



An Overview of the 2011 Atlantic Hurricane Season

Lee

Katia

Nate

Maria

Stacy Stewart

Senior Hurricane Specialist

NOAA National Hurricane Center, Miami, FL

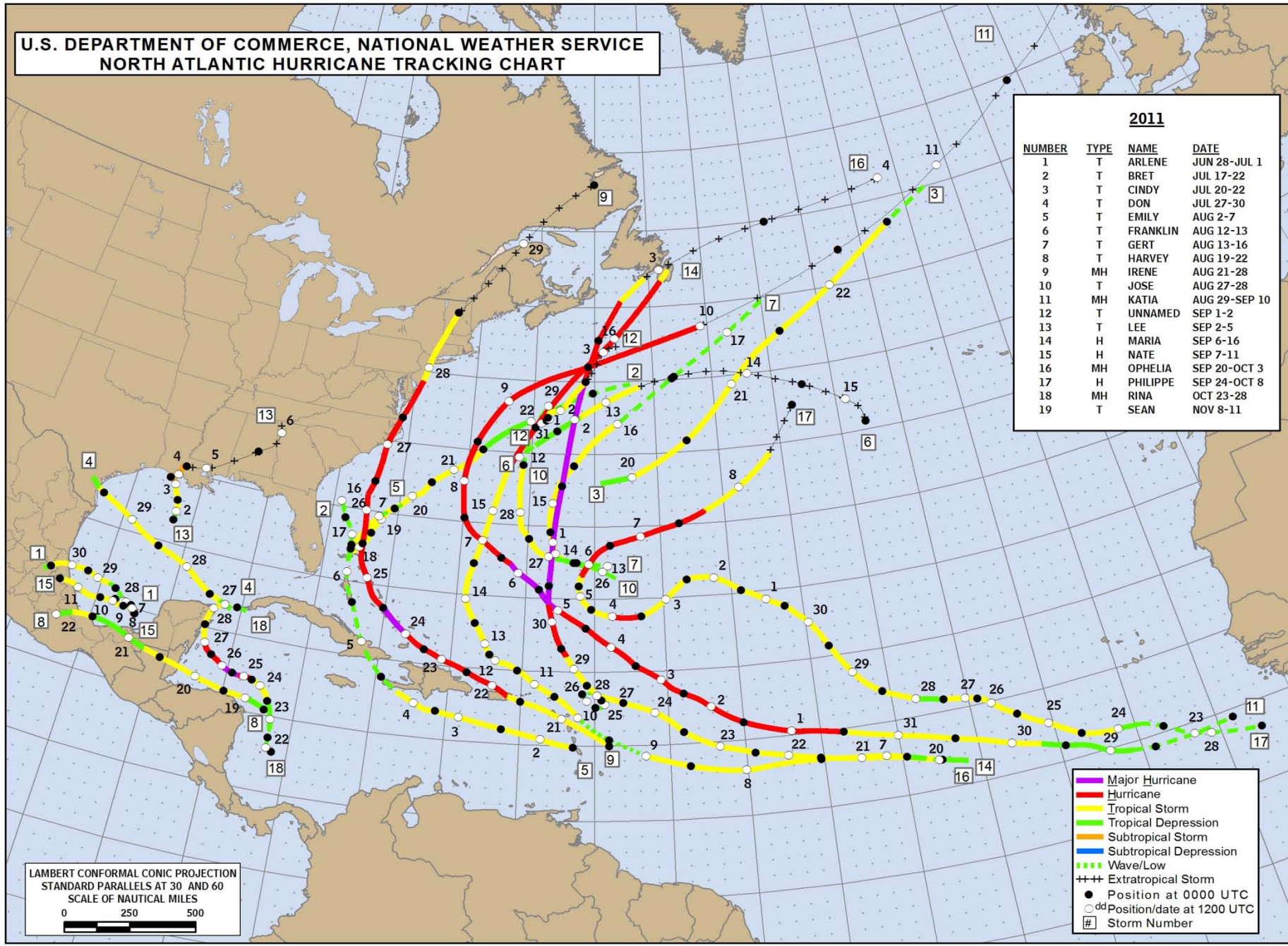
29 November 2011

120° 115° 110° 105° 100° 95° 90° 85° 80° 75° 70° 65° 60° 55° 50° 45° 40° 35° 30° 25° 20° 15° 10° 5° West 0° East 5° 10°

**U.S. DEPARTMENT OF COMMERCE, NATIONAL WEATHER SERVICE
NORTH ATLANTIC HURRICANE TRACKING CHART**

2011

NUMBER	TYPE	NAME	DATE
1	T	ARLENE	JUN 28-JUL 1
2	T	BRET	JUL 17-22
3	T	CINDY	JUL 20-22
4	T	DON	JUL 27-30
5	T	EMILY	AUG 2-7
6	T	FRANKLIN	AUG 12-13
7	T	GERT	AUG 13-16
8	T	HARVEY	AUG 19-22
9	MH	IRENE	AUG 21-28
10	T	JOSE	AUG 27-28
11	MH	KATIA	AUG 29-SEP 10
12	T	UNNAMED	SEP 1-2
13	T	LEE	SEP 2-5
14	H	MARIA	SEP 6-16
15	H	NATE	SEP 7-11
16	MH	OPHELIA	SEP 20-OCT 3
17	H	PHILIPPE	SEP 24-OCT 8
18	MH	RINA	OCT 23-28
19	T	SEAN	NOV 8-11



LAMBERT CONFORMAL CONIC PROJECTION
STANDARD PARALLELS AT 30 AND 60
SCALE OF NAUTICAL MILES
0 250 500

- Major Hurricane
- Hurricane
- Tropical Storm
- Tropical Depression
- Subtropical Storm
- Subtropical Depression
- ⋯ Wave/Low
- +++ Extratropical Storm
- Position at 0000 UTC
- Position/date at 1200 UTC
- # Storm Number

50°
45°
40°
35°
30°
25°
20°
15°
10°
5°
North
0°
South

50°
45°
40°
35°
30°
25°
20°
15°
10°
5°
0°

90° 85° 80° 75° 70° 65° 60° 55° 50° 45° 40° 35° 30° 25°

2011 ATLANTIC HURRICANE SEASON STATISTICS

NAME	DATES	MIN. PRESS (MB)	MAX. WINDS (MPH)	DIRECT DEATHS	US DAMAGE (\$MIL)
TS ARLENE	29 JUN - 1 JUL	993	65	18	
TS BRET	17 - 22 JUL	995	70		
TS CINDY	20 - 22 JUL	994	70		
TS DON	27 - 30 JUL	997	50		
TS EMILY	1 - 7 AUG	1003	50	3	
TS FRANKLIN	12 - 13 AUG	1004	45		
TS GERT	13 - 16 AUG	1000	65		
TS HARVEY	19 - 22 AUG	994	65	3	
MH IRENE	21 - 28 AUG	942	120 (3)	49	7000
TS JOSE	28 - 29 AUG	1006	45		
MH KATIA	29 AUG - 10 SEP	942	140 (4)		
UNNAMED TS	1 - 2 SEP	1002	45		
TS LEE	2 - 5 SEP	986	60	3	[510]
H MARIA	6 - 16 SEP	983	80 (1)		
H NATE**	7 - 11 SEP	994	75 (1)	4	
MH OPHELIA	21 SEP - 3 OCT	940	140 (4)		
H PHILLIPE	24 SEP - 9 OCT	976	90 (1)		
MH RINA	23 - 28 OCT	966	115 (3)		
TS SEAN	8 - 11 NOV	982	65		

**upgraded to hurricane status in post-analysis

[] = preliminary data

2011 ATLANTIC HURRICANE SEASON STATISTICS

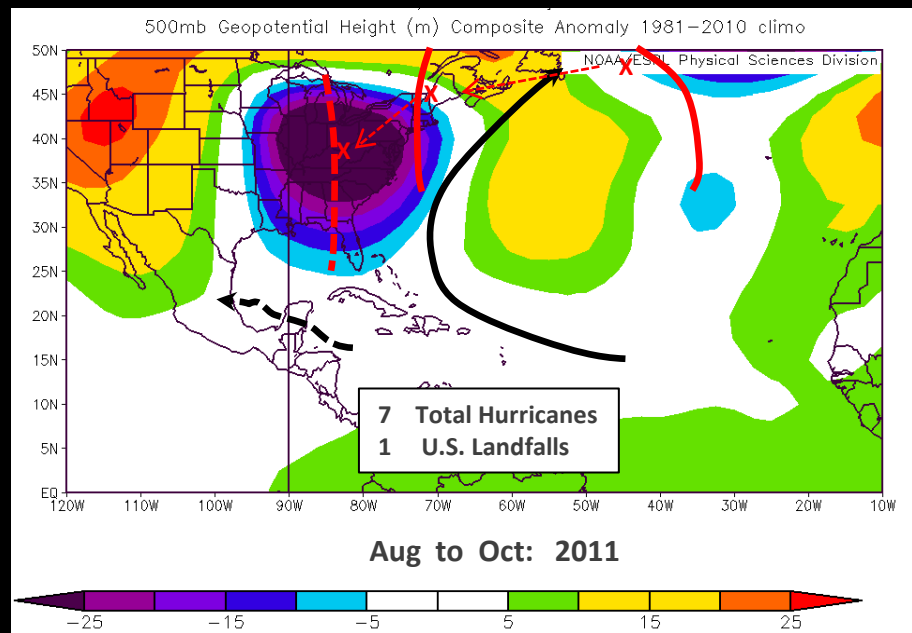
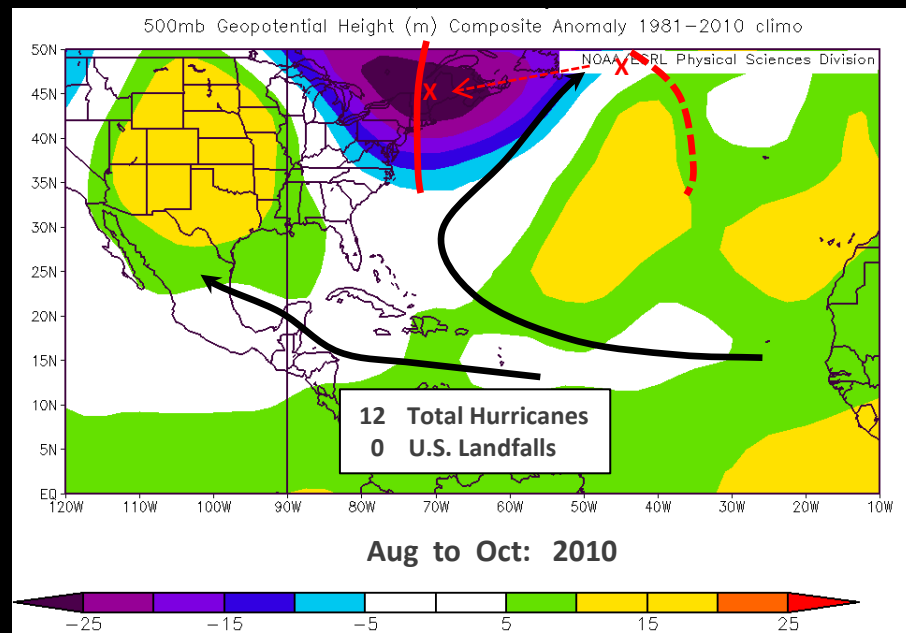
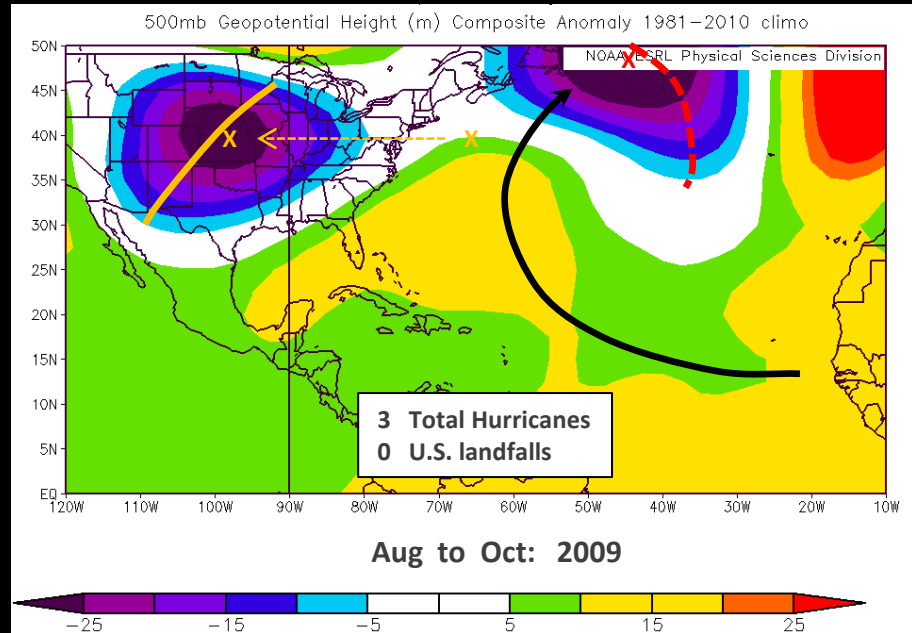
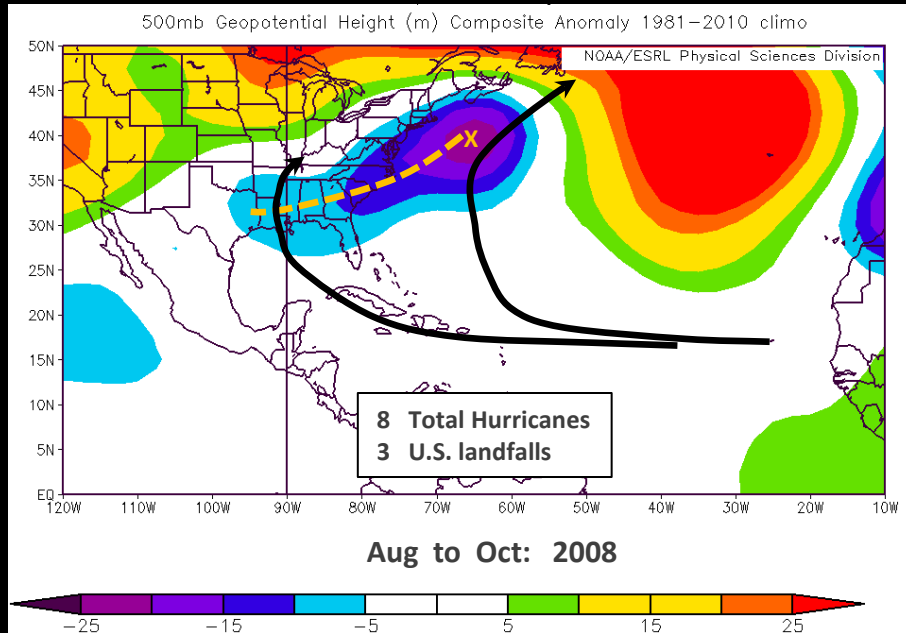
System Type	May Outlook	August Update	Actual Activity
Tropical Cyclone			20
Named Storms	12 - 18	14 - 19	19
Hurricanes	6 - 10	7 - 10	7
Major Hurricanes	3 - 6	3 - 5	4



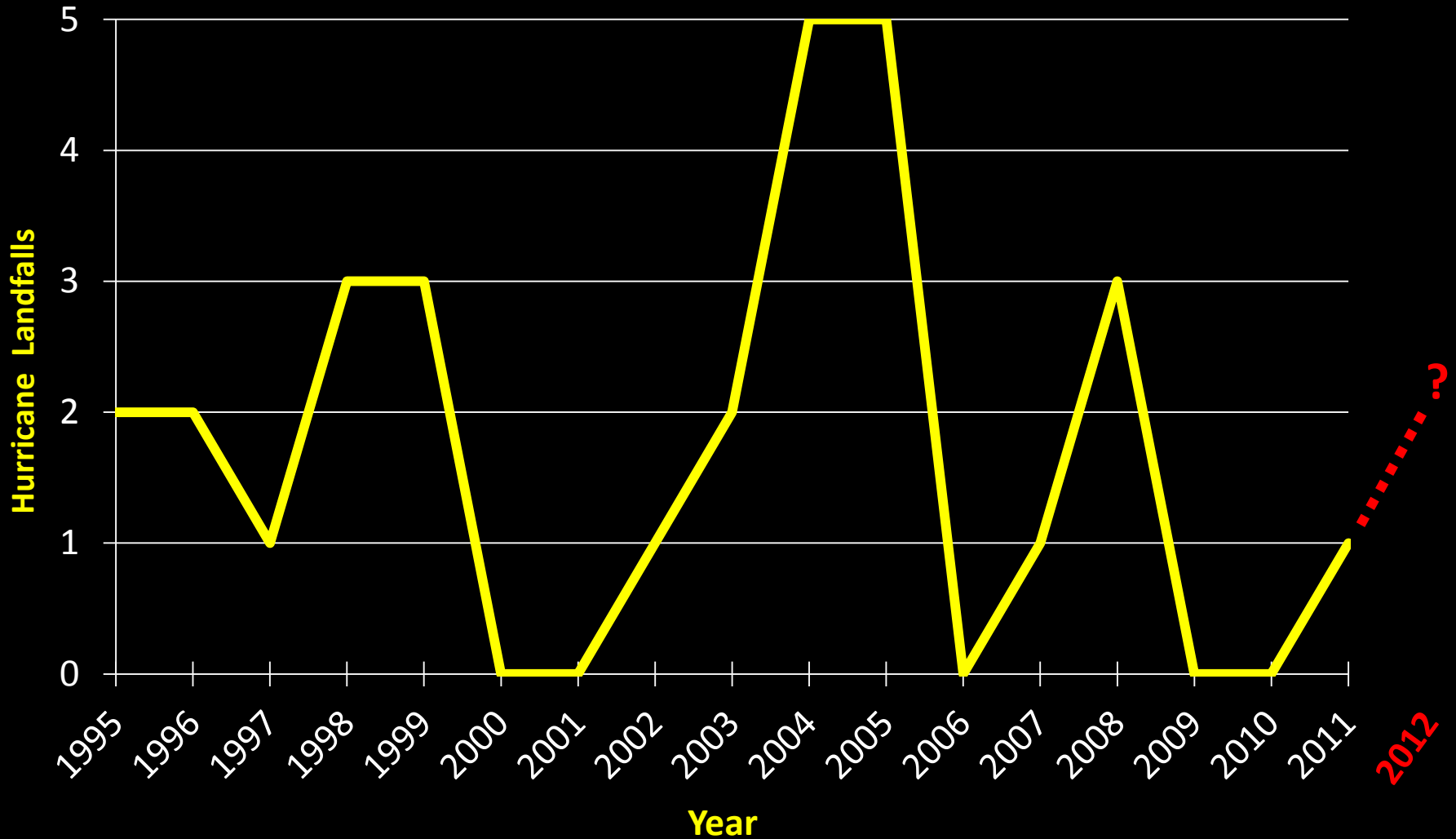
2011 Season Facts

- **19 tropical storms, 7 of which became hurricanes, including 4 major hurricanes:**
 - Above the long-term averages of 11/6/2
 - Four major hurricanes is twice the long-term average
 - One additional tropical depression (25-26 August)
- Tied with 1995 and 2010 for third-highest total number of named storms.
- The Accumulated Cyclone Energy (ACE) index for the season was **137%** of the long-term median -- an 'above-average' season, but not 'hyperactive'.
- Three tropical cyclone landfalls in the U.S. – Irene was first landfalling-hurricane in 3 years (2008 had three landfalls), plus TS Don and TS Lee.
- Only 6 of the 20 tropical cyclones lasted for 120 hours or longer -- i.e., a "season of quantity...not quality".
- One non-tropical cyclone near Melbourne, FL that produced damaging winds and a MSLP of approximately 995 mb; system was not added to historical database.

Westward Shift In Mean Steering Flow -- 2008 to 2011

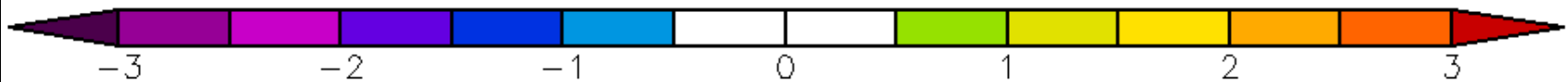
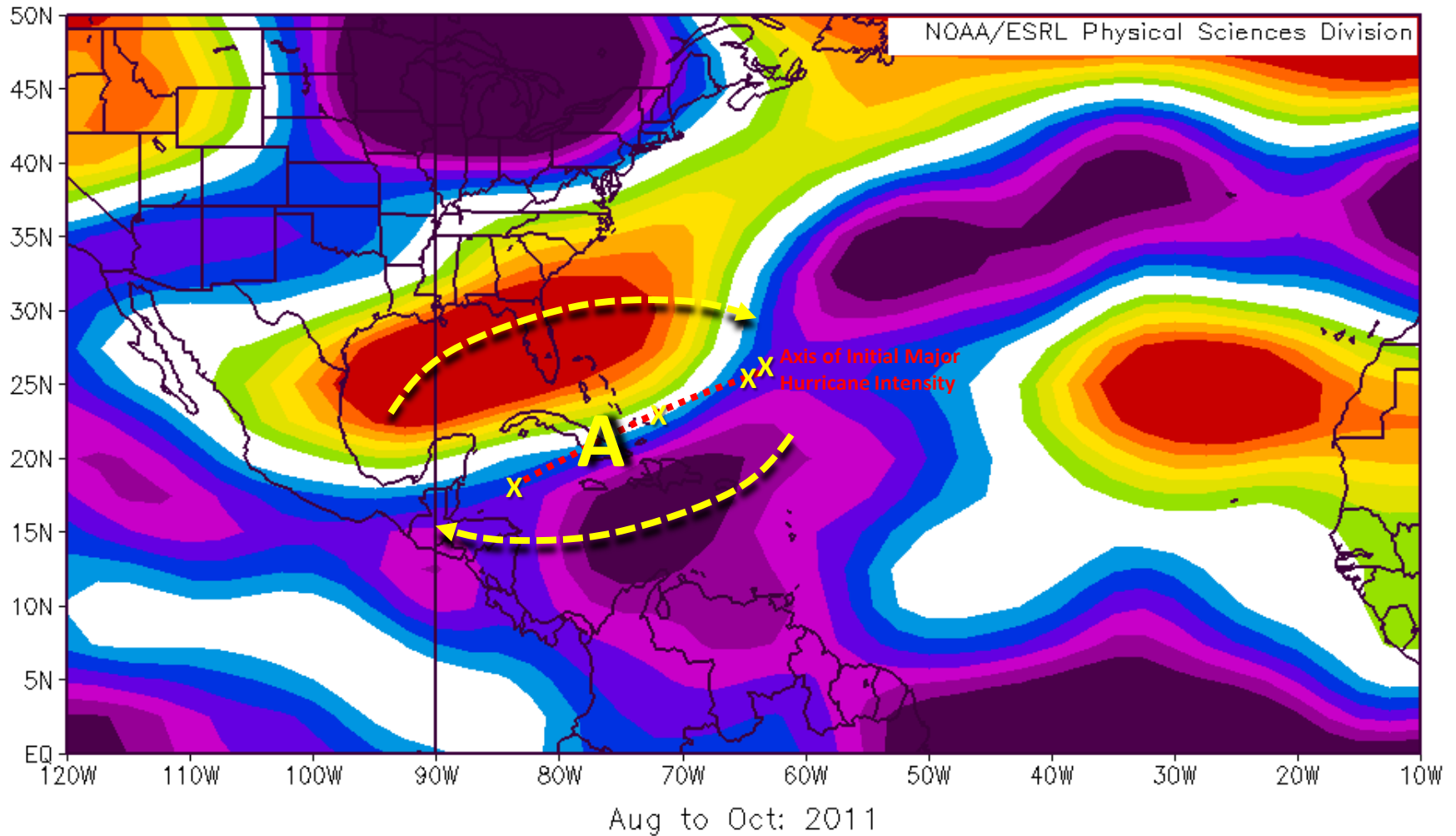


U.S. Hurricane Landfalls Since 1995



Favorable 200 mb Anticyclonic Gyre Over Greater Antilles

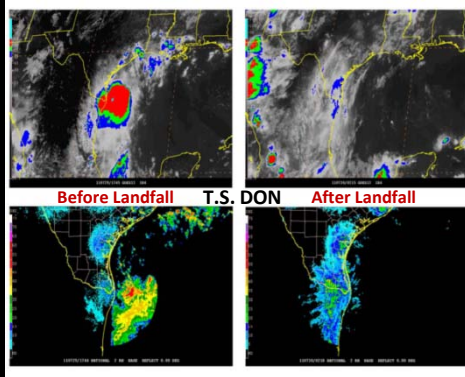
200mb Zonal Wind (m/s) Composite Anomaly 1981–2010 climo



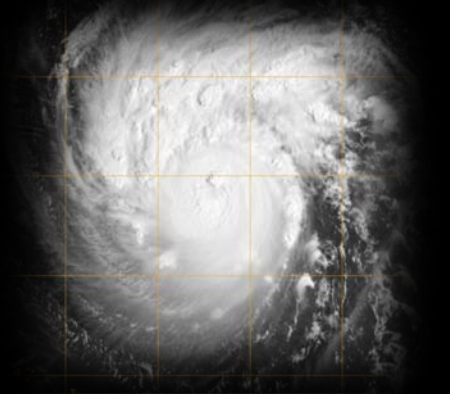


Forecast Challenges in 2011

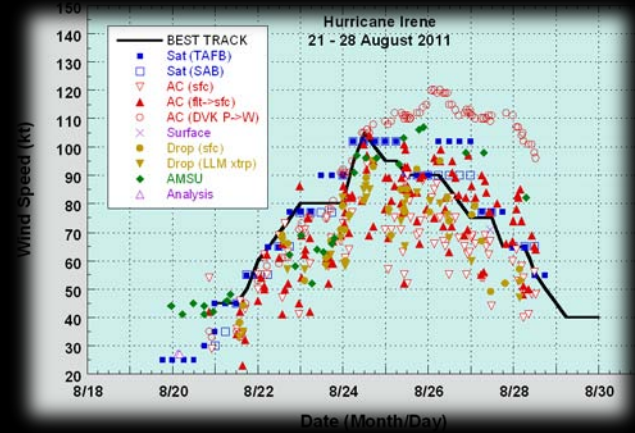
Rapid Weakening After Landfall



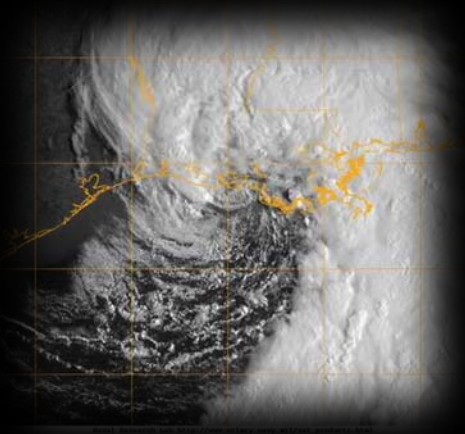
Stronger than Dvorak estimates



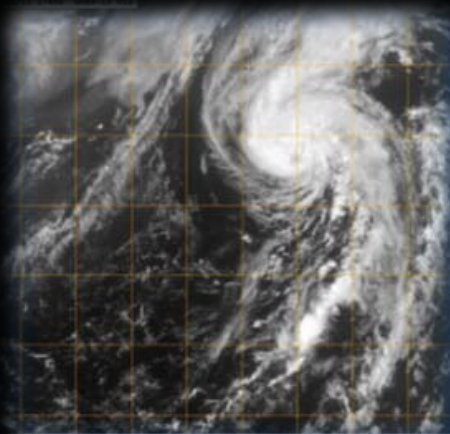
Atypical Pressure-Wind Relationships



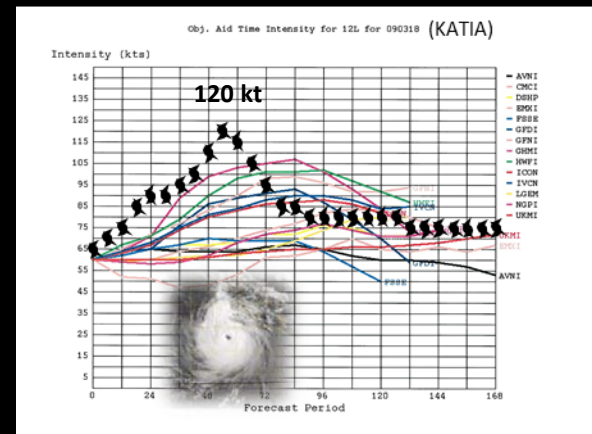
Classification TS or ST?



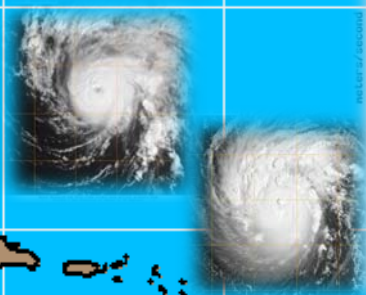
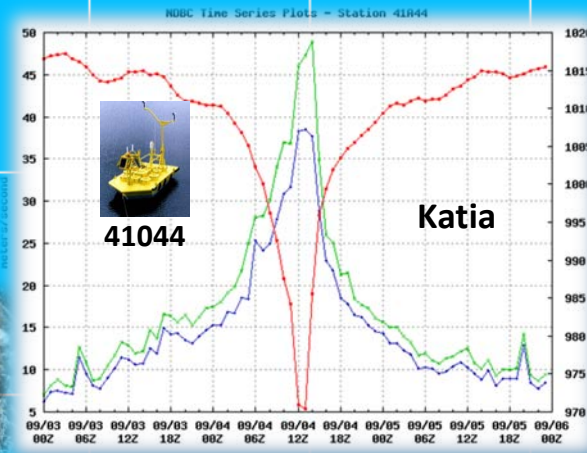
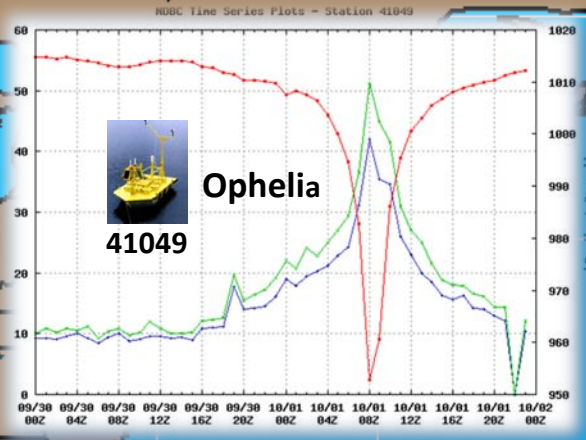
Unexpected Genesis



Rapid Intensification/Weakening

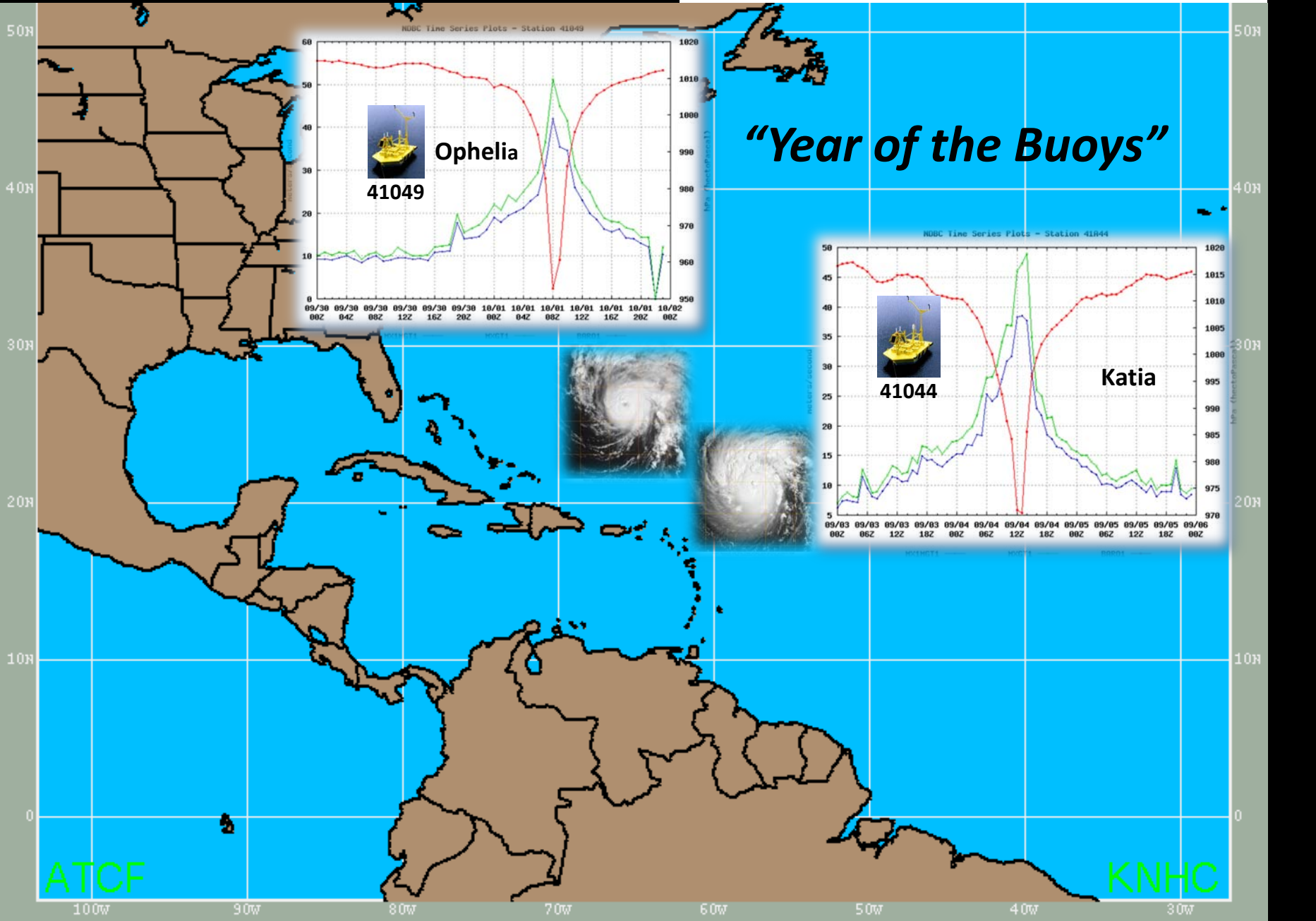


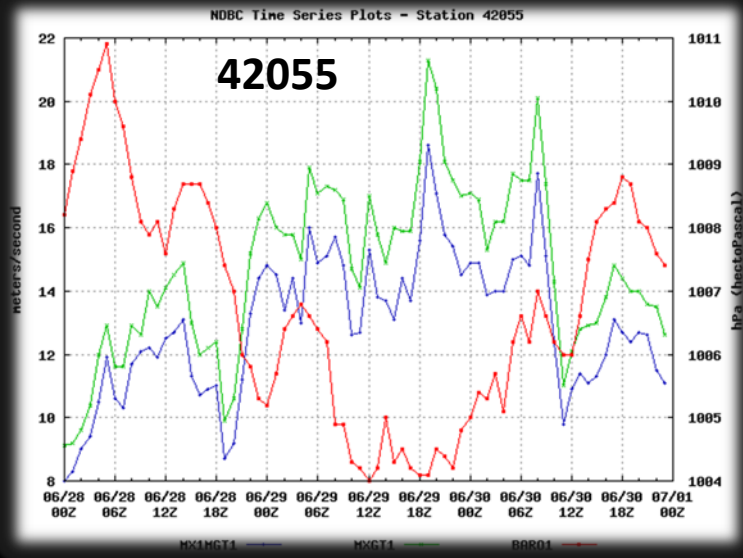
"Year of the Buoys"



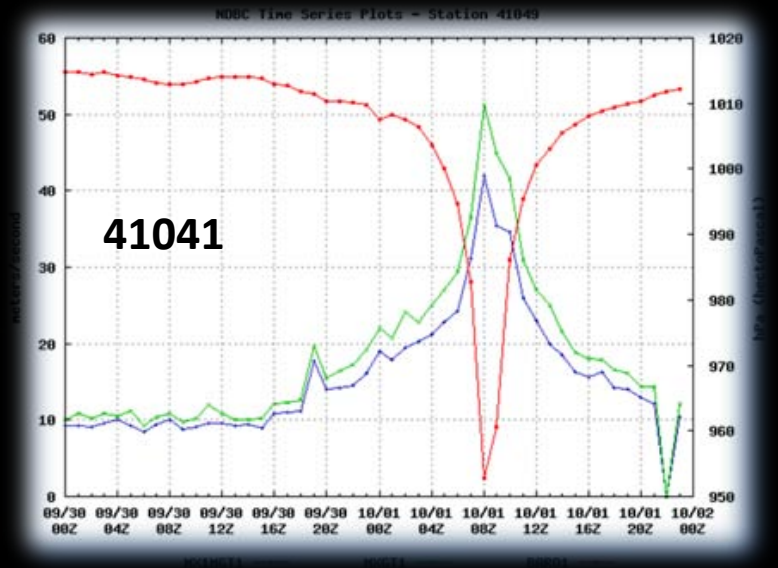
ATCF

KNHC

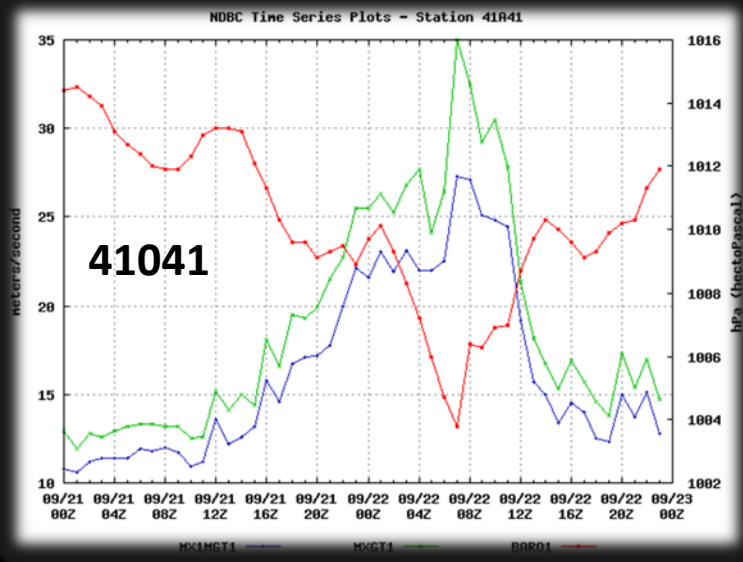




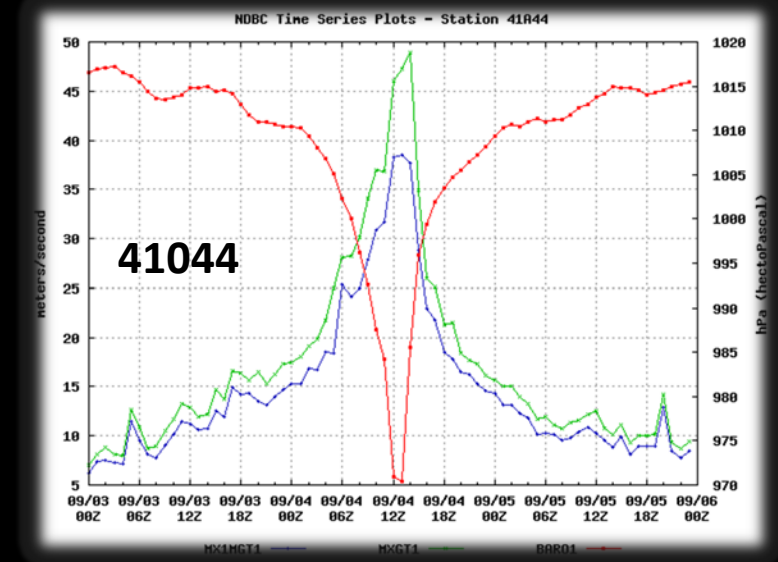
Arlene



Ophelia



Maria



Katia

Cindy (unexpected genesis)

ABNT20 KNHC 191736
TWOAT

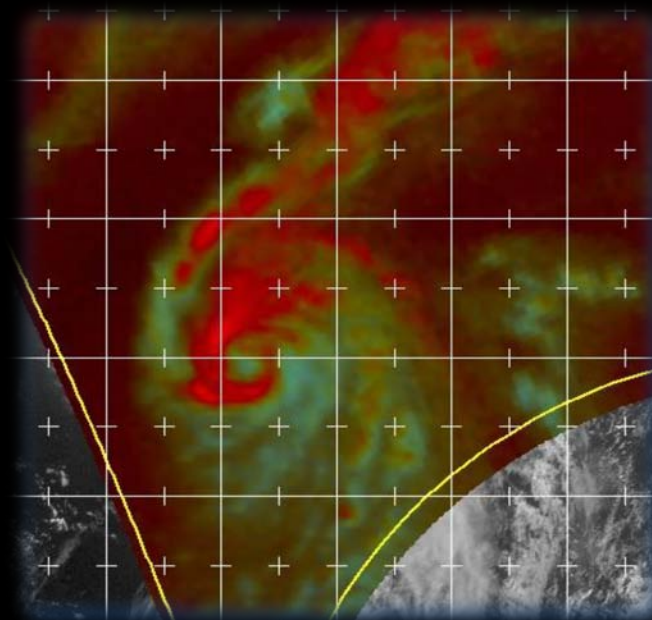
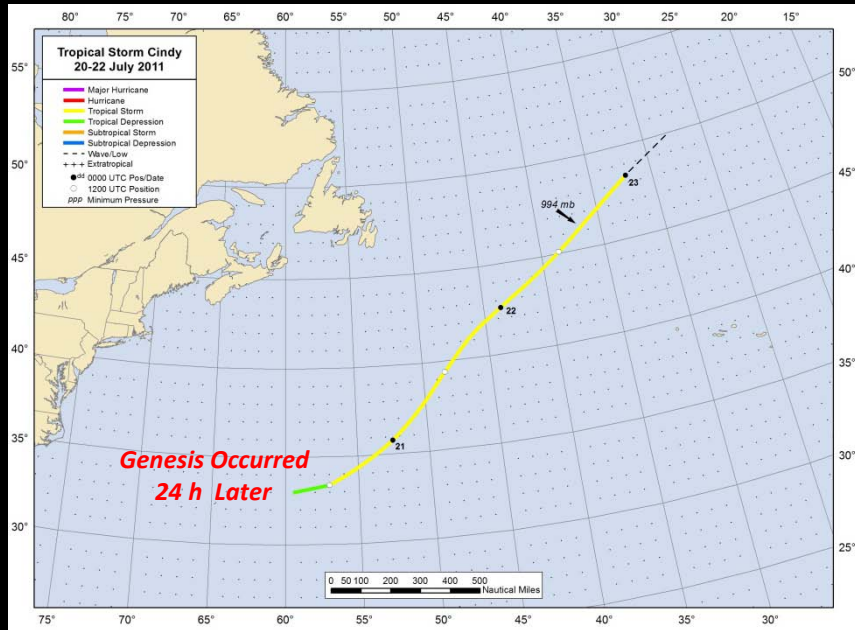
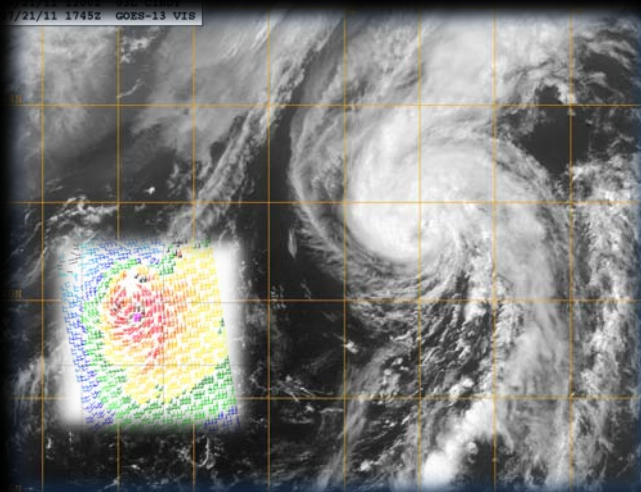
TROPICAL WEATHER OUTLOOK
NWS NATIONAL HURRICANE CENTER MIAMI FL
200 PM EDT TUE JUL 19 2011

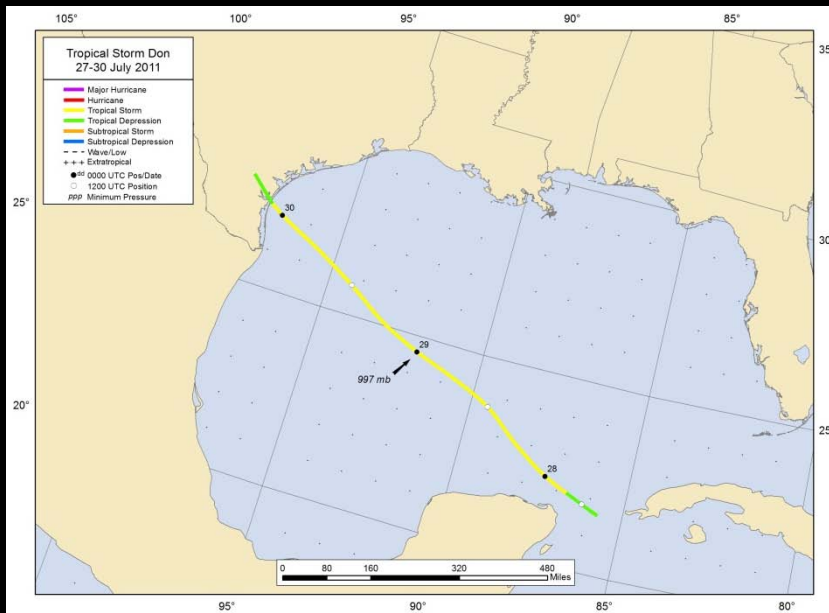
FOR THE NORTH ATLANTIC...CARIBBEAN SEA AND THE GULF OF MEXICO...

THE NATIONAL HURRICANE CENTER IS ISSUING ADVISORIES ON TROPICAL STORM BRET...LOCATED ABOUT 365 MILES SOUTH OF CAPE HATTERAS NORTH CAROLINA.

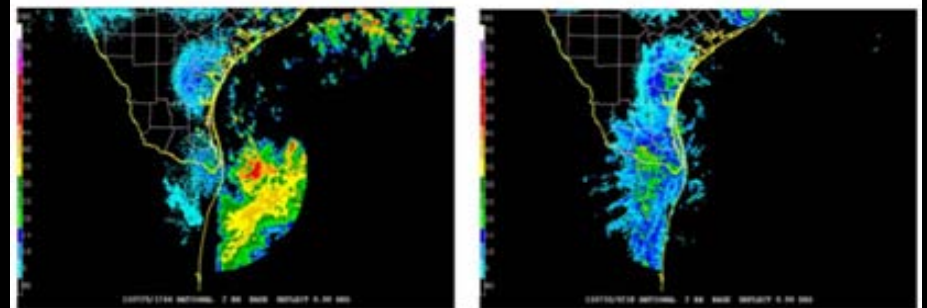
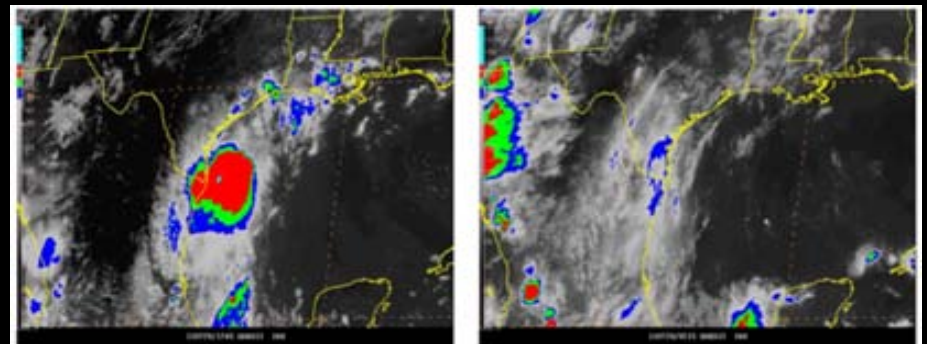
ELSEWHERE...TROPICAL CYCLONE FORMATION IS NOT EXPECTED DURING THE NEXT 48 HOURS.

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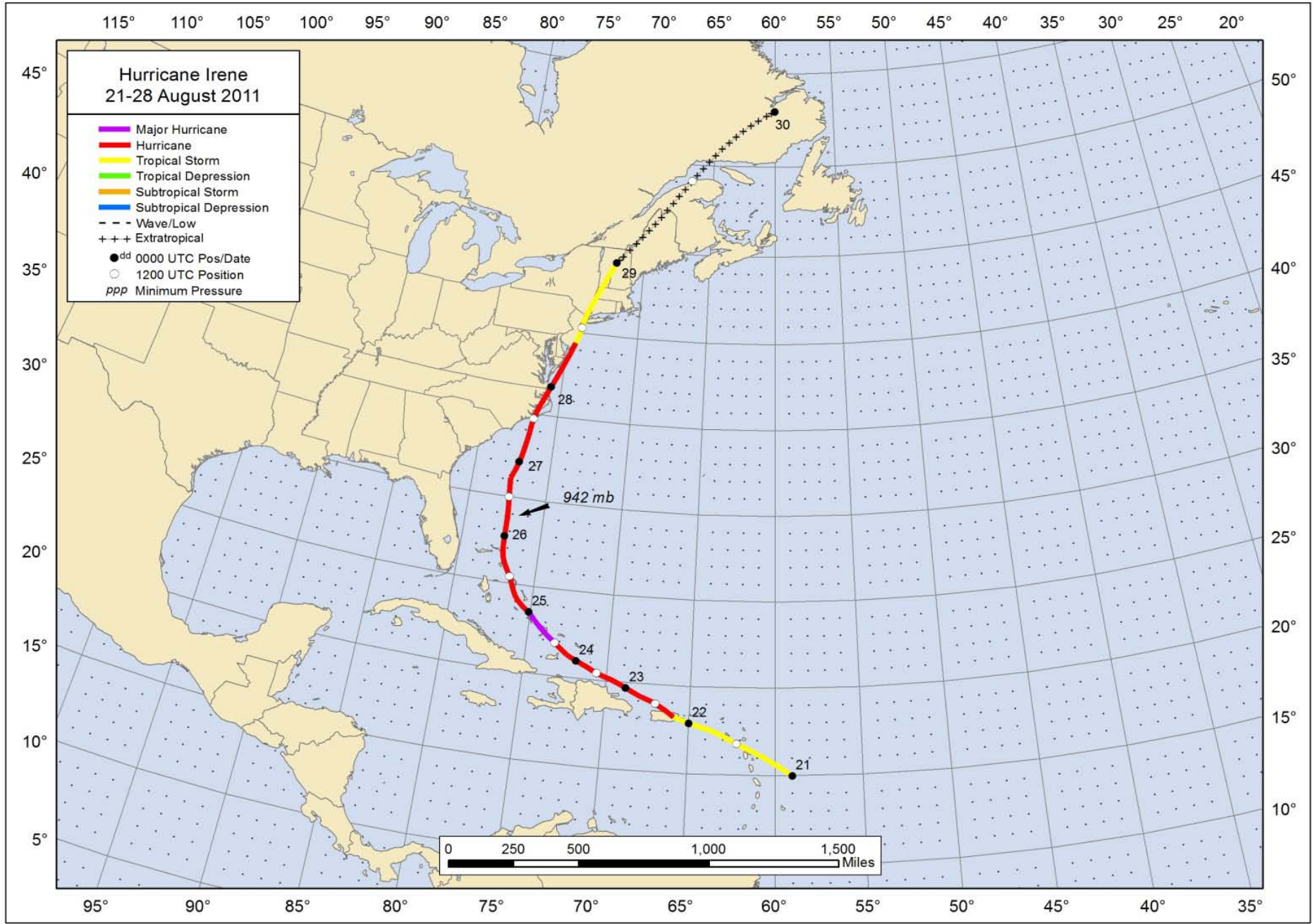


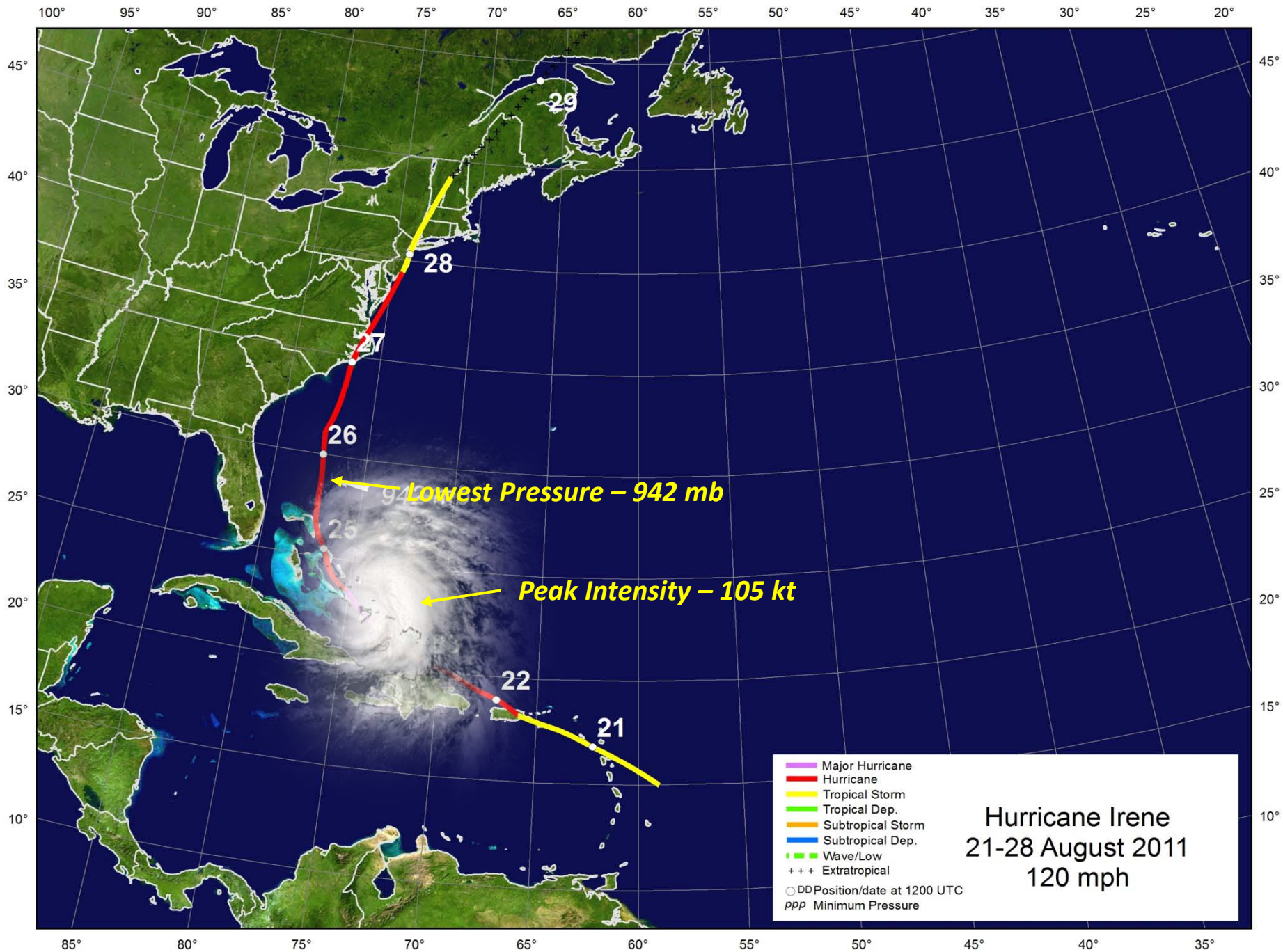
**Tropical Storm Don --
Basically Evaporated
Immediately After
Landfall!**

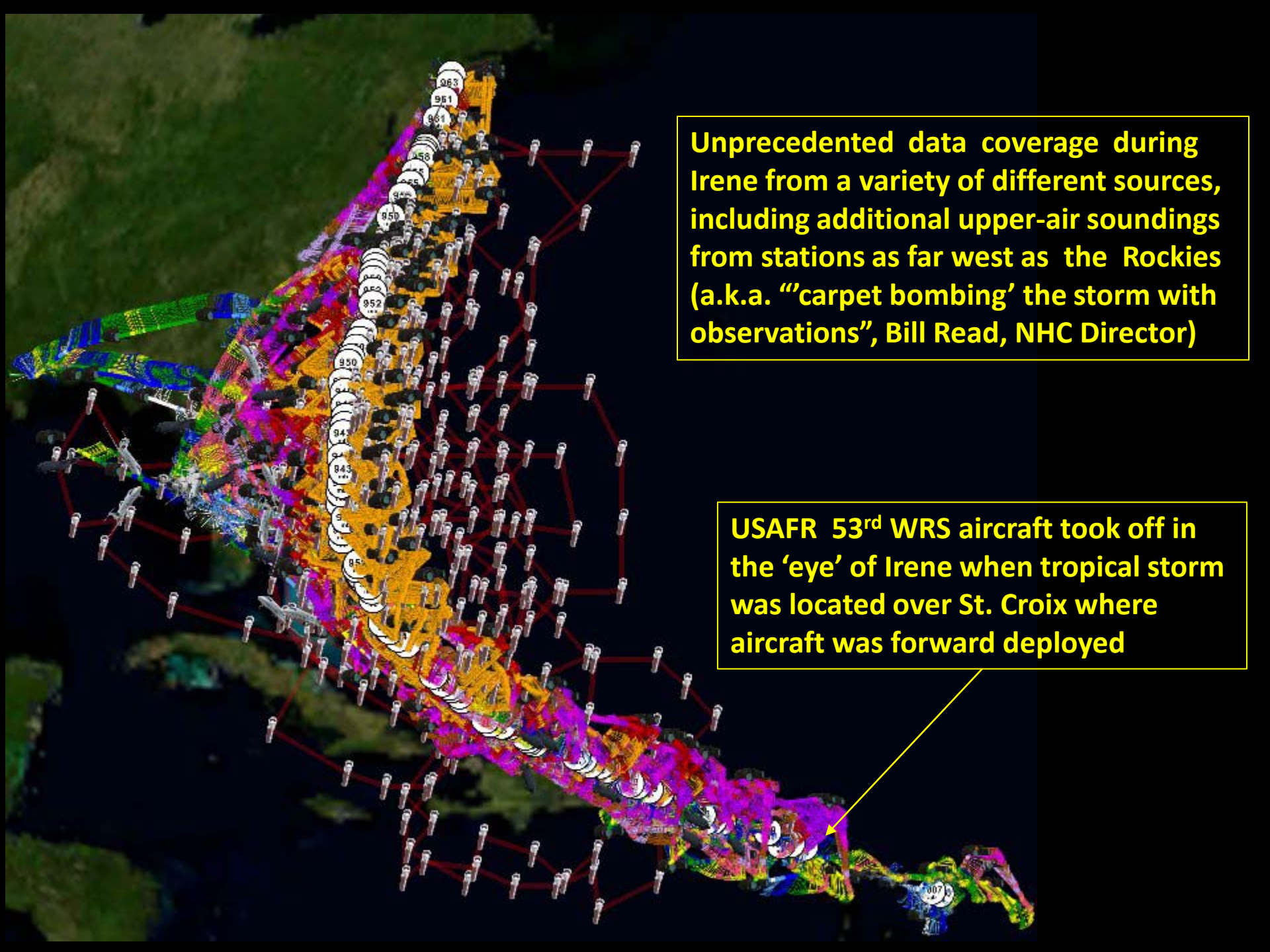


Before Landfall

6h After Landfall



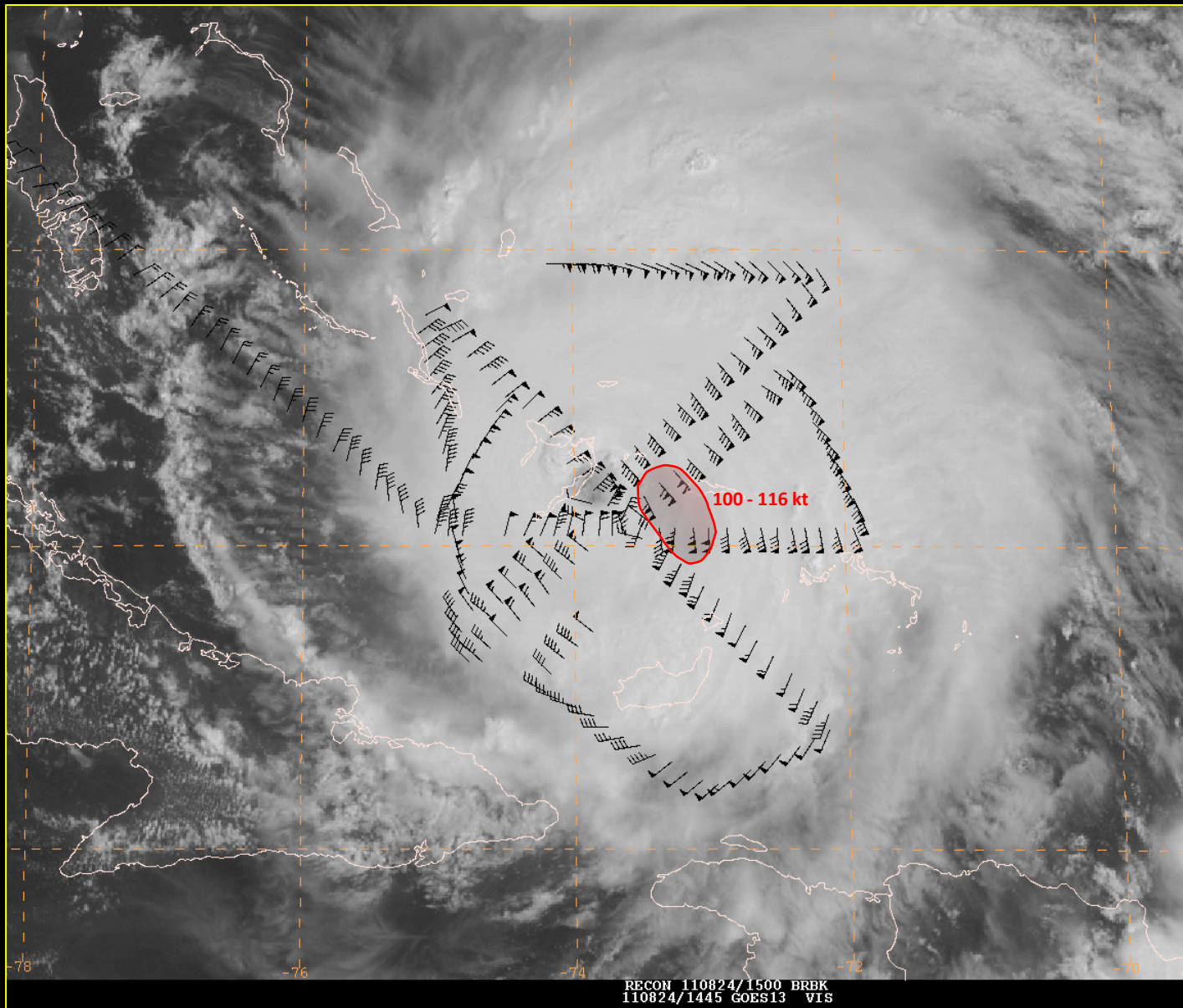


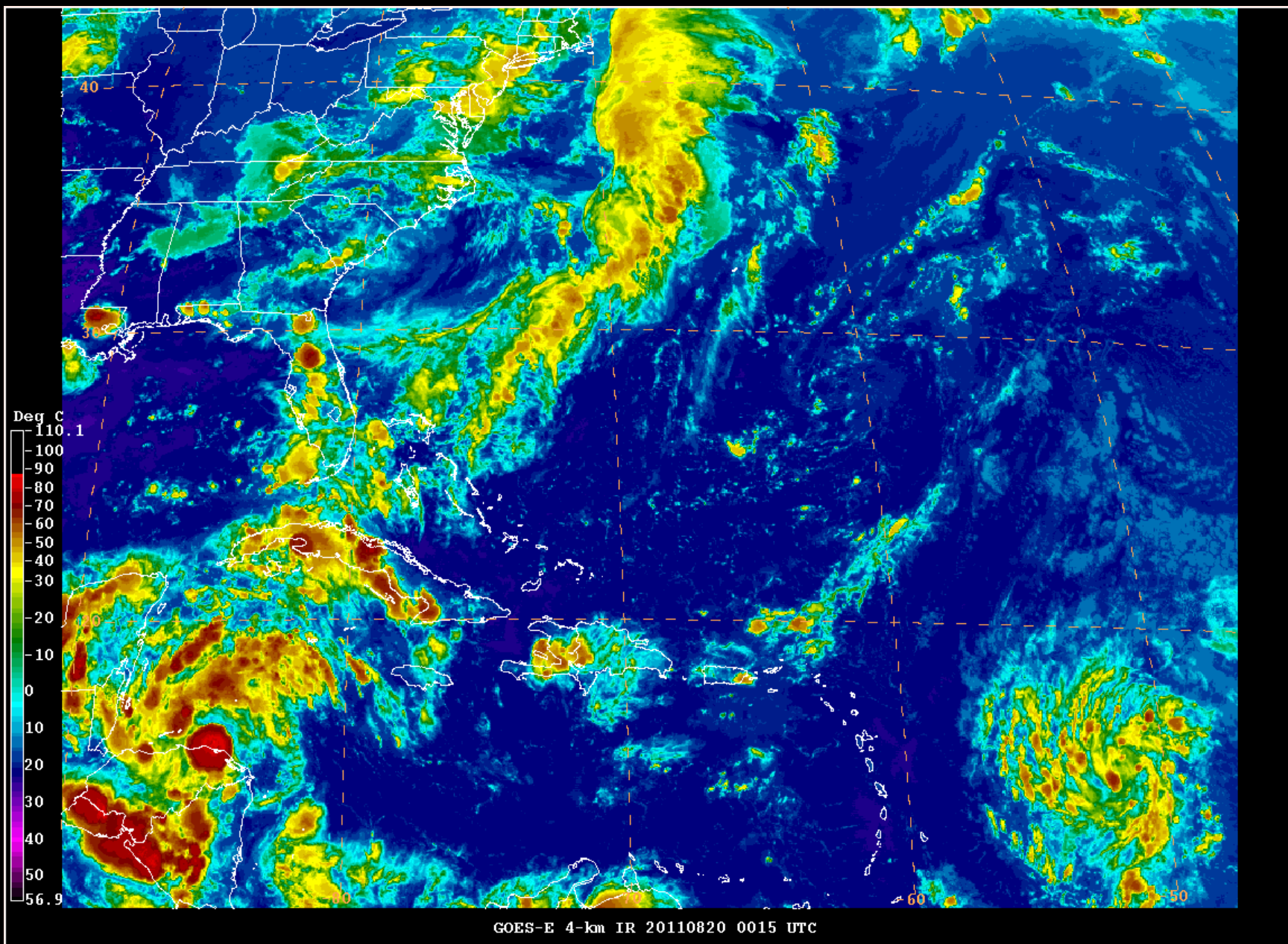


Unprecedented data coverage during Irene from a variety of different sources, including additional upper-air soundings from stations as far west as the Rockies (a.k.a. “carpet bombing’ the storm with observations”, Bill Read, NHC Director)

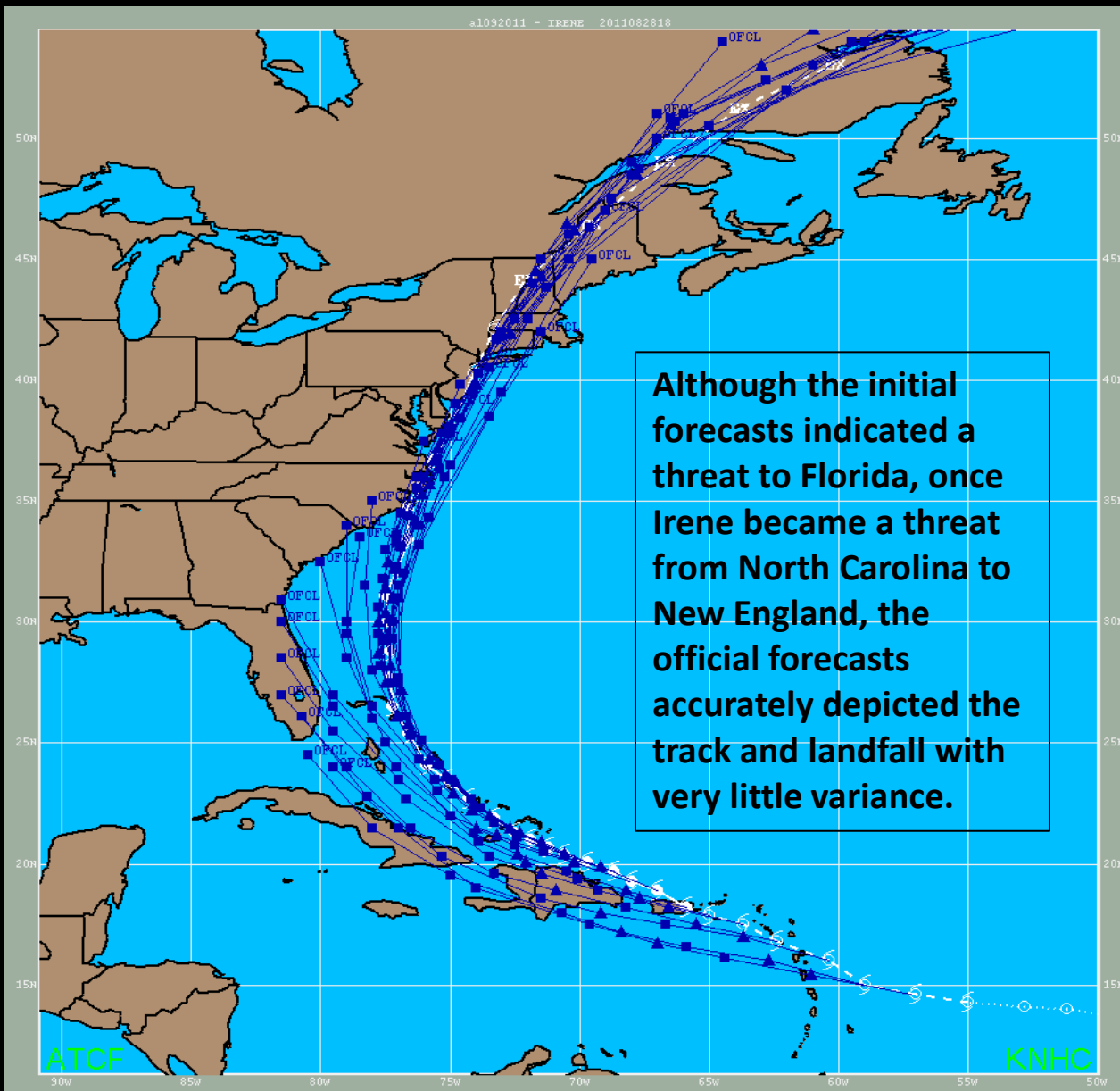
USAFR 53rd WRS aircraft took off in the ‘eye’ of Irene when tropical storm was located over St. Croix where aircraft was forward deployed

Reconnaissance aircraft's flight track during Irene's peak intensity

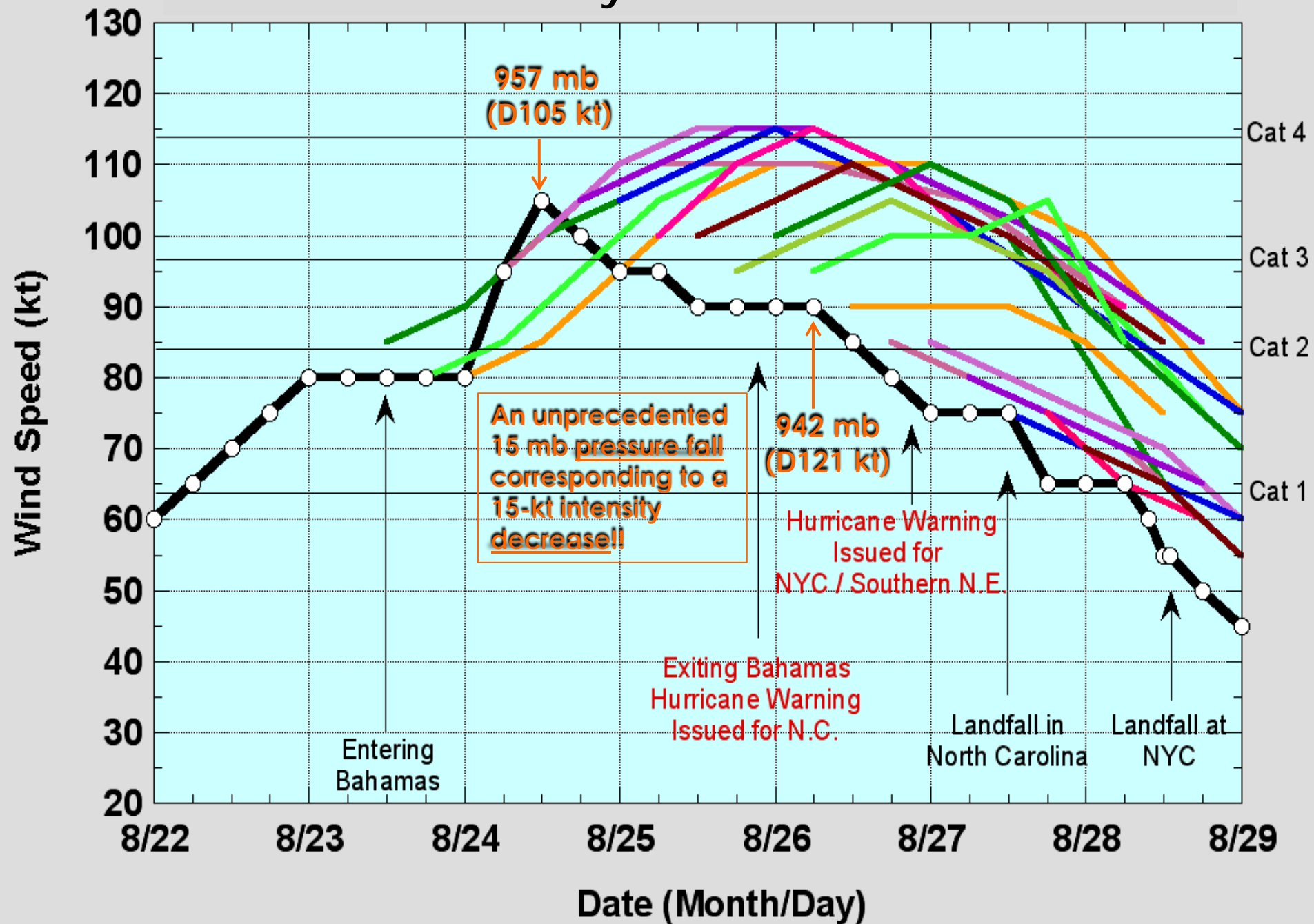




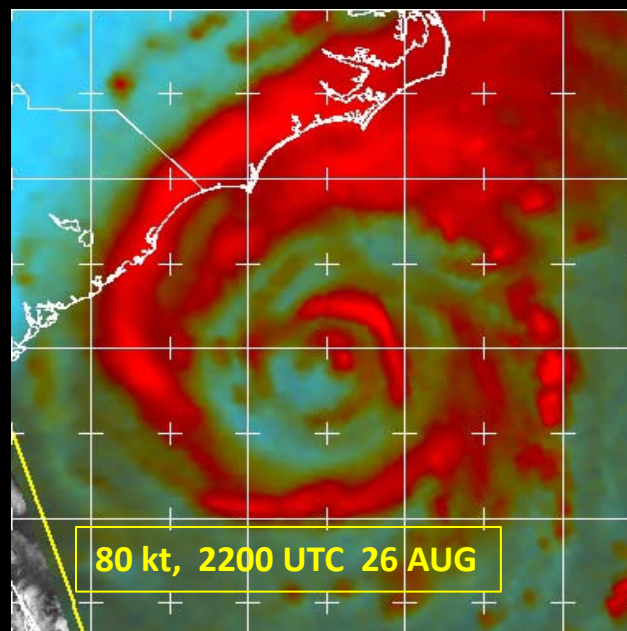
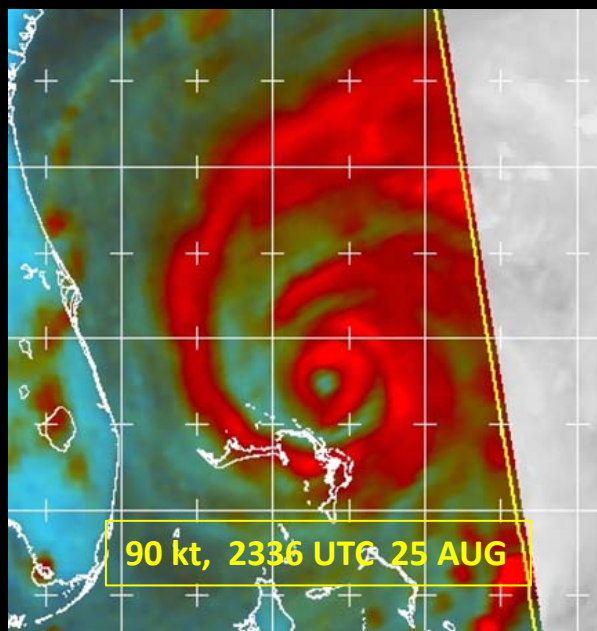
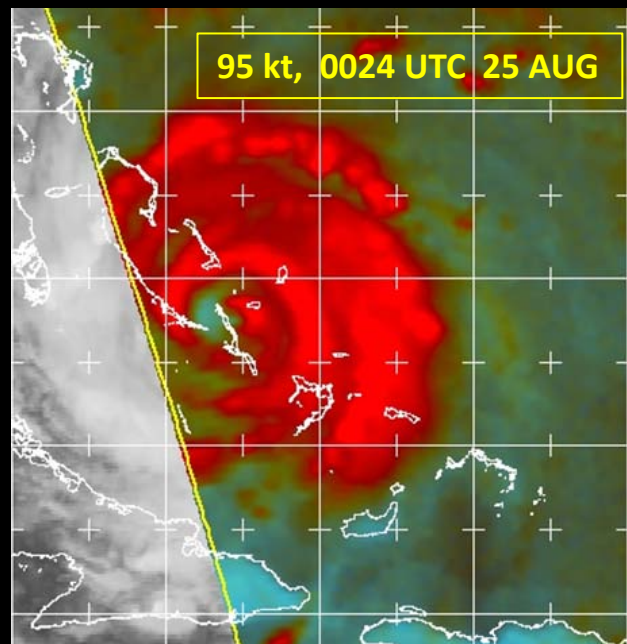
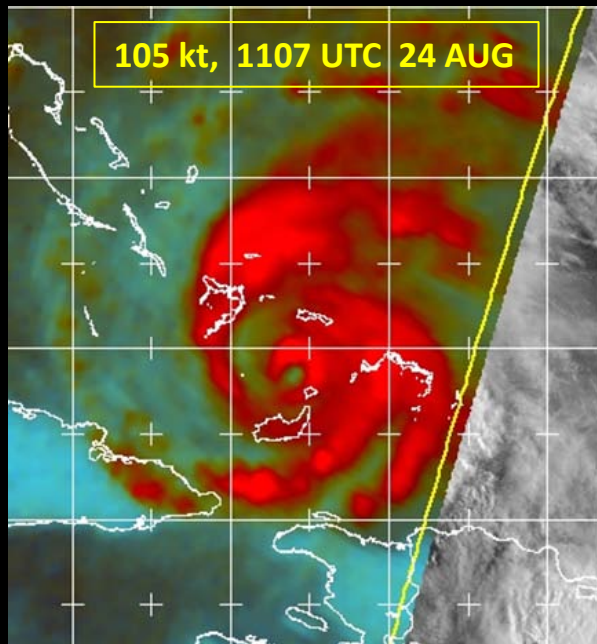
NHC Official Track Forecasts

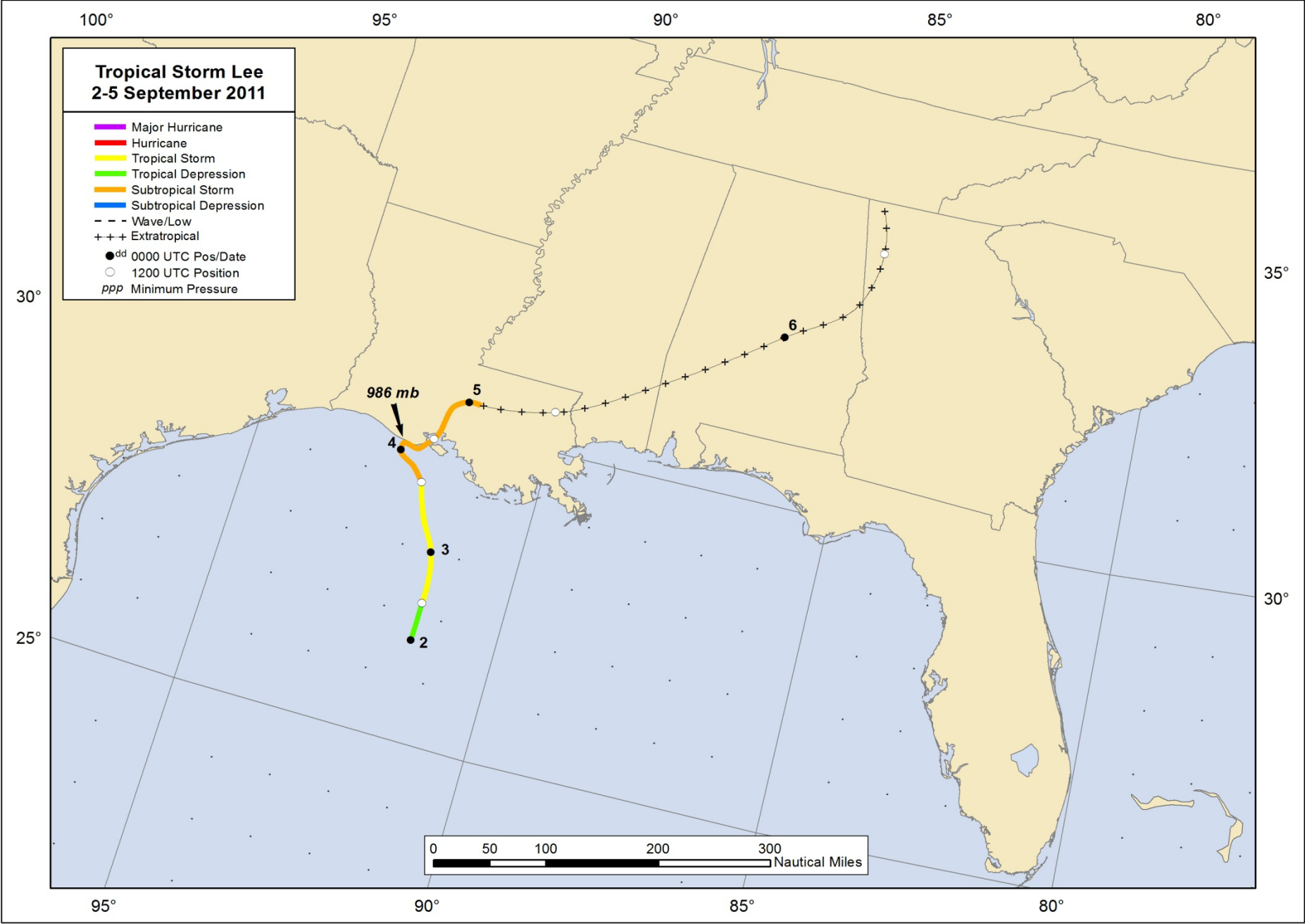


NHC Official Intensity Forecasts – Hurricane Irene



Hurricane Irene Structural Changes





**Tropical Storm Lee
2-5 September 2011**

- Major Hurricane
- Hurricane
- Tropical Storm
- Tropical Depression
- Subtropical Storm
- Subtropical Depression
- Wave/Low
- Extratropical
- dd 0000 UTC Pos/Date
- 1200 UTC Position
- ppp Minimum Pressure

986 mb

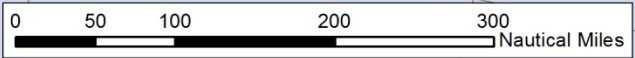
4

5

6

3

2



95° 90° 85° 80°

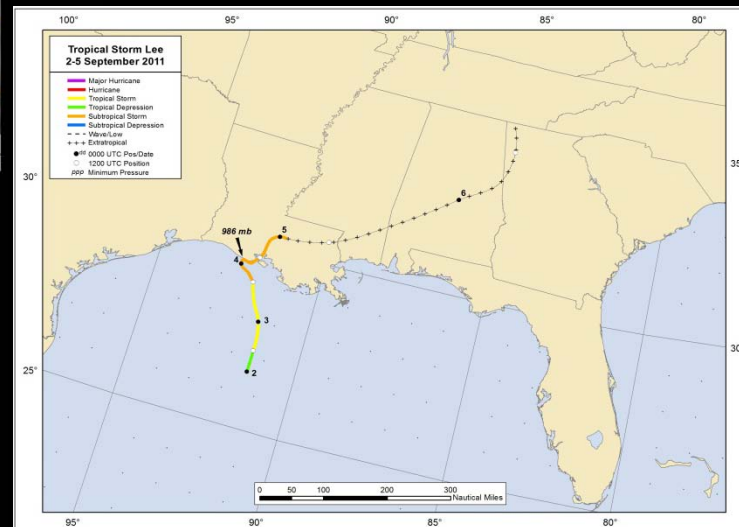
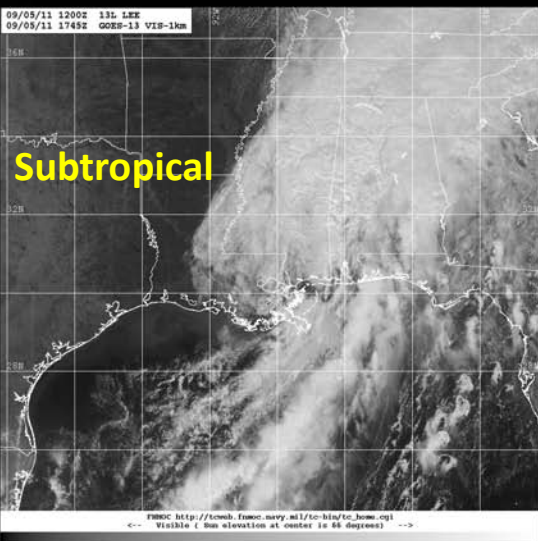
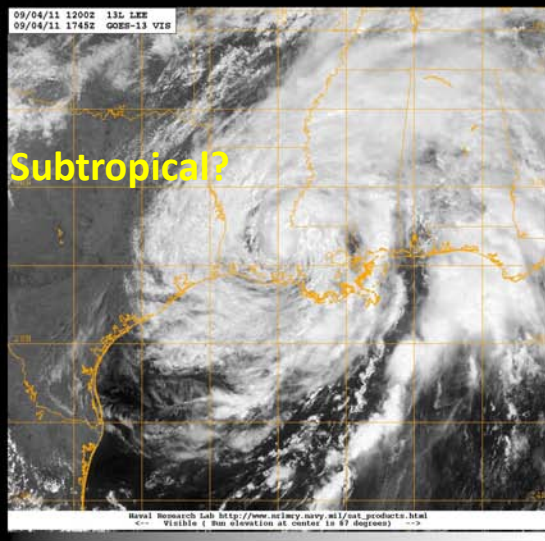
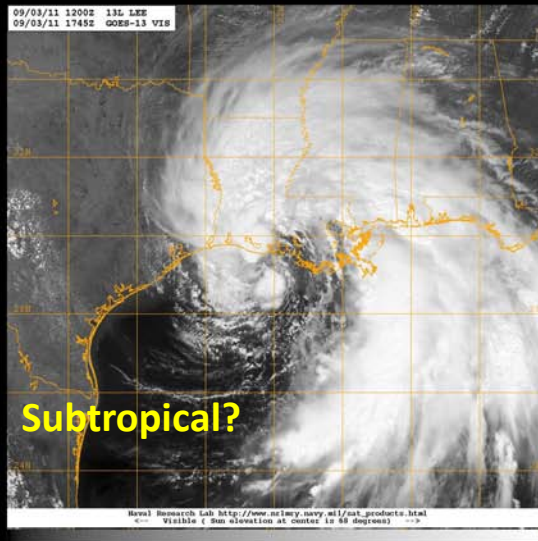
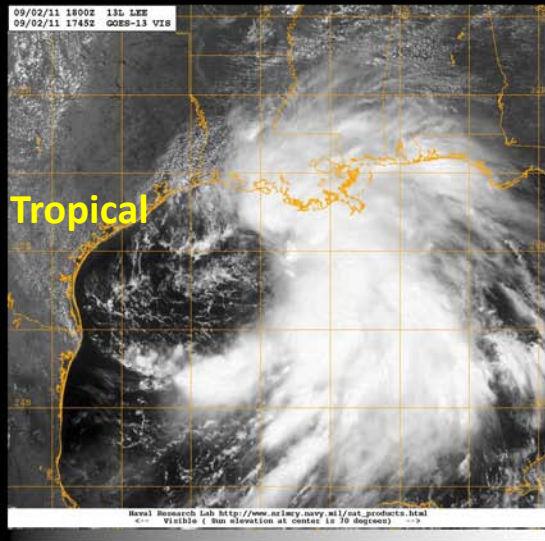
30°

25°

35°

30°

Evolution of Lee from tropical to subtropical cyclone



100°

95°

90°

20°

25°

20°

15°

95°

90°

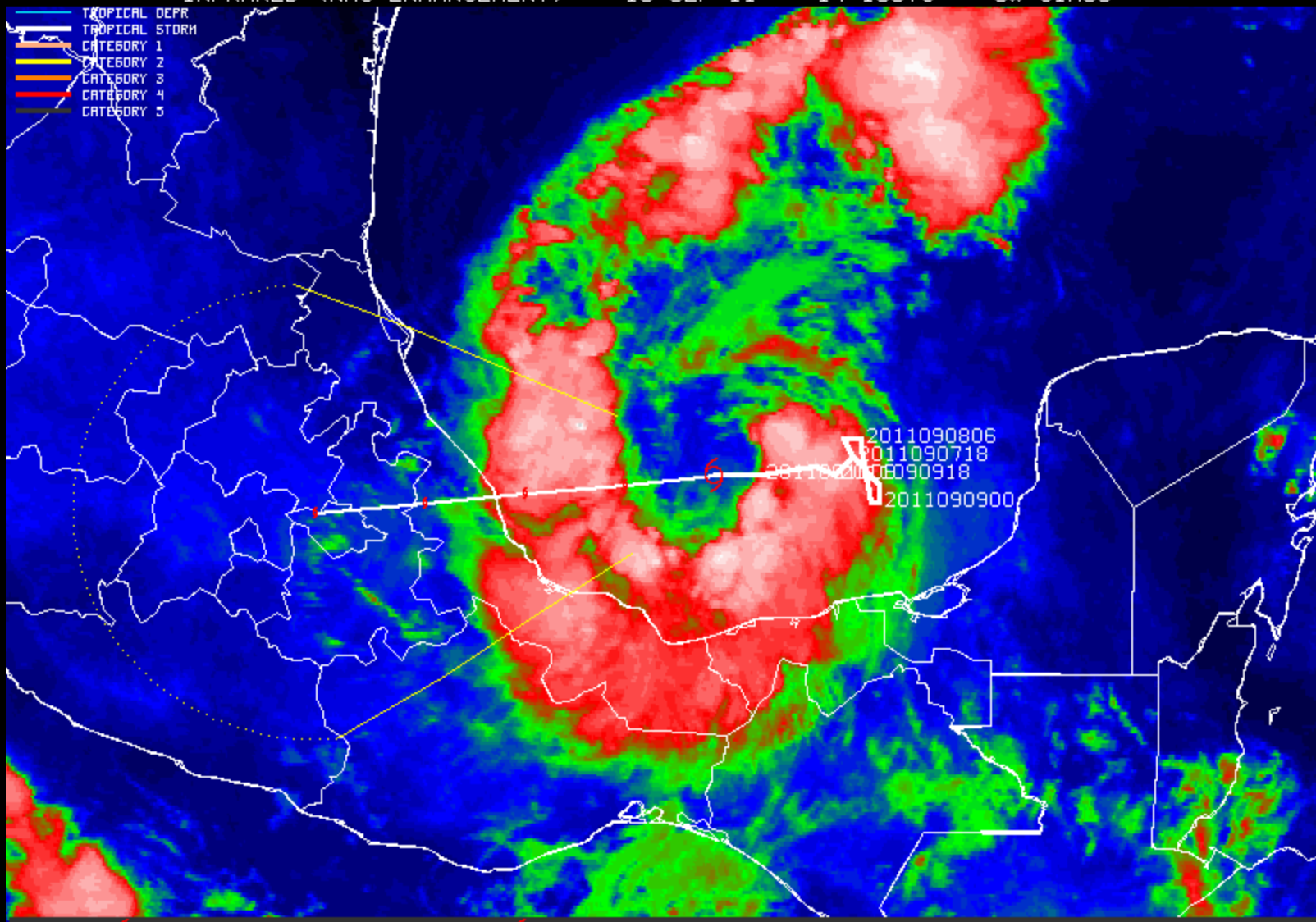
**Upgraded to hurricane status
in post-storm analysis based
on 1-minute sustained wind of
67 kt (adjusted) received from
PEMEX oil rig after the event**



	Major Hurricane
	Hurricane
	Tropical Storm
	Tropical Dep.
	Subtropical Storm
	Subtropical Dep.
	Wave/Low
	Extratropical
	DD Position/date at 1200 UTC
	Minimum Pressure

Hurricane Nate
7-11 September 2011
75 mph

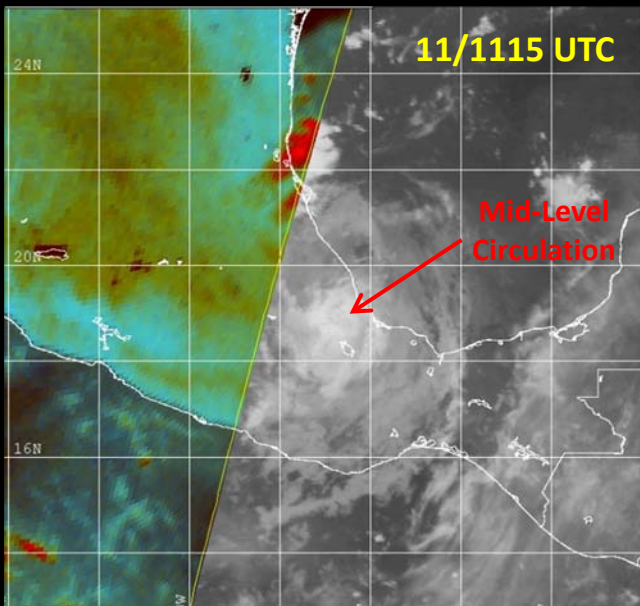
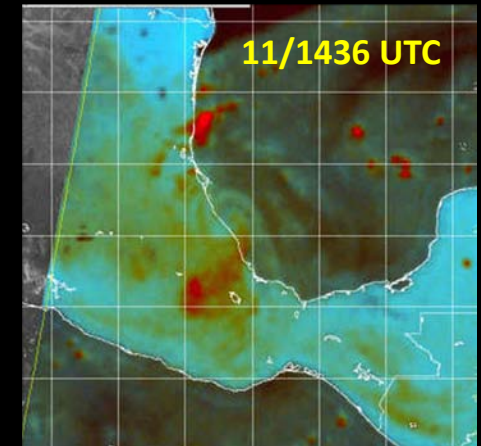
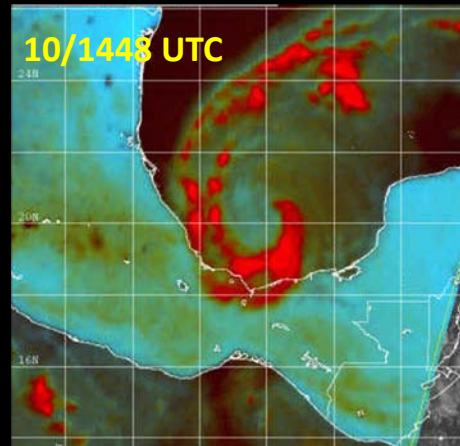
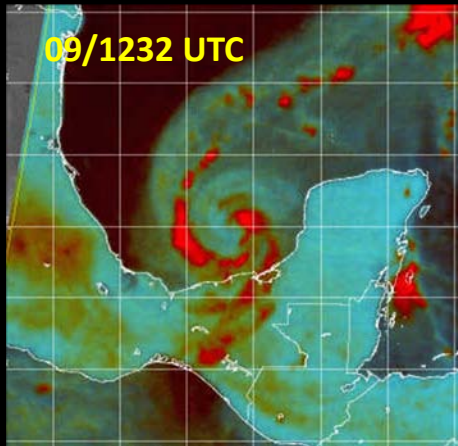
- TROPICAL DEPR
- TROPICAL STORM
- CATEGORY 1
- CATEGORY 2
- CATEGORY 3
- CATEGORY 4
- CATEGORY 5



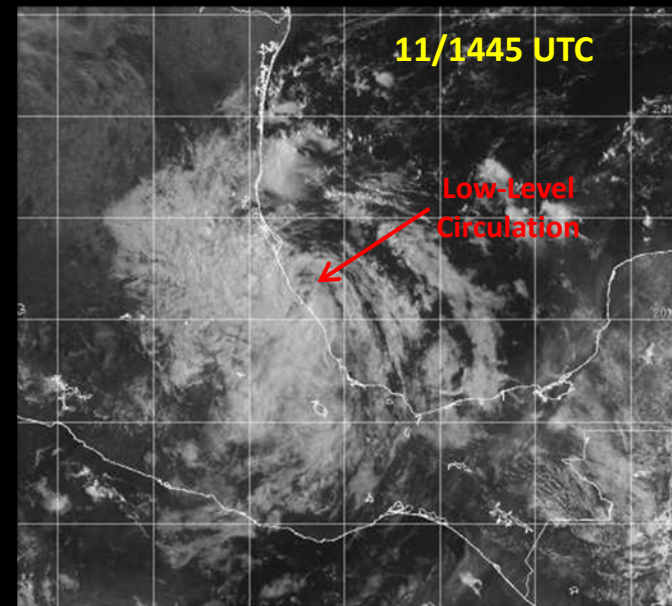
Legend : - Hurricane/Typhoon (w/category) - Tropical Storm - Tropical Depression - Invest Area

Forecast Time : 10SEP2011/12:00UTC (source:NOAA/TPC) McIDAS

Evolution of Nate



Difference between low- and mid-level circulations resulted in premature landfall declaration



BULLETIN
TROPICAL STORM NATE ADVISORY NUMBER 14
NWS NATIONAL HURRICANE CENTER MIAMI FL AL152011
1000 PM CDT SAT SEP 10 2011

...NATE EXPECTED TO BE A HURRICANE BEFORE LANDFALL ON SUNDAY...

BULLETIN
TROPICAL STORM NATE INTERMEDIATE ADVISORY NUMBER 14A
NWS NATIONAL HURRICANE CENTER MIAMI FL AL152011
100 AM CDT SUN SEP 11 2011

...NATE IS NOT STRENGTHENING...EXPECTED TO MAKE LANDFALL OVER SOUTHERN MEXICO LATER TODAY...

BULLETIN
TROPICAL STORM NATE ADVISORY NUMBER 15
NWS NATIONAL HURRICANE CENTER MIAMI FL AL152011
400 AM CDT SUN SEP 11 2011

...NATE WEAKENS A LITTLE...EXPECTED TO MAKE LANDFALL OVER SOUTHERN MEXICO LATER TODAY...

BULLETIN
TROPICAL STORM NATE INTERMEDIATE ADVISORY NUMBER 15A
NWS NATIONAL HURRICANE CENTER MIAMI FL AL152011
700 AM CDT SUN SEP 11 2011

...NATE MAKING LANDFALL JUST NORTH OF VERACRUZ...

TROPICAL STORM NATE
TROPICAL CYCLONE UPDATE
NWS NATIONAL HURRICANE CENTER MIAMI FL AL152011
800 AM CDT SUN SEP 11 2011

...VISIBLE SATELLITE IMAGERY SUGGESTS THAT NATE IS LOCATED FARTHER NORTH...
ABOUT TO MAKE LANDFALL BETWEEN VERACRUZ AND TUXPAN...

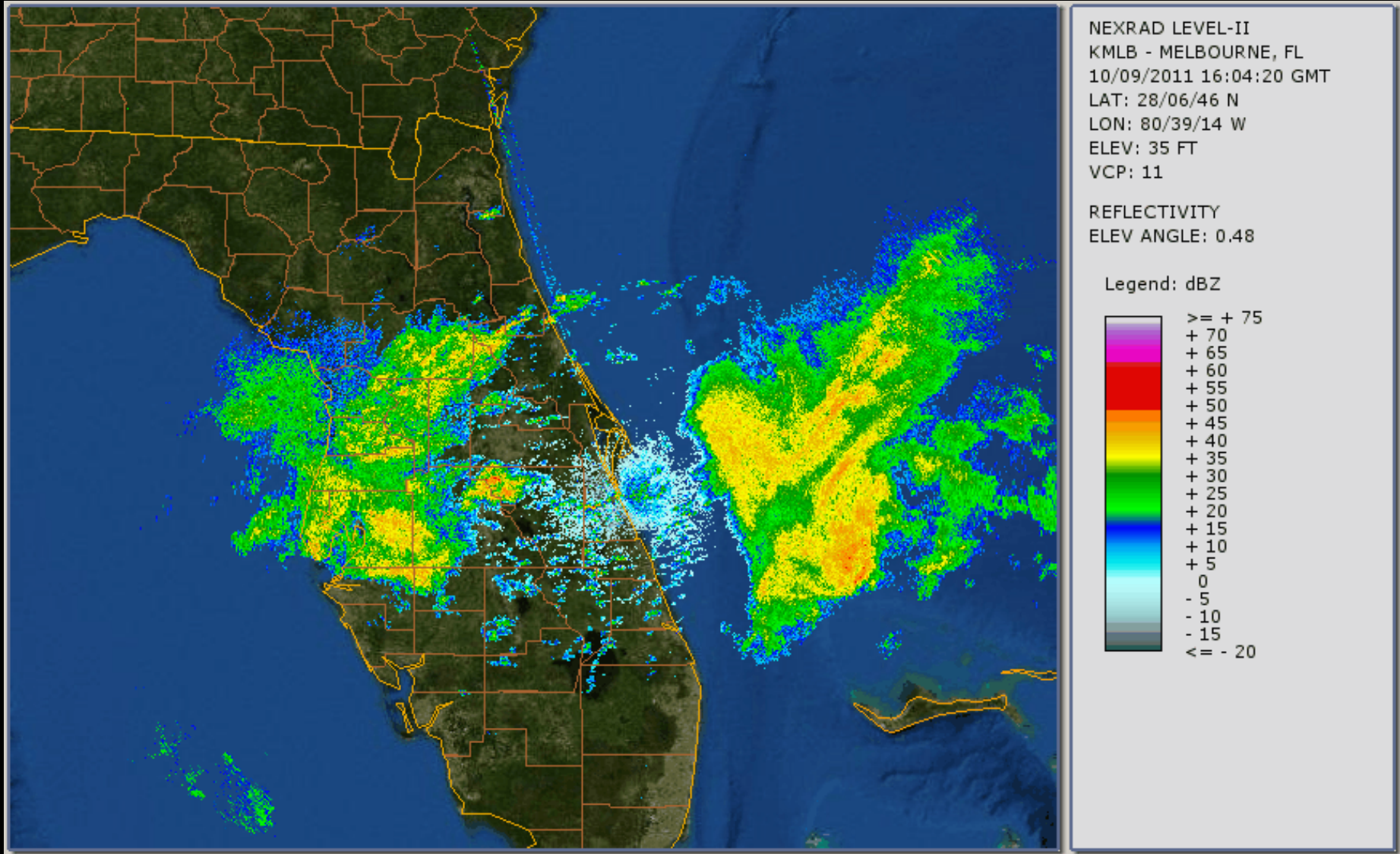
**Even professionals in other vocations
occasionally have an 'off-day'**



INVEST 93L non-tropical cyclone near Melbourne, FL, 9-10 OCT

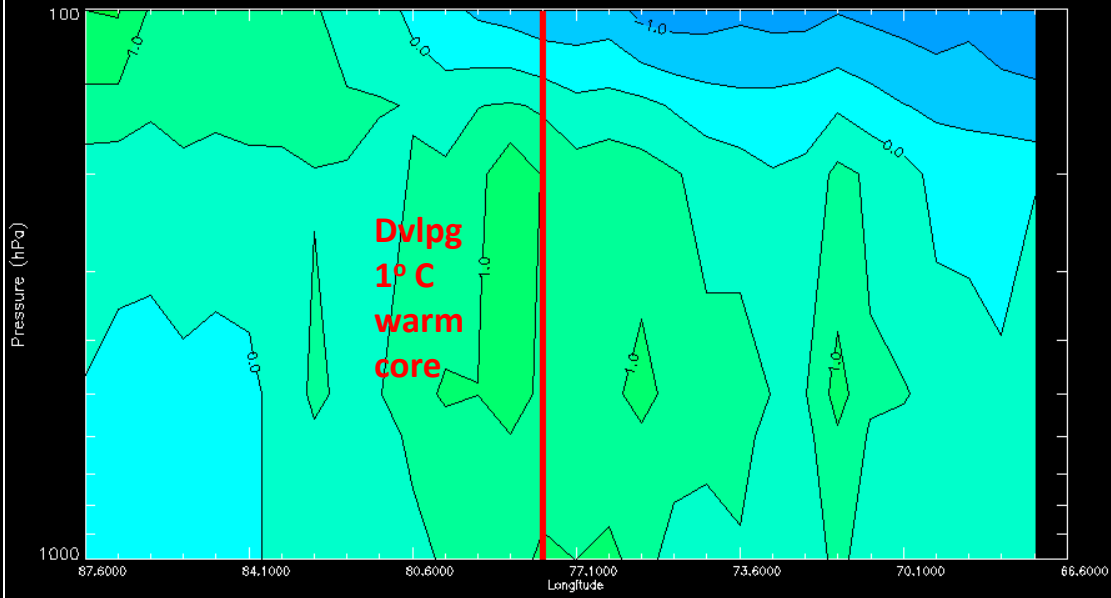
- Peak intensity of the storm before landfall was **at least** 50 kt based on three observations of 45 kt over a one-hour period from buoy 41009 from 0020-0120 UTC 10 October (anemometer height is 5 m; wind averaging period is 8.5 minutes).
- There is anecdotal evidence that the Royal Caribbean cruise ship affected by the storm recorded 100-kt gusts (150+ ft above waterline).
- Minimum pressure estimated from nearby observations (adjusting pressure using observed wind speeds) was approximately 995 mb.
- System had a small, tight inner-core wind field, which is more indicative of a tropical cyclone than a subtropical or extratropical cyclone.
- Warm core thermal & kinematic characteristics existed beneath cold core characteristics, which is indicative of a subtropical cyclone.
- Advisories were not initiated by choice in order to allow WFOs to provide better public services and products.

INVEST 93L cyclone KMLB-KJAX radar animation, 9-10 OCT 2011



201193L MMDD: 01009 YEAR: 2011 Time(UTC): 0749 NOAA-18
AMSU-A Brightness Temperature Anomaly (Storm Center-Environment)

Vertical red line indicates approx location of TC/Invest
Approx latitude of cross section is 26.99

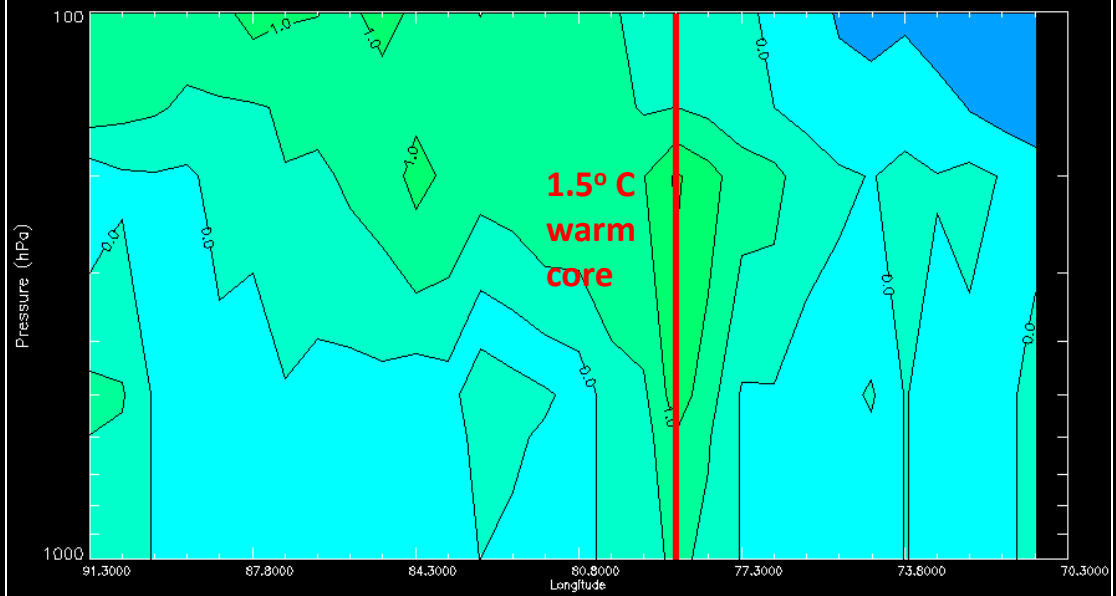


Warm core developing over surface low located between Bahamas and southeastern Florida at 0749 UTC 9 OCT

14 hours later, warm core is better developed and directly above surface low located just to the southeast of Melbourne, Florida at 2145 UTC 9 OCT

201193L MMDD: 01009 YEAR: 2011 Time(UTC): 2145 NOAA-15
AMSU-A Brightness Temperature Anomaly (Storm Center-Environment)

Vertical red line indicates approx location of TC/Invest
Approx latitude of cross section is 27.43

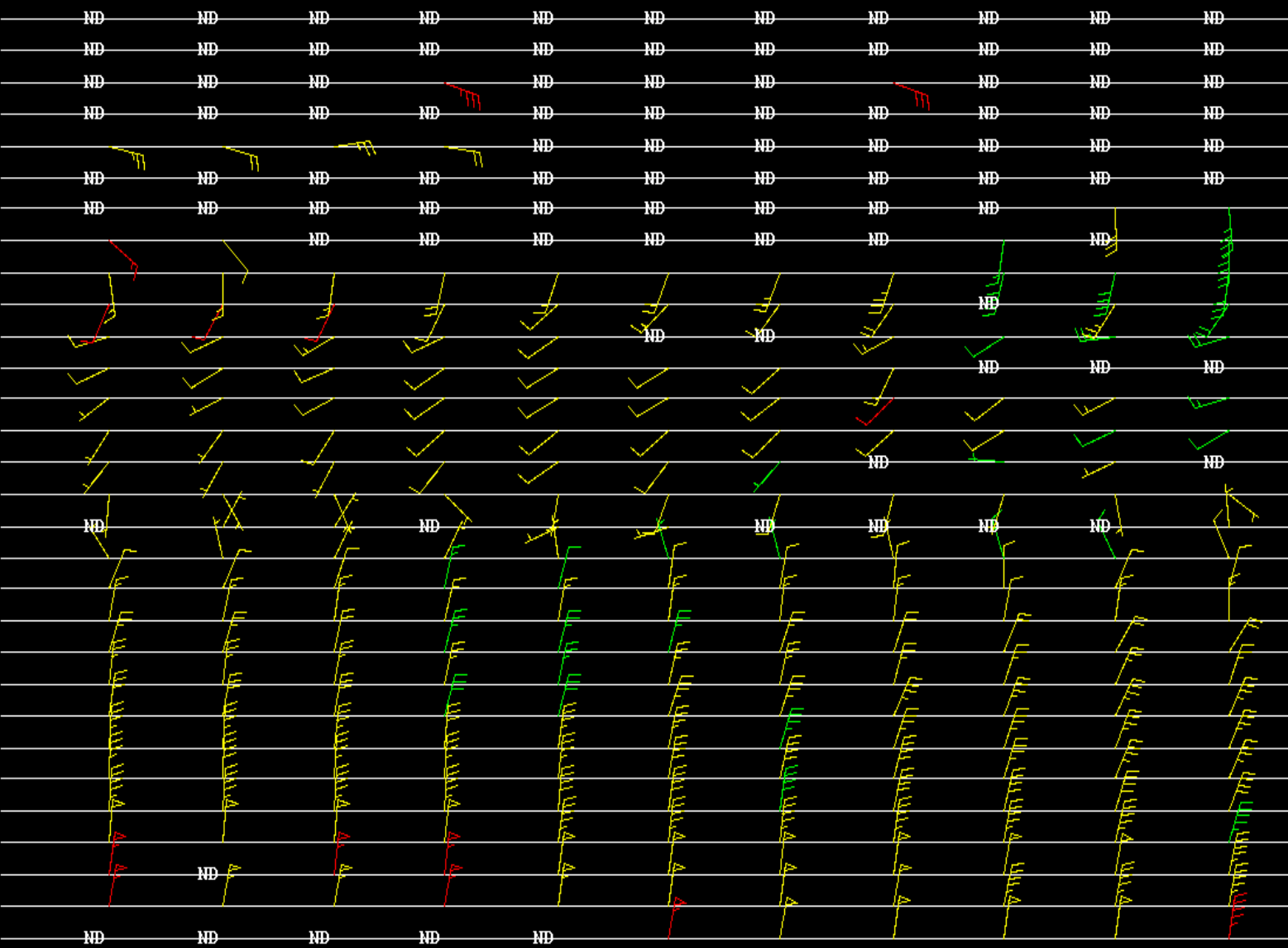


ALT KFT

50
45
40
35
30
28
26
25
24
22
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1

Increasing winds and backing flow above warm core indicative of cold core and cold air advection aloft

Strongest winds in lowest 4 kft with decreasing winds above that layer to 13 kft – i.e., indicative of warm core

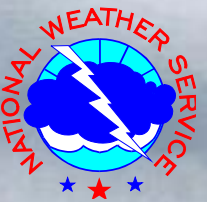


TIME

0010 0015 0019 0024 0029 0033 0038 0042 0047 0052 0056

**So exactly what was INVEST
93L near Melbourne, FL???**

**A system that lay between
Extratropical and Subtropical
on the low pressure spectrum.**



Thank You!

Questions?