



6th Symposium on the Impacts of an Ice-Diminishing Arctic on



Naval and Maritime Operations

SYMPOSIUM REPORT

July 14 - 16, 2015

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Co-Hosted by the U.S. National Ice Center
and the U.S. Arctic Research Commission

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EXECUTIVE SUMMARY

This 6th Symposium in the series focusing on U.S. naval operations and strategic issues in the “Ice-Diminishing Arctic” was held in Washington, D.C. during July 14-16, 2015. Over the three days of the symposium, 294 people representing over 100 organizations from government, academia, industry, and the media participated. There were 45 presentations from members of Congress, senior military Officers and Agency officials, renowned Arctic scientists, and experts from the private sector as well as two panel discussions and 9 posters.

Among these experts, there is no question that the climate of the Arctic is changing in very significant ways. While the sea ice is decreasing in extent and thickness across the whole Arctic, the most significant changes have been in the Chukchi and Beaufort Seas. The diminishing Arctic sea ice is accompanied by changes in the ocean, on the land and in the atmosphere that are physical, chemical and biological. The major challenge, as iterated by many speakers, is in getting the American people and their elected Representatives to understand that the Arctic is a national issue and a national asset – that changes in the Arctic have national and global implications.

A continuing theme throughout the Symposium was the current and projected increase in commercial activities in the U.S. Arctic, primarily related to oil and gas exploration. Investments by other countries, both Arctic and non-Arctic, were noted as evidence that trans-Arctic shipping is expected to become a reality in decades to come. As the only western entrance to the Arctic, Bering Strait will receive all of this increased ship traffic with attendant environmental, social, and security risks. The need to develop infrastructure - including port facilities, hydrographic charts, accurate weather forecasts, supply depots, search and rescue capacities and oil spill response capabilities - was a common thread.

Support at the Symposium was unanimous for the acquisition of two new heavy icebreakers by the U.S. seen as essential for the U.S to operate effectively in the Arctic. There was general agreement that this should be a national priority and that the funding must come from beyond the U.S. Coast Guard budget.

The importance of multi-agency, multi-level and multi-national collaboration was stressed by almost every presenter. The Arctic is too complex and operating there is too expensive to anyone to go it alone. In the past few years, there has been a significant increase in cooperation among Agencies within the U.S. federal family.

Chairing the Arctic Council over the next two years gives the U.S. an opportunity to demonstrate leadership in the Arctic. The Arctic Council was mentioned by several speakers as an increasingly legitimate and influential international forum.

The Symposium was sponsored by the [U.S. National/Naval Ice Center](#) and the [U.S. Arctic Research Commission](#) and organized by Dr. Pablo Clemente-Colón (NIC) and Ms. Kathy Farrow (USARC).

KEYNOTE ADDRESSES

SYMPOSIUM OPENING AND WELCOMING REMARKS: CDR KELLY TAYLOR, DIRECTOR AND COMMANDING OFFICER, U.S. NATIONAL / NAVAL ICE CENTER (NIC)

See [Presentation](#)

Summary Points

- Welcomed participants on behalf of NIC and the U.S.ARC
- Recent environmental changes have resulted in greater global awareness of the Arctic and a greater sense of urgency to predict what is happening, not just in the near term, but in the next several decades
- Arctic sea ice is declining in every month of the year – ice in the Chukchi and Beaufort is thinner and a lot of Multi-Year ice is gone
- Intent at this Symposium is to garner understanding and a broader perspective of the Arctic to towards better collaboration and policies

REMARKS FROM THE U.S. ARCTIC RESEARCH COMMISSION: DR. JOHN W. FARRELL, EXECUTIVE DIRECTOR, U.S. ARCTIC RESEARCH COMMISSION (THE U.S.ARC)

See [Presentation](#)

Summary Points

- Average U.S. citizen is not aware of the size and importance of the Arctic – everyone here has a responsibility to communicate this importance
- Overview of the U.S.ARC activities and goals
- the U.S.ARC supports using small controlled oil spills for research purposes
- the U.S.ARC encourages strong U.S. participation in the development of science-based standards for offshore Arctic operations
- the U.S.ARC recommends more frequent updating of engineering guidance documents that address sea level rise and storm surges and emphasis on civil engineering research for maritime infrastructure
- Two heavy icebreakers still makes sense – should be owned by the government, not Public-Private Partnership; they should be a total Department of Defense expense, not just Coast Guard

REMARKS FROM THE ALASKA CONGRESSIONAL DELEGATION: HON. LISA A. MURKOWSKI, U.S. SENATOR FOR THE STATE OF ALASKA AND MEMBER OF THE CONFERENCE OF PARLIAMENTARIANS OF THE ARCTIC REGION STANDING COMMITTEE

The full text of Senator Murkowski's speech can be found at:

<http://www.murkowski.senate.gov/public/index.cfm/2015/7/speech-symposium-on-the-impacts-of-an-ice-diminishing-arctic-on-naval-and-maritime-operations>

Summary Points

- Navy believes vessel activity will more than double and NSR transits will increase 10-fold by 2025
- Makes sense for the United States to develop infrastructure in the Arctic from national security, economic and environmental perspectives
 - Bering Strait is the only western entrance to the Arctic – a chokepoint
- Developing the necessary infrastructure will require investment from the private sector, multiple levels of government and international partners
- Other countries, including non-Arctic states, are building Arctic infrastructure - Opportunity is there but the U.S. must step up to play its part
- We must get the nation to recognize that the Arctic is a national term, a national priority and a national asset – not just an Alaska issue

- Need to consider new options for icebreakers – international consortium providing ship escort service across the Arctic to break Russia’s monopoly; public-private partnerships for commercial icebreaking services; financing of icebreakers by individual states with Arctic interest
- None of this development should occur without engagement with the local populations that will be most affected - economic development and environmental stewardship are not mutually exclusive and local communities are best positioned to lead this
- Need to be more aggressive in charting of Arctic areas – We have not utilized modern mapping technologies in many areas and are woefully behind

REMARKS FROM THE ALASKA CONGRESSIONAL DELEGATION: HON. DON YOUNG, U.S. REPRESENTATIVE FOR THE STATE OF ALASKA

Summary Points

- Opening of the Arctic is a crucial issue to the nation and to the world – there are huge resources that have not yet been exploited
- Hard for people in the lower 48 to understand how important the Arctic is – however Russia understands and is building infrastructure while the U.S. is not; this puts the U.S. in a position of weakness in the world
- Number one issue is to get this message to the public - Needs help to convey this message to Congress and to the people – an advertising campaign about the importance of the Arctic
- To be an Arctic nation is difficult if we don’t have proper information – we must learn to adapt, utilize and protect
- Need to work with friendly neighbors – hopeful that the U.S. can work with Russia but is suspicious of Russia’s intentions
- Need icebreakers but it is clear that Congress will not appropriate the money – it must come from the DoD – not just from the USCG
- Not as worried about oil drilling as about shipping –need scientists’ help to put together a program that concentrates money and builds the Arctic nation
- There are people who live above the Arctic circle and are affected by activities there – they are smart people who know the Arctic intimately – consider them and engage them

Q & A

- *Could congress set up a special account since this is a strategic initiative important to the defense of the nation?* Trying to do this - there will be no ships bought offshore – promote lease-build-maintain contract for icebreakers – wants to consolidate DoD and the USCG
- *Is there money to use robotics to help?* Drones are a great way to do survey work – must apply this technology – mapping of sea bottom is crucial
- *What has changed in relations between U.S. and Russia concerning the Arctic?* Don’t understand where Putin is headed - their plan is an unknown quantity
- *Ratification of the Law of Sea?* Hoping to get it done in the Senate; it is important and the U.S. needs it to be at the table to participate

U.S. NAVY KEYNOTE ADDRESS: RADM MATHIAS W. WINTER, CHIEF OF NAVAL RESEARCH (CNR), OFFICE OF NAVAL RESEARCH (ONR)

See [Presentation](#)

Summary Points

- Navy strives to maintain an appropriate balance of basic, applied, and advanced research with near, mid and long term S&T investments in hundreds of individual projects; the Arctic is key region
- ONR has an international presence with offices in several countries; it is the venture capitalist of the Navy
- Navy’s Arctic guidance derives from the [Naval S&T Strategy](#), the [U.S. Navy Arctic Roadmap](#), and the [DoD Arctic Strategy](#), among others
- Longer range predictions are essential to ensure operational capability in the Arctic aligned with the national strategy

- The Navy forecast of sea ice through 2030 sees diminishing sea ice that will allow sea lanes to open where they were not before and with different durations over the year – this provides both opportunity and challenges
- ONR conducts research across all domains to avoid stovepipes
- ONR is looking for the next generation of technologies that will improve Arctic capability
- In its support to Arctic Science, ONR funds 20,000 projects across a \$2.1B portfolio; basic and applied research with application to military operations is open source in partnership with academia, industry and northern countries

Questions

1. What can you say about sub-surface S&T activities?
 - ONR has an Unmanned Underwater Vehicle (UUV) program that is derived from the aeronautical program
 - There is a research focus on large scale undersea logistical constellations looking at how to deploy and maintain a large scale network for long durations (decades) and the ability for materials to withstand harsh environments
 - Other areas of study include acoustic and non-acoustic propagation
2. What is the relationship between ONR and DARPA?
 - It is very close. We exchange scientists and technologies, share advances and discoveries and are undertaking some 70 projects jointly. We have monthly meetings to understand overlaps and benefit from them.

U.S. COAST GUARD KEY NOTE ADDRESS: ADM PAUL F. ZUKUNFT, COMMANDANT, UNITED STATES COAST GUARD (USCG)

Summary Points

- USCG is the lead federal maritime agency in all things Arctic; it provides a presence in the Arctic to protect sovereignty, provide checks on commercial operations to protect the environment, enforce laws, and protect private developments
- USCG is a law enforcement agency whose job is to keep federal maritime waterways open for commerce
- USCG engages in extensive outreach to work with other Arctic coast guards as developments proceed over the next century and beyond; Canada, Russia, China, Korea, and the U.S. have been doing joint operations on fisheries patrols for the past 12 years
- This year there will be a table top exercise for Arctic Search and Rescue (SAR) with all the Arctic nations – with an actual exercise next year; the exercise will feature the mass evacuation from a cruise ship – a very probable risk considering that only 5% of the Arctic is charted to modern standards and there are many cruise ships with thousands of passengers operating without full diligence
- There will also be a marine environmental response table top exercise
- U.S. will host the summit meeting of the Arctic Coast Guard Forum this fall; relations with the Russian Coast Guard are not affected by other State relations with Russia
- Another major portfolio of the Coast Guard is fishing patrols but the Coast Guard does not have the capacity to enforce fishing regulations in the Chukchi
- Korea and China are both doing scientific research in the U.S. extended continental shelf Law of the Sea claim area; there is a bit of a land grab going on in the Arctic now with the potential for a future loss of resources
- Mitigating environmental risk requires making trade-off decisions based on the “whole of science” in the absence of peer-reviewed science; USCG must ensure that Shell has the capability to deal with a worst case scenario – as much as 25,000 oil barrels (bbls) per day in a loss of well control scenario
- We are asking private industry to meet exacting MARPOL standards of IMO but the old U.S. icebreakers don't meet these standards
- In terms of capacity, the U.S. is not even in the Arctic game compared to Russia; Russia has a large fleet of very capable icebreakers and the U.S. is trying to keep our old ones together – without a real Arctic capability, the U.S. is an Arctic nation in name only
- *Polar Star* came to the aid of Russia, China and New Zealand in Antarctica last year; however, if *Polar Star* suffered an engineering casualty there is no one to come to their rescue – the U.S. has no self-rescue capability – this is not a position to put the crew in

- The U.S. cannot do it alone – we must have relationships with other Arctic nations; we have a national Arctic strategy but there is no over-arching grand strategy that does not rely solely on military capability
- International and interagency contact, collaboration and joint efforts are essential

NOAA KEYNOTE ADDRESS: DR. RICHARD W. (RICK) SPINRAD, CHIEF SCIENTIST, NOAA

See [Presentation](#)

Summary Points

- Prediction is as much about nowcasting and hindcasting as it is about the future
- NOAA has a diverse set of responsibilities – fisheries, oceans, weather, mapping, charting
- It is impossible to address all of the challenges for all mission objectives – must prioritize
- Alaska forecast skill is considerably lower than for the lower 48 – day 1 in Alaska is about as accurate as a day 5 for the lower 48; we need much better understanding of ice-ocean-atmosphere coupling to improve
- We are not ready for development in terms of the days to weeks forecasts that are needed; the rate of formation of ice is important – observations are critical but if we are to predict on daily-weekly basis, we must anticipate step jumps in ice formation
- Zooplankton and fish stocks are very dependent on seasonal temperatures – how far ahead could we make these projections?
- Ocean acidification is magnified in the Arctic with direct impacts on species – but what are the species' responses? Decadal predictions are needed to develop response strategies
- To design proper infrastructure, we need true decadal predictions – is there a new normal in meteorology in the Arctic?
- We expect to have 5 months of open water by 2040; the shipping industry needs predictions of open routes months in advance; community planning for infrastructure needs long term predictions; it is NOAA's job to understand the limits of predictability
- What is needed:
 - Observing System Simulation Experiments (OSSEs) and Observing System Experiments (OSEs) to learn how to optimize observing systems to address requirements
 - Focused observations – one of the biggest challenges is that we don't understand the full water column throughout year
 - Modeling investments are needed along with observing system upgrades
 - Coordinated development of products - partnerships are critical; the upcoming Year Of Polar Prediction provides an opportunity
 - The Arctic Testbed is modeled on the hurricane and hazardous weather testbeds

Questions

1. Can you comment on deterministic versus statistical predictions?
 - Everyone wants deterministic predictions but will always deal with probabilistic predictions. It is more important to convey the information to the user in a way that can be used most effectively. We need to take stronger advantage of partnerships. We will always have to deal with probabilistic forecasts but we need to better understand user requirements and sophistication.
2. What would it take to get a better 2-week forecast?
 - Observations and modeling. The key is in understanding the atmospheric-ocean coupling. We need to understand what observations are really critical to the model results. The most important question is “to what end”? What is “good enough” for operational decision-making?

PANEL DISCUSSIONS

MARINE TRANSPORTATION AND THE POLAR CODE: LEAD, PROF. CRAIG H. ALLEN, DIRECTOR, UW ARCTIC LAW & POLICY INSTITUTE, JUDSON FALKNER PROFESSOR OF LAW, AND PROFESSOR OF MARINE AND ENVIRONMENTAL AFFAIRS, UW SCHOOL OF LAW

Panelists:

CAPT John W. Mauger, Commanding Officer, the USCG Marine Safety Center

Dr. Alyson Azzara, Senior Maritime Advisor, U.S. Committee on the Marine Transportation System

Mr. Michael Kingston, Partner, Marine, Trade & Energy, DWF LLP

Mr. Chris W. Hladick, Commissioner, Alaska Department of Commerce, Community, and Economic Development

Questions & Discussion

1. Will the U.S. enforce the IMO Polar Code or will it enforce its own laws?
 - Polar Code sets the floor below which no flag state can go – states can exceed the Polar Code
 - U.S. does enforce international laws and also U.S. laws – e.g. ballast-water – if the U.S. is not convinced that an international standard is good enough, it enforces the U.S. law; don't think there is any problem with the Polar Code but if there did arise a problem, U.S. law would be enforced
 - Local authority cannot prevent a foreign vessel from traversing an international strait – regulations can only be enforced if the vessel comes into port
 - An on-going argument is whether coastal states in the Arctic can enforce exceeded standards on vessels going through their EEZ
 - Each jurisdiction is responsible for enacting laws in their areas – if the laws are responsible then there should be no problem; for example, Canada has a higher standard in the Arctic that vessels must adhere to but in states that have no national standards, the Polar Code will help
2. Large cruise ships face a Search and Rescue (SAR) dilemma. Is there anything in the IMO Polar Code about cruise ships travelling in pairs?
 - To get a polar operating certificate a vessel must have an operating plan which includes a backup for SAR; a whole risk assessment – not just vessel capability; could include having other ships in the vicinity
 - Cruise industry is accepting the requirement to demonstrate worst case scenario - International Association of Antarctic Tour Operators, Arctic Cruise Operators
 - Crystal Celebrity plans to cruise the Northwest Passage and will have an icebreaker escort
3. Who bears liability for SAR and damages if ice conditions change drastically in middle of a voyage?
 - SAR costs are usually borne by responder – there are ways of insisting that SAR is in place
4. Did the U.S. do better by resisting a regional treaty vs holding out for the IMO Polar Code?
 - The IMO has been very valuable for the U.S. – having a common set of safety standards and environmental standards while minimizing the need to set up an additional enforcement regime
 - A regional standard would not apply to foreign ships transiting an international strait
 - The U.S. has been adhering to the IMO Polar Code
5. What agency determines the ice regime that must be used when applying the Polar Code?
 - Aim is to have the best information available; for the voyage pre-plan, must be able to show that they know the ice conditions to be expected
 - Ice regime system must be accepted by the administration where the vessel is travelling
 - Ship must have an ice navigator who will determine in real time whether the ship can operate in the ice regime actually present
 - This is great in an area where there is information – in other areas where there is no ice information available, a polar operating certificate should not be issued
6. Does the State of Alaska feel good about the Polar Code?

- Yes but there are concerns about how it will be enforced – Lawson Brigham has been intimately involved and has kept the State informed; Polar Code development in the U.S. was an inclusive process that should allay fears
 - Enforcement of the Polar Code must include education so flag states know what they have to do before issuing a polar certificate; if a flag state applies the right standards, then insurers can give insurance - then it is up to the flag state to ensure compliance
 - Perhaps the Arctic Council could get an education forum going
 - Hard to imagine 2000 transits in Bering Strait but, if it were to happen, we need more risk assessment, spill equipment, training and emergency preparedness
7. What is the penalty of operating without a polar certificate?
- Insurance is a key underlying piece that allows the investment to put the whole system in place – self-insured voyages are rare and risky
 - A key aspect of the Polar Code is that it is goal based rather than prescriptive - to obtain a polar certificate, must show how you will coordinate with an administration; for example, if you have not contacted the U.S. and are not carrying something required by the U.S., you will pay
 - National Technical Means can be used to monitor vessel traffic; if a vessel comes into a U.S. port, there are several penalties that can be applied including detaining the vessel; if the vessel does not come into port, enforcement assets could be deployed to get the vessel
 - We are not looking for violators but will actively monitor and enforce when necessary
 - Innocent passage does occur and a full risk assessment is not always done – for example, what is the methodology for determining that your ship can travel into these ice waters? – the Polar Code will help ensure that this gets done
8. As a result of the Polar Code, is it more likely that a ship will join an oil spill response organization?
- There is nothing inherent in the Polar Code about this but there are requirements such as contingency planning which could include an oil spill response agreement; basic hooks are in the Polar Code but it does not mandate that a vessel have a contract with an oil spill response organization
 - If calling on a U.S. port, a vessel must have a liability certificate showing that it has an oil spill response capability – usually a contract with an oil spill response organization; transiting vessels do not
9. Does the Polar Code include provisions for air emissions? Is there anything to protect the U.S. Arctic from sooty emissions?
- MARPOL has requirements for air emissions but these have not been put into the Polar Code
 - Work is going on to define soot and measure it – it is an active item but not sure when completion is expected; in meantime, current U.S. law applies
 - Some Arctic Council members are opposed to IMO work on black carbon – no confidence that it will be passed; each country is to submit a paper on their position this fall
10. Automatic Identification System (AIS) applies to 300 metric ton vessels – does the Polar Code require AIS?
- Polar Code does not require AIS but does require communications capability in high latitudes
 - Large classes of vessels not covered by the safety provisions of the Polar Code including yachts, barges, fishing, and towing vessels; in the U.S., work is underway to bring towing vessels into the regulation

In Summary

- We have got things in place with the Polar Code but need to continue the implementation and continue to pay attention to it

SAFE ARCTIC ACTIVITIES BEYOND MARINE TRANSPORTATION: LEAD, DR. JAMES (JIM) KENDALL, REGIONAL DIRECTOR, ALASKA OCS REGION, BUREAU OF OCEAN ENERGY MANAGEMENT (BOEM)

Panelists:

Dr. Lisa B. Eisner, Research Oceanographer, Auke Bay Laboratory, NOAA Alaska Fisheries Science Center

Dr. Hajo Eicken, Interim Director, International Arctic Research Center, UAF

Dr. Igor Krupnik, Curator, Department of Anthropology, Smithsonian Institution

Dr. Helena Wisniewski, Vice Provost for Research, University of Alaska Anchorage

Introduction by Dr. Kendall

- Department of Interior proposed revised standards for the Arctic Outer Continental Shelf (OCS) following the 2012 incidents – we have good regulations but must go further
- the Arctic is characterized by extreme conditions, lack of infrastructure, etc. which affect the safety of oil & gas operations
- proposed standards require comprehensive planning and seek to establish a proactive approach to offshore safety – consider all possible risks to eliminate or mitigate
- must have equipment available to eliminate loss of well control and conducting the operation in a manner suitable for Arctic conditions
- develop an integrated operating plan 90 days prior to submitting the exploration plan – have immediate access to equipment – access to separate relief rig – proper contractor oversight – oil spill response plan tailored to Arctic conditions – all proposed and very similar to what has been required on an ad-hoc basis

Panelists Introductory Remarks

Dr. Eisner

- Fisheries research is very limited in the Arctic; there are few surveys so we don't even know what all fish are there; the benthic invertebrate population makes up 90% of the biomass – clams, etc. – and is not mobile
- The Arctic is not homogenous – there are different water masses in the Chukchi and Beaufort Seas; there is low production in the Laptev Sea because of sediments
- To understand what we are risking, we need a better understanding

Dr. Eicken (see [presentation](#))

- As ice cover changes, we are seeing a significant increase in the speed of ice drift in all seasons – this has significant implications for operations
- Highly deformed sea ice is a major hazard that extends from north of Alaska westward to the Chukchi Sea oil lease areas – it has a mean thickness of 15-25 m
- Getting a good handle on these key hazards is very difficult; how do we design and make regulations to deal with these hazards?
- Tracking ice deformation and deformed ice is increasingly relevant
- At the Barrow sea ice observatory, a key initiative is to incorporate the knowledge that indigenous people have been using for centuries into the southern way of working that is very rule-based
- We need a framework to sustain community-based observations and use it to drive science and research

Dr. Krupnik

- We rarely consider the priorities of the people who live in the Arctic; To them, our actions seem crazy at times; for example, why are we trying to break the ice because it is already breaking – we keep breaking it with ships in the spring breakup which is detrimental to people who hunt; we break it in the fall during the migrations and impact normal freeze-up patterns; – soon we will break up the “last ice”
- On a positive note, the NSF changed the *Healy* cruise after listening to whalers' concerns it would create artificial leads and take the whales away from the traditional migration pattern

Dr. Wisniewski

- We must enhance Arctic domain awareness; engaging Alaska native communities can help with that
- The goal of the ADAC Integrated Intelligent System of Systems is to enable decision makers to make the best decisions with the best information including predictive analytics that incorporates indigenous knowledge

- Alaskan natives are first responders and are part of the ADAC team – they are receiving funding, getting training and communications equipment
- It is important that we train our future workforce so that they can make best use of the things that are being developed

Questions & Discussion

1. Concerning Canada-U.S. cooperation in the Beaufort Sea, is the degree of dialogue on safety –security issues, blowout issues and facilities issue, adequate?
 - See a lot of dialogue coming very quickly – there are some differences but it is coming together rapidly – Anchorage EPA folks talk regularly with their Canadian counterparts
2. Is the Arctic ERMA talking to the Arctic Domain Awareness Center (ADAC) and integrating all of the World Wildlife Fund (WWF) data?
 - ADAC is collecting data from various sources and would like to establish a relationship with ERMA to get as many more data sources as possible –have not yet integrated WWF data or fisheries data
 - Because ERMA is used by the USCG, there is already a link to ADAC
 - Have integrated community knowledge about currents with USCG folks to develop a mutual level of trust and get different views of the environment
 - We also have people at table who are strongly opposed to oil development and opposed to government – the University of Alaska Fairbanks (UAF) tries to act as an honest broker to build bridges and promote understanding and collaboration
3. In addition to ERMA and the ADAC Integrated Intelligent System of Systems (IISOS), there is also the Arctic Collaborative Environment (ACE) hosted at UAF. Is there a concern about multiple systems becoming a barrier? It is important that these systems pool their talents to make the best system possible.
 - IISOS is to pull these systems together providing intelligent analysis and forecasting
4. If Shell gets a license to drill what are the worries and what are the benefits?
 - (Kendall) BOEM's role is to be an honest broker; at the exploration phase we only have estimates – the benefit is to get better estimates of what is there and whether it is viable; the worries are that we have to take a holistic approach involving all players – everyone has to back each other up
 - (Krupnik) There are concerns from the indigenous people but they are not all of one voice; people in Barrow are probably in favor of oil – to tax it – they are used to political power; a small community may be totally opposed; it very much depends on individual perspectives – in the future, we will lose the idea that all indigenous people are of the same mind - the environment will become politically more fragmented and radicalized
 - (Eisner) We need to understand baseline conditions to know what is there and how the life cycles work – currently, there is a lack of information
 - (Eicken) UAF's role is to ensure that all players – industry, NGOs, government, citizens – have the information that they need to make decisions; oil companies tend to view it as an engineering problem but have learned that it is also a societal problem; local communities like Wainwright are being overwhelmed by requests for permits and information – we are not where we need to be
 - (Krupnik) We must learn to deal with people who reject all benefits - who are willing to forego all the benefits to be allowed to live the way they want
 - (Kendall) All Shell employees must take cultural training; the company has invested heavily in community involvement
5. As an incident commander, I need to have a briefing with the 2-3 things that I need to know right now. Decisions must be taken quickly across a broad scope of operations. There is little no time. How can academia help in a crisis?
 - Information pathways exist between first responders and incident commanders but are very dependent on the personality of the incident commander; it is necessary to understand how to interact with local people and people who can act as translators
 - There is a framework for how knowledge is to be shared – the key issue is context – if information is used in the wrong context it could be erroneous or dangerous
 - Important to remember that, if a safety case is applied, then government must ensure that the operator has everything in place to implement the plan when an incident occurs - it is exactly same as a polar certificate in the Polar Code

6. Should ships be advised when there are hunters on the ice and water now that there is more ship traffic?
 - Hunting trips to 60-70 miles offshore are becoming common – currently these take place in May-June before the ship traffic starts so there is no conflict yet – but there will be in future
 - There is a long history of local peoples interacting with the whaling fleet back to the 1850s - there is a knowledge from the past that should be applied
 - Alaska Whaling Commission has had a good protocol with the oil and gas companies in the past to know where vessels are in potential conflict with whales – there is a need to get non-oil & gas vessels brought into the protocol
7. Dr. Kendall directed a question to John Farrell – We just spent 3 days talking about the Arctic and yet the average American citizen does not see the importance. What can you tell a soccer mom in 30 seconds why the Arctic is important?
 - We need to convey in clear terms the impacts changes in the Arctic have on sea level rise, energy security, climate change, severe weather, etc. What happens in Arctic does not stay in the Arctic.

PRESENTATIONS

(In alphabetical order by presenter's last name)

THE R/V SIKULIAQ - A NEW U.S. ARCTIC RESEARCH PLATFORM: DR. CARIN ASHJIAN, SENIOR SCIENTIST, DEPARTMENT OF BIOLOGY, , WOODS HOLE OCEANOGRAPHIC INSTITUTION

See [Presentation](#)

Summary and Talking Points

- Describes the new technologically advanced, ice-capable research vessel R/V Sikuliaq
- Results from the ice trials are preliminary only – expect the ship to live up to its design specs
- Science trials were very successful

Questions

1. How was the crew hired?
 - Crew was recruited over a period of time using NOAA Corps. They are very experienced on ships but not in yet in ice. Under the IMO Polar Code, the crew will have to comply with certain training requirements.

A 10-YEAR PROJECTION OF MARITIME ACTIVITY IN THE US ARCTIC: DR. ALYSON AZZARA, SENIOR MARITIME ADVISOR, U.S. COMMITTEE ON THE MARINE TRANSPORTATION SYSTEM

See [Presentation](#)

Report is available at www.CMTS.gov

Summary and Talking Points

- Projection for 2025 has a total range of 75-430% increase over 2013; container vessels were separated because their needs for a regular schedule makes Arctic routes less attractive; 2000+ transits of Bering Strait possible
- For 2021-2030 time period, project 100-150 days of open water access to Alaskan waters compared with 50-100 days currently; areas of highest variability are also the areas of greatest interest to shipping which may reduce the number of days of access

Questions

- *Were new technologies considered in the future scenarios?*
 - No. For example, a deep water port was not included.
- *There are large differences between the CMTS and Navy estimates of future shipping. Are you talking to one another to resolve these?*
 - Yes, we are talking to each other. The planning assumptions were different.
- *What infrastructure improvements are most important to respond to likely economic development?*
 - Things that are already in the plans were considered but going forward we did not include new developments.

INFRASTRUCTURE INVESTMENT FOR RESOURCE EXTRACTION IN THE ARCTIC: MR. HARRY BADER, LEAD, POLAR ENVIRONMENTAL SECURITY PROGRAM, UNIVERSITY OF ALASKA FAIRBANKS

See [Presentation](#)

Summary and Talking Points

- Changes in the Arctic dictate changes in human activity; there is no such thing as one Arctic – it is incredibly diverse; the differences create different rates and types of change and elicit different responses from populations; the Arctic Council agreements ignore the differences in capability
- WE must make long term infrastructure investments coupled with assessments of what is technically feasible and economically prudent

- North American Arctic represents 40% of the area north of the Arctic Circle but only 3% of the population; in North America 90% of the people are indigenous as compared to 30% in Europe and 50% in Asia
- Index of Arctic Infrastructure Capabilities is a density dependent index of the ability of the current infrastructure to sustain the assets to complete a mission; on a scale of 0-10 where 0 represents no capability and 10 represents Portland, Oregon
- Norway has the most capable infrastructure in the Arctic – the U.S. would spend itself into oblivion if it try to match Norway because the environment is different and the vast distance is an impediment that cannot be engineered around; focus should be on monitoring, detection, prevention and deterrence rather than building response capability
- Small response units will be most capable of meeting the need using small nimble well-trained teams with Arctic field craft and the capability to operate without communications; remote and autonomous surveillance is needed with reliance on local communities as a first line of response
- Must move to performance based standards rather than prescriptive
- In a sampling of mid- and senior level NORAD personnel taking security training, 40% are skeptical about the science that they are hearing - both in terms of intensity, scale and scope; these are smart, good people who doubt the veracity of what scientists are saying

Questions

1. Given the pace of development, if the future unfolds as we expect, in a 100 years we will need infrastructure. Can we afford to not build it?
 - The difficulty is that we are building in a rapidly changing environment. For example, the permafrost boundary will always be there but will be somewhat deeper than today. This is the reason we need performance based standards rather than prescriptive standards based on today's environment.

ARCTIC SEA ICE PREDICTION: CHALLENGES AND OPPORTUNITIES: PROF. CECILIA BITZ, ATMOSPHERIC SCIENCE, UNIVERSITY OF WASHINGTON (UW)

See [Presentation](#)

Summary and Talking Points

- Sea ice outlook forecasts the September Arctic Sea Ice Extent in June: the spread of the various forecasts is large and maybe not helpful but quantitative methods are converging on a narrower forecast that is meaningful; median of all the predictions for the September 2015 minimum ice extent is 5 million sq miles
- A 4-month forecast of September Arctic sea ice extent is comparable to a 10-day weather forecast; 2 month forecasts are not much improved over the 4-month – the reason is not known
- Prediction of sea ice spatial distribution appears to have some success
- Sea ice has much greater complexity in real life than in models – there are opportunities to predict more fields

Questions

1. A prediction of ice edge location is of greater interest to mariners than pan-Arctic ice extent. What is the state of that predictability?
 - We do not have enough data to assess the confidence of the models for ice edge location.
2. What other observations are needed to improve predictability?
 - Ice thickness and melt ponds coverage over the past 30 years would be very useful assess the skill of the models. New observations of these variables have value but don't help with establishing confidence limits.
3. A forecast of freeze-up date would be very valuable to stakeholders. Is this possible?
 - All models forecast freeze-up date so a product could be made available.

NOAA ARCTIC RESEARCH OFFICE ACTIVITIES: DR. KATHLEEN (KATHY) CRANE, PROGRAM MANAGER, ARCTIC RESEARCH OFFICE, CLIMATE PROGRAM OFFICE (CPO), OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH (OAR), NOAA

See [Presentation](#)

Summary and Talking Points

- Provided suggestions for repeat climate-ecosystem transects of the Arctic to better understand the causes and consequences of sea ice change
- The second decade of RESULCA is commencing – will move northward to look at heat transport into the Arctic
- Trying to understand the impact of Atlantic water coming from other side of the Arctic Ocean and possibly mixing with Pacific water; the area is becoming very stratified but huge storms could mix the Ocean better – Atlantic water is warm and if it gets into the mixing layer, there could be significant impacts
- Looking for partners who can contribute resources to the Arctic Research Program goals

DISTRIBUTION AND MOVEMENTS OF ARCTIC MARINE MAMMALS IN RESPONSE TO SEA ICE LOSS: MR. DAVID C. DOUGLAS, RESEARCH WILDLIFE BIOLOGIST, ALASKA SCIENCE CENTER (ASC) BIOLOGY OFFICE, U.S. GEOLOGICAL SURVEY (USGS)

See [Presentation](#)

Summary and Talking Points

- Many partners are involved in Arctic marine ecological research
- Polar bears must contend with vast areas of rapidly melting sea ice; most bears want to remain with pack ice but more and more are coming to land; bear can swim phenomenal distances
- When ice disappears from the shelf, walrus come to shore – in the past they would have stayed on the ice; shore haulouts are increasing in size and duration; foraging from land is much less efficient than from the ice which is closer to the food source
- Amassing data to better understand the movements of animals to we can predict what they might do in the face of a changing climate is key to practicing environmental stewardship

Questions

1. Do male polar bears go to the same place as females?
 - We only collar females. Males might move a little less but we're not sure.
2. What is the total walrus population?
 - It is difficult to count – there are really broad confidence limits.
3. IS there any science on the fatalities of bears while swimming?
 - There is some anecdotal evidence to say that bears have a difficult time during storms. We want to get small pingers for cubs to determine when they get separated from mom because cub survival is big issue.

LOSS OF SEA ICE IMPACT ON ALASKA'S LARGE MARINE ECOSYSTEMS: DR. LISA B. EISNER, RESEARCH OCEANOGRAPHER, AUKE BAY LABORATORY, NOAA ALASKA FISHERIES SCIENCE CENTER

See [Presentation](#)

Summary and Talking Points

- While sea ice extent in the Arctic has declined, the sea ice extent in the Bering Sea has fluctuated with no consistent trend
- Groundfish in the eastern Bering Sea will not move northward because they are barred by a pool of cold deep water in the northern Bering Sea; however Pacific salmon abundance will increase in the U.S. Arctic
- Reduced sea ice extent and duration in Alaska's Arctic and Subarctic ecosystems will limit the available high fat prey (e.g. Arctic cod) that animals require for good health and survival
- This could impact commercial fisheries as well as marine mammals

Questions

1. Fishing is currently closed north of Bering Strait. What fishery has the greatest potential?
 - Snow crab and elephant sole have the potential to move northward.
2. Ground fisheries include crabs. Could the change in sea ice change the behaviors of fishers in the Bering Sea?
 - There has been no work done on this question.
3. Your data show that forage fish are moving south. Can you explain that?
 - Cannot explain. The data may be suspect.

THE NSF DIVISION OF POLAR PROGRAMS ARCTIC UPDATE: DR. KELLY K. FALKNER, DIRECTOR, DIVISION OF POLAR PROGRAMS, NATIONAL SCIENCE FOUNDATION

See [Presentation](#)

Summary and Talking Points

- NSF Arctic Science Section invests about \$100M per year in Arctic research; almost the same amount goes into Arctic research from other NSF units
- It is important to keep an eye on the whole system at the basic research level; NSF uses a large variety of research vessels to do this; NSF has good relations with Russian colleagues
- Need to monitor key spots in the Arctic Ocean circulation system – Atlantic water entering the Barents-Kara-Laptev seas has been the warmest on record recently; just received permission from Russia to continue monitoring this year; there is an MOU with Canada to monitor the Beaufort Gyre using a Canadian ship
- Partnerships are essential – the pace of change and the scale of the problem is such that it cannot be done by one agency alone; are continuing an experiment to allow the private sector, academia, and government to collaborate in an open Internet environment to reinforce one another and avoid duplication
- Ice diminishing Arctic – NSF needs operational awareness of weather, etc to support field ops

Questions

1. Is any science work done on the *Polar Star* in the Antarctic?
 - NSF is always open to proposals but the primary mission of *Polar Star* is to re-supply McMurdo
2. Could the climate for Arctic science be improved with a Science Agreement within the Arctic Council?
 - Yes. An agreement could facilitate cross-border exchange of scientists, equipment and licenses etc. Seven of the eight nations in the Arctic Council are in agreement but Canada is the hold out.
3. If Arctic claims are settled in the Law of the Sea, will the U.S. have less access to the Arctic?
 - Don't think so but I am not an expert

THE ONR ARCTIC PROGRAM: DR. SCOTT L. HARPER, TEAM LEAD, ARCTIC AND GLOBAL PREDICTION, OFFICE OF NAVAL RESEARCH

See [Presentation](#)

Summary and Talking Points

- Overview of the new ONR Arctic program that is focused on the changing climate in the Arctic
- Investing in research to enable the Navy to prepare for and respond to future Arctic missions through enhanced understanding of the Arctic physical system, development and use of new observing tools, and development of Earth system numerical prediction models to enable improved forecasts

STATE OF ALASKA MARITIME ECONOMIC ACTIVITIES: MR. CHRIS W. HLADICK, COMMISSIONER, ALASKA DEPARTMENT OF COMMERCE, COMMUNITY, AND ECONOMIC DEVELOPMENT

See [Presentation](#)

Summary and Talking Points

- [Alaska's Official Arctic Policy](#) was passed by the State Legislature this year
- 5000 ships transit the Pacific great circle route each year passing through the Aleutian Islands – Alaska must be ready to deal with ship disasters; the major pass is Unalaska Pass
- USCG would like to see an Arctic Next Generation Navigational Safety Information System to provide real time information on weather, where hunters are, where whales are, etc. and manage ship traffic accordingly; USCG, the Marine Exchange and the Alaska Dept. of Environmental Conservation have a unique partnership
- There is a huge gap between infrastructure costs and growing demand – will likely lead to more reliance on revolving loan funds
- AKLNG project to build a gas pipeline from Prudhoe to Nikiski at a cost of \$55B project; the State does have the authority to sell gas in Asian markets
- Commercial fishery is the 2nd largest employer in the state; there are concerns about potential conflicts between fishing and commercial shipping – an oil spill could easily affect global fish markets
- Unalaska is a focal point of the oil and gas development with major investments being made; Port Fourchon, LA has been used as a model oil and gas port; the oil field will have to pay for infrastructure developments

Questions

1. What stage are the projects to develop new ports in?
 - Various stages of panning with some only on a wish list. Development will require partnerships with private industry to make them happen.

THE NORTH AMERICAN ICE SERVICE (NAIS): MR. DAVID (DAVE) JACKSON, DIRECTOR, CANADIAN ICE SERVICE (CIS) AND CO-DIRECTOR, NAIS

See [Presentation](#)

Summary and Talking Points

- The NAIS is a collaboration between the CIS, NIC and the USCG International Ice Patrol providing harmonized products, common tools and infrastructure to increase overall efficiency
- Dash-7 surveillance aircraft of the ICS is multitasked – ice, oil, fisheries, maritime surveillance

Questions

1. Is Canada a member of the Arctic Council?
 - Yes - Canada chaired the Arctic Council for the past two years; The Hon. Leona Aglukkaq is Canada's Minister for the Arctic Council; Canada has representation on all of the Arctic Council panels
2. Do commercial companies have to pay for ice information?
 - Not normally – it is provided free in the interests of safety of navigation
3. What is the plan to make RADARSAT-2 data available for research?
 - The Canadian government does not own RADARSAT-2. It has an agreement with MDA for an imagery package and can make this available as a finished product but not as raw data. You need to talk to MDA directly about getting research access to raw data.
4. How is the process of early adopters working?
 - Early adoption of new technologies is very important. For example, CIS developed an enviable relationship with the Canadian Space Agency early in the development of RADARSAT-1 and, as a result, the sensor package was optimized for ice. We need to maintain close relationships with key agencies, such as ESA, DLR, and NASA to extend data available beyond RADARSAT-2.

THE STATE OF THE ARCTIC ENVIRONMENTAL SYSTEM (THE ARCTIC REPORT CARD): DR. MARTIN JEFFRIES, ARCTIC SCIENCE ADVISOR & PROGRAM OFFICER, ARCTIC AND GLOBAL PREDICTION, OFFICE OF NAVAL RESEARCH

See [Presentation](#)

Summary and Talking Points

- All of the indicators – air temperature, terrestrial snow cover, sea ice, the Greenland ice sheet, sea surface temperature, ocean primary production, and tundra greenness – all point to significant change in the Arctic with global consequences
- In 2014, the Arctic was strongly connected to lower latitudes – a hypothesis is that the polar vortex is becoming more sinuous and weaker with large north-south excursions bringing warm Pacific air into Alaska and cold Arctic air to the eastern U.S.
- The state of the Arctic is reported annually in the [Arctic Report Card](#) (December) and in the [State of the Climate](#) (July/August)

U.S. ARCTIC OUTER CONTINENTAL SHELF (OCS) ENERGY DEVELOPMENT AND PRODUCTION PLANS: DR. JAMES (JIM) KENDALL, REGIONAL DIRECTOR, ALASKA OCS REGION, BUREAU OF OCEAN ENERGY MANAGEMENT (BOEM)

See [Presentation](#)

Summary and Talking Points

- We will be dependent on oil and gas for the next couple of decades – the goal is to transition to renewable energy sources
- There is more oil in Alaska's offshore than has been produced in the Gulf of Mexico in the past 50 years
- The changing climate is the major challenge of Arctic resources management
- Shell will likely take 3-4 years to drill the 6 wells they want in the Chukchi Sea
- First real Outer Continental Shelf production in the Arctic will likely be the Hilcorp's Liberty Island – a man-made gravel island in federal waters 5.6 miles offshore

THE ARCTIC EXECUTIVE STEERING COMMITTEE AND THE NOAA'S ARCTIC EXECUTIVE COMMITTEE AND ARCTIC ACTION TEAM: MR. DAVID (DAVE) M. KENNEDY, SENIOR ADVISER FOR THE ARCTIC REGION, NOAA

See [Presentation](#)

Summary and Talking Points

- The Arctic Committee and Action Team work to ensure that all of what NOAA is doing in the Arctic is mutually supportive and synergistic
- Outlines six major goals of [NOAA's Arctic Action Plan](#) as updated in 2014

Questions

1. How does the Arctic Executive Steering Committee relate to the Interagency Arctic Research Policy Committee?

The Arctic Executive Steering Committee was created by Executive Order in January 2015 to provide guidance to executive departments and agencies. The Arctic is important and we need to move the U.S. forward to do the right things. It is chaired by the President's Science Advisor. Its first task is to generate a report on overlaps, duplications, and gaps, which is in draft form now. It will look at special issues in the Arctic and will develop white papers across all of the agencies to help resolve them. The Executive Committee works with IARPC. IARPC would be one of many Arctic organizations that report to the Executive Committee.

2. What is NOAA's position on Canada's Polar Communications and Weather satellite project??
 - NOAA is interested and is talking to the Canadian Space Agency about participation.

OPERATIONALISING THE POLAR CODE IN THE ARCTIC OCEAN INSURANCE INDUSTRY CONTRIBUTIONS: MR. MICHAEL KINGSTON, PARTNER MARINE, TRADE & ENERGY, DWF LLP

See [Presentation](#)

Summary and Talking Points

- Polar Code is not a stand-alone convention because it would take too long to ratify; rather, it will come into force as an amendment to three existing conventions so ratification is not necessary
- Polar Code requires operators to have a Polar Waters Operation Manual that explains that they have a plan to deal with a worst case scenario in the conditions that may be encountered; reference must be made to an ice regime methodology that shows how their ship will deal with ice in the area that is being contemplated; the must be explained in the Polar Ship Certificate that will be issued by the Flag State of the ship
- Attention of the insurance industry has become focused on the Arctic as a result of the Deepwater Horizon disaster and the increase in shipping in the Arctic – especially on the Northern Sea Route
- Clear from Deepwater Horizon that human error, safety culture, risk assessment, communication, control of contractors are always highlighted as the problem; regulatory regimes around the globe are fundamentally different and sometimes deeply flawed
- 75% of incidents are due to human error
- A single ice regime system across the whole Arctic with rules that are clearly understood is recommended; see the Conference report on [Sustainable Arctic Shipping and Marine Operations](#)
- POLARIS has been developed as a risk assessment system; The Polar Code requires that a methodology such as POLARIS must be used; POLARIS is in addition to the Canadian AIRS, the Russian ice regime system and the Swedish-Finnish rules for the Baltic

IMPACTS OF A CHANGING ARCTIC OCEAN-HUMAN DIMENSION: DR. IGOR KRUPNIK, CURATOR, DEPARTMENT OF ANTHROPOLOGY, SMITHSONIAN INSTITUTION

See [Presentation](#)

Summary and Talking Points

- Many players anticipate the loss of sea ice with enthusiasm for its potential benefits; this is a very different impression when compared to other ecosystem changes in the world - such as the declining coral reefs – which are viewed as tragedies
- Rather than focusing on the Arctic as a whole, we would be better advised to focus on the changes around local communities
- There is an intimate knowledge among the indigenous people of when and who events occur; they often have detailed calendars of activities related to ice; however, without systematically accessing this knowledge, it is being lost as elders die; it is necessary to go into coastal communities to access this knowledge
- For the 1980s corresponding with the satellite era, there are people still around with good knowledge
- For the 1960s, some people still around that usually remember significant events
- For the 1930s, some elders in their 80s and 90s may still have memories of the period –very significant events but not in an exact time frame
- For the 1920s, direct memory has been lost but people may have knowledge from the stories of their parents; also, old photographs can be interpreted and compared with later periods
- Earliest baseline is the 1890s from which there are still ample records, diaries, and photographs that could be analyzed and related to present conditions
- It is important to secure this diminishing knowledge before it is too late

Questions

1. Why are the physical sciences more successful at getting funding than the social sciences?
 - Social sciences focus on ethics and emotion - that is more difficult to explain to funding agencies.

THE NATIONAL PETROLEUM COUNCIL (NPC) ARCTIC STUDY REPORT: MR. STEVEN R. LAWS, SUPERVISOR, DEVELOPMENT PLANNING - ARCTIC, EXXONMOBIL DEVELOPMENT COMPANY

See [Presentation](#)

Summary and Talking Points

- [Arctic Potential](#) report was published in 2015 at the request of the Secretary of Energy

- U.S. Arctic has as much oil as Russia but we must start to develop it now if Alaskan oil can take over for the expected decline in the lower 48
- Most U.S. Arctic offshore is developable with existing technology
- There has been significant improvements in well control technology; it must be validated to convince the public that it is safe
- Collaboration between government and industry is necessary to evaluate new technologies to enhance environmental stewardship
- Current limitation on the drilling season is barely enough to drill an exploratory well; report proposes to double this time to 150-160 days by eliminating the requirement to drill relief wells
- Energy industry has a lot of experience in oil spill preparedness and response and should be engaged by government for response exercises

Questions

1. What is conventional and unconventional petroleum?
 - Unconventional is shale gas or oil sands. Conventional is lighter oil that will flow. A lot of Arctic oil and gas is conventional but there may be some unconventional.
2. Are approvals likely for burning or dispersant experiments?
 - Mechanical recovery is the requirement at the present time. The government could open up the options and leave it to industry to determine best approach but that would likely be a difficult hurdle given public and environmental groups.
3. In the case of an oil spill in a sea ice environment, what is technology for avoiding contamination of the sea ice?
 - Don't know
4. Why is the Department of Energy the expert advisor to the Secretary?
 - There is not a clear focal point in government for Arctic development. There are a lot of individual players but no clear point of contact.
5. What area was the study looking at?
 - We used the Exclusive Economic Zone but did not look significantly at disputed zone.
6. Blowout preventer failure statistics are rather high. How does that effect things?
 - There is never zero risk but it must be balanced. The focus is on prevention but must also look at control and mitigation.
7. Why is there not a recommendation to enact legislation for a safety case performance based approach as opposed to the current prescriptive approach?
 - We did look at practices in other countries and did recommend more performance-based approaches to allow for technology advance but didn't get into specifics about legislation.

INVESTIGATING THE BEAUFORT SEA MARGINAL ICE ZONE WITH ROBOTIC TECHNOLOGY: DR. CRAIG LEE, SENIOR PRINCIPAL OCEANOGRAPHER, APL, UW & MR. LEE FREITAG, PRINCIPAL ENGINEER, APPLIED OCEAN PHYSICS AND ENGINEERING, WOODS HOLE OCEANOGRAPHIC INSTITUTE

See [Presentation](#)

Summary and Talking Points

- A large integrated program using advanced robotic observing technologies – autonomous glider, ice mass balance buoys, wave buoys on ice to sense waves propagated into ice, IPT-V profiles in upper 500 m of ocean, underwater geolocation with acoustics – to better understand the Marginal Ice Zone
- Recent formation of an acoustic duct at water depths of 100-200m created by warm Alaska coastal and summer Bering Sea water has led to the successful development of acoustic geolocation technologies that are the key to underwater robotic observing systems

USCG AND THE IMPLEMENTATION OF THE IMO POLAR CODE: CAPT JOHN W. MAUGER,
COMMANDING OFFICER, USCG MARINE SAFETY CENTER

See [Presentation](#)

Summary and Talking Points

- With the Polar Code we now have a uniform international regulatory standard that applies to shipping in the Polar regions; there is an opportunity for additional work to amplify the regulatory text to promote consistency in the application of the Code
- Benefit of implementing the Polar Code by amending 3 international treaties is that the Code will enter into force January 2017 without the need for ratification; the limitations are that some things, such as grey water and fishing vessels are not included – these are known gaps
- Towing vessels will not be covered by the Polar Code but will be covered by U.S. domestic regulations
- Implementation will be focused on foreign flag vessels coming into Red Dog and Kotzebue; Standard port state control and inspection regimes will apply

THE INTERNATIONAL ICE PATROL (IIP): CDR GABRIELLE McGRATH, COMMANDER, INTERNATIONAL ICE PATROL (IIP) AND CO-DIRECTOR, NAIS

See [Presentation](#)

Summary and Talking Points

- The IIP core values are Partnerships, Improvement and Commitment (PIC)
- The Grand Banks is only place in the world where a concentration of icebergs coincides with major shipping lanes
- Iceberg analysis charts are issued as a NAIS product – produced by IIP in summer and by CIS during winter; the iceberg Limit is available in Arctic ERMA as a standard product
 - Best correlation to date between satellite and aircraft detection is 45% with RADARSAT-2 Wide Fine mode and 52% with TerraSAR-X; fishing vessels are confused with icebergs
- Working with the Danish Meteorological Institute and C-CORE to extend observations using Sentinel-1 interferometric wide swath data
- Would like to extend the NAIS iceberg warning area to cover all of METAREA-IV – currently there are gaps in coverage

Questions

1. What are the smallest icebergs you can detect?
 - 15m is smallest detectable
2. Are climate records broken down by iceberg size?
 - All records are available on the IIP website

TRENDS AND SEASONAL VARIATIONS IN ARCTIC SHIPPING ACTIVITIES FROM FIVE YEARS OF SATELLITE AIS DATA: DR. ØYSTEIN OLSEN, SENIOR SCIENTIST, NORWEGIAN DEFENSE RESEARCH ESTABLISHMENT (FFI)

See [Presentation](#)

Summary and Talking Points

- AISat-1 was launched in 2010 as a demonstration; AISat-2 was launched in 2014
- AIS has detected a 20% increase in the number of vessels in the Arctic in the last 5 years; in the Russian sector, the number of vessels has doubled in 5 years
- The median vessel size has increased in the August–December season; there are many passenger vessels in the high Arctic
- Use data to clean up routes – more Russian tankers further

- Northern Sea Route expects that there will be a large increase in shipping FFI expects that this will not be the case in the next few years because of a lack of infrastructure and port facilities and because new Russian icebreakers will not be ready before 2020

Questions

1. Can the system use any other satellite data besides the two owned by Norway?
 - No. We want to try more data but it is very expensive. This is commercial data that Norway owns and is skeptical about putting into the open.
2. Do all of the reports represent unique vessels or are there multiple reports from the same vessel?
 - Each vessel is counted only once per month.
3. Could the data be used for fisheries enforcement?
 - The fishery is organizing and is cooperating with Russia on illegal fishing.

U.S. ARCTIC COUNCIL CHAIRMANSHIP PROGRAM: ADMIRAL ROBERT J. PAPP, JR., THE USCG (RET.), SPECIAL REPRESENTATIVE FOR THE ARCTIC, U.S. DEPARTMENT OF STATE

See [Presentation](#)

Summary and Talking Points

- Aggressive but balanced agenda for the U.S. Chairmanship of the Arctic Council based on Arctic communities, Arctic ocean, and Arctic climate
- Focus on infrastructure and environment
- Essential to maintain relations with global politics to be successful in the maritime world –Singapore, Hong Kong and Shanghai understand that and are building relationships toward a future where Arctic shipping routes surpass southern ones
- Challenge for the U.S. is to get out of the trap of the annual budget cycle and make strategic investments for future decades – need to invest in Arctic infrastructure, including icebreakers
- Must get people acting on making the Arctic a priority

THE USCG ICEBREAKING PROGRAM: CDR ERIC D. PEACE, MANAGER, USCG ICEBREAKING PROGRAM

See [Presentation](#)

Summary and Talking Points

- USCG operates the nation's icebreaking program
- Polar research has become the primary use of Polar icebreaker tie
- The heavy icebreaker *Polar Star* is 40 years old and will undergo a mid-life refit in a couple of years
- *Polar Star* costs about \$24M per year to maintain – increasingly hard to procure parts and technical expertise
- Operational requirements document for a new icebreaker reflects whole of government requirements and is nearing completion

Questions

1. Is our experience with Great Lakes icebreaking relevant to Polar icebreakers?
 - Great Lakes icebreaking is strictly domestic – there is a lot of escort duty and little scientific activity
2. What is the status of the *Polar Sea*?
 - *Polar Sea* is currently in inactive unmanned status – we have funding to preserve what is left; hoping to get funding to assess the feasibility of re-activating
3. What is the estimated cost of a new icebreaker?
 - \$1B is strictly an estimate - there are not a lot of icebreakers to compare with – the only ones that meet the requirement might be the Russian nuclear icebreakers. It is important to note that one icebreaker does not make a program – at a minimum, we need two icebreakers to sustain a program

NAVY SEA ICE FORECASTING - RECENT UPDATES AND FUTURE PLANS: MS. PAMELA G. (PAM) POSEY, OCEANOGRAPHER, OCEANOGRAPHY DIVISION, NAVAL RESEARCH LABORATORY (NRL) AT STENNIS SPACE CENTER

See [Presentation](#)

Summary and Talking Points

- Update on the Navy's ice forecasting capabilities
- Arctic Cap Nowcast/Forecast System (ACNFS) is the current operational model; produces 7-day forecasts of ice concentration, ice thickness, ice drift, sea surface temperature and salinity, and ocean currents for the Northern Hemisphere
- Global Ocean Forecast System (GOFS) is currently undergoing operational testing and will replace ACNFS when accepted
- Next generation of model will be the Earth System Prediction Capability (ASPC) scheduled to be running in real-time by 2018

Questions

1. When doing support for *Healy*, do you get data from the ship?
 - Yes

KINGDOM OF DENMARK'S ICE-DIMINISHING ARCTIC CHALLENGES AND OPPORTUNITIES: CDR JAKOB D. ROUSØE, ASSISTANT DEFENSE, MILITARY, NAVAL & AIR ATTACHÉ, DEFENSE SECTION, EMBASSY OF DENMARK

See [Presentation](#)

Summary and Talking Points

- Danish government has launched a comprehensive analysis of the future needs Greenland and the Faroe Islands – a whole of government approach
- There are many opportunities in Greenland including fishing, tourism, minerals, oil and gas – the important part is to understand what is actually happening to the ice
- We also have responsibilities to take care of risks and clean up if necessary
- Pollution on the ice cap is accelerating melting with a significant reduction of glaciers and the possibility of slowing of North Atlantic gyre
- Cruise ships are now going into areas that have never been open before and have never been surveyed
- Ice conditions are extremely variable – it is difficult to explain to politicians why resources should be expended if there is no steady trend to less ice and more economic activity
- Variability makes it very hard to predict future needs; with current world prices, not much oil or mineral activity is expected in the near future – the greatest potential areas are tourism and the fishery

Questions

1. How would you describe the new ice? Is it thinner and melts quicker?
 - On the west coast of Greenland the ice opens up very quickly. On the east coast that is not true – it looks normal.
2. Do the changes in geopolitics have an influence on defense policy?
 - The recommendations will not change but the perception of readers may change as a result of Russian activities in Ukraine and Crimea. Tension with Russia will be focused more on continental shelf claims. We have very good relations with Russian experts but it is difficult to understand Russian political moves.

NOAA VESSEL OPERATIONS IN ARCTIC WATERS: RADM DAVID A. SCORE, DIRECTOR, NOAA CORPS AND NOAA'S OFFICE OF MARINE AND AVIATION OPERATIONS (OMAO)

See [Presentation](#)

Summary and Talking Points

- Mindset and practices have changed in recent years to look for partnerships in every Arctic endeavor; has seen a change in the past 5 years for people and agencies to work together
- OMAO gets requests for about 8000 sea-days annually against a capability of about 6000 with partners and contracts; requirements are diverse – weather, fisheries, chemical oceanography, atmospheric work, charting
- Want to do a better job of informing scientists what NOAA vessels are doing and what they could be doing – invites comments from the audience

Questions

1. Will NOAA ship Oscar Dyson do fish stock assessments north of Bering Strait with a view to lifting the moratorium?
 - There is interest in getting some baseline information but that won't be a priority for now. It is more important to get the best data in traditional waters.

PIOMAS AND USIABP STATUS: DR. MIKE STEELE, SENIOR PRINCIPAL OCEANOGRAPHER, POLAR SCIENCE CENTER (PSC), APPLIED PHYSICS LABORATORY (APL), UW

See [Presentation](#)

Summary and Talking Points

- Update on the Pan-Arctic Ice-Ocean Modeling and Assimilation System (PIOMAS) and the U.S. Interagency Arctic Buoy Program (USIABP)
- Arctic ice volume has been decreasing by about 3,000 km³ per decade; there has been some recovery in the last couple of years but nowhere close to normal values
- Time lag between sea ice opening in the eastern and western Beaufort Sea has decreased from 40 days to 20 days; the time lag between ice opening and real ice retreat can be 6 weeks
- Sea ice is retreating with regional differences, temporal variability and geometric variations

Questions

1. How do you define floe size in a consolidated ice pack?
 - Floe size is a fictitious concept in winter.

NOAA ARCTIC TESTBED FOR SEA ICE AND WEATHER FORECASTING: MR. JOSEPH (JOE) SIENKIEWICZ, DIRECTOR (ACTING), OCEAN PREDICTION CENTER, NOAA NATIONAL WEATHER SERVICE (NWS)

See [Presentation](#)

Summary and Talking Points

- Report card on the NOAA/MWS Arctic test bed to improve marine, weather, climate and sea ice forecasting decision support capability to meet expanding needs in the Arctic; to be located at the Anchorage forecast facility
- Test bed is in a test phase – staffing is to commence this year; the biggest challenge is to define what can actually be done

Questions

1. How would a user begin the process of requesting support?
 - Speak to Mr. Carven Scott. Note that this is an experimental forum but it will be integrated into NWS systems in future.
2. Will weather data from buoys be incorporated into the forecasts?
 - If the data is being brought in through normal means then it will be. Data shared on a weekly basis is not incorporated into the daily operation.
3. Will you have long range forecasts for weather and sea ice?

- We will have at least a seasonal capability from the Climate Prediction Center for melt and freeze-up. We know that week 2 – Week 6 forecasts are critical to determine feasibility of maintaining offshore operations. Multi-billion dollar decisions are made 6-8 months before activity actually begins.

U.S. NATIONAL ICE CENTER SEA ICE PRODUCTS AND SERVICES: CDR KELLY TAYLOR, DIRECTOR AND COMMANDING OFFICER, NIC AND CO-DIRECTOR, NORTH AMERICAN ICE SERVICE (NAIS)

See [Presentation](#)

Summary and Talking Points

- NIC supports the common National Strategies – Improving Awareness, Broadening Partnerships, Strengthening Foundational Science – on a daily basis; NIC does not conduct research itself but supports many Arctic research activities
- Many domestic and international partnerships
- Supports Arctic Maritime Domain Awareness
- Provides Routine Support, Tactical Support, and Mission Support

NASA ARCTIC SCIENCE ACTIVITIES: DR. THOMAS P. (TOM) WAGNER, MANAGER, PROGRAM SCIENTIST FOR THE CRYOSPHERE, EARTH SCIENCE DIVISION, SCIENCE MISSION DIRECTORATE, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

See [Presentation](#)

Summary and Talking Points

- Overview of NASA Arctic programs focusing on satellite and aircraft observations, and data availability
- NASA has large number of websites making data available to scientists and non-scientists to maximize the exploitation of data
- Operation IceBridge to bridge the gap between ICESat-1 and ICESat-2 to measure ice thickness and snow depth; IceBridge snow depth is a major step forward in assessing Arctic snow cover
- New team – Systematic Improvements to Reanalysis of The Arctic (SIRTA) - to look at reanalyses and ensure that new programs are collecting the kind of data that will really make a difference

Questions

1. Is NASA cooperating with Denmark to produce synthetic aperture radar maps of Greenland using NASA's UAVSAR on Global Hawk?
 - The Danes are primarily interested in testing Global Hawk. The UAVSAR pod is not yet available for use on the Global Hawk.
2. What about SMAP?
 - NASA is encouraging early adoption of SMAP data by end users.
3. NASA and the Arctic Council?
 - International collaboration is important. The biggest challenge is understanding geophysical processes in the Arctic. We need to work with international partners to do that.

ARCTIC SEA ICE, FROM THE 1800s TO TODAY: DR. JOHN WALSH, CHIEF SCIENTIST, ALASKA CENTER FOR CLIMATE ASSESSMENT & POLICY AND CHIEF SCIENTIST, INTERNATIONAL ARCTIC RESEARCH CENTER (IARC), UNIVERSITY OF ALASKA FAIRBANKS

See [Presentation](#)

Summary and Talking Points

- Attempting to extend the sea ice record back to the 1800s in a useful format to determine how unique the recent retreat of ice is?
- Sources of data are many and diverse
- Conclusion is that the recent ice retreat is unique in the period since 1850

- Recent loss of ice is much greater in summer than in winter – which is consistent with climate model projections for the future

Questions

1. What is the basis for DMI pan-Arctic charts that date back to the 1870s?
 - Ship data and shore reports plus some aircraft data in more recent years
2. How far could back could we separate First Year vs Multi Year Ice?
 - Depends on the region – perhaps back to the 1950s in Alaska but not further than the 1970s for the North Atlantic

REMOTE SENSING OF THE ARCTIC OCEAN USING NATIONAL TECHNICAL MEANS: MS. MELINDA WEBSTER, RESEARCH ASSISTANT, POLAR SCIENCE CENTER, APPLIED PHYSICS LAB, UNIVERSITY OF WASHINGTON

See [Presentation](#)

Summary and Talking Points

- National Tech Means imagery is a valuable tool for studying sea ice processes
- Major unknown is how melt pond evolve on drifting ice – previous studies have all been on landfast ice
- NTM high resolution is available openly at [USGS Access Portal](#)
- Surprising result is that melt ponds form about 3 weeks earlier on MYI than on FYI; the pace of melt changes because of pond draining on FYI which is not seen on MYI

Questions

1. How many years of data is there and is it continuing?
 - For this comparison study, we used every image available. There are 1000s of images available. We plan to use these additional data in future.
2. Will the melt pond algorithm work on all images?
 - Algorithm runs on any image – additional data from aircraft and in situ observations are useful in interpretation
3. How broad was the study area?
 - The conclusions may be influenced by the study area being located at the MYI-FYI boundary.

U.S. NAVY ARCTIC ROADMAP UPDATE: RADM JONATHAN WHITE. OCEANOGRAPHER AND NAVIGATOR OF THE NAVY, DIRECTOR, SPACE AND MARITIME DOMAIN AWARENESS, AND DIRECTOR, TASK FORCE CLIMATE CHANGE (TFCC), U.S. NAVY

See [Presentation](#)

Summary and Talking Points

- Navy is not as far along as we would like but many priorities need to be balanced – the Arctic is clearly on the Navy's mind
- Navy planning estimate is that by the mid-2020's a near polar route will occasionally be open
- Navy planning is not about ice but about how the Arctic will unfold for resource exploitation and trans-Arctic shipping – and the risks associated
- Key Missions are to ensure U.S. sovereignty, ensure freedom of the seas and to support the Coast Guard and other partners; The Navy-Coast Guard team will be there when called upon
- There is a low likelihood of conflict in the Arctic; in the near term, Navy is concentrating on enablers, such as weather prediction and on building relationships
- Navy supports getting new icebreakers for the Coast Guard but doesn't want to take money out of other Navy activities – national decision-making is needed
-

Questions

1. What are the Navy's strategic roles? How are we managing the nuclear deterrent?
 - We are very concerned about what Russia is doing. One top priority is the ability to operate the submarine fleet anywhere in world. We are relying on the Arctic Council to help with building partnerships in the Arctic. We need strong partnerships.
2. What is the Arctic Center of Excellence? Hopefully it would be involved with the Coast Guard Center for Arctic Study.
 - We want to establish an Arctic Center of Excellence to better understand environmental conditions. Whether it is virtual or concrete is an open question? There is lots of Arctic expertise spread around and we want to find a way to bring that together.
3. Are other Services thinking about an Arctic roadmap and are they coordinating with the Navy?
 - Yes. They are thinking strategically but are a few years behind. They are coordinating at the level of the Joint Chiefs. Maritime capability is the driver and the Navy comes first right behind the Coast Guard.

DEPARTMENT OF HOMELAND SECURITY ARCTIC DOMAIN AWARENESS' CENTER OF EXCELLENCE: DR. HELENA S. WISNIEWSKI, VICE PROVOST FOR RESEARCH, UNIVERSITY OF ALASKA ANCHORAGE

See [Presentation](#)

Summary and Talking Points

- Overview of the Arctic Domain Awareness Center of Excellence (ADAC)
- The Intelligent Integrated System is Systems has been operational for 9 months incorporating data from community based observing networks and from online databases – the next step is to imbue the system with intelligence

NOAA'S ARCTIC ENVIRONMENTAL RESPONSE AND MANAGEMENT: MR. ROBB K. WRIGHT, GEOGRAPHER, TECHNICAL SERVICES BRANCH, NOAA OFFICE OF RESPONSE & RESTORATION (ORR)

See [Presentation](#)

Summary and Talking Points

- There are several regionally based ERMAs each with a lot of regional and site-specific data - but all of them can share national data
- ERMA is located in the Amazon cloud and pulls data from many sources – ERMA could be set up in a local command
- Encourage people to get their data out of their desk drawers and into [Arctic ERMA](#)

POSTERS

ICE VALIDATION AND VERIFICATION OF THE GLOBAL OCEAN FORECAST SYSTEM 3.1

Ruth H. Preller¹, E. Joseph Metzger¹, Pamela G. Posey¹, Alan J. Wallcraft¹, Ole M. Smedstad², and Michael W. Phelps³

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SEA STATE AND BOUNDARY LAYER PHYSICS OF THE EMERGING ARCTIC OCEAN,

J. Thomson¹, V. Squire¹, S. Ackley¹, E. Rogers¹, A. Babanin¹, P. Guest¹, T. Maksym¹, P. Wadhams¹, S. Stammerjohn¹, C. Fairall¹, O. Persson¹, M. Doble¹, H. Graber¹, H. Shen¹, J. Gemmrich¹, S. Lehner¹, B. Holt¹, T. Williams¹, J. Bidlot¹, F. Girard-Arduin¹, W. Perrie¹, J. Brozena¹

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TRIVARIATE SEA ICE PRESENCE MAP PRODUCTS AND DATA SETS DERIVED FROM THE US NATIONAL ICE CENTER ARCHIVE DATA

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ARCTIC OBSERVING EXPERIMENT – AN ASSESSMENT OF INSTRUMENTS USED TO MONITOR THE POLAR ENVIRONMENTS

I.G. Rigor¹, J. Johnson¹, P. Clemente-Colon^{2,3}, S.V. Nghiem⁴, D.K. Hall⁵, J.Woods³, G. Henderson³, J.Zook³, Z. Davis³

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REGIONAL ARCTIC SYSTEM MODEL (RASM): A TOOL TO ADDRESS THE U.S. NAVY / IARPC ARCTIC CLIMATE MODELING AND PREDICTION PRIORITIES

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SEA ICE CONCENTRATION FIELDS FOR OPERATIONAL FORECAST MODEL INITIALIZATION: AN R2O SUCCESS STORY

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DEVELOPING AN OCEAN OBSERVING SYSTEM IN THE U.S. ARCTIC: OPPORTUNITIES AND CHALLENGES

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A RISK-BASED METHODOLOGY OF ASSESSING THE ADEQUACY OF CHARTING PRODUCTS IN THE ARCTIC REGION: IDENTIFYING THE SURVEY PRIORITIES OF THE FUTURE

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SEA ICE TRAFFICABILITY SUPPORT USING UNMANNED AIRCRAFT NEAR BARROW ALASKA

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ARCTIC SEA ICE PREDICTABILITY & THE SEA ICE PREDICTION NETWORK (SIPN)

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