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The Global Digital Sea Ice Data Bank at NSIDC, 1986-2005

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Note: The GDSIDB project has not been active since 2005, and it is no longer being updated. This Special Report was created in May 2022 and is adapted from the old NSIDC GDSDB web site to capture the work that was done. It will remain online as a reference for later work with sea ice chart digital formats.

About GDSIDB

The World Meteorological Organization (WMO) Commission on Marine Meteorology (now the Joint WMO/ Intergovernmental Oceanographic Commission for Oceanography and Marine Meteorology, or JCOMM) established a Global Sea Ice Data Bank of digital sea ice chart information from the operational ice forecasting centers of participating nations in November 1986 (WMO, Summary Report of "Informal Workshop on feasibility of establishment of a Global Sea Ice Data Bank", Washington, D.C., Joint Ice Center, 3-5 November 1986). By bilateral agreement between NSIDC and the Arctic and Antarctic Research Institute (AARI), St. Petersburg, Russia, elaborated and signed by the directors of given institutions in September 1990 and approved by WMO Secretariat in 1991, two archiving centers (at NSIDC and AARI) were established.

The objective of the GDSIDB project was to preserve ice chart data for use by researchers, and to encourage its conversion from paper or graphical form to digital form. The GDSIDB began as a 1984 Commission on Marine Meteorology recommendation, because, at that time, most ice services produced paper charts by manually integrating various source data. The U.S. National Ice Center, for example, converted to a wholly digital method of producing and distributing charts in 1996. Prior to the use of digital technology by the ice services, charts could only be archived by storing them as paper products or by scanning them. The GDSIDB instituted a method for converting analog charts to raster digital products, established a format for them, and designated archive locations (at AARI and NSIDC). Most ice services now use GIS systems to produce charts.

At NSIDC, GDSIDB data sets are handled under the NOAA data management project, and are part of the World Data Center for Glaciology, Boulder. NSIDC's efforts focused on acquiring funds for the digitization of historical paper charts, on reformatting digital chart data to make it easier for researchers to use, and on helping develop a new vector format. Florence Fetterer led the GDSIDB project at NSIDC.

At AARI, Vasily Smolyanitsky led the GDSIDB project. Work included the development of on-line browse tools for selected data sets, climatological products, and documentation including on-line terms of reference and glossaries in Russian and English. Potential users are encouraged to explore the GDSIDB at AARI, where you will find data products and information not available in this document.

GDSIDB Structure and Meetings

The GDSIDB was a project under JCOMM. A Steering Committee for the GDSIDB was co-chaired by Ivan Frolov, the Director of AARI in St. Petersburg, Russia; and Roger Barry, the Director of NSIDC at the University of Colorado, USA. The Steering Committee met approximately every

two years, and in 2001, was composed of representatives from Australia, Canada, China, Japan, Russia, and the U.S.

The JCOMM Expert Team on Sea Ice contributed to the GDSIDB project. The Team was chaired by Vasily Smolyanitsky, AARI, and, in 2001, included representatives from Argentina, Canada, China, Denmark, Germany, Iceland, Japan, Russia, and the U.S. The WMO provides this information about JCOMM:

"In line with its status as a technical commission of WMO, JCOMM is an intergovernmental body of technical experts in the field of oceanography and marine meteorology, with a mandate to prepare both regulatory (what Member States shall do) and guidance (what Member States should do) material relating to marine observing systems, data management and services. The role of the full commission in session is to act as a final review body for activities, proposals and recommendations prepared for it by its sub-structure of working groups, expert teams and rapporteurs. Based on these, it then prepares recommendations for actions by Member States, for consideration and adoption by the respective governing bodies of WMO and IOC."

GDSIDB meetings were documented in WMO reports. The following reports are examples that document the adoption and revision of the SIGRID-3 format. Additional reports may be found by searching the WMO Publications library.

GDSIDB Sessions Reports

- 11th Session of the GDSIDB Steering Group (Geneva, Switzerland, 28 - 31 March 2007)
- 10th Session of the GDSIDB Steering Group (Hamburg, Germany, 15 - 17 April 2004)
- 9th Session of the GDSIDB Steering Group (Buenos Aires, Argentina, 21 - 25 October 2002)
- Report, 8th Session of the GDSIDB Steering Group (Ottawa, Canada, 30 April - 1 May 2000)
- Report, 7th Session of the GDSIDB Steering Group (Boulder, Colorado, USA, 10 - 12 August 1998)
- Report, 6th Session of the GDSIDB Steering Group (Copenhagen, Denmark, 22 - 26 September 1997)

See Also

- WMO Sea Ice Nomenclature (WMO-No.259)
- Sea-ice Information Services in the World (WMO-No.574)
- The International Ice Charting Working Group (IICWG)
- JCOMM: The Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology

GDSIDB Data Formats

Sea ice data are encoded in a format called Sea Ice Grid (SIGRID) and come in three versions: SIGRID-1, SIGRID-2, and SIGRID-3. These and related formats are described below.

SIGRID

On sea ice charts, ice parameters are represented by symbols and accompanying numbers giving the values of the ice parameters. The symbols varied depending on what nation was compiling the chart until the 1980s, when an international standard was developed by the WMO. The egg code, which gets its name from the shape of the symbol used to embody the WMO standard sea ice information, is now used for most sea ice charts. See Appendix A - Ice Chart Symbology for a brief explanation of the egg code from the U.S. National Ice Center. Also see the Government of Canada Manual of Ice (MANICE) for a detailed explanation of the egg code.

SIGRID is an alphanumeric coding of ice chart information obtained by overlaying a grid on the original paper chart and encoding the ice information in each grid cell. Thompson (1981) provides a description of the proposed SIGRID-1 format. Knight (1984) describes how SIGRID makes it possible to build a database for research. The official 1989 version of SIGRID-1 is described in the Annex to Recommendation 11 on pages 81 to 111 of the Abridged Final Report of the Tenth Session of the WMO Commission for Marine Meteorology which contains a number of differences from the 1981 proposal. In 1994, a simplified version of the original format, SIGRID-2 (WMO, 1994), was adopted and is described in the report Format to Provide Sea Ice Data for the World Climate Program (SIGRID-2).

SIGRID encodes the information in each egg as illustrated by the following example:

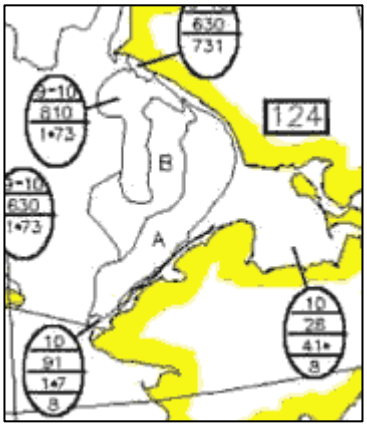

Figure 1. NIC sea ice chart showing the egg code. The numbers in the egg give total concentration (usually as a range); partial concentration of the first, second, and third thickest ice; stage of development of the first, second, and third thickest ice; and other information such as form, if available. See Appendix A - Ice Chart Symbology for more.

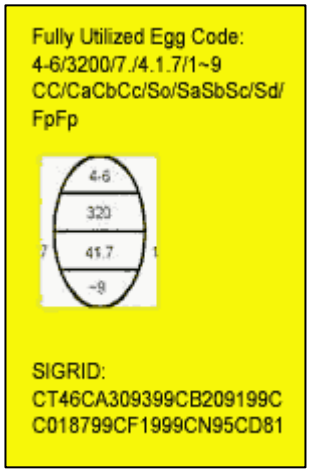

Figure 2. The SIGRID string captures all the information in the egg above.

The nominal resolution of a SIGRID grid is 15 minutes latitude. The longitudinal resolution varies with latitude, as illustrated by the drawing at left and the plot at right in Figure 3.

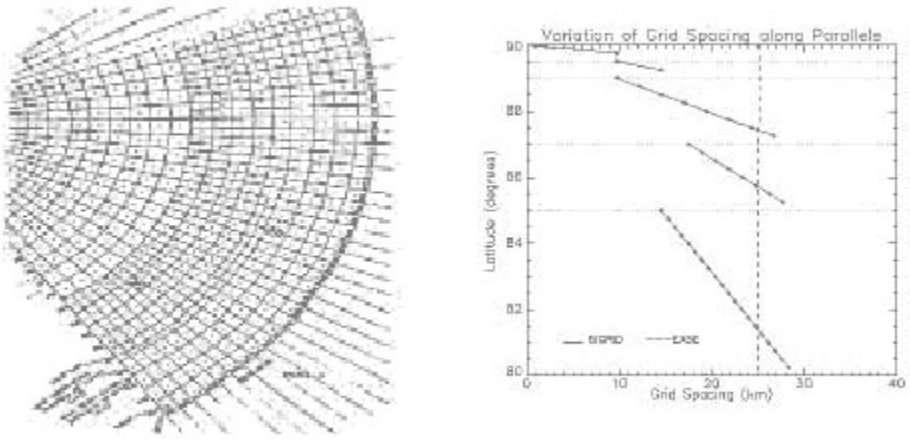

Figure 3. Illustration showing longitudinal resolution varying with latitude

SIGRID-3

While converting data from SIGRID to EASE-Grid makes it easier for most to use, SIGRID and EASE-Grid formats are limited in that they do not contain all the information in the original chart; therefore, they cannot be used to reconstruct the original chart. Figure 4 shows why. In the SIGRID raster format, a single point within a cell represents the entire cell, and the shape of the boundary between regions is lost. To preserve this information and to avoid losing spatial resolution, a vector rather than raster format is needed.

In 1997, AARI proposed a vector format called CONTOUR 2; however, the sea ice community did not adopt this format. In 1999, work on a new vector format began based on ESRI shapefiles. The vector format preserves the chart information in a series of vertices that define the spatial extent of each ice region or polygon, and in a table with a record of attributes for each polygon encoded in SIGRID descriptors for that polygon's egg code. This new format, SIGRID-3, is found in the International Ice Charting Working Group's Ad Hoc Format discussion (see the SIGRID-3 Development section). The SIGRID-3 format was adopted by JCOMM as an official WMO format in May, 2004. It is described in SIGRID-3: A Vector Archive Format for Sea Ice Charts (WMO/TD 1214).

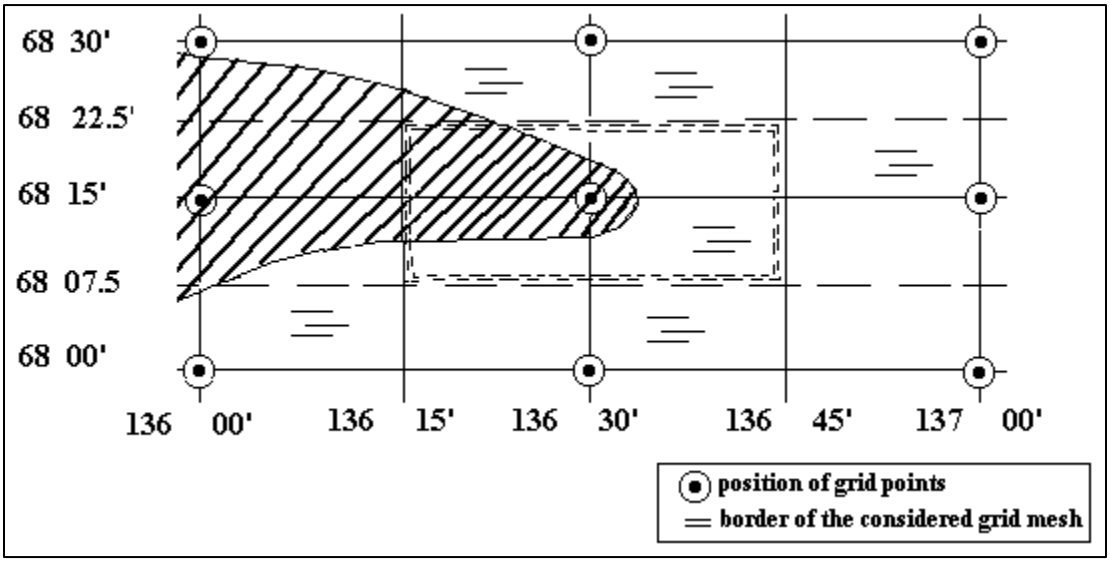

Figure 4. SIGRID Raster Format. Source: NSIDC Special Report - 9: Methods for Regridding AARI Data in SIGRID Format to the EASE-Grid Projection.

Most ice centers now use GIS tools for ice chart production. SIGRID-3 is relatively easy for those centers to output as part of their production routine. This should lead to increased ice center participation in the GDSIDB.

EASE-Grid

A chart in SIGRID format is an ASCII file that must be interpreted by a computer program before the information it contains can be viewed. Because there are ten layers of information per chart, the format makes the data difficult to compare and analyze. The ten layers reflect the egg code: total ice concentration, concentration of the first thickest ice, stage of development of the first thickest ice (these are WMO-designated stages such as nilas, second year ice, and so forth), form of first thickest ice (generally fast ice is the only form used, out of several allowed by SIGRID), concentration of the second thickest ice, stage of development of the second thickest ice, form of second thickest ice, concentration of the third thickest ice, stage of development of the third thickest ice, and form of the third thickest ice. To simplify viewing and data analysis, NSIDC and AARI reformatted the collection of GDSIDB data from AARI and created the data set, Sea Ice Charts of the Russian Arctic in Gridded Format, 1933-2006. Data were re-gridded from SIGRID to the Equal-Area Scalable Earth Grid (EASE-Grid). EASE-Grid is a grid and projection combination used at NSIDC and elsewhere. It is described in A Guide to EASE Grids web page. One advantage of EASE-Grid is that the grid cell size remains the same with latitude.

Figure 5 illustrates how information in the ASCII SIGRID file is regridded and displayed. In this case the concentration of first year ice is shown.

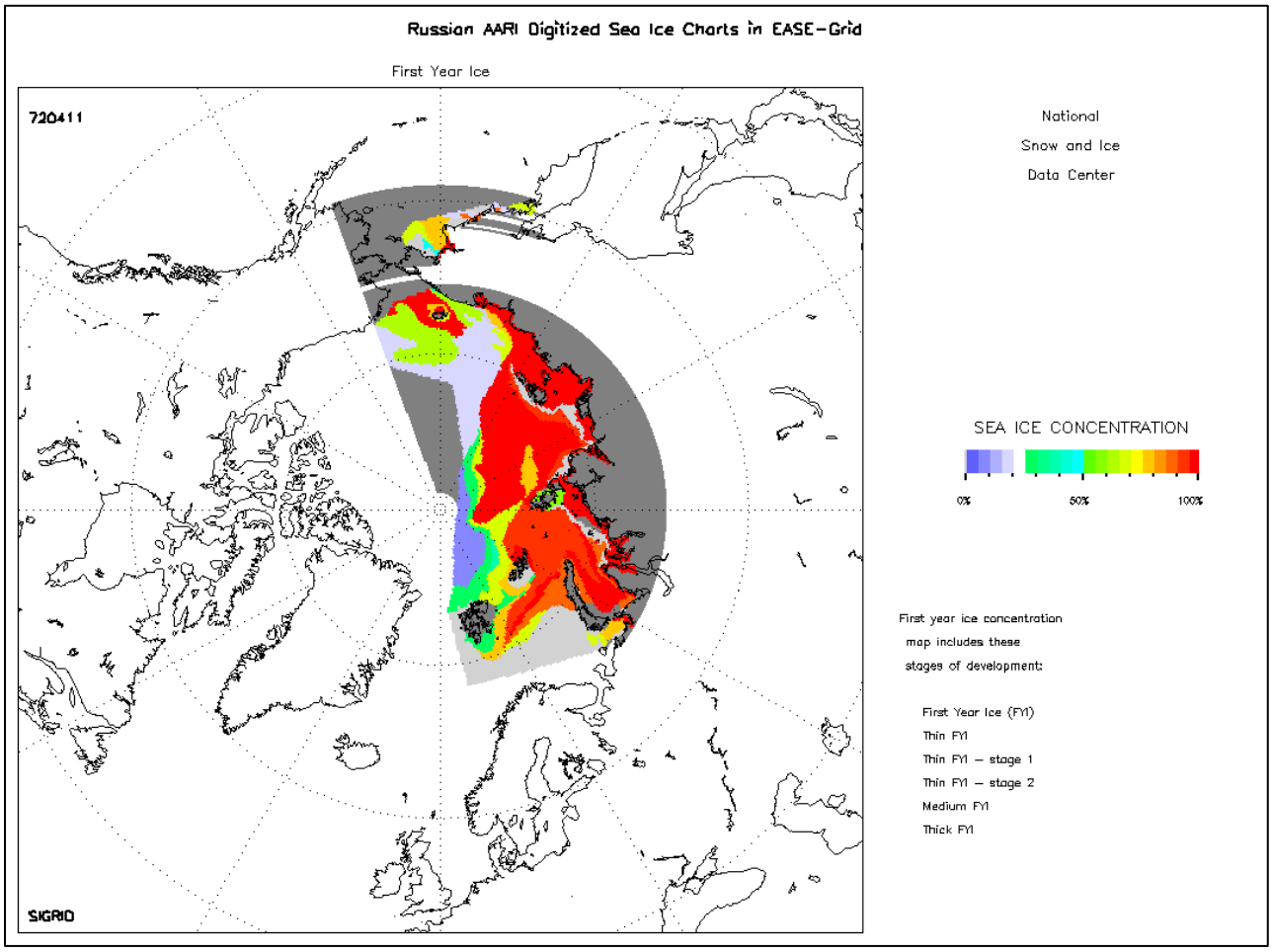

Figure 5. ASCII SIGRID file regridded and displayed to EASE-Grid, SIGRIDINF :RFAA:099:A7680002400:BO410213:C0015: D06CTCABCCNCD: SIGRID01:E98201049999:F001 =K002:L021163:M0213 :R19CT92CA808799CB208...02LL...

GDSIDB Data Holdings

Arctic and Antarctic Research Institute (AARI)

Note: Links to AARI data in this section do not work. They are being left in place as a matter of historical record.

AARI's collection is easily viewed using an on-line browse tool. There you will find statistical summaries and data series of total concentration provided as GIF images.

Arctic	Antarctic
• 10-days AARI, 1950-1992 • 7-days NIC, 1972-1994 • Mixed AARI/NIC charts • J. Walsh monthly, 1901-1997 Greenland Sea • 7-days, NIC, 1972-1994 Baltic Sea • 7 days, NIC, 1972-1994	• 10-days, AARI, 1990 • 7-days, NIC, 1973-1991 • J. Walsh monthly, 1973-1990

National Snow and Ice Data Center (NSIDC)

The GDSIDB was initially established as a pilot program using data from test year 1982. At present, the GDSIDB at NSIDC consists of the data sets in the table below. Note that NSIDC has distributed only the U.S. National Ice Center (NIC) data and Russian Federation, AARI, data.

Users often find simple gridded ice concentration data easier to work with than SIGRID-1, SIGRID-2, or SIGRID-3 data. For this reason, NSIDC published an EASE-Grid version of the NIC and AARI data.

Most ice services have no easy way to produce charts in SIGRID-1, SIGRID-2, or SIGRID-3 format. As a result, the GDSIDB lacks complete records from all services with the exception of the Japan Meteorological Agency. This problem has been addressed through the International Ice Charting Working Group Ad Hoc Format team, and will be taken up by JCOMM.

History of GDSIDB Data Sets at NSIDC	
Arctic (Alaskan and Canadian coasts)	
Originator	William H. Dehn and Sea Ice Consultants, Inc.
Record length/	1953-1986; frequency varies from about 80 to about 350 charts per year

Chart frequency	
Format	PNG and TIFF
Data available from NSIDC?	Yes. The Dehn Collection of Arctic Sea Ice Charts, 1953-1986 is publicly available.
NSIDC reference numbers	G01111, FD0170
Arctic (complete coverage)	
Originator	U.S. National Ice Center
Record length/ Chart frequency	1972-2004; monthly climatology products are median, maximum, minimum, first quartile, and third quartile concentrations, as well as frequency of occurrence of ice at any concentration for 33-year, 10-year, and 5-year periods
Format	EASE-Grid, GIF and GIS (geodatabase)
Data available from NSIDC?	Yes. The data set title is National Ice Center Arctic Sea Ice Charts and Climatologies in Gridded Format
NSIDC reference number	G02172
Arctic and Antarctic	
Originator	U.S. National Ice Center
Record length/ Chart frequency	1972-1994, every seven days
Format	SIGRID-1 (EWG Atlas is in SIGRID, EASE-Grid, and GIS formats.)
Data available from NSIDC?	No.
NSIDC reference numbers	FD4, FD20, G00793 EWG Atlas: G01962
Notes	SIGRID data were distributed on a CD-ROM titled "NIC Arctic and Antarctic Sea Ice Data", published by NIC and NOAA NCDC. The CD-ROM was removed from circulation after coding errors for ice type were discovered. The Arctic portion was replaced in 2000 by the quality-controlled data on

	the Environmental Working Group Joint U.S.-Russian Arctic Sea Ice Atlas and later by the National Ice Center Arctic Sea Ice Charts and Climatologies in Gridded Format.
Canadian Arctic	
Originator	Canadian Ice Service
Record length/ Chart frequency	March 2006-present; weekly
Format	SIGRID-3
Data available from NSIDC?	Yes. The data set title is Canadian Ice Service Arctic Regional Sea Ice Charts in SIGRID-3 Format.
NSIDC reference number	G02171
Eurasian Arctic	
Originator	Russian Federation, AARI
Record length/ Chart frequency	1953-1990, every ten days
Format	Original format: SIGRID-1,2 Distributed version: EASE-Grid
Data available from NSIDC?	No. This data set has been replaced by the AARI 10-Day Arctic Ocean EASE-Grid Sea Ice Observations and then replaced in 2007 by Sea Ice Charts of the Russian Arctic in Gridded Format, 1933-2006.
NSIDC reference numbers	FD157 EASE-Grid product: G02119
Russian Arctic	
Originator	AARI
Record length/ Chart frequency	1933-2006; chart frequency varies (charts were compiled every 10 days during the navigation season and monthly for the rest of the year over most of the time series)
Format	SIGRID-1 and EASE-Grid
Data available from NSIDC?	Yes. The Sea Ice Charts of the Russian Arctic in Gridded Format, 1933-2006 data set is publicly available.

NSIDC reference number	G02176
Notes	There is a data gap between 1993 and 1996.
Great Lakes	
Originator	U. S. National Ice Center, Canadian Ice Service
Record length/ Chart frequency	1973-74 ice season to present; frequency varies per year throughout the ice season
Format	Most files are available in GIF format
Data available from NSIDC?	Yes. The Great Lakes Ice Charts data set is available.
NSIDC reference numbers	G00486, FD0055
Gulf of Newfoundland, Hudson Bay, Arctic	
Originator	Canadian Ice Service
Record length/ Chart frequency	1962-1982, 1962-1983, 1959-1980
Format	SIGRID-1
Data available from NSIDC?	No.
NSIDC reference numbers	FD168, rcvd 1992, 1998
Notes	No plans to distribute.
Sea of Okhotsk	
Originator	Japan Meteorological Agency
Record length/ Chart frequency	1971-last ice season, every five days
Format	SIGRID-1,2

Data available from NSIDC?	No.
NSIDC reference numbers	FD042
Notes	NSIDC plans to convert this data set to EASE-Grid before distribution.
Various	
Originator	Argentina, Canada, Japan, U.S., and USSR
Record length/ Chart frequency	1982
Format	SIGRID-1
Data available from NSIDC?	No.
NSIDC reference numbers	FD111, rcvd 1989
Notes	SIGRID Global Sea Ice Data Bank Test Tape. No plans to distribute.

SIGRID-3 Development

June 1, 2004

The Ad Hoc Format Working Group's efforts have led to a new WMO JCOMM-sanctioned format. The descriptive document may be referenced as:

IICWG. 2004. SIGRID-3: A Vector Archive Format for Sea Ice Charts. JCOMM Technical Report Series No. 23, WMO/TD-No. 1214.

ESRI Shapefile Technical Description (PDF file)

Sample SIGRID-3 Charts

As of May 2022, this SIGRID-3 data set is available from NSIDC:

Canadian Ice Service. 2009. *Canadian Ice Service Arctic Regional Sea Ice Charts in SIGRID-3 Format, Version 1*. Boulder, Colorado USA. NSIDC: National Snow and Ice Data Center. doi: https://doi.org/10.7265/N51V5BW9.

This data set is based on SIGRID-3 data from the U.S. National Ice Center. As of May 2022, the SIGRID-3 data upon which it is based are being prepared for publication:

U.S. National Ice Center. Compiled by F. Fetterer and J. S. Stewart. 2020. *U.S. National Ice Center Arctic and Antarctic Sea Ice Concentration and Climatologies in Gridded Format, Version*

1. Boulder, Colorado USA. NSIDC: National Snow and Ice Data Center. doi: https://doi.org/10.7265/46cc-3952.

References

Arctic and Antarctic Research Institute. 2007. *Sea Ice Charts of the Russian Arctic in Gridded Format, 1933-2006, Version 1*. Compiled by V. Smolyanitsky, V. Borodachev, A. Mahoney, F. Fetterer, and R. G. Barry. Boulder, Colorado USA. NSIDC: National Snow and Ice Data Center. doi: https://doi.org/10.7265/N5D21VHJ.

IICWG. 2004. SIGRID-3: A Vector Archive Format for Sea Ice Charts. JCOMM Technical Report Series No. 23, WMO/TD-No. 1214.

Knight, R.W. 1984. Introduction to a new sea-ice database. Annals of Glaciology 5, 81-84.

Thompson, T. 1981. Proposed Format for Gridded Sea Ice Information (SIGRID).Unpublished report prepared for the WMO World Climate Programme.

U.S. National Ice Center. 2006, updated 2009. *U.S. National Ice Center Arctic Sea Ice Charts and Climatologies in Gridded Format, 1972 - 2007, Version 1*. Compiled by F. Fetterer and C. Fowler. Boulder, Colorado USA. NSIDC: National Snow and Ice Data Center. doi: https://doi.org/10.7265/N5X34VDB.

World Meteorological Organization. 1994. Format to Provide Sea Ice Data for the World Climate Program (SIGRID-2). World Meteorological Organization.

World Meteorological Organization. 1989. Abridged Final Report of the Tenth Session of the WMO Commission for Marine Meteorology. Paris, France. February 1989. World Meteorological Organization.

Appendix A - Ice Chart Symbology

From US National Ice Center Web Site: http://www.natice.noaa.gov/products/egg_code.html (Accessed June 2011)

The World Meteorology Organization (WMO) system for sea ice symbology is more frequently referred to as the "Egg Code" due to the oval shape of the symbol (Figure A - 1).

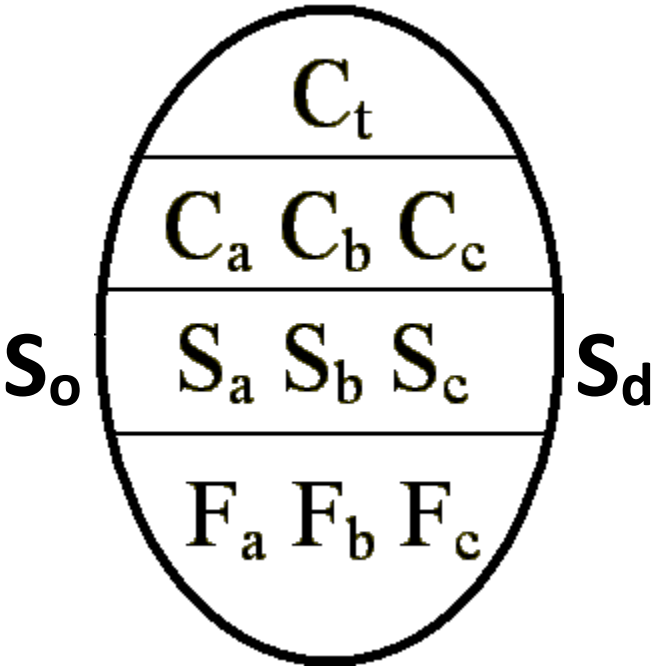

Figure A - 1. WMO Egg Code Ice Symbology

C_t - Total concentration of ice in area, reported in tenths. May be expressed as a single number or as a range, not to exceed two tenths (3-5, 5-7 etc.)

C_a C_b C_c - Partial concentration (C_a, C_b, C_c) are reported in tenths, as a single digit. These are reported in order of decreasing thickness. C_a is the concentration of the thickest ice and C_c is the concentration of the thinnest ice.

S_a S_b S_c - Stages of development (S_a, S_b, S_c) are listed using the code shown in Table 1 below, in decreasing order of thickness. (NOTE: If there is a dot (.), all stages of development codes to the left of the dot (.) are assumed to carry the dot (.)) These codes correspond directly with the partial concentrations above. C_a is the concentration of stage S_a, C_b is the concentration of stage S_b, and C_c is the concentration of S_c.

S_o S_d - Development stage (age) of remaining ice types. S_o if reported is a trace of ice type thicker/older than S_a. S_d is a thinner ice type which is reported when there are four or more ice thickness types.

F_a F_b F_c - Predominant form of ice (floe size) corresponding to S_a, S_b and S_c respectively. Table 2 below shows the codes used to express this information.

Table A - 1. Egg Codes for Stages of Ice Development (Sx Codes)

Stage of Development for Sea Ice	Code Figure	Stage of Development for Fresh Water Ice
New Ice-Frazil, Grease, Slush, Shuga (0-10 cm)	1	New Ice (0 - 5 cm)
Nilas, Ice Rind (0 - 10 cm)	2	
Young (10 - 30 cm)	3	

Gray (10 - 15 cm)	4	Thin Ice (5 - 15 cm)
Gray - White (15 - 30 cm)	5	Medium Ice (15 - 30 cm)
First Year (30 - 200 cm)	6	
First Year Thin (30 - 70 cm)	7	Thick Ice (30 - 70 cm)
First Year Thin - First Stage (30 - 70 cm)	8	First Stage Thick Ice (30 - 50 cm)
First Year Thin - Second Stage (30 - 70 cm)	9	Second Stage Thick Ice (50 - 70 cm)
Medium First Year (70 - 120 cm)	1.	Very Thick Ice (70 - 120 cm)
Thick First Year (>120 cm)	4.	
Old - Survived at least one season's melt (>2 m)	7.	
Second Year (>2 m)	8.	
Multi-Year (>2 m)	9.	
Ice of Land Origin		

Table A - 2. Egg Codes for Forms of Ice (Fx Codes)

Forms of Sea Ice	Code Figure	Forms of Fresh Water Ice
	~F	Belts and Strips symbol followed by ice concentration
New Ice (0-10 cm)	X	
Pancake Ice (30 cm - 3 m)	0	
Brash Ice (< 2m)	1	
Ice Cake (3 - 20 m)	2	
Small Ice Floe (20 - 100 m)	3	
Medium Ice Floe (100 - 500 m)	4	
Big Ice Floe (500 m - 2 km)	5	
Vast Ice Floe (2 - 10 km)	6	
Giant Ice Floe (> 10 km)	7	
Fast Ice	8	Fast Ice
Ice of Land Origin	9	
Undetermined or Unknown (Iceberg, Growlers, Bergy Bits)	/	