An Autonomous Underwater Vehicle System for Arctic Operations

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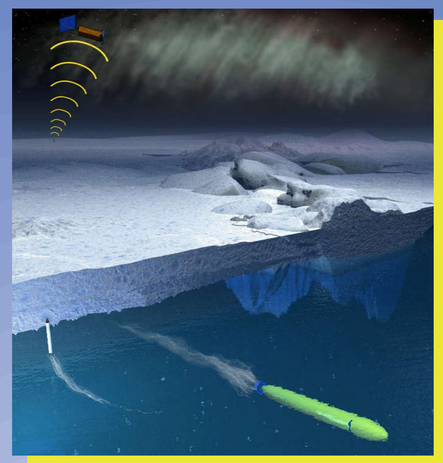


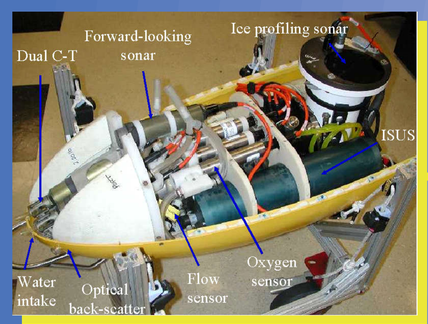
Arctic Basin Survey
Autonomy - 2 weeks
Range - 1500 km
Depth rating - 1500 m (w buoys) 4500 m (wo)
Satellite reporting
Modular/reconfigurable
Dorado AUV
Ice Thickness
Physical Oceanography

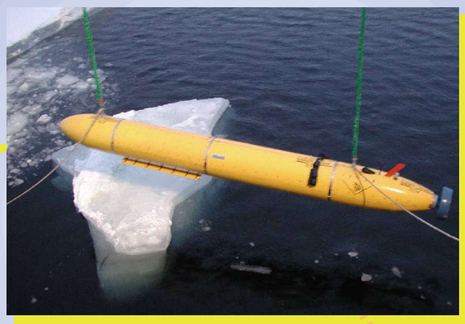
Functional/User Requirements:

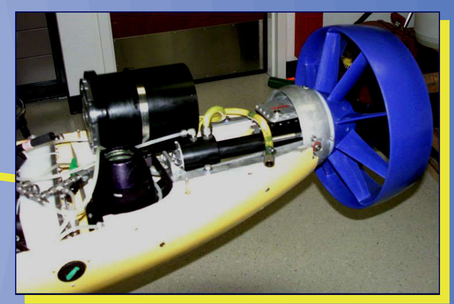
The design of the ALTEX AUV was guided by a set of needs distilled from both the specifics of the Atlantic Layer Tracking Experiment, and from more general observations of Arctic science. The primary requirement is for an AUV with a range that enables basin scale observations. The vehicle must have at least a 1500 m depth rating for Arctic hydrography, but ideally should be capable operating through the entire range of depths of the Arctic basin. Furthermore, the vehicle must be small enough to be logistically manageable, and must be cost effective. Finally, the system must be reconfigurable to satisfy a wide range of science objectives.

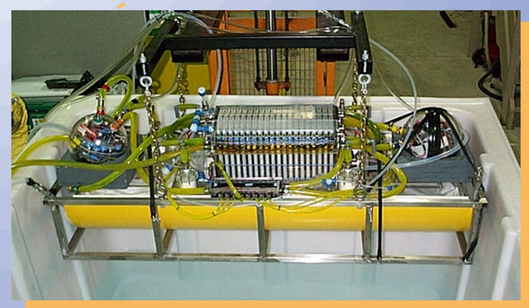
Transitions:

The ALTEX project included collaborations with many institutes including MBARI, WHOI, MIT, SSI, FCT USCG, and the NSF. MBARI was chosen to initially develop a new tailcone to control and propel the AU After the design was proven at MBARI and a patent was granted, Bluefin Robotics commercialized the and is now selling vehicles, with the MBARI designed tailcone, to outside commercial customers. MBA also on the forefront of architecting a modular, object oriented framework for the vehicle control and lo software. This software development was also commercialized and extended by Bluefin Robotics in th Odyssey III (Dorado @ MBARI) line of vehicles. Through Bluefin Robotics, MBARI's ALTEX funded tech is making its way into the commercial and science research world. Orders for Dorado style vehicles ha placed fellow research institutions at Oregon State University, Scripps, MIT, WHOI, and a German rese









Field/Testing Results:

The Dorado AUV development effort at MBARI in 2000-2001 was directed towards long endurance high latitude under-ice operations during the ALTEX cruise aboard the USCG Ice Breaker Healy in October and November of 2001. Integration of an advanced power source (Fuel Cell Technologies semi fuel cell), remote data transfer system (Scientific Solutions International buoy launcher), high latitude capable navigation system, and a configurable data acquisition system were emphasized [5]. Fig. 4 shows the full length vehicle being deployed in the icy waters of the Arctic.

Operational Issues:

MBARI performed field trials of the ALTEX vehicle in the Arctic in October 2001. The USCGC Icebreaker Healy (WAGB-20) supported operations to the north of Norway up to latitudes of 84 N. The sun slipped under the horizon permanently after the first week of operations. Cold and windy weather seemed to follow shortly afterwards. Launching of the ALTEX AUV was accomplished by using the port crane on the stern. Quick-release latches were used to divorce the AUV from the lifting bar and straps. Recovery of the AUV involved more human support. A small boat with 4 personnel was launched in the water to assist attaching lifting hardware onto the AUV. Because of this requirement, sea state, weather, and boat functionality limited operations in the dark Arctic. The Icebreaker had amazing capabilities to plow through ice up to 10 feet thick. Although a significant portion of the ice in the Arctic is multi-year ice thicker than 10 feet, MBARI and PMEL scientists took advantage of the ALTEX AUV's autonomous capability and sent it under the thicker multi-year ice to collect CTD, nitrate, particle, and ice draft data on multiple hour long missions, at speeds up to 3 knots. There were times when the AUV traveled over a kilometer away, out of tracking range from the Healy . The reliable operation and navigation brought it right back to the aft quarter every time. High latitude heading estimation and under ice navigation capability was also tested with multiple sensors on the ALTEX AUV. A Kearfott SeaDeViL integrated ring laser gyro/inertial navigation sensor/Doppler velocimeter logger sensor provided the best heading estimate and position estimation. The sensor was "aligned" on the deck of the ship with the help of GPS, then lauched in the water. Since the AUV was operated in water depths of around 3000m, the onboard DVL could not provide relative velocities until the vehicle was under the ice. The DVL aided the INS by sending its sonar beams towards the ice and calculating velocities from the Doppler shifts received back.

MBARI's community of collaborators, government agencies, and industry

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