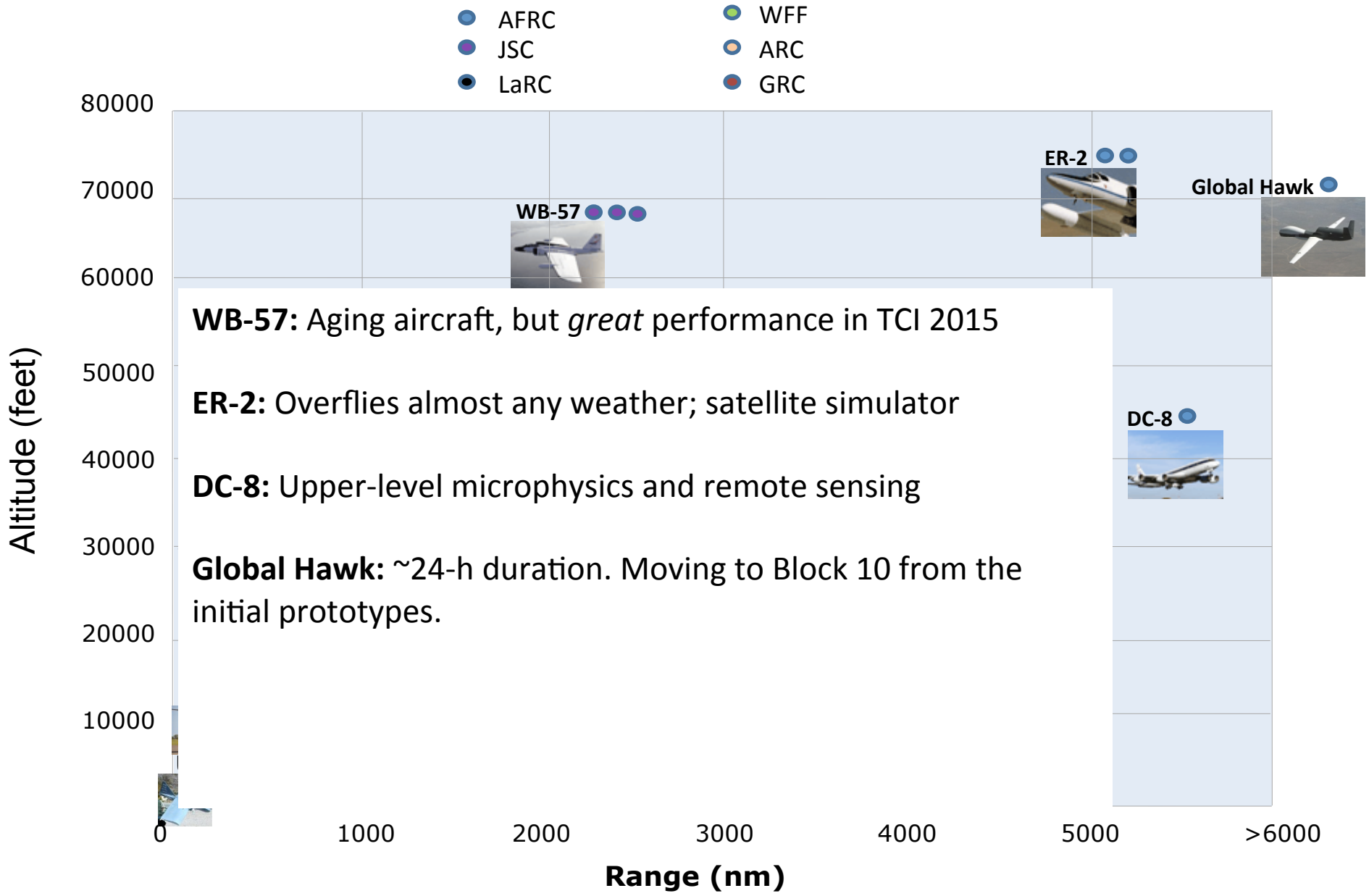
NASA Airborne Platforms and Instrumentation Relevant to Tropical Cyclones

Dan Cecil

NASA Marshall Space Flight Center

Daniel.J.Cecil@nasa.gov

NASA Earth Science Research Capable Aircraft (2016)



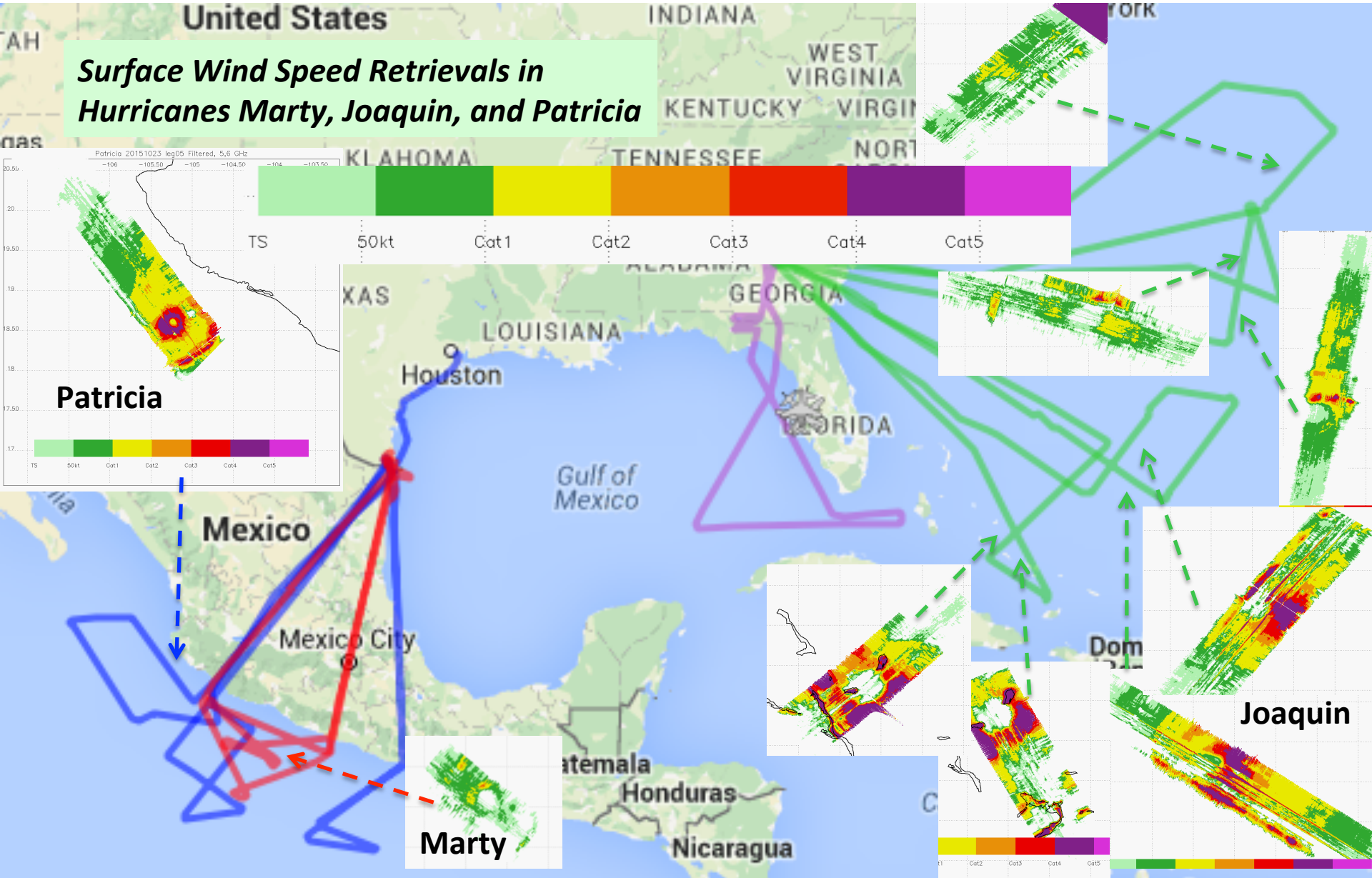
WB-57: Aging aircraft, but *great* performance in TCI 2015

ER-2: Overflies almost any weather; satellite simulator

DC-8: Upper-level microphysics and remote sensing

Global Hawk: ~24-h duration. Moving to Block 10 from the initial prototypes.

Hurricane Imaging Radiometer (HIRAD) 2015 Science Flights (ONR TCI project on WB-57)

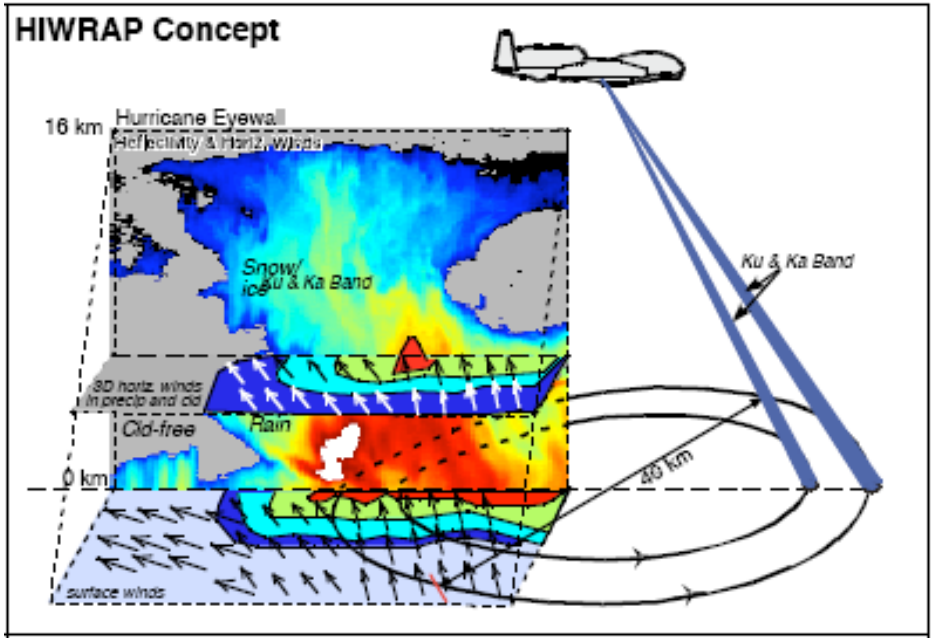


High-Altitude Imaging Wind and Rain Airborne Profiler (HIWRAP)

MEASUREMENTS:

Map the 3-dimensional winds and precipitation within hurricanes and other severe weather events.

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



NASA Global Hawk:
19 km altitude, 24 hours

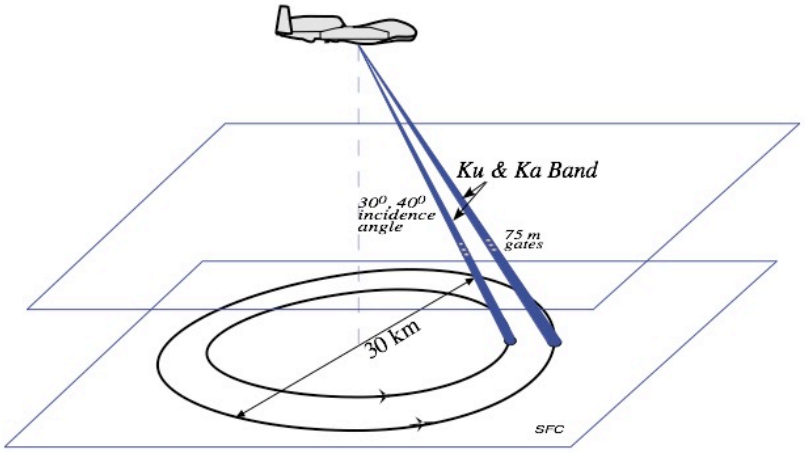
HIWRAP Characteristics:

- *Conically scanning.*
- *Simultaneous Ku/Ka-band & two beams @30 and 40 deg*
- *Winds using precipitation & clouds as tracers.*
- *Ocean vector wind scatter-*ometry similar to QuikScat.

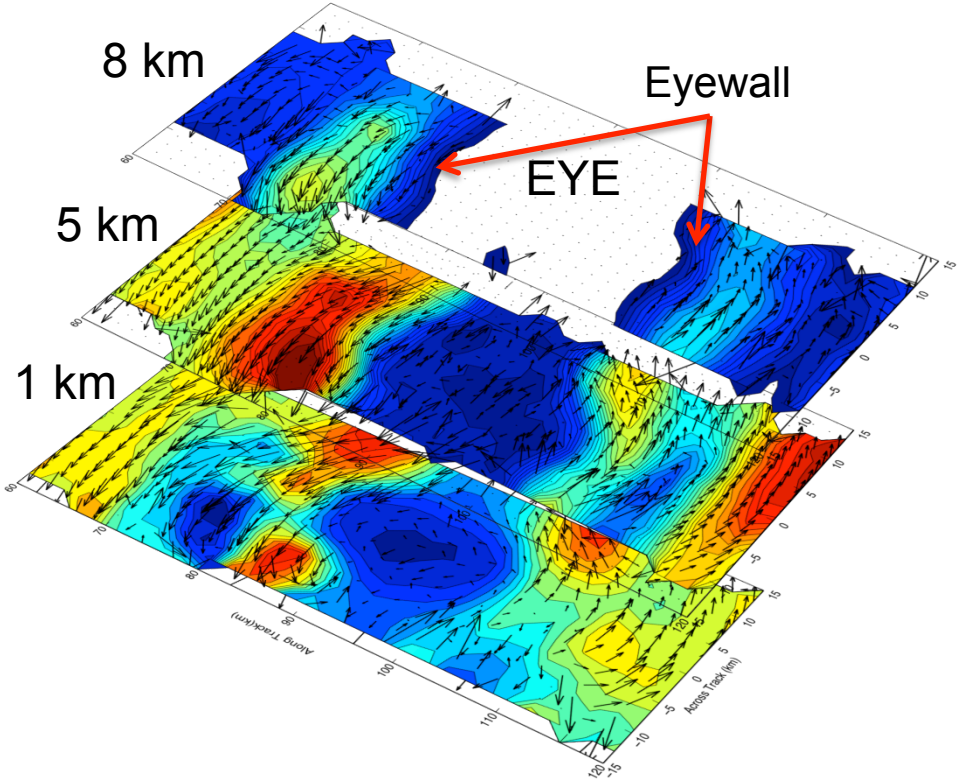
HIWRAP Views Hurricane Karl During GRIP

- HIWRAP made 20 crossings of Hurricane Karl on September 17, 2010 during GRIP over 14 hours.
- Doppler line of sight wind measurements are continually profiled during the conical scans.
- Horizontal winds are calculated from Doppler winds from multi look angles as the Global Hawk passes across the storm.

HIWRAP Measurement Geometry

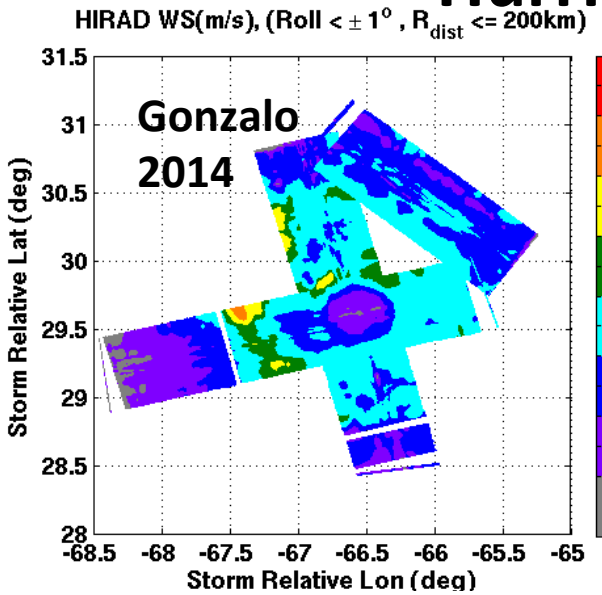


Horizontal winds (m/s) and reflectivity (dBZ) derived from one pass across Hurricane Karl's eye/eyewall region



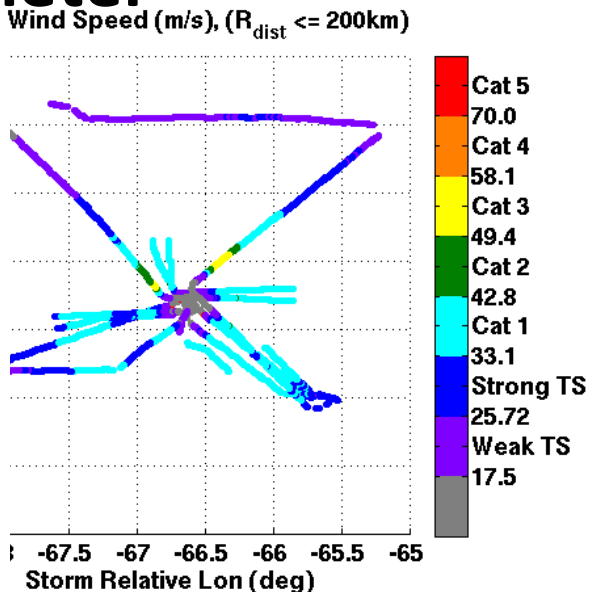
Grid is at 1.5 km x 1.5 km x 0.150 km intervals

HIRAD Wind Retrievals
Hurricane Imaging Radiometer



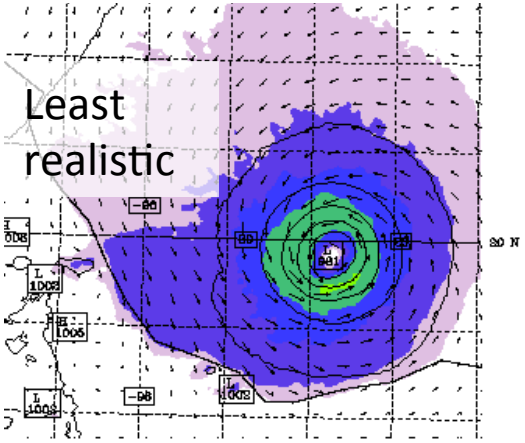
Wide swath from NASA MSFC's HIRAD (left panels) quickly maps the wind structure of the hurricane.

Narrow sampling from operational instruments (right panels) requires several passes by the aircraft.

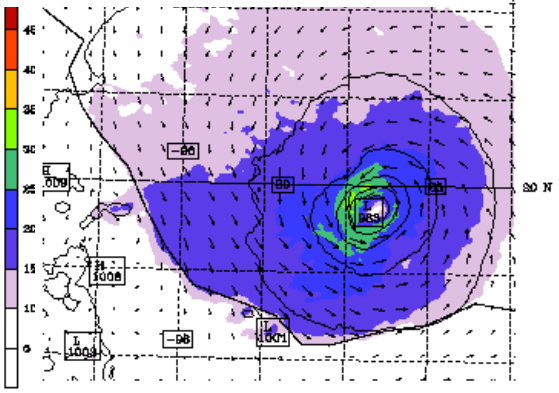


HIWRAP VAD wind assimilated

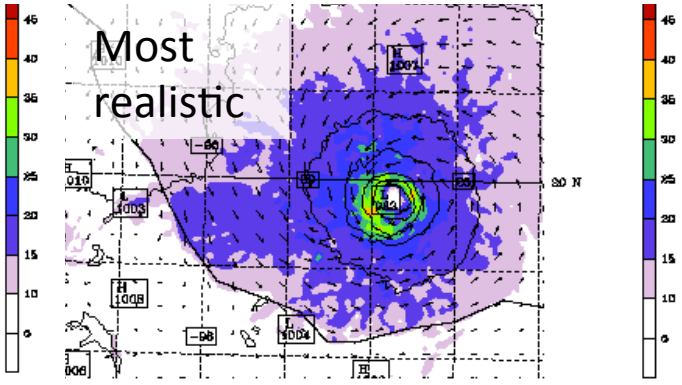
Karl 2010



HIRAD surface wind plus HIWRAP VAD wind assimilated



HIRAD surface wind, dropsonde wind, and HIWRAP VAD wind assimilated



ER-2 over Hurricane Emily (2005)