A satellite image of the Arctic region, showing a large, bright white ice sheet in the center, surrounded by dark blue water and brownish landmasses. The text is overlaid on the image.

**Second International Conference on
Arctic Research Planning (ICARP II):**

**The Arctic System in a Changing
World**

Conference Proceedings

**Copenhagen, Denmark
10-12 November 2005**

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Full texts of Research and Implementation Plans will be published in a
separate document.

INTERNATIONAL CONFERENCE ON ARCTIC RESEARCH PLANNING II

The Arctic System in a Changing World

COPENHAGEN, DENMARK
November 10-12, 2005

CONFERENCE STATEMENT

The second International Conference on Arctic Research Planning (ICARP II) brought together over 450 scientists, policy makers, research managers, Indigenous Peoples and others interested in and concerned about the future of Arctic research. Conference participants concluded that:

Since the first Conference on Arctic Research Planning held in 1995 in New Hampshire, there has been a paradigm shift to a holistic and multidimensional perspective in the Arctic. This holistic perspective integrally includes the human dimension, Indigenous insights and a more full integration of Arctic processes in the earth system.

The Conference is the culmination of a 24-month planning process involving over 140 scientists working to develop research plans around thirteen critical research themes identified by the Conference sponsors based upon input from the science and Arctic community at large. Conference participants were actively involved in modifying and improving these plans for future implementation.

The Arctic is a unique and important part of the Earth system, environmentally, socially, economically and politically. It surrounds a northern polar sea strategically positioned between two continents and bridging eastern and western societies. How the Arctic system works, how it is changing, and what will it be like in the future are the important questions being asked by policy makers, land use managers, and people who reside in the Arctic. The ICARP II Conference put voice to these questions and developed plans to address them. But several important issues arose during the proceedings.

It became clear during the work of the Conference that the Arctic is a system that can no longer be divided into traditional disciplines. The linkages to other disciplines and other knowledge systems and to the global system is critical and must be addressed in the post-conference process. During the breakout sessions and in the concluding plenary session, it was repeatedly stated that education and outreach are critical components of successfully tackling the issues of the next decade as well as critical to creating the next generation of scientists. The integration of education and outreach is another element which must be addressed in each working group report and in the post-conference process.

Conference participants also raised continued concern about issues surrounding data management, interoperability and dissemination. It is clear that in light of the International Polar Year and implementation of ICARP II plans over the next decade that the research community must urgently address this issue. The need for enabling infrastructure to provide the platforms for the next generation of users is a critical need highlighted in the reports and during the conference plenary sessions. Providing for our future remote sensing needs, ice breakers, circum Arctic observing networks and the such is critical to meeting the needs of scientists in the years to come.

The ICARP II process will continue with the revision of working group reports guided by the Conference discussions, the development of a full Conference proceedings and ultimately implementation of the research plans that will benefit those who live in and near the Arctic as well as the global community at large.

Executive Summary

Overview

The Second International Conference on Arctic Research Planning (ICARP II) was held in Copenhagen, Denmark from November 10th through the 12th, 2005 and brought together over 480 scientists, policy makers, research managers, indigenous peoples and others interested in and concerned about the future of Arctic research. Through plenary sessions, breakout sessions and informal discussions, conference participants addressed long-range research planning challenges documented in twelve draft research plans, and concluded in summary that:

Since the first Conference on Arctic Research Planning held in 1995 in New Hampshire, there has been a paradigm shift to a more holistic and multidimensional perspective in the Arctic. This perspective includes more integrally the human dimension, the social sciences, and indigenous insights as well as a recognition that the Arctic is a system that can no longer be divided into traditional disciplines nor treated as separate from the planet as a whole and hence requires integration of Arctic processes into the earth system.

The Conference was the culmination of a 24-month planning process involving over 140 scientists working to develop research plans around thirteen critical research themes identified by the Conference sponsors which were identified with input from the science and Arctic communities at large. Conference participants were actively involved in modifying and improving these plans for future implementation.

The Conference

During the work of the Conference it was recognized that the Arctic is a system that can no longer be divided into traditional disciplines. While the Conference was organized along traditional disciplinary lines, it became evident throughout the plenary sessions, and even more so in the breakout sessions, that distinctions between disciplines are being blurred and, in particular, the human dimension is an integral part of every discipline, whether it be natural or social sciences. In addition, Conference participants stressed that the Arctic System is no longer treated as separate from the planet as a whole. The linkages to the global system are critical.

During the breakout sessions and in the concluding plenary session, it was repeatedly stated that education and outreach are critical components of successfully tackling the issues of the next decade as well as important to creating the next generation of scientists. The integration of education and outreach is another element which must be addressed in each working group report and in the post-conference process.

Conference participants also raised concerns about issues surrounding data management, interoperability and dissemination. The need for a more robust enabling infrastructure to provide the platforms and logistic systems for the next generation of users is a critical need highlighted both in the reports and during the conference plenary sessions, including remote sensing needs,

ice breakers, circumpolar observing networks, and data management capabilities. Access into foreign exclusive economic zones (EEZ) in the Arctic was also identified as a critical issue. It is clear that, in light of the International Polar Year (IPY) and implementation of ICARP II plans over the next decade, the research community and the final ICARP II reports must urgently address these issues.

Plenary Sessions: Plenary sessions provided a venue to address a series of science and public policy issues, including presentations by:

- **The Honorable Uffe Toudal Pedersen**, Danish Permanent Secretary of the Danish Ministry for Science Technology and Innovation, who challenged the ICARP II participants to see their planning activities as nested in the on-going agenda of social and economic development of the various Arctic countries;
- **Ambassador Gunnar Palsson** of Iceland urged the ICARP II participants to review and more fully understand the implications of our assumptions concerning the issues across the science-policy interface, particularly the role of scientists in the policy debates;
- **The Honorable Minister Alfred Jakobsen** of Greenland who shared his perspectives on the critical issues of environmental change and how they challenge the very culture of the peoples of northern communities, and asked the Conference participants to give these matters high priority in the planning process;
- **The Honorable Minister Connie Hedegaard** of Denmark wanted the ICARP II participants to recognize the need to view their work in an international environmental policy framework and to accept the responsibility for communicating the results of their research to the policy community and to all citizens;
- **Ambassador Vitaly Churkin**, Chair of the Arctic Council's Senior Arctic Officials, who outlined the role of the Arctic Council in the implementation of Arctic scientific efforts and the importance of bringing science to the policy process; and
- **The Honorable Ole Henrik Magga**, Professor of Saami linguistics at the Saami University College in Guovdageaidnu (Kautokeino, Norway) and recent Chair of the United Nations Permanent Forum on Indigenous Issues, who raised the issue of the integration of local and traditional knowledge into the planning process and the challenges of blending such knowledge in ways that enables the acquisition and integration of such knowledge into the research planning process, but does so within an ethically sound framework that recognizes, preserves, and protects the heritage of indigenous cultures.

All of the speakers highlighted the need to bring science to the policy process and the reinforced the perception that the Arctic is a fully integrated system with important linkages to the global system.

In addition to the keynote speakers a number of other important plenary sessions were convened. First, there was a plenary session to provide an update on and current status of IPY 2007-2008 and the connection of the IPY to the ICARP II planning process. Second, an important session on new technology and research needs for regional observation networks and data management capabilities was held with several presentations on new or existing technology. Third, participants were treated to a plenary session on the opportunities for observational and monitoring capabilities that serve the regional needs of the Arctic that can be derived from the major global-scale observational programs, such as the Global Earth Observation System of

Systems (GEOSS) and the observational programmes of the World Meteorological Organization (WMO). Fourth, the Conference included a session to explore the implications for ICARP II planning on research infrastructure needs, opportunities and requirements for the Arctic, presented as needs identified in the twelve draft science plans, and then extended during the Breakout Sessions and other discussions during the Conference. This session was facilitated by a report by the Forum of Arctic Research Operators who examined all of the science plans for their implications and resource requirements.

In addition, a plenary session to explore the potential of drafting a short and widely-readable paper for non-scientific audiences that describes the grand research challenges for the Arctic region, and draws its focus from a synthesis of critical research needs identified by the ICARP II process, the perspectives evolving out of the International Polar Year (IPY) process, the research gaps identified during the preparation of the Arctic Climate Impact Assessment (ACIA), and issues raised by the International Arctic Science Committee (IASC) and the International Arctic Social Sciences Association (IASSA), and others with insights about Arctic research needs for the decade or so ahead. This session resulted in a lively debate on the issues and how they should be presented.

Finally, the Conference included a plenary session to address research questions possibly inadequately covered by the existing working groups' draft science plans. After an open solicitation of ideas, the ICARP II Steering Committee identified three topics for presentation during this plenary session, namely:

- The Role of Permafrost in a Warming Planet,
- Emerging Human Health Research Issues, and
- Human Security in the Arctic.

A summary of these reports is included in these proceedings.

In addition, the Conference invited scientific papers to be presented in poster sessions as these papers have the potential of further expanding the discussions on future research needs. A total of 145 posters presentations were approved for inclusion in the Conference program and displayed during the Conference. These posters provided additional opportunities for substantive discussions of emerging scientific questions and research programs.

The Conference hosts, the Danish Polar Center, hosted numerous receptions and dinners which provided Conference participants the opportunity for open and frank exchange of ideas on the margins of the breakout and plenary sessions. These informal discussions facilitated cross-fertilization of ideas and enhanced the interdisciplinary nature of the proceedings.

Breakout Sessions: The Conference was designed as a culminating element of a comprehensive process that engaged the scientific and related communities in the preparation of research plans. The breakout sessions provided an effective venue for Conference participants, with a broad range of interests and ideas, to assess, review and critique the working groups' draft research plans. The Conference devoted substantial parts of the schedule to these breakout sessions in order to review the draft plans of the following twelve working groups:

- Working Group 1 Sustainable Development: Arctic Economies (WG Chair: Henry Huntington)
- Working Group 2 Indigenous Peoples and Change in the Arctic: Adaptation, Adjustment and Empowerment (WG Chair: Jens Dahl)
- Working Group 3 Arctic Coastal Processes (WG Chair: Volker Rachold)
- Working Group 4 Deep Central Basin of the Arctic Ocean (WG Chair: Bernie Coakley)
- Working Group 5 Arctic Margins and Gateways (WG Chair: Jackie Grebmeier)

Working Group 6 Arctic Shelf Seas (WG Chair: Heidi Kassens)
 Working Group 7 Terrestrial Cryosphere and Hydrologic Processes and Systems (WG Chair: Terry Prowse)
 Working Group 8 Terrestrial and Freshwater Biosphere and Biodiversity (WG Chair: Terry Callaghan and Torben Christensen)
 Working Group 9 Modeling and Predicting Arctic Weather and Climate (WG Chair: Lennart Bengtsson)
 Working Group 10 Resilience, Vulnerability and Rapid Change (WG Chair: Gary Kofinas)
 Working Group 11 Arctic Science in the Public Interest (WG Chair: Lars Kullerud)
 Special Session: Paper on Contaminants in the Arctic Region, provided by AMAP (Session Chairs: Lars-Otto Reiersen and Simon Wilson)

During the Breakout Sessions, the participants were asked to address a series of questions, including:

- Have the key scientific questions been identified and addressed, if not, what is missing?
- Are there key elements either missing or over stated in the Science plan?
- Is the proposed research feasible and within the capability of the science community during the next 10-15 years?
- Have the connections between the proposed research, the IPY and other major Arctic research programs been adequately covered?
- Are there any events or circumstances that may prevent the potential implementation of this research?
- Overall, what, if anything, should be altered, extended or added?

Feedback and Observations by Conference Participants

There were many helpful and constructive suggestions for improvements to the draft research plans of the working groups, a record of which is contained in the breakout sessions' rapporteur reports and presented in summary form during the closing session of the Conference. The common messages and suggestions from these reports are summarized here.

Specific Suggestions:

Long Range Vision: There may be too much "business as usual" in some of the draft science plans – some of the plans do not place enough emphasis on a long-range vision, i.e., the 10-15 year perspectives of the ICARP II objective. In particular, the time scales for implementation often require long-range planning and the identification of which was not always evident in the current draft Science plans.

Multi-Facet Perspectives: The science of the Arctic is nested in a multi-facet context, more than climate change—UV, contaminants, globalization, cultural and demographic dynamics, etc.—all of which play interacting roles. These perspectives should be better integrated into the final research plans giving ICARP II a more holistic perspective.

Global Context: Arctic research challenges are nested in a global context, but that context was not always clearly addressed in some of the draft science plans, and in some cases was totally absent. Linkages to other global change programs must be demonstrated.

Data Management: The issues of data systems, acquisition, archiving, access, and long-term stability and funding support needs special attention and should be addressed more fully in the draft research plans and in a special section in the final report of the ICARP II process. The Working Groups should consider linkages to other Arctic data programs, like those being discussed by the IPY.

Outreach and Communications: Outreach and communication perspectives were seen by the Conference participants as a very critical element in the ICARP II process, but not always well articulated and often lacking in detail and vision in the plans. These issues should be more fully developed in the final research plans and in a special section of the ICARP II final report.

Infrastructure: The infrastructure needs in the draft research plans have not been as fully identified as some believe essential. The infrastructure sections of the research plans should outline more completely both near-term and long-term needs, including major facilities, platforms, observatories, instrumentation, and new and innovative technologies and the special section of the final ICARP II report should provide an integrated perspective on these needs.

ICARP II Theme Framing: The ICARP II Working Group themes, while multidisciplinary in design, had the unanticipated opposite effect of segregation and, therefore, an important task will be to re-integrate the many sub-themes across the existing draft science plans. The need is clearly for a more holistic and well-integrated long-range perspective for scientific research across the Arctic issues for the decade or two ahead and should be so reflected in the final research plans.

Enabling Institutions: There is a need to more explicitly describe the role, importance and future plans that enabling institutions (e.g., international programmes and coordinating organizations such as IASC, AOSB, AMAP, ISAC, CliC, IGFA, FARO, etc. as well as other NGO's and national programs and institutions) play in the implementation of the ICARP II Plans.

Balance across the “Spheres” of the Arctic: The balance of emphasis across the “spheres” of the Arctic, i.e., oceans, lands, atmosphere, is seen as missing from several of the draft research plans, and some major issues such as sea ice and ice caps were not as fully developed as some believe is essential.

Spatial and Temporal Scaling: There were strong suggestions that the range of spatial and temporal scales have not been adequately addressed.

General Impressions:

- The research plans need more focus and a sense of priorities.
- There should be a greater focus on training and education of the next generation of scientists.
- There should be stronger efforts to more fully engage young scientists and to address the gender issue more directly.
- The plans should be more concrete and not a shopping list of too many priorities.
- The plans should have a more realistic potential for implementation.

A Major Conclusion from the ICARP II Conference

There was a general consensus, captured in the Conference Statement, that a paradigm shift has occurred in the science over the past decade or so to a more holistic and multi-faceted perspective—with a marked increase in the integration of the human dimensions, social sciences,

and indigenous insights into the traditional realm of the natural sciences. Additionally, there was a recognition that the Arctic is an integral part of the Earth's system, not one that can be considered in a vacuum, but rather one which impacts on the global system and is impacted upon by the larger system. Further, there was general agreement that scientific research in the Arctic has increasingly become an important part of the public policy and societal decision-making processes: environmentally, socially, economically and politically.

Next Steps in the ICARP II Process

The ICARP II process seeks to set the research plans in a context of "How the Arctic system works, how it is changing, and what will it be like in the future?" as these are the fundamental questions being asked by policy makers, land use managers, and people who reside in the Arctic. The ICARP II Conference sought to put additional content to these questions and to enhance the continued development of the science plans.

Each of the WG's is charged with redrafting of their research plans in light of the input received during the Conference. Their redrafted plans will be completed early in 2006 and made available on the ICARP II website for further review and evaluation.

Concluding Thoughts

These Conference Proceedings will be published and presented at the 8th Arctic Sciences Summit Week (ASSW), March 22-29, 2006, in Potsdam, Germany. The final ICARP II Full Report, which will be published in the fall of 2006, will include all 12 science plans, a comprehensive overview of the challenges for Arctic research in the decade or two ahead, and special sections on data management, infrastructure, and education and outreach. A draft of the ICARP II Report will be presented during ASSW 2006.

The ultimate objective of the ICARP II planning process is to initiate and foster the implementation of forward-looking national and international research projects. The success of ICARP II lies in the degree to which new knowledge is facilitated by the process and by fostering new and innovative cutting-edge research projects that are attractive to funding agencies. The ICARP II Conference was a critical element in moving the process towards this objective.

SUMMARY OF BREAKOUT GROUP DISCUSSIONS



Working Group 1: Sustainable Development: Arctic Economies

The draft research plan for Working Group 1: Sustainable Development: Arctic Economies was presented to an ICARP II breakout session. The session was convened by Bob Corell, chair of the ICARP II steering group, with Frank Sejersen representing the working group chair. Susie Crate, a member of WG-1 acted, as rapporteur. Three reviews were given by:

- Peter Schweitzer, *an independent reviewer*;
- Rune Fjellheim, *an indigenous scholar and member of WG-11*; and
- Helga Ogmundardottir, *a young scientist*.

In general, the comments in the reviews and subsequent discussion criticized the report with regard to (a) the ambiguity of the term “sustainable development,” (b) the relative lack of emphasis on economics, and (c) failure to be more ambitious. Specific comments emphasized various problems with terminology (not just “sustainability”), the need to incorporate multiple perspectives when considering the lives of Arctic peoples, the need for appropriate indicators that are relevant to the concerns and needs of Arctic peoples, and the importance of links to education, cultural programs, and similar activities.

Working Group 1 will revise the report, under the direction of Joan Nymand Larsen, to:

- Expand the treatment of economics,
- Rewrite the discussion about sustainability to acknowledge the terminological problems but also the opportunity to develop a working definition in the Arctic context,
- Strengthen the focus on basic research questions, seeking to be more ambitious, and
- Add a section on Education and Outreach, as requested by the ICARP II Steering Group.



Working Group 2: Indigenous Peoples and Change in the Arctic: Adaptation, Adjustment and Empowerment

The draft research plan for Working Group II: Indigenous Peoples and Change in the Arctic: Adaptation, Adjustment and Empowerment was presented to an ICARP II breakout session of about 50 participants on Friday 11 November. Carl Christian Olsen, liaison from the ICARP II steering Group, chaired the session. Jens Dahl presented the Working Group report. Yvon Csonka acted as rapporteur. Reviewers of the report were:

- Frank Sejersen, *young scientist and member of WG 1*;
- Maliina Abelsen, *indigenous scholar*; and
- Gert Mulvad, *independent reviewer*.

In general, the report was well received by the reviewers and by the audience. There were positive comments about the balance of the report in relation to the diversity of Arctic societies and to the complexity of the themes. The audience regretted that the panel mainly represented scientific knowledge with reference to Greenland.

The general comments to the report included the following:

- a) Arctic cultures are not static, which has implications to the analysis of knowledge, traditional knowledge, relationship between elders and young people, etc.
- b) Arctic communities have a long tradition of adapting to changes from outside, but researchers should also be aware of threats and dynamics internal to the Arctic societies.
- c) The report, specifically in relation to health and well being, should carefully consider when the research focus should be upon the individual and when the focus should be on groups or communities.
- d) The report should properly reflect the diversity of the Arctic societies and the problems this might entail in relation to collection of data.

The working group will revise the report in accordance with the general comments and the specific comments and suggestions.

The breakout session emphasised the importance of the four main themes dealt with by the Working Group, and the future strategy will reflect this. However, it was also suggested that “economic development” should be dealt with together with “sustainability”. To this end there should be a discussion with WG 1.



Working Group 3: Arctic Coastal Processes

The draft research plan for Working Group 3: Arctic Coastal Processes was presented to an ICARP II breakout session. Geoff Holland, the Steering Group liaison, convened the session. Volker Rachold, the Working Group Chair, presented the draft research plan and Hugues Lantuit served as rapporteur. Reviews of the plan were given by:

- Martin Bergmann, *external reviewer*;
- Igor Dimitrenko, *reviewer from another working group (WG6)*;
- Greg de Pascale, *young scientist*; and
- Maaki Kakki, *Local community representative*.

The following text summarizes the discussions that took place. The comments from all attendees and conveners are indiscriminately listed in the following summary. These comments have been organized into themes, in order to fit the feedback more easily into the final science plan.

Clarifications to bring to key WG3 scientific questions

Driving processes

- A distinction between what is already known about the driving processes in coastal settings and what remains to be understood has to be clearly established.
- State precisely within the document what are the questions to be answered during the next 10-15 years.
- It is necessary to define the specificity of Arctic Coasts in contrast to other coasts.
- It is necessary to compare methods with existing coastal programs at lower latitudes.
- What exactly are the criteria required to be considered an observatory?

Project magnitude

- Costs associated with each observatory will have to be precisely defined.
- Costs will be necessarily reduced because methods, contacts, and infrastructures are already present in most observatories. This project could therefore be highly successful.

Possible broadening of WG3 scientific questions

Environmental factors

- The oceanographic impact for coastal change needs to be emphasized in the report.
- The role of sea ice is also important and should be more clearly stated in the final report.
- The interaction between the shelf and the coast is another component of this broadened approach.

Biodiversity

- Not enough emphasis on biodiversity in the research plan. ACBio is willing to add some important questions to the research plan.

Societal/political issues

- Analysis of changing marine access (shipping routes) is not addressed.
- The final report of WG3 should be written with the end-users in mind and take advantage of existing programs which operate with such a relationship (e.g., the circumpolar biodiversity program). This applies to ICARP II as a whole.
- The question of protected areas is important and the implementation of the WG3 research plan will surely participate in providing additional capacities to existing reserves.

Funding

- Funding is largely an unknown parameter but several attendees noted the potential of the WG3 research plan to attract funds through its strong connections to existing and planned major projects. There was therefore a consensus that the research plan is feasible.

Broadening vs. focus

- Several persons requested a more holistic approach to coastal processes in the research plan. It became evident, however, that generating additional components in the coastal observatories would dilute the message it carried.

Definition of the coastal zone

- The WG has to define first what the coastal zone is in the research plan in order to establish its mandate.

Integrative approach / cross-group relationships

- An integrative approach is needed to avoid unnecessary overlap amongst the various WGs. Dealing with the need for multi-disciplinary and multi-sectoral approaches, whilst preserving focus was an issue common to all WGs and indeed had been discussed at length by the Steering Group.
- An integrative approach to different aspects and scales is necessary. For WG3, it was evident that an integrative approach will help achieve objectives. Most participants emphasized the clearness and the quality of its organization and its focused perspective.
- If the objectives of the group are expanded, it should be done through cross-group relationships and in close collaboration with other WGs chairs.

Data Management

- Data dissemination policies have to be more clearly emphasized in the document.
- There is no existing data management system for Arctic communities at the circumpolar level, in regard to traditional knowledge.

Local communities

- Answers will be sought through involving the local population early in the monitoring phase.
- The quality of the research plan regarding community-based monitoring and training of northerners was appreciated by the audience. Most participants in the WG have decade-long experience in community involvement.

Remote Sensing

- A circumarctic initiative aimed at providing imagery for the whole of the Arctic coast would be a remarkable initiative. These initiatives already exist under WMO's umbrella. However, the existing programs are not necessarily incorporating sensors adapted to the scale of interest to coastal zone research.
- A clear statement in the research plan of remote sensing requirements for observatories is required, both in the ICARP WG's science plan and in the IPY proposal. Some high-resolution sensors (optical, LIDAR, etc.) may not appear in larger scale global initiatives.



Working Group 4: Deep Central Basin of the Arctic Ocean

For about three hours, the Draft Research Plan for the ICARPII Working Group on the Deep Central Basin of the Arctic Ocean was presented to approximately 50 attendees at ICARPII. The session was convened and moderated by Dr. Jörn Thiede, the ICARPII Steering Group Liaison member for the Working Group. Dr Yngve Kristoffersen, a Working Group 4 member, acted as rapporteur. Three reviews of the plan were offered by:

- Wieslaw Maslowski, *reviewer from another WG (WG 5 & 6);*
- Margo Edwards, *potential user;* and
- Bodil Blum, *young scientist*

Dr. Bernard Coakley, Chair of the Working Group, in conjunction with Yngve Kristoffersen, formulated a set of notes summarizing the main issues raised by the reviewers and by the audience during the breakout session. These are summarized below and provide the basis for the subsequent modification of the draft research plan.

There were very few objections to the report's content. Two significant gaps were noted, particularly with regard to the atmosphere and, to a lesser extent, the study of sea ice. Other suggestions about how to structure the revised report were also offered by the participants.

Panel Comments on Report Structure

There was a consistent preference for a thematic focus in the text. A challenge to contributors/reviewers was to define the links between these diverse topics, spatially (bottom to top, west to east); temporally (e.g., basin/gateway formation v. circulation); and frame in a global context

Also, where and how will components come together? What is the means of integration across working groups? What is the means of integration of data management and accessibility and in terms of legacy?

Other Panel Comments

- Data Archive/Availability Issues
- Incorporate more and more specific sea ice questions

- More emphasis on sea ice is needed. For example, there is a need to measure and understand causes and effects of variability in sea ice thickness and volume. Update sea ice data through 2005.
 - How about snow: e.g., albedo effect, energy balance, etc.
 - Where is the Atmosphere?
 - wind forcing
 - solar radiation/clouds
 - sea-ice-atmosphere feedback processes
 - data coverage in the central Arctic

Discussion Comments

- Emphasis on the need for site survey data to support drilling in the Arctic Ocean.
- Multi-disciplinary need for expanded and improved bathymetric data coverage.
- How to explore in the most difficult ice conditions, north of Greenland and Ellesmere Island?
- Discussion of the need for proactive technological development to enable exploration.
- Suggestions to broaden the paleo-oceanographic content of the report.



Working Group 5: Arctic Margins and Gateways

The goal of the Arctic Ocean WG5 margins and gateways research plan is to provide a coordinated, international research strategy for both modern and paleo scientific studies to investigate critical issues at the Arctic continental margins and gateways of relevance to global and climate change. Shelf-basin sub-bottom and exchange measurements need to be made at key locations around the Arctic coincident with similar measurements in the gateways to/from the Arctic (Bering Strait, the Canadian Archipelago, the western Barents Sea and Fram Strait).

During the breakout session discussions, a large group of ICARPII participants discussed the WG5 draft research plan and undertook discussions of how to fill gaps. The session was convened and moderated by Dr. Jean-Claude Gascard, the ICARPII Steering Group Liaison member for WG5. Dr. Jackie Grebmeier, chair of ICARPII Working Group 5, presented the draft research plan. Three reviews of the WG5 plan were offered by:

- Dr. James Overland, *independent reviewer*;
- Dr. Rodger Harvey, *potential user*; and
- Dr. Marit Reigstad, *young scientist*.

Drs. Ursula Schauer and Karen Frey acted as rapporteur for the breakout session. In conjunction with Dr. Grebmeier, they formulated a set of notes summarizing the main issues raised by the reviewers and by the audience during the open forum. Below are highlights of those discussions that will form the basis for modification of the WG5 draft research plan.

Overview of goals:

- The gateways in and out of the Arctic are key regulators of forcing factors for the Arctic and the global climate system, while the margins are the active transformation sites along oceanic boundary pathways and the locations of water, carbon and sediment transport from the shelves to the deep basins within the Arctic.
- The shelf-break is a key location for studying ecosystem response to climate change, which integrates responses in ice cover, boundary currents and shelf-basin exchange. The gateways can be considered the “front doors” to the Arctic system, but the “room” inside is changing, and the WG5 studies will investigate the key processes of both sites.

Identify big issues for ongoing changes in the Arctic (related to WG5 questions in the draft research plan):

1. Sea ice and heat content (WG5 Questions 3.1, 3.2, 3.4), especially shifts in ocean heat transport, interaction with ice/atmosphere/climate, including Western (Pacific Sector) Arctic/Barents Sea
2. Fresh Water (Questions 3.3, 3.5), note Kara/Laptev Seas (stratification) vs. Canadian/Fram outflows
3. Ice-ecosystem reorganization (Question 3.4)

4. Climate change (Questions 3.6, 3.7), via impacts by regions, including variability vs. anthropogenic

Needs:

1. Identify priority topics for the margins and gateways topic, specifically related to near-field (IPY) objectives vs. far-field (5-10 yr ICARP2) time scale.
2. Include more long-term paleoceanographic studies, including geophysical aspects to establish detailed tectonic, geodynamic, sedimentary and paleo-topographic histories of continental margins and oceanic gateways.
3. Identify cross-over links between the other marine working groups, specifically WG4 Arctic deep basin and WG6 shelf groups.
4. Include synthesis of programs, both existing and proposed programs.
5. Identify use of satellite and ocean colour to detect ice cover, productivity extent.
6. Include productivity measurements and/or population responses at intermediate or higher trophic levels to detect increased primary production or increased food quality, and connect these measurements to human living resource issues.
7. Specify the use of different models to different tasks and how to combine them to get a more synoptic picture.
8. Develop regional coupled models with sufficiently high spatial resolution to evaluate ecosystem responses (production is highly sensitive to topography, wind fields).
9. Address how changing sea ice coverage alters exchange (e.g., sediment transport, etc.) to margins in different regions of the Arctic.
10. Incorporate both marine production and terrestrial inputs into process studies, carbon budgets and modeling studies.
11. Coordinate and communicate with ongoing and planned field programs, especially with other marine groups (WG4 and WG6).

Data Issues

- There is a need for data rescue and archiving, along with a strategy to achieve desired results.
- There is a need for a data management plan, including both national and international cooperative agreements for data submission, access, release and free access.
- There is a need for a protocol for long-term data archiving of margins and gateway data.

Infrastructure

Field studies would include moorings, process studies, sub-bottom structural imaging and paleoceanographic coring that can be coordinated internationally, and can be used to validate and improve models and their predictions of change, and to leverage ongoing and planned field operations

- There is a requirement for open water, ice strengthened, and heavy icebreaker use for pan-Arctic sections and gateway access, and
- access into foreign waters, especially into the Russian EEZ which entrains more than half of the total Arctic shelf and margin area.



Working Group 6: Arctic Shelf Seas

Over approximately a 3-hour period, the Draft Research Plan for the ICARPII Working Group on Arctic Shelf Seas was presented and discussed with approximately 100 attendees at ICARP II. The session was convened and moderated by Dr. Jean-Claude Gascard, the ICARPII Steering Group Liaison member for the Working Group. Dr. Heidi Kassens, Chair of the Working Group, presented the draft plan. Four reviews of the plan were offered by:

- Dr. Niels Nørgaard-Pedersen, *an independent reviewer*;
- Dr. Jackie Grebmeier, *a reviewer from another WG (WG5)*;
- Dr. Ekatarina Abramova, *an indigenous reviewer*; and
- Dr. Carolyn Wegner, *a young scientist*.

Dr. Jody Deming, a member of Working Group 6, acted as rapporteur. In conjunction with Dr. Kassens she formulated a set of notes summarizing the main issues raised by the reviewers and by the audience during the open forum. These issues are summarized below and are providing the basis for the subsequent modification of the draft research plan.

In general, the comments expressed during the breakout session were supportive of the draft plan. As particular aspects were reviewed in detail, however, the need to clarify, and in some areas expand, the existing document became clear. Like other working groups, the challenge is to maintain focus even as existing concepts are elaborated and new plans are added. Given repeated comments from diverse perspectives on the scientific, user-based and logistical importance of polynyas on the Arctic shelves in a pan-Arctic sense, polynyas (or the larger flaw-lead polynya system) emerged as a stronger organizing principle for the document than originally featured. We recognized that filling gaps in the existing plan and providing the further elaboration required to make clearer links between disciplinary and larger issues could be accomplished without a diffusive effect, if the focus on polynyas as integrators was sharpened. The bases for improvements are summarized below under general headings of *Polynyas*, *Gaps*, *Clarifications* and *Novel Opportunities*. The content follows very closely that presented in summary discussion to the entire ICARPII audience following completion of the Breakout Sessions.

Polynyas

- Organize according to shelf type: inflow, outflow and inner shelves.
- Include the Chukchi flaw-lead polynya system as a key inflow integrator.
- Recognize each shelf type by its main polynya characteristic, e.g.:
 - Chukchi Sea (inflow) for ability to modify incoming Pacific water;

- Cape Bathurst Polynya (inflow) for sensitivity to pack-ice movement and river input;
- Laptev Sea (inner) for strong ice production, sediment transport, response to warming Atlantic waters and river input;
- Kara Sea (inner) as most accessible (affordable) Siberian shelf;
- Storfjorden Polynya (outflow) for strong winter brine production;
- North Water (outflow) for high productivity and historical stability;
- Northeast Water (outflow) as the first to morph to marginal ice zone.

Gaps

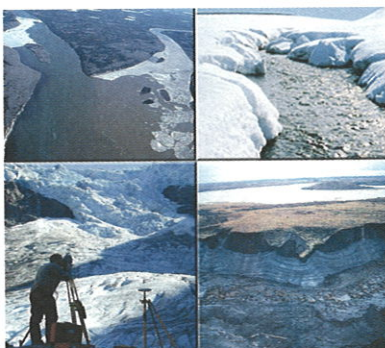
- Recognize that evaluating the paleorecord can help in developing future scenarios.
- Recognize that all open water areas host cloud formation, with effects and feedbacks critical to, yet absent from, climate models.

Clarifications

- Emphasize organisms of higher trophic levels, including potential displacement by new species, a shift to lower trophic levels and the possible arrival of nuisance species and pathogens, and contaminant pathways.
- Elaborate connections between impacts of change on ecosystems and local communities given economic openings (navigable and exploitable resources).
- Specify the direct roles that indigenous talent can play in advancing observations, understanding and discovery.
- Emphasize mechanistic links between landfast ice, polynyas and brine formation, effects of sea-ice changes on transfer of gas, mass and energy, and atmospheric/oceanic couplings at the shelf-slope break.
- Emphasize the primary role of shelves in material transport.
- Expand the list of programs in place or proposed to help achieve goals.

Novel Opportunities

- Cloud studies that inform large-scale climate scenarios and feedbacks to ecosystems as open-water areas increase.
- Wintertime studies that link physics and biology (from microbes to higher trophic levels).
- Long-term evaluations of multiple circulation, transport, exchange and ecosystem issues using cabled seafloor observatories.
- Subsea permafrost studies that examine shelf history, gas chemistry and microbial life.
- Paleo studies to develop future scenarios and to determine historical locations of polynyas (if they existed) when Arctic shelves were exposed.



Working Group 7: Terrestrial Cryospheric & Hydrologic Processes and Systems

Over approximately a 3-hour period, the Draft Research Plan for the ICARPII Working Group on Terrestrial Cryospheric & Hydrologic Processes and Systems was presented and discussed with approximately 150 attendees at ICARPII. The session was convened and moderated by Dr. Vladimir Kotlyakov, the ICARPII Steering Group Liaison member for the Working Group. Dr. Terry Prowse, Chair of the Working Group presented the draft plan. Four reviews of the plan were offered by:

- Dr. Charles Vorosmarty, *an independent reviewer*;
- Dr. Torben Christensen, *co-chair of ICARPII Working Group 8*;
- Mr. David Milburn, *a potential user*;
- Mr. Sebastian Mernild, *a young scientist*.

Drs. Larry Hinzman and Andrey Glazovsky, both Working Group 7 members, acted as rapporteurs. In conjunction with Dr. Prowse, they formulated a set of notes summarizing the main issues raised by the reviewers and by the audience during the breakout session discussion. These are summarized below and are providing the basis for the subsequent modification of the Draft Research Plan.

In general, the comments expressed during the breakout session exemplified the greatest ongoing challenge experienced by the Working Group members in tackling such a broad area of study: achieving focus without becoming too broad and too diffuse. However, despite the breadth of the issue areas that the Working Group were charged by the ICARPII Steering Group to address, it was recognized that there remained some important gaps to be addressed and further articulated in the plan, and other areas that needed improvement. These are summarized below under general headings of *Gaps*, *Measurements*, *Cryospheric Studies* and *Integration*. The content is identical to that presented in summary discussion to the entire ICARPII audience following completion of the Breakout Sessions.

Gaps

- Missing a detailed strategy for securing funding.
- Need some synthesis of programs via table or wiring diagram showing connections among existing and proposed programs.
- Report emphasizes “upscaling and extrapolation” to the exclusion of “downscaling.” Need to clarify approach to scaling issues.
- Need to address extreme events (floods, droughts, high precipitation events).
- Geomorphological changes induced by permafrost thaw should be considered and could possibly provide a link with WG8.

- Flow regime should also consider source water, not simply flow summaries.
- Geochemical fluxes should include water temperature because it is a major driver of ecological processes.
- Clear links to user community is not well articulated.
- Document is thin on community involvement.

Data

- Need for data rescue and archiving & strategy to achieve it should be articulated.
- Some centralization of data and data services necessary; *end-to-end* prototype studies needed; consult revised IPY Arctic-HYDRA plans for ideas.
- Data management problem, particularly remote sensing data is a crucial point limiting future progress.
- Should have free access to data.
- Data must be archived in permanent residence.

Measurements

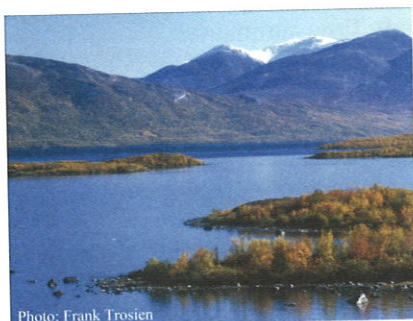
- Remote sensing is the predominant technology promoted; need more on innovative technology-driven sensors: e.g., *in situ*, automated samplers equipped with WiMAX.
- Emphasis must be added to address support and continuation of unique long-term series of runoff measurements, as disruption or loss of these continuous long-term series required for in-depth analysis are unrecoverable.
- A hydrological observing network such as Arctic-HYCOS/HYDRA may be the springboard or prototyping environment from an IPY hydrology effort through a 10-15 year legacy program.

Cryospheric Studies

- Discussion showed deep concern regarding the integration and emphasis of snow cover, Greenland ice sheet, and ice caps studies (such as effects on albedo, glacial runoff, ice volume change, sea level, ice core records and equilibrium snow line on glaciers) in the structure of the ICARP scientific plans.
- More explicit material needs to be included about how the cryosphere affects climate, and more broadly the whole earth system.

Integration

- Synthesis among working groups needs further efforts.
- The need remains to develop an international strategy for international Arctic research coordination and some organizational entity to facilitate collaboration and establish priorities. Various recommendations have included the Arctic Council, ISAC (International Study of Arctic Change), ICARP and CliC (Climate and Cryosphere). Some group needs to step up and fill that void.



Working Group 8: Terrestrial and Freshwater Biosphere and Biodiversity

During the breakout session, the Draft Research Plan for the ICARPII Working Group on Terrestrial and Freshwater Biosphere and Biodiversity was presented to approximately 100 attendees at ICARPII. The session was convened and moderated by Dr. Kristján Kristjánsson, the Liaison to the WG of the ICARP II Steering Group. An overview of the plan was given by co-chair Dr. Torben R. Christensen and three reviews of the plan were offered by:

- Larry Hinzman, *an independent reviewer*;
- Terry Prowse, *chair of ICARPII Working Group 7*; and
- Craig Tweedie, *a young scientist*.

Dr. Skip Walker acted as rapporteur. In conjunction with Dr. Christensen of the Working Group, a set of notes summarizing the main issues were prepared as raised by the reviewers and by the audience during the open discussion, as well as some comments that have appeared post-conference in the web-based discussion forum. These are summarized below and will be dealt with in the final WG report.

Larry Hinzman (independent reviewer)

- Need for a focus. There is a danger of becoming too diffuse if all suggestions are incorporated.
- The focus related to “understanding and predicting biospheric feedbacks on the atmosphere” should be maintained. The plan should also include negative feedbacks which are quite few but very important in limiting the spin-up of climate warming (e.g., some aerosols sulfides). Also there is a need to include a discussion of thresholds.
- The plan needs a focus on variability in tundra landscapes. For example, areas of potential paludification vs. aridification resulting from permafrost thawing results in local geographical differences in drainage and evapotranspiration.

Terry Prowse (WG7)

- Greater focus should be placed on freshwater biosphere and biodiversity as articulated in the ACIA chapter on Freshwater Ecosystems and Fisheries. The WG could take advantage of the recently endorsed IPY program on: “Arctic Freshwater Biodiversity Monitoring and Research Network.”
- Link a proposed network of terrestrial research sites to the WG 7 proposed supersites, or Cryo-hydrologic Observing Sites.

Craig Tweedie (Young Scientist)

- Establish/improve baselines: Tissue banks – genetics, contaminants, isotopes etc.; Taxonomy, biogeography, phylogeography; High temporal resolution palaeo history; DEM's and baseline maps; Data portal development; Data rescue.

- Use campaign efforts (*sensu* Swedish Beringia 2005 Expedition) where researchers visit numerous remote field sites in a short period of time.
- Support development of flagship research stations but also remote field-sites located where scientific purpose is clearly defined.
- Initiate programs that cross cut disciplines, for example, land-atmosphere-freshwater-marine-social. In some cases examining flow of energy between systems might be the best focus of such programs.
- Need better coordination between observatory networks and programs ~ has become a niche for initiatives such as CEON and COMAAR.
- Develop opportunities for pan-arctic synthesis in which young people can actively partake (e.g. develop questions that can be addressed in student theses).

Audience comments (overarching issues only):

- General satisfaction with the document and felt the working group should be commended for a good job with a very broad topic.
- All the ecosystem function questions relate to the carbon cycle. Some thought the focus on the carbon cycle was at the expense of other important changes in the terrestrial and freshwater systems.
- Is climate the most important? The plan needs to discuss other elements in the total suite of drivers. UV B is mentioned, but what about industrial development, perhaps the biggest agent of rapid terrestrial change in the Arctic. (Consider roads, and interactions of climate change with more direct anthropogenic changes.) Others might include effects of change on food webs and subsistence resources.
- There needs to be a more sophisticated discussion of biodiversity and its role in ecosystem function. Clearer statement of how biodiversity is important. The CAT B meeting during ICARP II endorsed the general WG8 document, but thought that biodiversity discussion could be improved.
- More emphasis on the need for molecular genetics and phylogeography, especially of the soil component, fungal mycorrhizae, and genetics of the vascular flora. There was a particular plea for the need for baseline studies, particularly in the high Arctic.
- There needs to be clearer linkages with other working groups. For example, changes in sea ice could be one of the big drivers of change in the Arctic terrestrial system because the tundra biome is defined by its proximity to the Arctic Ocean and sea ice. Need to make clearer linkages between what is going on with big-scale changes in climate system, oceans and sea ice and what happening on land.
- The plan needs to include wildlife; trophic interactions at higher levels, trophic cascades etc.
- Social sciences are not well developed and also the involvement of children and elders, and native inputs.



Working Group 9: Modeling and Predicting Arctic Weather and Climate

Over approximately a 3-hour period, the Draft Research Plan for the ICARPII Working Group on Modeling and Predicting Arctic Weather and Climate was presented and discussed in an ICARP II breakout session. The session was convened and moderated by Dr. Barry Goodison, the ICARPII Steering Group Liaison member for the Working Group. Dr. Lennart Bengtsson, Chair of the Working Group, presented the draft plan. Four reviews of the plan were offered by:

- Peter Lemke, *an independent reviewer*;
- Dennis Lentenmaier, *a member of WG 7*;
- Rodion Sulyandziga, *an indigenous reviewer*; and
- Peter Lang Langen, *a young scientist*.

Dr. Eigil Kaas acted as rapporteur. In conjunction with Dr. Bengtsson, a set of notes summarizing the main issues were prepared as raised by the reviewers and by the audience during the open discussion. These are summarized below and will be dealt with in the final WG report.

Limitation and overlaps

- Only components feeding directly back to the climate system should be considered.
- Several areas of overlap with other working groups. Need careful consideration in the last phase.
- Weight on process studies and links to observations – what do climate modellers mean by process studies.
- Science questions should be clearer in the text. What are the limits of knowledge at present and how should we prioritise.

Components/processes considered

- Eco-system, land surface and biota modelling should be included
- Ice sheet modelling should be included (including mass balance and run-off). Link to WG7.
- More emphasis in the report on the role of oceans
- Chemistry (ozone, aerosol chemistry of importance to e.g. albedo on ice/snow) components of climate models should be emphasised.

Validation/verification

- There was some discussion on new measures of model reliability. Better Arctic data (remote sensing) is needed for verification.

Science questions/limitations

- There is a need for less emphasis on NWP (ThorpeX) and more on longer time scales (COPES)
- Regarding past climates, the Holocene is not enough. There is a lot to learn from ice-age dynamics and deep past climates (e.g. the Eocene problem).
- Models of intermediate complexity for studying very long-time scales and very long-time scales should be used with care.

Other issues

- Link to IPY not sufficiently emphasised.
- Concluding section and implementation plan is missing.
- Funding issues have not been discussed in the report.



Working Group 10: Resilience, Vulnerability and Rapid Change

Over approximately a 3-hour period, the Draft Research Plan for the ICARPII Working Group on Resilience, Vulnerability and Rapid Change was presented and discussed in an ICARP II breakout session. The session was convened and moderated by Dr. Oran Young, the ICARP II Steering Group Liaison member for the Working Group. Dr. Gary Kofinas, Chair of the Working Group, presented the draft plan. Four reviews of the plan were offered by:

- Grete Hovelsrud-Broda, *an independent reviewer*;
- Natalia Novikova, *an individual from a related ICARP II working group*;
- Ambassador Karen Kraft-Sloan, *a potential user of the plan*; and
- Robin Urquhart, a young scientist.

About 30 individuals participated in the workshop/breakout session. Panel members presented their impressions of the plan (10 minutes each) and workshop participants then contributed to an open discussion. Some of the key points from that discussion are listed below.

- Overall, there was a positive response to the plan by those in attendance.
- People commented that they liked the interdisciplinary/integrated social-ecological approach of the plan and its explicit links with policy.
- The consensus is that focus on rapid change is critical.
- The plan's approach was viewed as a way of unifying all other ICARP II Working Group foci.

Comments about science

- What do we mean by "science?" This question has important relevance given that the plan talks about the inclusion of indigenous perspectives.
- History matters; include more explicit mention of how research on the past can inform our research and practice of the future.

Comments about institutional dimension

- The plan seems to put an emphasis on formal institutions but does not include enough discussion about the potential contribution of informal institutions or customary law as elements contributing to the system's resilience.
- There are currently problems with institutional performance in the Arctic at all levels. In some cases co-management is failing to meet its objective. Empirically based comparative work is important, and is needed to identify current conditions and overall trends.
- The plan calls for society to be flexible and responsive, but governments strive for stability. How do we reconcile these differences in approach?

- A more elaborated discussion of institutions and their potential role in social-ecological systems is needed.

Comments about linkages

- The approach to cross-scale linkages needs to be better defined.
- “Exogenous Drivers of Change” mentioned in the plan need to be defined more clearly; they are not isolates and local communities are not sitting ducks in the change process.
- It is important to remember that change at one level can maintain something at another level. Social-ecological linkages and embeddedness need to be considered in tandem.

Comments about “communities”

- There is a need to think beyond issues of indigenous peoples. For example, northern communities of Norway are composed of non-native oil workers. How will rapid change affect their communities?
- Language is a critical part of the process, and in 10 to 15 years there may be a dramatic downturn in the number of people in the Arctic who speak indigenous language (passing of today’s elders). How will this loss affect social-ecological relations?

Comments about the measures

- Who defines “vulnerability?” That is a critical question in any analysis. There is a need to involve those potentially affected directly in all research, which places a heavy but important burden on the researcher.
- There is a need to avoid simple indices of vulnerability – e.g., 10 is high/5 is low; and to avoid a government push to give number-based relative measures of vulnerability. All evaluations need to be grounded with qualitative analysis.

Comments about focus

- The research plan has a strong North American perspective; there is a need to emphasize European reality.
- The plan should include more discussion about the needs to measure rates of change.

Based on these comments, the WG 10 research plan will be revised.



Working Group 11: Arctic Science in the Public Interest

The breakout session of WG 10: Arctic Science in the Public Interest gathered over 100 persons from all over the Arctic, representing a wide range of institutions and sciences. Oran Young, the ICARPII Steering Group Liaison member for the Working Group, convened the session. Five reviewers discussed the research plan, prepared by a working group of over 30 persons over the past year with Chris Southcott as lead author:

- Mai Brit Utsi, *an external reviewer*;
- Bob Corell, *a reviewer from a related ICARP II working group*;
- Rodion Sylandziga, *an indigenous reviewer*;
- Gwen Healy, *a young researcher on health*; and,
- Anna Sinisalo, *young researcher in glaciology*.

Professor Jim McDonald, WG 11 member, acted as rapporteur and reported to the ICARP II plenary. The breakout sessions started with Lars Kullerud, Chair of WG 11, giving a history of the Working Group and a summary of the existing draft of the research plan. He noted a general interest among many involved in Arctic science to find better ways of ensuring that Arctic research meets the needs of various publics. A proper understanding of the relationship between Arctic science and the public interest requires an understanding of the social, historical, cultural, economic, and political forces that drive Arctic science and understanding of the relationship of these forces to the public interests. Working Group 11 identified five key areas for discussion:

Q1: Understanding the Image of the Arctic and Arctic Science

The public outside the Arctic has images of the North that are often formed by science, national identity, sovereignty, and resource needs, while people living in the North have images of their homelands linked to their cultures, resources, and opportunities for a good life. Studies should allow us to better understand the major forces shaping these images.

Q2: The Construction of Research Questions

Social forces shape the research questions that drive Arctic science. It is time to have a closer look at how the research questions are shaped, whether they actually get addressed, and if there are questions that never get asked.

Q3: Research Conduct in the Arctic

Researchers have increasingly come to realize that research can have a significant effect on certain populations. Most research-related institutions and organizations have established ethical principles to guide research in the North. It is now time to examine, compare, and evaluate these guidelines.

Q4: Knowledge Control and Communication

Understanding the impact of rights and access to knowledge is essential. There is a need to understand how the ownership, legitimation, dissimulation, and dissemination of knowledge in and about the Arctic been effected in the past, present, and future.

Q5: Research Impacts

Research impacts occur on the political, economic, cultural, social, and environmental levels. It is important to understand the impacts of the research itself and of the results of the research, as well as the impact of the communication of research results.

Breakout Session Discussion

The Working Group noted early in its work the need to find better ways of educating, communicating, and ensuring outreach to these publics. While the members of the Working Group agreed that education and outreach were important issues, it was agreed that it is rather a field of skills that needs to be improved in science and elsewhere than a subject of a research plan that hopes to find better ways of ensuring closer relations between the Arctic science and the public. As a result, the Working Group decided that its focus would be to development of a research plan dealing with the relationship between Arctic science and the public. The working group also has taken on the task to develop a separate Education and Outreach Strategy that could be used by Arctic science.

Much of the discussion during the breakout session dealt with the importance of effective education, communication, and outreach strategies for Arctic research. The importance of finding better ways of using the Internet, new models of education, and the best ways of getting the messages of Arctic science to policy makers was stressed. One of the young researchers commented that in order to improve the training of future generations of Arctic scientists, we need to find ways to improve multidisciplinary and to improve the communication skills of scientists. Participants in the audience pointed out the need to also develop tools or strategies for Arctic scientists to best communicate their findings to the public.

Others agreed that there are many more profound issues that need to be addressed by the research discussed in the Plan. Representatives of indigenous groups noted the need to better understand the relationship between indigenous knowledge and scientific knowledge. They noted the need to understand why it was so difficult for indigenous culture and the indigenous perspective to become integrated into Arctic science. Why has Arctic science had such a difficult time responding to the research needs of Arctic communities? Several participants felt that the research plan should not try and deal with better ways of communicating Arctic science to policy makers and the public, it should instead find ways of enabling Arctic communities and policy makers to better communicate to and educate Arctic scientists.

Participants noted that many of the questions outlined in the research plan are questions that are relevant to all sciences. They also noted that they are especially relevant to Arctic science because of the political distance that separates Arctic science and Arctic peoples. Several participants noted the need to critically examine the power relationships inherent in Arctic science. The ownership issue is one such example. What is the right of ownership of indigenous groups concerning knowledge that is collected from them? Who owns DNA, bones and artefacts collected by Arctic? These questions have to be investigated to ensure a better relationship between Arctic science and indigenous peoples.

In summing up, the participants in the breakout session stressed the need for an additional Education and Outreach Strategy to accompany the final ICARP 11 report and that members of Working Group 11 should assist in the preparation of this strategy. As concerns the existing research plan, participants accepted the key research questions but suggested that more specific scientific projects be added.

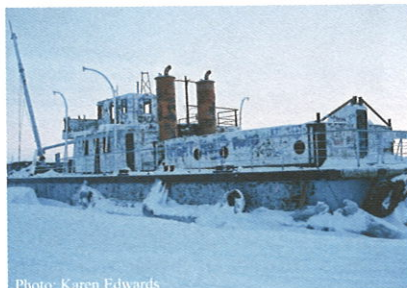


Photo: Karen Edwards

Working Group on Contaminants

The Contaminants break-out session was chaired by Lars-Otto Reiersen (AMAP Executive Secretary). Approximately 50 participants attended the session.

The introduction to the contaminant topic under ICARP II emphasised that the background document for the Contaminants Session of ICARP II is not in itself a research plan.

Contaminants issues are relevant within all ICARP WG themes, and as such it is expected that the research plans of the other ICARP WGs will address contaminant issues. The results of AMAP activities over past 15 years should provide the starting point for consideration of contaminants by the other ICARP WGs. The background document prepared for the session reflects *Gaps in knowledge and Recommendations and Priorities* for Arctic Contaminants research identified through AMAP scientific assessment activities over the past 15-years.

The break-out session comprised a series of brief presentation of gaps/priorities for various contaminant issues: Petroleum Hydrocarbons in the Arctic, presented by Hein Rune Skjoldal (Norway); Radioactivity: Knowledge gaps and priorities, presented by Justin Brown (Norway); POPs and Metals in the Arctic, presented by Simon Wilson (AMAP); Contaminants and Human Health in the Arctic, presented by Jens C. Hansen (Denmark); and National Implementation of Contaminants Research, presented by Rune Dietz (Denmark).

The session was convened by Hanne Petersen, the ICARPII Steering Group Liaison, and four reviews were provided.

- Gary Stern, *an independent reviewer*,
- Lisa Loseto, *a young scientist*;
- Adelheid Herrmann, *a representative from related ICARP II WG*;
- and
- Morten Olsen, *an end-user*.

The reviewers presented their observations on the material presented, and on the general issue of Arctic contaminants research. The session participants then provided their input in an open and free-ranging discussion.

Common themes identified in the presentations and ensuing discussions included: human health implications of contaminants; combined effects of contaminants (and contaminants and other stressors); climate and contaminants linkages (changing pathways, changing routes of exposure, interactions); “new” contaminants (in particular POPs); and population/ecosystem effects.

The breakout-session discussions highlighted the following elements:

Integration

- The need to promote synergy between monitoring and research. These are inherently coupled activities (e.g., programmes monitoring climate and contaminants establish the context for many research activities, however, results of research are crucial if monitoring data are to be correctly interpreted).
- The need for AMAP to remain an integrating entity for contaminants and climate related monitoring and research in the Arctic. AMAP should therefore be more involved in consultation on IPY projects to enhance linkages, etc.
- Attention should be paid to integration of research activities with new industrial and economic development in the Arctic, e.g., conducting comprehensive impact assessment studies to ensure that such developments do not lead to contamination problems. For example, studies should be proactive rather than retroactive.

Operational aspects

- The need to address scale issues. AMAP has, in the past, focussed on a circumpolar perspective, but in relation to contaminants effects, there is a need to look more at regional, even local, scales).
- The urgent need to address the serious problem of the lack of stations and/or observation platforms, especially those with a long-term perspective. Closure of stations rather than establishment of new stations is still the reality, in spite of IPY.
- The need for information from groups engaged in various fields of research to better understand how climate change will influence transport of contaminants or (re)mobilize existing contamination.
- The need to change emphasis from ‘description of risk’ to risk management (e.g. human health, radioactivity);
- The need to better explain to politicians and funding agencies why key questions are important, including a clearer prioritisation towards results that can be used in order to “politically sell” the proposed activities in an environment of intense competition for public funding and to avoid a perception of “research for research sake.”

Communication, community involvement

- The importance of proper communication of science results at an appropriate level to the public and, in particular to indigenous audiences, including the use of language accessible to users and taking account of regional differences. Partnerships between scientists and communication experts should be developed and improved.
- There should be a focus on responding to specific questions about how contaminant/climate issues will affect people at the individual as well as community/population level, in particular for indigenous people and others living vulnerable northern communities.
- Risk communication, specific for target communities, should include involvement of affected communities in risk management.

The session discussions further highlighted the need to ensure a balance in the research to avoid the danger of focusing too much on some issues and neglecting other important issues. For instance, mercury is a continuing priority, but there is also a need to address other contaminants; atmospheric pathways are critical in contaminant transport to the Arctic, but ocean pathways are not well understood and deserve more attention as well. Work has focused on contaminant transport to the Arctic, but what about return flows? There are a number of well-recognized limitations and constraints (including regional differences in ability to conduct monitoring/research, and the wide range of contaminants/issues involved), but how to address

these is an ongoing process. There is a need to work more closely with and involve scientists and decision-makers from other regions (e.g., new contaminant source areas outside of the Arctic).

Subject to funding limitations, major advances in contaminants-related research in the Arctic is feasible and within the capability of the science community during the next 10 to 15 years. However, declining funding is a major concern. This may be related to the past successes in establishing international agreements concerning contaminants (e.g., Stockholm Convention) leading to a mistaken perception that problems are solved. Some research questions, for example, the issue of combined effects, are more difficult than others. Involvement of industry in research, and issues relating to disclosure of results of industry research are aspects that need to be taken into account in order to ensure that these questions can be addressed properly and be adequately supported. Research funding tends to be “more available” in fields that are of importance to economic development.

Lack of stations/observation platforms and lack of a long-term funding perspective may prevent the potential implementation of research. Funding is a continuous problem; it is declining, hence the importance of prioritisation and the need to recognize the Arctic as an area for research relevant to other regions. IPY is a funding opportunity, but if it is simply based on a reallocation of existing funds rather than new funding it will not meet current expectations regarding significantly enhancing knowledge beyond what would have been achieved through ongoing programmes, and may disrupt rather than complement ongoing activities.

A number of IPY proposals address contaminant issues and when the funding situation is clarified it will be possible to see whether potential linkages are realised. This may not be the case if some related projects are funded and others not. One disadvantage of the IPY process is that it has encouraged scientists to build cross-border plans, but most funding is often not cross-border. Access to results from IPY projects is important and it is crucial that IPY realises its goal of establishing a legacy.

The ability of ICARP to address contaminants research priorities depends on the inclusion of contaminants research objectives in the research plans of the various ICARP WGs. The contaminants breakout session participants were not able to confirm (on the basis of the published research plans) that this is the case. It was suggested that the ICARP steering group should circulate a request to all other ICARP WGs as soon as possible asking them to document the contaminants research related components within their respective research plans, in order to confirm that contaminants issues and priorities identified in the Contaminants WG background document are being appropriately covered.

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