Operational Utility of Spectrum Width

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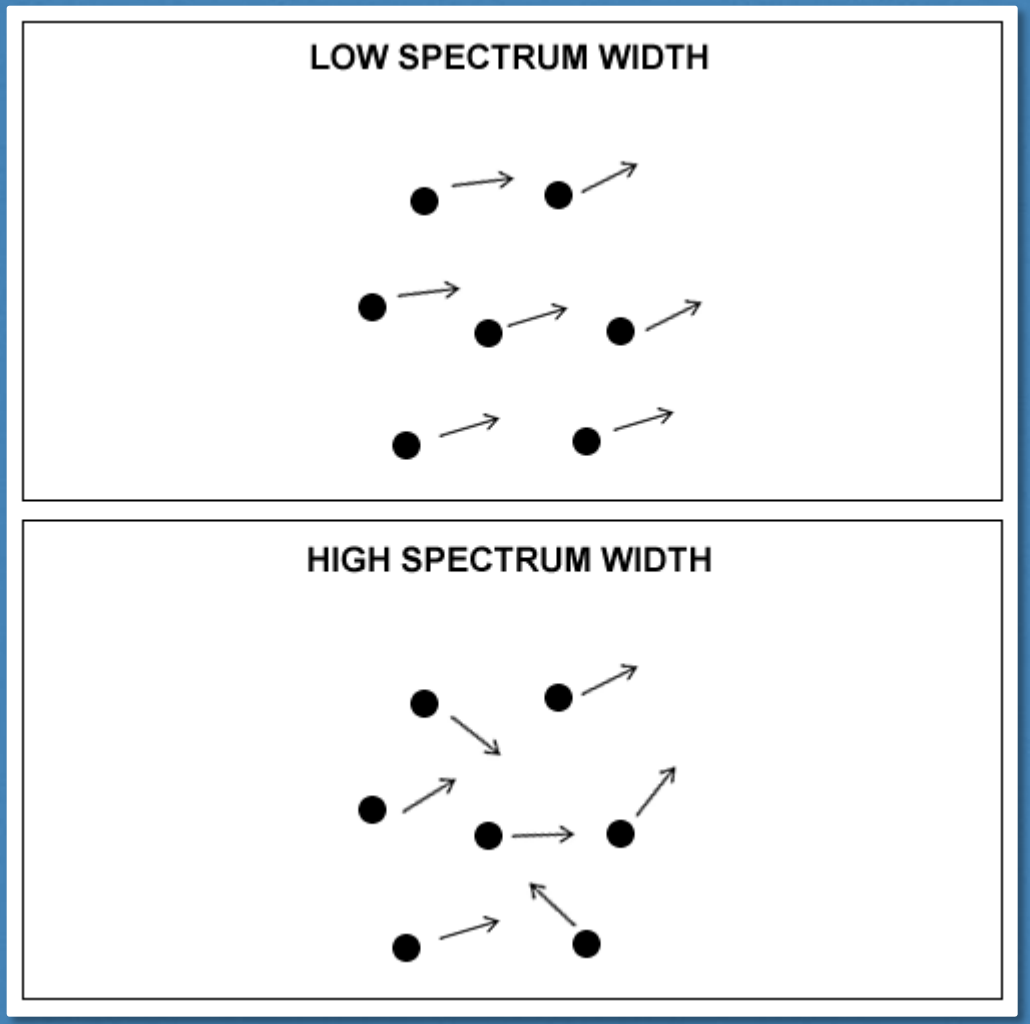
Technical Advisory Committee (TAC)

Overview

- What is Spectrum Width (SW)?
- How can we use SW in an operational setting?

Spectrum Width (SW)

- Measure of the velocity dispersion within a pulse volume
- Low values = small dispersion
- High values = large dispersion



Factors Affecting SW

- Wind Shear
- Turbulence
- Signal-to-Noise Ratio (SNR)
- Particle Fall Speed Dispersion
  - Typically ignored due to max elevation of 20 degrees
- Antenna Rotation
  - Typically ignored because contribution to error is small
- Clutter/Clutter Residue
  - Typically minimized or eliminated
- System Noise
  - Typically minimized or eliminated

OPERATIONAL APPLICATIONS

Accelerated Flow

- Very smooth; Little turbulence
  - Narrow spectrum widths (< 4 ms^{-1})
- Examples
  - Intense updrafts
    - Can extend above BWER in reflectivity
    - Other causes for low SW
      - Condensation processes
      - Helicity inhibiting downward cascade of energy
  - Low-level updraft inflow
  - Tropical Storm inflow and eye wall intensification

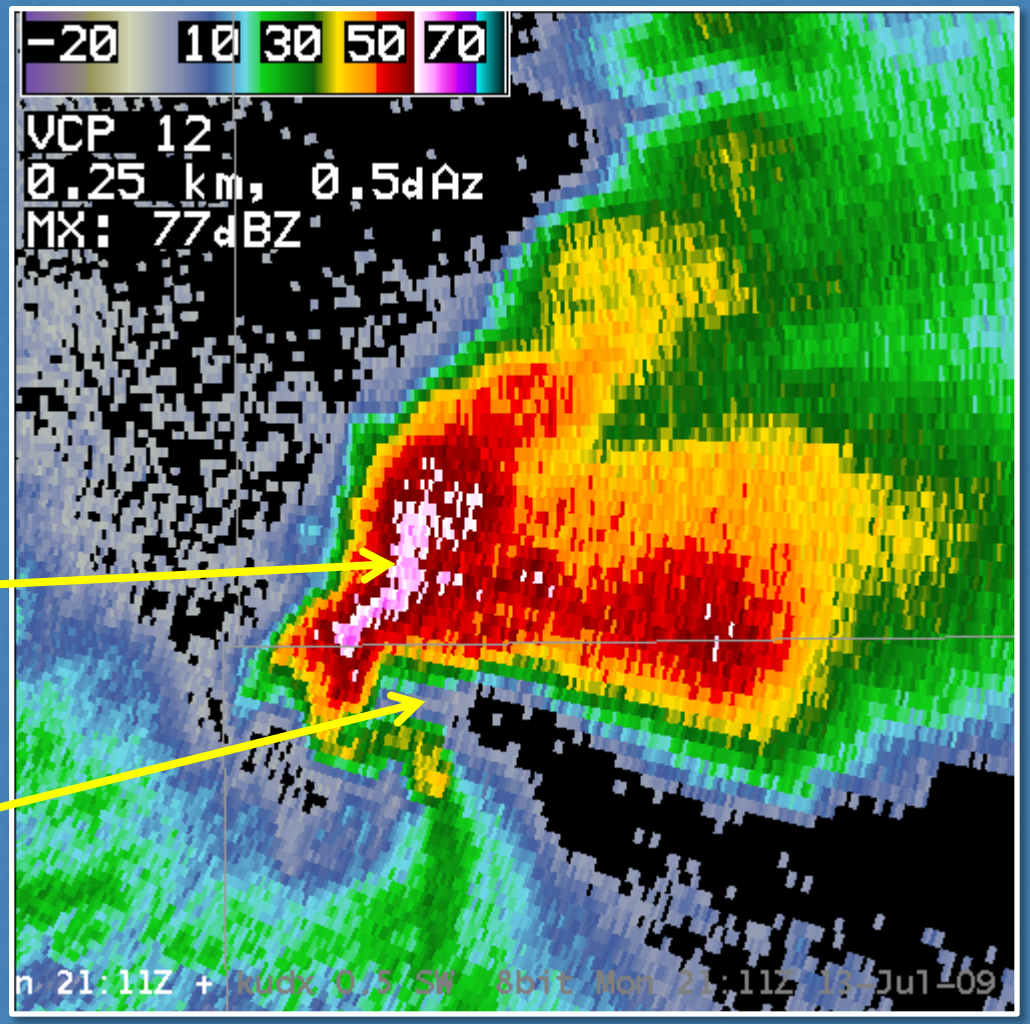
Decelerating (Non-Accelerating) Flow

- Tends to be very turbulent
  - Leads to very broad spectrum widths (> 5 to 10 ms^{-1})
- Examples
  - Downdrafts
    - Precipitation cores
    - Except Rear Flank Downdrafts
  - Fronts/Convergence Zones (to be discussed later)

Acceleration/Deceleration Example

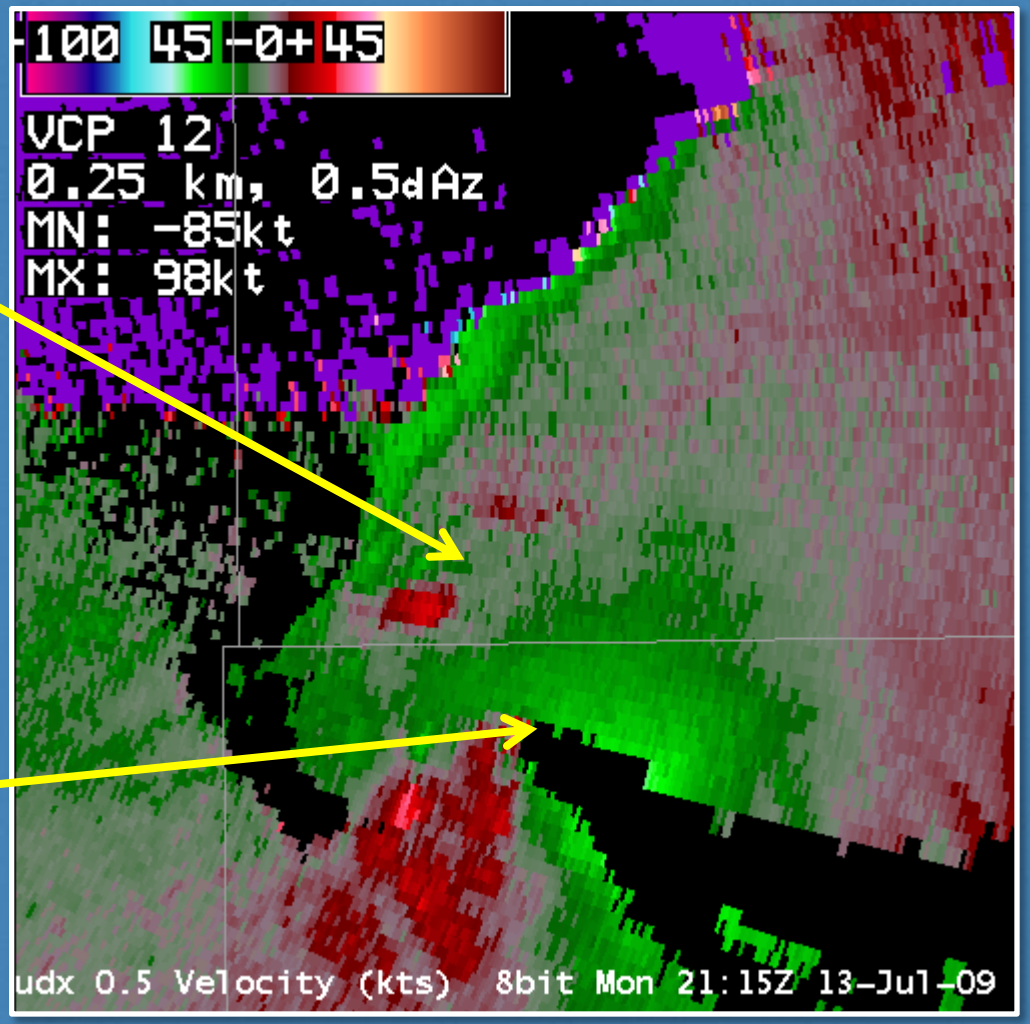
- **0.5 degrees**
- **2111 UTC 13 July 2009**
- **South Dakota**

- Precip Region
- Inflow Region



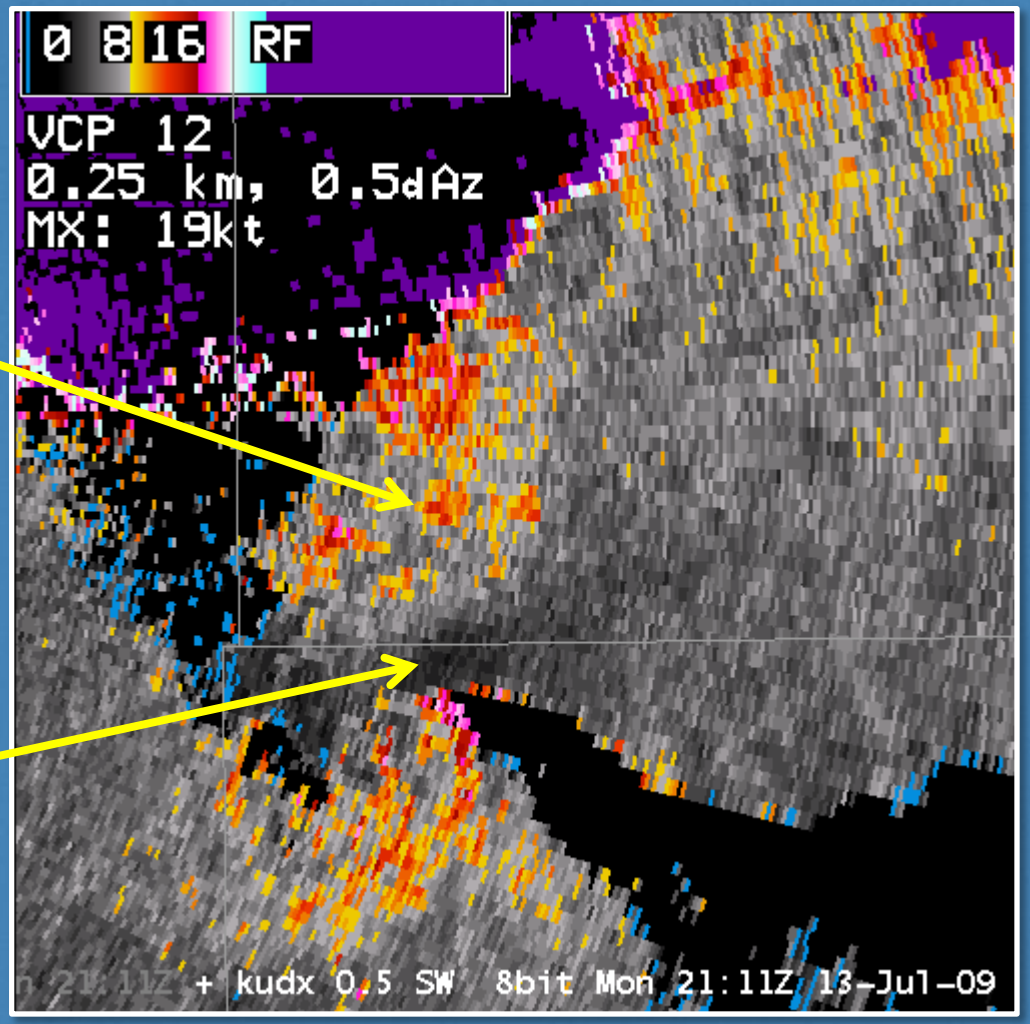
Acceleration/Deceleration Example

- Noisier precip core
- Strong smooth inflow



Acceleration/Deceleration Example

- Precip core
- Strong smooth inflow



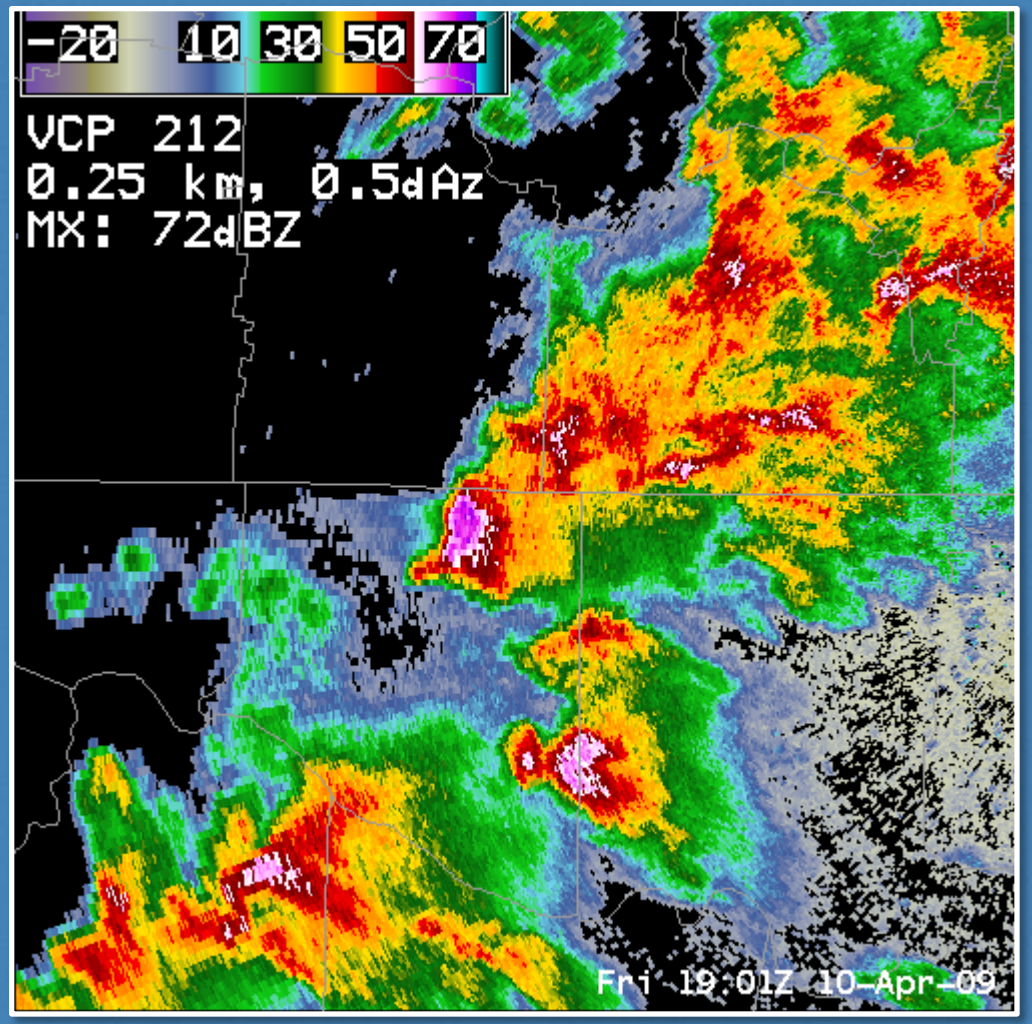
Three Body Scatter Spikes (TBSS)

- Low reflectivity signature down radial of large hail
  - 10 to 30 km length
  - Low velocity values (< 5 m/s)
  - High spectrum widths (> 20 m/s)
- Most often, can be seen clearly in reflectivity
  - Parent storm echo structure can obscure
    - Spectrum width still shows signature
- Example
  - Hail core and Mesocyclone

TBSS Example

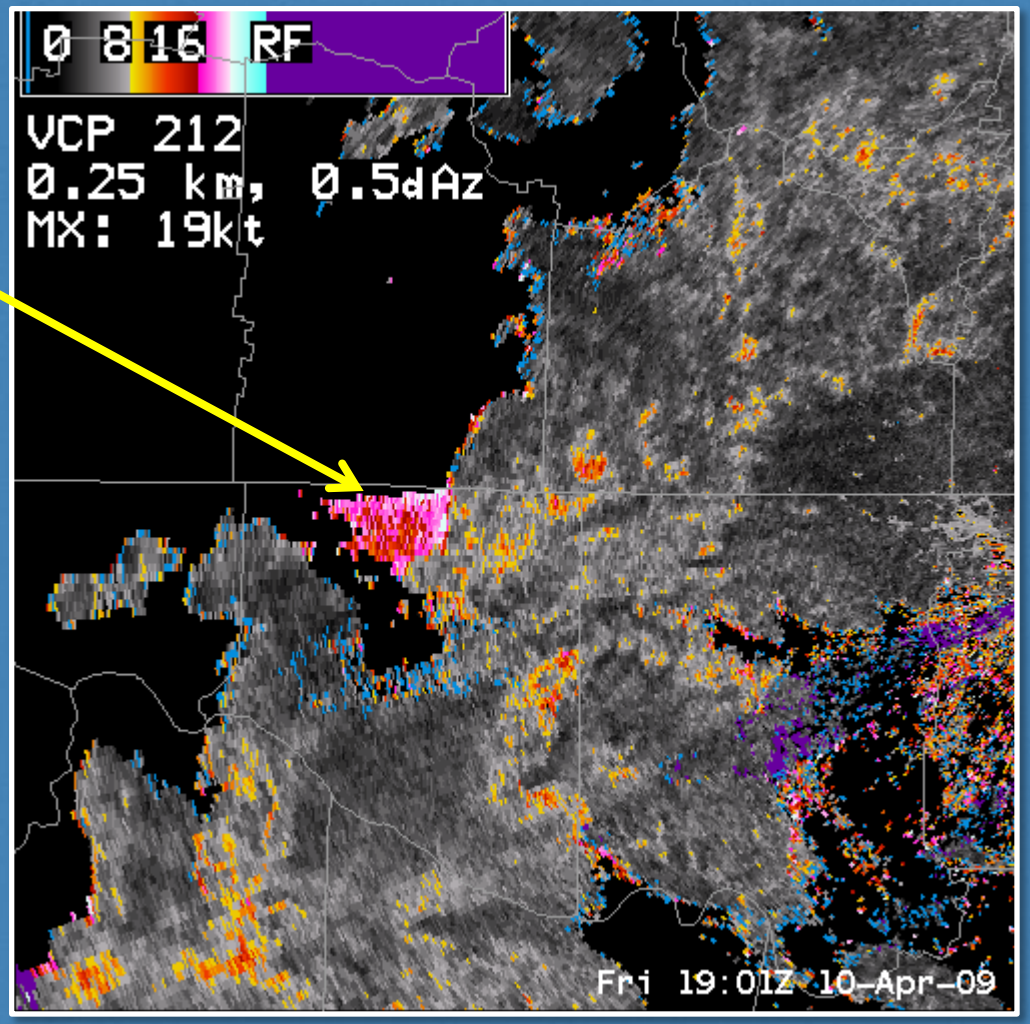
- **0.5 degrees**
- **1901 UTC**
- **Huntsville, AL**

- Does the TBSS stand out to you on this image?



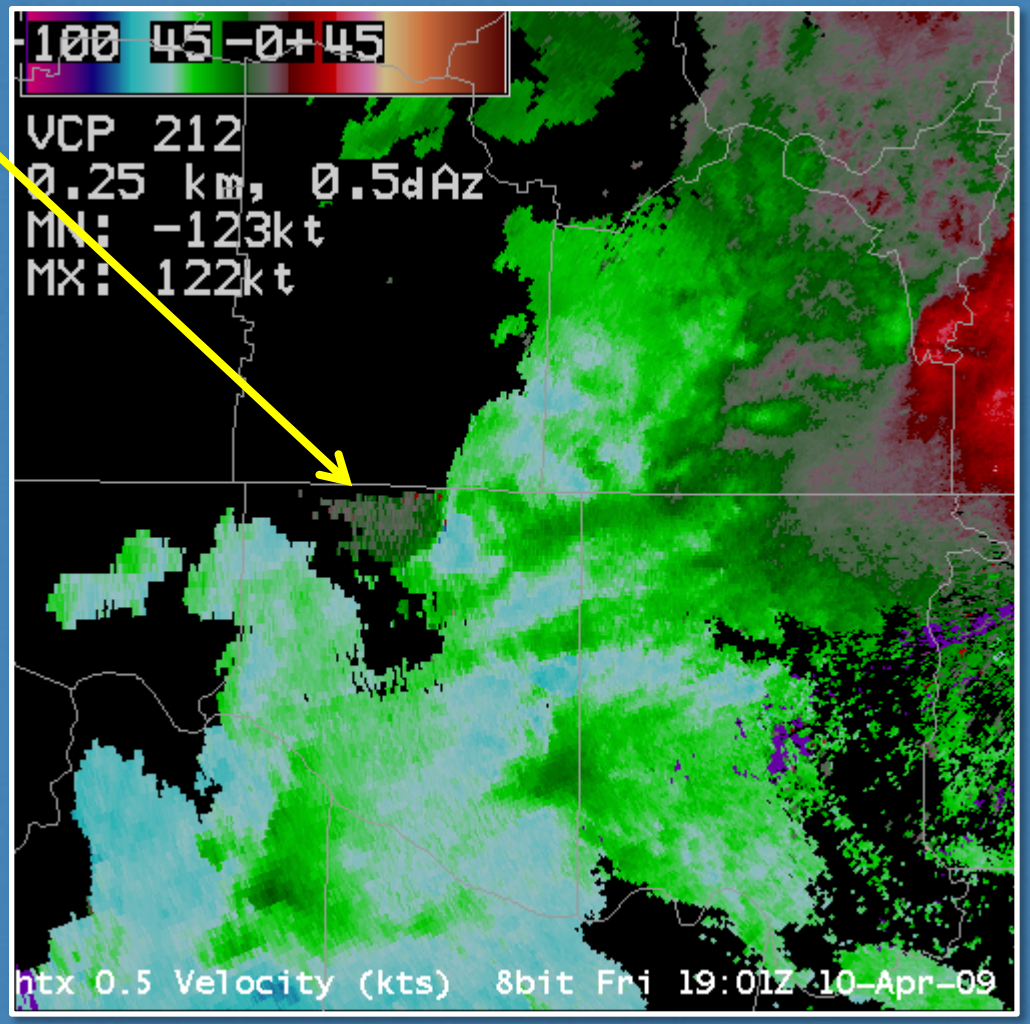
TBSS Example

- How about in SW?
- Whoa! Right There!



TBSS Example

- Very low velocities



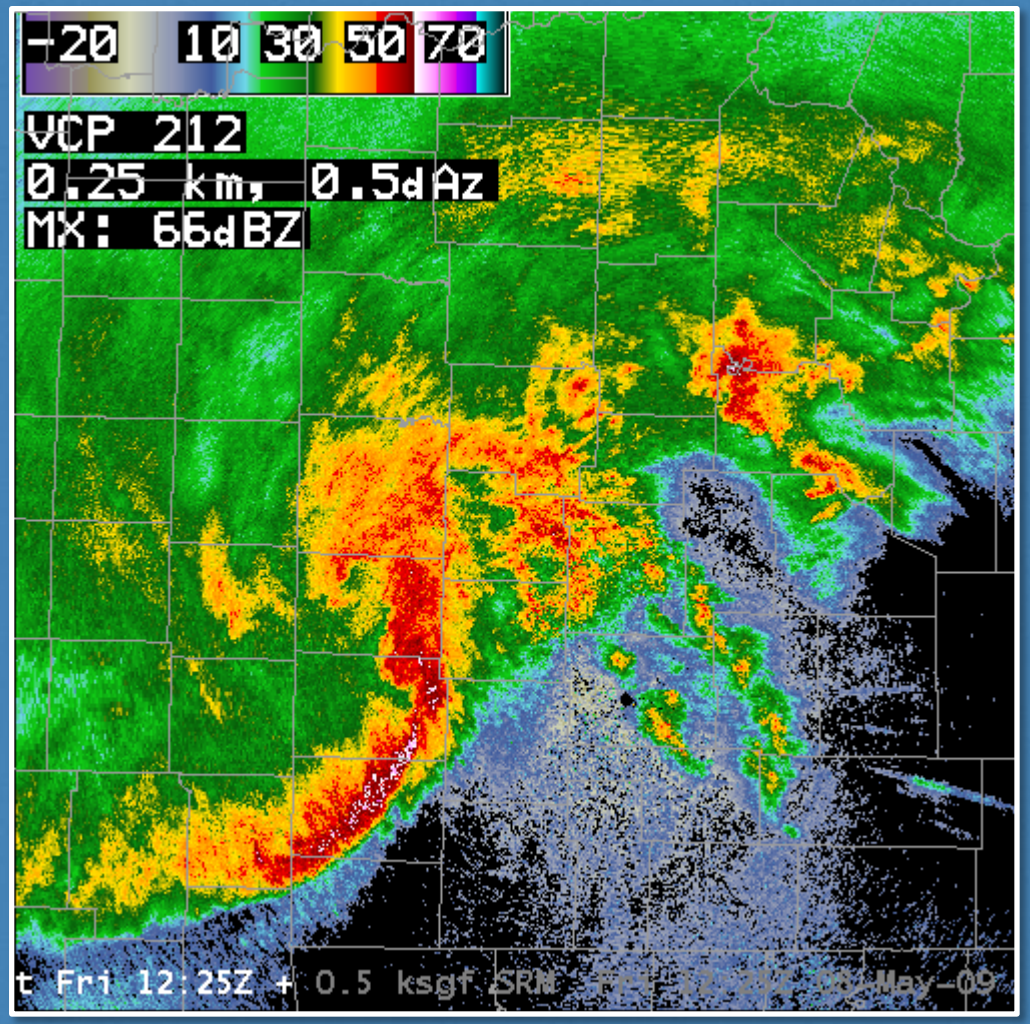
Fronts and Wind Shifts

- The interface between colliding air masses tend to experience high turbulence.
  - Examples: Cold Fronts, Gust Fronts, etc.
  - Leads to very broad spectrum widths
- Zones of wind shifts are characterized by high turbulence and wind shear.
  - Leads to very broad spectrum widths

Fronts and Wind Shifts Example

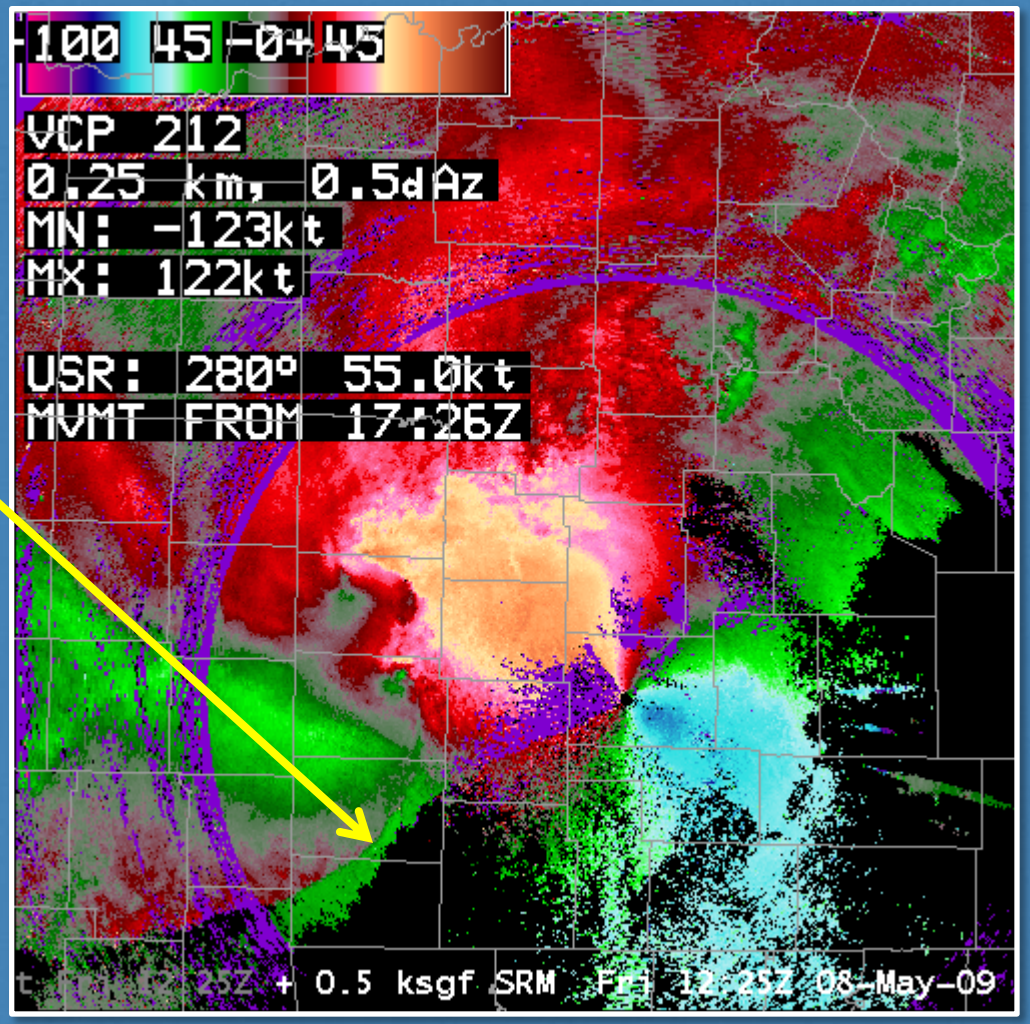
- **0.5 degrees**
- **1225 UTC 08 May 2009**
- **Springfield, MO**

- Where are the boundaries?



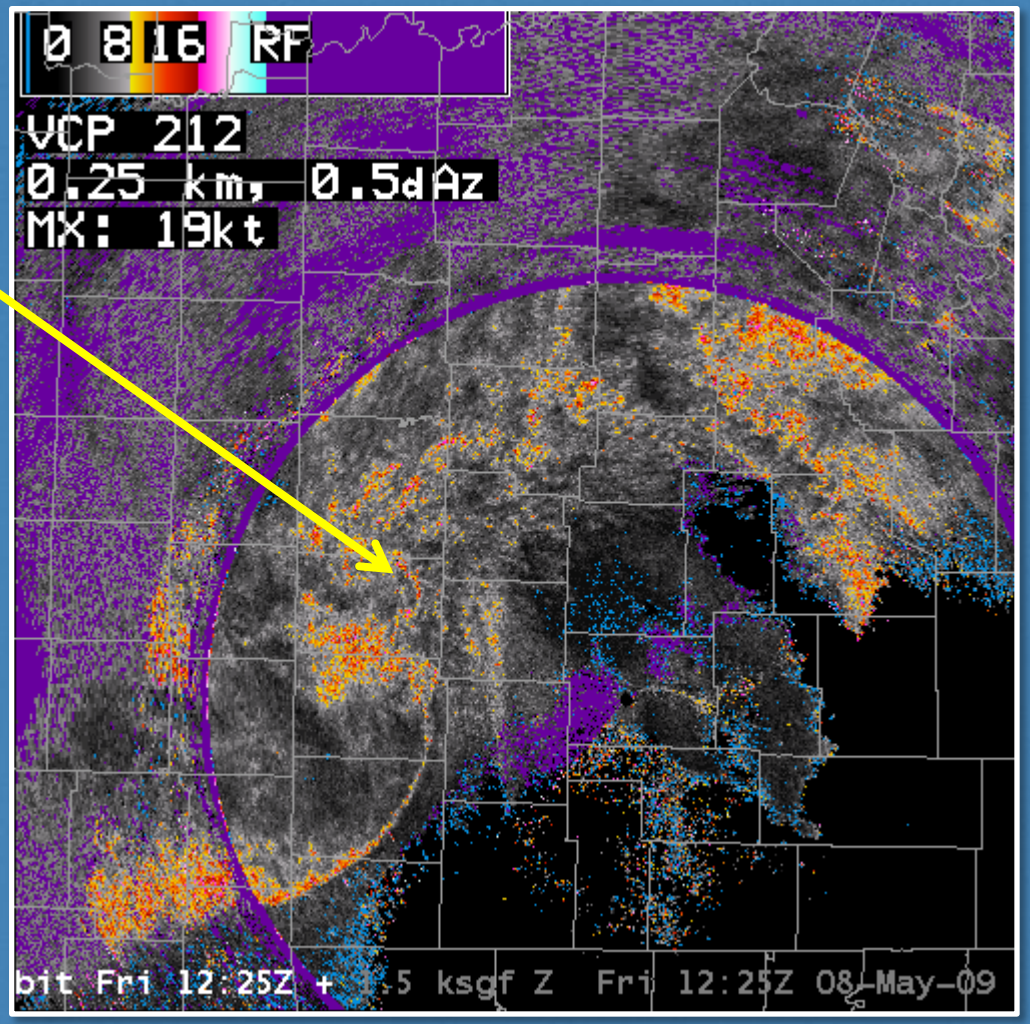
Fronts and Wind Shifts Example

- Front/Boundary noticable here on velocity



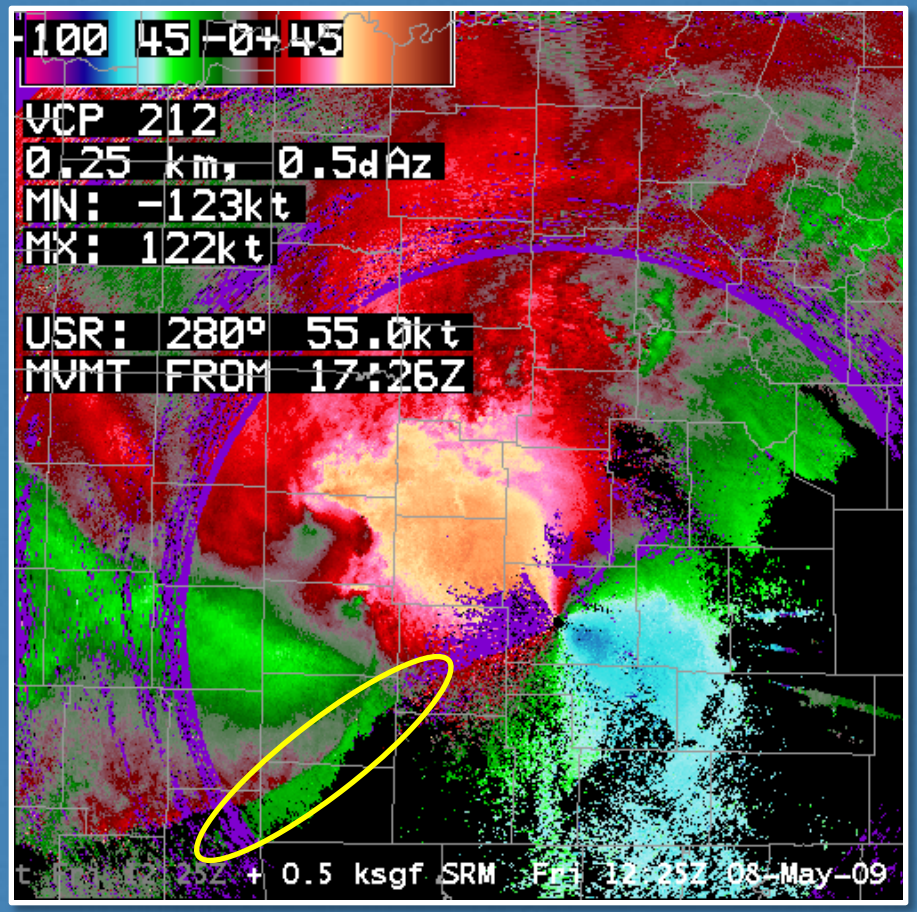
Fronts and Wind Shifts Example

- Did you see the boundary here?
- It shows up better on SW

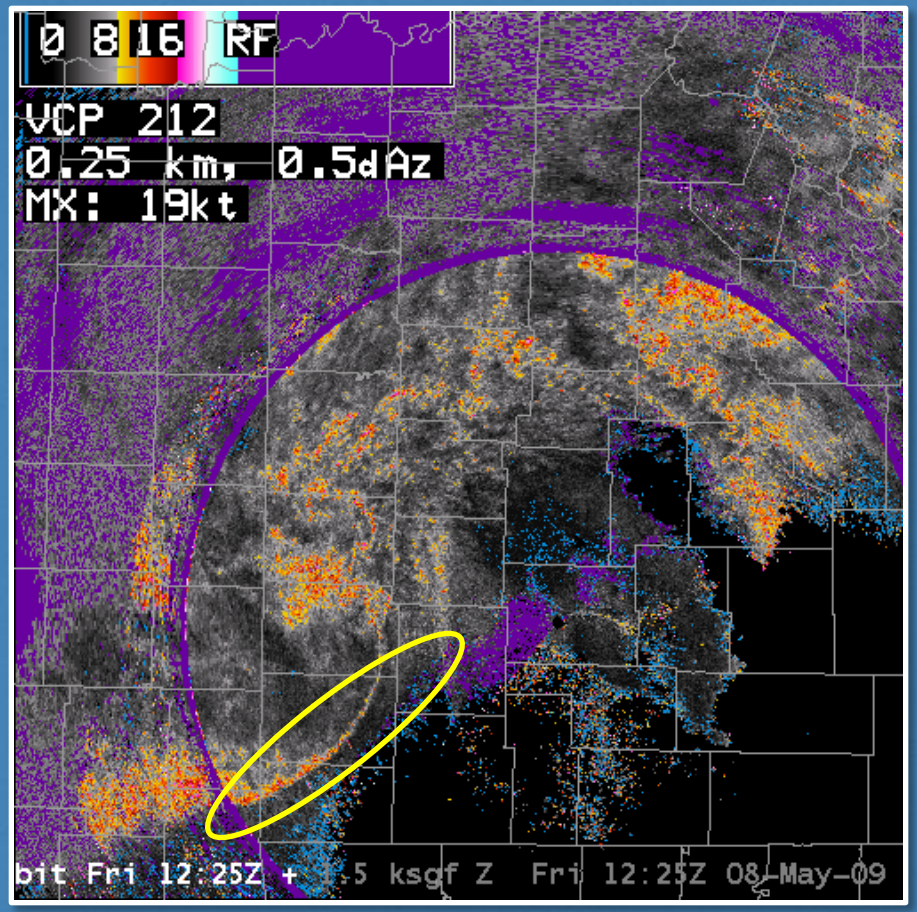


Deep Convergence Zones

SRM



Velocity



Zone of deep radial velocity convergence (as much as 10 km)

Orographic Effects

- Thunderstorms interacting with mountainous terrain can produce extreme turbulence. On radar, this would be noted by broad spectrum widths.

- Examples
  - Typhoon hitting Taiwan

Future Applications

- Due to increased accuracy of SW, and attention, more applications may be forthcoming
  - L&D 1979 mesocyclone model
- Turbulence algorithm
  - Better than earlier version with better estimator?
  - Help aviation community
- Others???

QUESTIONS?