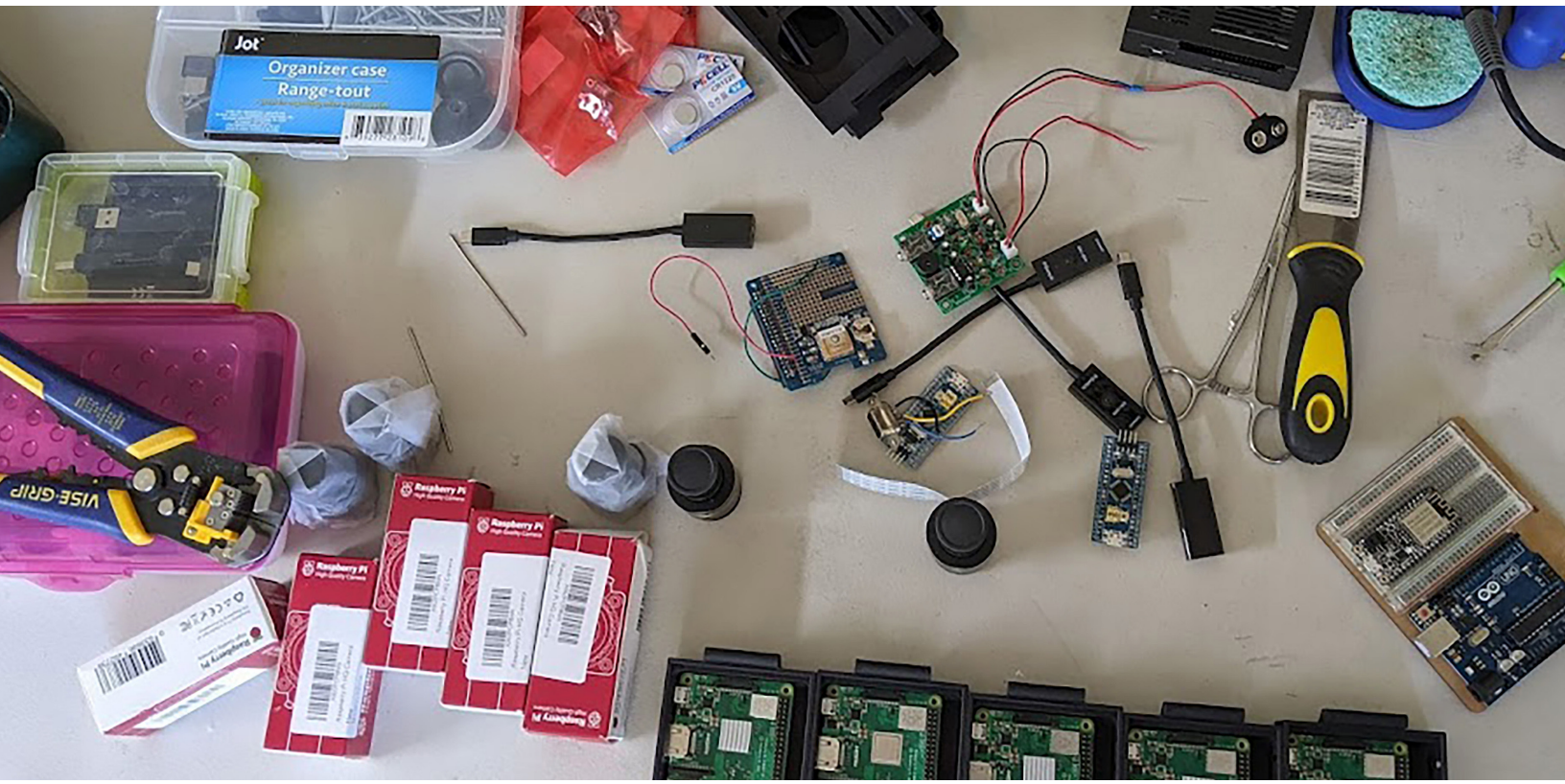
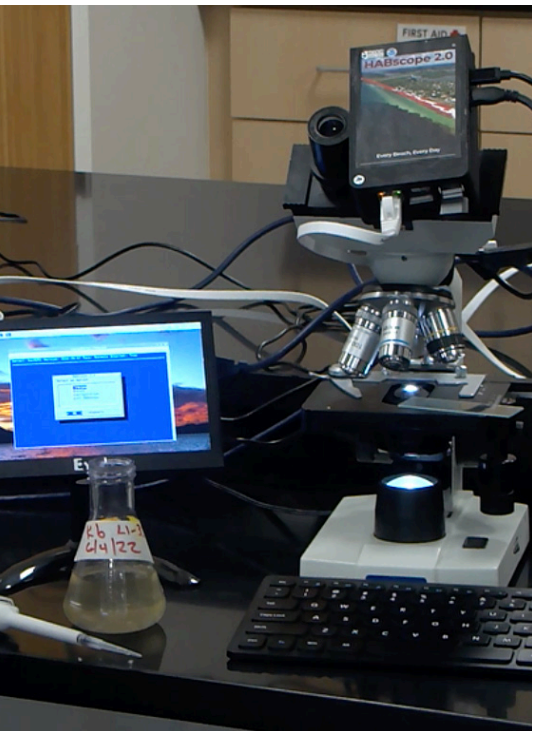
1 November 2022

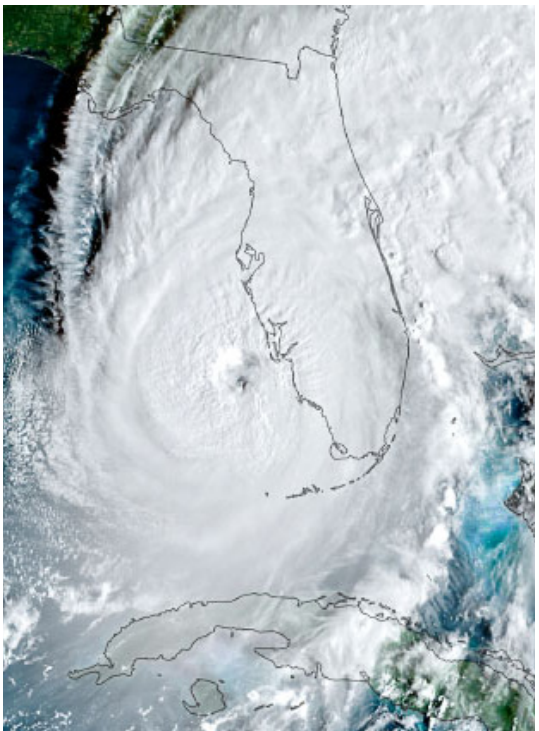
GCOOS
GULF OF MEXICO
COASTAL OCEAN
OBSERVING SYSTEM

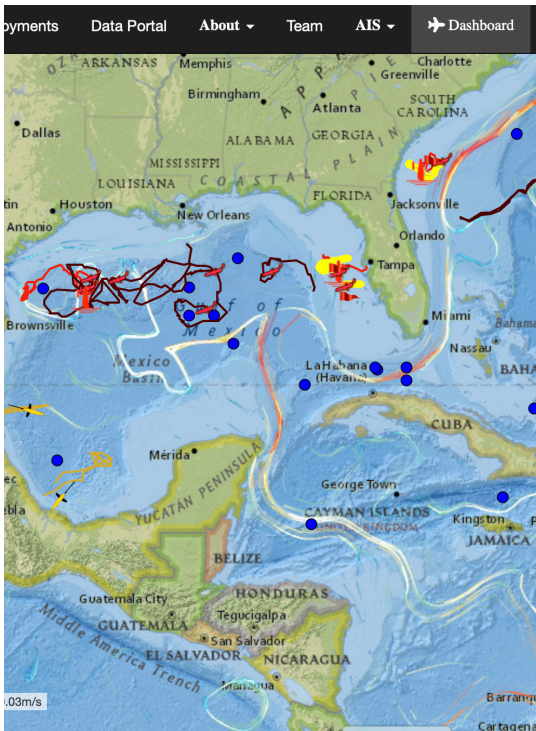
Build-Out Plan Addendum

Addendum to Build-Out Plan
Version 2.1 of 27 January 2015









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Acknowledgments

The GCOOS Board of Directors would like to acknowledge the valuable contributions of our members and stakeholders across the Gulf of Mexico large marine ecosystem who help guide our work. The input provided was essential to confirm current priorities of the Regional Information Coordination Entity condensed in this addendum to the GCOOS Build-Out Plan. The GCOOS work is supported financially by the U.S. Integrated Ocean Observing System (IOOS) of the National Ocean Service of NOAA. This work would not have been possible without the contributions of the GCOOS Board members and staff.

The GCOOS Board thanks the following people for their major contributions to this document: Joe Swaykos, Barbara Kirkpatrick, Grant Craig, Robert Currier, Felimon Gayanilo, Stephan Howden, Bill Lingsch, Chris Simoniello, Nadine Slimak and Nan Walker.

On the Cover: Top photo: HABscope 2.0 parts ready for assembly. **Bottom left:** A fully assembled HABscope 2.0. (Photos by GCOOS.) **Middle image:** Hurricane Ian makes landfall in Florida on 28 September 2022. (Photo by NOAA/RAMMB/CIRA.) **Bottom right:** Tracking autonomous vehicles outfitted with ocean sensors on the GCOOS glider dashboard, GANDALF. (Photo by GCOOS.)

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Introduction

With members from Texas, Louisiana, Mississippi, Alabama and Florida, the **Gulf of Mexico Coastal Ocean Observing System (GCOOS)** has established a sustained observing system for the Gulf of Mexico to provide observations and products needed by users in this region for:

- Protecting public health and safety;
- Supporting healthy ecosystems and water quality;
- Mitigating the effects of storms and man-made disasters;
- Ensuring safe and efficient marine operations;
- Monitoring the Gulf for long-term changes and environmental trends.

Figure 1. GCOOS is the only certified ocean observing entity focused entirely on the Gulf of Mexico.

The **GCOOS** Build-Out Plan was originally developed in 2014, and updated a year later. But these versions were written at a time when the greater U.S. Integrated Ocean Observing System (U.S. IOOS) was still evolving among 11 Regional Associations (RAs).

IOOS eventually developed a certification process and the RAs were renamed "Regional Information Coordination Entities" (RICEs).

Today, the certification process includes a thorough review of systems, observations, data management, outreach and education efforts, five-year operating budgets based on the grant cycle and funded operations and research. Once certified, a RICE obtains legal liability protection for its operations.

GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

RICE recertification occurs every five years. In 2022, the GCOOS Board of Directors reviewed its Build-Out Plan and deemed it to be out of date, voluminous (102 pages), and too detailed to be a meaningful, useful guiding document.

The voluminous nature of Build-Out Plan Version 2.1 resulted from its formulation as a statement of what a RICE could be with an anticipated annual budget of $25-$30M, while actual funding levels have averaged between $3M-$5M. The realities of RICE funding posed a fundamental question when the Board was developing a strategy for updating the existing Build-Out Plan:

- Should we continue to envision an observation system funded at a 10-fold increase above past and present funding?
- Should we develop a strategy of status quo in terms of existing systems and current funding levels?
- Or should we focus on observing systems that are providing new and essential data now, but with plenty of room for expansion with a goal of filling existing geographic data gaps?

In this addendum, the Board decided to focus on creating a concise guiding document for an observing system that provides new and essential data now, but with room for expansion and a goal of filling existing geographic data gaps.

This document also includes our need to discuss the expansion of our engagement with Mexico and Cuba.

While the existing capabilities of Cuba are largely unknown, the capabilities within the Mexican scientific community have been ambitious and highly successful.

Sharing our respective data in real time will be of significant benefit to all stakeholders in each nation. However, with resources being underfunded, we need to strike a balance between supporting and expanding our U.S. efforts and supporting our southern Gulf of Mexico partners.

Another emerging requirement that this document addresses is the establishment of meaningful diversity, equity and inclusion (DEI) practices within NOAA and IOOS, and GCOOS has developed and included a systematic approach to meeting DEI needs in this addendum.

Addressing our Strategic Priorities*

High Frequency Radar (HFR)

Since version 2.1 of the GCOOS Build-Out Plan was written, nine long-range CODAR SeaSondes have been installed along the U.S. Gulf Coast (Figure 2):

- Six stations were installed by Texas A&M- College Station (TAMU-College Station) along the Texas coast using state funding;
- Two stations have been installed on the Louisiana coast by Fugro and the University of Southern Mississippi (USM) using funding from the IOOS "Filling the Gaps Campaign";
- One station has been installed on Marathon Key in Florida through funding from the National Academies of Sciences, Engineering and Medicine's (NASEM) Gulf Research Program (GRP).

Additionally, two stations were installed on the Yucatan Peninsula through a collaboration between TAMU-College Station and Universidad Nacional Autónoma de México (UNAM), with funding from the GRP. Four more stations are scheduled to be installed through GRP support, though long-term funding is uncertain. Stations will be installed on each of the offshore Shell production platforms URSA and Appomattox, and two stations will be installed in the Florida Keys and Dry Tortugas.

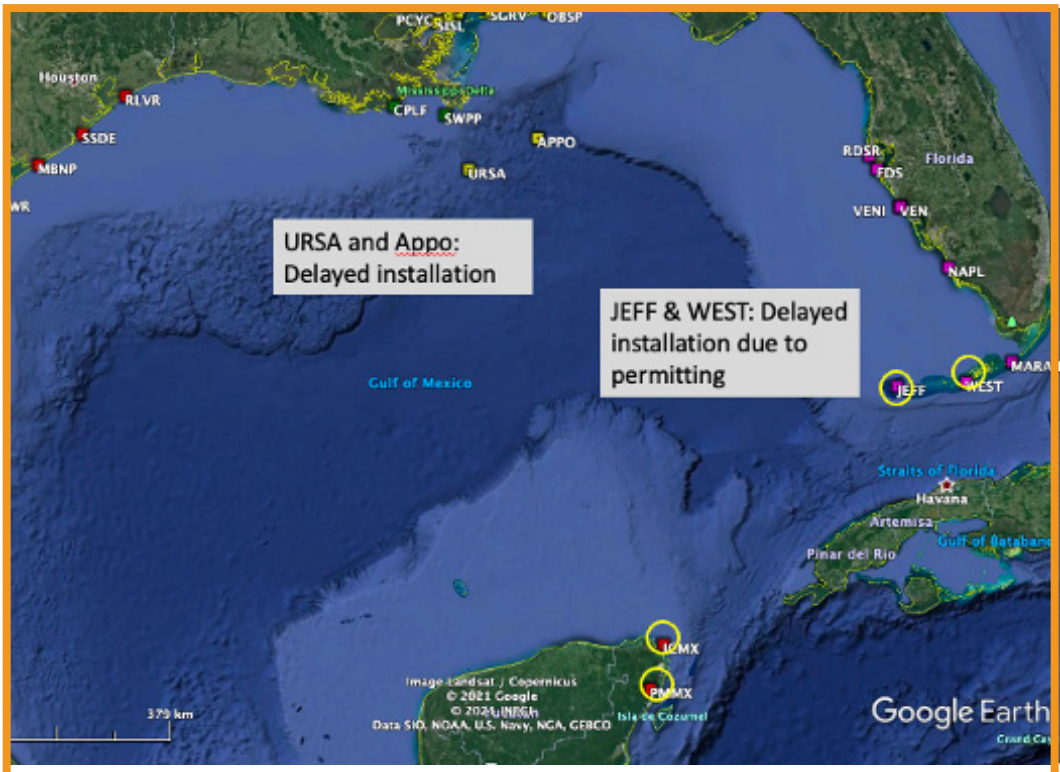


Figure 2. The HFR Network in the U.S. Gulf of Mexico and Yucatan Peninsula.

Despite nine additional long-range HFR, and four more planned, two large gaps remain in long-range HFR coverage in the

*For more on the Focus Areas these priorities fulfill, please refer to the GCOOS Strategic Plan (GCOOS.org/about-us/strategic-plan/)

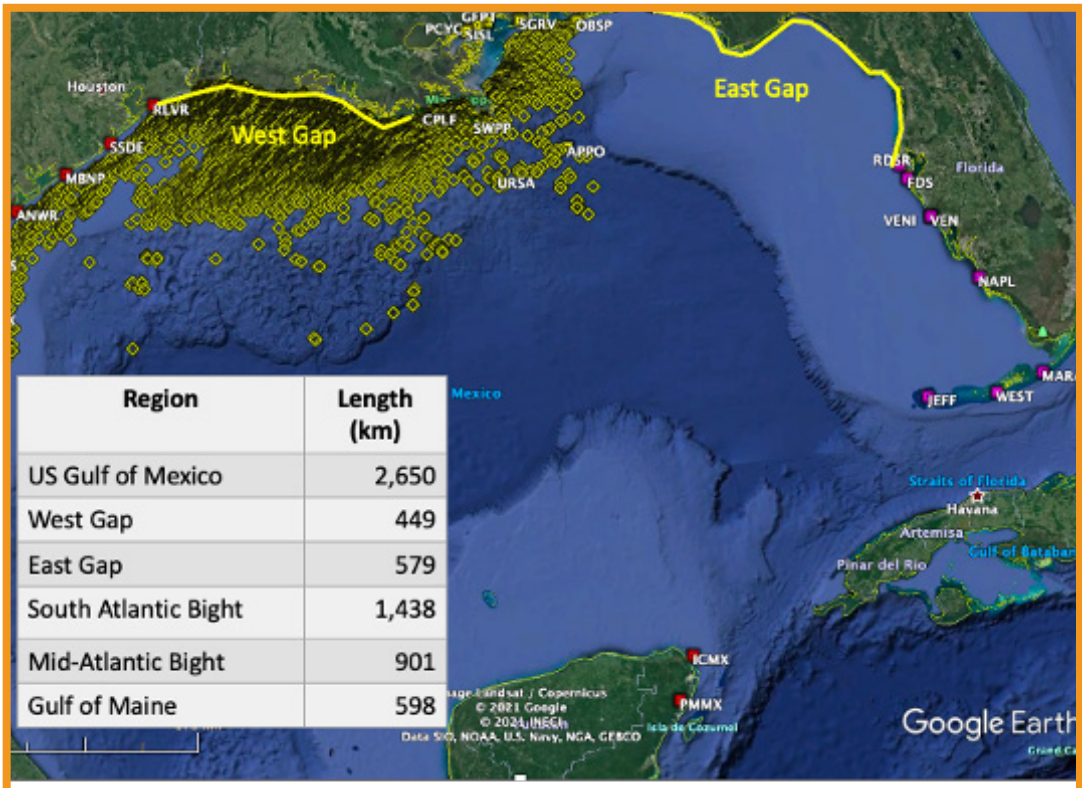
U.S. Exclusive Economic Zone (EEZ) of the Gulf of Mexico. The combined coastline of the two gaps is 1,028km, which is larger than Mid-Atlantic Bight and more than two thirds of the South-Atlantic Bight. Figure 3 highlights these gaps and illustrates the density of oil and gas platforms in the U.S. EEZ. The western gap is where a concentration of offshore oil and gas infrastructure is located.

HFR Expansion Challenges

There are a number of challenges to operating and expanding the HFR network in the Gulf of Mexico.

The coastline where the gaps are located is mostly low, marshy, and remote. The topography of the coast is very flat and all of the stations are vulnerable to tropical storm winds and storm surge. Many are in places where hurricane hardening would be very expensive and in places that are difficult to evacuate ahead of the 72-hour window ordered before a tropical cyclone's forecasted landfall. Finally, the remoteness of many stations make them logistically difficult to service and repair. For example, the station at the Southwest Pass of the Mississippi River requires a drive down to Venice, Louisiana, and then a trip via pilot boat further south to the pilot's station where the radar is located.

Since the last GCOOS Build-Out Plan was written, NOAA has awarded a Small Business Innovation Research (SBIR) grant to CODAR Ocean Systems and TAMU-College Station to develop a single antenna structure long-range SeaSonde and test its operation on a NOAA Sentinel station (Figure 3). These stations are built to survive severe (Category 4) storms. The project has been completed and CODAR is moving to commercialize the product. If successful, the single-antenna structure would simplify installations in gap areas identified in the Gulf of Mexico.



Region	Length (km)
US Gulf of Mexico	2,650
West Gap	449
East Gap	579
South Atlantic Bight	1,438
Mid-Atlantic Bight	901
Gulf of Maine	598

Figure 3. HFR Network in the Gulf of Mexico, oil and gas infrastructure and gaps in the long-range HFR network.

Installation of additional NOAA sentinel stations along the Louisiana coast would further enhance our ability to fill HFR gaps.

The NASEM GRP-funded Yucatan Straits CODAR stations require an IOOS HFR grid for total current generation to be served on the National HFR Server. Additionally, the Universidad Autónoma de Baja California operates HFR stations in the Mexican EEZ within the Gulf of Mexico, and there are plans for HFR collaboration with Cuba.

Expanding the HFR grid to the entire Gulf of Mexico, including the Yucatan Straits and the Florida Straits, would facilitate international collaborations.

Figure 4. This single antenna long-range SeaSonde is an HFR alternative for some locations.

HFR Expansion Priorities

- Weighing the challenges with the needs, GCOOS recommends that the single structure antennae system recently developed be implemented in the Gulf of Mexico.
- GCOOS also recommends the HFR grid be expanded to include the southern Gulf.

Uncrewed Systems

There are many different types of robotic marine vehicles, including floats, gliders, uncrewed underwater vehicles (UUVs) and uncrewed surface vehicles (USVs) that offer a plethora of new platforms and techniques for ocean measurement and reporting both in near-real time and post mission. Operationally, these platforms are divided into those with surface and sub-surface capabilities.

For a monitoring network like **GCOOS**, these platforms and their associated sensors are critical to supporting sustained observations over long periods, as well as collecting data during short-term missions focused on episodic events. They are deployable for a month to a year, depending on mission requirements.

Vehicle technology in uncrewed maritime systems continues to advance rapidly in deployment endurance, payload capacity, energy budgets and the relative lowering of purchase costs.

Complementary to these vehicles are the sensors they transport that measure and record the physical, biological, chemical and geological conditions and parameters as these technologies continue to evolve rapidly as well. Vehicle propulsion and power source is dependent on the vehicle's intended use.

In general, surface monitoring vehicles optimize wave motion, wind, solar, and batteries while subsurface vehicles use buoyancy or propellers and batteries. Some vehicles use a combination of technologies to optimize endurance and sensor energy budgets.

The intent of this Build-Out Plan addendum is to identify technologies — both current and emerging — that meet stakeholder needs for ocean monitoring. Budgetary considerations and the feasibility of implementing technologies will influence short- and long-term plans.

Please note that the following discussion of uncrewed systems and priorities is not exhaustive nor intended to promote any one technology or manufacturer.

Uncrewed Systems: Profiling Floats

The development of predictive environmental models requires sustained, broad-scale measurements of the ocean state — measurements that can be obtained using autonomous platforms such as profiling floats and gliders. Argo profilers are being used in the Global Ocean Data Assimilation Experiment (GODAE) OceanPredict program for global-to-regional ocean prediction models.

Measuring deep ocean currents (including temperature and salinity) is possible using electromagnetic Autonomous Profiling Explorer floats (EM-APEX).

The floats are marketed by Teledyne-Webb Research and developed at the Applied Physics Laboratory of the University of Washington (UW) (D'Asaro et al. 2007; Sanford et al. 2007, 2011). The concept of measurement is similar to that of the expendable current profiler (XCP) based on motional induction developed at the UW Applied Physics Laboratory (Sanford et. al., 2007; Shay et. al., 2011.)

The floats can also be equipped with biochemical sensors such as Aanderraa's Optode 4330F sensor for measuring dissolved oxygen; and Sea-Bird Scientific's WETlabs ECOpuck Flbb-CD.

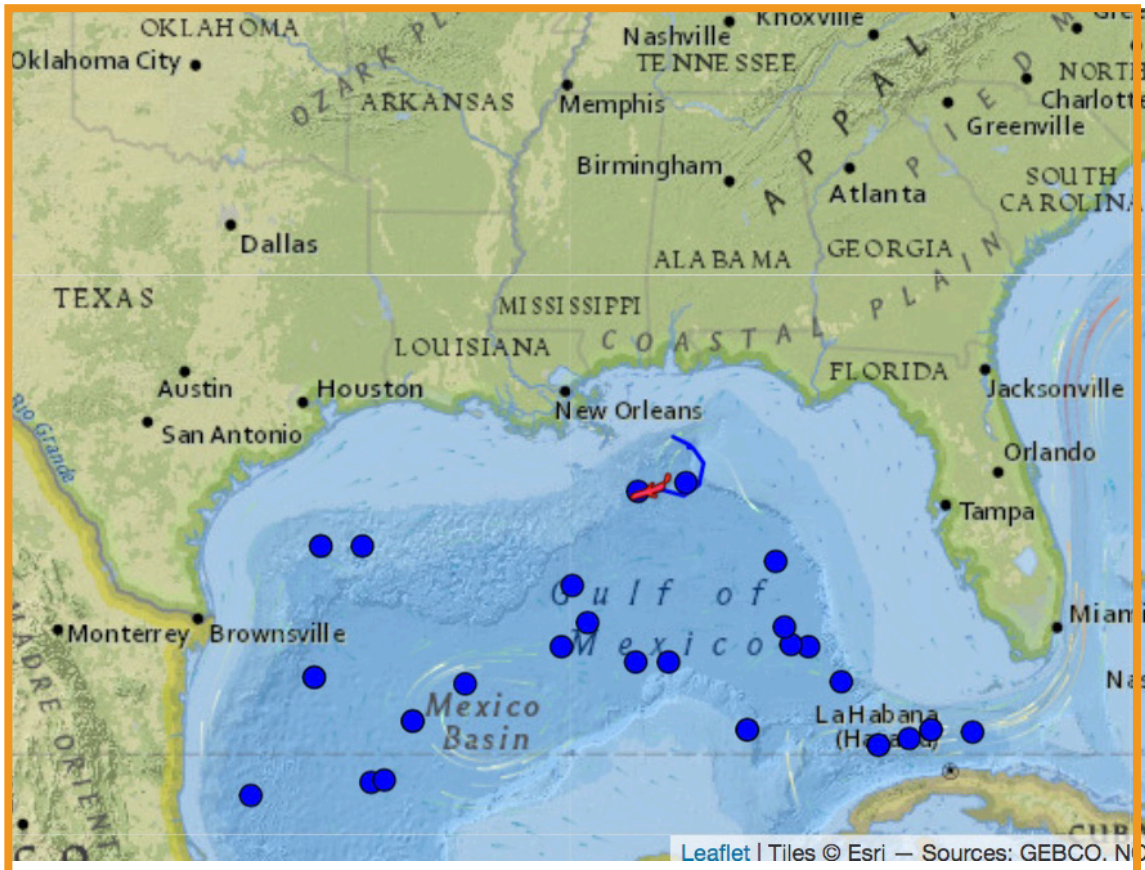


Figure 5. The blue dots depict ARGO floats in the Gulf of Mexico on 15 July 2022.

The ECOpuck sensor combines measurement of chlorophyll fluorescence as proxy of phytoplankton abundance, measurement of backscatter as proxy of particle concentration (incl. various marine particles and oil droplets as well as emulsions), and colored dissolved organic matter (CDOM) fluorescence as proxy of CDOM (incl. the fluorophoric oil components). The ECOpuck has been specifically designed to minimize space and power requirements for applications in autonomous measuring platforms including profiling floats and is rated for sampling to 2000m depth. The combination makes this float quite powerful in that both the physical and biogeochemical fields can be sampled simultaneously from the surface layer to depth.

Another option is to equip the EM-APEX floats with microrider sensors developed by Rockland Scientific International Inc., which include shear probes (2x), fast thermistors (1x), and micro-conductivity (1x). Pressure rating is for 1000m, but these could go to as deep as 6000m. The purpose of the sensors is to provide

important turbulence measurement in areas of strong mixing to assess mixing used in the models. For more information see: RocklandScientific.com.

Profiling Float Priorities

- GCOOS urges the Steering Committee of the Global Ocean Observing System (GOOS) and the Argo Project Office to maintain the Argo network at the nominal Argo density (1 float per 3° longitude by 3° latitude square, or roughly 15 floats in the deep Gulf) to maintain the best possible boundary conditions for models supporting hurricane intensity forecasting and the coastal component of GCOOS in the Gulf of Mexico. Floats capable of profiling below 2000m would be of particular value in the central Gulf, where the interaction of the Loop Current with topography is strong.

Uncrewed Systems: Buoyancy Gliders

Buoyancy gliders are a type of autonomous underwater vehicle (AUV) that employs variable-buoyancy propulsion instead of traditional propellers or thrusters similar to a profiling float. But unlike a float that can only move up and down, an underwater glider is fitted with hydrofoils (underwater wings) that allow it to glide forward while descending and ascending through the water. At a precise depth, the glider switches to positive buoyancy to climb back up and forward and the cycle repeats to propel the glider through the water column.

While not as fast as conventional AUVs, gliders offer significantly greater range and endurance, extending ocean sampling missions to months and even up to a year, depending on sampling rate and sensor packages. Gliders typically measure temperature, conductivity, currents, chlorophyll fluorescence, optical backscatter, bottom depth and acoustic backscatter or ambient noise. Sensor technology continues to evolve for these vehicles.

These vehicles are optimal for monitoring physical, biological, chemical and acoustic ocean conditions both over long-term continuous operations and during episodic/surge events. Continuous operations can include monitoring climate change, hypoxia, essential ocean features (EOFs) and physical conditions that inform

real-time ocean models (physical and biological) and climatology. Episodic events may include events such as harmful algal blooms (HABs), hurricanes and chemical/oil spills.

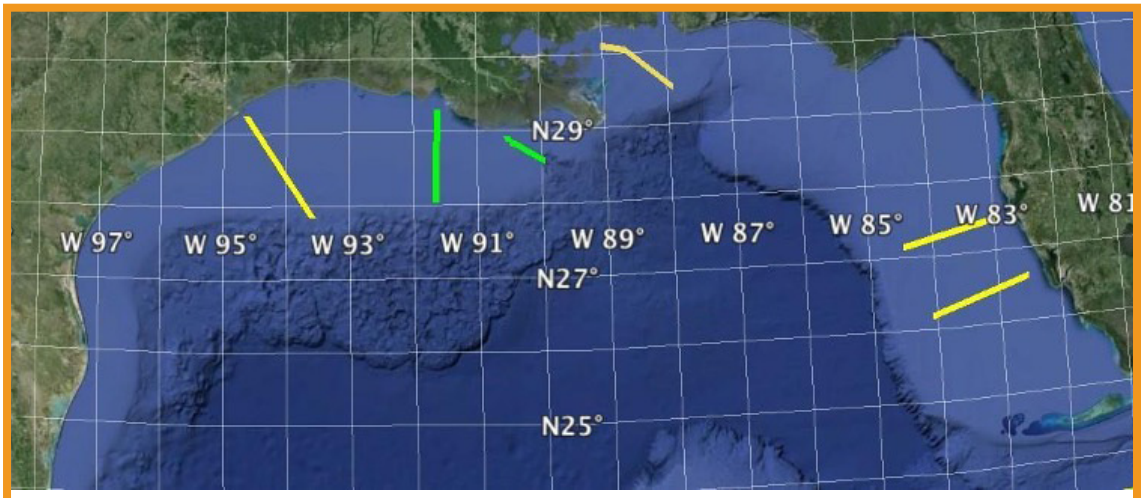


Figure 6. The four yellow transects would be operated by institutions that already have gliders. From west to east, the operators are Texas A&M, University of Southern Mississippi, University of South Florida and Mote Marine Laboratory. The USM track is included in the Hypoxia Glider Implementation Plan. The westernmost thin yellow line is a potential GCOOS transect line that could be operated by TAMU. The two greens glider lines will be implemented when feasible.

To operate these vehicles across the U.S. Gulf coast, it is essential to have autonomous underwater vehicle (AUV) centers from which to launch, pilot, recover and refurbish gliders. Currently Texas A&M Geochemical and Environmental Research Group (GERG), USM, Mote Marine Laboratory (MML), and the University of South Florida (USF) provide these services and are conveniently spread across the Gulf of Mexico. Their contributions as partners to GCOOS are essential for these operationally complex missions.

Glider Priorities

- Sustained Transects: Onshore-offshore glider transects are called for in the NOAA Glider Hypoxia Implementation Plan and the IOOS National Glider Plan. The latter plan would have 3-4 transects in the Gulf of Mexico, but locations for those transects are not specified. Figure 6 shows the four glider transects in the northern Gulf. These will be especially useful for monitoring the occurrence of hypoxia east and west of the Mississippi River Delta and are along four of the station lines for planned summertime hypoxia surveys.

- Adaptive Sampling: Version 1 of the GCOOS Build-Out Plan included a glider "conveyor belt" which had gliders operating simultaneously along a zig-zag path

over the entire U.S. Gulf Continental Shelf. However, with limited funding for glider operations, this has not and will probably not be feasible in the near-term. A more effective and practical approach has been to use adaptive sampling strategies, allowing for missions to be planned based on seasonal and/or oceanographic features requiring further investigation. Examples of this approach have been used during hurricane season, during HAB events, and in forecasting movement of the Loop Current and Loop Current eddies. HAB and nutrient sensors will be added to the AUV payload suite as sensor technology improves, and additional AUVs will be added to provide denser coverage in algal bloom and hypoxic areas.

Uncrewed Systems: Surface Vehicles

Surface vehicles have recently been deployed in the Gulf of Mexico and also demonstrate high value both in terms of the density of observations and in endurance.

We anticipate that this technology will continue to grow in the near term.

Overall Priorities for Uncrewed Systems

- The uncrewed systems outlined above, along with emerging new technologies, are highly effective at providing high-density observations throughout the water column. Given the size of the northern Gulf of Mexico, these technologies are highly effective for sustained and adaptive sampling needs. We will continue to work with IOOS and partners to develop an operational budget for uncrewed systems.

Harmful Algal Bloom Detection and Observations

HABscope is a low cost, easy to use microscope system developed by GCOOS that can detect and enumerate concentrations of *Karenia brevis*, the organism that causes red tides in the Gulf of Mexico, in water samples. Volunteers upload a video of a water sample to the HABscope cloud server where artificial intelligence determines the number of *Karenia brevis* cells present.

HABscope was developed to create a cost-effective tool that could be used by trained volunteers and staff at water-quality focused organizations along the Gulf of Mexico coastline affected by red tide blooms. The capability to utilize a non-specialist community scientist network to collect daily water samples and use HABscope to enumerate cell counts at individual beaches provides the necessary data to fuel a near-real time red tide respiratory irritation forecast.

The Red Tide Respiratory Forecast, which is available in English (RedTideForecast.com) and Spanish (PronosticoMareaRoja.com), is a public health tool that informs beachgoers and coastal residents of the potential respiratory impacts from aerosol brevetoxins produced by red tide.

The tagline for the Forecast is “Every Beach Every Day,” indicating the forecast goal of providing daily respiratory impact information on every beach affected by red tide blooms.

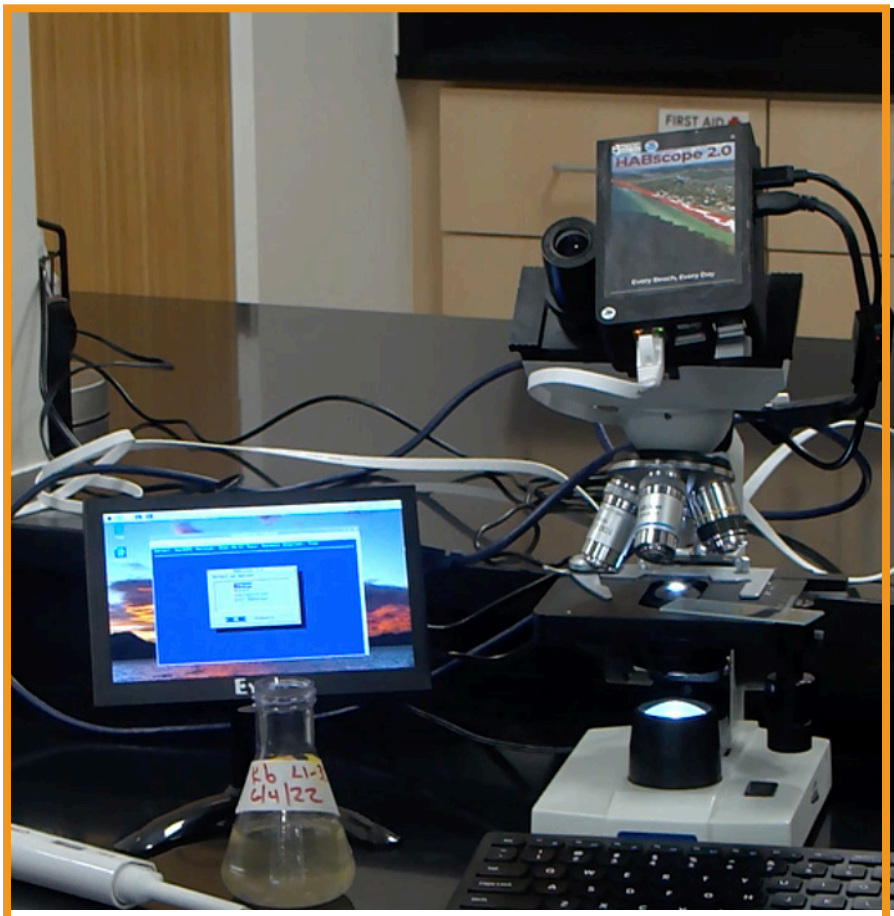


Figure 7. HABscope 2.0 utilizes a Raspberry Pi computer to process and upload video to the cloud.

HABscope was created using Apple iPods to record and upload videos to the HABscope website. After five-plus years, HABscope has been revamped and reconfigured (HABscope 2.0) to operate using a single-board computer (Raspberry Pi) with an attached camera and lens as the video recording and processing device.

HABscope 2.0 provides enhanced capabilities, including higher resolution and the ability to detect multiple HAB species. HABscope 2.0 is projected to fully replace HABscope 1.0 in 2023.

Over the last five years, the HABscope community science network has steadily expanded to fill gaps and cover additional beaches. State and local government and nonprofit organizations collecting water quality data make up a large part of the HABscope network. Each of these organizations may have multiple staff working with HABscope in addition to volunteers — who are retirees, coastal residents and even high school students. They play an essential role in filling data gaps and increasing our efforts to provide a forecast for every beach every day.

With HABscope 2.0, GCOOS will be able to increase both the functional applications and geographical coverage of HABscope.

- In addition to Florida and Texas, there are HABscope units deployed in Virginia and Alaska, where we are testing its ability to identify species other than *K. brevis*.
- HABscope can be a great tool for partners and other RICEs that could enhance the National Harmful Algal Bloom Observation Network.
- The aquaculture community is also interested in HABscope for monitoring around coastal aquaculture sites.

There is currently a HABscope unit with the University of Florida's Nature Coast Biological Station on Cedar Key, Florida, for use around shellfish beds, and the Florida Department of Agriculture and Consumer Services Division of Aquaculture will soon be equipped with a HABscope.

GCOOS will continue to build and maintain the HABscope community science network in the Gulf of Mexico to add monitoring sites and work toward "Every Beach Every Day." Additional organizations, academic institutions and individuals in all Gulf states and even Mexico have expressed interest in becoming part of the HABscope effort to help protect public health and safety.

HABscope Priorities

- In the short-term, HABscope 2.0 will need to become fully operational from its current research phase. TAMU has submitted a patent for HABScope 2.0 and is actively seeking licensing partners.
- HABscope 2.0 needs to be licensed so this innovative new technology is not left on the "research shelf."

Satellite-Based Observations

One of the cornerstones of a real-time observing system for the Gulf is rapid and easy access to satellite observations, which are essential for near-real time surveillance of oceanic and atmospheric circulation events often occurring over large spatial scales (Muller-Karger et al. 2013 and Walker et al. 2011). The synoptic and frequent observations that satellites provide can be integrated with *in-situ* data to greatly improve timely environmental assessments to fulfill the GCOOS mission.

Satellite imagery have proved indispensable for tracking and understanding the Gulf environment, including the Loop Current, its associated eddies, tropical storms, hurricanes, oil spills, river floods and harmful algal blooms. Satellite observations are also used to initialize and validate numerical circulation models of the Loop Current, which stills defies prediction. Satellite-derived products support key scientific and operational applications, including ocean physics, ocean biogeochemistry, coastal water quality, meteorology, storm tracking and impacts, coastal land use, coastal air quality and episodic events impacting oil and gas activities, commerce, search and rescue and human and environmental health.

Sea surface temperature (SST), ocean color (chlorophyll a, suspended sediment, true color) and sea surface height (SSH) are other core products that have proved essential to the GCOOS mission. These core variables can aid in supporting underwater glider operations and model evaluation. During summer months, the SSH data are especially essential to locating the Loop Current and warm-core/cold-core eddies — essential data for predicting hurricane intensity (Walker et al. 2005).

The GCOOS products web portal hosts data products from our satellite data and product partners, as well as an approximate 20-year time series of SSH data and an approximate 20-year archive of de-clouded night-time SST composite data using GOES-East GVAR and ABI data.

This product significantly improves on the imaging of frontal features during summer's high humidity conditions (Figure 8). Animations of these de-clouded SST images is an effective way to visualize finer-scale frontal features of the Loop Current system evolution and eddy separations. Merging SST and SSH data is also useful to monitor Loop Current circulation (Figure 8).

GCOOS supports the development of other satellite products such as SST climatologies and research in the detection of sargassum weed in the Gulf of Mexico.

Satellite Data & Product Priorities

- Satellite products could be employed to aid visualization and interpretation of HFR surface current data, which is being measured in many nearshore coastal areas. GANDALF, GCOOS's autonomous vehicle piloting dashboard, could also provide a platform for visualizing radar-based currents. (It currently offers data layers of SST and chlorophyll a, variables that can aid in locating fronts associated with water masses and strong currents, especially when appropriately enhanced.) Clouds often inhibit the use of the current core products, therefore the use of high-quality SST image composite products could be considered to improve Loop Current and eddy surveillance.

- Additional types of satellite data could be also added to the suite of core variables, such as microwave salinity and temperature. Although the pixel size of microwave data is much larger (~25km) than that of the current core satellite products (250 m – 2km) the microwave data are not compromised by cloud cover, thus providing oceanic data throughout cloudy conditions. Addition of SSH (contoured and along-track) as well as heat content maps as new data layers could aid in the assessment — and ultimately the prediction — of rapid hurricane intensification before landfall.

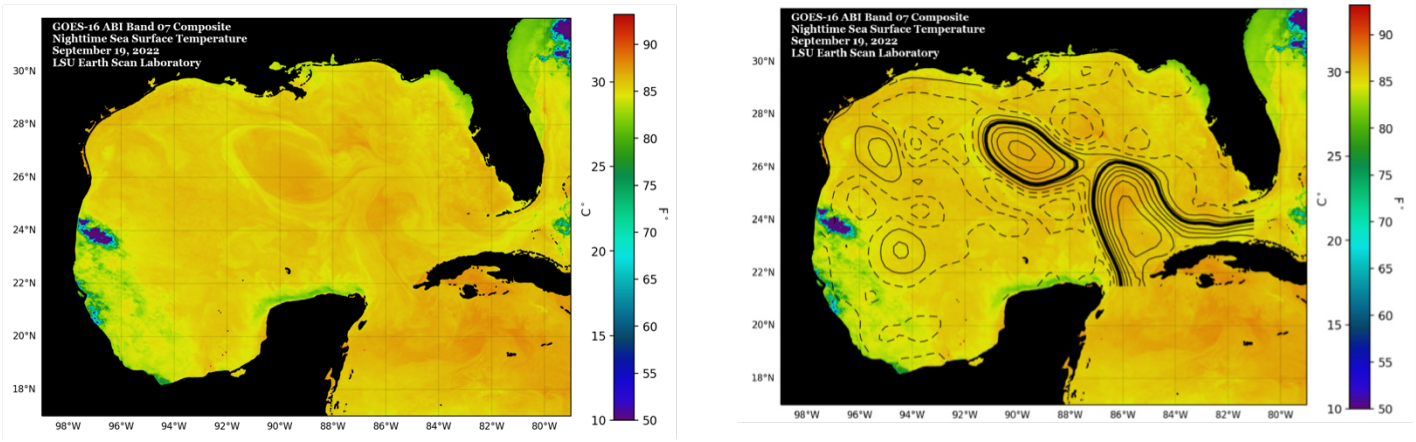


Figure 8. Left: GOES-16 ABI night-time SST composite using band 7 (Mid-IR). 19 September 2022 (LSU Earth Scan Lab) shows Loop Current frontal details with newly separated warm-core eddy "Yazoo." Right: Leben SSH superimposed on LSU SST image from 19 September 2022. SSH spacing is 10 cm. Solid lines show positive SSH, depicting the Loop Current and warm-core eddies; dashed lines show negative SSH, (Loop Current cold-core frontal eddies); dark solid line depicts the 17 cm SSH contour, used to define Loop Current and warm-core eddy margins.

Data Portal/Products/Dissemination

GCOOS Data Portal

The GCOOS data portal ingests and displays data from more than 1,625 sensors in the Gulf of Mexico from a wide variety of providers and includes a wide variety of data types — from HFR to tide gauges to water quality parameters. Before publication, all data meets the QA/QC protocols defined by RICE standards. The GCOOS data team is commended for their constant attention to these details.

In 2019, GCOOS assumed the data-streaming function for data from energy industry platforms as mandated by the Bureau of Safety and Environmental Enforcement Notice to Lessees and Operators (BSEE NTL). The prior steward of the data was the National Data Buoy Center (NDBC). Although the data-streaming functions to process and publish the NTL data are now operational, there is still much work to be done to improve the communication between the data providers and GCOOS.
Some data from the energy observing stations are from self-contained floating drilling platforms (e.g., jackups, submersible and semisubmersible), commonly referred to as Mobile Offshore Drilling Units (MODU). Sometimes, sensors are updated or swapped with another make and model and the metadata information is not provided to GCOOS. Although an operational procedure is established for operators to update GCOOS on these changes, there are cases where operators do not inform GCOOS of changes in the observing asset. Improved communications among the Bureau of Ocean Energy Management (BOEM), BSEE, offshore operators and GCOOS is needed to strengthen and ensure data quality.

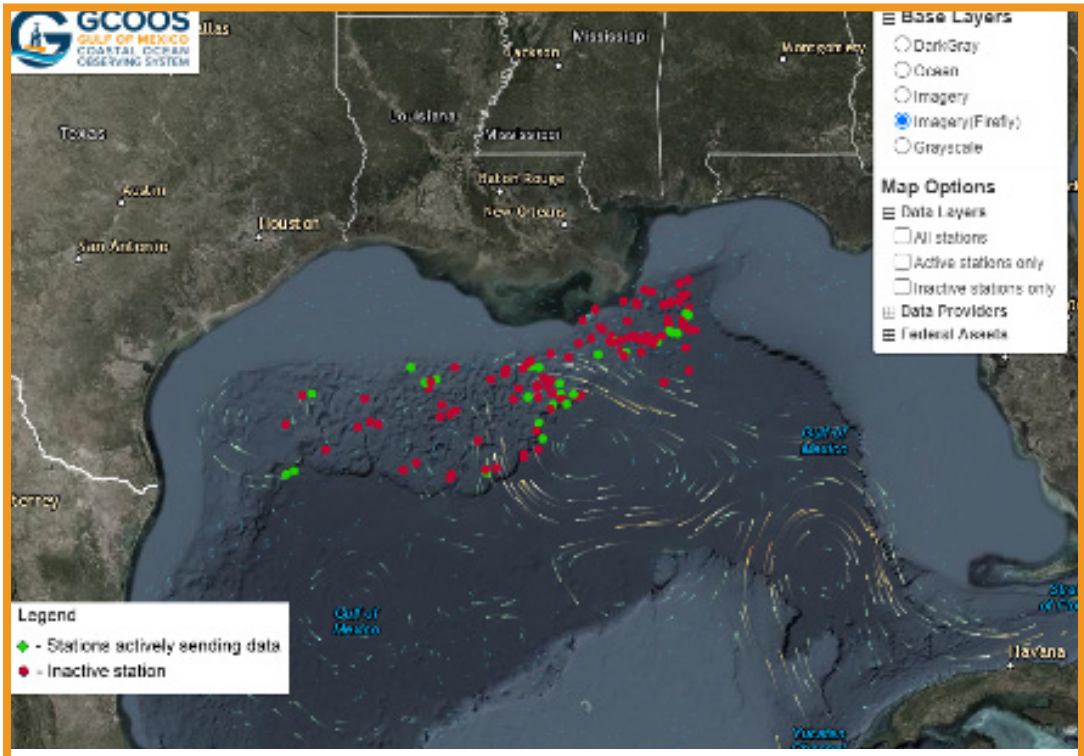


Figure 9: NTL/ADCP stations. 13 September 2022.

Data Portal Priority

- In the short-term, GCOOS should seek funding for an NTL/acoustic Doppler current profiler (ADCP) coordinator and for additional personnel to help ensure the quality of this extensive dataset, including: (1) coordinating the design, development, and deployment of an alert system to notify all parties involved for issues related to the quality of data being processed and published; (2) developing effective means to update records; (3) regularly publishing compliance reports; and (4) coordinating data acquisition and sharing.

GANDALF Piloting Tool

The Global Autonomous underwater vehicle Network and Data Archiving Long-term storage Facility (GANDALF) has grown over the eight years since its conception from a single institution user (TAMU) and a single platform (Slocum gliders) to become a glider piloting tool used nationwide — from Alaska to New England, to the Gulf of Mexico. The dashboard is also hosting a variety of uncrewed platforms including ARGO floats, Seagliders, and surface vehicles such as Saildrones (Figure 10). The Glider Operation Center (GOC) of the U.S. Navy has also used GANDALF when piloting AUVs focused on data collection for hurricane forecasts.

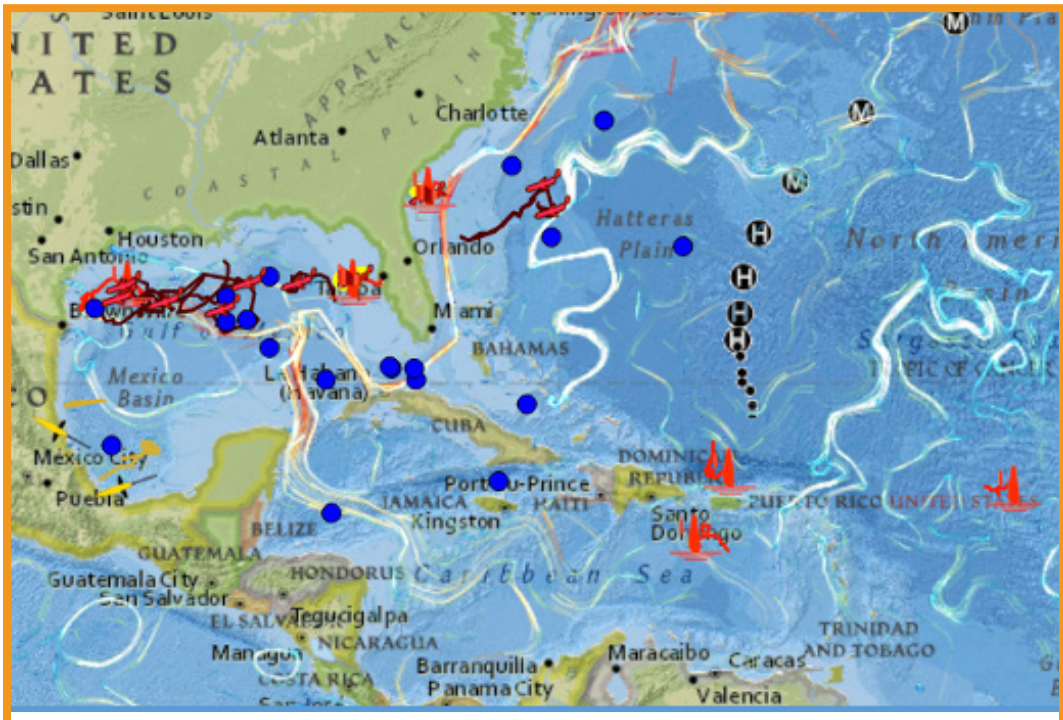


Figure 10: A snapshot of the vehicles being piloted via GANDALF on 7 September 2022.

GANDALF is perhaps the best example of GCOOS's commitment to producing stakeholder-driven products. Over the years, different layers have been requested by users and now the tool includes five navigation layers, three model layers, and seven satellite and

radar layers. (For more information about the development of GANDALF (Iwamoto et. al. 2019)

GANDALF Priorities

- The organization should continue to promote and support GANDALF and GCOOS should also seek additional funds from the U.S. IOOS Program Office to sustain this service, which has proven valuable to glider operators across the nation.

Stakeholder Communications

The GCOOS website is the public face of the organization — the place where stakeholders can find information about the organizational structure, responsibilities and mission. The website is currently maintained by the GCOOS communications manager with input from the executive director, the outreach manager and the GCOOS staff. The primary challenge is to keep the site fresh with new information and stories to keep people engaged in the IOOS/GCOOS mission.

The monthly e-newsletter continues to be well received and read by stakeholders with an open rate far exceeding the average for governmental and non-governmental newsletters.

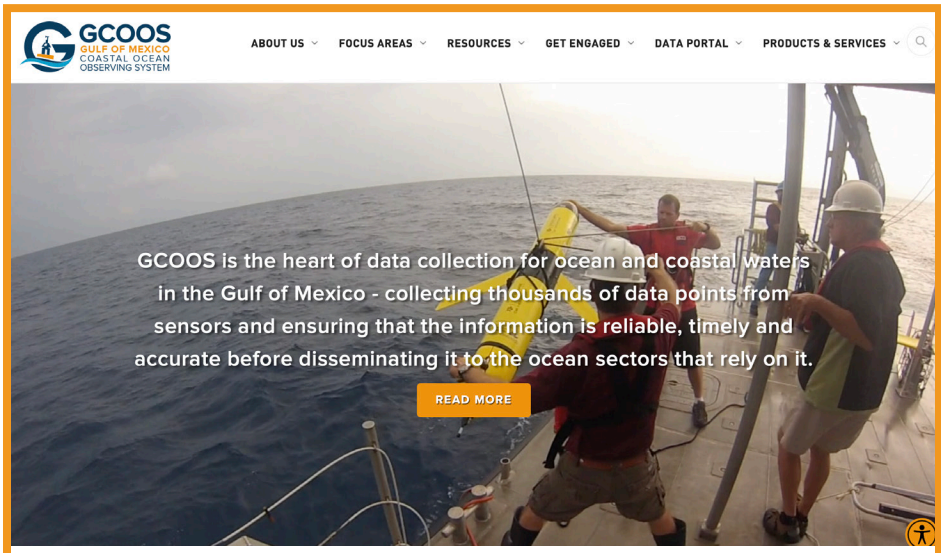


Figure 11: The GCOOS website home page, GCOOS.org.

Press releases have demonstrated their value getting messages out to the public via the media quickly and accurately.

Social media is similarly managed by the communications manager with input from the staff. Two-to-three social media posts per week is the current goal. These four strategies on outreach communication enable us to reach a wide variety of stakeholders.

Stakeholder Communications Priorities

- The website, newsletter and social media and press releases are the main ways that information about GCOOS data and products reach the diverse population of the five U.S. Gulf of Mexico states. The dedicated but small staff makes the day-to-day operations of these products challenging, and the staff should be commended for their ongoing efforts.
- GCOOS should continue to support these multiple communications approaches to maximize messaging to stakeholders.
- GCOOS should also seek funding to translate key communications into Spanish.

Outreach and Education

Outreach and Education is a cross-cutting theme of the GCOOS Strategic Plan. The six goals designed to build resilient ocean-literate, climate-literate and energy-literate Gulf communities are:

1. Establish and maintain a GCOOS O/E network within the Gulf of Mexico region that includes working toward a diverse OEC membership;
2. Coordinate messaging within GCOOS and across regional and national partner programs to maximize the relevancy and usefulness of products;
3. Work toward the use and application of GCOOS observations, products and services throughout the region by development and understanding of relevant programs and materials for audiences such as the public, formal and informal educators, coastal decision makers, resource managers and elected officials;
4. Include workforce development within the ocean observing system enterprise through a variety of mechanisms (e.g., training, mentorships, professional development, volunteer opportunities);
5. Provide ongoing evaluation of the effectiveness of GCOOS products and activities;
6. Continue efforts to leverage and increase funding for GCOOS O/E activities and build on previous successes with Sea Grant, National Estuarine Research Reserve System

(NERRS), NOAA Gulf of Mexico Regional Collaboration Team, Gulf of Mexico Alliance (GOMA) and others that have allowed us to jointly develop outreach products and educational resources and remain vibrant and active through extensive regional cooperation.

7. In summary, the Outreach and Education Subsystem supports all aspects of the IOOS enterprise that enables GCOOS to remain agile and responsive to user-identified needs.

Figure 12: GCOOS Outreach and Education activities include reaching the youngest ocean users.

GCOOS will continue to maintain the Outreach and Education subsystem to provide two-way communication between stakeholders and regional data providers and product developers. The Outreach and Education Manager and Outreach and Education Council (OEC) members work closely with other GCOOS Councils, Committees, Task Teams and the Board to identify needs for data and information on the environmental state of the coastal and offshore waters of the Gulf of Mexico, extend the use of these data and products by diverse audiences, assess the utility of existing products, and identify the professional development and workforce training needed to fully capitalize on and enhance the system.

Outreach and Education Priorities

- Priorities identified in our 2021-2026 IOOS award and those supported through complementary non-IOOS funded projects will guide specific outreach activities to targeted audiences over the next five years. Examples of potential areas of engagement include:
  - Collaborating on the development of an IOOS Marine Life Program through our Marine Biodiversity

Observation Network (MBON) projects.

- Facilitating end-user-driven product development and outreach in support of observations from sensors on fixed and mobile platforms and remote instruments such as HFR, satellites, gliders, ARGO floats and emerging vehicle operations such as Saildrones;

- Maintaining and expanding capacity of the volunteer harmful algal bloom monitoring network (i.e., HABScope);

- Working with the newly formed GCOOS Modeling Task Team to solicit information about user priorities and requirements, and feedback on beta products;

- Building capacity for the Gulf of Mexico Coastal Acidification Network (GCAN);

- Working to implement actions identified by the newly formed GCOOS Diversity, Equity, Inclusion and Accessibility Task Team;

- Supporting GCOOS efforts to expand international partnerships with Mexico and Cuba .

A Connected Gulf of Mexico

Early in its establishment, GCOOS recognized the strength in collaborating with our observing colleagues in Mexico, and over the years, numerous Mexican scientists have attended and presented at GCOOS Board and Member meetings and workshops. GCOOS staff and Board members have also made multiple trips to Mexico over the years.

Other initiatives outside the direct GCOOS domain have also fostered the idea of data sharing, including the Trinational Initiative in 2007, the Large Marine Ecosystem Project (LME) cited in version 1 of the GCOOS Build Out Plan (2011), and the Gulf Marine Research Consortium (CIGOM) managed by CICESE in 2015. GCAN, managed by GCOOS, along with the Harte Research Institute at TAMU-Corpus Christi, recently initiated an international working group on Gulf whole system ocean acidification research and monitoring. The work group met for the first time in the Fall of 2022 in Merida, Yucatan, (Figure 13) to discuss regional challenges and a joint plan for collaboration.

A Connected Gulf Priorities

Clearly, the willingness to collaborate has not been the challenge, instead the challenge has been in the exchange of observing data — particularly in real time or near real time — between the northern and southern Gulf organizations.

To support the understanding of the Gulf of Mexico whole system, GCOOS is currently exploring coordination of three aspects with the CIGOM consortium: gliders, HFR and biological data.

In September 2022, CICESE started using GCOOS's GANDALF dashboard to pilot two seagliders and we are continuing to work on new ways to collaborate.

The National Academies funded projects, "Understanding the Gulf Ocean Systems," have also supported research in the Gulf-wide system. A result of the past funding cycle is that TAMU's GERG installed two HFR stations in the Mexican Caribbean coast. As part of the new project, starting in 2023, CICESE's glider group is funded to conduct a series of missions to understand the interactions of the Loop Current north and south in the Gulf.

- GCOOS will continue to foster observation data sharing across the northern and southern Gulf of Mexico focusing on HFR, glider, biologic, and ocean acidification data in the near term and will seek additional opportunities for future collaborations that will include moorings and numerical models coordination.

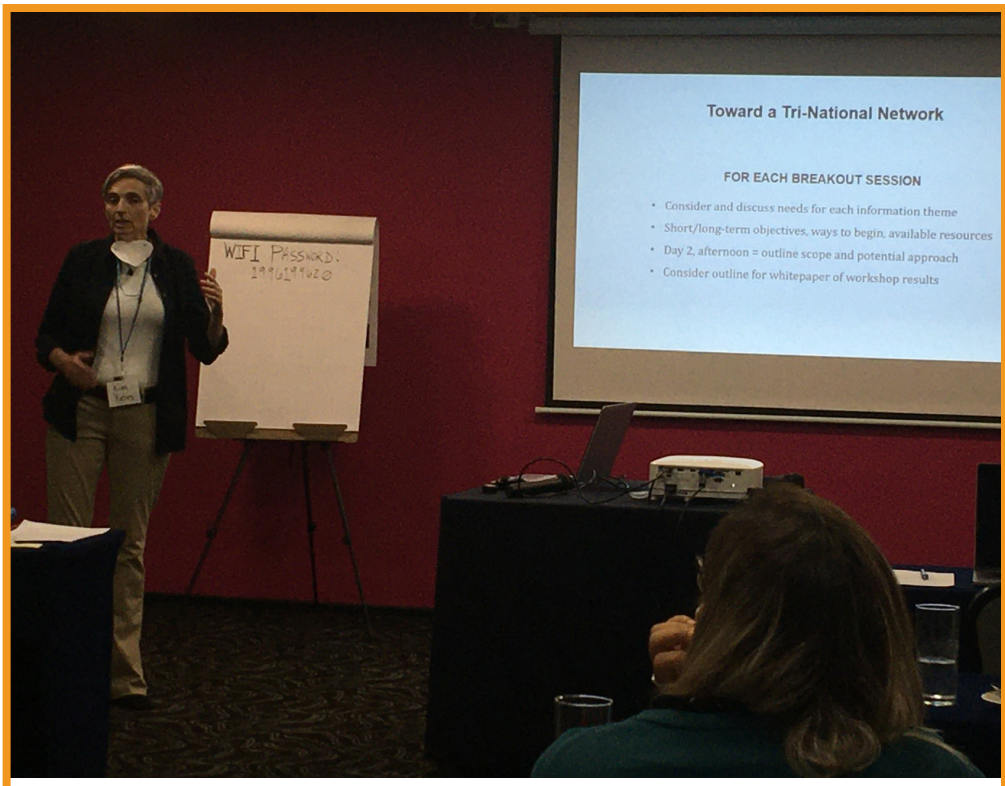


Figure 13: Researchers from Cuba, Mexico and the U.S. met in Mexico in the Fall of 2022 to discuss how to address ocean acidification together.

Diversity, Equity, Inclusion and Accessibility

GCOOS has reviewed the new NOAA Diversity and Inclusion Strategic Plan.

As a starting point, a review of the GCOOS 17-member Board reveals that it is comprised of eight men and nine women, including eight Ph.D. holders.

The GCOOS staff is comprised of seven men and five women, including three Ph.D. holders and an Ed.D. holder. The Executive Director is Mexican-American; other staff members are Filipino-American, Nigerian and Finnish. Two students are from India.

Because GCOOS is under the umbrella of the much larger TAMU, the organization's full-time employees have access to — and annual requirements to complete — professional training in subjects such as diversity, equity, inclusion and justice, sexual harassment, gender and racial bias, etc. The courses are completed upon successful scores on post-unit quizzes.

Our Gulf of Mexico stakeholders vary widely in age, professions/careers and encompass a wide range of ethnicities and cultural backgrounds. An initial step in better communicating with our diverse clientele was to translate the Red Tide Respiratory Forecast into Spanish. A next step — based on our demographic needs in the Gulf — will be to build additional Spanish-language capabilities into the GCOOS website.

Diversity, Equity, Inclusion and Accessibility Priorities

Several short-term priorities to move these efforts forward in our region include:

- Create a DEIA Task Team. The team will be chaired by a member elected by the team, facilitated by the GCOOS Outreach manager and consist of five members from each of the five Gulf of Mexico states. The team will be tasked with creating strategies to improve DEIA within the GCOOS-RICE for the Board to review, modify and adopt.

- Create a DEIA Task Team section on the GCOOS website and in the e-newsletter informing stakeholders of the Team's actions and efforts.

- Have a DEIA presentation/ discussion at each GCOOS Board and Members' meeting.

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Appendix 1

Appendix 1: Stakeholder Input Summary

User needs identified in an August-October 2022 convenience survey (n=108) align with the four high-level focus areas and four cross-cutting themes of the GCOOS Strategic Plan 2020-2025 (Figure A-1).

Sixty-nine percent of responses were for three areas: Healthy Ecosystems & Living Resources, Coastal Hazards and Outreach and Education (27%, 23% and 19%, respectively). Long-term change (11%) and Numerical Modeling (2%) are likely underrepresented because of the sorting and binning process — some answers fit into multiple categories and when that was the case, answers were binned into the relevant high-level focus area rather than the cross-cutting theme.

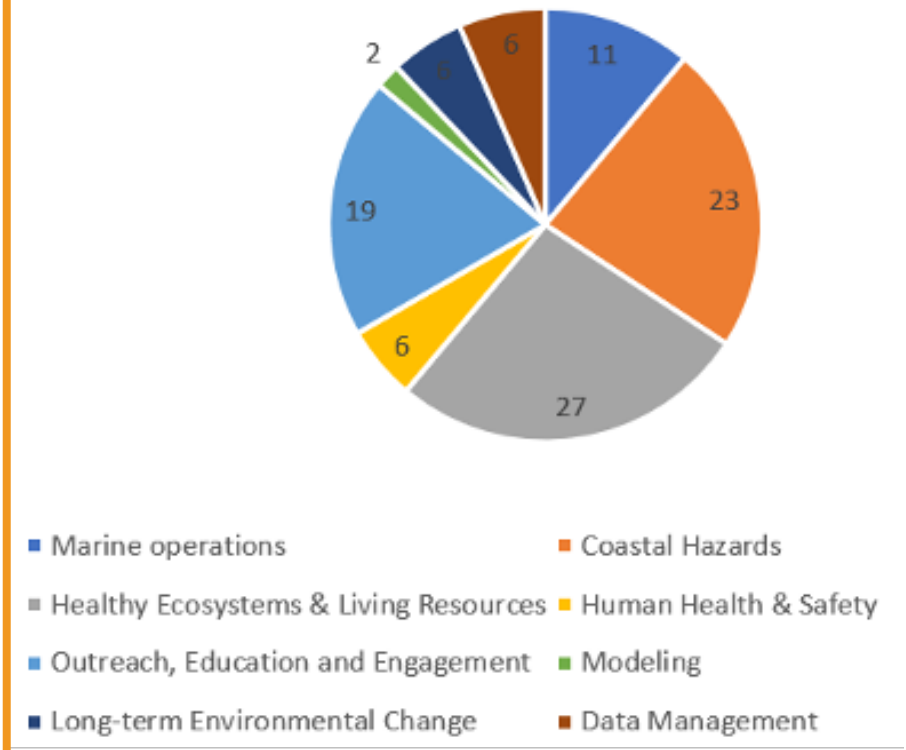

Figure A-1: Percent stakeholder input by strategic plan priority

We used several approaches to obtain stakeholder needs for measurements and derived products. Informing this updated plan is input from more than 400 people representing 117 organizations.

Table 1 summarizes the organizations by sector and includes government, academia, education, private business and industry, media and non-governmental organizations (NGO).

Figure A-2 shows the percent of stakeholder input provided by each sector. The private, NGO and academia/education sectors had the most representation with 27%, 25%, and 22% of input, respectively. The government and media sectors were also well-represented, accounting for 17% and 9% of input, respectively.

The methods used to ensure that GCOOS remains an inclusive, stakeholder-drive entity include:

- In-person surveys of GCOOS Board, council, committee and task team

members, including in-progress development of a Diversity, Equity, Inclusion and Accessibility (DEIA) Task Team;

- Workshops for specific stakeholder communities to identify and prioritize the measurements and products needed by the specific community;
- Online surveys;
- Partnering with other organizations to learn about the information needs of their constituents;
- Information gleaned when participating on the committees and working groups of relevant organizations (e.g., the NOAA GoM Regional Collaboration Team, GOMA Priority Issue Teams, GCAN, Florida HAB Task Force, GRP, GoM Sea Grant programs, Earth System Information Partners, MBON, etc.);
- Direct conversations with partners and data users (e.g., unmanned vehicle pilots using GANDALF, HABscope volunteers, users of online education lessons, MBON partners, Gulf energy community providing currents/NTL data, etc.);
- And inputs from guiding regional and national planning documents (e.g., national mooring, modeling, HFR, data management, glider, hypoxia, education and port plans; Gulf of Mexico Alliance Action Plan IV; SECOORA Buildout Plan; relevant National Academies GRP reports; Texas, Louisiana, Mississippi, Alabama and Florida state restoration plans; relevant priorities identified by RESTORE Centers of Excellence; observing needs identified in Sea Grant, NEP and NERR plans, etc.).

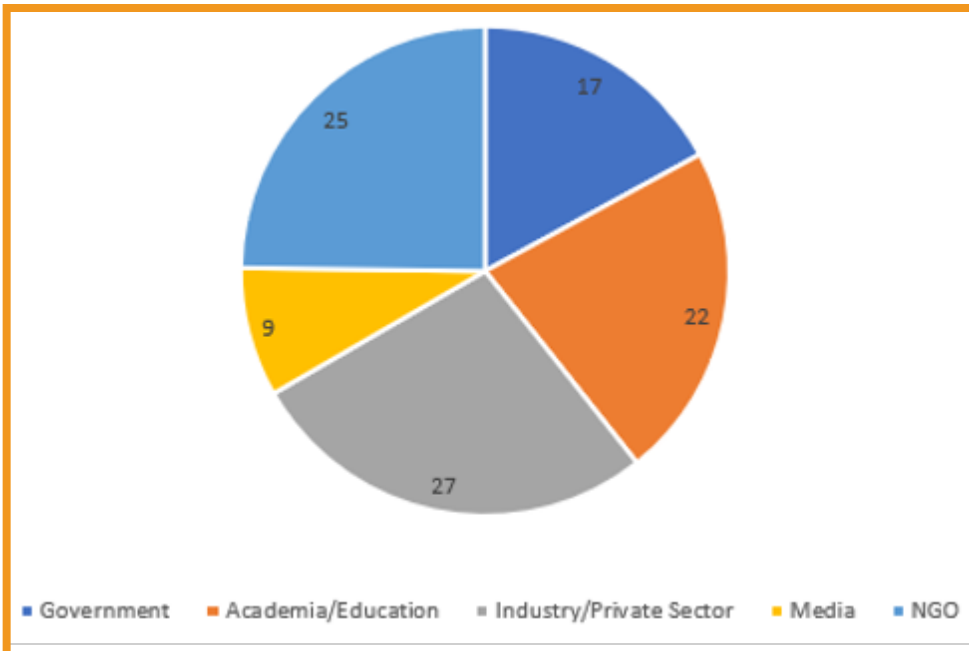

Figure A-2: Percent stakeholder input by sector.

Guided by the information provided by stakeholders, the GCOOS Board of Directors balances needs with existing and potential resources to establish priorities. Building out infrastructure for high frequency radars, uncrewed systems such as profiling floats, surface vehicles, buoyancy gliders and instrumentation for HAB detection will enable us to apply the core data acquired from these platforms to a wide range of stakeholder-identified issues.

For example, governmental agencies and industry have the need to fill big gaps in surface current and water level coverage in the Gulf of Mexico. Many water quality-related issues such as hypoxia, HABs and contamination from spills that are of interest to all 117 organizations surveyed can be better addressed by a system that includes ongoing surveillance and response using uncrewed technology.

These platforms would also allow for important datasets needed to improve forecasts of severe weather, with data for 3-D modeling of coastal hazards and ocean heat content being especially important to national, state and local governmental agencies, resilience practitioners and academic users.

There is also regional, national and global interest in expanding GCOOS capabilities for citizen scientist HAB monitoring and for adding navigation, model, satellite, radar and other data layers to the GANDALF piloting tool.

In addition to data availability and accessibility, stakeholder feedback indicated the importance of GCOOS outreach, education, engagement and communication activities.

For example, private sector and industry survey takers requested that GCOOS increase activities to facilitate and champion public-private-academic partnerships to support new Blue Economy initiatives that focus on enhancing private sector engagement. Also specifically requested is the need for:

- Public outreach to promote better understanding of climate-related ocean and water quality impacts on communities;
- Strengthening ties with NOAA partners;
- Making IOOS/GCOOS resources more student-friendly (e.g., simple graphing capabilities to overlay data);
- And offering more workshops and professional development opportunities for educators, researchers, resource managers and the media.

We will continue to leverage and increase funding for GCOOS outreach and education activities by seeking external funding sources.

Collaborations with Sea Grant, NERRS, NOAA Gulf of Mexico Regional Collaboration Team, GOMA, Earth Science Information Partners (ESIP), Shell Oil Co., National Academies GRP, and others have allowed us to jointly develop outreach products and resources and remain vibrant and active. This practice of leveraging and collaboration to advance regional, national and international outreach and education capabilities will remain an important GCOOS strategy; we will continue collaborations and seek new partners.

Table A1-1. Summary of organizations providing input to the GCOOS build out plan addendum.

Government	Academia/Education	Private Sector	Media	NGO
AL Mar Res Division	Dauphin Island Sea Lab	Aquatic Obsession Dive	Anna Maria Island Sun	Charlotte County Chamber of Commerce
BOEM	DISL Discovery Hall Programs	Bilmar Beach Resort	Charlotte Sun	Englewood Chamber
EPA	Florida Aquarium	Cape Haze Marina	PCC TV Station	Galveston Bay Foundation
FL DEP	FL Gulf Coast University	Capt. Brian On The Water	TB Times/FL Climate Reporting Network	Gulf of Mexico Alliance
FL DOH-Charlotte Co	Florida Sea Grant	Clwtr Beach Marriott Suites Sand Key	Tampa Bay Times/ Env Reporter	Grand Bay NERR
FL Doh--Pinellas County	LA Dept of Education	Crabby Bills-Indian Rocks Beach	The Gulfport Gabber	Institute for Global Env Strategies
Florida Fish and Wildlife	Louisiana State University	Cutthroat Clams	The Poynter Institute	IOOS Association
LA Dept of Wildlife and Fisheries	LA Sea Grant College Program	Discount Tackle Outlet	The St. Pete Catalyst	Manatee Chamber
MS Department of Marine Resources	MS-AL Sea Grant Consortium	EcoSolutions, Inc.	Waterline Magazine	Mission Aransas NERR
NASA	Mississippi State University	Farlow's On The Water Restaurant	Weekly Challenger	Mote Marine Laboratory
NOAA NDBC	Santa Rosa School District, FL	Fishermen's Village		National Academies GRP
NOAA NCEI	St. James Episcopal School	Fishing guide-Private, Naples, FL		Navarre Beach Marine Science Station
NOAA National Weather Service	Texas A&M University-Galveston	Fugro		Pinellas County Economic Development
NOAA OMAO	TAMU College Station	Happy Paddler Kayak Tours		Punta Gorda/ Englewood Beach Vstr & Conv Bureau
NOAA GoM Regional Collaboration Team	TAMU-Corpus Christi	Hooked on SUP		Sanibel Captiva Conservation Foundation
NOAA Southeast Regional Office	TX School District	Islander Properties (Don Pedro)		Sarasota Bay Estuary Program

Government	Academia/Education	Private Sector	Media	NGO
Oak Ridge National Research Lab	Texas Sea Grant College Program	King Fisher Fleet		Schmidt Ocean Institute
Sankofa Wetland Park and Nature Trail	University of Alabama-Huntsville	Mastry's Brewing		St. Petersburg Area Chamber of Commerce
USGS	University of Florida	Ocean Associates, Inc.		St. Petersburg Innovation District
U.S. Navy	University of New Orleans	Placida Gold - Clams		SECOORA
	University of Miami	Shell		The Water Institute of the Gulf
	University of Mississippi	Sirata Beach Resort		Underwater Glider User Group
	University of Southern MS	Stantec		Weeks Bay NERR
	USM GCRL	Tarpon Realty (Little Gasparilla)		Tampa Bay Beaches Chamber of Commerce
	University of South Florida	The Chiles (Restaurant) Group		Tampa Bay Estuary Program
	Washington College	The Wyvern Hotel		Tampa Bay Watch
		The Don CeSar Hotel		Treasure Island & Madeira Bch Chamb of Comm
		Tradewinds Island Resorts		Visit St. Pete-Clearwater
		Treasure Bay Resort and Marina		Visit Sarasota County
		Ocean Sierra, LLC		
		Woods Hole Group, Inc.		
		Woody's Waterfront St. Pete Beach		

Table A1-2: Appendix 1 content originally submitted to IOOS as part of the GCOOS recertification package was to include input from people participating in our Board and Members meetings planned for 28-29 September 2022. However, Hurricane Ian disrupted this plan and instead, we held virtual meetings 15-16 November 2022. This table summarizes existing and emerging stakeholder needs identified by approximately 100 participants at these meetings. Not all identified needs can be supported at the current GCOOS funding level; however, the information can serve as a road map to help seek outside funding opportunities. Additional input included assessing the value of observations to the Gulf economy and finding a way to capture who is using GCOOS data and products and how these are being used.

Coastal Hazards	Healthy Ecosystems	Human Health	Outreach, Education, Engagement	Modeling	DMAC	Long-term env. change
Low cost water-level (WL) sensors	Need to understand habitat use of species of interest near energy platforms — including birds	Support platforms/ sustained monitoring of range of HAB species, DO, pH and hypoxia for shellfisheries	Connect GoM stakeholders for offshore wind energy development	3-D Modeling for a range of hazard, ecosystem and health applications	Continue hosting NTL ADCP data; add data from new NTL providers & operators	Coupled pH-DO sensors for hypoxia & OA work
Multi-hazard products that use low cost WL and web cams and integrate model output to inform decisions at community level	Offshore aquaculture monitoring; is there a role for GCOOS with DOE?	Need sustained monitoring for multiple species — not just *Karenia brevis*, e.g., *Pseudo-nitzschia*	Can GCOOS enable discovery of wide range of data sets in GoM? Not just GCOOS but others (e.g., GRIID C, RESTORE…)	Integrated satellite products (e.g., satellite data layers in GANDALF)	Explore data support role for offshore wind energy efforts that are ramping up	
Gap-filling for real time near-shore wind, wave and currents related to coastal storms and winter storms	Fill T,S gaps; gliders help but need routine obs from rivers to open ocean-higher res needed-ie sentinel sites	Bonnet Carre Spillway—need to monitor range of HAB species when spillway opens; impacts N GoM shellfish harvest	Support partnerships & collaborations for the integration of biogeochemical obs into GCOOS	Models and DMAC role for wind characterization-data to quantify baselines once wind leases issued; fill gaps in NOAA/ BOEM	Aggregate data for Marine Spatial Planning Models & scenarios to help cite offshore wind farm areas, turbine locations	

Coastal Hazards	Healthy Ecosystems	Human Health	Outreach, Education, Engagement	Modeling	DMAC	Long-term env. change
Fill HFR gaps between eastern and western GoM	pH, T, S, DO obs at sea floor for hypoxia — USM buoy obs at surface; hypoxia and associated changes at sea floor; data to ground truth		Lead collaborative efforts among agencies and institutions for access and use of satellite imagery	Support high resolution local model development by academia		
Coupled WL-HFR stations that are hurricane-hardened (e.g., single antenna systems, long range stations)-in LA	East of MS River Delta, evidence of sediment ground water discharge; important player in hypoxia: role for GCOOS?		Lead coordination of funding for real-time transmission of satellite imagery data			
	Critical need for buoys to be replaced in FGBNMS					

Appendix 2

Appendix 2: Observational Asset Inventories

Table A2-1: Inventory of High Frequency Radar, Imaging Flow Cytobot, Programmable Hyperspectral Seawater Scanner and Ocean Acidification Buoy.

Asset	Lead Org.	Point of Contact	Station ID	Station Name	Type	Frequency	Location	State	Year Deployed	GCOOS Funded?*
HFR										
	Fugro	Ben Williams	CPLF	Chevron Pipeline Facility	CODAR	4.4 MHz	Lafourche Parish	Louisiana	2019	Yf
			SWPP	Southwest Pass	CODAR	4.4 MHz	Plaquemines Parish	Louisiana	2019	Yf
	GERG - Texas A&M University	Tony Knap	RLVR	Rollover Pass	CODAR	4.4 MHz	Gilchrist	Texas	2016	Yf
			SSDE	Surfside	CODAR	4.4 MHz	Surfside	Texas	2016	Yf
			MBNP	Matagorda Bay Nature Park	CODAR	4.4 MHz	Matagorda	Texas	2018	Yf
			ANWR	Aransas National Wildlife Refuge	CODAR	4.4 MHz	Austwell	Texas	2018	Yf
			PINS	Padre Island National Seashore	CODAR	4.4 MHz	Corpus Christi	Texas	2016	Yf
	University of Southern Mississippi	Stephan Howden	GPTP	Gulfport	CODAR	25.2 MHz	Port of Gulfport	Mississippi	2021	Yp
			HBSP	Henderson Beach State Park	CODAR	4.5 MHz	Destin	Florida	2006	Yp
			OBSP	Orange Beach State Park	CODAR	4.5 MHz	Orange Beach	Alabama	2006	Yp

Asset	Lead Org.	Point of Contact	Station ID	Station Name	Type	Frequency	Location	State	Year Deployed	GCOOS Funded?*
			PCYC	Pass Christian Yatch Club	CODAR	25.6 MHz	Pass Christian	Mississippi	2011	Yp
			SGRV	Singing River Island	CODAR	4.7 MHz	Pascagoula	Mississippi	2009	Yp
			SISL	Silver Slipper Casino	CODAR	25.4 MHz	Bay St Louis	Mississippi	2011	Yp
IFCB										
	University of Alabama	Kenneth Hoadley		Dauphin Island Sea Lab			Dauphin Island	Alabama	2022	Yf
	Texas A&M University	Darren Henrichs	IFCB_PortA	TOAST Port Aransas			Port Aransas	Texas	2007	Yp
			IFCB_Surfside	TOAST Surfside			Surfside	Texas	2017	Yp
PHySS										
	Mote Marine Laboratory	John J. Langan	PHySS-2 # 1	Channel Marker 2, San Carlos Bay	Pylon		Sanibel	Florida	2020	Yp
			PHySS-2 # 2	New Pass Boat Dock	Dock		Sarasota	Florida	2020	Yp
OA										
	University of Southern Mississippi	Stephan Howden	USM Buoy	USM Buoy	3-m discus			Louisiana	2017	Yp

**GCOOS Funded?: Yf = Fully funded; Yp = Partially funded*

Appendix 2: Moorings and Coastal Stations

Table A2-2: Inventory of Moorings and Coastal Stations Providing Data to GCOOS.

Asset	Lead Organization	Station ID	Station Name	Platform Type	GCOOS Funded?**
NTL	ATP Oil & Gas Corporation	wmo:42381	Innovator - Mississippi Canyon 711	Fixed	N
NTL	BHP Billiton	wmo:42897	42897 - Development Driller 1 - DeSoto Canyon 726	Offshore Platform	N
NTL	BHP Billiton	wmo:42932	42932 - Deepwater Invictus - Green Canyon 653	Offshore Platform	N
NTL	BP Inc	wmo:42370	42370 - Holstein - Green Canyon 645	Fixed	N
NTL	BP Inc	wmo:42916	42916 - Development Driller 3 - Green Canyon 743	Offshore Platform	N
NTL	BP Inc	wmo:42908	42908 - West Sirius - Keathley Canyon 57	Offshore Platform	N
NTL	BP Inc	wmo:42901	Station 42901 - Q5000 - Green Canyon 137	Offshore Platform	N
NTL	BP Inc	wmo:42885	42885 - GSF Development Driller II - Mississippi Canyon 727 #2	Offshore Platform	N
NTL	Chevron	wmo:42385	42385 - Blind Faith - Mississippi Canyon 696	Fixed	N
NTL	Chevron	wmo:42386	42386 - Tahiti - Green Canyon 641	Fixed	N
NTL	Chevron	wmo:42929	42929 - Pacific Santa Ana - Keathley Canyon 10	Offshore Platform	N
NTL	Chevron	wmo:42934	42934 - Pacific Sharav - Mississippi Canyon 607	Offshore Platform	N
NTL	Chevron	wmo:42402	42402 - Big Foot - Walker Ridge 29 A	Offshore Platform	N
NTL	Cobalt Energy	wmo:42898	42898 - Rowan Reliance - Keathley Canyon 129	Offshore Platform	N

Asset	Lead Organization	Station ID	Station Name	Platform Type	GCOOS Funded?**
NTL	ConocoPhillips	wmo:42883	42883 - Maersk Valiant - Alaminos Canyon 475	Offshore Platform	N
NTL	ConocoPhillips	wmo:42368	Magnolia - Garden Banks 783	Fixed	N
NTL	Deep Gulf Energy	wmo:42924	42924 - ENSCO 8503 - Mississippi Gulf 214	Offshore Platform	N
NTL	El Paso E&P Company, L.P.	wmo:42384	42384 - Prince TLP - Ewing Bank 1003	Fixed	N
NTL	ExxonMobil	wmo:42899	42899 - Ocean Endeavor - Keathley Canyon 919	Offshore Platform	N
NTL	Freeport-McMoRan	wmo:42939	42939 - Noble Tom Madden - Mississippi Canyon 84	Offshore Platform	N
NTL	Helix	wmo:42388	42388 - Helix Producer 1 - Green Canyon 237	Offshore Platform	N
NTL	Helix	wmo:42859	42859 - Discoverer 534 (D534) - Green Canyon 516	Offshore Platform	N
NTL	Kerr-McGee Oil and Gas Corporation	wmo:42382	42382 - Gunnison - Garden Banks 668	Fixed	N
NTL	Kerr-McGee Oil and Gas Corporation	wmo:42366	Red Hawk - Garden Banks 877	Fixed	N
NTL	LLOG	wmo:42852	42852 - Who Dat FPS - Mississippi Canyon 547	Offshore Platform	N
NTL	LLOG	wmo:42940	42940 - West Neptune - Keathley Canyon 829	Offshore Platform	N
NTL	LLOG	wmo:42894	42894 - Lorris Bouzigard - Mississippi Canyon 199	Offshore Platform	N
NTL	LLOG	wmo:42875	Amos Runner - Mississippi Canyon 751	Offshore Platform	N
NTL	Maersk Drilling USA	wmo:42915	42915 - Maersk Developer - Green Canyon 726	Offshore Platform	N
NTL	Murphy Exploration & Production Company	wmo:42387	Thunderhawk - Mississippi Canyon 734	Fixed	N
NTL	Murphy Exploration & Production Company	wmo:42867	DeepSeas - Keathley Canyon 785	Offshore Platform	N

Asset	Lead Organization	Station ID	Station Name	Platform Type	GCOOS Funded?**
NTL	Murphy Exploration & Production Company	wmo:42874	42874 - Deepwater Asgard - Atwater Valley 23	Offshore Platform	N
NTL	Murphy Exploration and Production Company	wmo:42360	BW Pioneer buoy - C16471 - Walker Ridge 249	Fixed	N
NTL	Noble Energy Inc	wmo:42860	42860 - Atwood Advantage - Mississippi Canyon 40	Offshore Platform	N
NTL	Petrobras - USA	wmo:42905	42905 - Belford Dolphin - Green Canyon 561	Offshore Platform	N
NTL	Petrobras - USA	wmo:42856	42856 - Titanium Explorer - Walker Ridge 425	Offshore Platform	N
NTL	Repsol	wmo:42903	42903 - Rowan Renaissance - Keathley Canyon 686	Offshore Platform	N
NTL	Shell International E&P	NOAA.NDBC:WDEL1	WDEL1 - Shell West Delta 143	Fixed	N
NTL	Shell International E&P	wmo:42861	42861 - Deepwater Nautilus - Mississippi Canyon 348	Offshore Platform	N
NTL	Shell International E&P	wmo:42906	42906 - Deepwater Poseidon - Mississippi Canyon 612	Offshore Platform	N
NTL	Shell International E&P	wmo:42864	42864 - Thalassa - Walker Ridge 464	Offshore Platform	N
NTL	Shell International E&P	wmo:42394	42394 - Olympus TLP - Mississippi Canyon 807	Offshore Platform	N
NTL	Shell International E&P	wmo:42922	42922 - Noble Jim Day - Walker Ridge 508	Offshore Platform	N
NTL	Shell International E&P	wmo:42403	42403 - Vito - MC939	Offshore Platform	N
NTL	Statoil Hydro	wmo:42914	42914 - Discoverer Americas - Walker Ridge 543	Offshore Platform	N
NTL	Stone Energy	wmo:42863	Ocean Victory - Green Canyon 300 #2	Offshore Platform	N
NTL		wmo:42892	Saipem Santorini - Green Canyon 297	Offshore Platform	N

***GCOOS Funded?: Yp = Partially funded; N = Not funded.*

Appendix 2: Underwater Gliders

Table A2-3: Inventory of Underwater Gliders.

Asset	Lead Organization	Point of Contact	Glider ID	Type	Pump	Year Acquired	Sensors	Name
Glider								
	GERG - Texas A&M University	Tony Knap	Unit 307					Reveille
			Unit 308	Slocum G2	1000		CTD	Howdy
			Unit 540					Stommel
			Unit 541					Sverdrup
	Mote Marine Laboratory	John J. Langan	Unit 555	Slocum G2	1000	2015	CTD, DO, CDOM	Genie
			Unit 839	Slocum G3	1000	2020	CTD, DO, CDOM	Dora
	University of South Florida	Chad Lembke	Unit 122	Slocum G1	200	2008	CTD, DO, FL, PAM, Radiance	
			Unit 123	Slocum G1	200	2008	CTD, DO, FL, PAM	Sam
			Unit 125	Slocum G1	200	2008	CTD, DO, FL, PAM, Radiance	Bass
			Unit 137	Slocum G1	1000	2008	CTD, DO, FL, PAM, Radiance	Murphy
			Unit 771	Slocum G3	150/350/1000	2018	CTD, DO, FL, PAM, Echosounder	Stella
			Unit 772	Slocum G3	150/350/1000	2018	CTD, DO, FL, PAM, Echosounder	Gansett

Asset	Lead Organization	Point of Contact	Glider ID	Type	Pump	Year Acquired	Sensors	Name
			Unit 847	Slocum G3	150/350/1000	2020	CTD, DO, FL, Nitrate	JaiAlai
	University of Southern Mississippi	Kevin Martin	SG677	Seaglider	1000	2021	CTD, DO, CDOM, Chl-a, Turbidity	
			Unit 174	Slocum G1	200	2007	CTD (need to upgrade)	
			Unit 078	Slocum G1	30	2010	CTD (need to upgrade)	


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GCOOS is the Gulf of Mexico regional component of the U.S. Integrated Ocean Observing System (IOOS) and the only certified system focused solely on the Gulf of Mexico. Our mission is to provide timely, reliable, accurate and on-demand information on the open ocean and coastal ocean waters of the Gulf of Mexico to ensure a healthy, clean, productive ocean and resilient coastal zone.

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