

# DUAL-POLARIZATION OF WSR-88D NETWORK



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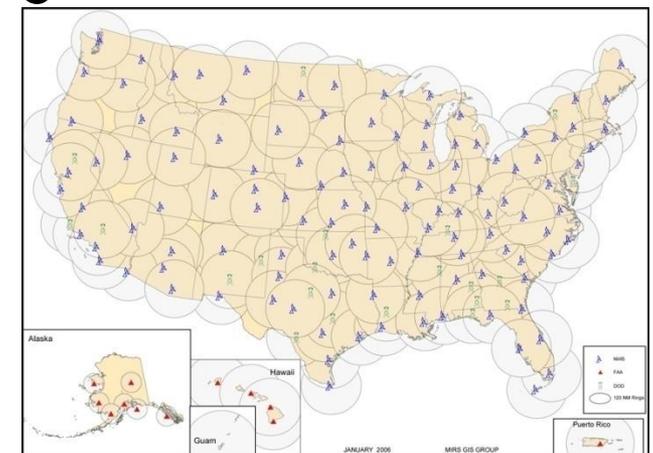


Emergency Management Meeting

# Dual-Polarization Radar: Coming Soon!



- Impacts entire WSR-88D network
- Several new products available
- Training content still evolving



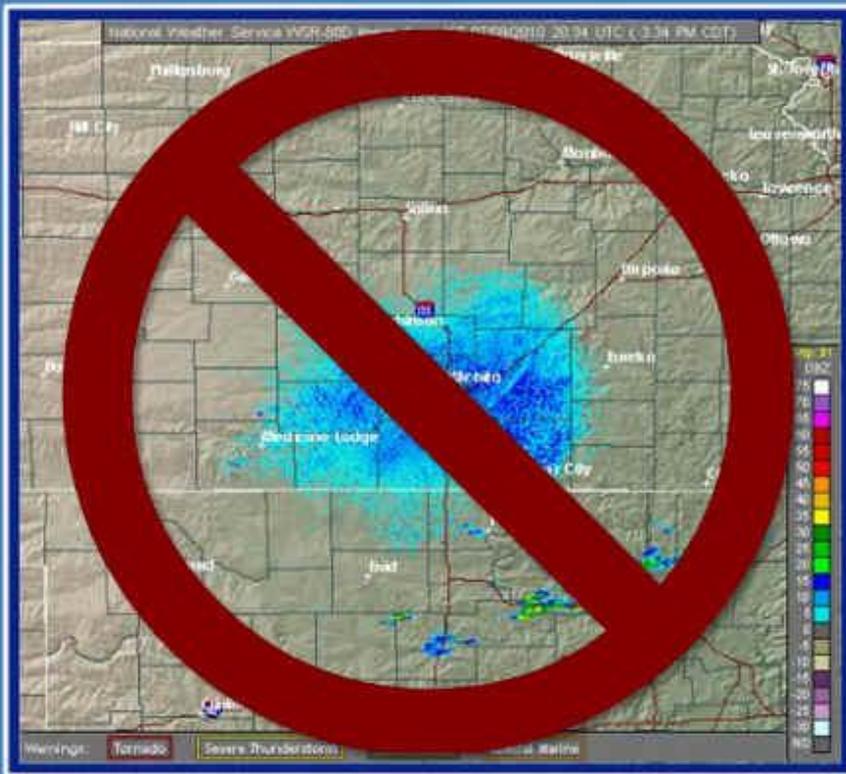
# Dual-Polarization Radar Technology: Current Schedule for Upgrade

- KLOT will be part of the Beta Test period
- February 28 – March 13, 2011

Installation Phases	Jan Feb Mar 2010	Apr May Jun 2010	July Aug Sep 2010	Oct Nov Dec 2010	Jan Feb Mar 2011	Apr May Jun 2011	July Aug Sep 2011	Oct Nov Dec 2011	Jan Feb Mar 2012	Apr May Jun 2012	July Aug Sep 2012	Oct Nov Dec 2012
<b>Phase 1:</b> Testbed Radar (KOUN)	Testing & evaluation process											
<b>Phase 2:</b> Beta Test Sites					Tests at 5 WSR-88D sites							
<b>Phase 3:</b> WSR-88D Network Upgrade						Dual-polarization technology installed at NWS, Dept. of Defense, & FAA sites throughout network						

# Impacts of the New Technology

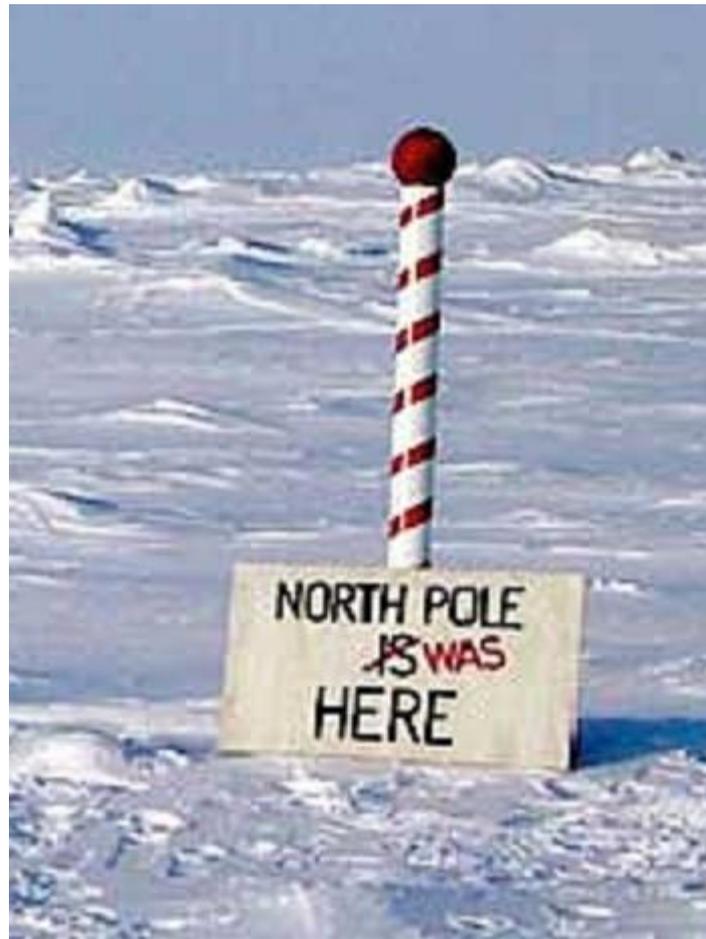
Short-Term Impact #1:  
Temporary Loss of Data



Short-Term Impact #2:  
Steep Learning Curve

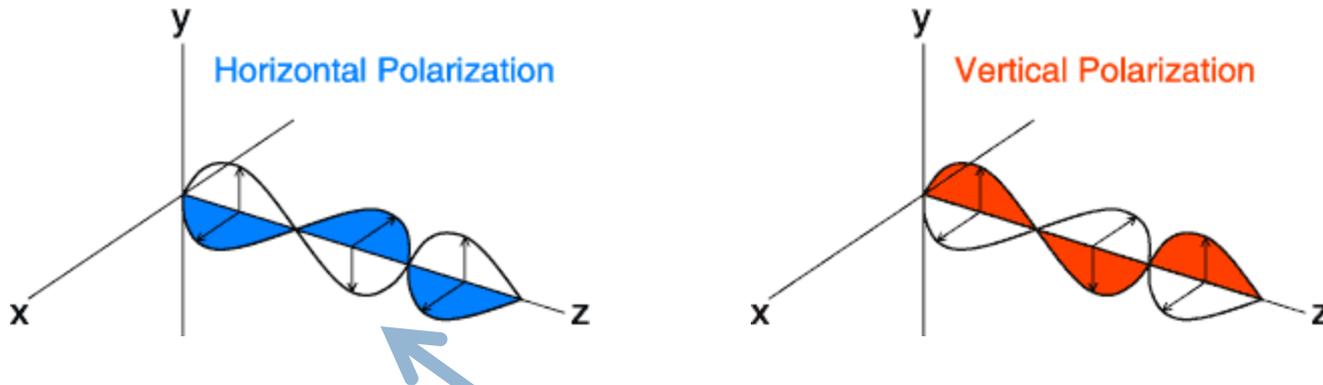


# What is Dual-Polarization?



# What is Dual-Polarization?

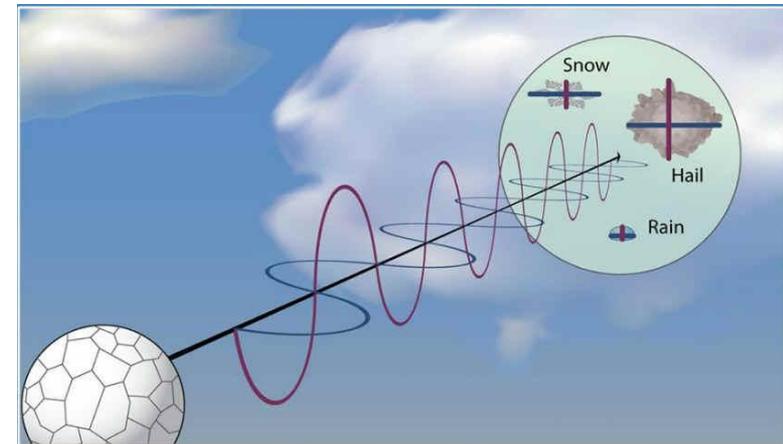
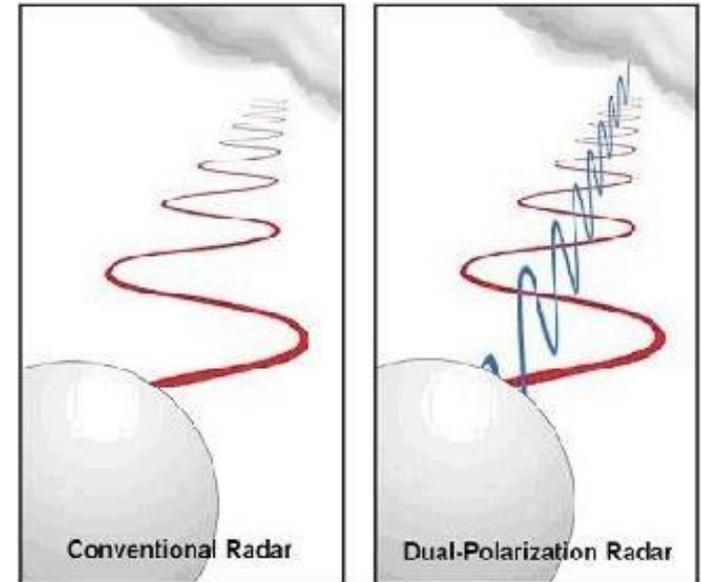
- A radio wave is a series of oscillating electromagnetic fields. If we could see them, they would look like this:



Polarization currently used by WSR-88D's

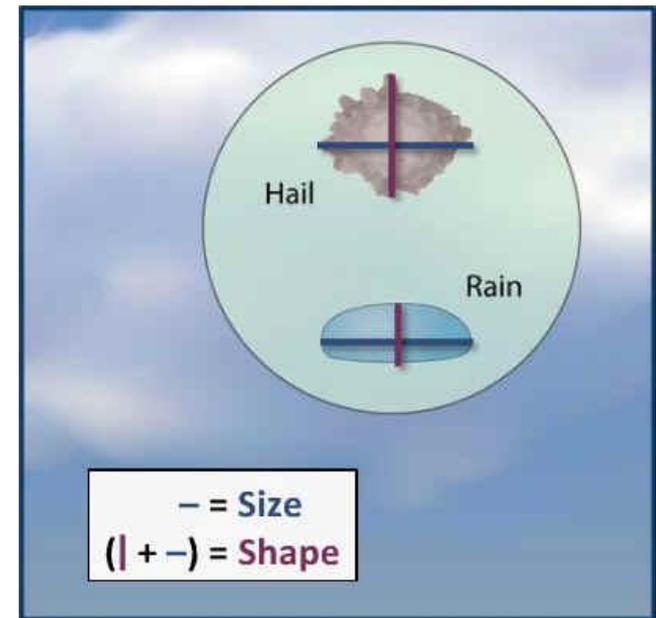
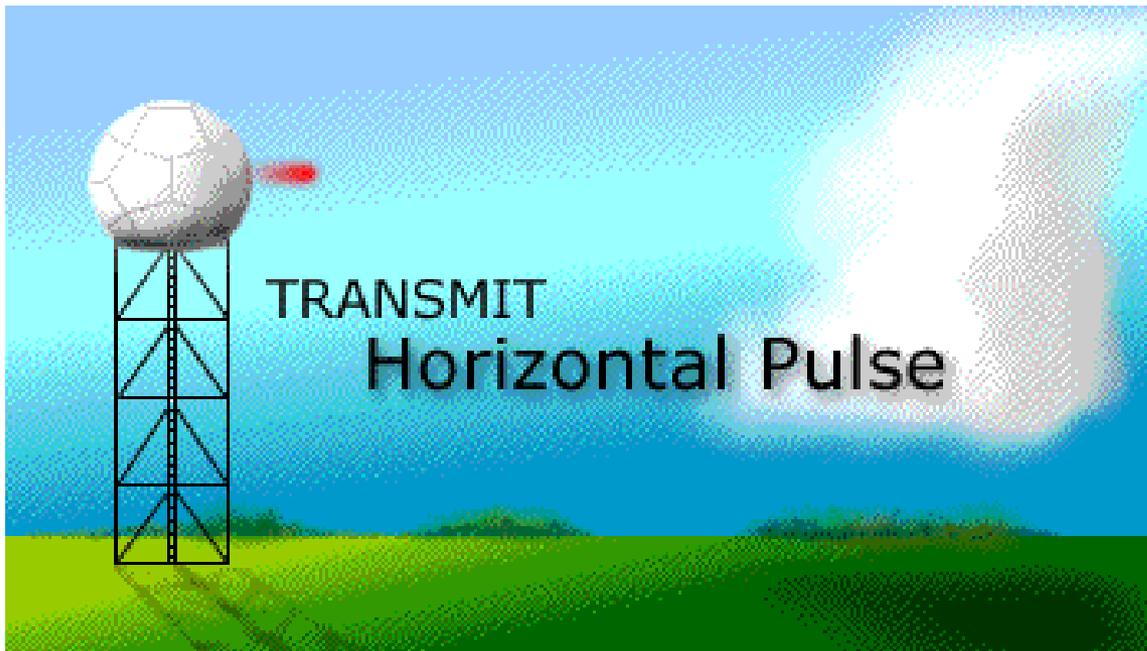
# What is Dual-Polarization & How Is It Different from Conventional Doppler Radar??

- Most radars (WSR-88D included) transmit and receive radio waves with a single, horizontal polarization
- Polarimetric radars transmit and receive both horizontal and vertical polarizations
- This is most commonly done by alternating between horizontal and vertical polarizations with each successive pulse



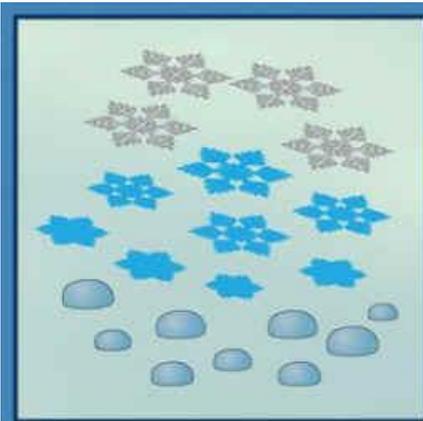
# Polarimetric Radar:

- Polarimetric radars measure both the horizontal and vertical dimensions of cloud and precipitation particles – can determine SIZE and SHAPE



# Why are two poles better than one?

- By comparing these reflected power returns of the two phases in different ways (ratios, correlations, etc.), we are able to obtain information on the size, shape, and ice density of cloud and precipitation particles, as well as better identify non-weather echoes.



More than one precipitation type



Differentiating biological from weather targets

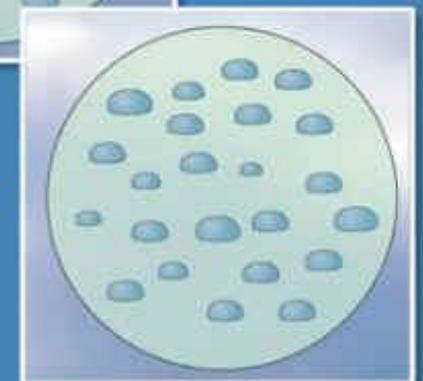
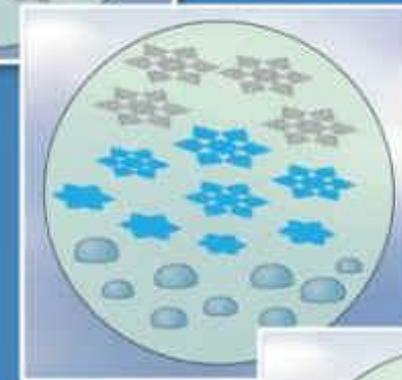
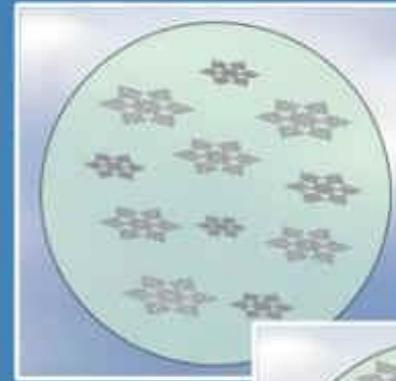
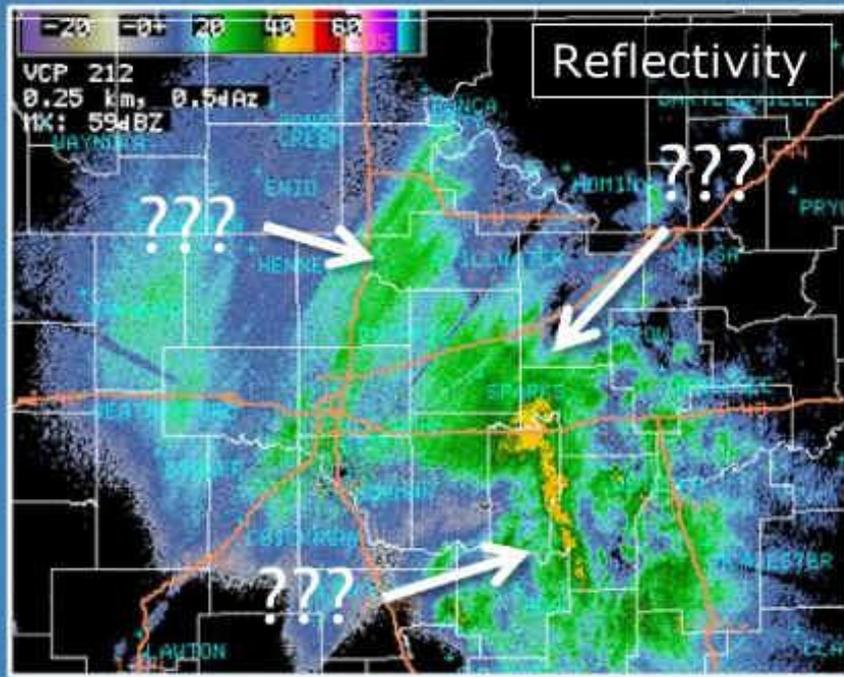


Identifying debris from significant tornadoes

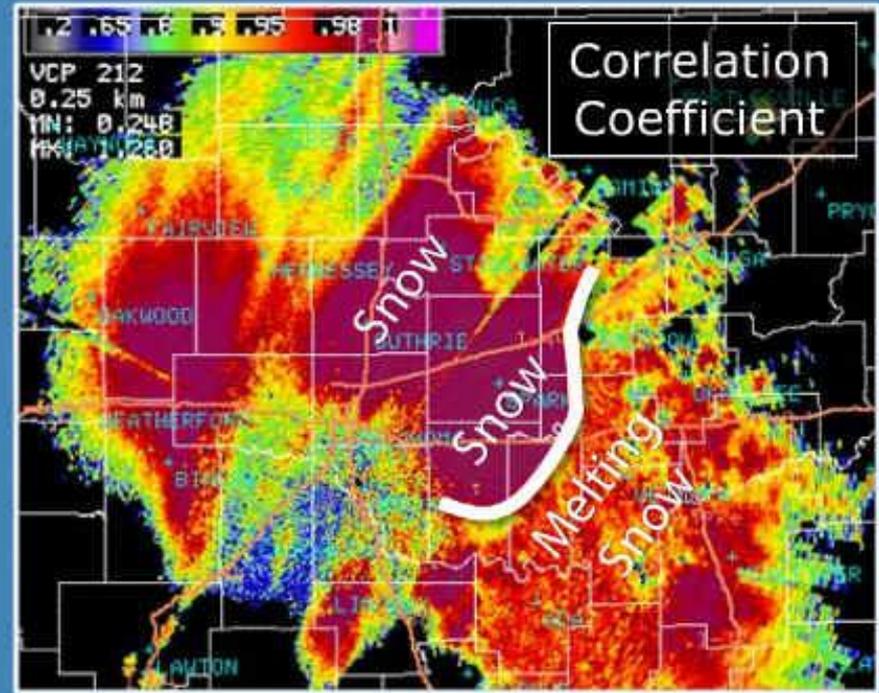
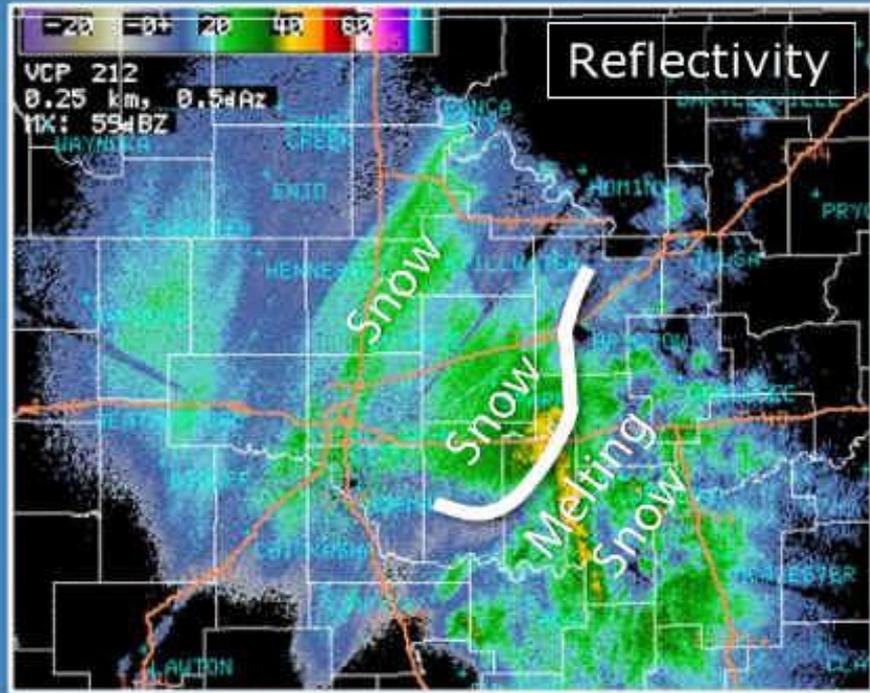
# Benefits of Dual-Polarization:

- Detect when hail is present in a thunderstorm
- Detect areas of heavy rain better (Improved precipitation estimation via determining droplet distributions (rainfall rates))
- Differentiate rain, snow, melting snow
- Identify non-weather echoes more easily
- Detect debris lofted by significant tornadoes

# Using Shape and Variety Info to Differentiate Rain, Snow, and Melting Snow



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NOTE: Dual-polarization radar identifies precipitation type above the ground, not at the surface!

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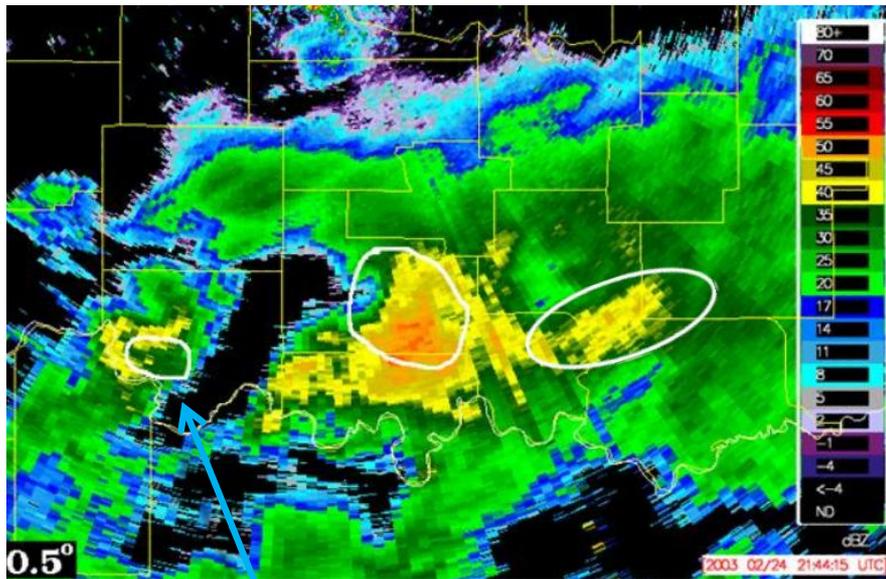
## □ Correlation Coefficient (CC)

- $0.96 < CC < 1$  – Small hydrometeor diversity\*
- $0.85 < CC < 0.96$  – Large hydrometeor diversity\*
- $CC < 0.85$  – Non-hydrometeors present
  - \* refers to sizes, shapes, orientations, etc.

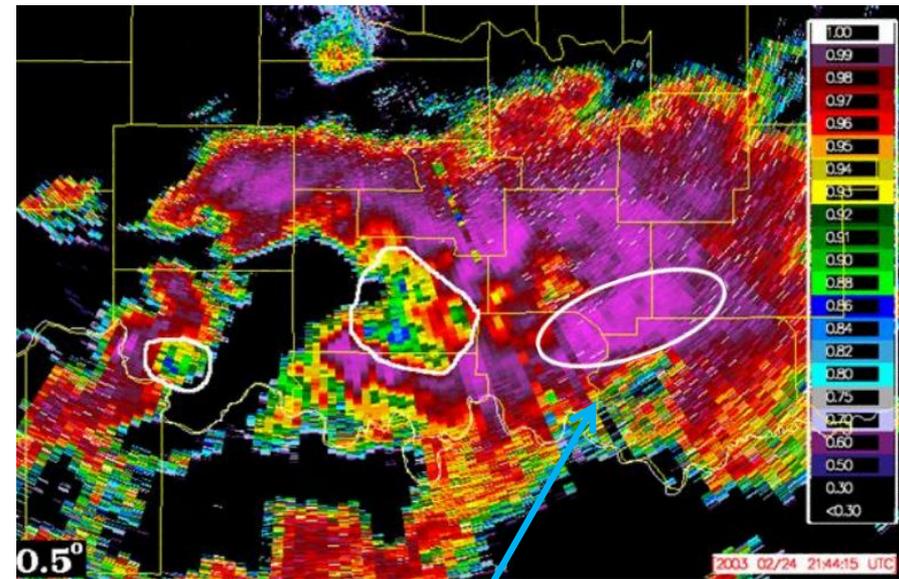


# Using Shape and Variety Info to Differentiate Rain, Snow, and Melting Snow

Reflectivity:



Correlation Coefficient:



High CC indicates all one precip type  
Low CC indicates mix (melting)



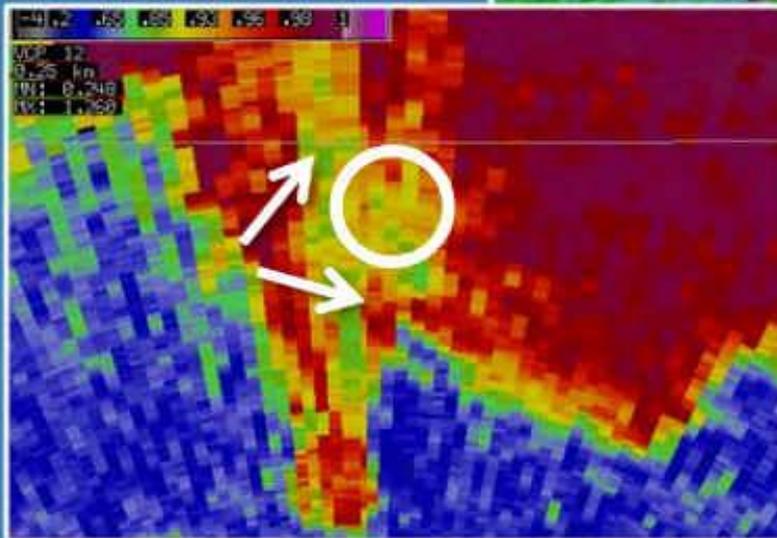
# Using Shape and Variety Info to Better Detect Hail

High values of reflectivity can be due to hail



High confidence of hail in circle

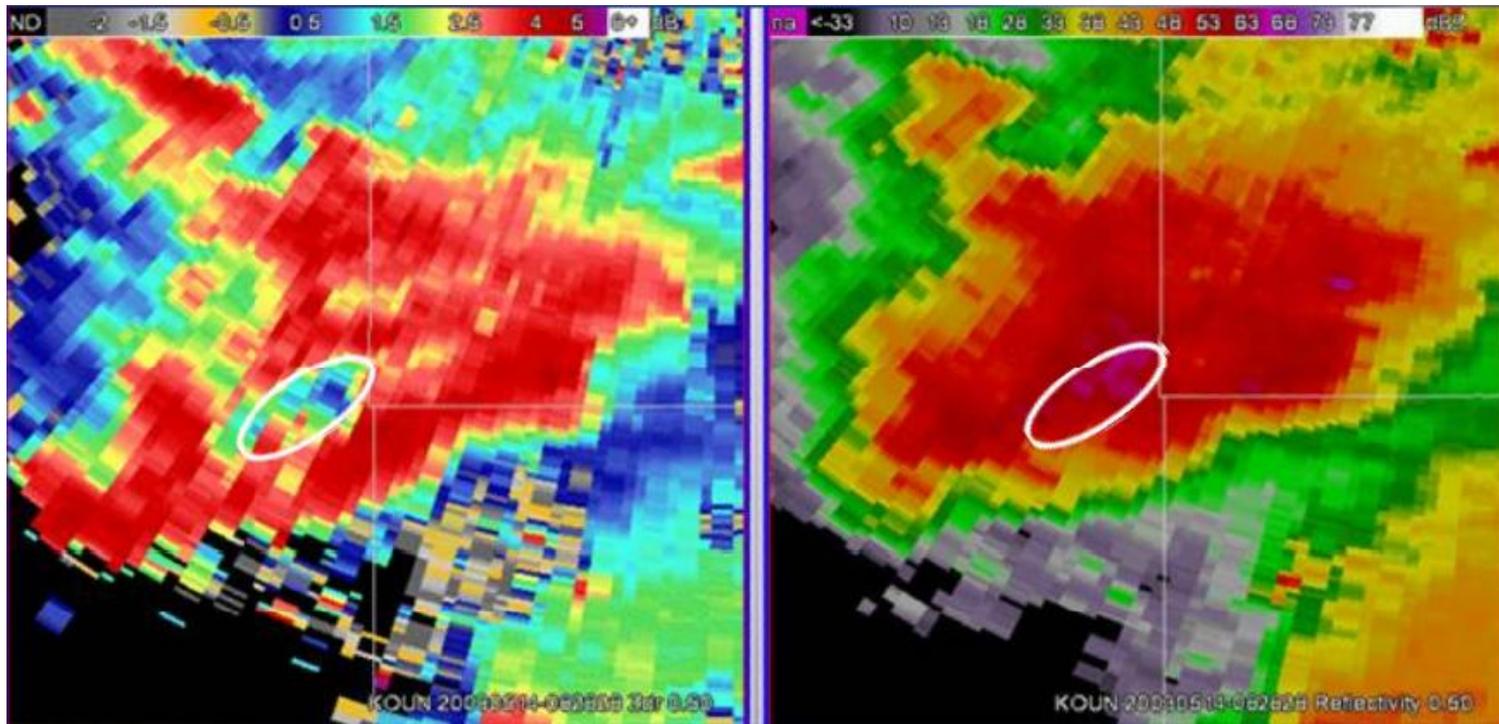
Where rain mixed w/ some hail possible



# Using Shape and Variety Info to Better Detect Hail

**Z** on right:  
note high  
reflectivity  
core in purple

**ZDR** on left:  
note minima  
of near zero  
where highest  
Z co-located.  
This indicates  
hail core!



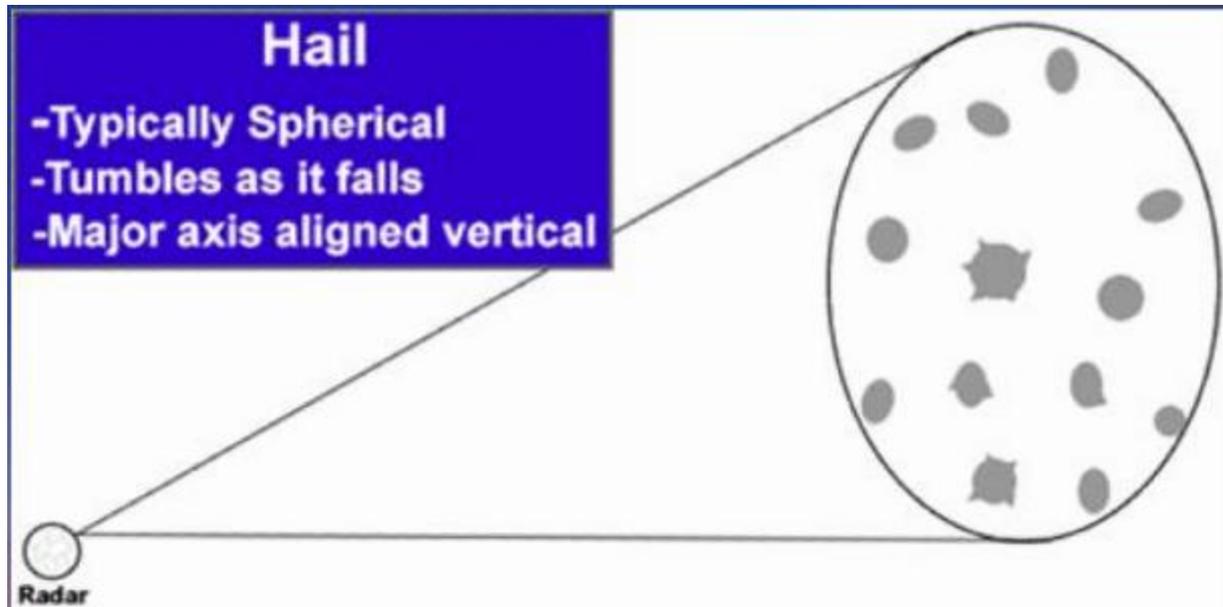
# ZDR > 0:

- Positive ZDR indicates a mean power return profile wider than it is tall
- Larger positive ZDR usually indicates the presence of larger liquid drops
- Falling rain drops flatten into “hamburger bun” shape (generally range from 0.5 to 5.0 dB)



# ZDR $\sim$ 0:

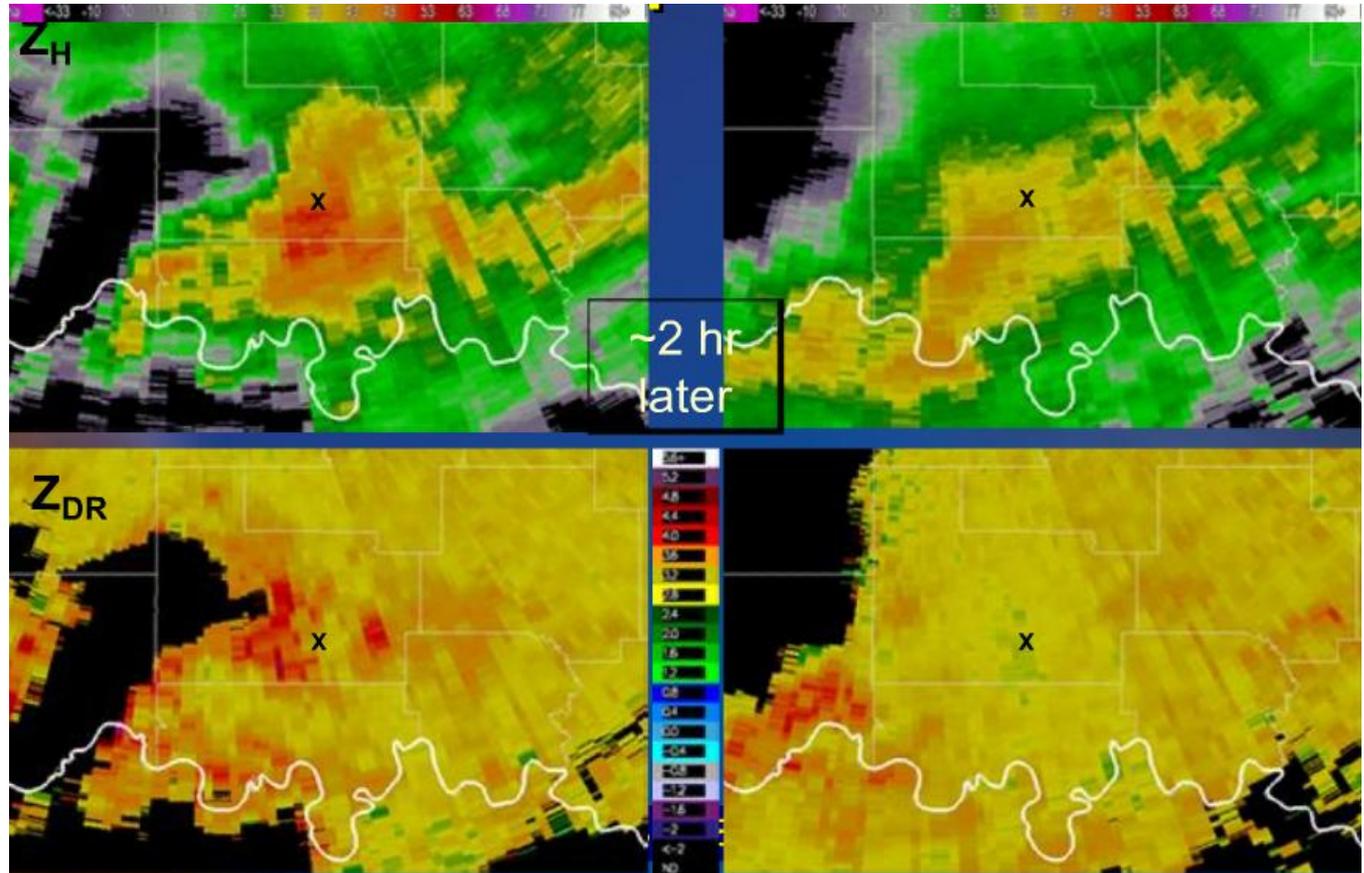
- ZDR values around zero indicate a spherical mean profile power return
- Tumbling hail stones result in nearly spherical return



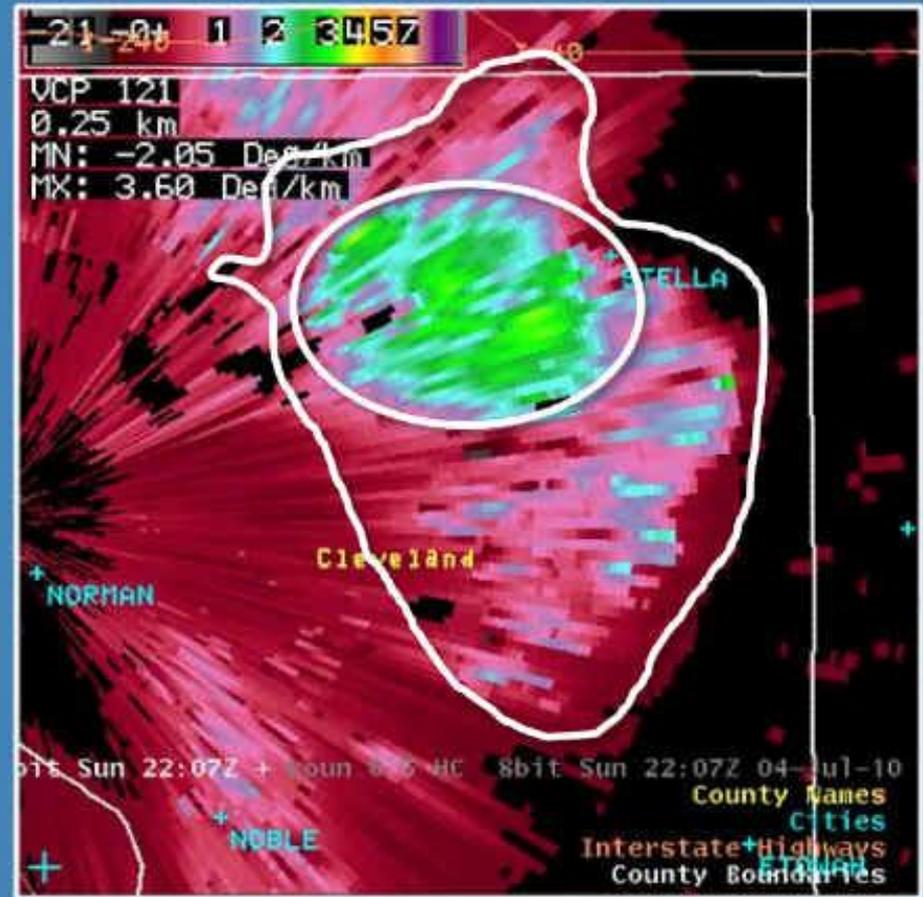
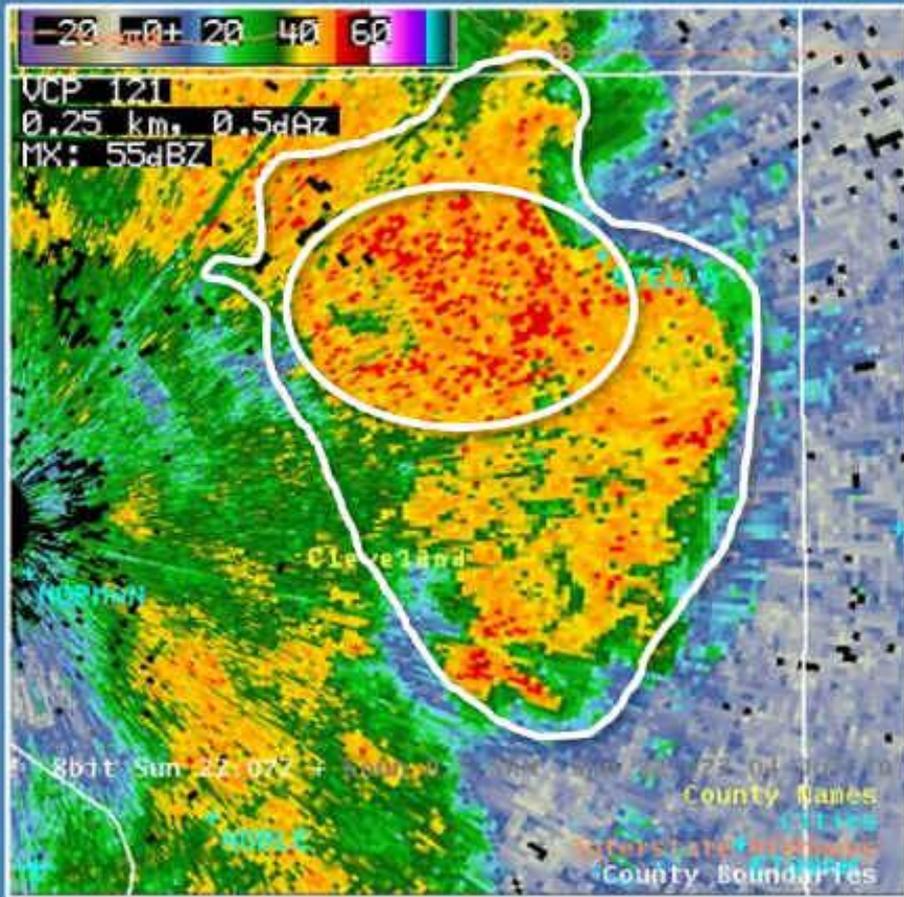
# Rain/Sleet Changing to Snow:

**Left:** High ZDR indicates liquid covered sleet/snow

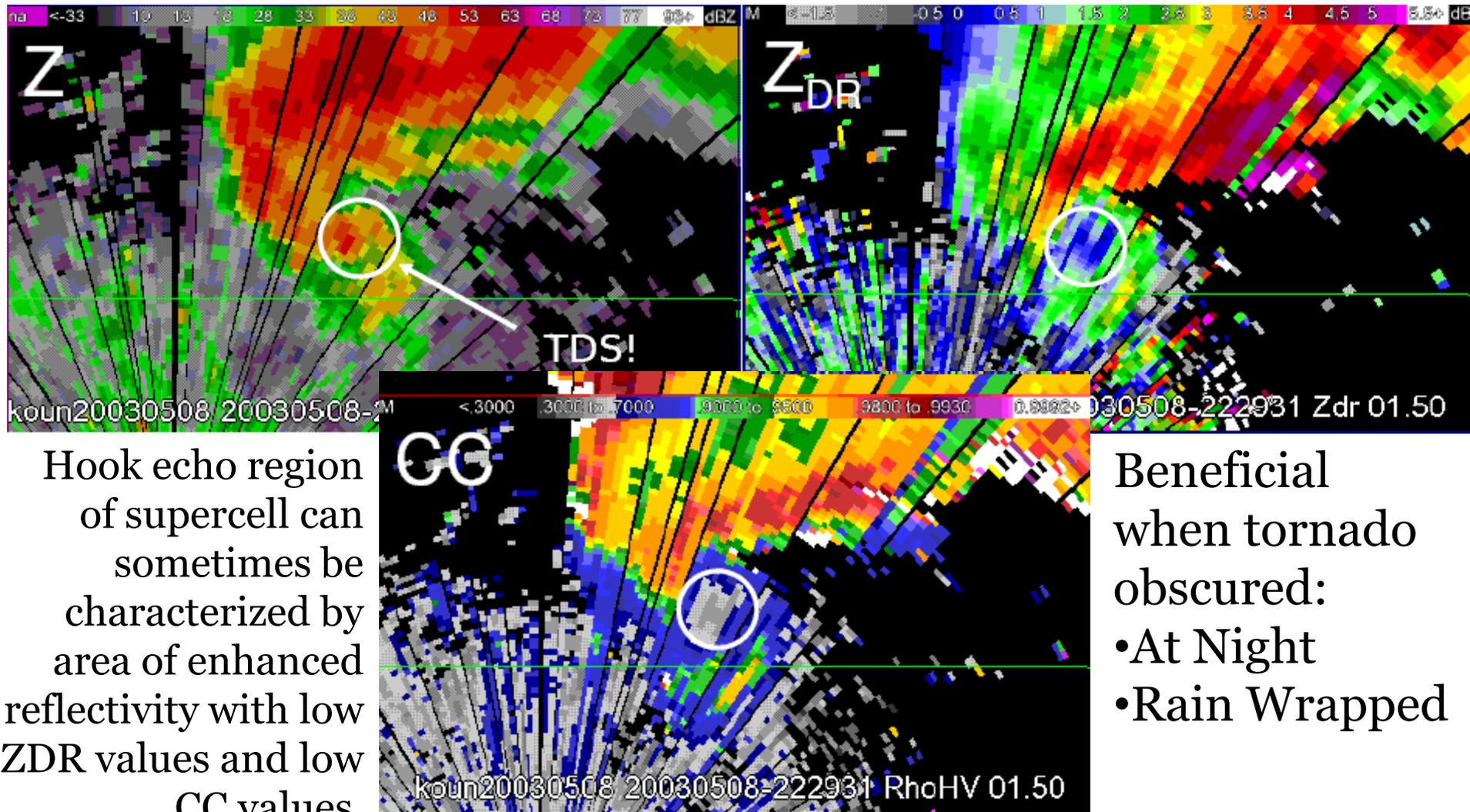
**Right:** 2 hours later, precip changing to snow. Note decrease in ZDR



# Heavy Rain Detection Should Improve with Dual Pol Upgrade



# Dual Pol Radars Can Detect Debris From Significant Tornadoes



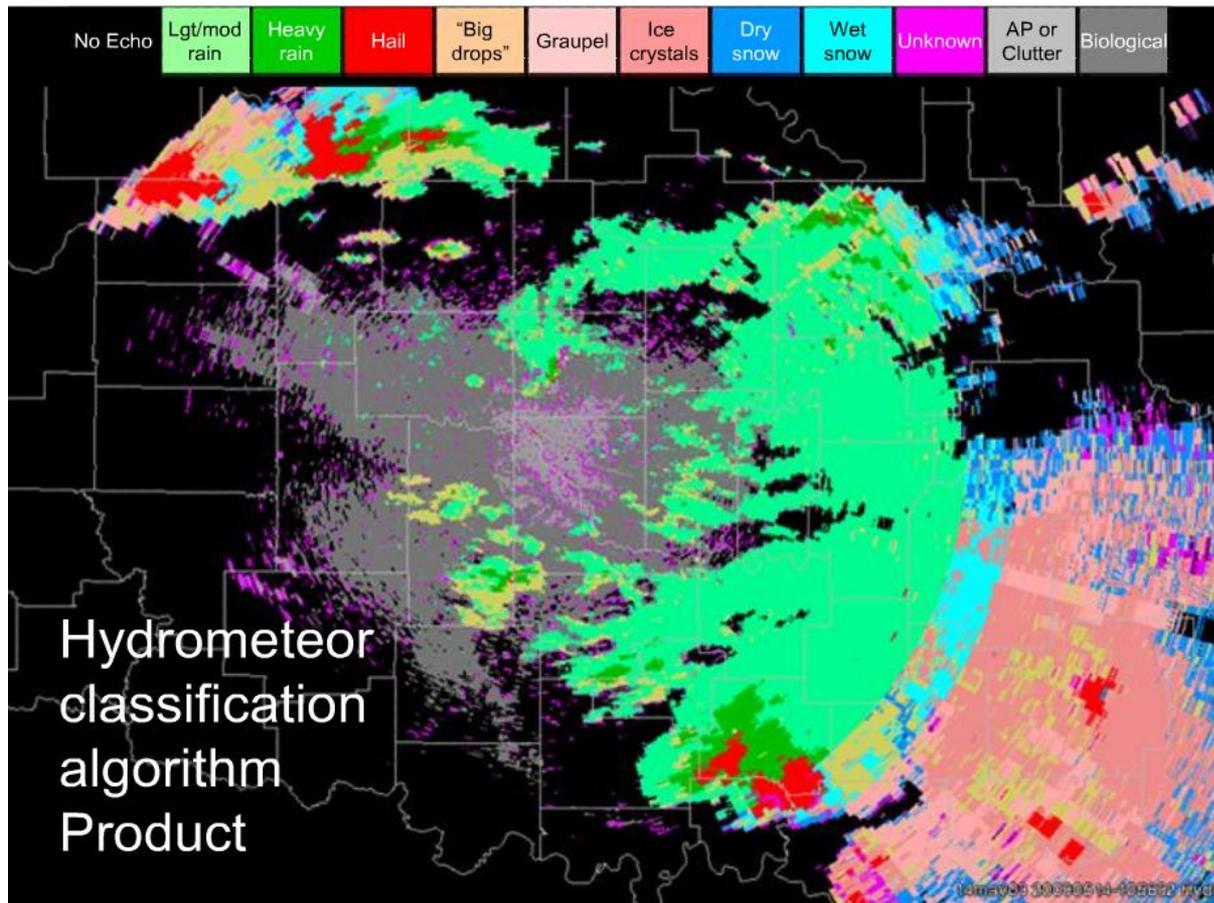
Hook echo region of supercell can sometimes be characterized by area of enhanced reflectivity with low ZDR values and low CC values.

Beneficial when tornado obscured:

- At Night
- Rain Wrapped

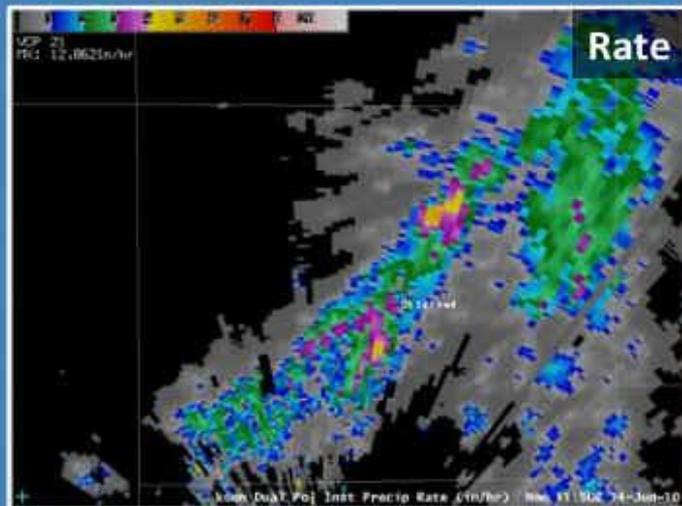
# Potential Derived Products: Hydrometeor Classification Algorithm

- Assigns hydrometeor classification to each range bin (11 types). Uses base output, MLDA output and “fuzzy logic”



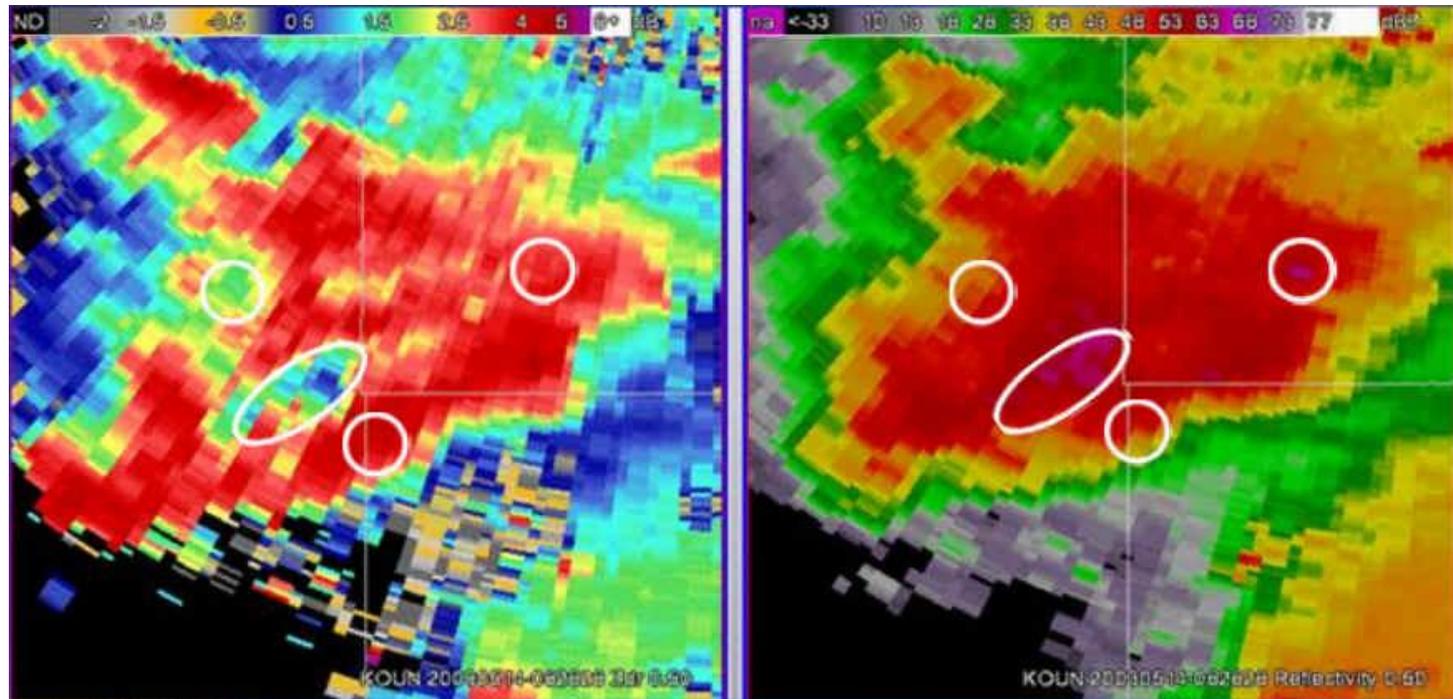
# Estimation of Rainfall Amounts

- 1 hour (OHA)
- Storm Total (STA)
- Instantaneous Rate (DPR)



# Estimation of Rainfall Amounts

Areas either side of hail shaft – similar values of  $Z$ , but area NW has much lower values of  $ZDR$  – much higher concentration of smaller drops



# Want to Learn More Details about Dual Polarization Radar?

 **National Weather Service**  
**Warning Decision Training Branch**

Site Map      News      Organization

WDTB Home

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**Our Mission**

The Warning Decision Training Branch (WDTB) develops and delivers training on the integrated elements of the warning process within a National Oceanic and Atmospheric Administration (NOAA)/National Weather Service (NWS) forecast office. WDTB instructors develop and deliver a variety of in-residence, teletraining, and on-line asynchronous training content to meet this mission. Our goal is to increase expertise among NOAA/NWS personnel so that they can better serve the public during warning operations.

**Featured Training Topics**

**Wind Farms, the WSR-88D and Coexistence**

Significant growth of wind farms for alternative energy production is well underway in the U.S. In some cases, wind turbines have been placed close enough to WSR-88D radars to create Wind Turbine Clutter (WTC) on the radar products.

**Wind Turbine "Signal"**



WDTB and the Radar Operations Center (ROC) have collaborated on this training module. It is designed to inform NWS decision makers, tri-agency partners, and wind energy proponents to support a cooperative environment for all as wind energy continues to develop.

**WDTB Training News**

*Updated: October 6, 2010 16:17 CT*

- WDTB's FY11 Training Schedule:
- The initial release of the Dual-Polarization Radar Operations Course is available for WSR-88D beta-test sites
- The early release of Dual-Polarization Radar Training for NWS Partners is now on-line
- WES 9.2 Update - September 2010 Now Available!
- RPG Build 12.0 Training
- RCAkit now available
- Tornado & Severe Thunderstorm Warning Best Practices Course
- Dual-Polarization Technology Training Page
- Severe Convection Forecasting & Warnings Professional Development Series (PDS)
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## □ Dual-Polarization Radar Training for NWS Partners

### □ Meteorologists

### □ Non-Meteorologists who use the data

#### ■ Technology Overview

#### ■ Hydrometeor Classification Product

#### ■ Estimated Rainfall Amount Products

□ [www.wdtb.noaa.gov](http://www.wdtb.noaa.gov)

# Summary

- Dual-Polarization will arrive KLOT March 1, 2011
- New base products and new derived products, but nothing gone from what you're currently using
- Improved precipitation estimates, identification of freezing/frozen/liquid precipitation types, location of hail cores, updrafts, etc.
- Identification of non-meteorological returns, and better filtering from processed data

# Thank You!

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