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| **WORLD METEOROLOGICAL ORGANIZATION****\_\_\_\_\_\_\_\_\_\_\_\_\_** |  | **INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)\_\_\_\_\_\_\_\_\_\_\_** |

JCOMM Expert Team on Sea Ice

**SIGRID-3: A VECTOR ARCHIVE FORMAT FOR SEA ICE GEOREFERENCED INFORMATION AND DATA**

**Version 3.0**

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# Introduction

This document describes Version 3.0 of SIGRID-3 (Sea Ice GeoReferenced Information and Data), an evolution of the SIGRID series of standards for coding, exchange and archiving of digital ice charts. Version 3.0 retains the essential structure of its predecessor and is backwards compatible with earlier versions of SIGRID-3. The important extension of Version 3 is to incorporate the features, attributes and encoding of the Ice Objects Catalogue for Electronic Navigation Charts (ENCs). The purpose of this extension is to facilitate the automatic translation of digital ice charts into S-57 and S-10x ENC formats.

## Background

SIGRID (“Sea Ice Grid”) was originally proposed in 1981 (Ref: Thompson 1981) as a way of digitizing sea ice charts to aid climatological analysis and improve operational ice chart production. Ice characteristics, as defined by a number of code tables, were described at grid points. SIGRID was adopted by the World Meteorological Organization (WMO) in 1989 (Ref: WMO 1989b) as the international standard for ice chart data in digital form.

After several years of use by ice services, SIGRID was revised in a substantial way to address a number of operational difficulties. SIGRID-2, which simplified the code tables and gridding mechanism, was approved by the WMO in 1994 (Ref: WMO 1994) as the new standard for digital ice chart information. The emphasis of SIGRID-2 was on the exchange of ice chart information for archiving and climatological analysis.

With advances in Geographic Information System (GIS) technology and the adoption of GIS by ice services for chart production, it became much easier to describe ice chart information in vector format, rather than at grid points, with significant advantages. The vector format preserves all of the information in the original chart and charts can be reproduced, re-projected or re-scaled without loss of information. Vector format can easily be converted to raster on any arbitrary grid when desired. SIGRID-3, a vector archive format for sea ice charts (Ref: JCOMM 2010b), was originally adopted by the JCOMM Expert Team on Sea Ice in 2004. It was revised in 2007 and 2010 to harmonize it with the WMO Sea Ice Nomenclature (Ref: WMO 1989a) and the Electronic Navigation Chart Ice Objects Catalogue (Ref: JCOMM 2010a).

In 2012, several ice services developed software to convert SIGRID-3 directly into the S-57 format that is the standard for exchange of data for Electronic Navigation Chart Systems (ENCS), of which Electronic Chart Display and Information Systems (ECDIS) are the subset approved for ship navigation. This was a major step forward in making ice information available in ENCS, a major goal of the ice services. However, previous versions of SIGRID-3 support only area features – polygons with attributes describing the ice in the polygon. Attributes are limited to those contained in the WMO international ice symbology – the “egg” code. There is no support for line or point features such as are described in the Ice Objects Catalogue.

At the 13th meeting of the International Ice Charting Working Group in 2012, it was agreed that SIGRID-3 should be developed as the “parent” standard for digital ice chart information – a standard from which S-57 and the future S-10x formats could be derived (Ref: IICWG 2012). This means that SIGRID is no longer just a format for archiving ice chart data for climatology. Version 3.0 of SIGRID-3 extends support to all ENCS objects including line and point features. Feature attributes are adopted from the Ice Objects Catalogue.

Version 3.0 of SIGRID-3 was approved by the Expert Team on Sea Ice at its 5th meeting in March 2014.

## Overview of the SIGRID-3 Version 3.0 format

Version 3.0 retains the essential components of SIGRID-3. The shapefile basis and file structure are unchanged. The major changes are to the database file as described below.

Version 3.0 (like earlier versions) is based on a format called “shapefile.” The shapefile format is an open source, vector file format originally developed by Environmental Systems Research Institute (Ref: ESRI 1998, ESRI 2011). A description of shapefiles can be found at <http://en.wikipedia.org/wiki/Shapefile>. Vector formats represent features (such as areas of ice outlined on a chart) as a series of vertices that define the outline of the feature in space. An associated list of attributes (such as the concentration, stage of development, and form of ice) characterizes ice within the outlined area.

Shapefiles can be read and produced by most GIS software including public domain programs such as Quantum GIS and commercial software such ESRI’s ArcGIS. It is, therefore, a de facto standard for the exchange of GIS information among different software platforms.

A basic understanding of GIS software packages on the part of producers and users of shapefiles is assumed and details are not given here. For detailed descriptions of tools and functions in GIS software, the user should refer to the relevant software documentation.

# SIGRID-3 Version 3.0 Shapefiles

This section provides an overview of the shapefile format as implemented in Version 3.0.

## File Naming Convention

File names are divided into five parts, plus an extension, containing information on the issuing organization, region covered, date, feature type and version, as follows:

*organization-code\_region-name\_valid-date\_feature-type\_version.ext*

An underscore separates each division. The file name is not case sensitive.

* *organization-*code is a unique identifier adopted by each issuing organization (for example, CIS, DMI, AARI, NIC). The number of characters to be used for the organization code is not prescribed but should be kept reasonably short for practical purposes.
* *region-*name is a descriptive name assigned by the issuing organization to identify the geographic region described by the file (for example, Baffin, Baltic, Chukchi, Hudson Bay, Arctic, Antarctic). The number of characters to be used for the region name is not prescribed but should be kept reasonably short for practical purposes.
* *valid-*date is eight characters representing the date for which the information in the file is valid, in the format “yyyymmdd”. If the information in the file is valid for more than one date, the issuing organization should assign the date that is most representative. More precise date information can be contained in the metadata (see Appendix D).
* *feature-type* is two characters identifying the type of features contained in the shapefile set – “pl” for polygons, “ln” for lines, or “pt” for points. (see Section 2.2)
* *version i*s a single character used to distinguish between charts that would otherwise have the same name or to facilitate versioning. The first or only chart will use “a”. Additional charts, if any, will use “b”, “c”, and so on.
* The extension, represented by “ext” above, is shp, shx, dbf, prj or xml depending on the file type (see Section 2.3).

Examples:

CIS\_Foxe\_20120114\_ln\_a.shp

NIC\_antarc\_20030210\_pl\_a.dbf

AARI\_kar\_20111030\_pt\_b.prj

## Feature Type Shapefiles

In accordance with the shapefile standard, feature types (polygons, lines, points) cannot be intermingled in the same shapefile. Each type requires a separate shapefile. To describe an ice chart containing polygons (e.g. ice areas), lines (e.g. ice edge) and points (e.g. ice drift), requires three separate, but related, root file names.

## Mandatory Files

A “shapefile” is actually a set of related files, each with the same root name but with different extensions. Five files are mandatory for each shapefile in Version 3.0:

* \*.shp – the main file containing the geographic reference points that define each of the features. The shapefile portrays the continental shoreline, islands, and all the ice lines as drawn by the analyst. Each record describes a shape as a list of latitude/longitude vertices.
* \*.shx – an index file that links shapes to their attributes.
* \*.dbf – a dBase IV file containing the attributes for each feature. Attributes are stored in a one-to-one relationship with shapes.
* \*.prj – a projection file giving the geographic coordinate system of the data in the \*.shp file. Note that a projection file is not mandatory for generic shapefiles but is required for SIGRID-3 to make it easier for users to display the shapefile.
* \*.xml – an XML file containing the metadata that describes the ice chart information in the shapefile.

## Examples

To describe an ice chart containing polygons, lines and points requires a total of fifteen separate files – five mandatory files for the polygon shapefile, five for the line shapefile and five for the point shapefile.

The table below gives an example of a full list of files in a complete shapefile set describing an ice chart containing polygons, lines and points. This file was produced by the Canadian Ice Service on August 21, 2012 and covers the Baffin Bay region.

|  |  |
| --- | --- |
| CIS\_Baffin\_20120821\_pl\_a.shp | Main geographic reference file for polygon features |
| CIS\_Baffin\_20120821\_pl\_a.shx | Index file linking polygon features to database attributes |
| CIS\_Baffin\_20120821\_pl\_a.dbf | Database file containing attribute information for each polygon |
| CIS\_Baffin\_20120821\_pl\_a.prj | Projection file describing the projection of the polygon file |
| CIS\_Baffin\_20120821\_pl\_a.xml | Metadata file describing the polygon feature fileset |
| CIS\_Baffin\_20120821\_ln\_a.shp | Main geographic reference file for line features |
| CIS\_Baffin\_20120821\_ln\_a.shx | Index file linking line features to database attributes |
| CIS\_Baffin\_20120821\_ln\_a.dbf | Database file containing attribute information for each line |
| CIS\_Baffin\_20120821\_ln\_a.prj | Projection file describing the projection of the line file |
| CIS\_Baffin\_20120821\_ln\_a.xml | Metadata file describing the line feature fileset |
| CIS\_Baffin\_20120821\_pt\_a.shp | Main geographic reference file for point features |
| CIS\_Baffin\_20120821\_pt\_a.shx | Index file linking point features to database attributes |
| CIS\_Baffin\_20120821\_pt\_a.dbf | Database file containing attribute information for each point |
| CIS\_Baffin\_20120821\_pt\_a.prj | Projection file describing the projection of the point file |
| CIS\_Baffin\_20120821\_pt\_a.xml | Metadata file describing the point feature fileset |

Note that the three projection files would be identical since they describe the projection of the ice chart that originally contained the three different feature types. Similarly, the three metadata files might be identical unless information specific to the different feature types was included.

# SIGRID-3 Version 3.0 Shapefile Details

## Main File (\*.shp)

The \*.shp file is created by the GIS software and is common for all shapefiles so it can be read by GIS software. There is nothing unique about the format for SIGRID-3. It is well documented in the references and will not be further described here.

SIGRID-3 \*.shp files should be in geographic coordinates (latitude, longitude).

## Index File (\*.shx)

Similarly, the \*.shx file is created by the GIS software and is common for all shapefiles so it can be read by GIS software. There is nothing unique about the format for SIGRID-3. It is well documented in the references and will not be further described here.

## Projection File (\*.prj)

The \*.prj file is a small text file created by the GIS software and is common for all shapefiles so it can be read by GIS software. The information contained in the \*.prj file specifies the geographic coordinate system of the geometric data in the \*.shp file. Although not mandatory in the shapefile standard, it has been required for SIGRID-3 since 2012 to make it easier for users to view the shapefile and this requirement is carried forward to Version 3.0. The file contains a single record in “well-known text” (WKT) format containing:

* Name of Geographic coordinate system or Map projection
* Datum (geodesy)
* Spheroid
* Prime meridian
* Units used
* Parameters necessary to define the map projection, for example: Latitude of origin
* Scale factor
* Central meridian
* False northing
* False easting
* Standard parallels

Examples:

GEOGCS["GCS\_WGS\_1984",DATUM["D\_WGS\_1984",SPHEROID["WGS\_1984",6378137.0,298.257223563]],PRIMEM["Greenwich",0.0],UNIT["Degree",0.0174532925199433]]

PROJCS["WGS\_1984\_Stereographic\_North\_Pole",GEOGCS["GCS\_WGS\_1984",DATUM["D\_WGS\_1984",SPHEROID["WGS\_1984",6378137.0,298.257223563]],PRIMEM["Greenwich",0.0],UNIT["Degree",0.0174532925199433]],PROJECTION["Stereographic\_North\_Pole"],PARAMETER["False\_Easting",0.0],PARAMETER["False\_Northing",0.0],PARAMETER["Central\_Meridian",180.0],PARAMETER["Standard\_Parallel\_1",60.0],UNIT["Meter",1.0]]

## Database File (\*.dbf)

The database file (\*.dbf) stores the attribute information for each feature. This file is in dBase format, a format originally held by Borland, Inc. and used in shapefile production (Ref: dBASE 2012). This file contains two records – a header record and an attribute record. The header record describes the contents of the attribute record which contains all of the attribute information for every feature. Conceptually, it is easiest to think of the \*.dbf file as a table in which every row corresponds to a different feature on the ice chart and columns (fields) contain attributes describing the feature in the form of SIGRID variables. The \*.dbf file can be directly accessed by reading the header record and using it to decode the attribute record. More easily, it can be viewed in a table format using GIS software, Microsoft Excel, OpenOffice Base (providing also direct editing) or other relational database software packages. The \*.dbf file must have the same root name as the \*.shp, \*.shx, \*.prj and \*.xml files and it must contain a record of SIGRID-3 attributes for each feature. These records must be in the same order as their corresponding features in the main (\*.shp) file.

The details of the inner structure of the \*.dbf file are described in reference dBASE 2012. Figure 1 illustrates the structure of a dBase file and its relationship to ice chart features.

As noted, a shapefile can contain only one type of feature – polygons, lines or points. The mandatory and optional database fields are different for each feature type. Appendix A specifies the fields for SIGRID-3 Version 3.0 shapefiles containing polygons. Appendix B specifies the fields for line shapefiles and Appendix C specifies the fields for point shapefiles.

*Note: “field”, “column” and “attribute” are used interchangeably in this document to mean the same thing. “Field” comes from dBase terminology. “Column” comes from table or spreadsheet terminology. “Attribute” comes from geodata terminology.*

**

## Metadata File (\*.xml)

### Background

Metadata files contain important descriptive information about associated chart data. SIGRID-3 uses a format that is sanctioned by the U.S. Federal Geographic Data Committee (FGDC): the Content Standard for Digital Geospatial Metadata (CSDGM) (Ref: FGDC 2012). The FGDC reference provides up to date information about the evolution of the standard as well as software tools to create, edit and validate metadata files against the standard.

FGDC coordinates the development of the U.S. National Spatial Data Infrastructure which develops policies, standards and procedures for U.S. organizations to produce and share geographic data. The U.S. National Ice Center and National Snow and Ice Data Center must follow the FGDC format. The International Organization for Standardization (ISO) coordinates the international development of policies, standards, and procedures for the production and distribution of geographic data. ISO members are continuing to develop the standardization of geographic data and ISO Project 19115 specifically deals with metadata. Since the United States is a member of ISO, FGDC metadata will eventually be harmonized with the ISO standard. Adopting the FGDC standard for SIGRID-3 will minimize the steps needed to make SIGRID-3 ISO compliant in future.

### Metadata Structure

SIGRID-3 uses the widely accepted, public domain XML structure (Ref: XML) for metadata. A file in XML can be read using a web browser and made easily available for searches via the Internet. XML is text based and can be read by both humans and machines. It can be created with a standard text editor or with software tools that simplify the task.

XML uses unique “tags” to organize a metadata document while at the same time describing that document’s content. These tags will always be the same for each ice chart and must be unique from every other tag used in the XML document. For example, projection information will always be located within the same set of XML tags *(Note that projection information in the metadata file duplicates that information in the \*.prj file. The \*.prj file is required in SIGRID-3 because not all GIS software can process the metadata.)*

Appendix D gives the details of metadata contents and structure.

# Using SIGRID-3 for coding ice observations

SIGRID-3 format may be used to code coastal, shipborne or airborne visual observations of ice parameters. It is proposed to use an ‘egg-code’ scheme and follow instructions from Appendix A (“Database file Contents for Polygon Shapefiles”) for coding ice parameters regardless of their geometry (polygon, line or point). Field name T1 (RECDAT) in a valid date and time format should be used to define date and time of observation.

# Using SIGRID-3 for coding prognostic information

SIGRID-3 format may be used to code prognostic ice information presented in vector format: polygon, linear or point. Field name T2 (SORDAT) in a valid date and time format should be used to define date and time of validity of information.

# Conclusion

SIGRID-3 is issued under the authority of the JCOMM Expert Team on Sea Ice (ETSI). ETSI is also recognized by the International Hydrographic Organization as the responsible authority for the Electronic Navigation Chart Ice Objects Catalogue. It will be important to keep both of these mutually dependent standard up to date as users’ needs and technologies evolve. A review of these standards should be a standing agenda item for ETSI meetings.

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Appendix A - Database File Contents for Polygon Shapefiles

# Introduction

As noted earlier, it is in the database file that the major differences between Version 3.0 and earlier versions of SIGRID-3 are found. To provide backwards compatibility, all of the earlier SIGRID-3 fields are retained. To simplify the production of S-57/S-10x files, fields from the Ice Objects Catalogue are added to Version 3.0. Most of these new fields can be used in place of the previous fields and, over time, it is expected that use of the older fields will be phased out.

The \*.dbf file for polygon shapefiles consists of a set of fields (attributes) that describe each polygon feature in the shapefile. Visualizing the database file as a table of rows and columns, there is one row for each polygon and one column for each field. The rows must be in the same order as features in the main (\*.shp) file. All mandatory fields must be present in the database file and the naming, type and length of the fields must follow the layout defined in Table A-2. The easiest way to create the database file is with GIS software capable of creating shapefiles but it is also possible to create them with database or custom software.

Note that all fields present in the database file must also be described in the metadata file (Appendix D).

# Fields (Attributes) in SIGRID-3 Version 3.0 vs Earlier Versions

Field names in SIGRID-3 were carried forward from earlier versions of SIGRID and mostly consist of 2-character identifiers (CT, CA, etc.). Version 3.0 retains support for these fields but also adds of the fields found in the Ice Objects Catalogue. The Ice Objects Catalogue fields replace earlier SIGRID-3 fields but not necessarily on a one-to-one basis. For example, the Ice Objects Catalogue field ICEACT is a direct one-to-one replacement for the SIGRID-3 field CT. However, the single Catalogue field ICEAPC replaces the three SIGRID-3 fields CA, CB and CC. Table A-1 provides a mapping of the SIGRID-3 fields to those from the Ice Objects Catalogue. Note that, in some cases, there is no Ice Objects Catalogue field corresponding to a SIGRID-3 field. These cases will have to be examined in future to determine if missing fields are still required.

It is permissible to mix fields from SIGRID-3 and fields from the Ice Objects Catalogue *provided* that theydo not come from the same row in Table A-1. For example, both CT and ICEACT may not be used in the same database file since they appear in the same row. Similarly, if ICEAPC is used, then none of CA, CB or CC may be used. However, it is permissible to use ICEACT and CA, CB or CC. There is no confusion between which set of fields is being used since every field in the database file must be described in the file header record, as defined by the dBase format.

# Mandatory Fields

There are three mandatory fields for polygon features: AREA, PERIMETER and POLY\_TYPE. The area and perimeter of each polygon are typically computed by GIS software. POLY\_TYPE is a one-character code that defines the type of the polygon feature.

# Optional Fields

Previous versions of SIGRID-3 identified 17 mandatory fields (including the three described above) that were required in every polygon database file. Additionally, a number of optional fields were identified and there was provision for producers to define additional optional fields.

In contrast to earlier versions, all fields in Version 3.0, except for the three identified above, are optional. This is a practical measure dictated by the flexibility to use either SIGRID-3 fields or Ice Objects Catalogue fields since some of these are mutually exclusive. It is left to producers to incorporate as many fields as necessary to describe the ice chart as completely as possible. The list of SIGRID-3 mandatory fields or their Ice Objects Catalogue counterparts is a good starting point.

Table A-1 identifies the SIGRID-3 Version 3.0 mandatory and optional fields together with their Ice Objects Catalogue counterparts.

Database fields may be placed in any order and any number of fields may be used subject to dBase format limitations. The dBase format places limitations on size: the maximum number of fields is 255, maximum length of a field name is 10 characters, and the maximum length of a string is 254 characters. The dBase header record defines the name, length and location of the fields. Database fields must also be defined in the XML metadata.

# Polygon Field Enumerations

Each field in a database file can contain only the values specified in Table A-2. Free-format strings are not allowed. Table A-2 specifies whether a field contains a number or text. In all cases, when text is indicated, there is a reference to a code table that lists the permissible text values. References to “SIGRID Code Tables” denote codes used in earlier SIGRID versions and are re-produced in Appendix 5 for convenience. References to “IOC Codes” refer to the attribute code numbers in the Ice Objects Catalogue. The Catalogue is not copied here for sake of brevity. Usage should be consistent with the description in the Catalogue with one exception: no field separators (e.g. commas, brackets) are used in the dBase file.

All fields have the fixed length as described below. If a field or a portion of a field is not used, it should be padded with ASCII blanks on the right. For example, if there are only two types of ice present, then the fields for ICEAPC would have two ASCII blanks padded on the right (e.g. ICEAPC=6010bb). In this same example, ICESOD would have the value bb9381bbbb and ICEFLZ would be 0502bb *(where bb represents two ASCII blanks).*

# Unused Fields

Note that, because of the structure of the dBase file, if a field is used for any polygon feature, then it must be included for all polygon features in the database (i.e. it forms a “column” of the database array). Fields not used for a feature shall be filled with blanks.

Table A-1 – SIGRID-3 Version 3.0 Polygon Database Fields

| **SIGRID-3 Field Name** | **SIGRID-3****Field Definition** | **Ice Objects Catalogue Field Name** | **Ice Objects Catalogue****Field Definition** |
| --- | --- | --- | --- |
| FIELDS MANDATORY IN ALL VERSIONS OF SIGRID-3 |
| AREA | Area of polygon feature | AREA | Area of polygon feature |
| PERIMETER | Perimeter length of polygon feature | PERIMETER | Perimeter length of polygon feature |
| POLY\_TYPE | Type of polygon feature | POLY\_TYPE | Type of polygon feature |
| FIELDS MANDATORY ONLY IN EARLIER VERSIONS OF SIGRID-3; OPTIONAL IN VERSION 3.0 |
| CT | Total concentration | ICEACT | Total concentration |
| CA | Partial concentration of thickest ice | ICEAPC | Partial concentrations of up to three types of ice (Ca,Cb,Cc) |
| CB | Partial concentration of second thickest ice |
| CC | Partial concentration of the third thickest ice |
| CN | Stage of development of ice thicker than SA but with concentration less than 1/10 (corresponds to So) | ICESOD | Stage of development of up to five types of ice (So,Sa,Sb,Sc,Sd) |
| SA | Stage of development of thickest ice |
| SB | Stage of development of second thickest Ice |
| SC | Stage of development of third thickest ice |
| CD | Stage of development of any remaining class of ice (corresponds to Sd) |
| FA | Form of thickest ice | ICEFLZ | Form of up to three types of ice (Fa,Fb,Fc) |
| FB | Form of second thickest ice |
| FC | Form of third thickest ice |
| FP | Predominant form of ice | No corresponding attribute |
| FS | Secondary form of ice | No corresponding attribute |
| FIELDS OPTIONAL IN ALL VERSIONS OF SIGRID-3 |
| DP | Dynamic processes | ICECST | Compacting Strength |
| DD | Direction of dynamic processes  | ICEDDR | Ice Drift Direction  |
| DR | Rate of ice drift in tenths of knots | ICEDSP | Speed of an ice mass in knots (floating point) |
| DO | Observational Method | No corresponding attribute |
| WF | Form of water openings | ICEFTYICELST | Ice Fracture TypeIce Lead Status |
| WN | Number of water openings | ICELFQ | Frequency of Leads or Fractures |
| WD | Orientation (direction) of water openings | ICELOR | Orientation of Leads or Fractures |
| WW | Width of water openings in hundreds of meters | ICELWD | Ice Lead (or Fracture or Crack) Width (integer number of meters) |
| WO | Observational Method | No corresponding attribute |
| RN | Nature of topography feature  | ICELVL | Level Ice |
| RA | Age of topography feature  | ICERDV | Ice Ridge Classification |
| RD | Orientation of topography feature  | No corresponding attribute |
| RC | Concentration of topography feature | ICERCNICEFCNIA\_HLG | Ice Ridge ConcentrationIce Rafting ConcentrationIce Hillock Concentration |
| RF | Frequency of topography feature; number per nautical mile  | ICERFQ | Ice Ridge Frequency (integer number per nautical mile) |
| RH | Mean height of topography feature in tenths of meters | ICERMH | Ice Ridge Mean Height (integer number of decimeters) |
| RX | Maximum height of topography feature in tenths of meters | ICERXH | Ice Ridge Maximum Height (integer number of decimeters) |
| RO | Observational Method | No corresponding attribute |
| EM | Mean thickness of level ice in cm  | ICETCK | Ice Average Thickness (integer number of cm) |
| EX | Maximum thickness of level ice in cm  | ICEMAX | Maximum Ice Thickness (integer number of cm) |
| EI | Thickness interval (range); tntntntxtxtx, where tntntn is minimum thickness and txtxtx is maximum thickness, in cm | ICEMAXICEMIN | There is no single attribute corresponding to EI. The two attributes ICEMAX and ICEMIN can be used to provide the thickness range |
| EO | Observational Method | ICETTY | Ice Thickness Type |
| AV | Concentration of very thick brash ice (>4 metres) | ICEBRS | Brash Ice |
| AK | Concentration of thick brash ice (>2-4 metres) |
| AM | Concentration of medium brash ice (1-2 metres) |
| AT | Concentration of thin brash ice (<1 metre) |
| SC | Concentration of snow | ICESCN | Snow Cover Concentration |
| SN | Snow depth | ICESCT | Snow Depth |
| SD | Orientation (direction) of sastrugi | ICEDOS | Direction of Sastrugi |
| SM | Melting forms | ICEMLT | Melt Stage |
| SW[[1]](#footnote-1) | Area coverage of water on ice in tenths | No corresponding attribute |
| SO | Observational Method | No corresponding attribute |
| BL | Type of iceberg (Form,Size) | IA\_BFMICEBSZ | Prevailing Iceberg FormIceberg Size |
| BD | Direction of drift of iceberg  | ICEDDR | Ice Drift Direction |
| BE | Rate of drift in tenths of knots  | ICEDSP | Speed of an ice mass in knots (floating point) |
| BN | Number of icebergs  | IA\_OBN | Number of Ice Objects |
| BY | Day of month  | No corresponding attribute |
| BO | Observational Method | No corresponding attribute |
| TT | Sea surface temperature in tenths of degrees Celsius | No corresponding attribute |
| TO | Observational Method | No corresponding attribute |
| OP | Primary source of information on which the chart is based | No corresponding attribute |
| OS | Secondary source of information on which the chart is based | No corresponding attribute |
| OT | Tertiary source of information on which the chart is based | No corresponding attribute |
| T1 | Date and time when the object was observed | RECDAT | The date when the object was captured, edited or deleted |
| T2 | Date and time when the object is valid | SORDAT | The production date of the source, i.e. the date of measurement |

Table A-2: Polygon Field Enumeration References

| **Field or Column Name** | **Data Type** | **Length (bytes)** | **Code Table Reference** | **Field Definition** |
| --- | --- | --- | --- | --- |
| AREA | Double precision binary | 20 |  | Area of polygon feature |
| PERIMETER | Double precision binary | 20 |  | Perimeter length of polygon feature |
| POLY\_TYPE | Text | 1 | SIGRID Table 4 | Type of polygon feature |
| ICEACT | Text | 2 | IOC Code 30300 | Total Concentration |
| ICEAPC | Text | 6 | IOC Code 30301 | Partial Concentration |
| ICESOD | Text | 10 | IOC Code 30302 | Ice Stage of Development |
| ICEFLZ | Text | 6 | IOC Code 30304 | Floe Sizes |
| ICEMLT | Text | 2 | IOC Code 30305 | Melt Stage |
| ICELVL | Text | 2 | IOC Code 30308 | Level Ice |
| ICECST | Text | 2 | IOC Code 30309 | Compacting Strength |
| ICEFTY | Text | 2 | IOC Code 30310 | Ice Fracture Type |
| ICELST | Text | 2 | IOC Code 30311 | Ice Lead Status |
| ICELFQ | Integer | 2 | IOC Code 30312 | Frequency of Leads or Fractures |
| ICELOR | Text | 2 | IOC Code 30313 | Orientation of Leads of Fractures |
| ICELWD | Integer | 2 | IOC Code 30314 | Ice Lead (or Fracture or Crack) Width (integer number of meters) |
| ICEBSZ | Text | 2 | IOC Code 30316 | Iceberg Size |
| ICEDDR | Text | 2 | IOC Code 30317 | Ice Drift Direction  |
| ICEDSP | Floating Point | 4 | IOC Code 30318 | Speed of an ice mass in knots (floating point) |
| ICETCK | Integer | 2 | IOC Code 30319 | Ice Average Thickness (integer number of cm) |
| ICEMAX | Integer | 2 | IOC Code 30320 | Maximum Ice Thickness (integer number of cm) |
| ICEMIN | Integer | 2 | IOC Code 30321 | Minimum Ice Thickness (integer number of cm) |
| ICETTY | Text | 2 | IOC Code 30322 | Ice Thickness Type |
| ICESCT | Integer | 2 | IOC Code 30323 | Snow Depth |
| ICESCN | Text | 2 | IOC Code 30324 | Snow Cover Concentration |
| ICEDOS | Text | 2 | IOC Code 30325 | Direction of Sastrugi |
| ICERCN | Text | 2 | IOC Code 30326 | Ice Ridge Concentration |
| ICERDV | Text | 2 | IOC Code 30327 | Ice Ridge Classification |
| ICERMH | Integer | 2 | IOC Code 30328 | Ice Ridge Mean Height (integer number of decimeters) |
| ICERFQ | Integer | 2 | IOC Code 30329 | Ice Ridge Frequency (number per nautical mile) |
| ICERXH | Integer | 2 | IOC Code 30330 | Ice Ridge Maximum Height (integer number of decimeters) |
| ICEKCN | Text | 2 | IOC Code 30331 | Ice Keel Concentration |
| ICEKFQ | Integer | 2 | IOC Code 30332 | Ice Keel Frequency (number per nautical mile) |
| ICEKMD | Integer | 2 | IOC Code 30333 | Ice Keel Mean Depth (integer number of decimeters) |
| ICEKXD | Integer | 2 | IOC Code 30334 | Ice Keel Maximum Depth (integer number of decimeters) |
| ICEFCN | Text | 2 | IOC Code 30335 | Ice Rafting Concentration |
| IA\_SFA | Text | 12 | IOC Code 30336 | Combination Ice Stage of Development and Floe Size for the 1st partial concentration |
| IA\_SFB | Text | 12 | IOC Code 30337 | Combination Ice Stage of Development and Floe Size for the 2nd partial concentration |
| IA\_SFC | Text | 12 | IOC Code 30338 | Combination Ice Stage of Development and Floe Size for the 3rd partial concentration |
| IA\_FFA | Text | 14 | IOC Code 30339 | Ice Breccia for the first partial concentration |
| IA\_FFB | Text | 14 | IOC Code 30340 | Ice Breccia for the second partial concentration |
| IA\_FFC | Text | 14 | IOC Code 30341 | Ice Breccia for the third partial concentration |
| IA\_SNG | Text | 2 | IOC Code 30344 | Snow Cover |
| IA\_PLG | Text | 2 | IOC Code 30346 | Contamination |
| IC\_HLG | Text | 2 | IOC Code 30347 | Ice Hillock Concentration |
| IA\_BFM | Text | 2 | IOC Code 30354 | Prevailing Iceberg Form |
| IA\_OBN | Integer | 2 | IOC Code 30358 | Number of Ice Objects |
| ICEBRS | Text | 8 | IOC Code 30362 | Brash Ice |
| RECDAT | Date and Time | 10-22 | ISO 8601 | Date and time of observation |
| SORDAT | Date and Time | 10-22 | ISO 8601 | Date and time of validity |
| CT | Text | 2 | SIGRID Table 1 | Total concentration |
| CA | Text | 2 | SIGRID Table 1 | Partial concentration of thickest ice |
| CB | Text | 2 | SIGRID Table 1 | Partial concentration of second thickest ice |
| CC | Text | 2 | SIGRID Table 1 | Partial concentration of the third thickest ice |
| CN | Text | 2 | SIGRID Table 1 | Stage of development of ice thicker than SA but with concentration less then 1/10 |
| SA | Text | 2 | SIGRID Table 2 | Stage of development of thickest ice |
| SB | Text | 2 | SIGRID Table 2 | Stage of development of second thickest Ice |
| SC | Text | 2 | SIGRID Table 2 | Stage of development of third thickest ice |
| CD | Text | 2 | SIGRID Table 1 | Stage of development of any remaining class of ice |
| FA | Text | 2 | SIGRID Table 3 | Form of thickest ice |
| FB | Text | 2 | SIGRID Table 3 | Form of second thickest ice |
| FC | Text | 2 | SIGRID Table 3 | Form of third thickest ice |
| FP | Text | 2 | SIGRID Table 3 | Predominant form of ice |
| FS | Text | 2 | SIGRID Table 3 | Secondary form of ice |
| DP | Text | 1 | SIGRID Table 5 | Dynamic processes |
| DD | Text | 1 | SIGRID Table 6 | Direction of dynamic processes |
| DR | Integer | 2 |  | Rate of ice drift in tenths of knots |
| DO | Text | 1 | SIGRID Table 15 | Observational Method |
| WF | Text | 1 | SIGRID Table 7 | Form of water openings |
| WN | Text | 1 | SIGRID Table 8 | Number of water openings |
| WD | Text | 1 | SIGRID Table 6 | Orientation (direction) of water openings |
| WW | Integer | 2 |  | Width of water openings in hundreds of meters |
| WO | Text | 1 | SIGRID Table 15 | Observational Method |
| RN | Text | 1 | SIGRID Table 9 | Nature of topography feature  |
| RA | Text | 1 | SIGRID Table 10 | Age of topography feature  |
| RD | Text | 1 | SIGRID Table 6 | Orientation of topography feature  |
| RC | Text | 2 | SIGRID Table 1 | Concentration of topography feature |
| RF | Integer | 2 |  | Frequency of topography feature; number per nautical mile  |
| RH | Integer | 2 |  | Mean height of topography feature in tenths of meters |
| RX | Integer | 2 |  | Maximum height of topography feature in tenths of meters |
| RO | Text | 1 | SIGRID Table 15 | Observational Method |
| EM | Integer | 2 |  | Mean thickness of level ice in cm  |
| EX | Integer | 2 |  | Maximum thickness of level ice in cm  |
| EI | Integer | 2 |  | Thickness interval (range); tntntntxtxtx, where tntntn is minimum thickness and txtxtx is maximum thickness, in cm |
| EO | Text | 1 | SIGRID Table 15 | Observational Method |
| AV | Text | 2 | SIGRID Table 1 | Concentration of very thick brash ice (>4 metres) |
| AK | Text | 2 | SIGRID Table 1 | Concentration of thick brash ice (>2-4 metres) |
| AM | Text | 2 | SIGRID Table 1 | Concentration of medium brash ice (1-2 metres) |
| AT | Text | 2 | SIGRID Table 1 | Concentration of thin brash ice (<1 metre) |
| SD | Text | 1 | SIGRID Table 6 | Orientation (direction) of sastrugies |
| SM | Text | 1 | SIGRID Table 11 | Melting forms |
| SW[[2]](#footnote-2) | Text | 2 | Pad with preceding blanks | Area coverage of water on ice in tenths |
| SO | Text | 1 | SIGRID Table 15 | Observational Method |
| BL | Text | 2 | SIGRID Table 13 | Type of iceberg (Form, Size) |
| BD | Text | 1 | SIGRID Table 6 | Direction of drift of iceberg  |
| BE | Integer | 2 |  | Rate of drift in tenths of knots  |
| BN | Text | 2 | SIGRID Table 14 | Number of icebergs  |
| BY | Integer | 2 |  | Day of month  |
| BO | Text | 1 | SIGRID Table 15 | Observational Method |
| TT | Integer | 2 |  | Sea surface temperature in tenths of degrees Celsius |
| TO | Text | 1 | SIGRID Table 15 | Observational Method |
| OP | Text | 1 | SIGRID Table 15 | Primary source of information on which the chart is based |
| OS | Text | 1 | SIGRID Table 15 | Secondary source of information on which the chart is based |
| OT | Text | 1 | SIGRID Table 15 | Tertiary source of information on which the chart is based |
| T1 | Date and Time | 10-22 | ISO 8601 | Date and time of observation |
| T2 | Date and Time | 10-22 | ISO 8601 | Date and time of validity |

Appendix B - Database File Contents for Line Shapefiles

# Introduction

The \*.dbf file for line (also called “polyline”) shapefiles consists of a set of mandatory and optional fields (attributes) that describe each line feature in the shapefile. Visualizing the database file as a table of rows and columns, there is one row for each line feature and one column for each field. The rows must be in the same order as features in the main (\*.shp) file. All mandatory fields must be present in the database file and the naming, type and length of the fields must follow the layout defined in Table B-1. The easiest way to create the database file is with GIS software capable of creating shapefiles but it is also possible to create them with database or custom software.

Note that all fields present in the database file must also be described in the metadata file (Appendix D).

# Mandatory Fields

The mandatory fields for line features are LENGTH, LINE\_TYPE and ICE\_LOC. The length of each line is typically computed by GIS software. LINE\_TYPE is a six-character code that defines the type of the line feature. ICE\_LOC is a two-character code that indicates where the ice lies relative to an ice edge, iceberg limit, limit of open water or limit of all known ice. If the value of LINE\_TYPE is I\_RIDG, I\_LEAD, I-FRAL or I\_CRAC, then ICE\_LOC is not relevant and should be filled with blanks.

# Optional Fields

The fields (attributes) listed in Table B-3 may be used to further describe ridge, lead, fracture or crack line features. References to “IOC Codes” refer to the attribute code numbers in the Ice Objects Catalogue. Usage should be consistent with the description in the Catalogue with one exception: no field separators (e.g. commas, brackets) are used in the dBase file.

All fields have the fixed length given in Table B-3. If a field or a portion of a field is not used, it should be padded with ASCII blanks on the right.

# Unused Fields

Note that, because of the structure of the dBase file, if an optional field is used for any line feature, then it must be included for all line features in the database (i.e. it forms a “column” of the database array). Fields not used for any feature shall be filled with blanks.

Table B-1: Mandatory Fields in a SIGRID-3 Version 3.0 Line Database File

| **Field or Column Name** | **Data Type** | **Length (bytes)** | **Code Table Reference** | **Field Definition** |
| --- | --- | --- | --- | --- |
| LENGTH | Double precision binary | 20 |  | Length of line feature |
| LINE\_TYPE | Text | 3 | Table B-2 | Type of line feature |
| ICE\_LOC | Text | 2 | SIGRID Table 6a | Location of ice relative to line feature |

Table B-2: List of LINE\_TYPE Character Variables

|  |  |
| --- | --- |
| Name from Ice Objects Catalogue | LINE\_TYPE |
| 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 |

Table B-3: Optional Fields for Line Features

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field or Column Name** | **Data Type** | **Length (bytes)** | **Code Table Reference** | **Field Definition** |
| ICERDV | Text | 2 | IOC Code 30327 | Ice Ridge Classification |
| ICERMH | Integer | 2 |  | Ice Ridge Mean Height in decimetres |
| ICERXH | Integer | 2 |  | Ice Ridge Maximum Height in decimetres |
| ICELWD | Integer | 2 |  | Mean Width: mean width of a lead, fracture or crack in metres |
| IA\_DMW | Integer | 2 |  | Minimum Width: minimum width of a lead, fracture or crack in metres |
| IA\_DXW | Integer | 2 |  | Maximum Width: maximum width of a lead, fracture or crack in metres |
| ICESOD | Text | 2 | IOC Code 30302 | Ice Stage of Development; used with Line of Ice Lead (I\_LEAD) to indicate the Stage of Development of ice on the lead |
| IA\_OBN | Integer | 2 |  | Number of Ice Objects; used with Line of Ice Lead (I\_LEAD) to indicate the Number of Objects associated with the lead |
| RECDAT | Date and Time | 10-22 | ISO 8601 | Date and time of observation |
| SORDAT | Date and Time | 10-22 | ISO 8601 | Date and time of validity |

Appendix C - Database File Contents for Point Shapefiles

# Introduction

The \*.dbf file for point shapefiles consists of a set of mandatory and optional fields (attributes) that describe each point feature in the shapefile. Visualizing the database file as a table of rows and columns, there is one row for each point feature and one column for each field. The rows must be in the same order as features in the main (\*.shp) file. All mandatory fields must be present in the database file and the naming, type and length of the fields must follow the layout defined in Table C-1. The easiest way to create the database file is with GIS software capable of creating shapefiles but it is also possible to create them with database or custom software.

Note that all fields present in the database file must also be described in the metadata file (Appendix D).

# Mandatory Fields

The only mandatory field for point features is POINT\_TYPE. POINT\_TYPE is a six-character code taken from the Ice Objects Catalogue that defines the type of the point feature. Usage should be consistent with the Ice Objects Catalogue.

# Optional Fields

The fields (attributes) listed in Table C-3 may be used to further describe point features. References to “IOC Codes” refer to the attribute code numbers in the Ice Objects Catalogue. Usage should be consistent with the description in the Catalogue with one exception: no field separators (e.g. commas, brackets) are used in the dBase file.

All fields have the fixed length as described below. If a field or a portion of a field is not used, it should be padded with ASCII blanks on the right.

# Unused Fields

Note that, because of the structure of the dBase file, if an optional field is used for any point feature, then it must be included for all point features in the database (i.e. it forms a “column” of the database array). Fields not used for any feature shall be filled with blanks.

Table C-1: Mandatory Fields in a SIGRID-3 Version 3.0 Point Database File

| **Field or Column Name** | **Data Type** | **Length (bytes)** | **Code Table Reference** | **Field Definition** |
| --- | --- | --- | --- | --- |
| POINT\_TYPE | Text | 3 | Table C-2 | Type of point feature |

Table C-2: List of POINT\_TYPE Character Variables

| **Name from Ice Objects Catalogue** | **POINT\_TYPE** |
| --- | --- |
| Ice Compacting | ICECOM |
| Ice Lead | ICELEA |
| Iceberg | ICEBRG |
| Floeberg | FLOBRG |
| Ice Thickness | ICETHK |
| Ice Shear | ICESHR |
| Ice Divergence | ICEDIV |
| Ice Ridge/Hummock | ICERDG |
| Ice Keel/Bummock | ICEKEL |
| Ice Drift | ICEDFT |
| 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 |

Table C-3: Optional Fields for Point Features

| **Field or Column Name** | **Data Type** | **Length (bytes)** | **IOC Code Table Reference** | **Field Definition** |
| --- | --- | --- | --- | --- |
| ICESOD | Text | 2 | IOC Code 30302 | Indicates stage of development of ice |
| ICEMLT | Text | 2 | IOC Code 30305 | Indicates stage of ice melt |
| ICESPC | Text | 2 | IOC Code 30306 | Indicates concentration of ice within the area of strips and patches |
| ICECST | Text | 2 | IOC Code 30309 | Ice Compacting Strength |
| ICEFTY | Text | 2 | IOC Code 30310 | Type of fracture based upon width |
| ICELST | Text | 2 | IOC Code 30311 | Indicates the surface nature of a lead |
| ICELOC | Text | 2 | IOC Code 30315 | Indicates whether a lead is at a specific location or whether there is a presence in the area |
| ICEBSZ | Text | 2 | IOC Code 30316 | Iceberg Size |
| ICEDDR | Text | 2 | IOC Code 30317 | Direction in which an ice mass or iceberg is drifting |
| ICETTY | Text | 2 | IOC Code 30322 | Indicates whether ice thickness is measured or estimated |
| ICESCN | Text | 2 | IOC Code 30324 | Indicates concentration of snow in tenths |
| ICEDOS | Text | 2 | IOC Code 30325 | Bearing of a sastrugi |
| ICERCN | Text | 2 | IOC Code 30326 | Concentration of ridges / hummocks |
| ICERDV | Text | 2 | IOC Code 30327 | Predominant type of ice ridge(s) present |
| ICEKCN | Text | 2 | IOC Code 30331 | Concentration of ice keels beneath an ice area |
| IA\_BFM | Text | 2 | IOC Code 30354 | Form of an iceberg or the prevailing form of icebergs in the vicinity |
| IA\_BUH | Integer | 2 |   | Maximum height of an iceberg above the waterline in meters |
| IA\_DMW | Integer | 2 |   | Minimum width of an ice lead or fracture or crack in meters. |
| IA\_DXW | Integer | 2 |   | Maximum width of an ice lead or fracture or crack in meters. |
| IA\_OBN | Integer | 2 |   | Number of ice objects (icebergs, leads, etc.) |
| ICEBNM | Integer | 2 |   | Number of icebergs in a one degree latitude by one degree longitude area; not to be used for latitudes greater than 80N or 80S |
| ICEDSP | Floating Point | 10 |   | Speed in knots at which an ice mass or iceberg is moving  |
| ICEKFQ | Integer | 2 |   | Number of keels per nautical mile |
| ICEKMD | Integer | 2 |   | Mean depth of ice keels |
| ICEKXD | Integer | 2 |   | Maximum depth of ice keels |
| ICELWD | Integer | 2 |   | Width in meters of a lead, fracture or crack |
| ICEMAX | Integer | 2 |   | Maximum ice thickness in centimeters |
| ICEMIN | Integer | 2 |   | Minimum ice thickness in centimeters |
| ICERFQ | Integer | 2 |   | Frequency of ice ridges in number per nautical mile |
| ICERMH | Integer | 2 |   | Mean height of ice ridge(s) in decimetres |
| ICERXH | Integer | 2 |   | Maximum height of ice ridge(s) in decimetres |
| ICESCT | Integer | 2 |   | Depth of snow cover in centimeters |
| ICETCK | Integer | 2 |   | Average thickness of ice in centimeters |
| RECDAT | Date/Time | 10-22 | ISO 8601 | Date and time of observation |
| SORDAT | Date/Time | 10-22 | ISO 8601 | Date and time of validity |

Appendix D - Metadata File Structure and Contents

# Introduction

SIGRID-3 metadata files are compliant with the FGDC Content Standard for Digital Geospatial Metadata (CSDGM) which is available at <http://www.fgdc.gov/metadata/csdgm>. The details of this standard are well described in the reference so only a brief overview with examples pertinent to SIGRID-3 is given here.

As described in the reference, the CSDGM breaks metadata into seven major categories:

* Identification information
* Data Quality Information
* Spatial Data Organization Information
* Spatial Reference Information
* Entity and Attribute Information
* Distribution Information
* Metadata Reference Information

# SIGRID-3 Version 3.0 Mandatory Metadata Content

While previous versions of SIGRID-3 identified a requirement for metadata, the standard was silent on the mandatory information to be included. Version 3.0 provides specific content requirements as described in this section. A complete xml metadata file from the Canadian Ice Service is attached at Annex 1 as an example. Note that these tags must appear within their proper hierarchy of tags. While only the lowest level xml tags are identified here for sake of brevity, all of the parent tags must also be present in the xml file. For example, <origin> is a child of four high order tags. To include <origin> as a tag, the higher order tags and all of the end tags must also be present:

<metadata>

 <idinfo>

 <citation>

 <citeinfo>

 <origin>*name of producing organization</origin>*

 </citeinfo>

 </citation>

 </idinfo>

</metadata>

## Identification Information

Identification Information describes the higher order information about the shapefile and the chart it represents. Identification information attributes provide information on the producer, location of the coverage, date of origin, constraints on use, region, and associated theme keywords.

The following xml tags, as described in the CSDGM, must be completed for SIGRID-3 files. Organizations are encouraged to complete the content for other tags as much as possible.

 <origin> name of the organization that produced the ice chart

 <pubdate> date on which the chart was produced in *YYYYMMDD* format

 <title> shapefile name as specified in Section 2.1 of the SIGRID-3 specification

 <caldate> date for which the ice chart is valid in *YYYYMMDD* format

 <time> UTC time for which the ice chart is valid in *HHMM SS UTC* format

 <westbc> westernmost coordinate of the limit of coverage expressed in real degrees of longitude in the range -180.0 to 180.0 (west longitude is negative)

 <eastbc) easternmost coordinate of the limit of coverage expressed in real degrees of longitude

 <northbc> northernmost coordinate of the limit of coverage expressed in real degrees of latitude in the range -90.0 to 90.0 (south latitude is negative)

 <southbc> southernmost coordinate of the limit of coverage expressed in real degrees of latitude

 <themekey> at least one theme keyword, “sea ice” or “iceberg” as appropriate, must be specified. Other theme keywords such as “pack ice”, “Ice concentration”, etc. may also be included

 <placekey> at least one place keyword identifying the general area of coverage of the ice chart must be specified. Examples are “Arctic”, “Baltic Sea”, “Barents Sea”, etc. Additional place keywords may be used to further describe the area. Ice services should assemble a suitable list of place keywords that must be consistent to all charts in a series

 <cntorg> name of the organization to contact for information about the dataset

 <cntaddr> address of the contact organization

 <cntvoice> telephone number of the contact organization

 <cntfax> fax number of the contact organization

 <cntemail> e-mail of the contact organization

## Data Quality Information

Data quality elements describe the overall quality of the information so users can assess its suitability for their need. For ice analysis charts, the source of data used to produce a chart is a primary indicator of its quality. The data quality information can be repeated for the total number of different sources used, including in-situ observations and remotely sensed data. Additionally, the process used to produce the ice chart can be described to give users a sense of the quality.

The following xml tags, as described in the CSDGM, must be completed for SIGRID-3 files. Organizations are encouraged to complete the content for other tags as much as possible.

 <logic> brief comments on the quality of the dataset

 <complete> comments about unknown or unidentified features in the chart

 (*The following tags should be repeated for each data source used in the chart)*

 <origin> name of the data source

 <source time period of content> date/time of the data source (e.g. date of satellite image or aircraft flight)

## Spatial Data Organization Information

These elements describe how spatial data is organized in the dataset. It is useful for data discovery purposes by users not familiar with SIGRID-3 and producers are encouraged to complete the appropriate tags. However, because the shapefile standard pre-determines the organization of spatial data, this section is not mandatory for SIGRID-3.

## Spatial Reference Information

The spatial reference information contains the projection name followed by all information needed to define the projection. This will generally include latitudes, longitudes, units, datum and ellipsoid. If the projection is not a common projection, the equations used to define the projection should be included in this section.

The following xml tags, as described in the CSDGM, must be completed for SIGRID-3 files. Organizations are encouraged to complete the content for other tags as much as possible.

 <horizdn> name of the horizontal datum reference system

 <ellips> name of the ellipsoid used to define the Earth’s shape

 <semiaxis> radius of the equatorial axis of the ellipsoid

 <denflat> denominator of the flattening ratio

 <absres> abscissa resolution

 <ordres> ordinate resolution

 <plandu> planar distance units

 <mapprojn> map projection name

 Parameters, specific to the particular map projection are required to completely define it. *For example, for a Lambert Conformal Conic projection:*

 <stdparll> standard parallel (2 required)

 <longcm> longitude of central meridian

 <latprjo> latitude of the projection origin

 *For example, for a Polar Stereographic projection:*

 <stdparll> standard parallel (1 required)

 <svlong> longitude to be oriented straight up from Pole

## Entity and Attribute Information

This section is used to describe the contents of the individual fields in the database file. The following xml tags, as described in the CSDGM, must be completed for each field (column) in the \*.dbf file. These must be in the same order as in the \*.dbf file. Organizations are encouraged to complete the content for other tags as much as possible.

 <attrlabl> attribute (field or column) name (as in Tables A-1, A-2, B-1, B-3, C-1, C-3)

 <attrdef> attribute (field definition) definition (as in Tables A-1, A-2, B-1, B-3, C-1, C-3)

 <attrdefs> attribute definition source – set to “JCOMM ETSI”

 <codesetn> code set name – set to “SIGRID-3 Version 3.0”

 <codesets> code set source – set to “JCOMM ETSI”

## Distribution Information

The distribution information category is used to convey information to users about how the data can be obtained. The following xml tags, as described in the CSDGM, must be completed for SIGRID-3 files. Organizations are encouraged to complete the content for other tags as much as possible.

 <formname> format name – set to “SIGRID-3”

 <formvern> SIGRID-3 format version number

 <formverd> SIGRID-3 format version date in format YYYYMMDD

## Metadata Reference Information

Metadata reference information provides additional information about the creator of the SIGRID-3 shapefile.

The following xml tags, as described in the CSDGM must be completed for SIGRID-3 files. Organizations are encouraged to complete the content for other tags as much as possible.

 <metd> date that the metadata were last updated

 <metstdn> metadata standard name – set to “FGDC Content Standard for Digital Geospatial Metadata”

 <metstdv> metadata standard version – set to “FGDC-STD-001-1998“ until a new version is adopted

Appendix E - Code Tables for SIGRID-3 Variables

Table 1: Concentration codes for variable identifiers CT, CA, CB, CC, AV, AK, AM and AT.

|  |  |
| --- | --- |
| Definition | Code Figure |
| Ice Free | 98 |
| Less than 1/10 (open water) | 01 |
| Bergy Water | 02 |
| 1/10 | 10 |
| 2/10 | 20 |
| 3/10 | 30 |
| 4/10 | 40 |
| 5/10 | 50 |
| 6/10 | 60 |
| 7/10 | 70 |
| 8/10 | 80 |
| 9/10 | 90 |
| 10/10 | 92 |
|  |  |
| Concentration intervals (lowest concentration in interval followed by highest concentration in interval) |
| 9/10 –10/10 or 9+/10 | 91 |
| 8/10 – 9/10 | 89 |
| 8/10 – 10/10 | 81 |
| 7/10 – 9/10 | 79 |
| 7/10 – 8 /10 | 78 |
| 6/10 – 8/10 | 68 |
| 6/10 – 7/10 | 67 |
| 5/10 – 7/10 | 57 |
| 5/10 – 6/10 | 56 |
| 4/10 – 6/10 | 46 |
| 4/10 – 5/10 | 45 |
| 3/10 – 5/10 | 35 |
| 3/10 – 4/10 | 34 |
| 2/10 – 4/10 | 24 |
| 2/10 – 3/10 | 23 |
| 1/10 – 3/10 | 13 |
| 1/10 – 2/10 | 12 |
| Undetermined / Unknown | 99 |

Notes:

1. When AV, AK, AM and AT are used, the total of the concentrations represented by the values for AV, AK, AM and AT must sum to the concentration represented by the value for CA.
2. When this table is used for concentration of ridges,rafting, snow cover, etc (ICERCN, ICEFCN, ICESCN, etc), the code value 98 is interpreted as “*no ridging/rafting/snow/etc*”

Table 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 |
| Ice Thickness in cm | 1-2 cm | 02 |
|  | 3 cm | 03 |
|  | 4 cm | 04 |
|  | … | … |
|  | 50 cm | 50 |
| Ice Thickness interval, 5 cm | 55 cm | 51 |
|  | 60 cm | 52 |
|  | 65 cm | 53 |
|  | … | … |
|  | 95 cm | 59 |
| Ice Thickness interval, 10 cm | 100 cm | 60 |
|  | 110 cm | 61 |
|  | 120 cm | 62 |
|  | … | … |
|  | 190 cm | 69 |
| Ice Thickness interval, 50 cm | 200 cm | 70 |
|  | 250 cm | 71 |
|  | 300 cm | 72 |
|  | 350 cm | 73 |
| Ice Thickness interval, 100 cm | 400 cm  | 74 |
|  | 500 cm | 75 |
|  | 600 cm | 76 |
|  | 700 cm | 77 |
|  | 800 cm | 78 |
| Brash Ice | Given by AV, AT, AM, AT in Table 3.3 | 79 |
| 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 |
| Residual Ice |  | 94 |
| Old Ice |  | 95 |
| Second Year Ice |  | 96 |
| Multi-Year Ice |  | 97 |
| Glacier Ice |  | 98 |
| Undetermined/Unknown |  | 99 |

Notes:

1. This table has been extended to conform with the original SIGRID (1981) specification with two exceptions:
* Code 01 has been used to represent Ice Free instead of an ice thickness of 1 cm. To conform with S-57 standards, code 00 is not used. There is little significant difference between an ice thickness of 1 cm and 2 cm.
* Code 79 has been used for brash ice instead of a thickness of 900 cm as in the original SIGRID. The maximum ice thickness that can be reported by this code is therefore 800 cm instead of 900 cm.
1. When used for ICESOD, the two-digit codes in this table are repeated up to five times for each partial concentration. If a partial concentration is not used, it should be blank-filled.

e.g. 4 ice types present – So=98, Sa=97, Sb=86, Sc=81 : ICEAPC = 98978681*bb* 3 ice types present – Sa=97, Sb=86, Sc=81 : ICEAPC = *bb*978681bb 2 ice types present – Sa=96, Sb=88 : ICEAPC = *bb*9688*bbbb*

 1 ice type present – Sa= 95 : ICEAPC = *bb*95*bbbbbb*

1. To differentiate dark and light nilas gradations, use stage of development codes ‘03’ and ‘07’ respectively.

Table 3: Form of ice codes for variable identifiers FA, FB, FC, FP and FS.

|  |  |  |
| --- | --- | --- |
| 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 Floebits |  | 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 |

Notes:

1. When used for ICEFLZ, the two-digit codes in this table are repeated up to three times for each partial concentration. If a partial concentration is not used, it should be blank-filled.

e.g. 3 ice types present – Fa=06, Fb=03, Fc=22 : ICEFLZ = 060322 2 ice types present – Fa=06, Fb=01 : ICEFLZ = 0601*bb*

 1 ice type present – Fa-02 : ICEFLZ = 02*bbbb*

Table 4: List of POLY\_TYPE character variables

|  |  |
| --- | --- |
| Land | L |
| Water – sea ice free | W |
| Ice – of any concentration  | I |
| No Data | N |
| Ice Shelf / Ice of Land Origin | S |

Table 5: Dynamic processes

|  |  |
| --- | --- |
| Compacting ice, no intensity given  | 0 |
| Compacting ice, slight | 1 |
| Compacting ice, considerable  | 2 |
| Compacting ice, strong  | 3 |
| Diverging ice  | 4 |
| Shearing ice  | 5 |
| Ice drift, rate 0,1 - 0,9 knots  | 6 |
| Ice drift, rate 1,0 - 1,9 knots  | 7 |
| Ice drift, rate 2,0 - 2,9 knots  | 7 |
| Ice drift, rate 3,0 knots or more  | 9 |

Note: When actual rates of ice drift (ViVi) are given, code figure ViVi = 99 is used for rate unknown.

Table 6: Direction indicator

****

The direction is identified in relation to the grid. In a geographical grid, 1 would indicate northeast, 2 east, 3 southeast, etc.

Table 6a: Direction

|  |  |
| --- | --- |
| NorthEast  | 01 |
| East  | 02 |
| Southeast  | 03 |
| South  | 04 |
| Southwest  | 05 |
| West  | 06 |
| Northwest  | 07 |
| North  | 08 |
| North and East  | 09 |
| North and West  | 10 |
| South and East  | 11 |
| South and West  | 12 |
| Within | 13 |
| Variable | 97 |
| No Feature | 98 |
| Undetermined / Unknown | 99 |

Table 7: Form of water opening

|  |  |
| --- | --- |
| Cracks  | 1 |
| Crack at specific location  | 2 |
| Lead | 3 |
| Frozen lead | 4 |
| Polynya | 5 |
| Ice edge | 6 |

Table 8: Number of water openings

|  |  |
| --- | --- |
| 1 | 1 |
| 2 | 2 |
| 3-5 | 3 |
| 5-10 | 4 |
| > 10 | 5 |

Table 9: Nature of topographic feature (deformation)

|  |  |
| --- | --- |
| Rafting | 1 |
| Hummocks | 2 |
| Ridges | 3 |
| Jammed brash barrier | 4 |

Table 10: Age of topographic feature

|  |  |
| --- | --- |
| New | 1 |
| Weathered | 2 |
| very weathered | 3 |
| Aged | 4 |
| Consolidated | 5 |

Table 11: Melting forms

|  |  |
| --- | --- |
| No melt | 0 |
| Few puddles | 1 |
| Many puddles | 2 |
| Flooded ice | 3 |
| Few thaw holes | 4 |
| Many thaw holes | 5 |
| Dried ice | 6 |
| Rotten ice | 7 |
| Few frozen puddles | 8 |
| All frozen puddles | 9 |

Table 12: Snow depth

|  |
| --- |
| WMO code 3889 |

**3889**

**Sss *Total depth of snow***

Code

figure

000 Not used

001 1 cm

etc. etc.

996 996 cm

997 Less than 0.5 cm

998 Snow cover, not continuous

999 Measurement impossible or inaccurate

N o t e : See Regulations 12.4.6.1 and 12.4.6.2.

Table 13: Ice of land origin (type of iceberg)

|  |  |
| --- | --- |
| Form (1st character) | Size (2nd character) |
| Growler and or bergy bit | 1 | unspecified | 0 |
| Iceberg, unspecified | 2 | small | 1 |
| Iceberg, glacier berg | 3 | medium | 2 |
| Iceberg, domed | 4 | large | 3 |
| Iceberg, pinnacled | 5 | very large | 4 |
| Iceberg, tabular | 6 |  |  |
| Ice island | 7 |  |  |
| Radar target | 9 |  |  |

Table 14: Number of icebergs

|  |
| --- |
| WMO code 2877 |

**2877**

***nBnB Number of icebergs within the area***

***nGnG Number of growlers and bergy bits within the area***

Code Code

Figure figure

00 None 15 15

01 1 16 16

02 2 17 17

03 3 18 18

04 4 19 19

05 5 20 1– 9

06 6 21 10– 19

07 7 22 20– 29

08 8 23 30– 39

09 9 24 40– 49

10 10 25 50– 99

11 11 26 100– 199

12 12 27 200– 499

13 13 28 500 or more

14 14 99 No indication because counting has been impossible

N o t e s :

(1) If the exact number, 1 to 19, is known, code figures 01 to 19 shall be used.

(2) If the number is more than 19, or if the exact number can only be estimated, code figures 20 to 28 shall

be used.

(3) Code figure 99 shall only be used when it is absolutely impossible to make a reasonable estimate of

the number.

Table 15: Observational method

|  |  |
| --- | --- |
| Visual surface observation | 1 |
| Visual aircraft observation | 2 |
| Visual and infrared satellite observation | 3 |
| Passive microwave satellite observation | 4 |
| Radar satellite surface or airborne observation | 5 |
| Radar satellite observation (SAR) | 6 |
| Laser/scatterometer/sonar | 7 |
| Data buoys | 8 |
| Estimated (temporal and/or spatial) | 9 |
| Unknown | 0 |

1. This parameter was “SA” in earlier versions of SIGRID. It has been re-named to avoid confusion with SA – Stage of development of thickest ice. [↑](#footnote-ref-1)
2. This parameter was “SA” in earlier versions of SIGRID. It has been re-named to avoid confusion with SA – Stage of development of thickest ice. [↑](#footnote-ref-2)