Team successfully tests new unmanned autonomous surface vessel

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The U.S. Army Engineer and Development Center's Justin Wilkens, a research biologist with the Environmental Laboratory, checks the waypoints using the SubSeaSail's G6 navigation software on his laptop. The unmanned surface vessel was taken to Vieques, an island off the coast of Puerto Rico, for a demonstration by Wilkens and a team of ERDC-EL research biologists, including Dr. Guilherme Lotufo and Dr. Mark Ballentine. The USV gathered data indicating the presence of munitions constituents from unexploded underwater ordnance, a problem at sites around the world. Chris Todter, far left, a SubSeaSail partner, and Tom Goddard, far right, SubSeaSail Fabrication and Testing, are also visible in the photo.

Anxious at first about the specter of possible software glitches that would derail the project, the U.S. Army Engineer and Development Center's Justin Wilkens, a research biologist with the Environmental Laboratory, soon confirmed that everything was functioning well. He and a team of other EL research biologists, including Dr. Guilherme Lotufo and Dr. Mark Ballentine, visited Vieques, an island off the coast of Puerto Rico, for five days in February to demonstrate a new unmanned autonomous surface vessel, or USV.

"Like all software, navigation software for USV's is continuously evolving and improving," Wilkens said. "Our software charted a course and tracked the position of the USV. This allowed our team to successfully navigate the vessel through our study area and complete our monitoring mission.

"The construction and durability of the vessel is excellent," he said. It's engineered for simplicity so it's more affordable, yet it's more than capable of completing many monitoring tasks.

"We bought it from SubSeaSail, LLC, and the G6 is the sixth iteration of their invention. Some parts are custom fabricated while other parts are off-the-shelf – the idea is that if it needs repairs, we can fix some things ourselves. The design limits the use of complicated or vulnerable electronics so there are fewer things that could fail."

The G6 is a sailing vessel powered by the wind and solar energy. The sail is controlled without any lines, pulleys or electronics, with the servo-managed rudder constituting the only electro-mechanical component required for the USV to sail – that means the vessel requires less than one Watt of power. Chris Todter, a SubSeaSail partner, and Tom Goddard, Fabrication and Testing, accompanied the team to Vieques to provide technical support for the three-meter-tall, one-and-a-half meter-long USV.

In this demonstration, the team used the vessel to monitor munitions constituents from unexploded underwater ordnance, a problem at various sites around the world.

Lotufo, along with Wilkens, Robert "Robby" Boyd and Gunther Rosen —— a scientist with the Naval Information Warfare Center Pacific (NIWC Pacific) and a collaborator of Lotufo's —— started working together over a year ago to identify a vessel that met ERDC's criteria.

Rosen facilitated all the logistics for the trip with the U.S. Navy, who hosted the team in Vieques. "The Navy provided the work boat, which we used each day to launch our vessel from. Without their help and support, that trip would not have happened," Wilkens said.

The demonstration was performed at Bahia Salina del Sur, an embayment once used as a Navy live training site. The team tested the vessel at three spots in the bay, using between eight and 20 waypoints for each area.

The Navy once controlled vast portions of Vieques and conducted naval gunfire support and air-to-ground training from 1941 to 2003; exercises were performed on the island itself and off the coast of Vieques and have resulted in the accumulation of munitions on land and surrounding waters.

"Munitions constituents, such as 2,4,6-trinitrotoluene - commonly known as TNT- and 1,3,5-trinitro-1,3,5-triazine - or RDX - may be released into the surrounding aquatic environments as a result of the munitions' corrosion and breaching of the outer casing," Lotufo said.

"Exposure to munitions constituents in water can be toxic to aquatic organisms," he said. "The use of integrative passive samplers allows us to more effectively detect chemicals when their concentrations fluctuate over time because they have a sorbent that continuously traps munitions constituents." SubSeaSail customized the USV to hold a Polar Organic Compounds Integrative Sampler (POCIS), for the detection of munitions constituents, and a multifunctional sensor for water quality measurements such as temperature, conductivity and turbidity.

Ballentine was responsible for applying the new sensing technologies developed under a nano congressional project by Missouri State University and Brewer Science Inc. to the USV. The nano congressional project includes placing sensors on various unmanned platforms to fine tune and test the sensor technology. The sensors had been previously placed on ERDC Unmanned Aircraft Systems to test for structural issues and potential battery failure.

Lotufo said the placement and retrieval of POCIS at various locations within the bay has required munitions response technicians and divers trained to safely conduct fieldwork over three resource-intensive field investigations. "The safety requirements for diving operations at munitions response sites can be very expensive," he said. "Using innovative USV technology like this to deploy POCIS can greatly reduce costs."

Wilkens ultimately hopes to utilize the USV to provide a service to customers, similar to the way the ERDC-EL UAS team has built a reputation for successful data collection projects. He expects to work on projects monitoring water quality parameters. "There is potential there to use it to monitor indicators for harmful algal blooms, for example," he said.