

2005

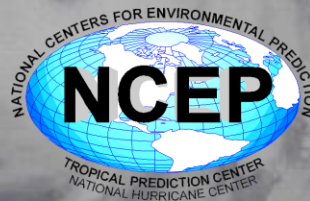
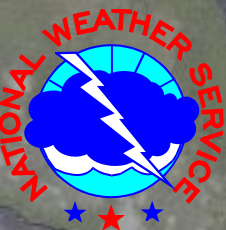
New Analysis/Forecasting Tools/Techniques/Products

Chris Landsea
National Hurricane Center

13 May, 2008

Katrina
28 August

Florida Governors Hurricane Conference



The Forecasters (us):

National Hurricane Center
Tropical Prediction Center



The Researchers (them):

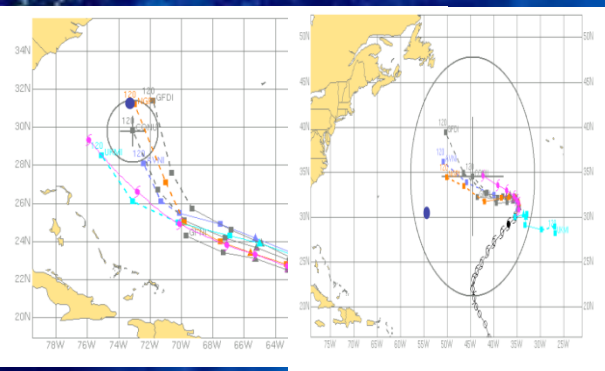


How to
bridge
the
“valley
of
death”?

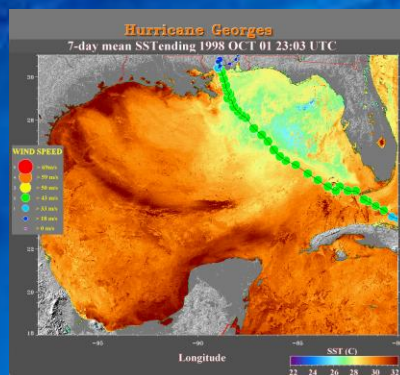
JHT Mission Statement

The mission of the Joint Hurricane Test Bed is to **transfer** more rapidly and smoothly new technology, research results, and observational advances of the United States Weather Research, its sponsoring agencies, the academic community and other groups into improved tropical cyclone analysis and prediction at operational centers.

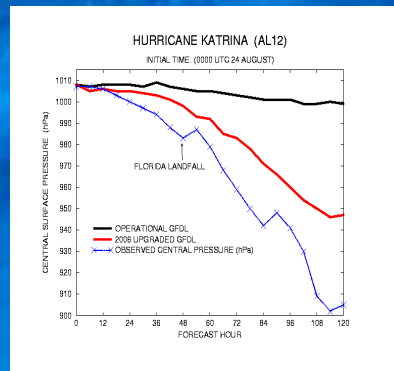
JHT 2nd Round Implemented Projects



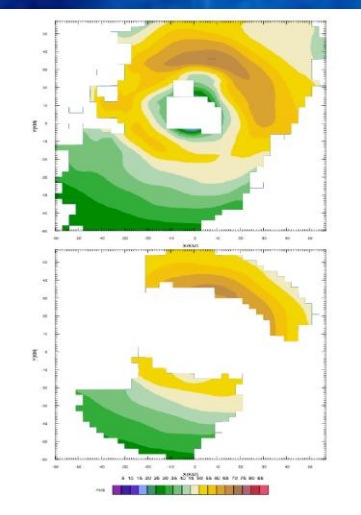
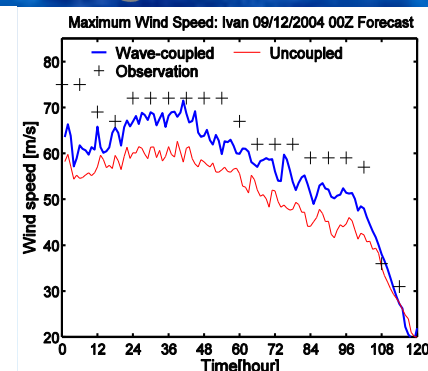
Track Uncertainty Estimates (Goerss)



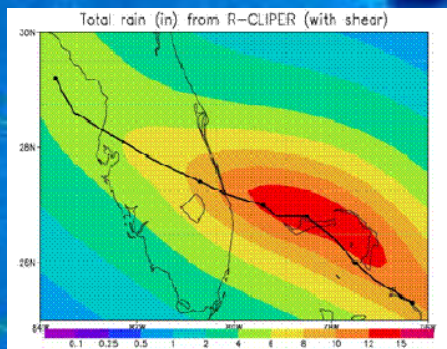
Inner Core SSTs (Cione)



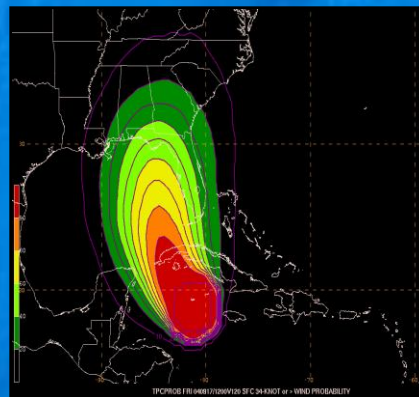
GFDL/URI Hurricane Model upgrades (Bender; Ginis)



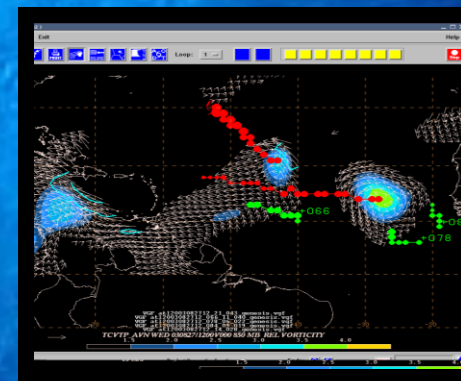
Doppler Winds (Gamache)



Rain-CLIPER & rainfall verification (Rogers)



SHIPS & Wind Probabilities (DeMaria/Knaff)



Genesis forecasting assessments (Harr)

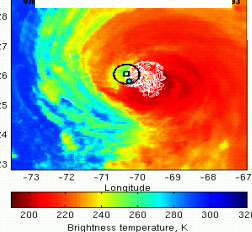
JHT 2nd Round Projects - Implemented

Hurricane Isabel

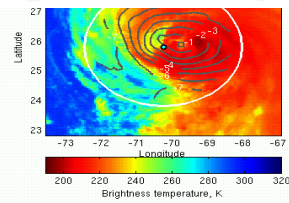
16 Sept 2003
00:15UTC

Brightness temperature, K

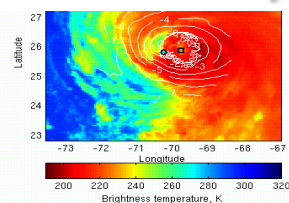
Ring Analysis



Spiral Analysis

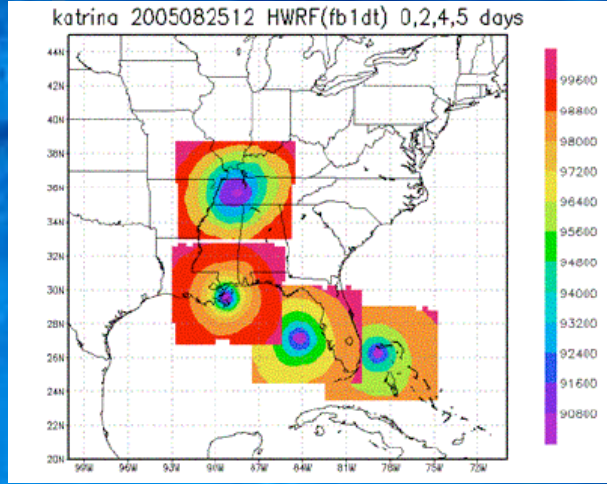


Combo Analysis

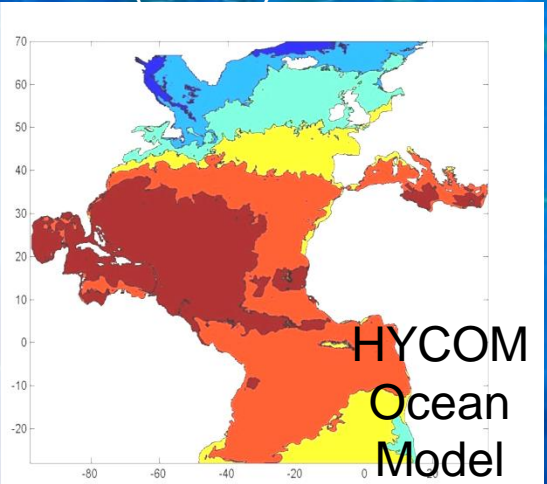


Advanced Objective
Dvorak Technique
(Kossin/Velden)

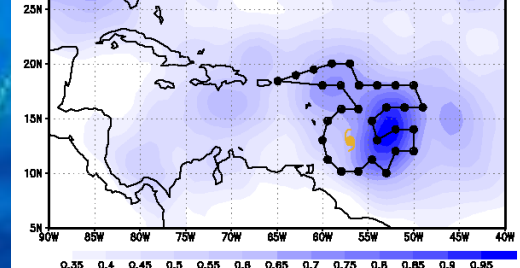
Hurricane-Weather
Research Forecasting
Model (Tuleya)



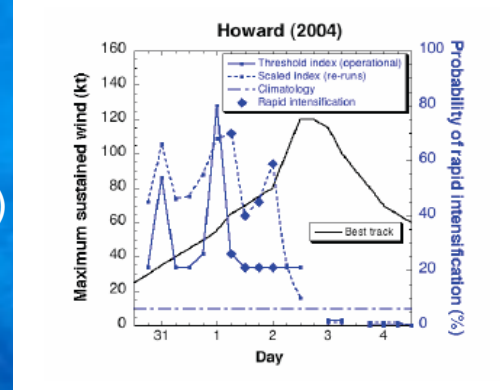
Ocean Modeling
(Jacob)



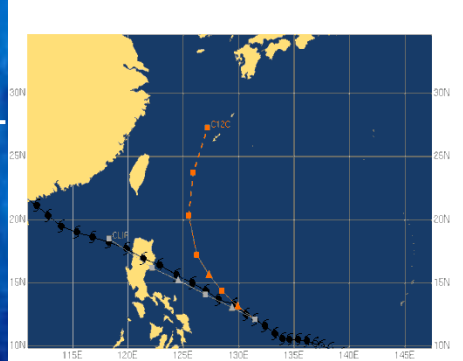
Targeted
Observations
(Majumdar/Aberson)



Rapid
Intensification
Index (Kaplan)



5 day
Climatology-
Persistence
Model
(Aberson)



STEPPED FREQUENCY MICROWAVE RADIOMETER

Impacts National Hurricane Center forecast during the 2004 hurricane season

Presentation:

Accomplishments of Our JHT
SFMR Effort

Authors:

Jim Carswell, RSS

Peter Black, NRL / SAIC

Paul Chang, NOAA/NESDIS

Eric Uhlhorn, NOAA HRD

Acknowledgements:

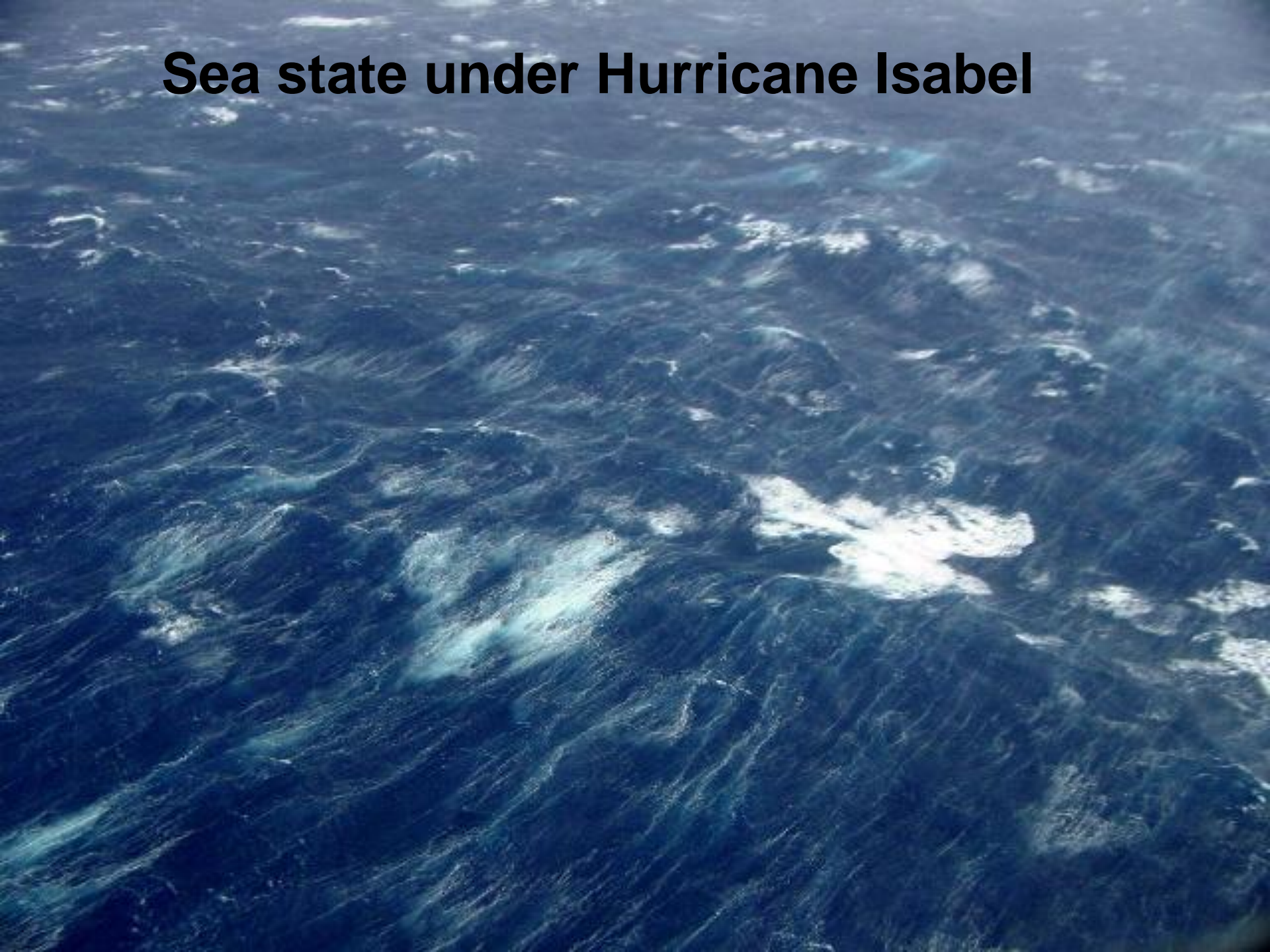
Chris Sisko, Jose Salazar and Brian Maher

Work funded through JHT.



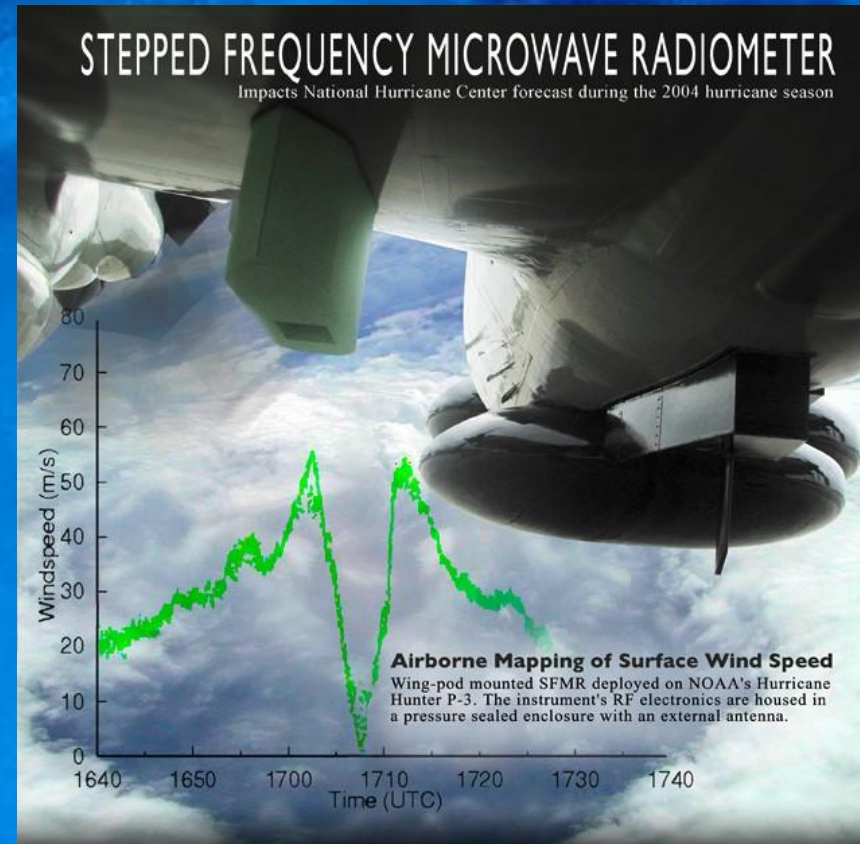
Airborne Mapping of Surface Wind Speed
The SFMR deployed on NOAA's Hurricane Hunter P-3. The instrument's RF electronics are housed in a pressure sealed enclosure with an external antenna.

Sea state under Hurricane Isabel

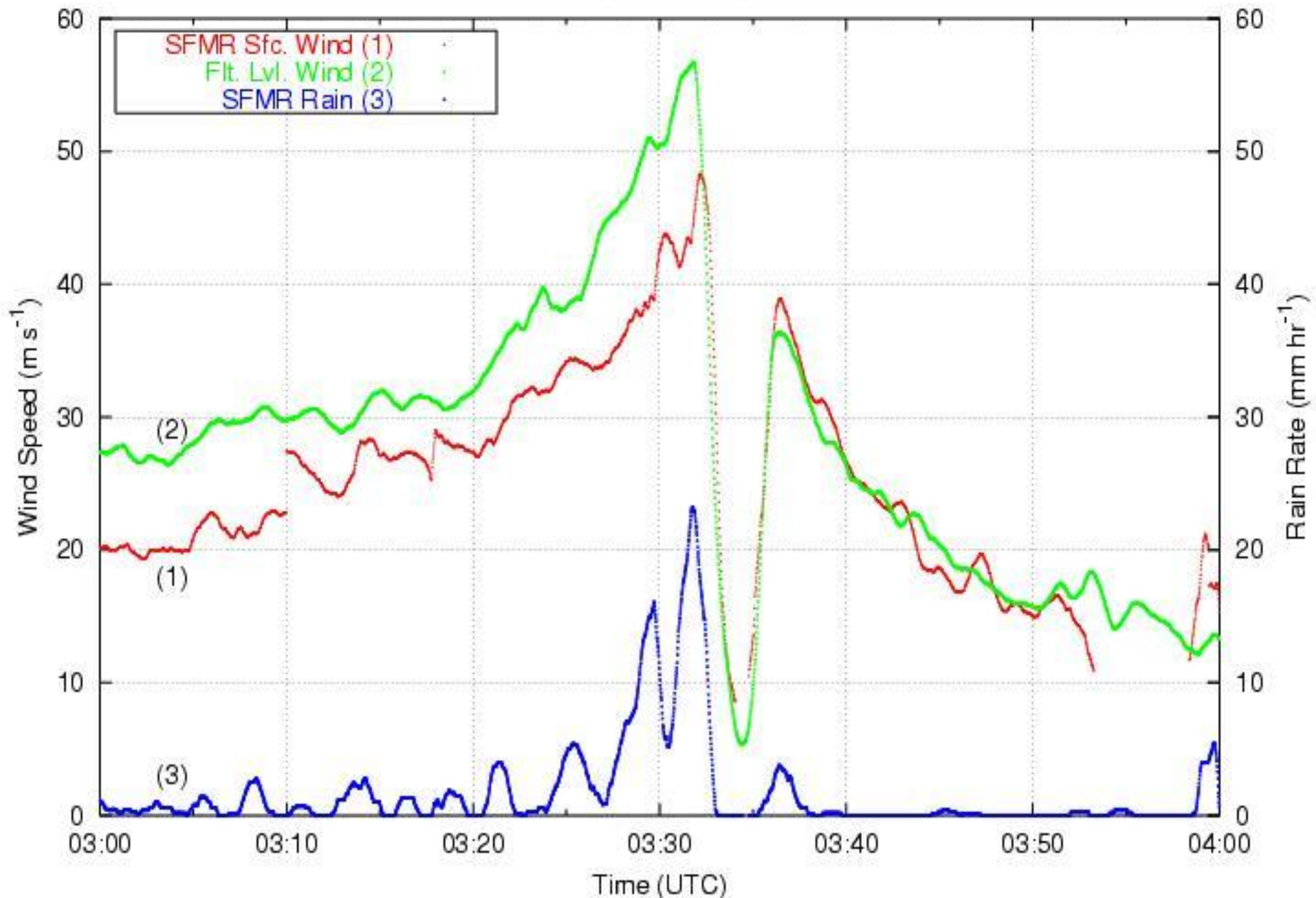


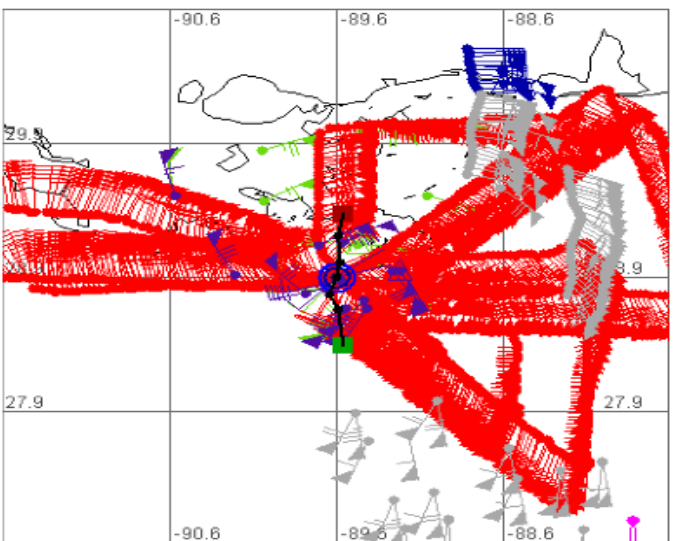
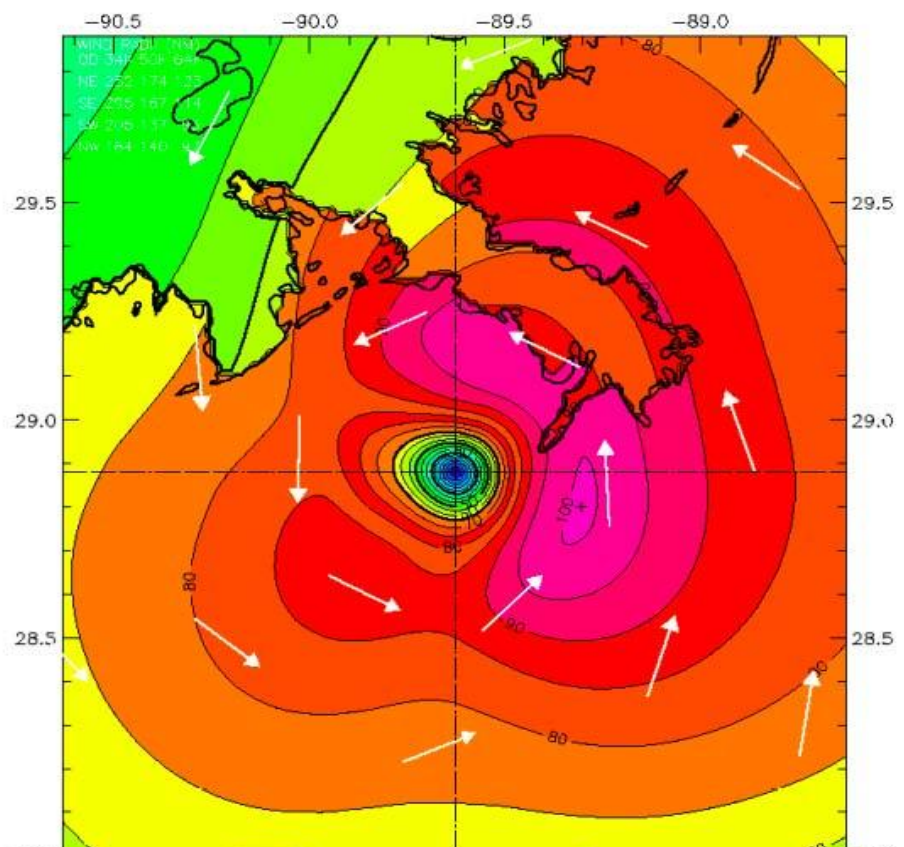
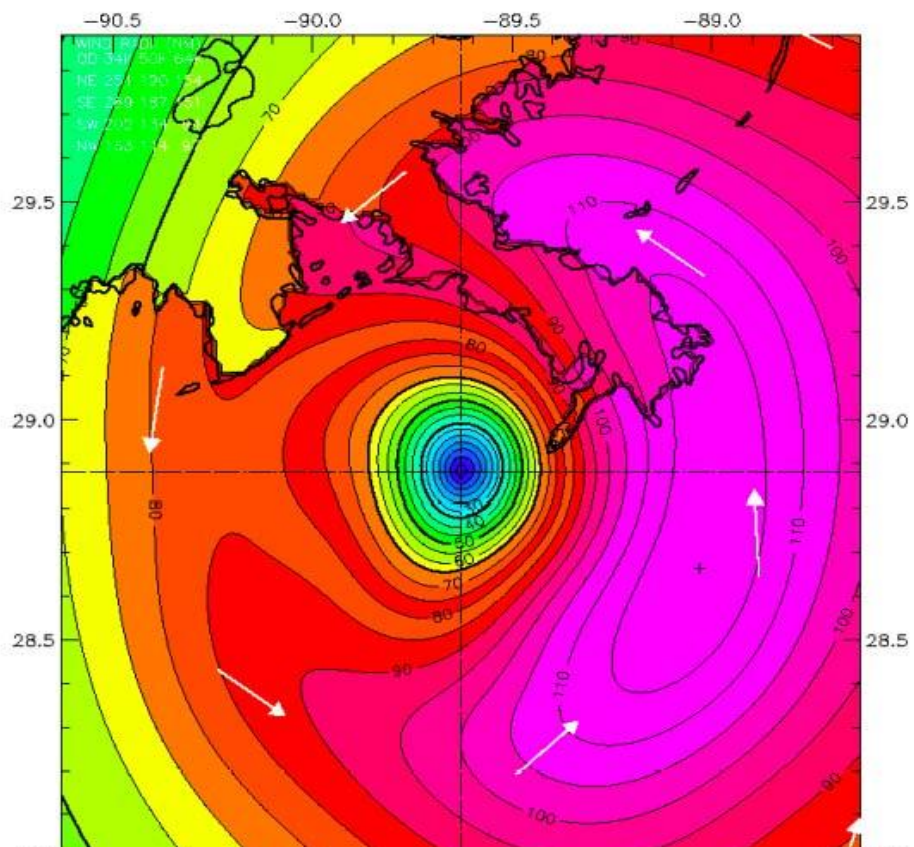
Stepped-Frequency Microwave Radiometer

- Measures nadir brightness temperature at 6 C-band frequencies.
- Geophysical model function relates emissivity to wind speed. Emissivity depends on surface foam coverage and rain rate.
- Calibrated with GPS dropsonde data.
- First data from C-130s in 2007.

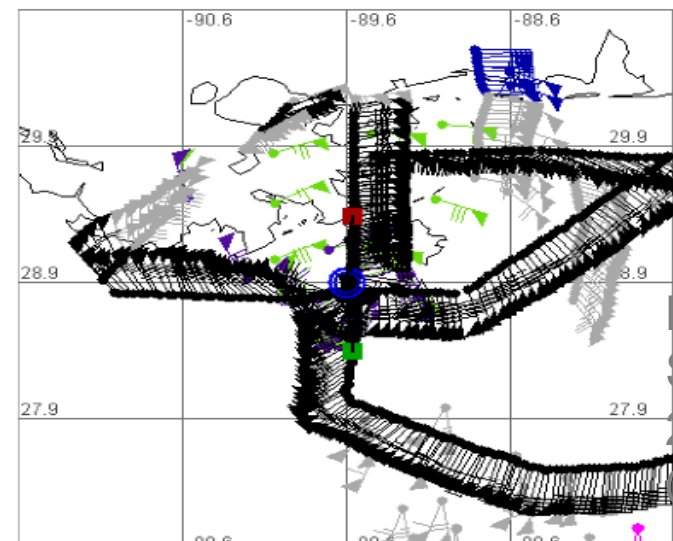


Hurricane Lili (2002/10/02)
Cross-Track Winds and Rain





Air Force
29 Aug
0930 UTC



NOAA
SFMR
29 Aug
0930 UTC



C130s Now Equipped with SFMR

Thanks to: HRD,
AOC, RSS,
NESDIS,
ProSensing,
CARCAH, AF 53rd
Reconn. Squad.



VORTRAC – A Utility to Deduce Central Pressure and Radius of Maximum Wind of Landfalling Tropical Cyclones Using WSR-88D Data

Wen-Chau Lee

NCAR/EOL

Paul Harasti

UCAR/NRL

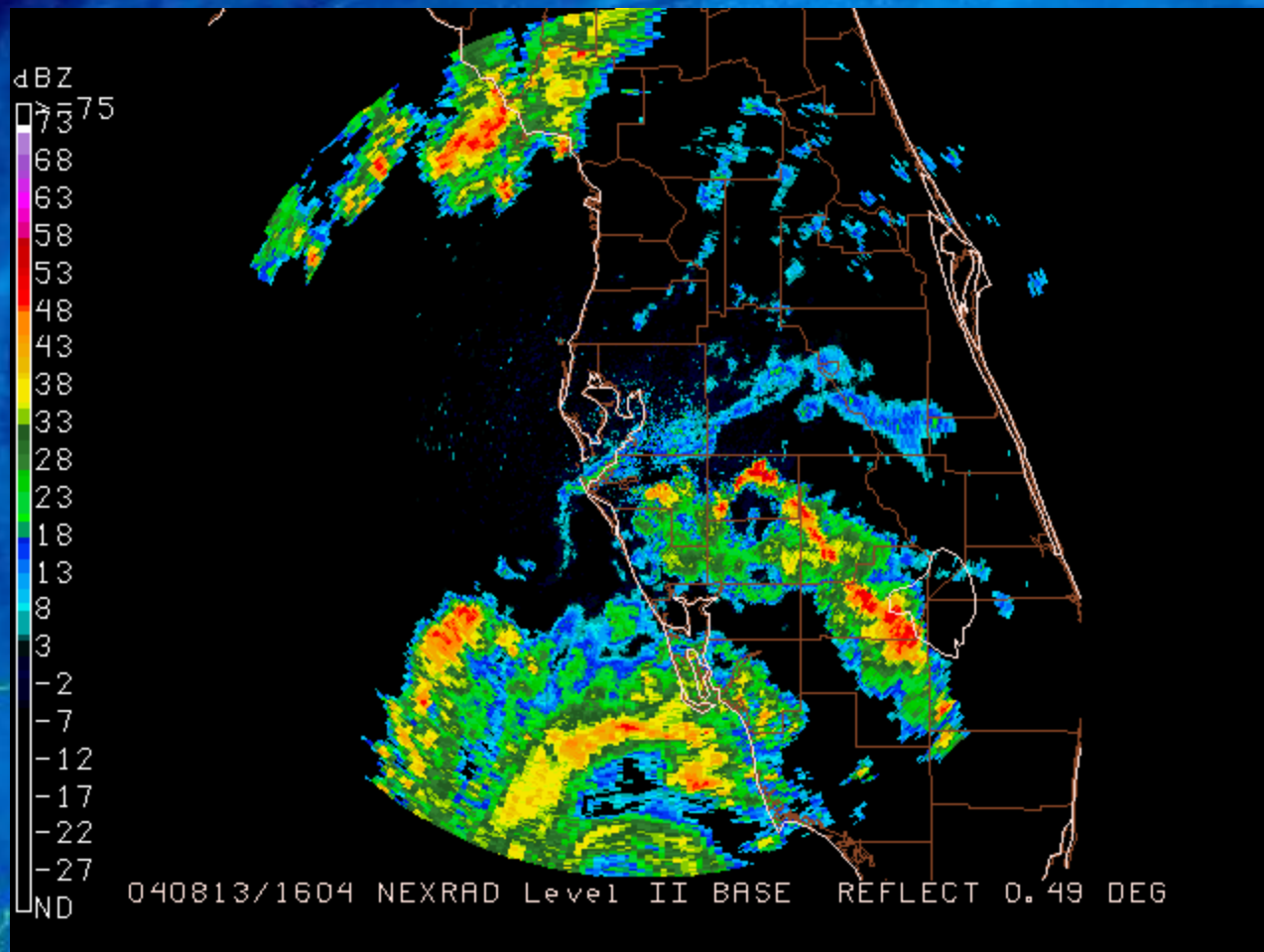
Michael Bell

NCAR/EOL

Colin McAdie

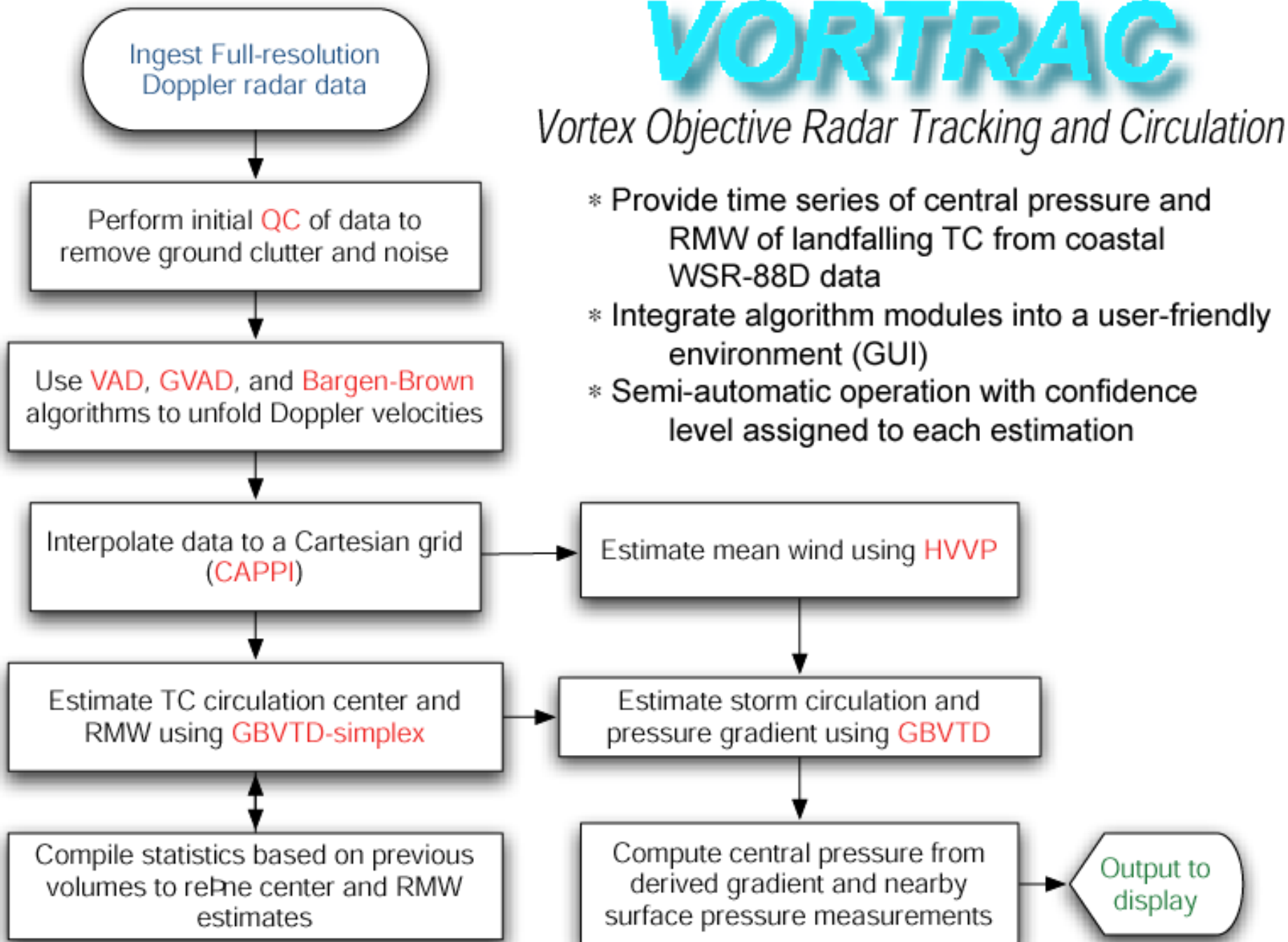
TPC Contact

Hurricane Charlie at Landfall



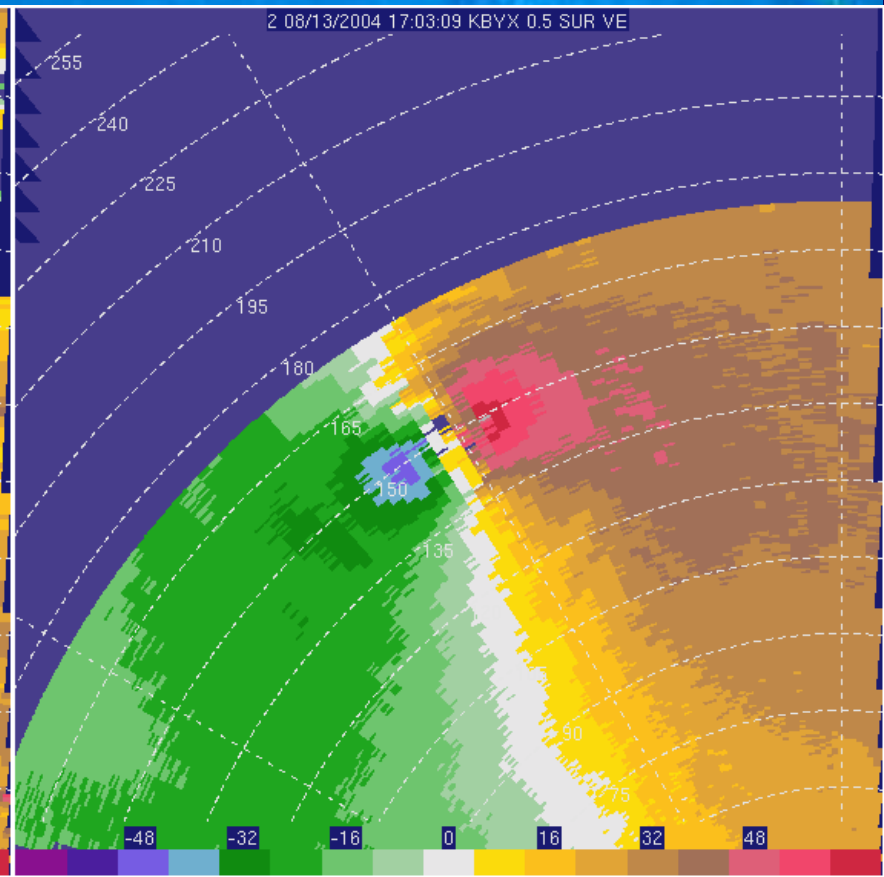
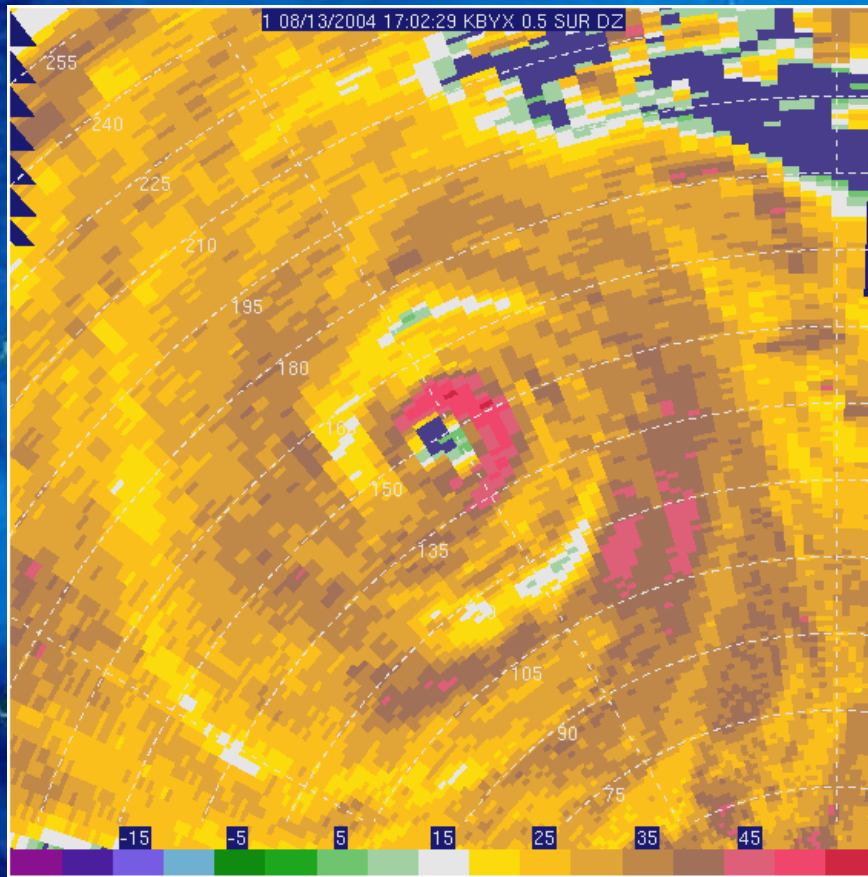
VORTRAC

Vortex Objective Radar Tracking and Circulation



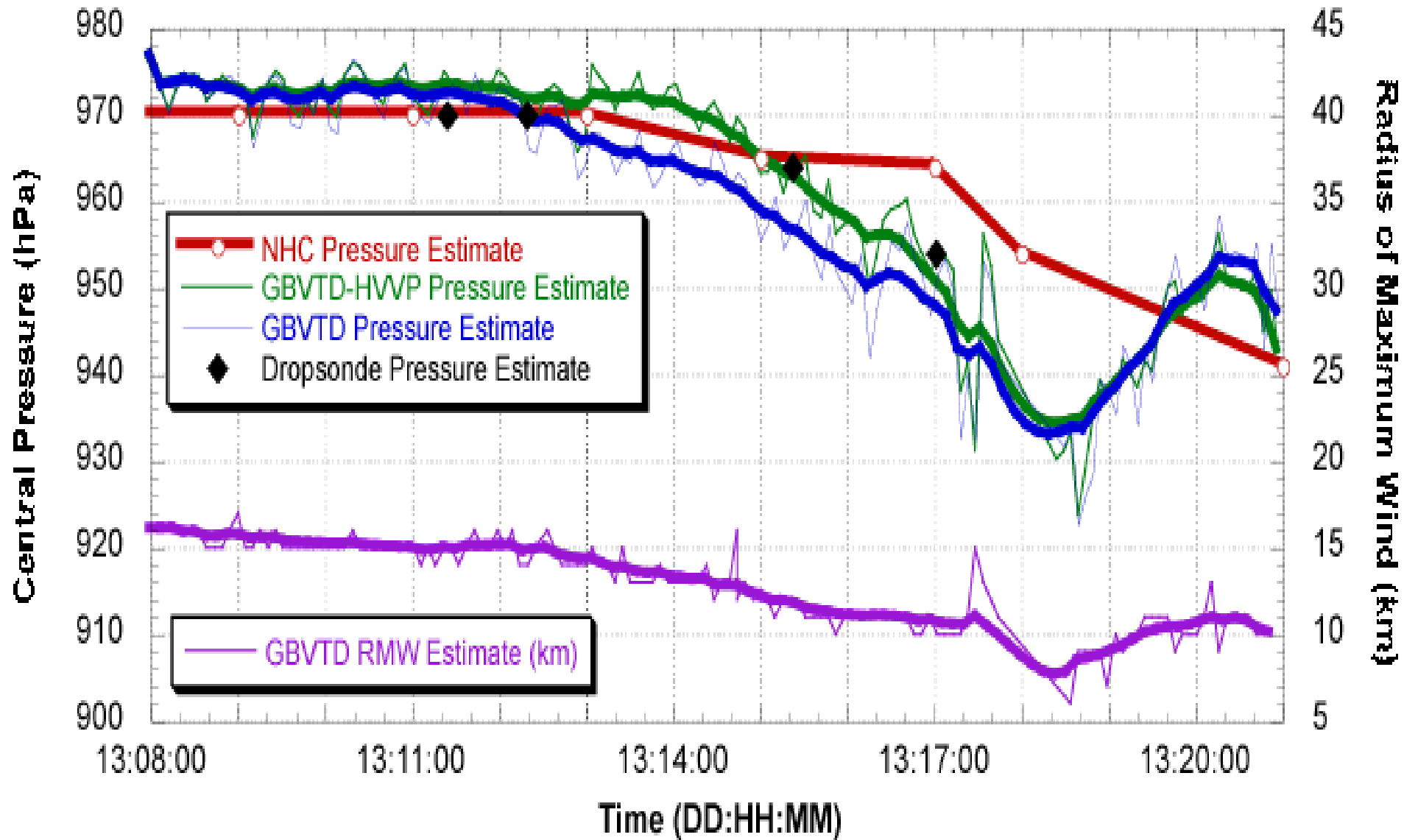
Basic Assumptions

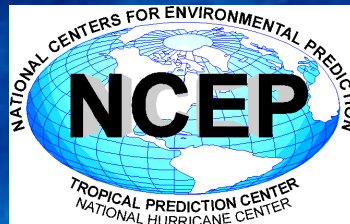
- A single circulation center and the center can be identified accurately
- Gradient wind balance



Hurricane Charley (2004)

Central Pressure and Radius of Maximum Wind Estimates





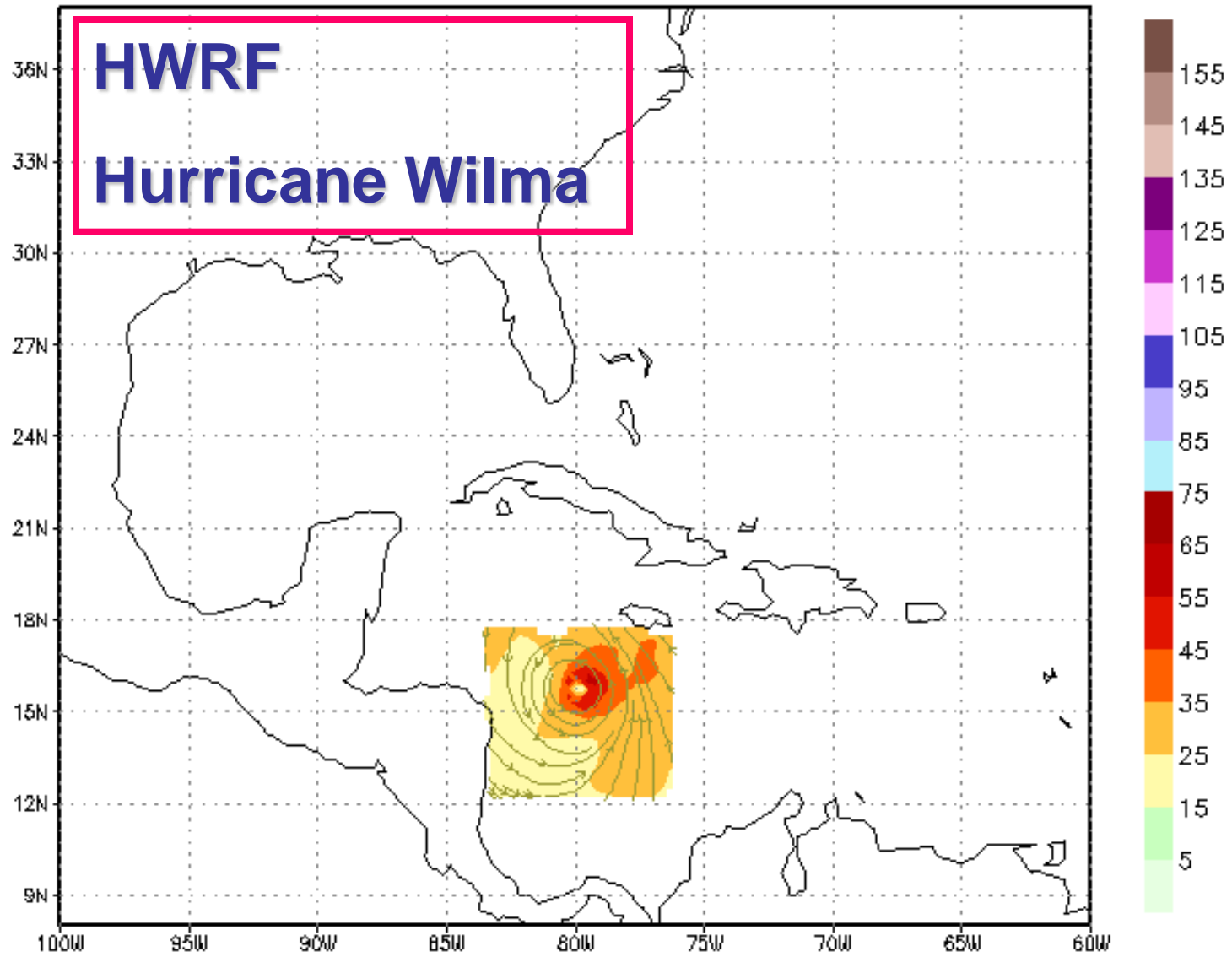
Advanced Hurricane Modeling at the Environmental Modeling Center (EMC): The Hurricane Weather Research and Forecasting (HWRF) Model

Naomi Surgi
and HWRF Team

NCEP/Environmental Modeling Center

WHERE AMERICA'S CLIMATE AND WEATHER SERVICES BEGIN

OCT 18, 2005 06Z: HURRICANE WILMA MOVING NEST FCST: 0



THE HWRF SYSTEM (Initial Operating Capability)

2007

- Movable, 2- way nested grid (9km; 27km/42L; ~75X75)
- Advanced Physics (GFS&GFDL)
- Advanced vortex initialization – made use of prototype Gridpoint Statistical Interpolation 3D var (advancement over bogus)
- Princeton Ocean Model (w/loop current init – same as GFDL)

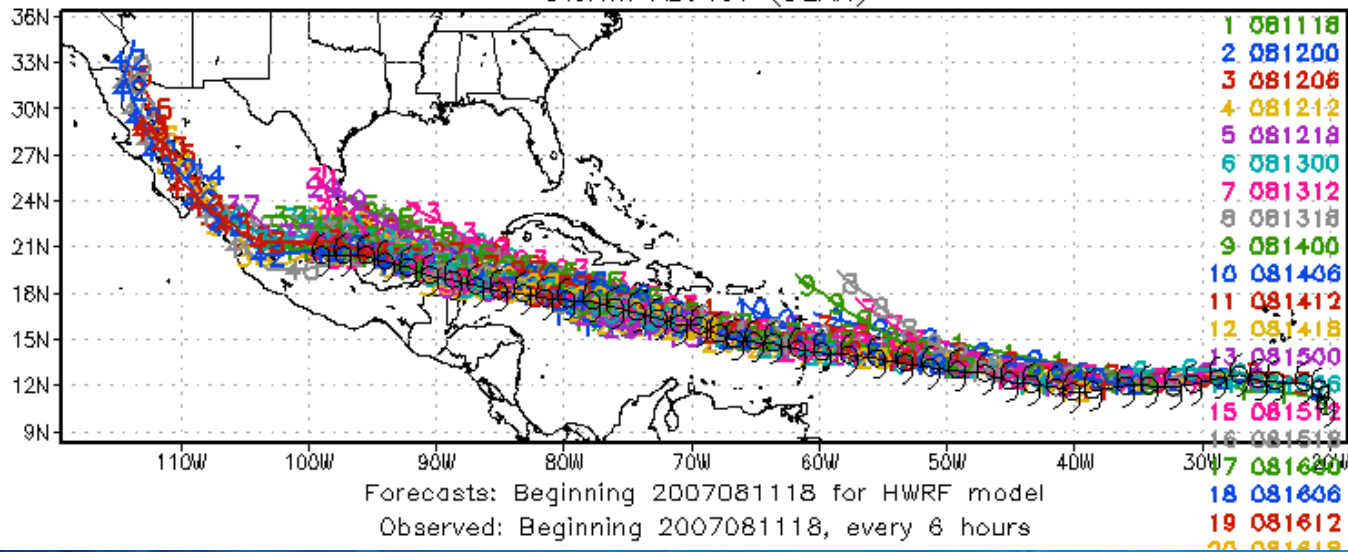
HWRF Development

- **CONDUCTED 27 EXPERIMENTS** since 2002 , ie: 27 versions of the HWRF
- Tested each upgrade (numerics, physics, coupling) for clean comparisons - comprehensive testing (>200 runs)
- **FINALIZED HWRF FOR '07**
- **PERFORMED EXTENSIVE COMPARISONS BETWEEN GFDL AND HWRF FOR MULTIPLE SEASONS AND STORMS - THREE SEASONS** ('04, '05, '06) for both ATL and EPAC basins

Note: HWRF, 1745 runs; GFDL 900 runs; HWRF ran 4X/day, GFDL 2X/day. Ran homogeneous comparison between HWRF and GFDL for 0Z and 12Z runs

- **NO TUNING OF HWRF** (tuning has a lot of impact on track and intensity skill)
- **NO OCEAN COUPLING IN EPAC**

HWRf: Operational Coupled Hurricane WRF (NCO PROD)
 2007 Tropical Cyclone Tracks
 Storm: AL0407 (DEAN)



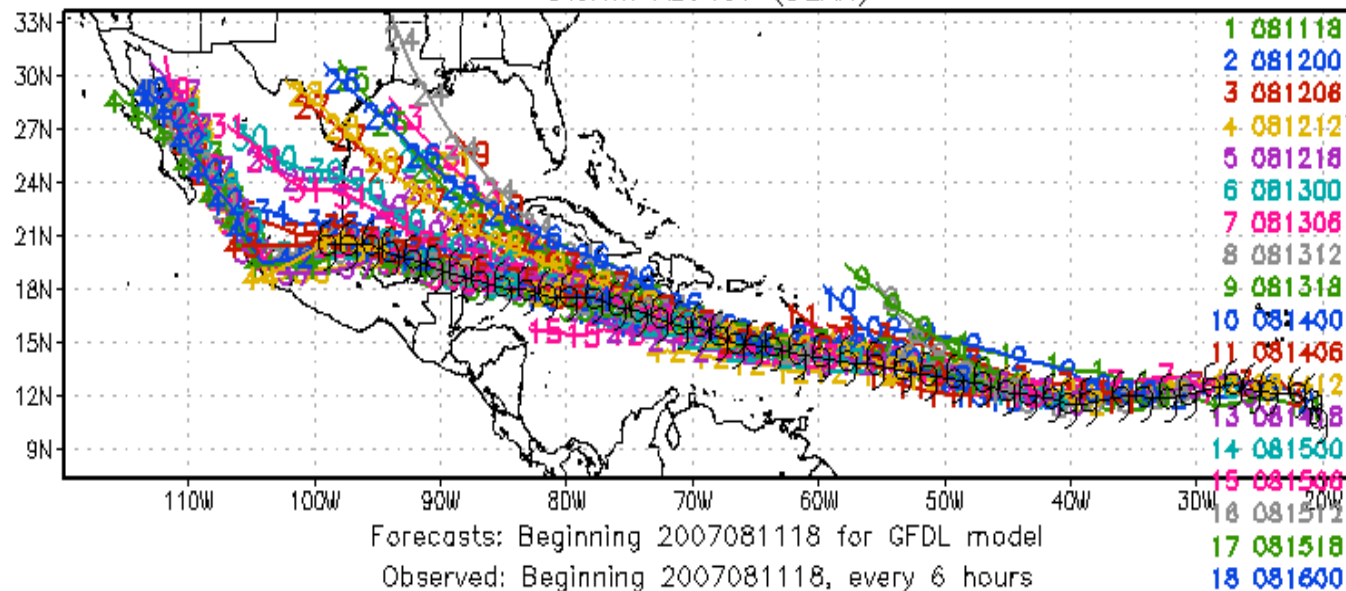
HWRf

**Hurricane
 Dean**

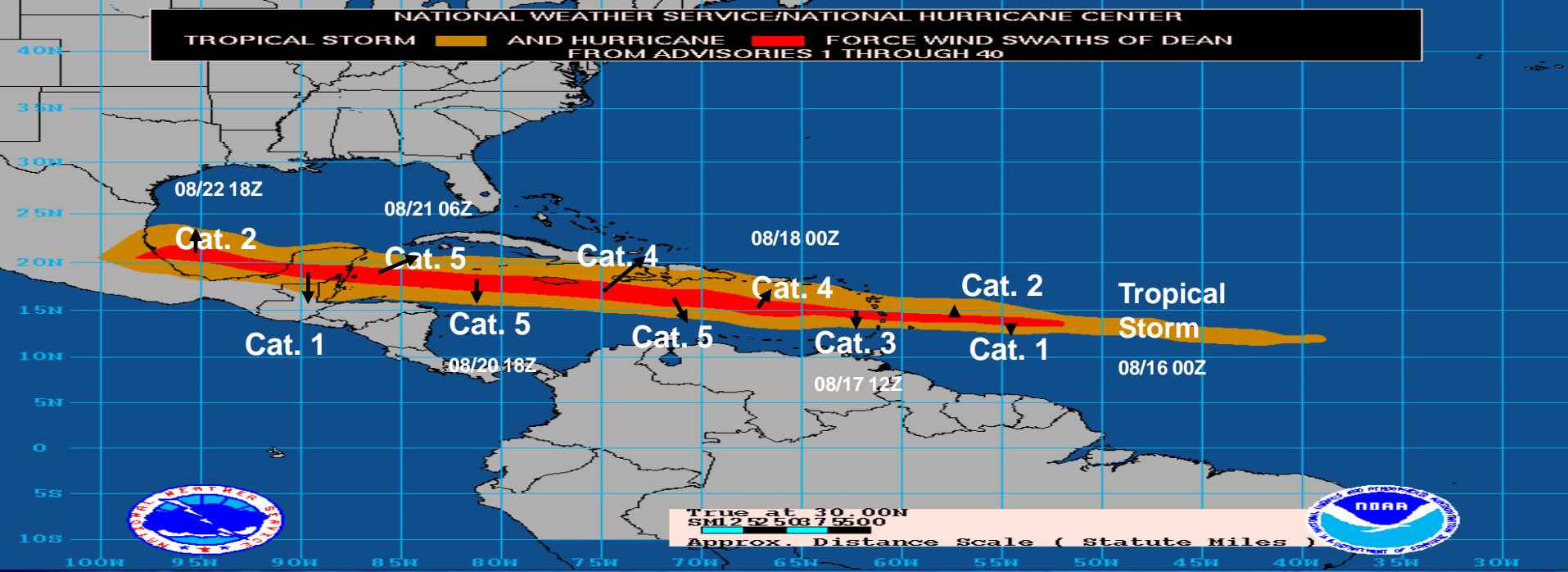
**August 11–
 22, 2007**

GFDL

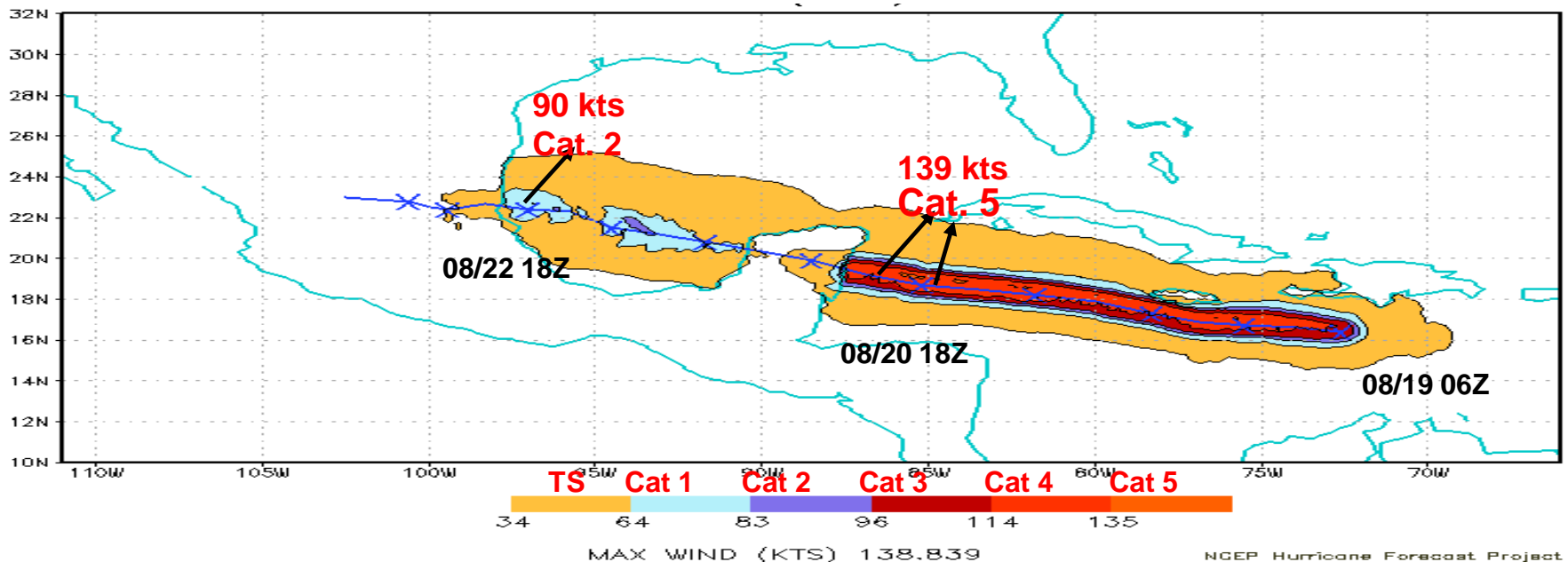
GFDL Operational Hurricane Model
 2007 Tropical Cyclone Tracks
 Storm: AL0407 (DEAN)



Forecasts: Beginning 2007081118 for GFDL model
 Observed: Beginning 2007081118, every 6 hours



Hurricane Dean 5 day forecasts of maximum winds starting from 8/19/06Z

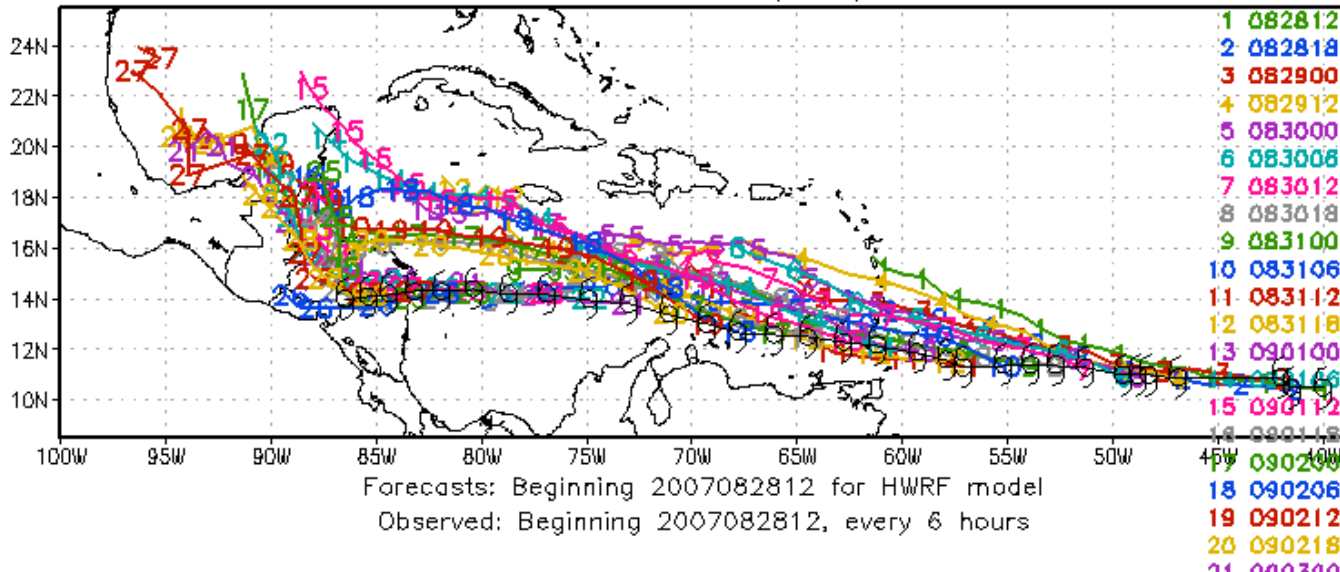


HWRf: Operational Coupled Hurricane WRF (NCO PROD)

2007 Tropical Cyclone Tracks

Storm: AL0607 (FELIX)

HWRf



Hurricane Felix

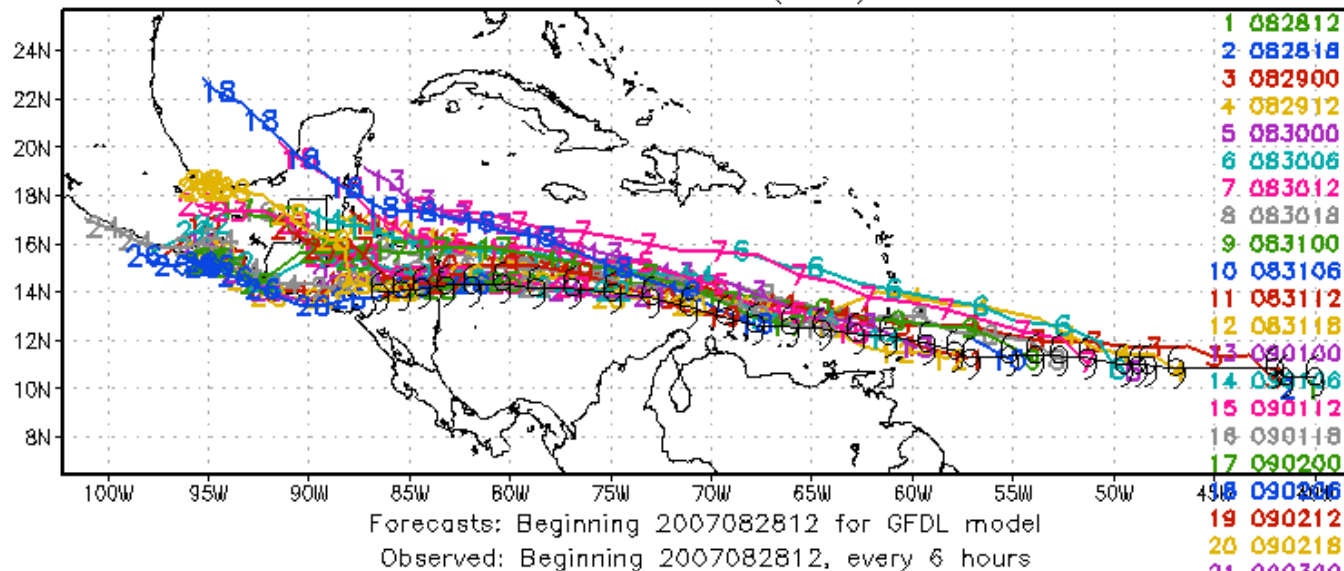
Aug. 28–Sep. 05,
2007

GFDL

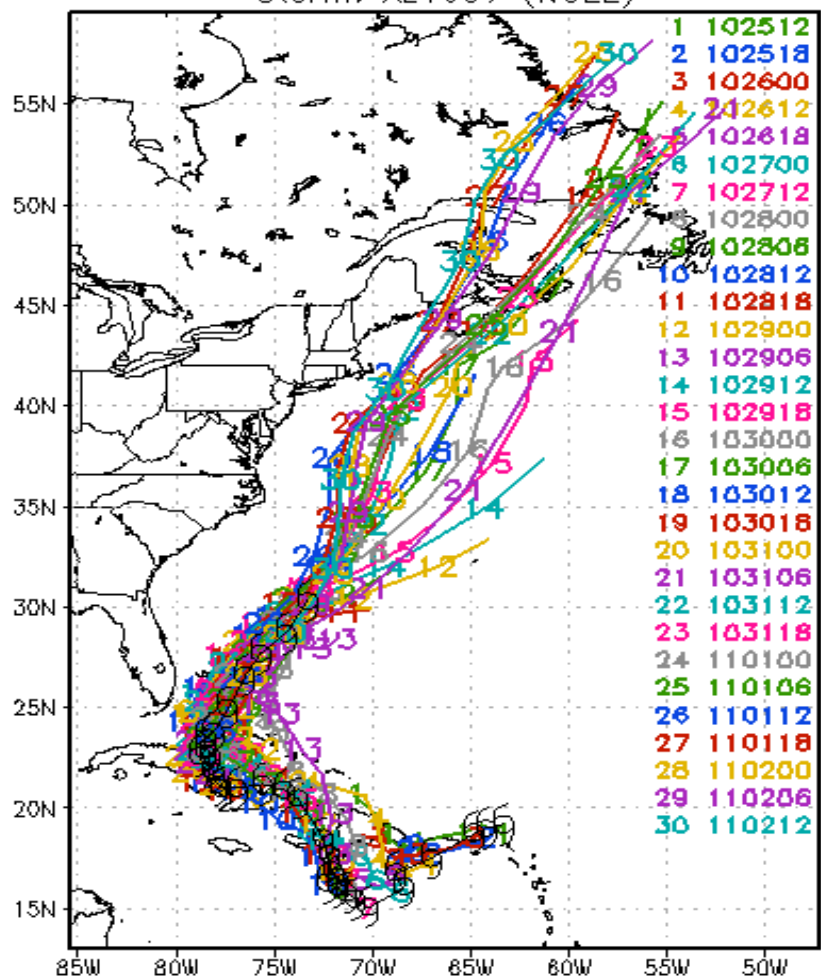
GFDL Operational Hurricane Model

2007 Tropical Cyclone Tracks

Storm: AL0607 (FELIX)



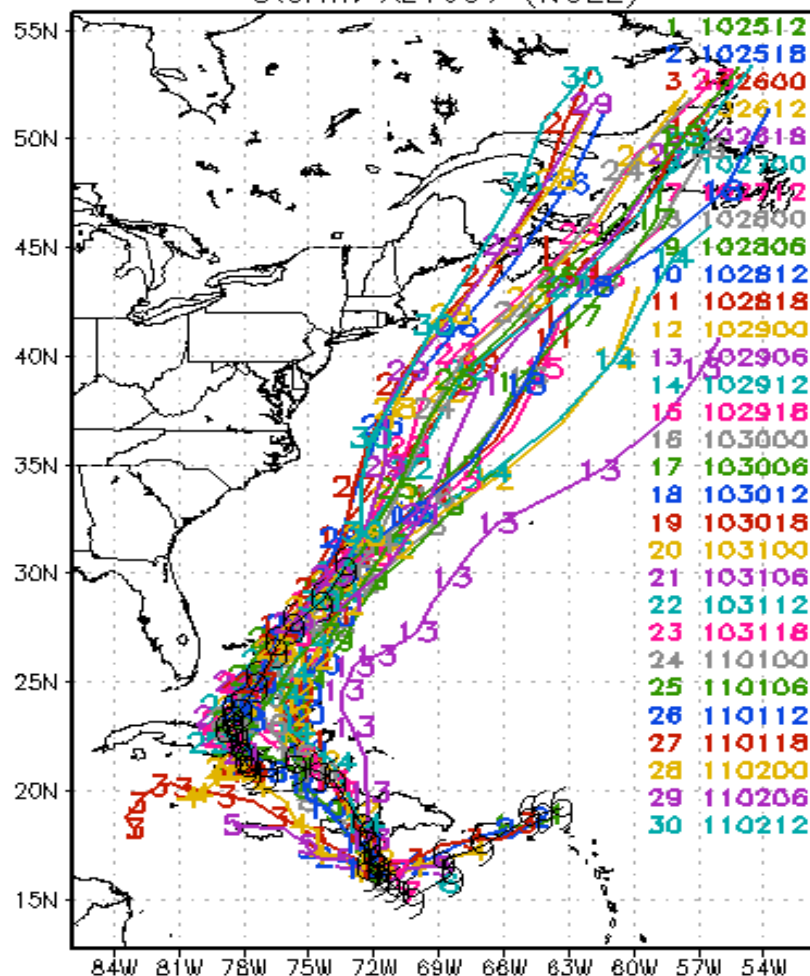
HWRF: Operational Coupled Hurricane WRF (NCO PROD)
 2007 Tropical Cyclone Tracks
 Storm: AL1607 (NOEL)



Forecasts: Beginning 2007102512 for HWRF model
 Observed: Beginning 2007102512, every 6 hours

NCEP Hu

GFDL Operational Hurricane Model
 2007 Tropical Cyclone Tracks
 Storm: AL1607 (NOEL)



Forecasts: Beginning 2007102512 for GFDL model
 Observed: Beginning 2007102512, every 6 hours

NCEP Hu

HWRF

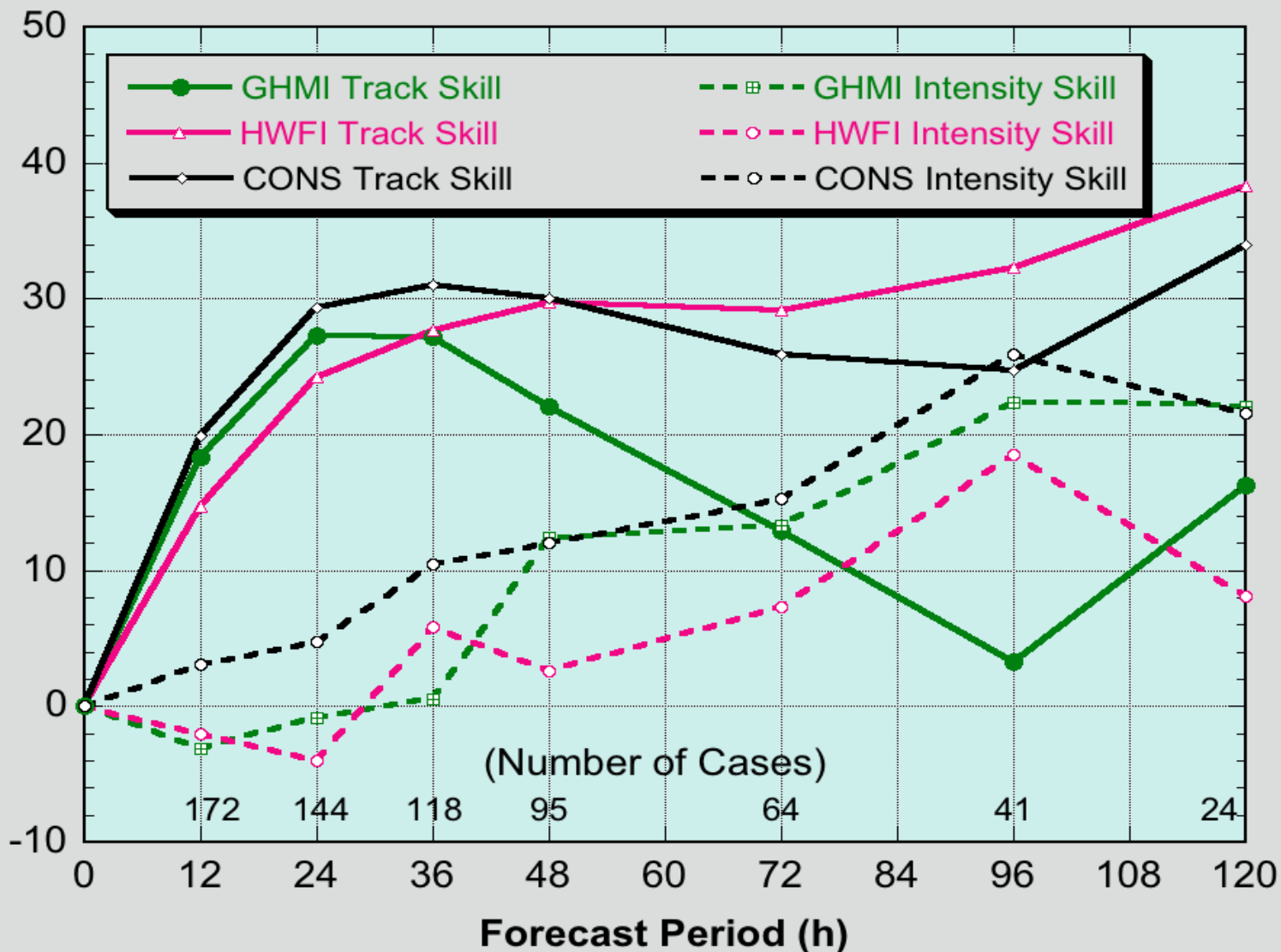
Hurricane Noel

GFDL

October 25-November 02, 2007

GFDL-HWRF Comparison

**GFDL vs HWRF
2007 - Atlantic Basin**



Good first year for the HWRF; competitive for intensity, better than GFDL for track (mainly Dean). Consensus of the two better than either alone.

2008 IMPLEMENTATION

- UPGRADE HURRICANE INITIALIZATION
- UPGRADE PHYSICS

Testing and Evaluation – rerun '05 and Aug/Sep 07

To run In parallel:

Vortex initialization w/assimilation of airborne doppler radar obs

HWRF + HYCOM + WAVEWATCH

Advancing HURRICANE WRF System



08

09

10

11

12

Mesoscale Data Assimilation for Hurricane Core

Radial velocities Advance reflectivity → **4DVAR**

Atm. Model physics and resolution upgrades (continuous)

Atm/ocean boundary layer: wave drag, enthalpy fluxes (sea spray)

Microphysics, radiation

Incr. Res: 4-6km.?

HWRF Ensembles?

Land surface Coupling

Waves: multi-grid/surf-zone physics

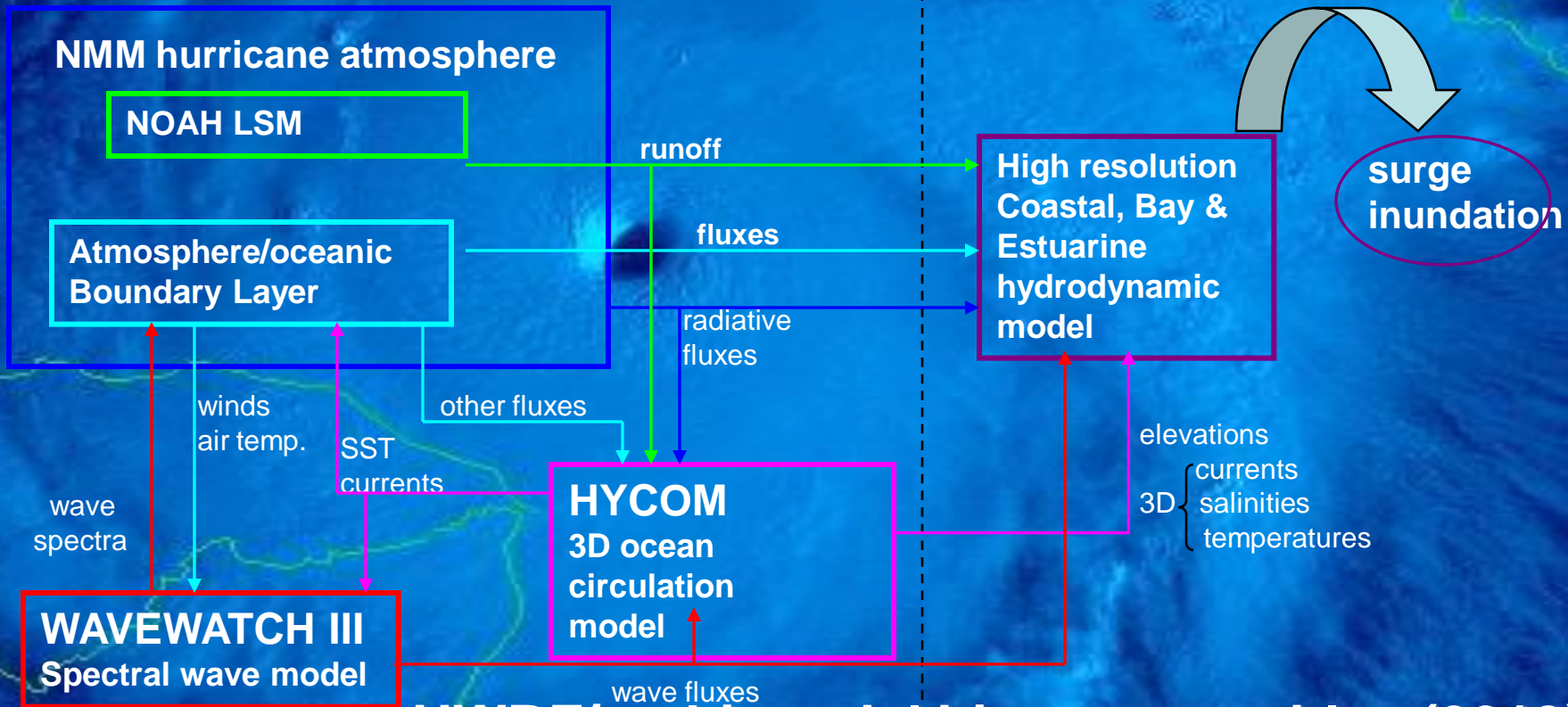
Ocean: 4km. - continuous upgrades in Ocean Data Assimilation

Hurricane-Wave-Ocean-Surge-Inundation Coupled Models

NCEP/Environmental Modeling Center
Atmosphere- Ocean-Wave-Land

NOS
land and coastal waters

HWRF SYSTEM



**HWRF/multi-model hi-res ensembles (2013)
for adv. storm surge model**

JHT Website

www.nhc.noaa.gov/jht/index.shtml

USWRP 

Joint Hurricane Testbed

- [JHT Home](#)
- [Terms of Reference \(PDF\)](#)
- [Staff](#)
- [Steering Committee](#)
- [Main Activities](#)
- [Highlights - 2001 to present](#)
- [Current Projects \(2005-2007\)](#)
- [Past Projects](#)
- [Administrative Presentations and Information](#)

Mission Statement

The mission of the Joint (National Oceanic and Atmospheric Administration - NOAA, Navy, and National Aeronautics and Space Administration - NASA) Hurricane Test Bed is to transfer more rapidly and smoothly new technology, research results, and observational advances of the United States Weather Research Program (USWRP), its sponsoring agencies, the academic community and other groups into improved tropical cyclone analysis and prediction at operational centers.

WHAT'S NEW

Updated January 31, 2006:

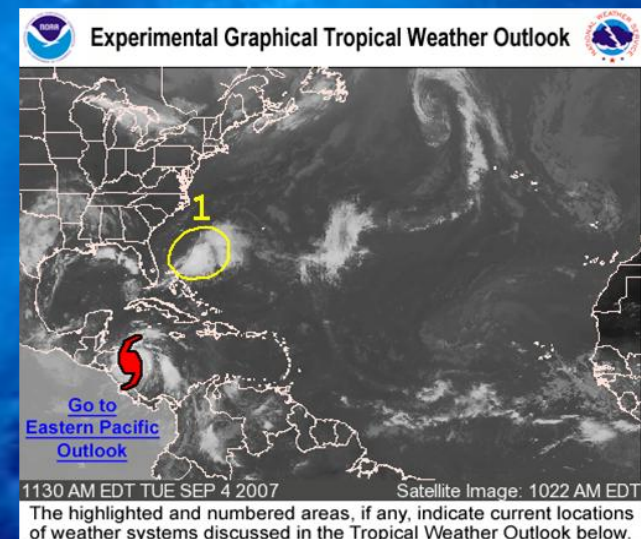
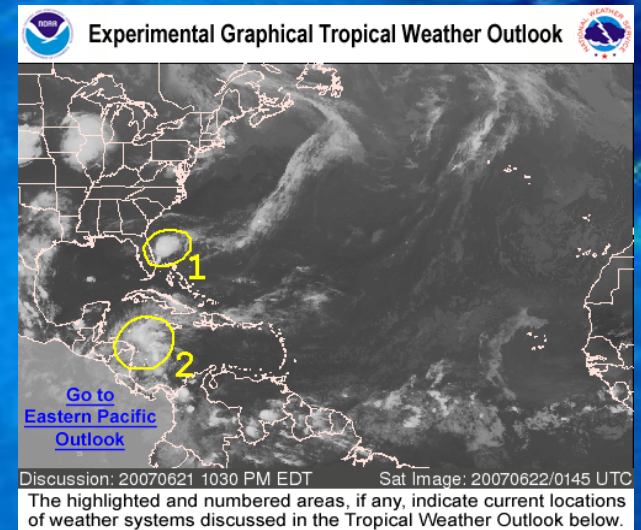
- 2005-2007 [Projects and Goals](#)
- The 2005 Midyear Reports are available in the [Project Table](#)

Added February 10, 2006:

- The Joint Hurricane Testbed (JHT): Progress and Future Plans, Chris Landsea (TPC/NHC) - American Meteorological Society's Annual Meeting, February 2006 presentation. (PDF format)

The Graphical Tropical Weather Outlook

- A visual companion product to the text Tropical Weather Outlook
- A web-based graphic superimposed on the most recently available geostationary satellite mosaic of the GOES-East, GOES-West, and Meteosat 9 satellites
- Indicates the current locations of areas of disturbed weather discussed in the TWO by encircling them. No indication of motion or forecast
- Active tropical cyclones are also shown on the Graphical TWO with a cyclone symbol



GTWO Changes for 2008

1. Move the issuance times of the operational text Tropical Weather Outlook (TWO) and the experimental graphical TWO for both the Atlantic and East Pacific basins to synoptic time.
2. Increase the availability of the graphical TWO from two to four times daily.
3. Include 3-tiered categorical genesis forecasts (color-coding) in the experimental graphical TWO.

-Low-probability of genesis → less than 20%
-Medium-probability of genesis → between 20-50%
-High-probability of genesis → greater than 50%

New 2008 TWO and GTWO Issuance Times Shown in Yellow with Old 2007 Issuance Times Shown in Orange

↓ indicates approximate arrival time of numerical model guidance

2 AM EDT/ 1 AM EST
Atlantic and Pacific TWO
and experimental GTWO

8 AM EDT/ 7 AM EST
Atlantic and Pacific TWO
and experimental GTWO

2 PM EDT/ 1 PM EST
Atlantic and Pacific TWO
and experimental GTWO

8 PM EDT/ 7 PM EST
Atlantic and Pacific TWO
and experimental GTWO



0600 UTC



1200 UTC



1800 UTC



0000 UTC

10 PM PT
Pacific TWO
and
experimental
GTWO

5:30AM ET
Atlantic TWO

4 AM PT
Pacific TWO

11:30AM ET
Atlantic TWO
and
experimental
GTWO

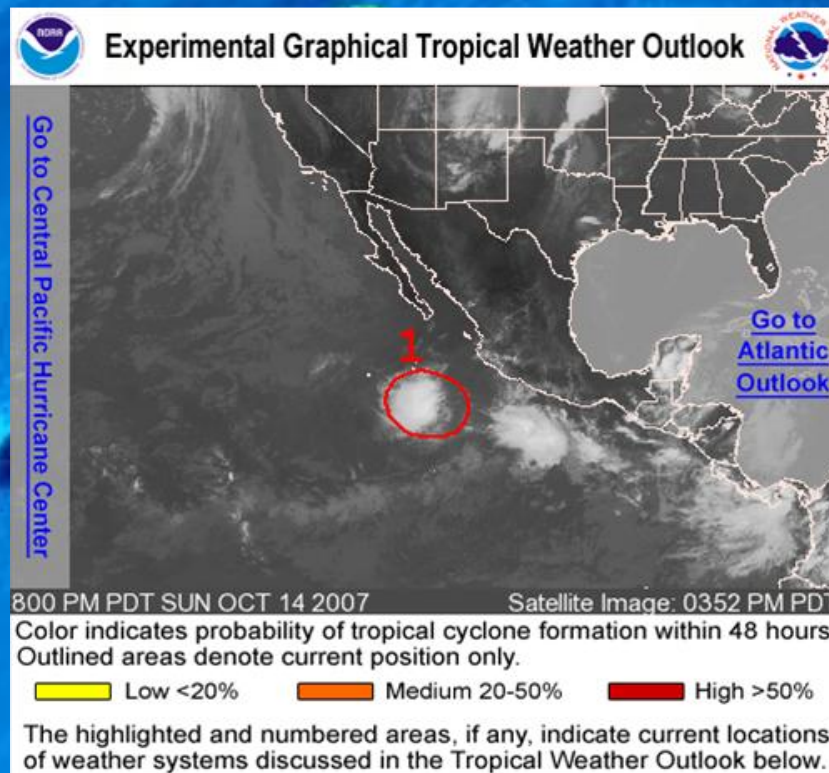
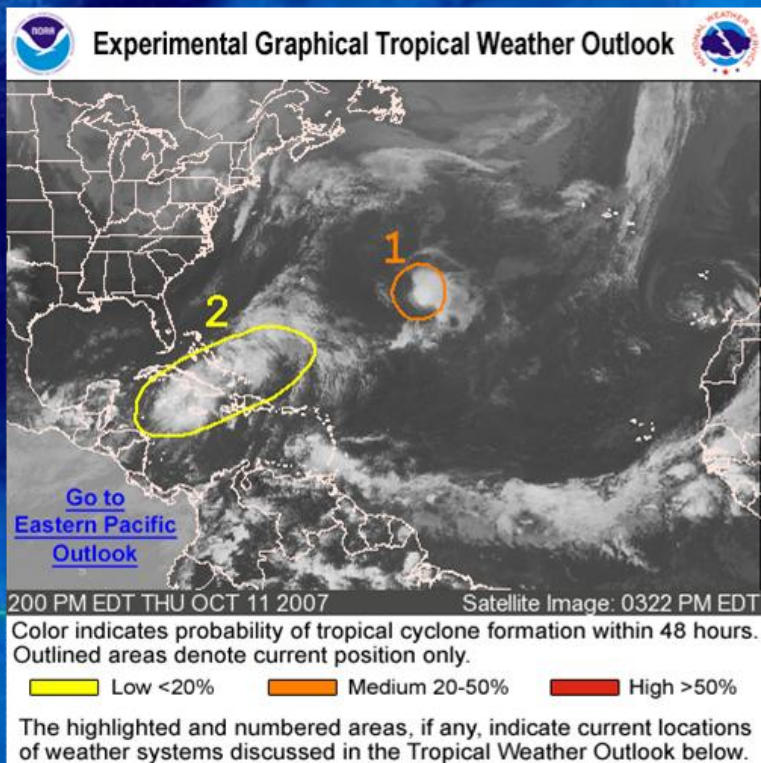
10 AM PT
Pacific TWO
and
experimental
GTWO

5:30PM
ET
Atlantic
TWO

4 PM
PT
Pacific
TWO


10:30PM ET
Atlantic TWO
and
experimental
GTWO

2008 GTWO




- <http://hurricanes.gov/gtwo-example1>
- <http://hurricanes.gov/gtwo->

Wind Speed Probability Table



Maximum 1-minute Wind Speed Probability Table for Dean
From NHC Advisory 16
5:00 AM EDT Aug 17 2007



Wind Speed Interval (mph)	Forecast Time						
	12 hour for 2 PM Fri	24 hour for 2 AM Sat	36 hour for 2 PM Sat	48 hour for 2 AM Sun	72 hour for 2 AM Mon	96 hour for 2 AM Tue	120 hour for 2 AM Wed
Dissipated	<2%	<2%	<2%	<2%	<2%	3%	16%
Tropical Depression (<39)	<2%	<2%	<2%	<2%	<2%	3%	13%
Tropical Storm (39-73)	<2%	<2%	2%	<2%	4%	22%	23%
Hurricane (>=74)	100%	100%	99%	99%	95%	72%	49%
Category 1 (74-95)	<2%	2%	5%	5%	8%	28%	18%
Category 2 (96-110)	3%	7%	9%	10%	14%	21%	12%
Category 3 (111-130)	58%	43%	33%	36%	28%	16%	12%
Category 4 (131-155)	38%	44%	44%	38%	32%	6%	6%
Category 5 (>155)	<2%	4%	8%	11%	13%	<2%	<2%

- Expanded probability forecasts from 72 hours to 120 hours
- New format with forecasts provided in columns and wind speed intervals will be provided in rows
- Table also included in text product
- Effects of land now used in computations

Changes to the Wind Speed Probability Table

NNNN
 ZCZC MIAPWSAT4 ALL
 TTA00 KNHC DDHMM
 TROPICAL DEPRESSION NINE WIND SPEED PROBABILITIES NUMBER 1
 NWS TPC/NATIONAL HURRICANE CENTER MIAMI FL AL092007
 1500 UTC WED SEP 12 2007

AT 1500Z THE CENTER OF TROPICAL DEPRESSION NINE WAS LOCATED NEAR
 LATITUDE 28.1 NORTH...LONGITUDE 95.2 WEST WITH MAXIMUM SUSTAINED
 WINDS NEAR 30 KTS...35 MPH...55 KM/HR.

Z INDICATES COORDINATED UNIVERSAL TIME (GREENWICH)
 ATLANTIC STANDARD TIME (AST)...SUBTRACT 4 HOURS FROM Z TIME
 EASTERN DAYLIGHT TIME (EDT)...SUBTRACT 4 HOURS FROM Z TIME
 CENTRAL DAYLIGHT TIME (CDT)...SUBTRACT 5 HOURS FROM Z TIME

I. MAXIMUM WIND SPEED (INTENSITY) PROBABILITY TABLE

CHANCES THAT THE MAXIMUM SUSTAINED (1-MINUTE AVERAGE) WIND SPEED OF THE TROPICAL
 CYCLONE WILL BE WITHIN ANY OF THE FOLLOWING CATEGORIES AT EACH OFFICIAL FORECAST
 TIME DURING THE NEXT 5 DAYS. PROBABILITIES ARE GIVEN IN PERCENT. X INDICATES
 PROBABILITIES LESS THAN 2 PERCENT.

- - - MAXIMUM WIND SPEED (INTENSITY) PROBABILITIES - - -

VALID TIME	00Z THU	12Z THU	00Z FRI	12Z FRI	12Z SAT	12Z SUN	12Z MON
FORECAST HOUR	12	24	36	48	72	96	120
FCST MAX WIND KT	40	40	30	20	0	0	0

DISSIPATED	3	5	15	40	98	98	98
TROP DEPRESSION	15	20	35	40	X	X	X
TROPICAL STORM	80	65	40	15	X	X	X
HURRICANE	3	10	5	5	X	X	X

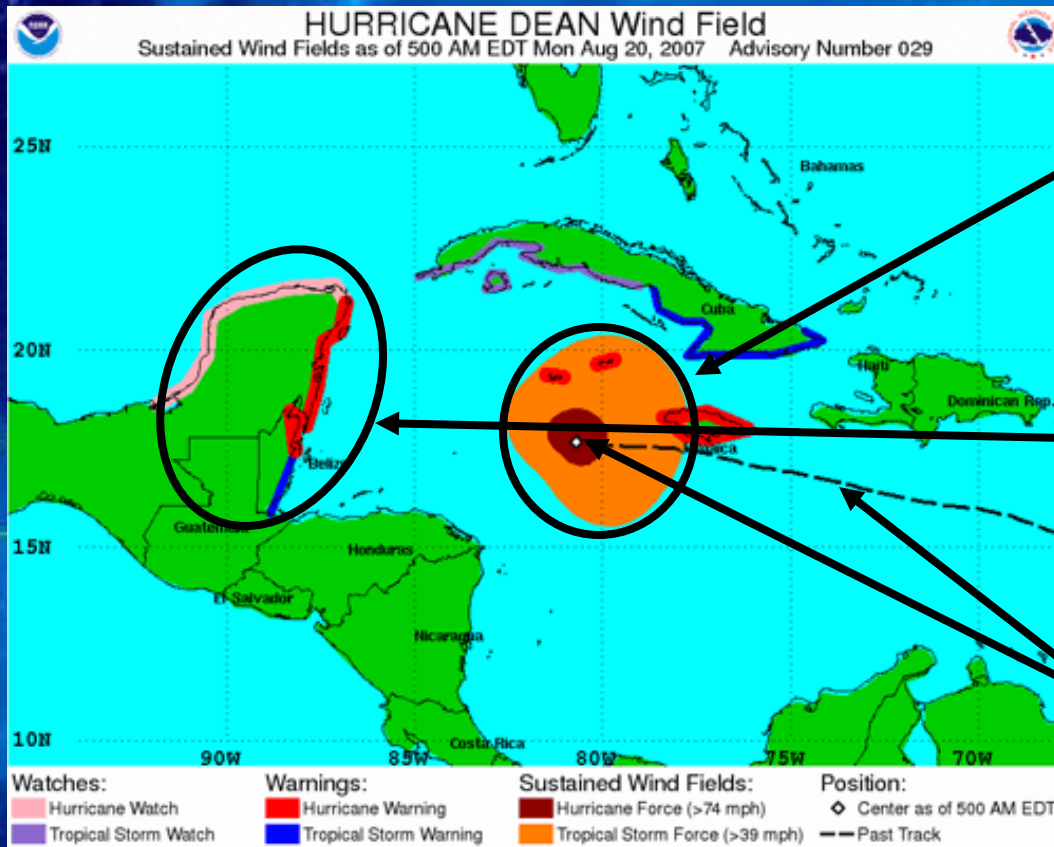
HUR CAT 1	3	10	5	5	X	X	X
HUR CAT 2	X	X	X	X	X	X	X
HUR CAT 3	X	X	X	X	X	X	X
HUR CAT 4	X	X	X	X	X	X	X
HUR CAT 5	X	X	X	X	X	X	X

II. WIND SPEED PROBABILITY TABLE FOR SPECIFIC LOCATIONS

CHANCES OF SUSTAINED (1-MINUTE AVERAGE) WIND SPEEDS OF AT LEAST
 ...34 KT (39 MPH... 63 KPH)...
 ...50 KT (58 MPH... 93 KPH)...
 ...64 KT (74 MPH...119 KPH)...

- New section added which denotes the probabilities that the maximum sustained wind speed will be within any of nine categories ranging from dissipated to a category 5 hurricane
- The pre-existing wind speed probabilities for specific locations will move to section II but otherwise remain unchanged

Tropical Cyclone Wind Field Graphic



- Graphic shows the areas potentially being affected by the sustained winds of tropical storm force (in orange) and hurricane force (in red)*

- Includes representation of coastal areas under a hurricane warning (red), hurricane watch (pink), tropical storm warning (blue) and tropical storm watch (purple).

- Current position of the center of the tropical cyclone shown with white dot while the past track is shown with a dashed line.

* Wind radii represent the maximum possible extent of a given wind speed within particular quadrants around the tropical cyclone. As a result, not all locations falling within the orange or red shaded areas will be experiencing sustained tropical storm or hurricane force winds, respectively.

Extend Generalized Forecast Information in Public Advisories to 48 Hours

ZCZC MIATCPAT2 ALL
TTAA00 KNHC DDHMM
BULLETIN
HURRICANE KATRINA ADVISORY NUMBER 10
NWS TPC/NATIONAL HURRICANE CENTER MIAMI FL
11 PM EDT THU AUG 25 2005

...EYE OF KATRINA MOVING SOUTHWESTWARD ACROSS MIAMI-DADE COUNTY...

A HURRICANE WARNING REMAINS IN EFFECT FOR THE SOUTHEAST FLORIDA COAST FROM JUPITER INLET SOUTHWARD TO FLORIDA CITY...INCLUDING LAKE OKEECHOBEE. PREPARATIONS TO PROTECT LIFE AND PROPERTY SHOULD HAVE BEEN COMPLETED.

A TROPICAL STORM WARNING IS IN EFFECT FOR ALL THE FLORIDA KEYS AND FLORIDA BAY FROM KEY WEST NORTHWARD...AND ALONG THE GULF COAST OF FLORIDA FROM LONGBOAT KEY SOUTH AND EASTWARD TO SOUTH OF FLORIDA CITY.

A TROPICAL STORM WATCH REMAINS IN EFFECT FOR PORTIONS THE FLORIDA WEST COAST FROM NORTH OF LONGBOAT KEY TO ANCLOTE KEY. A TROPICAL STORM WATCH MEANS THAT TROPICAL STORM CONDITIONS ARE POSSIBLE WITHIN THE WATCH AREA...GENERALLY WITHIN 36 HOURS.

AT 11 PM EDT...0300Z...THE TROPICAL STORM WARNING AND TROPICAL STORM WATCH ALONG THE EAST COAST OF FLORIDA NORTH OF JUPITER HAVE BEEN DISCONTINUED.

INTERESTS ELSEWHERE ALONG THE GULF COAST OF THE UNITED STATES SHOULD MONITOR THE PROGRESS OF KATRINA.

FOR STORM INFORMATION SPECIFIC TO YOUR AREA...INCLUDING POSSIBLE INLAND WATCHES AND WARNINGS...PLEASE MONITOR PRODUCTS ISSUED BY YOUR LOCAL WEATHER OFFICE.

AT 11 PM EDT...0300Z...THE EYE OF HURRICANE KATRINA WAS LOCATED NEAR LATITUDE 25.5 NORTH...LONGITUDE 80.7 WEST OR ABOUT 35 MILES... SOUTHWEST OF MIAMI FLORIDA OR 20 MILES NORTHWEST OF THE CITY OF HOMESTEAD.

KATRINA IS MOVING TOWARD THE SOUTHWEST NEAR 8 MPH AND THIS MOTION IS EXPECTED TO CONTINUE DURING THE NEXT SEVERAL HOURS. KATRINA IS EXPECTED TO MOVE OVER THE EASTERN GULF OF MEXICO FRIDAY AND SATURDAY.

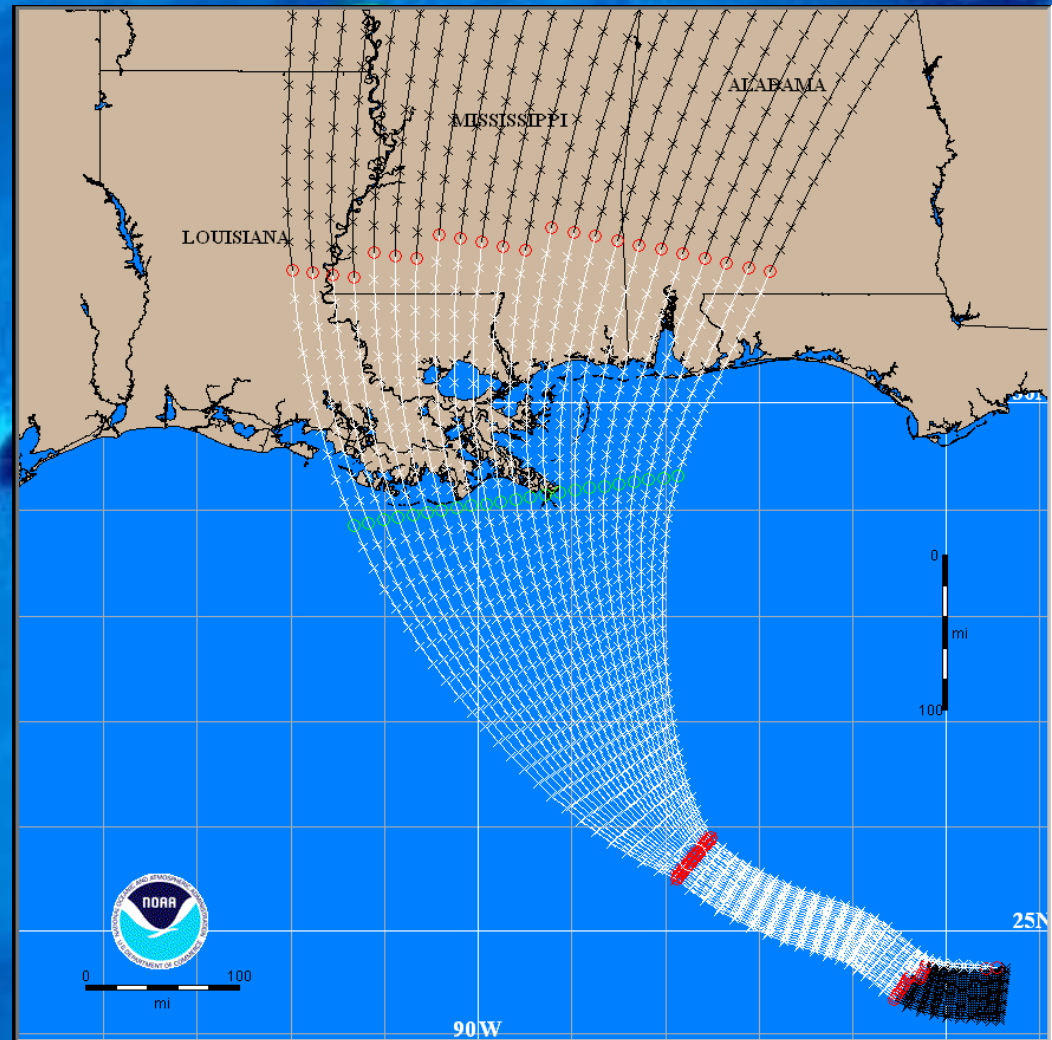
MAXIMUM SUSTAINED WINDS ARE NEAR 75 MPH WITH HIGHER GUSTS. KATRINA IS A CATEGORY ONE HURRICANE ON THE SAFFIR-SIMPSON SCALE. SOME ADDITIONAL WEAKENING IS ANTICIPATED WHILE KATRINA IS OVER LAND. AND IT COULD WEAKEN TO A TROPICAL STORM EARLY ON FRIDAY. RESTRENGTHENING IS EXPECTED ON FRIDAY OR SATURDAY... AND KATRINA COULD BECOME A DANGEROUS HURRICANE IN THE GULF OF MEXICO IN 2 TO 3 DAYS.

HURRICANE FORCE WINDS EXTEND OUTWARD UP TO 10 MILES FROM THE

- Broad, cautionary statements for areas that could potentially be affected beyond 48 hours may also be included.
- Public advisories will contain generalized track and intensity forecast information, using wording that appropriately conveys the uncertainties in those forecasts, out to 48 hours.

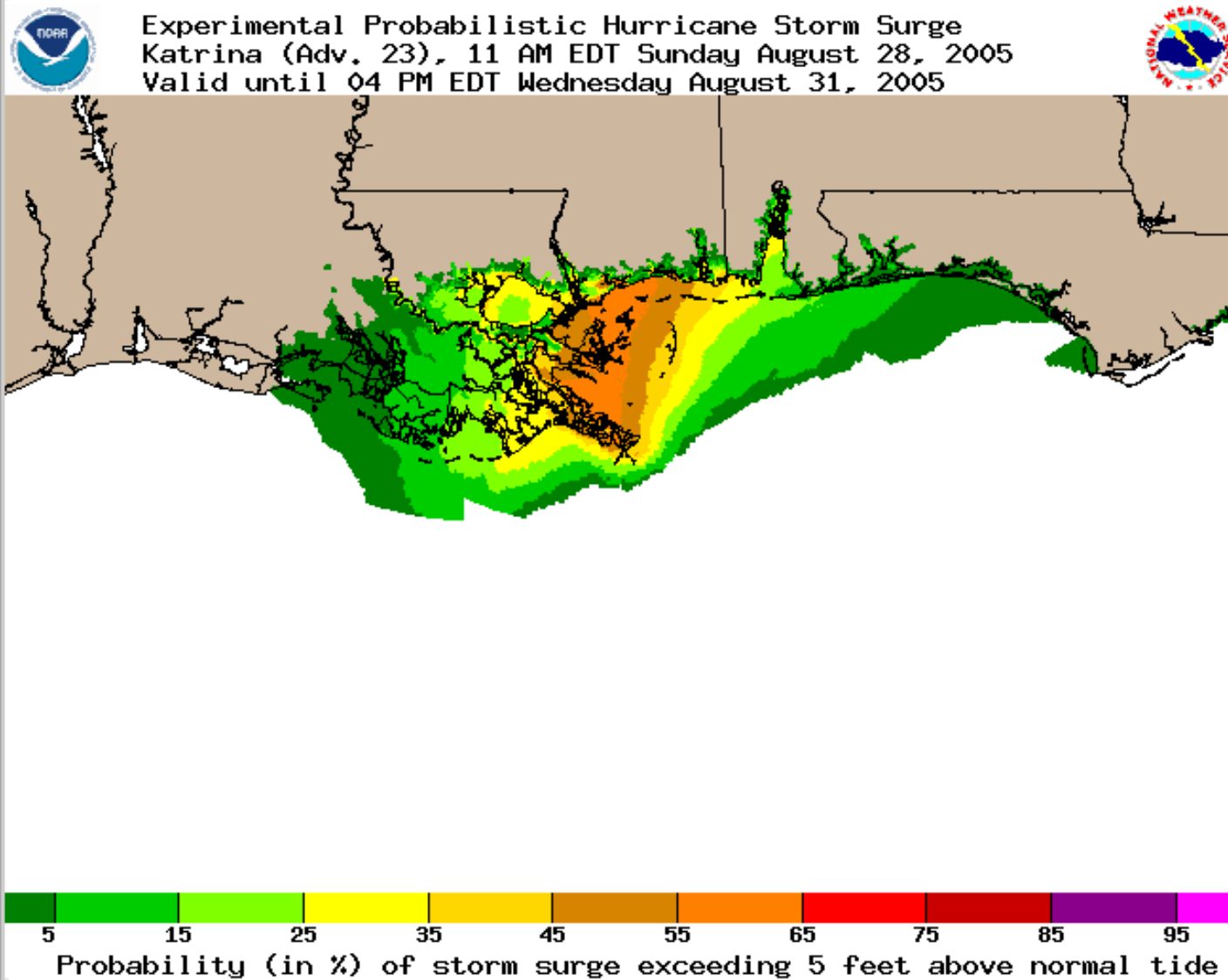
Probabilistic Storm Surge

- Based upon an ensemble of SLOSH model runs using the NHC forecast information
- Uses historical information on NHC's forecast accuracy and an estimate of storm size.



Probabilistic Storm Surge

(Probability of storm surge exceeding 5 ft)



The Forecasters (us):

National Hurricane Center
Tropical Prediction Center

A satellite image of a hurricane, showing a distinct eye and spiral cloud bands, centered in the lower half of the white box.

The Researchers (them):



How to
bridge
the
“valley
of
death”?

JHT Process

- **Principal Investigators apply for funding through NOAA**
- **A seven member Steering Committee rates all proposals**
- **Funded projects are tested during one or two hurricane seasons in conjunction with NHC/ Environmental Modeling Center points of contact**
- **At the project's end, each are evaluated by NHC/EMC staff**
- **Implementation of successful projects are then carried out by NHC/EMC staff/Pis**

What Have We Accomplished 2001-2008

- Total projects funded (round 1-4) – **50**
- Number of projects completed (round 1-3) – **39**
- Number of projects accepted for implementation – **28**
- Number of completed projects not accepted – **3**
- Number of completed projects pending further evaluation – **8**
- **Number of projects implemented – 21**

Dedicated NHC & JHT staff, and close collaborations between the PIs, NHC forecasters and support staff is the key.

Preparing for the 4th round (2007-09) of Joint Hurricane Testbed Projects

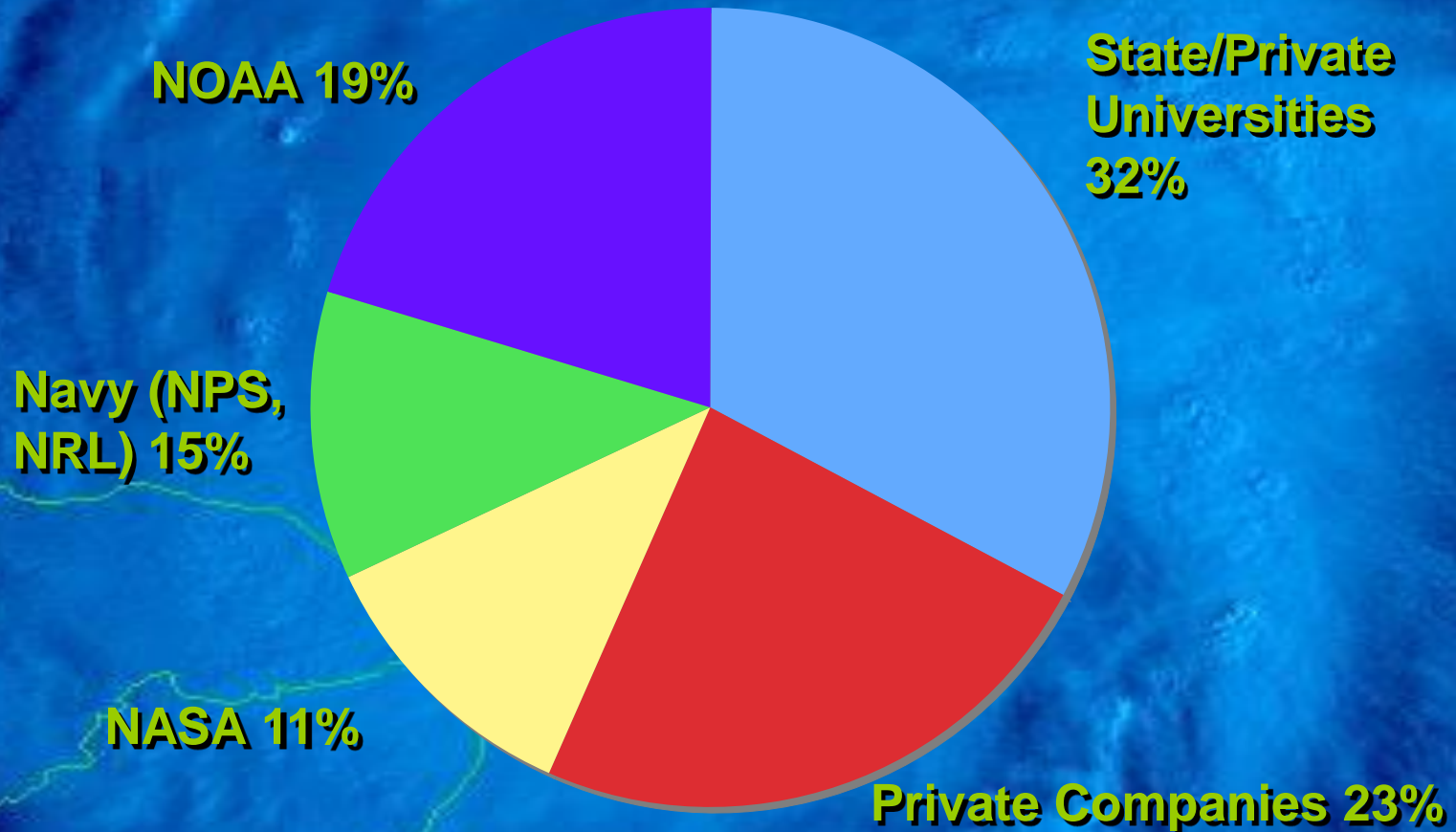
- Drafting of Federal Funding Opportunity (Spring 2006)**
- Announcement of Federal Funding Opportunity (June 16th)**
- 43 Letters of Intent received (July 31st)**
- 20 encouraged to submit a full proposal (Sep)**
- Full proposals due (December 6th)**
- 27 Full proposals reviewed (Dec. 2005-Feb. 2007)**
- TPC/JHT Directors' recommend for funding (Mar. 1st, 2007)**
- New 4th Round Projects begin (Summer 2007)**

4th Round Project Focus Areas

Primary Area of Focus	# of Projects
Improvements to dynamical models (for track, intensity, and precipitation forecasts)	5
Statistical intensity forecast guidance	1
Tropical cyclone structure/wind/wave distribution	2
Track forecast guidance	1
Enhancements to operational environment	1
Total	10

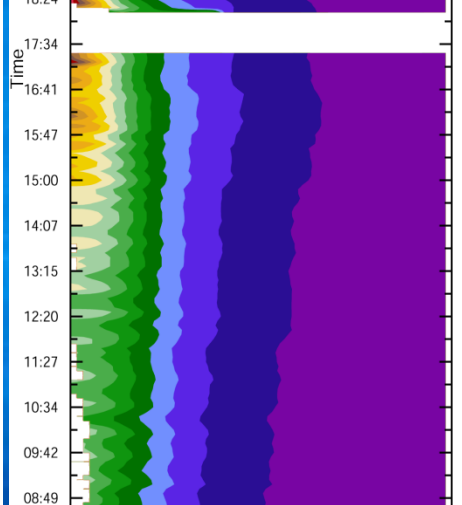
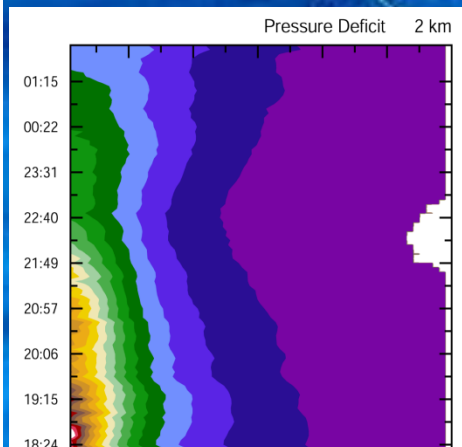
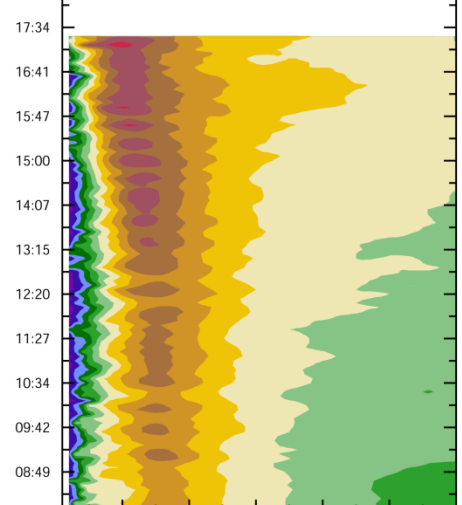
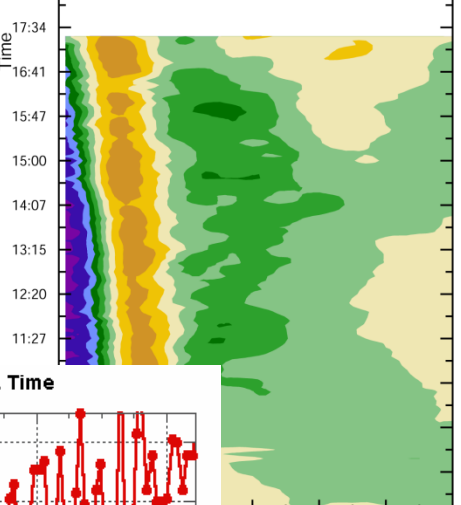
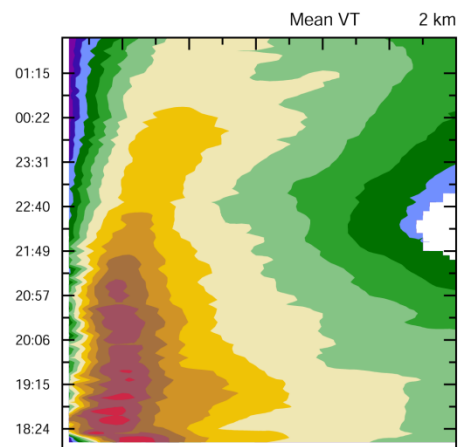
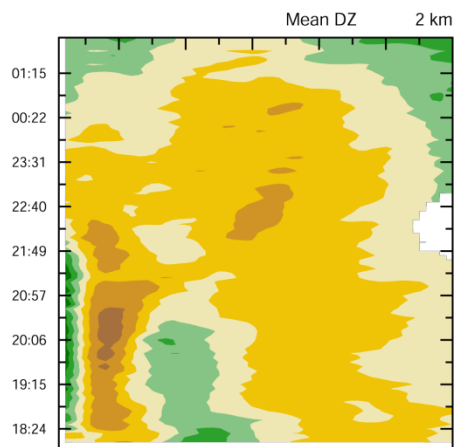
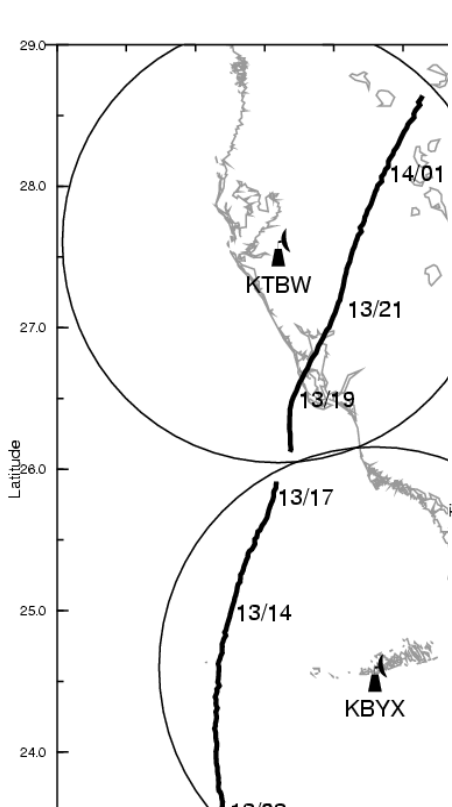
4th Round (FY07) Funding Distribution

Total \$1.03M

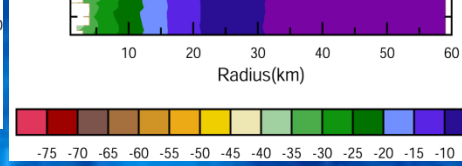
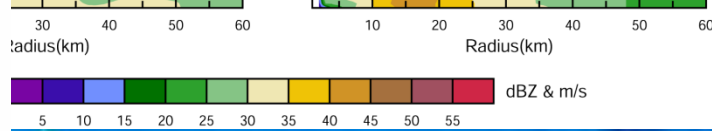
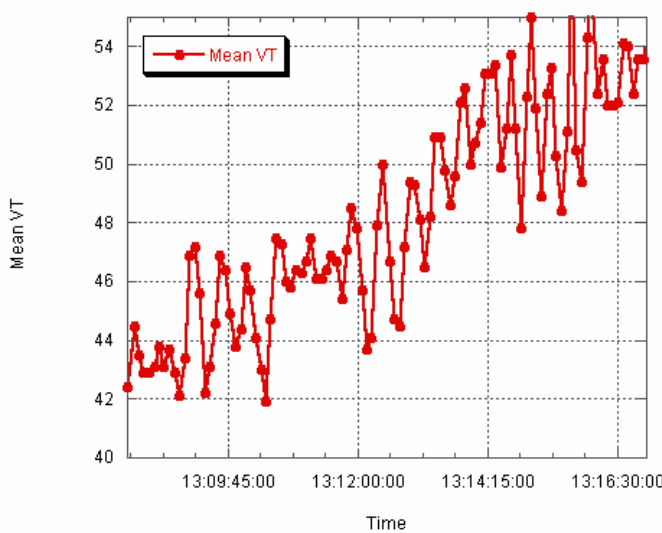


Hurricane Charley (2004) GBVTD-d

Hurricane Charley (2004) 13/08Z - 14/02Z

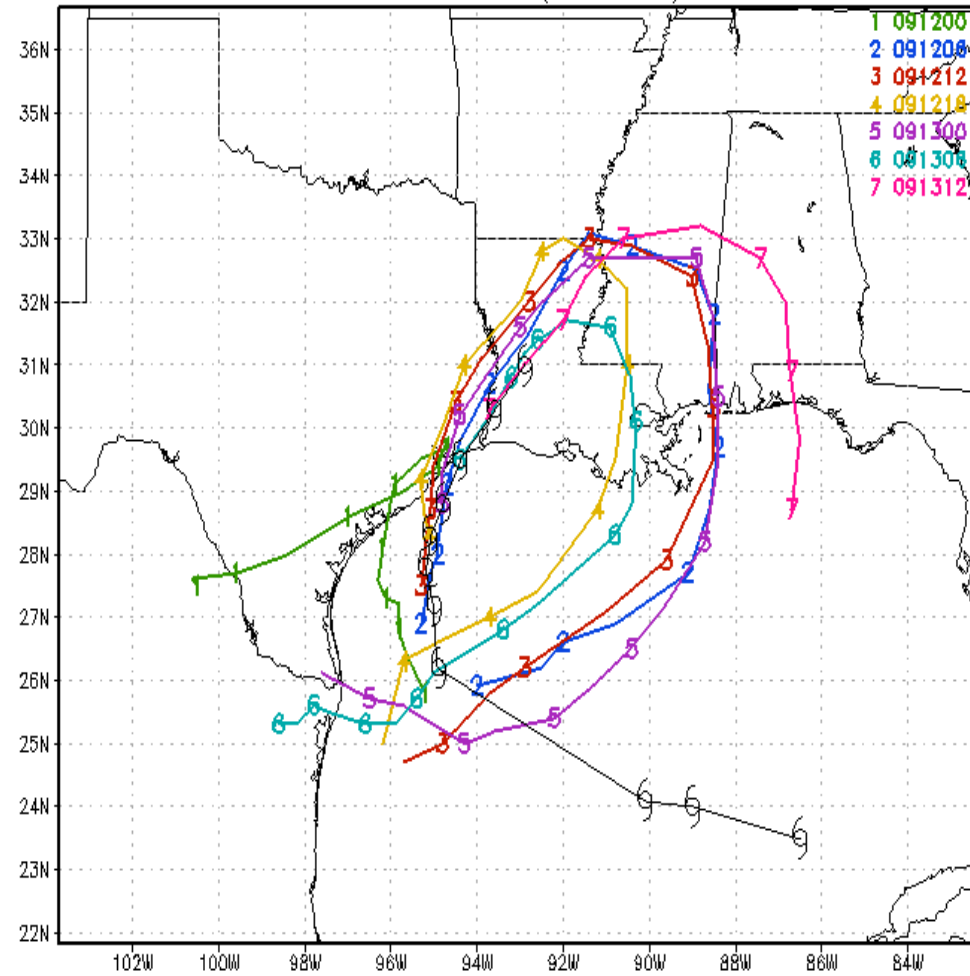
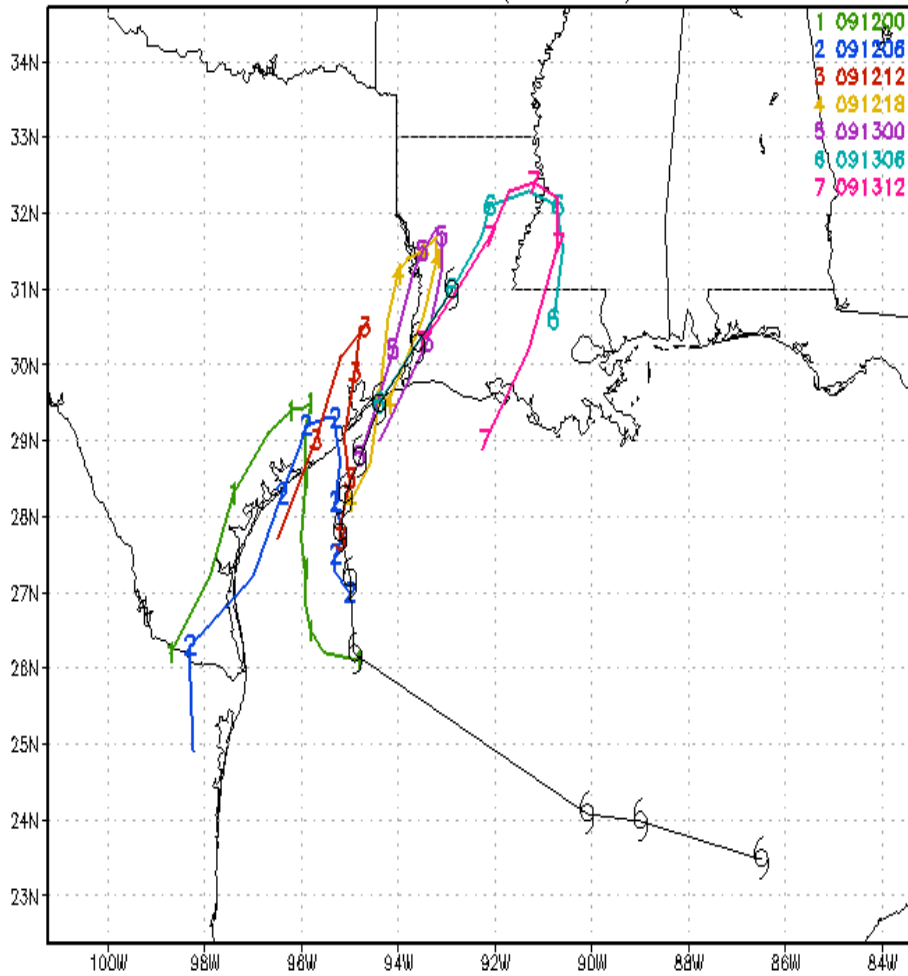


KBYX Mean VT vs. Time



HWRf: Operational Coupled Hurricane WRF (NCO PR0D)
 2007 Tropical Cyclone Tracks
 Storm: AL0907 (HUMBERTO)

GFDL Operational Hurricane Model
 2007 Tropical Cyclone Tracks
 Storm: AL0907 (HUMBERTO)



Forecasts: Beginning 2007091200 for HWRf model
 Observed: Beginning 2007090900, every 6 hours

Forecasts: Beginning 2007091200 for GFDL model
 Observed: Beginning 2007090900, every 6 hours

NCEP Hurricane Forecast

NCEP Hurricane Forecast

HWRf

Hurricane Humberto

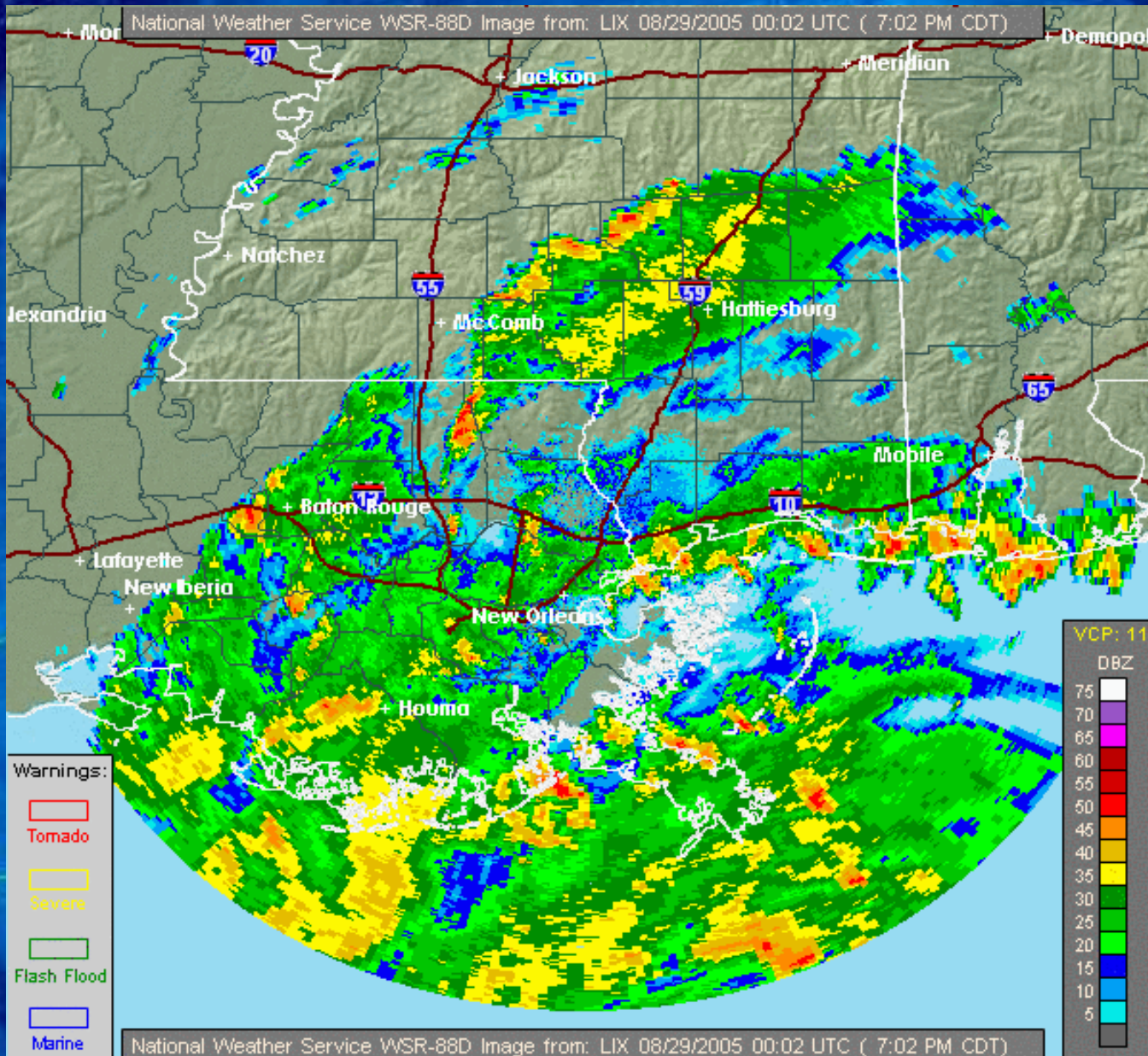
GFDL

September 12-13, 2007

Changes for 2008

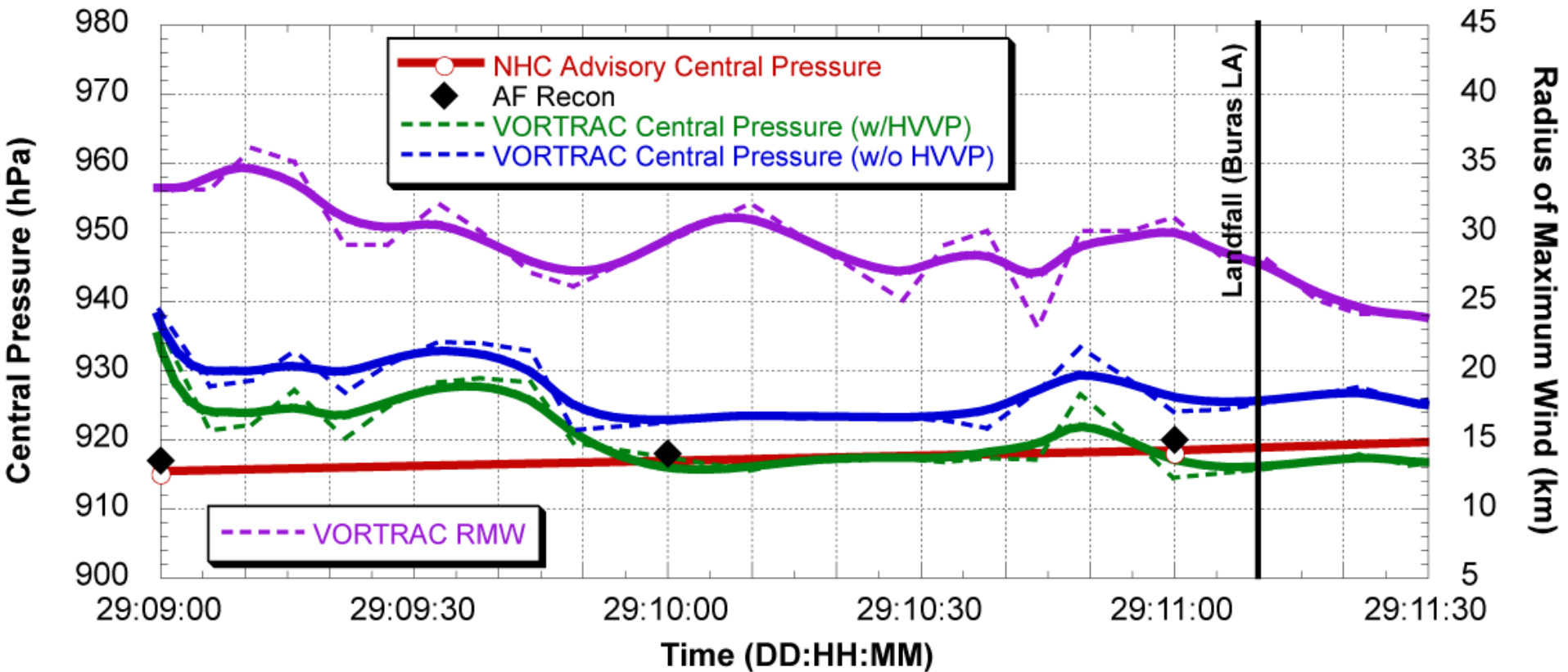
- **Enhancements to the graphical tropical weather outlook**
 - 4 times daily
 - Three-tiered categorical genesis forecast
- **Changes in issuance times for tropical weather outlook**
 - Move to synoptic time
- **Changes to wind speed probability table**
 - Format changes
- **Changes to wind speed intensity table**
 - Expanded to include 96 and 120 hours forecasts
 - Format changes
 - Inclusion of land effects in computation
- **Changes to public advisory**
 - Extend generalized forecast information in public advisories through 48 hours
 - Issue intermediates inland
 - Issue East Pacific public advisories
- **New probabilistic storm surge graphic**
- **New tropical cyclone wind field graphic**
- **SLOSH Maximum of Maximums (MOMS) added to web page**

Hurricane Katrina at Landfall

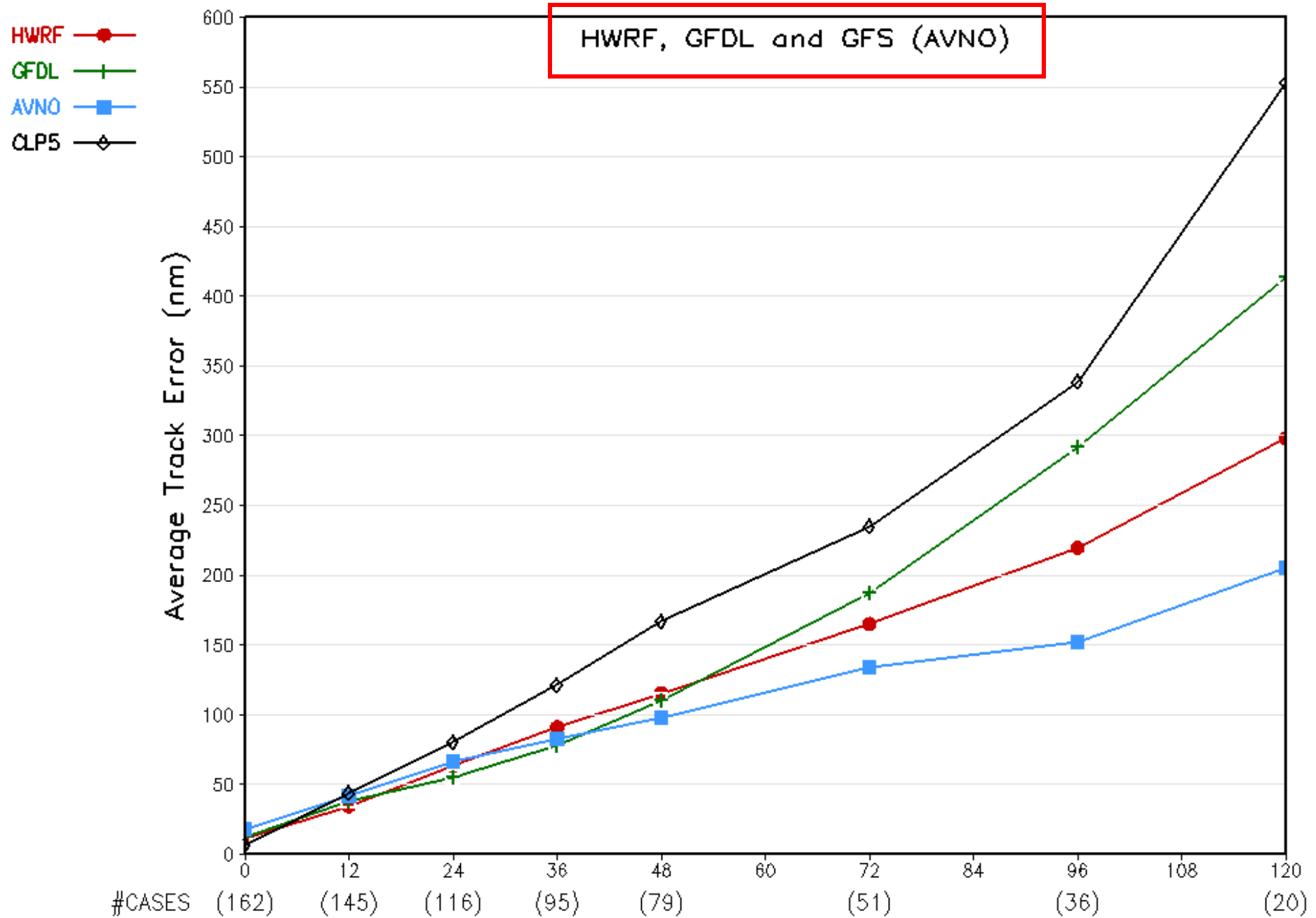


Hurricane Katrina (2005)

Hurricane Katrina (2005)
Central Pressure and Radius of Maximum Wind Estimates



Track Error Comparison, Atlantic Hurricanes (2007)
Coupled HWRF (2007 Operational Version) NCO PROD



Intensity Error Comparison – Atlantic Hurricanes (2007)
 Coupled HWRF (2007 Operational Version) NCO PROD

HWRF, GFDL and STATISTICAL MODELS

- HWRF ●
- GFDL +
- LGEM ■
- SHF5 ◆
- SHIP ×
- DSHP ▲

