Glider Observations for Research and Forecasts NOAA's Atlantic Oceanographic and Meteorological Laboratory

Underwater gliders are recovered in the waters of Puerto Rico, October 2020. Image Credit: NOAA/CIMAS/CARICOOS.

NOAA Research Improves Models and Forecasts

Scientists and engineers from NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) and the Cooperative Institute For Marine and Atmospheric Studies (CIMAS) of the University of Miami have annually operated underwater gliders to monitor ocean conditions during every hurricane season since 2014, surveying ocean conditions in over 20 Atlantic hurricanes. Researchers at AOML and CIMAS have worked with many partners to operate these autonomous vehicles. These partners include the US Navy, US IOOS (Integrated Ocean Observing System) Regional Associations in the Caribbean Sea (CARICOOS), Southeast US (SECOORA), and Gulf of Mexico (GCOOS), the National Maritime Affairs Authority (ANAMAR) and Naval Auxiliaries of the Dominican Republic, the University of Puerto Rico-Mayaguez, and Cape Eleuthera Institute (Bahamas).

The observations obtained from underwater gliders allow ocean conditions to be more accurately represented in ocean models. Because of the strong interaction between the ocean and atmosphere during the passage of a hurricane, improved representation of the ocean in hurricane forecast models, particularly of temperature and salinity in the upper hundred of meters, has been shown to lead to more accurate hurricane intensity forecasts within NOAA experimental forecast models. Studies led by AOML and CIMAS, together with scientists from NOAA's National Weather Service, IOOS, and academic institutions, have shown that underwater glider data have the greatest impact in improving hurricane intensity forecasts of all ocean observing platforms. These gliders provide high-volume, high-resolution data in areas where hurricanes frequently travel and intensify or weaken, but where there may traditionally be a scarcity of ocean observations.

GLIDERS IMPROVE INTENSITY FORECASTS

20+
Hurricanes Surveyed by Underwater Gliders

9 years
Of continuous glider measurements for hurricane research and forecasts

20-80%
Per Storm Improvement by Adding Glider Data into Models

Underwater Robots Explore the Upper Ocean to Improve Hurricane Intensity Forecasts

NOAA's Atlantic Oceanographic and Meteorological Laboratory deploys and operates underwater gliders that gather ocean data that may help to increase the accuracy of hurricane intensity forecast models. These autonomous uncrewed vehicles are equipped with sensors to measure salinity, temperature, and other physical, chemical, and environmental parameters as they travel through the ocean.

For the 2022 hurricane season, scientists at AOML, CIMAS, and their partners will launch and operate approximately six glider missions from ships off the coasts of Puerto Rico, Dominican Republic, and Bahamas, with additional gliders launched by partners in the South and Mid-Atlantic Bight and Gulf of Mexico regions. This year's missions are fully supported by 2019 and 2021 Diaster Supplemental funds.

These battery-powered, remotely-piloted gliders are operated for up to four months and then recovered. They can operate and transmit data under hurricane wind conditions. Upon reaching the ocean surface, the data are transmitted via satellite for immediate use in scientific analysis and hurricane forecast models.

Glider Deployments Occur in Areas Where Hurricanes are Frequent

The maps below show the locations where glider operations in 2022 will be carried out by NOAA, CIMAS, and their partners to record temperature and salinity data at the sea surface down to a half mile depth. Once launched, the gliders make regular dives along set courses, surfacing several times a day and send their data via satellite to be used in hurricane forecast models.

The locations surveyed by the gliders are characterized by the presence of ocean features, such as warm rings and eddies, warm currents, warm surface waters of riverine origin, and subsurface cold waters, all of which have been linked to changes in hurricane intensity.
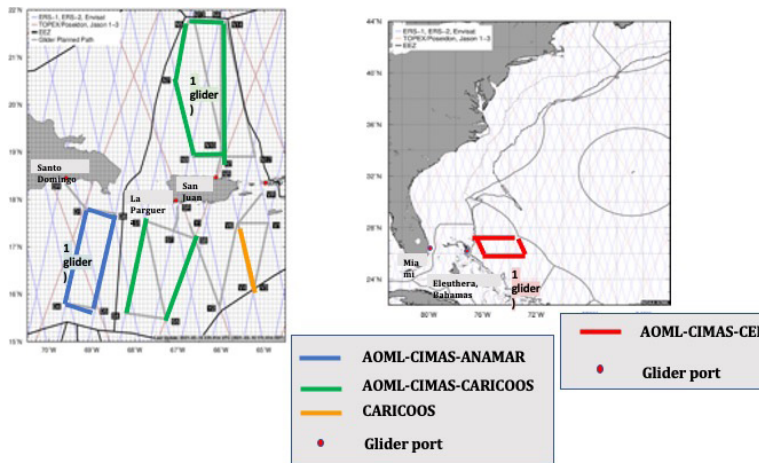

The 2022 Observational Plan for the Underwater Gliders
Image Credit: NOAA/AOML

Water temperature and salinity provide important information about water mass properties that may impact he intensity of a hurricane. As a hurricane passes by overhead, warmer surface water is mixed with cooler water below the surface, reducing the energy available to fuel the passing storm. However, if there is a layer of fresher, warmer water of riverine origin at the surface, it can serve as a cap that prevents mixing of ocean waters and keeps heat energy at the ocean's surface, continuing to fuel the passing storm that, therefore, may gain strength. Knowing if a storm will pass over predominantly warm water or areas where cold water may be stirred up from below helps scientists and forecasters better predict whether a storm will intensify or weaken as it travels. The observations obtained from gliders and other components of the ocean observing system allow these features to be better identified, monitored, and be represented more accurately in the ocean component of hurricane forecast models.

AOML and CIMAS will deploy 5 NOAA gliders in 2022 to obtain and transmit ocean profile data in real-time for assimilation into ocean and ocean-atmosphere forecast models. The autonomous characteristics of these vehicles and the strong collaborations in place with regional, academic, and governmental partners have been key to the success of the project. In addition, AOML is partnering with the National Weather Service to assess the impact of underwater glider and other ocean data on NOAA's new generation of hurricane models.

Ocean Observations Viewer Displays Recent Ocean Conditions

AOML and NOAA CoastWatch host NOAA's Ocean Observations Viewer, which is used as an interface for tropical cyclone research and operations. The interactive maps enable researchers to monitor ocean conditions and help NOAA to plan its field operations by providing a user friendly interface with easy access to global and regional ocean-atmospheric observations and products. Researchers at AOML also use these maps to assess ocean and atmospheric conditions prior to, during, and after the passage of a tropical cyclone. The large set of targeted ocean observations featured in this product, including ocean gliders, drifters, and floats, enable scientists to better monitor ocean conditions during each hurricane season. As glider deployments are made throughout hurricane season, the data will become available for viewing on this site.
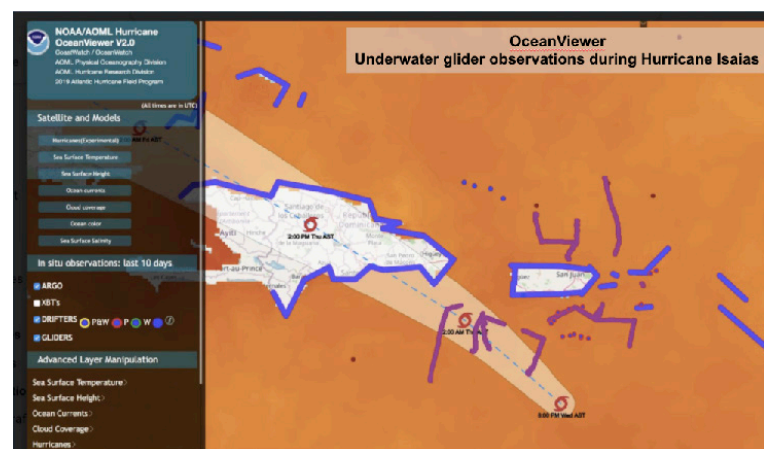
For a view of ocean conditions that can inform hurricane forecasts, visit: https://cwcgom.aoml.noaa.gov/cgom/OceanViewer/index_hrd.html

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For additional information: www.aoml.noaa.gov/hurricane-glider-project/