

Sizing Up Hurricanes:

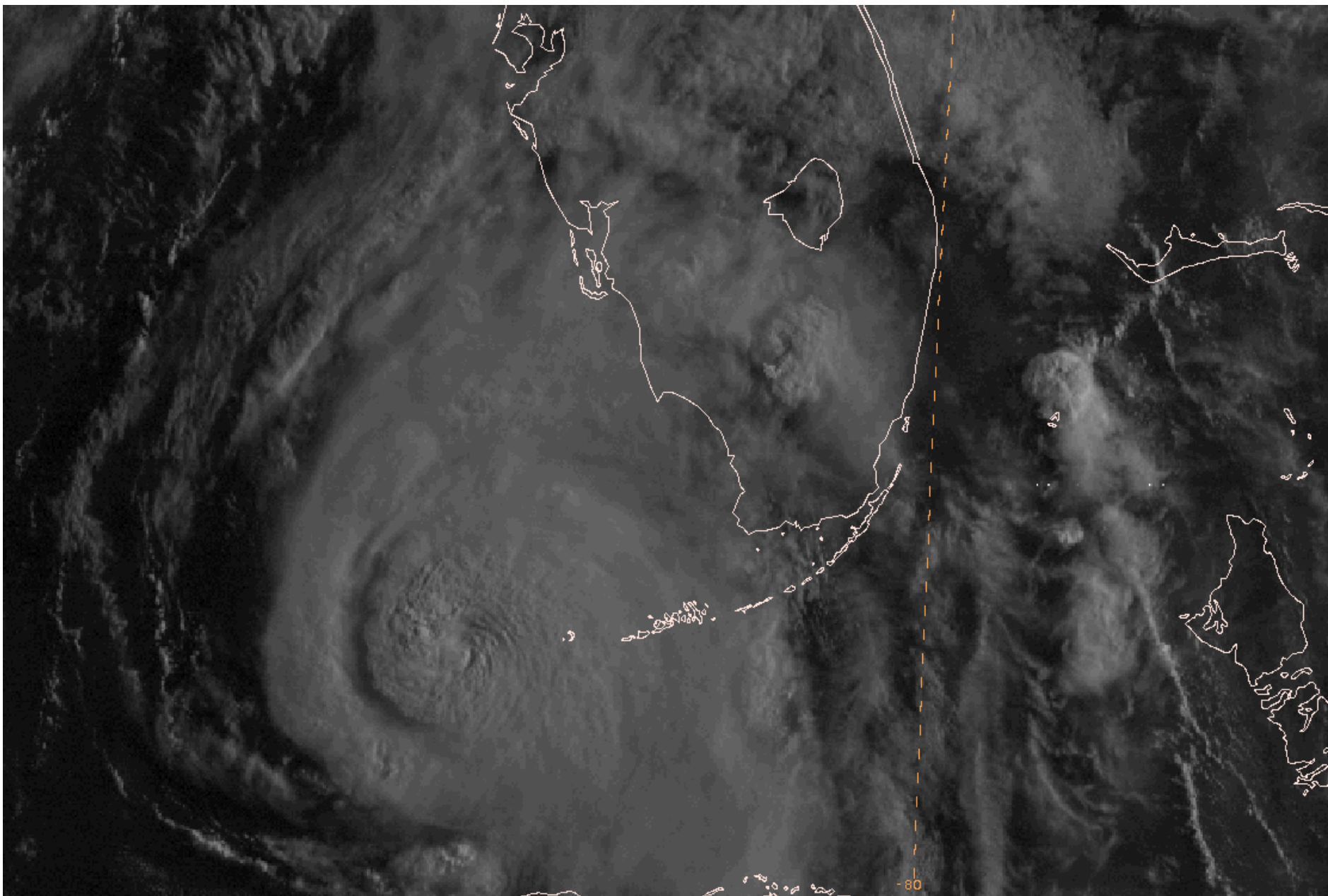
Science, Forecasting, Impacts, and Preparedness

**Dr. Rick Knabb, Director
National Hurricane Center
Miami, Florida, USA**

London Power Forum 13 November 2013



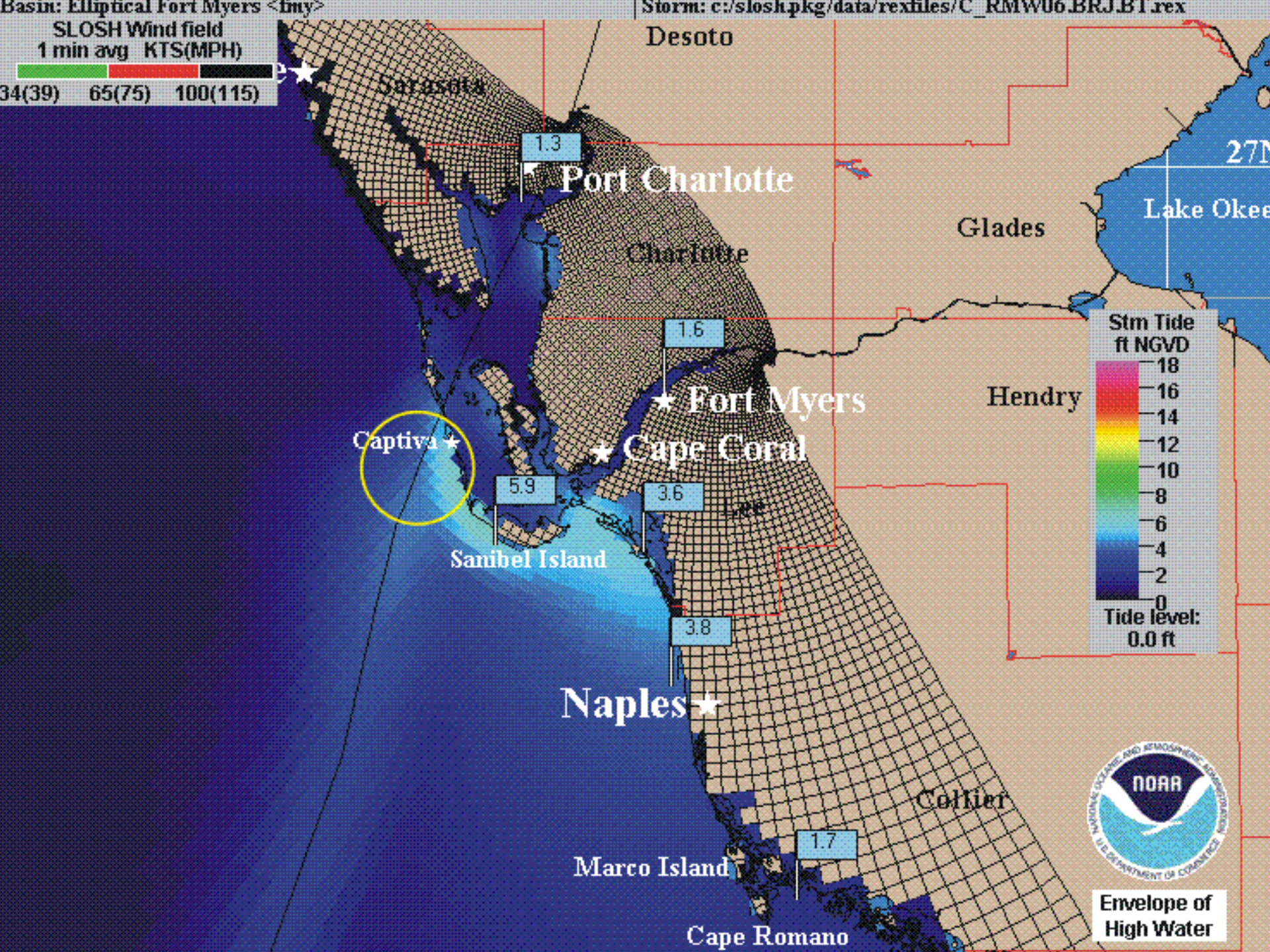
Hurricane Charley (2004)



040813/1215 GOES-12 VIS-CH01

Basin: Elliptical Fort Myers <fmy>
SLOSH Wind field
1 min avg KTS(MPH)
34(39) 65(75) 100(115)

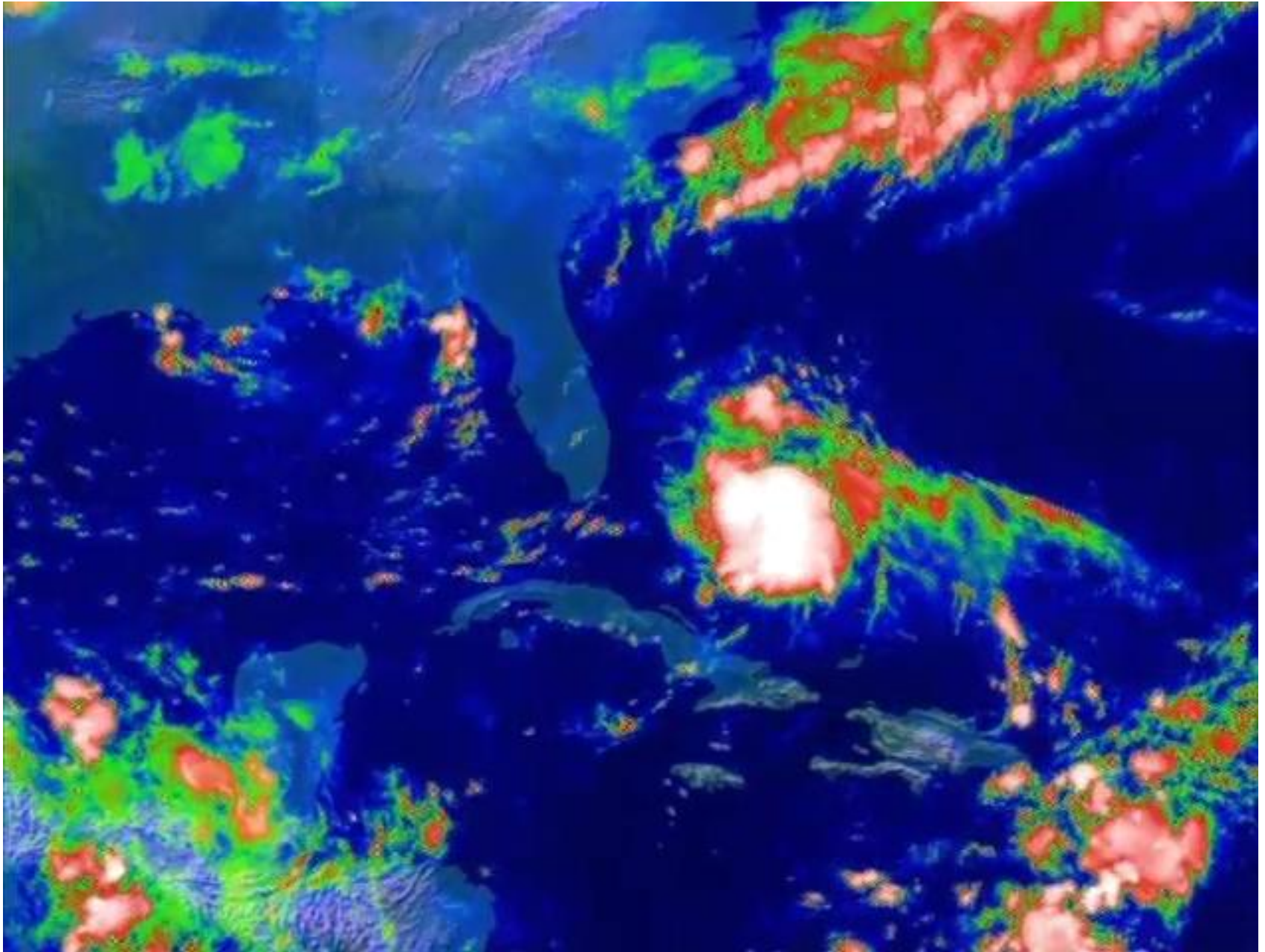
Storm: c:/slosh/pkg/data/rexfiles/C_RMWO6_BRJ.B1.rex



Charley's damage in southwestern Florida



Hurricane Katrina (2005)





Storm Surge from Hurricane Katrina 2005 Gulfport Beach, Mississippi



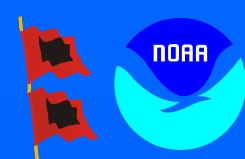
Hurricane Katrina (2005)

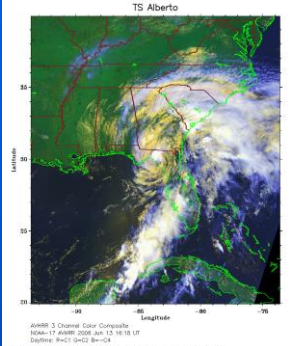
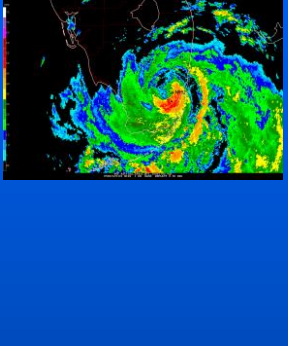
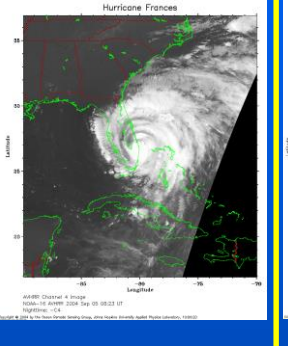
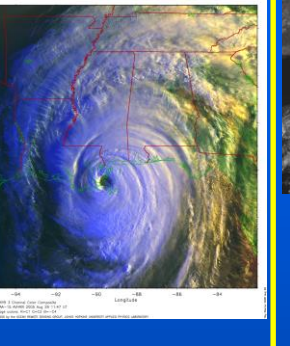




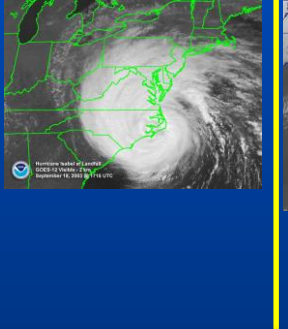
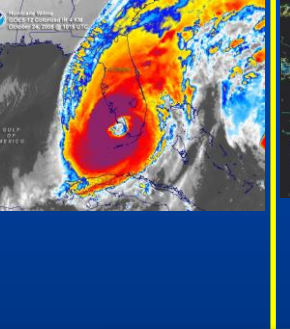

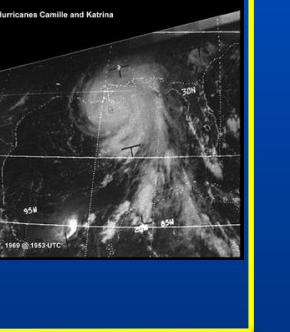




Saffir-Simpson Hurricane Wind Scale

with historical examples at landfall



Major hurricanes					
Tropical Storm	Category 1	Category 2	Category 3	Category 4	Category 5
Winds: 39-73 mph (34-63 kt)	Winds: 74-95 mph (64-82 kt)	Winds: 96-110 mph (83-95 kt)	Winds: 111-130 mph (96-113 kt)	Winds: 130-156 mph (113-136 kt)	Winds: > 156 mph (> 136 kt)
Alberto 2006  <p>TS Alberto August 17, 2006 00:00 UTC Latitude: 24°N Longitude: 102°W</p>	Katrina 2005  <p>Hurricane Katrina August 14, 2005 00:00 UTC Latitude: 28°N Longitude: 90°W</p>	Frances 2004  <p>Hurricane Frances September 12, 2004 00:00 UTC Latitude: 28°N Longitude: 80°W</p>	Katrina 2005  <p>Hurricane Katrina August 14, 2005 00:00 UTC Latitude: 28°N Longitude: 90°W</p>	Charley 2004  <p>Hurricane Charley September 13, 2004 00:00 UTC Latitude: 26°N Longitude: 82°W</p>	Andrew 1992  <p>HURRICANE ANDREW August 17, 1992 04:30 EDT Latitude: 25°N Longitude: 80°W</p>
Alison 2001  <p>Hurricane Alison September 12, 2001 00:00 UTC Latitude: 24°N Longitude: 102°W</p>	Claudette 2003  <p>Hurricane Claudette comes ashore in Texas 1948 UTC, 13 July 2003 Latitude: 28°N Longitude: 90°W</p>	Isabel 2003  <p>Hurricane Isabel September 18, 2003 00:00 UTC Latitude: 24°N Longitude: 102°W</p>	Wilma 2005  <p>Hurricane Wilma October 23, 2005 00:00 UTC Latitude: 24°N Longitude: 102°W</p>	Hugo 1989  <p>HURRICANE HUGO September 23, 1989 00:00 EDT Latitude: 24°N Longitude: 80°W</p>	Camille 1969  <p>Hurricanes Camille and Katrina August 17, 1969 00:00 UTC Latitude: 24°N Longitude: 80°W</p>



Interstate 10, Looking West, Houston



Photo: Houston Chronicle

Interstate 10, Tropical Storm Allison Houston

OPERATIONAL COMMUNICATIONS

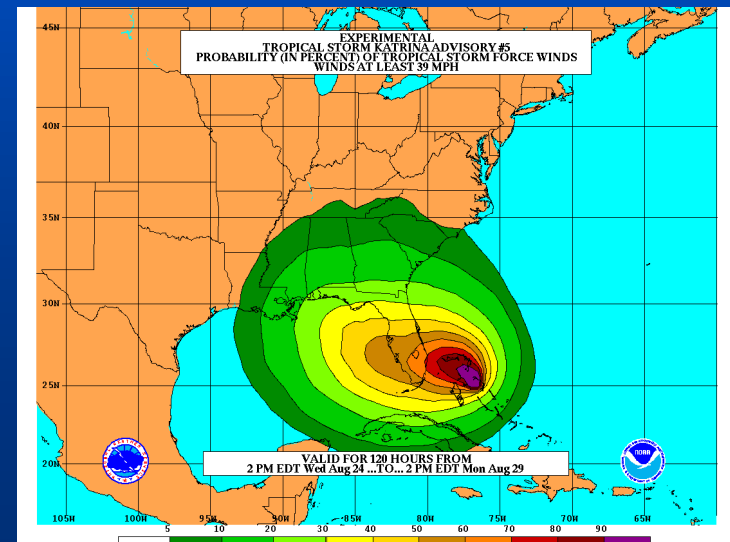
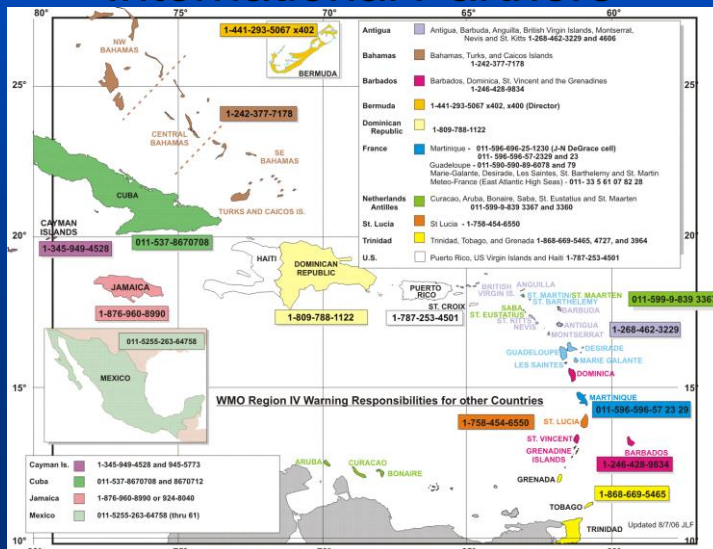
Decision Support and Briefings

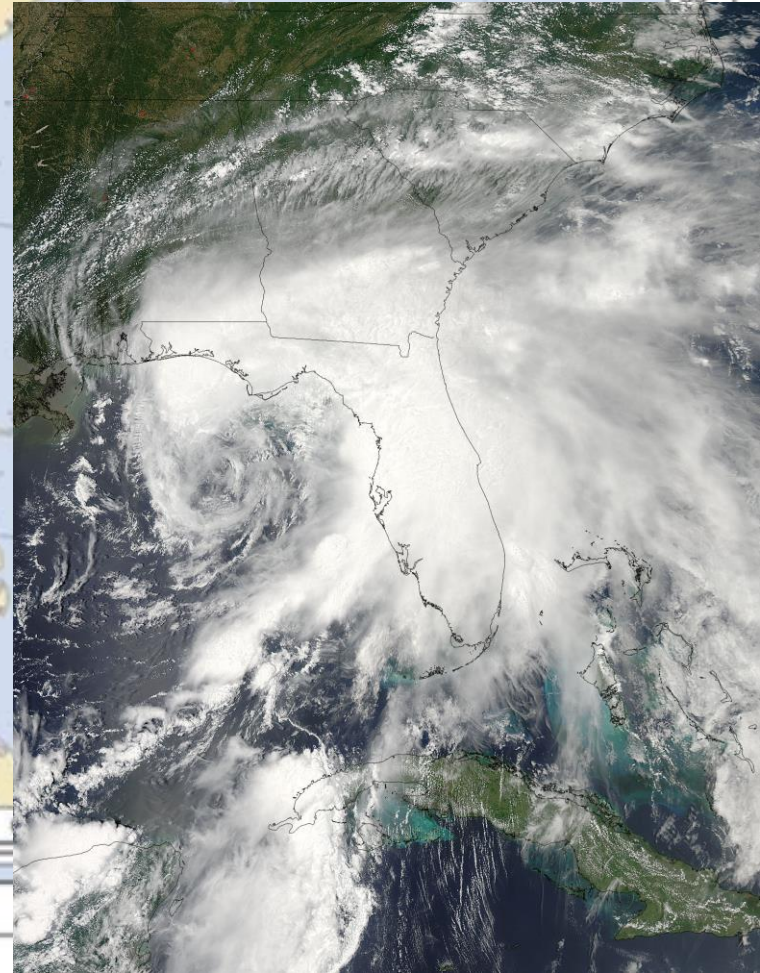
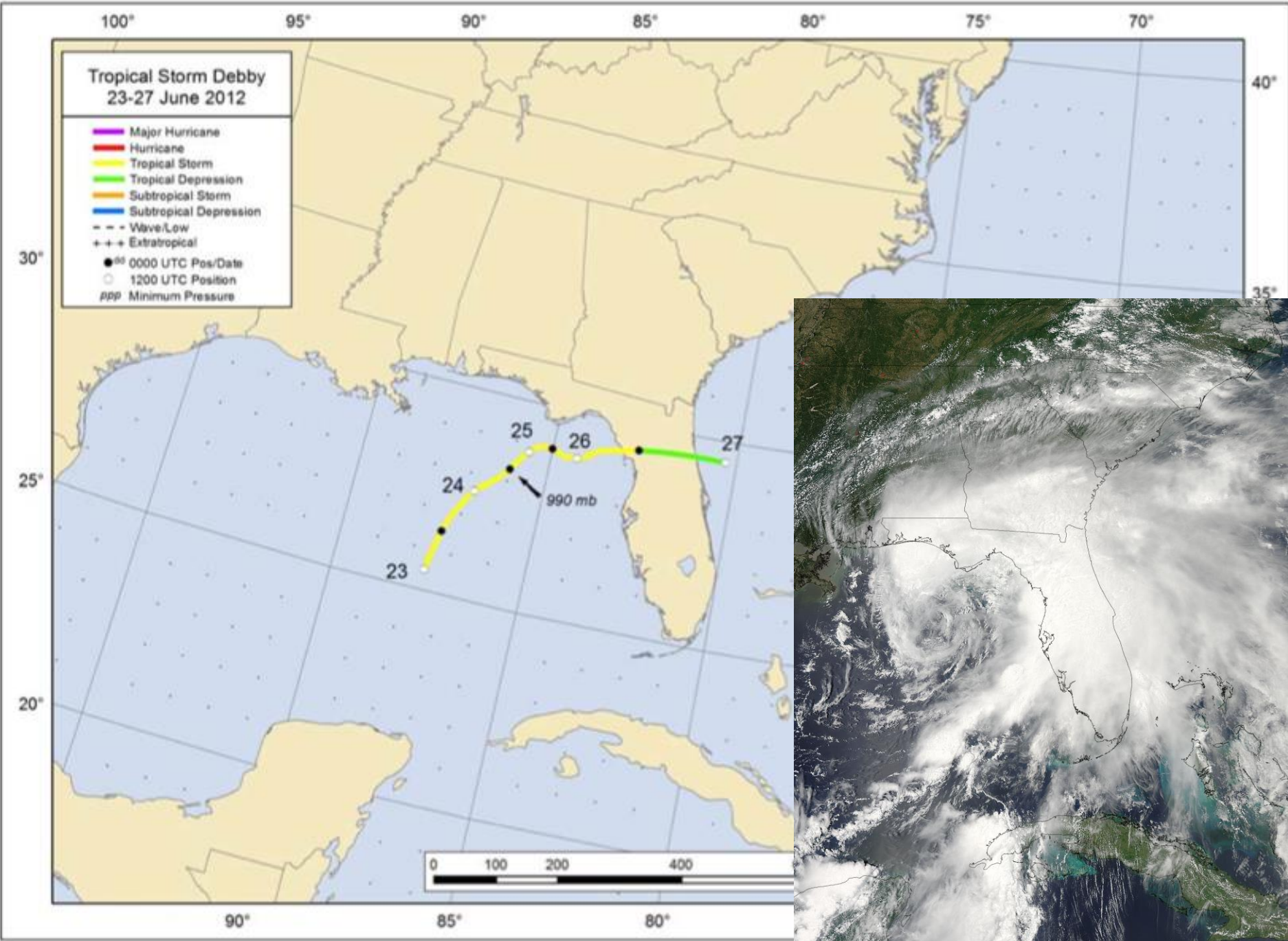
Media



International Partners

Public Products







St. Petersburg, FL (Oriana Sofia)



Juno Beach, FL (Steve Weagle)



Lake Placid, FL (Skip Dent)

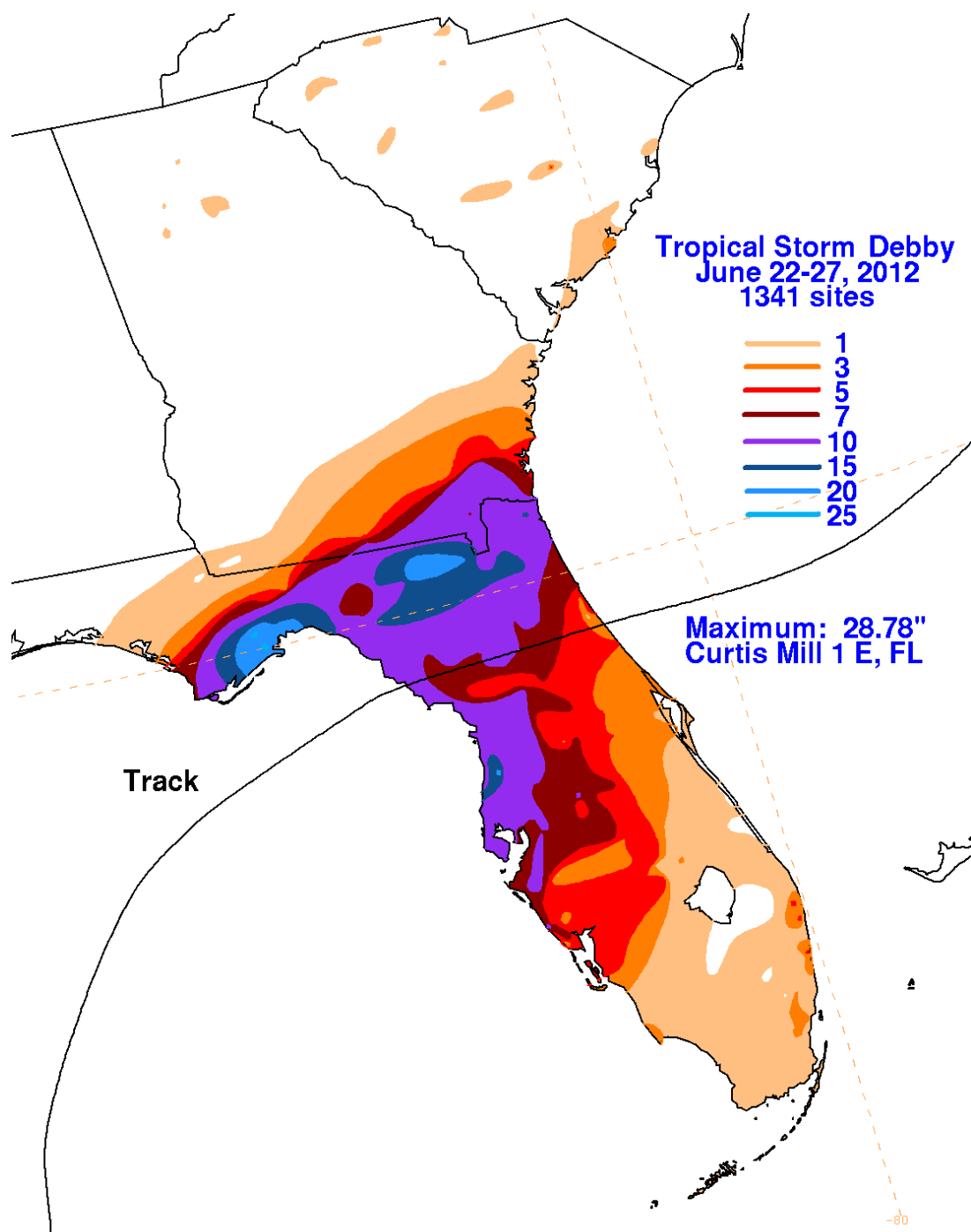


Collier County, FL



West Palm Beach, FL (ParsAreOk)

Debby Rainfall





Ft. White, Santa Fe River, FL (George Armstrong)



Live Oak, FL (Matt Stamey/AP/The Gainesville Sun)



Live Oak, FL (Dave Martin/AP)



Middleburg, FL (Will Dickey/AP/Florida Times-Union)



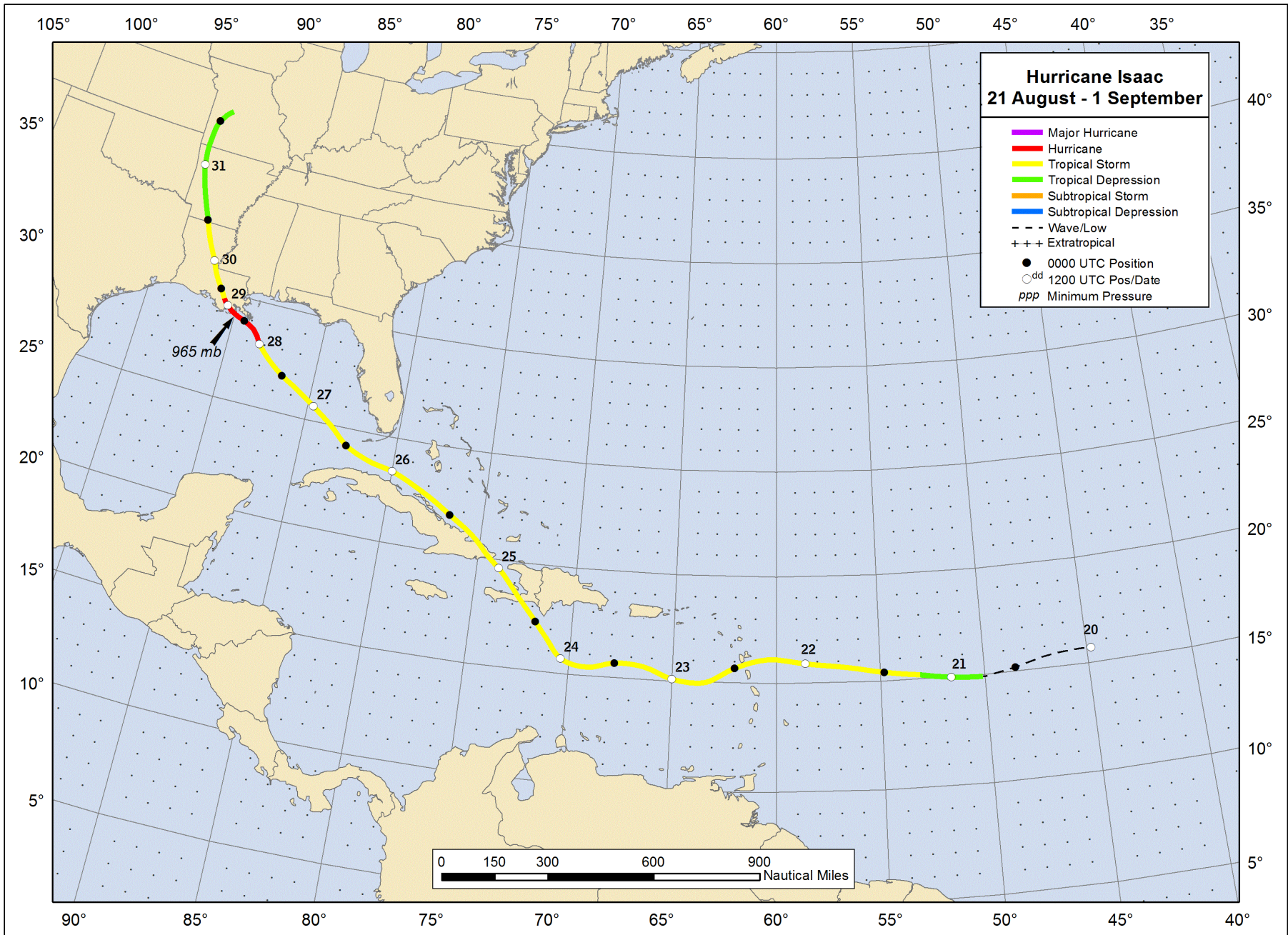
Bayshore Blvd., Tampa, FL (Milleniumforce)



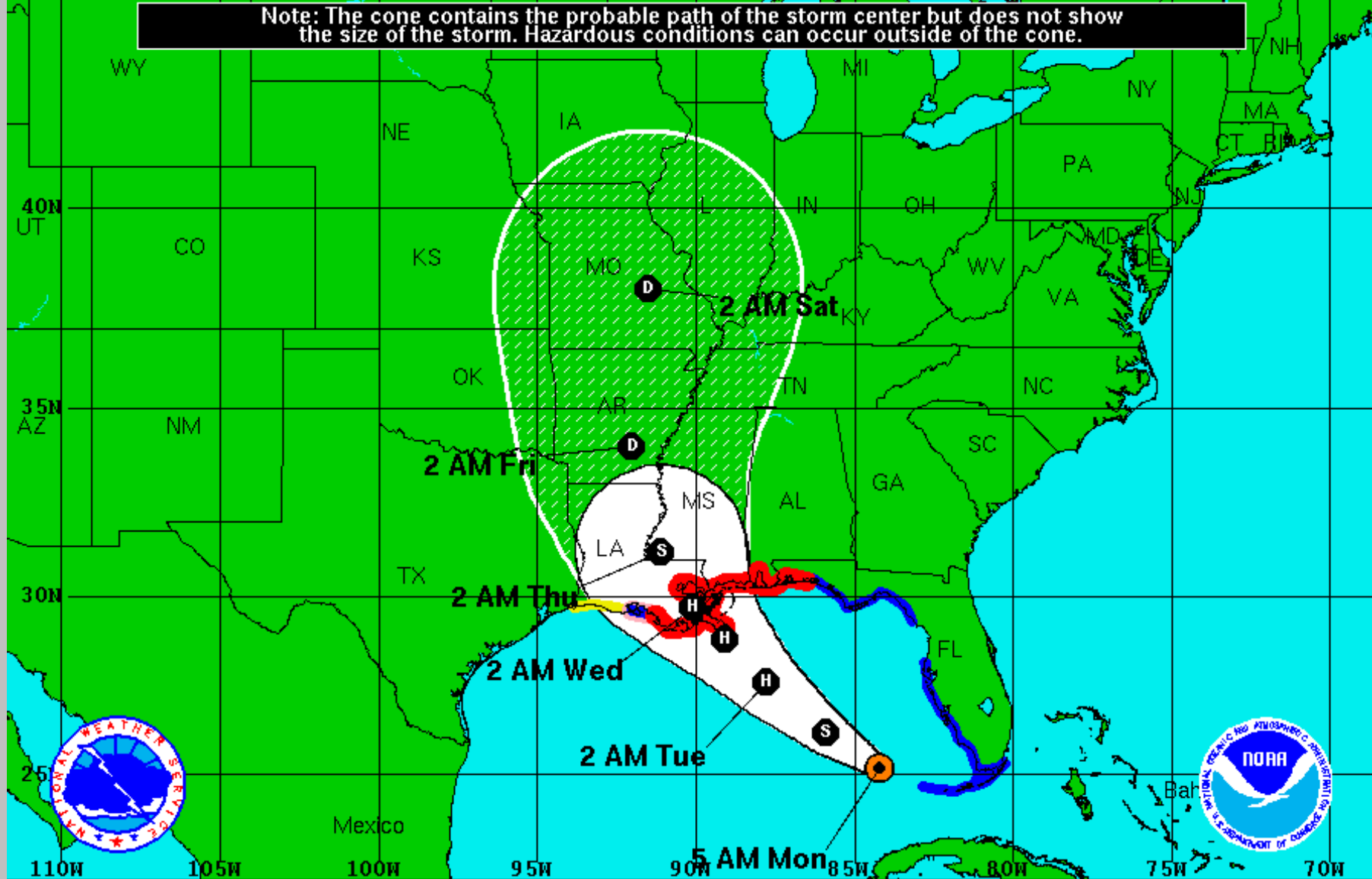
Bradenton Beach, FL (LowTegra)




Cedar Key, FL (DreamingOfTheTropics)





Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.



Tropical Storm Isaac
 Monday August 27, 2012
 5 AM EDT Advisory 25
 NWS National Hurricane Center

Current Information: 
 Center Location 25.2 N 84.2 W
 Max Sustained Wind 65 mph
 Movement WNW at 14 mph

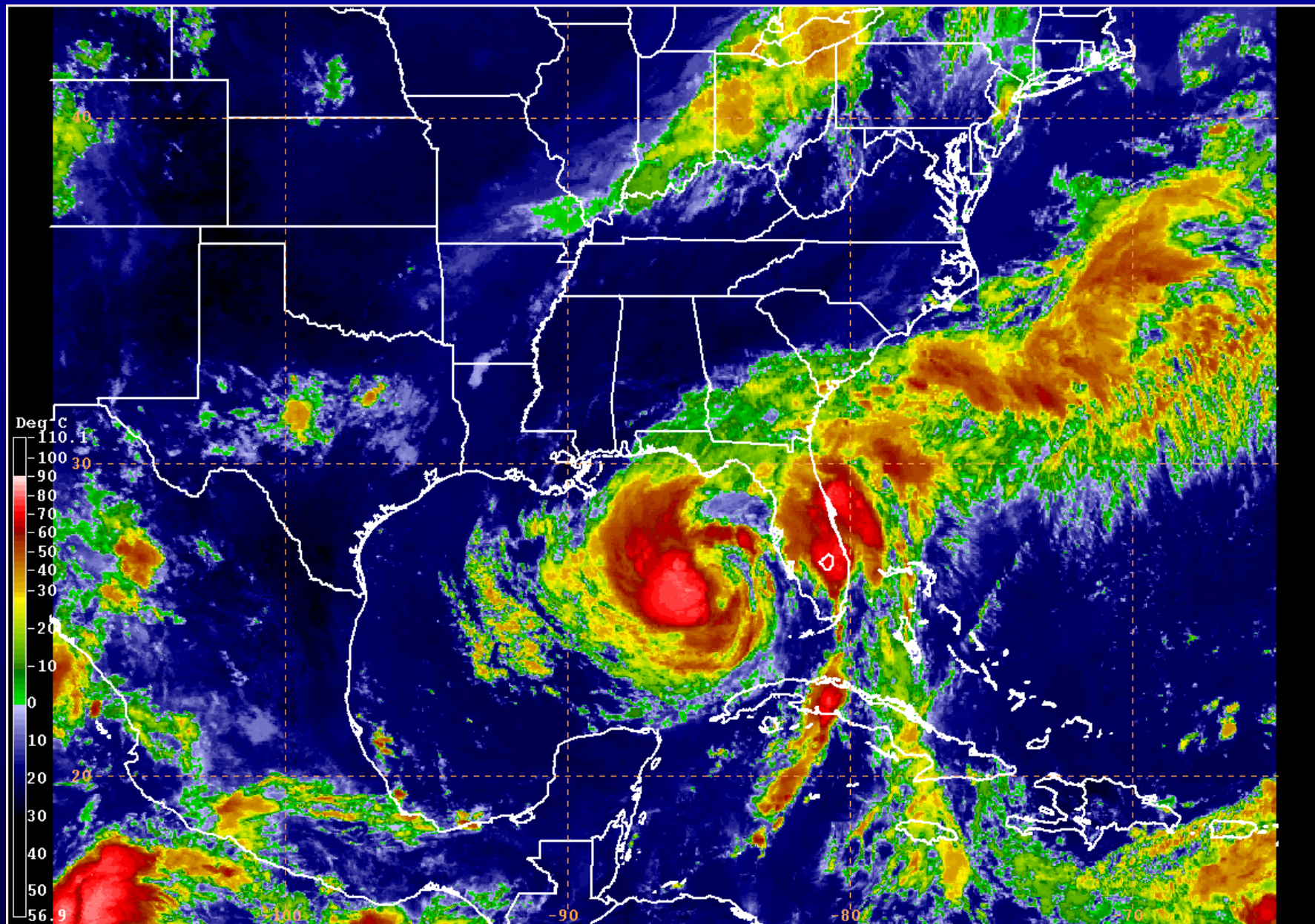
Forecast Positions:
 Tropical Cyclone  Post-Tropical
 Sustained Winds: D < 39 mph
 S 39-73 mph H 74-110 mph M > 110mph

Potential Track Area:
 Day 1-3  Day 4-5

Watches:
 Hurricane  Trop. Storm

Warnings:
 Hurricane  Trop. Storm

Tropical Storm Isaac 1515 UTC 27 Aug 2012



GOES-E 4-km IR 20120827 1515 UTC

Western Palm Beach County, FL



Isaac Storm Surge



Braithwaite, Louisiana (Twitter/JMLblanc23)



Slidell, Louisiana (Michael DeMocker/Times-Picayune)



Laplace, Louisiana (Michael DeMocker/Times-Picayune)



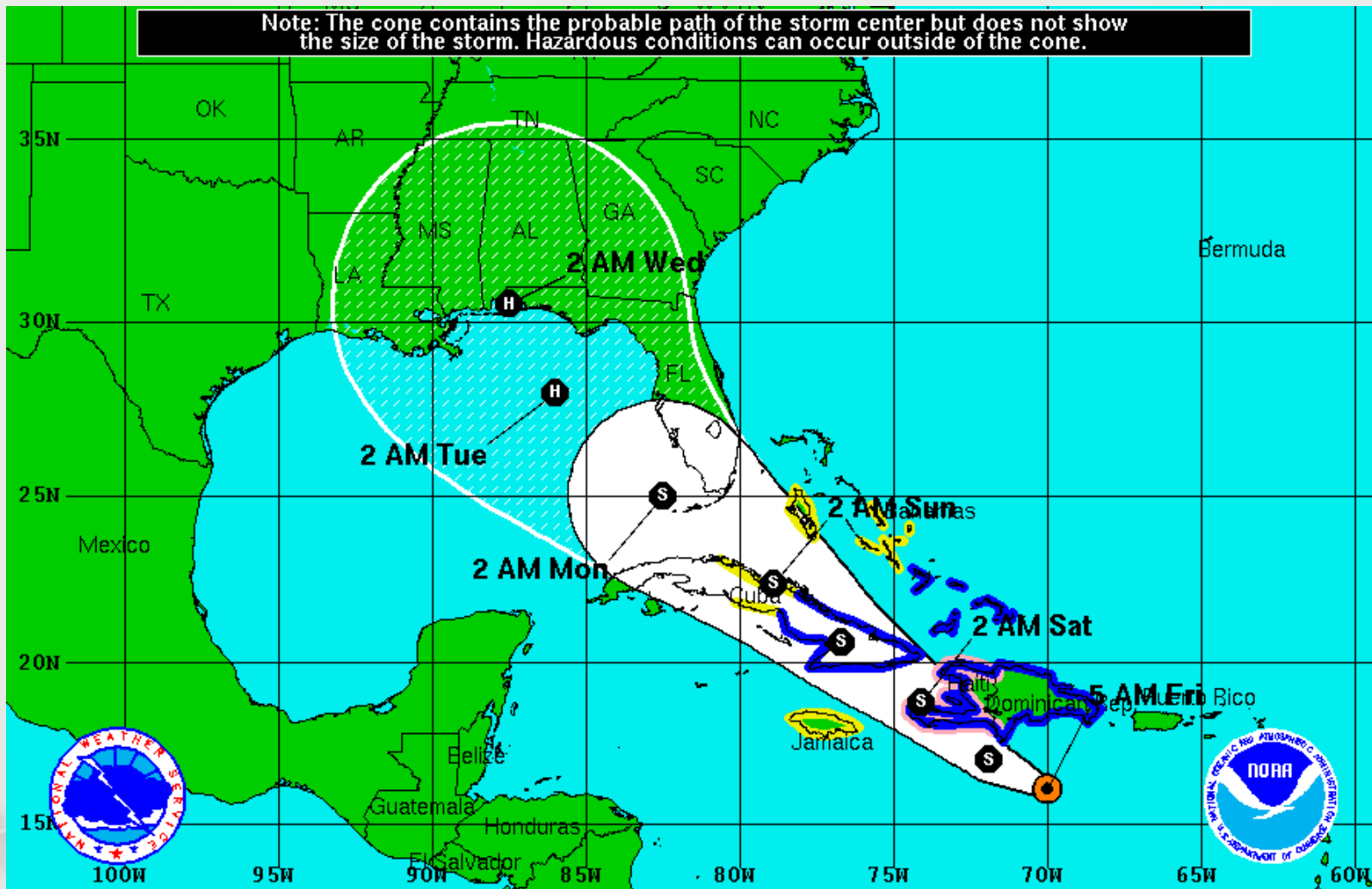
Plaquemines Parish, Louisiana (Homeland Security Watch)












Isaac Advisory 13 with 2008 Cone



Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.



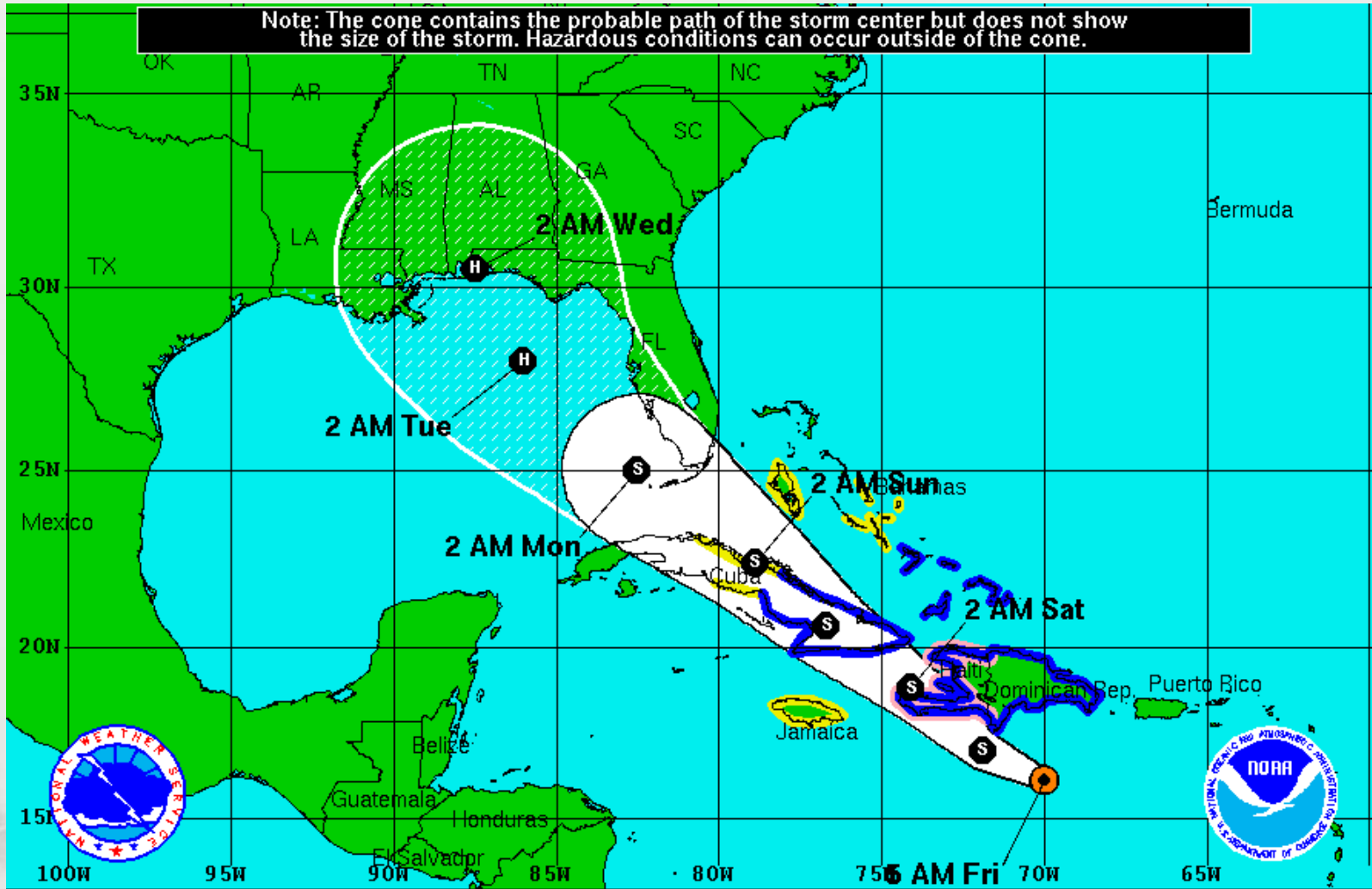
<p>Tropical Storm Isaac Friday August 24, 2012 5 AM EDT Advisory 13 NWS National Hurricane Center</p>	<p>Current Information:  Center Location 16.1 N 70.0 W Max Sustained Wind 45 mph Movement W at 15 mph</p>	<p>Forecast Positions:  Tropical Cyclone  Post-Tropical Sustained Winds: D < 39 mph S 39-73 mph H 74-110 mph M > 110mph</p>
<p>Potential Track Area:  Day 1-3  Day 4-5</p>	<p>Watches:  Hurricane  Trop.Storm</p>	<p>Warnings:  Hurricane  Trop.Storm</p>



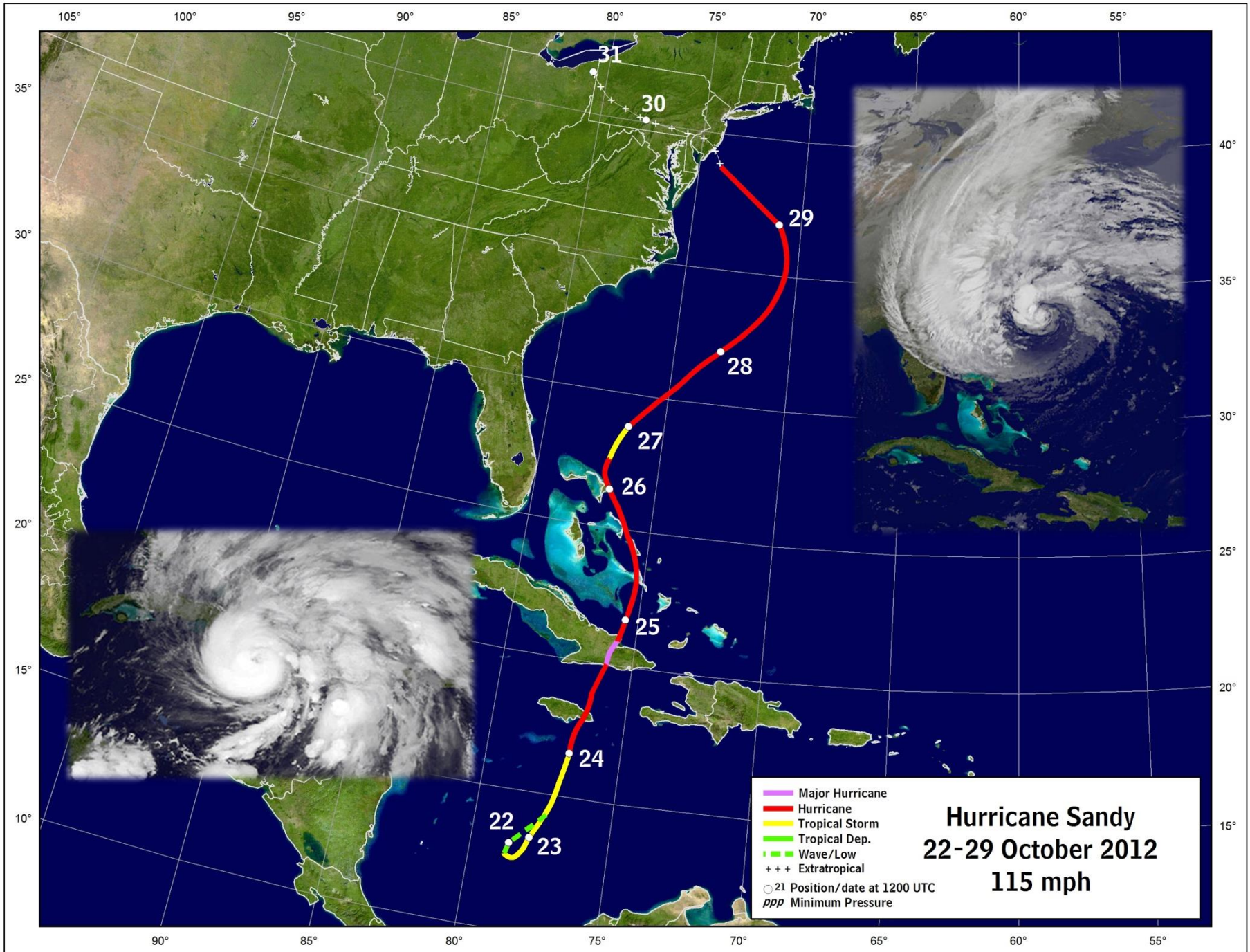
Isaac Advisory 13 with 2013 Cone



Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.

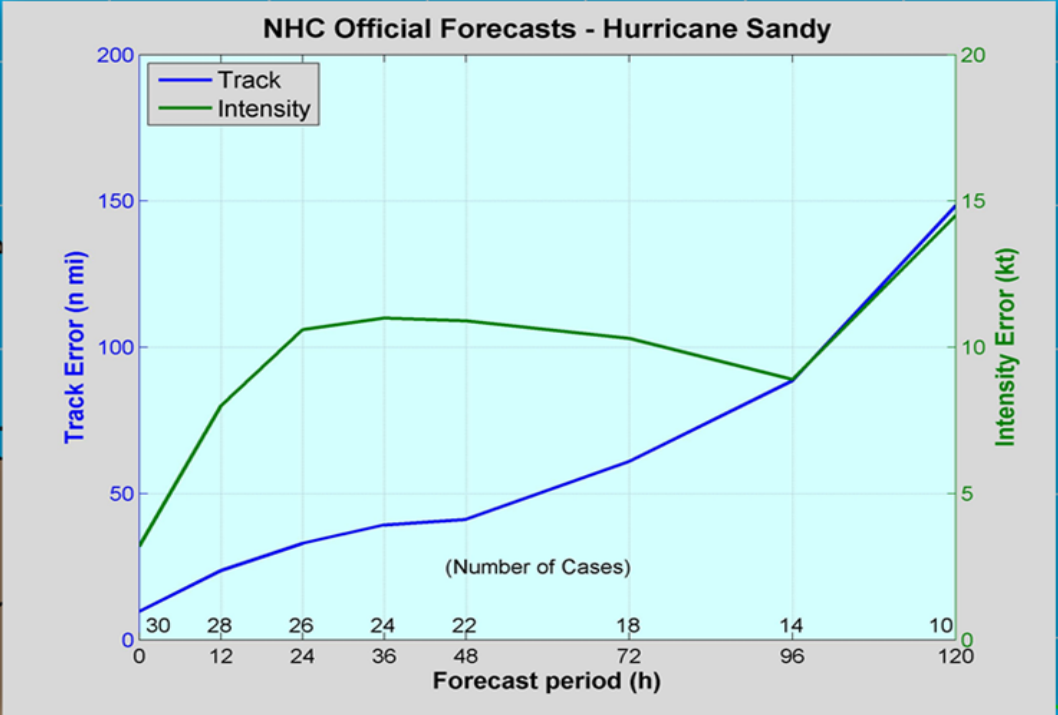
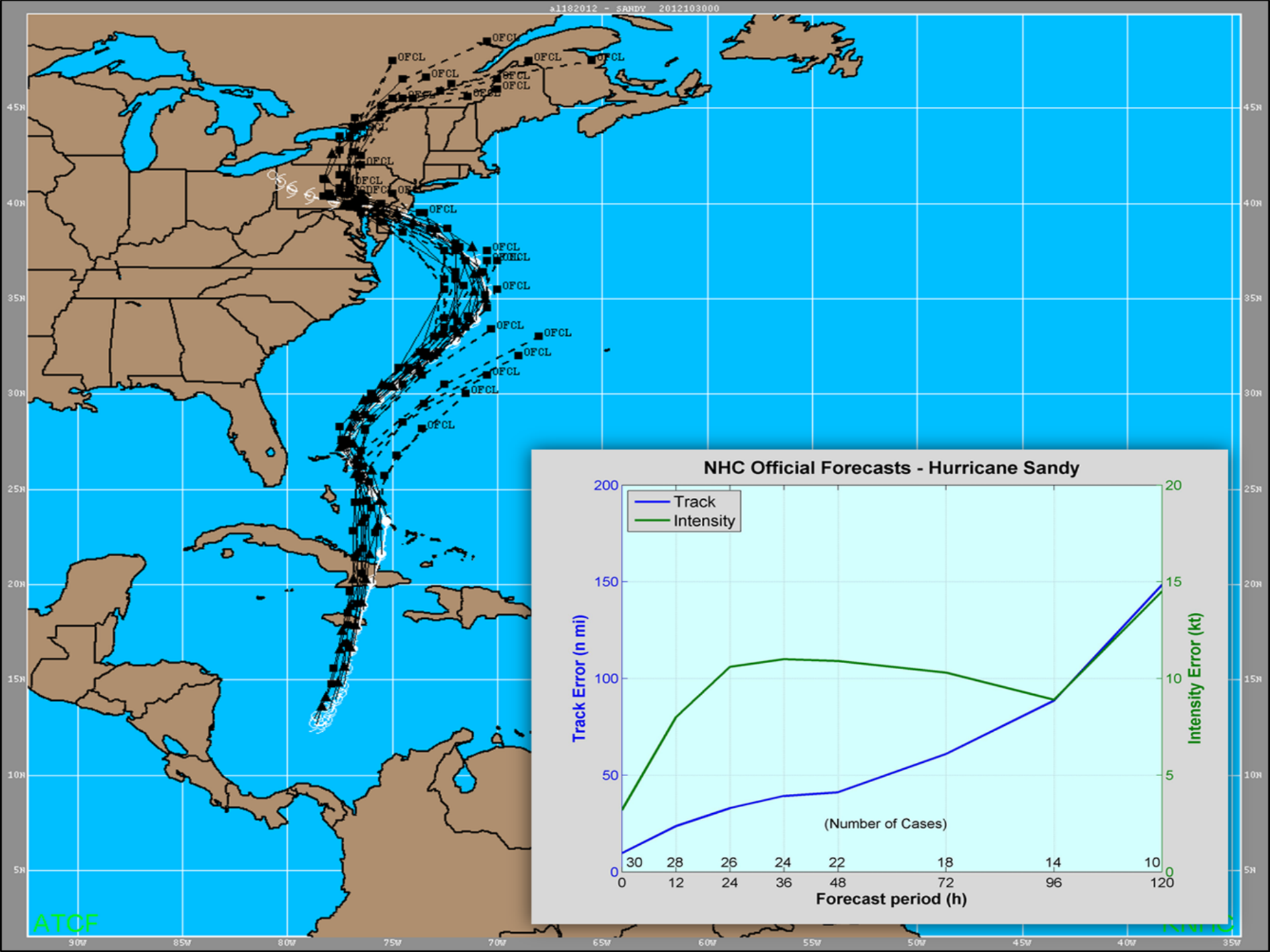


<p>Tropical Storm Isaac Friday August 24, 2012 5 AM EDT Advisory 13 NWS National Hurricane Center</p>	<p>Current Information: ● Center Location 16.1 N 70.0 W Max Sustained Wind 45 mph Movement W at 15 mph</p>	<p>Forecast Positions: ● Tropical Cyclone ○ Post-Tropical Sustained Winds: D < 39 mph S 39-73 mph H 74-110 mph M > 110mph</p>
<p>Potential Track Area: Day 1-3 Day 4-5</p>	<p>Watches: Hurricane Trop.Storm</p>	<p>Warnings: Hurricane Trop.Storm</p>



- Major Hurricane
- Hurricane
- Tropical Storm
- Tropical Dep.
- - - Wave/Low
- +++ Extratropical
- 21 Position/date at 1200 UTC
- ppp Minimum Pressure

Hurricane Sandy
22-29 October 2012
115 mph

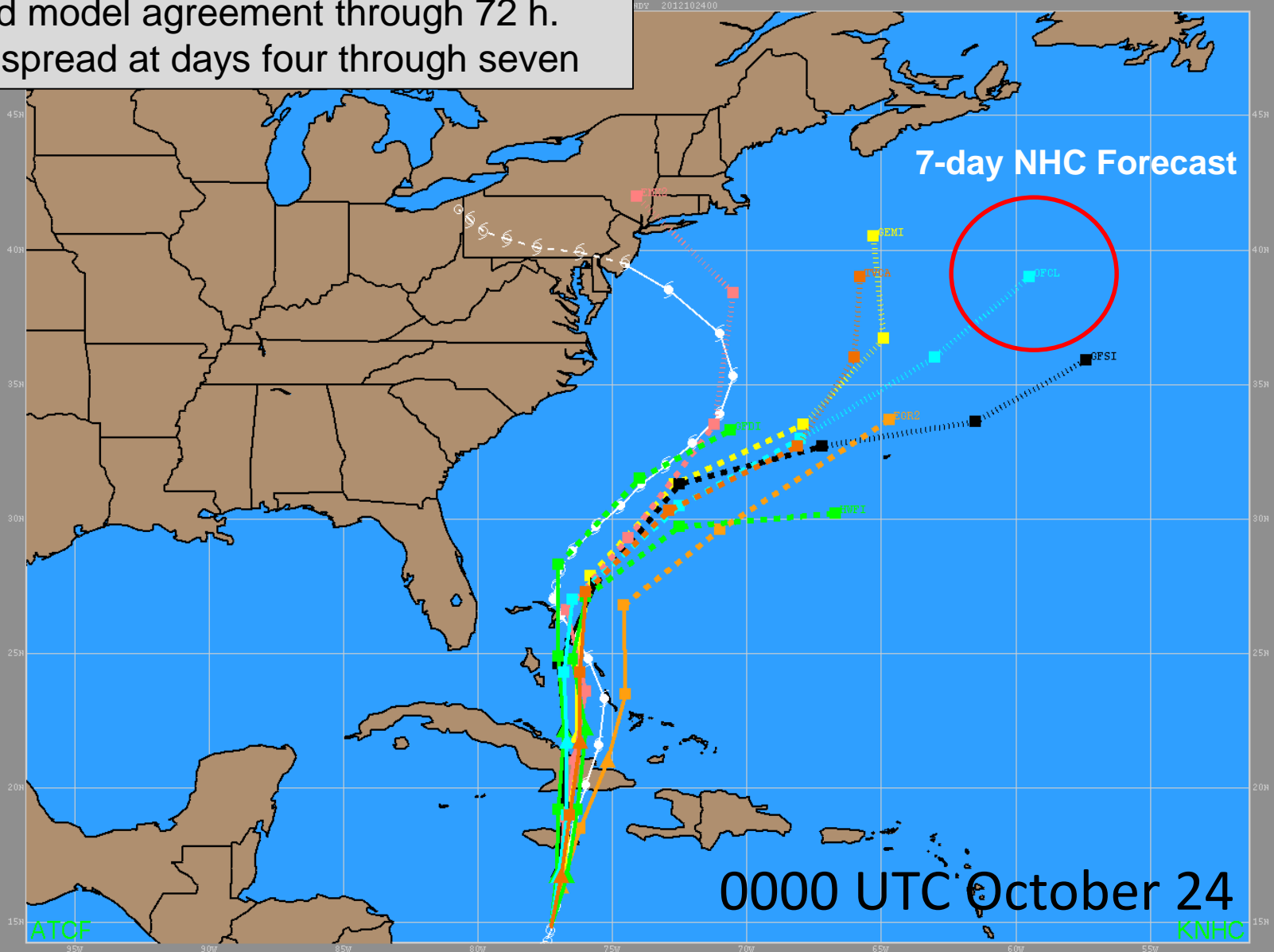




6- and 7-day Forecasts for Sandy Were Initially Out to Sea



Good model agreement through 72 h.
More spread at days four through seven

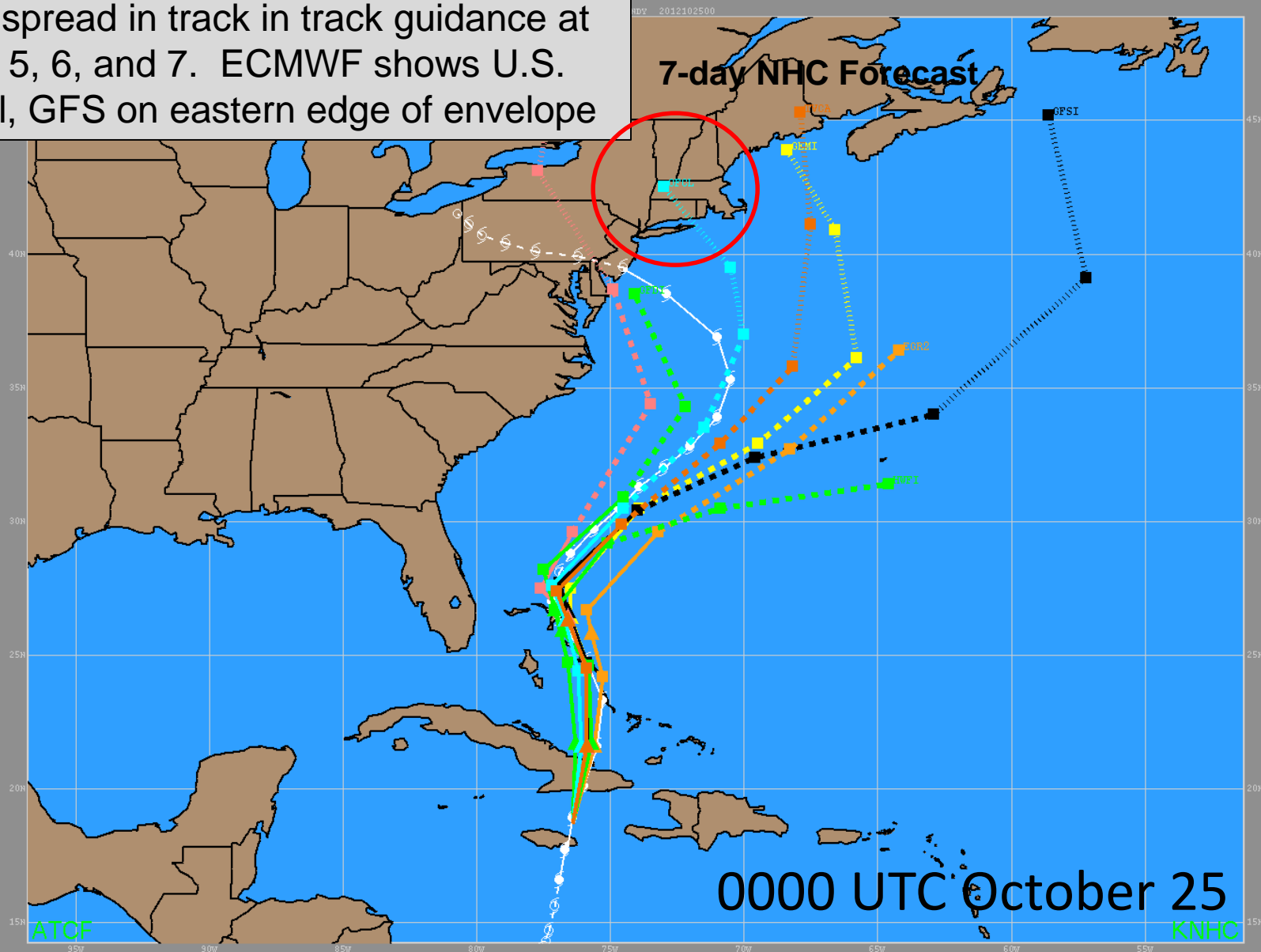




Forecasts Shifted Westward About 6 Days Before Landfall



Large spread in track in track guidance at days 5, 6, and 7. ECMWF shows U.S. landfall, GFS on eastern edge of envelope

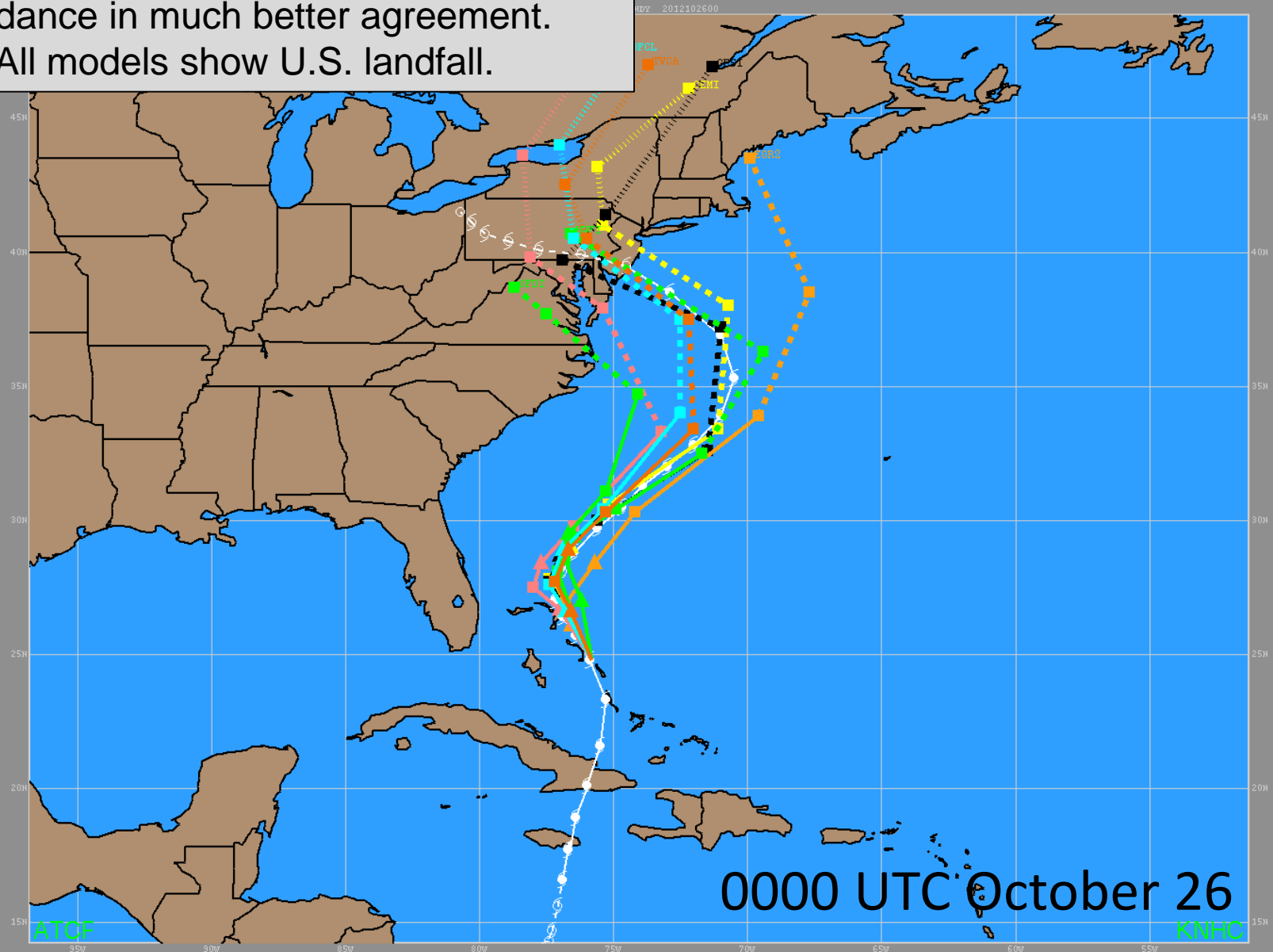




Models in Better Agreement About 5 Days Before Landfall



Guidance in much better agreement.
All models show U.S. landfall.





Debby Forms

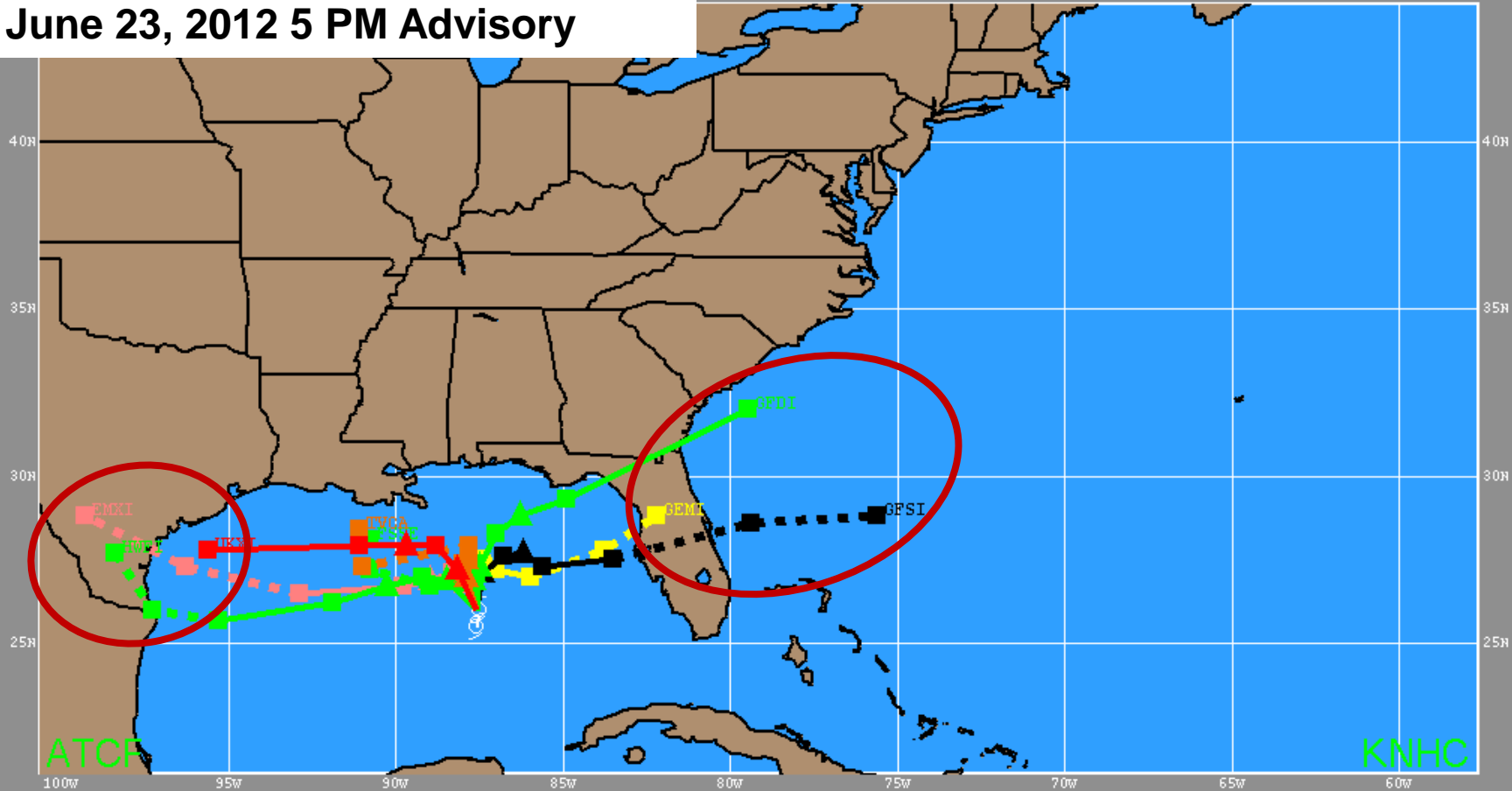
Diverging Forecast Guidance

Texas or Florida?



Tropical Storm Debby Track Guidance
June 23, 2012 5 PM Advisory

2 - DEBBY 2012062318





Media and emergency management briefings began when Sandy was still in the Caribbean...



...and continued
until well after final
landfall



BULLETIN

HURRICANE SANDY ADVISORY NUMBER 21

NWS NATIONAL HURRICANE CENTER MIAMI FL

AL182012

1100 AM EDT SAT OCT 27 2012

STORM SURGE...THE COMBINATION OF A DANGEROUS STORM SURGE AND THE TIDE WILL CAUSE NORMALLY DRY AREAS NEAR THE COAST TO BE FLOODED BY RISING WATERS. THE WATER COULD REACH THE FOLLOWING DEPTHS ABOVE GROUND IF THE PEAK SURGE OCCURS AT THE TIME OF HIGH TIDE...

FL EAST COAST NORTH OF CAPE CANAVERAL...1 TO 2 FT

NC SOUTH OF SURF CITY...1 TO 3 FT

NC NORTH OF SURF CITY INCLUDING PAMLICO/ALBERMARLE SNDS...3 TO 5 FT

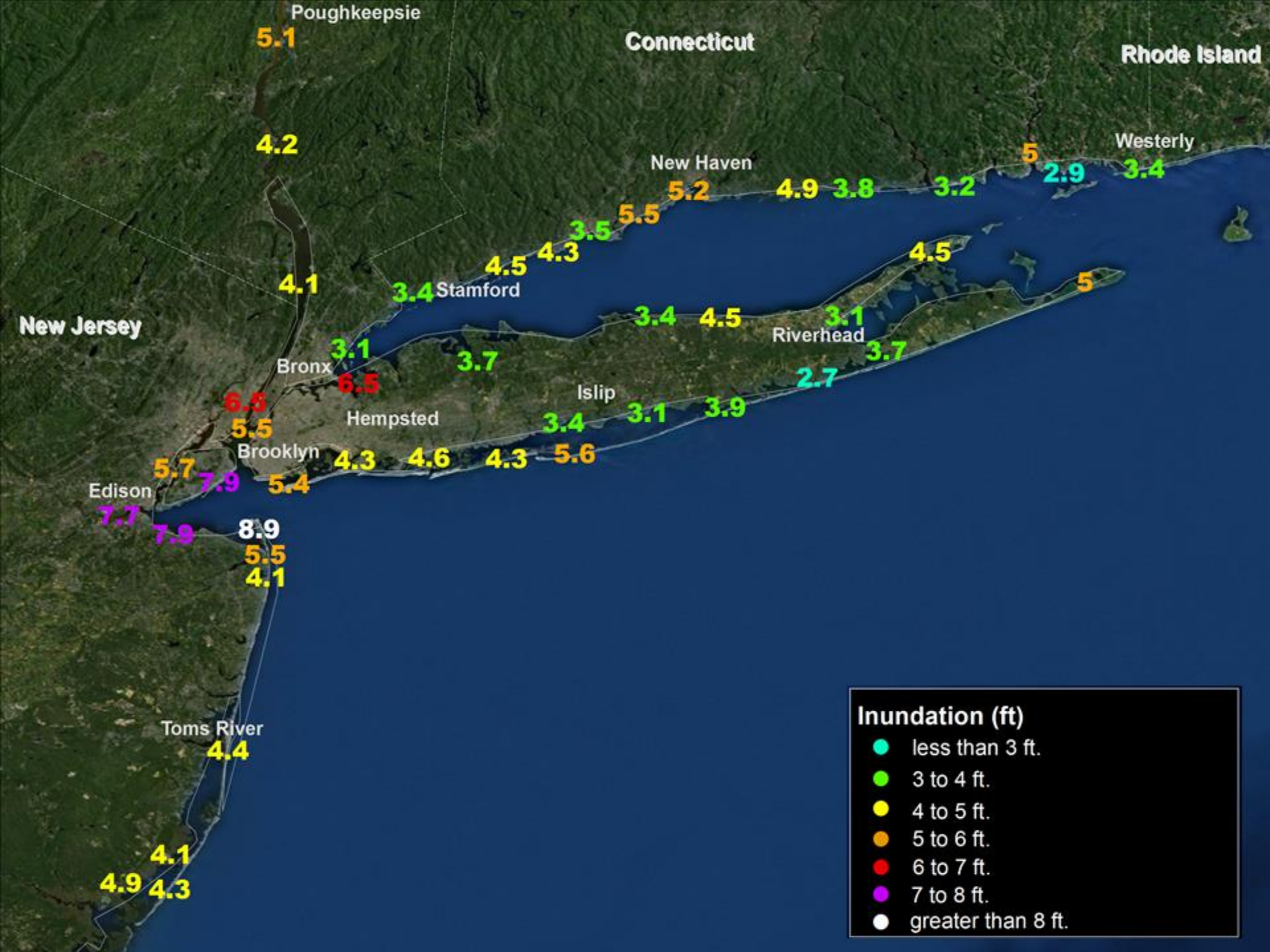
SE VA AND DELMARVA INCLUDING LOWER CHESAPEAKE BAY...2 TO 4 FT

UPPER CHESAPEAKE BAY...1 TO 2 FT

OCEAN CITY MD TO THE CT/RI BORDER...4 TO 8 FT

LONG ISLAND SOUND...RARITAN BAY...AND DELAWARE BAY...4 TO 8 FT

SURGE-RELATED FLOODING DEPENDS ON THE RELATIVE TIMING OF THE SURGE AND THE TIDAL CYCLE...AND CAN VARY GREATLY OVER SHORT DISTANCES. GIVEN THE LARGE WIND FIELD ASSOCIATED WITH SANDY...ELEVATED WATER LEVELS COULD SPAN MULTIPLE TIDE CYCLES RESULTING IN REPEATED AND EXTENDED PERIODS OF COASTAL AND BAYSIDE FLOODING. IN ADDITION...ELEVATED WATERS COULD OCCUR FAR REMOVED FROM THE CENTER OF SANDY. FURTHERMORE...THESE CONDITIONS WILL OCCUR REGARDLESS OF WHETHER SANDY IS A TROPICAL OR POST-TROPICAL CYCLONE. FOR INFORMATION SPECIFIC TO YOUR AREA...PLEASE SEE PRODUCTS ISSUED BY YOUR LOCAL NATIONAL WEATHER SERVICE OFFICE.





8th St./Ave. C, Manhattan, NY
(YouTube/Kevin Barnett)



Midland Beach, Staten Island, NY
(YouTube/Pablo Pintor)



Jersey City, NJ (YouTube/echtjbm)



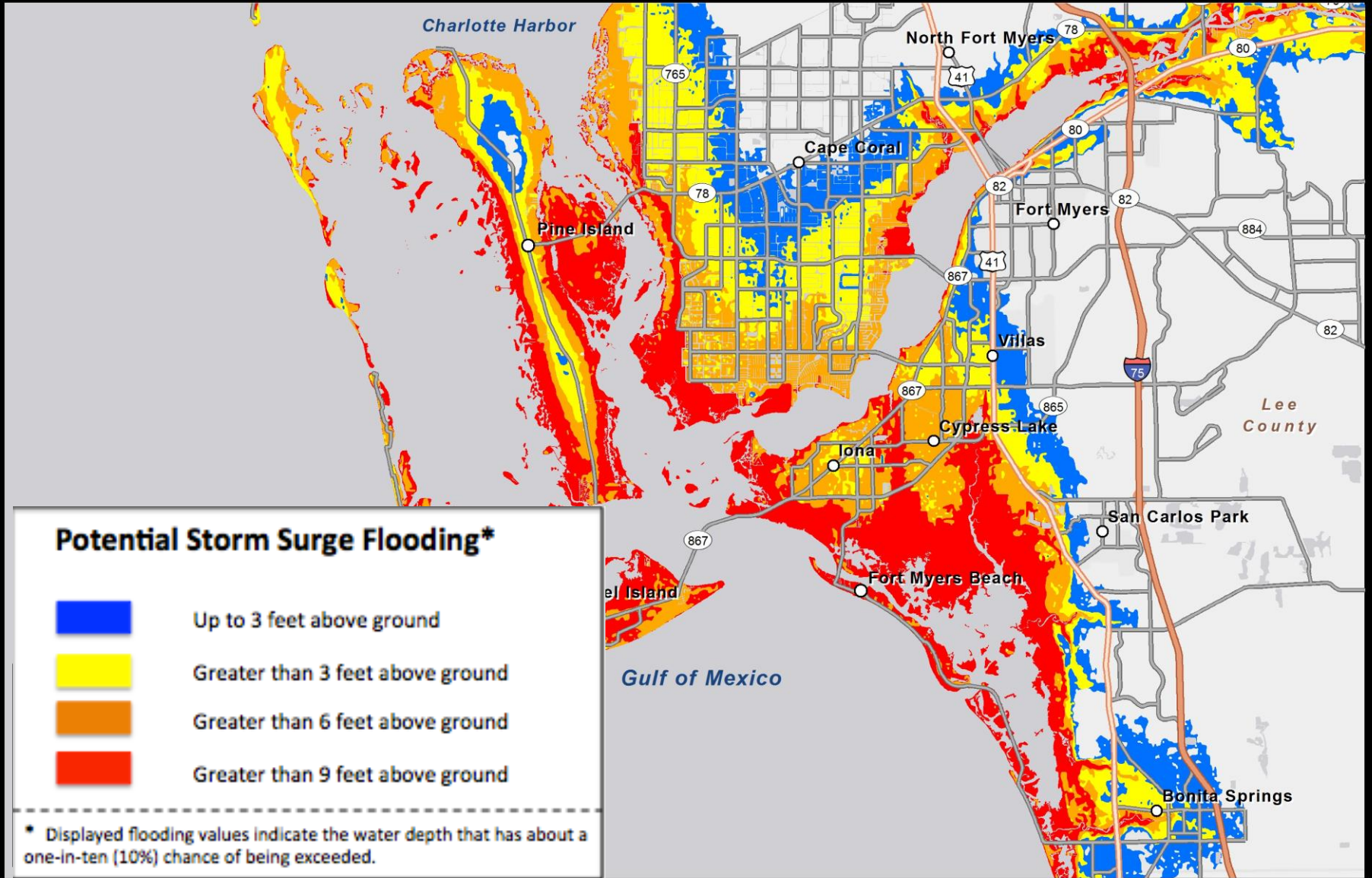
Long Beach, NY (YouTube/105Florida)

Between Mantoloking and Point Pleasant, NJ

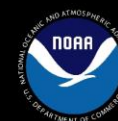




Experimental Graphic Prototype Hurricane X



Planned for experimental availability in 2014

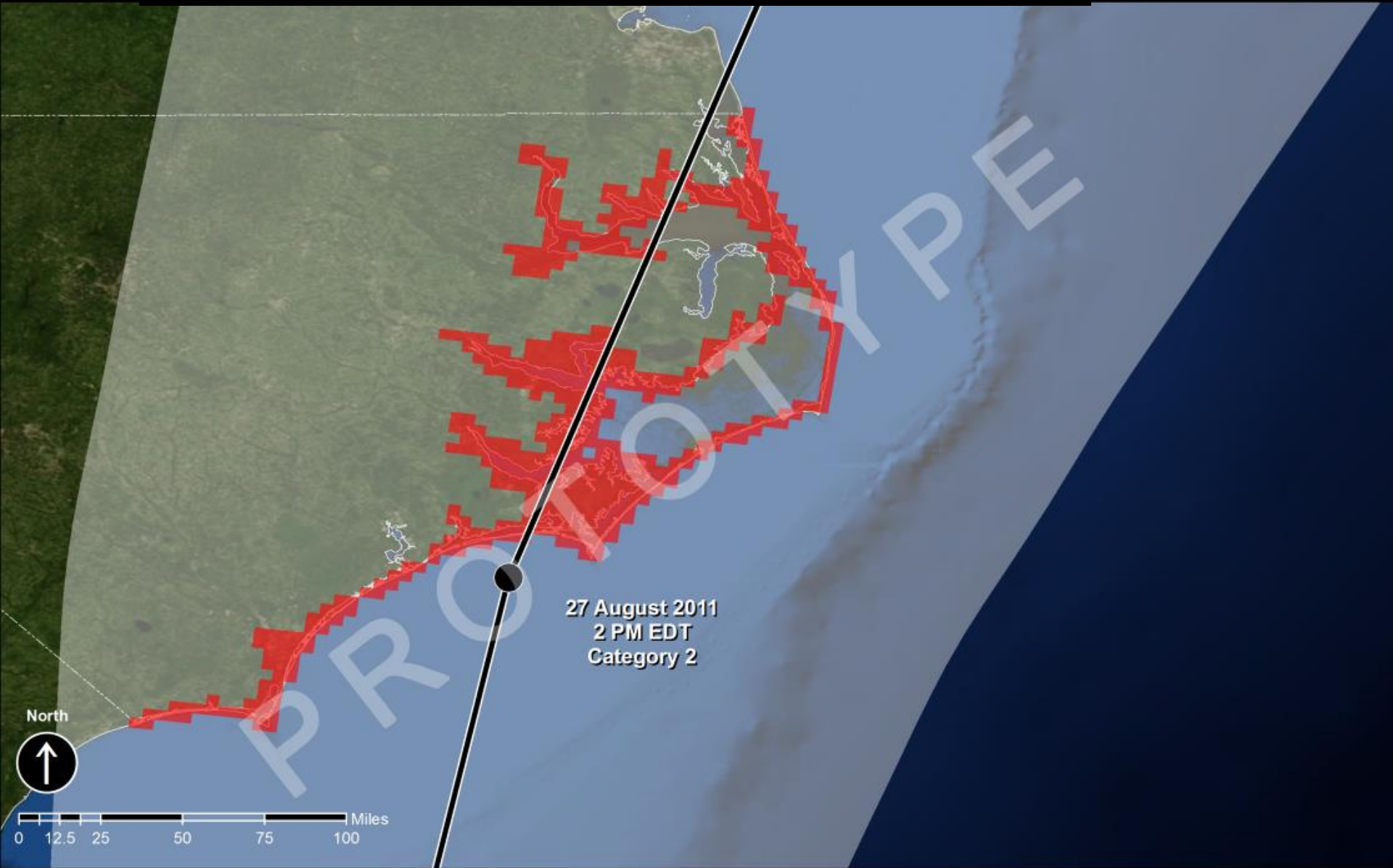


National Hurricane Center
Storm Surge Unit



Storm Surge Warning Prototype

Target of 2015 for public dissemination



27 August 2011
2 PM EDT
Category 2



0 12.5 25 50 75 100 Miles



National Hurricane Center
Storm Surge Unit



Hurricane Irene Adv #22 Forecast Track



NWS/NHC Storm Surge Warning

Annual FEMA/NHC Courses for Emergency Managers



NHC Operations Breakout



Annual WMO International Workshop at NHC



Caribbean Hurricane Awareness Tour

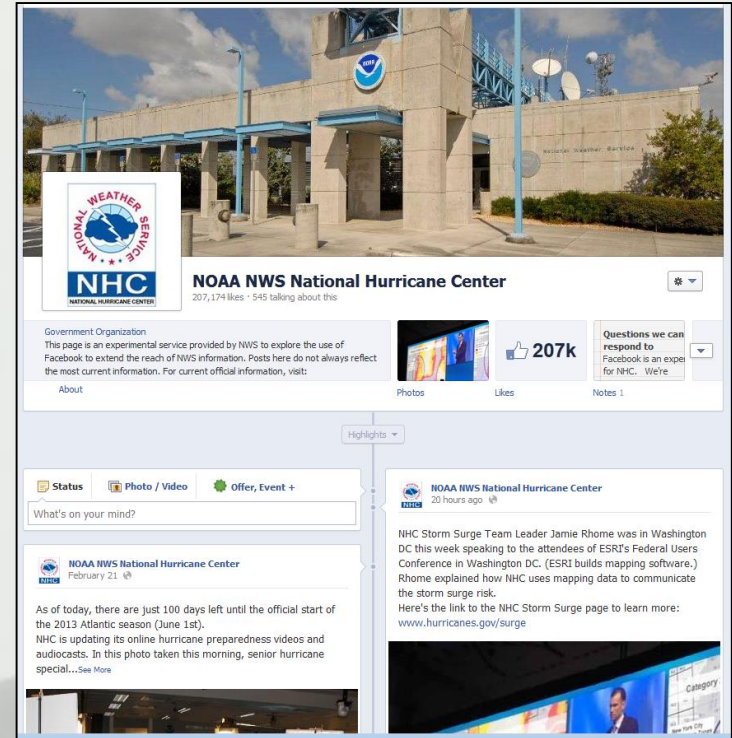


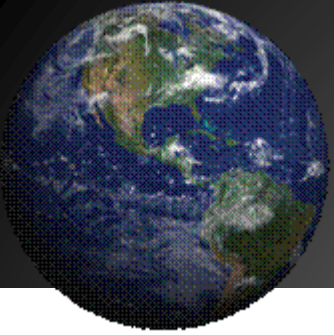


Social Media and NHC



- NHC Facebook & Twitter feeds began in 2011
- Twitter: @NHC_Atlantic, @NHC_Pacific, @NHC_Surge, @NHCDirector
- Hurricane Awareness Week- Public Service Announcements





Weather-Ready Nation

Five Major Focus Areas

Internal

- ☑ Communications/Outreach
 - ☑ Impact-based Decision Support Services
 - ☑ Science & Technology Advances
 - ☑ Information Delivery
-
- ☑ Innovative Partnerships

External to NOAA

