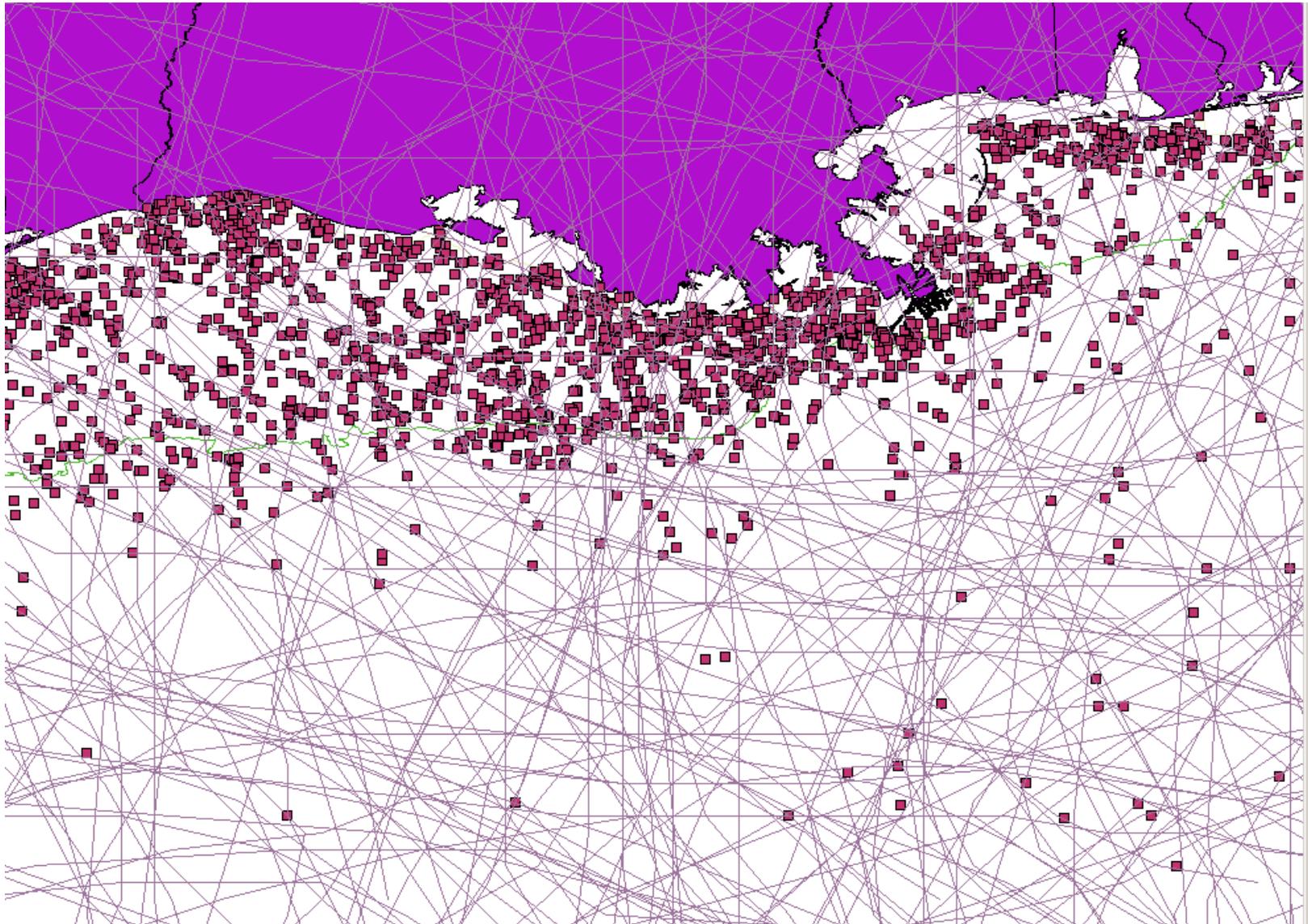
An aerial photograph of a shipwreck in the Gulf of Mexico. The ship's hull is visible, surrounded by a circular area of disturbed water. The background shows the deep blue and green hues of the ocean.

# IMPACTS OF HURRICANES ON SHIPWRECKS IN THE GULF OF MEXICO

**Bob Gearhart**  
PBS&J

# HURRICANE TRACKS & SHIPWRECKS

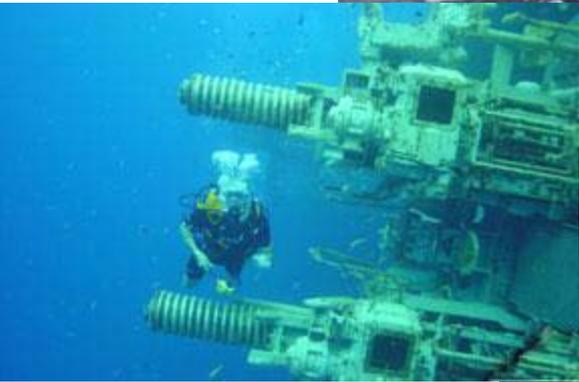


# Impacts of Recent Hurricane Activity on Shipwrecks in the Gulf of Mexico

## Study Objectives:

- (1) conduct remote sensing surveys to document the macro-scale post-storm condition of the sites;
- (2) compare and contrast pre- and post-storm remote-sensing data from each site;
- (3) carry out diver investigations of selected sites to document areas that had changed during the period between pre- and post-storm surveys;
- (4) collect sedimentary samples in order to characterize the substrate;
- (5) estimate peak storm conditions on the seafloor at each site based on wave-current interaction models;
- (6) conduct archival and historical research on each of the primary study sites to fill gaps in their histories.

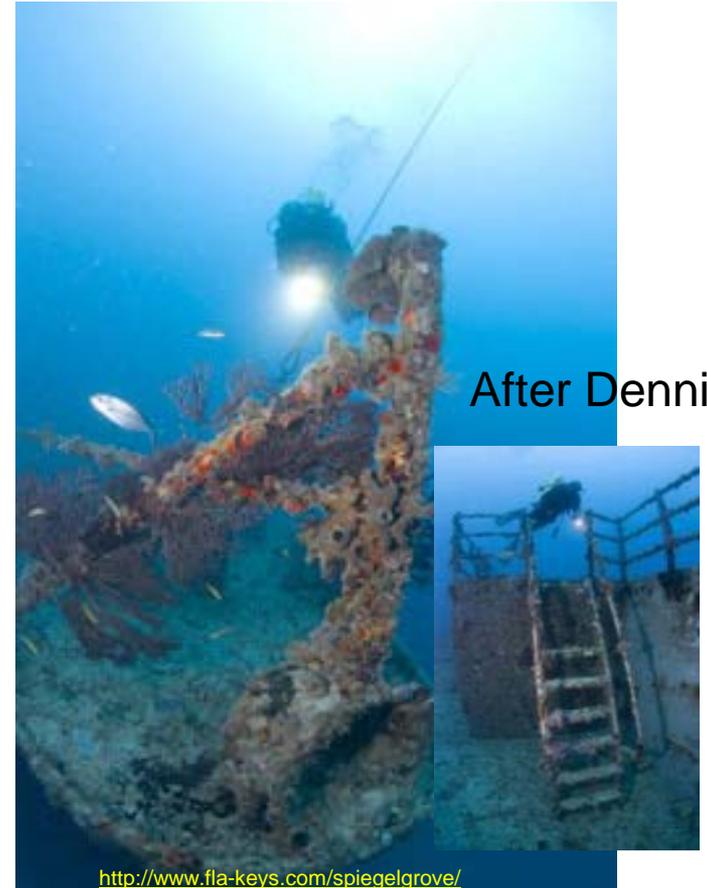
On July 9, 2005, Hurricane Dennis turned the 510-foot *Spiegel Grove* upright from its position on its starboard side in 130 feet of water.



Before Dennis

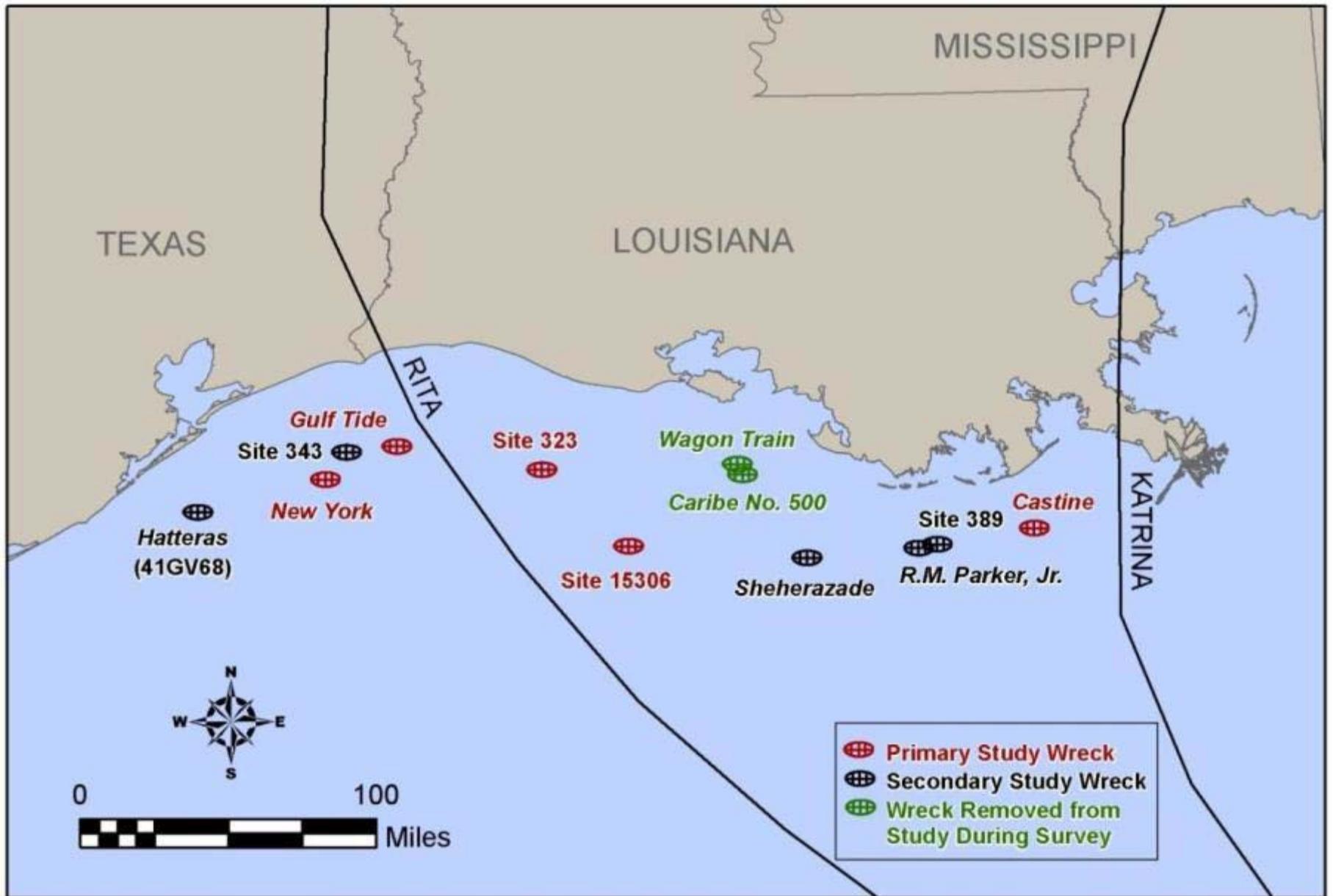


<http://www.southernindianascuba.com/spiegel/day2.html>



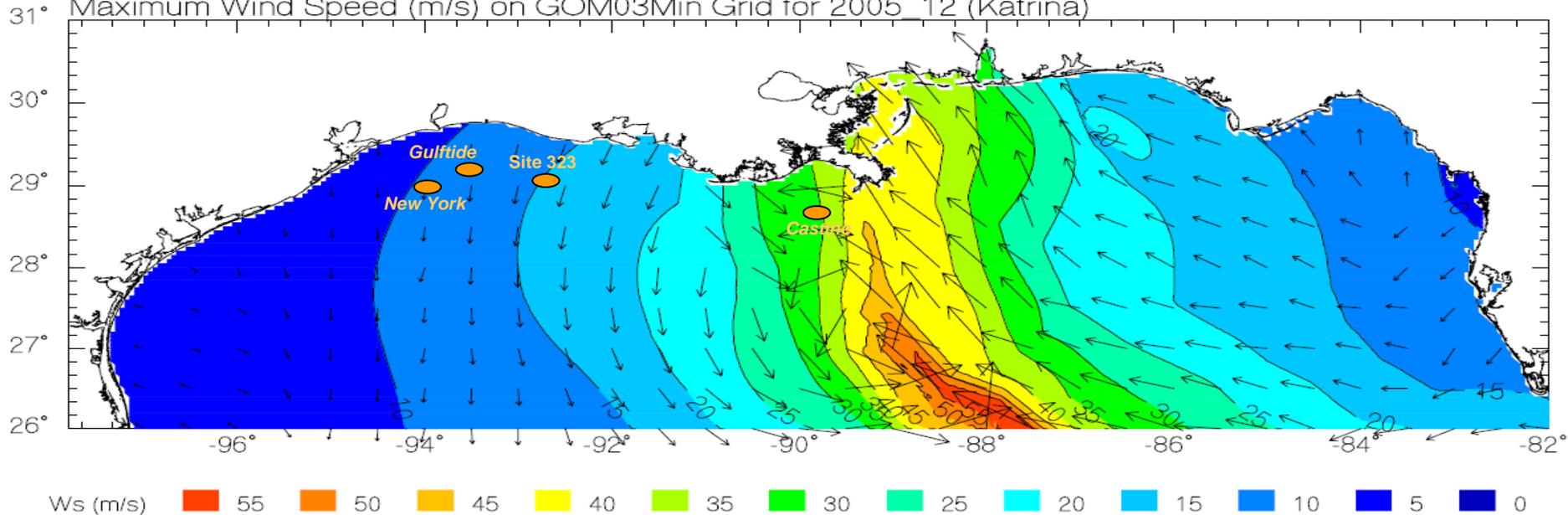
After Dennis

<http://www.fla-keys.com/spiegelgrove/>



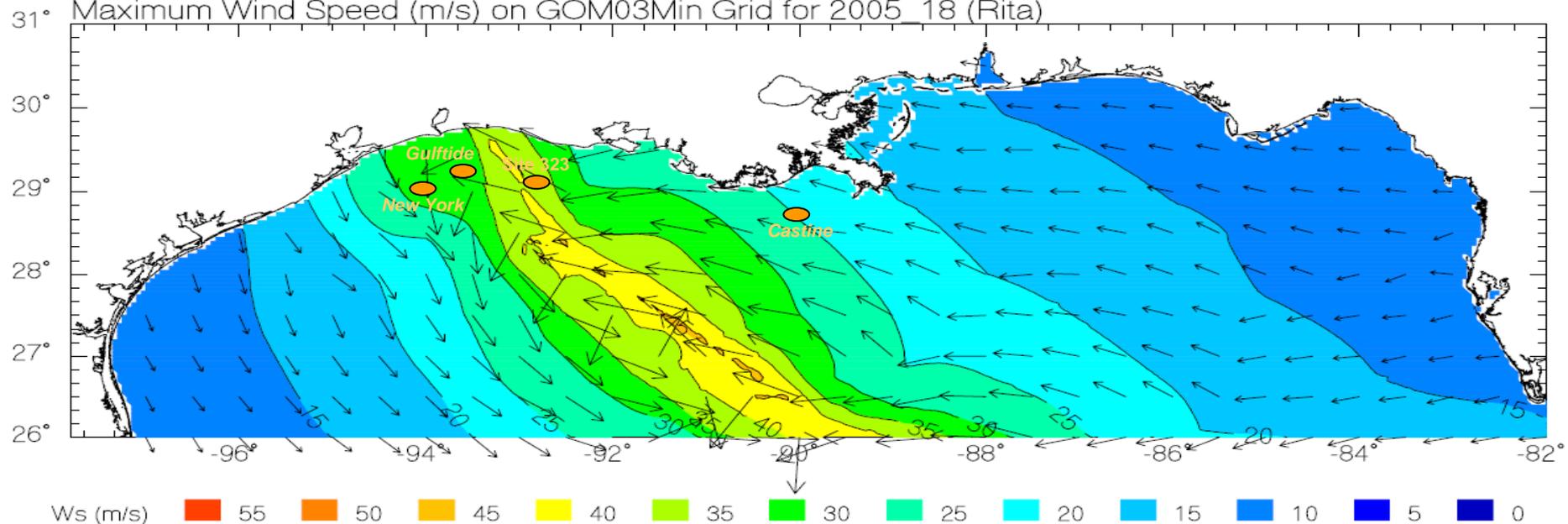
# MMS Katrina and Rita Hindcast Study

## Maximum Wind Speed (m/s) on GOM03Min Grid for 2005\_12 (Katrina)

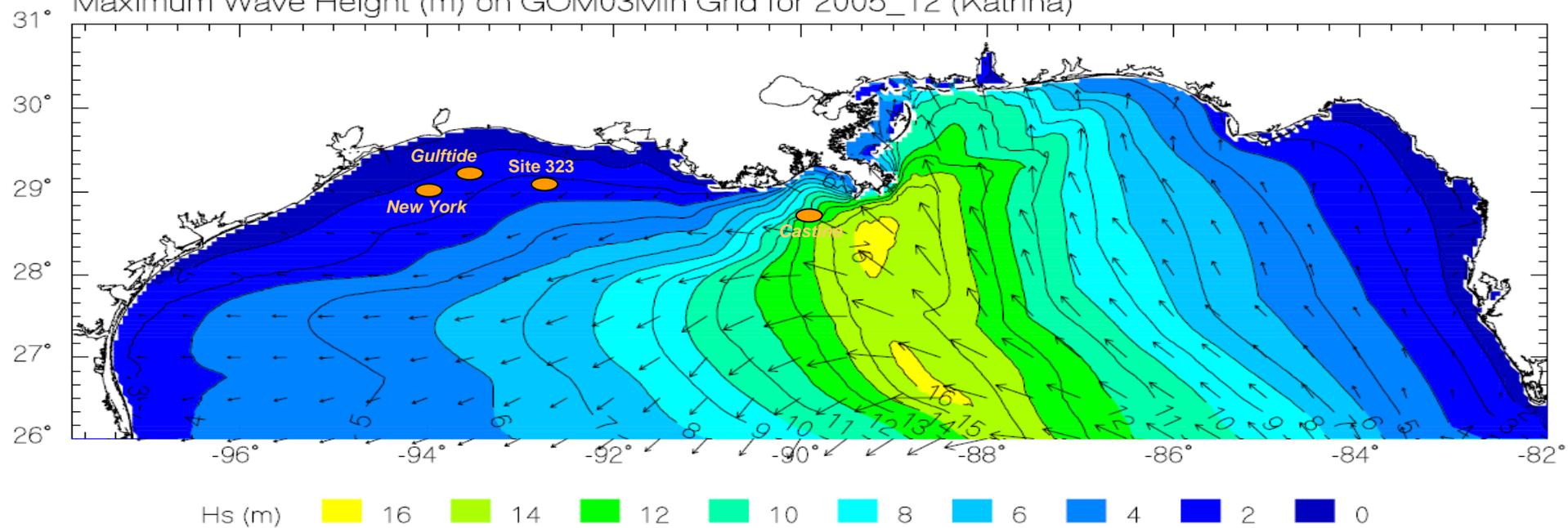


# MMS Katrina and Rita Hindcast Study

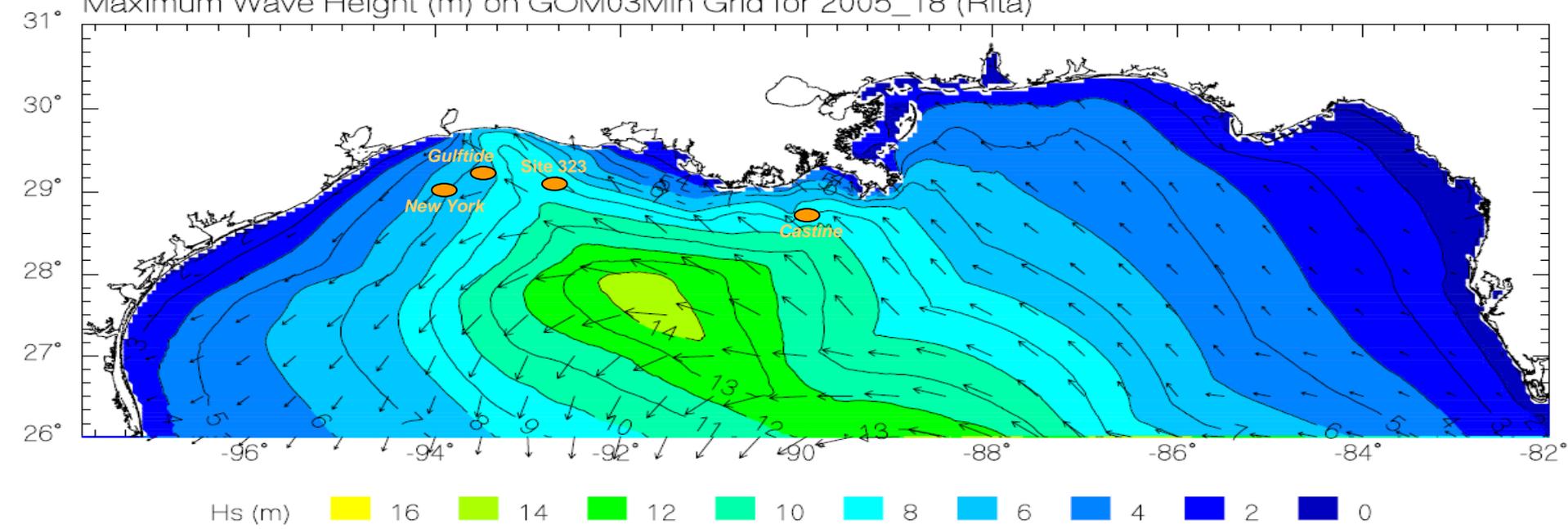
## Maximum Wind Speed (m/s) on GOM03Min Grid for 2005\_18 (Rita)



MMS Katrina and Rita Hindcast Study  
Maximum Wave Height (m) on GOM03Min Grid for 2005\_12 (Katrina)



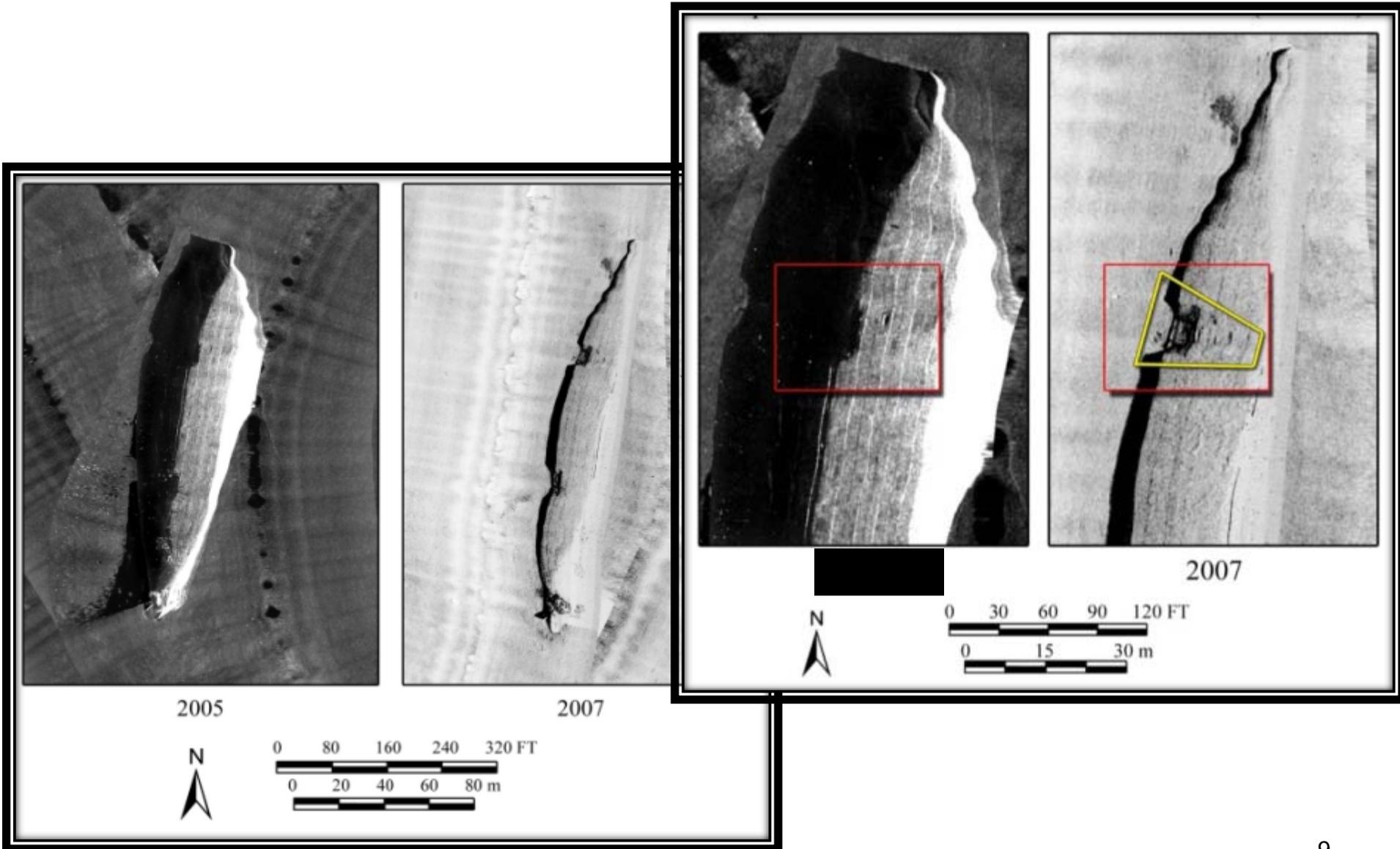
MMS Katrina and Rita Hindcast Study  
Maximum Wave Height (m) on GOM03Min Grid for 2005\_18 (Rita)



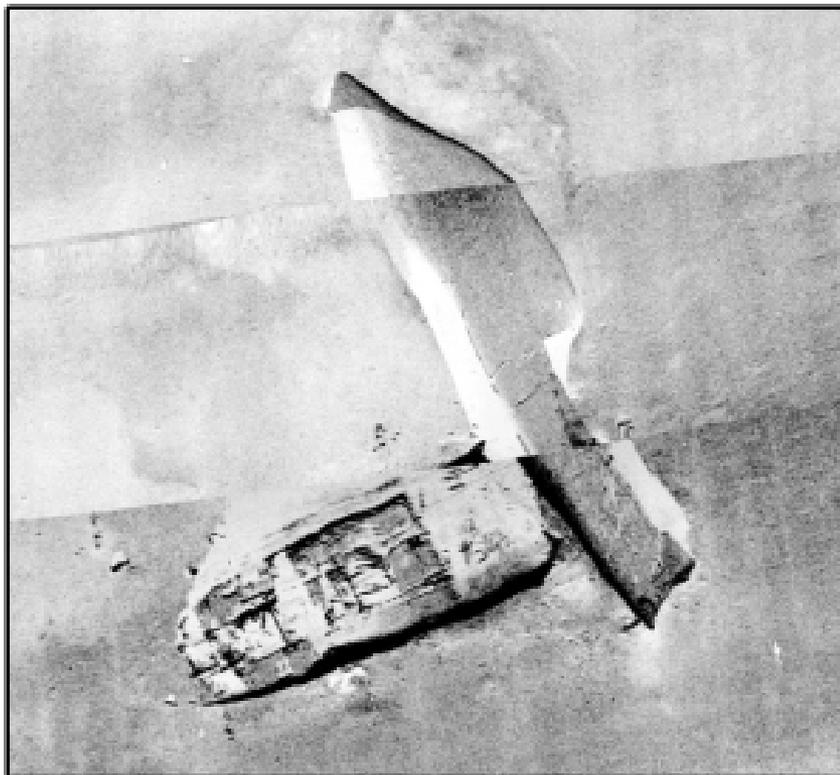
# DAMAGE ASSESSMENT & RECOMMENDATIONS

NAME	HURRICANE PROXIMITY	DAMAGE	RECOMMENDATIONS
New York	29.9 nm west of Rita	Increased exposure; reports of salvage activity	Diving to document extent of salvage and storm damage
Gulf Tide	7.3 nm west of Rita	Possibly increased exposure, but earlier sonar imagery of poor quality	Diving to document extent of storm damage
Site 323	24.8 nm east of Rita	Broken near stern	Diving to document extent of storm damage
Castine	26.4 nm west of Katrina	No apparent change	Diving is recommended because this is the closest wreck to Katrina
*R.M. Parker Jr.	60.5 nm west of Katrina	No apparent change	No further investigation
*Sheherazade	71.8 nm east of Rita	No apparent change	No further investigation
*Site 15306	32.6 nm east of Rita	No apparent change	No further investigation
**Site 389	55.0 nm west of Katrina	No apparent change	No further investigation
**Site 343	20.3 nm west of Rita	Change undeterminable	No further investigation
**USS Hatteras	67.5 nm west of Rita	No apparent change	No further investigation

# Site 328 – *Sheherazade*



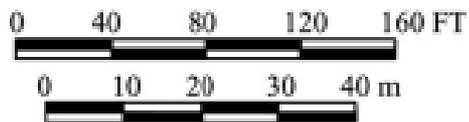
# Site 432 – *R.M. Parker Jr*



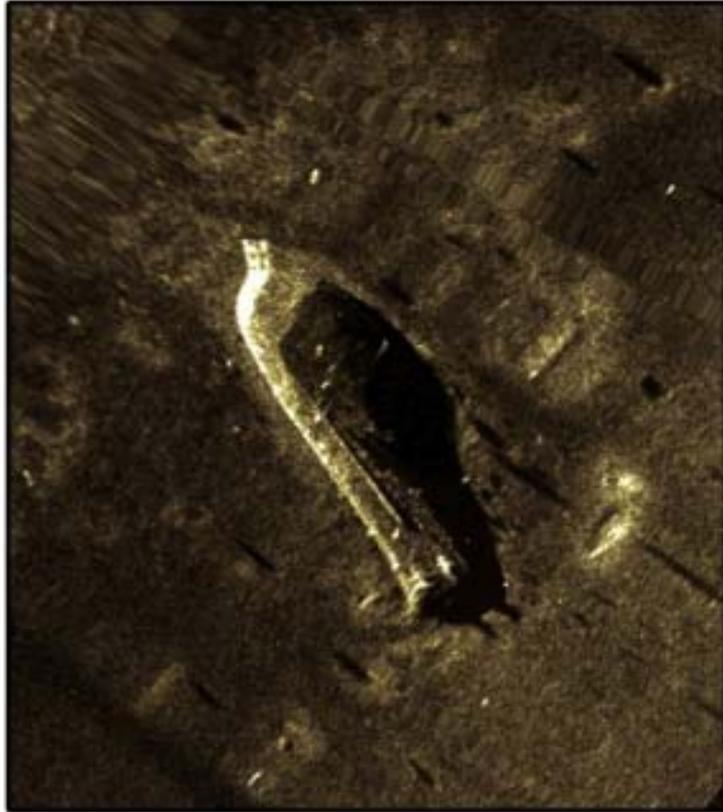
2005



2007



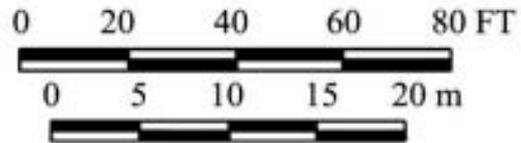
# Site 15306



2004



2007



# Site 389 – Suspected *J.A. Bisso*



2005



2007



0 20 40 60 80 FT



0 5 10 15 20 m



# Site 343



1997



2007



0 20 40 60 80 FT



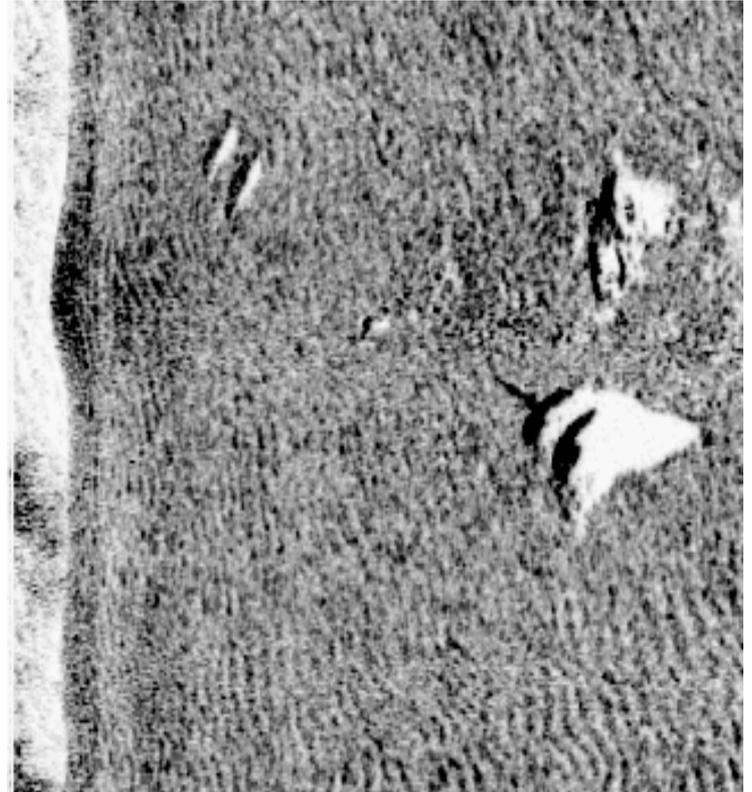
0 5 10 15 20 m



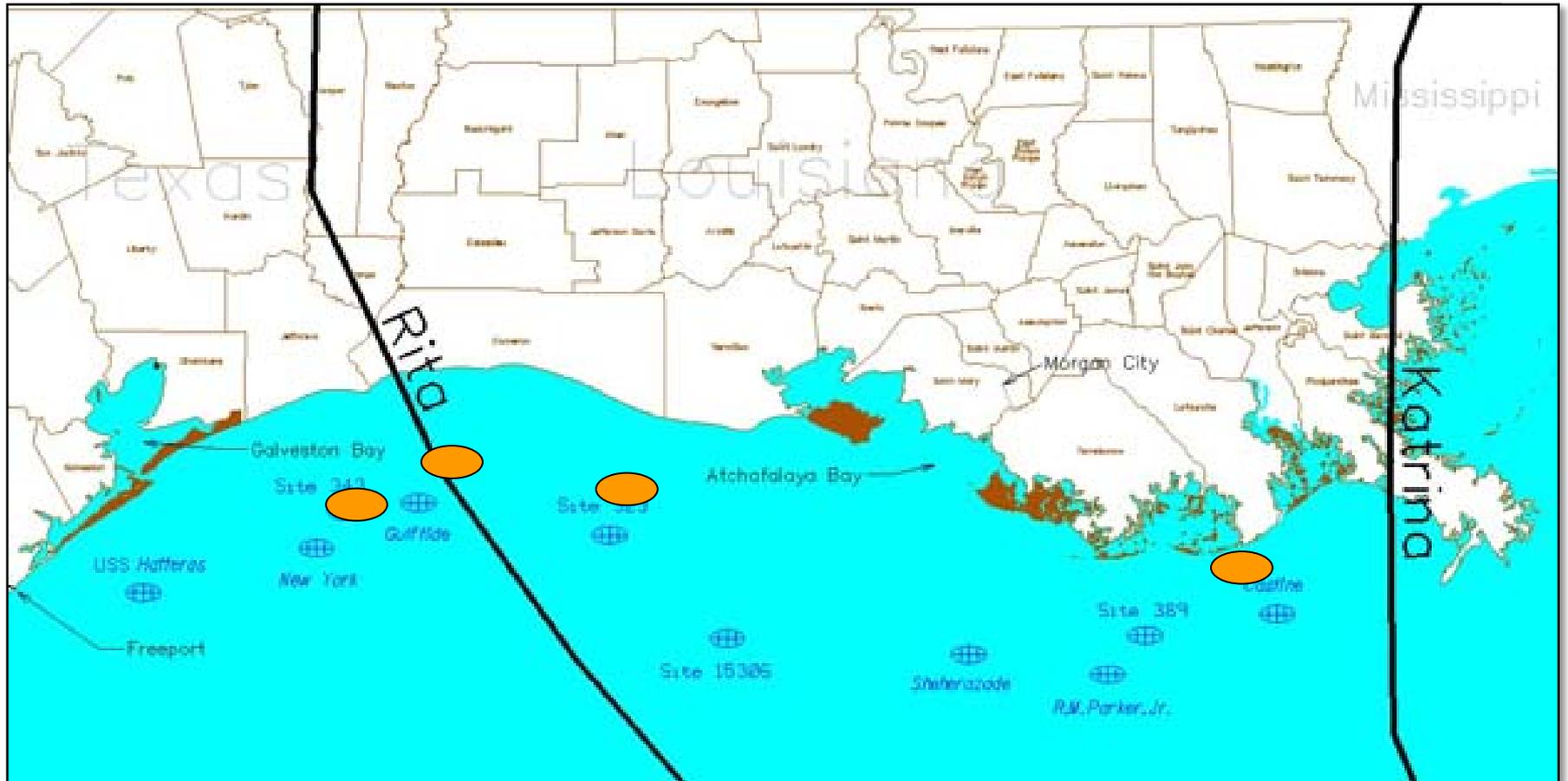
# Site 236 – USS *Hatteras*



2007



2004



# Site 323



## Hindcast Data

25 nautical miles east of eye  
85.7 mph – peak sustained wind  
30.8 ft – maximum significant  
wave height

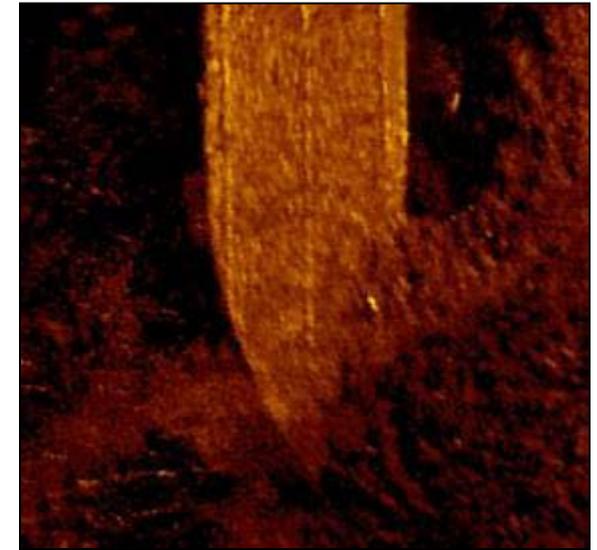
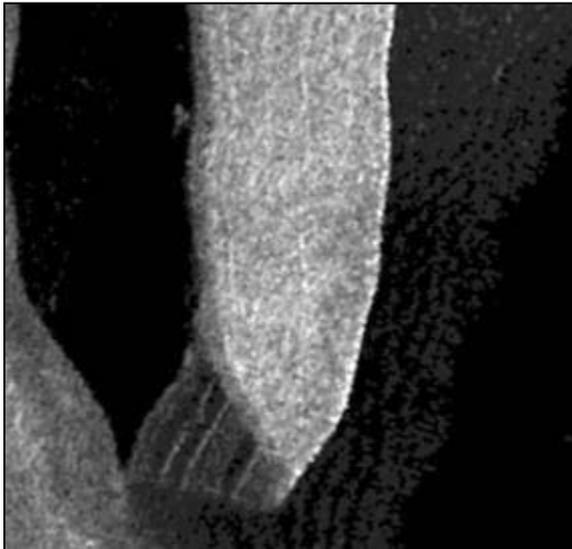
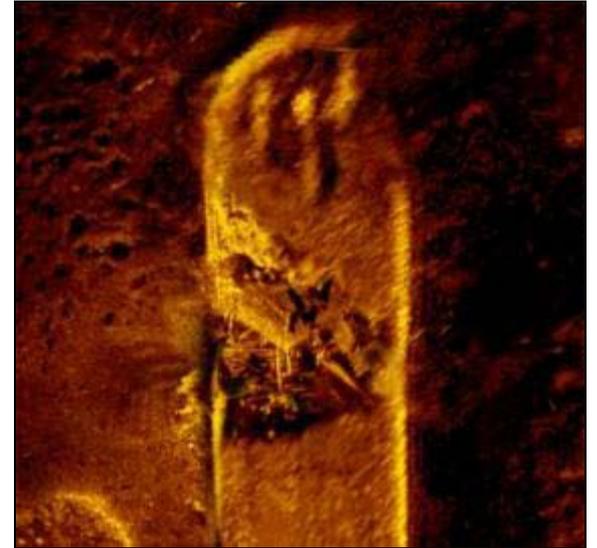
2004

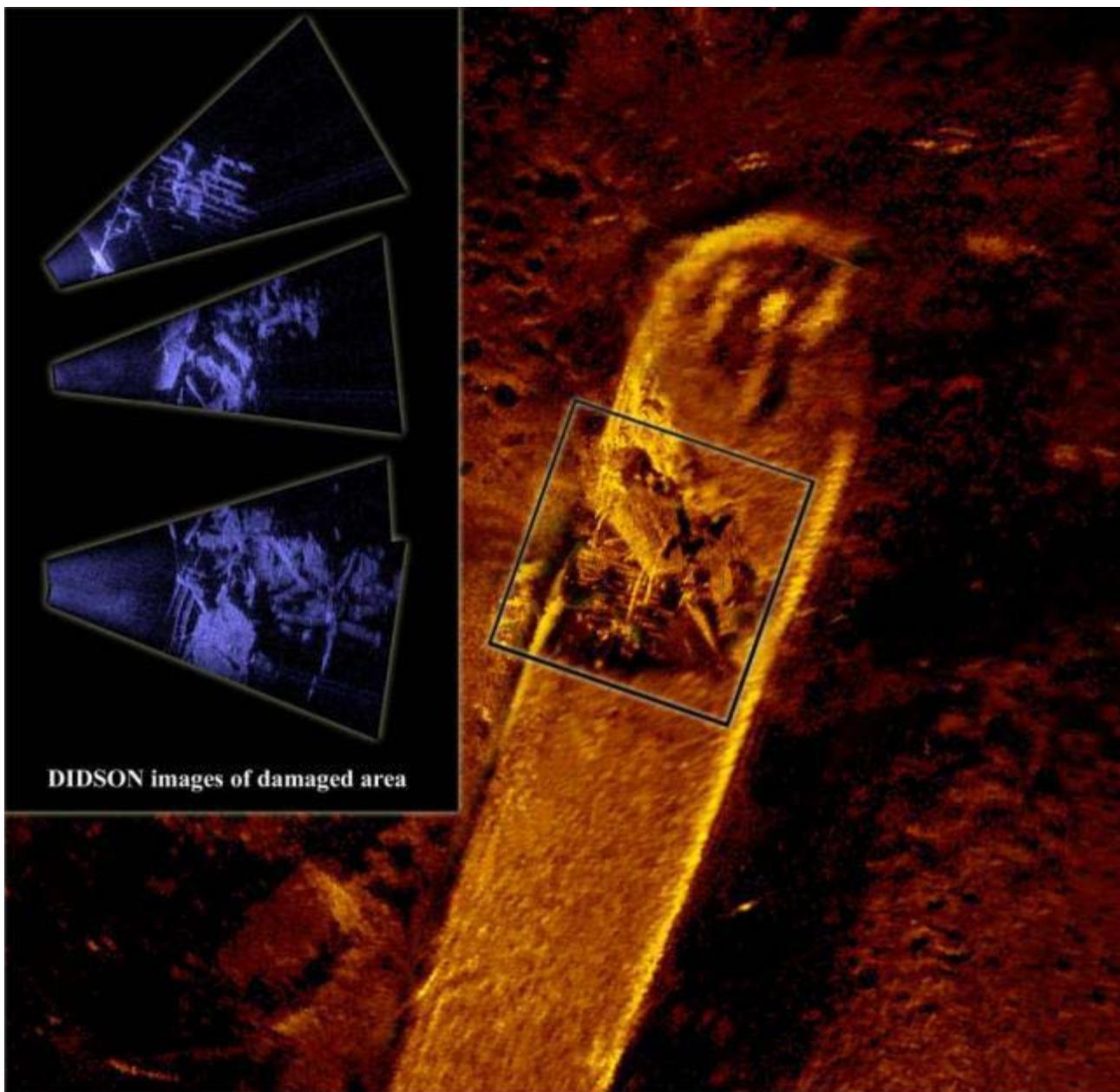


2007

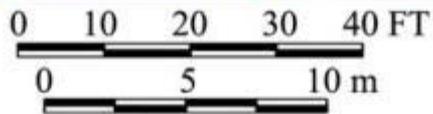


2007



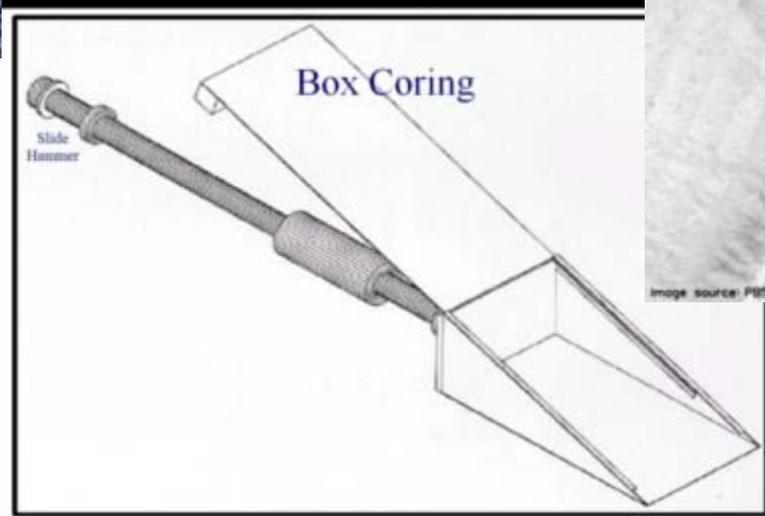


DIDSON images of damaged area





# Beaumont Clay in Box Core from Site 323



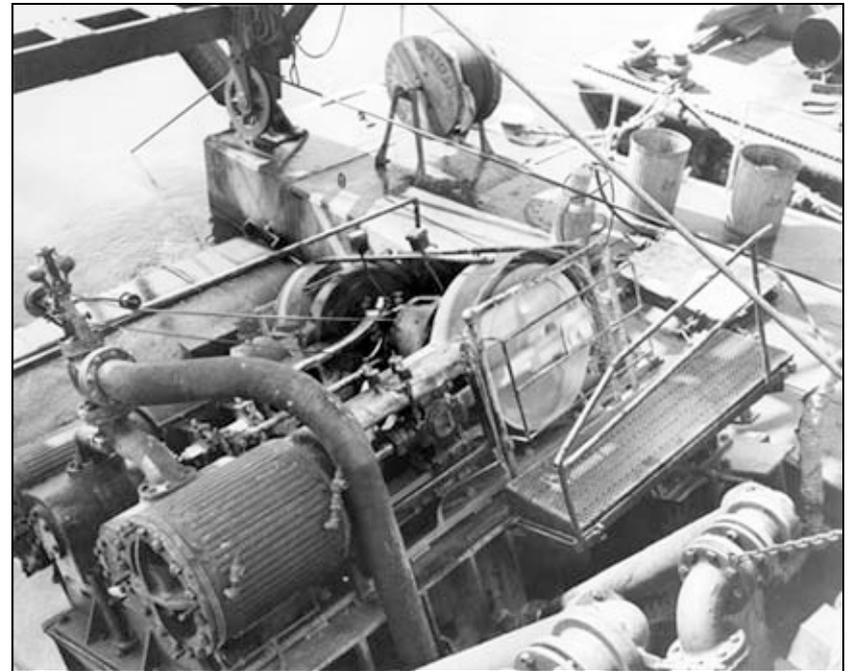
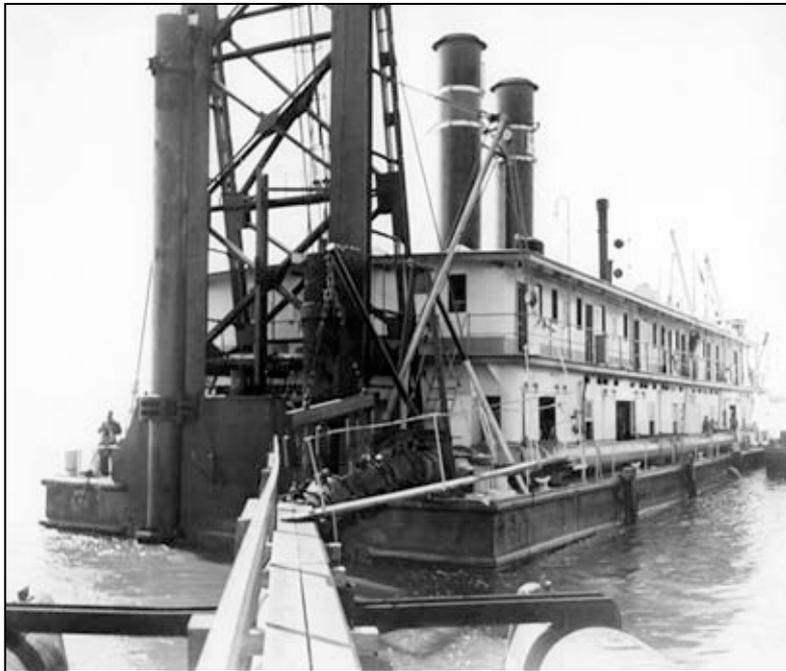
# *Gulf Tide*



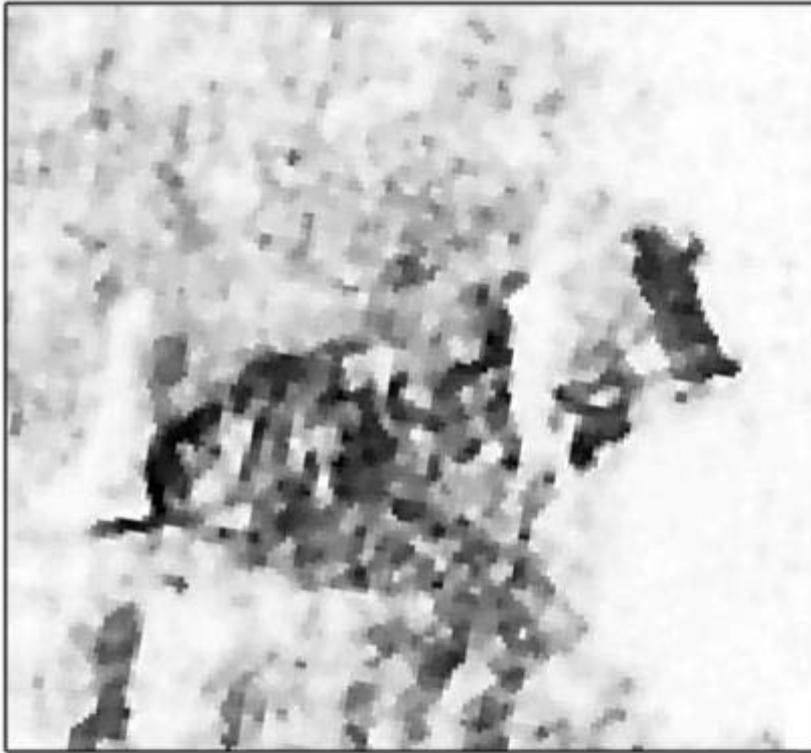
## Hindcast Data

7.3 nautical miles west of eye  
79 mph – peak sustained wind  
23 ft – maximum significant  
wave height

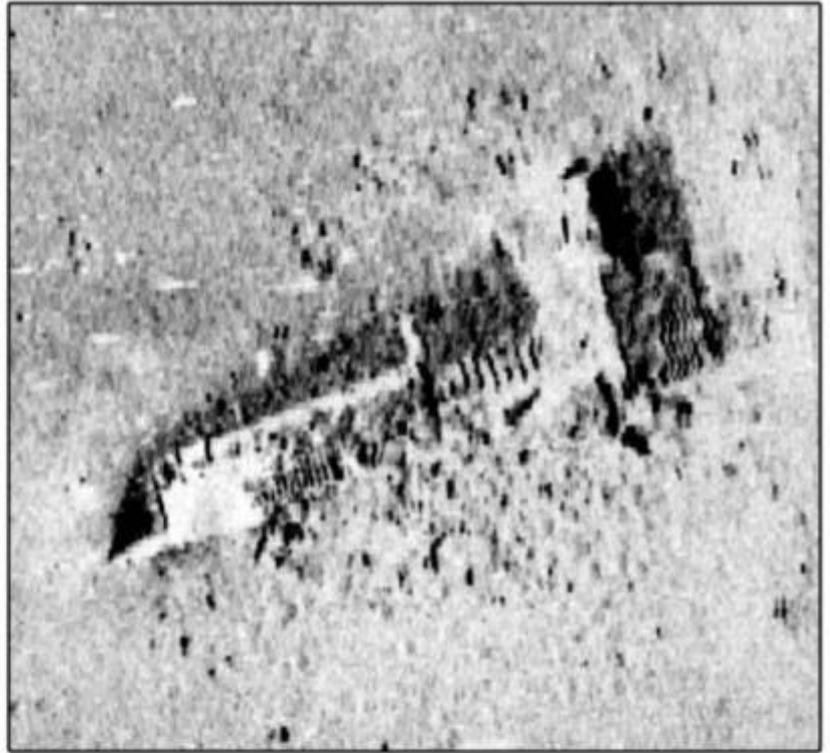
*Henry Bacon*  
160 x 41 x 9 ft.  
Built in 1931



*Gulf Tide (Site 417)*



1997



2007

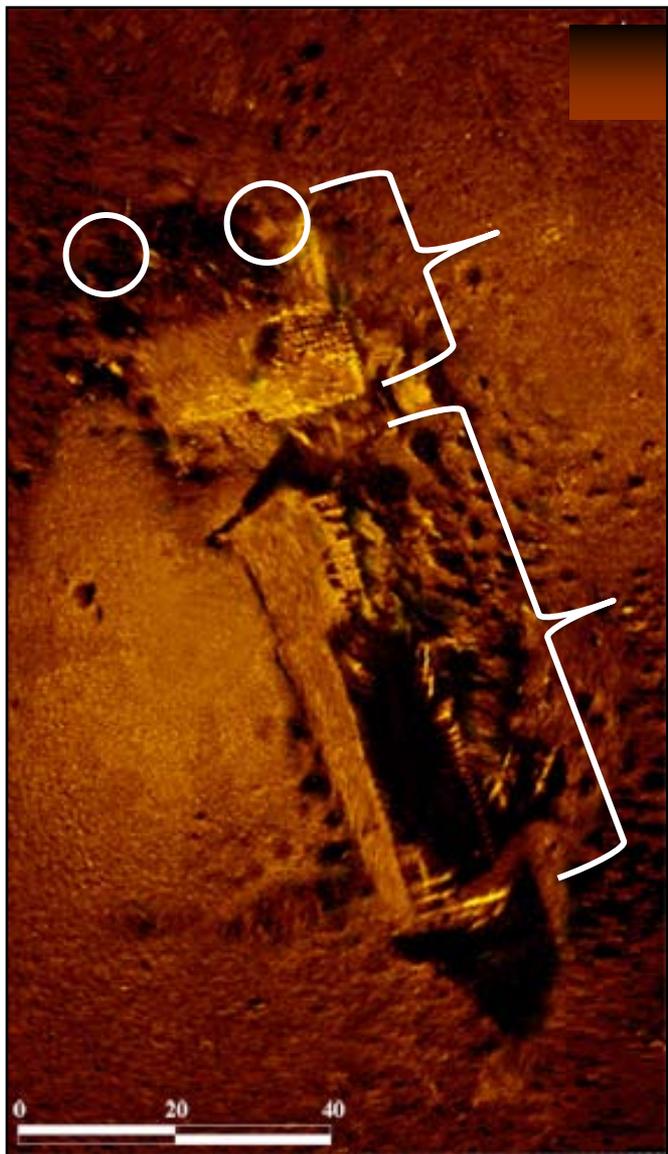


0 10 20 30 40 FT

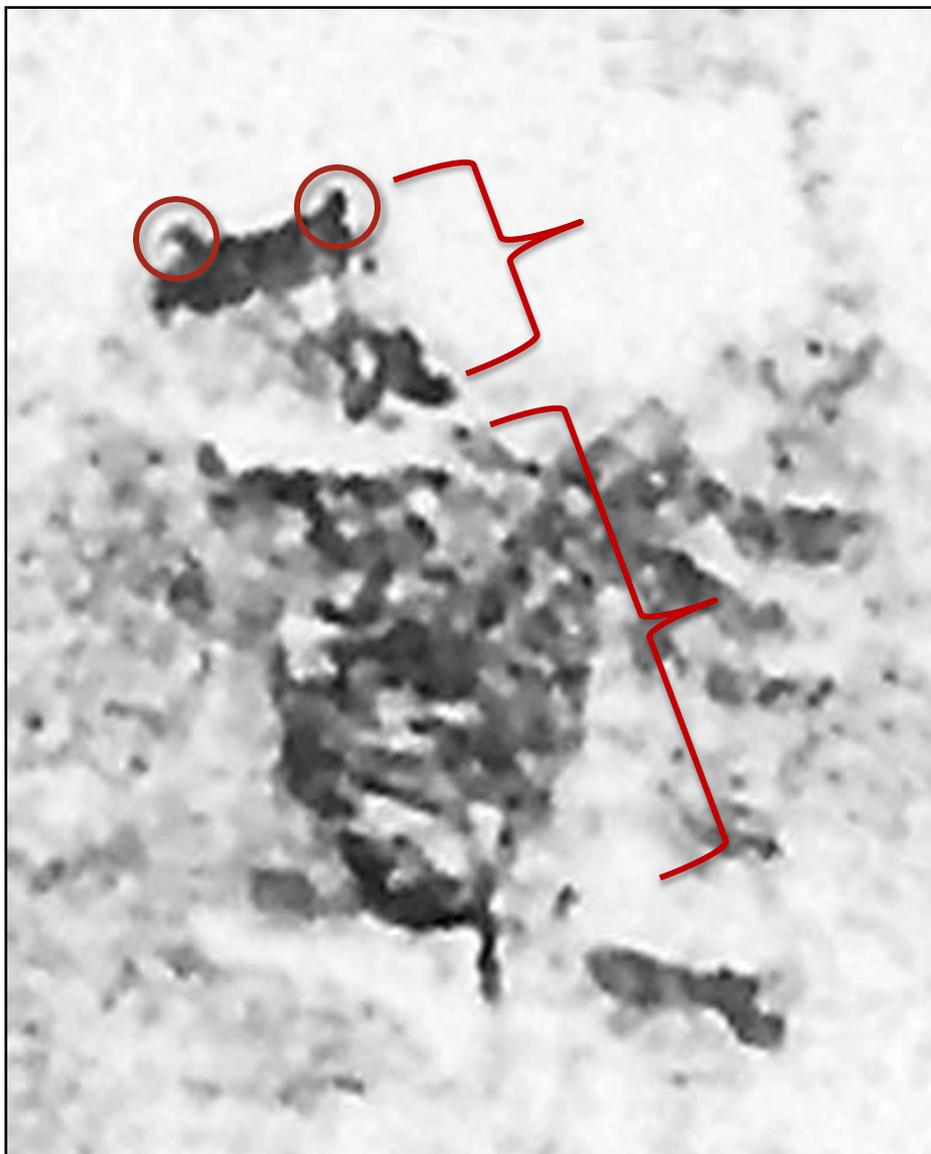


0 5 10 15 20 m

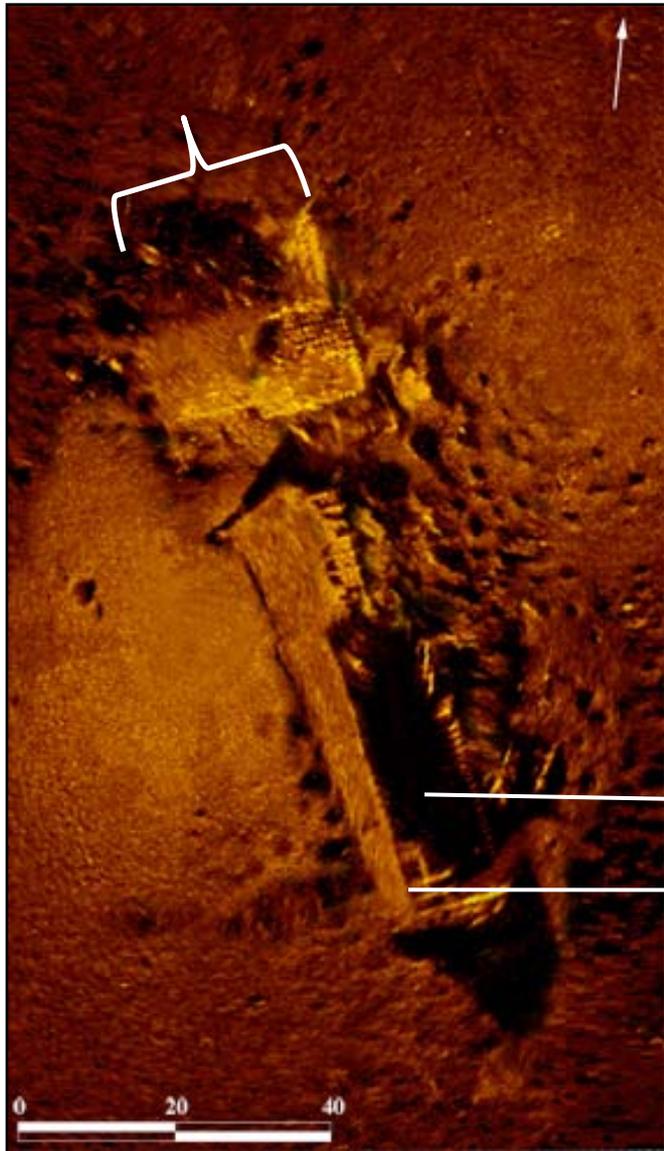




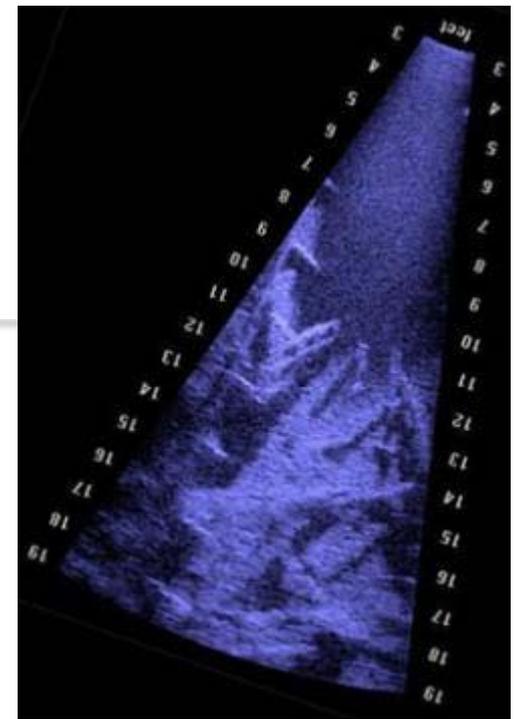
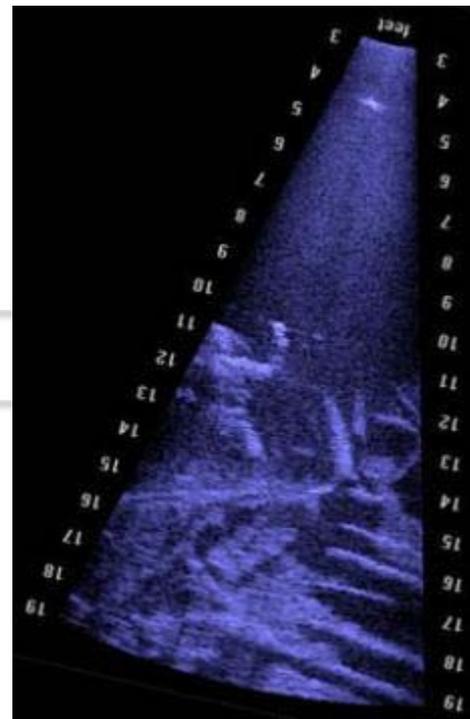
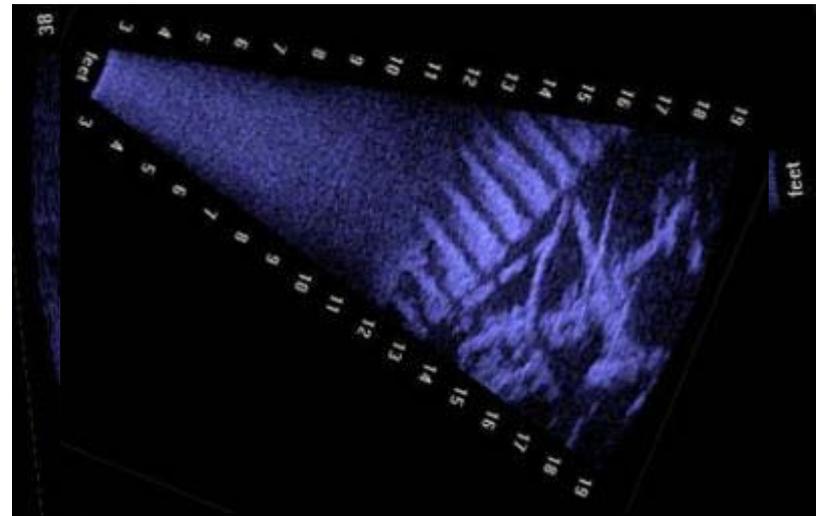
**Sector-Scan 2007**



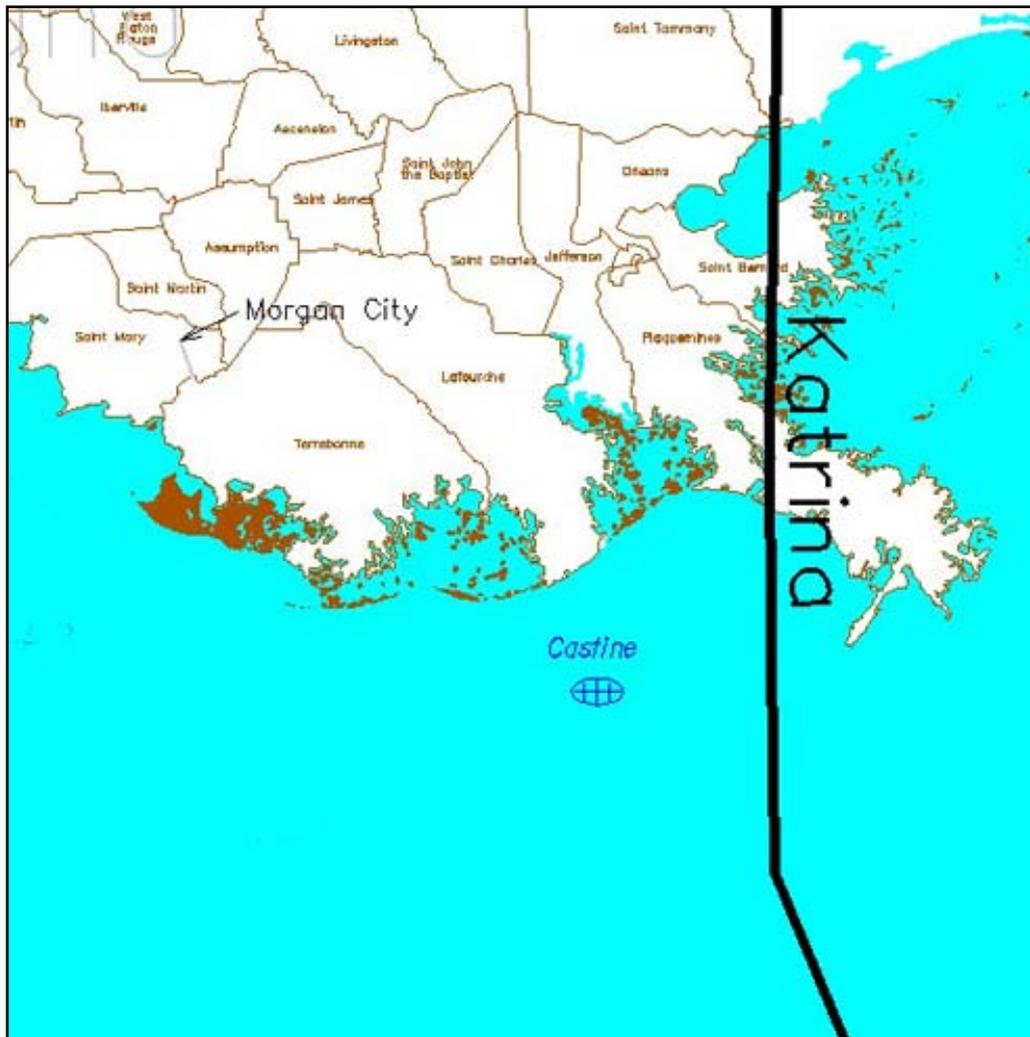
**Sonar Image 1997**



**Sector-Scan 2007**



# *Castine* 1892 – 1924



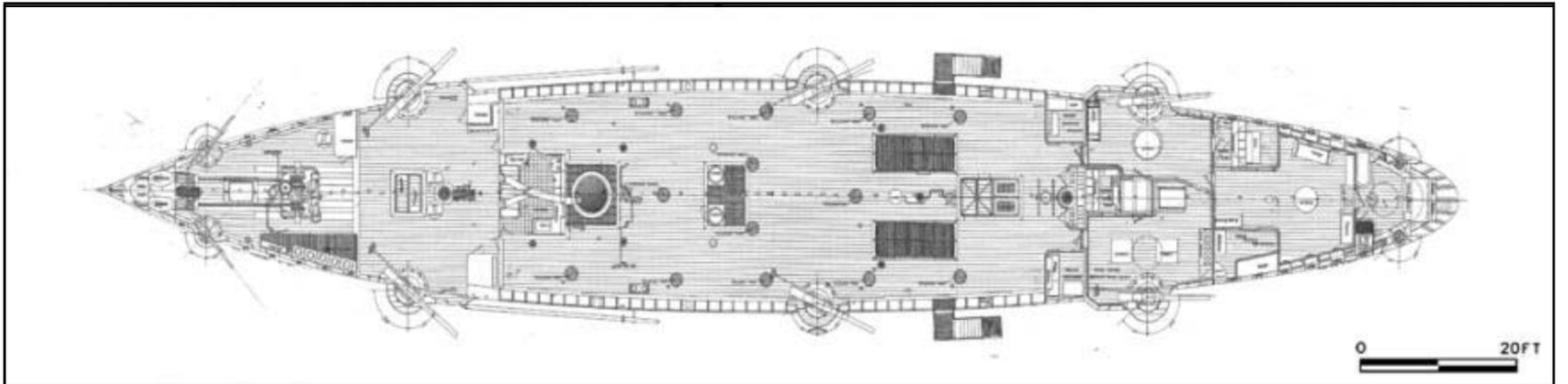
## Hindcast Data

26 nautical miles west of path  
74 mph – peak sustained wind  
32 ft – maximum significant  
wave height

# *Castine*

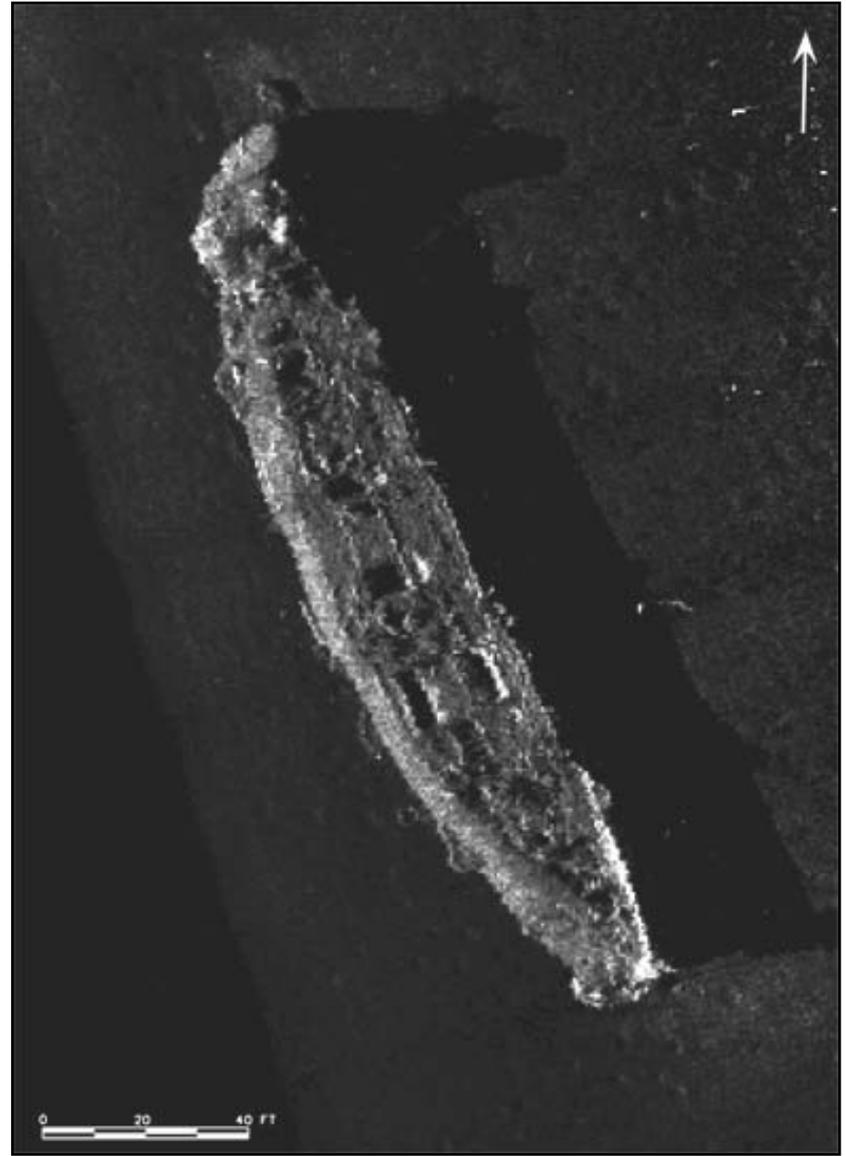
1892–1924







**Side-Scan 2007**



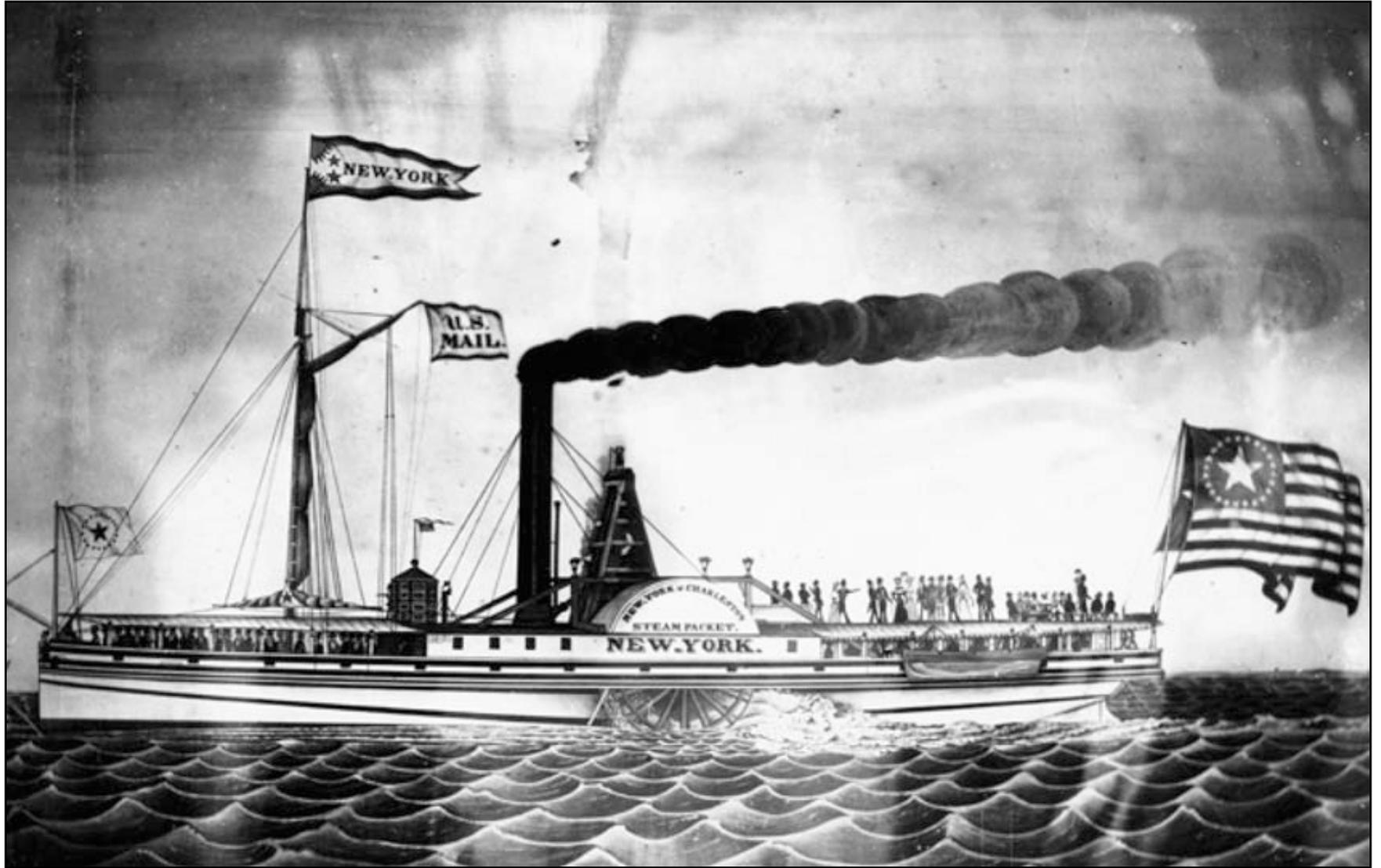
**Side-Scan 2004**

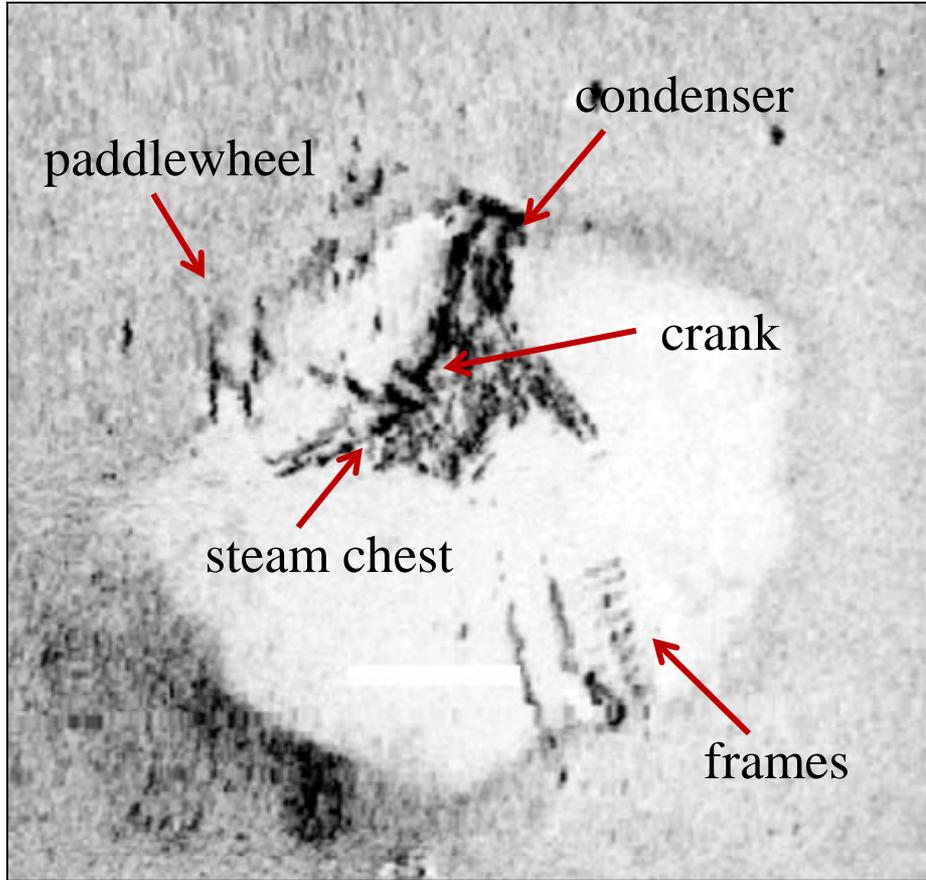
# SS *New York* 1837–1846



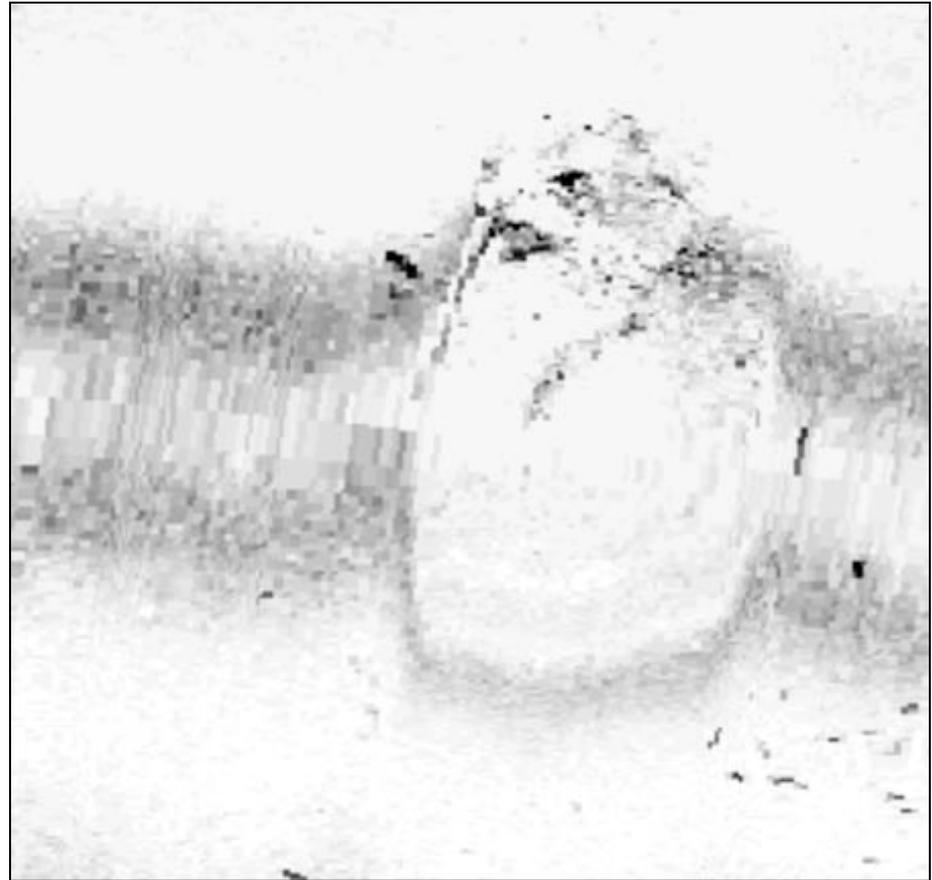
## Hindcast Data

26 nautical miles west of path  
74 mph – peak sustained wind  
32 ft – maximum sustained wave height





**Sonar Image 2007**

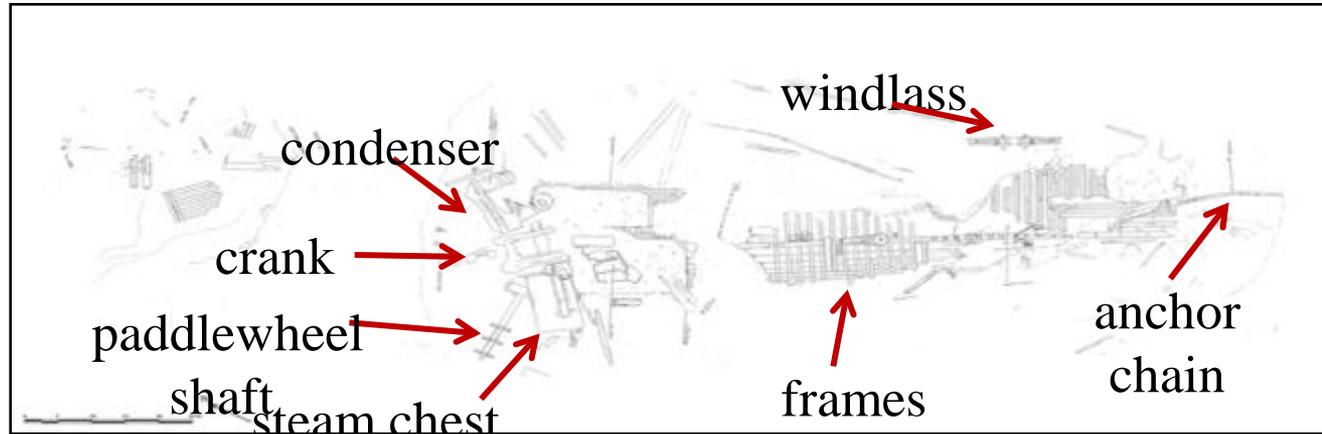


**Sonar Image 1997**

Sonar Image  
May 2007

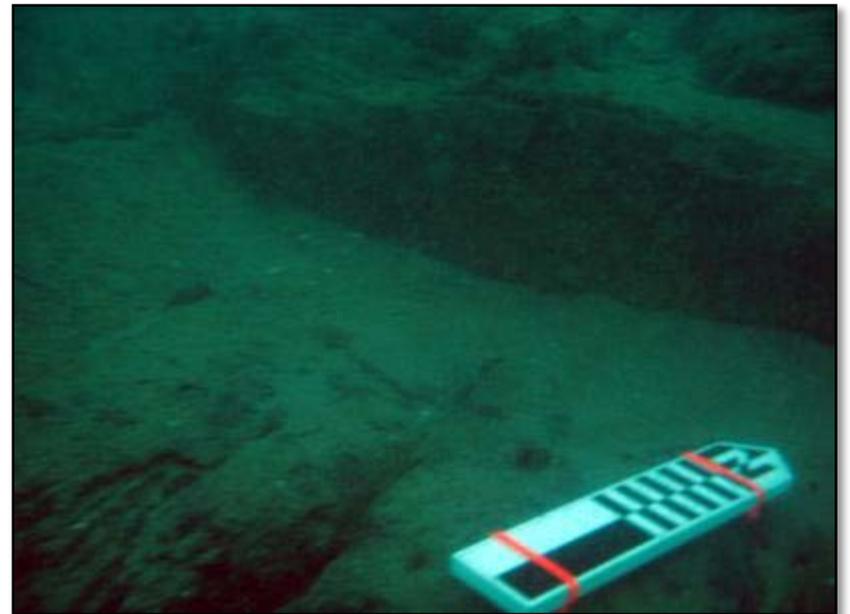


PBS&J draft  
site plan



Sector Scan  
October 2007

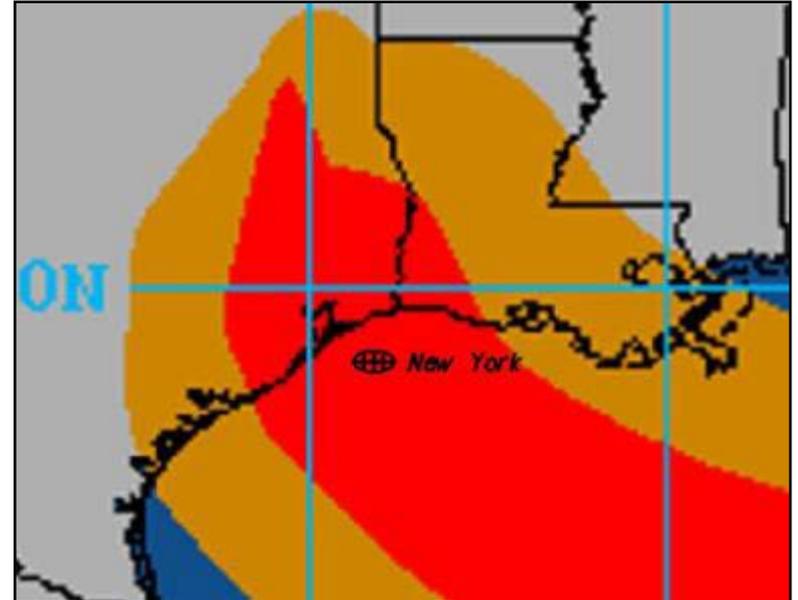








# Hurricane Ike Path

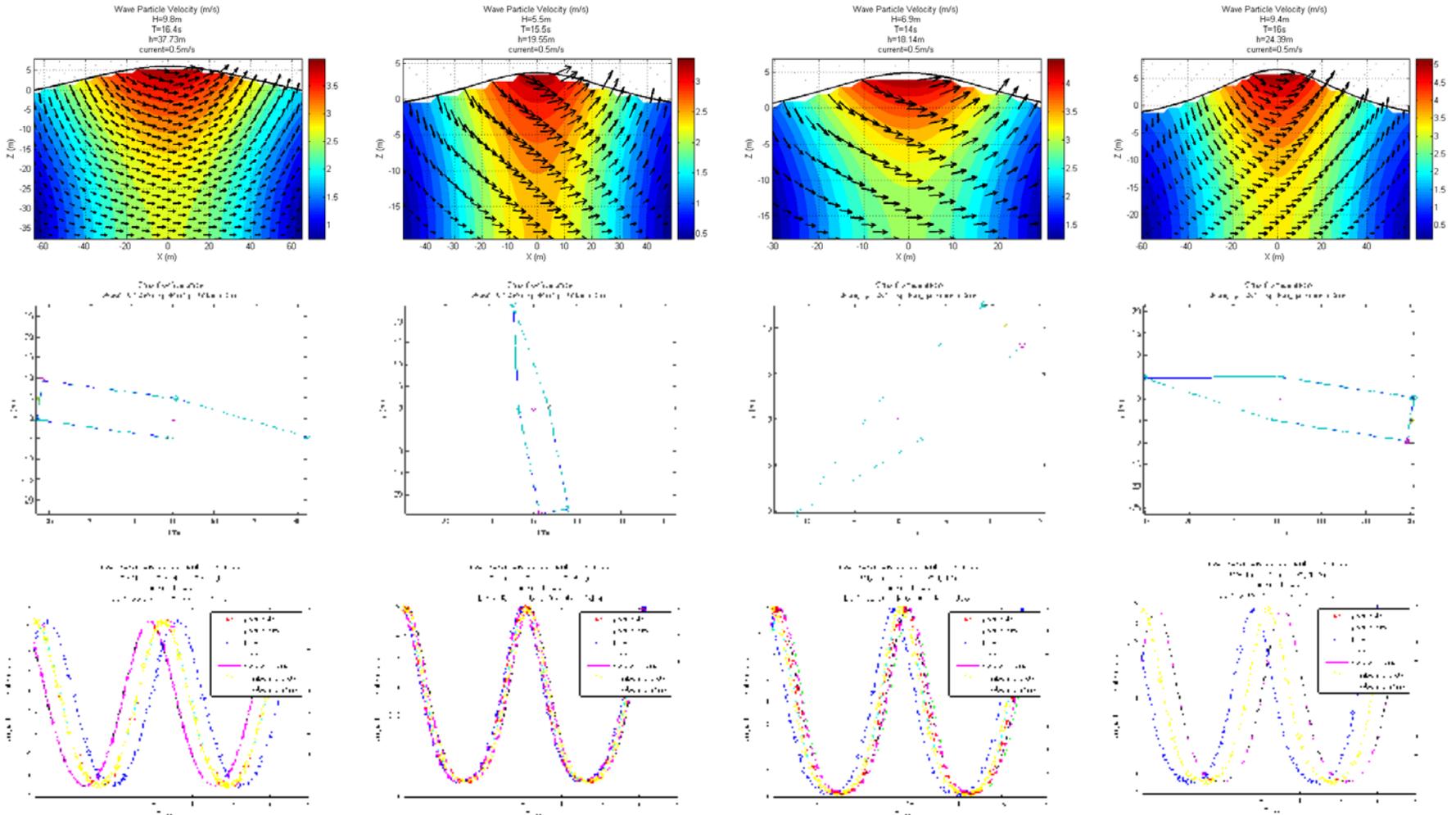


# Wave Model Input Parameters

<u>Wreck</u>	<u>USS Castine</u>	<u>New York</u>	<u>Gulftide</u>	<u>Site 323</u>
Height of Water Column (m)	37.7	19.6	18.1	24.4
*Max. Sig. Wave Height (m)	9.8	5.5	6.9	9.4
*Wave Period (sec)	16.4	15.5	14	16
Uniform Current (m/s)	<b>0.5</b>	<b>0.5</b>	<b>0.5</b>	<b>0.5</b>

\* From Oceanweather, Inc. 2006. Hindcast data on winds, waves, and currents in Northern Gulf of Mexico in Hurricanes Katrina and Rita.

# Castine - New York - Gulftide - Site 323



# Equivalent Forces in Air (for comparison)

	<i>USS Castine</i>	<i>New York</i>	<i>Gulf Tide</i>	<i>Site 323</i>
Maximum (forward) bottom current velocity	5.8 mph [2.6 m/s]	5.6 mph [2.5 m/s]	6.5 mph [2.9 m/s]	7.6 mph [3.4 m/s]
Forward wind speed required for *equivalent force	164 mph [73 m/s]	158 mph [71 m/s]	183 mph [82 m/s]	215 mph [96 m/s]
Minimum (reverse) bottom current velocity	-2.9 mph [-1.3 m/s]	-1.6 mph [-0.7 m/s]	-2.0 mph [-0.9 m/s]	-2.7 mph [-1.2 m/s]
Reverse wind speed required for *equivalent force	-82 mph [-37 m/s]	-44 mph [-20 m/s]	-57 mph [-26 m/s]	-76 mph [-34 m/s]
Combined amplitude of forward and reverse bottom current	8.7 mph [3.9 m/s]	7.2 mph [3.2 m/s]	8.5 mph [3.8 m/s]	10.3 mph [4.6 m/s]
Combined amplitude of *equivalent forward and reverse wind shear	247 mph [110 m/s]	202 mph [90 m/s]	240 mph [107 m/s]	291 mph [130 m/s]

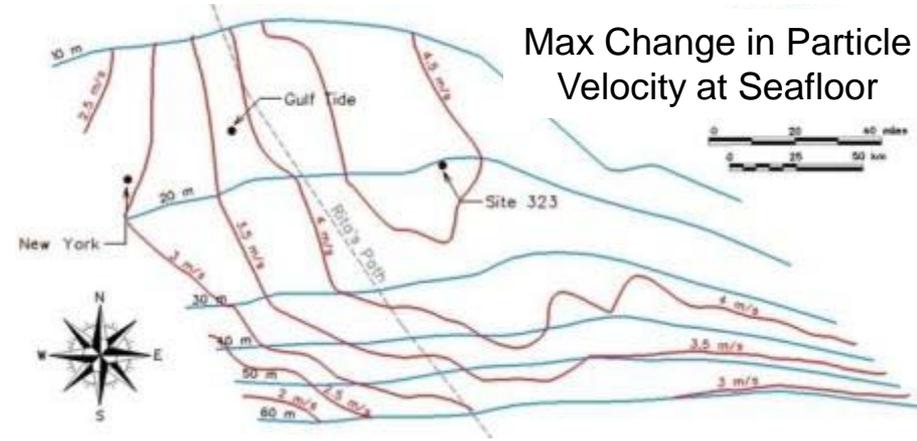
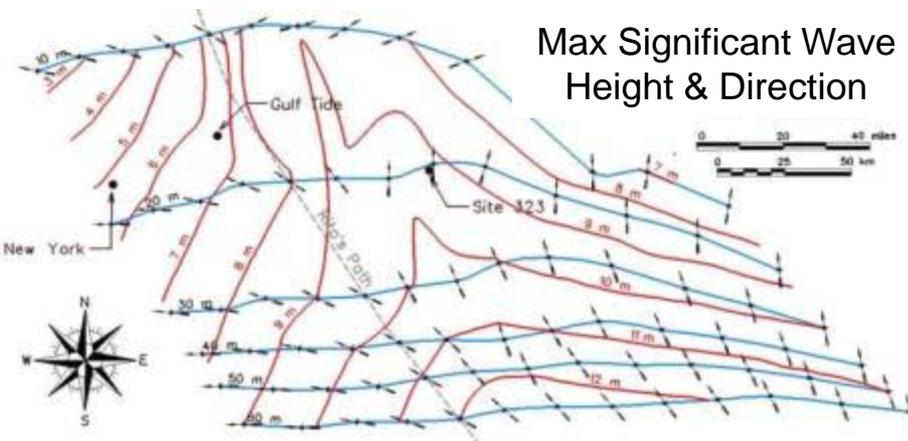
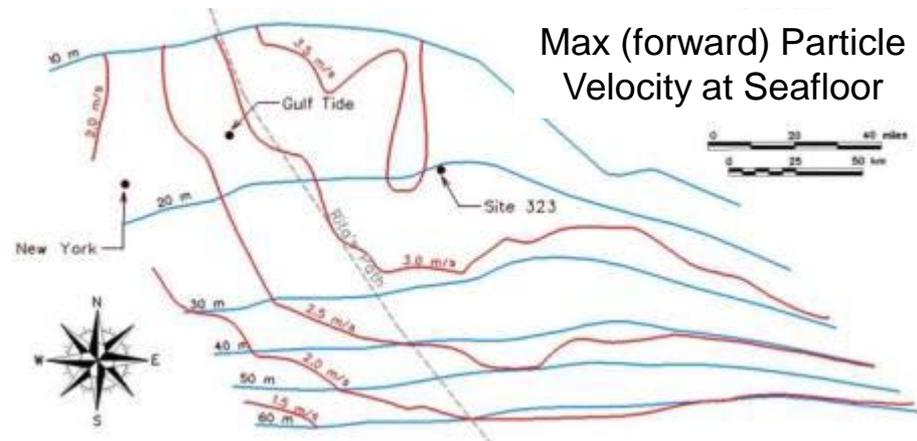
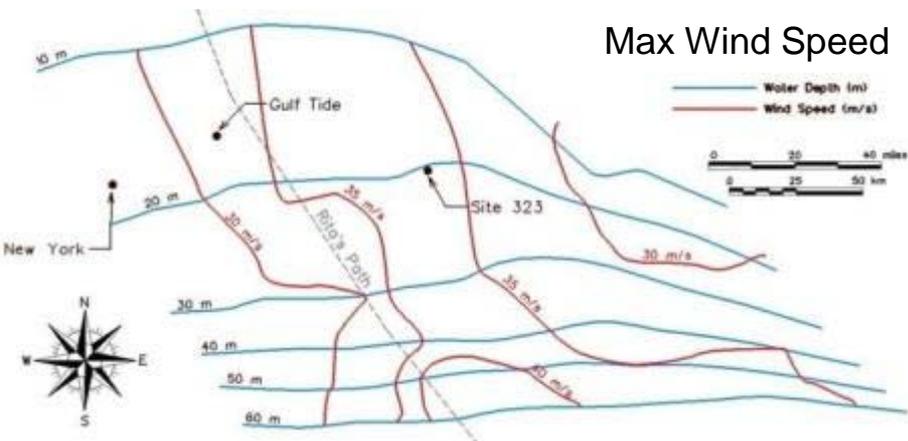
\* Velocity of seawater x 28.3 = velocity of air having equivalent force

# Equivalent Forces in Air (for comparison)

	USS <i>Castine</i>	<i>New York</i>	<i>Gulf Tide</i>	<i>Site 323</i>
Forward wind speed required for *equivalent force	164 mph	158 mph	183 mph	215 mph
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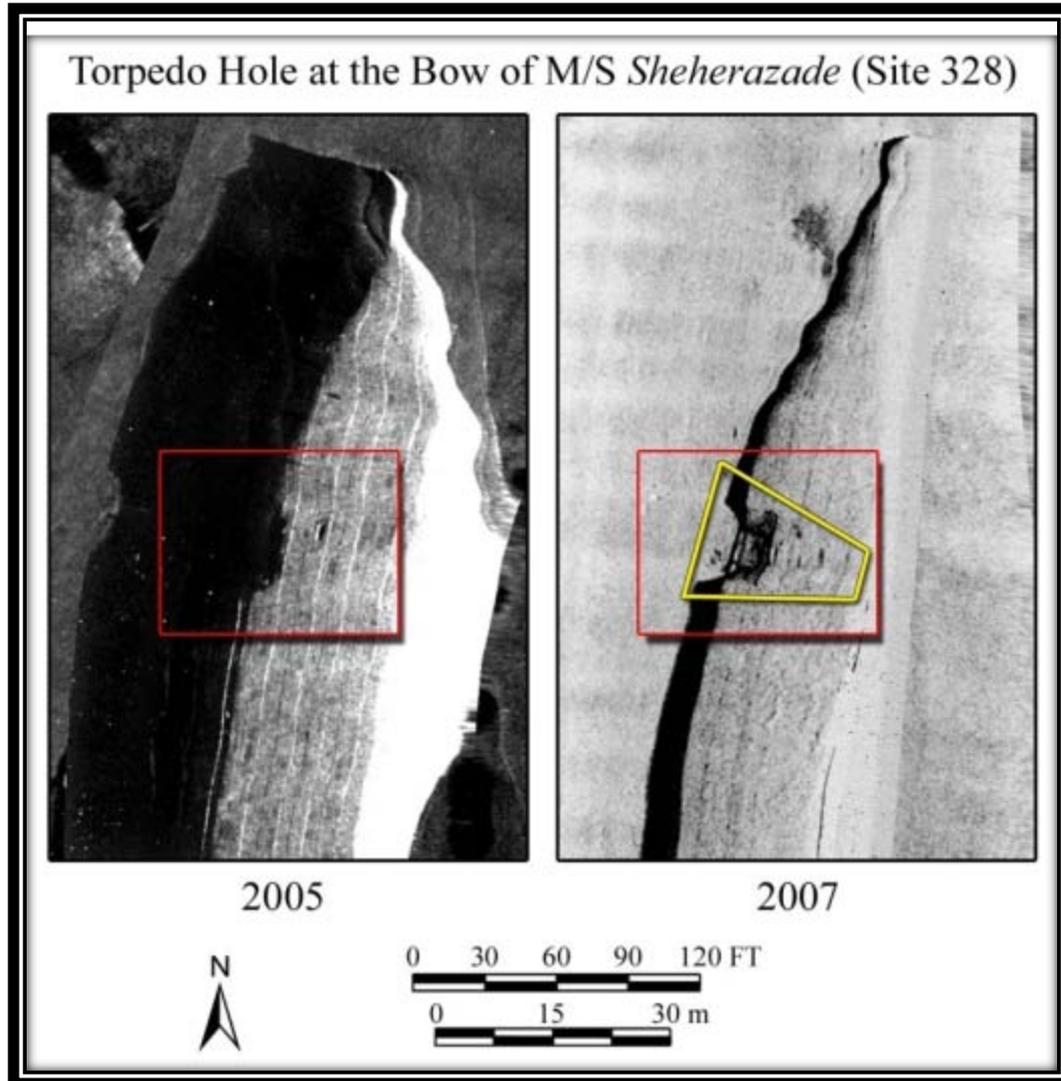
# Modeling Rita's Path



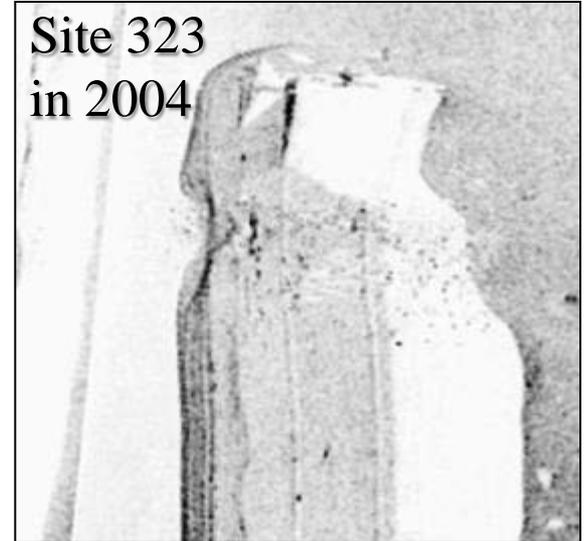
# Conclusions

1. Hurricanes generate substantial seafloor forces on the shallow continental shelf in the Gulf of Mexico
2. Damage to primary study wrecks was substantially less than anticipated based on the level of damage reported for many artificial reef vessels
3. Burial of wooden hulls has been demonstrated, in the case of New York, to provide a high degree of protection from hurricane damage
4. Anthropogenic damage to shipwrecks may be caused directly by human action or indirectly by hurricanes acting upon man-made structures

# Hurricane Damage Substantially Less Than Anticipated



Site 323  
in 2004



Site 323  
in 2007

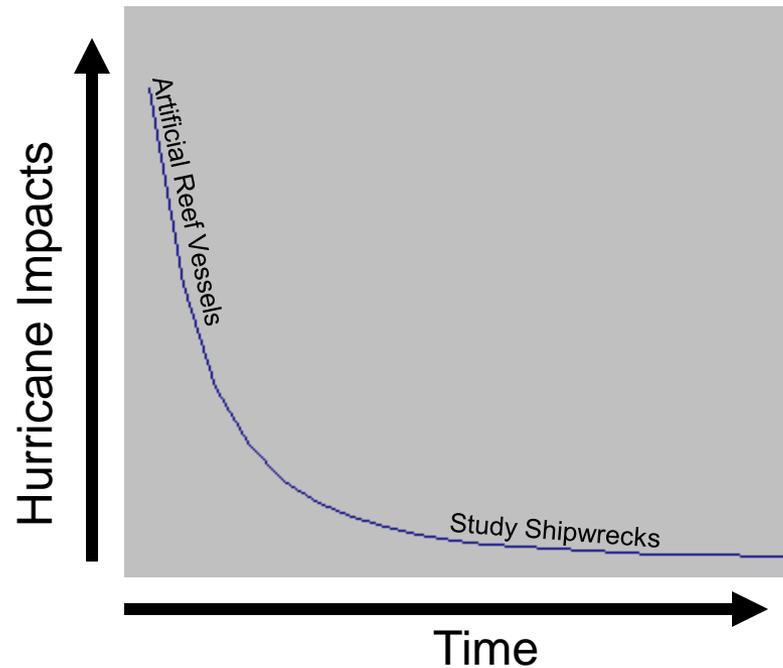


# TIME

An aerial photograph of a large, circular crater, likely a meteorite impact site. The crater features prominent concentric rings and a central peak, creating a spiral-like pattern that visually represents the concept of time. The surrounding terrain is relatively flat and appears to be a mix of light-colored soil or sand and sparse vegetation.

# Hypothesis:

*Major structural damage and movement tends to happen early in the life of a shipwreck as it settles toward a state of relative equilibrium with its environment*



# Burial of Wooden Hulls has been Demonstrated, in the Case of *New York*, to Provide a High Degree of Protection from Hurricane Damage

