Enabling Precision Marine Navigation in the U.S.

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Julia Powell

NOAA/National Ocean Service/ Office of Coast Survey

NOAA Navigation Services

What is precision marine navigation?

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

Why initiate the Precision Marine Navigation program?

To make critical decisions mariners use more than one device or system to get NOAA data:

- Portable Pilot Units
- Electronic Chart Systems
- Electronic Chart Display and Information Systems
- Cell phones

NOAA datasets are encoded in different data formats:
(none of these are navigation standards)

- NetCDF
- GRIB2
- SHEF
- GeoTIFF
- plain text

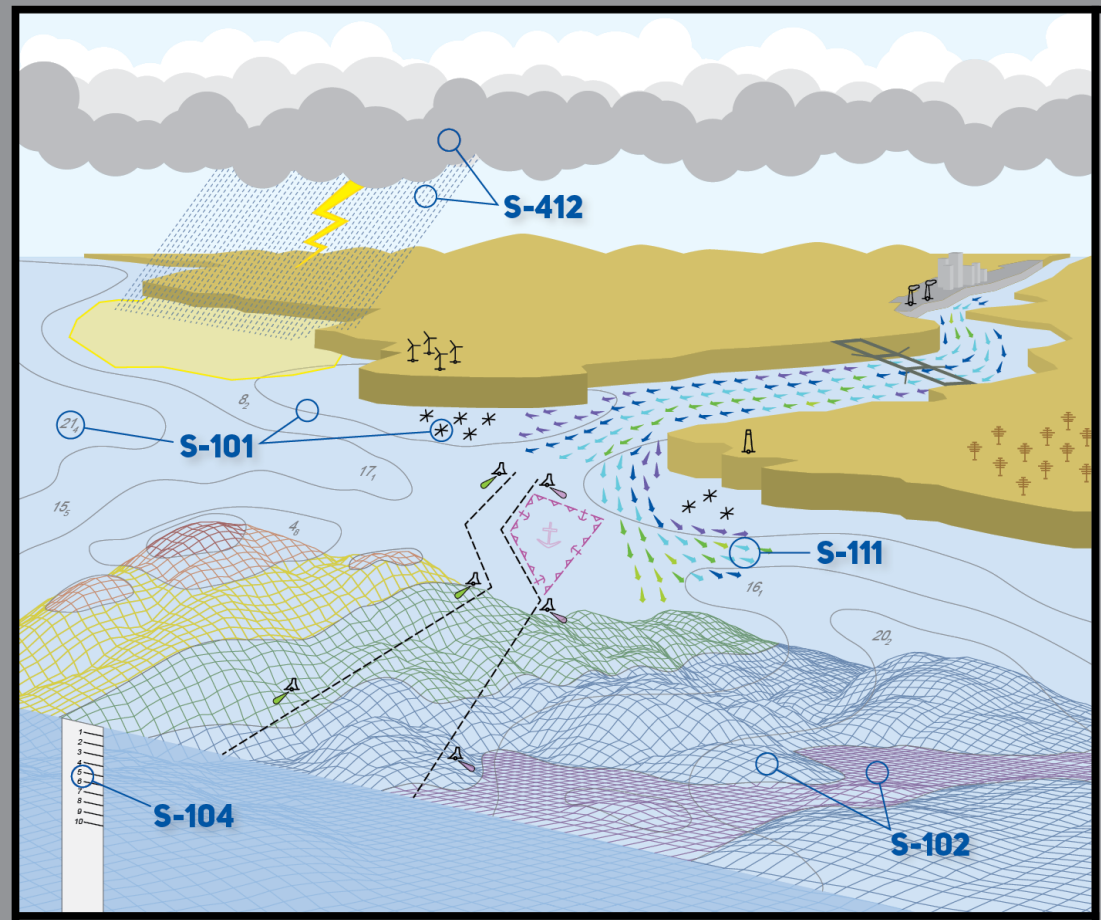
Navigation datasets are spread across various entities across Federal agencies

This presents challenges for navigation system manufacturers in acquiring & processing the NOAA data for distribution to their customers

SOLAS mandate –

- "ensure the greatest possible uniformity in charts and nautical publications and to take into account, whenever possible, relevant international resolutions and recommendations"
- "co-ordinate their activities to the greatest possible degree in order to ensure that hydrographic and nautical, information is made available on a world-wide scale as timely, reliably, and unambiguously as possible"

S-100 provides the framework for precision navigation



S-101
ELECTRONIC NAVIAGTIONAL CHART

S-102
BATHYMETRIC SURFACE

S-104
WATER LEVEL INFORMATION FOR SURFACE NAVIGATION

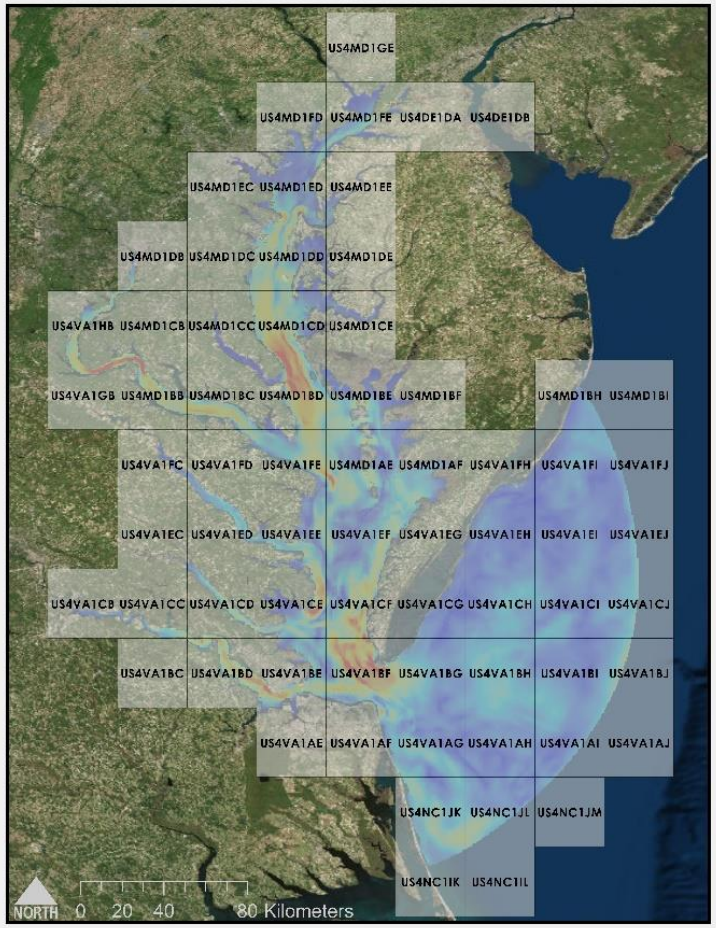
S-111
SURFACE CURRENTS

S-412
WEATHER OVERLAY

Prototype NOAA Data Processing & Dissemination System

- **Functioning prototype system running on the Cloud**
  - Automatically generates tiles of NOAA 3-day forecasts of S-111 Surface Water Currents (4 times/day)
  - Publically available via the NOAA Big Data Project for free
    - Initial Operating Capability for early adopters
  - Provides sample OFS forecast guidance data optimized for web mapping services

- **Map viewer for users to discover/visualize/download Surface Water Currents Guidance & Bathymetric Surface Overlay Tiles**

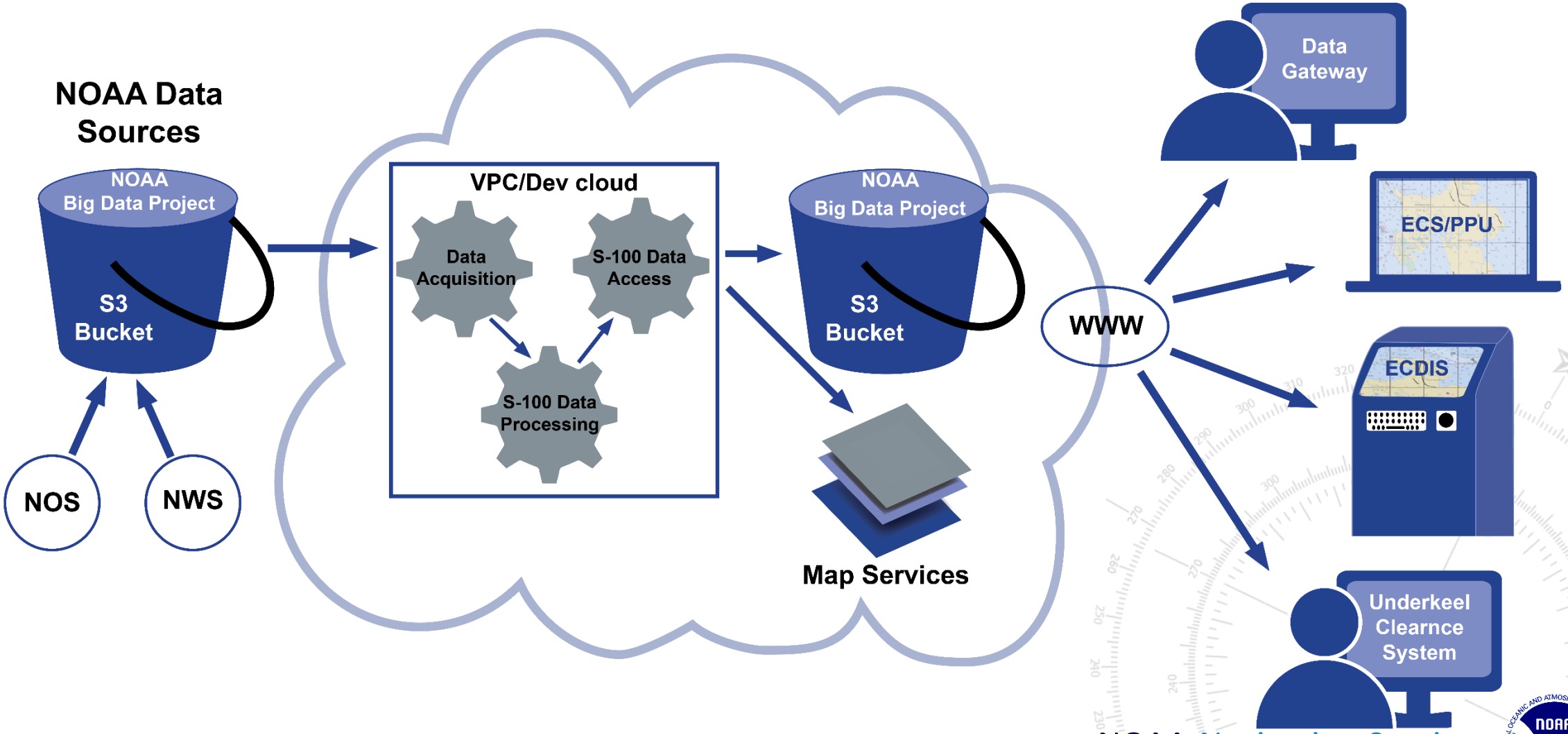


NOS Chesapeake Bay Operational Forecast System (CBOFS) BAND4 Tiles

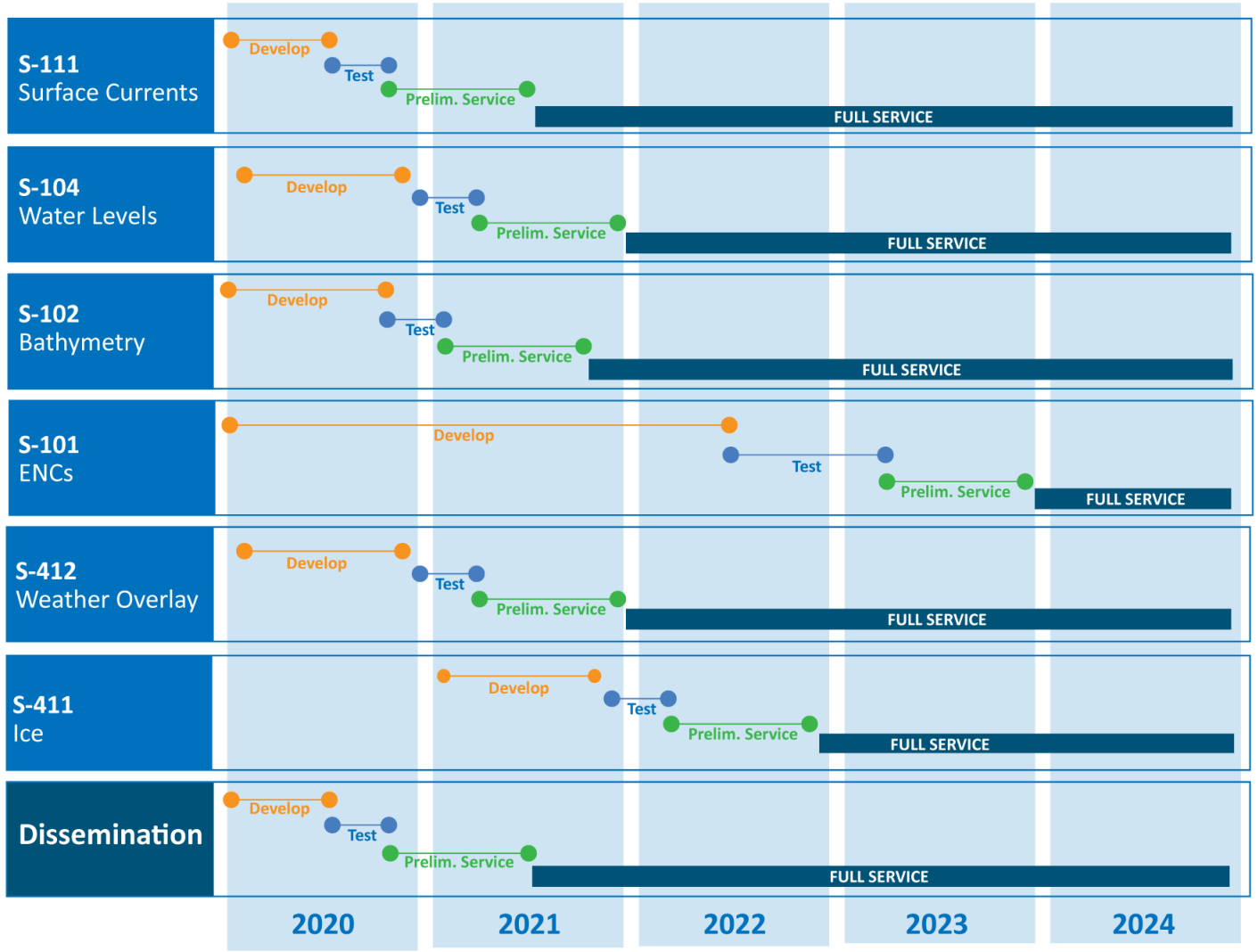
(access restricted to NOS IP Address Range)

NOAA Navigation Services

High-Level Schematic of Prototype on AWS



Notional Product Rollout

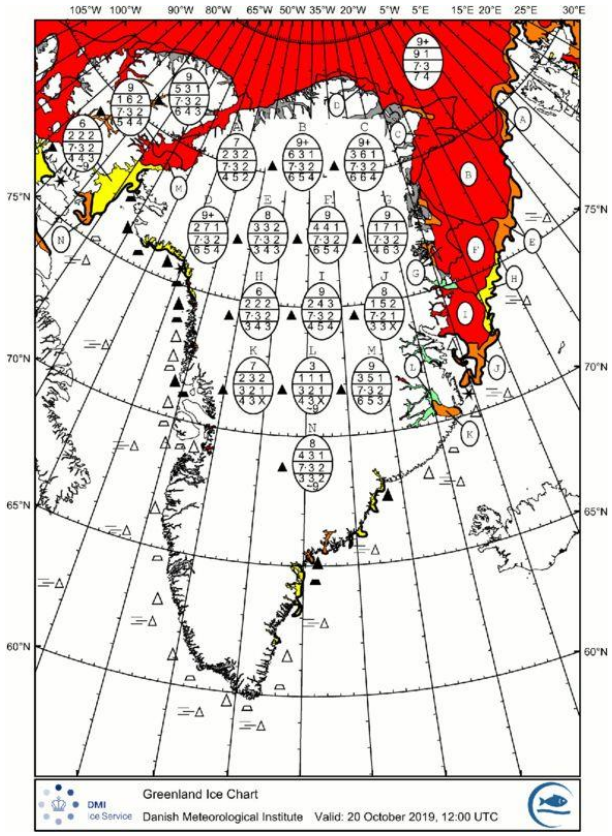


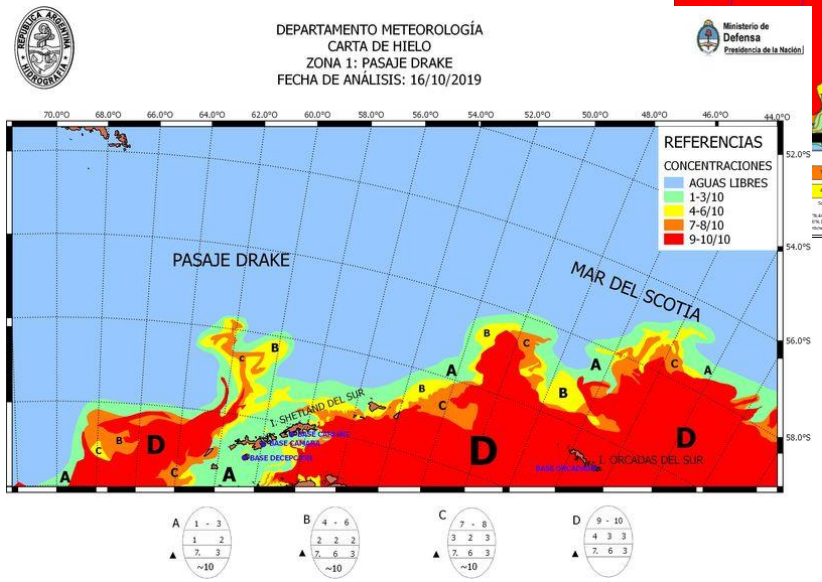
Summary

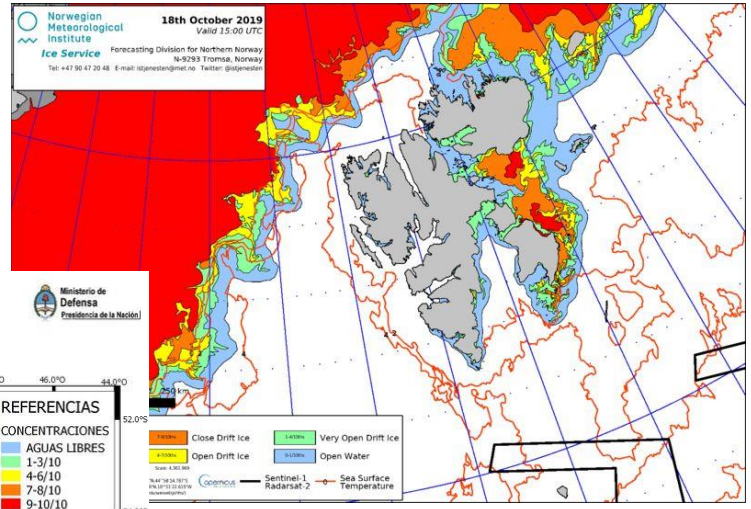
- Leverages the S-100 Framework for the next generation of products
- Not just for high traffic ports
- Continuous engagement with stakeholders is the key to success

S411 Ice in ECDIS

S-411 is primarily intended for encoding the extent and nature of Sea Ice for navigational purpose.





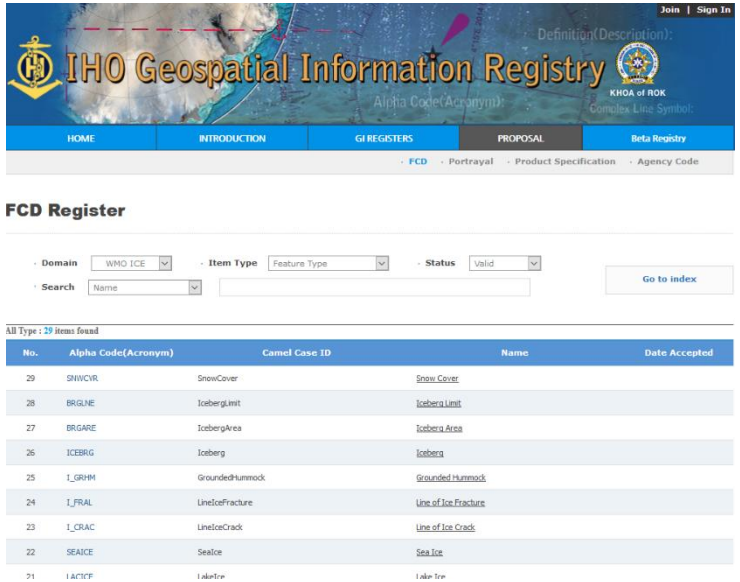


Some examples of paper/pdf charts

History of S-411

S-411 is primarily intended for encoding the extent and nature of Sea Ice for navigational purpose.

June 2014: S-411 Ice Information Product Specification approved, based on S-100 Ver. 1.0



JCOMM
Expert Team on Sea Ice

Electronic Chart Systems
Ice Objects Catalogue
Version 5.1

DRAFT FOR APPROAVAL

February 2012

Proposed Secretarial Amendments

Prepared by:

John Falkingham, ENC Ice Objects Task Group Leader

Vasily Smolyanitsky, ETSI Chair

INTERNATIONAL HYDROGRAPHIC ORGANIZATION

JCOMM

Ice Information Product Specification

Edition 1.1.0, June 2014

Special Publication JCOMM S-411

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E-mail: info@ihb.mc
Web: www.iho.int

The application schema contains 28 feature types (points, line strings, polygons) with their attributes and enumerations

History of S-411

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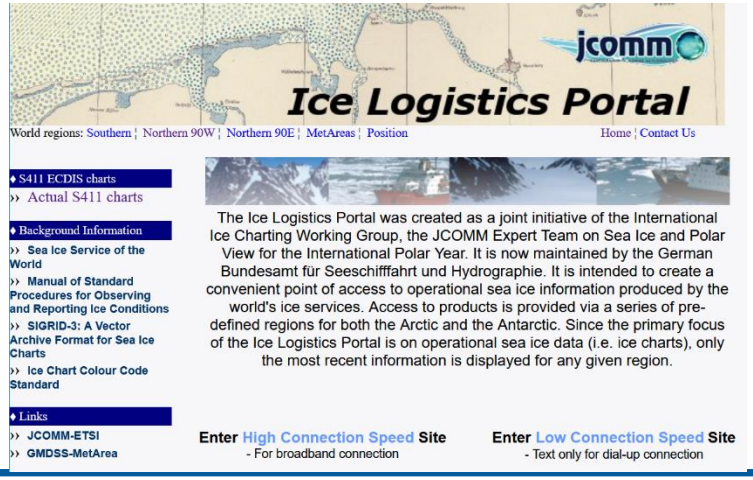
December 2015: most operational ice charts available in S-411



Snapshot date 4.8.2020

http://www.bsis-ice.de/IcePortal/
Also available via ftp at ftp.bsh.de/outgoing/m12/S411/

History of S-411

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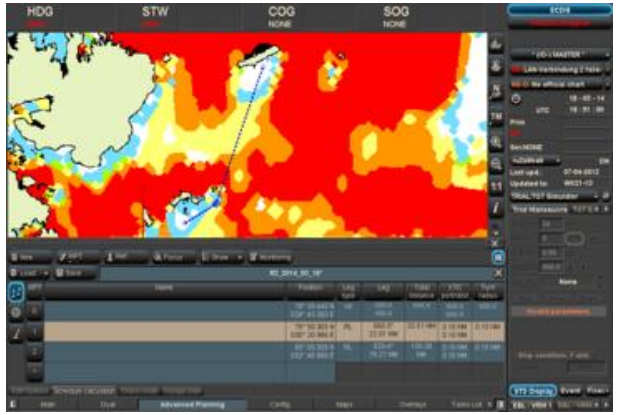
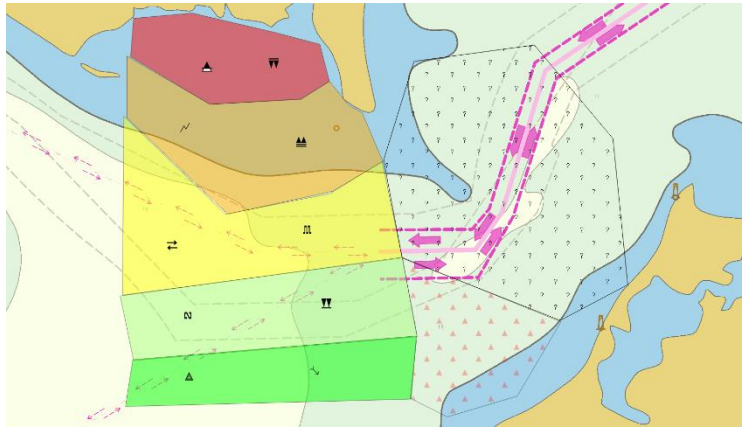
December 2015: most operational ice charts available in S-411

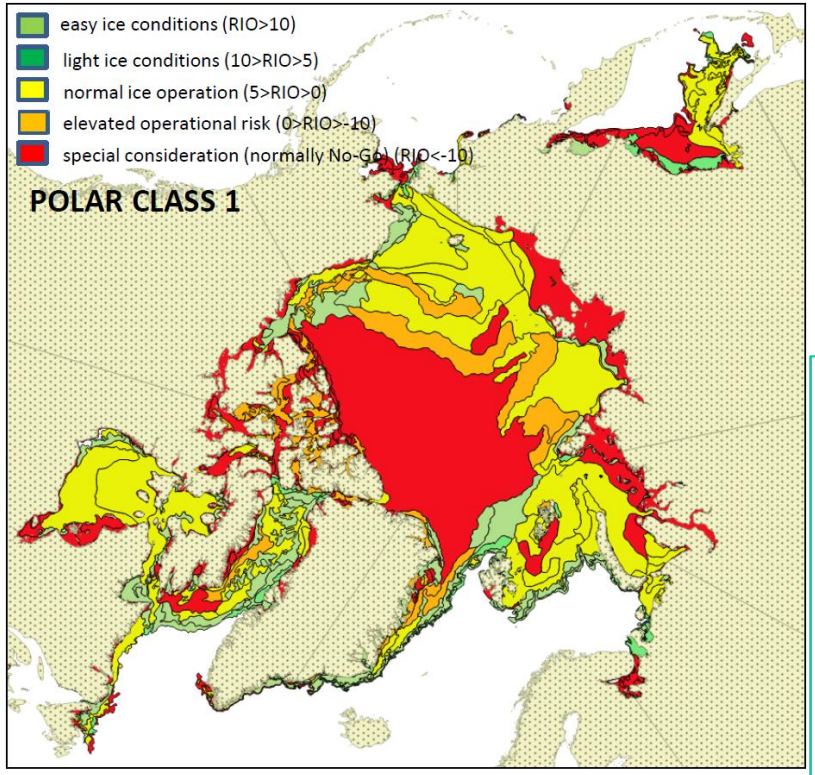
2020: still no S-411 capable ECDIS available (although test systems exist)

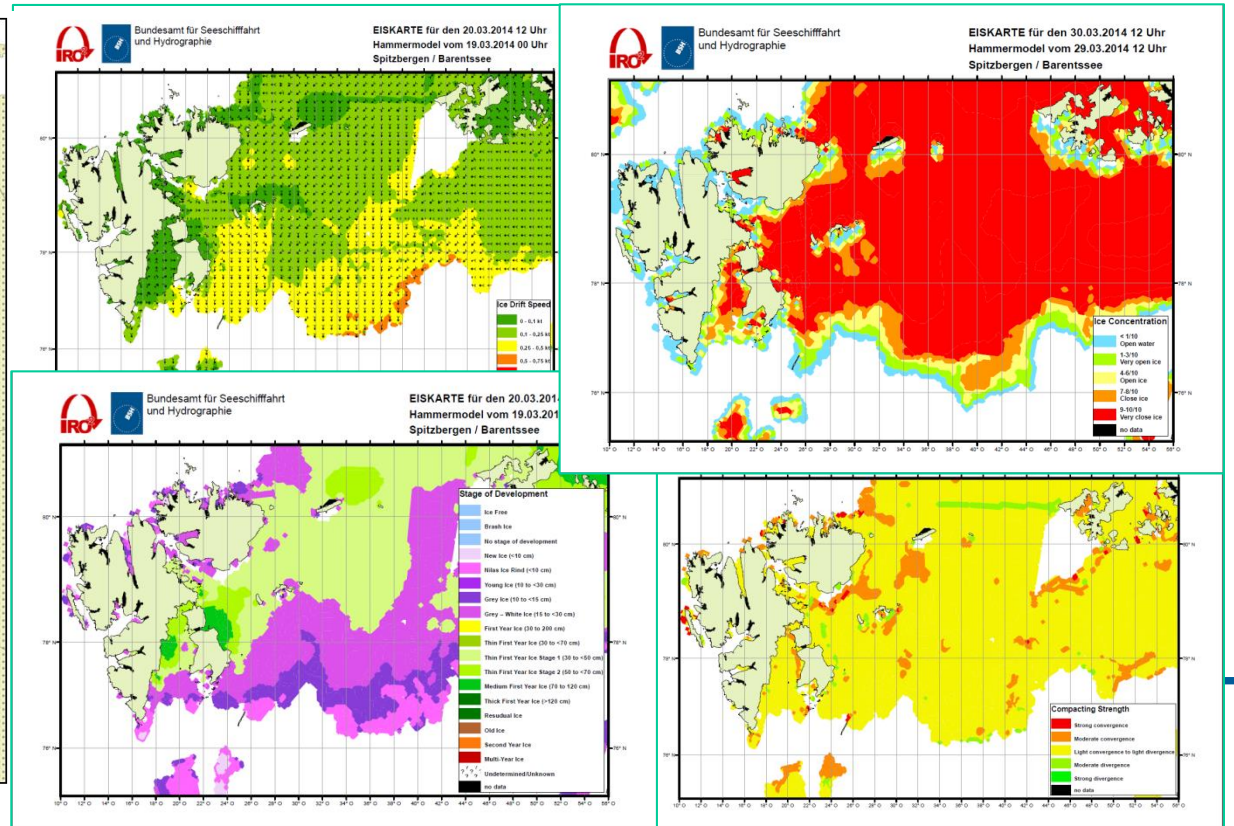




Portrayal

The portrayal specification is based on Styled Layer Descriptors (SLD), follows OGC standards and supports 3 polygon portrayals, one according to the vessels ice capabilities, the second and third one being the WMO ice concentration/stages of development colour codes.

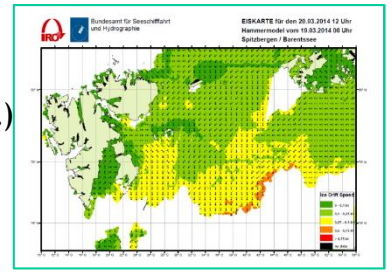




Future ice products (also in S-411)

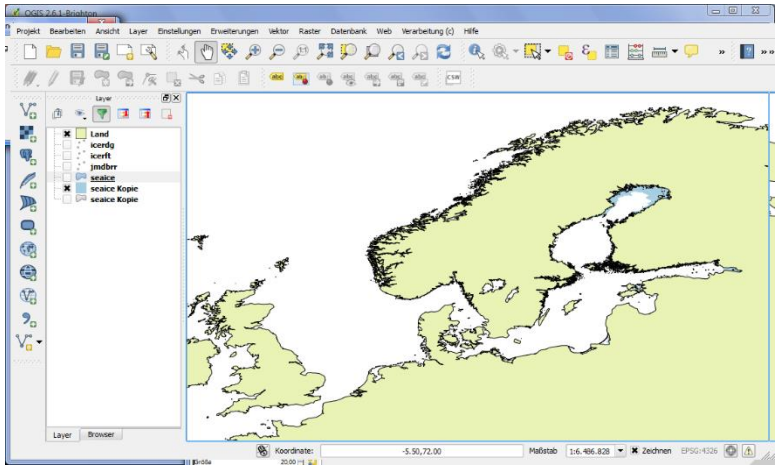
A) Sea ice forecasts

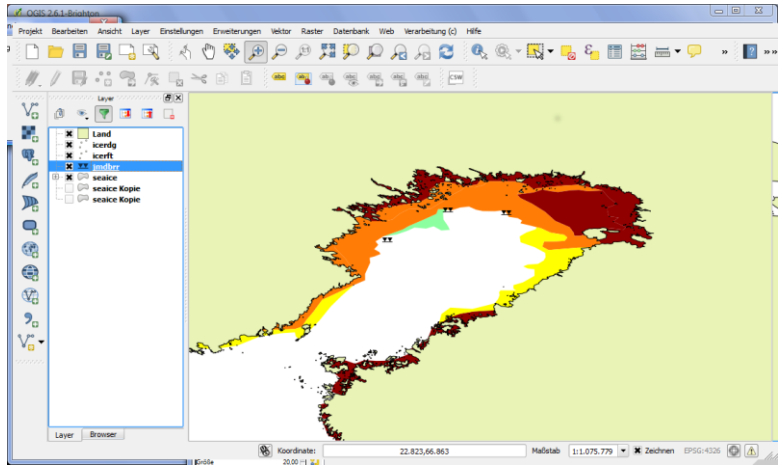
Needs better models (operational with data assimilation, improved ice representation,…)
S411 charts for times in the future are already possible (but needs refinement)



B) Large scale maps

Already possible on demand, but not operational
Needs reliable automatic SAR classification or lots of working power or large scale numerical models
S-411: Large scale maps -> automatic generalization -> small scale maps





Same S-411 chart shown at different scales

S-41X - Weather Overlays for Electronic Navigation Systems

Joe Sienkiewicz

Chief, Ocean Applications Branch

NOAA Ocean Prediction Center

11-13 Aug Jul 2020

Present Day Services

Hazardous Winds & Seas Warning Bulletins*

FZNT01 KWBC 092217 HSFAT1

HIGH SEAS FORECAST FOR METAREA IV
NWS OCEAN PREDICTION CENTER WASHINGTON DC
2230 UTC MON JAN 09 2020

CCODE/1:31:04:01:00/AOW/NWS/CCODE
SUPERSEDED BY NEXT ISSUANCE IN **6 HOURS**

SEAS GIVEN AS SIGNIFICANT WAVE HEIGHT...WHICH IS THE AVERAGE HEIGHT OF THE HIGHEST 1/3 OF THE WAVES. INDIVIDUAL WAVES MAY BE MORE THAN TWICE THE SIGNIFICANT WAVE HEIGHT. ONLY YOU KNOW THE WEATHER AT YOUR POSITION. REPORT IT TO THE NATIONAL WEATHER SERVICE. EMAIL US AT VOSOPS@NOAA.GOV(LOWERCASE).

NORTH ATLANTIC NORTH OF 31N TO 67N AND WEST OF 35W
SYNOPSIS VALID 1800 UTC JAN 09
24 HOUR FORECAST VALID 1800 UTC JAN 10
48 HOUR FORECAST VALID 1800 UTC JAN 11

.WARNINGS.
...HURRICANE FORCE WIND WARNING...
.LOW 59N41W 986 MB MOVING NE 15 KT. OVER FORECAST WATERS WITHIN 120 NM W SEMICIRCLE WINDS 50 TO 65 KT. SEAS 11 TO 18 FT. ELSEWHERE WITHIN 240 NM S QUADRANT WINDS 40 TO 50 KT. SEAS 14 TO 21 FT. ALSO WITHIN 420 NM NE QUADRANT AND WITHIN 480 NM NW OF A LINE FROM 54N35W TO 49N53W WINDS 25 TO 40 KT. SEAS 10 TO 18 FT. .24 HOUR FORECAST LOW 62N34W 989 MB. WITHIN 300 NM SE AND 240 NM NE QUADRANTS WINDS 50 TO 65 KT. SEAS 16 TO 28 FT. ELSEWHERE WITHIN 480 NM N OF A LINE FROM 53N53W TO 53N35W WINDS 40 TO 50 KT. SEAS 17 TO 30 FT. ALSO FROM 49N TO 63N BETWEEN 60W AND 35W WINDS 25 TO 40 KT. SEAS 8 TO 17 FT.
.48 HOUR FORECAST LOW E OF AREA. FROM 54N TO 61N E OF 45W WINDS 40 TO 50 KT. SEAS 14 TO 17 FT. ELSEWHERE WITHIN 540 NM N OF A LINE FROM 52N52W TO 52N35W WINDS 25 TO 40 KT. SEAS 10 TO 20 FT. ALSO N OF 51N E OF 50W WINDS 20 TO 30 KT. SEAS 8 TO 16 FT.

...STORM WARNING...
.LOW 59N53W 994 MB MOVING E 10 KT. WITHIN 180 NM SW SEMICIRCLE WINDS 35 TO 45 KT. SEAS 10 TO 17 FT. ELSEWHERE WITHIN 240 NM W SEMICIRCLE AND 240 NM S QUADRANT WINDS 25 TO 35 KT. SEAS 8 TO 14 FT.

.24 HOUR FORECAST LOW ABSORBED AND CONDITIONS DESCRIBED ABOVE WITH LOW 62N34W.

...GALE WARNING...
.COMPLEX LOW WITH FIRST CENTER 47N45W 1013 MB MOVING NE 45 KT AND SECOND CENTER 44N49W 1012 MB MOVING NE 30 KT. FRONT EXTENDS FROM 52N35W TO FIRST CENTER TO 31N57W. WITHIN 300 NM E AND SE OF THE FRONT AND WITHIN 540 NM SW QUADF FT.
ALSO FROM 31N TO 47N BETWEEN 72W ANI
COMBINED LOW ABSORBED E OF AREA. FR 00
NM NW OF THE FRONT WINDS 35 TO 45 KT.
WINDS 25 TO 35 KT. SEAS 8 TO 16 FT.
.48 HOUR FORECAST FRONT TO EXTEND FF F
THE FRONT WINDS 25 TO 35 KT. SEAS 10 TC
WINDS 20 TO 30 KT. SEAS 8 TO 13 FT.

...GALE WARNING...
.36 HOUR FORECAST OVER FORECAST WA
WINDS 25 TO 40 KT. SEAS 8 TO 13 FT..48 HC S
25 TO 40 KT. SEAS 8 TO 14 FT.

...HEAVY FREEZING SPRAY WARNING...
.MODERATE TO HEAVY FREEZING SPRAY OVER FORECAST WATERS N OF 43N W OF 55W...AND W AND NW OF A LINE FROM 49N53W TO 55N51W TO 63N57W TO 66N53W.
.24 HOUR FORECAST MODERATE TO HEAVY FREEZING SPRAY W AND NW OF A LINE FROM 52N49W TO 66N53W.
.48 HOUR FORECAST MODERATE TO HEAVY FREEZING SPRAY W AND NW OF A LINE FROM 58N58W TO 63N50W.

.SYNOPSIS AND FORECAST.

.OVER FORECAST WATERS SE AND E OF A LINE FROM 31N46W TO 37N35W WINDS 20 TO 30 KT. SEAS 8 TO 14 FT.
.24 HOUR FORECAST FROM 31N TO 39N E OF 46W WIND
.48 HOUR FORECAST WITHIN 600 NM NE OF A LINE FRO S TO 11 FT.

.DENSE FOG. VSBY OCCASIONALLY LESS THAN 1 NM O 44W...AND FROM 48N TO 53N E OF 38W.
.24 HOUR FORECAST CONDITIONS IMPROVED.

.HIGH 44N69W 1039 MB MOVING E 20 KT.
.24 HOUR FORECAST HIGH 45N57W 1046 MB.
.48 HOUR FORECAST HIGH 49N47W 1043 MB.
.HIGH 36N78W 1042 MB NEARLY STATIONARY.
.24 HOUR FORECAST LITTLE CHANGE.
.48 HOUR FORECAST HIGH 37N64W 1033 MB.

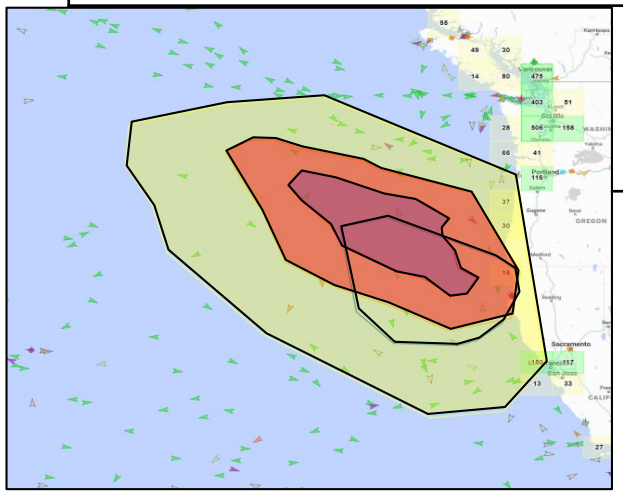
.FORECASTER CLINE OCEAN PREDICTION CENTER.

S-41X Weather Overlays

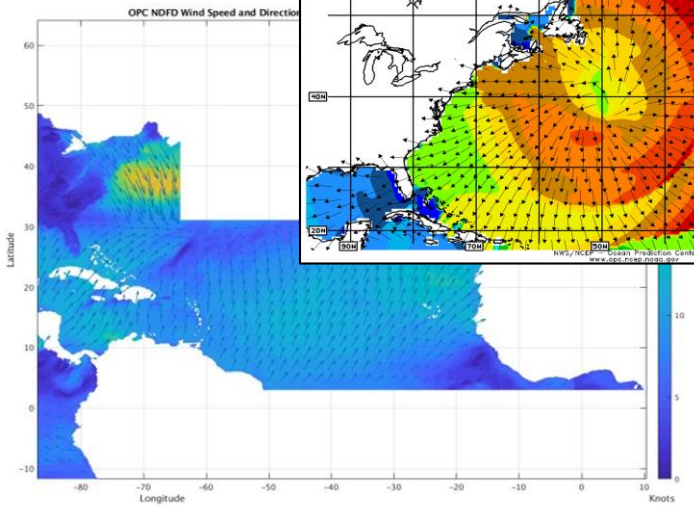
S-412	S-413	S-414
Wave and Weather Hazards	Wave and Weather Conditions (features e.g. fronts)	Wave and Weather Observations

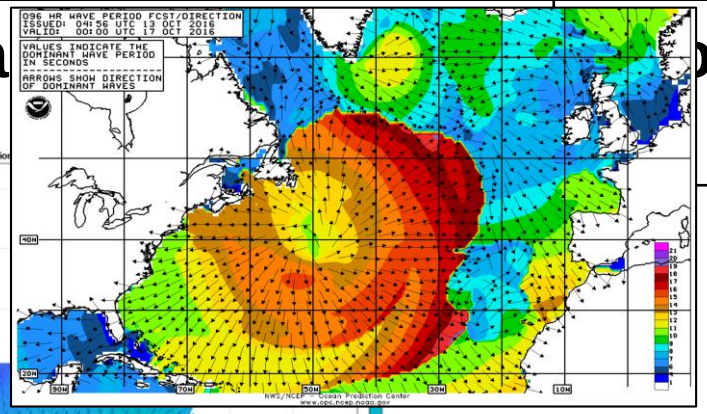
Separation Approved May 2019

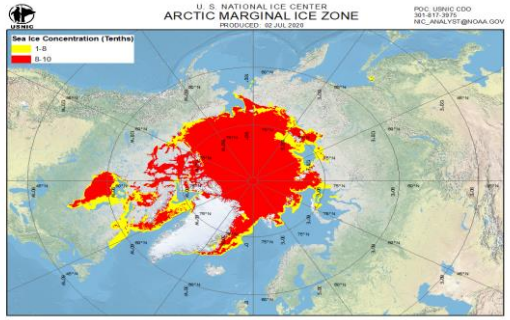
Gra **oin**



Warnings, Seas 30 ft, greater







S-411

Future Considerations

- Opportunities
  - Streamline and standardize outputs on a global level
  - Integrated information into ECS & other applications
- Challenges
  - Technology
    - METAREA providers
    - Collaboration
  - Dissemination
  - Implementation
    - Training