Ship-based Doppler Lidar Measurements

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# The shipborne High Resolution Doppler Lidar (HRDL)

- Solid state 2 micron transmitter
  - Invisible & Eyesafe
- High spatial and temporal resolution
  - 30 m along beam
  - ½ second
- Max range 3-8 km
- Range resolved line-of-sight wind speed and aerosol backscatter strength

- Housed in a 20 ft seatainer
- 6 Ship-based deployments
- Motion stabilized hemispheric scanner

The motion compensation system

- Stabilizes orientation and corrects for ship motion
- Essential for ship based measurements
- Differential GPS & 6 axis accelerometer
- 3 axis hemispherical scanner
- Orientation feedback and correction occurs at 40 hz
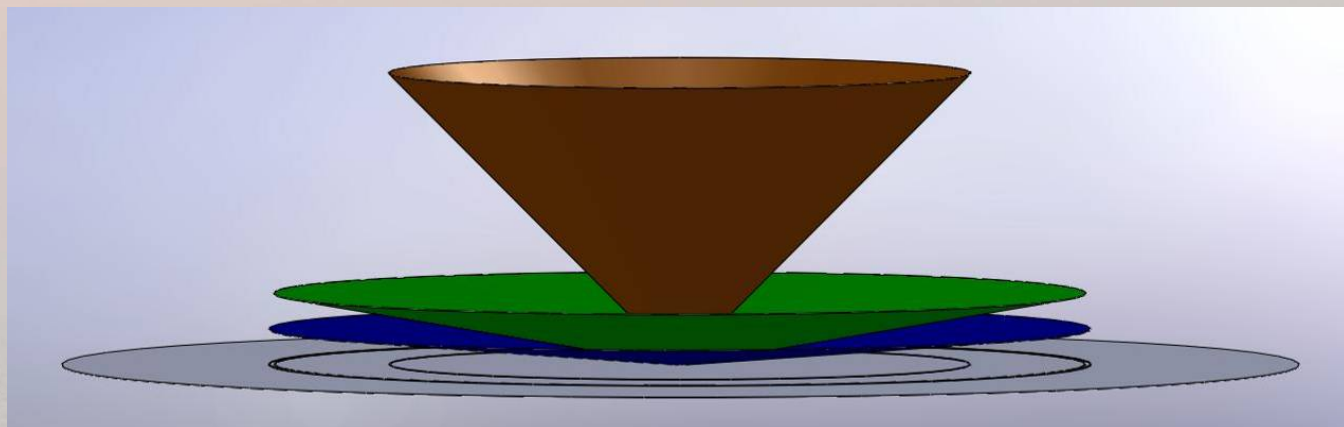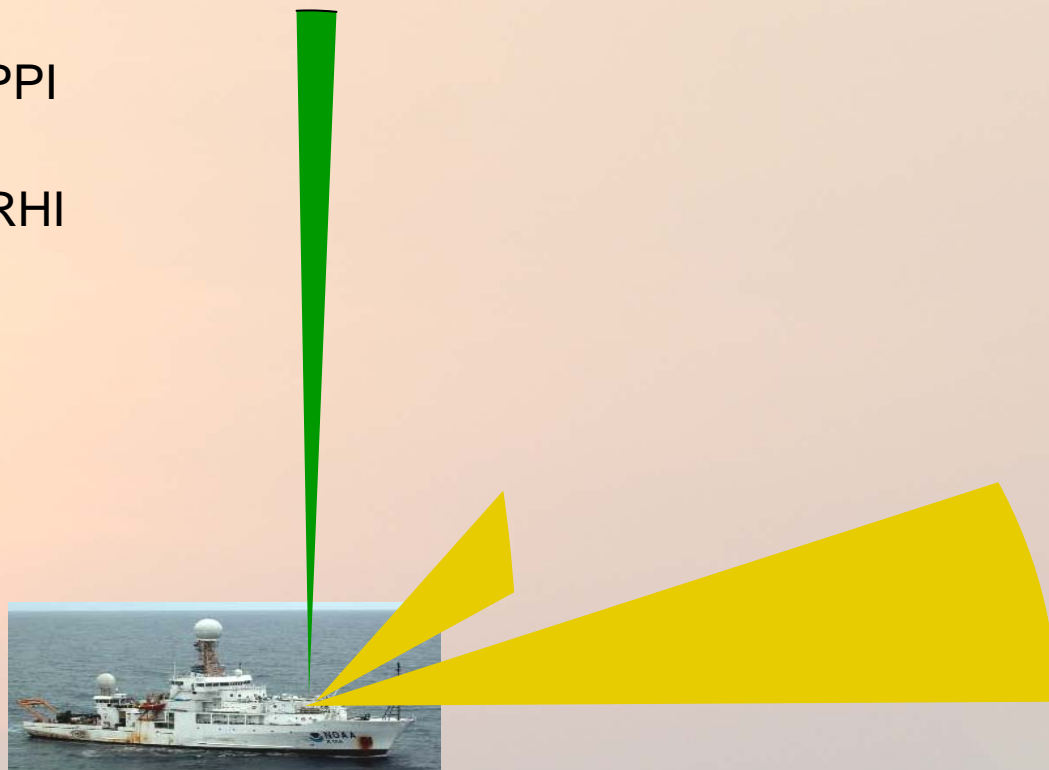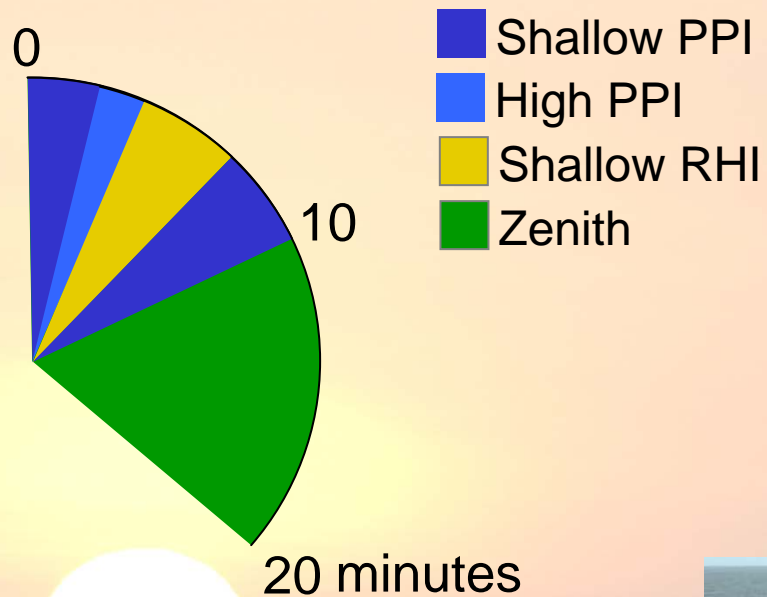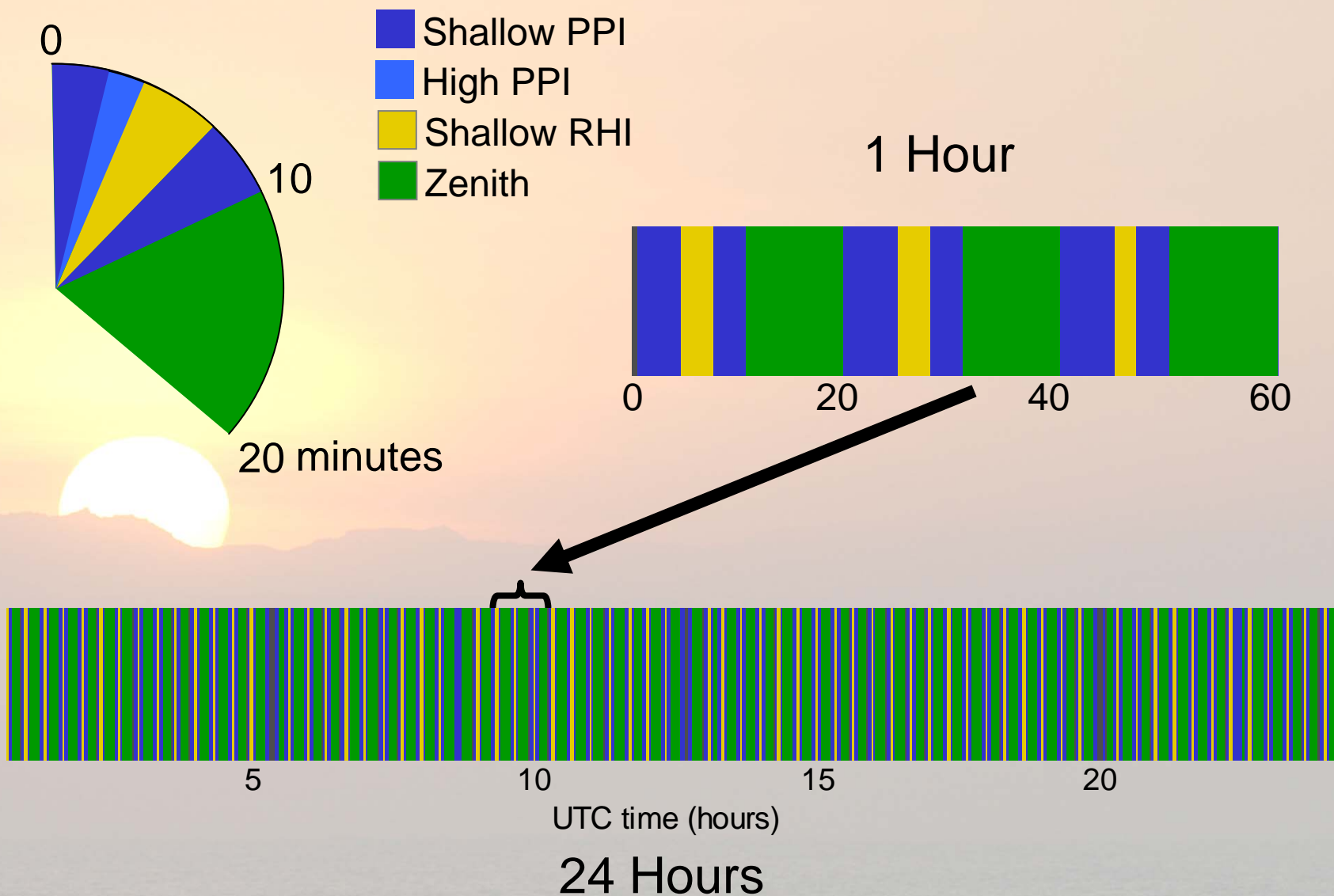- Typical 0.5 degree precision
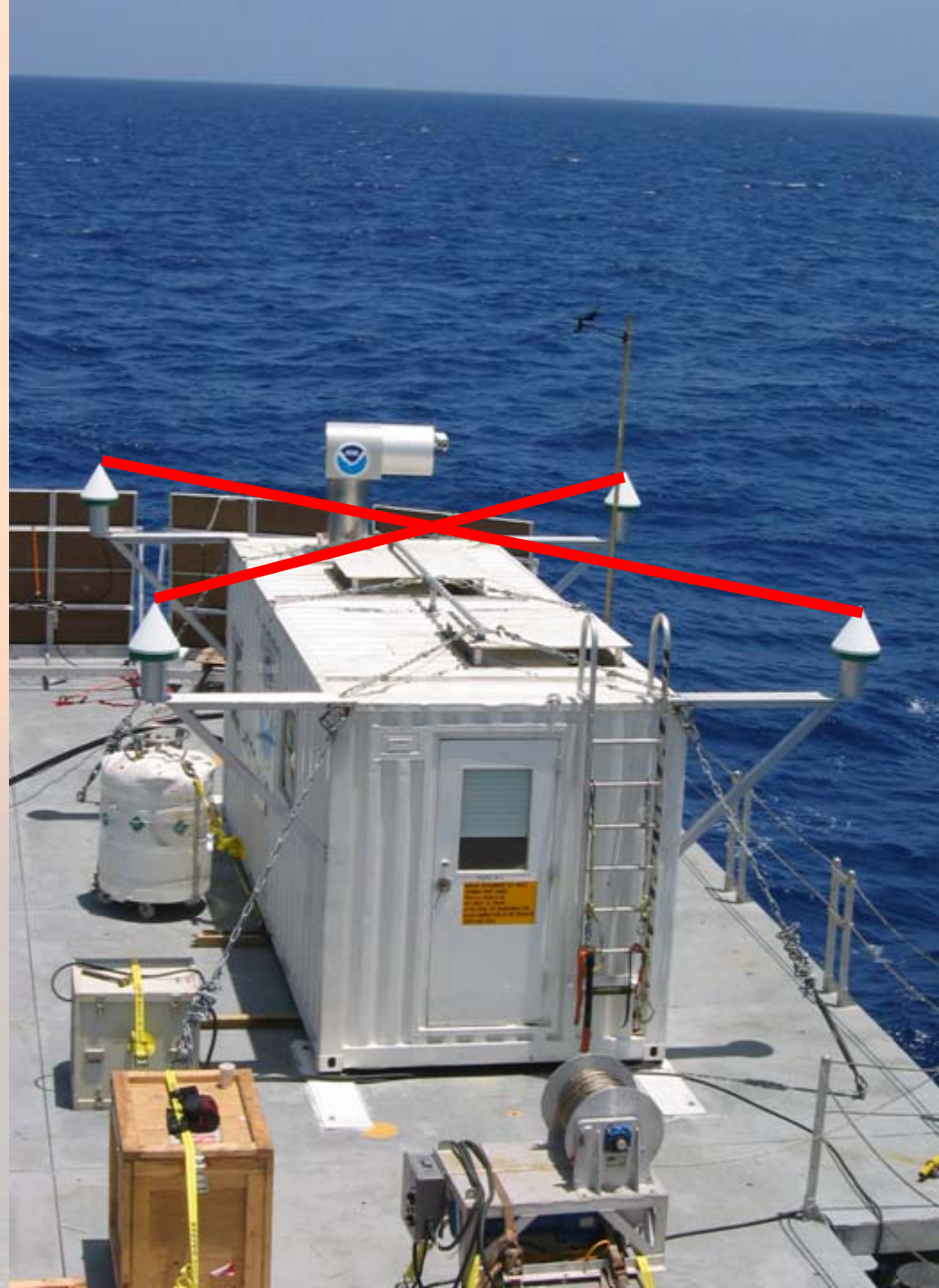
Typical operational mode :

- Continuous operation (24/7)
- Repeating scan sequence
- Automatic data analysis and display
- Post results in near real time to internal ship server and internet (when available).

A repeating 20 minute scan sequence

0

10

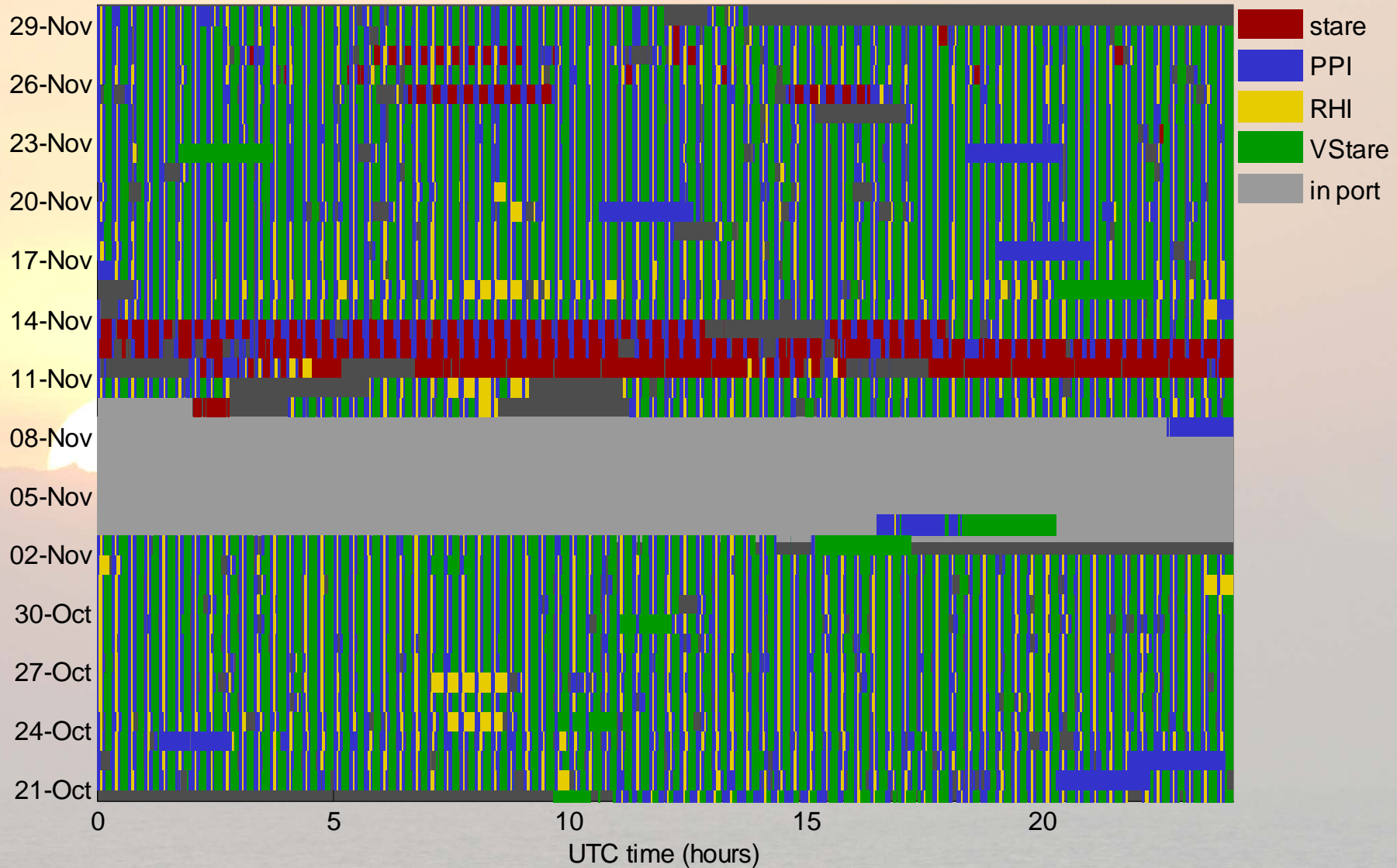20 minutes

Shallow PPI
High PPI
Shallow RHI
Zenith

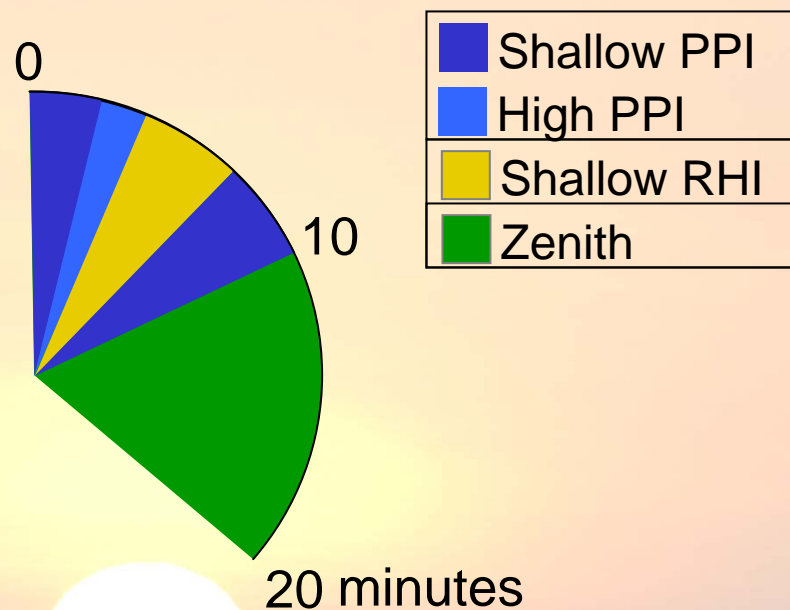A repeating 20 minute scan sequence

Continuous operation during VOCALS-Rex
21 Oct – 30 Nov 2008

HRDL RV Brown -VOCALS 2008: Scan Type vs. Date and Time
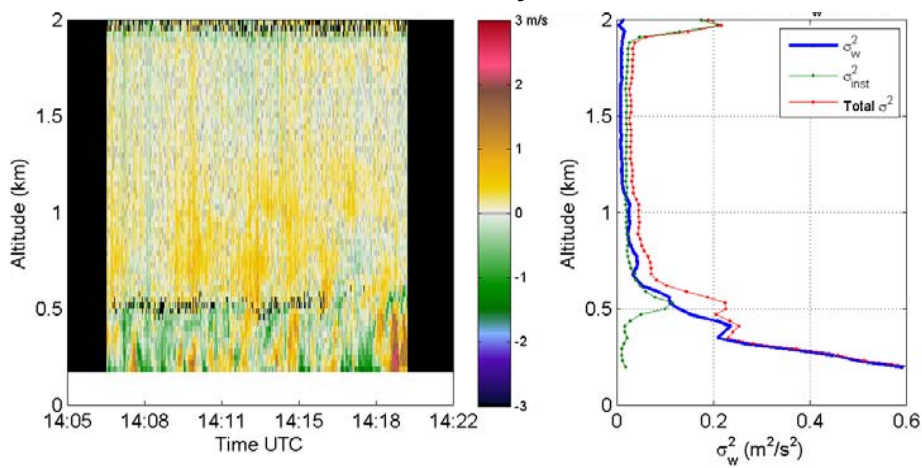
Continuous data products: Vertical Profiles

0

10

20 minutes

Shallow PPI
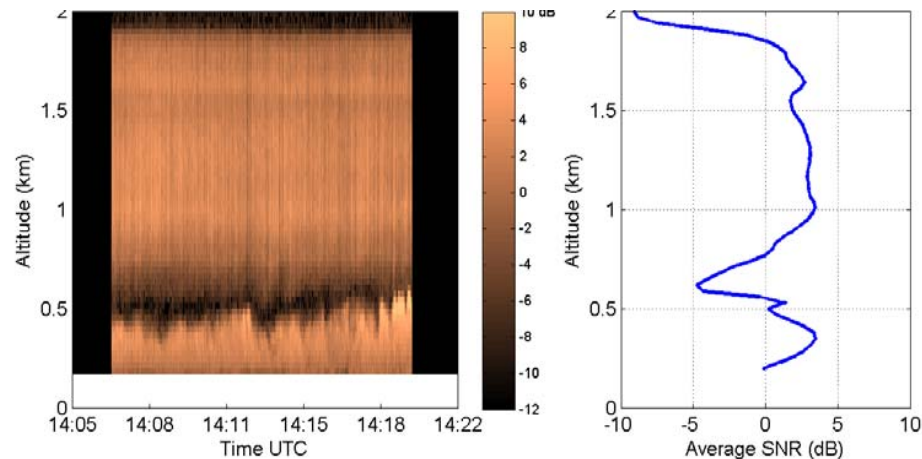High PPI
Shallow RHI
Zenith

Horizontal wind speed & direction
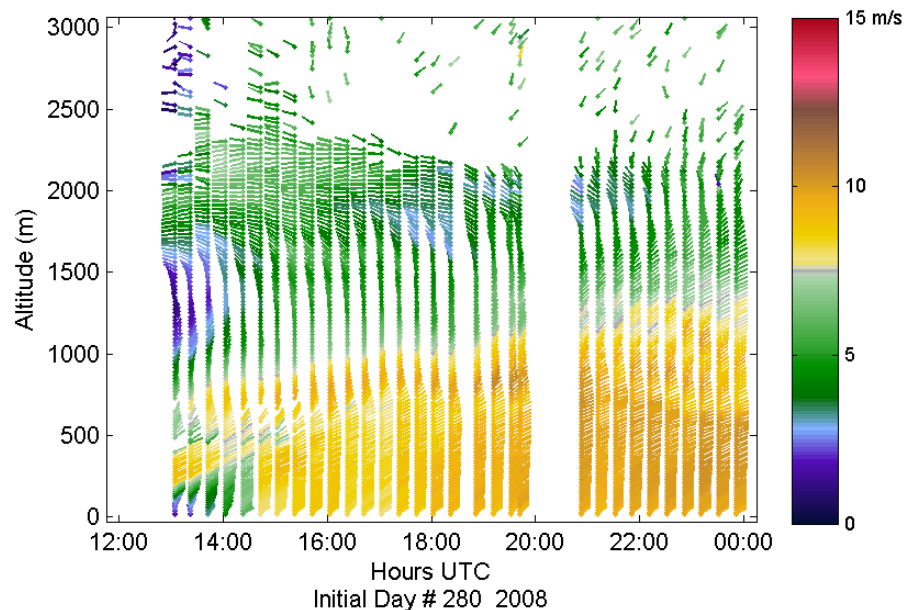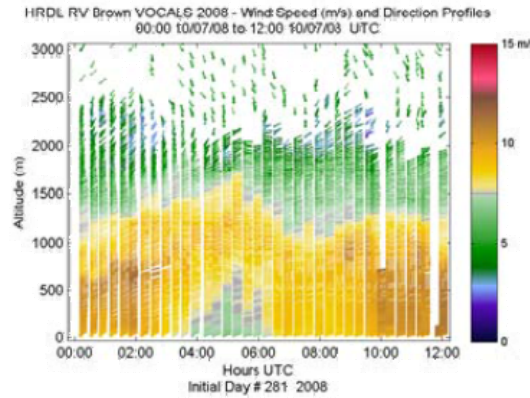
Vertical velocity variance
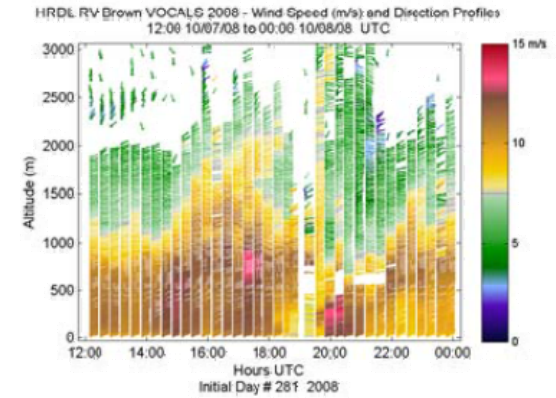
Aerosol backscatter signal strength

Real time processed results are uploaded to web every 20 minutes

24 hour profiles of:

Horizontal wind speed & dir
Backscatter intensity
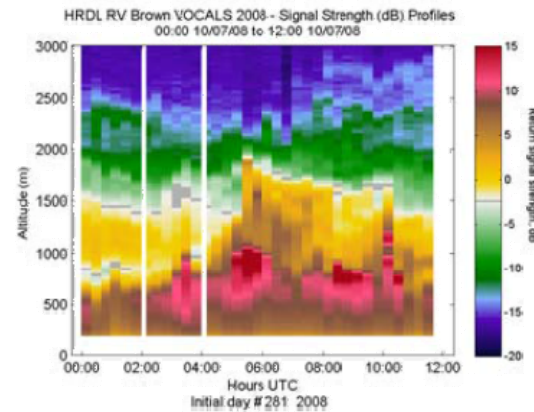Vertical velocity variance

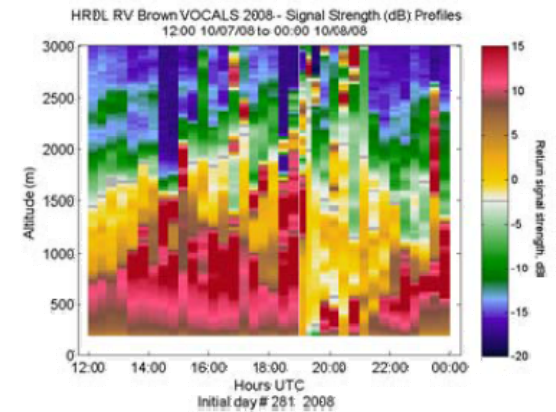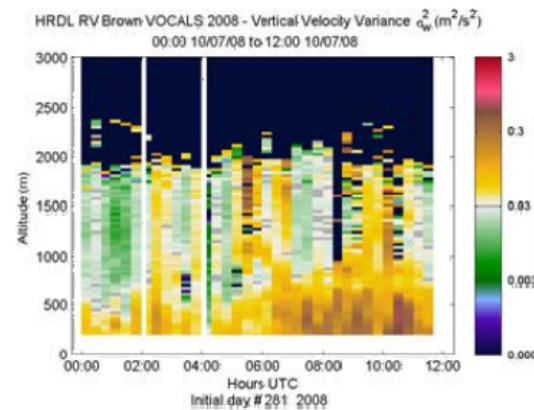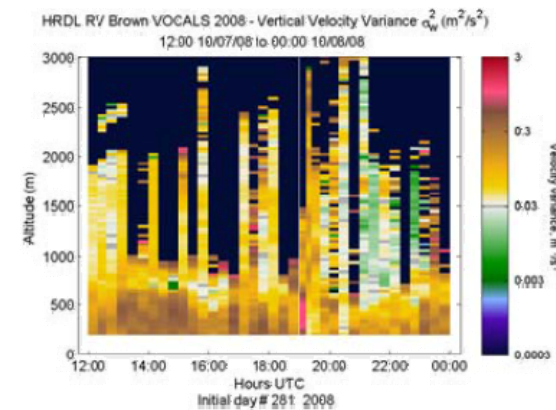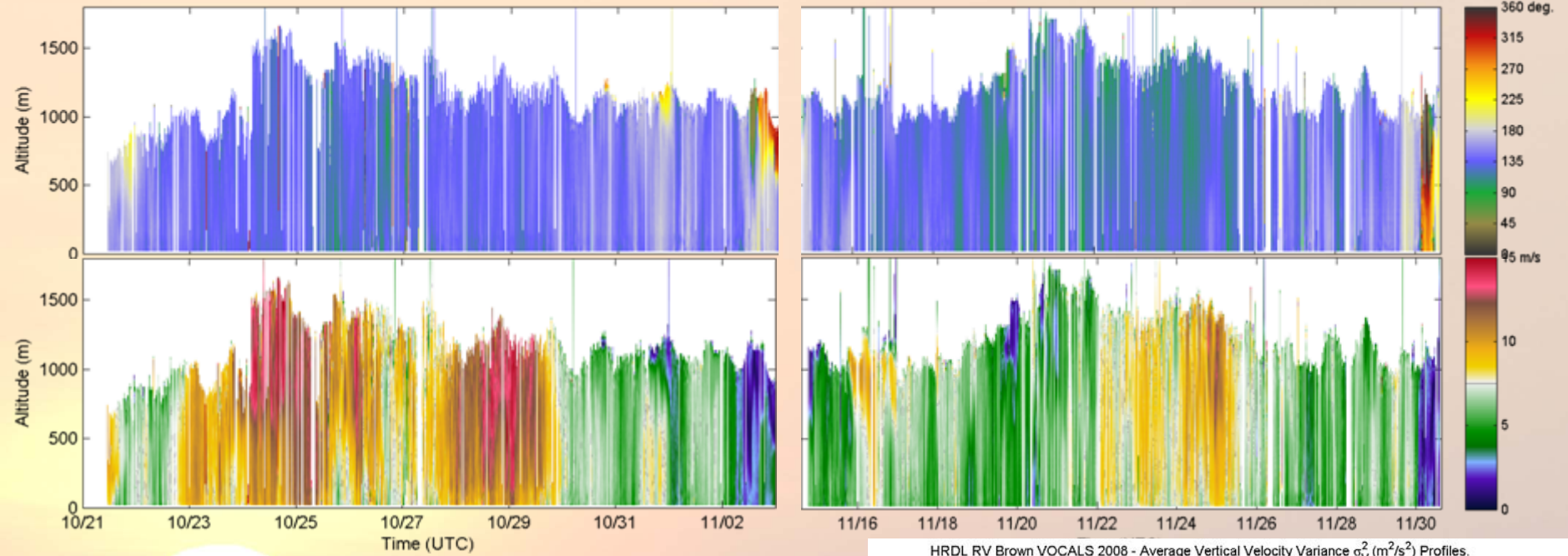**21 Oct – 30 Nov   Horizontal wind direction (top)   Horizontal wind speed (bottom)**

Long term, continuous coverage

- Boundary layer winds
- Turbulence profiles
- Mixed layer heights
- Atmospheric decoupling
- Sub cloud velocity statistics

HRDL RV Brown VOCALS 2008 - Average Vertical Velocity Variance σ_V^2 (m²/s²) Profiles.
21-Oct to 03-Dec 2008

HRDL RV Brown VOCALS 2008 - Average Vertical Velocity Variance σ_V^2 (m²/s²) Profiles.
09-Nov to 01-Dec 2008
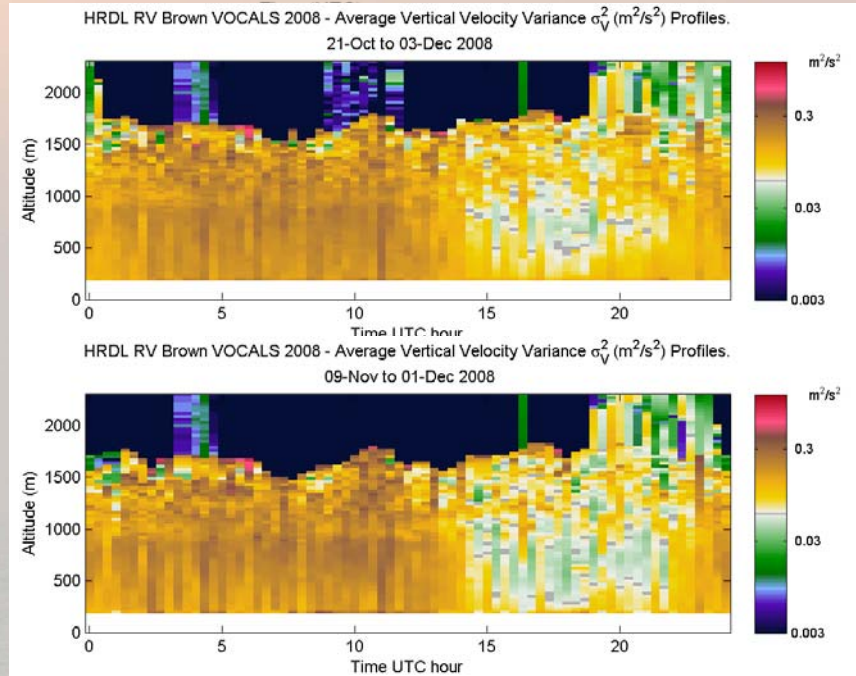
# Complex, time-evolving flow patterns (such as colliding precipitation outflows) can be studied with repeating, multiple plane scans

- Combining scanning data & vertically staring data
- Spatial distribution and temporal evolution of:
  - Line-of-site velocity fields
    - Residual wind field
    - Resolvable divergence field
  - 2 micron backscatter signal strength
    - Aerosol field
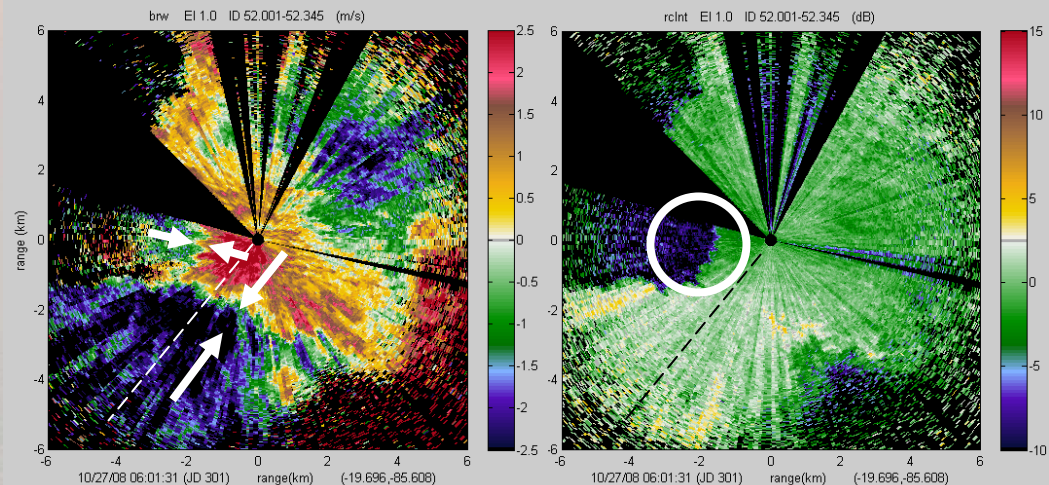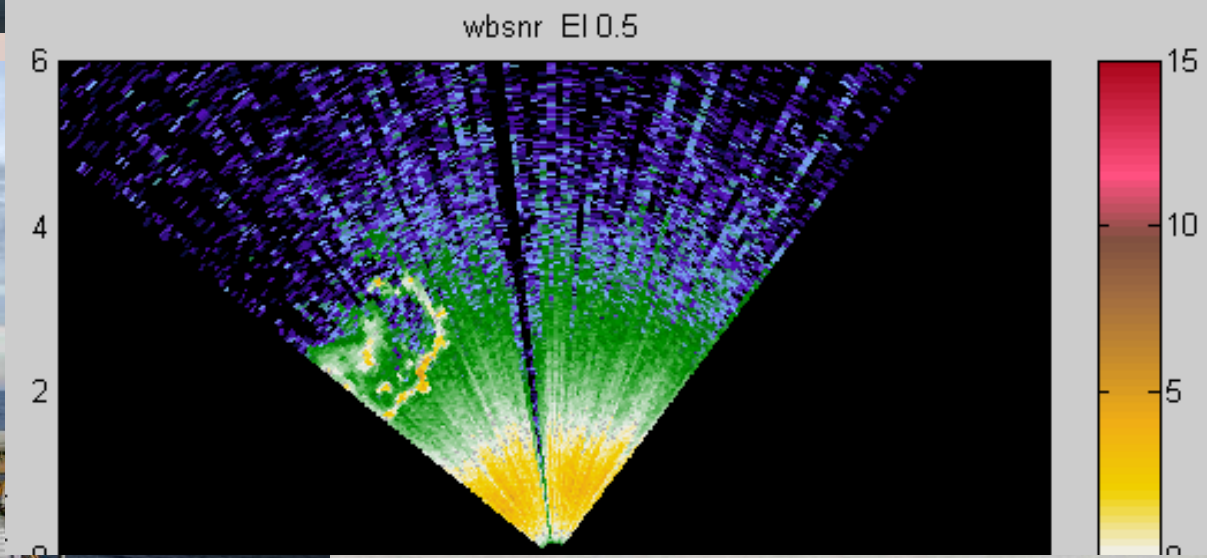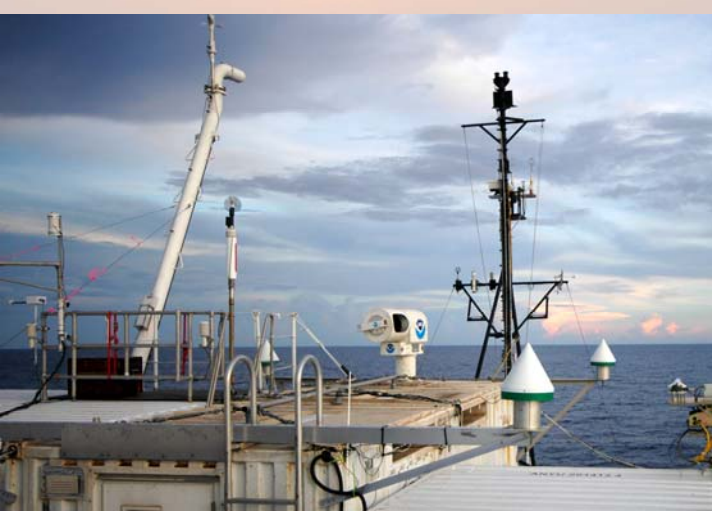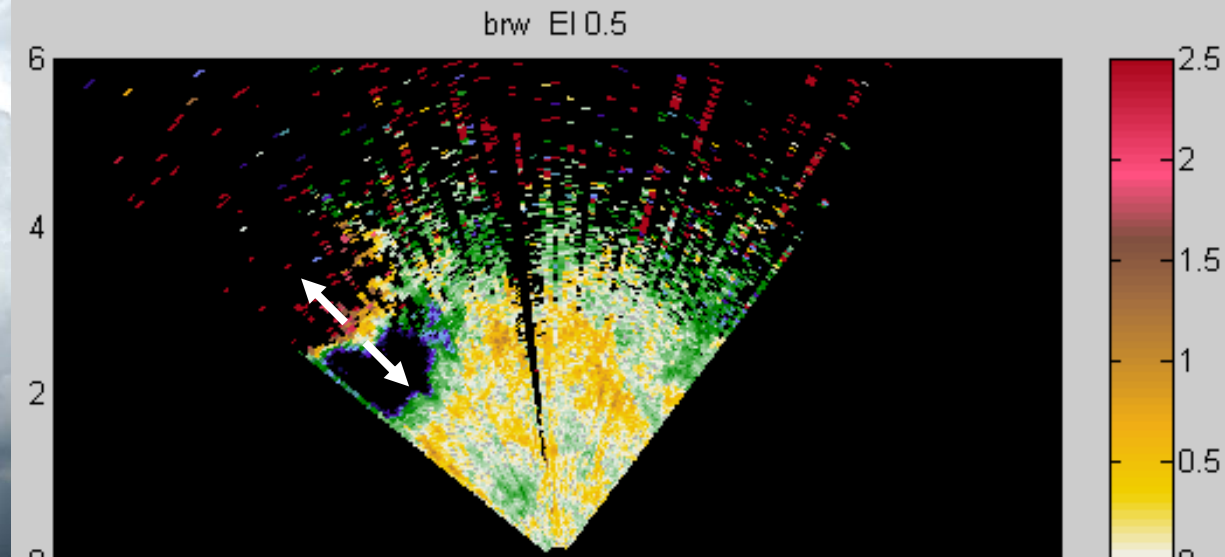   - Identification of different air masses

RHI
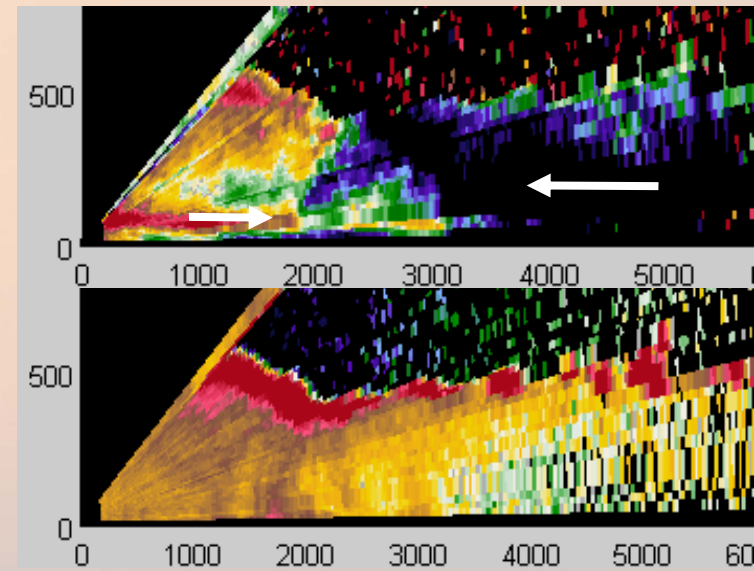
Zenith
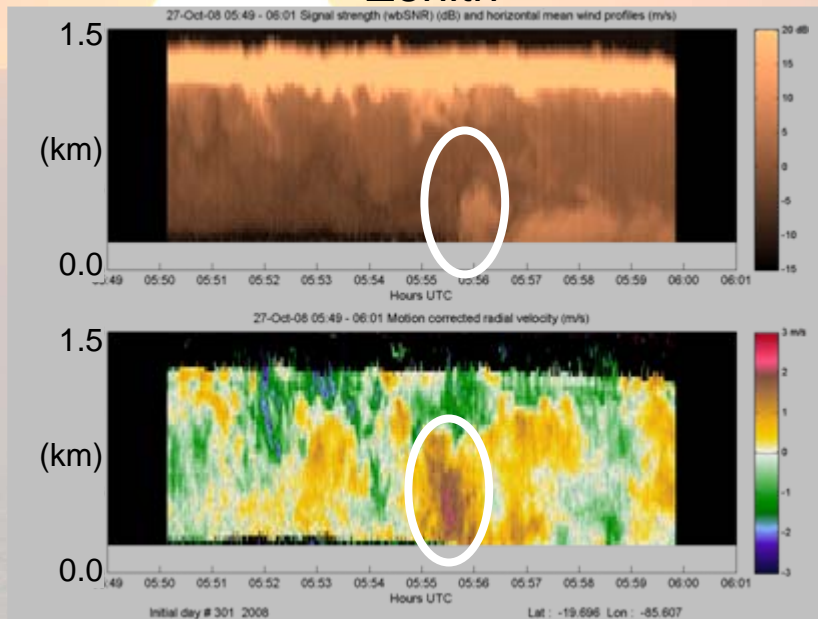
PPI

Precipitating Cumulus Outflow example : VOCALS-Rex Transit

Measurement capability combines
  Continuous monitoring
    - Vertical profiles
      – Horizontal wind fields
      – Vertical velocity variance - turbulence / mixing strength
      – Aerosol distribution - layering / mixing
    - BL mixing heights
    - Vertical velocity statistics

High temporal and spatial study of complex flow patterns
    - Precipitation initiation – convergence / uplift / vertical velocity
    - Sub convective cloud dynamics & aerosol – outflows

Combined measurements
    - Scanning C-Band
    - Vertically pointing W-Band
    - In-situ aerosol properties