2017 PACIFIC ARCTIC GROUP SPRING MEETING MINUTES

Arctic Science Summit Week 2017, Prague, Czech Republic
Date: April 2nd, 2017 (9:00 – 17:30)
Venue: Clarion Congress Hotel Prague, Rm Tycho

CITATION: SHINJI HIDA, TAKASHI KIKUCHI, and JACKIE GREBMEIER (EDS), 2017 PAG MEETING MINUTES, JAPAN AGENCY FOR MARINE-EARTH SCIENCE AND TECHNOLOGY (JAMSTEC), July 2017.

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Welcome and Introduction

[PPT 1] Takashi Kikuchi, PAG Chair, welcomed participants to the meeting, giving an introduction of PAG and an overview of the meeting agenda. Outlining PAG's history, mission, on-going research programs and activities, Takashi highlighted the group's growth and development from its beginnings as an informal forum under IASC to an autonomous global network facilitating scientific cooperation for large-scale, multidisciplinary research and synthesis.

1. Update plans for 2017 field season

1.1 Canada

[PPT 2] Humfrey Melling presented on the 2017 Canadian marine science plans in Pacific Arctic waters. First, he explained sustained observations in the Beaufort and Chukchi seas on the CCGS *Sir Wilfrid Laurier*, which has been conducted more than a quarter century at some of the locations. During the transit to the Arctic across the North East Pacific in 2-23 July 2017, 6 days of science operation are planned to be implemented by a group of 15 scientists, such as U-CTD & X-CTDs, CTD/Rosette casts across the Gulf of Alaska, underway seawater sampling, seabird observations and deployment of Argo floats and moorings, with the stop at Dutch Harbor to board 12 scientists for DBO sampling, specifically, sediment sampling using van Veen grabs in the northern Bering and Chukchi Seas, CTD & geochemical sampling with the rosette, and plankton samples with vertically towed bongos. On the return leg to the Pacific, 13 days of ship time will be dedicated to an oceanographic mooring programme in the Beaufort & Chuchi Seas at 22 sites. He also showed the long-term observing site in the Arctic region during autumn this year as well as the aim of year-round observations from submerged moorings that reveals the natural range of conditions, extremes, trends, etc. of a wide variety of parameters.

Regarding the science cruise on CCGS *Louis St-Laurent,* he announced that the transect in 2016 was extended from Svalbard to the North Pole and across the Beaufort Gyre, providing an XCTD section with rosette casts when possible. In additions, he introduced the Joint Ocean Ice Studies (JOIS) Arctic Observing Network (AON) expedition on CCGS *Louis St-Laurent* planned in Sep 7- October 2 by a team of 35 scientists in Canada Basin which will conduct CTD/rosette profiling & biogeochemical sampling, vertical net tows, infill survey using XCTD & UCTD, recovering & deploying 3 moorings (WHOI), deploying 3-4 ice-tethered profilers, with collaborations with WHOI, JAMSTEC, TUMSAT, and others.

He also explained that F/V *Frosti* Mid-depth trawl surveys of 2012-14 will be repeated in 2017 in Beaufort Sea for 6 weeks, looking at fish abundance and

diversity with the goal to develop a fish population census, understand fish community structure, ecosystem linkages and associated environmental conditions.

An ecological study of the physical environment will be made at the Kitikmeot Sea in mid-August to mid-September 2017 by the R/V *Martin Bergmann,* including ocean moorings, as well as continued evaluation of cabled observations in Cambridge Bay. There are also reference oceanographic transects that will be occupied and a joint effort with the Canadian Rangers (CROW).

The cabled observatory in the NW Passage was described, noting its establishment in 2009. This cabled observatory in the NW Passage is the infrastructure for monitoring and reporting ocean data. The cabled installation is 3 km off the coast of Devon Island in Lancaster Sound and operated jointly by DFO and Canada's Department of Defense.

In 2017 the NGCC / CCGS *Amundsen* expedition will be conducted in four legs starting from the end of May to mid-October with no leg in the Beaufort this summer. He mentioned that this is a human health program (Inuit health survey) and not an ocean program.

1.2 China

[PPT 3]: **Jianfeng He** presented on the Chinese research activities in 2016 and 2017. For the 2016 activities, the 7th Chinese National Arctic Research Expedition (CHINARE) was conducted from July to September 2016 with 84 CTD deployments along the DBO 2 and 3 lines, as well as a Russia-China Joint Cruise made from August to September 2016 during which 40 CTD stations were deployed. For 2017 activities, there is a cruise through the north-west passage planned on the Chinese R/V *Xuelong* from July to September for repeat transects in the Bering Sea and Central Arctic Ocean, including repeat work in DBO 3 and DBO 2; however, there are no plans for a joint Russia-China cruise.

1.3 Japan:

[PPT 4] Takashi Kikuchi presented on behalf of **Shigeto Nishino** on the 2017 updated plans for Japanese research activities. Two cruises are planned in 2017: one by T/S *Oshoro-maru* from July to August with research focus on biology, and another by the R/V *Mirai* from August to September with observational activities, such as sediment traps and mooring deployment/recovery, with research focus on biology and physical and chemical oceanography.

1.4 Korea:

[PPT 5] Eun Jin Yang presented on Korean Arctic Ocean research plans in 2017. The R/V ARAON visitsvthe western Arctic every year from July to the end of September. Two legs were carried out in 2016.the 1st leg focused on ocean and sea ice studies aimed at investigating the structure and processes in the water column around the Northern Bering Sea, Chukchi Sea, and East Siberian Sea that are undergoing rapid transition with sea ice retreat and included international collaborations. In this leg, two sea ice stations as well as 8 ocean mooring stations were deployed. The 2nd leg focused on a marine geological/geophysical survey in the Beaufort Sea which included AUV mapping and ROV deployments.

1.5 United States:

[PPT 6] Jackie Grebmeier presented on U.S. Arctic Ocean research activities. The 2017 PAG and DBO annual cruise field plans were shown. The ASGARD project, funded by the North Pacific Research Board Arctic Program, will occupy DBO line 2 and 3 with a broader survey program that includes mooring and sediment trap deployments. The Canada's Three Oceans (C3O)/DBO field program on the CCGS Sir Wilfrid Laurier will cover DBO lines 1, 2, 3, 4 and 5 in July 2017. The Arctic Marine Biodiversity Observing Network (AMBON) field program will occupy DBO 3 and 4 on the Norseman II within a broader biodiversity survey in the Chukchi Sea in August. The NE Chukchi Ecosystem Observatory (CEO) was deployed starting in 2015 that includes a 24-bottle sediment trap deployment. The DBO-NCIS (Northern Chukchi Sea Integrated Study), which is NOAA Arctic Research Program supporting scientists from WHOI, CBL/UMCES and NOAA PMEL, will be carried out in August-September and will occupy DBO line 3, 4 and 5, along with a process study in the NE Chukchi Sea. The Beaufort Shelf Break Ecology Study will use the RV Sikuliaq in September 2017. In addition, the Aerial Survey of Arctic Marine Mammals (ASAMM) program as well as multiple seabird surveys will occur in 2017. Activities of the Arctic Integrated Ecosystem Research Program (AIERP) and other 2017-2018 moorings was explained as well. Lastly, the need for communication/ coordination with coastal communities during subsistence whaling in the Arctic was raised.

2. Updates for planning of PAG joint field and modeling activities

2.1 NABOS

[PPT 7] Takashi Kikuchi presented on behalf of **Igor Polyakov** on the Nansen and Amundsen Basins Observational System II (NABOS-II) of which the overarching goal of 2012-2017 study is to compile a cohesive picture of climatic changes in the Eurasian and Makarov basins of the Arctic Ocean. Also, an overview of past cruises in 2013 and 2015, in addition to the 2017 field campaign, of the joint NABOS-

Transdrift AWI cruise was discussed.

2.2 SAON and observing activities

[PPT 8] Hajo Eicken presented on an Arctic Observing Summit (AOS) follow-up. First, it was presented that the sea ice this year will be excellent for the spring hunting as presented in the Sea Ice for Walrus Outlook (SIWO) report. Then, he explained the goal of Arctic Observing Summit is to provide community-driven, science-based guidance for the design, implementation, coordination and sustained long-term (decades) operation of an international network of Arctic observing systems that serves a wide spectrum of needs, and to create a forum for coordination and exchange between academia, government agencies, local communities, industry, non-governmental organizations and other Arctic stakeholders involved in or in need of long-term observations. Also, he mentioned that the Arctic Observing Network (AON) effort is one of the tasks for SAON for implementation of a pan-Arctic observing system. In addition, he introduced that the next AON meeting will be held in Davos, Switzerland, during the June ASSW 2017. He also encouraged researchers to share information about planned research asset deployments and cruises in the Arctic research assets map and portal of the Alaska Ocean Observing System (AOOS), accessible at http://portal.aoos.org/research-assets.

3. Status report on PAG-endorsed activities

3.1 Distributed Biological Observatory (DBO): Highlights and Updates

[PPT 9] Jackie Grebmeier presented a update on the Distributed Biological Observatory (DBO) activities. The development of standard sampling orotocols was introduced. Integrated Chlorophyll a is collected annually during the DBO cruises as well as phytoplankton taxonomy on some cruises, presented as examples of DBO data products. The publication by Itoh et al. in Elserview from mooring observations at DBO-5 was introduced. As part of the DBO Data Sharing Protocol, a data sharing site was established and supported through NSF at the Earth Observations Lab, UCAR, and currently now housed at the Arctic Data Center at UC Santa Barbara, CA. Also, the 4th DBO Data workshop was introduced of which objectives include presentation of recent field results and reviewing the US-IARPC DBO Implementation Plan as well as International 10-year future efforts. In addition, the annual cycle of the DBO implementation plan and recent efforts was discussed. Recently the DBO line 4 was occupied with surface gliders; however, the need for coordination for sub-surface gliders was mentioned.

[PPT 10] Regarding the developing Atlantic DBO, an agreement was made on the importance and need to coordinate and extend the existing efforts during a workshop held in Tromsø, Norway in November 2016. Among the discussion points and tasks, the need to make an implementation plan was decided and is ongoing.

3.2. Pacific Arctic Climate Ecosystem Observatory (PACEO)

[PPT 11] Sung-Ho Kang presented on the outline of PACEO. He explained that Arctic Ocean currents are changing due to global warming and run-off of Russian rivers and more melting of sea ice is freshening the Arctic Ocean.

3.2.1 Physical oceanography

[PPT 12] Kyoung-Ho Cho presented on KOPRI's physical oceanography activities in 2016 and plans for 2017. The motivation of the investigation is to understand water mass distribution and its variability in the Chukchi Borderland region. It was mentioned that the R/V Araon Arctic cruise in 2016 occupied 34 CTD stations and 38 XCTD stations were deployed, but the mooring recovery failed. Distribution of summer water and winter water minimum potential temperature suggests that Winter Water tends to extend to the marginal regions. Also, as the contrasting patterns in 2012 and 2016 physical parameters, changes in sea ice concentration was observed. Also, as anomaly correlation in southerly/southwesterly winds directly/indirectly intensify eastward/northeastward along the shelf currents, which appears to change a pathway of warm summer water flowing from the Beaufort Sea. Finally, the 2017 ARAON cruise plan was introduced to be conducted in Aug 6-23 in which 35-40 CTD stations will be deployed as well as some moorings.

3.2.2 Biological oceanography

[PPT 13] Eun Jin Yang presented on the biochemical response ti sea ice reduction on the PACEO Line on behalf of **Jisoo Park.** Research objectives were introduced focused on understanding the influence of sea ice reduction on the plankton community, microbial composition, nutrient, and DOC and POC distributions in the Chukchi and the East Siberian Seas through data comparisons between August 2012 and 2015.

From this study, phytoplankton groups appeared to be controlled mainly by seeding from sea ice in the Chukchi and the East Siberian Seas. Furthermore, it may suggest that underwater light conditions might be one of the influential factors for phytoplankton distribution in the subsurface chlorophyll maximum layer of the study area. The east-west gradients of some abiotic and biotic variables need to be taken into consideration for future study of the effect of water mass distribution.

3.2.3 Ocean Acidification

[PPT 14] Dong Sun Kim presented on ocean acidification in the western Arctic Ocean in 2016 summer. It was summarized from the study that most of the surface waters were supersaturated with respect to aragonite in the western Arctic ocean during 2016 summer, and that sea ice melt waters and biological activities are main factors controlling the surface distribution of aragonite saturation states. Most of the subsurface waters (50~250 m) were undersaturated with respect to aragonite. The undersaturated subsurface waters result from the contribution of CO_2 remineralized from organic matter produced on the continental shelf and that aragonite undersaturation in the subsurface waters had considerably progressed from 2002 to 2016.

[PPT 15] Liyang Zhan has presented on ocean acidification and Greenhouse gases. It was explained that 7 Arctic Cruises have been carried out so far from 1999 to 2016. In the studies, an increase in acidifying water in the western Arctic Ocean was observed, of which results were publicized on Nature Climate Change, adding that corrosive water area is expanding at a rate of 1.5 % each year. Also, a similar phenomenon is occurring for greenhouse gases (GG), as there is enhancement of GG concentrations in the Pacific inflow water at a subsurface layer, and perhaps significant denitrification and activity in the sediments. Further studies will be done to continue this research using new technology.

3.2.4 Atmosphere and Sea Ice

[PPT 16] Joo-Hong Kim presented on sea-Ice and atmosphere topics.
As an international effort on sea-ice studies through buoy deployments, the Year of Polar Prediction (YOPP) was introduced. The YOPP goals is to increase the number of sea ice and atmospheric observations through enhanced observations to improve predictability of future changes in these parameters. In addition, an international radiosonde campaign has been carried out regularly onboard the M/V ARAON for weather and sea-ice forecasts. As for the field activities in 2017, two legs on the ARAON are planned, one in August for ship-borne meteorological observations as well as sea-ice buoy deployments, and another from August to September for ship-borne meteorological observations. In addition, the study of a melt pond energy budget was explained as it suggests that the convective radiative balance in melt ponds during summer is a non-negligible first-order process in the surface energy flux balance. Then, the study of the great Arctic cyclone and analysis of inter-annual climate variability was presented.

3.2.5 Satellite observation and *p* (Polar)-WebGIS

[PPT 17] Hyun-Cheol Kim presented on a new project for sea-ice monitoring: Research on analytical technique for satellite observation of Arctic Sea-ice. Among KOPRI activities, this is a new project for sea-ice monitoring amid the situation that South Korean government is starting to release funds for arctic research for the purpose of developing analytical techniques for satellite observations on Arctic sea ice as well as the development of an Arctic sea satellite observing network by 2025. Research content includes analytical techniques for satellite data process, Korean satellite data, and developing an International network for satellite observing. The budget is 3 million USD per year and the period of the first stage is from 2017 to 2019. The 2015 Summer Arctic sea expedition by the Korean satellite was developed as KOMPSAT-2 for 160 scenes, KOMPSAT-3 for 130 scenes and KOMPSAT-5 SAR for 135 scenes, with high resolution imaging of the location of the ARAON.

[PPT 18] Hyun-Cheol Kim also presented on the *p* (Polar)-WebGIS for Arctic Data Sharing. It was explained that 23 types of in-situ measurements from the 2016 Arctic cruise data will be available through the website. Also, the strength, weakness, opportunities and threat of these measurements was analyzed in a table. Newdata categories as well as future plans using a roadmap figure were presented.

3.2.6 Modelling

[PPT 19] Joo-Hong Kim presented on the updates of KOPRI Modeling Activities on behalf of **Baek-Min Kim**.

The main themes with the modeling activities are listed below:

1. Sea ice

   -Understanding characteristics of a stand-alone sea ice model through sensitivity experiments to boundary forcings and physical parameterizations

   -Preparing seasonal prediction of sea ice extent and concentration through assessing an impact of sea ice initialization as well as Ice-ocean coupled sea ice prediction (Plan)

2. Weather

   -A weather prediction system with added ARAON observations (Plan)

3. Climate

   -A coupled seasonal climate prediction system (Plan)

Also, the sea ice initialization system was explained as the initialization process is a key of the dynamical sea ice prediction by producing an initial condition of the dynamical sea ice model to successfully predict the future sea ice and induced global climate variability. Furthermore, there was an explanation of the KOPRI POlar Prediction System (KPOPS) with two categories, one for weather including ocean/land initialization, improved polar cloud parameterization, and the other for

climate, including a coupled climate prediction system, improved polar cloud parameterization and optimal initialization.

4. PAG Synthesis activities

4.1 Biogeosciences special issue (Takashi Kikuchi)

[PPT 20] Takashi Kikuchi outlined the papers published in the Biogeosciences special issue.

4.2 Deep Sea Research - DBO Special Issue update (Jackie Grebmeier)

[PPT 21] Jackie Grebmeier provided an update on the Deep Sea Research - DBO Special Issue manuscript submissions planned and ongoing.

5. Interactions with other organizations and activities – IASC, SAON, FARO, others

5.1 Year of Polar Prediction (YOPP) (Jun Inoue)

[PPT 22] Jun Inoue presented on the Polar Prediction Project (PPP)/ Year of Polar Prediction (YOPP) updates. The YOPP core phase begins from 15 May 2017 to mid-2019, followed by a consolidation phase from mid-2019 to 2020. Also, as an example of an Arctic radiosonde observing network, the Arctic Research Collaboration for Radiosonde Observing System Experiment (ARCROSE) project aims at better predictions via additional observations and modeling. Also, in terms of extreme events during extra Arctic soundings, the fact that special observations from the RV Polarstern improved the forecast skill of the great Arctic cyclone on Aug. 6, 2012 was exemplified. In addition, how Arctic Radiosondes contribute to the increase in weather forecast accuracy, including tropical cyclone track forecasts, was explained. The R/V *Mirai* cruise schedule in 2017-2019 was presented as well.
In summary, several pre-YOPP activities have been conducted by experimental Arctic observing networks in summer and winter, local and remote, and weather and sea-ice forecasts. International coordination and communication for extra Arctic observations are important for data denial experiments. Regarding the Russian observations, NIPR will conclude an agreement on Baranova soundings with AARI.

5.2 Arctic in Rapid Transition (ART)

[PPT 23] Nathalie Morata presented a progress report of the activities of the Arctic

in Rapid Transition (ART) network. As the overview, the ART initiative is an international, interdisciplinary, pan-Arctic scientific network to study the spatial and temporal changes of biogeochemical cycling and ecological functions in the rapidly changing Arctic and to foster activities and cooperation among early career polar researchers. The ART Executive Committee includes 13 scientists (early career stage) from 8 countries. In addition, several senior scientists support ART via the advisory board. On its history, workshops from the initiation level to implementation plans and science discussions were held in the past. The outcome of an ART science workshop in 2014 in Brest, France was development of 8 Priority sheets presented at the ICARP III meeting in Toyama, Japan 2015. In addition, the Transitions in the Arctic Seasonal Ice Zone (TRANSSIZ) cruise was carried out as one of the ART activities with the goal of conducting ecological and biogeochemical early spring process studies from the shelf to the basins of the European Arctic margin, in order to link past and present sea-ice transitions in the Arctic Ocean. Also, some of the past IASC sessions were (co) chaired by ART. Lastly, as for future plans, a workshop in Vienna in 2018 is under consideration and efforts need to be made for another cruise opportunity in 2018.

5.3 Central Arctic Ocean science planning activities (Marc Meloche)

[PPT 24] Marc Meloche presented on an international scientific coordinating mechanism for the high seas region of the Central Arctic Ocean(CAO). 2015 OSLO declaration was explained as below:

- Consensus/acknowledgement on crucial role of healthy marine ecosystems and sustainable fisheries for food and nutrition
- Obligations of states (international law) – cooperation, conservation, management of living resources in high seas – apply “precautionary approach”
- Promote scientific research - Integrate scientific, local, traditional knowledge
- Establish joint program of scientific research, cooperation with relevant scientific bodies including ICES, PICES.
- Continue to engage Arctic residents, particularly Arctic Indigenous peoples.
- Working with other states to develop commitments consistent with Declaration. (Note: Negotiations in progress with China, European Union, Iceland, Japan, South Korea)

Under the above situation, there is a need for International Scientific Coordinating Mechanism/Organization between “parties/signatories” & existing Arctic Ocean research organizations.

He concluded as follows:

- No decisions on international scientific coordinating mechanism/organization.
- Experts have advanced thinking on scientific support for the signatories.
- Resources invested by signatories into leveraging CAO components into Arctic

research and monitoring activities - necessary condition for success.
- Use of an ecosystem-based approach inclusive of “fish” in CAO research efforts.

As the next step, followings were raised:
- Engagement of (Arctic) indigenous peoples and associated organizations.
- Reaching out more formally to the parties/signatories of (imminent) agreement on international scientific coordinating mechanism/organization considerations.
- Governance and administration associated with scientific coordinating mechanism/organization to be defined then addressed and determined by signatories.
- Small secretariat required to serve as coordinator, repository of records, window/point of contact – located in one of (imminent) signatories’ territory, on a rotational basis.

5.4 CAFF/PAME/AMAP activities (Jackie Grebmeier)

[PPT 25] Jackie Grebmeier presented on a Central Arctic Ocean Synthesis Activity as part of ICES/PICES/PAME Arctic Council Working Group on Integrated Ecosystem Assessment for the Central Arctic Ocean (WGICA). The meeting was held in May 2016 and an upcoming meeting is planned in Seattle in April 2017. Its terms of reference includes preparing an IEA outline for the current status of the CAO ecosystem (CAO LME and adjacent slope waters including Atlantic and Pacific inflows and relevant shelf-basin exchanges), considering requirements and design of monitoring of the CAO, and identifying priority research issues.

Summary of work plan is shown below:
Year 1: Consider approach and methodology for IEA, start assembling of data and information, and consider monitoring requirements
Year 2: Continue assembling of data and information and carry out analyses. Prepare an initial and incomplete draft of IEA
Year 3: Finalize IEA report and consider monitoring requirements and priority research issues

Also, an Integrated Ecosystem Assessment (IEA) is a core element of the Ecosystem Approach to Management (EA). The principle of the EA was adopted by the Arctic Council in 2004 as part of the Arctic Marine Strategic Plan (AMSP). A definition of EA was adopted by the Arctic Council in 2013.

In addition, two assessment teams were established to initiate work on the development of integrated assessments on a sub-regional basis in 2016:
1.Amerasian Basin/Pacific gateway team (lead: Jackie Grebmeier, USA)
2.Eurasian Basin/Atlantic gateway team (lead: Randi Ingvaldsen, Norway)

5.5 Ecosystem Studies of Subarctic and Arctic Seas (ESSAS) (Sei-ichi Saitoh)

[PPT 26] Sei-ichi Saitoh presented on the Ecosystem Studies of Subarctic and Arctic Seas (ESSAS). The goal is to compare, quantify and predict the impact of climate variability and global change on the productivity and sustainability of Sub-Arctic and Arctic marine ecosystems.

The task of the ESSAS WGs are to carry out focused research in Sub-Arctic regions and the WGs are 1. Arctic-Subarctic Interactions, investigating the effects of advection between the Arctic and the Subarctic, 2. Paleo-Ecology of Sub-Arctic Seas, understanding past and present interactions of climate, oceans and humans, 3. Human Dimensions, studying responses of human systems to shifts in biophysical systems, and 4. Bioenergetics of Subarctic and Arctic Fishes Field, lab and modeling studies on growth and energetics of juvenile fishes.

A series of meetings were held in Yokohama in 2016, including ESSAS SSC and Annual science meetings. In 2017, the ESSAS Open Science Meeting on Subarctic and Arctic Science will be held in Tromsø, Norway in June, co-sponsored by PICES and ICES.

5.6 Belmont Forum: Resilience and adaptive capacity of arctic marine systems under a changing climate (RACArctic)

[PPT 27] Sei-ichi Saitoh presented on RACArctic – Resilience and Adaptive Capacity of Arctic marine systems under a changing climate, an international funding framework in which Belmont Forum Collaborative Research Action (CRA) called for proposal on “Arctic Observing and Research for Sustainability” as international opportunities fund. Japan, the US and Norway submitted a proposal entitled *Resilience and adaptive capacity of Arctic marine systems under a changing climate* ***RACArctic***, and one out of ten programs was accepted, of which synthesis grant would run from mid-2015 to mid-2018.

The goal is to review and synthesize results from national programs in the three member countries (Japan, USA, Norway) to assess the resilience and adaptive capacity of these arctic marine systems in a changing climate, from both a natural and social science perspective, which Focus on two Subarctic-to-Arctic transition zones:

- Eastern Bering Sea and Chukchi Sea in the Pacific Arctic
- Barents Sea/Fram Strait in the Northwest Atlantic Arctic

Three workshops (Japan, Norway, US) were held in Hakodate, Japan in March

2016, Juneau, Alaska in March in 2017 and an upcoming workshop to be held in Bergen or Tromso, Norway with participants such as:

- Principle Investigators from each country
- Stakeholders from the seafood industry
- Arctic communities dependent on marine ecosystems
- Agencies managing Arctic living marine resources

The deliverables will be

– **Data inventory** for data collected as part of national projects, data archived in and available through national data centers
– **Peer-reviewed publications**: Papers on the ecosystem, fisheries management and socio-economics to be published in a special issue
– **Presentations at international meetings**: PICES, ICES, Ocean Science Meeting, ESSAS, Arctic Frontiers conference, Arctic Science Summit week, and others
– **Dissemination of results** to managers through involvement of PIs in national management organizations and at various national and international for a
– **Summary of findings (brochure)** for stakeholders and for the broader public

5.7 Synoptic Arctic Survey (Takashi Kikuchi)

[PPT 28] Takashi Kikuchi gave a presentation on the Synoptic Arctic Survey (SAS) SAS is a bottom-up, researcher driven initiative aimed at collecting empirical data in the Arctic basin that cannot be done in any other way than through cruises! As of now, SAS will take place in 2020 involving the coordination of many research vessels (not all ice breakers), with the goal to generate a comprehensive dataset that allow for a complete characterization of Arctic hydrography and circulation, carbon uptake and ocean acidification, tracer distribution and pollution, and organismal and ecosystem functioning and productivity. The data will provide a unique baseline that will allow us to track climate change and its impacts as they unfold in the Arctic over the coming years, decades and centuries.

SAS builds on 3 themes below, each with 3 key research questions in addition to overall question of its overall question: *What is the present state of the Arctic marine system and what are the major ongoing transformations?*

- Physical Oceanography
- Marine Ecosystems
- Carbon Cycle and Ocean Acidification

As for the timeline, an inaugural workshop was already held in 2015, the Science plan is being developed during 2016-17, plans for raising funding for national participation in 2018-19, and the survey will be conducted in 2020 by 5-10 ice

breakers and research vessels, with each country occupying zones of interest. Sections must cross each other and be ships must be capable of full depth water sampling. Measurements of T, S, oxygen, nutrients, inorganic carbon chemistry, organic carbon (POC and DOC), age tracers (CFCs), C-isotopes, $CH_{4.,}$ and ecosystem characteristics such as viruses, bacteria, phyoplankton, meso and macro zooplankton, benthos, acoustics, and primary production will be carried out.

5.8 International Conference on Arctic Science (AMAP conference)

[PPT 29] Takashi Kikuchi presented on the upcoming International Conference on Arctic Science (AMAP conference) which will be held in April in Reston, Virginia and organized by the Arctic Monitoring and Assessment Program (AMAP). The objective of the 2017 “International Conference on Arctic Science : Bringing Knowledge to Action” is to bring together diverse expert communities ranging from scientists to decision-makers in order to identify, explore and create mechanisms and venues where science and knowledge can inform the development of policies and decision-making.

Also, the Conference will provide a venue for dialogue, discussions and networking. It will creatively promote timely and effective response to the increasingly clear need to translate science to knowledge and the subsequent transformation of this and other forms of knowledge into actions. It is these actions that support and enhance all forms of decision-making and public policy at all relevant scales providing the foundation for successful adaptation and ultimately sustainability of natural and human resources.

5.9 Trilateral High-Level Dialogue on the Arctic (among China, Korea, and Japan)

[PPT 30] Takashi Kikuchi presented on the Trilateral High-Level Dialogue on the Arctic among China, Korea, and Japan. The 1st meeting was held in Seoul, Korea in April 2016 to identify cooperative projects, and the second meeting is planned to be held in Tokyo in early June 2017. A concept paper on research collaboration is being planned.

5.10 The 5th International Symposium on Arctic Science (ISAR-5)

[PPT 31] Yuji Kodama presented on the 5th International Symposium on Arctic Science (ISAR-5), which will be held in January 2018 at Hitotsubashi Hall in Tokyo. This symposium will be devoted to discussions on environmental changes in the Arctic and their regional and global implications, to seek additional international scientific collaboration in this area by gathering, synthesizing and sharing information related to these changes occurring in the Arctic. Special emphasis will be placed on

the fields of the social sciences and humanities, which were not included in the previous ISARs.

In addition, the important dates were announced as below,

April 15	Call for Session ends
June 15	Call for Abstract / Registration starts
August 31	Call for Abstract ends
December 15	Registration ends

It was informed that some side meetings will be held as well.

6. PAG structure

The PAG Executive Committee is composed of the PAG Chair, Vice-Chairs, and leads from each of PAG activities: DBO, PACEO, sea ice-atmosphere, and so on.

As he introduced the current Chair and Secretariat rotation plan below, Takashi informed that one of two vice chairs position is currently vacant as the chair rotation has occurred:
2014-2016 – Korea (Sung-Ho Kang, KOPRI)-past chair
2016-2018 – Japan (Takashi Kikuchi, JAMSTEC)-current chair

In response, there was a voice to select a candidate from Canada and Russia in terms of rotation order. It was informed that Bill William of Canada would be willing to take on a vice chair.

7. Future PAG meetings

Takashi announced that it will be Japan's turn to host the next PAG meeting, and that there were two schedule options of having it in November 2017 or January 2018 during ISAR-5 period. An opinion was raised that as many scientists will go out to Antarctica in January, it would be better to avoid the season. Also, it was suggested that PAG meeting will be held in combination with the 4th DBO data workshop in Japan or Seattle in November 2017, which will be composed of DBO workshop for 2 days and PAG meeting for 1.5 days

As the further action, Takashi mentioned that he would check the schedule with Japanese side and present it with PAG executive committee. Jackie informed that if it will not be possible to hold the meeting in Japan she could have it in Seattle. .
[Post this report, it was decided that the fall 2017 PAG meeting will be held November 6-7 and 4th DBO workshop November 8-9 in Seattle, Washington, USA].

- ASSW 2018 – Davos, Switzerland (June 2018)
- Fall 2018 – TBD
  There was an opinion to have the next meeting in Canada.

8. Other Business

There was information from China regarding Chinese Ice Breaker that its first test cruise will be conducted at the end of 2019 and hopefully will go to the Antarctic in 2020.

9. Appendix

9.1 Participants List

No	Name	Affiliation	Country	E-mail
1	Renate Deger	University of Vienna	Austria	renate.deger@univie.ac.at
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9.2 Acronyms

Acronym	Meaning
AARI	Arctic and Antarctic Research Institution of Russia
ABL	Alaska Fisheries Science Center's Auke Bay Laboratories
ADCP	Acoustic Doppler Current Profiler
AICC	Arctic Icebreaker Coordinating Committee
AMBON	Arctic Marine Biodiversity Monitoring Network
AON	Arctic Observing Network
AOOS	Alaska Ocean Observing System
ART	Arctic in Rapid Transition
ASCOS	Arctic Summer Cloud Ocean Study
ASR	Arctic Sea Route
BAS	British Antarctic Survey
BGOS	Beaufort Gyre Observing System
CAA	Chinese Arctic & Antarctic Administration
CAFF	Conservation of Arctic Flora and Fauna
CBL	Chesapeake Biological Laboratory
CBMP	Circumpolar Biodiversity Monitoring Program
CS	Chukchi Sea
DBO	Distributed Biological Observatory
DFO	Department of Fisheries and Ocean Canada
DSR II	Deep Sea Research II
ECS	Early Career Scientists
EEZ	Exclusive Economic Zone
EPB	European Polar Board
ESS	East Siberian Sea

Acronym	Meaning
FARO	Forum of Arctic Research Operators
FIO	First Institute of Oceanography
IACE	Institute of Arctic Climate and Environment Research
IARC	International Arctic Research Center, UAF
IARPC	Interagency Arctic Research and Policy Committee
IASC	International Arctic Science Committee
IASOA	International Arctic Systems for Observing the Atmosphere
ICARP III	Third International Conference on Arctic Research Planning
INSROP	International Northern Sea Route Programme
ISTAS	Integrating Spatial and Temporal scales in the changing Arctic System
ITP	Ice Tethered Profiler
JAMSTEC	Japan Marine Science and Technology Center
JOIS	Joint Ocean Ice Studies
KOPRI	Korea Polar Research Institute
MIZ	Marginal Ice Zone
MOSAiC	Multidisciplinary drifting Observatory for the Study of Arctic Climate
NMEMC	National Marine Environmental Monitoring Center, China
NOAA	National Oceanic and Atmospheric Administration
NPRB	North Pacific Research Board
NSF	National Science Foundation
NUIST	Nanjing University of Information Science and Technology
OUC	Ocean University of China
PACEO	Pacific Arctic Climate Ecosystem Observatory
PPP	Polar Prediction Project
PRB	Polar Research Board
PRIC	Polar Research Institute of China
RUSALCA	Russian American Long-term Census of the Arctic
SAMS	The Scottish Association for Marine Science
SAON	Sustaining Arctic Observing Network
SIO	Second Institute of Oceanography
SOA	State Oceanic Administration
TRANSSIZ	Transitions in the Arctic Seasonal Sea Ice Zone
TOA	Third Institute of Oceanography
TUMSAT	Tokyo University of Marine and Science Technology
UAF	University of Alaska Fairbanks
UMCES	University of Maryland Center for Environment Sciences
USCG	US Coast Guard
UW	University of Washington
WHOI	Woods Hole Oceanography Institute
YOPP	Year of Polar Prediction