4th Test Strategy Task Group Meeting
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Paper for Consideration by the S100WG Focus Group/Test Strategy Meeting

Update on Development of S-412, Weather Overlay Product Specification

Submitted by:	United States, NOAA National Weather Service
Executive Summary:	A link is provided to a recent article in *Hydro International*, which describes the effort to design an S-100 *IHO Universal Hydrographic Data Model* compliant product specification for a marine weather overlay product. Current Objects are provided in Annex A and Attributes are provided in Annex B, with annotation identifying those added into the IHO Registry and complex attributes. Symbols that have completed ETMSS review and those under review to portray in ECDIS are provided in Annex C.
Related Documents:	S-100 *IHO Universal Hydrographic Data Model*
Related Projects:	All other S-100 product specifications and related WGs.

Introduction / Background

The Joint WMO-IOC (World Meteorological Organization – Intergovernmental Oceanographic Commission) Technical Commission for Oceanography and Marine Meteorology (JCOMM) made ECDIS weather overlay products a priority in 2012 and designated the U.S. National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) as the project lead. The project is being reviewed by JCOMM's Expert Team on Maritime Safety Services (ETMSS) during development. The Brazilian Hydrographic Office (DHN) recognised the importance of delivering life-saving weather information via ECDIS and joined the project in 2014.

The development of the S-412 "Weather Overlay" product specification is described in "Designing a New Way to Deliver Marine Weather Data" in the November-December 2015 issue of *Hydro International*. As all other S-100 based product specifications do, S-412 will define the feature catalogue, comprised of objects (Annex A) and attributes (Annex B), and the symbols (Annex C) that will be used to portray marine meteorological data within an ECDIS.

Analysis / Discussion

The feature catalogue encoding guide is maturing and now includes additional features and attributes, including complex attributes. Additionally, redundant features present in other overlays have been identified and removed. The current feature catalogue encoding guide comprises 35 objects and 126 attributes. Integrating this catalogue into the IHO registry is still in progress; objects and attributes that have been added are identified in Annex A and B with an asterisk. It is anticipated that additional adjustments will be required as the encoding guide is added into the IHO Registry and the feature catalogue is built.

Point and line geometric symbols are still under review by ETMSS. These symbols will comprise the Portrayal Catalogue and will have undergone extensive review and comment periods when completed. To date, ETMSS has completed review of 13 portrayals (Annex C, Section 1) and 37 symbols are still under review (Annex C, Section 2). Area geometric symbol development is underway and will be reviewed following completion of the symbols identified in Annex C, Section 2. Presentation requirements specific to each portrayal are being identified as they complete review by ETMSS and are tested within the S-100 Test Bed.

Challenges have been encountered while identifying how features are used in S-412. For example, in some cases the terminology used to define a system has evolved into describing the potential impact the system may have. This presents a challenge specifically for tropical cyclone terminology, where multiple and sometimes conflicting terms are used in different ocean basins to describe a similar tropical system (hurricane, typhoon, very severe cyclonic storm, tropical storm, severe tropical storm, etc). It would be highly inappropriate and potentially dangerous to use a term that misrepresents a storm's potential impact to the end user. The solution to remedy this and similar problems is to use a feature's lowest common denominator and leverage feature attributes and portrayal capabilities. In this case, the lowest common denominator term to describe these storms is "tropical cyclone" and the portrayals for these systems will be based off the feature's wind speed

range attribute, as opposed to the type or category of the system.

S-412 has also begun participation in the S-100 Test Bed. A test scenario has been created that aims to recreate a 2016 North Pacific early summer forecast product. This scenario includes portrayal testing of 4 features commonly found on forecasting charts and draft interoperability requirements specific to S-412 features. The results of this test scenario will be used to better understand the S-100 and electronic navigation environment S-412 needs to adhere to, refine the S-412 product specification including the portrayal and feature catalogues, identify file formatting constraints directly related to product dissemination and to define interoperability requirements. More information about this will be discussed during the S-100 Test Bed presentation.

Conclusions

The effort to develop a weather overlay to be displayed in ECDIS has made significant progress and has uploaded a set of objects and attributes into the IHO Registry. Point and line portrayals are under review by ETMSS. Additionally S-412 has begun participating in the S-100 Test Bed.

Recommendations

It is requested that S-100WG

a. Continue providing advice and support for NOAA/DHN technical issues during S-412 development;
b. Continue S-100 Test Bed activities and development of interoperability specifications; and
c. Foster Coordination with other working groups.

Justification and Impacts

It is expected that S-100WG comments will contribute significantly to this project's development, assuring user requirements in this interdisciplinary project are met, and the interoperability needs of this product and others. This new product, together with other new products, shall impact industry and users interests transitioning to S-100 standard.

Action required of S-100WG

S-100WG is invited to:

a. Note the progress being made in the development of this particular S-100 overlay product;
b. Provide recommendations that may be helpful in developing S-412; and
c. Support JCOMM/ETMSS S-412 activities

ANNEX A: S-412 Object List

Object Number	Object Name	Acronym	Feature Type
1.1	Air Temperature*	AIRTEM	Geo
1.2	Atmospheric Pressure*	AIRPSR	Geo
1.3	Centre of High*	CENHIP	Geo
1.4	Centre of Low*	CENLOW	Geo
1.5	Cloud*	CLOUDS	Geo
1.6	Convergent Boundaries*	CONVBO	Geo
1.7	Dew-point Temperature*	DPTEMP	Geo
1.8	Freezing Spray*	FZSPRY	Geo
1.9	Front*	FRONTS	Geo
1.10	Gust*	GUSGUS	Geo
1.11	Isoheight*	ISOHGT	Geo
1.12	Low Water Level*	LOWATR	Geo
1.13	Maximum Air Temperature*	MAXTEM	Geo
1.14	Maximum Dew-point Temperature*	MAXDPT	Geo
1.15	Maximum Sea Surface Temperature*	MAXSST	Geo
1.16	Metarea*	METARE	Meta
1.17	Minimum Air Temperature*	MINTEM	Geo
1.18	Minimum Dew-point Temperature*	MINDPT	Geo
1.19	Minimum Sea Surface Temperature*	MINSST	Geo
1.20	Observations*	OBSERV	Geo
1.21	Pressure Tendency*	PRETEN	Geo
1.22	Primary Swell	PSWELL	GEO
1.23	Ridge*	RIDGES	Geo
1.24	Sea Surface Temperature*	SSTEMP	Geo
1.25	Secondary Swell	SSWELL	Geo
1.26	Significant Wave	SIGWAV	Geo
1.27	Significant Weather*	SIGWET	Geo
1.28	Storm Surge*	STOSUR	Geo
1.29	Surface Visibility*	SURVIS	Geo
1.30	Surface Wind*	SUWIND	Geo
1.31	Thickness*	THKNSS	Geo
1.32	Tropical Cyclone*	TROCYC	Geo
1.33	Tsunami*	TSUNAM	Geo
1.34	Watch/Warning*	WRNING	Geo
1.35	Wind Wave*	WINWAV	Geo

* indicates an attribute has been added into the IHO Registry

ANNEX B: S-412 Attribute List

Attribute Number	Attribute Name	Acronym
2.001	Amount of Pressure Change	AMPRCH
2.002	Atmospheric Pressure (c)	ATMPRE
2.003	Atmospheric Pressure Accuracy	ATPACC
2.004	Atmospheric Pressure Change (c)	ATMPRC
2.005	Azimuth Degrees of Swell Wave Direction*	DEGSWL
2.006	Azimuth Degrees of Significant Wave Direction*	DEGWAV
2.007	Azimuth Degrees of Surface Wind Direction*	DEGWND
2.008	Azimuth Degrees of Wind Wave Direction*	DEGWWA
2.009	Beaufort Force	BEAFOR
2.010	Category of Convergent Boundaries	CATCON
2.011	Category of Front	CATFRO
2.012	Category of Low	CATLOW
2.013	Category of Swell Wave Height	CATSWH
2.014	Category of Swell Wave Direction	CATSWD
2.015	Category of Significant Wave Height	CATSEH
2.016	Category of Significant Wave Direction	SIWADE
2.017	Category of Significant Weather	CATSWE
2.018	Category of Surface Visibility	CATVIS
2.019	Category of Warning	CATWRN
2.020	Category of Wind Wave Direction	CATWWD
2.021	Category of Wind Wave Height	CATWWH
2.022	Change in Significant Wave Height	CHWAHE
2.023	Change in Significant Wave Period	CHWAPE
2.024	Change in Surface Wind Direction	CHAWDI
2.025	Change in Surface Wind Speed	CHCWDS
2.026	Change in Swell Wave Height	CHSWHE
2.027	Change in Swell Wave Period	CHSWPE
2.028	Change in Wind Wave Height	CHWWHE
2.029	Characteristic of Pressure Change	CHPRCH
2.030	Compass Point of Surface Wind Direction	COMDIR
2.031	Deterministic Inundation (c)	DETIND
2.032	Dew-Point Temperature (c)	DPTEMP
2.033	Direction of Expected Movement	DREXMO
2.034	Expected Change in Intensity	EXPINT
2.035	Expected Movement (c)	EXPMOV
2.036	Front Level	FROLEV
2.037	Frontal Development	FRODEV
2.038	Height Contour (c)	HGTCON
2.037	Height of Cloud Base	HCLOBA
2.040	Height of Storm Surge	HEISUR
2.041	Horizontal Visibility Range (c)	HZVBRG
2.042	Icing Intensity	ICIINT
2.043	Information	INFORM
2.044	Isallobar Time Interval	ISLOTM
2.045	Issue Time	ISSTIM
2.046	Length Units	LUNITS
2.047	Level of Front (c)	LVLFRT
2.048	Low Water Level	LOWLVL
2.049	Low Water Level Value (c)	LOWLVE
2.050	Lower Isobaric Level	LOWLEV
2.051	Metarea Number	METNUM

2.052	Next Update Time	NUPTIM
2.053	Observation Information (c)	OBSINF
2.054	Observation Source	OBSRCE
2.055	Observation Source Identification	OBSIDS
2.056	Observation Source Status	OBSTAT
2.057	Predicted Tsunami Maximum Wave Height	TMWHGT
2.058	Primary Swell Wave Direction (c)	PSWDIR
2.059	Primary Swell Wave Height (c)	PSWHGT
2.060	Primary Swell Wave Height Change	PSWHTC
2.061	Primary Swell Wave Period	PSWPRD
2.062	Primary Swell Wave Period Change	PSWPDC
2.063	Probabilistic Inundation (c)	PRBIND
2.064	Saffir-Simpson Category	SAFSIM
2.065	Sea Surface Temperature (c)	SESTMP
2.066	Secondary Swell Wave Direction(c)	SSWDIR
2.067	Secondary Swell Wave Height (c)	SSWEHT
2.068	Secondary Swell Wave Height Change	SSWHTC
2.069	Secondary Swell Wave Period	SSWPRD
2.070	Secondary Swell Wave Period Change	SSWPDC
2.071	Significant Wave Direction (c)	SIGWDR
2.072	Significant Wave Height (c)	SIGHGT
2.073	Significant Wave Height*	SIWAHE
2.074	Significant Wave Height Change (c)	SIGHCG
2.075	Significant Wave Height Change Time Interval	SWHETI
2.076	Significant Wave Period*	SIWAPE
2.077	Significant Wave Period Change (c)	SIGPCG
2.078	Significant Wave Period Change Time Interval	SWPCTI
2.079	Speed of Expected Movement*	SPEXMO
2.080	Storm Surge Height (c)	SSHGHT
2.081	Surface Gust Direction (c)	SURGDR
2.082	Surface Gust Speed (c)	SURGSD
2.083	Surface Wind Direction (c)	SURWDD
2.084	Surface Wind Direction Change (c)	SUWDDC
2.085	Surface Wind Speed (c)	SURWSD
2.086	Surface Wind Speed Change (c)	SUWDMC
2.087	Swell Wave Height*	SSWHGT
2.088	Swell Wave Height Change Time Interval*	SWHTTI
2.089	Swell Wave Period*	SWLPRD
2.090	Swell Wave Period Change Time Interval*	SWPETI
2.091	Temperature (c)	TEMPER
2.092	Temperature Accuracy	TMPACC
2.093	Thickness Height*	THKNSS
2.094	Tidal Datum	LEVREF
2.095	Time (c)	TIMECC
2.096	Total Cloud Cover	TCLOCO
2.097	Tsunami Height Probability*	THPROB
2.098	Tsunami Wave Arrival Time	ARRTIM
2.099	Tsunami Wave Period*	TSUPER
2.100	Upper Isobaric Level	UPRLEV
2.101	Valid Time	VALTIM
2.102	Value of Atmospheric Pressure*	VALPSR
2.103	Value of Dew-point Temperature	VALTDT
2.104	Value of Height Contour*	VALHGT
2.105	Value of Sea Surface Temperature	VALSST
2.106	Value of Surface Wind Gust	VALGST
2.107	Value of Surface Wind Speed	VAWISP

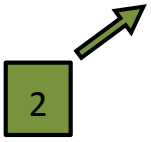
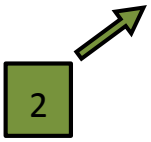
2.108	Value of Temperature	VALTMP
2.109	Velocity Units	VUNITS
2.110	Visibility Range	VIZRNG
2.111	Warning End Time	WRNEND
2.112	Warning Start Time	WSTART
2.113	Watch/Warning (c)	WATWAR
2.114	Watch/Warning Type	WTCWRN
2.115	Water Height Units	HUNITS
2.116	Wind Average Period	WNDAVP
2.117	Wind Change Time Interval*	WNDTIM
2.118	Wind Speed Range	WDSPRG
2.119	Wind Wave Direction (c)	WDWADR
2.120	Wind Wave Height (c)	WWHGHT
2.121	Wind Wave Height*	WIWAHE
2.122	Wind Wave Height Change (c)	WWHGCG
2.123	Wind Wave Height Change Time Interval*	WWHETI
2.124	Wind Wave Period*	WIWAPE
2.125	Wind Wave Period Change (c)	WWPDCG
2.126	Wind Wave Period Change Time Interval*	WWPETI

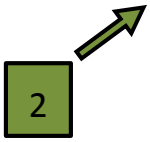
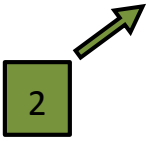
(c) indicates a complex attribute.

* indicates an attribute has been added into the IHO Registry.

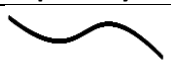
ANNEX C: S-412 Symbols (as of 1 September 2016)

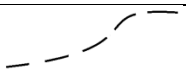
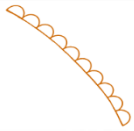
Section 1: Portrayals that have passed review by ETMSS

Feature	Acronym	Attribute	Geometry	Complete Symbol	Significant Notes
Centre of High	CENHIP	All Attributes	Point		
Centre of Low	CENLOW	CATLOW 1: Extra-Tropical Cyclone	Point		-Symbol will be used for all low pressure systems below 34 knots and all extra-tropical cyclones.
Centre of Low	CENLOW	CATLOW 2: Post-Tropical Cyclone	Point		-Symbol shall be used for post-tropical cyclones with wind speeds ≥ 34 knots.
Freezing Spray	FZSPRY	ICINT 1: Light Icing Intensity	Point		
Freezing Spray	FZSPRY	ICINT 2: Moderate Icing Intensity	Point		
Freezing Spray	FZSPRY	ICINT 3: Severe Icing Intensity	Point		
Freezing Spray	FZSPRY	ICINT 4: Very Severe Icing Intensity	Point		
Tropical Cyclone	TROCYC	WDSPRG 1: 34 knots – 63 knots	Point		-Symbol shall be used for named tropical cyclones until wind speed decreases below 34 knots or increases above 63 knots.
Tropical Cyclone	TROCYC	WDSPRG 2: ≥ 64 knots	Point		-Symbol shall be used for named tropical cyclones with wind speeds above 63 knots.
Primary Swell	PSWELL	SSWHGT CATSWD	Point		-SSWGHT determines colour -CATSWD determines direction -User has option of displaying vector magnitude and direction separately or together
Secondary Swell	SSWELL	SSWHGT CATSWD	Point		-SSWGHT determines colour -CATSWD determines direction -User has option of displaying vector magnitude and direction separately or together

Significant Wave	SIGWAV	SIWAHE SIWADE	Point		-SIWAHE determines colour -SIWADE determines direction -User has option of displaying vector magnitude and direction separately or together
Wind Wave	WINWAV	WIWAHE CATWWD	Point		-WIWAHE determines colour -CATWWD determines direction -User has option of displaying vector magnitude and direction separately or together

ANNEX C, Section 2: Portrayals under review by ETMSS

Feature	Acronym	Attribute	Geometry	Complete Symbol
Atmospheric Pressure	AIRPSR	VALPSR	Curve	
Convergent Boundary	CONVBO	CATCON 1: Intertropical Convergence Zone	Curve	
Convergent Boundary	CONVBO	CATCON 2: Squall Line	Curve	
Convergent Boundary	CONVBO	CATCON 3: Trough Line	Curve	
Convergent Boundary	CONVBO	CATCON 4: Trough	Curve	
Convergent Boundary	CONVBO	CATCON 5: Shear Line	Curve	
Convergent Boundary	CONVBO	CATCON 6: Convergence Line	Curve	
Convergent Boundary	CONVBO	CATCON 7: Monsoon Trough	Curve	
Convergent Boundary	CONVBO	CATCON 8: Tropical Wave	Curve	
Freezing Spray	FZSPRY	ICINT 1: Light Icing Intensity	Curve	
Freezing Spray	FZSPRY	ICINT 2: Moderate Icing Intensity	Curve	
Freezing Spray	FZSPRY	ICINT 3: Severe Icing Intensity	Curve	
Freezing Spray	FZSPRY	ICINT 4: Very Severe Icing Intensity	Curve	
Front	FRONTS	CATFRO 1: Cold FRODEV 1: Developing	Curve	
Front	FRONTS	CATFRO 1: Cold FRODEV 2: Dissipating	Curve	
Front	FRONTS	CATFRO 1: Cold FROVLEV 1: Surface	Curve	
Front	FRONTS	CATFRO 1: Cold FROLEV 2: Above Surface	Curve	
Front	FRONTS	CATFRO 1: Cold FROLEV 2: Above Surface FRODEV 1: Developing	Curve	
Front	FRONTS	CATFRO 1: Cold FROLEV 2: Above Surface FRODEV 2: Dissipating	Curve	
Front	FRONTS	CATFRO 2: Warm FRODEV 1: Developing	Curve	
Front	FRONTS	CATFRO 2: Warm FRODEV 2: Dissipating	Curve	
Front	FRONTS	CATFRO 2: Warm FROLEV 1: Surface	Curve	
Front	FRONTS	CATFRO 2: Warm FROLEV 2: Above Surface	Curve	
Front	FRONTS	CATFRO 2: Warm FROLEV 2: Above Surface FRODEV 1: Developing	Curve	
Front	FRONTS	CATFRO 2: Warm FROLEV 2: Above Surface FRODEV 1: Dissipating	Curve	

Front	FRONTS	CATFRO 3: Occluded	Curve	
Front	FRONTS	CATFRO 3: Occluded FROLEV 2: Above Surface	Curve	
Front	FRONTS	CATFRO 4: Quasi-stationary Front FROLEV 1: Surface	Curve	
Front	FRONTS	CATFRO 4: Quasi-stationary Front FROLEV 2: Above Surface	Curve	
Front	FRONTS	CATFRO 5: Convergence Line	Curve	
Front	FRONTS	CATFRO 6: Dry Line	Curve	
Ridge	RIDGE	All Attributes	Curve	
Surface Wind	SUWIND	SURWDD SUWDDC -> VAWISP = 2	Point	
Surface Wind	SUWIND	SURWDD SUWDDC -> VAWISP = 5	Point	
Surface Wind	SUWIND	SURWDD SUWDDC -> VAWISP = 10	Point	
Surface Wind	SUWIND	SURWDD SUWDDC -> VAWISP = 50	Point