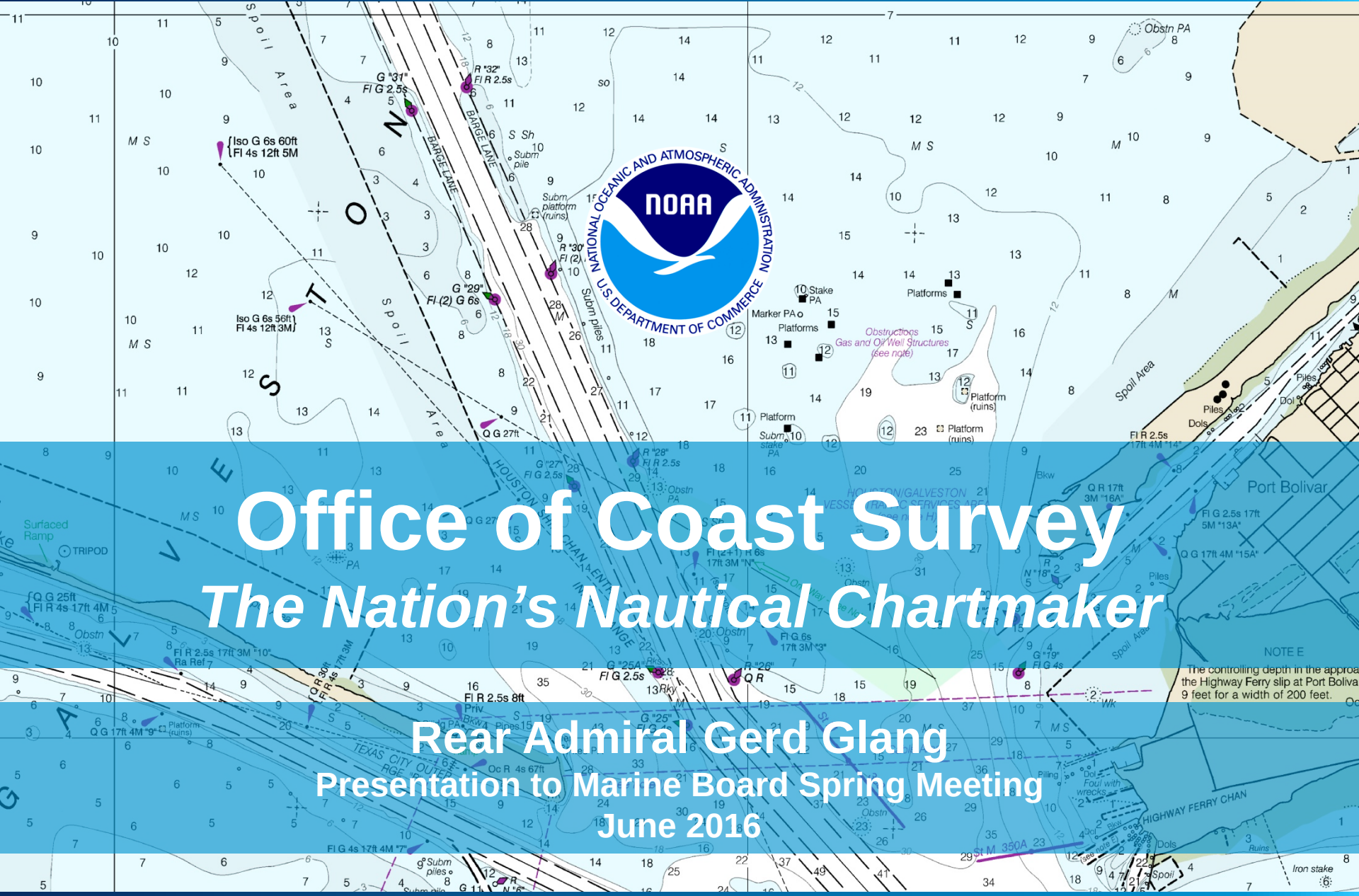

Office of Coast Survey

The Nation's Nautical Chartmaker

Rear Admiral Gerd Glang

Presentation to Marine Board Spring Meeting

June 2016


Chart 11347

New editions have several years of critical changes

Number	Description	Source Date	Due Date	Compilation Date
H-12485	Long Island Sound, CT Joshua Cove to Mansfield Pt OPR-B370-TJ-13 Survey Scale file AHB	5/13/2013	2/4/2016	2/29/2016
DD-27145	Long Island Sound, CT Joshua Cove to Mansfield Pt OPR-B370-TJ-13 Chart Scale/HCell file AHB	5/13/2013	2/4/2016	2/29/2016
L-1380-2015	LONG ISLAND SOUND, CT THIMBLE ISLANDS CUT IN TWO ISLAND BRIDGE USCG DISTRICT 1	8/28/2015	9/23/2015	9/24/2015
L-1119-2015	Long Island Sound, CT Joshua Cove to Mansfield Pt Various Rocks and Shoals OPR-B370-TJ-13 H12485 TJ/AHB	5/13/2013	7/10/2015	6/26/2015
DD-26374	Long Island Sound, CT Joshua Cove to Mansfield Pt Various Rocks and Shoals .XML File	5/13/2013	7/10/2015	6/26/2015

	OPR-B370-TJ-13 H12485 TJ/AHB			
DD-26117	GUILFORD HARBOR, CT 6 FOOT CHANNEL, SLUICE CREEK CHANNEL, ANCHORAGE AND MARINA NEW ENGLAND DISTRICT USACE	3/1/2015	5/26/2015	5/27/2015
DD-26118	BRANFORD HARBOR, CT 8.5 FOOT CHANNEL NEW ENGLAND DISTRICT USACE	3/1/2015	5/26/2015	5/28/2015
L-802-2015	GUILFORD HARBOR, CT 6 FOOT CHANNEL AND SLUICE CREEK CHANNEL AND ANCHORAGE NEW ENGLAND DISTRICT USACE	4/28/2015	5/26/2015	5/27/2015
L-803-2015	BRANFORD HARBOR, CT 8.5 FOOT CHANNEL NEW ENGLAND DISTRICT USACE	4/28/2015	5/26/2015	5/28/2015
H-12479	Long Island Sound, CT 4 NM South of Guildford Pt, CT OPR-B370-TJ-12 Survey Scale File AHB	10/17/2012	10/9/2014	12/2/2014
DD-2505	Long Island Sound, CT	10/17/2012	10/9/2014	12/2/2014

	4 NM South of Guildford Pt, CT OPR-B370-TJ-12 Chart Scale / HCell File AHB			
DD-24269	LONG ISLAND SOUND, CT VICINITY OF FALKNER ISLAND OPR-B370-TJ-12 CHART SCALE/HCELL FILE AHB	11/6/2012	5/20/2014	6/27/2014
H-12484	LONG ISLAND SOUND, CT VICINITY OF FALKNER ISLAND OPR-B370-TJ-12 SURVEY SCALE FILE AHB	11/6/2012	5/20/2014	6/27/2014
L-2110-2013	STONY CREEK, CT NEW ENGLAND DISTRICT	10/22/2013	11/19/2013	11/27/2013
DD-23892	STONY CREEK, CT 6-FOOT CHANNEL AND MANEUVERING BASIN NEW ENGLAND USACE DISTRICT	7/31/2013	11/19/2013	11/27/2013
DD-23700	GUILFORD HARBOR, CT 6-FOOT CHANNELS AND ANCHORAGE EAST RIVER SLUICE CREEK	7/31/2013	10/2/2013	9/24/2013

Number	Description	Source Date	Due Date	Compilation Date
H-12485	Long Island Sound, CT Joshua Cove to Mansfield Pt OPR-B370-TJ-13 Survey Scale file AHB	5/13/2013	2/4/2016	2/29/2016
DD-27145	Long Island Sound, CT Joshua Cove to Mansfield Pt OPR-B370-TJ-13 Chart Scale/HCell file AHB	5/13/2013	2/4/2016	2/29/2016
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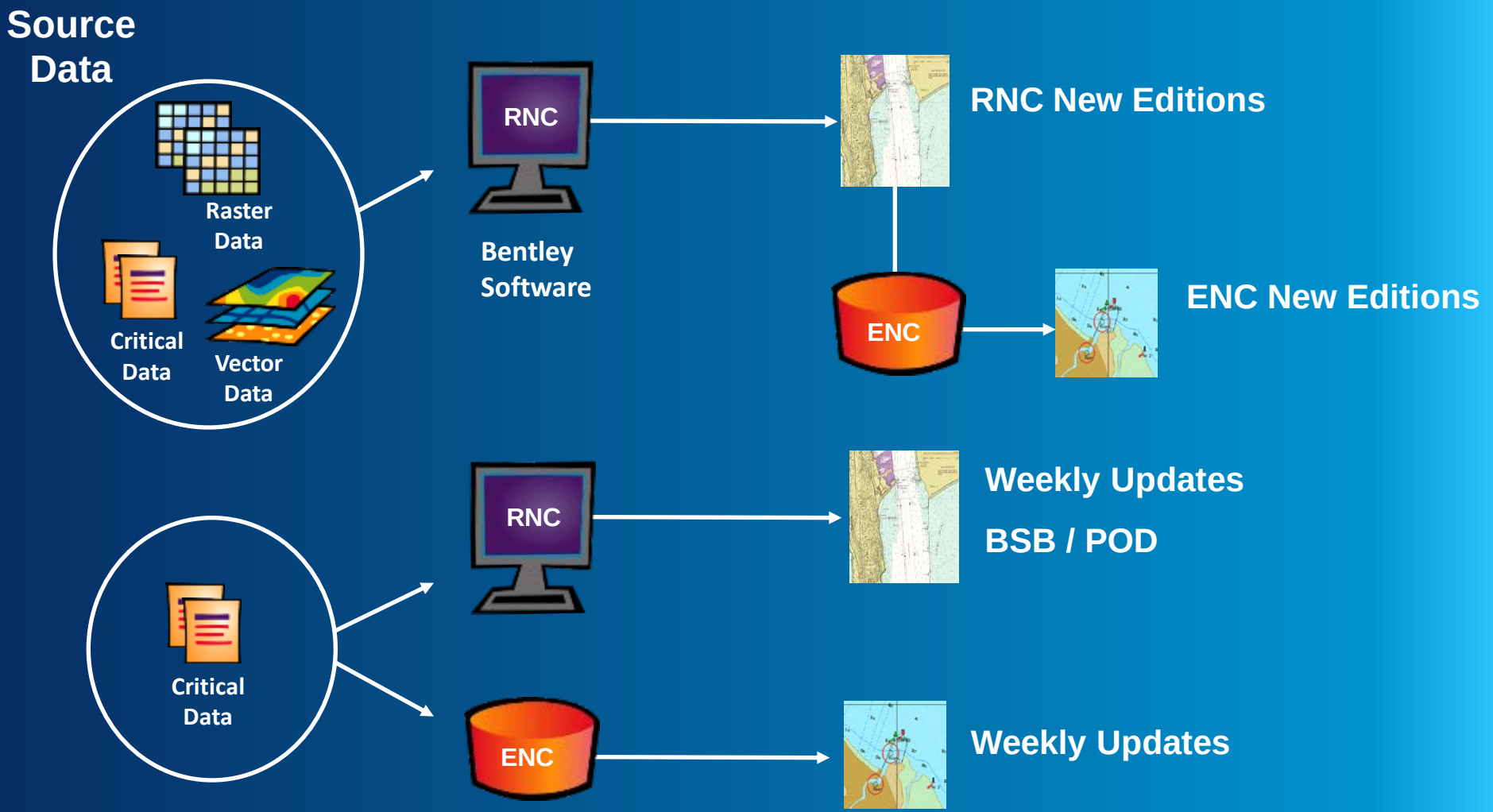
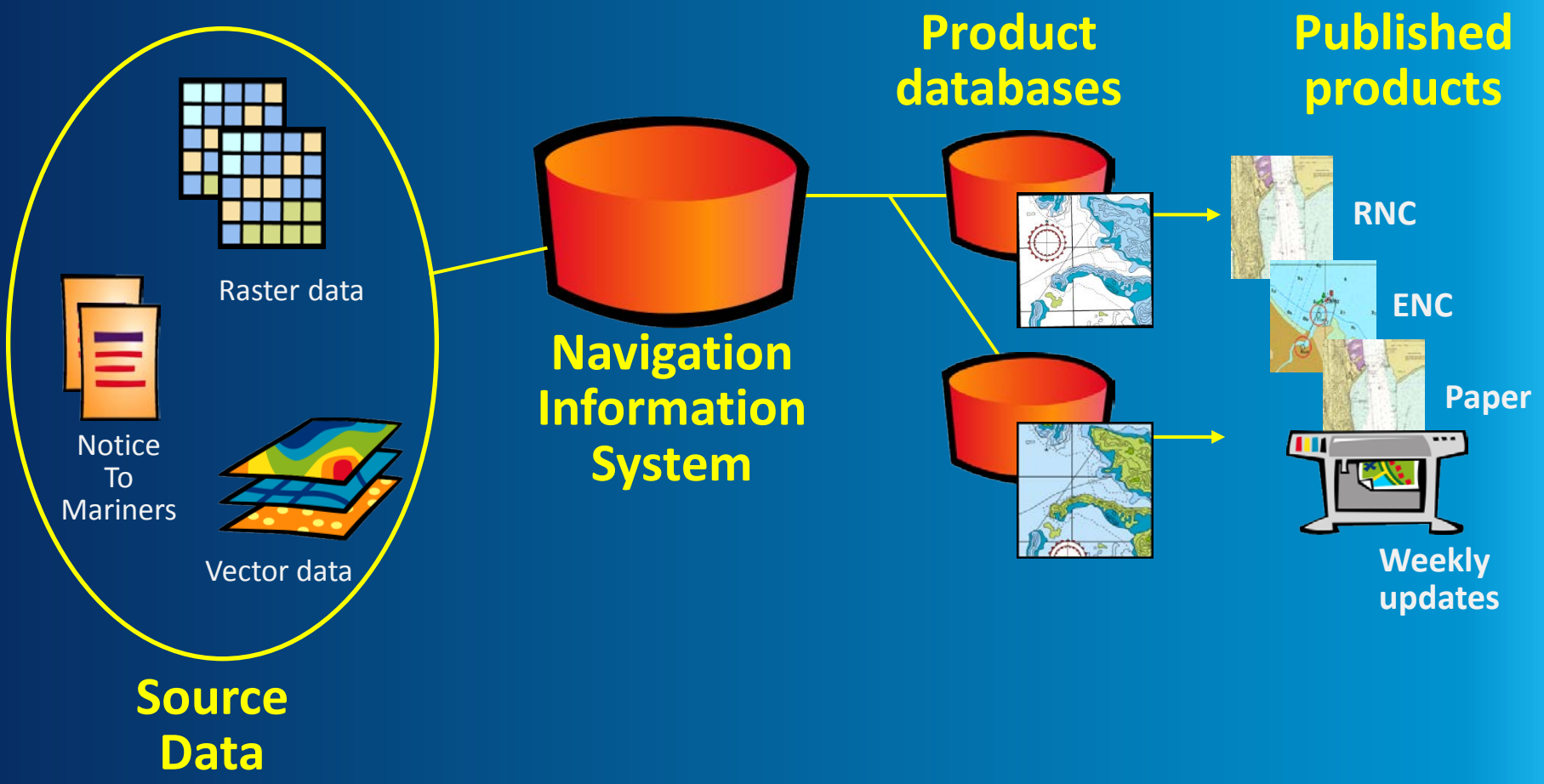
DD-26374	Long Island Sound, CT Joshua Cove to Mansfield Pt Various Rocks and Shoals .XML File	5/13/2013	7/10/2015	6/26/2015

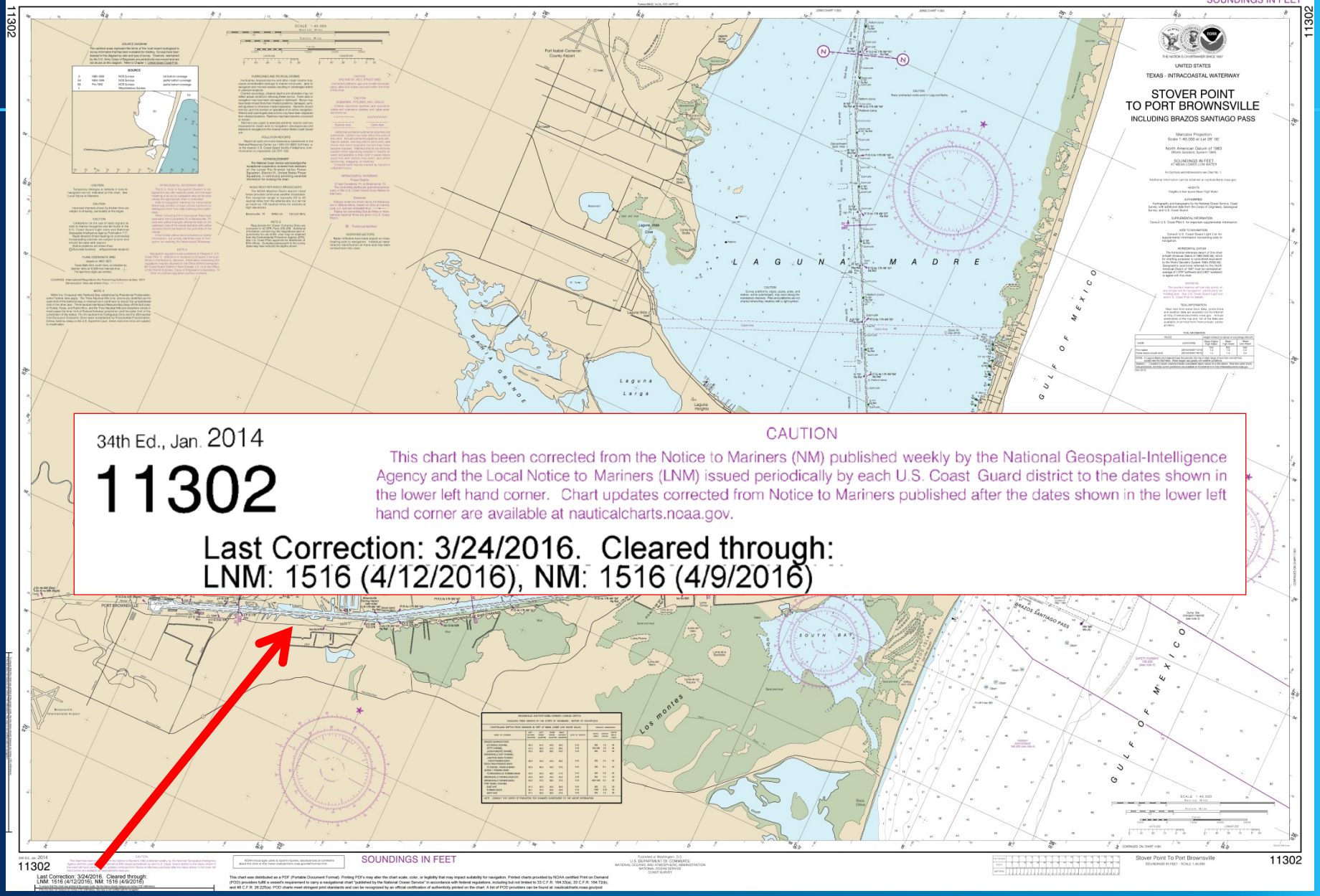
Chart 12373

Legacy charting system

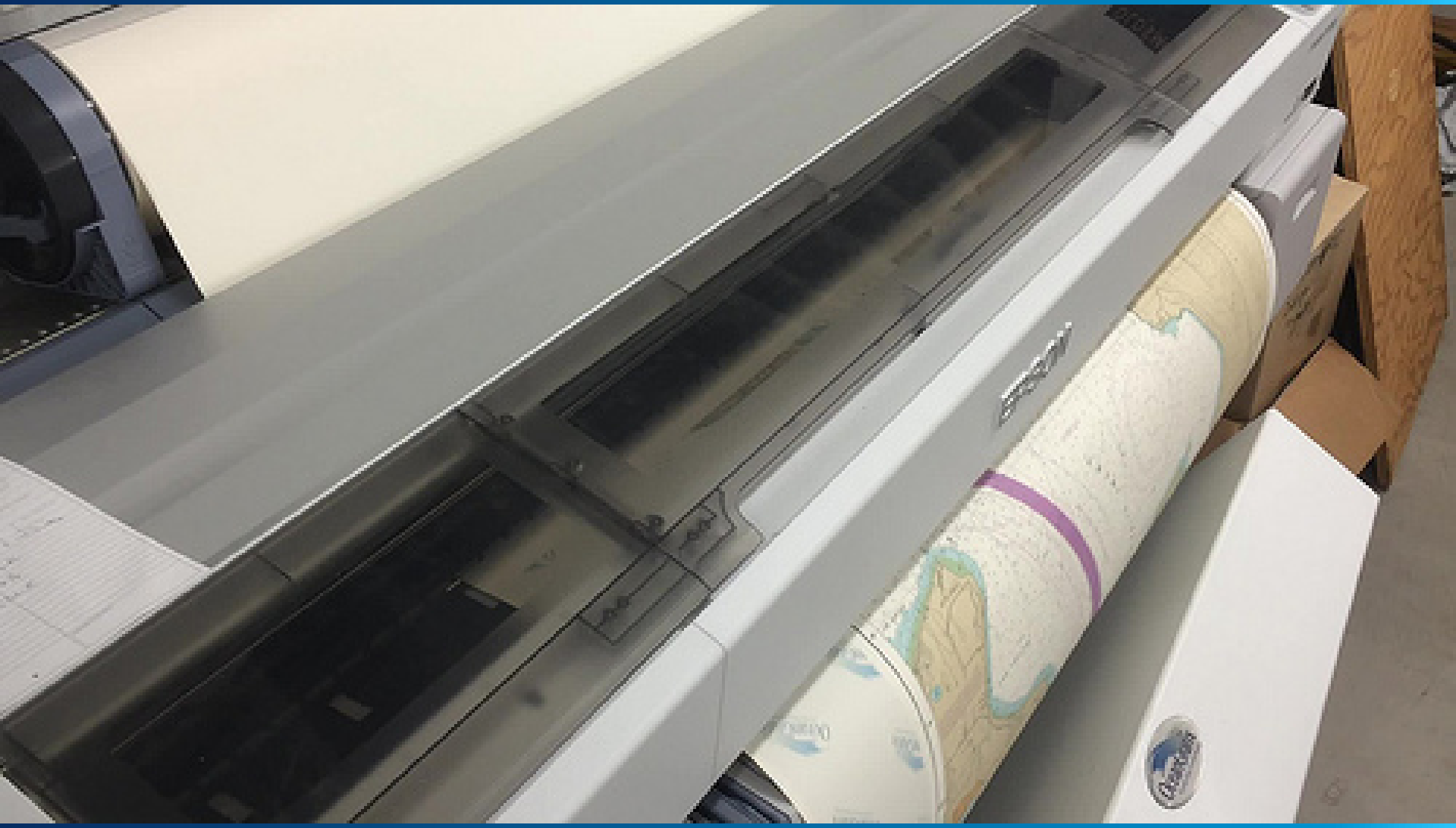


Moving to a central database

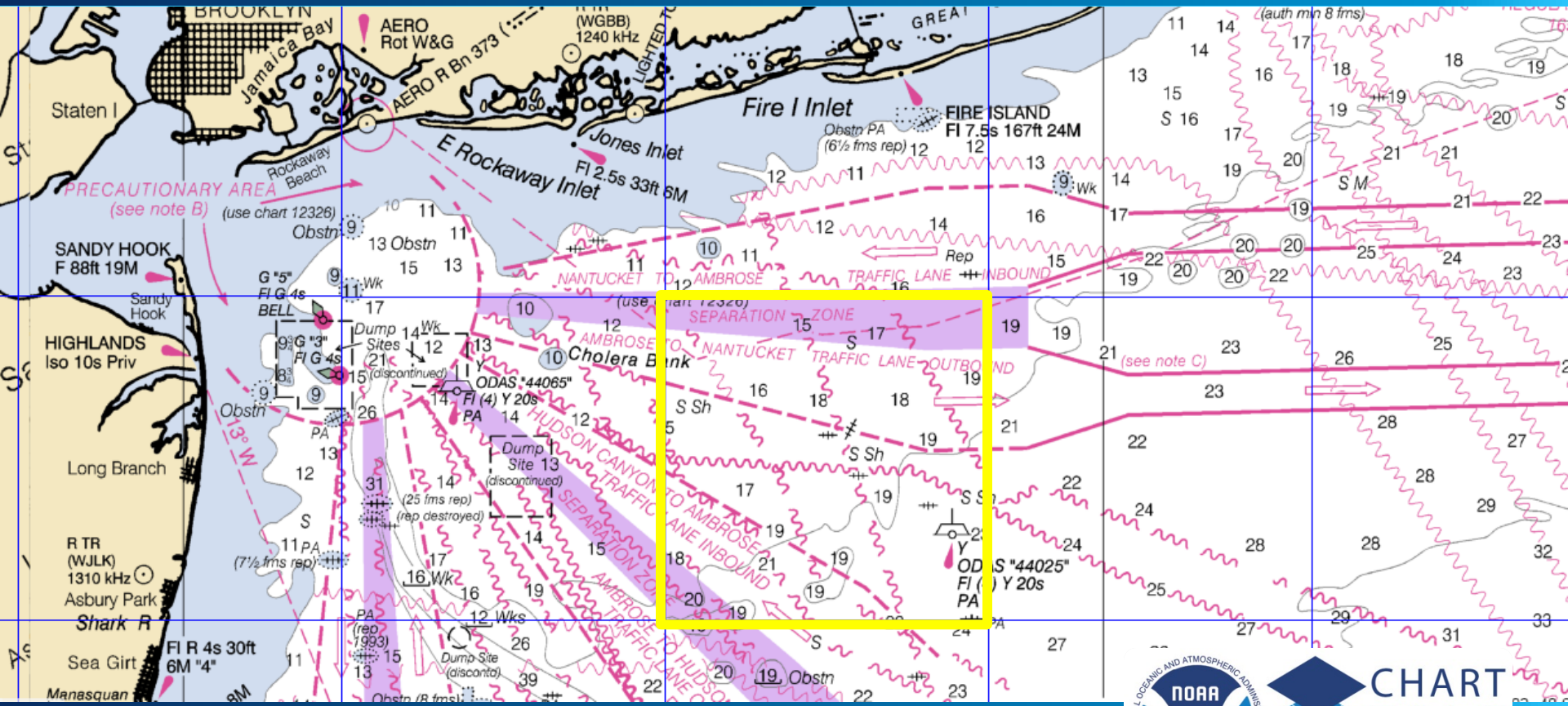



SOUNDINGS IN FEET
11302
UNITED STATES
TEXAS - INTRACOASTAL WATERWAY
STOVER POINT
TO PORT BROWNSVILLE
INCLUDING BRAZOS SANTIAGO PASS
L A G U N A M A D R E
GULF OF MEXICO
34th Ed., Jan. 2014
11302
CAUTION
This chart has been corrected from the Notice to Mariners (NM) published weekly by the National Geospatial-Intelligence Agency and the Local Notice to Mariners (LNM) issued periodically by each U.S. Coast Guard district to the dates shown in the lower left hand corner. Chart updates corrected from Notice to Mariners published after the dates shown in the lower left hand corner are available at nauticalcharts.noaa.gov.
Last Correction: 3/24/2016. Cleared through:
LNM: 1516 (4/12/2016), NM: 1516 (4/9/2016)
PORT BROWNSVILLE
Los Montes
SOUTH BAY
BRAZOS SANTIAGO PASS
SOUNDINGS IN FEET
Stover Point To Port Brownsville

Print-on-demand paper charts



Raster chart tile service



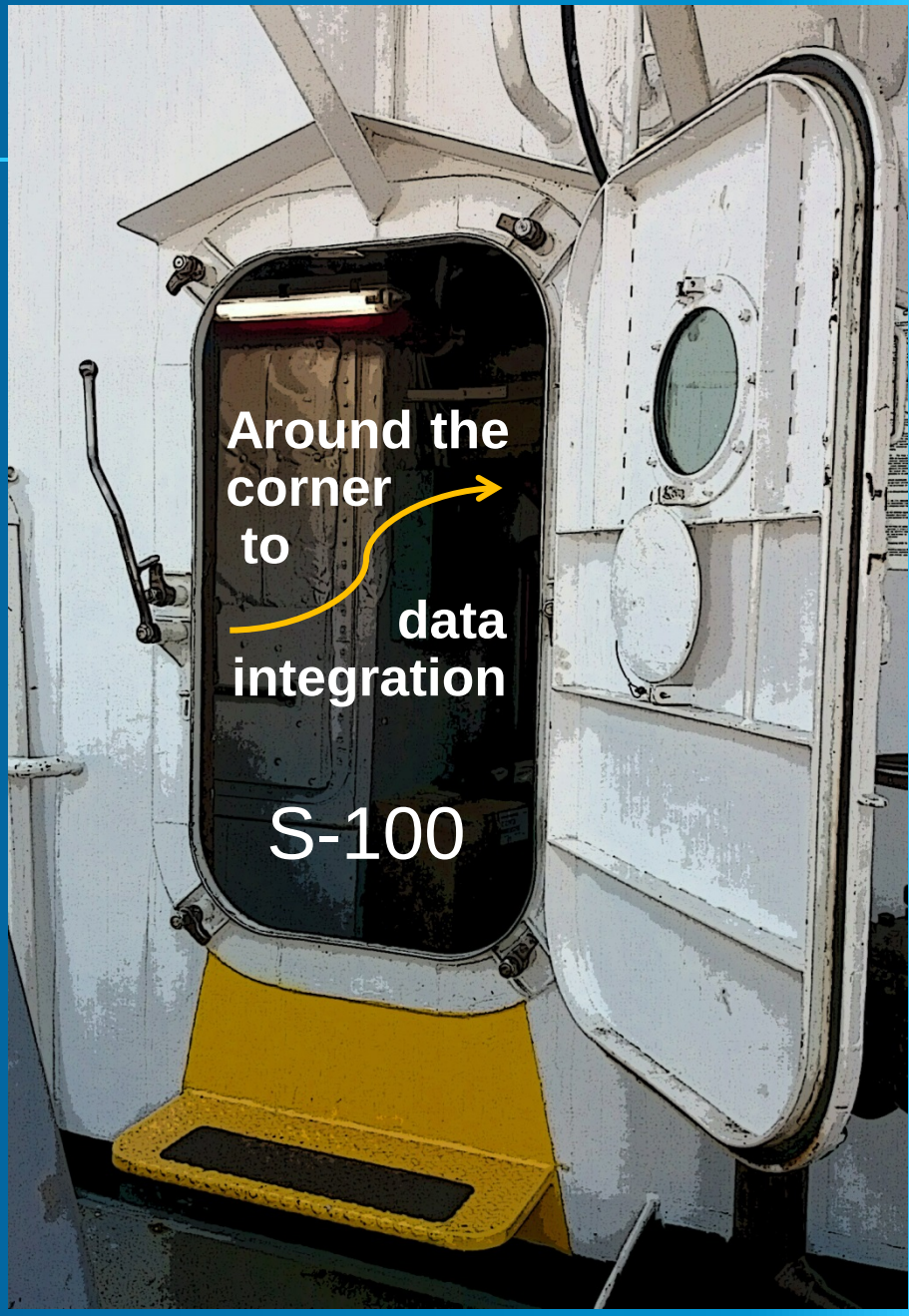
Instead of updating large files of entire charts, the tile service only updates a smaller tile of the exact area needing the update.

Huge reduction of upload time and resources.

CHART TILE SERVICE

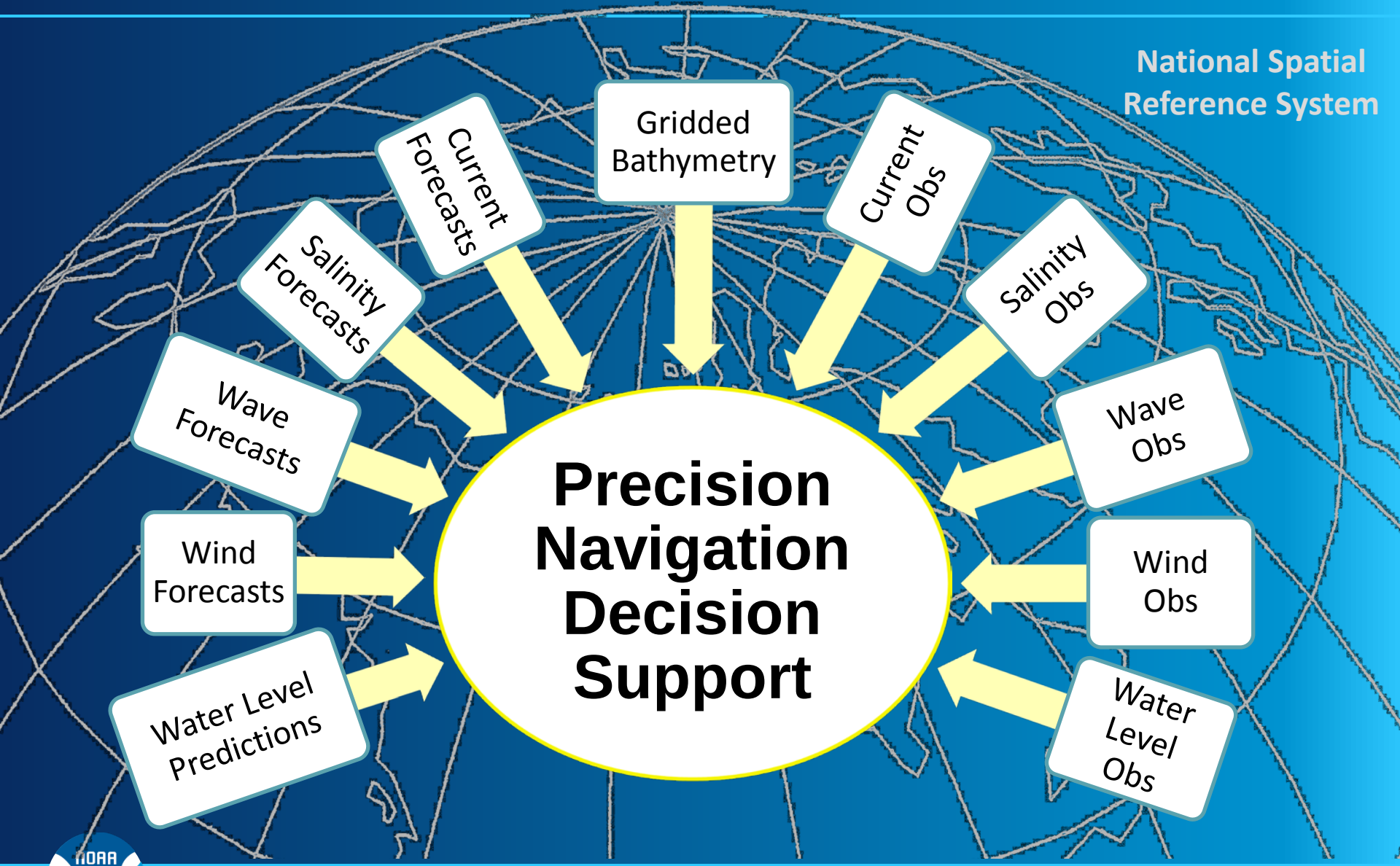
Electronic navigational charts

Door to data integration



Next generation navigation

Better data for better decisions

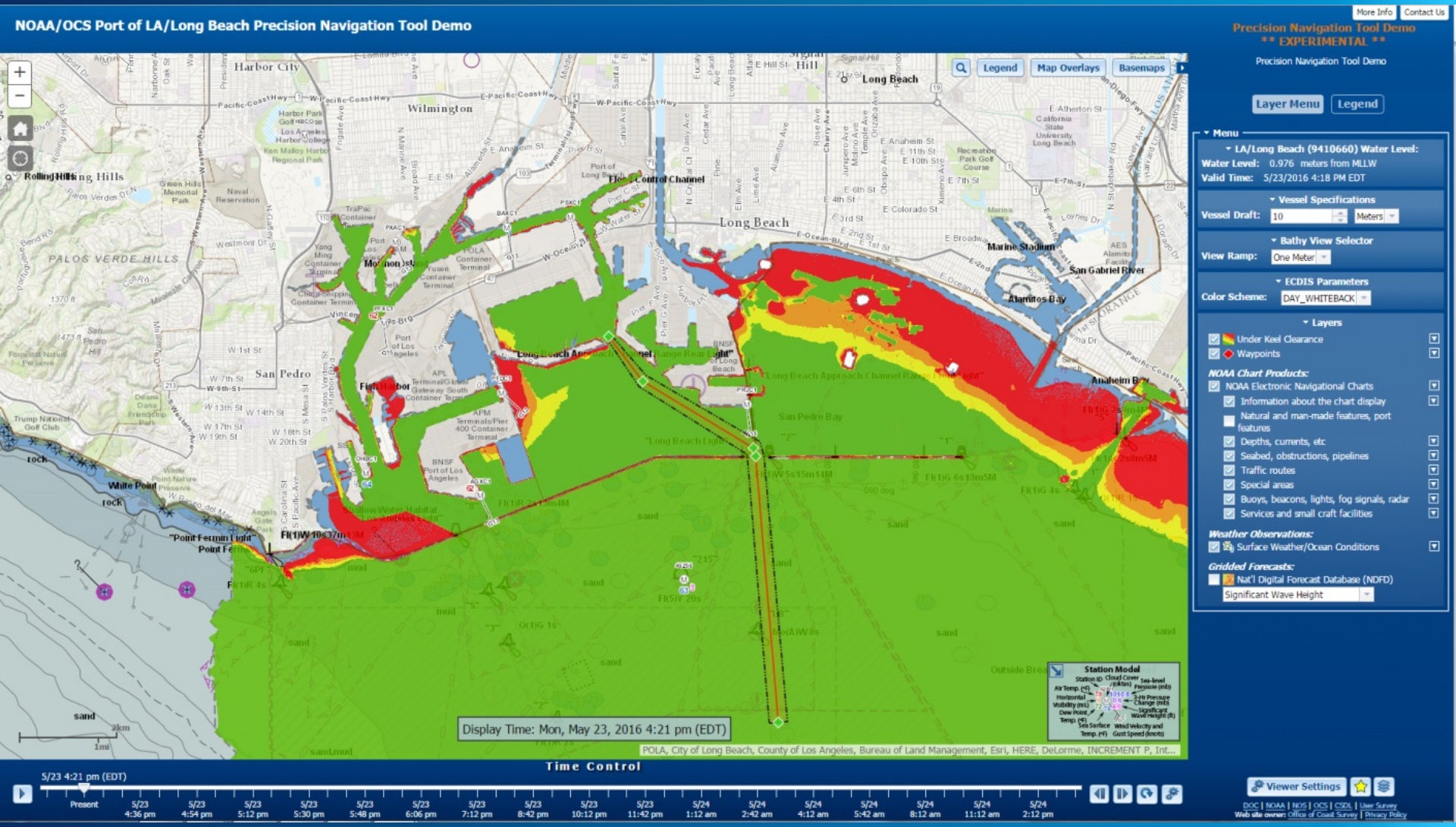


Ports of Los Angeles and Long Beach

Photo courtesy of Tom Jacobsen

LA/LB project = new operational information

- High resolution bathymetry
- Wave modeling
- More observations
- Partnerships



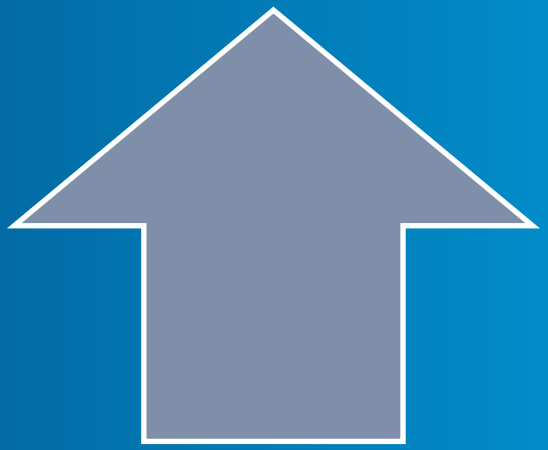
Precision Navigation Tool Demo

Next generation navigation does it better

Reduce risk of collisions, groundings, and oil spills

Economic and social benefits

Maximize cargo volume while reducing delays and congestion



Collaboration is key to data integration

- Charts
- High resolution bathymetry
- Safety contours
- Tides & water levels
- Currents
- Winds
- Wave heights
- Weather
- Regulatory restrictions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Twitter @NOAAcharts
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Rear Admiral Gerd F. Glang
Director, Office of Coast Survey
National Oceanic and Atmospheric Administration

Presentation to
Marine Board Spring Meeting

June 2016

SLIDE 1: INTRO CHART

Thank you for this opportunity to discuss NOAA's vision for the future of navigation. Today I'm going to talk about the future of nautical charting, as well as the future of navigation. To start, I will focus on one of the most important juncture points between NOAA's navigation services and its federal partners – our nautical charts.

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. To be blunt: in most cases, they aren't getting it.

NOAA's Office of Coast Survey recognizes the maritime frustration with old charting data, so 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.

When I started my current job as Coast Survey director, in 2012, I would explain that we maintain a suite of over a thousand charts. Now, though, just three and half years later, it doesn't make sense to quantify charts numerically, as separate pieces of paper. We are rapidly moving beyond individual charts into seamless digital vistas of charted data, with no edges and no "editions."

SLIDE 2: CAPTAIN USING PAPER CHART

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, and the Army Corps to avoid a disconnect between mariner expectations, charting products, and regulations for safe navigation. So I truly appreciate the invitation to speak to you today.

SLIDE 3: CRIT REPORT

Paper charts have always posed a problem for mariners: the inherent drawback is they are out-of-date from the moment they arrive in the pilothouse.

When we were printing editions of charts every few years, we would save changes to the charts on an internal working version of the chart, and only release it to the public at the time of a new edition, which added several years of latency from the time we gathered the information until it was available for the mariner's use. The timing of new editions was arbitrary, tied loosely to an arcane method of counting existing printed stock on hand, and the volume of new information to go on the chart. Consequently, new chart editions might be spaced sometimes years apart; years might pass before new hydrography appeared on a new chart edition.

With the transition from government-printed paper charts to our digitally-based private market, we had the opportunity to dramatically improve the efficiency of our chart production system. Instead of continuing the arbitrary process of creating new editions, we looked at what the mariner needed, and opted instead for more frequent updates, available to the mariner within days.

SLIDE 4: LEGACY CHARTING SYSTEM

Changing a centuries-old chart production system isn't a simple task. Ever since electronic navigational charts came into production in the 1990s, we've had two chart production systems, one to support paper, the other to support digital. The production of nautical charts in two formats with two different production systems meant we had to enter data separately and in different formats, and it was difficult to keep products synchronized across the two production systems. We often had to slow down electronic chart updates, to keep everything in sync.

SLIDE 5: MOVING TO A CENTRAL DATABASE

Now, however, we have changed the entire paradigm. We are currently integrating a new charting system that will use one central database to produce all NOAA chart products. This new way of doing business slims down the system while it beefs up performance, speeding new data and updates to all chart versions of the same charted areas and removing inconsistencies. We have been working on this for years. Procedures and tools need to be rebuilt, technology is a challenge, and we have millions of pieces of data to handle.

Changing the paradigm – moving to a single system – means we have no reason to hold back changes to the charts. By moving from paper to digital products, we can make the whole chart system simpler and support faster

updates that are synchronized across all products. It will also be easier to create new chart products.

SLIDE 6: UPDATE

NOAA has quietly been improving our service delivery by updating our digital charts weekly for the past two years. These changes are no longer limited to Notice to Mariners corrections; they might include full hydrographic surveys or shoreline updates as well. We apply these updates to all versions of the chart, including the print-on-demand paper charts. One interesting implication is that we can now support digital publication of changes to the chart that happen on time scales of months, rather than the time scale of years if we had to apply to a paper chart. We can accurately chart an ocean inlet that is changed by winter storms in time for the summer small boating season. Or, as we are doing with a new provisional chart for the Yukon River, we can assess satellite-derived bathymetry after the ice melts, and adjust the chart for barge companies in time for most of their summer season.

So what does this mean to the mariner? What NOAA navigational products are available to them now, and what do we anticipate for the future?

SLIDE 7: PRINT-ON-DEMAND PAPER CHARTS

We expect that most responsible ships and boats will continue to carry paper charts for some time to come, primarily for backup. We privatized the printing and distribution of official NOAA charts to a group of approved print-on-demand agents, who are allowed to tailor their products, as long as the charts remain usable to meet carriage requirements. This print-on-demand technology is an improvement that allows incremental changes from notice-to-mariners to be applied at the time of ordering. We all recognize, however, that getting a new paper chart to the mariner at sea, every week, is not realistic.

SLIDE 8: RASTER CHART 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. Until last December, these systems used tile sets that were commercially created from our raster navigational charts. This is time

consuming and awkward, since multiple charts may cover the same area at the same scale, and the service must choose one chart to populate each tile. As a result, the companies that do this to support their deployed applications only updated their tiles once or twice per year. This means that even though we have issued updates to our raster charts, customers still have a delay in getting updated charts.

We are addressing this problem by providing a service to the application manufacturers and the end users that ensures both ease of access and up-to-date chart products. In December, NOAA introduced the first set of chart tile services compatible with these systems. These tile sets are updated weekly with the latest Notice to Mariners, as well as any other changes to the charts that are made that week. The first phase was for online tiles, compatible with web mapping applications. This summer, we plan to roll out tile sets packaged for offline use, where all tiles at all scales within a geographic region will be packaged together. These tile packages can then be updated with weekly “delta” packages, containing only the tiles that have changed since the last full package.

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

SLIDE 9: ENC

Most of our work in the near future is addressing the content of ENCs. We have a lot of work ahead to optimize our ENCs for electronic navigation using ECDIS and electronic charting systems. To be honest, we have heard a lot of feedback from users concerning too many alarms, discontinuous depth areas, chart clutter, and unclear symbology.

As I mentioned earlier, we are streamlining our chart production system and giving priority to electronic navigational charts. As we near completion of the population of our vector charting database, we are planning a suite-wide update of our ENCs. We plan to examine all the features that cause alarms, with an eye to reducing the incidence of unnecessary alarms. We plan to 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. We will review all isolated hazards, such as wrecks and obstructions, to ensure they have the attribution necessary to reduce false alarms and chart clutter.

Once we finish the transition, we hope to be able to access the U.S. Coast Guard Aids to Navigation database directly, with specialized semi-automated tools to make the changes to 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. Vector-to-vector tools will be able to automatically populate the charted channel information.

SLIDE 10: DOOR TO DATA INTEGRATION

Paper remains a trusted adviser to the prudent navigator, but is no longer king. We have deposed the king by putting into force international regulations for ECDIS and ENC carriage, which are leading to the next generation of navigation.

The digital chart, coupled with streams of own-ship position data, provides instantaneous situational awareness, “I am here, right now.” A digital chart can also integrate AIS data streams and radar data, which instantly disambiguate the relationship and identity of other ships to own-ship in the navigation picture, allowing immediate assessments.

More information will be available and seamlessly integrated into bridge systems through the growth of internet at sea. Therefore, a major challenge ahead for hydrographic offices and the electronic charting industry is to develop and mature the data standards necessary to ensure the interoperability of charts and streams of environmental data.

To this end, the International Hydrographic Organization continues to work on their S-100 universal data model, currently creating the 3rd edition. S-100 is the door to data integration. It is the international framework for creating new digital data products, and Coast Survey is making progress on building new products under the framework. However, we are still a couple of years away from bringing our ENCs under the S-100 mantle.

In the meantime, as I said, NOAA and our partners in the marine transportation system need to work together to modernize the delivery of our marine safety information, and to ensure that the regulatory requirements support the use of innovative technology that will make navigation safer and more efficient. That is our mission, and I know it is yours.

SLIDE 11: NEXT GENERATION NAVIGATION

So far I have talked about the future of nautical charting. Now I am going to broaden that discussion to include the other critical navigation services NOAA has to offer, and our steps toward improving and integrating these services. We are working towards next generation navigation.

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

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.

SLIDE 12: BETTER DATA FOR BETTER DECISIONS

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.

SLIDE 13: PORT OF LA/LONG BEACH

Three years ago, NOAA began a pilot project in the Port of LA/Long Beach. A year ago, at the Spring Marine Board Meeting in Irvine, California, our navigation manager, Jeff Ferguson, briefed you on the status of this project. I wanted to provide an update for you now in the context of next generation navigation.

We selected the Port of LA/Long Beach as a prototype due to a variety of navigational factors. This is clearly not a protected harbor. Ships are exposed to open ocean, influenced by unique wave, swell, and water-level conditions. The ships themselves – with their larger size – have outpaced the infrastructure to support them.

SLIDE 14: PORT OF LA/LONG BEACH PROJECT

For the LA/Long Beach project, NOAA provided new, high quality, operational, environmental information to support the software system in a manner consistent with existing NOAA product delivery.

First, NOAA Ship *Fairweather* conducted multibeam surveys of the ports over three months, covering approximately 61 sq. nautical miles. This 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.

We also increased our 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.

Modeling and building forecasts are also key to next generation navigation. We developed a near-shore wave prediction system 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.

Most importantly, this project demonstrated the primary importance of 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.

We are also working with industry partners and app developers for mobile devices to deliver data in a unified, intuitive fashion with minimal intervention from the mariner. This will provide mariners with accurate, real-

time information that is simultaneously collected, integrated, analyzed, and delivered electronically to the user in a harmonized fashion to ensure their safety, the security of their vessel, and the protection of the marine environment.

SLIDE 15: LA/LONG BEACH TOOL DEMO

This is a demonstration of the tool we are developing for next generation navigation. (http://205.156.4.87/pnt/)

SLIDE 16: NAVIGATIONAL, ECONOMIC, SOCIETAL BENEFITS

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.

Thanks to the success of the Port of LA/Long Beach pilot, several maritime industries have expressed similar interest and need for precision navigation capabilities in ports from the Gulf of Mexico to New York/New Jersey. In the future, mariners will have all high-resolution, real-time streams of data at their disposal for use in whatever navigational situation they may find themselves to make the best decisions possible. This new, but increasingly expected method of conducting business will deliver benefits encompassing a variety of navigational factors from the environment to the economy.

SLIDE 17: COLLABORATION

As I've said, the key for the future of navigation is the integration and delivery of coastal intelligence data. Our challenge, as data providers, is to create streams of information that are transparent and flexible.

I referenced S100, the door to data integration, earlier in this discussion. The IHO's new S100 data format seeks to transform the shipboard ECDIS into a robust decision support system. By combining the navigational chart with wind, wave, current and weather forecast data a mariner can make better informed decisions about routing, port approaches, and various offshore manuevers, like lightering, passing arrangements, or fishing, for example.

We are challenged by mounting public expectations for nautical charts. Meeting these expectations, transforming our current state of technology into the robust integrated system we envision, will require a stronger -- more vigorous -- cooperation between all the agencies involved in marine transportation, as well as our non-federal partners. I have no doubt that we will all rise to the challenge, and that the next generation of navigation is around the corner.

SLIDE 18: END