

# High-Altitude Imaging Wind and Rain Airborne Profiler (HIWRAP) Measurements During GRIP

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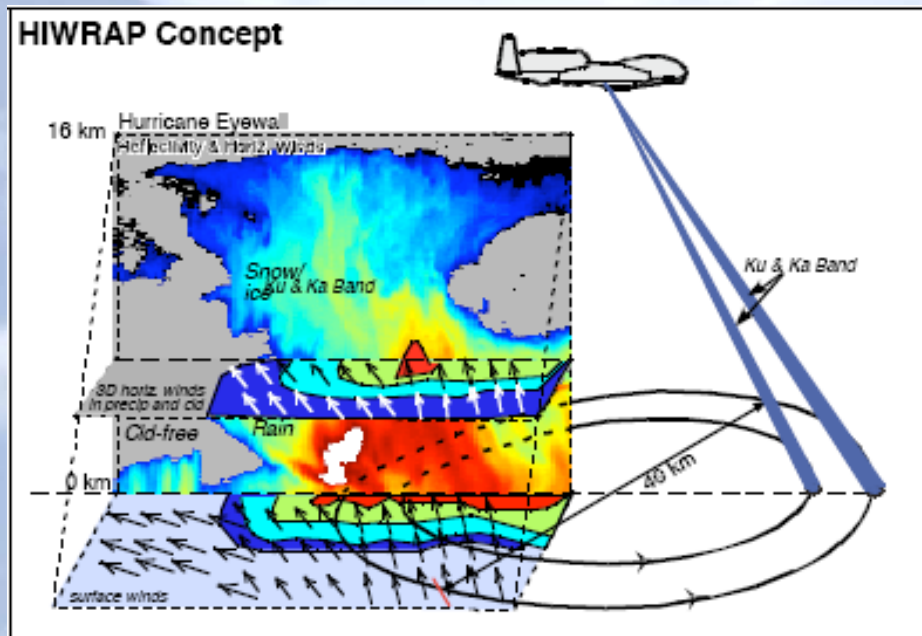


# High-Altitude Imaging Wind and Rain Airborne Profiler (HIWRAP)

## MEASUREMENTS GOALS:

Map the 3-dimensional winds and precipitation in precipitation regions associated with tropical storms.

Map ocean surface winds in clear to light rain regions using scatterometry.



## NASA Global Hawk:

19 km altitude, ~30 hour flight

## HIWRAP Characteristics:

- *Conically scanning.*
- *Simultaneous Ku/Ka-band & two beams @ 30 and 40 deg*
- *New technologies in radar: low power solid state transmitters with pulse compression, single antenna*
- *GPM radar frequencies.*



# HIWRAP System

Parameters	Specifications	
	Ku-band	Ka-band
RF Frequency (GHz)	Inner Beam: 13.91	Inner Beam: 35.56
	Outer Beam: 13.47	Outer Beam: 33.72
Peak Transmit Power (W)	25	4
3 dB Beamwidth (°)	2.9	1.2
Polarization	H (inner beam), V (outer beam)	
Dynamic Range (dB)	> 65	
Min. Detect. Reflectivity (dBZe, 60m res. 10 km range and 3 km chirp pulse)	0	-5
Doppler Velocity (ms <sup>-1</sup> )	0-150 (Accuracy < 1.5 ms <sup>-1</sup> for SNR>10)	
Scanning	Conical scan 10-30 RPM (nom. 16 RPM)	





# Cases

- 2 Sept 2010 – Hurricane Earl
- 12 Sept 2010 – AL92 (Karl genesis)
- 16 Sept 2010 – Hurricane Karl [no outer beam collected]
- 24 Sept 2010 – Hurricane Matthew

## Data Issues/Quality:

- >Raw (I,Q) data collected at Ku and Ka-band ~2 GB/min, ~8-10 h/flight
- >Post processing for pulse compression filter, pulse pair velocity and averaging.
- >Digital receiver –noise in I, Q except 24 Sept (Matthew) & reduced sensitivity. Most of time spent on Matthew.
- >Ran at reduced range resolution (150 m, 2 deg azimuth spacing) because of data rates stored to disk.



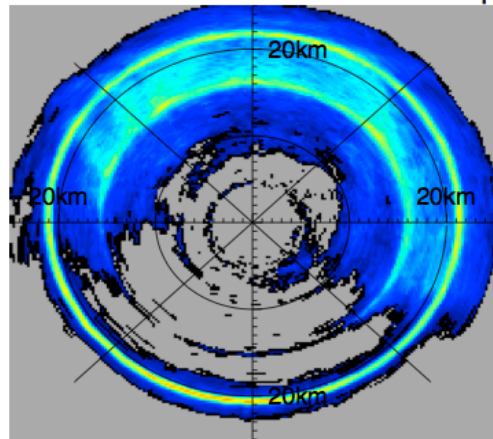
# Data Processing

- Most time spent on 24 Sept but slowly working backward to other cases (Karl and Earl).
- Doppler processing (pulse pair) from I, Q.
  - *Working on fix for dig receiver noise prior to Matthew.*
- Merge antenna, navigation, and Doppler data.
  - *data editing (thresholding, unfolding,...)*
  - *Ka-band unfolding - more work req'd*
  - *merge short pulse & chirp for improved near sfc data - more work req'd*
- Antenna pointing analysis using sfc Doppler - completed
- Reflectivity calibration
  - *Preliminary but needs validation; Ka-band needs more work*
- Working toward netCDF distribution files.

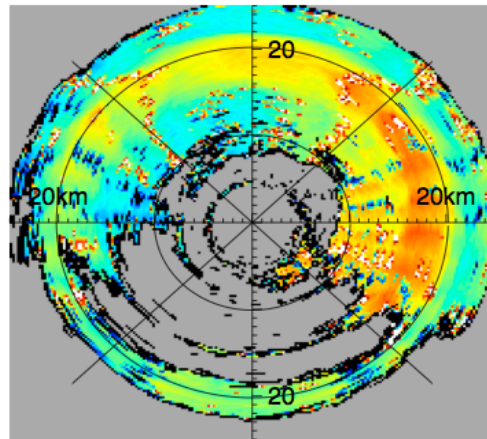


# 24 Sept 2010 Matthew

HIWRAP Scan #0371 01:23:11  
Ku-band Inner Chirp DOPCORR Tilt: 29.80

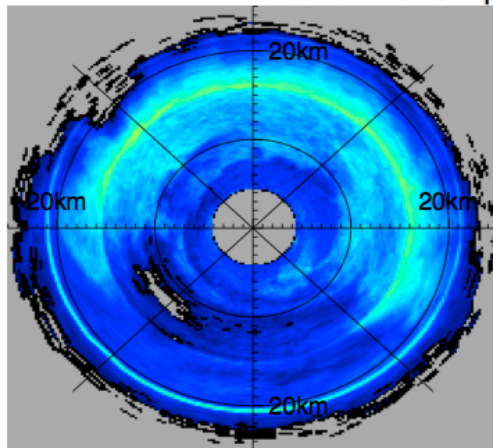


228 238 248 258 268  
Uncalibrated Reflectivity (dBZ)

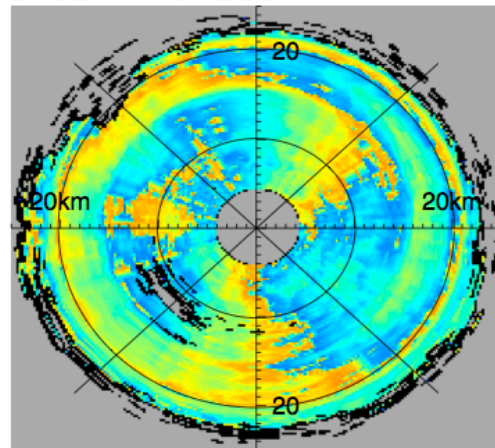


-30 -15 0 15 30  
Doppler (m/s)

HIWRAP Scan #0371 01:23:11  
Ka-band Inner Chirp DOPCORR Tilt: 29.80



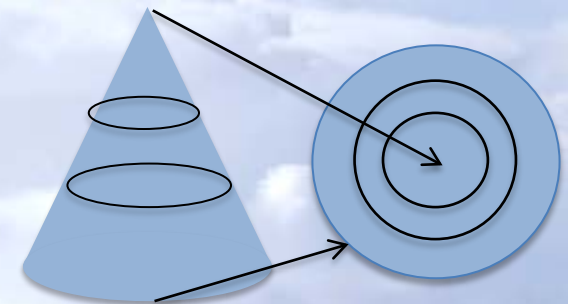
208 218 228 238 248 258  
Uncalibrated Reflectivity (dBZ)



-15 -5 5 15  
Doppler (m/s)

Uncalib. Reflectivity  
Doppler (air+fallspd)

< Ku-Band  
Inner Beam (30°H)



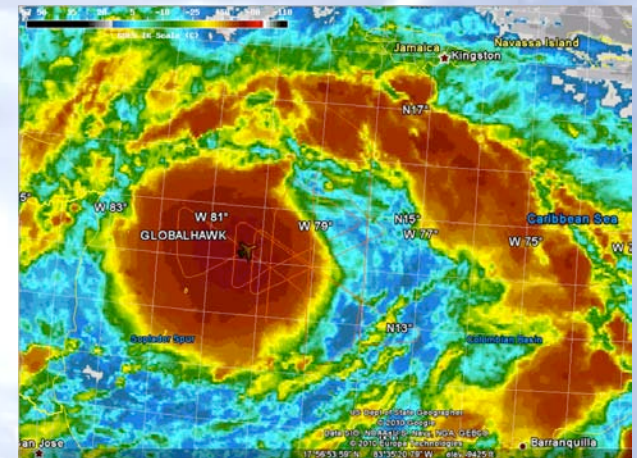
< Ka-Band  
Inner Beam (30°H)





# Mapping & Retrievals

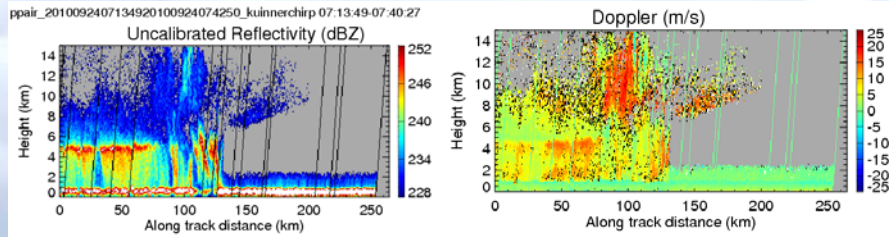
- 2D curtain below GH - reflectivity, winds [similar to EDOP]
- 3D grid point analysis - reflectivity, winds
- Ocean surface winds



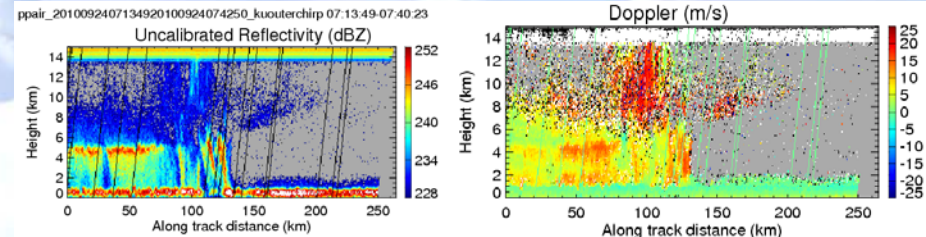
Hurricane Matthew

# Matthew - Reconstructed Along-Track Cross Section

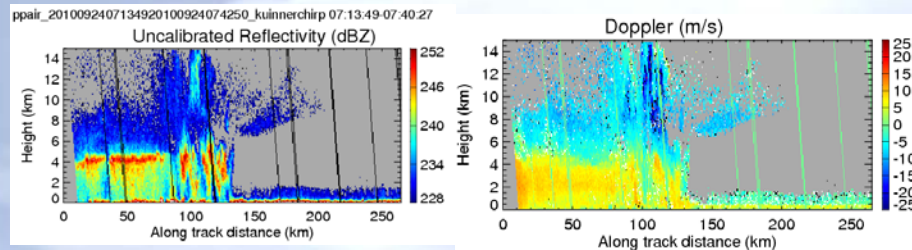
**Ku** inner chirp (30° beam, H)  
Rear look



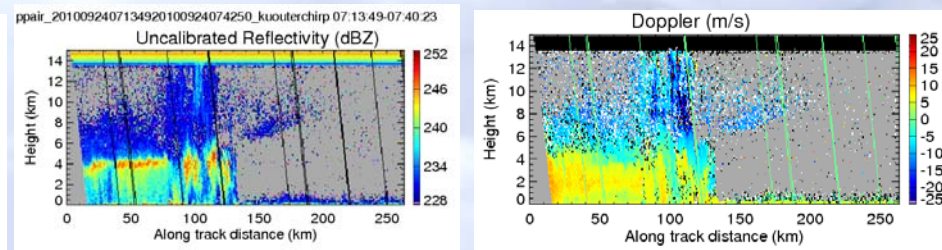
**Ku** outer chirp (40° beam, V)  
Rear look



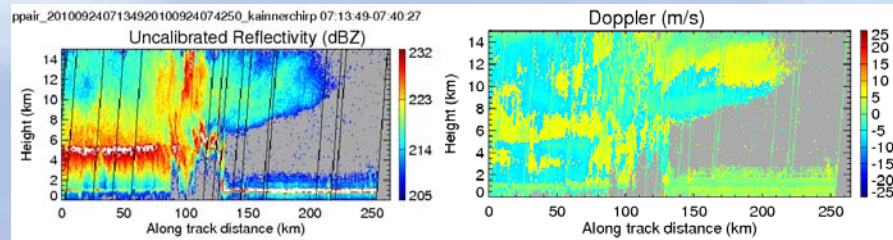
Forward look



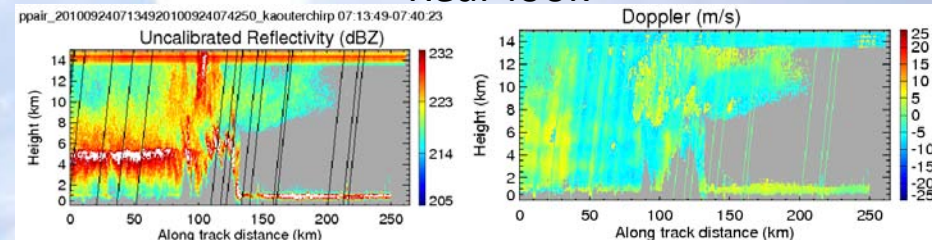
Forward look



**Ka** inner chirp (30° beam, H)  
Rear look



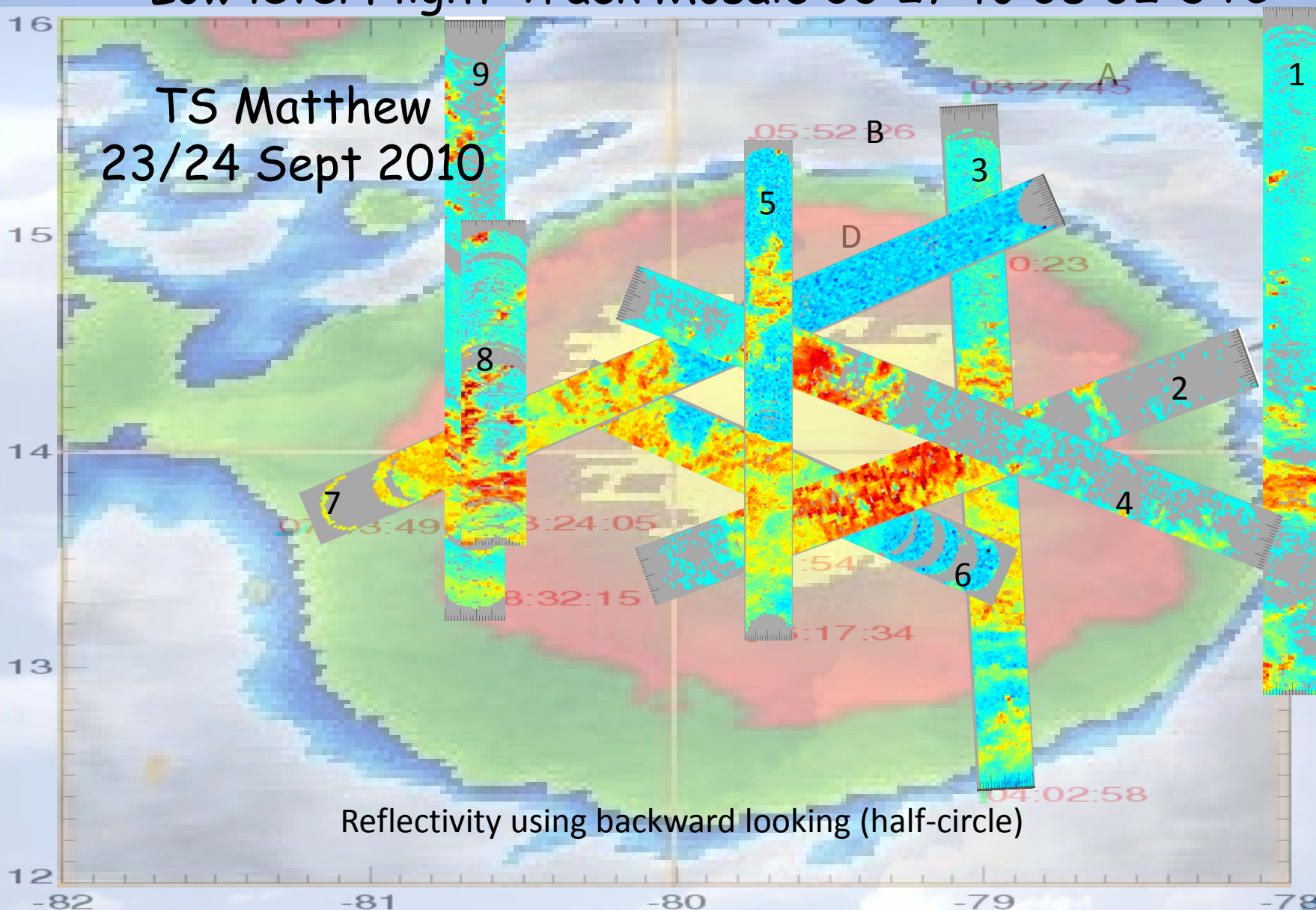
**Ka** outer chirp (30° beam, V)  
Rear look





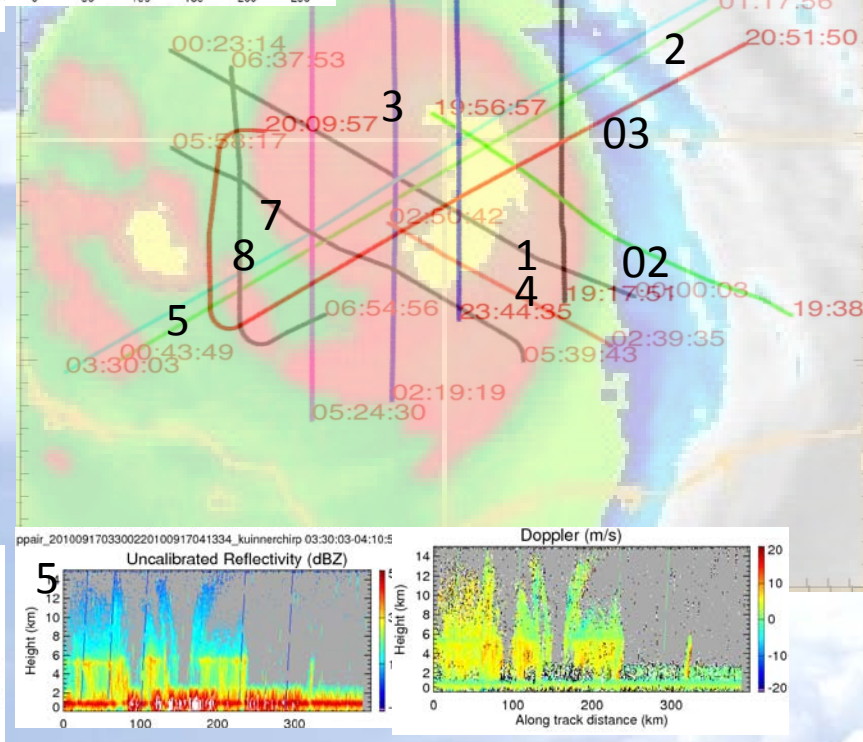
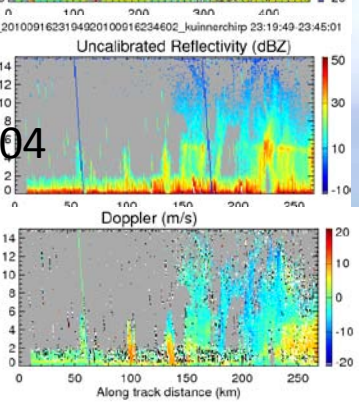
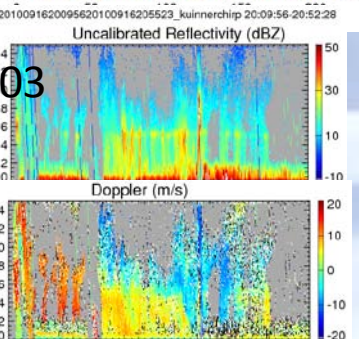
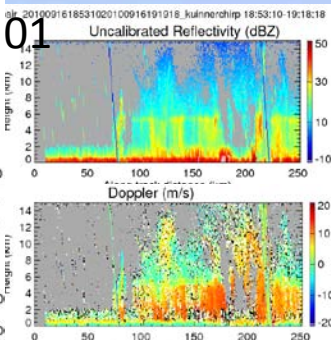
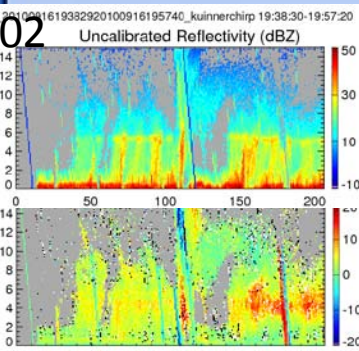
# Low level Flight Track Mosaic 03:27 to 08:32 UTC

TS Matthew  
23/24 Sept 2010



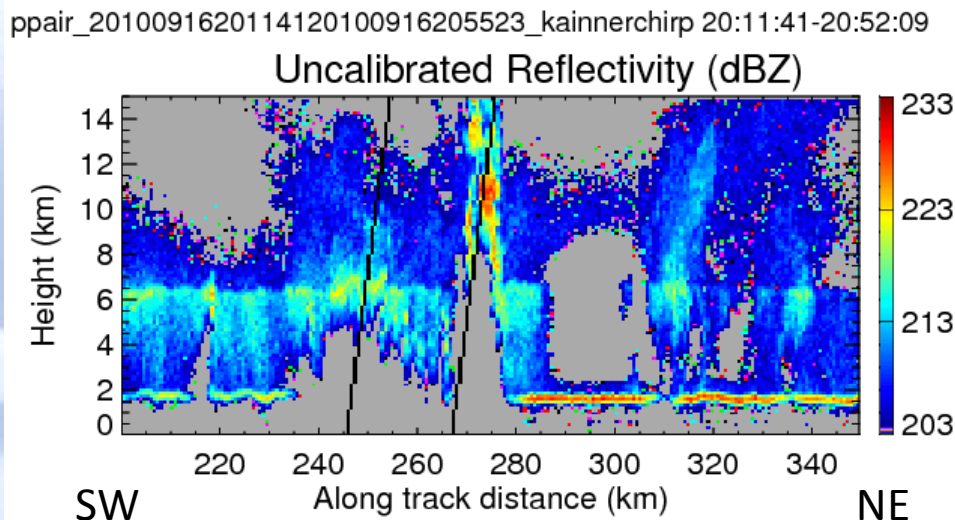


# Hurricane Karl 16 Sept 2011

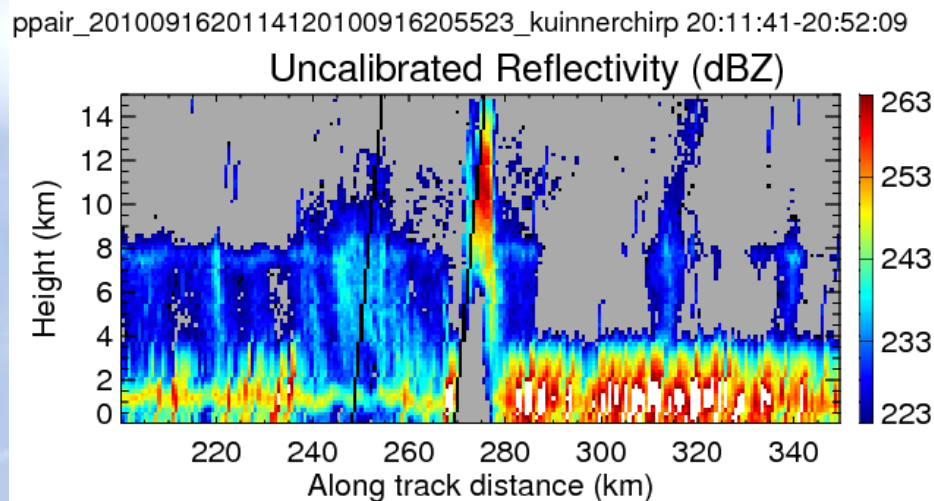


# Hurricane Karl Reflectivity

**Ka-band  
(chirp)**



**Ku-band  
(chirp)**





# Questions?



