HIWRAP GRIP Status

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Remote Sensing SOLUTIONS

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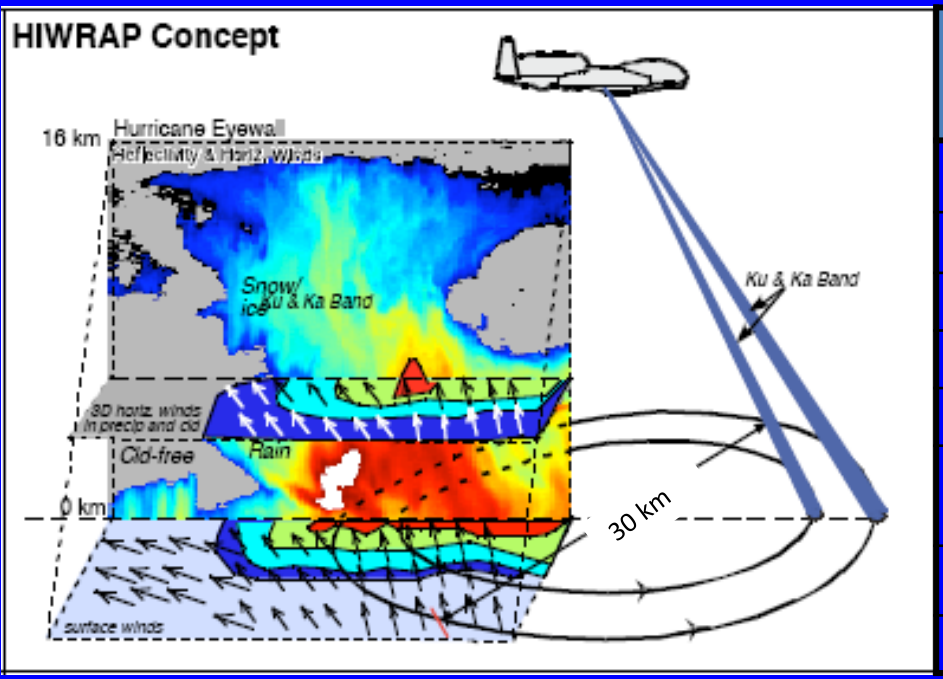
High-Altitude Imaging Wind and Rain Airborne Profiler (HIWRAP)



Parameters	Specifications	
	Ku-band	Ka-band
Inner/Outer Frequency (GHz)	13.91,13.47	35.56, 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,10 km range)	0	-5
Doppler Velocity (ms^{-1})	0-150 (< 1.5 ms^{-1} @ SNR > 10)	
Conical Scanning	10-30 RPM (nom. 16 RPM)	

MEASUREMENTS GOALS:

- ***Precipitation and 3-D winds***
- ***Ocean surface vector winds in clear to light rain regions***

New technologies in HIWRAP: Solid-state transmitters with novel frequency diversity pulse compression waveforms & Ku/Ka-band single aperture antenna.

HIWRAP GRIP Flights

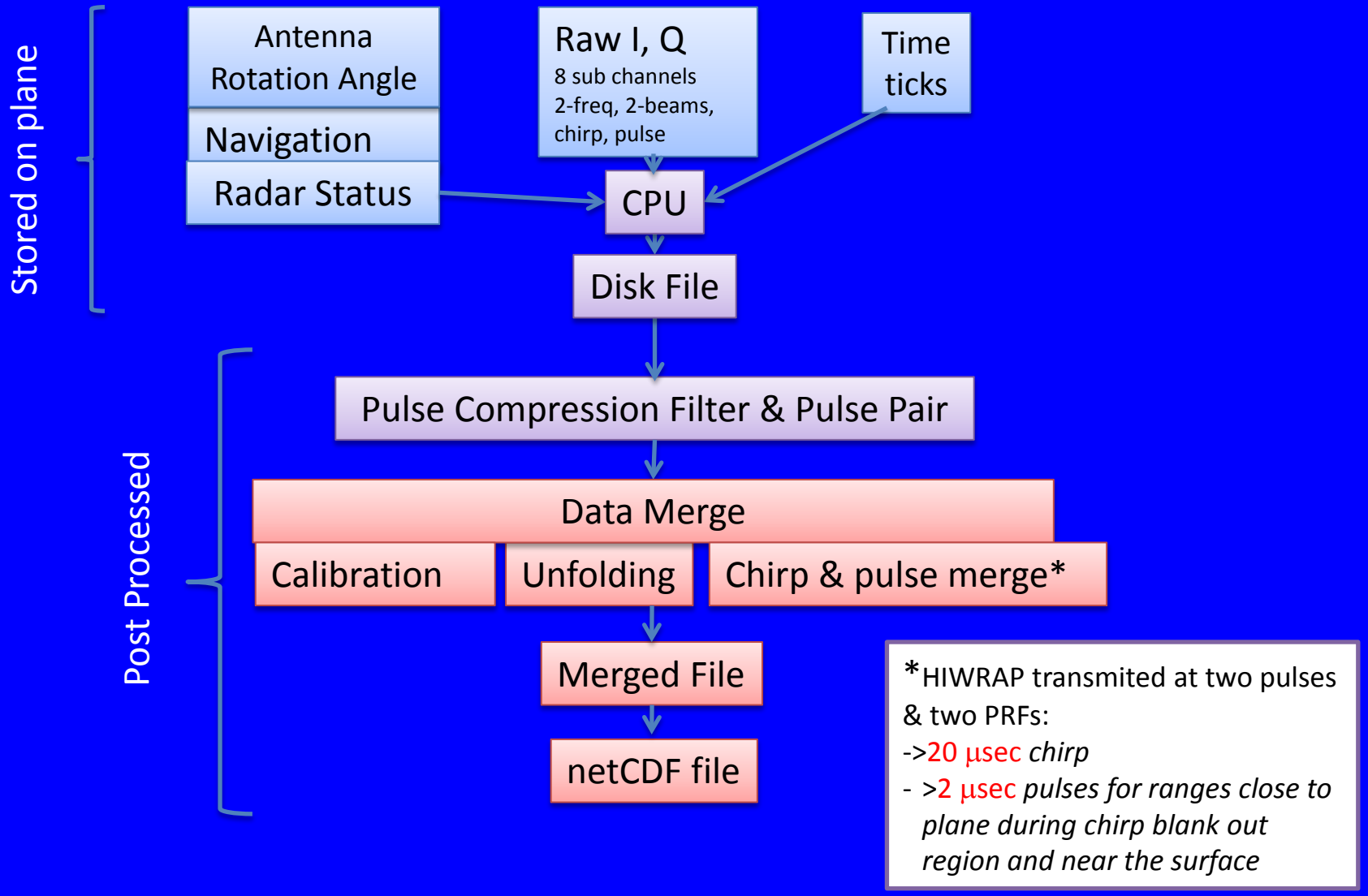
- First field campaign for HIWRAP.
- Operated and collected data through all five GRIP science flights.
- HIWRAP was operated in raw data mode with limited bandwidth due to the delay of the digital receiver processing firmware.
- Data issues mostly due to digital receiver.

->Bottom line: Sensitivity of radar was reduced and Doppler noisier than expected. Ka-band worked better than Ku-band.

HIWRAP Flights

- 2 Sept 2010 Earl
  - Range window missed surface
- 12 Sept 2010 pre-Karl
  - Range window missed surface
- 16 Sept 2010 Karl
  - Data collected only for inner beam
- 24 Sept 2010 Tropical Storm Matthew
  - Best data quality during GRIP

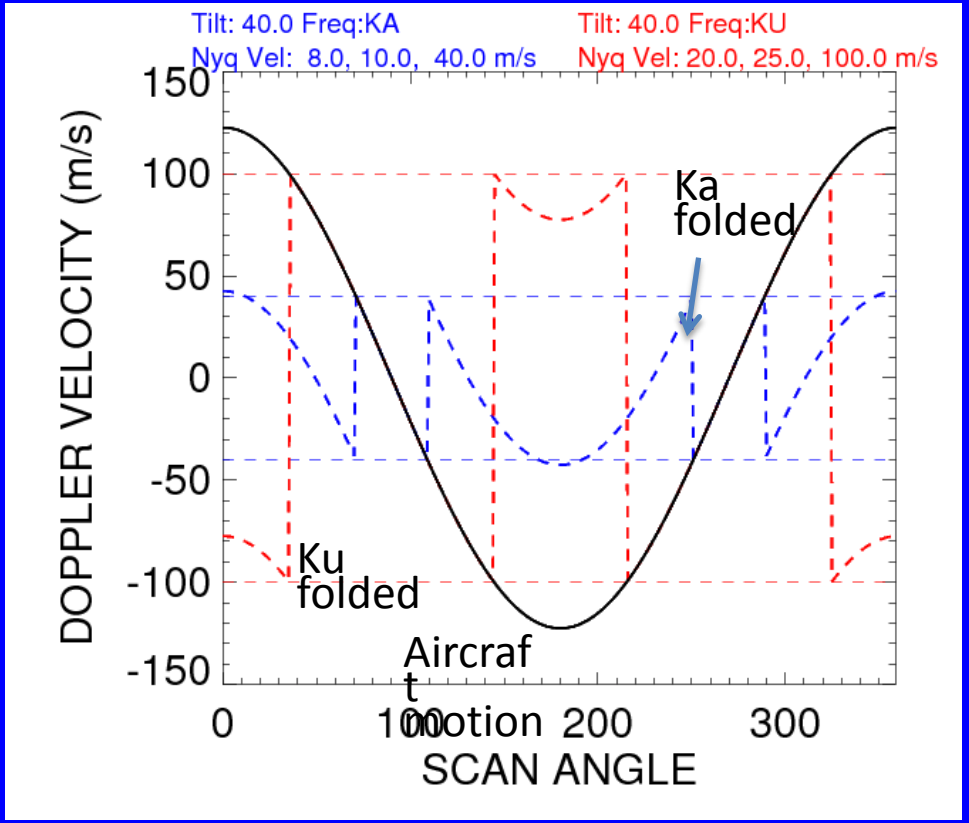
HIWRAP Data Flow - GRIP



*HIWRAP transmited at two pulses & two PRFs:
->20 μsec *chirp*
- >2 μsec *pulses for ranges close to plane during chirp blank out region and near the surface*

HIWRAP Doppler Unfolding

- Ku-band automated unfolding working reasonably well.
- Ka-band is more problematic because of low Nyquist velocity
- Tests are in progress to use Ku-band with higher Nyquist velocity to unfold Ka-band Doppler



PRF: 4000, 5000 Hz

Pulse-pair velocities: low PRF, high PRF, dual PRF

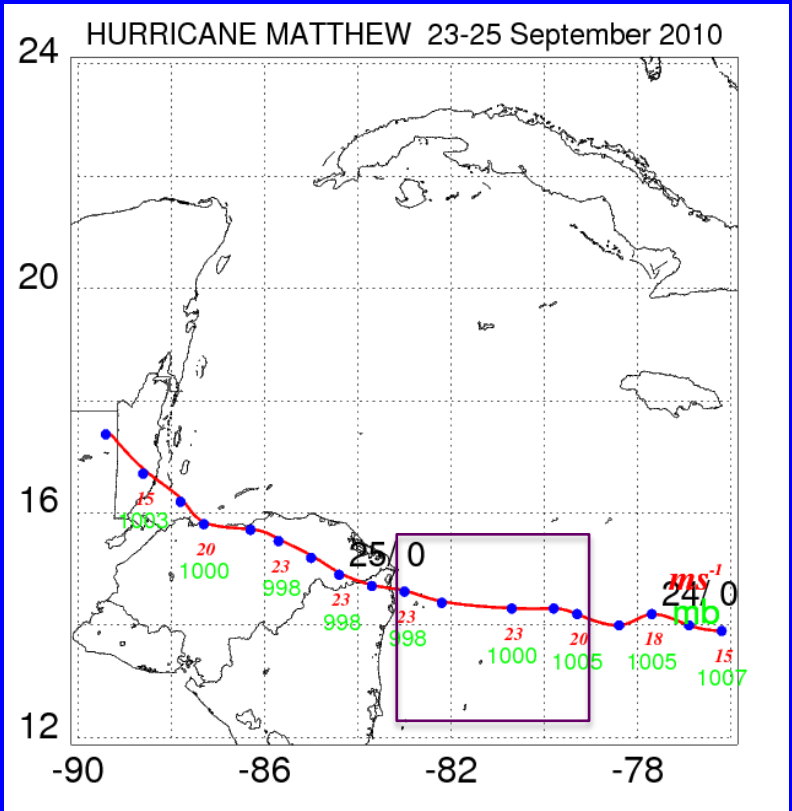
Ku: 20, 25, 100 m/s

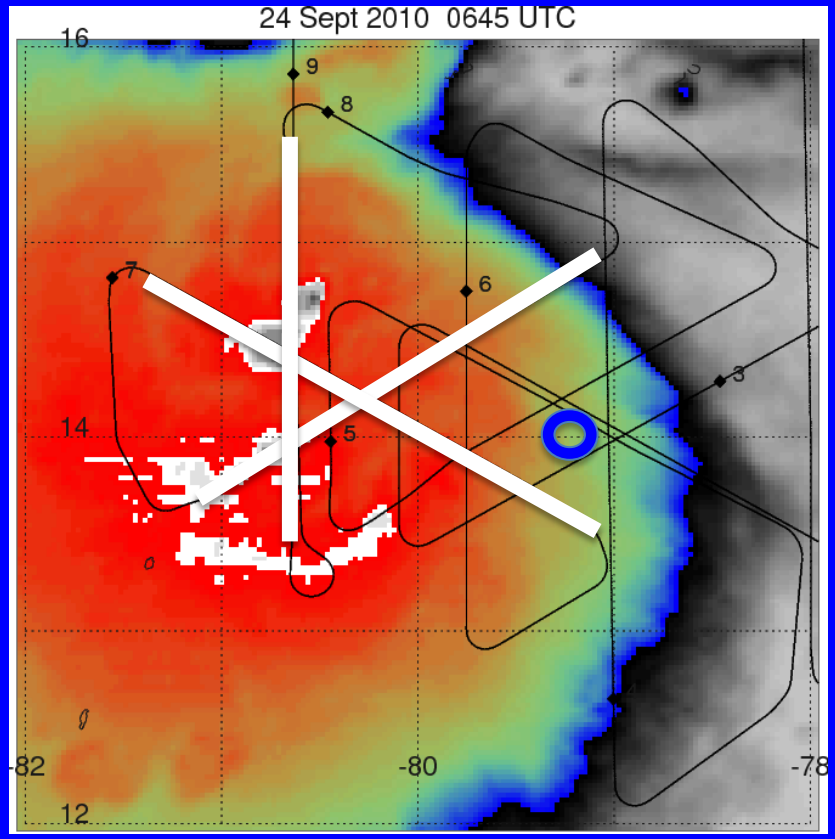
Ka: 8, 10, 40 m/s

Data Status

- Data processed for Karl (9/16) and Matthew (9/24)
- Calibration status
  - Calibration signal from each transmit pulse used as reference along with measured radar parameters in the radar equation.
  - Final consistency check using the ocean surface as an external reference similar to previous literature (e.g., Tanelli et al. 2006).
- Data from 9/16 and 9/24 in GRIP archive in netCDF
- Still attempting to get something from 9/2 Earl flight

Tropical Storm Matthew 24 Sept 2010

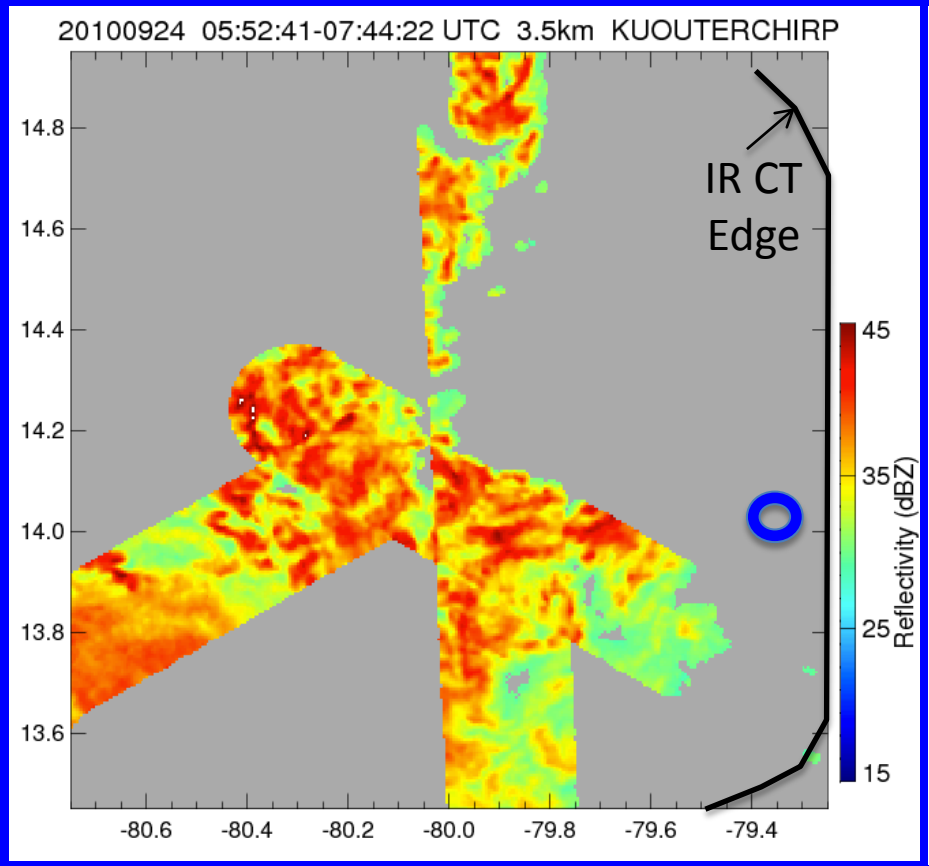


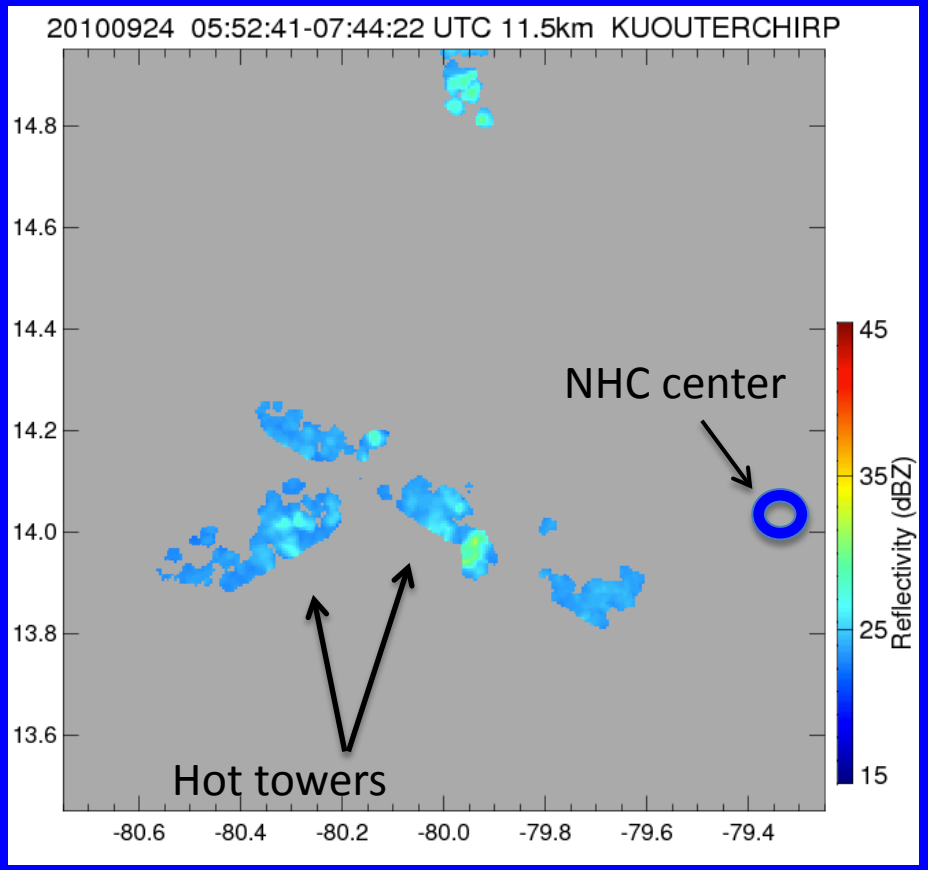


Min Tb's 185-190K

- Storm center not well-defined
- Marginal tropical storm (45 kts) late on 24 Sept
- Prominent convective burst; persisted for many hours
- Global Hawk made many crossings of convective burst, some good, some not so good.

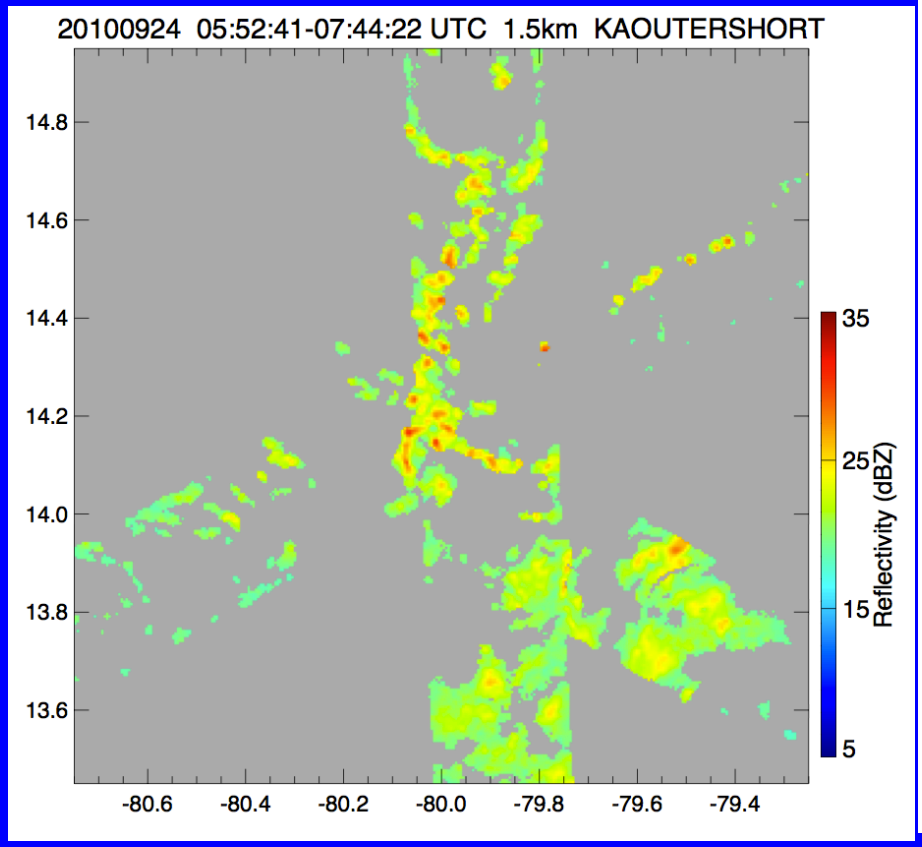
Matthew 0645 UTC
Ku-band Reflectivity: 3.5 km and 11.5 km

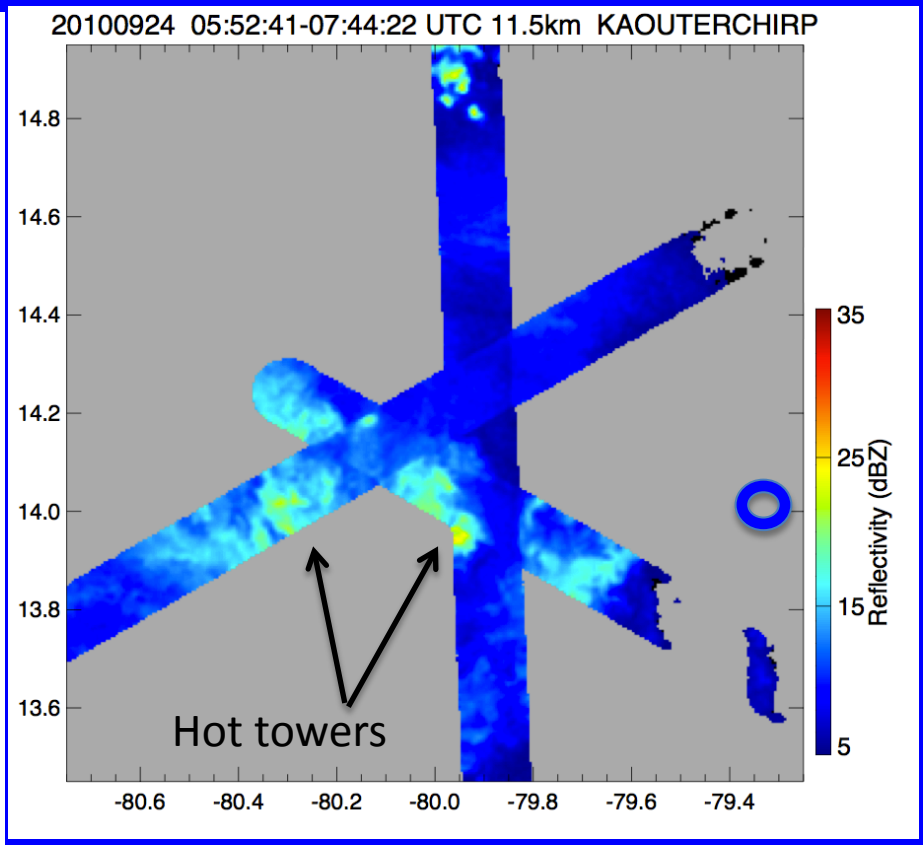




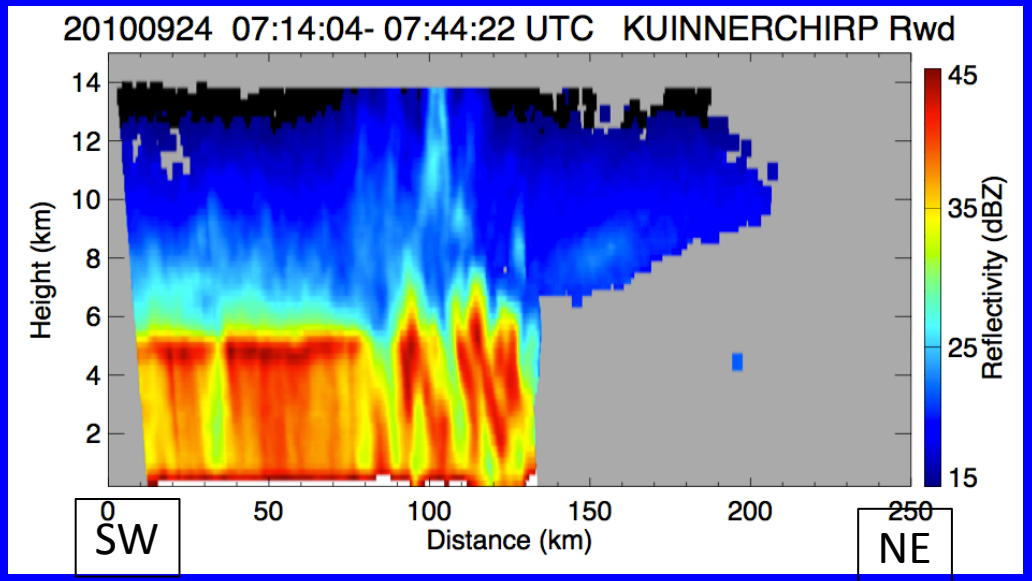
3 flight lines over 110 minutes mapped to common time

Matthew 0645 UTC
Ka-band Reflectivity: 3.5 km and 11.5 km

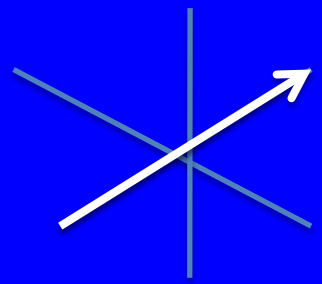


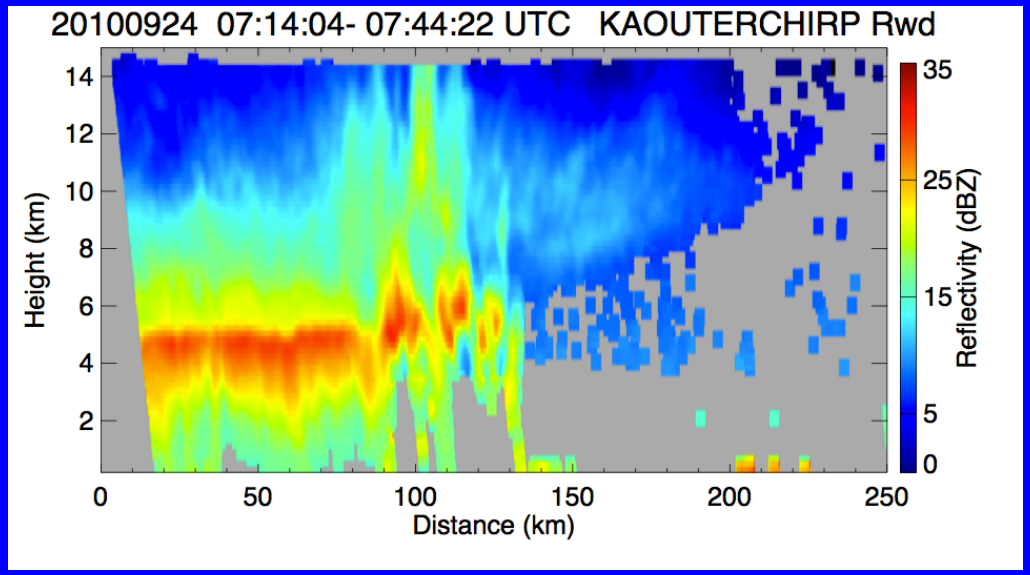


Sept 24 0714 - 0744UTC Reflectivity



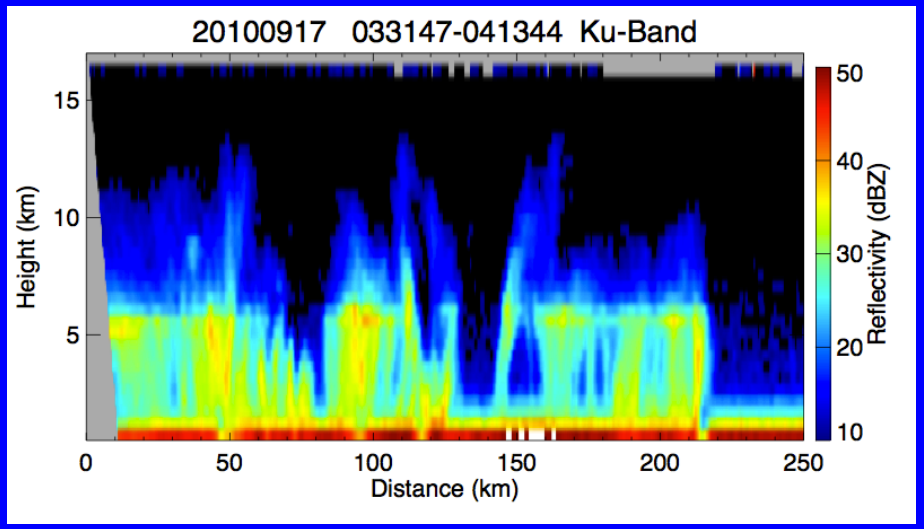
Ku-band
Inner Beam

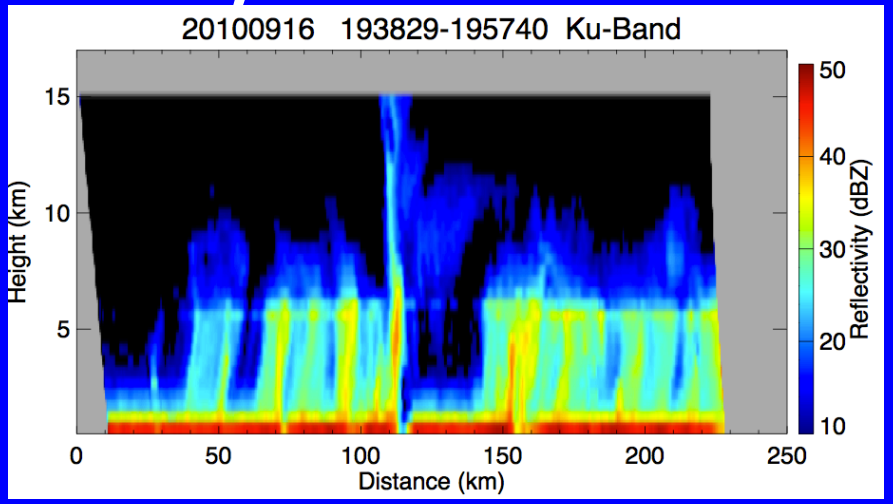


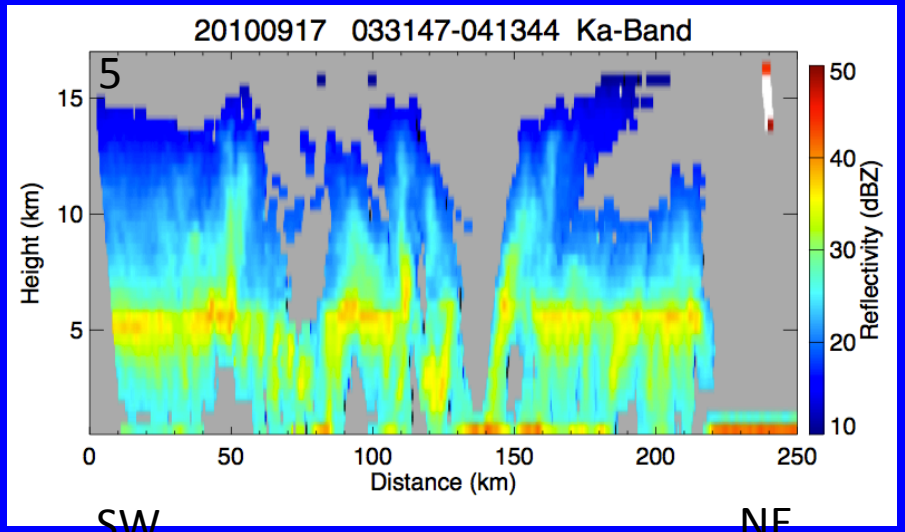


Ka-band
Inner Beam

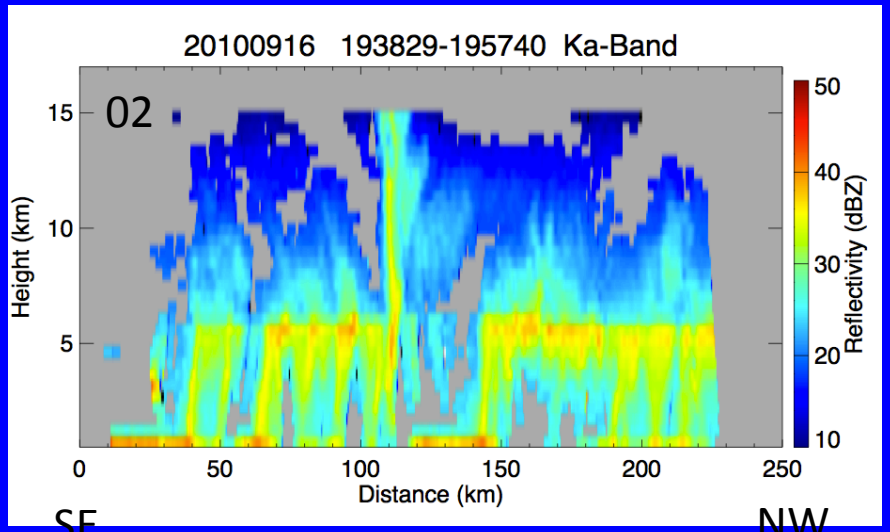
Hurricane Karl Eye Passes- Reflectivity





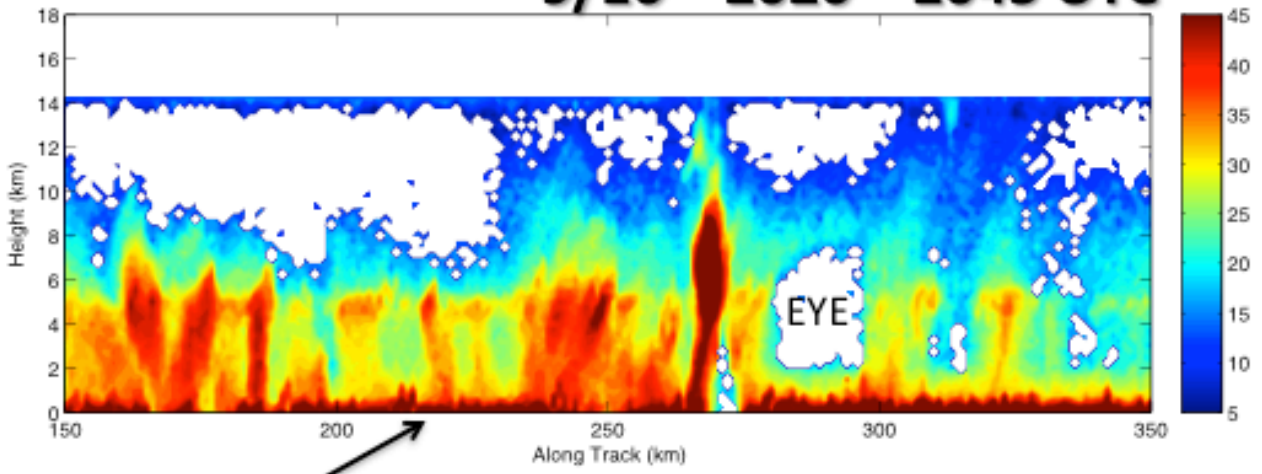


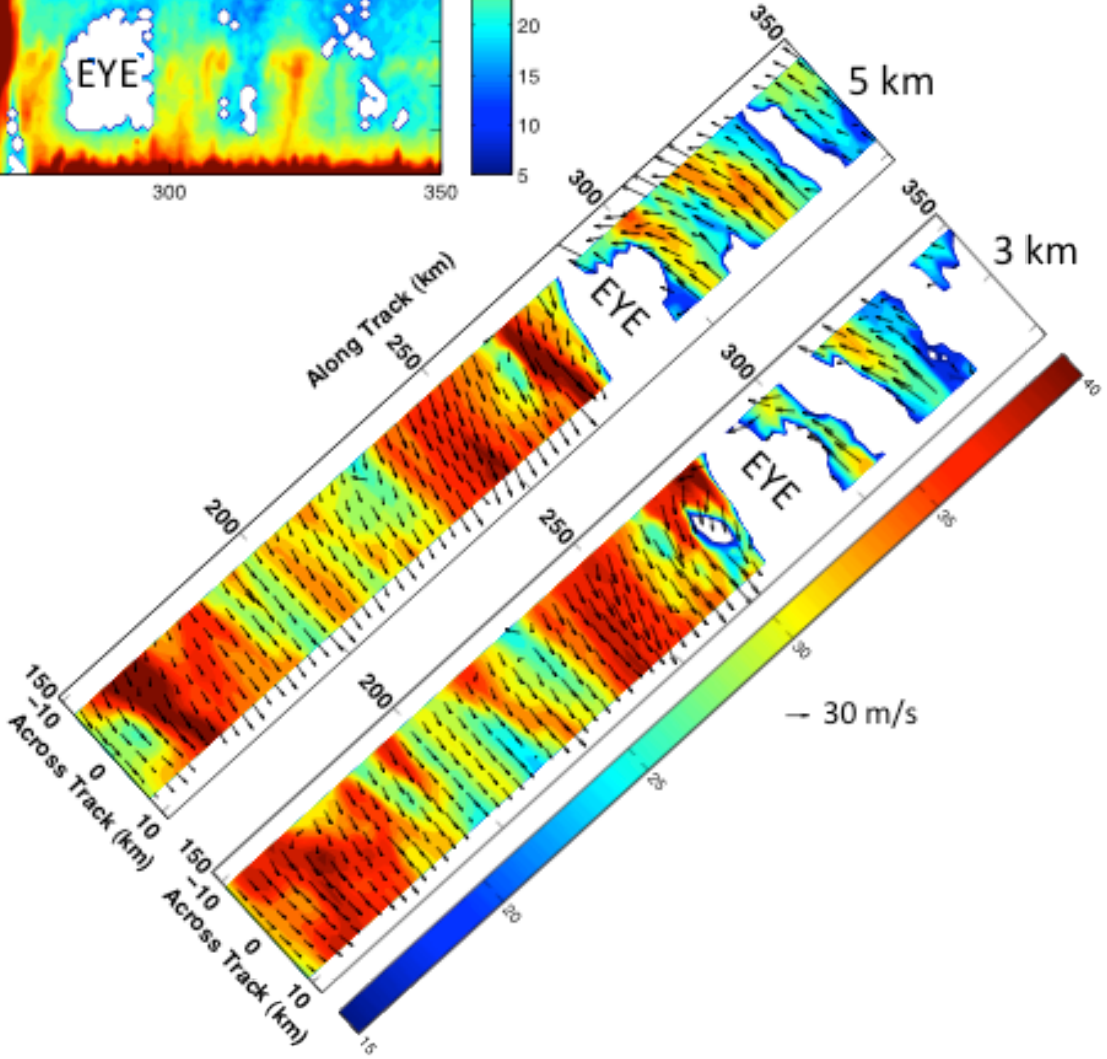
SW NE



SE NW

Hurricane Karl (2010) Ku-Band HIWRAP Analyses
9/16 ~ 2020 – 2045 UTC





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Future Work

- Case studies (Karl and Matthew)
  - General storm structure
  - Karl HIWRAP comparisons with APR-2
- HIWRAP instrument paper
- Continuation of wind retrieval algorithm development
- Scatterometry (ocean surface wind vector)

Questions?