



Australian Government



## Australian Antarctic Science Decadal Strategy



2025-2035





**Australian Government**

# Foreword



**Antarctica is an extraordinary place.** It is vast, awe inspiring and unique. It has captivated explorers and scientists from all around the world for more than a century. For Australia, our deep connection with the great, white continent dates back to Australian explorer and scientist, Sir Douglas Mawson. His legacy and the endeavours of all Australians who have followed in his footsteps have shaped Australia's enduring national interests in Antarctica and the Southern Ocean. Australia claims 42 per cent of Antarctic and for more than a century, we have been committed to the protection and preservation of Antarctica as a place dedicated to peace and science, for the benefit of current and future generations.

Antarctic science has never been more important. Antarctica and the Southern Ocean are crucial for understanding and studying global climate change and unique ecosystems.

The region's isolation, nature largely untouched by human intervention make it a fascinating and unparalleled laboratory for scientific research.

Antarctica plays a vital role when studying the earth's climate. Changes in ice sheets track sea level rises, and ice core drilling can help understand historical climate patterns.

The Antarctic and Southern Ocean region supports unique wildlife, including penguins, flying seabirds, seals, krill, whales and microscopic organisms adapted to the extreme cold. In many cases these species have still not recovered from historical over-exploitation; all are vulnerable to a changing climate. Our scientific research is integral to the protection and management of these species, as well as more broadly, the region's unique terrestrial and nearshore marine environments and associated ecosystems.

Antarctic science is also fundamental to upholding our national interests in Antarctica. It supports our leadership in maintaining strong and effective international arrangements for the region through the Antarctic Treaty system. It underpins our commitment to being an international leader in environmental stewardship, including through the environmental performance of the Australian Antarctic Program. It also supports the administration of the Australian Antarctic Territory, and in the subAntarctic, the Territory of Heard Island and McDonald Islands.

Australia should be proud of its world class scientists who devote their lives to understanding this fascinating region. The research conducted on this remote continent has worldwide implications for policies in climate change, sea levels and environmental protection.

This *Australian Antarctic Science Decadal Strategy* sits under the overarching framework of the *Australian Antarctic Strategy and 20 Year Action Plan*. It seeks to enhance Australia's role as a leader in world class science by outlining the priorities for Australian Antarctic science over the next decade. To deliver on these priorities, we will build upon Australia's long-standing scientific excellence, as well as Australia's operational, logistical and technological capabilities, with the RSV *Nuyina* a flagship of these capabilities.

Research will be driven through effective partnerships and collaboration between the government, Australian universities and other relevant organisations. There has never been a more important time to be at the forefront of Antarctic scientific research, and I am excited by what we can achieve through close collaboration across the Antarctic science community over the coming decade.

**THE HON TANYA PLIBERSEK MP**

Minister for the Environment and Water



## Context

Australia has enduring national interests in Antarctica, including to conduct world-class scientific research.

To support Australia's continued leadership and excellence in Antarctic science, the decadal strategy sets the scene and the ambition for the Australian Antarctic Science Program. Developed by the Australian Antarctic Science Council (the Council) at the request of Government in consultation with the Australian Antarctic research community, the decadal strategy delivers on a commitment also articulated in the 2022 update to the *Australian Antarctic Strategy and 20 Year Action Plan*.

To develop this decadal strategy, which builds on all previous Antarctic science strategies and the plans, the Australian Antarctic Division and the Council facilitated an extensive consultation and prioritisation process involving the Australian Antarctic science community. The priority research themes in the strategy are drawn from the outcomes of that consultation process, a summary of which is attached at Attachment A.

The decadal strategy reflects the highest priority scientific outcomes that advance Australia's national interests in Antarctica, the Southern Ocean and sub-Antarctic islands. It will be delivered through an Implementation Plan with more detailed treatment of research themes, objectives and deliverables over the 10-year horizon of the decadal strategy.





## Australia's national interests in Antarctica

Australia has enduring national interests in Antarctica that are articulated in the *Australian Antarctic Strategy and 20 Year Action Plan* (Strategy and Action Plan). These are to:

- Maintain Antarctica's freedom from strategic and/or political confrontation
- Preserve our sovereignty over the Australian Antarctic Territory (AAT), including our sovereign rights over adjacent offshore areas
- Support a strong and effective Antarctic Treaty system (ATS)
- Conduct world-class scientific research consistent with national priorities
- Protect the Antarctic environment, having regard to its special qualities and effects on our region
- Be informed about and able to influence developments in a region geographically proximate to Australia
- Foster economic opportunities arising from Antarctica and the Southern Ocean, consistent with our ATS obligations including the ban on mining and oil drilling.

Priorities in all other Australian Government statements, such as the National Science and Research Priorities, are covered in these national interests insofar as they apply to Antarctica.

The Strategy and Action Plan articulates the actions the Government is taking to advance these national interests, including through leadership and excellence in Antarctic science. The decadal strategy provides further detail on how Australia's Antarctic and Southern Ocean scientific research will specifically advance these interests.









## The Australian Antarctic Science Program

Science is at the core of the Australian Antarctic Program. The Australian Antarctic Science Program is delivered through a partnership of Commonwealth and State government agencies, organisations and academic institutions. It is led by the Australian Antarctic Division of the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) and delivered in collaboration with Australian research community. The Australian Antarctic Division also administers the Australian Antarctic Territory, and in the sub-Antarctic, the Territory of Heard Island and McDonald Islands.

Each research partner delivers science excellence and significant contributions to the Australian Antarctic Science Program in their own right. No single partner has the breadth of expertise and research infrastructure to serve all national interests, fill critical knowledge gaps, address the complex challenges facing Antarctica and the Southern Ocean, and achieve the science outcomes identified in the decadal strategy. The Australian Antarctic Science Program is further augmented by research partnerships with other National Antarctic Programs and international research institutions.

Maintaining and strengthening collaboration among national and international partners, including alignment and coordination of research effort, will be critical to achieving the outcomes identified in the decadal strategy, which builds on Australia's long and proud history of Antarctic exploration and scientific research and collaboration.

The Australian Antarctic Science Council provides strategic advice to Government. It guides and advises the Australian Antarctic Division and the broader Antarctic science community on science outcomes that meet Australian Government requirements to support Australia's national interests. The Council has had a key role in the development of the decadal strategy and will advise on its implementation.

The science activities delivered under the decadal strategy align with Government priorities, including the National Science and Research Priorities, and will be delivered according to available funding, and scientific, logistic and operational capabilities. Priority will be given to excellent science that both improves our ability to predict and respond to climatic and environmental change and protect biodiversity, and fulfills our international commitments and statutory responsibilities.





## Mission

Conduct impactful science in Antarctica and the Southern Ocean that supports Australia's national interests.

## Vision

Global leadership and excellence in Antarctic and Southern Ocean science that is priority-driven, influential, and is at the core of Australia's Antarctic activities.









## Delivery of the Science Decadal Strategy

The Australian Antarctic Science Program is delivered primarily through the specialised Antarctic logistics provided by the Australian Antarctic Division. It also relies heavily on infrastructure made available through the National Collaborative Research Infrastructure Strategy (NCRIS).

- o In delivering the Australian Antarctic Program, the Australian Antarctic Division prioritises safety of people, and of the workplaces, infrastructure and logistics that it manages in Antarctica and Tasmania.
- o Integration of the Bureau of Meteorology's operational support function (long-term collection of observational data, climate systems and weather forecasting) is critical to the success of the Australian Antarctic Program, while also maintaining the safety of its people.

The governance model through which Antarctic research projects are selected and supported continues to evolve as long-term funding arrangements change. The principles guiding the selection process will ensure it is robust, efficient and transparent and maximises Australia's national interests in Antarctica in a way that balances efficiency and the research ambitions of all partners in Australia's Antarctic Science Program.

An integrated digital strategy will form a major part of the decadal strategy. It will enhance our ability to predict the behaviour of Antarctic systems in the present and future by strengthening modelling capability and digital infrastructure, as well as guiding strategic data collection, synthesis and analysis (including artificial intelligence and machine learning). It will operate within the Australian context, but will link, where appropriate, to global systems and strategies.

Scientific data will be archived and managed by the Australian Antarctic Data Centre and other appropriate national and international repositories in accordance with the FAIR (Findable, Accessible, Inter-operable, Reusable) principles.









## Scientific Priorities

The following priority research themes were identified by the Australian Antarctic research sector and are accepted as the most pressing contemporary Antarctic research needs, particularly in Eastern Antarctica, for the next 10 years.









## Key Priorities



### Climate system and change

**The Antarctic ocean-atmosphere-cryosphere (ice sheet, ice shelves and sea ice) system is crucial to our understanding of global climate systems, including sea level rise, shifting weather patterns and extreme events.**

Human-driven climate warming risks this system passing irreversible tipping points. It drives fundamental processes such as: sea level changes; weather and climate in Australia and across the globe; energy and moisture transport between the tropics and the high southern latitudes; global ocean circulation; carbon dioxide cycling between the ocean and atmosphere, reflection and absorption of solar radiation and its influence on the global energy balance; and the structuring and function of Antarctic ecosystems.

Sea level rise is one of the most pressing challenges arising from changes within this system. Antarctica's vast sea ice coverage on the ocean surrounding Antarctica has plummeted to record lows over the past decade. Changes to the annual cycle of sea ice growth and retreat have major implications for global ocean and atmosphere systems. Antarctica's shrinking ice sheets threaten more than a half a billion people globally, with Australia's Indo-Pacific neighbours being among the most vulnerable. In Australia, it has been estimated that one metre of sea-level rise could cost \$345 billion in damage and loss of residential, commercial and public infrastructure.

The East Antarctic Ice Sheet, which contains enough ice to raise global sea levels by 52 metres, has recently begun to show signs of contributing to sea level rise. Improved projections for future sea level rise requires understanding the accumulation, structure and flow of the East Antarctic ice sheet and the characteristics of the Earth it sits on, the adjacent floating ice shelves, and the surrounding fine-scale ocean circulation.



Improved understanding of the Antarctic and Southern Ocean environment will allow greater accuracy in global climate models and the Australian capability to forecast weather, to provide seasonal outlooks and climate projections, as well as assessing the state and response of ecosystems to physical processes and change. Translation of the knowledge gained is highly relevant to Australia and its neighbours in the areas of agriculture, fisheries, human health and the built environment.

Outputs, particularly in the form of predictive models, will inform mitigation strategies to better protect ecosystems, communities and infrastructure, and to deliver greater resilience to climate change. It will contribute to Australia's international leadership in climate-related international fora and to national research priorities and strategic needs.





## Key Priorities

### Biodiversity

#### **Comprehensive protection, conservation and management of the unique environments, associated ecosystems and biodiversity of Antarctica and the Southern Ocean.**

The biodiversity of Antarctica and the Southern Ocean is iconic and globally unique, with very high endemism. In addition to its intrinsic value, it provides critical functions that underpin ecosystem health and resilience such as carbon sequestration, oxygen production, and nutrient recycling. The Southern Ocean also contains large-scale fisheries that contribute to the Australian economy and global food security.

Despite the remoteness of Antarctica and the Southern Ocean, threats including climate change, exploitation of marine living resources, biological invasions, disease, pollution, and the expanding footprint of human activity, are degrading environments, destabilising ecosystems and threatening the future survival of more species than ever before. As most Antarctic species are specifically adapted to the Antarctic environment, they are particularly vulnerable to global warming trends.

Protecting biodiversity is more complex than preserving individual species. We need to understand, monitor, protect and conserve biodiversity at all levels (genetic, species, population, community and ecosystem) because biodiversity underpins ecosystem health and resilience.

Australia is a global leader in the science of Antarctic biodiversity. Research conducted on keystone species such as Antarctic krill, their predators and ecosystems, and the assessment and monitoring of Australia's Southern Ocean finfish fisheries, will ensure that Australia can continue to influence the sustainable management of Antarctica's marine living resources.

Australia's terrestrial and nearshore research in Antarctica is also critical for informing biodiversity conservation and management. Successful delivery of this research will increase our understanding of Antarctica and Southern Ocean biodiversity and threats to its biodiversity and trajectories of change. It will ensure the provision of reliable scientific information that supports informed conservation and management decisions and mitigation responses at local, national, regional and global levels, and sustain Australia's leadership and influence in international forums.

Research conducted on biodiversity protection will drive management procedures that support ecologically sustainable fisheries robust to environmental and climate change impacts.







## Key Priorities



### Human impacts

**Impacts from past, present and future human activities are avoided or mitigated through best practice environmental stewardship that protects, manages and remediates Antarctica's unique environment.**

The natural values of Antarctica and the Southern Ocean, including its biodiversity, geology, ecosystems, and the ecosystem processes that link the living and non-living elements of the environment, all contribute to making it globally unique.

However, human activities at local, regional and global scales impact Antarctica and the Southern Ocean and can alter these natural values. Most human activities tend to be concentrated in rare ice-free and biologically rich areas of the continent, and often near the coastline. These unique environments are particularly sensitive and slow to recover if disturbed, which can result in significant and lasting impacts. Human activities outside the Antarctic region can also have an additional impact on the environment through atmospheric transport of pollutants, oceanic circulation of microplastics or emissions. As human activities increase and diversify alongside a changing climate, the risk of new and cumulative impacts also increase. These impacts result in singular and cumulative pressures of a physical (e.g. disturbance), chemical (e.g. pollution or contamination) or biological (e.g. establishment of non-native species) nature, and can alter intrinsic wilderness, aesthetic and scientific values.

Human impacts research will build on existing areas in which Australia leads, and monitor the effectiveness of management and mitigation actions, including those related to environmental risk and contaminant remediation, non-native species and biosecurity, and protected areas. It will also expand in areas for improved environmentally sustainable operations in Antarctica, including net zero strategies, assessment and mitigation of cumulative pressures and impacts, and landscape restoration. Successful delivery of this priority will continue, and strengthen, Australia's leadership and influence in environmental stewardship into the future.









## Key Enabling Capabilities

The delivery of the Australian Antarctic Science Program requires sustained access to national and dedicated enabling capabilities. These include leveraging national capabilities provided through the National Collaborative Research Infrastructure Strategy (NCRIS), such as the Australian Community Climate and Earth System Simulator (ACCESS), high performing computing capabilities, and utilisation of Australia’s Marine National Facility.

Underpinning the delivery of the key priorities in this decadal strategy are two fundamental Antarctic science enabling capabilities:

- Monitoring Antarctica and the Southern Ocean; and
- Data and technological innovation.





### Monitoring Antarctica and the Southern Ocean

**Long-term integrated monitoring and strategic, multidisciplinary field programs in East Antarctica and the Southern Ocean underpins Antarctic and Southern Ocean research, protection, conservation and management.**

All of Australia's Antarctic science pursuits are reliant on the most up-to-date and accurate data and monitoring, integrated across disciplines.

Monitoring physical and natural systems on an appropriate spatial and temporal scale requires a significant investment for the sustained collection, curation, analysis and synthesis of information. Consequently, analyses and models that inform monitoring design, including the identification of variables, methods and digital integration are prioritised in the decadal strategy.

For decades, Australia has been monitoring marine and terrestrial biodiversity and wildlife populations, oceanographic processes, atmosphere, ice-sheet dynamics, and sea ice in East Antarctica, and contributing to a number of international field campaigns, forums and assessments. Australia's monitoring programs have both contributed to and benefitted from participation in regional and global monitoring programs. This contribution to global science endeavours will continue under the decadal strategy.

Through an interdisciplinary and strategically prioritised monitoring and field campaign plan, focused on East Antarctica, Australia will continue to build and expand on sustained observations of essential biodiversity, climate, and ocean variables in a targeted, integrated and coordinated way. Such monitoring will also take advantage of technological developments in remote and automated sensors, space-borne instruments, autonomous vehicles, the use of eDNA tools for biodiversity assessments, and data science to enhance observations and mapping.



## Data and technical innovation

### An Integrated Digital Strategy for East Antarctica.

Serving Australia's national interests and addressing the increasingly complex environmental and geopolitical challenges facing Antarctica and the Southern Ocean requires an integrated digital strategy that orchestrates a fundamental shift in how we collect, access, integrate, analyse, interpret and communicate data and data-derived products. This strategy will underpin and facilitate world leading Antarctic science and act as a lynchpin for national and international science collaboration.

Under this integrated digital strategy, models will be developed to provide increased predictive capability to forecast change in key elements of Antarctic systems. The improved predictive skill will inform policy and decision-making, supporting effective adaptation, environmental protection, conservation and management. This will be achieved by providing efficient access to authoritative data sets from federated sources, building capability in modelling complex and coupled Antarctic systems (atmosphere, oceans, cryosphere and biosphere) and drawing upon and collaborating with researchers and national high-performance computing infrastructure. Strengthening modelling capability and developing new approaches employing artificial intelligence and machine learning to build on available data will see Australian research touching on all areas in Antarctica.

An integrated digital strategy will address policy and stakeholder needs, underpin domestic and international science initiatives and outputs and amplify Australian science leadership and influence through world leading Antarctic research that is less vulnerable to logistical constraints that affect field-based research.





## Outcomes

The expected outcomes of the delivery of the key science priorities include:

### Leadership and influence in Antarctica

- Australia's leadership supports a strong and effective Antarctic Treaty system, and we meet our commitments under the Antarctic Treaty system and other relevant international agreements, and obligations under domestic legislation.
- Australia's scientific activities, outputs and collaborations places it among the influential leaders in the Antarctic Treaty system.
- Enhanced international collaboration and coordination through greater alignment and integration of research and monitoring, and logistics and resources across National Antarctic Programs, to tackle global challenges affecting Antarctica and the Southern Ocean.
- Understanding of Antarctic and Southern Ocean biodiversity and ecosystem function is advanced, to improve predictive capability to inform conservation and sustainable management of living resources, including provision of best available scientific advice to support the establishment and management of protected areas in Antarctica and the Southern Ocean, and for the sustainable and ecosystem-based management of Southern Ocean fisheries.
- Quantification and predictions of climate changes and vulnerabilities in Antarctica and the Southern Ocean aid climate change mitigation and adaptation policy decisions, including through Australian leadership and contributions to the Intergovernmental Panel on Climate Change.





## Leadership and excellence in Antarctic science

- Australia is a leader in scientific research in East Antarctica and the area of the Southern Ocean to our south.
- Australian Antarctic researchers provide leadership and strategic contributions to key and influential organisations including, but not limited to, the agreements and arrangements of the Antarctic Treaty System (ATS), the Scientific Committee on Antarctic Research (SCAR), the World Climate Research Program (WCRP), the Intergovernmental Panel on Climate Change (IPCC) and the International Whaling Commission.
- A fundamental knowledge of Antarctic and Southern Ocean biodiversity hotspots, ecosystems, ecological processes and ecosystem services and their vulnerability to threats and drivers of change, particularly climate change.
- A comprehensive understanding of how Antarctica and the Southern Ocean are contributing to and affected by climate change.
- Robust forecasts and projections of changes in climate, weather, seasonal outlooks, sea level rise, ocean circulation, extreme events and ecosystem change enabling more effective risk assessment, impact and cost mitigation, adaptation and resilience of Australian communities and industries, and the protection of Antarctic and Southern Ocean biodiversity, including species, habitats and ecosystems.
- World-leading science is supported through improved accessibility, usability and integration of multidisciplinary Antarctic and Southern Ocean models and datasets.
- Trusted data, scientific models and expert advice informs risk assessments, forecasts and projections; is used to support decision making, effective management and environmental protection, and provide a foundation to deliver the science outcomes identified within this decadal strategy.



## Leadership in environmental stewardship in Antarctica

- Australia's existing commitment to, and leadership in, stewardship and protection of the Antarctic and Southern Ocean environment is enhanced through continued effective conservation and ecosystem-based management of biodiversity, ecosystems and marine living resources, and the development and adherence to best practice environmental standards and guidelines.
- Excellence in the administration of the Australian Antarctic Territory and the Territory of Heard Island and McDonald Islands is supported and enhanced, including through a broad geographic presence and authoritative knowledge of East Antarctica.
- Best practice regulation and management of all activities, operations and infrastructure in the Australian Antarctic Program is facilitated to avoid or minimise human impacts on the Antarctic and Southern Ocean environments.
- Improved understanding and management of human activities and impacts in Antarctica, including through strengthening and broadening area protection mechanisms, and the assessment, mitigation and remediation of a range of environmental risks.







## Review

The Australian Antarctic Division, in close consultation with the Council and the Australian Antarctic Science sector, will review the decadal strategy at least every five years. The reviews will assess progress against achieving Australia's national interests in Antarctica, and to determine any required revisions or extension. Any revisions to this decadal strategy will take account of any updates to the *Australian Antarctic Strategy and 20 Year Action Plan*.

The Implementation Plan to support the decadal strategy, will be developed by the Australian Antarctic Division in consultation with the Council and the Australian Antarctic science community. It will have a long-term planning horizon, with greater detail in the early years and more aspiration in the outer years. It will be a living document and reviewed annually, including in the context of the Australian Antarctic Division's integrated planning.





### **Summary of priority science outcomes as determined by the Australian Antarctic science community**

The Australian Antarctic Science Decadal Strategy was developed through an extensive consultation and prioritisation process involving the Australian Antarctic science community, facilitated by the Australian Antarctic Division and the Australian Antarctic Science Council. The following priority science outcomes were identified through that process and informed the decadal strategy.

#### **Monitoring Antarctica**

An enduring East Antarctic Monitoring Program that provides Australian research leadership to keep East Antarctica valued, protected and understood.

#### **Sea level vulnerability**

Enhanced capability to project the behaviour of the Antarctic ice sheet and its contribution to sea level rise.

#### **Biodiversity protection**

Comprehensive understanding of the current and future dynamics of Antarctic biodiversity, to support its protection.

#### **Human impacts**

Evidence-based stewardship practises to minimise human impacts in a changing East Antarctic environment.

#### **Climate changes**

Improved projections of Antarctica's influence on Australia in a whole Earth System context.

#### **Integrated Digital East Antarctica**

An interdisciplinary digital strategy and analytical capabilities to underpin Australian science and geopolitical leadership.





**Australian Government**