(version 18 March 2008)

Climate Change and the Cryosphere: Snow, Water, Ice, and Permafrost in the Arctic (SWIPA)

A Proposed Arctic Council 'Cryosphere Project' in Cooperation with IASC, CliC and IPY

Project Proposal for SAOs (Part 1):

Project Basis, Objectives, Plans for Project Organization and Implementation, and Status of Project Development

Basis for a 'Cryosphere Project' and Guidance from Ministers/SAOs

At their meeting in Salekhard in 2006, the Arctic Council Ministers:

> **"Requested** the SAOs and the Arctic Council working groups to continue supporting, analyzing and synthesizing Arctic climate research …
>
> **Endorsed** the ongoing efforts of the SAOs and the Arctic Council working groups to implement activities, as appropriate, to follow-up the Arctic Climate Impact Assessment (ACIA) and the ACIA Policy Document …
>
> **Requested** the … Arctic Monitoring and Assessment Program (AMAP) to cooperate with other AC working groups and relevant scientific bodies in continuously reviewing needs and gaps in climate monitoring in the Arctic …
>
> **Requested** Working Groups to continue coordination and/or collaboration with relevant IPY projects so that data and information from the IPY can be included in the continuing work of the Arctic Council."
>
> *[Salekhard Declaration, 2006]*

The joint statement by Norway, Denmark and Sweden concerning their common objectives for the period of their respective chairmanships of the Arctic Council (2006-2012) *[http://arctic-council.org/article/2007/11/common_priorities]* include a commitment to "continuing to follow up on the findings of the ACIA report … " and an emphasis on the Arctic Council "continuing its efforts to provide high quality information on climate change …" with " … Updated information on the consequences of and challenges posed by climate change in the Arctic … gathered and presented to AC Member States at regular intervals." Priority areas for work proposed by Norway for the period of their leadership of the Arctic Council include further studies on the reduction of snow and ice in the Arctic.

At the SAOs meeting in April 2007, Norway, on behalf of Denmark, Norway, and Sweden, presented a concept for a 'Cryosphere Project'. The SAOs requested that the proposal be developed more fully, with responsibility for this being assigned to AMAP, and that a modified proposal be presented to SAOs in November 2007. At that time the SAOs had additional comments and requested an updated proposal be submitted to the SAO meeting in April 2008. These comments included general agreement "that the value-added of the project was to go beyond describing research gaps and to synthesize and integrate new research, including that related to IPY." and instructions to AMAP regarding "the importance to focus on impacts, including on the human dimension." *[Draft minutes of the Narvik SAO meeting]*

This Paper

This document presents a proposal for an Arctic Council 'Cryosphere Project' (SWIPA), in response to the decisions made during the SAO meeting in April 2007. Since April 2007, experts from the eight Arctic Countries and several relevant international organizations have further discussed and developed the content of the proposed project. Additional 'Cryosphere project' planning documentation (*Climate Change and the Cryosphere: Snow, Water, Ice, and Permafrost in the Arctic (SWIPA) – Project Proposal for SAOs (Part 2) - Project Components/Modules – Provisional List of Content*) contains more detailed descriptions of the plans for the various components of the project.

Rationale, Concept and Scope

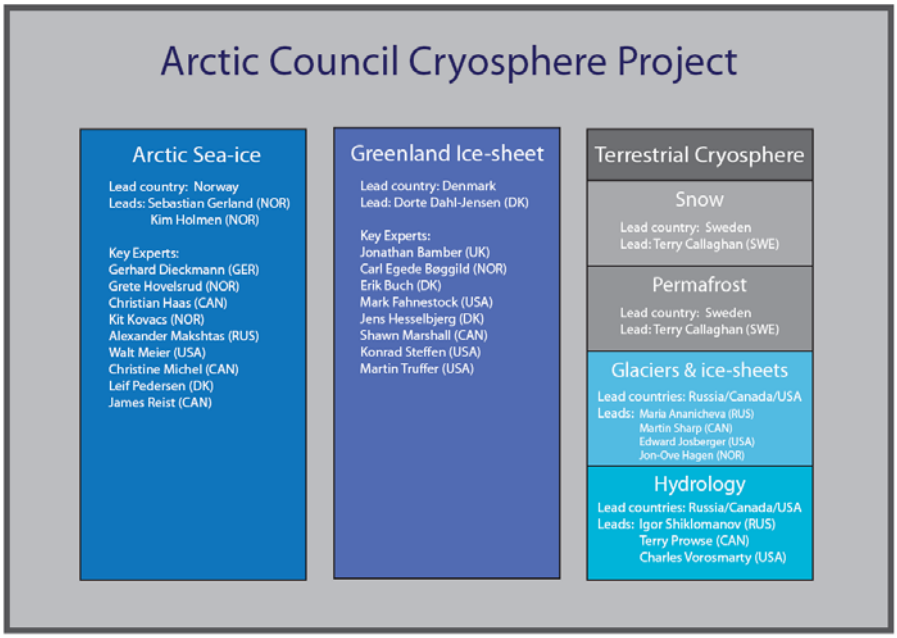
During the past 5–6 years, the rate of loss of sea ice in the Arctic Ocean has increased considerably, and more rapidly than projected. If this accelerated loss of sea ice continues, the Arctic Ocean could be ice-free during summer earlier than was projected in the 2004 Arctic Climate Impact Assessment (ACIA). At the same time, increased movements of ice-flows draining the Greenland Ice Sheet have come as a surprise to the scientists. IPCC (2007) concluded that the physical processes explaining the increased movements are not well understood. In addition, observations show that snow cover extent on land and the ice in small glaciers and ice caps in the Arctic is being reduced, and that the permafrost is increasingly vulnerable to thaw.

Although developed as a part of the proposed ACIA follow-up, the 'Cryosphere project' is not an ACIA-2 assessment. The objective of the 'Cryosphere Project' is to integrate scientific information on the impacts of climate change on the ice, snow and permafrost (=cryosphere) characteristics of the Arctic, considering impacts within the Arctic and beyond. The project will update the scientific information with results of relevant new research and monitoring in order to provide the Arctic Council with timely and up-to-date information on issues that are central to the climate change debate, and the implications of changing conditions in the Arctic. The planned work would logically also feed into the IPCC process.

The project focuses on key areas of cryospheric science where effects of climate change have potentially far-reaching implications for both the Arctic and the globe. In addition to the integration of information on the physical changes to the system, several countries and Permanent Participants have also proposed that the project include the 'human dimension' and consider impacts on humans.

Although conceived as an integrated project, for practical (organizational/management) purposes the project implementation plan is based on dividing the work into three main components focusing on: Arctic sea-ice, the Greenland Ice Sheet; and the Arctic terrestrial cryosphere – the latter being further divided into four modules dealing with glaciers and ice-sheets, snow, permafrost, and hydrological systems, respectively.

Project implementation would be through groups of experts working on specific components and modules, with different countries undertaking a 'lead country' role to support implementation of the various parts (see diagram below). An 'integration team' will ensure that project integration (during preparation, implementation and reporting phases) is realized.

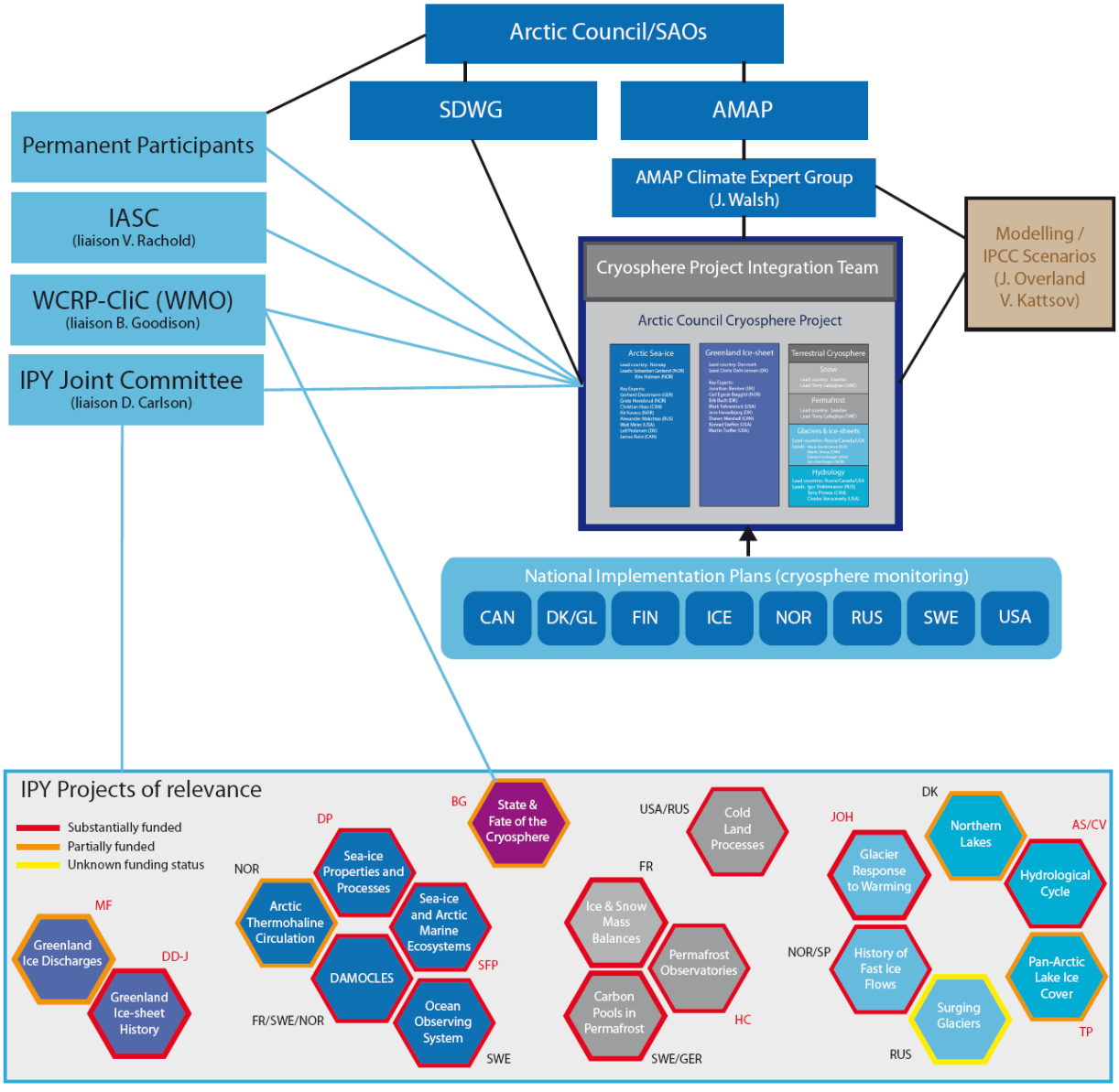


Project Organization

A project 'integration team' will be established to coordinate and 'assimilate' the information arising from the various parts in an integrative and holistic manner, including the evaluation of social impacts.

The Arctic Council's Arctic Monitoring and Assessment Programme (AMAP) Working Group is responsible for organizing and managing the project implementation, with scientific guidance provided by the AMAP Climate Expert Group (lead: John Walsh (USA)). Evaluation of social impacts may involve the Permanent Participants and Sustainable Development Working Group.

The Cryosphere Project will be closely coordinated with other parts of AMAP's climate change work, including climate modeling initiatives that will ensure compatibility with IPCC scenario modeling and model downscaling activities that are being coordinated by the AMAP Climate Expert Group; AMAP National Implementation Plans of the Arctic countries; and relevant activities of the international scientific community and the International Polar Year (IPY) (see diagram below).



Annotations beside IPY projects indicate the IPY project-Cryosphere Project liaison persons (M. Fahnestock; D. Dahl Jensen; D. Perovich; B. Goodson; S. Falk-Petersen; H. Christiansen; J-O. Hagen; Árni Snorrason; Charles Vorosmarty; T. Prowse), or the countries leading the IPY project.

Project Deliverables

The major deliverables will be:

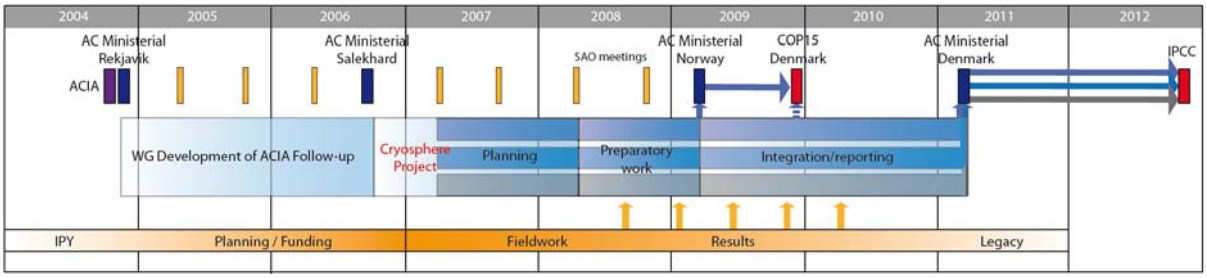
(1) Scientific reports from each of the components and modules containing evaluation and analyses of scientific information and data pertaining to the various subject areas, including identification of gaps in knowledge and projections of climate change impacts on the Arctic cryosphere based on agreed scenarios.

(2) An integrated synthesis of the information from the various components and modules, providing an overview of the interactions between the various parts of the overall project and an improved analysis of the impacts of climate change on the Arctic cryosphere, and additional analyses of the associated impacts on human society in a regional context.

Timing Aspects

Because the implementation of the Cryosphere Project is intrinsically linked to other international initiatives, such as the WMO-CliC, IPY, etc., the Cryosphere Project is envisaged as a programme of activities that will be carried out 'in-parallel' during the next few years, rather than a sequential process leading up to the delivery of a single 'assessment' product at a particular Ministerial meeting.

Project preparatory work is already well-developed. In general, however, the main project implementation is scheduled to take place between 2008 and 2011 (see diagram below).



In part this timing is designed to take advantage of the fact that results of highly relevant IPY activities will become available from 2008 onward. Coordinated work to synthesis IPY project results and elevate them from a purely scientific context into the realm of information for decision-makers is a primary objective of the Cryosphere Project. The planned activities are also timed taking into account the future work of the IPCC, whose next assessment is expected to be delivered in 2012/2013. There is a strong desire from Denmark to produce a report on the Greenland Ice-Sheet component as an input to the United Nations Climate Change Conference (COP15) that will take place in Copenhagen in 2009; such an input would profile the Arctic Council in this international fora.

Funding Issues

The 'Cryosphere Project' is not a major new monitoring and research activity. Rather it is a project that is designed to access results of relevant ongoing monitoring and research activities in the Arctic countries, including AMAP national implementation projects and programmes, relevant IPY projects, and other national and internationally coordinated monitoring and research activities, and to synthesize and communicate this information to the Arctic Council in a way that is consistent with the stated goals of the Arctic Council in responding to the ACIA.

Funding will be required to enable experts to conduct the envisaged work, and for this reason a lead country approach to implementing the project components has been proposed, so that countries can allocate resources to those project components that are of most relevance to their national priorities. Similarly, a mechanism for national nomination of experts to take part in the Cryosphere Project will facilitate the required support for experts from the Arctic countries, and other countries with an interest in supporting the project.

Relationship between the Cryosphere Project and other International Initiatives

Meetings between representatives of AMAP and a number of other international players (WMO- WCRP/CliC, IASC, IPY, etc.) have been held to discuss coordination and harmonization of respective activities.

Part of this coordination will be achieved through the engagement of (lead) experts in the Cryosphere Project who also have similar key functions in some of the other relevant projects/initiatives (and vice versa). This 'liaison' mechanism ensures that project planning within the various related initiatives is compatible and complementary, and either avoids potential overlap and duplication or coordinates activities in a manner that is mutually acceptable/advantageous.

Relationship to IASC

The mission of IASC is to 'encourage and facilitate cooperation in all aspects of Arctic research, in all countries engaged in Arctic research and in all areas of the Arctic region'. In this respect, the proposed Cryosphere Project is recognized as an important means of strengthening and reinforcing cooperation within the Arctic scientific community.

IASC research planning initiatives such as ICARP (International Conference on Arctic Research Planning) have highlighted the importance of cryospheric research, and with the significant ongoing changes (such as indications of reduction in sea ice far beyond scenarios), IASC believe that it is very timely to get science-based data and information to the policy community as soon as possible. SWIPA is considered by IASC to represent an excellent vehicle to achieve this.

IASC has been involved in the preparatory planning of the Cryosphere Project from the earliest discussions, and has indicated its continued support for the initiative. Cryosphere Project linkages to IASC include collaboration through the Working Group of Arctic Glaciology and the International Study of Arctic Change (ISAC).

Relationship to WMO (CliC and WCRP)

WMO organizations, in particular CliC, have also been involved in the planning of the Cryosphere Project. CliC and WCRP are jointly responsible for the proposed IPY 'State and Fate of the Cryosphere' project (CRYOS), aimed at synthesizing and evaluating the global cryosphere, including results from the other IPY cryosphere projects. Although, over 80 scientists expressed interest in being involved in the project, substantial funding for the CRYOS project did not materialize under the IPY, and thus no overall mechanism to achieve the projects aims currently exists. The Arctic Council Cryosphere Project is therefore a means to accomplish some of the aims of CRYOS, and several of the scientists who supported CRYOS are involved in the Cryosphere Project. Lead scientists of CRYOS would participate in the Cryosphere Project Integration Team.

Relationship to IPY

In February 2006, representatives of the AMAP WG held discussions with IPY International Programme Office to discuss mutual cooperation on implementation of AMAP and IPY projects. It was agreed that synthesis and presentation of the results of scientific outcome of the IPY was both a desirable and logical focus of cooperation between AMAP and the IPY steering body.

The Cryosphere Project plan is entirely cognizant of the existence of the IPY – where results of field work in 2007 and 2008 should become available from 2008 onwards. At the scientific level, linkages exist between the Cryosphere Project components and some 18 number of IPY projects, as indicated on the diagram above. In addition to the CRYOS project (see above), an additional five of the 18 identified IPY projects concerning the Arctic cryosphere are only partially funded. Most of the funded IPY projects are designed to obtain new data and information, and therefore will serve as inputs to the Cryosphere Project. The Cryosphere Project will provide a means of linking these IPY projects into a wider scientific context, including other related national and international monitoring and research activities and the 'human dimension'.

Coordination between specific IPY projects and Cryosphere Project activities is addressed in the Cryosphere Project planning effort, not least through arrangements by which lead scientists or key members of IPY project groups are also nominated as national experts to the Cryosphere sub-project groups; currently the leads of 9 of the 18 identified IPY project clusters are members of the Cryosphere project core groups. This ensures that the respective Cryosphere and IPY project activities are complementary rather than competitive or duplicating.

Current Status of Project Planning Activities

The project development work is ongoing pending the continuing discussions by the SAOs.

Preparatory work began in April 2007 and was further developed during the joint AMAP HoDs/AMAP Climate Expert Group meeting in Copenhagen in September, 2007 and at the WG Chairs meetings.

Meetings to develop specific project components have been or will be held as follows: Sea ice component (Internet conference, February 2008), Greenland Ice-Sheet component (Copenhagen, December 2007 and April 2008); Glaciers and Ice-sheets, and Hydrology modules (St Petersburg, February 2008); Snow and Permafrost modules (Potsdam, February 2008).

The process of (national) nomination of experts has been initiated, to identify potential experts in relevant fields; to identify experts that would act as liaisons to, e.g., IPY activities; and, in particular, to allow (lead and other) countries to identify and enter into discussions with experts who might be charged with leading project components or taking on lead author responsibilities. It is particularly important to initiate these discussions now in order to ensure that these 'key experts' are not only willing to undertake these roles but can also plan their engagement in the work in relation to other commitments. The nomination process for additional contributors is open, in principle, throughout the period of the Cryosphere Project; however lead authors will be identified during the planning/preparatory period by the component/module leads, in close collaboration with the Arctic countries, AMAP WG/CEG, lead countries and international organizations. A list of nominations received to date is available.

A first meeting of the project coordinating group (Integration Team) is provisionally scheduled for early-June 2008.