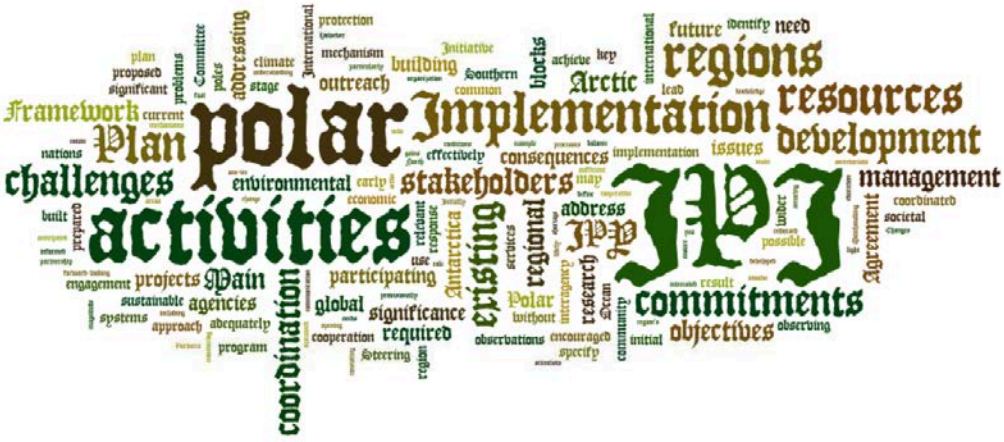
DRAFT CONCEPT

of a potential long-term International cooperative initiative in the polar regions



(short name: ‘International Polar Initiative’, IPI)

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Executive Summary

The polar regions of the world are undergoing fast and dramatic transformations. Changes in them are anticipated to increase in the decades to come and result in significant global implications. For example, melting of the Arctic sea-ice and corresponding "opening" of the Arctic stimulates active industrial development of the region. However, the acute shortage of sustainable environmental observations in the Arctic and, as a result, lack of comprehensive information services is an impediment for the human development of the North and adaptation of this region to changing climate, economic and environmental conditions. In the case of the Southern Ocean and Antarctica, scarcity by observations impedes understanding of the processes governing the role of these regions in global change and is an obstacle to both protection of the region's environment and the safety of activities there.

The magnitude, interdependence, and the interdisciplinary nature of the challenges facing the polar regions call for a coordinated, resourceful, informed, and a forward-looking response from international and national stakeholders with mandate and interest in polar activities. No stakeholder will be able to effectively achieve its objectives without ramping up the level of coordination and sharing of resources with other stakeholders and partners and without commitments from the impacted nations, both within and outside the polar regions. Inaction will lead to serious consequences for current and future generations.

To effectively address the polar challenges and efficiently use the resources available, we propose a cooperation framework provisionally entitled the "International Polar Initiative" (IPI). Under the Framework, a common IPI Implementation Plan should be prepared for the development of observing systems, research, services, related education and outreach, and practical applications of scientific knowledge in the polar regions. The IPI would optimize the use of existing resources and identify areas where new investments in polar activities are necessary for environmental protection, sustainable development, and addressing existing and emerging societal needs. Existing polar programs and infrastructure including the legacy of the recently concluded International Polar Year 2007-2008 (IPY) will provide initial building blocks for IPI.

The IPI Framework Agreement will create a platform enabling efficient cooperative response to existing and future challenges. The IPI Implementation Plan will turn existing polar activities into a coordinated series of highly productive interagency initiatives to address the identified challenges.

Motivation for IPI

The vision of the polar regions as remote, snow- and ice-covered deserts is past history. The current state the Arctic, for example, is characterized by large-scale industrial development, including significant gas and oil extraction, intensifying shipping, and multiple stresses on local residents and the environment. Fisheries in the Arctic and Southern Ocean are an important source of food for people worldwide, but their sustainability creates widespread concerns. 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 climate change.

There are governance arrangements in the polar regions and substantial plans to address the challenges and strengthen the protection of the Arctic and the Antarctic environment. However, these instruments need to be supported 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, as a rule, by larger biases and uncertainties than for the rest of the globe. Lack of reliable observational data, insufficient knowledge and predictive capabilities make it extremely difficult to provide efficient environmental information services to people and the economy. Such services are critical in view of the "opening" of the Arctic and the massive industrialization and resource exploitation that are unfolding there, on the backdrop of rapid environmental changes, and in view of the increased accessibility of the Antarctica.

The 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 relative scarcity of available resources requires a highly coordinated, efficient, targeted, and systematic approach to planning and executing polar activities. Working together, coordinating efforts and sharing resources will make it possible to set ambitious goals for polar activities such as eventual implementation of an operational sustainable observing system, significantly enhancing our abilities to predict polar weather, climate, hydrological and environmental conditions, to track human development trends in the polar regions, to provide a wide range of environmental information services, to promote relevant education, to enable adaptation to and facilitate mitigation of climate change, to contribute to the protection and, where appropriate, sustainable development of the polar regions and the planet, as a whole, and to recruit, involve, and train the next generation to carry on these activities.

Beyond the practical needs for sciences and corresponding services, there is a continuing call for polar science communication from the public. Considerably increased interest to the polar regions and dramatic changes occurring there is one of the IPY legacies. Polar displays at museums are on the rise, and so are polar related articles and polar educator events and organizations. In order to capitalize on this momentum and support the public interests, an active and effective outreach program is needed that brings together scientists, practitioners, educationalists, younger generation, and local residents.

Main polar issues of regional significance: Arctic

The Arctic is changing drastically, irreversibly, and in many ways. “Opening” of the Arctic involves buildup of infrastructure, increase of shipping, already very significant exploration and extraction and transportation 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. Arctic amplification of global warming leads to systemic changes in the regional environment, including a rapid decline of Arctic Ocean sea-ice cover, melting of the Greenland Ice Sheet and Arctic glaciers, and warming or thawing of permafrost. The warming, sea-ice retreat, ocean acidification, and pollution impact the vulnerable Arctic Ocean ecosystems. Risks of environmental disasters such as major pollution accidents are increasing. Besides environmental changes, the existence of some Arctic cultures is under threat, and some are undergoing dramatic modification.

During recent years unprecedented anomalies in atmospheric circulation patterns and the emergence of a stratospheric ozone hole, similar to the one over Antarctica, 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. With 2012 displaying the lowest sea ice extent in recorded history, it is prudent now more than ever to note that 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 that the reasons for this failure are not yet fully known.

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. The dramatic inadequacy in our ability to provide the needed environmental and social information and services in the rapidly changing conditions is alarming.

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

Interrelated changes in the Southern Ocean and Antarctica involve local manifestations of global warming and the stratospheric ozone hole. Modern environmental science is only starting to realize the multitude and complexity of the physical and biogeochemical processes that take place in this region from the bottom of the ocean to the heights of stratosphere. While some locations on the Antarctic Peninsula have exhibited the largest warming trends on the planet in recent decades, the overall average sea-ice extent in the region has had a small positive trend. Recently, however, signs of warming have started to profoundly manifest themselves in many parts of the continent and in the ocean that surrounds it. Satellite observations have demonstrated recent destruction of several ice shelves that buttress ice sheets and help to reduce the speed of continental ice flow to the ocean. Subsequently, the increased pace of the total ice mass loss from Antarctica has been confirmed by several types of observations. Recent studies shattered the old views of the Antarctic Ice Sheet as a solid mass of ice. The subglacial aquatic environment of this continent is characterized by the existence of an interconnected system of under-ice lakes and rivers, with still unknown rheology and dynamics. Moreover, the West Antarctic Ice Sheet is in many places below sea level. Its potential instability is therefore is a matter of concern and subject of intensive scientific research.

There are many other unknowns. The Southern Ocean regional ecosystem, characterized by a rather simple food web linking phytoplankton at lower trophic levels to the Antarctic krill, on which fish, squid, baleen whales, seals, penguins and seabirds feed, is at present under significant stress. Complex, still poorly assessed but largely detrimental impacts of environmental changes, including acidification, on the Southern Ocean phytoplankton and krill have been reported.

Except for the regional observing system of the WMO, most of the observations in Antarctica are supported entirely by research funding. Observations in Antarctica and Southern Ocean are more expensive than in the other regions of the world, and therefore their sustainability is very difficult to achieve. A general shortage of data from the Southern Ocean and Antarctica reduces our ability to understand how changes across a vast continent and its adjacent ocean are connected with the rest of the world In particular, it reduces the skill of numerical weather predictions, which adversely impacts the safety of shipping, tourism, and research activities in this region.

Main issues of regional significance: the alpine regions

There are significant *similarities between polar and alpine regions*. Their cold climate creates severe environment for life and activities. Important synergies of polar and alpine regions are associated with the existence of the cryosphere. Warming trends in the polar regions (with some notable exceptions) and alpine regions result in similar changes, such as reduction of the snow and ice cover, significant ecosystem changes, and loss of habitat. Melting of both alpine glaciers and polar ice sheets contributes to the sea-level rise. A key issue for the alpine regions is their current and future role in providing fresh water to people. Observing systems in the alpine and polar regions are generally less developed than elsewhere.

Polar regions and the globe: what happens in the poles does not stay in the poles

The Poles strongly and in many ways affect the global climate and its extremes, and shape the pace and geographical distribution of sea-level rise. Industrial development in the polar regions also has a global footprint. The "opening" of the Arctic will further increase its already significant role as a major player in the global economy. New routes and conditions of marine transportation, production and transportation of gas, oil and minerals, new jobs and labor needs, opportunities and risks – it is difficult to imagine all the ways and the magnitude of the changes to occur.

Ironically, the increasingly open waters in the Arctic, due to emissions of carbon, will offer possibilities for additional extraction of hydrocarbons, thus strengthening the anthropogenic influence on climate. Natural processes will also strengthen this same impact. Most known Arctic climate feedbacks tend to accelerate global climate change. There is likelihood that within several decades, due to thawing permafrost and associated release of methane, the Arctic will turn from a carbon sink into a carbon source. The fate of the Southern Ocean as a carbon sink is also under close scientific scrutiny. 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 ocean acidification, is regarded as the more likely scenario. In addition, variations in the freshwater balance of the Arctic and Southern Oceans are known to affect the strength of the global meridional overturning circulation, particularly in the North Atlantic Ocean, with potential implications for changing global climate.

The warming of the Arctic Ocean and the atmosphere above it means smaller temperature contrast between the equator and pole, which acts as the main forcing factor for the general atmospheric circulation with westerly winds in the mid-latitudes. Similarly, smaller temperature gradients across the subarctic affect the position and the strength of Northern Hemisphere polar jet and polar atmosphere circulation modes. As a result, one would expect meridional perturbations of the zonal circulation regimes with more frequent and stronger heat waves and cold spells in temperate climate regions, creating for example, more frequent cold episodes in Europe. 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 causal link has been proposed 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 devastating Pakistan flood that occurred at the same time.

Until present, most of the cryospheric contribution to sea-level rise has been associated with melting of glaciers. 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. To reduce uncertainties in estimates of this key factor in sea-level rise, we need to expand our understanding and modeling of ocean-ice interactions and ice sheet dynamics.

It cannot be stated any more plainly: what happens in the poles does not stay in the poles.

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

In the coming decades, the impacts of global climate change, amplified in the Arctic, will intensify. Manifestations of these changes will strengthen also in the Antarctica and Southern Ocean, where warming has been already detected at almost all depths. The scientific predictions of these impacts, which may be presently viewed as theoretical “possibilities” or remote threats, will start to present themselves as real and hard challenges for decision-making. Future polar research and operations agenda will therefore need to become more focused on our practical ability to address the unrolling environmental changes and their impacts. This will require more detailed and reliable assessments that result in feasible recommendations for actions. Knowing that inaction only aggravates the situation, considerably stronger commitments and obligations to implement the recommendations of such assessments, as well as monitoring and verification activities, will be expected. Obviously, beyond the currently known and expected, there will also be surprises and discoveries, and new issues will emerge.

Interest in the evolving jurisdiction and governance of polar regions will increase as well and we will require comprehensive knowledge of the legal and political instruments available for protecting and governing these regions (and harnessing available resources for the case of the Arctic), as well as a nuanced understanding of the social, political and cultural barriers to invoking these instruments. Increased pressures are likely to come particularly from resource exploitation, industrial growth, multiple stresses on local residents, expanding polar tourism, marine and pipeline transport, and other developments.

Are we adequately addressing key problems? If not, what will be the consequences?

Over the last several decades there has been clear progress in polar observations, research, provision of services, development of information products, etc. However, despite several genuine attempts to establish operational sustained observing systems in the polar regions, they remain the most extensive data voids on the planet. Some observing networks have shrunk or suffered significant losses. Monitoring of human development and social change in the Arctic is in its infancy.

The severe environment, existence of ice cover, and sparse population are the reasons why traditional methods of observations are less efficient in the polar regions. Innovative observing techniques are required, which are usually more expensive than in other parts of the globe. Satellite observations are extremely promising for the polar regions but require sustained plans for missions and data acquisition, as well as high-quality in-situ campaigns for calibrating instruments and validating results. Prototypes of polar observing systems have been successfully developed and deployed to demonstrate their potential capabilities before 2007, during and after the IPY. Almost all of them are fully dependant on research funding. Attributions of past environmental changes, models capable of realistically reproducing various aspects of global and polar environments and their changes, datasets representing past environmental conditions, such re-analyses, and all other elements of a system that would have the potential to comprehensively describe the state of the polar regions, are also available in prototype versions only.

In the case of Arctic, the current lack of resources for sustainable polar observations and, as a result, of availability of adequate information services, is a huge impediment for the sustainable human development of the North and efficiency of adaptation of this region to changing climate, economic and environmental conditions. Climate change in the Arctic has already led to the necessity to evacuate coastal villages, has affected the stability of many structures on permafrost, and has strongly affected polar flora and fauna. The lack of precautionary approach in dealing with environmental, economic, cultural and social matters may lead to huge losses. Particular concerns are associated with the safety of operations and increasing risks of pollution accidents, with potential devastating impacts on the polar ecosystems that tend to 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 in the Arctic, yet our ability to readily track these changes is highly inadequate. *For the Southern Ocean and Antarctica, the inadequacy of the observing system results in lack of or insufficient understanding of several key processes*, which significantly reduces the degree of trust in available predictions and projections of the global and regional climate and state of environment of this region.

The *main polar issues are not addressed at present as effectively as required*. There needs to be a considerably greater sense of urgency among decision makers and awareness by the general public regarding the global importance of environmental issues in the polar regions and of the need to address them in coordinated, sustained, planned, timely, and resourceful manner and to speed up the transition of activities from research to operations. *A failure to effectively address the polar issues listed above will be felt much more strongly and in an increased number and variety of ways by future generations*.

Are we in position to address the existing challenges in the polar regions? If yes, how?

Since 2007, IPY research made significant advances in many scientific disciplines. It produced a massive "snapshot" of the polar regions and demonstrated that innovative technologies exist for observing the polar oceans, land and the atmosphere from space, air, and *in-situ*. Improved modeling and data assimilation capacity showed promise for development of information products and services to reduce exposure to hazards and inform paths towards sustainable development and adaptation to change in the polar regions. Some very positive experience has been gained in addressing the issues and concerns of local residents in an open and participatory way. The outcomes of IPY, in large sense, have demonstrated the feasibility of addressing most of the polar issues in a much more coordinated and efficient manner than even before. Since IPY, preliminary progress has also been made at developing means for tracking various aspects of human development in the Arctic. At present there is the possibility to ensure more reliable and comprehensive monitoring of the polar regions and to further deepen the understanding of main processes and phenomena and their interactions in order to enable a range of predictions and provision of services to support informed decision making. The IPY also catalyzed the training of the next generation of polar researchers, which the IPI will be poised to harness for these goals. These results can be utilized to conduct future polar activities in a socially conscious manner and in a true cooperation with local residents.

Current global financial difficulties are reflected in a shortage of resources for all, including polar, activities. This calls for increased efficiency of using existing funding, aiming at high return on investment and focusing on practical use of research outcomes and the ability to do more with less. Cooperation, coordination, and sharing of resources should therefore be the main strategy for developing polar activities, while involving additional partners and stakeholders will also be required. 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, education and outreach, 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 would be able to achieve significant results far beyond reach of any of them in the case of acting individually. This would create a completely new situation in the polar activities and significantly enhance their value for the whole globe. Building on existing activities, including the results of IPY, and starting some necessary parts of the work before that the whole IPI concept is endorsed and acquires momentum, may be highly recommendable and will result in overall savings. This can be true for follow-up on several scientific lessons of IPY, existing collaborations, outreach activities, continuing key data records, capacity building activities, and involving the next generation of scientists and practitioners in polar activities.

Scope of IPI

The magnitude of the changes at the poles and the strength of their interactions with the rest of the Earth System call for a set of polar activities that involve the *full breadth of polar and environmental sciences, observations, modeling, prediction and services*. It may also require specific process studies in some critical areas where our knowledge is still poor. A cross-disciplinary and Earth System approach will be needed that addresses *both the natural and human systems* and their interaction. Capitalizing on the research and development conducted in the past, it is possible to start designing and implementing an *end-to-end observation, research and prediction system for the polar regions* that would serve as the foundation for addressing remaining gaps in the required knowledge, and that would result in an *accessible knowledge base* that informs stakeholders and guides them to decisions on risk reduction, conservation, and sustainable development. A more integrated and coordinated approach to improving various polar aspects of modeling will also be needed, in view of still remaining considerable biases in models and their inability to adequately represent important regional processes.

Outreach, education, mentoring of *early career scientists*, and building the work force for decades to come are necessary conditions for the initiative's success. The role of APECS and similar communities in this process will be central. The training of the next generation in both the North and South is an investment for both short-term research as well as long-term monitoring. In addition, meaningful and resourceful involvement of the *local residents*, including indigenous peoples, should be ensured. The evaluation of IPI achievements will be most efficient at the local level, where the real action takes place, and this should help monitoring the overall success of IPI. A crucial lesson learned from the IPY is that capacity building and human resource development are not single year projects; investment in training and involvement must take place over multi-year to decadal scales.

There are multiple synergies in polar research in the Northern and Southern Hemispheres, which have been successfully exploited by SCAR and IASC. Seasonal coordination of field activities between the hemispheres is a factor of additional efficiency in using resources. There are similar approaches to polar observations, for example, by satellite remote sensing and in research and service provision. To a large extent, they involve the same community of scientists and specialists. This justifies the choice of IPI as a *bipolar initiative*.

As stated above, there are significant *similarities between polar and alpine regions*. One of them is the existence of the cryosphere. At the same time, as a rule, existing projects and programmes for polar and mountainous regions have somewhat different foci and sources of funding. Because some individual polar and alpine activities might benefit from common approach and resource sharing, inclusion of alpine thematic in IPI is recommended *on a project level*. There is no reason to limit the consideration to the area of Himalayan and Tibetan Plateau regions ("The Third Pole"). *All alpine regions of the world should be considered* where relevant.

No program is able to cover all aspects of polar activities and resolve all the existing concerns. However, IPI should include all key research, observation, education and outreach, and practical matters for the polar regions. Capitalizing on interaction with IPI, associated communities may decide to address a wide spectrum of other related and dependent issues.

Partners, stakeholders, building blocks, and resources

The critical case for expanded and sustained observation, prediction and services systems in the polar regions has been well made. Both the Arctic Council and Antarctic Treaty Consultative Meetings consider human safety and environmental protection as their highest priorities. The high societal importance of the polar issues means that the proposed activities will need to be implemented in all circumstances, sooner or later, with a framework like IPI or without it. To address the challenges, major international agencies have a broad range of individual and cooperative programs with respect to the polar regions. The scope of the existing programs reflects professional duties, objectives, and historically evolved division of labor of parent organizations. Taking into account the stakeholders' main goals, objectives, resources and available expertise and the magnitude of the challenges facing us and their interdisciplinary nature leads to the unequivocal conclusion that *no stakeholder can effectively achieve its objectives in the polar regions without efficient coordination and sharing resources with partners*.

The IPI Implementation Plan should therefore include all activities and commitments necessary for establishment and maintenance of the polar observing, assessment, prediction, and services systems. The initial focus should be on the coordination and strengthening of existing and developing programs, and expanding them. If a gap is identified in the IPI activities that cannot be filled through an existing program, a new program or a project should be developed that can close the gap and at the same time satisfy a set of predefined IPI criteria, such as close coordination with existing programs or projects, cooperative nature of activities, scientific excellence, etc.

Initial investments into the development of the Plan could come from leading research funding agencies and other interested agencies. At the beginning the initiative will require very modest resources for the development of the Framework and Implementation Plan. Initial investment into activities will be focused on adding value to existing activities through their improved coordination and cooperation. These costs will be small in comparison with significant direct and indirect gains resulting from improved coordination of activities. With the IPI Implementation 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 are likely to provide significantly greater return on investment. Such 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.

With time, achievement of considerably more ambitious goals should become feasible, and this may justify more investments into polar activities.

The role of international organizations will be to assist coordination and cooperation of the activities, while actual investments into these activities will need to be made by national funding agencies. Involvement of the private sector, where appropriate, should be facilitated as well. The economic viability of the plan and efficiency of the initiatives that comprise it should be regularly assessed.

Data

An essential IPY lesson is that having an early developed and well-elaborated data policy, promoting it, and strictly adhering to it should be a cornerstone of IPI. One of strong recommendations made at the IPI Town Hall Meeting conducted during the 2012 American Geophysical Union Fall Meeting was about the need to change the situation with data in the polar regions. Not only they remain poorly observed. Despite the widely announced calls for submitting IPY field data to international and national data centers, IPY field observations from scientific projects, more often than not, are not available in data centers and are therefore not accessible for the research community. Notable exception is the observations, analysis and predictions collected through the WMO system and satellite data.

The data policy should include all necessary elements, requirements and arrangements for effective functioning of observing systems, prediction technologies and provision of services. It should foster significant reduction of data acquisition time for common use, allowing expansion of real-time services. Discretional aspects of social data should be properly addressed. Data interoperability arrangements should be included in the data policy so that efficiency of data collection, exchange, reliability of storage and archiving, and data accessibility could be reinforced on the regional level while interoperability of the data and information should follow the existing global and regional standards.

Strong incentives for contributing to effective execution of the data policy should be developed; indeed data management should be integrated into the IPI program such that it promotes efficient publication, synthesis, integration, and sharing in this time of rapid change. The data policy and data and information management arrangements should be targeted to ensure satisfaction of the data users' interests at all levels of the end-to-end data processing system. Arrangements for efficient data rescue and archiving, including for some IPY field data, will be needed. Adherence to the data policy should be facilitated and strictly monitored and enforced, including by funding agencies.

Education, outreach, communication and engagement of the wider community

Existing global and regional challenges can be adequately addressed only with strong public and stakeholder awareness, engagement and support. IPY was one of the first international environmental initiatives that assigned significant prominence to this dimension of a predominantly scientific undertaking.

There is at present a continuing call for communication from the public that goes well beyond the interest in polar science. In order to capitalize on this momentum, the IPI needs to facilitate the provision and uptake of current and relevant information at several levels. Building on the experience from the IPY, outreach should be integrated into every facet of the IPI. The IPY Education and Outreach Assessment provides a solid starting point for widespread and long-term engagement at upper levels as well as through grassroots involvement. Direct integration of education, outreach, and communication with research and development projects provides logical opportunities for training, and sharing of information and ideas. As with scientific projects, there are many synergies to be found in collaborations between stakeholders. Attention to some regionally and globally profound events anticipated over the next 10-15 years may help capture the imagination of the wider community.

To be successful, the IPI should build a vigorous outreach strategy integrating education, outreach, and communication with each other and with the core activities of the IPI from the planning stages through to IPI deliverables and conferences. Involvement of various decision makers, funders of activities, business leaders, educators, teachers, and interested citizens is required. Other categories of stakeholders, both young and older, may need to be identified.

Implementation approach and management of IPI

Initially, an *IPI Framework Agreement* will need to be prepared to *identify common IPI goals and objectives of high societal, regional and global value and to secure the overall commitment of participating agencies and organizations to coordinate and cooperate in order to achieve these goals and objectives.* An additional Protocol to the IPI Framework Agreement would specify initial activities and commitments of participating agencies. This would include formation of an IPI Steering Committee to develop a phased IPI Implementation Plan. Involvement of funders and expressions of interest from national agencies and relevant committees will be sought.

The *IPI Implementation Plan* will define an interagency international collaborative program of polar activities. It will specify the goals, main implementation mechanisms, cooperation and coordination arrangements, and commitments towards and resources for conducting the activities and monitoring their progress. The Implementation Plan will be built on commitments of interested nations. Individual projects (elements, building blocks) of the program could be built by a single agency, through bilateral and, where required, multi-lateral agreements. The Implementation Plan will be an evolving document with activities unrolling according to a schedule and when they become feasible and commitments and resources for them are in place. This method of organization of activities in IPI will be a significant difference from the almost entirely bottom-up approach taken by IPY.

Time will be needed for developing the IPI Implementation Plan and securing commitments and resources for its implementation. This period, as IPI gains momentum, should not lead to a slow-down of the on-going deployment of already proposed and endorsed observing systems, research, and other relevant activities. Support to important existing polar activities that need to be sustained and further developed should be considered at the very early stage of the plan development, while their increased coordination with other activities, where possible, should be encouraged.

A management and coordination mechanism for the Initiative will be required as there are multiple benefits to be had from improved coordination. Such a mechanism will need to be proposed concurrently with the plan development. The management structure of IPI should be as “light” as possible, particularly given the current economic climate. The IPI Steering Committee supported by representatives of the secretariats of participating agencies may be sufficient at the beginning. Matchmaking management boards consisting of funders and stakeholders may be required for major projects at the later stage. Management of research projects will be encouraged to involve partnership of senior and early career scientists. The latter will periodically rotate to ensure a balance between focus on their science and groundwork for future leadership.

Tentative timeline

The following tentative timeline can be envisioned:

Second half 2012 - first half 2013:	Finalization of the draft IPI Concept and its wide discussion with the communities of polar researchers and funding agencies
Second half 2013 – first half 2014:	Review of the IPI Concept by executive bodies of international agencies, its update and endorsement
	Discussion of IPI at national level
	Establishment of an IPI Interim Committee for preparing the IPI Framework Agreement and Protocol to it
Second half 2014:	Signing of the IPI Framework Agreement and its initial Protocol
	Establishment of IPI Steering Committee representing participating agencies
	Identification of important existing activities to be sustained and developed under IPI
~2015-2016:	Development of the first version of the IPI Implementation Plan
	Establishment of initial working bodies of IPI including the IPI Data Management Committee
	Initial calls for IPI activities
~2017-2018:	Start of IPI implementation
~2022:	5-year milestone for IPI
~2027:	10-year milestone for IPI
2032-2033	International Polar Year 2032-2033

Main IPI - relevant objectives and activities of stakeholders

This following section of the IPI Concept very briefly reviews the highest-level objectives and main activities or initiatives of the international agencies, which were represented on the Steering Group that proposed IPI.

The list of activities is not exhaustive and does not imply any priority. In addition, there are some initiatives, for which it was difficult to adequately present the parentage. This was the case, for example, for some initiatives addressing societal issues in the Arctic.

It is hoped that in the future more organizations, agencies, and individuals will review the IPI Concept, decide to join IPI, or express ideas and proposals that are useful for its development. In the result, more additional initiatives and existing projects will be included in the list as building blocks for IPI.

Expressions of interest in joining IPI can be sent to the IPI Focal Point, Dr Vladimir Ryabinin, at vryabinin @ wmo.int.

Arctic Monitoring and Assessment Programme (AMAP)

URL: http://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) impact on Arctic ecosystems and human health. AMAP has been in operation since 1991, and since 1993 had in place a monitoring programme 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. 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. A major challenge for AMAP has been - and is - to secure enough reliable data from the circumpolar region. Therefore AMAP supports SAON as an important tool to achieve this objective.
For the assessment work AMAP has established expert groups on persistent organic pollutants, mercury, radionuclides, petroleum hydrocarbons, human health, climate change (including the cryosphere), the short-lived climate forcers (black carbon, ozone and methane), and ocean acidification. The groups involve experts from the Arctic countries, non-Arctic countries, the Arctic indigenous peoples and international organizations. The assessments are conducted in close cooperation with international organizations and Arctic Council working groups and are becoming increasingly multi-disciplinary and integrating. The examples are 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 (SWIPA). The assessment of combined effects of several stressors and drivers (e.g. climate and contaminants) is today of high priority for AMAP. Several of the AMAP assessments serve as regional input to global assessments such as conducted by UNEP, the Stockholm Convention, and IPCC.

Association of Polar Early Career Scientists (APECS)

URL: http://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 a very wide and dynamic range of 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 of the European Science Foundation (EPB-ESF)

URL: http://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)

URL: http://www.iasc.info

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 circum-Arctic 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)

URL: http://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.

IASSA convenes a tri-annual Congress, and publishes a semi-annual newsletter, Northern Notes.

International Council for Science (ICSU)

URL: http://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.

One of ICSU-led major initiatives is the "Future Earth", focusing on the science in support of the required changes to ensure sustainable development. IPI will be able to serve as a polar regional component of the Future Earth.

Intergovernmental Oceanographic Commission of UNESCO (IOC)

URL: http://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 indigenous knowledge systems and their integration with scientific knowledge systems.

Scientific Committee on Antarctic Research (SCAR)

URL: http://www.scar.org

The Scientific Committee on Antarctic Research (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.

SCAR will accomplish its vision and mission by:

- encouraging excellence in Antarctic and Southern Ocean transformational scientific programmes that address issues of regional and global importance;
- scanning the horizon to identify evolving issues and emerging frontiers in Antarctic science; expanding its activities to include the human element (e.g., history, social sciences and the value of Antarctica);
- providing objective and independent scientific advice on the conservation and management of Antarctica and the Southern Ocean;
- partnering with other Antarctic Treaty advisory bodies to provide objective and authoritative scientific advice
- expanding its advisory sphere of influence on global issues to other audiences
- affiliating with organizations with complementary interests to address regional and global issues;
- providing venues for presentation of the latest research results, exchange of up-to- the-minute scientific findings, and promotion of cross- and interdisciplinary communication
- promoting an interdisciplinary philosophy and eliminating barriers to cross- fertilization of ideas;
- motivating cooperation with Arctic counterparts;
- preserving and building on the legacies of the IPY 2007-2008;
- facilitating unrestricted access to Antarctic scientific data as a portal to repositories;
- developing the capacity of students and early career scientists;
- encouraging emerging national Antarctic programmes;
- recruiting countries that have not traditionally participated in Antarctic research;
- promoting and facilitating the incorporation of Antarctic science into education at all levels; and
- informing the public and the media of the importance of the knowledge gained by the

study of Antarctica and the Southern Ocean.

University of the Arctic (UArctic)

URL: http://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)

URL: http://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.

World Climate Research Programme (WCRP)

URL: http://www.wcrp-climate.org

Sponsored by the WMO, ICSU and IOC, WCRP supports a number of high priority scientific research activities with the aims of understanding the predictability of and the human impact on climate and 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.

World Meteorological Organization (WMO)

URL: http://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, hydrological and environmental services 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.

Some historical background

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. The initial thinking on the approach to sustaining the IPY legacy focused on a proposal for an International Polar Decade (IPD). A WMO-Roshydromet workshop held in Saint Petersburg, Russian Federation, in April 2011 was dedicated to discussing the original idea of an IPD.

The Workshop 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 possible long-term polar initiative that would be of significant value for the whole globe and would maximize return on investment. This Steering Group was formed and attempted to impartially analyze the current needs and issues in the polar regions and means of addressing them. The initial concept of IPI was presented to participants in the Action Forum Momentum Series of the Conference IPY2012 “From Knowledge to Action” in Montréal in April 2012. The concept was met with interest and its further development was encouraged. The Steering Group agreed to further develop the concept and present it to another major public forum. If there is further support to the concept, it will be offered for consideration of agencies represented on the Steering Group.

The key conclusions of the IPD Workshop are given below.

Extracts from conclusions of the WMO-Roshydromet International Polar Decade (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 (i.e. *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.

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[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.