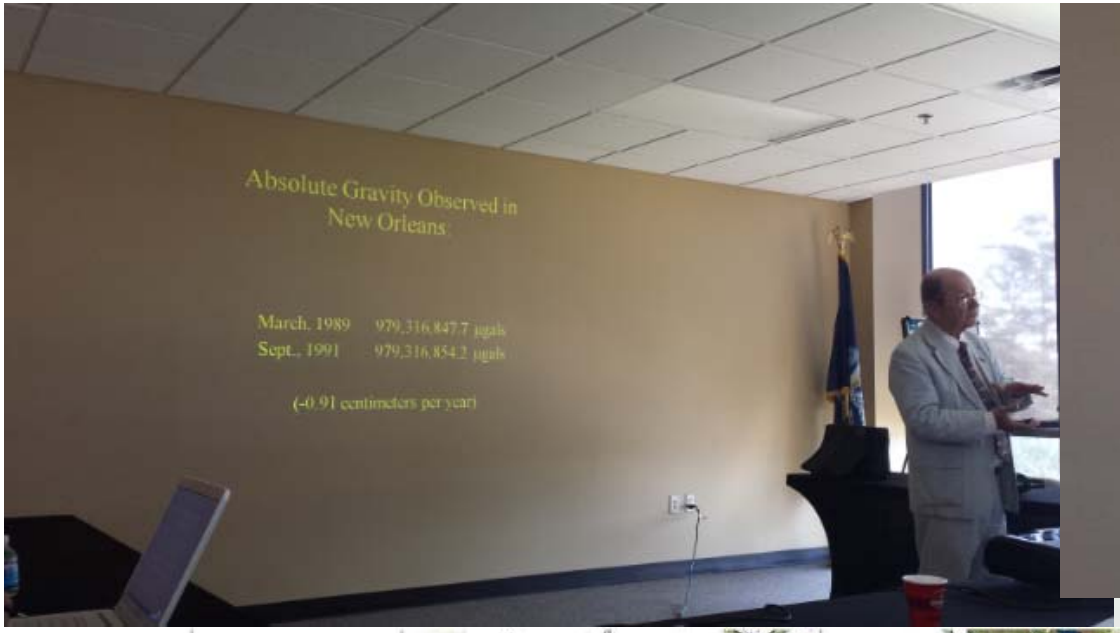
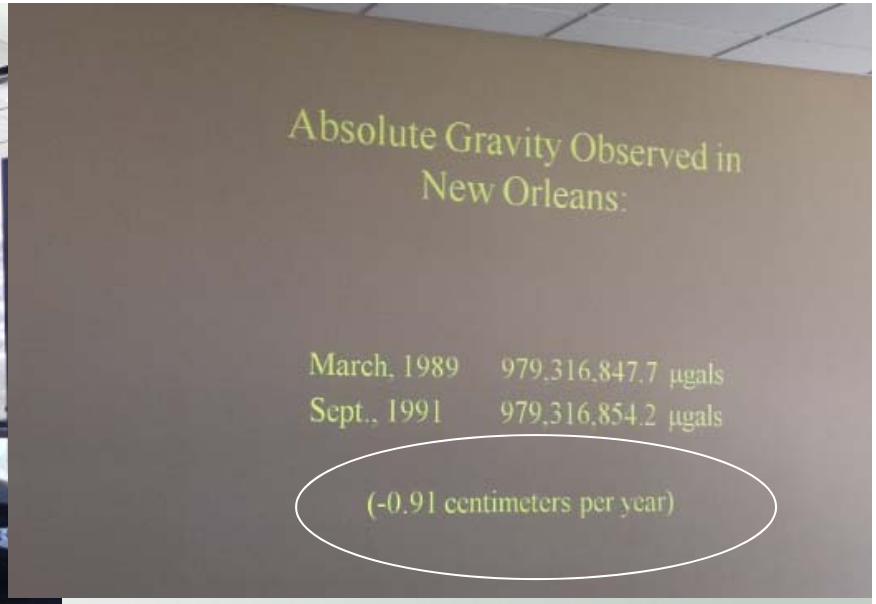
Advancing Real Time Observations and Coastal Modeling Forecasts-
Moving Forward in a Changing Coastal Landscape


Absolute Gravity Observed in
New Orleans:
March, 1989 979,316,847.7 µgals
Sept., 1991 979,316,854.2 µgals
(-0.91 centimeters per year)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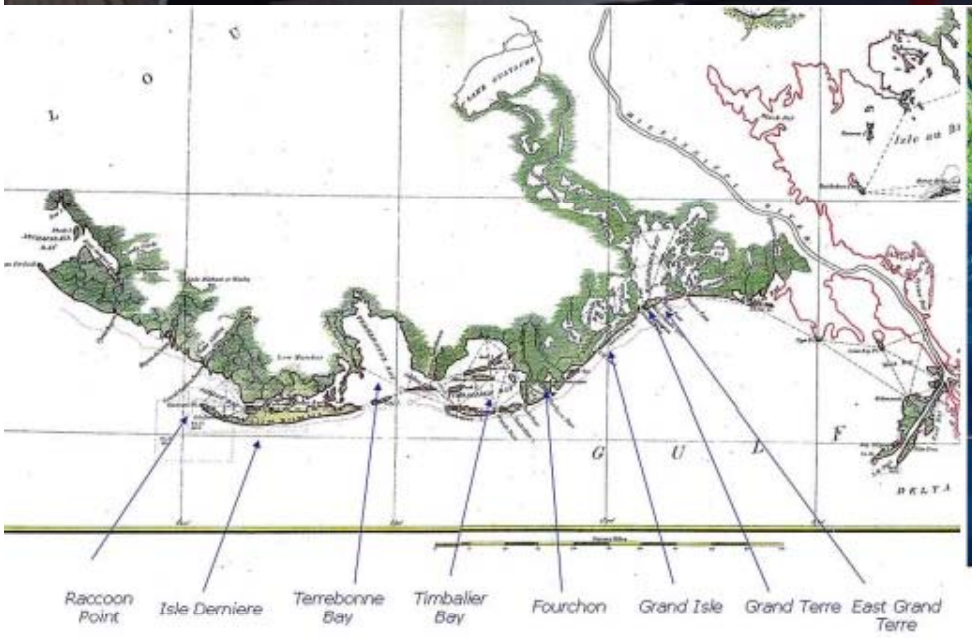
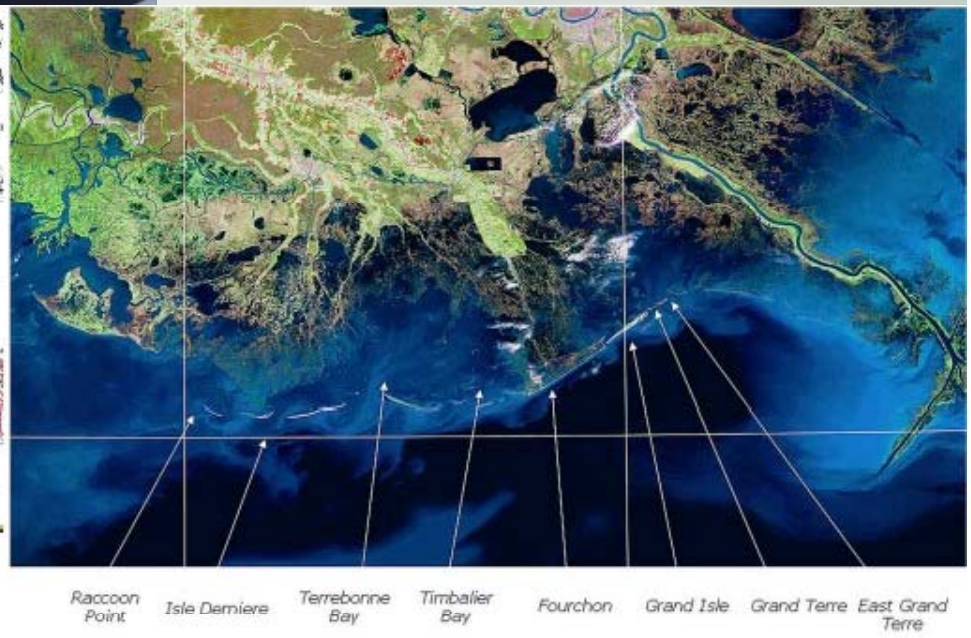
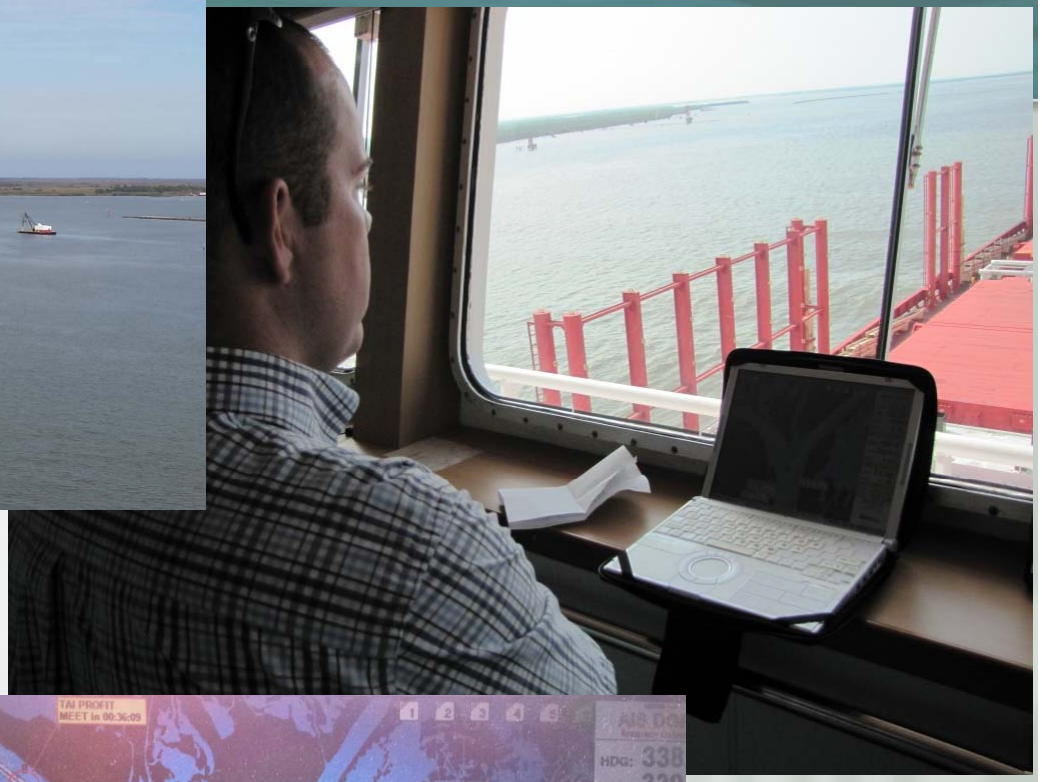

Raccoon Point
Isle Derniere
Terrebonne Bay
Timbalier Bay
Fourchon
Grand Isle
Grand Terre
East Grand Terre


Raccoon Point
Isle Derniere
Terrebonne Bay
Timbalier Bay
Fourchon
Grand Isle
Grand Terre
East Grand Terre

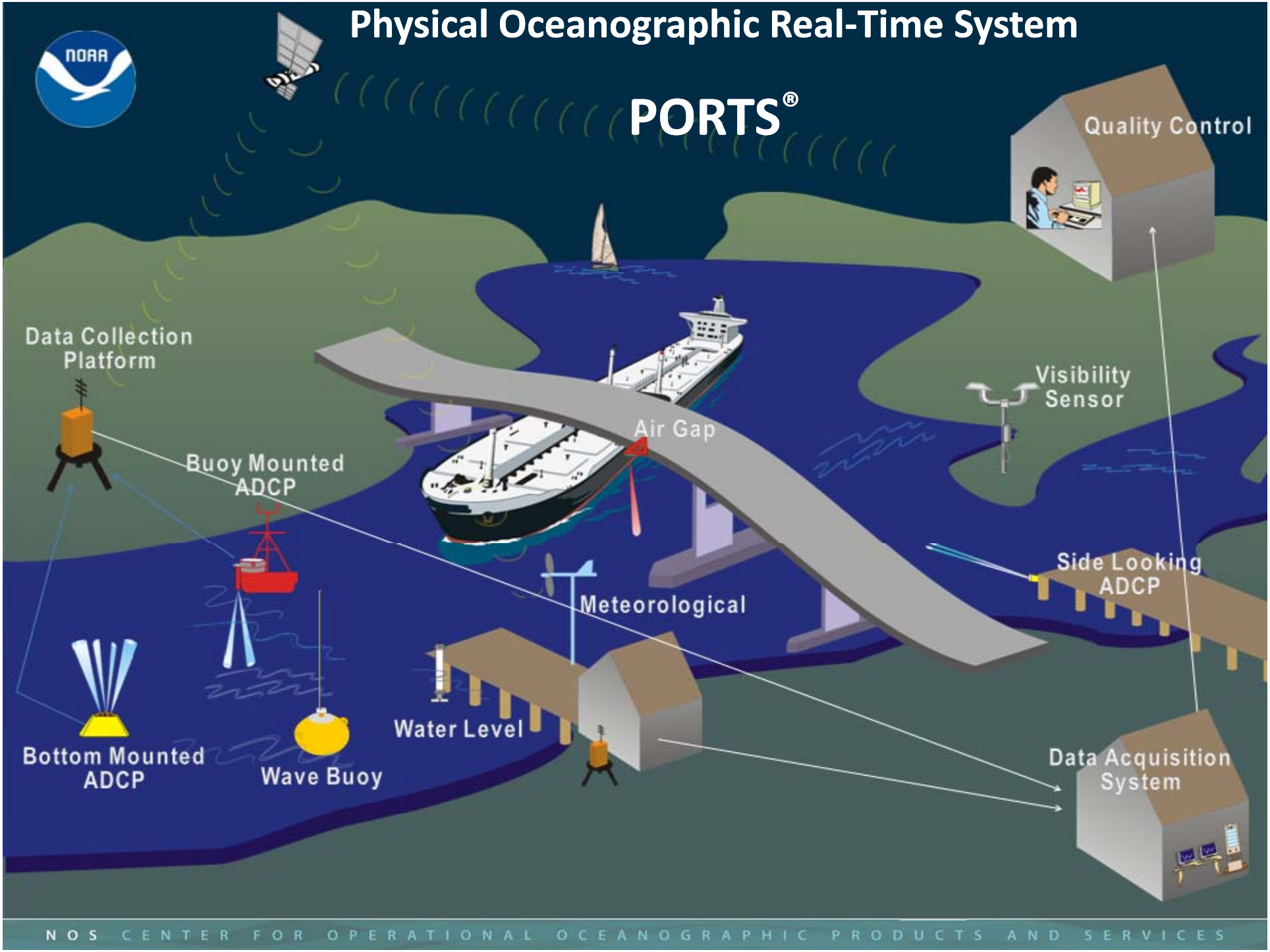
Next Generation Navigation-Coastal Operations- Coastal and Nearshore Coastal Operational Forecasting




SHIP DGPS
HDG: 223.6
COG: 220.8
SOG: 15.7
ROT: 5.0
BRG: 206.3
TTG: :17
DIST: 412
ETA: 11:05
DIST: 16.63
10:02:01
Using Ship's GPS
Logging
Menu

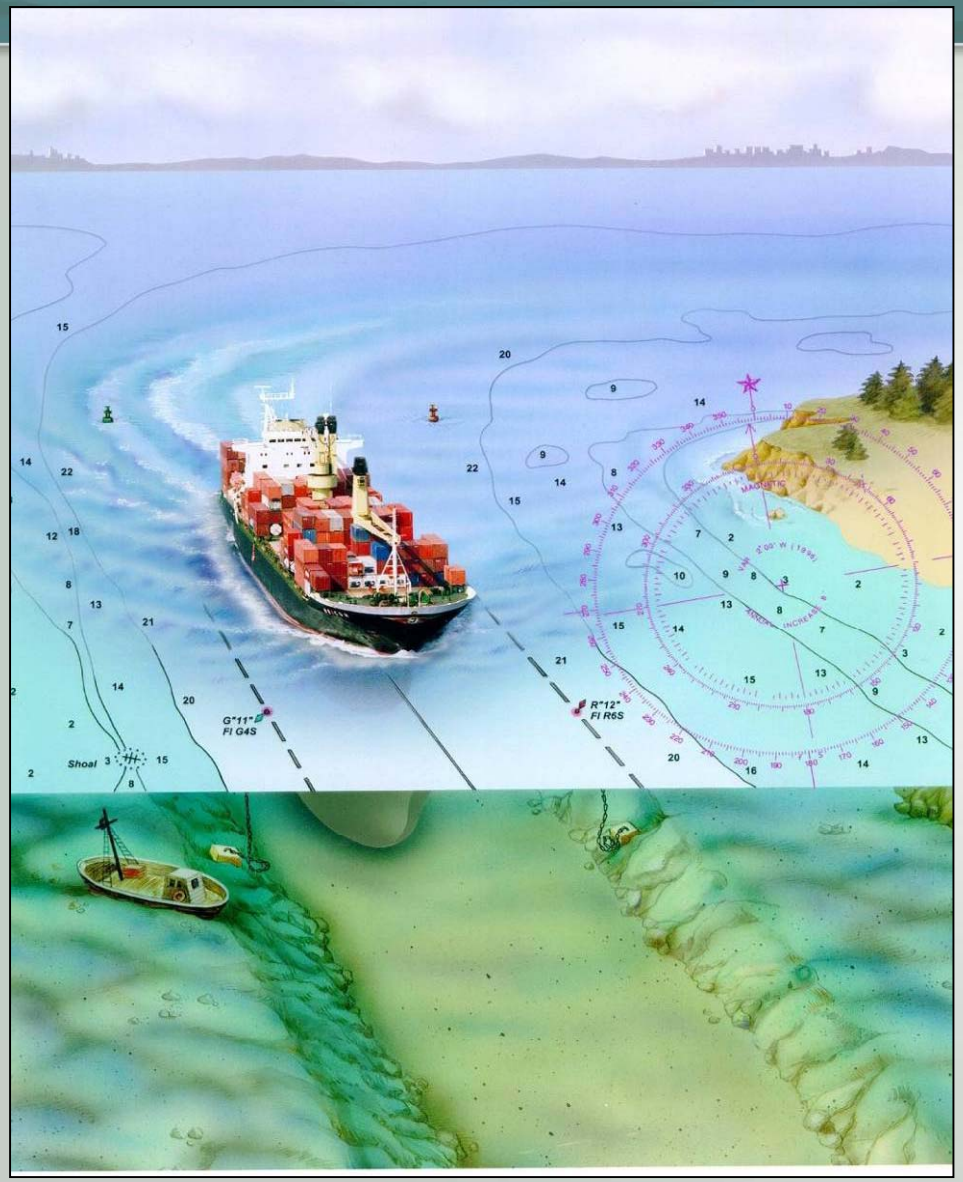

TAI PROFIT
MEET in 00:36:09
AIS: HARVEY BRONCO
Brg: 317° Dst: 7.3nm
Cog: 125° Sog: 2.0kt
AIS: JANE
Brg: 326° Dst: 5.1nm
Cog: 318° Sog: 3.6kt
AIS: CAPT. LUKE C
Brg: 341° Dst: 1.1nm
Cog: 333° Sog: 6.5kt
Lower Pilottown Anchorage
165 ft
TTG: 00:10
Speed Planner
AIS: RIVER PILOT
Brg: 286° Dst: 0.0nm
Cog: 341° Sog: 13.6kt
AIS: MS. GERT
Brg: 333° Dst: 1.6nm
Cog: 342° Sog: 7.6kt
AIS: LADY JOYELLE
Brg: 140° Dst: 1.8nm
Cog: -° Sog: 0.5kt
AIS: JC LOVE JR
Brg: 151° Dst: 1.3nm
Cog: 335° Sog: 3.5kt
HDG: 338
COG: 339
SOG: 8
ROT:
BRG: 338
TTG: 00:0
DIST: 0.4
ETA: 13:2
DIST: 16
13:26:11
12/12/2014
Menu

Why Do We Need PORTS®?


Physical Oceanographic Real-Time System
PORTS®
NOAA
Quality Control
Data Collection Platform
Visibility Sensor
Air Gap
Buoy Mounted ADCP
Side Looking ADCP
Meteorological
Water Level
Bottom Mounted ADCP
Wave Buoy
Data Acquisition System
NOS CENTER FOR OPERATIONAL OCEANOGRAPHIC PRODUCTS AND SERVICES

“The greatest safety concern…is the availability of timely, accurate, and reliable navigation information.”

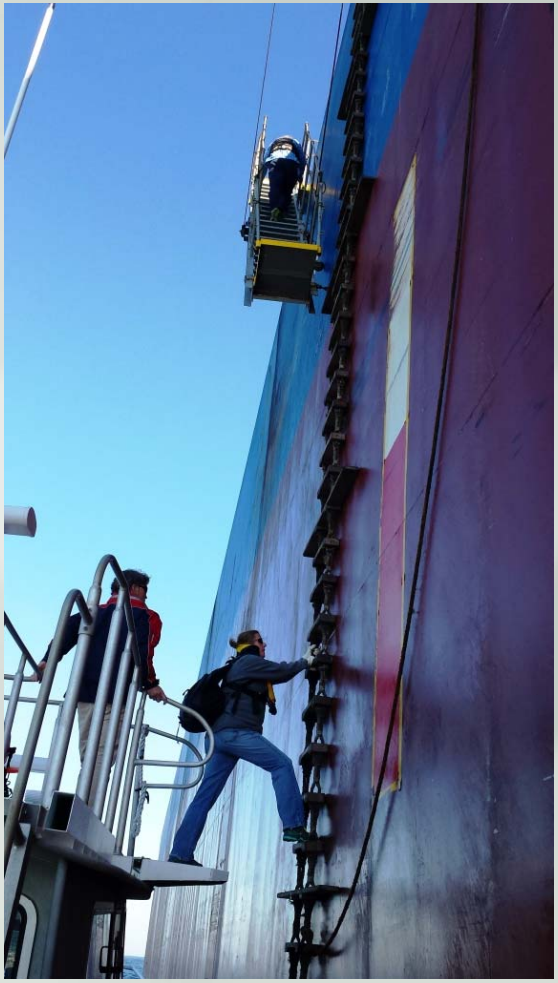
1999 MTS Report to Congress



NOAA

- Larger vessels in small channels
- Zero tolerance for error

More Ships, Larger Ships, More Cargo- Greater Demand on the Envelope- Channel, Weather, Water and Sea State



PORTS®

PORTS® is a NOAA program that provides:

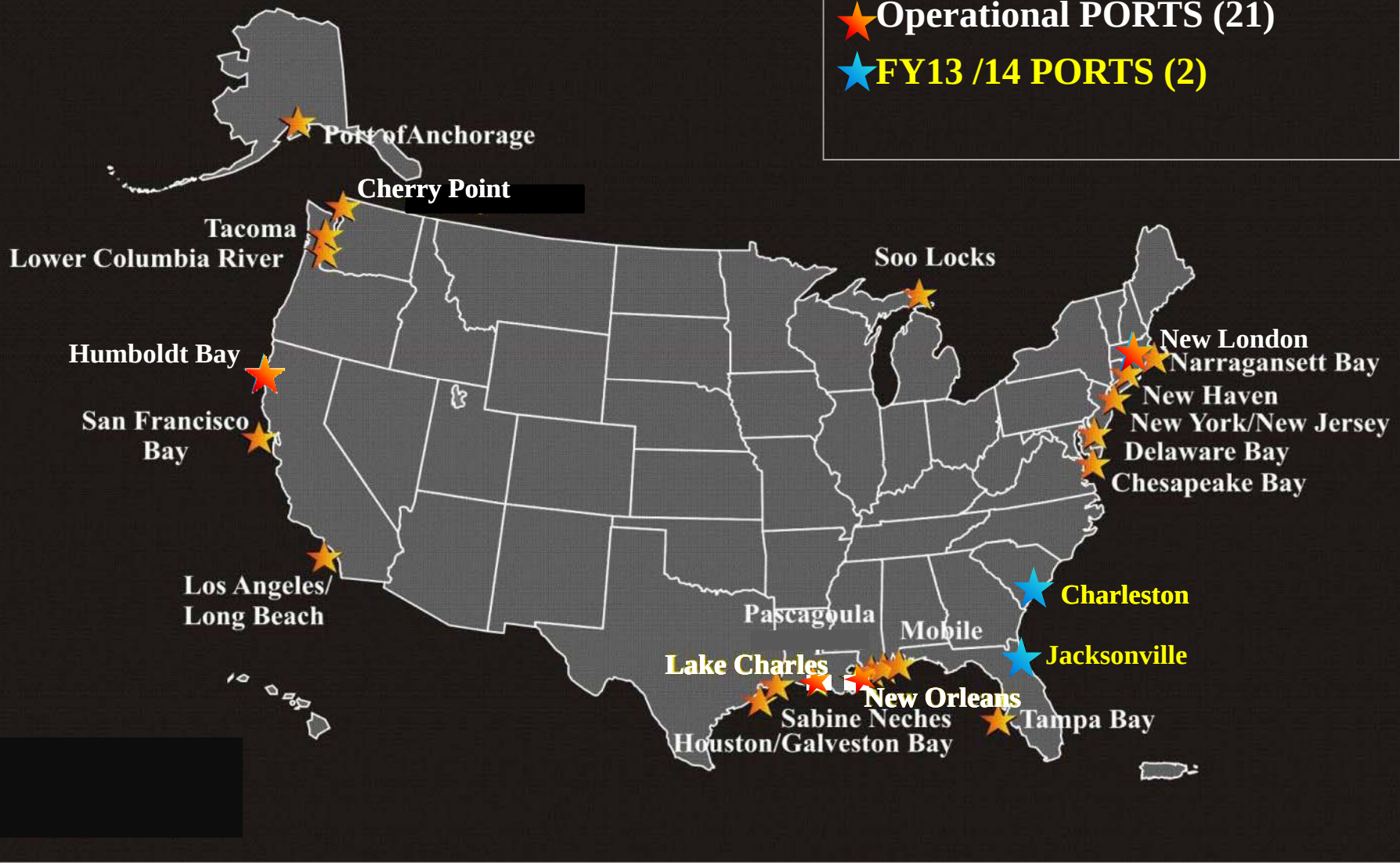
- **Accurate real-time information to improve safety**
  - **Avoided groundings**
  - **Safer vessel maneuvers**
- **Efficiency of maritime commerce**
  - **Increased cargo**
  - **Reduced delays**
  - **Improved SAR performance**
- **Environmental Protection and Planning Assistance**
  - **Improved hazardous material response**
  - **Improved environmental restoration activities**

PORTS®

- **Recreational Planning Assistance**
  - **Boating decisions**
  - **Fishing decisions**
  - **Beach visit decisions**
- **Improved Forecasts**
  - **Marine weather forecasts**
  - **Storm surge forecasts**
- **Scientific and Educational Information**
  - **Scientific research**
  - **Secondary education**

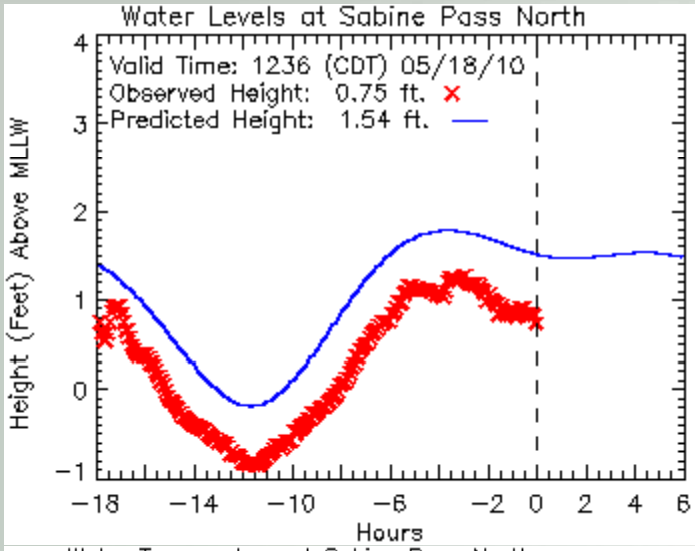
Physical Oceanographic Real-Time System®

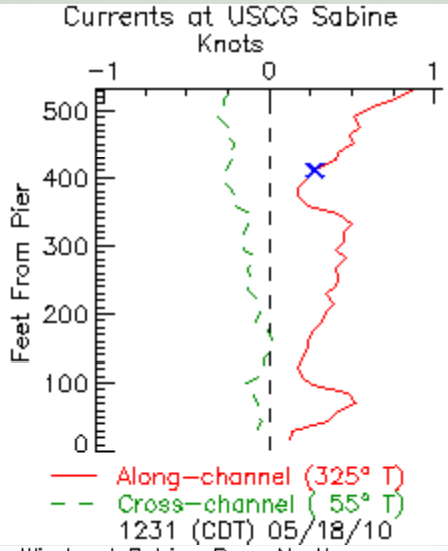
PORTS®

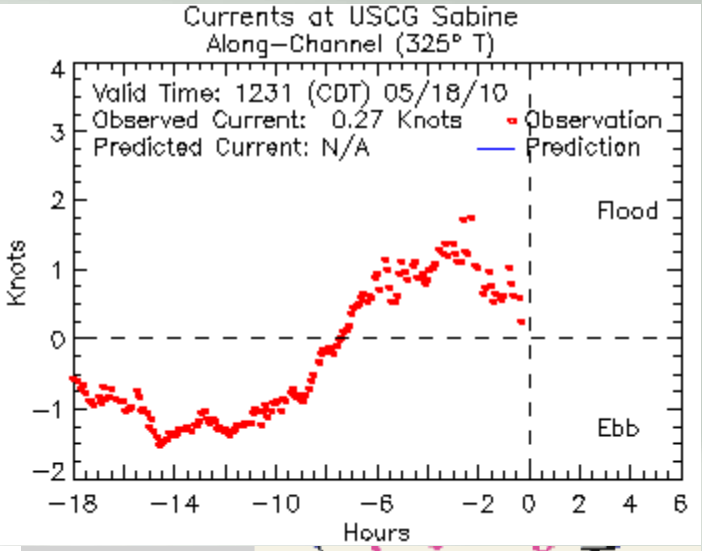


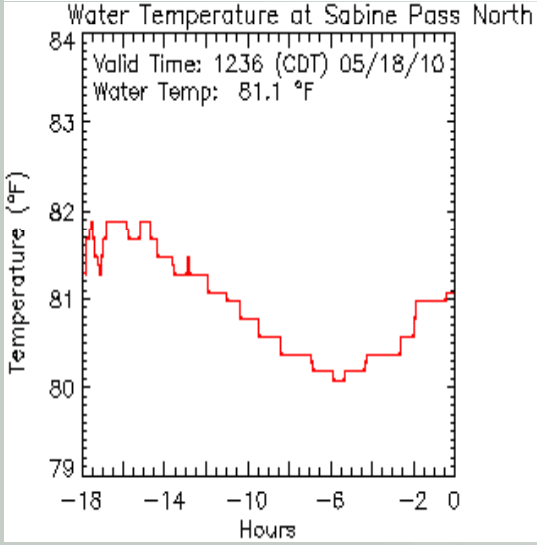

Map
Satellite
Hybrid
Port of Beaumont (cu)
Rainbow Bridge (wl)
Rainbow Bridge (cu)
West Port Arthur Bridge (cu)
Sabine Front Range (cu)
Sabine Pass North (wl,wind,at,wt,baro)
USCG Sabine (cu)
Sabine Bank Channel LBB 34 (cu)
Sabine-Neches PORTS®
Google
10 mi
10 km
Imagery ©2010 TerraMetrics - Terms of Use
Legend:
wl - water level
cu - current
ct - conductivity/salinity
wt - water temperature
wind - speed and direction
baro - barometric pressure
at - air temperature
ag - air gap
vi - visibility

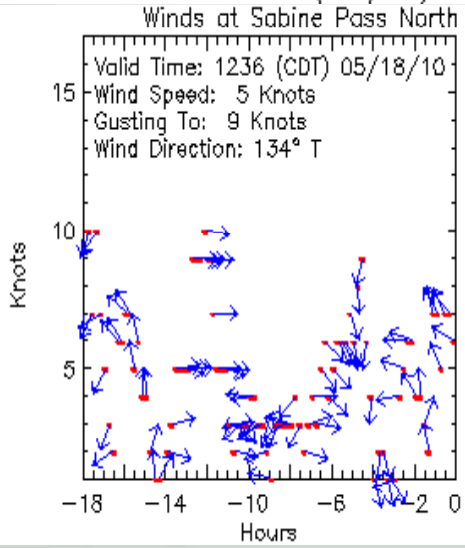
PORTS® Graphics
USCG Sabine

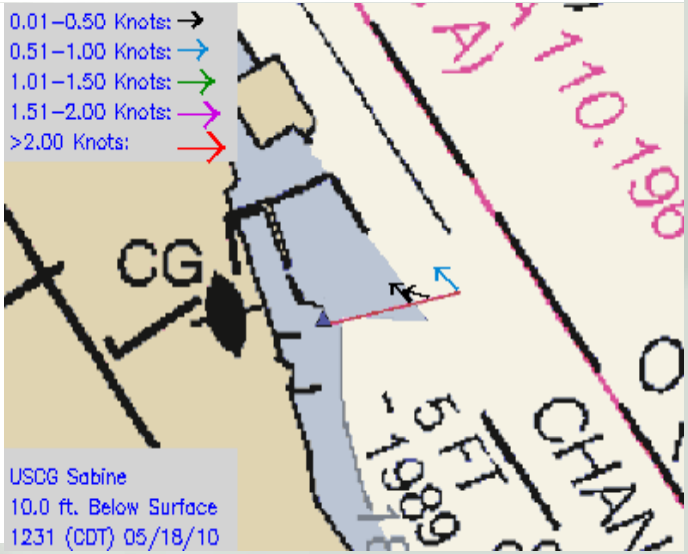












PORTS® Instruments

Water Levels

Air Temperature

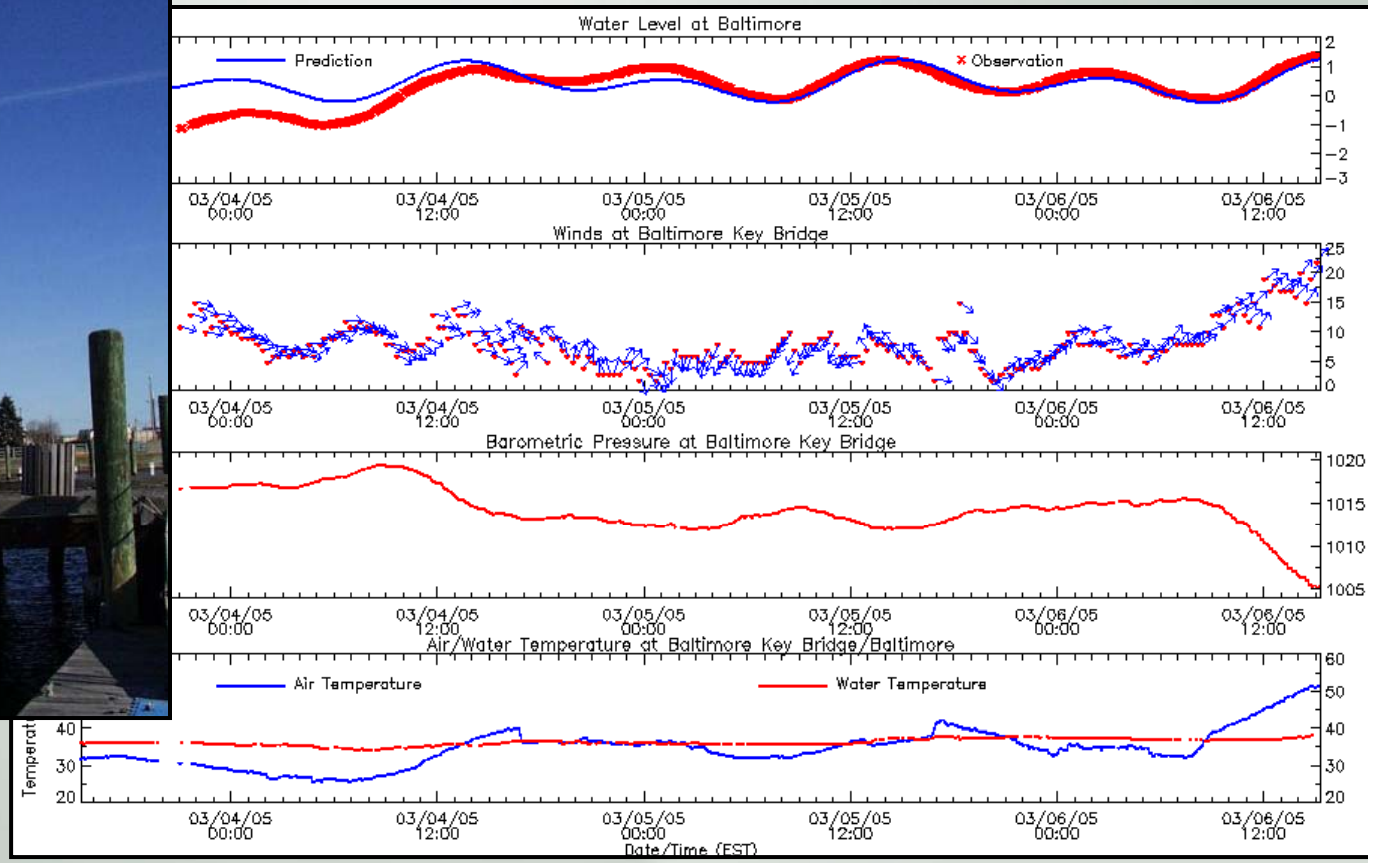
Currents

Conductivity

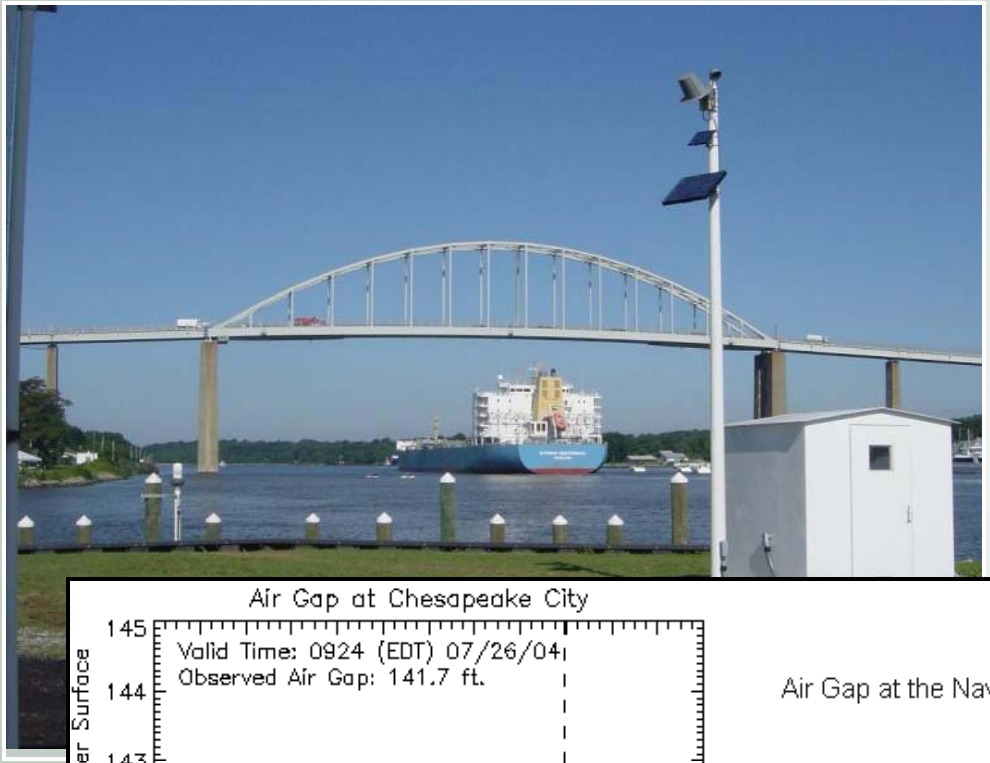
Wind

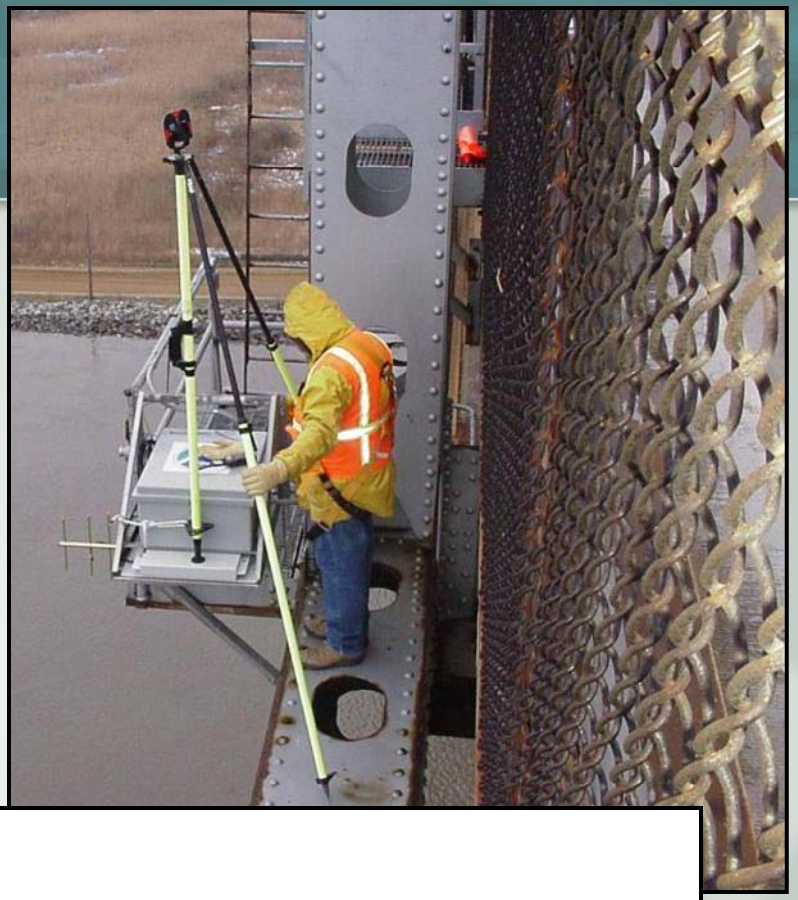
Air Gap

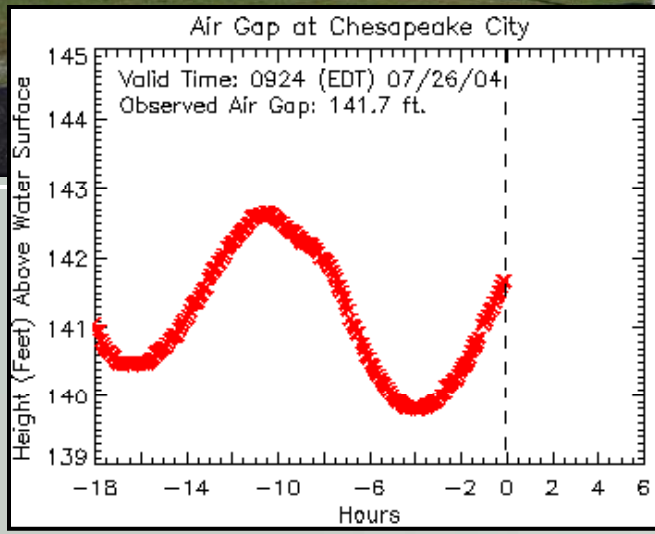
WATER LEVELS and METEOROLOGY

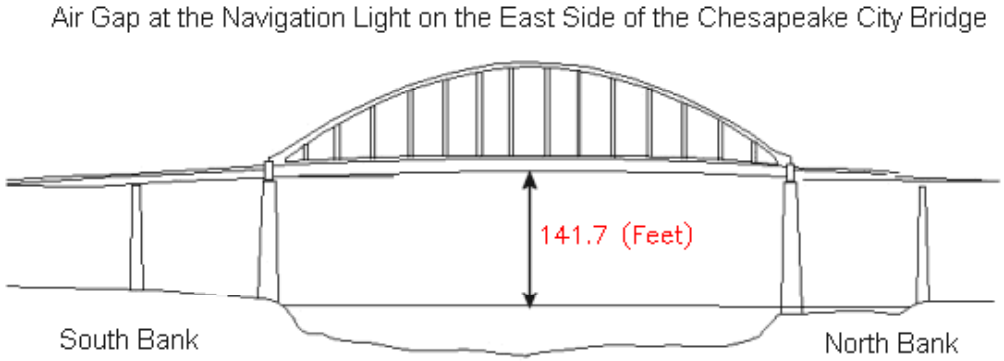


AIR GAP



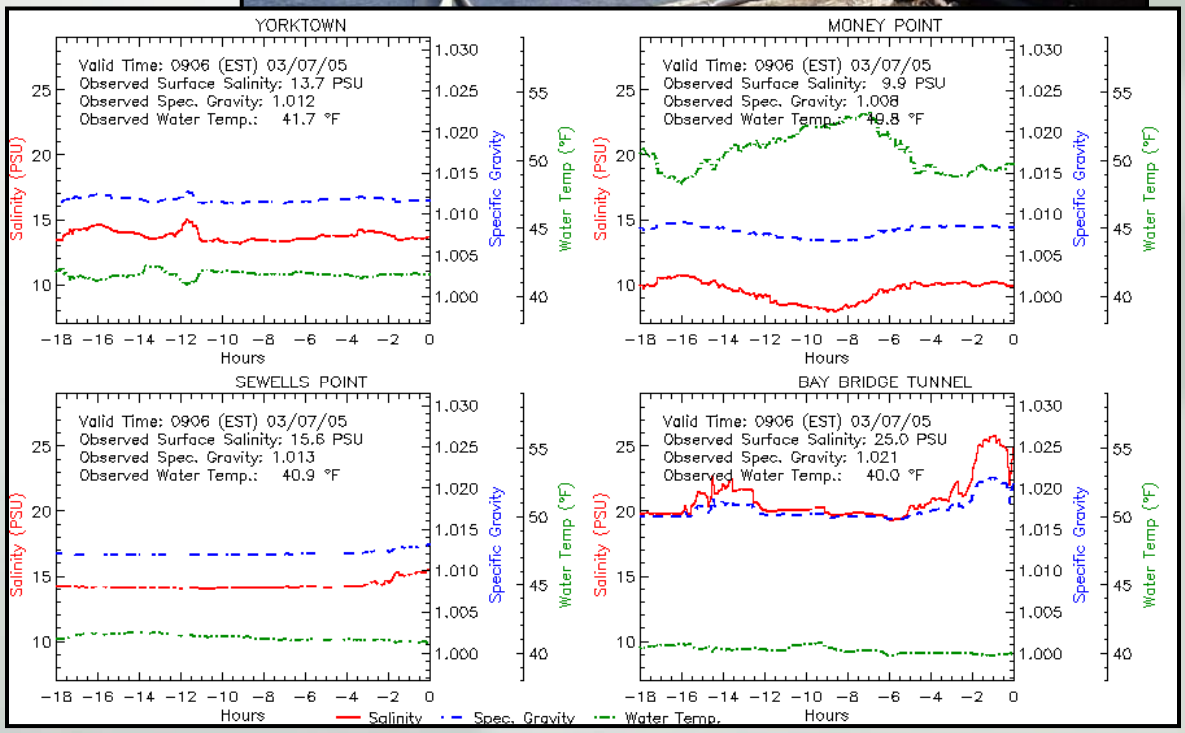



Air Gap at Chesapeake City
Valid Time: 0924 (EDT) 07/26/04
Observed Air Gap: 141.7 ft.
Height (Feet) Above Water Surface
145
144
143
142
141
140
139
−18
−14
−10
−6
−2
0
2
4
6
Hours

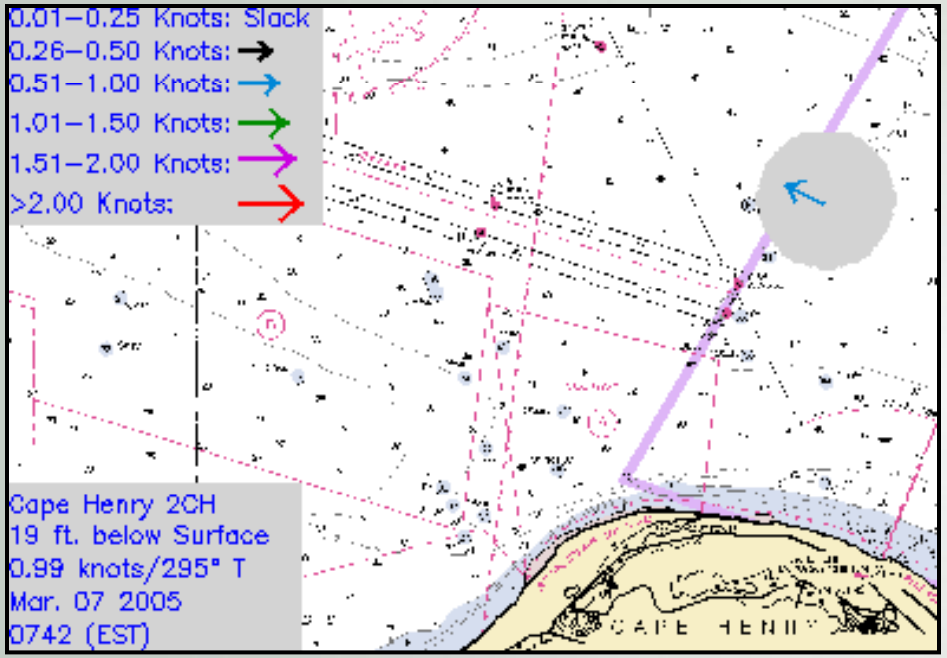

Air Gap at the Navigation Light on the East Side of the Chesapeake City Bridge
141.7 (Feet)
South Bank
North Bank

SALINITY

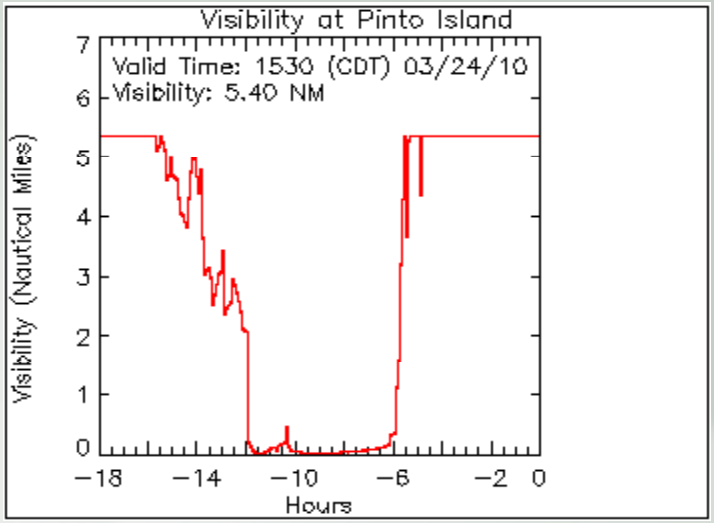
Conductivity/Temperature (C/T) Sensors



ATON MOUNTED CURRENT METERS



Technology Infusion: **Visibility**

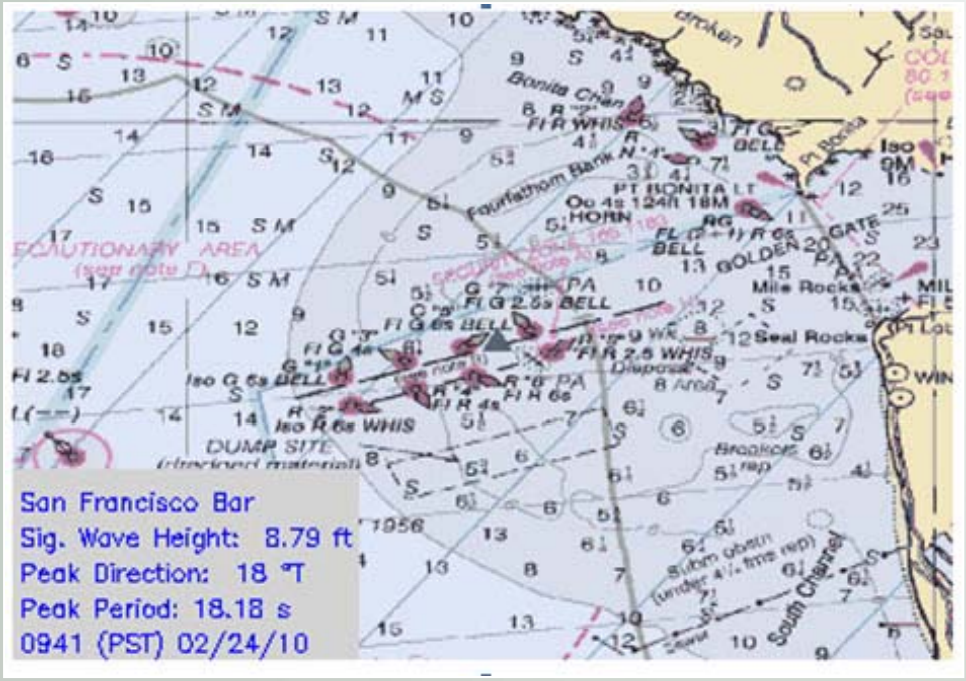


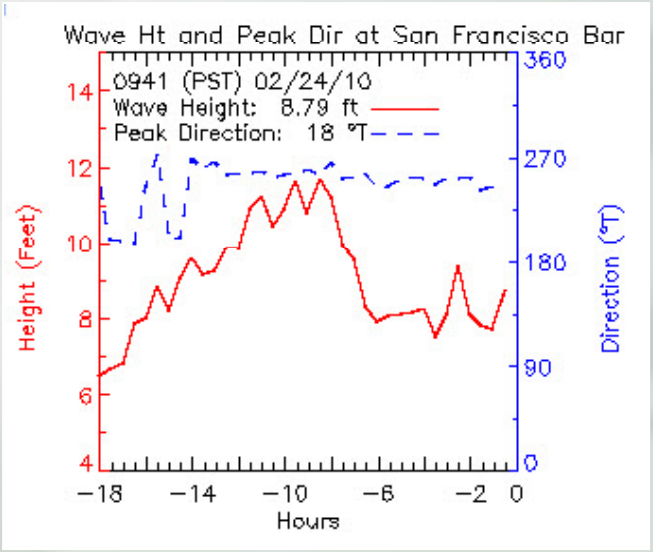
3/23 21:30 – 3/24 15:30 CDT

- **Photo taken at the trade center in downtown Mobile, looking south down the ship channel:**
- **3/24/10 ~8:30am CDT**
- **Episode: 00:00 to 10:30 CDT**

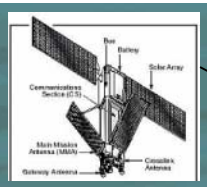
Technology Infusion: **Waves**

- **Partnership with USACE and SCRIPPS to integrate wave buoy data into PORTS®**

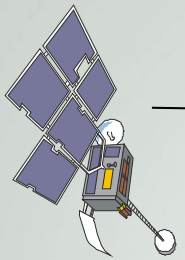




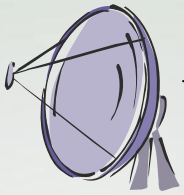
NOAA Operational Data Acquisition



Iridium Satellite



GOES



GOES Ground Station

Iridium Ground Station

DOMSAT

Measurement System

Telephone (backup)

NOAA

Line of Site Radios

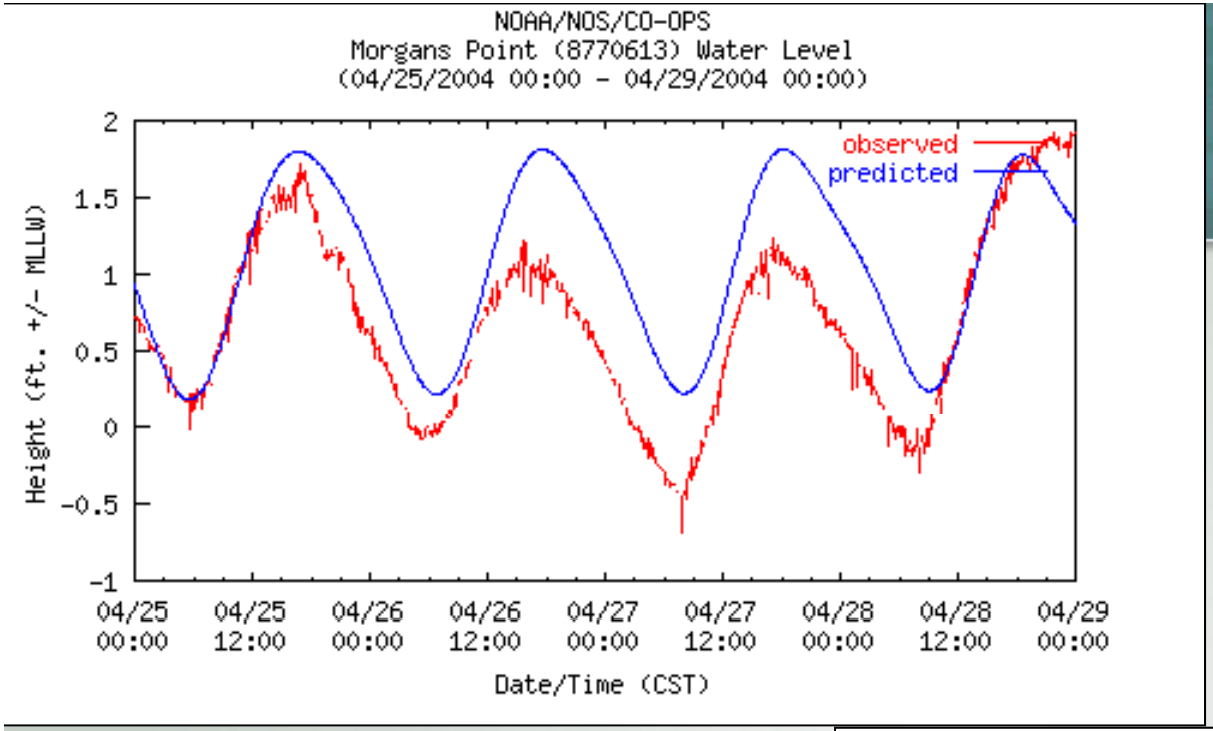
Local Data Acquisition System

MCI 24x7* Internet Backbone

IP Modem

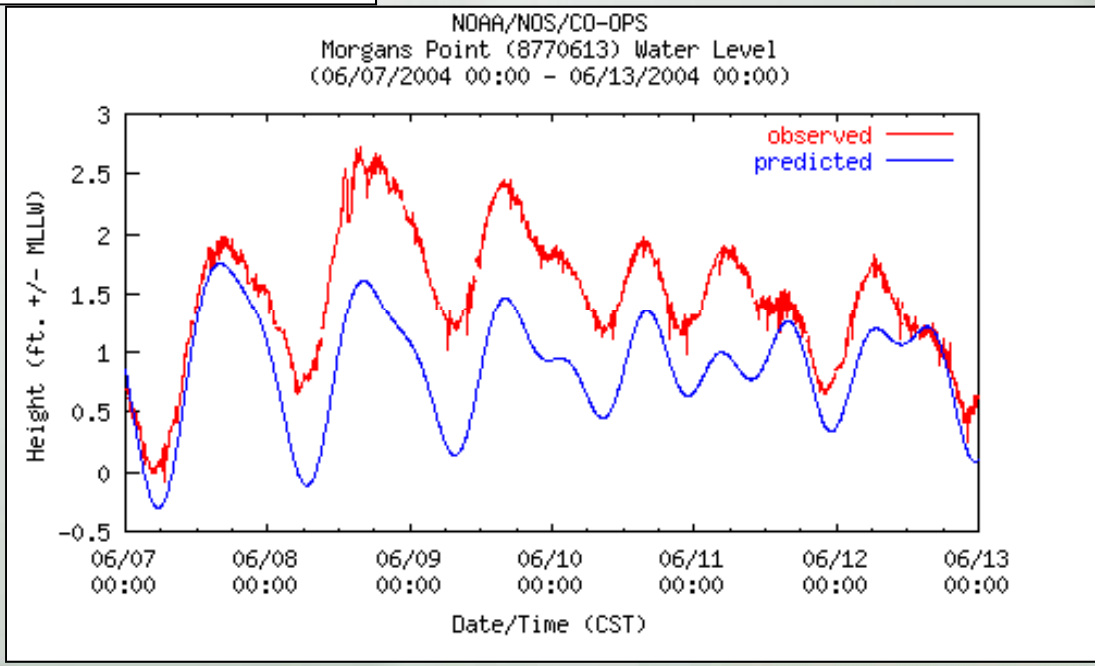
*Secure Communication Using Secure FTP And Secure Copy

System Monitoring and Quality Control
24x7



Safety?

More Cargo?



NOAA PORTS SYSTEMS INCREASED SAFETY

Accidents have been reduced at seaports currently served by PORTS®.

Collisions and Groundings

↓ 59% Groundings
(33% when groundings are combined with collisions)

↓ 37% Property damage

↓ 45% Injuries

↓ 60% Deaths

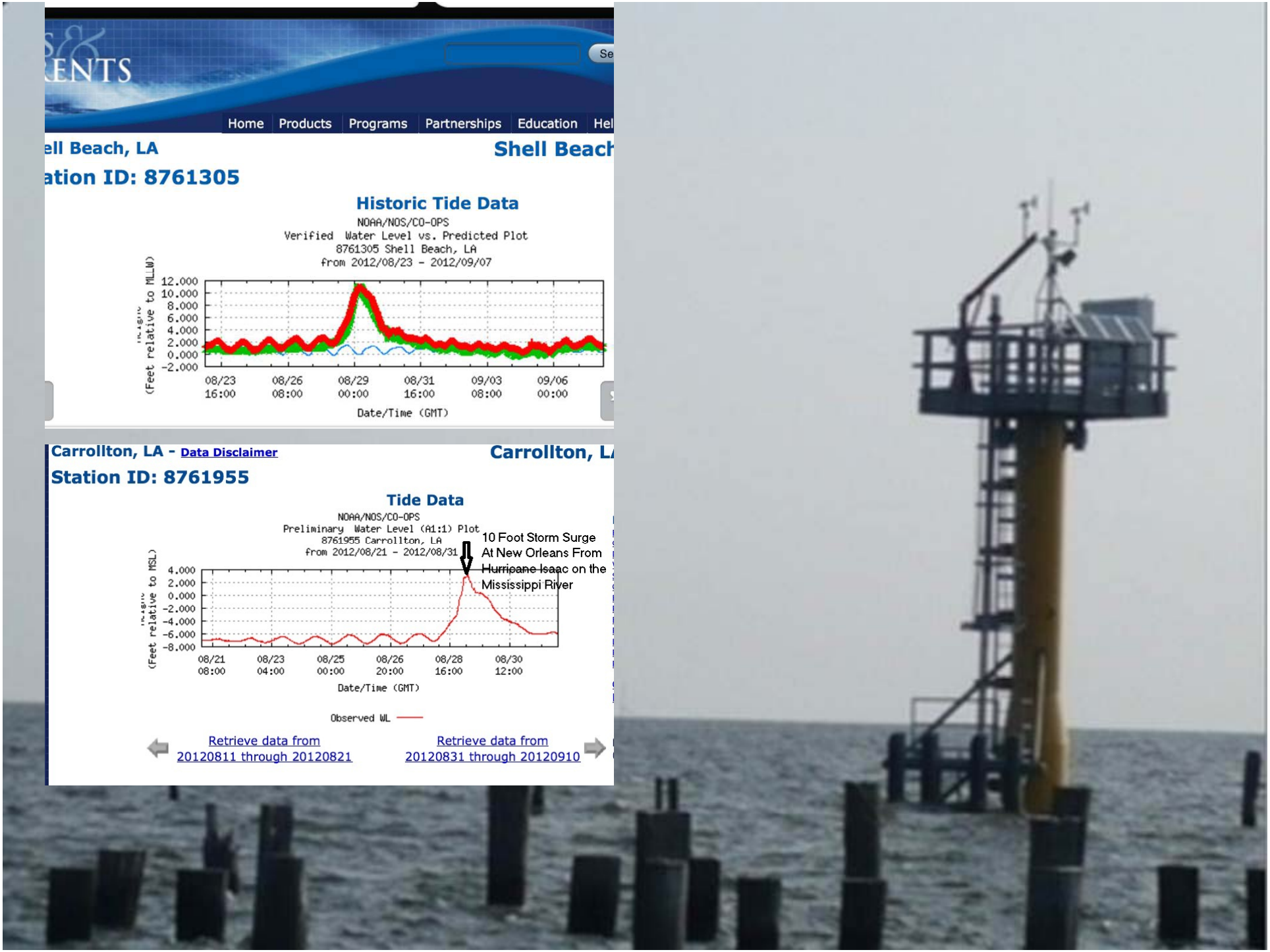
Oil spills have been reduced at seaports currently served by PORTS®.

Oil Spills

↓ 21% Reduction in oil releases due to collisions and groundings at seaports currently served by PORTS®.

COMPELLING NEED - ECONOMICS
One Foot of Draft

- 20,000 – 22,000 barrels of crude on an average 500,000 barrel Crude tanker
- Extra tanker every 25 voyages or 2 months
- Extra trip cost $1.5 Million / $9 M annually
- Added congestion
- Increased dock utilization
- Increased mathematical risk of grounding, collision or allision


Home
Products
Programs
Partnerships
Education
Shell Beach
Historic Tide Data
NOAA/NOS/CO-OPS
Verified Water Level vs. Predicted Plot
8761305 Shell Beach, LA
from 2012/08/23 - 2012/09/07
(Feet relative to MLLW)
12.000
10.000
8.000
6.000
4.000
2.000
0.000
-2.000
08/23 16:00
08/26 08:00
08/29 00:00
08/31 16:00
09/03 08:00
09/06 00:00
Date/Time (GMT)
Carrollton, LA - Data Disclaimer
Station ID: 8761955
Tide Data
NOAA/NOS/CO-OPS
Preliminary Water Level (A1:1) Plot
8761955 Carrollton, LA
from 2012/08/21 - 2012/08/31
10 Foot Storm Surge
At New Orleans From
Hurripane Isaac on the
Mississippi River
(Feet relative to MSL)
4.000
2.000
0.000
-2.000
-4.000
-6.000
-8.000
08/21 08:00
08/23 04:00
08/25 00:00
08/26 20:00
08/28 16:00
08/30 12:00
Date/Time (GMT)
Observed WL
Retrieve data from
20120811 through 20120821
Retrieve data from
20120831 through 20120910

Mobile County Commission & NOAA Establish a New Real-Time Storm Surge Monitoring Network

BACKGROUND

There are many coastal communities throughout Mobile County that are particularly susceptible to flooding during periods of elevated water levels. This area was among the areas hardest hit when Hurricane Katrina ravaged the U.S. Gulf Coast in August of 2005. As a result of this experience, the Mobile County Commission was determined to establish a state-of-the-art storm surge monitoring network designed to monitor for hazardous storm surges in the Bay generated by hurricanes and tropical storms. The network strengthens the ability of emergency management officials to alert and prepare this Alabama coastal community to deadly and quickly-traveling surges and other dangerous water level conditions that could flood coastal areas and damage critical infrastructure.

The Commission petitioned Congressional representatives for support, and in FY10 the National Oceanic and Atmospheric Administration (NOAA) received federal funding in partnership with the Commission to establish and maintain a storm surge network for Mobile County. Congressman Jo Bonner was sponsor of the appropriation on behalf of the Mobile County Commission, with support from Senator Richard Shelby. The five network stations were installed from June to November 2011, and successfully recorded the storm surge of Tropical Storm Lee in September 2011 and Hurricane Isaac in August 2012.

Network Requirements

- Install five stations in Mobile County and provide for near-term operation and maintenance
- Elevate electronics to Category 5 Storm Surge Height (22-25 ft. above Mean Sea Level)
- Plan to use existing bridges, where possible, to attain that height
- Complete the installations and spend $600k funding within two years

STAKEHOLDERS

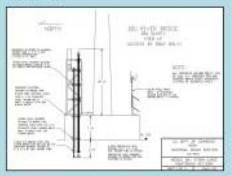
Mobile County Commission	NOAA	USACE Regional Rock's
Mobile County EMA	National Weather Service	US Army Corps of Engineers
ALDOT	National Hurricane Center	Dauphin Island Sea Lab
ARBA	Weather Forecast Offices	
ADEM	Storm Surge Program	
AL State Port Authority	National Estuarine Research Reserves	

PRODUCTS AND SERVICES

ENGINEERING

Original Design (2010)

- Use acoustic sensor as primary sensor, mounted to the elevated frame, with pressure backup sensor
- Elevated frame only applicable for Dog River and East Fowl River Bridge pier footers
- Need four pile elevated platform for other three sites (too costly)

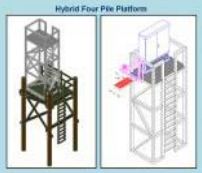


Original vs. Improved Design Concept

Improved Design (2011)

- Use microwave radar sensor as primary and backup sensor on three bridges (Dog, East Fowl, and West Fowl River Bridges)
- Need hybrid four pile platforms for only two stations (microwave radar as primary sensor, pressure backup sensor)
- Saved enough money on installations to fund three years of operation and maintenance through 2014

Hybrid Four Pile Platform



Bridge Systems

Microwave Radar Sensor Design Analysis Waterlog H-3611i

- Non-contact, remote sensing capability
- Easier and less costly to install than the acoustic sensor
- Reduced maintenance costs
- Excellent performance in protected, short fetch and low average wave height site locations

HURRICANE ISAAC

Hurricane Isaac, August 29-30, 2012

Throughout Hurricane Isaac in late August 2012, NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) served a critical role in the protection of life and property through the observation and delivery of real-time water level information. Hurricane Isaac marked the first hurricane captured by the newly established Mobile County Storm Surge Monitoring Network. This five station network provided information to emergency managers on the magnitude of flooding in the County, where water levels rose 3-4 feet above normal tide levels in many locations, from both storm surge and rain, causing substantial flooding in low-lying areas. All five stations operated flawlessly throughout the storm.

Isaac made landfall in the same location nearly seven years to the day after Hurricane Katrina devastated southeast Louisiana, Mississippi, and Alabama. Since then, CO-OPS has constructed five "Sentinels of the Coast," 25-foot steel tide gauge structures constructed to withstand wind and wave action from Category 4 hurricanes. The Sentinel station at Shell Beach measured the peak storm surge for the event of 11 feet, and information from these stations was widely reported throughout national media outlets. Information at CO-OPS tide stations was used by the National Weather Service to validate and improve storm surge forecasts throughout the event, allowing emergency managers across the Gulf to take necessary action, including mandatory evacuations in many places. The majority of all rescues that needed to occur during Isaac were in mandatory evacuation areas where people chose not to heed warnings, evidence that the relationship between the observations and forecasts, and local management action, is essential.

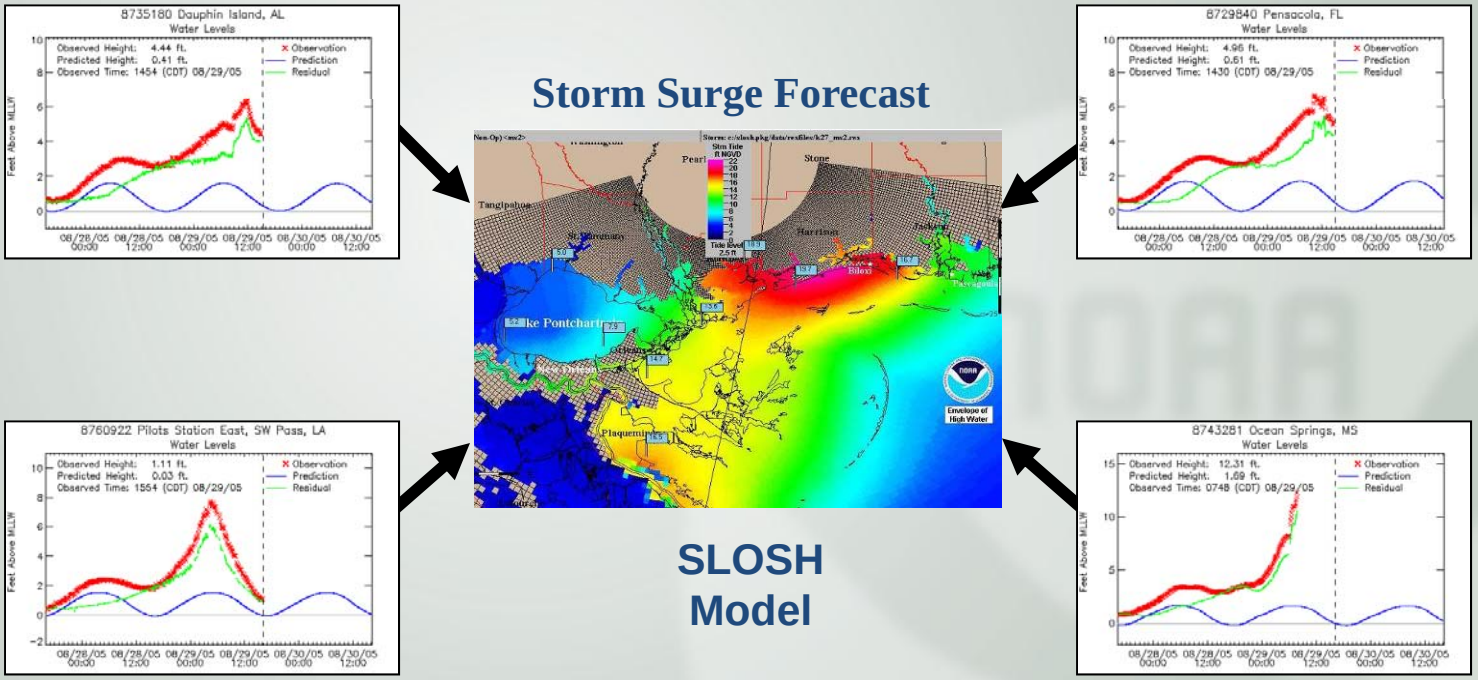
SUMMARY

- NBSSIRN involves CO-OPS first operational installation of radar water level measurement technology. Results from CO-OPS three years of radar sensor testing supports usage of this technology in the application.
- The establishment of the Mobile County Storm Surge Monitoring Network (NBSSIRN) has resulted in a valuable real-time observatory with unique spatial coverage of water level observations across a complex estuarine system.
- NBSSIRN real-time observations will be very valuable in guiding emergency management decisions before and during the passage of the next severe episodic storm events.
- Surge signals detected during the passage of Hurricane Isaac in 2012 provide an example of the variability of surge that can occur across the Mobile County coastal area during the passage of a large storm.

PORTS Data Feeds National Weather Service Models

National Hurricane Center Utilization of Real-Time Storm Tide Data

Improved Model Output by Data Validation



USERS: NWS Forecast Offices & National Hurricane Center, NDBC

Beyond Observations- Coastal and Nearshore Forecasting for Navigation and Dredging Support

- Operational Models for the Northern Gulf are Now Available for Water Levels, Winds, Currents, Salinity, Waves, etc
- This is a Next Generation Move to Combining Coastal and Offshore Real Time Observations with 3 Dimensional Model Forecasting of Weather, Water, Current, Wave, et al Forecasting

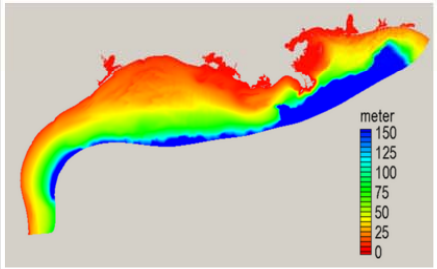
The Northern Gulf of Mexico Operational Forecast System (NGOFS)

Oceanographic nowcasts and forecast guidance are scientific predictions about the present and future states of a water body (generally including water levels, currents, water temperature and salinity). These predictions rely on either observed data or forecasts from large-scale numerical models. A nowcast incorporates recent (and often near real-time) observed meteorological, oceanographic, and/or river flow rate data and/or analyzed (e.g. gridded) meteorological and oceanographic products. A nowcast covers the period of time from the recent past (e.g., the past few days) to the present, and it can make predictions for locations where observational data are not available. Forecast guidance incorporates meteorological, oceanographic, and/or river flow rate forecasts and makes predictions about the future states of a water body. A forecast is usually initiated by the state of a nowcast.

NGOFS model domain and grid image

The wind data used to run NGOFS are based on the National Weather Service (NWS) nested, high resolution (4 km) North American Mesoscale (NAM) weather prediction model winds (for the nowcast and forecast).

Additionally, NGOFS relies on CO-OPS' real-time water level, temperature and salinity observations, NWS Extratropical Storm Surge (ETSS) forecasts, the Advanced CIRCulation Model (ADCIRC) ec2001 tide database, U.S. Geological Survey (USGS) river data, and the Global Real-Time Ocean Forecast System (G-RTOFS).



NCOFS bathy image

The NGOFS grid has 91,652 nodes and 17,6545 elements. Grid resolution ranges from 10 km on the open ocean boundary to approximately 600 m near the coast, indicating the flexibility of the grid size based on bathymetry from the deep ocean to the coast.

Additionally, the higher resolution along the navigational channels within bays, from approximately 200 m to 300 m, provides detailed current features. The NGOFS grid and spatial extent is indicated above. Note that the greatest resolution of the NGOFS grid corresponds with the major bays in the northern Gulf of Mexico. The northern Gulf of Mexico bathymetry is indicated below.

NGOFS runs on NOAA's High Performance Computers (HPC) in a new Coastal Ocean Modeling Framework (COMF) developed by CO-OPS. As a result, NGOFS has direct access to NWS operational meteorological products that it needs to run reliably. Nowcast and forecast guidance cycles are run 4 times a day (every 6 hours).

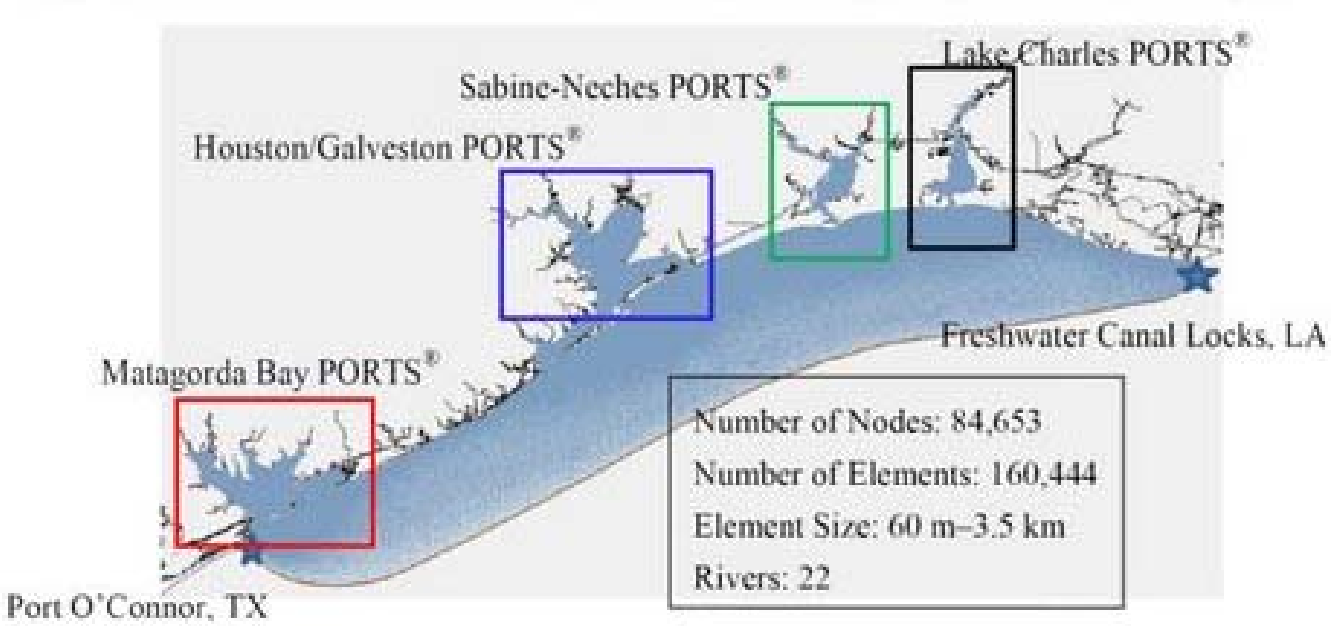
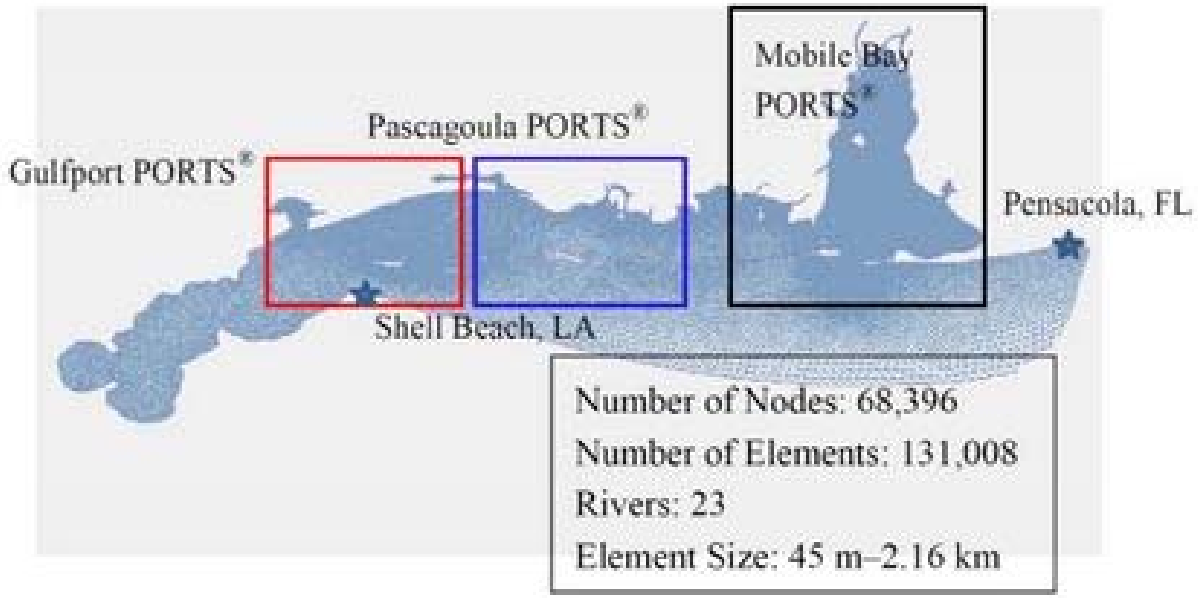
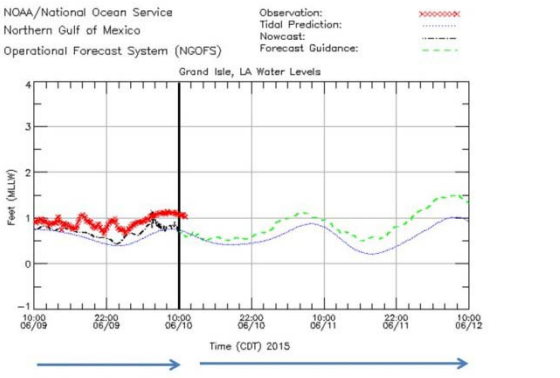
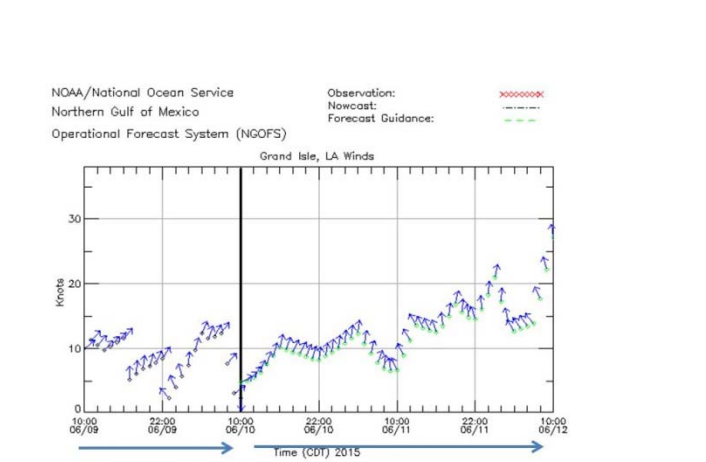


Figure 3. Northeast Gulf of Mexico Operational Forecast System (NEGOFS) model grid.



Real Time Observations Merged with Forecast Models Into One Viewable Format

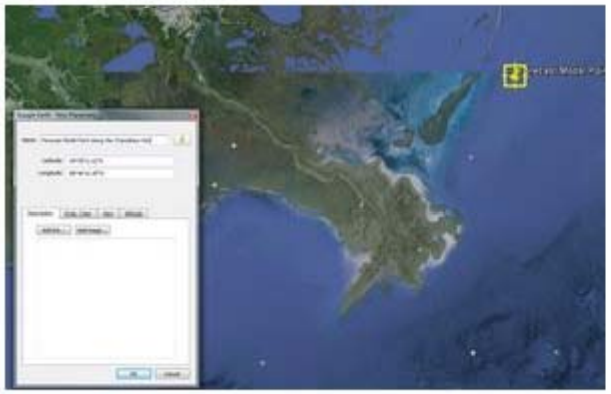


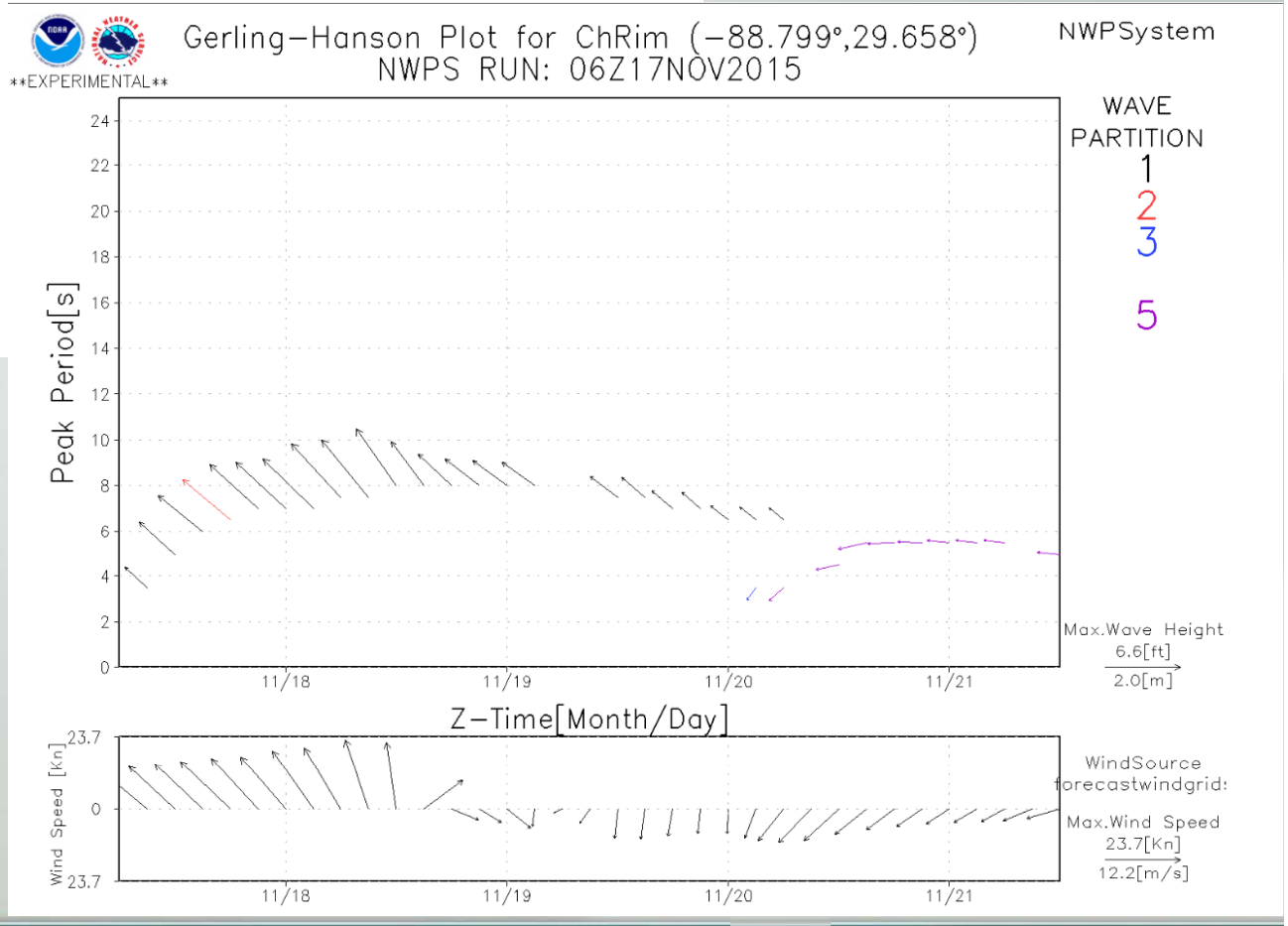


Nearshore Wave and Wind Forecast Models for Coastal Dredging, Navigation, Restoration and Other Activities SWAN/NWPS- NOAA NWS

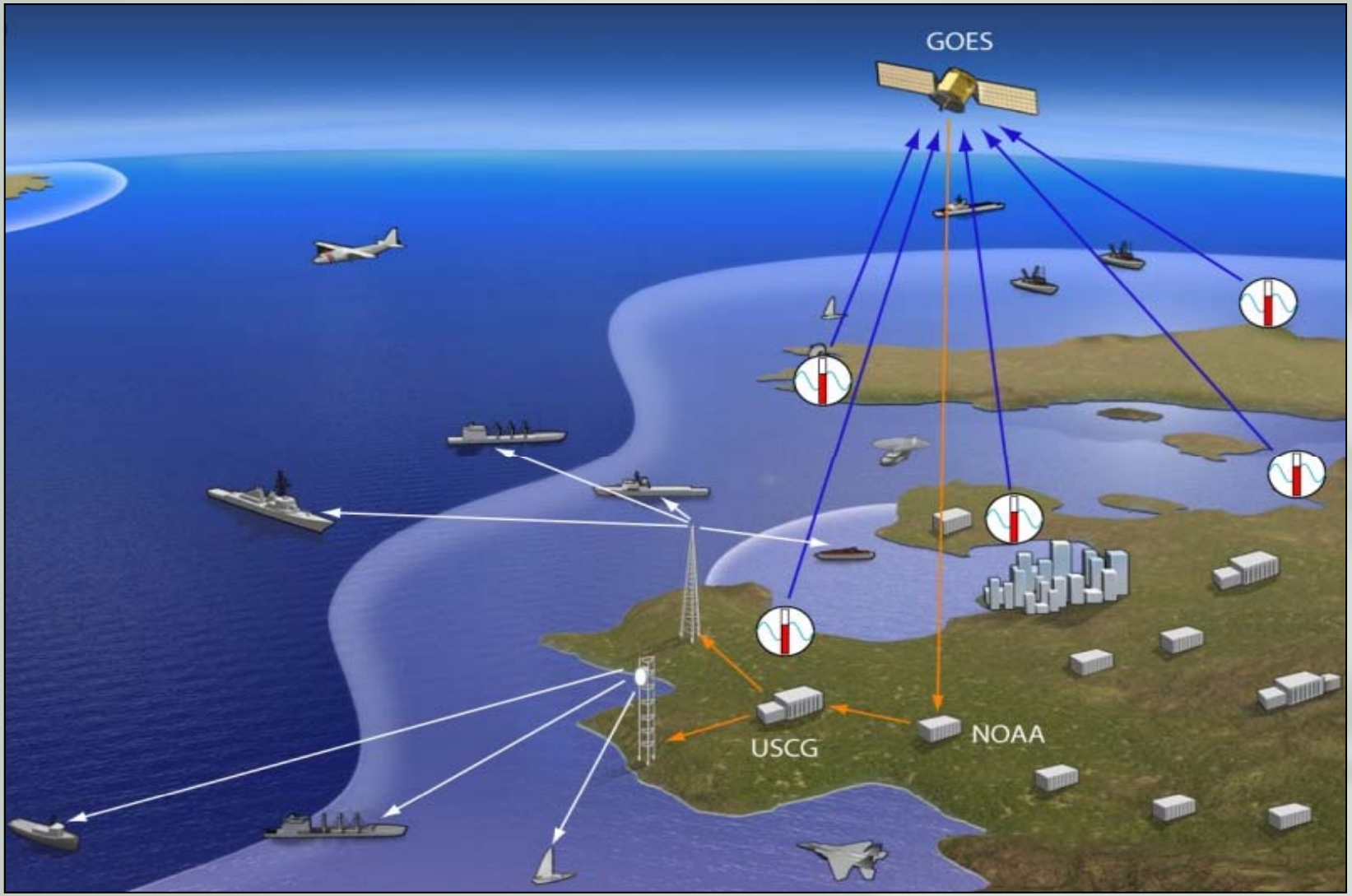
Nearshore and Coastal Chandeleur Bay Area

http://innovation.srh.noaa.gov/images/rtimages/lix/nwps/partition/CG1/Hansonplot_ChRim.png





PORTS® Data Through Coast Guard's Automatic Identification System (AIS) – (in development)



Thank you

Tim Osborn
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337-254-5933

Letter from Mobile

Dear Judith,

I would like to thank Alabama State Port Authority for their investment in the PORTS system now operating at Mobile.

Our Agency has already utilized the system in cooperation with the Harbor Master and Mobile Bar Pilots Association to determine whether or not it was safe to bring a vessel which was loaded to a 40 Ft. draft (FW) into Mobile Ship Channel. In one instance, it was clear that the ***risk was too great to allow the vessel to transit*** the ship channel upon arrival Mobile Pilot Station. Therefore, as recommended by both the Harbor Master and Pilots, the ship anchored outside for about 8 hours in order for the vessel to transit the area of concern in the ship channel during a **rising tide**. As a result, we are ***convinced*** that, ***because of the PORTS system, a potential grounding was avoided***. In view of the high cost of panamax ships, at this time, which is currently over $80,000 per day, it was a tough decision to delay the ship by 8 hours at an estimated cost of almost $27,000. On the other hand, if the ship had grounded in the ship channel during the inbound transit, the cost and possible damage to the ship would have been considerably higher. Even worse, if the ship had grounded, it could have closed the ship channel to ALL navigation until the vessel was re-floated and moved, thus affecting the commerce of the entire Port.

Letter from Mobile

More recently, we had another almost identical situation which was complicated by having neep tides as well as winds from a Northerly direction which, we presume, were responsible for lowering the "actual" water level. However, ***the ship was able to safely transit from the Pilot Station to the berth at Blakeley Island without incident***. If we had ***not had access to the real time data available through the PORTS system***, the Master and Pilots ***could not have made a responsible decision*** as this was a borderline situation.

While writing, I would like to complement the NOAA representatives for the excellent presentation they gave and especially for answering the numerous questions we raised. Perhaps you could let NOAA know our appreciation for their cooperation in explaining the PORTS system in such a professional, yet cordial, manner. The Port of Mobile is indeed very fortunate to have this information available and we are grateful to both ASPA as well as NOAA for their efforts to install the equipment and keep it running.

Best regards,

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