Physical Processes of Hurricane Intensity Change
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)

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)

Florida
Louisiana
Inner Core Sea Surface Temperature

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

TC Inner-Cooling Algorithm (SHIPS Model)
1989-2002 Dependent Sample

Largest positive impacts: 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

16 September 2006
Saharan Air Layer (NE of Barbados)
NOAA G-IV jet (45,000 ft)
Tropical Cyclone Eyewall Replacement Cycles

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

Radar Reflectivity (dBZ)

Wind Speed (m/s)

Vertical Wind (m/s)

Radial Wind (m/s)

NOAA-43 LF radar 22 Sep 2005 1915 UTC
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)

QUESTIONS?
Understanding TC Intensity & Structure
...so many issues, so little time (10 min)

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

advancing understanding through field program efforts and merging available technology

shear+dry air: impact on intensity change

TC/trough interactions

role of deep convection on TC intensity change & genesis

impact of aerosols on convection

inner core/rainband interactions

hurricane boundary layer/air-sea transfer
Main Science Objective:
Understand and describe the 3-D structure of TCs