

Pacific Arctic Group, PMEL, Seattle, October 28-29, 2014



Photo credit: Aleksey Ostrovskiy

THE PACIFIC ARCTIC GROUP (PAG) MEETING

October 28-29, 2014
Seattle, Washington

*Meeting
Minutes*

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2014 PAG Minutes

October 28-29, 2014

Pacific Marine Environmental Laboratory (PMEL)/National Oceanic and Atmospheric Administration (NOAA), 7600 Sand Point Way NE, Bldg. 3, Seattle, WA 98115 USA

A. Day 1: October 28, 2014 (Tuesday)

A1. Introduction and Welcome

NOAA/PMEL Director, **Christopher Sabine** opened the meeting by welcoming all participants to the meeting. He noted that this is timely work as others are just beginning to recognize the impacts of climate on marine ecosystems.

Jackie Grebmeier (UMCES/CBL) ([ppt1](#)) gave a brief introduction of PAG and the meeting agenda. She also provided a brief history of the PAG, including the recent renewal of a collaborative agreement with the International Arctic Science Committee (IASC). Appendix A provides a listing of the final agenda for the PAG fall 2014 meeting. Appendix B lists the participants attending the PAG meeting.

The Fall PAG meeting is hosted at various locations in alternating PAG countries after the Arctic field season and is focused on review of accomplishments during the previous summer and provides a forum for discussion of ongoing and future activities. These discussions are useful in developing scientific exchanges and other types of collaborations during and after field operations. The spring PAG meetings are held during Arctic Science Summit Week (ASSW) and are focused on “business” issues and an update on research plans for the coming field season.

A2. Country Highlights of 2014 Field Results/Science Findings, with Preliminary 2015 Field Plans

A2.1 Canada

Bill Williams (Institute of Ocean Sciences) ([ppt2a](#)) gave an update of Canadian activities according to the ship cruises. This summer F/V Frosti’s main goal was scientific fishing in the Canadian Beaufort Sea and was also considered an ecosystem project. The cruise sampling went to the deep waters of the Beaufort Sea as well as in the shallower Amundsen Gulf. He did not have the results of their accomplishments, but it was considered successful. Secondly, he

presented on a DFO-led UNCLOS project by the CCGS Louis S. St. Laurent where they deployed transited from Halifax across the North both, with buoys deployed in the Beaufort Gyre. During this cruise, there were 126 XCDTs deployed, many around the North Pole. Bill presented the XCDT section results of the Fram Strait. Lastly, the CCGS Sir Wilfrid Laurier collected data on the physical, biological and geochemical properties of ocean water across the North Pacific Ocean, and the shelf regions of the Bering and Chukchi Seas as part of the C30/DBO collaborative effort.

Humfrey Melling (DFO Canada) (ppt2b) gave an overview of the Arctic Ice Monitoring (AIM) site on the Chukchi Plateau which was established in 2003. The goal of the Chukchi AIM observatory site is to look at different Arctic sea ice environments, mainly focusing on differentiating multiyear ice and first year ice. By studying the southern Beaufort Sea, which has multiyear ice drifts and ice decay events, their aim is to gain more insight into the ice mechanics and sea ice climate change. The AIM observatory site, which is in the pathway of the Pacific Water (PW) flowing into the Arctic Basin, was identified to have high sea ice variability. At this site, they used submerged sonars (IPS & ADCP) to measure ice drift, ice draft, ocean current and plankton echoes. They also installed sensors for temperature and salinity and ambient sounds. Dr. Melling presented data showing that the Chukchi Plateau's first year ice appears to have no unusual change over the last decade, but there is a tendency for the ice to drift from west to northwest showing ice disappearing northward rather than melting back. This may indicate that the "missing ice" may not be due to melting, but rather varying ice-drift due to varying winds. Ambient sound recordings, ocean current measurements and planktonic echoes were taken and the results suggested substantial new ice (red in map) and transitional and first year ice. It was interesting to note that there was high variability in the ice patterns. Graphs of drifts over time show some new ice development. There have been periods of no ice development occurring since 2000 and annual mean drift decline from 2-4 m to 1.5 m.

A2.2 China

Jackie Grebmeier (UMCES/CBL) (ppt3) reported on behalf of Dr. Jianfeng He who was unable to attend the PAG meeting at the last moment. China's main purpose for these studies is to understand how the rapid sea ice retreat in the Arctic environment will affect the climate in China and as well as the carbon biogeochemistry. The Chinese had a 75 day cruise in the Bering Sea, Chukchi Sea, Canadian Basin and the central Arctic Ocean on the RV Xuelong. They are building a second icebreaker for enhanced research in the Polar Regions. Data related to sea ice retreat and environmental change was collected, including carbon biogeochemistry. Some data may have been collected in DBO 2, 3 and maybe 5. The cruise extended as far north as 85°N.

A2.3 Japan

Takashi Kikuchi (JAMSTEC) (ppt4) reported on the Japanese research vessel activities of the R/V Mirai in the Arctic and the R/V Hakuho-Maru where cruises focused on ecology and the project

“Arctic Research Collaboration for Radiosonde Observing System Experiment” (ARCROSE). Through Japan’s collaborations with Canada and South Korea on arctic research, many Japanese scientists also worked on those countries icebreakers. During the R/V Mirai Arctic cruise, measurements, such as radio-sonde, ozone-sonde, CTDs, water sampling and turbulent measurements, were made. He presented the 2014 preliminary results from CTD, radio sonde, sea level pressure, and wind speed measurements. Further details will be available during the ASSW 2015 in Toyama, Japan next April. The R/V Hakuho-maru, belonging to JAMSTEC, primarily focused on meridional distribution observations in the Northern Pacific. In 2015 the R/V Mirari cruise is being planned to occur between Sept-Oct 2015. The objectives of this cruise are to understand the water masses and horizontal distribution of hydrological chemical properties in the Siberian shelf and basin. In 2010 there were huge warm core eddies found that were high in nutrients and biological activities. How strong are these eddies? During the cruise there will be major observations to understand the eddy activity and the strong shelf break exchange in this area.

A2.4 Republic of Korea

Sung-Ho Kang (KOPRI) (ppt5) gave a report on the RV Araon cruise that consisted of Leg 1 (water column and sea ice process) and Leg 2 (geological structures of the permafrost) with 83 participants from 10 nations, including polar bear guards. Atmospheric observations, measurements of the CO₂ system in the water column, satellite remote sensing observations, a hydrographic survey, and microbe/plankton ecology were core measurements collected during the cruise. Collections with the CTD and XCTD were made on stations on the DBO3 transect line as well as sampling in the US EEZ at an ice camp. Leg 1 of the 2014 Araon Arctic Cruise consisted of the Araon MIZ (Marginal Ice Zone) Ice Camp, a collaborative KOPRI-ONR-MIZ 7-day ice camp, to measure ocean-ice heat flux, and physical oceanographic measurements under sea ice. Also, there were buoy deployments, helicopter surveys and biogeochemical sea ice studies. This joint effort is providing Korea and international partners an opportunity for beneficial collaborations. No polar bears were sighted during the cruise. KOPRI has recently published multiple cruise reports and there is a preliminary site to view the 2015 Arctic cruise plan, which has been focusing on the east Siberian area since 2010. Araon also visited the Chukchi Sea and deployed moorings and undertook coring activities in recent years. Participants noted that Korea is open to discuss multiple areas of collaboration on future cruises.

A2.5 Russia

Aleksey Ostrovskiy (Alliance Group) (ppt6a) presented preliminary data from the RUSALCA (Russian-American Longterm Census of the Arctic) 2014 cruise that had just been cleared by Russia for public review. The general areas of the RUSALCA study sites, primarily in Russian waters, were presented. Mooring measurements were initially deployed in Bering Strait in 2004 and have been maintained annually to the present. The main goal for the 2014 cruise was to redeploy a mooring into the Western Bering Strait in Russian waters to reconnect the

monitoring chain across the strait, and also to perform physical and chemical transects of the DBO3 and CS lines north of Bering Strait. Kathy Crane (NOAA) commented that all instruments should be purchased and delivered to the Russian side in 2015 as occurred in 2014, although other cargo and people went through a different method of transport. Although the expedition consisted of a small team, there was insufficient time for all the planned activities. Aleksey gave a detailed map of the Bering Strait showing the mooring position. Results were also presented on profiles of observed whales, Kittlitz's murrelet (rare seabird species), and the monitoring of traditional birds from the ship. Kathy Crane commented that there were high numbers of gray whales near Chukotka, which should be continuously tracked. These data could be combined for an interesting synthesis paper. In general, data was difficult to obtain, but noted that it is important to collect seabird and marine mammal data during this cruise as it covers the Chukchi region on the Russian side.

Kathy Kuletz (USFWS) (ppt6b) presented the 2014 raw data points of seabird observations at sea that give an overall view of the transect lines during the RUSALCA 2014 mooring cruise. There was a large coastal coverage in 2014 as compared to 2012 that influenced the species composition compared to other years. Kathy compared the species composition in July 2012 and July 2014 in the Chirikov Basin in the northern Bering Sea versus the Hope Basin in the Southern Chukchi Sea. Her group also analyzed the seabird distribution by region in the North Bering Sea, South Chukchi Sea, and the North Chukchi Sea from a variety of cruises, including RUSALCA.

A2.6 United States (ppt7 – composite)

Dr. Lee Cooper, chair of the US Arctic Icebreaker Coordinating Committee (AICC), gave a brief presentation on the objectives of the AICC and foreign access to US territorial waters. Foreign and international participants who apply to work on US icebreakers or even just in US waters on their own national ships, are evaluated by the US Coast Guard (USCG) and by the AICC. Lee discussed the need to pre-discuss cruises that would impact traditional hunting in coastal regions prior to any cruise. All international members were encouraged to ask Lee for help, if needed, related to US icebreaker collaborations or interactions with local Alaskan communities. He also noted that there is a Community primer document for using USCG icebreakers and contacting local Alaskan communities at the web link: <http://icefloe.net/community-primer/>.

Jackie Grebmeier (UMCES/CBL) presented a composite US presentation (see co-author summaries in the following paragraphs presented by different individuals). She began her presentation with a slide of the average (1981-2010) changes in temperature across the Bering Sea as of September 2014. In St. Paul and Cold Bay, both in the Bering Sea, the warmest months on record were in 2014. PAG focuses on the northern Bering Sea and the connectivity between the Bering Sea activities into the Arctic. Dr. Grebmeier and her team participated in the annual Canada Coast Guard Ship (CCGS) Sir Wilfrid Laurier cruise to occupy the 5 DBO as part of the joint Canada's Three Oceans (C3O) and DBO effort. CTD casts were collected at every station to obtain transects of species composition of phytoplankton and zooplankton along each DBO line.

One of the DBO outputs includes integrated chlorophyll *a* (chl *a*) values for each of the 5 DBO transect lines annually. DBO3 in the southern Chukchi Sea is a region of annual high chl *a* biomass maintained by high Pacific nutrient inflow water. The data sets shown were examples of the type of data the project has generated from the cruise. There is a collaborative effort among Canada, USA and Japan both on the annual DBO cruises on the CCGS Sir Wilfrid Laurier as well as the 2014 September cruise on the CCGS Amundsen, a program sponsored by the Canadian ArcticNet program, with 2014 being the first time that the Amundsen from Quebec worked in the Pacific Arctic. During this September Amundsen cruise a wide variety of process-oriented data were collected and some of these results will be presented at the December Arctic Change conference in Ottawa, Canada.

Robert Pickart (WHOI) presented a summary of the cruises he participated in on the USCG Cutter Healy. The first cruise was in May – June 2014 to study phytoplankton blooms under sea ice. The participants did a broad scale survey over the Chukchi Sea, but the ice conditions limited their access as it was very early in the season, but nonetheless, obtained good coverage in the northern regions. The three main components for the cruise were physical, biology and ice studies. The cruise consisted of 235 CTD stations, 14 transects, 12 ice stations, and full sets of biological stations in certain places providing high resolution data sets. Heavy ice prevented the Healy from getting further north in the Arctic Basin. Physical oceanographic results of the central channel sections in the northern Chukchi Sea from 1 July 2010 show that winter water was high in nitrate. The cruise had a goal to obtain initial conditions of the Chukchi Sea, prior to the initiation of the phytoplankton blooms, and observed winter water still present on the northern Chukchi Sea shelf. Interestingly, high nutrient water was found throughout the Chukchi shelf water column, such that the whole shelf was reset with cold winter water nutrients. The second Healy cruise in July 2014 was to study the shelf break region to assess the Pacific water boundary current. There was a detectable ice cover difference between the first and second Healy cruises. This latter July cruise focused more on the shelf break rather than the mid-shelf, and occupied 10 transects and serviced 5 moorings. Since no phytoplankton bloom was observed during the first Healy cruise, the latter cruise participants tried to find under ice plankton activity at the beginning of the second cruise. They saw some biological activity and so occupied more transects in the area. In short, Dr. Pickart presented a combination the HLY 1401 and 1402 cruises and their resulting composite datasets from the Chukchi shelf from May to July 2014.

Dan Holiday (BOEM) - The Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA) program launched in 1999 has provided baseline data and monitoring results for chemical contamination, turbidity, Boulder Patch productivity, and subsistence whaling in the vicinity of oil industry development in the Beaufort Sea outer continental shelf. Dan presented the 2014 ANIMIDA stations in the Beaufort Sea, which had an overall total of occupation of 400 sites. The map in the presentation showed the precise locations of the collection sites.

Kathy Kuletz (USFWS) gave an overview of the seabird surveys and prey populations in the Pacific Arctic. Auklets and murrelets were surveyed on four of the 2014 cruises, along with many other seabird species. Seabird species composition and abundance were similar from 2010-

2013, but these patterns were different in 2014. Additionally, although shearwaters had constituted half of the birds from 2010-2013 in the Northern Bering and Chukchi Seas, they were absent in 2014. Auklet distribution tended to be found in higher salinity-chl *a*-zooplankton zones. Shearwaters were also missing in the eastern region (based on results from the 2014 RUSALCA cruise). There was very little information on seabirds for the western Bering Sea during this time. Kathy's aim is to observe how the changes in water mass components, especially zooplankton and fish, are related to the changes in the Arctic.

Arny Blanchard (UAF) - The Chukchi Sea Environmental Studies Program (CSESP), an industry-funded program initiated in 2008, is a multiyear, multi-discipline marine site research program in the northeastern Chukchi Sea. This website, <http://www.chukchiscience.com>, offers more detailed reports. Dr. Blanchard presented the sampling design and the DBO4 transect line that was initiated in 2013. Data from biological oceanography from 2008 - 2014 demonstrates significant inter-annual variability. In the benthic macroinfauna they observed spatial differences, but there was a general increase in the abundance of animals and number of taxa offshore. The physical oceanographers concluded that the study area was a surprisingly complex system with a great deal of spatial and temporal variability, suggestive of a system in flux. Additionally, there were surprising benthic macroinfauna patterns between 2008-2013 (see graphs), on the order of 400% change in density over 5 years supporting the statement of this region being a system in flux. There was also high geographic variability for seabird distributions. Ocean acidification patterns in 2013 were similar to 2010-2012 showing that aragonite becomes undersaturated in bottom water seasonally.

Seth Danielson (UAF) introduced the circulation studies that were carried out in the northeastern Chukchi Sea over the last 7 – 8 years. The Chukchi and Western Beaufort Circulation Study focuses on providing crucial information to associate with the potential oil and gas development in the northeastern Chukchi Sea. A variety of land-based high frequency (HF) radars were installed at three sites in the northeastern Chukchi Sea and the western Beaufort Sea. Daily maps from the surface circulation from the HF radar data are available as well as mooring sites can be found in the project website (<http://dm.sfos.uaf.edu/chukchi-beaufort/>). Supporting data for the velocity observation data include data from meteorological buoys, ship-based CTDs, towed CTDs (acrobat system), gliders since 2010, temperature, and acoustical results to measure real time data for marine mammals. Jackie asked what the plans were to continue this type of sampling, and Seth said they hoped to receive funds in 2015 to do that. Note that these types of HF Radar are not available for Canadian waters.

Russ Hopcroft (UAF) – Russ presented the results from the US-Canada TRANSboundary collaborative cruise that has been collecting data for three years, with this year (2014) being the final field year for the project. The preliminary data for 2014 indicates that the Beaufort shelf was cooler than the off shore waters, and there were no pronounced thermal climate change indicators. Nutrients, chlorophyll, zooplankton measurements with different net sizes, benthos collected with trawls and traditional grabs, and fish collections using trawls were made during the cruises. He noted that Carin Ashjian is involved in a separate Arctic Observing Network (AON) project and has sampled for 10 years near Barrow in both the Chukchi and Beaufort seas

measuring temperature, salinity, chlorophyll a and CDOM fluorescence, and zooplankton with nets.

A3. Update and Planning of PAG Joint Field and Modeling Activities

John Calder (NASA) (ppt8) opened the session with a presentation of “points to consider” moving forward with PAG. He noted the main objectives of the session were to: (1) introduce and discuss new research focus areas that would be appropriate for joint and/or coordinated efforts by PAG participants, (2) confirm the identity of potential participants and coordinators for each focus area, and (3) identify next steps toward implementation. Points to consider included:

1. What is the overarching rationale of the proposed activities?
2. What are the specific outcomes of the proposed activities?
3. Should testable hypotheses be stated to guide activities?
4. Should specific space-time coordinates for stations and moorings be defined in advance?

In addition, Jackie Grebmeier (UMCES/CBL) reminded the group about the ICARP III sessions during the ASSW 2015 and emphasized that the deadline for the ICARP III abstracts is 9 November 2014. Koji Shimada is planning a workshop (to be held prior to the Toyama ASSW 2015 conference) to develop a white paper for the “Pacific Climate Line.” The workshop will focus on the Chukchi Borderland/Arctic Basin joint activities in relation to developing international “Pacific Climate Line” for the Canada Basin and shelf-basin lines.

Kathy Crane (NOAA) (ppt9) discussed the Arctic research program’s plan for future PAG collaboration 2015-2025 as well as a review of the RUSALCA activities. RUSALCA has obtained valuable data over the last decade on observations of ecosystems and physical systems, which are currently being synthesized into multiple papers to be published next September in the Oceanography Magazine as “the first decade of RUSALCA”. Data has shown that obtaining a full transect that is not limited by international borders is essential as extrapolation on one side of the sea cannot accurately predict the variability of the other side, for example for the DBO3 transect line between the USA and Russia. As another example of RUSALCA results, the tracking of fish using trawls also showed unexpected results with the Adolph’s Eelpout – a species discovered over the Chukchi Cap. Before the RUSALCA cruise these species were found only on the other side of the Arctic. In addition, the yellow Irish Lord - a boreal species - was found moving through the Bering Strait. Part of the RUSALCA program involves tracking changes in the whole Arctic system. In short, RUSALCA would like to continue sampling the Chukchi Sea, DBO3 and develop an extension of DBO4. In addition, they would like to expand RUSALCA northwards by collaborating with Pacific Arctic countries, including designing and implementing the Pacific Arctic ocean climate-ecosystem line, including atmospheric observations, and to provide data to the Alaska Ocean Observing System (AOOS) as a US contribution to the Arctic Council’s Arctic Biodiversity Data Service for the Circumarctic Biodiversity Monitoring Program (CBMP). There is a need to clarify and plan how to collaborate with Russia to collect more data

in Russian waters as it is difficult to use non-Russian vessels in that region. Kathy posed these questions: 1) Is there an agreement in place for Argo floats that can be used as a template?, and, 2) Is RUSALCA considering ice-tethered autonomous observations, or only ship-based ones? Such questions should be discussed among atmospheric scientists.

Koji Shimada (Tokyo University of Marine Science and Technology) ([ppt10](#)). The Arctic sea ice is receding and this will become one of the major hotspots in the next decade. The Arctic Ocean is one of the key factors influencing climate change. The sea ice motion affects the ocean circulation of the Pacific Water layer. When there is heavy sea ice, sea ice movement is restricted, but in low sea ice conditions, the sea ice moves more rapidly. Sea ice extent may be related to upper water conditions. Although sea ice motion in winter is very large, the ocean circulation is compact, centered at the east of the Northwind Ridge. Thus, it is an important area to understand the exchange of shelf water into the basin. Annual heat release explains part of the sea ice change. When the Pacific Ocean temperature was becoming warmer, there was a sudden cooling showing a huge amount of heat release in 2007 and 2008, and a reduction in Pacific Summer Water. The large amount of heat release measured and increased sea ice motion accounted for the reduction in sea ice in the region. Upper ocean response is delayed about three years relative to surface forcing (wind or sea ice motion), so the fact that the ocean does not respond immediately is key factor in the changes in the region. Therefore, the Pacific Climate Line section would be important in identifying the ocean circulation that is affecting the receding ice in the Arctic (i.e. center of action on sea ice reduction!). There are so many projects going on in the study area that our understanding has been improved; however, there is a gap in the northeastern Siberian region where a link between international projects would be extremely useful for understanding overall system change.

Dr. Bob Pickart and Dr. Jia Wang commented that this area is highly complex and complicated area that is rather hostile. Hence, they suggested first doing a model-based study before setting the Pacific Climate lines. Dr. Carin Ashjian pointed out that this is a huge area to cover, so she suggested it might be better to focus on a smaller area. Dr. Russ Hopcroft noted that ships would need to share the work rather than working at different times in order to address the scales simultaneously and to integrate the data for the Pacific Climate Line. For this Pacific Climate Line to be effective, PAG needs to carefully coordinate and collaborate.

Matthew Alkire (UW) ([ppt11](#)) presented goals, data and future activities of Nansen and Amundsen Basins Observational System (NABOS) and summarized the 2013 field campaign's preliminary data. The main focus was on formation mechanisms of halocline water in the Eurasian Basin using 116 stations with salinity and stable isotopes. NABOS is a biannual program that began in 2013 and the next cruise is planned to be in 2015 with a desire to collaborate with RUSALCA. NABOS focuses on the Siberian continental slope and the transport of branches of Atlantic water from the Fram Strait along the continental slope and mixing with the Siberian shelf waters.

Russell Hopcroft (UAF) ([ppt12](#)) - The Conservation of Arctic Flora and Fauna (CAFF) is the biodiversity working group of the Arctic Council. CAFF's Circumpolar Biodiversity Monitoring

Program (CBMP) goal is to facilitate more rapid detection, communication and response with respect to the significant biodiversity-related trends and pressures affecting the circumpolar world. The plankton effort of the CBMP continues to consolidate the zooplankton data. Two large datasets were delivered to the AOOS AXIOM data site effort. A number of methods for consolidating data are being undertaken as GIS-based approaches useful for developing more dynamic models coupled to physics. Environmental layers will be used to define niche habitat and predict species distribution. It was noted that some of the mapped distributions are pretty good. The data will be located on the AOOS website in preparation for transfer to the CBMP portal. Visualizations and aggregation of data are organized by hexagon cells that are clickable and identify information. The lack of skill to identify plankton is one of the biggest challenges in studying biodiversity, so molecular techniques are being increasingly used by barcoding the DNA sequences. If done properly, this method can be used to assign the animals to its closest relative, but naming still remains a challenge. It was noted that they are reviewing published papers and grey literature as well as contacting outside experts since taxonomic species identifications are a dying art. Technological advances in DNA sequencing are improving in order to match up with some of the taxa already known.

A4. Sea Ice and Atmospheric Studies

Joo-Hong Kim (KOPRI) ([ppt13a](#)) - KOPRI's research activities have focused on atmosphere and sea ice in the Arctic Ocean. Sea ice reduction and articles on cloud control on sunlight and its importance to sea ice have been published. Meteorological data (air pressure) patterns have been generated from 2008-2014 as well as predicted/estimated from 2015-2020. The RV Araon had continuous onboard atmospheric measurements during the 2014 Arctic cruise (Leg 1), such as air pressure, wind direction and speed, air temperature, humidity, shortwave and longwave radiations, greenhouse gases (H₂O, CO₂), and eddy momentum and heat fluxes. Also, at the first sea-ice station, an Atmosphere Weather Sampler (AWS) station was deployed to measure pressure, temperature and humidity of ambient air. During the first sea-ice camp (period: 8 August – 14 August), air pressure was high and had a general decreasing trend, the wind speed was relatively calm without much fluctuation, and the wind mainly blew from the north. During the period before implementation of the sea ice camp, however, the wind speed and direction showed high fluctuation due to the ship migrating between different weather regimes. The decrease of the total net radiation during the sea ice camp means that the sky became cloudier as it can be confirmed by sky pictures taken every day. Unfortunately, there were no reliable instruments for measurements of cloud properties. Dr. Kim hopes that next year there will be more enhanced cloud observation instruments. These ship-based, single time-series observations of near surface meteorological data alone may not be interesting at least to meteorologists who seek new scientific findings. However, these can become important data for improving the accuracy of model forecast through assimilating these data to the weather forecast system. Models are biased due to the high uncertainty, but assimilation of these data can improve the model's accuracy. Dr. Kim's long-term plan is to integrate records to study ice-atmospheric interactions. In the cruise, he also took part in the deployment of many types of buoys that measured ice mass balance, ice thickness, atmosphere radiation and other

meteorological variables. Integration of these atmospheric and oceanographic data will give valuable understanding on sea ice energy balance. As noted in the published papers, clouds significantly influence the Arctic surface energy budget, thereby affecting sea ice. During the discussion period, Dr. Joey Comiso suggested the integration of satellite data as well, but the different scales between satellite data and point measurements are an obstacle that needs to be overcome.

Kyoung-Ho Cho (ppt13b) - Changes in atmospheric circulation were examined in relation to positive feedback that drives catastrophic changes in the Arctic climate system. It was found that activation of sea ice motion is associated with an increase in wind factors (affecting sea ice speed/wind speed). It was found that freshwater content increased before 2008 and decreased after 2009. It was also found that the 2007 and 2008 sea ice reductions were caused by a heat release event. Surface warming after such a heat release and subsequent heat release events are crucial for sea ice reduction in the forthcoming summer. The presentation summarized the key issues as follows: 1) the atmospheric circulation wind factor is associated with sea ice properties, 2) upper ocean circulation and horizontal heat transportation are important, and 3) vertical heat flux is associated with turbulent mixing. It was noted that understanding of “feedback systems” is a key component in the Arctic Ocean.

Taneil Uttal (ppt13c) presented on behalf of Matthew Shupe about the 2014 activities to improve the understanding of clouds, boundary-layer structure, and air-ice/air-ocean interactions in the marginal ice zone. In 2015 the group will participate in the Sea State Field Program in the Beaufort/Chukchi Sea ice edge. The Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC), led by Matthew Shupe, is aiming to study Arctic first year ice. Comparing the Surface Heat Budget of the Arctic Ocean (SHEBA) project in 1997-1998 with MOSAiC, the MOSAiC team will perform more sophisticated measurements that SHEBA was unable to do. Moreover, the Arctic system is most likely to be in a different state relative to 20 years ago when the SHEBA project had been launched. Many papers have resulted from the SHEBA project, but no paper addresses the whole system of the Arctic yet. Dr. John Calder commented that Dr. Kim and Dr. Uttal’s presentations are an opportunity for the oceanographers to collaborate with the atmospheric scientists. It was also asked if PAG activities could be coordinated with MOSAiC?

A5. Modeling Activities

Clara Deal (UAF) (ppt14a, ppt14b) gave a brief overview of Dimethylsulfide (DMS) cycling using the Global Coupled Ice-Ocean Model: CICE-POP Biogeochemistry (BGCI) Model. This effort is in collaboration with the U.S. Los Alamos National Laboratory since 2008. The DMS model has biogeochemical compartments and processes in the numerical model. The DMS results in the model are intermittently linked to the marine food web. Clara presented data on comparisons with observations with DMS data density in the distribution of seawater DMS concentration data. Data from sea surface DMS concentrations in summer from 1959 -2009 were shown in the form of gridded observations, modeled values and modeled-gridded observations. Model results

suggested that the increasing DMS emissions were located where sea ice reduction was the greatest.

Gleb Penteleev (IARC) ([ppt15](#)) highlighted his colleague's activities, which includes the analysis of climate variability in the circulation in the Pacific Arctic Oscillation (AO). The analysis revealed anomalous circulation in PSAO (Pacific Side Arctic Oscillation) during 2008 -2009. EOF analysis of the T/S observations in the Chukchi Sea during 1948-2008 reveals strong difference of Pacific water flow from the "warm" and "cold years, implying that there was a strong impact on the biology and chemistry. Additionally they also obtained two MDOTs for the Pacific AO, which may be used as a SSH (sea surface height) reference in the assimilation of satellite altimetry observations. For operational hind cast/forecast of the Pacific AO circulation, locations of HFR (high frequency radars) were optimized with respect to the accuracy in estimating the Bering Strait transport. Reconstructions of the Chukchi Sea circulation were done through the assimilation of HFR velocities. The new approaches are: 1) adjoint-free variational data assimilation into regional models that showed excellent data assimilation; and 2) maximum likelihood ensemble filter ROMS-ICE model. John Calder asked that since there are many circulation models of the Chukchi Sea, will this work be useful to them? Gleb answered, yes, for the period constructed, they can try and use the inflow and outflow to improve their model.

Jia Wang (NOAA/GLERL), Haoguo Hu (University of Michigan) and Xuezhi Bai (University of Michigan) ([ppt16](#)) made presentations on modeling the Beaufort-Chukchi Sea Ice – Ocean Ecosystem using the coupled CIOM (Chukchi Sea Ice-Ocean Model) – PhEcoM (Physical-Ecosystem Model-NPZ). Haoguo showed the CIOM-stimulated August depth-averaged currents in the Chukchi Sea. The CIOM-stimulated model could be verified by the 2004 RUSALCA data in the Bering, Beaufort and Chukchi Seas. Xuezhi Bai showed the responses of the Chukchi-Beaufort Sea as a storm passed during the winter of 2006 and 2007 that had a difference of ice and water speed increasing with wind speed. Their observations are from the Chukchi and Beaufort seas. Also, shelf break currents reversed upwelling and downwelling. Surface heat flux was found to increase dramatically during storm passages, mainly from the sensible flux over the open water. Jia Wang presented CIOM-stimulated from January-June climatological landfast ice extent compared to landfast ice edge locations derived from synthetic aperture radar satellite data averaged over the period from 1996-2004. The model can also calculate the Beaufort-Chukchi Sea landfast ice seasonal cycle from 1990-2007. Jia proposed a new Arctic-CIOM configuration to collaborate with RUSALCA's northward expansion in 2015 -2020.

Dr. Muyin Wang (NOAA) - Modeling efforts and an Arctic flux field campaign were done in order to understand the ocean change in the system for predicting the future Arctic system. Dr. Wang's goal is to assess the best way of using global models. The global model resolution is too coarse and only provides initial conditions for regional models like ROMS. The length of ice presence estimated by 12 models showed that by the end of the century there will only be 1-2 months of ice cover in the Chukchi Sea. In 2013 and 2014 NOAA scientists flew missions on the NOAA P3 flights over the Chukchi and Beaufort Sea measuring the vertical profile of atmospheric parameters from the plane and dropping instruments (BTs) in open water. Vertical cross sections above open water and ice show differences in vertical cross sections. NCEP

matches the open water vertical structure well, but not over ice. Animation for forecast prediction was shown and compared with the data. It was noted that the Chukchi sea ice annual cover has been reduced.

B. October 29, 2014 (Wednesday morning)

B1. Coordinating Mooring Locations

Phyllis Stabeno (NOAA/PMEL) (ppt17a) will coordinate the PAG mooring location effort. The locations of known Arctic moorings were shown on a map. Phyllis aims to update all the known mooring sites on a map and build a list of the moorings with the contact person and upload them to the PAG website. Participants noted that industry moorings are not included, so more moorings were actually in the water than were present on the map. The issue with moorings is that not everybody reports to the notice to mariners of the mooring locations, especially bottom moorings. Furthermore, moorings are still lost to fishing gear despite notices to mariners. As some of the presented mooring sites were not accurately positioned, the owners of the moorings were asked to send Phyllis the correct GPS information for the updated map. New maps should include active dates and fates of the deployed moorings. This effort will produce valuable data sets for collaboration of mooring deployments by international partners.

Matthew Alkire (UW) (ppt11). NABOS (Nansen and Amundsen Basins Observational System) 2015-2020 cruise plan is aiming to extend the cruise to the East Siberian Sea/Markarov basin and adding two more transect lines to obtain more data on the shelf. NABOS also proposed to deploy 3 moorings in deep waters and two shallow moorings, plus hydrographic surveys to deepen their understanding of variability in the Arctic as well as examine heat, freshwater and geochemical processes affecting ecological processes in the region.

Seth Danielson (UAF) (ppt17b) showed one slide summarizing the moored long-term ecosystem monitoring. Objectives included: 1) monitor the Chukchi ecosystem year round; 2) determine the relative timing and magnitude of fluctuations of nutrient and carbonate chemistry, particulate matter, phytoplankton, zooplankton, and fish parameters to variations in each other and the current, waves, wind, light and ice; and, 3) provide researchers and resource managers with a multi-year reference to an arctic shelf biogeochemical dataset.

B2. Other PAG Relevant Activities – Open Discussion

Jinping Zhao (ppt18a) presented the Ocean University of China (OUC)'s effort on physical processes in the central Arctic. 2010 had record low sea ice concentration in the Central Arctic during summer compared to the summer of 2007. Due to heavy ice this year, the vessel could only go up to 85°N. Three ITPS buoys were deployed in collaboration with WHOI and long-term

observations of melt ponds. OCU deployed optical instruments for under sea ice observations and used an ROV (remotely operated vehicle) to measure the solar radiation associated with ice thickness. A weather balloon was used for joint observations of fog and sea ice. This year OCU deployed over 50 drifting buoys. Ocean circulation and water mass variations in the Canadian Basin indicated that since 2008 the denser water is found shallower in the water column while the light water is found deeper. Winds have been found to be stronger in 2008, while density was the driver before 2008. Density determines the depth of water buoyancy, but after 2008 the wind influenced the surface ice more. Although optical data is difficult to interpret it is useful for identifying the different types of water. Dr. Zhao is the lead PI of one of the new and largest projects for the Global Change Research Program of China in the Arctic. Understanding the amplification impacts and global climate effects related to sea ice retreat in the Arctic is the major goal of this program.

Gleb Penteleev (IARC) ([ppt18b](#)) presented a summary of observations and analysis of surface waves, currents, ice thickness and wave-ice interactions in the Chukchi Sea. Significant wave height measurements determined by satellite observations in the southern Chukchi Sea are being undertaken. Wave height has increased 35% over the past 20 years (Francis et. al. 2011). Coastal erosion in the north of Alaska was also estimated and mapped.

During this session there was a continuation of discussion on the Pacific Climate line, and issues of moorings. John Calder will help develop a scoping document of the PAG climate line for the spring PAG meeting and Phyllis Stabeno will continue her efforts on consolidating the mooring data.

B3. Status Report on PAG-endorsed DBO Ongoing and Planned Activities

Jackie Grebmeier, ([ppt19](#)) - The presentation included:

- Listing of the agenda for the 2nd DBO data workshop, Oct 29-31, 2014
- Highlights of science findings from the DBO pilot program, 2010-2014
- Topic of establishing new DBO lines in Beaufort Sea, NW Chukchi Sea, other locations in the Arctic

The goals of the DBO program were presented, including the linking of physics to biology and standardizing sampling protocols. Examples of data that have been collected included surface and integrated chlorophyll *a* (chl *a*) content, plankton, macroinfaunal biomass, and seabird and marine mammal surveys. Some of the highest chl *a* values were found via satellites and field data in the Bering Strait and SE Chukchi Sea in the area of DBO3, indicating that the SE Chukchi is a hotspot for primary production.

Lis Lindal Jørgensen (Institute of Marine Science (IMR), Tromsø, Norway) ([ppt20](#)) presented the goals of her teams work that included: informing the group about the annual joint Norwegian-Russian Barents Sea Ecosystem Survey, a possible position for a Northern Barents Sea DBO transect line, and the upcoming announcement for a post-doc (and possible starting

point for a DBO collaboration). The annual joint Norwegian-Russian Ecosystem Survey in the Barents Sea collects data on commercial fish stocks with an annual sampling grid including CTD, nutrients, phytoplankton, zooplankton, pelagic and benthic fauna, marine mammals, seabirds, and pollution parameters. Ecosystem survey data include long term datasets collected since 2003 that can be used for mapping as well as allows migrating species to be followed. There are still challenges in understanding the links and processes influencing the Barents Sea ecosystem. Hence, to address this issue there are two strategic initiatives investigating the processes and interactions in food webs: 1) the SI Arctic (Strategic Initiative-Arctic), and 2) Trophic Interactions in the Barents Sea (TIBA) that are steps towards an Integrated Ecosystems Assessment. Dr. Jørgensen proposed a potential DBO line in the northern Barents Sea shelf/slope where there is a planned extension of annual ecosystem data in coordination with collections already being obtained annually with many partners in Germany and Poland. Dr. Pickart suggested extending the line to the Atlantic boundary current, but the issue of ice conditions and depth of 4000 m needs to be considered. Lastly, IMR is searching for a post-doctoral researcher to work on boreal-arctic marine food-web ecology and stable isotope collections on the potential DBO transect line. The group can check the following website for data updates: www.imr.no/forskning/forskningsdata/en/.

Jackie Grebmeier (UMCES/CBL) (ppt19) discussed the DBO AXIOM workspace and EOL DBO data archive. The team is finalizing a DBO and PAG data metadata policy for all participants in the program in order to allow the Pacific Arctic Group to share datasets and make them available to the public. There are national and international data sharing and metadata issues to consider. AXIOM is developing visualization tools and will transfer data to a long-term archive.

Sue Moore (NOAA/NMSF) - presented information related to the Future Earth Science Cluster Network and noted that ISCU Future Earth Initiative is a planning tool that aims to connect existing programs and projects to support transformation to a sustainable earth.

B4. Data Sharing within PAG

Jackie Grebmeier gave a brief update on data sharing topic ([ppt21](#)). PAG agreed to follow the IASC data policy that was approved by IASC Council in 2013. Data should be open and used as free data. There was discussion as to whether the group wanted a standard metadata site on the common PAG portal with links to national data portals. Since PAG and DBO are endorsed by IASC, we agree in principle that the data obtained should be shared. See the IASC Statement of Principles and Practices for Arctic Data Management [here](http://www.iasc.info/home/iasc/data/):

B5. Synthesis-Status and Future Plans

Jackie Grebmeier (UMCES/CBL) (ppt21) has co-edited the PAG-endorsed book on the “Pacific Arctic Region” that was published by Springer in June 2014 and consists of 12 chapters.

Sung-Ho Kang (KOPRI) added that KOPRI has submitted 15 papers of which, 6 were currently accepted, 5 are still under revision, and 4 were rejected. The special issue for ARAON Arctic research will come out in Deep Sea Research II.

Takashi Kikuchi (JAMSTEC) (ppt22) has contributed to the special volume in the journal Biogeosciences entitled “Catastrophic reduction of sea ice in the Arctic Ocean - its impact on the marine organisms and ecosystems in the polar region”. He presented the titles of the journals, which currently has 26 papers planned for the special issue.

B6. Updates on Interactions with Other Organizations and Upcoming Meetings – IASC, SAON, PICES, APECS

Sung-Ho Kang (KOPRI) (ppt23) - The North Pacific Marine Science Organization (PICES) is an intergovernmental scientific organization established in 1992 to promote and coordinate marine research in the northern North Pacific and adjacent seas. The annual PICES Meeting was recently held in Yeosu, Korea. Dr. Hyoung-Chul Shin, from the Department of International Affairs of KOPRI, briefly introduced PAG and reported to the committee that PAG is planning to expand the PAG observations, discussed the recent developments with data exchange and sharing, and outlined the PAG contribution to the ongoing initiative to coordinate and prioritize the future Arctic research questions. PICES expressed a positive response on the observations in the sub-Arctic and Arctic waters and data sharing practices of PAG.

Takashi Kikuchi (JAMSTEC) (ppt24) - The Arctic Change 2014 Conference (9-12 December 2014) aims to stimulate discussion and foster collaborations among people with a vested interest in the Arctic and its peoples. PAG organized the session “T46, The Pacific Arctic Region: Physical Forcing and Ecosystem Response”, co-chaired by Takashi Kikuchi, Jackie Grebmeier and Sung-Ho Kang. Takashi highlighted other interesting sessions that members may attend.

Jacqueline Grebmeier (UMCES/CBL)

- The AGU 2014 Fall meeting brings together a large number of earth and space sciences community members for discussion of emerging trends and the latest research. This will be held in San Francisco 15-19 December 2014.
- The IASC Marine Working Group has endorsed and supported the 2014 DBO workshop.
- SAON (Sustaining Arctic Observation Networks) under the Arctic Council has endorsed DBO as one of its tasks. SAON has two groups, the observing group and a data group. Jackie is part of the observing group within SAON.
- ASSW 2015 Toyama, Abstract deadline November 10, 2014
- Gordon Research Seminar/Gordon Research Conference, March 2015 Tuscany, Italy update (Co-Chair Jackie Grebmeier update, Chair: Paul Wassmann, Norway)

Kathy Crane (NOAA) (ppt25a, ppt25b) is the Steering Group Chair of the Circumpolar Marine

Biodiversity Monitoring Program (CBMP) which is part of CAFF. Sentinel RUSALCA stations within the DBO will feed into an international understanding of changes in biodiversity. Additionally, sentinel seabird plankton stations and transects will be important to PAG. CAFF will become open for observer countries in 2015 for those who are interested in contributing expert knowledge and long-term datasets.

Phillip Mundy (NOAA/NMSF/AFSC) (ppt26) - Protection of the Arctic Marine Environment (PAME) is an ecosystem-based management. PAME's primary interests are related to the Alaskan Coastal Waters and it is working with Canada to develop a transboundary ecosystem-based management program for the region. Arctic Council activities of interest to PAG include: AMAP (SWIPA), marine shipping assessment and IIC – Identification of Arctic marine areas of heightened ecological and cultural significance. They were also interested in DBO as an organizing principal and applications for the ecosystem-based management. It was noted that they have been able to occupy the eastern Bering Sea most years.

Sung-Ho Kang (KOPRI) (ppt27) – ICARP III provides a blueprint to help identify the Arctic science priorities for the next decade and to coordinate various Arctic research agendas. ICARP III does not undertake the development of new science plans, rather it builds on the many comprehensive science plans that exist already, complimenting them by filling the gaps that may need attention. ICARP III was formally launched in ASSW 2014 in Helsinki, Finland, culminating to a final conference during ASSW 2015 in Toyama, Japan next April 2015. PAG can participate in the ICARP III by providing valuable dataset for ongoing research and development of cooperative synthesis in the Pacific and Atlantic marine sector. PAG is highlighting its ongoing DBO studies as well as studies in the western Chukchi/Canada Basin of physical oceanographic research programs, including continued development of a Chukchi Borderland/Arctic Basin Environmental Observing system. PAG is participating in ICARPIII by providing valuable dataset for ongoing research and development of cooperative synthesis in the Pacific and Atlantic marine sector.

B7. PAG Structure

The PAG Executive Committee is composed of PAGs Chair, Vice-Chairs, and leads from each of PAG activities: DBO (Jackie Grebmeier), Canada Basin and Pacific Climate Line (Koji Shimada), shelf-basin exchange (Bill Williams), sea ice-atmosphere (Joo-Hong Kim)

Current rotation plan: Chair and Secretariat

- 2012-2014 – USA (Jackie Grebmeier, UMCES)
- 2014-2016 – Korea (Dr. Sung-Ho Kang, KOPRI)
- 2016-2018 – Japan (TBD)
- 2018-2020 – Russia, Canada, or China?

8. PAG Secretariat (moving from UMCES to KOPRI over next 6 months)

- Organizes fall meeting with host country, spring meeting with ASSW organizers
- As the PAG becomes larger, science subgroups may need to hold meetings outside the PAG meeting schedule or be co-incident with PAG meetings. This topic is under continued discussion.
- The PAG website remains in Iceland (Arctic Portal), but the administrator will transition from the US to KOPRI (Alyne Bayard, CBL/UMCES to Dr. Sung-Ho Kang, KOPRI).

9. Future PAG meetings

- April 2015 – ASSW2015, Toyama, Japan (<http://www.assw2015.org/>)
 - April 23-25, 2015: Business meetings (PAG meeting April 24, 2014)
 - April 26: public lecture and excursion
 - April 27-20: ICARPIII and ISAR4
- Fall 2015 – Korea
- Spring 2016 mid-March - ASSW2016, Fairbanks, Alaska (March)
- Fall 2016-TBD (open offers)
- Spring 2017 - ASSW2017, Prague, Czech Republic
- Fall 2017-TBD (open offers)
- June 2018 - ASSW2018 as Joint SCAR-IASC Conference, Davos, Switzerland

Sung-Ho Kang, the new PAG chair, thanked Jackie Grebmeier for her outstanding leadership and enormous contribution to PAG. He then closed the meeting.

Appendix C1. 2nd DBO Data Workshop Final Agenda

Pacific Arctic Group (PAG) Fall Meeting Agenda ([ppt0](#)) October 28-29, 2014

Pacific Marine Environmental Laboratory (PMEL)/National Oceanic and Atmospheric Administration (NOAA), 7600 Sand Point Way NE, Bldg. 3, Oceanographer Room
Seattle, WA 98115 USA

Tues. October 28, 2014	Wed. October 29, 2014
0730 and 08:00 - transport hotel to PMEL; security clearance and registration	0730 and 0800 transport hotel to PMEL
0900 - 1030 Morning 1	0830 - 1000 Morning 1
1030 - 1050 Coffee break	1000 - 1020 Coffee break
1050 - 1230 Morning 2	1020 - 1200 Morning 2
1230 - 1330 Lunch at PMEL cafeteria (no host)	1200 End of PAG meeting; van rides back to the hotel for those not staying for DBO workshop
1330 - 1500 Afternoon 1	1230-1330 Lunch at PMEL cafeteria (no host)
1500 - 1520 Coffee	1330 Begin DBO Data Workshop
1520 - 1700 Afternoon 2	
1715 - van rides to hotel;	
1730-1830 - wine reception at hotel; dinner on own	

Overview: The Fall PAG meeting is hosted at various locations in alternating PAG countries after the field season and is focused on review of accomplishments during the previous summer and outlooks for the future. These discussions are useful in developing scientific exchanges and other types of collaborations during and after field operations. The Spring PAG meetings are held during Arctic Science Summit Week and are focused on “business” issues and an update on research plans for the coming field season.

2014 Fall PAG Meeting: 28 October 09:00 start time at PMEL (see schedule above)

Introduction and Welcome (Jackie Grebmeier)

- Welcoming remarks (Christopher Sabine, PMEL Director)
- Brief introduction of PAG and meeting agenda (Jackie Grebmeier, Chair)-**ppt1**

Appendix C1. 2nd DBO Data Workshop Final Agenda (cont.)

Agenda items:

- Update (highlights) of 2014 field results and science findings; preliminary 2015 plans (up to 30 minute maximum time per country, including discussion) (**morning**)
 - Canada: Bill Williams-**ppt2a** and Humprey Melling-**ppt2b**
 - China: Jianfeng He-**ppt3** (Jackie Grebmeier presented from April 2014 PAG meeting presentation)
 - Japan: Takashi Kikuchi-**ppt4**
 - Korea: Sung-Ho Kang—**ppt5**
 - Russia: RUSALCA (Aleksey Ostrovskiy-**ppt6a**, Kathy Kuletz-**ppt6b**)
 - United States: Jackie Grebmeier/Robert Pickart/Russ Hopcroft/Arny Blanchard/Kathy Kuletz/Catherine Berchok-**ppt7**

- Updates and Planning of PAG joint field and modeling activities-**Discussion Lead: John Calder—ppt8**: Introduction to session and topical overview of components, including:
 - Chukchi Borderland/Arctic Basin joint activities in relation to developing international “Pacific Climate Line” for Canada Basin and shelf-basin lines; possible workshop proposed prior to ASSW15 in Toyama, Japan
 - RUSALCA northern expansion program shelf to basin (Kathy Crane-**ppt9**)
 - CB/Basin and shelf-basin exchange lines (Koji Shimada-**ppt10**, Sung-Ho Kang, Bill Williams, Bob Pickart, Humfrey Melling, Takashi Kikuchi, Richard Krishfield)
 - NABOS update: Matthew Alkire-**ppt11**
 - Biodiversity (Russ Hopcroft/Kathy Kuletz)-**ppt12**
 - Sea ice and atmosphere: Joo-Hong Kim-**ppt13a**, Ichiro-**ppt13b**, Taneil Uttal-**ppt13c**
 - Modeling activities (Clara Deal-**ppt14a**, **ppt14b**, Gleb Panteleev-**ppt15**, Meibing Jin, Jia Wang, Hu and Bai-**ppt16**, Muyin Wang)
 - Coordinating mooring locations (Phyllis Stabeno-**ppt17a**), Seth Danielson-**ppt17b**)
 - Other PAG relevant activities-open discussion-Jinping Zhao-**ppt18a**, Gleb Penteleev (**ppt18b**)

- Status report on PAG-endorsed DBO ongoing and planned future activities (Jackie Grebmeier beyond presented in country reports)-**ppt19**
 - Introduction of agenda 2nd DBO data workshop, Oct 29-31, 2014
 - Brief highlight science findings from the DBO pilot program 2010-2014
 - Establishing new DBO lines in Beaufort Sea, NW Chukchi Sea, N Barents Sea
 - Beaufort Sea region (Jackie Grebmeier)
 - NW Chukchi Sea (Kathy Crane/RUSALCA)

Appendix C1. 2nd DBO Data Workshop Final Agenda (cont.)

- Northern Barents Sea (Lis Lindal Jørgensen, Institute of Marine Research, Tromsø, Norway)-**ppt20**
 - DBO AXIOM workspace and EOL archive, DBO and PAG data metadata policy
 - Plans for DBO publications and 2015 field activities
 - Future Earth Science Cluster Network update
- Data sharing and issues-discussion-**ppt21**
 - Agree on following IASC data policy approved by IASC Council 2013
 - Discussion if want standard metadata site on common PAG portal, with links to national data portals
 - Mooring data-status and need coordinate metafile?
 - Other input?
- 5. Synthesis-status and future plans
 - Springer PAR synthesis book published June 2014 (Jackie Grebmeier)-**ppt21**
 - ARAON DSR Special issue update (Sang Lee)
 - Biogeosciences-Special issue update (Takashi Kikuchi)-**ppt22**
- 6. Updates on interactions with other organizations and upcoming meetings – IASC, SAON, PICES, APECS, others
 - PAG talk at PICES MONITOR meeting October 2014 (update Sung-Ho Kang)-**ppt23**
 - Arctic Net “Arctic Change 2014” Conference, Dec 9-12, 2014, PAG session (leads: Takashi Kikuchi, Sung-Ho Kang, and Jackie Grebmeier)-**ppt24**
 - AGU 2014 US Polar Research Board sponsored “Changing Arctic Ecosystems of the Arctic and Antarctic” (Jackie Grebmeier)
 - CAFF/PAME/AMAP activities (Kathy Crane-**ppt25a, ppt25b**, Phil Mundy-**ppt26**)
 - ICARPIII status report (Sung-Ho Kang)-**ppt27**
 - IASC Marine Working Group (Jackie Grebmeier)
 - SAON update (Jackie Grebmeier)
 - Gordon Research Seminar/Gordon Research Conference, March 2015 Tuscan, Italy update (Co-Chair Jackie Grebmeier update, Chair: Paul Wassmann, Norway)-**ppt21**
 - Others?
- 7. PAG structure
 - Executive committee composed of PAG Chair, Vice-Chairs, and leads from each of PAG activities: DBO (Jackie Grebmeier), Canada Basin, Pacific Climate Line shelf-basin exchange (Koji Shimada), sea ice-atmosphere (Joo-Hong Kim)
 - Current rotation plan: Chair and Secretariat

Appendix C1. 2nd DBO Data Workshop Final Agenda (cont.)

- 2012-2014 – US (Jackie Grebmeier, UMCES)
 - 2014-2016 – Korea (Sung-Ho Kang, KOPRI)
 - 2016-2018 – Japan (TBD)
 - 2018-2020 – Russia, Canada, or China?
8. PAG Secretariat (moving from UMCES to KOPRI over next 6 months)
- Organizes fall meeting with host country, spring meeting with ASSW organizers
 - Science subgroups hold meetings outside schedule or should these be co-incident with PAG meetings?
 - Location of Secretariat same as location of Chair or should we consider possible semi-permanent location for PAG Secretariat, how fund?)
9. Future PAG meetings:
- April 2015 – ASSW2015, Toyama, Japan (<http://www.assw2015.org/>)
 - April 23-25, 2015: Business meetings (PAG meeting April 24, 2014)
 - April 26: public lecture and excursion
 - April 27-30: ICARPIII and ISAR4
 - Fall 2015 –TBD (open to offers)
 - Spring 2016 - ASSW2016, Fairbanks, Alaska (March)
 - Fall 2016-TBD
 - Spring 2017 - ASSW2017, Prague, Czech Republic
 - Fall 2017-TBD
 - June 2018 - ASSW2018 as Joint SCAR-IASC Conference, Davos, Switzerland

Appendix C2. 2nd DBO Data Workshop Participant List

Country	First Name	Last Name	Affiliation	Email Address
Canada	Catherine	Lalande	Takuvik/ArcticNet, Université Laval	catherine.lalande@takuvik.ulaval.ca
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Appendix C2. 2nd DBO Data Workshop Participant List (cont.)

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Appendix C2. 2nd DBO Data Workshop Participant List (cont.)

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