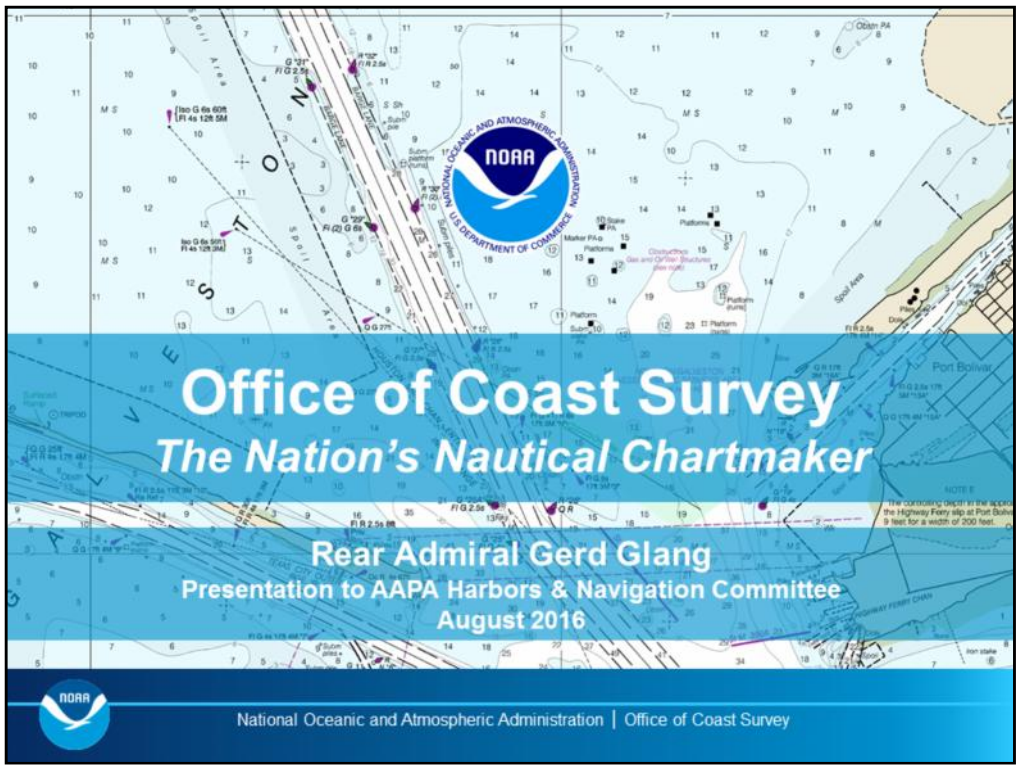
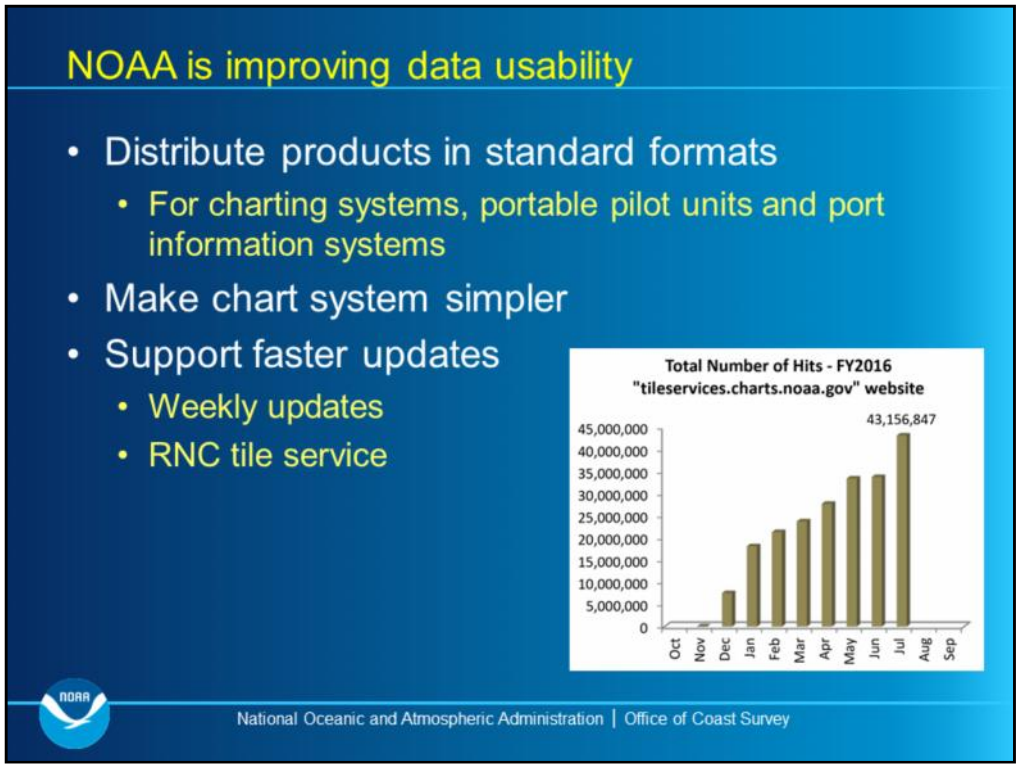


Coast Survey has been the Nation's chartmaker since the 1830s, and we now chart over 3.4 million square nautical miles. We are living with a grand sense of public expectations about those charts. Think to what you do when you plan a trip in your car: you click on Google Maps or turn on your GPS device, and you expect an accurate map that gives you real directions to your location. With the fantastic growth of new navigation electronics, mariners and boaters expect that same level of instantaneous accuracy from their nautical charts.

We are striving to change our production and delivery systems, to meet the needs of the 21st century. We are working to provide for the next generation of navigation.

The transition from paper nautical charts to electronic navigational charts has been underway for decades, but the transition is gaining speed. The development of digital charts resulted from the diffusion of computer technology into the pilothouse, and from the need to make the navigator more effective in decision-making. The next technology transition already underway in the pilothouse is internet-at-sea.

This evolution will require synchronization between NOAA, U.S. Coast Guard, the Army Corps, and the chart product distribution so that we can improve the end-user experience.



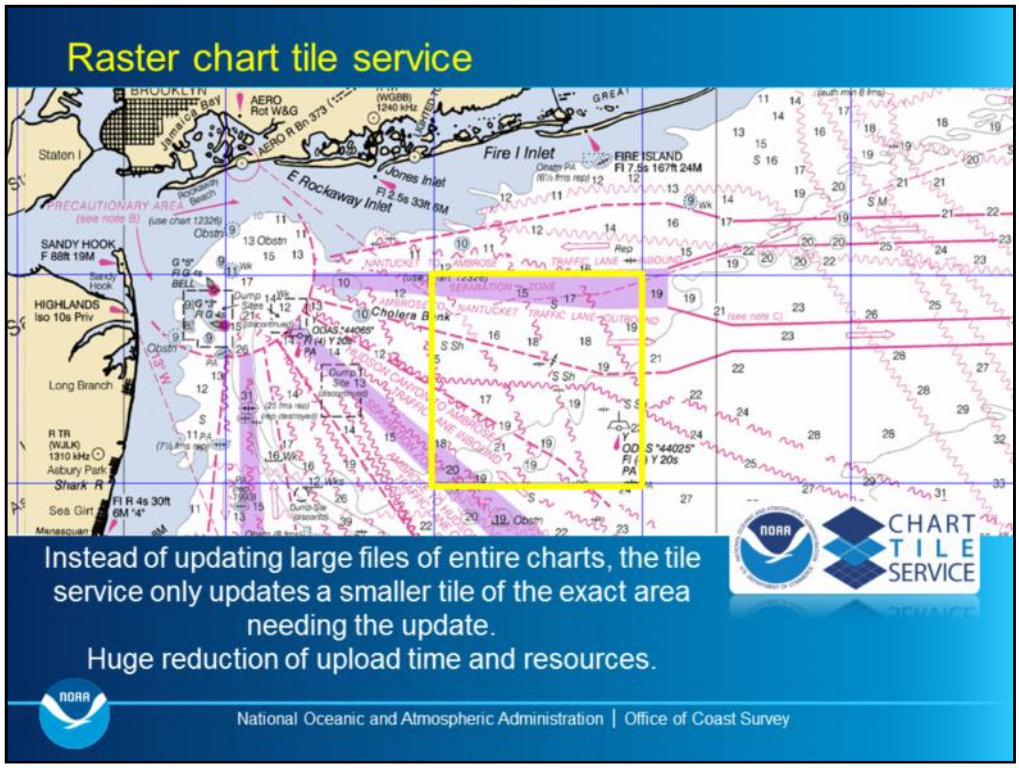
Putting data on websites is not enough. We need to distribute them in standard formats to charting systems, portable pilot units and port information systems to allow users to quantifiably manage navigation risk. Our old-school ENCs, tide tables, and marine radio weather are not sufficient for this purpose.

We need to make the whole chart system simpler and support faster updates.

NOAA has quietly been updating our digital charts weekly for the past 18 months.

We can now support digital publication of changes to the chart that happen on time scales of months. An ocean inlet that is reconfigured by winter storms could be charted accurately in time for the summer small boating season.

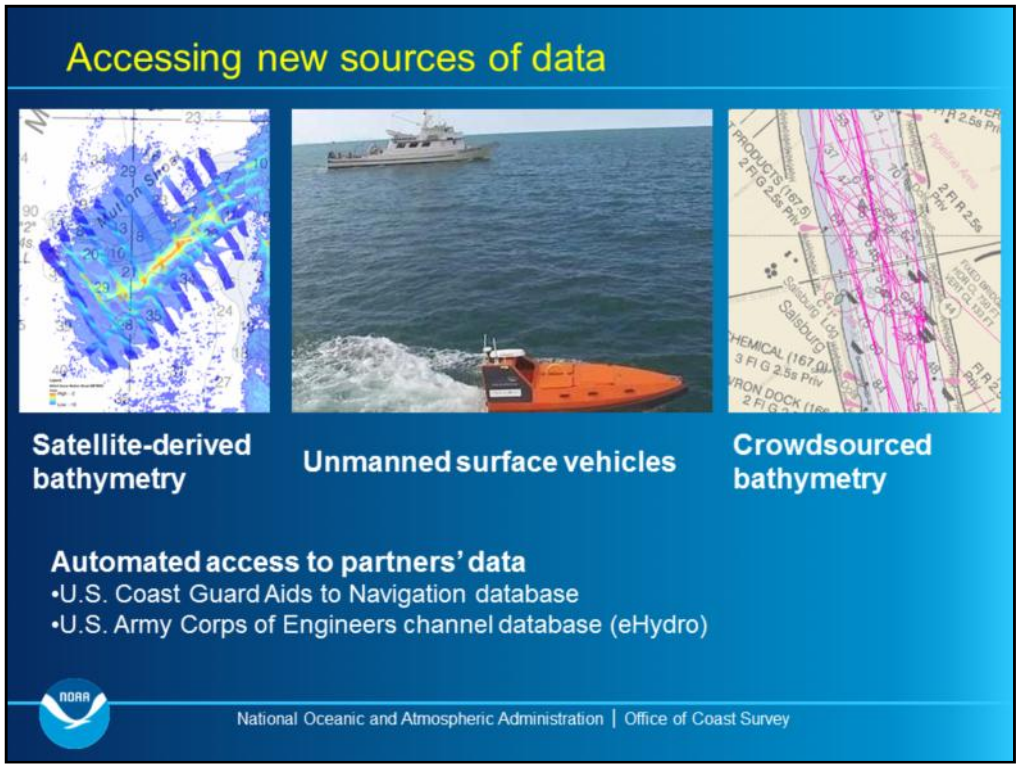
RNC tile service is operational, and is a tremendous resource for systems and apps using raster charts. The growth in usage over the first eight months since last December, shown in the graph, is phenomenal, with over 43 million hits last month.



Let me explain a little more about the tile service…

Most large vessels use electronic navigation in the form of chart plotters and computer-based navigation systems as their primary minute-by-minute aid for navigation. These systems often use commercial charts derived from official NOAA raster charts. In recent years, a number of the larger manufacturers have switched to NOAA raster charts themselves. These navigation systems, which also include tablets and mobile devices – at last count, there are over 60 mobile apps – as well as web mapping applications, increasingly use tile services to update their data. Instead of uploading entire gigantic files, they want only the section of the chart that is updated.

NOAA's raster chart tile service will dramatically reduce the bandwidth requirements necessary to keep a vessel's chart suite up-to-date.



With the demand for richer charts, especially in nearcoast and port areas, we are exploring force multipliers – new ways to acquire data: satellite-derived bathymetry, unmanned surface vehicles, crowdsourcing…

Also:

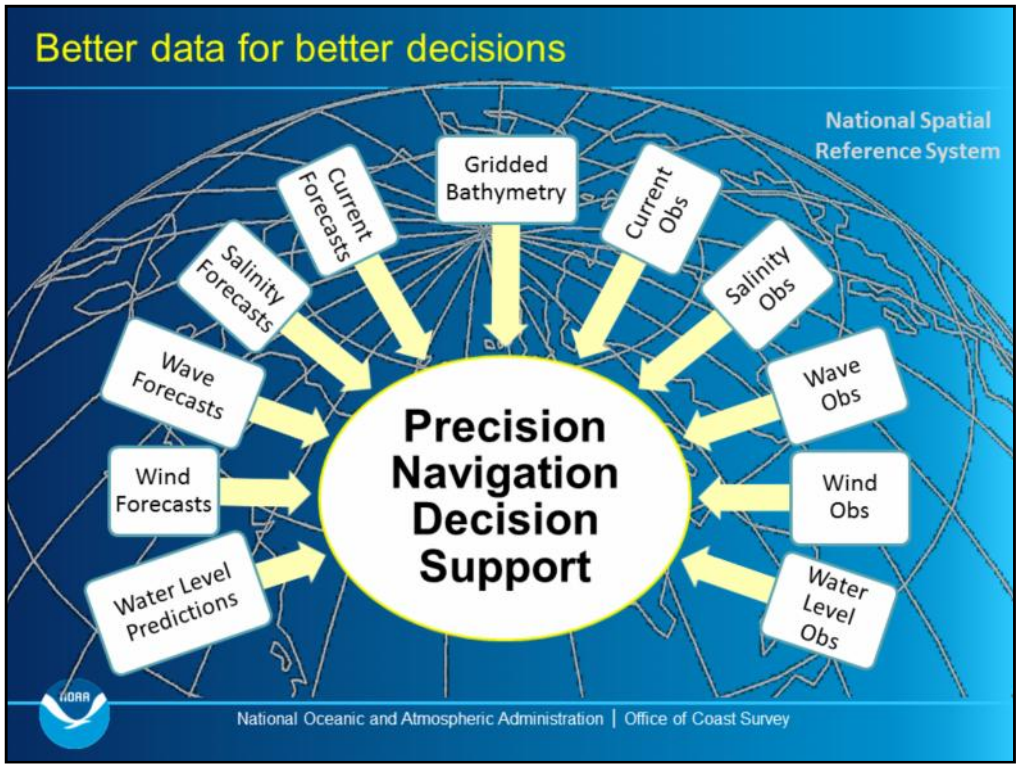
•We are working the U.S. Coast Guard on the feasibility of direct access its Aids to Navigation database, using specialized semi-automated tools to update the chart based on the changes in the Coast Guard database.

•Similarly, we are working with the U.S. Army Corps of Engineers to consolidate their channel condition surveys nationwide into a geo-database that is compatible with NOAA's charting system.

As maritime trade increases, mariners need more precise real-time information beyond the traditional navigation services.

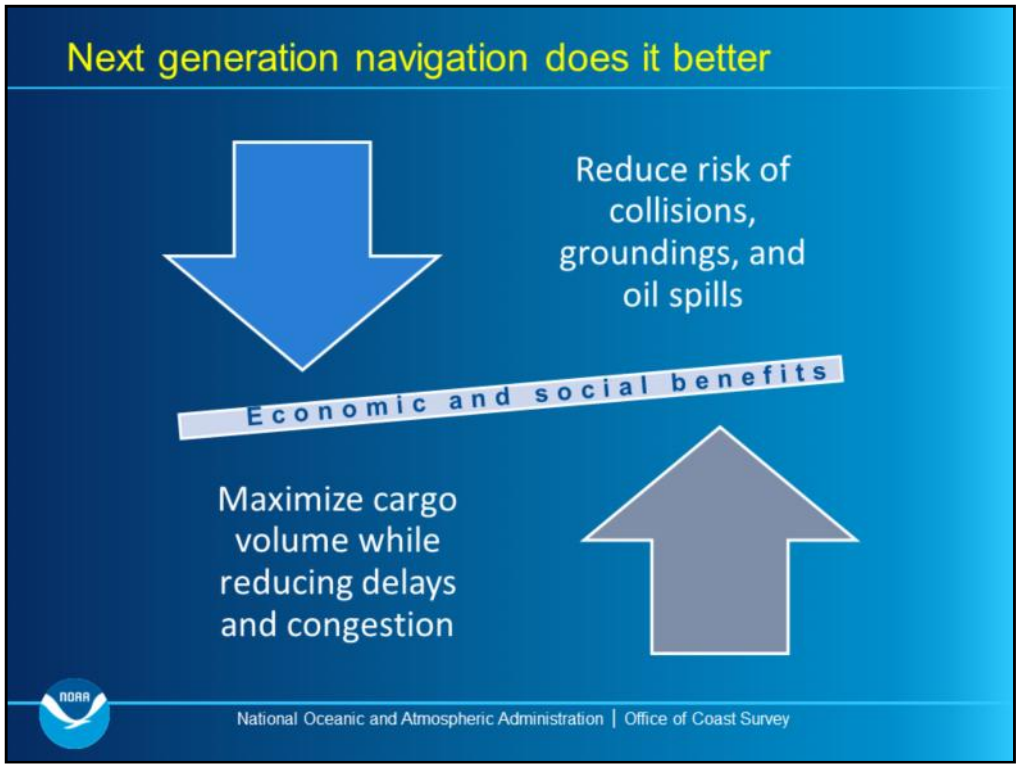
You will recall that Capt. Rick Brennan spoke to you about this last year.

Without modern navigation data and services, ships will often experience operational impacts such as increased wait times for port access, inability to fully load their cargo, or have to unload some cargo before entering port, resulting in significant economic impacts. We are looking at impacts in the millions of dollars. For instance, the Port of LA/Long Beach estimates that they will save an estimated $10 million per year if they are able to eliminate the need to offload vessels before they enter the port.



NOAA already delivers a lot of data. Bathymetry data and water level forecasts, accessed separately, are useful to ship operators and managers. However when these two data products are separate and independent they do not provide the power that today's mariners are demanding. By coupling these data products -- along with NOAA's other environmental intelligence, like real-time and forecasts waves, meteorology, currents, and salinity -- the whole is greater than the sum of its parts. That wholeness is the concept behind NOAA's next generation navigation.

You might wonder how this concept differs from PORTS®. PORTS measures and disseminates observations and predictions of water levels, currents, salinity, meteorological parameters, and bridge air gap measurements. Next generation navigation services will encompass not only CO-OPS' PORTS information, but also Coast Survey's nautical chart data with high resolution bathymetry. It will integrate National Weather Service wave and meteorological data and wave data, and IOOS oceanographic observations. It will all be underpinned by the geodetic datums computed and maintained by the National Geodetic Survey.



The endgame for the next generation of navigation is to reduce the risk of collisions, groundings, and oil spills. It's to allow ports and ships to maximize their cargo volume while reducing delays and congestion.

HIGH-RESOLUTION BATHYMETRY

•NOAA Ship *Fairweather* conducted multibeam surveys of the Ports of LA/Long Beach over a 3-month period and covering approximately 61 sq. nautical miles; enabled NOAA to create a seamless baseline of high resolution imagery from which to develop a gridded bathymetric database. A small section of the survey was selected to test the creation of an inland electronic navigational chart prototype. This information was successfully tested for readability in various Coastal Explorer software packages, allowing for more detailed and robust depth area renderings for mariners.

OBSERVATIONS

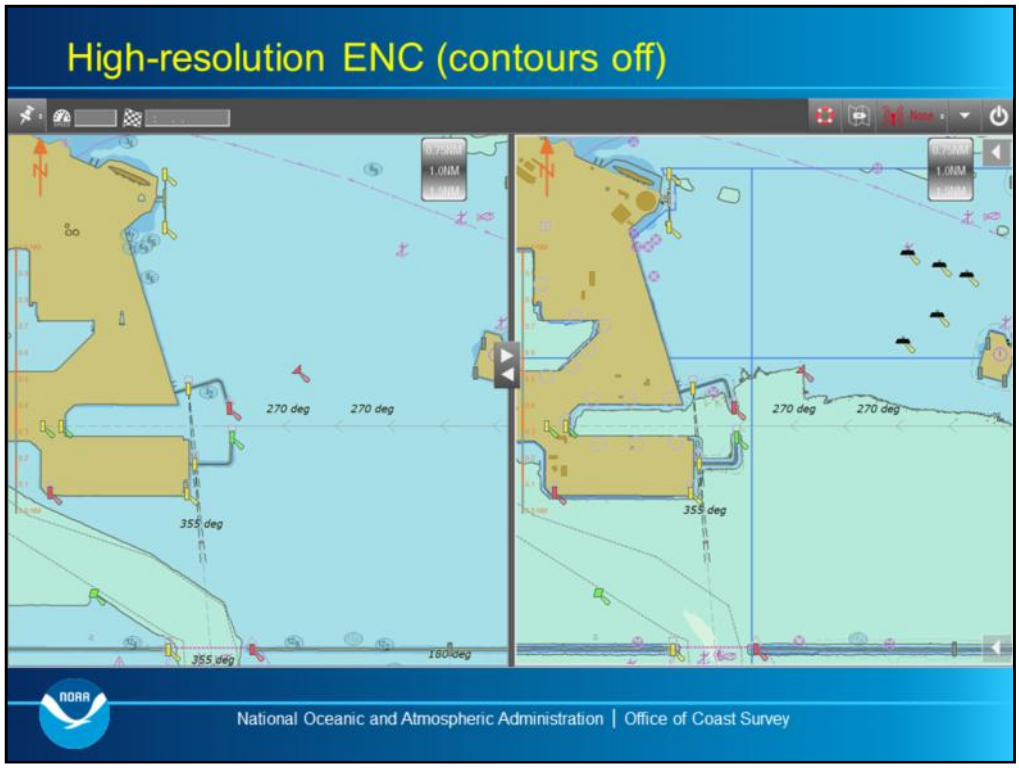
•In collaboration with the California Department of Boating and Waterways and the U.S. Army Corps of Engineers, we deployed a wave buoy in the port's southern shipping separation zone to provide near real-time information on wave height, period, and direction. This information is critical for harbor masters and mariners, to recreational boaters and surfers.

WAVE MODELING

•We've developed a Near-Shore Wave Prediction System (NSWPS) that provides coastal zone forecast wave guidance to support maritime activities from navigation to rip current forecasts. The prediction system forecasts sea variable including wave height and direction, as well as swells for up to five days in advance for improved port access and safety planning measures for the increasingly used ultra large, next generation cargo ships.

PARTNERSHIPS

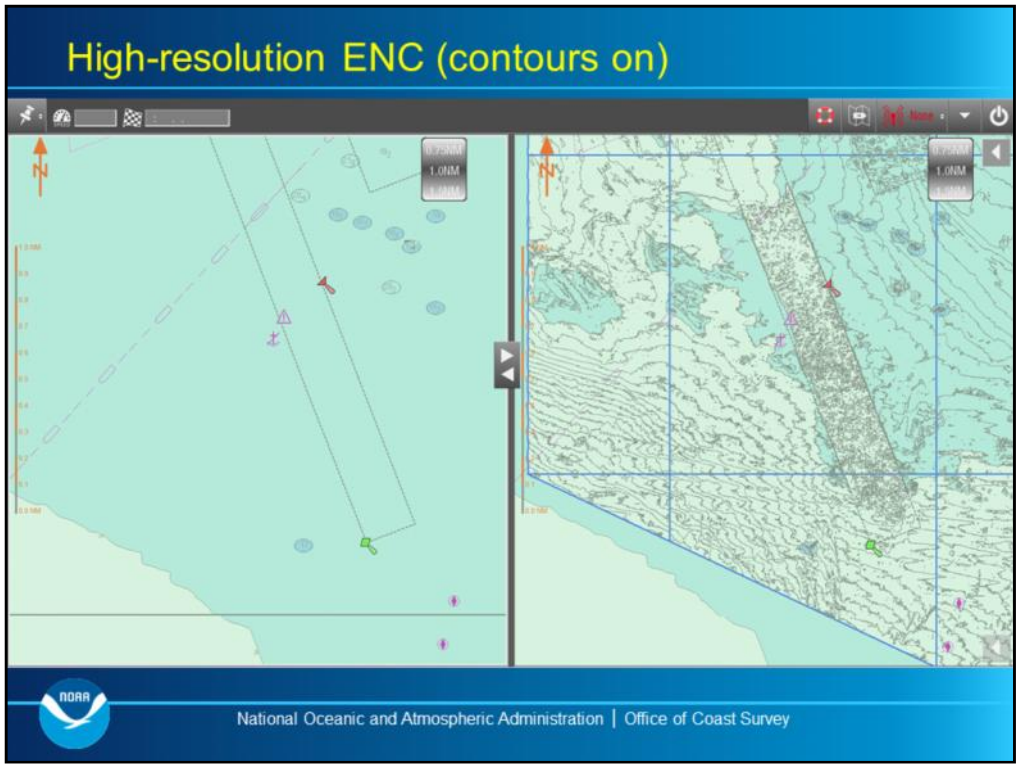
•We worked with stakeholders like Jacobsen Pilot Service and the Marine Exchange of Southern California. NOAA worked with other data providers, like the Army Corps of Engineers, and the Coastal Data Information Program, whose buoy you can see being deployed in the image. NOAA is working with industry partners and app developers for mobile devices to deliver data in a unified, intuitive fashion with minimal intervention from the mariner.



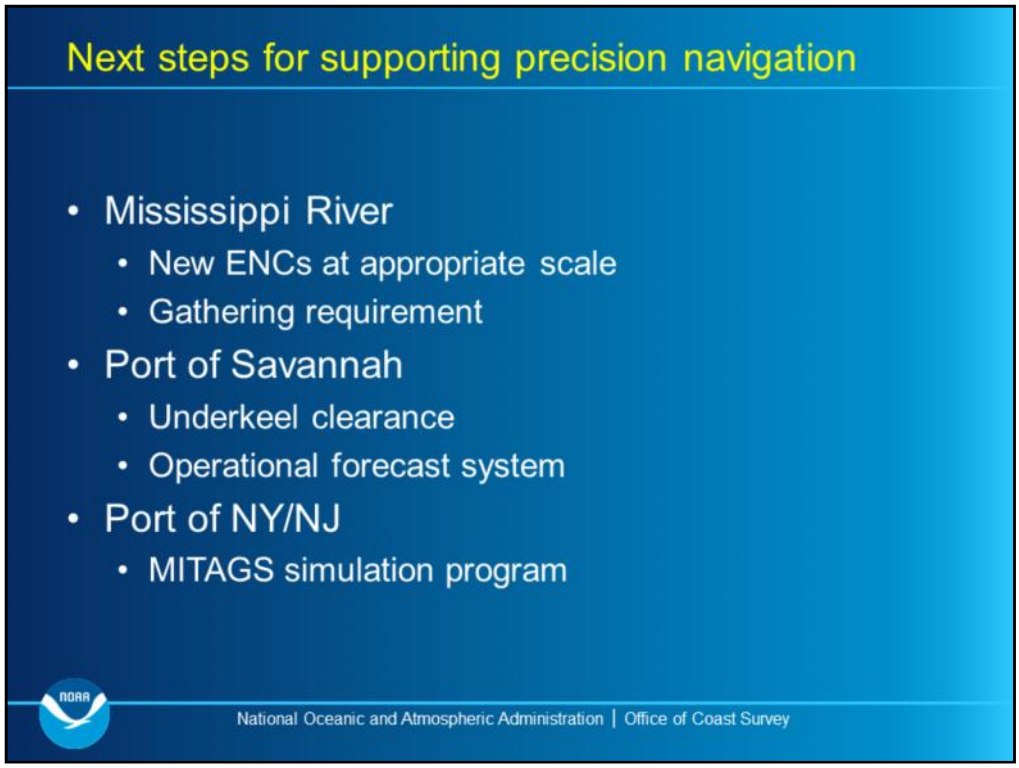
Just recently, Coast Survey has started producing and distributing high resolution electronic navigational chart overlays for the ports of Los Angeles and Long Beach These chart overlay files blend with existing NOAA ENCs and provide the mariner an as yet unparalleled level of bathymetric detail that allows them to make critical navigation decisions. Mariners can custom tailor these hi-res ENCs for the requirements of their particular vessel.

Coast survey is among the first hydrographic organizations in the world to produce and distribute these overlay files. and have helped lead the efforts among other hydrographic organizations and software manufacturers to fully automate the process. This leadership has allowed Coast Survey to produce a set of overlay files completely covering both ports less than a day after receiving the latest bathymetric data updates from our partners in the area.

ENC on the left and the high-resolution on the right. Display all contours is off. Heading into Pier J, you can now see that there is safe water.



ENC on the left and the high-res ENC on the right. Display all contours is on. You can see the increased level of detail that is now available to the mariner as well as seeing that the deep water coloration now appears in the channel.

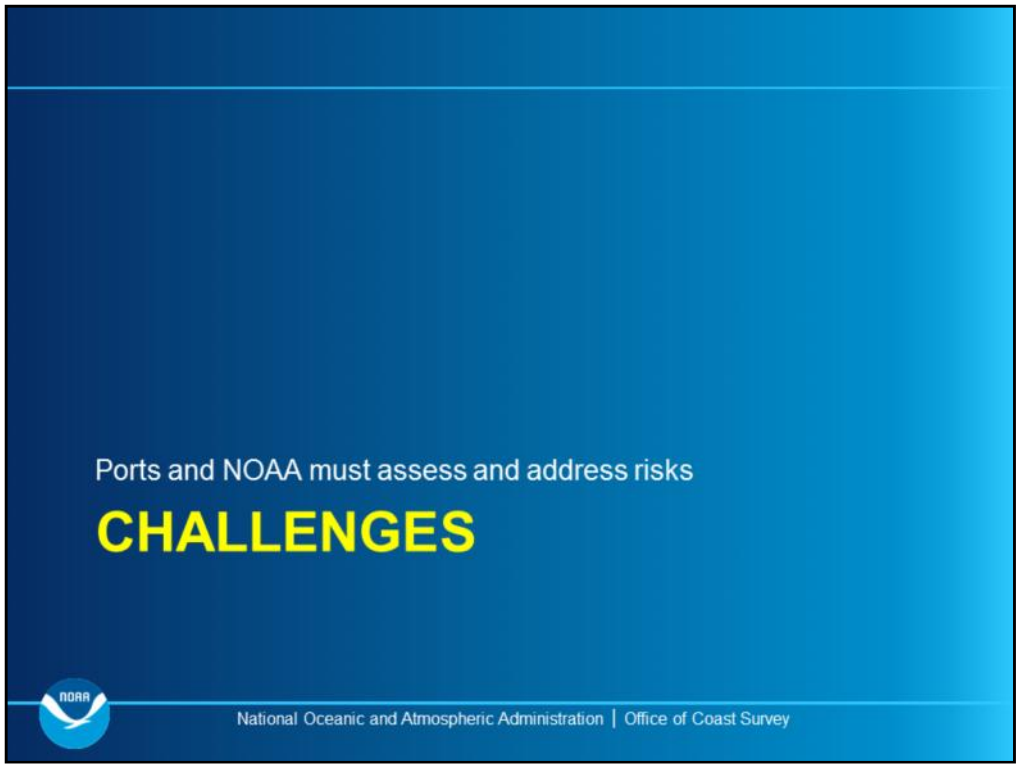


Two new Mississippi River ENCs (at larger scale) support initiative to provide next generation navigation to four ports along the Miss. River. There isn't more data but the scale is now appropriate for the type of navigation the pilots and commercial vessels have been doing on the river. The next step is to fill in with more robust data

We are gathering requirements from those who use the waterway.

Kyle Ward has been working with the Port of Savannah to determine what the port will need to support an underkeel clearance system. We are feeding requirement to operational forecast system modelers to feed them requirements in developing the new OFS that would be used by Port of Savannah in conjunction w/ their ukc - as a decision support tool for precision navigation.

Sam Debow is working w/ MITAGs and the Port of NY/NJ in their development of a simulation program at MITAGS to bring in a post-panax ship into the port. This is a huge effort between the port and MITAGS in the development of the program for their simulator and Sam has been providing NOAA support in terms of data availability and helping to bridge that gap - providing real time customer service in the practical applications of data usage for decision support in precision navigation.


Ports and NOAA must assess and address risks
CHALLENGES
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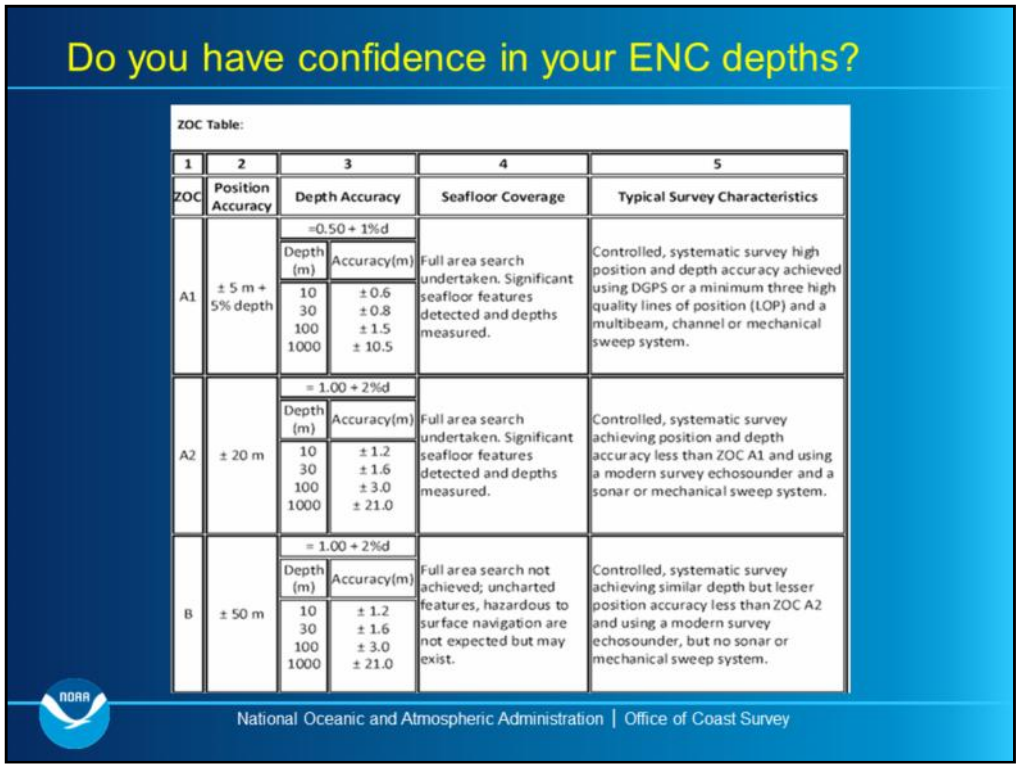

The age and accuracy of data on nautical charts can vary. Depth information on nautical charts, paper or digital, is based on data from the latest available hydrographic survey, which in many cases may be quite old. In too many cases, the data is more than 150 years old.

Mariners need to know if data is old. They need to understand the capabilities and the limitations of the chart. In particular, the mariner should understand that nautical chart data, especially when it is displayed on navigation systems and mobile apps, possess inherent accuracy limitations.

Before the advent of GPS, the position accuracy of features on a paper chart was more than adequate to serve the mariner's needs. Back then, Coast Survey cartographers were satisfied when we plotted a fix with three lines of position that resulted in an equilateral triangle whose sides were two millimeters in length at a chart scale of 1:20,000. In real world coordinates, the triangle would have 40-meter sides. Close enough!

Now, with GPS, charted locations that are off by 10 or 15 meters are not nearly close enough. Mariners now expect, just as they did 30 years ago, that the horizontal accuracy of their charts will be at least as accurate as the positioning system available to them. Unfortunately, charts based on data acquired with old survey technologies will never meet that expectation.

Do you have confidence in your ENC depths?

C	± 500 m	= 2.00 + 5%d		Full area search not achieved, depth anomalies may be expected.	Low accuracy survey or data collected on an opportunity basis such as soundings on passage.
		Depth (m)	Accuracy(m)		
		10	± 2.5		
		30	± 3.5		
		100	± 7.0		
		1000	± 52.0		
D	Worse than ZOC C	Worse than ZOC C		Full area search not achieved, large depth anomalies may be expected.	Poor quality data or data that cannot be quality assessed due to lack of information.
U	Unassessed - The quality of the bathymetric data has yet to be assessed.				

Houston Ship Channel

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Miami

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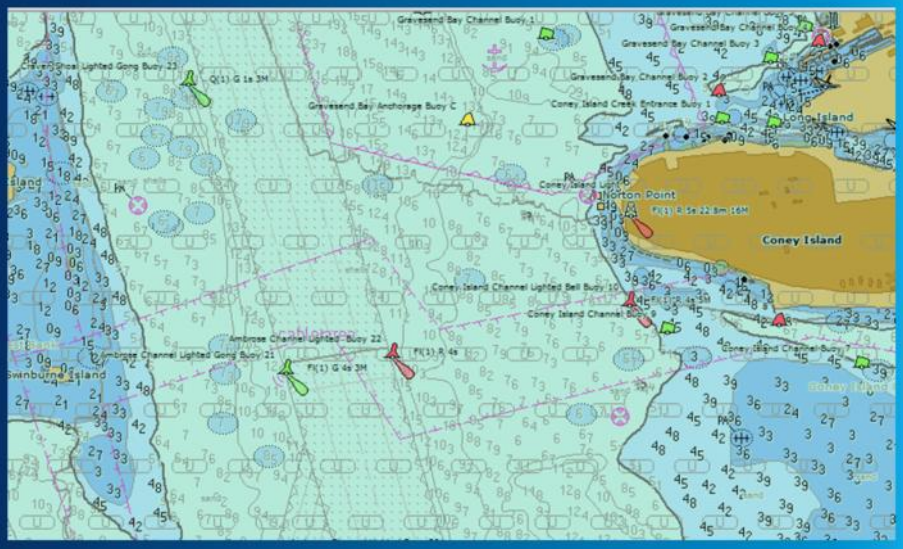
Entrance to New York



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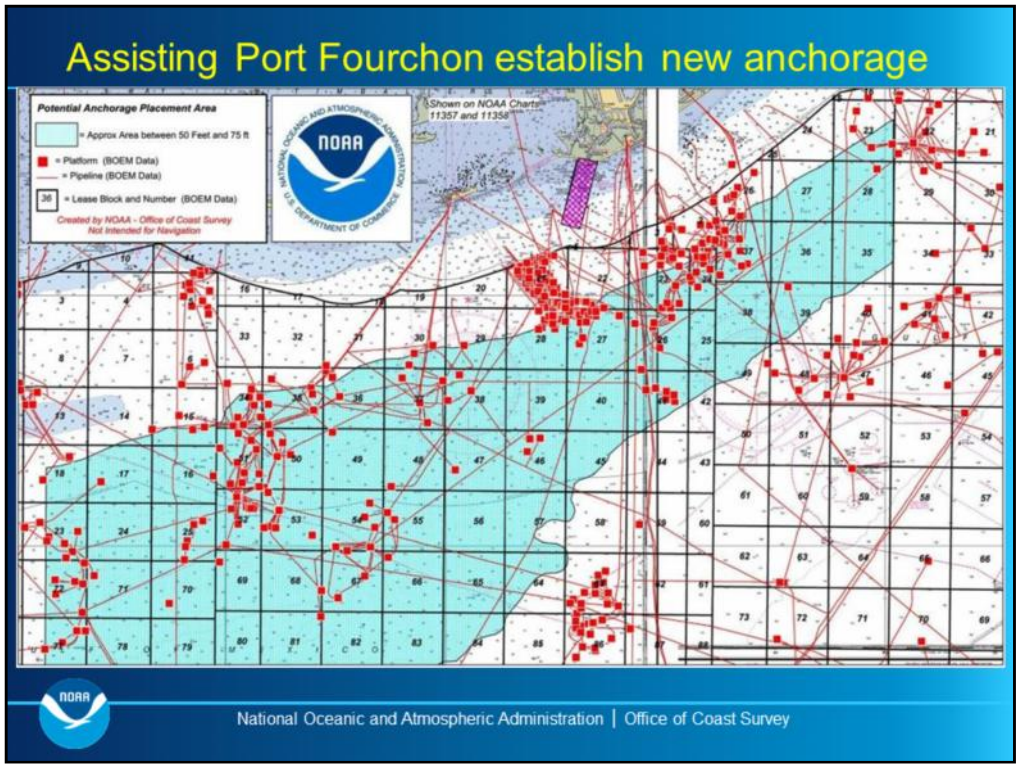
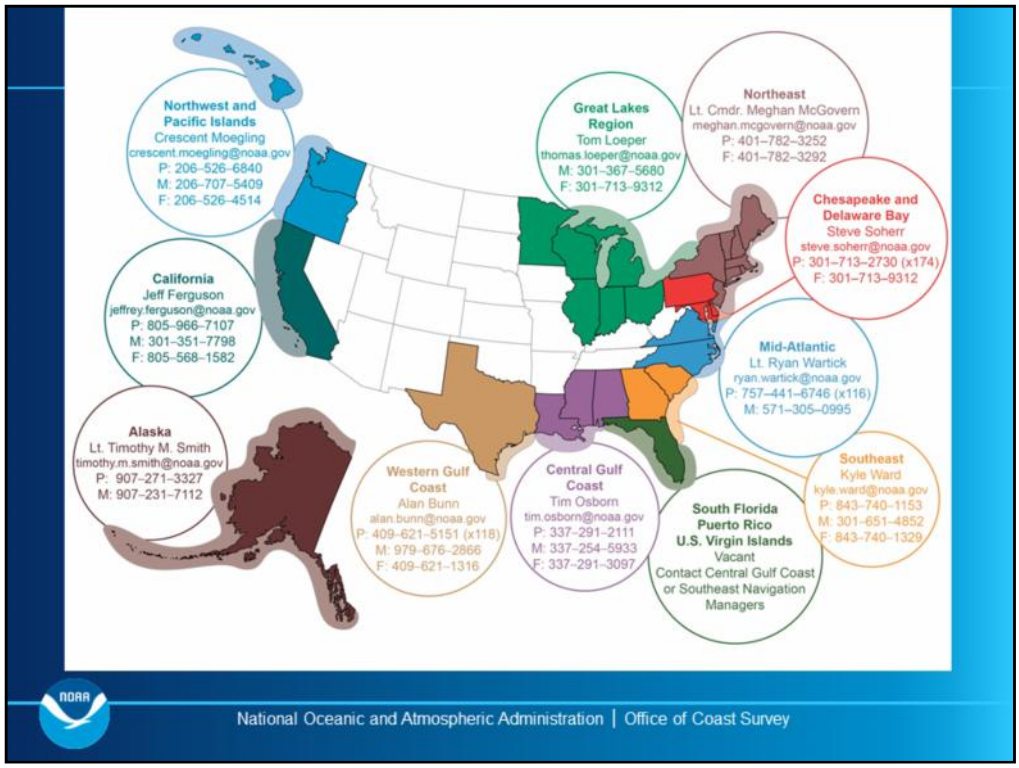
Athos I

Strengthen your information infrastructure

- Know your true underkeel clearance
- Know what the changes in usage will mean for charts
- Know the age of the survey data
- Ask NOAA Coast Survey to help assess your charts' margin of error
- Re-survey if necessary
- Re-chart to modern standards



We can assist you in a wide variety of activities. For instance, last year Port Fourchon needed to establish a new anchorage. Our navigation manager and cartographers collaborated with port officials and BOEM, and created this chart to visualize the area with an overlay of platforms and pipelines.

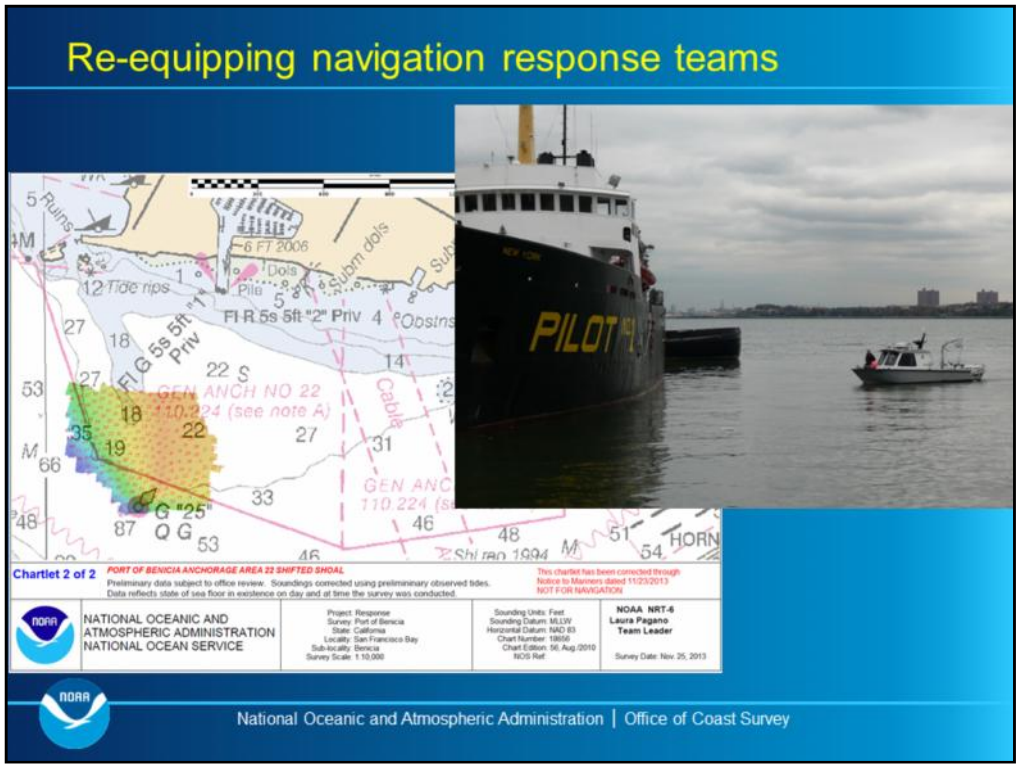


Most of you probably know the navigation manager. If you don't, I strongly encourage to contact them, to discuss the vintage of your charts and what is needed to get them to 21st century standards for the next generation of navigation.

The ability and capacity to perform hydrographic surveys is a core mission for Coast Survey. NOAA maintains mapping services to meet its statutory core mission requirements and continually builds expertise that is critical to overseeing activities like contracting for hydrographic and shoreline mapping surveys.

In the 1960s, we had 14 vessels in the hydrographic fleet. Today, NOAA owns and operates four ships (two on each coast) that are dedicated to conducting hydrographic surveys. Fairweather and Rainier are nearing 50 years old. The cost of operating the fleet, and the days allocated to maintenance instead of operations, reduce the sea days available for Coast Survey.

NOAA is actively pursuing fleet recapitalization and is working with the Administration to ensure the nation has a fleet of research ships that meet the Nation's observation requirements. Coast Survey is engaged with the NOAA fleet recapitalization planning efforts to identify and refine the requirements for replacement vessels.



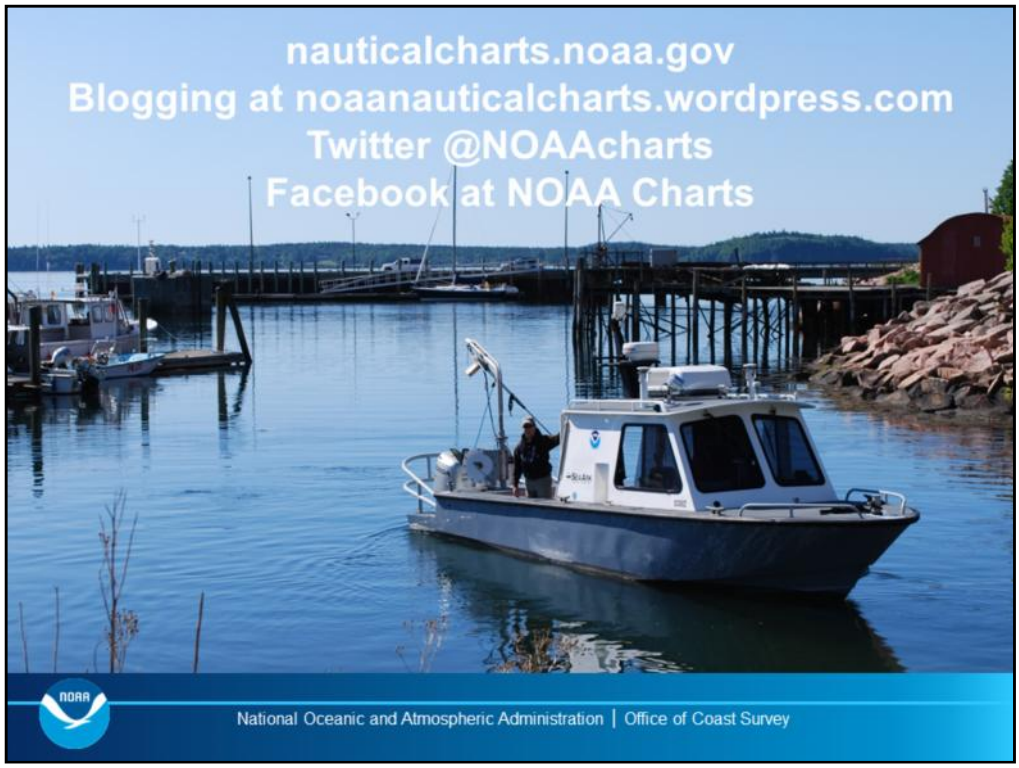
We have NRTs at six locations, able to reach any port in the lower 48 within 2 days. We are in the middle of rebuilding the teams. Unfortunately, we may have to reassess if Congressional appropriators approve the budget reductions put forward by the House appropriations committee.

Chart on left, NRT 6 assists Port of Benicia (California) find a shoal that had shifted in one of the anchorage areas.

Photo on right, NRT 5 meets up with a NY pilot as they search for underwater dangers to navigation after superstorm Sandy.

NOAA challenges: tightening budgets

Operations, Research and Facilities (ORF)	2016 Spend Plan	2017 President's Budget	2017 Senate Mark	2017 House Mark
Navigation, Observations and Positioning				
Navigation, Observations and Positioning	149,000	143,406	149,094	139,570
Hydrographic Survey Priorities / Contracts	27,000	25,000	27,000	25,000
IOOS Regional Observations	29,500	29,500	31,500	31,500
Total, Navigation, Observations and Positioning	205,500	197,906	207,594	196,070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BACK UP SLIDES

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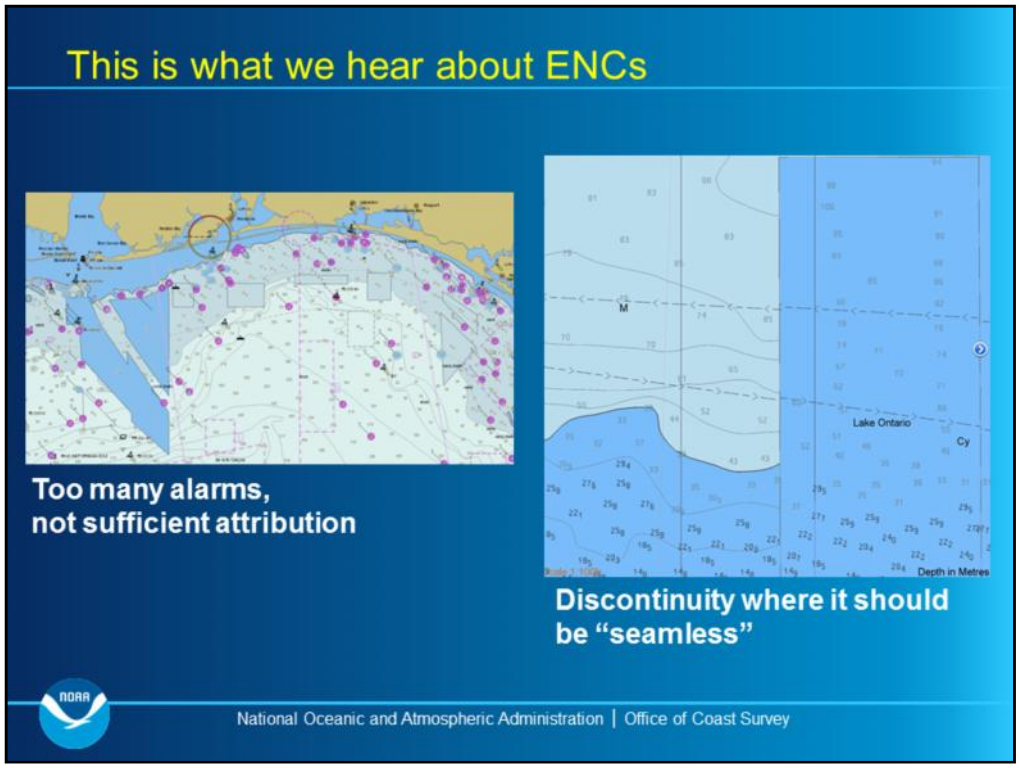

As for the content of charts, we have a lot of work ahead to optimize our ENCs for electronic navigation using ECDIS and electronic charting systems. We have heard a lot of feedback from users concerning too many alarms, discontinuous depth areas, chart clutter, and unclear symbols.

Suite-wide update of our ENCs:

•examine all the features that cause alarms, with an eye to reducing the incidence of unnecessary alarms

•review all isolated hazards, such as wrecks and obstructions, to ensure they have the attribution necessary to reduce false alarms and chart clutter

•look at the depth areas we digitized originally from paper charts, and augment the depth areas where we need to distinguish safe water from shoal water.