Meteorology 3110

DUAL POLARIZATION RADAR

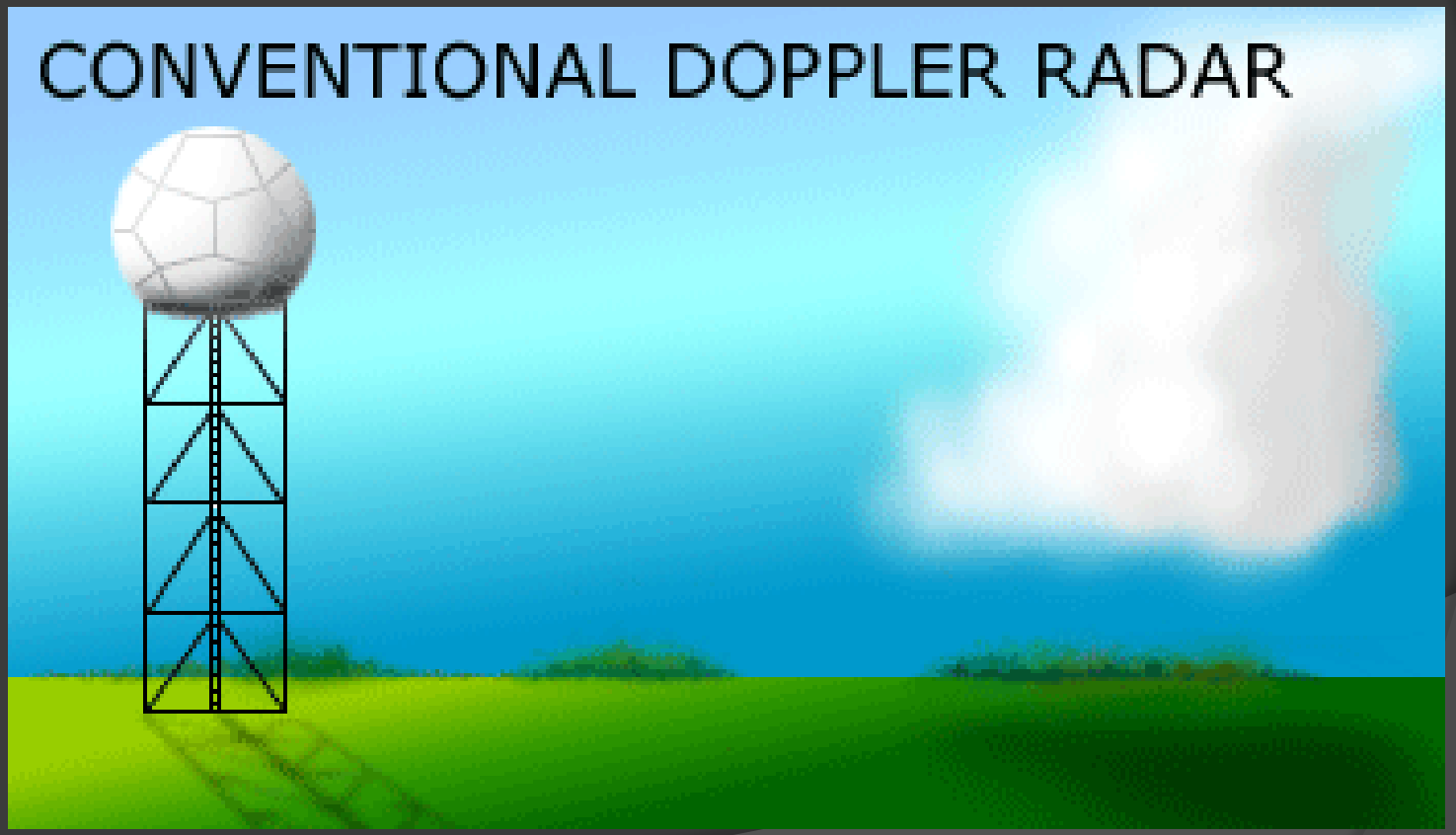
Dual Polarization

- 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.

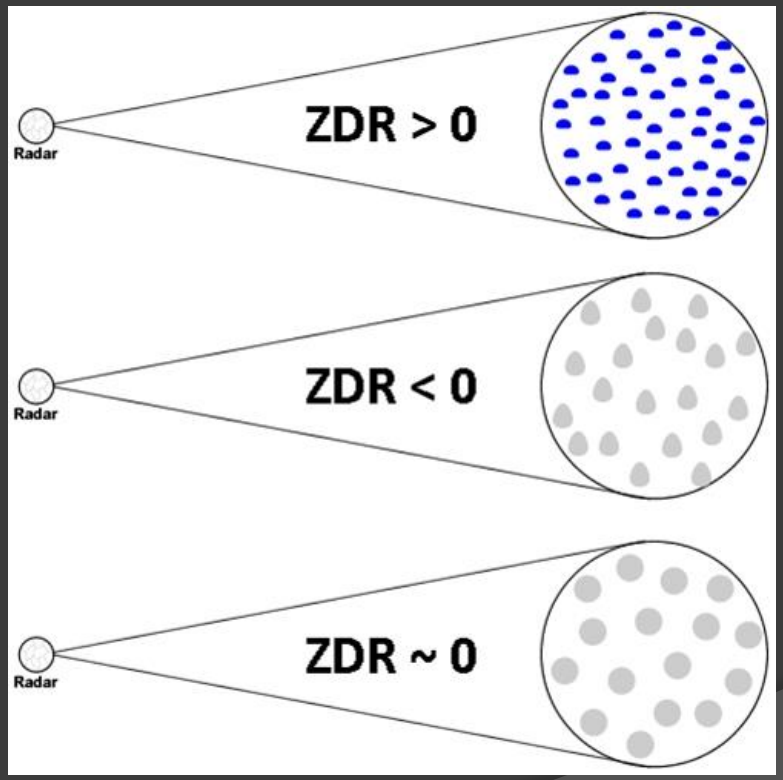
- Reference: http://www.cimms.ou.edu/~kscharf/pol/
  - Page produced by Kevin Scharfenberg, who was also an invited speaker at the 2008 Severe Storms and Doppler Radar Conference hosted by the Central Iowa NWA.

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
  - $Z_{DR} > 0$?
  - $Z_{DR} < 0$?
  - $Z_{DR} = 0$?



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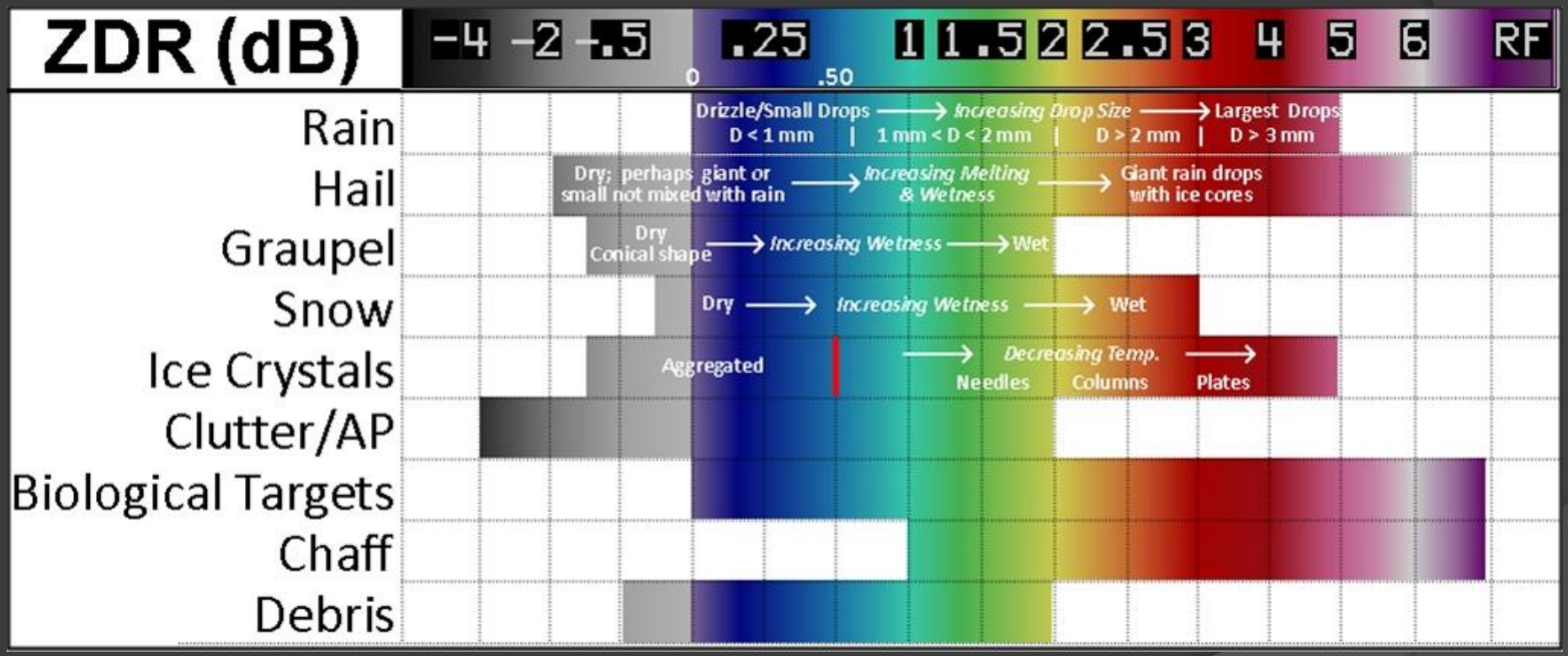
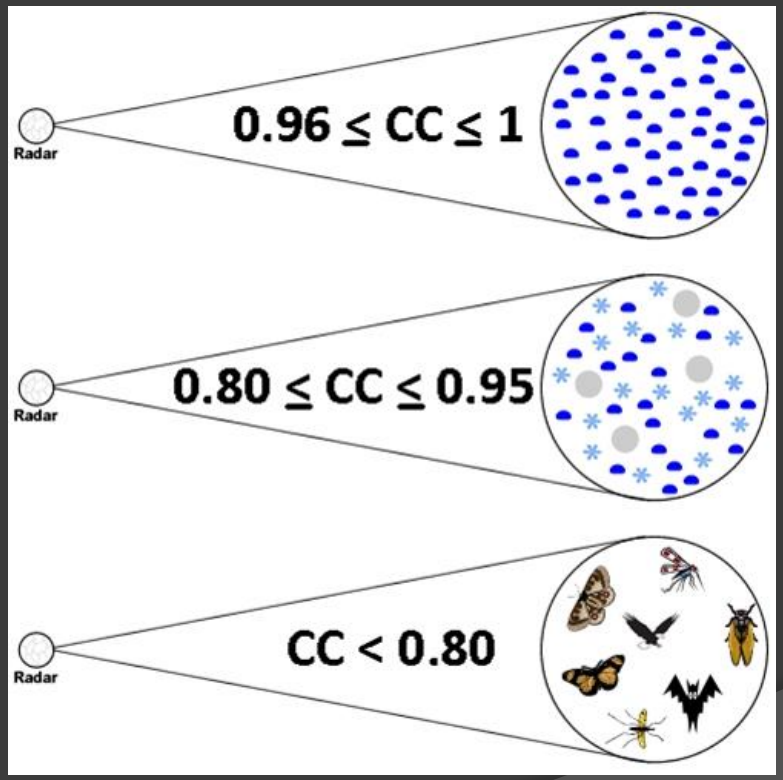


ZDR

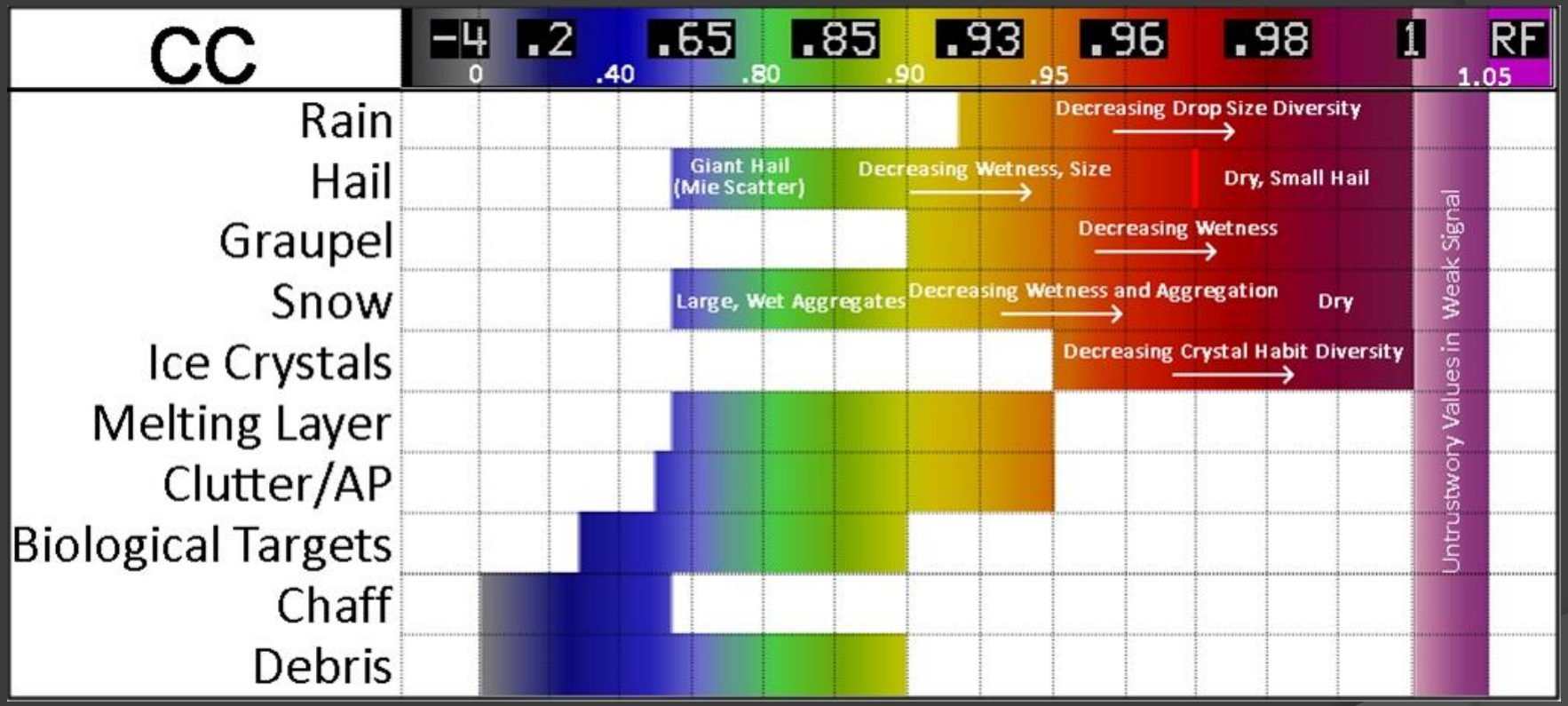
- Good for:
  - Identifying areas of increasing median raindrop sizes
  - Identifying Hail shafts (ZDR ~0, high Z)
  - Updraft detection: ZDR > 0 above the environmental 0°C level
- Limitations
  - Biased toward larger hydrometeors – a handful of large hailstones can bias the signal to ~0.

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

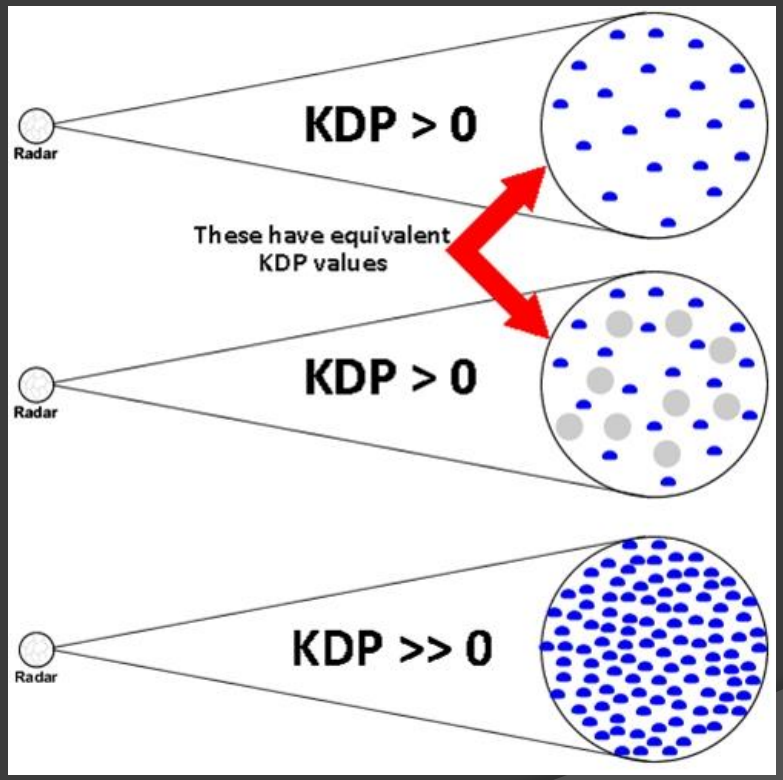


CC – Correlation Coefficient



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 $\varphi_{DP} = \varphi_h - \varphi_v$, 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.



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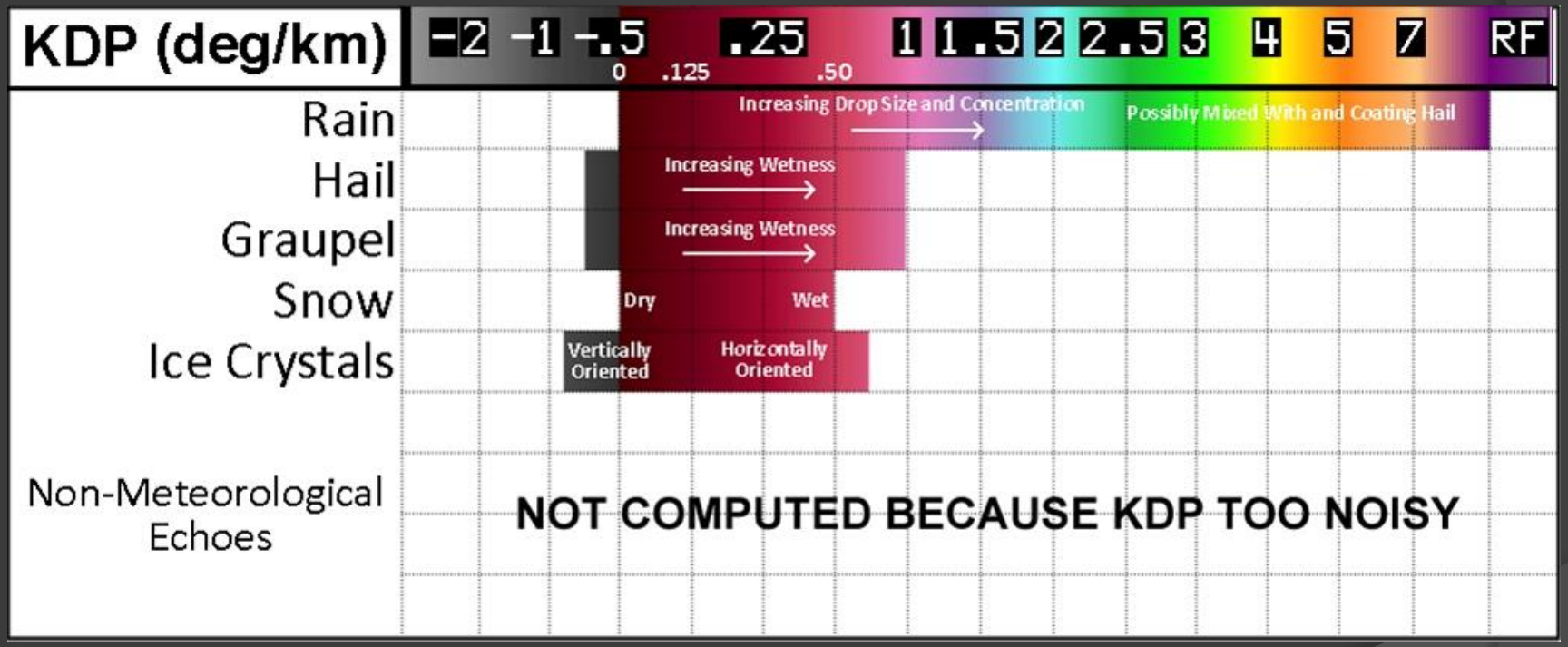


%
105
100
95
90
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80
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65
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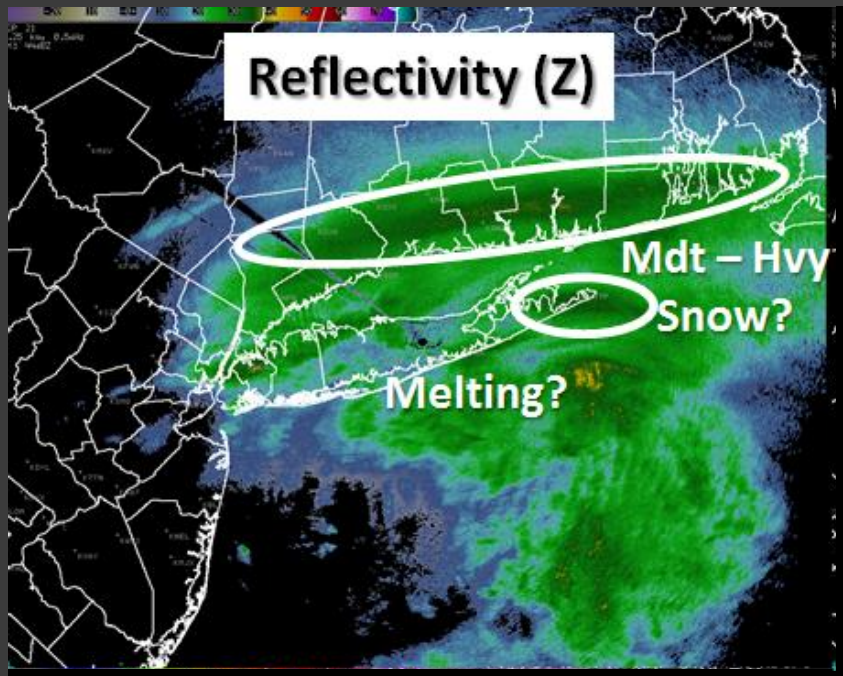
20
Reflectivity, Velocity, Correlation Coefficient
9:50 AM CST, Mar 2, 2012
NWS Huntsville, AL Radar


Reflectivity (Z)
Mdt – Hvy
Snow?
Melting?

Example

- Z > 50 dBZ
  - Local Maximum
- ZDR < 2 dB
  - Local minimum
- CC = 0.7 – 0.95
- What is this? Why?