International Cooperative Engagement Program for Polar Research (ICE-PPR)

EVENT SUMMARY
ANCHORAGE, ALASKA, U.S.A
25-27 OCTOBER 2017

“A Perspective from the Bering, Chukchi and Beaufort Regions”
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25-27 Oct 2017 ICE-PPR Summary
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I. Introduction

ICE-PPR: a unique collaboration in polar research, based on shared goals and mutual interest. A significant challenge faced by nations who operate in the Polar Regions, is transitioning from research and technology to operations. The International Cooperative Engagement Program for Polar Research (ICE-PPR), hosted by the Arctic Domain Awareness Center in Anchorage, Alaska from 25 to 27 October 2017, discussed challenges resulting from a changing Arctic environment, in addition to seeking to encourage collaboration on maritime research. A significant outcome of the forum was advancing combined approaches between ICE-PPR nations in polar science and technology research and testing.

The International Cooperative Exchange-Program for Polar Research (ICE-PPR) is a developing framework between the United States, Canada, Denmark, Finland, Iceland, New Zealand, Norway and Sweden. This unique collaboration provides national delegations the opportunity to expand cooperation with Arctic nations in terms of mutual interests in science and technology research that enhances regional security. As ICE-PPR is an inclusive framework to both Polar Regions, the research collaboration benefits from the participation of not only Arctic nations, but also gains insights to applicable research efforts from New Zealand’s orientation to the Antarctic.

The ICE-PPR participants are have initially established four research areas of collaboration between national delegations:

- Situational awareness;
- Human performance;
- Platforms;
- The Environment.

ICE-PPR establishes a suitable framework to share national advances in science and technology, benefiting security and defense support to participating national civil authorities in missions such as search and rescue, humanitarian assistance and disaster response.
The ICE-PPR framework provides improved opportunity via research and development to improve multi-national interoperability, while encouraging smart resource utilization in pooling and sharing of limited assets in polar research.

The ICE-PPR framework is flexible in terms of collaboration, encouraging paring of national delegations on research collaboration based on mutual interest. This includes military-to-military, and government-to-government research projects, and leveraging investments and research experience through cooperation. Important to the collaborative framework is the opportunity for experimentation via demonstrations, exercises and operations.

ICE-PPR delegations are currently developing a new multinational mil-to-mil framework agreement, led by an Executive Steering Council vested with permissions to facilitate and coordinate the following activities:

- Establish ICE-PPR Working Groups using Terms of Reference (TOR), for the purpose of harmonizing requirements to enable potential cooperative projects;
- Permit the exchange of RDT&E information and the establishment of Project Arrangements (PAs) with at least two of the nations;
- Enable Cooperative Project Personnel (CPP) and Equipment & Materiel Transfer Agreements (E&MTA); and
- Identify opportunities for Experimentation, Demonstration, Exercises (EDE)

While the ICE-PPR multi-lateral framework agreement continues in development and negotiation, the span of cooperation is oriented for mil-to-mil and mil-to-government cooperation, with no independent provisions to establish a multi-national governing construct with University conducted research activities.

Consistent with the established four areas of research collaboration, ICE-PPR participants place more emphasis on shared activities and mutual benefit research contributions than information exchanges. While still in development, a sampling of the types of potential cooperative activities under the ICE-PPR collaborative framework include:

- Polar Environmental Modeling, prediction, and information sharing;
- Polar Sensors and Remote Sensing techniques;
- Polar Communications and Situational Awareness;
- Platform Design and Performance for Polar Environments;
- RDT&E Infrastructure in and for Polar Environments;
- Experimentation and Demonstrations in Polar Environments;
- Education, Training and Exercises;
- Personnel Exchanges;
- Navigation in Ice Conditions;
- Logistics, including Energy Generation and Energy Efficiency, in Polar Environments;
- Polar Meteorology, Hydrography and Oceanography;
- Human Performance and Operations, e.g., medical, physiological, in Polar Environments;
- Social Science Research; and
- Operations Research.
As an illustration, as recently as summer 2017, a combined effort between participating ICE-PPR collaborators resulted in shared success in transporting and delivering advanced sensor-laden data buoys in remote Arctic waters to gain increased understanding of the Arctic Domain:

As highlighted by the U.S. Office of Naval Research, Air-Deployable Expendable Ice Beacon (AXIB) buoys were air delivered by a Royal Danish Air Force C-130 aircraft operating out of Thule Air Base Greenland. The buoys were made of Arctic hardened materials able to withstand open-ocean or freezing within sea ice. Designed for a three to five year lifespan, the buoys sense and record air pressure, air, ocean and ice temperature, along with ice movement. The mission was part of the International Arctic Buoy Program (IABP), and involved ONR, the U.S. National Ice Center, the Office of the Oceanographer of the Navy, Environment and Climate Change Canada, and the University of Washington. The IABP is composed of member groups that place and maintain drifting buoys throughout the Arctic—and offer meteorological and oceanographic data for scientific research.¹

ICE-PPR meetings occur on an approximately 6-month basis. The Royal Danish Defense Forces hosted the previous ICE-PPR meeting at Nuuk Greenland, in May 2017.

A unique Arctic region: The Bering, Chukchi and Beaufort Seas. The Bering, Chukchi and Beaufort Sea regions of the Arctic is unique in the physical, security and economic aspects, and distinctly different in all three of these factors when compared/contrasted to the Greenland, Norwegian and Barents Sea. The Bering and Chukchi regions provide a shallow and constrained access route to the Arctic for Pacific nations, utilized for entrance for both Russia’s Northern Sea Route and the Northwest Passage. In the coming decades, this region will likely serve as the western access point to Transpolar shipping...directly connecting commercial markets in East Asia with Europe.

In terms of the physical environment, temperatures in the Bering, Chukchi and Beaufort have lagged correspondingly similar latitudes in the Norwegian and Barents, (mostly due to the Gulf Stream affects in the Atlantic) and face increasingly difficult maritime weather. Economically, the Bering is a vital fishery, and the Chukchi and Beaufort Sea regions have considerable petroleum, natural gas and mineral wealth.

The people of the Bering and Chukchi region remain economically disadvantaged, while the Beaufort region people faring only slightly better.

Maritime traffic in this region continues to advance rapidly, due mostly to destination tourism and research. “Throughput” shipping is increasing as well, mostly due to liquefied Natural Gas produced in Russia steaming to East Asian markets.

Security and defense interests are significant in the Bering, Chukchi and Beaufort regions, due to constrained Arctic Ocean access and national sovereignty needs among the nations in the region.

The Bering, Chukchi and Beaufort Sea coastlines are increasingly threatened by the combination of thawing permafrost, diminished shorefast ice (which serves as a protective barrier from ocean waves) and increasing storm surge (with corresponding coastal inundation). The combined effects of thawed terrain, diminished shorefast ice, with increasing ocean fetch results in increased coastal erosion, threatening shoreline infrastructure.

The above discussion is a representative sample of the challenges faced in the Bering, Chukchi and Beaufort regions, provided as an initial orientation for ICE-PPR participants.

The U.S. Office of Naval Research decision to sponsor ICE-PPR at the University of Alaska, conducted by ADAC, provided an opportunity for ICE-PPR participants to learn about this unique Arctic region, physically and environmentally different from the Barents and Greenland Sea Arctic regions. This event provided an opportunity where academic and government operators who focus in the Bering, Chukchi and Beaufort Sea Regions could inform ICE-PPR national science and technology representatives.

Additionally, ADAC planners aligned the Alaska ICE-PPR workshop to follow ADAC’s conducting of an Arctic-related Incidents of National Significance (Arctic IoNS) research workshop titled “Coping with the Unthinkable...an Arctic Maritime Oil Spill” which was open for all ICE-PPR participants. ADAC was pleased that several ICE-PPR delegations took the opportunity to participate in the Arctic IoNS workshop. The 25-27 October ICE-PPR in Anchorage provided an opportunity for participants to discuss challenges in advancing research to meet operational needs in the Polar Regions as well as discuss emerging research gains from the participating ICE-PPR nations.
The end of the report contains an Annex that describes near-term options for combined ICE-PPR research collaboration.

The following is a summary of presentations provided by participants at the event.

II. Overview Presentations

Arctic Domain Awareness Center. Introduction and strategic overview, the Arctic Domain Awareness Center, a U.S. Department of Homeland Security Center of Excellence in Maritime Research hosted by the University of Alaska. The Arctic physical environment is increasingly dynamic due to warming trends. Current weather trends from multiple accredited sources validate that across the Arctic maritime region, sea ice melt is increasing and associated ice pack contraction in terms of area and volume is decreasing. Accordingly, (for at least the summer season), the historical barriers of ice in the Arctic maritime region continues to shrink, affording improved access to human activity.

The U.S. Navy and the U.S. Coast Guard have described the Arctic as a “new ocean.” This seasonal opening of the Arctic is affording new interest in Arctic maritime tourism, to include cruise ship passages of the fabled Northwest Passage. Seasonally ice reduced and ice-free Arctic Ocean spaces provide improved access to sea floors for rare earth and other mineral extraction. Reduced sea ice thickness (in particular, multi-year sea ice) will likely reduce challenges in future oil extraction. Reduced sea ice also affords increased access to throughput shipping, in particular, Russia’s Northern Sea Route and eventually, transpolar shipping. Due to shallow and narrow routes, Canada’s Northwest Passage remains a less desired route for polar transshipping traffic.

As human activity, increases, so does the potential of increased security threats, from both symmetrical and asymmetrical sources.
Maritime security and safety issues that exist in lower latitudes are likely to manifest in the opening of the Arctic maritime spaces, which currently receive a minimal amount of Coast Guard and other law enforcement presence. Patrolling and policing for illicit trafficking, illegal fishing, unregulated mineral extraction, and unsafe tourism practices is already difficult and will likely worsen as criminals see opportunity in the High North.

Resource extraction in a diminished ice-environment across the Arctic is more economically feasible and more readily accomplished. Petroleum, Natural Gas and rare earth minerals are abundant across the Arctic. Economic forecasts predict more nations and industry will increase activities to extract previously inaccessible natural wealth.

As the Arctic warms, ground frozen for centuries is thawing. This newly thawed terrain is proving to be vulnerable to erosion, which is of particular impact in coastal Arctic Alaska and the people who live across this fragile region. An increasingly dynamic environment in the Arctic is affecting populations whose ancestors have inhabited the region for generations.

Many of these people strive to retain culture and traditional ways of life, and live close to coastal shorelines that are eroding rapidly due to increased storm surges, lack of protective shore ice, and thawing permafrost.

Costly coastal infrastructure is failing. Arctic warming is reducing the amount of shore-fast ice that has historically served as a protective barrier from the sea for native villages along the coastal Arctic. As previously mentioned, warming in the Arctic is increasingly linked, to rising weather severity and coastal storm surges.

Arctic communities are less prepared to cope with seasonal increases in traffic and are virtually unable to cope in supporting a major emergency such as hosting tourists fleeing from a disabled cruise ship. These communities are also ill prepared to cope with increased law enforcement challenges. These changing environmental factors of reduced ice and thawing permafrost, coupled with increased storm frequency and severity united with increased human activity equates to increased demands of urgent and emergency response to U.S. and other Arctic nation’s Coast Guard (or other maritime emergency responders).
From a North American vantage U.S. and Canada Coast Guard missions across the North American Arctic region are complex, operationally risky and logistically straining. With the bulk of permanently assigned forces stationed in South Central Alaska, U.S. Coast Guard faces a “time and distance” problem in anticipating and responding to SAR, HA, and DR crisis in the Alaskan Arctic. Equally challenging is the ability to support any joint missions with Canadian first responders.

Accordingly, the ability to gain advanced domain awareness in the Arctic region and to leverage such awareness to increase decision agility, is needed to reduce mission risk and risk of mission failure. Quite literally, achieving awareness of the Arctic domain for the Coast Guard and other government operators is challenged due to lack of Arctic maritime domain knowledge. In particular, resilient infrastructure, imagery, information, environmental data, communications and inputs from array of sensors monitoring the domain, currently is insufficient to gain needed understanding and orient appropriate responses.

Through appropriate work in science and technology, many of these factors can be addressed to produce good and practical results...through skillful and well-networked research and development.

International Arctic Research Center (IARC)

The University of Alaska Fairbanks International Arctic Research Center (IARC) presentation focused discussions on the idea of a collaborative Arctic information infrastructure. It was noted by the presenter that observational data in the United States is currently obtained by approximately 1/4 federal, 1/3 academia, 1/6 local, and the remaining 1/4 from foreign nations. The core of this idea is to develop a system for synthesizing and storing data more effectively. IARC serves as a gateway to Arctic climate science for collaboration between agencies and foreign nations. In addition, the Center provides transformative Arctic Ocean trends in changing ice formation and concentration, showing a reduction in as much as 20 percent per decade. However, this loss of summer sea ice also includes an opening to enhanced communications. Sea ice concentration trends in March depict the reduction, meaning changes will happen during summer months, while restoration occurs during winter (resetting itself).
It was also noted that Arctic warming is unique since heat becomes available to ice cover differently than anywhere on earth, including the Antarctic. First, the vertical exchange of heat from Atlantic crust is increasing steadily, thinning the ice. It was expressed that IARC is currently unprepared to track this phenomenon, let alone predict it. Secondly, inertia of the currents is increasing rapidly (unpublished experimented research data), which used to be stable, causing turbulent heat transfer.

IARC argues that autonomous sensors and technology is imperative to observe sustainably. The rate of ice building (minus loss) is diminishing by two to three weeks per century; linear interpolation from this experimental data suggests there will be an “intersection” between the transition period of building and losing ice in which ice stops building sustainably. The Sea Ice Prediction Network (SIPN) includes several models providing synthesized and more accurate, longer range predictions on sea ice, including model uncertainty.

Questions from the Presentation:

Question: Is the as-mentioned IARC Synthetic Aperture Radar the first year of operation? It is the first year of its operation, which can detect millimeter differences in sea ice change.

Question: Given the difficulty with Russia in the Arctic, how does this affect 2017 modeling projections? There was close collaboration with Russia not long ago (2016), which included detailed research; this was a channel that related nations. Maintaining international research should not be underestimated. Additionally, the United States Coast Guard is able to communicate with Russia through an international Coast Guard forum.

Alaskan Command (ALCOM)

“Arctic operations by necessity are a collaborative effort,” quotes the Alaskan Command representative. Alaska is a strategic location for all Northern operations; it is the closest United States entity to all Northern capitals. It was argued that other nations are pushing for Arctic development so the United States should as well, if only to not be left behind. Alaska has little to no support from other parts of the U.S., as it lacks Emergency Management Assistance Compact (EMAC) agreements because there are no bordering states. In the event of an emergency, ALCOM offers kits that keep people safe for 72 hours until help arrives with viable transportation. The presenter illustrates that there are three recurring Arctic challenges: presence, communications, domain awareness, and infrastructure. It was argued the United States needs to show more responsibility with its Arctic presence, being an Arctic nation. Alaska is of great strategic value to the U.S. and other countries; the threat is real and Alaska offers premiere training areas.

Presentation Comment: Developing a framework to start training together would be a start; exercising each nation’s and agency’s forces together in the Arctic region is invaluable to build synergy and true multinational capability.
Canadian Joint Operations Command, Joint Task Force North

The first argument made by Joint Task Force North from Canada is that permafrost reduction could have a larger affect than expected. The presenter moved on to the core argument, which “challenges mean we have to collaborate.” The Canadian Armed Forces (CAF) presence in Canada’s North includes over 60 sites, which represent the anchor of activities in the North. Nonetheless, a Canadian-U.S. civil assistance plan would need to inquire resources from surrounding provincial entities. Canadian Rangers provide expertise in surviving and operating in the North, but infrequently activated. The presenter expressed that an Arctic Security working group as a potentially very effective way to start collaboration. The Ocean Watch program is one example of collaboration between Canadian industry and military.

Presentation Questions and comments:

Comment: An Arctic patrol ship having fuel capacity (enough for a 600-ton vessel) is to be activated in late 2018 – early 2019.

Question: How is tribal establishment maintained? Designated Canadian military personnel act as a liaison to communities but is still a notable challenge. A treaty has been established moving toward better relationships. The indigenous are important to keep on good terms; they are a force multiplier.

Question: How many Arctic patrol ships does [Joint Task Force North] have? Are they outfitted for spill response? Four to five will be operational in the 2019 timeline, and they will be multi-purpose vessels including scientific purpose and flexible in operation.

III. ICE-PPR National Presentations

The following is a brief Summary of the ICE-PPR National Presentations. Speakers from each nation provided their current capabilities and state of Arctic science and technology.
The purpose of the U.S. Office of Naval Research is to enable applications for the U.S. Navy, and in this case achieving a goal of the Department of Defense to understand the ionosphere. The presenter listed a series of ideas that may be useful for understanding the changing Arctic environment. First, to leverage insights on the Southern oceans. Second, to study the changing acoustics alongside the changing Arctic and relate its affects; possibly by performing a coordinated Arctic acoustic thermometry experiment. ONR has struggled with determining the errors in weather prediction capabilities. It is certain that they originate from Arctic storms. It may prove beneficial to fly through storms and drop sensors to increase the understanding of the physics and dynamics, thereby understanding how to model and predict its weather.

Questions and comments from the Presentation:

Comment: The [U.S.] National Weather Service (NWS) now has an Arctic test lab, which may offer updated observational activity.

Question: Will there be a shifting focus from Alaska to broader across this and future campaigns? The Arctic Cyclone Initiative is a program focused on understanding how the world is connected, in which, researchers involved with each other from around the Arctic and Antarctic help facilitate the advance of Arctic science.

Canada’s defence and security funding is focused toward intelligence, surveillance, reconnaissance (I.S.R.) and investing heavily in space entities, including satellites and how to utilize commercial space. Canadian space-based capabilities are concentrated on radar satellites for maritime surveillance, ecosystem monitoring, and disaster management. In addition, environmental detection capabilities will be launching next year. The Canadian Arctic Underwater Sentinel Experiment (CAUSE) will explore the value of low-frequency acoustic sources and understanding, utilizes commercial satellites, long-endurance UUVs, underwater communications, and more.

Presentation Comment: Canada has the lead on human performance with their Rangers including possible lessons learned and frameworks to be shared; it has been incredibly successful in view of its leveraging of local knowledge.
Denmark, Danish Defence Force

Denmark’s defense force operations in Greenland provide security important for the North American continent as well as fostering trans-Atlantic military cooperation. While Denmark operates a joint Arctic command in Greenland, there are few dedicated resources in the Danish Arctic, including six ships and two aircraft.

The Forsvarets Center for Operativ Oceanografi (FCOO) staff is composed of a small expertise group contributing to Danish Defense, including planning, operations, and experiments. FCOO receives ocean ice forecasts from NOAA and Navoceano, wave and meteorological data from the European Centre for Medium-Range Weather Forecast (ECMWF), and ice chart and satellite images from the Danish Meteorological Institute.

The Center aims to gather forecast data to integrate with future projects. Their recognized gaps in information include in-situ entities, such as buoys or autonomous vehicles, high-frequency radar, such as those that may be used to study wave currents, airborne remote sensing, and sea level monitoring.

Questions from the presentation:

Question: What is the name of the oil spill modeling program? Sea Track Web.

Question: If you had a regional sea track model, do you have the computing power for it? Yes/affirmative.

Finland, Finish Defence Forces

Few resources only allow the Finnish Defence Forces to concentrate primarily on nearby areas, but “there is not only one Arctic,” argues the Finnish representative. One helpful scientific resource is the European Union Polar Board—a strategic advisory body of polar science. An Arctic early warning and environment system utilizing existing weather forecast services may provide customer-specific services and flash warnings concerning space weather, icing, and more.

The Finnish representative offers several useful assets to understanding Arctic science. First, monitoring: such as Sentinel 1, used for SAR imaging, or ICEYE, having microsatellite SAR technology and nanosatellites for near real-time monitoring. Second, process and modeling offered by the Finnish Meteorological Institute Arctic Space Centre, having data...
reception and products available 24/7 for space weather service, alerting authorities early to hazards. Third, delivery of ionosphere tomography. Finally, the KARA SEA NEMO-LIM3 is a model that illustrates ice concentration.

Questions from the presentation:

Question: Is the Arctic weather warning system for ships or icing? It is for ships, drones, helicopters, predicting icing, and more.

Question: Is there a detection system for methane? Yes, there is a model that uses methods to detect if the area is dangerous from gases.

New Zealand, New Zealand Defense Forces
The New Zealand search and rescue region covers some thirty million square kilometres, extending from halfway between Australia and Chile and from near the Equator to the South Pole. It is imperative to form partnerships to collectively bring together sufficient, credible resources to enable research returns for all involved. Partnerships often begin small, but expand through a common vision and a shared, trusted acceptance of responsibilities, risks and returns. New Zealand is conducting studies in human performance when operating in the Southern Ocean region. A commercial company, Rocket Lab, is beginning small satellite launches from New Zealand direct into polar orbits. The goal is one launch per month. This will offer new, low cost and responsive openings for polar situational awareness. New Zealand also uses small UAV technology in the Deep South. The Southern Ocean is unique. For instance, it is the only ocean that circles the world. It is also poorly modelled and predicted. Better understanding of the growth and severity of storms and of the behaviour of Southern Ocean waves and sea-ice is critical to ensuring the safety of operators and equipment.

Norway, Norwegian Armed Forces
Norway offers a number of processing services, including sonar prediction, modeling the bearing capacity for ice in frozen soil, and recently acoustics under ice. HUGIN HUS is an underwater research vehicle designed for military and civilian scientific use; it is equipped with sensors, such as those for acoustic application. Open policies to share scientific data with the public means that these models can be used to achieve a forecast for Anchorage, Alaska. Forecast challenges, however, include accessibility and quality, and action in snow and ice-covered surfaces are limited in view of minimal equipment. Currently, Norway aims to learn more about developing evaporation duct height climatology for Norwegian waters, and different locations in which this model may operate.
IV. Academic Research

There are three types of polar efforts: policy, operational, and basic research. The ICE-PPR is a forum established to span the gap between research and operational efforts. Four emerging research areas became the focus of discussion, including situational awareness, human performance, platforms and infrastructure, and environmental resilience. University of Alaska professors presented on their current research and technology being performed in Arctic Alaska.

During the 25-27 October ICE-PPR session, workshop presenters received briefings from two University of Alaska entities: Dr. Bob McCoy, University of Alaska Fairbanks Geophysical Institute and Dr. Fred Barlow, University of Alaska Anchorage Dean of College of Engineering. Additionally, to provide ICE-PPR participants a glimpse of research that benefits the Arctic disaster response community, ADAC coordinated Dr. Eberhard Sauter, of the Alfred Wegner Institute, to provide a discussion of bio remediation research for maritime oil spills.

Geophysical Institute, University of Alaska Fairbanks. Director, Bob McCoy provided ICE-PPR participants a comprehensive overview of the Geophysical Institute, highlighting that Proximity to the Arctic provides excellent opportunities for high-latitude geosciences. Since 1948, the Geophysical Institute conducts research programs in space physics, atmospheric science, seismology, volcanology, satellite remote sensing, tectonics and sedimentation. The institute operates a rocket range for space research and a satellite ground station with processing and archiving capabilities for earth science support.

College of Engineering, University of Alaska Anchorage. Dean, Dr. Fred Barlow, provided ICE-PPR participants a review of Arctic oriented research conducted by faculty and students of the College. Coastal Storm Surge and Erosion, Sensor research, Arctic Oil Spill modeling and more highlight the college’s contribution to Arctic research. The UAA College of Engineering works closely with the Arctic Domain Awareness Center in driving research of importance to Arctic operators.

In follow-up to participating in the Arctic Domain Awareness Center’s “Coping with the Unthinkable...an Arctic Maritime Oil Spill” Arctic Incidents of National Significance Workshop, Dr. Eberhard Sauter, of the Alfred Wegner Institute, to provide a discussion of bio remediation research for maritime oil spills.
V. Focused Discussion Topics

Effective response and anticipation requires effective prediction systems and sustained autonomous observations.

Recent Buoy Deployments and Experimentation

Reinforced by study and precision observation, there is a retreat of Arctic seas ice, as is depicted by several models. Multi-year sea ice is flushing out of the Arctic, leaving diminishing levels of older ice, with correspondingly increased levels of new-formed ice. Overall, Arctic sea ice has reduced lifetimes (as low as two to five years).

One major gap in Arctic research is the number of buoys deployed in the Arctic, which is very few. Buoy data integrated with models enhances performance and reduces uncertainty. Air-deployable, expendable ice buoys may be deployed and frozen within the ice to understand how the ice pack is moving and reacting to the changing conditions.

Questions from the Discussions:

Question: Are communications currently emitting from these buoys? How do they stop running? Where do they end up resurfacing? Communications are currently emitting from the air-deployable buoys. They run on battery power. Some sink, some wash up; they are inexpensive and expendable.

Question: What are the sizes of these buoys? Sizes vary. Some are tank-sized and others vary down to beach ball-sized.

Data Collection Campaigns

The principle aim is to look for centralized logistics and aircraft capability to synchronize with the National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service (NWS) to further advance the state of knowledge and shared capability. These coordinated efforts allow more diverse and accurate (and even verified) data collection.

Nations need to identify which projects having sensors need platforms, and identify platforms that need sensors—then link these pairs. Efforts to develop technology and coordinate may be technology demonstrations that include ICE-PPR nations to marry the sensors with the platforms. It is important to utilize all levels of military, thereby taking the data and using it as opposed to simply collecting it. Heat flux from the last lower level of the atmosphere (a few hundred feet), especially over the ocean, is a gap in the current cache of collected data.
Clouds become an issue from lack of visibility to extreme cold weather conditions. This blind spot is having the gap but not being able to identify who can fill it.

**Modeling & Simulation**

It is important to continue exploring and de-risking technologies in the Arctic; from aerospace warnings to maritime surface surveillance to sub-surface surveillance. The Arctic is very data-limited. Although improved modeling would be universally approved, the lack of in-situ observations is a gap in the modeling process. There is an explicit need for ice thickness data which cannot be obtained with satellites, but rather with on-the-ground sensors. “Something as simple as putting a meteorological sensor on a buoy would be of great value,” argues one operator. A significant connection between the research community and operators is developing an unmanned aerial space to be used to measure and collect data over a long range. Operators need to be provided with tailored operational forecasts, and allowed to be followed with feedback from the operators. These validation techniques, on whether the product is working or where to direct it, is an aspect of technology that operators currently do not have. “Develop a wiki...a ‘one-stop shop’,” argues a participant. There is a distinct difference between data and information; that is, data leads to information.

**VI. ICE-PPR Field portion**

The workshop included a field visit to the Port of Anchorage. The port visit was intended to highlight the challenges the United States faces with designating/creating an Arctic Strategic Port. The Port of Anchorage is the farthest U.S. Northwesterly Strategic Port, which contains deep draft, and multi-modal capability. Existing U.S. ports on the Bering, Chukchi and Beaufort Seas are currently not deep draft, nor possessing of rail or strategic sized airports.

Due to inclement weather (which posed a significant safety hazard to transshipping vehicles from Fairbanks to Anchorage), the planned University of Alaska technology demonstration for the participants of ICE-PPR, focusing on the adaptation and usage of unmanned vehicles in a maritime environment was cancelled.
In lieu of the demonstration, ADAC hosted a comprehensive briefing highlighting key aspects (focusing on unmanned aerial systems with multi-sensor integration). In particular, Dr. Cathy Cahill, Director for the Alaska Center for Unmanned Aircraft Systems Integration (ACUASI) at the University of Alaska Fairbanks provided ICE-PPR participants a superb discussion and orientation to advancements in unmanned aircraft systems and sensors integrations with direct Arctic application. Cutting-edge sensors integrated to adaptable and Arctic capable flying platforms with agile support teams provide an array of customer applications for timely information needs from an array of tactical and operationally capable platforms. ACUASI was established under the University of Alaska Fairbanks in the Geophysical Institute where it originated, but was given the role of leading all unmanned aircraft programs for the entire University of Alaska system.

The program originated in 2001, and over the years has expanded its scope, the equipment it operates, and the variety and complexity of research projects it executes.

In 2013 ACUASI submitted a proposal to the FAA to become one of the six test sites established by the 2012 FAA Modernization and Reform Act. In December 2013, FAA announced that the University of Alaska had been selected. The Pan Pacific UAS Test Range Complex reports to ACUASI, but also includes principal partners in Oregon and Hawaii as well as 56 non-state partners located all over the U.S. and internationally. Ranges are located in the three states as well as in Iceland, our key international partner.²

VII. Scratch Pad Collaboration

In the final hours of the 25-27 Oct 2017 ICE-PPR, national collaboration between participants took the form of a series of “Scratch-Pad” sheets. This provided each delegation an opportunity to offer and to discover an opportunity to combine research and or research testing and more. This construct builds from recent (May 2017) U.S. and Danish experience in which Danish airlift delivered ONR research buoys. Accordingly, the ICE-PPR “Scratch Pad” session served to draft ideas and will be further refined in follow-up teleconferences. The below is a summary of potential collaboration.

Platforms (to shape) for lift, demo’s etc.
- SeaHunter UAV
- Saildrone (Southern Ocean, Bering Sea) / WAM-v’s
- CG C130s
- CG Buoytenders
- Sentinel-3 CAL/VAL

Unmanned vehicles
- Oliktok Point- DOE-ARM program/NOAA/SeaHunter

² http://gi.alaska.edu/facilities/acuasi/
- UUV monitoring of ice keels through choke points, ports of interest
- Near real time UUV assessment of ice thickness for model initialization & satellite CAL/VAL.
- Autonomous UUV or surface for delivery of buoys (“pickup truck”) or emergency supplies
- Identify oil spill
- Autonomous SAR support
- BVLOS regulations/airspace integration
- SASAKAWA (Japan) AUV-UAS (start 2018) ice ridge effort (above – below)

Data collection campaigns
- Baffin Bay Ex?
  - CAN/DEN/USA -> transitional RDT&E
  - Develop Best Practice to validate visibility
- Southern Ocean Buoy deployments – ONR/IPAB/NZL
- Ice Observation Standardization USA/CAN/NZL
- Aircraft met ObS into models
- Hyperspectral measurement campaign in the Arctic (all four seasons. (UAV) SAR – Spaceborne: UAS & aircraft

Modeling & Simulation
- Iceberg (US-National Ice Center-Denmark-Canada)
  - Drift & Deterioration
  - Coupled model (Ocean-Air-Ice)
- Nested grids for coupled ice model
- Choke point/port coverage ( USA/NIC, others?)
- Stress/Strain models w/fast ice (USA/NIC, others?)
- Humidity & temperature modeling in the lower 50m over marginal ice
  - “Easy-to-set up” regional ice –ocean model, combined with obs. Campaign (include buoys)

Sensor development & Test
- In-situ obs (USA-NIC)
  - Buoys that can winter-over, submerge & continue to provide ocean data until sea ice recedes.
- Algorithms to semi-automate analysis of satellite imagery for ice extent & characterization. & Icebergs.
  - Need to be able to manipulate in a GIS.
- On-board processing algorithm for identifying targets (whales, ships etc.) and sending info via low bandwidth coms.
- EM sensor for ice thickness
- BVLOS icing predictions
Other ideas

- Relationship building
- Personnel exchange
  - U.S.N. participation/observer at OP Nunalivut
- USNA- ADAC & Norway (NPI, UNIS, etc...)
- Operation Castle NZL/USN METOC 2018

VIII. ICE-PPR Conclusion

The workshop concluded with overall agreement to find solutions in multi-national science and technology ventures, using the joint U.S. and Danish venture from May 2017 as a key example. As discussed, multiple entries for future, possible collaboration between ICE-PPR nations were drafted in the closing session of the workshop.

ADAC was deeply honored to host the 25-27 Oct 2017 ICE-PPR and was pleased that several ICE-PPR participants were able to join the proceeding “Coping with the Unthinkable...an Arctic Maritime Oil Spill” Arctic Incidents of National Significance Workshop. ADAC will seek to support the U.S. Office of Naval Research in future occurrences of this remarkable forum.