· Opinion Editorial · Advances in Polar Science
doi: 10.12429/j.advps.2025.0013 June 2025 Vol. 36 No. 2: 89-94

5th International Polar Year (IPY-5) 2032–2033 with global inclusion

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Received 31 May 2025; accepted 13 June 2025; published online 30 June 2025

Abstract The 5th International Polar Year (IPY-5) 2032–2033 is the next step with the "oldest continuous climate research program created by humanity", which started in 1882–1883 with IPY-1 intentionally during a Solar Maximum after the "Little Ice Age" had impacted Europe across the previous four centuries. IPY-5 is a rare research opportunity to stimulate transdisciplinary initiatives with efficiencies and synergies that are relevant to all people and life on Earth pole-to-pole, across the cryosphere that includes high mountains on lands in between, connected by the atmosphere and ocean with Solar forcing across periods relevant to human survival. This editorial explores current and accelerating momentum to implement science with society across the International Decade of Sciences for Sustainable Development (IDSSD) 2024–2033 with IPY-5 as a guiding light.

Keywords **International Geophysical Year, transdisciplinary, climate, global, science diplomacy**

Citation: Berkman P A. 5th International Polar Year (IPY-5) 2032–2033 with global inclusion. Adv Polar Sci, 2025, 36(2): 89-94, doi: 10.12429/j.advps.2025.0013

1 International Polar Year (IPY) and planetary thinking across centuries

The 5th International Polar Year (IPY-5) in 2032–2033 is the next step with the "oldest continuous climate research program created by humanity" (Berkman, 2025), revealing pathways to operate across planetary boundaries (Rockström et al., 2024) over centuries. IPY-5 is being planned as an inclusive scientific process early next decade (IASC-SCAR, 2023, 2024). But, what is inclusion? What is science? What are the decadal actions? The purpose of this editorial is to share observations and inspire next-generation leaders — many of you who will be living in the 22nd century — learning global lessons during this transitional period in human history to contribute across the transdisciplinary interfaces of science with society for the benefit of all on Earth across generations.

This editorial also is a demonstration of the power that exists within the international science community to help humankind address its fears with hope. If we think it! We can build it!

IPY-1 in 1882–1883 was intentionally coordinated during a Solar Maximum as a planetary experiment with Earth-Sun connections (Table 1) in response to the "Little Ice Age" with concern about the "weather" that had negatively impacted health, economy and welfare of Europe across the preceding four centuries (Grove, 2004). Global concerns today about Earth's climate are the same, except we are looking into the future, motivated less by the past than during the 19th century. The common feature is time, addressing change, which is interpreted with natural sciences, social sciences and Indigenous knowledge — all of which reveal patterns, trends and processes that become the bases for decisions (albeit with different methods).

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Table 1 The International Polar Year (IPY) experiment

Characteristics	IPY-1	IPY-2	IPY-3*	IPY-4	IPY-5
	1882–1883	1932–1933	1957–1958	2007–2008	2032–2033
Solar activity	Solar Maximum	Solar Minimum	Solar Maximum	IHY**	Mid-Solar Cycle
Nations participating	11	40	67	60+	?
Disciplines	3	4	14	11	?
Observation distance from Earth	Ground-based	Balloon	Satellite	Satellite	Solar System (proposed herein)
Geographic focus	Arctic and Antarctic	Arctic and Antarctic	Earth System	Arctic and Antarctic	Pole-to-Pole (proposed herein)
International security issue	"Weather"	Radio	Satellites***	Polar	Climate (proposed herein)

Notes: * Renamed the International Geophysical Year (IGY).

** Earth-Sun connections were part of the International Heliophysical Year (IHY) in 2007. Considering IGY connections, there also was a separate Electronic Geophysical Year (eGY) 2007–2008.

*** First International Decade was introduced in 1961, following the IGY.

Adapted from Berkman (2003, 2020a, 2025).

IPY-2 in 1932–1933 was during a Solar Minimum, extending the Earth-Sun experiment into the 20th century, which was continued during a Solar Maximum again with IPY-3 that was renamed the International Geophysical Year (IGY) in 1957–1958 (Table 1). As a source of enduring inspiration, the IGY was dreamed during a dinner party in 1950 at the home of James Van Allen an astrophysicist with Sydney Chapman a geophysicist and Lloyd Berkner an engineer (Korsmo, 2007). As Berkner (1954) noted:

"Tired of war and dissension, men of all nations have turned to 'Mother Earth' for a common effort on which all find it easy to agree."

The IGY introduced Earth System Science (Steffen et al., 2020) with global leadership of the World Meteorological Organization (WMO) and International Council of Scientific Unions (ICSU), especially its Comité Spécial de l'Année Géophysique Internationale (CSAGI) and Special Committee on Antarctic Research that evolved into the Scientific Committee on Antarctic Research (SCAR).

Many scientific discoveries during the IGY have lasting value for humanity. The Van Allen (1959) radiation belts underscore dynamics of Earth's magnetosphere and space weather with the Solar wind, impacting critical electronic operations during our digital era. Pioneering measurements of the polar ice sheets (Bentley et al., 1960) and marine sediments remain central to understanding Earth's sea-level seesaw, undulating with ice volumes across Earth's cryosphere during cold and warm climate periods. Ice cores from Greenland and Antarctica (Langway, 1958, 2008) opened the door to high-resolution records of Earth's atmosphere across millennia with variability during Milankovitch cycles and in view of anthropogenic impacts, especially since the Industrial Era, which began around 1800 when the first billion people were alive at the same time. The Keeling (1960) "curve" produced from Antarctica and Hawaii demonstrates Earth's seasonal breathing, with ongoing necessity for coordinated global observations from the IGY forward to understand current and future climate dynamics during the Anthropocene.

The IGY was groundbreaking with technological innovations that have lasting import for the welfare of all on Earth. The first human-designed satellites were intentionally launched during the IGY by agreement with the United States and Soviet Union, as reflected by the first United States space policy (Berkman et al., 2011), opening the door to unparalleled synoptic capabilities with Earth observing systems. The IGY led directly to the first International Decade convened by the United Nations in 1961 (Berkman, 2025), planning science with society across longer periods. The IGY also awakened shared data management on a global scale, among allies and adversaries alike, with the system of World Data Centers (WDC) that has continued to evolve, amplified by the Committee on Data (CODATA) since 1966. At local-to-global levels, data is central to disaster risk reduction and management (UNDRR, 2025) short-to-long term.

Among its central contributions across the IPY experiment (Table 1), the IGY was as an unambiguous demonstration about the necessity of "scientific alliance in a divided world" (Sullivan, 1958), with world leaders understanding firsthand the horrors of world wars preceded because of nationalism in the 20th century. The concept of science for "peaceful purposes only" is "forever" memorialized with the 1959 Antarctic Treaty (Berkman, 2009). Moreover, the Antarctic Treaty became the first nuclear arms agreement — enabled by "matters of common interest" among superpower adversaries — emphasizing:

"Cooperation on the basis of freedom of scientific investigation in Antarctica as applied during the International Geophysical Year accords with the interests of science and the progress of all mankind."

These IGY lessons were explored with the Antarctic Treaty Summit (2009) as a project of IPY-4 in 2007–2008, leading to the first book on science diplomacy (Berkman et al., 2011). The lessons with science diplomacy (Berkman et

al., 2017) can continue to be elaborated from paper to practice — building common interests among allies and adversaries alike — as applied in 2010 with the first formal dialogue between the North Atlantic Treaty Organization (NATO) and Russia regarding security in the Arctic (Berkman and Vylegzhanin, 2013). IGY achievements during the peak heat of the Cold War offer lessons with currency today.

With many contributors around the world, science diplomacy has been accelerating as a transdisciplinary field, leading to the first Global Ministerial Dialogue on Science Diplomacy, which was convened by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in March 2025. This progress of science with society, in part, is attributable to IPY-4 contributions (Krupnik et al., 2011; National Research Council, 2012), integrating social sciences and Indigenous knowledge with Earth System Science, especially with next-generation leadership exemplified by the Association for Polar Early Career Scientists (APECS).

2 IPY-5 planning and implementation intersections

IPY-5 is now being planned, "striving for holistic, systemic, transdisciplinary research approaches", but with a timeline since IPY-4 (IASC-SCAR, 2023, 2024), which is unnecessarily short compared to the amplified timeline extended to the IGY (Berkman, 2025). Explicit consideration of Earth-Sun connections was absent with IPY-4 unlike preceding IPY (Table 1). There also was a separate Electronic Geophysical Year in 2007–2008 (eGY, 2008), missing global data connections with the IGY. How can IPY-5 include "forever" lessons and datasets as well as research programs, networks and institutions that were initiated with the IGY, which is the central step literally and figuratively in the IPY experiment across centuries (Table 1)?

The conventional approach would be to resolve the conflict between the two competing timelines, but there is a more powerful approach to recognize both research timelines have a common interest in the success of IPY-5 in 2032–2033. IPY-5 is being planned as an inclusive process with an Executive Committee comprised of SCAR and WMO as well as the International Arctic Science Committee (IASC) founded in 1990 and the International Science Council (ISC) formed in 2018 through the merger of ICSU with the International Social Sciences Council (ISSC). IPY-5 also involves a Planning Group currently comprised of 30+ international organizations, including APECS, with an open call for international organizations to join in planning the research campaigns during 2032–2033.

The IPY-5 workshop convened in May 2025 by the National Academies (2025) in the United States is an early example of outreach and engagement, setting a high bar for the international leadership structure of IPY-5 to inspire questions with inclusion (who, what, when, where, why and how) as the essence of knowledge discovery with this "next step in the oldest continuously climate research program created by humanity". The inclusive opportunity is to develop synergies with implementation before-through-after IPY-5 in 2032–2033 as an inflection point with informed decisionmaking (Berkman, 2020b).

There are significant head winds, however, truly testing the capacities of science inclusively (natural sciences, social sciences and Indigenous knowledge) to operate with society on a planetary scale across time. The inclusion with Open Science (UNESCO, 2020) — which is akin to the freedom of speech as a public good — is being undermined by short-sighted national leaders who are operating by fiat without dialogues to build common interests. As a consequence, attitudes and investments in global cooperation, as with climate research, are vacillating with science struggling to provide the necessary continuity and resilience independent of geopolitics across our world. Hope exists, however, in recognizing the IPY experiment (Table 1) has transcended two world wars across a "continuum of urgencies" initiated by the international polar research community in 1882–1883.

Such continuity short-to-long term comes from being open with each other in view of research methods that are independent of geopolitics, shared with education to empower next-generation leadership on a planetary scale. Evolution of the polar regions has global impacts, which has been understood since IPY-1 following the "Little Ice Age".

With "science as a global public good" (Boulton, 2021), there is forever necessity to build with developed and developing nations together on planet Earth. Such common-interest building extends with pole-to-pole research across the cryosphere from Antarctica to the Arctic, including the Third Pole (Yao et al., 2012), and emphasizing science with society across the spectrum of subnational-national-international jurisdictions (Berkman et al., 2022). With global considerations (Tang, 2022):

"Scientists have their own nationalities, but polar activities should strive for the absence of national boundaries. The IPYs are like a rich ancient book belonging to all humankind."

This imagination is inclusive, as with the United Nations (2024d) Pact for the Future, seeking to overcome the dilemma that nations will always think in view of national interests first and foremost on Earth and across our Solar System (Table 1). Success of IPY-5 is tied to balancing national interests and common interests North and South.

3 Triangulating past, present and future

Like the IGY, which stimulated emergence of International Decades, IPY-5 can awaken the "first International Century" (Berkman, 2025), presumably sometime during the 21st century. In the spirit of the IPY

experiment (Table 1), this presumption is testable, understanding that "informed decisions" operate across a "continuum of urgencies" — which is from security-to-sustainability time scales for peoples, nations and our world — unlike "uninformed decisions" that only operate at a moment in time (Berkman et al., 2022).

The frequency of International Decades has increased during and after the Cold War (Berkman, 2025), which is hopeful, suggesting international decisionmaking is becoming increasingly informed. "Relevant International Decades" are part of the formal IPY-5 planning (IASC-SCAR, 2023, 2024), highlighting international scientific cooperation and parallel planning with the Fourth International Conference on Arctic Research Planning (ICARP IV) coordinated by IASC (2025). With synergies, IPY-5 also is part of the planning with an increasing number of International Decades (UNESCO, 2025a), as reflected by the United Nations Decade of Ocean Science for Sustainable Development (UNDOS) 2021–2030 (UNESCO, 2025a).

In view of "holistic, systemic, transdisciplinary research approaches"— consider the temporal system of International Decades, Years, Weeks and Days that have been formally designated by the United Nations (2024a, 2024b, 2024c) to address diverse societal issues. Strategically chaining these ongoing as well as historical efforts ensures continuity and maximizes their impact — as an open-ended "Time Accordion Puzzle" for individuals and institutions to frame questions that lead to research discoveries based on resources that have already been allocated.

Questions to investigate with this temporal system are as varied as the targets and indicators with the seventeen United Nations Sustainable Development Goals — noting the International Decade of Sciences for Sustainable Development (IDSSD) 2024–2033 ends the same year as IPY-5 (UNESCO, 2025b). As a source of synergy, the cohort of ISC (2023) Fellows emerged at a "critical moment for science and sustainability for science as we enter the UN's International Decade of Sciences for Sustainable Development (IDSSD) in 2024".

The Time Accordion Puzzle is illustrated in relation to water – which is the primary driver of Earth's climate in its liquid, solid and gas phases — by the first World Day for Glaciers on 21 March 2025. This year also is the International Year of Glacial Preservation 2025, which is during the Decade of Action for Cryospheric Sciences 2025–2034. Collapsible-expandable, these three International periods were integrated by the Next-Generation Science Diplomat Committee with the University of the Arctic (UArctic) Thematic Network on Science Diplomacy in a webinar — "First World Day for Glaciers (21 March 2025): Planning Toward the 5th International Polar Year (IPY-5) 2032–2033" — which generated nearly 20000 viewers (Middleton et al., 2025). The World Day for Glaciers is a repeatable annual event to ask questions, share observations and build momentum toward IPY-5 as well as to pursue legacies afterward toward IPY-6 later this century.

Similarly, as an egalitarian case-study with research-into-action, the Global Indigenous Youth Summit on Climate Change (GIYSCC) emerged from the 2022 UArctic Assembly to become an annual event on 9 August, which is the International Day of the World's Indigenous Peoples (Sogbanmu et al., 2023). This "virtual dialogue by, for and among Indigenous youth with global inclusion" has been underway during the International Decade of Indigenous Language (IDIL) 2022–2032, noting GIYSCC-2023 and GIYSCC-2024 involved over 2100 registrants from 136 nations representing more than 285 languages. Success of GIYSCC is because the Indigenous youth leaders have been inclusive globally in framing the agenda and invitations with their ongoing dialogue, resonating with lessons to implement before, during and after IPY-5 in 2032–2033.

The power of Earth system modelling already allows us to see out to 2200 (Goelzer et al., 2020) and even 2300 (Seroussi et al., 2024), directly as an outcome of the IPY experiment over the past 150 years (Table 1). The cryospheric parameters that can be studied with IPY-5, including with the Third Pole, are essential to understand the Earth system across planetary boundaries with climate processes, patterns and trends that will impact generations living today into the 22nd century onward. Emanating with questions from a 1981 winter-over SCUBA research expedition in McMurdo Sound when I was 22 (Berkman, 2002; Guinness World Record, 1981) — my hope is IPY-5 will inspire, engage and empower next-generation Earth system scientists (Steffen et al., 2020), stimulating visionary research-into-action for the benefit of all on Earth and across our Solar System.

Acknowledgments With appreciation, this editorial was invited by Dr. Yeadong Kim (Co-Editor-in-Chief of *Advances in Polar Science*), following the *Cambridge Prisms* publication earlier this year. I thank Dr. Ruibo Lei, Editor-in-Chief and Dr. Yeadong Kim for their valuable comments as well as the UArctic Next-Generation Science Diplomat Committee for their inclusive collaboration.

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