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 (eg 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 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, 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 ship-borne 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 multidisciplinary 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 information 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 smaller-scale 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 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.

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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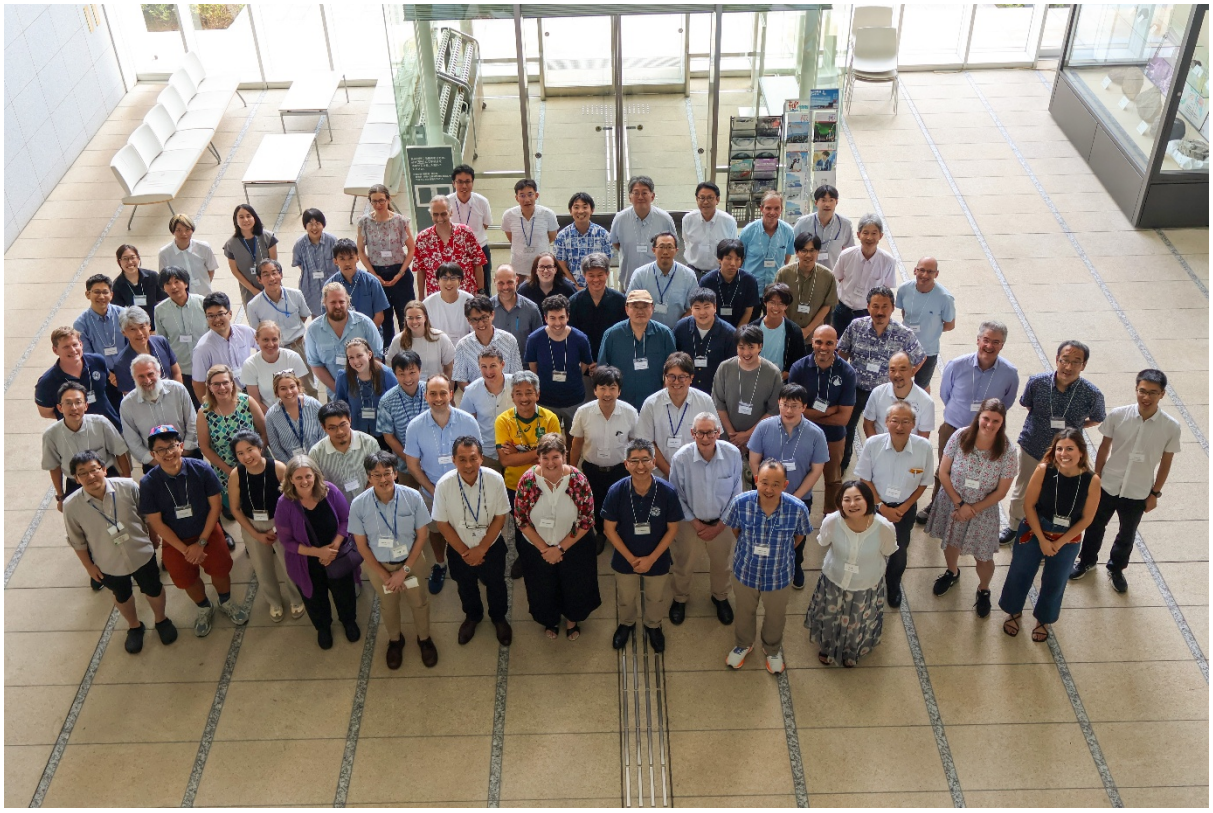

Attendees of the Japan-Australia Workshop on Antarctic Science (Photo: Mark Horstman/AAPP)