October 25, 1999

Dear Senior Arctic Officials,

In response to your guidance at the last meeting of the Senior Arctic Officials, the Assessment Steering Committee is pleased to submit a plan for the conduct of the Arctic Climate Impact Assessment (ACIA). This plan, ACIA Implementation Plan, Version 2.1, was prepared by the ASC, based on comments received in earlier versions from several Arctic countries. In addition, both the CAFF and AMAP working groups have reviewed this plan, and their comments are included in version 2.1.

The ASC asks that the SAO's consider version 2.1 and provide the following to ensure that the ACIA meets the needs of the Arctic Council:

- Comments on the scope of the ACIA.
- Comments on the proposed mechanisms for reporting to the Arctic Council and stakeholders.
- Comments on the proposed schedule.
- Any other comments that would improve version 2.1.
- The views of each member country regarding provision of resources.
- A final decision regarding the conduct of the ACIA.

The ASC and CAFF/AMAP are prepared to initiate this work as outlined in the Implementation Plan, including any modifications made during the SAO meeting in November, and to produce the initial versions of the assessment reports prior to the Ministerial meeting in 2002.

The proposal recognizes that the full assessment will take longer than two years because of the need to gather additional data and perform assessments of complex topics, especially in the socio-economic area. The reports presented in 2002 will represent the state of knowledge at that time. The assessment will be updated and enhanced prior to the Ministerial meeting in 2004. At that time, the Arctic Council will be asked for guidance regarding future updates.

We believe that the ACIA will provide the Arctic Council with an understanding of likely impacts of climate change and ozone depletion, potential mitigation steps under a variety of scenarios, and new insights regarding the future sustainable development of the Arctic region.

Respectfully submitted,

The **Assessment Steering Committee** which consists of representatives from AMAP, CAFF, IPCC, ICES/PICES, and WMO who are concerned with climate change impacts to the Arctic.

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Arctic Climate[1] Impact Assessment (ACIA)

An Assessment of Consequences of Climate Variability and Change and the Effects of Increased UV in the Arctic Region

A Draft Implementation Plan

Version 2.1

Prepared by the Assessment Steering Committee

October 22, 1999

[1] In this document the word "climate" is used as shorthand that includes climate variability, climate change, ozone depletion and increased UV-B radiation. "Climate change" refers to long-term or permanent trends (over at least ten years) or shifts in climate, while "climate variability" refers to short term (sub-decadal) climatic fluctuations.

PREFACE

This is a working draft of an implementation plan for an assessment of the consequences of climate variability and change and the effects of increased UV in the Arctic Region[1]. It is being developed by an "Assessment Steering Committee (ASC)" currently composed of representatives of AMAP, CAFF, IASC, IPCC, ICES and indigenous/native peoples. The development of this Implementation Plan is to respond to a proposal submitted to and encouraged by the Senior Arctic Officials of the Arctic Council on May 6, 1999.

The Arctic Ministers at their 2nd Arctic Environmental Protection Strategy (AEPS) Ministerial Conference in Nuuk, Greenland in 1993, noting the existing global cooperation on climate change and stratospheric ozone programs, requested that the Arctic Monitoring and Assessment Program regularly review the integrated results of these programs to identify gaps in the scope of the monitoring and research and ensure that specific issues related to the Arctic region are placed on the agenda of the appropriate international bodies. AMAP has addressed this request by publication of the "Climate Change" chapter in the report "Arctic Pollution Issues: A State of the Arctic Environment Report" presented to the 4th AEPS Ministerial Conference in Alta, Norway in 1997. This assessment review has been further supported by the more substantial assessment "Climate Change, Ozone and Ultraviolet Radiation," which was incorporated into "AMAP Assessment Report: Arctic Pollution Issues" and presented to the 1st Meeting of the Arctic Council (AC) in Iqaluit, Canada in 1998.

The Arctic Ministers, at their Arctic Environmental Protection Strategy (AEPS) Ministerial Conference in Alta, Norway in 1997, asked the Arctic Monitoring and Assessment Program AMAP to continue "monitoring, data collection, exchange of data on impacts, and assessment of the effects of contaminants and their pathways, increased ultraviolet (UV) radiation due to stratospheric ozone depletion, and climate change on Arctic ecosystems. Special emphasis is required on human health impacts and the effects of multiple stressors." A draft policy paper prepared by the U.S. representative to AMAP was submitted and discussed at the AMAP Working Group meeting in December 1998.

Further, at the First Meeting of the Arctic Council (AC) in Iqaluit, 1998, the Ministers asked the Program for the Conservation of Arctic Flora and Fauna (CAFF) to monitor and assess "in collaboration with AMAP, the effects of climate change and UV radiation on Arctic ecosystems." To foster this initiative, AMAP and CAFF established an Assessment Steering Committee (ASC) for the climate and UV work. Two workshops were arranged to document activities that are already ongoing within the Arctic region with respect to observation and assessment of climate change and UV, and to prepare proposals for an observation network and research program.

The International Arctic Science Committee (IASC) in the mid-1990's initiated a number of projects and planning activities on the science and impacts of climate change in the Arctic region. Then, in late 1998, the Executive Committee of IASC suggested that the

IASC, in concert with the Arctic Council (AC) and its appropriate subsidiary bodies and the Intergovernmental Panel on Climate Change (IPCC) and its appropriate subsidiary bodies, consider developing and sponsoring "A Scientific Assessment of Consequences of Climate Variability and Change and the Effects of Increased UV in the Arctic Region."

In the spring of 1999, AMAP, CAFF, IASC, IPCC, and WCRP jointly explored the idea of such an assessment with leaders in science, government and other interested bodies. These explorations and detailed discussions led to a formal proposal to the Senior Arctic Officials (SAOs) of the Arctic Council to plan for and conduct an Arctic Climate Impact Assessment (ACIA), including the effects of increased UV radiation, over the next several years.

INTRODUCTION

The Evidence

Climate variability and change, and more recently, notable increases in UV radiation, have become important issues in the Arctic region over the past few decades. These issues have also prevailed in the international scientific and political scene for over a decade through major programs of scientific research (e.g., WCRP), through intergovernmental assessments (e.g., AMAP, IPCC, WMO), and through international treaties, protocols and conventions.[2]

The results of scientific research and indigenous knowledge have increasingly documented climate related changes that are more pronounced in the Arctic region than in other regions of the world or are critical to our understanding of global-scale climatic processes. Observations from indigenous cultures of the Arctic indicate that the physical environment, as well as the flora and fauna, has been changing.

Some of the indicators of climate change summarized in the first AMAP and IPCC assessments are:

- Inland Arctic areas have warmed by 1.5°C per decade (Jones and Briffa 1992) while more coastal regions have shown less severe warming and some records have even shown slight cooling (Jones et al. 1986).

- Indigenous residents of northern Alaskan villages have reported thawing of previously frozen ground.

- Ozone depletion in northern latitudes and the resultant changes in UV radiation have increased markedly during the past decade, with some sectors of the Arctic experiencing upwards of 20% reductions in ozone and more than a 40% increase in UV radiation (Taalas et al. 1996, 1997).

- Precipitation has increased in high latitudes by up to 15% over the last 100 years. Most of this increase has occurred during winters in the northern latitudes within the last 40 years (Bradley et al. 1987**,** Groisman 1991, Karl et al. 1993, Groisman and Easterling 1994, Dahlstrøm 1994, Hanssen-Bauer and Førland 1994).

- Variations in the geographic ranges of animals have been observed in the last several decades. These animals include beaver and moose.

[2] E.g., UN Framework Convention for Climate Change, the Vienna Convention for the Protection of the Ozone Layer, and the Montreal Protocol on Substances that Deplete the Ozone Layer.

- Cyclone and anticyclone frequencies have increased over the Arctic between 1952 and 1989 (Serreze et al. 1993).

- Glaciers in the Arctic have generally receded, contributing to part of the concurrent sea level rise of about 15-30 cm (Revelle 1983).

Since the AMAP and IPCC assessments, further scientific studies have been completed which are particularly relevant to Arctic climate change. In addition, several important research programs have geared up to the point where results are emerging. The 1998 WMO Ozone Assessment gave increased attention to Arctic ozone depletion and the recent changes, including new analysis and highlighting the uncertainties for ozone recovery. Some of the recent scientific results of the last two years include:

- There has been increased coastal erosion in the Bering Sea from storm surges resulting from reduced sea ice (Weller 1998).

- Sea ice extent in the Arctic has decreased Arctic-wide by 0.35% per year since 1979. During summer of 1998, record reduction of sea ice coverage was observed in the Beaufort and Chukchi seas (Maslanik et al. 1999).

- Streamflow discharge of major Siberian rivers into the Arctic Ocean has increased in recent years and is associated with a warmer climate in the river basins (Semiletov et al. 1998).

- Since 1970, the Arctic Oscillation, which is a measure of the strength of the circumpolar vortex, has strengthened. This has been found to be consistent with temperature change in the Arctic (Thompson and Wallis 1998).

- There has been an increased warming of the Arctic Ocean's Atlantic layer and an approximate 20% greater coverage of Atlantic water types, as summarized in Serreze et al. (in press).

- General warming of permafrost, primarily from Alaskan data, has been observed over recent year, as summarized in Serreze et al. (in press).

The increase of scientific focus on the Arctic makes the assessment process proposed in this document particularly important for interpreting the emerging results.

Past assessments have shown that the Arctic is important to global-scale climatic processes in at least four important ways:

- The thermohaline circulation dominated by the Arctic Ocean and Nordic Seas is responsible for as much as half of the Earth's poleward heat transport. Alterations of this circulation, as have been observed during climatic changes of the past, can affect global climate and in particular the climate of Europe and North America. (Broecker

et al. 1985a, 1985b, 1990).

- The melting of the Arctic ice sheets, particularly around Greenland, can cause sea level rise around the world. A compilation of studies (Meier 1993) suggests that a global warming of 1°C will lead to ~1 mm per year of sea-level rise from small ice caps and glaciers. The Arctic will supply over half of this total, with an additional 0.3-0.4 mm per year contributed from the Greenland ice sheet (IPCC 1990a).

- Arctic soils can act as either sinks or sources of greenhouse gases depending on temperature and moisture changes within the Arctic. Moisture has opposing effects on the two major trace gases: CH_4 flux declines with soil drying while CO_2 flux initially increases (Oechel 1993, 1995, 1997). These changes can influence greenhouse gas warming globally.

- Our current understanding of the Arctic climate system suggests that positive feedbacks in high-latitude systems amplify anthropogenically-induced atmospheric changes and that disturbances in the circumpolar Arctic climate may substantially influence global climate (IPCC 1990a, 1992a, 1996a).

Regarding recent changes in climate, it is important to note that three signals have been observed in the Arctic. Over the last 30 years, average temperatures in western parts of North America and in Siberia have been increasing, while temperatures in Hudson Bay and Greenland have decreased. In the Scandinavian region, no significant change has been observed. These signals illustrate the complex nature of the response of the Arctic region to climate change. In addition to spatial differentiation, there are variable response times and differences in the magnitude of reactions. These result from the distinctive distribution of land and ocean and from couplings to regions outside the Arctic. This spectrum of change must be captured and sampled in the assessment process.

In summary, scientific research and indigenous knowledge are increasingly providing evidence of changes in the Arctic region that are regionally specific or unique and amplified compared to those observed in other regions.

Goal

The goal of the Arctic Climate Impact Assessment (ACIA) is to provide useful information on the consequences of climate variability and change and increased UV radiation, to the governments, organizations, and peoples of the Arctic region. The assessment will synthesize scientific information, predict environmental, human health, and socio-economic impacts, and recommend further actions. The ACIA will provide this information in the context of other developments and pressures on the Arctic environment, its economy, regional resources, and peoples.

The ACIA will be strongly based on existing information including peer reviewed publications, ecological indigenous knowledge, and existing data. Similar to the IPCC process, specific modeling and measurement studies will be made or recommended to funding agencies when gaps in our current understanding are identified. Priorities for further research identified during and at the completion of the assessment will be considered by the national funding agencies. The ASC will help coordinate the initiation of new research and monitoring. AMAP and CAFF identified priorities for research and monitoring in phase 1 as a part of their assessment process (e.g., detailed effects studies within a few areas, continued climate monitoring in Russia, and ocular UV effects). These programs should be initiated as soon as possible to provide data that are relevant for the assessment of climate effects. Similarly, AMAP and CAFF identified priorities for continued research in phase 1. It is important that current programs gathering relevant data (e.g., ITEX and permafrost programs) are continued.

The ACIA process will be guided by a short list of questions to amplify the intent, such as:

- What is the state of scientific knowledge of the consequences of changes in climate and UV radiation, and what are the current and anticipated effects on Arctic ecosystems and human health? What are the likely temporal and spatial trends and patterns of these consequences and impacts across the Arctic region?

- What are the current and future environmental stresses and issues for the Arctic region affecting potential impacts of climate change? How might these changes exacerbate or ameliorate existing problems in the region?

- What are the priorities for future research, observational/monitoring, and data/informational needs for the Arctic region that can better prepare the region and policy makers to reach informed decisions related to climate change? Do these have research implications over the short term and/or long term?

Rationale

Several factors speak for a circumpolar assessment of the consequences of climate change. These include:

There is Increased Focus on the Importance of Regional Scale Assessments. The work of IPCC and others strongly suggests that assessments must be increasingly conducted at geographical scales finer than is now the case and more explicitly across important socio-economic sectors of the nations of the world. Hence, IPCC is initiating increased assessment activities at regional scales and several nations are conducting detailed assessments at national/continental scales. The necessary climate models with meaningful regional scale resolution will most likely become much more robust over the next few years. This makes it possible to address the consequences of change at scales

that are more directly applicable to understanding the impact on critical socio-economic sectors and the regional variations or unevenness of climate change over the region. Additionally, the ACIA will focus on the sensitivity of ecosystems and people to climate change, and work to identify the critical thresholds associated with the expected changes.

There have been several efforts to assess climate change within the Arctic region. To date, these have focused on specific issues or geographical areas. Examples include studies of the impacts of climate change on particular regions. The Mackenzie Basin Impact Study is one example. However, with the exception of AMAP's synthesis (1998) and information in the IPCC Second Assessment Report's chapter on polar climate, there has been no regional-wide assessment of the consequences of climate change within the Arctic. Regional scales are particularly important in assessing climate change and UV effects on ecosystems and human health, and in accounting for a combination of other pressures affecting the environment.

AMAP, IASC, and others have summarized a number of important results in these assessments. Examination of past records has shown that climate variability can invoke shifts in ecosystems. One example is the northward migration of cod along the west coast of Greenland during the warming from the 1920s up to the late 1930s (Jensen 1939). The warm period came to an end in the late 1960s and the subsequent period consisted of three extremely cold periods attributed to different geophysical events. The West Greenland cod stock has not produced any good year classes since the cooling (Buch et al. 1994). During the warm period of the 1920s to early 1960s, the Norwegian Spring Spawn Herring stock had a feeding migration to Iceland. However, a marked climate shift with a temperature decrease of about 1°C resulted in the gradual disappearance of the herring from Iceland (Vilhjalmsson 1997). Other efforts include studies on polar bears, on sea ice, and on productivity in the marine environment. As further results emerge in the literature, it is important to synthesize these findings to coordinate current research, identify research needs, and come to a community decision on what is likely to occur in the future.

The Partnerships Essential to Implement a Circumpolar Assessment Exist. The nations of the world, including their scientific communities, have engaged in numerous assessments that address a number of environmentally related topics and areas of societal interest, from global issues such as climate change, ozone, and national security, to regional deforestation and desertification. There is growing recognition that such assessments are importantly enhanced if four elements are present through which the assessments can be organized, sponsored and supported, and conducted:

- The assessment should engage the national governments and indigenous and local authorities.

- Non-governmental organizations, the private sector, and other stakeholders with insights about the topic of the assessment should be involved.

- The process should engage the scientific community knowledgeable in the relevant

fields.

- There should be a body of information and experience summarizing past changes, and models for large-scale complex assessments.

All four of these elements are present in the Arctic region: the Arctic Council and its subsidiary bodies (AMAP and CAFF); IASC and its linkages to other scientific organizations; Indigenous Peoples' Organizations (IPOs); the emerging University of the Arctic; regional inter-governmental bodies; and various venues for participation by non-governmental organizations and the private sector. The Arctic countries have longterm observation activities in the region and recent political changes have created a background for making the observational data available for international assessment. Steps should be taken to ensure that all countries will collect data and provide information for the assessment. Unlike in their first three assessments, IPCC anticipates a stronger focus in their Fourth Assessment on regions of the Earth with higher sensitivities to climate change. The linkage with IPCC would enhance the ACIA process and provide connections across all four elements noted above.

Policy Makers Seek Regional Scale Understanding. The intergovernmental policy concerning the consequences of climate change has been set by the Kyoto Protocol and other formal conventions and agreements. These matters concern all nations and, further, the implementation of these "agreements" requires a detailed understanding and assessments of climate change across and within the Arctic region. Assessments, including those produced by ACIA, need to document (i) the state of scientific knowledge and understanding of climatic processes across the region, (ii) the consequences of these changes across socio-economic sectors relevant to the region as well as effects on ecosystems, biodiversity, and human health, and (iii) the foundations upon which nations and peoples of the region can adapt, adjust, cope and/or take constructive advantage of the opportunities afforded by the changes.

These factors, along with the interests of the governments of the Arctic nations and other stakeholders, set the foundation upon which an Arctic Climate Impact Assessment should be developed and implemented.

Benefits

An assessment of the consequences of climate change in the Arctic region will lead to the development of fundamental and useful information for the nations of the Arctic region, their economy, resources, and peoples. Examples include, inter alia:

- Providing clear scientific evidence on climate change and UV-B variations within the Arctic at hemispheric and regional levels, indicating the nature of impacts on human health, the natural environment, and food and water resources;

- Supporting the Arctic nations' interests and needs to address the consequences of climate and UV-B variability and change on such issues as human health, food and

water resources, and the flora and fauna of the region;

- Identifying gaps in basic knowledge and fundamental data that need to be acquired in order to better understand climate variability and change at a range of scales;

- Providing a clear and structured basis for future research into climate change and its impacts including interactive modeling;

- Identifying key strategies for future monitoring programs (parameters, measurement precision and frequency);

- Providing a foundation for adaptive and coping strategies to be developed;

- Providing benchmarks for future climate assessments;

- Offering guidance with respect to national and international policy on issues relevant to climate change and ozone depletion.

The nations south of the Arctic will feel the impacts of climate change, though to a lesser degree. These nations will also benefit from the assessment. Similarly, several non-Arctic nations conduct Arctic research, and their scientists can contribute significantly to the assessment.

STRUCTURE AND CONTENT

This draft "Implementation Plan" outlines a scientific assessment of the consequences of climate change in the Arctic region, which will be titled an "Arctic Climate Impact Assessment (ACIA)." The ACIA is designed to be carried out with partnerships, outlined in Section 3, between government bodies, indigenous peoples, other stakeholders, and the scientific community.

The ACIA will be implemented through an Assessment Steering Committee (ASC). The scope of the ACIA is intended to be comprehensive. An assessment is defined herein as an entire analytical and social process by which expert knowledge related to the policy issue is organized, evaluated, integrated, and presented to inform the broad scientific community, policy and decision-makers, and other users and stakeholders.

The assessment will provide a review of the state of knowledge about climate changes across regions and ecosystems; information concerning environmental and socio-economic scenarios; impact assessments for key sectors and environmental and human issues; and synthesis for the whole Arctic region. Recommendations for response measures will be included in Volume III.

The scoping meeting planned for early 2000 will clarify a number of details on the structure and main chapters of the assessments. Appendix 1 shows the proposed areas of

focus for the ACIA assessment. Appendix 2 shows the structure of AMAP's first assessment which is similar to the first IPCC assessment and reflects the potential range of topics to be addressed in the ACIA. Appendix 1 reflects increased focus and level of detail on the complexity of biological impacts over past assessments. A number of different physical and response scenarios will be examined to illustrate the range of climate change impacts in the Arctic. Unlike prior circumpolar assessments, this process will involve examination of potentially different responses to climate change on a synthesized basis. The final document will be focused on species, ecosystem and human responses as well as coping mechanisms, allowing a scientific basis for policy decisions as well as future scientific research. Final structure and emphasis will be determined at the scoping meeting with input from the inhabitants of the Arctic, the response from the Arctic Council and the involvement of the scientific community.

These resulting information will be provided in three documents:

Volume I: Synthesis Document (Short 20+ pages). A comprehensive **summary** that synthesizes the main findings of the assessment and places in a policy-makers framework the likely consequences of climate change over the entire Arctic region. Volume I will be concise, insightful, and could be titled, "An Arctic Climate Impact Assessment: A Summary View." This volume will be written by a scientific journalist together with the Lead-authors in a simple, jargon-free language meant for policy-makers and the broader public.

Volume II: Scientific Document. A series of assessment reviews and analyses that leads to an integrated understanding for the Arctic region (across sectors, sub-regions, indigenous and local interests) and for the circumpolar Arctic nations. Volume II will be fully referenced, and be composed of detailed scientific and technical information describing the current understanding of the consequences of climate change over the entire Arctic region. It will address, inter alia:

i. A summary of the state of knowledge, trends, and patterns in climate change across the Arctic region. This analysis will address appropriate scientific and technical issues such as changes in temperature, precipitation, sea level, extent of ice cover, glaciation, biological indicators, permafrost, and the marine environment.

ii. A set of likely scenarios for the climate system, including ozone and UV radiation trends, and for the projected trends and patterns in cultural and socio-economic aspects.

iii. Consequences and impacts on ecosystems, the Arctic human population, and sub-regional interests.

Volume III: Policy Document. A final document will be produced by AMAP and CAFF and will relate the information from the Synthesis and Scientific Documents to the policy needs of the Arctic Council and provide recommendations for follow-up measures.

AMAP and CAFF will address the question of what strategies can be recommended to cope with current environmental stresses, and possibly lessen the impacts of these changes in the climate and ultraviolet radiation. These recommendations will include advice relevant to national and international policy as well as advice to inhabitants of the Arctic.

IMPLEMENTATION

Management Structure and Responsibilities

The assessment will be carried out with partnerships between AMAP, CAFF and IASC, in cooperation with the IPCC, ICES/PICES, WCRP, and other partners to be identified. Participation in the scientific assessment aspects of the process will be inclusive across the science community with relevant experts chosen by the ASC after nominations from ACIA partners. The assessment is designed to serve the interests of the peoples and governments of the Arctic region through the auspices of the Arctic Council and its subsidiary bodies. It will be the responsibility of the ASC to maintain the partnerships with other existing organizations, programs and groups.

The results of the assessment will provide important perspectives and fundamental knowledge, data, and information for the fourth assessment of the IPCC. As a first principle, the ACIA will be conducted by the scientific community in close partnership with all affected stakeholders and draw from existing national, bilateral, multilateral and regional projects and programs. Workshops and meetings will be held to plan the ACIA in detail and thereafter to perform the assessment to ensure cross-fertilization between relevant scientific areas and disciplines, and stakeholders. Workshops will be hosted by participating countries on a voluntary basis. It will be the responsibility of the ASC to plan these workshops and encourage participation of all stakeholders.

The ASC will develop a **Long-term Management and Assessment Coordination Plan**, detailing management responsibilities. The plan would be submitted for approval to the Arctic Council or its Bureau, to IASC or its Executive Committee, and to AMAP and CAFF.

The assessment will be implemented and managed through:

- An **Assessment Steering Committee** (ASC) composed of a maximum of two individuals each from AMAP, CAFF and IASC, with representation from the Arctic Council. Representatives will also be sought from each of the polar countries and ICES/PICES, IPCC, WCRP, Indigenous Peoples Organizations, and other bodies representing Arctic interests in the assessment topics. The ASC will provide oversight and general guidance to the assessment process. The charge for the ASC is attached in Appendix 3.

- An **ASC Chair** will be selected by the ASC to lead the overall assessment process.

The ASC Chair will be the principal individual to guide the implementation of the assessment and will coordinate the work between the ASC, the Secretariat and the Lead-Authors. He or she should be a well respected leader in the scientific community. This person should be of senior level and of high international stature. He or she should be highly knowledgeable in the field and willing to devote 30-40% of his or her time to the task.

- An **ASC Secretariat** will be established to support the work of the ASC. The Secretariats of AMAP, CAFF, IASC, and possibly others will assist the ASC Secretariat.

- A **Lead-Author Strategy** will be used to conduct the actual assessments. Lead-authors will be designated by the ASC based on nominations from ACIA partners. The ASC would invite countries as well as the National Committees or IASC counterparts in respective countries to nominate experts to serve as Lead-authors. Lead-author responsibilities will be developed by the ASC. The Lead-authors will be composed into working teams to coordinate and prepare the assessments for each element of the overall assessment, i.e., for each of the chapters in Volume I and II. A similar procedure will be followed in the review process. Lead-authors will identify the individual contributing authors and the ASC will endorse such appointments. Lead-authors can be nominated by any organization and will be chosen based on proven excellence in research, breadth of understanding of the subject, and demonstrated independence from major political or organizational interests.

Guiding Principles

A set of principles will guide the implementation of the assessment. The principles address matters of strategy, content, venue, participation, and communication. Their implementation suggests an assessment that is (i) characterized by partnerships among governmental, public and private entities, (ii) focused on specific questions and information needed by policy-makers/stakeholders who are positioned to implement long-term coping strategies, and (iii) characterized by scientific excellence, openness, full participation, transparency, relevance to decision-making, and adequate communication processes. These principles are:

- **Breadth of Participation.** The process should be characterized by openness, inclusiveness, and broad participation by natural and social scientists, experts on indigenous knowledge, policy-makers/stakeholders and others with substantive knowledge and insights on the issue. Importantly, assessment activities should include participants from across all appropriate sectors;

- **Credibility of a Scientific Assessment/Open Review Process.** The assessment process should be open and transparent. The assessment is best served by subjecting the products of the assessment to a review, comments, and suggestions by a broad audience of interested individuals, parties, stakeholders and organizations;

- **Uncertainty.** The degree of uncertainty of the conclusions, due to imperfect theoretical models, insufficient data for model validation, and the nature of the assessment, should be made clear;

- **Communicating the Process, the Results and the Final Products.** The assessment process is markedly improved, and in the end more effective, if mechanisms are implemented to communicate broadly and continuously during the actual assessment all of the relevant information regarding the assessment content and process. Most importantly, an assessment should be designed to provide policy-makers, planners, managers, organizations, and often the public, with the documents and other communication media to support the policy-making process;

- **Scientific Integrity and Independence of the Process:** As policy options associated with global-scale issues are highly sensitive almost by definition, political and commercial pressures must be strenuously resisted so that the scientific integrity and independence of the assessment body is assured; and

- **Language:** The use of simple, jargon-free language in reports meant for policy-makers and the broader public is essential. Journalists and science writers can play a significant role in the integrated assessment process; their involvement at an early stage is highly desirable.

Communication Strategy

Communication with the interested parties is recognized to be a valuable partner in this process. It will be the responsibility of the ASC chair and secretariat to communicate regularly with interested parties.

The ASC will develop a "**Communications and Outreach Strategy**" for the ACIA that will include (i) the plans for the published reports and products, (ii) the development of ways and means for maintaining open and two-way dialogue during the assessment process (e.g., Web-sites, published schedules of meetings, circulation of draft documents, mechanisms for review, etc), (iii) publication policies and procedures, and (iv) other matters that will implement the policies of openness, inclusiveness, and broad participation, and maintain a process that subjects the products of the assessment to open review and comment.

Linkages with Other Assessments

The connections between this assessment and several related international and national/regional assessments will be considered and specific recommendations for cooperation, where appropriate, will be developed. For instance, the ACIA will build on the IPCC Third Assessment, and particularly on the IPCC Working Group II's report containing a chapter called "The Development and Application of Scenarios in Climate Change Impact, Adaptation, and Vulnerability Assessment." In addition, scenarios of

global climate change, including the changes over polar regions to the extent they are described by IPCC, will be used by ACIA. Likewise, it is expected that this assessment will provide fundamental information and insights for the IPCC during its fourth assessment. Hence the IPCC will appoint a liaison from its Secretariat to the ASC Secretariat and will appoint an individual to serve on the ASC. Similar arrangements will be sought with other organizations or programs joining the ACIA. The ASC will be responsible for developing and implementing these linkages. The ASC should promote two-way communication with other assessment processes. The ASC should seek to be represented in relevant international activities, particularly IPCC assessments, at both the planning and reporting stages, to assure the needs of ACIA are adequately addressed in these assessments.

RESOURCES AND FINANCIAL CONSIDERATIONS

Implementing the ACIA as outlined above will require dedicated financial resources. These resources will be detailed in a Management and Assessment Coordination Plan. However, the following guidelines are proposed concerning the development and allocation of resources:

- **In Kind Contributions.** All the expenses for the Lead-authors, scientific experts, and those serving as government observers should be covered by the agencies of the participating bodies. The data provided by each of the Arctic countries should be financed and delivered by the countries. This "distributed funding" strategy should enable the ACIA to be supported by participating governments without the need to fund a substantial centralized budget.

- **Joint Programs.** The Arctic region includes eight countries with widely differing geographical size and economic bases. To ensure relevant data from all countries, some joint programs may need to be implemented requiring common funding, both from Arctic countries themselves and other potential funding sources such as the UN, World Bank, EU, etc. The ASC Chair, the ASC, and the Secretariat will coordinate such issues.

- **Costs for Shared Interests.** It is planned that the Secretariats of CAFF, AMAP, and IASC will allocate resources as appropriate so that the respective interests of their parent organization in this assessment can be fully implemented.

- **Common Costs.** Some central funding will be required for coordination efforts, supporting authors or scientists with special needs for support (both from within the region and countries outside), supporting the development of scenarios or other information/data essential to the conduct of the assessment, conducting the modeling work, and preparing and publishing the reports. It is suggested that the Lead Country cover most of this central funding.

The ASC Chair, the ASC, and the Secretariat will develop a summary **Overall Budget** (a draft cost estimate is included in Appendix 4) and a detailed **Annual Budget** for the assessment, both to be completed by April 2000.

DATA/RESEARCH NEEDS

The assessment process is founded on the results from scientific research and analysis. Therefore, the ACIA urges that scientific programs of research should be implemented as needed by all interested governments, scientific communities and organizations. Steps should be taken to ensure that current global and national programs are maintained, and where necessary, expanded. Further steps should be made to make sure that data obtained by these programs are available to ACIA needs.

Similarly, the development of long-term circumpolar research and databases (observation and monitoring programs), needed for this and future assessments, should continue. AMAP and CAFF have developed a draft Research and Monitoring Program for Climate Change and UV-B and work on a Circumpolar Biodiversity Monitoring Program is underway.

The ASC and the Secretariat will provide support and information that can enhance the development of research and monitoring programs for the Arctic region. It is hoped that relevant national research and monitoring programs will link to the ACIA process and provide new data for the assessment as soon as they become available. The ASC and the Secretariat will maintain the necessary and appropriate arrangements to assure such coordination.

PROGRESS REVIEWS, REPORTS AND EVALUATIONS

The ACIA's goals are to provide useful information for the Arctic Council, the people of the Arctic, and the scientific community. To assure that the ACIA achieves these goals, the following reporting mechanism will be implemented:

- **Status Reports.** The ASC secretariat will prepare and deliver a status report at each meeting of the Senior Arctic Officials. The status report will include any requests for major alterations to the scope or implementation of the existing plans.

- **Annual Reviews.** The ASC and its Secretariat will prepare an **Annual Progress Report** and **Work Plan** for the coming year. These reports will be submitted to the Arctic Council and the ACIA partners approximately three weeks before they are presented at an annual meeting open to all. During the month following the annual meeting, the ASC's secretariat will collate the comments and submit them to the ASC for resolution. The ASC's actions will be communicated to the Arctic Council. Attendees at the meeting will have the opportunity to critique progress, comment on future plans and suggest modifications to the assessment process.

- **Review of Scientific Report.** The final review draft of the scientific report will be subjected to peer review to assure scientific quality and accuracy. The ASC will nominate potential reviewers for approval by AMAP, CAFF and IASC.

The complete ACIA timeline is outlined in Appendix 5. This timeline contains proposed dates for the reviews discussed above, and will help ensure completion of the assessment in the 2002 - 2003 timeframe.

APPENDICES

Appendix 1

Areas of Focus and Increased Attention for the ACIA (DRAFT)

The ACIA is designed to address the critical areas of impacts and consequences of climate variability, climate change, and UV depletions in the Arctic region over the next 100 years, especially to ecosystems, human health, and important socio-economic sectors of the Arctic region. The implementation plan is designed to address the key issues and the material that follows is presented as an initial framework for the assessment, a framework that will undoubtedly be changed in response to further planning, consultations with Arctic-rim nations, workshops, and the scientists and technical experts conducting the assessment. The ASC is committed to an open process that will continuously evaluate the state of progress of the assessment and adjust/adapt to the suggestions and contributions of the various partners on the assessment process.

The assessment (ACIA) is divided into three substantive parts:

1. **What do We Know (The State of Knowledge):** A review and assessment of the current state of knowledge of climate variability, climate change, and UV depletions as it relates to Arctic region.
2. **What are the Likely Changes in the Future (A Set of Scenarios):** A set of scenarios that estimate possible future trends and patterns of climate variability, climate change, and UV depletions in the Arctic region.
3. **What are the Possible Impacts Due to Climate Changes in the Future (Key Impact Areas):** A set of candidate "impact topics" that are proposed to be among the key areas in which impacts on the environment, the people, and the ecosystems of the Arctic are most likely.

Section I: What do We Know (The State of Knowledge):

A. **Introduction:** The synthesis of current knowledge of climate variability, climate change, and UV depletions as it relates to Arctic region will (i) build and extend upon IPCC and WMO Ozone assessments and any other global-scale assessments that document impacts in the Arctic region (e.g., IPCC Assessment I, II, III; the AMAP climate change assessment; etc.), and (ii) will document the best available scientific data and information that substantiates a consensus perspective on climate variability, climate change, and UV depletions as it relates to Arctic region. It is proposed that the state of knowledge be structured around the four key elements of the Arctic environment (i.e., atmospheric, terrestrial, freshwater, and marine environments, with the cryosphere appropriately integrated in these four).

B. Atmospheric Environments:

1. Climate variability/trends (temperature, precipitation, winds, etc.) by geographical area

- Terrestrial/Land Masses (North America, Greenland/Iceland, Scandinavia, and Russia)
- Oceans (North Atlantic, North Pacific, Arctic Ocean)

2. Evidence of effects on human health

C. Terrestrial Environments:

1. Effects on physical environment (permafrost, snow, soil)
   - North America (Alaska, Canada)
   - Greenland/Iceland
   - Scandinavia
   - Russia

2. Effects on ecosystems (changes in species composition, distributions, biodiversity, etc.)
   - North America (Alaska, Canada)
   - Greenland/Iceland
   - Scandinavia
   - Russia

D. Freshwater Environments:

1. Effects on physical environments
   - Glaciers, run off, ice

2. Effects on freshwater ecosystems (changes in species composition, distributions, biodiversity, etc.)
   - North America (Alaska, Canada)
   - Greenland/Iceland
   - Scandinavia
   - Russia

E. Marine Environments:

1. Effects on physical environments by area
   - North Pacific (Bering Sea)
   - North Atlantic (Barents Sea, Nordic Seas, Labrador Sea, Baffin Bay)
   - Arctic Ocean and adjacent seas (Kara Sea, Laptev Sea, East-Siberian Sea, Beaufort Sea)
   - Temperature, sea ice, freshwater outflow
   - Processes of general circulation, convection, etc.

2. Effects on large marine ecosystems
   - effects on plankton production

- distribution, recruitment, and growth of fish stocks
- effects on marine mammals

Section II: What are the Likely Changes in the Future (A Set of Scenarios):
Experience with the IPCC and other assessments has demonstrated that using a number of regional scenarios provides a consistent foundation for input to the assessment for most regions. The ACIA will use several regional scenarios specifically developed for the Arctic area, building and extending upon those scenarios developed by the IPCC and any other relevant bodies. These scenarios will be evaluated for their strengths in reproducing past changes and their consistency in predictions. These regional scenarios will provide a common "input" to the assessment analyses conducted on each of the candidate impacts topics described in the next section (i.e., commercial fisheries, human health, etc.).
The major purpose of using these regional scenarios is to provide several different but consistent climate trends and patterns across all impact topics being analyzed. These scenarios enable the projection of impacts of climate trends in the Arctic region over the next 100 years.
The ASC intends to establish an *ad hoc* group to guide this aspect of the assessment process, and conduct a workshop to develop the most relevant scenarios for the ACIA. The *ad hoc* group of skilled scientists will seek to connect to the current IPCC scenario planning group for coordination. It is anticipated that such regional scenarios, inter alia, will likely include:

- **Scenarios of natural variability** in the climate system, on timescales of a few years to a decade or so, derived from models and historic/paleoclimate records.
- **Scenarios that estimate changes in the climate system**, on timescales of a few decades to a century, derived from models with greenhouse gases increasing at the CO_2-equivalent rates of 1/2% per year and 1% per year.
- **Scenarios that estimate changes in ozone depletion and resultant UV increases**, on timescales of a few years to several decades.
- **Scenarios derived from historic and/or paleoclimate records** describing significant changes in climate over the Arctic region that, if applied to future changes in this region, could provide insights into potential impacts. These scenarios include: past changes in ocean temperatures that have significantly changed the fishery; changes in thermohaline circulation as occurred 11,000 years or so ago; and sub-regional changes in temperature and precipitation patterns that have altered indigenous food supplies.
- **Scenarios that describe potential trends and patterns in relevant socio-economic** factors for the Arctic region and the role such trends could play when combined with climate trends.

Section III: What are the Possible Impacts due to Climate Changes in the Future (Key Impact Areas):

The ASC has developed a set of candidate "impact topics" which are outlined below. The ASC will oversee a process that will define, through the review mechanisms noted elsewhere in this plan, a set of high priority impact topics important to the governments and people of the Arctic region. The initial set of candidate "impact topics" has been developed to provide example descriptions of the scope of questions to address and the likely content of the assessment of these impact topical areas.

- **Commercial Fisheries (Typical questions/issues to address in the assessment):**
  - What role, if any, do the changing patterns of temperature in the oceans play in the productivity of commercial fisheries of the Arctic region?
  - What role, if any, do the changing patterns of oceanic circulation and currents play in the productivity of commercial fisheries of the Arctic region?
  - Do the increases in UV and shifting patterns in temperature, oceanic circulation, etc., have an impact on the fisheries food chain and the productivity and health of fish stocks in the Arctic region?

- **Human Health (Typical questions/issues to address in the assessment):**
  - Have the changing patterns of climate-based changes in atmospheric temperature and precipitation influenced the distribution and patterns of infectious diseases in the Arctic region?
  - Have multi-year, even decadal, shifts in the El Nino influenced the distribution and patterns of infectious diseases in the Arctic region?
  - Have the changing patterns of climate-based changes in atmospheric temperature and precipitation influenced the distribution and patterns of key foods for indigenous people in the Arctic region, which in turn impacts human diets and health?
  - Do the increases in UV and shifting patterns in climate change and variability impact human health (e.g., skin cancer, cataracts and other eye disorders, immune suppression, etc.)?
  - Do changes in nutritional states, due to altered food availability, impact human health?
  - Do UV changes or changes in air quality, pollen, etc. cause changes in immune system response?

- **Hunting and Fishing: An indigenous peoples perspective (Typical questions/issues to address in the assessment):**
  - Impact on birds and fowl, important to subsistence living and essential to the species diversity of natural ecosystems
  - Impact on freshwater and near-coastal marine fishes
  - Impact of changes in the patterns and extent of sea ice on hunting and fishing
  - Impact of changes in UV radiation on hunting and fishing.
  - Do climate changes alter access to hunting and fishing grounds?

- **Marine Mammals (Typical questions/issues to address in the assessment):**

- Impacts on ringed seals, beluga, walrus, polar bear, etc.
- Impacts on the extent and productivity of the ice edge ecosystem and dependent species.
- Understanding the impacts on species important to indigenous peoples.

- **Civil Infrastructure/Engineering (Typical questions/issues to address in the assessment):**
  - Impacts on roads, constructed buildings and systems, transportation, shipping, and new construction.
  - Are climate-induced changes in the tundra and permafrost of importance and significance to the region's civil infrastructure?

- **The Energy and Mineral Industries**
  - Influences of climate change.
  - Impacts on social and economic development in the North

- **Reindeer Herding, Food and Agriculture (Typical questions/issues to address in the assessment):**
  - Impacts on reindeer/caribou herding and hunting: e.g., how will climate change affect reindeer pastures, diseases, etc.?
  - Have changes in climate or UV had impacts on important husbandry or agricultural products, e.g. influences on rates of productivity or on infectious diseases and pests?

- **Tourism (Typical questions/issues to address in the assessment):**
  - Understanding the role, if any, that changes in climate and UV have on the tourism industry.
  - Are there special problems (changes in snow and impacts on the skiing industry) for the tourism industry created by changes in climate or increased UV radiation?

- **Forestry and Forest Management (Typical questions/issues to address in the assessment):**
  - Will climate change increase/decrease productivity and economic value of northern boreal forests?
  - How will climate change affect general forest health (insect pests, wildfires, thermokarst, etc.)?

- **Conservation and Wildlife management (Typical questions/issues to address in the assessment):**
  - Impacts on selected list of rare and endangered species – e.g., are there species that will likely become extinct as a result of climate change?

- Impacts on protected areas – e.g., will some (or a significant portion of) Arctic protected areas become redundant as they no longer fulfill the role for which they were established?
- How will climate change affect the distribution of a selected list of wildlife species, including moskoks, wolf, and bears?
- Impacts on migratory birds – e.g., will the tundra ecozone become so narrow as to threaten migratory birds such as waders or geese?

- **Pollution (Typical questions/issues to address in the assessment):**
  - Do changes in climate or UV radiation affect the rates of the accumulation or degradation of key pollutants?

- **Risks and Hazards**
  - Effects of climate change in generation or exacerbation of problems such as floods, avalanches, and changes in sea level or thermokarst.
  - How will these problems affect roads, buildings, engineering, etc.?

- **Climate Feedback**
  - Feedback effects of CO_2 and CH_4 emissions from ecosystems, albedo variations due to changes in snow and vegetation cover, and thermohaline circulation.

- **Interactions with Lower Latitudes**
  - How will changes in the Arctic effect lower latitudes through sea level rise, thermohaline circulation, changes in fish distribution, and species migration?

Each of the impact areas that are finally selected for the assessment (ACIA) will be analyzed in a hierarchical manner. First, each impact area will be considered on a sub-regional basis (i.e., Scandinavia/Finland, Canada/Alaska, Greenland/Iceland, and Russia). Within each sub-region, the assessment will focus on three areas (the physical environment, ecosystems, and people). Ecosystems will be further divided to consider marine, terrestrial, and freshwater systems.

APPENDIX 2
Table of Contents from AMAP's First Climate Change Assessment

- 3.5. Arctic Ozone Anomalies
  - 3.5.1. Type 1 Arctic Ozone Anomaly
  - 3.5.2. Type 2 Arctic Ozone Anomaly

4. UV Radiation
   - 4.1. Measurements
   - 4.2. Modeling
   - 4.3. Biologically Relevant UV
     - 4.3.1. Spectral Considerations
     - 4.3.2. Geometrical Considerations
   - 4.4. UV on land
   - 4.5. UV Penetration in Aquatic Systems

5. Effects of Climate Change and UV Radiation on the Biosphere
   - 5.1. Terrestrial Ecosystems
     - 5.1.1. Climate Change Effects on Terrestrial Ecosystems
       - 5.1.1.1. Vegetation
       - 5.1.1.2. Invertebrates
       - 5.1.1.3. Animals
     - 5.1.2. UV Effects on Terrestrial Ecosystems
       - 5.1.2.1. Dwarf Shrubs, Mosses, and Lichens
       - 5.1.2.2. Decomposition
       - 5.1.2.3. Animals
   - 5.2. Aquatic Ecosystems
     - 5.2.1. Climate Change and Marine Ecosystems
       - 5.2.1.1. Marine Fish
       - 5.2.1.2. Larger Animals
     - 5.2.2. Photochemical Effects of UV-Dissolved Organic Matter
     - 5.2.3. UV and The Marine Ecosystem
       - 5.2.3.1. Primary Producers
       - 5.2.3.2. Bacteria
       - 5.2.3.3. Zooplankton
       - 5.2.3.4. Fish Populations
       - 5.2.3.5. Larger Animals
     - 5.2.4. Climate Change and Arctic Freshwater
       - 5.2.4.1. Climate Change and Arctic Lakes and Ponds
       - 5.2.4.2. Climate Change and Rivers and Streams
     - 5.2.5. UV and Arctic Freshwater

6. Effects of Climate Change and UV Radiation on Arctic peoples
   - 6.1. Pre-Historical and Historical Effects of Climate Change
   - 6.2. Settlement and Resource Use
   - 6.3. Economic Activities
     - 6.3.1. Commercial Fisheries
     - 6.3.2. Reindeer Herding
     - 6.3.3. Transportation

Appendix 3

Terms of Reference for the Assessment Steering Committee (ASC)

The ASC will be composed of representatives designated by the AMAP and CAFF Working Groups, the IASC, and each of ICES/PICES, IPCC, WCRP, Indigenous Peoples Organizations and other bodies representing Arctic interests in the assessment topics. Additionally, the Lead-authors, responsible for drafting the Scientific Document, will be members of the ASC. The ASC will be responsible for drafting the Synthesis Document. AMAP and CAFF will be responsible for drafting the Policy Document.

Responsibilities:

1. To oversee the assessment process and to coordinate all work related to the preparation of the assessment reports;
2. To foster cooperation and cross-fertilization between the Lead-authors and the groups comprising the ASC;
3. To plan and implement the submission of special inputs from the observing organizations and countries;
4. To ensure distribution of the drafts to experts of all of the participating countries and the observers, and receipt of comments from them;
5. To coordinate and forward draft assessments, including conclusions and recommendations to the AMAP and CAFF Working Groups;
6. To cooperate with appropriate international organizations in producing the assessments.

Appendix 4
Cost Estimates

Estimates are offered for the efforts necessary to produce the three documents (Volumes I-III) of the assessment, and to communicate the assessment results to the general public. The costs are broken down into a few categories. Much of the cost will be supplied "in kind," meaning that the work will be provided through the normal operations of existing organizations. Costs referred to as "extra" indicate the need for dedicated, additional funds. Funds will be needed to support the secretariat, the drafting, graphical layout, printing and distribution costs. Costs for authors including both time and travel will be incurred by the participating scientists and authors.

CENTRAL COSTS
Funds should be available for operational and common costs. In particular, the costs summarized in the first and the third tables are central costs that need to be covered in order for the successful completion of the three reports. These funds can be shared equally or derived from a few countries.

The establishment of an ACIA secretariat is key to the success of this project. One or two countries will be needed to sponsor the ASC Secretariat. The costs for the Secretariat would be in the neighborhood of 500,000 USD per year covering the cost of two staff members including salaries, benefits, travel, and additional rent as well as preparation and distribution of relevant documents.

There are occasions when individuals, experts and indigenous people, who do not have adequate funding will be needed for participation in specific workshops or meetings. There should be resources available to insure their participation. These resources will be distributed at the discretion of the secretariat with full reporting to the ACIA board. Costs for the Thematic Data Centers, modeling, production of the reports, and communication/symposia should be shared equally or derived from a few countries. Data gathering should be covered by each participating country, although some assistance may be needed in special cases. Likewise, while each participating country will contribute to ACIA activities, others will support the assessment efforts as well as related research.

	Time	**Cost**	**Source of Funds**
ASC Secretariat staff & operation	2 people ¼ admin	500,000	In kind, extra
Extra experts & Indigenous People	20 people per year		Extra
Thematic Data Center operation			In kind, extra
Data Gathering			In kind, extra

COSTS ASSOCIATED WITH PREPARATION OF MANUSCRIPTS
The primary costs for manuscript preparation will be the participants' time and travel. Lead-authors and all participants should cover their own costs. These costs may be either from dedicated funds from funding agencies or as a part of the scientists' normal

responsibilities. It will be the responsibility of the participating scientists to seek out the appropriate sources of funding. Lead-authors for the chapters will need to devote considerable time (3-6 months per year) and resources (editing, printing, distribution of drafts and considerable travel). The Lead-authors are likely to require support from the funding agencies in their countries.

	Number of Meetings	**Number of People**	**Source of Funds**
Overall ACIA scoping meeting	1	80-100	Participants
ASC Meetings	2 / year	10-20	Participants
Workshops, specific issues (e.g., Modeling workshop)	1-2 / year	20-60	Participants, in kind, extra
Annual open meeting	1 / year	80-100	Participants
Drafting meetings	1-2 / year / chapter	5-15 / meeting	Participants
Cross-fertilization meetings	1 / year	80-100	Participants
Lead-authors' work time		3-6 months /lead author	Lead Authors' Countries
Co-authors' work time		1 month / co-author	Participants

COSTS ASSOCIATED WITH PHYSICAL PREPARATION OF REPORTS AND OUTREACH

All participating bodies have considerable experience with preparation and distribution of assessments. The production costs are considerable. While not incurred until near the end of the project, planning should be made well in advance of the final year in order to properly budget for these costs.

	Time	**Cost**	**Source of Funds**
Journalist drafting	1 person-year		Extra
Technical support			
Review Panel for each chapter 10-15 Chapters	3 people for 2 meetings		In kind, extra
Graphical production	1 year		Extra
Layout (remove space), etc.	2 months		Extra
Communication / Symposium / Film		300,000 USD	Extra
Printing of Reports CD-ROM / Internet		100,000 USD	All countries
Distribution of Reports		2,000 USD	Participants/Extra

The estimates for the symposium costs are based on previous symposia of similar magnitude as planned here. These costs included meeting facilities, simultaneous translations, travel funds for over sixty Russians, and copies of the assessment.

Appendix 5

Timeline

It is planned that the assessment will be completed in the 2002 - 2003 timeframe outlined below, midway between the Third and Fourth IPCC assessments. In case of a Rio + 10 meeting taking place in 2002, the possibilities to make the first ACIA report, or at least its main conclusions, available to that meeting will be considered.

May, 1999	Version 1.0 of the ACIA Implementation Plan was presented to the SAO meeting in Anchorage.
July 1, 1999	Circulate Version 1.3 of the ACIA Implementation Plan to the leadership and secretariats of AMAP, CAFF, IASC, WCRP, and IPCC for review and comment.
September, 1999	Planning for sub-components of the study and recruitment of ASC Chair and Lead-Authors begins.
September, 1999	Identification by IASC, AMAP and CAFF of individuals for the interim Assessment Steering Committee (ASC) completed.
September 1, 1999	Comments on Version 1.3 due, the essential financial and management/coordination proposals for the implementation process completed. Suggestions on Table of Contents due.
September, 1999	Secretariats of AMAP, CAFF, IASC and IPCC to summarize internal comments on Version 1.3
September 16-17, 1999	ASC meeting in Copenhagen to develop Version 2.0 of the ACIA Implementation Plan, and agree on the new charge for the ASC.
September 23, 1999	Circulate Version 2.0 of the ACIA Implementation Plan to the Assessment Steering Committee, the leadership and secretariats of AMAP, CAFF, IASC, WCRP, IPCC, and other partners for final review and comment.
October 6, 1999	Final comments on Version 2.0 due to AMAP or CAFF secretariats.
October 14, 1999	Version 2.1 completed by the ad hoc ASC and copy sent to the Arctic Council Secretariat for distribution to the SAOs. Version 2.1 sent to leadership and secretariats of AMAP, CAFF, IASC, WCRP, and IPCC and other partners and interested parties.
November 15, 1999	ACIA Implementation Plan to be discussed and decisions taken at the SAO meeting.
First Quarter, 2000	Overall ACIA scoping meeting.
First Quarter, 2000	ASC Chair appointed.
First Quarter, 2000	First ACIA Implementation Workshop, scientific

	planning and assessment and recruitment of Lead-Authors completed.
First Quarter, 2000	Revisions and final endorsement of the ACIA Implementation Plan completed.
First Quarter, 2000	Annual Schedule of Work Plan and Budgetary Plans completed for Calendar Year (CY) 2000
First Quarter, 2000	Implement the Plan for the Assessment.
First Quarter, 2001	Annual Meeting to review Progress Report and 2001 Work Plan.
First Quarter, 2001	Annual Schedule of Work Plan and Budgetary Plans completed for CY 2001
First Quarter, 2002	Annual Meeting to review Progress Report and 2002 Work Plan.
First Quarter, 2002	Annual Schedule of Work Plan and Budgetary Plans for the review completed for CY 2002
First Quarter, 2002	Complete the assessment and begin the reviews by all appropriate parties and entities.
Early in 2002	Conduct a third-party review of the total assessment process and begin planning for updates to be completed by 2004.
Fall, 2002	Assessment Completed and presented to Ministerial Meeting of the Arctic Council. It is expected that all reports and documents will be published by this date.

Appendix 6

List of Acronyms

ACIA	Arctic Climate Impact Assessment
AMAP	Arctic Monitoring and Assessment Program
ASC	Assessment Steering Committee
CAFF	Conservation of Arctic Flora and Fauna
EU	European Union
IASC	International Arctic Science Committee
ICES	International Council for the Exploration of the Sea
IPCC	Intergovernmental Panel on Climate Change
IPO	Indigenous People's Organization
PICES	North Pacific Marine Science Organization
SAO	Senior Arctic Official
TEK	Traditional Ecological Knowledge
UN	United Nations
UV	Ultraviolet Radiation
WCRP	World Climate Research Program

Appendix 7
Abbreviated Bibliography

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