DRAFT CONCEPT NOTE

of a potential long-term International cooperative initiative in the Polar Regions

(short name: 'International Polar Initiative', IPI)

FOR DISCUSSION BY PARTICIPANTS AT IPY2012 CONFERNCE AND ARCTIC SCIENCE SUMMIT WEEK (ASSW 2012) IN MONTREAL

INPUT AND COMMENTS ARE REQUESTED BY THE IPI STEERING GROUP

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Abstract

The Polar Regions of the world are undergoing dramatic transformation that impacts their environment, economy and the life of local residents. These changes are anticipated to increase in the century to come and result in significant global implications. The emerging overarching challenges call for a coordinated and resourceful response from international stakeholders with mandate and interest in polar activities. However, the magnitude and interdependence of the challenges implies that no stakeholder can effectively achieve its objectives in the Polar Regions without ramping up the level of coordination and sharing of resources with other stakeholders and partners. The current lack of sustainable polar observations and, as a result, of comprehensive information services, in case of the Arctic, is an impediment for the economic and human development of the North and adaptation of this region to changing climate and environmental conditions. There will be serious consequences for future generations if we now fail to adequately address key polar issues. Therefore we propose a new and novel framework for their long-term cooperation provisionally entitled "International Polar Initiative" (IPI). Based on input from the various communities we seek to design a common implementation plan for the development of observing systems, research, services, related education and outreach, and practical applications of scientific knowledge in the Polar Regions that would optimize the use of existing resources and identify areas where new investments in polar activities are necessary for environmental protection and sustainable development of the regions.

Motivation and aspirations

The vision of the Polar Regions as remote, snow-covered deserts is past history. When one thinks about the current state the Arctic for example, there is now large-scale industrial development, including gas and oil extraction, intensifying shipping, and multiple stresses on local residents and the environment. Fishing in the Arctic and Southern Ocean is an important source of food for people worldwide, and polar tourism is on the rise. Not only are the Polar Regions going through marked and rapid changes in environmental, social and economic conditions, they are the nexus of several key global environmental challenges including the climate change.

The Arctic and Antarctic Peninsula have exhibited the highest rates of warming on the planet for over recent decades. This fact might have been considered "*local*", but such local warming accompanied by more subtle but widely geographically spread warming in other parts of Antarctica and the Southern Ocean is connected to the recently identified acceleration of melting of the Greenland and Antarctic ice sheets. The current estimates expect the global mean sea level to rise faster than projected by the IPCC Fourth Assessment Report of 2007, which would adversely affect many low-lying coastal regions of the globe. Amplification of warming in the Arctic, which is intrinsically linked to the rapid loss of the sea ice, is affecting atmospheric circulation over a large area of the Northern Hemisphere, with a potential to contribute in the future to more frequent and larger heat waves in the summer, cold spells in the winter, and extreme precipitation in flood vulnerable regions. Billions of people will feel this difference, and for millions of them the risks to lives and property will be significant. The future pace of global climate change depends on the ability of the ocean to continue to absorb excess heat and carbon from the atmosphere. The role of the Southern Ocean in these processes has been

hugely significant but several studies have suggested that the efficiency of this region in absorbing carbon dioxide is likely to decrease. Intrinsically linked to this is ocean acidification due to the uptake of anthropogenic carbon, which is often referred to as "the other CO_2 problem". Ocean ecosystems in Polar Regions are the most vulnerable to potential impacts of ocean acidification and it is in the polar oceans where acidification is already observed and expected to aggravate. Thawing of the Arctic permafrost may turn that region from a carbon sink to a source. This means that the two critical polar reservoirs for sequestering global carbon will be lost.

Are we doing all necessary to address the challenges in the Polar Regions? The governance regimes exist and there are substantial plans to strengthen the protection of the Antarctic and the Arctic environment. However, these plans need to be substantiated by our ability to support them, scientifically and technologically. Yet, the Polar Regions remain the largest observational data voids on the planet. We do not fully understand the complex interlinked processes governing the changes and variability in them; and, as a result, predictions and projections for the Polar Regions are characterized by large biases and significant uncertainties. Lack of reliable observational data, insufficient knowledge and predictive capabilities make it difficult, if at all possible, to *provide efficient environmental information services to people and the economy while such services are strongly required in view of the "opening" of the Arctic and massive industrialization and resource exploitation that are unrolling there on the background of the fastest environmental changes, and also because Polar Regions are becoming more and more accessible for work, significantly affecting the life of the local residents in the Arctic , and, in case of the Antarctic, for tourism.*

Are there possibilities for addressing the challenges? Yes, previous research and development, assessments, experience of exploration, and fieldwork, including the impressive outcomes of the recently concluded International Polar Year 2007-2008 (IPY), create a basis for addressing the challenges. However, there is a need for a "behavioral" change in polar activities. The complexity of the challenges and relative scarcity of resources require a highly coordinated, efficient, and targeted approach. There are many outstanding long-lived issues in the Polar Regions that remain difficult to resolve. In this Concept we substantiate a need for a systematic coordinated approach that may be productive in addressing the challenges. We do not have answers to all key questions but hope that the discussions at the IPY 2012 Conference and the input of the polar community, if it considers favorably the ideas expressed in this Note, will help us to continue developing this Concept and, with time, this will result in significant progress in polar research, observations, services, and assessments, reaching out to all concerned audiences, and, ultimately, supporting more informed decision making on global, regional, national, and local levels. Working together, coordinating efforts and sharing resources will make it possible to pose ambitious goals for polar activities such as eventual creation of operational observing system, significantly enhancing our abilities to predict polar weather, climate, hydrological and environmental conditions, provide a wide range of services, promote relevant education, enable adaptation to and facilitate mitigation of climate change, and contribute to the protection and where appropriate, sustainable development, of the Polar Regions and the planet.

Some recent historical background and the nature of this Concept Note

Many activities of the International Polar Year 2007-2008 (IPY) resulted in significant advances in polar observations, research and practical applications of knowledge for the benefit of mankind. It was therefore seen important to continue these achievements as an IPY legacy. Initial thinking on the approach to sustaining the IPY legacy focused on a proposal for an International Polar Decade (IPD). It quickly became obvious, however, that an extension of IPY

or an approximately ten-year IPY-like program would be suboptimal and not fully address the requirement for reliable ongoing observations of the polar environment. Thus that idea did not gain strong support from a number of stakeholders including the major research funding agencies.

A WMO-Roshydromet workshop held in Saint Petersburg, Russian Federation, in April 2011 was dedicated to discussing the original idea of an IPD. It proposed a consultative process, in which representatives of the main international organizations and agencies with interest in Polar Regions, acting as experts and members of a Steering Group, would work towards a consensus on the scope, timing, and mode of operation of a potential long-term polar initiative that would be of significant value for the whole globe and would maximize return on investment. The key conclusions of the Workshop are given in Annex 1.

In its work, the Steering Group was not trying to "invent" arguments in favor of or against a new polar initiative but attempted to impartially analyze the current needs and issues in the Polar Regions and means of addressing them. This document presents the initial concept of a desirable arrangement in polar activities that takes into account the concerns related to the proposal of an IPD and has the potential, with time, to result in a set of coordinated activities to address the identified issues in Polar Regions.

Main polar issues of regional significance: Arctic

The Arctic amplification of global warming leads to systemic changes in the regional environment including a rapid decline of the Arctic Ocean sea-ice cover, melting of the Greenland Ice Sheet, Arctic glaciers, and warming of permafrost and frozen ground. The Arctic Ocean ecosystems are highly vulnerable to ocean acidification, and will therefore feel the impacts of both local and global human activity. "Opening" of the Arctic involves buildup of infrastructure, increase of shipping, start of exploration and extraction and transport of natural resources onshore and offshore, a new level of mobility in and accessibility of the region, pollution of air and waters with impacts on human health and biology, ecosystem changes, loss of habitat and other impacts on flora and fauna, to name only most visible changes. This all is changing the region and life of its inhabitants drastically and irreversibly. The very existence of some arctic cultures is under threat or undergoing dramatic modification. One of the lessons from IPY is that massive changes in the Arctic call for adequate information support and interdisciplinary research addressing large geographical areas and themes with comprehensive involvement of social sciences. During recent years unprecedented anomalies in atmospheric circulation patterns and the emergence of a stratospheric ozone hole have been observed. Yet, the current data coverage of the atmosphere, land and oceans in the Arctic is absolutely insufficient for advancing our knowledge about ongoing and future changes. As of now, a significant part of funding for environmental observations and monitoring in the Arctic comes from research funding agencies and thus its sustainability cannot be guaranteed. The accuracy of the numerical weather prediction over the Polar Regions is on the average inferior to the global predictions. The observed rate of decline in the Arctic sea ice was underestimated by the ensemble of climate models participating in the IPCC Fourth Assessment Report of 2007, and the reasons for this failure are yet not fully known. This dramatic inadequacy in our ability to provide the needed environmental services in the rapidly changing conditions is alarming.

Main polar issues of regional significance: Antarctic and the Southern Ocean

Complex interrelated changes in the Antarctic and the Southern Ocean involve local manifestations of global warming and the stratospheric ozone hole. While some locations on the

Antarctic Peninsula exhibited the largest warming trends on the planet in recent decades, the overall average ice extent in the region has had a small positive trend. Recently, however, signs of warming have started to manifest themselves in other parts of the icy continent. Satellite observations demonstrated the two-step collapse of a significant part of the Larsen Ice Sheet. Ocean-ice interactions leading to the disappearance of ice shelves that normally buttress ice sheets and reduce the speed of propagation of the continental ice towards the ocean will likely lead to acceleration of the mass loss from Antarctica. It should be added here that the Western Antarctic Ice Sheet (WAIS) is in many places below sea-level and therefore potentially unstable. Relatively warm ocean temperatures have already cause significant retreat of the base of the ice shelves in several regions. The stability of the West Antarctic Ice Sheet, complete melting of which would release water equivalent of ~3.5 m is therefore is a matter of concern and subject of intensive scientific research. There are many other unknowns. For example, recent evidence shattered the old views of the Antarctic Ice Sheet as a solid mass of ice. The subglacial aquatic environments of this continent are characterized by existence of an interconnected system of under-ice lakes and rivers. Rheology and dynamics of this unique ice mass need to be urgently studied so that more reliable estimates of the future ice loss and sea-level rise can be obtained. The Southern Ocean regional ecosystem is characterized by a rather short food web linking phytoplankton at lower trophic levels to the Antarctic krill, on which fish, squid, baleen whales, seals, penguins and seabirds feed. The Southern Ocean ecosystem is at present under significant stress, and complex, still poorly assessed but largely detrimental impacts of environmental changes, including acidification, on the Southern Ocean phytoplankton and krill have been reported. With the notable exception of the observing system of the WMO, most of the observations in the region are supported entirely by national research funding. These observations are relatively more expensive than in the other regions of the world and their sustainability is not guaranteed. Modern environmental science is only starting to realize the multiple and complex links between various physical and biogeochemical processes taking place in this region from the bottom of the ocean to the height of stratosphere. A general shortage of data from the Southern Ocean and Antarctica reduces our ability to connect changes across a vast continent and its adjacent ocean with the rest of the world, and in particularly it influences the skill of numerical weather predictions, which impacts safety of people conducting research activities on the continent, but also shipping and tourism.

Global importance of changes in the Polar Regions

“Opening” of the Arctic will further increase its role as a major factor in the global economy. New shorter routes of marine transportation, export of gas, oil and mineral deposits, new jobs, new possibilities and risks – it is difficult to imagine all the ways and the magnitude of the changes to occur. Ironically, more open water in the Arctic due to emissions of carbon will offer possibilities for additional extraction of hydrocarbons strengthening anthropogenic influence on climate. In addition, there will be natural processes largely resulting in the same impact. First of all, Arctic climate feedbacks play a disproportionally large role in the mechanisms behind global climate change. Variations of the Arctic and Southern Ocean freshwater balance are known to affect the strength of the global meridional overturning circulation, particularly in the North Atlantic Ocean, with potential implications for the high latitude climate. There is a high likelihood that within several decades The Arctic is expected to turn into a potential carbon source due to permafrost thawing and associated release of methane.

The warming of the Arctic Ocean and the atmosphere above it means smaller temperature contrast between the equator and pole, which is the main driving force for general atmospheric circulation. Recently detected changes in the mid- and high-latitude atmospheric circulation indicate a possibility that meridional perturbations of the zonal circulation regimes in the mid- and high-latitudes of the Northern Hemisphere may become more frequent and intense. As a

result, one would expect similarly more frequent and stronger heat waves and cold spells in these regions. There is also a possibility that alterations in the circulation patterns in the mid-latitudes may be felt in the subtropical regions. For example, a casual link was detected between the blocking anticyclone that led to extreme heat and dramatic forest fires in central European Russia during the summer 2010 and the precipitation pattern that was responsible for the Pakistan flood that occurred at the same time.

The fate of the Southern Ocean carbon sink is under close attention of scientists. Complex biogeochemical and dynamical changes in the region may result in both strengthening and weakening of the sink, but the diminishing ability of the Southern Ocean to sequester carbon from the atmosphere due to a number of factors, including the ocean water acidification, is regarded as the more likely scenario.

There is now substantial observational evidence in favor of accelerating mass loss from the two existing ice sheets, the Greenland and Antarctic. This loss may become the main contributor to sea-level rise in the 21st century. Significant progress is required in understanding and modeling of ocean-ice interactions and ice sheet dynamics to reduce uncertainties in estimates of this key sea-level rise factor.

Does previous research and research conducted under IPY make it possible to practically address the locally- and globally- important issues in the Polar Regions?

IPY made significant advances in many scientific issues. Particular progress was associated with large-scale coordinated IPY initiatives that were intended to create foundations for observing systems and predictive capacities in the Polar Regions. IPY produced a massive "snapshot" of the Polar Regions and demonstrated that innovative technologies exist and are capable to observe the polar oceans, land and the atmosphere from space, air, and *in-situ*. Further advances are expected as the analysis and interpretation of IPY data continue and mature. They might include:

- synthesis of emerging IPY scientific results across projects and disciplines, including across the social/natural science division
- implementation of long-term observation systems planned and started in the course of IPY, at least at a minimum level,
- better integration of IPY field and space observations with modeling,
- better long term archiving and open access to IPY data, and
- development of information products and services to reduce exposure to hazards and inform paths towards sustainable development and adaptation in polar regions.

Despite significant advances, many issues remain open and their list includes many "same old questions" as existed before IPY. However, the experience and outcomes of IPY make it now possible to address most of the open issues in a more coordinated and efficient manner. This should help us to further deepen the understanding of main processes and phenomena and enable reliable and comprehensive monitoring of the Polar Regions, prediction of their future state at a range of time scales, and services supporting informed decision making.

Are "polar challenges" likely to be different in the next decade(s) than they are now?

It is possible to anticipate that the global importance of many of the issues listed above will significantly increase in decades to come. Over the next few decades global warming, amplified in the Arctic, will start to manifest itself very profoundly. Similar changes are expected to start occurring in the Southern Ocean and Antarctica.

Interest in the jurisdiction and governance of Polar Regions will increase as well and will require comprehensive knowledge of their environment and the legal and political instruments available for protecting it, as well as a nuanced understanding of the social and cultural barriers to effectively invoking these instruments. Increased pressures are likely to come particularly from resource exploitation, industrial growth, multiple stresses on local residents, expanding polar tourism, and other developments.

New technologies will provide more opportunities for observations in the severe environment, and, together with improved understanding and modeling, this will enable regional predictions and projections across a range of disciplines and time and space scales.

In summary, one should expect that the science issues listed above would remain while new issues may emerge. The main difference between the current and future polar research and operations agenda will likely be that the scientific predictions, which may be considered at the moment as future theoretical possibilities, will start to manifest themselves as real and hard challenges for decision making. We will need to have practical abilities to confront them.

Are key polar problems adequately addressed?

Over the last several decades there has been steady progress in polar observations, research, provision of services, development of information products, etc. IPY 2007-2008 achieved a very marked acceleration in these. However, IPY activities were organized as a community-driven bottom-up campaign, and hence data compilation, analysis, synthesis, and distribution and exchange; and a systematic transition from research to operations; were not as strong and did not benefit from the economies of scale as much as would a more centrally integrated and coordinated initiative. There needs to be a greater awareness by the general public and sense of urgency among decision makers of the global importance of environmental issues in Polar Regions (e.g. as listed above), and an appreciation of the need to address them in coordinated, sustained, planned, timely and resourceful manner. In turn, this requires actions to make sure that the general public is educated about the Polar Regions and their global significance. *The current lack of resources for sustainable polar observations and, as a result, of adequate information services, is a huge impediment for the sustainable economic and human development of the North and efficiency of adaptation of this region to changing climate and environmental conditions*.

What would be the consequences of failing to address the above issues?

Social and economic benefits of weather-, climate- and water-related information and services are well studied in the domains of hydrology and meteorology services. Several groups are studying corresponding needs for Polar Regions and have shown that they are more than just significant. Preparedness for climate and environmental changes and ability to adapt to them are not exclusively matters of concern for developing countries located in hot climates or low-lying coastal areas. Climate change in the Arctic has already led to the necessity to evacuate coastal villages, affected the stability of many constructions based on permafrost, and strongly affected polar flora and fauna. Particular concerns are associated with the safety of operations in the Arctic environment and increasing risks of pollution accidents, with impacts on ecosystems that may have less natural resiliency than in other areas of the world. Rapid social, cultural and economic change has generated serious social and health disorders and disparities. The examples of inadequate management decisions are multiple, and the lack of precautionary approach in dealing with environmental, cultural and social matters already results in huge

losses. However, the current failure to effectively address the polar issues listed above will be felt much stronger and in an increased number of ways by future generations.

Professional interests of key "polar" stakeholders

The international stakeholders represented on the Steering Group have a broad range of goals and objectives that reflect their professional duties and historically evolved division of labor. There are stakeholders with global and polar interests. Annex 2 provides brief descriptions of the general and polar objectives and activities of the stakeholders. The general unequivocal conclusion from the analysis of the stakeholder dependence on each other is that there is ***no stakeholder that can effectively achieve its objectives in the Polar Regions without efficient coordination and sharing resources with other stakeholders and partners***.

Given the current financial situation in the world and major changes occurring in the Polar Regions, is there a merit in a new long-term polar cooperative initiative? If yes, *what exactly* is needed?

Current global financial difficulties are reflected in a shortage of resources for polar activities. This calls for increased efficiency of using the existing funding, aiming at high return on investment and focusing on practical use of the research outcomes and the ability to do more with less. Cooperation, coordination, involvement of additional partners and stakeholders and sharing the resources should therefore be the main strategy for developing polar activities. A promising means of achieving the increased efficiency of joint activities by several organizations would be ***a common implementation plan for the development of observing systems, research, services and practical applications of knowledge in the Polar Regions***. Contributing to a mutually agreed set of socially valuable goals, funding agencies and international and national organizations will be able to achieve significant results far beyond reach of any of them in the case of acting individually. This will create a completely new situation in the polar activities and will significantly enhance their value for the whole globe.

Activities proposed in the plan will unroll gradually, according to a schedule and when they become necessary (or desirable) and feasible. They will have the duration that is realistically required to achieve the expected outcomes. Once the agreement to initiate such a plan by several main organizations has been obtained, the initiative can be declared open. Support to some valuable on-going polar activities that need to be continued, developed and sustained should be considered at an earlier stage of the plan development.

The length of time needed for developing the joint plan of activities in the Polar Regions and secure commitments and resources for its implementation should not result in a slow down of the on-going deployment of observing systems, research, and other continuing activities. To the extent possible, the future observations, research and services should be built on existing elements and commitments. The approach will be therefore internationally coordinated, economical, manageable, and would lead to an end-to-end system linking observations, research, products and services. The plan will have to be updated at regular intervals.

Resources

Preparation of the joint plan of polar activities should be funded by prospective participants in its implementation. Both research and practical applications should be envisioned. Initial, sufficiently modest investments into the development of the plan could come from leading

research funding agencies and interested agencies. The economic viability of the plan and initiatives that comprise it should be regularly assessed. With such a plan, national research funding agencies will be able to demonstrate to their respective governments that their research programs are effective and efficient, provide economy of scale, and facilitate future return on investment. This efficiency can be achieved by

- focusing on a manageable number of internationally coordinated and funded large projects addressing the "big questions" and
- sharing (largely national) funds and logistic resources on the basis of planned international collaboration and coordination.

The case for expanded and sustained observation, prediction and services systems at both poles has been well made. Both Arctic Council and Antarctic Treaty Consultative Meetings consider human safety and environmental protection as their highest priorities. Targeting the plan towards achieving necessary objectives of high societal value means that the considered set of activities would need to be implemented in all circumstances, sooner or later. Increased coordination of actions and involvement of several partners will help to share the expenses. Thus, it can be expected that the initiative will not require significant additional costs except for the development of plan, supervision of its execution, and its update. Such costs will be small in comparison with significant direct and indirect gains resulting from coordination of activities. It will be necessary, nevertheless, to convince international organizations and national funding agencies to join forces behind the initiative and pool resources. With time, achievement of considerably more ambitious goals should become feasible and this will justify investment of considerable funding in polar activities.

Scope of the activities to be considered

The magnitude of the changes at the poles and the strength of their interactions with the rest of the Earth System explain why Polar Regions should be well observed (monitored), their future state should be predicted as realistically as possible, and the consequences of the ongoing and future changes should be thoroughly assessed. This calls for a set of polar activities that involve the full breadth of polar sciences, observations, modeling, prediction and services. It may also require specific process studies in some critical areas where our knowledge is poor. A greater cross-disciplinary and Earth System approach, compared with the scope of IPY activities, will be required. An International Polar Initiative should also address not just the natural system but human systems, their interaction and dependence on polar ecosystem services, their potential impact, and how to create an accessible knowledge base that informs stakeholders and guides them to decisions on risk reduction, conservation, and sustainable development.

The severe environment, existence of ice cover, sparse population, and cultural diversity are the main reasons why Polar Regions require innovative observing techniques. Prototypes of polar observing systems have been successfully developed and deployed to demonstrate their potential capabilities, including during the period of IPY. However, attempts to develop operational and sustained observing systems in the polar areas have not been as successful as hoped, despite several new activities. Polar Regions remain the most extensive data voids on the planet. Monitoring of human development and social change in the Arctic is in its infancy. Attributions of past environmental changes, models capable of realistically reproducing various aspects of global and polar environment and its changes, cryospheric and polar re-analyses and all other elements of a system that has the potential to describe the state of the Polar Regions, are available mostly only in prototype versions.

At present there is a unique capability to capitalize on the research and development conducted in the past and start designing and implementing an end-to-end observation, research and

prediction system for the Polar Regions. This would serve as the foundation for addressing remaining gaps in the required knowledge, for providing regional services, and for contributing to sustainable development of the Polar Regions. It is expected that such a system will generate a significant long-term return on investments.

There are several synergies in polar research in the Northern and Southern Hemispheres that are successfully exploited by SCAR and IASC including through their bipolar action group. Seasonal coordination of field activities between the hemispheres is a factor of additional efficiency in using resources. There are similar approaches to polar observations and research, for example by satellite remote sensing. A single bipolar initiative was therefore appealing to the Steering Group.

Outreach, education, mentoring of early career scientists, and consciously building the work force for decades to come are necessary conditions for the initiative's success and should therefore be essential elements of the plan to be developed. The role of APECS in building the future work force will be central.

Consideration of alpine regions, altitude versus latitude

There are significant similarities between polar and alpine regions. Their cold climate creates severe environment for life and activities. Warming trends in the Polar Regions (with some notable exceptions) and alpine regions result in similar changes, e.g. in reduction of the snow and ice cover, significant ecosystem changes including loss of habitat, etc. Melting of both alpine glaciers and polar ice sheets contributes to the sea-level rise. Observing systems in the alpine and polar regions are generally less developed than elsewhere. Important synergies of polar and alpine regions are associated with the cryosphere and, for example, the scope of Global Cryosphere Watch issues includes mountain cryosphere. These were the reasons for considering a possible need to include alpine research and observations into the scope of activities coordinated by the prospective joint plan.

It was noted, however, that the communities involved in polar and alpine research are not the same. Funding for research and observations in polar and alpine also has different sources. As a rule, existing projects and programmes for polar and mountainous regions have been constructed separately and independently and have somewhat different foci. For example, a key issue for the alpine regions is their current and future role in providing fresh water to people. Therefore, the inclusion of alpine – oriented observations, research and services should not be imperative for the joint plan of polar activities. Nevertheless, some individual polar projects might benefit from inclusion of issues related to alpine issues. Thus, the Steering Group recommends considering alpine issues on a case-by-case basis. There seems to be no reason to limit the consideration to area of Himalayan and Tibetan Plateau regions (The Third Pole). All alpine regions of the world should be considered, where relevant. One key stakeholder to be consulted on such issues is the Mountain Research Initiative.

Will the initiative encourage new programs and develop new science plans or mainly focus on the coordination of existing or currently developing programs?

The joint plan of polar activities should envision all activities and commitments necessary for establishment and maintenance of polar observing, assessment, prediction, and services systems. Once the plan is in place, calls for funding proposals should be issued that will identify most promising and efficient research and development teams able to lead the implementation. However, the initial focus should be on coordination and strengthening of existing and

developing programs and strengthening and expanding them, as the activities mature, to include high priority new issues. A new program should be developed if the existing programs are not in position to fill the identified gap.

What kind of an undertaking is required?

Initially, a framework agreement would be the best approach to secure the concept of coordination and cooperation in achieving common agreed objectives of high societal impact. The development of a common plan of activities and start of their implementation, if it succeeds, will result in a wide interagency collaborative program of polar activities. Individual projects (elements, building blocks) of the program could be built by a single agency, through bilateral and, where required, multi-lateral agreements.

How will the plan be managed? What kind of 'structure' will be required?

There is resistance within some organizations to the idea of another structure with a program office etc., particularly in the current economic climate. However, everyone on the Steering Group agreed that a coordination mechanism was required as there are multiple benefits to be had from improved coordination. Thus, the management mechanisms need to be proposed concurrently with the plan development. A central advisory board to develop the plan and review main implementation mechanisms supported by representatives of the secretariats of participating agencies could be sufficient at the beginning. Matchmaking management boards consisting of funders and stakeholders may be required for each major project at the later stage. Management of projects could involve partnership of senior and early career scientists (ECS). ECS rotation would ensure a balance observed between letting ECS focus on their science as well as laying groundwork for future leadership.

Data policy

Having an adequate data policy and strictly adhering to it should be a cornerstone of the new initiative. This data policy should include all necessary elements, requirements and arrangements for effective functioning of observing systems, prediction technologies and provision of service. It should foster significant reduction of data acquisition time for common use allowing expansion of real-time services. Adherence to the data policy should be strictly monitored and enforced also by funding agencies.

Possible milestones

The following tentative milestones can be envisioned (incomplete initial list):

- 2012-2013: discussion of the Concept with potential partners and nations
- 2013-2014: establishment of an advisory group
- 2014: completion of the Arctic Human Development Report II
- 2014-2015: completion of survey of Arctic Ocean IPY data and first results of an Arctic Ocean IPY data synthesis; further integration of the Southern Ocean Observing System to other initiatives.
- 2015-2016: **completion of the first version of the joint plan of polar activities**
- 2016-2017: **signature of Framework Agreement and start of IPI**

- 2017-2018: Year Of Polar Prediction (YOPP) coinciding with a major ice floe experiment and a multi-satellite comprehensive snapshot of the Polar Regions
- 2017-2019: initial **core of an operational Southern Ocean Observing System established**
- 2017-2020: main elements of the Global Cryosphere Watch are in place
- 2018-2020: completion of the first phase of the WMO World Weather Research Programme Polar Prediction Project
- 2018-2020: completion of the WCRP Polar Climate Predictability Initiative
- 2019-2020: comprehensive update on global and regional sea level rise
- 2020-2021: initial **core of an operational Arctic Ocean observing system established**
- **5-year milestone for IPI**
- 2020-2022: core elements of the Global Integrated Polar Prediction System in place, with solid **production of regular polar predictions of polar weather, climate, hydrological and environmental conditions**
- **2026 10-year milestone for IPI**

Next steps, possible timeline:

A revised version of this Concept Note will be discussed by participants in the special session of the Conference IPY2012 "From Knowledge to Action" in Montréal in April 2012. If these discussions demonstrate broad support to the Concept, it will be offered for a further discussion within a wider set of communities, programs and agencies, including potential funders of polar research, observations, and services. Their contributions will be used to further update the Concept. The updated Concept will then be presented for detailed consideration by main international stakeholders in polar activities with a view to define, in more clear and definite terms, their interests, specific commitments to creating the joint plan of activities, and modalities and level of their contributions. Not later than at that stage wide consultations with nations should be held. After that the participating agencies and organizations could agree to sign the framework agreement and establish the interagency advisory coordination group, which will embark on elaborating the plan and identify together with national funding agencies and international organizations the financial resources to support implementation. These agencies should be engaged in discussions as early as possible.

Annex 1

Extracts from key conclusions of the WMO-Roshydromet IPD workshop
(St. Petersburg, April 2011, with the abbreviation IPD changed to the words "the new initiative")

1) Any scientific efforts under the auspices of the new initiative must be aligned to meeting broad societal needs such as those identified by WMO[1] and the ICSU Grand Challenges for Earth System Science for Global Sustainability[2], and be anchored on delivering better, more reliable scientific information for risk management and policy-making and other societal relevant activities in both Polar Regions;

2) The new initiative would begin beyond 2015 to permit existing programs and available resources to align to a set of dedicated decadal scale polar initiatives;

3) The scientific focus of the new initiative could be on topics such as: better understanding of the changes in the carbon cycle; optimization and development of observational methods, systems and networks for the Polar Regions; improved understanding of the polar climate predictability and reducing the uncertainties in the short-term to decadal "earth system" polar predictions and projections; and establishing a "peoples, societies and cultures" initiative that would integrate new understanding into their practices and culture resulting in improving livelihoods, community well-being and health of polar societies and the ecosystems upon which they, as well as the globe as a whole, depend.

4) The new initiative would be a negotiated program that still includes an element of merit-based competition. This program would be prepared in advance, and it would include a science outline and specific implementation considerations, with recommendations for actions and commitments by interested parties. The resultant more efficient and better-informed decisions in various domains of activity will be achieved through more economical, targeted, and shared expenditures.

5) Preparation of the initiative would require, therefore, cooperation and coordination of funding agencies (international and national) of polar research, relevant international organizations and polar agencies, national agencies managing monitoring and survey programs, ministries who direct the economic and operational frameworks of these, and other operators. These agencies should be engaged in discussions at the earliest possibility.

6) The next 6-12 months (*after April 2011*) should be used to ensure an open dialogue with all potential stakeholders in the new initiative in order to better define its framework, objectives, resource requirements, timing, and organizational structure.

[1] Desired societal outcomes referred to in the WMO Strategic Plan:
- Improved protection of life, livelihoods and property,
- Improved health and well-being of citizens,
- Increased safety on land, at sea and in the air
- Sustained economic growth in both developed and developing countries,
- Protection of other natural resources and improved environmental quality,
- Mitigation of natural disasters.

[2] ICSU (2010). Grand Challenges in Global Sustainability Research: A Systems Approach to Research Priorities for the Decade. ICSU, Paris.

Annex 2

Main polar interests and activities of key stakeholders

Arctic Monitoring and Assessment Programme (AMAP, www.amap.no)

AMAP is a working group under the Arctic Council with the mandate to monitor and assess levels, trends and effects of pollutants and climate change (including UV/ozone) on Arctic ecosystems and human health. AMAP has been in operation since 1991 and since 1993 had in place a monitoring programme (updated several times) for the priority contaminants, biological and non-biological effect variables of pollutants and climate and for human health related variables. The recommended methodologies and QA/QC requirements are harmonized with other ongoing international standards and programmes and data reported are stored at existing Thematic Data Centers (TDCs). The AMAP monitoring programme is integrated into national programmes performed by the eight Arctic countries and some of the non-Arctic countries that are observers to the Arctic Council and AMAP.

For the assessment work AMAP has established several expert groups composed of experts from the Arctic countries, non-Arctic countries, the Arctic indigenous peoples and international organizations, e.g. Persistent Organic Pollutants, Mercury, Radionuclides, Petroleum hydrocarbons, human health, climate change - including the Cryosphere, the Short Lived Climate Forces (Black Carbon, Ozone and methane) and Ocean acidification. For several of the assessments preformed and those under preparation the work is performed in close cooperation with existing international organization like IASC, WMO, Click, IASSA, ICES and IAEA and some of the Arctic Council working groups like CAFF, PAME and SDWG.

For assessments delivered the last 10 years the assessments have been more multi-disciplinary and integrating than in the first period, e.g. in the 2005 Arctic Climate Impact Assessment (ACIA) , the 2007 Arctic Oil and Gas Assessment and the 2011 Snow, Water, Ice and Permafrost in the Arctic (the SWIPA Assessment). The assessment of combined effects of several stressors and drivers (e.g. Climate and contaminants) is today of high priority for the AMAP work. Several of the AMAP assessments serve today as Arctic Regional assessments input to global assessments performed by UNEP, the Stockholm Convention and IPCC.

A major challenge for AMAP has been – and is - to secure enough reliable data from the circum-polar region, AMAP therefore view the establishment of SAON as an important tool to achieve this.

Association of Polar Early Career Scientists (APECS, www.apecs.is)

The Association of Polar Early Career Scientists (APECS) was created in 2006 by and for young polar researchers to facilitate opportunities to share ideas and experiences and to develop new research initiatives and collaborations. It is an international and interdisciplinary organization for undergraduate and graduate students, postdoctoral researchers, early faculty members, educators and others with interests in Polar Regions and the cryosphere. Comprising over 3300 members, hailing from over 76 countries and representing almost every major and minor Polar Science division and application, APECS is a truly diverse organization.

By providing networking and career development opportunities, APECS' activities aim to:

- raise the profile of polar research by providing a continuum of leadership that is both international and interdisciplinary in focus;
- develop effective leaders in research, education and outreach
- stimulate interdisciplinary and international research collaborations

European Polar Board-Expert Committee of the European Science Foundation (EPB-ESF, www.esf.org/research-areas/polar-sciences.html)

The European Polar Board (EPB) as part of the European Science Foundation has the task to be the voice of European polar research and to facilitate cooperation in all fields of polar science across Europe. Its strength is the comprehensive inclusion of all relevant partners in Europe and the broad coverage of all scientific fields of polar research. It has been agreed in a Memorandum of Understanding that European polar science is supported by the EPB as the central organizational structure. Its general topics and aims are being outlined in the Strategy Paper "European Research in the Polar Regions: Relevance, strategic context and setting future directions in the European Research Area".

EPB aids in developing joint scientific programmes, in optimized use of European research infrastructures and in representation of polar issues within European research framework programmes such as the Future Horizon 2020. The mission, scientific priorities and infrastructure projects of the EPB are to:

- identify future scientific areas and strategic priorities of polar science within Europe,
- coordinate scientific agenda setting and represent it in European Policy Formulation,
- represent European Polar Research in the global context, and
- Develop or support concepts for joint use of polar infrastructure.

International Arctic Science Committee (IASC, iasc.arcticportal.org)

IASC is a non-governmental organization that aims to encourage, facilitate and promote cooperation in all aspects of Arctic research in all countries engaged in Arctic research and in all areas of the Arctic region. IASC is an International Scientific Associate of ICSU and has observer status in the Arctic Council.

Overall, IASC promotes and supports leading-edge multi-disciplinary research in order to foster a greater scientific understanding of the Arctic region and its role in the Earth system. To achieve its mission, IASC:

- Initiates, coordinates and promotes scientific activities at a circumarctic or international level;
- Provides mechanisms and instruments to support science development;
- Provides objective and independent scientific advice on issues of science in the Arctic and communicates scientific information to the public;
- Seeks to ensure that scientific data and information from the Arctic are safeguarded, freely exchangeable and accessible;
- Promotes international access to all geographic areas and the sharing of knowledge, logistics and other resources;
- Provides for the freedom and ethical conduct of science;
- Promotes and involves the next generation of scientists working in the Arctic; and
- Promotes bipolar cooperation through interaction with relevant science organizations.

IASC maintains excellent relations with other polar and global organizations. The goal is to develop and stimulate shared initiatives that are of high interest to the broader arctic research community.

International Arctic Social Sciences Association (IASSA, www.iassa.org)

IASSA is an organization comprised of social scientists and humanities scholars. Membership is open to anyone interested in Arctic social sciences, and currently numbers over 500 individuals. IASSA's objectives are:

- to promote and stimulate international cooperation and to increase the participation of social scientists in national and international Arctic research;
- to promote communication and coordination with other research organizations;
- to promote the active collection, exchange, dissemination, and archiving of scientific information in the Arctic social sciences;

- to promote mutual respect, communication, and collaboration between social scientists and northern people;
- to facilitate culturally, developmentally, and linguistically appropriate education in the North; and
- to follow the IASSA statement of ethical principles for the conduct of research in the Arctic.

International Council for Science (ICSU, www.icsu.org)

The International Council for Science (ICSU) is a non-governmental organization with a global membership of national scientific bodies and International Scientific Unions. ICSU's mission is to strengthen international science for the benefit of society. To do this, ICSU mobilizes the knowledge and resources of the international science community to:

- Identify and address major issues of importance to science and society.
- Facilitate interaction amongst scientists across all disciplines and from all countries.
- Promote the participation of all scientists—regardless of race, citizenship, language, political stance, or gender—in the international scientific endeavor.
- Provide independent, authoritative advice to stimulate constructive dialogue between the scientific community and governments, civil society, and the private sector.

ICSU's strategic activities focus on three key areas:

- International Research Collaboration
- Science for Policy
- Universality of Science

ICSU's polar activities are largely coordinated through SCAR and IASC and aim at

- Building involvement of ICSU Unions and other bodies in polar issues
- Ensuring a strong polar component of the new ICSU initiative "Future Earth: research for global sustainability", and
- Data management, preservation and accessibility.

Intergovernmental Oceanographic Commission of UNESCO (IOC, ioc-unesco.org)

The mission of IOC is to promote international cooperation and to coordinate multilateral programmes in ocean observations, research, services and capacity development, to learn more about the nature and resources of the oceans and coastal areas, and to apply this knowledge to improved management, sustainable development and protection of the marine environment. IOC leads the Global Ocean Observing System serving as a platform for the setting of global requirements, coordinating observations including technical support and standards, and coordination of data management and information streams. Emerging observing technology will improve our ability to monitor the polar oceans, and develop services and information, including assessments, for action. The IOC cooperates with the WMO in a number of polar activities, and with the Southern Ocean Observing System (SOOS). It is a sponsor of the WCRP.

IOC is a part of UNESCO, which also has programmes promoting Arctic indigeneous knowledge systems and their integration with scientific knowledge systems.

The Scientific Committee on Antarctic Research (SCAR, www.scar.org)

The Scientific Committee on Antarctic Science (SCAR) is a non-governmental, Interdisciplinary Scientific Body of the International Council of Science (ICSU), and Observer to the Antarctic Treaty and the United Nations Framework Convention on Climate Change.

SCAR's Mission is to be the leading, independent, non-governmental facilitator, coordinator, and advocate of excellence in Antarctic and Southern Ocean science and research. Secondly, SCAR's Mission is to provide independent, sound, scientifically-based advice to the Antarctic Treaty System and other policy makers including the use of science to identify emerging trends and bring these issues to the attention of policy makers.

World Climate Research Programme (WCRP, www.wcrp-climate.org)
Sponsored by the WMO, ICSU and IOC, WCRP supports a number of high priority scientific research activities with the aim of facilitating analysis and prediction of Earth's climate system variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society. WCRP is the main facilitator and international coordinator of global and regional climate predictions and projections used in the IPCC assessments, WMO/UNEP Scientific Assessment of Ozone Depletion, SWIPA and many other global and polar assessments. The WCRP Climate and Cryosphere project cosponsored by IASC and SCAR aims to enable prediction of climate in the Arctic, Antarctic, and the Southern Ocean, prediction of terrestrial cryosphere and sea-level variability and change. WCRP is elaborating a bipolar initiative on polar climate predictability. Achievement of WCRP polar objectives requires strong input, collaboration and coordination with partners engaged in global and regional observations, research, modeling, and experimental prediction.

The World Meteorological Organization (WMO, www.wmo.int)
The vision of WMO is to provide world leadership in expertise and international cooperation in weather, climate, hydrology and water resources and related environmental issues and thereby contribute to the safety and wellbeing of people throughout the world and to the economic benefit of all nations. The current WMO priorities include the development of the Global Framework for Climate Services, implementation of the WMO Integrated Global Observing System and WMO Information System, aeronautical meteorology, capacity development, and disaster risk reduction. All aspects of polar weather, climate, and hydrology are of primary interest for WMO. Supervised by the WMO Executive Council Expert Team on Polar Observations, Research and Services, WMO is developing several major initiatives in the Polar Regions. They include

- the Global Integrated Polar Prediction System (GIPPS),
- the Global Cryosphere Watch (GCW),
- the Antarctic Observing Network (AntON), and
- the WMO World Weather Research Programme Polar Prediction Project.

Achievement of the WMO objectives in the Polar Regions requires strong cooperation and coordination with partners that complement WMO in observations, research, and delivery of services.

The University of the Arctic (UArctic, www.uarctic.org)
The University of the Arctic is a cooperative network of over 135 universities, colleges, and other organizations committed to higher education and research in the North. Its members share resources, facilities, and expertise to build post-secondary education programs that are relevant and accessible to northern students. The overall goal is to create a strong, sustainable circumpolar region by empowering northerners and northern communities through cutting-edge science, education and shared knowledge. Central to the operation of the UArctic is the Thematic Networks (TN) fostering issues-based cooperation within networks, which are focused but flexible enough to respond quickly to topical Arctic issues. They form a natural framework for development of UArctic education and research providing an optimal structure for increasing the knowledge generation and sharing across the North.

United Nations Environment Programme (UNEP, www.unep.org)
The mission of UNEP is to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations. The Polar Centre of UNEP resides at GRID-Arendal in Norway and is established to help review and provide assessments on environmental change and overall development, particularly in the Arctic region. These changes are creating both challenges and opportunities with global implications. The Polar Centre promotes sustainable development of the Arctic and Antarctica by engaging in international

stakeholder processes, raising awareness for sound decision-making, and building the capacity of Arctic peoples. In collaboration with numerous partners and regional stakeholders, the Polar Centre undertakes environmental management and capacity building initiatives focused on the Polar Regions in a global context.