The 2011 NOAA Intensity Forecasting Experiment (IFEX)

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Intensity Forecasting Experiment (IFEX; Rogers et al., BAMS, 2006)

THE INTENSITY FORECASTING EXPERIMENT

A NOAA Multiyear Field Program for Improving Tropical Cyclone Intensity Forecasts

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In probing the whole life cycle of these storms—not just mature hurricanes—IFEX is taking a new approach to developing physical understanding and forecast abilities as well as testing and enhancing real-time observational capabilities.

MOTIVATION FOR IFEX. One of the key activities in the National Oceanic and Atmospheric Administration's (NOAA's) strategic plan is to improve the understanding and prediction of tropical cyclones (TCs). The NOAA National Hurricane Center (NHC), a part of the National Centers for Environmental Prediction (NCEP), is responsible for forecasting TCs in the Atlantic and east Pacific basins, while NCEP's Environmental Modeling Center (EMC) develops the numerical model guidance for the forecasters. With support from NOAA's Hurricane Research Division (HRD) and others in the research community, continual progress has been made in improving forecasts of the TC track over the past 30 years (Franklin et al. 2003a; Aberson 2001). Advancements in state-of-the-art global and regional modeling systems at EMC and other operational numerical weather prediction centers have led to improvements in track skill over the past three decades, including a significant acceleration in improvements over the past decade. These advancements include improved assimilation of satellite and

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The abstract for this article can be found in this issue, following the table of contents.
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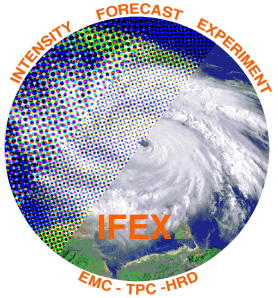
IFEX Goals



- Intended to improve prediction of TC intensity change by:
  1. collecting observations throughout the TC life cycle for model initialization and evaluation
  2. developing and refining measurement technologies for real-time monitoring of TC intensity, structure, and environment
  3. improving understanding of physical processes important in TC intensity change

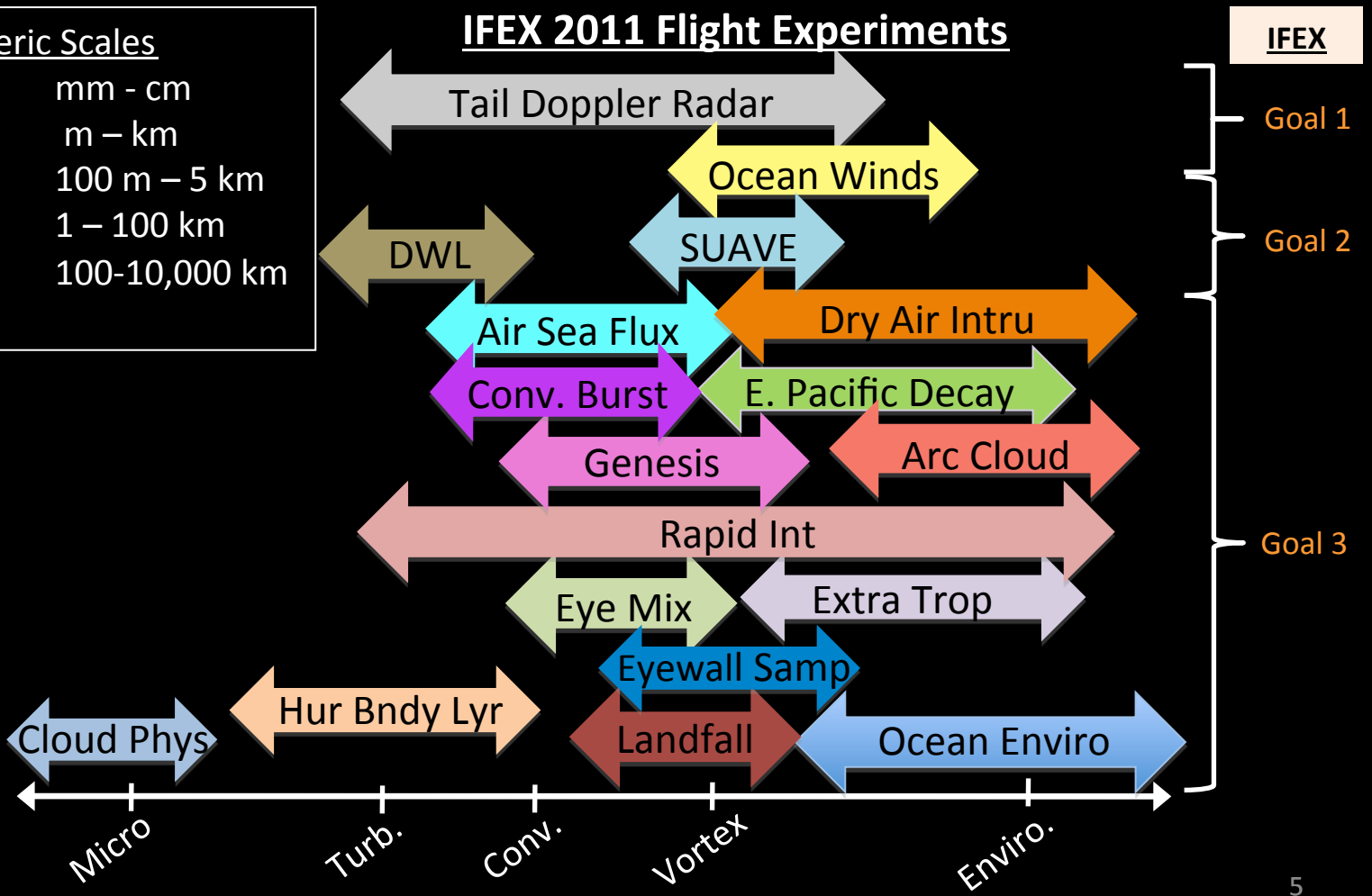
2011 IFEX Plans

- Continue addressing IFEX/HFIP goals
- Sustain our partnerships with EMC and NESDIS
  - Continue TDR missions and real-time Doppler data transmission
  - Collaborate with NESDIS – Ocean Winds Experiment
  - Coordinate with 53rd on float/drifter deployments
- Strengthen our interactions with NHC
- Fly operationally tasked missions
  - Based on EMC's and/or NHC's operational need
  - Selected modules may be attempted
- Encourage greater awareness in broader TC community

Intensity change is a multi-scale process

- Sample TCs and the environment on all scales

Atmospheric Scales	
Micro	mm - cm
Turbulent	m – km
Convective	100 m – 5 km
Vortex	1 – 100 km
Environment	100-10,000 km



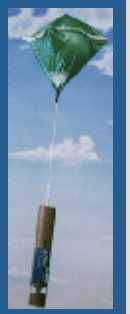
Types of Observations

Airborne

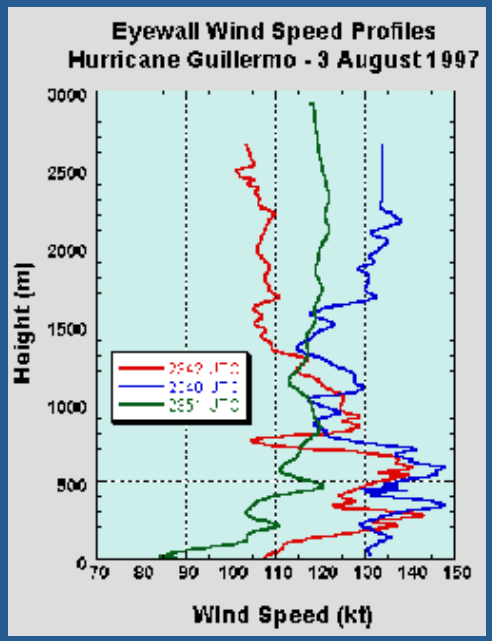
- **In-situ**
  - Wind, press., temp.

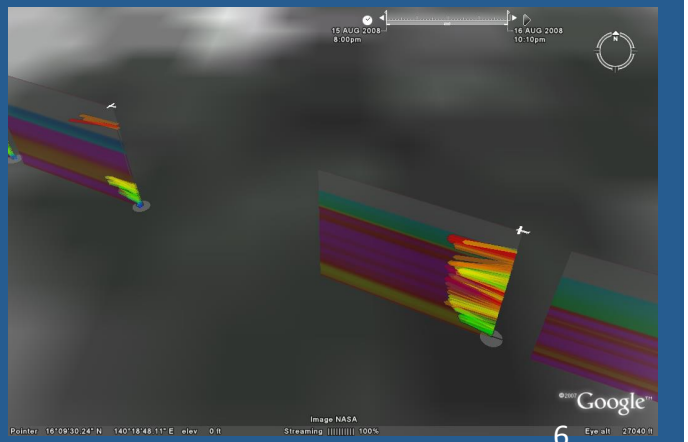
- **Expendables**
  - Dropsondes
  - AXBT, AXCP, buoy

- **Remote Sensors**
  - Doppler Radar
  - SFMR
  - DWL (ONR)
  - WSRA
  - Scatterometer/ profiler
  - UAS



Coyote UAS





NOAA42 Built in 1975 at Lockheed-Martin, Marietta, Georgia

NOAA43 Built in 1976 at Lockheed-Martin, Marietta, Georgia

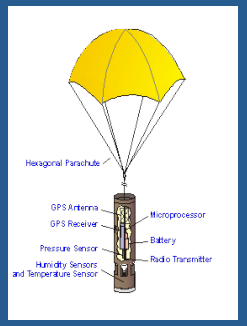
G-IV Built in 1994 at Gulfstream Aerospace Corporation in Savannah Georgia

NOAA Gulfstream-IV jet flies at high altitudes
in the hurricane environment

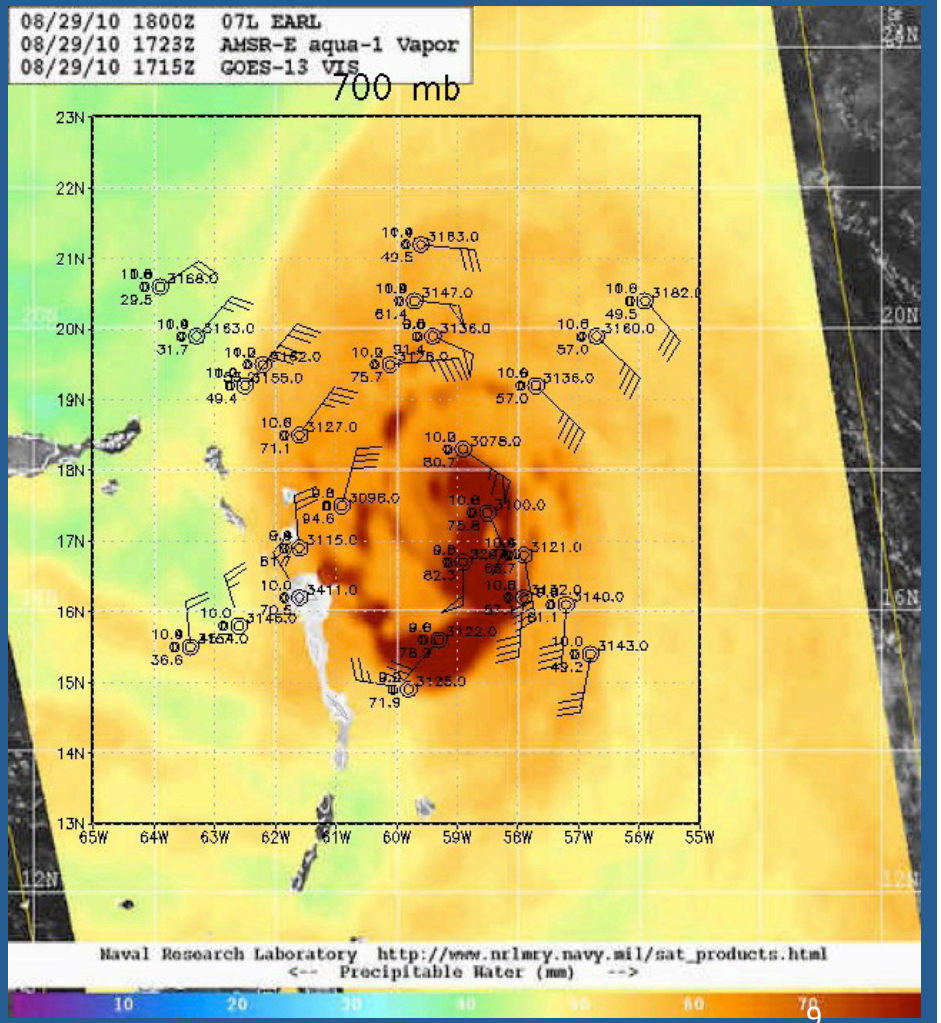
Types of Observations - Airborne

Environmental structure

- Synoptic-surveillance using dropsondes



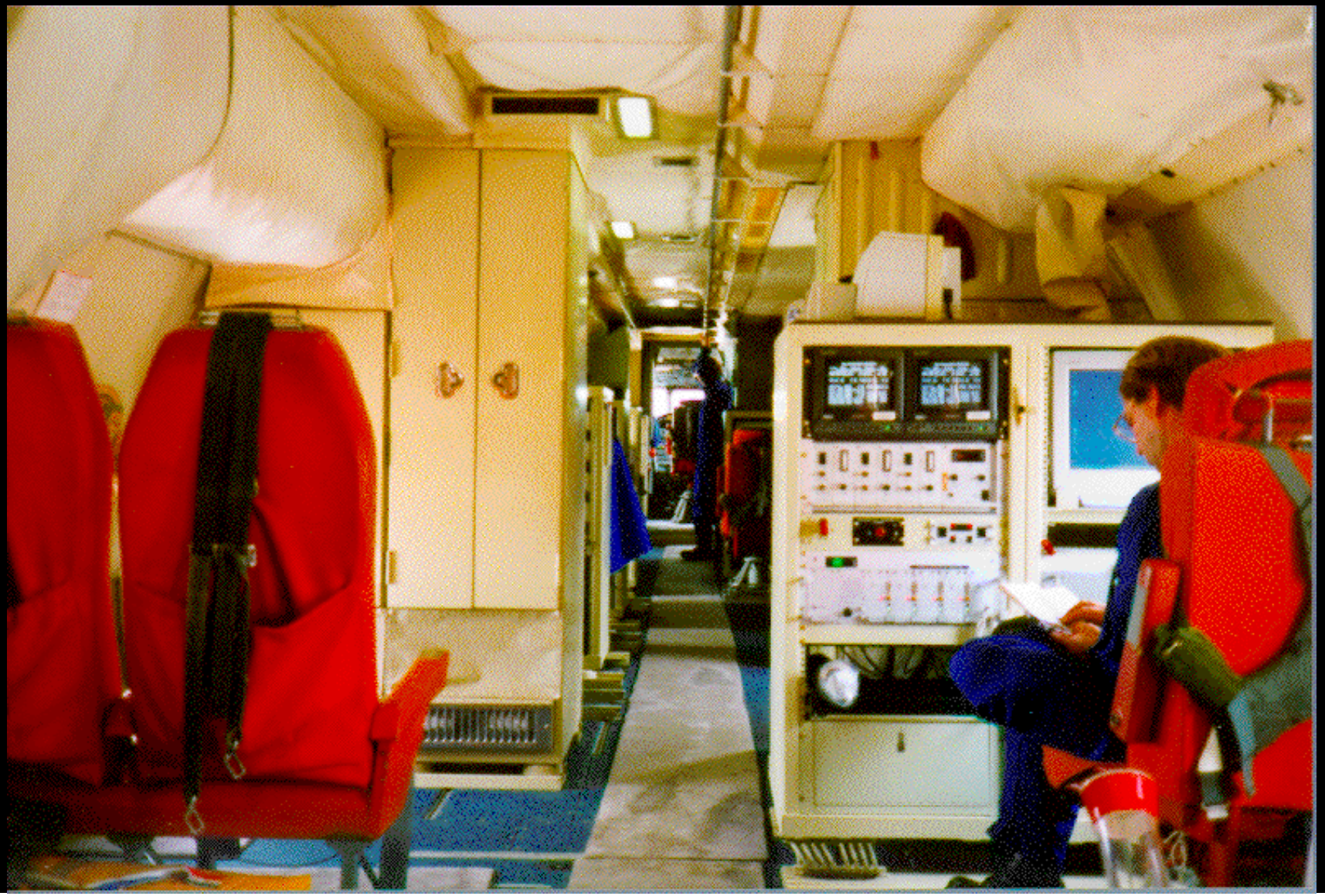
- Analytical & numerical studies.
- Ensemble track forecasting & targeted observations.




EXIT
EXIT


UNITED STATES DEPT. OF COMMERCE
N43RF

Inside the P-3 Aircraft



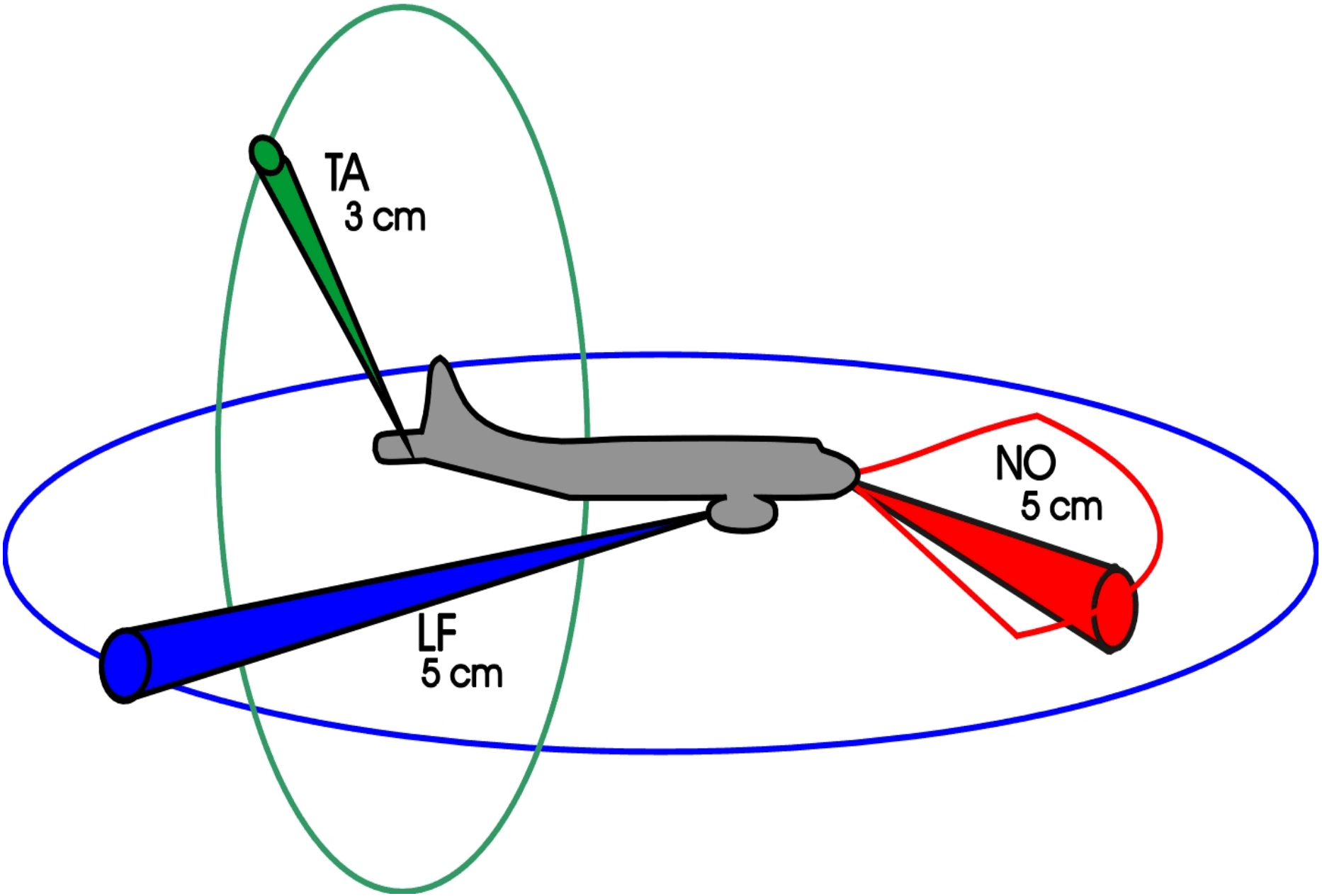
NOAA P-3 Flight Crew

Pilots Flight Engineers Meteorologists Flight Director

Co-Pilots Data Technicians Flight Navigator Flight Mechanics

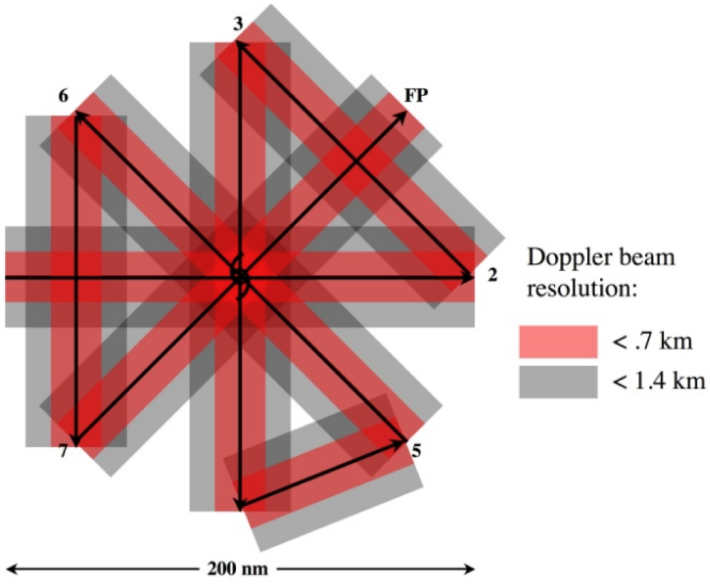
Electronic Technicians Science Engineers

WP-3D Radar



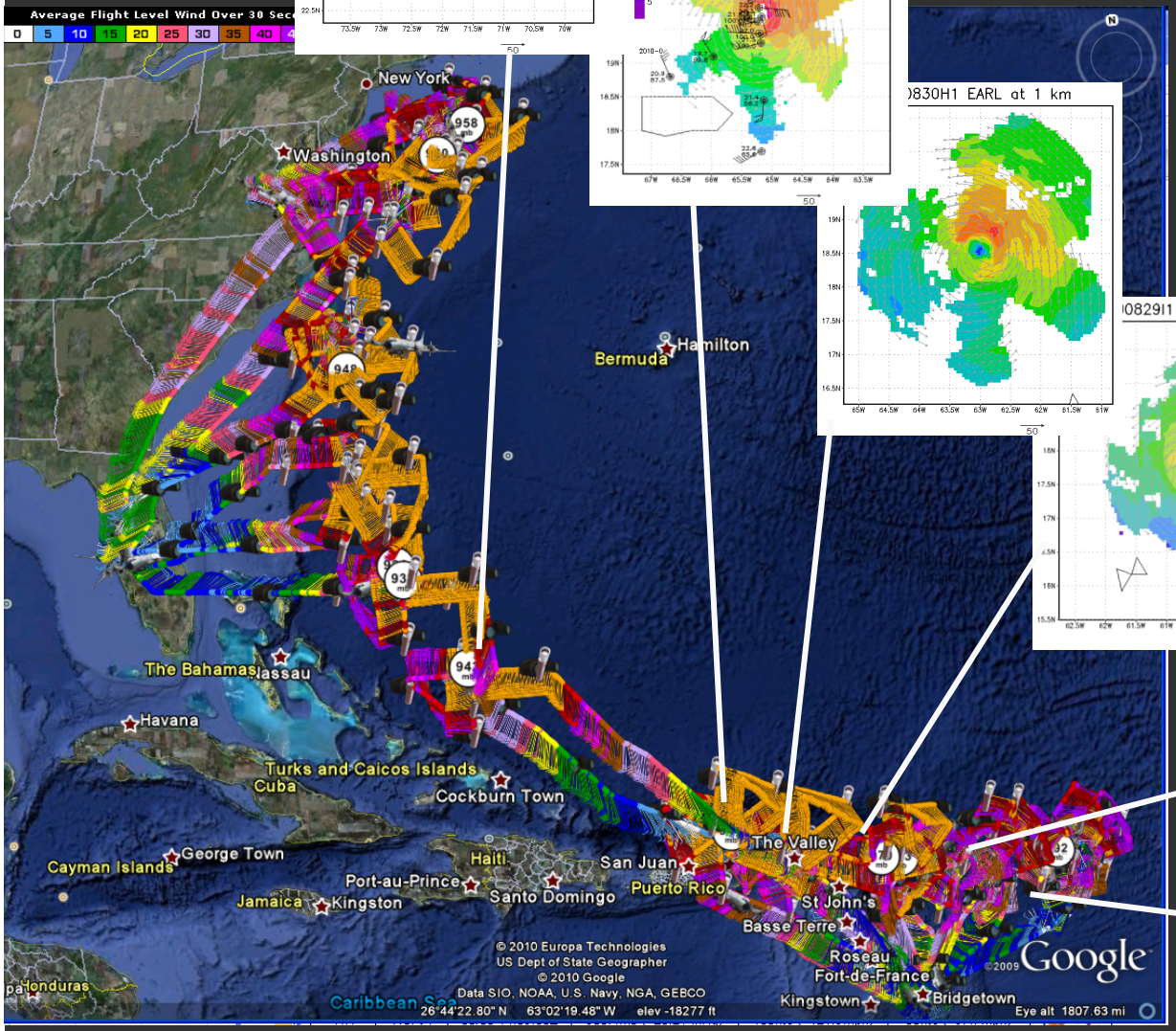
Tail Doppler Radar Experiment (TDR)

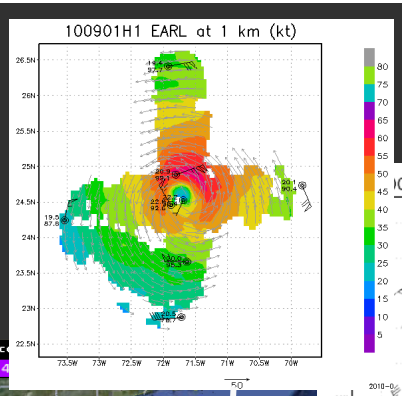
- Provide a comprehensive wind data set for initialization and evaluation of hurricane models (e.g. HWRF)
- Provide data sets to increase understanding of intensity change, using regular, periodic, collection
- 2 P-3 Flights per day--on-station time centered on 0 and 12 UTC analysis periods (8 and 20 UTC take-off)
- -optimum 3 days of flights in a row starting at tropical depression or maybe pre-depression stage

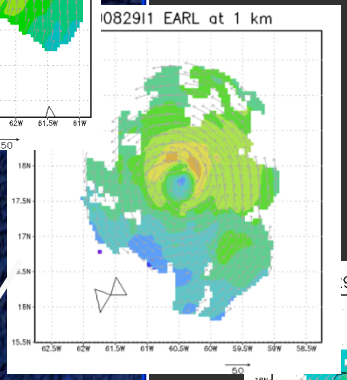


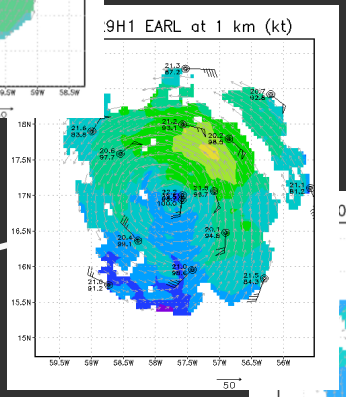
P-3 missions into Hurricane Earl 2010

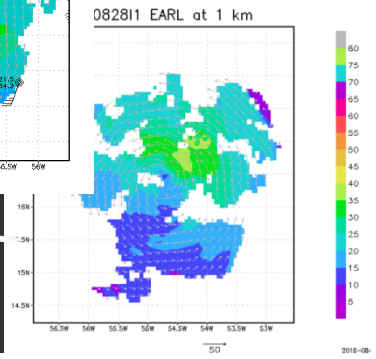
Combination of TDR, RI, and ET experiments







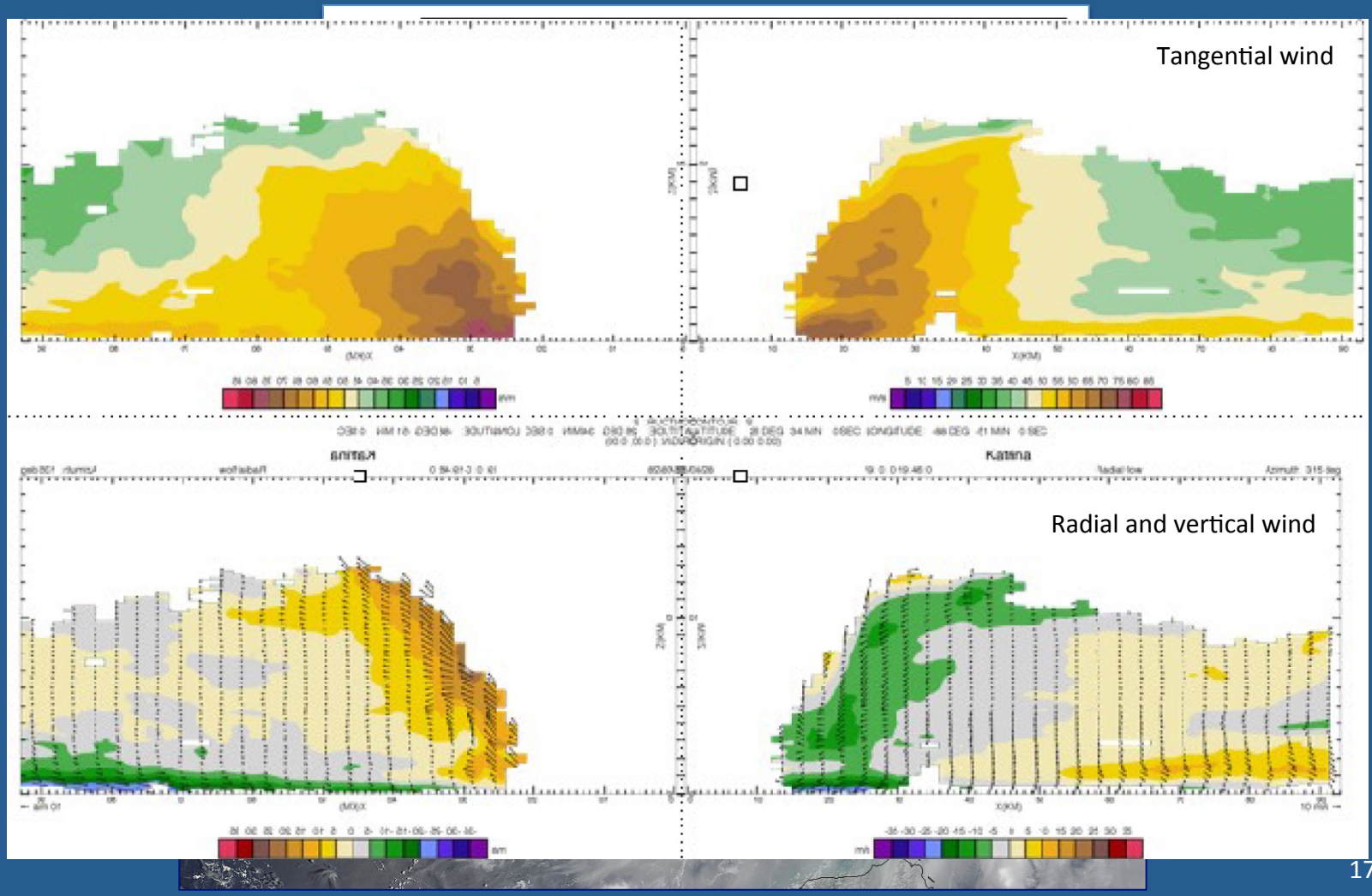


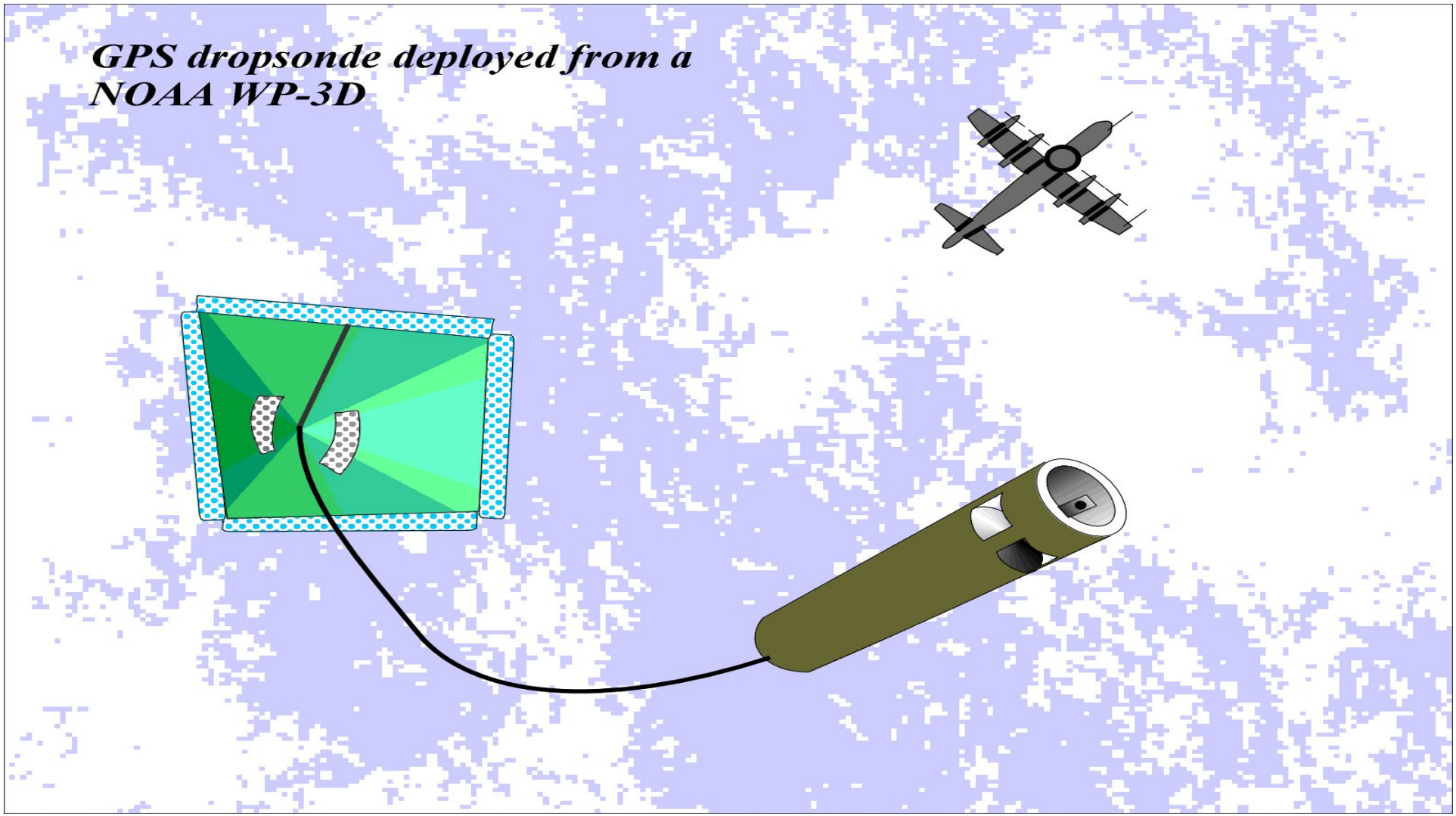


Types of Observations - Airborne

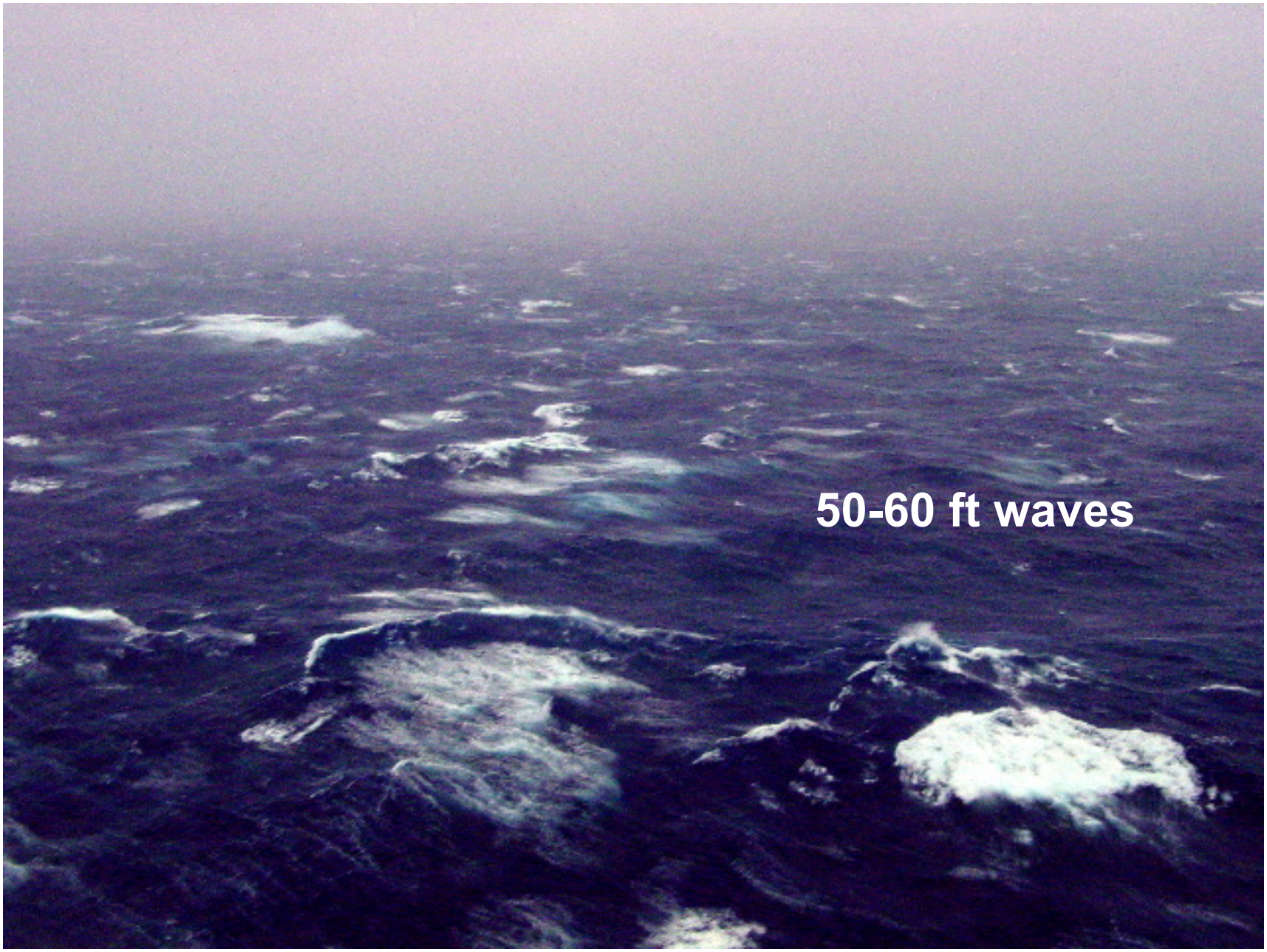
Vortex Structure

Vortex-scale measurements using Airborne Doppler radar




GPS dropsonde deployed from a
NOAA WP-3D

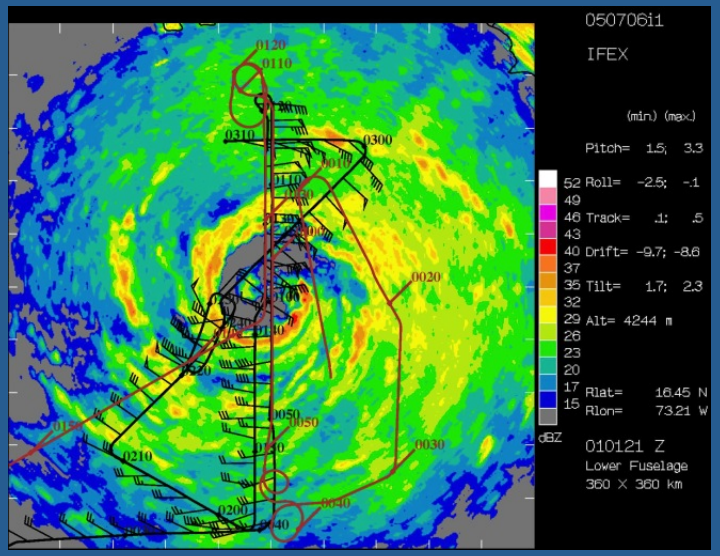
Hurricane Isabel 2003

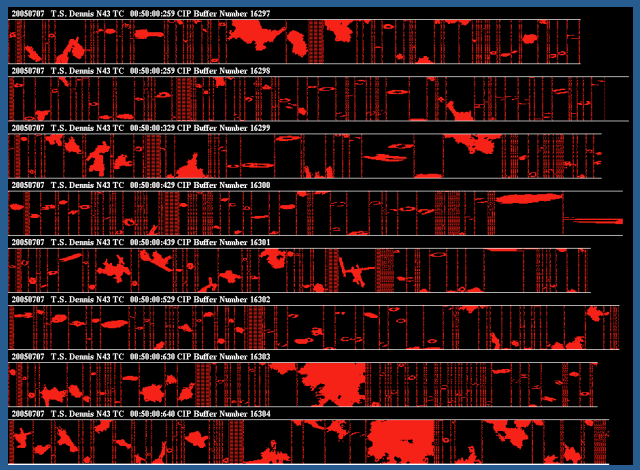

50-60 ft waves

Types of Observations - Airborne

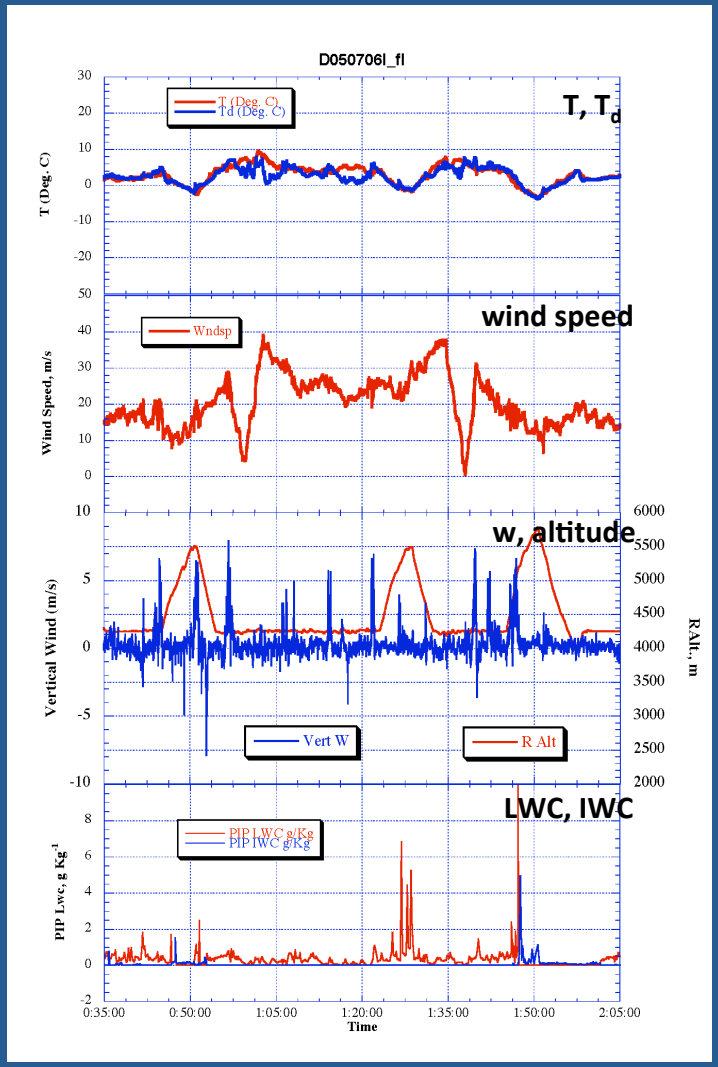
Microphysical Structure

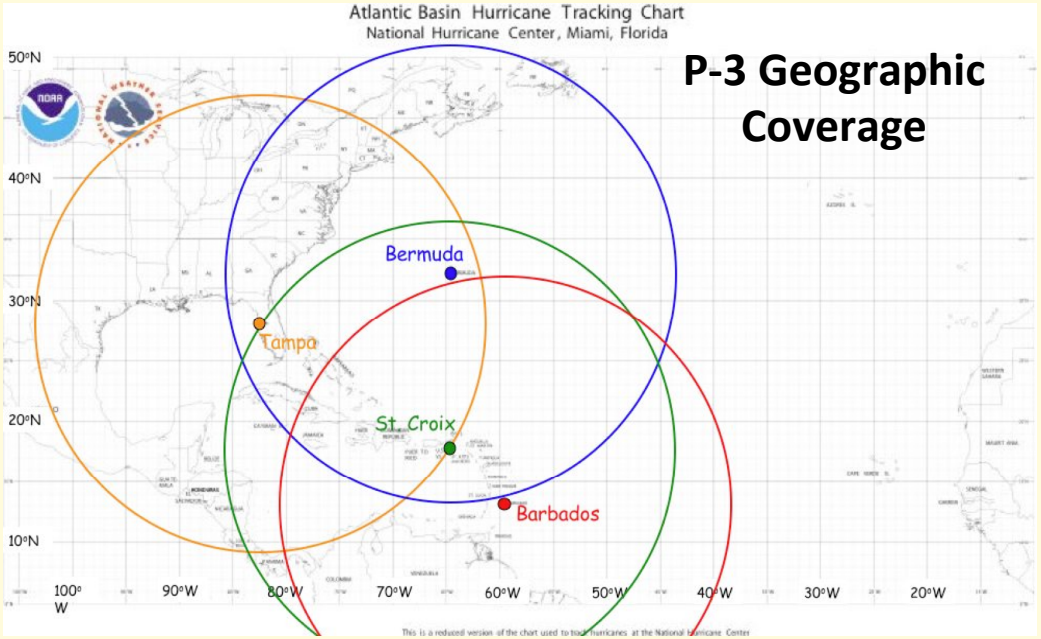
Flight-level parameters during north-south leg on July 6 for Dennis (2005)

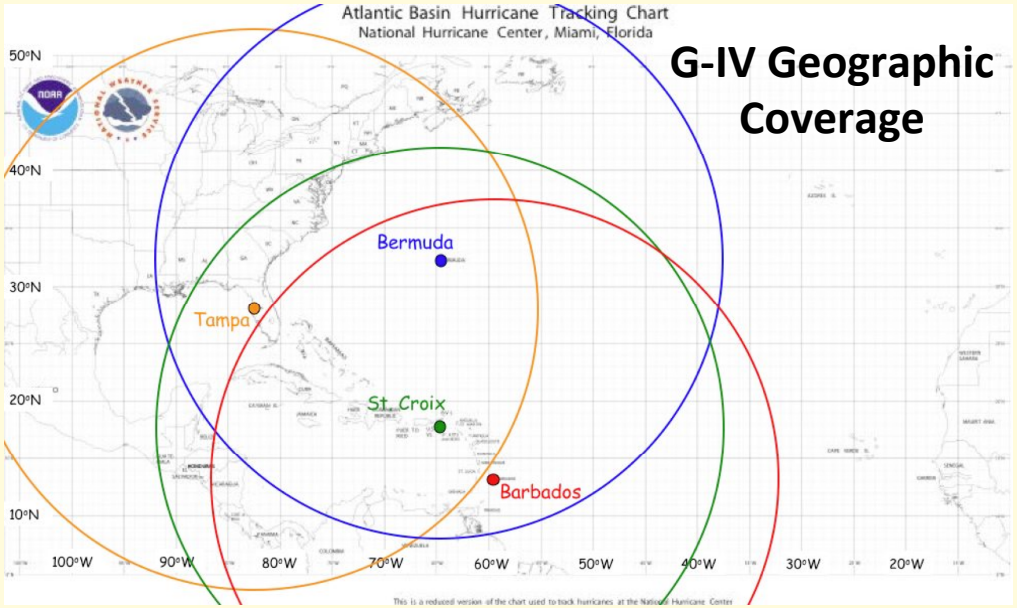




CIP images




Atlantic Basin Hurricane Tracking Chart
National Hurricane Center, Miami, Florida
P-3 Geographic Coverage
50°N
40°N
30°N
20°N
10°N
100° W
90°W
80°W
70°W
60°W
50°W
40°W
30°W
20°W
Bermuda
Tampa
St. Croix
Barbados


Atlantic Basin Hurricane Tracking Chart
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50°N
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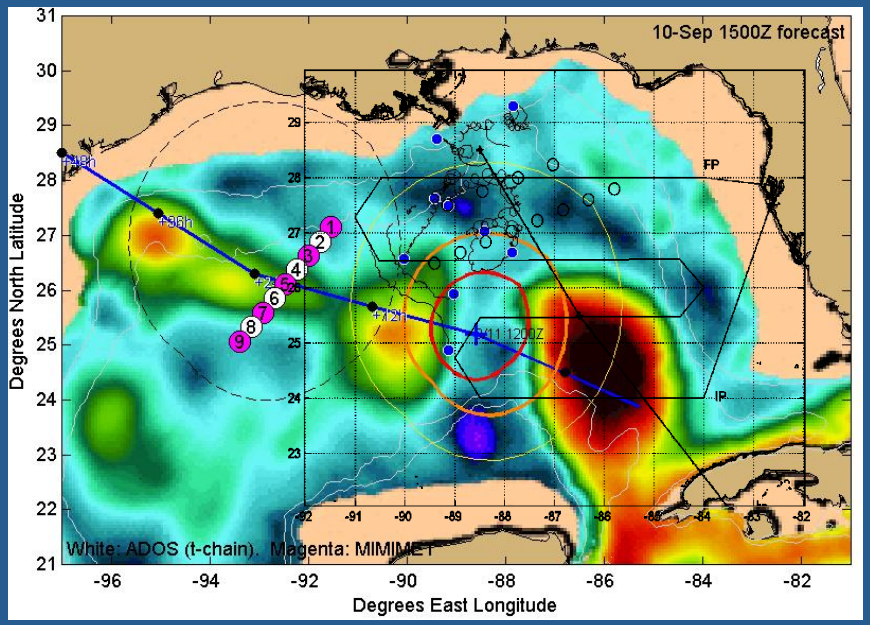
100°W
90°W
80°W
70°W
60°W
50°W
40°W
30°W
20°W
Bermuda
Tampa
St. Croix
Barbados

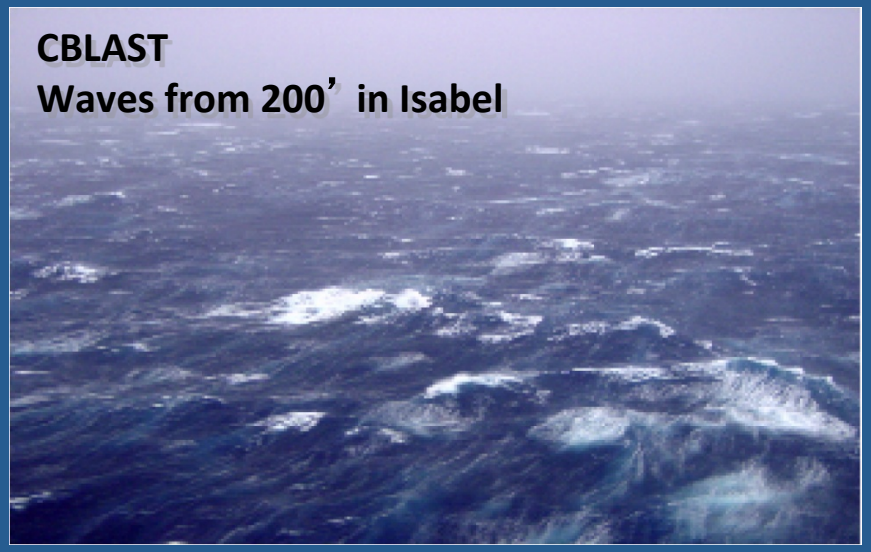
Types of Observations - Airborne

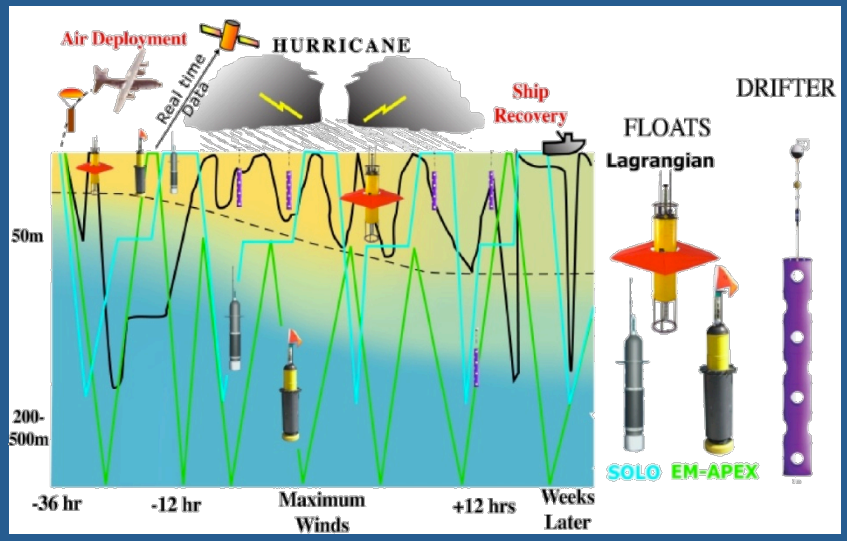
Environmental structure

Targeted upper ocean observations

TC impact on upper ocean effect of Hurricanes Gustav and Ike (2008)







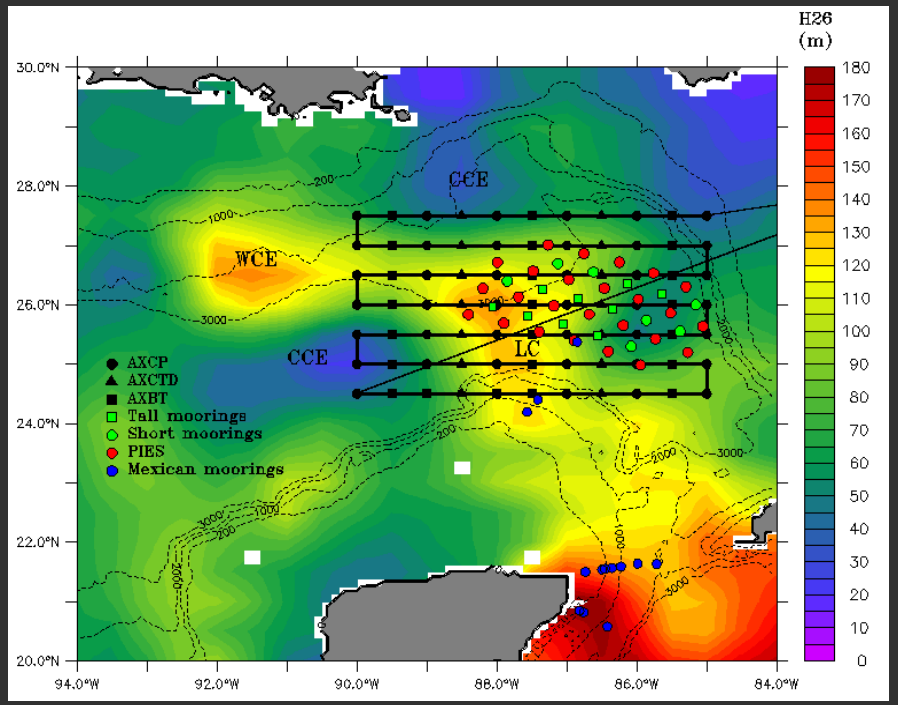
TC Ocean Interaction Experiment

PIs: Nick Shay (UM/RSMAS), Rick Lumpkin (AOML/PhoD) and Eric Uhlhorn (AOML/HRD)

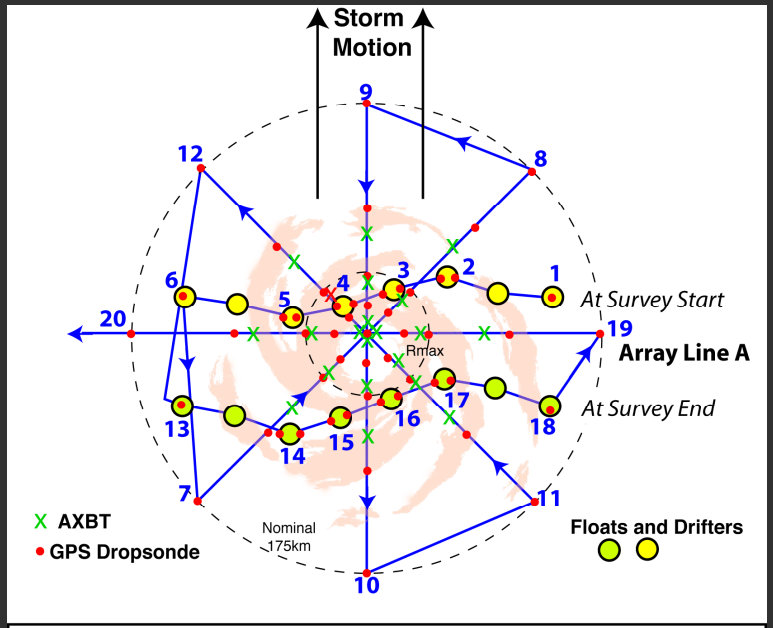
Purpose: Understand the Loop Current response to the near-surface wind structure during TC passages.

Plan: Multi-day exp. AFRC WC-130J float/drifter deployments, Pre-storm P-3 flight, P-3 in-storm mission and post-storm flight

P-3 pre-storm flight pattern



P-3 in-storm flight pattern



Notes:
4 diameter lines through eye each with
9 dropsondes. At eye, 0.5 Rmax, Rmax, 2 Rmax, Line end.
5 AXBT. At eye, Rmax, 2 Rmax
2 float array lines each with
10 dropsondes. 2 at each of 4 floats, 2 Line ends.
Total: 56 dropsondes, 20 AXBT

Resulting data analyses from TDR missions

- Assimilation development at HRD
- Composite storm-structure studies
- Observing System Experiments (OSEs)
- Evaluation of error characteristics of airborne Doppler data and analyses

New for this season…

Doppler Wind Lidar SAL Module

PI: Jason Dunion

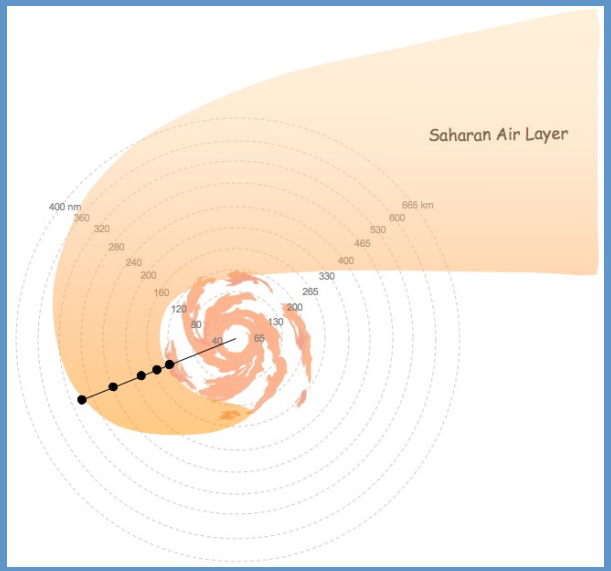
Detect winds and aerosols both above (up to ~14 km in the presence of high level cirrus) and below (down to ~100 m above the ocean surface) the aircraft flight level (typically 3 -5 km)

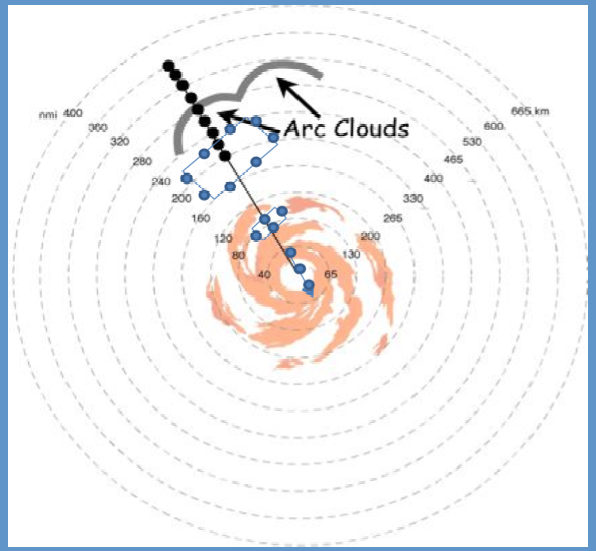
Purpose: Characterize the suspended Saharan dust and mid-levels and its affects on TCs

Plan: On outbound and inbound legs (19k ft) or higher

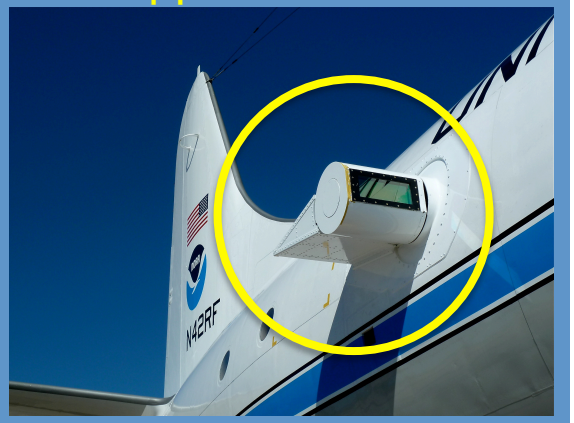
Set DWL to downward looking and full scan mode

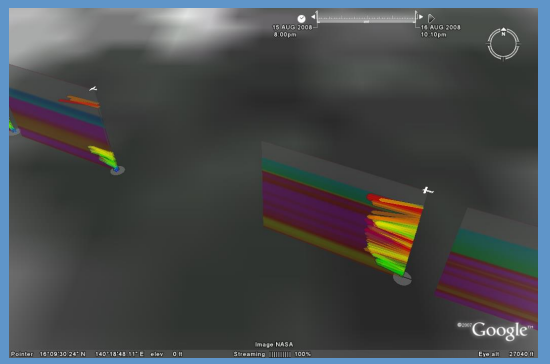
Drop sondes at 25-50 nmi increments in the SAL region





Doppler Wind Lidar





New this season

UAS – Small Unmanned Aerial Vehicle Experiment (SUAVE)

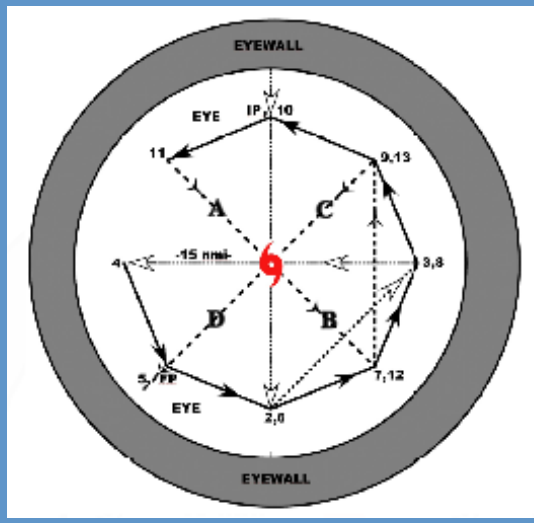
PI: Joe Cione

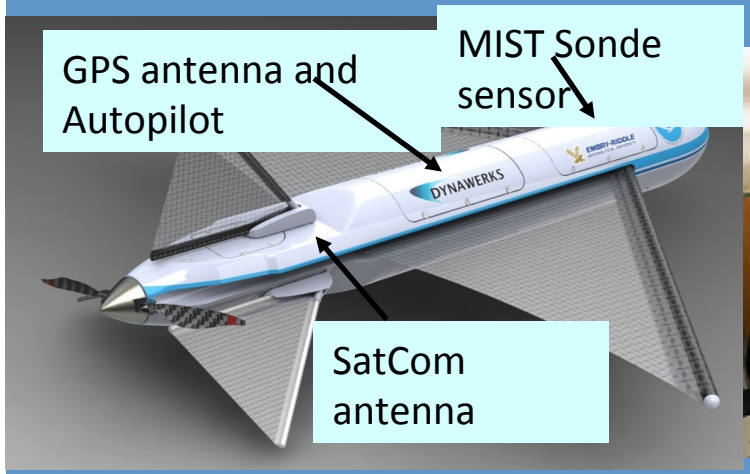
Purpose: Continuously monitor TC intensity & capturing an RI change event.

Plan: GALE released from P-3 free–fall AXBT chute (10,000 ft)

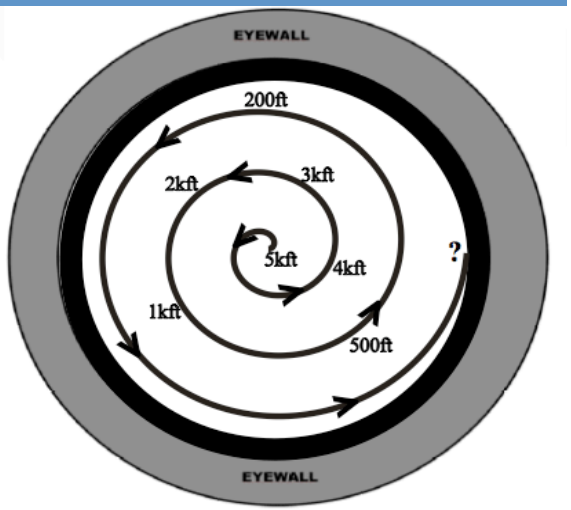
- P-3 performs a fig-4 in eye dropping sondes and BTs, then circumvents the eye
- GALE will loiter in the eye or eyewall region in mature storms
- Provide high-res near surface obs of (V, P, T and RH)
- Module flight duration: ~1 hr

P-3 Mature Storm Pattern





GALE -UAS Flight Pattern



Communicating in the field

- Our blog
http://noaahrd.wordpress.com
- HRD Web page
http://www.aoml.noaa.gov/hrd
- Facebook
http://www.facebook.com/noaahrd
- Twitter
http://twitter.com/#!/HRD_AOML_NOAA

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Thank you!