NOAA's Navigation Services

NOAA's Role in Safe and Efficient Marine Transportation

Captain Roger L. Parsons, NOA

February 2005

NOAA's Navigation Services

Primary NOAA Navigation Services offices:

- Coast Survey
- National Geodetic Survey
- Center for Operational Oceanographic Products and Services
- Office of Response and Restoration

NOAA Navigation Services programs support:

- Commerce
- Maritime safety
- Environmental protection
- Homeland Security

NOAA Navigation Services are part of larger interagency effort on MTS

Marine Transportation System outlook

NOAA -- 200 years of history, definitive mission requirements

NOAA's Navigation Services

The Navigation Programs:

- •Hydrographic Surveying, Shoreline mapping (fleet and contract)
- •Navigation Response Teams
- •Nautical Charting (paper, raster, ENC)
- •NOAA Water Levels -- real-time, nowcast/forecast
- •Geodesy -- importance of positioning for navigation, infrastructure

NOAA Research and Development

- •Joint Hydrographic Center at UNH

NOAA HazMat/Waterways Assessment

- •Prevention, Preparedness, Response

NOAA Nav Services Budget History 1994-2005

Hydrographic Services Review Panel

Ocean Commission/President's Action Plan

- •how NOAA Navigation Services relate

NOAA's Navigation Services

National Ocean Service

- Office of Coast Survey
- Center for Operational Oceanographic Products & Services
- National Geodetic Survey
- Office of Response and Restoration

National Weather Service

- Marine Weather

National Marine Fisheries Service

- Permit Reviews

Information for Safe and Efficient Commerce and Transportation

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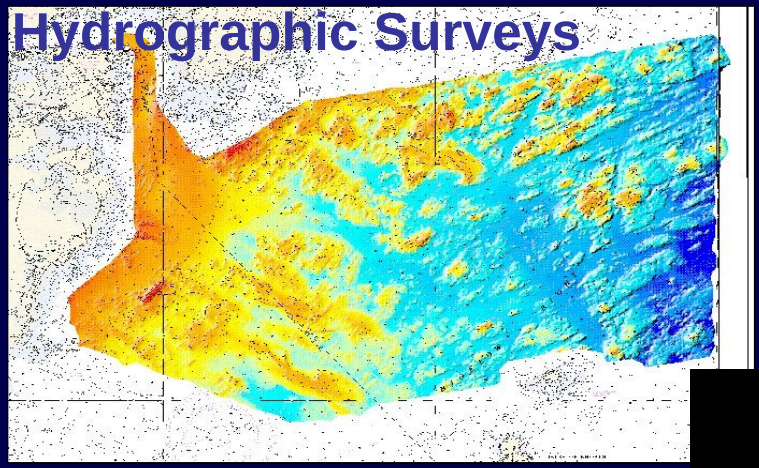
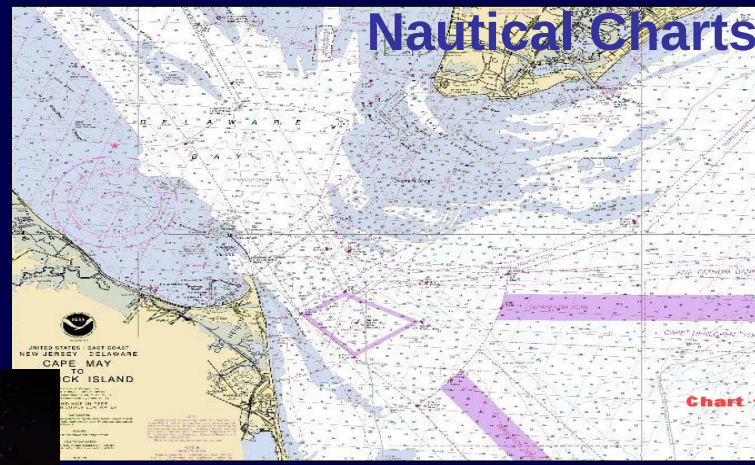
NOAA SUPPORTS SAFE NAVIGATION…

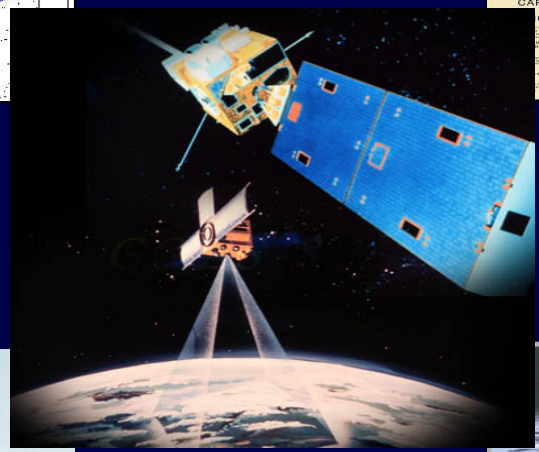
Hydrographic Surveys



Nautical Charts

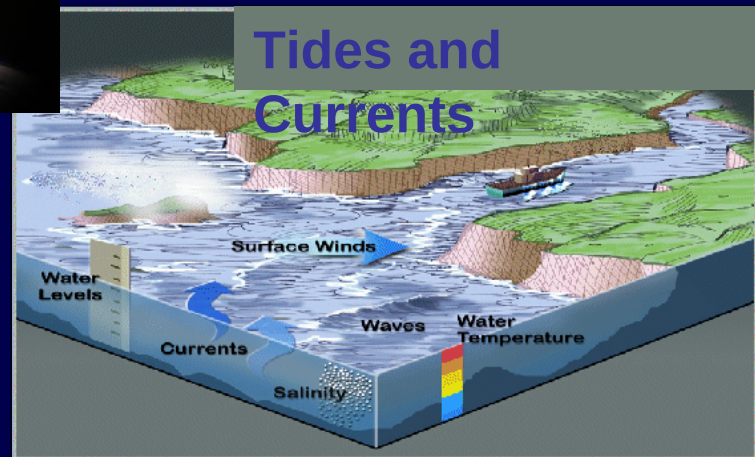


National Spatial Reference System



Marine Forecasts

Tides and Currents



NOAA's Integrated Suite of Navigation Services

- Charting
- Surveying
- Water Levels and Currents
- Accurate Positioning
- Accident Prevention and Response
- Weather Buoys
- Marine Forecasts
- Port Development assessments

- Commerce
- Safety
- Economic Growth
- Port/Economic Efficiency
- More Competitive U.S. Exports
- Environmental Protection
- Important IOOS contributions

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The MARINE TRANSPORTATION SYSTEM

The Nation's network of oceans, lakes, rivers, ~~canals, locks and dams~~

- 95,000 miles of U.S. coastline
- 25,000 miles of navigable channels
- 326 public/private ports
- 3700 marine terminals
- Supports 13M jobs, contributes $742B+ annually to U.S. GDP
- 95% of U.S. foreign trade in/out by ship
- 110,000 commercial/recreational fishing vessels
- 78M recreational boaters

Every U.S. citizen relies on the MTS: energy delivery, exports, transportation, cost-effective consumer goods, recreation, environmental protection

U.S. Coast Guard

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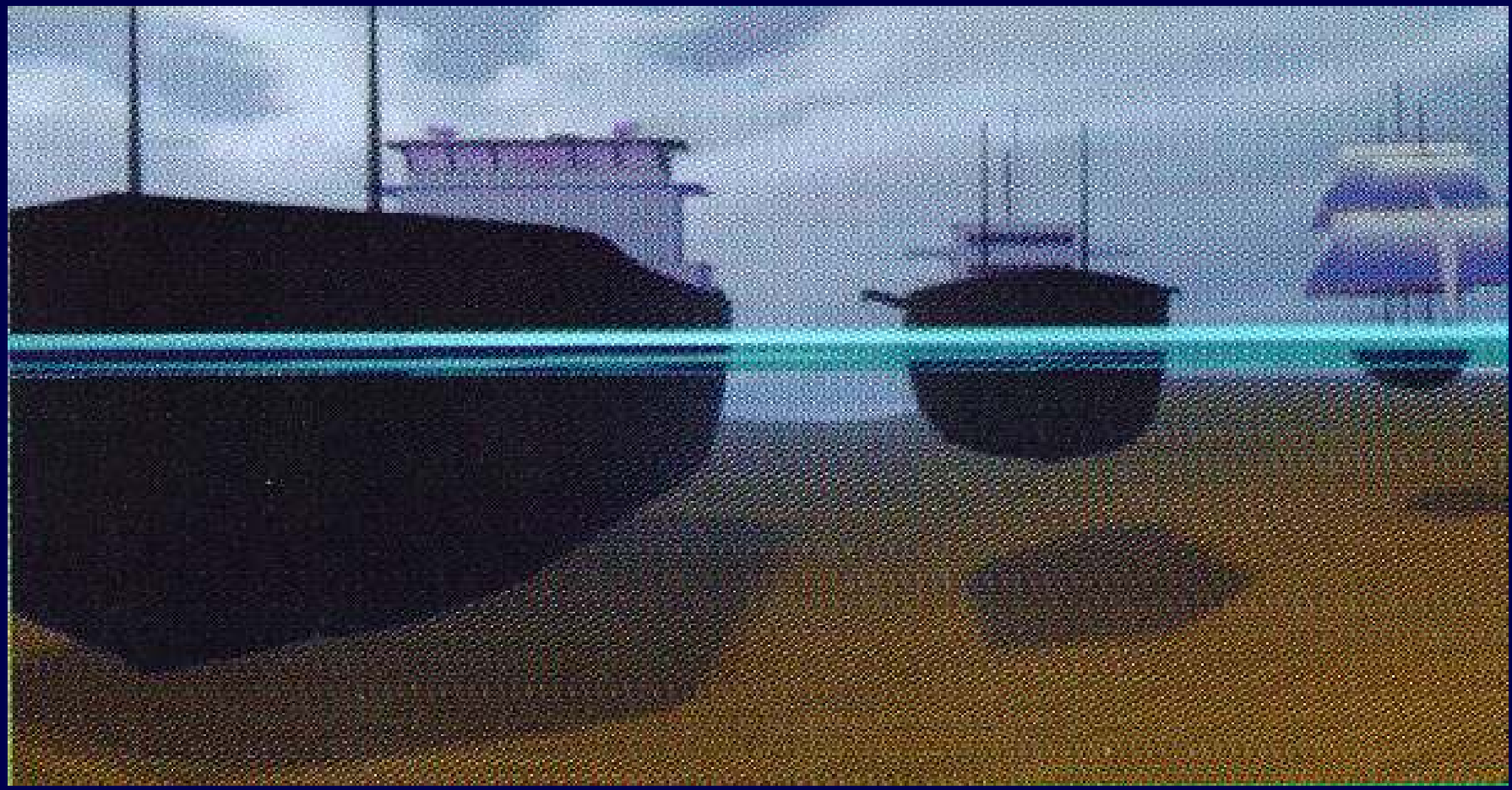
THE RISING TIDE OF CHANGE

- U.S. global maritime trade projected to more than double between 1998 and 2020
- From 1999-2003,containership capacity calling at U.S. ports increased by 29%
- Over 2 billion metric tons of domestic and international waterborne cargo move on U.S. waterways each year
- Ferry boats now carry over 100M passengers annually
- The U.S. MTS hosts more than 5 million cruise ship passengers each year
- The U.S. imports 3.5 billion barrels of oil by ship every year to meet energy demands
- U.S. ports are our gateways for rapid military deployment, economic security – heavy Homeland Security focus on U.S. coastline borders

Navigation in Perspective



Ships are growing longer, wider and deeper

SECURITY


U.S. Depends on the Uninterrupted Flow of Goods and Energy Products to Fuel the Nation
Homeland Security
Military Deployment

U.S. Mapping and Charting Responsibilities

U.S. Department of Commerce

- NOAA – Hydrography/legal National Shoreline surveys, Tides and Currents, Nautical Charts for U.S. Territorial waters (to U.S. EEZ 200 nautical mile limit)

U.S. Department of Defense

- Army Corps of Engineers – Dredging and maintenance of navigable channels and inland navigable waterways
- NAVOCEANO – Surveying international waters
- Nat'l Geospatial Intelligence Agency – Charting int'l waters

U.S. Department of Homeland Security

- Coast Guard – Maintenance of maritime Aids to Navigation
- FEMA – Disaster Response and Floodplain Mapping

U.S. Department of Interior

- U.S. Geological Survey – Interior to coastline base maps

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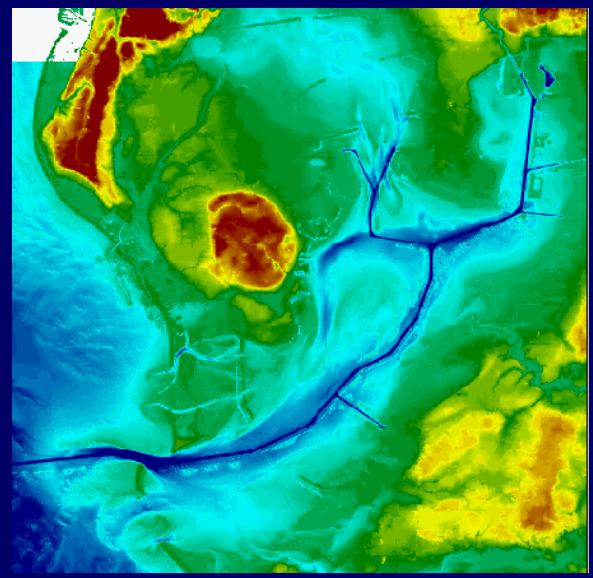
INTERAGENCY COOPERATION

NOAA/USGS

- Bathymetric/Topographic digital elevation models

NOAA/NAVY/Coast Guard

- *Homeland Security Surveys*
- *Water Circulation Models*
- *Law of the Sea Surveys (UNCLOS)*



NOAA/CORPS OF ENGINEERS

- Channel Survey data evaluation

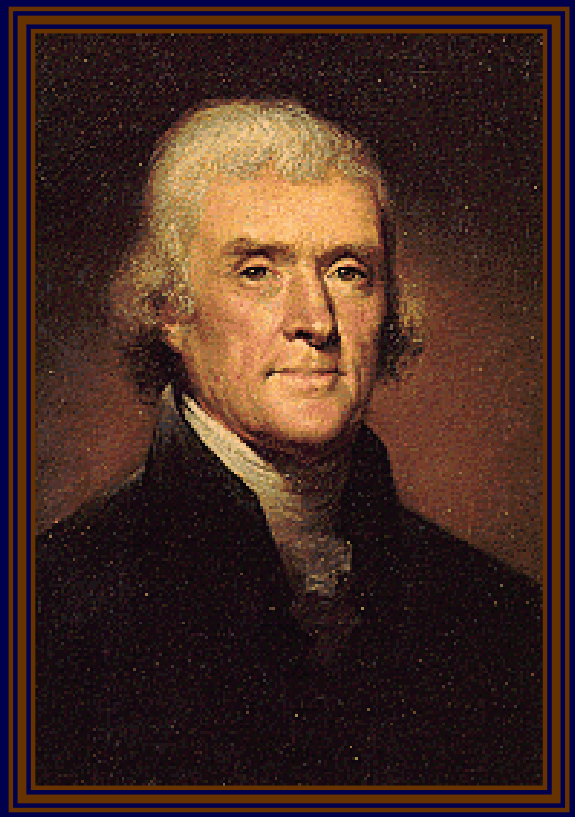
NOAA/COAST GUARD/NGA

- *Quality Improvements to Notice to Mariner System*

NOAA/COAST GUARD/CORPS OF ENGINEERS

- *Electronic Navigational Chart development*

Father of the Coast Survey



"…to cause a survey to be taken of coasts of the United States, in which shall be designated the island and shoals and places of anchorage...".

- President Thomas Jefferson, 1807

Current Authorizing Legislation:

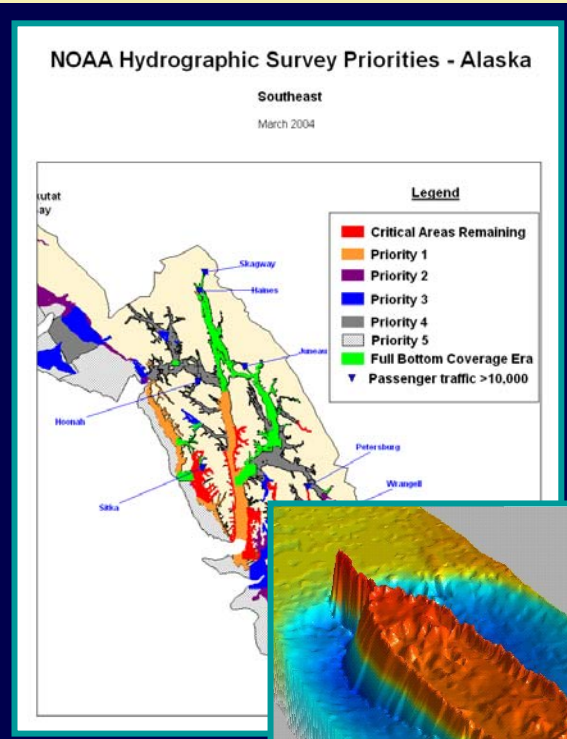
Coast and Geodetic Survey Act of 1947

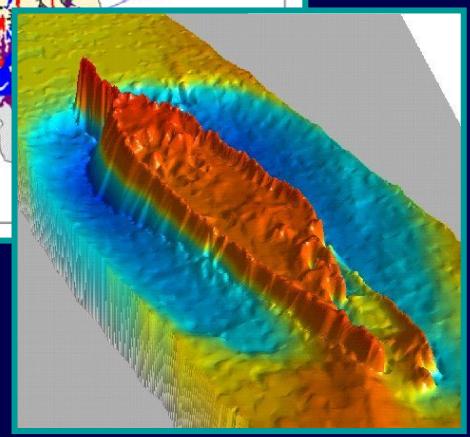
Hydrographic Services Improvement Acts of 1998, 2002

United States Exclusive Economic Zone

NOAA's AREAS of RESPONSIBILITY:
3.4 MILLION SQ MILES of U.S. EEZ

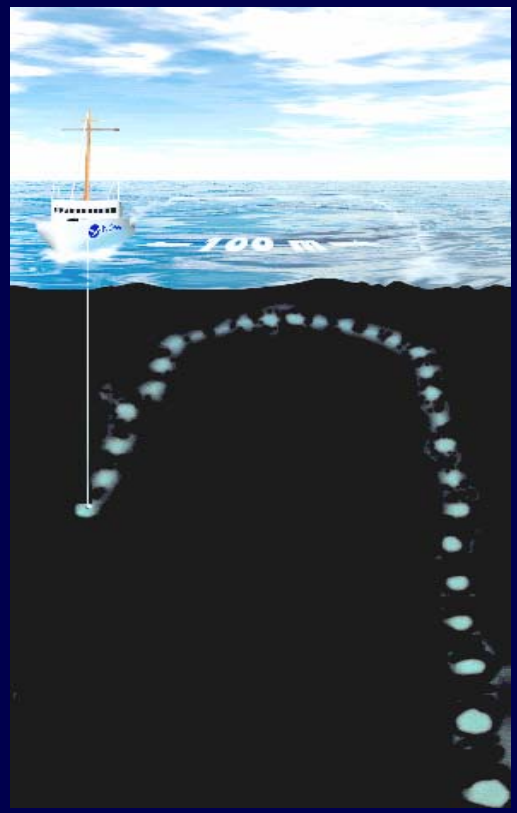
NOAA Navigation Services: Hydrographic Surveying





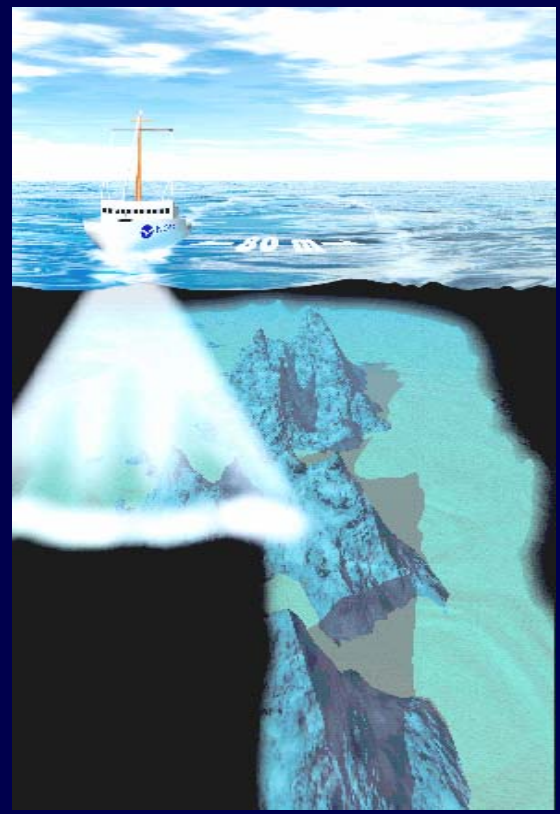
- *Integrated Ocean Observing System building block – basic parameter*
- *500,000 sq. nautical miles of EEZ are navigationally significant*
- *Rocks, wrecks, obstructions, depths and seafloor characteristics*
- *NOAA Hydro Survey Priorities at nauticalcharts.noaa.gov/staff/NHSP.html*

Hydrographic Survey Methods Over Time: Bottom Coverage & Data Density



Leadline
1-2000
soundings
per survey

Single Beam
500 – 750K
soundings
per survey



Multi Beam
4 – 100M
soundings
per survey

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NOAA Hydrographic Fleet

RAINIER
Seattle, WA
1968

BAY HYDROGRAPHER
Silver Spring, MD
1988 (1996 to NOAA)

FAIRWEATHER
Ketchikan, AK
1968 (2004 refit)

RUDE
Norfolk, VA
1967

THOMAS JEFFERSON
Norfolk, VA
1992 (2003 to NOAA)

SWATH Multipurpose Mapping Vessel
in FY07 (target)

NOAA's Navigation Services

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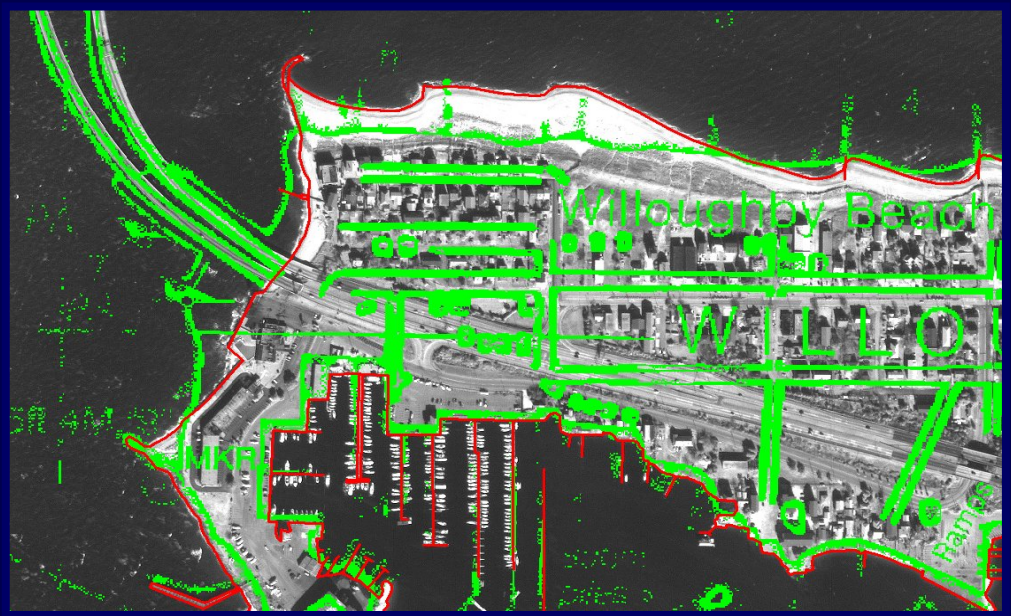
A NOAA IOM Vessel

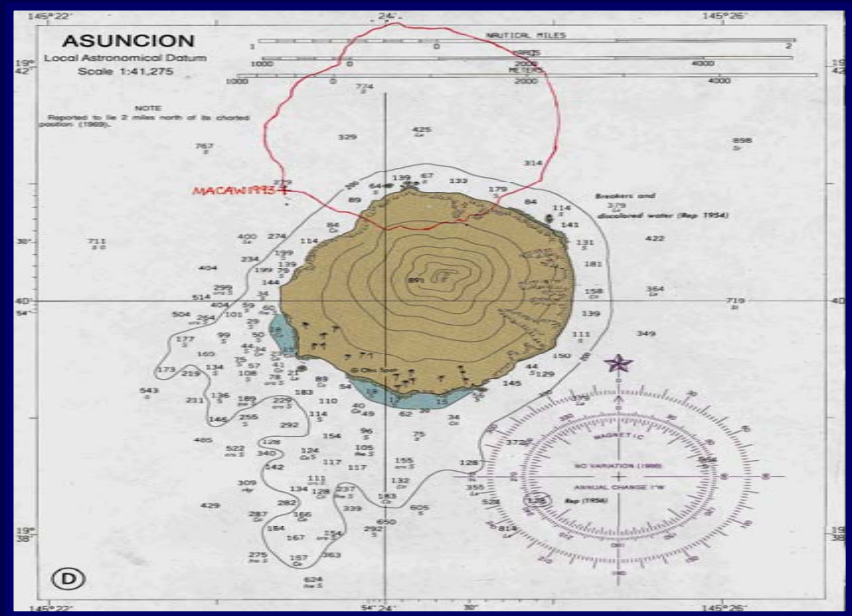
Integrated Ocean Mapping

- *IOM approach is one way to meet U.S. Commission on Ocean Policy/White House Action Plan intent for coordinating federal mapping activities – primarily NOS, NMFS, OAR within NOAA*
- *IOM vessel gathers multipurpose data, surveys to established general standards in order to meet needs of multiple users*
- *Navigationally significant waters, habitat mapping, ocean exploration… data gathered would be useful to all parties interested in area being surveyed*

NOAA Navigation Services: Shoreline Mapping

- Providing accurate, consistent legal National Shoreline data for 95,000 nautical miles of U.S. coastline
- Contract Surveys and Satellite Imagery Change Analysis to most efficiently map priority port areas, remainder of coastline on consistent basis
- Integrated Ocean Observing System building block





NOAA's Contract Survey Resources

$41.2M in FY04

$28.9M in FY05

Shoreline and Hydrographic Data Collection

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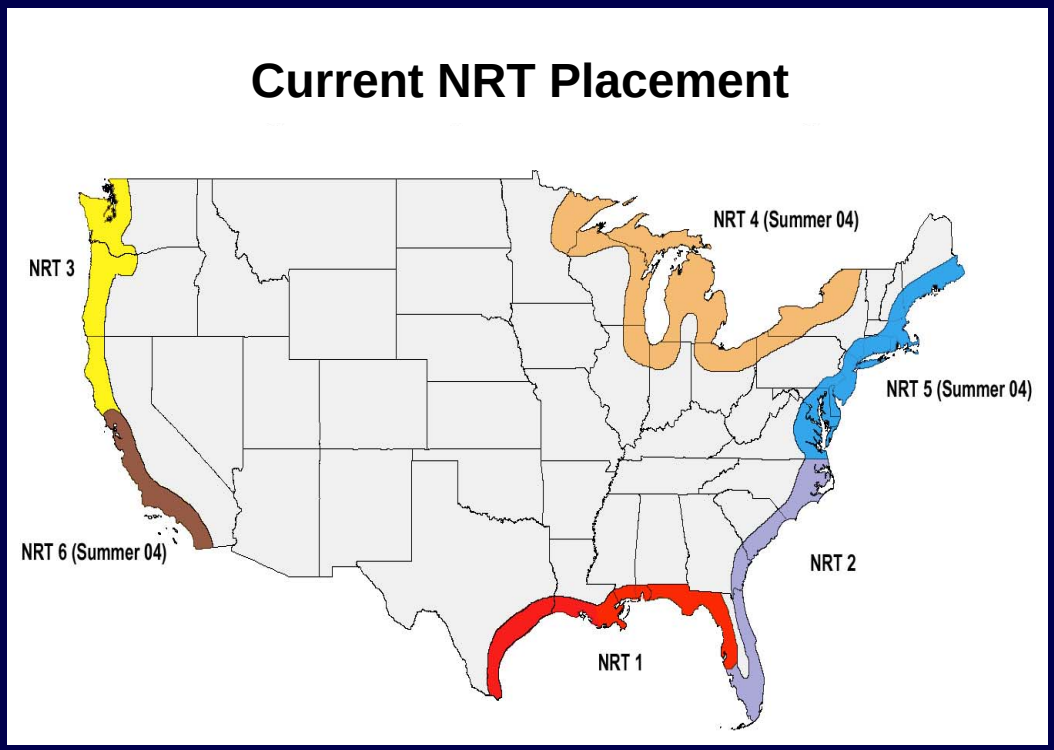
NOAA's Contracting Relationships

- NOAA is a major proponent of contracting to supplement its core capabilities on Navigation Services mission requirements
- NOAA/Private sector partnerships are very strong
  - Partnerships have fostered significant technology development, process improvements for shoreline/hydro surveying
  - E.g., contractors participate in NOAA Field Procedures Workshops, contribute ideas and techniques to improve data gathering processes – we learn from each other
- Report to Congress on NOAA contracting policy in review
  - Details NOAA and contract/grant mapping and charting %'s for FY03-05
  - Current policy will be studied and revisions recommended by Hydrographic Services Review Panel FACA at March 2005 meeting

NOAA Navigation Services: Navigation Response Teams



- Units are regional, can mobilize rapidly to respond to hurricanes, accidents, etc…
- Fully equipped with sidescan sonar for object detection
- Goal is 8 NRTs for adequate coverage

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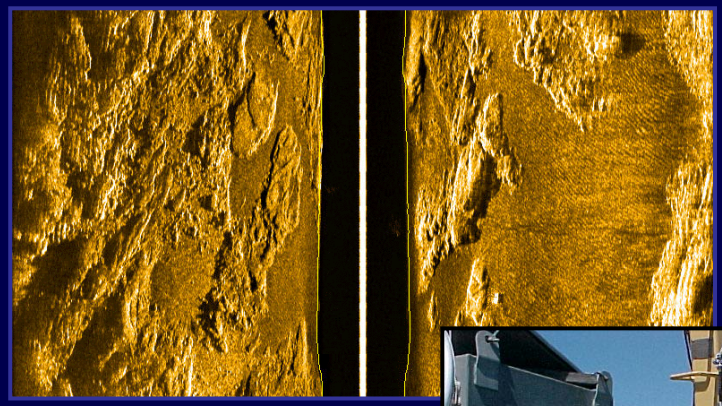
Homeland Security Activities

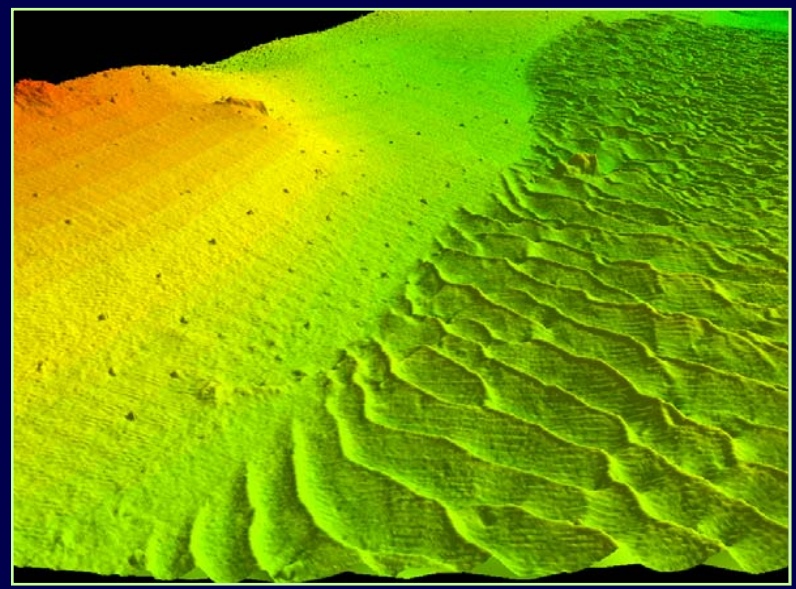


Side Scan Sonar & Detailed Imagery

NOAA, Navy & Army Corps of Engineers — 2001 Agreement on Port and Harbor Baseline Surveys for Change Detection

MLO Detection with NAVO

Detection of mine-like objects on the seafloor



- NOAA's hydrographic survey vessels and Navigation Response Teams use side scan and multibeam sonar to perform highly accurate monitoring surveys

- NOAA's systematic surveys provide data to the Navy for change analysis

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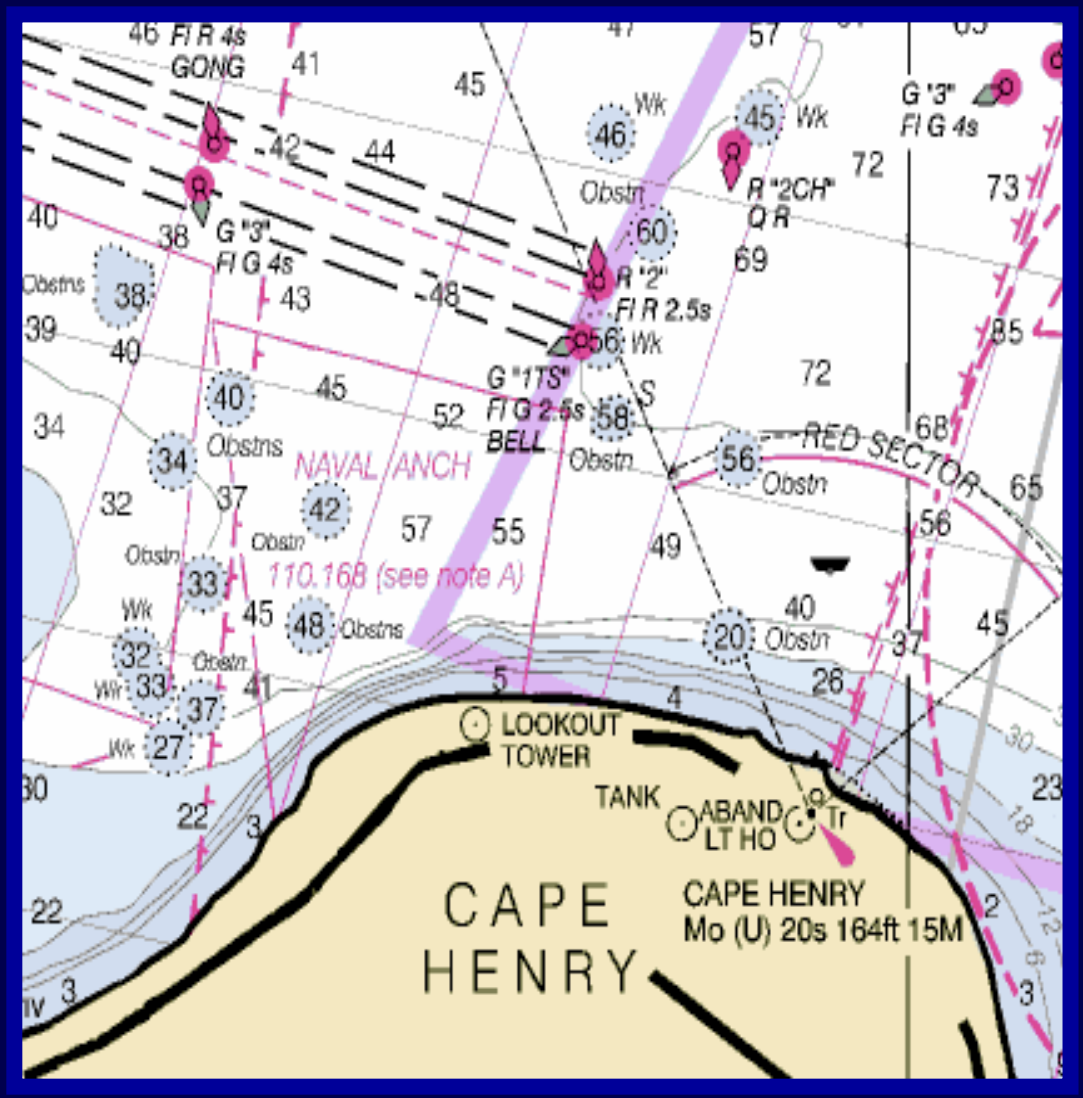
NOAA Nautical Charts:
The Mariner's Road Map



- Shoreline
- Depths, Depth Curves
- Obstructions
- Landmarks
- Dredged Channels
- Aids to Navigation
- Marine Boundaries
- Anchorages, Piers
- Marine Facilities and more!

- 1000 Paper/Raster Charts
- Weekly Updates
- Coast Pilot
- PRINT ON DEMAND - the world's most up-to-date nautical charts!!

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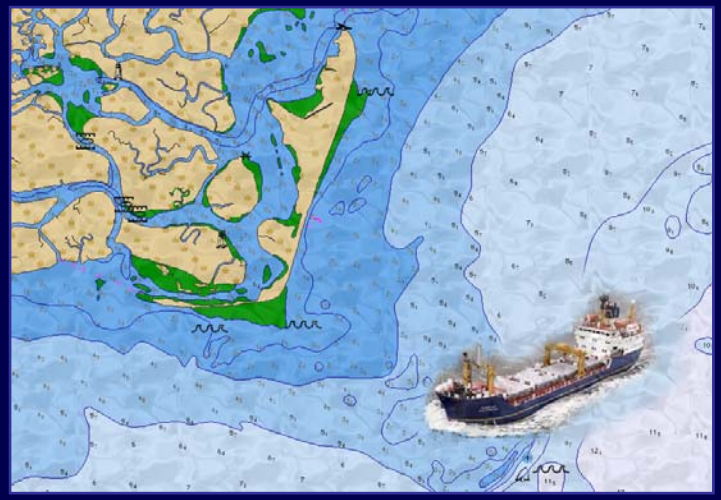
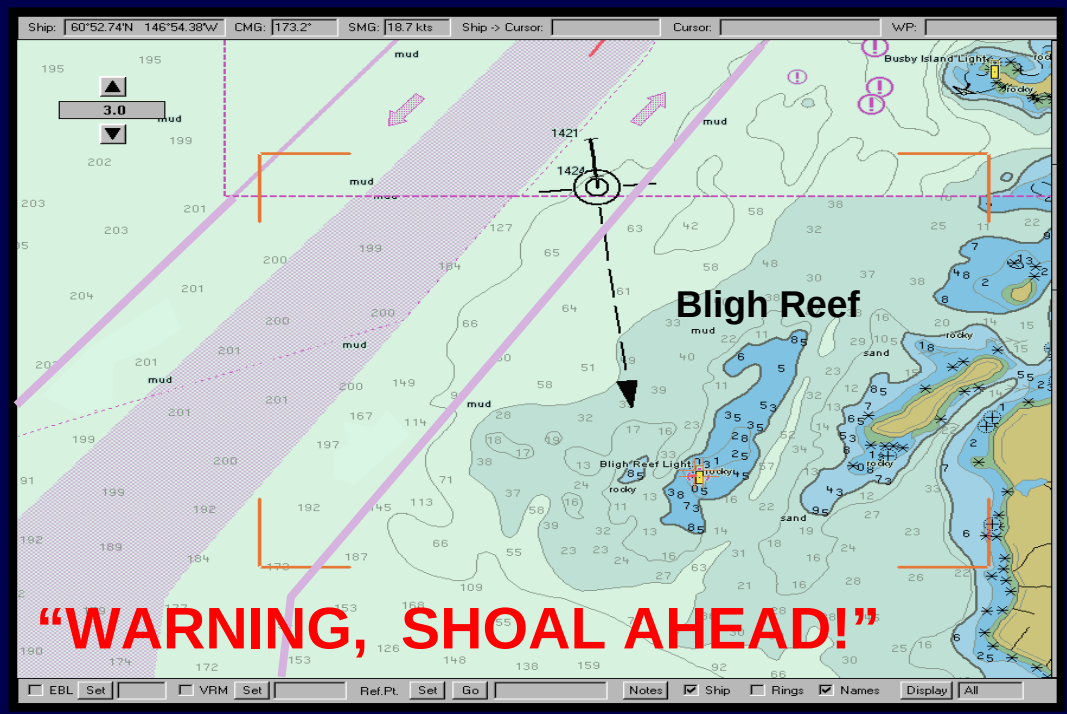
NOAA Nautical Charts: The NOAA ENC®



- Electronic Navigational Charts are databases of nautical chart info with enhanced flexibility
- ENCs work with U.S. Coast Guard Automatic Identification System, as a GIS for non-nav uses
- Available for Free on the Internet since 2001 (3 million downloads and counting)

Allision and grounding avoidance-- alarms sound if ship strays near dangerous areas



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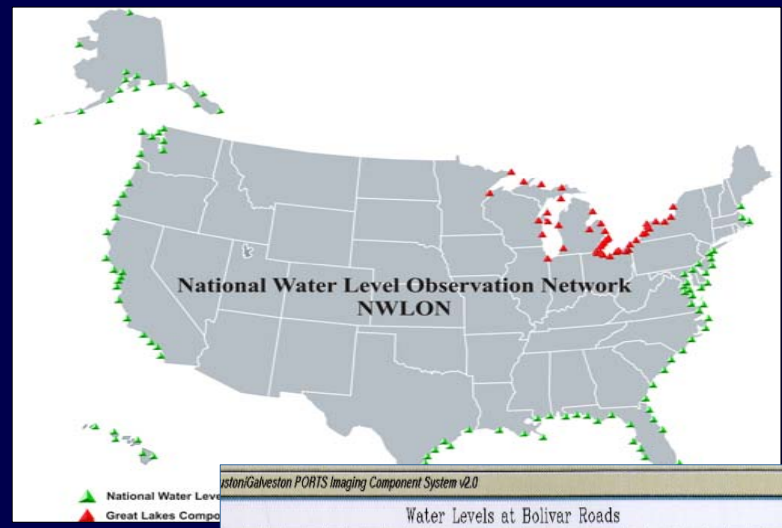
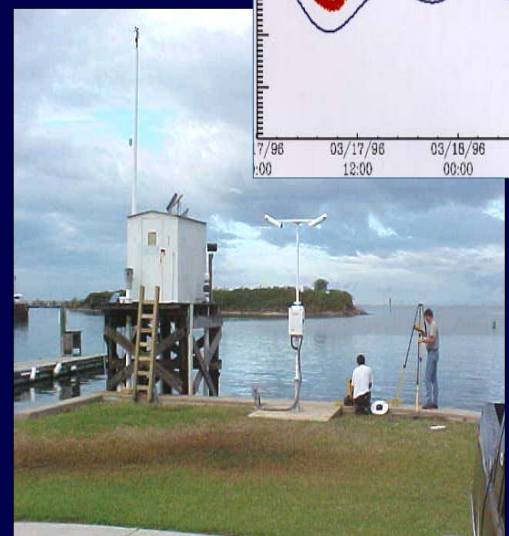
NOAA Navigation Services: Water Levels

- National Water Level Observation Network Supports:
  - NOAA Surveying and Charting
  - PORTS®
  - Under-bridge/Underkeel Clearances
  - Safer Navigation
  - Storm Surge, Tsunami Warning
- 175 long-term, continuously operating water level stations
- Integrated Ocean Observing System building block





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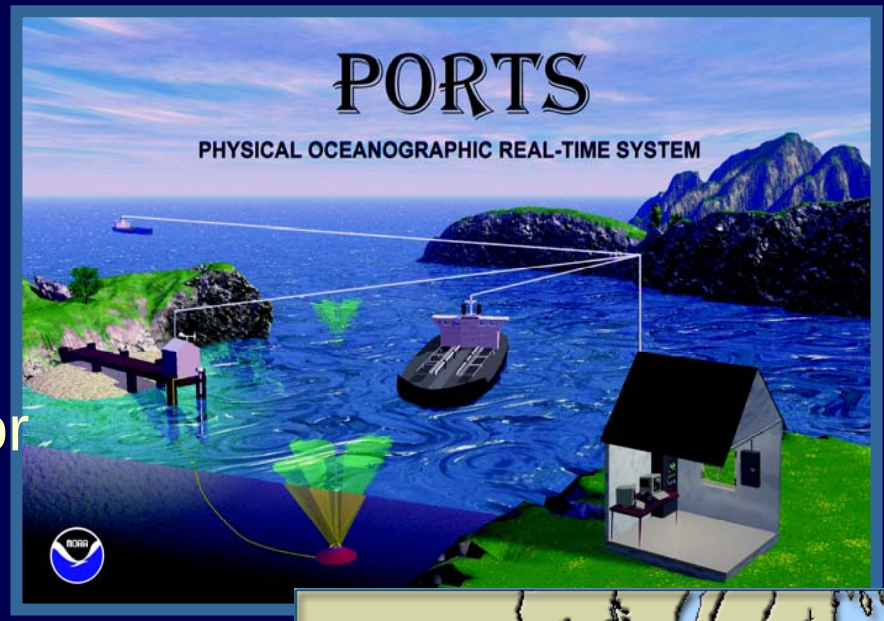
NOAA Navigation Services: Real-time Data

PORTS®:

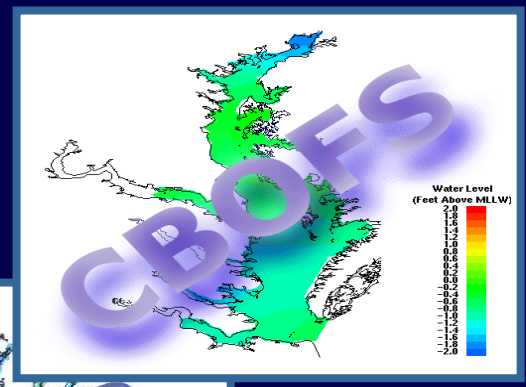
- Port of Anchorage
- Chesapeake Bay
- Delaware River & Bay
- Houston/Galveston
- New York/New Jersey Harbor
- Los Angeles/Long Beach
- Narragansett Bay
- San Francisco Bay
- Soo Locks
- Tampa Bay

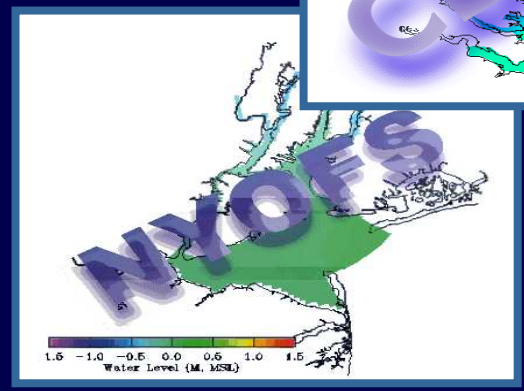


Real-time data helps mariners to know how close ship keels are to sea bottom and how much cargo to load

NOAA Navigation Services: Nowcast/Forecast Models

- Hydrodynamic models forecast water levels, currents conditions for hourly to 36-hour advance info
- Support for mariner safety/efficiency decisions:
  - How much cargo to load
- Trip routing for best water
  - Arrival/Departure Timing
- Operating models in Galveston, Chesapeake Bay, NY/NJ
- Tampa Bay, Delaware Bay, Great Lakes, Cook Inlet, Columbia River in development
- Critical IOOS Data Integrator





Operational Models available at co-ops.nos.noaa.gov

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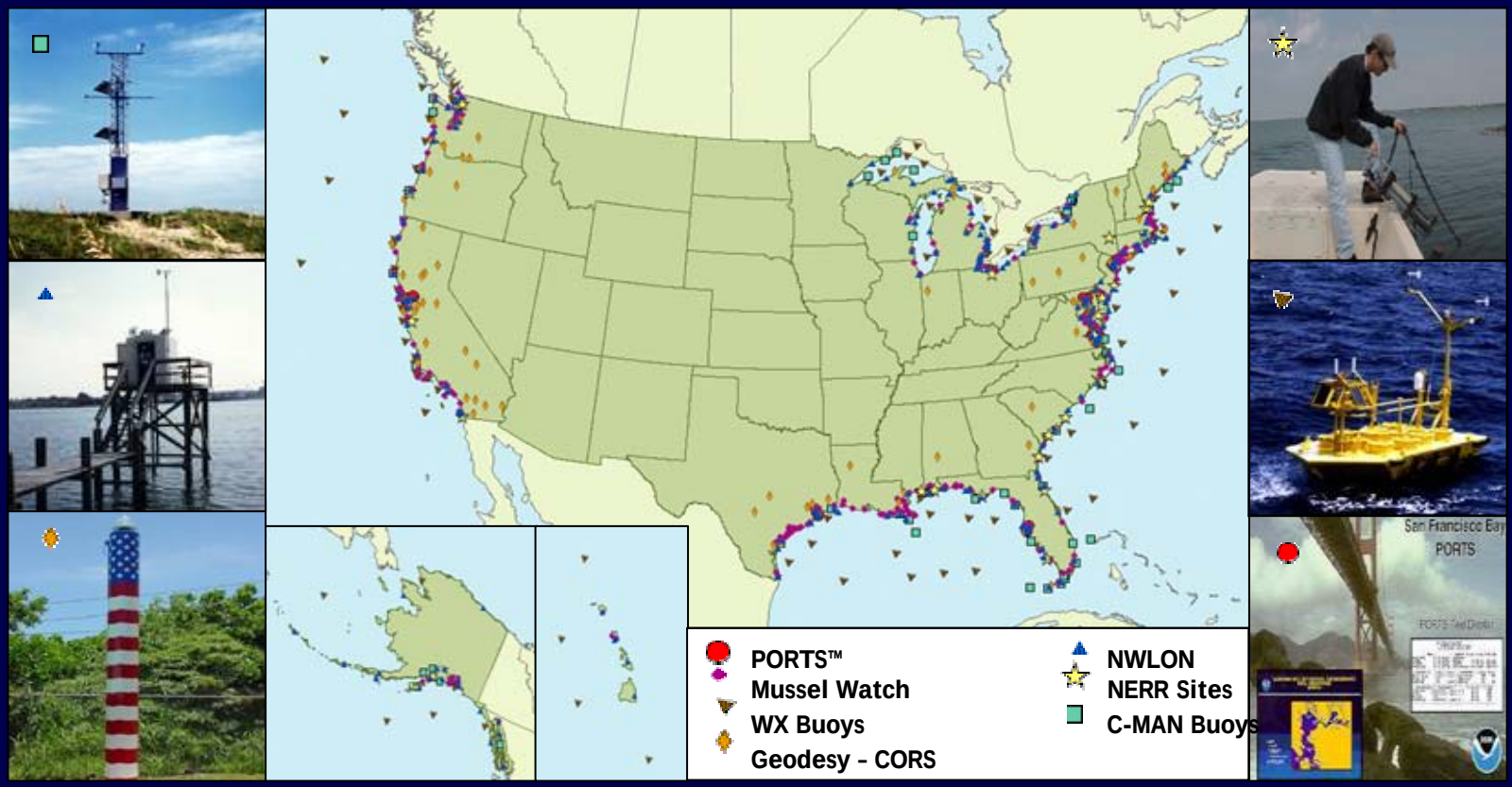
NOAA Navigation Services: Positioning

NOAA's National Spatial Reference System provides the integrity to GPS satellite data to make it useful

- **Navigation, Surveying, Mapping**
- **Infrastructure – buildings, roads, bridges**
- **The Vertical Dimension – accurate heights**
- **IOOS, Flood/Emergency Mgmt, Erosion and more!**

NOAA Integrated Ocean Observing System
Navigation Services Contributions



National Backbone parameters:

- Hydrographic Surveys
- Shoreline Mapping
- Geodetic Continuously Operating Reference Stations
- NWLON, PORTS
- Hydrodynamic models

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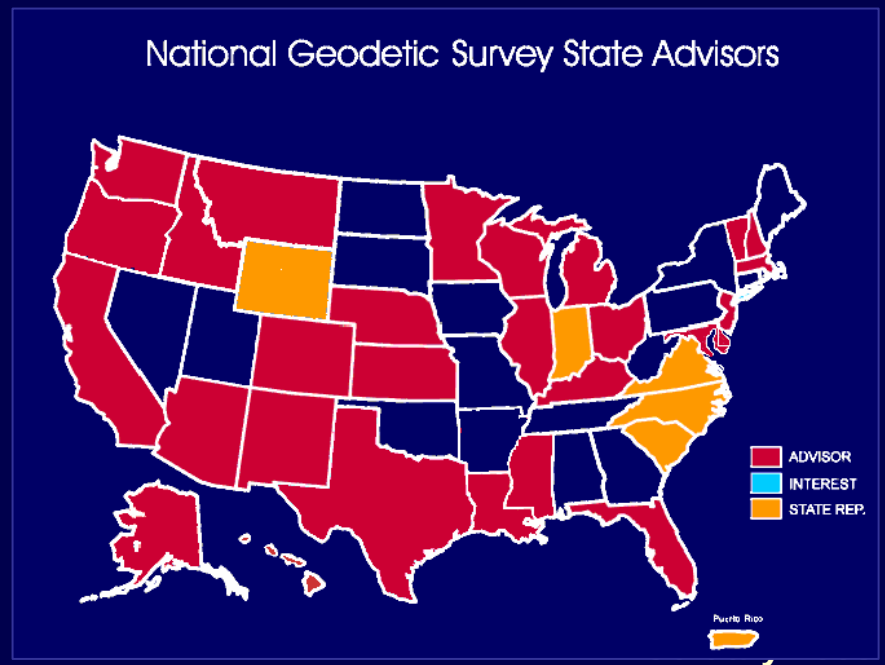
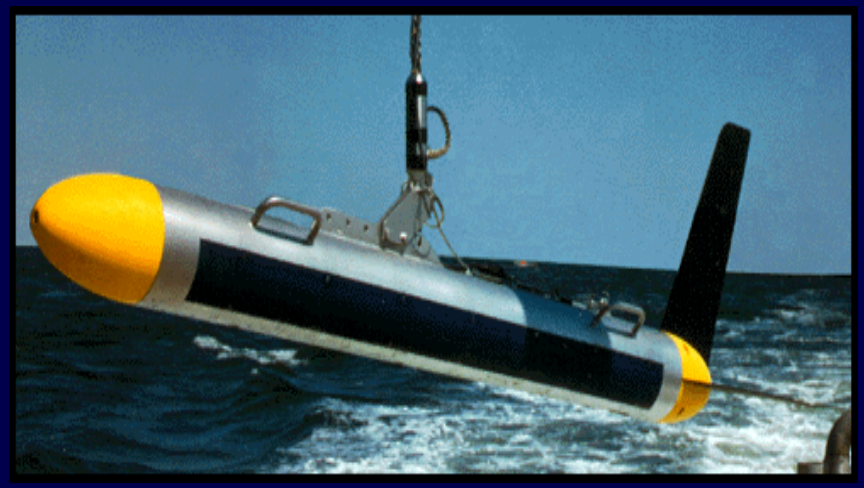
NOAA Navigation Services: Our Faces in the Field

- 10 Regional Navigation Managers serve as representatives in the field, working with local mariners to reflect their needs in NOAA navigation products
- NOAA State Geodetic Advisors liaise with 28 host states to guide and assist the states' geodetic and surveying programs



NOAA Navigation Services: Research and Technology Development



- Working with private sector on Autonomous Underwater Vehicle (AUV) Technology
- AUVs offer significant potential for fleet multiplier effect – hydrography, fisheries research, undersea research

Joint Hydrographic Center at UNH:

- learning center to promote education of new hydrographers and ocean mapping scientists
- research to develop and evaluate state-of-the-art ocean mapping technologies
  - Multibeam and sidescan sonar
  - Improved data processing techniques

CCOM JHC

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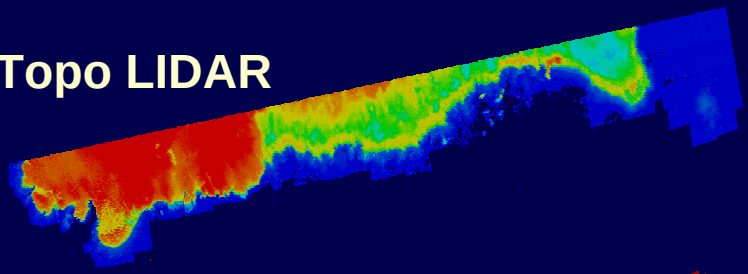
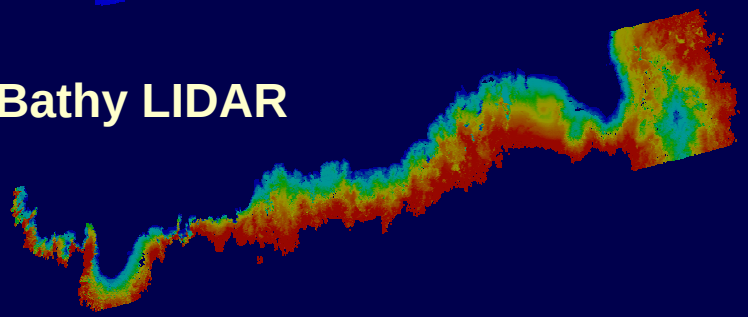
NOAA Navigation Services: Research and Technology Development

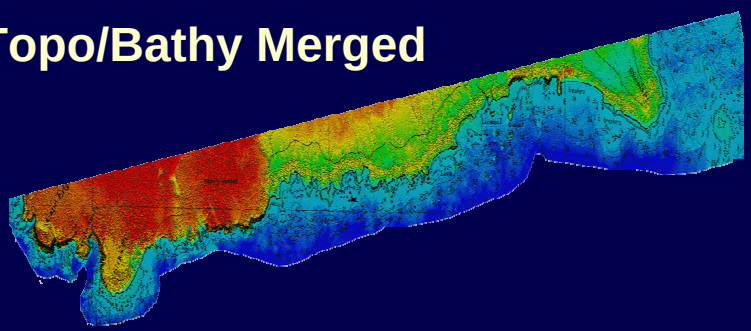
Topo LIDAR



Bathy LIDAR



Topo/Bathy Merged



- LIDAR Research: Light Detection and Ranging remote sensing systems
- LIDAR flown on aircraft offer potential for nearshore/shoreline surveying to:
  - gain efficiencies
  - maintain safety of survey operations
  - gather data in shallow nearshore areas that NOAA presently not surveying
- Topographic LIDAR images land
- Bathymetric LIDAR penetrates water unde right conditions (clear, no turbidity)
- NGS/OCS/CO-OPS studying potential for merged topo/bathy LIDAR systems to derive shoreline/water line/nearshore data
- Requires VDatum tide models to unify reference levels, blend data sets

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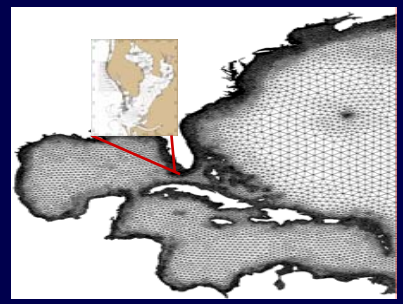
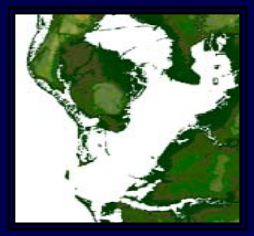
National VDatum

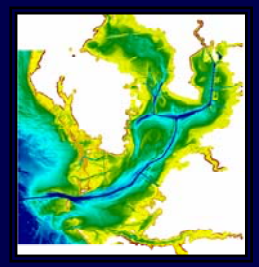
"In order to combine onshore and offshore data in a seamless geodetic framework, a national project to apply Vdatum tools should be initiated." – Nat't Academy of Sciences 2003 Report



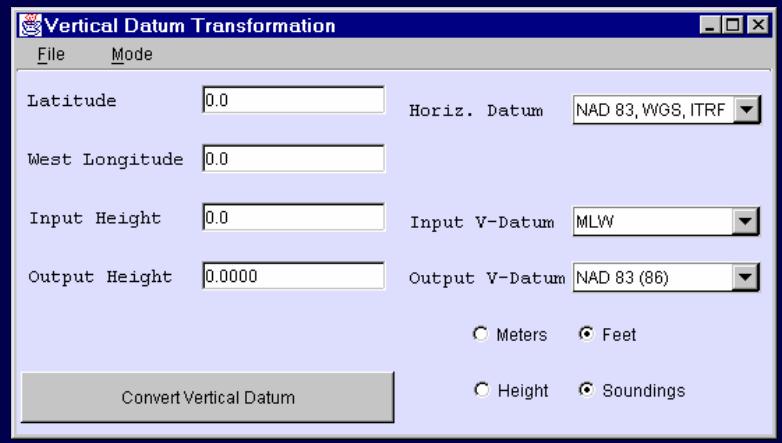
Geoid, Tide, and Ellipsoid Models



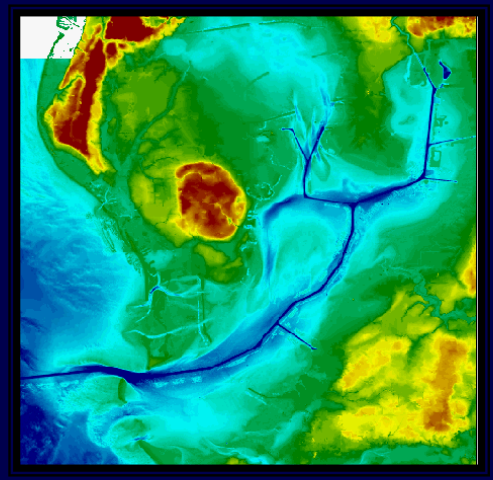
USGS Topography



NOAA Bathymetry



Bathymetric/Topographic Digital Elevation Model



PROBLEM- Datasets gathered at different vertical datums (MHW, MLLW) or reference levels (MSL) cannot be easily integrated

SOLUTION- VDatum Transformation Tool To:

- **Improve hydrographic survey efficiencies through the use of vertically referenced RTK-GPS Hydrographic Surveys**
- ***Consistently* define shoreline from LIDAR data**
- **Resolve NOAA-USGS shoreline variations**
- **Enable multiple use of datasets by a wide range of coastal GIS Users**

http://nauticalcharts.noaa.gov/bathytopo/

February 2005

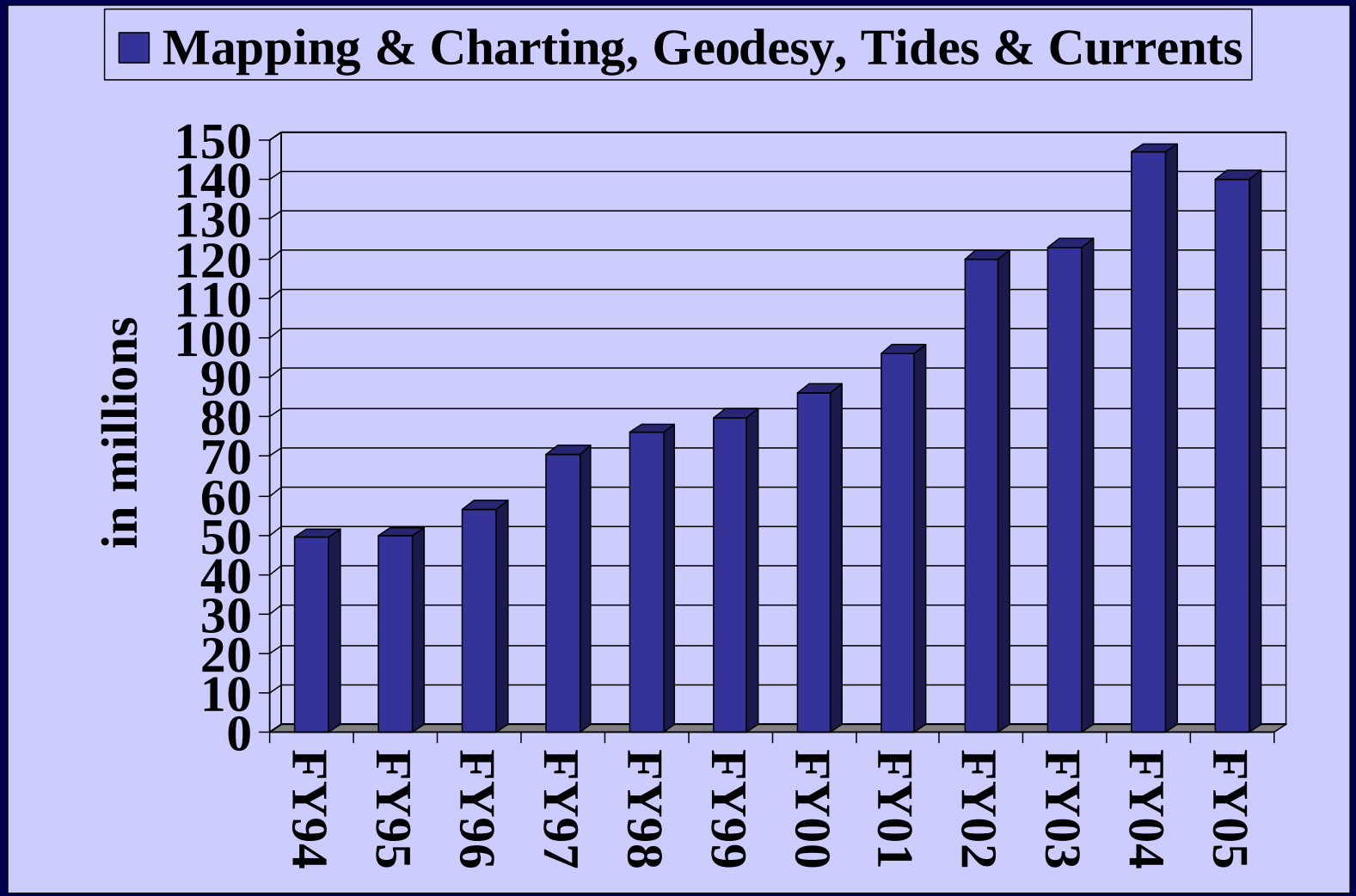
NOAA Navigation Services: Prevention, Preparedness, Response

- Oil and hazardous material spill response
- Spill Trajectory Modeling
- Contingency Planning
- Waterways Risk Assessment & Mgmt for environmental protection
- Port & urban waterfront development review and recommendations

700+ hazardous waste sites contaminate our coasts
2M gallons of oil spilled a year from marine accidents

February 2005

NOAA Navigation Services: Budget History



Hydrographic Services Review Panel

- **Congressionally Mandated in the Hydrographic Services Improvement Act (HSIA 2002)**
- **15 voting members appointed by the NOAA Administrator**
  - Chair Scott Rainey, APA -- Vice Chair Helen Brohl, NAMO
  - UNH Joint Hydrographic Center co-directors and 2 NOAA employees may serve as non-voting members
- **3 Meetings held since April 2004 initiation**

Purpose: To advise the NOAA Administrator on hydrographic matters

U. S. Commission on Ocean Policy/ White House Ocean Action Plan

- Commission recommended coordinated approach to federal ocean and coastal mapping and charting activities
- Also recommended codifying the Interagency Committee on the Marine Transportation System Commission (ICMTS) on which NOAA participates
- President's Ocean Action Plan:
  - ICMTS elevated to a cabinet-level body
  - Renewed push for coordinated ocean/coastal mapping activities at federal/non-federal levels
  - Support for UNCLOS Accession (relevant to claims for expanded continental shelf)
  - Build IOOS as part of Global Earth Observation Network

February 2005

Important NOAA Websites and Contacts

noaa.gov – Main Page

nauticalcharts.noaa.gov – Office of Coast Survey

Captain Roger L. Parsons, NOAA 301-713-2770

co-ops.nos.noaa.gov – Center for Operational Oceanographic Products and Services

Mike Szabados, 301-713-2981

geodesy.noaa.gov – National Geodetic Survey

Charlie Challstrom, 301-713-3222

orr.noaa.gov – Office of Response and Restoration

David Kennedy, 301-713-4246

April Black, NOAA Legislative Affairs

202-482-5447

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