



United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Expert Meeting

Climate Change and Arctic Sustainable Development: scientific, social, cultural and educational challenges

3-6 March 2009, Novotel Monte Carlo, Monaco

Report and recommendations

I. MEETING RATIONALE AND STRUCTURE

Climate change will have multiple and complex repercussions on the natural, social and cultural landscapes of the Arctic and sub-Arctic. The implications of these changes, including their global impact, have yet to be comprehensively monitored, evaluated, understood and communicated. To comprehensively analyse the multilayered and multiform interactions connecting global and Arctic processes, an international and interdisciplinary approach is required.

The International Expert Meeting 'Climate Change and Arctic Sustainable Development: scientific, social, cultural and educational challenges' was generously supported and hosted by the Principality of Monaco. The event was opened by H.S.H. Prince Albert II of Monaco, the Director General of UNESCO, Koichiro Matsuura, and Professor Jean Malaurie, UNESCO Goodwill Ambassador in charge of arctic polar issues. The meeting was also addressed by the Executive Director of UNEP, Mr Achim Steiner. H.S.H. Prince Albert II of Monaco also attended the closing session.

The expert meeting brought together 42 participants from 13 countries, including all Arctic states and Greenland. Participants were experts in the fields of the natural and social sciences, education, ethics, law, health and international affairs. These experts included representatives from UNEP and the Arctic Council, and circumpolar indigenous peoples working with the Russian Association of Indigenous Peoples of the North (RAIPON), the Inuit Circumpolar Council (ICC) and the Sami Parliament. Secretariat from UNESCO's Natural Science Sector, International Oceanographic Commission (IOC), Culture Sector and Social and Human Sciences Sector oversaw the meeting.

The agenda of the expert meeting is included in Annex I and the list of participants in Annexes II and III.

The meeting assessed the scientific, social, cultural and educational challenges to be met in order to ensure the sustainable development of the Arctic within a global context. A combination of discussions at the plenary and working group levels generated an interdisciplinary dynamic for the meeting. Four interdisciplinary working groups deliberated on the following facets of change in the Arctic:

1. Oceans, ice and atmosphere
2. Biodiversity and ecosystem services
3. Circumpolar indigenous peoples and intangible heritage
4. Economic development and social transformations

Four cross-cutting themes were also explored in these same working groups:

1. Education for sustainable development
2. Environmental ethics
3. Monitoring and observing systems
4. Global connections to change in the Arctic

Plenary sessions focused on further building dynamic interlinkages between disciplines and themes.

The participants identified key challenges and knowledge gaps and addressed recommendations to the Director General, for follow-up action by UNESCO and transmission to appropriate institutions, member states and intergovernmental committees.

II. KEY CHALLENGES

There is a clear sense of urgency in our discussions of the Arctic. Rapid changes are currently underway in the cryospheric (water in its frozen state on land and sea), terrestrial, oceanic and atmospheric systems of the Arctic and many of these changes are currently outpacing climate model predictions. Arctic sea ice is declining in all regions and in all months, with the smallest trends in winter and the largest at the end of the melt season in September. Since about 2002, the satellite data record has indicated that the downward trends in summer ice cover have accelerated, with the implication that a seasonally ice-free Arctic ocean may be realised sooner than projected by our most advanced climate models. Meanwhile, local communities have been noticing profound changes in the Arctic sea ice environment for several decades. During the same period, the Greenland ice sheet has shown enhanced surface melting and increased discharge rates from its outlet glaciers, impacting on global sea level rise. Almost all Arctic glaciers are currently losing mass and snow cover over Arctic land areas is declining. Permafrost is warming and its southern limits are thawing. Temperature rises in the Arctic are twice as large as those for the planet as a whole. Model projected Arctic amplification has recently emerged in autumn as the Arctic Ocean is covered by larger expanses of open water at the end of the summer melt season, which absorb more solar radiation than an ice covered ocean, with the potential to impact further on land surface temperatures. An ice-free "blue" Arctic Ocean will lead to profound changes in the marine ecosystem, the culture and livelihood of indigenous peoples, and economic activities in general.

The rapid rate of climatic change in the Arctic, coupled with the potential increased transmission of invasive species, greater industrialisation and rapid social change, makes understanding and conserving Arctic biodiversity an ever greater challenge. This is especially important in recognition of the 2010 Convention on Biological Diversity's target to reduce the rate of loss of biodiversity. The maintenance of healthy Arctic ecosystems is a global imperative as the Arctic plays a critical role in the Earth's physical, chemical and biological balance, providing ecosystem services that are vital to human well-being.

Circumpolar indigenous peoples live under the flags of many countries but share, with northern communities, many similarities in aspects of land use, culture, subsistence, environment, educational needs, language, social and resource development pressures, and traditional knowledge. In our discussions we shared our unique cultural perspectives and described the challenges we face, and addressed the ways we adapt to these changes. We also acknowledge that there are gaps in our knowledge base and response systems that can benefit from the expertise and collaborations with experts in many fields from all over world. It is a fact that our communities are experiencing dramatic changes to our environment due to climate change and that the repercussions of those changes fuel already existing problems. Yet it is not only people living in the Arctic that will be impacted by the profound

changes in the Arctic environment. Melting ice in the Arctic will have implications for the rest of the world in terms of its impact on global sea level, atmospheric and oceanic circulation. We believe that by sharing our experiences and knowledge of the Arctic, where climate change is more advanced than in other regions, we can play a vital role in better preparing the world for what is to come.

Action formulated to address Arctic issues must begin from an understanding that peoples of the Arctic have self-governing institutions at various levels of development. Indigenous peoples and their institutions have immense creativity and seek to advance the self-determination, prosperity and aspirations of their communities and their regions. The challenges of maintaining and enhancing the prosperity and cultural well-being of the people of the Arctic are often complicated by drivers of change which have non-Arctic origins. In addition, scientific, developmental and conservation efforts are often driven by interests outside the Arctic. Arctic governments and Arctic residents welcome the growing global interest in this important region. Efforts to advance Arctic knowledge through scientific, traditional and local means will be critically important to formulating responses to major challenges such as climate change and variability. As work advances on all fronts, it will be important to acknowledge the people of the Arctic and their institutions as actors with valid interests and not simply treat the Arctic as a project area to be researched.

III. KNOWLEDGE GAPS

In relation to work on physical earth systems, several reports have been written in the last five to ten years regarding gaps in knowledge and observations of the Arctic's ice, ocean and atmospheric systems. These include key observational gaps, gaps in infrastructure and gaps in data sharing (see for example the Sustained Arctic Observing Network (SAON), International Conference on Arctic Research Planning (ICARP), and Arctic Climate Impact Assessment (ACIA) reports). Our efforts here should not repeat those exercises, but rather should focus on action. That said, we acknowledge that this analysis of gaps will need to be updated over time, as some of these gaps will be filled, and new knowledge, including local and indigenous knowledge, may help us to identify new gaps.

Science challenges remain and it is recommended that UNESCO promote work on science aspects such as those listed below in order to achieve the possibility for regional predictions and interactions:

- The Arctic Ocean remains poorly understood both in its current state and its future state, including the influence of ocean circulation, inflow of Atlantic and Pacific waters into the Arctic, ocean bathymetry, ocean salinity and effects of ocean acidification;
- Atmospheric circulation requires further attention;
- Processes contributing to ice formation and ice melt, ice thickness and snow depth remain poorly known;
- The role of permafrost and frozen ground in the carbon cycle remains unclear;
- Many feedbacks remain poorly understood, i.e. methane released from thawing permafrost, cloud-radiation interactions, cloud-atmospheric aerosol interactions, and black carbon on albedo;
- Inconsistencies remain in modelling results and temperature data sets;
- Determination is needed of ice sheet and glacier mass balance and their contribution to sea level change;
- There is a need to improve prediction ability because present day global climate models are limited in their capacity to provide reliable projections of climate change in the Arctic.
- Observation networks for the Arctic are still quite limited, with only a few long-term stations, making it difficult to distinguish with confidence between the signals of natural variability and long-term climate change.

In terms of our understanding and protection of the Arctic's biodiversity, numerous gaps remain in knowledge and action:

- The critical role that Arctic ecosystems play in the Earth's physical, chemical and biological balance, providing ecosystem services that are vital to human well-being, are only somewhat understood by the public and policy-makers.
- Arctic states and Greenland also need to more proactively address and influence processes occurring outside of the Arctic which are negatively impacting Arctic biodiversity.
- The Arctic's size and complexity represents a significant challenge towards detecting and attributing important biodiversity trends, thereby demanding a coordinated, integrated, multi-disciplinary and ecosystem-based approach, yet established research and monitoring programmes remain largely uncoordinated and limited in coverage, lacking the ability to effectively monitor, understand and report on biodiversity trends at the circumpolar scale.
- Arctic residents are often forgotten or excluded from full and effective participation when discussing biodiversity despite their integral role in these ecosystems and the importance of Arctic biodiversity in supporting not only ecosystem services, but also cultural and spiritual values.
- While efforts have been made to include local and indigenous peoples and communities in monitoring and understanding change in the Arctic, more work is needed and successful projects need to be built upon.
- More timely and accessible information is needed to generate effective strategies for mitigating and adapting to changes in the Arctic - a process that ultimately depends on rigorous, integrated, and efficient research and monitoring programmes that have the power to detect change within a 'management' time frame.
- Existing information, be it historical accounts, indigenous/traditional knowledge or long-term scientific datasets, is of high potential value in determining past trends and identifying potential drivers of trends. Yet, this information is often forgotten or not easily accessed.
- Much of the information generated in the Arctic is fragmentary, disconnected across disciplines, and does not reach the public or policy makers or is not delivered in a proactive or appropriate format that facilitates communication and understanding.

There are also numerous gaps in our knowledge of the socio-cultural systems of the North, and the ways that these will be impacted by the rapid changes currently occurring.

- Gaps exist on connections and cross-disciplinarity between the sciences. Integration across disciplines is needed to help further our understanding of global change impacts, and to create solutions.
- Gaps in knowledge exist regarding non-Arctic drivers of Arctic change
- Communication of research results between the physical sciences and the social sciences on the impacts of climate change has been slow.
- Much research on the impacts of climate change is conducted on a large scale whereas human activity is highly localised, and impacts and responses will be conditioned by the local context. More needs to be done to reconcile the research on impacts of change with the need to understand and predict local consequences and adaptation.
- Gaps in knowledge exist in how indigenous and Arctic communities can deal with climate change on their own terms.
- Knowledge gaps exist in the flexibility of subsistence living approaches. Much research has been done on the problems that subsistence living will face due to climate change, but gaps exist in how those problems could be overcome by the people themselves.

- Arctic community characteristics need further study. Community structures matter with respect to climate challenges (according to some research, diverse communities are more able to adapt than more homogenous communities).
- Indigenous and Arctic communities need to be provided with a better predictive understanding of global and local climate, social, biological and economic trends. This includes building upon current pan-Arctic efforts to develop analytical frameworks and appropriate indicators useful for Arctic communities. Indicators should assist with the long-term monitoring of human development in the Arctic.
- There is insufficient integration and dissemination of the knowledge generated by research and conferences on issues such as arctic tourism and arctic energy systems.
- Considerable gaps exist between knowledge on Arctic change and actual action. There is a vast amount of knowledge on change and global change impacts, whereas action is lacking. Also, there has been little analysis of activities that have been successful, be they adaptation or mitigation.
- There are gaps in dialogue and communication, both between the sciences, and between science and arctic residents and other stakeholders. There are crucial gaps in the dialogue necessary to move from science to action. There is as yet little understanding of the extent to which Arctic communities and indigenous peoples influence decisions on science funding in the Arctic.
- Effective and legitimate policies need to take account of the interests, values and knowledge of the people directly affected by them. Often, although not invariably, the people most directly affected are local communities at relevant geographical scales. Yet there are major gaps in institutional design and policy processes. Local communities are sometimes not consulted at all; when they are, their contribution may be neglected. Furthermore, opportunities to be heard through non-institutional processes such as political mobilisation may be restricted. As a result, policies are commonly adopted that may be unacceptable to local communities or, because local knowledge is neglected, do not work.

IV. RECOMMENDATIONS

The recommendations below reflect the breadth and depth of the participants' expertise and experience and are addressed to a variety of audiences, including UNESCO but also other international organisations, national governments, NGOs, indigenous peoples and Arctic communities, and others involved in Arctic matters. They are organised according to the organic flow of discussions in the working groups and plenary. This ordering does not imply priority, and nor does it necessarily follow the structure of the themes and cross-cutting issues of the original meeting plan. For example, ethical issues are an integral part of many recommendations and thus are not separated into their own section. A rewarding and important characteristic of the discussions was that both indigenous and scientific knowledge and concerns were fully and equally considered. Several participants highlighted that they had valued the discussions precisely for this reason. The collective set of recommendations was compiled with this sense of shared purpose, and should be read with the understanding that they are intended to promote collaborative action.

Education, communication and outreach

1. Given the critical and high importance of education in terms of socio-economic development in the Arctic, UNESCO should expand its role as a promoter of education at all levels in the Arctic. In this connection UNESCO should:
 - a. Create an overview of best practices in primary and secondary education, to promote education that is relevant and adapted to the North;

- b. Promote and enhance integrated northern education systems that include traditional and scientific knowledge to facilitate better adaptation strategies in the Arctic;
 - c. Create a review of education evaluation systems so that in future they also promote local and traditional knowledge systems and local cultures and languages;
 - d. Support teacher training covering local cultures and languages;
 - e. Encourage formal and non-formal education efforts suited to the requirements of indigenous and northern communities, such as nomadic schools which bring quality education to children of families that must migrate for their livelihoods and thus are unable to attend regular schools;
 - f. Support universities in indigenous peoples' homelands and post graduate study programmes for indigenous peoples;
 - g. Promote and support the work of the University of the Arctic (UArctic), which is innovative, directly beneficial to and adapted to the needs of indigenous peoples and northern communities;
 - h. Collaborate with officials of the University of the Arctic as a starting point for further development of educational strategies and practices for sustainable development in the Arctic, as well as to prepare a new generation of polar researchers.
2. Scientists should be trained to communicate science effectively to indigenous and Arctic communities, and to have cultural sensitivity towards northern communities. Encourage journals, journal editors and reviewers to ensure that, where relevant, arctic science papers demonstrate communication with, and cultural sensitivity towards, indigenous and Arctic communities.
 3. UNESCO should support the continuation of the IPY APECS (International Polar Year Association of Polar Early Career Scientists) program.
 4. UNESCO, the Arctic Council and other relevant organisations should disseminate information to the global community about the pressures facing Arctic ecosystems and peoples. This could include the Arctic Council supporting and adopting a regular 'State of the Arctic' report that meets international, national and local reporting needs.
 5. UNESCO should take a lead in building on the International Polar Year (IPY) outreach committee in cooperation with Arctic indigenous peoples' organisations, the Arctic Council and other organisations, as global communication via the media, schools etc about Arctic culture, science and key issues is essential.
 6. UNESCO should make 'lessons learned' from Arctic education and the UArctic model available to education networks in other regions of the world.

Cultural heritage

7. UNESCO should encourage national governments, corporations, NGOs, and local communities in the Arctic to support and promote indigenous cultural traditions.
8. UNESCO should document, safeguard and promote the dynamism of the intangible cultural heritage of indigenous peoples such as language, oral history, folklore, knowledge and traditions. UNESCO, through its programmes on language retention, should also assist Arctic states and peoples in their efforts to preserve languages.

9. UNESCO should work to raise awareness among Arctic groups of the 2003 Convention for the Safeguarding of the Intangible Cultural Heritage.
10. It should be recognised that indigenous communities in the Arctic are modern societies and use modern technologies, and that use of such technologies is not incompatible with the maintenance of traditions or indigenous identity. Cultural programmes should affirm this, or risk undermining sustainable development.
11. A study should be produced on the trends of human migration, including the causes of immigration to and emigration from the Arctic, as well as internal migration within the Arctic region. Measures should be devised to reverse and/or reduce the consequent risks to Arctic cultures.
12. An international assessment should present an overview to UNESCO and the Arctic Council of heritage sites around the Arctic of particular international value that need special attention in the future in terms of management and protection.
13. Archaeological work should be prioritised to document and preserve tangible evidence of ancient coastal and inland heritage and sacred sites that are in danger of loss due to the impact of climate change and exploitation.

Well-being and health

14. The Arctic Council and the World Health Organisation (WHO) should take action on the human health recommendations put forward by chapter 15 of the Arctic Climate Impact Assessment and the report by the United Nations in the Russian Federation report, 'Climate Change Impact on Human Health in the Russian Arctic'.
15. WHO and other relevant authorities should continue to raise awareness of the problems of contaminants and other threats to human health.
16. UNESCO and WHO should work with other agencies to ensure the provision of adequate primary and other medical services to Arctic communities.
17. The United Nations Environment Programme (UNEP) and UNESCO should organise a 'food security' conference focusing on the Arctic, in collaboration with the Arctic Council.

Economic development and resource management

18. The renewal, conservation, and development of traditional forms of activities that will help to create employment and social and economic well-being of the indigenous peoples of the North should be promoted. All forms of local economics should be integrated into development plans in wide consultation with indigenous people.
19. A review should be made of policy options related to protection of the non-market subsistence sector in connection with the emergence of the mixed and industrial economy in the North.
20. The sustainable use of renewable resources, including for commercial purposes, should be recognised, supported and promoted throughout the circumpolar Arctic.

21. Sustainable use of renewable resources and sustaining ecosystems should be promoted in regards to exploration, development of oil and gas, mineral resources and shipping, through the application of the most stringent environmental standards, which should exceed today's standards, and through land-use planning that includes development thresholds to ensure that cumulative impacts are limited.
22. International investment, including from states outside the Arctic, should be mobilised to ensure safe, secure and reliable marine transportation in the Arctic.
23. National governments and corporations should take into account ecosystem services values during development planning, including spatial integrative planning and recognition of NO-GO zones.
24. Governments should be called on to establish new legislation, where needed, to ensure that industry operating in the Arctic supports and participates in integrated research and monitoring following set standards.
25. Assessments should be produced of the impacts of different-scales of resource and industrial development in the North. This should include alternate governance models to address resource conflicts related to the increased role and presence of multinational corporations in the North.
26. It should be ensured that indigenous peoples and Arctic communities are fully involved in decisions concerning development, are fully and effectively consulted, and have free prior and informed consent.
27. Best practices should be investigated and disseminated in the management of industrial development controlled by indigenous peoples, to ensure that local communities benefit as much as possible from the positive aspects of industrial development.
28. National governments and corporations should be stimulated to compensate any net negative impacts caused to indigenous peoples and Arctic communities by industrial development and climate change, through affirmative plans, education and support programmes.

Arctic governance

29. Governance initiatives should consider values beyond macroeconomic indicators and economic growth rates.
30. The United Nations Framework Convention on Climate Change (UNFCCC) should address land-use changes as an important driver of climate change.
31. UNESCO should work closely with the Arctic Council, which provides a forum for cooperation between Arctic and non-Arctic states, indigenous peoples and observer organisations, to promote sustainable development.
32. The full and effective participation of indigenous peoples in international climate change negotiations and debates should be ensured.
33. A working/advisory group should be established to develop dialogue and strategy on the challenges of climate change for circumpolar indigenous peoples, including

safeguarding intangible heritage and building synergies between indigenous and scientific knowledge.

34. UNESCO and other international bodies should support efforts by Arctic indigenous peoples and peoples of the Small Island Developing States and other vulnerable regions to achieve an effective climate change treaty that will reduce risks and vulnerabilities, in particular to peoples living in low lying areas, small islands and the Arctic.
35. Support should be encouraged for the recognition of human rights and the United Nations Declaration of the Rights of Indigenous Peoples, and the ratification and implementation of relevant Conventions including the 1989 International Labour Organization (ILO) Convention 169 concerning Indigenous and Tribal Peoples in Independent Countries, the 1992 Convention on Biological Diversity, and UNESCO's cultural conventions, in particular the 1972 World Heritage Convention and the 2003 Convention for the Safeguarding of the Intangible Cultural Heritage, as well as the 2001 Stockholm Convention on Persistent Organic Pollutants and the United Nations Framework Convention on Climate Change (UNFCCC). Self-determination should be supported on national and international levels.
36. Arctic peoples should be involved, formally and informally, in collaborative management of biodiversity at all levels of planning and decision-making concerning the Arctic and its future.
37. Sustainable use by indigenous peoples should be acknowledged when any proposals are made to place animals on endangered species lists. It should be recognised that indigenous peoples have depended upon this resource for their traditional diet, which has an impact on their health, and that sustainable use of the surplus of nature (sea mammals, deer, birds etc) is legitimate and is an important part of Arctic culture. Indigenous peoples should be fully and effectively consulted prior to any restrictive measures being considered.
38. Arctic wetlands and other underrepresented ecosystems should be properly represented in existing conventions and other international fora by stressing the important services that Arctic wetlands provide (regulating climate and hydrology).
39. UNESCO should support the efforts underway to improve international governance of the Arctic, such as broadening stakeholder participation. This should, in part, support improved outcomes for Arctic biodiversity such as the analysis of Multilateral Environmental Agreements being conducted by UNEP.
40. Arctic states and Greenland should be encouraged to recognise the importance and value of efforts by non-Arctic stakeholders, including international organisations and NGOs, to sustain the region's unique biological, social, and cultural heritage and reduce the effects of climate change, and they should collaborate with these efforts.
41. Both Arctic and non-Arctic states should be encouraged to work together to develop coordinated programmes to mitigate environmental deterioration in the Arctic.
42. All necessary efforts should be made to enable research to thrive by ensuring free and open scientific access to the Arctic. In view of the gaps in the application of Article 247 of the United Nations Convention on the Law of the Sea (UNCLOS), UNESCO is requested to act through the mechanisms of the IOC to develop related procedures which would improve access of researchers to the exclusive economic zones of Arctic states.

Establishing, sustaining and strengthening research and monitoring systems

43. Given the limited number of observation networks in the Arctic, sustaining, strengthening and further developing long-term comprehensive multidisciplinary integrated pan-arctic observing systems is recommended.
44. A mechanism should be established to facilitate international collaboration among operators, funding agencies, indigenous peoples' organisations and users of multidisciplinary observational systems and data over the Arctic region. The efforts of SAON (Sustained Arctic Observing Networks) and CBMP (Circumpolar Biodiversity Monitoring Program) to do this should be acknowledged and supported. UNESCO and its IOC should request that member countries support these observation and monitoring systems.
45. It is recommended the cryosphere aspects of this pan-arctic system be linked to the Global Climate Observing System (GCOS) in the Arctic, building on its main existing components currently in place such as the Global Ocean Observing System (GOOS), Global Terrestrial Observing System (GTOS) and new mechanisms such as Global Cryospheric Watch (GCW).
46. It is recommended that the core components of these observation systems that need to be developed, strengthened and sustained include at least the following:
 - a. A full gap analysis to determine where we can strategically fill priority gaps in research, monitoring and protected area coverage (geographic, thematic), including through indigenous knowledge;
 - b. Further development of satellite observations and ground truthing focused on the polar regions;
 - c. Continuation of existing polar observatories, other research and monitoring networks (regionally based/theme-based) and community-based monitoring networks and enhanced coordination among these observatories (networks of networks);
 - d. Maintenance of existing drifting ice and ship stations in the central Arctic Ocean;
 - e. Continuation and further deployment of autonomous observation platforms;
 - f. Continuation of data rescue efforts to enhance our understanding of long-term Arctic environmental change;
 - g. Full and effective participation of local communities and their institutions in community monitoring of variables such as snow, precipitation, ice, ocean and weather conditions, as well as larger operational and research programs;
 - h. Development of an overall status report on Arctic communities that reviews impacts on social, economic and cultural issues due to climate change. Include updates on the progress made by communities which are forced to move due to severe erosion;
 - i. Design and implementation of the Arctic Social Indicator monitoring system for long-term monitoring of human development and quality of life in the Arctic;
 - j. Development of guidelines and best practices for a standardised observing programme at all the observing stations, including community monitoring programmes;
 - k. Global tsunami warning systems should be extended to the Arctic (where appropriate).
47. UNESCO should work with Arctic states and Greenland to expand the network of Arctic biosphere reserves and World Heritage Sites and they should reactivate the Man and Biosphere (MAB) Northern Science Network.

48. UNESCO should support the work of the ongoing Arctic Biodiversity Assessment, aimed at international efforts to halt the loss of biodiversity.
49. UNESCO should promote coordinated and streamlined activities and processes as well as reporting on Arctic related issues such as biodiversity, climate change, land degradation, economic and social development, human rights and indigenous peoples in all its existing relevant international conventions and their liaison groups.
50. UNESCO should encourage comparative and multi-disciplinary research and monitoring approaches (both within and outside the Arctic) to facilitate the identification of drivers of change and to inform effective adaptation and management strategies.
51. UNESCO, the Arctic Council and other international bodies should support further monitoring and research aimed at linking climate change impacts on physical systems to biodiversity (including the full range of ecosystem services), and social systems, as highlighted in the ACIA report.
52. UNESCO should produce reports to examine how actions in non-Arctic states affect the Arctic, and how change in the Arctic will affect non-Arctic states. Already, recognising the connection, some distant large population states have become observers to the Arctic Council. Such reports would help bring attention to the enormity of the problems faced by the globe.
53. UNESCO could help perform assessments on information and communications technology, sustainable and stable cost energy, World Heritage, resources, and food security in the Arctic.
54. An integrated pan Arctic network of “supersites” should be established, building on existing infrastructure and facilities, where *in situ*, satellite, local knowledge and model data can be integrated to provide long-term, multidisciplinary data sets suitable for environmental monitoring and prediction;
55. In order to promote implementation of research and monitoring activities into operational services, it is recommended that:
 - a. Groups such as SAON, CBMP and/or Global Cryosphere Watch should be utilised by UNESCO as a means of addressing several of the above research and observational recommendations;
 - b. UNESCO should further encourage scientific research of Arctic climate in the framework of the World Climate Research Programme (WCRP), including creation of a new generation of climate models that would be able to address the above mentioned uncertainties;
 - c. UNESCO should support efforts started during IPY, including collaborations and cooperations already in place within programmes like DAMOCLES (Developing Arctic Modelling and Observing Capabilities for Long-term Environmental Studies);
 - d. UNESCO should use its potential as the organization having the mandate for interdisciplinary research to create through its existing programmes (i.e. IOC, MAB and the International Hydrological Programme (IHP)) and by other mechanisms, new information and knowledge which could be improved by the study of these science knowledge gaps;
 - e. A viable operational mechanism should be established, such as the Polar Climate Outlook Forum (PCOF), an IPY legacy project led by WMO, to

facilitate effective interactions between climate professionals and users/stakeholders.

56. In line with changes in the IPY that have included human dimensions in the polar science agenda for the first time, UNESCO, in cooperation with relevant bodies, should initiate a study on how research questions are formed in the Arctic, whether these get addressed, and where gaps appear in research agendas and activities.
57. WMO and UNESCO, as designated conveners by the UN for enhanced UN collaboration on climate knowledge: science, assessment, monitoring and early warning, are invited to promote UN collaboration for establishing, sustaining and strengthening research and monitoring systems in the Arctic.

Information access and data sharing

58. Research and monitoring systems, programmes and processes in the Arctic and elsewhere should:
 - a. Ensure a two way dialogue and exchange of information between indigenous and scientific knowledge. Ensure that indigenous and Arctic peoples are full and effective participants in the design and implementation of research and monitoring programmes, and that they receive the results from these programmes using formats both appropriate and comprehensible, e.g. using local languages;
 - b. Recognise and encourage parallel, collaborative processes between scientific methods and indigenous knowledge in setting regulations, laws and policies on the environment and natural resource management;
 - c. Place a greater emphasis on local and indigenous knowledge in mainstream science. Acknowledge Arctic Peoples' dependence on and stewardship of biodiversity, and the important contribution that indigenous knowledge can make to detecting and understanding change in Arctic ecosystems;
 - d. Support studies into how Arctic peoples have adapted to changing environmental conditions in the past to assist the development of adaptation strategies;
 - e. Encourage research cooperation and coordinate efforts between Arctic peoples' organisations, UNESCO and other bodies with regard to climate change impacts and adaptations. Adopt policies and programmes to address this relationship;
 - f. Identify the vulnerability of users in the Arctic and their needs for climate and cryosphere information;
 - g. Reinforce collaboration amongst the practitioners of natural science, social sciences and cultural issues;
 - h. Incorporate northern higher education institutions as infrastructure and platforms.
59. Data and information (including local and traditional knowledge, where appropriate) collected through polar research should be made available freely, openly and easily accessible in a timely fashion at minimal cost to users. This must take into account relevant international agreements and national legislation, as well as critical information needs of people and nations vulnerable to the effects of Arctic climate change. Furthermore, in order for the data collected to be useful, best practices (standardisation) for data collection and data format need to be provided and enforced.

60. UNESCO, WMO, the International Council for Science (ICSU) and other relevant international organisations should consider the idea of an International Polar Decade as a long-term process of research and observations in Polar Regions to meet the requirements for climate change studies, assessments and prediction to benefit society.
61. Arctic and non-Arctic governments should support and encourage efforts to rescue existing relevant information, including that on climate change, biodiversity trends and the drivers of these trends, and ethnographies of Arctic circumpolar indigenous peoples, as these information sources may have crucial relevance to trends seen in the contemporary Arctic.

Policy and decision support

62. UNESCO, together with WMO, UNEP and other relevant bodies, should fully evaluate adaptation potential for the whole of the Arctic and its individual regions. Special attention should also be given to the development of models and techniques for prediction of high impact climate events leading to serious socio-economical and ecological consequences. The organisations should serve as a clearinghouse of knowledge (collect, examine, disseminate), including but not limited to climate change, its impacts, its challenges and best practices.
63. The best available knowledge, including indigenous knowledge, scientific research and monitoring, should be utilised in the development of adaptation and mitigation strategies.
64. The UNFCCC Conference of the Parties 15 (COP15) should seek to mobilise sufficient resources to allow the world's vulnerable regions to adapt to rapid climate change.
65. It should be ensured that mitigation and adaptation strategies are in conflict neither with each other nor with other biodiversity values.
66. UNESCO is encouraged to address the Arctic research-policy linkage within the framework of the MOST (Management of Social Transformations) Programme.
67. UNESCO should participate in the organisation and conduct of the World Climate Conference - 3 (WCC-3), and UNESCO should continue to expand its productive collaboration with WMO and other relevant agencies as a key partner in implementation of the WCC-3 outcomes.

ANNEX I

AGENDA

TUESDAY 3 March 2009	
	Opening Event
09h30 to 10h30	HSH Prince Albert II of Monaco Koïchiro Matsuura, Director-General of UNESCO Jean Malaurie, UNESCO Goodwill Ambassador for Arctic Polar Issues <i>Master of ceremony:</i> <i>François Chantrait, Directeur du Centre de Presse du Gouvernement Princier</i>
	Plenary I
10h45 to 13h00	Background to the meeting & Introduction of UNESCO secretariat <i>UNESCO</i> <u>Keynote Addresses</u> <i>Chair: Jonathan Motzfeldt</i> The work of the Arctic Council (20') <i>Stein Rosenberg</i> Oceans, ice and atmosphere (20') <i>Julienne Stroeve</i> Biodiversity and ecosystem services (20') <i>Aevar Petersen</i> Circumpolar indigenous peoples (20') <i>Aqqaluk Lyngø</i>
	Plenary I / continued
14h30 to 16h00	<u>Keynote Addresses / continued</u> <i>Chair: Barry Goodison</i> Economic development & social transformations (20') <i>Mead Treadwell</i> Education for sustainable development (20') <i>Lars Kullerød</i> Environmental ethics (20') <i>Johan Hattingh</i>
	Plenary I / continued
16h15 to 18h00	<u>Keynote Addresses / continued</u> <i>Chair: Barry Goodison</i> Monitoring and observing systems (20') <i>Joan Nymand Larsen</i> General discussion of all themes (45') <u>Address by the Executive Director of UNEP</u> <i>Mr Achim Steiner</i>

WEDNESDAY 4 March 2009	
	Working groups
09h00 to 10h45	<u>Thematic presentations by experts (10' each)</u> <i>Chairs: See Annex II</i> Four working groups: 1. Oceans, ice and atmosphere 2. Biodiversity and ecosystem services 3. Economic development and social transformations 4. Circumpolar indigenous peoples and intangible heritage
11h00 to 13h00	Working groups Thematic presentations by experts (10' each) / continued

14h30 to 16h15	Working groups Thematic discussions
16h30 to 18h00	Plenary II Report to plenary on working group sessions Chair: <i>Gunn-Britt Retter</i> Discussion: building interlinkages between themes, issues & working groups

THURSDAY 5 March 2009	
9h00 to 10h30	Working groups Discussion: recommendations and interlinkages with other themes / issues
11h00 to 13h00	Working groups Discussion: recommendations and interlinkages with other themes / issues
15h00 to 18h00	Plenary III Integration of themes / consensus building Chair: <i>Peter M. Haugan</i>

FRIDAY 6 March 2009	
9h00 to 10h45	Plenary IV Drafting of common report and recommendations Chair: <i>John Crump</i>
11h00 to 13h00	Plenary IV / continued Drafting of common report and recommendations Chair: <i>John Crump</i>
14h30 to 15h30	Plenary V Presentation of final outcomes Chair: <i>Walter Erdelen</i> Discussion on follow-up
15h30 to 16h00	Closing Walter Erdelen, Assistant Director General for the Natural Sciences, UNESCO Jean Malaurie, UNESCO Goodwill Ambassador for Arctic Polar Issues Attended by HSH Prince Albert II of Monaco

ANNEX II**EXPERTS DIVIDED BY WORKING GROUP****Oceans, ice, and atmosphere****Chair:** Alexander Frolov**Rapporteur:** Julienne Stroeve

Frolov, Alexander	Deputy Head of Federal Service for Hydrometeorology and Environmental Monitoring (ROSHYDROMET), Russian Federation
Gascard, Jean-Claude	Co-chair of the EU framework project "DAMOCLES", France
Goodison, Barry	World Meteorological Organization, Switzerland
Hattingh, Johan	Professor of Philosophy, Stellenbosch University, South Africa; Member of UNESCO COMEST
Haugan, Peter M	Director, Geophysical Institute, University of Bergen, Norway
Itta, Edward S.	President, Inuit Circumpolar Council, Alaska; Mayor, North Slope Borough, Alaska
Kielsen, Lene Holm	Director of International Sustainable Development, Inuit Circumpolar Council (ICC) in Greenland
Kullerud, Lars	President, University of the Arctic, Norway
Stroeve, Julienne	National Snow and Ice Data Center, Cooperative Institute for Research in Environmental Sciences, University of Colorado, USA
Yamanouchi, Takashi	Professor, National Institute of Polar Research (NIPR), Japan

Biodiversity and ecosystem services**Chair:** Aevan Petersen**Rapporteur:** Mike Gill

Apressyan, Ruben	Professor; Head, Sector of Ethics, Institute of Philosophy, Russia; Member of COMEST UNESCO
Crump, John	Acting Manager, Polar Unit, UNEP/GRID-Arendal
Gill, Mike	Chair, Circumpolar Biodiversity Monitoring Program, Environment Canada
Huntington, Henry	Huntington Consulting, specialising in Arctic research and related activities, Alaska USA
Kari, Laine	Director, Thule Institute, University of Oulu, Finland
Koeck Günter	Executive Secretary, Austrian MAB National Committee, Austrian Academy of Sciences, Austria
Minaeva, Tatiana	Arctic Senior Technical Officer, Wetlands International, Russia
Petersen, Aevan	Incoming Chair of the CAFF Arctic Council Working Group, Iceland
Retter, Gunn-Britt	Head, Arctic and Environmental Unit, Saami Council, Norway

Circumpolar indigenous peoples and intangible cultural heritage**Chair:** Aqqaluk Lyngø**Rapporteur:** Sharon McClintock

Abryutina, Larisa	Vice-president, Russian Association of the Indigenous Peoples of the North (RAIPON), Russia
Baer, Lars-Anders	President, Sami Parliament in Sweden; Member of the UN Permanent Forum on Indigenous Issues
Lebedeva, Anastassia	Scientific Research Institute of the National Schools, Republic of Sakha (Yakutia)
Lyngø, Aqqaluk	President, Inuit Circumpolar Council, Greenland
McClintock, Sharon	President/Alaska Native Claims Land Specialist, McClintock Land Associates, Inc., USA
Malaurie, Jean	UNESCO Goodwill Ambassador for Arctic Polar Issues, Director, Centre of Arctic Studies (CNRS/EHESS), France
Motzfeldt, Jonathan	Former President of the Greenland Assembly, Former Prime Minister of Greenland
Näkkäljärvi, Klemetti	President, Finnish Saami Parliament, Finland
Parkinson, Alan	Deputy Director, Arctic Investigations Program, Center for Disease Control and Prevention, USA
Smith, Duane	Inuit Circumpolar Council, Canada
Southcott, Chris	Research Outreach Program Team (MIMIR), University of the Arctic, Canada
Tollemache, Nadja	COMEST member, New Zealand

Economic development and social transformations**Chair:** Susan Barr**Rapporteur:** Joan Nymand Larsen

Andreassen, Ann	Director, National School of Special Education, Ummannaq, Greenland
Barr, Susan	Senior Advisor (polar), Norwegian Directorate for Cultural Heritage, Norway
Funston, Bernard	Executive Secretary, Arctic Council Sustainable Development Working Group
Kelman, Ilan	Senior Research Fellow, CICERO (Center for International Climate and Environmental Research) Oslo, Norway
Larsen, Joan Nymand	President, International Arctic Social Sciences Association (IASSA); Stefansson Arctic Institute, Iceland
Pavlenko, Vladimir	Director, Arctic Research Centre of the Russian Academy of Science; Member, International Arctic Scientific Committee (IASC) and European Polar Board (EPB), Russia
Pelyasov, Alexander	Director, Center for Arctic and Northern Economies, Council for Research for Productive Forces, Moscow, Russia
Rogne, Odd	Senior Advisor, Arctic Monitoring and Assessment Programme & the International Programme Office for the International Polar Year, Norway
Rosenberg, Stein	Sustainable Development Working Group, Arctic Council; Norwegian Ministry of Foreign Affairs
Thomsen, Marianne Lykke	Senior Policy Advisor, Department of Foreign Affairs, Greenland Home Rule Government
Treadwell, Mead	U.S. Arctic Research Commission

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