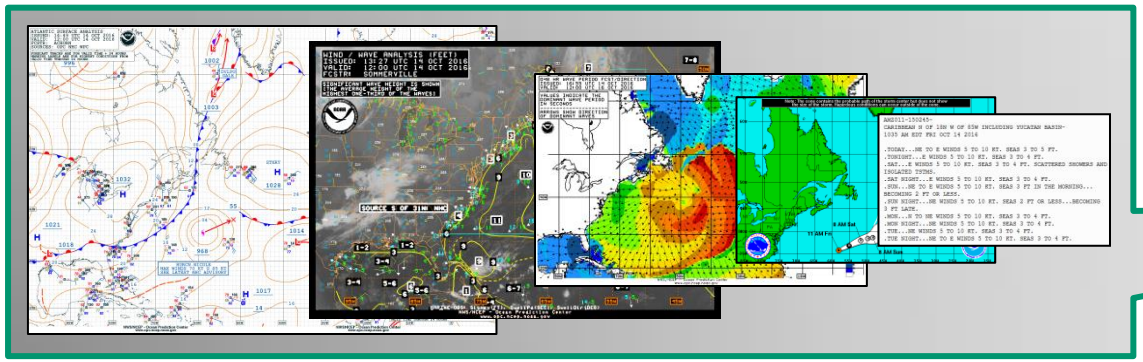
S-412
A Weather Overlay Product Specification

LT Joseph Phillips, NOAA Commissioned Corps
Technical Operations Coordination Meteorologist
National Weather Service - Ocean Prediction Center
5830 University Research Court, W/NP42, Room 4637
(301) 683-1555



S-412 Weather Overlay: Needed Components

Main	•Specifies what is needed to build a complete product •Feature Types •Geometry •Data formats and file size •Metadata
Feature Catalogue	•Features •Attributes •Enumerants •Bindings •Point, Curve or Surface
Portrayal Catalogue	•Symbols, Line Styles and Area Fills •Rule for how the feature attribute combination must be portrayed
Data Classification and Encoding Guide	•Contains the guidance for how the data should be encoded by the data producer •Useful as a template for building the feature catalogue
Exchange Format	•Data format that is used for data exchange •ISO 8211 – normally used for ECDIS

S-412 Weather Overlay: Feature Catalogue Status

- May 2014: Encoding Guide, version 1 completed
- February 2017: Encoding Guide, version 2 completed: 37 Objects and 135 Attributes defined.
- May 2017: Encoding Guide, version 2 added into IHO Registry
- Late 2017: Encoding Guide, version 3 estimated completion
- Early 2018: Estimated update of IHO Registry

S-412 Weather Overlay: Feature Catalogue Status

Preventing redundancy

- Features removed from Encoding Guides:
  - All Ice features (Ice Edge, Limit of Known Icebergs), associated attributes and enumerated values – (S-411 Sea Ice)
  - Surface Current feature – (S-111 Surface Currents)
  - Maximum Pressure Decrease/Minimum Pressure Increase
  - Maximum Pressure Increase/Minimum Pressure Decrease
  - Significant Weather
  - Universal Time Coordinated
  - Vertical Reference Frame

S-412 Weather Overlay: Feature Catalogue Status

Preventing redundancy

- Features may be removed from Encoding Guides version 3:
  - Low Water Level (S-102 Bathymetric Surface, S-112 Dynamic Water Levels)
  - Metarea (S-121 Maritime Limits and Boundaries, S-124 Navigational Warnings, 125 Navigational Services, appropriate as metadata)
  - Storm Surge (S-102 Bathymetric Surface, S-112 Dynamic Water Levels)
  - Tsunami (S-124 Navigational Warnings)
  - Thickness – Use case for maritime industry?

S-412 Weather Overlay: Feature Catalogue Challenges

WMO Publications are not always best for this product specification:

- Designed for observations and non-digital marine services
  - Definitions don't always exist (ie WMO 558 does not define freezing spray/ice accretion warning criteria) so individual forecasting agencies define them differently.
  - Allowable encodings differ between WMO and IHO (ie WMO 306 uses Code figure "0" – IHO allowable encodings start at 1).
  - Observation criteria conflicts with conservative forecasting (ie WMO 8 4.2.12.5 and WMO 306 Code Tables: if height is in two categories (ie 2-4 m and 4-6 m) then the height is included in the lower category).
- Using NOAA National Weather Service Directives when needed

S-412 Weather Overlay: Feature Catalogue Challenges

Multiple definitions exist between Metareas and finding compromises can be difficult.

Global Tropical Cyclone Terminology

Tropical cyclones can be defined in different ways elsewhere in the world. Often news reports from the United States or Asia will refer to hurricanes or typhoons. These are all tropical cyclones, but with different names. While the category definitions are not identical, the following provides an **approximate guide for comparison**

Australian name	Australian category	US*	US Saffir-Simpson category scale*	NW Pacific	Arabian Sea /Bay of Bengal	SW Indian Ocean	South Pacific (East of 160E)
Tropical low	-	Tropical depression	-	Tropical depression	Depression or severe depression	Tropical depression	Tropical depression
Tropical cyclone	1	Tropical storm	-	Tropical storm	Cyclonic storm	Moderate tropical storm	Tropical cyclone (Gale)
Tropical cyclone	2	Tropical storm	-	Severe tropical storm	Severe cyclonic storm	Severe tropical storm	Tropical cyclone (Storm)
Severe tropical Cyclone	3	Hurricane	1	Typhoon	Very severe cyclonic storm	Tropical cyclone	Tropical cyclone (Hurricane)
Severe tropical cyclone	4	Hurricane	2 - 3	Typhoon	Very severe cyclonic storm	Intense tropical cyclone	Tropical cyclone (Hurricane)
Severe tropical cyclone	5	Hurricane	4 - 5	Typhoon	Super cyclonic storm	Very intense tropical cyclone	Tropical cyclone (Hurricane)

** Note that the USA uses 1-minute wind averages, whichare generally greater than 10-minute wind averages used elsewherein the world – hence their intensity definitions (windstrengths) will differ by about 10%.*

http://www.bom.gov.au/cyclone/about/intensity.shtml#WindW

S-412 Weather Overlay: Feature Catalogue Challenges

Impact-based terminology can be ambiguous

Global Tropical Cyclone Terminology

Tropical cyclones can be defined in different ways elsewhere in the world. Often news reports from the United States or Asia will refer to hurricanes or typhoons. These are all tropical cyclones, but with different names. While the category definitions are not identical, the following provides an **approximate guide for comparison**

Australian name	Australian category	US*	US Saffir-Simpson category scale*	NW Pacific	Arabian Sea /Bay of Bengal	SW Indian Ocean	South Pacific (East of 160E)
Tropical low	-	Tropical depression	-	Tropical depression	Depression or severe depression	Tropical depression	Tropical depression
Tropical cyclone	1	Tropical storm	-	Tropical storm	Cyclonic storm	Moderate tropical storm	Tropical cyclone (Gale)
Tropical cyclone	2	Tropical storm	-	Severe tropical storm	Severe cyclonic storm	Severe tropical storm	Tropical cyclone (Storm)
Severe tropical Cyclone	3	Hurricane	1	Typhoon	Very severe cyclonic storm	Tropical cyclone	Tropical cyclone (Hurricane)
Severe tropical cyclone	4	Hurricane	2 - 3	Typhoon	Very severe cyclonic storm	Intense tropical cyclone	Tropical cyclone (Hurricane)
Severe tropical cyclone	5	Hurricane	4 - 5	Typhoon	Super cyclonic storm	Very intense tropical cyclone	Tropical cyclone (Hurricane)

** Note that the USA uses 1-minute wind averages, whichare generally greater than 10-minute wind averages used elsewherein the world – hence their intensity definitions (windstrengths) will differ by about 10%.*

http://www.bom.gov.au/cyclone/about/intensity.shtml#WindW

S-412 Weather Overlay: Feature Catalogue Challenges

Ensuring that Warning Services are managed and modeled appropriately

- How best to manage regionally and globally defined warnings?
- How to prevent redundancy between regionally and globally defined warnings?
- S-124 Navigational Warnings Guidance
  - How are warnings modeled in S-124?

S-412 Weather Overlay: Portrayal Catalogue Status

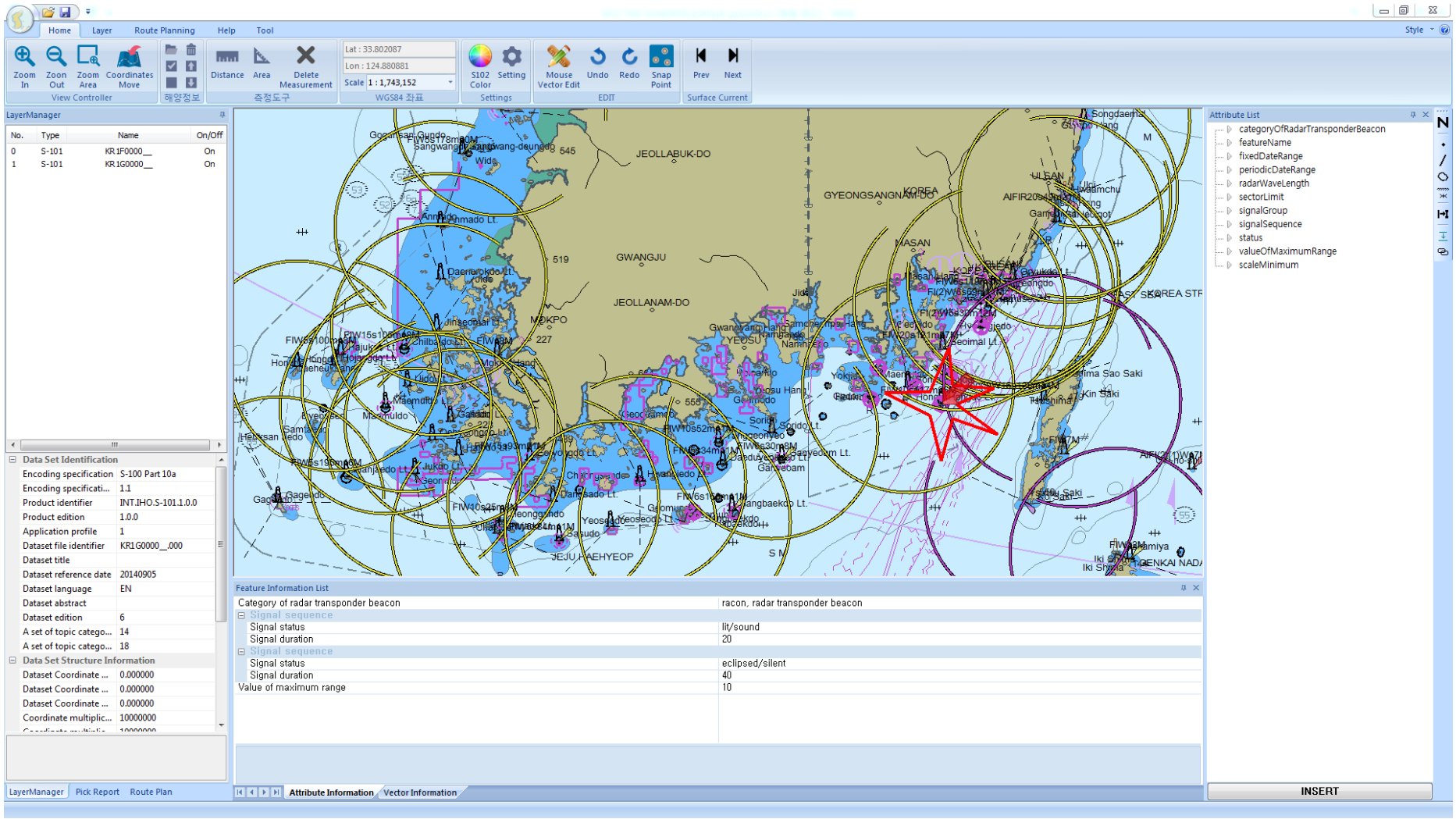
Status:

- 48 Point and Line symbols defined
- 44 Surface symbols currently under review
- AWIPS VGF to S-100 GML encoder development

Future Focus:

- Additional point, line and surface symbols will be considered.
- Continued SVG/XML development
- Develop gridded portrayal rules/symbols
- Comprehensive review of symbols and portrayal rules
- Merge symbols and rules into IHO Registry
- Utilize Portrayal Catalogue building tool

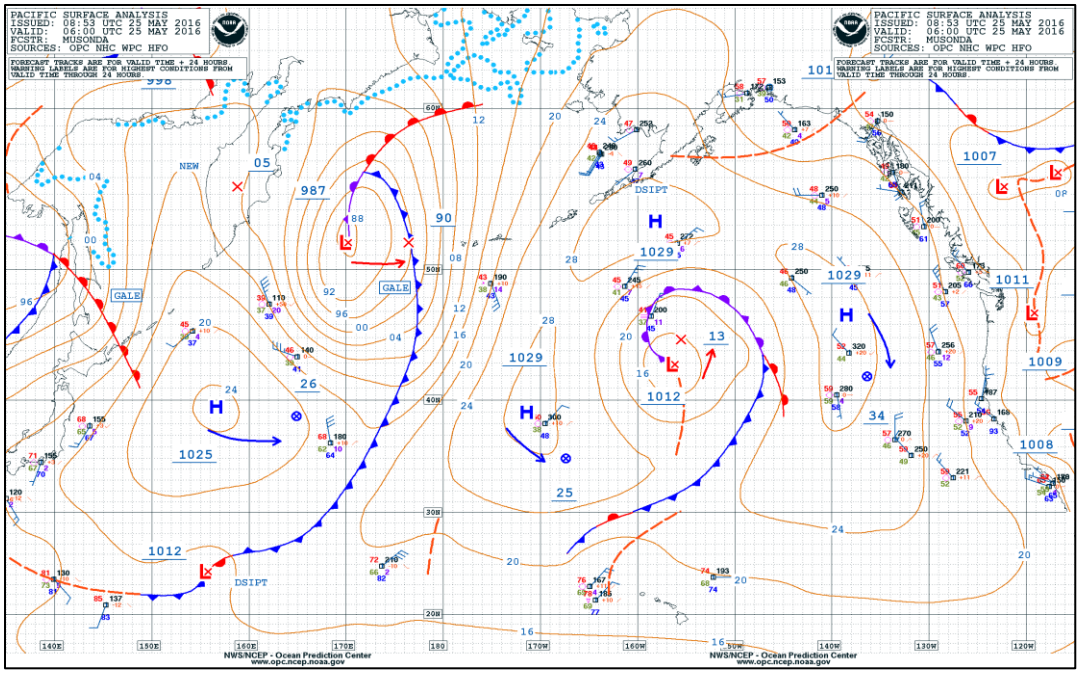
S-412 Weather Overlay: Testing



S-412 Weather Overlay: Testing

Synoptic scenario

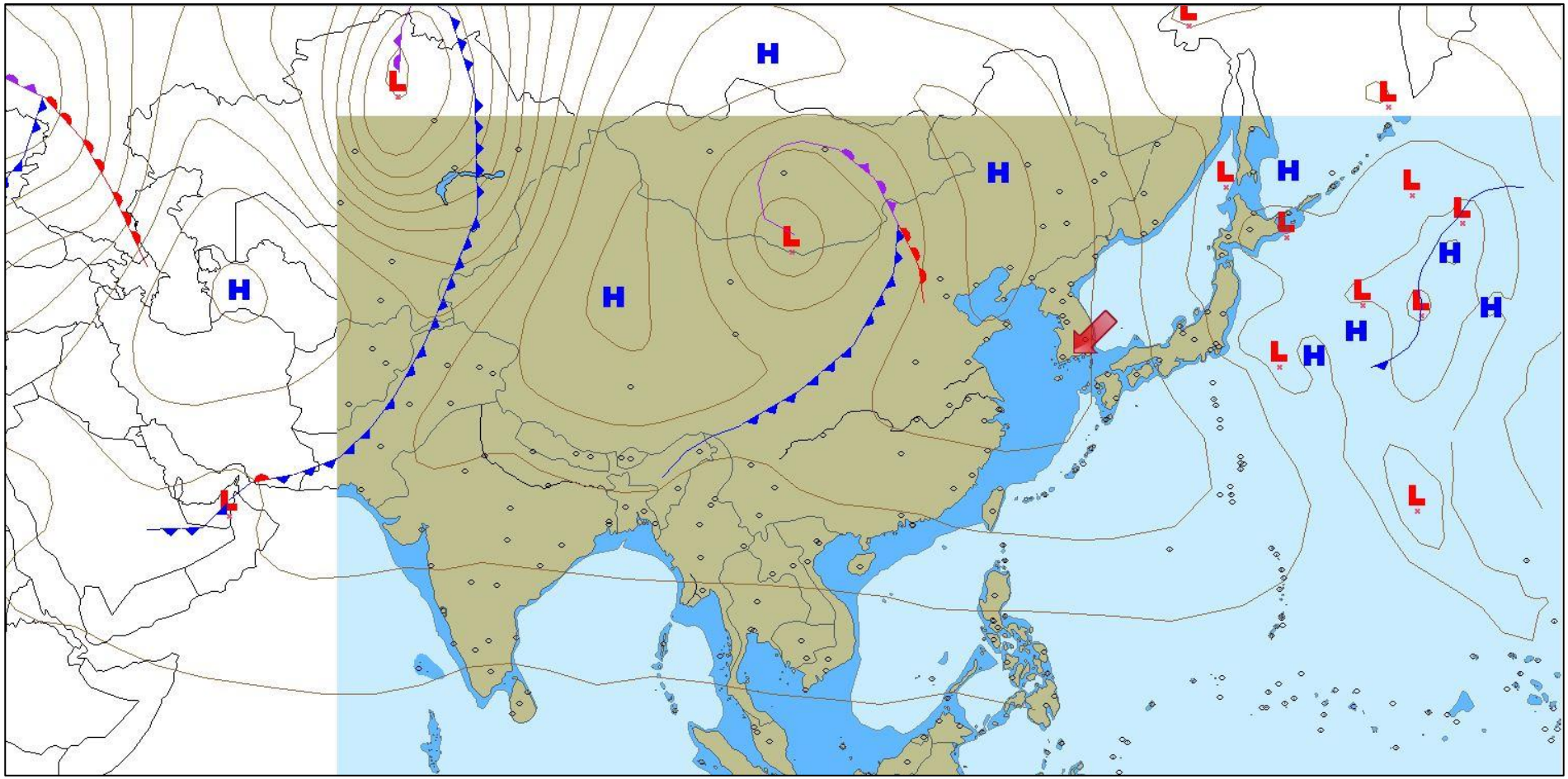
- 17 Attributes
- 4 Objects
- 7 Symbols
- 78 Feature Rules



Future Testing

- More complex scenarios
- Testing AWIPS VGF to S-100 GML encoder

S-412 Weather Overlay: Testing



S-412 Weather Overlay: Portrayal Challenges

While good for guidance, WMO publications are difficult to use for this product specification

- Legacy forecasting product are mainly text products.
- Symbol definitions do not exist for many of these features.
- WMO 558 represent hand drawn symbols.
- WMO 485 defined symbols do not always represent products and services used.

	Cold front at the surface
	Warm front at the surface
	Occluded front at the surface
	Quasi-stationary front at the surface
	Convergence line
	Inter-tropical convergence zone (ITCZ)
6	Centre of tropical cyclonic circulation (maximum winds 34–63 knots)
6	Centre of tropical cyclonic circulation (maximum winds of 64 knots or more)
	Fog

(b) Additional symbols:

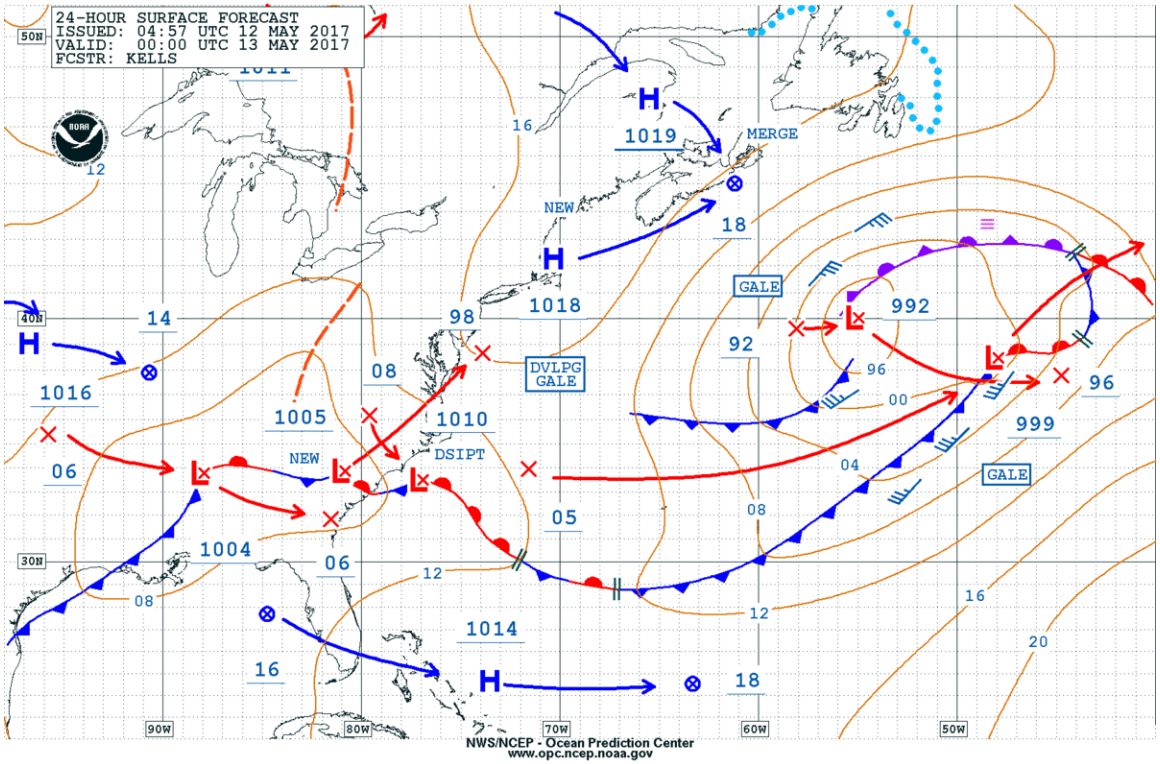
Ice accretion

Term	*Symbol*	
	Monochromatic	*Polychromatic*
1. Cold front at the surface		
2. Cold front above the surface		
3. Cold front frontogenesis		
4. Cold front frontolysis		blue
5. Warm front at the surface		
6. Warm front above the surface		
7. Warm front frontogenesis		
8. Warm front frontolysis		red
9. Occluded front at the surface		
10. Occluded front above the surface		purple
11. Quasi-stationary front at the surface		
12. Quasi-stationary front above the surface		
13. Quasi-stationary front frontogenesis		
14. Quasi-stationary front frontolysis		alternate red and blue
15. Instability line		
16. Shear line		black
17. Convergence line		
18. Intertropical convergence zone		orange

S-412 Weather Overlay: Portrayal Challenges

The need to preserving smoothed geometries in S-412:

- Isobar spacing and direction changes represent higher/lower wind speed and wind direction changes.
- Kinks in isobars represent airmass changes.
- Thousands of points for one line raises file size concerns



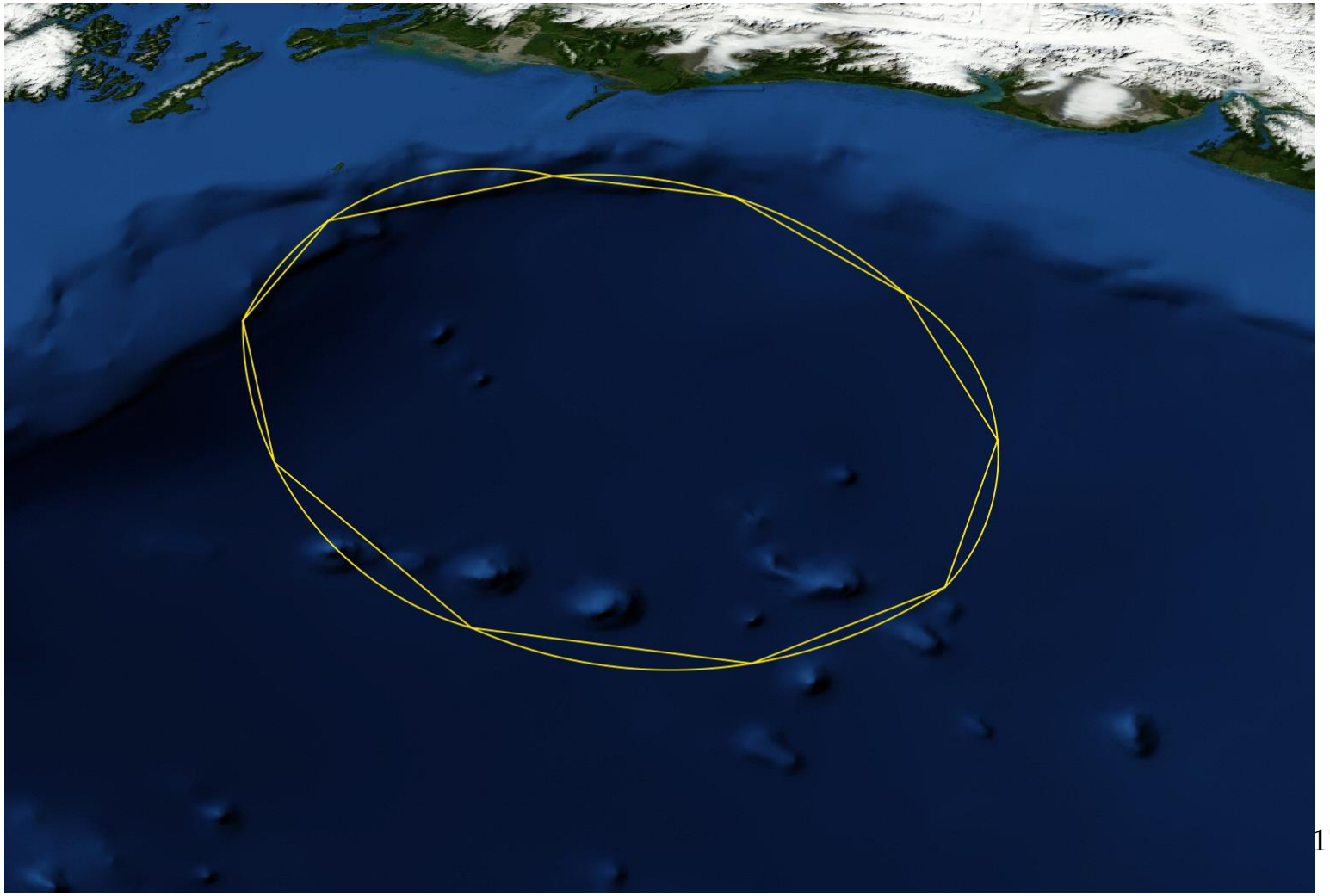
S-412 Weather Overlay: Portrayal Challenges

S-100 allows for a limited number of curved geometry options

S100_gmlProfile.xsd	S100_GM_CurveInterpolation	S100 approved element using	GML 3.2.1 element using
linear	Y	LineStringSegment	LineStringSegment
geodesic	Y	GeodesicString	Geodesic
circularArcCenterPointWithRadius	Y	S100_CircleByCenterPoint S100_ArcByCenterPoint	ArcByCenterPoint
circularArc3Points	Y	(not used- S100_ArcByCenterPoint used instead)	ArcString
elliptical	Y	N/A	N/A
conic	Y	N/A	N/A
loxodromic	Y	N/A	N/A
circularArc2PointWithBulge	N	N/A	ArcByBulge
clothoid	N	N/A	Clothoid
polynomialSpline	N	N/A	BSpline, Bezier
cubicSpline	N	N/A	CubicSpline
rationalSpline	N	N/A	Bspline

S-412 Weather Overlay: Portrayal Challenges

Preserving smoothed geometries in S-412.



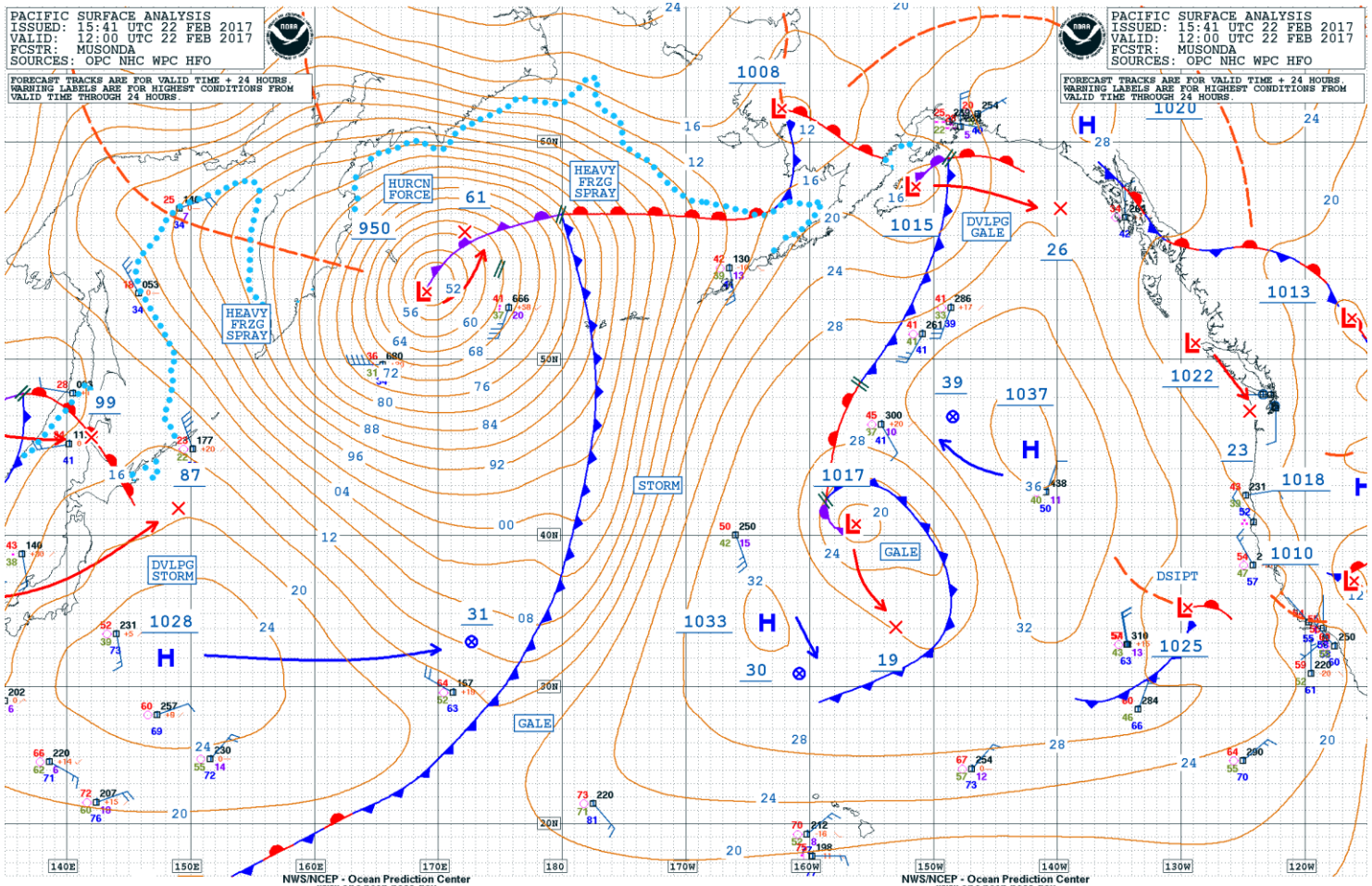
S-412 Weather Overlay: Portrayal Challenges

Difficulties finding solutions using linear line segments

S100_gmlProfile.xsd	S100_GM_CurveInterpolation	S100 element using	GML 3.2.1 element using	GDAL Support (can plot in QGIS)?	PGEN Array Issue? (memory issue -no point filtering)
linear	Y	LineStringSegment	LineStringSegment	Y	y
geodesic	Y	GeodesicString	Geodesic	Y	y
circularArcCenterPointWithRadius	Y	S100_CircleByCenterPoint S100_ArcByCenterPoint	ArcByCenterPoint	Y	n
circularArc3Points	Y	(not used- S100_ArcByCenterPoint used instead)	ArcString	Y	n
elliptical	Y	N/A	N/A	N	n
conic	Y	N/A	N/A	N	n
loxodromic	Y	N/A	N/A	N	n
circularArc2PointWithBulge	N	N/A	ArcByBulge	Y	n
clothoid	N	N/A	Clothoid	N	n
polynomialSpline	N	N/A	BSpline, Bezier	N	n
cubicSpline	N	N/A	CubicSpline	N	n
rationalSpline	N	N/A	Bspline	N	n

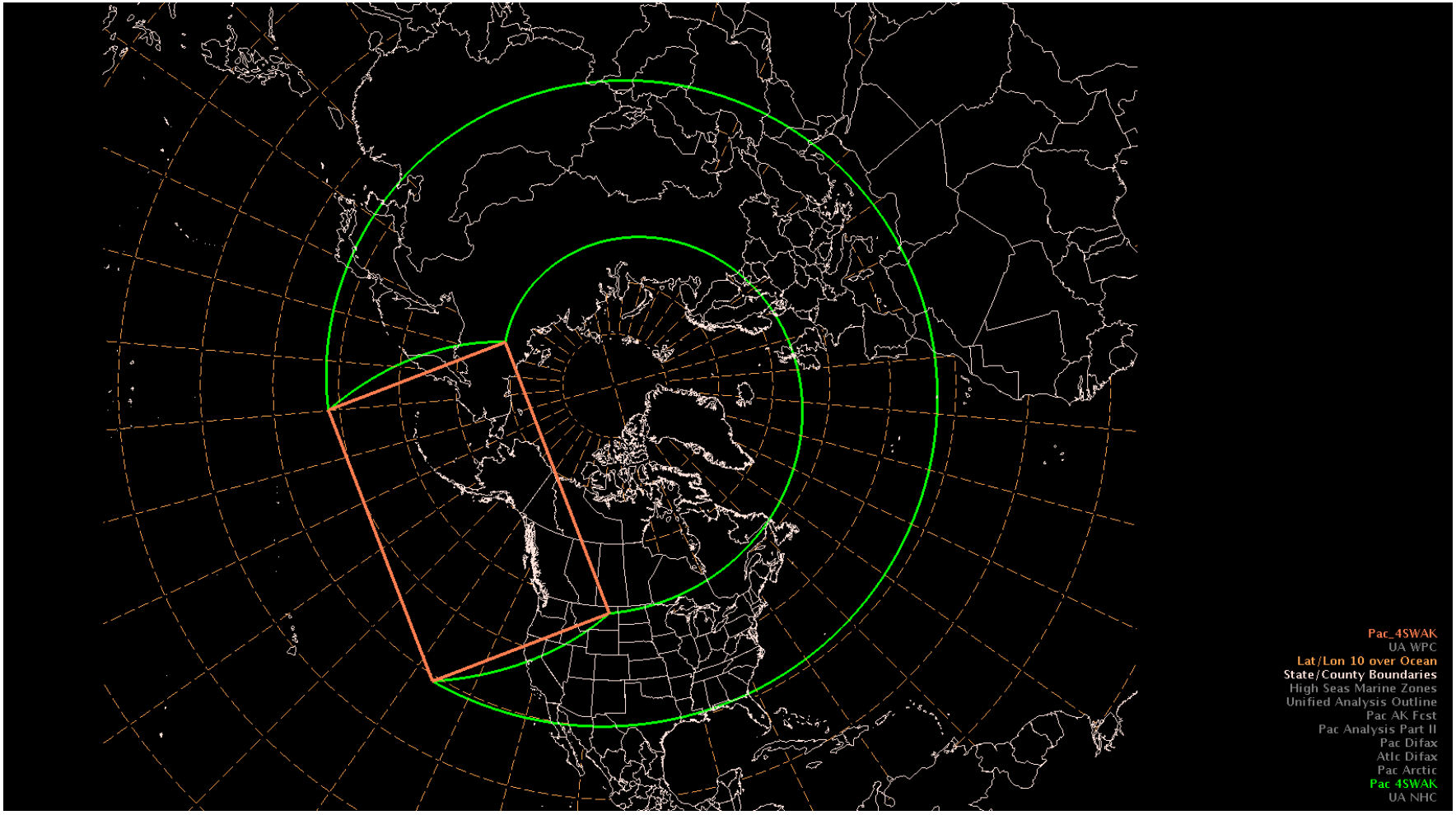
S-412 Weather Overlay: Portrayal Challenges

Managing datasets that cross the International Date Line



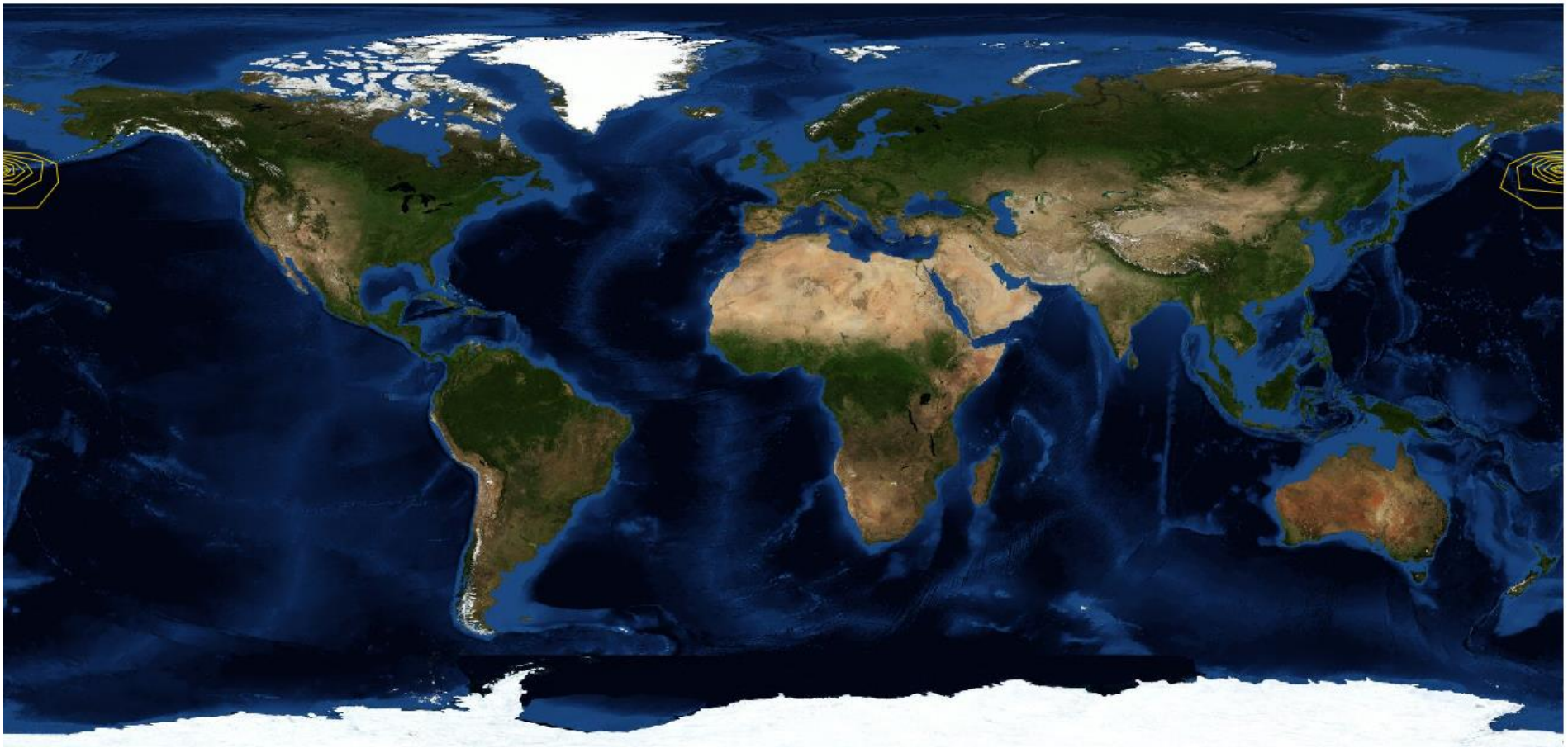
S-412 Weather Overlay: Portrayal Challenges

Managing datasets that cross the International Date Line



S-412 Weather Overlay: Portrayal Challenges

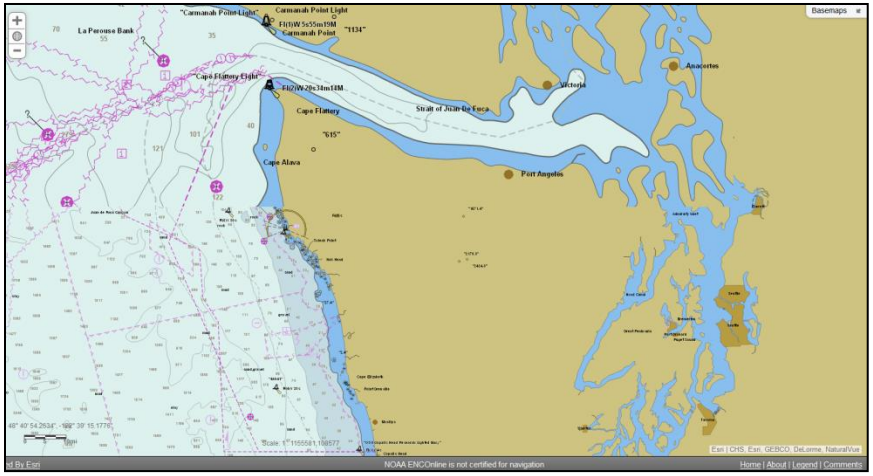
Managing datasets that cross the International Date Line

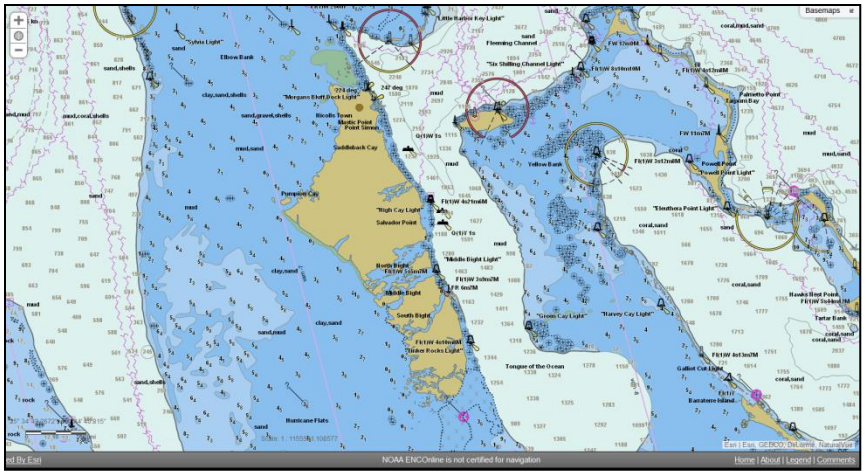


S-412 Weather Overlay: Portrayal Challenges

Defining scaling restrictions for S-412 Features

Approximately 1:1,100,000



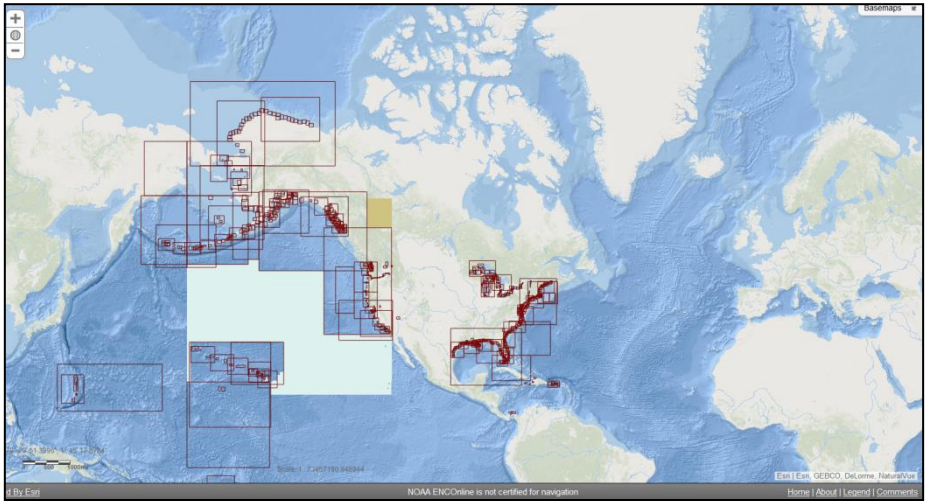


Centre of Low:

Scale minimum: 1:1,100,000

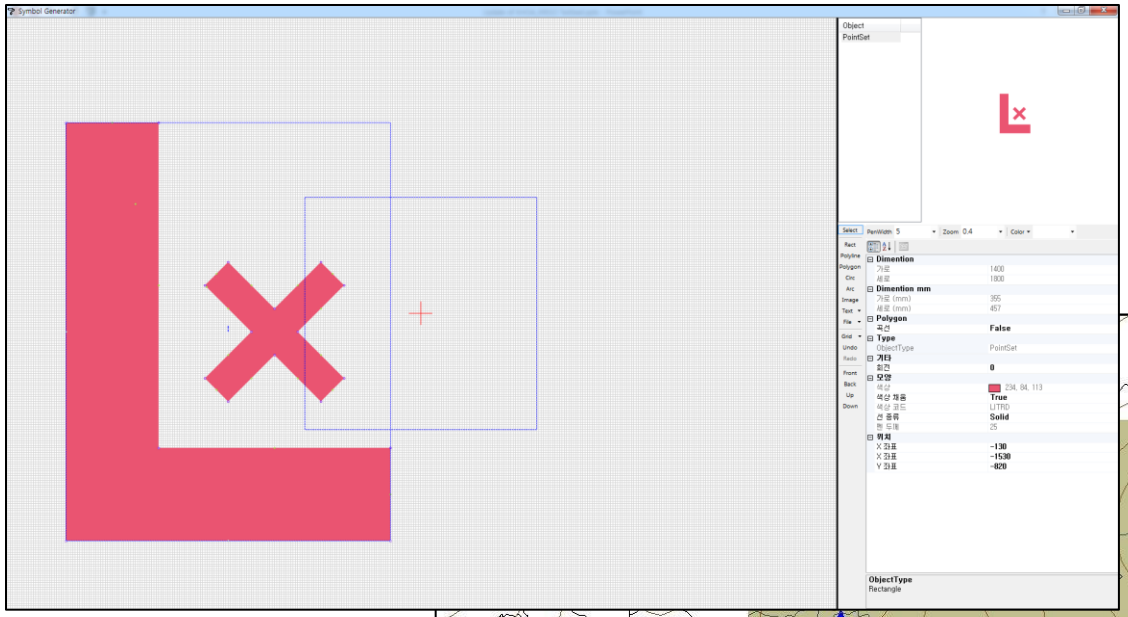
Scale maximum: 1:70,000,000

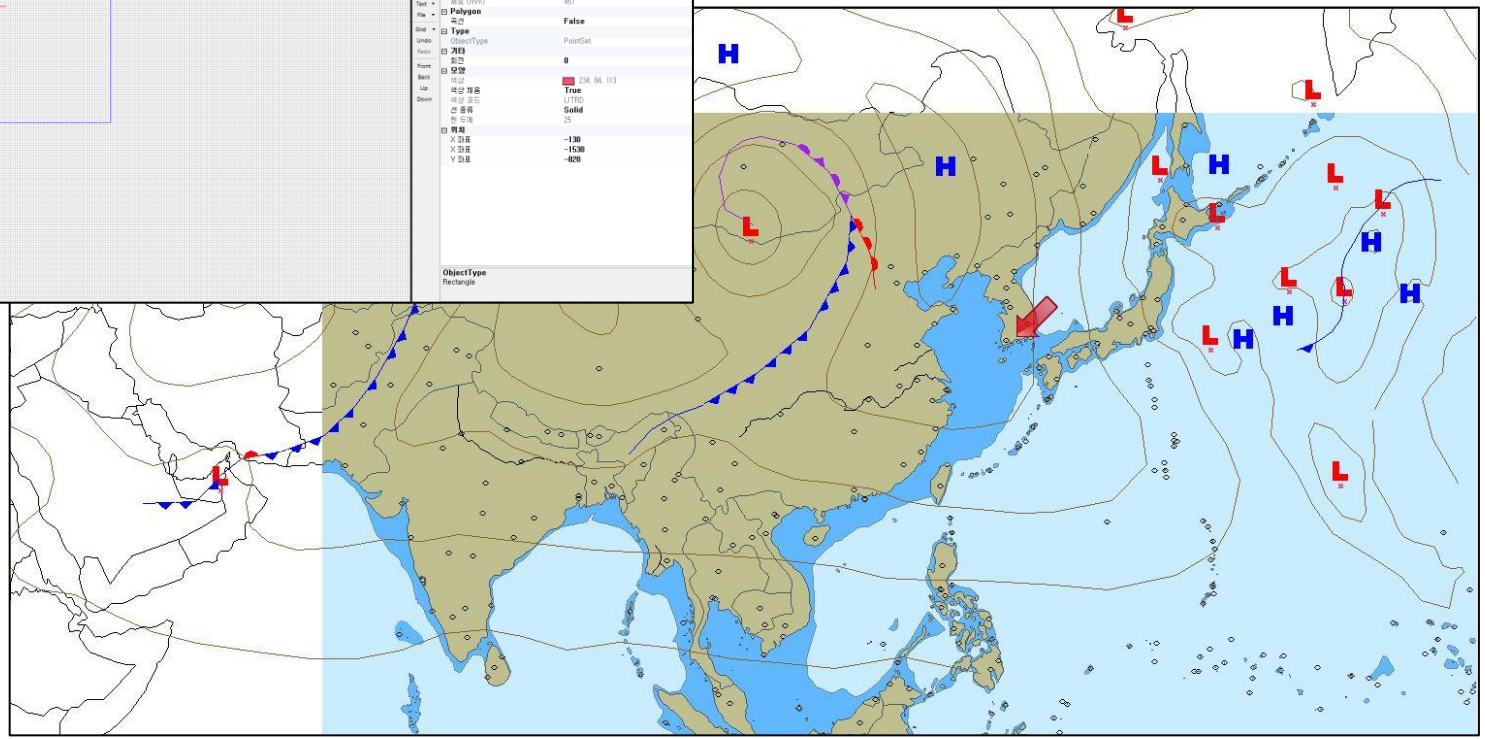
Approximately 1:70,00,000



S-412 Weather Overlay: Portrayal Challenges

Symbol sizing rules needed at multiple scales

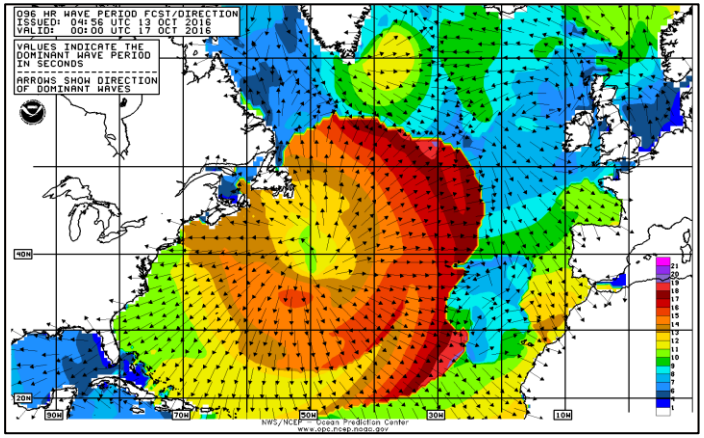


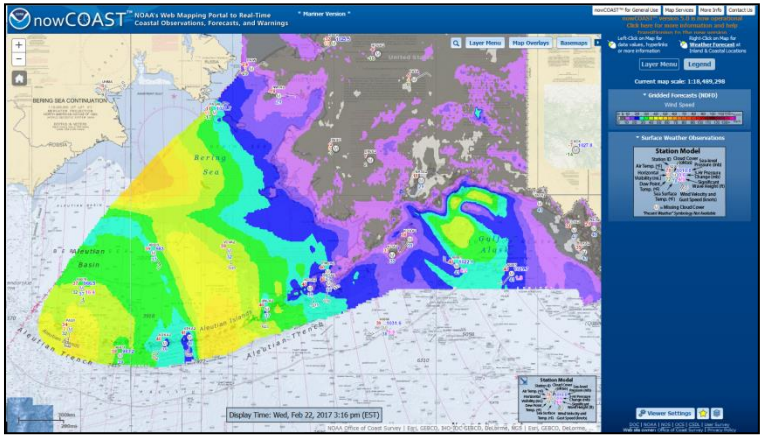


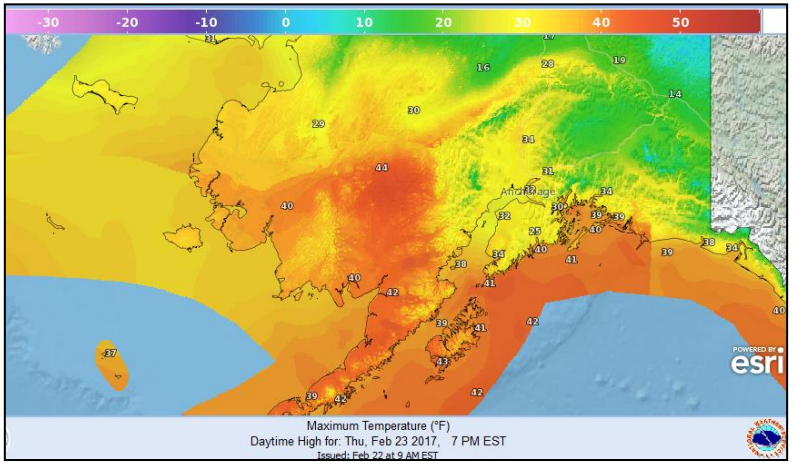
S-412 Weather Overlay: Portrayal Challenges

S-412 is considering colour ramps for portraying certain features.

- Colour ramps, scales, and gradients are commonly used by weather forecasting agencies for web-based services.







S-412 Weather Overlay: Interoperability Challenges

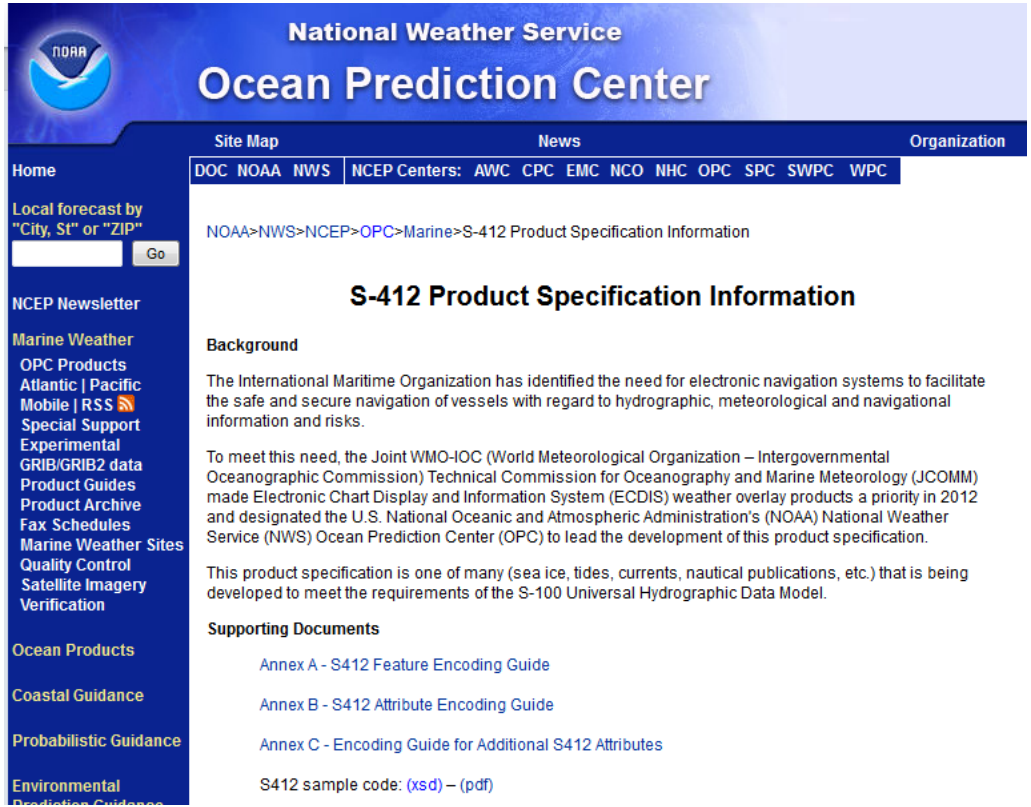
S-100 Interoperability Challenges

- S-412 Internal Operation Requirements
  - Concurrent displays of multiple features and attributes into one symbol (wave magnitude and direction)
  - Portrayal hierarchy
  - Symbol rules
- S-412 symbol size
- Feature Groups: groups of features related by definition, use case, or scale
- Feature combinations between product specifications (ie Observations, Complex Sea)

S-412 Weather Overlay: Outreach

To improve communication of the S-412 Product Specification, webpage is being developed for supporting documents, files and presentations.

www.ocean.weather.gov/s412



S-412 Weather Overlay

Questions?

Leaving Wednesday morning

LT Joseph Phillips
Joseph.T.Phillips@noaa.gov