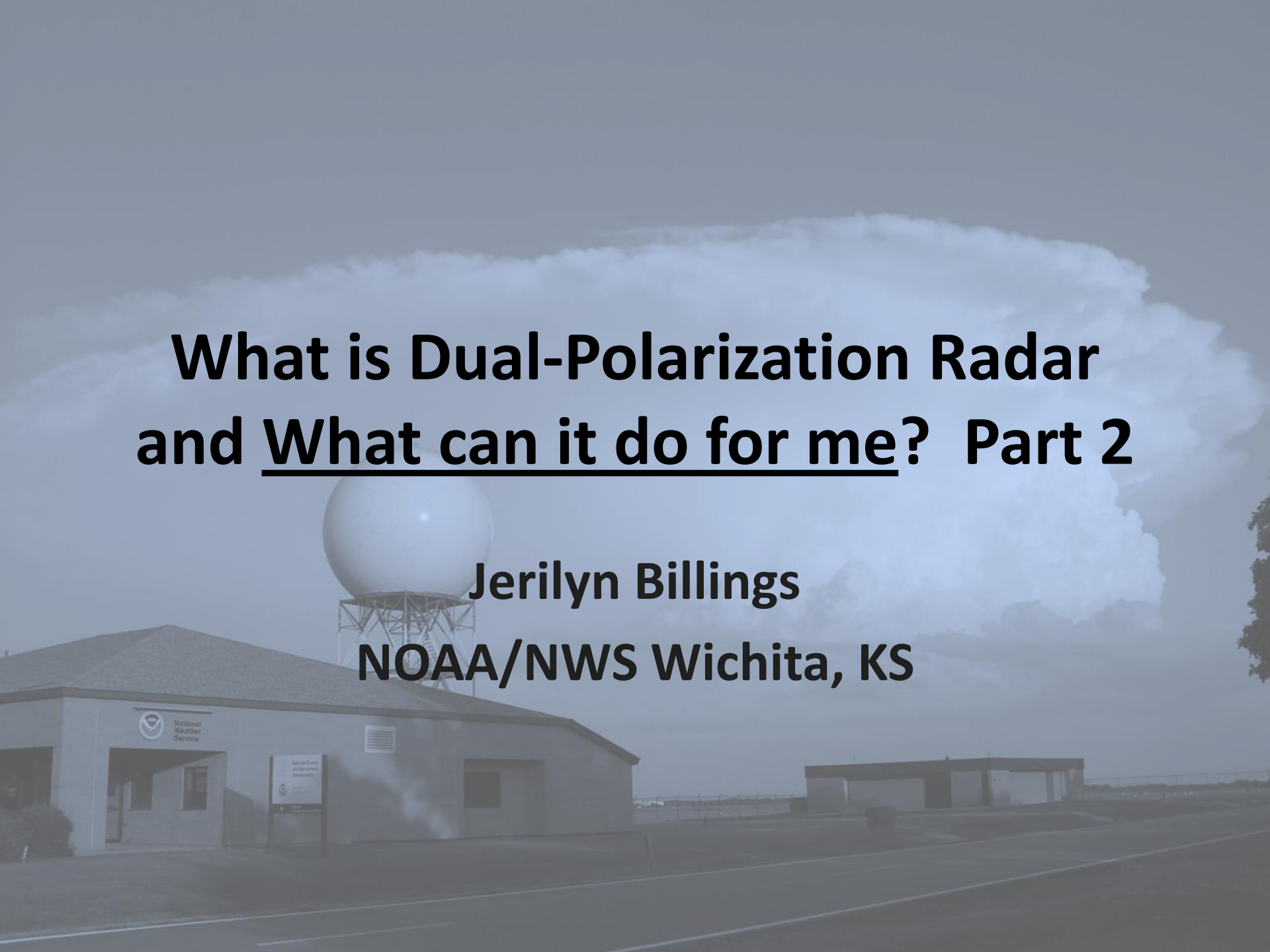


What is Dual-Polarization Radar and What can it do for me? Part 2

Jerilyn Billings

NOAA/NWS Wichita, KS

Applications

- New Base Varibles
  - Differential Reflectivity (ZDR)
  - Corrleation Coefficient (CC)
  - Specific Differential Phase (KDP)

- Utilizing the new variables in concert with the base data (Z,V,SW), Meteorologist's can apply the data in new ways.

Hail Detection

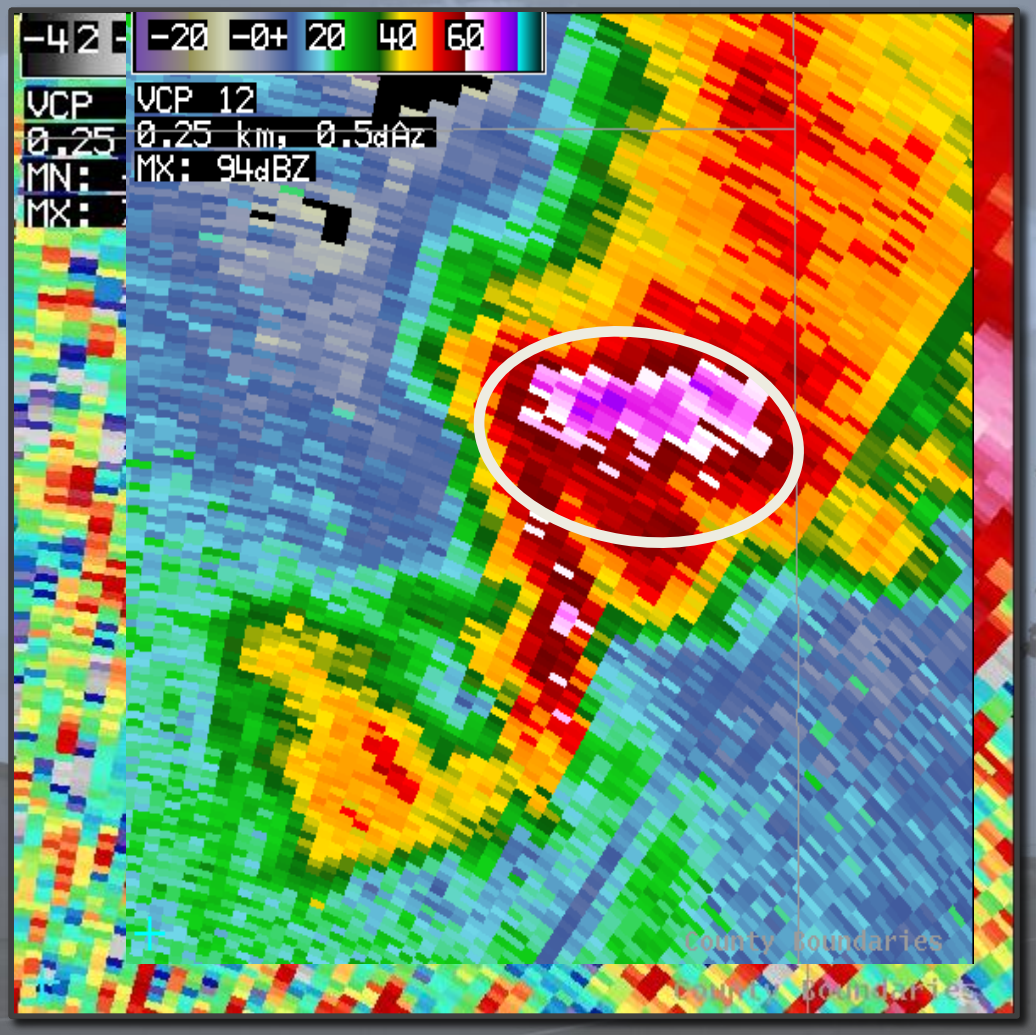
Hail Detection
Physical Characteristics of Hail Aloft

- Size widely varies
- Irregularly shaped
- Can tumble
  - "Looks" spherical to radar

Photo courtesy Clark Payne

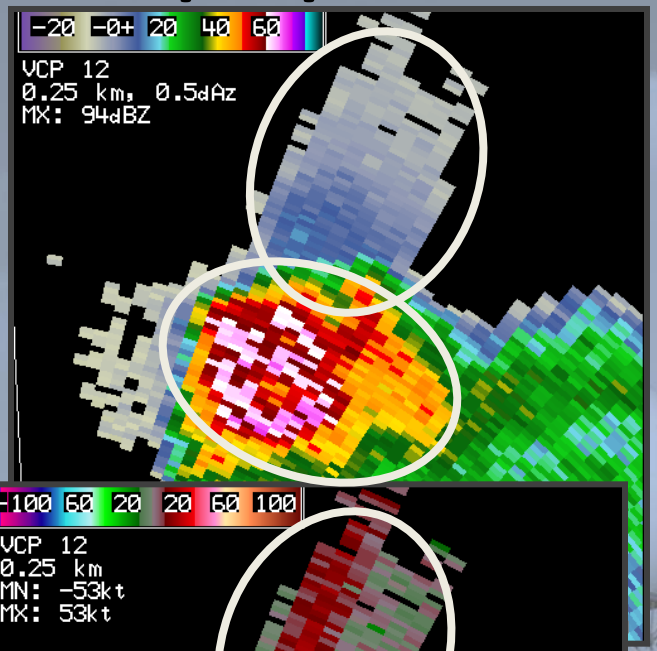
Dual-pol Base Data Characteristics in Regions of Hail

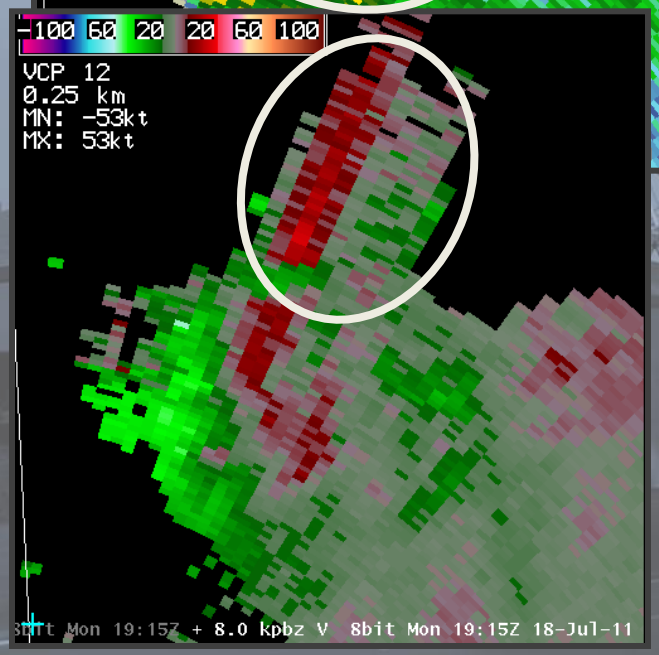
- Very high Z (> 55 dBZ)
- Variable ZDR:
  - Usually low (-0.5 - +1.5dB)
  - Positive when mixed with rain!
- Low CC (0.70-0.95)
- If melting hail, high KDP (>1.5 deg/km)
- Very Low CC (<.90) will be void in KDP

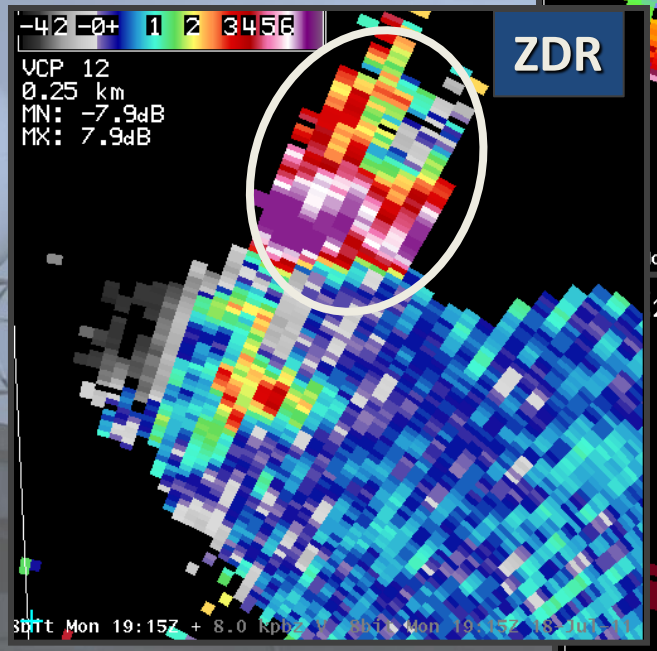


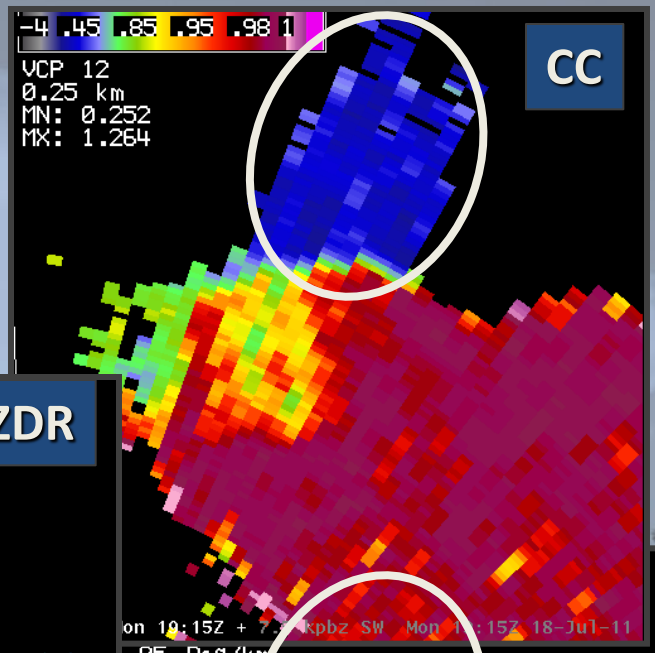
TBSS Example from Pittsburg, PA

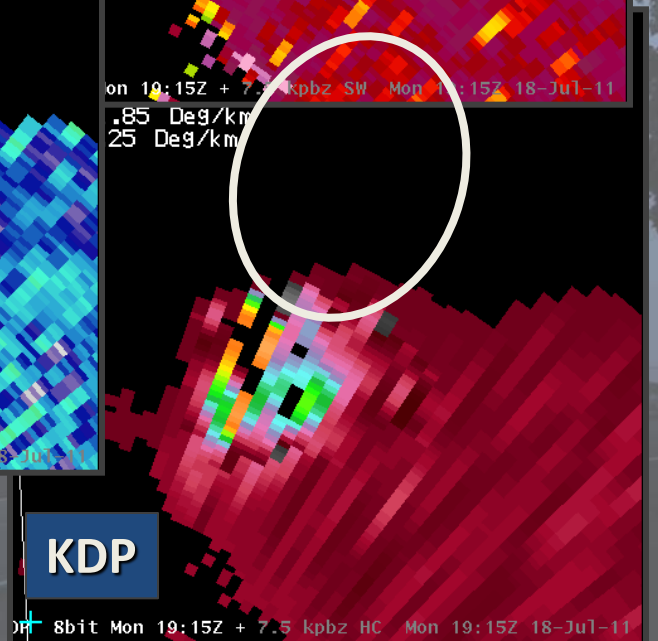
- **7/18/11…19:15Z…8.0°**





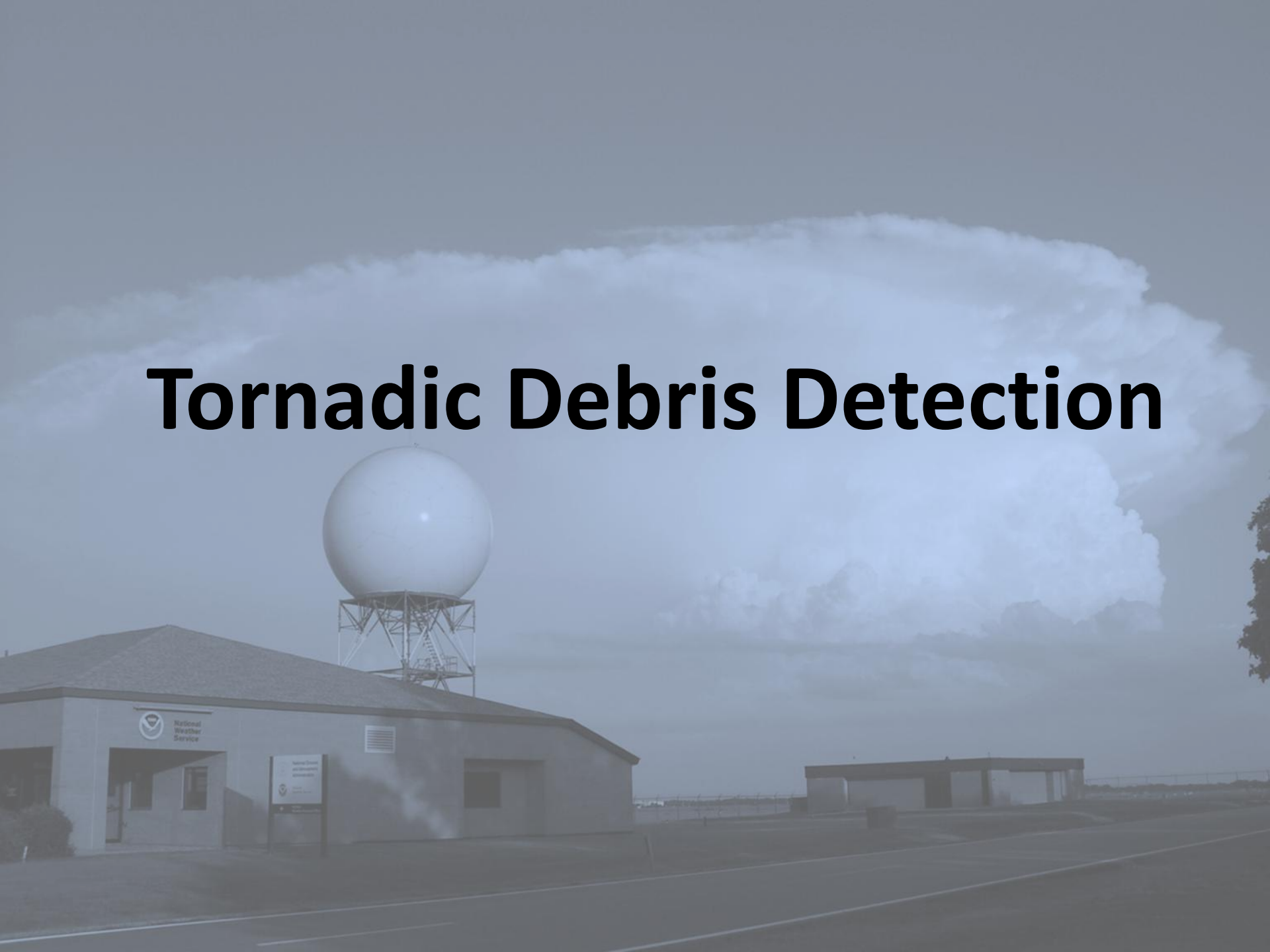






Strengths and Limitations of Dual-pol Hail Detection

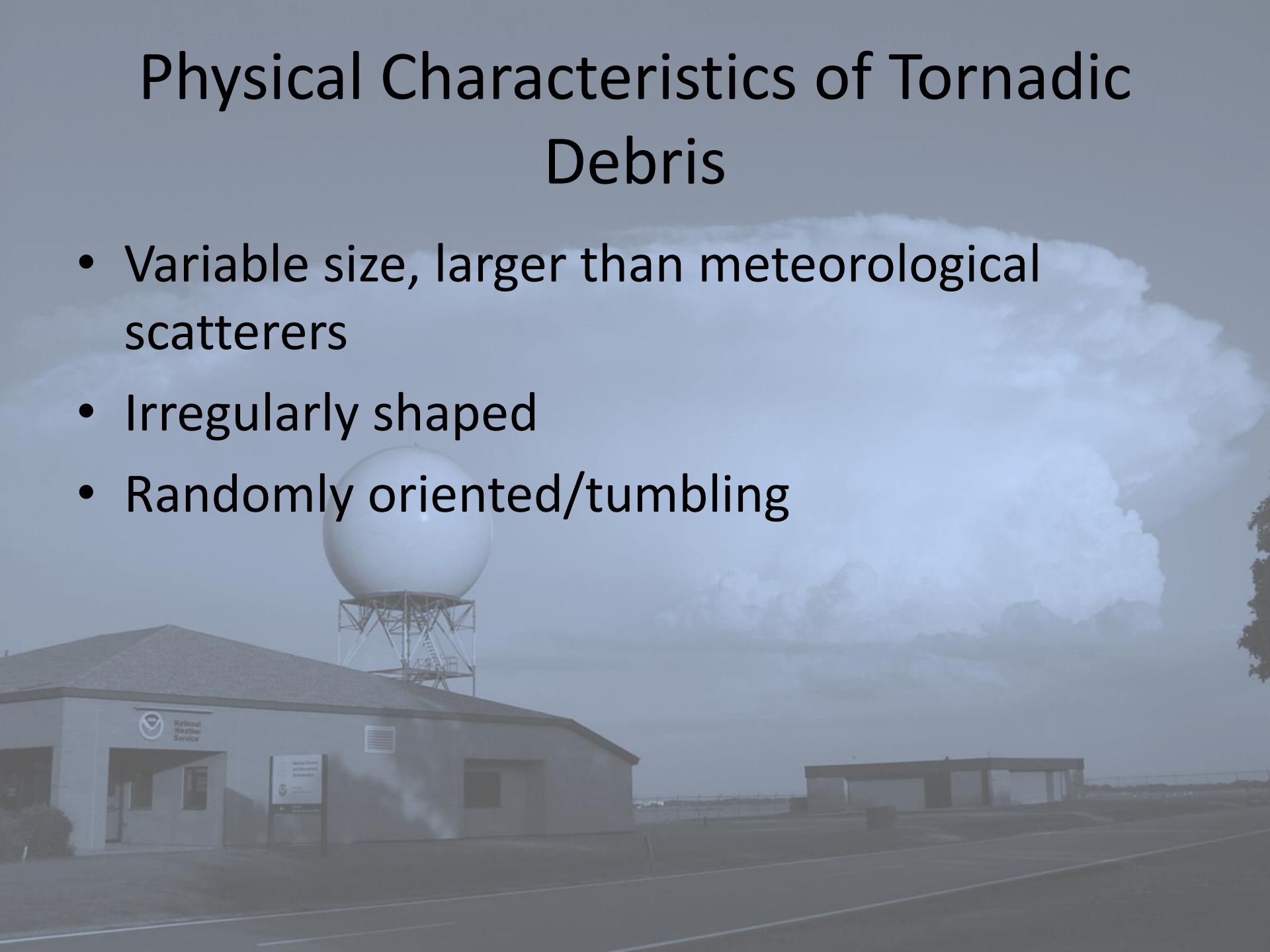
- Strengths
  - More robust than using Z alone
    - Can see hail signature in ZDR and/or CC even when Z is questionable
  - Can detect significant hail (> 2 inches diameter)
  - TBSS easier to detect
- Limitations
  - No explicit size estimation
    - Differentiation between marginally severe and non-severe hail
  - If hail is detected, sometimes still not possible to tell if it is reaching the ground



Tornadic Debris Detection

Physical Characteristics of Tornadic Debris

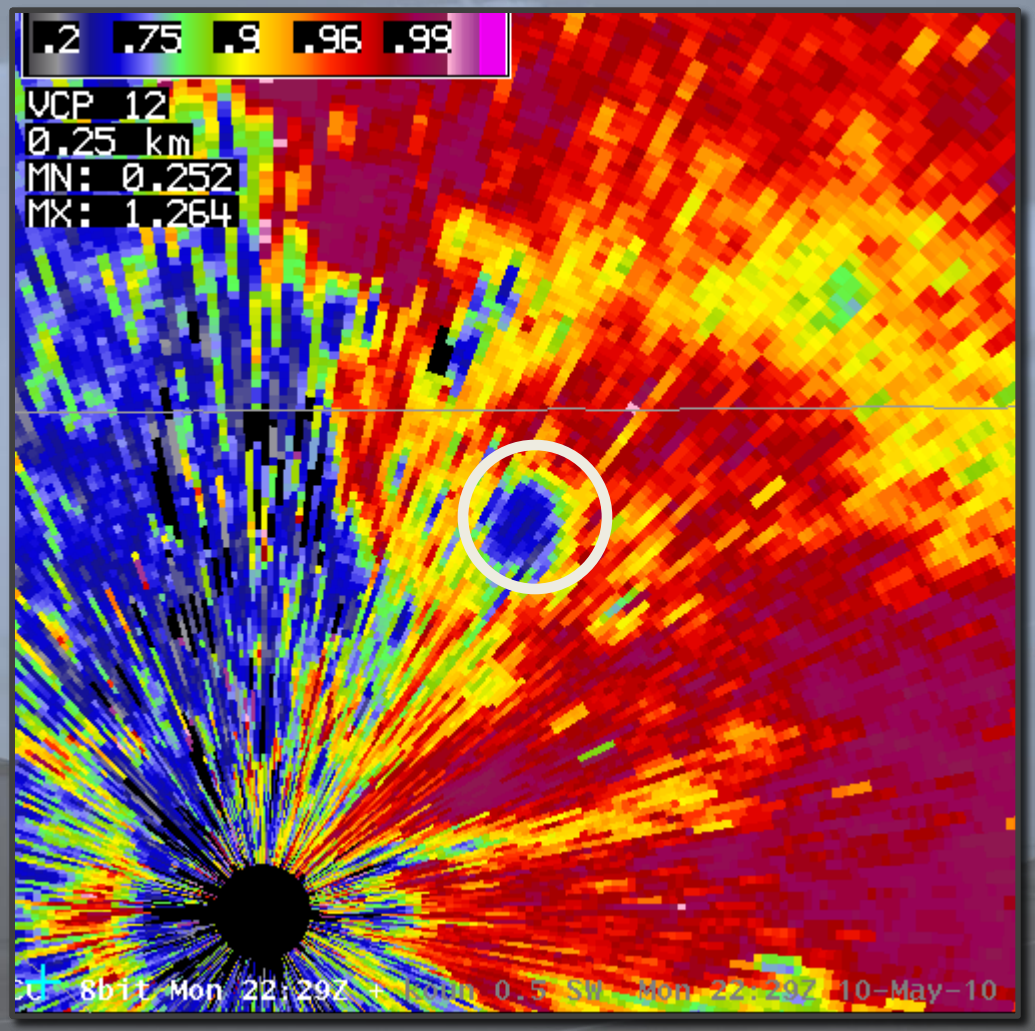
- Variable size, larger than meteorological scatterers
- Irregularly shaped
- Randomly oriented/tumbling



Dual-pol Radar Characteristics of Tornadic Debris

- Must have: Strong rotational signature in SRM
- High Reflectivity

- ZDR near 0 dB
- CC typically less than ~0.80



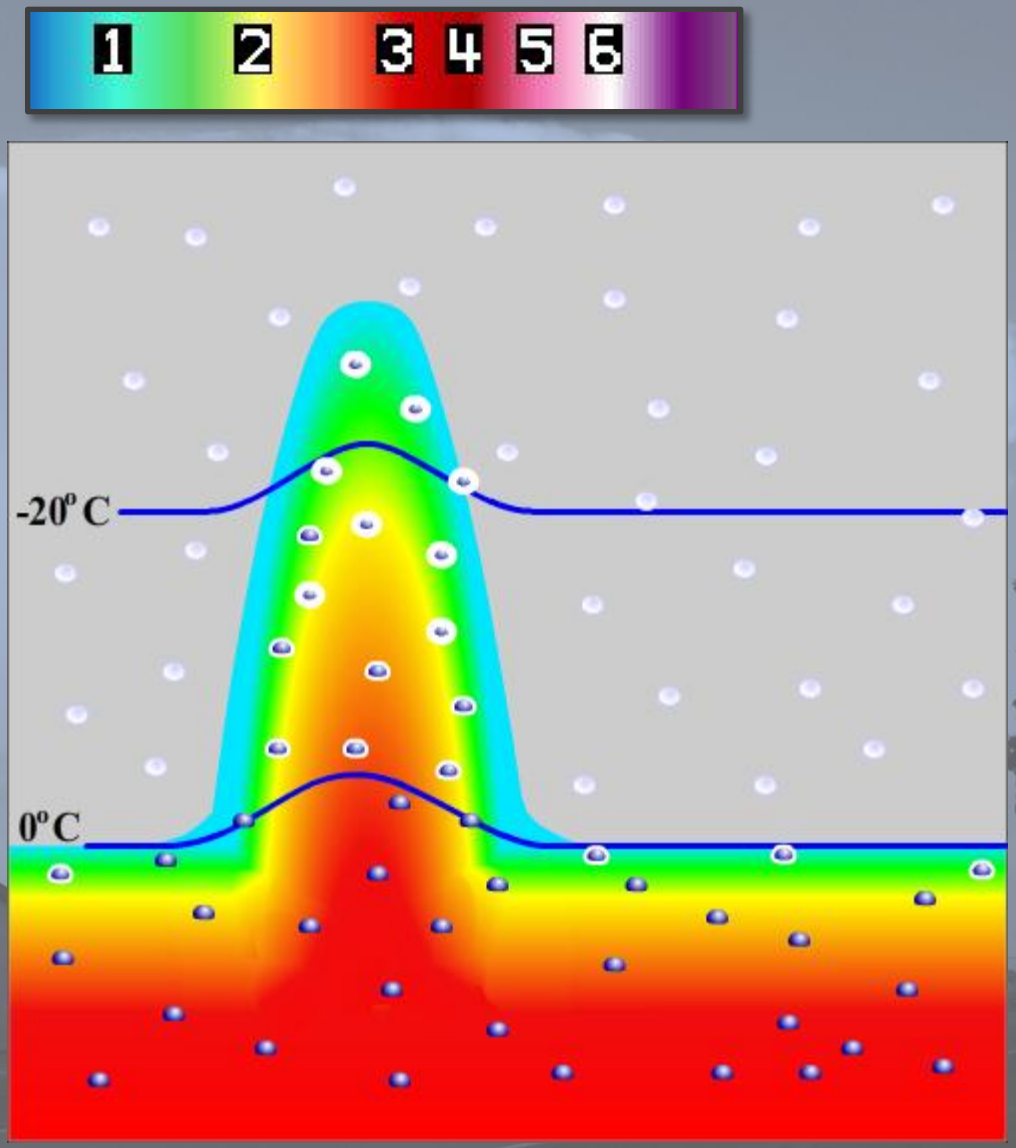
Strengths and Limitations of Dual-pol Tornadic Debris Detection

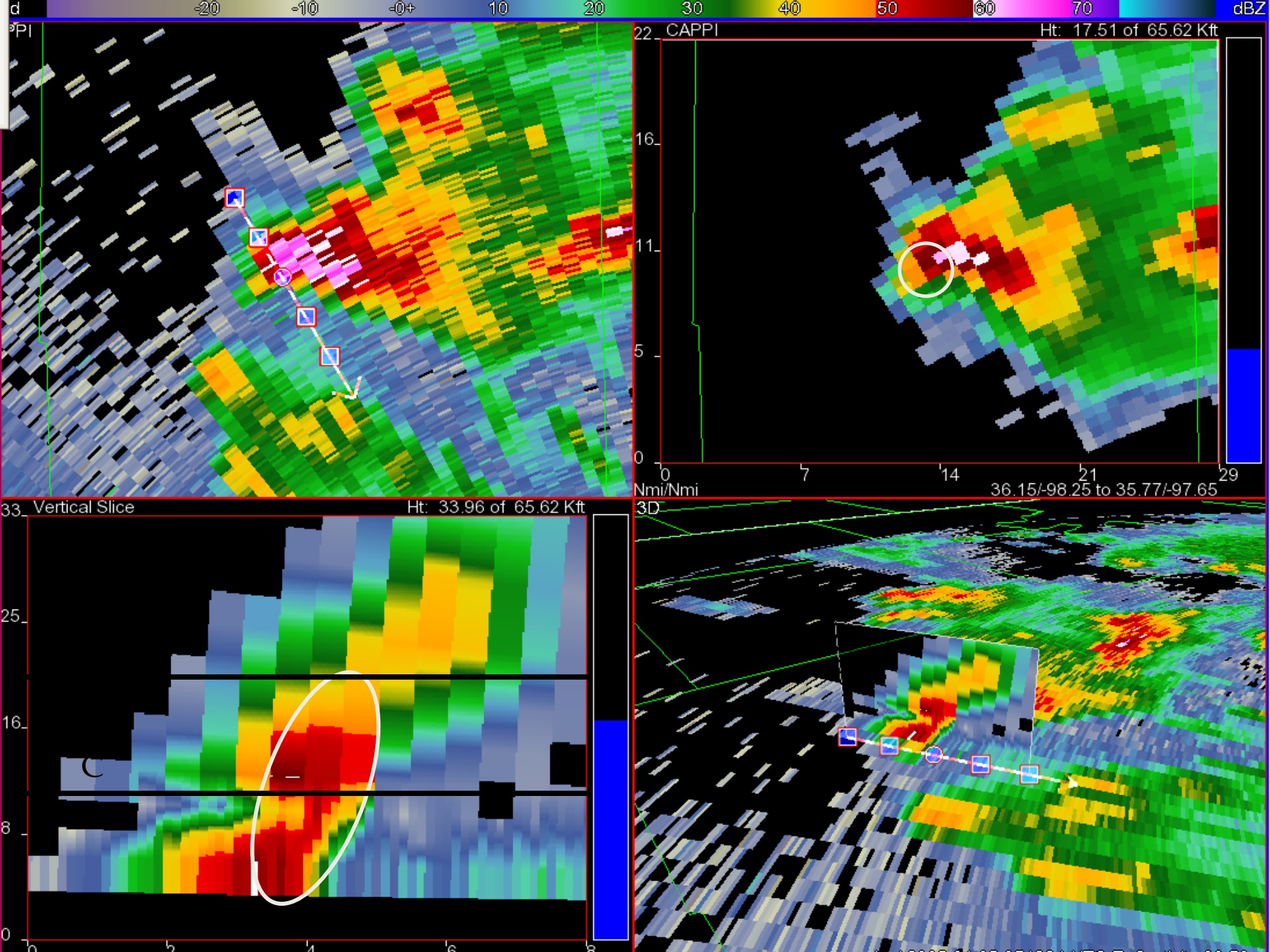
- Strengths
  - Indicates a tornado *is* occurring and that it is doing damage
  - Allows for specificity within a mile or less of the location of the tornado and torn (pursuant to standard radar location errors)
- Limitations
  - Not a predictor of a
  - Must be close range
  - Tornado must hit some oduce a signature
  - Maximum Dependable Range 60km (strong tornadoes further)

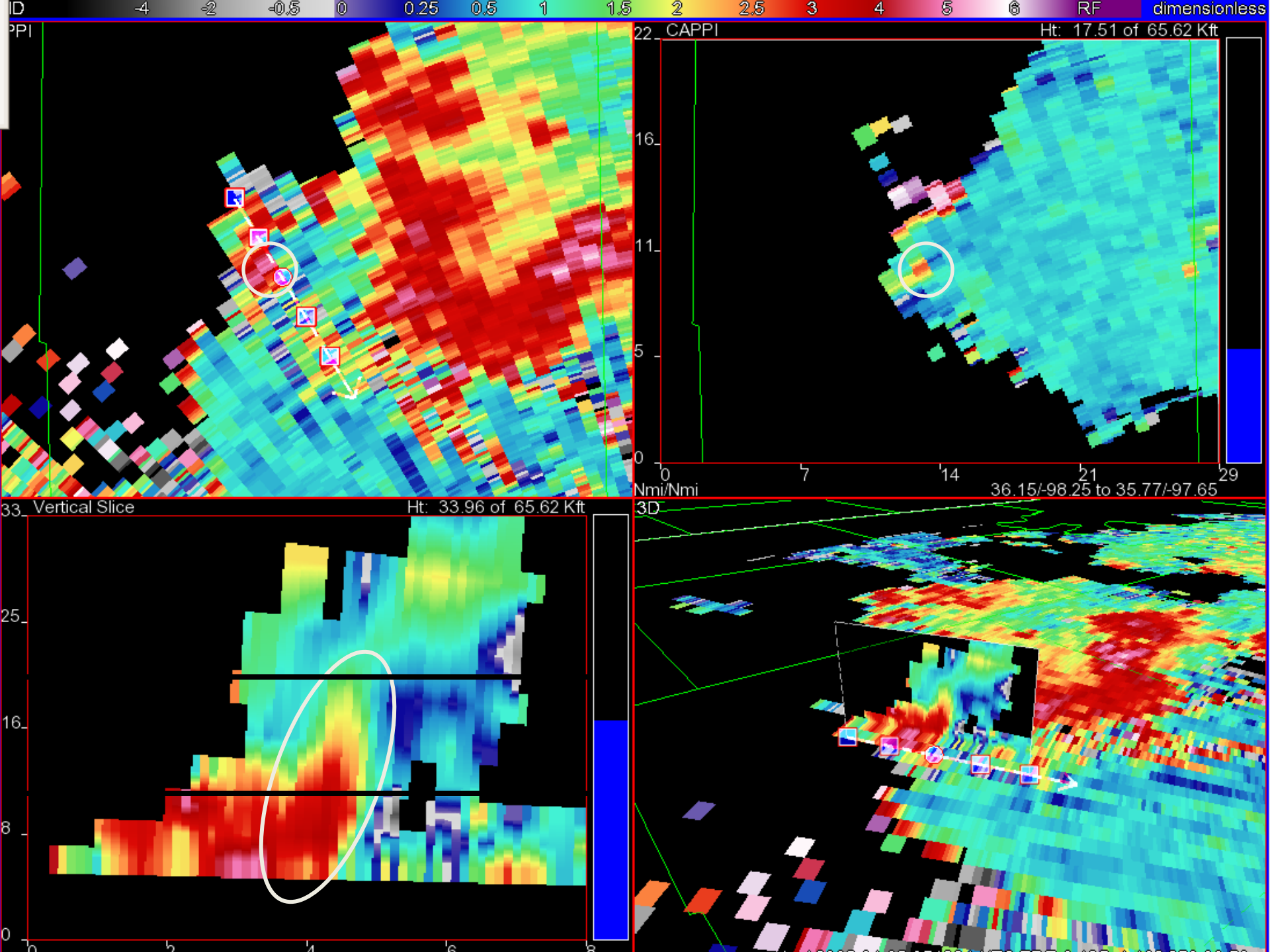
Updraft Detection

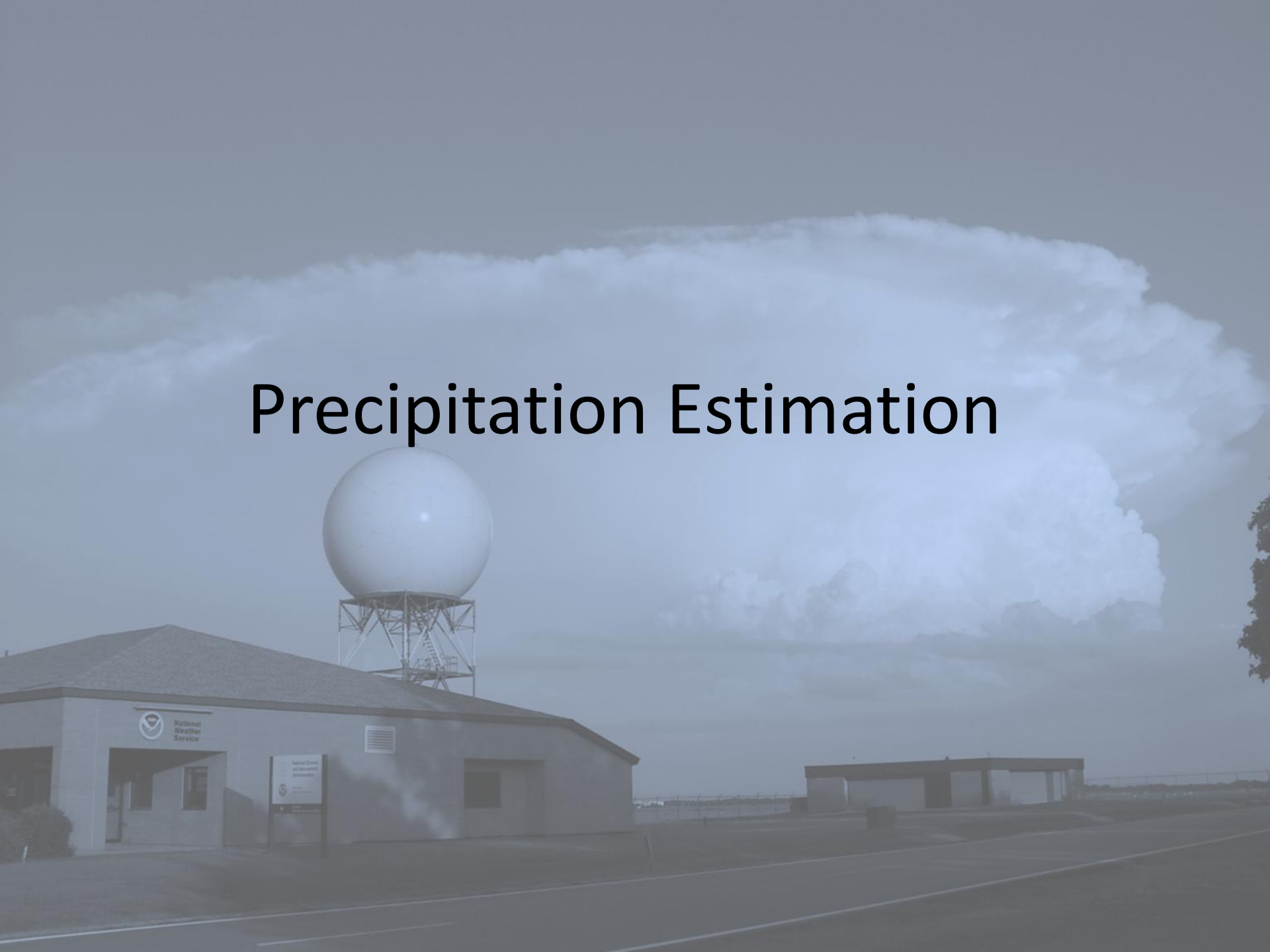
Updraft Detection

- "ZDR columns": regions of liquid water (strongly positive ZDR) found above the environmental 0°C height



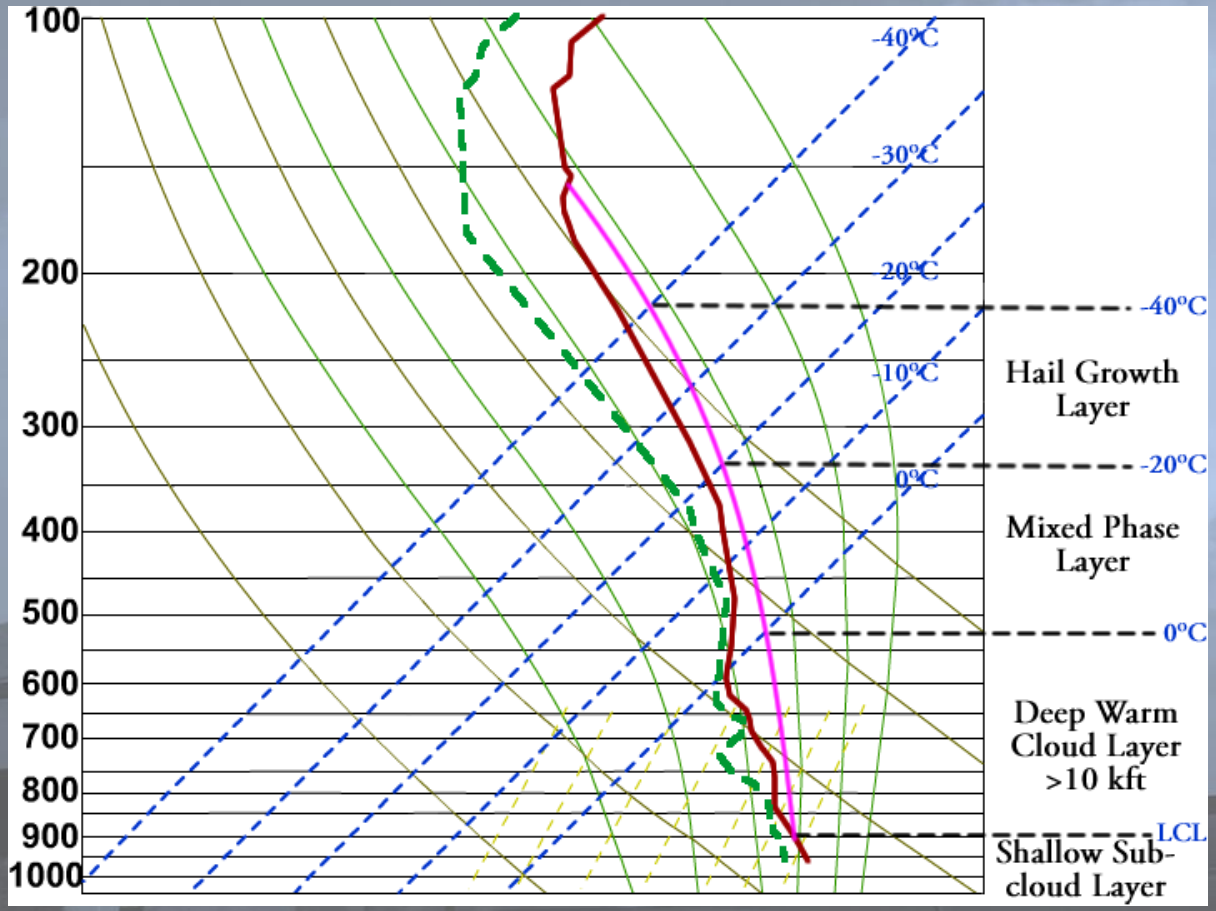

d
-20
-10
-0+
10
20
30
40
50
60
70
dBZ
PPI
CAPPI
Ht: 17.51 of 65.62 Kft
22
16
11
5
0
0
7
14
21
29
Nmi/Nmi
36.15/-98.25 to 35.77/-97.65
Vertical Slice
Ht: 33.96 of 65.62 Kft
33
25
16
8
0
0
2
4
6
8
3D


ID -4 -2 -0.5 0 0.25 0.5 1 1.5 2 2.5 3 4 5 6 RF dimensionless
PPI
CAPPI
Ht: 17.51 of 65.62 Kft
22
16
11
5
0
0 7 14 21 29
Nmi/Nmi
36.15/-98.25 to 35.77/-97.65
Vertical Slice
Ht: 33.96 of 65.62 Kft
33
25
16
8
0
3D



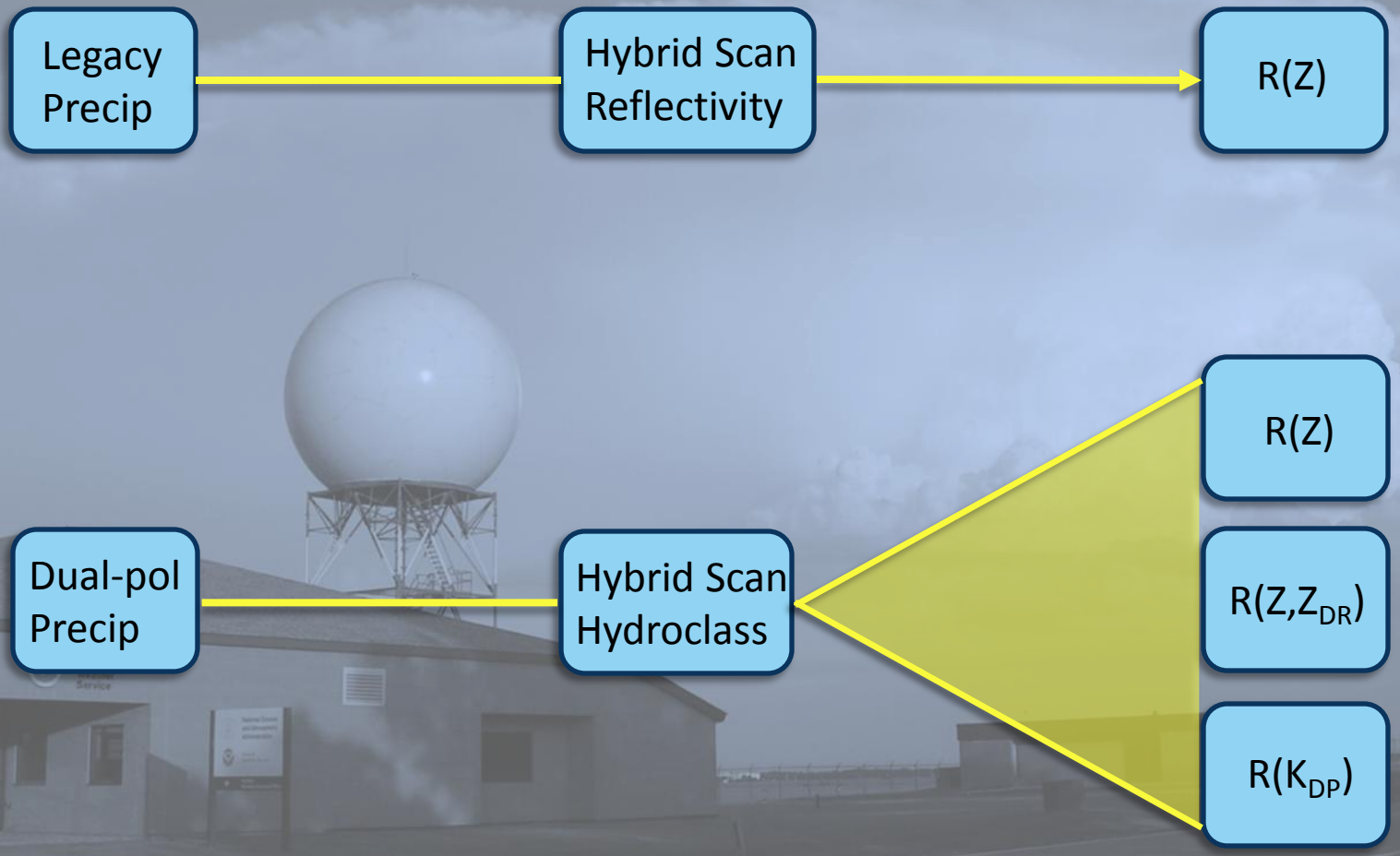
Precipitation Estimation

Characteristics of Heavy Rain are Dependent on the Near Storm Environment



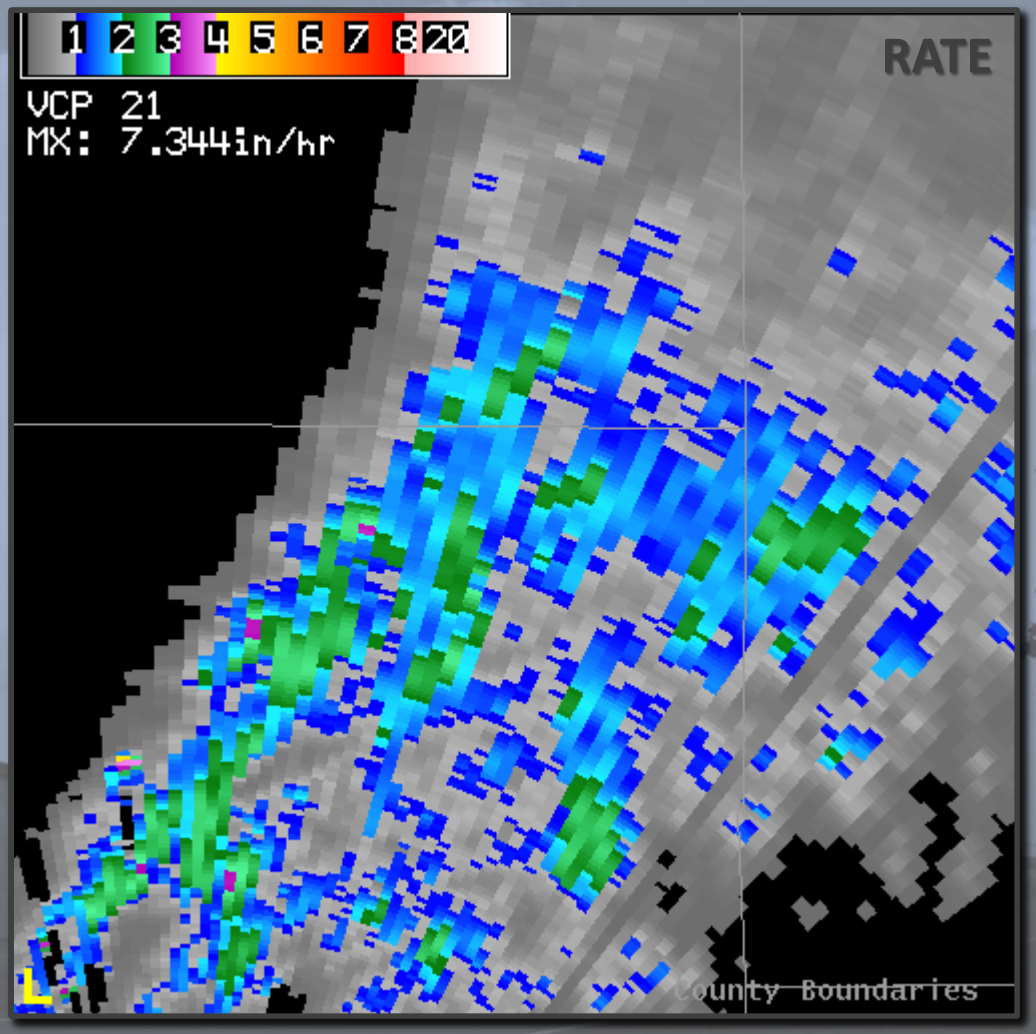
- Provides expectations of the rainfall signatures you should expect
  - Tropical
  - Cold rain processes
  - Possibly mixed with hail

Purpose: QPE Specific to Hydrometeor Type!



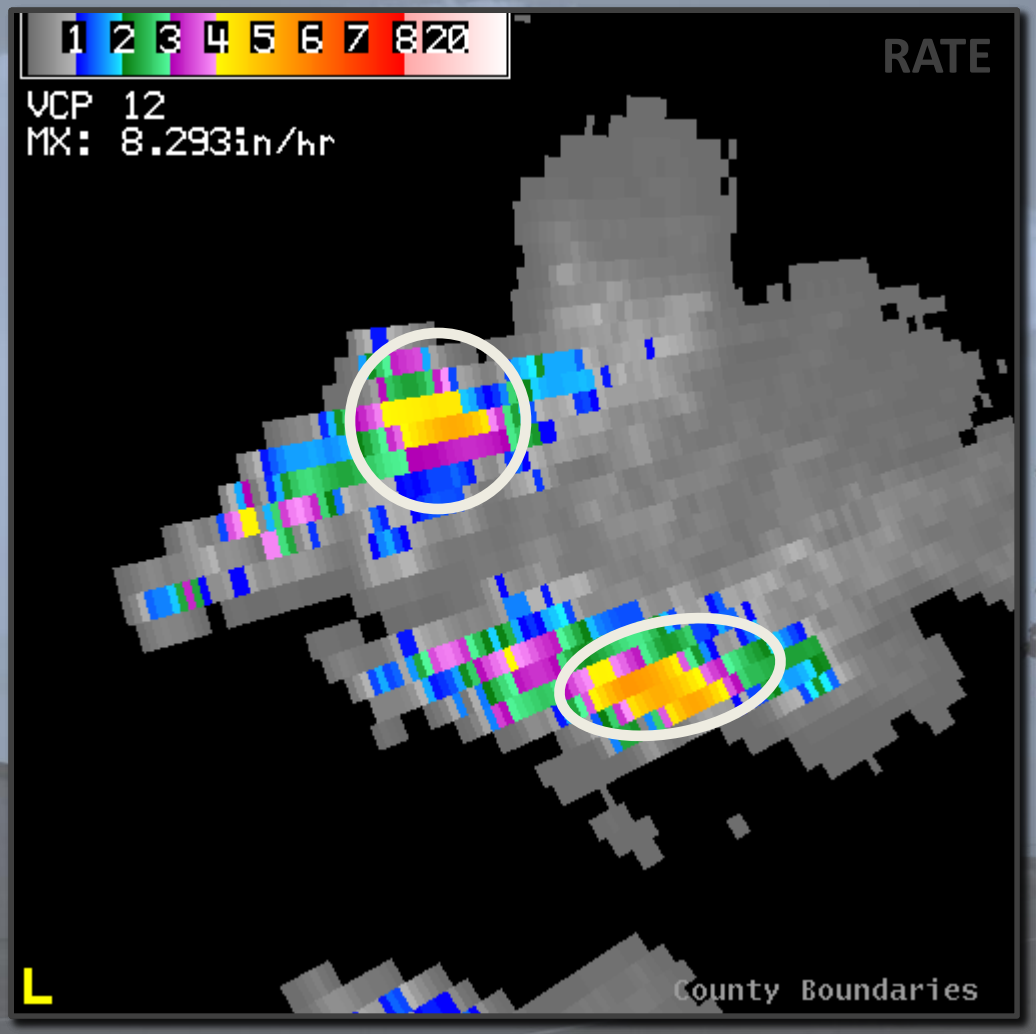
Dual-pol Base Data Characteristics of Heavy Rain: Tropical

- Fairly high 40 > Z > 55 dBZ
- 0.5 > ZDR > 3.0 dB
- CC > 0.98
- KDP > 1.0 deg/km



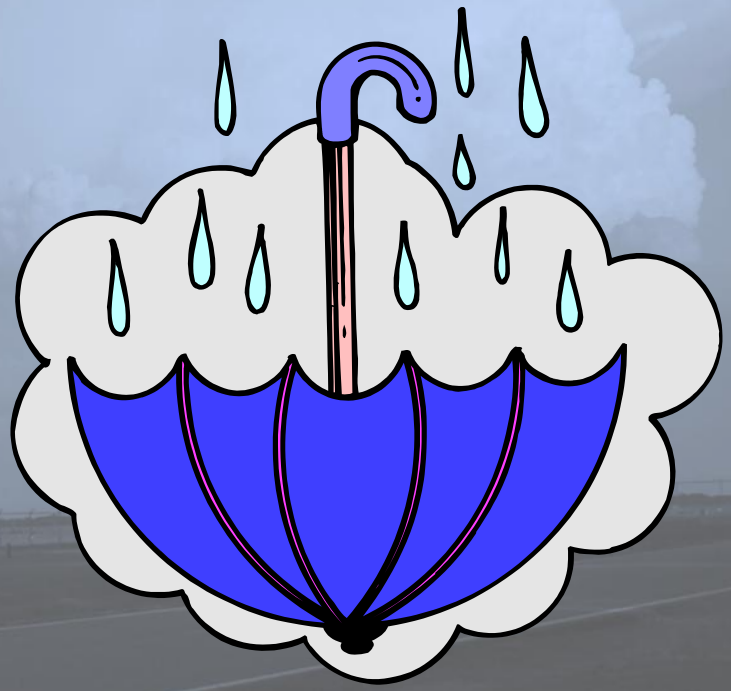
Dual-pol Base Data Characteristics of Heavy Rain: Continental

- High 50 > Z > 60 dBZ
- 2.0 > ZDR > 5.0 dB
- CC > 0.96
- KDP > 1.0 deg/km



Dual-pol QPE Limitations

- All standard radar limitations apply!
- Biases are not currently applied
- **Relations derived empirically**



Winter Weather

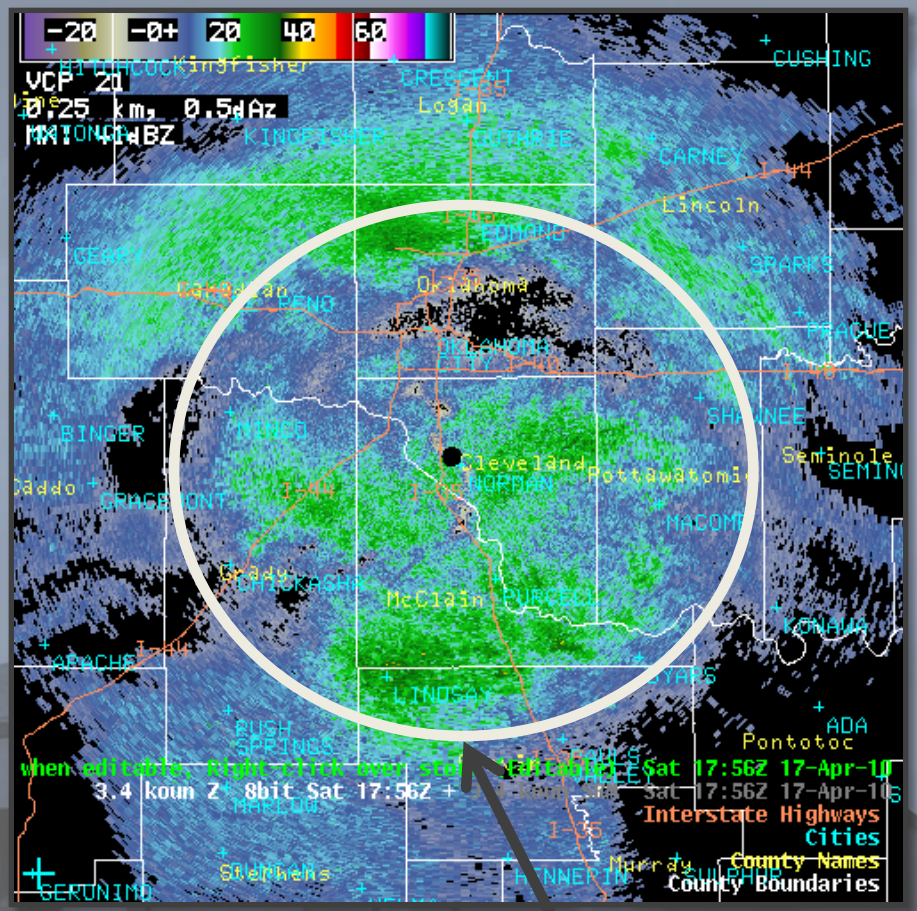
Winter Weather

- The use of the new dual-pol variables will help identify between frozen and liquid hydrometeors. They will also help identify areas of homogeneous and non-homogeneous hydrometeors.

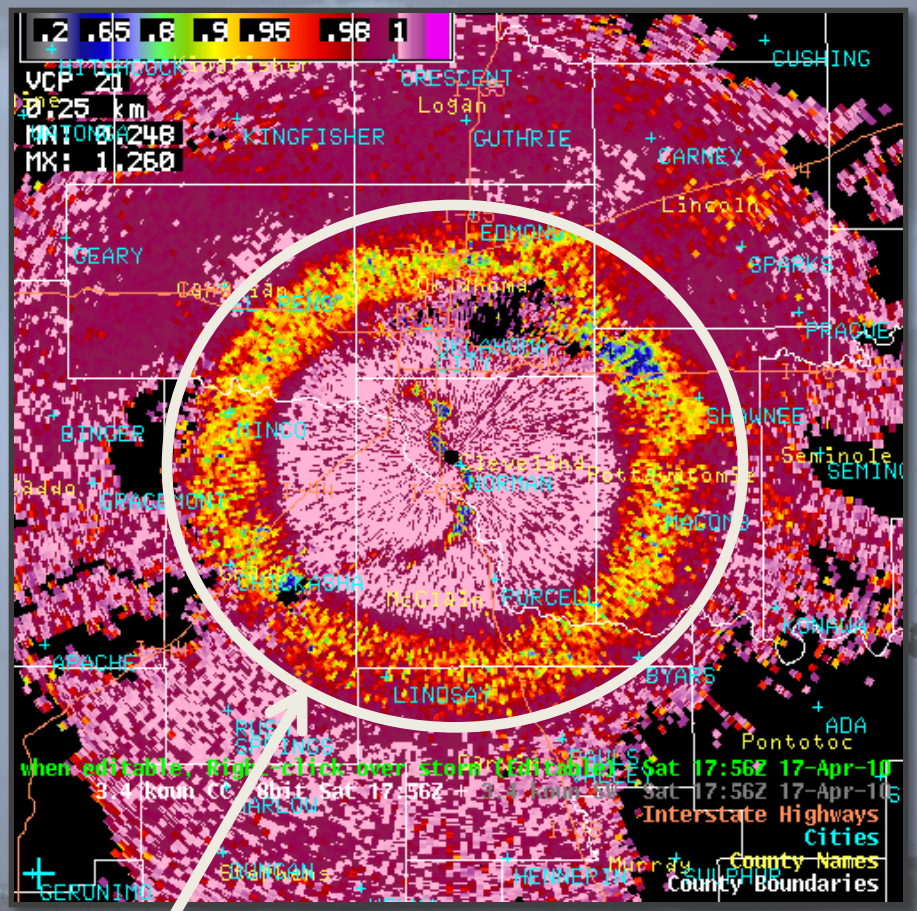
- Melting Layer

Melting Layer

Reflectivity



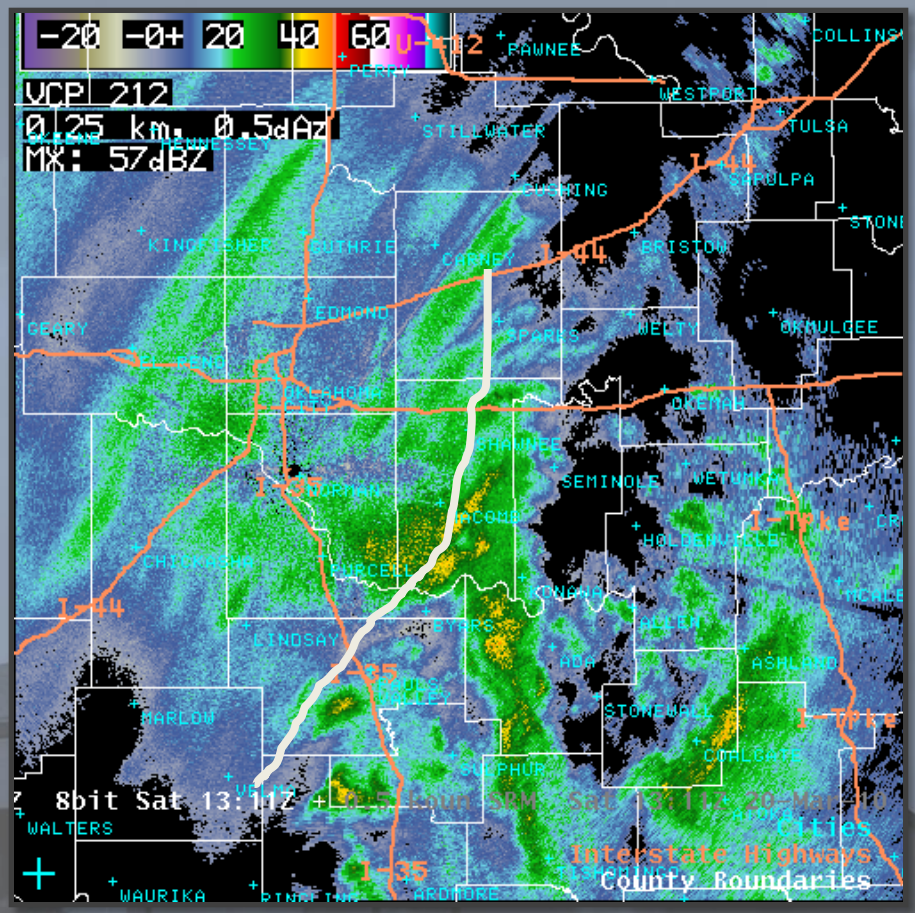
Correlation Coefficient



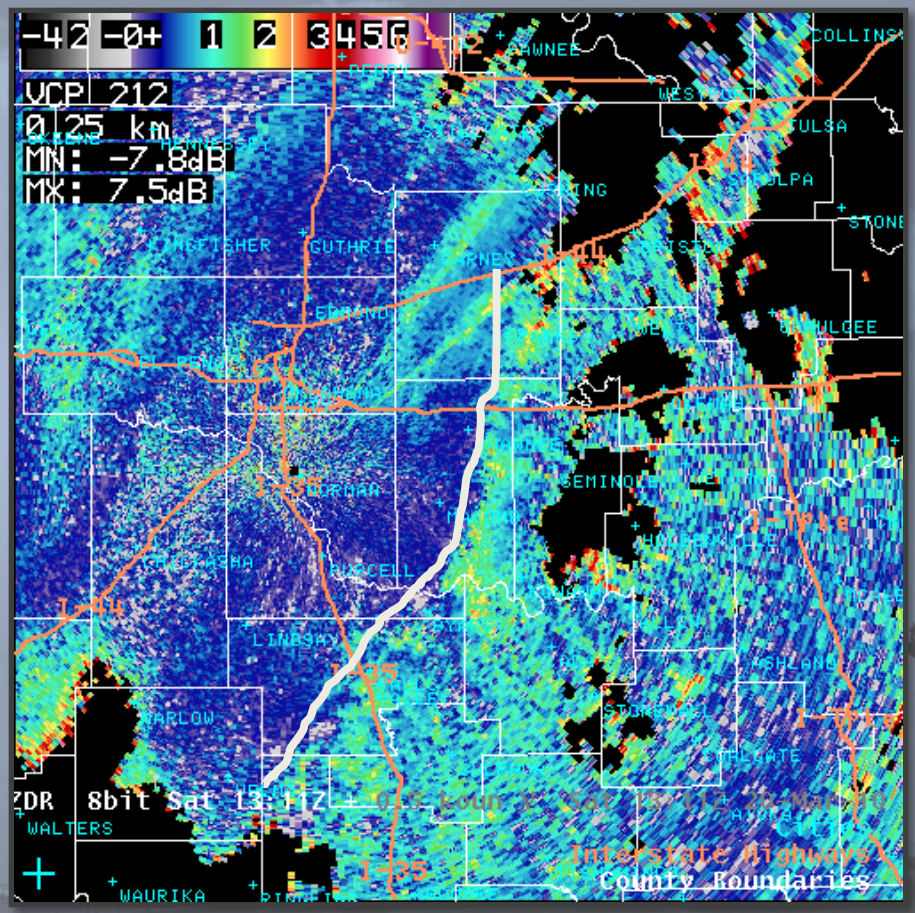
- **Bright band not always visible**
- **Shows up as a ring of low correlation coefficient**

Rain vs. Snow

Reflectivity



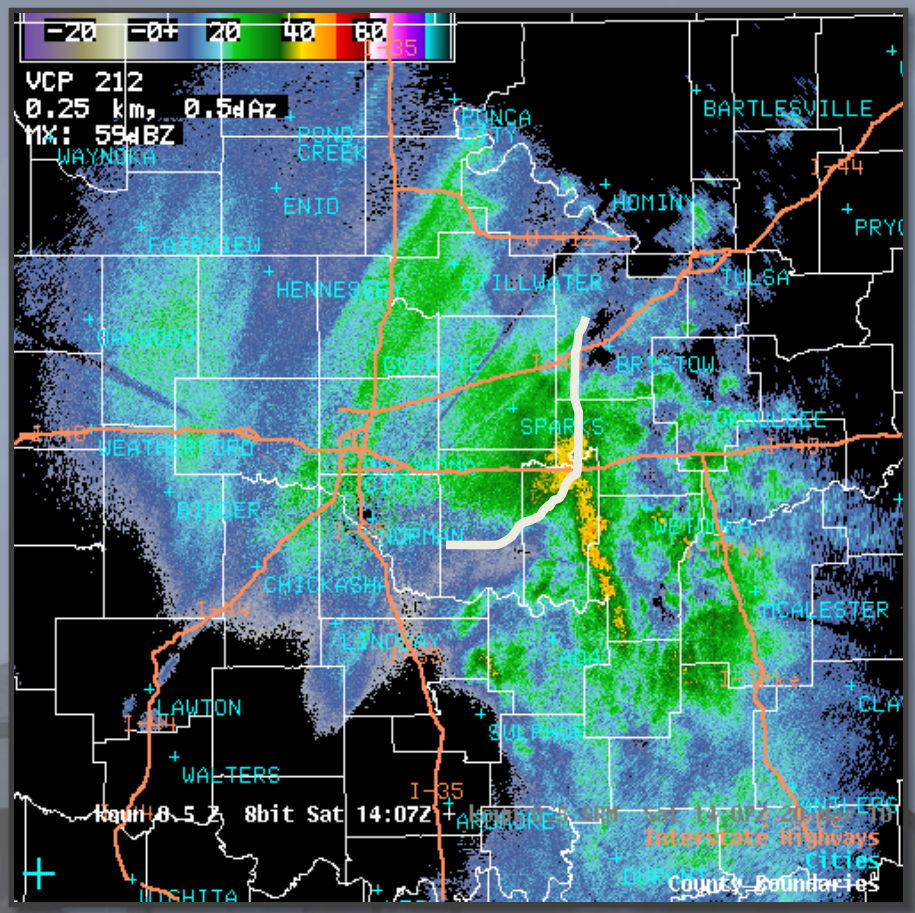
Differential Reflectivity



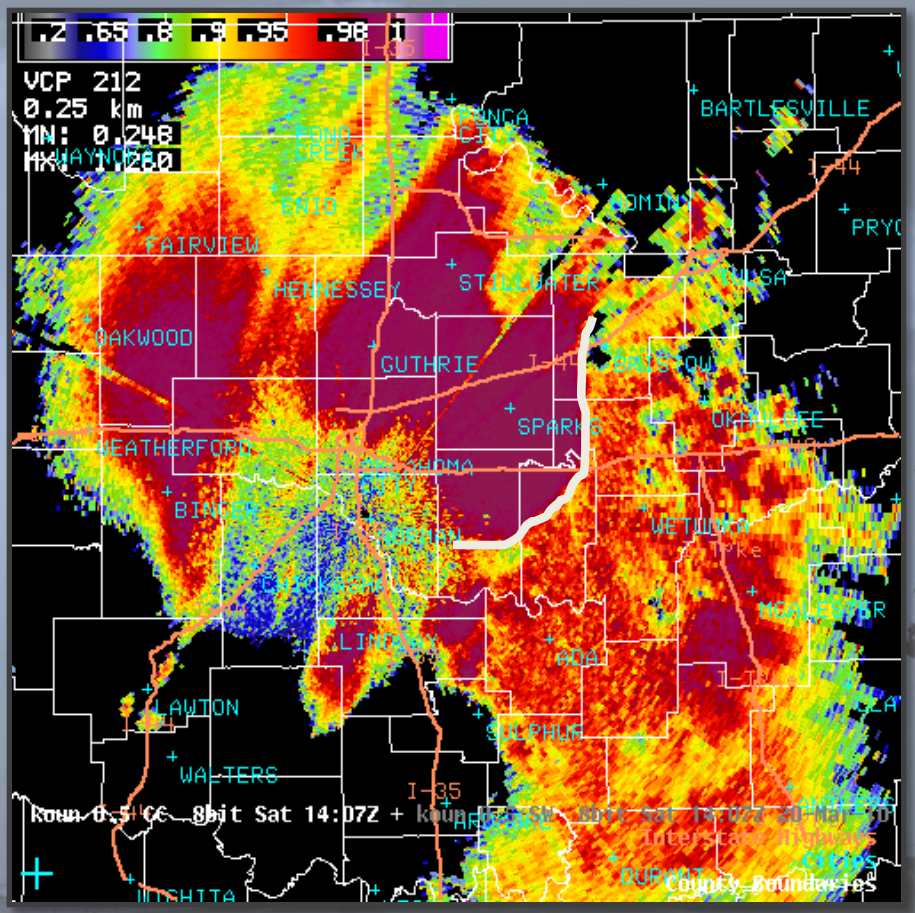
- Rain/Melting layer: ZDR > 1 dB and generally noisy
- Snow: ZDR < 0.5 dB

Rain vs. Snow

Reflectivity



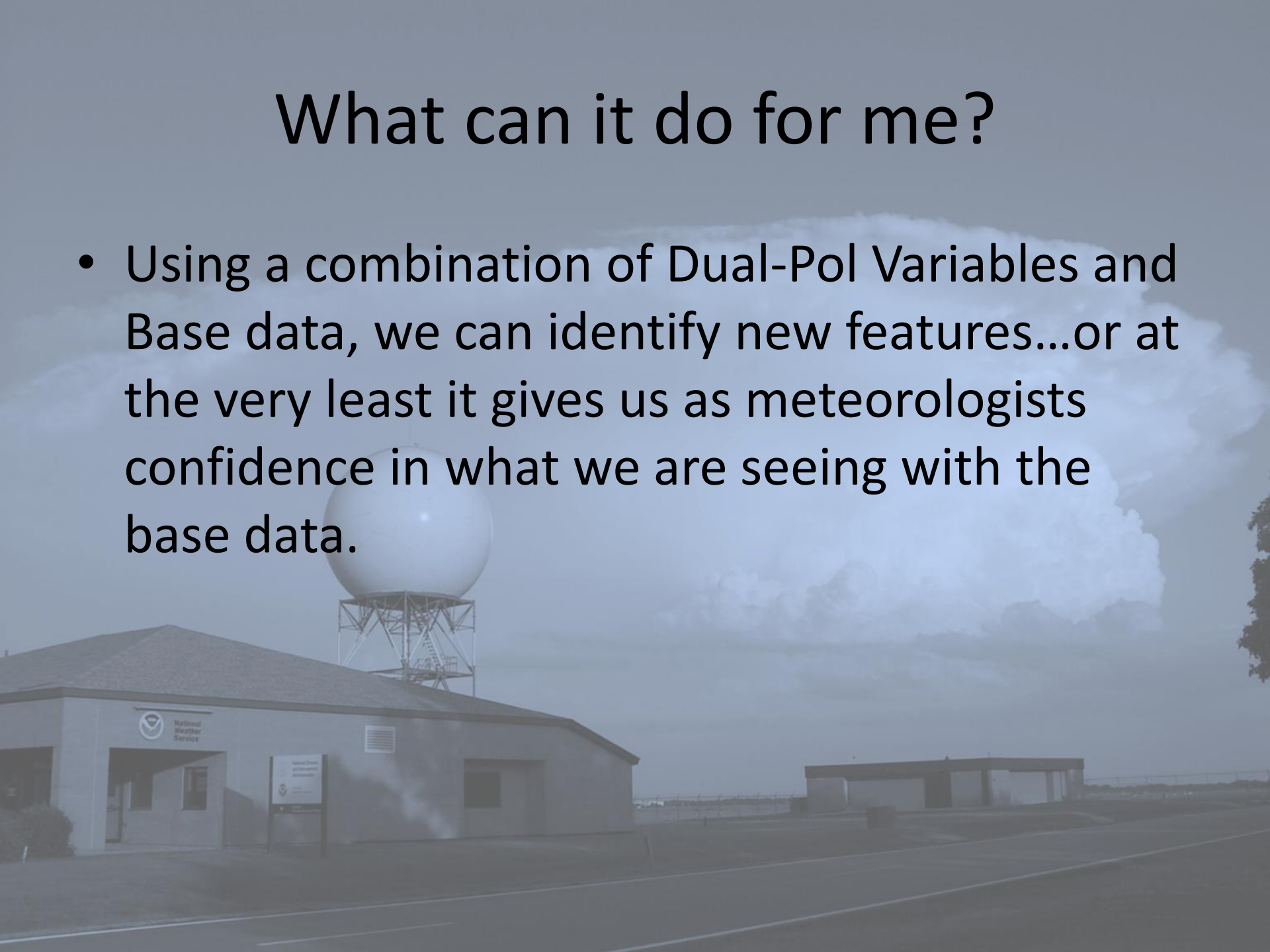
Correlation Coefficient



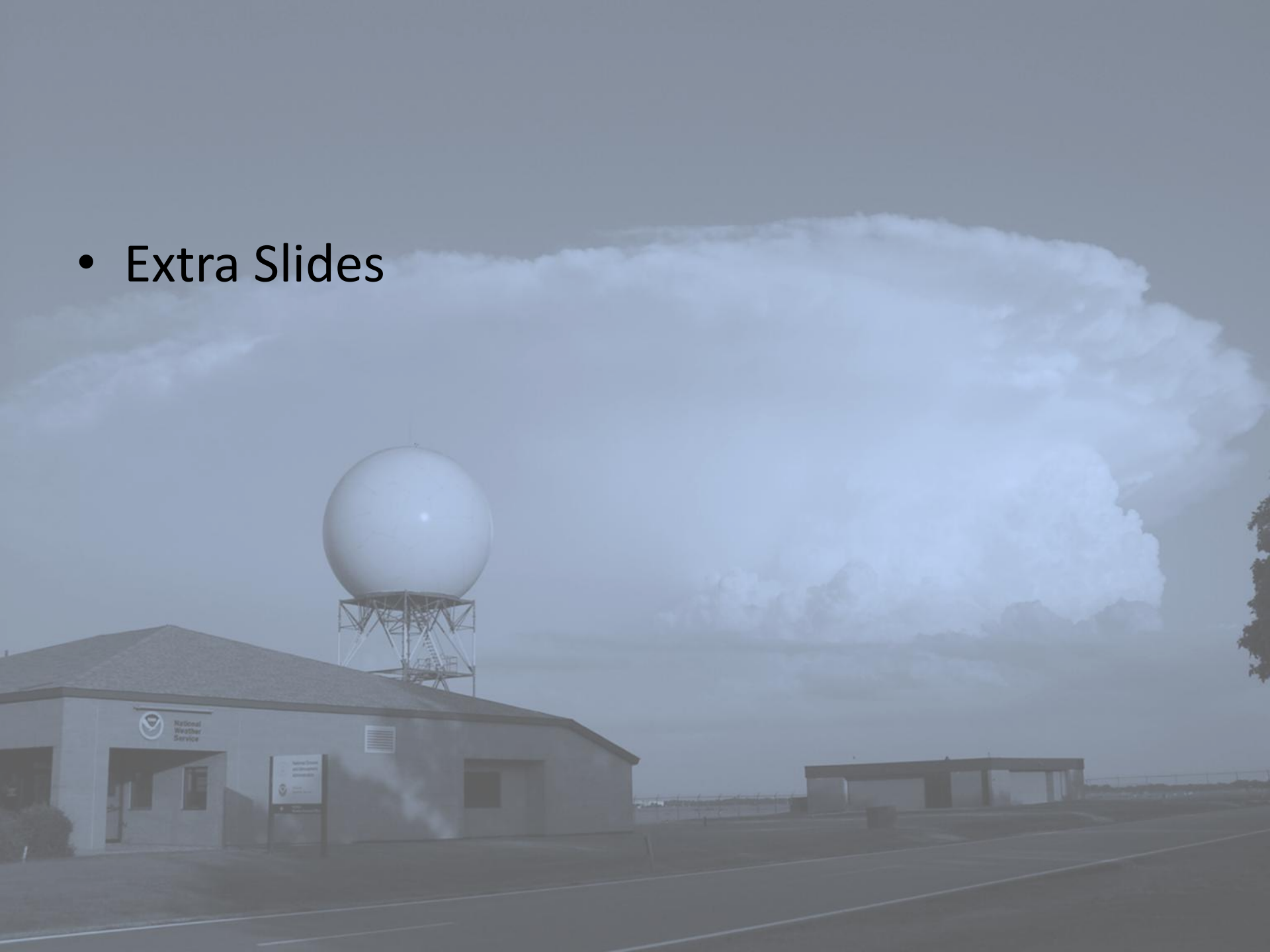
Transition from high to low CC marks the rain/snow transition line

What can it do for me?

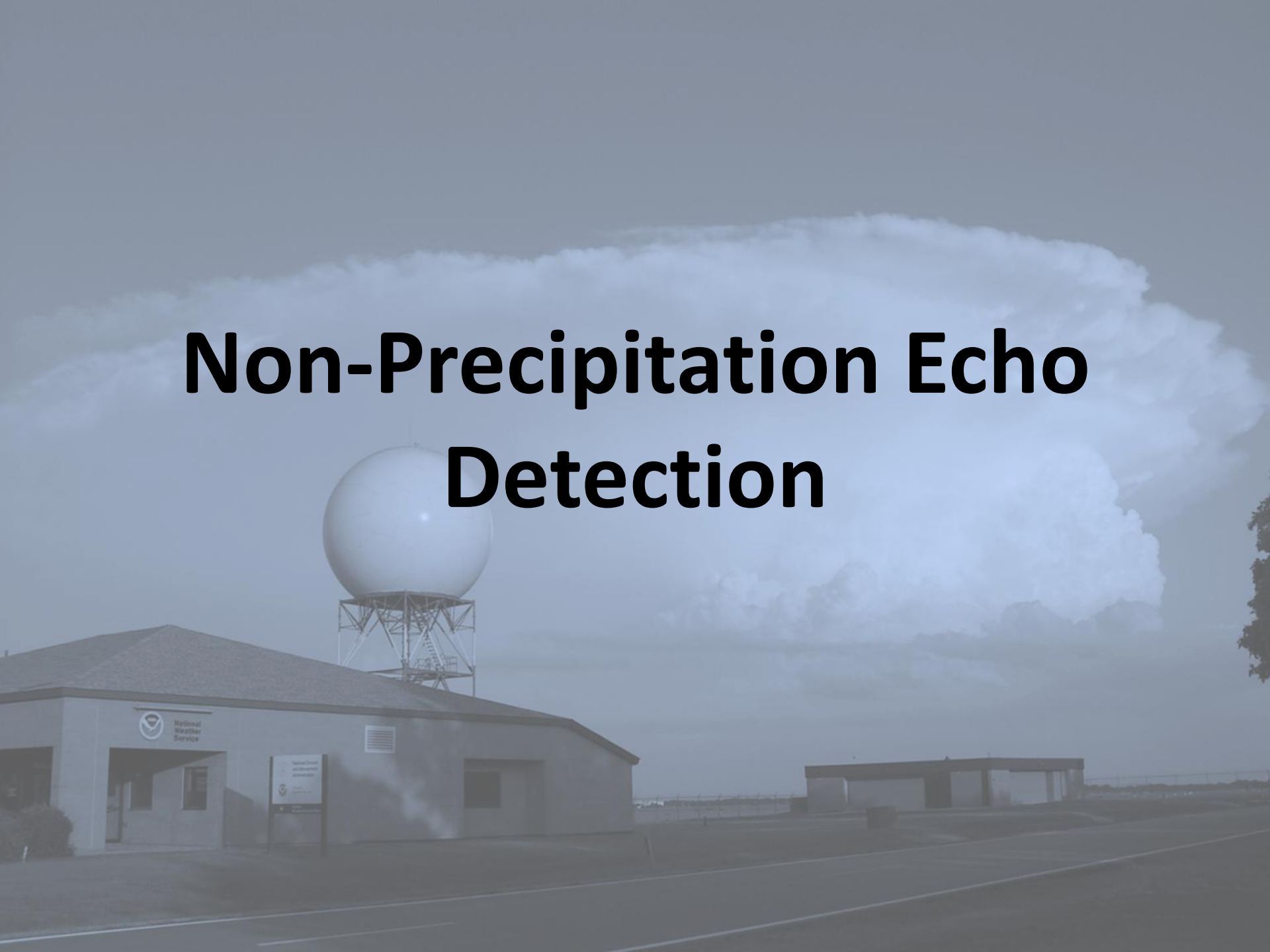
- Using a combination of Dual-Pol Variables and Base data, we can identify new features…or at the very least it gives us as meteorologists confidence in what we are seeing with the base data.



- Extra Slides



Non-Precipitation Echo Detection



Non-Precipitation Echo Detection