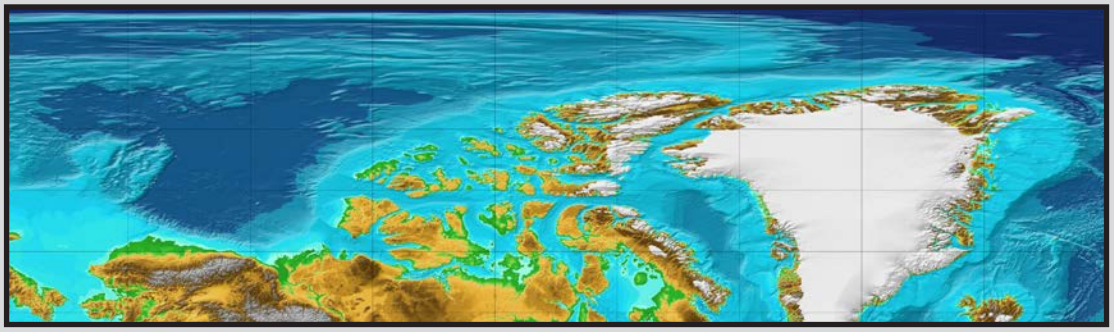
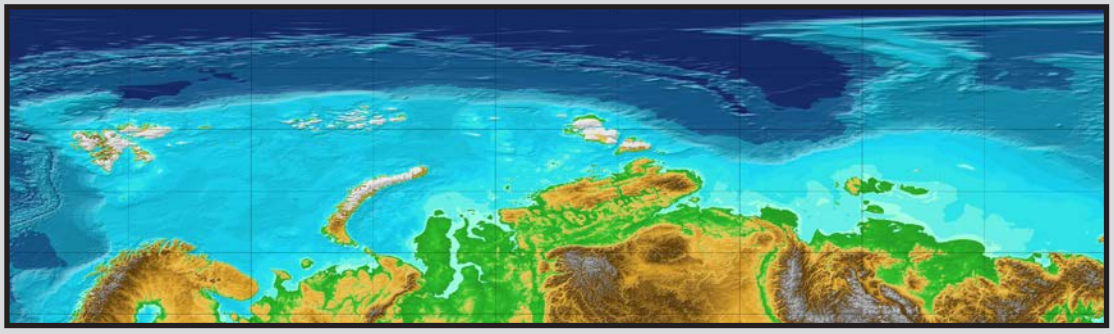
GSC Open File 4185

IASC/IOC/IHO Editorial Board for the International Bathymetric Chart of the Arctic Ocean

Third Meeting of the Editorial Board: New Hampshire, May 27-28, 2001





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IOC/IASC/IHO Editorial Board for the International Bathymetric Chart of the Arctic Ocean (EB-IBCAO)

Third Session: University of New Hampshire May 27-28, 2001

Summary of technical presentations on national contributions

Chairmen:

Ron Macnab
Chairman, EB-IBCAO
Geological Survey of Canada
Dartmouth NS, Canada

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This meeting was convened with the support of the following organizations: Center for Coastal and Ocean Mapping / Joint Hydrographic Center of the University of New Hampshire; the International Arctic Science Committee; the Intergovernmental Oceanographic Commission; and the US Polar Research Board.

Geological Survey of Canada Open File 4185
December, 2001

Cover figure: *Relief plot of seafloor and land areas north of 64EN, produced from the current version of the IBCAO grid which has been re-sampled over a geographic matrix at intervals of one minute of latitude by one minute of longitude. This re-sampling was performed to facilitate merging with the GEBCO Grid of Global Bathymetry, which is currently under development and which will be issued in the next edition of the GEBCO Digital Atlas (see text for details).*

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THIRD MEETING OF THE EDITORIAL BOARD OF THE IASC/IOC/IHO INTERNATIONAL BATHYMETRIC CHART OF THE ARCTIC OCEAN (IBCAO)

May 27-28

Center for Coastal and Ocean Mapping/Joint Hydrographic Center

University of New Hampshire

OPENING FORMALITIES

The meeting was called to order at 0945 with Ron Macnab as chairman, and Martin Jakobsson as vice-chairman.

Welcoming remarks were delivered by Larry Mayer, who described the technical mandate and activities of the Center for Coastal and Ocean Mapping, (CCOM) and by Andy Armstrong, who outlined the educational functions of the Joint Hydrographic Center (JHC) in the context of its relationship to the University of New Hampshire.

Remarks were also offered on behalf of two of IBCAO's sponsoring organizations. In the absence of IOC representative Dmitri Travin, Ron Macnab reported that participants at the recent meeting of the IOC's Consultative Group on Ocean Mapping (CGOM) had agreed that IBCAO should serve as a prototype for all future projects in the IOC's program to construct International Bathymetric Charts. As the past IASC representative to the group, Garrik Grikurov commented on the perceived and timely successes of the geoscientific initiatives operating under the Committee's sponsorship, as exemplified by IBCAO

In his capacity as the local meeting organizer, Martin Jakobsson explained logistical arrangements for the event. The agenda (Appendix B) was then discussed and adopted with minor revisions.

PRESENTATIONS AND RELATED DISCUSSIONS (MAX 15 MIN EACH)

1. Reviews of recent accomplishments

IBCAO presentations: Ron Macnab

The IBCAO project has received wide recognition and acceptance on account of the excellence of its output, and it has been gratifying to see increasing references to IBCAO as an important adjunct to scientific research in the Arctic. The visibility of the project is due in part to a concerted strategy of publicizing the activity's achievements at every possible opportunity, by means of written and oral reports delivered in a variety of media and conference settings. Most if not all members of the Editorial Board have played a role in this process by describing IBCAO at scientific and technical gatherings, with or without the presentation kit that was prepared and circulated in April 2000. Reports have been published not only in specific project documentation and in reviewed scientific and technical publications, but also in some popular media, as journalists have been made aware of the outcome of the project. The project Website has also served as an effective medium for information dissemination, and at least one popular television program ran a feature on the map (more on this in the following section).

Website activity: David Divins

The IBCAO continues to be the most popular of the International Bathymetric Charts projects hosted at NGDC. The number of users accessing IBCAO pages rose sharply to 99297 during February of 2001 reflecting a NOVA interview with Martin Jakobsson, which was broadcast on Swedish television. This illustrates the value of promoting the project to the public whenever possible. The average number of IBCAO unique users per week over the past year is 1010. The web page statistics show that the most popular page, after the IBCAO web page, is that of the provisional map. Also in February, subscriptions to the ibcao_announcements list server rose from 180 to 250. A test of the interest of the "print on demand" concept for the IBCAO map (scale 1:6,000,000) will be conducted at NGDC in the near future.

Beta grid; provisional map; Arctic GIS workshop (Seattle, Jan 2001): Martin Jakobsson

The IBCAO Beta grid was posted on the project's NGDC Website for public circulation in March 2000, following the appearance of an article in EOS (Jakobsson et al, 2000). The use of this grid has so far exceeded our expectations, as indicated by the NGDC website statistics mentioned above. Through the good offices of Bob Anderson and Dennis Conlon, ONR paid for the printing of a provisional colour shaded relief map at a scale of 1:8,795,800. This map appeared as an insert in a Stockholm University publication (Jakobsson, 2000), and a further 1500 copies were distributed separately.

During an Arctic GIS Workshop in Seattle that was organized in January 2001 by the Arctic Research Consortium of the US (ARCUS) and sponsored by the US National Science Foundation (NSF), IBCAO bathymetry was identified by users representing a broad range of disciplines as one of the most important GIS layers for purposes of Arctic research.

2. New data sets

The bathymetry of Fram Strait; Polarstern Hydrosweep data: Hans-Werner Schenke

In 1999 and 2000 "Polarstern" undertook two expeditions in Arctic waters while running the multibeam system Hydrosweep DS-2. The tracks are shown in Figure 1. The blue lines indicate multibeam lines and the red lines signify that only Narrow Beam Sonar data were collected. Systematic surveying was performed north of Svalbard

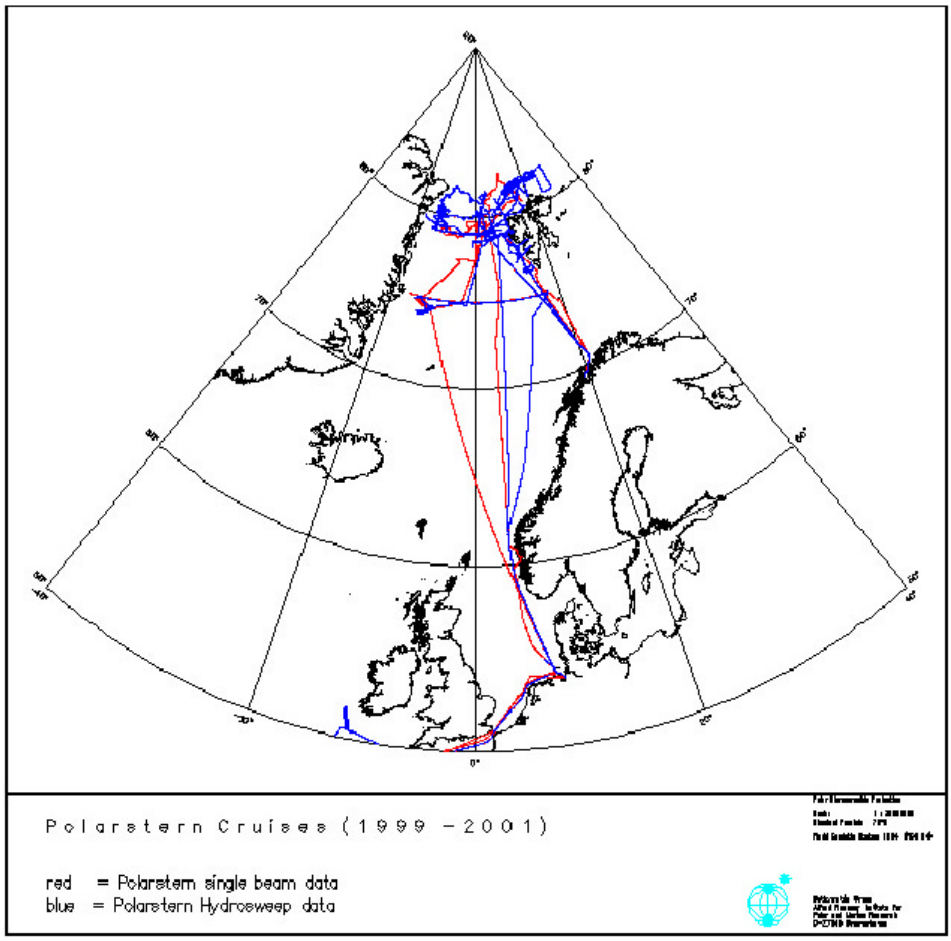

Figure 1. R/V"Polarstern"cruises in the Fram Strait region 1999- 2000.

along the continental shelf, and in Fram Strait. Several parallel tracks were recorded in Greenland Basin. Final processing has not been performed on most of the data, however, it is anticipated that this will be finished in 2001. Once processed, these data will be available for inclusion in the IBCAO.

AWI is also preparing sheets in the series of Bathymetric Charts of Fram Strait (AWI BCFS), at a scale of 1:100,000. All available multibeam data collected on R/V "Polarstern" cruises since 1984 will be portrayed at a contour interval of 20 m. Currently nine sheets are in preparation, following the scheme shown in Figure 2. Sheet numbering is based on the GEBCO 1:1,000,000 chart compilation (e.g. 581-21-1).

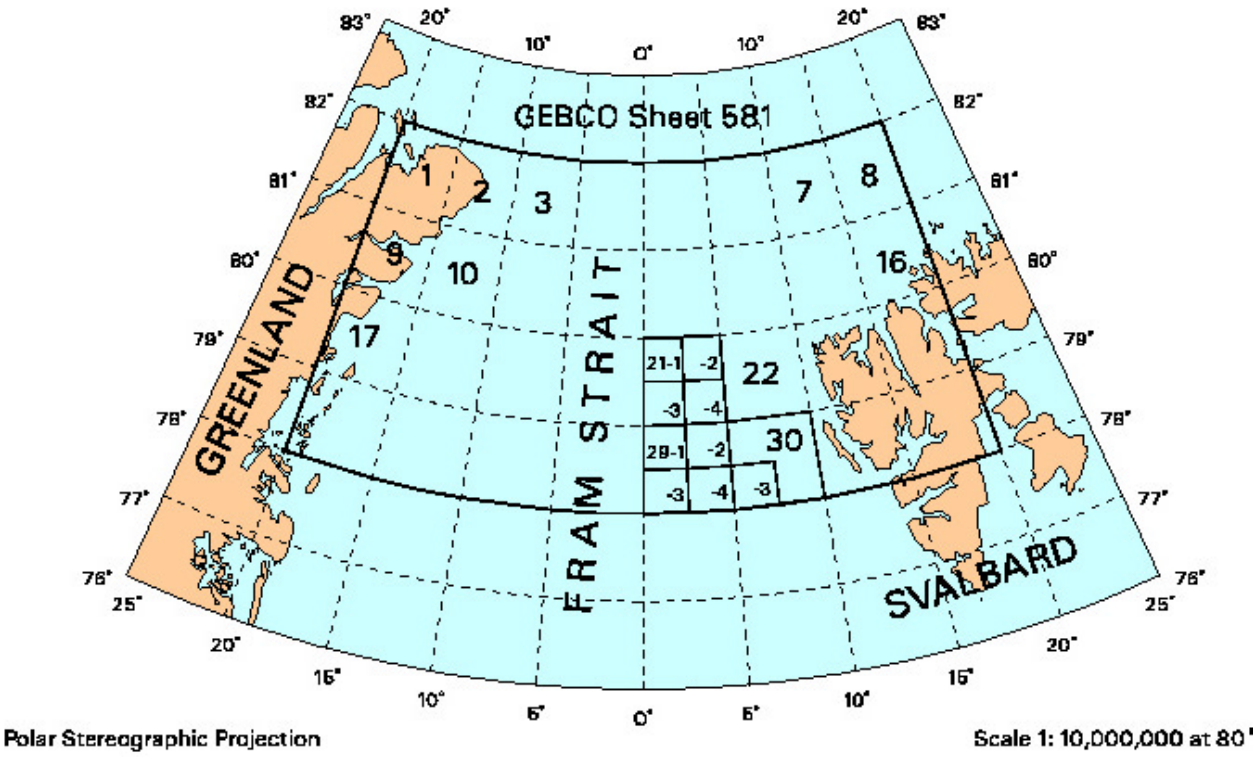

Figure 2. AWI BCFS Sheet Index Map

The sheets in preparation are:

AWI BCFS 581-21-1	AWI BCFS 581-21-4	AWI BCFS 581-29-3
AWI BCFS 581-21-2	AWI BCFS 581-29-1	AWI BCFS 581-29-4
AWI BCFS 581-21-3	AWI BCFS 581-29-2	AWI BCFS 581-30-3

FramBIS: A Bathymetric Information System for the Fram Strait

Multibeam bathymetry is a major reconnaissance tool for marine geological and geophysical surveys. Bathymetry, backscatter intensity and sidescan data are collected as a first stage of subsequent multiparameter surveys. The products derived are used for the interpretation of processes and features on the ocean floor.

The aim of the FramBIS project is the creation of a high resolution Digital Elevation Model (DEM) and bathymetric chart series (AWI BCFS) of Fram Strait, based on Seabeam and Hydrosweep multibeam data collected on R/V "Polarstern" from 1984 to the present date. The Fram Strait region is part of the extensive arctic ridge system, therefore its topography is of interest for diverse studies of geological and biological ridge process. The high

resolution morphology information gained from the multibeam data is a basis for a better understanding of the formation and evolution of the area and the processes involved. Up to now, only coarse bathymetric information exists in the region due to its remote location and annual ice-cover, making systematic surveys logistically demanding. The FramBIS project will generate raster DEMs, which will be interpolated at varying resolutions (50m to 500m) taking into account the heavily varying data quality and density. AWI has agreed to correct the multibeam data using CTD information before generating a DEM that will be contributed to the IBCAO project. The resolution of the grid to be provided to IBCAO will be finer than 2.5 km, preferably 1 km.

Data sets from the Norwegian Petroleum Directorate (NPD): Harald Brekke

During the summer seasons of 1999 and 2000, NPD acquired approximately 180 000 km^2 of deep sea multibeam swath bathymetric data in the Norwegian Sea between 63 and 72 deg N (Figure 3). The data were acquired with a Simrad EM12 in water depths between 2000 and 3500 meters. A 1x1 km grid of the full data set has been made available for IBCAO and is already incorporated in the latest version of the IBCAO grid. In the summer season of 2001, NPD will acquire additional multibeam swath bathymetric data along the Mohns spreading ridge, between Jan Mayen and Bjørnøya, in the central parts of the Norwegian-Greenland Sea. These data will be made available to IBCAO as a 1x1 km grid as soon as the final processing is completed.

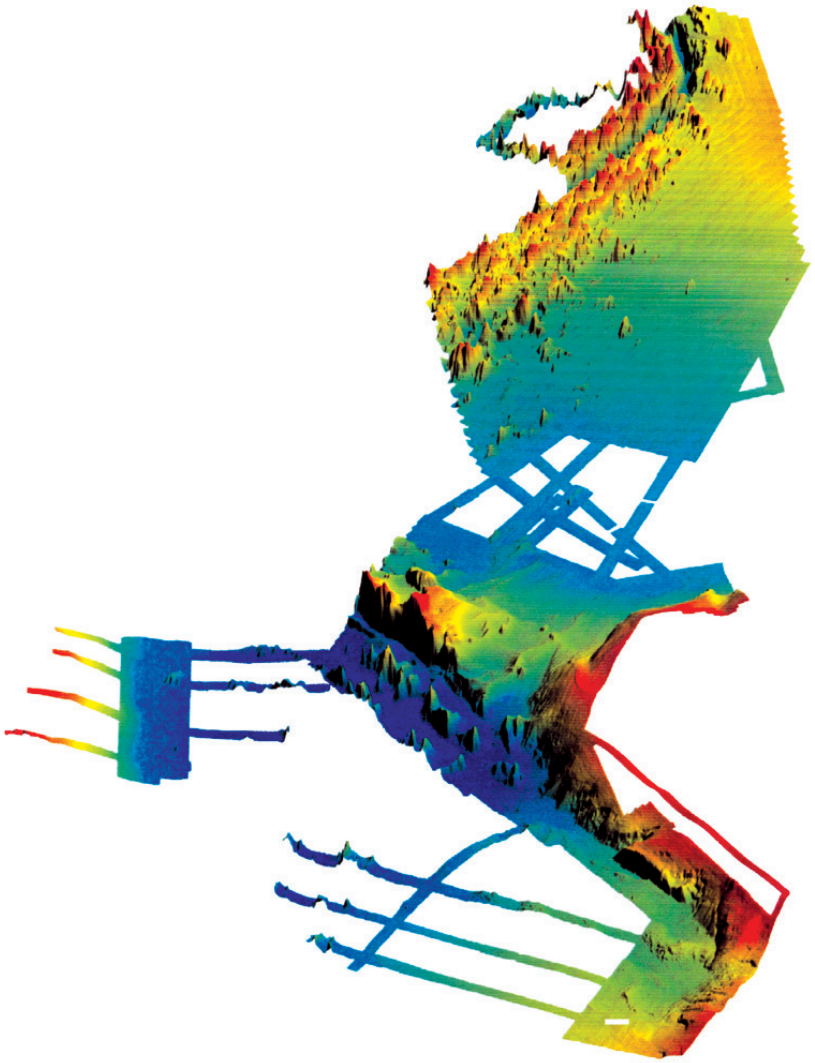

Figure 3. NPD multibeam data west of Norway. North is at the top of the image.

Preliminary bathymetric maps of the Gakkel ridge from submarine-acquired swath bathymetry: Robert Anderson

During 1998 and 1999, the Seafloor Characterization and Mapping Pods (SCAMP) system, which was developed under the sponsorship of the National Science Foundation, was deployed to the Arctic Ocean aboard USS Hawkbill as a part of the SCICEX cruise instrumentation. Bathymetric surveys were conducted with SCAMP over portions of the Gakkel Ridge (Figure 4), the Lomonosov Ridge, the Chukchi Borderlands, the Northwind Ridge, the Yermak Plateau, and the Alaskan Margin.

SCAMP incorporates a Side Scan Bathymetric Sonar (SSBS) system that derives bathymetry from multiple side-looking sonar arrays. The swath widths achieved during the arctic deployments were up to 20 km in width, dependent upon depth.

Difficulties were encountered in mosaicing the SCAMP survey data, due to positional ambiguities in the navigation data from the ship's inertial navigation system (GPS navigation is not feasible from a submerged submarine). Some progress has been made in resolving these ambiguities, which has thus far enabled the preparation of preliminary maps of the Gakkel Ridge. A location map plus three more detailed charts were presented. It should be cautioned that these are works in progress and are therefore to be considered only preliminary information. Some track-parallel artifacts remain on the charts, especially 250-022 and 250-024. Chart 250-024 (indicated on the location map) was not included in this distribution. It was suggested that a comparison between the NRL areomagnetic data and the SCAMP data be carried out to assist in the "re-navigation" of the SCAMP surveys.

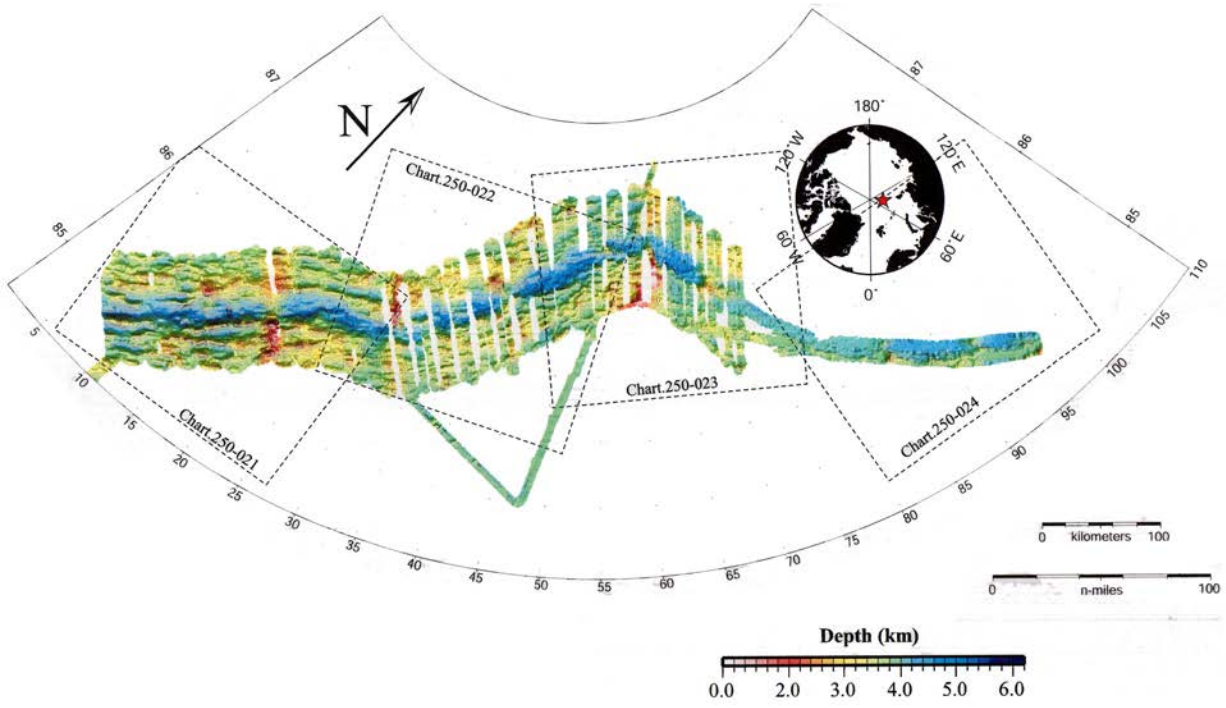

Figure 4. SCAMP mapping of the Gakkel Ridge.

IBCAO perspective for feed-in of VNIIOkeangeologia bathymetry data: Garrik Grikurov and Lena Daniel

VNIIOkeangeologia holds Russian bathymetry data of three types. The bulk of the data base consists of depth observations collected during dedicated offshore gravity surveys, both ship- and airborne, performed in the course of several decades by high-latitude expeditions of the Ministry of Natural Resources of the Russian Federation (formerly the Ministry of Geology of the USSR) at scales varying from 1:1,000,000 to approximately 1:3,000,000 (see Figure 5). In areas adjacent to the mainland, the survey coverage in most cases was sufficient for compilation of 1:1,000,000 gravity maps that were originally printed as classified systematic sheet series of the State Gravity Map of the USSR; each of such sheets displayed in analog format a considerable amount of depth soundings that were just shown on the map without reference to original point data. Farther offshore the survey coverage was, as a rule, less dense, and only selected areas could be mapped in detail sufficient to match the requirements of 1:1,000,000 sheet compilation. As a result, these data were not converted into standard map format and remained available only as classified point measurements (catalogues).

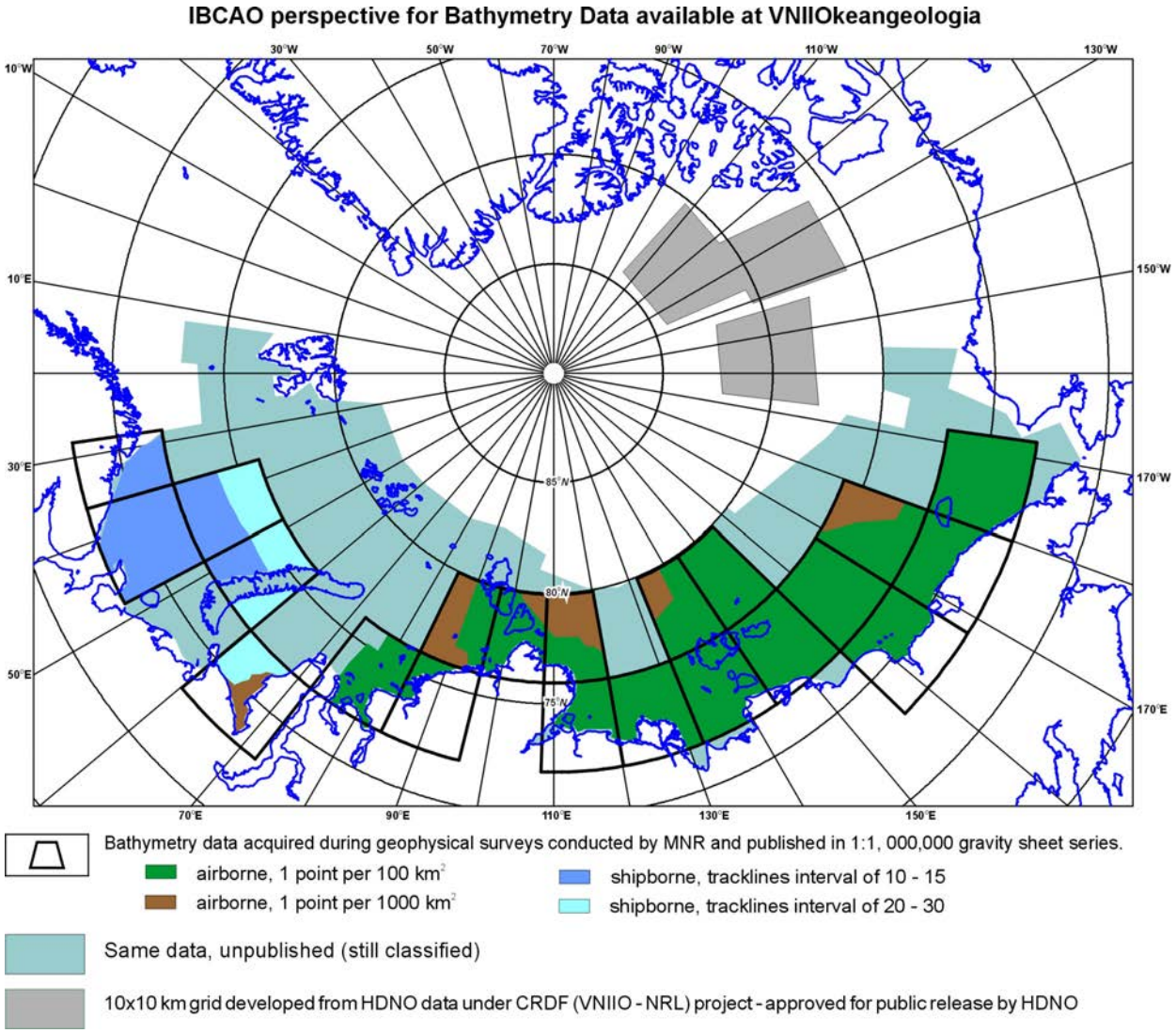

Figure 5. VNIIOkeangeologia data holdings.

In 1994 the Ministry (at that time Roscomnedra), following the public release of some Russian onshore gravity data, declassified the printed offshore 1:1,000,000 gravity sheet series and labeled them as proprietary products that could be used for scientific and/or commercial purposes subject to approval by adequate authorities. This allowed digitizing of depth soundings depicted on the declassified gravity maps and developing a bathymetry grid 5 X 5 km for the part of the area that was covered by printed gravity maps. Such grid was developed in VNIIOkeangeologia and has recently been submitted to the Ministry of Natural Resources for consideration of possibility of its release in the public domain. VNIIOkeangeologia believes that the merging of this grid with the existing IBCAO digital database could significantly improve the dataset for the eastern Russian Arctic marginal seas from where the largest part of observations was derived. Here the IBCAO grid appears most vulnerable because it was developed predominantly by digitizing the contours from navigational charts, and these contours are very widely spaced due to essentially flat bottom topography. More detailed point data used in compilation of VNIIOkeangeologia grid could, perhaps, significantly compensate for this deficiency.

The other part of VNIIOkeangeologia data that is represented by still-classified catalogues of observation points is probably not so relevant for IBCAO purposes because it covers the areas where more dissected bathymetry is known from a greater variety of sources, and the addition of the grid developed from Russian gravity surveys may have less importance for the final product. In any case, the perspective of declassifying the point data or any sensible grid developed from such a source appears in the current environment very remote or totally unrealistic.

Finally, for three areas in the Canada Basin VNIIOkeangeologia holds 10 X 0 km bathymetry grids prepared by HDNO for the purposes of the joint VNIIOkeangeologia - NRL project, which was supported by a CRDF grant. This grid is, perhaps, the least important for upgrading the IBCAO data set, but it is probably the easiest for obtaining permits for open use from the interested parties.

The Beta version of the IBCAO grid that is currently available on the Internet was successfully tested in the course of ongoing research activities of VNIIOkeangeologia. It was found very satisfactory as the source of regional digital data for the bottom relief of the Arctic Ocean and most helpful in resolving many geological and geophysical objectives, such as 3D gravity modeling, evaluation of isostatic compensation models, etc. It is planed to proceed with further testing of the IBCAO grid for the purposes of more local studies, e.g. in processing new Russian data collected in 2000 on the Mendeleev Rise.

3. Prospects for future data sets

Future surveys with the USCGC Healy: David Divins

The US Coast Guard cutter Healy was commissioned on August 21, 2001. The Healy's primary mission is to function as a high latitude research platform with emphasis on Arctic science. The operation of the USCGC Healy in the Arctic provides a potential source of new bathymetric data for this region. The quantity and quality of these data are to be determined, as is the frequency of data made available to the IBCAO project. However, the potential for significantly improving the IBCAO grid is very high. The first science cruise of the USCGC Healy will take place the summer of 2001 - this will be a two-ship expedition with the RV/Polarstern on the Gakkel Ridge. Multibeam bathymetry, seismic, and geologic data will be collected. It was agreed that discussions with the US Coast Guard should be continued in order to convince them of the necessity of routinely collecting bathymetric data regardless of the goals of the expedition.

Planned bathymetric work on Polarstern: Hans-Werner Schenke

Expedition ARK XVII/1 will focus on oceanography in the Greenland Sea and Fram Strait. A multibeam survey will be performed during the entire cruise outside the EEZ's of the visited countries. In addition, a systematic multibeam survey will be done off the Greenland shelf to study deep sea channels. The data will be made available to IBCAO after post-processing and scientific use.

Expedition ARK XVII/2 is planned as a joint two-ship experiment involving USCGC "Healy" and RV "Polarstern" to the Gakkel Ridge during summer 2001. The intention of this expedition is to execute a profile along the central

Gakkel Ridge. The two ice-breakers will sail in convoy, with the "Healy" carrying out the ice-breaking work during seismic profiling. The two ships may work independently for dredging, coring, and other scientific sampling whenever ice-conditions allow. A multibeam survey will be performed continuously during the entire expedition. During the cruise, it is intended to exchange data between the responsible scientific groups immediately after the first data cleaning process. The final post-processed data will be used to calibrate and correct the bathymetric data derived from the SCAMP system of the SCICEX missions. The planned profiles are shown in Figure 6.

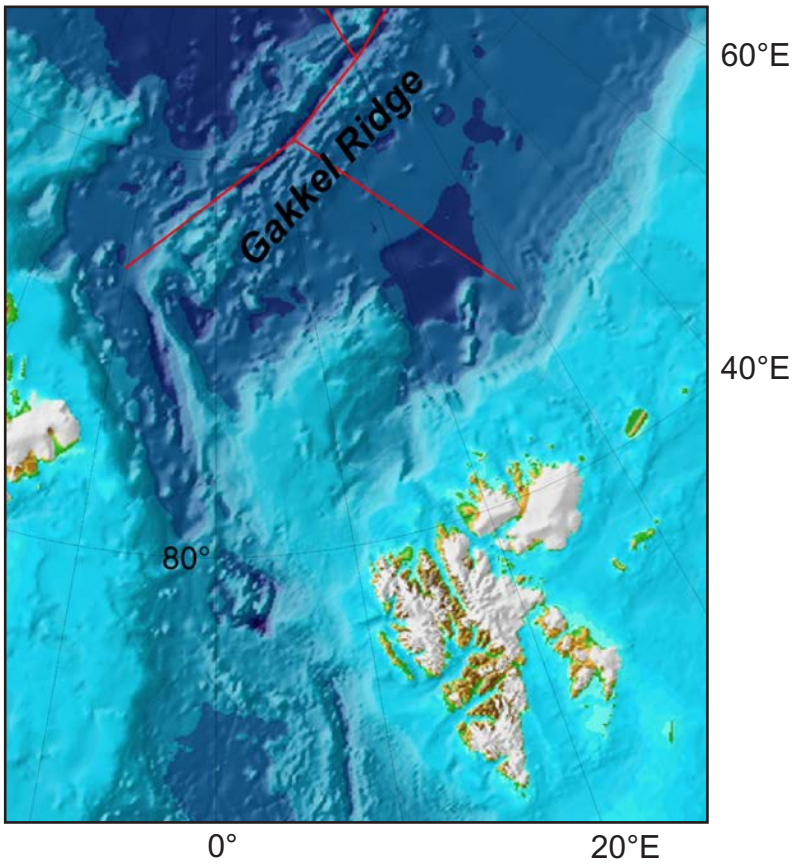

Figure 6. Track planning for the joint USCGC "Healy" and R/V" Polarstern" cruise along the Gakkel Ridge during summer 2001.

Danish investigations North of Greenland: Arne Nielsen

The Royal Danish Navy has extended an invitation to the US Navy to expand its program of unclassified Arctic Ocean investigations into the waters off Greenland. Thanks to the intermediary efforts of Robert Anderson, George Newton, and Bernard Coakley, the response from the US Navy was very positive. Even though no SCICEX activities are taking place for the time being, the exchange of communications between the two navies is very promising and provides a strong foundation for future cooperation in the waters around Greenland.

With regard to Danish plans for a multiyear ice camp campaign north of Greenland, it has been decided in principle to conduct a four-year operation. This campaign will feature ice camps of four to five weeks duration in April/May, starting in the year 2002. The first priority for the ice camps is to carry out bathymetric measurements from helicopters using proven technology and methods developed by the Canadian Hydrographic Service, Central and Arctic Region. The possibility of using a multibeam beam data acquisition system to collect information through the ice is also being considered. It has also been decided to scrutinize once again the existing bathymetric data sets from the waters around Greenland, and to consider whether other areas along the coast of Greenland should be included in

these or future investigations. The first meeting concerning this process took place on May 23, 2001.

A pilot study has been conducted in conjunction with a gravity data collection programme that took place in the waters between Greenland and Svalbard from April 24 to May 5, 2001. The study was very successful thanks to extended assistance from the Canadian Hydrographic Service and especially from Jon Biggar, Head of the Arctic Bathymetry Group. Without this assistance and Jon Biggar's active involvement, this study would not have been possible.

Partners in the ice camp campaign are:

- Danish Polar Centre
- ASIQ
- Danish and Greenland Geological Survey
- National Cadastre and Mapping Agency, Denmark
- Royal Danish Administration of Navigation and Hydrography
- Canadian Hydrographic Service

The future of SCICEX: Bernard Coakley

Since the end of the last scheduled SCICEX cruise in May 1999, there has been speculation about whether the program would continue. Enthusiasm for the program prompted the Greenland Home Rule to issue an invitation to the US Navy to collect data in their territorial waters. If another cruise were announced, it is likely that the Norwegians and the Canadians would invite SCICEX operations in their respective EEZs. While this enthusiasm is shared by a number of flag officers in the US Navy, further cruises have not been scheduled to date, due to the rapid decommissioning of US Sturgeon-class submarines. The significant loss of operational submarines has not been matched by reduced tasking. The submarine fleet is stretched to the limit to meet requirements for military operations. Under current scheduling constraints, they are unwilling to commit the 6 months of ship time necessary to support a new SCICEX cruise.

While the original SCICEX cruises were essentially given to the science community, it is clear that any additional cruises will have to compete with other Navy needs to gain access to submarines. Last August a group composed of a variety of scientists, some with SCICEX experience, met at NSF to prepare a report on what SCICEX had accomplished and underlined the opportunities, both academic and military (to the extent we could anticipate them) for future SCICEX cruises. This white paper (available via anonymous ftp; ftp.ldeo.columbia.edu in directory bjc) was presented to Admiral Ellis at the Pentagon. Admiral Ellis made it clear that despite the operational value of the data that could be collected during future SCICEX cruises, it was not possible at this time to offer additional submarine time to support civilian science. It is likely that SCICEX, as a series of unclassified cruises, is dead.

There are two opportunities that may permit additional submarine data acquisition in the Arctic. The Navy intends to put out an ice camp in 2003. It appears that they will turn over the camp to civilian scientists after completing their programs. Submarines typically operate in association with ice camps. Making one of these submarines available for an unclassified cruise is a possibility. The second opportunity could be ranked as being slightly stronger than a rumor. The US government is slowly awakening to the need to collect additional data to support an Article 76 claim for an extended Arctic EEZ. Initial discussions have begun about planning a unified data acquisition program, perhaps utilizing a submarine and an icebreaker operating independently.

Canadian hydrographic data: David Monahan

The Canadian Hydrographic Service has collected bathymetry data in the Arctic for many years, both in profile form from surface vessels and as spot depths from the ice surface. Data collected to 1978 were incorporated in GEBCO sheet 5.17, more recent data in raw form has been used in the preparation of IBCAO Beta version. The more recent data could benefit from an integration of datums and sound speed corrections, and could be "mined" for more detailed information. This may be the main contribution from Canada in the immediate future, since budget restrictions have severely curtailed field operations in the Arctic.

4. Work in progress and planned

IBCAO updates, conversion to general GIS formats; GEBCO Digital Atlas: Martin Jakobsson

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4.1. Dubious features, errors and new data sets

4.*1.1. Dubious features in Norwegian waters*
4.1.2. New data from the Norwegian Petroleum Directorate
4.1.3. Error due to gridding in the Frantz Josef Land Archipelago
4.1.4. False seamount like features north of Svalbard
Swedish cruise with icebreaker Oden, 1991.
4.1.5. New data on the Alaskan Pacific margin from the
Naval Oceanographic Office.
4.1.6. Newly incorporated data from AWI
4.1.7. Dubious feature in the Canada Basin
4.1.8. Dubious submarine track in Barrow Strait

4.2 Topography updates

4.2.1. Alaskan topography updated from GLOBE

4.3. Conversion to general GIS formats

4.4. GEBCO Digital Atlas

4.1 Dubious features, errors and new data sets

4.1.1. Dubious features in Norwegian waters

Through information from Morten Sand and Harald Brekke of the Norwegian Petroleum Directorate (NPD), several dubious features have been identified in the Norwegian waters. These include three positive, semi-circular features with up to 1000 m relief and up to 30 km diameter, and one negative feature with approx 400 m relief and a diameter of approximately 40 km northwest of the Lofoten Islands. The three positive features are approximately positioned respectively (Figure 7):

i) 70°E 30'N/4°E 40'E
ii) 68°E 45'N/9°E 55'E
iii) 70°E 05'N/11°E 30'E.

Feature i) has been covered by recent multibeam-surveys by the Norwegian Petroleum Directorate, and proven to be non-existent. Feature ii) is crossed by seismic lines (1982-vintage, fair navigational quality) and is proven to be non-existent. Feature iii) is not covered with data that is available to the Norwegian Petroleum Directorate, but they strongly doubt the existence. The negative feature mentioned is positioned at approximately (Figure 7):

iv) 70°E 00'N/6°E 45'E

This location was checked with available seismic by NPD and the feature is found to be non-existent. In the same area a number of smaller features also seem doubtful according to NPD (e.g.: a low at 69°00'N/6°40'E, a low/high couple at 69° 30'N/11°15'E, and a high at 69°35'/13°55'E).

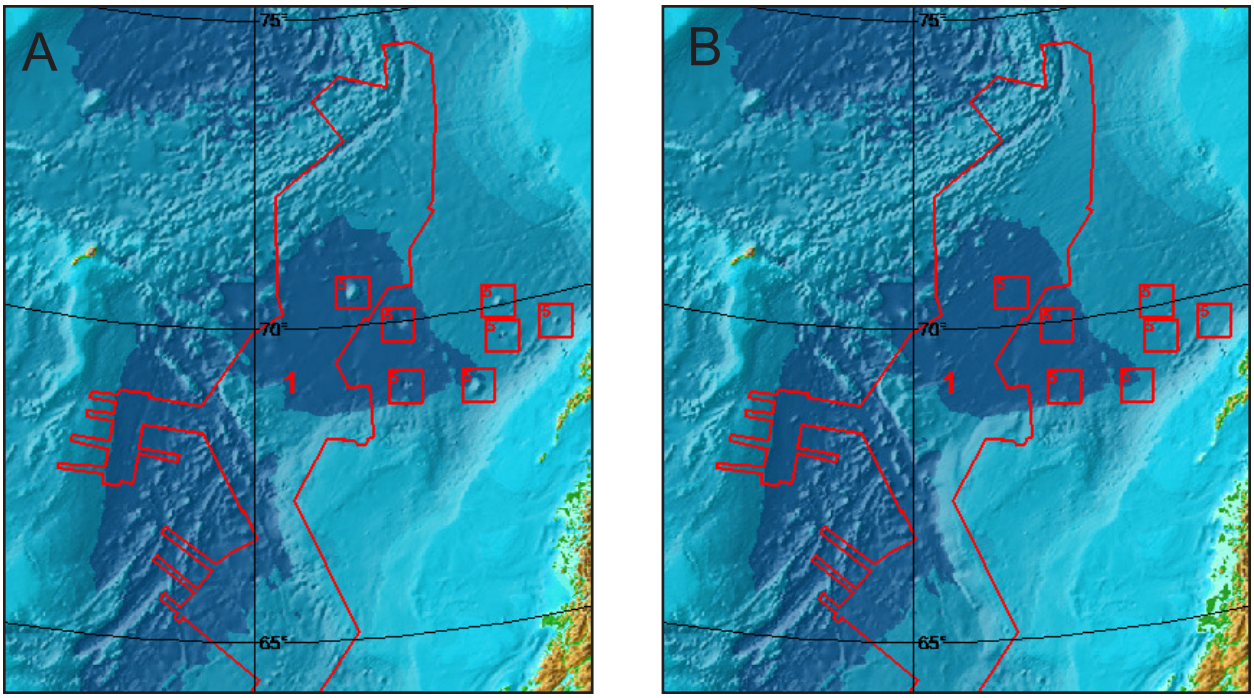

Figure 7. The large area (ca 180 000 km^2) indicated by no 1 was updated by incorporating the 1x1 km DTM from NPD. The small boxes show dubious features pointed out by NPD. Figure A shows the Beta grid and Figure B the updated version of IBCAO were the erroneous features are removed and the 1x1 km DTM from NPD included.

The above-mentioned main features i-iv were found to derive from the following sources:

i) An outlier from the Hawkbill 1999 data.
ii) Soundings from the Norwegian Institute of Fisheries
iii) Soundings from the Norwegian Institute of Fisheries
iv) Data retrieved from NGDC

These soundings and the soundings causing the smaller features that were questioned by NPD in Norwegian waters have been flagged, and will not be included in the gridding of the updated IBCAO version.

4.1.2. New data from the Norwegian Petroleum Directorate

An area of ca 180 000 km^2 has been covered by multibeam surveys carried out by NPD using a Simrad EM12-multibeam sonar during the summers of 1999 and 2000 (Figure 7). The data has been processed by NPD and provided to IBCAO as a 1x1 km DTM. The updated version of the IBCAO grid makes use of this entire DTM. Figure 7 shows a comparison between the Beta version of IBCAO and the new updated version in the area where the multibeam data from NPD has been included.

4.1.3. Error due to gridding in the Franz Josef Land Archipelago

In the Franz Josef Land Archipelago a false island appeared due to overshooting of the surface spline in tension gridding algorithm (Figure 8). This island has been removed by inserting depth values derived from the nearest contours, which has the effect of suppressing the overshooting in the gridding process.

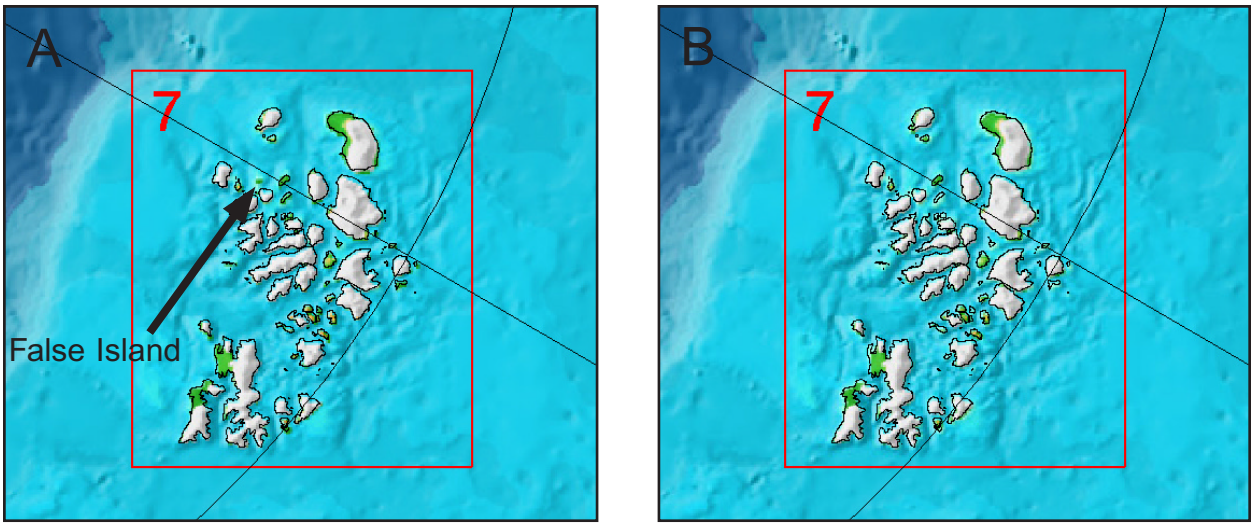

Figure 8. False island in the Franz Josef Land Archipelago (A) that appeared due to overshooting of the surface spline in tension gridding algorithm. This island has been removed by inserting depth values derived from the nearest contours, which has the effect of suppressing the overshooting in the gridding process (B).

4.1.4. False seamount like features north of Svalbard

North of Svalbard three elongated features trending NNE from approximately 81°50'N/23°E, with a max relief of approx 2000 m, caught our attention while developing a method for error estimation using the area around Svalbard as a test data set (see section 5). These features were associated with high errors in our error estimation (Figure 9). In addition, NPD also raised their doubts about these features. Finally, the new data from cruise ARK-XV/2 in 1999 with R/V Polarstern proved that these features did not exist. They arose from data collected by the Swedish icebreaker Oden in 1991. In the updated version of IBCAO these features are removed (Figure 10).

4.1.5. New data on the Alaskan Pacific margin from the Naval Oceanographic Office

Contours from NIMA charts over the Pacific margin have been digitized by NAVOCEANO. These contours are included in the updated version of IBCAO in order to supplement the contours from GEBCO used in the compilation of the Beta version of IBCAO.

4.1.6. Newly incorporated data from AWI

New AWI data incorporated in the updated version of IBCAO includes Hydrosweep (center beam) data from the ARK-XV/2 cruise in 1999, and Hydrosweep (all beams) data from the ARK-VII in 1991. The latter data set has been processed at the Center for Coastal and Ocean Mapping using CARIS HIPS. Figures 10 and 11 show the results of including the ARK-XV/2 and ARK-VII data, respectively. However, it was decided during the meeting that AWI will deliver a 1x1 km dtm based on all their Hydrosweep data north of Svalbard and in the Fram Strait. This data will be included in the updated version of IBCAO.

4.1.7. Dubious feature in the Canada Basin

A seamount-like feature located at approximately 73°54'N/138°54'W in the Beta grid was derived from contours digitized from the HDNO/VNIIO/RAS (1999) map (Figure 12). Canadian hydrographic observations at this location do not confirm the existence of this feature, therefore we removed these contours from the updated version of IBCAO.

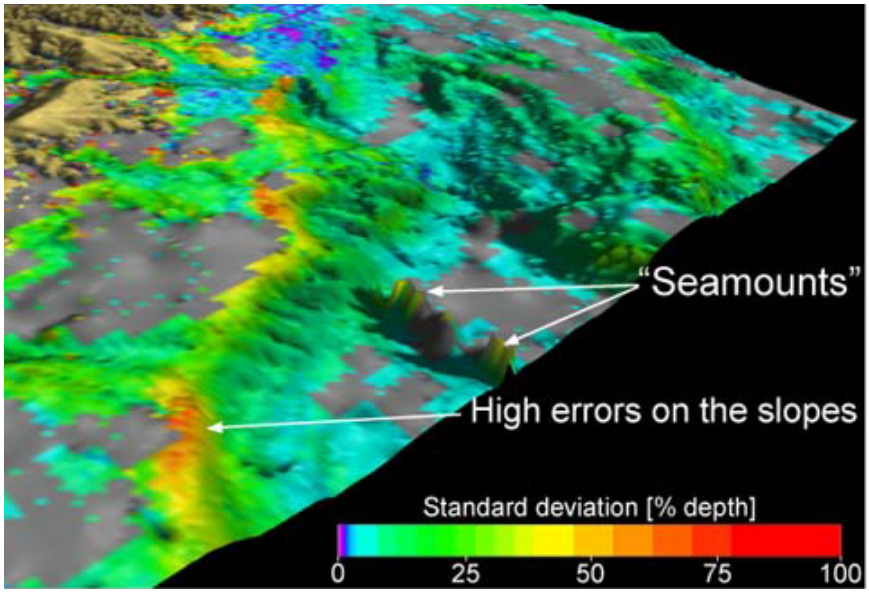

Figure 9. 3D-image, created using the software Fledermaus, showing the estimated standard deviation as a percentage of the depth draped on the IBCAO bathymetry. The error estimate shows clearly that significant error is associated with the indicated seamount like features later revealed not to exist by a recent survey with R/V Polarstern.

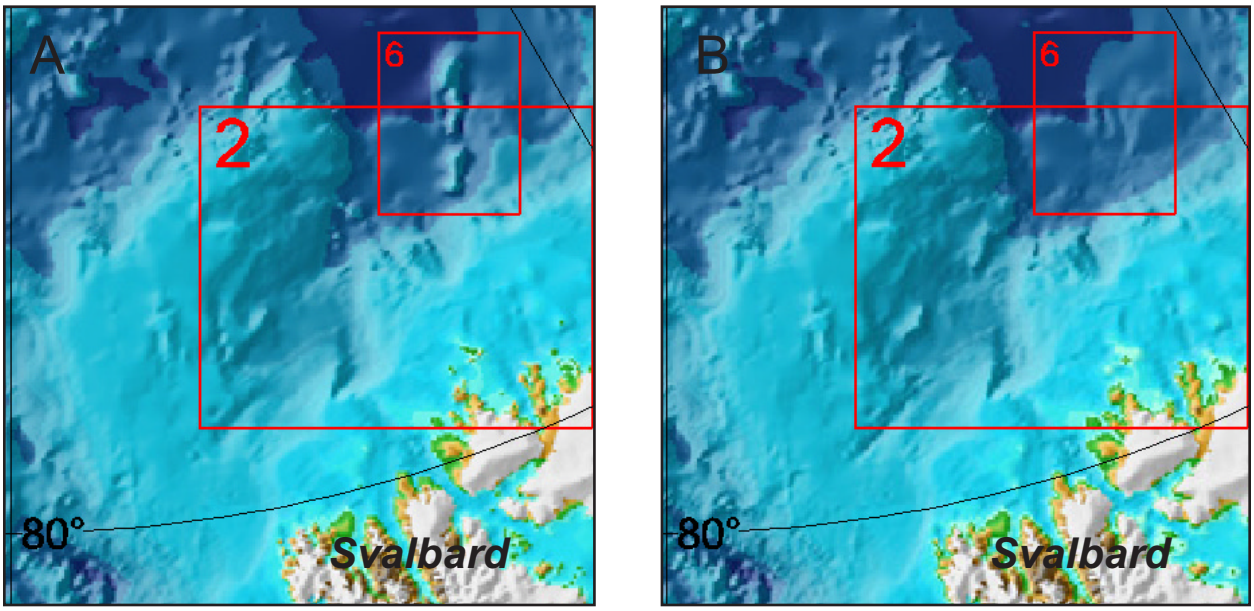

Figure 10. North of Svalbard (Box 6) three elongated features trending NNE with a max relief of approximately 2000 m were present in the IBCAO Beta version (A). These features were caused by erroneous data from the Swedish cruise with ice breaker *Oden* in 1991. In the updated version of IBCAO these features have been removed (B). Box 2 indicates the area were data has been included in the updated version of IBCAO from cruise ARK-XV/2 in with R/V Polarstern, 1999.

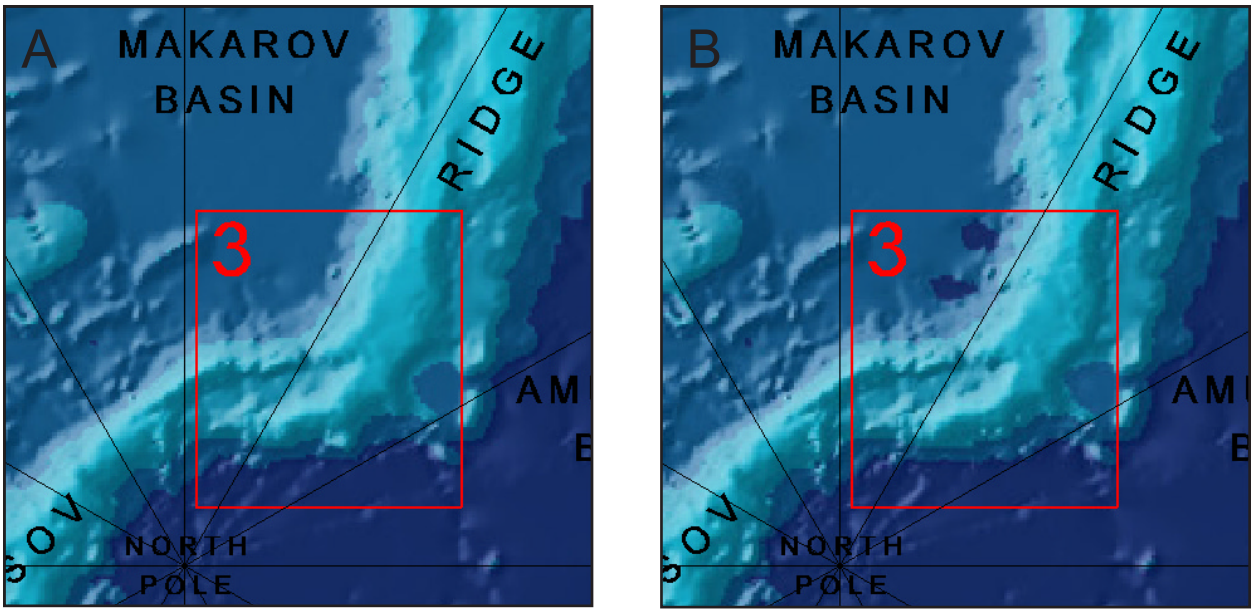

Figure 11. In the area of the Lomonosov Ridge indicated by box 3 Hydrosweep (all beams) data from the ARK-VII cruise in 1991 have been incorporated into the updated version of IBCAO (B). The data was processed at the Center for Coastal and Ocean Mapping using CARIS HIPS.

4.1.8. Dubious submarine track in Barrow Strait

Part of a submarine track executed between 1958 and 1962 portrays an elongated feature at a much greater depth than the surrounding data (Figure 13). Matching crossings at either end of this feature suggest that this part of the track is doubtful. Therefore, this part of the track was removed from the compilation of the updated version until it could be verified.

4.2. Topography updates

4.2.1. Alaskan topography updated from GLOBE

The IBCAO topography derives from GTOPO30, although it will be updated in areas where the GLOBE data set offers a more accurate topography. Errors were discovered in the area covered by GLOBE tile A, which derives in part from GTOPO 30. These errors have been updated in Release 1.1 of GLOBE, warranting a similar update in IBCAO. Below is the information about the updates, as it appears in the GLOBE readme file:

1. In the area between 66 and 67 degrees north latitude, 162 and 165 degrees west longitude: The data were discovered to be low by a ratio of feet to meters. This suggests that the original Defense Mapping Agency data, reformatted and distributed by the U. S. Geological Survey (GLOBE data type 5) were erroneously divided by that ratio. The source 3 arc-second data were multiplied by 3.28, compared with Digital Terrain Elevation Data for confirmation, then substituted at these new values into tile A. In source/lineage tile a11s, corresponding to this data tile a11g, areas so changed were given a source/lineage category 51. This class is considered original source 5, modified by GDC for GLOBE update version 1.1 for this tile. At the time of this work, other DEMs still apparently use the erroneously vertically referenced category 5 data in this area.

2. In the area between 61 and 62 degrees north latitude, 162 and 163 degrees west longitude: The source 3 arc-second USGS tile was found to cover only the northern half of this 1-degree area. The 3 arc-second data (GLOBE data type 5) were resampled to 30", and combined with DTED level 1 discrete data (GLOBE data

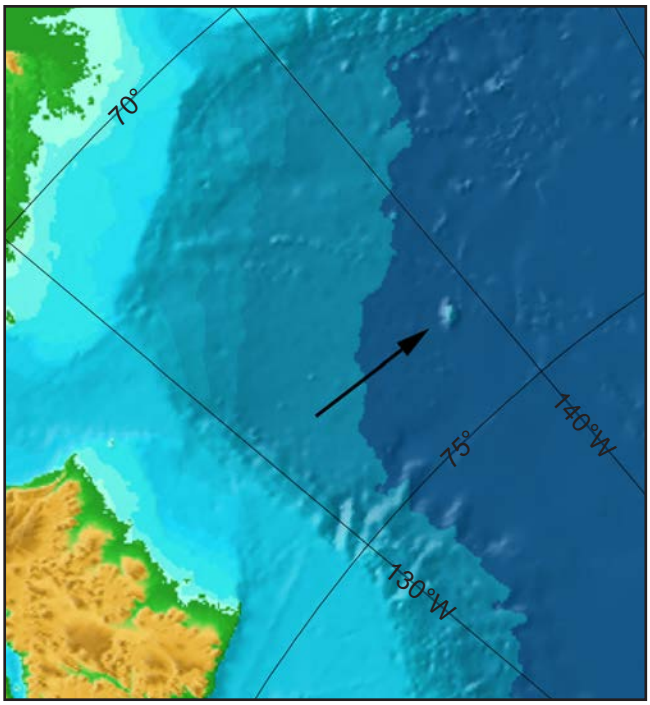

Figure 12. The seamount-like feature (indicated by the arrow) in the Beta grid was derived from contours digitized from the HDNO/VNIIO/RAS (1999) map. Canadian hydrographic observations at this location do not confirm the existence of this feature, therefore we removed these contours from the updated version of IBCAO.

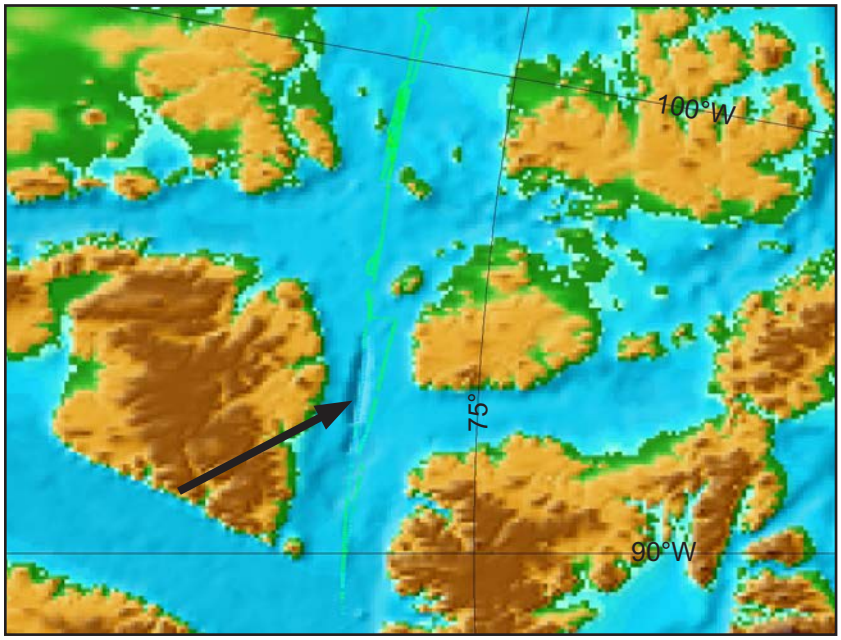

Figure 13. The arrow points at the part of a submarine track executed between 1958 and 1962 that portrays an elongated feature at a much greater depth than the surrounding data. Matching crossings at either end of this feature suggest that this part of the track is doubtful. Therefore, this part of the track was removed from the compilation of the updated version until it could be verified.

type 1) covering the southern half of the area. The resultant tile was compared with Digital Terrain Elevation Data for confirmation, then substituted into tile A. In source/lineage tile a11s, corresponding to this data tile a11g, areas so changed were given a source/lineage category 51. This class is considered original source 5, modified by NGDC for GLOBE update version 1.1 for this tile. Note that some of the updating uses GLOBE source/lineage category 1 data to replace nonexistant (previously misplaced) source/lineage category 5 data. At the time of this work, other DEMs still apparently use the misplaced category 5 data in their compilations.

3. In the area between 69 and 69 degrees north latitude, 134 and 135 degrees west longitude: The lowest-lying part of the Mackenzie River delta was labelled 15 meters, whereas the majority of that part of the delta (e.g. immediately to the west and south) was labelled 1 meter elevation. Many such modest discontinuities are found between 1x1 degree DTED cells. In this case, however, visualizations of the data were adversely affected. So that part of the delta in the abovementioned area was relabeled to 1 meter elevation, to be consistent with the data for the rest of the delta. In the source/lineage tile a11s, corresponding to this data tile a11g, areas so changed were given a source/lineage category 3a. This class is consisered original source 3, modified by NGDC for GLOBE update version 1.1 for this tile. At the time of this work, other DEMs still apparently use the discontinuous category 3 data in their compilations.

   This work was assisted by Sven Trudeau, of the Ecole Superieure des Geometres et Topographes (ESGT), Le Mans, France, during his visit to NGDC during January-July 2000, working on GLOBE.

4.3.0. Conversion to general GIS formats

Several IBCAO users have reported difficulties in importing the grid to various types of GIS software. This appears to be a particular problem for ArcView users, due to a mismatch between other GIS data such as vector coastlines and the zero metre level in the IBCAO grid. We have found that this is caused by a limitation in ArcView where the true scale (75°N for IBCAO) cannot be set in the polar stereographic projection which is supported in ArcView, nor can this projection be used with the WGS 1984 datum. Therefore we will take on the task of converting the IBCAO grid to formats suitable for some of the most widely used GIS and mapping software.

4.4.0. GEBCO Digital Atlas

The updated version of the IBCAO grid will be included in the global 1 min grid of the GEBCO Digital Atlas, which is scheduled to be completed during the summer of 2001. This will require a conversion of the polar stereographic grid to a geographic 1 min grid, or to regrid all the original un-projected cleaned data to a geographic 1 min grid. The latter approach is not feasible since the GMT gridding algorithm performs poorly at very high latitudes. After consultation with Walter Smith a conversion method was found:

1. Construct a geographic dummy grid of the area to be included (180°W-180°E, 64°-90°N) containing zeros as z-values.

2. Project this grid to the IBCAO projection (polar stereographic, true scale at 75°N). This was done using the GMT program *mapproject* (Wessel and Smith, 1990).

3. Use the GMT program *grdtrack* to interpolate points to projected coordinates of the dummy grid by using a linear interpolation and an associated grid (the new version of the polar stereographic IBCAO grid).

4. Unproject the interpolated points from grdtrack

5. Use the GMT program *xyz2grd* to create a netCDF geographic 1 min grid from the excersise above.

The result is shown in Figure 14.

GEBCO contour map: Norm Cherkis

The GEBCO Sixth Edition continues to evolve, but there are still no final plans for publication. One group favours "print on demand" while another favours printed maps. A gridded version is envisioned for the final product, however the present effort is to produce an updated, GEBCO Digital Atlas (GDA) in 2001. A "beta" version of GDA-2001 is presently in the hands of members of the GEBCO Subcommittee on Digital Bathymetry.

This version of the GDA (GDA-2001) will be updated by assimilating and edge-matching contours derived from the current version of the IBCAO grid. Departing from the standard GEBCO contours, however, the IBCAO data will be incorporated with the following contour intervals: 20, 50, 100, 150, 200, 250, 300, 350, 400, 500, 600, 800, 1000, 1200, 1400, 1500, 2000, 2500, 3000, 3500, 4000, 4500, 5000, 5500 and 6000 meters.

Cherkis will take the most complete set of these contours, provided by Martin Jakobsson of UNH, to the British Oceanographic Data Centre (BODC) in late June or early July of this year. The intention is to load them into BODC's GEBCO data base, and to make proper edge matches with GEBCO sheets 5.01 through 5.04. The work is expected to take about two weeks. The general release of the GDA-2001 is scheduled to occur late in 2001.

IOC contour map: Ron Macnab

At the last meeting of the Editorial Board, it was announced that HDNO had funds budgeted for printing Arctic sheets in the standard cartographic format of the IOC's International Bathymetric Charts (IBC) series. It was agreed that Martin Jakobsson and Sergei Maschenkov would discuss procedures for extracting a suite of standard isobaths from the IBCAO grid, which would then be conveyed to HDNO for use in constructing the IBC sheets. However during the May 2000 Arctic Earth Science Week in St. Petersburg, HDNO personnel expressed reservations about portraying grid-derived isobaths, and stated their preference for showing contours based upon actual observations,

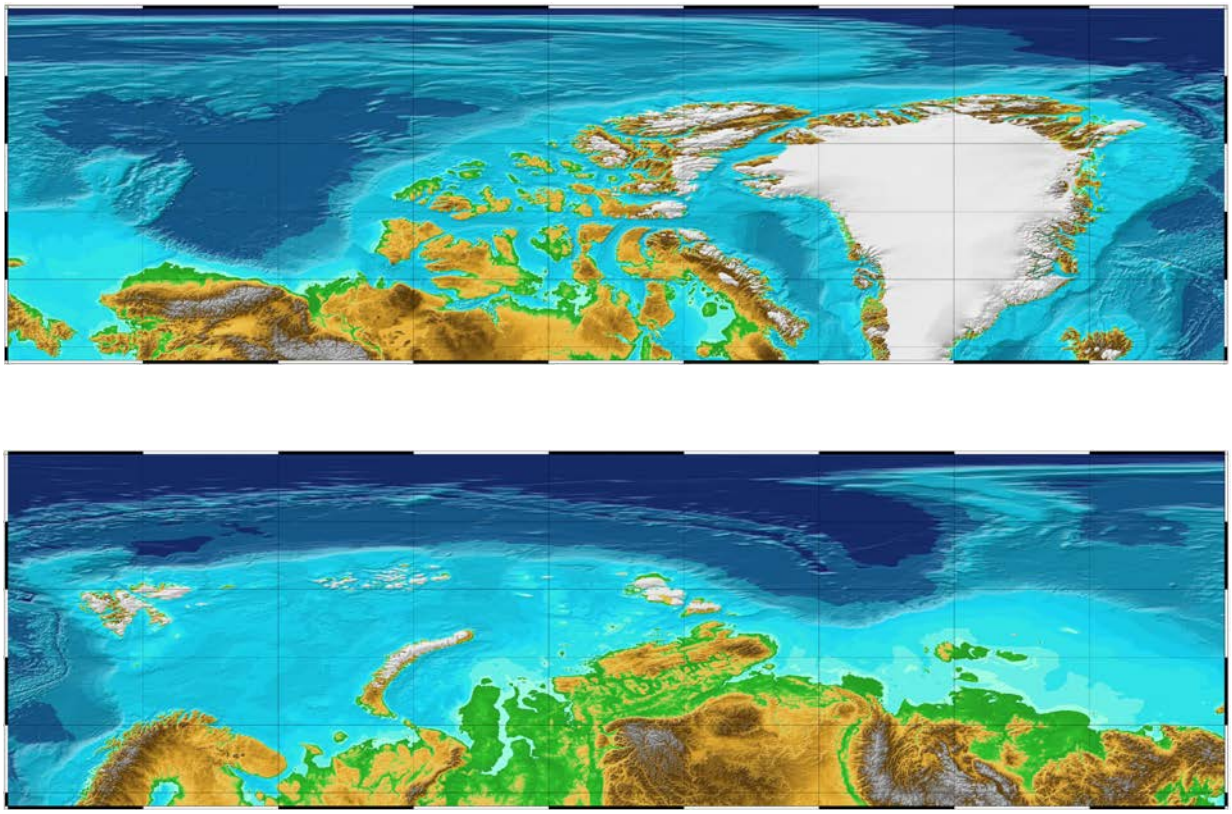

Figure 14. Shaded reliefs portaying the 1x1 min geographic grid (see text about compilation).

which could be extracted from the official map that was published by their organization and VNIIO in 1999. The matter was not further pursued at the time, and when it was brought up for discussion at the recent CGOM Meeting in St. Petersburg, no decision was taken concerning final action. Therefore for the time being, the matter is considered to be under IOC and HDNO advisement, and the Editorial Board will initiate no new action unless and until a specific request is received from IOC.

Sound speed correction model for the Arctic Ocean: Robert Anderson

Currently, sound speed corrections for the Arctic are based on Carter's Tables, which were generated using data collected in the early 1970s. Owing directly to a lack of oceanographic observations, the entire Arctic was lumped into one table, implying the lack of diversity in water masses in the region. Recently there have been several expeditions in the Arctic, both on the surface and below the ice, that have collected CTD data. Preliminary examination of the more recent information suggests that the Arctic is actually characterized by several velocity provinces. A more detailed and definitive investigation and collection of oceanographic data needs to be performed, and funding is being sought for this purpose.

5. Other IBCAO-related investigations

Spectral comparison between IBCAO bathymetry and ERS gravity: geophysical implications: David McAdoo and Seymour Laxon

Comparisons of the UCL/NOAA ERS Arctic marine gravity field (Version 3) with the IBCAO (Beta grid) bathymetry have been made using one-dimensional spectral techniques. These comparisons can help define the density and mechanical structure of the crust and upper mantle for portions of the Arctic Basin. Moreover, such comparisons reveal that: bathymetry in selected places such as the Chukchi Borderlands and the Mendeleev ridge is highly correlated with gravity, and is isostatically supported by a thin (<5 km), weak lithosphere - not unlike the Basin and Range Province in the western US. In many other areas of the Arctic such as the Canada Basin or the Siberian shelves, these bathymetry and gravity are quite uncorrelated due to processes such as erosion and sedimentation. In such areas if bathymetry is sufficiently smooth it may be possible to use gravity power spectra (PSD's) to help characterize basement topography or sediment thickness. The current version of the UCL/NOAA ERS Arctic marine gravity field may be obtained from the web at: http://ibis.grdl.noaa.gov/SAT/curr_res/polar.html

Estimation of errors in sparse bathymetric geophysical data sets with IBCAO as a case study: Brian Calder and Martin Jakobsson

We considered the problem of estimating the quality of gridded bathymetry when the input data consists of multiple datasets of varying origin and, thus, quality. In combining these data, we are also often forced to use a complex interpolation scheme due to the sparseness and irregularity of the data points. Consequently, we are faced with the difficult task of assessing the confidence that we can assign to the final grid product, a task that is not usually addressed in most bathymetric compilations This has important implications on use of the gridded data, especially when it is used in support of further oceanographic modeling tasks.

We approached the problem via a direct-simulation Monte Carlo method. We started with a small subset of hand-cleaned data from the (IBCAO) grid model. The test dataset shows examples of data sources ranging from single beam soundings with available metadata to spot soundings with no available metadata and digitized contours. From this database, we assigned *a priori* error variances based on available meta-data, and when this was not available, based on a worst-case scenario in an essentially heuristic manner. We then generated a number of synthetic datasets by randomly perturbing the base data using normally distributed random variates, scaled according to the predicted error model. These datasets were next re-gridded using the same methodology as the original product, generating a set of plausible grid models of the regional bathymetry that we could use for standard error estimates. Finally, we repeated the entire random estimation process and analysed each run's standard error grids in order to examine sampling bias and variance in the predictions. The final products of the estimation were a collection of standard error grids at different resolutions, a measurement of estimation reliability, and an overall assessment of gridding algorithm stability as a function of grid resolution.

Our experiments clearly showed areas of high certainty associated with the more accurate data in the dataset, and regions which were less reliable, typically associated with contour-based data. We also discovered areas of unexpectedly high uncertainty, which we subsequently found to be associated with erroneous data from a single transit line. We combined the estimates of stability at multiple resolutions into a single grid using an acceptability rate of 5% of the estimated depth, and found that areas of low stability typically correlated with significant relief in the seafloor and areas of sparse data. However, assessment of stability must be considered in conjunction with a measure of data density since the interpolation algorithm may be unrealistically stable in the presence of over-abundant data points from correlated data tracks (e.g., contours).

We concluded that prediction of accuracies in final gridded products is possible using this Monte Carlo approach, with the added advantage that the output error assessment is in the same form as the original gridded product. Our predictions on the test dataset agreed with common sense, and provide important caveats on the use of gridded data products. Our analysis at multiple resolutions suggested an approach to estimating stability in gridded products, and the possibility of prediction of grid resolution from data.

Arctic Gravity Map: Bernie Coakle

An Artic gravity map combining data from the US Naval Research Laboratory (NRL), measurements collected during the SCICEX expeditions, point data from the Geological Survey of Canada (GSC), and satellite derived gravity data is being constructed. The final version of this map is due to be released in 2002. The current version of this map may be viewed at: http://www.nima.mil/GandG/agp/

Map of Arctic Sediment Thickness: Ron Macnab

MAST is an attempt to complement existing thematic geoscientific maps of the Arctic Ocean (bathymetry, gravity, magnetics) with a portrayal of sediment thickness initially in the deep ocean basin, and eventually (circumstances permitting) on the continental shelves. IASC has agreed to sponsor the undertaking, and is supporting a Project Planning Group that first met in 2000, and which is scheduled to meet again in November 2001. From structural and operational viewpoints, the project is loosely patterned after the IBCAO initiative. Details may be obtained from the IASC Project Catalogue, which is available on-line at: http://www.iasc.no

ROUND TABLE DISCUSSION

Following the presentations above, a general discussion ensued with a focus on the future form and direction of the IBCAO project.

IBCAO version 1.0 (grid and printed map)

As noted in foregoing presentations, the IBCAO Beta grid has been updated through various corrections, along with the addition of new data sets. Various options were presented and considered with respect to the format and mechanism for releasing the updated grid and map, referred to as IBCAO Version 1.0.

It was agreed that Grid 1.0 will be placed on the project Website at NGDC for free downloading by users in a variety of GIS-compatible formats. The structure of this grid will be identical to that of the Beta Grid, i.e. square 2.5 X 2.5 km cells in a Cartesian coordinate system, with origin at the North Pole. NGDC will consider providing a burn-on-demand service, whereby users may request that selected grids be copied to CD-ROM for a nominal fee.

Grid 1.0 will also be provided to the GEBCO organization for inclusion in the 2001 edition of the GEBCO Digital Atlas (GDA). The grid will be presented in two coordinate systems: cartesian (2.5 x 2.5 km) and geographic (1x1 min), the latter to ensure seamless continuity of the GEBCO grid of global bathymetric up to the North Pole. It was announced also that standard GEBCO contours will be extracted from the IBCAO grid for inclusion in the GDA, and that Norm Cherkis will be verifying the continuity of the IBCAO contours with those of the adjacent GEBCO sheets to the south.

There was general agreement to construct a successor to the Provisional Map that first appeared as an insert in Martin Jakobsson's PhD thesis. This map will replicate the general layout of GEBCO Sheet 5.17, i.e. its scale will be 1:6,000,000 at 75°N, and its southern limit will be 64°N (except for extensions to accommodate Greenland, Iceland, etc). The map will actually be realized in a series consisting of one primary map (shaded relief with superimposed depth contours) and three auxiliary maps (depth contours only, data types and distributions, and grid uncertainties). It is anticipated that the primary map will satisfy purposes that are primarily aesthetic, whereas the auxiliary maps are expected to prove useful for a range of scientific and technical applications, e.g. analysis and interpretation, planning, reliability assessments.

Three distribution mechanisms are envisaged for the map(s). (1) The primary and auxiliary maps will be posted on the project Website as plot files for free downloading by users who have suitable plotting facilities at their disposal. (2) NGDC and GSC have facilities for printing and distributing these maps on demand, and one or both organizations may be disposed to offer such a service for a nominal fee; it was left to David Divins and Ron Macnab to explore options with their organizations, and to liaise between themselves with a view to devising a suitable arrangement. (3) Recognizing that there is likely to be a demand for a high-quality hardcopy version of the primary map and that not all users may be inclined to deal with the first two distribution mechanisms, it was decided, subject to a market analysis, that a quantity of such maps should be commercially printed for sale at a nominal price; NGDC will explore options in this respect.

For longer-term consideration, it was suggested that the IBCAO Website be enhanced to include an interactive GIS capability, which would permit users to interrogate selected components of the IBCAO data base, and to construct custom products for downloading. Tools for doing this exist and are readily available, however the design, implementation, and support of such a service will require human resources that are not immediately accessible.

The future of IBCAO

Since its inception, IBCAO has benefitted formally from the moral and/or financial support of three sponsoring organizations: the International Arctic Scientific Committee (IASC), the Intergovernmental Oceanographic Commission (IOC), and the International Hydrographic Organization (IHO). According to IASC's terms of reference, IBCAO is now considered to be a "mature" project that has achieved its primary objective. Consequently, IBCAO no longer qualifies in principle as a formal IASC project that is eligible for financial support; in IASC parlance, the Editorial Board is now designated as a "network". While the implications of this change in status have yet to be fully determined, it is presumed that IASC will maintain its interest in the IBCAO project, and that it will continue to endorse its objectives and operations.

IOC, on the other hand, has made it clear that the IBCAO project should remain an active component of its International Bathymetric Chart program, in order to promote exchange and interaction with similar initiatives in other regions, and to provide advice and expertise as and where needed. Similarly, IHO has confirmed its endorsement of the project, and appears ready to maintain its association with the activity.

To ensure IBCAO's continuing viability, it has long been appreciated that the project requires a stable base of operations, complemented by a core of dedicated individuals who will assume responsibility for maintaining the data base, for updating the grid and map products, and for ensuring their timely distribution. Thanks to the vision and generosity of CCOM/JHC and allied organizations such as NGDC, the primary fulfilment of these requirements appears to be relatively secure for the near term, however Editorial Board members were advised against complacency, and encouraged to take a long-term view concerning future requirements for maintaining IBCAO as a live, dynamic project that will continue to provide an authoritative portrayal of the Arctic seabed.

Provisions were discussed at some length for handling new contributions to the data base, and for incorporating them in future product versions. A preliminary model was developed that attempted to describe the flow of new information into the project data base, to allocate responsibilities for dealing with updates, revisions, etc, and to identify potential events or circumstances that might trigger different phases of the process (Figure 15). While the first two requirements appeared reasonably straightforward to define, the last one proved more difficult to resolve on account of the unpredictable nature and timing of the precipitating factors.

Data and product quality control emerged as critical factors in the development of future IBCAO grids and maps. It was pointed out that for a given data set, basic quality control should realistically be the responsibility of the data originator, who should also be prepared to present metadata when submitting a new data set for inclusion in IBCAO. Satisfying these requirements will substantially facilitate subsequent operations on the data base. Quality control for new grids and maps is normally performed during the revision/production process, but some level of external review is highly desirable before these products are fully released in the public domain. It was agreed that members of the Editorial Board are well qualified to serve as product reviewers, and that their feedback will be sought when new grids and maps need to be reviewed.

It was acknowledged that IBCAO activities have benefitted enormously from the volunteer efforts of enthusiastic individuals, and from in-kind contributions of generous organizations. Nevertheless, these will always need to be supplemented by a certain level of funding to support exchange visits, attendance at meetings, etc. In past and current years, project activities have been sustained by a series of fiscal contributions from various organizations: IASC, IOC, Swedish organizations (Stockholm University, Natural Science Research Council, Polar Secretariat, Ymer-80 Foundation), US organizations (Office of Naval Research, Polar Research Board), and the Canadian Hydrographic Service. Efforts will continue to attract at least moderate amounts of funding from these and similar sources. In light of IBCAO's high level of acceptance by the Arctic research community, it was suggested that the US National Science Foundation might be receptive to a proposal for a more substantial level of funding, and it was agreed that this option was worth investigating.

As reported at the beginning of the meeting, the IBCAO project is being touted by IOC as a model for future bathymetric compilations. At the 2000 meeting of the IOC Executive Council, a proposal was accepted to develop the International Bathymetric Chart of the South East Pacific Ocean (IBCSEPO) along similar lines; a meeting has been scheduled for early October 2001in Valparaiso, Chile, to consider the feasibility of this activity, and to develop a project plan. In the meantime, a suggestion has been advanced to undertake a parallel initiative in the South Atlantic Ocean; this will be pursued in the coming months to gauge potential levels of interest in the region, and if warranted, to prepare a proposal for consideration at next year's meeting of the IOC Executive Council.

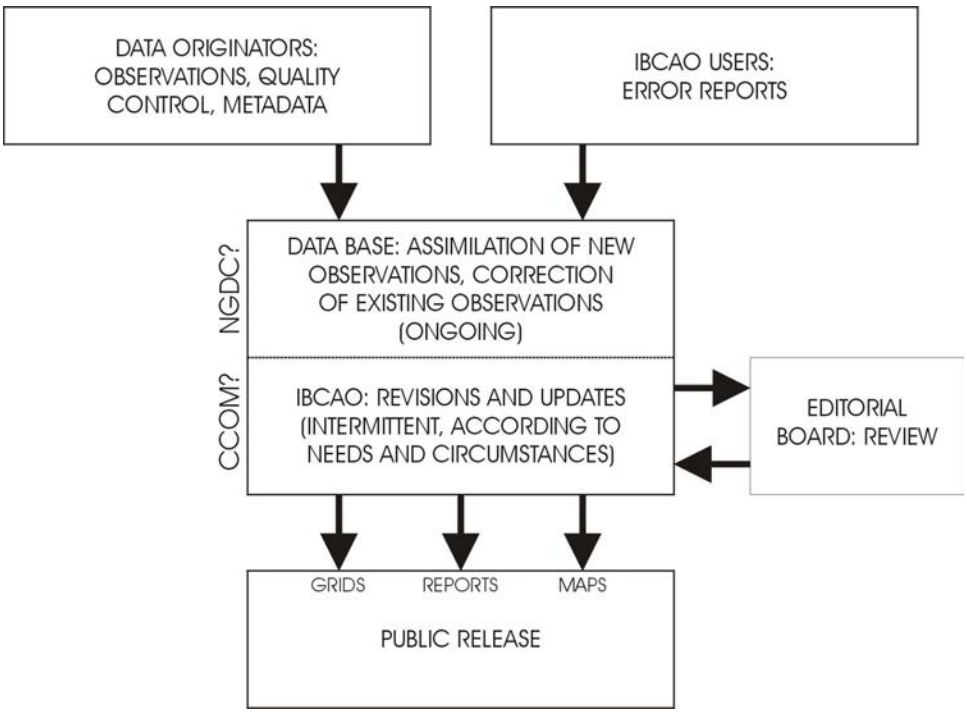

Figure 15. A preliminary model was developed that attempted to describe the flow of new information into the project data base, to allocate responsibilities for dealing with updates, revisions, etc, and to identify potential events or circumstances that might trigger different phases of the process.

CLOSE OF MEETING

Participants agreed provisionally that the next meeting of the Editorial Board would take place in the fall of 2002, in a location to be decided. The Chairman thanked the managers of CCOM/JHC for the use of their facilities and for the logistical support in staging the meeting. He expressed appreciation for assistance received from IASC, IOC, and the US Polar Research Board, in providing travel support to participants who might otherwise not have been able to attend. He thanked David Divins, who had cheerfully agreed to take notes on the proceedings. Finally, he thanked all participants for their lively and enthusiastic participation in the discussions, and declared the meeting closed at 1400 on Monday May 28.

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APPENDIX A: ACRONYMS AND ABBREVIATIONS

ARCUS	Arctic Research Consortium of the US
AWI	Alfred Wegener Institute
BCFS	Bathymetric Chart of Fram Strait
BODC	British Oceanographic Data Centre
CCOM	Center for Coastal and Oceanic Mapping
CGOM	Consultative Group on Ocean Mapping
CRDF	Civilian Research and Development Foundation
EEZ	Exclusive Economic Zone
ERS	European Research Satellite
FramBIS	Fram Strait Bathymetric Information System
GDA	GEBCO Digital Atlas
GEBCO	General Bathymetric Chart of the Oceans
GIS	Geographic Information System
GPS	Global Positioning System
HDNO	Head Department of Navigation and Oceanography
IASC	International Arctic Science Committee
IBC	International Bathymetric Chart
IBCAO	International Bathymetric Chart of the Arctic Ocean
IBCSEPO	International Bathymetric Chart of the South East Pacific Ocean
IHO	International Hydrographic organization
IOC	Intergovernmental Oceanographic commission
JHC	Joint Hydrographic Center
MAST	Map of Arctic Sediment Thickness
NGDC	National Geophysical Data Center
NOAA	National Oceanic and Atmospheric Administration
NPD	Norwegian Petroleum Directorate
NRL	Naval Research Laboratory
NSF	National Science Foundation
ONR	Office of Naval Research
SCAMP	Seabed Characterization and Mapping Pods
SCICEX	Science Ice Exercise
SSBS	Side Scan Bathymetric Sonar
UCL	University College London
USCGS	US Coast Guard Ship
VNIIO	Research Institute for Marine Geology and Mineral Resources of the World Ocean

APPENDIX B: AGENDA

OPENING FORMALITIES

Welcoming remarks		
	CCOM	Larry **MAYER**
	JHC	Andy **ARMSTRONG**
IBCAO sponsors' remarks		
	IOC	Ron **MACNAB**
	IASC	Garrik **GRIKUROV**
Logistical arrangements		Martin **JAKOBSSON**
Adoption of agenda		Ron **MACNAB**

PRESENTATIONS AND RELATED DISCUSSIONS (MAX 15 MIN EACH)

1. Reviews of recent accomplishments

IBCAO presentations	Ron **MACNAB**
Website activity	David **DIVINS**
Beta grid; provisional map; Arctic GIS workshop (Seattle, Jan 2001)	Martin **JAKOBSSON**

2. New data sets

The bathymetry of Fram Strait; Polarstern Hydrosweep data	Hans-Werner **SCHENKE**
Multibeam data from the NPD	Harald **BREKKE**
SCICEX SCAMP data	Robert **ANDERSON**
Prospects for Russian data	Garrik **GRIKUROV**

3. Prospects for future data sets

Future surveys with the USCGS Healy	David **DIVINS**
Polarstern cruises	Hans-Werner **SCHENKE**
Danish surveys North of Greenland	Arne **NIELSEN**
The future of SCICEX	Bernard **COAKLEY**
Canadian hydrographic data	David **MONAHAN**

4. Work in progress and planned

IBCAO grid, conversion to general GIS formats; GEBCO Digital Atlas	Martin **JAKOBSSON**
GEBCO contour map	Norm **CHERKIS**
IOC contour map	Ron **MACNAB**
Sound speed correction model for the Arctic Ocean	Robert **ANDERSON**

5. Other IBCAO-related investigations

Estimation of errors in sparse bathymetric geophysical data sets with IBCAO as a case study	Martin **JAKOBSSON/** Brian **CALDER**
Spectral comparison between IBCAO bathymetry and ERS gravity: geophysical implications	David **MCADOO**
Arctic Gravity Map	Bernie **COAKLEY**
Map of Arctic Sediment Thickness	Ron **MACNAB**

ROUND TABLE DISCUSSION

IBCAO version 1.0 (grid and printed map)

The future of IBCAO
- Project management and operating structure
- Data management and updates
- Quality control of IBCAO data
- Funding

Porting the IBCAO project model to other regions

CLOSE OF THE MEETING

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THIRD MEETING OF THE EDITORIAL BOARD OF THE IASC/IOC/IHO

INTERNATIONAL BATHYMETRIC CHART OF THE ARCTIC OCEAN (IBCAO)
May 27-28
Center for Coastal and Ocean Mapping/Joint Hydrographic Center

University of New Hampshire

Photo: David Wells

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2.	Bob **ANDERSON**	7.	Andrew **ARMSTRONG**	12.	David **DIVINS**
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