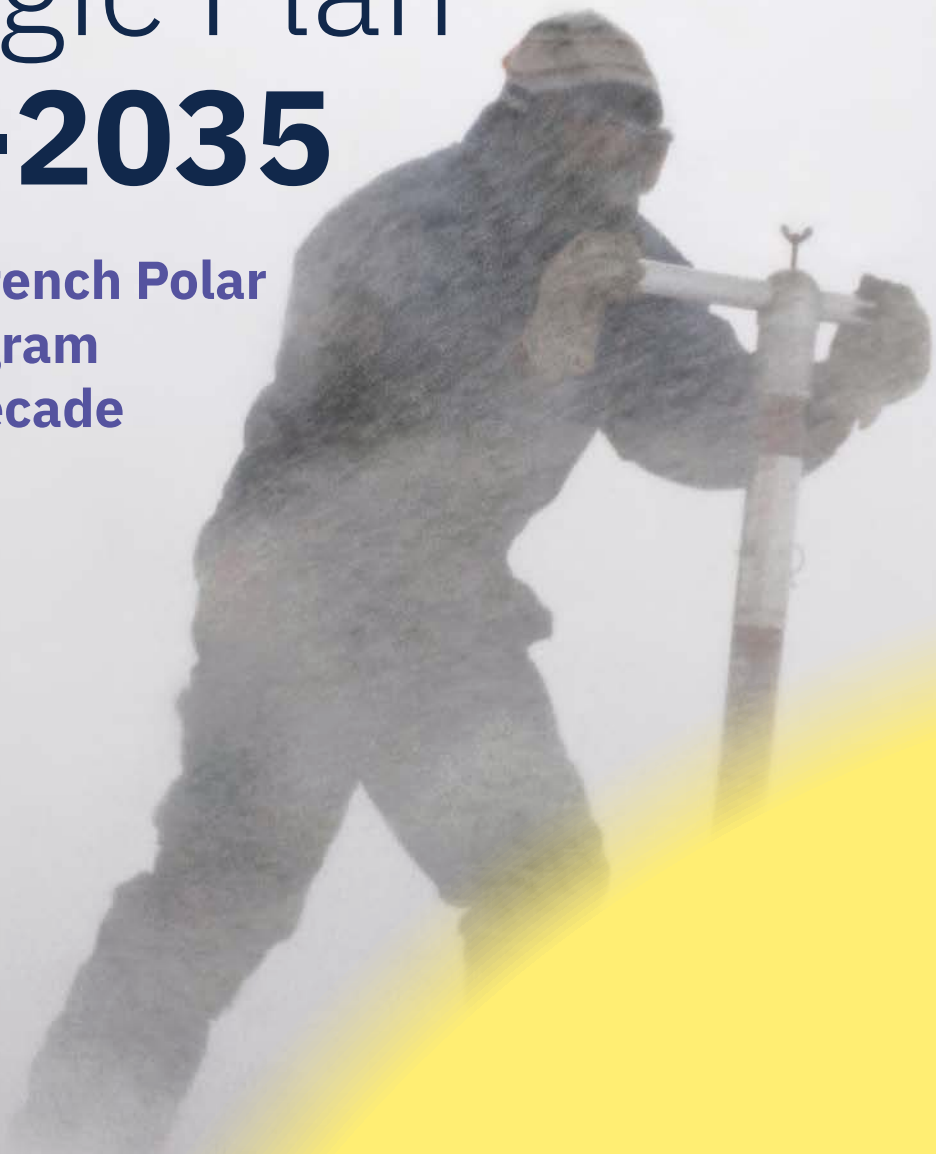
French Polar Research Strategic Plan **2025-2035**

Delivering a French Polar Research Program for the next decade

SUMMARY



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CLIMATE, BIODIVERSITY AND SUSTAINABLE SOCIETIES RESEARCH PROGRAMMING AGENCY

Forward

In 2022, the French Polar Strategy outlined a commitment by the government to develop a major research programme focused on the polar regions, addressing the climate, environmental, geopolitical, and societal challenges unique to these regions. The French Polar Research Strategic Plan—shaped by the French national scientific community—is presented in this document. This Strategic Plan is the result of a collective and interdisciplinary work coordinated under the leadership of the CNRS and its partners. The ambition to establish a French Polar Research Strategic Plan gained strong political backing during the *One Planet Polar Summit*, held in Paris in November 2023, where the President of France pledged financial support for the initiative. The programme's proposed budget of 100 million euros over ten years—endorsed by the scientific community—fits within the broader national investment of one billion euros planned by 2030. This includes the renovation of French Antarctic stations, the commissioning of a new research vessel, ongoing infrastructure investments, and dedicated support for scientific research. The purpose of this summary is to translate this vision into actionable priorities, helping to structure French polar research into a coherent, interdisciplinary program that has a key focus on international collaboration. This is particularly relevant in the context of major upcoming initiatives such as the World Decade of Cryospheric Sciences (2025–2034), the 5th International Polar Year (2032–2033), and the Antarctica InSync program.

Olivier Poivre d'Arvor, French Ambassador for the Poles and Maritime Issues

Introduction

Commissioned by the French Ministry of Higher Education and Research, the French Polar Research Strategic Plan was developed by the partners of the french research programming agency and represents the outcome of a six-month collaborative effort involving leading scientific experts in the field.

The plans outlined in this document are designed to support France's long-term polar research ambitions and to uphold the international leadership that French polar science has demonstrated for decades. The challenges are complex —scientific, logistical, and diplomatic—and require coordinated, strategic planning.

This plan has several key goals: to propose ambitious interdisciplinary scientific programmes; to enhance the logistical capacity of the national polar operator, IPEV, and to identify priority investments for enhancing infrastructure both at research stations and at sea.

Bringing these ambitious yet achievable proposals to life will require a sustained, multi-year commitment from the French government. If realized, this effort will firmly establish France as a global leader in polar science, well-positioned for the upcoming International Polar Year in 2032.

Antoine Petit, CNRS Chairman and CEO and President of the french research programming agency Climate, Biodiversity and Sustainable Societies

Inland lake formed in northeastern Greenland by the melting of the ice cap
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Summary

The Poles: Accelerating Changes with Global Consequences

The polar regions are undergoing rapid and unprecedented changes driven by climate change and increasing human activity, with major consequences for ecosystems, local populations, and the global climate system. These changes—unfolding faster than previously anticipated—highlight the urgent need to intensify research efforts to better understand their evolution and impacts.

The Arctic is warming three to four times faster than the global average, triggering accelerated melting of the cryosphere, a surge in wildfires (such as those seen in Canada in 2023), and shifts in the water and carbon cycles that directly affect ecosystems. **In Antarctica, the dramatic retreat of sea ice since 2016** signals a sudden and significant shift in the southern polar environment. An example of the ecological crises now accompanying climate change is the recent spread of the highly pathogenic avian influenza virus to bird and marine mammal colonies in both Subantarctic and Arctic regions.

These changes have global repercussions. **Sea level rise is accelerating** due to the melting of glaciers in Greenland and Antarctica, as well as the accumulation of ocean heat—half of which is stored in the Southern Ocean. Most observed changes are happening earlier and **more rapidly** than expected, pointing to the pressing need for enhanced research to better understand and predict these changes.

In light of these challenges, **an integrated scientific approach across the Arctic,** Subantarctic, and Antarctic regions is essential. This must combine **modeling, observations, and Indigenous knowledge.** The goal is to develop adaptation and preservation strategies at every level—local, national, and international—based on strengthened scientific cooperation.

River draining a lake formed on the surface of Zachariæ Isstrøm.
© Romain MILLAN / Anders Anker BJØRK / GE / University of Copenhagen / CNRS Images

The Geopolitical Challenges of the Changing Poles within a Global Context

The changes in the polar regions are taking place within a complex geopolitical framework where environmental, economic, and strategic issues are intertwined. In this context, scientific diplomacy plays a crucial role.

The poles lie at the heart of major international agreements, such as the Paris Agreement on climate change and the Kunming-Montreal Global Biodiversity Framework. However, rising tensions among global powers are putting international cooperation to the test. The war in Ukraine has led to a suspension of French and European scientific collaborations with Russia, while uncertainty looms over U.S. climate and environmental policy and the future direction of American polar research.

The Arctic has long been a strategically important region, with intersecting economic and military interests. Today, Arctic economic and military considerations are intensifying, driven by competition over the exploitation of natural resources—particularly rare earth elements—and renewed geopolitical interest in controlling shipping routes becoming more accessible due to sea ice loss. The United States is increasing its presence in the region, applying growing pressure on Canada and Greenland, and advancing plans to expand resource extraction in Alaska. An opportunity is emerging for France and Europe to build a shared vision with their partners for sustainable management and greater geopolitical stability in the Arctic.

The Antarctic Treaty, a cornerstone for the protection of this unique region, is also facing growing pressure. These pressures raise critical questions about the future governance of the region. Moreover, the expansion of tourism and resource exploitation activities led by private actors further exacerbates existing tensions. Finally, the emergence of polar geoengineering debates—centered on proposals to manipulate the climate to slow polar warming and ice loss—raises profound ethical and geopolitical concerns. Who would be entitled to carry out such interventions, at what cost, and under which governance frameworks? What would be the potential consequences and risks?

History has shown that scientific cooperation is an important instrument for peace and international relations, even in times of political conflict. For instance, certain exchanges persisted during periods of the Cold War. Today, more than ever, scientific diplomacy stands out as a vital instrument to safeguard peace and stability in the polar regions, while building resilience to the ongoing and future climate, environmental, and societal challenges.

Detail of an iceberg © Erwan AMICE / LEMAR / CNRS Images

A vision for French participation in the International Polar Year **2032–2033**

The UN Decade of Ocean Science for Sustainable Development, the Decade of Action for Cryosphere Science, and the upcoming International Polar Year are key initiatives that offer significant opportunities to strengthen cooperation and intensify research in polar regions.

Since 1882, International Polar Years (IPY) have marked major milestones in polar science. The fifth IPY (IPY-5, 2032—2033) will provide a unique opportunity to advance research on the polar regions, improve our understanding of their transformations, and reinforce the links between science, society, and policy. While IPY-5 will culminate in 2032—2033, preparations are already underway through initiatives such as the Decade of Action for Cryosphere Science and the Antarctica InSync program (2027—2030), which will be a key international contribution. IPY-5 and its associated programs represent a rare opportunity for France to take a leading role in polar research, influence international decision-making, and strengthen its commitment to protecting the polar regions and the global climate and ecosytems.

In parallel, the United Nations is advancing several major initiatives to better understand and protect the polar regions:

- **The UN Decade of Ocean Science** for Sustainable Development (2021—2030) highlights the critical role of polar oceans in regulating climate and biodiversity.
- **The Third United Nations Ocean Conference (UNOC)** to be held in France in June 2025, will be an important moment to reinforce international cooperation on ocean-related challenges.
- **The Decade of Action for Cryosphere Science** (2025-2034) focuses on glacier melt, sea-level rise, the impacts of permafrost thaw on the climate, and the effects on ecosystems and societies. It aims to improve polar monitoring, develop adaptation solutions, and raise awareness of the risks associated with the collapse of the cryosphere.

Boreal forest landscape with lakes formed by permafrost thaw (Yakoutie Centrale, Sibérie)
© Antoine Séjourné, Université Paris - Saclay

Strengthening the French Contribution to Global Polar Research

French polar research stands out on the international stage for its scientific excellence, interdisciplinary scope, and strong international collaborations. However, to ensure long-term impact and increase its global influence, it is essential to strengthen coordination within the French polar research community.

Ice coring at Concordia station
© Claude DELHAYE / IPEV / CNRS Images

France currently ranks 8th worldwide in terms of scientific publications on polar regions. The CNRS plays a pivotal role by structuring research efforts and providing strong international visibility, ranking as the second-highest institute globally in terms of polar research publications. French universities are key polar research partners and are also deeply engaged in training new generations of polar researchers.

To sustain and amplify the role of the French community in polar research, enhanced coordination within the French polar research community is needed. The establishment of a dedicated national forum is recommended to:

- **bring together** academic and institutional stakeholders
- **structure interactions** with national and international bodies
- **address** ethical considerations
- **guide** funding strategies
- **support** education and scientific outreach

Such a collaborative platform would help to more effectively represent French polar research internationally and maximize its influence in addressing major climatic, environmental, societal, and geopolitical challenges.

The Logistical Challenges of Polar Research

Infrastructure is central to polar research, which depends on organized access to remote regions, well-equipped research stations, reliable transportation, and strong international collaborations. Reinforcing access to the polar regions requires sustained support for national infrastructures, which form the foundation of international partnerships based on sharing and exchanging access. France is committed to remaining an active contributor to international cooperation in polar research through support of our Polar research infrastructures.

In the Arctic, research relies primarily on collaborations with Arctic nations and Indigenous communities, whereas in Antarctica and the Subantarctic, France maintains access to key regions through the operation of its own research infrastructures, which provide support for scientific research activities.

In the Arctic, field campaigns are conducted using partner stations and local infrastructures through international cooperations, including the French-German AWIPEV station in Svalbard. As France does not have its own maritime transport capacity in the Arctic, it depends heavily on ice-capable vessels or icebreakers operated by partner countries. Expanding bilateral and multilateral scientific cooperation is essential to improve access to study sites and to optimize the sharing and joint use of international infrastructure. For disciplines that share transport infrastructure with local populations, financial commitments must reflect the high logistical costs involved, which remain significant.

In the Subantarctic, access is primarily provided by the *Marion Dufresne* vessel, which serves both scientific and logistical missions. **Its planned decommissioning around 2032 and the provision of successor capabilities for both roles represent a critical issue.** Coastal vessels are also essential, particularly at Kerguelen and Amsterdam Islands, where the reconstruction of certain facilities will be required following the 2025 fire.

In Antarctica, logistical operations are centered around a supply route linking the *Dumont d'Urville, Robert Guillard, and Concordia* stations, supported by overland transport systems. **The aging *Dumont d'Urville* station will require complete reconstruction by 2050.** Strengthening multidisciplinary observation capacity—through the proposed *Navire Semi-Hauturier Pacifique-Antarctique (NSH PA)* and/or through international agreements—is crucial for advancing French polar science and maintaining France's presence in East Antarctica. International cooperation will be key to accelerating the implementation of these strategic objectives.

ASUMA traverse convoy in the middle of the Antarctic continent
© Bruno JOURDAIN / IGE /CNRS Image

IPEV: A Pillar of the Future of French Polar Research

The French Polar Institute Paul-Émile Victor (IPEV) is a central institution supporting French and international polar research. There is an urgent need for increased funding for IPEV within France. IPEV is essential for French polar research activities and the international cooperations that depend on these infrastructures.

Following in the footsteps of the French Institute for Polar Research and Technology (IFRTP), founded in 1992, IPEV was established in 2002. Each year, it supports between 70 and 90 research projects, ensuring access to extreme environments and enabling the collection of critical data. IPEV plays a key role in the long-term observation of polar environments, helping to anticipate ongoing climate and ecological changes. It also contributes significantly to the funding of research in the humanities and social sciences. Internationally, **IPEV serves as a cornerstone of polar cooperation,** partnering with many countries through the sharing of infrastructure and technical expertise.

However, IPEV now faces major challenges, including rising operational costs, the urgent need to modernize infrastructure, and the growing demand for innovation. Securing long-term support for IPEV is crucial to maintaining France's active role in international polar research and to meeting the evolving scientific and logistical needs of this rapidly changing field. **The Strategic Plan includes a call for stabilizing IPEV and ensuring its stability** both for the French and global polar science communities.

Adélie penguin colony at the Dumont d'Urville station, Antarctica
© Bruno Jourdain / IPEV / LGGE / CNRS Images

Arctic, Subantarctic, and Antarctic

15 Scientific Challenges in the Face of Climate and Environmental Change

Arctic

Arctic Societies: Past, Present, and Future

Nearly four million people live in the Arctic, around 10% of whom belong to Indigenous communities. In addition to the ongoing consequences of colonial policies that Indigenous peoples have had to face—and continue to confront—climate change has emerged in recent decades as another major challenge. It not only threatens the habitats and subsistence activities of Arctic residents, as well as the preservation of archaeological heritage, but also fuels the interest of industries and states due to easier access to underground resources and new maritime routes. Understanding the Arctic requires understanding the past and present lives and perspectives of its inhabitants, as well as the current and future challenges they face—and how they respond to them. This calls for the study of topics such as heritage, circulation and mobility, Indigenous knowledge of the environment and its changes, religious dynamics, Indigenous youth, and governance issues at all scales, all within a co-constructed research approach.

Arctic Amplification: A Regional Phenomenon with Global Impacts

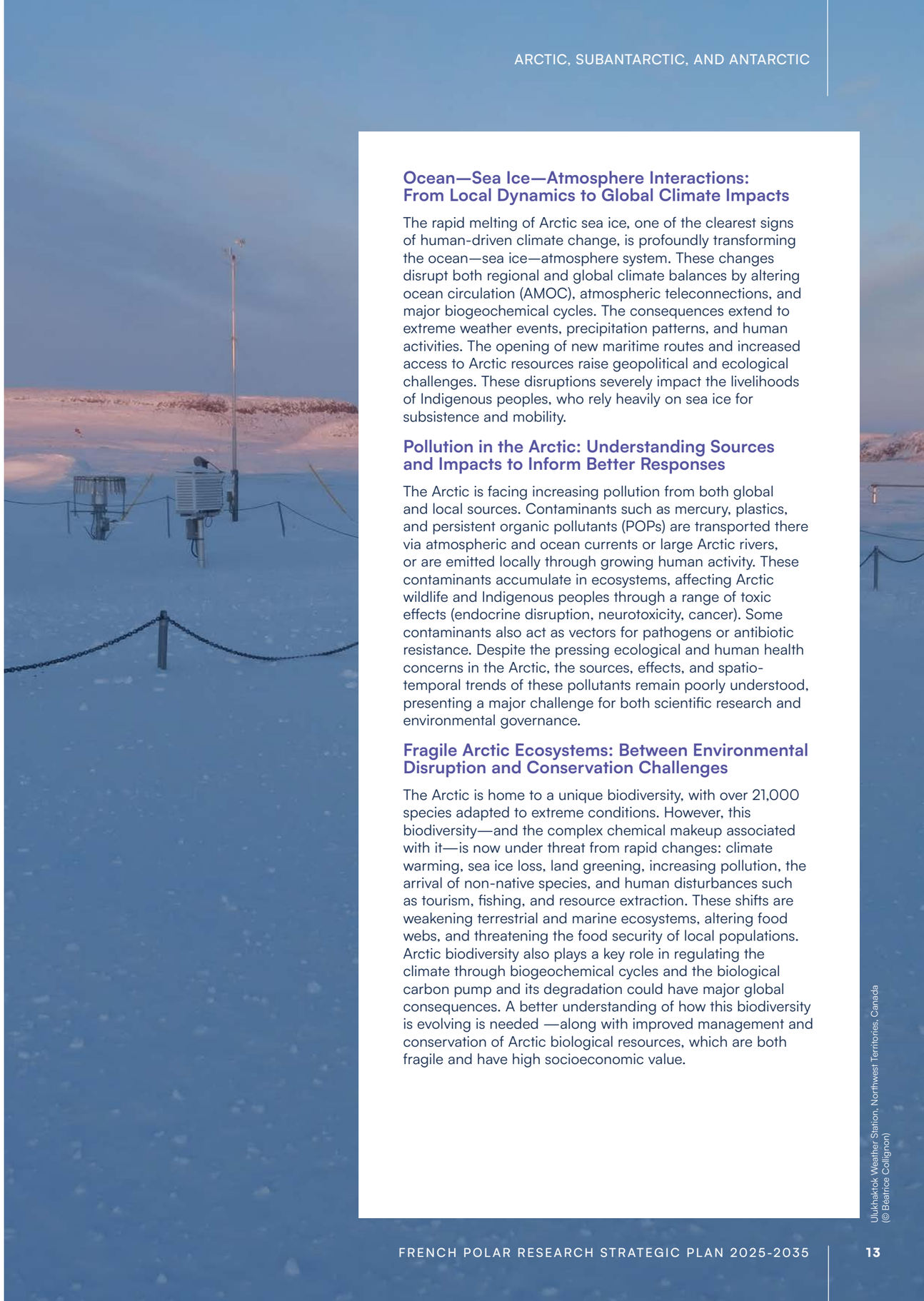
The Arctic is warming nearly four times faster than the rest of the globe, leading to a series of major transformations: sea ice and glacier melt, permafrost thaw, changes in albedo, increased wildfires, and biogeochemical disruptions. This phenomenon, known as Arctic amplification, is driven by complex feedbacks between the ocean and atmosphere involving snow, ice, clouds, and aerosols. These changes influence global climate dynamics, particularly through heat and water vapor exchanges. Gaining a better understanding of the mechanisms and interconnections behind this amplification is crucial for improving climate models and anticipating global impacts.

Permafrost Thaw and Accelerated Melting of Greenland: Climate Feedback Mechanisms, Environmental and Societal Impacts

Arctic amplification is profoundly transforming the water cycle and polar land surfaces. The decline in snow cover and the rapid thawing of permafrost are altering hydrological connectivity, river regimes, and causing erosion. Permafrost thaw, as a vast carbon reservoir, leads to increased greenhouse gas emissions (CO_2, CH4), threatening to further amplify global warming. These dynamics impact infrastructure and resources of local populations. Furthermore, the accelerated melting of the Greenland ice sheet, driven by warming, will result in a significant rise in sea level. Understanding and anticipating these changes is crucial for global climate and societal stability.

Understanding the Land-Sea Continuum in the Arctic: A Key Challenge for Studying Cryosphere—Biosphere—Human Society Interactions

The land-sea continuum in the Arctic—a transitional zone between the continent, ocean, and cryosphere—is undergoing profound changes due to accelerated climate warming. These transformations affect sea ice, ocean stratification, nutrient inputs, material fluxes, and marine ecosystems, with major impacts on biogeochemistry, biodiversity, health, the economy, and the cultural heritage of Arctic societies. Indigenous knowledge, rooted in intergenerational observation, must be integrated into studies through co-constructed approaches to understand the dynamics of these complex environments and to apply sustainable research and management strategies.



Ululkhaktok Weather Station, Northwest Territories, Canada (© Béatrice Collignon)

Ocean—Sea Ice—Atmosphere Interactions: From Local Dynamics to Global Climate Impacts

The rapid melting of Arctic sea ice, one of the clearest signs of human-driven climate change, is profoundly transforming the ocean—sea ice—atmosphere system. These changes disrupt both regional and global climate balances by altering ocean circulation (AMOC), atmospheric teleconnections, and major biogeochemical cycles. The consequences extend to extreme weather events, precipitation patterns, and human activities. The opening of new maritime routes and increased access to Arctic resources raise geopolitical and ecological challenges. These disruptions severely impact the livelihoods of Indigenous peoples, who rely heavily on sea ice for subsistence and mobility.

Pollution in the Arctic: Understanding Sources and Impacts to Inform Better Responses

The Arctic is facing increasing pollution from both global and local sources. Contaminants such as mercury, plastics, and persistent organic pollutants (POPs) are transported there via atmospheric and ocean currents or large Arctic rivers, or are emitted locally through growing human activity. These contaminants accumulate in ecosystems, affecting Arctic wildlife and Indigenous peoples through a range of toxic effects (endocrine disruption, neurotoxicity, cancer). Some contaminants also act as vectors for pathogens or antibiotic resistance. Despite the pressing ecological and human health concerns in the Arctic, the sources, effects, and spatio-temporal trends of these pollutants remain poorly understood, presenting a major challenge for both scientific research and environmental governance.

Fragile Arctic Ecosystems: Between Environmental Disruption and Conservation Challenges

The Arctic is home to a unique biodiversity, with over 21,000 species adapted to extreme conditions. However, this biodiversity—and the complex chemical makeup associated with it—is now under threat from rapid changes: climate warming, sea ice loss, land greening, increasing pollution, the arrival of non-native species, and human disturbances such as tourism, fishing, and resource extraction. These shifts are weakening terrestrial and marine ecosystems, altering food webs, and threatening the food security of local populations. Arctic biodiversity also plays a key role in regulating the climate through biogeochemical cycles and the biological carbon pump and its degradation could have major global consequences. A better understanding of how this biodiversity is evolving is needed —along with improved management and conservation of Arctic biological resources, which are both fragile and have high socioeconomic value.

Subantarctic

Understanding, Observing, and Modeling a Key Region in Transition: Synergies Between Climate Modeling and Atmospheric Observations

Climate warming is significantly altering the atmosphere of the southern mid-latitudes and the Subantarctic region, where there are the strongest westerly winds on the planet. These rapidly evolving winds play a central role in isolating Antarctica, transporting moisture to the ice sheet, and driving weather conditions. The variability of winds and their impacts are still poorly understood, due to limited historical data and uncertainties in their representation within models. This uncertainty undermines both regional and global climate projections. The Subantarctic marine atmosphere, closely linked to the Southern Ocean, influences cloud formation — a key factor for the global climate — which remains poorly represented in climate simulations.

Understanding the Subantarctic Southern Ocean: Circulation, Biogeochemistry, and Marine Ecology in a Changing Climate

The Subantarctic Southern Ocean plays a crucial role in regulating the global climate, shaped by the Antarctic Circumpolar Current and the meridional overturning circulation. It absorbs about 70% of the heat and 40% of the anthropogenic carbon taken up by the oceans, while redistributing nutrients essential for biological productivity. Over the past 50 years, this region has been experiencing warming, a deepening of the summer mixed layer, and increasing acidification. These changes—driven by climate forcing and the intensification of westerly winds—are already affecting the structure and dynamics of phytoplankton, altering the carbon cycle and marine food webs.

Threats to Biodiversity: Invasive Species, Epidemiology, Contaminants, and Warming

The French Subantarctic islands, rich in biodiversity and home to the world's second-largest marine protected area, are facing increasing pressures. Warming, acidification, and the intensification of extreme events are already disrupting island and marine ecosystems. The introduction of non-native species, facilitated by human activities, threatens ecological balance. At the same time, the spread of infectious diseases—exacerbated by environmental changes—raises major conservation challenges. Finally, chemical, plastic, and noise pollution may be affecting food webs, though their impacts are still poorly understood.

Territorial Stakeholder Relevant Approach to Studying the Land-to-Sea Continuum

The Subantarctic region is a unique observatory of the effects of global change on southern polar ecosystems, both terrestrial and marine. It is undergoing rapid transformations linked to climate change, pollution, increasing human activity (fishing, resource extraction, tourism), and the spread of pathogens. A land—sea continuum approach, which integrates interactions between environments and ecological processes, is essential for understanding the cumulative impacts on ecosystem health. Although fishing is strictly regulated, it remains a significant source of disturbance. Better anticipating its ecological and socio-economic effects is crucial for the sustainable management of these territories.

The Kerguelen cabbage, a native species endemic to the archipelago, is threatened by rabbits that were introduced © Thomas Saucède

Antarctic

The Antarctic Atmosphere: A Central Component of Climate and Climate Change at Regional and Global Scales

The atmosphere plays a key role in the Antarctic climate by controlling the exchange of heat, water, and chemical compounds, and by influencing the ice sheet, ocean, and sea ice. In recent decades, Antarctica has experienced significant warming in the west, while in the east, temperatures have remained relatively stable but precipitation is increasing. Distinguishing the effects of human activities on the Antarctic climate from natural variability remains a complex challenge. Projections suggest rising temperatures and increased precipitation, but there is still considerable uncertainty about the rate and magnitude of changes across different regions. Improving these projections requires refining the description, understanding, and modeling of the mechanisms that govern the dynamics and composition of the Antarctic atmosphere—both present and past—including nonlinear processes and extreme events. Antarctica also serves as a unique atmospheric laboratory, particularly through the *Concordia* Station, which provides valuable data under extreme conditions to help us understand the physico-chemistry of Earth's atmosphere as a whole.

Antarctic Ice Sheet Mass Balance: A Critical Uncertainty in Sea-Level Rise

Since the late 20th century, the polar ice sheets have been losing large amounts of ice, contributing to sea-level rise, which could reach 1 to 1.5 meters by 2100. Sea level rise poses a major threat to coastal areas, river deltas, and low-lying islands, with serious consequences for food security, public health, and migration. The evolution of the Antarctic ice sheet—particularly in West Antarctica and the Wilkes Land region—is the main source of uncertainty due to the risk of irreversible loss of the outlet glaciers. In the longer term, the stability of the entire Antarctic ice sheet is at stake. Forecasting its evolution requires a detailed understanding and integrated modeling of the ice and its complex, nonlinear interactions with the ocean and atmosphere over timescales ranging from decades to millennia. It is crucial to improve observations of the Antarctic ice sheet, from the coast to the East Antarctic plateau, and to strengthen modeling efforts in order to refine projections and better anticipate how vulnerable regions can adapt to rising sea levels.

Freezing of a polynya at the end of summer in Antarctica © Jérôme Fournier / IPEV / CNRS Images

Understanding Change and Feedbacks in the Southern Ocean

Global ocean circulation, which is essential to Earth's climate, is partly driven by the overturning circulation around Antarctica. This circulation governs the exchange of heat, carbon, and nutrients between the surface and the deep ocean. Concerning signs of slowdown—and even potential collapse—have been observed, with potentially major consequences for global temperatures, precipitation patterns, and the ocean's carbon sink capacity. The Antarctic sea ice, through its seasonal cycles and interactions with the ocean, plays a key role in this circulation. In addition, exchanges between the ocean and ice shelves strongly influence their melting and, consequently, sea-level rise. These oceanic dynamics also impact polar ecosystems and associated biodiversity, with critical socio-economic implications for France and beyond.

Unique and Fragile Ecosystems: Preserving Antarctic Biodiversity

Antarctic ecosystems, rich in biodiversity and marine resources, are under serious threat from a combination of climatic and human pressures. Climate warming is rapidly transforming the cryosphere, disrupting habitats, biogeochemical cycles, and species dynamics. Industrial fishing—particularly for krill and toothfish—is placing increasing pressure on both target and non-target species. At the same time, new threats are emerging, such as chemical and plastic pollution, the introduction of invasive species, diseases, and the direct impacts of human activities. These multiple disturbances could profoundly reshape Antarctic ecosystems. Understanding their cumulative effects and anticipating future ecological trajectories is essential for protecting these unique environments.

Establishing a Unified Approach to Polar Research

The three polar regions share many common and interconnected processes. Therefore, the polar regions must be studied through an integrated and comprehensive scientific approach that considers climate change as well as ecological, political, and social issues.

Chukchi reindeer herders' camp tchouktches, Tchoukotka © Virginie Vaté

The Arctic, Subantarctic, and Antarctic regions share many key processes that are central to understanding Earth's climate evolution. Ice sheet melt, ocean dynamics, and the balance of polar ecosystems are all interconnected phenomena that demand an integrated and global scientific approach.

This unified approach—both thematically and regionally—is essential to:

• fully develop, deploy, and analyze in situ and satellite observations,

• more effectively integrate knowledge from all three polar regions, including local and Indigenous knowledge, into climate and environmental models

• better understand and anticipate the past, present, and future trajectories of societies.

This Strategic Plan requires a collaborative and interdisciplinary approach that unifies the three polar regions while incorporating climatic, ecological, political, and social dimensions. It also involves engaging stakeholders—particularly local populations—in shaping the research. This calls for defining four cross-cutting methodological priorities:

• interdisciplinarity and co-construction of research,

• long-term observation sustainability, strengthening, and optimization,

• instrument development,

• modeling, data science, and artificial intelligence.

Only a coordinated approach—combining science, technological innovation, and science diplomacy—will provide the insights needed to inform decisions and address the ongoing transformations.

Fifteen knowledge challenges are detailed in the French Polar Research Strategic Plan: seven for the Arctic, four for the Subantarctic, and four for Antarctica. These are summarized earlier in this document. The issues addressed are structured around scientific disciplines, which represent thematic pillars. This organization reflects how scientific communities—both nationally and internationally—tend to cluster around thematic pillars. However, many of the research questions addressed in the Polar Research Strategic Plan reflect questions at the intersection of these pillars, representing a mulilti-diciplinary and trans-disciplinary approach (see figure on the right).

In the table below, the frequency of occurrence of the terminology associated with each thematic pillar is shown for each of the 15 identified scientific challenges. This objective method provides an overview of the level of interdisciplinarity within each challenge: the warmer the color (orange-yellow), the more prominently the terminology of the pillar appears in the given scientific challenge. Finally, it also allows for an estimation of the prominence of a discipline in one region compared to another.

Frequency of occurrence in % (0 – 20 – 40 – 60 – 80 – 100)

	Scientific Challenges	Societies	Atmosphere	Ocean	Sea ice	Snow & permafrost	Ice sheets & glaciers	Marine & terrestrial ecosystems
Arctic	Arctic Societies: Past, Present, and Future	55%	3%	3%	7%	9%	4%	18%
Arctic	Arctic Amplification: A Regional Phenomenon with Global Impacts	6%	19%	9%	20%	30%	7%	9%
Arctic	Permafrost Thaw and Accelerated Melting of Greenland: Climate Feedback Mechanisms, Environmental and Societal Impacts	19%	4%	5%	0%	45%	15%	12%
Arctic	Understanding the Land-Sea Continuum in the Arctic: A Key Challenge for Studying Cryosphere–Biosphere–Human Society Interactions	19%	7%	24%	8%	11%	15%	15%
Arctic	Ocean–Sea Ice–Atmosphere Interactions: From Local Dynamics to Global Climate Impacts	3%	14%	36%	38%	1%	3%	4%
Arctic	Pollution in the Arctic: Understanding Sources and Impacts to Inform Better Responses	20%	16%	18%	10%	9%	5%	22%
Arctic	Fragile Arctic Ecosystems: Between Environmental Disruption and Conservation Challenges	30%	0%	6%	9%	3%	1%	51%
Subantarctic	Understanding, Observing, and Modeling a Key Region in Transition: Synergies Between Climate Modeling and Atmospheric Observations	3%	49%	22%	0%	10%	13%	4%
Subantarctic	Understanding the Subantarctic Southern Ocean: Circulation, Biogeochemistry, and Marine Ecology in a Changing Climate	3%	1%	48%	0%	18%	18%	12%
Subantarctic	Threats to Biodiversity: Invasive Species, Epidemiology, Contaminants, and Warming	20%	2%	4%	0%	6%	6%	62%
Subantarctic	Territorial Stakeholder Relevant Approach to Studying the Land-to-Sea Continuum	13%	0%	21%	0%	0%	4%	63%
Antarctic	The Antarctic Atmosphere: A Central Component of Climate and Climate Change at Regional and Global Scales	0%	41%	14%	11%	14%	20%	0%
Antarctic	Antarctic Ice Sheet Mass Balance: A Critical Uncertainty in Sea-Level Rise	0%	8%	26%	3%	8%	56%	0%
Antarctic	Understanding Change and Feedbacks in the Southern Ocean	2%	11%	48%	32%	1%	3%	3%
Antarctic	Unique and Fragile Ecosystems: Preserving Antarctic Biodiversity	12%	0%	8%	12%	5%	6%	58%
	Regions							
	Arctic	85%	42%	40%	64%	72%	34%	57%
	Subantarctic	10%	25%	24%	0%	14%	18%	25%
	Antarctic	6%	33%	36%	36%	14%	48%	18%

Building a National Polar Research Program

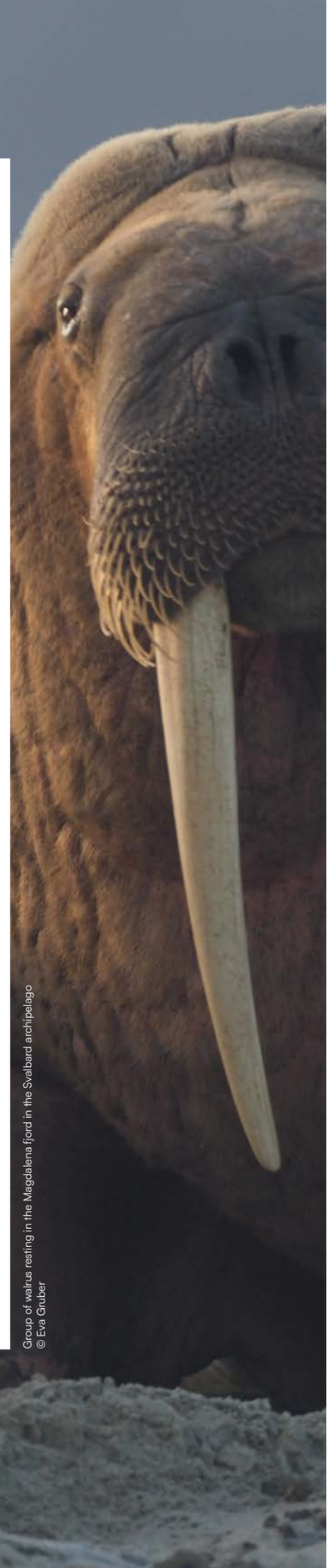
A National Polar Research Program is essential to sustainably strengthen France's participation in polar research, not only by ensuring effective coordination and alignment with international initiatives, but also by actively initiating collaborations, demonstrating scientific leadership, and deepening cooperation and participation in global efforts. This represents a unique opportunity to increase the visibility and impact of French research on the polar regions, while contributing to the scientific advances needed to better understand and anticipate climatic, environmental, social, and geopolitical changes. By writing the Strategic Plan, the preparation for establishing Polar research priorities has already started which is an important step in ensuring we are a trusted global partner and collaborator within Polar science.

To realize the ambitions set out in this Strategic Plan, a major National Polar Research Program is required. The French polar scientific community has an important role within the international context, along with the technical and logistical expertise needed to lead ambitious interdisciplinary research. Many individual nations and international organizations are already investing in Polar research in a coordinated way, for example with major pre-IPY-5 initiatives already planned such as **Antarctica InSync** (2027—2030) and increasing momentum for activities that will be carried out during **the 5th International Polar Year** (2032-2033).

The French Polar Research Program must be coordinated with the establishment of international priorities—particularly those of IPY-5. It should promote a multi- and interdisciplinary approach by connecting the identified disciplinary pillars with the **15 key scientific challenges** outlined. This structure will enable optimal allocation of human and technical resources based on these research priorities.

The French Polar Program must incorporate research ethics based on:

- integrating the perspectives and knowledge of Arctic populations,
- quantifying, monitoring, and reducing the environmental impact of research activities,
- measured collaboration with the private sector to preserve scientific independence and avoid negative side effects (e.g., greenwashing, tourism development),
- adopting a precautionary approach to polar geoengineering, excluding direct experimentation.



Group of walrus resting in the Magdalena fjord in the Svalbard archipelago
© Eva Gruber

Five priorities for the French Polar Research Program

The French Polar Research Strategic Plan outlines the need for €100 million in funding and is organized around five priorities for the Polar Research Program.

1. Program Coordination and Support for Interdisciplinary Research (€5 million – 5%)

Through the established national forum, part of the budget should be allocated to the overall coordination of the initiative, support for the development of interdisciplinary projects, consideration and implementation of ethical issues, training, and science communication. Dedicated seed funding for projects will encourage collaboration and innovative approaches between disciplines and with stakeholders in the field, particularly through co-designed research initiatives.

2. Strengthening Observation Capacity and Long-Term Monitoring (35 million – 35%)

It is essential to reinforce and ensure long-term monitoring of ecological, environmental, climatic, social, and political changes in polar regions. This part of the Program will require a balance between investment in research equipment and infrastructure development, as well as the implementation and sustainability of long-term observations and monitoring programs. Adequate funding will also be needed to cover transportation and accommodation costs for researchers working in the field using local infrastructure, ensuring fieldwork can be conducted under optimal safety conditions.

3. Development of Next Generation Modeling and Numerical Tools (€15 million – 15%)

Modeling and digital tools play a key role in understanding and anticipating polar climate and ecosystem changes, and in analyzing observational data. The program should support the development of polar modeling tools and the integration of new methodologies, particularly artificial intelligence, to optimize the use of collected data and improve climate and ecosystem projections.

4. Human Resources, Training, and Research Capacity Building (€30 million – 30%)

To ensure the sustainability and growth of the French polar scientific community, the Program must promote the teaching of polar sciences and their associated challenges at the university level, as well as outreach to the general public. Coordinated awareness events, university-level teaching, polar-themed schools, doctoral and post-doctoral opportunities, and the recruitment of permanent researchers, academics, engineers, and technicians will help attract young talent, solidify the research ecosystem, and expand polar expertise to a broader scientific community.

5. Support for Emerging Initiatives and International Programs (€15 million – 15%)

To ensure France's role in major international initiatives, specific calls for proposals will be encouraged, with particular attention to Antarctica InSync and IPY-5. With this commitment, French researchers, programs, and infrastructures will have the opportunity to play a central role in key initiatives such as InSync and the Fifth International Polar Year (IPY-5).

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