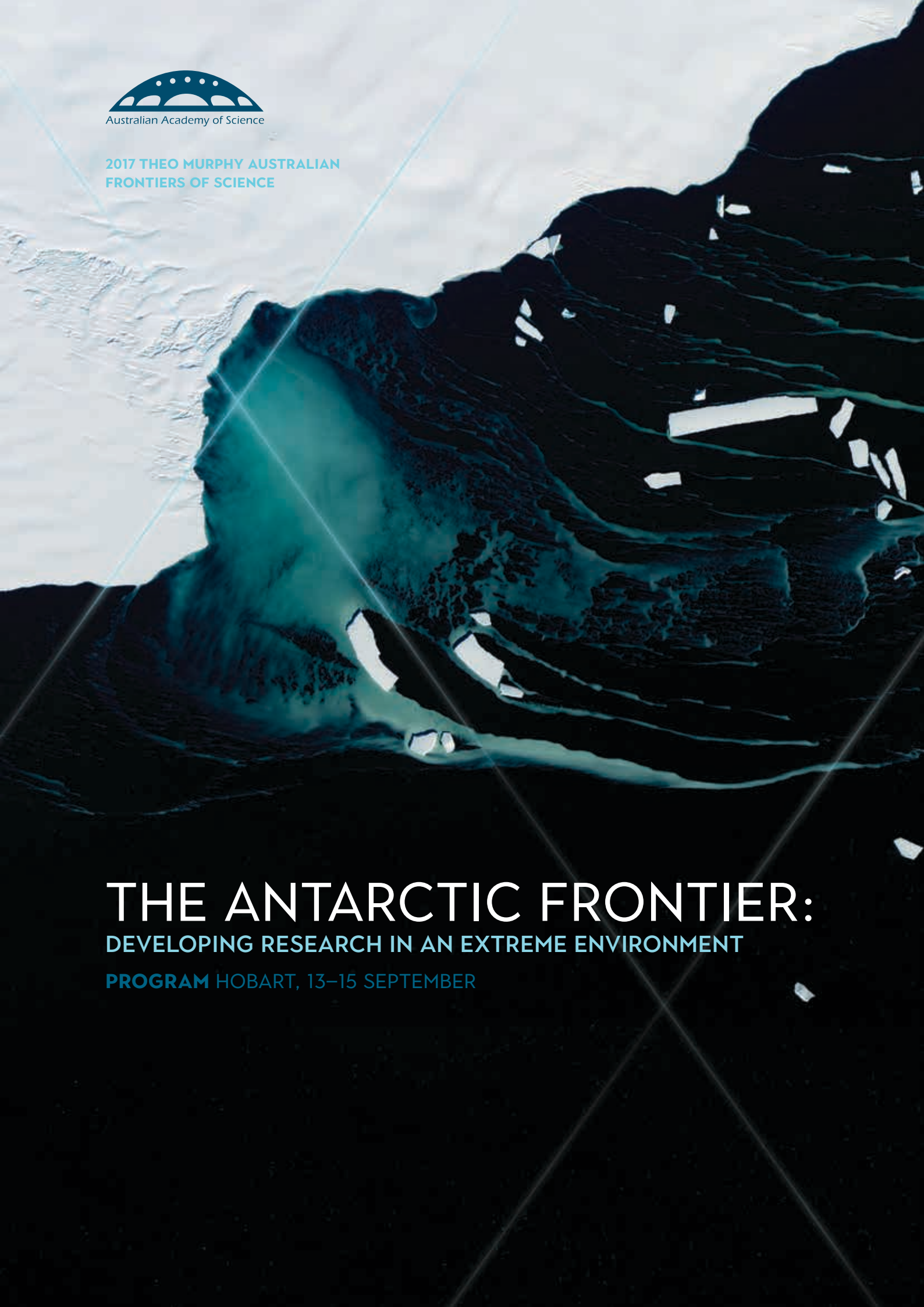


Australian Academy of Science

2017 THEO MURPHY AUSTRALIAN FRONTIERS OF SCIENCE

THE ANTARCTIC FRONTIER:

DEVELOPING RESEARCH IN AN EXTREME ENVIRONMENT

PROGRAM HOBART, 13–15 SEPTEMBER

CONTENTS

Australian Academy of Science events support and promote diversity, participation and intellectual freedom and excellence. As a condition of participating in this event all delegates, speakers and committee members agree to treat all other participants with courtesy and respect.

To tweet about Frontiers of Science during the event, please use the hashtag **#AusFoS17**

FOREWORD

IMAGE: MARK GRAHAM

The Academy has hosted the Theo Murphy Australian Frontiers of Science symposium since 2003, bringing together the very best young Australian scientists to discuss emerging technologies, new opportunities and exciting cutting-edge advances in their fields.

Antarctica represents a unique and powerful natural laboratory for science and international collaboration. Antarctic scientists are constantly forging new frontiers in understanding the drivers and feedbacks in the Earth's climate systems, the evolution of the subglacial mountains and lakes, the adaptations and vulnerabilities of polar ecosystems, and even the origins of life, Earth and the universe.

At this year's symposium, 75 outstanding early- and mid-career researchers from all fields relevant to Antarctic and Southern Ocean science will share their latest research findings, build networks and create pathways for future interdisciplinary research.

The 2017 Theo Murphy Australian Frontiers of Science symposium is generously supported by the Theo Murphy (Australia) Fund courtesy of the Royal Society of London. The Academy is delighted to have this funding available to enable some of Australia's brightest young scientists to engage in fresh thinking and to develop networks that will enrich their careers.

Professor Andrew Holmes AC PresAA FRS FTSE
President, Australian Academy of Science

SYMPOSIUM ORGANISERS

Organising Committee

Associate Professor Nerilie Abram
ARC Future Fellow
Australian National University

Dr Christopher Betters
Research Associate
University of Sydney

Dr Ceridwen Fraser
Senior Lecturer
Australian National University

Dr Ben Galton-Fenzi
Senior Scientist
Australian Antarctic Division and Antarctic Climate and Ecosystems Cooperative Research Centre

Dr Jacqueline Halpin
Senior Research Fellow/Geologist
Institute for Marine and Antarctic Studies

Dr Delphine Lannuzel
ARC DECRA Fellow
University of Tasmania

Dr Adrian McCallum
Lecturer
University of the Sunshine Coast

Dr Justine Shaw
Research Fellow
University of Queensland

Dr Nerida Wilson
Senior Research Scientist
Western Australian Museum

Oversight Committee

Professor Ian Allison AO FAA
Honorary Research Associate
Antarctic Climate and Ecosystems Cooperative Research Centre

Professor Joss Bland-Hawthorn FAA
ARC Laureate Fellow Professor of Physics and Director of the Sydney Institute for Astronomy
University of Sydney

Associate Professor Jan Strugnell
Associate Professor Aquaculture and Marine Science
James Cook University

PROGRAM OF EVENTS

Wednesday 13 September

4.45 pm	**Registration**
5.10 pm	**Welcome** Professor Ian Allison AO FAA Chair of the Oversight Committee
5.10 pm	**Keynote: Why does Australia invest in Antarctic science?** Dr Nick Gales, Director of the Australian Antarctic Division
5.40 pm	**Keynote: Antarctic politics in an era of geopolitical change** Professor Anne-Marie Brady, University of Canterbury
6.00 pm	**Discussion and question time with keynote speakers**
6.40 pm	**Introduction of opening addressee** Professor Andrew Holmes AC PresAA FRS FTSE, President of the Australian Academy of Science
6.42 pm	**Official opening address** Her Excellency Professor the Honourable Kate Warner AC, Governor of Tasmania
7.00 pm	**Cocktail reception**
9.00 pm	**Cocktail reception concludes**

Thursday 14 September

8.30 am	**General introduction** Dr Jacqueline Halpin, Co-Chair of the Organising Committee
8.40 am	**Session 1: Antarctica as a window to Earth and the universe beyond** Chairs: Dr Chris Betters and Dr Jacqueline Halpin
8.40 am	*Infrared astronomy from the Antarctic Plateau: Motivation and Australian plans* Associate Professor Michael Ireland, Australian National University
9.00 am	*The Kunlun Infrared Sky Survey (KISS) with AST3-3 infrared camera* Dr Jessica Zheng, Australian Astronomical Observatory
9.15 am	*Measuring the infrared sky background from the high plateau* Dr Matthew Freeman, UNSW Australia
9.30 am	*Volcanism on and around Heard and McDonald Islands: a complex history contributing to life in the Southern Oceans?* Ms Jodi Fox, University of Tasmania
9.45 am	Group discussion
10.10 am	**Morning tea**
10.50 am	**Session 2: Ice and climate** Chairs: Dr Nerilie Abram, Dr Ben Galton-Fenzi, Dr Adrian McCallum
10.50 am	*How continuous ice-penetrating radar records can help us to understand Antarctic ice-ocean interaction* Dr Sue Cook, Antarctic Climate and Ecosystems Cooperative Research Centre
11.05 am	*High-resolution simulation of dissolving ice-shelves in polar oceans* Dr Bishakhdatta Gayen, Australian National University
11.20 am	*Reassessing global ice volume changes since the Last Glacial Maximum: uncertainty and structure in sea level records* Dr Fiona Hibbert, Australian National University
11.35 am	*The driving mechanisms of Southern Ocean sea ice response to different anthropogenic forcings* Dr Will Hobbs, Antarctic Climate and Ecosystems Cooperative Research Centre
11.50 am	*Dense shelf water spreading from Antarctic coastal polynyas to the deep Southern Ocean: A regional circumpolar model study* Dr Kazuya Kusahara, Antarctic Climate and Ecosystems Cooperative Research Centre
11.53 am	*Improving simulations of ice sheet dynamics: challenges and recent developments* Dr Adam Treverrow, Antarctic Climate and Ecosystems Cooperative Research Centre
11.56 am	**Group discussion**
12.20 pm	**Lunch**
1.20 pm	**Session 3: New technologies to tackle extreme environments** Chairs: Dr Chris Betters, Dr Adrian McCallum, Dr Justine Shaw
1.20 pm	*A critical path to under ice observations of Antarctic ice* Dr Damien Guihen, University of Tasmania
1.35 pm	*Taking innovative technologies beneath the waves: using hyperspectral imaging to enhance sea ice ecological research* Dr Vanessa Lucieer, University of Tasmania
1.50 pm	*A UAV-mounted software-defined radar (SDR) ground-penetrating radar (GPR) for deep field geophysical assessment* Dr Adrian McCallum, University of the Sunshine Coast
1.55 pm	*Oceanic melting driving East Antarctic ice sheet dynamics* Dr Felicity Graham, University of Tasmania
2.00 pm	*Surface-based observations of Southern Ocean clouds and precipitation* Dr Simon Alexander, Australian Antarctic Division

NOTE: indicates lightning talks

2.05 pm	*From floe-scale to gridscale: expanding our observations of, over and under sea ice with autonomous platforms* Dr Guy Williams, Institute for Marine and Antarctic Studies
2.20 pm	*The Antarctic ocean-ice-atmosphere system: meeting the challenge of quantifying and exploring observed change* Dr Petra Heil, Australian Antarctic Division
2.35 pm	**Group discussion**
2.50 pm	**Afternoon tea**
3.30 pm	**Session 4: Understanding and managing Southern Oceans ecosystems** Chairs: Dr Ceridwen Fraser, Dr Nerida Wilson
3.30 pm	*Big challenges for Southern Ocean ecosystem science and management* Dr Jess Melbourne-Thomas, Australian Antarctic Division
3.45 pm	*Parasitic Syndiniales DNA dominates Southern Ocean* Dr Laurence Clarke, Antarctic Climate and Ecosystems Cooperative Research Centre / University of Tasmania
4.00 pm	*Understanding and managing life in extreme environments: insights from physical and biological datasets on the Antarctic seafloor* Dr Alix Post, Geoscience Australia
4.15 pm	*Assessing ecosystem status and trends for the Southern Ocean: why and how?* Dr Rowan Trebilco, Antarctic Climate and Ecosystems Cooperative Research Centre
4.19 pm	*Modelling mesopelagic taxa distribution and trophic linkages at a large scale: Combining stable isotope and active-acoustic data* Dr Andrea Walters, University of Tasmania
4.23 pm	*Statistical tools for understanding and mapping Southern Ocean biodiversity and its response to a changing climate* Dr Nicole Hill, Institute for Marine and Antarctic Studies / University of Tasmania
4.27 pm	*Regulating Antarctic bioprospecting: where should rising powers stand?* Dr Nengye Liu, University of Adelaide
4.31 pm	*New insights and directions in Southern Ocean sponge biogeographic research* Ms Rachel Downey, Australia National University
4.35 pm	**Group discussion**
5.00 pm	**End of day 2**
6.15 pm	**Coach departs for dinner venue**
7.00 pm	**Pre-dinner drinks**
7.30 pm	**Dinner at Willie Smith's Apple Shed** **Dinner speaker: Professor Nathan Bindoff, Head, Oceans and Cryosphere Program, Institute for Marine and Antarctic Science**
10.00 pm	**Coach return to hotel**

Friday 15 September

8.30 am	**Session 5: Human impacts in Antarctica and the Southern Ocean** Chairs: Dr Justine Shaw, Dr Nerida Wilson
8.30 am	*The environmental impacts of wastewater and sewage outfalls in Antarctica* Dr Jonny Stark, Australian Antarctic Division
8.45 am	*Conservation of Antarctic biodiversity in the face of multiple threats* Miss Jasmine Lee, University of Queensland
9.00 am	*Light-driven tipping points in polar ecosystems* Dr Graeme Clark, UNSW Australia
9.15 am	*Antarctic soil communities in the future: opportunities for multi-disciplinary science* Dr Uffe N Nielsen, Western Sydney University
9.30 am	*Adding value to existing datasets to inform environmental management decisions* Dr Tanya O'Neill, Waikato University
9.35 am	*Biomarkers of station derived contamination impact: Antarctic rock-cod (*Trematomus bernacchii*) as an indicator species* Dr Patricia Corbett, Deakin University
9.40 am	**Group discussion**
10.00 am	**Morning tea**
10.30 am	**Session 6: Taking a step back: the environmental, climatological and evolutionary history of Antarctica** Chairs: Dr Nerilie Abram, Dr Ceridwen Fraser
10.30 am	*Polar frontal migration in the warm Pliocene: diatom and geochemical evidence from the Wilkes Land margin, East Antarctica* Dr Christina Riesselman, University of Otago
10.45 am	*Old-growth mosses as potential biological proxies for past Antarctic climate* Dr Melinda Waterman, University of Wollongong
11.00 am	*Geochemical and isotopic tracers of past ice shelf stability* Dr Duanne White, University of Canberra
11.15 am	*Bipolar seesaw, ocean circulation, and Antarctic ice-sheet melting at the end of an ice age* Dr Gianluca Marino, Australian National University
11.30 am	**Group discussion**
12.00 pm	**Lunch**
1.00 pm	**Session 7: The Antarctic Plate: solid Earth and tectonic perspectives** Chairs: Dr Jacqueline Halpin, Dr Delphine Lannuzel
1.00 pm	*The role of plate tectonics in influencing ocean circulation and climate: a Tasman Seaway example* Dr Jo Whittaker, Institute for Marine and Antarctic Studies / University of Tasmania
1.15 pm	*Seafloor geomorphology of the Cape Darnley region: insights from a new bathymetry compilation* Dr Jodie Smith, Geoscience Australia
1.30 pm	*The tectonic history of the Rayner Complex, from Rodinia to Gondwana* Dr Laura Morrissey, University of South Australia

NOTE: indicates lightning talks

1.45 pm	*High-heat producing rocks and sub-glacial heat flow, possible clues to ice sheet dynamics from the continental rocks in southern and central Australia* Dr Sandra McLaren, University of Melbourne
2.00 pm	*Improving earth deformation models in the Parallel Ice Sheet Model for Antarctic palaeoclimate models* Dr Lenneke Jong, Antarctic Climate and Ecosystems Cooperative Research Centre / University of Tasmania
2.15 pm	**Group discussion**
2.30 pm	**Afternoon tea**
3.00 pm	**Session 8: Southern hemisphere atmospheric and oceanic circulation, weather and climate** Chairs: Dr Nerilie Abram, Dr Ben Galton-Fenzi, Dr Delphine Lannuzel
3.00 pm	*The unknown East: A new ice core to fill the climatological gap in the Indian Ocean sector of East Antarctica* Dr Tessa Vance, Antarctic Climate and Ecosystems Cooperative Research Centre
3.15 pm	*The Antarctic ozone hole and climate* Associate Professor Julie Arblaster, Monash University
3.30 pm	*Localised rapid warming of West Antarctic subsurface waters by remote winds* Dr Paul Spence, UNSW Australia
3.45 pm	*Ocean transport across the Antarctic continental slope* Dr Adele Morrison, Australian National University
4.00 pm	**Group discussion**
4.30 pm	**Closing remarks** Dr Nerilie Abram, Co-Chair of the organising committee
4.45 pm	**Coaches depart**

OPENING SPEAKER

Her Excellency Professor the Honourable Kate Warner AC
Governor of Tasmania

Tasmania's 28th Governor, Her Excellency Professor the Honourable Kate Warner AC, was sworn to Office in December 2014.

Previously she was Professor, Faculty of Law, at the University of Tasmania and Director of the Tasmania Law Reform Institute. She had also held the positions of Dean, Faculty of Law, and Head of School at the university. Following her appointment as Governor, she was made a professor emeritus.

In January 2017 Professor Warner was appointed a Companion of the Order of Australia (AC) for her eminent service to the people of Tasmania through leading contributions to the legal community, to law reform, to higher education as an academic, researcher and publisher and as a supporter of the arts and environmental and social justice initiatives.

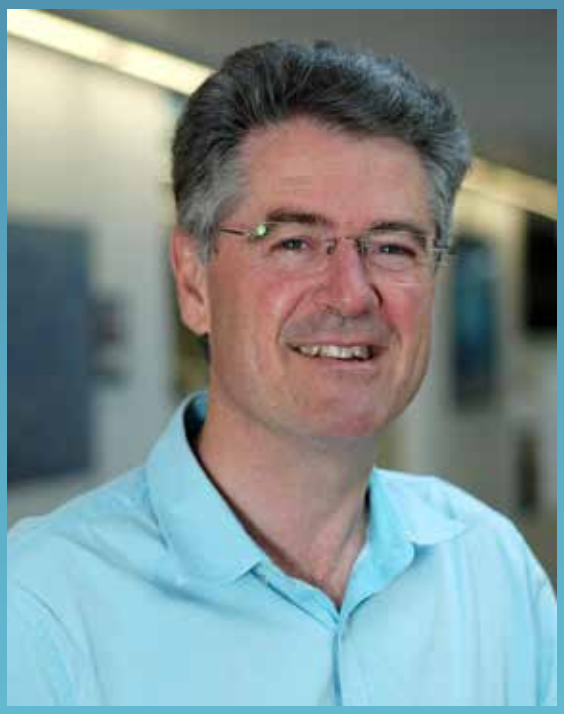
Her teaching interests included criminal law, evidence, criminology and sentencing, and her research interests included sentencing and criminal justice. Since her appointment as Governor, she has continued her research in sentencing, in particular.

Professor Warner has received a number of awards and fellowships, including Foundation Fellow of the Australian Academy of Law in 2007; Visiting Fellow All Souls College Oxford in 2009; the University of Tasmania Distinguished Service Medal in 2013; and the Women Lawyers Award for Leadership in 2013. She has been nominated as a finalist in the Tasmanian Australian of the Year Awards for her contributions to the law, law reform and legal education. In December 2016 she was made a Fellow of the Australian and New Zealand Society of Criminology.

She has published numerous journal articles, book chapters and law reform reports. She first published *Sentencing in Tasmania* in 1991, which has since become an indispensable tool for judges and magistrates. She is a member of the editorial boards of *Current Issues in Criminal Justice*; *Women Against Violence*; and the *Criminal Law Journal*. She contributed the annual Sentencing Review to the *Criminal Law Journal* from 1998 until 2014.

DINNER SPEAKER

Professor Nathan Bindoff
Head, Oceans and Cryosphere Program, Institute for Marine and Antarctic Science



Nathan Bindoff is Professor of Physical Oceanography at the University of Tasmania in Institute of Marine and Antarctic Studies, head of Oceans and Cryosphere Centre, and Associate Director of IMAS.

Nathan is also leader of the Climate Futures program in the Antarctic Climate and Ecosystems Cooperative Research Centre and Chief Investigator in the ARC Centre of Excellence in Climate System Science.

The Climate Futures program is all about understanding the consequences of climate change on Australian climate at regional scale. In particular, the impacts of human influence on extreme temperatures, rainfall, runoff, agriculture and ecosystems.

Nathan is also physical oceanographer, specialising in ocean climate and the earth's climate system, with a focus on understanding the causes of change in the oceans. He was the coordinating lead author for the ocean chapter in the Inter-Governmental Panel on Climate Change Fourth Assessment Report and Fifth Assessment reports. Nathan and colleagues documented some of the first evidence for changes in the oceans in the Indian, North Pacific, South Pacific and Southern Ocean's and the first evidence of changes in the Earth's hydrological cycle from ocean salinity. His most recent work is on documenting the decline in oxygen content of the oceans and dynamics of the Southern Ocean. He has spent more than two years on oceanographic ships, mostly in the Southern Ocean.

He contributed to the Inter-Governmental Panel for Climate Change winning the Noble Peace Prize in 2007, shared with Al Gore. Professor Bindoff has served on 14 international committees, been an invited speaker at 25 conferences and workshops, co-chaired 2 workshops and was guest editor on two special volumes of Deep Sea Research. He has published more than 115 peer reviewed papers and more than 44 reports.

PRESENTATION ABSTRACTS

Keynote presentations

Why does Australia invest in Antarctic Science?

DR NICK GALES

Australian Antarctic Division

Antarctic science is 'big' science; it requires large-scale funding by national governments, is logistically challenging and generally requires extensive national and international collaborations. Such a scale of endeavour requires a cogent and compelling rationale for long-term support. Australia's reasons for being an important Antarctic nation include our history (including our claim to 42% of the continent), the strategic significance of Antarctica and the Southern Ocean and the growing significance of our Antarctic science. Our priorities for Antarctic science, and the manner in which we select research proposals, reflect the complex and changing mix of these drivers and result in our Antarctic science addressing our most pressing questions and playing major roles in diplomacy (policy development) and for diplomacy (our international relationships).

Dr Gales will reflect on how the scientific rationale for our Antarctic activities interacts with changing strategic and geopolitical influences. He will posit that these interactions, the manner in which they are managed, and the scale and nature of our Antarctic presence adds a significance and impact to our science that bodes well for a future that ensures our understanding of Antarctica and its surrounding ocean is maximised and has impact.

Antarctic politics in an era of geopolitical change

PROFESSOR ANNE-MARIE BRADY

University of Canterbury

@thepolarjournal

Antarctica is of crucial importance to global security, offering unparalleled sources of food, water and energy, transport links, and research sites valuable for strategic scientific and military purposes. Antarctica is governed by the Antarctic Treaty, which was signed in 1959 and entered into force in 1961. When the Antarctic Treaty was signed the major powers had very limited ability to exploit the potential of Antarctica. Even getting to the continent was a major challenge. Now that the technological barriers are easing, the value of Antarctica has increased exponentially. To many states Antarctica is the 'last oil reserve', while to some, Antarctic waters are the 'last unspoiled ocean'. Antarctica is a prime site for prospecting for biological organisms with a commercial application. Antarctica is prized as a neutral territory where any nation with the capability can locate a civil-military polar satellite-receiving station. Antarctica and the Southern Ocean are also air and sea transit routes of last resort; should more common air and sea paths be blocked. Emerging Antarctic powers are taking on the benefits of the old order, without embracing the vision of that order. Rising states such as Brazil, China, India, Malaysia and South Korea, along with an embattled but defiant Russia, are all interested in taking leading roles in shaping new international instruments that will better reflect their national interests. The emerging states are almost all oil-deficient; they are looking for new sources of oil and natural gas in the medium term, when current supplies available to them will be exhausted. They are also looking to external resources to resolve food security concerns, to boost economic growth, and for means to boost their international standing.

Session 1: Antarctica as a window to Earth and the universe beyond

CHAIRS: DR CHRIS BETTERS AND DR JACQUELINE HALPIN

Observations and measurements from Antarctica provide unique opportunities to investigate processes and phenomena that allow us to develop our understanding of Earth and the universe. These include solar–terrestrial interactions and space weather, the rotation of Earth's inner core and the strength of its magnetic dipole, cosmic ray detection, and astronomy and astrophysics.

Infrared astronomy from the Antarctic Plateau: motivation and Australian plans

ASSOCIATE PROFESSOR MICHAEL IRELAND

Australian National University

Astronomy is increasingly dominated by telescopes at the very best sites in the world, including the mountains of the Atacama desert and Mauna Kea, or space telescopes when these are inadequate. The high Antarctic Plateau provides an opportunity to push ground-based astronomy to new

frontiers, and is an inevitable location for new major observatories in the coming decades. The key advantages of an Antarctic site will be described, focusing on infrared survey astronomy and high contrast or astrometric exoplanet detection. Australia's collaborations on the Kunlun Infrared Sky Survey is an excellent pathfinder for future, more ambitious projects.

The Kunlun Infrared Sky Survey (KISS) with AST3-3 infrared camera

DR JESSICA ZHENG
Australian Astronomical Observatory

The high Antarctic plateau provides exceptional conditions including the low Antarctic infrared sky thermal background especially at 2.4μm K dark near infrared atmospheric window and the long Antarctic nights (the uninterrupted four-month period of winter darkness). It is an excellent place for infrared observations of the cosmos on account of the cold, dry and stable atmosphere above the ice surface. The AST3-3 infrared camera is designed with a 50 cm aperture telescope to monitor the southern skies in the 2.4μm Kdark window to take advantage of the unique conditions of the Antarctic high plateau. It will be deployed in China's Kunlun station at Dome A, on the summit of the Antarctic plateau. Dr Zheng will introduce the scientific goals behind the first program to examine the time-varying universe in the infrared from Antarctica—the Kunlun Infrared Sky Survey (KISS). Its high-sensitivity data will be used for several science programs including the study of star formation, brown dwarfs and hot Jupiters, exoplanets, the supernovae, variable stars and the cosmic infrared background. It is also being developed as a pathfinder for the future 2.5 m KDUST optical and infrared telescope deployable on Antarctic Dome A.

Measuring the infrared sky background from the high plateau

MR MATTHEW FREEMAN
UNSW Australia

The high plateau in the centre of Antarctica is known to be an excellent site for astronomy. It is at a high elevation, and the air is extremely cold and dry. These factors reduce the effect that the atmosphere has on astronomical observations. This is particularly important for infrared observations, where background light from the atmosphere is a major obstacle. The extreme conditions when observing from the high plateau make it the best place on Earth for infrared astronomy. To quantify this effect, a robotic instrument called NISM was installed at a site near Dome A in 2015. NISM measures the background light emitted by the atmosphere at near-infrared wavelengths (2.4 micrometres). This instrument is a result of collaborations between Australia, China, and the US. The lower the infrared sky background is, the greater the potential for ground-based infrared telescopes in Antarctica.

Volcanism on and around Heard and McDonald Islands: a complex history contributing to life in the Southern Oceans?

MS JODI FOX
University of Tasmania

The Kerguelen Plateau is one of the largest submarine basaltic plateaux on earth, produced by the activity of the Kerguelen Plume. Subaerial volcanism at Heard and McDonald Islands (HDMI) is the current expression of the Kerguelen Plume. Iron from the Kerguelen Plateau is known to fuel annual phytoplankton blooms in the Southern Ocean (Coffin 2015). The phytoplankton blooms are a critical part of the entire Southern Ocean ecosystem. Until recently the source of iron was attributed to erosion of the ancient basalts of the plateau (Coffin 2015). Heard Island is a 2,813 m high active stratovolcano with a complex history of emergence, glacial erosion, sector collapse and eruption that has been the focus of a recent graduate research project. McDonald Islands are known to have erupted in 1992 and 1997. Fumaroles are active on the flanks of McDonald Islands, and ongoing submarine hydrothermal activity is suspected in the surrounding area. Recently acquired multibeam bathymetry/backscatter data have shown that McDonald Islands are central to a field of >70 submarine sea knolls interpreted as submarine volcanoes. Hydrothermal iron input along with iron produced by ongoing volcanic processes on HDMI may play a significant role in seeding iron into the Southern Ocean.

Session 2: Ice and climate

CHAIRS: DR NERILIE ABRAM, DR BEN GALTON-FENZI, DR ADRIAN MCCALLUM

IMAGE: MARTIN HARTLEY

Ice plays a critical role in climate as part of the way water is transported and distributed throughout the Earth system. It influences components such as global sea level, atmospheric and ocean temperatures and circulation, and surface albedo. For example, recent evidence suggests ocean

warming is causing retreat of some parts of the Antarctic ice sheet, and sea level rise. This theme will focus on the drivers and outcomes of ice mass changes in the Southern Hemisphere. It will cover research focused on: How are ice shelves reacting to warming oceans and atmospheres? How does that impact ice sheet stability? Why is the extent of Antarctic sea ice expanding? What are the key thresholds for, and processes governing, ice loss in a warming world?

How continuous ice-penetrating radar records can help us to understand Antarctic ice–ocean interaction

DR SUE COOK

Antarctic Climate and Ecosystems Cooperative Research Centre

The floating ice shelves around Antarctica are the location where the ice sheet loses 90% of its mass, via basal melting and calving of icebergs. They also provide buttressing, controlling the flow of grounded ice behind them. Understanding the processes occurring on ice shelves, and how to model them, is key to accurately predicting the future sea level contribution of the continent. Autonomous phase-sensitive radio-echo sounders (ApRES) are ice-penetrating radar instruments designed for the Antarctic environment. Their low power requirements allow them to be left recording in situ for long periods of time, providing us with records of changes in ice thickness on a daily basis. By tracking internal layers in the ice, the instruments can also separate the change in thickness into components arising from snow compaction, strain thinning and basal melt. This presentation examines what the results from ApRES instruments can tell us about variability in melt rates underneath ice shelves, how the calculations of vertical strain can provide insights into the ice flow processes occurring around the grounding line of a glacier, and how results can be used to validate oceanographic models.

High-resolution simulation of dissolving ice-shelves in polar oceans

DR BISHAKHDATTA GAYEN

Australian National University

Precise knowledge of ocean dynamics and interactions with the grounded ice at high latitudes is crucial for predicting sea-level rise and further development of adaptation strategies in a warming global climate. The physics of these ocean–ice interactions particularly related to small-scale processes is poorly understood which, along with limited observation constraints, leads to uncertainties in the predictions of future melt rate. This research involves high-resolution numerical simulation to investigate dissolving of ice into cold and salty seawater. The main focus is on the rate of dissolving of ice at ambient water temperatures between -1° C and 2° C and salinity around 35 psu and the dependence on stratification (as characterises many sites around Antarctica). It is also important to quantify the difference between the melting of a vertical ice wall and the melting of a sloping ice shelf. The basal slope is observed to vary significantly, due to the formation of crevasses, channels and terraces. The high-resolution simulations performed are designed for direct comparison with laboratory measurements and theory. The temperature and density structures found under Pine Island Glacier show several layers having a vertical scale that can also be explained by this study.

Reassessing global ice volume changes since the Last Glacial Maximum: uncertainty and structure in sea level records

DR FIONA HIBBERT

Australian National University

The Last Glacial Maximum to the current interglacial period is relevant to our understanding of future extreme sea-level change because it provides a suite of data beyond the range of modern/instrumental variability with which to robustly test simulations. Notably, the interval incorporates the last deglaciation, the most recent period of widespread destabilisation and collapse of major continental ice sheets. In model-based projections of future sea-level change, the contribution of polar ice-sheet collapse is associated with large uncertainties, for example, regarding the rates and mechanisms of response to climate forcing. Past sea-level records provide some constraint on the natural bounds to the rates and magnitudes of polar ice-sheet decay. Records spanning the last deglaciation (as well as the ice volume maxima) are few, fragmentary and seemingly inconsistent (e.g. the timing and magnitude of melt-water pulses), in part due to locational (tectonic and glacio-isostatic) as well as modern analogue considerations (e.g. palaeo-water depth or facies formation depth). Dr Hibbert will review the principal records for the last deglaciation, with particular consideration of the geological and biological context, as well as the uncertainties and structure of each record. She will discuss the implications of these uncertainties on our ability to constrain past cryosphere changes.

The driving mechanisms of Southern Ocean sea ice response to different anthropogenic forcings

DR WILL HOBBS

Antarctic Climate and Ecosystems Cooperative Research Centre

Formal change detection studies indicate that the observed trend in Southern Ocean sea ice cover is within the range of internal variability. However, this result depends on global coupled models that fail to capture strong local trends, especially during summer in the western Ross and Bellingshausen sectors. Additionally the model response to individual forcings has not been considered. In this work optimal fingerprinting has been applied to Southern Ocean sea ice, and to the local atmosphere and ocean, to individually explore the sea ice response to anthropogenic greenhouse gas and anthropogenic ozone depletion. The former is characterised by a thermodynamic reduction in sea ice at all seasons and sectors; the latter shows a seasonally and spatially-dependent response that is driven by the atmosphere and is similar to observed patterns. The all-forcings response, which has been used in previous detection studies, is dominated by the thermodynamic greenhouse gas forcing. This indicates that the models over-represent the thermal response in the high latitude southern hemisphere.

Session 3: New technologies to tackle extreme environments

CHAIRS: DR CHRIS BETTERS, DR ADRIAN MCCALLUM, DR JUSTINE SHAW

IMAGE: MARTIN HARTLEY

The remoteness and harshness of much of the Antarctic environment means that automated systems are the only way to gather long-term data covering vast areas and all seasons. These include automatic observing systems (AWS, ocean moorings, ARGO floats and gliders), autonomous astronomical telescopes and observatories, robots (AUVs, drones) and satellite remote sensing. What new technologies are needed to resolve key uncertainties? What new technologies are on the horizon?

A critical path to under ice observations of Antarctic ice

DR DAMIEN GUIHEN

University of Tasmania

@guihen

The floating ice of the Antarctic, in its various forms, represents a significant frontier both in our understanding of the cryosphere and our ability to examine the frozen environment. There are few options available for making the necessary observations of dynamics such as the melting and freezing at the ice-water interface, particularly in the case of thick ice shelves. Traditional techniques, including radar arrays and bore holes, provide high-resolution data at local scales. Satellite altimetry and gravimetry paint synoptic pictures but at the cost of spatial resolution. To refine our understanding of the cryosphere we must travel under the ice. The Antarctic Gateway Partnership, funded by the Australian Research Council, is a multidisciplinary effort to investigate the Antarctic along four themes, one of which includes the acquisition of a new autonomous underwater vehicle, specifically designed for polar applications. The Antarctic marine environment is complex and hazardous, as previous robotic expeditions have demonstrated, and so there is a critical path of development ahead. Dr Guihen will describe the current state of the Gateway vehicle and the science questions that intersect with nodes on the engineering critical path, along with the Antarctic scientific community's need to develop new sensing technologies and platforms.

Taking innovative technologies beneath the waves: using hyperspectral imaging to enhance sea ice ecological research

DR VANESSA LUCIEER

University of Tasmania

@seafloorness

IMAGE: MICHAEL RAYNER

Sea-ice algae plays a critical role in large-scale biogeochemical cycles. Traditional point sampling techniques are labour intensive, spatially limited, and invasive. This has implications for quantifying both the contribution of sea ice algae to primary production, and qualifying their response to environmental stress. Hyperspectral imaging (HI) technology was trialled to monitor the distribution and relative abundance of ice-associated algae in the lab using artificial sea-ice that was grown in a state-of-the-art inverted tank. The results highlighted the HI potential to capture in situ variability of the algal community at unprecedented scales in a non-invasive manner. However, there are challenges associated with HI based on light transmitted through the

ice compared to reflected light. To determine HI suitability for in situ deployment, different species of ice algae were sparsely inoculated in the inverted tank at different concentrations and a multi-sensor approach was utilised to further explore HI capabilities by a) quantifying per-pixel biomass abundance over millimetre resolution imagery, b) assessing achievable spatial resolutions, c) detecting differences between algal taxa, and d) coupling biomass distributions with fine scale bottom topography reconstructions derived from digital photogrammetry. Dr Lucieer will conclude with an overview of how field deployment of the HI technology will be approached.

From floe-scale to gridscale: expanding our observations of, over and under sea ice with autonomous platforms

DR GUY WILLIAMS

Institute for Marine and Antarctic Studies

Antarctic sea ice plays a critical role in global climate and Southern Ocean ecosystems and there is an urgent need to better understand how it is responding to climate change. To do this effectively with numerical models and satellites, we have to overcome significant gaps in our existing observational datasets. This talk will discuss the recent deployments of robotic systems (drones and submarines) in the polar environment that aim to reduce the gap from traditional point measurements (0–100 m) to larger areas (1–10 km) more meaningful for model and satellite evaluation.

The Antarctic ocean-ice-atmosphere system: meeting the challenge of quantifying and exploring observed change.

DR PETRA HEIL

Australian Antarctic Division

Antarctica and the Southern Ocean are vast, remote and extreme regions in a largely harsh natural setting. Good quality environmental observations from this region are sparse and long-term records are rare but much needed. Hence it is timely to integrate existing autonomous instrumentation plus other state-of-the-art sensors into standardised, accurate and sustainable observatories. This includes sensor suites for the collection of continuous underway data, especially with a view to the imminent fleet of modern research icebreakers. The latter will incorporate a suite of sensors, including electro-magnetic induction, (laser) snow-surface detection, camera systems and in situ analytical samplers. Similarly a combination of land-based and ice-moored instruments will be used to configure a near-coastal fast-ice observation site. Crucial for any such observatory sites will be a controlled data streaming, which includes cleaning and calibration of raw data, sending of data to the Global Telecommunication System as well as to a recognised data centre. At this stage, remotely-sensed data may be merged into the data stream. Dr Heil will discuss and present examples of the status of the observation network.

Session 4: Understanding and managing Southern Oceans ecosystems

CHAIRS: DR CERIDWEN FRASER, DR NERIDA WILSON

The Southern Ocean is biologically rich. Despite strong ocean currents, however, biogeographic structure and cryptic diversity has been detected in many Southern Ocean species. How can we measure diversity and connectivity among regions, and how can we effectively manage biodiversity? How do we best protect this diversity?

Big challenges for Southern Ocean ecosystem science and management

DR JESS MELBOURNE-THOMAS

Australian Antarctic Division

@DrJessMT

Southern Ocean ecosystems provide a range of important services at both global and regional scales. These systems account for a substantial share of global uptake of anthropogenic carbon dioxide, they support global food security and high value fisheries for Australia and other nations, and they also have significant conservation values; 80% of the world's high seas marine protected areas are in Antarctica. Given current and predicted future environmental change in Antarctica, two key questions are: (1) What are the consequences of climate-driven change in Southern Ocean food webs for carbon sequestration, Australian fisheries, and global food security? and (2) Are there weak links in the food web that could result in rapid collapse of ecosystems if certain thresholds in temperature or acidification are reached? An integrated approach using observations, experiments and models provides our only means to address these questions and to inform management approaches for Southern Ocean ecosystems. This presentation will describe the approach being used for ecosystem assessment and modelling in the Antarctic Climate and Ecosystems

Cooperative Research Centre and the Australian Antarctic Division, including recent work to coordinate the first circumpolar assessment of status and trends for Antarctic marine ecosystems.

Parasitic Syndiniales DNA dominates Southern Ocean

DR LAURENCE CLARKE

Antarctic Climate and Ecosystems Cooperative Research Centre / University of Tasmania

The role of parasites in Southern Ocean ecosystems remains almost completely unknown. For example, a recent survey of plankton communities in the southern Indian Ocean found that the parasitic Syndiniales group contributed more than 20% of eukaryotic diversity in the smallest plankton fractions (0.45–20 μm). Indeed, a single Syndiniales species contributed more than half the DNA sequences in many samples near the ice edge. Syndiniales could influence Southern Ocean ecosystems in a similar fashion to marine viruses, diverting energy and nutrients from the phytoplankton-krill-marine predator food chain.

Understanding and managing life in extreme environments: insights from physical and biological datasets on the Antarctic seafloor

DR ALIX POST

Geoscience Australia

Biological communities on the Antarctic seafloor are surprisingly diverse, with high biomass even under some of the most extreme conditions on Earth. This talk will provide examples of benthic communities and environments on the continental shelf and slope on the East Antarctic margin. Dr Post will highlight the physical characteristics of these environments and how these shape the distribution and diversity of fauna on the seafloor. Physical processes are key to understanding benthic habitats, with factors such as iceberg scour, advected food supply, sea ice cover, sedimentation, morphology and bottom circulation creating distinct seafloor environments that create a mosaic of seafloor communities. The strong association between benthic communities and seafloor characteristics allows physical parameters to be used to extend our knowledge of the nature of benthic habitats into areas with little or no biological data. Physical datasets, such as bathymetry, morphology and sediment composition are considerably more extensive than biological data. The physical datasets collected within the proposed network of East Antarctic marine protected areas (MPAs) aids our understanding of the nature of the benthic communities within the network. These data show a diversity of habitats within the proposed MPAs that likely supports a diverse range of benthic communities.

Session 5: Human impacts in Antarctica and the Southern Ocean

CHAIRS: DR JUSTINE SHAW, DR NERIDA WILSON

Antarctica is globally recognised as having high conservation value and unique biodiversity. Humans have only been present in Antarctica for less than 200 years. Yet despite this, and the implementation of the Environmental Protocol of the Antarctic Treaty System, humans have impact. What impacts do human activities have on Antarctica? How are we impacting Antarctic biodiversity? How do we alter the ecosystem services provided by Antarctica? How can we effectively mitigate against human impacts? How can science inform non-native species management?

The environmental impacts of wastewater and sewage outfalls in Antarctica

DR JONNY STARK

Australian Antarctic Division

The treatment and disposal of sewage and wastewater are an ongoing environmental concern in Antarctica. In 2010 an environmental impact assessment of the Davis Station sewage outfall was conducted. The aims were to: 1) determine the properties of wastewater effluent; 2) assess the hydrodynamic characteristics of the nearshore marine environment; and 3) describe the nature and extent of impacts. In addition we examined the potential impacts of wastewater treated and disposed according to the minimum requirements under the Antarctic Treaty. Wastewater was lethal to local marine invertebrates at dilutions as low as 3%. Hydrodynamic studies indicated that wastewater was generally dispersed in a narrow plume along the coast in the direction of prevailing winds, however, there was retention of effluent around the outfall and wharf. There were significant effects of the outfall ranging from histopathological deformities in fish, to impacts on macrobiological communities, and uptake of sewage and associated contaminants into the food chain. Genes encoding for anti-microbial resistance have been introduced into the Davis marine environment and were found in a filter feeding mollusc. The results of this study provide evidence that the minimum requirements of the Protocol on Environmental

Protection to the Antarctic Treaty are insufficient to prevent environmental degradation.

Conservation of Antarctic biodiversity in the face of multiple threats

MISS JASMINE LEE
University of Queensland
@jaszzyjas

Antarctic terrestrial biodiversity, including arthropods, nematodes, moss, tardigrades, breeding seabirds and microbes survive only in the less than 1% of Antarctica that is permanently ice-free. This biodiversity is threatened by multiple stressors including climate change, invasive species and an expanding human footprint. In fact, the ice-free habitat that biodiversity relies on could expand by over 25% by the end of the century, leading to new opportunities for both native and invasive species. Conservation planning is a crucial step toward protecting Antarctic's unique biodiversity in a rapidly changing world. One method of prioritising management actions for taxonomic groups or regions is using a Priority Threat Management (PTM) approach, which relies on expert elicitation to derive a cost-efficient outcome. The PTM approach was applied to terrestrial Antarctic biodiversity at a workshop in Belgium in July 2017 with over 25 Antarctic biodiversity experts and policymakers. A number of management strategies were devised and assessed under two different climate change scenarios which can be used to help conserve biodiversity in the face of multiple threats.

Light-driven tipping points in polar ecosystems

DR GRAEME CLARK
UNSW Australia

Some ecosystems can undergo abrupt transformation in response to relatively small environmental change. Identifying imminent 'tipping points' is critical for biodiversity conservation, particularly in the face of climate change. This research identifies a nonlinear relationship between the timing of ice melt and the amount of light that some ecosystems receive annually, and describes how this may induce widespread regime shifts in polar ecosystems. This principle is demonstrated on Antarctic shallow seabed ecosystems, which data suggest are sensitive to small changes in the timing of sea-ice melt. Algae respond to light thresholds that are easily exceeded by a slight reduction in sea-ice duration. Earlier sea-ice loss is likely to cause extensive regime-shifts in which endemic shallow-water invertebrate communities are replaced by algae, reducing coastal biodiversity and fundamentally changing ecosystem functioning. Modelling shows that recent changes in ice and snow cover have already transformed annual light budgets in large areas of the Arctic and Antarctic, and both aquatic and terrestrial ecosystems are likely to experience further significant change in light. This mechanism renders polar ecosystems acutely vulnerable to abrupt ecosystem change, as light-driven tipping points are breached by relatively slight shifts in the timing of snow and ice melt.

Antarctic soil communities in the future: Opportunities for multi-disciplinary science

DR UFFE N NIELSEN
Western Sydney University

Terrestrial ecosystems in Antarctica present a unique opportunity to address fundamental and applied ecological questions. Several recent ambitious projects have addressed important questions and contributed substantially to the understanding of the current and future distribution and ecology of terrestrial Antarctic biota, in part because of their multidisciplinary nature. However, it appears timely to further take advantage of the opportunities presented by multi-disciplinary science. In particular, robust frameworks are required for assessing potential global change impacts on terrestrial ecosystem functioning in the future. This requires a multi-disciplinary approach with the following aims: 1) establish more robust baselines for the current distribution of soil biota in Antarctica, and the climatic and environmental constraints on these; 2) quantify linkages between soil community composition and ecosystem functioning, and assess the potential global change impacts on these; 3) obtain scale-relevant climate and physical models to predict future community states, and 4) investigate potential climate change feedback loops due to changes to the terrestrial ecosystems. This presentation will illustrate some opportunities for collaborative multi-disciplinary projects and initiate a discussion on how this can be developed further.

Session 6: Taking a step back: the environmental, climatological and evolutionary history of Antarctica

CHAIRS: DR NERILIE ABRAM, DR CERIDWEN FRASER

Climate change has been a critical aspect of Earth's history, affecting diverse physical and biological processes. How did

Antarctica's environment and climate change in the past? What can Antarctic paleoclimatic research tell us about global climate trends? How has Antarctica's unique terrestrial life been shaped by past climate cycles, and what can we learn from Antarctica about biological responses to climate change?

Polar frontal migration in the warm Pliocene: diatom and geochemical evidence from the Wilkes Land margin, East Antarctica

DR CHRISTINA RIESSELMAN

University of Otago

The mid-Pliocene is the most recent interval in Earth's history to sustain global temperatures within the range of warming predicted for the 21st century, providing an appealing analog for the changes we might encounter in the coming century. Previous diatom-based Southern Ocean reconstructions suggest an average +2° summer SST anomaly during the 3.3–3.0 Ma interval relative to modern. A new reconstruction from a marine sediment core collected at IODP Site U1361, on the Wilkes Land margin continental rise is presented here. Diatom-rich mudstones interpretations record interglacial conditions between 3.8 and 2.8 Ma, and diatom data indicate significant differences between interglacials. There is an overall Pliocene shift from open-ocean to sea ice-influenced conditions, punctuated by a transient excursion to a subantarctic environment during a single interglacial interval, 3.17–3.15 Ma, coincident with the most recent time when atmospheric CO_2 was elevated to our modern, post-industrial level of 400 ppm. This single warm interglacial interval following the onset of Pliocene Antarctic cooling suggests that a temporary elevation in atmospheric CO_2 was sufficient to trigger a substantial climate response, including the migration of warm subpolar surface waters within 270 km of the modern marine margin of the East Antarctic Ice Sheet.

Old-growth mosses as potential biological proxies for past Antarctic climate

DR MELINDA WATERMAN

University of Wollongong

@mel_waterman

Due to the harsh nature of this frozen continent, the bryophyte-dominated (mosses, liverworts) Antarctic terrestrial flora constantly battles against changes in temperature, reduced stratospheric ozone levels, wind speed and precipitation changes. The reduction in stratospheric ozone substantially impacts meteorological patterns over the southern hemisphere potentially leading to dramatic shifts in Antarctic species diversity, location and abundance. Thus, it is imperative that we monitor and investigate Antarctic terrestrial communities and individual species in response to changes in climate, in particular to ozone depletion. There is also a substantial need for regional climate proxies given the sparse distribution, limitations and short record of Antarctic meteorological stations. Mosses are a suitable candidate for proxy development as they can preserve long-term records of their immediate microclimate in their chemical signatures. This research aims to develop and use Antarctic mosses as biological proxies for climate around the Antarctic coast. This includes analysing pigments and stable isotopes of a range of continental and maritime mosses that have been dated using the radiocarbon bomb-pulse method. Long-term regional climate records, such as moss water availability and ozone levels, could be locked away as chemical signatures within ancient moss shoots of up to 420 years old.

Geochemical and isotopic tracers of past ice shelf stability

DR DUANNE WHITE

University of Canberra

Ice shelves are a key component of the ice sheet drainage network. Most ice lost from the present day Antarctic ice sheet occurs via ice shelves, so ice shelf processes (e.g. calving and basal melt) modulate ice sheet mass balance. Knowledge of the past distribution and geometry of ice shelves will help understand their sensitivity to climate forcing, and the response of ice sheets to changes and loss of ice shelves. However, detecting the presence or absence of past ice shelves in the sedimentary record is challenging. Concentrations of elemental and isotopic tracers in modern sediments in open water in Prydz Bay were compared to those being deposited underneath the Amery Ice Shelf at ten sites across the region. Results suggest that sub-ice shelf and open water sediments differ in their acid-extractable elemental concentrations. Meteoric Be-10 concentrations are on average lower in sub-ice shelf settings than they are in open water environments, but the Be-10 concentration is modulated by sub-ice shelf ocean circulation. In combination, these tracers can be used as proxies to reconstruct former ice shelf geometries and sub-shelf circulation.

Bipolar seesaw, ocean circulation, and Antarctic ice-sheet melting at the end of an ice age

DR GIANLUCA MARINO
Australian National University

The ice age cycles of the last million years exemplify the response of ocean–atmosphere–cryosphere system to a combination of climate forcing (insolation) and superimposed feedbacks (CO_2). Each of these cycles initiates with slow global cooling and ice-volume growth and is terminated by rapid warming, ice-sheet melting, and prominent, out-of-phased interhemispheric climate change, the bipolar seesaw. Because of the rapidity at which they occur, a robust chronological control is mandatory to constrain the relationship between insolation forcing, ice-sheet melting, and bipolar seesaw at glacial terminations. Absolute dating of palaeoclimate archives from polar ice sheets, ocean basins, and land has been traditionally available only for the last termination, Termination I (T-I). An equally robust, radiometrically constrained chronology for the penultimate glacial termination, Termination II (T-II) was recently constructed. T-I and T-II were analysed with emphasis on the timing of ocean, climate, and ice-volume changes. The two terminations differ fundamentally from one another, particularly in the phasing of ice-sheet melting and bipolar seesaw developments. The latter, via sustained Southern Ocean heat gain, likely caused Antarctic and ice-sheet melting that may partly account for the last interglacial sea level to peak above present.

Session 7: The Antarctic Plate: solid Earth and tectonic perspectives

CHAIRS: DR JACQUELINE HALPIN, DR DELPHINE LANNUZEL

Antarctica contains some of the oldest known crust on Earth, built over billions of years. The breakup of Gondwana shaped the modern continent, leading to the opening of the Tasman and Drake gateways, the development of the Antarctic Circumpolar Current, and paving the way for the modern ice sheet. Yet there is much to learn, as the Antarctic continent reveals less than 2% of its rugged subglacial topography and its submarine margins remain poorly explored. Today the solid Earth continues to impart significant forcings on the ice sheet and ocean circulation, which are not well captured in ice sheet and climate models. This theme includes new insights into the evolution of the Antarctic plate, including the deep lithosphere, geological architecture, tectonics, geothermal heat flux, basal hydrology, glacial isostatic adjustment and bathymetry.

The role of plate tectonics in influencing ocean circulation and climate: a Tasman Seaway example

DR JO WHITTAKER
Institute for Marine and Antarctic Studies, University of Tasmania

Antarctica has overlain the South Pole for the past 100 million years. Despite this it hasn't always been the frozen place it is today: in the past, Antarctica has had thriving temperate forests. The opening of the Tasman Seaway, as Tasmania finally separated from Antarctica during the Late Eocene, has been proposed as one of the key tectonic events enabling the onset of the Antarctic Circumpolar Current. However, the evolution of this key seaway, when the Antarctic Circumpolar Current flowed through it, and how much of a role the oceanographic change played in influencing the transition to permanent icesheets on Antarctica, remains controversial. Dr Whittaker will look at the tectonic and geodynamic evolution of Antarctica and the Southern Ocean, and the temporal relationships to oceanographic conditions and climate.

Seafloor geomorphology of the Cape Darnley region: insights from a new bathymetry compilation

DR JODIE SMITH
Geoscience Australia

Cape Darnley, on the Mac. Robertson shelf in East Antarctica, is an area of particular interest to oceanographers, biologists, glaciologists and geologists. The continental margin in this area is a key location for understanding the Cretaceous breakup of central Gondwana; basins on the shelf contain valuable paleoenvironmental records; the shelf is an important marine habitat; and the Cape Darnley polynya is one of only four sites of Antarctic Bottom Water production—a cold, dense, nutrient-rich water mass that forms on the continental shelf and sinks to abyssal depths, driving ocean currents around the world. However, oceanographic and ecosystem models in this region are poorly constrained by lack of detailed bathymetry. This research presents the first detailed bathymetry compilation and geomorphic interpretation for the Cape Darnley region. The new data, compiled from several marine science voyages, improves previous regional bathymetric

representations and enables visualisation of shelf and slope morphology in unprecedented detail. The compilation provides important baseline information underpinning a range of scientific applications. In particular, the bathymetry provides the first detailed insights into potential bottom water transport pathways from the Cape Darnley polynya into the global deep ocean circulation system. Geomorphic interpretation of the bathymetry data provides insights into past glacial dynamics and contemporary seafloor processes.

The tectonic history of the Rayner Complex, from Rodinia to Gondwana

DR LAURA MORRISSEY

University of South Australia

The Rayner Complex comprises a large portion of the East Antarctic continent, extending from Enderby Land in the west to Princess Elizabeth Land in the east. It contains a metamorphic record of mountain building that coincides with two periods of supercontinent formation, Rodinia at c. 1000–900 Ma and Gondwana at c. 500 Ma, but its position within these supercontinents remains poorly understood. The Rayner Complex is pivotal in these reconstructions as it can be directly linked to the Eastern Ghats in India, which records some of the most extreme crustal temperatures observed in the continents. New U–Pb and Lu–Hf isotopic data from the northern Prince Charles Mountains (nPCM) provides further constraints on the tectonic setting of the Rayner Complex during the amalgamation of Rodina and Gondwana. Episodic, isotopically juvenile magmatism between 1150–900 Ma suggests the Rayner Complex was a long-lived accretionary system. The significance of the c. 500 Ma event in the nPCM has been debated, but a newly recognised cover sequence in the Fisher Terrane records only one phase of metamorphism at 510–520 Ma. This suggests that the record of Gondwana amalgamation is more important in the tectonic history of this region than previously thought.

High-heat producing rocks and sub-glacial heat flow, possible clues to ice sheet dynamics from the continental rocks in southern and central Australia

DR SANDRA MCLAREN

University of Melbourne

Important geological linkages connect Australia and Antarctica. Prior to the breakup of Gondwana (beginning around the late Cretaceous) cratonic rocks of southern Australia, including the Gawler and Curnamona cratons, are thought to have been contiguous with similar aged rocks in East Antarctica. In Australia, excellent outcrop exposure means that these rocks are reasonably well understood. One of the key characteristics of these Australian Proterozoic-aged cratonic blocks is unusually high measured surface heat flow, averaging 2–3 times that of similarly-aged cratonic blocks elsewhere globally. This high heat flow arises from anomalously high concentrations of the heat producing elements, U, Th and K, which have been demonstrated to profoundly impact a range of temperature-dependent geological processes, such as metamorphism and magmatism. Geochemical analysis of rocks from the George V Land-Terre Adelie and eastern Prydz Bay regions suggest heat flow is highly heterogenous in East Antarctica, with the presence and variable distribution of U, Th and K enriched crustal rocks providing a first-order control on sub-glacial heat flow variations. This research shows that variations in abundance and distribution of heat producing elements within the Antarctic continental crust results in greater and much more variable regional sub-glacial heat flows than currently assumed in ice modelling studies. Such elevated heat flows may have significant effect on ice sheet behaviour and highlights the importance of assessing the geological controls on heat flow for predictions of ice mass balance and sea-level change.

Improving earth deformation models in the Parallel Ice Sheet Model for Antarctic Palaeoclimate models

DR LENNEKE JONG

Antarctic Climate and Ecosystems Cooperative Research Centre / University of Tasmania

The deformation of bedrock due to changes in ice mass can impact the evolution of the Antarctic ice sheet and global sea level. Depending on the particular properties of the underlying bedrock in regions vulnerable to the marine ice sheet instability, this may have impacts over centennial timescales as well as the longer term evolution of the ice sheet over glacial cycles. Capturing the feedback mechanisms between ice sheet and sea level models require models of glacial isostatic adjustment (GIA) with a spatially varying, viscoelastic earth. While some ice sheet models incorporate simple models of glacial isostatic adjustment (GIA), fully capturing the feedback mechanisms between mass loss of the ice sheet and sea level requires a spatially varying, viscoelastic earth. Many solid earth deformation models do not use an explicit time stepping approach which ice sheet models commonly use, making coupling of these models computationally expensive. Progress has been made in coupling the SGVEM earth deformation model to the Parallel Ice Sheet Model (PISM) in order to investigate how sensitive of simulations of Antarctica from the Last Glacial Maximum to present day are to choices of GIA model.

Session 8: Southern hemisphere atmospheric and oceanic circulation, weather and climate

CHAIRS: DR NERILIE ABRAM, DR BEN GALTON-FENZI, DR DELPHINE LANNUZEL



The complex relationships between atmospheric and oceanic circulations largely contribute to weather patterns in the southern hemisphere, and ultimately our global climate. Through the Antarctic Circumpolar Current, the Southern Ocean connects the basins and currents of the Atlantic, Pacific and Indian oceans, redistributing heat, gas and nutrients around the globe. Large uncertainties remain around how changes such as the warming and freshening of the surface ocean will affect global circulation, or how the increase in atmospheric anthropogenic gases will affect marine primary productivity. This theme will focus on Southern Ocean circulation chemistry and compositional changes, atmospheric changes, and interactions between them, as well as the impacts on Australia's weather and climate.

The unknown East: A new ice core to fill the climatological gap in the Indian Ocean sector of East Antarctica

DR TESSA VANCE

Antarctic Climate and Ecosystems Cooperative Research Centre

High resolution ice core records are crucial to understanding past climate variability in Antarctica and the Southern Ocean. While existing long records tell us about how the climate has changed over centuries to millennia, only ice cores that resolve past climate at annual and ideally seasonal resolution can provide insight into features such as the Southern Annular Mode (SAM), westerly wind variability, sea ice extent and changes in snowfall accumulation. Records like this that span more than a few tens or hundreds of years are rare across Antarctica. For the region spanning Enderby Land to East Wilkes Land (~45-160° East), only two annually resolved records >2000 years exist. This summer a new ice core will be drilled to provide a 2000 year ice core record in Wilhelm II Land, to complement the emerging and existing proxy records from the Law Dome core. This record will assist in filling the climatological gap in our understanding of southern hemisphere past climate variability in the Indian Ocean sector.

The Antarctic ozone hole and climate

ASSOCIATE PROFESSOR JULIE ARBLASTER

Monash University

The ozone layer over Antarctica has been depleted by more than 50% of pre-1980s levels. Recent evidence based on theoretical arguments as well as simple and comprehensive climate models has built a strong case for the dominance of this ozone depletion in driving a strengthening and southward shift of the westerly winds over the Southern Ocean during austral summer. These altered winds have associated impacts on the ocean circulation, sea-ice and rainfall patterns over the Southern Hemisphere. The good news is that the Montreal Protocol, that was ratified in 1987 to ban ozone depleting substances, is on track to restore ozone levels over Antarctica by the middle to end of this century. How the recovery of the ozone layer will interact with increasing greenhouse gases in driving future climate change in the southern hemisphere is currently uncertain. Recent studies have also highlighted that short-term variability in stratospheric ozone over Antarctica may be associated with surface temperature and rainfall changes on daily to seasonal timescales. For example, a smaller than usual spring Antarctic ozone hole is strongly correlated with a subsequent hot summer in Australia. These findings have the potential to provide exciting new avenues for advances in climate prediction and projections.

Localised rapid warming of West Antarctic subsurface waters by remote winds

DR PAUL SPENCE

Climate Change Research Centre, UNSW Australia

The largest rates of Antarctic glacial ice mass loss are occurring to the west of the Antarctica Peninsula in regions where warming of subsurface continental shelf waters is also largest. However, the physical mechanisms responsible for this warming remain unknown. Localised changes in coastal winds off East Antarctica can produce significant subsurface temperature anomalies (>2° C) around much of the continent. Coastal-trapped barotropic Kelvin waves communicate the wind disturbance around the Antarctic coastline. The warming is focused on the western flank of the Antarctic Peninsula because the circulation induced by the coastal-trapped waves is intensified by the steep continental slope there, and because of the presence of pre-existing warm subsurface water offshore. The adjustment to the coastal-trapped waves shoals the subsurface isotherms and brings warm deep water upwards onto the continental shelf and closer to the coast. This result demonstrates the vulnerability of the West Antarctic region to a changing climate.

Ocean transport across the Antarctic continental slope

DR ADELE MORRISON

Australian National University

The flow of water onto and off the Antarctic continental shelf has a pivotal control on both the large-scale pole-to-pole overturning circulation, and global sea level. Mid-depth waters upwell southward from the Southern Ocean to the surface around Antarctica, transporting heat towards the floating ice shelves. Cold bottom waters that form near the Antarctic coastline cascade off the continental shelf into the abyss, filling up one third of the global ocean volume. In addition to the transport of these globally significant mid-depth and bottom waters across the Antarctic continental slope, surface waters also flow seasonally both on- and off-shore. Scarce observations and difficult modelling conditions mean that we know very little about what controls the transport of these different water masses and how the transports may be coupled to one another. A high-resolution global ocean model has been used to investigate the temporal and spatial variability of the ocean transport across the Antarctic continental slope. A particular focus is the possibility that the export of bottom waters may modify the stratification above, creating conditions that allow warm mid-depth waters easier access onto the shelf.

POSTER AND LIGHTNING TALK ABSTRACTS

Alphabetical by surname

NOTE: indicates lightning talks

Surface-based observations of Southern Ocean clouds and precipitation

DR SIMON ALEXANDER

Australian Antarctic Division

Surface-based cloud and precipitation remote sensing data collection is currently on-going at Macquarie Island (54S, 2016 – present). For the first time, this research quantifies the prolific amount of super-cooled liquid water clouds present at these latitudes and investigates the heterogeneous glaciation (i.e. due to aerosols) of mid-level super-cooled water clouds. The Macquarie Island results will be related to observations made from various recent ship-based campaigns in the Southern Ocean.

Drivers of Antarctic terrestrial diversity: insights from the Collembola

DR HELENA BAIRD

Monash University

Most of the Antarctic's terrestrial biodiversity exists in the soil, yet soil ecosystems are inadequately protected, despite threats from climate change and biological invasions. In line with a global initiative to redress this imbalance, recent work has been undertaken to demonstrate how key studies can simultaneously inform biogeography and conservation policy. The focus of this research is on the springtails (Collembola), one of Antarctica's dominant soil arthropod groups. This research provides a critical synthesis on the diversity and distribution of the group, with insights on drivers of species richness and turnover. The Antarctic assemblage consists of a concerning proportion of alien species, while native species are highly endemic. Although molecular approaches are starting to reveal cryptic speciation and taxonomic complexity, novel molecular techniques to better understand the region's diversity remain underutilised.

Biomarkers of station-derived contamination impact: Antarctic rock-cod (*Trematomus bernacchii*) as an indicator species

DR PATRICIA CORBETT

Deakin University

Increasing evidence of the impact on marine organisms from Antarctic station-derived contamination necessitates assessment of indicator species and development of a suite of biomarkers of sub-lethal exposure and impact. Twenty Antarctic rock-cod (*Trematomus bernacchii*) per site were collected within close proximity to Australian Antarctic Stations (Davis (2012–13) and Casey (2014–15), East Antarctica), in addition to reference sites. A multiple-line-of-evidence approach was applied. All fish within close proximity to the outfall exhibited significant histological alteration in both gill and liver tissue. The prevalence and severity of histopathology decreased with increasing distance from the Davis Station wastewater outfall. Nitrogen stable isotope analysis supported this trend with higher assimilation of sewage-derived nitrogen within the tissues of fish closest to the outfall. Findings provide direct evidence of the impact of station-derived contamination on Antarctic biota, and highlight the value of incorporation of histopathological investigations as part of Antarctic-based environmental risk assessment programs. The health index developed for *T. bernacchii* will allow direct comparison of impacts to this fish in future studies. Both isotopic assimilation and histopathology were shown to be viable biomarkers for investigation of station-derived contaminant exposure and longer-term monitoring in future.

How do winds and surface buoyancy fluxes steer the Southern Ocean meridional overturning circulation?

DR STEPHANIE DOWNES

Antarctic Climate and Ecosystems Cooperative Research Centre

The current generation of climate models exhibit a large spread in the steady-state and projected Southern Ocean upper and lower overturning circulation, with mechanisms for deep ocean variability remaining less well understood. Common Southern Ocean metrics in twelve models from the

Coordinated Ocean-ice Reference Experiment Phase II (CORE-II; 1948–2007) are assessed to understand what sets the magnitude of the coherent increasing trend in the upper overturning circulation, and a decrease in the lower branch across the CORE-II models. The southern hemisphere westerly winds drive a stronger upper meridional overturning circulation, however this increased overturning transports surface waters into the ocean interior that are lighter. Models with strengthened ocean interior stratification below 2 km depth and north of 60S exhibit a larger weakening of the lower overturning circulation, and a larger heat gain in the surface transformation of upwelled deep waters into lighter intermediate waters. The models with warmer and fresher intermediate waters exhibit larger weakening of the lower overturning circulation. A poleward shift and increase in the westerly winds affects surface density predominately where upwelled deep waters outcrop, and it is these deep waters that link the upper and lower overturning cells.

New insights and directions in Southern Ocean sponge biogeographic research

MS RACHEL DOWNEY
Australia National University

This research explores the response of sponges (Porifera) in the Southern Ocean and adjacent regions, combining methods in genetics and taxonomy, to understand the diversity of sponges, cryptic speciation, connectivity of sponge populations and their associated infauna, and how sponge communities have responded to past environmental change. Understanding how sponges have responded to changes in the recent past, through adaptation and migration, provides an indication of how they might respond to future changes. During the last glaciation, temperatures and sea levels dropped, ice-sheets grew extensively across the Antarctic shelf, and sea ice coverage, duration, and ice-scouring increased. Molecular studies have revealed that many benthic Antarctic organisms survived in refugia, either in deep water, localised shallow areas that were not heavily impacted by ice-scouring, or further north in the sub-Antarctic. Sponges are an excellent model taxon for this work because they are diverse and abundant, inhabit a wide range of environments, form a major part of marine food webs, are habitat for numerous organisms, and have diverse reproductive and life strategies.

Armchair Antarctic ecology: studying ecosystems without stepping on the ice

DR GRANT DUFFY
Monash University
@grant_duffy

The volume of combined data (climatological/geological/ecological/anthropogenic activity etc) now available for the Antarctic region means that 'big data' approaches are now applicable, and arguably a necessity, for Antarctic research. These data can be used not only to monitor historical and ongoing changes to flora and fauna, but also to quantify human activities and impacts. This will support conservation strategies that not only protect at-risk and unique ecosystems, but allow for the ever-growing tourism industry, which is an important means to raise awareness of the uniqueness of and threats facing the region, to be conscientiously managed through evidence-based methods. This poster demonstrates how ecoinformatic methods are being applied across the Antarctic region

Virus-host interactions in hypersaline Antarctic lakes

DR SUSANNE ERDMANN
UNSW Australia

Overwhelming evidence indicates that viruses play critical roles in Antarctic aquatic systems. This research aims to determine the influence of viruses on the community structure of very cold (down to -20° C), hypersaline Antarctic lake systems that are dominated by members of the third domain of life, the Archaea. Our work involves the isolation of new viruses and host organisms from water samples, their characterisation using electron microscopy, virus life cycle studies, analyses of host responses (e.g. CRISPR immune system and genomic changes) and the integration of this laboratory-based research with analyses of large environmental datasets (e.g. metagenomics and metaproteomics data). The research is helping illuminate the ways in which virus–host interactions regulate community composition and ecosystem function in Antarctic aquatic environments.

Traversing the Antarctic ice sheet safely with remote sensing

DR ALEXANDER FRASER

Antarctic Climate and Ecosystems Cooperative Research Centre

In situ access to remote areas of the Antarctic Ice Sheet via inland traverse convoy holds the promise of bountiful scientific gains. However, there are risks associated with traverses in regions rarely (or never before) traversed. Crevasse fields are often difficult to detect from surface observations, particularly in times of cloud cover or darkness. Even in clear sky conditions, thin snow bridges may cover crevasses, giving a false sense of safety. Remote sensing is a useful tool for crevasse detection in a lot of cases. In particular, high resolution, low sun-angle visible imagery can detect subtle changes in slope and shadows associated with crevasse presence. High resolution synthetic aperture radar imagery (particularly at X- or C-band) is also sensitive to crevasse presence, giving the added advantage of being able to reveal crevasses under thin snow bridges (especially at C-band). Automation and objective delineation of crevasse fields from remote sensing imagery is non-trivial, and this poster explores options in this space. Finally, in regions identified as hazardous for traverse activities, remote sensing can contribute valuable scientific knowledge via glaciological parameter retrieval.

Geothermal activity helped life survive past glacial periods in Antarctica

DR CERIDWEN FRASER

Australian National University

@CeridwenFraser

Geothermal activity, which can maintain ice-free terrain in glaciated regions, provides a tantalising solution to the question of how diverse life might have survived glacial periods in Antarctica. The continent has experienced repeated glaciations that most models indicate almost completely blanketed the continent in ice, yet many Antarctic species appear to have evolved in isolation for millions of years and hence must have persisted in Antarctica during glacial maxima. Under a hypothesis of geothermal glacial refugia and subsequent recolonisation of non-geothermal regions, greater contemporary diversity close to geothermal sites than in non-geothermal regions, and significant nestedness by distance of this diversity, would be expected. Spatial modelling approaches were used to create the most comprehensive, validated terrestrial biodiversity dataset yet for Antarctica to assess spatial patterns of diversity (estimated species richness) on the continent. Models clearly support the hypothesis, with the best models indicating higher species richness at geothermal versus non-geothermal sites for both plants and fungi, indicating that geothermally active regions have played a key role in structuring biodiversity patterns in Antarctica. These results provide critical insights into the evolutionary importance of geothermal refugia and the history of Antarctic species.

Oceanic melting driving East Antarctic ice sheet dynamics

DR FELICITY GRAHAM

University of Tasmania

The Totten Glacier, East Antarctica, drains a basin that contains enough ice to raise global sea levels by approximately 4 m. Observations show that the Totten Glacier has been retreating, coincident with ocean-driven thinning of the ice shelf. A state-of-the-art numerical ice sheet model, was used to investigate how ocean melt rates drive advance and retreat of the Totten Glacier. This revealed that the current Totten Glacier grounding line position—the interface between the grounded and floating portions of the ice sheet—is not stable, but retreats with present day ocean forcing. These results have implications for how to detect the anthropogenic climate change signal from internal variability in observations of glacier retreat.

Reconstructing global ice-volume variability over 3 million years (My)

DR KATHARINE GRANT

Australian National University

Sea-level reconstructions are critical for understanding the equilibrium response of ice sheets to sustained warming. Observational and historical sea-level measurements only extend to approximately 200 years ago, which is far too short a timeframe to capture the long-term (>10^4 years) response of global sea level to ice-sheet melting. Global sea-level changes are well-constrained since the last glacial maximum (~20,000 years ago, ky) by radiometrically-dated corals, and fairly well-constrained over the last glacial cycle (~150 ky). Prior to that, however, there are few continuous records and sparse coral data, so studies of ice-climate-sea level relationships rely on extricating a sea-level signal from carbonate $\delta^{18}O$ records, either by modelling, or by using deepwater temperature records.

An alternative sea-level reconstruction method (the 'isolated basin' approach) was developed for the Red Sea and recently attempted for the Mediterranean (Rohling et al, 2014). This method exploits the strong sensitivity of seawater

$\delta^{18}O$ in these basins to sea-level changes in the relatively narrow and shallow straits which connect the basins with the open ocean. The Mediterranean sea-level method cannot (yet) resolve sea-level highstands during northern hemisphere insolation maxima, when African monsoon run-off strongly depleted in $\delta^{18}O$ reached the Mediterranean. This research involves a geochemical proxy for monsoon intervals and a model-data synthesis of water column $\delta^{18}O$ changes over a strong monsoon interval during the last interglacial maximum. This will more accurately portray the timing of monsoon intervals and associated changes in water-column and run-off $\delta^{18}O$, and hence quantify the monsoon versus sea level (=ice volume) $\delta^{18}O$ imprint on Mediterranean carbonate (Foraminiferan) $\delta^{18}O$ records. New $\delta^{18}O$ records from ODP Site 967 (Eastern Mediterranean) will then be converted into a continuous, high-resolution relative sea level record spanning 3 My, with fully quantified uncertainties.

Feeling the heat from below: geothermal heat flux on the Antarctic Peninsula

DR JACQUELINE HALPIN

Institute for Marine and Antarctic Studies, University of Tasmania

As the climate changes, the Antarctic ice sheet represents the single largest potential source of sea level rise. However, one key parameter controlling how the ice sheet flows remains poorly constrained: the amount of heat supplied to the base of the ice sheet from the underlying Antarctic continent (known as geothermal heat flux). In areas of slow-flowing ice, this heat flux can control how well the ice sheet can flow over bedrock and even lead to melting of the ice at its base. Current models for Antarctica's heat flux use coarsely-resolved geophysical datasets to determine how thin the crust is and consequently how easily heat from Earth's mantle can warm the surface. This research shows that heat produced by radioactive decay within Earth's crust can have an even greater and much more variable contribution to the subglacial heat flux than estimated by these previous models. A new methodology has been developed allowing this crustal heat production to be calculated and combined with the geophysical models, producing a new map of heat flux on the Antarctic Peninsula highlighting the variations in heat flux caused by different rock types.

Differences between the last two glacial maxima and implications for ice-sheet, $\delta^{18}O$, and sea-level reconstructions

DR FIONA HIBBERT

Australian National University

Studies of past glacial cycles yield critical information about climate and sea-level (ice-volume) variability, including the sensitivity of climate to radiative change, and impacts of crustal rebound on sea-level reconstructions for past interglacials. This research identifies significant differences between the last and penultimate glacial maxima (LGM and PGM) in terms of global volume and distribution of land ice, despite similar global temperatures and radiative forcing. The analysis challenges conventional views of relationships between global ice volume, sea level, seawater oxygen isotope values, and deep-sea temperature, and supports the potential presence of large floating Arctic ice shelves during the PGM. A glacioisostatic assessment demonstrates how a different PGM ice-sheet configuration might affect sea-level estimates for the last interglacial. Results suggest that this may alter existing last interglacial sea-level estimates, which often use an LGM-like ice configuration, by several metres.

Statistical tools for understanding and mapping Southern Ocean biodiversity and its response to a changing climate

DR NICOLE HILL

Institute for Marine and Antarctic Studies, University of Tasmania

The Southern Ocean faces significant and increasing pressures from a range of sources, including a changing climate and an expanding human footprint. Understanding the current distribution of biological assemblages and how they have changed through time and space in response to environmental change and other drivers (such as fishing pressure) provides critical clues as to how they may respond in the future and will assist effective management. Quantifying current patterns and detecting, attributing and understanding recent changes in key Southern Ocean assemblages is not a trivial task. New statistical tools based on joint species distribution (JSDM) have been developed and latent variable models and show how they can offer new insights into this challenging issue.

Opening the window to the Southern Ocean: abrupt change in ventilation

DR ANDREAS KLOCKER

University of Tasmania

The surface waters of the Southern Ocean act as a control valve through which climatically important tracers such as heat, freshwater and CO_2 are transferred between the atmosphere and the ocean. The process that transports these climatically important tracers through the surface mixed layer into the ocean interior is known as ocean ventilation. Changes in ocean ventilation are thought to be important for both rapid transitions of the ocean's global overturning circulation during the last deglaciation, and the uptake and storage of excess heat and CO_2 as a consequence of anthropogenic climate change. This research shows how the interaction between Southern Ocean jets, topographic features, and ocean stratification can lead to an abrupt change in Southern Ocean ventilation. For increasing winds, this interaction leads from a state in which tracers are confined to the surface mixed layer, to a state in which tracers fill the ocean interior. This abrupt onset of Southern Ocean ventilation with increasing winds directly impacts the uptake of heat and CO_2 into the global ocean, with crucial consequences for the global climate system.

Dense shelf water spreading from Antarctic coastal polynyas to the deep Southern Ocean: a regional circumpolar model study

DR KAZUYA KUSAHARA

Antarctic Climate and Ecosystems Cooperative Research Centre

The spreading of dense shelf water (DSW) from Antarctic coastal margins to lower latitudes plays a vital role in the ocean thermohaline circulation and the global climate system. Through enhanced localised sea ice production in Antarctic coastal polynyas, cold and saline DSW is formed over the continental shelf regions as a precursor to Antarctic bottom water (AABW). However, the detailed fate of coastal DSW over the Southern Ocean is still unclear. Extensive passive tracer experiments were conducted using a circumpolar ocean-sea ice-ice shelf model to investigate pathways of the regional polynya-based DSW from the Antarctic margins to the deep Southern Ocean basins. In the numerical experiments, the Antarctic coastal margin was divided into nine regions, and a passive tracer was released from each region at the same rate as the local sea ice production. The modelled spatial distribution of the total concentration of the nine tracers was consistent with the observed AABW distribution and clearly demonstrates nine routes of the DSW over the Southern Ocean along its bottom topography. The model also shows that while ~50% of the total tracer is distributed northwards from the continental shelf to the deep ocean, ~7% is transported polewards beneath ice shelf cavities. The comprehensive tracer experiments allow us to estimate the contribution of local DSW to the total concentration along each of the pathways.

Projecting the impact of increasing Antarctic meltwater on global ocean circulation

MS VERONIQUE LAGO

UNSW Australia

The Southern Ocean is a major component of the global climate system and a gateway to the deep ocean, with a vast quantity of water sinking to the abyss around Antarctica. The Southern Ocean is also a major region of ocean heat and carbon uptake, moderating the rate of ongoing global warming. Changes in the Southern Ocean circulation can thus have a profound impact on the world's climate. Projected estimates suggest an increase in the meltwater contribution from the Antarctic ice sheet and ice shelves to the Southern Ocean. Yet little is known about the potential impact of the melting Antarctic ice sheets on ocean circulation and the associated heat and carbon uptake. The meltwater provides additional freshwater transferred to the ocean through basal runoff and melting icebergs distributed around the Southern Ocean. Using recent estimates for the pattern of distribution of this freshwater input around Antarctica combined with long-term projected estimates for the amplification of meltwater contribution from Antarctica, the impact on ocean circulation was evaluated using a global ocean model. Of particular interest were the estimated changes in the meridional overturning circulation, the ocean uptake of heat, and the circulation on and around the Antarctic continental shelf.

Top predators navigating extremes in a changing Southern Ocean

ASSOCIATE PROFESSOR MARY-ANNE LEA

Institute for Marine and Antarctic Studies, University of Tasmania

@icetempete

Marine vertebrate predators are challenged by a range of extreme events over and above the seasonal extremes encountered in the Southern Ocean and Antarctica. Some of these events are relatively well documented. For example, unseasonal snowfall and snowmelt can negatively affect penguin chick survival; large tabular icebergs may impede

access to the ocean for a range of species, notably penguins; and anomalous declines in local krill availability may simultaneously lead to complete reproductive failure for many species in some years. The incidence and effects of other events, however, are less well-understood. For example, how does the increasing incidence and intensity of storm events in the Southern Ocean affect the dispersal, behaviour and feeding success of marine vertebrates? What are the cumulative impacts of successive 'rare', extreme events on populations? Gaining a circumpolar appreciation of shifting conditions and their consequences is critical to predicting how circumpolar species will adapt into the future.

Regulating Antarctic bioprospecting: where should rising powers stand?

DR NENGYE LIU
University of Adelaide
@NengyeLiu


IMAGE: JAMES KNOWLER

The General Assembly of the United Nations (UNGA) decided, in its Resolution 69/292 of 19 June 2015, to develop an international legally binding instrument under the UNCLOS on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction. Prior to holding an intergovernmental negotiation conference, the UNGA established a Preparatory Committee (PrepCom) to make substantive recommendations to the General Assembly on the elements of a draft text of an international legally binding instrument. The PrepCom started its work in 2016 and completed its fourth session in July 2017). The PrepCom considers issues like marine genetic resources, including benefit sharing, which would happen in Antarctica as well. The finalisation of PrepCom presents a great challenge to the Antarctic Treaty System, which sees itself as unique and successful. It is also an opportune moment to examine which kind of positions that rising powers such as China, Brazil and India may hold on this pressing issue.

A UAV-mounted software-defined radar (SDR) ground-penetrating radar (GPR) for deep field geophysical assessment

DR ADRIAN MCCALLUM
University of the Sunshine Coast


IMAGE: MARTIN HARTLEY

Unmanned aerial vehicle (UAV) technology is rapidly developing and increased payloads are available from more affordable platforms. Similarly, the development of software-defined radio (SDR) technology provides opportunities for configuration of lightweight and low-cost ground-penetrating radar (GPR) systems. McCallum and Fairweather (2013) briefly discussed the potential for UAV-mounted GPR systems for remote area glaciology. Current research builds on that work and examines the contemporary viability of UAV and autonomous ground vehicle (AGV) mounted SDR GPR systems for site investigation of remote area or inaccessible geo-materials.

Understanding vulnerability of physical landscapes to human impacts: upcoming research in the Vestfold Hills, East Antarctica

DR STEPH MCLENNAN
Geoscience Australia

Ice-free regions of Antarctica make up only a fraction of the continent but are often the site of intensive activity associated with national programs and tourism. Without the protection of permanent snow and ice, poorly consolidated sediments and fragile polar landforms can be easily damaged by human activities. Natural recovery processes in the cold, dry climate are slow—tracks and landform disturbance can remain for decades in the poorly consolidated soils—and the effects on the chemical and physical characteristics of the soil are poorly constrained in East Antarctica. Over the next three years a research project under the Australian Antarctic Science Program will work towards understanding the vulnerability of landforms in the Vestfold Hills, East Antarctica. The project is a collaboration between Geoscience Australia, the Australian Antarctic Division, the University of Waikato and the University of Canberra. The work will build on existing systematic methods for assessing impact and recovery in West Antarctica to provide relevant and timely information for environmental management decisions. This will be achieved with field experiments and geomorphological mapping to characterise the physical and chemical changes that take place following human disturbance to understand the soil processes which contribute to vulnerability, resilience and recovery.

Eddy-induced carbon transport across the Antarctic Circumpolar Current

DR SEBASTIEN MOREAU
Institute for Marine and Antarctic Studies, University of Tasmania

The implications of a mesoscale eddy for the Southern Ocean carbon cycle was examined with in situ observations. The carbon properties inside a large (~190 km diameter) cyclonic eddy that detached from the Subantarctic Front (SAF) south of Tasmania in March 2016 was explored. Based on remote sensing, the eddy was present for ~2 months in the Subantarctic Zone (SAZ), an important region of oceanic

CO_2 uptake and carbon subduction, before it was re-absorbed into the SAF. The eddy was sampled during the middle of its life, one month after it spawned. Comparatively, the eddy was ~3°C colder, 0.5 PSU fresher and less biologically productive than surrounding SAZ waters. The eddy was also richer in dissolved inorganic carbon (DIC) and had lower saturation states of aragonite and calcite than the surrounding SAZ waters. As a consequence, it was a strong source of CO_2 to the atmosphere (with fluxes up to +25 mmol C m^{-2} d^{-1}). As they are commonly spawned from the Antarctic Circumpolar Current (ACC), and as 50% of them decay in the SAZ (the rest being re-absorbed by the SAF-N), these types of eddies may represent a significant south-north transport pathway for carbon across the ACC.

Valued, protected, understood: Antarctic values and the human dimension

MS HANNE NIELSEN
University of Tasmania
@WideWhiteStage

This poster outlines a range of frames through which Antarctica has been viewed over the course of its human history, from a place of commerce, to a place of heroes, to a place to protect. Most people never go to Antarctica, so the ideas they carry about the place are much more real to them than the ice itself. Those ideas, and their associated themes and narratives, play an important role in shaping attitudes towards Antarctic research and the value of the continent. It is therefore vital to gain an understanding of public perceptions of the place, in order to understand why it has been seen as valuable. The next frontier in Antarctic research is truly interdisciplinary work, where the social and scientific spheres of research are not viewed as disparate but are integrated to address wicked problems, such as climate change, and the protection of Antarctica. Protection is not inevitable, but rather the result of complex geopolitical structures; the desire to protect is based not so much on data, but rather on the philosophical, value-laden question 'why should we care?' Scientists and social scientists therefore need to integrate and engage in order to solve such multifaceted problems.

Adding value to existing datasets to inform environmental management decisions

DR TANYA O'NEILL
Waikato University

Ice-free areas represent biologically active, historically rich and environmentally sensitive sites in Antarctica. These environments face pressures from increasing human activity, climate change and introduction of non-native species. To understand and mitigate these pressures, the Scientific Committee on Antarctic Research states there is an urgent need to 'provide an integrated, comprehensive and dynamic approach to the conservation of Antarctica'. A New Zealand-led research program is collating environmental data to provide policy-relevant insights into the environmental pressures that Antarctica faces at a regional scale. The end product will be a spatially-explicit management tool providing capability to assess activities occurring in the Ross Sea region. Analyses currently being undertaken are: climate dynamics and forecasted climate using IPCC scenarios; availability of liquid water in ice-free areas both currently and in future scenarios; variation in soil attributes; refining bioregionalisations to understand how climate change will affect current and future species distribution; and modelling human movement and impact. Emerging datasets, such as GeoMAP and MODIS LST (temperature), can be combined with point data, such as soil pit and human activity data, to create new layers of information, such as water availability or trampling risk. From these, third tier products can be generated, such as invasive species risk or prioritise protected areas. The tool will fill an important gap in the suite of management tools available at all stages of the planning, permitting and implementation of activities to better limit adverse impacts on the environment.

Factors controlling primary productivity in the Mertz, the Dalton and the Ninnis polynyas

DR VIENA PUIGCORBÉ
Edith Cowan University

In the Southern Ocean, polynyas are the most productive regions per area, large CO_2 sinks, and active sites for the foraging by higher trophic levels such as birds, seals and whales. Several factors can control primary productivity in Antarctic polynyas: iron fertilisation from glacial and sea ice meltwaters, size and duration of open water area and mixing from katabatic wind mixing. This research observed large

differences in phytoplankton biomass between the three polynyas visited in January 2017 in the East Antarctic sector: the Dalton, the Mertz and the Ninnis. Total phytoplankton biomass was twice as large in the Mertz and the Ninnis compared to the Dalton Polynya. Photosynthetic parameters were similar in all three polynyas, but dissolved oxygen concentrations suggest that primary productivity was indeed higher in the Mertz and Ninnis than in the Dalton Polynya. Although a detailed analysis of the samples is needed to support this, the difference in marine productivity can be attributed to two plausible hypotheses: 1) the Mertz and Ninnis receive more iron (from either glacial or sea ice melt) and 2) higher predators are prolific at the Mertz and the Ninnis which result in strong pressure on krill, which can have a positive effect on phytoplankton, whereas krill predators are very rarely observed in the Dalton Polynya.

Marine animals and the biological carbon pump

DR LAVENIA RATNARAJAH

Antarctic Climate and Ecosystems Cooperative Research Centre

Phytoplankton and heterotrophic bacteria play an important role in marine ecosystems. Phytoplankton form the base of the marine food chain, take up atmospheric carbon dioxide and release oxygen. Heterotrophic bacteria remineralise organic material into its constituent elements, produce organic ligands and convert labile organic carbon to recalcitrant organic carbon. However, phytoplankton growth in the Southern Ocean is iron limited, whilst the growth of heterotrophic bacteria is both iron and carbon limited. Recent studies have demonstrated that marine animals are a recycled source of nutrients via their diet and defecation that would stimulate phytoplankton growth. A key question examined here is: Could biological recycling by baleen whales meet the demand for iron and carbon by phytoplankton and heterotrophic bacteria in the Southern Ocean? An in-situ field experiment demonstrated that whale faecal material was a source of nutrients that stimulated the growth of heterotrophic bacteria, however there was sufficient nutrients at the study site to stimulate phytoplankton growth. As the heterotrophic bacterial community utilise and deplete the iron and carbon from whale faecal material, this subsequently limits the nutrients available for phytoplankton growth after eight days. This suggests that heterotrophic bacteria and phytoplankton are likely competing for these nutrients in the natural environment.

Homeward Bound: leadership, science, strategy and gender in Antarctica

DR JUSTINE SHAW

University of Queensland

@justine_d_shaw

The world's first leadership, strategic and science program for women in science set sail for Antarctica in December 2016. It was the first voyage of a 10-year outreach initiative to build a 1,000-strong global collaboration of women in science who have had shared experience and learning in Antarctica, focusing on leadership, collaboration and science. Antarctica was the backdrop for this initiative and was pivotal to Homeward Bound's success. The 2016 program selected 768 remarkable female scientists from all around the world. The women worked on a range of research projects through 2016 prior to the 20-day trip to Antarctica. The 2018 cohort has been selected and is working in research teams prior to the voyage in 2019. Together and individually they are learning to elevate their leadership capabilities, refining their ability to design and execute strategy, and devise plans for future collaborations as women science leaders working towards a sustainable future. A science symposium was held at sea, off the Antarctic Peninsula. Nearly 80 science presentations were given and explored for collaborative opportunity. New opportunities emerged from the project.

Ice–ocean interaction at the Totten Glacier

MR ALESSANDRO SILVANO

University of Tasmania

Mass loss from the West Antarctic ice shelves and glaciers has been linked to rapid basal melt by ocean heat flux. The Totten Glacier on the Sabrina Coast (East Antarctica), which holds a 3.5 m sea-level change equivalent, also experiences rapid mass loss. This research shows for the first time that warm modified circumpolar deep water (MCDW) enters the cavity beneath the Totten Ice Shelf through a newly discovered deep channel, driving rapid basal melt (> 10 m yr^{-1}) and presumably triggering the mass loss of the Totten Glacier. MCDW is widespread on the continental shelf, forming a warm (> 0.3°C) and saline (34.5–34.6) bottom layer overlaid by cold (freezing point) and fresh (34.3) winter water. The absence of dense shelf water comes as a surprise given the relatively high rates of sea-ice production in the Dalton Polynya, east of the Totten Ice Shelf. Using a simple model driven by observed forcing, freshwater input from basal melt of the Moscow University Ice Shelf (upstream of

the Dalton Polynya) was shown to suppress dense shelf water formation. Consequently, MCDW is not eroded by polynya activity and floods the continental shelf. The same process occurs in the Amundsen Sea, where meltwater from basal melt of Pine Island and Thwaites ice shelves inhibits dense water formation in the Amundsen Polynya. This study indicates that the ocean conditions on the Sabrina Coast more closely resemble those found in West Antarctica than those typical of East Antarctica, where cold and dense waters dominate the continental shelf.

Assessing ecosystem status and trends for the Southern Ocean: why and how?

DR ROWAN TREBILCO
Antarctic Climate and Ecosystems Cooperative Research Centre
@RTreb

A fundamental challenge in marine ecosystem ecology and management is that the properties that determine how ecosystems function are extremely hard to observe and measure—a challenge that is made even more difficult by the remote and challenging environment of the Southern Ocean. The scale and complexity of Southern Ocean ecosystems make it hard to know how to robustly measure and summarise their overall status, and track how status is changing, to measure trends. Despite these challenges there is strengthening international coordination toward developing complementary suites of observation and models to enable quantification of ecosystem status and trends at circumpolar scales. This ecosystem benchmarking and development of subsequent strategic coordinated observation programs will be a new frontier to guide well-informed ecosystem management in a changing Southern Ocean. An overview of these challenges will be provided, along with a taste of the work toward solutions through the Antarctic Climate and Ecosystems Cooperative Research Centre as well as with international partner organisations.

Improving simulations of ice sheet dynamics: challenges and recent developments

DR ADAM TREVERROW
Antarctic Climate and Ecosystems Cooperative Research Centre

Presently the greatest source of uncertainty in forecasts of global sea level rise is the contribution arising from the discharge of ice grounded on the Antarctic continent into the ocean. This uncertainty has driven significant recent developments in ice sheet modelling capability. However, these advances have outpaced our understanding of ice flow properties; a fundamental component of the large-scale numerical models used to predict evolution of the Antarctic Ice Sheet. The challenges and recent developments in the numerical description of ice flow physics used in ice sheet models will be discussed.

Monitoring change in East Antarctic vegetation

DR JOHANNA TURNBULL
University of Wollongong

Antarctic climate change is regionally diverse with restrained change seen in East Antarctica. However, climatic shifts are evident in this region as increased wind speeds and a more positive Southern Annular Mode. These changes may be attributed to ozone depletion. Continental East Antarctic terrestrial ecosystems are simple, with minimal biotic interactions, providing an excellent system for the detection of shifts in abiotic variables. At the start of this century a long-term monitoring study established a series of transects spanning across water gradients in the Windmill Islands region, East Antarctica. Ongoing results show temporal changes in community composition with an increase in both moribund moss and desiccation-tolerant species, suggesting a regional drying trend. This is supported in other proxies from the region such as lake salinity records. These records inform policy, conservation and management through its contribution to the Australian State of the Environment Indicator 72.

Climate and environmental change during the last 3000 years in Lutzow-Holm Bay, Antarctica: evidence from two lake sediment records

DR JONATHAN TYLER
University of Adelaide
@jonathanjtyler

The spatial and temporal dynamics in Antarctica's past climate is fundamental to our understanding of future climate change in Antarctica and across the southern hemisphere. To date, the majority of research into past climate change in Antarctica has focused on ice cores, however lake sediments from coastal ice-free regions offer a new perspective from the margins of the continent. Cores from two lakes, Lake Hamagiku and Lake Naga, from the Skarvsnes foreland in East Antarctica have been used to generate palaeoenvironmental reconstructions which span the past 3000 years, constrained using radiocarbon dating. These reconstructions are based on sedimentary diatom species composition and isotope geochemistry of organic material. Both sites show variability in the relative abundance

of several key taxa, which can be attributed to nutrient availability and depth based on a regional diatom species training set. By examining sediment records from two neighbouring lake sites, the relative effects of shared climate forcing versus site-specific changes were revealed, which may have arisen from differences in lake location or morphology. The frequency of environmental oscillations within these lakes contrasts with the observed climate stability elsewhere in eastern Antarctica, highlighting the importance of coastal sites for future research.

Modelling mesopelagic taxa distribution and trophic linkages at a large scale: combining stable isotope and active-acoustic data

DR ANDREA WALTERS

University of Tasmania

Mesopelagic fish form an important yet poorly understood component of the open-ocean ecosystem with very little information about the biophysical determinants controlling the spatial and temporal distribution of mesopelagic fish in the open ocean regions. Here, natural abundance stable isotope tracers and active acoustic survey data are combined to address key gaps in the knowledge about mesopelagic fish ecology in a large-scale region of particular ecological importance, the Kerguelen Axis in the southern Indian Ocean sector. The trophic niches of key mesopelagic fish assemblages were investigated using bulk and amino acid compound stable isotope tracers. To investigate spatial variation in trophic interactions, fish were collected from the Antarctic continent to the BANZARE Bank and waters to the west and east of the Kerguelen Plateau in January–February 2016. Mesopelagic fish were sampled using an International Young Gadoid Pelagic Trawl (IYGPT) net equipped with a MIDOC multiple-opening cod-end device. Depth stratified net hauls (from the surface to 1000 m) were undertaken concurrently with active acoustics at 36 stations. Integrated acoustic and isotope data will be used to determine factors that differentiate fish assemblages in the region, something that is currently unknown, and to improve our understanding of the structure and function of mesopelagic components of food webs.

Clean up of contaminants in Antarctica—how clean is clean enough?

DR JANE WASLEY

Australian Antarctic Division

The Antarctic and subantarctic are considered to be pristine, yet contamination from global pollution and local sources regularly occurs. Sites with ongoing local pollution from past and present activities are currently being remediated by Australia, including oil spills and former waste disposal sites. But when should these sites be considered clean? Clean-up targets are available for temperate Australia, but to ensure targets are protective for polar environments they should be derived from a wide range of representative biota that are native to the region. A suite of traditional and novel ecotoxicological approaches are being used to conduct site-specific risk assessments for a range of contaminants that affect Antarctic and subantarctic terrestrial soils and marine waters. Progress to date will be summarised and remaining data gaps identified and prioritised. Results will be used to derive scientifically robust environmental guidelines, based on the potential risk contaminants pose to native biota. The outcomes of this work will inform environmental decision making for the region and will be incorporated into a clean-up manual for Antarctica. This document, endorsed by the Committee for Environmental Protection, extends the influence of this research beyond Australia to the jurisdiction of all Antarctic Treaty states.

Genetic monitoring for climate change in Antarctic marine invertebrates

DR NERIDA WILSON

Western Australian Museum

Climate change is expected to disproportionately affect the diversity of polar regions. In comparison, in other areas with latitudinal scope, organisms may be able to respond by changing their distributions to suit their physiological capacities. However this is not possible for polar species that simply have nowhere colder they can migrate to, even if they were able to. Although some level of adaptation and response to changing conditions is predicted, undoubtedly the loss of species diversity is ultimately expected. This research demonstrates the importance of having baseline phylogeographic information to be able to detect when the species diversity of Antarctic communities begin being impacted. This study system utilises cryptic species diversity in the Antarctic crinoid *Promachocrinus*, and differential species distributions to create a warning system of marine invertebrate community change.

DELEGATES

Alphabetical by surname

ASSOCIATE PROFESSOR NERILIE ABRAM

Co-Chair of the Organising Committee
ARC Future Fellow
Australian National University
nerilie.abram@anu.edu.au

Nerilie is a Future Fellow at the ANU Research School of Earth Sciences, and a Chief Investigator for the ARC Centre of Excellence for Climate Extremes. Her research focuses on reconstructing climate changes over the last 2000 years, using a variety of methods including the chemical analysis of Antarctic ice cores and tropical reef corals, as well as long climate model simulations. This provides valuable information about natural climate variability and the earliest stages of human-induced climate change which can't be assessed using traditional climate measurements.

DR SIMON ALEXANDER

Senior Research Scientist
Australian Antarctic Division
simonalexander7@gmail.com

Simon is an atmospheric scientist at the Australian Antarctic Division. His research interests include remote sensing of cloud, aerosol and precipitation over the Southern Ocean and the Antarctic. He has wintered at Davis, Antarctica.

PROFESSOR IAN ALLISON AO FAA

Chair of the Oversight Committee
Honorary Research Associate
Antarctic Climate and Ecosystems Cooperative Research Centre
ian.allison@utas.edu.au

Ian has studied ice and climate for 50 years and participated in or led 25 Antarctic research expeditions. He has published over 130 peer-reviewed papers on Antarctic science on topics including ice shelf-ocean interaction, Antarctic weather and climate, sea ice, and the Antarctic mass budget. He has been active in international collaboration in Antarctic science and was co-chair of the Joint Committee for the International Polar Year 2007–08, a two-year polar research program involving more than 50,000 participants from 60 countries. He was a lead author of the Intergovernmental Panel on Climate Change Second, Fourth and Fifth Assessment Reports.

ASSOCIATE PROFESSOR JULIE ARBLASTER

Associate Professor
School of Earth Atmosphere and Environment,
Monash University
julie.arblaster@monash.edu

Julie is an Associate Professor in the School of Earth, Atmosphere and Environment, having moved there in 2016 after more than a decade at the Australian Bureau of Meteorology. Prior to that she spent a number of years at the National Center for Atmospheric Research in the United States and still maintains strong collaborative ties with colleagues there. Her research interests include climate extremes, decadal variability and the role of the Antarctic ozone hole in shifting storm tracks.

DR HELENA BAIRD

Postdoctoral Research Associate
Monash University
helena.baird@monash.edu

Helena is passionate about understanding the evolution and distribution of invertebrate biodiversity in Antarctica. Her PhD uncovered extensive cryptic speciation and localised adaptation in Antarctic crustaceans. Since then she has contributed to a wide range of environmental projects, including an in-situ study of ocean acidification effects on Antarctic benthos. Helena has extensive fieldwork experience across the Antarctic, and has been engaged in promoting conservation through science outreach. Her postdoctoral research incorporates classic biogeography with modern molecular tools, to resolve relationships among sub-Antarctic terrestrial invertebrates and shed light on the evolutionary processes that have led to their unique biodiversity.

DR CHRISTOPHER BETTERS

Member of the Organising Committee

Research Associate
University of Sydney
christopher.betters@sydney.edu.au

Chris completed his PhD at Sydney University building compact spectrographs for astronomy. He continued this work as a postdoc, expanding his interests to the development of instruments for space, agriculture and other harsh environments.

PROFESSOR JOSS BLAND-HAWTHORN FAA

Member of the Oversight Committee

ARC Laureate Fellow Professor of Physics and Director of the Sydney Institute for Astronomy
University of Sydney

Joss has the rare distinction of having made major contributions both to experimental physics (photonics and astronomical instrumentation) and to astrophysics. In particular, he pioneered the field of astrophotonics, developing key devices such as the photonic lantern, OH-suppression fibres, hexabundles, and the photonic integrated multimode microspectrograph—these devices are revolutionising astronomical instrumentation, and the microspectrograph has important applications across the applied sciences. His broad contributions to astrophysics include the creation, with Ken Freeman, of the fields of galactic archaeology and near-field cosmology, recovering the formation history of the galaxy from stellar motions and chemical abundances. Joss is this year's winner of the Thomas Ranken Lyle Medal and is to be the Miller Professor of Astrophysics at Berkeley next year.

PROFESSOR ANNE-MARIE BRADY

Professor
University of Canterbury
anne-marie.brady@canterbury.ac.nz

Anne-Marie is a specialist on Chinese and polar politics in the Department of Political Science and International Relations and an Adjunct Fellow at Gateway Antarctica, University of Canterbury, Christchurch, New Zealand. She is the Executive and Academic Editor of The Polar Journal (Taylor and Francis) and a Global Fellow at the Wilson Center. Her most recent book is China as a Polar Great Power.

DR GRAEME CLARK

Senior Research Associate
UNSW Australia
g.clark@unsw.edu.au

Graeme is a senior research scientist at UNSW Australia. His Antarctic research focuses on how changes in sea-ice dynamics affect shallow marine environments and their ecosystems. He is also interested in understanding species invasions, and impacts of human activities on coastal ecosystems.

DR LAURENCE CLARKE

Post-doctoral Fellow
Antarctic Climate and Ecosystems Cooperative Research Centre
laurence.clarke@aad.gov.au

Laurence uses DNA-based approaches to study Southern Ocean ecosystems. Current projects include using DNA to characterise plankton communities, mesopelagic fish diets and bacteria associated with Antarctic krill, potentially some of the most abundant bacteria in the Southern Ocean!

DR SUE COOK

Ice Shelf Glaciologist
Antarctic Climate and Ecosystems Cooperative Research Centre
sue.cook@utas.edu.au

Sue's main research interest is the interaction of ice shelves with the ocean, and how that affects wider ice sheet dynamics. Her work ranges from examining the variation in melt rates underneath Antarctic ice shelves by geophysical fieldwork, to using numerical modelling to investigate how this melt affects fracture and calving on those ice shelves. This work aims to improve our understanding of the effect of the ocean on ice shelf evolution, and hence how it will impact the Antarctic Ice Sheet's response to a warming climate.

DR PATRICIA CORBETT

Associate Lecturer
Deakin University
pcorbett@deakin.edu.au

Patricia is an Associate Lecturer and Research Fellow at Deakin University. Her primary research interest is in marine ecotoxicology, incorporating the investigation of key ecosystem component responses to anthropogenic environmental stressors. Patricia is currently working in Deakin University's Marine Ecotoxicology Research team (led by Associate Professor Julie Mondon) on a number of projects in collaboration with the Australian Antarctic Division, CSIRO Land and Water and Charles Sturt University. Her research is predominantly focused on developing biomarkers of station-derived contamination impact on Antarctic fish and shellfish.

DR STEPHANIE DOWNES

Postdoctoral Research Fellow
Antarctic Climate and Ecosystems Cooperative Research Centre
s.downes@utas.edu.au

Stephanie is a physical oceanographer at the Antarctic Climate and Ecosystems Cooperative Research Centre, focusing on climate model projections of the Southern Ocean circulation and water masses associated with heat and carbon uptake. She also uses biogeochemical tracers to describe the pathways of deep Southern Ocean waters that form at hydrothermal vents. Stephanie combines climate models and observational data sets to tackle outstanding ocean circulation issues. Stephanie also chairs the national Australian Meteorological and Oceanographic Society (AMOS) Education and Outreach Committee, and thoroughly enjoys engaging with students and the general public in all matters associated with climate science.

MS RACHEL DOWNEY

PhD Researcher
Australian National University
rachel.v.downey@gmail.com

Rachel is a PhD researcher at the Australian National University and British Antarctic Survey, working on projects that explore Southern Ocean sponge biogeography using taxonomy and genetics. She is a team member of Antarctic Seabed Carbon Capture Change (ASCCC), a professional research group analysing polar seabed carbon cycling. Rachel has worked on projects exploring the effects of the collapse of the Larsen Ice Shelf on sponge communities and analysing sessile benthic communities to assess former ice-sheet dynamics at South Georgia. She is the Thematic Editor for sponges on RAMS (Register of Antarctic Marine Species). Rachel has six months' Antarctic sea-going experience on several international marine biology expeditions.

DR GRANT DUFFY

Postdoctoral Research Associate
Monash University
grant.duffy@monash.edu

Grant is an early-career ecologist based at Monash University, whose research interests incorporate ecoinformatic methods and the study of broad-scale patterns of terrestrial and marine ecosystems. His current work focuses on how species are responding to ongoing global climate change and how these responses interact with localised environmental changes. His work in Antarctic systems involves the application of distribution modelling methods, remote-sensed data, and large biodiversity datasets to answer a range of ecological questions and better inform conservation practices.

DR SUSANNE ERDMANN

Research Associate
UNSW Australia
s.erdmann@unsw.edu.au

Susanne is a Research Associate, School of Biotechnology and Biomolecular Sciences, UNSW. She was previously a postdoc at the University of Copenhagen. Her current research aims to determine the influence of viruses on the community structure of hypersaline Antarctic lakes that are dominated by members of the third domain of life, the Archaea. Her work involves the isolation of new viruses, their characterisation using electron microscopy, virus life cycle studies and analyses of host responses to viral infection.

MS JODI FOX

Graduate Student
University of Tasmania
jodi.fox@utas.edu.au

Jodi is a physical volcanologist interested in the interaction between lava and ice and the contribution of sub-marine and sub-glacial volcanism to the development of Antarctic and subantarctic ecosystems. She has a particular interest in volcanism on Heard and McDonald islands. Jodi is enthusiastic about how volcanoes shape the earth, influence climate and provide the environmental conditions for life to flourish even in extreme environments. There is still much to understand about submarine and subglacial volcanic eruptions especially in Antarctica. She is keen to collaborate with other scientists with related interests.

DR ALEXANDER FRASER

Remote Sensing Specialist
Antarctic Climate and Ecosystems Cooperative Research Centre
adfraser@utas.edu.au

Alex is a glaciologist with a particular interest in satellite remote sensing of Antarctic ice. His PhD research was in the area of satellite mapping of Antarctic landfast sea ice. More recently, Alex has worked on radar remote sensing of the Antarctic Ice Sheet. This includes large-scale estimation of Antarctic accumulation based on parameter retrieval from active microwave remote polar-orbiting satellites. Large-scale estimates of Antarctic accumulation distribution are a major contributor to the uncertainty associated with Antarctic mass balances estimates.

DR CERIDWEN FRASER

Member of the Organising Committee
Senior Lecturer
Australian National University
ceridwen.fraser@anu.edu.au

Crid is a biologist / phylogeographer at the Australian National University, and is broadly interested in the influence of environmental conditions, including past and future environmental change, on global patterns of biodiversity. She uses a wide range of techniques to address research questions, including ecological and genetic approaches, and has a particular focus on the high-latitude ecosystems of the southern hemisphere (the sub-Antarctic islands and Antarctica). She was the 2016 ACT Scientist of the Year.

MR MATTHEW FREEMAN

PhD Student
UNSW Australia
matthew.freeman@student.unsw.edu.au

Matthew is a PhD student at UNSW Australia working with Professor Michael Ashley. The topic of his PhD is infrared and terahertz astronomy from Antarctica. He is investigating the infrared sky background at the high plateau, at a site near Dome A. A suitably low background could make this the best site in the world for infrared astronomy. Matthew is also working with molecular cloud observations taken with a terahertz telescope near Dome A.

DR NICK GALES

Director
Australian Antarctic Division

Nick's career has been driven by a desire to conduct, communicate and translate science into tangible policy and program outcomes. Starting his career as a veterinarian, Nick moved quickly into applied marine mammal research working in Antarctica. He moved to Hobart taking a senior research role with the Australian Antarctic Division, culminating in his current role as Director. Prior to becoming Director, he held the position of Chief Scientist of both the Antarctic Division and the Department of the Environment, focusing his attention on shaping and delivering a high impact and efficient Antarctic science program. He currently holds the position of Australia's Commissioner to the International Whaling Commission.

BEN GALTON-FENZI

Member of the Organising Committee
Senior Scientist
Australian Antarctic Division and Antarctic Climate and Ecosystems Cooperative Research Centre
ben.galton-Fenzi@aad.gov.au

Ben's main interest is in the processes governing the interaction between the Earth's ice sheets, the oceans and other parts of the geophysical system. He combines computational methods, theory and available, yet sparse, observations to discover and test our understanding of the physical relationships in the global climate system. His specific interests include: the mechanisms controlling the dynamic interaction between the ice sheets and the oceans; dense water formation in Antarctica; the interactions between the ocean and sea ice, icebergs and ice shelves; and variability and change in the Southern Ocean and Antarctica.

DR BISHAKHDATTA GAYEN

ARC (DECRA) and ANU Research Fellow
The Australian National University
bishakhdatta.gayen@anu.edu.au

Bishakh received his MSc in 2010 and his PhD in 2012 from UC, San Diego where he pursued research work on turbulence and internal waves under the guidance of Professor Sarkar and was awarded the Andreas Acrivos Award for Outstanding Dissertation in Fluid Dynamics from the American Physical Society. He moved to Australia to pursue his postdoctoral research with Professor Griffiths at the Australian National University. Bishakh is currently an ARC Discovery Early Career and AAD Hawke Fellow. His current research interests are nonlinear internal waves in the ocean, turbulent convection, modelling of Antarctic ice melting and Southern Ocean dynamics.

DR FELICITY GRAHAM

Ice Sheet Modeller
University of Tasmania
felicity.graham@utas.edu.au

Felicity is an ice sheet modeller for the Antarctic Gateway Partnership, based at the Institute for Marine and Antarctic Studies at the University of Tasmania. Felicity's research focuses on the sensitivity of ice sheet dynamic processes in numerical models to basal conditions (topography, roughness and geothermal heat flux), ice rheology and oceanic melting. Her modelling work informs projections of sea level rise from ice mass loss in East Antarctica and guides fieldwork campaigns in Antarctica, such as the international ICECAP collaboration.

DR KATHARINE GRANT

Postdoctoral Research Fellow
Australian National University
katharine.grant@anu.edu.au

Katherine studied marine science with French as an undergraduate at Southampton University UK, then returned to Southampton in 2005 to work as a research assistant in palaeoceanography at the National Oceanography Centre. She stayed there to do a PhD, and since 2013 has been a postdoctoral scientist at the Australian National University. Katherine uses a multi-proxy approach (e.g. scanning XRF, stable isotopes, environmental magnetism) combined with statistical analyses to produce high-resolution palaeoclimate records over the Plio-Pleistocene. Her research to date has focused on sea-level/ice-volume variability, Mediterranean palaeoceanography and African monsoon variability.

DR DAMIEN GUIHEN

Researcher
University of Tasmania
damien.guihen@utas.edu.au

Damien is a postdoctoral researcher with the Antarctic Gateway Partnership and is based at the Australian Maritime College, University of Tasmania. Damien is a physical oceanographer by training, and studied the role that biological structure plays in the boundary dynamics at a Norwegian fjord for his PhD at the National University of Ireland. He then moved to the British Antarctic Survey, developing a method for the use of autonomous underwater gliders in acoustic surveys of Antarctic krill. Damien's current research focuses on the preparation of the Gateway autonomous underwater vehicle to conduct multidisciplinary science missions in the Antarctic.

DR JACQUELINE HALPIN

Co-Chair of the Organising Committee
Senior Research Fellow/Geologist
Institute for Marine and Antarctic Studies
jahalpin@utas.edu.au

Jacqueline is a geologist based at the Institute for Marine and Antarctic Studies, University of Tasmania. Her research explores the evolution of Earth's continents through geochronology (age dating of rocks and rates of tectonic processes), metamorphic analysis (decoding pressure-temperature conditions recorded in the crust) and geochemistry (tracking crustal chemical and isotopic evolution). Her work involves both field exploration and laboratory-based analytical methods to test and improve tectonic plate reconstructions, providing a window into Earth's changing shape over billions of years. Jacqueline's current focus in Antarctic geoscience explores the interactions between the rugged subglacial geology and the overlying ice sheet.

DR PETRA HEIL

Senior Research Scientist
Australian Antarctic Division
petra.heil@utas.edu.au

Petra is a senior research scientist with the Australian Antarctic Division, and part of the Antarctic Climate and Ecosystems Cooperative Research Centre's Sea Ice Processes and Change project. Her research focus is on physical sea-ice processes, which she investigates using in situ or

remotely sensed information and numerical modelling. Her current research interests include: investigation of sea-ice dynamics (buoys and remotely sensed); sea-ice modelling (stand-alone and coupled, decadal modelling and short-term forecasting); fast-ice studies (in situ and remotely sensed) and mixed-layer processes; spatio-temporal variability of sea ice, and their interaction with polar oceans and atmosphere; and polar atmospheric processes. Her previous work experience includes high-performance numerical modelling of the coupled Earth system (Tasmanian Partnership for Advanced Computing, 2002–2004), and improving the treatment of sea-ice dynamics in numerical models, International Arctic Research Center, Alaska.

DR FIONA HIBBERT

Postdoctoral scientist
Australian National University
fiona.hibbert@anu.edu.au

Fiona is interested in the interactions between the ice-ocean-climate system during the Quaternary. Her current research focuses on the contribution of former ice sheets to global sea-level budgets using both direct evidence such as marine records of ice-rafted debris and indirect evidence recorded in coral or sedimentary archives. Much of her work is collaborative and interdisciplinary, encompassing aspects of glaciology, climatology, oceanography and geochronology. Fiona joined the Australian National University in 2016. Prior to this she was based at the National Oceanography Centre, Southampton (UK) and obtained her PhD from the University of St Andrews (UK) in 2011.

DR NICOLE HILL

Research Fellow
Institute for Marine and Antarctic Studies, University of Tasmania
Nicole.Hill@utas.edu.au

Nicole is an ecologist whose research focuses on understanding, quantifying, mapping and monitoring marine biodiversity to support decision making in the marine environment. To achieve this, she works at the interface between ecology and statistics, applying cutting-edge statistical tools to complex problems and datasets as well as utilising new survey and monitoring tools. From 2009 to 2014, Nicole was a postdoctoral researcher with the Marine Biodiversity Hub predicting large-scale patterns in temperate reef biodiversity and developing robust monitoring programs for remote, offshore marine reserves. Since 2014, she has led research that applies novel techniques to quantify and map Antarctic marine biodiversity.

DR WILL HOBBS

Physical Oceanographer
Antarctic Climate and Ecosystems Cooperative Research Centre
whobbs@utas.edu.au

Will gained his PhD in 2009 from the University of California Los Angeles, where he studied the role of the atmosphere in driving large-scale variability of Southern Ocean sea ice. Following his PhD, Will was a postdoctoral researcher in the Ocean Circulation group at the NASA/Caltech Jet Propulsion Laboratory. His work at JPL involved combing satellite data with Argo float data to estimate the strength and heat transport of the Atlantic meridional overturning circulation (AMOC). This ground-breaking time series is regularly updated and is widely used in the AMOC community. He came to Hobart in 2012 to take up a position in Ocean Detection and Attribution with the Institute for Marine and Antarctic Studies (IMAS), before moving to the Antarctic Climate and Ecosystems Cooperative Research Centre in 2015.

ASSOCIATE PROFESSOR MICHAEL IRELAND

Future Fellow
Australian National University
michael.ireland@anu.edu.au

Michael develops and applies the latest optical and infrared technologies to build innovative astronomical instruments to probe the lifecycles of stars and planets. A central aim of his research has been to develop instrumentation and techniques capable of finding out how planets form and evolve, including leading the technical working group of the Planet Formation Imager project, which is considering an Antarctic site. He is currently building innovative astronomical instrumentation for detecting planets around other stars, both for Australian telescopes and the largest international telescopes.

DR LENNEKE JONG

Cryosphere System Modeller
Antarctic Climate and Ecosystems Cooperative Research Centre / Institute for Marine and Antarctic Studies
lenneke.jong@utas.edu.au

Lenneke is a crysophere system modeller in the Antarctic Gateway Partnership and the Antarctic Climate and Ecosystems Cooperative Research Centre. Her research focus is on computational modelling of the Antarctic ice sheet and how

interactions with other components of the Earth system, particularly the ocean and solid earth, influences its evolution and contribution to future sea level rise.

PROFESSOR MATT KING

Professor of Polar Geodesy
University of Tasmania
Matt.King@utas.edu.au

Matt is Professor of Polar Geodesy at the University of Tasmania where he works on sea level, ice-sheet change, and solid Earth deformation. He has published more than 100 peer-reviewed papers, with about 10% in the leading multidisciplinary journals. Matt is a theme leader within the Antarctic Gateway Partnership based in Hobart.

DR ANDREAS KLOCKER

Research Fellow
University of Tasmania
andreas.klocker@utas.edu.au

Andreas is a physical oceanographer at the University of Tasmania. His work focuses on understanding the role of turbulence in the Antarctic Circumpolar Current and Antarctic margins using a combination of observations, theory and numerical models.

DR KAZUYA KUSAHARA

Postdoctoral Fellow
Antarctic Climate and Ecosystems Cooperative Research Centre
kazuya.kusahara@gmail.com

Kazuya has been working with the Antarctic Climate and Ecosystems Cooperative Research Centre sea ice group since 2015. His research interest is modelling ocean–cryosphere interaction over the Southern Ocean, in particular coastal processes around Antarctica.

DR VERONIQUE LAGO

Postdoctoral Researcher
UNSW Australia
v.lago@unsw.edu.au

Veronique worked as a research assistant in 2007–2008 at Institut national de la recherche scientifique (INRS) in Québec City on observational ocean data in the Canadian Arctic. She then completed her MSc in 2011 at the University of Alberta analysing the impact of Greenland's ice sheet melt onto the subpolar gyre in different ocean model resolutions. In 2016, she completed her PhD at the University of Tasmania and CSIRO, studying the impact of multidecadal changes at the ocean surface on changes in the ocean interior. Veronique now works as a postdoctoral scientist at UNSW's Climate Change Research Centre on the effect of projected meltwater input from Antarctica onto the ocean interior.

DR DELPHINE LANNUZEL

Member of the Organising Committee

ARC DECRA Fellow
University of Tasmania
delphine.lannuzel@utas.edu.au

Delphine's research interests lie in the study of trace metal distributions, speciation and biogeochemistry in polar regions. The iron and other trace elements profiles generated during her PhD and postdoctoral projects represented the first data for the Antarctic pack ice zone. Her pioneer work highlighted the accumulation of trace element iron in the sea ice medium and therefore the paramount importance of Antarctic sea ice to iron biogeochemical cycling in polar ecosystems.

ASSOCIATE PROFESSOR MARY-ANNE LEA

Deputy Head, Ecology and Biodiversity Centre/ Senior Research Fellow
Institute for Marine and Antarctic Studies, University of Tasmania
MaryAnne.Lea@utas.edu.au

Mary-Anne is a polar/marine predator behavioural ecologist based at the Institute for Marine and Antarctic Studies at the University of Tasmania. She has researched the ecology and migration of a range of species (seals, sea lions, whales, seabirds and penguins) and systems (subantarctic/ Antarctic, subarctic Alaska and North Pacific and temperate) in large-scale collaborative, circumpolar research projects for 25 years. She is interested in the influence of climatic variability within the marine environment and extreme weather events on top predator behaviour and distributions in the Southern Ocean, and marine predator fisheries interactions are now forming a growing part of her research. She is also keenly promoting equity and diversity in STEM opportunities and is happy to engage with other participants in a mentoring capacity if helpful.

MISS JASMINE LEE

PhD Candidate
University of Queensland
jasmine.lee1@uqconnect.edu.au

Jasmine is a conservation scientist and spatial ecologist in the final year of her PhD, based at the University of Queensland, CSIRO and the Australian Antarctic Division. Her research focuses on conserving terrestrial Antarctic biodiversity in the face of multiple threats, including climate change, human activity and invasive species. She is passionate about using robust science to form evidence-based policy and help species and ecosystems cope with climate change, and she is aiming to pursue a career in Antarctic science and conservation.

DR NENGYE LIU

Senior Lecturer
University of Adelaide
nengye.liu@adelaide.edu.au

IMAGE: JAMES KNOWLER

Nengye is a Senior Lecturer at Adelaide Law School, University of Adelaide. He was educated in Wuhan University (China, LLB and LLM) and Ghent University (Belgium, Doctor of Law). Prior to moving to Adelaide, he worked in China, Singapore, Germany, United Kingdom and NSW. Nengye's research centres on enhancing global governance regime for better protection of the oceans, with particular focuses on the Polar Region.

DR VANESSA LUCIEER

Senior Research Scientist
University of Tasmania
vanessa.lucieer@utas.edu.au

IMAGE: MICHAEL RAYNER

Vanessa is currently a senior scientist at the Institute for Marine and Antarctic Studies at the University of Tasmania. Her multidisciplinary team collaborates closely with government and industry partners to apply the latest ocean mapping technologies to solve real-world problems. Her research interest include the application of seafloor and water column acoustics from shipboard and autonomous underwater vehicles for studying, mapping and monitoring marine ecosystems working across the fields of marine ecology, geology, oceanography, geomatics and ocean technology. Vanessa is a leading member of the International Multibeam Backscatter and Water-Column Working Group and is an editor for the journal Geosciences.

DR GIANLUCA MARINO

Postdoctoral Fellow
Australian National University
gianluca.marino@anu.edu.au

Gianluca obtained his MSc at the University of Naples Federico II (Italy) his PhD at Utrecht University (The Netherlands) in 2008. He was awarded a Postdoctoral Research Grant by the Autonomous University of Barcelona (Spain), where he stayed for five years. Gianluca joined the Australian National University in 2013, working as a Postdoctoral Fellow at the Research School of Earth Sciences. His research interests centre on the timing, magnitude and rates of (past) ocean and climate change; ocean chemistry and atmospheric CO_2 concentrations; and past temperature variations and climate sensitivity.

DR ADRIAN MCCALLUM

Member of the Organising Committee
Lecturer
University of the Sunshine Coast
amccallu@usc.edu.au

IMAGE: MARTIN HARTLEY

Adrian is a Lecturer in science and engineering at the University of the Sunshine Coast. He holds a PhD from the Scott Polar Research Institute, University of Cambridge and additional degrees in oceanography, meteorology and civil engineering. Adrian specialises in remote area science and engineering and has led or participated in research expeditions to the Himalayas, Patagonia, Svalbard, Greenland, across the Arctic and Antarctica. He is a Menzies Scholar and Director of the Menzies Foundation. In 2002 he was awarded the Australian Centenary Medal for his stewardship of the 2001 Australian Army Centenary Everest Expedition.

DR SANDRA MCLAREN

Senior Lecturer
University of Melbourne
mclarens@unimelb.edu.au

Sandra is a geologist with broad interests and research experience in understanding the evolution of the continental crust. She is currently a Senior Lecturer in the School of Earth Sciences at the University of Melbourne. Sandra received her PhD in 2001 from the University of Adelaide and has previously held a fellowship at the ANU. Sandra's research interests are largely focused on the long-term geological evolution of the Australian continent and she has

current research projects on rocks that range in age from the Proterozoic to the Neogene.

DR STEPH MCLENNAN

Geoscientist
Geoscience Australia
stephanie.mclennan@ga.gov.au

Steph completed her PhD in geochemistry and landscape evolution at the University of Adelaide, joining Geoscience Australia as a graduate in 2015. Her research has taken her through geomorphology, basin analysis, analytical chemistry, and 3D geological modelling throughout Australia. She joined the Antarctic Geoscience program in 2016 to lead the development of the landscape vulnerability project in East Antarctica. Her work focuses on understanding the physical and chemical basis for resilience and recovery from human disturbance in ice-free regions to support environmental management.

DR JESS MELBOURNE-THOMAS

Project Leader, Antarctic Climate and Ecosystems Cooperative Research Centre
Australian Antarctic Division
Jess.Melbourne-Thomas@aad.gov.au

Jess is a Research Scientist with the Australian Antarctic Division and a Project Leader with the Antarctic Climate and Ecosystems Cooperative Research Centre. She uses mathematical models of marine ecosystems to understand how these systems function and how they might respond to climate change and other human activities. She is highly engaged in the translation of science into decision making. Jess was named one of Australia's 30 Superstars of STEM in 2017 and Tasmania's Young Tall Poppy of the Year in 2015 for her excellence in research, science communication and policy engagement. She was a Rhodes Scholar at the University of Oxford from 2003–05.

DR SEBASTIEN MOREAU

Postdoctoral Scientist
Institute for Marine and Antarctic Studies
sebastien.moreau@utas.edu.au

Sebastien is a Postdoctoral Researcher at the Institute for Marine and Antarctic Studies (IMAS), Hobart, where he studies the biogeochemistry of the Southern Ocean, with a particular interest in primary productivity and more broadly the carbon cycle. Sebastien has a geographically wide interest of the Southern Ocean, from frontal jets and eddies to the sea ice covered areas, sea ice itself and polynyas. Before coming to Australia, he modelled sea ice biogeochemistry as a Postdoctoral Researcher in Belgium and studied the effects of climate change on the planktonic community of the Bellingshausen Sea as a PhD student in Canada.

DR ADELE MORRISON

Research Fellow
Australian National University
adele.morrison@anu.edu.au

Adele is an ARC DECRA Fellow in the Climate and Fluid Physics group at the Australian National University. Prior to that, Adele spent three years as a postdoctoral fellow at Princeton University. She received her PhD from ANU in 2014. Adele is a physical oceanographer who studies large-scale ocean circulation and its relationship with Earth's climate. Her main focus is on understanding the Southern Ocean's role under changing climate forcing, in particular how ocean circulation impacts heat and carbon uptake and the melt rate of Antarctic ice shelves.

DR LAURA MORRISSEY

Postdoctoral Researcher
University of South Australia
laura.morrissey@unisa.edu.au

Laura completed her PhD in metamorphic geology at the University of Adelaide in 2016 and is now a Postdoctoral Researcher at the University of South Australia. Her research uses the tools of metamorphic petrology, thermodynamic mineral equilibria modelling and geochronology to understand the evolution of the continental crust throughout Earth's history. Laura investigates the effects of melting and melt loss during high temperature metamorphism, with a focus on Australia and Antarctica.

DR UFFE N NIELSEN

Senior Lecturer
Western Sydney University
u.nielsen@westernsydney.edu.au

Uffe is a Senior Lecturer at the Hawkesbury Institute for the Environment, Western Sydney University. His research is wide-ranging but centred on soil ecology, with a specific focus on the biogeography of soil fauna, linkages between soil communities and ecosystem function

particularly in the light of global change impacts and sustainable land use management. He has been involved in research on the distribution and ecology of Antarctic soil organisms since 2008, with eight seasons spent in various research groups working in the McMurdo Dry Valleys, the Windmill Islands and the Antarctic Peninsula.

MS HANNE NIELSEN

PhD Student
University of Tasmania
hanne.nielsen@utas.edu.au

Hanne specialises in representations of Antarctica in advertising, media and popular culture. After completing a Masters in Antarctic Studies at the University of Canterbury in New Zealand, she moved to Hobart to take up a PhD project investigating the ways Antarctica has been framed in advertising material. Hanne is a vice President of the Association of Polar Early Career Scientists (APECS) and a member of the SCAR Antarctic Humanities and Social Sciences Expert Group Executive Committee. She spends her summers in the Antarctic Peninsula, working as a tour guide, and her winters in Hobart.

DR TANYA O'NEILL

Postdoctoral Scientist/Teaching Fellow
Waikato University
tanya.o'neill@waikato.ac.nz

Tanya currently works as a Teaching Fellow at Waikato University, New Zealand, teaching and tutoring second- and third-year soil and land management and environmental science papers. Her PhD, completed in 2013, was funded by Landcare Research, a crown-research institute in New Zealand, and assessed, predicted and managed the physical impacts of human activities on Antarctic ice-free environments. Tanya has also worked in the Antarctic Peninsula with the Spanish program, thus extending her work into the warmer, wetter and more frequently visited peninsula environment.

DR ALIX POST

Research Scientist
Geoscience Australia
alix.post@ga.gov.au

Alix is a marine geoscientist. She completed her PhD at the University of Tasmania in 2004 and has worked at Geoscience Australia in Canberra since 2002. Her research focuses on understanding marine processes and the environmental factors that influence the critters that live on the seafloor. She has worked from the northern tropics of Australia, through the temperate regions and south to the pole. She has sailed on 10 research voyages, with three to the Antarctic margin. Her work contributes to marine protected area planning and helps scientists and marine managers to better protect marine biodiversity.

DR VIENA PUIGCORBÉ

Postdoctoral Researcher
Edith Cowan University
v.puigcorbelacueva@ecu.edu.au

Viena is an environmental scientist from Barcelona, where she did her PhD using natural radioisotopes as tracers of particle export in the open ocean. During her PhD she joined several oceanographic cruises conducted in several areas, from the warm waters of the Gulf of California up to the Central Arctic. She is currently a Postdoctoral Scientist at Edith Cowan University in Perth. Her research there has been mainly focused in the Southern Ocean, quantifying the carbon export in eddies of the Antarctic Circumpolar Current as well as in the vicinity of the Antarctic continent.

DR LAVENIA RATNARAJAH

Postdoctoral Research Fellow
Antarctic Climate and Ecosystems Cooperative Research Centre
lavenia.ratnarajah@utas.edu.au

Lavenia is a marine biogeochemist interested in the cycling of nutrients, particularly iron and carbon in the Southern Ocean.

DR CHRISTINA RIESSELMAN

Lecturer
University of Otago
christina.riesselman@otago.ac.nz

Christina is a paleoceanographer based at the University of Otago, Dunedin, New Zealand. Her research employs stable isotope geochemistry and diatom micropalaeontology to reconstruct the response of Antarctic and Southern Ocean systems to past intervals of warm climate. Prior to moving to New Zealand, she held a USGS Mendenhall Fellowship with the PRISM research group. She received her PhD in Geological and Environmental Sciences from Stanford University and her BA in Geology and English from

the University of Nebraska—Lincoln. In 2015, she was awarded the inaugural L'Oréal–UNESCO For Women in Science NZ Fellowship.

DR FIONA SHANHUN

Acting Chief Scientific Advisor
Antarctica New Zealand
f.shanhun@antarcticanz.govt.nz

Fiona's expertise as a soil scientist has taken her to Antarctica many times, with both the New Zealand and Australian Antarctic programs. She has worked on soil CO_2 dynamics in the McMurdo Dry Valleys, and focused on understanding non-biological processes associated with CO_2 fluxes from soils. Fiona is currently the Acting Chief Scientific Advisor for Antarctica New Zealand and leads New Zealand's annual Ross Sea Adélie penguin census—understanding Antarctic biology is a new challenge! She is a former SCAR Fellow and is currently training for a 10-day multisport adventure race.

DR JUSTINE SHAW

Member of the Organising Committee

Research Fellow
University of Queensland
j.shaw6@uq.edu.au

Justine is a Research Fellow at the Centre for Biodiversity and Conservation Science, the University of Queensland. She applies decision science to Antarctic conservation. Her research focuses on terrestrial Antarctic and subantarctic island ecosystems. She is currently examining the risks posed by non-native species to Antarctic protected areas, the interactions between indigenous and non-native species and investigating how invasive species influence island ecosystems. Justine is interested in understanding species interactions, how this influences ecosystem function and the influence of climate change on these processes. She aims to deliver evidence-based science to inform management and guide policy.

MR ALESSANDRO SILVANO

PhD Student
University of Tasmania
alessandro.silvano@utas.edu.au

Alessandro is a PhD student at the University of Tasmania and CSIRO, working under the supervision of Steve Rintoul and Guy Williams. He obtained his undergraduate degree in physics and master's degree in physics of complex systems at the University of Turin, Italy. He completed his master's thesis at the Woods Hole Oceanographic Institution working on iceberg dynamics and thermodynamics. His current research focuses on the interaction between ice and ocean in Antarctica, including the analysis of the first oceanographic data set ever collected near the Totten Glacier, East Antarctica.

DR JODIE SMITH

Marine Geoscientist
Geoscience Australia
jodie.smith@ga.gov.au

Jodie is a marine geoscientist in the Antarctic Geoscience team at Geoscience Australia. She studied at UNSW, completing an environmental science degree followed by a PhD. She joined Geoscience Australia in 2004 and her research has spanned marine and coastal environments in tropical and temperate Australia and Antarctica. She has a broad range of experience in geochemistry, geomorphology, sedimentology, water quality, ocean acidification and benthic habitat mapping. She has been part of the Antarctic Geoscience team since 2010.

DR PAUL SPENCE

Senior Lecturer
UNSW Australia
paul.spence@unsw.edu.au

Paul grew up in Canada and has lived in Australia for the past eight years. He is currently using a suite of global climate models, ranging from coarse to ocean eddy-permitting, to investigate ocean dynamics. His research is focused on water mass transformation in the North Atlantic and the Southern Ocean, as well as dynamics in the equatorial Pacific. He enjoys playing in and thinking about the ocean.

DR JONNY STARK

Senior Research Scientist
Australian Antarctic Division
Jonny.Stark@aad.gov.au

Jonny is a Senior Research Scientist at the Australian Antarctic Division where he leads multidisciplinary research on Antarctic marine ecology. This ranges from ecological processes such as disturbance, recruitment and trophic interactions to applied environmental science. He is interested in how benthic communities respond to environmental change, from human impacts in coastal ecosystems to climate change such as ocean acidification. Jonny works on a wide

spectrum of Antarctic biomes including sediment microbial, meiofaunal and macrofaunal communities, reef invertebrate and macroalgal communities, fish and birds.

ASSOCIATE PROFESSOR JAN STRUGNELL

Member of the Oversight Committee

Associate Professor Aquaculture and Marine Science
James Cook University

Jan is marine biologist who investigates evolution in Antarctic and deep sea species in the context of past climatic change. She also works to solve bottlenecks in sustainable aquaculture and fisheries industries using genetic tools. Although growing up a long way from the sea in country Victoria, she travelled to James Cook University (JCU), Queensland to study marine biology and aquaculture. After completing her BSc at JCU Jan was awarded a Rhodes Scholarship to undertake her PhD studies at Oxford University, UK. There she brought together genetic information and fossil evidence for the first time to uncover evolutionary relationships between octopuses, squids and cuttlefishes. Jan then worked as a postdoctoral research fellow at Queen's University Belfast, the British Antarctic Survey and Cambridge University where she undertook research in Antarctica which led to her discovering that deep-sea fauna from other ocean basins originated from Antarctic animals. Jan returned to Australia in 2010, first to La Trobe University, Melbourne and then back to JCU in 2016. She continues to use genetics to understand the evolution of marine animals including octopus, lobsters and abalone. She is passionate about using genetics to help develop sustainable fisheries and aquaculture industries and also to better understand evolution in the Antarctic.

ASSOCIATE PROFESSOR ALEKS TERAUDS

Section Head—Biodiversity Conservation
Australian Antarctic Division
aleks.terauds@aad.gov.au

Aleks has around 20 years' experience and strong interest in subantarctic, Antarctic and Southern Ocean science, working on a diverse range of taxa across all ecosystems. He focuses on cutting-edge research that integrates strategic priorities and influences environmental policy and management at national and international levels. Aleks currently leads research into terrestrial spatial ecology at the Australian Antarctic Division, developing and delivering the scientific foundation for spatial management and area protection in Antarctica.

DR ROWAN TREBILCO

Marine Ecologist
Antarctic Climate and Ecosystems Cooperative Research Centre
rowan.trebilco@utas.edu.au

Rowan is a Marine Ecologist interested in understanding the processes that shape marine ecosystems at scales ranging from local assemblages to global biomes, with the goal of informing conservation and management. He holds a long-standing interest and engagement in the interface between science, decision-making and environmental stewardship. Rowan's diverse experience in this context ranges from Southern Ocean ecosystems to temperate and tropical reefs. He was a Rhodes Scholar at Oxford (2007–08), a Varnier Scholar at Simon Fraser University in Canada (2009–14), and most recently was awarded a Hawke Fellowship through the Australian Antarctic Program (2015).

DR ADAM TREVERROW

Ice Sheet Scientist
Antarctic Climate and Ecosystems Cooperative Research Centre
adam.treverrow@utas.edu.au

Adam's role as an Ice Sheet Modelling Scientist at the Antarctic Climate and Ecosystems Cooperative Research Centre is focused on understanding geophysical processes that control the dynamics of the Antarctic ice sheet and its contribution to future sea level rise. In particular, he has experience in conducting laboratory ice deformation experiments which provide data that is used to further develop and validate the numerical description of ice flow properties in large-scale models used to simulate dynamic evolution of Antarctic ice sheet. Adam also has an interest in the dynamics of ice shelves and the influence on ice shelf – ocean interactions on their structure and stability.

DR JOHANNA TURNBULL

Associate Lecturer
University of Wollongong
johannat@uow.edu.au

Johanna is an early career plant ecophysiologist and works in the areas of stress ecophysiology, photosynthesis, and plant responses to climate change. She received her PhD 2016. Her research assesses responses to climate change in the moss-dominated communities of continental

Antarctica. This is important for future conservation of these fragile ecosystems, but can also be used to indicate shifts in climate. There is a paucity of accurate long-term meteorological records in Antarctica, and the slow-growing moss communities hold signals from past climates.

DR JONATHAN TYLER

Lecturer
University of Adelaide
jonathan.tyler@adelaide.edu.au

Jonathan is a Lecturer in the Department of Earth Sciences at the University of Adelaide with a PhD from University College London and research experience from the universities of Tokyo, Oxford and Melbourne. His research and teaching revolve around climate variability past and present and the way Earth surface processes can be deciphered using chemical signatures in water, sediment and biological materials.

DR TESSA VANCE

Palaeoclimatologist
Antarctic Climate and Ecosystems Cooperative Research Centre
tessa.vance@utas.edu.au

Tessa develops high resolution palaeoclimate records, primarily from ice cores, with a view to understanding long-term climate variability and change in the southern hemisphere. Tessa has a particular interest in developing circulation, rainfall and drought records for Australia and the south east Pacific region over the last 2000 years, and in understanding the underlying climate processes that cause rainfall variability and extreme events. She is also progressing research in understanding high resolution climate variability from ice cores in East Antarctica.

DR ANDREA WALTERS

ARC Antarctic Gateway Partnership Postdoctoral Research Associate
University of Tasmania
Andrea.Walters@utas.edu.au

Andrea is a Mesopelagic Ecologist at the Institute for Marine and Antarctic Studies, University of Tasmania. She is interested in the ecological role that top- and mid-trophic level consumers play in marine food webs. Her PhD focused on methodologies to quantify trophic linkages of far-ranging Southern Ocean top predators, including seals and penguins. In her current role she is investigating the structure and function of mid-trophic components of Southern Ocean food webs using biogeochemical (bulk and amino acid stable isotopes), bioacoustic and survey data to investigate diet and to develop 3D habitat descriptions of key mesopelagic species to assist with development of food web and ecosystem-based models.

DR JANE WASLEY

Antarctic Conservation & Management
Australian Antarctic Division
jane.wasley@aad.gov.au

Jane received her PhD from the University of Wollongong in 2005, investigating the effects of climate change on Antarctic terrestrial vegetation. For most of her career since, she has been based at the Australian Antarctic Division and has focused primarily on human impacts research. Jane is currently working with a team who are developing environmental guidelines for remediation and risk assessment of environmental contaminants that affect Antarctic and subantarctic regions.

DR MELINDA WATERMAN

Associate Lecturer and Research Associate
University of Wollongong
melindaw@uow.edu.au

Melinda is an early-career biotechnologist examining the secondary metabolites and protective mechanisms of moss species that live in temperate and Antarctic regions in order to gauge their capacities to survive in harsh environments and to determine their potential as biological proxies. She uses radiocarbon dating techniques to determine the ages of long moss shoots and investigates the effects of microclimate changes on maritime Antarctic mosses. Her collaborations extend internationally with scientists in Chile, USA, Brazil and UK.

DR DUANNE WHITE

Associate Professor
University of Canberra
duanne.white@canberra.edu.au

Duanne is a geomorphologist and Quaternary geologist interested in past ice sheet dynamics and their climatic or topographic drivers. He also aims to widely disseminate knowledge of changes in ice sheet extent to understand how they affect patterns and behaviour of the present day biota or solid earth.

DR JO WHITTAKER

Cross-disciplinary Theme Leader (Ocean-Earth System) and Senior Lecturer
University of Tasmania
jo.whittaker@utas.edu.au

Jo is a marine geophysicist. She researches the ocean floor to understand how tectonic plates move, and how the hot, deep centre of the planet interacts with the surface. Jo uses data from satellites and research vessels around Australia to constrain models of the evolution of the oceans and seafloor. She is interested in reconstructing how the Indian, Australian and Antarctic tectonic plates separated over the past 160 million years, forming the Indian Ocean. Jo received her PhD from the University of Sydney in 2008. She joined the University of Tasmania in 2013.

DR GUY WILLIAMS

ARC Future Fellow
Institute for Marine and Antarctic Studies
guy.darvall.williams@gmail.com

Guy is an ARC Future Fellow focusing on autonomous platforms and biotagging: New insights into Antarctic ocean – sea ice interactions. His background is in observational polar oceanography, focusing on dense shelf water formation in the coastal polynyas of East Antarctica and its role in the production of Antarctic bottom water.

DR NERIDA WILSON

Member of the Organising Committee

Senior Research Scientist
Western Australian Museum
nerida.wilson@museum.wa.gov.au

Nerida is a marine molecular biologist, who received her BSc from University of Melbourne, and BSc. (Hons.) and PhD at University of Queensland (2004). She had a brief sojourn at the University of Adelaide and South Australian Museum, and then moved to the USA to pursue postdoctoral work at Auburn University (Alabama), and Scripps Institution of Oceanography (San Diego). She returned to Australia in 2010 to the Australian Museum as a Senior Research Scientist, and in 2014 moved to the Western Australian Museum.

DR JESSICA ZHENG

Instrument Scientist
Australian Astronomical Observatory
jzheng@aao.gov.au

Jessica is an instrument scientist at Australian Astronomical Observatory, developing new technology for astronomical instrumentation. Her key research area includes adaptive optics, optical testing and infrared optics design. She has been working on the new infrared camera design which is going to be deployed with the AST3-3 wide-field survey telescope to Dome A on the Antarctic plateau. She is currently involved on the future development of KDUST project which is a 2.5 m optical and infrared telescope deployable on Antarctic Dome A.

SPONSORS

UNIVERSITY of TASMANIA | IMAS INSTITUTE FOR MARINE & ANTARCTIC STUDIES

ACE CRC
ANTARCTIC CLIMATE & ECOSYSTEMS
COOPERATIVE RESEARCH CENTRE

ANTARCTIC GATEWAY PARTNERSHIP
A Special Research Initiative of the Australian Research Council

CSIRO

THE ROYAL SOCIETY

The Theo Murphy (Australia) Fund

The 2017 Australian Frontiers of Science is supported by the Royal Society of London—the national academy of science of the United Kingdom and the Commonwealth—through the Theo Murphy (Australia) Fund.

The Royal Society of London is a self-governing Fellowship of many of the world's most distinguished scientists drawn from all areas of science, engineering, and medicine. The Society's fundamental purpose, reflected in its founding Charters of the 1660s, is to recognise, promote, and support excellence in science and to encourage the development and use of science for the benefit of humanity.

NOTES

NOTES

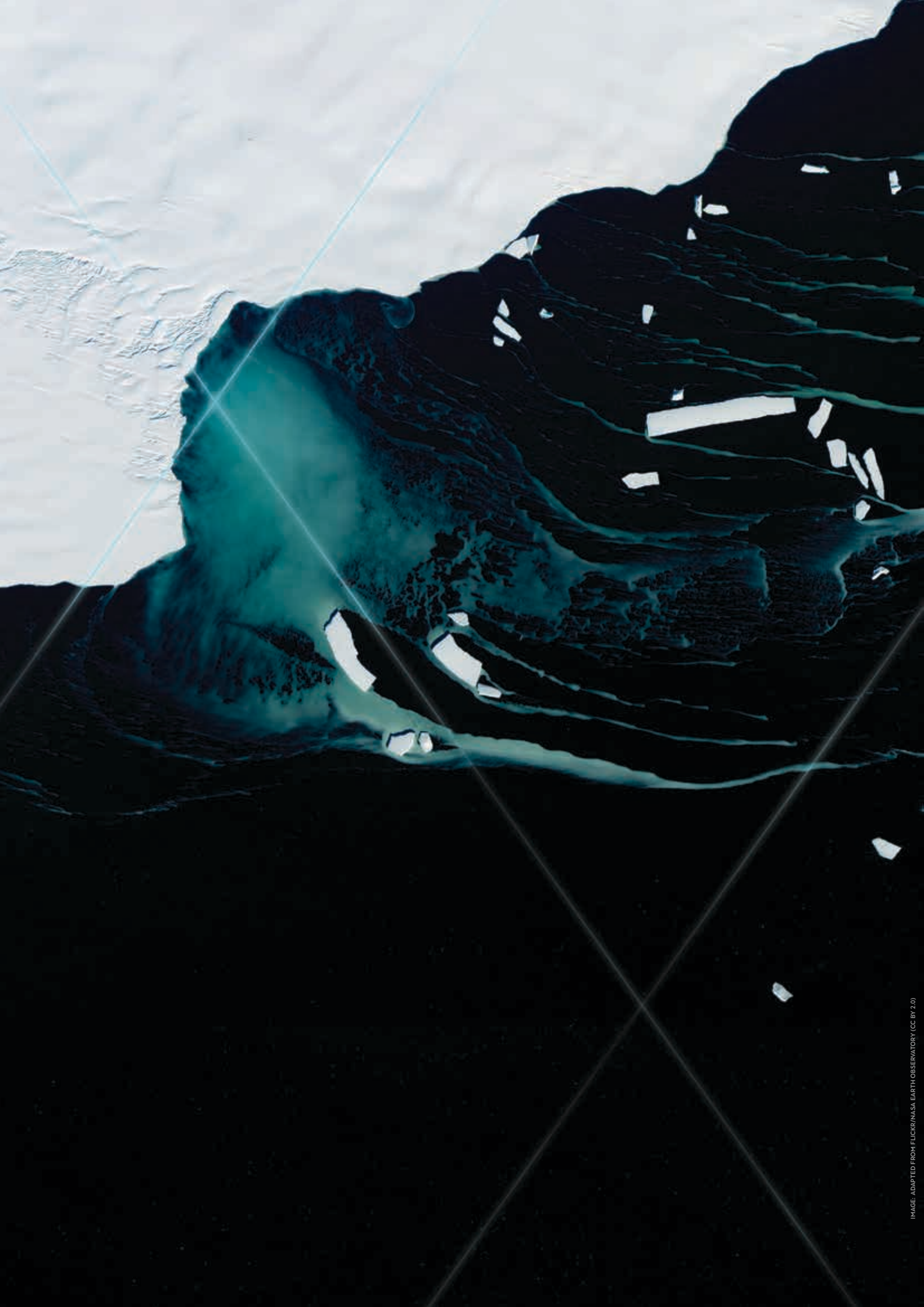


IMAGE: ADAPTED FROM FLICKR/NASA EARTH OBSERVATORY (CC BY 2.0)