Dual-Polarization and Dual-Wavelength Radar Measurements

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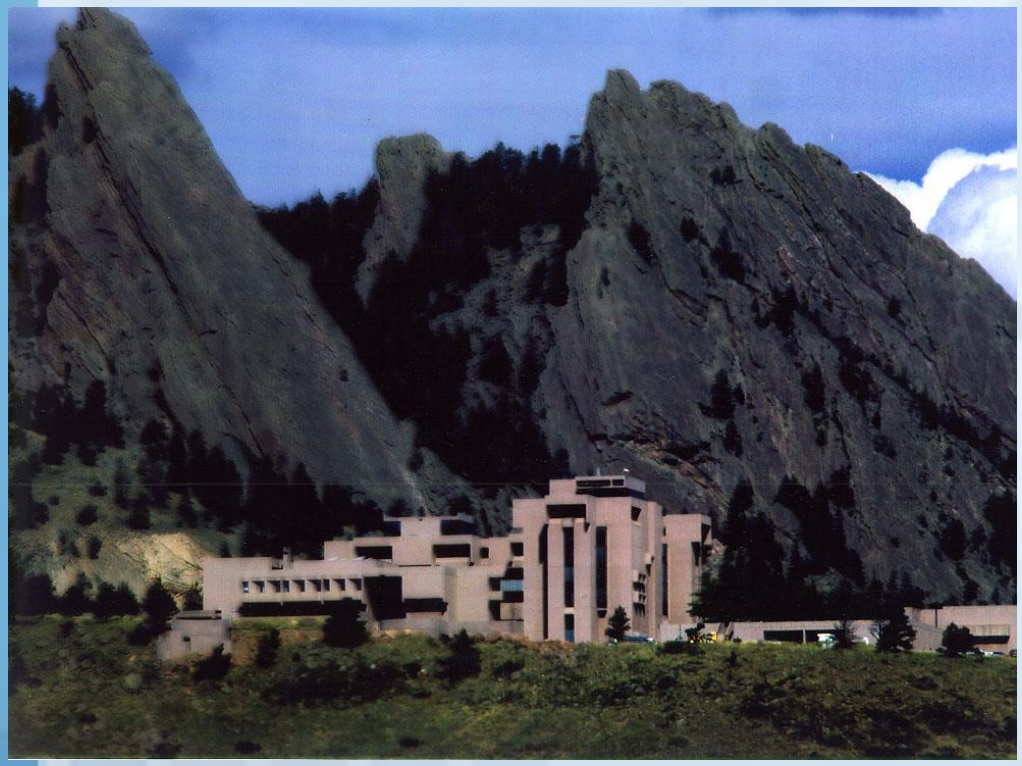


I. Polarization and dual-wavelength radar

II. Cloud microphysics

III. Examples of products and ka-band observations.

NCAR

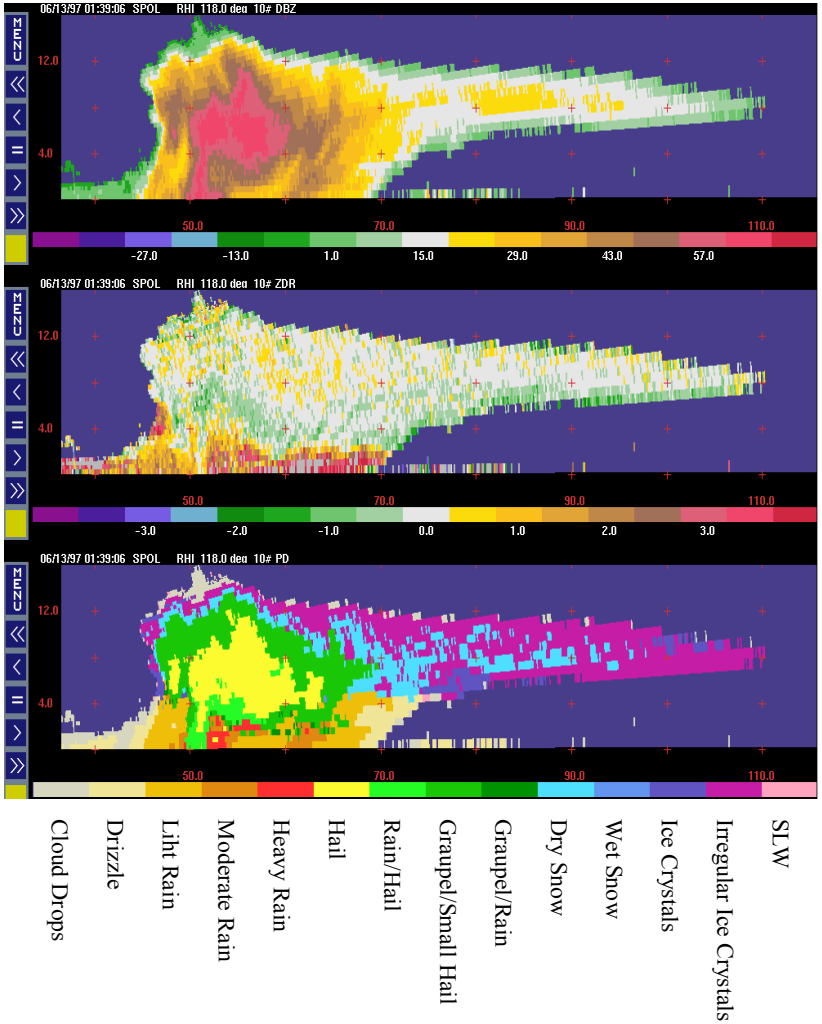
Dual-wavelength radar: S-Polka

Microphysics

- Precipitation type: Ice or liquid?
- Precipitation particle shape, size and concentration.

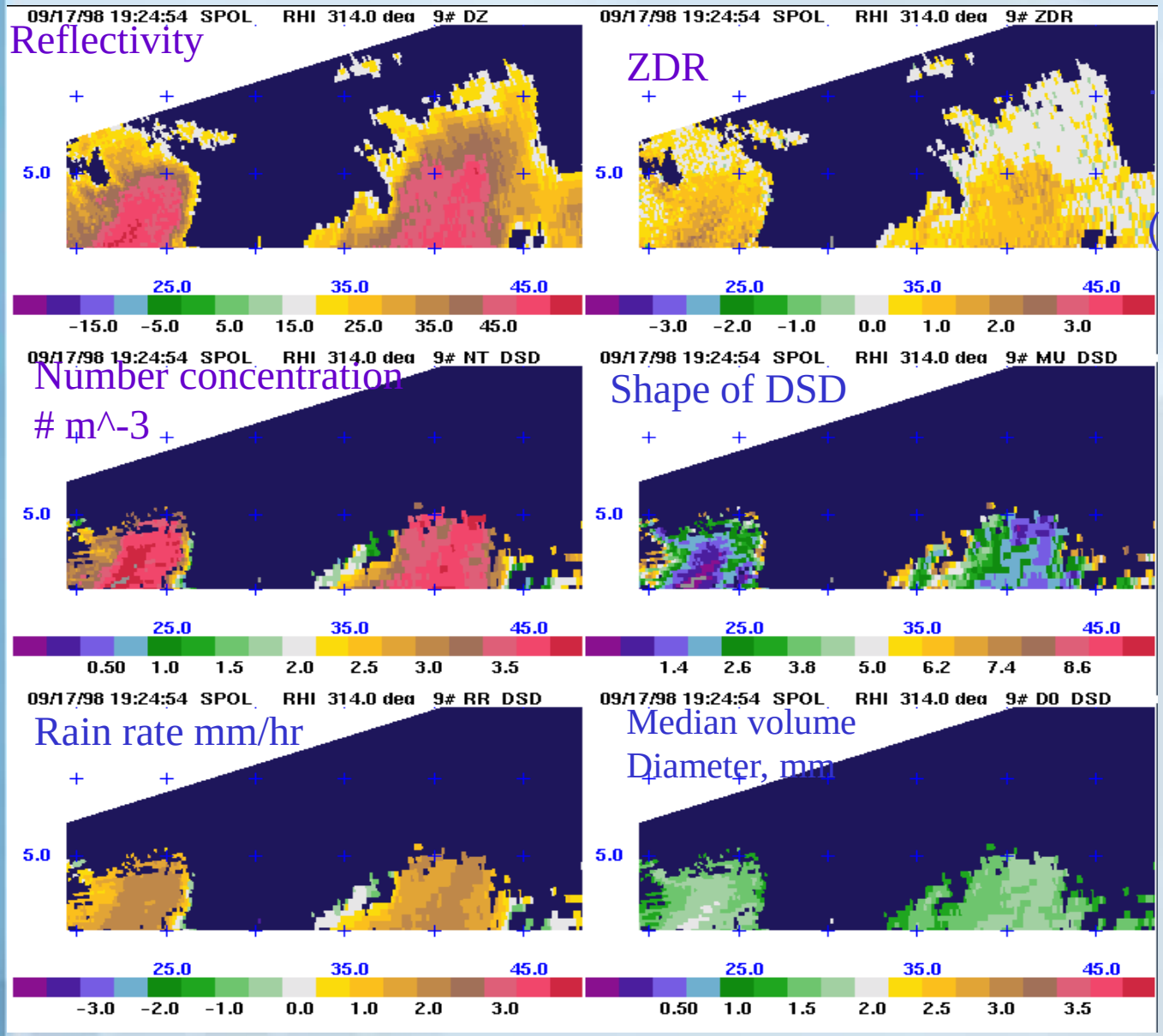
- Sensitivity: -10 dBZ @ 50 km

  0.1 mm droplet size100 per liter

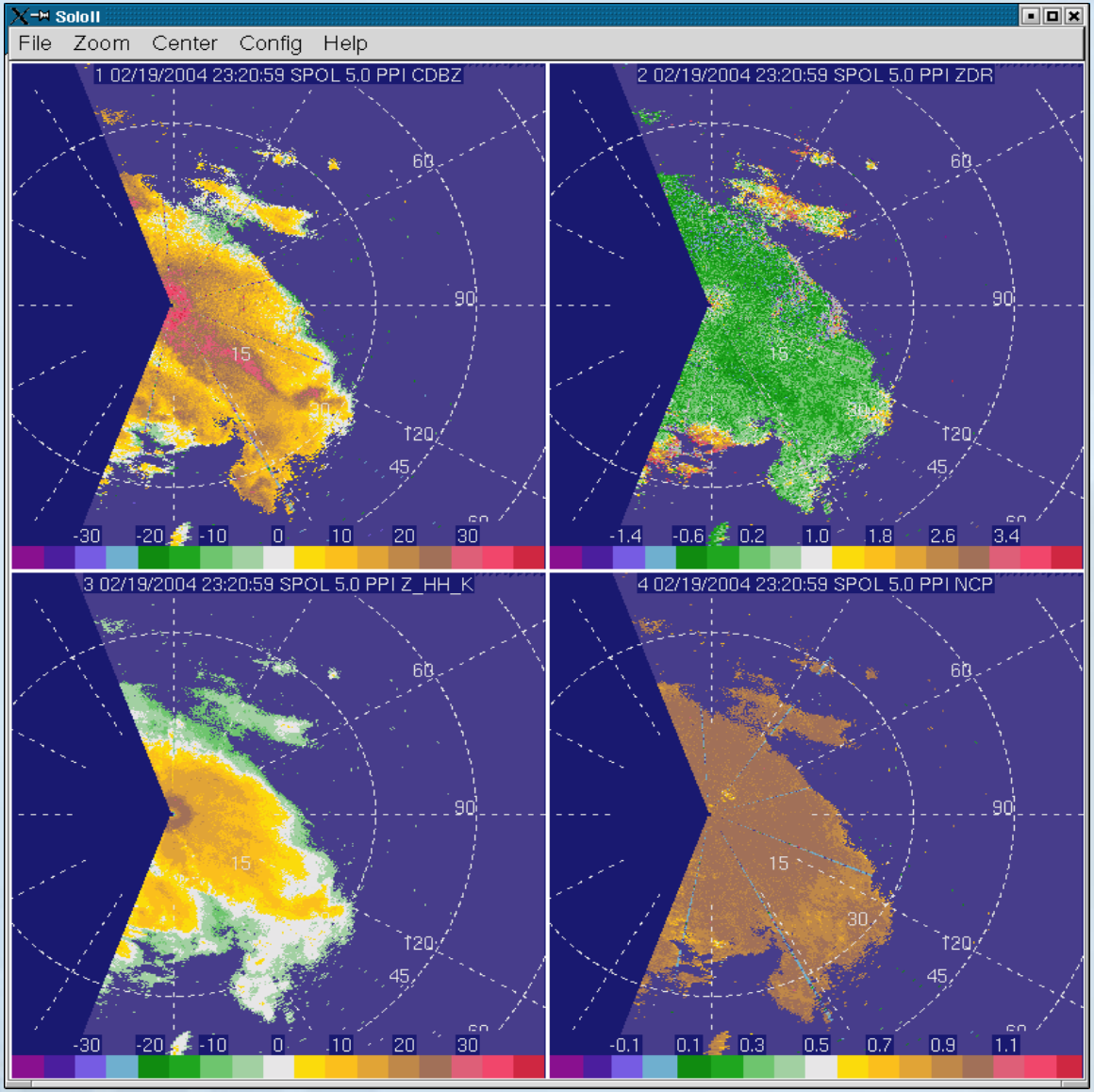


RHI scans of Z, ZDR and the corresponding particle classification results. The radar measurements were collected by NCAR S-Pol radar during the CASES 97 field program.

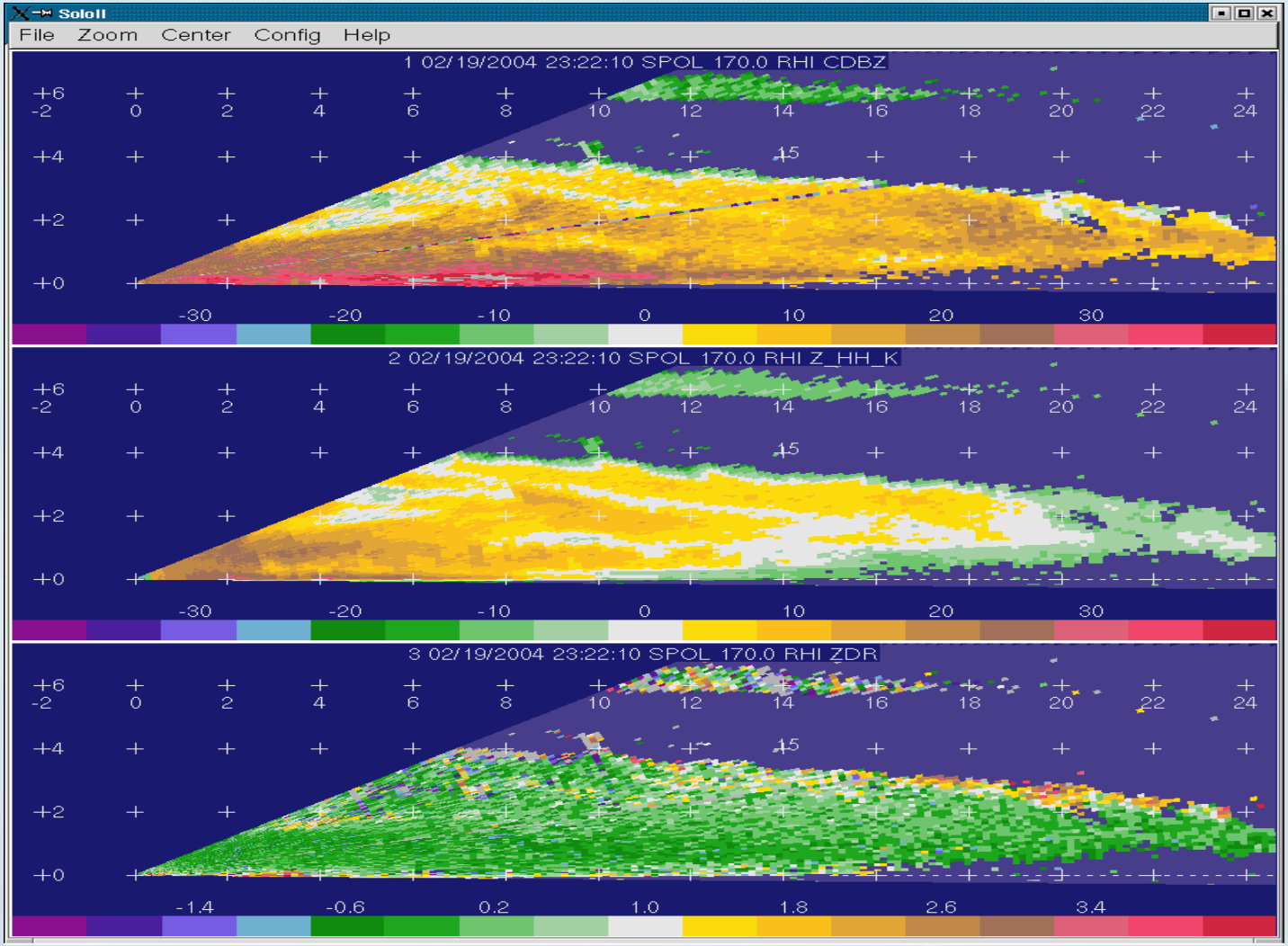
Spatial distribution of polarization radar measurements, retrieved DSD parameters, and rain rate

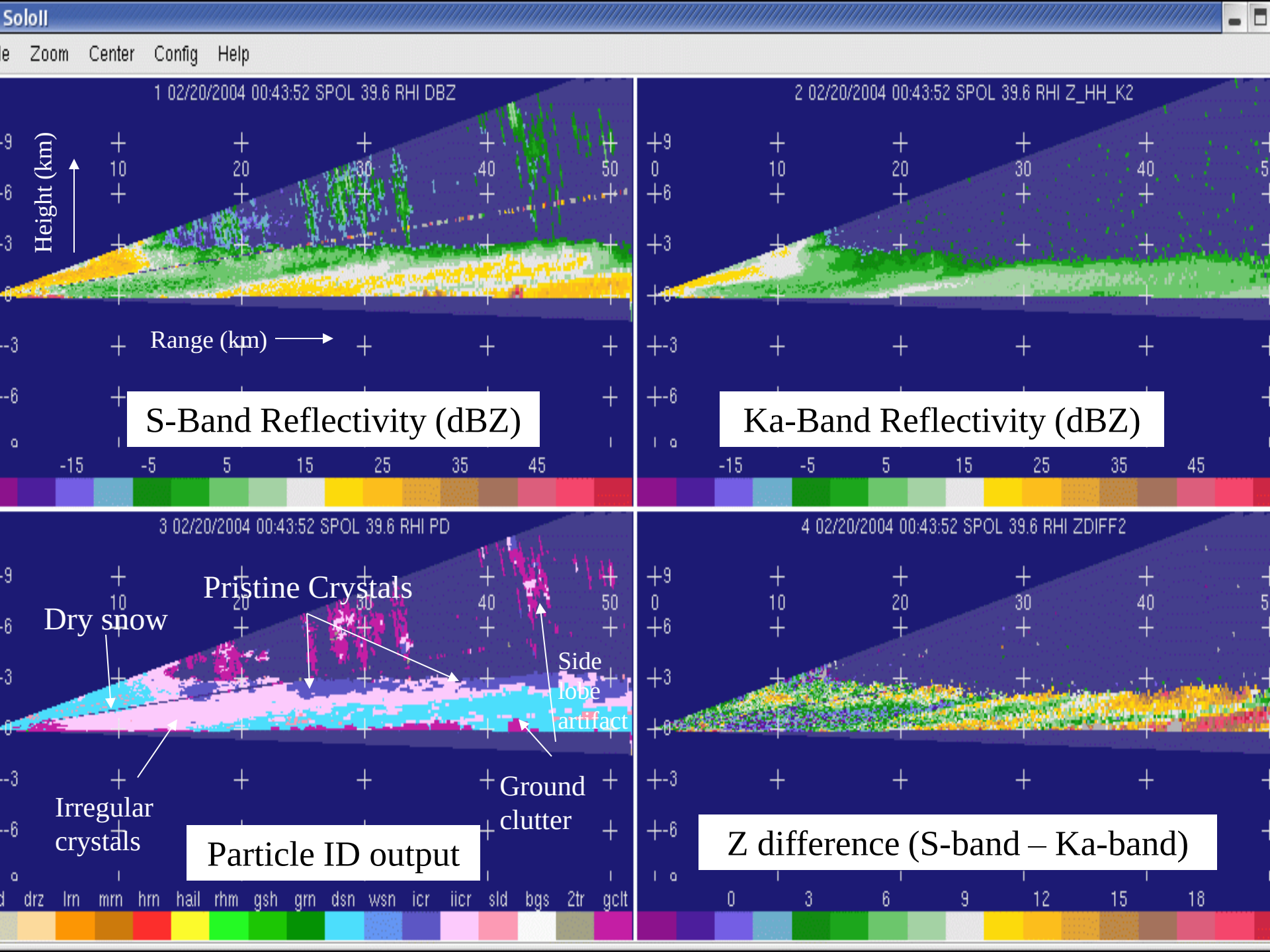


Examples of Ka-band radar Measurements



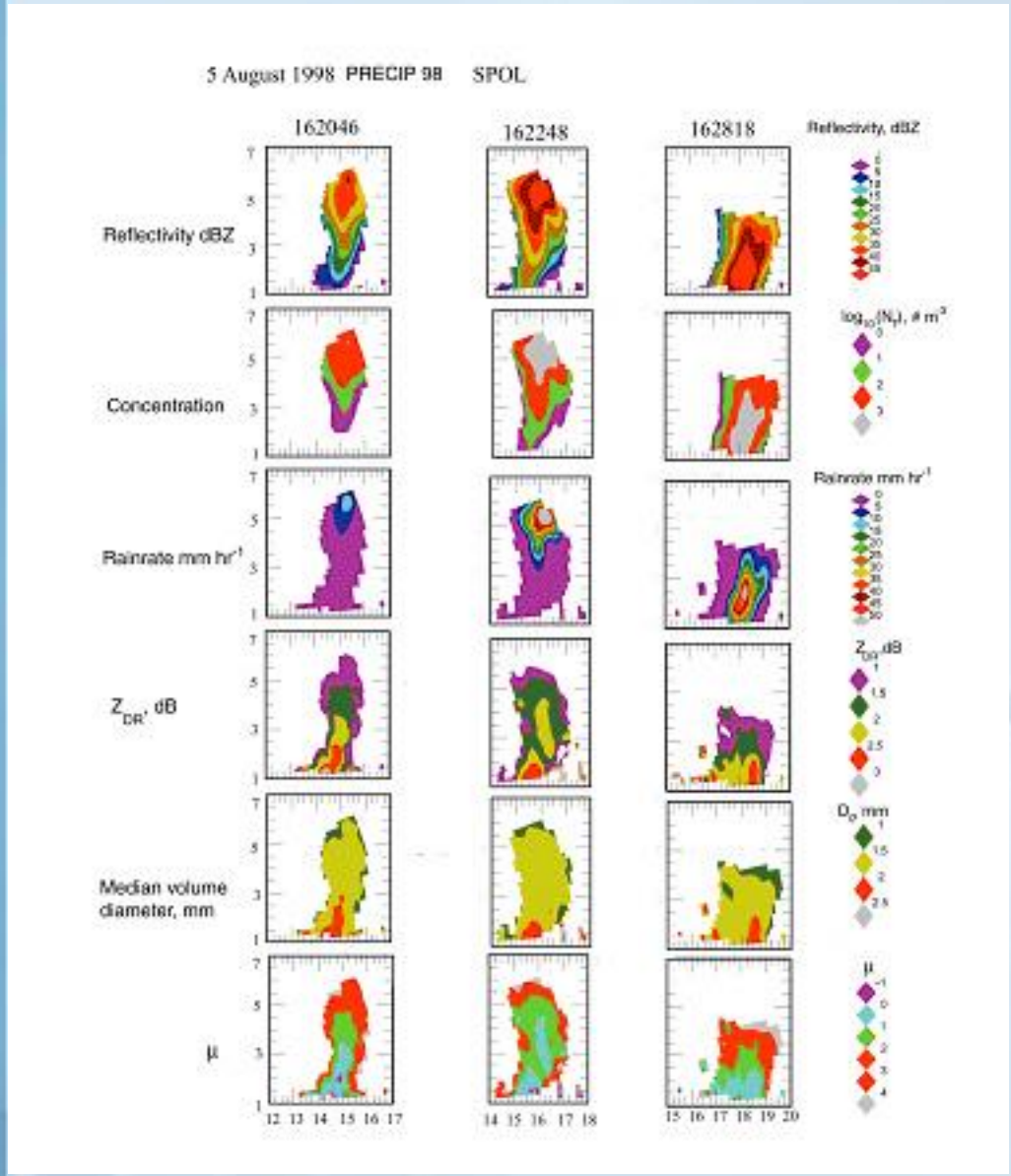
Sample Plane Parallel Indicator (PPI) Scan From WISP04, 2004.


SoloII
File Zoom Center Config Help
1 02/19/2004 23:22:10 SPOL 170.0 RHI CDBZ
+6 -2 0 2 4 6 8 10 12 14 16 18 20 22 24
+4 +2 +0
15
-30 -20 -10 0 10 20 30
2 02/19/2004 23:22:10 SPOL 170.0 RHI Z_HH_K
+6 -2 0 2 4 6 8 10 12 14 16 18 20 22 24
+4 +2 +0
15
-30 -20 -10 0 10 20 30
3 02/19/2004 23:22:10 SPOL 170.0 RHI ZDR
+6 -2 0 2 4 6 8 10 12 14 16 18 20 22 24
+4 +2 +0
15
-1.4 -0.6 0.2 1.0 1.8 2.6 3.4


Soloii
Zoom
Center
Config
Help
1 02/20/2004 00:43:52 SPOL 39.6 RHI DBZ
Height (km)
Range (km)
S-Band Reflectivity (dBZ)
2 02/20/2004 00:43:52 SPOL 39.6 RHI Z_HH_K2
Ka-Band Reflectivity (dBZ)
3 02/20/2004 00:43:52 SPOL 39.6 RHI PD
Dry snow
Pristine Crystals
Side lobe artifact
Irregular crystals
Ground clutter
Particle ID output
drz lrn mrn hrn hail rhm gsh grn dsn wsn icr iicr sld bgs 2tr gclt
4 02/20/2004 00:43:52 SPOL 39.6 RHI ZDIFF2
Z difference (S-band – Ka-band)

Advantages of dual-wavelength system

- Detection of cloud droplets.
- Estimate of size and LWC.
- Raindrop size distribution .
- Effect of Bragg scatter is less at Ka-band.
- Improved cloud microphysical retrieval using both dual-wavelength and dual-polarization observations.



Knight et al. JAS, *J. Atmos. Sci.*, **59**, 1454-1472.

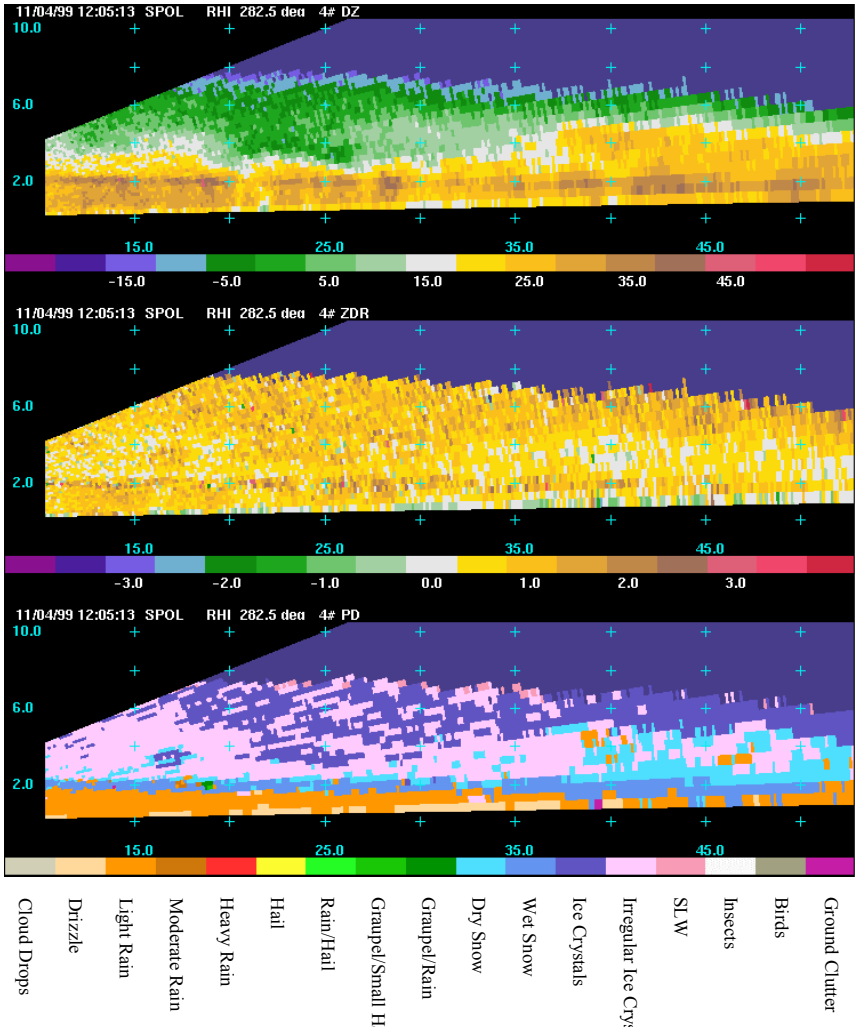
Data from the RHIs are fit to a Gamma distribution and characteristics of the drops are displayed here as labeled at the left at the three times for the three rows.

The last row, μ, is an exponent in the gamma distribution.

When $\mu = 0$ the distribution is exponential, and as μ increases it narrows.

The rainfall rate is calculated as if at the ground with zero vertical air velocity.

S-Pol data and particle ID results from MAP (Italy)



Issues: Measurement

- Number of independent samples and standard error of radar observables.
- Calibration of radar measurements.
- How to combine forward scattering observations with backscatter measurements?

Issues: Microphysics

- Drop shape and size distribution (DSD).
- Ice particle shape and density.
- How to separate DSD and particle shape effects in polarization measurements?
- How to detect super cooled droplets?