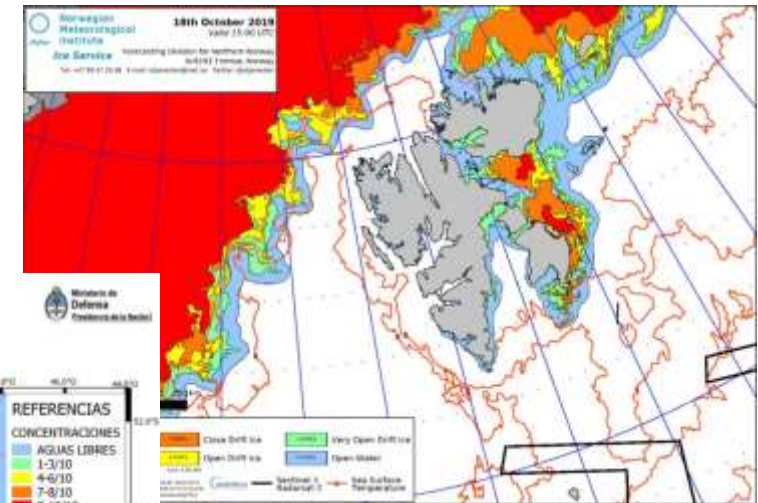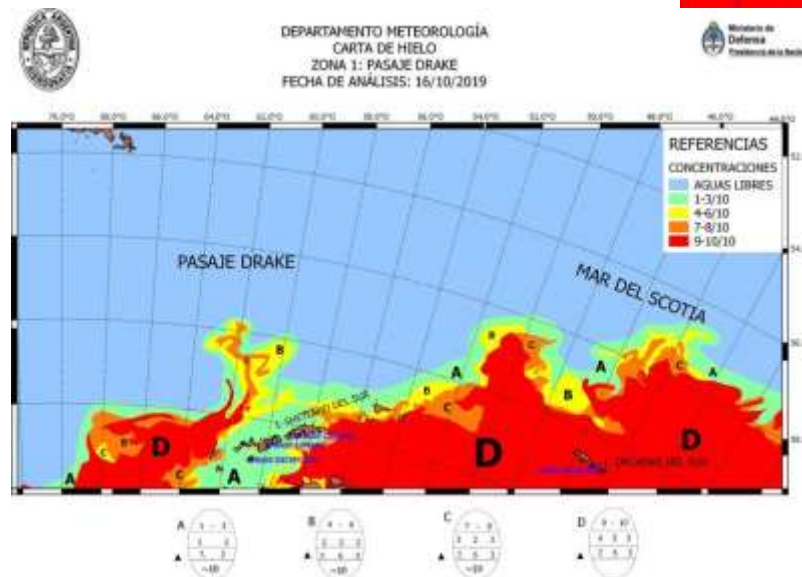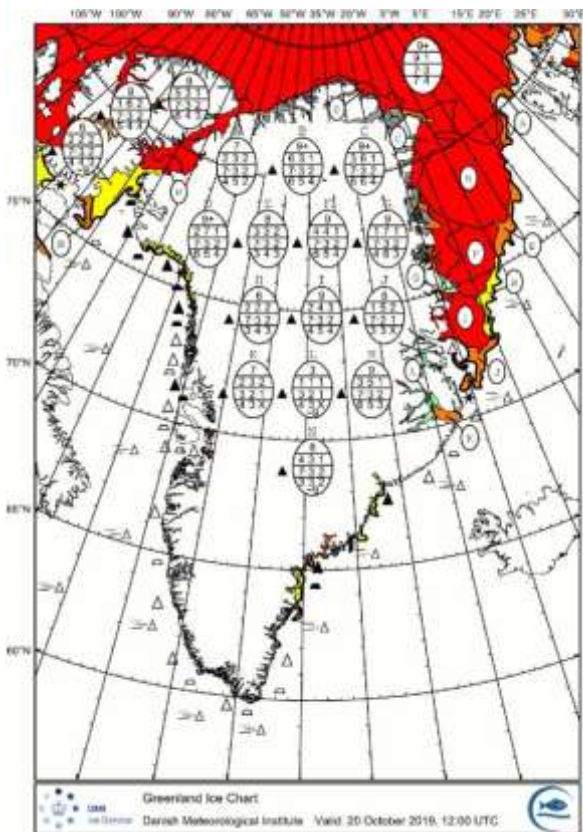# S-411   Ice in Ecdis

Dr. Jürgen Holfort

S411 Ice in ECDIS

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

History of S-411

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

December 2013: first operational S-411 ice charts available and viewable in GIS programs.

June 2014: S-411 Ice Information Product Specification approved

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

INTERNATIONAL HYDROGRAPHIC ORGANIZATION
JCOMM

Ice Information Product Specification

Edition 1.1.8, June 2014

Special Publication JCOMM S-411

Published by the
International Hydrographic Bureau
4, Quai Antoine 1er
B.P. 445 - MC 98011 MONACO Cedex
Principauté de Monaco
Telefax: (377) 93 10 81 40
E-mail: info@ihb.mc
Web: www.iho.int

History of S-411

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

December 2013: first operational S-411 ice charts available and viewable in GIS programs.

June 2014: S-411 Ice Information Product Specification approved

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

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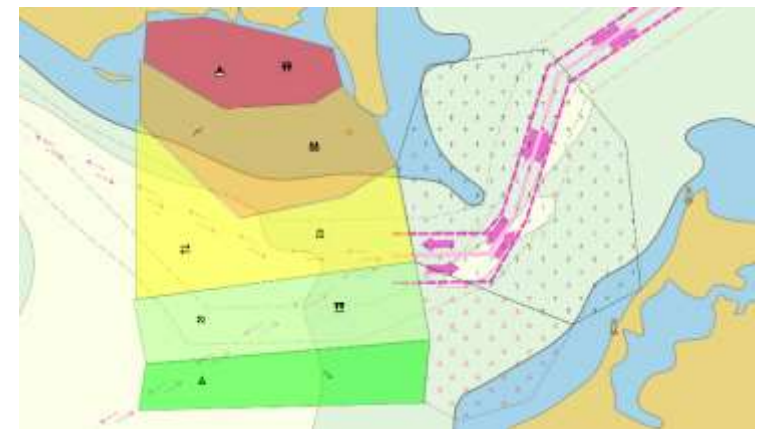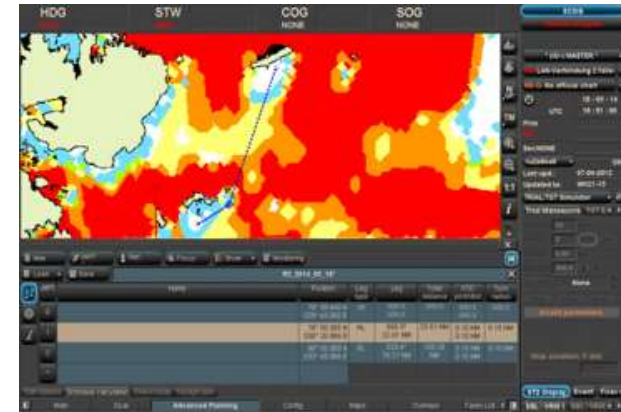
Structure

S-411 is fully based on :

      IHO S-100 (Version 1.0) framework specification,

      Geography Markup Language (GML) Encoding Standard

      ISO 19100 series of standards.

data/ is a subdirectory with the dataset (*.gml) in
            GML 3.2.1 format
support/ is a subdirectory with support files
        *.sld contains display rules (Symbology
        Encoding V.1.1.0 from OGC.)
        *.gml.xml contains the ISO 19139 Metadata
CATALOG.ICE is the metadata file (XML) for the whole
        Exchange Set

Structure

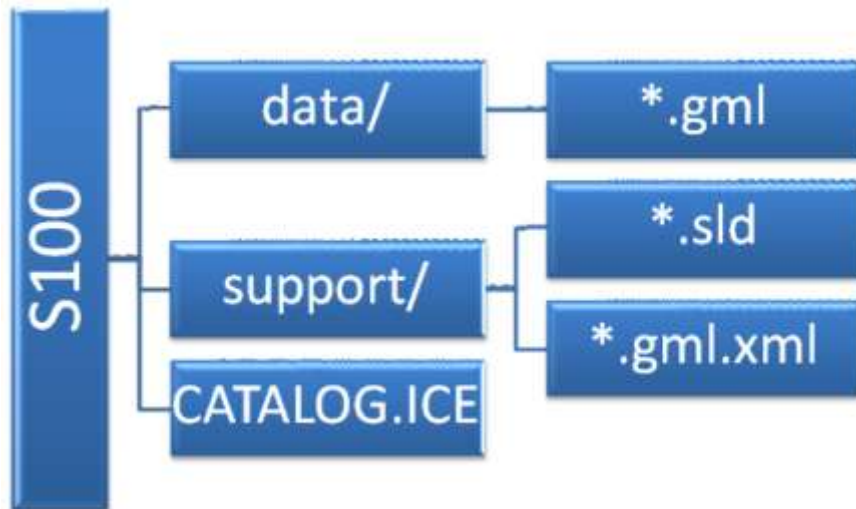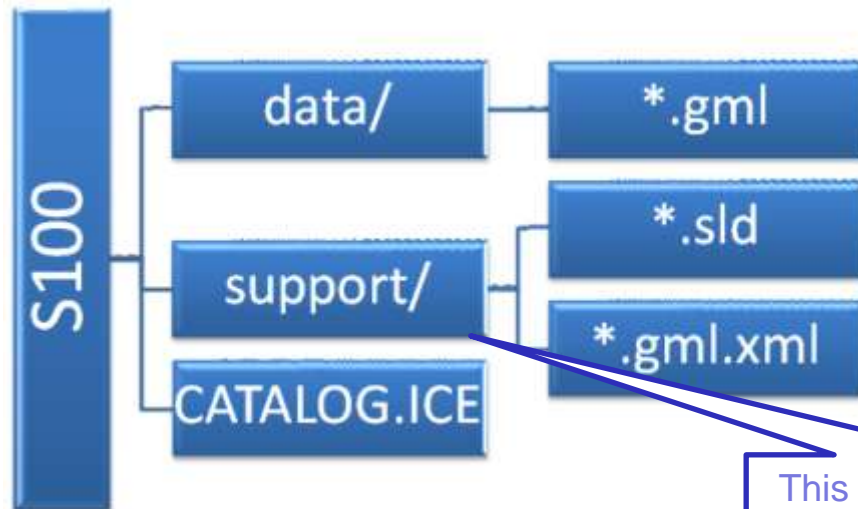The actual S-100 version 5.0 has more than 700 pages compared to the 329 pages of version 1.0

S-411 is fully based on :
>   IHO S-100 (Version 1.0) framework specification,
>   Geography Markup Language (GML) Encoding Standard
>   ISO 19100 series of standards.

data/ is a subdirectory with the dataset (*.gml) in GML 3.2.1 format
support/ is a subdirectory with support files
>   *.sld contains display rules (Symbology Encoding V.1.1.0 from OGC.)
>   *.gml.xml contains the ISO 19139 Metadata
CATALOG.ICE is the metadata file (XML) for the whole Exchange Set

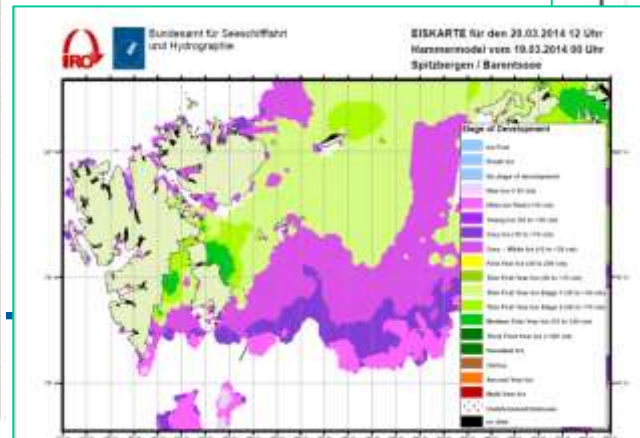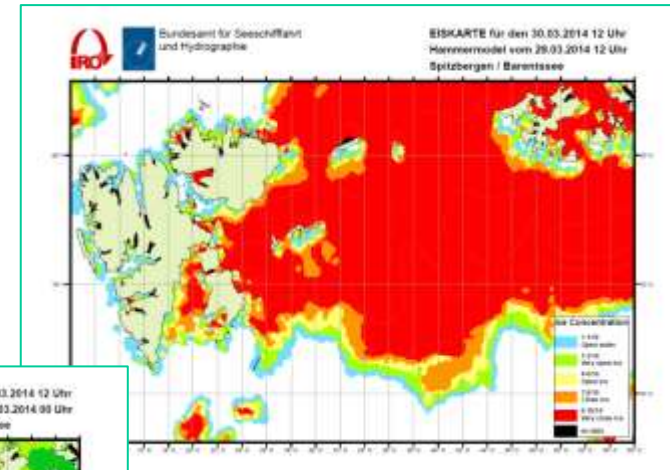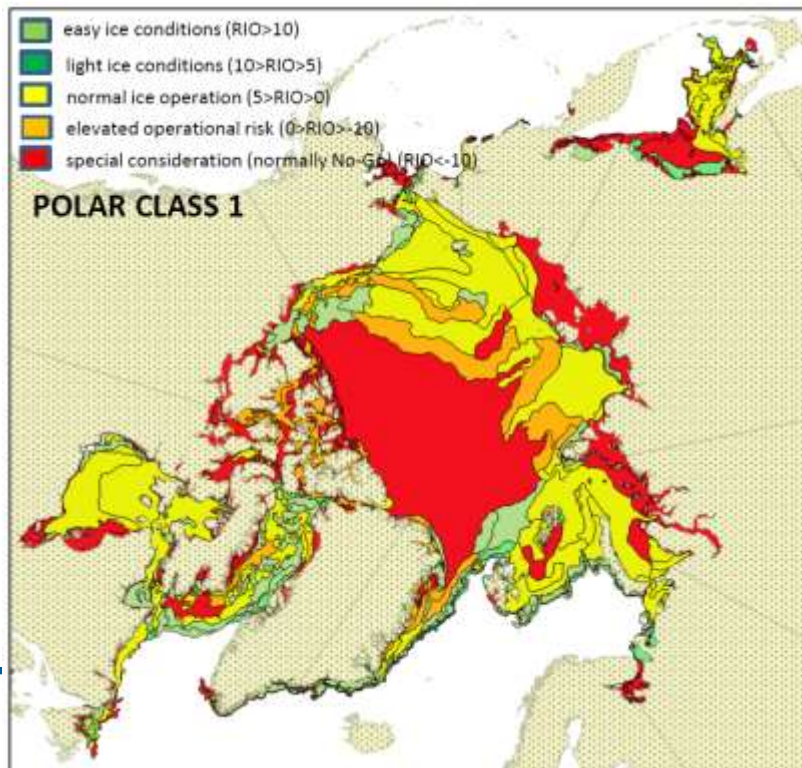This is a place for additional data like satellite pictures

Content

S411 is a vector product using S-100 Level 3a geometry which supports 0-, 1-, and 2-dimentional objects (points, line strings, polygons). The application schema contains 28 feature types with their attributes, enumerations and is based on the Ice Objects Catalogue.

Ice Object Class:	Sea Ice
Acronym:	SEAICE
Code:	30300
subset 'Attribute_A':	ICEACT; ICEAPC; ICESOD; ICEFLZ; ICESPC; ICELVL; ICECST; ICEFTY; ICEDSP; ICEDDR; ICERCN; ICERFQ; ICERMH; ICERXH; ICERDV; ICEKCN; ICEKFQ; ICEKMD; ICEKXD; ICEFCN; ICETCK; ICEMAX; ICEMIN; ICETTY; ICEMLT; ICESCN; ICESCT; ICEDOS; ICELST; ICELFQ; ICELOR;ICELWD; IA_SFA; IA_SFB; IA_SFC; IA_FFA; IA_FFB; IA_FFC; IA_SNG; IA_MLT; IA_PLG; IA_HLG; IA_DUG
subset 'Attribute_B':	NOBJNM; OBJNAM; INFORM; NINFOM; SCAMIN; SCAMAX; TXTDSC; NTXTDS; PICREP; ICESYM; ICNSYM
subset 'Attribute_C':	RECDAT; RECIND; SORDAT; SORIND;
Geometric Primitive:	Area
Definition:	Sea Ice is an area at sea that is covered, in whole or in part, with ice.
References:	"Workshop on International Standards for Ice Information in ECDIS," June 27-29, 1995, Canada/Germany/United States. "Ice in ECDIS Workshop," June 3-4, 2000, St. John's, Canada. "WMO Sea-Ice Nomenclature and International System of Sea-Ice Symbols", WMO Publication No. 259, Suppl. No. 5, 1989

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.

Portrayal

BUNDESAMT FÜR
SEESCHIFFFAHRT
UND
HYDROGRAPHIE

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.

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.
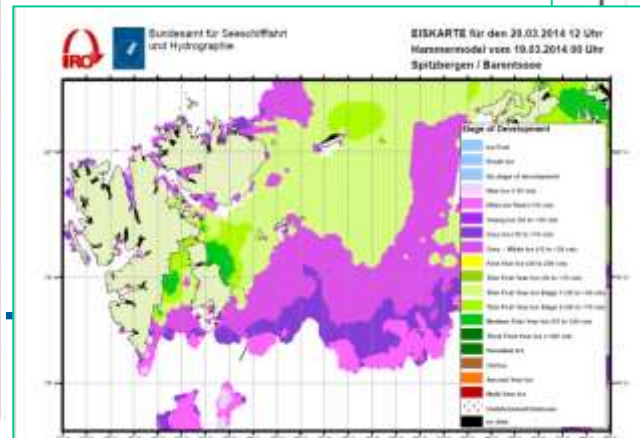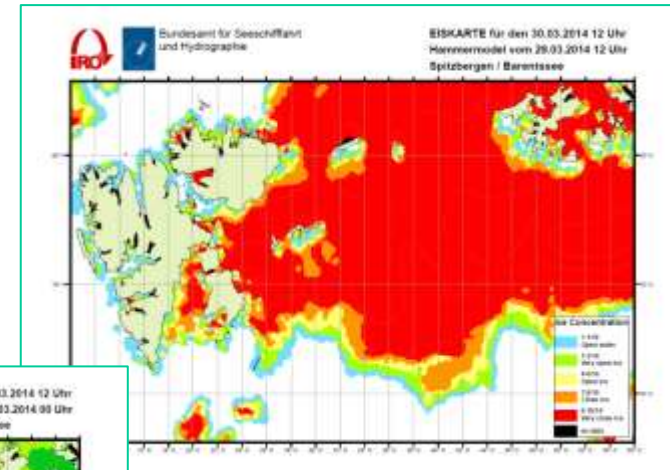
Lines and Symbols

Portrayals for line and point objects follow the WMO symbology and are implemented using SVG-graphics.

Availability of operational S411 charts

Ice Logistics Portal

World regions: Southern | Northern 90W | Northern 90E | MetAreas | Position   Home | Contact Us

- 411 ECDIS charts
- Actual S411 charts
- Background Information
  - Sea Ice Service of the World
  - Manual of Standard Procedures for Observing and Reporting Ice Conditions
  - SIGRID-3: A Vector Archive Format for Sea Ice Charts
  - Ice Chart Colour Code Standard
- Links
  - JCOMM-ETSI
  - GMDSS-MetArea

The Ice Logistics Portal was created as a joint initiative of the International Ice Charting Working Group, the JCOMM Expert Team on Sea Ice and Polar View for the International Polar Year. It is now maintained by the German Bundesamt für Seeschifffahrt und Hydrographie. It is intended to create a convenient point of access to operational sea ice information produced by the world's ice services. Access to products is provided via a series of pre-defined regions for both the Arctic and the Antarctic. Since the primary focus of the Ice Logistics Portal is on operational sea ice data (i.e. ice charts), only the most recent information is displayed for any given region.

Enter High Connection Speed Site - For broadband connection

Enter Low Connection Speed Site - Text only for dial-up connection

Charts from Argentina[*], Canada, Denmark, Finland[*], Germany[*], Norway, Poland[*], Russia, Sweden[*], USA.

Polar View — IPY Ice Logistics Portal

World regions: Southern | Northern 90W | Northern 90E | MetAreas | Position   Home | Contact Us

- Background Information
  - Sea Ice Service of the World
  - Manual of Standard Procedures for Observing and Reporting Ice Conditions
  - SIGRID-3: A Vector Archive Format for Sea Ice Charts
  - Ice Chart Colour Code Standard
- Links
  - JCOMM-ETSI
  - GMDSS-MetArea

S411 ice charts for ECDIS

The sea ice charts in S411 format are intended for the use in an ECDIS (or another GIS). Please contact your ECDIS Provider if your system is still not capable for this.

Available actual ice charts are:

- Alaska Waters from US_NWS (2019/10/19)
- Antarctica from AARI (2019/10/10)
- Antarctica from NIC (2019/10/10)
- Arctic from US NIC =>Quicklooks (2019/10/17)
- Greenland from DMI =>Quicklooks (2019/10/20)
- NorthWest-Greenland from DMI (2019/10/19)
- CentralWest-Greenland from DMI (2019/10/19)
- CentralEast-Greenland from DMI (2019/10/18)
- SouthEast-Greenland from DMI (2019/10/14)
- Cape Farewell from DMI (2019/10/19)
- Greenland Qaanaaq from DMI (2019/10/17)
- Northern North-Atlantic from Met.no (2019/10/18)

Availability of operational S411 charts

Ice Logistics Portal

jcomm

World regions: Southern | Northern 90W | Northern 90E | MetAreas |

- S411 ECDIS charts
- Actual S411 charts
- Background Information
  - Sea Ice Service of the World
  - Manual of Standard Procedures for Observing and Reporting Ice Conditions
  - SIGRID-3: A Vector Archive Format for Sea Ice Charts
  - Ice Chart Colour Code Standard
- Links
  - JCOMM-ETSI
  - GMDSS-MetArea

The Ice Logistics P...
Ice Charting Workin...
View for the Intern...
Bundesamt für Se...
convenient point of a...
world's ice servic...
defined regions for b...
of the Ice Logistics ...
the most rec...

Enter High Connecti...
- For broadband c...

Charts from Argentina[*], Can...
Germany[*], Norway, Poland[*],

But the Ice Logistics Portal will be incorporated into the Polar-View Portal (2023)

Production of S411 ice-charts will continue together with some form of web dissemination.

...e Logistics Portal

...E | MetAreas | Position   Home | Contact Us

...charts for ECDIS

...in S411 format are intended for the use in an ECDIS (or another GIS).
...ur ECDIS Provider if your system is still not capable for this.

...ce charts are:

- ...ers from US_NWS (2019/10/19)
- ...from AARI (2019/10/10)
- ...from NIC (2019/10/10)
- ...US NIC =>Quicklooks (2019/10/17)
- ...from DMI =>Quicklooks (2019/10/20)
- ...est-Greenland from DMI (2019/10/19)
- ...tralWest-Greenland from DMI (2019/10/19)
- CentralEast-Greenland from DMI (2019/10/18)
- SouthEast-Greenland from DMI (2019/10/14)
- Cape Farewell from DMI (2019/10/19)
- Greenland Qaanaaq from DMI (2019/10/17)
- Northern North-Atlantic from Met.no (2019/10/18)

BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE

S411 Ice in ECDIS

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

December 2013: first operational S-411 ice charts available and viewable in GIS programs.

June 2014: S-411 Ice Information Product Specification approved

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

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

Future work

Explore the interaction with other products like S-101 S-111,…, S-412,…

Examples of other S100 products:
* S-101 ENC (navigational charts) ➔
* S-111 Surface currents
* S-122 marine protected areas
* S-123 Marine radio services
* S-127 Marine Traffic management

Paper for Consideration by S-101PT

Improved data model for feature ICE AREA

Submitted by:	Germany
Executive Summary:	ICE Area should contain average ice extents, only.
Related Documents:	Data Classification and Encoding GuideEdition 1.1.0, Annex A, S-57 Ed.3.1
Related Projects:	S-101

Introduction / Background

Ice Area should be used for depiction of permanent ice structures such as glaciers or shelf ice. In case of polar ice or fast ice the object should be used to show average ice extents with a specific ice concentration for defined period of time, only. The object should not be used to publish actual ice information, because this is done by S-411 data.

Future work

Explore the interaction with other products like S-101 S-111,…, S-412,…

Examples of other S100 products:
• S-101 ENC (navigational charts) ➔
• S-111 Surface currents
• S-122 marine protected areas
• S-123 Marine radio services
• S-127 Marine Traffic management

? Should we be responsible for the climatological information in S-101 ?

? And also for the actual shelf ice (glacial) extent ?

Paper for Consideration by S-101PT

Improved data model for feature ICE AREA

Submitted by:	Germany
Executive Summary:	ICE Area should contain average ice extents, only.
Related Documents:	Data Classification and Encoding GuideEdition 1.1.0, Annex A, S-57 Ed.3.1
Related Projects:	S-101

Introduction / Background

Ice Area should be used for depiction of permanent ice structures such as glaciers or shelf ice. In case of polar ice or fast ice the object should be used to show average ice extents with a specific ice concentration for defined period of time, only. The object should not be used to publish actual ice information, because this is done by S-411 data.

Update S-411 to S-100 Version 5

- GML format is fine in version 5
- EPSG?? as Coordinate Reference System is fine in version 5
- Structure of Ice objects catalog is fine for version 5, but need updates of content
- Imagery/gridded data (in support dirctory) is probably fine, but needs more description (but up till now no data received)

- Portrayal needs work ➔ next page

Future work -Portayal-

From S-100 version 4: "*For example a product specification would include an input Schema derived from the abstract schema provided herein, a set of mapping rules, a set of symbols, linestyles, colors etc and make it available for use with product datasets.*"

Basic rules, symbols, linestyles and colors are given in S-411

- But only the real basics
- Needs updates for icebergs (also in the ice objects catalog)
- SLD rules have to be rewritten into XSLT or rules using the LUA programming language (this would also allow to calculate risk indexes directly)

Future work -Portayal-

From S-100 version 4: "*For example a product specification would include an input Schema derived from the abstract schema provided herein, a set of mapping rules, a set of symbols, linestyles, colors etc and make it available for use with product datasets.*"

Basic rules, symbols, linestyles and colors are given in S-411
- But only the real basics
- Needs updates for icebergs (also in the ice objects catalog)
- SLD rules have to be rewritten into XSLT or rules using the LUA programming language (this would also allow to calculate risk indexes directly)

Most of the work required to update S-411 to S-100 version 5 is of a more technical nature.

But XSLT or LUA are very powerful (e.G. possible interactions between different features; scale dependency; …) and the questions to ice services and their customers is more

"What should modern electronic ice charts look like?"

(also in interaction with other parameters).

Ice objects catalog changes/updates

Ice Keel Frequency	ICEKFQ	30 332
Ice Keel Mean Depth	ICEKMD	30 333
Ice Keel Maximum Depth	ICEKXD	30 334
Ice Rafting Concentration	ICEFCN	30 335
Ice Stage of Development and Floe Size for the 1st p.c.	IA_SFA	30 336
Ice Stage of Development and Floe Size for the 2nd p.c.	IA_SFB	30 337
Ice Stage of Development and Floe Size for the 3rd p.c.	IA_SFC	30 338
Ice Breccia for the 1st partial concentration	IA_FFA	30 339
Ice Breccia for the 2nd partial concentration	IA_FFB	30 340
Ice Breccia for the 3rd partial concentration	IA_FFC	30 341
Snow concentration	IA_SNG	30 344
Stage of melting	IA_MLT	30 345
Contamination	IA_PLG	30 346

I have never seen them in the wild.

Ice objects catalog changes/updates

Definitions: IA_SFA describes combination(s) of Ice Stage of Development and Floe Size for the first partial concentration in an ice area. Up to three (stage of development / form of ice) combinations are allowed to describe the ice in the first partial concentration group.

References:

Distinction: ICESOD, ICEFLZ, IA_FFA

Remarks: IA_SFA, IA_SFB and IA_SFC present an alternative encoding to ICESOD and ICEFLZ under the following rules:

Major stages of development (old, first-year, young, new) shall be delineated by different partial concentrations in ICEAPC

Stages of development belonging to the same major stage may be encoded inside using both single or different partial concentrations

Up to three forms of ice are allowed for each partial concentration group
SS / FF
SS / FF, SS / FF
SS / FF, SS / FF, SS / FF

An alternative to stage of development but not defined in POLARIS, so it cannot be used in risk assessment.

Suggestion:
Keep as a legacy, but not recommended for actual use.

Ice objects catalog : the ice egg

ICEACT

ICEAPC-a   ICEAPC-b   ICEAPC-c

ICESOD-0   ICESOD-a   ICESOD-b   ICESOD-c   ICESOD-d

ICEFLZ-a   ICEFLZ-b   ICEFLZ-c

There can be up to 3 partial concentrations, up to 5 stages of development (2 with implied partial concentrations) and up to 3 floe sizes.
Normally there are all related, but floe sizes can also be reported as primary and secondary, without relation to stage of development.

Figure 3.1: The Egg Code

From the Canadian ManIce.

Ice objects catalog : the ice egg

ICEACT

	ICEAPC-a	ICEAPC-b	ICEAPC-c	
ICESOD-0	ICESOD-a	ICESOD-b	ICESOD-c	ICES
	ICEFLZ-a	ICEFLZ-b	ICEFLZ-c	

There can be up to 3 partial concentrations, up to 5 stages of development (2
with implied partial concentrations) and up to 3 floe sizes.
Normally there are all related, but floe sizes can also be reported as primary
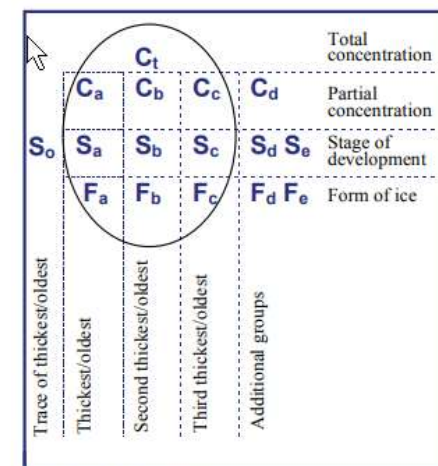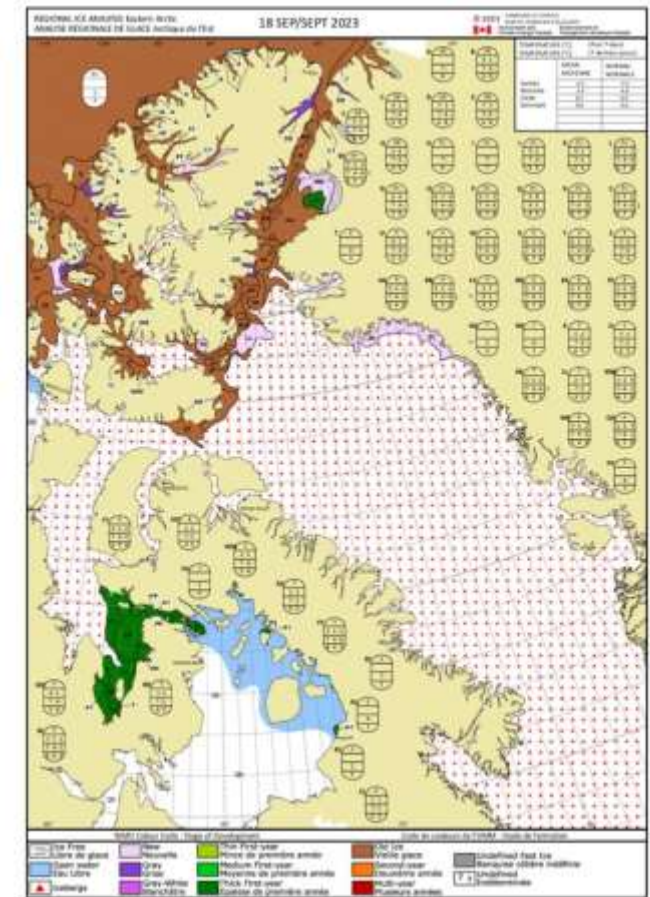and secondary, without relation to stage of development.

Suggestion:
Drop / forget / delete the ice egg !

ICEACT unchanged
1 to x values for ICEAPC   with the addition of a „traces" concentration
1 to x values of ICESOD   same number as ICEAPC
1 to x values of ICEFLZ   same number as ICEAPC

In addition other attributes; which normally has length=1 like ice ridge concentration/ classification/ frequency,… ; are also allowed to have the same length of ICEAPC so possibly differentiate between different partial concentrations.

With additions of other ids to ICESOD and ICEFLZ it should also be possible to use this schema for brash ice areas (actual attribute ICEBRS)

If ice services restrict themselves to a maximum of 5 values, an ice egg is still a feasible representation.

Ice objects catalog : the NEW ice egg

ICEACT unchanged
1 to x values for ICEAPC with the addition of a „traces" concentration
1 to x values of ICESOD same number as ICEAPC
1 to x values of ICEFLZ same number as ICEAPC

In addition other attributes; which normally has length=1 like ice ridge concentration/ classification/ frequency,… ; are also allowed to have the same length of ICEAPC so possibly differentiate between different partial concentrations.

With additions of other ids to ICESOD and ICEFLZ it should also be possible to use this schema for brash ice areas (actual attribute ICEBRS)

If ice services restrict themselves to a maximum of 3/5 values, an ice egg is still a feasible representation.

In S-411 version 2, an ice chart must have ICEAPS and ICESOD values, or it is considered to be of limited use (as no risk assessment values are possible).

S-411 version 2?

As S-411 does not include land information, polygons which are adherent to land should be closed inland, so other land masks do not lead to coastal polynyas.

S-411 will prescribe, that for portrayal the actual land mask is used to cut the ice polygons. If not available there will be a standard land mask definition available, perhaps different for different scales. But if the used land masked is given prior to the S-411 production, it should be technically possible to make the extension of the polygons over land programmatically

Polygons are defined by points connected by straight lines.

There is also the possibility to use splines to connect the points, but used with separated polygons this could lead to overlaps or gaps. Nice smooth polygons can be made using GIS smoothing producing many points (and increasing file size)

?The polygons can also be defined using a coverage?

This would even allow to implement scale dependent smoothing in the portrayal without needs to bother about overlaps and gaps.

???

"What should modern electronic ice charts look like?"

Displayed over an electronic navigational chart

and the addition of other meteorological and oceanographic parameters

and at different scales.

Thanks!

Vielen Dank!