

The International Polar Year 2007–2008: planning for a new phase of polar exploration and understanding

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Abstract: The concept of the International Polar Year (IPY) 2007–2008 is of an intensive burst of internationally coordinated, interdisciplinary, scientific research and observations focused on the Earth's Polar Regions. The research will address six themes organized around the environmental status of the Polar Regions and their relationship to change, the links between the poles and the rest of the globe, utilization of the unique features of the regions for science, and the human dimensions of communities in the Polar Regions. IPY will seek to exploit new technological and logistical capabilities, and make major advances in knowledge and understanding. Key objectives are to attract and develop the next generation of polar researchers and engineers, and to engage the interest and involvement of polar residents, and of schoolchildren, the general public, and decision makers, worldwide. The official observing period of IPY 2007–2008 will be from 1 March 2007 until 1 March 2009, under the international oversight of a Joint ICSU-WMO Committee.

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Introduction

The Polar Regions are integral components of the Earth system. They couple to global climate, sea level, biogeochemical cycles, ecosystems, and human activities. Through these connections, the Earth's high latitudes respond to, amplify, and drive changes elsewhere. At a time when humans are exerting an increasing impact on the planet, and when the human condition is increasingly affected by global changes, the Polar Regions are especially important and relevant.

New technological capabilities offer the potential to make major advances in polar science. These include satellite remote sensing, autonomous instruments and platforms capable of operating in extreme conditions of cold and darkness, high bandwidth global communications systems, and high powered numerical Earth System Simulators. The time is ripe to exploit these to achieve significant scientific advances.

However, the scope and scale of the polar research challenges lie beyond the capabilities of individual nations or traditional scientific disciplines. Numerous bodies exist to stimulate and coordinate multinational and multidisciplinary polar research activities, but the current rate of advances does not fulfil the urgent needs of policy makers to be provided with key information to underpin sustainable economic development.

The International Polar Year (IPY) 2007–2008 will be an intensive and internationally coordinated campaign of high

quality research activities and observations in the Polar Regions. It will have an interdisciplinary emphasis, with active inclusion of the social sciences, and is intended to lay the foundation for major scientific advances in knowledge and understanding of the nature and behaviour of the Polar Regions and their role in the functioning of the planet. In addition, this international activity aims to leave a legacy of observing sites, facilities and systems to support ongoing polar research and monitoring. The Polar Year will strengthen international coordination of research, enhance international collaboration and co-operation in both Polar Regions, and address their global interactions.

The IPY programmes will collect a broad-ranging set of samples, data and information regarding the state and behaviour of the Polar Regions to provide a reference for comparison with the future and the past. Data will be made available in an open and timely manner, and efforts to intensify the recovery of relevant historical data will add considerably to the corpus of available material.

These IPY programmes need to attract, engage and develop a new generation of polar researchers, engineers and logistics experts. In addition they must engage the awareness, interest and understanding of schoolchildren, the general public and decision makers worldwide in the purpose and value of polar research and monitoring.

Planning for these activities has been effected by an IPY Planning Group established by ICSU through its Executive Board in February 2003. The role of the Planning Group was to formulate a concept for an IPY 2007–2008 and to develop a mechanism for the design, development, guidance and oversight of an IPY. This paper outlines

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progress made by the IPY Planning Group in planning these activities, up to the end of 2004, when the Planning Group was replaced by a Joint Committee of ICSU and WMO to steer the implementation process, as explained below. The final report of the IPY Planning Group (Rapley *et al.* 2004) can be downloaded from the IPY website (www.ipy.org) or can be obtained on request from the International Council of Science.

ICSU-WMO Co-sponsorship of IPY 2007–2008

Following ICSU's establishment of an IPY Planning Group in February 2003, the WMO, at the Fourteenth World Meteorological Congress in May 2003, approved the concept of an International Polar Year as a means to achieve a broad set of research objectives. This activity was independent of the initial ICSU effort to plan an IPY, but communication was quickly established and at the second Planning Group meeting of the ICSU committee, a suggestion was made by WMO to merge interests in an IPY. The Planning Group recommended this arrangement to the ICSU Executive Board, which agreed in February 2004. As a result, when the IPY Planning Group's Science and Implementation Plan was presented to the ICSU Executive Board in October 2004, it was agreed that an ICSU-WMO Joint Committee (for IPY) should be convened to take the process forward.

There are many advantages to this co-sponsorship, besides the historical fact that both bodies spawned the International Geophysical Year (IGY) of 1957–58, which to a large extent played the role of the last IPY. WMO is a leading international scientific organisation in many countries, and its endorsement of the IPY greatly facilitates the involvement in IPY of the National Meteorological and Hydrological Services and scientists from those nations. WMO's political structures connect to the governments of many countries, increasing the possible pool of resources to support IPY. WMO and ICSU already share sponsorship of organisations, such as the World Climate Research Programme (WCRP), that have proposed a broad set of programmes suitable for IPY.

Characteristics of IPY 2007–2008 projects

ICSU's IPY Planning Group identified the need for all IPY activities to be high quality science as judged by the standard peer review processes. In addition, they need to address the following characteristics:

1. Be focussed on one or both Polar Regions and, where possible, their global relevance.
2. Have the potential to make significant advances within one or more of the IPY themes.
3. Constitute an intensive, time-limited burst of scientific

activity that takes place primarily during the IPY time frame.

4. Contribute to international collaboration and coordination.
5. Be logistically and technically feasible within the IPY 2007–2008 timeframe.
6. Avoid duplication or disruption of established initiatives and plans.
7. Provide open and timely access to data and encourages the long-term management of IPY data and information.
8. Follow guidelines, as appropriate, to be ethically and environmentally sensitive.
9. Maximize effective utilization of available logistical assets, as appropriate.
10. Explicitly include roles and tasks for young scientists, and technical and logistics experts.
11. Include specific education and outreach activities.

Additional desirable characteristics are that the programme should:

1. Leave a legacy of data, observing sites, facilities and systems to support ongoing polar research and monitoring, and to provide value to future generations. Builds on and adds value to existing or planned activities, where relevant.
2. Incorporate an interdisciplinary approach or the potential for interdisciplinary synthesis.
3. Facilitate international access to field sites.
4. Catalyse the broader involvement of nations in polar research.
5. Address training and capacity building.
6. Provide opportunities for regional scholarship within broader international activities.
7. Be readily communicable to the public.

Themes

Six scientific themes for the IPY were developed from extensive input from the polar science community, and are intended to provide an international framework for the specific activities proposed for the IPY.

Theme 1: To determine the present environmental status of the Polar Regions.

Rapid environmental change in the Polar Regions has

increasingly significant global ramifications. Well-planned synoptic observations of the current environmental status of the Polar Regions will serve as a valuable benchmark for scientists and decision makers globally. Consequently a key output will be to document contemporary natural and human environments of the Polar Regions, quantifying their spatial and short-term variability and characterizing present day processes.

Theme 2: To quantify, and understand, past and present natural environmental and social change in the Polar Regions; and to improve projections of future change.

To provide a framework for interpreting the synoptic observations made during the IPY we need to advance our understanding of the factors which drive natural environment and social change in the Polar Regions, and to develop and implement better systems to both monitor and predict future changes. Our overall objectives must be to quantify past changes, understand present and ongoing changes and to improve our ability to monitor and predict future changes over a range of time and space scales.

Theme 3: To advance our understanding on all scales of the links and interactions between Polar Regions and the rest of the globe, and of the processes controlling these links.

The global influence of the Polar Regions, especially in the climate system, is profound and far reaching. The Polar Regions contain some of the world's major resources such as fisheries and minerals; hold massive stores of ice capable of causing significant global sea level rise under global warming; represent large carbon reservoirs that under different circumstances might ameliorate or amplify the impacts of human greenhouse gas emissions; and are also home to peoples that contribute to global cultural diversity. Just as the Polar Regions influence global processes, global processes also impact the poles.

Theme 4: To investigate the frontiers of science in the Polar Regions.

Beneath the polar ice sheets and under the ice-covered oceans, the bedrock and sea floor are largely unknown. Similarly, the pattern and structure of polar ecosystems is yet to be mapped in detail, and nor can the impacts of large-scale resources exploitation on polar biodiversity and societies be reliably projected. Today the new scientific frontiers in the Polar Regions are at the intersection of disciplines. Progress can be made not only using new observational techniques, but also by interdisciplinary cross-analysis of existing databases, utilizing the overwhelming recent advances in computing capability.

Theme 5: To use the unique vantage point of the Polar Regions to develop and enhance observatories from the interior of the Earth to the Sun and the cosmos beyond.

The unique position of the poles on the planet makes them an ideal site for observation of diverse processes. Improved understanding of many processes and phenomena, such as solar-terrestrial interactions, the rotation of the Earth's inner core and the strength of its magnetic dipole, cosmic ray detection, and astronomy and astrophysics, are uniquely benefited by observations from both northern and southern Polar Regions. Several disciplinary based groups have existing programmes or well advanced plans to use the Polar Regions as observing platforms. These are complemented by interest in developing broader science agendas for new polar research stations proposed by several nations.

Theme 6: To investigate the cultural, historical, and social processes that shape the sustainability of circumpolar human societies, and to identify their unique contributions to global cultural diversity and citizenship.

Some 10–12 million people, both indigenous and more recent emigrants, now live in Polar Regions. The well-being of polar peoples has always been closely linked to their understanding of, and adaptation to, their environment, and polar societies have been agents in shaping changes in their environment for millennia. Understanding of the historical, social, and cultural dimensions of the Polar Regions and of the complexity and diversity of polar living conditions, both human and physical, has grown considerably. But key deficiencies remain with issues of partnership and public involvement, socio-economic development, governance, cultural viability, and the human rights of all polar people, but especially indigenous people. Studies of the vulnerability, resilience, adaptability and sustainable development of polar human societies should be undertaken by networks of researchers and experts, both local and international, with the inclusion of polar peoples as scientific partners in research.

WMO contributions

In their planning, WMO identified a number of activities of high priority for IPY. These activities, which are particularly relevant to Themes 1, 2 and 3, are summarized as:

1. Improvement and further development of the World Weather Watch Global Observing System in the Polar Regions, including the space-based component.
2. Enhancement of ozone layer monitoring, with increased spatial and temporal coverage.
3. Intensification of long-term integrated measurement and modelling of the transport of greenhouse gases and

aerosols, particularly in the Arctic.

4. Assessment of global-to-regional influences on the initiation, evolution and predictability of high impact weather events in polar circulation.
5. Intensification of studies addressing the role of polar cryospheric processes, and of feedbacks through which the polar cryosphere interacts with the other components of the climate system.
6. Establishment of a comprehensive database of polar climate data to support the assessment of current climate change in the Polar Regions, and to project future change.
7. Investigation of physical processes in polar oceans and establishment of the Arctic Ocean and the Southern Ocean Observing Systems.
8. Further development of capabilities to observe and model or parameterize the hydrological cycle of regions with cold climate, including the establishment of the Arctic Hydrological Cycle Observing System.

It is expected that the major WMO contributions in these activities will develop to take advantage of the potential for expanded observations and for establishing new observational networks throughout the Polar Regions during IPY 2007–2008. Such enhancements recognize IPY as a means to improve what already exists, to recover what has been lost, and to expand what has been planned; but without degrading or diminishing existing programmes in the Polar Regions.

New observational systems see proposed insert below

An overarching objective of the IPY is that it should leave a legacy of observing sites, facilities and systems to support ongoing polar research and monitoring so as to provide value to future generations. Some of the key questions facing humankind in our time can only be addressed if long-term funding of cost-effective observational networks is secured. These observing systems will provide scientists and decision makers with real time information on the evolving state of the poles for decades to come. Stations that remain relatively fixed in place, such as on land or on stable ice sheets, as well as stations moving with the ice and the seas, should be developed to integrate physical, biological and chemical measurements. These observation networks range from the meteorological stations in the Arctic to the installation of seismometers in pinwheel array in Antarctica. Co-located observations can be devised to measure such diverse features as the earth's atmosphere, oceans, magnetosphere, seismic structure of the lithosphere and mantle, and isostatic rebound. These permanent stations will enable scientists in the future to isolate short-term variability from long-term change for topics ranging from

climate to the earth's magnetic dipole. Observing systems should build on and add value to existing or planned activities.

In this context IPY 2007–2008 can

- a) serve as a framework for development and testing of a range of modern observational technologies,
- b) make the synoptic multidisciplinary observations needed to establish the status of the polar environment, and
- c) provide for long-term spatially distributed interdisciplinary observing networks to understand the polar regions in the coming years and decades.

International coordination in the Arctic has already started by the creation of an Arctic Ocean Observing System (AOOS) to be developed around four main components:

- a) a space component based on remote sensing, satellite data transmission and precise geo-location;
- b) a surface component based on ice-tethered platforms equipped with sensors for meteorological, sea ice and oceanographic observations;
- c) an underwater component based on autonomous underwater ballast controlled floats equipped with ice profiling upward looking sonars, gliders equipped with CTD and acoustic transceivers for navigation and ocean thermometry, and
- d) an integrated component dedicated to data analysis and data integration in numerical models to bridge gaps and develop interactions and synergies between observations and models. A similar, complementary observing system is required for the Southern Ocean.

The cryosphere is an important element of the Earth system, but probably its most under-sampled part. A framework is needed for improved coordination of cryospheric observations, and for improving the generation of the data and information needed by the research and the operational forecasting and climate communities. The community needs in particular:

- a) validate remote sensing and in situ observations of the land based cryosphere that are capable of providing a complete picture of precipitation and accumulation;
- b) comprehensive observations of sea ice characteristics; and
- c) a significantly enhanced monitoring system for ice sheets, ice caps, and glaciers.

The limited timeframe of IPY 2007–2008 encourages activities that focus on data collection and that utilize the potential of increased coordination of logistic assets. Many of the ideas submitted by the community recognized this

emphasis. Different discipline based groups often proposed similar activities, sampling strategies and field programmes. At the same time, several national or even different multinational groups advocated similar activities. Observational systems or observational programmes emerged to address each scientific theme, often with a strong interdisciplinary component.

Some of the key scientific questions facing mankind in our time can only be properly addressed if long-term funding of cost-effective observational networks is secured. Thus, one of the main contributions of the IPY 2007–2008 could be to serve as a framework for development and testing of a range of modern observational technologies, accompanied by science addressing integration and interpretation of observations.

Data management

Data management is a key component for transforming the IPY 2007–2008 into a legacy that will endure into the future, providing future generations with a relevant data base.

The overarching data management objective is to ensure the security, accessibility and free exchange of relevant data that both support current research and leave a lasting legacy. To achieve these aims IPY 2007–2008 needs a strong data and information management strategy and policy to guide the collection, handling, storage, description and distribution of data. Consistent with the data policy of ICSU, a key element of the IPY data policy should be free access to data and information collected under the IPY. The key to progress will be the establishment of a Data Policy and Management Subcommittee responsible for defining but not implementing the data and information. To succeed in data and information management, IPY 2007–2008 will need to create a full time, professional data and information unit as soon as possible to implement the programmes data and information management policy. This service, the Data and Information Service (DIS), should be closely associated with, but should probably not be located within the International Programme Office.

Education and outreach

The Polar Regions provide a powerful context for teaching and learning, attracting a wide and diverse audience. The education, outreach and communication strategy for the IPY must address the question: “Why are the Polar Regions and polar research important to all people on Earth?” through a series of nationally and internationally coordinated programmes producing an improved understanding of the importance of the poles globally.

Five major, sometimes overlapping, audiences for the IPY education, outreach and communication efforts have been identified:

1. Primary and secondary education communities,
2. Young and potential new polar researchers,
3. Arctic communities,
4. The general public,
5. Decision makers.

At the international level there will be a need for an Education, Outreach and Communication (EOC) Subcommittee. This will coordinate international communication activities; formulate a broadly accepted framework for IPY 2007–2008 education, outreach and communication; and serve as a forum for exchange of ideas to assist National Committees in their communication efforts. The IPY 2007–2008 education, outreach and communication framework should be adaptable to the business, language and cultural needs of each participant, while retaining a clear direction, identity and ‘voice’ for IPY 2007–2008. National IPY Committees and IPY Project Steering Committees will also organize various Education and Outreach projects, and their use of existing outreach and education networks and organisations will be essential.

Principles for implementation of the IPY 2007–2008

To be successful, IPY 2007–2008 needs a sound organisational structure with minimal bureaucracy that promotes efficient communication and attracts excellent people. This means a simple framework that makes effective use of existing polar organisations and avoids duplication of the roles of these organisations, yet provides needed additional coordinating and oversight bodies.

This implementation plan aims to be a transparent, inclusive process that gives an equal opportunity to all potential participants in IPY 2007–2008 and encourages projects that satisfy the IPY objectives. The core participants of IPY 2007–2008 will be self-organising groups of researchers, their parent organisations, existing bodies with a role in Polar Regions research and monitoring, and consortia of such bodies.

Role of ICSU and WMO as IPY sponsors

The IPY sponsors, ICSU and WMO, have established the International Polar Year 2007–2008 Joint Committee (JC) described below and will fund its activities. Neither ICSU, WMO nor the Joint Committee have, or will seek authority over national or international polar research programmes. The JC’s approach will be to influence the actions of the national and international bodies for the overall benefit of IPY 2007–2008 through encouragement, persuasion and consensus building. The one exception is that WMO will exert direct control over IPY contributions from internal WMO approved and funded programmes.

IPY 2007–2008 participants

IPY 2007–2008 research activities will be carried out by scientists and support staff from university research groups, other research organisations, operational bodies such as national meteorological services, and international organisations. Data management is expected to be supported within individual research activities by the contributing organisations using trained data specialists. To ensure that IPY 2007–2008 data sets are managed to fulfil the long-term IPY objective of increased polar research capacity, the data management must conform to the principles defined by the JC-appointed specialist Data Policy and Management Subcommittee.

IPY 2007–2008 education and outreach activities will be carried out both by scientists and their support teams, IPY 2007–2008 National Committees, the JC and by other organisations as appropriate. This critical aspect of IPY 2007–2008 will be led, advised and facilitated by a JC-appointed subcommittee on Education, Outreach and Communication.

IPY 2007–2008 funding

The financial support for IPY 2007–2008 activities will be obtained by researchers making proposals to existing funding organisations, many of which will be encouraging IPY-related work with specific solicitations. Thus, the research activities will mainly be approved and funded through national mechanisms, as well as through regional and international funding bodies, such as the European Commission.

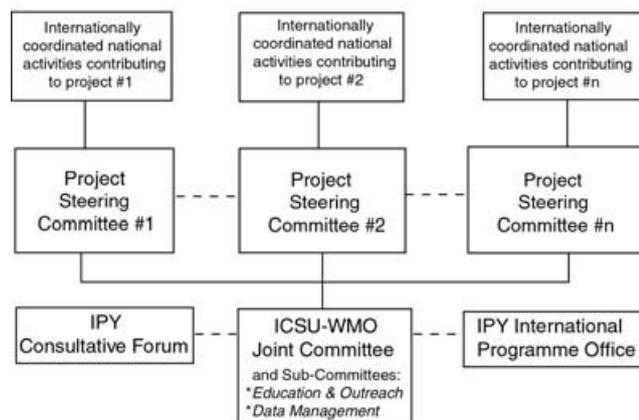


Fig. 1. The organisational structure for the IPY. The overall programme is addressed by a combination of a Consultative Forum and the ICSU-WMO IPY-JC, supported by the International Programme Office. Individual projects operate with a degree of autonomy under the direction of a Project Steering Committee. The connecting lines symbolise two-way communication pathways and (upwards) lines of decision making (to be exercised as far as possible through consensus.)

The Joint Committee is not a funding organisation and has no funds to dispense. It will, however, host a submission process that conveys official IPY 2007–2008 status as described below.

Organisational structure for the IPY

The structure shown in Fig. 1 will be established for IPY 2007–2008 to provide the enabling mechanism for the IPY activities to occur.

The IPY 2007–2008 Joint Committee (JC) will exist until the end of 2009. It consists of two Co-Chairs and no more than 12 additional members appointed by ICSU and WMO (Appendix). SCAR (Scientific Committee on Antarctic Research), IASC (International Arctic Science Committee) and IOC (Inter-governmental Oceanographic Commission) have each been invited to nominate *ex-officio* representatives. In addition, the Executive Heads of ICSU and WMO will each appoint an *ex-officio* member of the Committee. The Co-Chairs can invite additional persons to attend sessions for specific agenda items, as necessary. The Joint Committee will be responsible for overall scientific planning, coordination, guidance and oversight of IPY 2007–2008. In performing its functions, it will be supported by an International Programme Office (discussed below). It should work closely with all relevant organisations and National IPY Committees/contact persons. The Joint Committee will meet at least twice a year.

All IPY 2007–2008 projects will have a Project Steering Committee (PSC) appointed by the project owners that will serve as the point of contact between the project and the other elements of the IPY organisational structure. The size of the committee should be appropriate to the complexity of the project. Small or simple projects might decide that the Project Steering Committee functions can be handled by a single individual, while it is expected that more complex projects will have a larger, international Project Steering Committee. Funding for activities of the Project Steering Committee will be provided by national participants in the relevant IPY 2007–2008 project. The Project Steering Committee will be responsible for the detailed planning, execution and reporting of science activities of that project. Each Project Steering Committee must have an identified leader who is the communication link to the Joint Committee and to leaders of other Project Steering Committees. The Project Steering Committee will have considerable autonomy. Members are expected to be active participants of the activities or responsible for critical elements, such as logistics, data management, or education, outreach and communications.

An activity as large and complex as IPY 2007–2008 will require daily, full time staff support. Most of the IPY participants who will serve on the various IPY committees and sub-committees will be volunteers drawn from the academic community and from the stakeholder bodies. The

International Programme Office (IPO) will provide the day-to-day administrative support to the Joint Committee, its subcommittees and, to a more limited degree, to the larger Project Steering Committee. The International Programme Office is a crucial element of IPY implementation and is housed at British Antarctic Survey in Cambridge. The International Programme Office may have distributed sub-offices with specific tasks, as well as using ICSU and WMO facilities as appropriate.

Given the large numbers of IPY 2007–2008 stakeholders, an advisory Consultative Forum (CF) will be established to provide a consultative platform for IPY development including dialogue among the various stakeholders, expressions of views on IPY 2007–2008, and a venue for exchange of information with the Joint Committee on IPY 2007–2008 development. The opinions and views expressed by stakeholders at this forum will be considered by the Joint Committee in all aspects of planning, implementation and management of the IPY 2007–2008. The Consultative Forum will assemble at least once per year. The funding for these meetings will be provided by the participants and coordinated by the JC and the IPO.

A significant difference between the current IPY and its predecessors is the existence of a large number of bodies, both non-governmental and governmental, each with established roles and legitimate interests in the international coordination of scientific activities carried out in the Polar Regions. The Antarctic Treaty Consultative Meeting and the Arctic Council are especially significant in this respect. The potential exists for organisational arrangements to be established which imaginatively and cost-effectively draw upon the effort, funding and influence of existing bodies to implement the IPY, while at the same time satisfying their specific interests in an IPY involvement. A large number of these bodies have already given their endorsements to the IPY.

IPY vision

The IPY 2007–2008 has tapped a powerful vein of enthusiasm and energy within the scientific community. This in part derives from the wide recognition of the seminal nature of the IGY. The IGY fundamentally changed how earth and space science is conducted and reverberated

far beyond the initial years of exploration and research. The IGY of 1957–58 and its IPY predecessors provide an inspiring heritage.

At a time of significant change on the planetary scale, IPY 2007–2008 aims to provide scientists with the opportunity to go where they could not go before, to collect data in ways they have not done before, and to establish monitoring systems where none existed before. Breakthroughs and insights will follow.

Logistic capabilities and funding have limits, but the innovation, creativity and imagination of the polar science community do not. The stage is now set to make significant and enduring advances in polar science. It is the intent of IPY 2007–2008 to foster new research ideas and methods including accelerating initiatives that would otherwise be slow to emerge. Focusing collective attention on IPY 2007–2008 has produced the added benefit of focusing the attention of the world on the Polar Regions. This opportunity has abundant potential to impress upon people in all walks of life the multitude of ways that the Polar Regions are important to every person on Earth. Youth that are inspired to scientific or technical careers or that come to appreciate the importance of the Polar Regions and of their stewardship as part of an intimately linked climate and cultural system will give IPY 2007–2008 enduring impact.

Experience with the IGY and former international Polar Years suggests that there are likely to be benefits from IPY 2007–2008 that are entirely unplanned and that become clear only after the formal IPY period has ended. It is foreseen that polar science in the post-IPY 2007–2008 era will be vastly strengthened and improved. Fresh ideas seeded by examination of existing and new data will drive enlightened researchers to new discoveries about the Polar Regions and our world. It is this final legacy - the next generation of polar scientists, trained and enthused during IPY 2007–08 – that will be one of the most important.

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Appendix 1

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