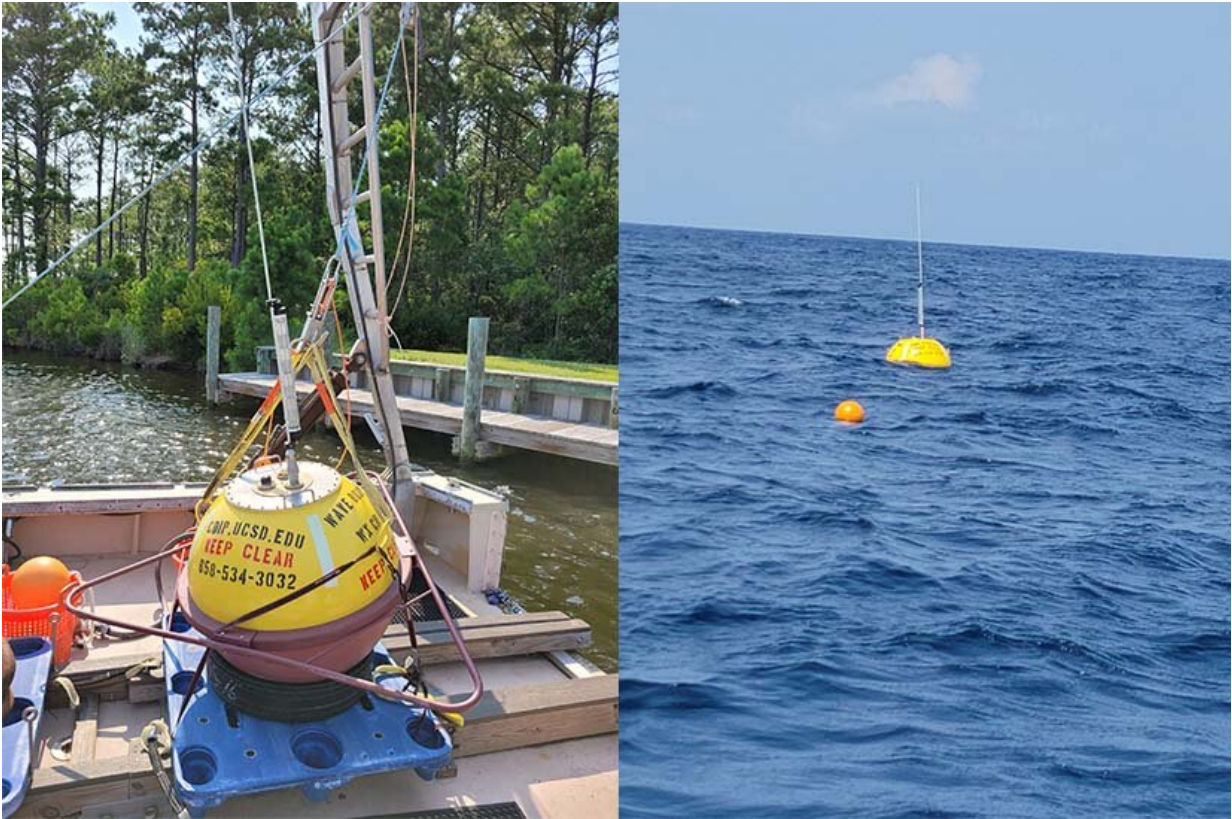


Waverider buoys collect data on the powerful clean energy available in our oceans

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This banana-yellow Waverider buoy will spend 12 months off North Carolina’s coast, collecting data on ocean waves, currents, tides, and water temperatures to help marine energy developers find the best spots to source clean, renewable energy from the ocean. Credit: Mike Muglia

A self-described surf junkie, Muglia catches waves on his surfboard off

the coast of the Outer Banks in North Carolina. Further into those waters—15 nautical miles to be exact—sits another surfer. Aptly named Waverider, this surfer is a 440-pound, half banana-yellow, half beet-purple buoy that Muglia uses to study the energy that flows in our oceans.

Marine [energy](#)—clean power generated from [ocean currents](#), waves, tides, and water temperature changes—is still young, but it has the potential to deliver clean, renewable electricity to coastal communities [where nearly 40% of Americans live](#). Before that can happen, scientists need to pinpoint which oceanic arteries host the most reliable energy. With [3.4 million square nautical miles of U.S. waters](#)—a larger area than the combined landmass of all 50 states—there is a lot left to explore.

Now, Muglia and Miguel Canals just deployed two new Waverider buoys—one off the coast of North Carolina and the other off Puerto Rico. There, the surfers will collect detailed data on the [surface waves](#) in those areas of the Atlantic Ocean, adding to publicly available data sets on waves, currents, and [water temperatures](#) that will not only move marine energy closer to widescale use but also help scientists understand how [climate change](#) is affecting our oceans.

Muglia is a principal investigator at the Southeast Atlantic Coastal Ocean Observing Regional Association and research professor at the Coastal Studies Institute of North Carolina, and Canals is a principal investigator at the Caribbean Coastal Ocean Observing System in Puerto Rico.

"We want to characterize the wave energy resources available," said Canals, who, like Muglia, surfs the same waves he studies. "But we also want to collect long-term data on waves to understand the [ocean](#) and the changing climate for the benefit of future generations."

The National Renewable Energy Laboratory (NREL), which owns the

two Waverider buoys, partnered with ocean experts Muglia and Canals to collect this critical new data. This NREL-led effort is part of a larger, nine-year project funded by the U.S. Department of Energy's Water Power Technologies Office. The collaborative, multi-institution study generates the resource data that technology and project developers need to design the next generation of devices. No one institution (or buoy) can collect it all, which is why partners like Muglia and Canals are so valuable. The data these partners generate are used to verify and improve model accuracy, and are also valuable on their own as detailed records of the real ocean. The data from this project—both the measurements and the models that use them—is publicly available on the [Marine Energy Atlas](#).

"The ocean," said Levi Kilcher, a physical oceanographer at NREL who leads the Waverider and Marine Energy Atlas projects, "is an extremely challenging environment. But we're starting to see success, which makes it a very exciting time to be in this industry."

On Aug. 2, 2021, Muglia set off in the Miss Caroline with a deckhand and marine mammal observer, who watched for sea turtles, dolphins, and other wildlife that might swim too close to the boat. For the 40-nautical-mile, three-hour trip, the bulbous Waverider buoy sat secure in a rubber tire on the back of the small skiff. When the Miss Caroline cruised to the selected spot—indistinguishable from the surrounding waters except by GPS—the team scanned the area for underwater obstacles before anchoring the Waverider under an almost-cloudless, blue sky.

From their lonely ocean homes, the two buoys will send live data back to Muglia's and Canals' teams using satellite communications systems. Solar panels help power those systems, and flashing lights alert boats to keep a safe distance.

Now, Muglia, Canals, and their colleagues and students wait impatiently

for the first batch of data to stream in. Wave energy researchers and engineers are also waiting impatiently. Using high-quality data on how the ocean moves, they can design wave energy converters that are better tailored to extract energy from the motion of the ocean surface.

The data can serve climate and environmental scientists, too.



In Puerto Rico, the Waverider buoy can help climate scientists track how extreme waves—forged in violent winter storms and summer hurricanes—can impact the coastal environment. Credit: Miguel Canals

In the tropical Puerto Rican waters, violent winter storms and summer hurricanes can create energetic seas. Canals and his team chose their buoy site specifically for its high energy potential—those waves pack power—but the data can also help researchers understand how extreme wave events impact the coastal environment. So far, Canals has only lost one buoy in Puerto Rico—to Hurricane Maria. It was recovered two weeks later off the Turks and Caicos Islands.

Canals, who successfully deployed his Waverider on June 15, 2021, also chose his site because the seabed lacked a significant population of benthic organisms—seabed dwellers, like clams, oysters, sea stars, or sea cucumbers—or sensitive habitats. "There's just sand and mud," he said, "which makes it an ideal location for the anchor deployment."

Neither Canals nor Muglia, who monitor multiple offshore buoys, have ever seen wildlife get tangled in buoy moorings. In fact, they have seen the opposite: The buoys attract shoals of slender, mud-colored Cobia and big-nosed, neon-yellow mahi-mahi, which like to swarm the bobbing devices.

And the Waveriders are not just for fish and scientists.

By streaming the buoys' measurements to North Carolina's Jennette's Pier aquarium, which welcomes about 250,000 visitors a year, "the public can walk in and see what the wave heights are, see what the water temperature is, see what the ocean surface currents look like off the coast of North Carolina," Muglia said.

You can find the same data from any computer anywhere in the world: With an online data feed available through the [Coastal Data Information Program](#), surfers like Canals and Muglia can check for dangerous currents, frigid temperatures, or flat waves before heading out on their surfboards. It can also help law enforcement navigate volatile waters to catch up with offshore lawbreakers.

"Even though the main purpose is for resource characterization," Canals said, "the buoy will have a lot of applications for surfers, fishermen, paddleboarders, divers, law enforcement, coastal managers, and boaters."

Both buoys now float near the Gulf Stream, which swings through the Gulf of Mexico (near the Caribbean Coastal Ocean Observing System on

Puerto Rico's northern coast) and hooks around Florida before heading up the east coast to Canada. With its warm and nutrient-rich waters, the Gulf Stream is a major regulator of the world's climate, feeds marine wildlife, and helps their populations thrive, so the U.S. fishing industry can thrive, too.

Still, Muglia said, "What happens down here is not well understood." Those rich, energetic waters could help power coastal communities with clean energy. But, if their temperatures shift or their speedy currents slow, that could disrupt global weather and climate, potentially causing more violent storms in Europe or higher sea levels in major U.S. cities like Boston and New York.

The two Waverider buoys will help both marine energy developers and climate scientists better understand these mysterious waters.

For now, as he waits for the data, Muglia is guaranteed to never miss another wave—either on his surfboard or in his laboratory—with the Waverider surfing offshore.

Provided by National Renewable Energy Laboratory

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