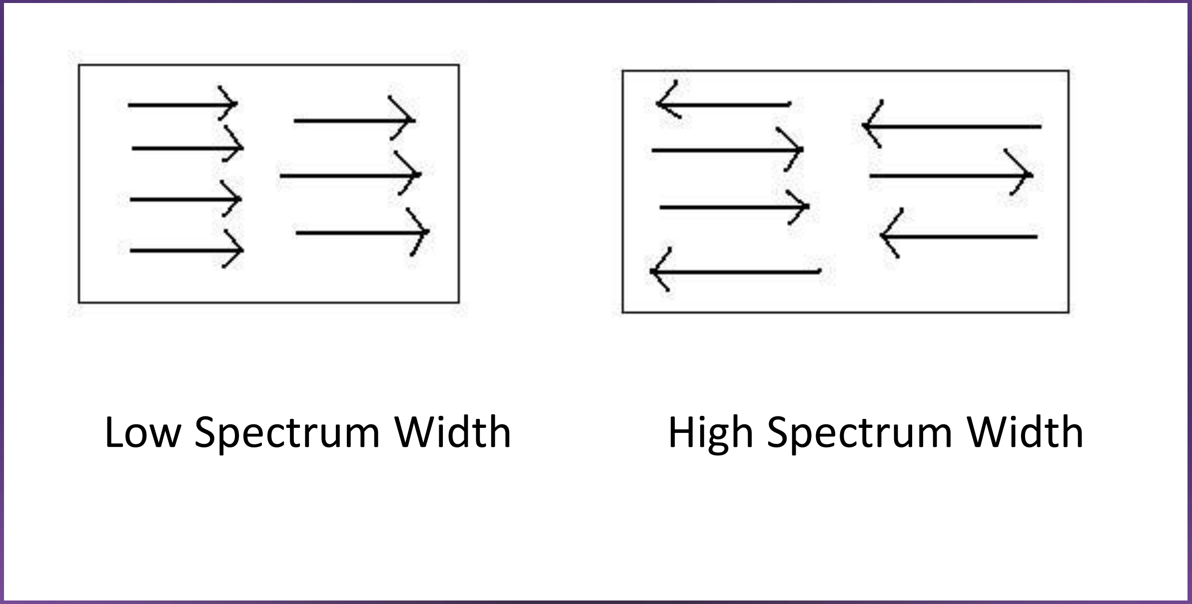
# Operational Use of Spectrum Width from NWS Doppler Radar Data

# Spectrum Width

- One of the 3 base moments available with NWS Doppler radar

- Depicts a measure of velocity dispersion. In a radar bin, it provides a measure of the variability of the mean radial velocity estimates (movement) due to wind shear, turbulence, and/or the quality of the velocity samples. The proper use of Spectrum Width can help the severe thunderstorm and tornado warning decision process. It is used to estimate turbulence associated with low-level boundaries, thunderstorms, mesocyclones in supercells, and mesovortices in quasi-linear convective systems (QLCSs).

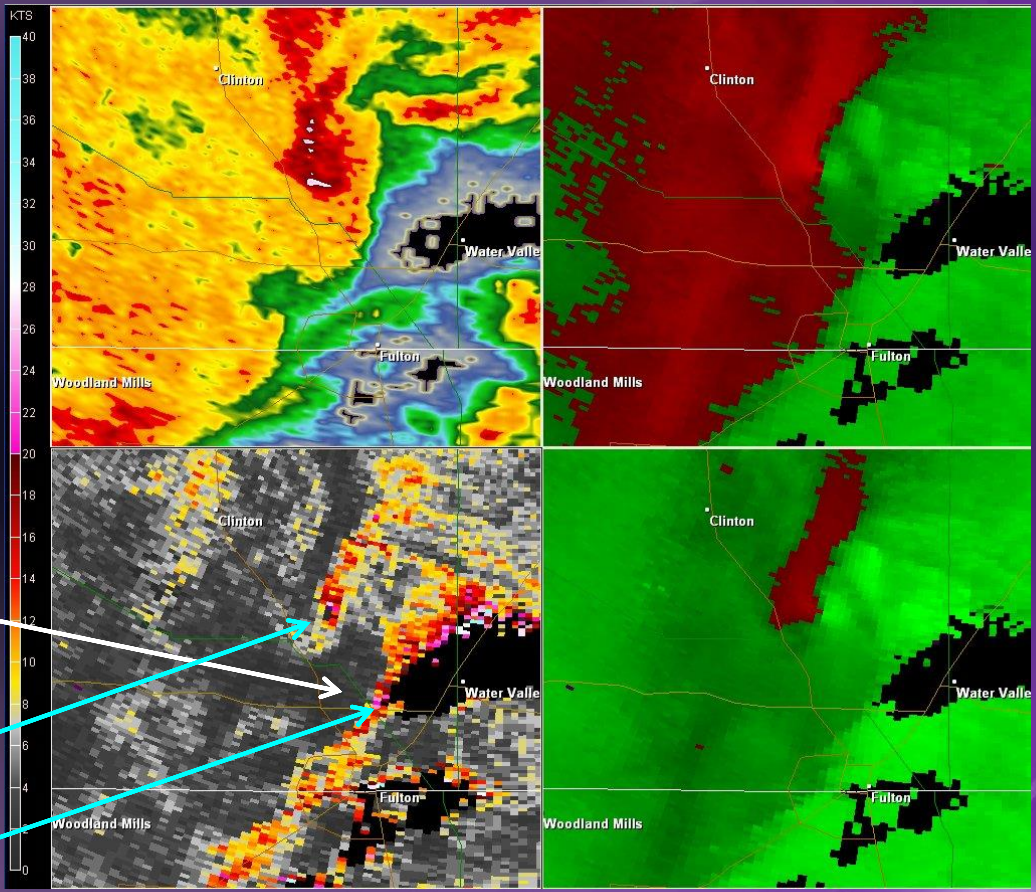
# Spectrum Width




Both situations can be helpful in data analysis.

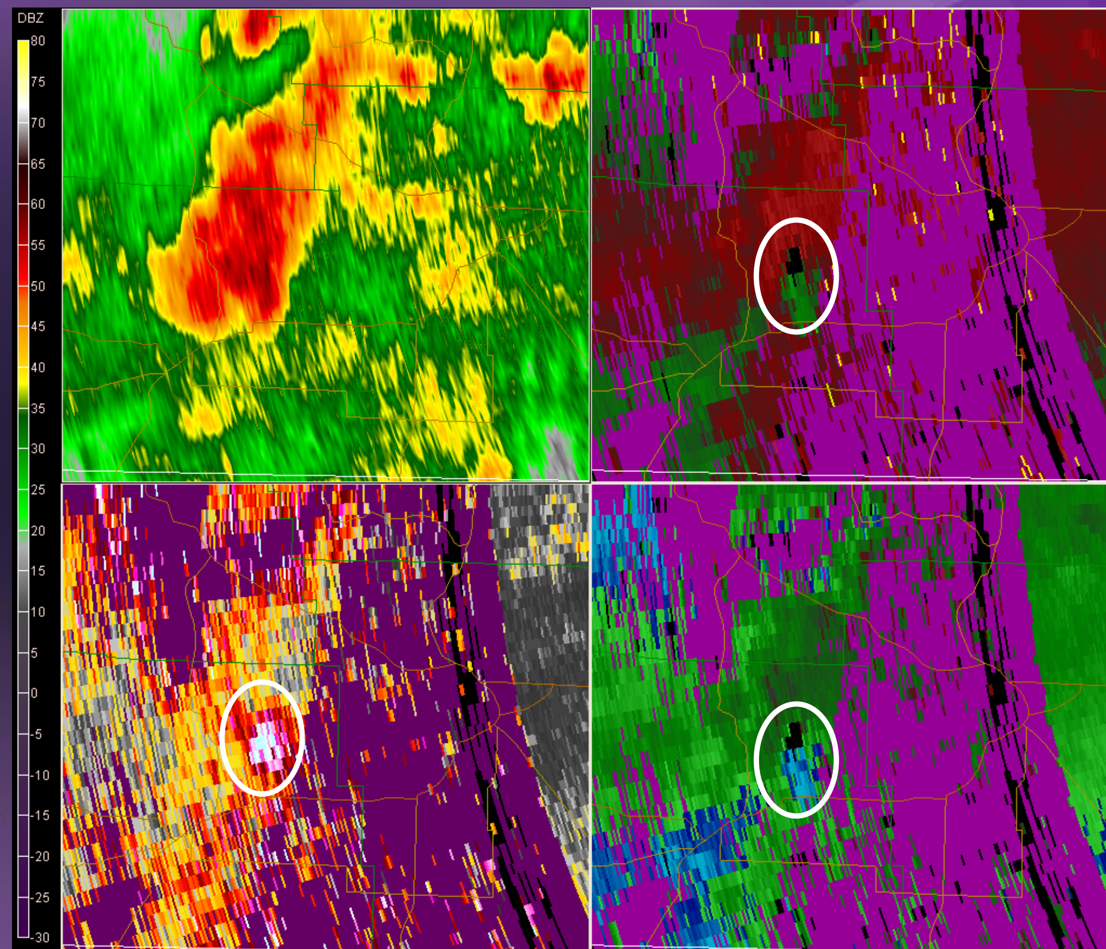
# Spectrum Width

- **Low values of SW** depict smooth flow
- **High values of SW** depict variability in movement, turbulence, and chaotic flow
- Supercell on May 2, 2010
- Low (smooth) values of SW associated with the rear flank downdraft of supercell.
- High (chaotic) values of SW associated with tornado location and leading edge gust front

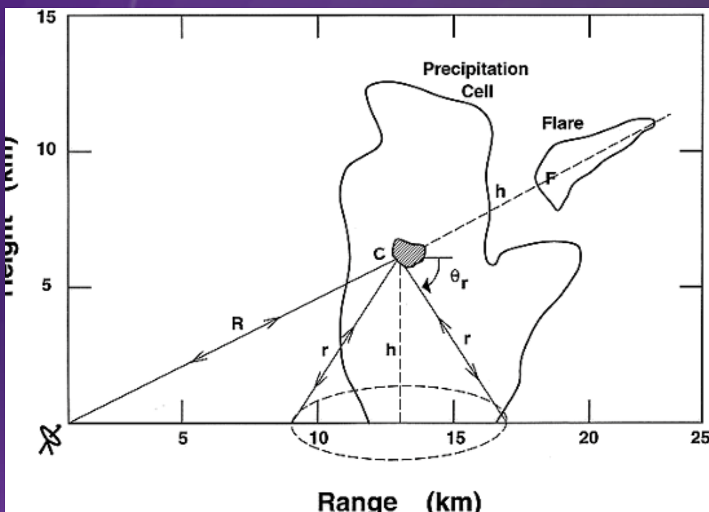


# Spectrum Width

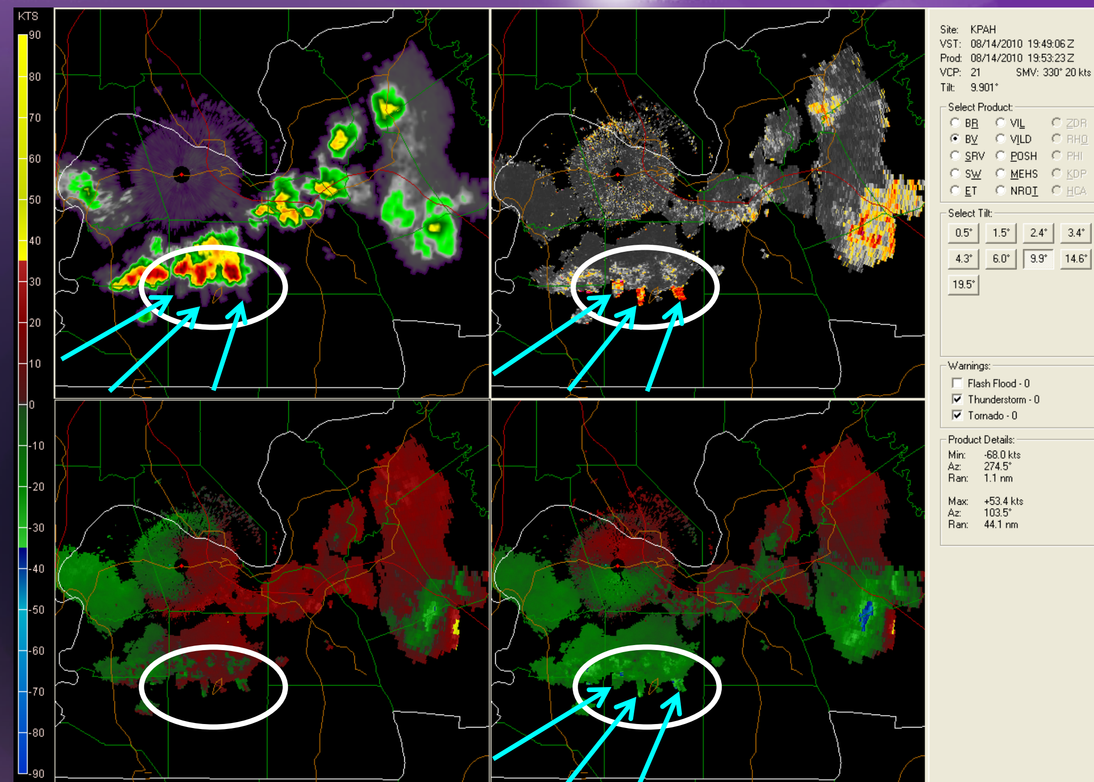
- Distant supercell on May 2, 2010
- EF-0 tornado associated with circulation in white circle (image is 10-15 minutes prior to touchdown
- Velocity data (upper right) showed a weak circulation, but spectrum width (lower left) clearly showed high values due to turbulent flow associated with the circulation



# Another Use of Spectrum Width



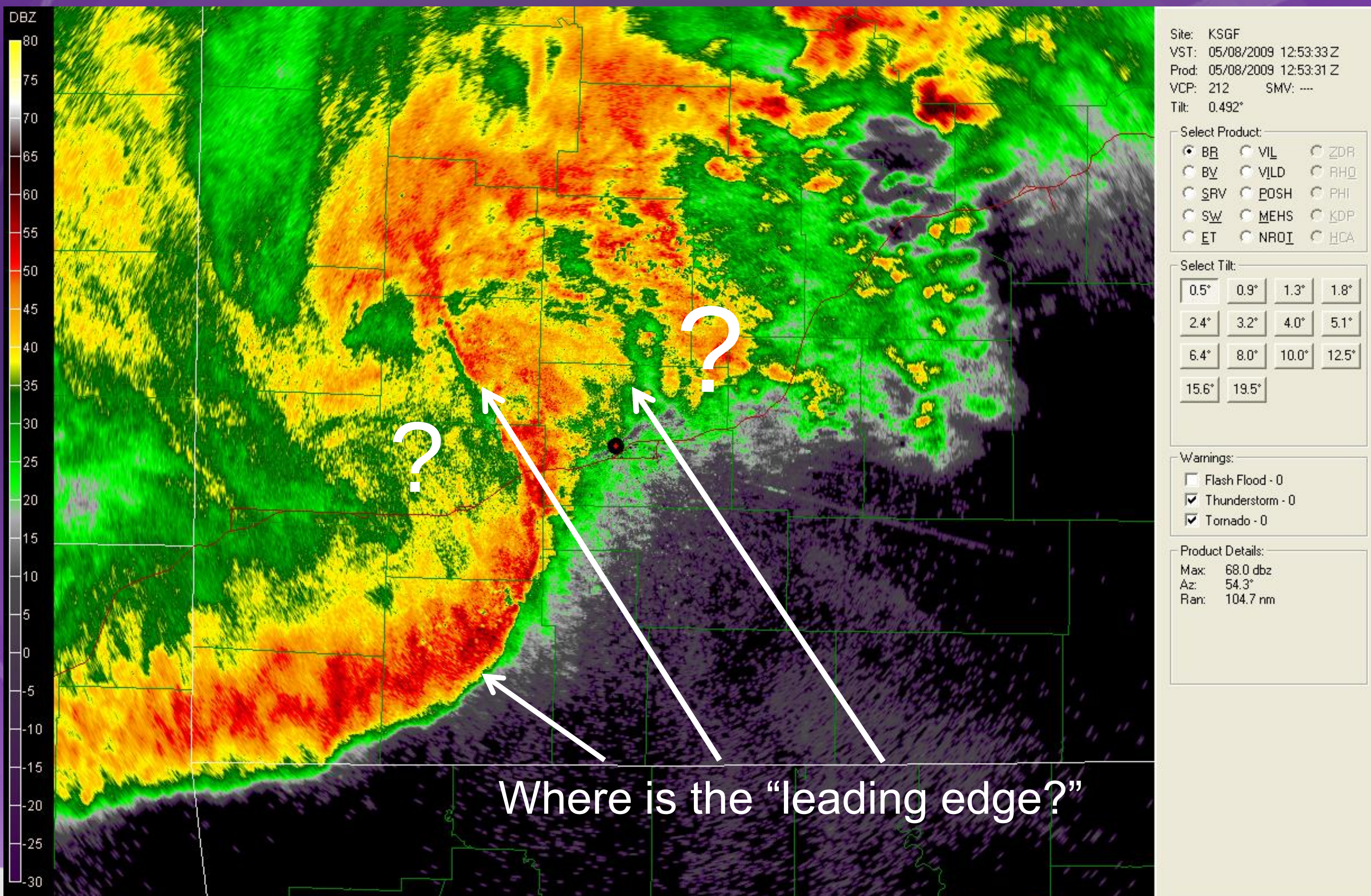

- TBSS – Three Body Scatter Spike due to large hail in storm




- August 14, 2010; 9.9 degree elevation angle (19,500 ft AGL) of NWS Doppler radar data
- High SW values (upper right) associated with TBSS seen 5-10 minutes prior to 65-70 mph microburst at ground

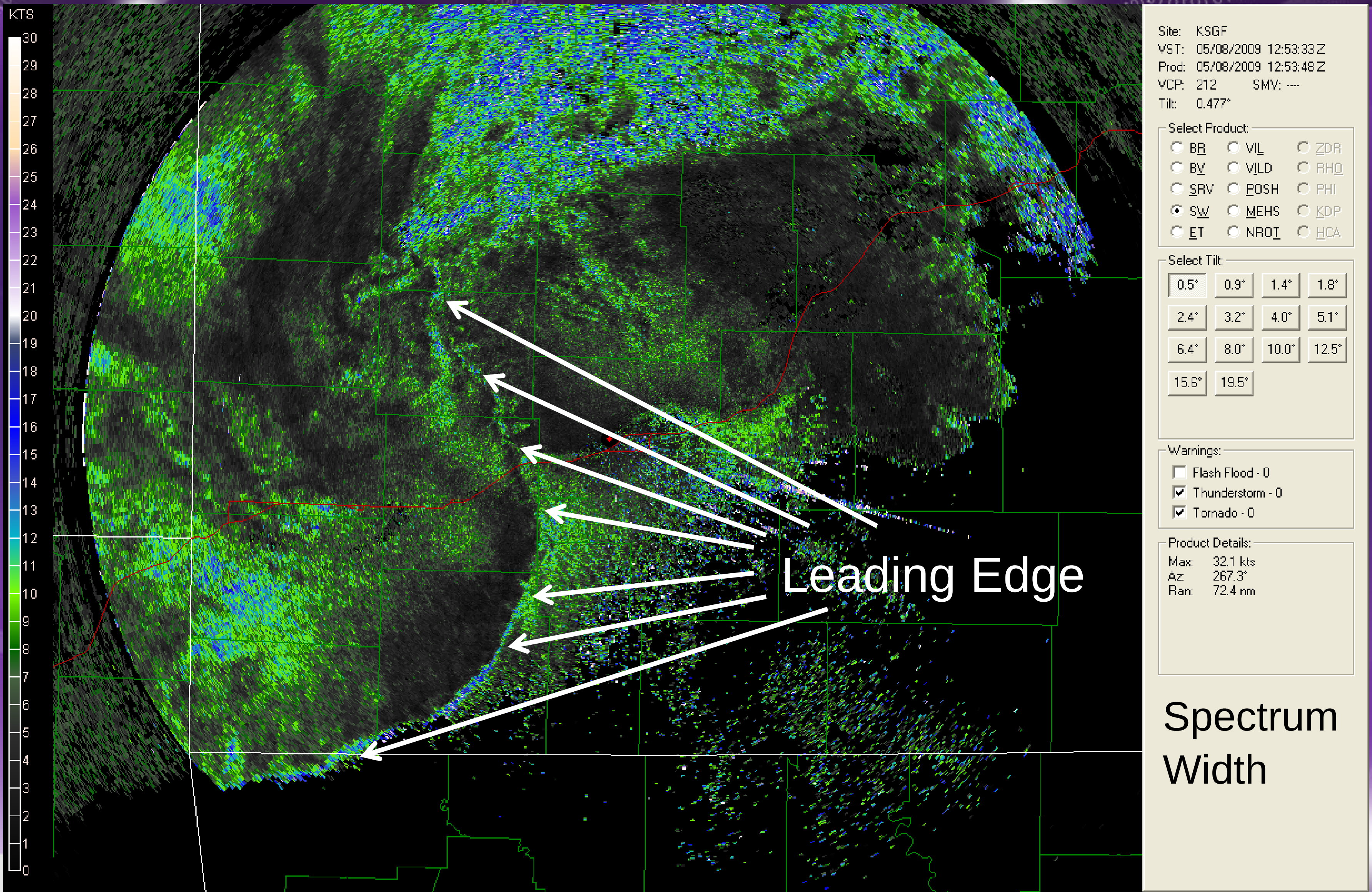
# Question: Where is the Leading Edge?

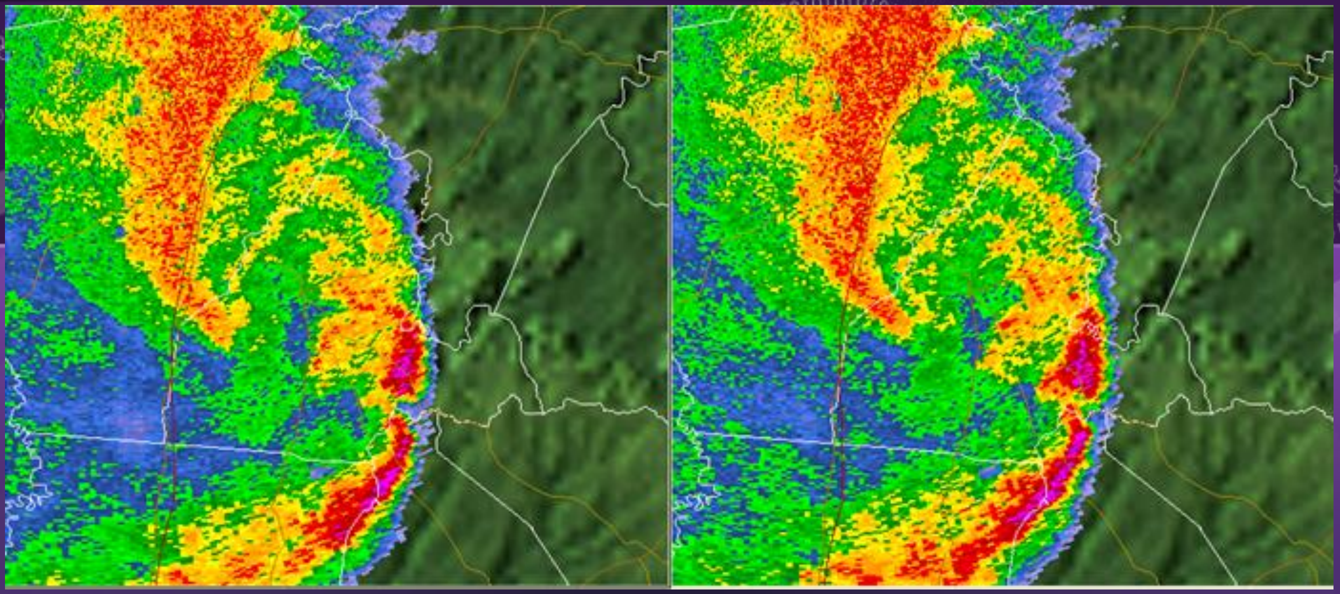
- It is not always clear nor easy to locate the true “leading edge”
  - Strong winds can push storms upshear which may complicate the matter



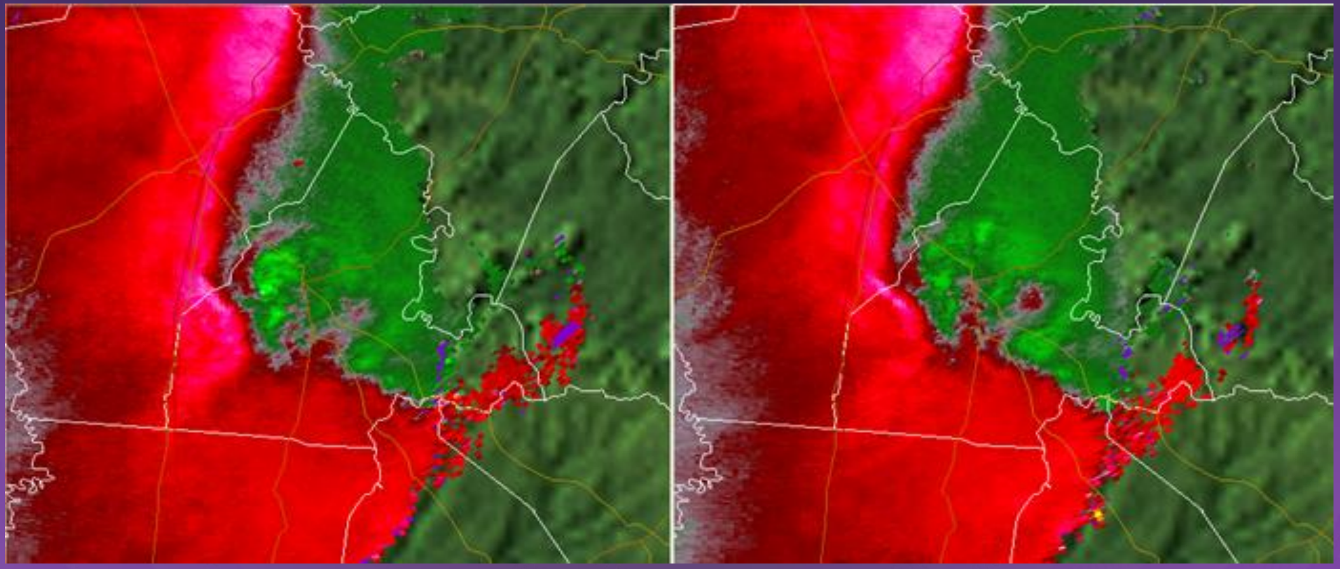
# Answer

- Use Spectrum Width or Velocity product

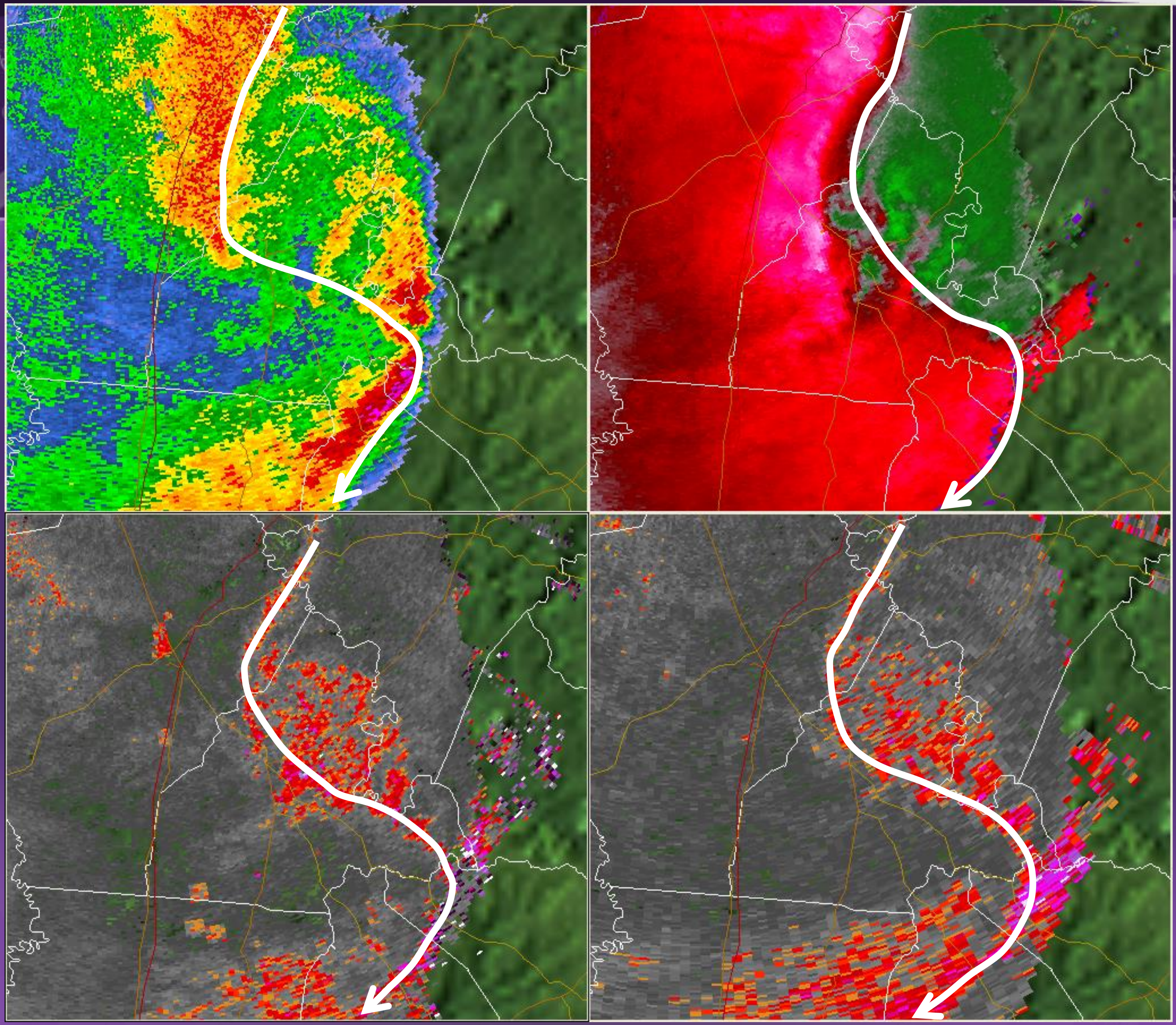




Where is the “leading edge” (gust front) of the convection above?



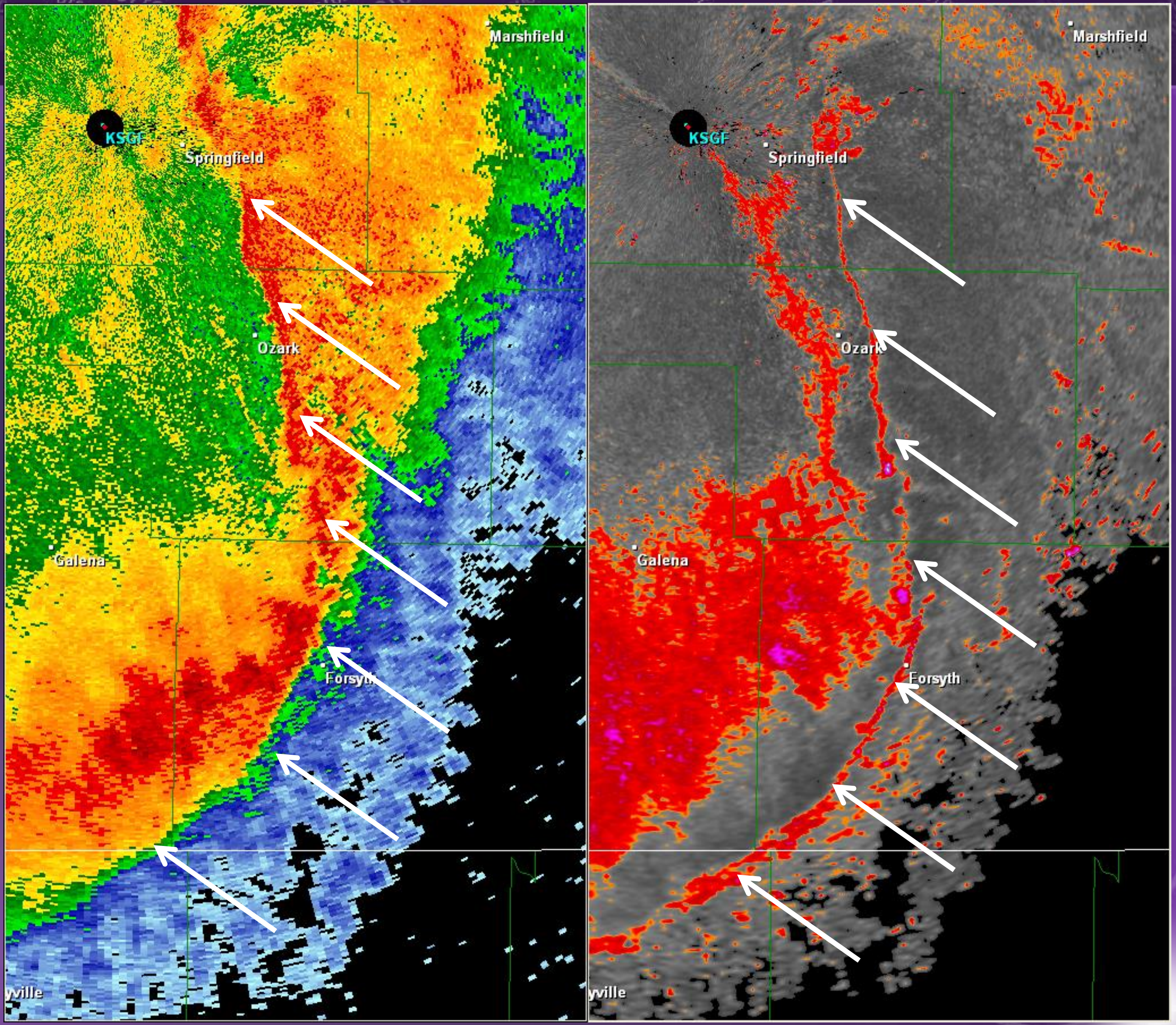
In velocity data, it is tucked back behind where reflectivity (top) suggested.



Spectrum Width can be an excellent way to identify interfaces/boundaries and mesovortices. White line identifies the leading edge (gust front) of the convection.

# 08 May 2009 (SGF)

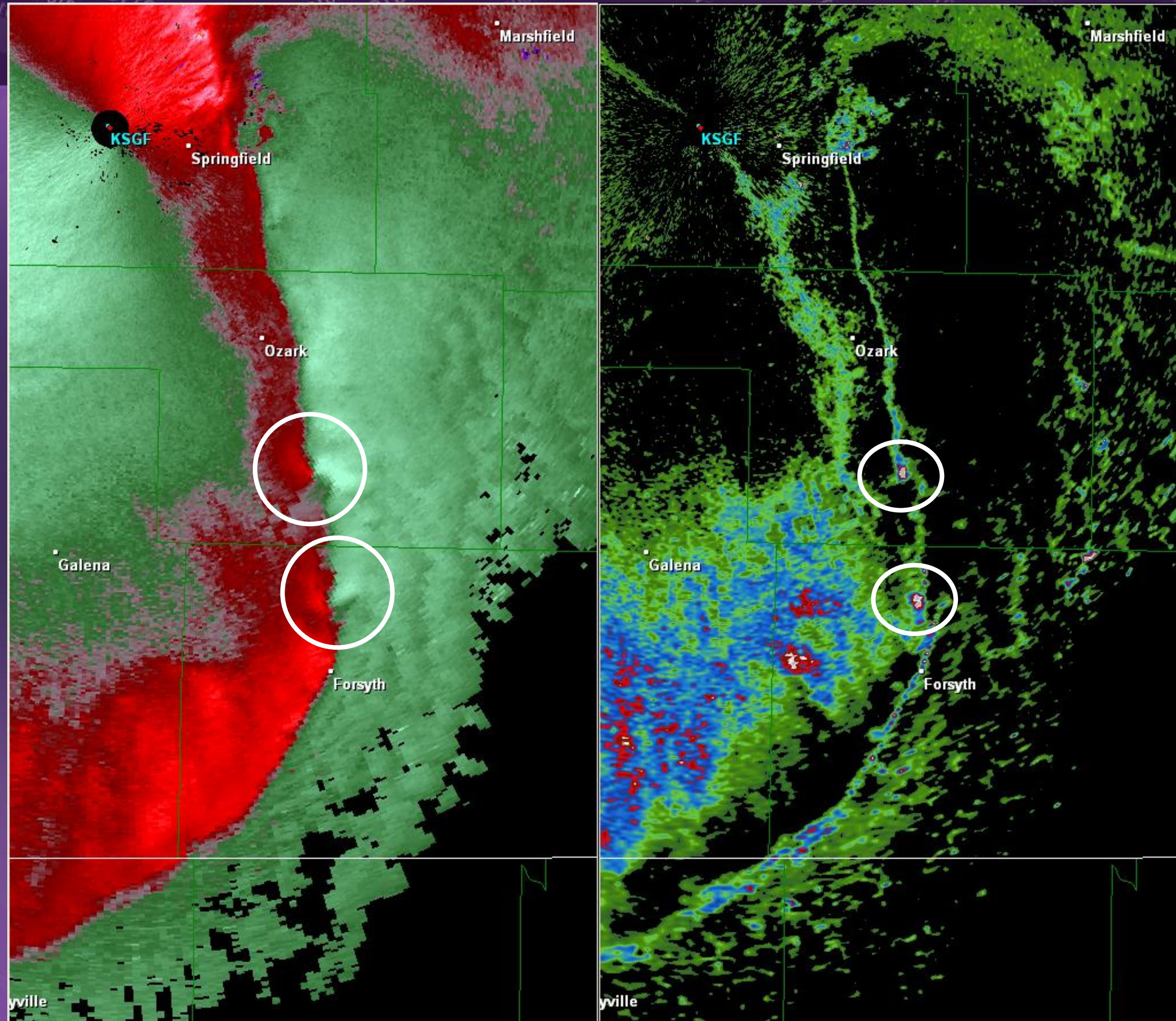
An extensive squall line (QLCS) is evident in reflectivity data. Note how spectrum width clearly identifies the effective boundary (white arrows). It is along leading edge of convection on the southern side of the QLCS (leading line-trailing stratiform). However, it is located on back edge of line in the northern section (leading stratiform-trailing line). Reflectivity does not show this as well as SW does.



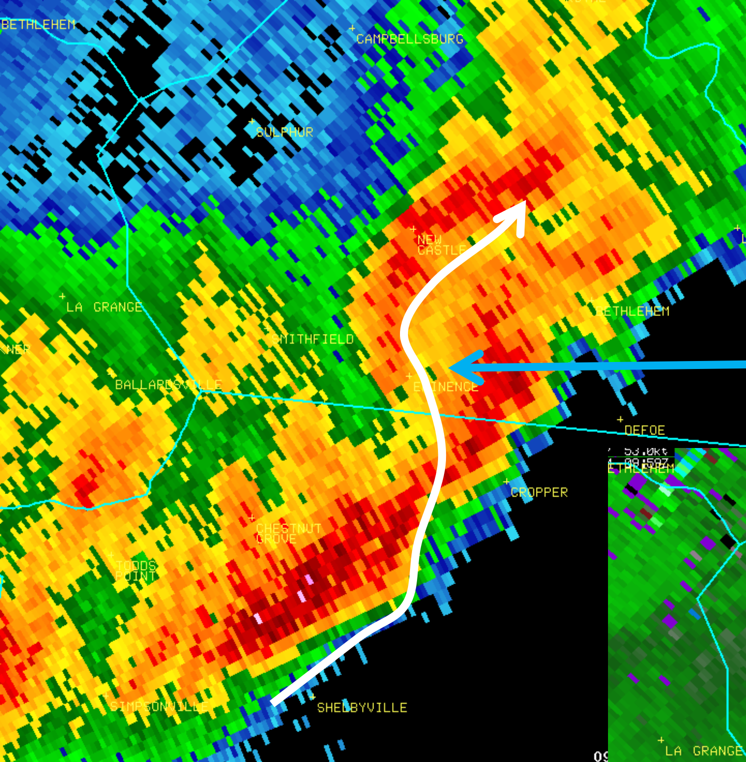
# 08 May 2009 (SGF)

An alternate spectrum width color curve (far right) also clearly defines the leading boundary location, coincident with that shown in velocity data.

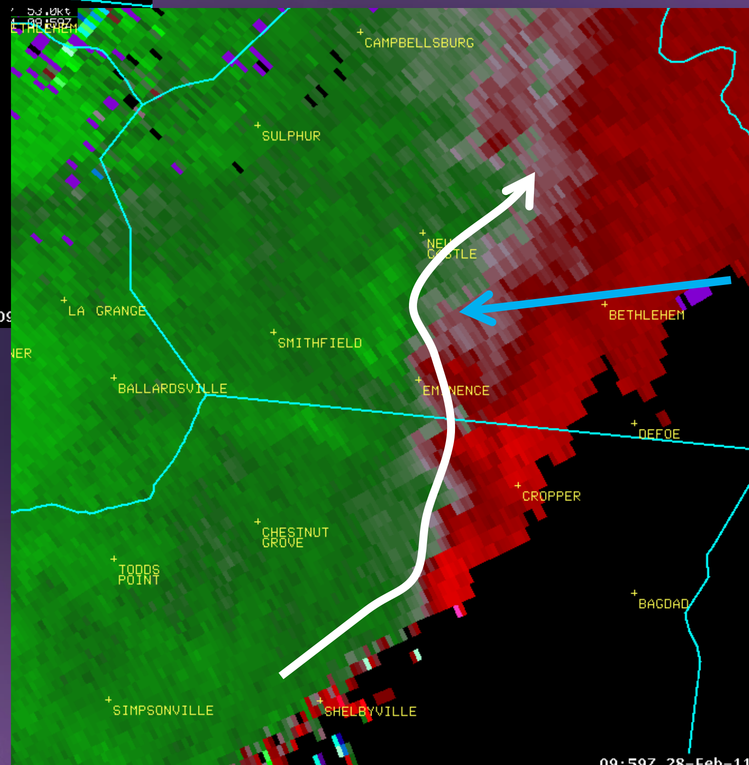
With this curve, spectrum width also clearly identifies the locations of two mesovortices (circulations) along the leading edge (concentrated area of high SW values within white circles). The mesovortices resulted in tornadoes.



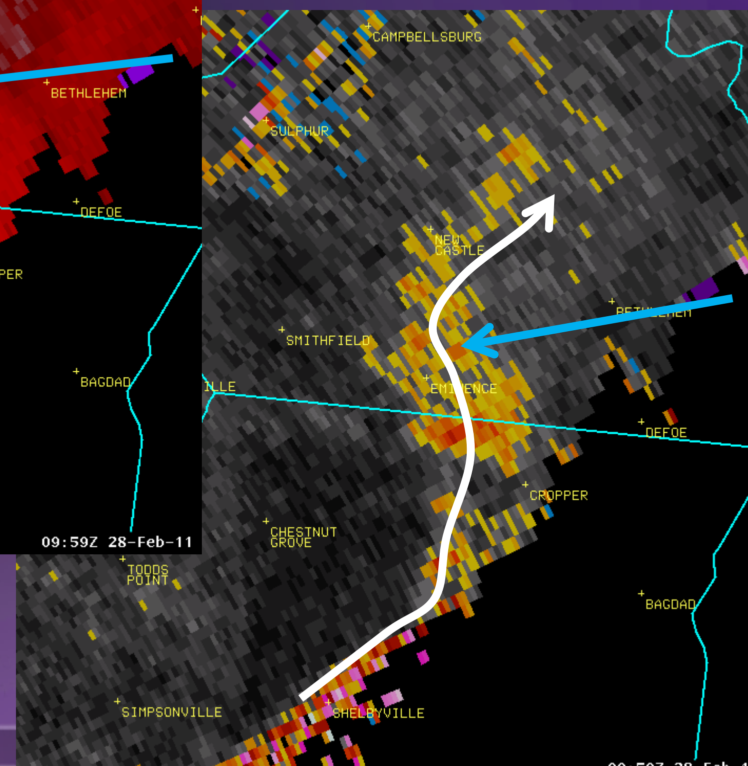
# 28 Feb 2011:  0959 UTC




Low-end EF3; heavy rain first, then a tornado



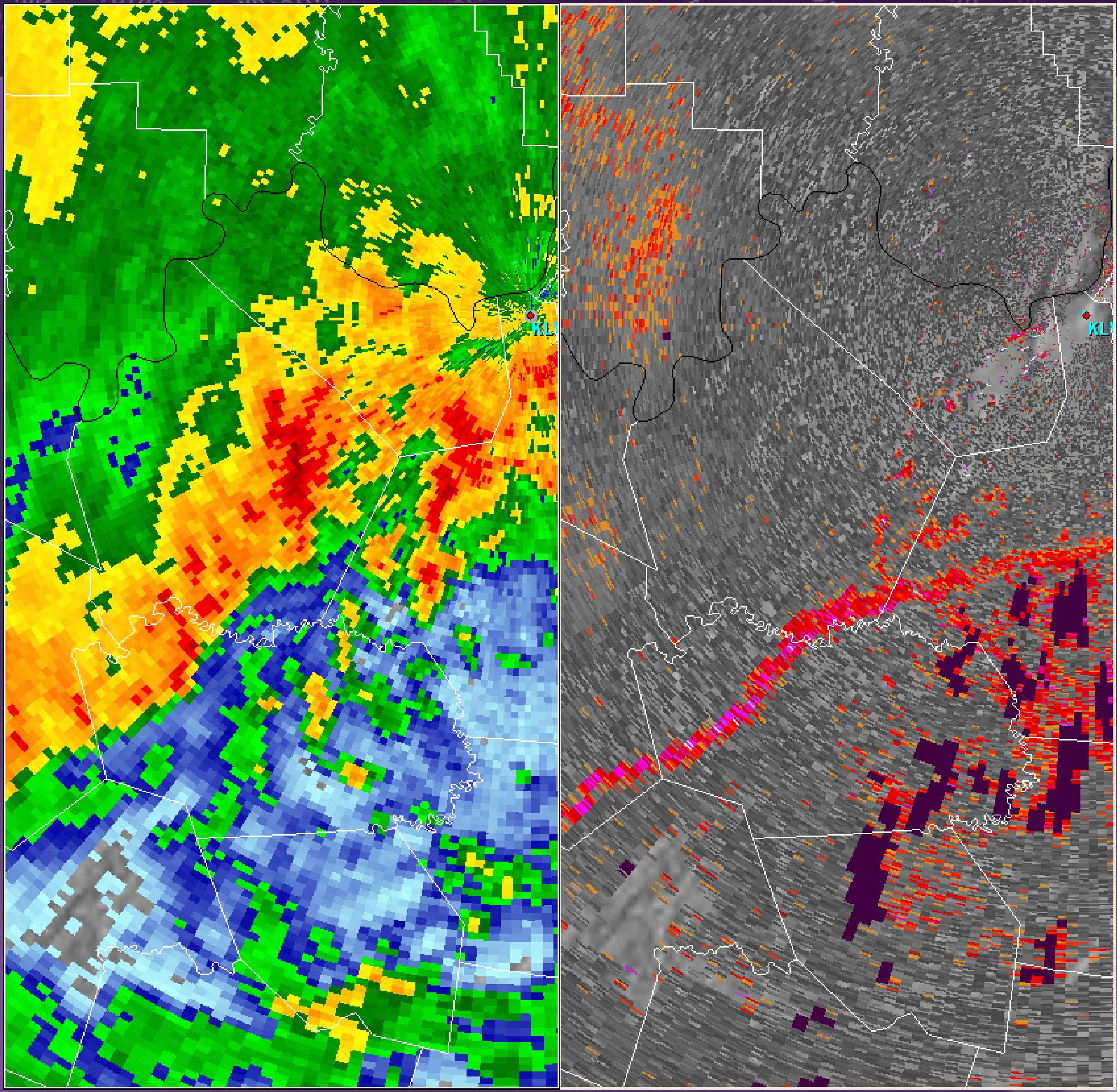

Storm-relative velocity (middle) and spectrum width (below) data identified the main boundary (white line) behind leading edge of heavy rain




Northeast of Louisville

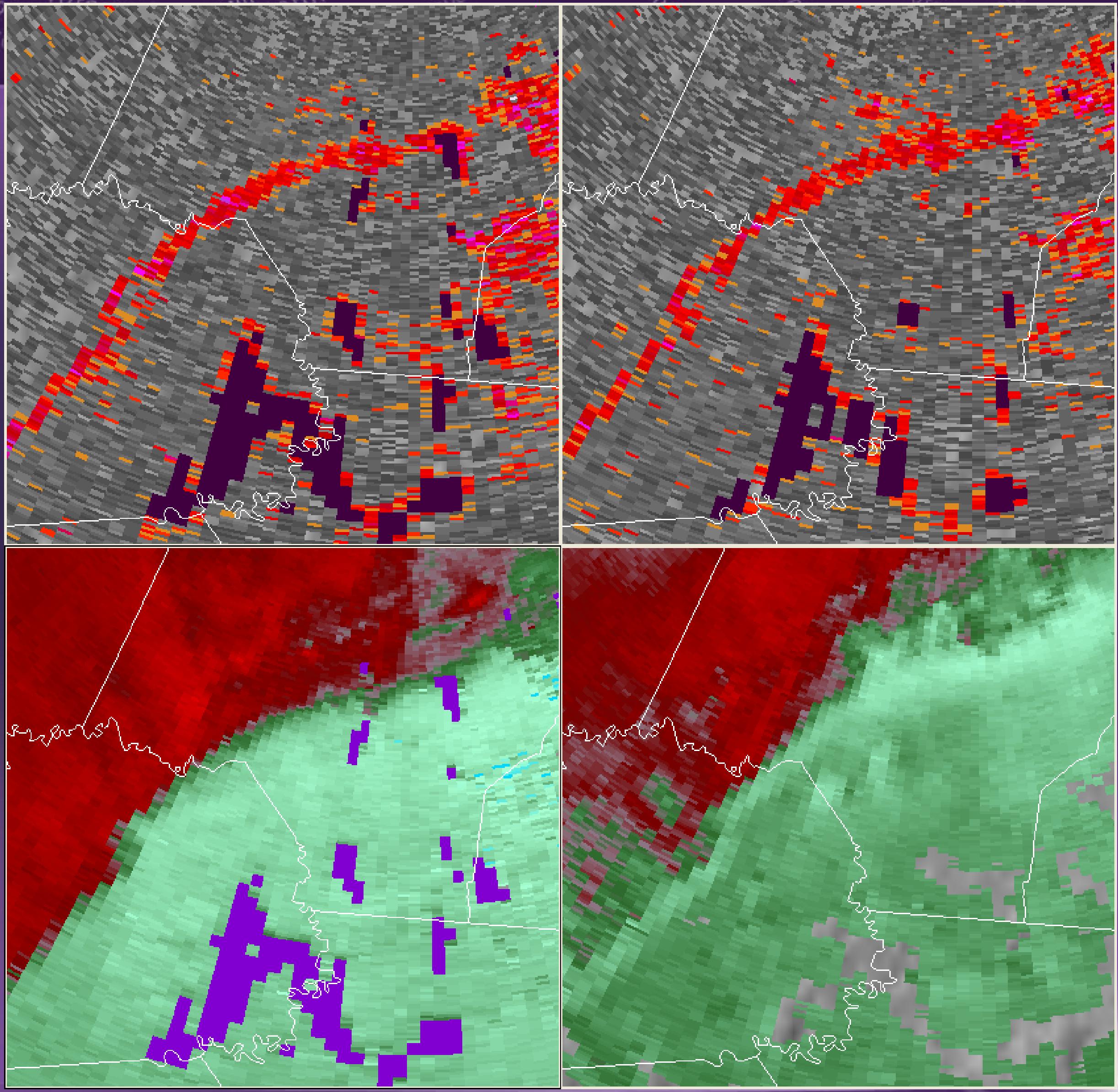
# 02 May 2006

Note how clearly spectrum width (far right) identifies the leading line boundary of the convection, whereby the boundary is only faintly distinguishable in reflectivity (near right).



# 02 May 2006

Spectrum width is very coherent in identifying and tracking the leading edge of the convection, and complements velocity data well in this case.



# Spectrum Width

- Depicts turbulence within the Doppler radar range bin
- Low values suggest “smooth flow”
  - Rear flank downdrafts, storm inflow zones
- High values suggest “turbulent or chaotic flow”
  - Convective boundaries or fronts
  - Tornadic signatures with rotation (mesovortices and mesocyclones)
- Use in conjunction with reflectivity and velocity data to enhance understanding