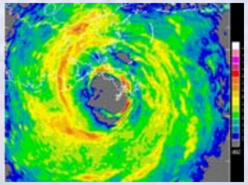
Physical Processes of Hurricane Intensity Change

Jason P. Dunion
AOML Program Review
18-20 March 2008

Outline

Motivation

- Improvements in intensity forecasts lagging behind those of track;
- Understanding TC Intensity: a multi-scale challenge;

Tropical Cyclone Intensity Change (surrounding environment)

- Rapid Intensification;
- Inner Core SST Responses;
- SST & Ocean Heat Content (Aircraft Buoy Deployments);
- Saharan Air Layer (i.e. Saharan dust storms);

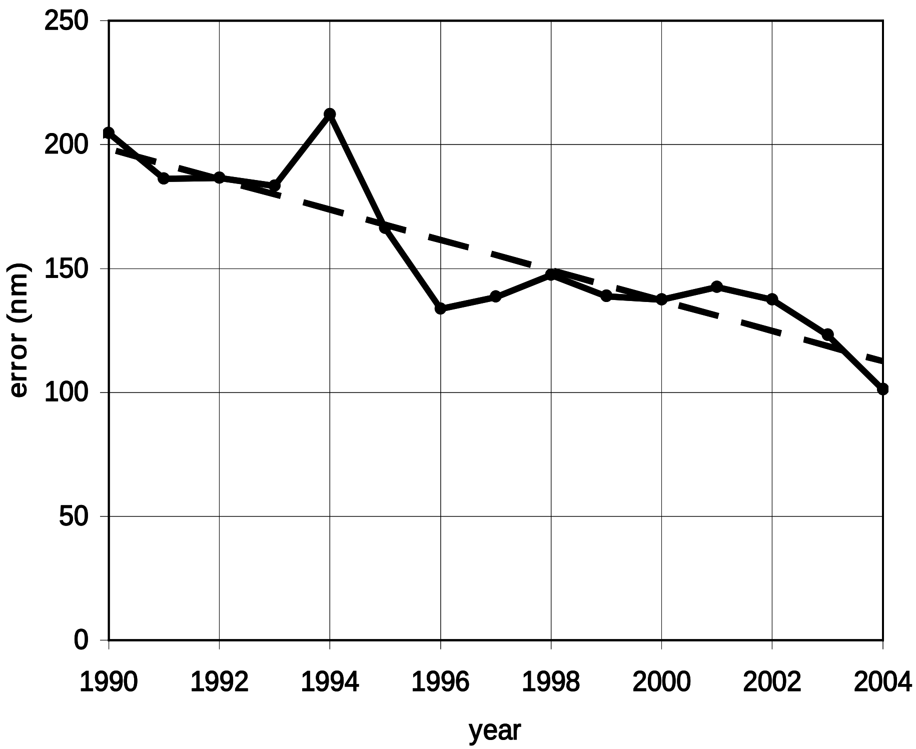
Tropical Cyclone Intensity Change (inner core processes)

- Eyewall replacement cycles;
- Eye-Eyewall mixing;

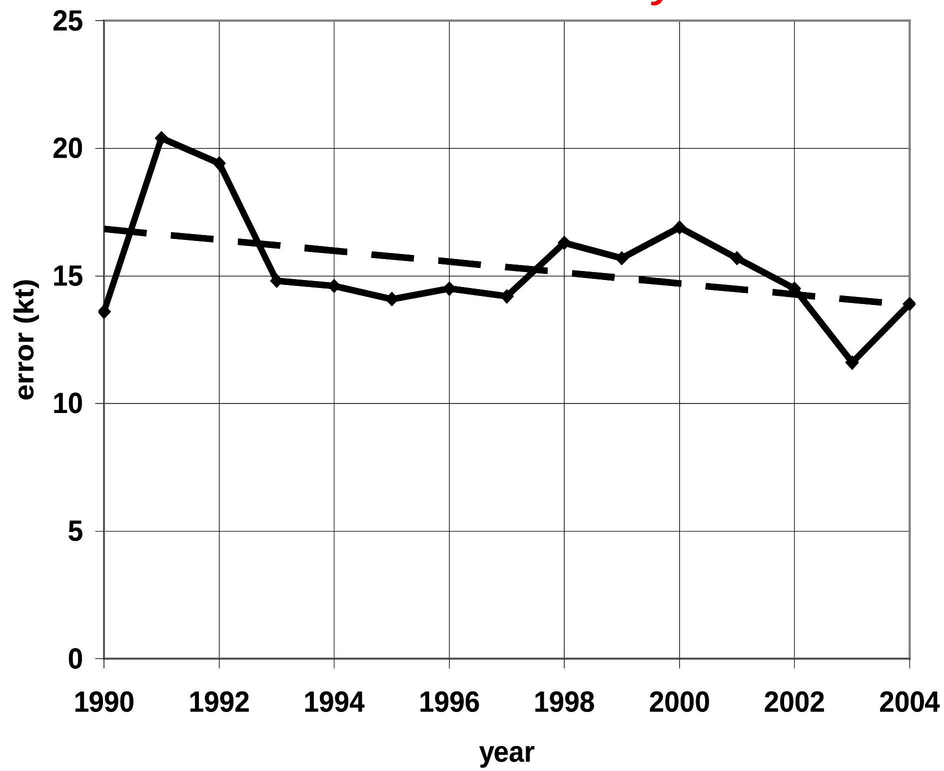
Questions (10-15 sec max)

Historical Improvements in Tropical Cyclone Forecasting (1990-2004)

NHC 48-hr track error



NHC 48-hr intensity error



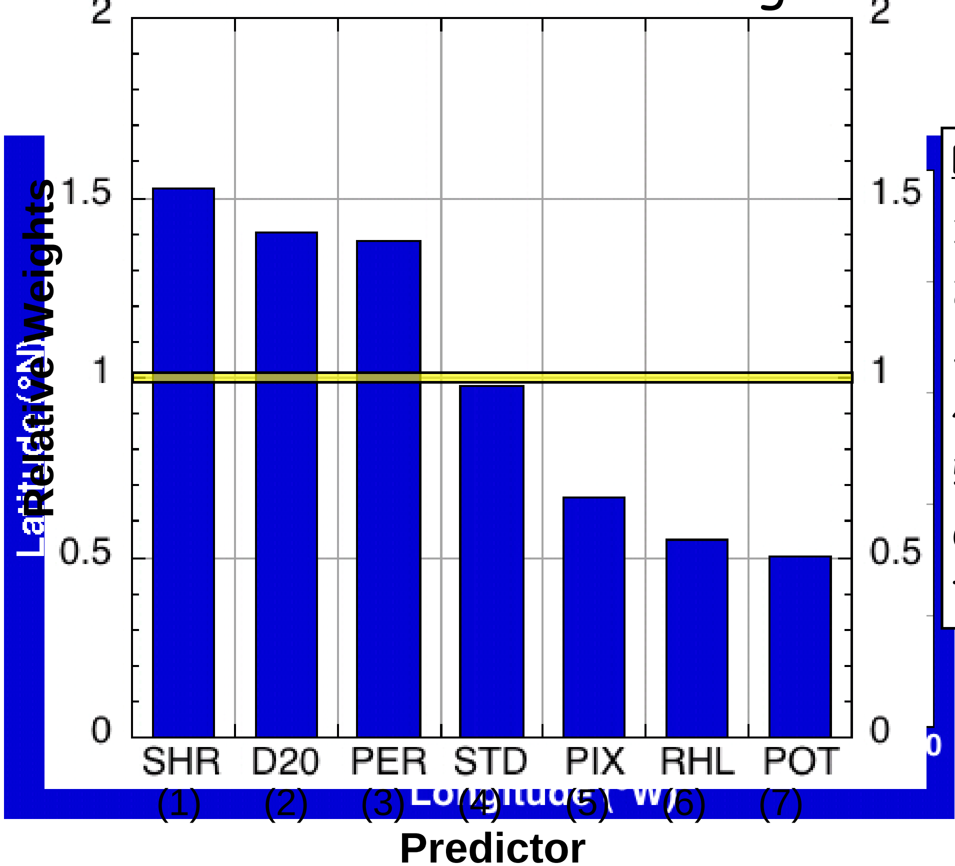
Improvements in intensity forecasts lagging ~15-20 years behind those for track

Tropical Cyclone Rapid Intensification

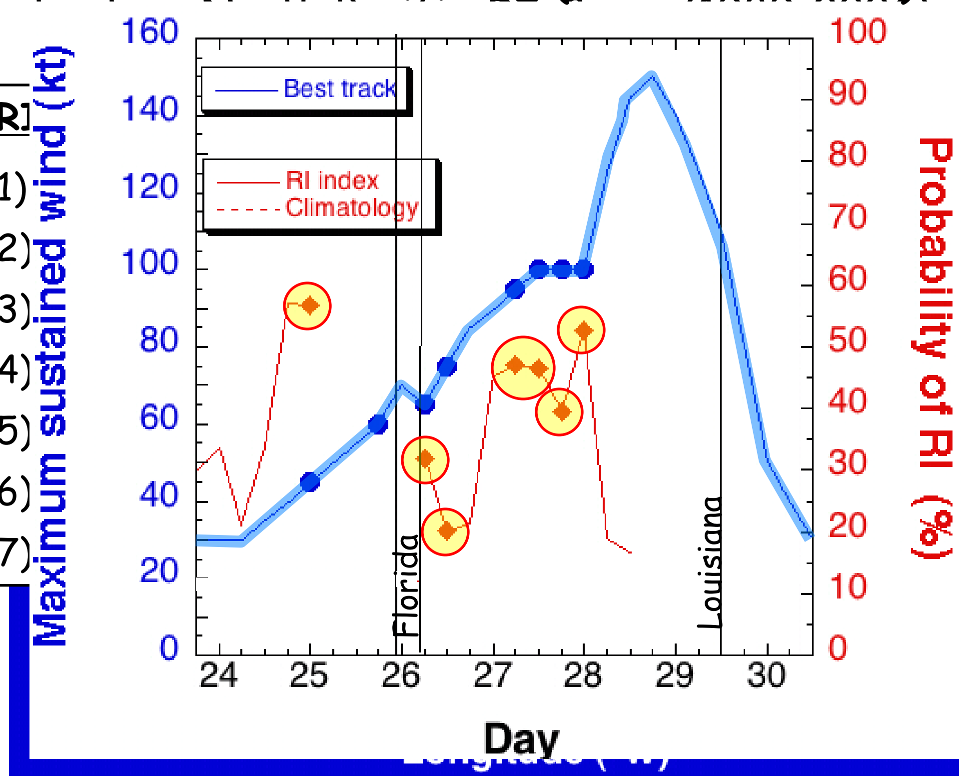
Main Science Objective:

Use statistical model guidance to understand and predict the likelihood of RI;

Atlantic RI Predictor Weights



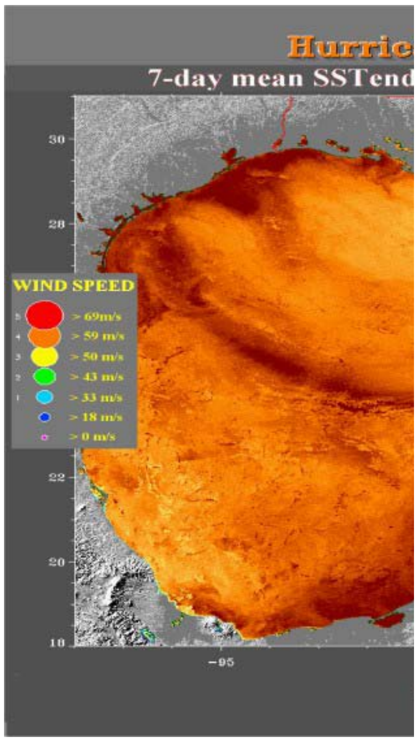
RI Index Guidance (2005 Katrina)

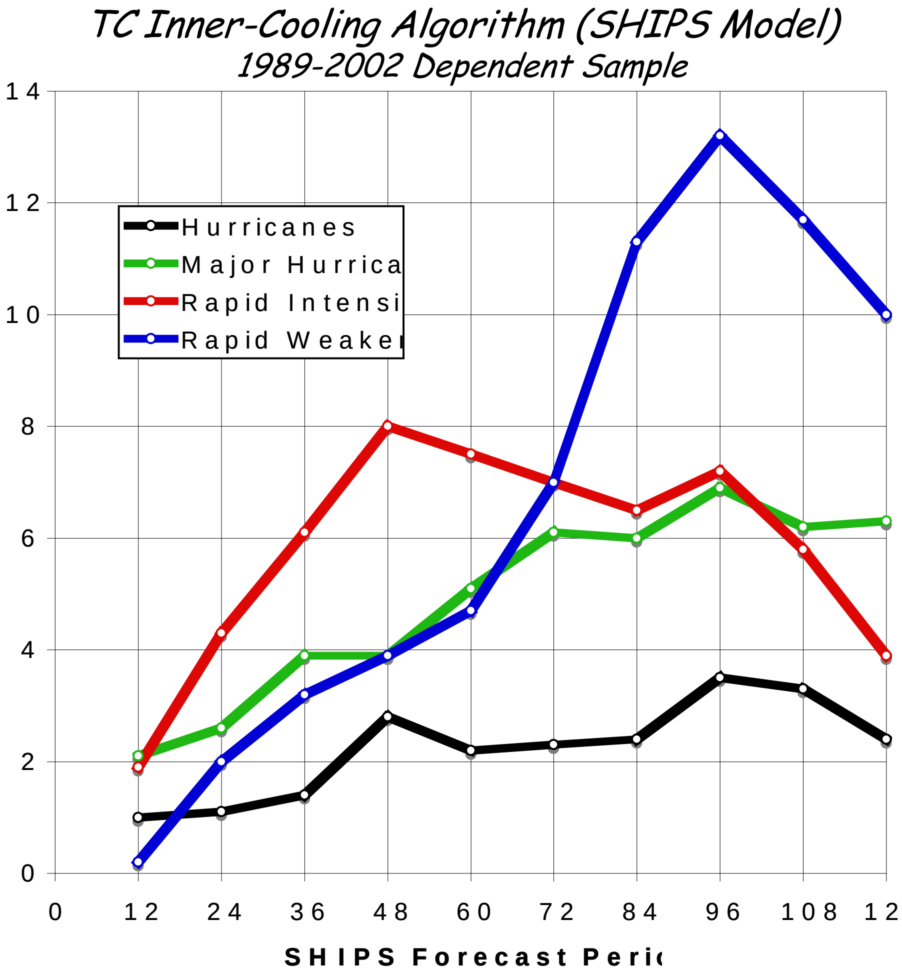


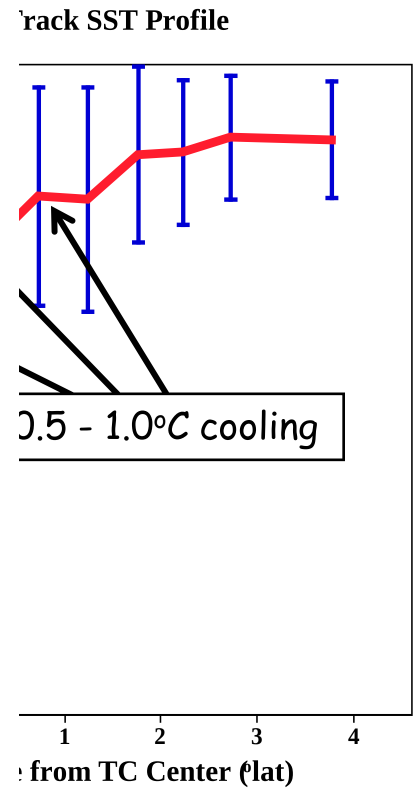
Inner Core Sea Surface Temperature

Main Science Objective:

Improve our understanding of the ocean response to TCs and its impact on TC intensity change;







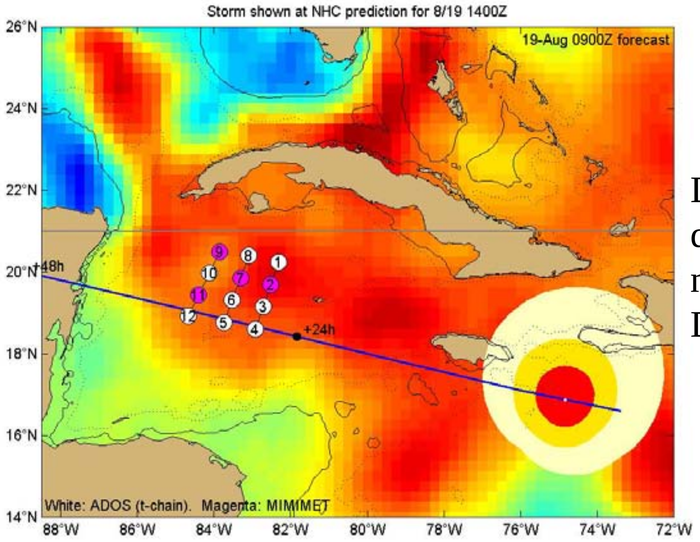
<u>Largest positive impacts:</u>

major hurricanes, rapid intensifiers, & rapid weakeners

Deployments of Buoy Drifter Arrays

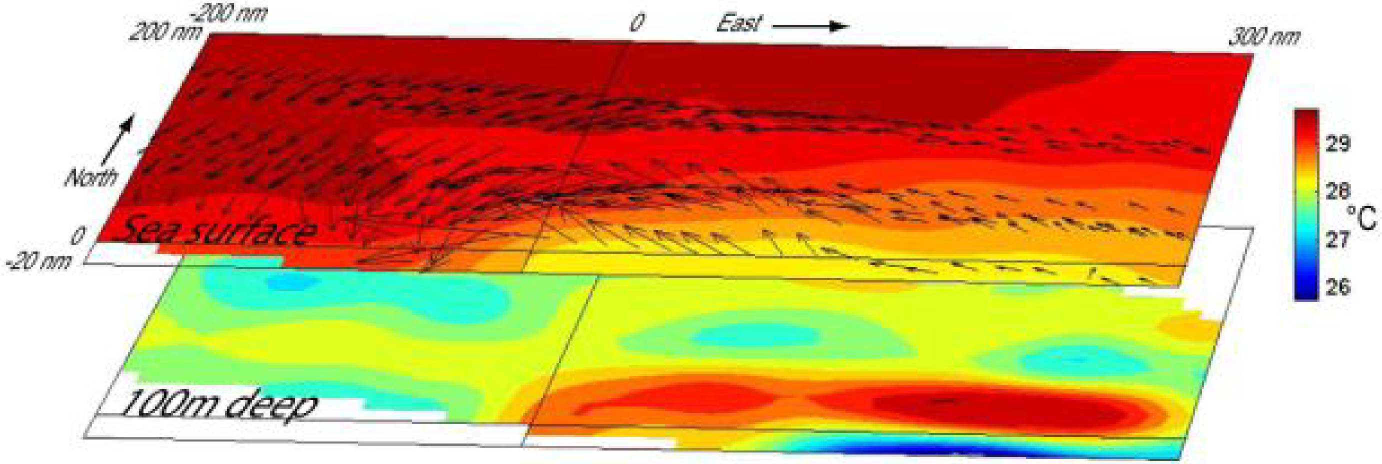
Main Science Objective:

Improve our understanding of the 3-dimensional ocean response to TCs



Drifting buoy array deployed in front of major Hurricane Dean (Aug 2007);

Upper Ocean Heat Content

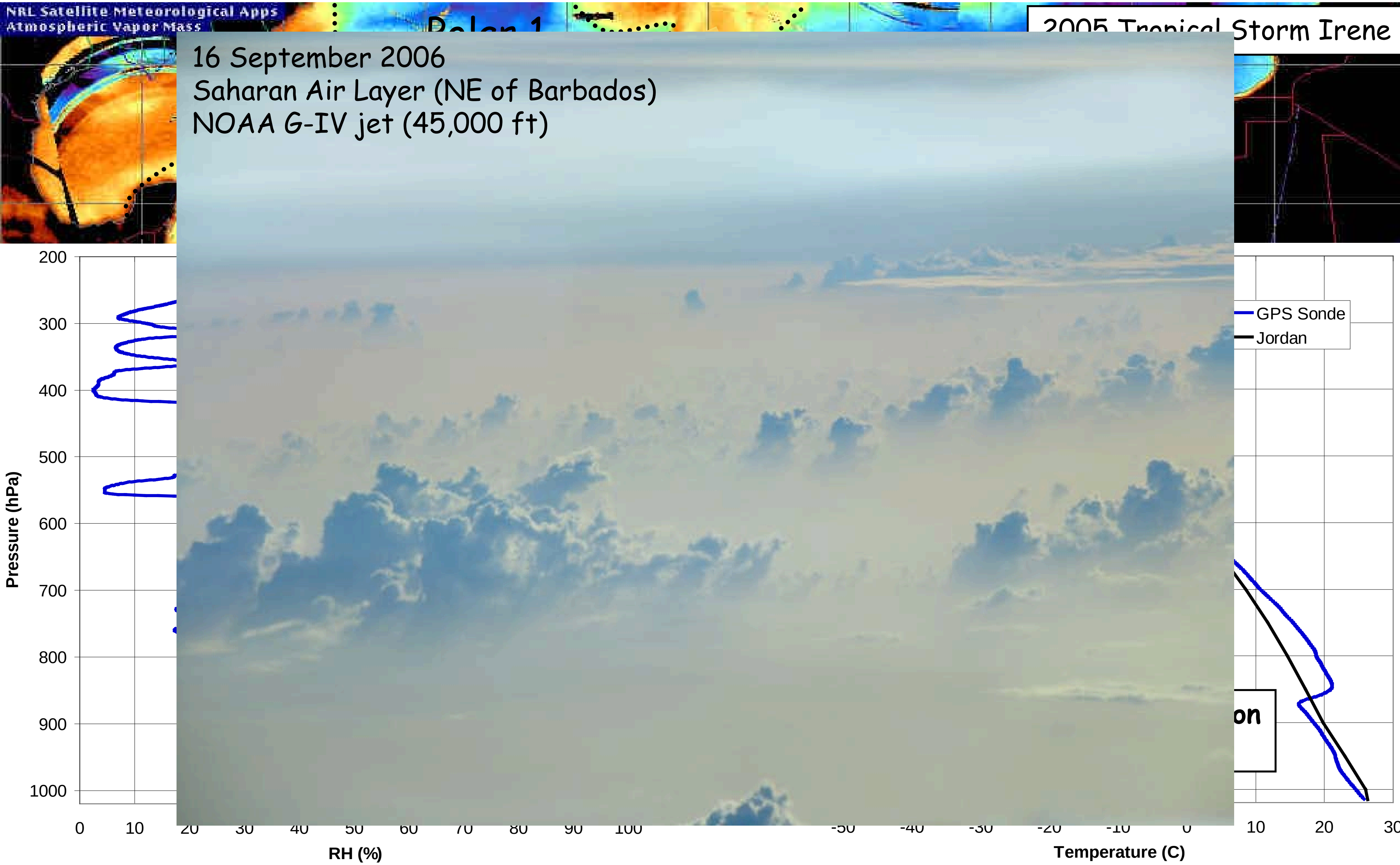


Top: Sea surface temperature (shading, °C) and winds (arrows) measured by the hurricane drifter array at top. Bottom: subsurface temperatures at a depth of 100m.

The Saharan Air Layer (Saharan Dust Storms)

Main Science Objectives:

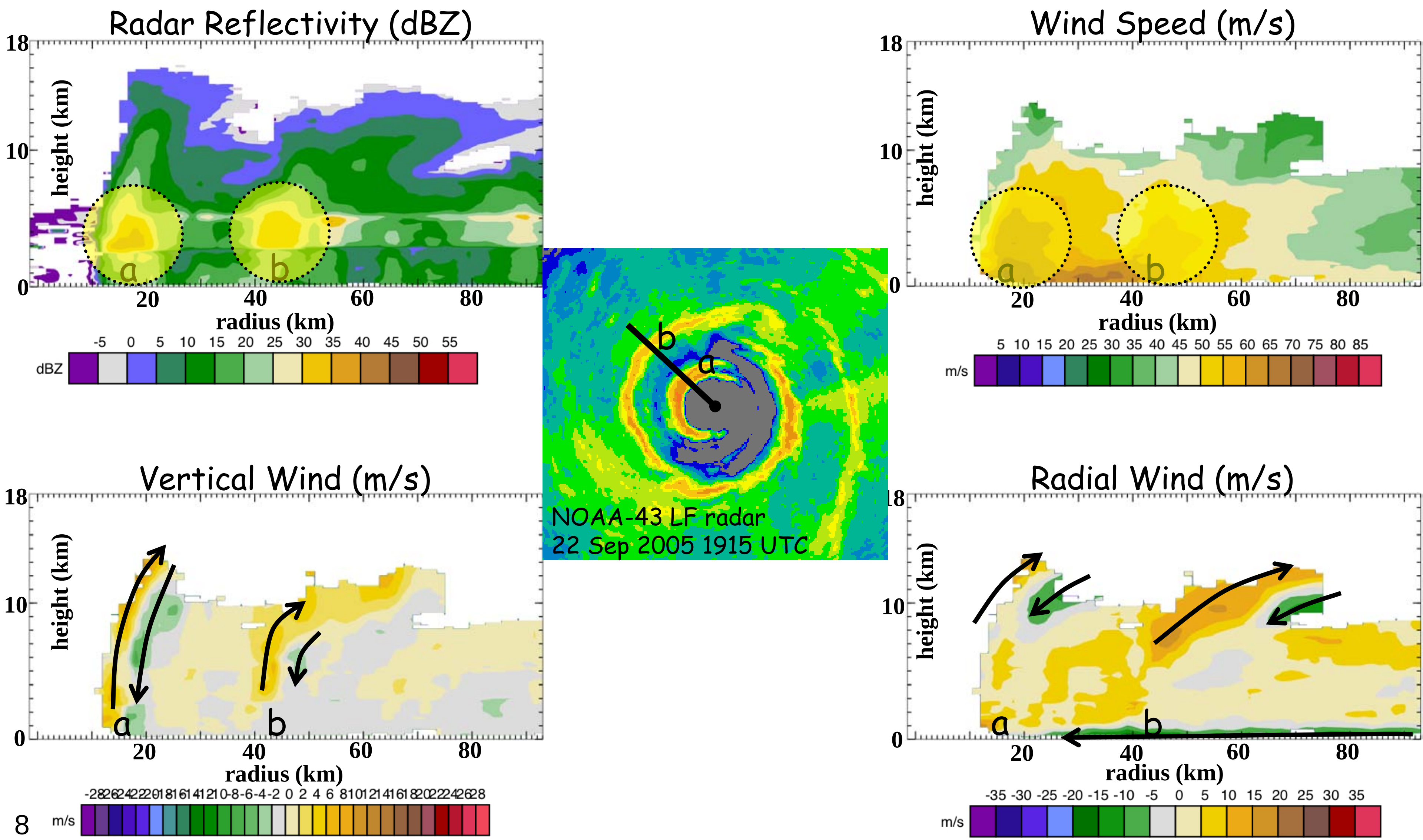
Improve our understanding *of how the SAL's* ***dry air, mid-level easterly jet****, and* ***suspended mineral dust*** *affect TC intensity change*



Tropical Cyclone Eyewall Replacement Cycles

Main Science Objective:

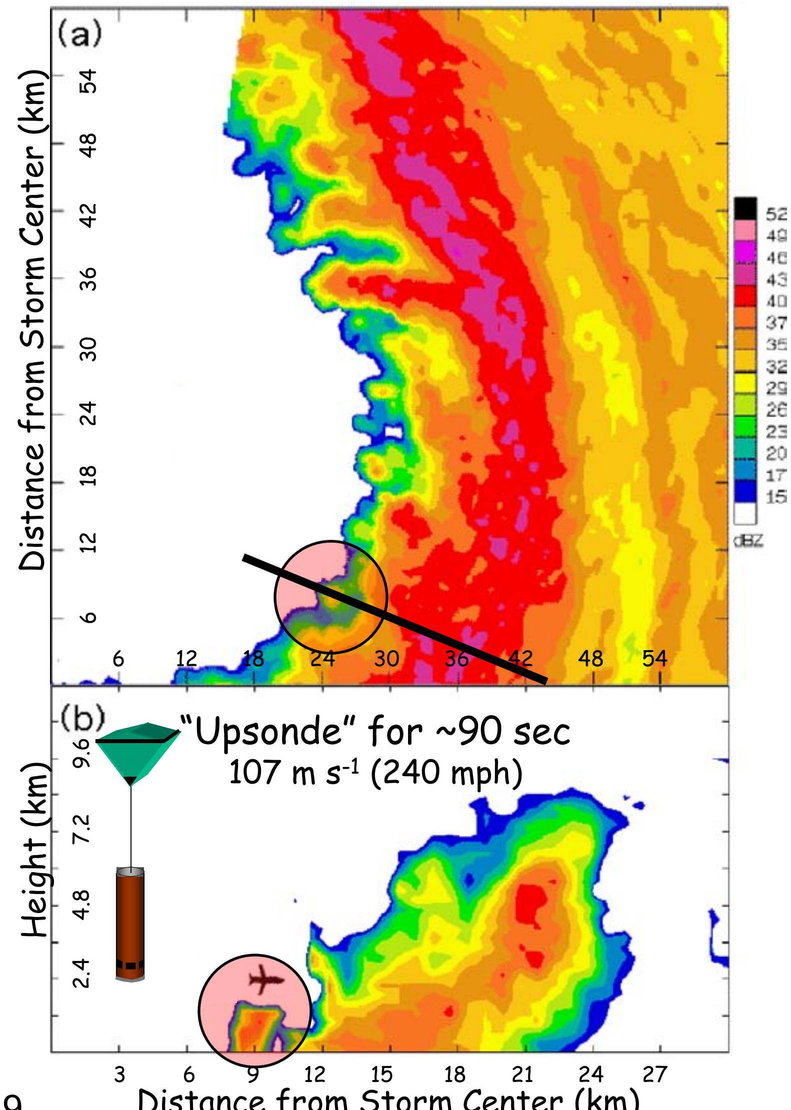
Observe & Understand the processes of eyewall replacement cycles
and associated changes in TC intensity;

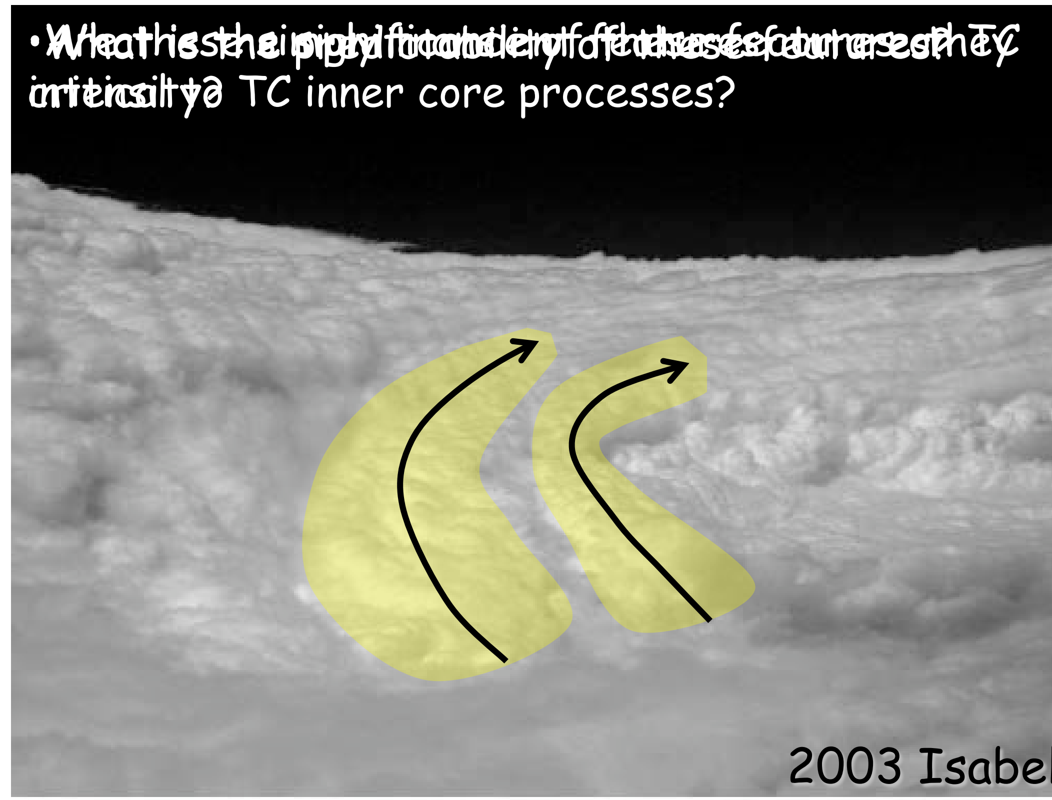


Eye-Eyewall Mixing Processes

Main Science Objective:

Understand and describe the small-scale features found in tropical cyclone eyewalls and their effect on intensity & landfall impacts





Possible mixing of warmer/moister air from the eye into the surrounding eyewall (on very short time scales: ~1.5 hr);

POSTER SESSION

Physical Processes of Hurricane Intensity Change

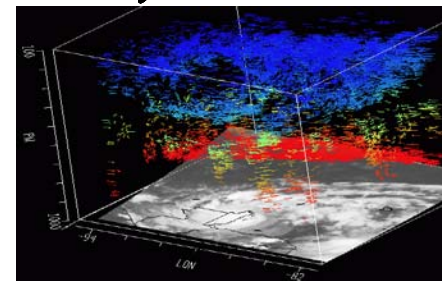
TC Rapid Intensification/TC Inland Decay	*(John Kaplan)*
Aerosonde Unmanned Aerial System	*(Joe Cione)*
Saharan Air Layer	*(Jason Dunion)*
Hurricane Danielle Genesis	*(Sim Aberson/Nelsie Ramos)*
CBLAST Experiment; Turb Flux Meas.	*(Jun Li)*
2006 Felix NOAA P-3 flight	*(Sim Aberson)*
Ocean Heat Content & Ocean Cooling	*(Gustavo Goni)*
Convective Bursts & RI (TRMM Satellite)	*(Rob Rogers)*
New Tech: Sfc Winds from Aircraft (HIRAD)	*(Eric Uhlhorn/Bob Atlas)*

QUESTIONS?

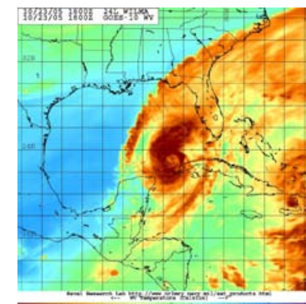
Understanding TC Intensity & Structure

…so many issues, so little time (10 min)

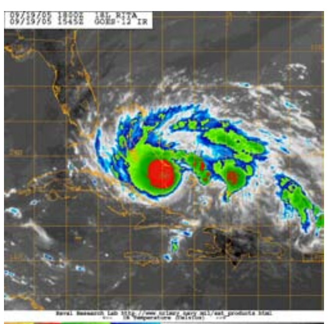
advancing understanding through field program efforts and merging available technology



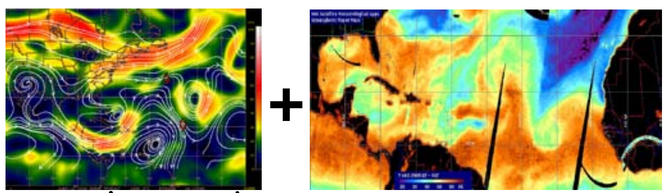
TC genesis: alignment of low-level vortex and mid-level vortex



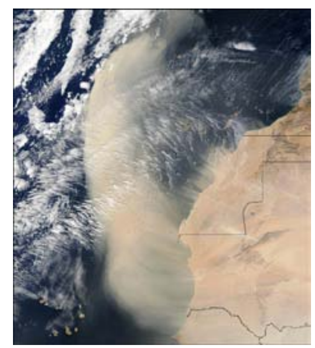
TC/trough interactions



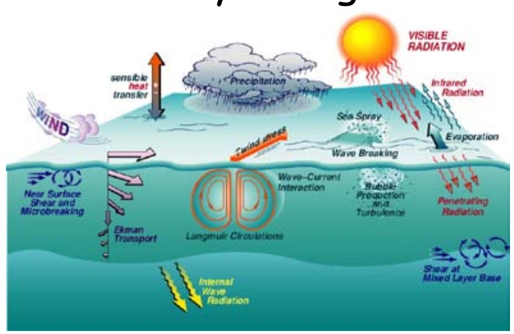
role of deep convection on TC intensity change & genesis



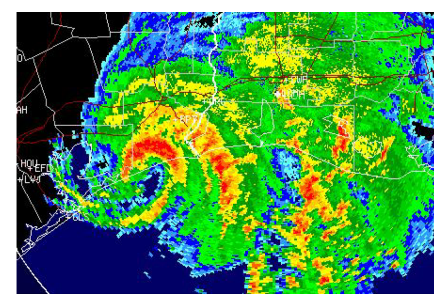
shear+dry air: impact on intensity change



impact of aerosols on convection



hurricane boundary layer/air-sea transfer



inner core/rainband interactions

TC Structure: Airborne Tail Doppler Radar

Main Science Objective:

Understand and describe the the 3-D structure of TCs