Amendments to the Sea Ice Nomenclature, SIGRID-3 and the ENC Ice Objects Catalogue as Approved by ETSI-IV

This document contains a summary of the amendments to the referenced documents that were approved by the Expert Team on Sea Ice at its 4th Session in St. Petersburg, March 1-5, 2010.

Part 1 - contains amendments made to harmonize the Sea Ice Nomenclature, SIGRID-3 and the ENC Ice Objects Catalogue Version 4.1. (Ref: Meeting Record paragraph 2.6.1.2)

Part 2 - contains amendments to the Sea Ice Nomenclature to add definitions used by ASPeCt in the Southern Ocean. (Ref: Meeting Record paragraph 2.6.2.6)

Part 3 - contains amendments to the Sea Ice Nomenclature necessary for consistency with the ENC Ice Objects Catalogue Version 5.0. (Ref: Meeting Record paragraph 2.6.2.7)

Part 1

Changes to Harmonize the WMO Sea Ice Nomenclature and Symbology, the SIGRID-3 Coding Standard and the ENC Ice Objects Catalogue Version 4.1

Summary of Proposed Changes

Reference	Change to WMO 259	Change to SIGRID	Change to Ice Objects
LACICE	Add Lake Ice terms		
BRGARE		Remove Floeberg from Table 4-13	
ICEBRG	Add iceberg types and renumber articles 4.7-4.12		
ICEFRA	Amend definition of symbols for “cracks”		
ICEACT		Amend Table 4.1 to remove code “00”	Change definition of Code 91 in ICEACT to include 9+/10
ICEAPC			Change definition of Code 91 in ICEAPC to include 9+/10
ICESOD	Amend definition for Jammed Brash Barrier	Amend Table 4.2 to remove code “00”, clarify ambiguities in thickness ranges.	Add “Brash Ice” with Code 70 to ICESOD. Add new Ice Attribute ICEBRS
ICELSO			Add “Brash Ice” with Code 70 to ICELSO.
ICEFLZ	Discontinue use of the second variant to describe the forms of ice – remove F_p and F_s from Sea Ice Symbols		
ICEFLZ		Amend Table 4.3 to remove code “00” and clarify ambiguities in size ranges.	
ICEMLT		Amend Table 4.11 to remove code “00” and add term for “many puddles”.	

Ice Object LACICE

Observation

Lake Ice Stages of Development are not supported by WMO Symbology. In producing the Ice Objects Catalogue Version 4.0, the values for this attribute were taken from "MANICE – Manual of Standards Procedures for Observing and Reporting Ice Conditions", 8th Edition, 1984, Canadian Ice Centre, Ottawa, Canada and have been in use for many years on Great Lakes ice charts produced by the Canadian Ice Service and the National Ice Center.

Recommendation

It is recommended that the Sea Ice Nomenclature and Symbology be expanded to include terminology for lake ice and be re-titled accordingly. The definitions of the terms should be extracted from the Canadian Ice Service MANICE, most recent edition.

Add the following new terms to the Nomenclature:

Item No.	English	French	Russian	Spanish
2.7	Development of Lake Ice: Because of the absence of salt in the water, the freezing and growth processes of lake ice are considerably different from those of sea ice. Generally, lake ice forms and is destroyed more quickly than sea ice, is more brittle and harder than sea ice.			
2.7.1	New Lake Ice: Recently formed lake ice less than 5 cm thick.			
2.7.2	Thin Lake Ice: Lake ice that is 5-15 cm in thickness.			
2.7.3	Medium Lake Ice: Lake ice that is 15-30 cm in thickness.			
2.7.4	Thick Lake Ice: Lake ice that is 30-70 cm in thickness.			
2.7.5	Very Thick Lake Ice: Lake ice that is greater than 70 cm in thickness.			

Rationale

There is continuous winter navigation on the Great Lakes and the North American Ice Service produces regular ice charts and bulletins in the same manner and with similar symbology as for the ice-encumbered oceans. However, there is no existing international terminology and symbology for lake ice. Since many terms and symbols for lake ice are similar to those for sea ice and since the information providers and users are largely the same, it is proposed that the best way to rectify this deficiency is to expand the Sea Ice Nomenclature to include lake ice.

Ice Object BRGARE

Observation

In the SIGRID-3 standard (SIGRID-3: A VECTOR ARCHIVE FORMAT FOR SEA ICE CHARTS WMO/TD-No. 1214; 2004; JCOMM Technical Report No. 23), Table 4.13 - Ice of land origin (type of iceberg) includes Floeberg with code value 8. Since a "Floeberg" is, by WMO definition, composed of sea ice and not glacial ice, floebergs have been excluded from the expected inputs of "BRGARE". This is consistent with both Canadian Ice Service and International Ice Patrol practice.

Recommendation

Remove "Floeberg" from Table 4.13 – Ice of land origin (type of ice iceberg) in the SIGRID-3 standard. The revised table would be:

Table 4.13 Ice of land origin (type of iceberg)

Form		Size	
Growler and or bergy bit	1	unspecified	0
Iceberg, unspecified	2	small	1
Iceberg, glacier berg	3	medium	2
Iceberg, dome	4	large	3
Iceberg, pinnacled	5	very large	4
Iceberg, tabular	6		
Ice island	7		
Radar target	9		

Ice Object ICEBRG

Observation

The WMO terminology does not include all of the iceberg descriptions in use by the International Ice Patrol and the Canadian Ice Service.

Recommendation

It is recommended that definitions for “dry-docked” and “blocky” icebergs be added, items 4.3.8 (Glacier berg), 4.3.9 (Tabular berg), 4.3.10 (Ice island), 4.3.11(Bergy bit) and 4.3.12 (Growler) be renumbered as below for consistency and mention of Antarctic large tabular bergs be made.

Specifically:

- amend Item 4.3.7 to included additional terms
- delete the items above and replace with the following:

Item No.	English	French	Russian	Spanish
4.3.7	Iceberg: Cf. 10.4.2 – A massive piece of ice of greatly varying shape, protruding more than 5 m above sea level, which has broken away from a glacier, and which may be afloat or aground. Icebergs may be described as tabular, dome-shaped, sloping, pinnacled, **dry-docked, blocky,** weathered or glacier bergs **in addition to having a size qualifier**.			
4.3.7.1	Glacier berg: Cf. 10.4.2.1 – An irregularly shaped iceberg			
4.3.7.2	Tabular berg: Cf. 10.4.2.2 – A flat-topped iceberg. Most tabular bergs form by calving from an ice shelf and show horizontal banding (cf. Ice island).			
4.3.7.3	Domed Iceberg: An iceberg which is smooth and rounded on top.			
4.3.7.4	Sloping Iceberg: An iceberg which is rather flat on top and with steep vertical sides on one end, sloping to lesser sides on the other end.			
4.3.7.5	Pinnacled Iceberg: An iceberg with a central spire or pyramid, with one or more spires.			
4.3.7.6	Dry-docked Iceberg: An iceberg which is eroded such that a U-shaped slot is formed near or at water level, with twin columns or pinnacles. This is also			

	referred to as a twinned iceberg.			
4.3.7.7	Blocky Iceberg: A flat-topped iceberg with steep vertical sides.			
4.3.7.8	Weathered Iceberg: An iceberg that shows marked signs of deterioration from the effects of atmosphere and ocean.			
4.3.7.9	Ice island: Cf. 10.4.3 - A large piece of floating ice protruding about 5 m above sea-level, which has broken away from an Arctic ice shelf, having a thickness of 30-50 m and an area of from a few thousand m^2 to 500 km^2 or more, and usually characterized by a regularly undulating surface which gives it a ribbed appearance from the air. This term is not commonly used in the Antarctic, where the term very large tabular iceberg describes the same phenomenon.			
4.3.7.10	Ice Island Fragment: Piece of an ice island that has broken away from the main mass.			
4.3.7.11	Very Large Iceberg: A piece of glacier ice extending more than 75 m above sea level and with a length of more than 200 m.			
4.3.7.12	Large Iceberg: A piece of glacier ice extending 46 to 75 m above sea level and with a length of 121 to 200 m.			
4.3.7.13	Medium Iceberg: A piece of glacier ice extending 16 to 45 m above sea level and with a length of 61 to 120 m.			
4.3.7.14	Small Iceberg: A piece of glacier ice extending 5 to 15 m above sea level and with a length of 15 to 60 m.			
4.3.7.14	Bergy bit: Cf. 10.4.4 - A large piece of floating glacier ice, generally showing less than 5 m above sea-level but more than 1 m and normally about 100-300 m^2 in area.			
4.3.7.15	Growler: Cf. 10.4.5 - Amended by ETSI-I (2001) to read: Piece of ice smaller than a bergy bit and floating less than 1 m above the sea surface, a growler generally appears white but sometimes transparent or blue-green in			

	colour. Extending less than 1 m above the sea surface and normally occupying an area of about 20 m², growlers are difficult to distinguish when surrounded by sea ice or in high sea state.			

Rationale

The International Ice Patrol is the most official source of iceberg information in the North Atlantic and has the largest base of clients for iceberg information. The International Sea (Floating) Ice Nomenclature should reflect the established practice of the IIP by including all of the terminology in use.

Additionally, the current numbering of articles 4.3.7 – 4.3.12 is not consistent with other sections of the Nomenclature. Article 4.3.7 is the general definition of "iceberg" and all of the specific types of icebergs should be sub-sections of 4.3.7.

Ice Object ICEFRA

Observation

There is no established WMO symbol to depict “Fracture”.

Recommendation

It is recommended that the existing symbols for “crack” be used to depict any “fracture”.

Fracture (symbol for a fracture at a specific location) 

Fracture (symbol indicating presence of fractures in the area) 

Rationale

The Nomenclature uses the term “fracture” (Ref: 7.1) for any generic break or rupture in very close pack ice, compact pack ice consolidated pack ice, fast ice or a single floe. The term “crack” (Ref: 7.1.1) is specific type of fracture of width less than 1 metre. For navigation purposes, there seems to be little rationale for distinguishing cracks as distinct from other fractures.

There is already a separate symbol for “lead” (Ref: 7.3) which is a navigationally important type of fracture.

Two classes of symbols, one for generic fractures and one for leads, would seem to be sufficient for portraying openings in the ice for navigational purposes.

Ice Attribute ICEACT

Observation

The codes for ICEACT are not fully in alignment with SIGRID-3 codes. Neither the code set for ICEACT nor the SIGRID-3 code set supports the North American use of “9+ tenths” concentration.

Recommendation

It is recommended that the definition of code 91 in ICEACT be changed to “9/10-10/10 **or “9+/10”**.

It is also recommended that the SIGRID-3 Code Table 4.1 be amended as follows:

1. Change the code for “Ice Free” from “00” to “98” (The purpose for this change is that the ECDIS standard discourages the use of “00” since it is reserved for special situations.)
2. Change the definition of code value “99” from “unknown” to “undetermined /unknown” for consistency both internally in SIGRID-3and with ICEACT

Rationale

“9+ tenths” concentration is defined and supported by the WMO Sea Ice Nomenclature and has been in use on ice charts for a long time. It represents a navigationally important category of ice concentration – almost completely ice covered but not consolidated. ETSI-III approved an amendment to the SIGRID-3 Table 4.1 to support its use and it should be continued for ENC ice information.

The code “00” is generally discouraged in S-57 because it is reserved for special situations that are not applicable to ice charts. The proposed change to an unused code number has the advantage of being backwards compatible with existing SIGRID-3 files. Software to read SIGRID-3 can treat “00” and the new code as both meaning the same thing. Software to produce SIGRID-3 should be changed to use only the new code.

Ice Attribute ICEAPC

Observation

The codes for ICEAPC do not support the North American use of “9+ tenths” concentration.

Recommendation

It is recommended that, for consistency, with SIGRID-3 and the above recommended change to ICEACT, the definition of code 91 in ICEAPC be changed to “9/10-10/10 **or “9+/10”**.

Rationale

This change is necessary for compatibility if the change to ICEACT is accepted.

Ice Attribute ICESOD

Observation

The codes for ICESOD are not fully in alignment with JCOMM SIGRID-3 codes and do not reflect the changes to SIGRID-3 adopted at ETSI-III regarding “brash ice”.

Recommendation

It is recommended to add an ID of 70 to the expected input for ICESOD with a meaning of “Brash Ice”.

It is recommended to add a new Ice Attribute, ICEBRS, to describe the concentrations of Very Thick Brash Ice (>4 m), Thick Brash Ice (>2 - 4 m), Medium Brash Ice (1 – 2 m) and Thin Brash Ice (<1 m) respectively. The expected input for these four new attributes will be similar to ice attribute ICEACT.

It is recommended that the definition of Jammed Brash Barrier in the Sea Ice Nomenclature be amended to read (added text in italics):

4.4.8.1.1 Jammed brash barrier: A strip or narrow belt of new, young or brash ice (usually 100-5000 m wide) formed at the edge of either drift or fast ice or at the shore. It is heavily compacted mostly due to wind action and may extend 2 to 20 m below the surface but does not normally have appreciable topography. Jammed brash barrier may disperse with changing winds but can also consolidate to form a strip of unusually thick ice in comparison with the surrounding drift ice. *This is also known as a Windrow in the Baltic Sea.*

It is recommended that the SIGRID-3 Code Table 4.2 be amended as follows:

1. Change the code for “ice free” to “01” (the ECDIS standard discourages the use of “00”).
2. In order to remove ambiguities in range values, add “<” and “>” symbols as appropriate to conform to the definitions for ICESOD.
3. Add a thickness range for “New Ice”.
4. Remove the upper thickness limit of 200 cm for First Year Ice (Code 86). Although First Year Ice usually never exceeds 200cm, there is no physical reason that it could not. Removing the upper limit is consistent with the existing definition of Thick First Year Ice (Code 93).

The revised Table 4.2 would look like:

Table 4.2 Thickness of ice or stage of development codes for variable identifiers SA, SB, SC, CN, and CD.

Stage of Development	Thickness	Code Figure
Ice Free		01
Brash Ice	Given by AV, AK, AM, AT in Table 3.3	70
No Stage of Development		80
New Ice	< 10 cm	81
Nilas, Ice Rind	< 10 cm	82
Young Ice	10 - <30 cm	83
Grey Ice	10 - <15 cm	84
Grey - White Ice	15 - <30 cm	85
First Year Ice	≥ 30 cm	86

Thin First Year Ice	30 - <70 cm	87
Thin First Year Stage 1	30 - <50 cm	88
Thin First Year Stage 2	50 - <70 cm	89
For Later Use		90
Medium First Year Ice	70 - <120 cm	91
For Later Use		92
Thick First Year Ice	≥ 120 cm	93
For Later Use		94
Old Ice		95
Second Year Ice		96
Multi-Year Ice		97
Glacier Ice		98
Undetermined/Unknown		99

Rationale

Brash Ice is a common occurrence in Canadian waters and is regularly reported on ice observation charts. ETSI-III approved the inclusion of Brash Ice in SIGRID-3 along with an encoding for its use. The Ice Object Catalogue should be amended to include Brash Ice for compatibility so that this phenomenon can be displayed on ENCs.

During previous work on standards, it was noted that the “jammed brash barrier” symbol was used on some Baltic Sea ice charts but was termed “windrow”.

Changes to the SIGRID-3 code table are primarily to overcome ambiguities in the definitions and to remove use of the code “00” for reasons described elsewhere.

Ice Attribute ICELSO

Observation

The codes for ICELSO do not support “brash ice”.

Recommendation

It is recommended to add an ID of 70 to the expected input for ICELSO with a meaning of “Brash Ice”.

The proposed new Ice Attributes, ICEBAV, ICEBAK, ICEBAM and ICEBAT (See ICESOD) would also apply to ICELSO.

Rationale

For consistency with the practice adopted for brash sea ice, brash lake ice is also commonly observed.

Ice Attribute ICEFLZ

Observation

The International System of Sea Ice Symbols (Ref: WMO Sea Ice Nomenclature No. 259 Supplement No. 4) provides two variants to describe the forms of ice. The first variant uses F_a, F_b and F_c corresponding to the three stages of development S_a, S_b, and S_c. The second variant uses the parameters F_p and F_s to describe the predominant and secondary floe sizes, independent from the stages of development. This practice was originally carried into the SIGRID-3 encoding through the use of FA, FB and FC or, alternatively, the parameter CF. ETSI-III recognized the possibility of this confusion and approved the removal of the parameter CF from the SIGRID-3 code. However, the Sea Ice Nomenclature was not amended at the same time.

Recommendation

It is proposed to discontinue use of the second variant to describe the forms of ice.

The parameters F_p and F_s would be removed from the System of Sea Ice Symbols.

Rationale

The dual, alternative uses to describe the forms of ice can, and have, led to considerable confusion. As a result, ETSI-III agreed to remove it from the SIGRID-3 code. It is believed that the second variant, F_p and F_s, is not in widespread use. It is therefore proposed to eliminate this permitted used.

Ice Attribute ICEFLZ

Observation

The codes for ICEFLZ are not fully in alignment with SIGRID-3 codes.

Recommendation

It is recommended that the SIGRID-3 Code Table 4.3 be amended as follows:

1. Change the code for “Pancake ice” to “22” (the ECDIS standard discourages the use of “00”).
2. In order to remove ambiguities in range values, add “<” and “>” symbols as appropriate to conform to the definitions above.
3. Remove the reference to CF from the heading of Table 4.3 (this is a housekeeping item since the parameter CF was removed from the code at ETSI-III)

The revised Table 4.3 would look like:

Table 4.3 Form of ice codes for variable identifiers FA, FB, FC(~~, and CF~~).

Form	Size/Concentration	Code Figure
Pancake Ice	30 cm - 3 m	22
Shuga/Small Ice Cake, Brash Ice	< 2 m across	01
Ice Cake	< 20 m across	02
Small Floe	20 m - <100 m across	03
Medium Floe	100 m - <500 m across	04
Big Floe	500 m - <2 km across	05
Vast Floe	2 km - <10 km across	06
Giant Floe	≥ 10 km across	07
Fast Ice		08
Growlers, Floebergs or Floebiits		09
Icebergs		10
Strips and Patches	concentrations 1/10	11
Strips and Patches	concentrations 2/10	12
Strips and Patches	concentrations 3/10	13
Strips and Patches	concentrations 4/10	14
Strips and Patches	concentrations 5/10	15
Strips and Patches	concentrations 6/10	16
Strips and Patches	concentrations 7/10	17
Strips and Patches	concentrations 8/10	18
Strips and Patches	concentrations 9/10	19
Strips and Patches	concentrations 9+/10	91
Strips and Patches	concentrations 10/10	20
Level Ice		21
Undetermined/Unknown		99

Rationale

Changes to the SIGRID-3 code table are primarily to overcome ambiguities in the definitions and to remove use of the code “00” for reasons described elsewhere.

Ice Attribute ICEMLT

Observation

The codes for ICEMLT are not fully in alignment with JCOMM SIGRID-3 codes.

Recommendation

It is recommended that the SIGRID-3 Code Table 4.11 be amended as follows:

1. Change the code of “No melt” to “01” (the ECDIS standard discourages the use of “00”).
2. An additional term for “many puddles” be added with Code “2”. (this omission was likely inadvertent in the initial version of SIGRID-3).

Rationale

These changes are to eliminate the use of “00” and to correct an assumed oversight in the original definition.

Part 2

Additions and Amendments to the WMO Sea Ice Nomenclature to add definitions used by ASPeCt in the Southern Ocean

1) SNOW ICE

There is no definition for snow ice in the WMO Sea Ice Nomenclature even though it makes a significant contribution to the total mass of Antarctic sea ice. (Ref: ASPeCt – Antarctic Sea Ice Processes and Climate (http://www.aspect.aq/snowice.html)

It is recommended to adopt a definition for "snow ice", based on the ASPeCt description, to be included in Section 2 Development.

> "2.7 Snow Ice: Ice formed by refreezing flooded snow creating an ice layer that bonds firmly to the top surface of a floe."

The ASPeCt definition is appropriate to adopt since it has been use for many years in the Antarctic.

2) MARGINAL ICE ZONE (MIZ)

There is no definition of Marginal Ice Zone in the WMO Sea Ice Nomenclature even though the term has widespread use.

It is recommended to adopt a definition for Marginal Ice Zone to be included in Section 4.4 Arrangement of Floating Ice.

> "4.4.11 Marginal Ice Zone: The region of an ice cover which is affected by waves and swell penetrating into the ice from the open ocean."

The definition follows from Peter Wadhams, "Ice in the Ocean", 2000, Overseas Publishers Association, Chapter 6. Wadhams devotes an entire Chapter to the marginal ice zone arguing that there are only four true MIZs in the world – East Greenland Sea, Labrador Sea, Bering Sea and the circumpolar Antarctic ice edge. Wadhams qualifies his definition by saying that the MIZ is "close to an open ocean". Anthony Worby, chair of the ASPeCt SSG, advises that, around Antarctica, ocean swell can penetrate hundreds of kilometers into an ice field.

3) FLOE

The current definition of "floe" in the Sea Ice Nomenclature is:

> "4.3.2 Floe: Any relatively flat piece of sea ice 20 m or more across. Floes are subdivided according to horizontal extent as follows:"

The following sub-paragraphs 4.3.2.1 through 4.3.2.5 define floe sized from giant to small.

A following paragraph defined ice cake:

> "4.3.3 Ice cake: Any relatively flat piece of sea ice less than 20 m across."

The ASPeCt definition of “floe” is:

> “A floe is any contiguous piece of sea ice. Floes may be described in terms of several size categories:”

Five floe sizes from giant to small, identical to the Sea Ice Nomenclature, follow with the addition of a note that: “Floes less than 20m across are called cake ice.”

Two differences stand out:

1) “contiguous piece” vs “relatively flat piece” – ASPeCt does not delineate floes by ridges and makes the point that large floes are usually formed by small floes freezing together and may be significantly ridged. On the other hand, “relatively flat” is correct in the sense that the vertical extent of any piece of sea ice is always much less than the horizontal extent.
2) Difference in treatment of floes/cakes less than 20m. Under the Sea Ice Nomenclature, an “ice cake” is not a “floe” (although it has the same root definition). ASPeCt is ambiguous – floes less than 20m are still floes but are called “cake ice”.

It is recommended that:

(a) The definition of “floe” be amended to read:

> “4.3.2 Floe: Any contiguous piece of sea ice. Floes are sub-divided according to horizontal extent as follows:”

(b) The definition of “ice cake” be renumbered from 4.3.3 to 4.3.2.6 and amended to read:

> “4.3.2.6 Ice cake: Less than 20 m across.”

(c) The definition of “small ice cake” be renumbered from 4.3.3.1 to 4.3.2.7 and amended to read:

> “4.3.2.7 Small ice cake: Less than 2 m across.”

4) CAKE ICE

There is no definition for Cake Ice in the WMO Sea Ice Nomenclature even though it is commonly used in Antarctica.

It is recommended to adopt a definition for cake ice as follows:

> “4.3.3.1 Cake Ice is commonly used in Antarctica to refer to a collection of ice cakes. This should not to be confused with “pancake ice”. Cake ice is older and thicker than pancake ice.”

This definition has been proposed by Anthony Worby, chair of the ASPeCt SSG.

If the definitions for ice cake and small ice cake are re-numbered as proposed in 3) above, then Cake Ice should be numbered as paragraph 4.3.3

5) FROST FLOWERS

This term was proposed a long time ago but was not included because it was not used in common practice. With the advance of microwave remote sensing, it has become an important surface feature of sea ice.

The ETSI-II Session (2004) discussed the inclusion of a definition for "frost flowers" which coincides with the Russian national nomenclature, originally proposed to the WMO Commission for Marine Meteorology in 1980. It was agreed that this term be included in a larger update of the Sea Ice Nomenclature, which has not yet been implemented.

It is recommended that the following definition be included in the Sea Ice Nomenclature:

"8.7 Frost flowers: A growth of ice crystals by condensation from the atmosphere at points on the surface of young ice. After formation, sea water may be drawn through the ice into the flowers. These delicate, highly saline crystals effectively roughen the surface, often dramatically altering the appearance of sea ice in microwave remote sensing imagery."

Part 1

Additions to Sea Ice Nomenclature Necessary for Consistency with the ENC Ice Objects Catalogue Version 5.0

Residual Ice

Observation

The WMO terminology does not fully adequately describe the difference between the first-year ice surviving the period of summer melt for which a term “second-year ice” should be used and the same “second-year ice” in mid winter or after 1 January. In Russian sea ice analysis after the moment of stable ice formation (typical dates are region-specific: 1st 10-days period in Kara Sea, November in Chukchi Sea) the surviving FYI is called residual ice. The moment of ice formation is determined by melt puddles freezing or new ice formation on their surface as a result of frosts.

Recommendation

It is recommended that definitions for “residual first-year ice” be added as term 2.6.1 inside section 2.6 (Old ice) and 2.6.1 (Second-year ice) and 2.6.2 ()Multi-year ice) be renumbered. Definition follows the Russian “Manual on conducting ice air reconnaissance” and proposed new version of the WMO Sea Ice Nomenclature by A.Bushuev. Appropriate changes should be also introduced to appropriate coding tables.

Code: 94 (spare).

Item No.	English	French	Russian	Spanish
2.6.1	**Residual first-year ice:** First-year ice that has survived the summer’s melt and is now in the new cycle of growth. It is 30 to 180 cm thick depending on the region where it was in summer. After 1 January (in the Southern hemisphere after 1 July), this ice is called second-year ice			

Snow Cover Concentration

Observation

The WMO terminology does not provide quantative description for snow cover concentration.

Recommendation

It is recommended to add the term 8.6.1 (Snow cover concentration) after 8.6 (Snow-covered ice) Definition follows the Russian “Manual on conducting ice air reconnaissance”.

Item No.	English	French	Russian	Spanish
8.6.1	**Snow cover concentration:** Concentration (aerial coverage) of snow-covered ice in an ice area in tenths.			

Ice Rafting Concentration

Observation

The WMO terminology does not provide description for ice rafting concentration.

Recommendation

It is recommended to add the term 8.2.1.1 (Ice Rafting Concentration) after 8.2.1 (Rafted Ice) with subsequent renumbering of item 8.2.1.1. Definition follows the Russian “Manual on conducting ice air reconnaissance”

Item No.	English	French	Russian	Spanish
8.2.3.1	**Ice ridge concentration:** Concentration (aerial coverage) of ice rafting in an ice area in tenths.			

Ice Ridge Concentration

Observation

The WMO terminology does not provide description for ridges and hummocks concentration.

Recommendation

It is recommended to add the term 8.2.3.1 (Ice Ridge Concentration) after 8.2.3 (Hummock) with subsequent renumbering of items 8.2.3.1 – 8.2.3.3. Definition follows the Russian "Manual on conducting ice air reconnaissance"

Item No.	English	French	Russian	Spanish
8.2.3.1	**Ice ridge concentration:** Concentration (aerial coverage) of hummocked ice of all kinds in an ice area in tenths. Up to three values may be given to correspond to the partial concentrations.			

Fractures Concentration

Observation

The WMO terminology does not provide description for fractures concentration which is alternative to floe size.

Recommendation

It is recommended to add the term 7.2.1 (Fractures Concentration) after 7.2 (Fracture zone). Definition follows the Russian “Manual on conducting ice air reconnaissance”

Item No.	English	French	Russian	Spanish
7.2.1	**Fractures concentration:** Degree of disunity in an ice area.			

Coding:

Code	Meaning
10	Frequency of Cracks and Leads seldom then in 10 km on Route
20	Frequency of Cracks and Leads in 5 – 10 km on Route
30	Frequency of Cracks and Leads in 3 – 5 km on Route
40	Frequency of Cracks and Leads in 2 – 3 km on Route
50	Frequency of Cracks and Leads often then in 2 km on Route
60	Small and Medium Floes – 1/10-3/10; Big Floes – 7/10-10/10 Conc.
70	Small and Medium Floes – 4/10-6/10; Big Floes – 4/10-6/10 Conc.
80	Small and Medium Floes – 7/10-10/10; Big Floes – 1/10-3/10 Conc.
90	Small and Medium Floes Only
92	Small Floes Only
98	No fractures
99	Undetermined / Unknown

Dirty Ice

Observation

The WMO terminology does not provide description for ice that has some mineral or organic contamination on the surface or in its strata, Naturally originated contamination may be wind-driven debris from barren tundra, bottom sediments included into the ice due to autumn storms, algae from the spring/summer blossoms etc. Dirty sea ice is typical for many areas of the Arctic Ocean, the degree of contamination influences surface albedo and structure, thus affecting thermal processes in ice.

Recommendation

It is recommended to add the term 8.7 (Dirty ice) after 8.6.2 (Snowdrift). Definition follows the Russian “Manual on ice air reconnaissance”

Item No.	English	French	Russian	Spanish
8.7	**Dirty ice:** Ice that has a mineral or organic content of natural or anthropogenic origin on the surface or in its strata.			