



PRECISION MARINE NAVIGATION

Darren Wright

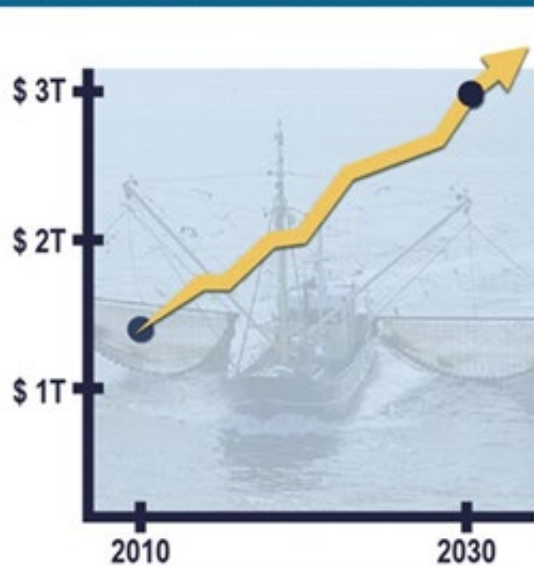
**Precision Marine Navigation
Program Manager**

What is Precision Marine Navigation?

...the ability of a vessel to safely and efficiently navigate and operate in close proximity to the other vessels, seafloor, bridges, narrow channels, or other marine hazards.



Projected Global Growth by 2030



Source: OECD (2016) *The Ocean Economy in 2030*



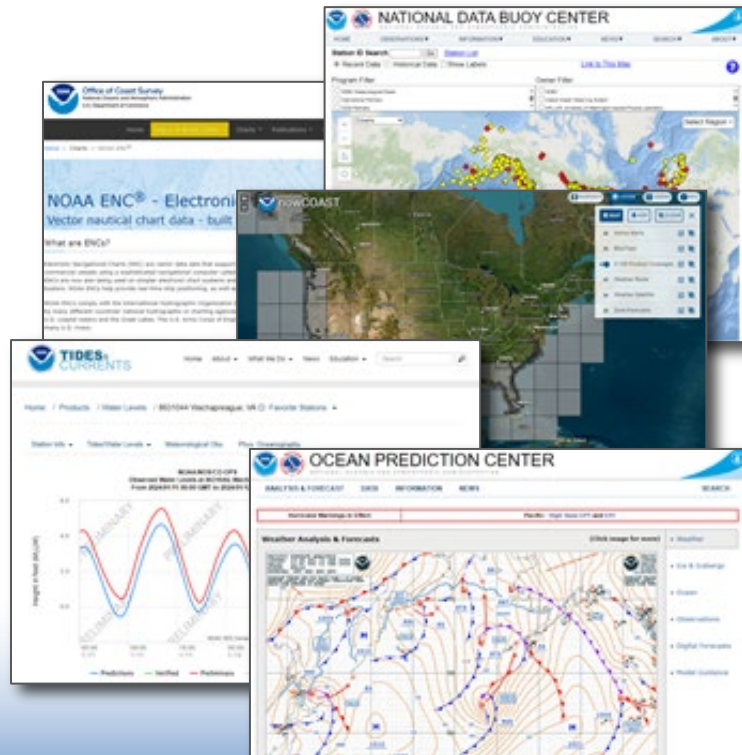
Ship Sizes Continue to Increase!

- Difficult navigation of deep draft ships in highly congested waterways
- Very tight harbors/berths
- Clearance Issues under bridges
- Demand for integrating environmental information into formats mariners can utilize to safely operate very high and very deep draft ships

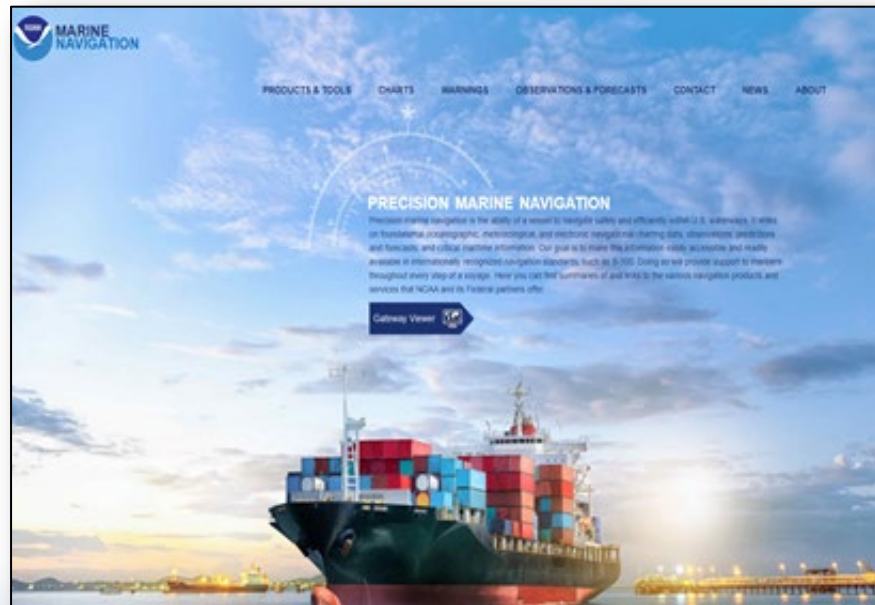


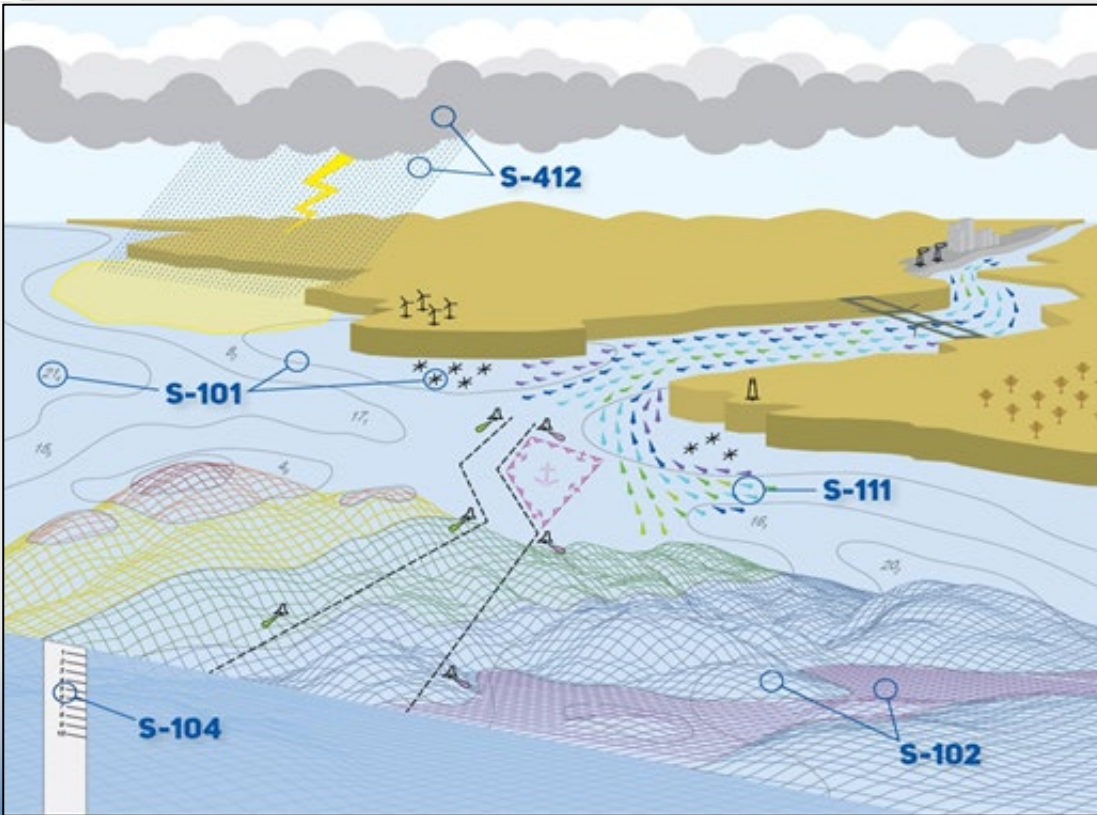
Difficult to access and process NOAA's navigation data, due to:

- Multiple devices and systems required to access the data
- Datasets spread across various websites and data servers
- Datasets are encoded in different formats that are not navigation standards



- Leveraging International Standards (S-100)
- Precision Marine Navigation Data and Dissemination Services
- Machine to Machine capability
- Marinenavigation.noaa.gov Website

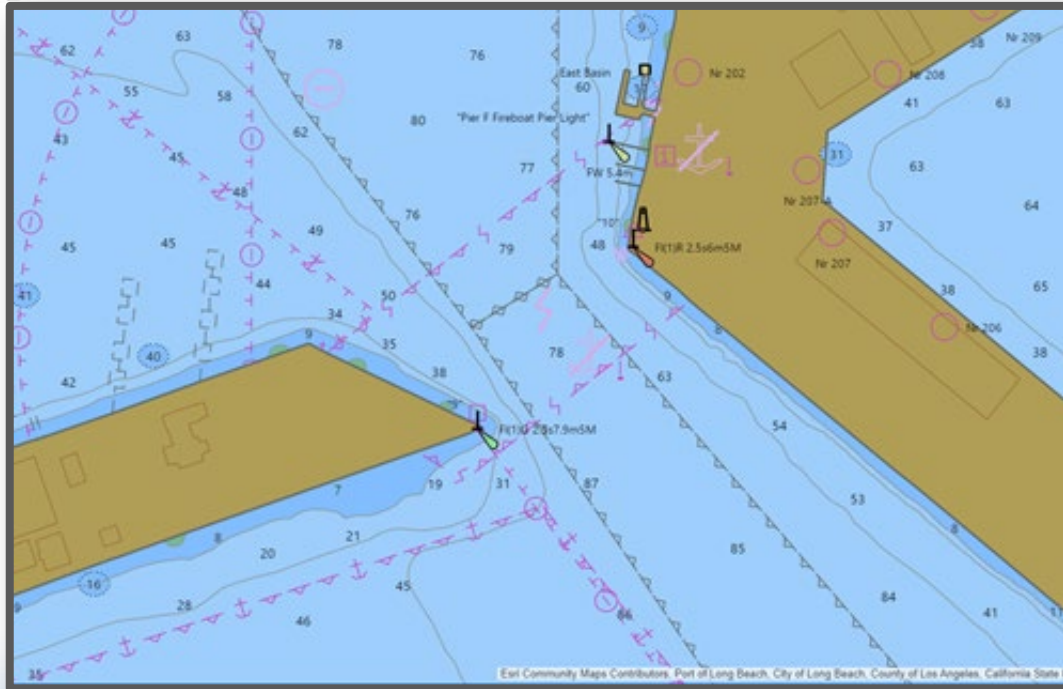




S-100 Data Products

- **S-101**: Electronic Navigational Charts (ENC)
- **S-102**: Bathymetric Surface
- **S-104**: Water Level Information
- **S-111**: Surface Currents
- **S-41X**: Weather Overlays

ENC of Transit to Port of Long Beach



ENC for the entrance to the Port of Long Beach, CA



Same view taken from the bridge of the vessel's deck in transit into the Port of Long Beach, California.
Credit: Jacobsen Pilot Service.



Jacobsen Pilot's portable pilot unit screen using the navigation system SEAIq Pilot, and S-102 data to draw custom safety contours. Credit: Jacobsen Pilot Service.



Same view taken from the bridge of the vessel's deck in transit into the Port of Long Beach, California. Credit: Jacobsen Pilot Service.

- S-102 Bathymetry Overlaid on ENC
- Safety Contour (red)



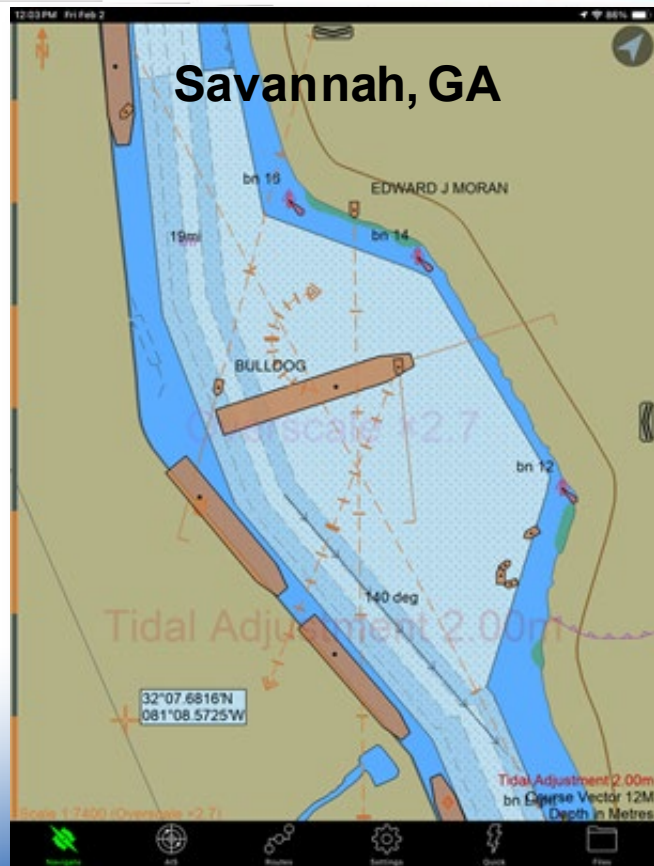
Combining S-102 bathymetry and a Water Level Adjustment (WLA) from S-104 water levels, dynamic safety contours can be created.

This image shows a **red** safety contour over a period of 12 hours for a specific vessels draft.

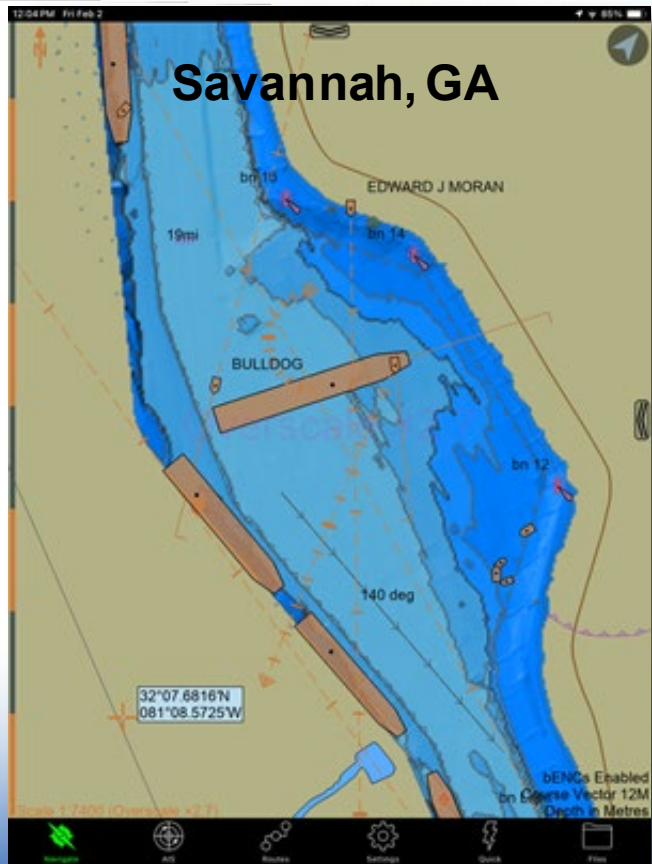


Combining S-102 bathymetry, Water Level Adjustment (S-104) and surface currents (S-111) gives a more complete picture of the environmental conditions.

ENC on a Portable Pilot Unit (PPU)

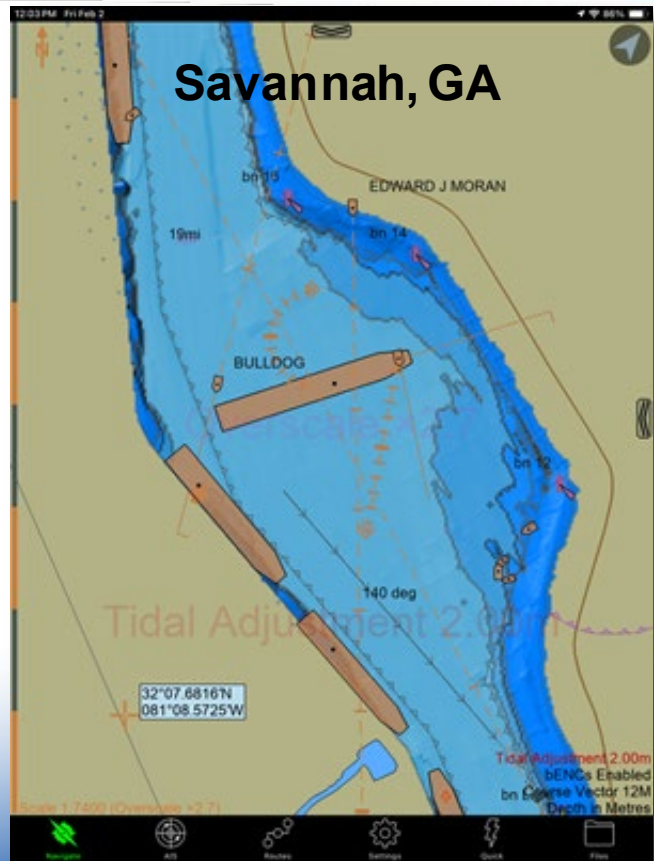


SEAIq PPU with
NOAA ENC

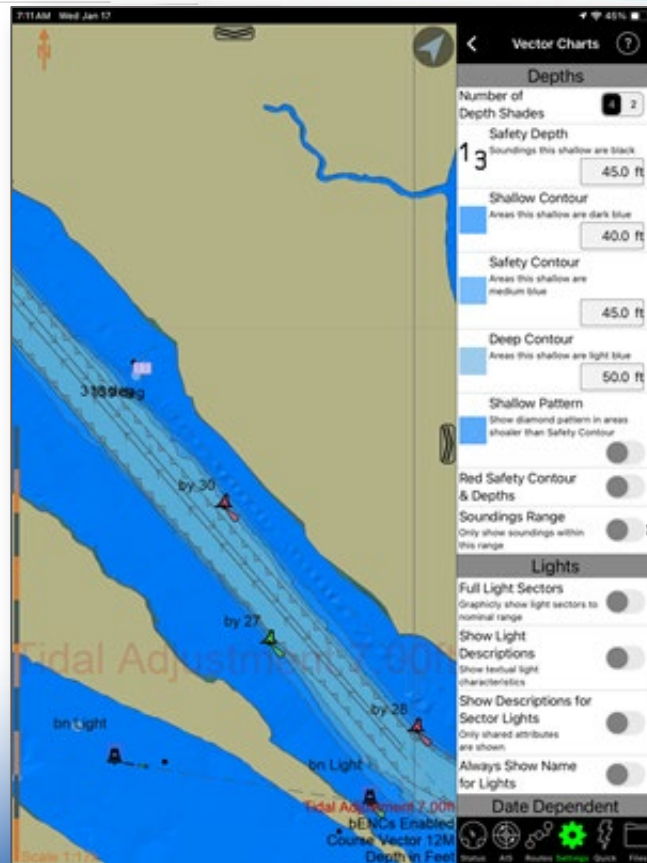


SEAIq PPU with
S-102 overlaid

PPU with Overlay and Tidal Adjustment



SEAIq PPU with tidal
adjustment
(2 m) added to the S-102
data



Configuration Screen of the SEAIq PPU

S - 411

Ice Hazards and
Information

Portrayal
Pending



S - 412

Weather and
Wave
Warnings

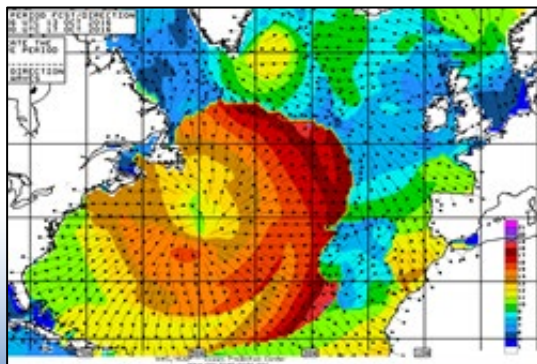
Polygons



S - 413

Weather and
Wave
Conditions

Graphics &
Gridded Data



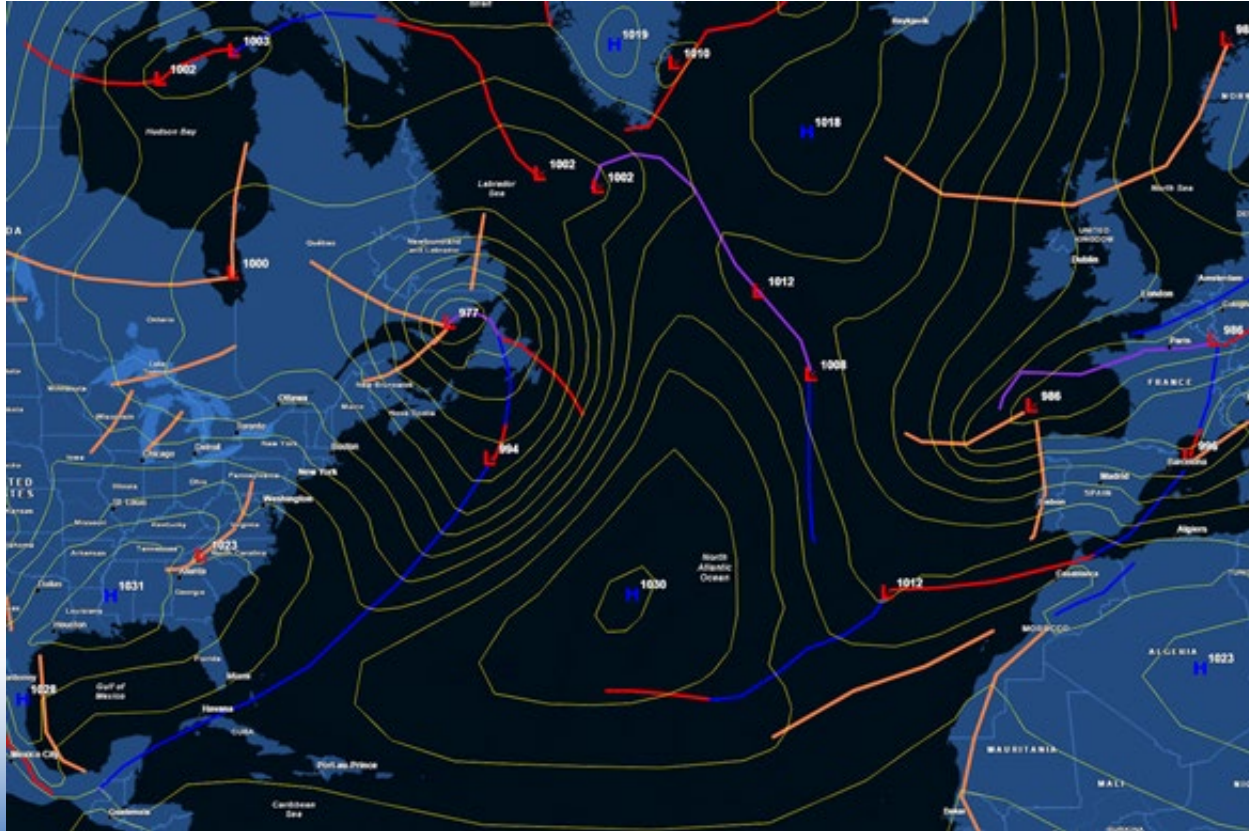
S - 414

Weather and
Wave
Observations

Point Based Data




Wind and Wave Warning Polygons



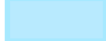
Wind Warnings:

Gale Force 

Storm Force 

Hurricane Force 

Wave Warnings:

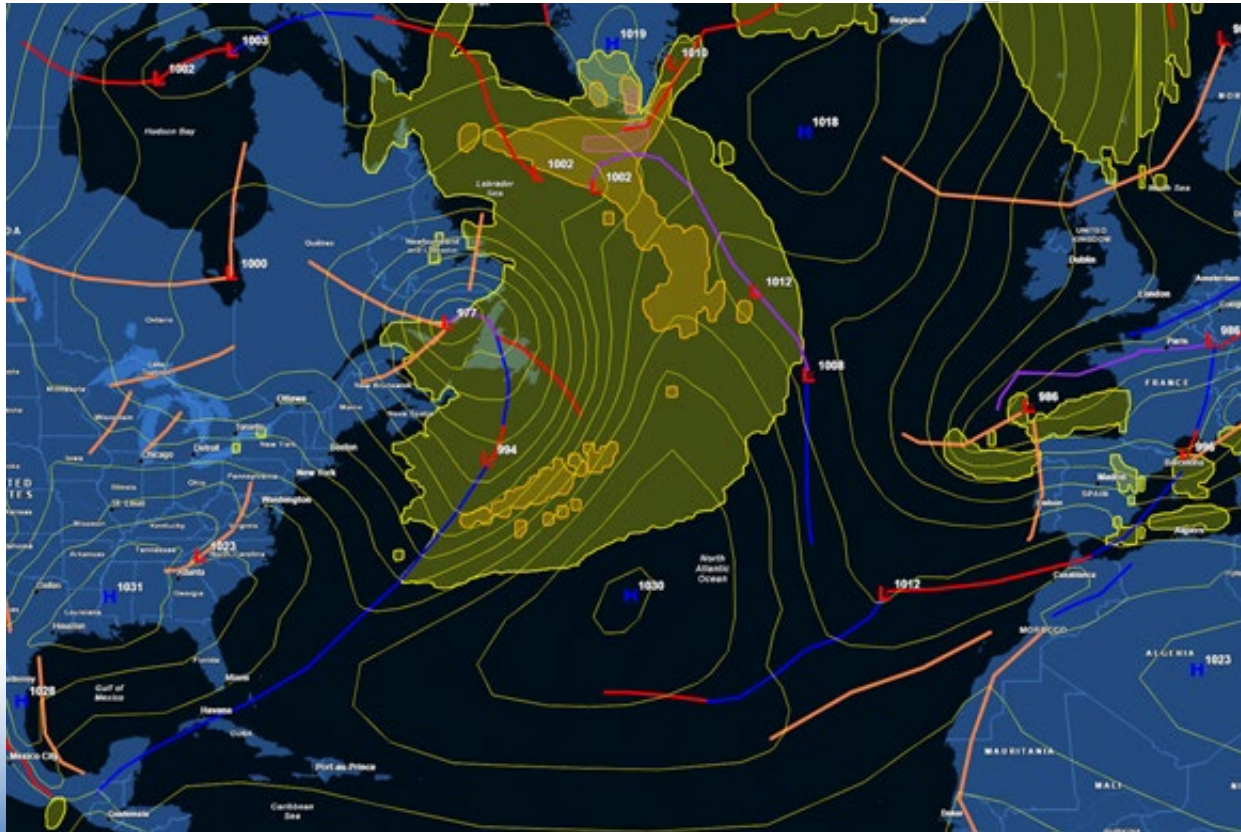
4-6 M 

6-9 M 

9-14 M 

14+ M 


Wind and Wave Warning Polygons



Wind Warnings:

Gale Force 

Storm Force 

Hurricane Force 

Wave Warnings:

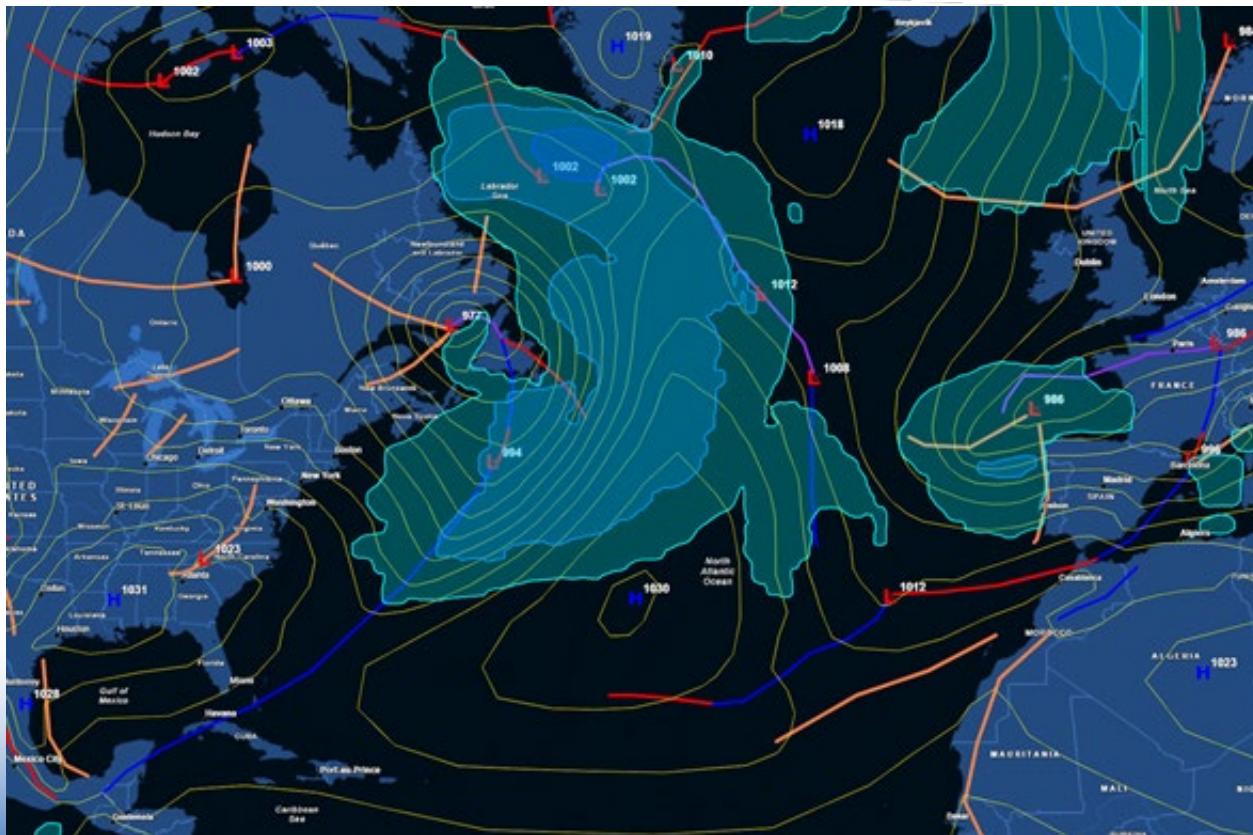
4-6 M 

6-9 M 

9-14 M 

14+ M 


Wind and Wave Warning Polygons



Wind Warnings:

Gale Force 

Storm Force 

Hurricane Force 

Wave Warnings:

4-6 M 

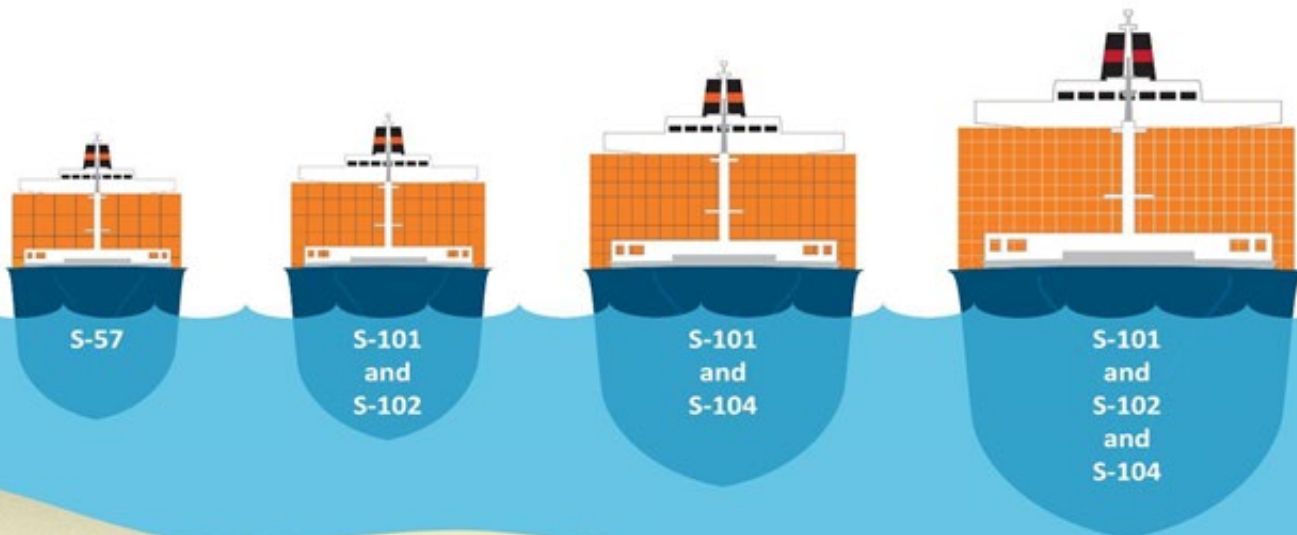
6-9 M 

9-14 M 

14+ M 

S-100 Data Enables Deeper Draft Vessels

Utilizing multiple S-100 products together provides better environmental awareness and the ability bring larger vessels into port

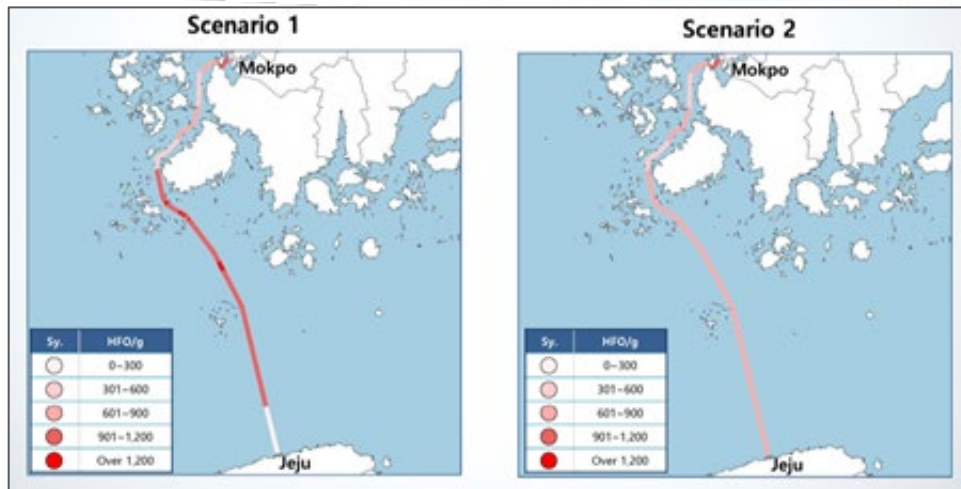


- Korea Hydrographic and Oceanographic Agency reported “Evaluation of the economic feasibility with S-10X data” at the IHO 6th Council (October 2022) with 2 topics (Economic, Usability)
- **Using S-102/104 data**, a new alternative route for passenger ship was produced as a part of economic study
- Alternative route was 55% shorter than the roundabout route resulting in a 45.5% fuel consumption reduction and a savings of **\$124,186 USD** annually.



Passenger ship Route	Roundabout route	Alternative route explored using S-100 data service
Estimated distance (m)	4,157	2,306
Distance difference between normal and roundabout/alternative(NM)	2.2	1.2
Total number of navigation	2,190 rounds	
Expected number of roundabout/alternative route	1,196 rounds	
Fuel consumption per hour	1,000 liters	
Fuel cost per liter	\$1.25 per liter (include 0.01% MGO tax)	
Economics analysis of coastal passenger ships	(A) \$273,209	(B) \$149,023
	(A) - (B) = \$124,186 (45.5% savings)	
	Total annual cost savings of \$124,186 (45.5% savings) would occur when the alternative route was used	

- Total sailing range was same for both scenarios; 148 km (approximately 92 miles)
- Both scenarios sailing took approximated 4hr 30min to satisfy real sailing schedule
- As the scenario 1 sailing with **fixed speed**, fuel consumption shows 13.02 ton
- However scenario 2 was designed for **optimal routing plan**, it **saved 14.6%** of fuel consumption and emissions

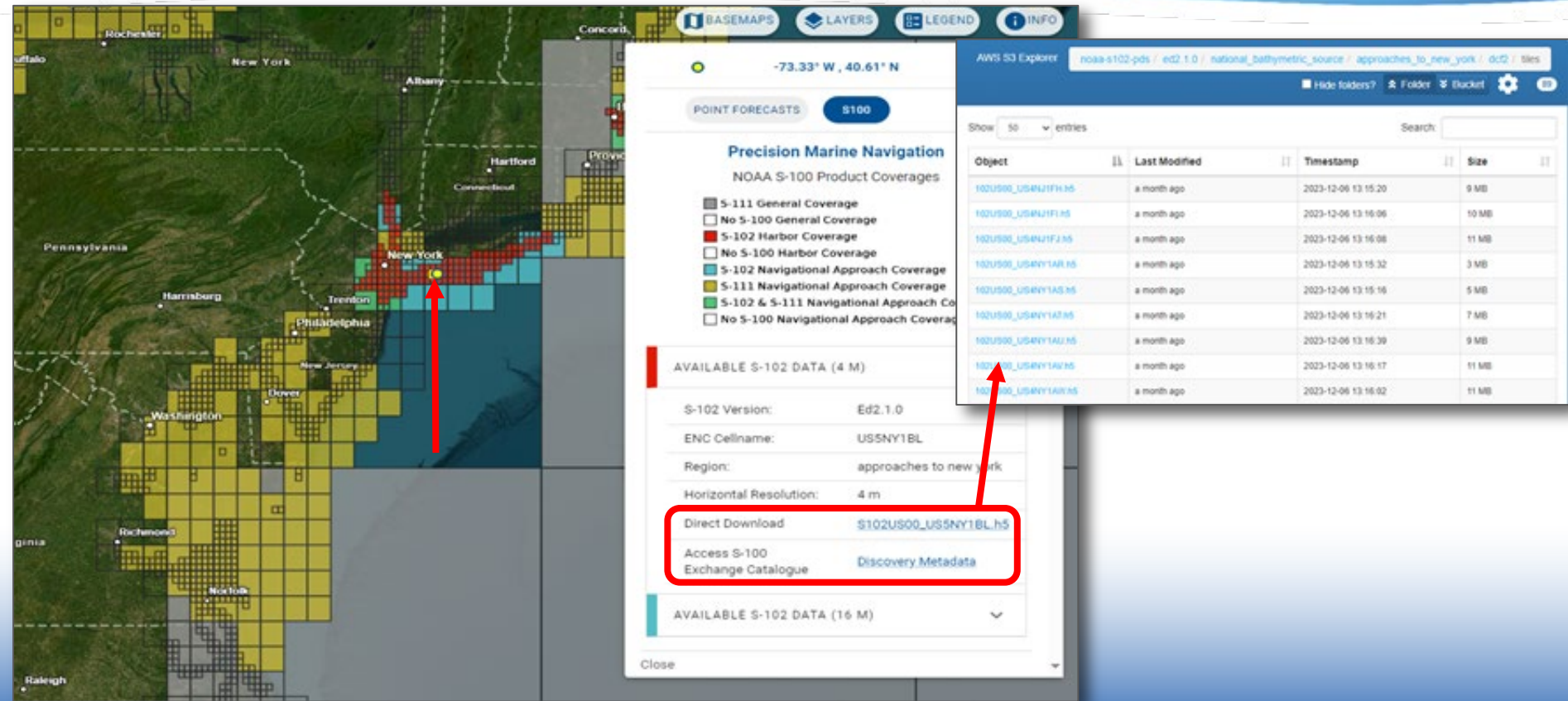


구분	Scenario 1	Scenario 2
Total sailing range	148 km (92 miles)	148 km (92 miles)
Total sailing time	4hr 24min	4hr 26min
Average RPM	102.3	100.3
Average speed	STW 19.4kts / SOG 20.7kts	STW 19.0kts / SOG 20.5kts
Fuel Consumption	13.02ton	11.12ton (▽ 14.6%)

NowCoast S-100 Product Coverage Viewer



<https://nowcoast.noaa.gov/>



The image shows a composite interface for accessing NOAA S-100 data. On the left is a map of the New York coastal region with various colored overlays representing different data products. A red arrow points from a specific area on the map to the 'AVAILABLE S-102 DATA (4 M)' section of the central panel.

The central panel, titled 'Precision Marine Navigation NOAA S-100 Product Coverages', includes a legend with the following items:

- 5-111 General Coverage
- No 5-100 General Coverage
- 5-102 Harbor Coverage
- No 5-100 Harbor Coverage
- 5-102 Navigational Approach Coverage
- 5-111 Navigational Approach Coverage
- 5-102 & 5-111 Navigational Approach Coverage
- No 5-100 Navigational Approach Coverage

Below the legend, the 'AVAILABLE S-102 DATA (4 M)' section displays the following details:

- S-102 Version: Ed2.1.0
- ENC Cellname: US5NY1BL
- Region: approaches to new york
- Horizontal Resolution: 4 m

At the bottom of this section, two options are listed, with the first one highlighted by a red box:

- Direct Download** [S102US00_US5NY1BL.h5](#)
- Access S-100 Exchange Catalogue [Discovery Metadata](#)

On the right, the 'AWS S3 Explorer' window shows the file structure for 'noaa-s102-pds / ed2.1.0 / national_bathymetric_source / approaches_to_new_york / d:c2 / files'. A table lists the files with their last modified dates, timestamps, and sizes:

Object	Last Modified	Timestamp	Size
102US00_US5NY1FH.M5	a month ago	2023-12-06 13:15:20	9 MB
102US00_US5NY1FH.M5	a month ago	2023-12-06 13:16:06	10 MB
102US00_US5NY1FJ.M5	a month ago	2023-12-06 13:16:08	11 MB
102US00_US5NY1AR.M5	a month ago	2023-12-06 13:15:32	3 MB
102US00_US5NY1AS.M5	a month ago	2023-12-06 13:15:16	5 MB
102US00_US5NY1AT.M5	a month ago	2023-12-06 13:16:21	7 MB
102US00_US5NY1AU.M5	a month ago	2023-12-06 13:16:39	9 MB
102US00_US5NY1AV.M5	a month ago	2023-12-06 13:16:17	11 MB
102US00_US5NY1AR.M5	a month ago	2023-12-06 13:16:02	11 MB

A red arrow points from the 'Direct Download' link in the central panel to the corresponding file entry in the AWS S3 Explorer table.

S-102 High Resolution Bathymetry

- S-102 Edition 2.1.0 available in the following locations
 - LA/LB, NY/NJ, [Boston](#), [Charleston](#), [Savannah](#), [working on LMR](#)
- Testing Edition 2.2.0 that will work with S-100 metadata upgrade (5.1.0)

S-104 Water Level Forecast Guidance

- Developing prototype S-104 water level forecast data using Global STOfS model
- Late 2024 release of test data

S-111 Surface Current Forecast Guidance

- Developed S-111 data products from NOAA's Operational Forecast Systems
- Upgrading S-111 processing to Edition 2.0.0 (FY24)

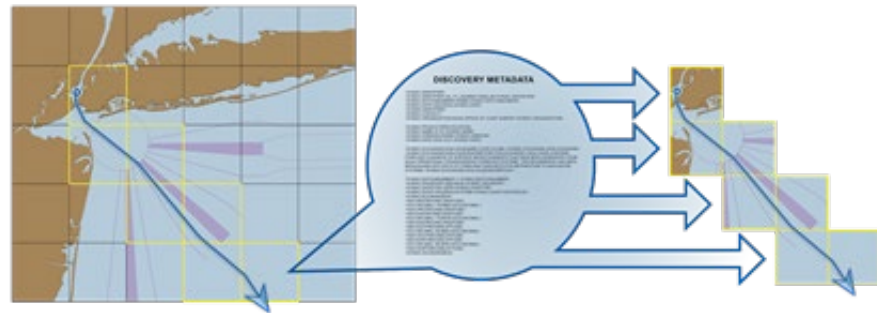
S-41X Weather and Ice Services

- Coordinating with NWS/OPC to ingest S-41X weather and ice products into the dissemination system.

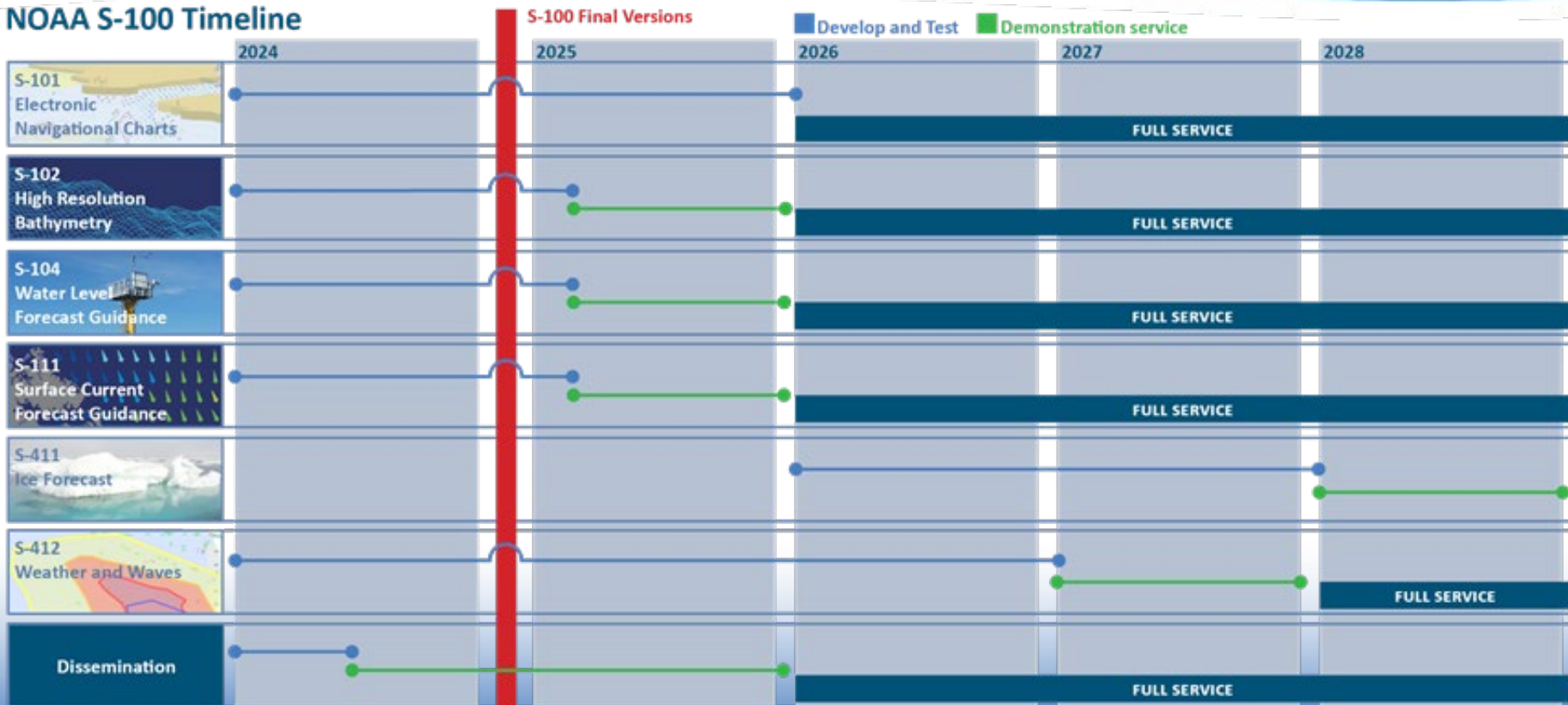
S-101 ENC

- Developed an S-57 to S-101 Transition Plan
- NOAA will need to have dual S-57 and S-101 (for major ports) production by 2026

- Discovery Metadata Upgrade (Ver. 5.1.0) - released 10/31/23
- S-100 Product Operational Versions (S-101,S-102, S-104, S-111, S-41X)
 - To be finalized end of 2024
- S-102 expansion will be put on hold until final standard is established



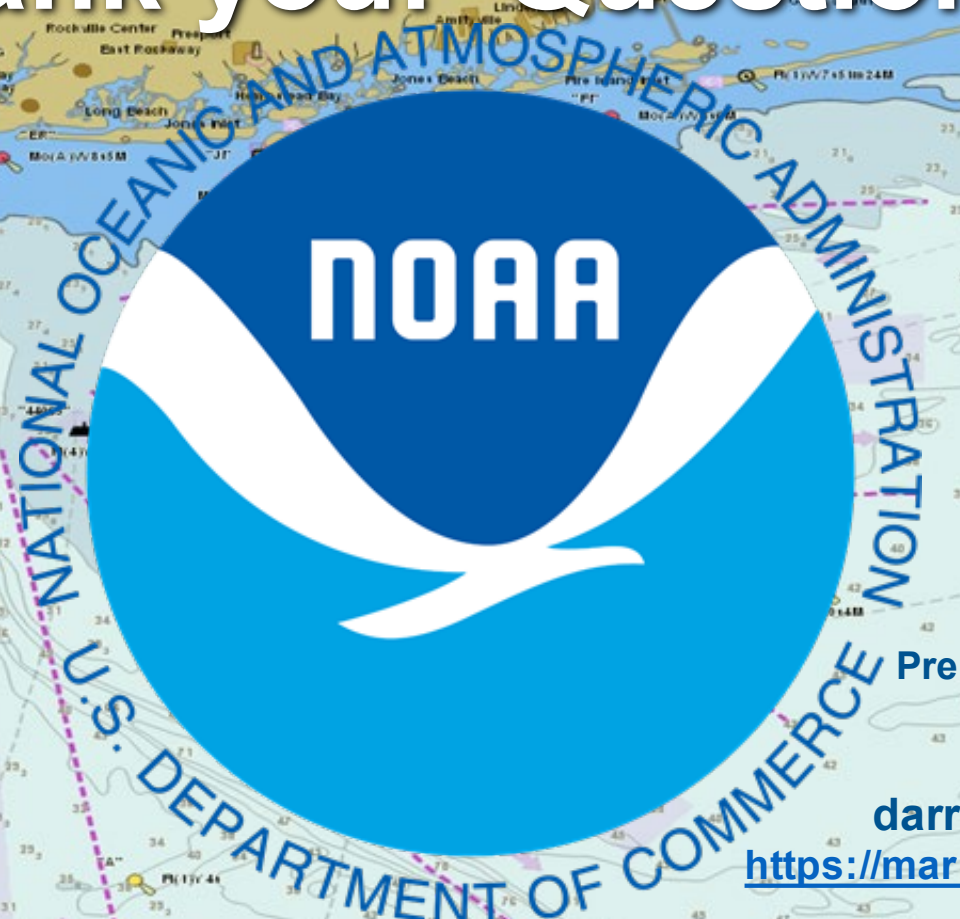
NOAA S-100 Timeline



- In 2022, the International Maritime Organization (IMO), amended its Electronic Chart Display and Information System (ECDIS) standard to leverage S-100 based ENC's beginning in 2026.
- S-100 ECDIS will be voluntary starting **1 January 2026**
- From **1 January 2029** new systems must comply with the new IMO Resolution on ECDIS Performance Standards (MSC.530(106))



Thank you! Questions?



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<https://marinenavigation.noaa.gov>

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