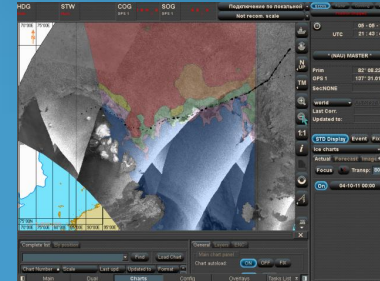
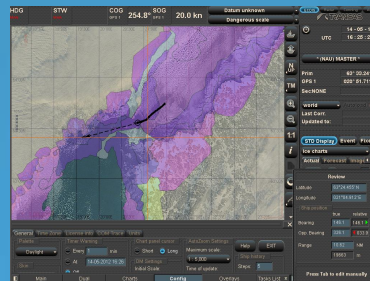
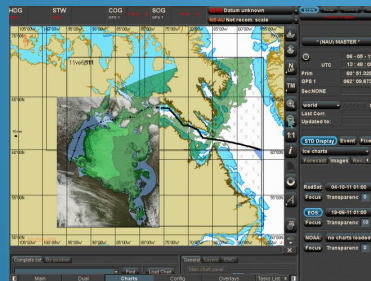


ENC/ECDIS for ice navigation

A presentation for the Science and Technology Workshop at
JCOMM-IV, May 24 – May 25, 2012

Vasily Smolyanitsky, ETSI chair
Arctic and Antarctic Research Institute (AARI), St.Petersburg, Russia

Jointly with ETSI TG ENCIO Co-authors: John Falkingham (IICWG/CIS),
Juergen Holfort (BSH), Konstantin Ivanov (TRANSAS)



ENC/ECDIS for ice navigation overview

- Vision
- History
- Procedures for sea ice standard management
- Ice Object Catalogue
- IHO Registry
- CIS-CCG-ICAN Pilot Project
- AARI-Transas Development
- Next Steps and roadmap for 2012-2013

Ice In ENC's vision

- In the polar and sub-polar seas, ice is a major hazard to safe navigation and a 'media' for [ice] navigation
- The integration of real time or near real-time ice information into ENC's (Electronic Navigation Chart systems) is an important and natural step, in particular in view of the increasing E-Navigation and a way to deliver binary products
- An ECDIS (Electronic Chart Display and Information System) is developed for ship navigation as a replacement for paper charts – but must be approved for such use by the IMO. There are strict rules about how the display of an ECDIS must appear.
- An ENCS may not be used for navigation and does not have to be approved by IMO – but it may be used for route planning. The IHO rules for display appearance are much more flexible. In practice, often the same physical system is used as both an ECDIS and an ENCS.
 - Currently, mariners get ice information in a variety of ways – NAVTEX, Internet etc but if not in S-57, are external to their Electronic Navigation Chart Systems
 - Integrating ice information into the ENCS would improve the efficiency and safety of navigation by making it easier to plan routes to avoid hazardous ice conditions
 - As basis the information of hydrographic charts will continue to be of uttermost importance, but the overlay of time varying meteorological and oceanographic parameters and satellite imagery as MIO (Marine Information Objects) layers will become increasingly important.

Ice In ENC's - History

- 1992 S57 Object Catalogue Workshop - Ottawa**
- 1995 Standards for Ice Information in ECDIS Workshop - Ottawa**
 - Ice Object Catalogue Ver 1.0
- 1996 ECDIS in Ice Navigation Workshop – Hamburg**
 - Ice Object Catalogue, Ver 2.0
- 1999 The ECDIS Ice Chart Project, SevenCs AG & Co.**
- 2000 Ice In ECDIS Workshop – St. John's, NFLD**
 - Ice Object Catalogue, Version 3.0
- 2002 Integration of Sea Ice into ECDIS, UNB Project**
- 2005 IHO Ice Register (Draft)**
- 2005 IICWG Interoperability Data Formats Workshop**
 - Trial implementation of Ice Objects catalogue
 - Catalogue revised to be consistent with other standards
- 2007 ETSI 3rd session**
 - Ice Object Catalogue Version 4.0
 - ETSI accepts ownership of Ice Register; approves Register management

Ice In ENCs – History (cont)

- 2007 IHO approves ETSI as owner of ICE Register**
 - IHO Register of Marine Information Objects goes on-line
 - ETSI establishes TG ENCIO task group
- 2008 CIS pilot project to produce S-57 daily ice charts**
 - Ice Objects Catalogue Ver 4.1
 - CARIS contracted to produce Ice MIO Product Specification
- 2009 AARI & Transas develop end-to-end capability to display ice charts on Transas NaviSailor ECDIS**
 - Presentation Library (international and national/regional)
- 2010 ETSI 4th session**
 - Ice Objects Catalogue Ver 5.0
 - Report to TSMAD
- 2012 Harmonization of Canadian / Russian expertise**
 - Rationalization and simplification of ver 5.0
 - Ice Objects Catalogue Ver 5.1 developed and registered in IHO Registry of Registries
 - Formal report to TSMAD-24 (IHB, 7-11 May 2012) and S-1xx for sea ice

Ice In ENCs – History (cont)

2009-2010 MetOcean information in ENC

- WMO Secretariat developed a draft Catalogue for MetOcean information in ENC
- ETMSS-III (October 2010) held general discussion on e-navigation concept, MetOcean Catalogue and its implementation in S-100
- WMO GRiB format is proposed for supporting gridded data

Procedures for sea ice standards management

- Within the WMO JCOMM ETSI is responsible for operational sea ice standards including WMO Sea Ice Nomenclature
- JCOMM ETMSS is responsible for GMDSS standards and is developing M.O.C.
 - in part of sea ice input is provided by ETSI
- By agreement with IHO TSMAD, JCOMM ETSI is the formal body responsible for the Ice Objects Catalogue
- WMO Secretariat is the manager of the catalogue together with the ETSI Electronic Navigation Chart Ice Objects Task Group (TG-ENCIO)
- International Ice Charting Working Group (IICWG)
 - Technical advisory body to ETSI
 - Meets annually

Procedures for sea ice standards management

High level harmonizing sea ice standard

- "WMO Sea Ice Nomenclature" (WMO No.259, revision Mar 2010)
 - Volumes 1 "Terminology" (terms and definitions) and
 - Volume 3 "International system of sea ice symbols" (coding tables and symbols for ice charts)
 - From 2007 WMO No.259 is formally managed in electronic form

Procedures for sea ice standards management

Sea ice information transport standards

- "SIGRID-3: a vector archive format for sea ice charts" (WMO/TD-No. 1214, revision 2 Mar 2010) is the main transport format for ice charts at a level of ice services.
 - geometry based on shapefile format
 - thematic content and coding compliant with WMO No.259
 - supports all types of sea ice objects: polygons (areas), lines and points
- Ice Object Catalogue (version 4.1 - Mar 2007 , version 5.0.1 - Mar 2010 & 5.1 - Feb 2012) is a standard sea ice content for ENC.
 - thematic content and coding compliant with WMO No.259
- WMO GRiB and NetCDF are used to support sea ice input/export for numerical models
 - no direct standard for sea ice exist (e.g. ice concentration is measured in 0.00 1.00 units)

IHO Registry of Hydrographic Related Features

- Ice Information is conceived as a Marine Information Overlay
 - Layer on top of hydrographic charts that can easily be turned on and off
 - Portrayal is more flexible than if the information is integrated with the hydrographic information
 - Ice Objects are managed in the IHO Registry of Registers
 - Hydro, Ice, IENC, NPUB, etc



IHO - HYDROGRAPHIC REGISTRY

Hydrographic related Feature Data Dictionaries

[Home](#)[Account](#)[Proposal](#)[Registry Details](#)[Administration](#)[Search](#)[Reports](#)[Help](#)

Data Dictionaries

HYDRO

[Feature Index](#)[Attribute Index](#)[Enumeration Index](#)[Information Index](#)

ICE

[Feature Index](#)[Attribute Index](#)[Enumeration Index](#)[Information Index](#)

OEF

[Feature Index](#)[Attribute Index](#)[Enumeration Index](#)[Information Index](#)

IENC

[Feature Index](#)[Attribute Index](#)[Enumeration Index](#)[Information Index](#)

NPUB

[Feature Index](#)[Attribute Index](#)[Enumeration Index](#)[Information Index](#)

ICE Features

[Valid](#) [Invalid](#) [Superseded](#) [Retired](#)

AlphaCode	Name	Status	Date Accepted	Date Amended	Use Type
BRGARE	Iceberg Area	Valid	0000-00-00	2010-08-22	Geo
BRGLNE	Iceberg Limit	Valid	0000-00-00	2010-08-22	Geo
FLOBRG	Floeberg	Valid	0000-00-00	2010-08-22	Geo
I_CRAC	Line of Ice Crack	Valid	0000-00-00	2010-09-02	Geo
I_FLOE	Separate Giant Floe	Valid	0000-00-00	2010-08-26	Geo
I_FRAL	Line of Ice Fracture	Valid	0000-00-00	2010-09-02	Geo
I_GRHM	Grounded Hummock	Valid	0000-00-00	2010-09-02	Geo
I_LEAD	Line of Ice Lead	Valid	0000-00-00	2010-08-26	Geo
I_RIDG	Line of Ice Ridge	Valid	0000-00-00	2010-08-26	Geo
ICEBRG	Iceberg	Valid	0000-00-00	2010-08-22	Geo
ICECOM	Ice Compacting	Valid	0000-00-00	2010-08-22	Geo
ICEDFT	Ice Drift	Valid	0000-00-00	2010-08-22	Geo
ICEDIV	Ice Divergence	Valid	0000-00-00	2010-08-22	Geo
ICEFRA	Ice Fracture	Valid	0000-00-00	2010-08-22	Geo
ICEKEL	Ice Keel/Bummock	Valid	0000-00-00	2010-08-22	Geo
ICELEA	Ice Lead	Valid	0000-00-00	2010-08-22	Geo
ICELNE	Ice Edge	Valid	0000-00-00	2010-08-22	Geo
ICERDG	Ice Ridge/Hummock	Valid	0000-00-00	2010-08-22	Geo
ICERFT	Ice Rafting	Valid	0000-00-00	2010-09-21	Geo


Data Dictionaries
HYDRO
[Feature Index](#)
[Attribute Index](#)
[Enumeration Index](#)
[Information Index](#)
ICE
[Feature Index](#)
[Attribute Index](#)
[Enumeration Index](#)
[Information Index](#)
OEF
[Feature Index](#)
[Attribute Index](#)
[Enumeration Index](#)
[Information Index](#)
IENC
[Feature Index](#)
[Attribute Index](#)
[Enumeration Index](#)
[Information Index](#)
NPUB
[Feature Index](#)
[Attribute Index](#)
[Enumeration Index](#)
[Information Index](#)
ICE Feature

Feature Details	
AlphaCode:	BRGARE
Name:	Iceberg Area
Alias:	Unspecified
camelCase:	AreaBerg
Use Type:	Geo
Definition:	An Iceberg Area is an area at sea in which icebergs, bergy bits, or growlers are present
Source Reference:	Unspecified
Source:	ETSI Ice Objects Catalogue \5.0
Similarity:	Identical
Int1:	Unspecified ▼
M4:	Unspecified ▼
Remarks:	Since a "Floeborg" is, by WMO definition, composed of sea ice and not glacial ice, floebergs have been excluded from the above definition of "Iceberg Area". Floebergs are not included in the associated IIP or CIS area product.
Status:	Valid
Accepted:	0000-00-00
Amended:	2010-08-22
Distinction:	Unspecified

Recommended Attributes

[NOBJNM](#) [OBJNAM](#) [IA](#) [BCN](#) [IA](#) [BFM](#) [IA](#) [BUH](#) [ICEBNM](#) [ICEBSZ](#)

This Feature Data Dictionary does not mandate the use of any attributes. The attributes listed here are recommended as being relevant to this particular feature. However, for some applications, certain attributes may be designated as mandatory for specific feature classes. These attributes must be listed in the appropriate product specification.

Management Details	
AlphaCode:	BRGARE
Status:	Final
Proposal:	Supersession
Submitting Organization:	JCOMM ETSI
Proposed Change:	Update Source Document and camelcase name; and to add new Attributes.
Justification:	To conform with ETSI Ice Objects Catalogue \5.0
Proposed:	2010-08-22
Disposed:	2010-08-22
Disposition:	Accepted
Successor:	Unspecified
Predecessor:	BRGARE
Decision:	Unspecified
Reg Manager:	Unspecified
Control Body Notes:	Unspecified

Ice Objects Catalogue version 5.1 – Feb 2012

- Rationalized and simplified version of Ice Objects Catalogue Version 5.0
- Duplication / overlapping attributes resolved
- Several definitions refined
 - Removed objects I_FAST; replaced with additional enumeration for form of ice in attributes ICEFLZ, IA_SFA, IA_SFB, IA_SFC, IA_FFA, IA_FFB, IA_FFC
 - Removed object I_FLOE
 - Object ICEBRG re-defined to indicate either a single iceberg or multiple icebergs around a point
 - Removed attributes IA_RCN, IA_FCN, IA_CST, IA_AVT, IA_MAX, IA_MIN, IA_RMH, IA_RXH, IA_DVW as being duplicates for ICERCN, ICEFCN, etc.
 - Moved attributes NOBJNM and OBJNAM to subset B
 - I_CRAC typo corrected
 - Attributes SYMINS and SMINSR replaced by newly defined attributes ICESYM and ICNSYM
 - Updated Introduction and Background and standardized formatting
- Formal adoption expected by October 2012 (ad-hoc ETSI during IICWG-XIII, Tromso, Norway)

JCOMM

Expert Team on Sea Ice

Electronic Chart Systems

Ice Objects Catalogue

Version 5.1

DRAFT FOR APPROVAL

February 2012

Proposed Secretarial Amendments

Prepared by:

John Falkingham, ENC Ice Objects Task Group Leader

Vasily Smolyanitsky, ETSI Chair

Ice objects classes in version 5.1

- 3 polygone classes (SEAICE, LACICE, BRGARE)
- 8 polyline classes (ICELNE, BGGLNE...)
- 17 point classes (ICECOM, ICELEA....)
- Supports both ice navigation and ice free navigation

Ice Object Class	Acronym	Code
Polygon		
Sea Ice	SEAICE	30 300
Lake Ice	LACICE	30 301
Iceberg Area	BRGARE	30 302
Polyline		
Ice Edge	ICELNE	30 320
Iceberg Limit	BRGLNE	30 321
Limit of Open Water	OPNLNE	30 322
Limit of All Known Ice	LKILNE	30 323
Line of Ice Ridge	I_RIDG	30 324
Line of Ice Lead	I_LEAD	30 325
Line of Ice Fracture	I_FRAL	30 326
Line of Ice Crack	I_CRAC	30 327
Point		
Ice Compacting	ICECOM	30 350
Ice Lead	ICELEA	30 351
Iceberg	ICEBRG	30 352
Floeberg	FLOBRG	30 353
Ice Thickness	ICETHK	30 354
Ice Shear	ICESHR	30 355
Ice Divergence	ICEDIV	30 356
Ice Ridge/Hummock	ICERDG	30 357
Ice Keel/Bummock	ICEKEL	30 358
Ice Drift	ICEDFT	30 359
Ice Fracture	ICEFRA	30 360
Ice Rafting	ICERFT	30 361
Jammed Brash Barrier	JMDBRR	30 362
Stage of Melt	STGMLT	30 363
Snow Cover	SNWCVR	30 364
Strips and Patches	STRPTC	30 365
Grounded Hummock	I_GRHM	30 366

Existing portrayal standards – WMO and IHO

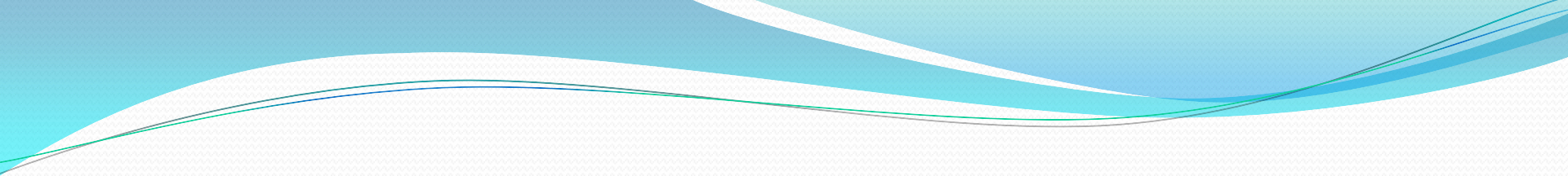
- Sea-ice symbols No.259 Vol 3
 - general graphic rules and patterns for symbols on ice charts
- Color standard for ice charts WMO/TD-No. 1215
 - Color schemes based on CT or SoD
- S-52 Preslib draft
 - CARYS/CIS Ice Coverage Portrayal Edition 1.0 (November 2008) based on IHO S-52
 - AARI/TRANSAS Presentation Schemes for Ice Objects (December 2009) defined in pseudo IHO S-52 Presentation library lookup tables

Table 1. Total Concentration Colour Code Standard

Colour		RGB colour model	Total concentration (definition from WMO Nomenclature)	Number from WMO Nomenclature
alternative	prime			
		000-100-255	Ice free	4.2.8
		150-200-255	Less than one tenth (open water)	4.2.6
		140-255-160	1/10 - 3/10 (very open ice)	4.2.5
		255-255-000	4/10 - 6/10 (open ice)	4.2.4
		255-125-007	7/10 - 8/10 (close ice)	4.2.3
		255-000-000	9/10 - 10/10 (very close ice)	4.2.2
		150-150-150	Fast ice	1.1.1
		210-210-210	Ice shelf	10.3
		255-255-255	Undefined ice	-
Optional		255-175-255	7/10-10/10 new ice	2.1
		255-100-255	9/10-10/10 nilas, grey ice (mainly on leads)	2.2, 2.4
Areas of No Information are annotated accordingly				

```

"SEAICE","ICEACT67IA_SFA??,??,??","SY(ICEINT01);SY(ICEICO18)"
"SEAICE","ICEACT70IA_SFA??,??,??","SY(ICEINT01);SY(ICEICO08)"
"SEAICE","ICEACT78IA_SFA??,??,??","SY(ICEINT01);SY(ICEICO19)"
"SEAICE","ICEACT80IA_SFA??,??,??","SY(ICEINT01);SY(ICEICO09)"
"SEAICE","ICEACT89IA_SFA??,??,??","SY(ICEINT01);SY(ICEICO20)"
"SEAICE","ICEACT90IA_SFA??,??,??","SY(ICEINT01);SY(ICEICO10)"
"SEAICE","ICEACT91IA_SFA??,??,??","SY(ICEINT01);SY(ICEICO11)"
"SEAICE","ICEACT92IA_SFA??,??,??","SY(ICEINT01);SY(ICEICO12)"
"SEAICE","ICEACT99IA_SFA??,??,??","SY(ICEBEL01);TX(?,1,2,2,16130,0,0,CHBLK,0)"
"SEAICE","ICEACT10ICEAPC?.?IA_SFA??,??,??,??IA_SFB??,??,??,??","SY(ICEINT01);SY(ICEICO02)"
"SEAICE","ICEACT12ICEAPC?.?IA_SFA??,??,??,??IA_SFB??,??,??,??","SY(ICEINT01);SY(ICEICO13)"
"SEAICE","ICEACT13ICEAPC?.?IA_SFA??,??,??,??IA_SFB??,??,??,??","SY(ICEINT01);SY(ICEICO03)"
"SEAICE","ICEACT20ICEAPC?.?IA_SFA??,??,??,??IA_SFB??,??,??,??","SY(ICEINT01);SY(ICEICO03)"
"SEAICE","ICEACT23ICEAPC?.?IA_SFA??,??,??,??IA_SFB??,??,??,??","SY(ICEINT01);SY(ICEICO14)"
"SEAICE","ICEACT30ICEAPC?.?IA_SFA??,??,??,??IA_SFB??,??,??,??","SY(ICEINT01);SY(ICEICO04)"
    
```



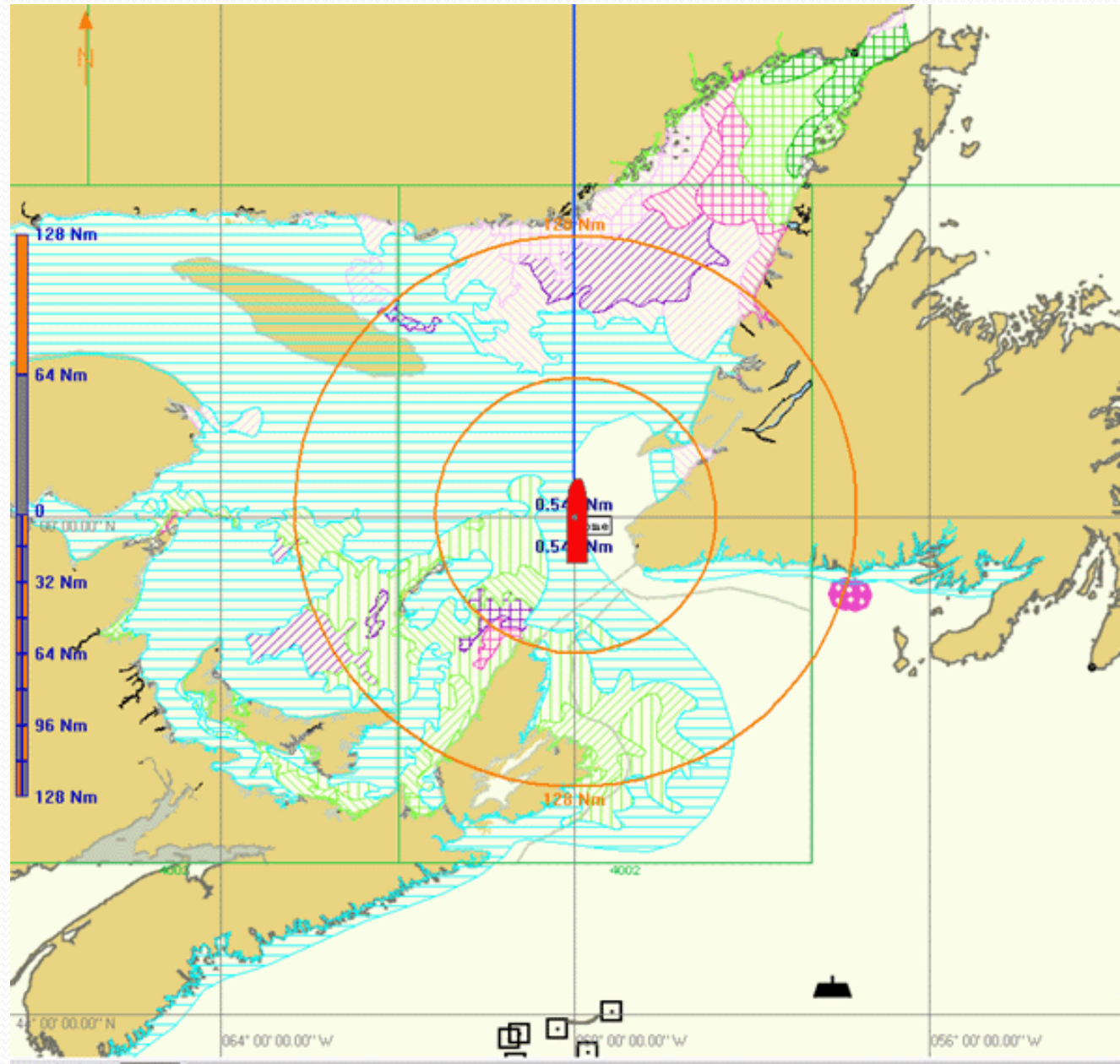
Ice Objects Catalogue implementation projects

- CIS (Canadian Ice Service) – CCG – ICAN
- AARI (Arctic and Antarctic Research Institute) -
TRANSAS

CIS-CCG-ICAN Pilot Project

- “Proof of concept”
- Ice Objects Catalogue version 4.0. taken as a base
 - Minor difficulties resolved with update to Ver 4.1
- Subset of Ice Objects reflecting the most important parameters for mariners
 - Not all Ice Objects included in product
- Ice attributes encoded in ice chart in accordance with WMO sea ice nomenclature
- Presentation via ICAN Aldebaran standard user definable zones as proxy for ice areas
 - No custom coding on ENCS
 - Visualization did not conform to WMO sea ice symbology

Canadian Ice Chart displayed on ICAN ENCS

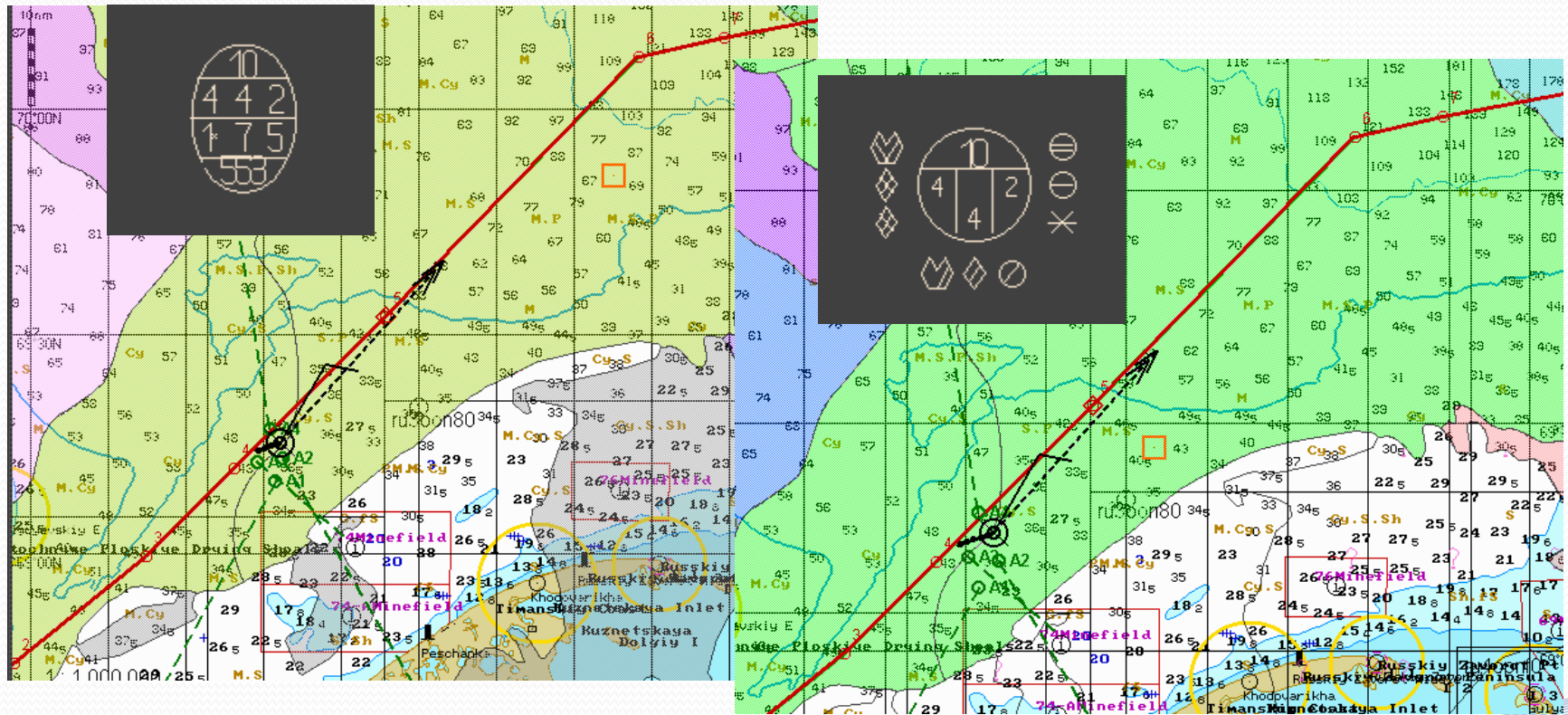


AARI-Transas Development

- “End-to-end” development
- Ice Objects Catalogue version 4.0. taken as a base
 - Additional Objects and Attributes added – update Ver 5.0
- Ice attributes encoded in ice chart in accordance with both WMO Russian national nomenclature
- Presentation rules defined in pseudo IHO S-52 Presentation library lookup tables
 - "SEAICE","ICEACT92ICEAPC?,?,?IA_SFA?/?/?/?/?IA_SFB?/?/?/?/?A_SFC?/?/?/?/?","SY(ICEBEL03);SY(ICENMB10)
 - ECDIS switch to allow presentation in either WMO international symbology or Russian national symbology
- Support for satellite imagery
- Near real-time data updates of information implemented

S-57 Ice charts

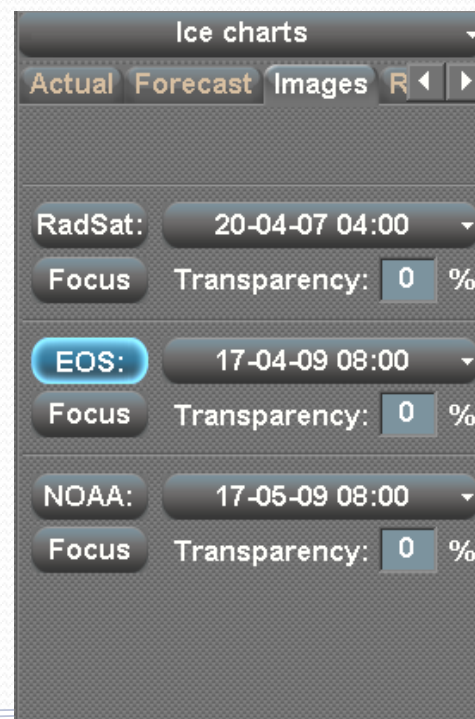
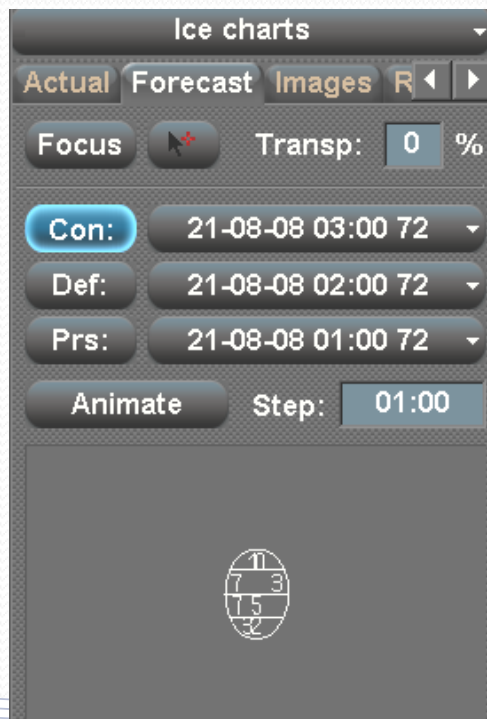
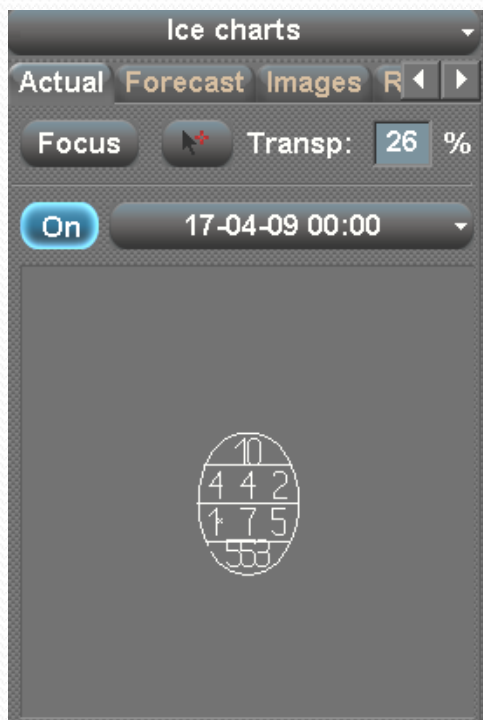
S-57 ice charts are displayed in ECDIS in conformity with Russian and International display regulations



Ice data management

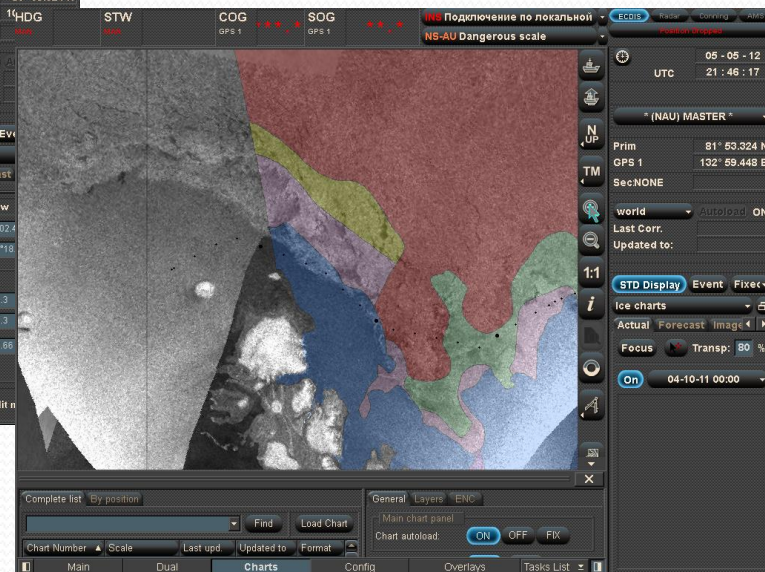
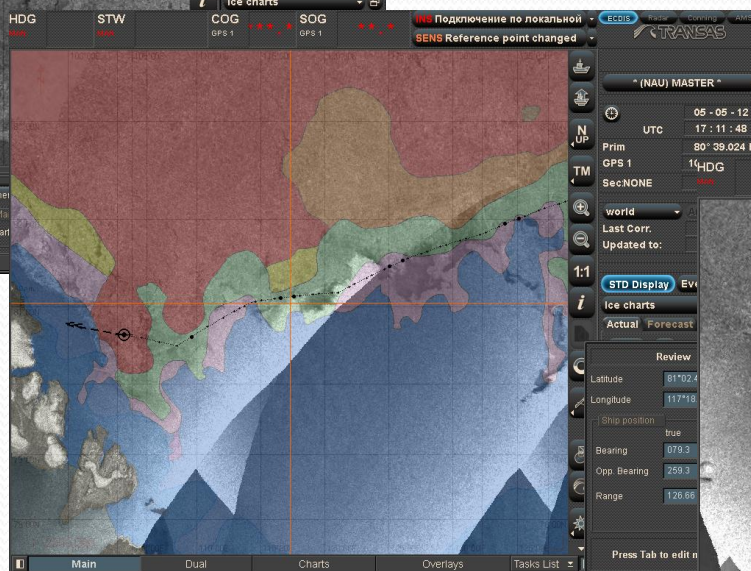
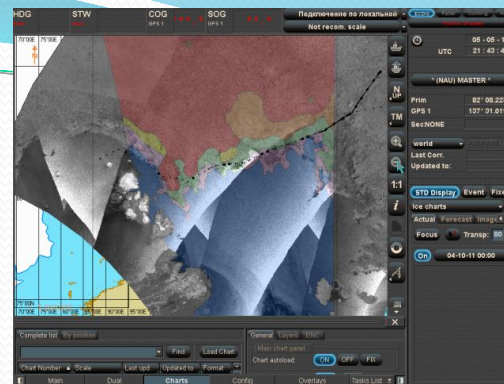
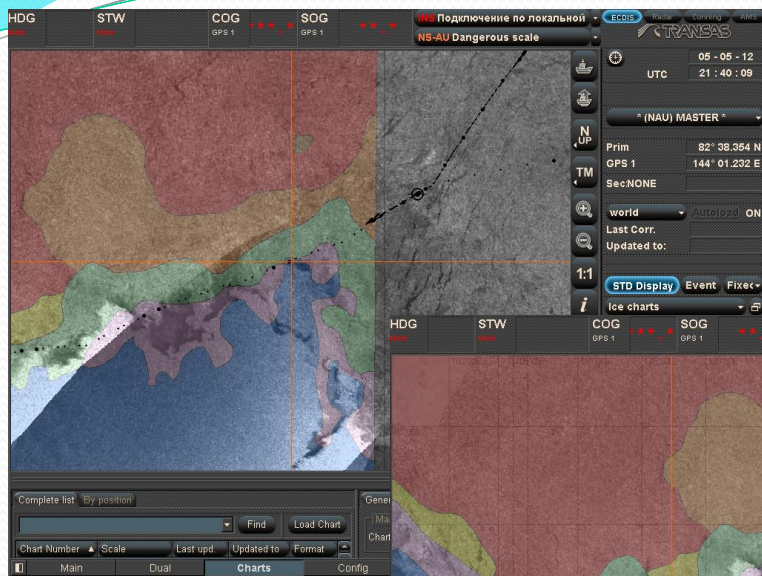
Main info panel consists of 4 pages

- Actual Ice Charts;
- Forecast Ice Charts;
- Raster Satellite Images;
- Recommended routes;

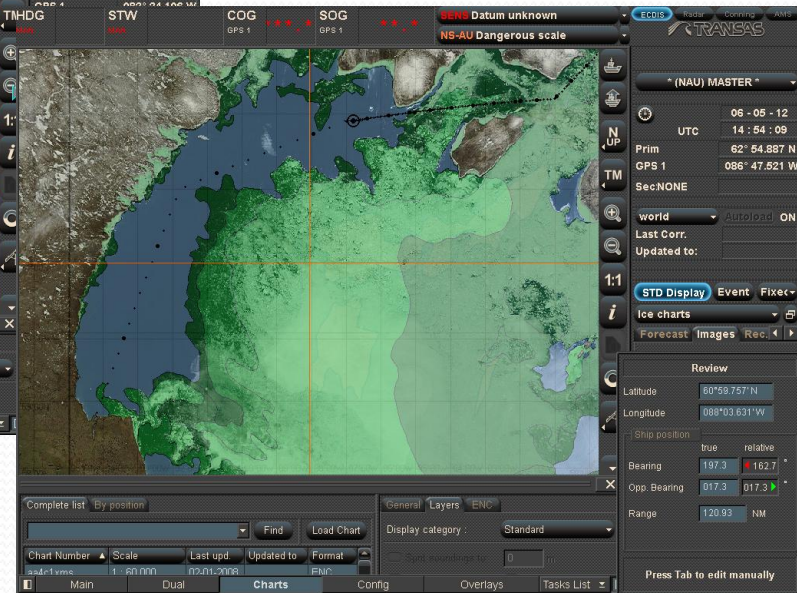
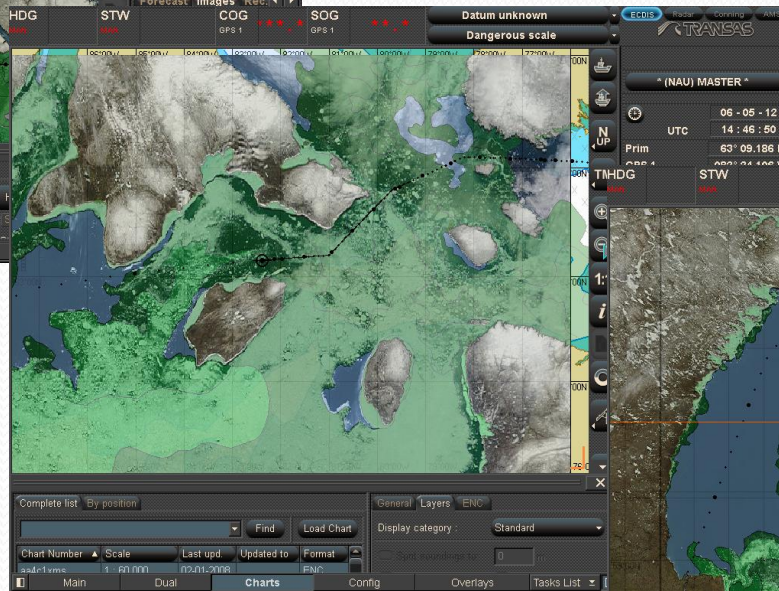
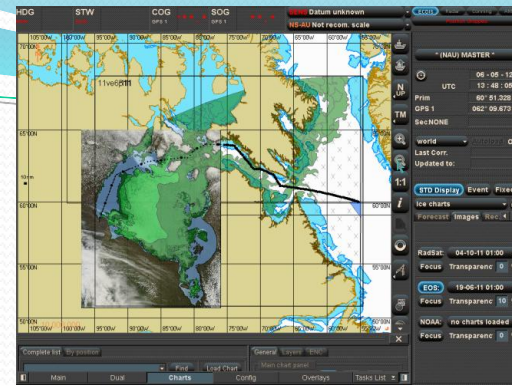
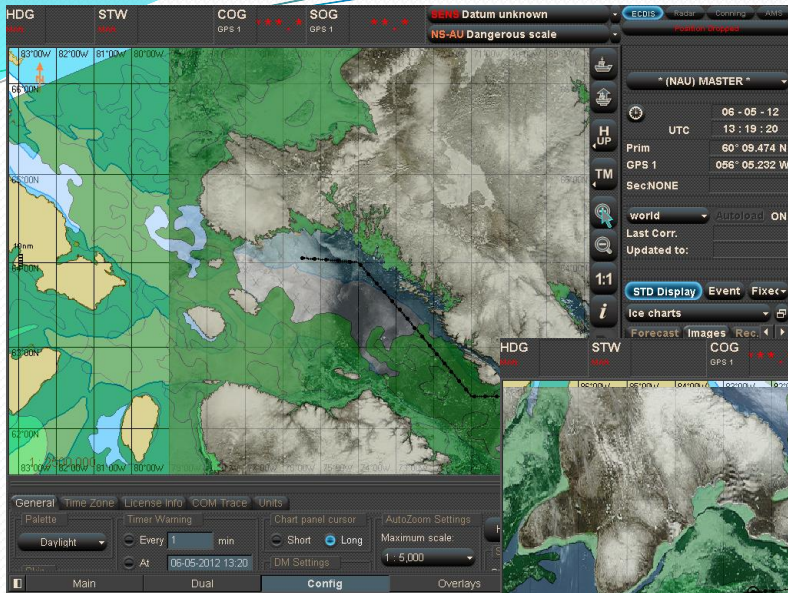


Status of support for ice charts and imagery in TRANSAS NaviSailor ECDIS (based on ver 5.0)

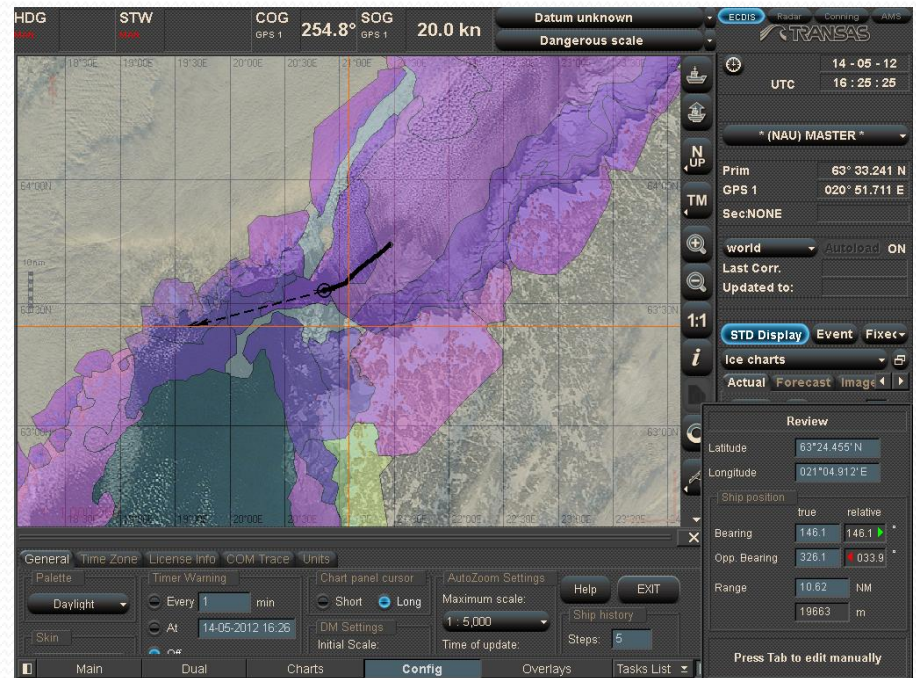
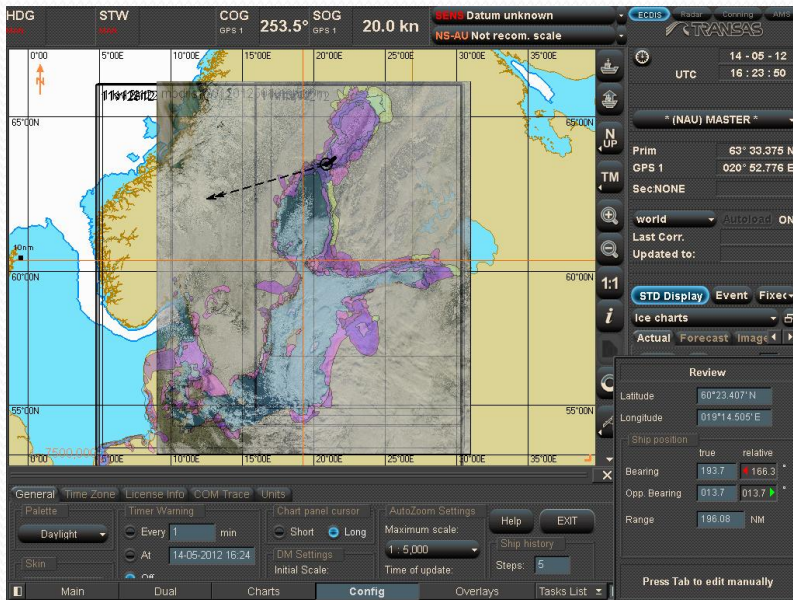
- Ice charts and imagery are displayed as MIO layers with a chosen level of transparency
- **Interoperability** for ice charts presentation is gained, i.e. the system is capable to receive and show **any** diagnostic and forecast ice chart converted to S-57 from WMO SIGRID-3 format (AARI, HMC Moscow, BSH, CIS, USA NIC.....)
- Satellite imagery (high, medium, low) in GeoTIFF/JPEG2000 is supported
- Support for other MSI is currently provided in manufacturer-formalized TRANSAS Navi-Planner ECDIS



AARI regional ice chart for Laptev Sea and ENVISAT 1 km 1d mosaic for 2011-10-04 displayed as Ice Chart S-57 and GeoTIFF/JPEG2000 MIOs in TRANSAS NaviSailor 4000 ECDIS with icebreaker [“Rossiya”] simulated track

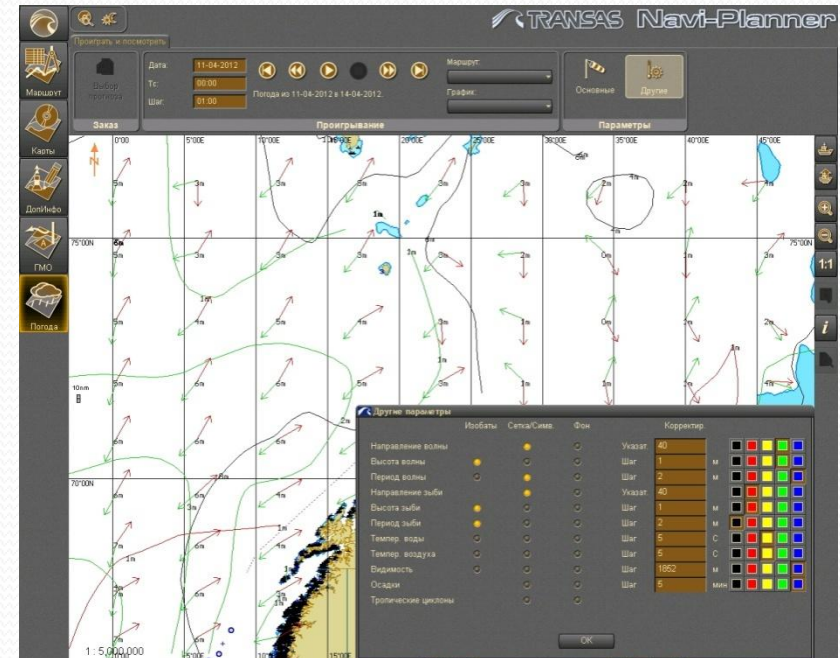
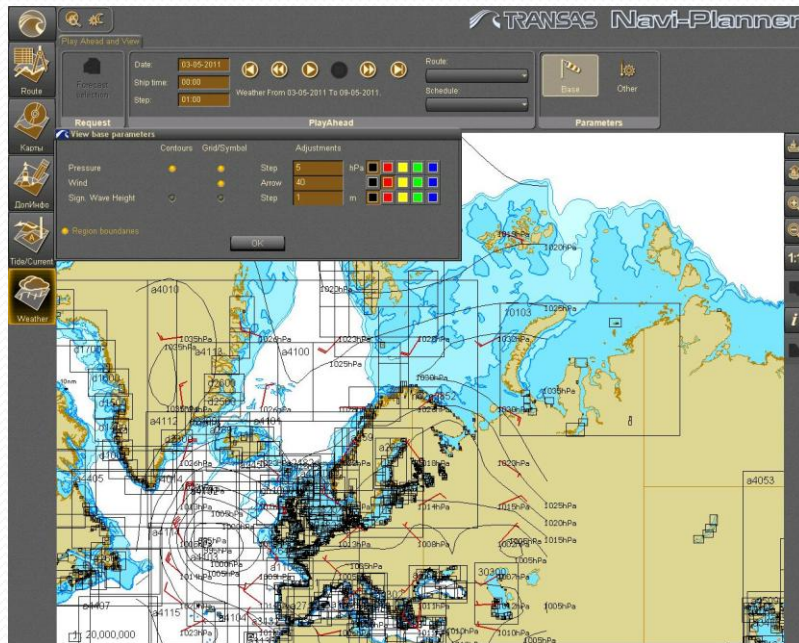


CIS regional ice chart for Hudson Bay and MODIS 1d mosaic for 2011-06-20 displayed as Ice Chart S-57 and GeoTIFF/JPEG2000 MIOs in TRANSAS NaviSailor 4000 ECDIS with an icebraking cargo vessel simulated track going through Hudson Strait to Churchill port



BSH – German ice service ice charts for the Baltic Sea for 2012-01-25 displayed as Ice Chart S-57 and GeoTIFF/JPEG2000 MIOs in TRANSAS NaviSailor 4000 ECDIS

Support for Marine Objects Catalogue classes in manufacturer-formalized by JCOMM TRANSAS Navi-Planner ECDIS



Atmosphere pressure and wind vectors (left) and sea wave parameters (right) - wind wave height, period and direction, swell height, period and direction.

*Any wave parameters can be displayed: combined or separately. Sea wave information. Sea wave information in WMO GRiB was taken from the wave model developed at AARI.

Next Steps (key tasks/activities)

- **ETSI formal management of Ice Objects Catalogue**
 - Harmonize and regular update IHO registry (do we need to keep ICEARE ?)
 - Extension of parameters list (e.g. edge → climatic median edge)
 - Geometry and attributes testing (mostly linear and point)
 - Codify portrayal, naming conventions, file structure rules
 - Define distribution and encryption means
- **ETSI develop standard at IHO as S-10x**
 - Follow procedures in IHO S-99 and S-100
 - Develop catalogue and presentation library as a single standard
 - Support for annotated satellite imagery
- **ENCS manufacturers and OGC develop software to accept ice data**
 - Produce test data sets and conduct trials
 - Support for sea ice in S-57/S-100 format in GIS, OpenGIS and ECDIS
- **Nat'l ice services develop capability/begin production of S-57/S-1xx data files**
 - Ensure interoperability of products and their presentation
 - Make products available to service providers or directly to end users
 - Service providers (e.g. PolarView, Ice Logistics Portal) could collect the data from national providers and deliver to ECDIS as regular subscription
- **Support implementation of MetOcean Catalogue** and standardizing the WMO formats for gridded data (GRIB etc) for S-1xx

Roadmap for Sea Ice in ECDIS: 2012- 2013

- **Preparation of a draft S-107 (or other number 10x)**
 - Delineation of explicit sea ice part within the S-100 framework. A first draft may be ready for discussion by correspondence by June 2012.
 - After incorporating changes the draft will be presented at the IICWG meeting in Tromsø in October
- **Preparation of a portrayal registry for the most commonly used parameters of the ice objects catalog**
 - As the specific technical/formal implementation of the S-100 portrayal registry is still being discussed at IHO, only preliminary steps are possible in the next months of .
 - The actual WMO nomenclature Volume 3 will be described using XML, as the chances of an, at least in parts, XML based registry is high. Then some ideas for a portrayal scheme that can be used in an ECDIS system overlaying an ENC will be prepared and circulated before the next IICWG meeting, so they can be discussed at these meeting.
- **Formalization of ideas and proposals reached at the IICWG**
 - should be discussed by ETSI-5th session preferable after October 2012 and before April 2013
 - Formal presentation of the draft for S-107 and the portrayal registry at an IHO meeting for official IHO approval (over WMO or an official IHO member institution like BSH) after the ETSI-5th session

Thank you for attention

Questions ?

