Operation Ice Camp Yields Treasure Trove of Arctic Data for NPS Students, Faculty

MONTEREY, CALIFORNIA, USA, July 30, 2024 /EINPresswire.com/ -- Early this year, inside the Arctic Circle – thousands of miles from the Naval Postgraduate School (NPS) campus in Monterey – a small team of students and faculty undertook a critical scientific research expedition, working with the Undersea Warfighting Development Center's Arctic Submarine Laboratory (ASL) at the biennial Operation Ice Camp.

While in transit in Prudhoe Bay, Alaska, a research team from the Naval Postgraduate School (NPS) met with two distinguished NPS alumni on their way to Operation Ice Camp – Secretary of the Navy Carlos Del Toro and Sen. Mark Kelly (D-Ariz.).

Positioned some 200 nautical miles away from land in the Beaufort Sea, standing atop 4 feet of ice over 12,000 feet of water at air temperatures reaching 45 degrees below zero, the four-person team from the school's Meteorology and Oceanography (METOC) program performed a series of experiments, collecting a trove of data that continues to provide invaluable insights into long-range acoustic propagation under, through and above the Arctic ice.

"On a scale of one to 10, I'd put it at an 11," said retired Navy Cmdr. John Joseph, faculty associate-research in the NPS Department of Oceanography, who led the expedition with Dr. Ben Reeder, a fellow Oceanography research professor.

"We were able to accomplish essentially all of our scientific objectives. The data we collected will help us better understand the impact that a changing Arctic has on the Navy's ASW (anti-submarine warfare) and ISR (intelligence, surveillance and reconnaissance) missions."

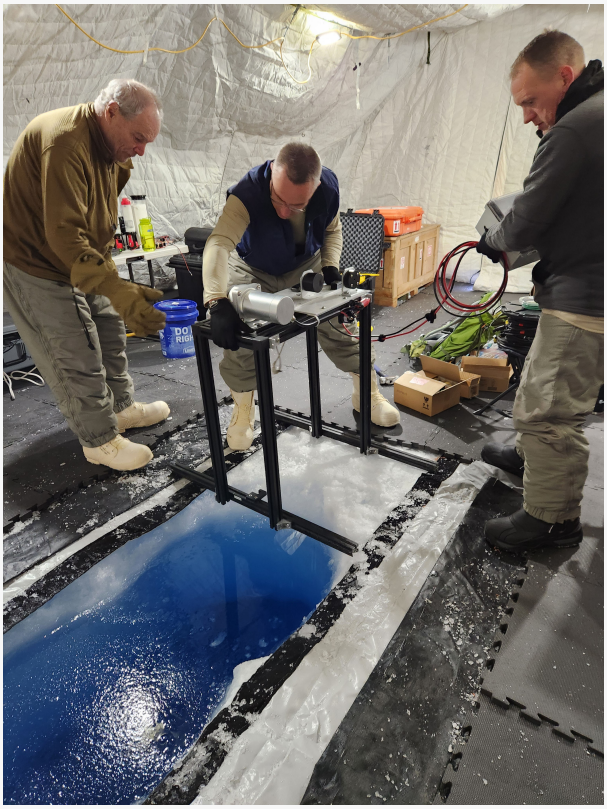
While on transit in Prudhoe Bay, Alaska, the NPS team was also thrilled to meet with two distinguished NPS alumni who were on their way to observe operations at Ice Camp Whale – Secretary of the Navy Carlos Del Toro, a Space Systems Operations graduate, and aeronautical

engineering alumnus Sen. Mark Kelly (D-Ariz.), a NASA Hall of Fame astronaut.

The NPS team's research efforts directly support the Department of Defense's recently released 2024 Arctic Strategy, which specifically calls for enhancing air and maritime domain ISR capabilities, advancing analysis to better sense, model and predict changing environmental conditions, as well as increasing "Arctic literacy" and research.

At the time of the strategy's release, Iris Ferguson, Deputy Assistant Secretary of Defense for Arctic and Global Resilience, emphasized the need to have the right sensing architecture in place.

"We must improve our domain awareness and enhance our ability to detect and respond with our Canadian allies to threats to the homeland," she said. "A key focus for my office is championing investments that will enhance our awareness of threats in the region."



Students and faculty from the Naval Postgraduate School (NPS) conduct experiments at Ice Camp Whale during Operation Ice Camp 2024.

Lt. Cmdr. Taylor Hudson, a student from the Naval Postgraduate School (NPS), measures sensor placements at Ice Camp Whale during Operation Ice Camp 2024.

Stretching from Maine and the North Atlantic across the Arctic Ocean through the Bering Strait and Alaska in the North Pacific, the Arctic is a region of strategic geopolitical and global importance. It holds an estimated 30 percent of the world's undiscovered gas reserves, 13 percent of its conventional oil reserves and $1 trillion worth of rare earth minerals. Despite having our planet's smallest ocean, it has the potential to connect nearly 75 percent of the earth's population.

This will especially be the case in the coming decades, as rapidly melting sea ice and increasingly navigable Arctic waters – which the Navy termed a "Blue Arctic" in its 2021 Strategic Blueprint for the Arctic – creates both challenges and opportunities. Chief among these challenges are the threats posed from rising maritime activity by Russia and China, which are posturing their navies to pursue nationalist agendas across the region.

Representatives from the United States, United Kingdom, Canada, France and Australia participated in Operation Ice Camp 2024, headquartered at Ice Camp Whale on the Arctic Ocean.

The Northern Lights appear over Ice Camp Whale during Operation Ice Camp 2024.

"Our world's changing climate brings with it increased access to shipping lanes that are normally frozen over for long periods of time, as well as access to undersea resources for further exploration," Del Toro noted in early 2024. "It is imperative that we ensure our approach to operating in the Arctic focuses on our combined resiliency in the region, and preserves our ability to freely maneuver in a contested maritime domain."

Since 1946, Operation Ice Camp has served as a central pillar of America's role in the Arctic. Previously known as Ice Exercise (ICEX), the three-week event was elevated to an operation in 2024 to better reflect the Navy's prioritization of the region. It is designed to research, test and evaluate operational capabilities in the Arctic region to maintain an enhanced Arctic presence, strengthen alliances and partnerships, and build a more capable Arctic naval force.

ASL serves as the lead organization for coordinating, planning and executing the operation.

Centered on its temporary command center Ice Camp Whale, Operation Ice Camp 2024 involved more than 200 participants from across the U.S. armed forces and the military services of partner nations, including representatives from the Royal Canadian Air Force, Royal Canadian

Navy, French Navy, the United Kingdom's Royal Navy and the Royal Australian Navy.

"Ice Camp Whale provides our teams the opportunity to conduct their research in one of the harshest and most demanding environments in the world," said ASL director Howard Reese during the operation's launch. "We are responsible for developing and maintaining the expertise to allow the Submarine Force to safely and effectively operate in this unique environment. We are able to take what we learn from this environment and apply the lessons to real world operations."

Joseph and Reeder have participated in the event since 2016. For the most recent iteration in March 2024, they were joined by two METOC students, Navy Lt. Cmdr. Colleen Wilmington and Lt. Cmdr. Taylor Hudson. The research the team conducted directly folds into their respective graduate theses.

"Our focus has always been to go up there and understand how the changing Arctic is affecting ASW type of operations," said Joseph. "Our lab is primarily focused on underwater acoustics."

In 2023, they built a device they term a cryophone, which functions like a hydrophone frozen in the ice. The cryophone is capable of 360 degrees of detection of acoustic wave propagation below, through and above the ice, through three media (water, ice and air).

"Basically, they're accelerometers grounded to a plate which then gets embedded in the ice and frozen in, which makes the ice part of the system," Joseph explained. "What we found out is that sound which is transmitted under the ice also propagates into the ice, which can be received by these cryophones on top of the ice."

Having a cryophone sit on top of the ice has multiple advantages, he noted.

In addition to communication possibilities, the instrument can collect and disseminate position, location and various data critical to the Navy's ASW and ISR mission sets. The cryophones can be used to provide this information on underwater sound sources, identify aircraft flying overhead, and even hear the sounds of people walking across the ice.

Much of the team's research this spring was devoted to testing out the cryophones' capabilities. In the process, they investigated how they could use the instrument to acoustically derive properties of the ice itself – how hard and thick it is, for example.

"This is useful information in doing Arctic operations," Joseph said. "A submarine coming to the surface, for instance, may want to know something about the ice above it."

The Arctic is currently undergoing profound environmental changes and will be for the foreseeable future. Understanding these changes in detail – especially how they affect acoustic propagation through water and ice – is critical to the Navy's operations in the region.

Using a device called a CTD (Conductivity, Temperature and Depth), the NPS team was able to strategically measure and track changes in temperature and salinity in the vicinity of the Ice Camp. These parameters affect the way sound propagates through the ocean

“We found that the biggest challenge up there is the effects of a slug of water that is coming through the Bering Strait; it’s especially warm and salty,” Joseph said. “Because it’s warm, it increases the speed of sound and because it’s salty, it sinks under the surface layer.”

“In doing so, it sets up this very strong subsurface duct which brings with it a significant change in acoustic propagation,” he continued. “This has been of very high interest to us.”

For Wilmington and Hudson, the data the team collected was a veritable gold mine for their theses.

“I think it’s a really unique opportunity to be able to go up and collect your own data,” said Wilmington. “The amount of data that we collected across our five days there provides more than enough data to analyze for the next 10 years!”

For her graduate thesis, Wilmington will use the data to focus on using acoustics to determine properties of ice.

“I’m looking at the ice density, the ice flexural strength and actual ice age, and then being able to use these to feed into modeling programs to determine what the ice melt is going to look like, as well as informing the National Ice Center to enable ships – especially ice breakers – to transit on the path of least resistance where it’s easiest to break the ice,” she explained.

Additionally, Wilmington plans to use the data to refine NPS’ Regional Arctic System Model (RASM), an ice model with a six-month outlook – the only model that forecasts that far out.

“I’ll be using the acoustic propagation through the X, Y and Z planes and comparing it to data collected through hydrophones and microphones, and then comparing that to the RASM to see if we can prove it,” she added. “RASM has been online for many years, but it’s still considered an experimental model per se. If I can use this data to prove that RASM is generally right, then it can be advertised as an operational model.”

With the Arctic becoming a contested region, having this information will allow more vessels to safely transit the region. The U.S. Coast Guard has a limited number of ice breakers, so knowing and being able to predict thinner ice that bow-strengthened surface vessels can potentially go through without an ice-breaker escort would vastly improve U.S. operability in the Arctic.

“If we can forecast the thickness and density of the ice and safely get units through, or be able to at least know where we station our ice breakers, it would assist our commerce and our ships’

traffic ability," Wilmington said.

The expedition was a boon for Hudson as well. For his graduate thesis work, Hudson's focus is on refining the cryophones' capabilities for over-, under- and through-the-ice acoustic work.

"It was a once-in-a-lifetime opportunity," he said. "We are focusing on sound above, captured in the air, and also through the ice using tactile sound transducers, as well as monitoring undersea sounds. Using the cryophone, what we want to do is capture the longitudinal, the shear and flexural waves of sound through the ice. If we can see all three of those, we can limit the amount of equipment that we actually need."

To do so, the team collected three types of data sources to test the cryophones: impulsive, such as the sound of an imploding light bulb as it sinks into the depths of the ocean; coherent, such as sounds emitted by tactile transducers; as well as following mobile sources such as from MK 39 Expendable Mobile Anti-Submarine Warfare Training Targets (EMATT).

What draws Hudson to this research is its operationally relevant nature. As a 27-year veteran of the Navy, including time as an enlisted sailor, he is thrilled to be working on something so potentially impactful.

Theoretically, he said, the cryophones are small enough to be deployed en masse from a P-8A Poseidon type of aircraft for rapid response, landing on the ice and melting themselves in to immediately begin listening in under the ice.

"Our work on the cryophones could potentially lead to an actual usable sensor that would bring an entire platform of P-8s back into the ASW fight in the Arctic," Hudson said. "The fact that we are actually working on something that's truly operationally relevant to the Navy is what gets me excited."

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