

# ARCTIC OCEAN SCIENCES BOARD

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## REPORT OF THE FOURTEENTH MEETING

9-10 March, 1995  
Bremerhaven, Germany

Cover photograph shows the bird cliffs at Mallemukfjeld on Holm Land. Photograph courtesy of Christian Hjort, Lund University, Lund Sweden.

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# Arctic Ocean Sciences Board (AOSB)

## Fourteenth Meeting (AOSB-XIV)

9-10 March, 1995  
The Alfred Wegener Institute  
Bremerhaven, Germany

### **Opening of the Meeting**

Dr. Pentti Mälkki, Chair of the AOSB, opened the meeting on 9 March, 1995. Dr. Max Tilzer, Director of the Alfred Wegener Institute for Polar and Ocean Research (AWI), welcomed the participants and expressed his pleasure in hosting this year's meeting at the Institute. The AWI has three functions, namely; to conduct polar research, to provide logistics support for all German research in polar regions, and to provide advice to the German Government on polar issues. In research, the Institute focuses on problems that require an interdisciplinary approach. Dr. Tilzer emphasized that coordination is essential in the conduct of Arctic research due to the complexity of both the science and logistics requirements.

The Chair welcomed the new participants to the Board, Drs. Pryamikov and Alekseev from Russia, and Mr. Odd Rogne, the Secretary of IASC. It was reported with regret that Dr. van Aken, The Netherlands; Dr. Ola Johannessen, Norway; and Dr. Dooley, ICES, would not be able to participate. The agenda for the meeting was adopted and is attached as Appendix IV.

### **The International Arctic Polynya Programme (IAPP)**

Dr. Legendre, chair of the IAPP was unable to attend but prepared a report on the current activities of the IAPP which the Board acknowledged. In this report Dr. Legendre noted that the SCG IAPP would meet in conjunction with the NEW Symposium in May, 1995 in Helsingor, Denmark, and would provide information to the Board on the IAPP activities at a later date. (\* 1)

### **The Northeast Water Polynya Programme (NEW)**

Planning for the NEW Symposium has been completed and is scheduled for May 1995 in Helsingor, Denmark. Many of the results and much of the data from the NEW research will be presented at the Symposium. It was mentioned that the results from the Symposium may be published by The Journal of Marine Research. However, no information was available to the Board regarding funding of such an endeavour. The Scientific Coordinating Group (SCG/IAPP) has assumed that a normal journal issue would result. It is also possible that a book would be produced describing the NEW studies in a semi-popular format; Danish colleagues are considering this option.

It was suggested that the data set from the summer period, May through September, is complete, but additional data is still required for the winter months. Planning is therefore underway for such a winter/spring expedition using the *R/V Polarstern* to bring in supplies in September, 1995. The scientific party will need to be flown in and out and discussions have been held with Polish

scientists in this respect. Dr. Weslawski reported that scientists in Poland are interested in continuing coastal marine ecology studies on phytoplankton and zooplankton with emphasis on autumn and spring water column processes. If funding can be obtained, the expedition would be implemented in early 1997 with the facility at Eskimonoes.

**The Board urged its members to participate in the NEW Symposium. The Board further agreed that an AOSB Newsheet summarising the Symposium results should be developed in cooperation with the Steering Committee for the Symposium. The Board recognised the potential value of a book on NEW to encourage public awareness and future support for polynya research. (\* 2)**

**The Board supports continuation of the NEW studies through a potential winter/spring expedition and invited scientists who might be interested to contact the IAPP. The Board requested the SCG/IAPP to consider the case for a winter NEW programme at its May meeting.**

#### **North Water Polynya Programme (NOW)**

Mr. Holland noted that the North Water polynya is again receiving more attention in Canada following interest from studies and workshops. A proposal has been submitted to the Canadian Natural Sciences and Engineering Research Council (NSERC). A large group of Canadian scientists (about twenty) is involved together with another twenty scientists from other countries. Such an expedition would be planned as early as 1996 aboard the *CCS Louis St. Laurent* and would last around twelve weeks with a possible winter-over in the polynya. Plans call for a second follow-up expedition led by U.S. scientists in 1997. The central goal will be to study the processes which govern the opening and development of the polynya. An interim expedition made to the North Water polynya two years ago on the motor vessel *Arctic* resulted in about one week's observations in the North Water; the data and results have not yet been published.

During the 1996 expedition scientists expect to study early biological productivity and follow its production from May to early August. The Canadian scientists have submitted a preliminary proposal; if NSERC shows interest, then a full proposal would be submitted. Anticipated costs for the Canadian programme would be around \$1.5 to \$2 million Canadian. A final decision is expected by May of 1995. Dr. Louis Legendre expects, if a decision is received by May of this year, it should be possible to begin the work as scheduled. U.S. scientists intend to present proposals for their follow-on studies to the National Science Foundation later this year. (\* 3)

**The Board strongly supported the planning for the NOW effort and encouraged polynya scientists currently involved in NEW to cooperate with the planning and implementation of the NOW study. The Board accepted the nomination of Dr. Louis Fortier to succeed Dr. Lyn Lewis as the NOW representative to the SCG/IAPP and invited the Japanese member to designate an observer to the SCG/IAPP. (\* 4)**

#### **St. Lawrence Island Polynya Programme (SLIP)**

It was noted that in Japan there has been a long history of collaborative investigations between Hokkaido University and the University of Alaska in the Bering Sea, including in the St. Lawrence Island Polynya (SLIP) area. This cooperative activity has been expanded to include the National Marine Fisheries Service of NOAA, and Old Dominion University. The fisheries' research vessel *Oshoro Maru* of the Hokkaido University is supporting this research. Last year studies were

undertaken on appendicularian tunicates which are dominant zooplankton in the SLIP area.

In the United States, key scientists in polynya research have been concentrating their efforts in the NEW programme and are also now becoming involved in planning activities for a potential NOW programme. This leaves little opportunity for an immediate thrust in the SLIP. **The Board recognised the wisdom of developing the IAPP on a sequential basis and suggested that the general observation programmes of Japan and the U.S. in the Bering Sea should be continued, but a larger scale study of SLIP should be left to a later date.**

### **The Greenland Sea Project (GSP)**

It was reported that the GSP Symposium was just being concluded in Hamburg. The Symposium had been very successful with many new and controversial results.

One major conclusion that emerged from the buoy measurements was that deep water convection in the 1980's had decreased to about 15-20% of its level in the 1950's and deep waters have become increasingly salty and warmer. This finding may well have implications for changes in the deep waters of the entire Atlantic Ocean and therefore on future climate. Dr. Meincke reported that the Symposium supported the conclusion of the GSP as planned and implemented by the AOSB.

Publication of results from the Symposium is still under discussion. A deadline of August 31, 1995, has been set for submission of manuscripts and it is expected that about 20-25 refereed papers will result. The Board members were asked to support the publication through their collective purchase of sufficient numbers of copies to eliminate page charges. Additionally, a volume of abstracts is being considered with a similar August 31, 1995 deadline for submission. The Steering Committee proposed that the AOSB join with the Deutsche Forschungsgemeinschaft (DFG) to publish this volume (which is expected to include 86 papers ranging from two to four pages).

It was noted that the original plans for the GSP called for intensive field studies over a five-year period followed by another five-year period of satellite observations in an attempt to obtain a long-term understanding of the prevailing phenomena. The first period had been extended to study the ocean features in more detail; however, the need for longer-term studies remains. From the observations to date, no one year has been equivalent to another in terms of measured parameters. For example, trends in the extent of sea-ice still have not been established. Furthermore, one of the basic problems that the Greenland Sea Project was to investigate, and which is still not understood, is the ice formation in Bukta Bay along the break of the continental shelf. In winters when the ice extends far into the Greenland Sea, the Bay opens from the north in a short span of time, five to seven days, and stays open the rest of the winter, despite freezing air temperatures. The mechanism behind this phenomenon is not understood.

It was reported that extensive investigations are being carried out in the ESOP programme (European Sub-polar Ocean Programme) of the European Union MAST II Programme, supported to a great extent by satellite remote sensing and modeling. This could be considered as a follow-on to GSP with participation of a number of scientists from the GSP. A proposal is being prepared for a continuation of this work under the MAST III programme.

It was suggested that the Board has an interest in the GSP data set being maintained and available for use by both scientists and students. These data might be very useful as a means of introducing young scientists to Arctic research. The International Council for Exploration of the Seas (ICES) has been acting as the GSP data center for all data except satellite data, although it was not clear

how much is readily available for use, especially the CTD data.

**The Board recognised that the GSP officially closed with the completion of the Symposium and expressed deep appreciation to the Steering Committee of the GSP for its outstanding work in the planning, implementation and successful conclusion of the programme. The Board agreed to consider assisting with the publication costs as suggested. (\* 5) The Board also considered that a follow-on GSP was being adequately covered by European programmes and no further AOSB action was required.**

**The Board decided to request ICES to provide information regarding the status of the GSP database; the individual data sets they have received; which data sets are lacking; and when such data sets are expected to be received. Following on from the discussion on GSP data, the Board agreed to bring to the attention of national authorities the usefulness of data and results from such coordinated international programmes such as the GSP and IAPP, whose value extends well beyond the research for which they were originally collected.**

### **Arctic Ocean Data Management**

The Board received Dr. van Aken's report on the proposed establishment of an "Arctic Marine Data Inventory Centre" which would serve as a focal point for inventorying and providing access to Arctic Ocean data, including electronic access through the Internet. The latter could also involve setting up an "Internet Home Page" for Arctic Ocean data. (\* 6)

An Arctic Data Centre could track software available for accessing and using in-situ and remote sensed data; categorise data by region or sub-region; and assist clients in the use of the system. This centre need not be centralised, but could provide access to a distributed data network. In the latter case, participating centres would provide quality control for their respective data holdings.

The centre could also generate products such as CD-ROM's with all Arctic Ocean data or all GSP data. The centre could operate on a cost-recovery basis, but the centre would still have to be managed. Estimates are not yet available for various options, but one professional serving as a "data scout" would be sufficient to support an arctic centre in the simplest mode. However, for a more comprehensive data centre, a larger staff would be needed.

It was noted that inventories for some Arctic ocean data inventories already exist, e.g., for the Arctic Monitoring and Assessment Programme (AMAP). However, the type of comprehensive system the Board is interested in would extend beyond such focused data sets. The European Union has set up a consortium, under the lead of the British Oceanographic Data Centre (BODC), to develop an inventory of all European ocean data (contact person - Meirion Jones at the BODC). (\* 7)

Under the Arctic Climate Study (ACSYS) of the World Climate Research Programme (WCRP), an effort is being undertaken to assemble an historical Arctic Ocean climate database which would include historical temperature, salinity, oxygen and nutrient measurements collected in the Arctic Ocean by various national agencies. Cooperation among Canadian, Russian, West European and U.S. scientists is already underway for compiling information on climatological fields. The Institute of Ocean Sciences (IOS), Canada, is the responsible institution for assembling the data. Most of the western Arctic Ocean data, as well as gridded early Russian data, has been assembled at IOS. This portion of the database hopefully will be released within the next few months, probably on an optical disk. (\* 8)

A major component of the Arctic data set are the Russian historical temperature and salinity Arctic Ocean data (collected from about 40,000 stations) assembled into a comprehensive database at the Arctic and Antarctic Research Institute (AARI), Russia. Historical chemical data are planned to be loaded into the AARI database in 1995-1996. Unfortunately, the Russian oceanographic station data prior to January 1, 1994, are under restriction and presently unavailable to the international ACSYS community.

Research-quality historical Arctic precipitation and run-off data are needed to provide input for more complex modeling of the Arctic hydrological cycle. A comprehensive Arctic Precipitation Data Archive (APDA) and an Arctic Run-off Database (ARDB), incorporating existing historical precipitation and river run-off records for the period of 1978-1994, are expected to be assembled under ACSYS. The APDA will be hosted at a major hydrological institute participating in ACSYS (the host agency has not yet been identified). GRDC data holdings on Arctic rivers are currently very limited (about 15 sites).

With respect to the corresponding situation in the Antarctic, two relevant scientific advisory bodies, SCAR and COMNAP, have set up a working group to develop specifications for an Antarctic data center which has resulted in plans for an Antarctic Master Directory. However, while the Antarctic Treaty establishes an intergovernmental framework through which such requirements can be identified and funded, there is no similar framework in the Arctic within which governments can be approached to develop a data management system.

The Secretary reported that a draft resolution is being presented to the WMO Congress which would confirm as a matter of policy the principle of free and unrestricted exchange of meteorological data and would, to implement this policy, establish an international practice of two tiers of exchange. The first tier would include data with no restrictions; the second tier would include data which would be submitted by nations to the WMO system, distributed internationally through the WMO GTS system, and be accepted by nations which would agree that such data would not be re-exported.

It was agreed that data collected under the aegis of the AOSB should be used for research and not for commercial purposes, although recognising that monitoring of commercial use would be very difficult. It was noted that the WMO/IOC/ICSU Joint Scientific Committee for the WCRP is scheduled to meet in March 1995 and is expected to formulate an unequivocal statement urging that the policy of free data exchange for research purposes be maintained. (\* 9)

Based on guidelines established last year, an ad-hoc working group developed a policy statement for management and exchange of Arctic Ocean data. It was noted that the term "meta-data" in this context refers to relevant related data, such as meteorological and terrestrial data.

**The Board agreed to set up an ad-hoc group on Arctic Ocean data with objectives, terms of reference, and membership as noted in Appendix II included in this report. (The Chair will identify a convener for this group after all the nominations have been received). (\* 10)** Additionally, the Board decided in terms of priority that: firstly it needed to deal with AOSB data; then consider access to related data sets, such as those of AMAP, ACSYS, etc., and then possibly national data sets; and finally consider needs for the identification and preservation of historical data sets. The Board recommended that, where possible, arctic ocean data collected under its auspices be used for research and not commercial purposes. The Board adopted the "Data Policy Statement" which is included as Appendix III to this report.

## Other Arctic Initiatives

### The International Arctic Buoy Programme (IABP)

Dr. V. Savtchenko reported that the Fifth session of the IABP will be held in Landover, Maryland, U.S. in early April, 1995. The IABP provides input to the World Weather Watch and to ACSYS. An agreement has been developed between the IABP and the Arctic and Antarctic Research Institute, Russia, to design, manufacture and deploy argos drifting buoys in the Kara, Laptev and East Siberian Seas. It was noted that if IABP buoys were to be used in polynya research, it would be necessary to redesign them to be able to work in open water, as well as on ice, and to be able to refreeze in forming ice so as to operate efficiently after refreezing.

### Arctic Monitoring and Assessment Programme (AMAP)

Dr. Simon Wilson presented a progress report on AMAP to the AOSB. AMAP has identified a number of qualified oceanographers to provide input with respect to the preparation of the upcoming Arctic Assessment Report (AAR) and the final AAR is intended to be compiled and edited by December 1996.

**The AOSB expressed its appreciation to AMAP for its report; indicated its continued interest in AMAP activities and its willingness to work with the AMAP to assure that AMAP activities are of the highest scientific calibre; and reaffirmed its shared interest in issues related to data management.**

### European Committee on Ocean and Polar Sciences (ECOPS)

Dr. Boissonnas reported that ECOPS had developed a series of "grand challenges" under its two sponsoring bodies, the European Science Foundation (ESF) and the Commission of the European Union. One of the "grand challenges" is the "Arctic Ocean Grand Challenge", which is a plan for ocean research in the Arctic for the next ten to fifteen years. The ECOPS plan goes far beyond the normal range of EU funding. The plan is offered to the EU members and participating countries. There are also other grand challenges focused on the deep-sea floor, continental shelf dynamics, biodiversity, and ice core drilling in the Antarctic. The total funds for each Grand Challenge may be in the order of a "a couple of tens of millions" of ECU.

During mid-March, 1995 a meeting is scheduled in Strasbourg to discuss and possibly establish a new European Ocean and Polar Research Board (or Boards). It is not yet clear whether this effort will focus on research and its coordination or on resources. The Board(s) will be staffed by a Secretariat of two people (one each for polar science and ocean science) which is already in place. It is expected that ECOPS will continue and will serve as an advisory mechanism to the new Board(s). The two boards, Polar and Marine, will be established under a common European Forum for Marine and Polar Sciences. The Forum's effort is likely to focus on such issues as strategic long-term thinking about futuristic priorities and programmes and on coordination of logistics, infrastructure and heavy equipment. The boards are planned as non-governmental bodies and will be comprised of expert representatives from research institutions. (\* 11)

In the past year some new programmes have been adopted by the EU. MAST-II will be replaced by MAST-III with a substantial budget increase. The four specific areas of MAST interest are marine science, strategic marine research, marine technology, and supporting initiatives.

MAST areas of research in the Arctic that may be of special interest to the AOSB are coastal processes, including physical and ecosystem processes, extreme marine environments, and marine technology. The MAST and Environment programmes will interact closely on such subjects as coastal ecosystems. MAST activities are open to non-EU/EFTA (European Free Trade Association) countries that are involved in consortia consisting of at least two EU/EFTA countries and are expected to bring their own share of the funding to the activity.

The EU Programme on Environment and Climate is also likely to be of interest to the AOSB. Its main topics of relevance are: basic processes in the climate system, the climate system in the past; and biosphere processes. Under this programme, the ENRICH network may also be of interest to the AOSB as some Arctic processes are included in the ENRICH scientific agenda.

The budget for MAST-III is ECU 228 million, that of Environment and Climate is ECU 532 million. Normal contracts require cost-sharing at around 50%, except for university contracts which can claim 100% of the incremental (marginal) costs of the research. A participating university is expected to continue to cover the salaries of its statutory staff (professors, etc.) taking part in the research. For universities, administrative (or overhead) costs are limited to 20% of the research costs.

### **Remote Sensing Activities**

The European Space Agencies (ESA) satellite ERS-1 is currently completing its second 168-day repeat cycle which permits excellent spatially detailed analysis of the gravity field of the Earth and establishment of an ocean surface reference. In March 1995, it will return to a 35-day repeat cycle. The satellite has produced a large data set of SAR (Synthetic Aperture Radar). The Along Tracking Scanning Radiometer (ATSR) has the capability of measuring sea surface temperature with an accuracy of  $\pm 0.3^\circ$  centigrade.

ERS-2 is being prepared for launch in Kourou, scheduled for April 11 or 12, 1995. The satellite duplicates ERS-1 instrumentation and adds a Global Ozone Monitoring Experiment (GOME). ERS-1 and ERS-2 will be operated simultaneously to "calibrate" the instruments by data comparison and thus establish a continuous data set over approximately eight years. Having two identical satellites with SAR capability in simultaneous operation permits determination of very small shifts of the Earth's surface. These techniques have already demonstrated measurements of small shifts in the order of 3 cm in areas of shore-fast ice.

(\* 12)

ENVISAT, the European contribution to the international polar platform system, is planned to be launched January 1999. It will carry an SAR operating at 5.3 GHz, i.e., the same frequency as ERS but with both horizontal and vertical polarization and a swathe that is increased to 400 km in one of the operational modes. The Medium Resolution Imaging System (MERIS) with narrow channels in the visual and near-infrared bands will, with its 900 meter resolution, be useful for ocean colour studies (plankton, suspended matter, etc.) under cloud free conditions.

Similarly, ESA developed a series of three METOP satellites for Eumetsat, the European meteorological satellite organisation. METOP-1 is scheduled for launch in the year 2001 with the other two following at five-year intervals. It comprises a double-swathe wind scatterometer to provide global wind fields on the oceans continuously and a Multichannel Imaging Microwave Radiometer (MIMR) which will give valuable data on ice extent and concentration.

The European Union has started the "Centre for Earth Observations" (CEO) programme, which is envisaged as a "distributed centre" of data suppliers (space agencies). To ensure proper coordination of activities in Europe, a European Earth Observation System (EEOS) has been established with participation of ESA and CEO personnel. ESA has begun planning two series of missions, Explorer Missions and Watch Missions comprised of satellites with a special application in contrast to present multi-purpose ESA systems. The first Explorer mission is being designed for land observations with a projected launch around year 2005.

The French SPOT-4 will be launched in 1997. SPOT-5 is being considered for launch around the year 2000, perhaps carrying an SAR operating at about 10 GHz. Radarsat-1 will finally be launched in August/September 1995, the main instrument being an SAR at 5.3 GHz with a number of operational modes, including a 400 km wide scan mode and a high resolution mode of 20 km with spatial resolutions of 100 m and 20 m, respectively.

### **The Canadian representative agreed to provide additional information on RADARSAT to the Secretariat. (\* 13)**

A new ADEOS satellite will be launched in February-March 1996 and an NSCAT including an ocean color scanner with accuracy similar to that of SEAWIFS. It was noted that the EUMETSAT system is charging all users, including research scientists, for using the data they collected. EUMETSAT has set up their own system for analysis and processing of data, comparable to the existing ESA system.

### **Nansen Arctic Drilling Programme (NAD)**

Dr. Fütterer reported on recent progress in NAD. A small NAD Secretariat was established and is co-located with the Ocean Drilling Program (ODP) offices in Washington, D.C. During a recent planning meeting for NAD a document was prepared discussing scientific drilling on the continental shelf margin of the Laptev Sea.

The history and paleo-climatic evolution of the Arctic Basin are the primary objectives of NAD. NAD has considered potential sites; the technology is available for this relatively shallow-water drilling; scientists are working on a proposal for funding under the Arctic Ocean Grand Challenge; and safety considerations are now being addressed. Swedish scientists have expressed interest in drilling (to 400m depth) on the Lomonosov ridge and are considering such a programme for 1996.

### **Laptev Sea Studies**

The Laptev Sea Studies are co-sponsored by a number of German and Russian institutions. The major objective is to study the evolution of processes in the Laptev Sea. The Laptev Sea is a primary producer of sea-ice and a sediment source which is exported with the ice. The ice also carries anthropogenic tracers that are very useful in sediment transport studies. The project is now moving into its third field season and plans are awaiting decisions on which platform(s) may be available for the coming field season. Results of these programmes will be of interest to other independent international programmes such as ACSYS which has similarly related projects underway.

The main objective of the first Laptev Sea study was to study fresh water outflow from the Lena River and its impact on the Laptev Sea. This outflow is carried primarily by three jets across the

continental shelf. The Kara Sea studies indicate that radionuclides found in sediments are of atmospheric origin; thus it appears that radionuclides generated in the Ob River system are not evidenced in the Kara Sea. Buoy deployments this year indicate that deployment by ship or helicopter permits improved accuracy of measurements of temperature, which cannot be obtained from buoys that are deployed from planes.

### **Scientific Committee on Oceanic Research (SCOR)**

SCOR activities in the Arctic are focusing on acoustic thermometry, sea-ice ecology, and a possible second JGOFS process study in the North Atlantic. SCOR will keep the Board apprised of these activities in order that both organisations are able to utilize and benefit from the results.

### **International Geosphere-Biosphere Programme (IGBP)**

There have been a number of IGBP activities in the Arctic, in particular in cooperation with IASC. In 1992 a workshop in Reykjavik, Iceland, identified about forty research projects in the Arctic related to global change. The report from the workshop entitled Scientific Plan for a Regional Research Programme in the Arctic on Global Change contains science plans for arctic global change, as well as a survey of ongoing or planned projects. In follow-up work, IASC has given priority to regional impact studies in the Barents and Bering Seas regions using the Mackenzie Basin Impact Study as a model.

Other projects endorsed include:

- \* An interdisciplinary study of the “Effects of Increased UV-Radiation in the Arctic”;  
Mass Balance of Glaciers and Ice Sheets (a science plan should be ready for distribution at the IASC Science Planning Conference in December); and  
Terrestrial Ecosystems and Feedbacks (a draft science plan is under review and an implementation plan is expected to be available by the end of the year).

The ocean science areas identified above clearly offer opportunities for close cooperation between IASC and AOSB. The IASC Working Group on Global Change, which includes all relevant sciences and some major arctic global change programmes, met last autumn in Stockholm, Sweden. This meeting included a workshop on regional impact studies which led to the identification of the above presented projects.

### **Surface Heat Budget of the Arctic Ocean (SHEBA)**

The U.S. Arctic System Science Study (ARCSS) identified three areas of emphasis: Northeast Water Polynya; the Arctic Ocean Section Study; and most recently the study of the Surface Heat Budget of the Arctic Ocean (SHEBA). Proposals were reviewed February 1995 for initial activities, especially for development of new technology and methodology needed for SHEBA. Proposals are expected to be received very soon from U.S. scientists for the programme. The initial activity is expected to be a programme mounted through a seventeen-month ice camp. A tethered balloon is expected to be flown twenty-four hours a day for low-level atmospheric measurements. (\* 14)

The scientists are convinced that a suitable ice-island can be located. For an arctic heat budget study, a one-point study for seventeen months represents a very large investment in one location. It is planned to augment this point study with helicopter and aircraft observations. International participation in the programme will be encouraged.

The plans for SHEBA appear to very much resemble some of the plans for the Arctic Ocean station being considered for the Arctic Ocean Grand Challenge. The Board foresaw a need for strong and active cooperation between the ECOPS Arctic Grand Challenge and SHEBA, as objectives for the respective programmes appear to be complementary. The approach to the Challenge might best be channeled through the European Science Foundation (ESF), since this would be a likely source of support for logistics for the Grand Challenge research.

**The Board agreed that it would be useful to ask the scientists who are designing the Challenge and SHEBA to investigate the possibilities for cooperation. It was also agreed that a letter should be drafted from the Board to suggest such cooperation could cover the whole suite of observations to be undertaken. (\* 15)**

### **Russian Activities**

Dr. Pryamikov and Dr. Alekseev presented a summary of major Russian science activities relevant to AOSB programmes which were undertaken in 1994. These included joint activities which were carried out with Norwegian colleagues, focusing on two expeditions between Franz Joseph Land and Spitsbergen. Investigations of fresh water input to the Kara Sea continue. Russian-German research was carried out in the Laptev Sea. Cooperative studies were undertaken with Japanese and U.S. scientists. U.S. and Russian scientists worked together on studies of radioactivity in the Ob River Basin.

The AARI recently was designated as Russia's State Center for Polar Research which assigns to the AARI a lead agency role for Arctic Ocean research, coordinating such research among all interested Russian institutions. Extensive cooperative research is planned in the future in the Russian Arctic with a number of expeditions planned for 1995.

### **The World Climate Research Programme (WCRP) and the Arctic Climate System Study (ACSYS)**

The physical climate system includes a "fast component" and a "slow component". The fast component is controlled by the atmospheric and upper-ocean heat engine. The slow component is controlled by the global ocean. ACSYS is one of the "slow climate processes" studies of the WCRP and is the only WCRP regional programme. A "Scientific Concept of the ACSYS" was issued as WCRP-72 in 1992. An initial implementation plan of the study was published in 1994 as WCRP-85. The primary goal of the programme is to ascertain the role of the Arctic in global climate. The main observational phase of the ACSYS began on January 1, 1994, and will continue for a ten-year period. The main focus of ACSYS is on the interactions between the Arctic Ocean circulation, sea-ice processes and the hydrological cycle.

The ultimate objectives of ACSYS are to:

- i) provide a valid scientific basis for the representation of the Arctic region in coupled global atmosphere-ocean models;
- ii) develop an effective climate monitoring scheme in the Arctic;
- iii) perform climate sensitivity studies with various model formulations; and
- iv) carry out scenario computations for specified large-scale atmospheric conditions, in order to evaluate possible impacts of climate change on the Arctic region.

ACSYS therefore includes studies of Arctic Ocean circulation and its variability, sea-ice cover, and Arctic atmosphere, as well as hydrological and oceanographic long-term climate research and monitoring.

The ACSYS modeling strategy includes optimization of different models for the Arctic region, using as many observations as possible, and response experiments to investigate the influence of the Arctic river run-off on the oceanic circulation, the dependence of the fresh water export to the North Atlantic upon processes occurring in the Arctic ocean, and the fresh water influence on the global “conveyor belt” circulation through modification of the deep water formation. Special emphasis is placed upon to what degree is high sensitivity of polar regions to increases in carbon dioxide; and whether this is due to inadequate model components or to true positive feedbacks.

### **The Canadian-U.S. Arctic Ocean Transect**

This joint expedition had originally been planned to begin in and end in the Bering Sea. However, when one of the vessels was damaged, it was decided they should exit the ice via the Atlantic. The study was interdisciplinary, involving atmospheric and oceanographic research. The goal was to increase the Arctic Ocean database related to global change, especially the Arctic Ocean Climate System; marine geology and geophysics; biology, including marine mammal studies; sea-ice studies related to ship performance; and ocean chemistry, including contaminant concentrations and their origins. More than fifty projects were completed.

From this transect, it appears that the Arctic Ocean is warming, as evidenced by the presence of Atlantic Water in the Arctic Basin. High levels of sediment were found in the ice virtually throughout the transect. Sedimentary changes in the basin appear to be occurring much more rapidly than had been expected. Biological productivity appears to be about ten times that suggested earlier. More definitive results are expected when the data from the transect is further analysed.

### **Future Scientific Focus for the AOSB**

#### **A) Paleo-river discharge study:**

In Scheveningen, the Board discussed the possibility of focusing its next scientific effort on paleo-river-discharge into the Arctic. Dr. Fütterer introduced a proposal for a study of "physical, chemical, biological, and geological processes of major Arctic river systems and their changes through the last 15,000 years". The major objectives would include studies of the modern river discharge system and of post-glacial Arctic Ocean river discharge. A special focus would be directed on fluxes between the river/shelf systems and the deeper waters.

Specific programmes might include:

- investigations of key biological species for different habitats;
- investigations of chemical tracers; and
- investigations of microfossil assemblages, sediment mineralogy, etc.

Specific areas for initial studies might include the Laptev Sea, the Eastern Barents Sea, and the Beaufort Shelf, each together with its related riverine systems. Research programmes underway or planned in all three of these areas could provide a base for these studies.

The proposed project has a strong land-ocean interaction component. It was proposed that a workshop be convened to consider this proposal and to develop a focused plan/proposal for a programme. It is clear that geographically a study of river inputs to the Arctic Ocean would focus on the Russian Arctic. Canadian scientists are interested in the potential programme of this type, although they do not foresee any major new activities in the Mackenzie River and basin region over the next few years. WCRP would very likely be interested in cooperating in such a project and it appears that the proposed project would be very closely related to the IGBP LOICZ program.

The Board addressed the question of what would be unique and valuable for Arctic scientists in pursuing such a programme. In the shallow areas, the sediment record is indicative of the climate history. Should a pilot project be considered (perhaps in the Pechora River Basin region) to, among other things, determine if the latter statement is accurate. The major difficulty is to get scientists to coordinate their efforts in the development of a realistic plan. It was noted that a U.S. programme exists on paleo-studies under the ARCSS program. In addition, a workshop will be convened in March/April 1995 to consider a possible programme in fluxes through the continental shelf. The interdisciplinary nature of such a project would make it uniquely valuable.

It was recognised, however, that the major interests of U.S. scientists are in the Bering Sea and Eastern Siberian waters (as expressed at the Ohio State workshop), whereas European scientists are interested in the Arctic Ocean Grand Challenge. European scientists meeting in Copenhagen recently indicated interest in the programme on the Quaternary Environment of the Eastern North (QUEEN). Under the Arctic Ocean Grand Challenge a programme has been proposed on paleoceanography.

The development of a bottom-up approach is needed to determine the level of interest in such a project. Freshwater input to the Arctic Ocean has long been recognised as very important for study of global change. Such a programme would have a strong oceanographic emphasis and the interests of other organisations and programmes could benefit a programme in this area.

It was suggested that possibly an initial focus on modern river discharge systems would be appropriate. Following an in-depth study, it could be determined whether it would be necessary to plan either a workshop or develop a new programme without further review or a start-up pilot project. A new programme would have to be designed to interact with QUEEN.

**The Board is generally favourable towards a study of post-glacial Arctic Ocean Paleo-River Discharge into the Arctic Ocean, and, in principle, decided to proceed with a programme in this area. Dr. Fütterer was asked to set up a small ad-hoc working group to consider the options for advancing this programme. The group was charged with moving quickly to explore the possible options for organising a programme. In particular, the group was asked to consider whether a workshop would be desirable to prepare a scientific plan for such a programme and if so, how such a workshop could be most effectively organised. The Group should also be aware of the Arctic Science Planning Conference now being planned by IASC.**  
(\* 16)

#### B) Tidal Glacier Discharge Study:

In some areas tidal glaciers are releasing sufficient freshwater to have significant impact locally and possibly regionally. In deep fjords the freshwater release from the glaciers has a substantial impact on formation of the deep water which flows out from the fjords. Ecosystems that develop in these fjords may differ significantly from those of other fjords.

There was a meeting to discuss Tidal Glacier Discharge involving scientists from Germany, Spain, France, Norway, Poland, the United Kingdom, and Russia. As many as five research vessels may be available for these studies which are designed as a component of a broader study of freshwater input to the Arctic or similar larger-scale study. Canadian scientists are planning a similar programme in the fjords of Ellesmere Island.

After rivers and sea-ice, tidal glacier ablation is the third largest inflow to the Arctic. The two areas of initial interest are the Sub-Arctic warm fjords, such as those of West Spitsbergen, compared with the fjords of Franz Joseph Land, which are much colder.

When ACSYS was initially designed, Arctic glacier discharge was thought to be not very significant. A WCRP Scientific Conference on the Dynamic of the Arctic Climate System (November 1994, Göteborg, Sweden) indicated the importance of such inflow. In the next version of the ACSYS Implementation Plan, expected to be prepared in 1997 - 1998, studies of such important elements of the hydrological cycle in the Arctic as run-off from Arctic glaciers and the Greenland ice sheet and iceberg calving will be reviewed. Interaction with the IASC Working Group on Glaciers, which is very interested in this topic, should be encouraged.

### **Relations with the International Arctic Science Committee (IASC)**

Mr. Rogne, Secretary of IASC, summarized briefly the history of IASC and its present activities. IASC emphasizes interdisciplinary sciences in broad themes with special emphasis being placed on interaction between the natural and the social sciences. He noted that IASC's scientific activities are organized primarily through working groups. IASC also has some "standing advisory committees".

IASC is now planning an "Arctic Science Conference" for December 1995 which is intended to be a scientific planning meeting. A number of working groups are preparing draft implementation plans for IASC priority projects for consideration at the Conference. The deadline for registration is 31 March, 1995, although this deadline may be extended. The priority areas for IASC and for the Conference are:

- Effects of Increased UV-Radiation;
- Regional Cumulative Impacts;
- Arctic Processes of Relevance to Global Systems;
- Natural Processes within the Arctic; and
- Sustainable Development in the Arctic.

IASC decided at its last meeting to invite the AOSB to become one of the "standing advisory bodies" to IASC. For the AOSB to assume this role, it would be necessary for the AOSB and IASC to sign a memorandum of understanding. Mr. Rogne distributed a draft MOU that could be utilised to define the future relationship between the AOSB and IASC. It was noted that the pre-ambular material in the MOU describes IASC and its objectives exclusively, but similar information on the AOSB was not included.

Mr. Rogne stated that the draft terms of reference should be interpreted as confirming that the AOSB addresses the entire Arctic region, but could also address science within smaller regions within the Arctic. Mr. Rogne indicated that IASC had extended the invitation to the AOSB to serve as an advisory body for "oceanography". The Board noted that the AOSB deals with the full range of "ocean sciences", not just "oceanography" which could be defined very narrowly.

The Chair interpreted the draft terms of reference to indicate that IASC would, if presented with a proposal for an ocean science activity, refer such a proposal to the AOSB. The question arose as to whether, if this interpretation is correct, present IASC ocean science programmes would be transferred to the AOSB or be maintained within the IASC structure. Further, it was noted that the Board has over its history focused on one or two major ocean science programmes at a time. If the Board were to accept IASC's invitation, the Board would assume responsibility for a wide range of, possibly all, ocean science programmes in the Arctic.

Such a new relationship could very well be in the best interests of Arctic Ocean science, in addition to other things, by clarifying the division of responsibilities for Arctic research between IASC and the AOSB. However, it was clear that this issue could not be resolved in the time available at this meeting.

The Board concluded that the development of such a new comprehensive working relationship with IASC should be thoughtfully pursued, and agreed that, if such an MOU is developed, the pre-ambular sections should each include parallel statements regarding IASC and the AOSB. The Secretary was asked to develop a text on the AOSB for submission to the IASC conference in Rovaniemi, Finland.

**The Board asked the Chair, working with the Bureau to continue negotiations with IASC to explore options for a long-term working relationship between the two organisations; to keep the Board informed of significant developments in this area; and, if warranted, agree on the AOSB's behalf to an appropriate arrangement establishing this relationship. (\* 17)**

#### **Relationship with the International Council for the Exploration of the Sea (ICES)**

The ICES Secretariat, which had specifically requested that ICES be invited to participate in AOSB activities, was unfortunately, not able to be represented at this meeting. It was noted that ICES has recently extended its activities, previously focused on the North Atlantic, to areas such as global change which are also of interest to the AOSB. ICES also acts as the data center for the GSP and ESOP. ICES holds an annual scientific conference which this year will include a mini-symposium on Arctic Ocean processes.

**The Board agreed to invite ICES to participate in future AOSB activities and to regularly distribute AOSB documents and information on AOSB activities to ICES. (\* 18)**

#### **NATO Advanced Study Initiative**

The Chair reported briefly on the status of this activity.

**The Board decided that no action in this area is necessary at this time, but asked the Secretary to keep the Board informed of any new developments.**

#### **Elections**

It was noted that the Board's tradition is to rotate the chairmanship between continents. The Chair then nominated Mr. Geoffrey Holland of Canada to assume the Chair in accordance with this tradition and Mr. Holland accepted the nomination

**The Board elected Mr. Holland as its next Chair by acclamation.**

Mr. Holland then nominated Dr. Dieter Fütterer of Germany to serve as Vice-Chair and Dr. Fütterer accepted the nomination.

**The Board then elected Dr. Fütterer as its next Vice-Chair by acclamation.**

### **Structure of the AOSB**

Dr. Mälkki thanked the members of the Board and the representatives of the participating international organisations for their assistance and cooperation in the work of the Board over the past two years. He noted that this very positive cooperation had made it possible for the Board to move forward in key areas over this period. However, the Board has had to work increasingly on an inter-sessional basis. He suggested that it might be useful for the Board to authorize a small "Bureau" to assist the Chair in taking actions needed on the Board's behalf between Board meetings.

**The Board established a Bureau consisting of the Chair, the Vice-Chair, the Past Chair and the Secretary.**

### **Other Business**

**Members which had not yet submitted to the Secretary their summaries of national activities were asked to do so within the next two weeks. (\* 19)**

The meeting participants were invited to review the distributed draft minutes, especially the sections regarding the discussions in which they had participated, and to similarly provide any comments to the Secretary within two weeks. The Secretary will compile a revised draft for distribution to all meeting participants. The final report will be prepared and printed for final distribution.

The Secretary reported that some members had expressed concern that the national reports included in the final reports are necessarily so brief that in many cases they do not permit inclusion of much information on national programmes that might be useful to members.

**The Board agreed and accepted an offer from the Secretary inviting members to submit, in addition to the brief report, a full national report which could be distributed separately to all participants.**

The Secretary suggested that the Board consider in the future making more use of electronic mail capabilities such as those of the Internet for both internal communications and for making information on the AOSB more readily available to those interested in Arctic Ocean research. (\* 20)

**The Board asked the Secretary to prepare a proposal on such an activity which the Board could implement at an early date. The Board also agreed that at future meetings the Board should include in its agenda, when appropriate, discussions of national and/or international Arctic science and/or related programmes and activities likely to be of special interest to the Board. (\* 21)**

### **Future Meeting**

**Dr. Mälkki invited the Board to hold its fifteenth meeting in Helsinki, Finland. The Board accepted this invitation and decided tentatively to convene its fifteenth meeting in Helsinki 27-29 March 1996.**

**The Board expressed its appreciation to Dr. Mälkki for his leadership over the past two years and welcomed his willingness to continue as past-chair and thus as a member of the bureau. The Chair expressed the thanks of the Board to the Alfred Wegener Institute for their hosting of this meeting and their excellent hospitality. Dr. Tilzer thanked the Board for coming to Bremerhaven.**

The Chair closed the meeting at 3:00 pm on Friday, 10 March 1995.

## APPENDIX A

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## APPENDIX IX

### ACRONYMS

AAR	Arctic Assessment Report
ACSYS	Arctic Climate System Study
AMAP	Arctic Monitoring and Assessment Programme
AOSB	Arctic Ocean Sciences Board
APDA	Arctic Precipitation Data Archive
ARDB	Arctic Run-off DataBase
ATSR	Along Tracking Satellite Radiometer
BODC	British Ocean Data Centre
ECOPSE	European Committee on the Ocean and Polar Sciences
ESA	European Space Agency
ESF	European Science Foundation
ESOP	European Subpolar Ocean Programme
EU	European Union
GOME	Global Ozone Monitoring Experiment
GSP	Greenland Sea Project
IABP	International Arctic Buoy Programme
IAPP	International Arctic Polynya Programme
IASC	International Arctic Science Committee
ICES	International Council for Exploration of the Seas
IGAC	International Global Atmosphere and Chemistry
IGBP	International Geosphere-Biosphere Programme
IOC	International Oceanographic Commission
IODE	International Oceanographic Data Exchange
IOS	Institute of Ocean Sciences
LOICZ	Land-Ocean Interactions in the Coastal Zone
MAST II	Marine Science and Technology
NAD	Nansen Arctic Drilling
NEW	Northeast Water Polynya Programme
NOW	North Water Polynya Programme
ODP	Ocean Drilling Programme
OECD	Organisation for Economic Cooperation and Development
QUEEN	Quaternary Environment of the Eastern North
SCG/IAPP	Scientific Coordinating Group/IAPP
SCOR	Scientific Committee on Oceanic Research
SHEBA	Surface Heat Budget of the Arctic Ocean
SLIP	St. Lawrence Island Polynya Programme
WCRP	World Climate Research Programme