



ARCTIC TECHNOLOGY EVALUATION 2017



Overview

Oil spill research in the freezing waters interspersed among the ice of the Arctic. Small unmanned aircraft systems (sUAS) scouting pathways through the ice for Coast Guard Cutter (CGC) HEALY. Unmanned surface and underwater vehicles scouring the frigid sea. The Coast Guard Research and Development Center (RDC) will explore these technologies and more this summer as part of its Arctic Technology Evaluation 2017.

The RDC, located in New London, Connecticut, conducts research for the purpose of improving Coast Guard operational and mission performance across all mission areas for the 88,000-member force stationed around the globe. On their upcoming expedition, RDC staff will travel on CGC HEALY, a 420-foot icebreaker, through the wild waters of the Bering, Chukchi, and Beaufort Seas. During the trip, they will conduct extensive research and technology evaluations to support the Coast Guard's Arctic strategy of promoting safe, secure, and environmentally responsible maritime activity in the region.

“We’re incredibly excited and feel a strong sense of purpose for our latest mission to the Arctic,” said Scot Tripp, RDC’s designated chief scientist for the HEALY voyage. “Now more than ever, Arctic research is critical to positioning the Coast Guard for long-term success in the region.”

Research will include operations with an unmanned maritime system (UMS) and unmanned underwater vehicle (UUV), conducting overhead ice dives, launching an sUAS, deploying an oil skimmer in the icy water, evaluating passive sensors, and deploying data collection buoys.

What will the RDC gain from this trip? “Vital data that will influence future operations and requirements of Coast Guard maritime governance

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in the Arctic region,” said RDC Surface Branch chief, Rich Hansen. “Information from the technology evaluations will allow leadership to make strategic decisions that will benefit the Coast Guard in the long term as the environment, resources, and priorities change. Our ability to adapt is what will give us the edge, and RDC research will position the Coast Guard to better respond to future Arctic operational needs.” ■



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Unmanned Underwater Vehicle Unmanned Maritime System

The RDC will test autonomous vehicles in the Arctic to help identify potential issues Coast Guard operators may have with unmanned surface and subsurface vessels. The unmanned underwater vehicle (UUV) is a small unmanned platform that is capable of executing a pre-programmed mission underwater and then return to the surface for recovery of the vehicle and its recorded data. The UUV also has side scan sonar, which is used to take sound imagery of the sea floor. The side scan sonar may also enable capturing imagery of the underside of the ice, and can be used to look for spilled oil trapped underneath.

Control signals are sent via Wi-Fi connection from a laptop, and the UUV is powered by a battery pack and launched and recovered by hand.

Objectives of the UUV testing include:

- Gaining experience with UUVs in an Arctic environment
- Testing the clarity of the side scan sonar at various depths and settings and experimenting with ice profiling, which will yield results on the ice edge and thickness
- Evaluating the command, control, and navigation of the UUV in the Arctic environment

The unmanned maritime system (UMS) is made up of three pieces that are combined to form a module that obtains imagery from the surface of the water. Built by RDC staff and powered by batteries and solar panels, the UMS can be operated by remote controls or in autonomous mode to execute pre-programmed missions. The UMS will have 360 degree elec-



Unmanned Underwater Vehicle Unmanned Maritime System Continued



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tro-optical camera field of view; additional payloads will also be evaluated.

Objectives of the UMS testing include:

- Conducting remote-controlled operations of a UMS in open water areas in the Arctic
- Conducting autonomous operations of a UMS
- Demonstrating the ability of a UMS to detect oil in the water using a fluorometer sensor
- Exploring overall UMS capabilities in the Arctic environment

UUVs and UMSs have the potential to be force multipliers for the Coast Guard. Proven technology could be used to supplement Coast Guard forces and provide increased maritime domain awareness, which is especially important in the Arctic due to the lack of infrastructure and vast harsh operating areas.



MSST San Diego Dive Team



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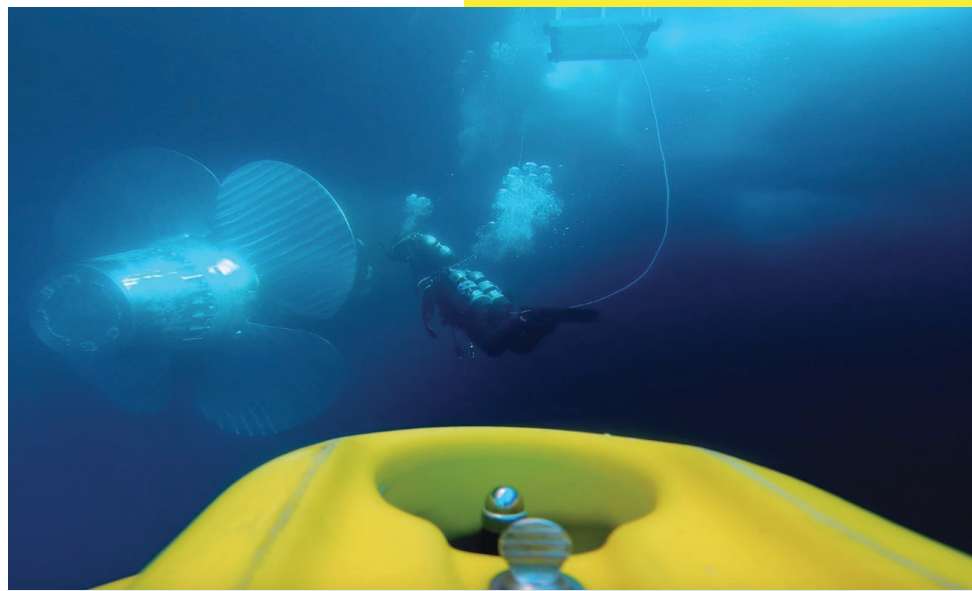
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The Coast Guard Maritime Safety and Security Team (MSST) San Diego Dive Team – which includes six Coast Guard divers who will be joined by six additional divers from the U.S. Navy – will conduct ice dives in the Chukchi Sea, northwest of Alaska. Ice dives are dives conducted in any water colder than 38 degrees.

The Navy will provide hyperbaric recompression chamber support, a capability the Coast Guard has yet to acquire due to infancy of the Coast Guard Dive rating/program. Coast Guard divers will lead the dive operations and expect to exercise the vast majority of specialized skills the Coast Guard offers in military diving. Coast Guard divers are made up primarily of enlisted personnel and can range from 21 to 50 years of age; during dives they must carry up to 120 pounds of equipment, stay below surface for up to two hours depending on depth and air source, and descend to a maximum depth of 190 feet sea water.

The Coast Guard Dive Team has three primary objectives for the trip:

1. Conduct ice dive exercises and training with the Navy as well as training with the emergency recompression chamber and dive medical technician, which are required life support resources because of the distance from medical services from which HEALY will be operating. The Coast Guard does not currently have emergency recompression chambers, a medical tool that treats diving-related illnesses.
2. Support a Coast Guard Marine Board of Investigation inquiry by searching for the location and taking underwater imagery of the crab fishing vessel *Destination*, a 95-foot boat that went missing two miles northwest of St. George's Island in the Bering Sea the morning of Feb. 11, 2017. Coast Guard divers hope to locate the vessel's underwater resting place and plan to use side scan sonar and remotely operated vehicles to photograph the ship and obtain evidence that will help explain what may have happened. Imagery from the vessel will be critical to the Marine Board of Investigation hearing, which will occur in September 2017. Dive members aboard HEALY intend to perform a cursory search and will return via another vessel to perform an in-depth investigation and complete the search at a later date.



Coast Guard Dive Lockers are trained to conduct polar operational support for polar icebreakers by performing engineering support including hull inspections and emergency underwater repairs in geographically remote areas.

MSST San Diego Dive Team

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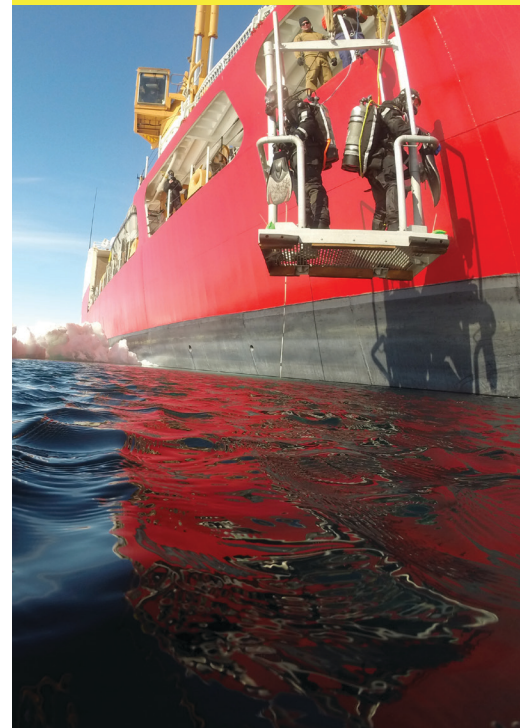
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3. Perform an underwater memorial to honor two Coast Guard divers who died as a result of a 2006 accident and demonstrate course correction and implementation of increased training and safety measures resulting from their sacrifice. This will be the first time Coast Guard divers will be attached for diving operations to HEALY since the accident. The deaths spawned drastic changes in Coast Guard diving, including creation of a job specialty/rating and enhancement of basic to advanced training. Required Coast Guard diver training to operate in cold weather environments includes the following:

- 2nd Class Dive School Naval Diving Salvage Training Center (NDSTC) (duration: 5 months)
- Cold Water Ice Diving Course (duration: 2 weeks)

The divers embarking on HEALY are pioneering the way forward for a safely modernized Coast Guard dive program. Introducing chambers to Arctic and Antarctic deployments is critical to risk mitigation and accident avoidance like the 2006 accident. Providing U.S. Coast Guard subsurface capabilities in the austere polar regions for science, security, and safety is a critical component for future Arctic operations.

By conducting ice dives and polar region training, Coast Guard divers will be better prepared to support Coast Guard missions there. By making use of Navy's dive hyperbaric recompression chamber, the team will demonstrate the importance of this critical life support tool for military diving. ■



Small Unmanned Aircraft System

Small unmanned aircraft systems (sUAS) are a primary research area for the RDC with three active projects currently underway exploring development capabilities of the technology. The RDC will test the sUAS capability InstantEye Mk-2 Gen4 in the Arctic to evaluate how the Coast Guard can potentially leverage this technology to enhance operational mission performance in Polar regions.

The InstantEye by Physical Sciences Inc. (PSI) Tactical Robotics Division is the smallest UAS at the RDC (two models can fit into a single backpack). Originally designed for soldiers in desert warfare, the sUAS will be tested in the Arctic maritime environment to determine operational utility in the uniquely Coast Guard domain. Perfect for research, the sUAS is operated by a wireless hand-held controller powered by a battery, features two cameras – including an infrared camera which allows for night imagery and visibility through fog and a color video camera array – and can be deployed by a single operator within 30 seconds. The sUAS also carries an infrared floodlight which can light up an object (while remaining undetectable to the human eye) and can be seen with night vision goggles – perfect for intelligence and reconnaissance operations. With a performance endurance of up to 30 minutes, the sUAS can fly to a maximum altitude of 12,000 feet above mean sea level, but will fly at 300 to 500 feet off HEALY.

The Coast Guard could potentially use the InstantEye in a number of ways: search and rescue cases, buoy location checks, ice conditions scouting, and oil spill clean-up guidance (using large aerial imagery to survey the severity of the damage). The InstantEye can also support the drug interdiction mission by flying over a suspect vessel to assess potential risks (weapons, drugs, etc.) prior to making a decision to board – a huge asset in the fight for criminal network disruption.

Testing the sUAS in the Arctic will unleash a wide range of possibilities for improved mission performance in the region and explore integrating autonomous systems into Coast Guard operations to realize the benefits of their force-multiplying potential. ■



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The InstantEye payload will include an infrared floodlight which illuminates the area directly below the vehicle, making objects highly visible in dark conditions when viewed with night-vision devices. Photo used with permission from PSI.

Oil Skimmer



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As a part of the Coast Guard Marine and Environmental Protection mission, the RDC is committed to oil spill response research and technology. There are currently two Arctic oil skimmer models in the world with the ability to self-propel; the RDC previously tested one of the Arctic skimmers, the self-propelled Polar Bear, in 2012. This year, the RDC will evaluate a standard self-propelled skimmer from Aqua-Guard, a company from Vancouver, Canada, to further support the RDC's Response to Oil in Ice and Arctic Operations Support projects in helping identify potential equipment the Coast Guard can utilize for spill response.

The RBS Triton skimmer is designed for use in various conditions in order to keep the ship farther away from oil so the ship's propellers or bow thruster do not pull oil into the water column. The Triton is not originally designed for Arctic use but the company is interested in expanding its areas of operation. This approach provides an alternative to keeping the skimmer attached to a crane and "dipping" into pools of oil. The skimmer has a hydraulic hose that controls the system, and a recovery hose brings the oil back to the ship. The U.S. Navy Supervisor of Salvage and Diving (SUPSALV) is providing a hydraulic power unit, the Oil Spill Recovery Institute (OSRI) of Cordova, Alaska, is providing funding and shipping for the skimmer, and three members from different Coast Guard Strike Teams will operate the skimmer.



The RBS Triton 150 RotoX Oil Skimming System. Photo used with permission from Aqua-Guard.

The objectives of this demonstration are to gather information that may be used by Coast Guard federal on-scene coordinators (FOSC) in encountering skimmers in the Arctic either in contingency plans or during an actual spill. Other objectives include:

- Determine support capabilities needed for Arctic skimmers in terms of area, personnel, power, vessel services, etc.
- Determine the best location on the HEALY icebreaker (and other vessels, including Coast Guard buoy tenders) to deploy the skimmer and route the hydraulic hose, recovery hose, and temporary recovery tanks
- Identify advantages and disadvantages of deployment methods

The preferred testing conditions for Triton are broken ice with pockets of water. A secondary deployment could be along a defined ice edge.

Oil Skimmer

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Testing of the system can be conducted in twilight conditions but not in near-darkness. No oil will be used during testing.

Testing of the Triton in the Arctic will further ensure the Coast Guard remains thoroughly prepared and ready to respond to oil spills in all conditions by leveraging the latest developments in spill response technology in real-world situations. Results of the testing will inform key spill response decisions in the future and influence future skimmer requirements. ■



The Triton in action. Photo used with permission from Aqua-Guard.

Passive Millimeter Wave Camera

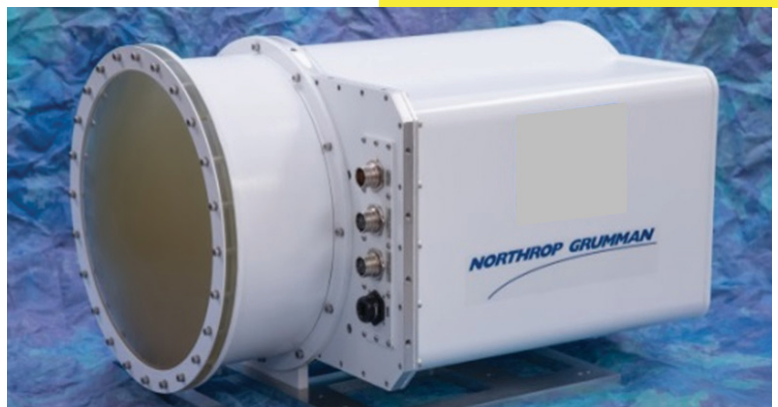


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In the harsh summer weather conditions of the Arctic, which often include fog, it is essential to have high visibility over a long distance in order to effectively navigate a vessel to avoid ice. The RDC will assist the Navy in testing a Northrop Grumman-developed passive millimeter wave camera, a passive sensor device that detects and responds to input from a physical environment and does not transmit energy. Weighing 50 pounds, the camera's sensors receive data from sunlight, fog, heat, and other environmental elements. Using the millimeter wave technology, operators will attempt to see through fog and potentially identify ice floes (large packs of floating ice) in the path of the vessel ahead. Testing will also involve determining if the camera can provide navigational aid in limited visibility conditions.

While phone cameras capture visible light waves, the passive camera captures a completely different spectrum of waves that are undetectable to the human eye. With the unpredictable weather in the region, the camera could be an important asset to operators underway in the future. ■



A passive millimeter wave camera. Photo used with permission from Northrop Grumman.

NOAA Buoy Deployment

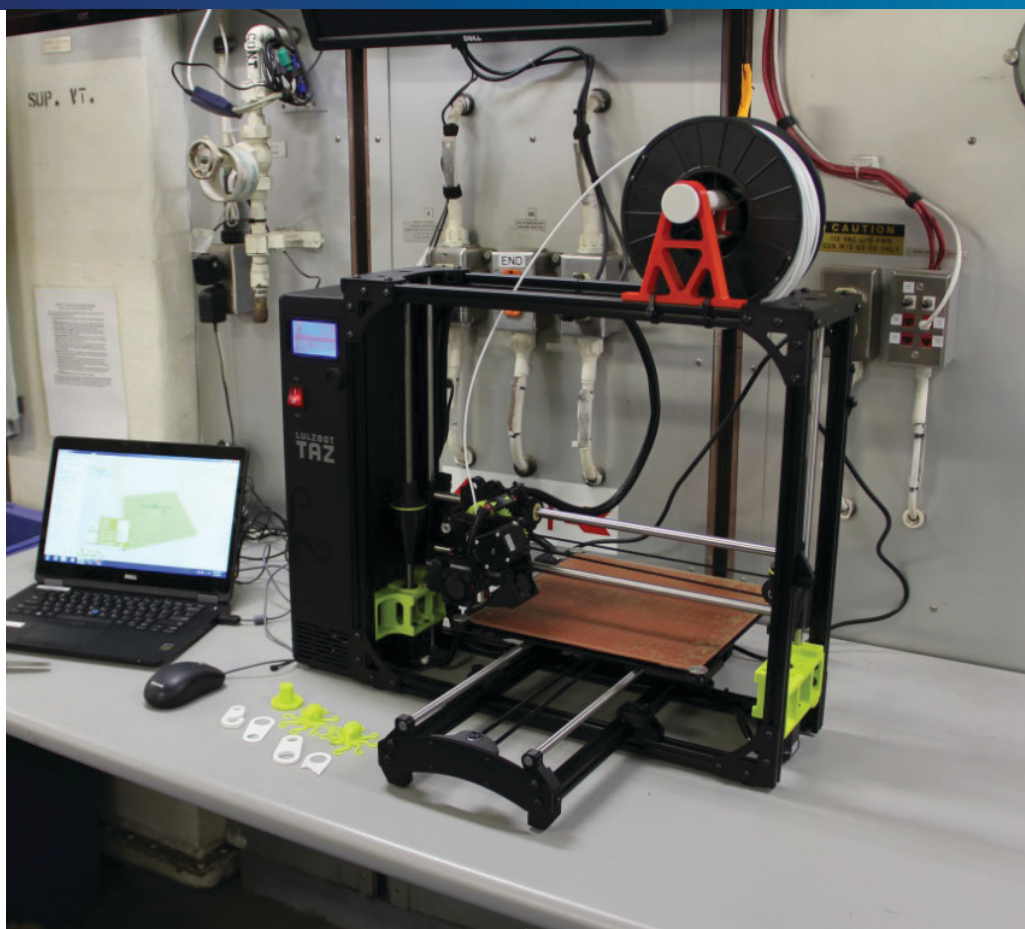
The National Oceanic and Atmospheric Administration (NOAA), one of the Coast Guard partners on the HEALY cruise, will work with the RDC to deploy a NOAA buoy. These systems will capture oceanographic and weather data to assist with weather forecasting for the ship.

The buoy – which contains scientific instruments to measure environmental elements – and the associated mooring line will be deployed from HEALY for a three-month deployment. After three months, the buoy will be recovered by another vessel in the fall before ice re-occupies the site. The buoy will serve as a test bed for evaluating innovative sensors and techniques for increasing the Coast Guard's and NOAA's observational capabilities in the Arctic. ■



3-D Printing

The RDC has installed 3-D printers on several Coast Guard cutters. Recent Coast Guard Academy graduates have been identified as points of contact (due to their computer-aided design (CAD) background) and have traveled to install printers and train crewmembers for operations while underway, including on CGC HEALY. The research into the viability and capability of the technology is ongoing, and RDC staff will have first-hand availability to witness the HEALY crew's use of the 3-D printer installed on the ship during the cruise this summer.



For more information:

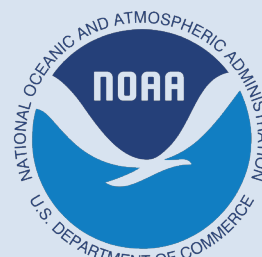
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