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REPORT OF THE 5TH

JOINT AUSTRALIA-JAPAN WORKSHOP ON ANTARCTIC SCIENCE

JULY 2025

VENUE

Science Council of Japan and National Institute of Polar Research, Tokyo, Japan

CO-CONVENERS

Toru Hirawake (NIPR), So Kawaguchi (AAD), and Satoshi Imura (NIPR)

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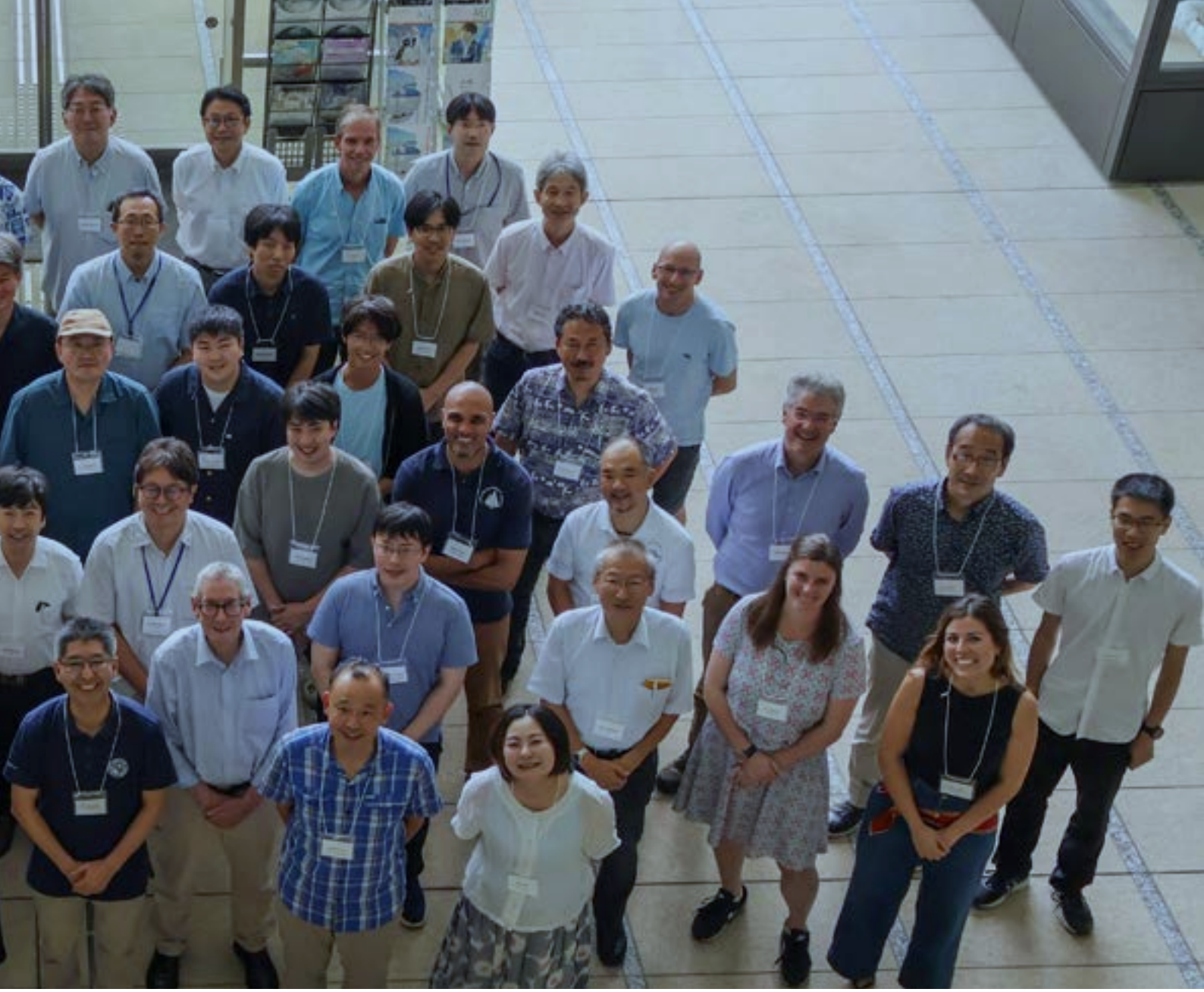

INTRODUCTION

1.1 The series of Australia-Japan Workshops on Antarctic Science was based on the Joint Communiqué between the Prime Ministers of both Australia and Japan when they met in Tokyo in June 2008, in paragraph 34, emphasising a firm commitment to collaborate on Antarctic climate change studies (https://www.mofa.go.jp/region/asia-paci/australia/joint0806.html). The Communiqué underlined the importance of cooperation in Antarctic science, which is also stipulated in the Antarctic Treaty, which led to holding regular joint research meetings between Australian and Japanese Antarctic scientists every three years since 2009. However, this workshop was the first one since 2018 after the COVID-19 pandemic disrupted this important regular workshop.

1.2 The 5th Australia-Japan Workshop on Antarctic Science was co-hosted by National Institute of Polar Research (NIPR), Japan, Australian Antarctic Division (AAD), Australian Antarctic Program Partnership (AAPP), University of Tasmania (UTAS), Science Council of Japan, and with the Australia-Japan Foundation and Japan Society for the Promotion of Science as the main sponsors.

1.3 The 5th Australia-Japan Workshop on Antarctic Science consisted of two parts:

a) Public symposium

"How would Global Warming Change Antarctica and the Southern Ocean - A new chapter for the collaboration between Japan and Australia" highlighted significant achievements in Australia-Japan collaborations in Antarctic science, future research collaborations and initiatives, and the importance of strengthening these Australia-Japan ties. Symposium flyer including its agenda is available in Appendix 1.

b) Closed business meeting

Australia-Japan Workshop on Antarctic Science was attended by 59 Japanese and 27 Australian scientists across various disciplines of Antarctic science, as well as four Government representatives and three support staff (a list of participants in Appendix 2). A series of plenary and disciplinary group sessions to review the current status of collaboration between Australia and Japan on Antarctic science aimed to cross-fertilise research ideas across national Antarctic programs and different scientific disciplines (e.g. marine ecosystem, physical oceanography, marine biogeochemistry, sea-ice physics, glaciology, sea-level rise, atmospheric science, and geoscience), and to improve science and logistical coordination and maximise the science outputs.

1.4 This workshop report covers the closed business meeting held from the afternoon of 28th to 30th July 2025.

OPENING OF THE MEETING

2.1 Prof Hirawake chaired the workshop.

2.2 The 5th Australia-Japan Workshop on Antarctic Science (the session closed to public) was held at Science Council of Japan in the afternoon of 28th July 2025 and at National Institute of Polar Research (NIPR) on 29th and 30th July, 2025. The Workshop was co-convened by Professor Toru Hirawake of the National Institute of Polar Research, Dr So Kawaguchi of the Australian Antarctic Division (AAD), and Professor Tony Press of Australian Antarctic Program Partnership, University of Tasmania. Local arrangements were led and coordinated by Professor Hirawake.

2.3 This report was jointly prepared by Prof Toru Hirawake, Dr So Kawaguchi, and Prof Tony Press.

2.4 Ms Taeko Onodera from the Ministry of Education, Culture, Sports, Science and Technology (MEXT) opened the workshop by providing a speech reflecting on the importance of science collaboration between Australia and Japan, especially the annual collaboration using *Umitaka-maru* of Tokyo University of Marine Science and Technology (TUMSAT) which visits Fremantle and Hobart every year, as well as the science and logistical collaboration between Australia and Japan during 50th Japanese Antarctic Research Expedition (JARE) when Australian Icebreaker *Aurora Australis* supported Syowa Station resupply when Japanese Icebreaker *Shirase* was not available. She also mentioned Agreements on research collaboration which have already been signed between NIPR and key Australian institutions such as AAD, the Bureau of Meteorology, and Geoscience Australia for further scientific collaborations between two countries.

2.5 The provisional workshop agenda was adopted without any amendments (Appendix 3).

2.6 Janine Pitt (Embassy of Australia in Tokyo) congratulated the huge success of the Public Symposium held in the morning of 28th July reflecting the series of presentations on the long-standing collaboration in Antarctic science between Australia and Japan. She mentioned the timeliness of reinvigorating this relationship as next year (2026) is the 50th anniversary since the signing of 'Basic Treaty of Friendship and Co-operation between Australia and Japan' in 1976 in Tokyo, and that she looks forward to the outcome of the workshop to be reported to next year's Japan-Australia Joint Science and Technology Cooperation Committee meeting to be held in Japan and serve to strengthen Antarctic science collaboration between the two nations into the future.

PURPOSE AND THE PROCEDURE OF THE WORKSHOP

3.1 The purpose of the workshop (WS) was to discuss plans for potential collaborative projects for the next five years, develop a Workshop Communiqué, and agree on summary points to report to the Japan-Australia Joint Science and Technology Cooperation Committee meeting to be held later in 2026.

3.2 The WS formed subgroups for disciplines to further their collaborative project plans for the next five years (the project table), as well as provide one headline paragraph summarising the group's outcome to be included in the Workshop Communiqué, and report back to the plenary.

3.3 Further, based on each subgroup discussion outcomes the WS pursued a discussion to cross-fertilise ideas between different disciplinary groups by exchanging and integrating ideas to set the directions of a holistic, multi-disciplinary collaboration in Antarctic science between the two nations.

REVIEW OF PAST COLLABORATIONS AND WHAT IS EXPECTED INTO THE FUTURE

4.1 Current and past collaborations between Australia and Japan were reviewed and future prospects were provided by Prof Press, Prof Imura, and Dr Kawaguchi.

4.2 Prof Press reviewed the long-standing collaborative relations in Antarctic science between Australia and Japan, and that both nations' Antarctic programs continue to play important roles in the Antarctic Treaty System. As science is the currency in the ATS he particularly stressed the importance of repeat observations under a rapidly changing climate and that this must be underpinned by top-class science to provide guidance of priorities for logistics and finance, especially what should be funded.

4.3 Prof Imura briefly outlined the long history of Australia-Japan collaboration since Nobu Shirase's Expedition in 1911. He mentioned the Joint Communiqué between the Prime Ministers of the two countries in June 2008 has underlined the importance of cooperation in Antarctic science and four Australia-Japan Workshops on Antarctic science have followed the Joint Communiqué in the last few decades. Research programs such as Studies on the Antarctic Ocean and Global Environment (STAGE), Collaborative East Antarctic Marine Census (CEAMARC), Southern Ocean Continuous Plankton Recorder Program (SO-CPR) were also introduced as good examples of collaborative marine science before COVID-19. He also introduced the sciences in JARE Phase X and showed that further collaborations with Australia are required during JARE Phase XI and International Polar Year (IPY).

4.4 Dr Kawaguchi summarised how the regular Australia-Japan Workshop began since the 2008 Prime Ministerial Joint Communiqué and the role it plays in the coordination of Antarctic science between Australia and Japan. He further gave a recent successful example of survey coordination (Japanese BROKE and Australian TEMPO) maximising the impact and outcomes which led to a joint proposal for updating CCAMLR's Conservation Measure for krill in East Antarctica. He also touched on possible ways to coordinate at-sea predator observation and predator tracking from research stations on the continent between Australian and Japanese programs.

4.4 The workshop drew attention to the timelines of both Programs – JARE Phase X (2022-2027) and Australian Antarctic Science Decadal Strategy (2025-2035) – in relation to the planning of future collaboration.

4.5 Antarctica InSync and IPY-5 were regarded by the workshop participants as providing excellent frameworks for collaboration in the next 5-10 years between the two nations.

4.6 As Antarctica InSync activities (2028-2029) and IPY-5 (2032-2034) will fall within next JARE Phase (JARE Phase XI: 2028-2034), and because planning for such collaboration and coordination requires at least two years of lead time, discussion needs to start immediately to reflect coordination planning within JARE XI for Australia and Japan to coordinate for Antarctica InSync and IPY-5. Australian Antarctic Program (AAP) is also currently developing its implementation plan for the Australian Antarctic Science Decadal Strategy (2025-2035), and the criticality of planned coordination to be reflected in the implementation plan was stressed.

PRIORITIES FOR AAP AND JARE

5.1 The Australian Antarctic Decadal Strategy was introduced by Dr David Souter. It has the following priorities that are relevant to this discussion and broad Australia-Japan Antarctic science collaboration:

- **Climate system and change:** The Antarctic ocean-atmosphere-cryosphere (ice sheet, ice shelves and sea ice) system is crucial to our understanding of global climate systems, including sea level rise, shifting weather patterns and extreme events.
- **Biodiversity:** Comprehensive protection, conservation and management of the unique environments, associated ecosystems and biodiversity of Antarctica and the Southern Ocean
- **Human impacts:** Impacts from past, present and future human activities are avoided or mitigated through best practice environmental stewardship that protects, manages and remediates Antarctica's unique environment.
- **Monitoring Antarctica and the Southern Ocean:** Long-term integrated monitoring and strategic, multidisciplinary field programs in East Antarctica and the Southern Ocean underpins Antarctic and Southern Ocean research, protection, conservation and management

5.2 Mr Robb Clifton gave a presentation on AAP logistics. A summary of the three Australian stations on the Antarctic continent and on the sub-Antarctic islands was provided. He then gave an overview of RSV *Nuyina* including exciting new capabilities such as wet well system, moon pool, various sediment corers, multibeam and advanced fishery sonar. He also gave an overview of Australia's aviation capabilities in the Antarctic operations including air bridge model.

5.3 JARE Phase X and XI was introduced by Profs Imura and Hashida. Phase X of the Japanese Antarctic Research Expedition since 2022 includes both fundamental observation aimed at continually obtaining and publishing critical scientific data demanded internationally and socially, as well as conducting innovative and pioneering research projects on the unique features of Antarctica. Prioritised research project findings in Phase X focus on characterising the future global environment system as inferred through investigating the past and present of the Antarctic. It has the following priorities that are relevant to this discussion and broad Australia-Japan Antarctic science collaboration:

- Investigating Antarctic ice sheet and global environmental changes through paleoenvironmental research centred on oldest ice core drilling.
- Exploring the melting mechanism of the East Antarctic ice sheet and changes in the biogeochemical cycles through integrated research and observation of the ice sheet – sea ice – ocean system.
- Exploring changes in atmospheric circulation and the influence of space based on observations using the large-scale atmospheric radar.

The Phase X also encompasses a diverse range of activities, including international collaboration, sharing research outcomes with the public, and partnerships with research organisations.

They also mentioned how to plan Phase XI of the Japanese Antarctic Research Project (2028-2033), which would cover the period of IPY-5.

5.4 The WS reaffirmed that the priorities for both AAP and JARE share common interests to better understand Antarctica and the Southern Ocean and to manage the environmental system in East Antarctica, which makes Australia and Japan strong allies in progressing science under the Antarctic Treaty System.

DISCIPLINARY SUBGROUP DISCUSSION

6.1 The aim of the subgroup discussion was to gather a list of current collaborations and to exchange ideas and aspirations for future collaborations. Each subgroup also identified gaps that need to be filled to address priority questions in Antarctic science and climate change, including development of plans for the collaborative work for the next five years and beyond (Appendix 4).

Outcomes of the Subgroup discussions

Physical Oceanography

6.2 The group worked on identifying activities that would support collaboration of Japan with Australia and vice versa by looking into current plans (2025-2027) and near-term plans (2028-2034), and activities to support collaboration. The group highlighted the need to engage with the regional and circumpolar modelling efforts to identify opportunities for field work design, model validation and analysis.

6.3 In the combined Australian Antarctic Program and Japanese shipping schedules it became clear that the Japanese planning for the JARE Phase XI will commence in earnest in December 2025 and will become “committed” in about June 2027. JARE Phase XI will start April 2028 and end March 2034, a total of six years. Discussions with the Australian Antarctic Division indicate that the next clear period for new large, coordinated projects begin after the East Antarctic Sector Experiment (EASE) project (in 2029/30 season, to be confirmed). The start date for new activities is likely to be July 1, 2031. The JARE Phase XI program will be in its fourth year.

Biogeochemical cycles and phytoplankton

6.4 The group discussed and identified current and potential collaborations in the next five years.

6.5 Sharing expertise in field techniques. Specifically, this includes underway and autonomous measurements of ocean productivity. There is a strong interest in the LabSTAF instrument (underway measurement of phytoplankton) as well as Biogeochemical Argo (BGC-Argo), and the importance of sharing expertise from both sides was expressed by the group.

6.6 Analysis of archived samples and data. For example, High Performance Liquid Chromatography (HPLC) analysis for phytoplankton pigment samples, was discussed. The group noted that there is an archive at AAD with no facility to undertake the analysis. NIPR has capacity to run such analysis. Sharing of samples from AAD to NIPR has commenced. Results can then be used for activities such as satellite validation and detection of long-term change.

6.7 Continuous monitoring by *Shirase* along 110E line since 1965 provides a long time series of chlorophyll and nutrients, and provides an excellent framework for its analysis in the context of model outputs, satellite observations and climate indices.

6.8 Evaluation of climate model and satellite algorithm predictions of ocean productivity will also be an area of collaboration, specifically contrasting floats and satellite algorithms against different types of CMIP models.

6.9 Carbon chemistry, trace metal and bacterial processes from JARE66/67, Denman, MISO, ENRICH and K-Axis provides excellent opportunities for the comparison of carbon cycle observations from the Totten, Denman and SOTS regions.

6.10 The group further discussed the potential opportunities for joint participation in upcoming voyages such as Marginal Ice Zone voyage in 2028 and JARE Phase XI *Shirase* 2029-30.

6.11 Further, augmentation of MEEK moorings with sediment traps was introduced to the group, which could provide exciting opportunities for collaboration through data exchange and comparisons between AAP and JARE.

Ice sheet and ocean research

6.12 The group discussed the ideas of collaboration, scope, challenges, opportunities and priorities.

6.13 The scope of ice-ocean and glaciology research are

- Ocean-driven melting beneath ice shelves
- Links between ice sheet / ocean interaction, atmosphere interaction, and biology
- Warm water inflow on continental shelves and modification processes on the shelf
- Coupled ocean-ice sheet dynamics and model development
- Development and evaluation of numerical models including parameterisation development
- Large-scale and long-timescale ice sheet simulations for SLR projections
- Use of satellite, shipboard and mooring observations to constrain models
- Use of models to guide shipborne, ground and airborne observational efforts

6.14 Current Priorities and Capabilities

- Key regions of interest: Amery/Cape Darnley, Totten, Wilkes Subglacial basin.
- Parameterisations - basal melting and calving.
- Synthesis of observational and modelling approaches, regional models.
- Circumpolar/global models
- Coupled ice sheet-ocean simulations
- Future ice sheet projections with large-scale simulations
- High quality sea-ice production datasets
- Ocean observations, e.g. at the ice front
- Ice shelf basal melt observations (e.g. APRES).
- Bathymetry & bedrock observations – sharing and opportunistic
- Autonomous methods

6.15 Key Knowledge Gaps & Problems

- Sparse observational coverage beneath ice shelves limits model evaluation
- Lack of observed bathymetry is major limiting factor for ice shelf-ocean simulation
- Melt parameterisations have missing physics.
- Under-utilised high-resolution observational datasets
- Lack of systematic intercomparison of ice shelf/ocean models across regions
- Disconnected modelling efforts
- Biogeochemical feedbacks in the cryosphere-ocean system remain relatively unexplored
- Recent upper ocean warming and impacts on sea-ice reduction and MICI
- Other missing physics and processes? Tides, frazil, subglacial drainage?

6.16 Joint Aims and Future Opportunities

- Coordinate model experiments with shared domains and forcing datasets (e.g. Totten, Prydz Bay/Cape Darnley). Co-development and intercomparison of realistic simulations.
- Compare and assess basal melt parameterisations, using model intercomparisons. Continued simulation and development of large-scale ice sheet simulations for IPCC AR7.
- Integrate up-to-date sea ice production data, to better incorporate dense water formation into ice shelf/ocean studies.
- Support early/mid-career researcher exchanges, training and co-supervision.

Sea ice and ocean research

6.17 The discussion covered topics in remote sensing/physics and wave/ice/ocean interaction. The group noted the collaborative research priorities are framed by the recent crash in Antarctic sea-ice extent over the past decade, providing a sense of extra urgency toward our continuing collaboration.

6.18 Discussions on remote sensing focused on satellite remote sensing of Antarctic sea ice, including new applications for existing data streams, new satellite sensor technology recently launched specifically for sea-ice research, observations of ice-ocean interaction, and landfast ice research.

6.19 Discussions on wave/ice/ocean interaction highlighted the numerous ship-borne wave and ice observations using the *Shirase* that were conducted by the Japanese group, providing a decades-long time series, whereas the Australian group is responsible for installing numerous advanced optical sensors on board the *Nuyina*. The potential collaboration will start with a joint effort in automating the visual observation of sea ice (also known as ASPeCt).

6.20 The area of interest extends beyond the MIZ and into the packed ice and land fast ice zones. Thermodynamic processes, such as air-sea fluxes and ocean-ice fluxes, are also critical. Moreover, both parties have access to wave-ice tanks and are developing coupled wave-ice-ocean regional models.

6.21 The group underscored the importance of the role that ECR exchange programs and scholarships in maintaining the links and nurturing the next generation of scientists to lead and drive the sea-ice research collaboration.

Zooplankton

6.22 The group discussed key areas of planned collaboration in the next several years and the challenges in pursuing the collaborations.

6.23 The main links identified in zooplankton collaboration were, but not limited to, plankton imaging (ZooScan, FlowCam, EVS), machine learning methodology, long-term monitoring programs (CPR), krill aquarium research and management, coastal zooplankton sampling, and high-resolution mapping of plankton distribution.

6.24 The key areas of collaboration identified are plankton community structure and its comparisons between various coastal areas, continuation of continuous plankton recorder, establishment of image analysis methodology, continued collaboration in aquarium studies, and lab and berth exchange between Japanese and Australian platforms.

6.25 Challenges identified were limited opportunities for reciprocal berths with changes of shipping regimes, limited funding to support positions and personnel required for sample processing.

6.26 Limited ability to collect live animals suitable for live experiments hampered the progress of physiological studies in zooplankton. However, this is now overcome due to the introduction of wet-well system on *Nuyina* that allows collection of intact animals in large number for physiological studies without using any extra ship time for net sampling.

6.27 Importance of the collaboration with researchers in other science discipline was also identified as a key to allow understanding what shifting climate might look like for plankton communities.

Predators

6.28 Recognising that Antarctic wildlife are vulnerable to ecosystem change in the Southern Ocean, collaborative research aims to understand recent broad-scale wildlife population change, to continue monitoring wildlife into the future, and to understand the interactions between wildlife and their sea ice environment to improve understanding of climate change impacts.

6.29 The primary focus for collaboration will be on Adélie penguins given their high abundance, relatively accessible breeding sites near Japanese and Australian Antarctic stations, dependence on sea ice, and high consumption of krill resulting in them being designated an indicator species for CCAMLR's ecosystem monitoring program (CEMP). As a priority, Japan and Australia will share observations indicating the presence and impact of the devastating avian influenza virus (HPAI H5N1) on wildlife in areas where each national Antarctic program operates.

East Antarctica Synthesis

6.30 Japan and Australia recently conducted shipboard synoptic multidisciplinary ecological surveys in East Antarctica. These surveys covered 80-150°E in austral summer 2018/19 (Japan; KY1804; Murase et al. 2025), 55-80°E in austral summer 2021 (Australia; TEMPO; Kawaguchi et al. 2025), and a smaller-scale survey 135-155°E in austral summer 2019 (Australia; ENRICH; Cox et al. 2025).

6.31 The new surveys provide an opportunity to update the synthesis of the East Antarctic pelagic ecosystem, to both test and develop the conceptual models of the krill-centric ecosystem derived from the BROKE voyages and to explore changes in the ecosystem that may have occurred over the intervening two decades. An updated synthesis of the East Antarctic pelagic ecosystem also provides an opportunity to develop a collaborative multinational and multidisciplinary survey/sampling framework to target key geographic areas and ecosystem components in future fieldwork campaigns.

Atmospheric science

6.32 Recent rapid changes in Antarctic forcing require a detailed understanding of atmospheric processes, from surface to near-space. Forcing from above and below needs to be clarified in the Antarctic region. Understanding clouds and aerosol processes is necessary in order to constrain radiative forcing over high southern latitudes, and provide limits on precipitation over the ice sheet and sea ice. High-top middle atmosphere general circulation models require sustained polar observations throughout the entire atmospheric column for validation and then assimilation. Our station- and ship-based collaborative observations of key atmospheric parameters will drive improvements in our understanding of the rapidly changing polar region. The resulting improvements to general circulation models will allow an increase in forecast abilities on a range of time scales at the surface, including for sea ice and polar oceans.

Geoscience

6.33 The group worked on identifying common areas of interest and collaboration in near future and longer-term plans in East Antarctica. The group also discussed the value of Japan and Australia's long-term collaborations on geoscience in Antarctica.

6.34 Bathymetry data, geological samples and geophysical data are essential to multidisciplinary studies addressing Antarctica's most pressing challenges. Australia and Japan will continue to work together, sharing data and information and conducting collaborative fieldwork, to understand the marine and terrestrial geological archives of Antarctica's past.

PLENARY CROSS-DISCIPLINARY DISCUSSION

Overarching science questions for the WS

7.1 The plenary discussion was guided by the following overarching science questions:

- How fast is the ice sheet in East Antarctica melting and what is its contribution to the sea level rise?
- What drives sea ice variability and change, and differing regional & seasonal sea-ice patterns?
- How does sea ice variability affect ecosystem processes?
- How does environmental change, and its variability, affect ecosystem interactions in East Antarctica?

7.2 The WS discussed how best we can start streamlining various science activities address such science questions across disciplines, acknowledging there are various thoughts and ideas on exciting topics of collaboration and priorities, and regions of priority, and most importantly, what would these collaborations look like. Such examples may include but are not limited to

- Identifying a geographical area of common interest, or identifying multiple areas for specific questions, or undertaking research in contrasting ecosystems or regions.
- Integrated studies and coordinated long-term measurement programs in the coastal zone (including fast ice and polynyas) and from research stations.
- Conducting similar observations in overlapping regions, sustained repeat observations across disciplines (not monitoring), and extend this to terrestrial and nearshore, building up a holistic picture over time.

7.3 The WS agreed that strategic collaboration that is well thought-out and well planned brings substantial benefits to the Antarctic research communities of both Australia and Japan, and will lead to the development of important cross-funding applications and ground-breaking new research on key priority questions for the Antarctic research strategies of both countries.

7.4 The WS participants recognised that enhanced logistic coordination between the two countries, such as coordination between Australian icebreaker RSV *Nuyina* and Japanese icebreaker *Shirase*, will increase opportunities for a holistic approach to measuring and modelling the Antarctic environment and its associated processes: key to addressing the climate change challenges that face both countries and the rest of the world.

7.5 The WS participants agreed that IPY-5 and the Antarctica InSync initiatives present excellent opportunities for coordinated research across East Antarctica. These initiatives should include all other nations operating in the region. Planning for these needs to start as soon as possible to ensure adequate funding and the coordination of the logistics required for its execution.

Regions of interest (Appendix 5)

7.6 The WS developed a matrix that maps out regions of interest at various geographical areas and scales for each science discipline, a list of known and prospective coordination and connections between Australia and Japan detailing the variables measured and platforms used, and existing data in Australia and Japan related to each science discipline. These tables collectively provide a summary of the landscape in Antarctic science and the capabilities of both nations and will serve as the fundamental documents for developing Antarctic research coordination between the two nations, and will remain as living documents to be updated. The workshop further underscored its usefulness for the research coordination towards Antarctica InSync and IPY-5 activities. Workshop Communiqué (Appendix 6).

7.7 The WS participants agreed to statements and plans from each discipline group and released as a Workshop Communiqué which was launched at a special event to open the 2025-26 Antarctic season, hosted by the City of Hobart.

7.8 The Communiqué is planned to be reported to a high-level bilateral meeting to be held in Japan 2026 (18th Japan-Australia Joint Science and Technology Cooperation Committee meeting).

EARLY CAREER RESEARCHER (ECR) EXCHANGE PROGRAMS

8.1 The WS agreed that the role that ECR exchange programs and scholarships play in maintaining the links and to nurture the next generation of scientists is fundamental to lead and to drive the sea-ice research collaboration into the future and that both Australia and Japan should make every effort to seek maintaining and further extending such programs wherever possible.

8.2 The WS further underscored the important role and support of the Japan Society for the Promotion of Science (JSPS) which has underpinned ECR exchange between the two nations.

FUTURE MEETINGS AND FORMATS

9.1 Executive representatives of all institutes agreed on the importance and great value of the Workshop, highlighting the vital nature of the collaboration.

9.2 The WS agreed that the next meeting should be in a few years' time, probably in Australia in 2028. The specific date for the Workshop will be coordinated between current participants of this meeting from TUMSAT, NIPR and AAD. The Workshop further noted that it would be beneficial to plan for the next Workshop well in advance to ensure maximum attendance of relevant scientists from across the disciplines.

9.3 The WS was considered to be an excellent and indeed invaluable opportunity for scientists from both nations to get a general overview of the latest Antarctic scientific activities and outcomes across all research fields in a digestible way. A suggestion was made that organising a symposium-style session during the next Workshop period again will benefit both the wider community and early career scientists.

9.4 The WS also highlighted the importance of reporting to the bilateral Japan-Australia Joint Science and Technology Cooperation Committee meeting scheduled in 2026, on the successful outcomes from this Workshop.

CLOSING OF THE WORKSHOP

10.1 Prior to closing, Prof Nogi congratulated the WS for marking a major step forward in starting cross-disciplinary streamlining of Antarctic science coordination between Australia and Japan.

10.2 The Chairs expressed their sincere thanks to all the sponsors and supporters for their support which made the WS a great success.

10.3 Finally, Chairs thanked all participants for their perseverance and engagement in the meeting. They particularly thanked the local NIPR host Professor Hirawake and all the staff who supported the meeting behind the scenes.

LIST OF APPENDICES

SPONSORS AND SUPPORTERS

APPENDIX 1: FIRST DAY SYMPOSIUM FLYER

APPENDIX 2: LIST OF PARTICIPANTS

Participants list of the Australia-Japan Workshop on Antarctic Science

Australia

- Simon Alexander AAD
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- Tsubasa Kodaira Hokkaido University
- Nobuo Kokubun NIPR
- Mizuki Komatsu Hokkaido University
- Kazuya Kusahara JAMSTEC
- Bofeng Li NIPR
- Yichen Lin Sun Yat-sen University, China (now visiting Hokkaido University)
- Masashi Machida Hokkaido University
- Ryosuke Makabe NIPR
- Tsuyoshi Matsuda Port of Nagoya Public Aquarium
- Koji Matsuoka The Institute of Cetacean Research

- Ami Matsuzaki Tokyo University of Marine Science and Technology
- Vigan Mensah Hokkaido University
- Kohei Mizobata Tokyo University of Marine Science and Technology
- Mao Mori Japan Fisheries Research and Education Agency
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- Hirotaka Terasaki Translator from Simal International Inc.
- Tsugumi Yamamoto Simal International Inc.

APPENDIX 3: WORKSHOP AGENDA

Day 1 (28 July 2025)

Public Symposium: *"How would Global Warming Change Antarctica and the Southern Ocean"*
- A new chapter for the collaboration between Japan and Australia

Primary Sponsor: Science Council of Japan

Co-hosts: National Institute of Polar Research; Australian Antarctic Division; University of Tasmania; Australian Antarctic Program Partnership; Australian Embassy Tokyo; Ministry of Education Culture, Sports, Science and Technology, Japan

Sponsors: Open Partnership Seminar, Japan Society for the Promotion of Science; Australia-Japan Foundation; Antarctic Tasmania, Tasmanian Government

Date and Time: 28 July 2025 10:00-17:00

Venue: Science Council of Japan Auditorium (7-22-34, Roppongi, Minato-ku, Tokyo)

Purpose of the Symposium: Recent research shows rapid change in the Antarctic environment. International collaborations are an essential part of maintaining and advancing scientific research in the Antarctic region. Japan and Australia have enjoyed long-term strong collaborations and friendship in Antarctic research. Regular joint research meetings have been held between Australian and Japanese Antarctic scientists since 2009, but the COVID-19 pandemic, and the subsequent rebuilding of Antarctic research programs and schedules has impacted these important discussions. This symposium will highlight significant achievements in Australia-Japan collaborations in Antarctic science and focus on future research collaborations and initiatives, and strengthen these important Australia-Japan ties.

Program

First Session: Latest Antarctic and Southern Ocean studies (Public symposium)

MC: Toru Hirawake (Professor, National Institute of Polar Research (NIPR))

10:00 – Opening Speech:

Welcome from Council Members and Australian Antarctic Division (AAD) Head of Division

- Nobuko Saigusa (Vice-President, the Science Council of Japan / Vice President, National Institute of Environmental Science)
- Takuji Nakamura (Council Member, the Science Council of Japan / Professor, NIPR)
- Emma Campbell (Division Head, AAD)

10:05 – Purpose of the Symposium

- Tony Press (Adjunct Professor, Australian Antarctic Partnership Program (AAPP), University of Tasmania / Chair, Tasmanian Antarctic Gateway Advisory Committee)

10:10-12:00 (15 minutes each including 1-2 quick questions from the audience)

- Naomi Harada (Member, the Science Council of Japan / Professor, Atmospheric and Ocean Research Institute, the University of Tokyo): The latest observation research conducted by the 66th Japanese Antarctic Research Expedition
- David Gwyther (Research Fellow, School of the Environment, Faculty of Science, University of Queensland): Emerging collaborative directions in ice sheet, ocean and sea level research
- Abigail Smith (Research Scientist, AAD): Antarctic krill vertical migrations modulate seasonal carbon export
- Akinori Takahashi (Professor, NIPR): Effects of Antarctic environmental change on penguins
- Kohei Mizobata (Associate Professor, Tokyo University of Marine Science and Technology, TUMSAT): Ocean heat transport processes causing East Antarctic ice sheet mass loss

- Alex Fraser (Australian Research Council Future Fellow / Senior Research Associate, Institute for Marine and Antarctic Studies, University of Tasmania): Understanding Antarctica's changing sea ice
- Mitsumu Ejiri (Associate Professor, NIPR / Deputy Leader, 67th JARE, and Station Leader, Overwintering Party): Japan-Australia collaboration on Antarctic atmosphere study and observation

12:00-13:00 Lunch (Meeting room at 6th floor)

13:00-13:45 Keynote Lecture

Chair: Shigeru Aoki (Professor, Institute of Low Temperature Science, Hokkaido University/ Leader, 67th JARE, and Leader, Summer Party)

- Nathan Bindoff (Professor, AAPP, University of Tasmania)

13:45-14:20 Panel Discussion

Chair: So Kawaguchi
(Principal Research Scientist, AAD)

Panel: All presenters

14:20-14:30 Close First Session (Public Session)

- Hiroyuki Enomoto (Member, the Science Council of Japan / Professor, NIPR)

14:30-15:00 Coffee Break (Meeting room at 6th floor)

Second Session (Closed to Public, Meeting room at 6th floor): Collaboration between Japan and Australia, looking into the future

(Chair Toru Hirawake, Professor, NIPR)

15:00 Greeting from MEXT

- Taeko Onodera (Director for Polar Research Programs, Ocean and Earth Division, Research and Development Bureau, MEXT (Ministry of Education, Culture, Sports, Science and Technology))

15:05 Presentations (15 minutes each)

- Tony Press (Adjunct Professor, AAPP, University of Tasmania /Chair, Tasmanian Antarctic Gateway Advisory Committee
- So Kawaguchi
(Principal Research Scientist, AAD)
- Satoshi Imura (Professor, NIPR)

15:50-16:50 (Chair: Tony Press, So Kawaguchi, Naomi Harada, Toru Hirawake)

- General Discussion and outcome of the day
- Commentary by Australian Embassy in Tokyo Janine Pitt (Counsellor (Education and Research), Australian Embassy)

16:50-17:00 Closing remarks

- Yoshifumi Nogi (Director-General, NIPR)

Day 2 & 3 (29-30 July)

Australia – Japan Workshop on Antarctic Science

Venue: NIPR (closed to public)
(10-3, Midori-cho, Tachikawa-shi, Tokyo)

Day 2 and 3 will focus on discussions to map out future collaborations in Antarctic science. The workshop will start with a scene-setting presentation by the co-conveners, followed by presentations of the outcomes from each discipline group out of the discussion they had leading up to the workshop, and also of the ideas for future collaboration. The workshop's ultimate goal is to have a cross-fertilisation of ideas between different disciplines by exchanging and integrating ideas to set the directions of a holistic, multi-disciplinary collaboration in Antarctic science between the two nations.

Expected outcomes of day 2 and 3 include

- Plans for potential collaborative projects for the next five years.
- Workshop communiqué
- Summary points to report to the Japan-Australia Joint Science and Technology Cooperation Committee meeting.

Day 2 and 3 Session times

- Session-1 09:30-10:50
- Session-2 11:10-12:30
- Session-3 14:00-15:20
- Session-4 15:40-17:00

Day 2 (29 July 2025)

Session 1 (Plenary)

- Opening remarks: Yoshifumi Nogi (5 min)
- Introductory presentation (scene setting) by the co-conveners: Toru Hirawake and So Kawaguchi (15 min)
- JARE
  - Phase X summary: Satoshi Imura (15min)
  - Logistics: Gen Hashida (15 min)
- AAP
  - Australian Antarctic Strategy, Decadal Science Strategy: David Souter (15 min)
  - Logistics: Robb Clifton (15 min)

Session 2 (Group)

- Group discussion

Session 3 (Group)

- Group discussion

Session 4

- Group discussion (Group)
- Summary of Day 2 (Plenary)

Day 3 (30 July 2025)

Session 1 (Plenary) (Chair: Co-conveners)

- Presentations on mutual interest and collaboration for the next five years (by each discipline group, probably around eight groups, 15 minutes each)

Session 2 (Plenary) (Chair: Co-conveners)

- Continue presentations on mutual interest and collaboration for the next five years

Session 3 (Plenary) (Chair: Co-conveners)

- Cross-fertilisation of ideas (exchange and integrate ideas and expertise from different disciplines and discuss.
- How do we streamline various science activities across disciplines and bring everyone together?
- Possible ideas on exciting area (topic) of collaboration and priorities, and regions of priority.
  - Similar observations in overlapping regions, sustained repeat observations across disciplines, (not monitoring). Extend to terrestrial and nearshore, and build up picture over time.
- What are we trying to achieve? Big questions?
  - What needs to be done to answer these questions?
  - Building lasting legacy

Session 4 (Plenary) (Chair: Co-conveners)

- Possible logistics coordination
- Outcome of the workshop
- Agreeing on workshop communiqué

Close of the Workshop: (Tony Press, AAPP)

APPENDIX 4: UPDATED FIVE-YEAR PLAN

This is a living document and therefore to be updated as we discuss the plans in the coming years.

Discipline	Types of campaign/study	Types of Platform /major tools required	Area/region	Proposed/ preferred timings of activities	Multilateral collaboration (if relevant)
Sea ice (atmosphere-ice interaction)	Small scale process for frazil ice formation (including blowing snow)	Icebreaker & modelling	Coastal polynya (fast ice edge) Discussions underway		Possible collaboration with NZ
Sea ice (Modelling)	Launch/provide buoys for WCRP/SCAR IABP – sea ice motion, mass balance, meteorol, ocean data (Petra Heil) Standard acquisition of hourly bridge sea ice obs on all voyages (Petra Heil)		Good discussion regarding acquisition of hourly sea ice observations, and development of a standardised system. Japanese scientists prefer, however, to continue using their own system. Discussions underway regarding buoy data.		
Ice/ocean observations	Ice-shelf/ocean interaction study (including AUV)	Icebreaker, helicopters, AUV	TBA (Totten?)	2019+	
Sea ice (modelling)	Improved ocean/sea ice modelling of 1) sea ice formation and melt processes; and 2) complex coastal elements (including fast ice)	Numerical sea ice-ocean model; observations to constrain the model(s)	East Antarctic/circumpolar	Ongoing	
Sea ice / atmosphere interaction	Data denial model experiments; studies of ice-atmosphere interaction	Instrumented marine science voyages; radiosonde observation across the Southern Ocean and within the sea ice zone; atmospheric model	Southern Ocean	Ongoing; many data already acquired	
Sea ice (Fast Ice)	Comparison of change and variability at Casey, Mawson, Davis and Syowa and drivers	Deployment of ice mass balance stations on fast ice at stations for coordinated Antarctic Fast Ice Network measurements – to ensure standardisation. Analysis of past fast ice datasets, with meteorological data analysis and remote sensing.	Areas around East Antarctic bases.	Compilation and analysis of existing data, from early 2019. Deployment of instruments on fast ice when appropriate.	
Sea ice (BGC)	Integrated observations and capacity building	Staff and student travel, intercomparison observations	Saroma-ko lagoon	2026+	Global
	Integrated observations of fast ice physcial-biogeochemical ecologcial processes	Early-season Davis or Mawson fast ice (small science team, 4 pax)	Davis/Mawson	2026 (or after MIZ)	Links into Ant InSync

Discipline	Types of campaign/study	Types of Platform /major tools required	Area/region	Proposed/ preferred timings of activities	Multilateral collaboration (if relevant)
Sea ice (MIZ voyage; BGC)	Australian-led MIZ voyage	Icebreaker (*Nuyina*)	TBC (110 East)	2028	Links to Ant InSync
Sea ice (BGC)	Joint Australia-Japan ice tank experiments at Southern Ocean Research Aquarium (Hobart)	SORA-Hobart	Japan/Australia	2027 onwards	Additional links with European partners
	Sea ice biogeochemical data mining	none	Circum-Antarctic	2025 start	Links into SCAR-BEPSII expert group
Wave-ice interaction (fast ice)	Deploying buoys on fast ice, drill-hole sea ice thickness measurement, remote sensings from the ship (EM, stereo camera)	*Shirase*	Lutzow-Holm Bay	Ongoing	
Wave-ice interaction (MIZ/PIZ)	Remote sensings from the ship (EM, stereo camera), buoys in open water, drone imaging	*Shirase*	Lutzow-Holm Bay	Ongoing	
Wave-ice interaction (fast ice, MIZ/PIZ)	Infrastructural navigation support	RSV *Nuyina*	circum-Antarctic	2027?	
Wave-ice interaction (coupled modelling)	Navigation assistance (forecast), hindcast simulation	modelling	circum-Antarctic	Ongoing	
Wave-ice interaction (buoy development)	Sensor, platform and communication development	*Shirase*, RSV *Nuyina*	Lutzow-Holm Bay, Totten Glacier	Ongoing	
Wave-ice interaction (wave-ice tank)	New ice formation, wave-wave interaction under ice, ice breakup by waves	Melbourne U. , U. of Tokyo	n/a	Ongoing	
Sea ice	Fast ice-polynya interaction, changes and trends, and water mass transformation based on satellite and mooring data	CPU/GPU/data	Antarctica; Cape Darnley focus	ongoing	Sea ice
	Validation of sea ice thickness computed by ice age/motion	CPU/data	Antarctica	2026+	Sea ice
	Better forcing of ocean models with surface fluxes: new melt dataset plus refined production datasets	New Japanese datasets into Australian models	Antarctica; regional studies	2025+	Sea ice
Zooplankton	Plankton community structure - Area comparison/ Identification work	*Nuyina* - Wet well/ *Shirase* - Vertical plankton net	Denman/Totten/Syowa/ Possible Cape Darnley/ Possible Mawson Station/ Casey	Samples are currently available	IMAS/AAPP/ NIPR/France (Dumont Durville)

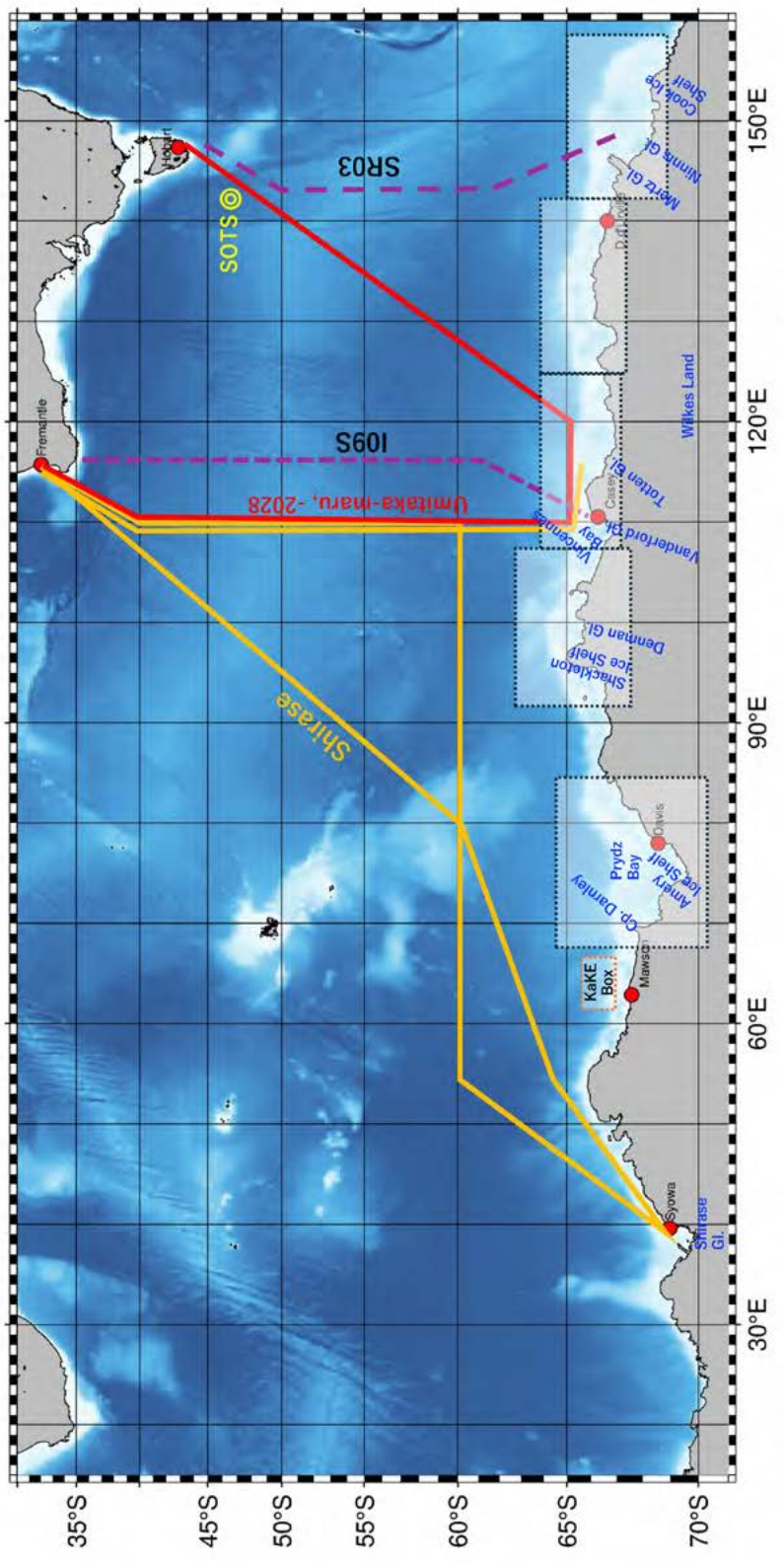
Discipline	Types of campaign/study	Types of Platform /major tools required	Area/region	Proposed/ preferred timings of activities	Multilateral collaboration (if relevant)
Zooplankton	Continuous Plankton Recorder – Data Paper, continued collaboration	*Umitaka Maru – Shirase - Nuyina*	Indian Sector of the Southern Ocean	Continuous	AAD/NIPR/ IMOS
	Japanese berths on *Nuyina*/students on Umitaka-Maru	Wet Well Sampling system	Southern Ocean	November-April seasons for AUS - January 2027/2028, 2028/2029 for JPN	IMAS/AAP/ NIPR
Marine Ecosystem	Role of MIZ in the Southern Ocean	1) *Shirase*-Umitaka Coordination? 2) *Nuyina*	MIZ	1) September 2027?	
Biogeo-chemistry and phytoplankton	Sharing expertise in field techniques, specifically underway and autonomous measurements of ocean productivity	*Nuyina*, *Shirase*, *Umitaka Maru*, BGC-Argo	110°E to 150°E	Historical to present and future	Includes international BGC-Argo program. In the Southern Ocean this is mainly US, France, Japan, Australia, Germany
	Analysis of archived samples and data, eg phytoplankton pigments. Uses include validation of satellite ocean color algorithms and detection of long term trends in phytoplankton productivity and community composition.	Labs at AAD and NIPR	110°E to 150°E, Totten, Denman and SOTS	Historical	
	Analysis of climate-driven trends in productivity and nutrients	Desk-based at NIPR, JAMSTEC, NIES and IMAS	110°E to 150°E	Historical to present	
	Evaluation of climate model and satellite algorithm predictions of ocean productivity	Desk-based at NIPR, JAMSTEC, NIES and IMAS. May require some high performance computing	East Antarctica	Historical to 2100	
	Comparison of carbon cycle observations from the Totten, Denman and SOTS regions	*Shirase*, *Umitaka Maru*, *Investigator* and *Nuyina*, SOTS Mooring (surface RAS and sediment trap)	East Antarctica	1990s to present	
	Joint participation in voyages	*Shirase*, *Umitaka Maru*, *Investigator* and *Nuyina*	East Antarctica	Potential campaigns include MIZ 2027 and Phase XI JARE *Shirase* 2029-30	
	Sediment trap deployments on moorings	AAD MEEK moorings SOTS (Longest sediment trap record in SAZ) Surface RAS (Sheds light on seasonal evolution of the phyto/microzooplankton community at SOTS)	Mawson and Kerguelen regions	Ongoing	

Discipline	Types of campaign/study	Types of Platform /major tools required	Area/region	Proposed/ preferred timings of activities	Multilateral collaboration (if relevant)
Physical Ocean-ography: Dense shelf water formation >AABW production	Ship-based	CTD, moorings, IHI profiling mooring, seals, ice-capable profiling floats	Cape Darnley, Prydz Bay Vincennes Bay, Mertz	Oct-Dec 2015 (& JARE 2016-2022); 2018/19 *Hakuho-maru*; 2021+ for RSV *Nuyina*	
Physical Ocean-ography: Ocean-ice shelf interaction	Ship-based	CTD, moorings, AUV, seals, airborne deployment of oceanographic sensors, icecapable profiling floats	*Shirase* Glacier, Totten Glacier, Cook Ice Shelf, West Ice Shelf, Shackleton Ice Shelf	2019/20; 2020/21; 2021+ for RSV *Nuyina*	
Physical Ocean-ography: ACC properties and dynamics	Ship-based	CTD, Deep-ARGO, seals, moorings, Argo	WOCE lines, 110, 140, BROKE-Revisit Deep Argo in Australian-Antarctic Basin	2016/17; 2018/19 Kaiyo-maru, 2019/20 Mirai; ; 2021+ for RSV *Nuyina*	
Physical Ocean-ography	Ship-based	General agreement on opportunities to deploy Australian instruments (mooring(s), glider, CPIES etc.) by *Shirase* icebreaker	East Antarctica	2026 onwards?	
	Ship-based	Potential deployment of Japanese/Australian Argo floats from Australian/ Japanese programs *Shirase*/*Nuyina*, and other vessels operated by Aus or Jpn Antarctic Programs	East Antarctica	2026 onwards?	
	Ship-based	Oxygen isotope samplig/ processing on MISO-2 (and P15S)	East Antarctica (MISO transects and P15S)	2026/27	
	Ship-based	Joint ASC obs system involving MISO-2, P15S and JARE67/68 in 2026/27 *Investigator*, *Shirase*	East Antarctica (MISO transects and P15S, and JARE transects)	2026/27	
	Ship-based	Antarctica InSync contributions: Australia: MISO-2, P15 and EAMIZ, Japan: JARE67/68 near-Totten sections *Investigator*, *Shirase*	East Antarctica (MISO transects and P15S, and JARE transects)	2026/27	Links to Ant InSync
	Ship-based	EAMIZ; any interests from Japanese? Validation of satelitebased sea ice velocity product by ADCP or drifters?	East Antarctica	Near-term (-2032)	
	Ship-based	A free horizon of extensive joint Aus-Jpn obs campaign	East Antarctica	Near-term (-2032)	
	Ship-based	2026/27 MISO2/P15 + crossslope 2 section (Umitakamaru)		2026/27	
	Ship-based	2027/28 MIZ Glider deployment retreival by Umitaka		2027*28	

Discipline	Types of campaign/study	Types of Platform /major tools required	Area/region	Proposed/ preferred timings of activities	Multilateral collaboration (if relevant)
Physical Ocean-ography	Ship-based	JARE Phase XI: Main theme is “Sea Ice Extremes”; Two Totten moorings to be maintained	East Antarctica	Near-term (-2032)	
	Ship-based	Potential Umitakamaru cruise to Cook on January 2028	East Antarctica	Near-term (-2032)	
	Ship-based	Potential Mirai II cruise to SO; Cook or somewhere difficult to access by *Shirase*	East Antarctica	Near-term (-2032)	
	Ship-based	*Hakuho-maru*?	East Antarctica	Near-term (-2032)	
	Ship-based	Winter campaign? (**Nuyina* is more available during freezing season)	East Antarctica	Near-term (-2032)	
	Ship-based	I9S/P15/SR3 Revisits by ~2034	East Antarctica	Near-term (-2032)	
	ECRs opportunities	Cruises (Umitakamaru, *Investigator*, *Nuyina*), Joint workshops for collaborative obs campaign. Seek for opportunities in highlevel govermental discussion. Scholarships; JSPS, HU-UTAS Tsuneichi-Fujii and Double-degree Program.			
Atmospheric Physics	Radar observations of winds and momentum fluxes	Radars/PANSY; Davis MST; MF and Meteor Radars	Syowa and Davis	Ongoing	
	Gravity wave source identification	Hydroxyl airglow imager/ MF and Meteor radar	Syowa and Davis	Dark-sky months ongoing	Mutual collaboration with US
	Investigations of the differences in gravity wave activity and sources above Davis and Syowa using ANGWIN network observations	Hydroxyl airglow imager/ MF and Meteor radar	Syowa and Davis	Dark-sky months ongoing	Mutual collaboration with US ANGWIN Action Group countries
	Comparison of observed and modelled inertia gravity wave momentum flux	Davis MST; reanalysis models	Davis, Japan and Australia	Ongoing to 2026	
	Assimilation of middle atmosphere observations into Japanese high-top GCM	High resolution modelling; Radars/PANSY; Davis MST; MF Radars	Syowa, Davis and Japan	Ongoing	
	Investigation of meteor influences on MF radar observations	MF Radars	Davis and Syowa	Ongoing	
	Auroral observations	Auroral camera system	Syowa, Davis and Casey	Ongoing	Part of NIPR Antarctica wide Aurora camera network

Discipline	Types of campaign/study	Types of Platform /major tools required	Area/region	Proposed/ preferred timings of activities	Multilateral collaboration (if relevant)
Atmospheric Physics	Observing System Experiment (OSE)	Davis VHF radar, Japanese JAMSTEC DA modelling capabilities	Davis	2025 -	
	Clouds, Precipitation and Atmospheric Rivers	Cloud and precipitation instruments e.g. X-Band, MRR, ceilometers etc.	Davis, Syowa, and remote field sites	2025 -	InSync
	Marginal Ice Zone Atmospheric Phenomena including cyclogenesis, snowfall on sea ice	Clouds and precipitation instruments	RSV *Nuyina* (MIZ Voyage)	2028	InSync
	EarthCARE satellite calibration and validation	Clouds and precipitation instruments	Syowa, Davis, ships	2025 -	InSync
Geoscience (Bathymetry)	The Seafloor geomorphology of the Continental Shelf in the Indian Ocean sector	Muti-Beam, Backscatter, Subbottom	Cape Darnley, Enderby Land, off Totten Glacier regions	Ongoing	
Geoscience (Database)	Sharing sample and bathymetric data to plan future expeditions	Database	The Indian Ocean sector	Ongoing	
Geoscience (Field work)	Planning field works to collect sediments		The Indian Ocean sector, Outcrops related to Australia and Japan	Ongoing	
Geoscience (Database)	Geodesy (Gravity, GNSS, etc)	Modelling	Outcrops related to Australia and Japan	Ongoing	
Geoscience (Field work and Information exchange)	Sharing the information of environmental management		Outcrops related to Australia and Japan	Ongoing	

APPENDIX 5: AREA OF COMMON INTERESTS



APPENDIX 6: COMMUNIQUÉ

Communiqué from the 5th Australia – Japan Workshop on Antarctic Science

1. The "5th Australia – Japan Workshop on Antarctic Science" was held during 28-30 July 2025 in Tokyo, and attended by 55 Japanese and 26 Australian scientists, across various disciplines of Antarctic science. Its purpose was to map out future Australia-Japan research collaborations and initiatives in Antarctic science, and to strengthen important Australia-Japan ties.

2. The workshop was co-hosted by National Institute of Polar Research (NIPR), Japan, Australian Antarctic Division (AAD), Australian Antarctic Program Partnership (AAPP), University of Tasmania (UTAS), Science Council of Japan, and with the Australia-Japan Foundation and Japan Society for the Promotion of Science as the main sponsors.

3. The workshop participants first reflected on the long-standing, strong and ongoing Australia-Japan collaborations in Antarctic science, and its important contribution to understanding and projecting changes in the global climate system. From 2009 to 2018 the Australia-Japan Workshops on Antarctic Science were held every three years. The current Workshop is the first since the COVID-19 pandemic. The participants agreed that these and future workshops continue to serve as a vital means for the furthering and strengthening collaboration and coordination in Australia-Japan relations.

4. The workshop participants agreed that strategic collaboration that is well thought-out and well planned brings substantial benefits to the Antarctic research communities of both Australia and Japan, and will lead to the development of important cross-funding applications and ground-breaking new research on key priority questions for the Antarctic research strategies of both countries.

5. The workshop participants recognised that enhanced logistic coordination between the two countries, such as coordination between Australian icebreaker RSV *Nuyina* and Japanese icebreaker *Shirase*, will increase opportunities for a holistic approach to measuring and modelling the Antarctic environment and its associated processes: key to addressing the climate change challenges that face both countries and the rest of the world.

6. The workshop participants agreed that the 5th International Polar Year ("IPY-5") and the "Antarctica InSync" initiative present excellent opportunities for coordinated research across East Antarctica. This initiative should include all other nations operating in the region. Planning for this initiative needs to start as soon as possible to ensure adequate funding and the coordination of the logistics required for its execution.

7. The workshop participants agreed that the active support of researcher exchanges have large benefit and should be a key part of the collaboration between the two nations.

8. The workshop participants further highlighted the following specific statements and plans from each discipline group:

8.1 Physical oceanography group

a. Antarctica's heartbeat is faltering. The ocean surface is warming, and sea ice is shrinking. Acceleration of continental ice melt will lead to an unpredictable sea level rise, and further the abyssal warming and slowing down of the deep overturning. Australia and Japan will cooperate to promote sustained measurement of the oceanic state and understanding of key processes in East Antarctica in both the near-term and long-term. We identified key activities for collaborations and cooperation for the remaining stage of Japanese Antarctic Research Expedition (JARE)

Phase X, and for new collaborations in JARE Phase XI, and upcoming Australian-led fieldwork. We will develop systems to promote researcher and student exchange and training.

8.2 Biogeochemical cycle and phytoplankton group

a. In the field of phytoplankton and biogeochemistry, we resolved to pursue collaborations in the areas of (1) sharing expertise in field techniques, specifically underway and autonomous measurements of ocean productivity; (2) analysis of archived samples and data, specifically phytoplankton pigments; (3) the analysis of climate-driven trends in productivity and nutrients; (4) the evaluation of climate model and satellite algorithm representations of ocean productivity; (5) comparison of carbon cycle observations from East Antarctic coastlines and key interest areas including the Totten, Denman and subantarctic regions.

8.3 Ice sheet and ocean research group

a. Key shared interests of the ice sheet & ocean research group include co-development and comparison of high-fidelity regional models (Totten, Wilkes subglacial basin and Amery Ice Shelf/Cape Darnley) and improving parameterisations of basal melt and calving. Process knowledge will benefit from improved coordination between modelling and observational campaigns. There must be continued focus on acquiring any bathymetry and ocean observations on the continental shelf and beneath the ice sheet, including with international partners (e.g. International Collaboration for Exploration of the Cryosphere through Aerogeophysical Profiling, ICECAP; Radar Investigation of Antarctic Ice-sheet and Glaciaric Systems, RINGS). Large-scale ice sheet modelling efforts in both countries will contribute to international efforts such as the Intergovernmental Panel on Climate Change (IPCC) 7th Assessment Report (AR7), providing policy relevant projections of sea level rise (SLR) and ocean state.

b. Current challenges to this effort include missing processes and physics (e.g. subglacial hydrology, ice sheet instability, sea ice-free summers and the impact on shallow ice shelf melting), sparse sub-ice shelf, ice front and sub-ice sheet observations, and underexplored interactions with sea ice, atmosphere and biology.

c. We aim to conduct model-targeted observations, produce and share high-quality datasets, and coordinate and compare modelling experiments.

d. The active support of researcher exchanges is considered to have large benefit and be a key part of the collaboration.

8.4 Sea ice remote sensing/physics group

a. The research field of sea ice remote sensing and physical properties has a rich history of Japan-Australia collaboration over more than 20 years, including several long-term personnel exchanges, high-profile publications, and voyage cross-participation. In the 5th workshop, we identified a large number of fruitful collaboration avenues. Our discussions focused on satellite remote sensing of Antarctic sea ice, including new applications for existing data streams, new satellite sensor technology recently launched specifically for sea-ice research, observations of ice-ocean interaction, and landfast ice research. Our collaborative research priorities are framed by the recent crash in Antarctic sea-ice extent over the past decade, providing a sense of extra urgency toward our continuing collaboration.

8.5 Sea ice biogeochemistry group

a. Sea ice is a structuring element in Antarctic marine ecosystems and plays a pivotal role in Southern Ocean biogeochemical cycles. Antarctic sea ice is characterised by complex microbial-habitat interactions and serves as a biogeochemcially-active interface between the ocean and the atmosphere. Recent observed rapid changes in Antarctic sea ice extent and other sea-ice physical properties are

expected to have major implications for Southern Ocean ecosystem functions and ice-associated biogeochemical processes. Building on existing and developing new initiatives, this sub-group discussed pathways to enhance understanding of Antarctic sea ice biogeochemical processes through collaborative research in marginal ice zone (MIZ) and fast ice areas, laboratory ice-tank experiments, data mining efforts, and exchange of personnel. The sub-group will also continue and further the use of Saroma-ko Lagoon (Hokkaido, Japan) as a low-latitude experimental field site for joint Japan-Australia training, as well as for developing and testing novel technologies for sea-ice research.

8.6 Wave/ice/ocean interaction group

a. Sea ice surrounding the Antarctic Ocean is protecting the ice shelves from the direct impact of high swells from the Southern Ocean. Unlike the Arctic, where increased open water fetch enhances wind-sea development, the penetration depth of swells into the sea ice in the Antarctic, through the Marginal Ice Zone (MIZ), pack ice, and to the landfast ice, depends strongly on the climatic variation of the sea ice. With a notable decreasing trend in sea ice over the past decade, the study of wave-ice interaction is now imperative. The members of the subgroup consist of ocean and coastal engineers, applied mathematicians, and physical oceanographers. The Japanese group has been conducting numerous shipborne wave and ice observations using the icebreaker *Shirase*, providing a decades-long time series, whereas the Australian group is responsible for installing numerous advanced optical sensors on board RSV *Nuyina*. The potential collaboration will start with a joint effort in automating the visual observation of sea ice (also known as Antarctic Sea ice Processes and Climate, ASPeCt). The area of interest extends beyond the MIZ and into the pack ice and landfast ice zones. Thermodynamic processes, such as air-sea fluxes and ocean-ice fluxes, are also critical. Moreover, both parties have access to wave-ice tanks and are developing coupled wave-ice-ocean regional models.

8.7 Zooplankton group

a. In the Southern Ocean and Antarctic ecosystems, zooplankton are a crucial link in the marine food web, transferring energy from primary producers to higher trophic levels. Australia and Japan have a strong history of collaborating on high quality plankton research in the Southern Ocean and East Antarctica. Our links include plankton imaging (ZooScan, FlowCam, EVS), machine learning methodology, long-term monitoring programs (Continuous Plankton Recorder, CPR), krill aquarium research and management, coastal zooplankton sampling, and high-resolution mapping of plankton distribution.

b. The key areas in which we plan to collaborate on, are as follows:
   i. Plankton community structure
   ii. Comparison of zooplankton distribution among the various coastal areas (Syowa, Cape Darnley, Denman, Casey, Totten, Cook Glacier)
   iii. Continuation of joint CPR programs (SO-CPR)
   iv. Image Analysis (establishing methodology)
   v. Continued collaboration between the AAD krill aquarium and the Port of Nagoya Public Aquarium
   vi. Laboratory/berth exchange between NIPR, Institute for Marine and Antarctic Studies (IMAS, UTAS), RSV *Nuyina* and TV *Umitaka-Maru*

c. Key challenges:
   i. Ship time is key for the continuation of zooplankton science – with the introduction of the Wet Well Sampling System on the RSV *Nuyina*, this offers a new avenue for sampling – one that does not require dedicated ship time
   ii. Positions and personnel to process samples - funding
   iii. Challenges with berths on reciprocal vessels – change of ship regimes

d. Within the next few years, an exchange of scientists between Japan and Australia will enable us to build on the discussion and set specific goals. This exchange will also allow both delegations to find collaboration with other teams within IMAS, NIPR, Tokyo University of Marine Science and Technology (TUMSAT) and the AAD, who are working on complementary Southern Ocean and Antarctic science. We will seek to collaborate with researchers in oceanographic, biogeochemical and sea-ice science, utilising data from underway observations, gliders, drifters, sea-ice core sampling and mooring arrays, allowing us to understand what a shifting climate might look like for plankton communities.

8.8 Predators group

a. Recognising that Antarctic wildlife are vulnerable to ecosystem change in the Southern Ocean, collaborative research aims to understand recent broad-scale wildlife population change, to continue monitoring wildlife into the future, and to understand the interactions between wildlife and their sea ice environment to improve understanding of climate change impacts. The primary focus for collaboration will be on Adélie penguins given their high abundance, relatively accessible breeding sites near Japanese and Australian Antarctic stations, dependence on sea ice, and high consumption of krill resulting in them being designated an indicator species for Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)'s ecosystem monitoring program (CEMP). Priority research includes 1) continuing long-term penguin monitoring programs, 2) updating East Antarctica broad-scale population surveys to understand population change, and 3) conducting simultaneous biotelemetry logger deployments on different penguin life history stages to understand penguin summer and winter foraging locations and their prey field.

8.9 Ecosystem synthesis group

a. Two broadscale mulmdisciplinary surveys, Baseline Research on Oceanography, Krill and the Environment (BROKE) (1996; 80-150°E) and BROKE-West (2006; 30-80°E) in the waters south of 62°S supported development of a conceptual model of the krill-centric ecosystem in East Antarctica arising from a synthesis of informamon on bathymetry and oceanography, phytoplankton and primary production, sea ice dynamics, Antarctic krill and other zooplankton, and predators from these voyages (Nicol and Raymond 2012). Recently, Japan and Australia conducted shipboard synoptic multidisciplinary ecological surveys in East Antarctica. These surveys covered 80-150°E in austral summer 2018/19 (Japan; KY1804; Murase et al. 2025), 55-80°E in austral summer 2021 (Australia; Trends in Euphausiids off Mawson, Predators, and Oceanography, TEMPO; Kawaguchi et al. 2025), and a smallerscale survey 135-155°E in austral summer 2019 (Australia; Euphausiids and Nutrient Recycling in Cetacean Hotspots, ENRICH; Cox et al. 2025). The new surveys provide an opportunity to update the synthesis of the East Antarctica pelagic ecosystem, to both test and develop the conceptual models of the krill-centric ecosystem derived from the BROKE voyages and to explore changes in the ecosystem that may have occurred over the intervening two decades. An updated synthesis of the East Antarctic pelagic ecosystem also provides an opportunity to develop a collaborative multinational and multidisciplinary survey/sampling framework to target key geographic areas and ecosystem components in future fieldwork campaigns.

b. CCAMLR uses a framework called the 'spatial overlap analysis' (SOA) to spatially and temporally spread catch limits in order to minimise risk of long-term impacts to krill and krill predator populations. In addition to ongoing land-based monitoring of krill predators across East Antarctica by Japanese, Australian and French National Antarctic Programs, the recent broadscale synoptic ecological surveys including krill biomass estimates by Japan (the KY1804 survey in the 2018/19 austral summer in

Division 58.4.1, 80-150°E; Murase et al. 2025) and Australia (TEMPO voyage in early 2021 in Division 58.4.2 east; 55-80°E; Kawaguchi et al. 2025) provide an opportunity to update the East Antarctic SOA. Scientists from Australia, Japan, the Netherlands and France will collaborate to develop data layers for the new East Antarctic SOA and these results will be presented to CCAMLR over the coming years.

8.10 Atmospheric science group

a. Recent rapid changes in Antarctic forcing require a detailed understanding of atmospheric processes, from surface to near-space. Forcing from above and below needs to be clarified in the Antarctic region. Understanding clouds and aerosol processes is necessary in order to constrain radiative forcing over high southern latitudes, and provide limits on precipitation over the ice sheet and sea ice. High-top middle atmosphere general circulation models require sustained polar observations throughout the entire atmospheric column for validation and then assimilation. Our station- and ship-based collaborative observations of key atmospheric parameters will drive improvements in our understanding of the rapidly changing polar region. The resulting improvements to general circulation models will allow an increase in forecast abilities on a range of time scales at the surface, including for sea ice and polar oceans.

8.11 Geoscience group

a. The bathymetry data, geological archives and geophysics data are important and essential for multidisciplinary studies, working together between Australia and Japan by sharing the data and information and conducting the collaborative field works.

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Prof Yoshifumi Nogi (Director-General, National Institute of Polar Research) with Emma Campbell (Head of the Australian Antarctic Division) and Dr So Kawaguchi (AAD krill biologist) at the Polar Science Museum at NIPR

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