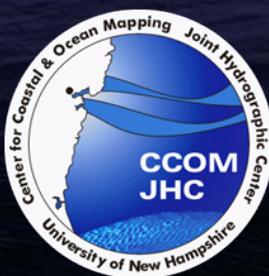


# Providing Meteorological and Hydrographic Information via AIS Application-Specific Messages: Challenges and Opportunities



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# e-Navigation

## Definition:

*“the harmonized collection, integration, exchange, presentation and analysis of maritime information onboard and ashore by electronic means to enhance berth-to-berth navigation and related services, for safety and security at sea and protection of the marine environment.”*

# e-Navigation

Significant outcomes/benefits related to:

1. Shipboard navigation systems
2. Management of VTS and related services
3. Communications infrastructure

# e-Navigation (IMO vision)

## 1. Shipboard navigation systems

- Integration of ownship sensors
- Supporting information
- Standard user interface
- Comprehensive systems for managing guard zones and alerts

Core elements include:

- High-integrity electronic positioning (e.g., GNSS)
- Use of ENCs and ECDIS
- An analysis capability to reduce human error

All while actively engaging the mariner in the process of navigation while preventing human error.

# e-Navigation (IMO vision)

## 2. Management of vessel traffic and related services from ashore

*- to be “enhanced” through better provision, coordination, and exchange of comprehensive data in [digital] formats that will be more easily understood and utilized.*

# e-Navigation (IMO vision)

## 3. A communications infrastructure

*...designed to enable authorized seamless information transfer*

*...onboard ship, between ships, between ship and shore, and between shore authorities.*

# e-Navigation

## Goals

Safety-of-Navigation

Efficiency of Maritime Transportation

Marine Environmental Protection

Port/Coastal Security

## Components:

### AIS

- AtoN
- **ASMs**
- LRIT

### ECDIS

### VTS

### PPU

### INS

- SatComms
- Radar/ARPA
- GNSS

### AtoN

### MIOs

“Others” (TBD)

# e-Navigation Harmonization Challenges

For AIS Application Specific Messages (ASMs):

1. Data vs. Information
2. Presentation/display → Portrayal
3. Providers vs. Users

# AIS ASM Standards

**IMO SN/Circ.236** – *Guidance on the Application of AIS Binary Messages*  
(May 2004)

**IMO SN.1/Circ.289** – *Guidance on the Use of AIS Application-Specific Messages* (June 2010)

**IMO SN.1/Circ.290** – *Guidance on the Presentation and Display of AIS Application-Specific Messages* (June 2010)

**ITU-R.M. Recommendation 1371-1** – *Technical characteristics for a universal shipborne automatic identification system using time division multiple access in the VHF marine mobile band* (2001)

**RTCM [121xx.1]** – *Draft RTCM Standard for AIS Binary Application-specific Messages: International and Regional Use* [2011]

IMO SN/Circ.236			IMO SN.1/Circ.289		
Appl No.	Message Name	FI	Message Name	FI	
1	Meteorological/Hydrological	11	Meteorological and Hydrographic	11	
2	Dangerous cargo indication	12	Dangerous cargo indication	25	
3	Fairway closed	13	---	--	
4	Tidal window	14	Tidal window	14	
5	Extended ship static and voyage related data	15	Extended ship static and voyage related data	24	
6	No. of persons onboard	16	No. of persons onboard	16	
7	Pseudo-AIS targets	17	VTS-generated targets	17	
			Clearance time to enter port	18	
			Marine traffic signal	19	
			Berthing data	20	
			Weather report from ships	21	
			Area Notice - broadcast	22	
			Area Notice - addressed	23	
			Environmental	26	
			Route Information – broadcast	27	
			Route Information – addressed	28	
			Text Description – broadcast	29	
			Text Description – addressed	30	

# Key parameters and descriptions for Met/Hydro AIS ASMs

<u>Table</u>	<u>Application</u>
1.1	Meteorological and hydrographic Data
3.1	Tidal window
10.1	Weather observation report – from ship to other ships
11.1 -3	Area notice broadcast and addressed
.5	Circle or point (e.g., endangered whales detected)
.6	Rectangle
.7	Sector
.8	Waypoint or polyline (e.g., for an ice boundary or storm front)
.9	Polygon
.11	Notice description (e.g., #99 - chart feature: shoal area)
12.1	Environmental
.2	Environmental message sensor report framework
.3	Environmental message sensor report types
.4	Sensor site location
.5	Station ID
.6	Wind report
.7	Water level report
.8	Current flow report: two-dimensions (x & y)
.9	Current flow report: 3-dimensionsl (x, y, & z)
.10	Horizontal current flow report
.11	Sea-state report
.12	Salinity report
.13	Weather report
.14	Air gap

# Data and Information Content

Parameter	No. bits	Description
Message ID	6	Identifier for Message 8; always 8
Repeat Indicator	2	Used by the repeater to indicate how many times a message has been repeated.
Source ID	30	MMST number of source station
Spare	2	Not used. Should be set to zero.
IAI	16	DAC=001; FF11
Latitude	24	Measuring position, 0 to +/-90 degrees, 1/1000th minute
Longitude	25	Measuring position, 0 to +/-180 degrees, 1/1000th minute
Date and time	16	Time of transmission, Day, hour, minute, (ddhhmm in UTC)
Average wind speed	7	Average of wind speed values for the last 10 minutes
Wind gust	7	Maximum wind speed value reading during the last 10 minutes, 0-120 kts, 1kt
Wind direction	9	0-359, 1 degree
Wind gust direction	9	0-359, 1 degree
Air temperature	11	Dry bulb temperature -60.0 to +60.0 degrees Celsius, 0.1 of a degree
Relative humidity	7	0-100, 1%
Dew point	10	-20.0 - +50.0 degrees, 0.1 degree
Air pressure	9	800-1200 hPa, 1hPa
Air pressure tendency	2	0 = steady, 1 = decreasing, 2 = increasing
Horizontal visibility	8	0-250, 0.1 NM
Water level (incl. tide)	9	Deviation from local chart datum, -10.0 to 30.0 m
Water level trend	2	0 = steady, 1 = decreasing, 2 = increasing
Surface current direction	9	0-359 degrees, 1 degree
Current speed, #2	8	Current measured at a chosen level below the sea surface, 0.0 - 25.0 knts, 0.1 kt
Current direction, #2	9	0-359, 1 degree
Current measuring level #2	5	Measuring level in m below sea surface, 0-30m, 1 m
Current speed, #3	8	0.0 - 25.0 knots, 0.1 knot
Current direction, #3	9	0-359 degrees, 1 degree
Current measuring level, #3	5	Measuring level in m below sea surface, 0-30 m, 1 m
Significant wave height	8	0.0 - 25.0 m, 0.1 m
Wave period	6	Period in seconds, 0-60 s, 1 s
Wave direction	9	0-359 degrees, 1 degree
Swell height	8	0.0 - 25.0 m, 0.1 m
Swell period	6	Period in seconds, 0 - 60 s, 1 s
Swell direction	9	0-359 degrees, 1 degree
Sea state	4	According to Beaufort scale (manual input?), 0 to 12, 1
Water temperature	10	-10.0 - +50.0 degrees, 0.1 degree
Precipitation (type)	3	According to WMO
Salinity	9	0.0 - 50.0 PPT, 0.1 PPT
Ice	2	Yes/No
Spare	6	
Total	352	Occupies 2 slots

IMO Meteorology and Hydrology Message as specified in IMO SN/Circ.236, Annex 2, Application 1.  
Also described in AIG, Vol. 1, Part 1, Operational Issues, Ed. 1.3. IALA Guideline No 1028, p. 131.

# AIS Binary Message in XML format

```
<?xml version="1.0" encoding="utf-8"?>

<ais-binary-message version="1.0"
xmlns:xi="http://www.w3.org/2001/XInclude">

<!-- XInclude is not used in this file. Here for demonstration only --&gt;
&lt;xi:include href="structs-inc.xml"/&gt;

&lt;struct name="pos_small" postgis_type="POINT"&gt;
  &lt;description&gt;Generic representation of position on the WGS84
sphereoid. Smaller number of bits than standard position.
Lat/Lon reversed.
  &lt;/description&gt;

  &lt;field name="latitude" numberofbits="24" type="decimal"&gt;
    &lt;description&gt;North South location&lt;/description&gt;
    &lt;range min="-90" max="90"/&gt;
    &lt;unavailable&gt;91&lt;/unavailable&gt;
    &lt;units&gt;degrees&lt;/units&gt;
    &lt;scale&gt;60000&lt;/scale&gt;
    &lt;decimalplaces&gt;4&lt;/decimalplaces&gt;
    &lt;testvalue&gt;37.42446&lt;/testvalue&gt;
  &lt;/field&gt;

  &lt;field name="longitude" numberofbits="25" type="decimal"&gt;
    &lt;description&gt;East West location&lt;/description&gt;
    &lt;range min="-180" max="180"/&gt;
    &lt;unavailable&gt;181&lt;/unavailable&gt;
    &lt;units&gt;degrees&lt;/units&gt;
    &lt;scale&gt;60000&lt;/scale&gt;
    &lt;decimalplaces&gt;4&lt;/decimalplaces&gt;
    &lt;testvalue&gt;-122.16328&lt;/testvalue&gt;
  &lt;/field&gt;

&lt;/struct&gt;</pre>
```

# Displaying AIS Application-Specific Messages

At present, SOLAS vessels not required to have specific equipment to display AIS application-specific messages.

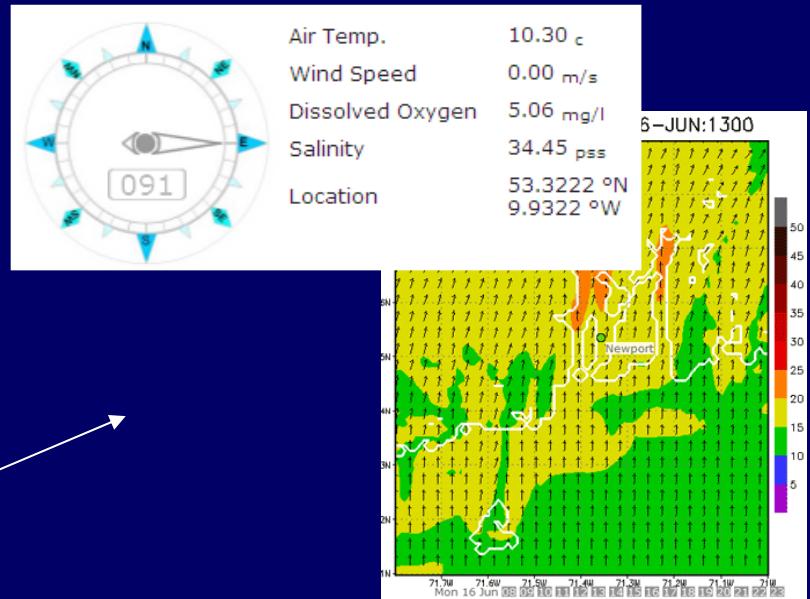
- AIS Minimum Keyboard Display (MKD) can only display text information.
- Some AIS binary messages already being displayed on:

ECDIS (in ECS mode of operation)

Integrated Navigation Systems (INS)

Portable Piloting Units (PPUs)

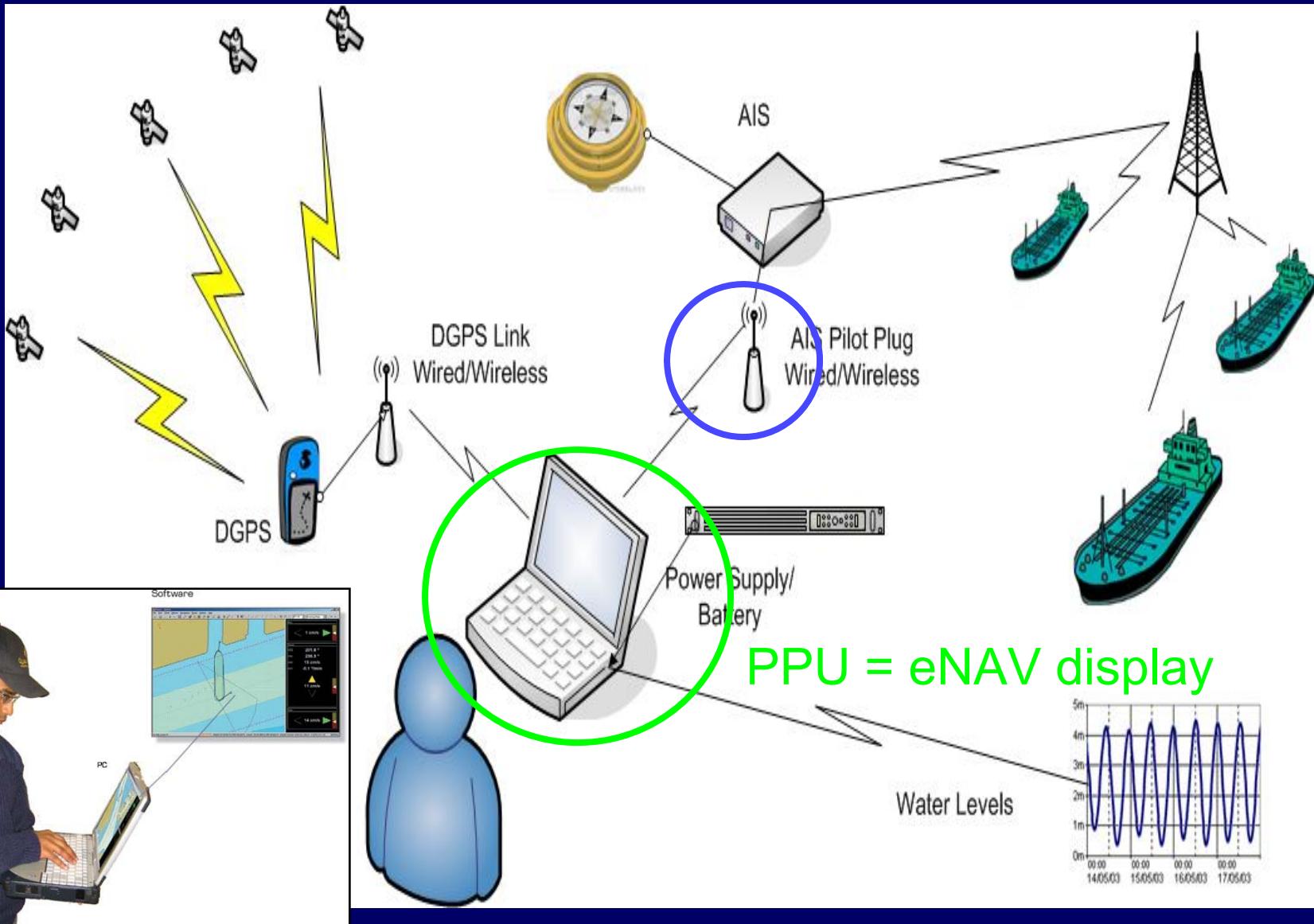
# AIS display limitations



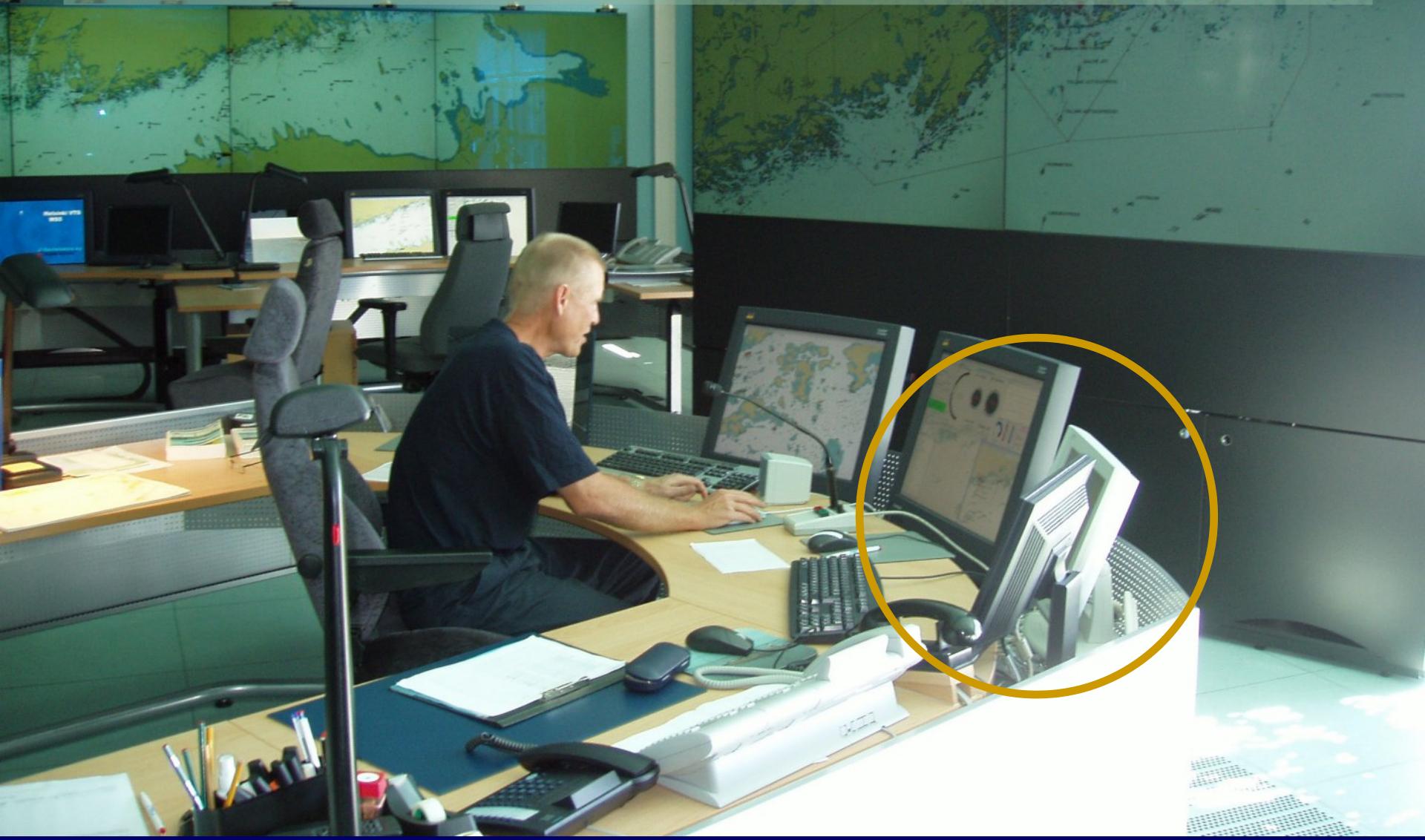
No effective way to display AIS ASMs for:

- Dangerous cargo indication, addressed
- Extended ship static and voyage related data, broadcast
- Area Notice, addressed or broadcast
- Route Information, addressed or broadcast
- Text Description, addressed or broadcast

# Portable Piloting Unit (PPU)



# Test facilities for information exchange at the Gulf of Finland Traffic Centre



# Notebook computer onboard MS *Silja Serenade*



Pilot plug

# Guiding Principles for Displaying AIS ASMs

1. *Use consistent symbology across all displays*
2. *Uniqueness – only one possible meaning*
3. *Non-ambiguous – ability to determine differences  
(i.e., distinct)*
4. *Intuitively obvious – an easily recognized symbol,  
icon or pattern*
5. *Have basic symbol for different categories. Further  
attributes should be enhancements (not changes)  
to the basic symbol.*

# Display Options for AIS Application Specific Messages



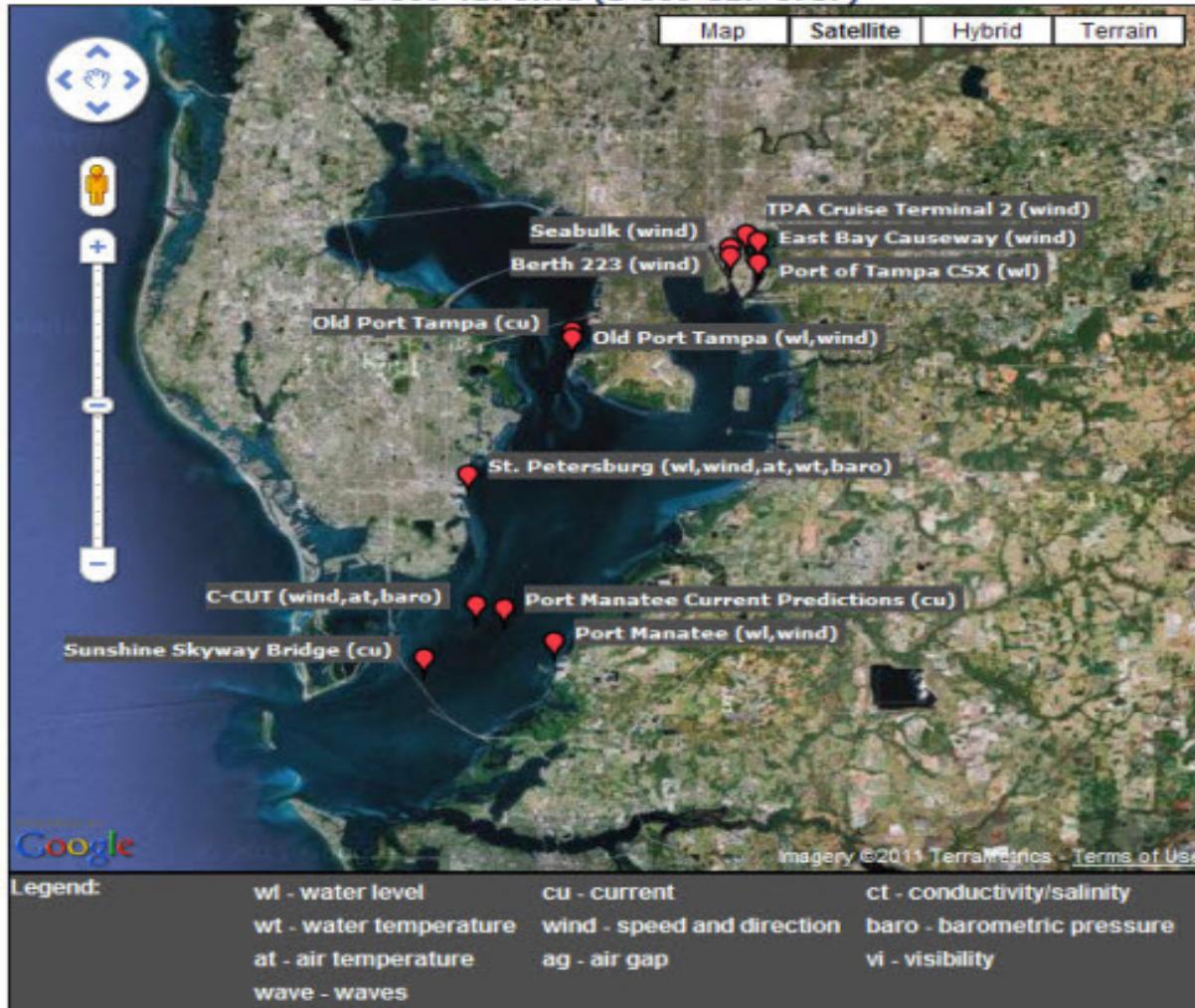
Application	Alpha-numeric (text & numbers)	Graphical (time-series graph)	Symbol (or icon)	Geo-spatial (Point, line, or area)
Meteorological and Hydrographic	X	X	X	X
Tidal window	X	X	X	X
Weather Report from Ships	X			
Area Notice - broadcast	X	X		X
Area Notice - addressed	X	X	X	
Environmental	X	X	X	X

Met/hydro applications in IMO SN.1/Circ.289

Display options from IMO SN.1/Circ.290

# Tampa Bay PORTS®

[Real Time Text Summary](#) New! [Click HERE for text-based PORTS® Screen](#)  
Voice data response system:  
**1-866-TBPORTS (1-866-827-6787)**



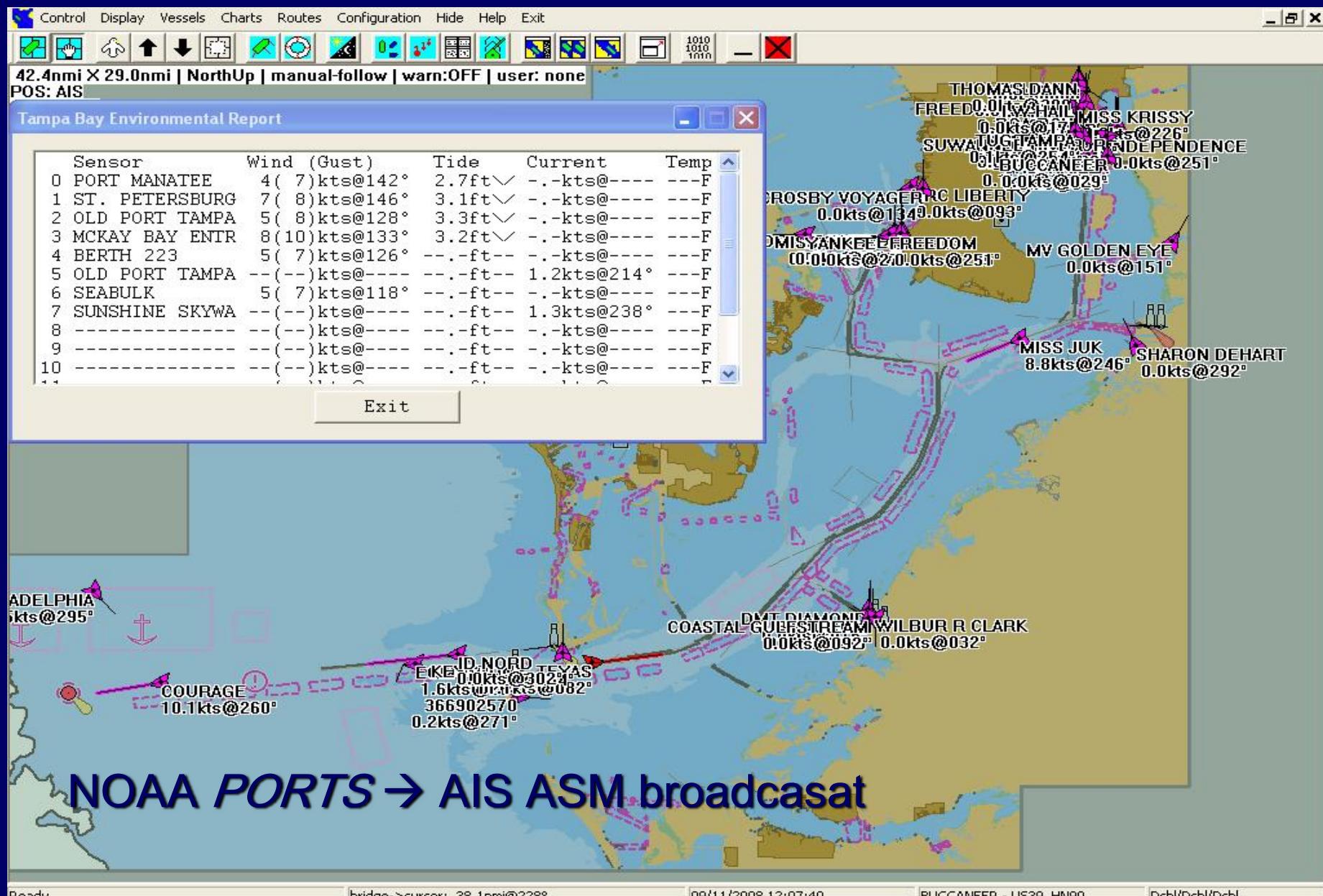
MyPORTS

[Create a custom PORTS® page!](#)

[Other real-time weather observations](#)

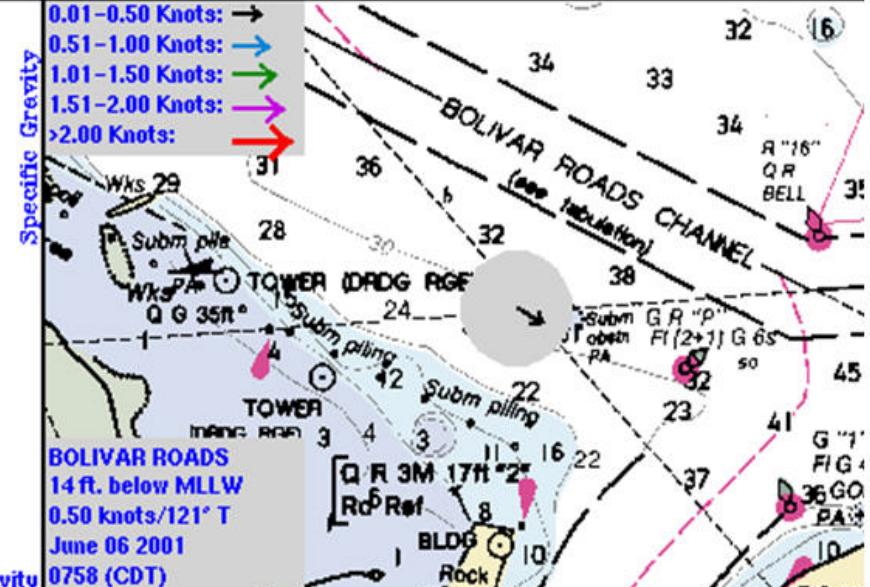
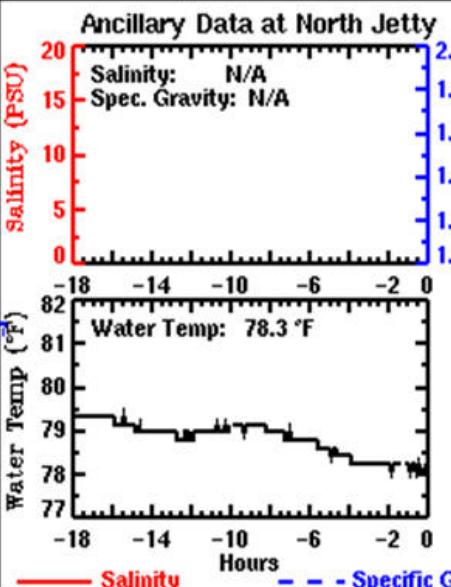
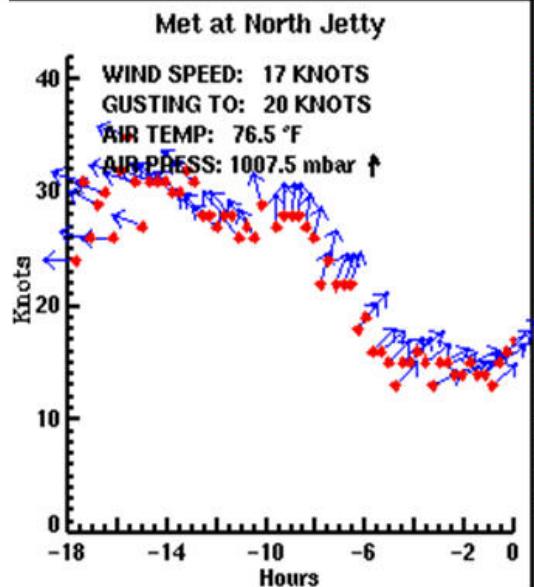
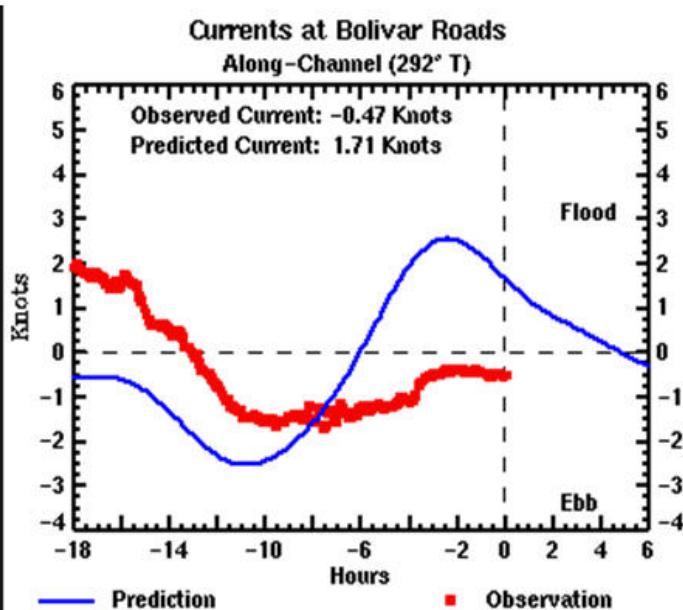
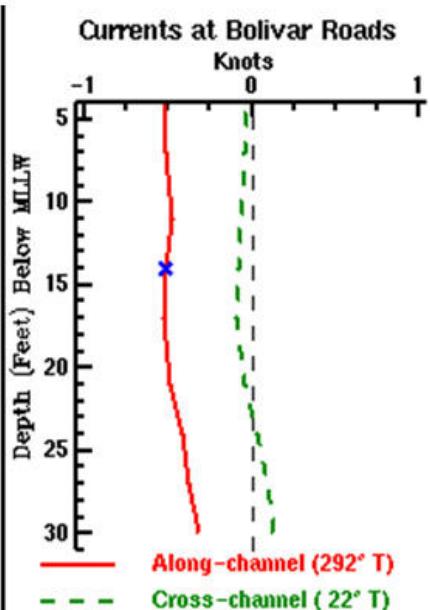
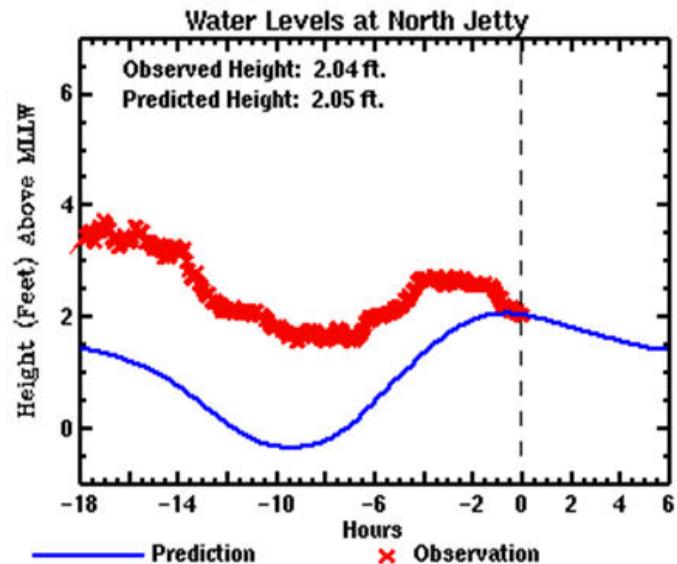
[NWS marine weather forecast](#)

# AIS ASM Broadcast Testbed – Tampa Bay



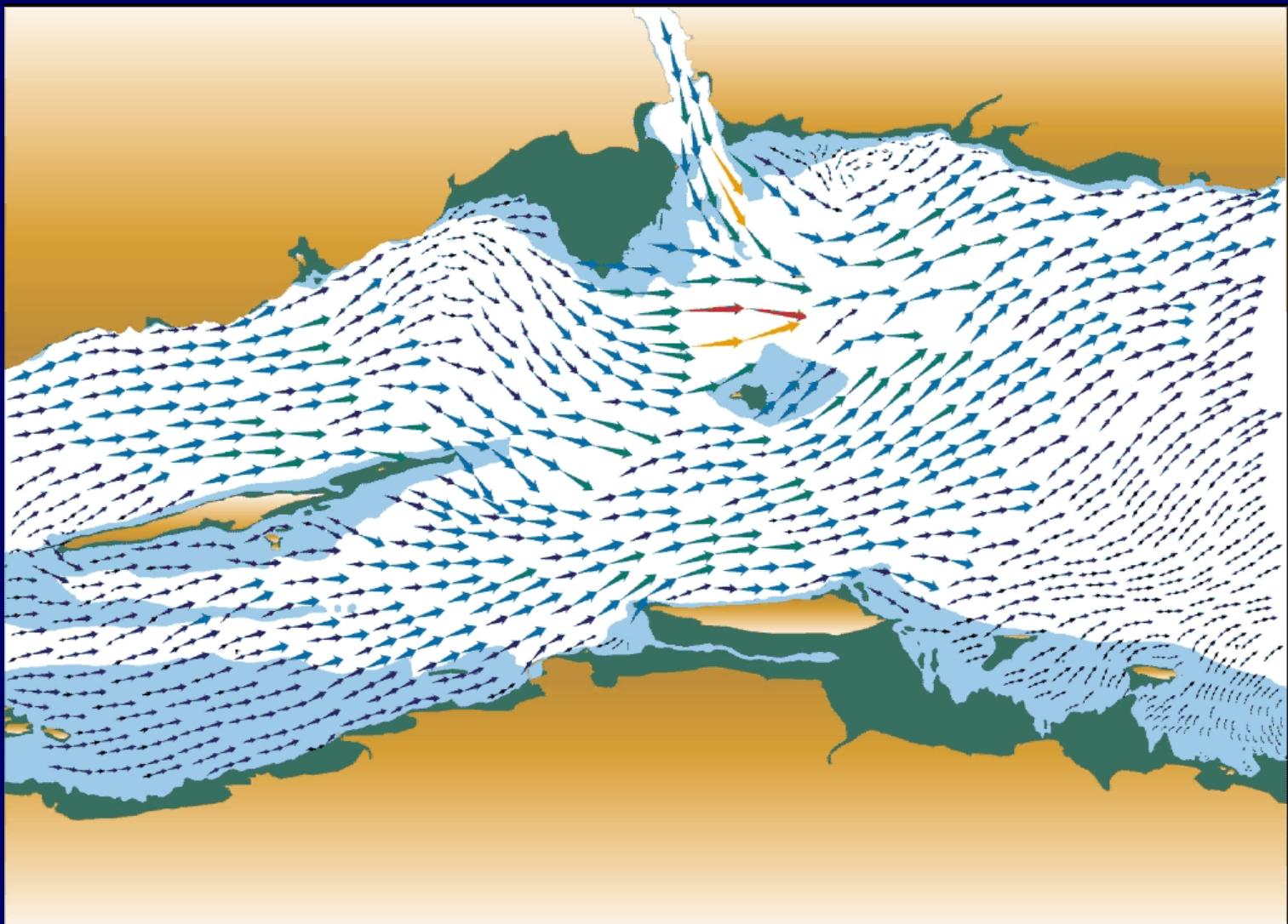
# Met/Hydro NOAA PORTS in Galveston, TX

Valid Time: 0754 (CDT) 06/06/01



# Tidal Currents in the St. Lawrence River, Canada

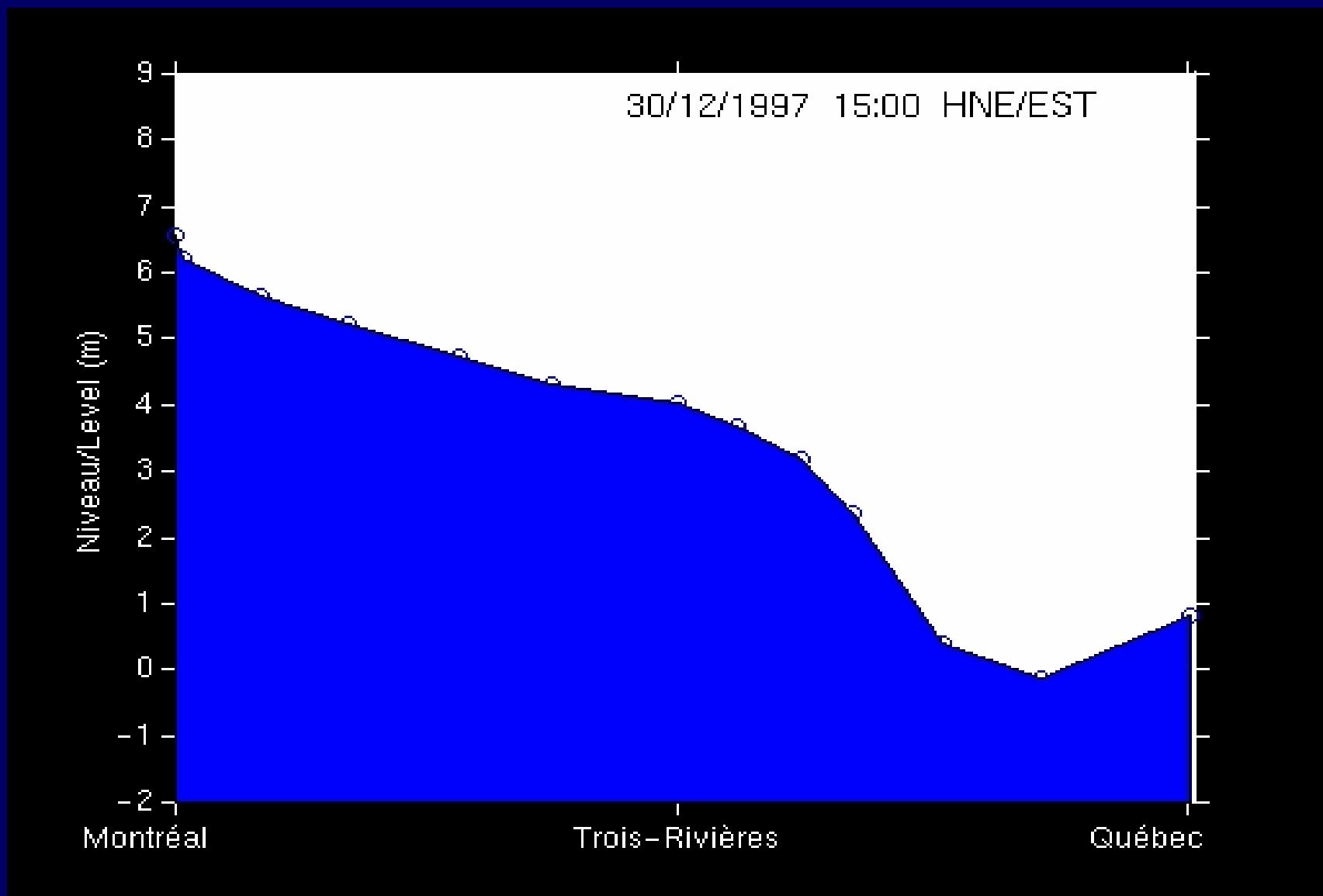
Predicted  
(current tables)  
Real-time (via  
AIS Broadcast)  
  
Forecast  
  
Nowcast



Source: *Atlas of Tidal Currents – St. Lawrence Estuary*, Department of Fisheries and Oceans, Canada

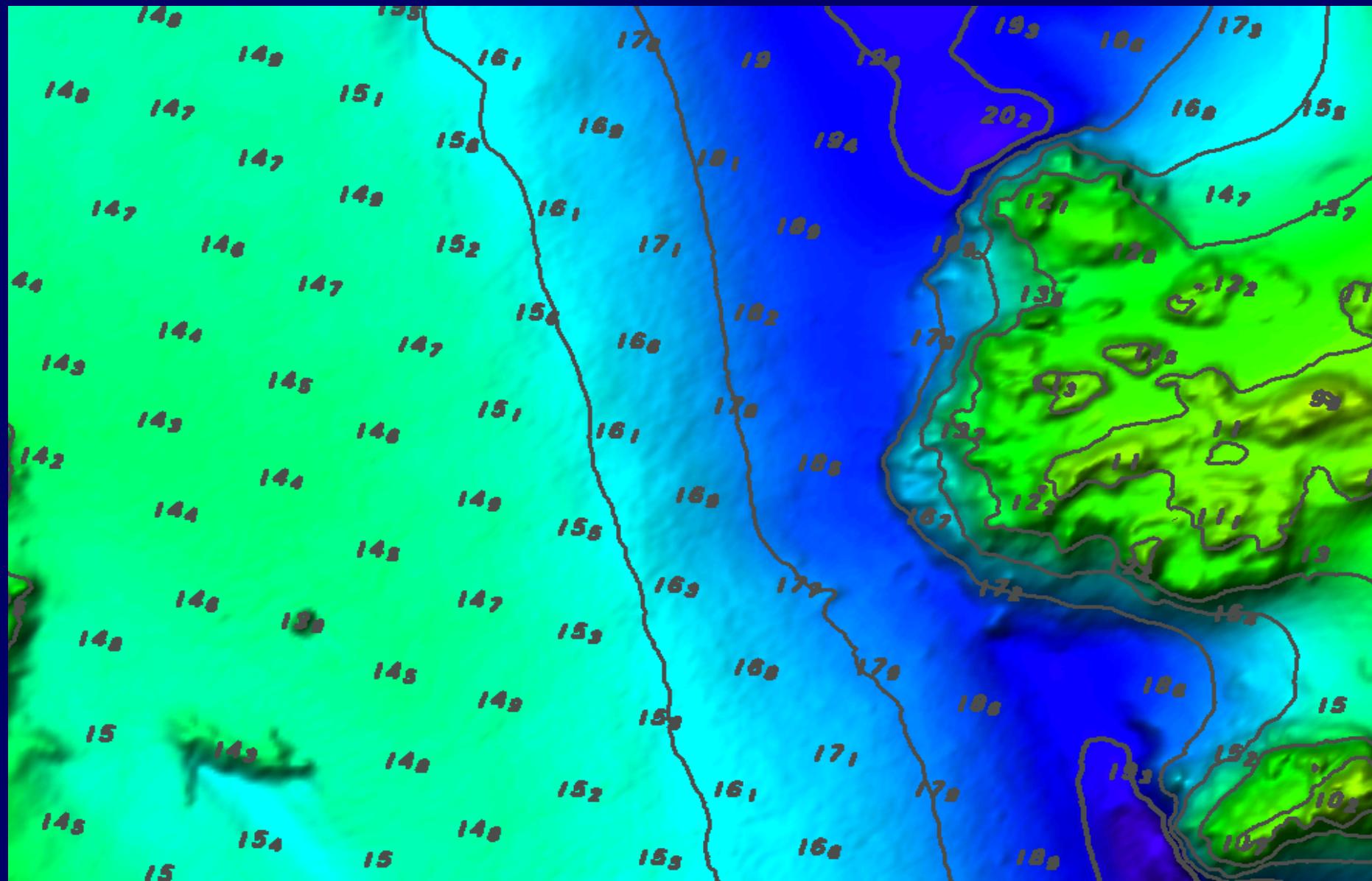
Simulation provided by: Canadian Hydrographic Service - Maurice Lamontagne Institute, Mont-Joli, Quebec

# Tide/Water Levels in St. Lawrence River, Canada

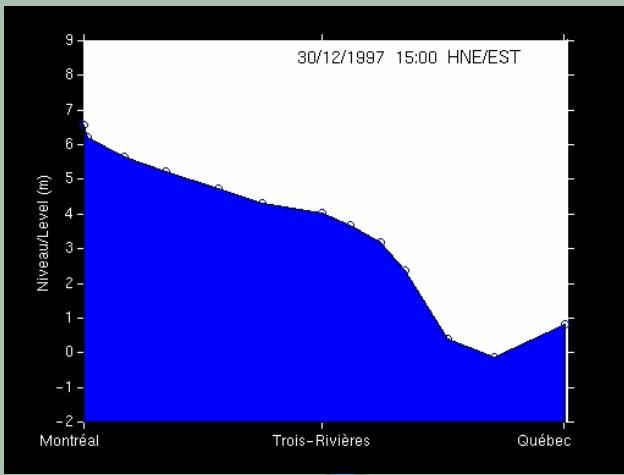


Source: Gilles Ringuette, Canadian Coast Guard, Quebec

# Decimeter Soundings and Depth Contours produced from a *Navigation Surface*



# Tide-Aware ENC



Approach to Portsmouth,  
New Hampshire, USA

# Relationship to IMO Standards

## IHO S-57, Ed. 3.1

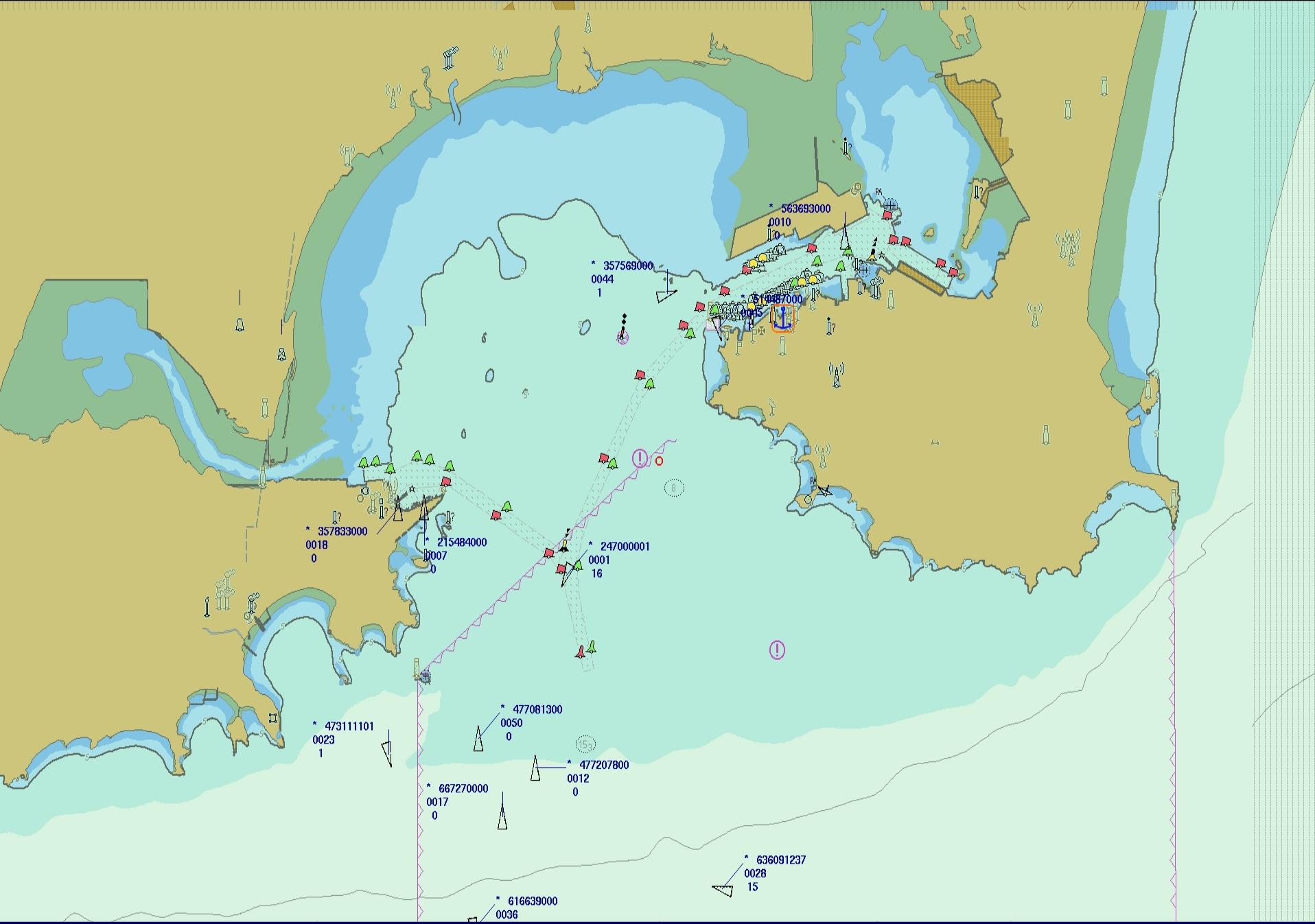
- ENCs for ECDIS
- Marine Information Overlays (MIOs) – both static and dynamic

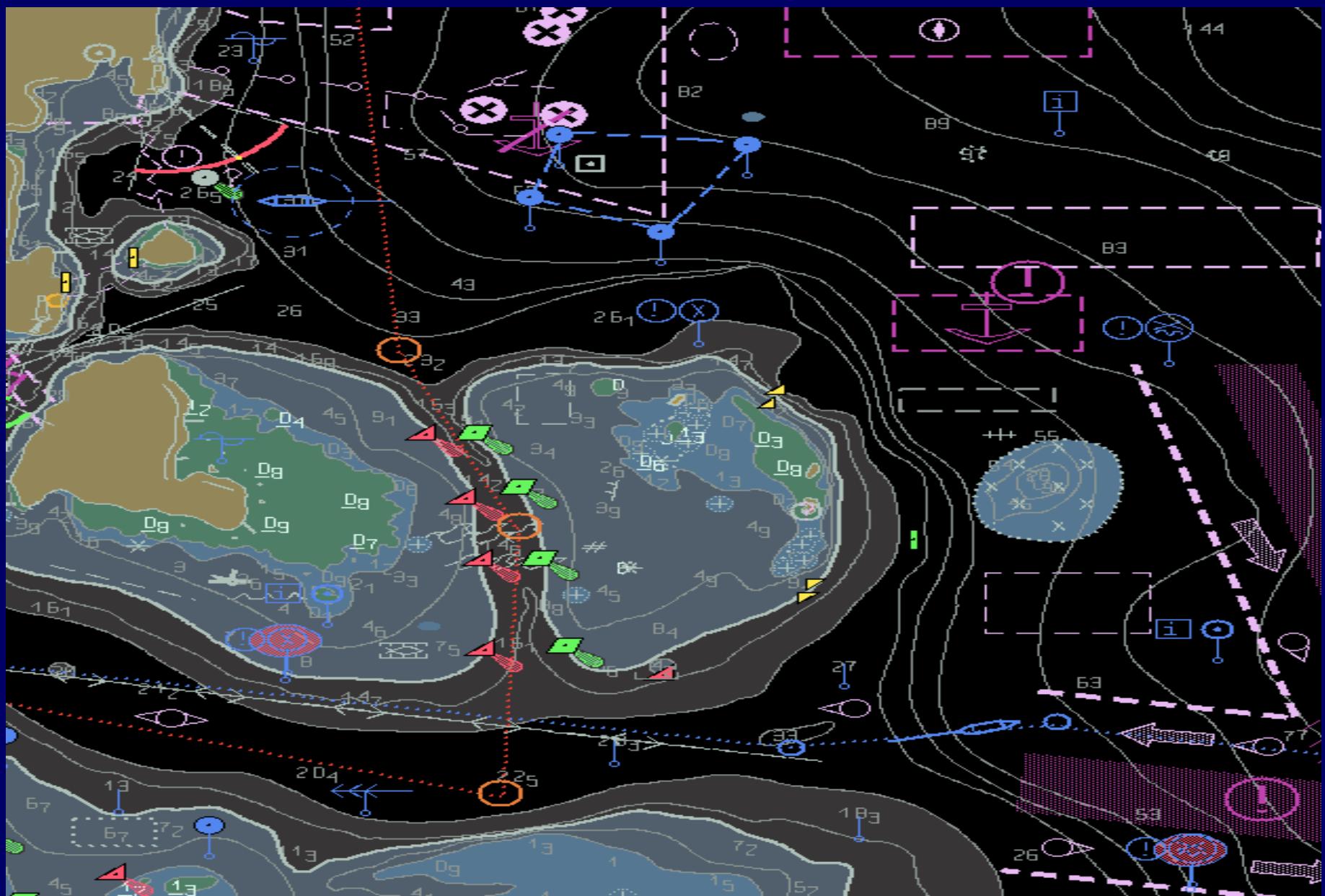
## IHO S-100

- S-101 “next generation” ENC for ECDIS
- new products and services

## IHO S-52

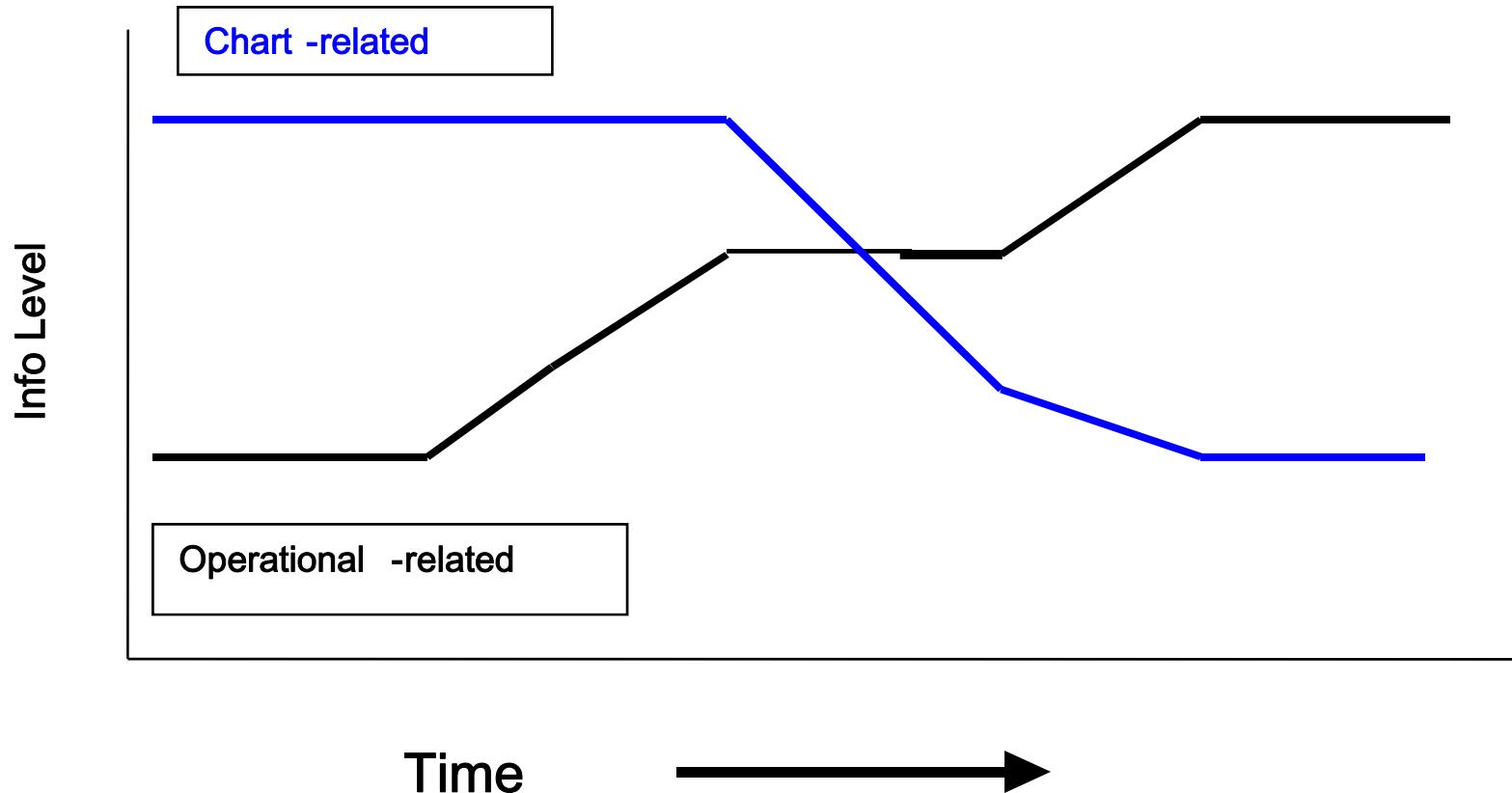
- Colours and Symbols for ECDIS



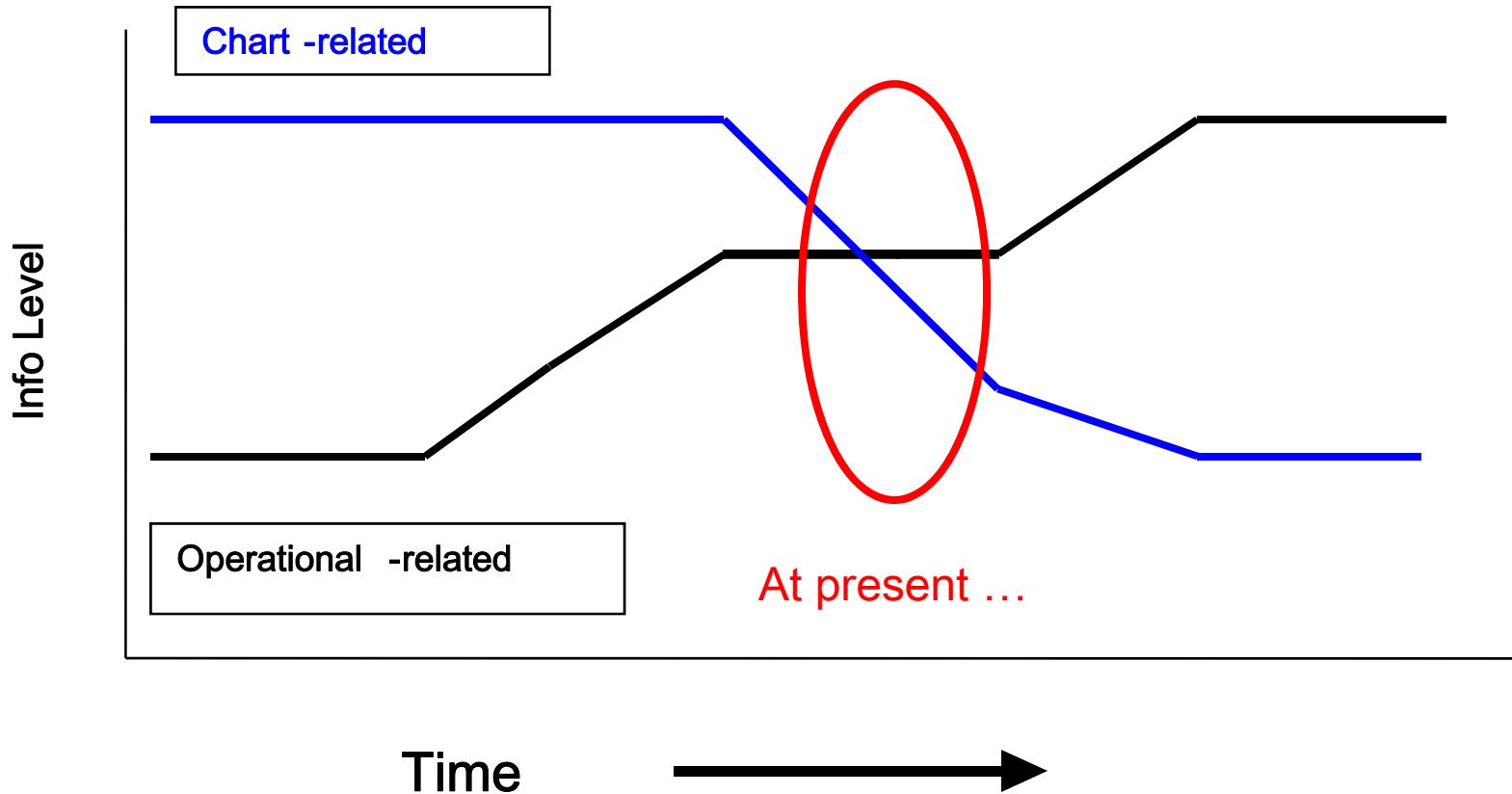


## IHO S-52 Colours and Symbols

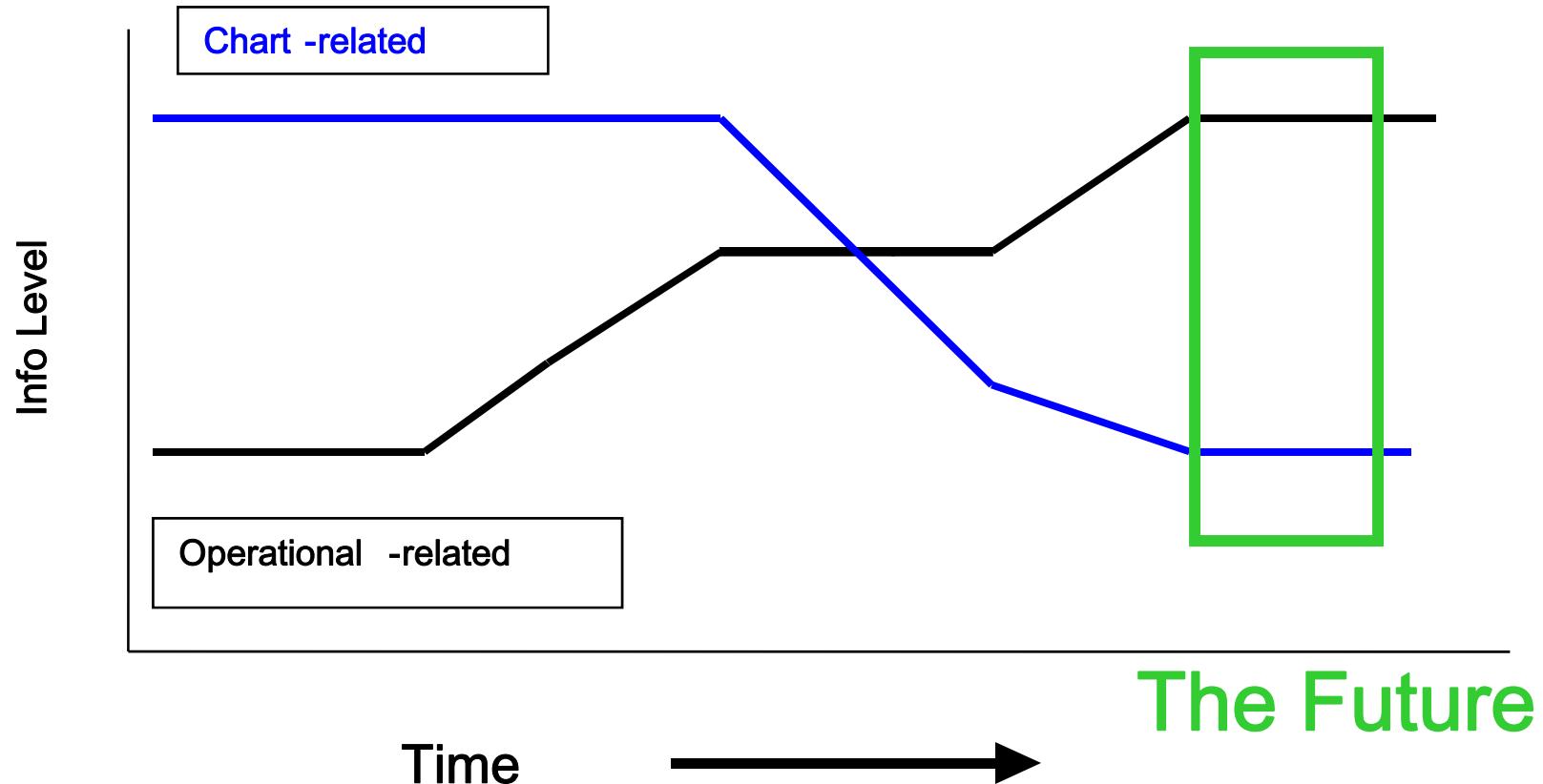
# Trend in Display of Navigation-related Information



# Trend in Display of Navigation-related Information



# Trend in Display of Navigation-related Information



# Recommendations

For IHO S-57 and S-100-related standards dealing with dynamic met/hydro information:

- Use the same data content fields and parameters that are defined in IMO SN.1/Circ.289.

For IHO S-52 Colours and Symbols for ECDIS:

- Consider how AIS ASMs will be displayed on ECDIS and other shipborne navigation systems (e.g., INS and PPUs).
- Follow the guidance provided IMO SN.1/Circ.290 regarding presentation/display.

# Looking Ahead...

## Challenges

- More organizational than technical.
- Different agencies have different ideas about:
  - What met/hydro information is important
  - How to provide it (Internet vs. AIS ASMs)
  - How it should be used, and for what purpose

## Challenge → Opportunity

- Better cooperation between intra- and inter-government agencies, as well as equipment manufacturers and maritime user groups.