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Preface

This summary volume is an attempt to capture the context, motivations, initiation, planning, implementation and the outcomes of the International Polar Year (IPY) 2007–2008, as well as the lessons derived from this key undertaking. IPY invigorated polar science, led to an unprecedented level of action, and attracted global attention to the polar regions at a critical moment in the changing relation between humanity and the environment.

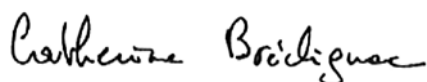
Under the auspices of the IPY, co-sponsored by the International Council for Science (ICSU)¹ and the World Meteorological Organization (WMO)², thousands of scientists and educators contributed to implement a large number of internationally coordinated projects that made major discoveries in Earth's polar regions and reinforced the basis for monitoring changes and predicting the resulting regional and global impacts of those changes. The IPY was an international endeavour that involved more than 60 nations. It was also highly multidisciplinary, with strong engagement from biological and social disciplines to complement the geophysical sciences. Furthermore, IPY was multigenerational, since it drew together participants from the International Geophysical Year (IGY) 1957–1958 as well as a fresh cadre of the early career scientists who will increasingly lead polar science over the (polar) years to come. Finally, IPY was an educational endeavour that engaged an international network of teachers, developed key educational resources and captured broad public attention through a vigorous and creative outreach campaign.

On behalf of the international ICSU and WMO communities, we thank the many thousands of IPY participants, in particular the hundreds of project leaders, the numerous funding bodies that fuelled IPY, the logistics providers that enabled it, the committees that coordinated national efforts, the IPY International Programme Office that facilitated international coordination and nurtured networks of teachers and early career scientists, the ICSU Planning Group that developed the conceptual framework for IPY, the WMO Intercommission Task Group on IPY that promoted IPY ideas among WMO Members, and the ICSU-WMO Joint Committee and its Subcommittees that oversaw and steered IPY preparations and implementation. It is from the Joint Committee that the idea of this summary arose, and we further thank the committee members for their leadership in shaping the document. Nearly 300 contributors generously provided material for and edited sections of this volume and we especially wish to thank Drs Igor Krupnik and David Hik for tirelessly steering the overall writing project to its completion.

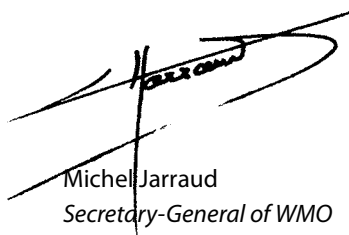
The example of IPY illustrates how ICSU and WMO work with the international scientific community to shape, launch and support international scientific programs of global significance. As described in the first part of this overview, there were many initial strands of discussion within the polar science community on the IPY concept. The ideas came from groups affiliated with ICSU and WMO, and from independent sources, and they ultimately coalesced into the IPY plan, which was given international legitimacy through the approval of WMO and ICSU's respective governing bodies. Our organizations jointly procured a venue and a director for the IPY International Programme Office and funded the meetings of the IPY Joint Committee, a modest investment that was amplified by several orders of magnitude

through the generous contributions of numerous countries and donors. The key result of this collaborative approach was an impressive scientific and educational programme that has yielded new discoveries, developed new capabilities, and forged new partnerships that now lead us strongly into the legacy phase of IPY, as described in the summary report.

We are confident that you will enjoy the story of the IPY, and we urge you to take note of the work still ahead, since the study of the polar regions reveals their global significance and their influence on the rest of our planet. We hope that the overview of IPY will catalyse further enrichment of the IPY story and that it will serve as a valuable guide to planners of the future international and interdisciplinary scientific endeavours that will undoubtedly be needed in order to meet societies' diverse and mounting global environmental challenges.



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¹ www.icsu.org

² www.wmo.int

Acknowledgements

IPY 2007–2008 was the first international polar program ever to be organized on such a broad multi-disciplinary basis, with strong engagement of biological, social, and human sciences that complemented the core geophysical sciences of the earlier IPY/IGY.

Even more notable was a new level of collaboration of polar residents, including Indigenous people, with the IPY scientific teams, in the design, conduct and communication of many IPY projects and their results.

The Co-Chairs of the Joint Committee for International Polar Year 2007–2008 would like to express their deep appreciation and sincere thanks to:

- The many individuals who advocated for IPY during its formative years and during the implementation and observation phase.
- ICSU and WMO, the two main sponsors of IPY 2007–2008 international effort, who recognized and supported the IPY initiative from planning to completion (and also supported the activities of the IPY Joint Committee and its bodies).
- Many international organizations who threw their weight behind the development and implementation of IPY over those long years (2002–2010), including the International Arctic Science Committee, Scientific Committee on Antarctic Research, Arctic Council, Antarctic Treaty Consultative Meeting, Intergovernmental Oceanographic Commission of UNESCO, World Climate Research Programme, Council of Managers of National Antarctic Programs, Forum of Arctic Research Operators, European Polar Board, Arctic Ocean Sciences Board, International Arctic Social Science Association, International Permafrost Association, and many others, as well as national funding agencies, and national academies.
- National and international Space Agencies for the generous in-kind support in making available free of charge important satellite observational data and products specially tailored for the polar regions.
- Those national organizations and agencies that generously provided financial support to the Joint Committee, the International Programme Office, the JC subcommittees, the Association of Polar Early Career Scientists, and the activities they initiated.
- The governments of Canada, China, Finland, Germany, the Netherlands, Norway, Poland, Republic of Korea, Russian Federation, Spain, Sweden, Switzerland, U.K. and the U.S.A. that provided financial contributions to the IPY Trust Fund, and a secondment to support the International Programme Office's day-to-day activities, including the coordination of IPY operational data, and hosting the IPY meetings and workshops.
- Many dedicated IPY leaders who served as members of the ICSU Planning Group (2003–2004); the Joint Committee (2005–2010) and its subcommittees on Data Policy, Observations, Education, Outreach and Communication; Space Task Group; the Association of Polar Early Career Scientists, Eurasian International Programme Sub-Office; and many *ad hoc* groups established to advance IPY 2007–2008.
- The Staff of the International Programme Office (IPO), including David Carlson,

Director; Cynan Ellis-Evans, Senior Adviser; Odd Rogne, Senior Advisor; Nicola Munro, Administrator; Rhian Salmon, Education, Outreach, and Communication Coordinator; Camilla Hansen, Events Coordinator; Melissa Deets, Karen Edwards, and several other people who supported IPO activities in various forms throughout these years.

- The Heads of the Arctic and Antarctic IPY Secretariats who promoted International Polar Year in the countries involved, helped coordinate each countries' contribution to the IPY process and interactions with the national funding agencies.
- The staff of ICSU and WMO Secretariats who supported our meetings, outreach and public events, exhibitions and publications.
- The national committees and national polar programmes, which generated resources and support for IPY 2007–2008, both in their respective nations and internationally.
- Coordinators of 228 endorsed international IPY projects who played a key role in organizing the IPY science program and communicating its results to millions of people interested in the polar regions.
- Host countries, secretariats, and steering committees for the two major IPY Conferences in Russia (2008) and Norway (2010), and to Canada and the Canadian organizations in charge of the third IPY Conference, 'From Knowledge to Action' to take place in April 2012.
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- AND, MOST IMPORTANTLY, to the many thousands of participants in IPY 2007–2008, recognizing that IPY science and observations also depended on pilots, ship crews, drivers, indigenous and local partners in the host communities, technicians, student assistants, medical and support personnel, rescue crews, and many more people who worked so hard over many years to make IPY 2007–2008 a major success and an enduring example of international collaboration.

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“Summarizing IPY”: Perspective from February 2011

Igor Krupnik and David Hik

The Task

At its eighth meeting (JC-8) in February 2009, the Joint Committee (JC) for IPY 2007–2008 decided to produce a ‘substantial summary report’ on IPY 2007–2008 operations and to make it available to the IPY community by June 2010 at the first post-IPY Science Conference in Oslo, Norway. Immediately after that conference, the Committee’s tenure was to end and the ‘summary’ report would serve as the final overview of the JC activities in the organization and implementation of IPY, to be delivered to the sponsor organizations, national committees, funding agencies and thousands of IPY participants. This document is the outcome of a collective leadership effort of the JC team as it completes its five and a half-year service to the IPY community.

Viewed from a historical perspective, particularly in comparison with the preceding International Polar Years, the bar has never been raised so high, both in terms of the time and scope of the work involved in producing such a summary. At the equivalent date, a year after the official completion of the first International Polar Year (IPY-1) 1882–1883, the world had just lived through the shock and the triumph of the rescue of the last IPY-1 field party of Adolphus Greely, with the tragic loss of 19 of its 25 members. Major reports on the results of IPY-1 were in the making but still a few years away. A year after the completion of the second International Polar Year of 1932–1933 (IPY-2) there had been no substantial overview of its results and the Organizing Committee estimated that it would take five years to produce a full summary. It did not happen until 25 years later. In 1960, a year after the completion of International Geophysical Year (IGY) 1957–1958, the publications related to IGY were streaming in and the first ten volumes in the IGY series, *Annals of the International Geophysical Year* were already printed. Nonetheless, no comprehensive summary of the IGY operations by its international committee followed. Clearly, *summarizing* an IPY was a tall order and was usually accomplished a long time after the year’s completion or not at all.

Challenges

The challenges to producing a single document to summarize the operations of IPY 2007–2008 were many. This ‘fourth’ polar year was one of the most ambitious science initiatives ever attempted; it eventually evolved into the largest internationally coordinated research program in the Earth’s polar regions in the past 50 years. It was a truly international endeavour that engaged an estimated 50,000 researchers, local observers, educators, students and support personnel from over 60 countries participating in more than 230 international projects and innumerable national and local efforts. It included intensive research and observations in both the Arctic and the Antarctic over a two-year period, from 1 March 2007 till 1 March 2009, but recognized that many activities would continue beyond that date. IPY 2007–2008 explored the links between both polar regions and the rest of the globe and ushered in a new era in polar science collaboration, as it involved the largest ever range of scientific disciplines, from geophysics and ecology to social science, humanities and economics. Also, unlike previous IPYs, it made Education, Outreach and Communication of science results to the public one of its primary missions. Because of that, it reached out to many new constituencies, including polar residents, arctic Indigenous nations and millions of people on this planet with no direct connection to the high latitudes. Altogether, IPY 2007–2008 broadened the ranks of its participants and the diversity of their products and activities to an extent never realized or even envisioned in the earlier IPYs.

IPY 2007–2008 was co-sponsored by the International Council for Science (ICSU) and the World Meteorological Organization (WMO); it was also supported—financially, logistically, intellectually, politically and publicly—by a great number of international organizations, science bodies, national agencies, independent and non-governmental groups, organizations of polar residents and

indigenous people, national and local governments (see *Acknowledgments*). According to the estimates of the IPY International Programme Office, IPY 2007–2008 stimulated approximately US\$ 400 M in new polar science research funding and approximately US\$ 1200 M in total funding, not counting many national polar infrastructure investments.

Following in the footsteps of its celebrated predecessors, particularly IGY, IPY 2007–2008 was launched to create a legacy of enhanced observational systems, new research facilities and infrastructure. The observational networks envisioned as major outcomes of this IPY included integrated ocean observing systems in both the Arctic and Southern oceans, coordinated acquisition of satellite data products from multiple space agencies, and observational systems for meteorology and atmospheric chemistry, terrestrial and marine ecosystems, permafrost, sea ice and glaciers, human health and the well-being of polar communities. Many observing systems developed for IPY were intended to eventually become parts of the growing framework of existing global observing systems to serve the polar regions and the planet.

The goals and the vision of IPY 2007–2008 have been disseminated widely, since at least 2004, in several major outline documents (Rapley et al., 2004; NAS, 2004), at numerous international meetings, in hundreds of publications in major world languages, and on scores of websites. Since the very start of IPY planning, it was announced that the fundamental concept of the new IPY was of an intensive burst of internationally coordinated, interdisciplinary scientific research and observations focused on the Earth's polar regions. The aim of IPY was to exploit the intellectual resources and science assets of nations worldwide to make major advances in polar knowledge and understanding. The main geographic focus was the Earth's high latitudes, both the Arctic and Antarctica, but studies in any region relevant to the understanding of polar processes or phenomena were also encouraged. In addition, IPY

2007–2008 aspired to leave a legacy of new observational systems as the basis for observing and forecasting change, in order to improve understanding of the poles as key components of the global environment.

The initiators and planners of IPY 2007–2008 put a strong rationale for such a massive research, observation and public outreach program 50 years after the International Geophysical Year 1957–1958. They argued that the polar regions are especially important for a common understanding of planetary processes for the following reasons (Allison et al., 2007):

- Polar environments are changing faster than any other regions on Earth, with regional and global implications for societies, economies and ecosystems. These changes are particularly evident in widespread shrinking of snow and ice.
- Processes in polar regions have a profound influence on the global environment and, in particular, on the weather and climate system and sea level. At the same time, the polar environment is affected by processes at lower latitudes. Examples include the formation of the ozone “holes” and the accumulation of pollutants in the Arctic environment.
- The polar regions, particularly the Arctic, are home to more than four million people, and these communities face changes in their natural environment and in their natural resources and food systems that are, for the most part, faster and larger than any in recent experience or traditional knowledge.
- Within the polar regions lie important scientific challenges yet to be investigated and unique vantage points for science. The regions beneath the polar ice sheets and under the ice-covered oceans remain largely unknown. Many of the new scientific frontiers in the polar regions are at the intersection of traditional scientific disciplines.

There was also a strong *societal message* behind the urgency to launch a major new research and observational program in the polar regions at the beginning of the new millennium.

As the polar regions are integral components of the Earth system, they couple to global climate, sea level change, ocean circulation, biogeochemical cycles, ecosystems and human activities. At a time when the world's population is exerting an increasing influence on this planet and its environment, and the human condition is rapidly affected by global changes, the polar regions are critical to any vision of the Humanity's overall prospects on the 'ever-stressed' Earth. With the new technological capabilities now available (such as satellite remote sensing, autonomous platforms, global communications systems, high powered numerical Earth System Simulators and others) the time appeared ripe to achieve significant scientific advances during IPY. By stimulating and guiding an intense international burst of effort, IPY 2007–2008 aimed to accelerate progress in our common knowledge and to fulfill the needs in key information on polar processes and their global linkages for policy makers. At this critical time, it became clearer that the polar regions provide a litmus test and the insight to help the society recognize the planetary limits of our behavior (Allison et al., 2007).

The Scope

IPY 2007–2008 occupies a special place even when compared to the monumental and most comprehensive assessment programs of the past decade, such as the *Arctic Climate Impact Assessment* (ACIA, 2005), the *Antarctic Climate Change and the Environment* review (Turner et al., 2009), the *Arctic Human Development Report* (AHDR, 2004) and the *IPCC Fourth Assessment Report* (IPCC, 2007; Solomon et al., 2007). These and similar ventures were usually commissioned by high-level intergovernmental organizations or major international bodies, with a clear task, terms of reference and the message coming 'from the top.' IPY 2007–2008, to the contrary, started as an open grass-roots initiative aimed at *new research*. It maintained its 'bottom-up' character during its lifespan and it capitalized upon energy, ideas and activities assembled through free submissions by researchers, educators, data experts and media specialists from more than 60 nations.

The overall IPY program was built as a wide-ranging 'universe' of 228 international projects endorsed by the JC in 2005–2006 and supplemented by thousands

of local actions undertaken by national institutions, school and environmental groups, and polar communities over the next five years. By February 2010, the electronic publication database for IPY 2007–2008 listed 2957 entries related to IPY activities (<http://nes.biblioline.com/scripts/login.dll>). As of June 2010, that number, was close to 4000, as several IPY-related books and reports were planned to be unveiled by or at the Oslo IPY Conference in June 2010. The overall scope of IPY 2007–2008 is hard to overestimate and its total 'footprint'—in science and observational activities, data collected, papers and books, students trained, web-based products, and innumerable public events—may not be fully known for many years.

For these and other reasons, any effort to 'summarize' IPY 2007–2008 at this time could only be addressed with certain boundaries in mind. First, any overview of IPY activities could only be a time-framed 'snapshot', a **preliminary** Summary based on information available to a certain point in time – in this case, summer-fall 2010. Second, an overview of such a massive program would be naturally focused on what had already taken place, in that case, on the planning, organization and the operations of IPY during 2005–2009, with but a fraction of its data processed and science results known by spring 2010. For that reason, this volume is framed primarily as an **operational** Summary of IPY rather than a 'synthesis' document on its science achievements. For the latter, the time will come in due course (we note that it took many years for syntheses of various scientific results to emerge from the IGY).

Third, it is widely assumed that major fields, disciplines, national IPY committees and individual IPY projects would eventually produce strings of products of their own. This is already happening. The Joint Committee, thus, can be accountable solely for the activities it initiated, endorsed and in which it participated to a certain extent. There are, in fact, 'many IPYs' familiar under various manifestations and in different languages to many people and groups, both national and international. This Summary represents the **JC-framed overview** of the planning and implementation of IPY over 10 years, from 2001 till mid 2010, during which the JC or its direct predecessors were directly involved. By this definition, it cannot be judged as a "down-to-the-last-detail" narrative that lists everything and everyone in the IPY field over those years, even though we tried

to be as comprehensive as was practical. We hope the time will come for many groups that participated in IPY to produce their accounts of IPY history. This will enrich and expand the more specific 'JC' story. Nevertheless, we are convinced that the JC vision in this summary is worth sharing with the community not only to justify the common effort and the expenditures from many sources, but also as a prospective blueprint to follow for the next IPY.

Lastly, any summary of a multifaceted and diverse initiative, like IPY, cannot be but **multi-vocal** in its use of professional languages, visions, and styles. That breadth of 'many IPY voices' had to be preserved, so that space and Earth scientists, climatologists, oceanographers and cryosphere specialists, marine biologists, anthropologists, polar historians, indigenous researchers, educators and other IPY participants feel comfortable under one book cover – just as they enjoyed being together in 'one IPY'. That task was hardly on the mind of the earlier IPY/IGY organizers, who structured their summaries by major disciplines ('aurora', 'solar radiation', 'meteorology', 'earth currents', etc.) or under the national IPY report format. The JC team agreed from the beginning on the variety of styles, so that each constituent field in IPY 2007–2008 and each writing group could tell about its activities in a language familiar to its audience. That diversity of styles and goals is what really made IPY 2007–2008 so special; we did our best to retain it in this Summary. We assume that each group or discipline will eventually have the opportunity to present its own story in the format of its choice.

The Structure

The JC first discussed the idea to produce an in-depth IPY 'overview' document at the JC-7 meeting in July 2008 and more thoroughly at the JC-8 meeting in February 2009, following the release of the 12-page summary of IPY activities, *The State of the Polar Research* (Allison et al., 2009 – Chapter 1.5). The JC members approved the prospective title for the Summary (*Understanding Earth's Polar Challenges*), the draft outline for a document of five major parts (see below) and appointed a small Editorial Team to lead the effort, with a release of the final Summary scheduled for early 2011. It was envisioned to become the key reference source on the broad range of IPY activities, including

origination, planning and implementation of IPY, with a succinct overview of its major results for participating researchers, science and agency planners, students, media specialists, and science historians.

In July 2009, an Editorial Team led by Igor Krupnik and David Hik, and assisted by Paul Cutler, Volker Rachold, Eduard Sarukhanian and Colin Summerhayes developed a detailed outline for the Summary of 30-some chapters organized in five Parts: *Planning and Implementing IPY 2007–2008* (Part 1); *IPY Science Program* (Part 2); *IPY Observing Systems, Their Legacy, and Data Management* (Part 3); *IPY Public Programs; Archiving and Publishing IPY* (Part 4); and *The Legacy of IPY and the Future of Polar Research* (Part 5). Eventually, each of these large sections comprising several Chapters received its 'coordinating editors – Paul Cutler and Igor Krupnik (Part 1); Ian Allison and Jerónimo López-Martínez (Part 2); Eduard Sarukhanian and Colin Summerhayes (Part 3); David Hik (Part 4); and Igor Krupnik and Volker Rachold (Part 5). Those eight 'coordinating editors' constituted the Editorial Board, together with Robin Bell, and under the overall leadership of Krupnik and Hik. The writing of individual chapters started in October-November 2009; the editing, reviewing, and revision of its many constituent parts continued through summer 2010. Some chapters were not completed until fall 2010.

All 21 JC members and observers, members of the Subcommittees on Observations, Data Management, and Education Outreach and Communication, as well as the staff of the International Programme Office (IPO) were invited to participate as contributors – writers, reviewers, editors, liaisons, etc. Most of them volunteered to serve. It was also agreed from the beginning that the JC team would reach out to many IPY scientists and invite them to join as lead and contributing authors, according to their respective fields of expertise. Almost 90% of people we invited off the JC-IPO network enthusiastically agreed to participate, often on very short notice. Over 50 scientists were also approached as external reviewers; most of them also agreed to serve. That outpouring of support greatly expanded the vision and the capabilities of the original JC team. Broadening the team also helped elevate the status of this volume from a 'technical overview' of IPY 2007–2008 to the high-quality scholarly summary of its many constituent fields and cover preliminary results

from many of the IPY projects, which was not foreseen under the original plan.

All chapters written for the IPY Summary underwent several levels of peer-review, both internal and external. As of the last count (February 2011) the full Report team includes more than 240 lead and contributing authors and 50 reviewers from almost 30 nations and in all disciplines that participated in IPY. The Volume size and diversity conveys the energy of the large IPY community and we expect more people to assist us as reviewers and commentators in the months to come.

The draft Summary was submitted by the JC at the Oslo Conference in June 2010 as the main outcome of its work and in completion of its service in the implementation of IPY 2007–2008. As the JC completed its term at the Oslo IPY Conference, a small editorial group was tasked to undertake revisions and edits collected from the IPY community at the Oslo Conference and beyond. The completed Summary is now being disseminated to a wider audience as an electronic file and a printed book.

There was yet another factor that helped lift the enthusiasm of the JC team. None of the previous IPY/IGYs ever produced a full summary by its leading body as a large stand-alone document. So, the effort undertaken by the team assembled by the JC, in less than two years after the completion of IPY 2007–2008 observational period in March 2009 stands as a remarkable achievement. But neither did any previous IPY/IGY team face a community forum of the magnitude of the Oslo Science Conference, with its more than 2300 participants, as a concluding event for an IPY. This is once-in-a-lifetime opportunity for the JC to fulfill its mandate to the large community that worked tirelessly to make IPY the most exciting event in polar research in fifty years.

The Team

A Summary like this one is only as good as the team of volunteers who shared the JC commitment and vision. We believe this volume offers an ample reflection of the enthusiasm generated by IPY 2007–2008 that inspired so many people and organizations over 10 years, including the JC team and its collaborators.

We wish to acknowledge and thank all of the Coordinating Editors, who did most of the

organizational groundwork for their respective sections. The Editorial board and the full JC team produced a shared vision for this summary overview of IPY that has driven our work over the past 15 months. Our warmest thanks go to the ‘extended team’, the many colleagues in IPY, who served as writers, chapter contributors, advisors and reviewers. This extended team wrote, rewrote, reviewed and provided so much inspiration, often on a very short notice. Working in a big team, rather than within a small group of the JC members, gave us strength and assured that this Summary is a *collective* and *collegial* perspective on why IPY was launched and what it has achieved. Without your input, we would never be able to produce such an extensive and in-depth coverage of many fields of IPY science and observational activities, history of its planning, and the assessment of its legacy. We are grateful for your energy, shared knowledge and your unyielding support to this last of the JC initiatives.

Nicola Munro, former Administrator of the International Programme Office deserves special appreciation for her help with the many Appendices and illustrations.

The production team in Edmonton included several members of the former Canadian IPY Secretariat. With deadlines pressing, Stacey Strilesky and Kristi Skebo made superhuman efforts to manage the flow of materials and to copy edit the text and supporting material from each of the chapters. Sandy Riel completed the layout and design, and her previous work on the ICARP II report, the SAON Initiating Group report and other IPY reports including the Polar Resource Book made this a very easy relationship. Additional copy-editing support was provided by Cara Seitchek in Washington, D.C.

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