World Meteorological Organization
Commission for Marine Meteorology

Steering group for the WMO Project Global Digital Sea Ice Data Bank (GDSIDB), Subgroup on Sea Ice (SGSI).

Final report

of the 7th Session of the Steering Group
for the GDSIDB and the informal session of the SGSI.

USA National Snow and Ice Data Center/World Data Center A for Glaciology

Boulder, Colorado, 10-12 August 1998

Minutes of the Meetings

1. ORGANIZATION OF THE MEETING.

1.1 Opening of the meeting.

1.1.1. The Director of the USA National Snow and Ice Data Center / World Data Center A for Glaciology (NSIDC/WDC A for Glaciology) Roger Barry opened the joint informal Commission for Marine Meteorology (CMM) Sub-Group on Sea Ice (SGSI) and Global Digital Sea Ice Data Bank (GDSIDB) meetings and welcomed representatives.
1.1.2. In turn WMO representative Mikhail Krasnoperov welcomed the participants, especially new members from France, China and Iceland.
1.1.3. Participants then introduced themselves. Full list of participants is given in Appendix 1.
1.1.4. Roger Barry proposed that Ivan Frolov be a Chairman of the SGSI meeting, held on the first day. M.Krasnoperov proposed Roger Barry to be the chairman of the GDSIDB meeting.

1.2 Adoption of the agenda.

1.2.1. The meeting was invited to comment on the agenda and the proposed work plan.
1.2.2. The agenda was adopted and include as Appendix 2.

1.3 Working arrangements.

1.3.1. It was agreed that the working hours should be from 09h 00 min to 13h 00 and from 14h 00 to 18h 00.

2. INFORMAL SESSION OF THE CMM SGSI

2.1 Report by the SGSI chairman, Ivan Frolov

Participants discussed the report, especially the part dedicated to the revision of the WMO publication No.574 "Sea Ice Information Services in the World". Representative of the WMO Secretariat Mikhail Krasnoperov noted that this publication should be prepared for submission to WMO by December 1998. National Services are asked to provide appropriate information directly to the representative from Sweden J.-E.Lundqvist who will compile all corrections and proposed additions and pass them to WMO Secretariat for editing and publication. Also Roger Barry noted the necessity for development of a complete WWW-page with links to Internet resources of the Ice Services. Participants agreed to compile a preliminary version of such a list by the closure of meetings (see Appendix 3). The full text of Ivan Frolov's report is given as Annex A.

2.2 Reports by the members of the SGSI.

2.2.1 A report from Sweden was delivered by the expert from Swedish Meteorological and Hydrological Institute (SMHI) Jan-Eric Lundqvist. Full text is given as Annex B.
2.2.2 A report from the Canadian Ice Service (CIS) was delivered by Wayne Lumsden. Full text is given as Annex C.
2.2.3 A report from the USA National Ice Center (NIC) was delivered by David Benner. Full text is given as Annex D.
2.2.4 A report from the French Meteorological Service (Meteo-France) was delivered by David Salas y Melia. Full text is given as Annex E.

2.2.5 A report from National Space Development Agency of Japan (NASDA - Frontier - International Arctic Research Center/IARC) was delivered by Jinro Ukita. Report is given as Annex F.

2.2.6 A report by the expert from the Icelandic Meteorological Office, Ingibjorg Jonsdottir. Report is given as Annex G.

2.2.7 Report by the expert from China, State Oceanic Administration, National Marine Environmental Forecasts Center (NMEFC) in Beijing, Wei Min. The reporter described Chinese activity for ice conditions in the Bohai Sea. At present information is published at a web-site both in Chinese and in English. The Administration has produced maps since 1960s. Maps are now produced daily. Historical charts are archived on paper and in national format. The NMEFC is in charge of sea ice forecasts as assigned by the government, for the China coastline. This is NMEFC the first time has attended this kind of meeting. The main purpose of attending this meeting is to learn and communicate the relevant information from sea ice steering group of CMM. NMEFC intends to actively participate in cooperation with the sea ice steering group of CMM after this meeting. At the same time, NMEFC would like to contribute its work to the steering group of CMM. NMEFC wishes to obtain routinely all related information and materials from the steering group of CMM and keep close ties with the steering group in the future. Information on a numerical sea ice forecast system for the Bohai Sea is given as Annex H.

2.2.8 Brief information on the operational activity of the Russian Arctic and Antarctic Research Institute (AARI) was delivered by Vasily Smolyanitsky. The reported described the operational products prepared by the institute related to sea ice mapping and forecasting, polar meteorology and geophysics both for the Arctic and Antarctic. Most of the products are compiled weekly by the Center of Ice Hydrometeorological Information on the basis of satellite information received at the facilities operated and owned by the institute. Satellite material include NOAA HRPT products, data from Russian satellites COSMOS and Meteor and data received through international exchange from ESA. The reporter noted that samples of most products are available via AARI web-site (http://www.aari.nw.ru).

2.2.9 Report from Argentina. Manuel Picasso informed the WMO Secretariat that he could not be at the meetings because he has a number of workshops at the same time. He also informed WMO that Argentina is now ready to submit sea-ice observations from Argentinean Antarctic coastal stations and ships to the GDSIDB centers. They have prepared a number of sets of sea-ice data for the bank. Formats and exchange mechanisms will be directly coordinated with both centres. In the future, Argentina may also contribute all additional sea ice data that are available in the Argentinean sea ice service.

2.3 Report from the Baltic Sea Ice Meeting

A report was delivered by the expert from SMHI, Jan-Eric Lundqvist. Full text is given as Annex I.

2.4. WMO sea ice guidance materials and publications.

The WMO representative Mikhail Krasnoperov reported on the status of the main items of the CMM-XII related to the WMO guidance materials for mariners and material on meteorological services in sea ice areas. The presentation is given as Annex M.

2.5 Formats for operational and historical sea ice data exchange.

Report on the topic was delivered by AARI expert Vasily Smolyanitsky. Vasily Smolyanitsky presented the scope of the WMO Sea Ice Nomenclature and necessity for its amendment. Nomenclature was adopted by WMO Secretariat in 1971, but amendments were incorporated into it up to 1989. Formats for sea ice international exchange reflect the above document. The first SIGRID format was adopted in 1989, the second one - in 1994. Both use raster, gridded presentation of ice data with a commonly used resolution of 15 geographical minutes which can be extended down to 1 geographical minute. For the main sea ice parameters, the accuracy of coding units is 1%

for concentration and is 1 cm for thickness. In most cases this exceeds the accuracy provided as a result of the mapping process in the ice services. The necessity for modifications to the codes may come from the need to describe new sea ice parameters derived from the modern observational means or in order to incorporate data from the other data banks (e.g. BSIM). The future format CONTOUR-2 will be based on the vector coding of the sea ice information and can be used as a format for operational exchange of the sea ice products in electronic form or as a set of rules describing the scope and accuracy of sea ice data mapped on the ice chart.

2.6 Future SGSI activity

Representatives endorsed the continuation of the SGSI activities (see Annex A) and proposed the following additions for future activity:

2.6.1 To coordinate a workshop on "Mapping and archiving sea ice data derived from radar data processing", potentially sponsored by WMO and hosted by Canada. The Canadian representative agreed to investigate the feasibility of hosting the meeting in Ottawa. Preferred CIS timing is May 2000. Topics for workshop include understanding radar sea ice signatures, archiving radar data etc. The SGSI requests WMO to consider sponsorship of this workshop.

2.6.2 The SGSI chair will investigate the possibility of including sea ice information from Black, Azov and Caspian seas into GDSIDB (as information possibly containing climatic signals) by December 1998.

2.6.3 Representative from AARI Vasily Smolyanitsky will prepare a list of Sea Ice Service addresses and resources and point of contacts and other relevant information for the special web page for SGSI. This list will be provided to WMO by February 1999 (see Appendix 3).

2.6.4 To prepare recommendations on archival and operational formats. An ad-hoc working group was designated by the participants and prepared preliminary recommendations are given as Appendix 4. The Canadian representative and SGSI chair will take the lead in planning this activity.

11 August

3. GLOBAL DIGITAL SEA ICE DATA BANK ACTIVITIES

3.1 Reports from GDSIDB Centers.

3.1.1 Florence Fetterer, NSIDC presented an overview of GDSIDB activities at NSIDC. In particular she reported statistics for 08/1997 to 08/1998 describing the number of requests for GDSIDB files (see Annex J).

3.1.2 V.Smolyanitsky, AARI presented a status summary of the Work Plan for previous period. It was about 90% completed by the time of the meeting. Status summary is included below as Annex K.

3.1.3 David Benner, NIC reported on the NIC part of GDSIDB. He described plans for data products, including the Russian - USA joint Environmental Working Group Arctic Sea Ice Atlas on CD ROM. (see Annex D).

During discussion on item 3.1, M.Krasnoperov commented that GDSIDB activity had made substantial progress since the last meeting. WMO invited the United Kingdom, Chile, Argentina and Australia to participate in the GDSIDB activity. Attending this meeting for the first time are representatives from China, France and Iceland. Other possible countries are Ukraine, South Africa and Norway. It was suggested that the GDSIDB co-chairs advise leading sea ice specialists in those countries about this activity.

R.Barry asked the GDSIDB centers representatives whether the year 2000 problem would affect the databases. Representatives agreed to investigate the problem and to report to the co-chairs by December 1998. It was noted that the SIGRID format provides only a 3-digit time group for the date.

Meeting participants discussed the status of AARI WDC. I.Frolov explained that the WDC-B "Sea Ice" title had not been approved. It was suggested and agreed to use the title: AARI Sea Ice Data Center (ASIDC) in the interim.

The possibility of widening the scope of the GDSIDB to include land ice data was raised. It was pointed out that this would not be appropriate as a CMM sponsored activity. The participants of the meeting agreed that the scope of the GSIDB should remain as at present. R.Barry also mentioned the new activity of WCRP for Climate and the Cryosphere (CLIC), see item 4. W.Lumsden asked whether the GDSIDB center could archive iceberg data in view of potential risk of loss of such record and their value for Global Change. The GDSIDB centers offered to accept such data.

3.2 Results of the joint ACSYS and NIC workshop "Sea Ice Charts of the Arctic" (5-7 August 1998, Seattle, USA).

R.Barry gave a summary of the meeting. During the workshop three working groups met:

- Data management.
- Historical record
- Science and operations

Abstacts of the presentations and a short summary of the WG discussions will be compiled by Roger Colony and will be made available in a few months.

3.3 Development of sea-ice data processing (NSIDC, AARI, JMA, etc)

3.3.1 The NIC report was delivered by David Benner. Mapping starts from the high-resolution products. Gaps are filled from low-resolution passive microwave data. He described plans for algorithm development, namely ARKTOS (Advanced Reasoning using Knowledge for Typing of Sea Ice) and MIMS (the Multi-Year Ice Mapping System). Future data sources will include Radarsat-2, Envisat which will become operational in 2000-2001. Access to Radarsat data is via NOAA SAA (Satellite Active Archive) if one is employed by the US government or has a federal research project (see Annex D).

3.3.2 The CIS report was delivered by Wayne Lumsden. Data sources include aircraft, satellites (ERS, NOAA, GOES, DMSP) and others coming from ships, shore, icebreakers and helicopters used near the ship. Composite data are used for the ice analysis. Regional charts are compiled on a weekly basis and are available free of charge. Daily charts are available on a commercial basis.

3.3.3. The SMHI report was presented by Jan-Eric Lundqvist. He observed the progress in processing techniques in Sweden. Techniques include processing of the ice chart in digital form which provides the possibility of merging the latest sea ice chart with the current NOAA image on the same screen, which in turn makes it easy to compare mapped product with all other ice formation. Today SMHI is unable to put the radar images on the same screen (as products are inconsistent in scale). SMHI plans to improve technical processing in order to incorporate Radarsat information if it becomes affordable in future.

3.3.4 The AARI report was presented by Vasily Smolyanitsky and is included as Annex K.

3.3.5 Development of user-services.

R.Barry pointed out that many users require meteorological or oceanographic web information in conjunction with the sea ice products. Representatives agreed that the GDSIDB centers should provide links to complementary data, namely buoy data, surface pressure, winds, air temperature and sea surface temperature. Also the Centers should look at the possibility of including time stamps in the sea ice information in order for users to select consistent supplementary meteorological data.

3.4. Submission of new sea-ice data to the GDSIDB

Jan-Eric Lundqvist together with Vasily Smolyanitsky gave a summary of plans to incorporate Baltic Sea Ice Data by December 1998 (given as Annex L). D.Benner reported on plans at NIC for additional data products. Iceland agreed to send current ice information on a regular basis. Representatives identified possible addtional data sources: Australia, Chile and South Africa for the Antarctic and Russia, Ukraine and Kazakhstan for the Black, Azov and Caspian seas (see item 3.5)

3.5 Development and adoption of the working plan for the next intersessional period

Participants discussed and adopted the Working Plan for the next intersessional period (see Appendix 5).

12 August

4. RELATIONS TO OTHER WMO AND INTERNATIONAL PROGRAMS

4.1. R.Barry described relative components of the WCRP and noted plans for a new Climate and Cryosphere activity (CLIC). The GSIDB is likely to be a valuable data resource for CLIC.

4.2. It was noted that an input sea ice data set for ECMWF reanalysis is being prepared by an ad-hoc group of specialists, using GDSIDB and other data. The task is to be completed by October 1998. It was agreed by the meeting that this product should be archived in the GDSIDB.

5. Data and place of the next session.

The meeting was pleased to receive the tentative offer from Canada to host the proposed workshop on the use of radar data in sea ice analysis and the 8th session of GDSIDB in Ottawa, Canada in late May/early June 2000.

6. Closure of the meeting.

The 7th session of the Steering Group for the GDSIDB and informal meeting of the CMM Sub-Group on Sea Ice was closed at noon Wednesday, 12 August 1998.

Appendix 1

List of participants

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Appendix 2.

AGENDA

10 August

1. ORGANIZATION OF THE MEETING
   - 1.1 Opening of the meeting
   - 1.2 Adoption of the agenda
   - 1.3 Working arrangements

2. INFORMAL SESSION OF THE CMM SUB GROUP ON SEA ICE (SGSI)
   - 2.1 Report by the Chairman of the SGSI
   - 2.2 Reports by the members of SGSI
   - 2.2.1 Report by the expert from the Swedish Meteorological and Hydrological Institute
   - 2.2.2 Report by the expert from the Canadian Ice Service
   - 2.2.3 Report by the expert from the USA National Ice Center
   - 2.2.4 Report from Meteo-France
   - 2.2.5 Report from National Space Development Agency of Japan (NASDA).
   - 2.2.6 Report from the Icelandic Meteorological Office.
   - 2.2.7 Report by the expert from China, State Oceanic Administration, National Marine Environmental Forecasts Center in Beijing
   - 2.2.8 Report from the Russian Arctic and Antarctic Research Institute
   - 2.2.9 Report from Argentina
   - 2.3 Report from the Baltic Sea Ice Meeting
   - 2.4 WMO sea ice guidance materials and publications
   - 2.5 Formats for operational and historical sea ice data exchange
   - 2.6 Future SGSI activity. Workplan.

11 August

3. GLOBAL DIGITAL SEA ICE DATA BANK (GDSIDB) ACTIVITIES
   - 3.1 Reports of the GDSIDB centers
   - 3.2 Results of the workshops on *Sea Ice Charts of the Arctic* (5-7 August 1998, Seattle, USA)
   - 3.3 Development of sea-ice data processing and user-services(NSIDC, AARI, JMA, etc)
   - 3.4 Submission of new sea-ice data to the GDSIDB.
   - 3.5 Development and adoption of the working plan for the next intersessional period

12 August

4. RELATIONS TO OTHER WMO AND INTERNATIONAL PROGRAMS
5. DATE AND PLACE OF THE NEXT SESSION
6. CLOSURE OF THE SESSION

Appendix 3

Preliminary list of references to resources available through http- and ftp- protocols for the Agencies involved in the current SGSI/GDSIDB activities

Agency/Sea Ice Service	**URLs to resources available through the http and ftp protocols**	**Notes**
Arctic and Antarctic Research Institute, Russia	http://www.aari.nw.ru/index_en.html http://www.aari.nw.ru/gdsidb/gdsidb_2.html ftp://aari.nw.ru	Main page (in English) URL to GDSIDB page anonymous ftp
Canadian Ice Service	http://cis.ec.gc.ca	Main page in English and French
China State Oceanographic Agency (S.O.A.)	http://axp800.nmefc.gov.cn	Main page in Chinese and English
Danish Meteorological Institute	http://www.min.dk	Main page in Danish and English
Icelandic Meteorological Office	http://www.vedur.is	Main page (Icelandic and English)
Japan Meteorological Agency	http://www.kishou.go.jp http://www.jodc.jhd.go.jp/inf/institute/jma/jma.htm	Main page in Japanese Main page in English (tbd)
National Space Development Agency of Japan	http://www.nasda.go.jp	
Meteo-France	http://www.meteo.fr	Main page
National Ice Center	http://www-natice.noaa.gov ftp://www-natice.noaa.gov	Main page anonymous ftp
National Snow and Ice Data Center, USA	http://www-nsidc.colorado.edu ftp://sidads.colorado.edu	Main page anonymous ftp
Swedish Meteorological and Hydrological Institute	http://www.smhi.se ftp://ftp.smhi.se	Main page ftp
WMO	http://www.wmo.ch ftp://www.wmo.ch	Main page anonymous ftp

Appendix 4

Report of the ad-hoc Data Format Working Group

Working group consisted of Vasily Smolyanitsky (AARI), David Benner (NIC) and Wayne Lumsden (CIS).

The group first discussed users which were categorized as:

Near-Real-Time
- operational sea ice analysis and forecast centers;
- mariners including military, commercial, coast guard and fishing;
- operational numerical weather, ocean and ice modelling;

and

Non Real-Time
- weather, ocean and ice model developers;
- climate modellers;
- environmental and operational strategic planners;
- ice researchers;
- value added consultant industry

Secondly, the working group discussed and designated the following objectives:

a. To provide sea ice grid point data to the GDSIDB in a format that preserves the physical attributes of the ice, to the maximum extent possible, by the most cost effective mechanism.
b. To provide the GDSIDB sea ice information in a vector format that preserves the physical attributes of the ice, to the maximum extent possible, by the most cost effective mechanism.

Following recommendations were elaborated:

It is recommended that:
a. NSIDC or AARI provide national centers with an ASCII file containing the latitude longitude pairs for the data points of primary interest for grid point data;
b. National centers provide all future sea ice data for the grid points specified in the SIGRID format;
c. Contour 2 format specifications be finalized by AARI and forwarded for WMO acceptance by December 1998;
d. the Canadian, Russian and US National Centers examine the problems associated with the real-time exchange of vector sea ice between national centers including but not limited to:
    - the requirement for a common coast line
    - geographic projection to be used
    - scope and accuracy of the sea ice parameters to be included in the exchange
    - the potential of Contour 2 as an exchange format
    - communications media

An interim report will be circulated via E-mail by September 1999 and the final report and recommendations presented at the next GDSIDB meeting.

Appendix 5.

Work Plan for Cooperation between the members of the Steering Group on the WMO Project Global Digital Sea-Ice Data Bank for August 1998 - May 2000

1. Technique Development

The experts from the GDSIDB centers will to continue make available data browsers, translating and other necessary software for processing data in SIGRID, ArcInfo and EASE-grid formats

2. Data Exchange.

2.1 Schedule for sea ice data transfer to GDSIDB centers

	Institute	Region	Time interval	Exchange date
1.	**ASIDC/AARI**	Arctic, corrected version Antarctic	1950-1992 (10-days period) 1971-1990 (10-days period)	when the data are available for ASIDC, June 1999 when the data are available for ASIDC, pending funding
2.	**NIC**	reprocessed Arctic and Antarctic	1972/1973 -1994	by January 1999
3.	**JMA**	Sea of Okhotsk	ongoing data forward in time	once a year
4.	**CIS**	Canadian Arctic Archipelago, high resolution data	1970-1995	June 1999
5.	**DMI**	Arctic, Northern Atlantic	1890-1994, ongoing data forward in time	dependent on software development at DMI and resources
6.	**BSIM**	Baltic Sea Baltic Sea	1961-1979, BASIS data samples 1961-1979, SIGRID data	by autumn 1998 after completion of software by the AARI and BSIM experts, December 1998
7.	**Federal Maritime and Hydrographic service** (BSH), Germany	Baltic Sea (south of 56°N and to the west of 14 20')	1960-1982 and updates	to be determined
8	**Argentinean**	Weddell and	App. 1973 to 1990,	June 1999

	Navy Hydrographic Service	Bellingshausen Seas	point observations	
9	**Icelandic Meteorological Office**	Icelandic waters	to be determined	once a year
10	**State Oceanic Administration, China**	Bohai Sea	1968 -	to be determined

2.2 Technical assistance.

2.2.1. SG experts from AARI and NSIDC will continue to provide assistance for incorporation of ice information in formats other than SIGRID (EASE-grid, Contour etc.) provided that adequate documentation and access software are attached.
2.2.2 NSIDC and AARI will continue to provide guidance on preparation of metadata and other necessary documentation accompanying data submitted or to be submitted to GDSIDB.
2.2.3. NSIDC and AARI will develop web-links to complementary meteorological and oceanographic data sources.

3. Modification of formats for data exchange

3.1 AARI will finalize the CONTOUR-2 format by December 1998.
3.2 The ad-hoc working group on data formats will assess the feasibility of using CONTOUR-2 for operational exchange of data (see Appendix 4).

4. Use, validation and intercomparison of GDSIDB data

4.1	Experts from SG will continue joint activity on development of sea ice climate estimates from the GDSIDB data	1998-2000
4.2	Experts from SG will continue joint activity on intercomparison of GDSIDB data provided from different sources	1998-2000
4.3	SG members will endeavor to establish linkages with the other programs and projects concerning the development of climate estimates, validation and intercomparison of GDSIDB data	1998-2000

5. Future activity

5.1	Members of the SG will develop plans for future activity for subsequent discussion at the 8th session of the SG	early 2000
5.2	SG recommend that Chairman of the Sub-Group on Sea Ice explore the possibility of inviting other countries collecting sea ice data to contribute data to GDSIDB	1998-2000

Annexes

Annex A

Report of the
Chairman of the CMM Sub-Group on Sea Ice (SGSI*)*
Ivan Frolov, Arctic and Antarctic Research Institute
Informal session of SGSI, Boulder, 10 August 1998

Main Items

1. According to the Workplan of CMM - XII for the period of 1997-2001 and decisions adopted at the informal meeting in Copenhagen, September 1997, the prime working items of the SGSI are as follows:

(i) to coordinate marine climatological requirements (including sea-ice data) with WCP and provision of technical advice on exchange and archival of such data - continuous, D.Bener (USA);

(ii) to promote cooperation in improving the methodology for the acquisition exchange, processing, quality control, storage and dissemination of sea-ice data (including remotely- sensed data) - continuous, Y.Kano (Japan) and S.Lapczak (Canada);

(iii) to review the formats, nomenclature and quality procedure for digital sea-ice data - 2001, A.Bushuev (Russia) and H.Valeur (Danmark);

(iv) to review and update sea-ice nomenclature and SIGRID data format -1997, V.Smolianitski and J.E.Lundqvist.

(v) to review and update the following publications, with appropriate target dates:

(v.1) Analysis and forecast of sea ice, I.Frolov - 1997;

(v.2) Sea-ice information services in the world (WMO - N574), J.E.Lundqvist, 1997

(vi) to prepare an overview of the GDSIDB activity for the ACSYS workshop on "Sea Ice Charts of the Arctic" to be held 5-7 August in Seattle, USA.

2. During the intersessional period 1997-1998 progress in the following activities according to numeration used above is to be noted:

2.1 Coordination of marine climatological requirements and provision of technical advice on exchange and archival of sea ice data

During the intersessional period contacts between the experts from NIC, NSIDC, JMA and AARI promoted the following activities within the GDSIDB project:

a) SGSI continued to provide support and supervision of the GDSIDB during the intersessional period.

b) Newly digitized data for 1950-1992 with 10-days interval or greater, in WMO format for international sea ice data exchange SIGRID, were prepared at the Arctic and Antarctic Research Institute (AARI) and will be released to WDC-A for glaciology and WDC-B "Sea Ice" after final Quality Control (QC) in April 1999. Ice specialists at the USA National Ice Center (NIC) are close to releasing the second checked and corrected version of CD-ROM (in comparison with the one

released in 1996 as version 1.0) containing weekly Arctic and Antarctic data in SIGRID format for 1972-1994 and 1973-1994 respectively. Release to WDCs is planned for autumn 1998. Data for the Sea of Okhotsk on sea ice total concentration were prepared at the Japan Meteorological Agency (JMA) in the SIGRID-2 format for 1996/1997 winter period, submitted to WDCs, thus forming an addendum to the existing one for 1972-1996 with 5 days and monthly interval.

c) In order to facilitate the access of users to the GDSIDB information experts at USA National Snow and Ice Data Center (NSIDC) converted the Russian part of the SIGRID database into the 12.5 by 12.5 km EASE-grid projection.

d) During the intersessional period fruitful cooperation was initiated with the Danish Meteorological Institute (DMI) on possibilities of insertion of sea ice data for Greenland waters into the GDSIDB. Proposals in that direction were elaborated by the DMI experts for the current meeting and are included as an attachment. Similar proposals were elaborated by experts from Canadian Ice Service (CIS) and Icelandic Ice Service and will be discussed during the current meeting. Cooperation with experts from Argentine (Argentine Navy Hydrographical Service) can be noted, including the mailing to AARI of the latest sea ice Atlas compiled by the service.

An extended report on the GDSIDB activity is to be delivered by experts during the special GDSIDB meeting and is included as an attachment.

2.2 Promotion of cooperation in improving the methodology for the acquisition, exchange, processing, quality control, storage and dissemination of sea-ice.

(a) This activity supports the intentions of the world research community to extend operational, interactive, intellectual exchange of the reference, factual and derivative information made possible by the WWW/Internet. Under that activity special pages describing historical sea ice data were published on the NSIDC and AARI Internet servers.

(b) As previously, an activity on the comparative analysis of sea ice data from different sources and originating from different agencies was continued; and as a result a technique will be developed for comprehensive, merged or blended data sets. This in turn will facilitate and extend utilization of the GDSIDB material;

2.3 Review the formats, nomenclature and quality procedure for digital sea-ice data

(a) At the previous SGSI informal meeting the experts from AARI presented the draft of a new format CONTOUR-2 aimed to standardize the international exchange of operational data. Experts of the SGSI, mainly from DMI provided some valuable remarks on the format. It was planned to finalize the given format by the next session, but AARI experts did not make or incorporate amendments/corrections. The finalization of the given format is rather significant in the respect that it can serve as a set of rules for construction of electronic sea ice charts and also to prevent additional work for of implementation of commercial formats. Experts from AARI will make the final steps for format preparation in the near future.

2.4 Review and update the sea-ice nomenclature and the SIGRID data format.

(a) Experts from the Swedish Meteorological and Hydrological Institute (SMHI) and AARI developed a preliminary version of a conversion technique for the Baltic Sea Ice Data Bank (BASIS) format into SIGRID and prepared several samples of sea ice charts for the Baltic Sea for spring 1978.

(b) Appropriate amendments and extensions to the SIGRID and the SIGRID-2 were discussed and elaborated by the above experts in order to preserve the accuracy of the original data in the BASIS while converting it to the SIGRID.

2.5 Review and update the following publications, with appropriate target dates.

2.5.1 Analysis and forecast of sea ice

(a) This publication is being prepared according to recommendations of the CMM-X and CMM-XI. The Handbook represents the means to transfer knowledge to countries without practical ice experience. During the intersessional period much work was done to improve both graphical and textual material in the English version. Extensive work by Dr W.Weeks (USA) and Dr V.Gavrilo (Russia) should be noted. Due to underestimation of the work, this publication is still in preparation. It is expected that the editorial board will finalize it by the end of this year and pass it to the WMO Secretariat for publication.

2.5.2 Sea-ice information Services in the World (WMO - N574)
This item was discussed during 19th Baltic Sea Ice Meeting (BSIM) in Lelystad, the Netherlands, May 1998 J.-E.Lundqvist and M.Krasnoperov were asked to prepare the updated version of that publication.

2.6 Preparation of an overview of the GDSIDB activity for the ACSYS workshop on "Sea Ice Charts of the Arctic" held 5-7 August in Seattle, USA.
A report on the topic was delivered by AARI expert V.Smolyanitsky 6 August 1998 and is to be published in the transactions of the Conference. Extended information on the results of this Conference will be prepared and delivered by Dr R.Barry (USA).

2.7 Other questions and cooperative activities.

2.7.1 During the intersessional period information on the SGSI and GDSIDB activity was submitted by its experts at BSIM-19.

2.7.2 Dr R.Barry provided coordination with ACSYS SSG.

2.7.3 Questions related to ECDIS activity of the IOC and IHO are reflected in the letter by the expert from DMI, H.Valeur (see attached).

Annex B

Report from the Swedish Meteorological and Hydrographic Institute (SMHI)

Jan-Eric Lundqvist

The ice service is organized by the "Marine Forecasting Service" at the Swedish Meteorological and Hydrological Institute (SMHI). Electronically the service can be addressed by e-mail: ice@smhi.se (winter season) or weatherrouting@smhi.se (all the year).

SMHI has a very close cooperation with the Swedish Ice Breaking Service at the Swedish Maritime Administration (SMA) and also with the Finnish Institute of Maritime Administration (FMA).

All the above services use the same computerized communication system (IRIS) where they exchange ice observations, ice and weather forecasts between the ice services and ice breakers.

SMHI daily collects ice information from all other countries in the Baltic region, both by code (Baltic Sea Ice Code, BSIC), clear text in English language and regional ice charts from Russia, Estonia, Poland and Germany.

The Swedish ice chart covers the whole Baltic region including the Danish Belts, the Sound, Kattegat, Skagerrak and the German Bight in the North Sea. It is transmitted, at present on fax, to Germany and retransmitted on radio facsimile via Pinneberg (short range) and Offenbach (long range). It can be sent by fax on request to vessels, free of charge.

The ice chart is produced in digital form and can be sent by e-mail in tiff-format.

Annex C

Report from the Canadian Ice Service

Wayne Lumsden

The Canadian Ice Service (CIS) Ice Chart Digitization project was initiated in 1996 to digitize CIS Weekly Regional Ice Charts for East Coast, Hudson Bay, Eastern Arctic and Western Arctic (the Great Lakes charts are being digitized by Great Lakes Environmental Research Laboratory). The weekly Regional ice charts collection started in 1968 and replaced the older Historical ice charts collection which started in 1959. The charts are produced once a week except for Eastern Coast charts that were produced 3 times per week before 1992). Prior to 1982, CIS used the ratio code to describe the ice information on its charts. In 1982, the WMO egg code was introduced and adopted by CIS.

In the 1980s, a first effort was made to provide this data in digital format; Historical and Regional ice charts between 1959 and 1983 were manually digitized using a fixed grid point spacing and the resulting grid point database was used by CIS to produce the Canadian Ice Atlases. This data was also made available internationally (1998) through the World Data Center in SIGRID format.

For the current digitization project, a vector digitization method is used instead of the manual grid point extraction approach; a grid point extraction routine will then be applied to the vector charts to produce a new grid point database; this method allows more flexibility in the selection of the grid and does not require re-digitizing the charts if a new grid is required.

CIS contracted Tecsult Foresterie of Quebec to digitize the collection of weekly Regional charts in the ArcInfo format containing both polygon lines and sea ice attributes. This format was selected because it is totally compatible with the operational ISIS system currently used at CIS to produce the weekly Regional ice charts. This format (to ensure ISIS compatibility) however is not a **standard ArcInfo** (i.e. polygons are not formed and attributes appear as a single string); future work will convert these files to standard ArcInfo coverages containing formed polygons and separate parameter for each ice attribute . The files are now available as tarred export files on exabyte tapes but the new files will be made available on CDROM for distribution to our clients. The table below shows the current status of the digitization project.

Region	Years of data	Years digitized	Format
Eastern Coast	1968 to present	1968 to 1996	CIS Arcinfo
Hudson Bay	1971 to present	1971 to 1996	CIS Arcinfo
Eastern Arctic	1968 to present	1978 to 1996	CIS Arcinfo
Western Arctic	1968 to present	1984 to 1997	CIS Arcinfo

In the process of capturing the ice attributes, egg code attributes were captured as is for charts from 1982 and after; charts before 1982 were using a different code referred to as the "ratio code" and for these charts, the ratio code were captured but a filter was then applied to it to convert to egg code in order to provide an homogeneous database.

Several validation rules were used during the digitization process to help identify and correct errors present in the historical charts. The resulting digital charts are therefore of improved quality. Further quality control could still be applied using the information gathered during the digitization process but this is a major project.

During 1998 CIS plans to:

- digitize remaining charts (approximately 500)
- convert to standard ArcInfo format and produce CDROM
- produce a new grid point database
- provide data to GDSIDB (format TBD; possibly SIGRID).
- generate a soft atlas for the East Coast (climate charts will be available on the Web)

More work is required to create a GIS database from all the ArcInfo Coverages. This will facilitate database queries for use in responding to client requests for ice climate information at specific locations (spot analysis). CIS also plans to have the ice analysis and forecast system, ISIS, send it's coverages directly to the archive system, thus eliminating the requirement for the vector digitization of paper charts.

Annex D

Report from the USA National Ice Center (NIC)

David Benner

The mission of the National Ice Center is to provide global sea ice services to U.S. Government agencies, commercial organizations and scientific research interests.

NIC is composed of manpower and fiscal resources contributed by the U.S. Navy, the National Oceanic Atmospheric Administration (NOAA) and the U.S. Coast Guard.

Composite regional-scale ice analyses are produced through the integration of remotely sensed and in-situ data. Remotely sensed data include: visual/ infrared imagery from the NOAA TIROS Advanced Very High Resolution Radiometer (AVHRR); DMSP Operational Linescan System (OLS); DMSP Special Sensor Microwave Imager (SSM/I); RADARSAT Synthetic Aperture Radar (SAR) and visual aerial reconnaissance. Data are interpreted and integrated using Seaspace TERASCAN / Naval Satellite Image Processing System (NSIPS) software on SUN Microsystem ULTRA-2 Workstations.

Current ice products include: weekly regional-scale Arctic/ Antarctic ice analyses in Graphics Interface Format (.gif) and Geographic Information System (GIS)-compatible files.

Tailored tactical-scale products include: ASCII messages with latitude/longitude pairs, annotated imagery (with ice analysis graphics) in JPEG format and Optimum Ship Track Registry (OTSR) recommendations.

NIC ice products are distributed via the Internet World Wide Web (http://www.natice.noaa.gov), an autopolling facsimile system and directly to vessels at sea using Inmarsat services.

Status of NIC historical sea ice data sets include: a) 1972-1994 weekly Arctic and Antarctic ice analyses (north of 45°N) presently being quality controlled and projected to be available to GDSIDB in December 1998; b) 1995-1996 weekly Arctic and Antarctic ice analyses (north of 30°N) presently being digitized and projected to be available to GDSIDB in December 1998; c) 1997-present weekly Arctic and Antarctic ice analyses (north of 30°N) available on the NIC WWW site and d) 1985-present weekly Yellow Sea (Bohai and Korea Bay) ice analyses presently being digitized and projected to be available to GDSIDB in December, 1998. Available digital formats will be ARC/INFO GIS coverages in geographic projection and SIGRID-1 using GRID-point coding procedures.

Metadata narratives highlighting datasources used for ice analyses are available for all NIC ice analyses from 1997-present.

Plans for future NIC legacy products include: ice coverage/extent statistics and an Environmental Working Group (EWG) ice climatology based on blended unclassified and national security data.

Annex E

Report from the METEO-FRANCE (French Meteorological Service)

David Salas y Melia

Sea ice related activities/data needs at METEO-FRANCE are marked by asterisk. (*).

1. Marine forecasting

* We need to answer particular needs expressed by some of our customers (navigation in polar regions), even if these requests are relatively seldom. Such users generally ask for real-time data. For the time being, some sea ice data is available from ECMWF, under GRIB format. We welcome any other kind of easily accessible data (for example from Internet).

* Wave models

- they are run operationally daily in the tropical part of the Atlantic
- in development: extend these runs to Atlantic, Pacific and Indian oceans, with further extension to a global domain. Then it will be desirable to assimilate the position of the sea ice edge, if possible once a week.

* Numerical weather prediction model

For the time being, a sea ice climatology is used to distinguish ocean and sea ice surface boundary conditions in polar regions. However, no real-time sea ice data assimilation (even e.g. monthly) is planned in the near future.

2. Climate studies

METEO-FRANCE has developed and uses a dynamic-thermodynamic, multi ice types sea ice model that was validated (in forced mode) by NSIDC data (retrieved from Internet). Coupling of this model with OPA ocean general circulation model is in progress, and will be run for different periods. Sea ice model output should be compared to corresponding analyzed data.

3. Our contacts with IFREMER

IFREMER processes sea ice satellite data, which is generally available about two weeks after measurements were performed. Processed data are not available on Internet, but the following WEB page describes these activities: http://www.ifremer.fr/cersat/ACTIVITE/CEO/IMSI/E_IFIMSI.HTM

Annex F

Report from the National Space Development Agency of Japan (NASDA - Frontier - IARC)

Jinro Ukita

I would like to express my deep appreciation to the WMO and NSIDC who not only have put some effort to organize this meeting, but also are rapidly achieving the objectives of the GDSIDB. Although I cannot officially speak on behalf of the Japanese Meteorological Agency, a Japanese member to the CMM SSG on sea ice , my formal affiliation with the National Development Agency of Japan (NASDA) should allow me to express a couple of thoughts that developed during the meeting.

First, realizing increasing reliance on space-borne remote sensing methods for acquiring sea ice information, it seems desirable, to extend the membership of this meeting to include both national and international space agencies (if necessary as observers). In fact, some of them have already been in contact with, and have close association with, national ice centers in various stages of processing sea ice information. By formally extending invitations to those space agencies, we may achieve the following goals; (1) better security in terms of space platforms as well as sensors, (2) optimizing financial resources particularly in terms of cost sharing for data processing, and (3) improving the quality of data from regional sea ice centers who do not have the same degree of access to remote sensing data as others do.

Another point that I would like to raise is that an effort to plan for finding a proxy record for sea ice, say its extent, for the century time scale would be extremely valuable. Given the fact that climate change is our main driving force for international collaboration in developing a sea ice data base, both the climate research and modelling communities will benefit from such an effort. Although this may not be within this committee's domain of interest, addressing this issue within the WMO framework and possibly initiating dialogues with other groups, i.e. WCRP CLIVAR seems appropriate.

Annex G

Sea-ice monitoring in Icelandic Waters.

Ingibjorg Jonsdottir

The sea-ice group at the Icelandic Meteorological Office (IMO) in Reykjavik provides information on sea ice in Icelandic Waters. On a regular basis the group consists of two or three researchers but a few graduate student have also worked there from time to time.

The sea ice that in some years reaches Iceland is mostly winter ice formed in the Greenland Sea and multiyear ice from the Arctic Ocean. Icebergs that have calved from glaciers in Greenland are sometimes found within the ice pack. The maximum ice extent in the Denmark Strait and Iceland Sea is usually during late winter or spring. Hardly any ice is formed locally, due to the relatively warm Irminger Current that comes up towards the South Coast and flows clockwise around the island. The ice will, in most cases, reach the North West peninsula of Vestfirdir first and then flow eastward along the North Coast, following the surface currents of the ocean. In severe ice years the ice has reached as far as to the South Coast, but that does not happen very often. Sea ice can be expected to cause some difficulties in navigation off Vestfirdir roughly every second year, the North Coast once every five years and the East Coast once a decade. Severe ice years have been much fewer during the 20th century than the 19th century, but there are great variations in the amount and duration of sea ice off the Icelandic Coast on all time scales. The causes are believed to be due to a) fluxes in the amount of ice and arctic water in the East Greenland Current, b) atmospheric circulation in the area, and c) oceanographic conditions in Icelandic Waters.

The main customers that require real time sea-ice information are the fishing fleet in the Iceland Sea and Denmark Strait, research vessels, tourist ships and various freighters navigating in the area.

Statistics on sea-ice extent in the past are sometimes requested for specific planning projects, for example when deciding where to place an aluminum factory or an oil-refinery. Historical sea-ice information and sea-ice indices are important as a proxy data for climate research.

The present sources of sea-ice information are:

1. Ice reports from ships in Icelandic Waters, received irregularly by telex, fax, telephone or e-mail.
2. Coastal weather stations send ice reports daily when ice is present near the coast.
3. Sea-ice charts and reports from the Icelandic Coast Guard, based on visual and radar observations during ice reconnaissance flights. The frequency of ice reconnaissance flights varies from about 1-10 per month.
4. NOAA visible and infrared images received daily at IMO.
5. Sea-ice charts, received irregularly from the Danish Meteorological Institute, mainly based on NOAA AVHRR images.
6. Weekly sea-ice charts from other ice centers, such as the Norwegian Meteorological Institute and the National Ice Center in the USA
7. Various sea-ice charts or satellite images available on the internet, in particular web pages compiled by the Danish Center for Remote Sensing and the Danish Meteorological Institute. These include SSM/I passive microwave images and NOAA AVHRR visible and infrared images.
8. In the spring of 1998, several ERS-2 SAR images were received from the Tromso Satellite Station in Norway, in order to evaluate them for sea-ice monitoring.

The means of distributing real time sea-ice information are as follows:

1. Sea-ice reports from ships and the Coast Guard are broadcast with the weather forecast in the Icelandic National Radio (in Icelandic).
2. Information on the position of the ice edge is sent to ships by Navtex. Until now these reports have mainly included ice reports from ships and the Coast Guard but the intention is to send some information out on the Navtex more regularly (biweekly), using information from the Danish Meteorological Office and the National Ice Center.
3. Ice charts are sent to customers and other ice centers via fax, and ice information and informal ice forecasts are given via telephone, on request.
4. Icelandic ice reports and charts are now available on a "preliminary" web page (access via http://www.vedur.is).

All the Icelandic sea-ice data from 1988 onwards are stored in an Ingres database. ArcView will be used to view the information. Annual ice reports are published at IMO: "Sea Ice off the Icelandic Coasts" and a monthly summary is included in the climatic bulletin "Vedrattan".

Future intentions include:
1. Using SAR active microwave images (for example from RadarSat) for sea-ice monitoring. This is in order to get more reliable high resolution data on a more regular basis.
2. Improving the web page.
3. Organizing a automated fax service/fax-on-request system.
4. Provide Icelandic sea-ice data in a SIGRID format to GDSIDB.
5. Increase cooperation with other ice centers.

Annex I

Report from the Baltic Sea Ice Meeting (BSIM)

Jan-Eric Lundqvist

1. 19TH BALTIC SEA ICE MEETING

1.1 The 19th Baltic Sea Ice Meeting was held 25-29 May 1998, organized by the RIZA (Institute for Inland Water Management and Waste Water Treatment) in Lelystad, the Netherlands. Twenty-two delegates from nine countries and the representative from the WMO attended the Meeting.

1.2 The most important topic of the meeting was to update the information about the different methods of obtaining, processing, transmitting and exchanging ice information in the Baltic countries.

1.3 Finland, Germany and Sweden are working with new techniques like ICEMAP which enables services to digitize ice maps. Finland and Sweden have also used RADARSAT in 1998, which gave very detailed ice charts. 1997 ERS-1 was used and comparison could be done.

1.4 The use of Internet and E-mail is quite new. A problem is that the computer systems used have to be compatible. Another problem is the use of the ice information for commercial purposes.

1.5 The costs for producing ice charts have risen due to new techniques. Discussion about costs show different policies in the countries. The meeting stressed that vessels at need should have the ice information, ice charts free of charge.

1.6 Russia uses the international ice symbols on the ice chart for the Baltic from the winter 1996/97 and has begun to exchange ice charts with the ice services of Estonia and Finland by fax.

1.7 At the last meeting it was agreed that every country surrounding the Baltic Sea should send their updated information to the WMO-secretary in order to update the publication nr.574 "Sea Ice Information Services in the World". Mr M. Krasnoperov, the delegate of the WMO, stated that various countries have failed to do so and urged these countries to update their available data and send them directly to the WMO.

2. BALTIC SEA ICE CODE.

The present Baltic Sea Ice Code has been in use since 1981. There is no need for further development.

3. INTERNATIONAL SEA ICE SYMBOLS.

In the Baltic countries the egg-symbol is hardly used. The hatched code is preferred in the Baltic region, especially by the users for winter navigation. For scientific and climatic work the egg-symbol is sometimes added. It was stated, that there was no need for any changes.

4. SEA ICE CLIMATOLOGY

For the Baltic region Finland and Sweden have an Ice Data Bank for the period 1961-1979 in BASIS-format (Baltic Sea Ice System). The data are available for all Baltic countries. Future plans are made to complete and update the ice data bank. It was also pointed out that the new data would be converted to SIGRID format.

It was also announced that Russia and Sweden have started a work to transfer data from the old ice data bank to WMO GDSIDB. Experiences about work on Baltic climate were presented and discussed.

5. NEW PRODUCTION

A proposal was discussed to find one centralized ice service for the whole Baltic in the form of a Baltic Sea Ice Information Center. At present there are 9 national ice services in the region. A wider range of earth observation data can be used in a more effective way, a more accurate ice product can be made and the distribution to users can be more effective. A proposal was to set up a working group trying to find a step-by-step solution in this direction.

6. REMOTE SENSING

A presentation of different satellite data was discussed. A special resolution was accepted and sent to ESA.

7. FINAL ITEM

One must point out that the BSIM is a very important forum for meeting new ice colleagues, for discussions and getting new information and ideas for improving and developing the ice services.
Next meeting will be held last week of September 2000.

Annex J

NSIDC report on usage statistics for the AARI GDSIDB data set in EASE grid format

Florence Fetterer

The AARI sea ice data set is available to users through ftp file transfer. Documentation for the data set is available on line in NSIDC's data catalogue, which is accessible through NSIDC's web site at http://www-nsidc.colorado.edu. The data set was released in January of 1997. From February 1997 through June 1998, 138 unique hosts visited the ftp site for the data. The number of unique hosts is roughly equivalent to the number of users of the data. A total of 710 Mbytes was downloaded. (A complete data set, including all years and documentation, is 46 Mbytes. Users can download just a part of the data set if desired).

NSIDC WDC for Glaciology summary of GDSIDB data holdings:

Area Covered	Time interval	Originator	Format	Notes
Arctic and Antarctic	1972-1994, every 7 days	US National Ice Center	SIGRID-1	Codeing errors for ice type, concentration OK, corrected version by 12/98
Arctic	1953-1990, every 10 days	Arctic and Antarctic Research Inst.	SIGRID-1,2;EASE	Distributed in EASE-Grid; discontinuous in space
Sea of Okhotsk	1971-1996	Japan Meteorological Agency	SIGRID-1,2	Not currently distributed, plan to convert to EASE
Arctic, N. Atlantic	1959-1983	Canadian Ice Service	AES Grid	
Gulf of Newfoundland, Hudson Bay, Arctic	1962, 1973,1982	Canadian Ice Service	SIGRID 1	

NSIDC summary of anticipated data sets to be contributed by GDSIDB members, on a schedule dictated by available resources

Area Covered	Time interval	Originator	Notes
Canadian archipelago	1970-1994	Canadian Ice Service	High resolution (< 10 km)
Local areas near Greenland	1960-1996	Danish Meteorological Inst.	Now in gridded format, AARI may translate to SIGRID
Arctic, N. Atlantic	1890-1994	Danish Meteorological Inst.	No plans for this at present

Baltic Sea	1961-1979	Baltic Sea Ice Meetings	Baltic Sea Ice Code, but will be delivered in SIGRID I. Samples for 1978 now at AARI
Baltic Sea	1960-1982	Federal Maritime and Hydrographic Service (Germany)	
Weddell and Bellingshausen Seas	1973-1990	Argentine Navy	Point observations. Argentina contacted WMO, intends to deliver.

Annex K

WMO sea ice guidance materials and publications

Mikhail Krasnoperov

Guidance material for mariners on marine meteorological services in sea-ice areas.

(i) Handbook on Sea Ice Navigation in the Southern Ocean

The abbreviated version of the Handbook on Sea Ice Navigation in the Southern Ocean has recently been published in the series Marine Meteorology and Related Oceanographic Activities. The CMM expressed its appreciation to the author, Prof A.Romanov (Russian Federation),as well as to all the experts involved in the review and editing process, for their substantial contributions to WMO. It considered that this publication is of considerable value to all countries, their agencies and services, concerned with marine operations in the Antarctic, and therefore he recommended that as wide as possible a distribution should be undertaken, including to IMO and IHO.

(ii) Handbook on the Analysis and Forecasting of Sea Ice.

Progress has been made by the Russian Federation and USA experts in the preparation of the Handbook, which has been published in the Russian version and the English version will be completed by the end of this year and passed to the WMO Secretariat for publication.

(iii) Forewords, nomenclature and quality procedure for digital sea-ice data will be prepared by 2001 (A.Bushuev, Russia and H.Valeur, Denmark).

(iv) Sea Ice Information Services in the World (WMO No 574)
Contributions from CMM members will be sent to J.-Eric Lundqvist for compilation in order to be passed to the WMO Secretariat for publication.

(v) Internet World Wide Web.
Work on the operational exchange of sea-ice data through the Internet World Wide Web, including the establishment of home pages by both the AARI and the NSIDC devoted to historical sea-ice data, has been completed. The home page addresses of the GDSIDB centers are:

- http://www.aari.nw.ru/gdsidb/gdsidb_2.html (AARI, St.Petersburg, Russia)
- http://www-nsidc.colorado.edu (NSIDC, Boulder, Colorado, USA)