Annual Report 2021

Securing Antarctica's Environmental Future

Image: Emiliano Cimoli

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SAEF Securing Antarctica's Environmental Future

Australian Research Council
Special Research Initiative

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1

Our program

Director
Professor Steven Chown FAA

Antarctica and the Southern Ocean are critical parts of the Earth System.

Antarctic ice sheets contain approximately 58 m of sea level rise. The Southern Ocean absorbs more than two-thirds of ocean anthropogenic heat and half of the total ocean anthropogenic carbon. Southern Ocean ecosystems are highly productive, incredibly diverse and include some of the world's most iconic species. Although the Antarctic continent is poor in biodiversity, it is unusual in many respects, including having microbial communities where chemosynthesis is critical, and one of the largest wildernesses on Earth, with extensive areas that people have never touched.

Changes arising from other parts of the globe affect Antarctica and the Southern Ocean, which in turn feed back to influence global areas: their futures are inseparable. Antarctica is *en route* to being a place very different to what it has been for all of recorded human history. Reducing uncertainty about what the future holds, unveiling ways to mitigate the impacts of change, and delivering dynamic, effective options for environmental stewardship are pressing global challenges. Securing Antarctica's Environmental Future (SAEF) has been established to deliver integrated, interdisciplinary research and new research capability to help address these challenges. Securing Antarctica means securing our future.

This report is the first reflection of our endeavours over a relatively short period. SAEF has been formally active for only six months; yet we are off to a productive start. We anticipate that over the next year we will further demonstrate the value of our contributions, both here and abroad.

Deputy Director—Science Implementation
Distinguished Professor Sharon Robinson

Since commencement we have been working to ensure SAEF provides the leadership in science and environmental stewardship that lies at the heart of securing the environmental future of Antarctica, the Southern Ocean and the sub-Antarctic islands. Our program is designed around three key themes—**Climate Processes and Change; Biodiversity Status and Trends; and Supporting Environmental Stewardship**—each of which is led by two of our Chief Investigators (CIs). As Deputy Director–Science Implementation, I am working with this science leadership team and Dr Diana King (Deputy Program Manager–Science) to develop our SAEF projects and ensure integration of the program. Each theme has held regular open theme meetings involving our CIs and Partner Investigators (PIs) from across the globe, and increasingly our new researchers and students here in Australia.

Unfortunately COVID restrictions and lockdowns have meant we have not yet been able to all meet in person, but have held whole of SAEF online workshops. At our second meeting in November, we held a workshop introducing our first tranche of projects, mapping linkages between projects and facilitating integration across the program. We also held a workshop examining how technology and data science tools can assist projects across the program, allowing us to analyse, interpret and visualise Antarctic data in new and exciting ways.

This is just the start of the journey, and we plan more workshops to further this integration in 2022; hopefully some of these will be in person! The future is bright as we start to build a new collaborative Antarctic science workforce with skills and experience in interdisciplinarity.

Deputy Director—Career Development
Professor Kerrie Wilson

As Deputy Director–Career Development, my focus in 2021 was to work with our leadership team and our growing research community to establish a respectful and inclusive SAEF culture.

A vibrant, supportive, inclusive culture is especially important in an organisation like SAEF that brings together people from many organisations from many parts of the world. We all bring different personal, social and disciplinary backgrounds and are at different stages of our careers; with different priorities and facing different challenges and opportunities.

SAEF is striving to create a more diverse Antarctic science workforce of the future that is comfortable in interdisciplinary and policy settings. One of our first priorities was creating an Equity, Diversity and Inclusion Plan as a basis for providing equal opportunities to all participants and equitable access to groups currently under-represented in STEM disciplines. SAEF's values of ambition, collaboration, community and diversity are further reflected in our Code of Conduct.

Our second major priority was developing a Leadership, Mentoring and Career Development Plan. Its goal is to give SAEF staff and students a broad range of professional development opportunities to prepare them for diverse career paths in Antarctic research, management and governance, and across the STEM disciplines. Dr Justine Shaw led thought-provoking culture workshops in November, at which we also launched a major element of the plan, the SAEF Mentoring Program.

Thank you to everyone who contributed to the thinking and planning to get these major initiatives underway. We look forward to working with you all in 2022 and further building the culture of SAEF, facilitating cross-node supervision and building the capacity of SAEF staff and students.

Governance Advisory Board Chair
Mr Drew Clarke AO PSM FTSE

The governance model of SAEF includes a Governance Advisory Board. The initial membership has people with expertise in public policy, the environmental industry, the Antarctic Treaty System, research program management, early career research and of course Antarctic science. The SAEF Director and the Chair of the International Science Advisory Panel are ex-officio members. Two Board members are from outside Australia.

The Board is well-placed to provide independent advice to the Director on good governance. Our agenda includes strategy, performance, risk and impact – all critical to the success of SAEF. The strategy agenda includes consideration of the institutional, geopolitical and scientific context of SAEF research, both within Australia and internationally.

We understand that Boards play a critical role in shaping an organisation's culture, which in turn significantly influences outcomes. We are developing a Board culture that supports the SAEF goal of impactful interdisciplinary science, through the values of collaboration, ambition, diversity and community. Each of these values has a specific SAEF context which we uphold.

I am grateful to the Director and staff of SAEF for their efforts in supporting the Board, and to the members for their participation and insights. I am confident that the foundations have been laid for a successful research body and program.

International Science Advisory Panel Chair
Associate Professor Nancy Bertler

SAEF is a large interdisciplinary program that aims to forecast climate change impacts on the Antarctic environment and ecosystem and to support the development of new, more effective pathways to evidence-informed decision making for policy makers.

The role of the International Science Advisory Panel (ISAP) is to provide advice to the SAEF leadership and governance group on science excellence, opportunities to lead, connect, and integrate with the international community on global science and policy priorities, and to assist the SAEF team in their ambition to deliver a scientific workforce of the future.

The ISAP comprises an external group of leading scientists in relevant disciplines, early career researcher representation from within the SAEF team and *ex-officio* membership by the SAEF leadership team and governance group.

We are excited to join the SAEF team on this exciting and important journey to better understand and manage the Antarctic environment and ecosystem in a warming world.

01

Vision, purpose and values

Our vision

An environmentally secure Antarctic valued for its role in the Earth System and for its significance to society.

Values

In addition to the values that lie at the heart of our institutions and that are characteristic of a joint research endeavour – such as curiosity, respect and openness – values that underpin SAEF include:

Collaboration:

- interdisciplinary
- innovative
- inspirational

Ambition:

- for the planet
- for our science
- for change

Diversity:

- of membership
- in approach
- of benefit

Community:

- considered
- inclusive
- transformational

Purpose

SAEF delivers globally valued, collaborative, interdisciplinary research to:

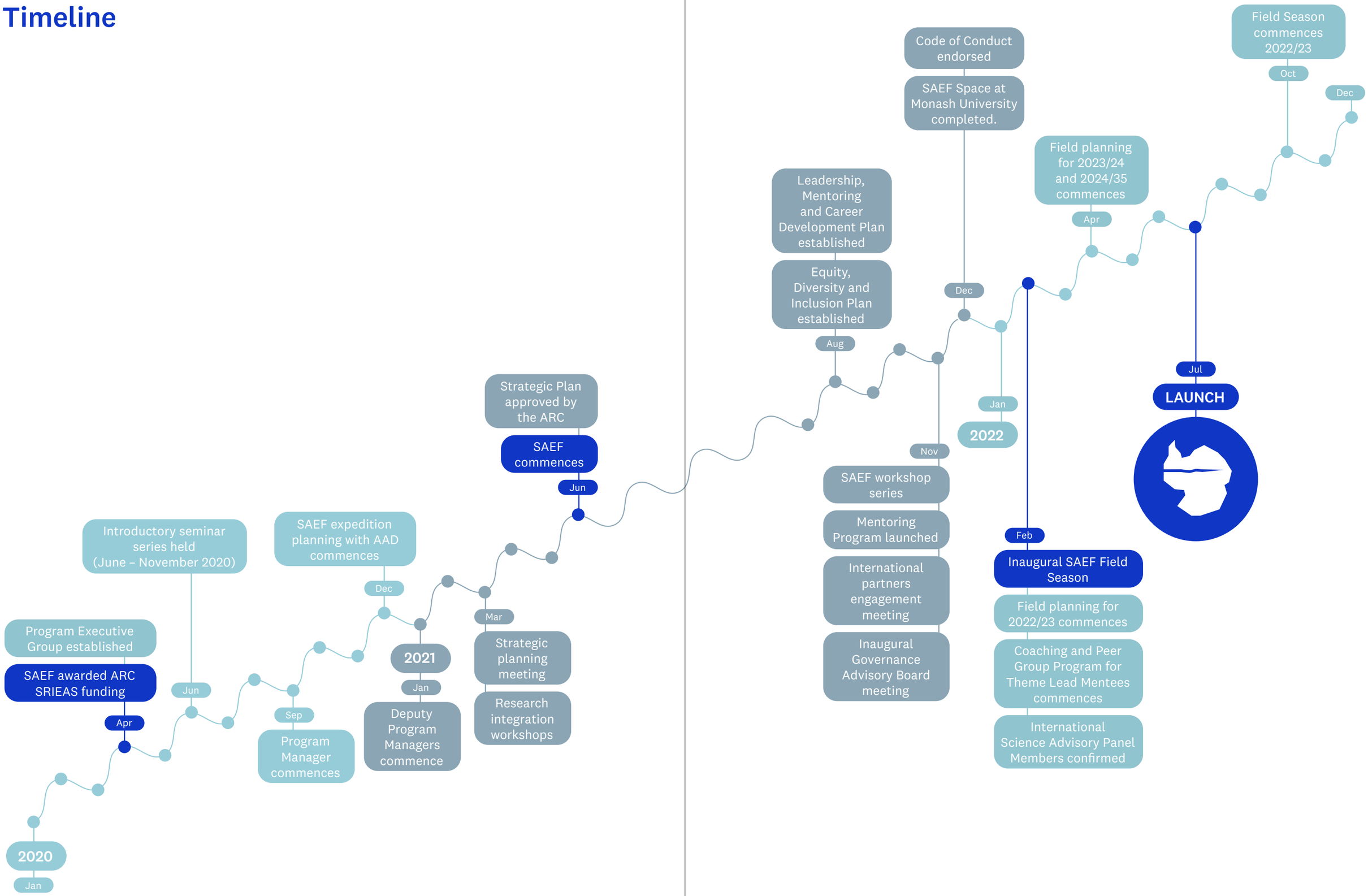
① Understand the Antarctic region's changing biodiversity and role in the Earth System

② Reconstruct and forecast environmental change across the Antarctic and Southern Ocean

③ Deploy effective environmental stewardship strategies to mitigate and adapt to change

④ Deliver the diverse Antarctic science workforce of the future

Timeline


2020
Jan
Apr
Program Executive Group established
SAEF awarded ARC SRIEAS funding
Jun
Introductory seminar series held (June – November 2020)
Sep
SAEF expedition planning with AAD commences
Program Manager commences
Dec
2021
Jan
Deputy Program Managers commence
Mar
Strategic planning meeting
Research integration workshops
Jun
Strategic Plan approved by the ARC
SAEF commences
Aug
Leadership, Mentoring and Career Development Plan established
Equity, Diversity and Inclusion Plan established
Nov
SAEF workshop series
Mentoring Program launched
International partners engagement meeting
Inaugural Governance Advisory Board meeting
Dec
Code of Conduct endorsed
SAEF Space at Monash University completed.
Jan
2022
Feb
Inaugural SAEF Field Season
Field planning for 2022/23 commences
Coaching and Peer Group Program for Theme Lead Mentees commences
International Science Advisory Panel Members confirmed
Apr
Field planning for 2023/24 and 2024/35 commences
Jul
LAUNCH
Oct
Field Season commences 2022/23
Dec

SAEF in numbers

SAEF commenced on Monday 14th June 2021

101
members

52
investigators

9
early career
researchers

16
students

3
volunteers

24
partner
organisations

6
program
collaborators

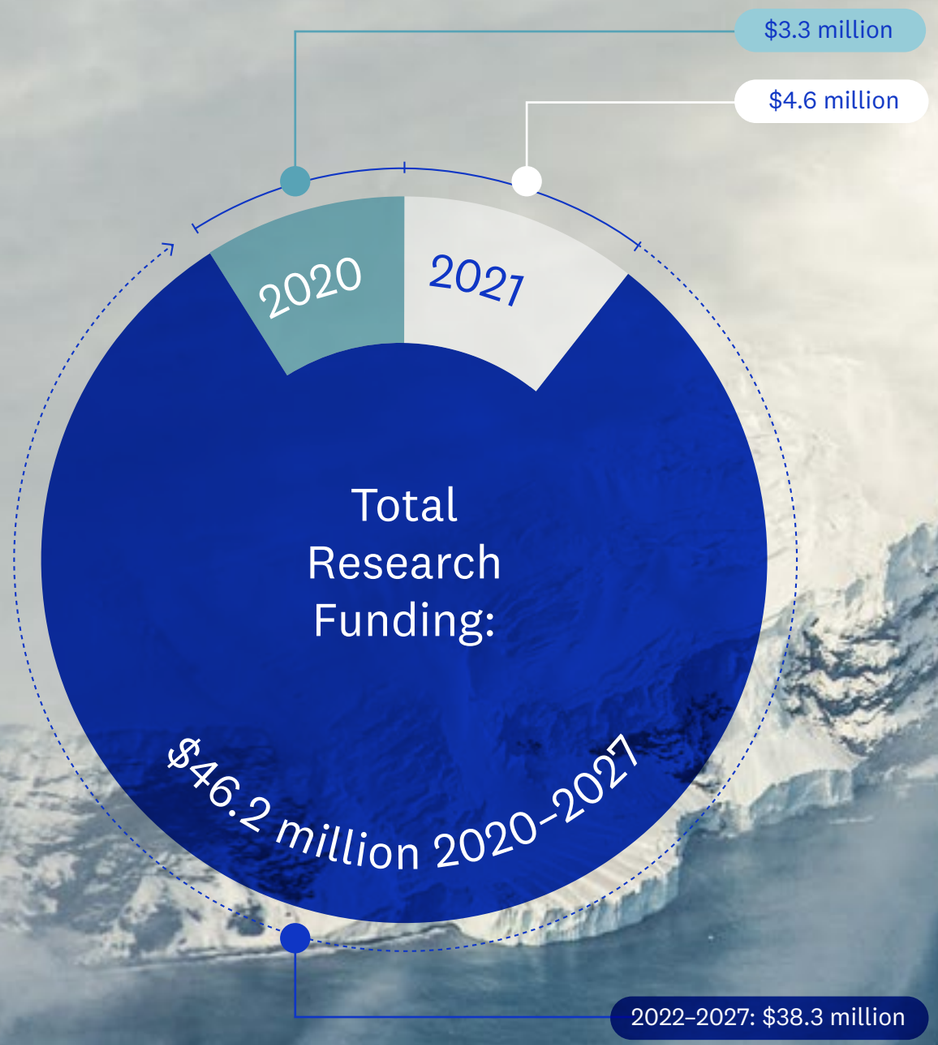
$1.1 million
institutional
contributions

$3.5 million
ARC funding

$8.7 million
in-kind funding

$2.7 million
associated
additional
funding

SAEF funding



Hits

① SAEF commenced. We have agreed on our foundational values, our approaches to collaboration and the ways we interact with each other to deliver our ambitions for our science, for change and for the planet.

② One early paper has shown that Antarctic microbial life is characterised by bacteria that derive energy and building blocks from scavenging trace gases such as hydrogen and carbon monoxide, but also that water can be produced from these gases to sustain life.

This discovery decouples the search for life from the search for water.

③ Another early paper reviewing the environmental effects of stratospheric ozone depletion has highlighted the strong link between such depletion and the climate of the Southern Hemisphere, with pronounced relationships between depletion and precipitation in both Chile and Australia.

④ SAEF researchers led the drafting, for the Scientific Committee on Antarctic Research (SCAR), of a Working Paper on *Antarctic and Southern Ocean Climate Change in a Global Context*, presented to the XLIII Antarctic Treaty Consultative Meeting (ATCM).

The paper played a significant role, in the context of a Working Paper by the United Kingdom, Australia and five other consultative parties on Antarctica in a Changing Climate, in the adoption by the Antarctic Treaty Consultative Parties of Resolution 8 from the meeting, recommending further action on and research about Antarctica in a Changing Climate.

Misses

① SAEF was unable to host early meetings with international collaborators associated with various meetings, either of SCAR or of the Antarctic Treaty System.

Travel restrictions remained in place and online discussions do not provide the networking opportunities offered by in-person meetings.

These same travel restrictions prevented international students from travelling to their host institutions and complicated the recruitment of international postdoctoral research associates.

② Domestic restrictions also prevented the in-person networking we would have preferred to finalise our strategy and settle on the details of logistic plans for the 2022/23 and 2023/24 Antarctic field seasons.

③ Although e-meetings have many benefits, they lack margins and incidental conversations.

Their highly formulaic nature invites distraction and, as a result, washes away much innovation.

This is SAEF

This is SAEF

SAEF aims to become the world's leading research program delivering interdisciplinary science to forecast environmental change across the Antarctic region; to deploy effective environmental stewardship strategies in the face of this change; and to secure Antarctica as a natural reserve devoted to peace and science.

SAEF will exemplify the leadership in science and environmental stewardship that lies at the heart of securing the environmental future of Antarctica, the Southern Ocean and the sub-Antarctic islands. SAEF delivers outcomes across three key themes.

Integration of these outcomes will strengthen Antarctic science, policy and governance leadership at a time of rapid environmental and geopolitical change.

Themes and leads

Theme 1
Climate Process and Change

Theme Lead
Professor Andrew Mackintosh
(Monash University)

Theme Lead Mentee
Professor Helen McGregor
(University of Wollongong)

SAEF will integrate knowledge from ice sheet reconstructions, satellite observations, meteorological field measurements, and high-resolution climate proxies from Antarctica and the sub-Antarctic islands to understand recent variability and change in Antarctica's weather, climate and ice sheets. SAEF will also undertake targeted model experiments and develop methods to better constrain future projections.

Theme 2
Biodiversity Status and Trends

Theme Lead
Professor Melodie McGeoch
(LaTrobe University)

Theme Lead Mentee
Professor Jan Strugnell
(James Cook University)

Using downscaled climate and environmental information; novel biodiversity and genomic data; and integrated biological and geochemical proxies, SAEF will produce transformative insights about the structure, function, drivers and future of Antarctic and sub-Antarctic terrestrial and aquatic biodiversity. Outcomes will inform spatiotemporal planning for conservation and will provide a scientific basis for leading environmental stewardship.

Theme 3
Supporting Environmental Stewardship

Theme Lead
Professor Michael Bode
(Queensland University of Technology)

Theme Lead Mentee
Dr Kate Helmstedt
(Queensland University of Technology)

In collaboration with key stakeholders, SAEF will develop bespoke decision support tools to identify conservation priorities and strategies in the face of alternative environmental and political futures. To ensure that stewardship focuses on the most important environmental and biodiversity features, a data-to-decision framework will explicitly and visually connect new biodiversity and human activity data streams, monitoring technologies and modelling outcomes with the key questions that managers tell us they need to answer. SAEF will deliver interdisciplinary science to forecast environmental change across the Antarctic region; deploy effective environmental stewardship strategies in the face of this change; and secure Antarctica as a natural reserve devoted to peace and science.

Investigators

Professor Julie Arblaster
Monash University

Julie's research uses climate models as tools to investigate mechanisms of recent and future climate change.

Professor Steven Chown FAA
Monash University

Steven's research concerns biodiversity variation through space and time, the conservation requirements for mitigating the impacts of environmental change, and the science-policy interface.

Dr Grant Duffy
Monash University

Grant is an ecologist with interests in ecoinformatics, thermal physiology and environmental science. This work has had broad applications from forecasting alien species invasions in Antarctica, to characterising human heat stress in tropical cities.

Associate Professor Chris Greening
Monash University

Chris is investigating the microbiology and biogeochemistry of Antarctic ecosystems. He is profiling microbial biodiversity in the continent, resolving metabolic pathways that sustain life and testing how microbes influence the environment.

Dr Ben Henley
Monash University

Ben's research combines multi-proxy palaeoclimate data, instrumental observations and climate model data to understand decadal to centennial variability in climate and hydrological systems in the context of current climate change.

Dr Richard Jones
Monash University

Richard's research combines ice sheet modelling and glacial chronology to better understand ice sheet response to climate change.

Investigators

Professor Andrew Mackintosh
Monash University

Andrew's research uses glaciology and glacial geology to understand ice sheet responses to climate forcing, and resultant sea level change.

Dr Felicity McCormack
Monash University

Felicity's research uses ice sheet models to investigate the impact of climate variability and change on the East Antarctic Ice Sheet, and the contribution of this to future sea level rise.

Professor Steven Siems
Monash University

Steve's research uses field observations, satellite observations and reanalysis products to improve estimates of precipitation over the Southern Ocean and Antarctic.

Dr Matthew Adams
Queensland University of Technology

Matthew is a Lecturer and Research Fellow who applies mathematical models to investigate the environmental functioning of Antarctic ecosystems, focusing on mechanistic modelling of biological processes and their interaction with the physical landscape. His work aims to provide insights into the mechanisms responsible for present and future changes in Antarctic ecosystems, and to identify opportunities for mathematics to help inform management of these novel systems.

Professor Michael Bode
Queensland University of Technology

Michael is a Professor and ARC Future Fellow. He examines the behaviour and control of uncertain and complex dynamical systems, and in spatial aspects of ecology and conservation – particularly when multiple conservation actors (e.g., multiple Non Government Organisations) operate in a landscape.

Distinguished Professor Peter Corke FAA
Queensland University of Technology

Peter's research interests lie in robotic vision. His work is concerned with robotic perception using vision and force, dynamics and control, and the application of robots to mining, agriculture and environmental monitoring.

Professor Matthew Dunbabin,
Queensland University of Technology

Matthew conducts transdisciplinary research into environmental robotics focusing on advanced perception-to-action solutions with application to large-scale management and monitoring of challenges. His wide research interests include vision-based perception and classification, vision-based navigation, adaptive sampling and path planning, and cooperative robotics.

Professor Felipe Gonzalez,
Queensland University of Technology

Felipe's research interests are in creating aerial robots and drones that possess a high level of cognition, using efficient on-board computer algorithms. He applies advanced optimisation and game theory approaches that help to understand and improve the physical and natural world.

Dr Kate Helmstedt
Queensland University of Technology

Kate uses maths and data science to help understand and manage threatened ecological systems and species. Kate's research expertise is in using optimisation and modelling to guide smart decision making for biodiversity conservation. The ultimate goal of her research is to guide future management decisions towards cost efficiency, transparency and defensibility.

Distinguished Professor Kerrie Mengersen FAA FASSA
Queensland University of Technology

Kerrie's focus is on using and developing new statistical and computational methods that can help to solve complex problems in the real world. These problems are in the fields of environment, genetics, health and medicine, and industry. Her research expertise includes Bayesian statistics, hierarchical modelling and complex systems.

Professor Kerrie Wilson
Queensland University of Technology

Kerrie is a leading interdisciplinary decision scientist with more than 190 research publications focusing on applied resource allocation problems, such as where to invest limited resources to protect or restore biodiversity, and what factors influence success. She has developed and applied decision science to inform investments in environmental protection, management and restoration initiatives.

Dr Johan Barthélemy
University of Wollongong

Johan is leading the Simulation, Modelling, Analysis, Research and Teaching (SMART) Internet of Things (IoT) Hub and the Digital Living Lab, developing sensors and edge computing devices for IoT applications using low-power wide-area network networks including connected beer kegs, smart cameras and water level monitoring, and low-cost gas sensing. He is currently focusing on the development of new applications of artificial intelligence and intelligent video analytics for smart cities and environmental monitoring.

Investigators

Distinguished Professor Noel Cressie FRSN FAA
University of Wollongong

Noel's research focus is on developing statistical methodology and its applications for spatial and spatiotemporal data. He is a world leader in environmental informatics, particularly in statistical remote sensing developed for the US National Aeronautics and Space Administration (NASA) on contracts and ARC Discovery Projects. His methodological research is centrally Bayesian and empirical, employing Bayesian approaches to build big, complex, hierarchical statistical models.

Distinguished Professor Stuart Kaye
University of Wollongong

Stuart has extensive research interests in the Law of the Sea and international law. He has written a number of books, including Australia's Maritime Boundaries (2001), The Torres Strait (1997), International Fisheries Management (2001), Freedom of Navigation in the Indo-Pacific Region (2008) and over 100 other articles and book chapters. Stuart is Director and Professor of Law in the Australian National Centre for Ocean Resources and Security.

Professor Helen McGregor
University of Wollongong

Helen is a paleoclimatologist who has made substantial advances in understanding civilisation's most serious threats: global climate change, El Niño-Southern Oscillation and human–climate–environment impacts. Helen studies the climate of the past to better understand present-day climate, improving forecasts of climate change and addressing key questions on the origins of natural climate variation.

Senior Professor Pascal Perez
University of Wollongong

Pascal is currently overseeing research in infrastructure-related fields such as water and energy efficiency, future transport and mobility, smart cities and communities, and infrastructure system engineering and logistics. He is a Fellow of the Royal Society of New South Wales and of the Modelling and Simulation Society of Australia and New Zealand. He is also a member of the national Scientific Committee of the Australian Urban Research Infrastructure Network.

Distinguished Professor Sharon Robinson
University of Wollongong

Sharon researches how Antarctic plants respond to climate change. She uses radiocarbon signatures left behind in the atmosphere by nuclear testing to date mosses and track environmental change around the coast of Antarctica. Her group identifies the sunscreens that plants make to protect themselves from elevated UV-B radiation resulting from ozone depletion. She is currently a member of the United Nations Environment Programme (UNEP) Environmental Effects Assessment Panel, assessing the various effects of ozone depletion worldwide.

Dr Andrew Zammit-Mangion
University of Wollongong

Andrew's research interests lie in spatial and spatiotemporal modelling and the tools that enable it. He has developed and applied novel statistical methodologies in areas of climate concerned with the quantification of greenhouse gas sources and sinks, and the contribution of ice sheets to sea level rise.

Professor Jan Strugnell
James Cook University

Jan is an evolutionary molecular biologist investigating the evolution and function of marine organisms using genomic and proteomic techniques. She is investigating population- and species-level molecular evolution in Antarctic taxa in the context of past climatic and geological change.

Associate Professor Graeme Clark
University of New South Wales

Graeme works on a diverse range of topics in the field of coastal and marine ecology, including Antarctic marine biology, invasive species and human impacts to the coast.

Professor Emma Johnston AO FTSE FRSN
University of New South Wales

Emma is Dean of Science at the UNSW Sydney. She is a leading authority in marine ecology, former Pro Vice-Chancellor (Research) at UNSW, and has led major research projects for industry, government, the ARC and the Australian Antarctic Science Program.

Associate Professor Phillip Cassey
University of Adelaide

Phill has a global reputation in invasion ecology and environmental biosecurity. As a transdisciplinary scientist he brings critical analysis and translation to conservation issues characterised by complexity and uncertainty.

Professor Melodie McGeoch
La Trobe University

Melodie is lead CI on two SAEF projects: one on modelling and monitoring Antarctic biodiversity and another on a predictive framework for climate change impacts on biodiversity in the region.

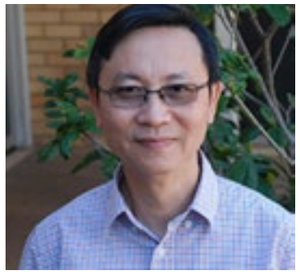
Dr Jonathon Stark
Australian Antarctic Division

Jonny is a Principal Research Scientist in the Environmental Protection Program and section leader of Coastal Marine Ecology at the AAD. He is a marine ecologist with a focus on research into the effects of environmental change on marine communities to inform and influence environmental management.

Investigators

Dr Aleks Terauds
Australian Antarctic Division

Aleks is a Senior Principal Research Scientist and Program Leader of the Marine Conservation and Management Program at the AAD. He is a quantitative ecologist with a focus on research that influences and drives Antarctic and Southern Ocean environmental policy and management.



Dr Quan Hua
Australian Nuclear Science and Technology Organisation

Quan specialises in radiocarbon dating and its applications—in particular radiocarbon calibration—and developing high-resolution climate records from mosses, corals, speleothems, tree rings and sediments.

Dr Karina Meredith
Australian Nuclear Science and Technology Organisation

Karina is a hydrogeochemist specialising in isotope hydrology. Her research interests entail applying a variety of stable, radiogenic and cosmogenic isotopic tracers to investigate lake water processes and soil–water–air interactions.

Dr Krystyna Saunders
Australian Nuclear Science and Technology Organisation

Krystyna is a palaeoclimatologist specialising in reconstructing past climates and ecosystems from sedimentary lake records. Her research interests involve applying biological, geochemical and nuclear techniques to understand past processes.

Dr Eun-Pa Lim
Bureau of Meteorology

Eun-Pa is a Senior Research Scientist at the BOM and specialises in the dynamics of the Southern Annular Mode and its relationship with El Niño and the Southern Oscillation, and the Antarctic stratospheric vortex, as well as the predictability of the Australian climate.

Dr Matthew Wheeler
Bureau of Meteorology

Matt is a principal research scientist at the BOM and specialises in equatorial waves, the Madden–Julian oscillation, the Australian monsoon and mechanisms of rainfall variability.

Dr Stephanie McLennan
Geoscience Australia

Stephanie's research involves mapping and characterising the physical terrestrial environment in Antarctica to understand human impacts, past ice sheet behaviour and landscape evolution processes.

Dr Jodie Smith
Geoscience Australia

Jodie's research involves mapping the physical seafloor environment around the Antarctic margin to understand past ice sheet history, ice–ocean interactions and biophysical interactions.

Dr Mark Stevens
South Australia Museum

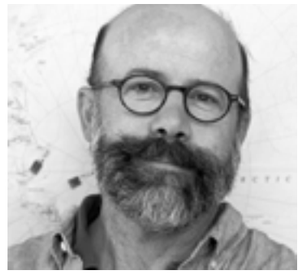
Mark is an evolutionary biologist who collaborates nationally and internationally. His research projects have focused on invertebrate groups to explore patterns in diversification contrasted against climate and biome shifts using a range of molecular approaches.

Dr Nerida Wilson
Western Australian Museum

Nerida is a research scientist at the museum and manages its Molecular Systematic Unit. Her research interests focus on understanding and describing the extent of biological diversity present on Earth, and resolving evolutionary relationships among those taxa. She is passionate about taxonomy and systematics as the foundational discipline that underpins biological science.

Associate Professor Barbara Bollard
Auckland University of Technology

Barbara's research interests span geospatial science, ecosystem management and spatial ecology. Her research focuses on the identification, selection and environmental monitoring of protected areas using remote sensing technology, such as unmanned aerial vehicles, to map habitats and landscapes for conservation planning and integrating social data with environmental and biological information using decision support systems, multivariate statistics and GIS.



Dr Greg Balco
Berkeley Geochronology Centre

Greg is an Earth scientist. His recent research has focused on developing and using subglacial bedrock recovery drilling systems to also learn about how much smaller ice sheets were during past warm periods, and how big their impact was on global sea level, by recovering geologic data from below the present ice sheet.

Investigators

Dr Miguel Ángel Olalla-Tárraga
King Juan Carlos University

Miguel's research is broadly focused on macroecology and conservation biogeography, and encompasses studies of vertebrates and plants.

Associate Professor Brent Goehring
Tulane University

Brent's research interests include cosmogenic nuclides and surface exposure dating, glacial geology and geomorphology, paleoclimatology and neotectonics.

Dr Jaume Flexas
University of the Balearic Islands

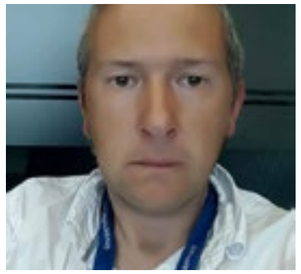
Jaume's research focuses on plant ecophysiology; in particular on photosynthesis and plant responses to environmental stresses. Antarctica is a perfect laboratory as it combines the coldest and windiest world conditions with substantial soil dryness.

Assistant Professor Cassandra Brooks
University of Colorado Boulder

Cassandra's research draws on a diversity of disciplines including marine science, environmental policy and science communication to study and seek solutions to pressing environmental problems. Active in the Antarctic science policy sphere since 2012, Cassandra has participated in meetings of the Commission for the Conservation of Antarctic Marine Living Resources through the SCAR delegation.

Professor Dan Charman
University of Exeter

Dan is an Earth System scientist interested in long-term ecosystem and climate change. His current research projects focus on reconstruction of past climate variability in the Antarctic, the contribution of peatlands to the global carbon cycle, carbon dynamics in permafrost, and developing stable isotope techniques for climate reconstruction.



Dr Ilya Maclean
University of Exeter

Ilya is an applied ecologist broadly interested in understanding and predicting the biological effects of climate change. His research group has pioneered the development of software and tools for modelling microclimate. They are studying how knowledge of fine-scale climate can be used to adapt natural and managed systems to climate change.

Associate Professor Ceridwen Fraser
University of Otago

Crid's research combines molecular ecology with aspects of Earth sciences to understand the processes that shape global patterns of biodiversity. She uses a wide range of techniques to address research questions, including genetics (e.g. metabarcoding and phylogenomic analyses) and ecology, and has a particular focus on the high-latitude ecosystems of the Southern Hemisphere (the sub-Antarctic and Antarctica).

Professor Don Cowan
University of Pretoria

Don is the Director of the Centre for Microbial Ecology and Genomics. His research is in the fields of microbial ecology and microbial genomics, where he and his team use modern 'omics' methods to understand the diversity, functions and adaptations of microorganisms in extreme environments; particularly hot and cold desert soils.

Professor Gustavo Zuñiga
University of Santiago

Gustavo's research focuses on the responses of plants to climate change by studying the biochemical and metabolomics responses of plants.

Professor Margaret Barbour
University of Waikato

Margaret is an experimental plant physiologist. She pioneered novel stable isotope techniques to measure isofluxes between plants and the atmosphere, and developed an underlying theory to explain variation. These techniques and theory have led to new understanding of plant regulation of carbon and water dynamics, with applications in crop production, plant ecological physiology and paleoclimatic reconstruction from tree rings.

Dr Kevin Norton
Victoria University of Wellington

Kevin's research aims to determine which processes are responsible for generating the landscapes that we see today and to measure the rates at which they change. He draws on expertise from across the geosciences (e.g. tectonics, petrology, geochemistry, geomorphology) and applies a variety of methods including cosmogenic nuclides, geochemical tracers, GIS, surveying and numerical modelling to geomorphic problems.

Integration at a glance

Partner Investigator

Chief Investigator

Organisations and universities

- Monash
- QUT
- UoW
- JCU
- UNSW
- UAdelaide
- LaTrobe
- AAD
- ANSTO
- BoM
- GeosciAus
- SA Museum
- WA Museum

Chown, Monash — Director

Robinson, UoW — Deputy Director

Wilson, QUT — Deputy Director

International partners/ collaborators

IAATO International Assoc. of Antarctica Tour Operators

Barbour, UWaikato
Bollard, AUT
Fraser, UOtago
Norton, Victoria
Dept. of Conservation, Te Papa Atawhai

Crowan, Pretoria

Norwegian Polar Institute

Charman • Maclean, Exeter
British Antarctic Survey

Flexas, UIB
Olalla-Tárraga, URJC

Zuñiga, USantiago
Instituto Antártico Chileno

Balco, Berkeley
Brooks, Colorado
Goehring, Tulane

Mackintosh, Monash — Theme 1 Climate

McGeoch, LaTrobe — Theme 2 Biodiversity

Bode, QUT — Theme 3 Stewardship

spatio-temporal statistical prediction — Cressie, UoW — statistical down-scaling

near-shore ecology — Johnston, UNSW — biological invasions

Arblaster, Monash — climate extremes ozone dynamics

env. modelling decision-making — Mengersen, QUT

demographic analyses — Strugnell, JCU — molecular ecology

Cassey, UAdelaide — climate-change ecology biological invasions

HUA, ANSTO — radiocarbon dating quaternary climate

international/ environmental law — Kaye, UoW

paleoclimate reconstruction — Henley, Monash

Stevens, SA Museum — systematics

Gonzalez, QUT — remote sensing robotic vision

Lim, BoM — climate seasonality

Dunbabin, QUT — env. monitoring artificial intelligence

conservation decision theory — Helmstedt, QUT

paleoclimatology — Saunders, ANSTO — paleoecology

quantitative/ spatial ecology — Terauds, AAD — science → policy change

McCormack, Monash — ice sheet modelling

Greening, Monash — microbiology molecular ecology

climate processes — Wheeler, BoM

agent-based modelling — Perez, UoW — participatory decision making

phylogenetics — Wilson, WA Museum — molecular ecology

statistical climate modelling — Zammit-Mangion, UoW

benthic ecology — Stark, AAD — environmental impacts

marine ice-sheet history — Smith, GeosciAus — seabed mapping

ecoinformatics biological invasions — Duffy, Monash

ocean-atmos. interface — Siems, Monash — precipitation

near-shore ecology ecoinformatics — Clark, UNSW — biological invasions

Meredith, ANSTO — hydro-geochemistry

Corke, QUT — robotic vision env. monitoring

McGregor, UoW — paleoclimatology

smart sensing high perf. computing — Barthélemy, UoW — agent-based modelling

terrestrial ice-sheet history — McLennan, GeosciAus — geomorphic mapping

ecological modelling — Adams, QUT — conservation decision making

“Now is the time — we have more knowledge, technology, and expertise than ever before.

It’s our responsibility to use that to help.”

— Kate

Researchers

Dr Justine Shaw
Queensland University
of Technology

Justine is a Senior Research Fellow whose research focus is the conservation of Antarctic and sub-Antarctic terrestrial ecosystems; in particular conservation planning and invasive species establishment in these areas of relatively low human pressure. She examines interactions between indigenous and non-indigenous species, and how invasive species influence ecosystem function.

Dr Sean Bay
Monash University

Sean has a particular interest in understanding how soil bacteria utilise atmospheric trace gases such as hydrogen, carbon monoxide and methane to enhance their survival in extreme ecosystems, utilising ecological soil surveying, molecular, biochemical and computational methodologies. Sean's work is focused on gaining a systematic understanding of microbial biogeography and the carbon and energy acquisition strategies of microbes in Antarctica.

Dr Rachel Leihy
Monash University

Rachel's research focus is on understanding Antarctic and sub-Antarctic ecosystems and biodiversity. She is especially interested in quantifying the patterns and processes underlying biodiversity, and understanding how human activity has impacted Antarctic systems.

Dr Laura Woods
Monash University

Laura is a bioinformatician investigating microbial biodiversity in Antarctic soils by hybridising long- and short-read metagenomic sequencing.

Dr Jasmine Lee
Queensland University
of Technology

Jasmine is a conservation biologist and quantitative ecologist. Her work focuses on understanding biological vulnerability to climate change; predicting how species and ecosystems will respond to climate change impacts; biophysical modelling of the effects of climate change; and determining how we might best plan for a brighter future for Antarctic and sub-Antarctic biodiversity.

Dr Liza McDonough
Australian Nuclear Science and
Technology Organisation

Liza is an environmental researcher specialising in inorganic and organic water chemistry. Liza's expertise lies in nutrient cycling in aquatic environments with a background in radiocarbon, stable isotope and carbon characterisation techniques. Liza also has experience in the reconstruction of past climates (paleo-environmental studies) and statistical/coding skills.

Dr Melinda Waterman
University of Wollongong

Melinda is an early career biotechnologist examining secondary metabolites and protective mechanisms of temperate and Antarctic mosses; in particular, how they cope in various stressful situations such as high levels of UV radiation, water stress and high light levels.

Ms Ruth Davis
University of Wollongong

Ruth's primary research interests are in the fields of international environmental law, marine environmental law and polar law and governance. She is currently working on a PhD thesis concerning the protection of cetaceans under international law.

Ms Krystal Randall
University of Wollongong

Krystal is interested in developing our understanding of how Antarctic plants feel the climate, and how the climate impacts their health, based on where they are growing. She is currently working on a PhD, modelling and mapping ultra-fine-scale microclimates of Antarctic moss beds from first principles, and examining the links between microclimate, and moss health and productivity in Antarctica.

Students
PhD

Lawrence Bird
Supervisor Organisation:
Monash University

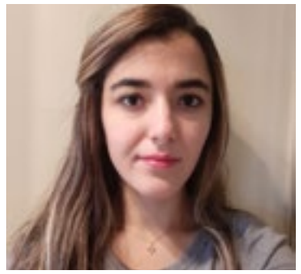
Theme 1
Climate Process
and Change

Arathy Kurup
Supervisor Organisation:
Monash University

Theme 1
Climate Process
and Change

Jessica Macha
Supervisor Organisation:
Monash University

Theme 1
Climate Process
and Change



Teharah Alinajadtabrizi
Supervisor Organisation:
Monash University

Theme 1
Climate Process
and Change

Hao Yin
Supervisor Organisation:
University of Wollongong

Theme 2
Biodiversity Status
and Trendsv

Bao Vu
Supervisor Organisations:
Monash University &
University of Wollongong

Theme 1
Climate Process
and Change

Krystal Randall
Supervisor Organisation:
University of Wollongong

Theme 2
Biodiversity Status
and Trends

Samuel Beale
Supervisor Organisations:
La Trobe University &
Queensland University
of Technology

Theme 2
Biodiversity Status
and Trends

Yifan Wu
Supervisor Organisation:
University of Wollongong

Theme 2
Biodiversity Status
and Trends

Andrea Johansen
Supervisor Organisations:
University of Wollongong
& Australian Nuclear Science and
Technology Organisation

Theme 2
Biodiversity Status
and Trends

Joanna Burrows
Supervisor Organisation:
Queensland University
of Technology

Theme 3
Supporting Environmental
Stewardship

Grace Heron
Supervisor Organisation:
Queensland University
of Technology

Theme 3
Supporting Environmental
Stewardship

Students
PhD

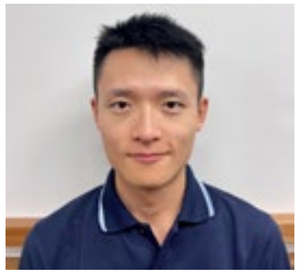
Oakes Holland
Supervisor Organisations:
Queensland University
of Technology & Australian
Antarctic Division

Theme 3
Supporting Environmental
Stewardship

Constance Johnson
Supervisor Organisation:
University of Wollongong

Theme 3
Supporting Environmental
Stewardship

Students
Masters



Zhao Xiang
Supervisor Organisations:
Queensland University
of Technology

Theme 3
Supporting Environmental
Stewardship

Douglass Henness
Supervisor Organisation:
University of Wollongong

Theme 2
Biodiversity Status
and Trends

Research professionals

Rebecca Hallas
Monash University

Theme 2
Biodiversity Status
and Trends

Laura Phillips
Monash University

Theme 2
Biodiversity Status
and Trends

Georgia Watson
University of Wollongong

Theme 2
Biodiversity Status
and Trends

Stewart Bisset
La Trobe University

Theme 2
Biodiversity Status
and Trends

Keita Richardson
Australian Nuclear Science
and Technology Organisation

Theme 1
Climate Process
and Change

Program team

The SAEF Program team is in place to support and facilitate achievement of the ambitions of the SAEF program.

Jodie Weller
Program Manager
Monash University

Working closely with SAEF members, partners and funders, Jodie provides leadership and management of operations, budgets, people and risk to facilitate the delivery of the program's strategic goals.

Ilva Sporne
Deputy Program Manager
Queensland University of Technology

Ilva works in collaboration with the Deputy Director–Career Development and the SAEF Central team to coordinate operations and effective integration across the program.

Andy Cianchi
Senior Logistics Coordinator
Monash University

Andy is based at the AAD in Hobart and works with SAEF members and partners to facilitate the program's field logistics planning and coordination.

Angela Firth
Senior Program Officer
Monash University

Angela works closely with the Director and Program Manager, to provide high-level administrative support and act as the key contact and liaison point for the program.

Diana King
Deputy Program Manager
University of Wollongong

Diana works closely with the Deputy Director–Career Development and the SAEF Central team to coordinate operations and effective integration across the program.

Anna Quinn
Senior Communications Adviser
Monash University

Anna is responsible for leading communication strategies and initiatives in support of SAEF's ambitions.

Appointment Pending*
Data Management Specialist
Queensland University of Technology

The Data Management Specialist will provide informatics capability that lies at the heart of SAEF's synthesis and integration of data and decision making requirements.

*to commence 1st March 2022

Liz Regan
Administrative Support
University of Wollongong

Liz provides administrative support to the Deputy Director–Science Implementation.

*currently on leave

Jodi Barrie
Administrative Support
University of Wollongong

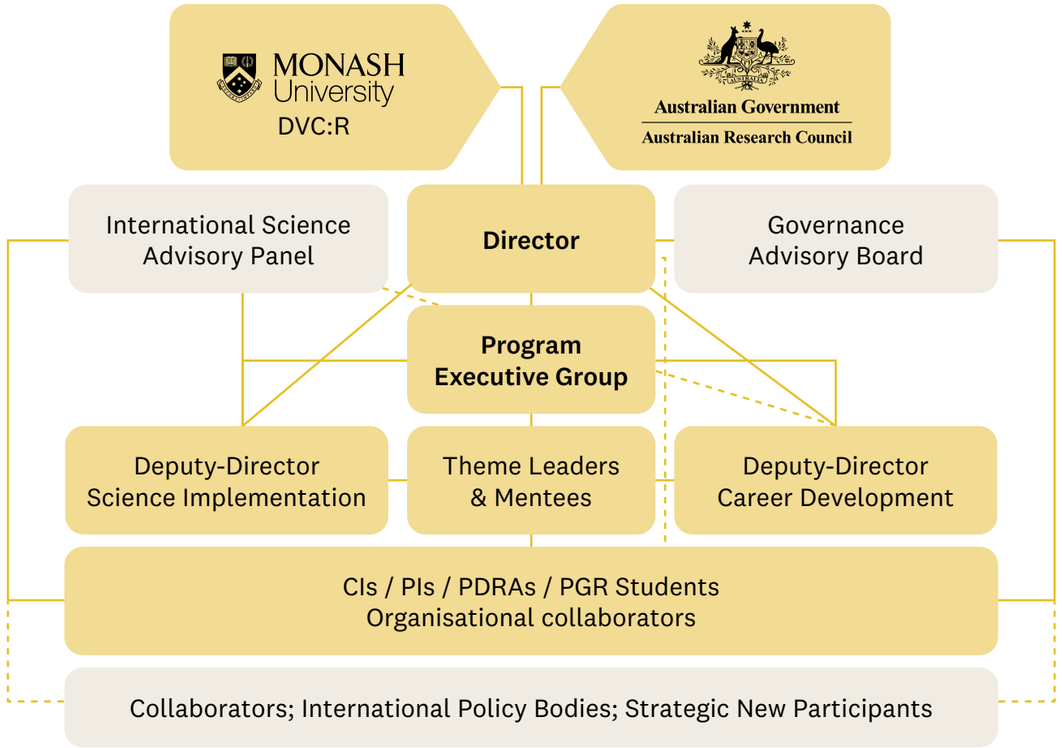
Liz provides administrative support to the Deputy Director–Science Implementation.

*commenced September 2022

Governance

SAEF's governance structure aims to ensure the efficient operation of the program.

The governance arrangements allow for both strategic planning and day-to-day management of the program.



Governance Advisory Board

The SAEF Governance Advisory Board will meet three times annually to monitor and advise the Director on SAEF direction, risk management and performance.

The inaugural GAB meeting was held in November 2021.

Mr Drew Clarke AO PSM FTSE
(Chair)

Drew Clarke is an experienced Board Director with a background in public policy and administration. His 40 years in the Australian Public Service encompassed leadership of applied science agencies, industry innovation programs, data policy, energy policy and technology programs, as well as terms as Secretary of the Department of Resources and Energy and Secretary of the Department of Communications. He is currently Chair of the Australian Energy Market Operator Ltd, a Director of the national science agency CSIRO and a Director of the national broadband company NBNCo. He also has several advisory roles in energy research and technology.

Drew began his public sector career working as a surveyor in Australia and Antarctica. His Antarctic experience includes fieldwork in Enderby Land, chairing the SCAR Working Group on Geodesy and Geographic Information, and leading policy reviews on Antarctic data management and science governance. He has a Master of Science from The Ohio State University, is a Fellow of the Australian Academy of Technological Sciences and Engineering, and a Member of the Australian Institute of Company Directors. In 2016, Mr Clarke was appointed an Officer in the Order of Australia for distinguished service to public administration.

Mr Andrew Grant
Executive Chairman,
Tasman Environmental Investments

Andrew Grant is widely recognised as a carbon market leader, having pioneered much of the development of carbon markets in Australia, New Zealand and South-East Asia. Andrew is an award-winning entrepreneur (Ernst & Young National Entrepreneur of the year—Cleantech) rated among the top-10 industry leaders for carbon markets and the top-50 most influential international sustainability leaders. In 2014, Andrew co-founded TEM, which has grown to become the leading voluntary market service provider in Australasia with active expansion into broader international markets.

TEM is also a significant carbon project development company with a suite of projects across the natural resources sector. Andrew is a leading authority on nature conservation and its intersection with carbon markets. Andrew is a highly experienced board member, having held a range of roles as Chair and Director with government agencies, research centres, not for profits and listed public companies.

Governance Advisory Board

Associate Prof Nancy Bertler
ISAP Chair, Victoria University of Wellington
& GNS New Zealand

Nancy Bertler has led 13 major field campaigns to investigate past change using Antarctic ice cores, including the nine-nation Roosevelt Island Climate Evolution Programme. She is an Associate Professor at the Antarctic Research Centre at VUW, a Principal Scientist at GNS Science, and the Director of the Antarctic Science Platform at Antarctica New Zealand.

Internationally, Nancy served as the inaugural chair of AntarcticClimate21 research program of the SCAR to improve 21st century projections for Antarctica and the Southern Ocean. She leads New Zealand's National Ice Core Research Laboratory and is a member of the 'Melt Ice and Rising Seas' team that was awarded the 2019 Prime Minister's Science Prize.

Dr Nicole Webster
Chief Scientist, Australian Antarctic Division

Dr Nicole Webster obtained her PhD in marine microbiology from James Cook University in 2001, studying how microorganisms contribute to the health of coral reef invertebrates. Moving from the tropics to the poles, Nicole's postdoctoral research was undertaken at the University of Canterbury, New Zealand, investigating the utility of microbes as biomarkers for environmental stress in the Ross Sea, Antarctica.

In 2005, Nicole commenced a role as Research Scientist at the Australian Institute of Marine Science, and in 2017 commenced a joint appointment as Professor at the Australian Centre for Ecogenomics, University of Queensland. Throughout her research career, Nicole has employed experimental and field-based ecological research combined with metagenomic, metatranscriptomic and advanced imaging approaches to uncover the contributions of microscopic life to the health, survival and adaptation of marine species. Nicole also has a strong focus on translating fundamental research outcomes into strategic tools for coral reef management.

In 2021, with an ever-growing desire to play a greater role in positioning science at the forefront of society's decision making, Nicole commenced as Chief Scientist for the Australian Antarctic Division where she is looking forward to developing the innovative and collaborative pathways needed to improve our understanding, management and conservation of this wild and fragile ecosystem.

Mr Ben Playle
Department of Foreign Affairs and Trade

Ben Playle is Assistant Secretary of the Sanctions, Crime and Sea Law Branch in the Australian Department of Foreign Affairs and Trade (DFAT) in Canberra.

Mr Playle served as Deputy High Commissioner at the Australian High Commission in Pretoria from 2015 to 2018, Liaison Officer for the Khmer Rouge Trials in the United Nations Secretariat in New York and Phnom Penh from 2010 to 2011, and First Secretary and Legal Adviser at the Australian Mission to the UN in New York from 2004 to 2007.

He previously served in a variety of roles in Canberra, including in the Legal Division, North Asia Division and South-East Asia Division of DFAT.

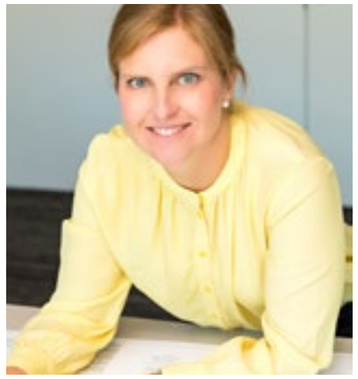
Mr Playle joined DFAT in 2001. He holds a Master of Law from the University of Cambridge, where he was a Cambridge Australia Scholar.

Dr Jane Rumble OBE FRGS
UK Foreign, Commonwealth & Development Office

Jane Rumble joined the Polar Regions Department in the Foreign, Commonwealth and Development Office in 2003, and has been Head of Department since January 2007. In this role, Jane leads on all Antarctic issues for the UK Government, including as Head of the UK Delegation to the ATCM and UK Commissioner to the CCAMLR. She also oversees the UK's engagement with the Arctic Council.

Jane also oversees delivery of the 'Blue Belt' program to enhance marine protection measures around the UK Overseas Territories. A geographer by background, Jane is a Fellow of the Royal Geographical Society. Jane was appointed an OBE at the Queen's Birthday Honours in June 2018 for services to polar science, marine conservation and diplomacy; and was made an honorary Doctor of Science by Leeds University in July 2018. 'Rumble Point' on the Antarctic Peninsula was named after her by the UK Antarctic Place-names Committee in 2021.

Governance Advisory Board



Dr Jodie Smith
Geoscience Australia,
SAEF EMCR Representative

Dr Jodie Smith is an environmental scientist with experience in marine and coastal environments spanning the entire Australian continent from the tropical north, temperate south and Antarctica.

Jodie studied at University of New South Wales, completing an undergraduate degree in environmental science and a PhD in geochemistry in the School of Biological, Earth and Environmental Sciences. She joined Geoscience Australia in 2004. Her initial focus was on estuarine biogeochemistry and she led Geoscience Australia's contributions to the Tropical Rivers and Coastal Knowledge program. Jodie also worked as a volunteer water quality specialist in Vietnam for 12 months.

Jodie joined the GA team in 2010. Her research involves mapping and understanding the physical seafloor environment around the Antarctic margin, including bathymetry, geomorphic features, sediment characteristics and benthic habitats. Her work spans the shallow coastal waters to the continental shelf and slope and into the deep ocean. Jodie collaborates with scientists across multiple disciplines, both in Australia and internationally, and ensures high-quality seafloor data are publicly available to support scientific, strategic and operational applications.

Jodie is the Australian representative on the Antarctic Seismic Data Library System, the International Bathymetry Chart of the Southern Ocean Expert Group and the Seabed 2030 Southern Ocean Regional Mapping Board.

As a government scientist, Jodie has a thorough understanding of Australia's Antarctic strategic and science priorities. She advises GA's executives on Antarctic matters and works closely with the AAD to support Australia's national interests in Antarctica. Jodie has represented the Australian Government and GA at several high-level forums, including at parliamentary hearings and as part of the Australian Government delegation to the ATCM in 2019.

Jodie is a PI in the SAEF research program. She is the GA node lead on the Program Executive Group and the early/mid-career representative on the GAB.

Professor Steven Chown FAA
SAEF Director ex officio

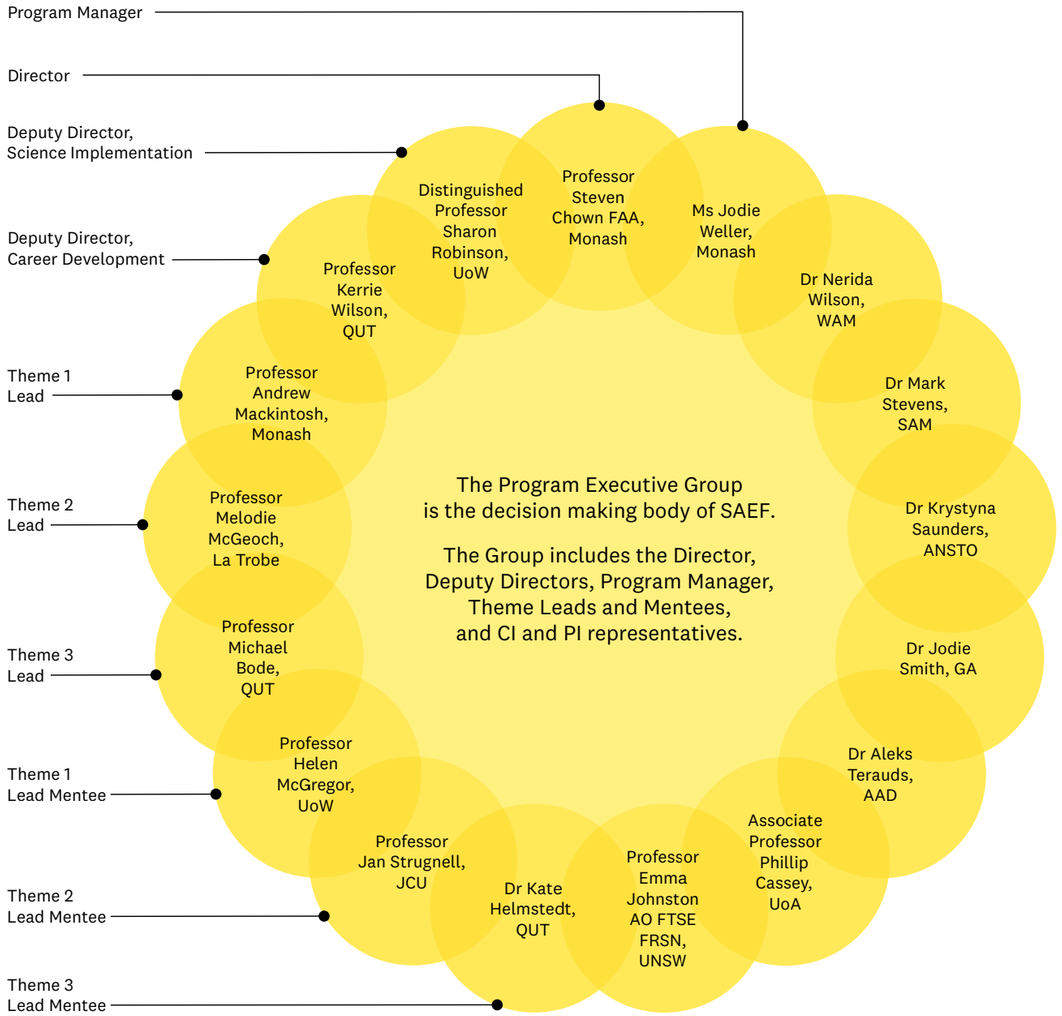
Ms Jodie Weller
Program Manager, Board Secretary

International Science Advisory Panel

Scientific performance and career development will be guided by the ISAP.

Associate Professor Nancy Bertler (VUW & GNS New Zealand) chairs the panel, and its membership will be confirmed in early 2022. The panel will meet twice annually with the first meeting to be scheduled in early 2022.

Program Executive Group



Equity, diversity and inclusion

SAEF is developing the future Antarctic research workforce and has a fundamental commitment to equity, diversity and inclusion.

SAEF promotes a safe and inclusive environment for its diverse community. It celebrates and recognises that its community's diversity of identities brings crucial experience, knowledge and perspectives. SAEF's success and impact will be driven by the diversity in the backgrounds and perspectives of our team.

The Program Executive Group is responsible for equity, inclusion and diversity. SAEF held three culture-focused sessions in 2021.

"The opportunity to meet other members within SAEF and learn more about each other's work.

I also appreciated the focus on establishing a positive culture and collaborative way of working with each other."

Target group	Focus	Facilitator/s	Participants
CIs, PIs, Program Staff	What is success, what does this look like in a SAEF context?	Justine Shaw	25
ECRs Researchers, PhD Students and Research Professional Staff	What drives you? What is your purpose?	Justine Shaw	20
All SAEF	Defining our culture in SAEF	Justine Shaw & Kerrie Wilson	34

Overarching plans and procedures

SAEF has established overarching plans and procedures to guide our commitment to equity, diversity and inclusion:

- Equity, Diversity and Inclusion Plan
- SAEF Grievance Handling Procedure
- SAEF Acknowledgement of Country
- SAEF Ombudspeople
- SAEF Code of Conduct

"SAEF is committed to providing equal opportunities to all participants and additional support to women and other groups who are currently under-represented in the STEM workforce."

— Professor Kerrie Wilson,
Deputy Director–Career Development

4

Establishment

Foundations

SAEF is founded on the simple, yet crucial idea that social and ecological systems are inseparable. The future of the Antarctic and of the Earth System depend on understanding social–ecological systems, communicating the outcomes of considering them together in a research framework, and deploying stewardship that recognises their inseparability.

SAEF's Social–Ecological Systems Foundational Framework

Science strategy

SAEF is being delivered under three themes, each focusing on a major component of the research, feeding into and receiving feedback from the other themes, in recognition of the interconnected nature of evidence and decision making in social–ecological systems.

Interactions are both planned—seeking to address particular challenges—and organic, creating new solutions to previously unidentified problems.

SAEF's activity is structured into 17 major, integrated objectives across the three key themes:

Theme One
Climate Processes and Change

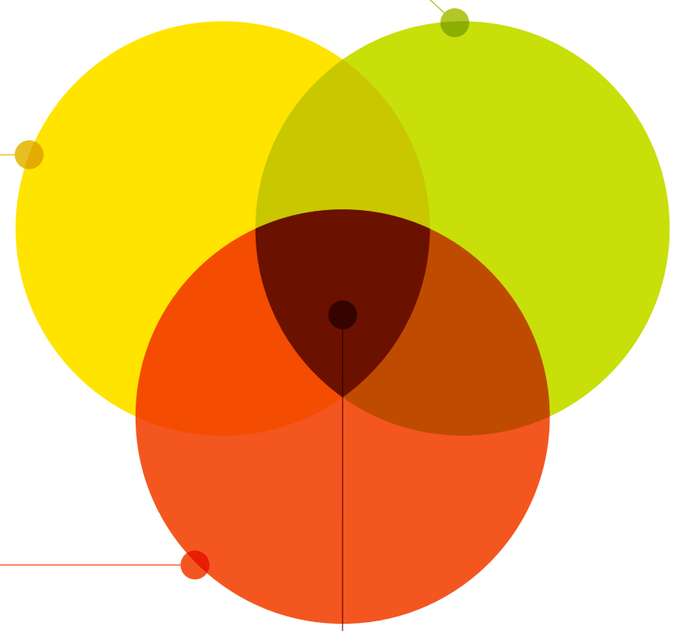
- Large-scale Antarctic climate dynamics: past, present and future
- Constrained climate projections
- Drivers of ice sheet change
- Precipitation processes

Theme Two
Biodiversity Status and Trends

- Environmental characterisation and climate downscaling
- Biodiversity dynamics and biogeography
- Climate change consequences for living systems
- Antarctic life's future energy budget

Theme Three
Supporting Environmental Stewardship

- Conservation planning
- Strategic monitoring frameworks and technology
- Visualising geopolitics
- Optimal monitoring



Across all themes

- Quantifying uncertainty
- Sensing platform technologies
- Rapid information deployment
- Skills developing in an interdisciplinary setting
- Workforce evolution

SAEF projects

SAEF's science is further structured into 27 interrelated projects that are designed to ensure visibility of components and to explore further connections. These projects also serve as a means to ensure that the field logistics components are delivered at the scale required to ensure the science outcomes that are desired.

At the heart of SAEF's approach lies collaboration—among disciplines, national researchers, international colleagues and others seeking the maintenance of the Antarctic region for peace and science through research and its application to inform policy.

SAEF provides a broad range of professional development opportunities to prepare staff and students for diverse career paths in Antarctic research, management and governance, and across the sector.

SAEF's projects cover all of the objectives and often span multiple themes. See the Table below.

Icon	Project #	Short title
	P2	Past Climate
	P3	Ocean
	P4	Westerlies
	P5	Surface Climate
	Pv6	Ice Sheets
	P7	Vanderford
	P8	Stats
	P11	Ice Loss
	P12	Precipitation
	P13	Paleo
	P14	SciComms
	P15	Info Biodiversity
	P16	Biodiversity Change
	P17	AIoT

Icon	Project #	Short title
	P18	Chemosynthesis
	P19	Lakes
	P20	Connectivity
	P22	Moss
	P23	Remote Sensing
	P24	Coastal
	P25	Invasion
	P26	Drivers
	P27	VOI
	P28	Conservation
	P29	Decision Support
	P31	Legal
	P36	Regime Shift

Building Australia's research capacity with robots

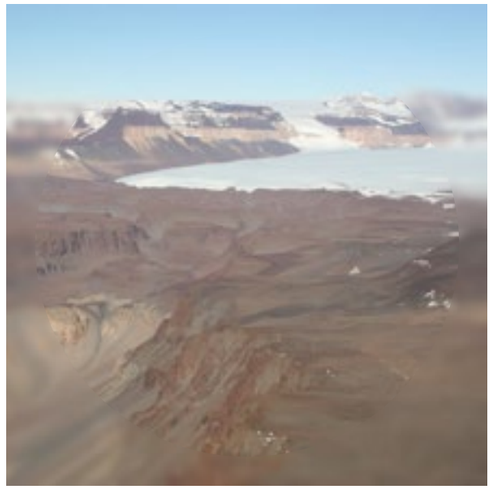
The Antarctic research community could soon have access to new robots to support their research in this remote and hard-to-reach environment.

SAEF researchers Peter Corke and Matthew Dunbabin from Queensland University of Technology's Centre for Robotics are working on two new robot prototypes that will improve SAEF's research capacity in the Antarctic region.

The health of Antarctic moss is closely linked to the overall health of Antarctica's climate. Therefore it is important that it is frequently monitored. Scientists are currently able to assess this via drones, however they are limited in their ability to capture the highest level of image resolution due to needing to stay a certain distance from the moss to protect it. One project, led by Peter, seeks to develop a ground mobile robot which can capture higher quality images and enable a more in-depth analysis of the moss health. Promising progress was made in 2021 and the team is keen to find ways to translate this to real survey work in the Antarctic environment.

Meanwhile, Matthew's team has been developing two robotic prototypes; a self-powering rover and an underwater vehicle. A scale prototype rover has been constructed for developing systems to survive the entire Antarctic winter. The underwater robot can fit through holes drilled into the ice and carry novel sample collection tools. The ambition is that this could be used to access and collect samples in ocean environments in ways that are more efficient than current methods.

Living on air



SAEF researchers Chris Greening, Steven Chown and Sean Bay based at Monash University have redefined our understanding of the minimum requirements for life on Earth.

Together with PhD student Pok Man Leung, they have discovered that Antarctic bacteria survive by scavenging hydrogen from the air as fuel. By studying 451 different kinds of bacteria from East Antarctica they found approximately 90% of them survive this way.

These incredible bacteria live in the ice-free desert soils north of Mackay Glacier where few higher plants or animals can prosper due to little available water, temperatures below zero and pitch-black polar winters. Despite these harsh conditions, hundreds of bacterial species thrive, making for a unique and diverse ecosystem.

Most of the bacteria the team studied use a process called chemosynthesis. Rather than relying on sunlight to power the conversion of carbon dioxide into biomass, they use inorganic compounds such as the gases hydrogen, methane and carbon monoxide. The most reliable source of these energy-rich compounds is the air.

One by-product is water. This is an important bonus for Antarctic bacteria - they live in an area where water is unavailable because it is permanently frozen so the ability to generate water from “thin air” is significant.

Providing advice to the Australian Antarctic Division

Kerrie Wilson and Justine Shaw from the Queensland University of Technology have shared their advice with the AAD to assist them with environmental protection of the Antarctic.

This has included collaborating with scientists based at the AAD to identify invasive species, for example terrestrial invertebrates, terrestrial plants, marine plants and invertebrates. Justine has co-facilitated workshops with an international group of experts working in biosecurity and environmental management. The aim of these workshops was to determine the risk of their arrival and establishment in Antarctica, alongside the likely impacts on biodiversity. SAEF researchers have also been involved in research to inform the feasibility and application of eDNA tools for surveillance and monitoring of invasive species in Antarctica.

In October, SAEF researchers held two workshops with AAD staff and research scientists which explored the concept of “cost” as it relates to area protection, conservation planning and structured decision-making in a global context. These workshops have provided an opportunity for AAD staff to learn more about invasive species biology and conservation planning.

As a result, a report will be written for the Department of Agriculture, Water and the Environment (DAWE) on eDNA and its potential application for biosecurity surveillance and management in Antarctica. Justine will provide input to the report and AAD staff will have the opportunity to have input to a manuscript arising from the cost workshop.

5

Engagement

Partner organisations

SAEF brings new collaboration to the Australian Antarctic research landscape.

Nationally, the team includes researchers at seven universities, two museums and four public sector organisations.

International researchers and research organisations playing a central role in SAEF include researchers from Chile, New Zealand, South Africa, Spain, the UK and the USA, as well as program collaborators from Chile, New Zealand, Norway, the UK, and the International Association of Antarctica Tour Operators (IAATO).

Partner universities, research organisations & program collaborators

Monash University

Queensland University of Technology

University of Wollongong

University of New South Wales

James Cook University

La Trobe University

University of Adelaide

Australian Antarctic Division

Australian Nuclear Science and Technology Organisation

Bureau of Meteorology

Geoscience Australia

South Australian Museum

Western Australian Museum

Auckland University of Technology, New Zealand

Berkeley Geochronology Centre, USA

Tulane University, USA

University of Colorado, Boulder, USA

University of Exeter, UK

University of the Balaeric Islands, Spain

University of Otago, New Zealand

University of Pretoria, South Africa

King Juan Carlos University, Spain

University of Santiago, Chile

University of Waikato, New Zealand

Victoria University of Wellington, New Zealand

British Antarctic Survey

Chilean Antarctic Institute

International Association of Antarctica Tour Operators

Norwegian Polar Institute

NZ Department of Conservation

Domestic engagement

SAEF's domestic engagement has taken two major avenues in the first six months of the Special Research Initiative.

First, extensive discussions have taken place between the SAEF Director and the Directors of the Australian Antarctic Program Partnership and the Australian Centre for Excellence in Antarctic Science, in conjunction with the AAD and the ARC, to ensure further complementarity and effective coordination between the three large programs, and the research conducted within the AAD. Documentation to illustrate effectively the complementarity of the various areas of endeavour of each of the major programs is under development.

Second, discussions have been held between SAEF and newly appointed AAD Chief Scientist. Research alignment has been sought, in particular in the context of the new Australian Antarctic Science Strategic Plan and the recommendations of the review of the AAD Science Branch. The SAEF Director has agreed to contribute a proportion of his time to the decadal planning process envisaged by the recommendations of the Science Branch Review.

↑ Antarctic Program Partnership

↑ Australian Centre for Excellence in Antarctic Science

Internal activity

In March 2021, SAEF brought our whole team together for two days of planning workshops. The group kicked things off by sharing what drew them to SAEF.

"Connecting with others determined to make a difference in protecting Antarctica"

"The opportunity to connect my science with decision makers"

"Safeguarding a unique and vital environment"

"The ambition of the program"

"Opportunity to work across disciplines"

"The opportunity to work with such a diverse team"

Next, everyone discussed their visions for SAEF.

They then broke into groups to develop a fictional news article for Nature that reflected those visions.

nature

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NEWS AND VIEWS · 17 MARCH 2028

Unique Antarctic life identified and protected following catastrophic ice shelf collapse

Multiple researchers have worked together for the past 7 years to predict and identify the impacts of the Shackleton Ice Shelf collapse. This catastrophic event has exposed the area, both terrestrial and marine, to an array of natural and anthropogenic impacts.

Alarm bells were sounded years earlier by the combination of SAEF climate and ice sheet modelling experts (Felicity McCormack and Julie Arblaster). They found in 2035 that this ice shelf was vulnerable to collapse. This event was also forecasted by palaeo-records contained within lake sediments from the Last Interglacial when the world was slightly warmer than present. Following the unprecedented collapse of this 30,000 km square ice shelf in 2034, a 2037 cruise of the new Australian Icebreaker Nuyina allowed marine genomics scientists (Jan Strugnell and Scerida Wilson) to collect evidence to past connectivity of this pristine environment and suggest links to warmer periods.

The once inland Bunger Hills after the collapse of the ice sheet is now highly a coastal environment. The terrestrial team have been documenting the area under the SAEF program over the past 7 years and have identified tremendous changes in ecosystem processes from the land to the ocean. Moreover, there was growing international interest in building a large station and potentially a major runway.

A team led by Kerrie Wilson and Stuart Kaye have worked with policy makers to ensure the exposed, vulnerable Bunger Hills environment is now recognised as an Antarctic Specially Protected Area. There will now be extensive efforts to monitor changes in biodiversity and productivity in the Bunger Hills and the waters once beneath the Shackleton Ice Shelf.

Saving the last pole

This month key global leaders at COP 34 felt the final frozen touch of the last polar ice cap. Immersed in the sensory surrounds of a detailed 4D model of East Antarctica they witnessed melting ice sheets and zoomed into specific locations in the remarkable Vestfold Hills where ragged looking penguins clumsily explored newly exposed rock. Virtually diving underwater they saw the telltale shimmer of a freshwater melt-plume descend on strange invertebrate gardens, withering unique communities of sponges, corals and anemones, then moving along the seafloor they watched marine snow draw carbon pellets down to the deep. Travelling finally, forward through decades, they emerged on the other side of the Southern Ocean and witnessed the waves of our melted polar ice, lap high on the walls of their own megacities. A world drowned by an unsafe pole.

This remarkable virtual journey is just one product from a synthetic research project called SAEF. Initiated just 7 years ago, SAEF has the express objectives of securing Antarctica's future and growing awareness of its significance to humanity. This interdisciplinary research initiative brought together state of the art climate modelers with ecologists and social scientists to work on the critical questions that will deepen our understanding of Antarctica and how to use that information to influence those that decide its future. Over 7 years the team worked in creative ways to reveal the causes and patterns of change in order to forecast Antarctica's future and plan its conservation. To date, over 10 million people across the globe have accessed the SAEF experiential model to witness this synthetic evidence-based visual journey through Antarctica's future and the experience is changing hearts and minds. Emerging from this sensory overload, the key global leaders, surrounded by their senior bureaucrats holding copies of SAEF's final report, voted for sharper, shared carbon emissions targets. They voted to keep Antarctica in the freezer.

One SAEF Antarctica

Through remarkable global cooperation, science has facilitated the seemingly impossible. Through 8 years of data collection, synthesis, visualisation and innovation, Antarctic Treaty Parties now share a collective vision of how to best manage and protect Antarctica. Importantly, Parties have agreed upon (1) the global value to humanity of the incredible data created and brought together by SAEF interdisciplinary scientific consortium, (2) the acceptance of contrasted interpretations of information provided but the need to reach a global consensus and (3) a common set of interventions and regulations that will secure a One Safe Antarctica for the future generations.

SAEF delivered: Coordinated observational network generating new data of Antarctic change and a framework for using these data in informed and collaborative stewardship and decision making
Synthesis of data and decision impacts communicated through the One SAEF Antarctica strategic game

By playing the One SAEF Antarctica game, Antarctic Treaty Parties were able to better understand environmental impacts, potential management strategies and effective tools and for the first time come to a consensus agreement on the long term future management of the continent.

We shared our views about how to make integration of our program intentional.

- "Make project workshops open to all"
- "Funded research visits across institutions"
- "ECR and student exchanges"
- "Cross-node and cross-theme workshops"
- "Opportunities for continued conversations over the next 7 years"
- "Share our Instagram, LinkedIn and Twitter accounts so we can learn about each other organically"
- "Coffee meet-ups over Zoom... to help get to know each other and create opportunities for ideas to percolate"
- "Commitment to genuine communication"
- "Problem-centred meetings instead of theme-based would be good"

We discussed what values matter to our researchers.

- "Collaborative — we think beyond ourselves and respectfully draw on each others expertise to succeed"
- "Inclusive — our approach to research considers all perspectives in the team to deliver innovative science"
- Ambition — optimism and pushing barriers to realise our vision of quality science, people and careers"
- "Diversity — of thought, culture, age, ability, discipline, gender, experience, sexual orientation"
- "Resilience — Antarctica is changing and that is difficult to watch."
- "Benevolence — caring about the science, each other, our different disciplines and experiences, for the next generation of scientists, humanity and the penguins"

What did researchers value most over the two days?

- "The opportunity to connect"
- "Great to finally meet Drew and get his powerful insights."
- "Everyone was so generous and excited. It was fun."
- "Meeting everyone"
- "Learning about all the ambitious research objectives and goals"
- "The gender balance"
- "Being inspired"

Awards

Steph McLennan
ACT Tall Poppy

Steph McLennan has been recognised as a Tall Poppy by the Australian Institute of Policy and Science. As a winner, Steph was engaged in activities to promote interest in science among school students and teachers, and to enhance the appreciation of science in the broader community.

Between lockdowns she was able to undertake a few school visits and Zoom sessions. One of her favourites was a workshop at a Canberra school for Year 9 and 10 girls at which she got them to plan an Antarctic expedition. They received background materials making them “experts’ in different areas, such as clothing, biosecurity, food, shelter and transport, and worked in teams to plan a voyage on the RSV Nuyina or to deploy sensors on the Sørsdal Glacier.

Jan Strugnell
JCU Award for Excellence

Jan Strugnell has been recognised for her outstanding achievement in leadership in JCU’s annual Excellence Awards.

This award is for Jan’s work in removing barriers for women in science at the university. This includes being part of a team that developed JCU’s successful application for an Athena Swan Bronze Award, for facilitating screenings of documentaries such as *Picture a Scientist* and *The Bystander Effect* and hosting subsequent panel discussions to raise issues surrounding gender equity for women in science. She has also been an active mentor for female HDRs, ECRs and MCRs.

Sharon Robinson
Top Researcher In Biophysics

Distinguished Professor Sharon Robinson’s year has been bookended by major awards that highlight her outstanding contributions to advancing Antarctic science and reducing the impacts of climate change.

In January, Sharon was awarded the Innovation Achievement Award in Wollongong City Council’s Australia Day 2021 Awards, which celebrate the city’s sporting stars, community volunteers, creatives and innovators. In November, she was identified as the top researcher in her field of biophysics by *The Australian’s 2021 Research Magazine*.

This year Sharon was also a finalist for the Australian Museum Eureka Prize for environmental research and science leadership.

Steven Chown
Medal for the 30th Anniversary of the Madrid Protocol

Steven Chown received extraordinary recognition from the French foreign ministry when he was awarded the medal commemorating the 30th anniversary of the signing of the Protocol on Environmental Protection to the Antarctic Treaty (‘the Madrid Protocol’). This significant international agreement designates the entire continent as a ‘natural reserve, devoted to peace and science’.

The award recognises Steven’s extensive and highly regarded contributions to the protection of the Antarctic environment.

This year Steven also became a Fellow of the Australian Academy of Science (AAS).

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Impact

“We need to secure Antarctica’s environmental future for the health of our planet and all life within it.”

— Barbara

SAEF researchers have contributed 17 presentations to government, NGOs, business and civil society, including:

Government

Antarctic Treaty System

SAEF researchers co-led the drafting, for SCAR, of a Working Paper entitled Antarctic and Southern Ocean Climate Change in a Global Context presented to the XLIII ATCM under Agenda Item 16 and to the Committee for Environmental Protection under Agenda Item 7a.

That paper played a significant role in the adoption by the Antarctic Treaty Consultative Parties of Resolution 8 from the meeting, recommending further action on and research about Antarctica in a changing climate.

SAEF researchers also co-led the drafting of an information paper to the XLIII ATCM entitled *Antarctic Wilderness and Inviolate Areas*, jointly developed by New Zealand, the Netherlands and Australia and considered under Committee for Environmental Protection Agenda Item 13.

Queensland University of Technology visit by the Honourable Meaghan Scanlon MP Minister for the Environment and the Great Barrier Reef and Minister for Science and Youth Affairs in the Queensland cabinet

On Friday 26 November 2021, the Honourable Meghan Scanlon MP visited QUT. SAEF Deputy Director, Professor Kerrie Wilson and Theme 3 Lead and Mentee, Professor Michael Bode and Dr Kate Helmstedt presented the SAEF program to the Minister.

The SAEF investigators briefed the Minister of the present and looming environmental and ecological threats in Antarctica; the need for monitoring, modelling and managing ecosystems to protect them and the expertise SAEF brings together to secure Antarctica's future.

Interactions with AAD Policy and International Branch

SAEF members met with members of the AAD Policy and International Branch to explore focal areas for future research and emerging management issues; develop pathways for effective science policy interaction; and make a contribution to the XLIII ATCM via an information paper on wilderness presented by Australia and other Antarctic Treaty Consultative Parties.

The discussions with the AAD are complemented by focused research and management engagement with Natural Resource and Environment (Tasmania) and Tasmania Parks & Wildlife Service given the responsibility of these agencies for the conservation management of Macquarie Island.

International bodies

Many of our SAEF CIs and PIs across all our themes hold roles on national and international advisory committees.

SAEF researchers have contributed to the development of information for the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Invasive Alien Species Assessment. The extent of terrestrial invasions, the impacts they have had on the sub-Antarctic islands and the Antarctic continent, and currently implemented biosecurity options were the focus of these contributions, which remain under review at IPBES. The prevention of the introduction of and impacts by alien (or non-native) species is one of the highest priorities of the Antarctic Treaty's Committee for Environmental Protection.

Professor Melodie McGeoch was appointed as the Global Biodiversity Information Facility (GBIF) Science Committee's first Vice-chair following nomination by the Australian Head of Delegation to GBIF and election by the 40 Voting Participant countries. This Standing Committee of the GBIF Board provides high-level advice to the Secretariat on the GBIF Work Program and is strategically well aligned with the biodiversity informatics objectives of Theme 2.

In 2021, Dr Felicity McCormack, was appointed Co-Chair of the International Union of Geodesy and Geophysics (IUGG) Joint Commission on Ice–Ocean Interactions (JCIOI). Following the IUGG meeting in Montreal in July 2019, the International Association of Cryospheric Sciences (IACS) and International Association for the Physical Sciences of the Oceans (IAPSO) established the JCIOI in recognition of the need for glaciologist and ocean scientists to interact and collaborate on this topic.

JCIOI was formally established in January 2021. Its aim is to address knowledge gaps in ice–ocean interactions by globally coordinating and engaging in research and development related to understanding, observing and modelling these interactions. This will involve research under ice shelves, at the ice–ocean front in tidewater glaciers and at the sea surface in the marginal ice zone.

Dr Aleks Terauds is Co-Chief Officer of the SCAR Scientific Research Programme–Integrated Science to Inform Antarctic and Southern Ocean Conservation (Ant-ICON). Ant-ICON will answer fundamental science questions (as identified by the SCAR Horizon Scan) relating to the conservation and management of Antarctica and the Southern Ocean.

It will carry out high-quality research to drive and inform international decision making and policy development. While there is a strong biological focus for much of the proposed research, the scientific research program will integrate research from multiple disciplines, complement existing SCAR activities and engage with policy bodies to achieve conservation outcomes in Antarctica and protect Antarctic environments and biodiversity.

Civil society

Antarctica Day Program

In collaboration with the Early Start Discovery Space, University of Wollongong, SAEF researchers put together a two-week program with hands-on activities aimed at kids (up to 10-years-old) that involved looking down microscopes and focusing on Antarctic landscapes, animals, plants, equipment, vehicles, clothing and stories. The program included images (e.g. terrestrial moss banks), props (boots, clothing, pelican cases) and live Q&A sessions where the kids posed both live and pre-prepared questions about anything related to Antarctica.

National Science Week — Women in STEM

Dr Nerida Wilson, SAEF PI and Manager of the Molecular Systematics Unit at the Western Australian Museum (WAM) was one of the role models and panel members that participated in the WAM's National Science Week–Women in STEM panel. Nerida, along with four other "women in STEM" provided an opportunity for school students to chat with them about their work, ask questions and discover what inspired them to work in the STEM field, what they're passionate about and why.

World Climate Research Program Workshop

Bureau of Meteorology SAEF PI, Dr Eun-Pa Lim presented her research "Understanding and predicting the 2019 Antarctic spring polar vortex warming and its impacts" as part of a World Climate Research Program Workshop on Extremes in Climate Prediction Ensembles hosted in Busan, South Korea, in October 2021.

This was an online workshop focused on subseasonal, seasonal, annual to decadal, and longer-term prediction ensembles to improve prediction and understanding of extreme weather and climate events. Eun-Pa presented research that investigated the very rare Southern Hemisphere stratospheric polar vortex weakening event that occurred in 2019 for its monthly evolution, dynamics, predictability and impact on the surface climate, including the devastating Australian bushfires on the far eastern seaboard of New South Wales.

This research was a successful outcome of an active international collaboration.

Australian Council of Learned Academies (ACOLA) and the Parliamentary Library, Independent Evidence-based Briefing to Parliament

On 14 April 2021, SAEF Director Professor Steven Chown and Scientia Professor Rosemary Rayfuse presented a seminar entitled *The Antarctic. Strategic Competition and the Future of the Legal Regime.* The Vital Issues Program is a series of seminars organised by the Parliamentary Library for the benefit of Senators and Members.

The aim of the seminar program is to bring notable speakers to the Parliament to give Senators, Members and their staff the opportunity to hear—firsthand—expert opinion on a range of currently relevant topics.

A recording of the presentation is available through this QR code.

World Economic Forum — Strategic Intelligence

The 'Antarctic' Insight Area on the World Economic Strategic Intelligence Platform was launched.

This briefing is curated in partnership with Monash University SAEF CIs Professor Steven Chown, Professor Andrew Mackintosh and Dr Felicity McCormack, and SAEF Postdoctoral Fellow Dr Rachel Leihy. The World Economic Forum has developed strategic intelligence capabilities to help make sense of the complex forces driving transformational change across economies, industries and global issues.

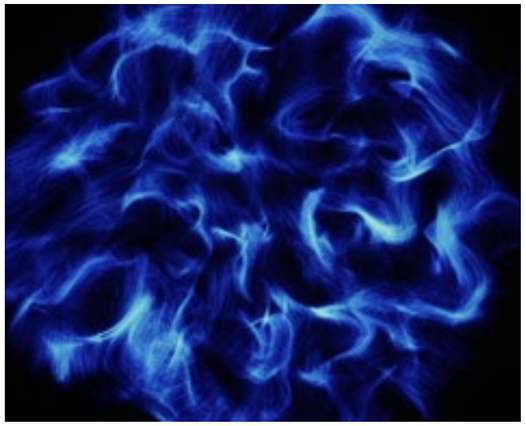
World Economic Forum Agenda — Road to COP26

"Antarctica has benefitted from extraordinary global cooperation. Are its days numbered?"

This commentary by Professor Steven Chown outlines the challenges ahead for Antarctica, and the role it plays in the Earth System. These include:

- Global human activities are eroding the isolation of the Antarctic region in major ways, melting the continent's ice sheets and influencing weather.
- Regulatory decisions about the ATS grow more difficult.
- Without ambitious targets being hit at COP26, Antarctica will significantly disrupt global systems.

Professor Chown explains that while there are views that the future looks bleak, an alternative, more deliberate future is possible—a future that recognises the need for political dexterity, innovation and appreciation for variation in approaches and the limits of knowledge.



Artistic Works: Solveig

Solveig is the work of a collective of artists, with advice provided by Professor Steven Chown, available via the QR code below.

Solveig is an ecosystem of memory, ice and flux inspired by the fugitive terrain of Antarctica.

Three musicians play in Solveig. Every sound they make is collected in a system of infinite sustain, dispersed via elegant sound design. Haunting colour spectrums move slowly across a canopy of holographic gauze, almost coalescing into occasional images, before dispersing once more into light.

Solveig aims to build empathy with our ecosystem by creating an experience that draws people into a personal connection with Antarctica.

It highlights our collective complicity in the endangerment of this fragile wilderness, and ways in which we can change the trajectory of a warming world.

Workforce development

SAEF's Leadership, Mentoring and Career Development Plan articulates our overarching goal to deliver a new Antarctic interdisciplinary workforce.

SAEF provides an integrated development program for HDR students, researchers at every career stage, leaders and professional staff.

The program includes cross-node and partner organisation supervision; personalised skill needs assessments and induction; an annual calendar of workshops and training opportunities; and a range of mentoring and networking opportunities.

Mentoring

- Professional Development
- Research Leadership

Training

- Skills development workshops
- Science/policy interactive training
- Media training
- Success in interdisciplinary and transdisciplinary settings

Our Mentoring Program was formally launched in November 2021. The Program is facilitated by Linda Betts. Linda is an organisational consultant with broad experience across university, research and health sectors including mentoring programs, mentoring for women's advancement, faculty programs focused on early/mid-career researchers, and professional staff programs.

2021 Training and workshops

SAEF held a series of Workshops in 2021, covering a range of topics of interests and relevance to our Program.

- Antarctic Field Experiences
- Antarctic Policy Workshop
- Communications
- Quantitative Skills Workshops
  - Game theory
  - NGO strategies
  - Clustering
  - Modularity
- Research Workshops
  - Path to Impact and Stewardship
  - Sensing Platforms, Tools and Technology
- Success in interdisciplinary and transdisciplinary research

Workshop feedback

"Would love to do this in person—the reason the breakout groups worked well is because everyone clearly really wanted to meet and talk with each other."

"The opportunity to meet other members within SAEF and learn more about each other's work.

I also appreciated the focus on establishing a positive cultureand collaborative way of working with each other."

"I really enjoyed the interactive and immediate-response tools that Phil used during the interdisciplinary research workshop. The ability to chat to people randomly assigned in the breakout rooms was also great...

I feel like a welcome member of the broader team now."

"There is great value in these workshops, particularly for younger and less experienced researchers."

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Outlook

“We must understand the impact of climate change on Antarctica to protect and preserve not only its unique and delicate ecosystem, but the entire planet for future generations.”

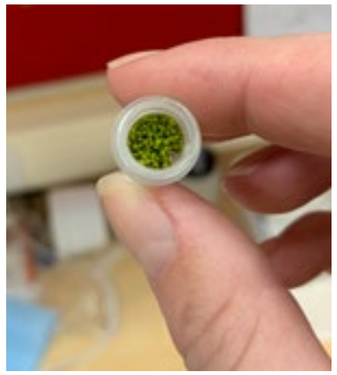
— Johan

Research

Throughout 2022, SAEF will continue to ramp up its research capability and endeavours.

Theme 1: Climate Processes and Change

In Theme 1, one of the most exciting developments will be the commissioning of the ~$6M clean laboratory at Monash University for processing Antarctic rock samples. Assessments of standards and both precision and accuracy will be undertaken in collaboration with our Australian partners at ANSTO, and our international collaborators at the Berkeley Geochronology Center and Tulane University in the USA. The first samples to be processed through the facility are expected to arrive from the Vanderford Glacier region close to Casey Station. Further fieldwork at the Vanderford Glacier and a new campaign in the Framnes Mountains close to Mawson Station will deliver further samples in the Antarctic summer season of 2022/23.



Theme 2: Biodiversity Status and Trends

Theme 2 expects several key results from approaches to integrate essential biodiversity variables with value-of-information approaches. At its heart, this work involves drawing together legacy data, analysing them in modern ways using new biodiversity informatics approaches, and finalising survey designs to complement these data and derive the most from downscaling and uncertainty reduction approaches. Outcomes from microbial ecology and resurvey of long-term field sites in the Windmill islands are anticipated to reveal new insights into the functioning of life at very low temperatures and the changes that are proceeding in response to changes to the Southern Annual Mode, in East Antarctic Terrestrial Systems.

Theme 3: Supporting Environmental Stewardship

Researchers in Theme 3 expect to deliver new, spatially explicit products about the values across the Antarctic—in East Antarctica in particular—identified by the Protocol on Environmental Protection to the Antarctic Treaty as central to Antarctica's environmental stewardship. Visualisation of these values at a range of scales, and contributions to the Integrated Digital East Antarctica—to be developed as a recommendation of the AAD Science Branch Review—are essential components of upcoming research and development.

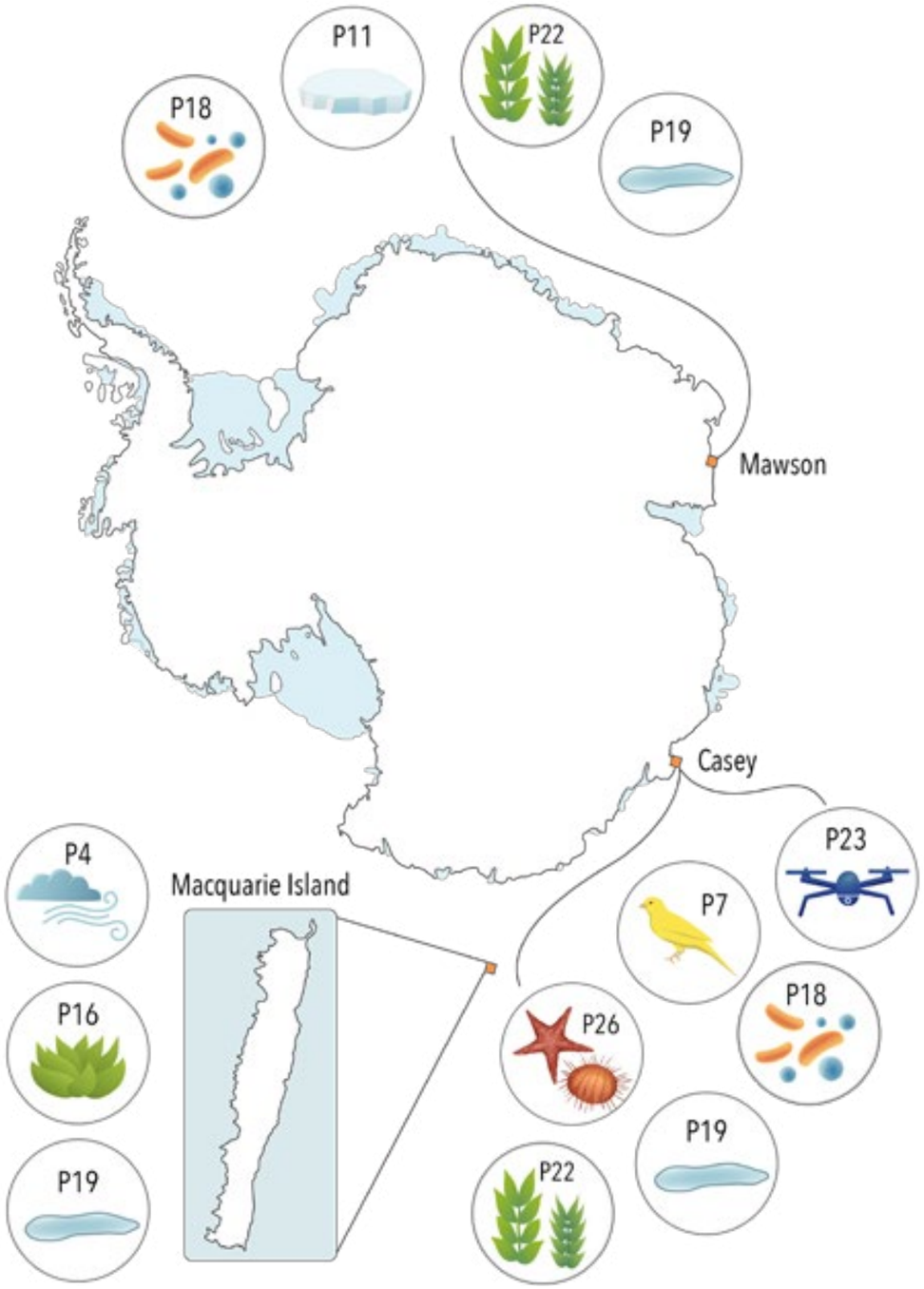
SAEF expects a growing number of students to join across our university partners and in collaboration with others both domestically and abroad. Growth in researcher numbers and an increase in cross-institutional and interdisciplinary research is much anticipated given the return to more normal domestic and international research practice.

This return to more usual practice will also signal the debut of SAEF on the international conference stage, notably through the Open Science Conference of the SCAR. A suite of other domestic and international meetings will see the participation of SAEF investigators, researchers and students.

The translation of benefits from research is expected to unfold in two distinct ways. First, SAEF is planning to contribute to papers that will be presented for discussion within the ATS. Second, Dr Steph McLennan of GA will undertake a three-month secondment with the Treaties and Territories Section, Policy and International Branch at the AAD in early 2022. The purpose of the secondment is to gain a stronger understanding of the interaction between science, environmental management and the ATS.

Forthcoming field work

These are the planned locations and the projects that will undertake field work in the 2021/22 and 2022/23 field seasons.



SAEF Projects involved in field work 2022

Location	Icon	Project #	Short title
2021/22 Season			
Casey		P22	Moss
Casey		P7	Vanderford
Casey		P18	Chemosynthesis
Casey		P19	Lakes
2022/23 Season			
Casey		P26	Drivers
Casey		P23	Remote Sensing
Casey		P22	Moss
Casey		P7	Vanderford
Mawson		P11	Ice Loss
Mawson		P18	Chemosynthesis
Mawson		P22	Moss
Mawson		P19	Lakes
Macquarie Island		P16	Biodiversity Change
Macquarie Island		P19	Westerlies
Macquarie Island		P4	Westerlies

“Antarctica brings out in me that sense of wonder; a sense that was so much easier to capture as a child, but nevertheless a reminder that the world is an amazing place.”

— Ruth

Outlook for engagement

As part of the Strategic Plan, SAEF members have set out the intended outcomes, impacts and translation pathways of our work across a range of areas. To realise these intentions in a productive, effective manner requires the development of an implementation plan in collaboration with the intended beneficiaries. Achieving this is a major task for 2022. Alignment, through leadership, will also be sought with a major drive across a range of areas to establish the best ways of assessing impact of the Australian Antarctic Science Program.

In part, the success of the science policy aspects of implementation depends on the availability of a policy forum that will:

- Consider science outcomes that are imminent and that relate to domestic and international policy, including the ATS (ATCM, CEP, CCAMLR) and other international decision-making bodies (e.g. UNFCCC, ACAP , UNEP), providing early opportunities to consider the likely impact of and deployment of knowledge from those outcomes;
- Provide draft papers, emerging from the science, for consideration by AAD, DFAT and potentially other departments, for delivery to a range of forums, but with a focus on the ATS;
- Identify areas of emerging policy concern that require either immediate knowledge synthesis or longer-term scientific research and that can be incorporated into both research and research planning;
- Engage with the diversity of views on the nexus between global Antarctic geopolitics, science and Australia’s position and strategy, while maintaining the confidentiality of exchanges about these matters, through annual forum discussions.

The delivery of such a forum in partnership with others in the Australian Antarctic Program will be a major further focus of activity in 2022.

With the slow return of in-person activities across civil society, government and NGOs, SAEF expects to lead and participate in a broad array of engagement activities over the forthcoming year.

Developing a ‘SAEF Space’ for ECRs

Joanna Burrows
PhD Student

The combination of commencing a PhD during the pandemic and being one of the first students to join SAEF meant that Joanna Burrows found it difficult to make connections and navigate her new environment. Moving into Antarctic research for the first time also meant that she was finding it hard to keep up with the more experienced investigators around her.

“A few of my peers at Queensland University of Technology and I reflected on our similar experiences and came up with the idea to establish a ‘safe space’ for students and other early career researchers in SAEF to get to know one another, ask each other questions, and potentially generate opportunities for collaboration,” Joanna explained.

This has led to the concept of SAEF Space, which will be launched in 2022 with all SAEF ECRs welcome to join. Goals for 2022 include establishing an Executive Committee and hosting social and professional development events. An intranet will also be established to keep members informed and connected; it will be integrated with that of the broader program.

Joanna is leading this project alongside undertaking her PhD. Following the completion of a Master of Conservation Science in 2017, she became a research coordinator at Lone Pine Koala Sanctuary and then moved to the Queensland Government’s Department of Environment and Science where she worked in a number of policy and program roles.

“I found that I loved conservation policy and research, and was eager to broaden my knowledge by applying my skills in these areas to a totally new context beyond southeast Queensland. When I started looking for PhD projects and came across SAEF and its environmental stewardship theme, it was a great fit,” Joanna explained.

With her interest in evidence-based conservation policy, Joanna’s PhD research is focused on the effectiveness of Antarctic Specially Protected Areas (ASAPs) for conserving environmental values.

Joanna said, “the ASPA network has been criticised for being too small and unrepresentative of the continent’s biodiversity, so work is currently underway to revise and expand it. However, we still don’t know whether ASPAs are being managed to provide adequate protection to the values for which they were designated. I hope to contribute new perspectives and findings on this topic, and ultimately improve the efficiency of Antarctic conservation policies.”

Linking SAEF science to decision making

Ruth Davis
Researcher

Ruth Davis's research seeks to link SAEF's science to decision making so that our ambition of securing Antarctica's environmental future can be realised.

Currently, based at the Australian National Centre for Ocean Resources and Security at the UoW, Ruth is looking into questions about how SAEF can better translate science into policy and decision making in the annual CCAMLR and the ATCMs.

"I'm interested in how key negotiations proceed and the success (or otherwise) of various efforts to advance protected areas — both marine and terrestrial," Ruth explained.

She came to this area of research when she returned to university to study international and environmental law.

"That was my first real exposure to the strange and fascinating legal regime that governs Antarctica. In the mid to late 1990s, there was a lot happening in the Antarctic law and policy space, with the signing of the Madrid Protocol in 1991 and its implementation thereafter. It was an exciting time to be an international lawyer."

Ruth's initial interest was in marine environments, with a particular focus on the management in international spaces of fisheries. This interest eventually drifted to the poles, drawing her to CCAMLR and its role in the protection of the Southern Ocean.

One of the unexpected benefits of the COVID-19 pandemic for Ruth's work has been that the transition to virtual meetings has made it easier to observe firsthand negotiations and debates in important decision-making authorities in regional fisheries management.

"Prior to the pandemic, limited time and travel budgets would impose significant constraints upon observing these important decision-making bodies. Virtual meetings have allowed us to attend more meetings and to build up a much better understanding of their operation," Ruth explained.

This newfound advantage for Ruth and her research, will no doubt result in advantages for the Antarctic region and its biodiversity too.

Making sense of climate drivers

Jessica Macha
PhD Student

Jessica Macha has always been fascinated by the complexity of the way in which the world works. It was while undertaking her Masters in Environmental Studies that she discovered the complexity of climate drivers, and also discovered that this was what she wanted to research.

This led to her undertaking a PhD project at Monash University that aims to better understand the key drivers of climate variability on the Antarctic ice sheet over the past 2000 years. It will involve using ice cores and other climate proxies from across the continent to establish the influence of climate variability on Antarctic surface mass.

"It is really exciting to be applying my research to such a significant region of the world," Jessica said.

"By better understanding the drivers of Antarctic climate on interdecadal scales we can better understand and project both the changes in Antarctic climate in the future and the implications of these changes in climate on the Antarctic Ice Sheet, biodiversity, and so many other important fields."

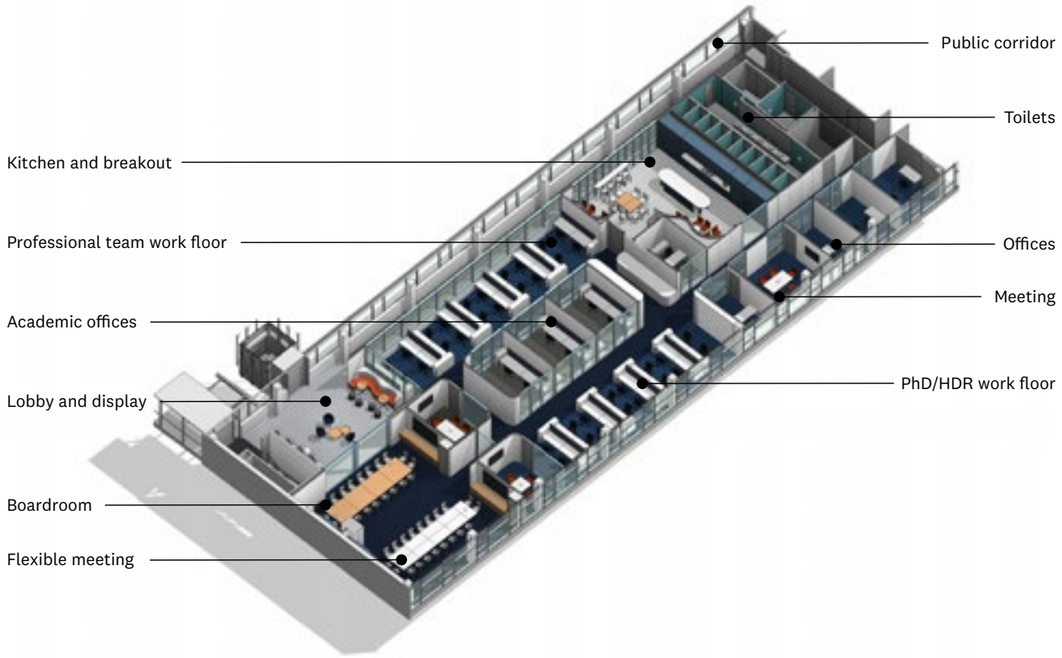
Jessica's journey to Australia has also been rather complex. Because of the COVID-19 pandemic and strict border conditions, her start date was postponed several times. However, she found an unexpected benefit of the delay in the form of a policy role with the Welsh Government.

"It was a really great insight into policy and science communication in government and has given me a more rounded view of research," Jessica explained.

In June she was finally able to move to Australia, and after being stuck in NSW for a few months due to state border restrictions, she finally got to Melbourne and commenced her PhD in September. Hopefully, the most complex thing that Jessica has to face now is her PhD!

Monash facility

Antarctic science has a Melbourne base. Monash University has newly refurbished a suite of spaces to enable interdisciplinary collaboration among SAEF's national and international partners and collaborators.



Credit: DS Architect Pty Ltd

"The space is light, large and has been a wonderful place for us to reconnect with each other after the last two years of working in isolation."

— Rebecca

Performance

Performance

7
awards

2
non-traditional
research outputs

2
data sets

45:55
Male:Female
program
members

10
journal articles
6 in the top quartile in article's primary Clarivate InCites JCR category

17
presentations
- 4 to public
- 2 to 'Women in STEM' events
- 4 to government
- 7 to professional bodies

28%
cross node
student
supervision

50:50
Male:Female
Researchers
(inc. students)

1
new investigator

1
new research
organisation

5
members hold
roles with SCAR

385
Twitter followers
+ 178 mentions

2
Antarctic
Treaty System
Workshops

2
Antarctic
Treaty System
Papers

1
Antarctica
and Australia
engagement
event with
a Museum

27
LinkedIn followers
+ 141 page views

Challenges and mitigation

Challenges	Mitigation
COVID 19 pandemic	
Establishing a new multidisciplinary research entity with international membership in the midst of a pandemic which has involved extended periods of working from home and restricted domestic and international travel.	• Using digital platforms such as Zoom to hold meetings for discussion and decision-making. • Holding hybrid meetings to support members attending in-person and online • Hosting flexible Drop In sessions for SAEF members to ask questions and learn information • Seeking to scheduling in-person events in 2022 (as travel restrictions allow).
Recruitment has been constrained due to domestic and international travel restrictions, at times limiting the pool of quality applicants for positions.	• Proactive and targeted recruitment campaigns, which have included advertising through existing domestic and international research networks and associations. • Delaying recruitment or readvertising until the COVID-19 restrictions have eased.
Effective interdisciplinary research	
Effective interdisciplinary research can be time-intensive, meeting-heavy and requires the right mix of disciplinary expertise	• Acknowledging that time and effort is required to produce outstanding, interdisciplinary outcomes. • Facilitating meetings and connections between SAEF researchers. • Developing a process for Project Leads to present projects to PEG to promote understanding and to identify opportunities for further collaboration.
Scheduling of Program meetings, workshops and training	
Coordinating online activities across time zones, as SAEF operates across 12 time zones including Antarctica.	• In the future we intend to run more events face-to-face to minimise the time zone constraints. • Recording workshops and seminars where possible. • Scheduling meetings with international partners at times to maximise participation and inclusion.

SAEF finances

2021 SAEF Finance Statement	
Opening Balance	**$ 3,363,216**
Closing Balance	**$ 6,869,168**
Income	
ARC Funding (includes indexation)	$ 3,468,272
Organisation Cash Contributions	$ 1,140,843
Total Income	**$ 4,609,115**
Expenditure	
Salaries	$ 1,051,054
Stipends	$ 10,961
Travel	
Equipment	$ 18,449
Consumables	$ 3,451
Other Direct Expenses	$ 19,248
Logistics	
Total Expenditure	**$1,103,163**
Net Result	**$ 3,505,952**

Budget Notes:

SAEF was awarded in 2020 and formally commenced in 2021.

The Opening Balance for 2021 is the funding received from the ARC in 2020, including $500,000 approved Establishment Funds.

Key performance indicators

Performance Measure	KPI 2021	Actual 2021
1. Number of research outputs		
Journal articles	5	10
Data sets	3	2
Books	0	0
Book Chapters	0	0
Conference publications	0	0
Non-Traditional Research Outputs (Artistic performances/exhibitions/ works)	0	2
2. Quality of research outputs		
Journal articles in top quartile in article's primary Clarivate InCites JCR category	5	6
H-index distributions (Scopus) (SAEF researchers) >80:>70:>50:>40:>20	0:2:3:9:17	0:2:7:4:26
Annual research prizes/awards/recognition	1	7
Percentage cross-node student supervisions	5	28
Percentage of multidisciplinary, cross-node research papers	10	0
3. Number of workshops/confderences held/offered by the SRI		
National workshops including SAEF team symposia	3	4
National decision-support workshops	0	0
International workshops	0	0
4. Number of training courses held/offered by the SRI		
Quantitative skills development workshops (ECRs)	1	2
Science policy and/or Antarctic policy interactive training (also open to ACEAS/AAPP/etc.)	1	1
SAEF CI/PI/Researcher/Student bottom-up driven training requests	1	1
Media and social media engagement	1	1
Success in interdisciplinary and transdisciplinary research	1	1

Performance Measure	KPI 2021	Actual 2021
5. Number of additional ARC-funded researchers working on SRI research		
Postdoctoral researchers	5	7
Honours students	3	2
PhD students	5	14
Masters by research students	1	2
6. Number of postgraduate completions held /offered by the SRI		
PhDs	0	0
Masters by research	0	0
7. Number of mentoring programs offered by the SRI		
Professional development	1	0
Research leadership	1	0
ARC and additional grant application mentoring and review	15	195
International PO-directed collaboration/mentorship events	1	0
Writing for evidence-based policy documents	1	0
8. Number of presentations/briefings		
To the public	5	4
To Women in STEM events (in keeping with Decadal Plan and School Programs)	1	2
To government (parliamentarians and department/agencies at either State or Federal level)	1	4
To industry/business/end users	1	0
To non-government organisations	1	0
To professional organisations and bodies	0	7
9. Number of new organisations collaborating with, or involved in, the SRI		
National Polar Programs or Equivalent	0	0
Research Organisations	1	1
Researchers	2	1
10. Diversity of personnel (% Male:Female:Unspecified diversity)*		
Researchers (incl. PhD students)	40:40:20	50: 50:00
Professional staff	40:40:20	13:87:00
Program Executive Group Members	40:40:20	36:64:00
Governance Advisory Board Members	40:40:20	45:55:00
International ScienceAdvisory Panel Members	40:40:20	N/A

* Self-declared

Performance Measure	KPI 2021	Actual 2021
11. Centre-specific KPIs		
11. Antarctic Treaty System workshops and/or discussions (with decision makers)	0	2
12. Visualisation products (for research or policy insights)	0	0
13. Antarctic Treaty System proposed papers	1	2
14. SCAR Roles	1	5
15. International and national science advisory roles (e.g. IPCC/UN/ISC/Gov Advisory)	2	25
16. Cross-sector events (open to Australian Antarctic Science Program and others)	1	0
17. Field programs successfully concluded	0	0
18. Short films for engagement	0	0
19. Antarctica and Australia engagement events with museums /State-Territory partners	0	1
20. Low SES and diversity program to offer better access to students	0	0
21. Social media posts/activity about research outcomes	25	6
22. Print media features	1	17
23. Radio features	1	3
24. TV features	1	0

Appendix

SAEF members
Full membership list 2021

Name	Organisation
Chief Investigators	
Professor Julie Arblaster	Monash University
Professor Steven Chown FAA	Monash University
Dr Grant Duffy	Monash University
Associate Professor Christopher Greening	Monash University
Dr Benjamin Henley	Monash University
Professor Andrew Mackintosh	Monash University
Dr Felicity McCormack	Monash University
Professor Steven Siems	Monash University
Dr Matthew Adams	Queensland University of Technology
Professor Michael Bode	Queensland University of Technology
Distinguished Professor Peter Corke FAA	Queensland University of Technology
Professor Matthew Dunbabin	Queensland University of Technology
Professor Felipe Gonzalez	Queensland University of Technology
Dr Kate Helmstedt	Queensland University of Technology
Distinguished Professor Kerrie Mengersen FAA FASSA	Queensland University of Technology
Professor Kerrie Wilson	Queensland University of Technology
Dr Johan Barthélemy	University of Wollongong
Dr Noel Cressie	University of Wollongong
Distinguished Professor Stuart Kaye	University of Wollongong
Professor Helen McGregor	University of Wollongong
Senior Professor Pascal Perez	University of Wollongong
Distinguished Professor Sharon Robinson	University of Wollongong
Dr Andrew Zammit-Mangion	University of Wollongong
Associate Professor Graeme Clark	University of New South Wales
Professor Emma Johnston AO FTSE FRSN	University of New South Wales
Professor Jan Strugnell	James Cook University
Professor Melodie McGeoch	La Trobe University
Associate Professor Phillip Cassey	University of Adelaide

Title	Organisation
Partner Investigators	
Dr Jonathan Stark	Australian Antarctic Division
Dr Aleks Terauds	Australian Antarctic Division
Dr Quan Hua	Australian Nuclear Science and Technology Organisation
Dr Karina Meredith	Australian Nuclear Science and Technology Organisation
Dr Krystyna Saunders	Australian Nuclear Science and Technology Organisation
Dr Eun-Pa Lim	Bureau of Meteorology
Dr Matthew Wheeler	Bureau of Meteorology
Dr Stephanie McLennan	Geoscience Australia
Dr Jodie Smith	Geoscience Australia
Dr Mark Stevens	South Australian Museum
Dr Nerida Wilson	Western Australian Museum
Associate Professor Barbara Bollard	Auckland University of Technology
Dr Greg Balco	Berkeley Geochronology Centre
Associate Professor Brent Goehring	Tulane University
Dr Cassandra Brooks	University of Colorado Boulder
Professor Dan Charman	University of Exeter
Dr Ilya Maclean	University of Exeter
Dr Jaume Flexas Sans	University of the Balearic Islands
Associate Professor Ceridwen Fraser	University of Otago
Professor Donald Cowan	University of Pretoria
Dr Miguel Ángel Olalla-Tárraga	King Juan Carlos University
Professor Gustavo Zúñiga	University of Santiago
Professor Margaret Barbour	University of Waikato
Dr Kevin Norton	Victoria University of Wellington
Associate Investigators	
Dr Richard Jones	Monash University
Research Fellows, Post Doctoral Research Associates and Researchers	
Dr Justine Shaw	Queensland University of Technology
Dr Sean Bay	Monash University
Dr Rachel Leihy	Monash University
Dr Laura Woods	Monash University
Dr Jasmine Lee	Queensland University of Technology
Ms Ruth Davis	University of Wollongong
Ms Krystal Randall	University of Wollongong
Dr Melinda Waterman	University of Wollongong
Dr Liza McDonough	Australian Nuclear Science and Technology Organisation

Name	Organisation	Supervisors	Project title
Students — PhDs			
Lawrence Bird	Monash University	Felicity McCormack, Andrew Mackintosh, Richard Jones	Controls on East Antarctic Ice Shelf stability: how ocean and subglacial hydrology interactions impact ice shelf melt
Jessica Macha	Monash University	Felicity McCormack, Andrew Mackintosh, Richard Jones, Ben Henley	Decadal to centennial-scale climate drivers of Antarctic Ice Sheet mass changes; a multi-proxy approach
Teharah Alinajadtabrizi	Monash University	Steven Siems	Wet deposition over the Southern Ocean
Arathy Kurup	Monash University	Steven Siems	Understanding biases in satellite retrievals of clouds over Antarctica and the Southern Ocean
Joanna Burrows	Queensland University of Technology	Kerrie Wilson, Michael Bode	The future of Antarctic biodiversity conservation and terrestrial protected area management
Grace Heron	Queensland University of Technology	Kate Helmstedt, Kerrie Mengersen	Complex data and value of information theory for smarter management of complex ecosystems
Oakes Holland	Queensland University of Technology	Kerrie Wilson, Kate Helmstedt, Justine Shaw, Jonny Stark	Assessing the risk of marine invasive species to nearshore marine ecosystems of Australia's Antarctic research stations and sub-Antarctic islands
Krystal Randall	University of Wollongong	Sharon Robinson	Modelling centimetre scale variation in surface temperatures for vegetated regions in Antarctica
Bao Vu	University of Wollongong	Andrew Zammit-Mangion, Noel Cressie, Felicity McCormack	Statistical Calibration of Ice Sheet Models
Hao Yin	University of Wollongong	Sharon Robinson	The responses of Antarctic vegetation to changing ultraviolet regimes
Yifan Wu	University of Wollongong	Sharon Robinson	The impact of climate change on the biodiversity of Antarctic vegetation
Andrea Johansen	University of Wollongong	Sharon Robinson, Krystyna Saunders	Understanding the Contribution of Dust to Ecosystem Fertilisation in the South Pacific and the Southern Ocean
Constance Johnson	University of Wollongong	Stuart Kaye	Challenges and Solutions for the Effective Governance and Regulation of the Southern Oceans Areas Beyond National Jurisdiction
Samuel Beale	La Trobe University	Melodie McGeoch, Justine Shaw	Predicting climate change impacts on the vascular flora of the sub-Antarctic Islands
Students — Masters			
Zhao Xiang	Queensland University of Technology	Kerrie Wilson	Assessing the costs of biodiversity monitoring and surveying in terrestrial Antarctica.
Douglass Henness	University of Wollongong	Johan Barthélemy	Artificial Intelligence of Things (AIoT) Sensing Platform for Antarctica – Application to hydrology and microclimate models

Name	Organisation	Supervisors	Project title
Students — Honours			
Rachel O'Shannessy	University of Wollongong	Sharon Robinson	Mosses as proxies for changing Antarctic climates
Isabella Todd	University of Wollongong	Sharon Robinson, Kerrie Wilson, Justine Shaw	Using species distribution modelling to improve understanding of species

Name	Organisation	Supervisors
Research Professionals		
Rebecca Hallas	Monash University	Steven Chown
Laura Phillips	Monash University	Steven Chown
Zoe Nay	Queensland University of Technology	Michael Bode
Georgia Watson	University of Wollongong	Sharon Robinson
Stewart Bisset	La Trobe University	Melodie McGeoch
Keita Richardson	Australian Nuclear Science and Technology Organisation	Karina Meredith
SAEF Program Team		
Andy Cianchi	Monash University	Senior Logistics Coordinator
Angela Firth	Monash University	Senior Program Officer
Anna Quinn	Monash University	Senior Communications Advisor
Jodie Weller	Monash University	Program Manager
Ilva Sporne	Queensland University of Technology	Deputy Program Manager
Jodi Barrie	University of Wollongong	Administrative Support
Diana King	University of Wollongong	Deputy Program Manager
Liz Regan	University of Wollongong	Administrative Support
Volunteers		
Jade Hameister OAM	Monash University	
Shannon Hubert	Monash University	
Kade Berman	Monash University	
Internships and Vacation Research Students		
Elise Mills	Queensland University of Technology	
Luke Stockholm	Queensland University of Technology	

Program Collaborators
British Antarctic Survey
Chilean Antarctic Institute
International Association of Antarctica Tour Operators
Norwegian Polar Institute
New Zealand Department of Conservation

Outputs

Peer reviewed

1. Baird, H.P., Shin, S., Oberprieler, R.G., Hullé, M., Vernon, P., Moon, K.L., Adams, R.H., McKenna, D.D. & Chown, S.L. (2021) Fifty million years of beetle evolution along the Antarctic Polar Front. *Proceedings of the National Academy of Sciences of the U.S.A.* **118,** e2017384118. DOI: https://doi.org/10.1073/pnas.2017384118

2. Cooke, S.J., Bergman, J.N., Madliger, C.L., Cramp, R.L., Beardall, J., Burness, G.P., Clark, T.D., Dantzer, B., de la Barrera, E., Fangue, N.A., Franklin, C.E., Fuller, A., Hawkes, L.A., Hultine, K.R., Hunt, K.E., Love, O.P., MacMillan, H.A., Mandelman, J.W., Mark, F.C., Martin, L.B., Newman, A.E.M., Nicotra, A.B., Raby, G.D., Robinson, S.A., Ropert-Coudert, Y., Rummer, J.L., Seebacher, F., Todgham, A.E., Tomlinson, S. & Chown, S.L. (2021) One hundred research questions in conservation physiology for generating actionable evidence to inform conservation policy and practice. *Conservation Physiology* **9**, coab009. DOI: https://doi.org/10.1093/conphys/coab009

3. Kearney, M.R., Jusup, M., Kooijman, S.L. & Chown, S.L. (2021) Where do functional traits come from? The role of theory and models. *Functional Ecology* **35,** coab038. DOI: https://doi.org/10.1111/1365-2435.13829

4. Madlinger, C.L., Franklin, C.E., Chown,S.L., Fuller, A., Hultine, K.R., Constantini, D., Hopkins, W.A., Peck, M.A., Rummer, J.L., Sack, L., Willis, C.K.R. & Cooke, S.J. 2021. The second warning to humanity: Contributions and solutions from conservation physiology. *Conservation Physiology* **9,** coab038 DOI: https://doi.org/10.1093/conphys/coab038

5. Ortiz, M., Leung, P.M., Shelley, G., Jirapanjawat, T., Nauer, P.A., Van Goethem, M.W., Bay, S.K., Islam, Z.F., Jordaan, K., Vikram, S., Chown, S.L., Hogg, I.D., Makhalanyane, T.P., Grinter, R., Cowan, D.A. & Greening, C. (2021) Multiple energy sources and metabolic strategies sustain microbial diversity in Antarctic desert soils. *Proceedings of the National Academy of Sciences of the U.S.A.* **118,** e2025322118. DOI: https://doi.org/10.1073/pnas.2025322118

6. Power, S., Lengaigne, M., Capotondi, A., Khodri, M., Vialard, J., Jebri, B., Guilyardi, E., McGregor, S., Kug, J.-S., Newman, M., McPhaden, M.J., Meehl, G., Smith, D., Cole, J., Emile-Geay, J., Vimont, D., Wittenberg, A.T., Collins, M., Kim, G.-I., Cai, W., Okumura, Y., Chung, C., Cobb, K.M., Dealge, F., Planton, Y.Y., Levine, A., Zhu, F., Sprintall, J., Di Lorenzo, E., Zhang, X., Luo, J.-J., Lin, X., Balmaseda, M., Wang, G. & Henley, B. J. (2021) Decadal climate variability in the tropical Pacific: Characteristics, causes, predictability and prospects. *Science* **374**, eaay9165. DOI: https://doi.org/10.1126/science.aay9165

7. Stutz, J., Mackintosh, A., Norton, K., Whitmore, R., Baroni, C., Jamieson, S.S.R., Jones, R.S., Balco, G., Salvatore, M.C., Casale, S., Lee, J.I., Seong, Y.B., McKay, R., Vargo, L.J., Lowry, D., Spector, P., Christl, M., Och, S.I., Di Nicola, L., Iarossi, M., Stuart, F., & Woodruff, T. (2021) Mid Holocene thinning of David Glacier, Antarctica: Chronology and controls. *The Cryosphere* **15**, 5447–5471. DOI: https://doi.org/10.5194/tc-15-5447-2021

8. Barnes, P. W., Bornman, J. F., Pandey, K. K., Bernhard, G. H., Bais, A. F., Neale, R. E., Robson, T. M., Neale, P. J., Williamson, C. E., Zepp, R. G., Madronich, S., Wilson, S. R., Andrady, A. L., Heikkilä, A. M., & Robinson, S. A. (2021) The success of the Montreal Protocol in mitigating interactive effects of stratospheric ozone depletion and climate change on the environment. *Global Change Biology* **27**, 5681–5683. DOI: https://doi.org/10.1111/GCB.15841

9. Neale, R.E., Barnes, P.W., Robson, T.M., Neale, P.J., Williamson, C.E., Zepp, R.G., Wilson, S.R., Madronich, S., Andrady, A.L., Heikkilä, A.M., Bernhard, G.H., Bais, A.F., Aucamp, P.J., Banaszak, A.T., Bornman, J.F., Bruckman, L.S., Byrne, S.N., Foereid, B., Häder, D.P., Hollestein, L.M., Hou, W.-C., Hylander, S., Jansen, M.A.K., Klekociuk, A.R., Liley, J.B., Longstreth, J., Lucas, R.M., Martinez-Abaigar, J., McNeill, K., Olsen, C.M., Pandey, K.K., Rhodes, L.E., Robinson, S. A, Rose, K.C., Schikowski, T.,, Solomon, K.R>, Sulzberger, B, Ukpebor, J.E., Wang, Q.-W., Wangberg, S.-A., White, C.C., Yazar, S., Young, A.R., Young, P.J. Zhu, L. & .Zhu, M. (2021) Environmental effects of stratospheric ozone depletion, UV radiation, and interactions with climate change: UNEP Environmental Effects Assessment Panel, Update 2020. *Photochemical & Photobiological Sciences* **20**, 1-67. DOI: https://doi.org/10.1007/S43630-020-00001-X

10. Lau, S.C.Y., Strugnell, J.M., Sands, C.J., Silva, C.N.S., & Wilson, N.G. (2021) Evolutionary innovations in Antarctic brittle stars linked to glacial refugia. *Ecology and Evolution* **11**, 17428-17446. DOI: https://doi.org/10.1002/ece3.8376

Presentations and Briefings

Datasets

1. Baird, H.P., Shin, S., Oberprieler, R.G., Hullé, M., Vernon, P., Moon, K.L., Adams, R.H., McKenna, D.D. & Chown, S.L. (2021) SNP dataset, analysis scripts, and raw phylogenetic & phylogenomic trees for the sub-Antarctic Ectemnorhinini weevils. https://bridges.monash.edu/articles/dataset/SNP_dataset_analysis_scripts_and_raw_phylogenetic_trees_for_the_sub-Antarctic_Ectemnorhinini_tribe_of_weevils/14446023

2. Lau, S.C.Y., Strugnell, J.M., Sands, C.J., Silva, C.N.S., & Wilson, N.G. (2021) GenBank accession numbers MZ543435 - MZ543949, http://www.ncbi.nlm.nih.gov/nuccore/?term=MZ543435%3AMZ543949%5Baccn%5D

Non traditional

1. Gebhardt, A., Lacey, G., Little, R., Grabowsky, P., Ollerenshaw, M., Hayes, D., Barton, W., Lumholdt, M., Atkins, J., de Wardener, M., Chown, S.L., Duncan, K. & Herskedal, D. (2021) Solveig – Work in Progress. https://genevievelacey.com/projects/solveig/ Description: Six-minute initial concept for Visual Art and Composition combining data, digital art, and original score and performance.

2. Terauds, A. (co-investigator) (2021) Virtual Macquarie Island. Inkhorn Projects / Tasmanian Museum and Art Gallery. A national project of museum installations of a virtual Macquarie Island. Description: An interactive exhibition to present a 3D photo-realistic simulation of Macquarie Island; including a virtual guided tour from digital avatars based on real-life Australian Antarctic Division scientists, and digitised collection material relevant to the history of Macquarie Island as an important scientific research station and World Heritage Site.

Public

1. Waterman, M., Balez, R., & Robinson, S.A. (2021) *Antarctica Day at the Discovery Space,* Live Q&A's. Early Start Discovery Space, University of Wollongong, 1 December 2021. https://www.facebook.com/UOWEarlyStartDiscoverySpace/photos/a.837086382994164/4458566107512822

2. Wilson, K. (2021) *Securing Antarctica's Environmental Future.* Digital Poster for Conversations at the Cube, 23-27 August 2021, Queensland University of Technology.

3. Henley, B. J. (2021) *Climate Emergency 2021: How the records of the past and models of the future show us what we need to do.* Australian Plants Society, Newcastle, 4 November 2021

4. Henley, B. J.(2021) *Climate Science: Should we let our fascinations drive our career choices?* Quantum Victoria and AIPS Tall Poppy Outreach Experience, 19 Aug 2021. https://www.quantumvictoria.vic.edu.au/events/2021/08/2021-tall-poppy-virtual-experience-secondary-yrs-7-10

Women in STEM events

1. Wilson, N.G. (2021) *Women in Science panel for schools,* Boola Bardip, Perth, 20 August 2021

2. Strugnell, J.M. (2021) JCU hosted a screening of the documentary *'The Bystander Moment,'* 21 October 2021.

To government

1. Chown, S.L. (2021) C*limate Change and the Antarctic.* Antarctic Parliamentarians Assembly, London, United Kingdom, 1 December 2021 https://www.antarcticparliamentarians.com/virtual-apa-2021

2. Rayfuse, R. and Chown, S.L. (2021) *The Antarctic. Strategic Competition and the Future of the Legal Regime.* ACOLA and the Parliamentary Library, Independent Evidence-Based Briefing to Parliament. 14 April 2021.

3. Wilson, K., Helmstedt, K., and Bode, M. (2021) *Presentation of Securing Antarctica's Environmental Future (SAEF) program.* QUT Visit by the Honourable Meaghan Scanlon MP Minister for the Environment and the Great Barrier Reef and Minister for Science and Youth Affairs, Friday 26 November 2021.

4. McGregor, H. (2021) *Analysis of gender statistics in the National Competitive Grant Program.* Presentation to Australian Research Council Executive Directors and others, 12 Nov 2021.

To professional bodies

1. Chown, S.L. (2021) *Facing Antarctica's Connected Future.* Congreso Antártico X, Punta Arenas, Chile, 4-8 October 2021 https://www.inach.cl/xcongresoantartico/

2. Arblaster, J.M. (2021) T*ropical to extratropical interactions in the Southern Hemisphere.* Environmental Research 2021, 15–19 November 2021 https://ioppublishing.org/er-2021

3. Greening, C. (2021) *Mycobacterial persistence depends on alternative energy sources.* Malaysian Society for Microbiology Annual Conference 2021 https://mymicro.org/international-conference/

4. Greening, C. (2021) *Metabolic flexibility: A universal trait of environmental and pathogenic bacteria.* Australian Society for Microbiology Annual Conference 2021 https://www.theasmmeeting.org.au/

5. Greening, C. (2021) *Mycobacterial persistence depends on alternative energy sources.* Joint Academic Microbiology Seminars Kuala Lumpur https://jams.org.au/index.php/jams-kuala-lumpur/

6. Bode, M. (2021) *Securing Antarctica's Environmental Future.* Centre for the Environment's Annual Symposium, 3 December 2021, Ship Inn, South Brisbane.

7. Lim, E.-P. (2021) *Understanding and predicting the 2019 Antarctic spring polar vortex warming and its impacts.* World Climate Research Program Workshop on Extremes in Climate Prediction Ensembles (ExCPEns), 25 October 2021, Busan, South Korea.

Awards

1. Steven Chown (2021) *Medal of the 30th Anniversary of the Madrid Protocol*. French Foreign Ministry.

2. Steven Chown (2021) *Fellow of the Australian Academy of Science (FAA)* https://www.science.org.au/profile/steven-chown

3. Steven Chown (2021) *Clarivate Highly Cited Researcher* https://recognition.webofscience.com/awards/highly-cited/2021/

4. Sharon Robinson (2021) *Australia's Top Researcher in Biophysics.* The Australian Research Magazine 2021. https://www.theaustralian.com.au/special-reports/the-australians-research-magazine-takes-a-deep-dive-into-research/news-story/6bde9f53e5846a150a25abe7758adedd

5. Sharon Robinson (2021) *Australia Day 2021 Innovation Achievement Award*. Wollongong City Council 2021. https://www.uow.edu.au/media/2021/uow-scientist-wins-wollongong-australia-day-2021-innovation-achievement-award.php

6. Jan Strugnell (2021) *Award for Excellence in recognition of your outstanding achievement in the category of leadership for contribution and commitment to JCU's Strategic Intent and particularly contribution to gender equity.* James Cook University

7. Stephanie McLennan (2021) *ACT Tall Poppy Australian Institute for Policy and Science* https://aips.net.au/tall-poppies/2021-act-winner/dr-steph-mclennan

Antarctic Treaty System papers

1. Chown, S.L. & Leihy, R.I. (2021) *Antarctic and Southern Ocean Climate Change in a Global Context*. Working Paper 17 submitted by SCAR to the XLIII Antarctic Treaty Consultative Meeting, Paris, France, June 2021. https://www.ats.aq/devAS/Meetings/Past/92

2. Leihy, R.I., Chown, S.L. (original draft, further edited by AAD) (2021) *Antarctic Wilderness and Inviolate Areas.* Information Paper 14 submitted by Australia, Netherlands and New Zealand to the XLIII Antarctic Treaty Consultative Meeting, Paris, France, June 2021. https://www.ats.aq/devAS/Meetings/Past/92

Advisory roles

Name	Role
Noel Cressie	Independent Member of the Australian Antarctic Science Council
Benjamin Henley	Member of PAGES 2k Phase 4 International Coordination Team (2021–24)
Eun-Pa Lim	Member of the Australian Meteorological and Oceanographic Society Expert Group on Climate Variability, (2017–) Member of Stratosphere-troposphere Processes And their Role in Climate (SPARC)-Dynamical Variability (DynVar) activity committee, (2020 –) Member of SPARC-Stratospheric Network for the Assessment of Predictability (SNAP) activity committee, (2021–)
Andrew Mackintosh	Committee Member, Union Commission on Climate and Environmental Change, International Union of Geodesy and Geophysics . (2019–23)
Andrew Mackintosh	Vice President, International Association of Cryospheric Sciences (2019–23)
Felicity McCormack	Co-Chair of the IUGG Joint Commission on Ice-Ocean Interactions (2021–24)
Melodie McGeoch	First Vice-chair Global Biodiversity Information Facility Science Committee (2021–)
Helen McGregor	ARC College of Experts
Kerrie Mengersen	National Committee for Mathematical Sciences, Australian Academy of Science (2020–2023)
Sharon Robinson	Member of the Australian Academy of Science, National Committee for Antarctic Research Member of US National Academies, Committee on Technology Developments to Advance Antarctic Research Member of the Max Day Environmental Science Fellowship Award Committee Chair, Excellence in Research Australia Engagement and Impact Cluster Member of UN Environment Programme Environmental Effects Assessment Panel Antarctic Science Foundation Member of Science Sub-Committee
Matthew Wheeler	Member of the World Meteorological Organization Research Board, (2020–) Member of the WMO-Intergovernmental Oceanographic Commission Joint Collaboration Board, (2020–)
Kerrie Wilson	Australia's Man and the Biosphere National Committee (2020–) Australian Heritage Council Natural Heritage expert (2019–) AAS Awards Committee (Fenner Conference on the Environment and Nancy Millis Medal) (2019–) Natural Sciences Commissioner of the Australian National Commission for UNESCO (2018–) Reef 2050 Plan Independent Expert Panel (2017–)
Nerida Wilson	Research Advisory Committee Member, National Marine Facility

Scientific Committee on Antarctic Research (SCAR)

Steven Chown	Immediate Past-President (2021–22)
Felicity McCormack	Steering Committee Member of the Antarctic RINGS Action Group (a SCAR Action Group) (2021–23)
Sharon Robinson	Member of the SCAR Antarctic Nearshore Terrestrial Observing System (ANTOS) Expert Group
Jonathan Stark	Member of the ANTOS Committee
Aleks Terauds	Co-Chief Officer of the SCAR Scientific Research Program—Integrated science to inform Antarctic and Southern Ocean Conservation

Grants Awarded associated with SAEF

SAEF member	Organisation	Grant scheme (name and number)	Amount	Grant title
Krystyna Saunders	ANSTO	ARC Discovery Project, (DP220100828)	$409,193	Long range toxic metal pollution in Australia and the Southern Ocean
Mark Stevens	SAM	ARC LIEF grant (LE220100050)	$361,354	State-of the-art genotyping technologies for evolutionary and environmental studies. This project will enable researchers to utilise DNA samples at femtogram levels, resulting in significant outcomes, including fundamental and applied projects to detect, mitigate and manage changes in the environment. This enhanced capacity will also provide significant benefits for students, by providing cutting-edge training that keeps them at the forefront of technological advances in genome sequencing.
Pascal Perez, Johan Barthélemy	UoW	Federal Government Strategic University Reform Fund	$1.7 million	The Telstra-UoW Hub for AIoT Solutions www.uow.edu.au/media/2021/telstra-uow-hub-to-make-australia-a-global-leader-in-aiot-solutions.php
Johan Barthelemy, Pascal Perez, Sharon Robinson, Krystal Randall, Melinda Waterman	UoW	University of Wollongong Major Equipment Grant	$140,543	Climate controlled testing facility for simulating mild to extreme environmental conditions
Andrew-Zammit Mangion, Noel Cressie	UoW	University of Wollongong Major Equipment Grant	$74,878	Upgrade of the High-Performance Computer at the National Institute for Applied Statistics Research Australia
Sean Bay	Monash	Faculty of Science Strategic Uplift Seed Funding Scheme	$15,000	Survival in the dark: Which biogeochemical processes sustain cavernous life?
Helen McGregor	UoW	University of Wollongong Major Equipment Grant	$26,828	A Micro Balance (CUBIS II MCA) for high precision weighing of geologic and organic material
Helen McGregor	UoW	PAGES Data Stewardship Scholarship	US$15,000	PAGES2k Phase 4 Working Group endorsed for 2022-2025. Able to apply for workshop funds
Helen McGregor	UoW	PAGES2K Phase 4 Working Group Endorsement	Non-monetary	PAGES2k Network Data Stewardship Scholarship

Project List

Icon	Number	Short name	Title
	T1-P002	Past Climate	Variability, trends and remote drivers of Antarctica's past climate: Southern Hemisphere synthesis and assimilation
	T1-P003	Ocean	Variability in Southern Ocean upwelling
	T1-P004	Westerlies	Past westerly wind variability as a context for understanding present-day mid-high latitude Southern Hemisphere climate
	T1-P005	Surface Climate	Remote forcing of Antarctic surface climate
	T1-P006	Ice Sheets	East Antarctic ice sheet-climate interactions: a strategic modelling analysis of multi-scale variability and change
	T1-P007	Vanderford	Canary in the coalmine: the vulnerability of Vanderford Glacier, East Antarctica to climate change
	T1-P008	Stats	Statistical methods for making inference on climate, ice sheet, and ecological processes in the cryosphere
	T1-P011	Ice Loss	Are East Antarctic Ice Sheet and Heard Island glacier mass losses unprecedented in recent millennia?
	T1-P012	Precipitation	Precipitation processes
	T1-P013	Paleo	Paleoclimate data-model integration to improve projections for Antarctic and Southern Ocean climate variability
	T1-P014	SciComms	Anticipating science communication needs and policy responses based on possible Antarctic climate calamities
	T2-P015	Info Biodiversity	A novel, integrative approach to modelling and monitoring Antarctic biodiversity
	T2-P016	Biodiversity Change	A predictive framework for the impacts of climate change on biodiversity across the Antarctic
	T2-P017	AIoT	AIoT Sensing Platform for Antarctica – Application to hydrology and microclimate models

Project List (Continued)

Key	Number	Short name	Title
	T2-P018	Chemosynthesis	Antarctica – the chemosynthetic continent
	T2-P019	Lakes	Spatial and temporal trends in isotopic signatures in Sub-Antarctic and Antarctic lakes
	T2-P020	Connectivity	Connectivity in the Southern Ocean through space and time
	T2-P022	Moss	Past climates from living mosses
	T2-P023	Remote Sensing	UAS remote sensing for vegetation cover, health and drivers
	T2-P024	Coastal	Climate change in Antarctic coastal ecosystems
	T2-P025	Invasion	Biosecurity and invasion pathways
	T2-P026	Drivers	Drivers of Antarctic marine biodiversity
	T3-P027	VOI	Value of Information for effective stewardship
	T3-P028	Conservation	Conservation planning in Antarctica
	T3-P029	Decision Support	Strategic Decision Support for Antarctic governance
	T3-P031	Legal	Law and policy link to Antarctic science
	T2-P036	Regime Shift	Classifying, analysing and modelling regime shifts: Antarctica as a case study

Acronyms

Acronym	Meaning
AAD	Australian Antarctic Division
ACAP	Agreement for the Conservation of Albatrosses and Petrels
ACOLA	Australian Council of Learned Academies
ACT	Australian Capital Territory
AIoT	Artificial Intelligence of Things
ANSTO	Australian Nuclear Science and Technology Organisation
ANTOS	Antarctic Nearshore and Terrestrial Observing System
ARC	Australian Research Council
ASPA	Antarctic Specially Protected Area
ATCM	Antarctic Treaty Consultative Meeting
ATCP	Antarctic Treaty Consultative Parties
ATS	Antarctic Treaty System
AUT	Auckland University of Technology
BOM	Bureau of Meteorology
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CEP	Committee for Environmental Protection
CI	Chief Investigator
DFAT	Australian Department of Foreign Affairs and Trade
ERA	Excellence in Research Australia
GAB	Governance Advisory Board
GA	Geoscience Australia
GBIF	Global Biodiversity Information Facility
IAATO	International Association of Antarctica Tour Operators
IOC	Intergovernmental Oceanographic Commission

Acronym	Meaning
IoT	Internet of Things
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
ISAP	International Science Advisory Panel
IUGG	International Union of Geodesy and Geophysics
JCIOI	Joint Commission on Ice-Ocean Interactions
JCU	James Cook University
NASA	National Aeronautics and Space Administration
PI	Partner Investigator
QUT	Queensland University of Technology
SAEF	Securing Antarctica's Environmental Future
SAM	South Australian Museum
SCAR	Scientific Committee on Antarctic Research
SNAP	Stratospheric Network for the Assessment of Predictability
SRIEAS	Special Research Initiative in Excellence in Antarctic Science
STEM	Science, Technology Engineering and Mathematics
TEM	Tasman Environmental Markets
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNEP	UN Environment Programme
UNSW	University of New South Wales
UoW	University of Wollongong
WAM	Western Australian Museum
WMO	World Meteorological Organisation

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