—シンポジウム/会合報告—
Symposium/Meeting Report

Report of the 3rd Joint Australia-Japan Workshop "Australia and Japan collaboration in Antarctic Science"

So Kawaguchi[1,2*] and Kentaro Watanabe[3]

第 3 回豪日南極研究協力ワークショップの報告

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(Received January 15, 2016; Accepted February 2, 2016)

要旨:　2015 年 8 月 6–7 日にタスマニア大学，海洋南極研究所において第 3 回豪日南極研究協力ワークショップが開催された．本ワークショップは現在すでに進行中ならびに今後 4–5 年内に計画されている共同研究および調査に関する情報を共有し東南極における国際的な研究効率化や研究機会の増大効果に資することにあった . 議論は，両国が共有する研究課題，プロポーザルの共同執筆，研究設備共有や多国間研究コーディネーションなど多岐にわたった．

Abstract:　The 3rd Joint Workshop on Australian and Japanese Collaboration in Antarctic Science was held at the Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Australia on the 6th and 7th of August 2015. The primary aim of the workshop was to identify and highlight current collaborations and campaigns, and those planned for the next few years, and to share this information to maximize the synergy and opportunities for East Antarctic science within the international context. Discussion covered a range of issues including research areas of common interest, resource sharing, development of joint research proposals, multinational research coordination, and future meetings.

Keywords:　Australian Antarctic Program, Japanese Antarctic Program, Multi-disciplinary science

1.　Opening of the meeting

The 3rd Joint Workshop on Australian and Japanese Collaboration in Antarctic Science was held at the Institute for Marine and Antarctic Studies (IMAS), University of Tasmania, Hobart, Australia on the 6th and 7th of August 2015. The workshop was co-convened by

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南極資料，Vol. 60，19–34，2016
Nankyoku Shiryô (Antarctic Record), Vol. 60, 19–34, 2016

Dr. So Kawaguchi (Australian Antarctic Division: AAD) and Professor Kentaro Watanabe (National Institute of Polar Research, Japan: NIPR). Local arrangements were coordinated by the AAD and the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC). The workshop agenda is described in Appendix 1.

The workshop was opened by Dr. Nick Gales, Chief Scientist and incoming Director of the AAD, and Professor Tony Worby, CEO of the ACE CRC, who welcomed the 35 participants (21 from Australia, 14 from Japan: Table 1, Photo 1). They referred to the long history of successful Antarctic research collaboration between Australia and Japan, and its importance, and noted that the workshop provides an important basis for coordination between the two countries and the various disciplines involved, in order to maximize efficiency and the scientific outcomes.

Table 1. List of participants.

Australia	
Chris Carson	Geoscience Australia (GA)
Andrew Constable	Australian Antarctic Division (AAD)
Stuart Corney	Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC)
Bill de la Mare	Australian Antarctic Division (AAD)
Gwen Fenton	Australian Antarctic Division (AAD)
Nick Gales	Chief Scientist, and incoming Director, Australian Antarctic Division (AAD)
Ben Galton-Fenzi	Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC)
Barry Giles	Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC)
Petra Heil	Australian Antarctic Division (AAD) and Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC)
So Kawaguchi	Australian Antarctic Division (AAD)
Kazuya Kusahara	Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC)
Jan Lieser	Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC)
Rob Massom	Australian Antarctic Division (AAD)
Jess Melbourne-Thomas	Australian Antarctic Division (AAD)
Damian Murphy	Australian Antarctic Division (AAD)
Alix Post	Geoscience Australia (GA)
Phil Reid	Bureau of Meteorology, Australia (BoM) and Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC)
Kerrie Swadling	Institute for Antarctic and Marine Studies, University of Tasmania, Australia (IMAS) and Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC)
Tas van Ommen	Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC)
Guy Williams	Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC)
Tony Worby	CEO, Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC)
Japan	
Shigeru Aoki	Institute of Low Temperature Science, Hokkaido University, Japan
Gen Hashida	National Institute of Polar Research, Japan
Ryosuke Makabe	National Institute of Polar Research, Japan
Yoshimasa Matsumura	Institute of Low Temperature Science, Hokkaido University, Japan
Kohei Mizobata	Tokyo University of Marine Science and Technology, Japan
Masato Moteki	Tokyo University of Marine Science and Technology, Japan
Yoichi Motoyoshi	Vice National Institute of Polar Research, Japan, Vice Director-General
Daiki Nomura	Institute of Low Temperature Science, Hokkaido University, Japan
Tsuneo Odate	National Institute of Polar Research, Japan
Kunio Takahashi	National Institute of Polar Research, Japan
Takeshi Tamura	National Institute of Polar Research, Japan
Atsushi Tanimura	National Institute of Polar Research, Japan
Masaki Tsutsumi	National Institute of Polar Research, Japan
Kentaro Watanabe	National Institute of Polar Research, Japan

Photo 1. Participants at the workshop.

2. Background and purpose of the workshop

The meeting was based on a joint communiqué between the Prime Ministers of Australia and Japan, when they met in Tokyo in June 2008. This emphasized a firm commitment to collaborate on Antarctic climate change studies. The communiqué underlined the importance of cooperation in Antarctic science, which is also stipulated in the Antarctic Treaty.

Dr. Kawaguchi explained that at the 1st (2009) and 2nd (2012) workshops it was agreed that the research efforts of the two countries in Antarctica be maximized, and reports were produced to form the basis of the development of future project proposals by each country (Kawaguchi *et al*., 2014). The purpose of this 3rd workshop was to gather information on aspirations for future research within each discipline, so as to further streamline future coordination, review capabilities and capacities, initiate practical proposals, and to streamline multinational collaborations.

Prior to the workshop, each research discipline was asked to complete a pro forma (Appendix 2) providing an overview of the current coordination in Antarctic research between Australia and Japan in that particular field. This formed an excellent basis to progress the discussion, by providing an overview of aspirations for future projects within each research discipline. A complete list of scientists who contributed to the preparatory work is provided in Table 2.

3. Overview of the national programs

To set the scene for the workshop, overviews of the Antarctic science strategy of each country were presented, and updates on collaborations between Australia and Japan were provided.

Table 2. Full list of scientists who contributed to the preparatory work for each scientific discipline.

Science Management across discipline	Nick Gales (AAD Chief Scientist), Gwen Fenton (Science Planning), Tony Worby (ACE CRC CEO) Yoichi Motoyoshi (NIPR Vice Director-General), Kentaro Watanabe (NIPR)
Physical Oceanography	Guy Williams (ACE CRC), Steve Rintoul (CSIRO) Shigeru Aoki (ILTS), Yujiro Kitade (TUMSAT), Keishi Shimada (TUMSAT)
Marine Ecosystem	Bill de la Mare, Andrew Constable, Jess Melbourne-Thomas, Dirk Welsford, So Kawaguchi (AAD), Stuart Corney (ACE CRC), Kerrie Swadling (IMAS), Bill de la Mare (AAD) Tsuneo Odate, Atsushi Tanimura, Gen Hashida, Kunio Takahashi, Ryosuke Makabe (NIPR), Masato Moteki, Kohei Mizobata (TUMSAT)
Sea-Ice and Glaciology	Tas vanOmmen, Rob Massom (AAD), Ben Galton-Fenzi (ACE CRC), Klaus Meiners (AAD), Kazuya Kusahara (ACE CRC), Petra Heil (AAD/ACE CRC), Barry Giles (ACE CRC), Jan Lieser (ACE CRC), Phil Reid (BoM / ACE CRC), Takeshi Tamura (NIPR), Yoshimasa Matsumura, Daiki Nomura, Takenobu Toyota (ILTS)
Ice/Ocean Interaction	Ben Galton-Fenzi (ACE CRC), Rob Massom (AAD), Takeshi Tamura (NIPR), Yoshimasa Matsumura, Daiki Nomura, Shigeru Aoki, Ralf Greve, Kay Oshima (ILTS), Hiro Hasumi, Ayako Abe-Ouchi (CCSR)
Upper Atmospheric Science	Andrew Klekociuk, Damian Murphy (AAD), Takuji Nakamura, Masaki Tsutsumi (NIPR)
Geoscience	Chris Carson, Alix Post (GA), Yoichi Motoyoshi, Yoshifumi Nogi (NIPR)

AAD: Australian Antarctic Division
ACE CRC: Antarctic Climate and Ecosystems Cooperative Research Centre, Australia
BoM: Bureau of Meteorology, Australia
GA: Geoscience Australia
ILTS: Institute of Low Temperature Science, Hokkaido University, Japan
IMAS: Institute for Antarctic and Marine Studies, University of Tasmania, Australia
NIPR: National Institute of Polar Research, Japan
TUMSAT: Tokyo University of Marine Science and Technology, Japan

3. 1. Australian Antarctic Program

Dr. Gales overviewed Australian Antarctic science, Australian Government goals, research directions, the structure of the Australian National Antarctic Program, areas of science undertaken, the project assessment process, and areas of research interest. He emphasized the current financial constraints in the science budget, and that it is currently impossible to undertake a major single-discipline scientific campaign. He stressed that important and major science campaigns can only occur through collaborations.

He further explained that the Australian Antarctic Program has reached a turning point. Under this program an air link was introduced in 2008, which necessarily meant some step back in support of marine science. He also noted that the current Australian icebreaker, *Aurora Australis*, is close to its retirement age (within two years), and delivery of its

replacement is only expected during the 2019/20 field season. Because a two-year gap is expected before the new icebreaker can be delivered, and because *Aurora Australis* is ageing, operational plans involving the use of an Australian icebreaker for marine science in the next few years need to be modest.

3. 2. Japanese Antarctic Program

Professor Motoyoshi described the framework of the Japanese Antarctic Program, notably the objectives of the 6-year Phase IX plan from the 2016/17 field season, which is expected to be approved under the Japanese Antarctic Program in November 2015. The main theme of Phase IX ("*Global changes and movements on Earth system through Antarctic observations*") has been launched, and has the aim of promoting advanced scientific research from a global view of the Earth and space, by combining various research projects. The project is also designed to meet social demands and international research trends with respect to global environmental issues. The research areas involved include atmospheric sciences, oceanography, glaciology (ice sheet and sea ice), aurora observations, biology, geology, and astronomical observations.

3. 3. Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC)

Professor Worby explained that the purpose of ACE CRC is to provide government and industry with information on climate change and its likely impacts, and that ACE CRC consists of 7 core partners and 13 supporting partners, which include NIPR and Institute of Low Temperature Science, Hokkaido University (ILTS) (note: Tokyo University of Marine Science and Technology (TUMSAT) became the 14th partner in January 2016, following the workshop). He further stressed the importance of collaborations in marine science involving the research vessel *T/V Umitaka-maru*, noting and highlighting the successful voyage in early 2015. The *T/V Umitaka-maru* is also taking part in the broad Kerguelen Axis program, which is the signature research campaign for the ACE CRC in early 2016. New key areas of research by ACE CRC include understanding the ice-ocean interaction (specifically how ice shelves are affected by climate change), and carbon dioxide uptake by the ocean from the atmosphere.

4. Current status of collaboration and future plans

Each research discipline presented the status of its collaborations and future plans. The two delegations updated the workshop on recent developments and future plans in the two national Antarctic research programs (the Australian Antarctic Program and the Japanese Antarctic Program). They also exchanged information on scientific collaborations between Australian and Japanese research institutions and universities in the fields of physical oceanography, marine ecosystems, sea ice physics and glaciology, ice-ocean interactions, and atmospheric science and geoscience, and provided a summary update of research and future plans (further details will be available from So Kawaguchi on request: so.kawaguchi@aad.gov.au).

4. 1. Marine Science

4. 1. 1. Physical oceanography

The Southern Ocean and Antarctica play vital roles in the global climate. The structure of and changes to oceanic overturning circulation have global impacts. The oceanic conditions are closely linked to ice-ocean interaction processes on the Antarctic continental shelf. As also described in the following subsections, understanding of the processes involved in the interactions of sea ice and continental ice are crucial. In the field of oceanographic observations, both Australia and Japan have been working in the Indo-Pacific sectors of the Southern Ocean. The key questions of mutual and global interest are:

ⅰ) How does sea ice behave, and how much bottom water is produced from the East Antarctic shelf?

ⅱ) How does the ocean affect discharges from glaciers and ice shelves in East Antarctica?

ⅲ) How much is the transport of water mass and how does the heat content and freshwater budget change?

The group has the following strategies for addressing these key questions.

ⅰ) Quantifying sea ice processes (including formation, growth, and melting) through cooperative in situ observational research will enable research outcomes to be maximized. To quantify the bottom water production from large to mid-sized polynyas, cooperation over moorings and Deep Argo deployments will be of benefit.

ⅱ) To describe the ice-ocean interactions, innovative approaches including biologging and ROV/AUV deployments will be effective and necessary. Totten Glacier, which has not been well studied, is the target of substantial future cooperative research because of its warm water intrusion and accelerating discharge, and the new technologies will enable major research breakthroughs.

ⅲ) Top-to-bottom hydrography, associated with intensive deployment of Deep Argo, will enhance understanding of the transport, pathways, and changes in properties of water masses in the Southern Ocean. These observations will contribute to the development of various numerical models, and the utilization and development of satellite observations and numerical models will enhance and contribute to understanding of the physical processes.

4. 1. 2. Ecosystem research

The main themes for marine ecosystem collaborations concern changes to the Southern Ocean ecosystem, and the reasons for differences between food webs, with Antarctic krill being a major prey species in the south, and myctophid fish being major prey in the north. Thus, the key science questions guiding the collaborations are:

ⅰ) How is the marine ecosystem changing in the Indian sector of the Southern Ocean?

ⅱ) What factors cause spatial differences in the relative importance of krill and fish as dominant prey in the Southern Ocean?

ⅲ) How will the Southern Ocean ecosystem change in the future?

To address these questions, Australia, Japan and France will collaborate under the Southern Ocean Sentinel program (led by Australia) to establish a framework to routinely monitor and assess the state of the pelagic marine ecosystem in the Indian sector of the Southern Ocean. A key feature of the framework will be the identification of meaningful

ecosystem indicators. In 2016 the Kerguelen Axis program will investigate food web linkages and identify drivers of the ecosystem. This will lead to an international conference on ecosystem assessment, planned for Hobart in 2018, and a potential circumpolar benchmarking of the Southern Ocean marine ecosystem in approximately 2020. This type of research will only be successful through the involvement of multiple research platforms; the Australia-Japan collaboration forms the core of this multilateral collaboration. The knowledge gained through this collaboration will be essential for ecosystem-based management of fisheries and the conservation of marine biodiversity. The results will also be important for assessing likely responses to change in the ecosystem, the global oceans, and the carbon cycle, which are fundamental to the Earth's response to climate change.

4. 1. 3. Antarctic ice sheet and ocean interactions, and their responses to change

Sea level rise is a major impact of climate change that greatly affects human society, given the concentration of human populations, industry, and infrastructure in coastal areas. The largest uncertainty in estimates of future sea level rise hinges on the response of the Antarctic ice shelves to warming of the surrounding oceans. The dynamic response to increased melting of the base of the fringing ice shelves will result in more rapid mass loss from the Antarctic ice sheet, and faster sea level rise. However, the processes regulating the flow of ice and melting of the ice shelves are poorly understood, and projections of future sea level rise are therefore uncertain. This project will investigate processes and feedbacks between the Antarctic ice sheet and the oceans, using a range of approaches including a hierarchy of numerical models, observations, laboratory studies, and the development of theory. The project provides for the use of observational datasets derived from other projects. Outputs will include improved parameterizations and incorporation of important ice sheet and ocean processes in models, including coupled ice sheet/sea ice/ocean modeling. The main outcome is expected to be an efficient and effective multinational response to future sea level rise and global ocean circulation changes, informed by improved knowledge of the response of the Antarctic ice sheet and sea level to climate change.

4. 1. 4. Sea ice

Two high priority areas were highlighted for collaboration in sea ice research related to i) the Marginal Ice Zone (MIZ) and ii) coastal fast ice. Both form important building blocks of the East Antarctic sea ice zone, which has exhibited complex changes in the patterns of annual sea ice advance, retreat, and duration over recent decades. These changes have varied across the sector, with potentially wide-ranging effects on atmosphere-ocean interactions, ecosystems, and shipping/logistical/tourist operations. What is driving the observed patterns of change is currently unknown. In particular, because of a lack of data very little is known about the role of intense air-sea ice interactions (including waves) in the highly dynamic outer sea ice zone (MIZ), and how these drive the advance and retreat of sea ice, and the seasonal and regional dependence of these processes. Obtaining such information is crucial to improving climate and short- to seasonal-term sea ice forecasting models, and their ability to accurately predict sea ice conditions. This multidisciplinary project is based around coordinated field experiments in the East Antarctic MIZ, combined with modeling; the research is proposed to occur around the Japanese long-term measurement transect at 110°E, but will involve more than one ship operating in series, and will potentially include vessels from other countries. The project is focused on sea ice and

ecosystems, and involves biogeochemistry, oceanography, satellite remote sensing, and atmospheric physics.

Land-fast sea ice (fast ice) is a crucially important interface between the ice sheet margin and the ocean/sea ice zone. It is closely coupled to polynyas, which affect sea ice and Antarctic Bottom Water (AABW) formation rates and biological productivity, forms a key habit (and impediment) for Emperor penguins and seals, is highly sensitive/vulnerable to climate change, and is closely coupled to icebergs and ice shelf-ocean interactions. It also forms a major impediment or an aid to base resupply operations, depending on extent and persistence. Thus, developing a better understanding of change and variability in East Antarctic fast ice, and the processes responsible, is a high priority. This multidisciplinary project forms an important means of tying together existing or planned work in both the Japanese and Australian programs, and will also boost Japanese participation in the Australian-led international circum-Antarctic fast ice monitoring program (Antarctic Fast Ice Network: AFIN), which will improve understanding of coupled physical-biological processes in Antarctic fast ice, and enhance associated measurement capabilities. By combining field experiments, the use of automated observatories, historical data collation, satellite observations, and modeling, the project will provide new data at local to circum-Antarctic scales; this will greatly enhance understanding of fast ice and its response to climate change/variability. Implementing a working relationship between the Australian and Japanese logistics programs will ensure maximum data collection, with benefits for both operations and science.

4. 2. Atmospheric physics

Collaboration between Japan and Australia in atmospheric physics began almost two decades ago, and continues to bring benefits to the science programs of both countries. A cornerstone of the collaboration has been the development of extensive observation infrastructure at Syowa and Davis stations. Currently, highly capable atmospheric radars, lidars (laser radars), and spectrometers provide wind and temperature measurements over a large range of altitudes, from the surface to approximately 100 km. In particular, the high power large aperture PANSY radar (Programs of the Antarctic Syowa MST/IS Radar) has recently become fully operational. Japanese development of a high spatial and temporal resolution climate model has added to shared research capacity. Collaborative efforts in coming years will focus on measurements of summer winds and gravity wave momentum fluxes, as part of an international campaign to study coupling between the northern and southern hemispheres. Understanding of the dependence of this coupling on a variety of processes will enable contributions to a broad range of physical processes. Additional winter observations of gravity waves, and investigations of their sources, will inform the development of parameterization models, and analysis of the wave characteristics in high-resolution models.

4. 3. Geoscience

The collaborative project will involve interpretation of the sea floor glacial geomorphology, using existing bathymetrical datasets previously acquired during recent marine science voyages involving the *R/V Shirase*. In general, the glacial history of the seafloor of the continental shelf around the East Antarctic margin is poorly understood.

Accurate and detailed bathymetric datasets are fundamental to understanding of the sea floor environment, and underpin major geological, glaciological, and benthic ecosystem research in offshore Antarctica. This study will utilize available high-resolution bathymetry and backscatter data, and provide significant new insights into the physical processes influencing the Antarctic sea floor. The seafloor morphology can be related to recent glacial marine sedimentary processes, and research in this area will enable regional-scale analysis of active sedimentary processes. Seabed mapping also enables the identification of geomorphic features that may have been instrumental in determining the history of past glacial events, and will facilitate development of improved models of the paleo-ice sheet behavior during, and since, the Last Glacial Maximum. Furthermore, assessment of the seafloor geomorphology will inevitably lead to improved physical models of other regional-scale phenomena of global significance, including ocean circulation patterns.

5. Discussion outcomes

A plenary discussion was held concerning the current status of collaboration and the future plans provided by each discipline group. The discussion covered a range of issues including research areas of common interest, resource sharing, development of joint research proposals, multinational research coordination, and future meetings. The workshop confirmed the long and successful history of mature bilateral collaboration between Australia and Japan in Antarctic science. A number of high-quality joint projects are currently ongoing at each research discipline level.

5. 1. Research areas of common interest

The workshop developed a table summarizing areas of common research interest to guide developing future projects and resource sharing; the table is available from So Kawaguchi on request: so.kawaguchi@aad.gov.au.

The workshop recognized various potential synergies between disciplines in the future plans. A coordinated MIZ study was highlighted as a major topical study that Australia and Japan can jointly propose. It has strong synergies between ecosystem and biogeochemical processes, sea ice, oceanography, and atmospheric physics. The workshop also identified a common gap in carbon cycle research capabilities within the current Australia-Japan research community, and agreed that involving research groups having such expertise would further add value to the current collaboration.

5. 2. Resource sharing

The workshop agreed on the importance of furthering international cooperation and coordination in Antarctic research, especially by sharing and utilizing large-scale infrastructure, including research vessels and observation instruments.

The types of resource sharing include, but are not limited to:

i) *Sharing a single platform for research in a common geographical area*: this provides opportunities for a multidisciplinary approach to a single campaign. For example, information on bathymetric mapping (*e.g.*, canyons) contributes to understanding of the biological activities and processes in the region, is important

for progressing palaeontology and ice sheet reconstruction, and further contributes to informing environmental management practices.

ii) *Sharing burdens among multiple platforms*: this increases spatial and temporal coverage, as well as operational efficiency, which are difficult to achieve from a single platform.

iii) *Use of resupply cruises*: there may be opportunities to acquire simple but useful observations during resupply voyages along regular tracks and/or when unexpected opportunities arise.

iv) *Joint development of technologies that can be deployed in the sea ice zone*: for example, moorings, remote sensing equipment, gliders, and other new technologies.

5. 3. Practical issues related to vessel operation in coming years

The workshop highlighted the following important issues. To improve and maximize opportunities, these will need to be taken into account in the planning and implementation of future coordinated and collaborative ventures.

i) The current contract for *R/V Aurora Australis* ends in two years, but the delivery of the new Australian icebreaker is not expected until the 2019/20 season. Opportunities for marine science are uncertain during this two-year gap; therefore, planning for marine science research over the next few years needs to be modest.

ii) Effective use of ship time involving the *R/V Investigator* is encouraged, although this is an ice-strengthened ship only.

iii) Operation of the *R/V Shirase* is relatively inflexible for undertaking marine science. Currently, little time is allocated for marine science, and scientists need to spend a long time on board, but can only carry out short-term experiments (conditions permitting).

5. 4. Remote sensing and data storage

The workshop agreed on the importance of: i) securing access and continuity of satellite data, especially for high-resolution images; and ii) computational resources and massive data storage facilities, for the continuity of long-term data streams, and their processing and analysis.

5. 5. Standardization across platforms

To ensure data collected by different ships is compatible, standardizing measurements and protocols among vessels is essential. Regular communication among scientists is also essential, and establishment of a joint working group to develop various standard protocols may be of benefit to both countries.

Increasing communication between vessels, and having standard vessel capabilities, will maximize the opportunities to take advantage of unexpected events, and so enable collection of valuable data. Furthermore, access to real-time data externally is important in enabling scientists to make decisions and remotely give directions to the vessels. It was also stressed that standardization of sensor packages and data collection protocols is very important for data compatibility.

6. Data contribution to wider international communities and initiatives

Coordination of Japanese and Australian research activities in Antarctica (current and/or planned) can make a major contribution to the following major international research initiatives, which will also benefit the outcomes of the Antarctic programs of both countries:

i) Collection of data for the AFIN (http://seaice.acecrc.org.au/afin/) and ASPeCt (Antarctic Sea Ice Processes & Climate) programs. Long-term observations of fast ice provide a valuable indicator of change in the Antarctic coastal ocean-ice-atmosphere system, while the ASPeCt program aims to improve understanding of the Antarctic sea ice zone, through focused ongoing field programs, remote sensing, and numerical modeling.

ii) Collection of data for submission to the Polar Prediction Project (PPP) and the Year of Polar Prediction (YOPP) (http://polarprediction.net). These projects promote cooperative international research enabling development of improved weather and environmental prediction services for the polar regions.

iii) Contribution to SOOS (Southern Ocean Observing System) (http://www.soos.aq/). SOOS adopts well-known and commonly agreed protocols for data collection, quality control, data publishing, and dataset description. The SOOS coordinates and expands the efforts of all countries and programs that gather data from the Southern Ocean, with the specific aim of developing a coherent and efficient observing system that will deliver the observations required to address key scientific and societal challenges.

7. Development and timings of proposals over the next few years

Dr. Gwen Fenton explained that the next Australian Antarctic Science (AAS) project proposal submission period opens in May 2016, and another opens in March 2017. Following the 2017 round it will open every two years. Project proposals for major campaigns need to be submitted at least three years in advance of the proposed year of commencement of the field work.

The workshop noted that a coordinated MIZ study was identified as a high priority across the disciplines (oceanography, ecosystems, sea ice, ice-ocean interactions, meteorology) for the next several years. Based on the requirement that proposals for a major campaign be submitted at least three years prior to the field work commencing, the earliest that the field work could be initiated would be the 2018/19 season. The timing will also depend on the availability of an Australian icebreaker in the next few years; in this regard note sections 3. 1 and 5. 3 (i). There is also potential for involvement of vessels from other countries; for example, US scientists are planning to conduct an Antarctic MIZ study.

It was stressed that when developing research proposals it is important to clearly address the questions: why does the project matter to the government at the policy level, and how does the project link to (other) international programs? Time schedules for developing joint research proposals were formulated by each discipline.

8. Multinational coordination in the Indian Ocean sector

The workshop confirmed the long and successful history of bilateral collaborations and friendship between Australia and Japan in Antarctic science.

The workshop noted that in addition to Australia, Japan, and France, who have been operating in the region for a number of years, an increasing number of countries are interested in the Indian Ocean sector. China is rapidly increasing the scale and intensity of its operations in the region; Korea is actively operating towards the east of the region using its new icebreaker, and has the Jang Bogo Station in the Ross Sea; and India is expressing interest in taking part in observations involving the second Bharati Station.

Dr. Fenton briefly explained that an East Antarctica Workshop to be co-hosted by Australia and China is proposed for 2016 in Hobart; to encourage wider coordination this workshop will aim to coordinate and streamline multinational collaboration. Through this forum, Australia and Japan may encourage other countries to take part in various international forums, including CCAMLR and SOOS.

The importance of recruiting young scientists through mutual cooperation was highlighted as key to the continuation of long-term international collaboration across generations. Initiatives including the International Antarctic Institute and its Saroma field course were cited as successful examples of the nurturing of young scientists.

9. Future meetings and formats

The workshop agreed that the next meeting should be in two to three years, probably in Japan at a venue in Tokyo (TUMSAT or NIPR). This timing seemed to fit well with the timeline discussed during the workshop, because the outcomes of the project proposals that were discussed will be available by that time, and the detailed schedules of the joint projects and campaigns should be known. A firm date for the next workshop will be coordinated by the TUMSAT, NIPR, and AAD participants at the current meeting. The workshop noted that to provide opportunities to present the scientific developments, it would be beneficial to schedule the next workshop to align with other conferences, including the annual NIPR Symposium on Polar Science.

10. Close of the workshop

In closing, Professor Motoyoshi congratulated the workshop participants for marking a major step forward in starting cross-disciplinary streamlining of the coordination of Antarctic science between Australia and Japan. On behalf of the participants, Professor Motoyoshi thanked Dr. Kawaguchi and Professor Watanabe for their leadership and enthusiasm throughout the meeting.

Acknowledgements

This workshop was supported by the Australian Antarctic Division, the Antarctic Climate and Ecosystem Cooperative Research Centre (ACE CRC), and the University of

Tasmania. The travel of Japanese participants were supported by the Research Organization of Information and Systems (ROIS), Japan. We are also grateful to the ACE CRC for providing travel support for one of the Japanese participants.

Reference

Kawaguchi, S., Motoyoshi, Y., Watanabe, K., Odate, T. and Fukuchi, M. (2014): Report on 1st and 2nd joint workshops on Australian and Japanese collaboration in Antarctic science and related achievements. Nankyoku Shiryô (Antarctic Record), **58**, 71–88.

Appendix 1. Workshop agenda. (1/2)

Agenda for the 3rd Aus-Jpn workshop

6-7 August 2015

Venue: Institute for Marine and Antarctic Studies,
University of Tasmania Waterfront Building
20 Castray Esplanade, Hobart, Tasmania, Australia

Co-conveners: So Kawaguchi (AAD) and Kentaro Watanabe (NIPR)

Day-1 (Thursday 6th) Chair: Co-conveners

Lecture Theatre (9:00-10:30)

1) Opening (Welcome from Nick Gales and Tony Worby) (9:00-9:10)
2) Adoption of the Agenda (9:10-9:15)
3) Background and purpose of the Workshop (Co-convenors) (9:15-9:30)
4) Australian Research Plans Overviews for the next 5 years (Nick Gales) (9:30-9:45)
5) Japanese Research Plans Overviews for the next 5 years (Yoichi Motoyoshi) (9:45-10:00)
6) ACE-CRC updates on Aus-Jpn partnership and collaboration (Tony Worby) (10:00-10:15)

-Coffee (10:30-11:00)-

Flex room (11:00-12:30)

7) Presentations (15 minutes) followed by discussion for each discipline group regarding project coordination and plans for the next few years (11:00-12:30)
    a) Marine Science
        i. Physical Oceanography (Shigeru Aoki)
        ii. Ecosystem (Tsuneo Odate, Andrew Constable)
        iii. Ice/Ocean Interaction (Ben Galton-Fenzi)
        iv. Sea Ice and Glaciology (Takeshi Tamura, Phil Reid)
        v. *R/V Shirase* Capability (Kunio Takahashi, Gen Hashida)
    b) Upper Atmospheric Science (Damian Murphy)
    c) Geoscience (Chris Carson)

-Lunch (12:30-13:30)-

Lecture Theatre (13:30-17:30)

8) Continue presentations from each discipline (13:30-15:00)

-Coffee (15:00-15:30)-

9) Breakout Group discussion (Physical Oceanography, Ecosystem, Sea ice, Glaciology, Upper Atmospheric Science, Geoscience) (15:30-)

Appendix 1. Workshop agenda. (2/2)

Day-2 (Friday 7th) Chair: Co-conveners

Lecture Theatre (9:00-10:30)

10) Group discussion outcomes and plans for the next few years (9:00-10:30)
    a) Marine Science
    b) Upper Atmospheric Science
    c) Geoscience

-Coffee (10:30-11:00)-

Flex room (11:00-12:30)

11) Resources and research platforms sharing (11:00-11:30)
12) Multilateral collaboration (11:30-12:00)
    a) Current status and the way forward
    b) Networking with other nations operating in the region
13) Other business, including considerations for future meetings and its formats (12:00-12:30)

-Lunch (12:30-13:30)-

Lecture Theatre (13:30-)

14) Workshop Summary
15) Report adoption (with discussion outcomes from each small group compiled)
16) Close of the meeting (Remarks from Yoichi Motoyoshi)

-Coffee (15:00 -15:30)-

-Individual group discussion to continue if required-

-WS Dinner (Friday 7th 19:00-: Astor Grill)-

Appendix 2. Pro forma for project descriptions.

Plans for current Australia-Japan Collaboration:

Key Research Question:

Title of Project/Coordination:

Links to other projects including domestic projects:

Institutions:

Discipline:

Personnel:

Project summary (200 words):

Timeframe and milestones:

Outputs and outcomes:

Other countries involved/International context: