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Lessons and Legacies of International Polar Year 2007–2008

International Polar Year 2007–2008 (IPY) was an intense, coordinated field campaign of observations, research, and analysis. IPY engaged the public to communicate the relevance of polar research to the entire planet, strengthened connections with the Indigenous people of the Arctic, and established new observational networks. Overall, IPY was an outstanding success. Activities at both poles led to scientific discoveries that provided a step change in scientific understanding and helped translate scientific knowledge into policy-relevant information—and at a time when the polar regions are undergoing a transformation from an icy wilderness to a new zone for human affairs, these insights could not be more timely or more relevant. From outreach activities that engaged the general public to collaborative studies with Indigenous people and projects that brought researchers from multiple disciplines and several nations together, the legacies of IPY extend far beyond the scientific results achieved, and valuable lessons learned from the process will guide future endeavors of similar magnitude.

How does life persist in the coldest, darkest corners of the globe? How will changes in glaciers, ice sheets, snow cover, sea ice and permafrost affect the entire Earth? How will traditional ways of life in the North be altered by the challenges of a changing planet? During International Polar Year, which ran from March 1, 2007 to March 1, 2009, scientists and educators worked together to answer these questions and many more as part of the most comprehensive polar research campaign ever mounted.

Credit: Max, age 5, Seattle, WA

Bringing together more than 50,000 researchers, local residents, educators, students, and support personnel from 60 nations and numerous scientific disciplines, International Polar Year (IPY) used new tools and technologies to observe polar systems. Reaching across the science spectrum, IPY's 228 projects ranged from the first high-resolution images of whole mountain ranges buried beneath the Antarctic ice sheet to modeling studies of the poles' geologic past that helped advance understanding of the risks and uncertainties of global change.

Starting from the efforts of a small number of enthusiasts and agencies and building on existing multinational collaborations and science programs, IPY developed into a world-wide, community-based effort. The project facilitated a major expansion of polar science capabilities in terms of the number of researchers, tools, and systems devoted to this endeavor, and inspired a new level of engagement from educators, students, the residents of polar regions, and the public at large.

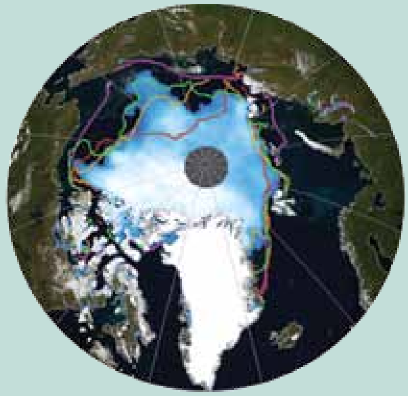
The Human Element in IPY

People were the engine that powered IPY. Without the enterprise and commitment of the many participants in IPY, the wide-ranging and

IPY 2007–2008 was built on a foundation laid by previous International Polar years in 1882–1883 and 1932–1933, and the International Geophysical Year in 1957–1958. Each of these campaigns in its time marked a breakthrough in internationally coordinated exploration of Earth and space.

Box 1. Investigating Arctic Sea Ice

With minimum sea ice extent in 2007, 27 percent lower than the previous record low in 2005, IPY provided an unprecedented opportunity to study the Arctic in a time of rapid change. Several projects investigated sea ice thickness and the mechanisms behind melting. In this satellite image (left), the red line marks the September 2007 sea ice extent, the orange line the extent for September 2008, the green line the September 2009 extent, and the pink line the climatological monthly mean for September 1979–2000.



To broaden perspectives and gain more historical information on sea ice, IPY projects matched Indigenous knowledge of sea ice with scientific data. For example, Indigenous terms can distinguish between numerous types of ice and related phenomena in a small area, easily describing the various ice formations show in the image on the right, such as large floes (puktaat), vertical blocks of ice (puikaanit), pieces of dirt ice (taaglut), and small floating pieces of ice (sangalait).

Sources: *Top:* Stroeve et al., 2011.
Bottom: Winton Weyapuk, Jr., May 21, 2007 – Krupnik and Weyapuk 2010, p. 341.

significant achievements of the project would not have been possible. Notably, IPY projects encouraged international collaboration that allowed the polar science community to become more connected and leveraged infrastructure and intellectual assets from multiple nations to make numerous research projects more efficient.

IPY projects helped empower the next generation of polar scientists. The Association of Polar Early Career Scientists (APECS), an active peer network that aims to support early career scientists from around the world by providing opportunities for networking, holding seminars and workshops, and promoting education and outreach, got its start during IPY. In addition, IPY sought to build diversity into the polar research community by engaging more women, both in terms of project leadership and participation on project teams, increasing the number of female lead scientists from near zero during International Geophysical Year in 1957–1958 to around one-fourth during IPY. IPY also increased the participation of racial and ethnic minorities in polar science, for example by actively recruiting minority graduate and undergraduate students in science programs.

A major objective of IPY was to create new connections between science and the public to increase understanding of the role of the poles in global systems through a broad spectrum of education and outreach activities. One of the most prominent outreach activities was Polar Palooza, which engaged audiences with big-screen video presentations, music, and opportunities to interact face to face with dynamic polar researchers and Arctic residents with powerful stories to tell.

Scientific Advances and Discoveries

IPY helped develop new collaborations that enhanced scientists' observational capacity in many of the poles' most remote areas. For example, numerous satellite data enabled international teams to study large changes occurring in the Greenland and Antarctic ice sheets. Taken together, these assessments showed that the pace of ice sheet mass loss has increased since the end of the last century, and is accelerating sea level rise. With data generated during IPY, scientists generated projections that show an accelerating trend for sea level rise, with model predictions ranging from 20 to 180 centimeters by 2100.

An entire mountain range under the Antarctic ice sheet was discovered during the International Geophysical Year in 1957–58, but its extreme inaccessibility meant that it remained uninvestigated until this IPY. The *Antarctic Gamburtsev Province* (AGAP) project used cutting-edge airborne radar to investigate the subglacial Gamburtsev Mountains, which are thought to be the initial originating site of the East Antarctic ice sheet millions of years ago. The data reveal an Alps-like mountain range with river valleys to the south, truncated by an extension of the Lambert Rift to the North. Radar data show areas where hundreds of meters of ice frozen onto the bottom of the ice sheet drive subglacial flow and ice sheet behavior in ways not captured by present models. These are just a couple examples of the myriad of scientific advances and discoveries that happened during IPY.

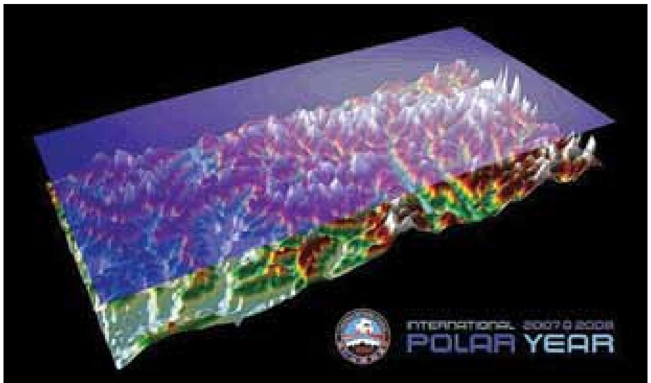


Figure 1. Until IPY 2007–2008, an entire mountain range under the Antarctic ice sheet remained uninvestigated because of inaccessibility. Airborne radar was used to investigate the Gamburtsev Mountains revealing topography otherwise completely covered by ice near the center of the East Antarctic Ice Sheet. Source: Michael Studinger, NASA

Scientific Tools and Infrastructure

IPY saw not only the use of existing tools in new places, but also the deployment of new tools that will remain in place long after IPY is over. A number of observing networks established during IPY combined or extended data collection capabilities beyond what single countries or projects could install or sustain. In the Arctic, the integrated Arctic Ocean Observing System collects ocean observations from the sea bed to the surface and across both major inflow/outflow pathways between Arctic and sub-Arctic waters. As of 2008, 174 moorings were in place monitoring the main Arctic Ocean basin, its peripheral seas, the Canadian Archipelago, the Fram, Davis, and Bering Straits, Greenland, and the Russian Arctic, and a sub-set of these sites will remain in operation after IPY.

The Polar Earth Observing Network (POLENET) is a land-based observational network for geodesy and seismology established at both poles during IPY. About 50 autonomous seismic stations operated continuously in the Antarctic interior during IPY as contrasted with just one at the South Pole prior to IPY. Data from these stations will contribute important insights into internal processes within the ice and rates of ice loss at both poles. In combination with satellite data, POLENET data will improve ice mass balance estimates to determine how the world's largest ice sheets in Greenland and Antarctica are changing.

IPY provided the impetus for a number of international programs to recover long, high resolution geologic records of changing environmental conditions in the high latitudes, such as ice and sediment cores that can provide new information about past variations in climate and environmental conditions. Because of the exceptional logistical and technical challenges in obtaining ice and sediment cores in polar regions, new instrumentation and geological drilling systems were designed. For example, at Lake El'gygytgyn in remote northeastern Russia, cores were extracted using a newly designed hydraulic rotary system consisting of a diamond coring rig positioned on a mobile platform that was weather-protected by insulated walls and a custom-made tent atop a 20 meter derrick. This equipment will be available as a tool for scientific drilling operations in Russia, at no cost to the scientific community, until 2014.

Knowledge to Action

IPY activities, particularly in human health, community vulnerability, food security, and local observations of change, sought to convert scientific data into societally relevant information to be shared with polar communities, local agencies, and grassroots organizations, particularly in Alaska and the Arctic. One example comes from the IPY Sea Ice for Walrus Outlook, a web-based monitoring and data-sharing network in the Bering Strait region. Sea ice conditions have a direct impact on quality of life for Arctic communities. Arctic residents depend on knowledge of sea ice conditions for the success of

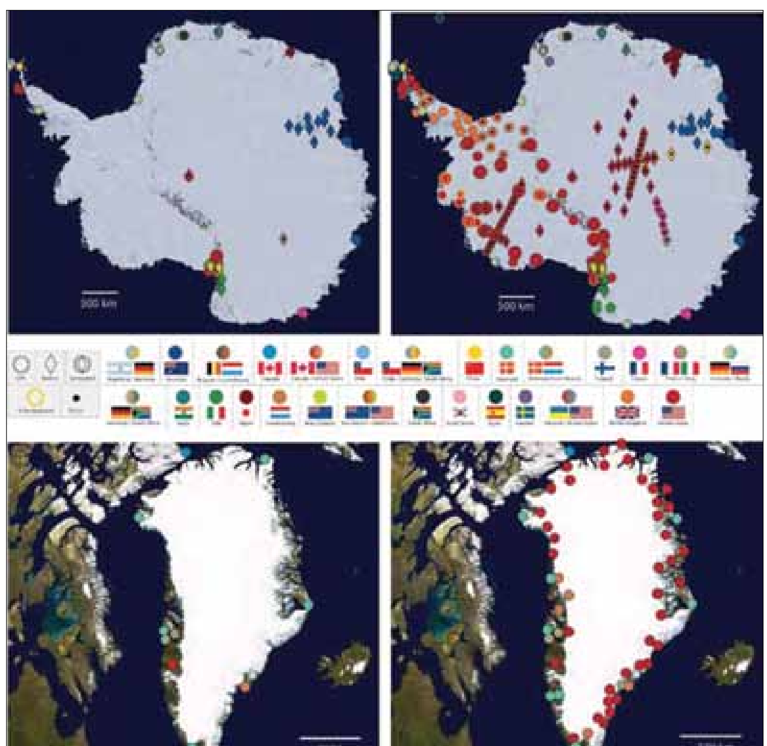


Figure 2. POLENET networks before (*left*) and after IPY (*right*).
Source: POLENET database; maps drafted by M. Berg and S. Konfal.

traditional hunting practices, but climate change means patterns of sea ice are no longer predictable, even by seasoned hunters. Developed by ice scientists in partnership with the Eskimo Walrus Commission and several local village monitors, the Sea Ice for Walrus Outlook uses high resolution satellite images, analysis of weather and ice patterns, and observations from local scientists and Indigenous experts to provide forecasts for the spring ice break-up and the walrus migration in the northern Bering Sea region.

Looking to the future, IPY-related predictive modeling will continue to play a crucial role in helping commercial enterprises, individuals, and governments assess the regional and global risks associated with ongoing melting ice, sea level rise, permafrost degradation, and other effects of rising polar temperatures in a warming world. Such assessments can help inform a wide variety of decisions about the management, location, and insurance of coastal property and infrastructure, community planning and zoning, construction of ice roads, emergency preparedness, disaster response, and long-term planning for moving military, industrial, and public infrastructure to higher ground.

Lessons and Legacies

Coming at a time of rapid polar and global change, IPY investments enabled the scientific community to observe and benchmark the state of the polar system. The concept of an "international year" undertaken once in a generation's lifetime proved as valid today as it did decades ago. The inclusiveness of IPY helped ensure that the polar research community grew in number, skill, and knowledge, and researchers have forged new collaborations to carry out ambitious projects far beyond the capability of any single nation.

However, not everything worked perfectly during IPY. Despite efforts by the IPY Data Committee and several coordinating workshops, the development and accessibility of IPY data products is not optimal. A further disappointment has been the lack of continued support to coordinate programs initiated during IPY. It has been hard to maintain some networks developed and nurtured during IPY, and valued components of the large IPY structure—such as the international IPY website, its publication database, and educational and outreach efforts—have struggled to find alternative resources.

On balance, IPY achieved its goals and was an overwhelming success. The world will continue to change, and processes of polar amplification will continue the rapid transformation of the high latitudes in coming decades. The legacy of IPY will help society to understand these changes and put knowledge into action, forging new frontiers in the protection and management of the planet's resources at all latitudes. Lessons learned from this IPY will provide a guide for planning and carrying out future international science projects.

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The National Academies appointed the above committee of experts to address the specific task requested by the National Science Foundation. The members volunteered their time for this activity; their report is peer-reviewed and the final product signed off by both the committee members and the National Academies. This report brief was prepared by the National Research Council based on the committee's report.

For more information, contact the Polar Research Board at (202) 334-3479 or visit http://dels.nas.edu/prb. Copies of *Lessons and Legacies of International Polar Year 2007–2008* are available from the National Academies Press, 500 Fifth Street, NW, Washington, D.C. 20001; (800) 624-6242; www.nap.edu.