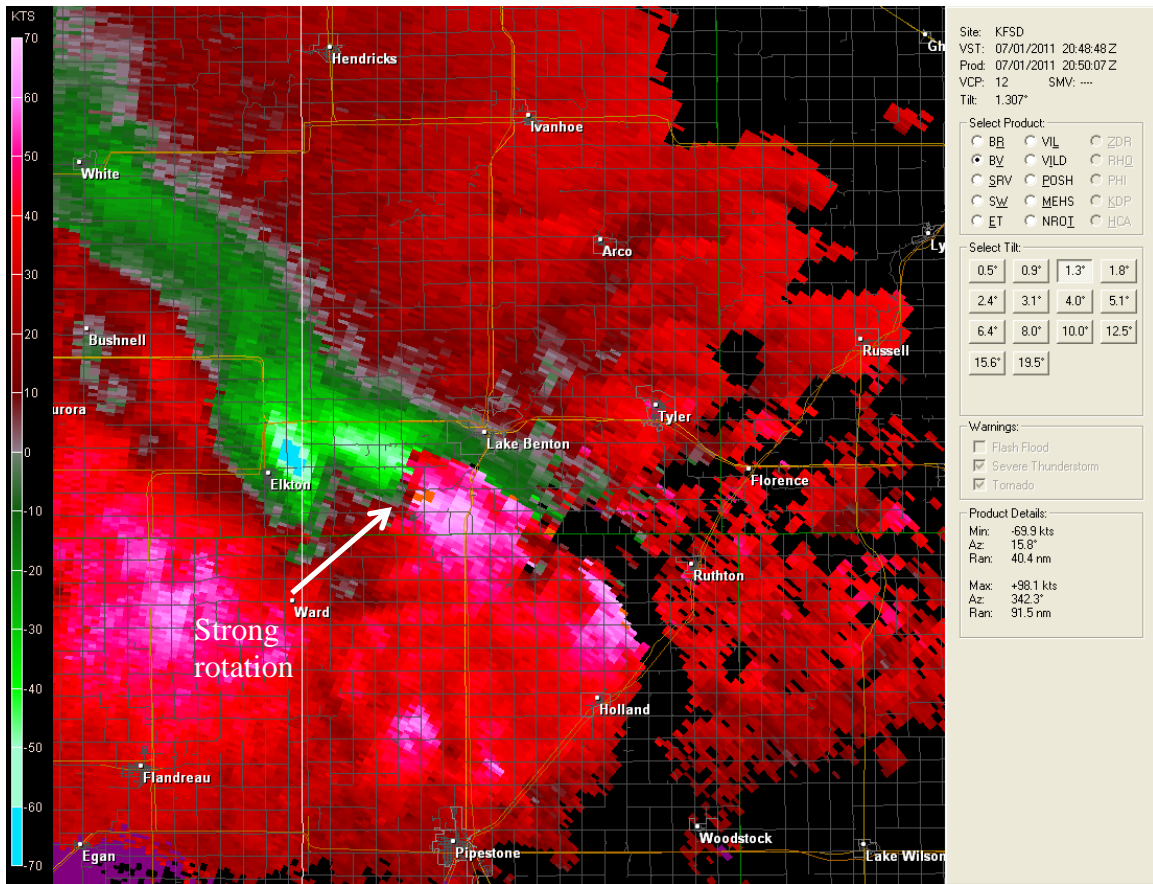


Image 14. This is the 1.3 degree velocity which is a few thousand feet above the 0.5 degree velocity. This image shows the intense and deep circulation near Lake Benton, the strongest of its lifecycle, just before moving into Tyler.