

2023

Annual Report

Gulf of Mexico Coastal
Ocean Observing System



Introduction

While Gulf coast residents may not always realize it, GCOOS data impact their lives in large and small ways almost every day. The data our partners collect and that we disseminate are crucial for things such as predicting storm intensification, supporting a safe offshore energy industry and even keeping people safe from toxic algal blooms.

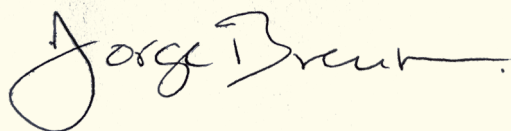
In 2023, ocean temperatures around the world soared to unprecedented levels. As our climate continues to change, ecosystems and coastal communities will continue to be impacted by sea level rise and more severe weather patterns. These changes mean that the GCOOS mission is even more important today than when ocean observation systems were first envisioned decades ago.

Since 2005, GCOOS has been working to build a robust, sustained, operational system that integrates physical, meteorological, biogeochemical, biological, bathymetric and other types of data critical to understanding our changing climate, as well as the short- and long-term impacts of changing weather patterns.

Because we are a data provider certified by the National Oceanic and Atmospheric Administration (NOAA), coastal communities can rest assured that GCOOS meets the gold standard for data gathering and management practices and operates inclusively, transparently and with stakeholder guidance to help us determine system priorities.

Developing such a robust system of on-demand data from across the Gulf of Mexico in U.S. and international waters would not be possible without strong partners in industry, academia and at governmental and nongovernmental organizations in Texas, Louisiana, Mississippi, Alabama and Florida. And, recognizing that oceans have no boundaries, we're extending our partnerships beyond the U.S. Gulf states to include partners from Mexico and the wider Caribbean.

This report provides a brief summary of the work we undertook in 2023 to support a healthy Gulf and resilient coastal communities.

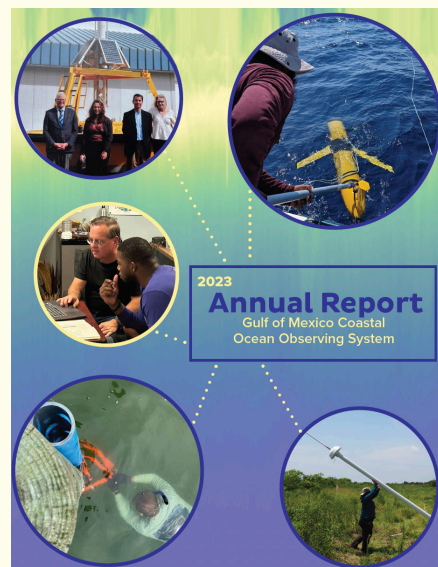


Jorge Brenner, Ph.D.
Executive Director
Gulf of Mexico
Coastal Ocean Observing System



Our Mission

The GCOOS mission is to provide on-demand information about the Gulf's coastal and open ocean waters that is accurate, reliable and benefits people, ecosystems and the economy.



On the Cover (clockwise from top left): The National Data Buoy Center (NDBC), Stennis, Mississippi (©NDBC); Retrieving a Slocum glider off the Texas coast (©TAMU-GERG); Installing a high-frequency radar in Louisiana (©RATES, Inc.); Installing a stilling well at a water quality station in Alabama (©Cory Harper/DISL); Teaching next-generation ocean observers in Florida. **Background Image:** A salinity profile from an Argo float in the Gulf of Mexico (©GCOOS).

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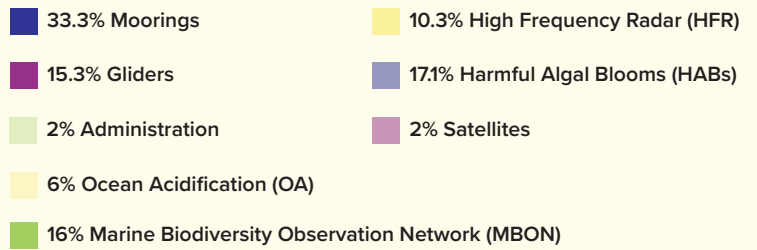
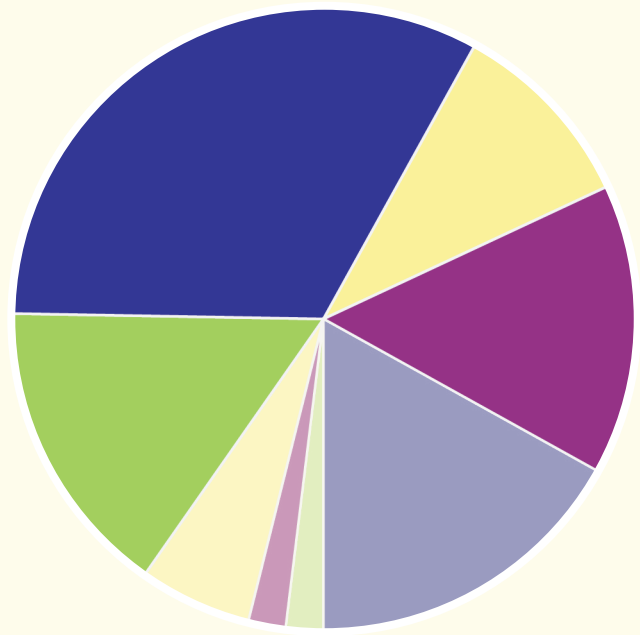
Funding the System

The majority of funding for GCOOS is competitively awarded through the U.S. IOOS office (under the umbrella of the National Oceanic and Atmospheric Administration) via multi-year grants (typically five-year cycles), cooperative agreements and/or contracts.

GCOOS also seeks revenue sources that supplement this income to bolster ocean-observing capabilities in the Gulf of Mexico and to develop the tools and products needed by our constituents; 27 percent of the GCOOS budget is supplied by outside grants and contracts.

GCOOS is currently in year three — covering July 1, 2023-June 30, 2024 — of the current five-year IOOS grant cycle with a budget total of \$3,614,953.

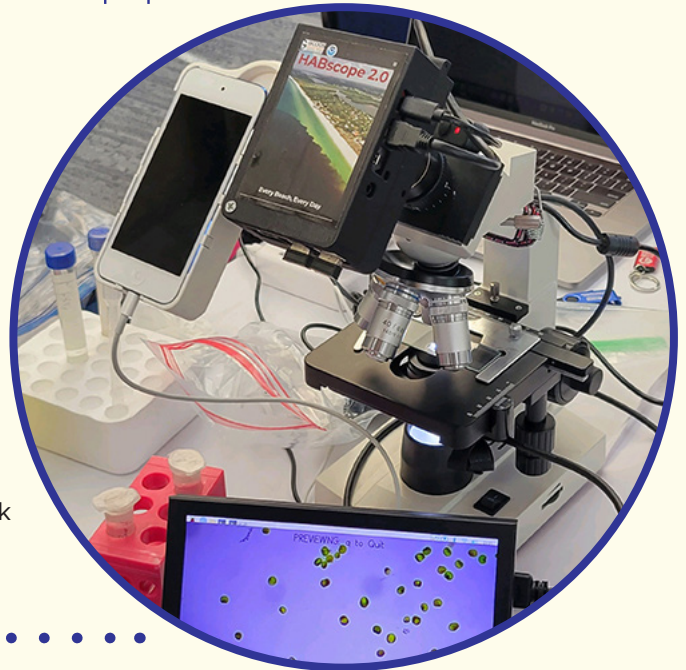
The award supports activities focused on harmful algal blooms (HAB), ocean acidification (OA) and the Marine Biodiversity Observation Network, as well as work related to observing platforms such as underwater gliders, moorings, high frequency radar and satellites.



Technology and Data in Support of Coastal Communities

When red tide blooms are occurring the Red Tide Respiratory Forecast provides a risk-level forecast for red tide respiratory conditions on Florida and Texas beaches, allowing coastal residents to avoid impacts. (www.RedTideForecast.com) The forecast is made possible with **HABscope 2.0tm**, a low-cost microscope system developed by GCOOS that uses AI to classify blooms, and a team of volunteers who are trained to use HABscope to gather water sample data.

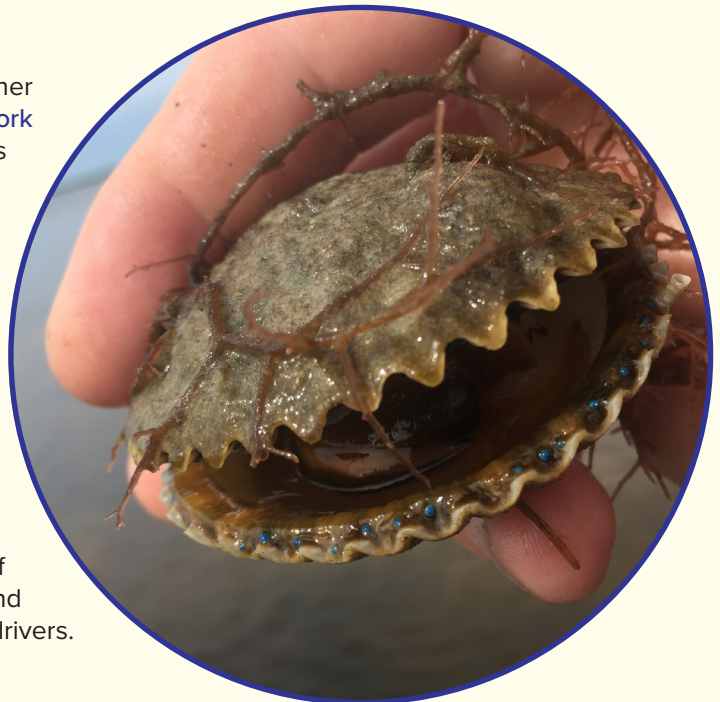
GCOOS also supports Imaging **Flow CytoBots (IFCB)** in Texas and Alabama that combine a flow cytometer with video imaging and pattern recognition software to automate detection of algal species and act as an early warning system for communities at risk from toxic blooms.



Sargassum is a brown macroalgae that floats on the ocean's surface and provides important habitat for animals such as sea turtle hatchlings and fish. Large sargassum blooms, however, can create problems for coastal communities when it washes into boating channels and onto local beaches, where it can decay and produce hydrogen sulfide gas, which can cause breathing difficulties in humans. GCOOS, SECOORA and CARICOOS are teaming up with the University of South Florida to **develop models** that can support response and mitigation for sargassum inundation events in the Southeast Atlantic and Gulf of Mexico.

Ocean acidification (OA) puts clam, oyster and other fisheries at risk. The **Gulf of Mexico Coastal Acidification Network (GCAN)** works with scientists, resource managers, stakeholders and educators to facilitate, synthesize and communicate coastal and ocean acidification science in the Gulf of Mexico. It also collaborates with other regional efforts in the U.S. and Caribbean and NOAA's Ocean Acidification Program (OAP).

In 2023, GCAN leaders helped to develop the **Ocean Chemistry Vulnerability Assessment — Report to Congress**, which describes the vulnerability of coastal communities to acidification in seven regions, including the Gulf of Mexico. In the Gulf, the assessment found that carbonate chemistry remains relatively under-observed, resulting in knowledge, research and monitoring gaps that limit current understanding of the environmental, ecological and socioeconomic impacts of OA. It also found that international collaboration with Mexico and Cuba is key to understanding the influence of basin-scale OA drivers.



Marine biodiversity is vital to humanity. We depend on marine ecosystems for food, the air we breathe, and the climate we live in, and increasing risks to the ocean make observing ocean health imperative to our own survival. Differences in the way people sample and share information, and gaps in the type of information collected make monitoring ocean ecosystems difficult. The **Marine Biodiversity Observation Network (MBON)** is laying the foundation to enhance our understanding of life in the sea from local to global scales. GCOOS is the data management partner for the South Florida MBON and also supports outreach and education related to MBON projects, such as the development of a new water quality dashboard for the Flower Garden Banks National Marine Sanctuary (FGBNMS).



In 2023, GCOOS launched a one-stop shop for information beachgoers need to have a fun, safe day at a Gulf of Mexico beach: **All Things Beaches — the Gulf of Mexico Beach Guide**. The interactive guide includes beaches that are regularly monitored and tested for water quality in coastal Texas, Louisiana, Mississippi, Alabama and Florida’s west coast and provides information about weather alerts and rip currents.

GCOOS is working with numerous partners to develop CETACEAN: the **Compilation of Environmental, Threats, and Animal Data for Cetacean Population Health Analyses**. This comprehensive data platform will be used to guide and track the restoration of open-ocean marine mammals in the Gulf of Mexico. Funded through the Natural Resources Damage Assessment following the Deepwater Horizon Oil Spill, the project is focused on helping to track and restore Gulf cetacean species injured during the spill.



GCOOS is working to create a **Framework for Coastal Climate Services (FCCS)** aimed at improving the overall effectiveness of the climate data available and climate-related service delivery across Gulf region states. This effort, which draws inspiration from the Federal Framework and Action Plan for Climate Services and leveraging insights from the Global Framework for Climate Services, will identify the challenges and opportunities in the Gulf and contribute to broader government-led initiatives aimed at addressing the climate crisis, enhancing community resilience, and promoting sustainable socio-economic growth in the U.S.

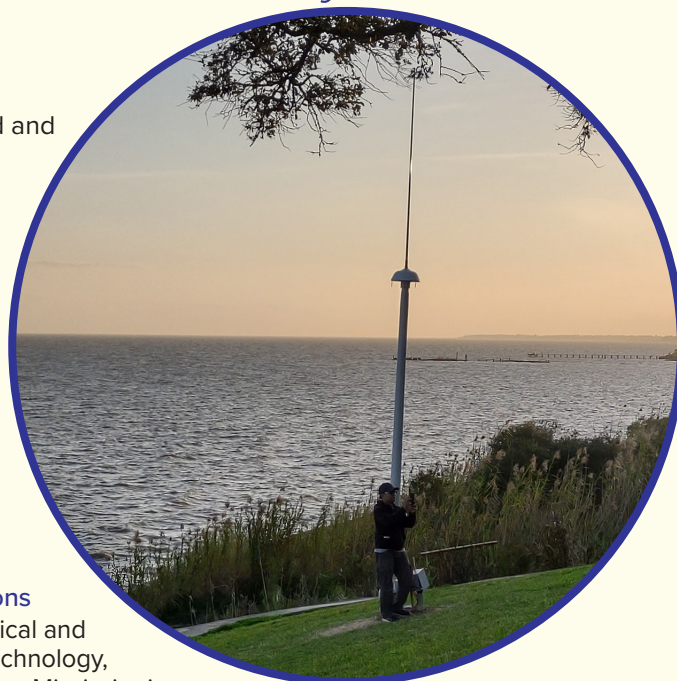
Assets in Support of Human Safety in the Gulf of Mexico

High-frequency radar (HFR) measures the speed and direction of ocean surface currents in near-real time — providing accurate and timely information to people who depend on the data. The information is crucial for those conducting search and rescue operations and tracking contaminants such as oil spills. It is also critical for the safety of ship navigation, which depends on immediate information about ocean height to move large vessels safely in and out of ports and channels.

In the past year, GCOOS has awarded funds to Florida State University to work in collaboration with the University of Southern Mississippi to install a new HFR station in Panama City, Florida. This new station, which will be operational in 2024, is part of a wider effort to bridge high priority HFR network data gaps in the Gulf of Mexico.

GCOOS also **hosts data from 19 stations in the U.S. and two stations in Mexico**. Data providers include Texas A&M University's Geochemical and Environmental Research Group (TAMU-GERG), Research, Applied Technology, Education Services, Inc. (RATES), Fugro and the University of Southern Mississippi (USM).

In 2023, NOAA awarded funding for eight new stations along the Louisiana coastline to Louisiana State University (LSU), which are expected to come online over the next five years. GCOOS will also host those HFR data.

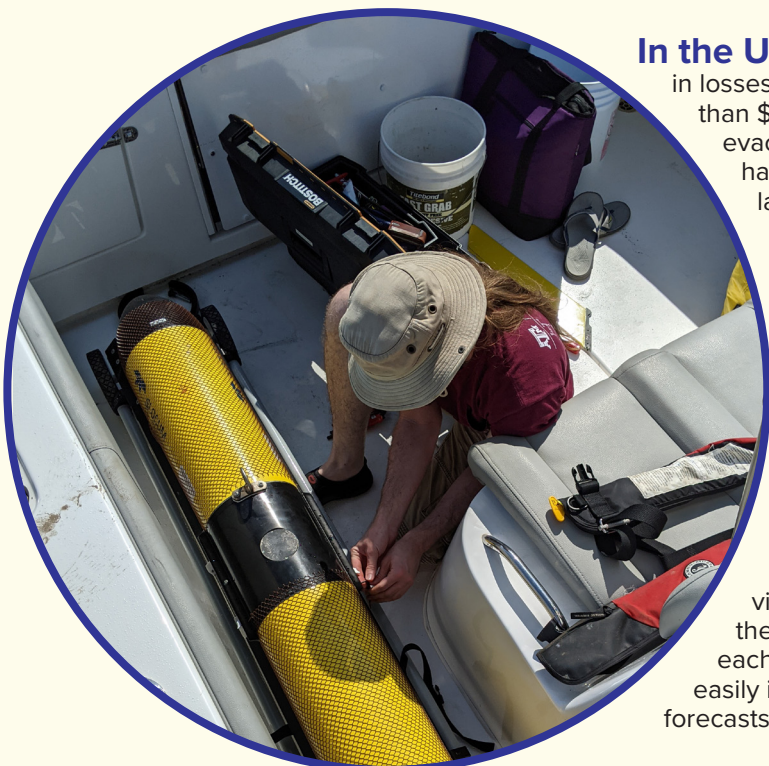


In the U.S., hurricanes have caused more than \$1 trillion in losses since 1980 — Hurricane Ian in 2022 alone caused more than \$112 billion in damage. While the landfall forecasts that drive evacuation orders and guide coastal preparations ahead of storms have been steadily improving, storm strength forecasting has lagged.

To help bridge the data gap and improve forecasts, GCOOS and its key scientific and data-gathering partners work together to plan and launch **autonomous underwater and surface vehicles** in the Gulf. These uncrewed systems, which can operate even during dangerous conditions, gather and transmit critical ocean temperature data in near-real time that can be used immediately by hurricane modelers to help predict how and where storms will develop and how intense they could become.

The missions of uncrewed systems are tracked on GCOOS's piloting dashboard known as **GANDALF**, a free and powerful visualization tool that helps operators plan missions and pilot their vehicles and quickly and easily see the water column data each vehicle is collecting. The interface also allows modelers to easily ingest the data being gathered in near-real time to improve forecasts.

The vehicles are piloted by numerous organizations and agencies, including NOAA, TAMU-GERG, USM, University of South Florida (USF), Skidaway Marine Institute of Oceanography (SKIO), the University of Louisiana at Lafayette (ULL) and gliders on loan from the U.S. Navy that are provided to GCOOS each year to enhance storm intensification research. GCOOS also hosts glider data from Centro de Investigación Científica y de Educación Superior de Ensenada's (CICESE) in Mexico.



Principal Investigators

GCOOS is a “network of networks” and develops strong partnerships with academic, governmental, non-governmental and industry members to create a collective focused on data gathering and dissemination across the Gulf. GCOOS also makes sub-awards to principal investigators who are selected through a competitive process based on system-wide gaps and needs.

Principle Investigator	Organization	Project
Dr. Brian Dzwonkowski	Dauphin Island Sea Lab (DISL)	Gulf of Mexico harmful algal bloom (HAB) pilot testbed project; coastal monitoring from Alabama’s Real-Time Coastal Observing System (ARCOS)
Felimon Gayanilo	TAMU-Corpus Christi (TAMU-CC)	Continuing support services to maintain and enhance interoperable data portals for GCOOS and ocean acidification monitoring at a Texas coastal bay
Dr. Cathrine Hancock	Florida State University (FSU)	Modernization and recapitalization of GCOOS
Dr. Darren Henrichs & Dr. Lisa Campbell	TAMU-Oceanography (TAMU-OCNG)	Continuing the TOAST network of high-resolution time series for observation of long term trends and prediction of harmful algal blooms in Texas
Dr. Stephan Howden & Dr. Arne Dierks	University of Southern Mississippi (USM)	Sustained coastal monitoring of surface currents in the Mississippi Bight; the northern Gulf of Mexico glider sentinel line and ocean acidification monitoring in the hypoxic zone of the Louisiana Shelf
Dr. Tony Knap & Dr. Steve DiMarco	Texas A&M University - Geochemical and Environmental Research Group (TAMU-GERG)	Maintenance and operation of the Texas HFR network; system upgrades to the Texas Automated Buoy System (TABS); Gulf of Mexico hurricane glider operations in support of tropical cyclone intensification forecasts
John Langan	Mote Marine Laboratory (MML)	Maintenance and augmentation of an existing HAB observatory to monitor environmental conditions for human and ecosystem health
Dr. Robert Leben	University of Colorado (UC)	Continued development of GCOOS: Satellite Altimetry Data
Dr. Mark Luther, Chad Lembke, Dr. Frank Muller-Karger & Dr. Chuanmin Hu	University of South Florida (USF)	Maritime transportation, satellite Earth observations and glider deployments for GCOOS
Dr. Eric Milbrandt	Sanibel-Captiva Conservation Foundation (SCCF)	Real-time water quality and weather for Southwest Florida from the River, Estuary and Coastal Observing Network (RECON) and delivery to GCOOS
Dr. Behzad Mortazavi, Dr. Ken Hoadley	University of Alabama (UA)	Gulf of Mexico HAB pilot testbed project
Dr. Beth Stauffer	University of Louisiana - Lafayette (ULL)	Building a network of nutrient sensing in the northern Gulf of Mexico, Phase I
Dr. Nan Walker & Dr. Chunyan Li	Louisiana State University (LSU)	Satellite remote sensing in support of GCOOS
Ben Williams & Dr. Kerri Whilden	Fugro	Continued maintenance for Louisiana HFR: Port Fourchon and Southwest Pass, Louisiana

Certified Data for Gulf of Mexico Communities

When forecasters predict the next hurricane, and rescuers need information on currents in the Gulf of Mexico or clean-up crews have to map movements of the next oil spill, they can rest assured of one thing: The real-time and near-real time data provided by the Gulf of Mexico Coastal Ocean Observing System (GCOOS) has been **certified to meet the highest quality standards possible.**

In 2023, GCOOS was recertified for the next five years by the U.S. Integrated Ocean Observing System (U.S. IOOS®) and the National Oceanic and Atmospheric Administration (NOAA). Recertification means that GCOOS continues to meet the gold standard for data gathering and management and operates inclusively, transparently and seeks user input to determine system priorities.



GCOOS is an independent, nonprofit organization housed at Texas A&M University and the only certified observing system whose sole focus is the coastal and ocean waters of the Gulf of Mexico. The organization includes **118 members** from the academic, governmental, nongovernmental and industry sectors and hosts data from more than **60 data partners** who have **more than 1,600 sensors** throughout the Gulf. GCOOS also develops and deploys tools designed to support data collection and dissemination and applications that improve public access to life-improving information.

Key Access Points for GCOOS Data and Products

Main website

- www.GCOOS.org

Main data portal

- <https://data.gcoos.org/>

Data by type

- Moorings and coastal stations: <https://data.gcoos.org/>
- High Frequency Radar: <https://data.gcoos.org/hfradar/>
- Autonomous underwater and surface vehicles: <https://gandalf.gcoos.org/>
- Bureau of Safety and Environmental Enforcement (BSEE) Notice to Lessees (NTL): <https://ntl.gcoos.org/>
- Water quality: <https://wq.gcoos.org/>
- Meteorology: <https://boem.gcoos.org/>
- Models: <https://data2.gcoos.org/ModelHandler>

Key current and historical databases

- Historical collection of oceanographic and meteorological data: <https://gcoos5.geos.tamu.edu/erddap/index.html>
- Oceanographic and meteorological data and near-real-time data from in-situ observing systems: <https://erddap.gcoos.org/erddap/index.html>
- Biological and socioeconomic data: <https://gcoos4.tamu.edu/erddap/index.html>

Data Products for the Public

- The Red Tide Respiratory Forecast: www.RedTideForecast.com
- All Things Beaches: <https://bit.ly/GOM-beach-guide>



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