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).

Report

of the 6th Session of the Steering Group for the GDSIDB and the informal session of the SGSI.

Danish Meteorological Institute

Copenhagen, 22 - 26 September 1997.

1. Organization of the meeting.

1.1 Opening of the meeting.

1.1.1 The Director of the Danish Meteorological Institute Dr P.Prahm welcomed the participants of the sea-ice meetings. In noting the importance of the sea ice cover as one of the crucial parameter for climatic modeling, he emphasized the effort that has been made through the last 15 years to create a reliable global ice data bank. P.Prahm wished the participants very successful meetings, and a pleasant stay in Copenhagen.

1.1.2 The full text of the DMI Director's address is given in Appendix A.

1.1.3 Dr M.Krasnoperov, representative of WMO Secretariat noted that the meetings are being organized at a time when there is increased interest by Members States in the investigation of sea-ice conditions in the ocean and the data describing them are being widely used. The course of action to be taken to create the necessary conditions for the further development of sea-ice activities, required for operational and scientific purposes, must be determined. M.Krasnoperov addressed the delegates, wishing them fruitful work and cooperation during the meeting.

1.1.4 The list of participants is given in Appendix B.

1.1.5 Prof. R. Barry (WDC-A for Glaciology, USA) was nominated as the chairman of the 6th session of the Steering Group for the GDSIDB.

1.2 Adoption of the agenda.

1.2.1 The meeting was invited to comment on the agenda and the proposed work plan.

1.2.1. The agenda was adopted as reproduced in Appendix C.

1.3 Working arrangements.

1.3.1 It was agreed that the working hours should be from 09h 30min to 12h 00 and from 13h 00 to 18h 00.

2. Reports on the Global Digital Sea Ice Data Bank (GDSIDB) activities.

2.1 Report by the WMO representative and report on the implementation of the work plan for cooperation.

2.1.1 The session noted the report of Mr. Krasnoperov on some issues concerning development of the GDSIDB, emerging from XIIth session of the WMO Commission for Marine Meteorology (CMM), which took place in March, 1997 in Havana (Cuba). He informed the session that the Commission expressed its appreciation of the Steering Group for the GDSIDB for the considerable and very valuable work accomplished during the intersessional period. Mr. Krasnoperov informed the participants that the CMM in particular noted with satisfaction that the CDSIDB was now operational in the National Snow and Ice Data Center (NSIDC), Boulder, USA, and the Arctic and Antarctic Research Institute (AARI), St. Petersburg, the Russian Federation, and offered its special thanks to these two centers and to all members contributing data to the data bank for their efforts in implementing, maintaining and expanding the GDSIDB. It recognized the direct value of the GDSIDB to the WCP and the WCRP, as well as to services and other sea-ice activities of members concerned, including seasonal forecasting. It therefore strongly encouraged all members having historical and/or current sea-ice data in chart and other forms to arrange for them to be digitized in either the complete SIGRID 1 or reduced SIGRID 2 format, and submitted to either GDSIDB data center, in order that the bank can become as complete as possible, containing data from both north and south polar regions. In this connection, the Commission noted with appreciation the offer by Iceland to contribute data to the GDSIDB. The Commission recommended that WMO should

continue to support the valuable work of the Steering Group for the GDSIDB during the coming intersessional period and agreed the proposes project objectives for this period.

2.1.2 Dr R Barry, Director of the WDC-A for Glaciology, informed the session on the status of the implementation the work plan for cooperation between the members of the Steering Group for the GDSIDB. In his report he summarized the work accomplished by the National Sea Ice Data Center (NSIDC) in the acquisition, documentation, and management of Arctic sea ice data from the Arctic and Antarctic Research Institute (AARI), St. Petersburg, as well as research related to the use of the data set. Dr. R.Barry recalled that this activity is based on an agreement between the AARI and WDC-A for Glaciology signed by Dr. R. Barry and Dr. I. Frolov in St. Petersburg in July 1992 that expanded previous collaboration under the auspices of the WMO (1990, 1991) for the development of the GDSIDB at the two centers. Dr R.Barry informed the session that the present task under which this activity is fonded is completed. He also informed the session, that the NSIDC received Arctic data from the AARI for 1953 - 1966 in SIGRID format and a subset of these data in SIGRID-2 format. The NSIDC also received updates from the JMA for the Sea of Okhotsk for 1994-1996. He noted that in August 1998 there will be a Workshop in Seattle on sea ice charts of the Arctic called by the Arctic Climate System Study (ACSYS) of the World Climate Research Programme (WCRP). He proposed he work of the GDSIDB be presented at this meeting.

2.1.3 The NIC provided Arctic and Antarctic data for 1972/3 - 1990 (second release) to the NSIDC on DC - ROM. Despite corrections made to the first release, to remove errors previously reported by NSIDC and users, the digitizing still contains coding errors. For example, ice in the central Arctic in winter is depicted as first year ice. The plan to develop a merged AARI-NIC product as recommended by the ACSYS SSG (1996) has been postponed until these problems are rectified.

2.1.4 The full content of Dr R.Barry report is given in Appendix D.

2.1.5 Mr. V.Smolianitski (AARI) summarized the results of the implementation of the work plan for cooperation within the WMO project GDSIDB during 1996-1997 (see Appendix E). In his report Mr. V Smolianitski noted that the mentioned work was done with close cooperation between the AARI, National Ice Center (NIC), NSIDC, and from 1995 with the Japan Meteorological Agency (JMA). Mr Smolianitski noted that during 1992 - 1997 the following data were archived in the GDSIDB:

(i) Arctic data for 1953-1990 with 10-day interval or greater (AARI) and for 1972 - 1994 with consistent 7-day interval (NIC) were prepared in the international format for sea ice data exchange SIGRID and submitted to World Data Centers.

(ii) Antarctic data for 1973-1994 with consistent 7-day interval (NIC) were prepared in SIGRID format and submitted to the World Data Centers.

(iii) Data for the Okhotsk Sea on the total ice concentration were prepared at JMA in SIGRID format for 1972-1996 with 5 day and monthly intervals, and submitted to the World Data Centers.

(iv) World Data Center -B for Sea Ice was organized at the AARI.

(v) From 1995 the AARI started development of the national digital data base in the SIGRID format for the Antarctic region.

(vi) Preliminary comparative analysis of the AARI- and NIC originated data for 1972-1990 (Arctic) and for 1975-1990 (Antarctic) was carried out using such criteria as:

- **coincidence/difference for actually recorded sea ice condition**
- **coincidence/difference for climatically averaged ice conditions**
- **possibility of existence of nomenclature differences in two centers for total concentration and stages of ice development.**

These results will be made available on the WWW (http://www.aari.nw.ru).

2.1.6 Thus from 1996, the GDSIDB represented an informational structure simultaneously operated by the AARI and the NSIDC under the auspices of the WMO. It is close to meeting WCP requirements for the problems of estimating climate from 1950s and development of the «ground-truth data» for mathematical modeling.

2.1.7 The 5th session of the GDSIDB experts was held in September, 1995 at the AARI, St. Petersburg, Russia. The session provided the opportunity to involve representatives from Canada, Japan and Denmark in the activity of the project. The following potential members of the project, which have significant data archives and are not involved in its activity, are: Great Britain, Norway, Australia, Chile, Argentina, China and South Africa.

2.1.8 Results of the work plan for implementation were considered by the participants to be useful. A review of these results is attached as Appendix E.

2.2 Report by the representative from Japan.

2.2.1 Mr. Y. Kano reported the progress in preparing SIGRID format data from the JMA's charts in the Sea of Okhotsk. The JMA has compiled SIGRID data from 1971 to 1996 and submitted them to centers WDC- A and B. In addition he emphasized the usefulness of the SIGRID data by showing how the SIGRID data for the Sea of Okhotsk have been applied to global warming issues.

2.2.1.1 The sea ice extent in the Sea of Okhotsk shows a recent decreasing trend, consistent with the results of the Coupled Ocean General Circulation Model developed by the Meteorological Research Institute of the JMA. He also indicated the effectiveness of the SIGRID data for long-range statistical sea ice forecasting.

2.3 Reports by representatives from Canada and Denmark.

2.3.1 The meeting was informed by the representative from Canada Mr. S. Lapczak, that Canada had been unable to contribute the sea ice data as had been promised at the last session. A variety of reasons contributed to this.

2.3.2 The Canadian Ice Center has been directly digitizing its operational data and has been processing historical charts. The Canadian expert emphasized that:

(i) There are a number of issues which need to be considered:
- **what scale should be used?**
- **if the size of the grid is equal to the data currently in the database, will the Canadian contribution be significant?**
- **are there areas in Canadian waters where there is a need for higher resolution data?**

(ii) What is the future of SIGRID -2?
- **clients seem to find it difficult to use**
- **other formats are being proposed**
- **conversion of data from format to format causes a loss of information. Is SIGRID the best format to use today?**

(iii) Resource availability depending on the work required, progress in converting Canadian data to SIGRID format could be slow.

2.3.3. The Appendix F summarizes the status of Canadian sea ice data.

2.3.4. The session considered the report presented by Dr H.Valeur from the Danish Meteorological Institute (DMI). He pointed out the large stock of ice charts since 1880 (1820) available in the DMI, as a result of sea-ice observations from stations, ships, aircrafts and satellites. He informed the session that some of

those sea-ice data were gridded but only from selected areas. The reason is shortage of financial support. It was noted that the DMI plans to deal with automatic database development.

2.3.5. The presentation from the DMI is attached as Appendix G to the report.

2.4. Report by the Chairman of the Baltic Sea Ice Meetings (BSIMs)

2.4.1 The Chairman of the BSIM Mr. E. Lundqvist informed the meeting that the existing climatogical ice data bank for the Baltic produced by Sweden and Finland contains digital data from the period 1963 - 1979, but not in SIGRID code. This data bank will be completed as a first project between Finland and Sweden for the full 30 year period 1961 - 1990 and subsequently. This work will be simplified as the two countries now have the same equipment for producing ice charts in a digital form. The charts will be digitized in the BASIS format.

2.4.2 The Steering Group was asked to help in converting sea-ice data from BASIS format to the SIGRID format to be included in the GDSIDB. AARI agreed to help in this activity.

3. GDSIDB technical presentations.

3. Development of the GDSIDB archive

3.1.1 A review of the development of the GDSDB active was presented by V. Smolianitski. He mentioned the recent contributions of sea-ice data in the format SIGRID for 1953 - 1990 from the AARI, for 1972 - 1994 from the NIC/NSIDC and for 1995 - 1996 from JMA. Experts from the AARI and NIC continued their work on quality control of sea-ice data sets during 1996-1997. Full information on the AARI activities, including digitization of the Antarctic data for 1971 - 1990 is given in Appendix H.

3.1.2 Dr. G. Barry noted, that in response to user suggestions, NSIDC evaluated procedures to reprocess the SIGRID data into the EASE-grid form. A nearest neighbor procedure was adopted to generate a 12.5 km equal area grid product. Additionally, the ten - layer AARI files were compressed to five layers - total concentration, multiyear ice concentration, first-year concentration, thin ice and fast ice. A comparison of monthly averaged AARI data and satellite passive microwave data for April-October shows that the total ice concentrations derived from the satellite data are 10 - 30 % higher than the AARI records. The passive microwave data do not resolve leads and tend to accentuate the ice marginal zone gradient.

3.1.3 In his technical presentation Mr. L.Petersen demonstrated the results of research on passive microwave remote sensing of sea ice.

3.2 Processing of sea-ice data.

3.2.1 V.Smolianitski and Y.Scherbakov informed the session on the processing of historical data for the GDSIDB at the AARI (Appendix H and I). Stages of digitization of the initial charts via the national vector to stereographic GRID, calculation of statistical parameters, using data in the GRID format, the production of graphic images in the GIF and the JPEG format, with further publication on the AARI web-site, are described in their reports.

3.3 New electronic techniques and facilities for exchange and storage of sea-ice data.

3.3.1 V.Smolianitski described the results of the AARI activity aimed at the improvement of the quality of data stored at the GDSIDB. The current AARI data set contains no significant syntax mistakes but it has some problems with the land mask used for creation of the data set (false codes in the vicinity of the coastline) and inconsistent temporal and spatial sampling. Proposals to overcome this problem were presented. Information released at the NIC and disseminated by the NSIDC/WDC-A for Glaciology has no gaps in time and space, so it has excellent global coverage. However the NIC data in the SIGRID format have syntax mistakes. This can be corrected by expert control using a SIGRID browser. The QC of the

GDSIDB also included comparative analysis of data of different origins for both Polar regions (Appendix H).

3.3.2 V.Smolianitski informed the session on the estimation of sea ice climate parameters based on the GDSIDB data. He noted that a set of sea ice statistics important for WCP and WCRP can be derived from the GDSIDB data. Mean values are available for each ice parameter (total concentration, partial concentrations, derived parameters). All calculations are based on computation of the histogram values, which provide complete statistical parameters after a single-pass of the data array. The statistics are described in Appendix H.

3.4 Cooperation with users of sea-ice data.

3.4.1. Information on the GDSID data provided to users was presented by R.Barry. He noted that the AARI 10-day EASE-grid sea ice observations for the Arctic Ocean were made available in February 1997 via the on line NSIDC data catalogue (http://www-nsidc.colorado.edu) and also announced in the winter 1997 issue of «NSIDC Notes». A demonstration of the NSIDC web-page was presented. Since February 1997, 73 unique hosts have downloaded 324 files; 70% of the hosts were US educational sites; 18% US commercial; and 7% US governmental agencies. The remainder included 10 other countries. The usage greatly exceeds that of the former SIGRID release.

3.4.2 Yu.Shcherbakov briefly described the situation concerning the support from the AARI provided to users of the hydrometeorological information. The general scheme of the Russian Automated Ice Information System for the Arctic region was presented. The main goals of the existing systems were pointed out.

3.5. Cooperation with other climatic programs.

3.5.1 A report on the possibilities for processing and access to the historical ice data for the Russian Arctic was presented by V.Smolianitski (Appendix J). He noted that Russian material exists in mapped form from the early 20th century; similar earlier mapped material is archived by Denmark and Norway. As a first step in processing the historical material V.Smolianitski proposed that a web-page on historical data be developed. Possible contributions will be requested from the members of the SGSI and from other agencies and investigators. Web-page will be maintained at the two centers.

3.5.2 Dr R. G. Barry briefly reviewed the interest of the ACSYS research community in arctic data sets. Sea ice models are now being developed for regional application with 5-10 km resolution and it seems appropriate that the GDSIDB requirement for 0.25 degree resolution data be reviewed, especially for areas of complex local ice conditions such as the Canadian Arctic Archipelago, Baltic Sea and Southern Greenland.

3.5.3 Dr R.Barry reported also on a proposal submitted to the ACSYS Scientific Steering Group and GDSIDB by Dr R.Colony and Dr.T.Vijne (Oslo) for development of an historical Ice archive. The project proposes to assemble for digitization and archival:

(i) nineteenth and early twentieth century ice charts and
(ii) ships logs and other documentary reports for both polar regions.

In the discussion it was noted that the GDSIDB is bipolar and will over the next 3-5 years be extended back into the 1930s. The problems of quality control and fragmentary spatial - temporal coverage of information were noted. DMI analyses of extreme variability on short time scales in the vicinity of Cape Farewell illustrate the sampling problem and issue of data resolution.

3.5.4 The Sub Group recommends to ACSYS:

(i) the project, if developed, would be appropriately coordinated under the GDSIDB umbrella.
(ii) the first steps should involve the preparation of an inventory of available map sources, log books and similar records.

These inventories should be made available via the web-sites of WDC-A for Glaciology /NSIDC and WDC-B for Sea Ice so that the community can add to them. On this basis, prioritization of the digitization can be decided. The digital chart data would be appropriate for inclusion in the GDSIDB.

4. WMO CMM Sub Group on Sea Ice (SGSI) activities.

4.1 Remarks by the WMO representative.

4.1.1 The WMO representative M. Krasnoperov reported on the main items of the CMM-XII related to SGSI activities. He mentioned that at present WMO's activities concerning the sea-ice through the SGSI are directed to the development of methods for observations of sea-ice and the management of sea-ice data. The SGSI was reestablished by CMM-XII. Sea-ice experts from Argentina, Canada, Denmark, Japan, the Russian Federation, Sweden and USA are the members of the Sub Group. Dr I.Frolov was selected as chairman of the SGSI, which is a part of the Working Group on Marine Meteorological Services.

4.1.2. For the period since CMM-XI (April 1993), progress has been made towards the following subjects:

(i) 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;

(ii) the Russian version of the Handbook on the Analysis and Forecasting of Sea Ice has been published in Russia, and an English version will soon be completed and published by WMO in an appropriate series.

(iii) the work on standardizing and generalizing procedures for the operational exchange of sea-ice data through the Internet WWW, including the establishment of home pages by both the AARI and the NSIDC devoted to sea-ice data, has been completed.

4.1.3 The meeting noted with interest the report of Dr. I. Frolov, chairman of the Sub Group on Sea Ice and expressed its appreciation to the Sub Group for the considerable work accomplished during the inter-sessional period. The full report of the SGSI chairman is attached as Appendix K.

4.2. Development of new formats for operational and non-operational sea-ice data exchange.

4.2.1 The Steering Group for the GDSIDB prepared in 1993 and submitted to the WMO Secretariat an abridged version of the «Format To Provide Sea Ice Data For The World Climate Program» (SIGRID-2). In 1994 the SIGRID-2 format was adopted by the WMO and from 1995 this format has been used by the JMA and the AARI. From 1995 these agencies started to provide data in the SIGRID-2 format to WDC-A and AARI. By the end of 1997 activity on the next format CONTOUR-2 will be finalized by the AARI experts. This format is intended to incorporate the latest solutions on operational sea ice data mapping and exchange. The present CONTOUR-2 format is published on the AARI WWW page (http:/www.aari.nw.ru/formats/contour2.htm).

4.2.2 The DMI made comments on the proposed CONTOUR-2 format:

(i) the overall concept of having a single format which contains all the necessary information to generate a digital ice chart (including ice egg information) is good;

(ii) a standard «digital ice chart format» like CONTOUR-2 would probably be of benefit both to end users and the ice information providers themselves, because ice charts may be distributed and handled in a more uniform and efficient way;

(iii) common software modules for processing, handling and display will, in principle, only have to be developed and maintained by one institution;

(iv) any grid information may be extracted from the CONTOUR-2 format.

4.2.3 The DMI suggested that various additions and changes to the format should be incorporated to make CONTOUR-2 more flexible:

(i) the coordinates of points, nodes and vertices should be in latitude and longitude format;

(ii) the accuracy of the coordinates should not be fixed;

(iii) the CONTOUR-2 format should include a new section (e.g. 'Projection') giving information about the applied ellipsoid and datum;

(iv) the time identifier should be extended to include an hour-ID;.

(v) the syntax of CONTOUR-2 should be defined by the Bachus-Naur notation and be readable by using simple text editors;

(vi) the notation should allow for future satellite missions;

(vii) there should be a distinction between metadata and actual ice chart data;

4.3 Reports by Members of the SGSI

4.3.1 The representative from Argentina Cap. M. Picasso presented a general overview of constraints and operations by Argentina (Appendix L) in the Antarctic areas. He stated that the Glaciological Division of the Argentinean Navy Hydrographic Service produces operational sea ice and iceberg support to Argentinean vessels, mainly in the Weddell and Bellingshausen seas, and to other mariners, who may require such support for planning navigation purposes. The Division also promotes land and shipborne observations from Argentinean stations and ships. For that purpose the Hydrographic Service each year holds a 10-day Sea Ice Observer course, and an Antarctic Navigation 10-day course in cooperation with the Argentinean Navigation Institute. Sea ice observations are made following the observation codes of the U.S. National Ice Center. Two sea ice atlases have been published in Argentina using data from the U.S. National Ice Center in SIGRID format, and a draft version of the Antarctic Navigation Handbook has recently been issued. The Glaciological Division is currently involved in reviewing the Spanish Version of the WMO Sea Ice Nomenclature and in translation of the Guide to Environmental Services and Ice Observations Handbook of the U.S. National Ice Center.

4.3.2 S.Lapczak presented a summary of the Canadian Ice Service (CIS) activities in the field of sea ice. He noted that the CIS provides ice and iceberg information services for Canadian marine areas. The Service's mission is to warn marine operators of hazardous ice conditions in order to protect the safety of life, property, and environment. The Service also maintains a historical knowledge of Canada's ice conditions to support policy and regulation development, and for design purposes. The primary client of the Service is the Icebreaking Program of the Canadian Coast Guard. The objective is to minimize the cost of icebreaking services by providing timely tactical and strategic ice information.

4.3.2.1 Services are provided on a daily basis, during the two primary ice operation seasons. The Arctic or summer season normally begins around the last week of June or the first week of July as the eastern Arctic ice begins to break up and move both north and west as the summer progresses. Normally the Arctic support effort ends near the end of October. During the winter, ice services commence in early December and continue through April. Services are provided for the Labrador and Newfoundland coasts, the Gulf of St. Lawrence, the St. Lawrence River system including the port of Montreal and the Great Lakes.

4.3.2.2 RADARSAT was launched on November 4th, 1995 and operational use by CIS began in February 1996. The sensor is a right-looking C-band SAR, capable of a variety of swath modes. The CIS is the main user of fast-delivery data. These data replace the X-band radar data previously collected by one of the reconnaissance aircraft. The product most used by CIS is the SCANSAR Wide georeferenced (SCW)

product. It has the best combination of swath width (500km) and resolution (100m with 50mx50m pixel spacing) for synoptic ice monitoring. Additionally, SCANSAR narrow georeferenced (SCN) data (300km swath width and 25mx25m pixel spacing) is acquired for tactical support purposes. The CIS processes in excess of 1 gigabyte of RADARSAT data per day.

4.3.2.3 Air reconnaissance products are delivered directly from the aircraft to the icebreakers by a high speed S-band data link. The Ice Centre products are delivered through a variety of communications systems. Each of the Coast Guard, on both the icebreakers and the shore stations are equipped with an IceVu system. The data are delivered to these systems using either INMARSAT, MSat, cellular or normal telephone links. Products are also delivered to other clients through an electronic bulletin board service, e-mail, auto-fax, fax-back and by the Internet using file transfer protocol. An Internet World Wide Web home page service delivery mechanism will be available in the near future.

4.3.2.4 The vast quantities of RADARSAT data has spurred the development of automatic data extraction algorithms in order to exploit its potential fully. An Ice Tracking System has been developed and installed at the Ice Centre. This system calculates ice displacements from image pairs by matching locations using a corner matching algorithm. The resultant graphical output is used to calculate ice motion. In addition, an ice/no-ice classifier has been developed. This classifier incorporates ancillary data sets, such as previous ice chart information, additional satellite data and environmental fields, to initiate the classification of the RADARSAT imagery.

4.3.2.5 Both of these algorithms are presently running in test mode using the operational RADARSAT data stream and the results are provided to ice analysts for evaluation. In the future, it is anticipated that these algorithms will be fully integrated into the operational toolkit and used routinely to produce new outputs such as ice concentration and ice pressure products.

4.3.3. Y.Kano informed the session that the sea ice conditions in the Sea of Okhotsk and its adjacent seas are operationally analyzed by JMA, mainly based on satellite observations. The analysis products with brief explanatory descriptions are distributed to ship masters and managers of ports and coastal areas. In addition to the imagery data from the Geostationary Meteorological Satellite (GMS) and NOAA Satellites, DMSP's SSM/I data are utilized for sea ice analysis. The data from AMSR and other sensors from the ADEOS-II, to be launched in 1999, are being considered for use in sea ice analysis, since the function of ADEOS were lost in June 1997.

4.3.3.1 The sea ice analysis products are digitized for sea ice area and concentration. The digitized data are utilized as a boundary condition of the Regional Spectral Model for weather forecasts resulting in significant improvement of the surface wind prediction around Japan. The data are also used for operation of the Ocean Wave Model and the SST analysis at the JMA.

4.3.3.2 Sea ice forecasts are carried out operationally by means of the Regional Sea Ice Model, which includes ice transport by winds and ocean currents and thermodynamic processes of freezing and melting. Weather forecast data on wind and air temperature are essential for operating the model. These sea ice analyses and forecasts are issued to users, including those in foreign countries, twice a week through a radio facsimile and the Global Telecommunication System (GTS).

4.3.3.3 Sea ice data were digitized in the SIGRID Format. All the data have been submitted to the World Data Centers (WDCs) A and B since the beginning of the project. From 1994 the sea ice data has been digitized by SIGRID-2 format based on CMM-XI's recommendation.

4.3.3.4 The GDSIDB data are used for climatological study; these results are included in annual publications such as «Monitoring of Global Warming and Ozone Depletion» issued by the JMA.

4.3.4. The review of the Danish sea-ice activities was submitted by Dr H.Valeur.

4.3.4.1 Since 1889 the Danish Meteorological Institute (DMI) has collected and issued information on ice

conditions in the Arctic seas, and since 1959 it has undertaken operational mapping of sea ice for the sake of safe navigation in the Greenland waters. The mapping has primarily been based on observations with a specially equipped aircraft. To an increasing extent the air observations have been supplemented by satellite data, primarily AVHRR received at ground stations in Greenland and near Copenhagen.

4.3.4.2 Since 1991 a dedicated satellite image interpretation system has been in use operationally, and additional data from microwave equipped satellites (both active and passive) are being used. The ERS-1/2 SAR and RADARSAT have proven very efficient in the ice mapping, and hopefully the air observations may become obsolete. However, in the waters around Cape Farewell (southernmost Greenland), which are the most important from a navigational point of view, the mapping of sea ice has proved extremely difficult. The sea is frequently rough due to stormy weather, and the ice consisting mainly of small floes in medium concentrations cannot generally be directly detected on the images due to the heavy backscatter from the surrounding water. As the thickness of the ice is several meters, the ice floes (and bergy bits) form a severe menace to navigation. In recent years, much emphasis has been placed on first-order statistical filtering of the images, whereby even moderate concentrations of small and medium ice floes may be detected. A number of simultaneous underflights has been carried out to compare the satellite-based SAR data with visual observations, video recordings and photographs from the reconnaissance aircraft.

4.3.4.3 Since the ice in the Greenland waters is often a mixture of various types, the storing of digital ice data is relatively complicated. It is warranted that a digital database be created and data added automatically simultaneously with the production of operational charts. Various solutions, including the SIGRID format, have been discussed but so far no systematic digital data base has been set up.

4.3.4.4 Technical reports on the Danish services were presented as follows:

(i) Demonstration of the DMI satellite - based ice mapping (P.Nielsen, DMI).

(ii) Experiences with gridded data from the West Greenland waters (K.Q. Hansen, DMI)

(iii) Use of historical ice data in climate research (T.C. Schmith, DMI)

(iv) Atmospheric Circulation Related to Oscillation in Sea-ice and Salinity (ACROSS), (P.Frich).

The participants greatly appreciated the presentation of these technical reports at the meeting .

4.3.5 In his report the chairman of BSIM, J.E.Lundqvist noted that the members of the BSIM are:

(i) Finland, Russia, Poland, Germany, Denmark, Norway, Netherlands, Sweden and

(ii) the new members- Estonia, Latvia, and Lithuania

4.3.5.1 Separate organizations in these countries are responsible for the sea ice information along their coastal sector.

4.3.5.2 J.E.Lundqvist informed the meeting that ice charts for the Baltic Sea are produced daily by Finland, Sweden, Russia, Estonia and Germany. Ice charts in digital form are produced by Finland, Sweden and Germany (Ice Map-system). Sweden collects ice information from all Baltic countries and makes an ice chart covering the total area. The ice charts are transmitted to Germany and retransmitted on radio facsimile via Offenbach/Pinneberg. Ice charts twice a week are produced and issued by mail also by Russia and Poland. All Baltic countries code ice information in the BSIC (Baltic Sea Ice Code). Most countries, after recommendation from the BSIM, complete the information in English. Ice charts are transmitted on fax to customers for a small fee. To the navigational use ice charts are provided free of charge to vessels on request via mobile telephones. Finland uses a polling fax. Sweden collects all ice information and transmits ice reports in English on NAVTEX (Navigational telex).

5. Problems and future of the GDSIDB and the SGSI.

5.1. Assessment of climate sea ice statistics on the basis of accumulated GDSIDB data.

5.1.1 V. Smolianitski presented some additional information on items 3.1 - 3.3. He stressed that at present we can provide a «0» version of the climate set of statistics for Arctic and Antarctic regions for decadal, seasonal and monthly intervals for 1950 - 1990 with a spatial resolution up to 25 x 25 km close to the WCP and the WCRP requirements. At the same time, more precise information will be available when the next stage of data quality control is finalized.

5.2 Development of comprehensive sea-ice data sets.

5.2.1 The report provided by V. Smolianitski (see section 3.1) provides a description of the errors of syntax and coding identified in the NIC data and errors in the AARI data associated with the land mask that was used. In order to develop the planned comprehensive archive for the 1950 - 1994 and to enable this to be presented at the ACSYS workshop on Sea Ice Charts of the Arctic in Seattle, WA, 5-7 August 1998, the meeting requests that:

(i) the NIC endeavor to deliver a finalized version of both the Arctic and Antarctic data files for 1972 - 94 to the two Sea Ice Data Centers by the end of March 1998;

(ii) the AARI review and adjust the Russian ice data to incorporate more accurate land masks for the Arctic land areas by May 1998;

(iii) national representatives provide appropriate and or augmented metadata describing data sets contributed to the GDSIDB. In particular the typical spatial and temporal coverage provided by coastal radar, ship and other observations should be detailed for their chart areas.

5.2.2 The meeting requests the Chairman of the SGSI to communicate these matters to appropriate agencies for their action.

5.3 Current and planned cooperation in the field of sea-ice data exchange.

5.3.1 According to the decisions of CMM - XII, it is planned to direct the activity of the Sub-group to solving the following problems and responsible individuals:

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

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

5.3.2 Cap. M.Picasso proposed to submit sea ice observations from Argentinean Antarctic coastal stations and ships to the GDSIDB centers on a regular basis. Land observations are made twice a week throughout the whole year while shipborne observations are made every 6 hours when ships are in sea ice areas. Formats and exchange mechanisms will be directly coordinated with both centers. In the future, Argentina may also contribute all additional sea ice data that are available in the Argentinean sea ice service.

5.3.3 The meeting discussed means to assess the quality of the GDSIDB archive. It is recommended that the statistical assessments of the GDSIDB by the responsible data centers be made available through the World Wide Web. These assessments should be extended and finalized as appropriate. The GDSIDB centers request the assistance of national experts in review and assessment of the data contained in the GDSIDB for their geographical areas of ice charting responsibility AARI will make available a browser to assist in this evaluation through a special section of the web page of AARI. These results and assessments will be integrated by the GDSIDB centers and used by them to guide the production of a blended ice product for the Arctic.

5.3.4 The meeting requests that, for areas of complex ice conditions (such as southern Greenland, the Canadian Arctic Archipelago, the Baltic), national agencies make available to the GDSIDB regional subsets of ice data at resolutions of 10 x 10 km, or finer, as appropriate for those areas.

5.3.5. M. Picasso drew attention to special problems in Antarctica. During the last Antarctic campaign of Argentina, in February 1997, some grid errors were observed in satellite images of the southeastern part of the Weddell Sea. These errors were not quantified, but estimates suggest not more than 4 n.m (7 km) in the worst case; this is near the 10 km resolution proposed for the future high resolution GDSIDB archives. Corrections to the grid could not be carried out because of the lack of land reference points in those areas completely covered by land ice, ice shelves and glaciers where the ice front moves significantly from year to year. The northern part of the Antarctic Peninsula, where all the land reference points are concentrated, is often cloud-covered. The few available SAR images cover a small area. For these reasons, good land reference points cannot be obtained.

5.4 Elaboration of the Work Plan for the GDSIDB future development and cooperation between sea-ice centers and corresponding institutions.

5.4.1 The meeting discussed and adopted the Workplan for the GDSIDB development (included in Annex 1).

5.4.2 Members of the Steering group and representatives are requested to provide to both GDSIDB centers preliminary lists of information on sources of historical ice data for potential inclusion on a Web listing of such sources.

5.4.3 The Subgroup on Sea Ice is requested to provide a review of existing international activities/programs in both polar regions (e.g. WMO, SCAR, IASC, IGBP) to which the GDSIDB activity can contribute.

5.4.4. The meeting proposes that the two GDSIDB centers work towards the preparation, production and distribution of a CD-ROM within a two-year frame containing results of comparative analysis of the AARI, NIC and JMA data for periods and areas of overlap, in support of WCP programmes, accompanied by the current GDSIDB archive for both polar regions, associated metadata and derived climate statistics.

5.5 Other coordination activities.

(i) R.G. Barry was asked to report to the ACSYS SSG on the 6th session of the GDSIDB Steering Group, including the proposal submitted to ACSYS by R. Colony and T.Vinje.

(ii) H. Valeur was asked by the meeting to provide liaison with the ECDIS activity of the IOC.

(iii) R.G Barry was asked by the meeting to provide liaison with WCRP/GCOS.

6 PUBLICATIONS

6.1 The meeting recalled that the 12th CMM session recommended its work plan for the coming intersessional period. According to this adopted work plan, the informal session of the Sub-Group on Sea Ice appointed

the following rapporteurs to review and update the following publications, with appropriate target dates:

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

(ii) Sea-ice information Services in the World (WMO - N574) , J.E.Lundqvist - 1997

6.2 The meeting requests that the GDSIDB centers contribute an overview of their activities and the current integrated data base to the ACSYS workshop on «Sea Ice Charts of the Arctic» to be held 5-7 August in Seattle, USA.

6.3 The Contour-2 format will be modified by the AARI, circulated electronically to other members for comments by spring 1998, finalized and submitted for publication to WMO.

7 Data and place of the next session.

7.1 The meeting was pleased to receive the tentative offer by USA to host the 7th session of the Steering Group for the GDSIDB in August, 1998, Boulder, after the Workshop on Sea Ice Charts of the Arctic, which will take place 5 -7 August, 1998, Seattle, USA.

8. Closure of the meeting.

8.1. The 6-th session of the Steering Group for the GDSIDB and informal meeting of the CMM Sub Group on Sea Ice closed at 12 30p.m. Friday, 26. September 1997.

Annex 1.

Work Plan for Cooperation between the members of the Steering Group on the WMO Project Global Digital Sea-Ice Data Bank from WDC-A For Glaciology (NSIDC), WDC-B Sea Ice (AARI), Argentinien Navy Hydrographic Service (ANHS), Canadian Ice Service (CIS), Danish Meteorological Institute (DMI), Baltic Sea Ice Meeting (BSIM) and Japan Meteorological Agency (JMA) for October 1997- August 1998

1. Technique Development

1.1 The experts from the GDSIDB centers will make available data browsers and other necessary software for processing data in SIGRID and EASE-grid formats — autumn 1997

2. Data Exchange.

2.1 Schedule for sea ice data transfer to WDCs with subsequent submissions to members of SG

	Institute	Region	Time interval	Exchange date
1.	**WDC-B Sea Ice/AARI**	Arctic, corrected version Antarctic	1950-1991 (10-days period) 1971-1990 (10-days period)	when the data are available for WDC-B Sea Ice when the data are available for WDC-B Sea Ice
2.	**NIC/WDC-A for Glaciology-NSIDC**	reprocessed Arctic and Antarctic	1972/1973 -1994	by March 1998
3.	**JMA**	Sea of Okhotsk	1997, ongoing data forward in time	once a year
4.	**CIS**	Arctic, Northern Atlantic, grid-point data Canadian archipelago, high resolution data	1959-1983 app. 1970-1994	by March 1998 dependent on resources
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(2) data	autumn 1997 after completion of software by the AARI and BSIM experts
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	by March 1998
8	**ANHS**	Weddell and Bellingshausen Seas	App. 1973 to 1990, point observations	when the data are available for WDC

Notes:

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. NSIDC and AARI will continue to provide guidance on preparation of DIF and all ongoing necessary documentation accompanying data submitted or to be submitted to GDSIDB.
3. EOSDIS node is being planned at WDC-B for Sea Ice in collaboration with WDC-A for glaciology

3. Modification of formats for data exchange

3.1 AARI and other centers will cooperate in developing CONTOUR-2 format.
3.2 AARI and BSIM will cooperate in data exchange for the Baltic region, preferably using SIGRID-2 format.

4. Development of climate estimates, validation and intercomparison of GDSIDB data

4.1	Experts from SG will continue joint activity on development of sea ice climate estimates based on GDSIDB data with subsequent provision of results at the next WG session and further to WMO Secretariat	1998
4.2	Experts from SG will continue joint activity on intercomparison of GDSIDB data provided from different sources	1998
4.3	SG will endeavor to establish the linkages with the other programs and projects concerned the development of climate estimates, validation and intercomparison of GDSIDB data	1998

5. Future activity

5.1	GDSIDB centers will prepare a report on activities for the Workshop on Sea Ice Charts to be held in Seattle	August 1998
5.2	Members of the SG will develop plans for future activity for subsequent discussion at the next session of the SG	early 1998
5.3	SG will ask the Chairman of the Sub-Group on Sea Ice to explore the possibility of inviting other countries collecting sea ice data to contribute data to GDSIDB	1998
5.4	Members of the Steering Group will submit information on historical archives to the GDSIDB centers with subsequent publication on the WWW.	December 1997