

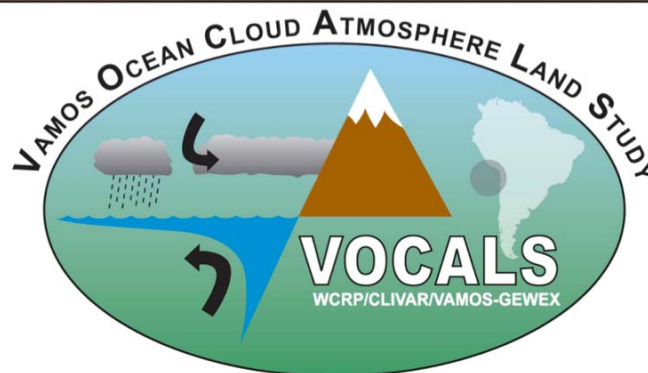
# Doppler Lidar Measurements Made From the RV Brown

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## Acknowledge:

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Chris Fairall, Derek Coffman, Dave Covert



Earth Systems Research Laboratory

# The NOAA/ESRL HRDL High Resolution Doppler Lidar

- 2 micron Coherent Doppler Lidar
  - Line of site wind speed
  - Aerosol backscatter sig strength
- 30 m / ½ second resolution
- 6-7 km typical range
- Motion stabilized scanning



# Measurement Strategy : Two Paths

## Resolvable features

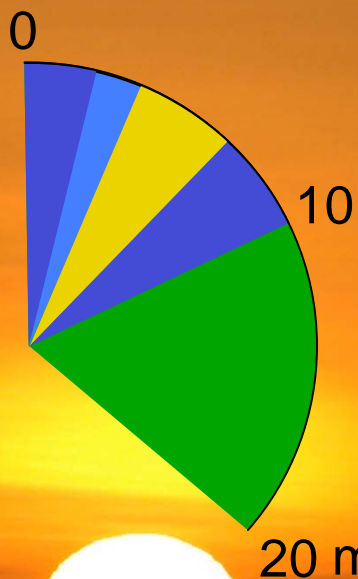
- Spatial distribution and temporal evolution of aerosol and wind field (30m – 12km)
- Rapid acquisition to track spatial and temporal coherence (0.5 second – 10 minutes)

## Averaged Quantities / Profiles

- Periodic scans to calculate average vertical profiles
- Longer acquisition for better statistics
- Continuous coverage



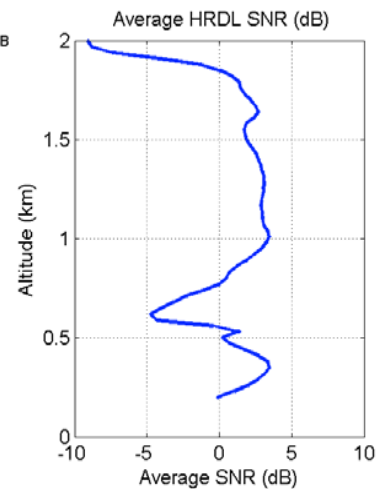
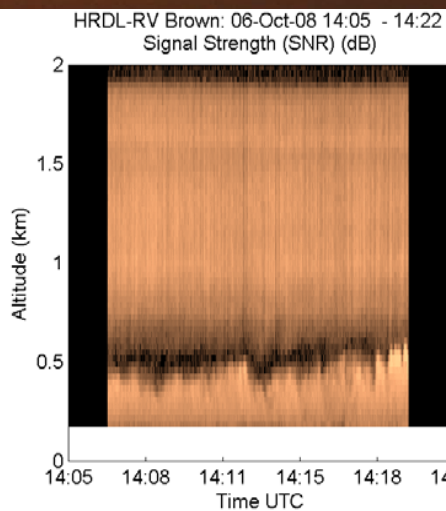
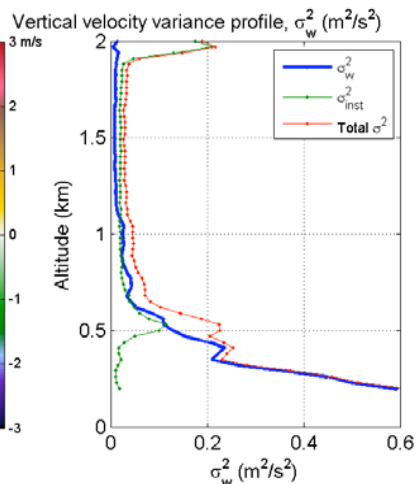
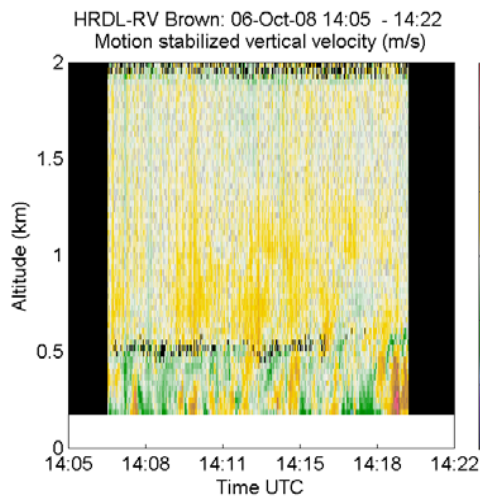
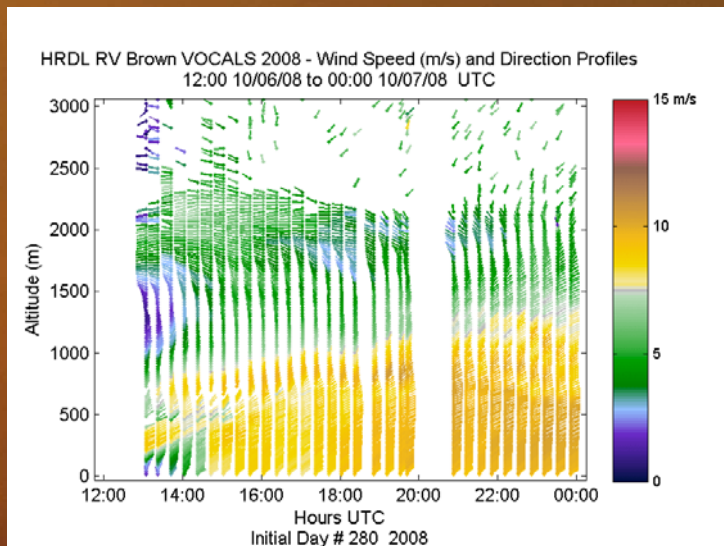
# 20 minute Scan Sequence : Average Profiles



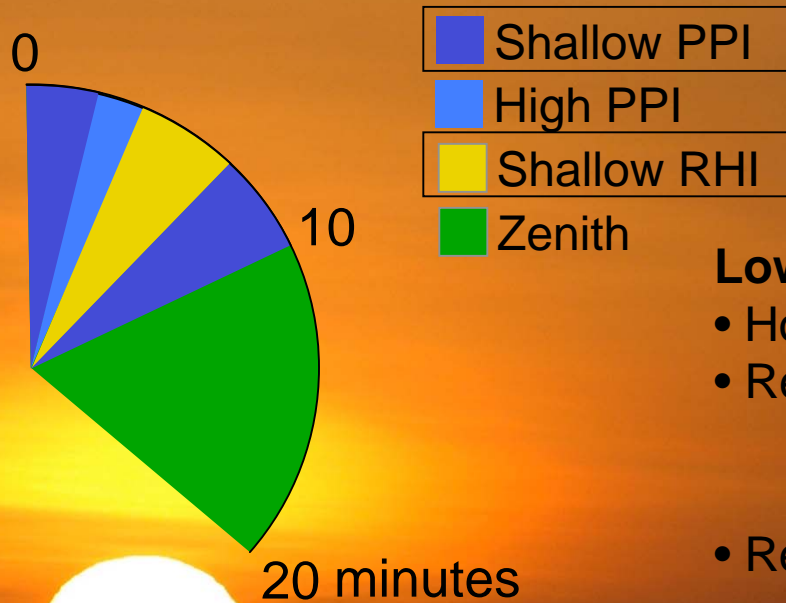
## Vertical Profiles

- Hor. windspeed & Dir
- Vert. vel & vel variance (dc)
- 2 micron backscatter int

20 minutes

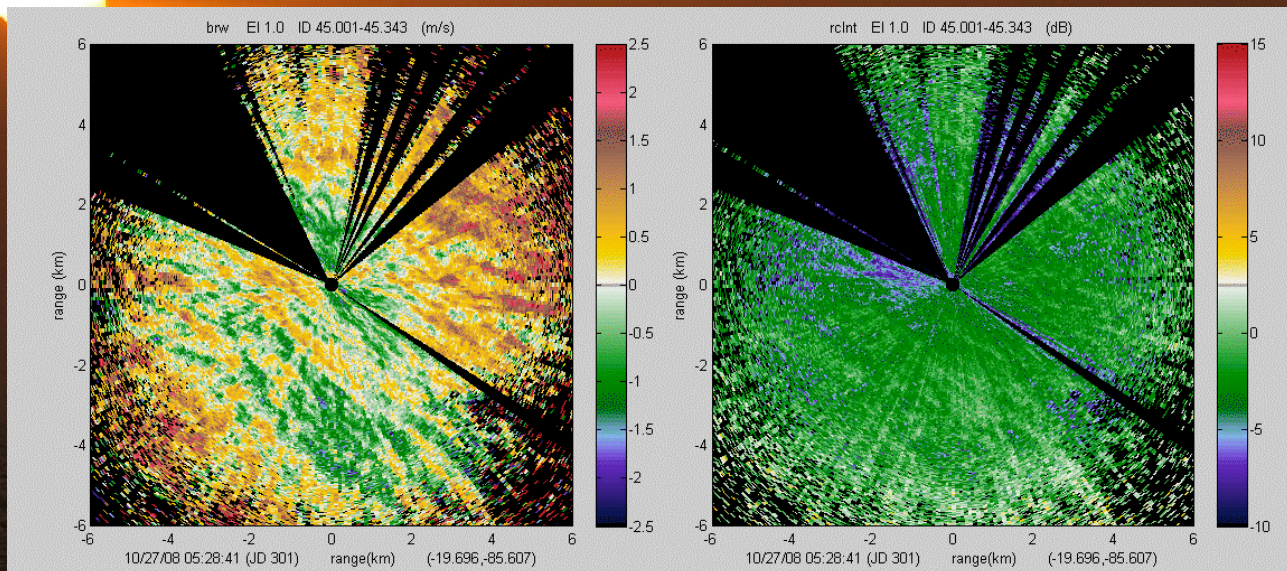


# 20 minute Scan Sequence : Resolvable fields

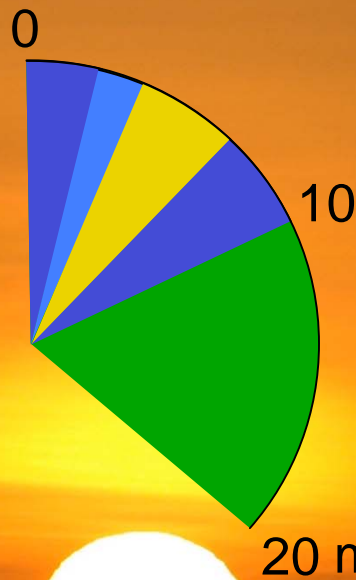


## Low Angle Horizontal / Vertical scans

- Horizontal Distribution of Backscatter Intensity
- Residual radial windfield
  - Convergence
  - Vorticity
- Revisit every 7-10 minutes (spatial and temporal coherence)

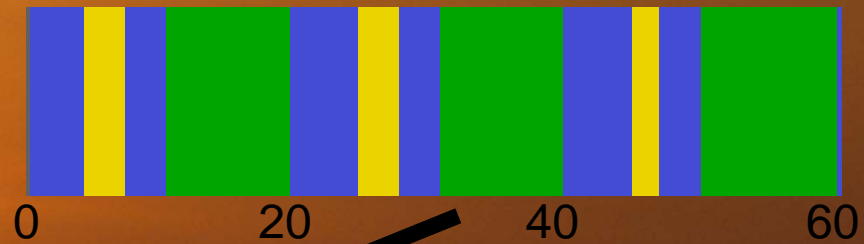


# Repeating 20 minute Scan Sequence

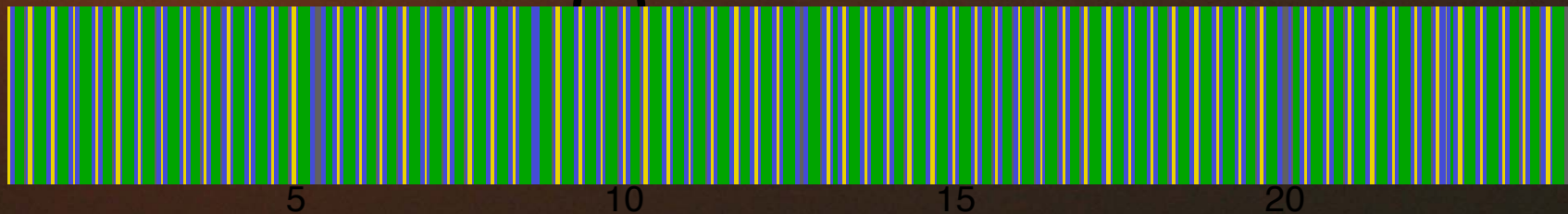


- Shallow PPI
- High PPI
- Shallow RHI
- Zenith

1 Hour



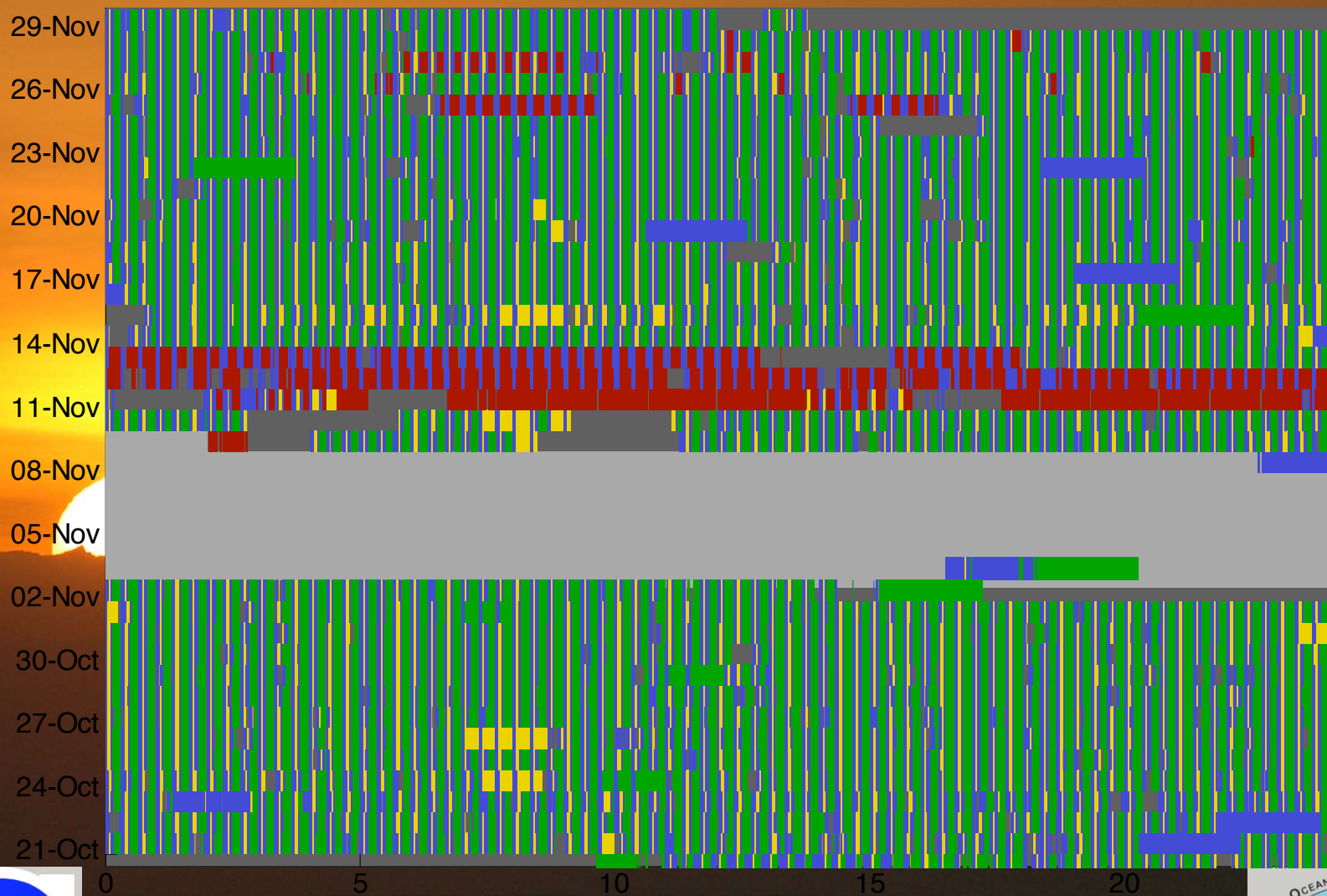
20 minutes



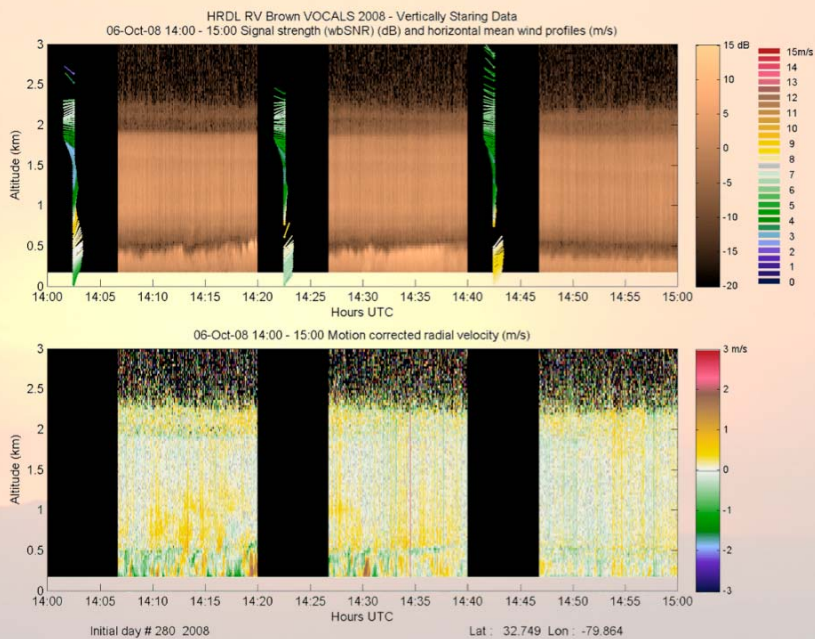
24 Hours



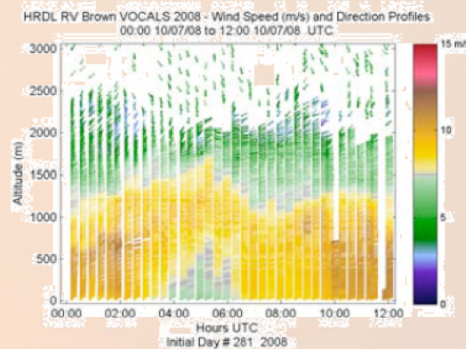
# Continuous operation 21 Oct – 30 Nov 2008



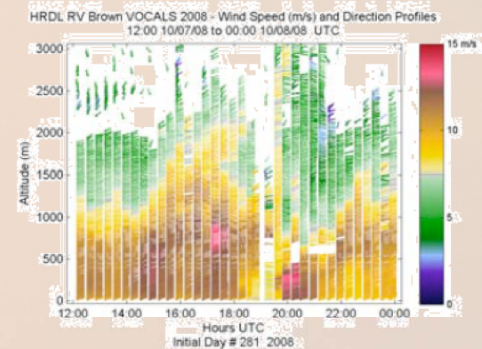
Realtime processed results were uploaded to web every 20 minutes



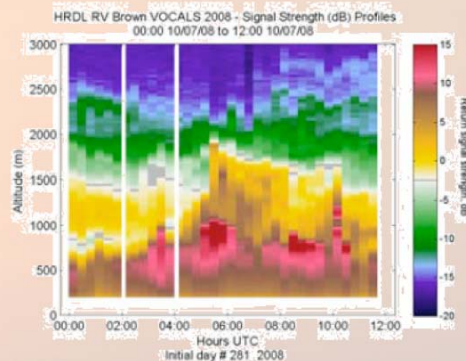
Wind Speed and Direction



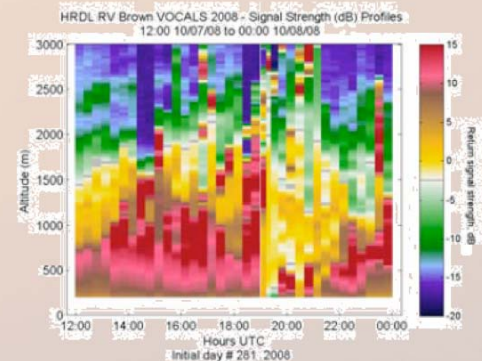
Wind Speed and Direction



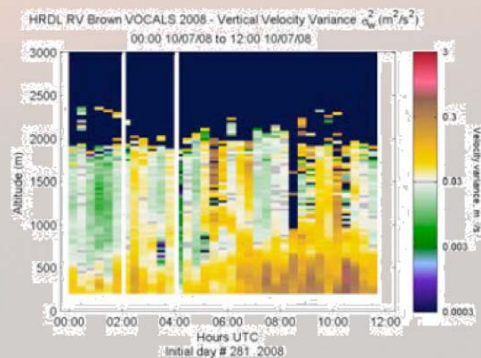
Signal Strength



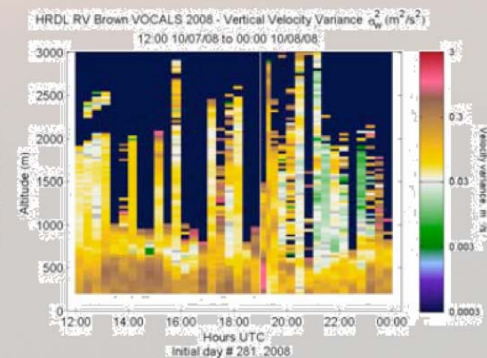
Signal Strength



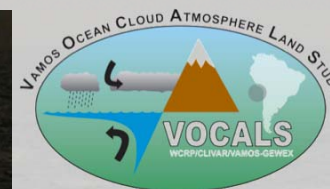
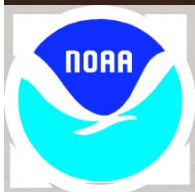
Vertical Velocity Variance



Vertical Velocity Variance



<http://esrl.noaa.gov/csd/lidar/vocals/latest.html>





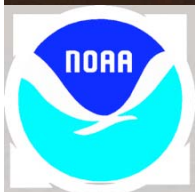
Example:

## Combined measurements to investigate the dynamics of colliding outflows

- Doppler Lidar
  - Residual velocity
  - Aerosol Backscatter signal strength
- C-Band Radar
- W-Band Radar
- In-situ Aerosol Properties

Open Cell Convection

27 Oct 2008



# Using LES models to study open cell convection

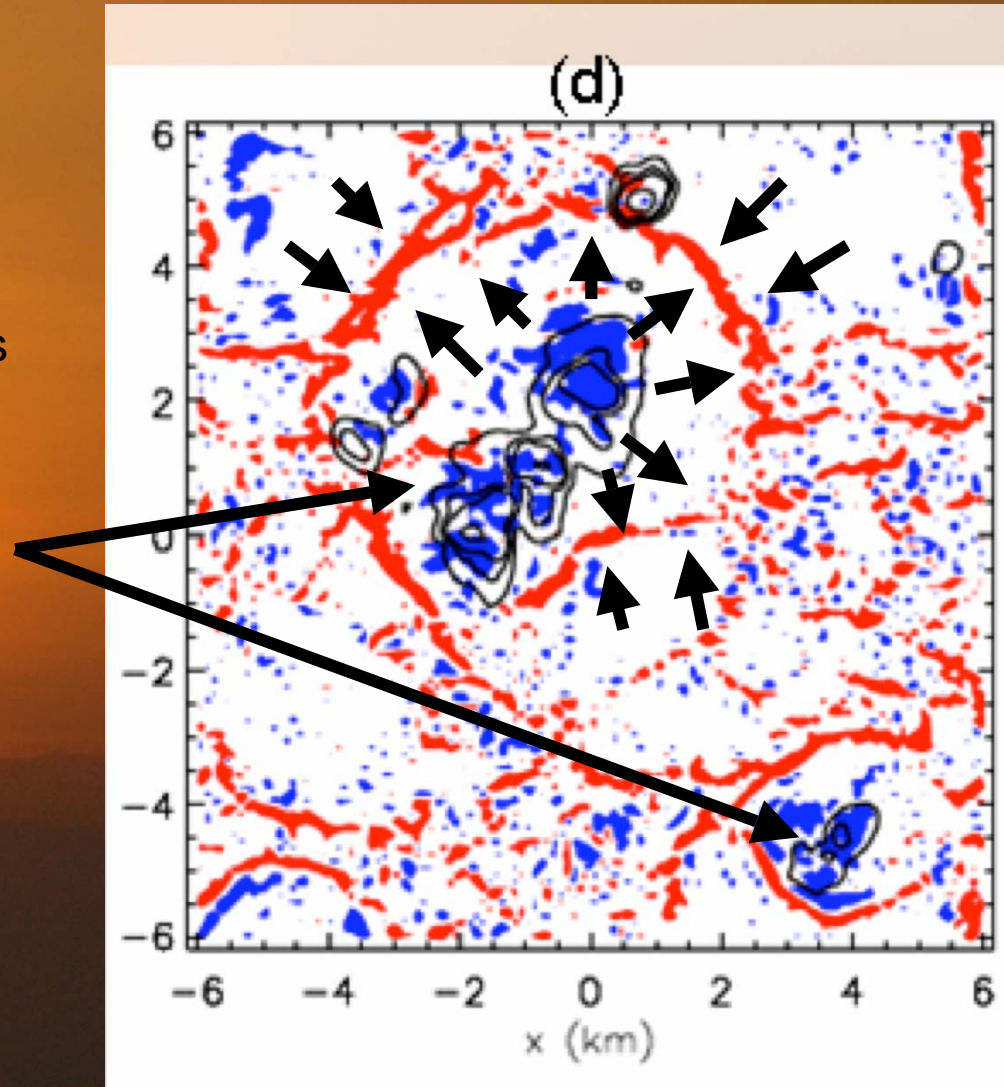
## Important Factors :

- Dynamics
- Precipitation
- Aerosol distribution and properties
- Thermodynamic properties

Precipitation – black

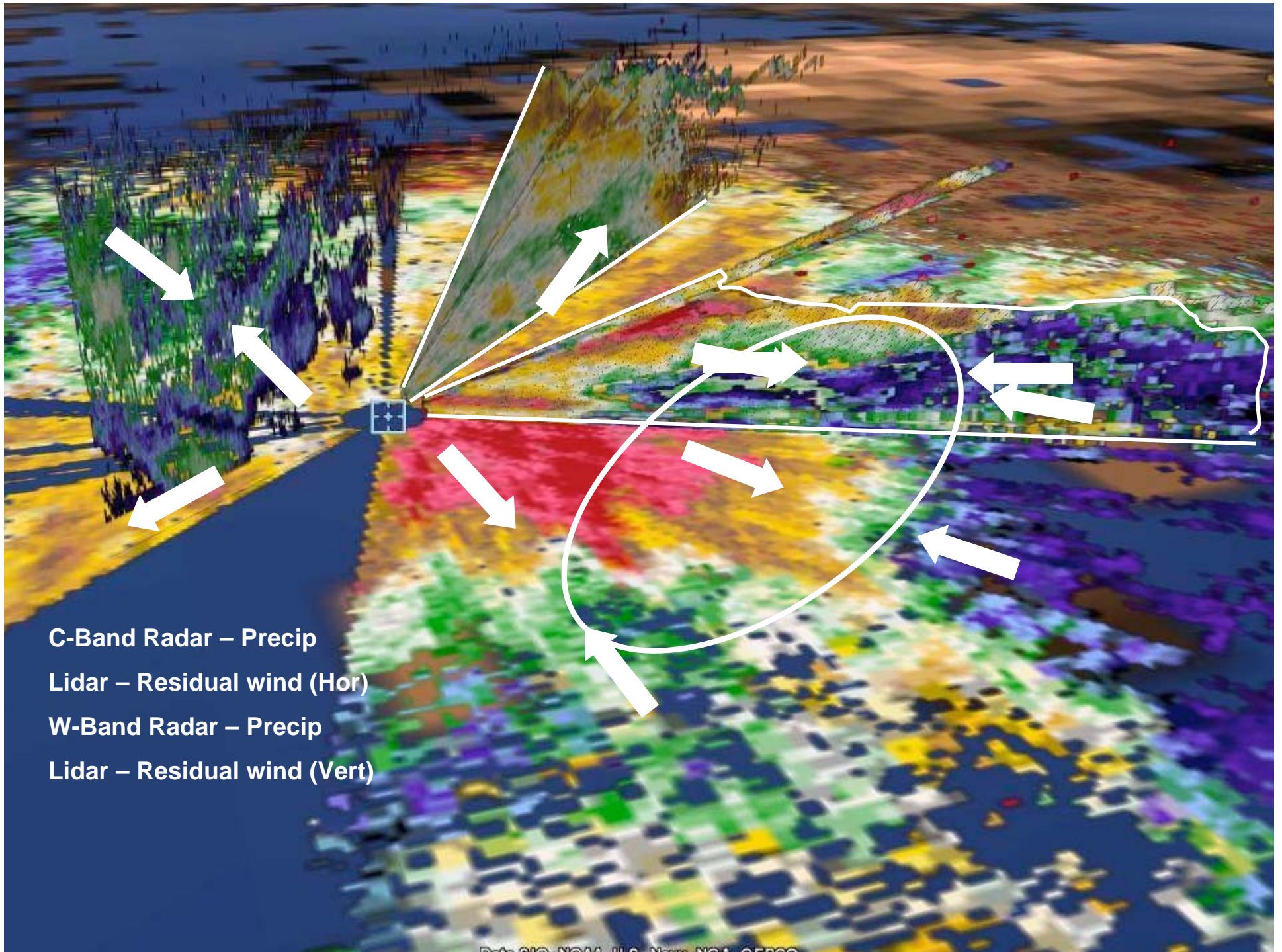
Surface divergence – blue

Surface convergence - red



Graham Feingold  
Hailong Wang  
Huiwen Xue





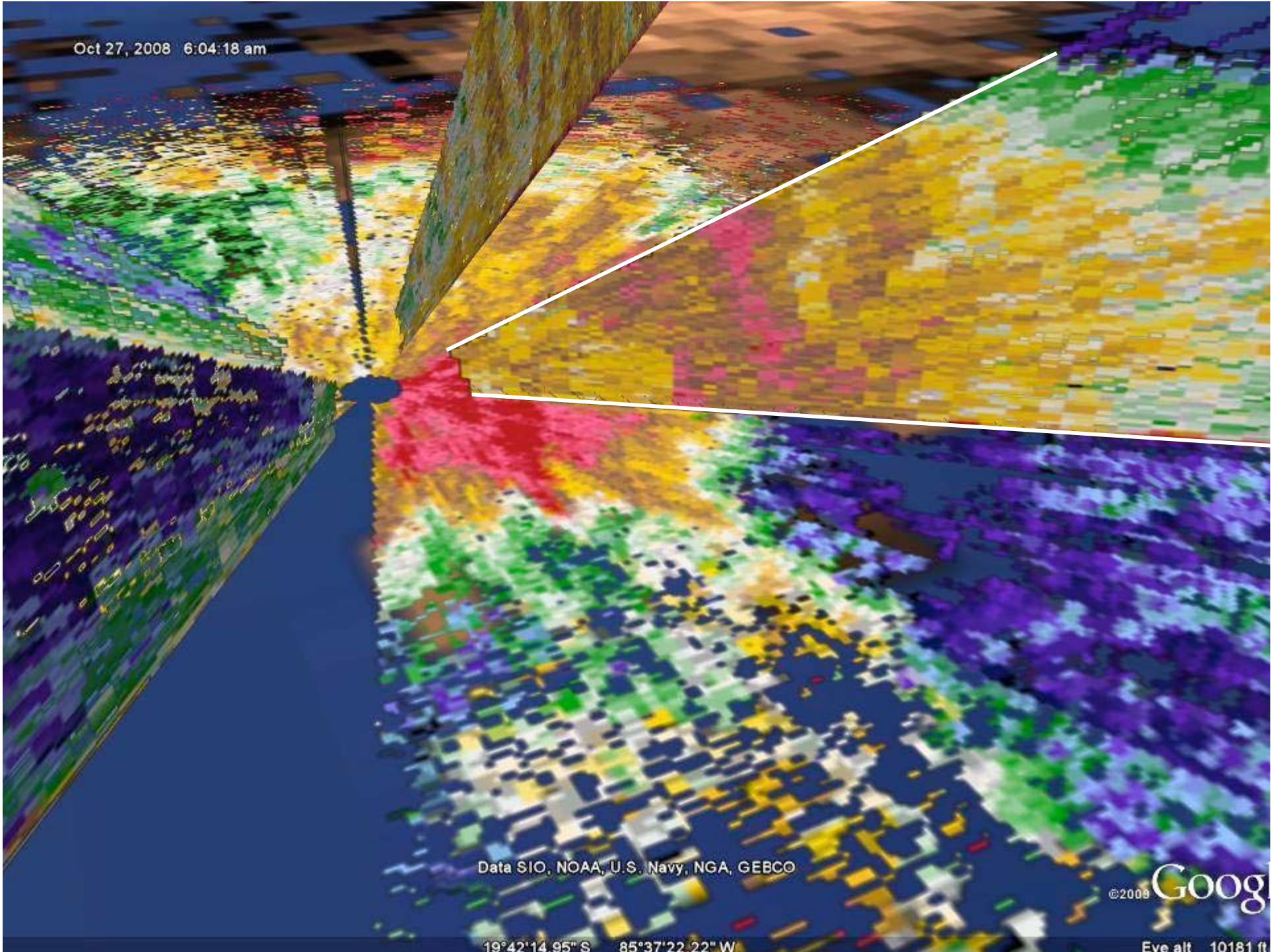
C-Band Radar – Precip  
Lidar – Residual wind (Hor)  
W-Band Radar – Precip  
Lidar – Residual wind (Vert)

# Ship based measurements



C-Band Radar – Precip

Oct 27, 2008 6:04:18 am



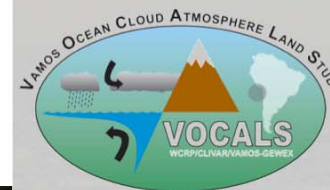
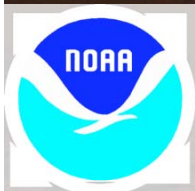
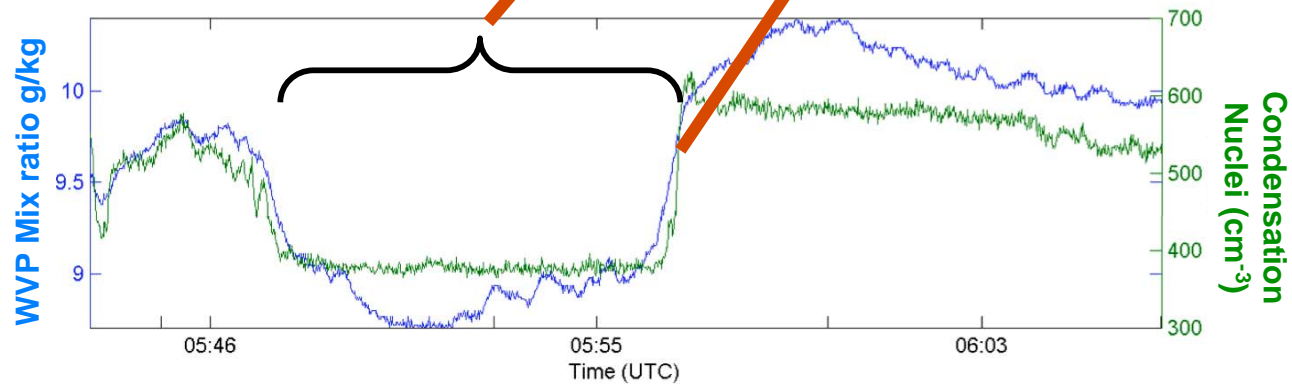
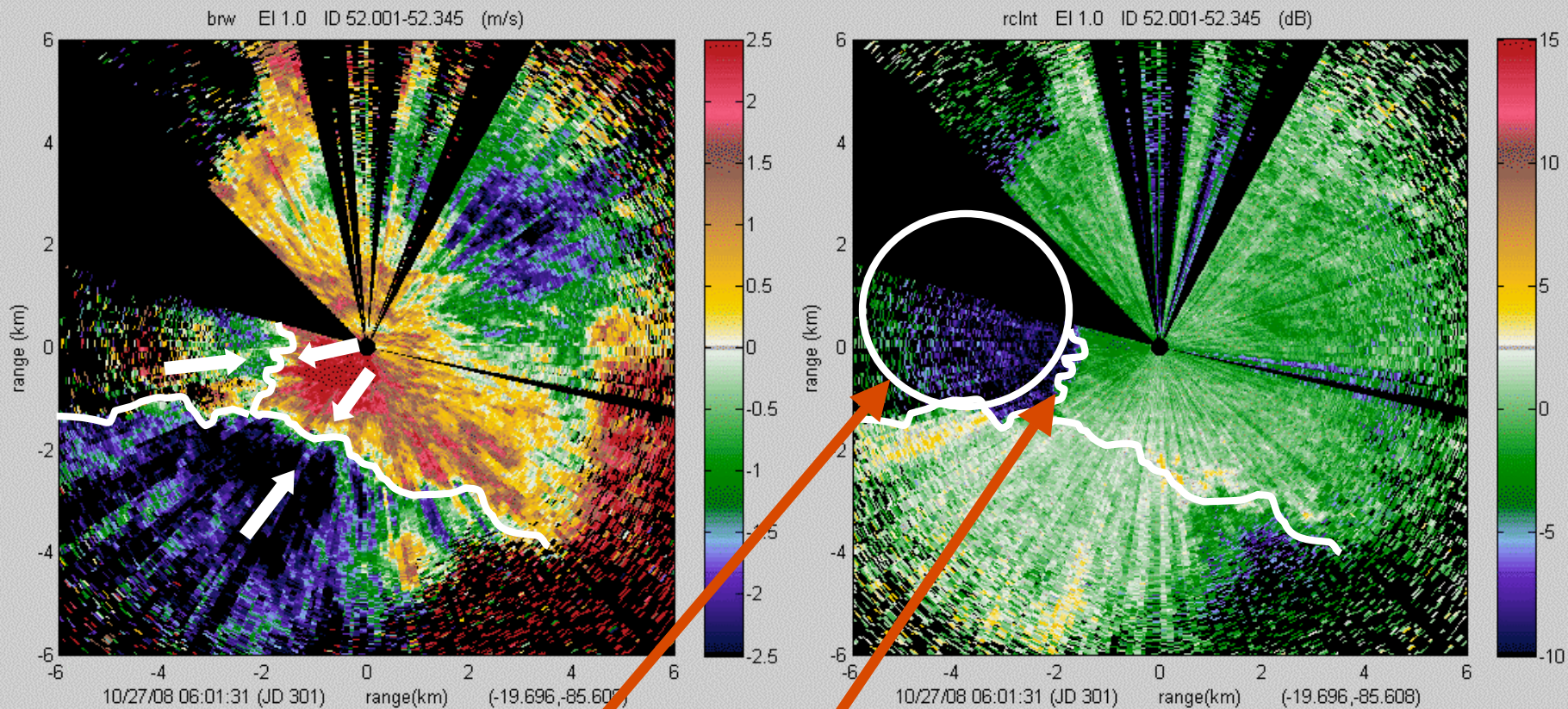
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

©2008 Google

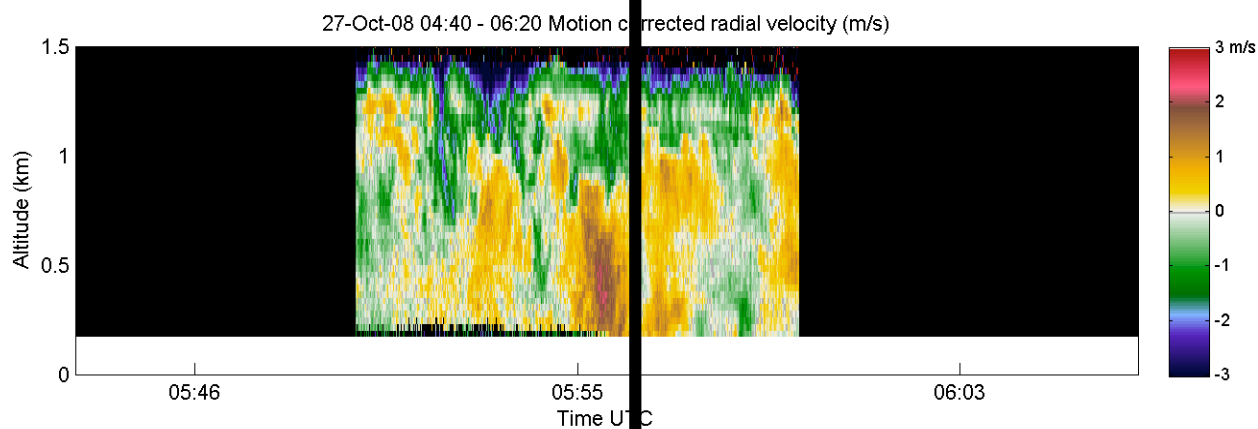
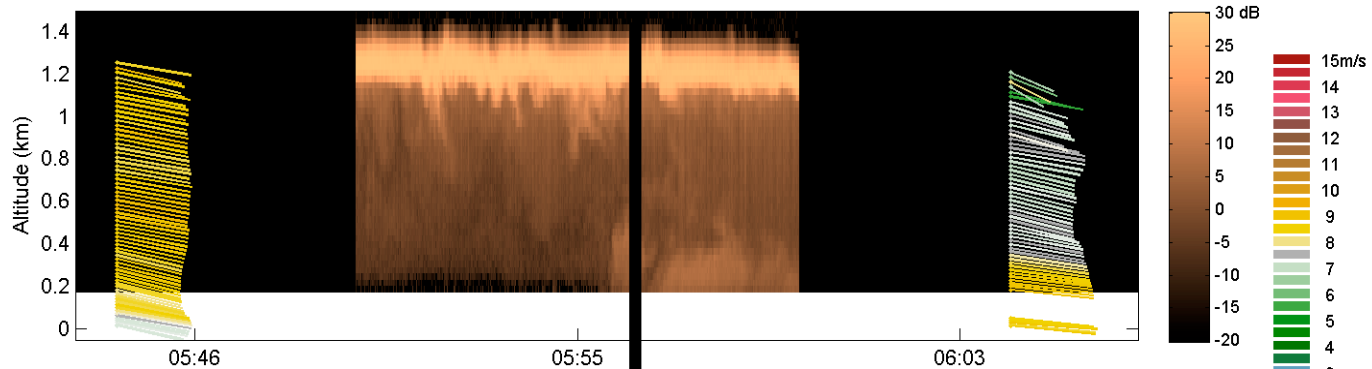
19°42'14.95" S 85°37'22.22" W

Eye alt 10181 ft

# Convergence of 3 air masses

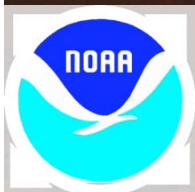
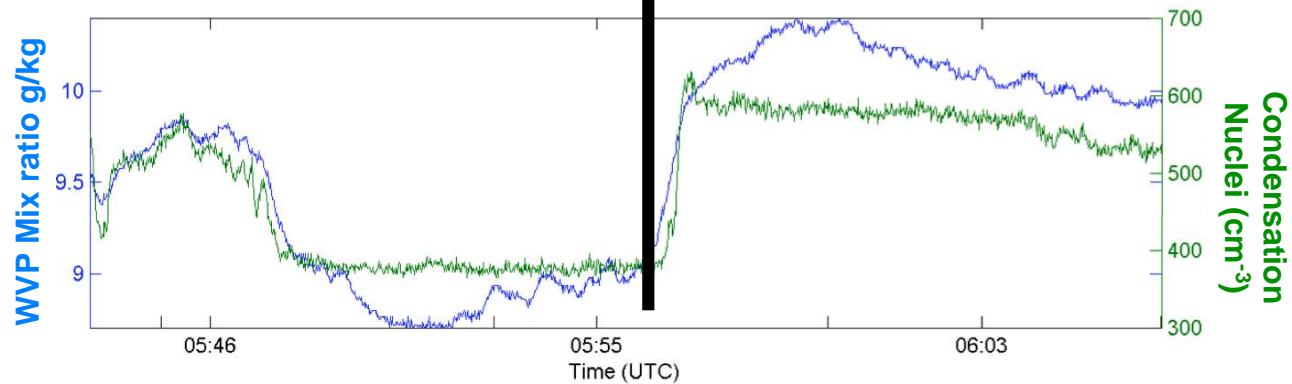


HRDL RV Brown VOCALS 2008 - Vertically Staring Data  
 27-Oct-08 04:40 - 06:20 Signal strength (wbSNR) (dB) and horizontal mean wind profiles (m/s)



Initial day # 301 2008

Lat : -19.696 Lon : -85.607



# Summary

- HRDL measurement overview / strategy
- Monitoring
  - Realtime Average Profiles
  - Post Processed Time Series
- Case driven observational studies
  - Combining data sets & models
  - Visualization
  - Sweep averaged quantities









# Combining lidar and w-band radar vertical measurements

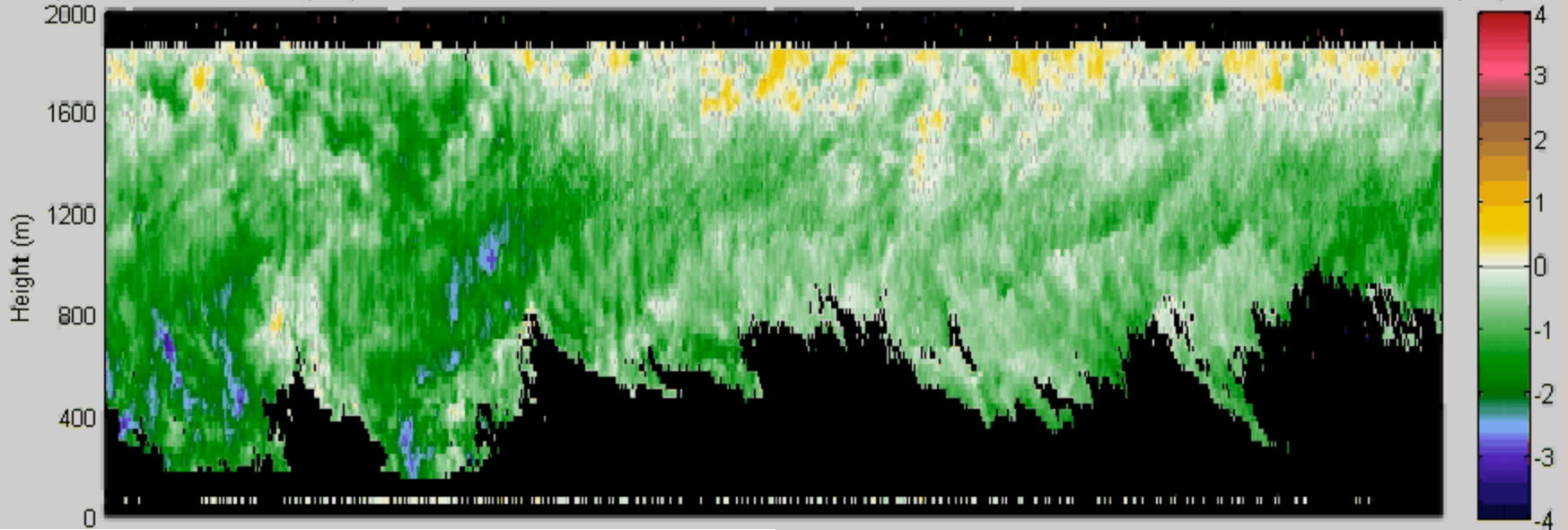
- Light drizzle conditions
- Radar : Large drops ( $w + V_{\text{drop}}$ )
- Lidar: Small particles ( $w$ )
- Combine to determine  $V_{\text{drop}}$  (dBz)
- Lidar: clear air  $w$  / Radar: in cloud  $w$



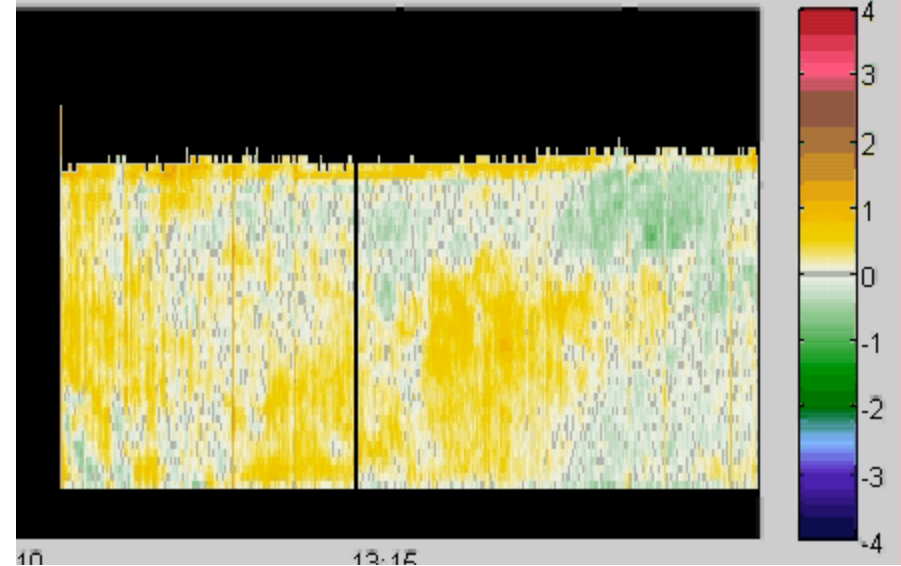
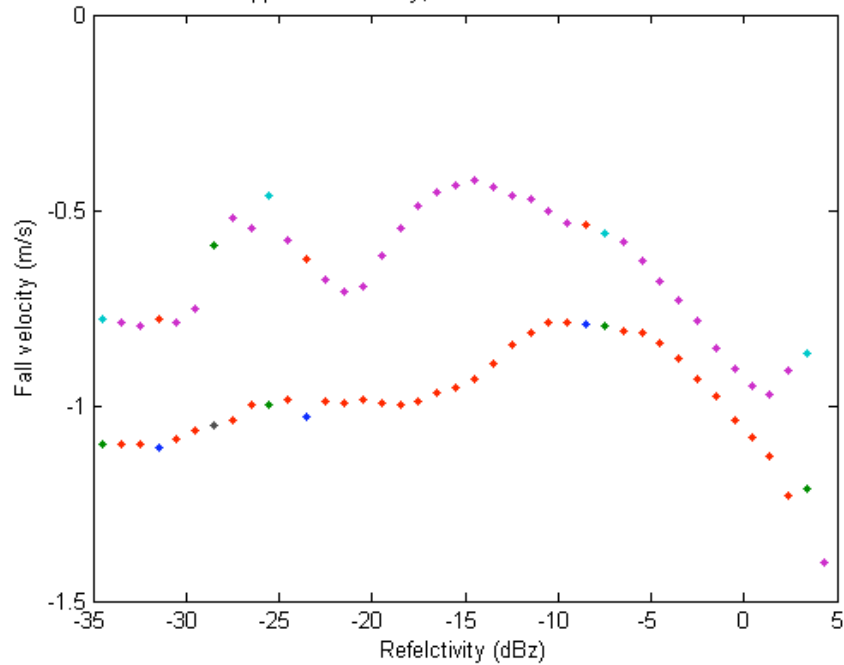
HRDL & Wband Zenith Data

Top: WBand MC Vert Vel (m/s)

Bot: Lidar Thresh Vert Vel (m/s)

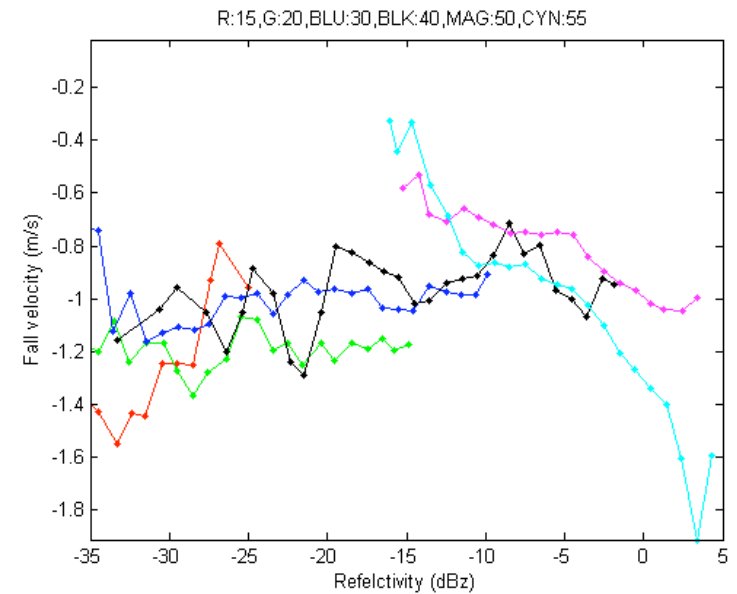
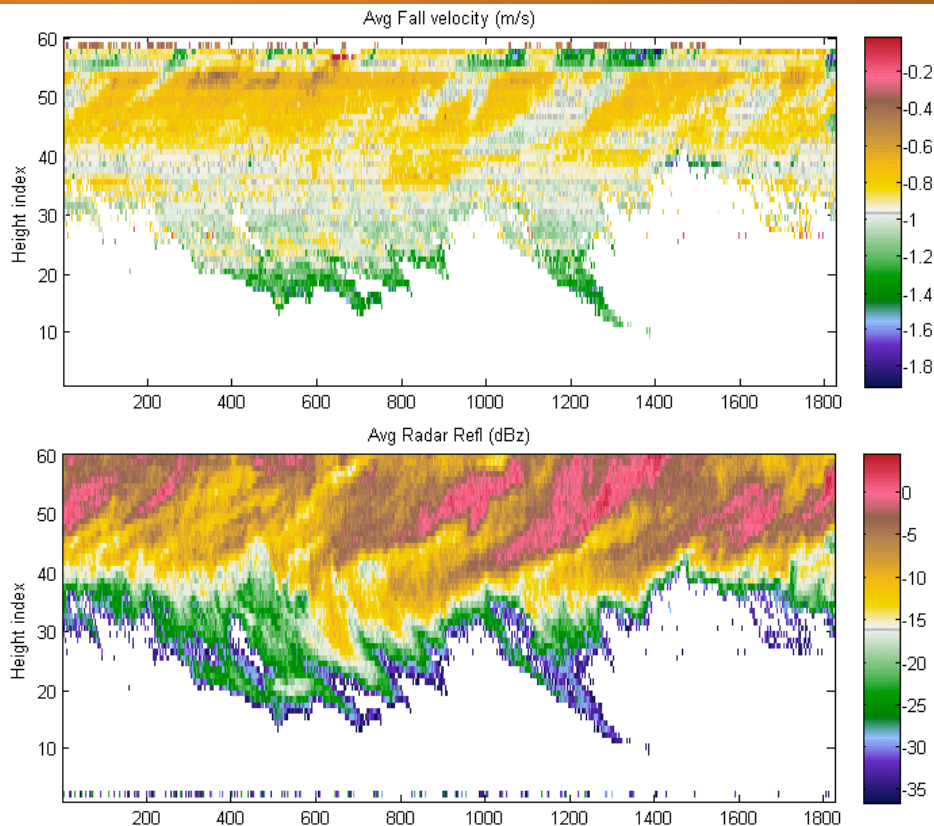


Upper radar V only, lower with Lidar correction



$V_{\text{drop}}$  as a function of dBZ

# $V_{\text{drop}}$ (dBz) as a function of height



Height Index  
Red: 15  
Green: 20  
Blue: 30  
Black: 40  
Magenta: 50  
Cyan: 55

