INTERNATIONAL HYDROGRAPHIC ORGANIZATION

JCOMM

Ice Information Product Specification

Edition 1.1.0, June 2014

Special Publication JCOMM S-411

Version Number	Date	Author	Purpose
1.0.0	28.02.2014	Alexander Benke	
1.1.0	15.06.213	Jürgen Holfort	Clarifications in the based on ETSI Meeting 2014 and new color for 10/10.

Contents

1 Overview

This document has been produced by the BSH as part of JCOMM/ETSI in response to a requirement to produce an ice data product that can be used within Electronic Chart Display and Information Systems.

1.1 Introduction

The Ice Information product specification is based on the IHO S-100 framework specification, Geography Markup Language (GML) Encoding Standard and the ISO 19100 series of standards. It is a vector product specification that is primarily intended for encoding the extent and nature of Sea Ice for navigational purpose.

1.2 References

S-100   IHO Universal Hydrographic Data Model
GML   OpenGIS® Geography Markup Language (GML) Encoding Standard (Version 3.2.1)

1.3 Terms, definitions and abbreviations

1.3.1 Use of Language

- "Must" indicates a mandatory requirement.
- "Should" indicates an optional requirement, that is the recommended process to be followed, but is not mandatory.
- "May" means "allowed to" or "could possibly", and is not mandatory.

1.3.2 Terms and Definitions

1.3.3 Abbreviation

CRS	Coordinate Reference System
ECDIS	Electronic Chart Display Information System
EPSG	European Petroleum Survey Group
ENC	Electronic Navigational Chart
IHO	International Hydrographic Organization
IMO	International Maritime Organization
ISO	International Organization for Standardization
GML	Geography Markup Language
ETSI	Expert Team on Sea Ice

1.4 General Data Product Description

Title:	**Ice Information**	
Abstract:	**Ice information for ship navigation**	
Content:	**Ice features as vector data**	
Spatial Extent:		
	Description:	
	East Bounding Longitude:	-180
	West Bounding Longitude:	180
	North Bounding Latitude:	90
	South Bounding Latitude:	-90
Purpose:	**Navigation in ice covered regions**	

1.5　Data product specification metadata

Title:	**Ice Information Product Specification**
S-100 Version:	**1.0.0**
S-411 Version:	**1.0.0**
Date:	**28.02.2013**
Language:	**English**
Contact:	**Jürgen Holfort (ice@bsh.de)**
Identifier:	**JCOMM S-411**
Maintenance:	**Changes to this product specification are coordinated by ETSI.**

1.5.1　Product Specification Maintenance

1.5.1.1　Introduction

Changes to JCOMM S-411 will be released by the IHO as a new edition, revision, or clarification.

1.5.1.2　New Edition

New Editions of S-10n introduce significant changes. New Editions enable new concepts, such as the ability to support new functions or applications, or the introduction of new constructs or data types. New Editions are likely to have a significant impact on either existing users or future users of S-10n.

1.5.1.3　Revisions

Revisions are defined as substantive semantic changes to S-10n. Typically, revisions will change S-10n to correct factual errors; introduce necessary changes that have become evident as a result of practical experience or changing circumstances. A revision must not be classified as a clarification. Revisions could have an impact on either existing users or future users of S-10n. All cumulative clarifications must be included with the release of approved corrections revisions. Changes in a revision are minor and ensure backward compatibility with the previous versions within the same Edition. Newer revisions, for example, introduce new features and attributes. Within the same Edition, a dataset of one version could always be processed with a later version of the feature and portrayal catalogues. In most cases a new feature or portrayal catalogue will result in a revision of S-10n.

1.5.1.4　Clarification

Clarifications are non-substantive changes to S-10n. Typically, clarifications: remove ambiguity; correct grammatical and spelling errors; amend or update cross references; insert improved graphics in spelling, punctuation and grammar. A clarification must not cause any substantive semantic change to S-10n. Changes in a clarification are minor and ensure backward compatibility with the previous versions within the same Edition. Within the same Edition, a dataset of one clarification version could always be processed with a later version of the feature and portrayal catalogues, and a portrayal catalogue can always rely on earlier versions of the feature catalogues. Changes in a clarification are minor and ensure backward compatibility with the previous versions

1.5.1.5　Version Numbers

The associated version control numbering to identify changes (n) to S-10n must be as follows:
New Editions denoted as **n**.0.0
Revisions denoted as n.**n**.0
Clarifications denoted as n.n.**n**

2   Specification Scopes

2.1   General Scope

Scope Identification: JCOMM S-411 dataset

Hierarchical Lelvel: MD_ScopeCode -005

Hierarchical Level Name: dataset

Extent: EX_GeographicExtent -Global coverage of maritime areas.
EX_TemporalExtent -Not defined for this product specification.
EX_VerticalExtent-Not defined for this product specification.

3   Data Product Identification

Title: Ice Information

Abstract: Ice Information for navigation in ice covered regions

Topic Category: transportation, climatologyMeteorologyAtmosphere

Geographic Description: Ice covered regions

Spatial Resolution: ---

Purpose: Navigation in ice covered regions

Language: English (optional additional)

Classification: Unclassified

Spatial Representation Type: vector

Point of Contact: Producing Agency

Use Limitation: ---

4 Data Content and Structure

4.1 Introduction

The application schema of ice information product contains 28 feature types with their attributes, enumerations etc. It is based on the ice objects catalogue (Version 5.1) and can also be found in the ICE domain of the IHO Registry. Because of this it is not possible to describe full schema in suitable form in this specification. The full schema can be found as XML Schema File in Annex B – Data Product format (encoding).

4.2 Application Schema

Picture below shows very simplified structure of ice data structure
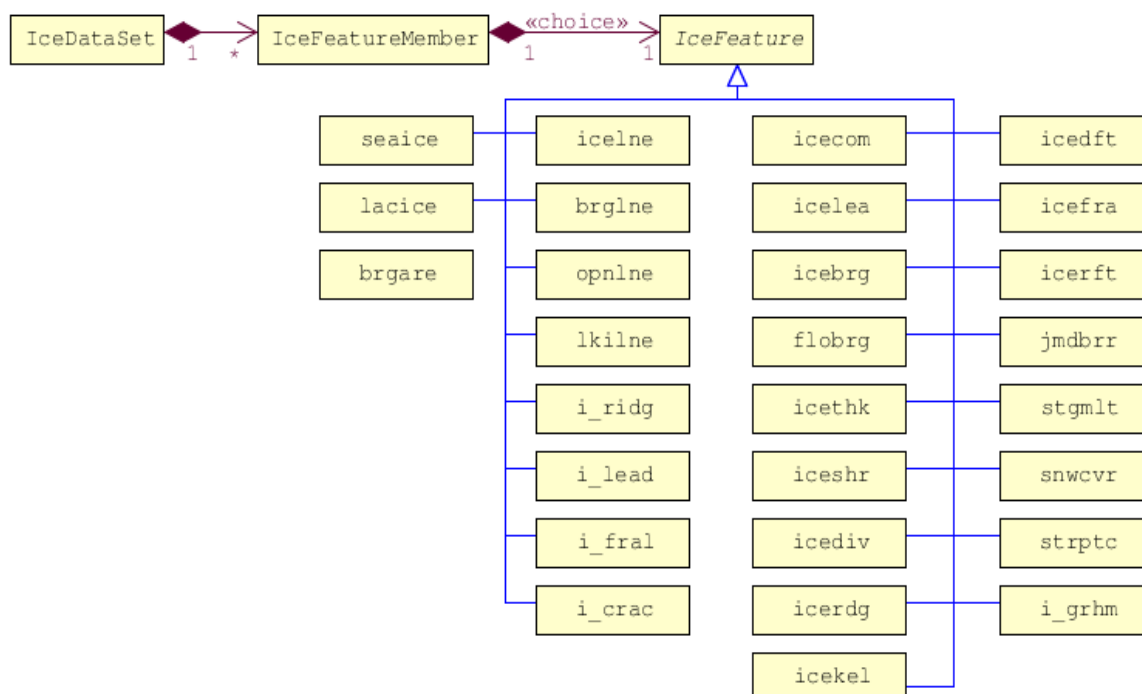
Figure 1: Ice Data Product – Structure

General GML (XML) representation:

```
<?xml version="1.0" encoding="UTF-8"?>
<ice:IceDataSet xmlns:ice="http://www.iho.int/ice"
                xmlns:gml=http://www.opengis.net/gml/3.2>
    <ice:IceFeatureMember>
        <ice:seaice>
            <ice:iceact> … </ice:iceact>
               .
               .
            <gml:Polygon srsName="..">… </gml:Polygon>
        </ice:seaice>
    </ice:IceMember>
    <ice:IceMember>
        <ice:i_ridg>
            <ice:icerdv> … </ice:icerdv>
```

```
            .
            .
            <gml:LineString srsName="..">… </gml:LineString>
        </ice:i_ridg>
</ice:IceMember>
<ice:IceMember>
        <ice:icebrg>
            <ice:icebsz> … </ice:icebsz>
            .
            .
            <gml:Point srsName="..">… </gml:Point>
        </ice:icebrg>
</ice:IceFeatureMember>
```

4.3   Feature Catalogue

4.3.1   Introduction

The feature Catalogue for Ice Information contains only geographic features. The ice features which can be used in ECDIS are fully presented in the ICE domain of the IHO Registry.

4.3.2   Application Schema Elements, Named Types
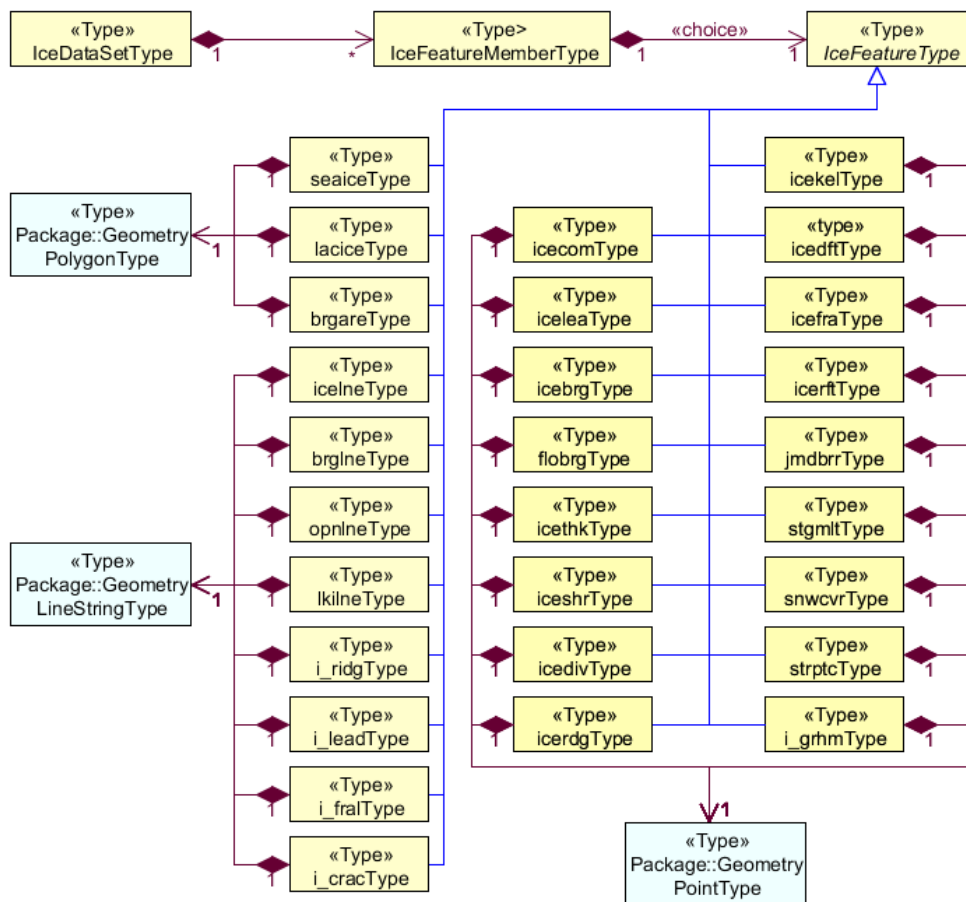
4.3.2.1   Ice Application Schema Types Overview

Figure 2: Ice App Schema Types

Role Name	Name	Description	Mult.	Data Type
Class	IceDataSet	Set of ice data	-	IceDataSetType
Association	IceFeatureMember	Contains ice feature members	1..*	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	IceFeatureMember	A member of Ice Features in a Dataset	-	IceFeatureMember Type
Association	IceFeature	Abstract ice feature	1..1 (choice)	IceFeatureType
Association	IceDataSet	Set of ice data	*..1	IceDataSetType

Role Name	Name	Description	Mult.	Data Type
Class	IceFeature	Abstract ice feature class	-	IceFeatureType
Association	IceFeatureMember	Contains one of ice feature	1..1 (choice)	IceFeatureMemberType
Association	seaice	One of choice options: Sea Ice	1..1	seaiceType
Association	lacice	One of choice options: Lake Ice	1..1	laciceType
Association	brgare	One of choice options: Iceberg Area	1..1	brgareType
Association	icelne	One of choice options: Ice Edge	1..1	icelneType
Association	brglne	One of choice options: Iceberg Limit	1..1	brglneType
Association	opnlne	One of choice options: Limit of Open Water	1..1	opnlneType
Association	lkilne	One of choice options: Limit of All Known Ice	1..1	lkilneType
Association	i_ridg	One of choice options: Line of Ice Ridge	1..1	i_ridgType
Association	i_lead	One of choice options: Line of Ice Lead	1..1	i_leadType
Association	i_fral	One of choice options: Line of Ice Fracture	1..1	i_fralType
Association	i_crac	One of choice options: Line of Ice Crack	1..1	i_cracType
Association	icecom	One of choice options: Ice Compacting	1..1	icecomType
Association	icelea	One of choice options: Ice Lead	1..1	iceleaType
Association	icebrg	One of choice options: Iceberg	1..1	icebrgType
Association	flobrg	One of choice options: Floeberg	1..1	flobrgType

Association	icethk	One of choice options: Ice Thickness	1..1	icethkType
Association	iceshr	One of choice options: Ice Shear	1..1	iceshrType
Association	icediv	One of choice options: Ice Divergence	1..1	icedivType
Association	icerdg	One of choice options: Ice Ridge	1..1	icerdgType
Association	icekel	One of choice options: Ice Keel	1..1	icekelType
Association	icedft	One of choice options: Ice Drift	1..1	icedftType
Association	icefra	One of choice options: Ice Fracture	1..1	icefraType
Association	icerft	One of choice options: Ice Rafting	1..1	icerftType
Association	jmdbrr	One of choice options: Jammed Brash Barrier	1..1	jmdbrrType
Association	stgmlt	One of choice options: Stage of Melt	1..1	stgmltType
Association	snwcvr	One of choice options: Snow cover	1..1	snwcvrType
Association	strptc	One of choice options: Strips and Patches	1..1	strptcType
Association	i_grhm	One of choice options: Grounded Hummock	1..1	i_grhmType

Role Name	Name	Description	Mult.	Data Type
Class	seaice	Sea Ice, one of IceFeatureMember	-	seaiceType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	lacice	Lake Ice, one of IceFeatureMember	-	laciceType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	brgare	Iceberg Area, one of IceFeatureMember	-	brgareType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	icelne	Ice Edge, one of IceFeatureMember	-	icelneType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	brglne	Iceberg Limit, one of IceFeatureMember	-	brglneType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	opnlne	Limint of Open Water, one of IceFeatureMember	-	opnlneType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	lkilne	Limint of All Known Ice, one of IceFeatureMember	-	lkilneType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	i_ridg	Line of Ice Ridge, one of IceFeatureMember	-	i_ridgType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	i_lead	Line of Ice Lead, one of IceFeatureMember	-	i_leadType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	i_fral	Line of Ice Fracture, one of IceFeatureMember	-	i_fralType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	i_crac	Line of Ice Crack, one of IceFeatureMember	-	i_cracType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	icecom	Ice Compacting, one of IceFeatureMember	-	icecomType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	icelea	Ice Lead, one of IceFeatureMember	-	iceleaType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	icebrg	Iceberg, one of IceFeatureMember	-	seaiceType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	flobrg	Floeberg, one of IceFeatureMember	-	seaiceType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	icethk	Ice Thickness, one of IceFeatureMember	-	icethkType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	iceshr	Ice Shear, one of IceFeatureMember	-	iceshrType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	icediv	Ice Divergence, one of IceFeatureMember	-	icedivType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	icerdg	Ice Ridge / Hummock, one of IceFeatureMember	-	icerdgType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	icekel	Ice Keel / Bummock, one of IceFeatureMember	-	icekelType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	icedft	Ice Drift, one of IceFeatureMember	-	icedftType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	icefra	Ice Fracture, one of IceFeatureMember	-	icefraType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	icerft	Ice Rafting, one of IceFeatureMember	-	icerftType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	jmdbrr	Jammed Brash Barrier, one of IceFeatureMember	-	jmdbrrType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	stgmlt	Stage of melt, one of IceFeatureMember	-	stgmltType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	snwcvr	Snow cover, one of IceFeatureMember	-	snwcvrType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	strptc	Strips and Patches, one of IceFeatureMember	-	strptcType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

Role Name	Name	Description	Mult.	Data Type
Class	i_grhm	Grounded Hummock, one of IceFeatureMember	-	i_grhmType
Association	IceFeatureMember	contains ice feature	1..1	IceFeatureMemberType

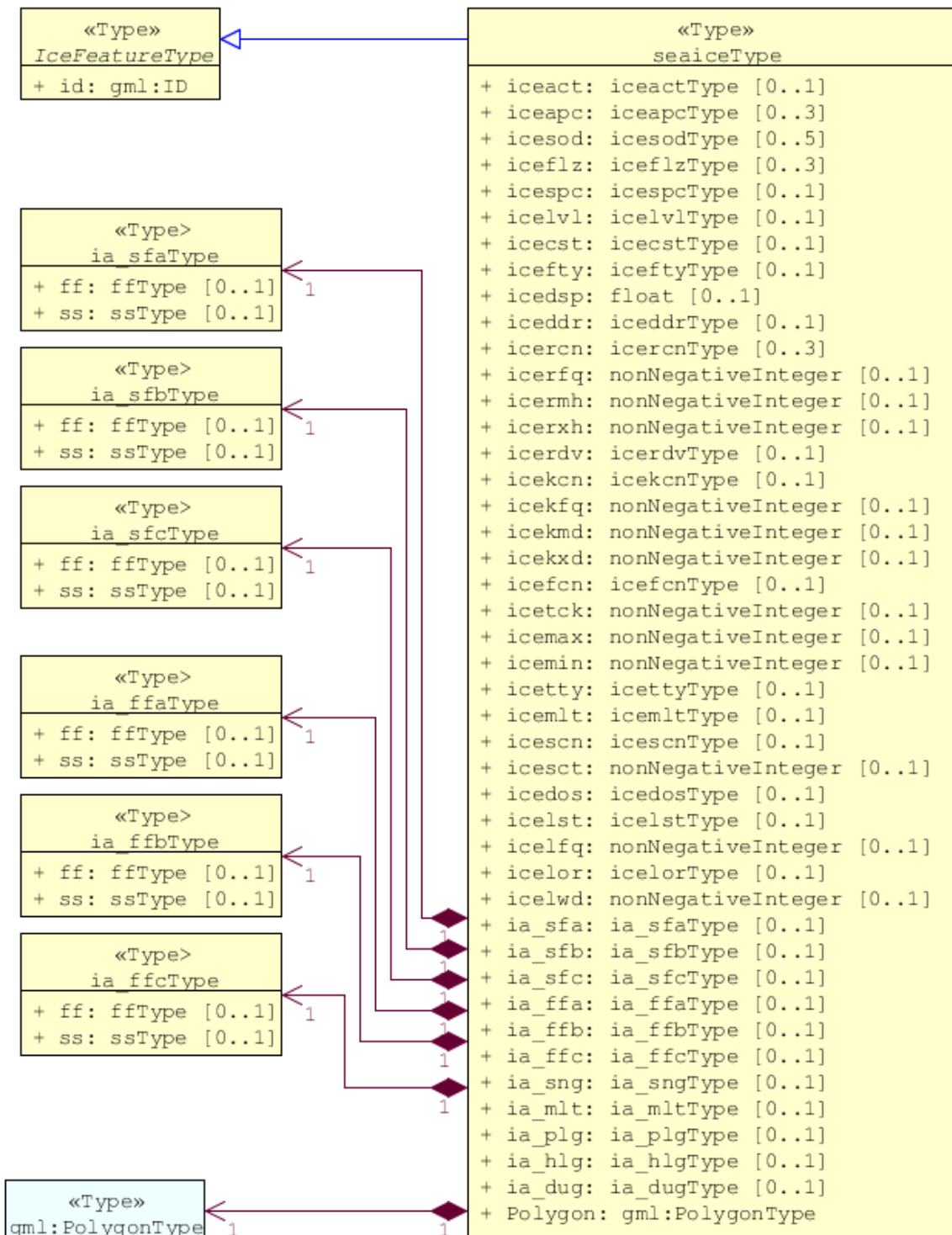### 4.3.2.2   IceDataSet / Types

4.3.2.2.1   IceDataSetType

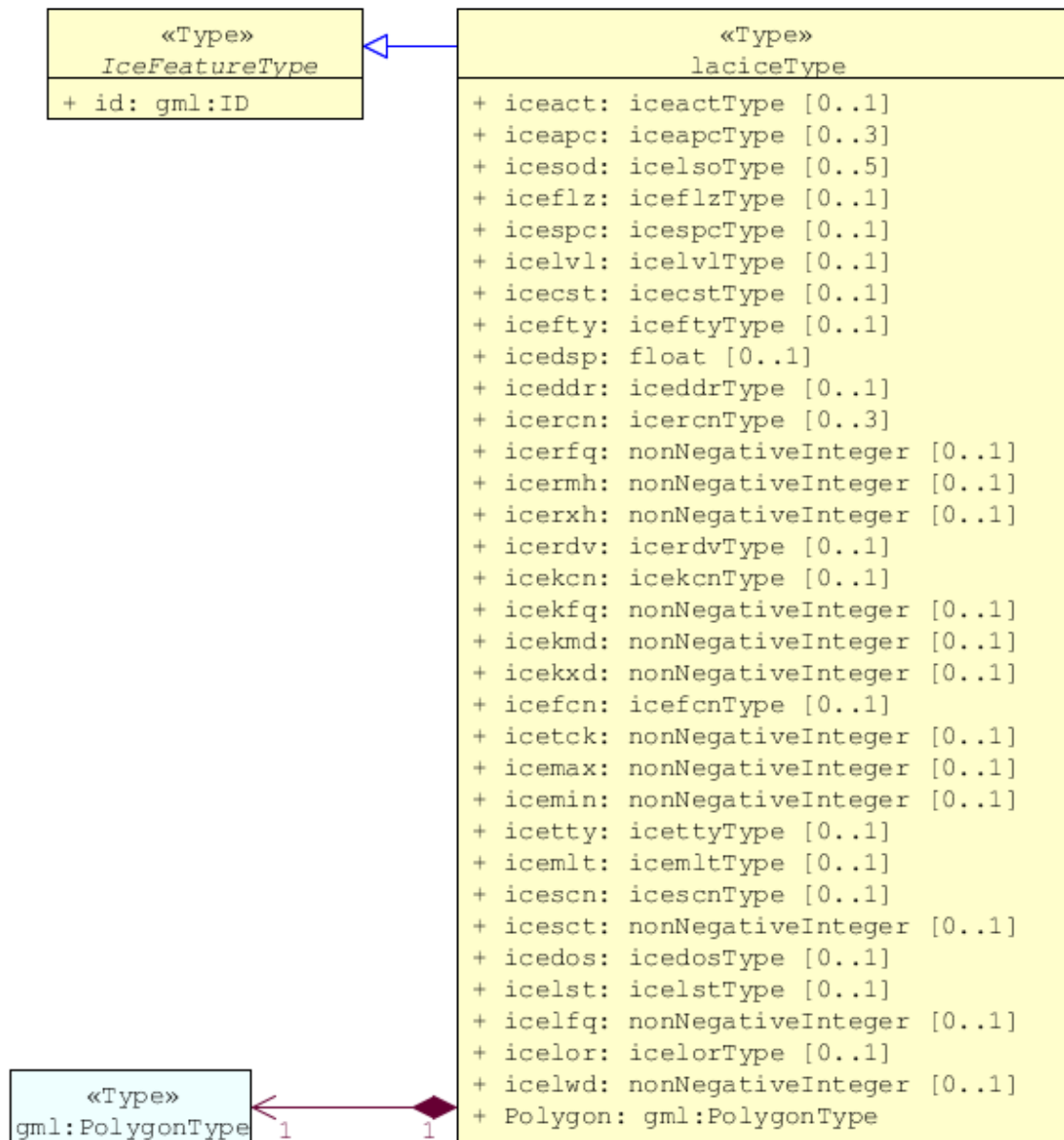*IceDataSetType* is a type of root Element of an ice information data set.
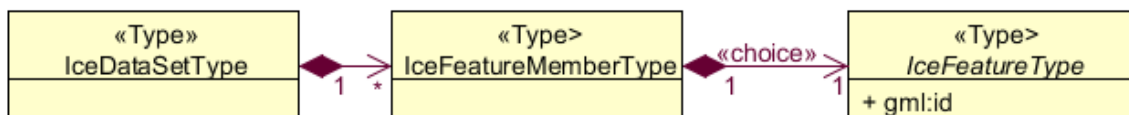
Ice Data Set contains an unlimited number of Ice Feature Members, each Ice Feature Member contains one Ice Feature (seaice, lacice, iceberg, etc.).
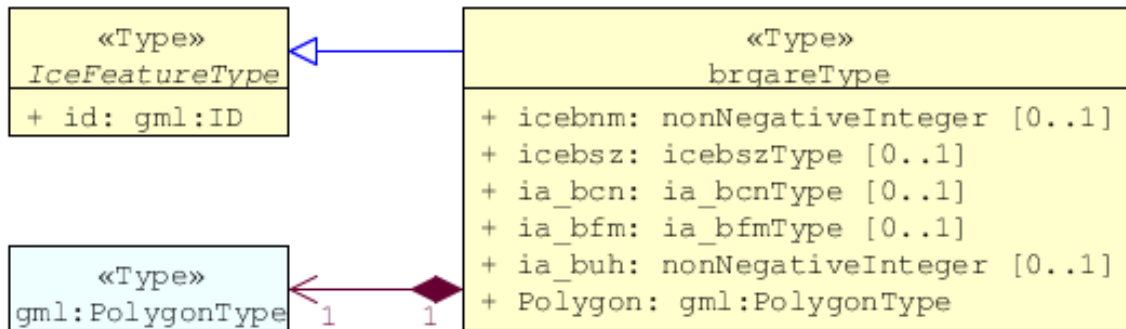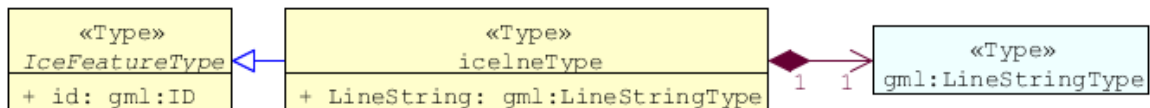
## 4.3.2.3 seaiceType (Sea Ice)

4.3.2.4   IaciceType - Lake Ice

```
        «Type»                              «Type»
     IceFeatureType    ◁──────────         IaciceType
  ─────────────────              ───────────────────────────────────
   + id: gml:ID                   + iceact: iceactType [0..1]
                                  + iceapc: iceapcType [0..3]
                                  + icesod: icelsoType [0..5]
                                  + iceflz: iceflzType [0..1]
                                  + icespc: icespcType [0..1]
                                  + icelvl: icelvlType [0..1]
                                  + icecst: icecstType [0..1]
                                  + icefty: iceftyType [0..1]
                                  + icedsp: float [0..1]
                                  + iceddr: iceddrType [0..1]
                                  + icercn: icercnType [0..3]
                                  + icerfq: nonNegativeInteger [0..1]
                                  + icermh: nonNegativeInteger [0..1]
                                  + icerxh: nonNegativeInteger [0..1]
                                  + icerdv: icerdvType [0..1]
                                  + icekcn: icekcnType [0..1]
                                  + icekfq: nonNegativeInteger [0..1]
                                  + icekmd: nonNegativeInteger [0..1]
                                  + icekxd: nonNegativeInteger [0..1]
                                  + icefcn: icefcnType [0..1]
                                  + icetck: nonNegativeInteger [0..1]
                                  + icemax: nonNegativeInteger [0..1]
                                  + icemin: nonNegativeInteger [0..1]
                                  + icetty: icettyType [0..1]
                                  + icemlt: icemltType [0..1]
                                  + icescn: icescnType [0..1]
                                  + icesct: nonNegativeInteger [0..1]
                                  + icedos: icedosType [0..1]
                                  + icelst: icelstType [0..1]
                                  + icelfq: nonNegativeInteger [0..1]
        «Type»                    + icelor: icelorType [0..1]
  gml:PolygonType  ◁──────────◆   + icelwd: nonNegativeInteger [0..1]
                      1        1   + Polygon: gml:PolygonType
```

4.3.2.5   brgareType - Iceberg Area

4.3.2.6   icelneType - Ice Edge
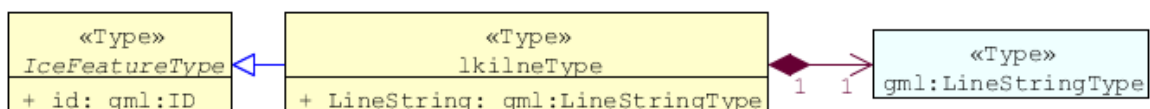

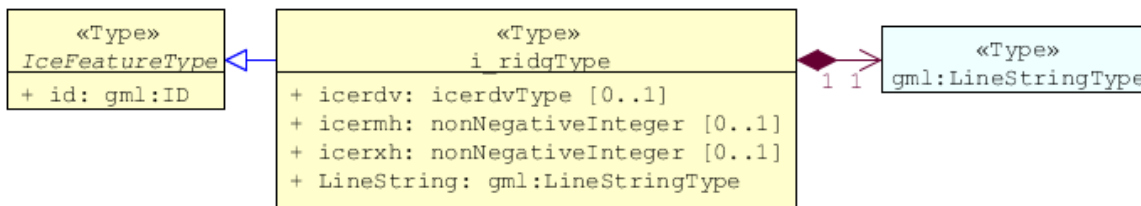### 4.3.2.7   brglneType - Iceberg Limit
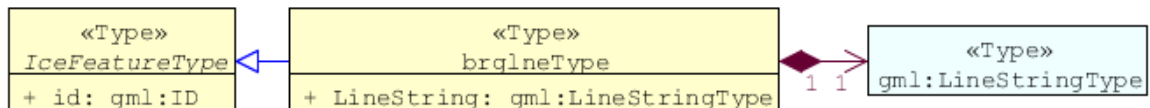
4.3.2.8   opnlneType - Limit of Open Water
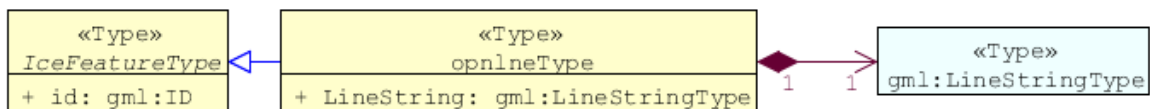
4.3.2.9   lkilneType - Limit of All Known Ice

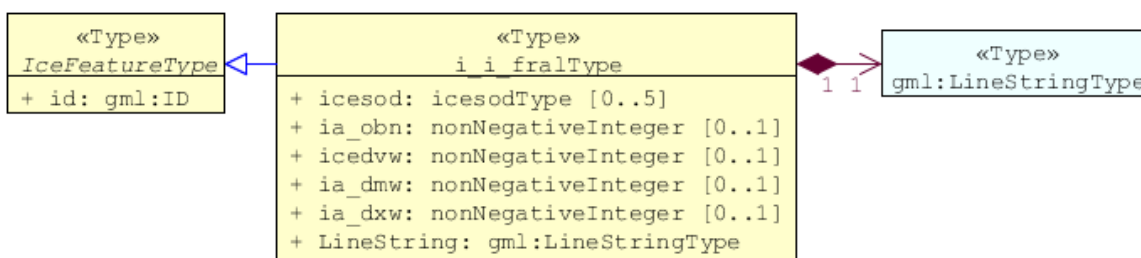### 4.3.2.10   i_ridgType - Line of Ice Ridge

```
  «Type»                    «Type»                              «Type»
IceFeatureType            i_ridgType                      gml:LineStringType
+ id: gml:ID       + icerdv: icerdvType [0..1]
                   + icermh: nonNegativeInteger [0..1]
                   + icerxh: nonNegativeInteger [0..1]
                   + LineString: gml:LineStringType
```
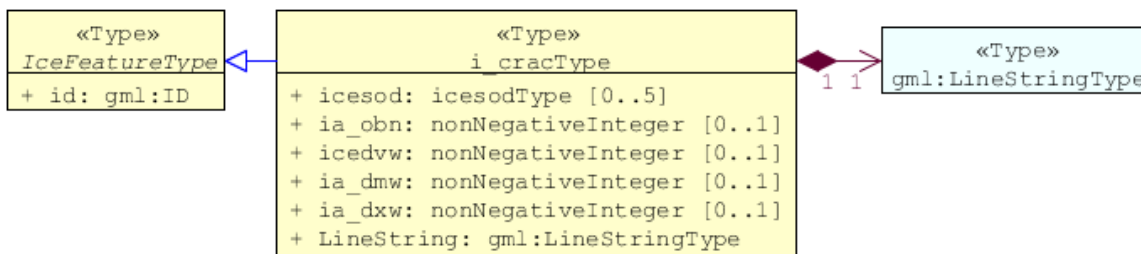
4.3.2.11   i_leadType - Line of Ice Lead

```
  «Type»                    «Type»                              «Type»
IceFeatureType            i_leadType                      gml:LineStringType
+ id: gml:ID       + icesod: icesodType [0..5]
                   + ia_obn: nonNegativeInteger [0..1]
                   + icedvw: nonNegativeInteger [0..1]
                   + ia_dmw: nonNegativeInteger [0..1]
                   + ia_dxw: nonNegativeInteger [0..1]
                   + LineString: gml:LineStringType
```
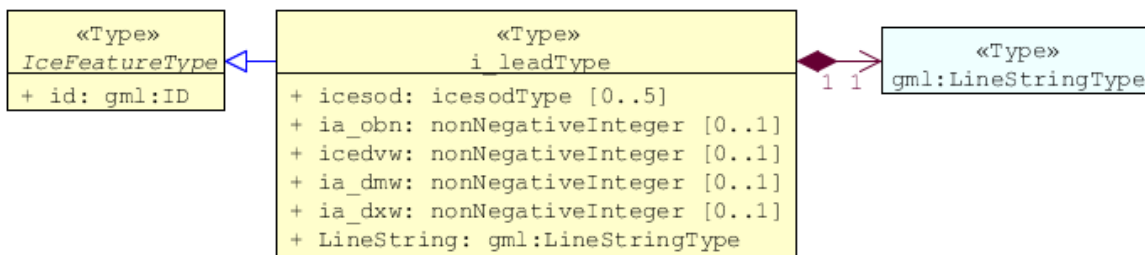
4.3.2.12   i_fralType - Line of Ice Fracture

```
  «Type»                    «Type»                              «Type»
IceFeatureType           i_i_fralType                     gml:LineStringType
+ id: gml:ID       + icesod: icesodType [0..5]
                   + ia_obn: nonNegativeInteger [0..1]
                   + icedvw: nonNegativeInteger [0..1]
                   + ia_dmw: nonNegativeInteger [0..1]
                   + ia_dxw: nonNegativeInteger [0..1]
                   + LineString: gml:LineStringType
```

4.3.2.13   i_cracType - Line of Ice Crack

```
  «Type»                    «Type»                              «Type»
IceFeatureType            i_cracType                      gml:LineStringType
+ id: gml:ID       + icesod: icesodType [0..5]
                   + ia_obn: nonNegativeInteger [0..1]
                   + icedvw: nonNegativeInteger [0..1]
                   + ia_dmw: nonNegativeInteger [0..1]
                   + ia_dxw: nonNegativeInteger [0..1]
                   + LineString: gml:LineStringType
```

4.3.2.14   icecomType – Ice Compacting
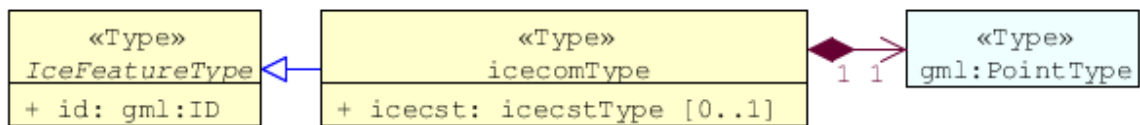
4.3.2.15   iceleaType – Ice Lead
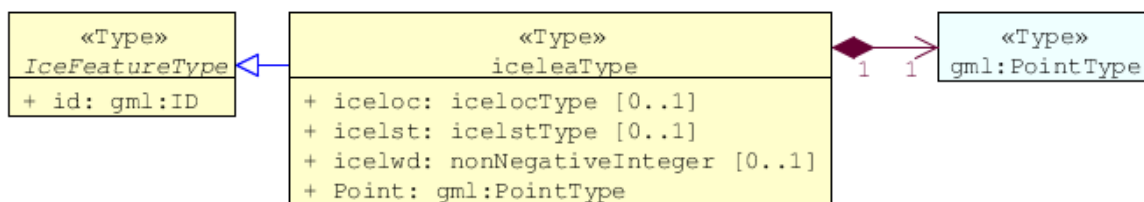
4.3.2.16   icebrgType – Iceberg
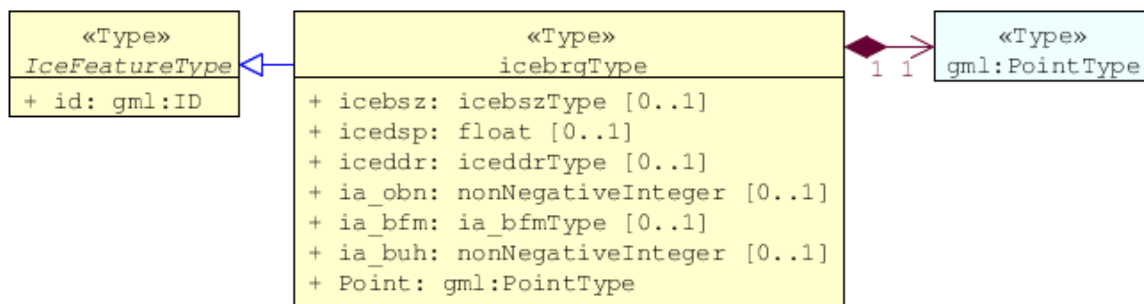
4.3.2.17   flobrgType – Floeberg
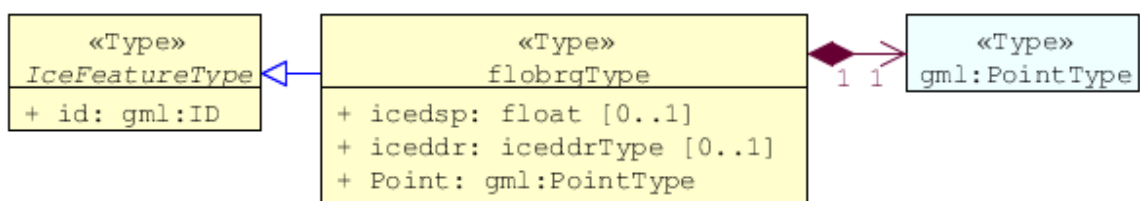
4.3.2.18   icethkType – Ice Thickness
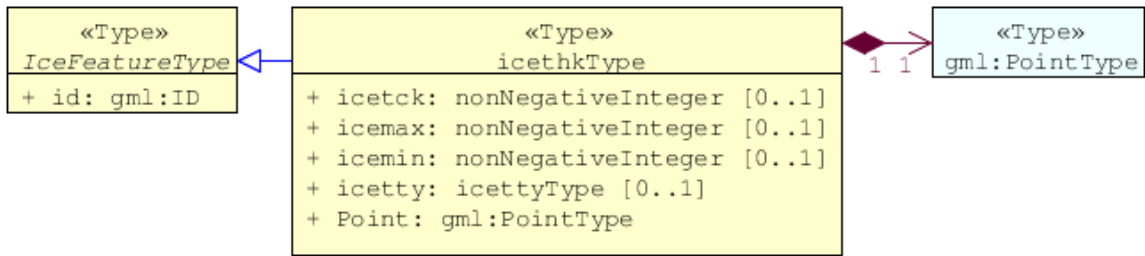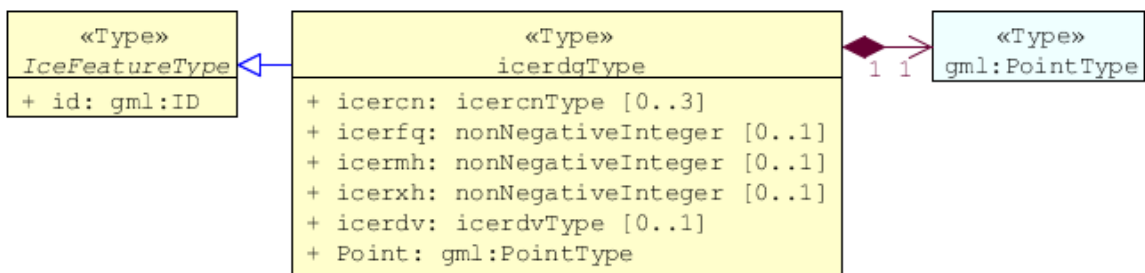

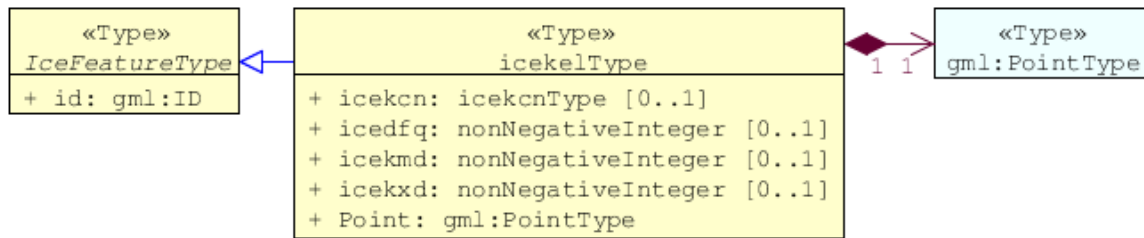### 4.3.2.19   iceshrType – Ice Shear
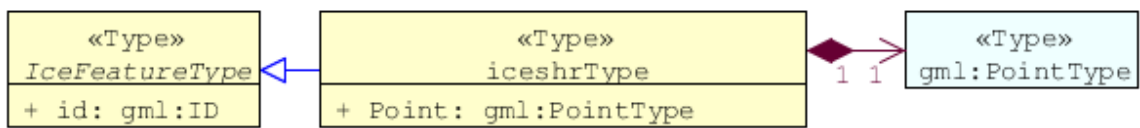
4.3.2.20   icedivType – Ice Divergence
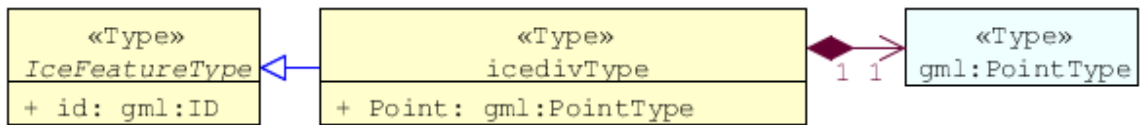
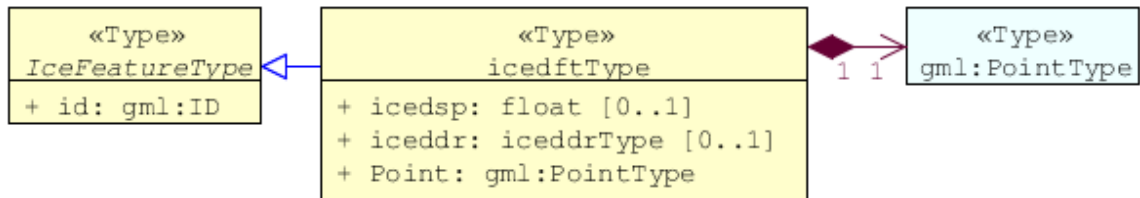### 4.3.2.21   icerdgType – Ice Ridge/Hummock
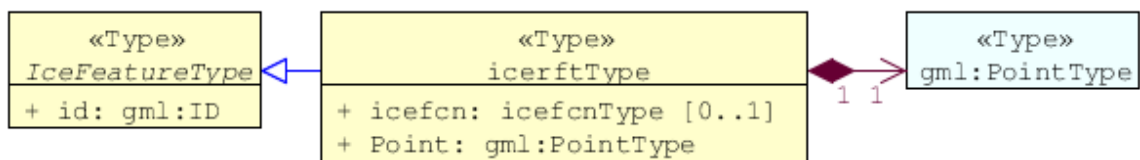
4.3.2.22   icekelType – Ice Keel/Bummock

«Type»
IceFeatureType
+ id: gml:ID

«Type»
icekelType
+ icekcn: icekcnType [0..1]
+ icedfq: nonNegativeInteger [0..1]
+ icekmd: nonNegativeInteger [0..1]
+ icekxd: nonNegativeInteger [0..1]
+ Point: gml:PointType

«Type»
gml:PointType

1 1

4.3.2.23   icedftType – Ice Drift

«Type»
IceFeatureType
+ id: gml:ID

«Type»
icedftType
+ icedsp: float [0..1]
+ iceddr: iceddrType [0..1]
+ Point: gml:PointType

«Type»
gml:PointType

1 1

4.3.2.24   icefraType – Ice Fracture

«Type»
IceFeatureType
+ id: gml:ID

«Type»
icefraType
+ icefty: iceftyType
+ iceloc: icelocType
+ ia_obn: nonNegativeInteger [0..1]
+ icesod: icesodType [0..5]
+ icedvw: nonNegativeInteger [0..1]
+ ia_dmw: nonNegativeInteger [0..1]
+ ia_dxw: nonNegativeInteger [0..1]
+ Point: gml:PointType

«Type»
gml:PointType

1 1
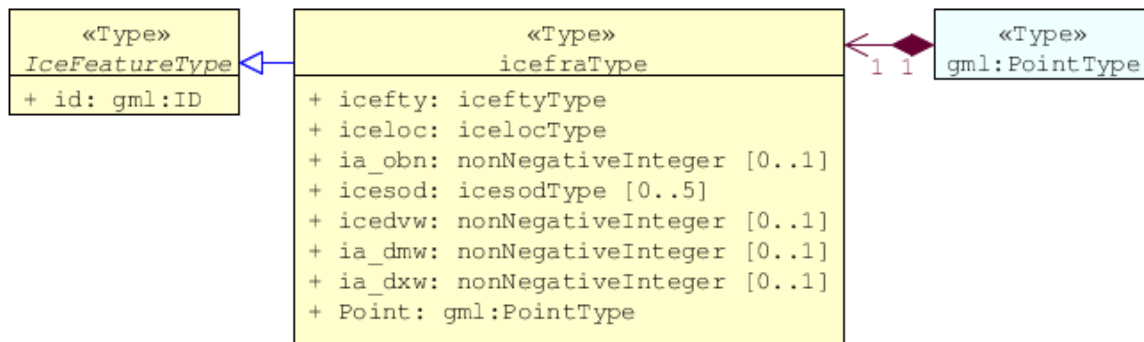
4.3.2.25   icerftType – Ice Rafting

«Type»
IceFeatureType
+ id: gml:ID

«Type»
icerftType
+ icefcn: icefcnType [0..1]
+ Point: gml:PointType

«Type»
gml:PointType

1 1

4.3.2.26   jmdbrrType – Jammed Brash Barrier
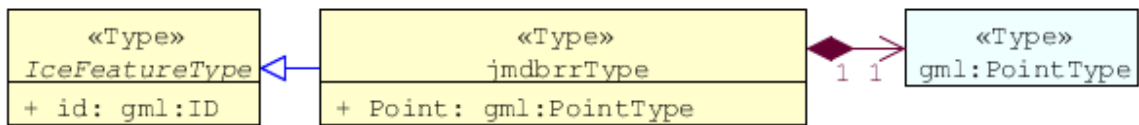
4.3.2.27   stgmltType – Stage of Melt
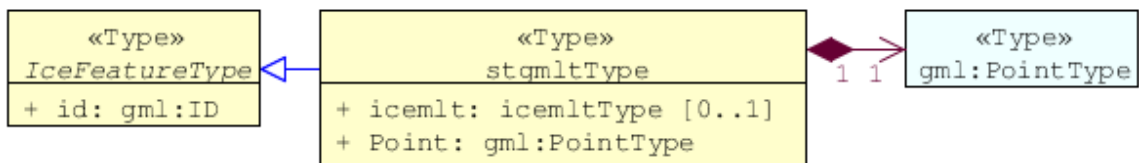
4.3.2.28   snwcvrType – Snow Cover
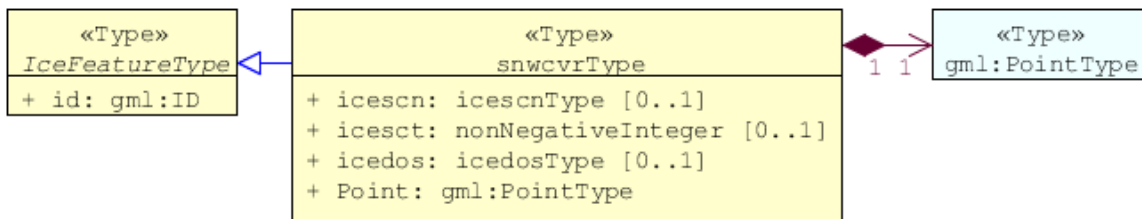
4.3.2.29   strptcType – Strips and Patches
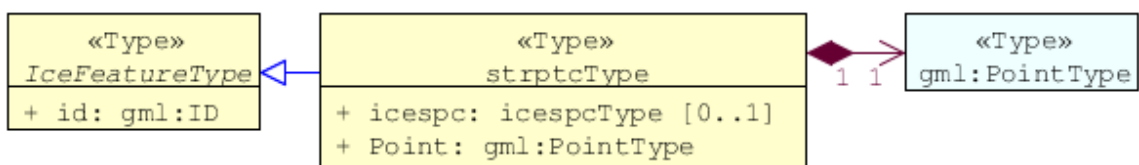
4.3.2.30   i_grhmType – Grounded Hummock
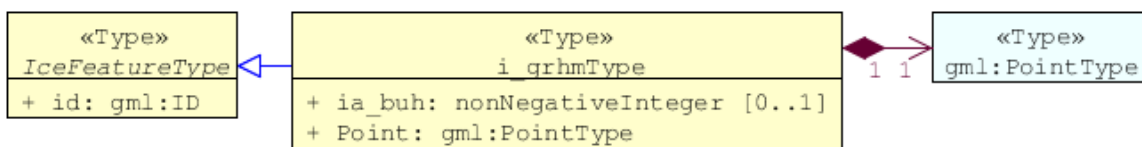
4.3.3 Feature Types Summary

Table 1: Summary of Types

Register Dictionary	Index	Alpha code	Name
IceFCD	Feature	SEAICE	Sea Ice
IceFCD	Feature	LACICE	Lake Ice
IceFCD	Feature	BRGARE	Iceberg Area
IceFCD	Feature	ICELNE	Ice Edge
IceFCD	Feature	BRGLNE	Iceberg Limit
IceFCD	Feature	OPNLNE	Limit of Open Water
IceFCD	Feature	LKILNE	Limit of All Known Ice
IceFCD	Feature	I_RIDG	Line of Ice Ridge
IceFCD	Feature	I_LEAD	Line of Ice Lead
IceFCD	Feature	I_FRAL	Line of Ice Fracture
IceFCD	Feature	I_CRAC	Line of Ice Crack
IceFCD	Feature	ICECOM	Ice Compacting
IceFCD	Feature	ICELEA	Ice Lead
IceFCD	Feature	ICEBRG	Iceberg
IceFCD	Feature	FLOBRG	Floeberg
IceFCD	Feature	ICETHK	Ice Thickness
IceFCD	Feature	ICESHR	Ice Shear
IceFCD	Feature	ICEDIV	Ice Divergence
IceFCD	Feature	ICERDG	Ice Ridge/Hummock
IceFCD	Feature	ICEKEL	Ice Keel/Bummock
IceFCD	Feature	ICEDFT	Ice Drift
IceFCD	Feature	ICEFRA	Ice Fracture
IceFCD	Feature	ICERFT	Ice Rafting
IceFCD	Feature	JMDBRR	Jammed Brash Barrier
IceFCD	Feature	STGMLT	Stage of Melt
IceFCD	Feature	SNWCVR	Snow Cover
IceFCD	Feature	STRPTC	Strips and Patches
IceFCD	Feature	I_GRHM	Grounded Hummock
IceFCD	Attribute	ICEACT	Total Concentration
IceFCD	Attribute	ICEAPC	Partial Concentration
IceFCD	Attribute	ICESOD	Ice Stage of Development
IceFCD	Attribute	ICELSO	Lake Ice Stage of Development
IceFCD	Attribute	ICEFLZ	Floe Sizes
IceFCD	Attribute	ICEMLT	Melt Stage
IceFCD	Attribute	ICESPC	Concentration of Strips and Patches
IceFCD	Attribute	ICEBNM	Number of Icebergs in Area
IceFCD	Attribute	ICELVL	Level Ice
IceFCD	Attribute	ICECST	Compacting Strength
IceFCD	Attribute	ICEFTY	Ice Fracture Type
IceFCD	Attribute	ICELST	Ice Lead Status
IceFCD	Attribute	ICELFQ	Frequency of Leads or Fractures
IceFCD	Attribute	ICELOR	Orientation of Leads or Fractures
IceFCD	Attribute	ICELWD	Ice Lead (or Fracture or Crack) Width
IceFCD	Attribute	ICELOC	Ice Location Information
IceFCD	Attribute	ICEBSZ	Iceberg Size

Register Dictionary	Index	Alpha code	Name
IceFCD	Attribute	ICEDDR	Ice Drift Direction
IceFCD	Attribute	ICEDSP	Ice Drift Speed
IceFCD	Attribute	ICETCK	Ice Average Thickness
IceFCD	Attribute	ICEMAX	Maximum Ice Thickness
IceFCD	Attribute	ICEMIN	Minimum Ice Thickness
IceFCD	Attribute	ICETTY	Ice Thickness Type
IceFCD	Attribute	ICESCT	Snow Depth
IceFCD	Attribute	ICESCN	Snow Cover Concentration
IceFCD	Attribute	ICEDOS	Direction Of Sastrugi
IceFCD	Attribute	ICERCN	Ice Ridge Concentration
IceFCD	Attribute	ICERDV	Ice Ridge Classification
IceFCD	Attribute	ICERMH	Ice Ridge Mean Height
IceFCD	Attribute	ICERFQ	Ice Ridge Frequency
IceFCD	Attribute	ICERXH	Ice Ridge Maximum Height
IceFCD	Attribute	ICEKCN	Ice Keel Concentration
IceFCD	Attribute	ICEKFQ	Ice Keel Frequency
IceFCD	Attribute	ICEKMD	Ice Keel Mean Depth
IceFCD	Attribute	ICEKXD	Ice Keel Maximum Depth
IceFCD	Attribute	ICEFCN	Ice Rafting Concentration
IceFCD	Attribute	IA_SFA	Ice Stage of Development and Floe Size for the 1_{st} p.c.
IceFCD	Attribute	IA_SFB	Ice Stage of Development and Floe Size for the 2_{nd} p.c.
IceFCD	Attribute	IA_SFC	Ice Stage of Development and Floe Size for the 3_{rd} p.c.
IceFCD	Attribute	IA_FFA	Ice Breccia for the 1_{st} partial concentration
IceFCD	Attribute	IA_FFB	Ice Breccia for the 2_{nd} partial concentration
IceFCD	Attribute	IA_FFC	Ice Breccia for the 3_{rd} partial concentration
IceFCD	Attribute	IA_SNG	Snow concentration
IceFCD	Attribute	IA_MLT	Stage of melting
IceFCD	Attribute	IA_PLG	Contamination
IceFCD	Attribute	IA_HLG	Hills concentration
IceFCD	Attribute	IA_DUG	Fractures concentration
IceFCD	Attribute	IA_BCN	Icebergs concentration
IceFCD	Attribute	IA_BFM	Prevailing iceberg form
IceFCD	Attribute	IA_BUH	Max. height of the above-water part (iceberg / grounded hummock)
IceFCD	Attribute	IA_OBN	Number of ice objects
IceFCD	Attribute	IA_DXW	Max. width of ice lead (or fracture or crack)
IceFCD	Attribute	IA_DMW	Min. width of ice lead (or fracture or crack)
IceFCD	Attribute	ICEBRS	Brash Ice

4.4 Dataset Types

4.4.1 Introduction

At the moment is only one type of dataset supported. This is GML(XML) encoded ice feature collections.

4.5 Geometry

Ice Information datasets use S-100 Level 3a geometry which supports 0-, 1-, and 2-dimensional objects (points, line strings, and polygons).
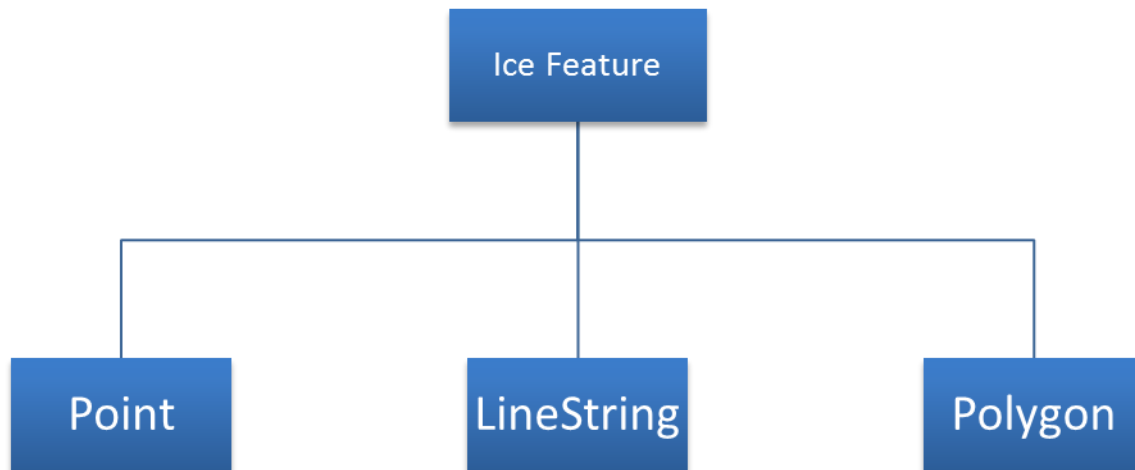

Figure 3: Geometric Primitives in Ice Information Product

There are three types of geometry: Point, Line String and Polygon. Multi-geometries will be not supported. The standard geometries of GML where redefined for S-411. The reason for this is to reduce file sizes. It is only possible to use "posList" with blanks separated coordinate values, like

```
<gml:posList>-73.991 40.736 -73.991 40.736</gml:posList>
```

For standard GML it would be also possible to use following (**DO NOT USE THIS**):
```
<gml:posList>
        <pos>-73.991 40.736</pos>
        <pos>-73.991 40.736</pos>
</gml:posList>
```

Which means much more chars in the file and growing of file size.

All multi-geometries must be splitted into single geometries. Encoding for geometry is GML:

Point encoding example:
```
<gml:Point>
     <gml:pos>147.291 -42.851</gml:pos>
</gml:Point>
```

Line String encoding example:
```
<gml:LineString>
     <gml:posList>-73.991 40.736 -73.991 40.736</gml:posList>
</gml:LineString>
```

Polygon encoding example:

```
<gml:Polygon>
    <gml:exterior>
        <gml:LinearRing>
            <gml:posList>
                22.546 62.391 25.033 62.404 24.995 60.182 22.483
                60.169 22.546 62.391
            </gml:posList>
        </gml:LinearRing>
    </gml:exterior>
    <gml:interior>
        <gml:LinearRing>
            <gml:posList>
                23.227 61.811 23.467 61.306 24.023 61.621 24.035
                61.621 23.227 61.811
            </gml:posList>
        </gml:LinearRing>
    </gml:interior>
</gml:Polygon>
```

5   Coordinate Reference Systems (CRS)

For exchange of ice data WGS84 (EPSG: 4326) must be used.

6   Data Quality

As ice charts are done for different purposes (from weekly overview to tactical charts and further to model forecasts) data quality can differ. Differences can also be found between ice charts of the same region and same nominal date resulting from different issuing agencies or also from different forecasts models. Further information can be found in the WMO publication 574.

7   Data Capture and Classification

The data will be captured normally from satellite data. The extraction and classification will be done by ice analysts. In some areas of the world (e.g. the Baltic Sea) in addition also some direct shore and ship based observations and textual ice reports from ice authorities will be used. Further information can be found in the WMO publication 574 in Appendix A.

8   Data Product format (encoding)

8.1   Introduction

This clause describes encoding rules for S-100 base ice datasets. For the encoding of ice datasets GML 3.2.1 was used.

8.2   Encoding Rules

8.2.1   Longitude / Latitude

- Longitude and latitude must be encoded in decimal degrees, e.g. : 12.567 56.765
- Number of decimals is not limited, but it should be as less as possible for minimizing of file size, normally 3 or even 2 digits are enough

8.2.2   Elements and attributes

- Names of elements representing ice features or attributes (from IceFDC dictionary see Table 1: Summary of Types) must be encoded with lower case letters
- Names of elements representing features or attributes from other dictionaries must be encoded with upper case letters
- Character Set is UTF-8
- Elements or attributes may be empty, but it should be eliminated for minimizing of file size

8.3   Encoding Examples

Below there are three examples of the encoding of various ice features using different geometric primitives, the encoding of other ice objects can be done in a similar way.

8.3.1   Polygon Feature

```
<ice:IceFeatureMember>
 <ice:brgare gml:id="brgare.1">
    <ice:icebnm/>
    <ice:icebsz/>
    <ice:ia_bcn/>
    <ice:ia_bfm/>
    <ice:ia_buh/>
    <gml:Polygon srsName="http://www.opengis.net/gml/srs/epsg.xml#4326">
      <gml:exterior>
        <gml:LinearRing>
          <gml:posList>
                  22.546 62.391 25.033 62.404 24.995 60.182 22.483 60.169 22.546 62.391
          </gml:posList>
        </gml:LinearRing>
      </gml:exterior>
      <gml:interior>
        <gml:LinearRing>
          <gml:posList>
                  23.227 61.811 23.467 61.306 24.023 61.621 24.035 61.621 23.227 61.811
          </gml:posList>
        </gml:LinearRing>
      </gml:interior>
    </gml:Polygon>
  </ice:brgare>
</ice:IceFeatureMember>
```

8.3.2   LineString Feature

```
<ice:IceFeatureMember>
  <ice:i_fral gml:id="i_fral.1">
    <ice:icesod>83</ice:icesod>
```

```
      <ice:ia_obn>50</ice:ia_obn>
      <ice:icedvw>30</ice:icedvw>
      <ice:ia_dmw>25</ice:ia_dmw>
      <ice:ia_dxw>35</ice:ia_dxw>
      <gml:LineString srsName="http://www.opengis.net/gml/srs/epsg.xml#4326">
        <gml:posList>-73.991 40.736 -73.991 40.736</gml:posList>
      </gml:LineString>
   </ice:i_fral>
</ice:IceFeatureMember>
```

8.3.3   Point Feature

```
<ice:IceFeatureMember>
  <ice:icecom gml:id="icecom.1">
    <ice:icecst/>
    <gml:Point srsDimension="2" srsName="http://www.opengis.net/gml/srs/epsg.xml#4326">
      <gml:pos>147.291 -42.851</gml:pos>
    </gml:Point>
  </ice:icecom>
</ice:IceFeatureMember>
```

9 Data Product Delivery

9.1 Introduction

Ice Information Product will be delivered as Exchange Set, containing dataset itself, metadata, etc. It is also possible that several charts are available for an area. The decision, which one to use, is within the responsibility of the navigator on the vessel.

9.2 Exchange Set

The exchange set for the Ice Information Product has following structure:
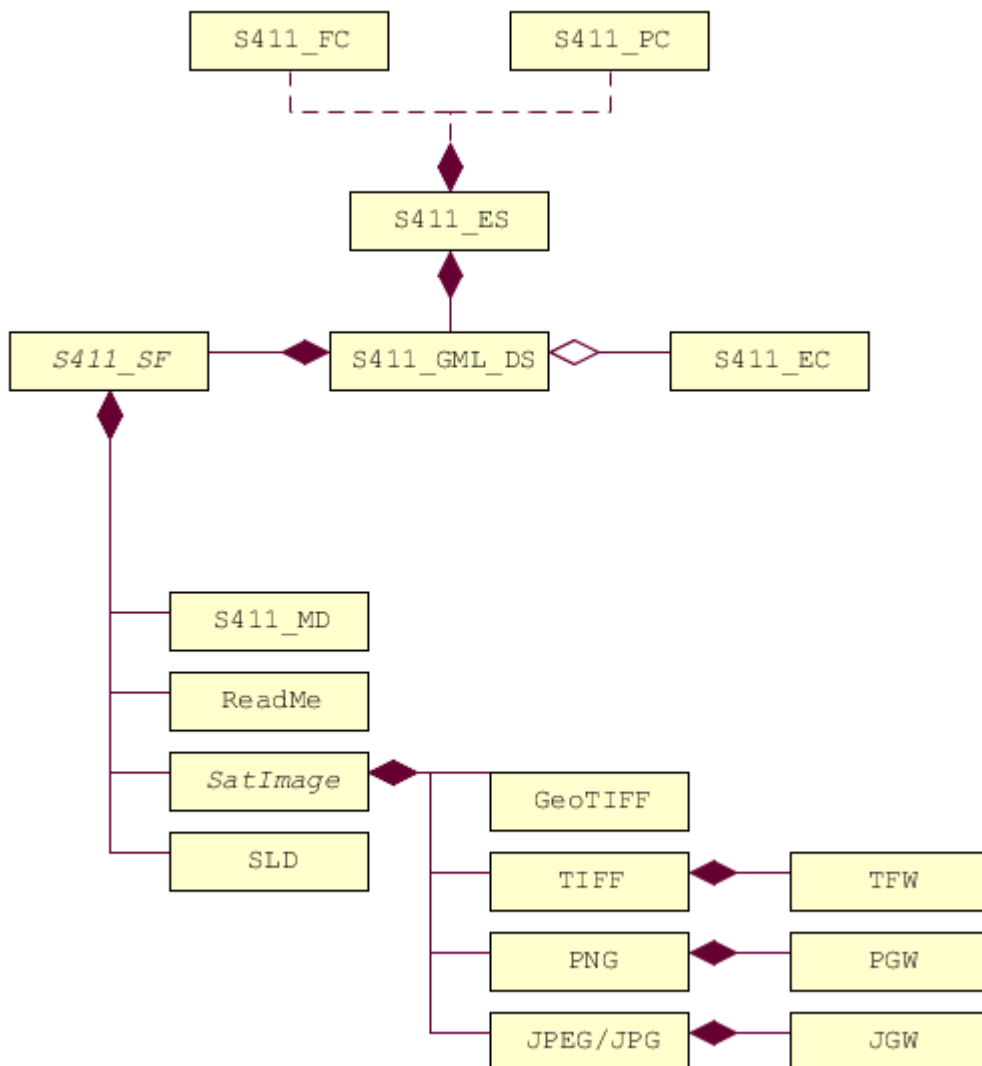
Figure 4: Exchange Set Structure

9.2.1   Exchange Set Naming

Name of Exchange Set has following structure:

`S411_ProducerCode_DatasetNameWithoutEnding`

Example: `S411_BSH_ek1-20130305-17`

An exchange Set can be a simple data folder, but it is recommended to zip this folder for minimizing file size. In this case name of Exchange Set looks like:

`S411_ProducerCode_DatasetNameWithoundEnding.zip`

Example: `S411_BSH_ek1-20130305-17.zip`

or if .tar.gz compressing algorithm is in use:

`S411_ProducerCode_DatasetNameWithoutEnding.tar.gz`

Example: `S411_BSH_ek1-20130305-17.tar.gz`

9.3   Dataset

9.3.1   Dataset Naming

The data producer are free to choose file name for data set. The ending or postfix must be "*.gml".

Example: **ek1-20130305-17.gml**

9.4   Support Files

9.4.1   Support File Naming

There are no restrictions for support file naming. But it is important to describe the files in the exchange catalogue file.

9.4.1.1   ISO Metadata File

The metadata for Dataset based on ISO 19139/19115, is also official S-100 Metadata with mandatory file identifier. (See Chapter 10)

9.4.1.2   Portrayal, Symbology

The portrayal (display instructions) should be a part of system, installed on board. But as option display instructions could be a part of exchange set, that means the display instruction xml file and svg symbols can be delivered within the exchange set as support files.

9.4.1.3   SVG Graphics

9.4.1.4   Readme

9.5   Exchange Catalogue

9.5.1   Exchange Catalogue Naming

Name of Exchange Catalogue is

CATALOG.ICE

10 Metadata

10.1 Introduction

There are two kinds of metadata to prepare:
- ISO 19139 Metadata
  This kind of metadata implementation can be read by broad range of software.
- S100 Metadata
  The S100 metadata are for describing the structure of Exchange Catalogue

10.1.1 ISO 19139 Metadata

For the description of ice data following metadata are necessary:
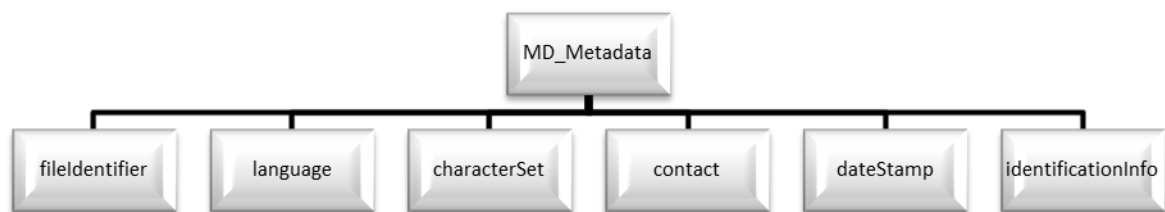
Element Name	Description	Namespace
MD_Metadata	root element	gmd
fileIdentifier	Id for dataset	gmd
language	Product language	gmd
characterSet	Used characterset	gmd
contact	Contact data	gmd
dateStamp	date of publishing	gmd
identificationInfo	Specific info about product	gmd

```xml
<?xml version="1.0" encoding="UTF-8"?>
<gmd:MD_Metadata  xmlns:gmd="http://www.isotc211.org/2005/gmd"
                  xmlns:gco="http://www.isotc211.org/2005/gco"
                  xmlns:gml="http://www.opengis.net/gml/3.2">
    <gmd:fileIdentifier> ... </gmd:fileIdentifier>
    <gmd:language> ... </gmd:language>
    <gmd:characterSet> ... </gmd:characterSet>
    <gmd:contact> ... </gmd:contact>
    <gmd:dateStamp> ... </gmd:dateStamp>
    <gmd:identificationInfo> ... </gmd:identificationInfo>
</gmd:MD_Metadata>
```

10.1.1.1 fileIdentifier

Element Name	Description	Namespace
fileIdentifier	Id for dataset	gmd
CharacterString	String contained id value	gco

```xml
<gmd:fileIdentifier>
    <gco:CharacterString>bsh_ek1-20130114-08</gco:CharacterString>
</gmd:fileIdentifier>
```

10.1.1.2 language

Element Name	Description	Namespace
language	Language of dataset	gmd
LanguageCode	Code for language	gmd

LanguageCode element contains two attributes:
- codeList: Link to the list containing the codes for languages
- codeListValue value from the list defining the used language

```
<gmd:language>
    <gmd:LanguageCode
codeList="http://www.isotc211.org/2005/resources/Codelist/ML_gmxCodelists.xml#LanguageCode" codeListValue="eng">English</gmd:LanguageCode>
</gmd:language>
```

10.1.1.3 characterSet

Element Name	Description	Namespace
characterSet	characterSet of dataset	gmd
MD_CharacterSetCode	Code for characterSet	gmd

MD_CharacterSetCode element contains two attributes:
- codeList: Link to the list containing the codes for character set
- codeListValue value from the list defining the used character set

```
<gmd:characterSet>
    <gmd:MD_CharacterSetCode
codeList="http://www.isotc211.org/2005/resources/Codelist/ML_gmxCodelists.xml#MD_CharacterSetCode" codeListValue="utf8">UTF 8</gmd:MD_CharacterSetCode>
</gmd:characterSet>
```

10.1.1.4 contact

Element Name	Description	Namespace
contact	Contact for questions to dataset	gmd
CI_ResponsibleParty	ISO Element for contact data	gmd
individualName	Name of responsible person	gmd
CharacterString	individualName value (text)	gco
organisationName	Name of responsible organisation	gmd
CharacterString	organisationName value (text)	gco
contactInfo	Contact information	gmd
CI_Contact	ISO Element for contact information	gmd
phone	phone	gmd
CI_Telephone		gmd
voice		gmd
CharacterString	Voice telephone value (text)	gco
facsimile		gmd
CharacterString	Fax number value (text)	gco
address		gmd
CI_Address		gmd
deliveryPoint		gmd
CharacterString	Postal Address (street, house number)	gco
city		gmd
CharacterString	City name value (text)	gco
administrativeArea		gmd
CharacterString	Administrative Area name value (text)	gco
postalCode		gmd
CharacterString		gco
electronicMailAddress		gmd
CharacterString	Email value (text)	gco
role		gmd
CI_RoleCode		gmd

CI_RoleCode element contains two attributes

- codeList: Link to the list containing the codes for roles
- codeListValue   value from the list defining the used roles

```xml
<gmd:contact>
    <gmd:CI_ResponsibleParty>
      <gmd:individualName>
        <gco:CharacterString>Jürgen Holfort</gco:CharacterString>
      </gmd:individualName>
      <gmd:organisationName>
        <gco:CharacterString>FMHA Germany (BSH)</gco:CharacterString>
      </gmd:organisationName>
      <gmd:contactInfo>
        <gmd:CI_Contact>
          <gmd:phone>
            <gmd:CI_Telephone>
             <gmd:voice>
               <gco:CharacterString>+49 (0) 381 4563-782</gco:CharacterString>
             </gmd:voice>
             <gmd:facsimile>
               <gco:CharacterString>+49 (0) 381 4563-949</gco:CharacterString>
             </gmd:facsimile>
            </gmd:CI_Telephone>
          </gmd:phone>
          <gmd:address>
            <gmd:CI_Address>
              <gmd:deliveryPoint>
                <gco:CharacterString>Neptunallee 5</gco:CharacterString>
              </gmd:deliveryPoint>
              <gmd:administrativeArea>
                <gco:CharacterString>Rostock</gco:CharacterString>
              </gmd:administrativeArea>
              <gmd:postalCode>
                <gco:CharacterString>18057</gco:CharacterString>
              </gmd:postalCode>
              <gmd:electronicMailAddress>
                <gco:CharacterString>ice@bsh.de</gco:CharacterString>
              </gmd:electronicMailAddress>
            </gmd:CI_Address>
          </gmd:address>
        </gmd:CI_Contact>
      </gmd:contactInfo>
      <gmd:role>
        <gmd:CI_RoleCode
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_RoleC
ode" codeListValue="originator">originator</gmd:CI_RoleCode>
      </gmd:role>
    </gmd:CI_ResponsibleParty>
</gmd:contact>
```

10.1.1.5   dateStamp

Element Name	Description	Namespace
dataStamp	Date Stamp	gmd
Date	Formatted String (yyyy-MM-dd)	gco

The dateStamp should be used for the publication date (just day using gco:date or including the time using gco:datetime). The date and time where the ice chart is considered valid should be given in identificationinfo (see 10.1.1.6). Classic operational ice charts should have a time stamp within the temporal extent given in identificationinfo, a dateStamp preceding the temporal extent denotes a prognosis chart, a dateStamp that is more recent then the temporal extent denotes an historic reanalysis or a climatological chart.

```
<gmd:dateStamp>
    <gco:Date>2013-02-25</gco:Date>
</gmd:dateStamp>
```

10.1.1.6   identificationInfo

Element Name	Description	Namespace
identificationInfo		gmd
MD_DataIdentification		
citation		
CI_Citation		
title		
CharacterString		gco
date		
CI_Date		
date		
Date		gco
dateType		
CI_DateTypeCode		
abstract		
CharacterString		gco
language		
LanguageCode		
characterSet		
MD_CharacterSetCode		
topicCategory		
MD_TopicCategoryCode		
extent		
EX_Extent		
geographicElement		
EX_GeographicBoundingBox		
westBoundLongitude		
Decimal		gco
eastBoundLongitude		
Decimal		gco
southBoundLatitude		
Decimal		gco
northBoundLatitude		gmd
Decimal		gco
temporalElement		gmd
EX_TemporalExtent		gmd
extent		gmd
TimePeriod		gml
beginPosition		gml
endPosition		gml

```
<gmd:identificationInfo>
    <gmd:MD_DataIdentification>
      <gmd:citation>
        <gmd:CI_Citation>
          <gmd:title>
            <gco:CharacterString>IceArea25022013.shp</gco:CharacterString>
          </gmd:title>
          <gmd:date>
            <gmd:CI_Date>
              <gmd:date>
                <gco:Date>2013-02-25</gco:Date>
              </gmd:date>
```

```
            <gmd:dateType>
               <gmd:CI_DateTypeCode
codeList="http://www.isotc211.org/2005/resources/Codelist/ML_gmxCodelists.xml#CI_Da
teTypeCode" codeListValue="creation">creation</gmd:CI_DateTypeCode>
            </gmd:dateType>
          </gmd:CI_Date>
        </gmd:date>
      </gmd:CI_Citation>
    </gmd:citation>
    <gmd:abstract>
      <gco:CharacterString>Ice Chart for Baltic sea</gco:CharacterString>
    </gmd:abstract>
    <gmd:language>
      <gmd:LanguageCode
codeList="http://www.isotc211.org/2005/resources/Codelist/ML_gmxCodelists.xml#Langu
ageCode" codeListValue="eng">English</gmd:LanguageCode>
    </gmd:language>
    <gmd:characterSet>
      <gmd:MD_CharacterSetCode
codeList="http://www.isotc211.org/2005/resources/Codelist/ML_gmxCodelists.xml#MD_C
haracterSetCode" codeListValue="utf8">UTF 8</gmd:MD_CharacterSetCode>
    </gmd:characterSet>
    <gmd:topicCategory>

<gmd:MD_TopicCategoryCode>geoscientificInformation</gmd:MD_TopicCategoryCode>
    </gmd:topicCategory>
    <gmd:extent>
      <gmd:EX_Extent>
        <gmd:geographicElement>
          <gmd:EX_GeographicBoundingBox>
            <gmd:westBoundLongitude>
              <gco:Decimal>8.963</gco:Decimal>
            </gmd:westBoundLongitude>
            <gmd:eastBoundLongitude>
              <gco:Decimal>30.353</gco:Decimal>
            </gmd:eastBoundLongitude>
            <gmd:southBoundLatitude>
              <gco:Decimal>53.613</gco:Decimal>
            </gmd:southBoundLatitude>
            <gmd:northBoundLatitude>
              <gco:Decimal>65.0</gco:Decimal>
            </gmd:northBoundLatitude>
          </gmd:EX_GeographicBoundingBox>
        </gmd:geographicElement>
        <gmd:temporalElement>
          <gmd:EX_TemporalExtent>
            <gmd:extent>
              <gml:TimePeriod gml:id="ek1-20130225-16">
                <gml:beginPosition>2013-02-25</gml:beginPosition>
                <gml:endPosition>2013-02-27</gml:endPosition>
              </gml:TimePeriod>
            </gmd:extent>
          </gmd:EX_TemporalExtent>
        </gmd:temporalElement>
      </gmd:EX_Extent>
    </gmd:extent>
  </gmd:MD_DataIdentification>
</gmd:identificationInfo>
```

10.2 Language

The language used in metadata must be English. Other languages are optional and only as addition
to the English version.

11 Maintenance

11.1 Maintenance and Update Frequency

Ice information datasets should be maintained if a new dataset of region and provider is available. There is no updating mechanism necessary, because the datasets itself will not updated. The old one have to be replaced with new one.

12 Portrayal

12.1 Rules
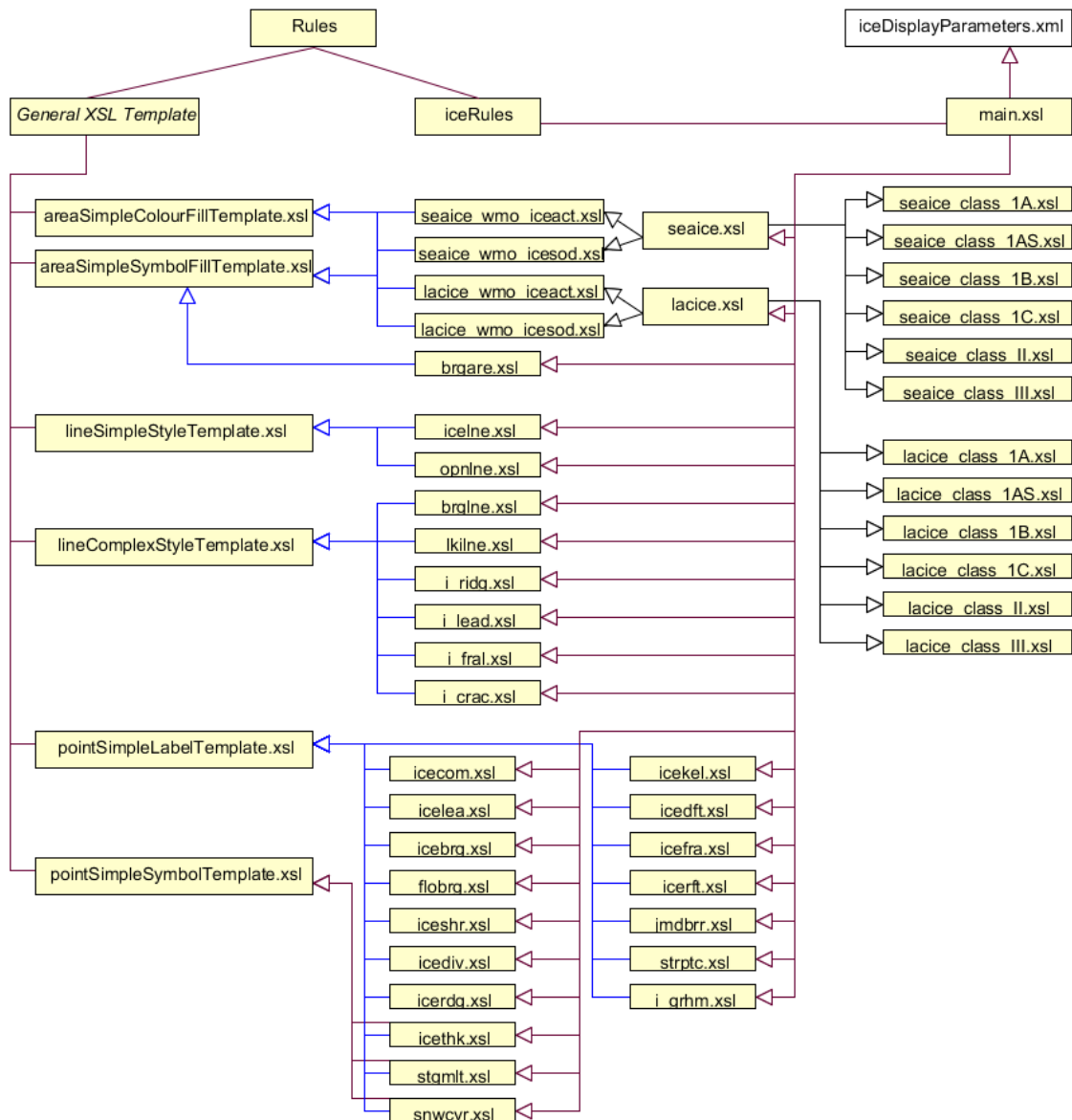
main.xsl includes all the rules for single feature types. It manages the selection of the right rule, depending on current feature type in dataset and parameters in `iceDisplayParameters.xml`.

iceDisplayParameters.xml contains parameters important for display of ice features:
- String `iceclass`
- Boolean `encoverlay`
- String `Display Mode`
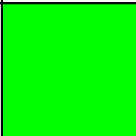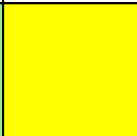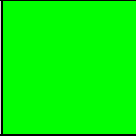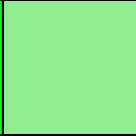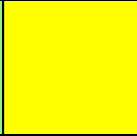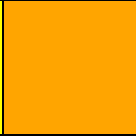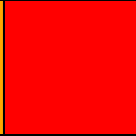
Depending on the iceclass parameter the right `seaice` or `lacice` rule can be selected. The default is `*_class_III.xsl`

The `encoverlay` parameter helps to calculate the priority for display of single ice feature types. If `encoverlay` is true, the priority will be calculated, depending on priority of land area feature in ENC. The area objects of ice features should be displayed under the land area polygons, because they are usually drawn over the land.

12.2 Symbols

12.2.1   Polygon Features

12.2.1.1   IceNavigationalDisplayMode (Traffic Light Principle, depends on Ice Class)

Object Class	Acronym						
Sea Ice	seaice						
Lake Ice	lacice						
Iceberg Area	icebrg						
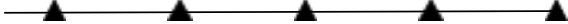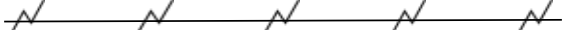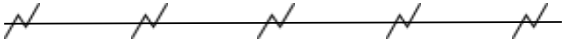
12.2.1.2   IceScientificIceactDisplayMode

iceact	description	rgb	color
1	Ice Free	000 100 255	
2	Open Water (< 1/10 ice)	150 200 255	
3	Bergy Water	150 200 255	
10	1/10 ice	140 255 160	
12	1/10 to 2/10 ice	140 255 160	
13	1/10 to 3/10 ice	140 255 160	
20	2/10 ice	140 255 160	
23	2/10 to 3/10 ice	140 255 160	
24	2/10 to 4/10 ice	140 255 160	
30	3/10 ice	140 255 160	
34	3/10 to 4/10 ice	140 255 160	
35	3/10 to 5/10 ice	255 255 000	
40	4/10 ice	255 255 000	
45	4/10 to 5/10 ice	255 255 000	
46	4/10 to 6/10 ice	255 255 000	
50	5/10 ice	255 255 000	
56	5/10 to 6/10 ice	255 255 000	
57	5/10 to 7/10 ice	255 255 000	
60	6/10 ice	255 255 000	
67	6/10 to 7/10 ice	255 255 000	
68	6/10 to 8/10 ice	255 125 007	
70	7/10 ice	255 125 007	
78	7/10 to 8/10 ice	255 125 007	
79	7/10 to 9/10 ice	255 125 007	
80	8/10 ice	255 125 007	
81	8/10 to 10/10 ice	255 000 000	
89	8/10 to 9/10 ice	255 125 007	
90	9/10 ice	255 000 000	
91	9/10 to 10/10 or 9+/10 ice	255 000 000	
92	10/10 ice	145 000 000	
99	Undetermined/Unknown	SymbolFill	

12.2.1.3 IceScientificIcesodDisplayMode

icesod	desc	rgb	color
1	Ice Free	150 200 255	
70	Brash Ice	150 200 255	
80	No stage of development	150 200 255	
81	New Ice (<10 cm)	240 210 250	
82	Nilas Ice Rind (<10 cm)	255 100 255	
83	Young Ice (10 to <30 cm)	170 040 240	
84	Grey Ice (10 to <15 cm)	135 060 215	
85	Grey – White Ice (15 to <30 cm)	220 080 235	
86	First Year Ice (30 to 200 cm)	255 255 000	
87	Thin First Year Ice (30 to <70 cm)	155 210 000	
88	Thin First Year Ice Stage 1 (30 to <50 cm)	215 250 130	
89	Thin First Year Ice Stage 2 (50 to <70 cm)	175 250 000	
91	Medium First Year Ice (70 to 120 cm)	000 200 020	
93	Thick First Year Ice (>120 cm)	000 120 000	
94	Residual Ice	000 120 000	
95	Old Ice	180 100 050	
96	Second Year Ice	255 120 010	
97	Multi-Year Ice	200 000 000	
98	Glacier Ice (Icebergs)	SymbolFill	
99	Undetermined/Unknown	SymbolFill	

12.2.2   Line Features

Object Class	Acronym	
Ice Edge	icelne	————————————
Iceberg Limit	brglne	—▲——▲——▲——▲——▲
Limit of Open Water	opnlne	————————————
Limit of All Known Ice	lkilne	————————————
Line of Ice Ridge	i_ridg	▲▲—▲▲—▲▲—▲▲—▲▲
Line of Ice Lead	i_lead	⌐—⌐—⌐—⌐—⌐
Line of Ice Fracture	i_fral	⋀—⋀—⋀—⋀—⋀
Line of Ice Crack	i_crac	⋀—⋀—⋀—⋀—⋀

12.2.3   Point Features

Feature Class	Acronym	Symbol
Ice Compacting	icecom	→←
Ice Lead	icelea	≈
Floeberg	flobrg	▲
Ice Shear	iceshr	⇄
Ice Divergence	icediv	↔
Ice Ridge / Hummock	icerdg	▲▲
Ice Keel / Bummock	icekel	▼▼
Ice Fracture	icefra	⫽
Ice Rafting	icerft	⊓⊔
Jammed Brash Barrier	jmdbrr	▼▼
Stage of Melt	stgmlt	▽
Snow Cover	snwcvr	(
Strips and Patches	strptc	∾
Grounded Hummock	i_grhm	≜
Iceberg	icebrg	
	icebrg 01 (Growler)	◠
	icebrg 02 (Bergy Bit)	◠
	icebrg 03 (Small Iceberg)	△
	icebrg 04 (Medium Iceberg)	△
	icebrg 05 (Large Iceberg)	△
	icebrg 06 (Very large Iceberg)	△
	icebrg 07 (Ice Island Fragment)	◁
	icebrg 08 (Ice Island)	⬡
	icebrg 09 (Radar Target)	⊗
	icebrg 99 (Unknown)	△
Ice Drift	icedft	
	icedft 01 (No Ice Motion)	✳
	icedft 02 (NE)	↗
	icedft 03 (E)	→
	icedft 04 (SE)	↘
	icedft 05 (S)	↓
	icedft 06 (SW)	↙
	icedft 07 (W)	←
	icedft 08 (NW)	↖
	icedft 09 (N)	↑
	icedft 10 (Variable)	✳

	icedft 99 (Unkonwn)	⌖

12.2.4   Draw order

The highest number will be drawn on the top.

No.	Name	Acronym
1	Sea Ice	seacie
1	Lake Ice	lacice
2	Iceberg Area	icebrg
3	Ice Edge	icelne
4	Iceberg Limit	brglne
5	Limit of Open Water	opnlne
6	Limit of All Known Ice	lkilne
7	Line of Ice Ridge	i_ridg
8	Line of Ice Lead	i_lead
9	Line of Ice Fracture	i_fral
10	Line of Ice Crack	i_crac
11	Ice Compacting	icecom
12	Ice Lead	icelea
13	Iceberg	icebrg
14	Floeberg	flobrg
15	Ice Thickness	icethk
16	Ice Shear	iceshr
17	Ice Divergence	icediv
18	Ice Ridge / Hummock	icerdg
19	Ice Keel / Bummock	icekel
20	Ice Drift	icedft
21	Ice Fracture	icefra
22	Ice Rafting	icerft
23	Jammed Brash Barrier	jmdbrr
24	Stage of Melt	stgmlt
25	Snow Cover	snwcvr
26	Strips and Patches	strptc
27	Grounded Hummock	i_grhm

13 Additional Information

Annex A – Data Classification and Encoding Guide

The data classification is generally done by ice services, the WMO publication 574 is given as reference in file WMO574.pdf. As a guide for encoding some python scripts are given in directory "software" to convert shapefiles (e.G. Sigrid-3) into S-411.

Annex B – Data Product format (encoding)

In directory "Schemas"

Annex D – Feature Catalogue

File S411FC.xml

Annex F – Portrayal Catalogue (SE, XSLT + SVG)

In directory "Portrayal"

Annex G – Encoding Example for all ice features

In directory "Test"

Annex I – Exchange Catalogue Example

In directory "Example"; templates for Metadata and Exchange set are also found in directory "software".