

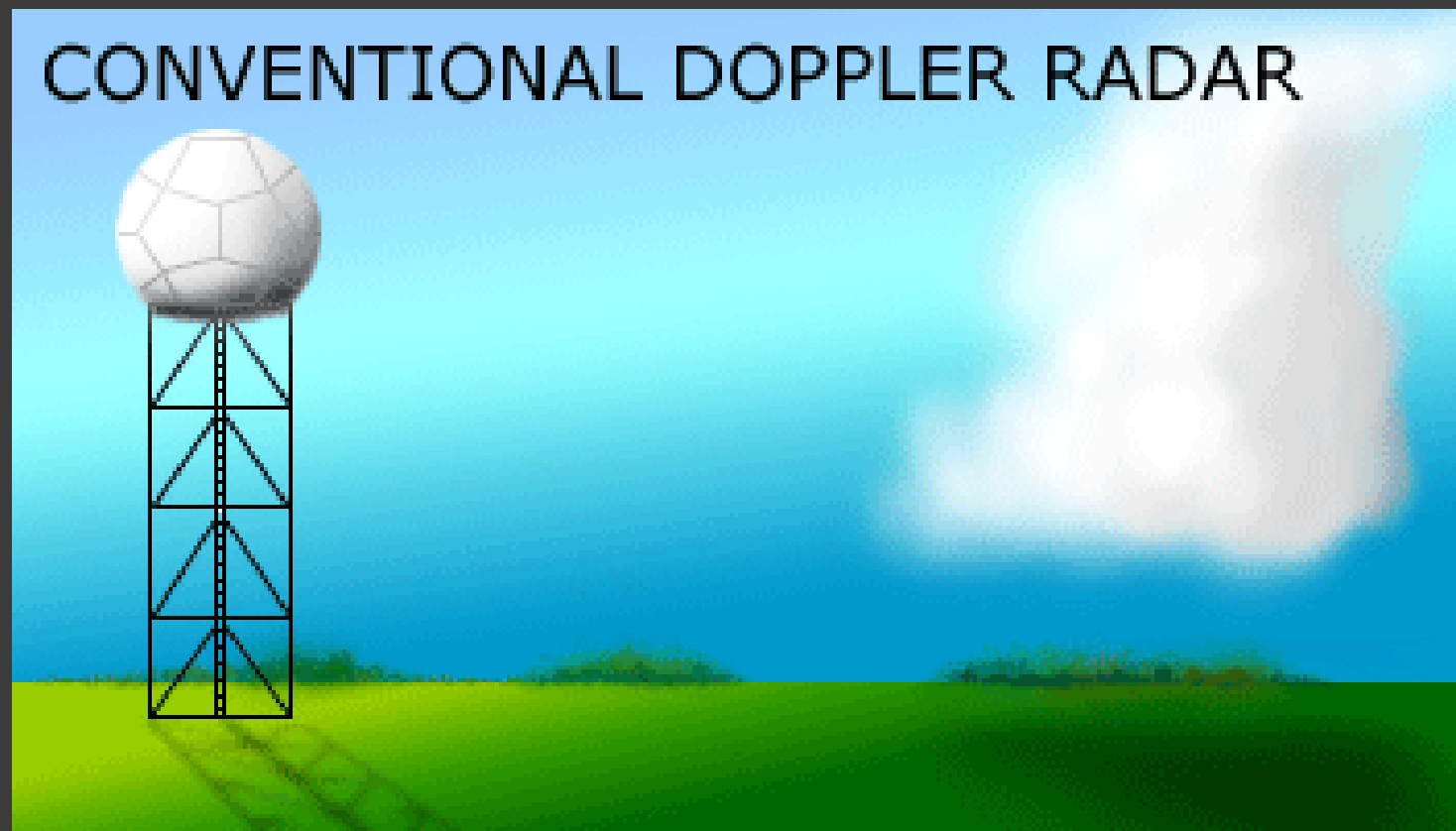
Meteorology 3110

DUAL POLARIZATION RADAR

Dual Polarization

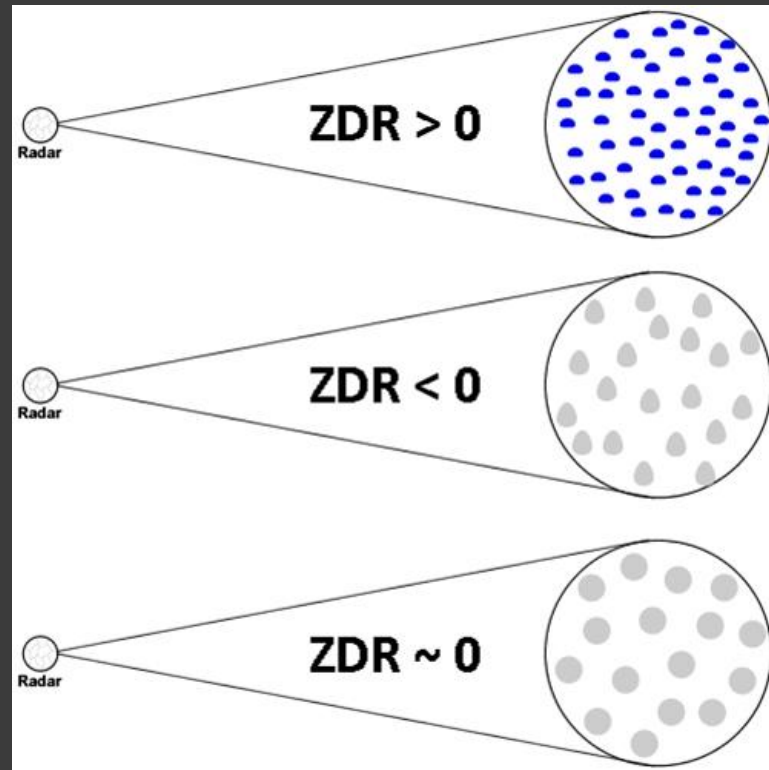
- ⦿ Two beams with different polarization directions: one with horizontal polarization (current polarization) and one with vertical polarization
- ⦿ New products (or moments) useful for:
 - Precipitation type.
 - Rain and snow rate estimates.
 - Identification of aircraft icing conditions.

Dual Polarization



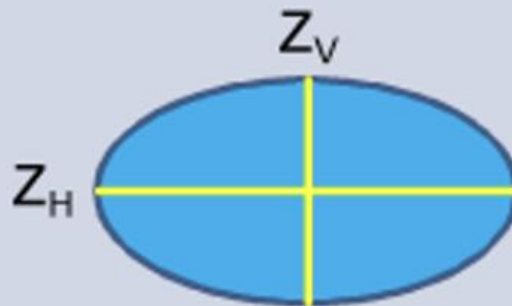
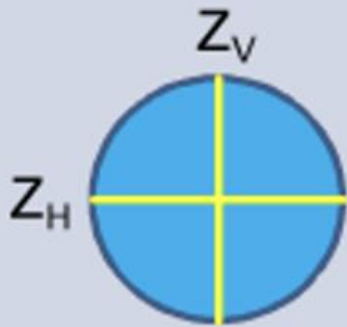
Z_{DR} – Differential Reflectivity

- $Z_{DR} \sim 10 \log (P_h / P_v)$ [db]
- Average shape of what you are measuring.
- Typical values range from - 2 db to 6 db.
- Type discriminator
 - $Z_{DR} > 0$?
 - $Z_{DR} < 0$?
 - $Z_{DR} = 0$?

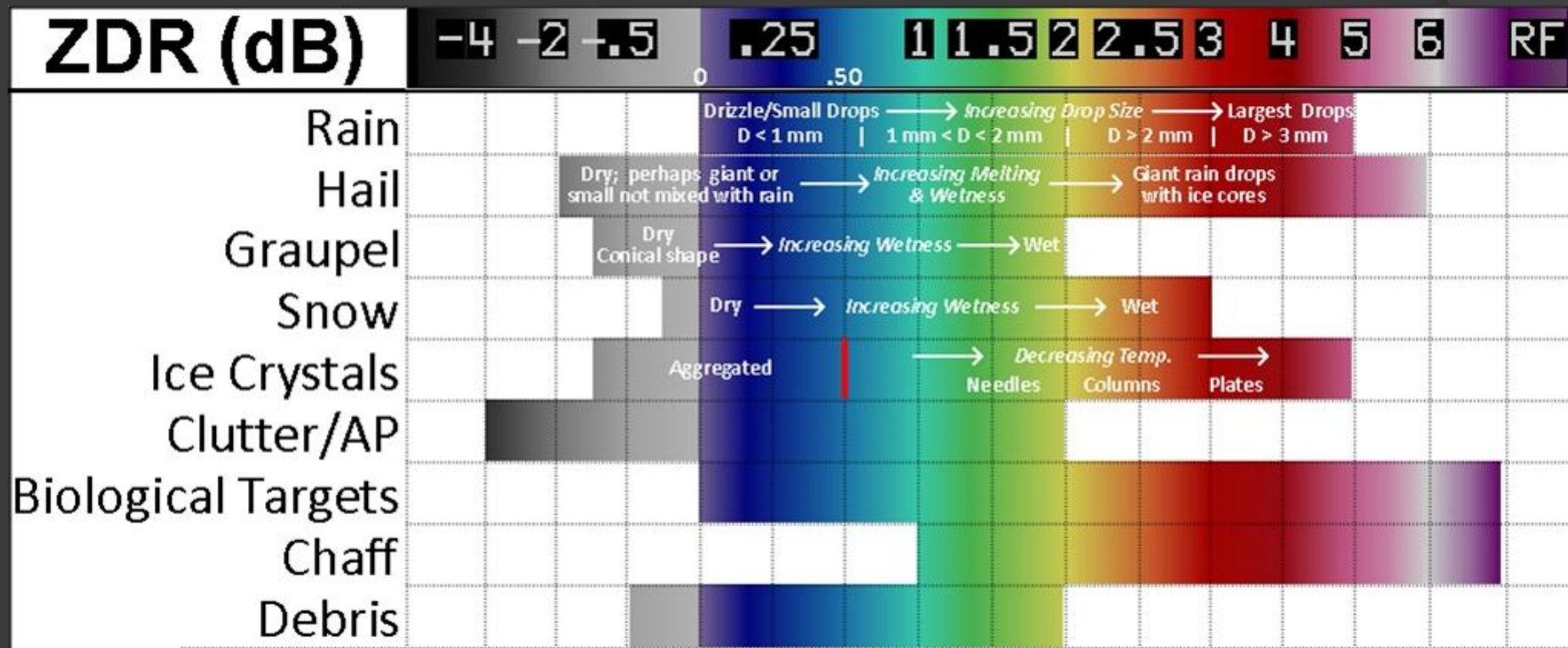


Z_{DR} – Differential Reflectivity

$$ZDR = Z_H - Z_V$$



Z_{DR} – Differential Reflectivity



ZDR

⦿ Good for:

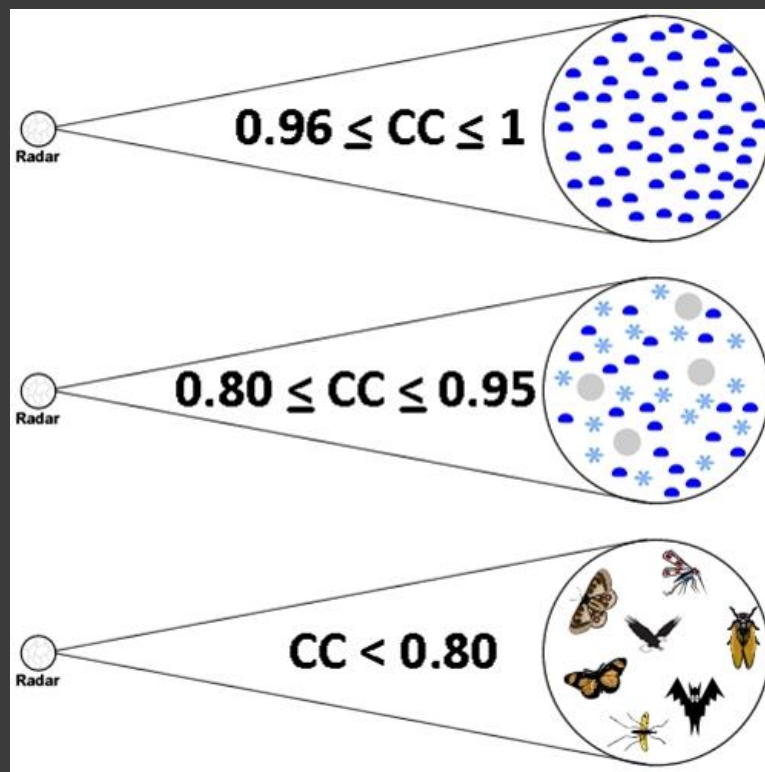
- Identifying areas of increasing median raindrop sizes
- Identifying Hail shafts ($ZDR \sim 0$, high Z)
- Updraft detection: $ZDR > 0$ above the environmental 0°C level

⦿ Limitations

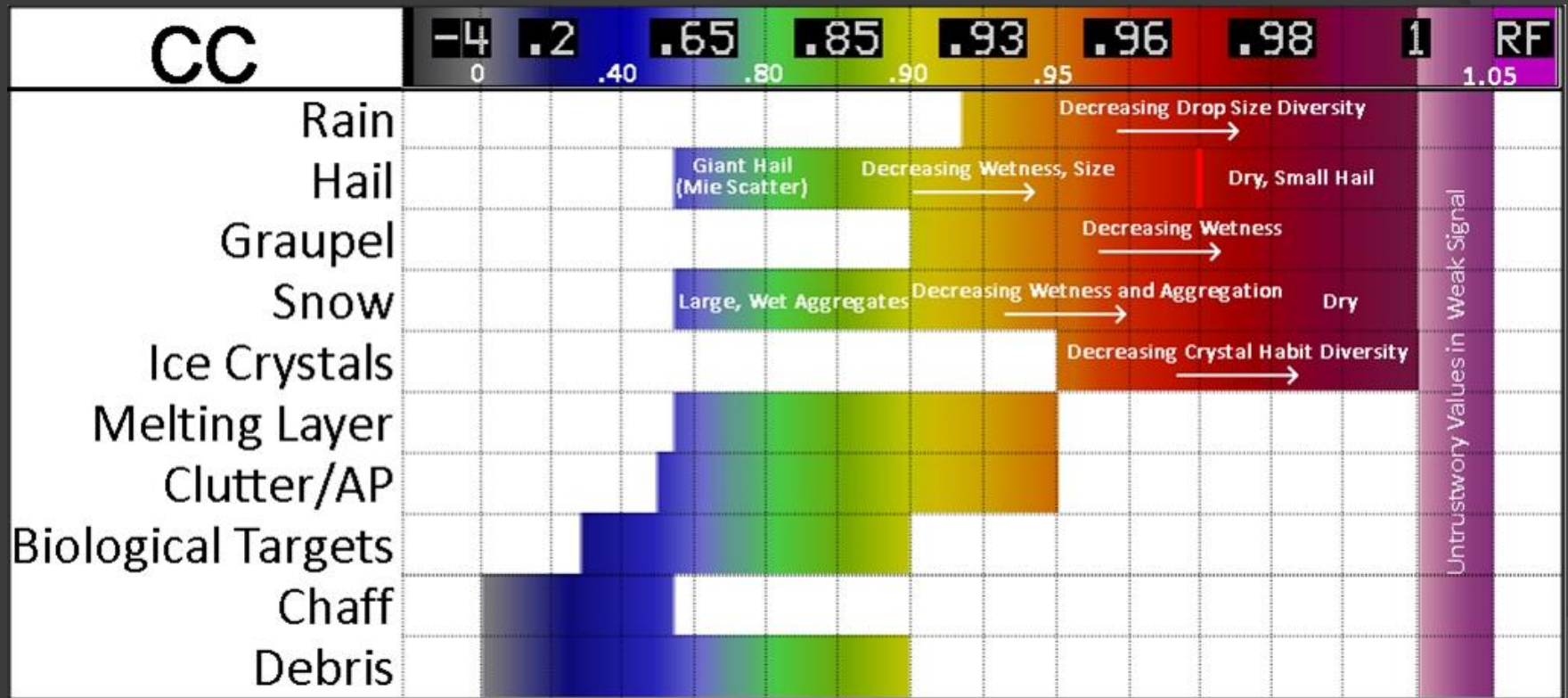
- Biased toward larger hydrometeors – a handful of large hailstones can bias the signal to ~ 0 .

CC (ρ_{hv}) – Correlation Coefficient

- Measures how similarly the horizontal and vertical returned powers behave in a sample volume.
- Diversity of hydrometeors
- Meteorological echoes: $CC > 0.80$
- Non-Meteorological echoes: $CC < 0.80$.
- Rain: typically above 0.95.
- Hail: 0.90 to 0.95. Large Hail $CC < 0.80$ and ~ 0 ZDR.
- Bright band/Melting layer: 0.80 to 0.95,
- Good indicator of mixed precipitation regions



CC – Correlation Coefficient



CC – Correlation Coefficient

Non Meteorological

- Birds
- Buildings
- Bugs
- Smoke

Non-Uniform Meteorological

- Hail
- Water Coated Hail
- Rain/Snow Mix
- Sleet/Snow Mix

Uniform Meteorological

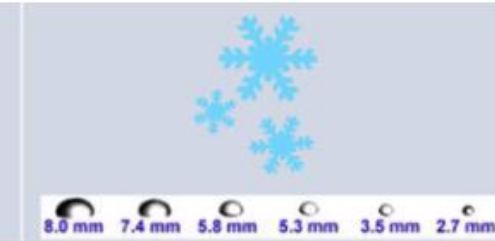
- All Rain
- All Snow



Low CC
(< 0.80)

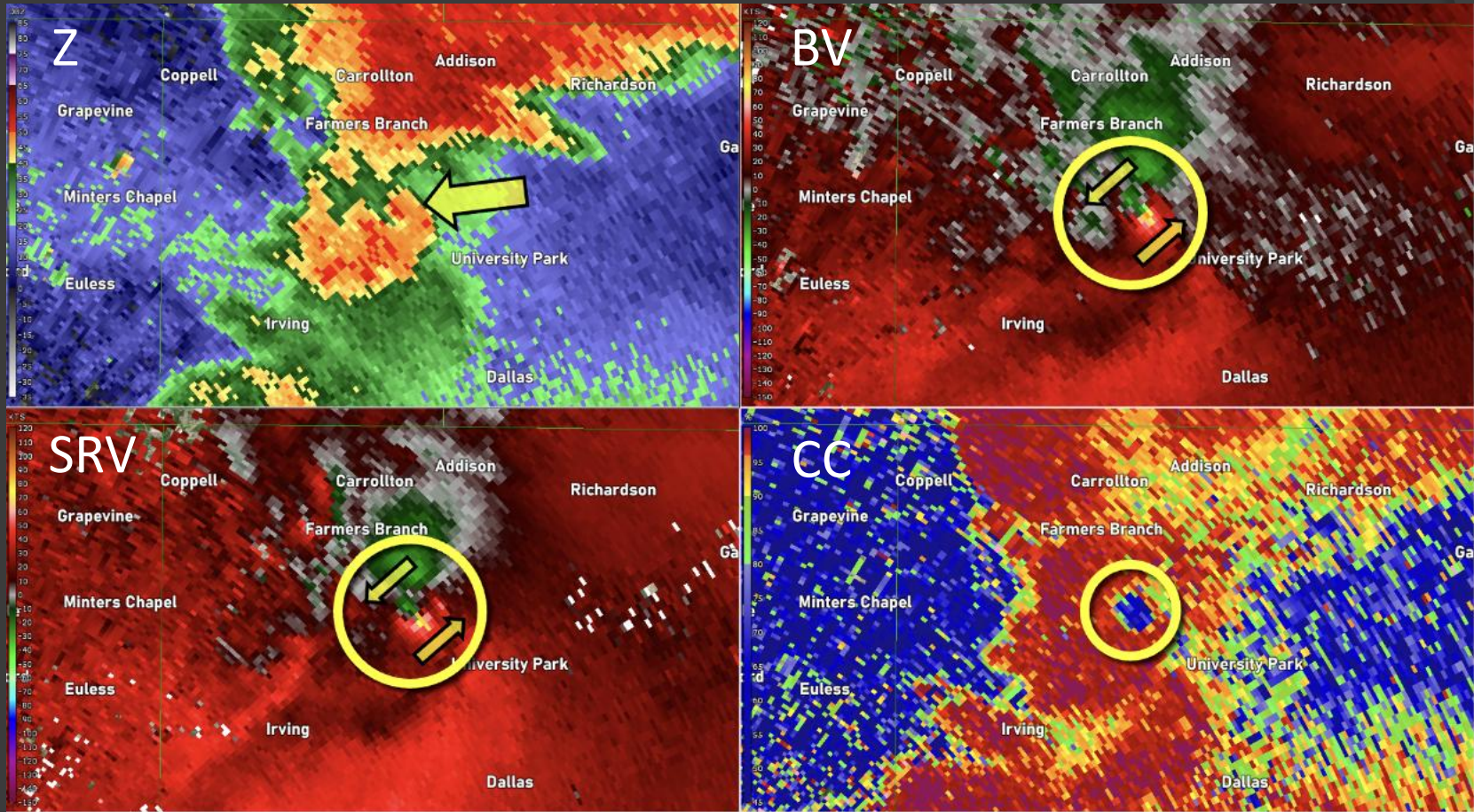


Moderate CC
(> 0.80 to 0.97)

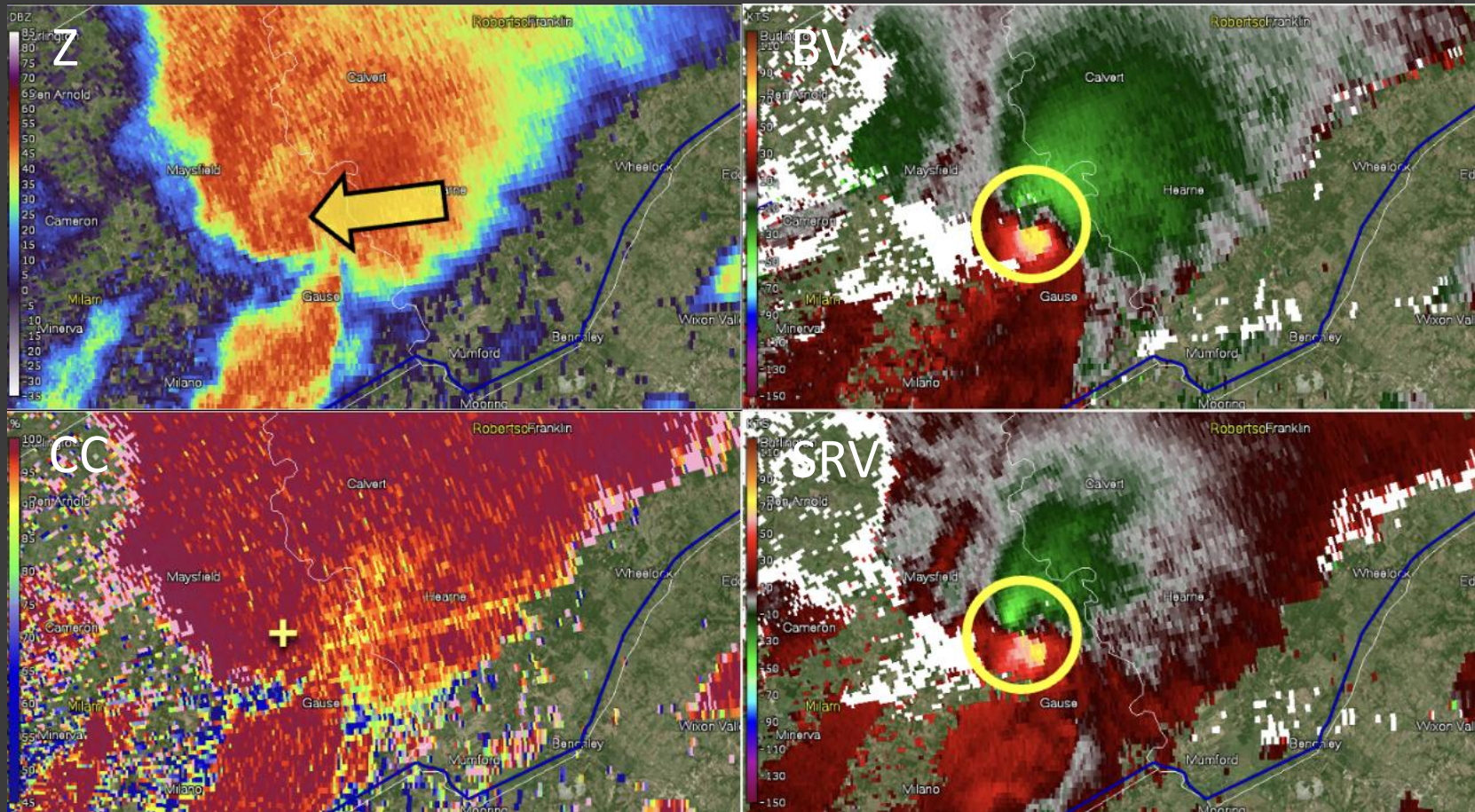


High CC
(> 0.97)

CC – Correlation Coefficient

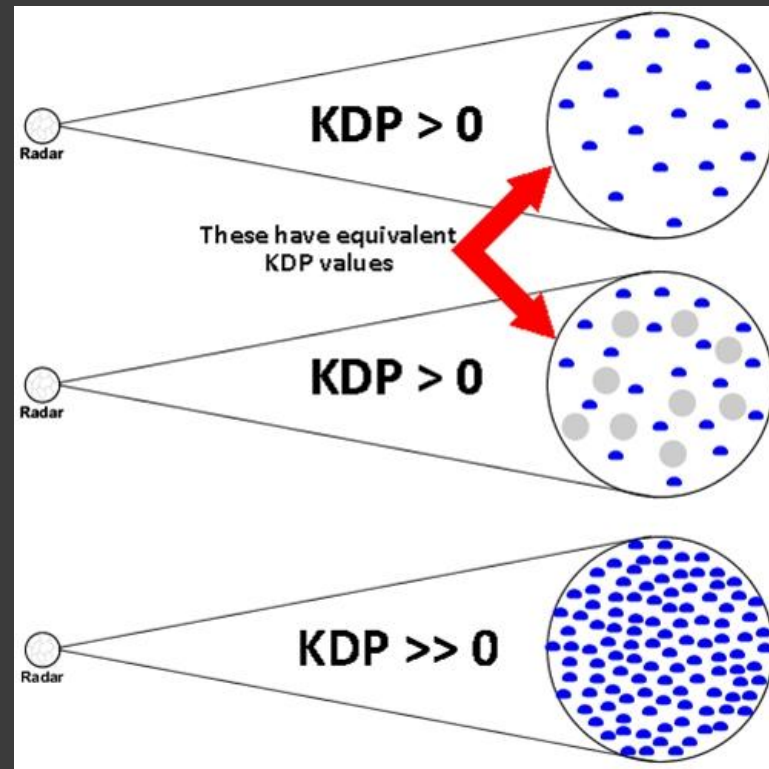


CC – Correlation Coefficient

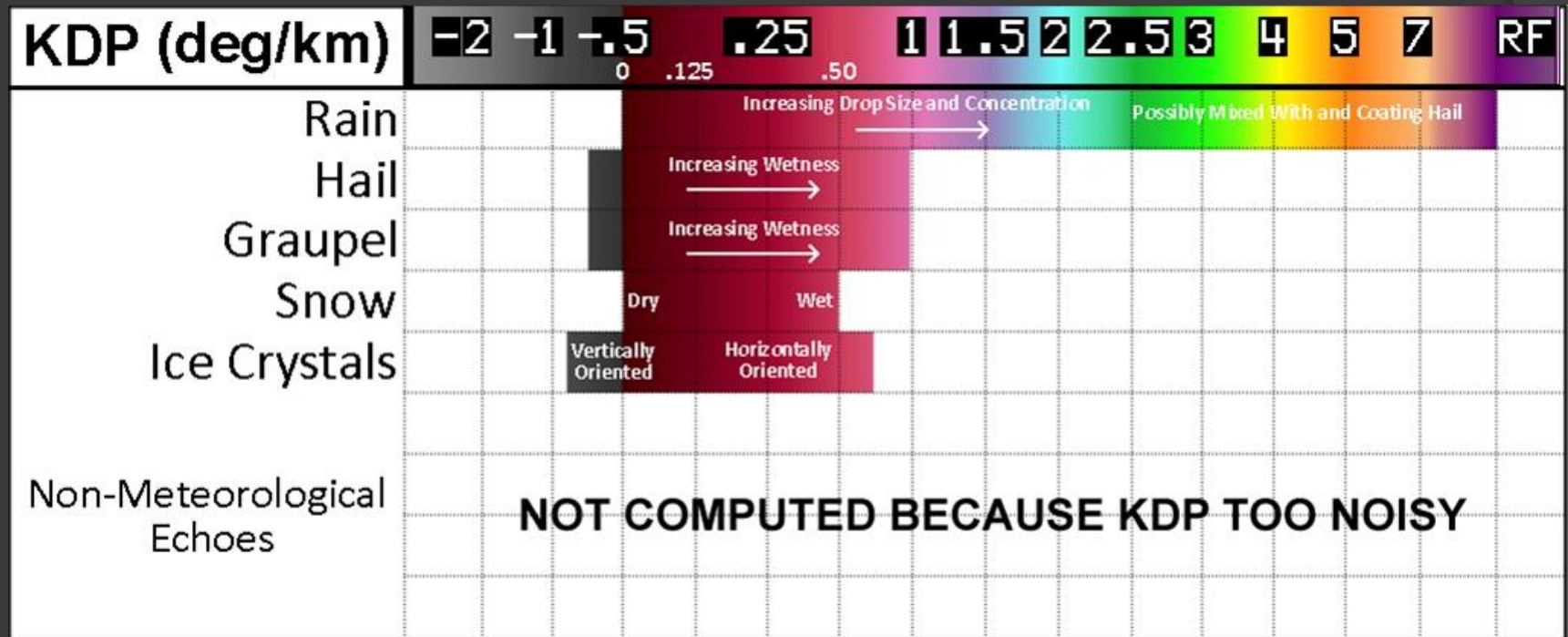


KDP (ϕ_{DP}) – Specific differential phase

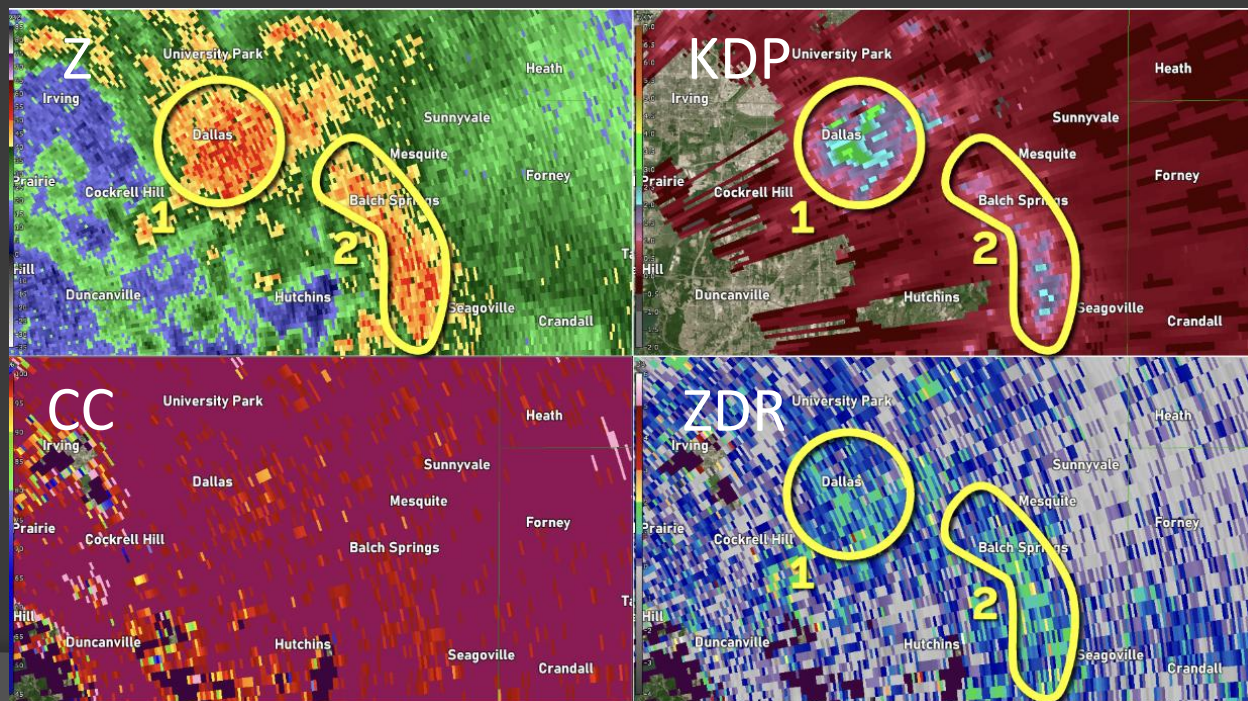
- Takes advantage of difference in propagation speeds of pulses in different media (water vs. air).
- Takes range from radar into account to determine where phase difference is occurring.
- Proportional to $\phi_{DP} = \phi_h - \phi_v$, called the differential phase shift.
- KDP increases as the size and concentration of raindrops increase.
- Useful in identifying where the heaviest rain is occurring.
- Increasing positive values of KDP indicate higher rainfall rates and larger drops.

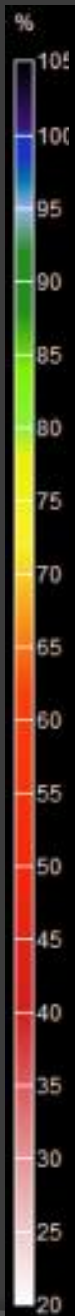


KDP (ϕ_{DP}) – Specific differential phase

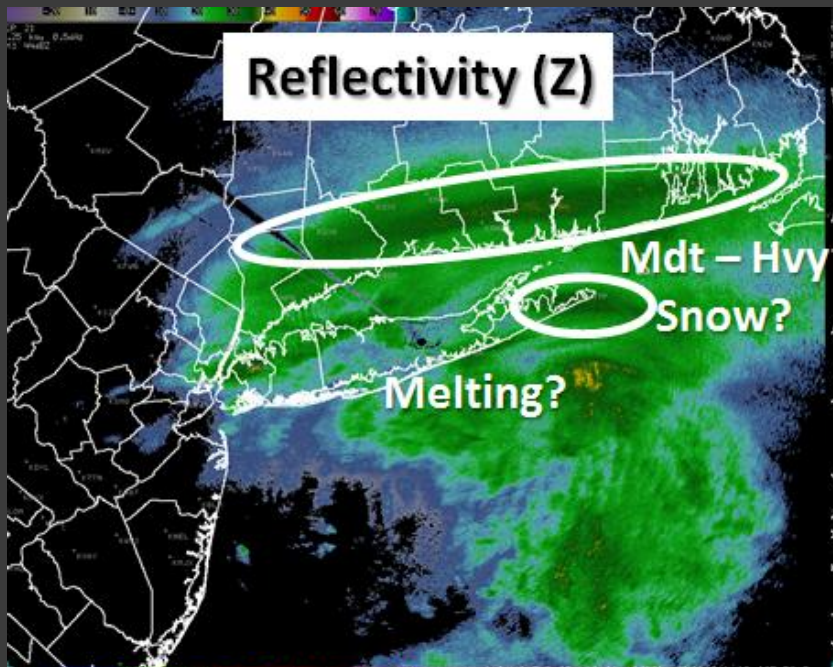


KDP (ϕ_{DP}) – Specific differential phase





Reflectivity, Velocity, Correlation Coefficient
9:50 AM CST, Mar 2, 2012
NWS Huntsville, AL Radar



Example

- ⦿ $Z > 50 \text{ dBZ}$
 - Local Maximum
- ⦿ $ZDR < 2 \text{ dB}$
 - Local minimum
- ⦿ $CC = 0.7 - 0.95$
- ⦿ What is this? Why?