

Development of the International Polar Years and their benefits for China

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Abstract International Polar Years, which have been held four times, have greatly promoted human understanding of the polar regions. The development of the International Polar Years has the following features: increasing interdisciplinary trend; importance of international organizations in initiating and participating in projects; and science diplomacy playing an important role in promoting cooperation and resolving differences. China was highly involved in the fourth International Polar Year in 2007–08, and the PANDA project which as a China-led international project marked a gradual shift in China's polar activities. China could play a bigger role in the fifth International Polar Year, including the following: initiating a new International Polar Year; initiating more international projects; promoting international organizations; actively conducting science diplomacy; and publicizing its polar activities in different ways.

Keywords International Polar Year, International Geophysical Year, Antarctic Treaty, China

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1 Introduction

The polar regions are ideal places for examining climate change. The International Polar Years (IPYs) are collaborative research events that focus on the Arctic and Antarctic. So far, IPYs have been held four times (1882–83, 1932–33, 1957–58, and 2007–08); the third one was also called the International Geophysical Year (IGY). Taking the opportunity of the IGY, 12 countries (including the United States and Soviet Union) conducted Antarctic cooperation during the Cold War and signed the Antarctic Treaty. The Antarctic Treaty System (ATS) has proved remarkably effective (Young, 1999). For over a century during their development, the IPYs have grown from regional to global events: participation has spread

from Europe to wider regions. Chinese stations and observatories participated in observations for the first three IPYs; however, the country did not participate substantially until the fourth IPY. Compared with foreign scholars (e.g., Barr and Lüdecke, 2010; Launius et al., 2010), Chinese scholars' research related to the IPYs has been limited: it has mainly focused on matters related to the fourth IPY (e.g., Yan and Zhu, 2009). There has been little discussion about a fifth IPY. In this regard, it is necessary to examine the development of the IPYs and what benefits they have had for China. In light of the timing of previous IPYs, the next one could be held in 2032–33 or 2057–58. It is important to assess whether China could perform better in the next IPY. This study analyzes the development of the IPYs and summarizes their features. From China's participation in previous IPYs, this paper will make a forward assessment of the fifth IPY.

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2 Features of IPY development

The idea of the IPY can be traced back to the 1870s. A lieutenant in the Austro-Hungarian Navy, geophysicist, and explorer, Karl Weyprecht stated that decisive scientific results could be attained only through a series of synchronous expeditions; their task would be to distribute themselves over Arctic regions and obtain a series of observations over one year using the same method (Weyprecht, 1875). The International Polar Commission was established in 1879, principally to coordinate the first IPY (Shadian and Tennberg, 2009). In 1882–83, 11 European nations undertook combined expeditions to study meteorology along with magnetic and auroral phenomena in the Arctic for the benefit of the nations involved (Berkman, 2002). The second IPY and the IGY were suggested separately by Leonid Breitfuss and Lloyd Berkner in 1926 and 1950 (Barr and Lüdecke, 2010). The fourth IPY has been discussed longer than the previous IPYs, which can be traced back to the late 1970s (Krupnik et al., 2011).

The development of the IPYs has the following features. An interdisciplinary trend has become increasingly apparent. The Arctic and Antarctic have long been considered natural laboratories for scientific research

(Abdel-Motaal, 2016). Accordingly, natural science has always been the main theme of the IPYs. The first IPY examined meteorology, magnetism and auroras. The second IPY added radio science. The IGY covered a wider range of matters, such as rockets, satellites, and nuclear radiation (Berkman, 2002). During the IGY, the United States and Soviet Union separately established Amundsen–Scott South Pole Station and Vostok Station close, respectively, to the geographic and geomagnetic south poles. At the Amundsen–Scott South Pole Station, research covers many areas, such as astronomy, astrophysics, and meteorology. Social sciences and the humanities became an important part of the fourth IPY, greatly expanding previous research disciplines.

Social sciences and the humanities emerged during the first IPY, such as studying the Inuit. During the first IPY, several field stations produced extensive ethnographic and natural history collections; historical photographs, diaries, and travel reports; and early publications. However, no records related to the social sciences and humanities emerged from the second IPY, and related activities were limited in the IGY (Barr, 1983; Krupnik et al., 2005). The social sciences and humanities reappeared in the fourth IPY; at that time, Arctic states and states outside the Arctic region participated in certain projects (Table 1).

Table 1 Projects in the social sciences and humanities in 2007–09 related to the fourth IPY

Full title	Participating nations	Observers of the Arctic Council
Historical Exploitation of Polar Areas	Norway, Russia, Sweden, The Netherlands, United Kingdom, United States	The Netherlands, 1998; United Kingdom, 1998
History of International Polar Years	Germany, Russia	Germany, 1998
Linguistic and Cultural Heritage Electronic Network	Finland, Norway, United Kingdom	United Kingdom
Polar Field Stations and IPY History: Culture, Heritage, Governance (1882–present)	Denmark, Norway, Russia, Sweden, United Kingdom, United States	United Kingdom
Northern High Latitude Climate Variability During the Past 2000 Years: Implications for Human Settlement.	Canada, Greenland (a part of Denmark), Iceland, Norway, The Netherlands, United States	The Netherlands
Sea Ice Knowledge and Use: Assessing Arctic Environmental and Social Change	Canada, France, Greenland, Russia, United States	France, 2000
Engaging Communities in the Monitoring of Zoonoses, Country Food Safety and Wildlife Health	Canada, Denmark, Greenland, Norway, Poland	Poland, 1998
Social-Science Migrating Field Station: Monitoring the Human-Rangifer Link by Following Herd Migration	Bulgaria, Finland, Germany, Norway, Russia	Germany
6th International Congress of Arctic Social Sciences	Canada, Denmark, Finland, Greenland, Iceland, Norway, Russia, Sweden, United Kingdom, United States	United Kingdom
Polar Heritage: Protection and Preservation of Scientific Bases in Polar Regions – Polar Base Preservation Workshop	Australia, Norway, United Kingdom, United States	United Kingdom

Source: Krupnik et al., 2011

As evident in Table 1, the United Kingdom participated in the most projects; it was followed by the Netherlands and Germany; France and Poland separately participated in one project. These five nations were all observers of the Arctic Council (AC); the AC comprises eight Arctic states, six permanent participants, and several observers. The participation of those five countries has

helped promote participation by other observers, such as China.

There are two reasons to explain this feature. The first is the development of science and technology. During the IGY, the rapid development of science and technology made it possible to conduct some large-scale research projects in Antarctica (Wei and Guo, 1989). Thus, the disciplines

involved in the IGY far exceeded those of the second IPY. With the rise and development of social networks, the fourth IPY undertook various forms of education, outreach, and communication projects. For example, such new media as Twitter were applied to Ice Stories: Dispatches from Polar Scientists, which was a project funded by the US National Science Foundation. People around the world were able to learn about the scientists' fieldwork through the Ice Stories website. The second reason is that the objectives of the IPY have been adjusted. The origins of the IGY are complex, but easing political tension in the Antarctic was the main factor (Barr and Lüdecke, 2010). With the fourth IPY, governance of the polar regions was primarily established: it involves the ATS in Antarctica and the regime complex in the Arctic represented by the AC and the International Arctic Scientific Committee (IASC) (Young,

2011). The result is the polar regions having entered a golden age of international cooperation. Hence, the objectives of the fourth IPY included expanded capacity in the quest for new scientific knowledge and forging new connections between academia and the public (National Research Council of the National Academies, 2012).

International organizations are important actors in initiating and participating in IPYs. The relevant organizations can be divided into two categories: international bodies that initiated and organized the fourth IPY, mainly the World Meteorological Organization (WMO) and the International Council for Science (Table 2); international organizations that participated in certain projects related to the fourth IPY, such as the International Arctic Social Sciences Association (IASSA), the University of the Arctic (UArctic), and the Aleut International Association (AIA).

Table 2 International organizations related to the fourth IPY

Different kinds of organizations	Relevant organizations	
International organizations that initiated and organized the fourth IPY	International Council for Science; WMO	
International organizations involved in initiating and organizing the fourth IPY	Arctic Ocean Studies Board; European Polar Board; IASC; Intergovernmental Oceanographic Commission; International Permafrost Association	
A case study of the IASC	1997–2002	IASC conducted preliminary discussion on the fourth IPY.
	2003	IASC conducted considerable discussion on the fourth IPY.
	2004	The fourth IPY became one of the key issues on IASC's agenda.
	2005–2010	IASC representatives took active part in all meetings of the IPY Joint Committee and in the implementation of the fourth IPY.
IASC: International Arctic Scientific Committee; WMO: World Meteorological Organization Source: Krupnik et al., 2011.		

The WMO and its predecessor, the International Meteorological Organization (IMO), is the only international body to have initiated and organized all IPYs. Three International Polar Conferences (IPCs) took place before the first IPY was held. Nine individuals participated in the first IPC in 1879; four of them (Christophorus Buys Ballot, Elenthère Mascart, Henrik Mohn, and Georg Neumayer) were also members of the IMO, which was established at the International Meteorological Congress held in Rome the same year. The IMO was decided at the Rome congress to support Weyprecht's scientific enterprise pertaining to the polar regions. It was through the IMO that the first IPY could be successfully held. The International Council for Science and its predecessor, the International Council of Science Unions (ICSU), has also participated in initiating and organizing the IGY and the fourth IPY. The ICSU supported the IGY (Shadian and Tennberg, 2009), and it has managed to keep the focus on scientific planning and away from political aspirations (Davis and Patman, 2015). Since 2008, the International Council for Science has continued to promote follow-up efforts for the fourth IPY, including the 2012 International Polar Year Conference

(Yang, 2018).

The IASC, an intergovernmental organization established by the Arctic states in 1990, was significantly involved in the fourth IPY (Table 2). China joined the IASC in 1996, which provided a basis for China's first Arctic scientific expedition in 1999. The IASC's participation also brings inspiration to China's initiation and participation in the IPY in the future.

Non-governmental organizations, such as the UArctic and AIA, actively participated in implementing certain projects related to the fourth IPY. The UArctic IPY education and outreach program included various projects, which had different targets: primary and secondary students; undergraduate students; graduate students; early career scientists and university faculty; communities and the general public (Krupnik et al., 2011). Several Chinese universities and research institutes have joined the UArctic since 2013. As a permanent participant in the AC, the AIA was among the first organizations involved in social and human studies to respond to the call for projects related to the fourth IPY in winter 2004; one project in which the AIA was involved was the Bering Sea Sub-Network:

International Community-Based Observation Alliance for Arctic Observing Network (Krupnik et al., 2011). Among all permanent participants of the AC, the AIA has participated in the most projects.

Science diplomacy plays a unique role in promoting cooperation and resolving differences related to the polar regions. A concept that emerged in the 2000s, science diplomacy can be defined as using international scientific collaboration to address problems facing humanity in the twenty-first century and to build constructive global partnerships (Fedoroff, 2009). The Antarctic Treaty has been regarded as successful practice of science diplomacy

(Berkman et al., 2011). Table 3 presents the legal background to the signing of the Antarctic Treaty, and four groups of claims and differences are evident. For example, the claims of Argentina, Chile, and the United Kingdom overlap (Triggs, 1987). Accordingly, the United Kingdom filed the Antarctica Case at the International Court of Justice in 1955. As another example, the United States initially excluded the Soviet Union from participating in Antarctic governance; the Soviet Union said without its participation, it could not recognize as legal any decision regarding governance of the Antarctic (Berkman et al., 2011).

Table 3 Legal background to the signing of the Antarctic Treaty

Different groups	Relevant countries	Differences
First group	States claim territorial sovereignty in Antarctica: Argentina, Australia, Chile, France, New Zealand, Norway and the United Kingdom	Differences between the claimant states: the United Kingdom, Argentina and Chile
Second group	States did not recognize the claims made by seven other states, meanwhile reserved the right to proclaim their own sovereign rights in the future: the United States and the Soviet Union	Differences between the United States and the Soviet Union/Differences between the superpowers (the United States and the then Soviet Union) and the claimant states
Third group	Scientific purposes: Belgium, Japan	None
Fourth group	Economic purposes	None

Source: Barrie, 1975

The IGY provided an excellent opportunity for various countries to promote cooperation and resolve differences. It made two vital contributions to the eventual success of negotiations of the Antarctic Treaty. First, the Soviet Union was able to organize its Antarctic research program. Second, the Chilean proposal to suspend claims and focus on scientific cooperation proved practical (Bulkeley, 2010). Eventually, the United States invited 11 countries, including the Soviet Union, to sign the Antarctic Treaty. This treaty prevented Antarctica from becoming a site of future international conflict (Joyner and Theis, 1987). The Antarctic Treaty served the interests of the superpowers in securing access to the whole continent while exempting the region from the competitiveness of the Cold War (Young, 2010).

With the IGY, Antarctica entered the era of scientific observation. Since then, ever more countries have participated in Antarctic expeditions. By cooperating with such countries as Japan, the United States, and the Soviet Union, China built its first Antarctic station (Great Wall Station) in 1985 (Lee, 1990). The same year, China achieved the status of Antarctic Treaty Consultative Party (the original twelve Parties to the Antarctic Treaty and those Parties that demonstrate their interest in Antarctica by conducting substantial research activity there), and it has since acquired decision-making power over Antarctic affairs within the ATS (Zou, 1993). Thus far, the United States has been at the forefront in science diplomacy, which included establishing the Center for Science Diplomacy in 2008. The Center aims to build bridges between communities, societies, and nations through closer interactions between

science and diplomacy and elevate the role of science in foreign policy to address national and global challenges (American Association for the Advancement of Science, 2019). Since 2011, the Arctic states have signed three legally binding instruments under the auspices of the AC. The instrument concerning scientific cooperation is regarded as an example of science diplomacy in the polar regions, whereby the United States and Russia were able to conduct scientific cooperation in the Arctic despite the conflicts in Ukraine and Syria in 2010s.

3 China and the IPY

China carried out its first National Antarctic and Arctic Research Expedition in 1984 and 1999, respectively. Thus, China participated in the first three IPYs only through stations and observatories located within the country (Table 4).

China's participation in the IGY laid the foundation for the development of its polar activities. Former vice-president of the Chinese Academy of Sciences, Zhu Kezhen was the key figure for China's preparations for the IGY. In 1957, he observed that as a big country, China needed to study the polar regions. He suggested that Chinese students overseas should study polar science so as to engage in future polar scientific research. Following Zhu Kezhen's proposal, Xie Zichu was sent to Moscow University and become the first Chinese student to major in polar glaciers (Wu and Qian, 1994). China was deeply involved in the fourth IPY, from which the IPY National Committee for China was established. Two scientific

research projects (PANDA project in Antarctica and Arctic Change and its Tele-impacts on Mid-Latitudes in the Arctic)

have increased Chinese polar activities to an unprecedented level (Yang, 2012).

Table 4 China's stations and observatories in the first three IPYs

IPYs	Disciplines	Sites
The first IPY	Geomagnetism	Sheshan
The second IPY	Geomagnetism, solar radiation, longitude and latitude measurement, meteorology	Emei, Qingdao, Shanghai, Sheshan, Taishan
The IGY	Meteorology, geomagnetism, aurora observation, ionosphere, solar activities, cosmic rays, longitude and latitude measurement, seismology	A station near Tianjin, Beijing, Chongqing, Dongchuan, Ganzhou, Guangzhou, Haikou, Hankou, Kunming, Lanzhou, Lhasa, Manzhouli, Nanjing, Shanghai, Sheshan, Wuhan

Source: Launius et al., 2010

China achieved at least two breakthroughs in the fourth IPY. First, the PANDA (The Prydz Bay, Amery Ice Shelf and Dome A Observatories) project marked China's gradual shift in polar efforts. China began research on the Amery Ice Shelf in 2002, and it successfully reached the core region of Dome A in 2005. The Dome A region has enormous scientific value and has drawn worldwide attention (Key Lab. for Polar Surveying and Mapping Science, 2009). Dome A is the highest place on the polar ice cap, with an altitude of 4093 m, which is the best site for optical astronomical observation on earth (Li, 2020). Three of China's seven legacies of the fourth IPY are related to Dome A (Yang, 2012). China has played a leading role in initiating and implementing the PANDA project. Dong Zhaoqian, honorary director of the Polar Research Institute of China, presided over the drafting of the PANDA project (Huang, 2021). Other countries, such as Canada, Australia, France, Germany, Japan, Russia, South Korea, United States, United Kingdom have participated in the PANDA project (Drafting Group of IPY China Action Programme, 2007). For example, the PANDA traverse (an Antarctic inland expedition), successfully delivered PLATO (PLATEau Observatory) to Dome A in 2008. A large international team has contributed to PLATO and its instruments, with Iridium satellite communications having been provided by the United States Antarctic Program (Krupnik et al., 2011).

Second, through the Asian Forum for Polar Sciences (AFoPS), international efforts initiated by China have been involved in polar activities. Established in 2004, the AFoPS aims to encourage and facilitate cooperation for advancing polar sciences among Asian countries. China has long participated in polar activities through organizations initiated overseas, notably the Scientific Committee on Antarctic Research (SCAR), IASC, and AC. Members of the AFoPS, particularly China, India, Japan, South Korea and Malaysia, actively participated in the fourth IPY. During the fourth IPY, China, India, Japan, Malaysia, and South Korea established national IPY committees and set national IPY programs (Krupnik et al., 2011). In 2008, China's third Arctic scientific expedition

included 12 researchers from other countries, such as Japan and South Korea (Su and Mayer, 2018); that constituted an important part of China's program for the fourth IPY (Hong, 2020).

4 Discussion and conclusion

The IPYs developed over a long period, involving many different disciplines and a broad range of participation. Based on scientific advances and lessons of the fourth IPY, WMO Executive Council proposed to launch an International Polar Decade in 2008 as a long-term process of research and observations in polar regions (WMO-Roshydromet Workshop on International Polar Decade Initiative, 2011). Anton Vasiliev who was a Russia's former senior Arctic official has called for a fifth IPY in 2032–2033 (Vasiliev, 2021). SCAR has launched a survey called "International Polar Year 2032–2033" in which an ad hoc group (of mostly Arctic scientists) was considered the desirability and feasibility of planning for an International Polar Year in 2032–2033. These reflect the attention of the international community to the fifth IPY. I would like to make some suggestions for China's future participation in the fifth IPY.

First, China could initiate the fifth IPY. As noted above, the initial discussions of the fourth IPY can be traced back to the late 1970s, nearly 30 years before its official launching. Thus, China should focus on the fifth IPY as soon as possible and undertake initiatives. China could actively respond to related initiatives, for example, especially by taking advantage of the fact that Chinese scientist is currently serving as group leader of the SCAR. Chinese individuals who worked as chief scientists in the country's Antarctic and Arctic expeditions and who are involved with relevant international organizations, such as the WMO and the International Science Council (ISC, a combination of the International Council for Science and the International Social Science Council), could promote the fifth IPY. For example, two Chinese scientists (Sun Qizhen of the National Marine Environmental Forecasting Center and Yang Qinghua of Sun Yat-sen University) are members of the

Polar Prediction Project Steering Group (PPP-SG). The PPP-SG is a 10-year (2013–22) endeavor of the WMO World Weather Research Programme. As members of PPP-SG, those two scientists could discuss future polar cooperation under the framework of the WMO, including the fifth IPY. Chinese scientists who served in polar-specific and polar-related international organizations (e.g., Dong Zhaoqian as vice-president of the SCAR in 1992–96) could also make initiatives towards the fifth IPY (Xue and He, 2018).

Second, China could initiate more international projects. In Antarctica, China could initiate projects around the Dome A region. With the Arctic, new icebreakers from Japan and South Korea will come into operation over the next decade, thereby improving the Arctic expedition capability of Asian countries. China could jointly initiate such projects as the Multidisciplinary Drifting Observatory for the Study of Arctic Climate (MOSAiC) that conducted in 2019–20. MOSAiC was the first year-round expedition into the central Arctic to explore the Arctic climate, and it involved over 400 people from 20 countries. China and the United States could jointly initiate projects in social sciences and the humanities. The opening of the Arctic Research Center (ASC) of Liaocheng University (Liaocheng City is located in the west of Shandong Province) was announced in March 2018; the ASC focuses on Arctic anthropology, archaeology, history, and international relations. The research fields of the ASC are consistent with most of the projects in social sciences and the humanities conducted during the fourth IPY. Liaocheng University and the University of Alaska Fairbanks (UAF) established a cooperative relationship in November 2018, and the UAF was highly involved in the fourth IPY. As a member of the UArctic, Liaocheng University could make initiatives toward holding the fifth IPY in the form of related symposia in the near future.

Third, China could initiate international efforts to promote the fifth IPY, mainly through the AFoPS and China-Nordic Arctic Research Center (CNARC). The AFoPS could summarize its experience in participating in the fourth IPY, and on this basis, could more comprehensively and deeply participate in the fifth IPY. The AFoPS could learn from the IASC when involving the fifth IPY. The SCAR and IASC worked closely together as members of the IPY Joint Committee (2005–10), and they jointly sponsored the Open Science Conference in St. Petersburg, Russia in 2008 (Krupnik et al., 2011). In October 2021, representatives of the AFoPS, SCAR, and IASC renewed the Memorandum of Understanding among the three organizations to continue their cooperation on polar science and technology. Bilateral cooperation between the SCAR and IASC in the fourth IPY could expand to trilateral cooperation among the IASC, SCAR, and AFoPS for the fifth IPY. Asian countries could initiate further international polar programs through the AFoPS (Kim and Jeong, 2015). Established in 2013 with 18 member institutes, the CNARC is another international organization

initiated by China. One of the aims of the CNARC is to promote cooperation for sustainable development of the Nordic Arctic and coherent development of China in a global context. The CNARC could participate in the fifth IPY by cooperating with other international organizations, such as the European Polar Board.

Fourth, China could actively conduct science diplomacy. Today, the international situation for China's participation in polar affairs is more complex than it was in the 1980s and 1990s; thus, the polar regions could be regarded as a good practice area for science diplomacy. By concluding the Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean, China has substantially participated in making international law for the Arctic; however, it could improve such efforts by making the change from active participation to providing timely guidance. As with negotiating the Antarctic Treaty, China should make good use of science diplomacy in making international law in the polar regions. China should also focus on resolving differences with priority countries: South Africa, New Zealand, Australia, Chile, and Argentina in Antarctica and the United States, Russia, and Canada in the Arctic. All these countries could be regarded as gateways for Chinese Antarctic and Arctic expeditions. In that process, more cooperation between cities should be conducted as a useful means of promoting cooperation at the national level, such as the collaboration between Shanghai and Christchurch. As early as 1992, New Zealand expressed its good will to develop Antarctic cooperation with China through Christchurch.

Fifth, China could publicize its polar activities in different ways. The fifth IPY provides an opportunity for China to exhibit its polar activities abroad. For example, the general public could be invited to visit China's polar research vessels *Xuelong* and *Xuelong 2* when they dock at overseas ports, such as Cape Town, Christchurch, Hobart, Punta Arenas, and Ushuaia. China could also document its Antarctic and Arctic expeditions using such apps as TikTok and Kuaishou. China, for example, could conduct more live broadcasts in its polar research vessels and research stations, just like the Ice Stories: Dispatches from Polar Scientists in the fourth IPY, and expand to an overseas audience.

The original intention of the IPYs was to help people effectively understand the polar regions through international cooperation. Scientists have their own nationalities, but polar activities should strive for an absence of national boundaries. The IPYs are like a rich ancient book belonging to all humankind. The IPYs are important events linking China with the world. I firmly believe that China could make a good contribution to the fifth IPY.

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