Understanding the Natural Processes that Produce Hazards: The Hurricane Example

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for

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WHERE AMERICA'S CLIMATE AND WEATHER SERVICES BEGIN

OVERVIEW

- OPERATIONAL HURRICANE FORECAST ISSUES

- HISTORICAL PERSPECTIVE ON IMPROVING HURRICANE TRACK FORECASTS

- SCIENCE AND MODELING CHALLENGES FOR INTENSITY/STRUCTURE, RAINFALL

- DEVELOPMENT OF A NEW OPERTIONAL MODELING SYSTEM

- SOME PRELIMINARY RESULTS

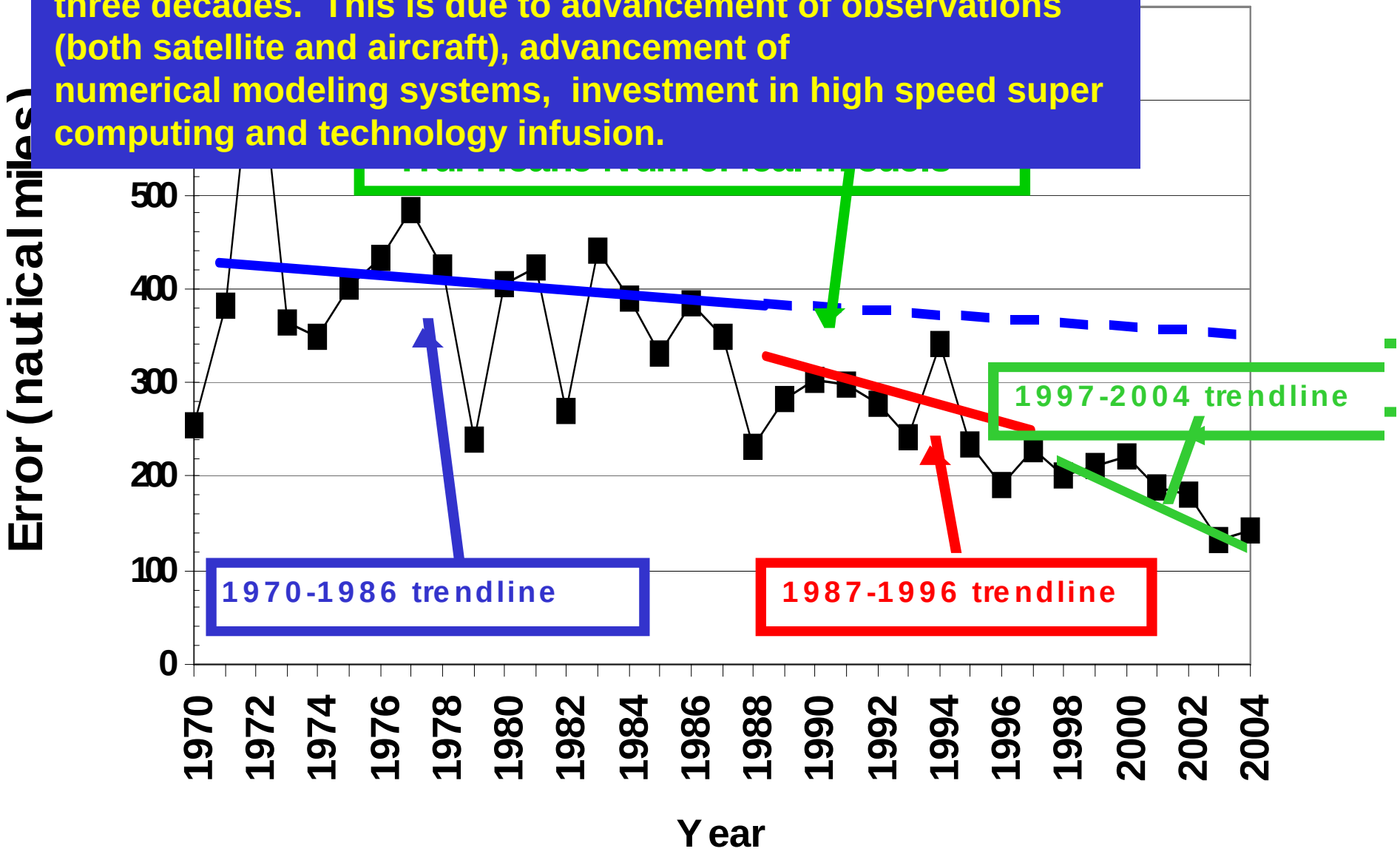
- FUTURE CHALLENGES

OPERATIONAL FORECAST ISSUES:

- CONTINUED ADVANCEMENT OF TRACK FORECASTS
- IMPROVED INTENSITY PREDICTION
- IMPROVED PREDICTION OF SURFACE WIND DISTRIBUTION
- IMPROVED RAINFALL FORECASTS
- WAVES, STORM SURGE, HURRICANE GENESIS

TPC Atlantic 72 hr Track Forecast Errors

With the exception of "stalling and looping storms", hurricane track prediction has shown remarkable progress over the past three decades. This is due to advancement of observations (both satellite and aircraft), advancement of numerical modeling systems, investment in high speed super computing and technology infusion.



How NOAA Improved Track Forecasts

Three components of modeling system:

- **HIGH QUALITY OBSERVATIONS (large scale environment surrounding hurricane, e.g. satellite, aircraft)**
- **MADE BETTER USE OF OBSERVATIONS IN HURRICANE MODELS (advances in data assimilation, e.g. for satellites- direct assimilation of radiances)**
- **IMPROVED HURRICANE MODELS (improved representation of physical processes, increased resolution, improved initial specification of vortex)**

NOAA's Hurricane Aircraft

NOAA's G-IV (high altitude jet)

flies in storm environment

releases dropsondes to obtain measurements of wind, temperature and moisture - **TRACK**

upgrade w/ doppler radar to obtain core observations - **INTENSITY/STRUCTURE**

NOAA's P-3's (turbo- props)

augments G-IV observations in environment

hurricane core observations

****AFRES (Bilxoxi, MS) provides mainstay of recon for NHC

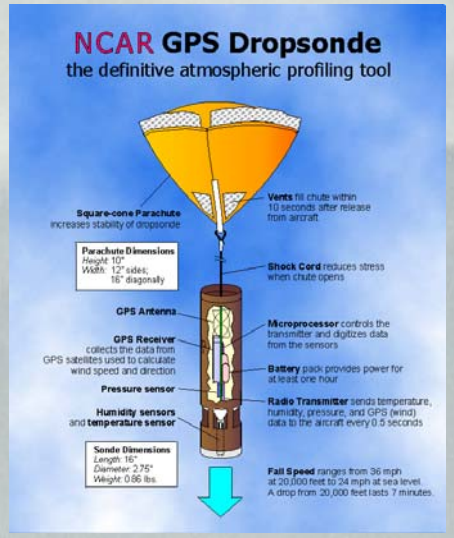
NOAA G-IV AIRCRAFT

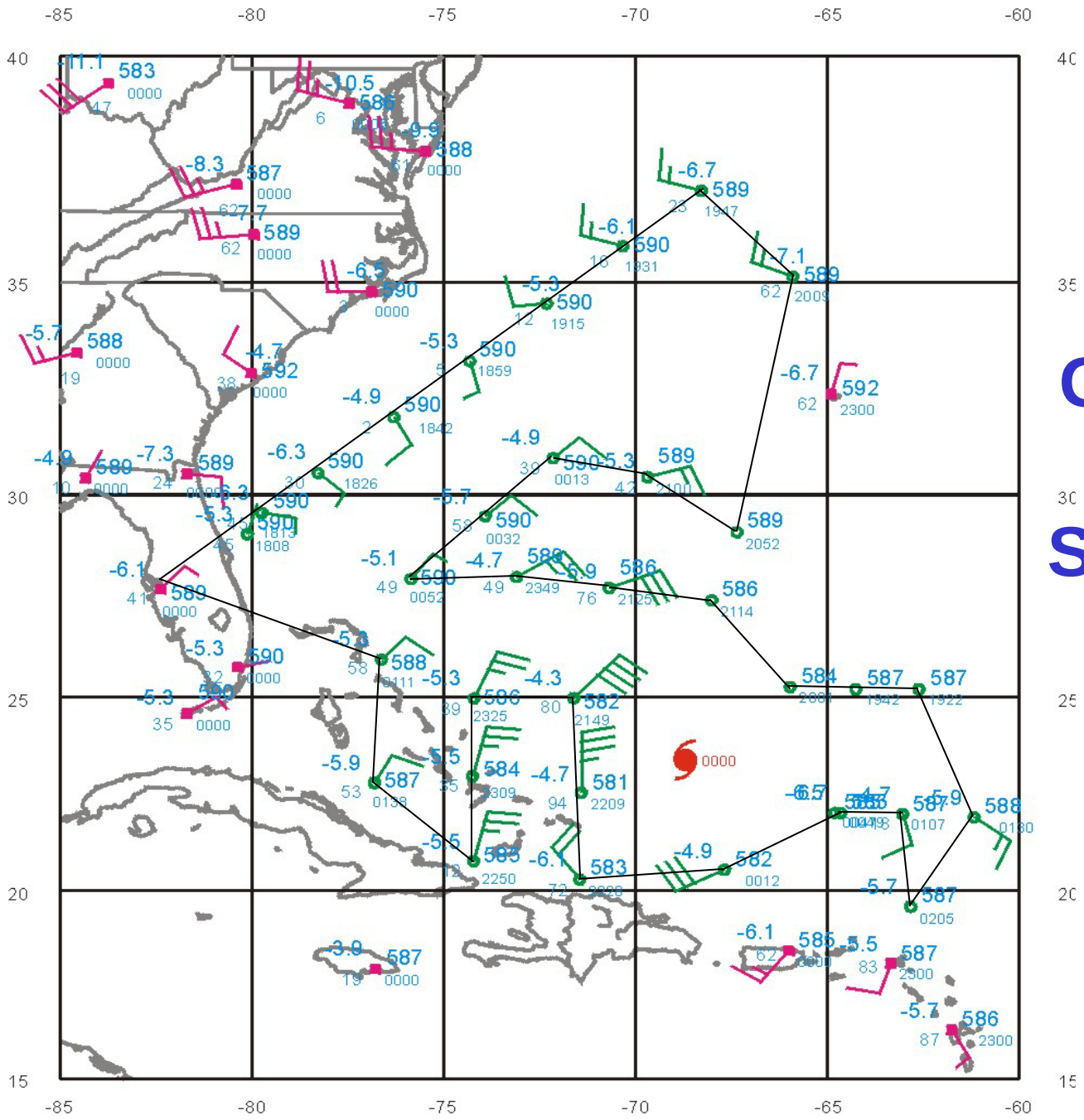
FLIGHT LEVEL: ~45K

RANGE: 4200nm

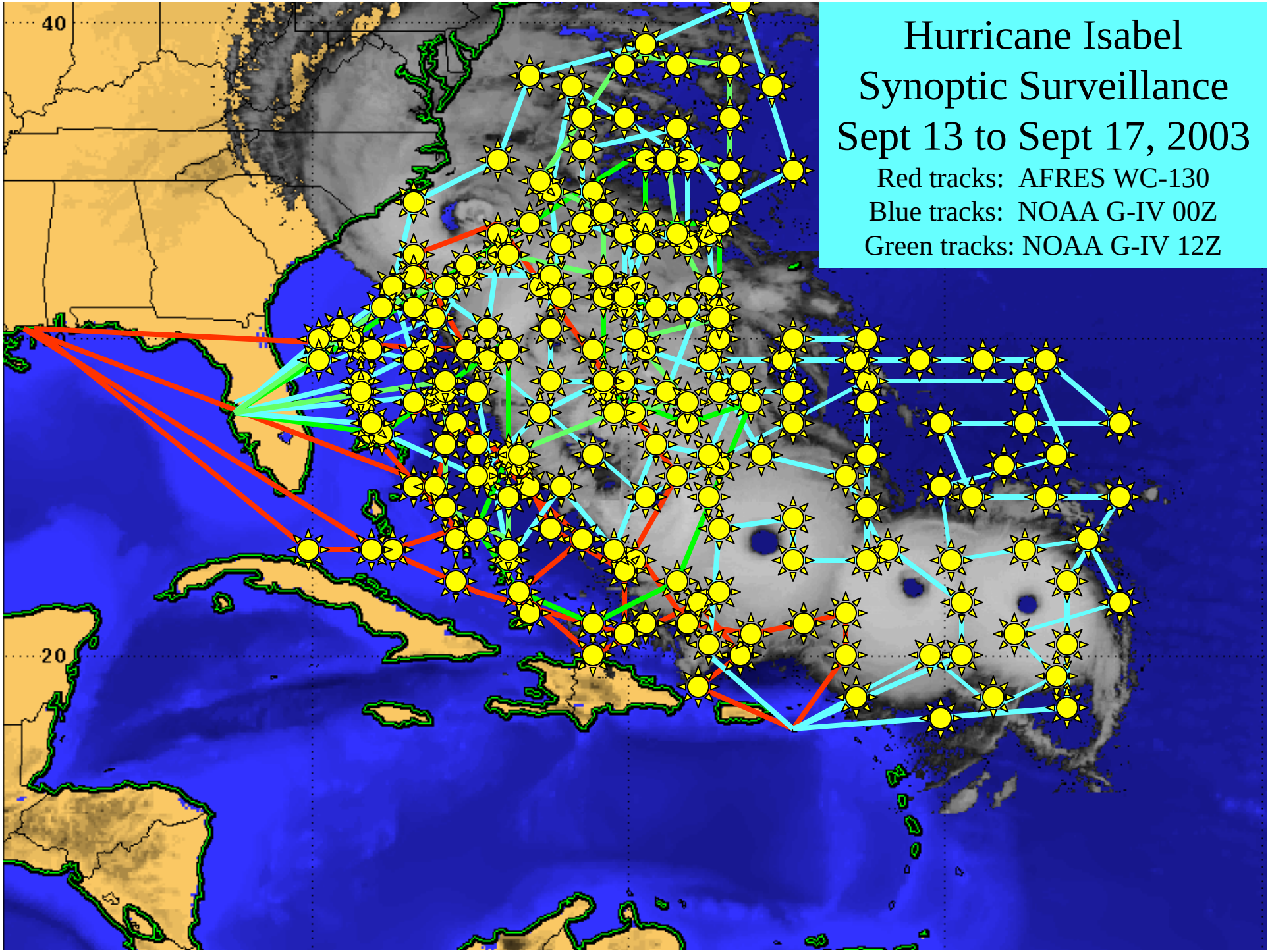
SPEED: 442 KTS.

~30 drops per mission





GIV Aircraft Synoptic Surveillance Pattern

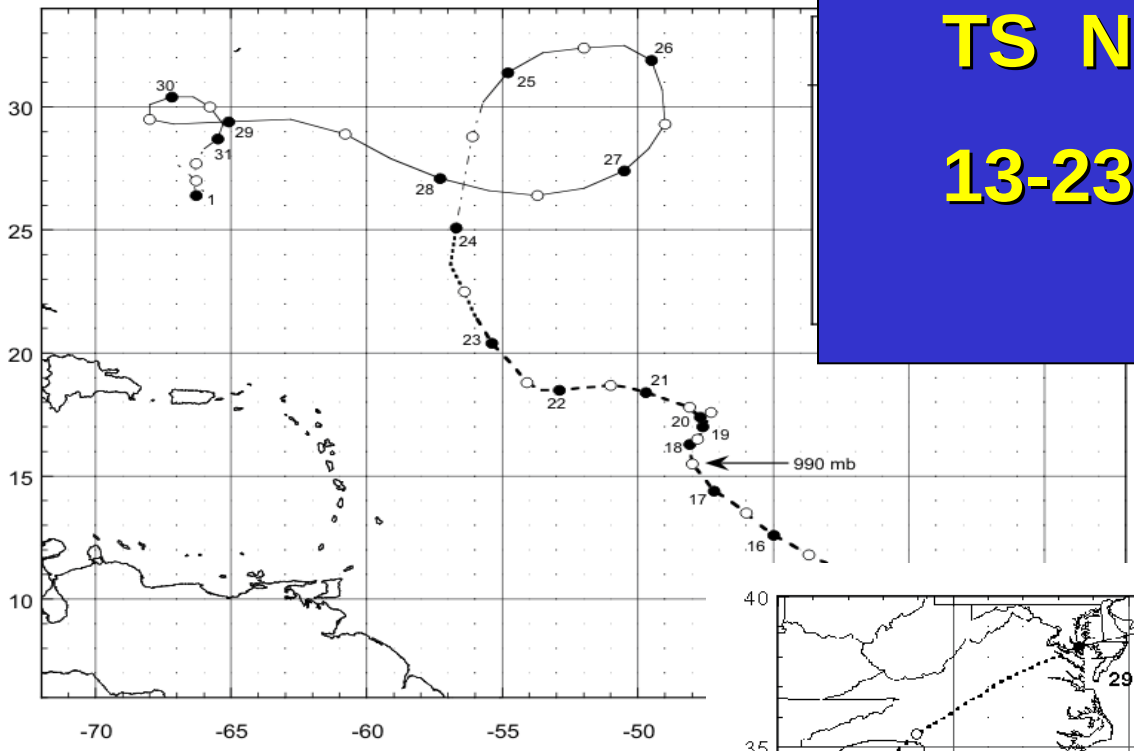

Hurricane Isabel
Synoptic Surveillance
Sept 13 to Sept 17, 2003
Red tracks: AFRES WC-130
Blue tracks: NOAA G-IV 00Z
Green tracks: NOAA G-IV 12Z
40
20

We are now at the juncture of improving intensity forecasts, where we were a decade ago in advancing hurricane track forecasts…….

But let's put the intensity problem into the proper forecast context……

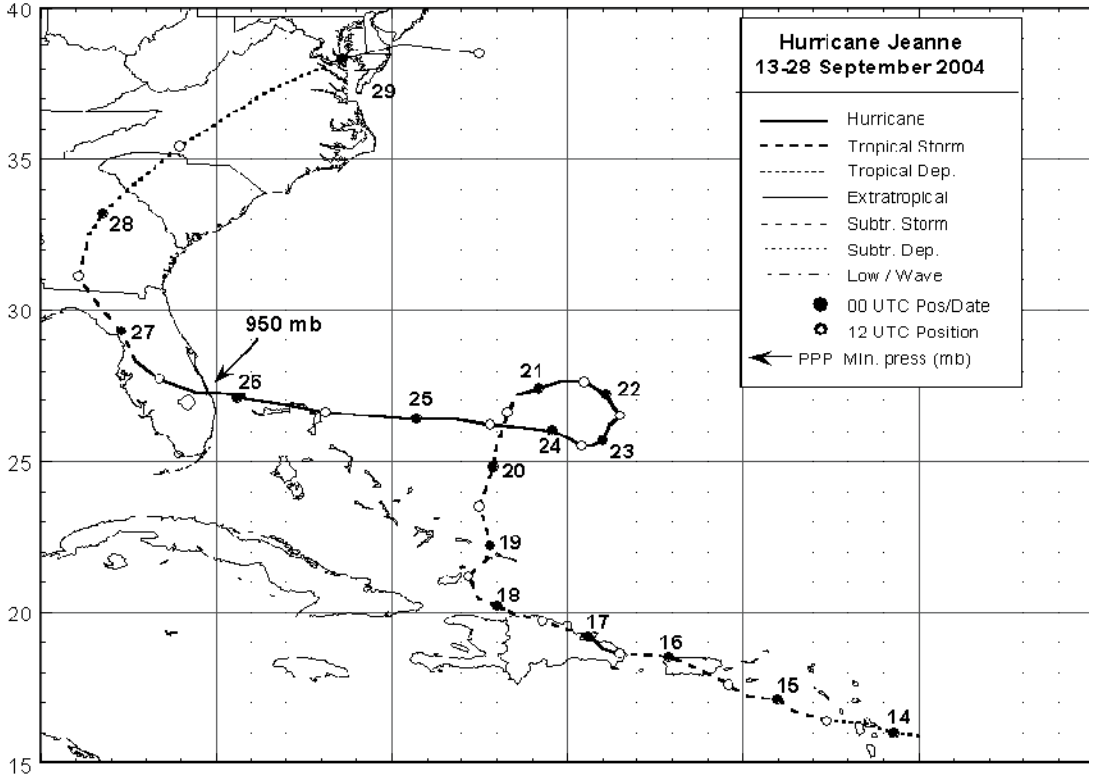
TS Nicholas

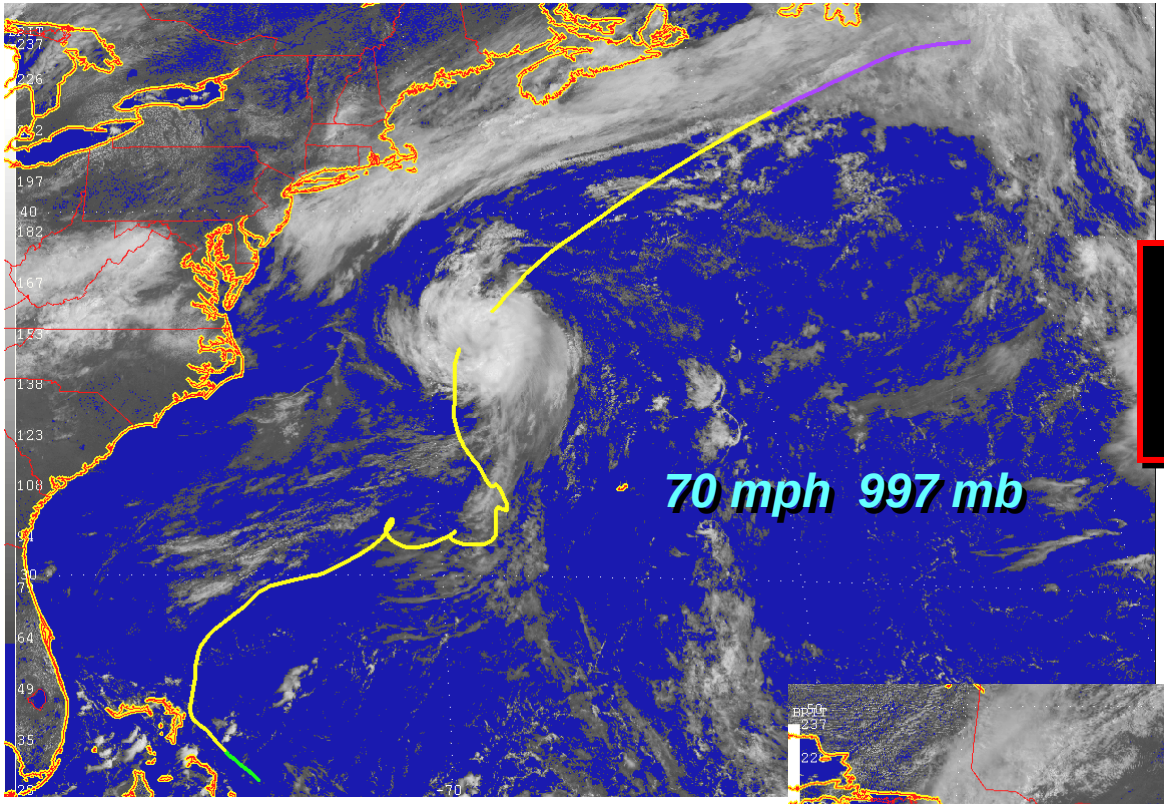
13-23 October 2003



HURRICANE JEANNE

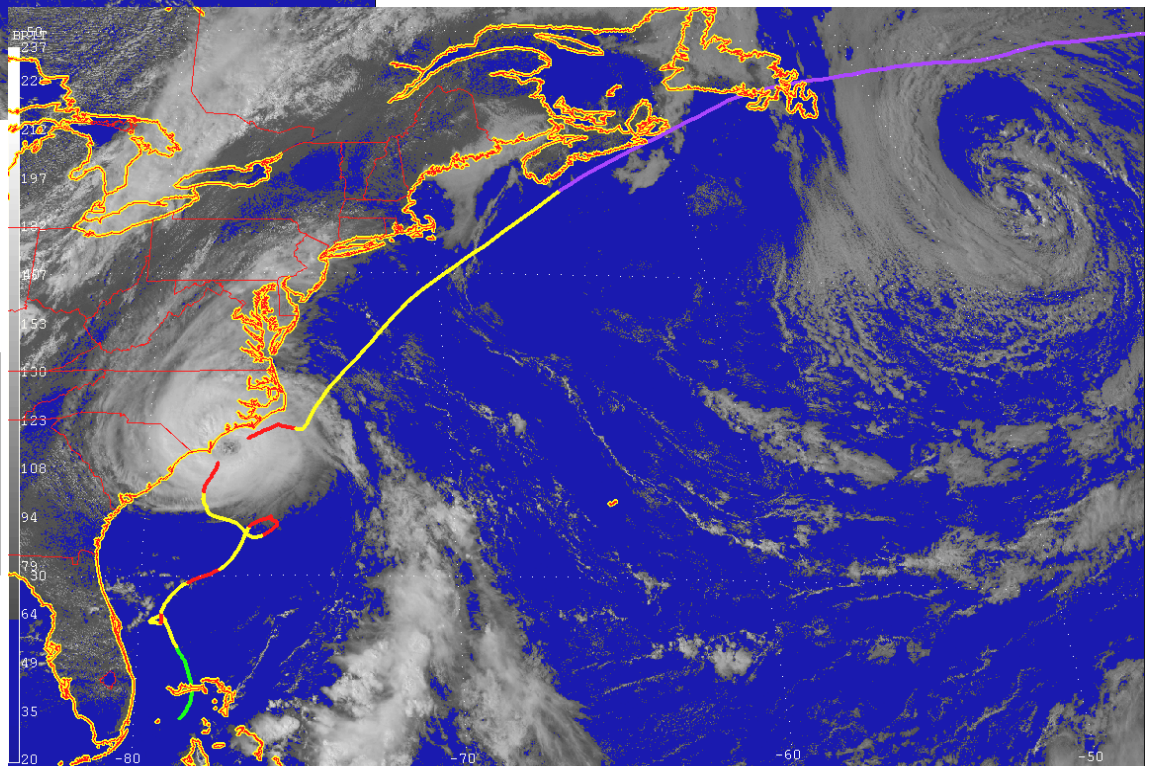
13-28 SEPTEMBER 2004





Tropical Storm Franklin

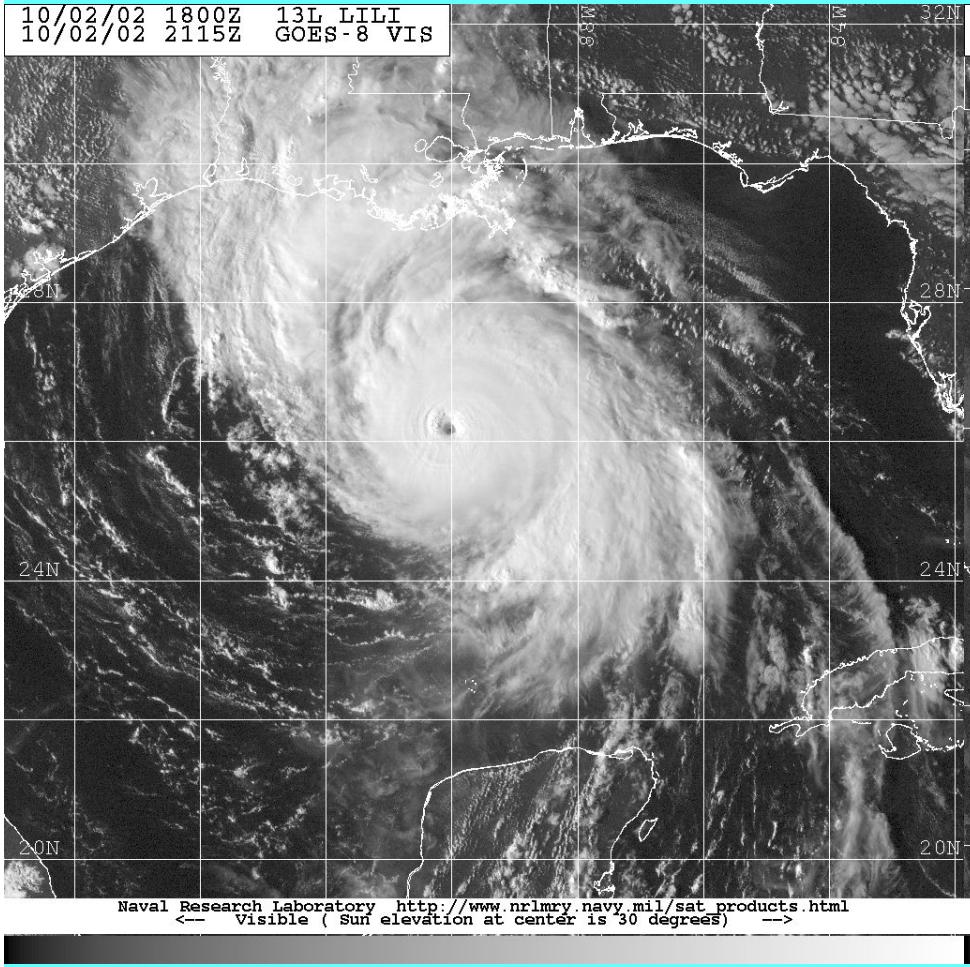
21 - 29 July 2005



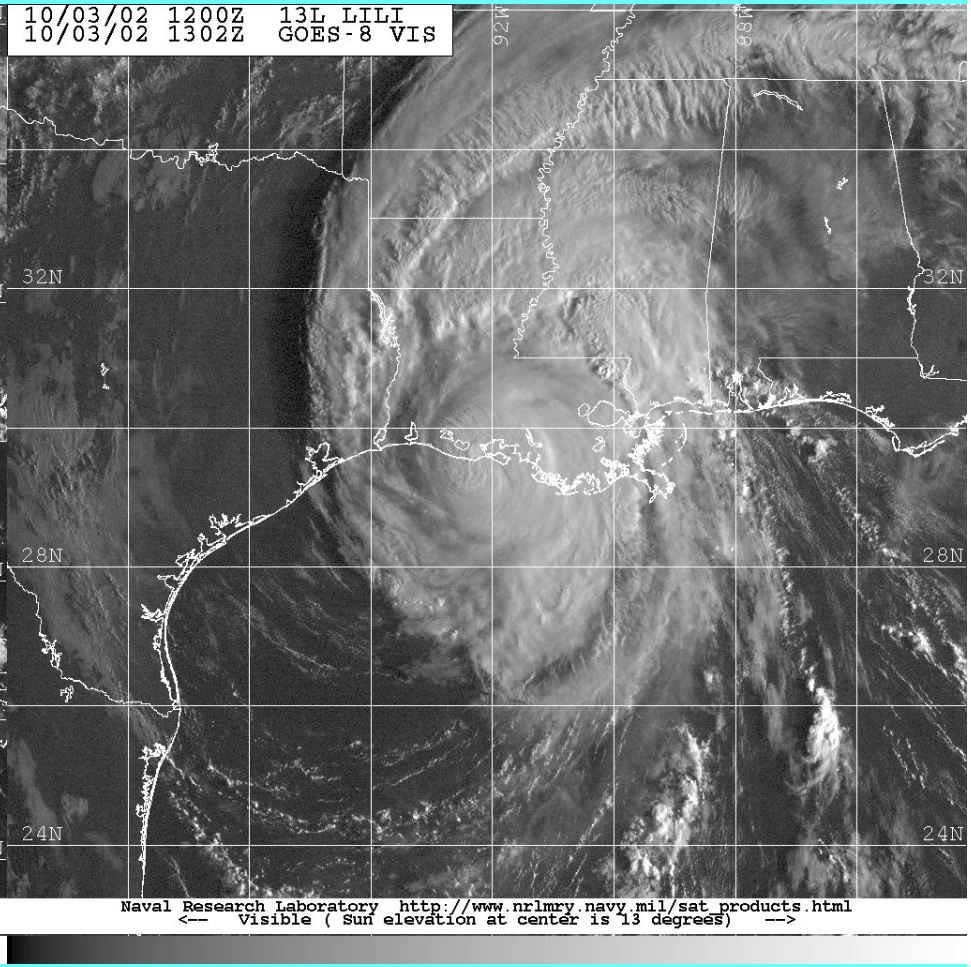
Hurricane Ophelia

6 - 17 September 2005

AFTER QUICKLY STRENGTHENING TO A STRONG CAT. 4 HURRICANE, LILI WEAKENED EVEN MORE RAPIDLY THAN IT HAD INTENSIFIED

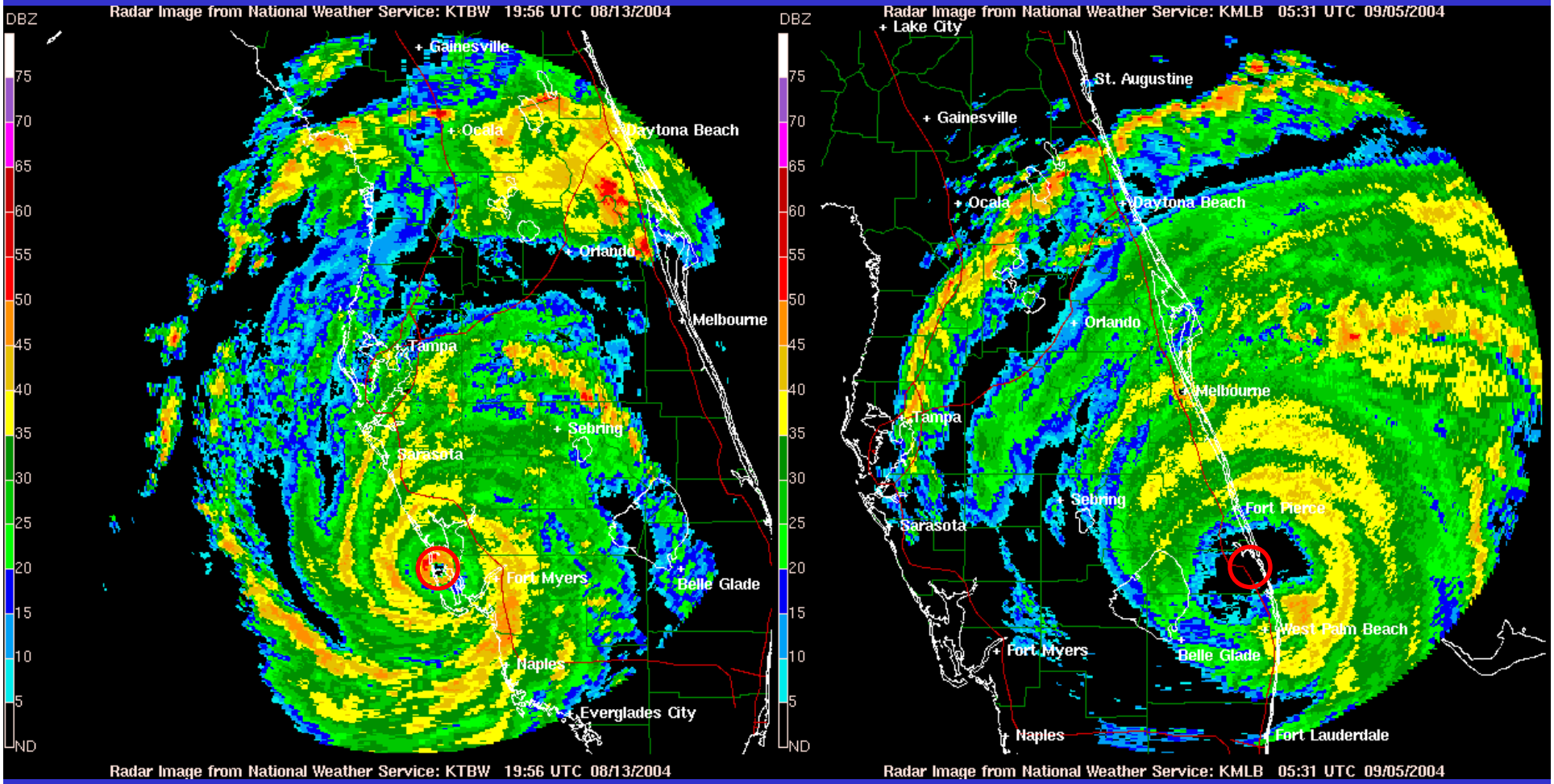


LILI NEAR ITS MAXIMUM INTENSITY OF 145 MPH



LILI MAKING LANDFALL AS A CAT. 1 HURRICANE

Charley/Frances Core Sizes



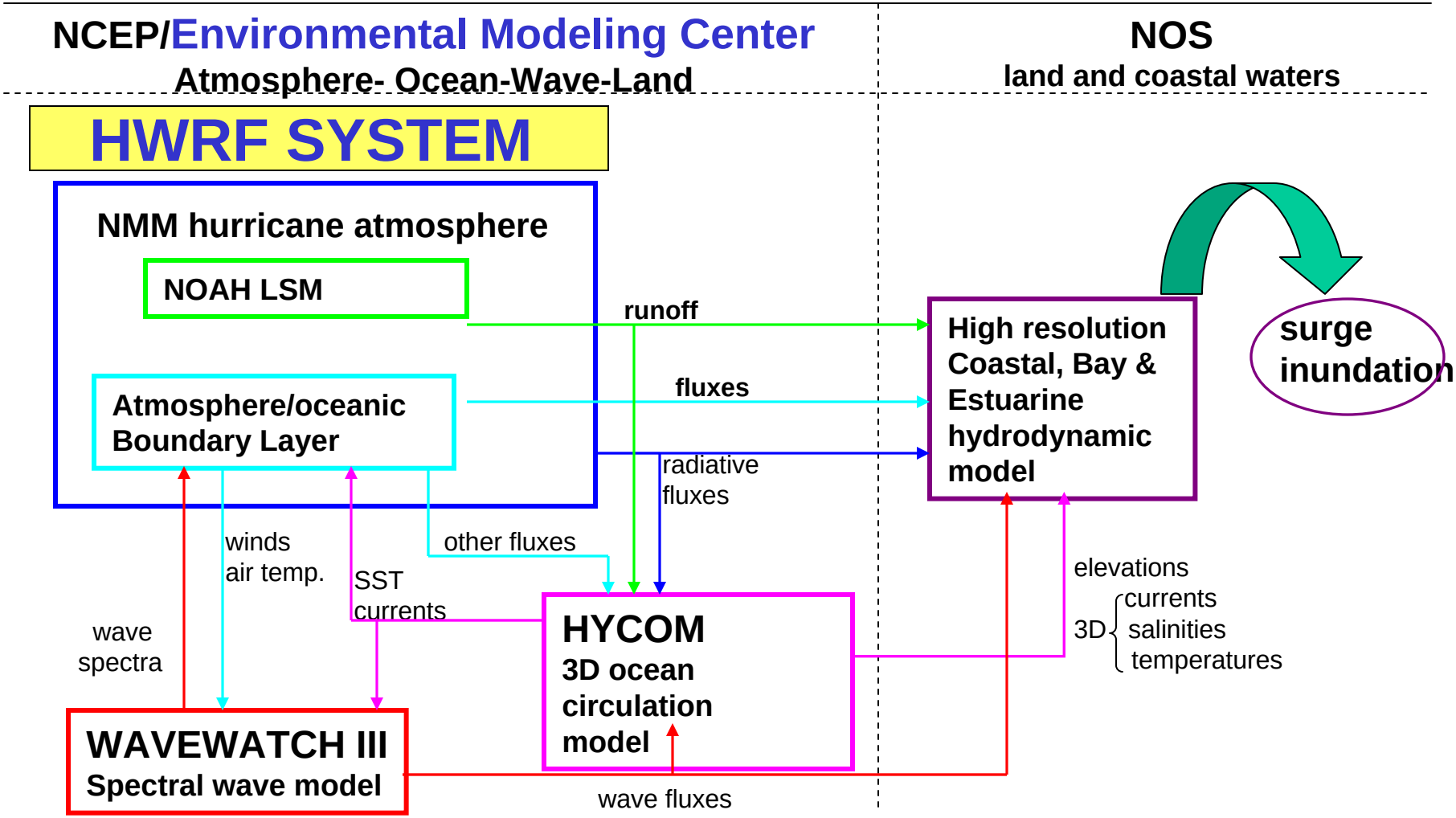
Charley: 35nm diameter

FRANCIS: 115nm

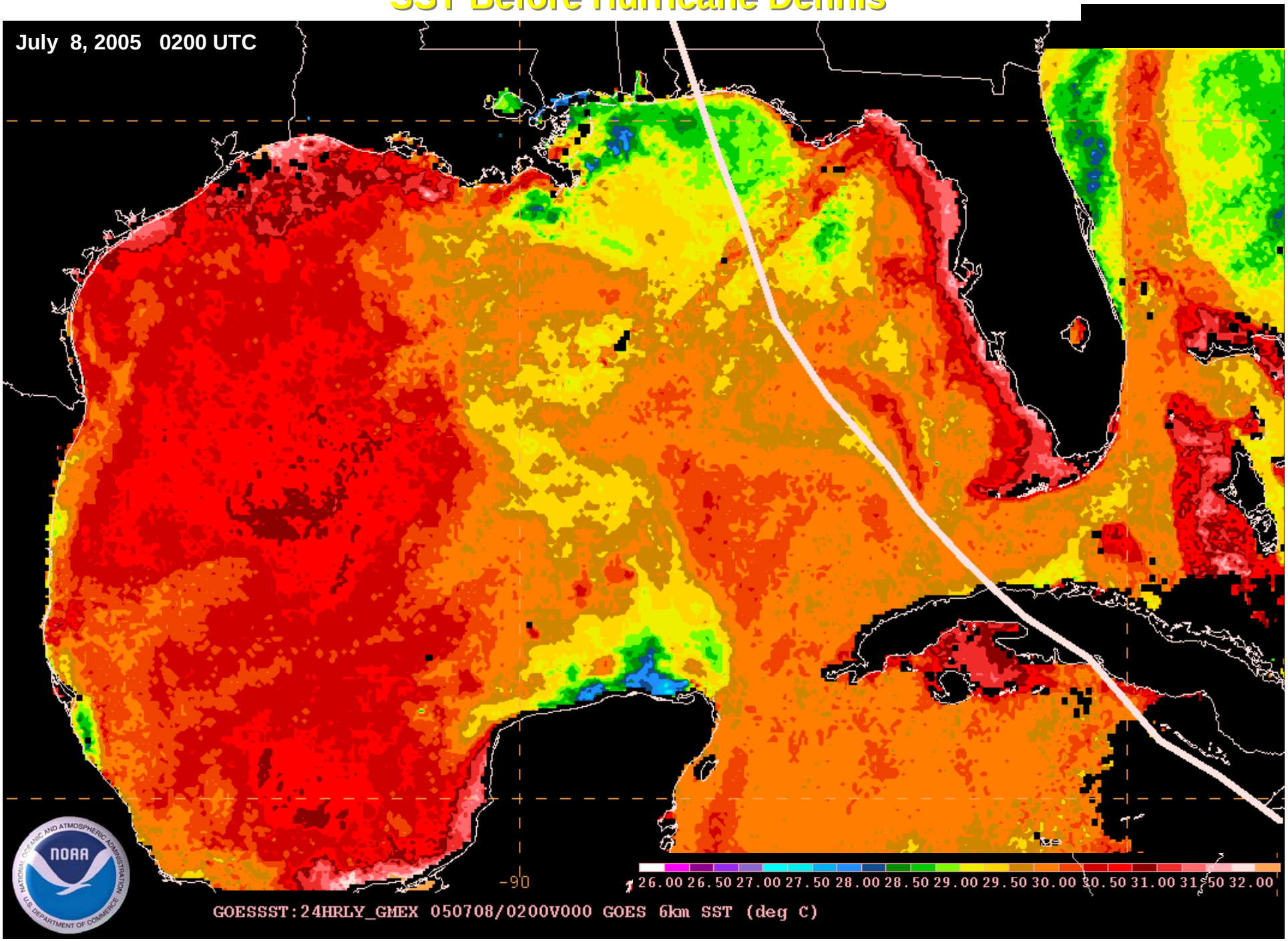
IVAN: 190NM

Dennis: 50nm

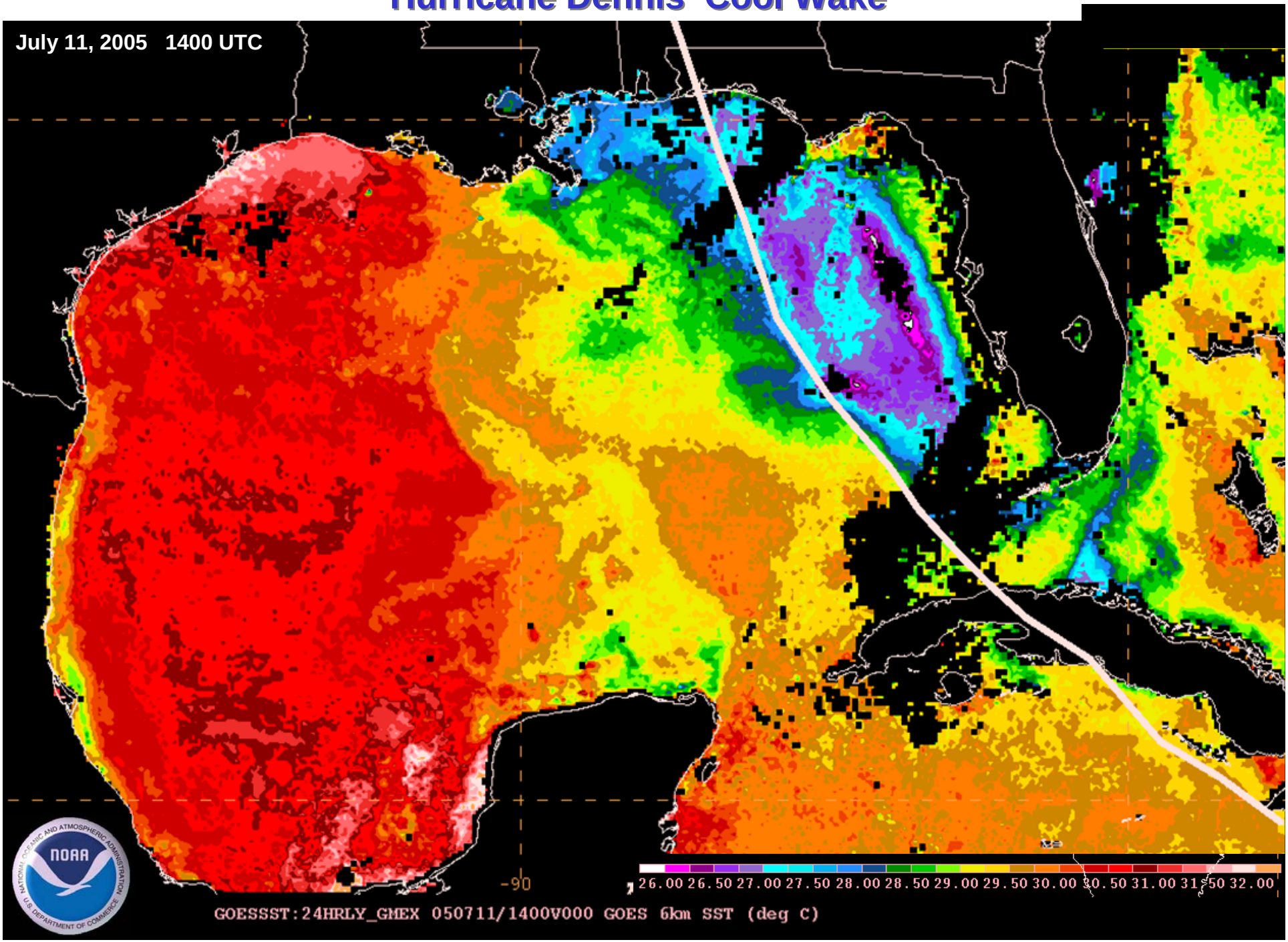
Hurricane-Wave-Ocean-Surge-Inundation Coupled Models



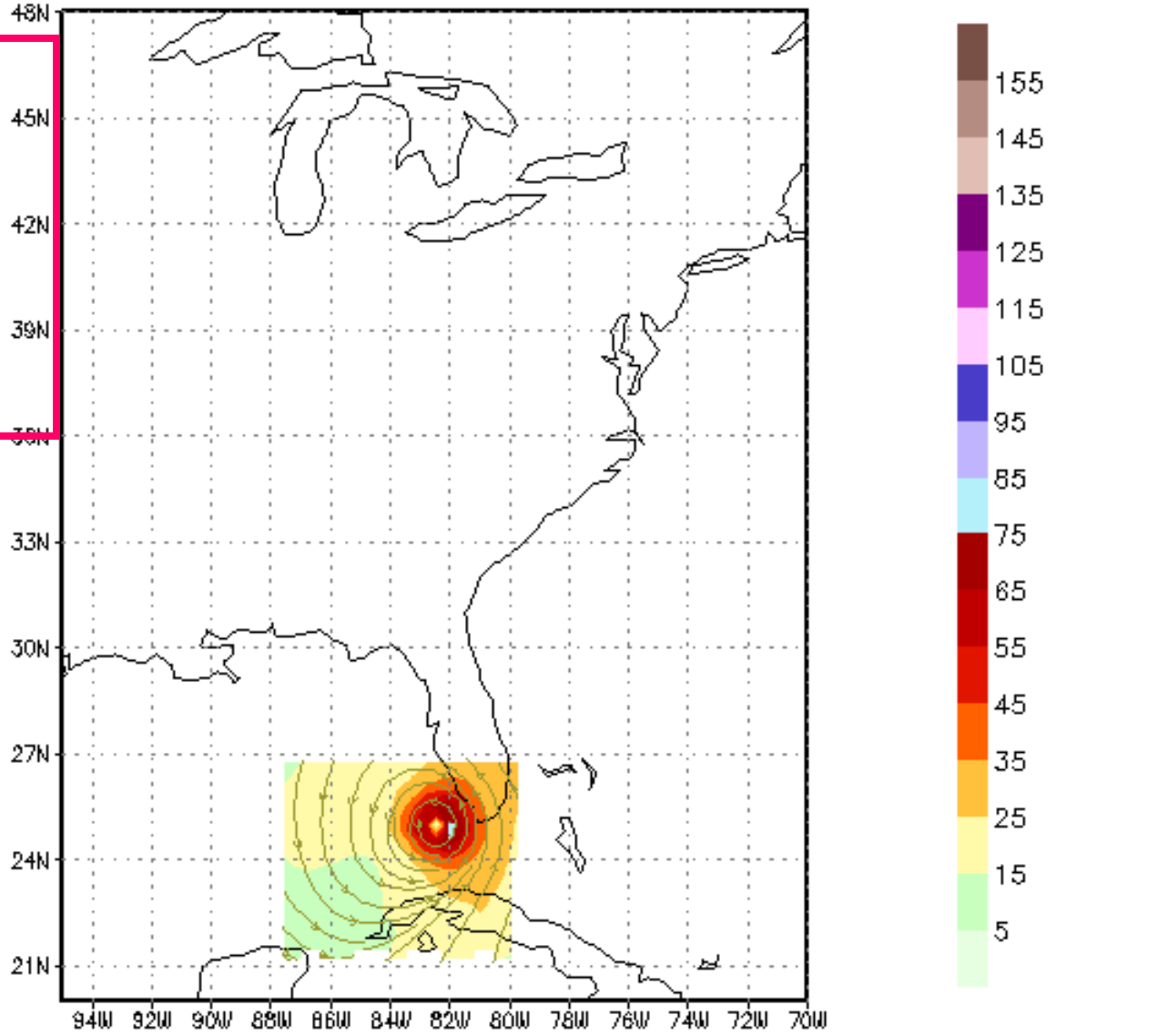
SST Before Hurricane Dennis



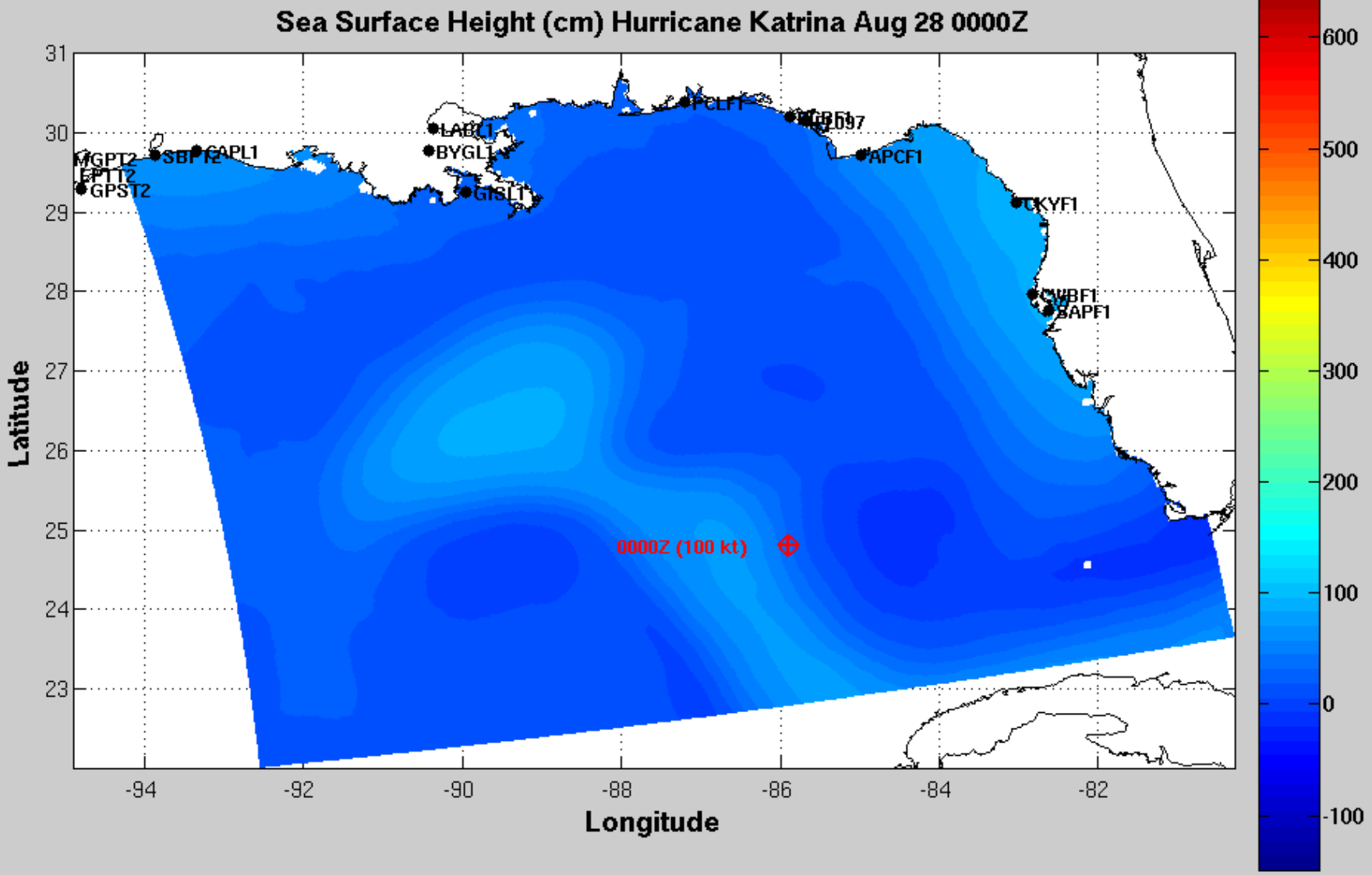
Hurricane Dennis' Cool Wake



HWRF Hurricane Katrina



HYCOM T&E Katrina



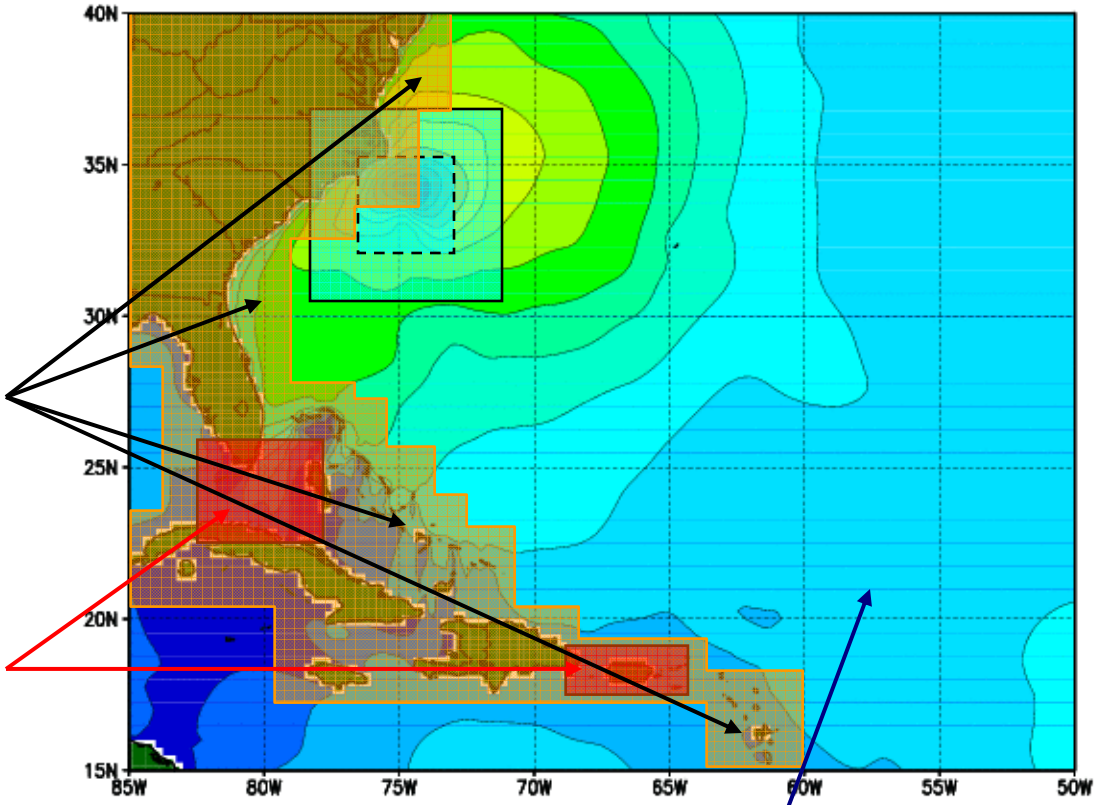
Center Fixes from NHC Tropical Cyclone Advisories

The Future

Deep ocean model resolution dictated by GFS model

Higher coastal model resolution dictated by model economy

Highest model resolution in areas of special interest



Hurricane nests moving with storm(s) like GFDL and HWRF

"We'll feel pretty silly if it's downgraded to a tropical storm."

THANK YOU

FOR YOUR

ATTENTION…