**GCOOS Spring Board and Members Meeting, TAMU-Galveston**

8 May, Closed Board Mtg

Welcome and Roll Call: Board Chair Kirsten Larsen welcomed everyone.

Attendees: In Person Board Members: Dave Driver, Kirsten Larsen, Bill Lingsch, Suraida Nanez-James, Ruth Perry, Antonietta Quigg, Kim Yates. In-person Others: Jorge Brenner, Felimon Gayanilo, Rosa Gonzalez, Carl Gouldman, Chris Simoniello, Jen Vreeland, Shari Yvon-Lewis. Participating virtually: Sara Graves, Pat Hogan, Kate Hubbard, Nick Shay, Jan van Smirren, Nan Walker

Motion to accept agenda, Kim, Bill second, all in favor

Board members signed the Conflict of Interest forms.

**CARL GOULDMAN**—IOOS Office updates: Carl congratulated GCOOS for: partnership work with CARICOOS and SECOORA on the Sargassum project; glider work with the Navy; HFR with LSU as part of the IOOS Association Closing the Gaps campaign; and Inflation Reduction Act proposal efforts. Program highlights and plans for FY24 included six OTT awards last fall; Navy/IOOS hurricane collaborations including MOA with Navy for gliders (10 this year cf 15 previously) and a UG2 workshop in September; COMT awardees will be notified in June; and modelling/cloud computing (NOAA Cloud Sandbox). IOOS Marine Life—the White House will be releasing the National Ocean Biodiversity Strategy at CHOW in early June. NHABON- $3.5M in FY24. Awardees have been selected and RAs notified. These are building on some of the OTT Sargassum projects. IRA-Three main areas are: 1) Improve coastal observing systems; 2) Strengthen delivery of data and predictions; and 3) Enhance partnerships that deliver services and products. Ocean-based climate resilience accelerators--$60M in funding. Phase 1 includes about $4M for 16 projects. Phase 2 applications are due July 31. Themes include ocean renewable energy, coastal and ocean carbon sequestration, hazard mitigation and ecosystem services (change detection, change analysis, change adaptation/mitigation); The President's budget challenge is that IOOS is going from $69 M to $10M. There is nothing to plan until after we hear from Congress. See Carl's slide for a summary of the IOOS FY2021-FY2027 budget (Disaster, IRA, BIL and base funding). Also see Carl's slide from Ocean Service FY2025-2029; there will be implementation; challenges for the RAs and solutions to alleviate funding challenges will be needed if base funding is reduced. Core capabilities are not included in IRA and BIL and must be in place for those to be successful.

Questions: Pat asked if IOOS is trying to move 5 yr IRA funding in FY2024. Carl said yes because it is most efficient to manage this way. Scope of work will be managed year by year but adjustments during different periods of the award can be made, if needed (e.g., if HFR breaks in Y4, can ask for Y5 funds to fix). Ruth commented that BIL and IRA funding makes it tough to champion increased IOOS base funding. It looks like we already got an increase. Advocacy is needed to separate what each pot of money is doing. President's budget vs IRA vs BIL—creating skewed perspective that there's a lot of money in the line office. IRA equitable services delivery is predicated on receiving core funding from previous years. Funders are creating a house of cards if they think we can do ESD with IRA funds without core funding; Kim asked if we should start prioritizing observations that might go offline. Some RAs do

an annual review to prioritize assets. For GCOOS, we have IRA funds for LSU radars but no O&M funds to sustain. Nan asked if we can use specific language that states our IRA-funded projects require IOOS base funding. The IPO must support the President's budget but the IOOS Association can use such language.

**KRISTEN YARINCIK**, IOOS Association: Advocacy Efforts Update; IOOS is aiming to move IRA money by September. See Kristen's Appropriations slide for FY24. Commerce, Justice and Science (CJS) passed as part of a $6B package on Friday, March 8. The IOOS regional line is $42.5M compared to the FY24 IOOS request of $80.5M for infrastructure (BIL plus IRA anticipated =$135M); FY25 request is $56M ($50M core funding plus $6M for innovation via NHHABON, OTT, COMT). There is regular inflation and asset depreciation in annual requests. We need to start to socialize IRA capacity and projects that are tangible and resonate with Congress; we also need to prepare for funding cliff if the President's budget is realized. $13M is planned for the program office (Congress does not direct specific funding). There was bi-partisan appropriations advocacy: House-Pingree (D-ME), Carbajal (D-CA), Posey (R-FL). As of April 29, there were 85 signatures, including 11 Republicans (e.g., Garcia-D-TX, Weber, R-TX, Castor, D-FL, Donalds, R-FL, Frost, D-FL; Senate-Cantwell, D-WA, Wicker, R-MS). The advocacy window closed May 7th. Cassidy, R-LA, was also a supporter of IOOS. The Written Testimony deadline is May 24. IOOS Association, National Ocean Service Roundtable, Friends of NOAA, OAR/NOS/Cooperative Institutes Coalition are all places to respond to the FY25 President's Budget. So far, sign-on letters have 655 signatories. Letters from federal partners have 429 signatures. An article was published by CNN, focused on strategizing for influencing the FY25 president's budget.

Questions: Jorge thanked Kristen for the information. Nick asked if anyone has calculated the cost of not having the core activities. What happens if all these in-water activities go away? What is economic impact on the blue economy? Kristen says there has been talk about these impacts but there is no quantitative information about what that means. We don't really even know how much of IOOS data gets into the NWS. The only concrete number we have is a 2/3 reduction in USCG SAR operations search area from HFR data. A major challenge is that IOOS is a piece of many things and we don't always know how much of our information is being used. There is a recent economic study (2023) by Colgan and Castelletto (https://cbe.miis.edu/publications/21/).

**BYLAWS CHANGES**: Kim and Joe have been investigating how other RAs handle international representation on their boards and talking with IPO leadership to make sure what GCOOS proposes is acceptable. International board members without voting restrictions are allowed. GLOS and NERACOOS have Canadian members. GCOOS bylaws have been amended to allow international board members with full voting privileges. Kim made a motion to accept the bylaw revisions; Antonietta second and discussion ensued. Once board members had the same version of the bylaw revision, they agreed that a voting member must be an individual representing an organization (as defined in the bylaws—no longer specifically a U.S. organization). "Associate member" was removed from previous language, giving international members full member status. Several questions about international participant were asked: Will extra time be needed for international members to participate in the voting process? Will translation services be needed? Is there a limit to the number of international members on the Board? Kim said none of these issues have come up with other RAs. Treasury department approval might be needed for participants from e.g., Cuba. Are there additional considerations if applying to be a board member from another country? The GCOOS board needs to assemble a package before the next election for people from other countries. What travel costs can GCOOS cover for them? What might be off-limits? Virtual participation option allows us to move forward as the board works through these

questions. Input from TAMU is needed regarding possible participation from Cuban citizens to address possible ethics and compliance issues. Gulf and Caribbean fisheries institutes deal with these issues. Ruth suggests talking with them to learn how they operate. Following the discussion, the vote continued. All were in favor, none were opposed and the bylaw changes were accepted.

**SHARI YVON LEWIS**, Texas A&M University-College Station: There have been many disruptions as TAMU restructuring resulted in the Department of Oceanography going from one of four departments in the College of Geosciences, which was dissolved in 2023, to one of 18 departments in the College of Arts and Sciences. This year marks the 75th anniversary of TAMU. President Welsh took over when President Banks stepped down. Plans to move personnel and programs to Galveston are suspended. GERG will remain in College Station. However, it is now considered to be an "on campus" facility and full IDC, which is 52.5% and increasing to 54% September 1, will be charged. For TGLO, the state agency IDC rate allowed is 15%. Steve DiMarco has been the GERG director since September 2023. The main implication for GCOOS is future grants with GERG and the increased IDC rate. GCOOS has about 30 projects that require TAMU post-award project management. More are coming with IRA funding. There is currently one project manager and Shari is working to get her help before the IRA projects start. Texas SB 17 policy states that we cannot hire in any way that shows intent to increase diversity; research focused on underserved groups is protected and ok. Teaching about diversity is acceptable. The main implications are related to hiring and training focused on diversity. IOOS is working to keep neutral wording for IRA ESD activities. The focus is on identifying where and how well services are being delivered. TAMU general counsel is available to answer questions. The National Academies GRP Board on Gulf Education & Engagement has a resource for navigating diversity language. Florida and Texas are already problematic. Alabama is soon following suit.

**JORGE BRENNER**: Executive Director updates: GCOOS priorities include sustaining core observations; DMAC reconciliation and future; international collaboration; and smart expansion with new funding. This includes new assets and observations for waves, water level and web cams, biodiversity restoration, new networks of national importance (i.e., acoustic telemetry) and new partners (e.g., academic, Native American). Glider data from Mexico is now going to the GTS. There is a new focus on HFR data (15 radars). Biodiversity efforts include MBON, CETACEAN, and sea turtle projects which will require several years to build the data bases. IRA funds will support an OTN node. GCOOS recently hired Xiao Qi, product developer in training, and Megan Howson as the lead data scientist for CETACEAN. The GIS manager position is being reopened as well as a Director's assistant position. More than $9M in proposals were submitted, including $8.2M in IRA funding for 20 projects over five years. This includes 13 subawards and seven new PIs (FGBNMS, LUMCON, RATES Inc., TAMUG, UF, USGS and WHG).

Disaster supplements totaling about $236K went out to SCCF and MML. AWI/CO-OPS AI Water level QA/QC project (2 yrs) includes funds for a post-doc to work with Felimon to develop work flow for quality control. GCOOS will be developing a NRDA/NMFS sea turtle atlas. The five to ten-year project includes $300K in Y1 as GCOOS add-on funds from IOOS. GCOOS intends to support a student to develop a Marine Heatwave project—something related to nowcasts/forecasts of MHW thresholds. GCOOS may also be getting a GRP Policy Fellow this year.

IRA Funds: Funds to federal entities (FGBNMS for wave buoys and USGS for OA monitoring) will be held back and flow directly to them as interagency transfers. USGS will develop an OA observatory in Galveston Bay over 2 years; It will be part of a Galveston Bay/Tampa Bay pilot study. Money must be

obligated by 2026 but the work can go on beyond 2026. GCOOS will be advertising for a Program/Project Director, with the requirement of a B.S. plus five or more years of experience. GCOOS allocated about $12M in FY2024. The main Y3 award ends in June 2026. The main Y4 award is ~$3.8M ($2.4M core plus $1.4M add-ons) and has many subawards that need to be managed. September 5 is the next deadline for Bipartisan Infrastructure Law Provision 11 and 12 funding. The goal is to repair equipment damaged by Hurricane Ian in 2022 (e.g., buoys, PHySS). Fugro's two HFRs are not going well. They are receiving ~$75K annually and have not had data for 3 years. The idea was for GCOOS to provide funds to purchase the radars and for Ben William's team to maintain them. However, O&M costs have been very high—travel is required every time something fails. GCOOS, the IPO and Fugro need to have a conversation about how to proceed. If they cannot solve the issues and deliver according to the agreement, do we take back the asset? Should LSU or USM take on the job? Carl said some RAs have taken ownership of gliders—universities don't like but it makes it easier to share assets.

**JAN VAN SMIRREN**, Ocean Sierra, asked about the GCOOS Board categories. In the most recent election, MML had a candidate run for the private sector. In previous elections, MML represented OE. Can an organization change its designation from one election to another? Is it the person's experience or the organization's classification (e.g., for OE, Nan and Sara would really fall under the academic category). MML could technically fall under research, OE or private. Private was originally intended for industry. Do we need to change our definitions to get qualified people elected in each category? How do we make sure we have industry representation? Instead of private sector should we specify "for profit" organizations? MML is a private not-for-profit; if we specify industry position, we'll also need to specify NGO positions. **ACTION**: revisit composition and definitions of board positions. Volunteer team includes: Kirsten, Ruth, Suraida, Jan, Antonietta, Chris and Jen. The group will review definitions of board positions. What do other RAs do?

GCOOS Anniversary: create a team to ID scope of what we might do for the 20th anniversary. Showcase GCOOS history and successes over the years. Should we revisit the GOMA Embrace the Gulf model? Board members suggest we involve our partners in the planning—GOMA—Becky Ginn and Laura Bowie-connect to All Hands meeting. Volunteers: Ruth, Kristin Yarincik, GOMA, Chris, Grant, Jen, Nadine, OEC members, IOOS Program Office. Will there be a budget for this? If so, how much?

**THURSDAY, MAY 9, 2024 OPEN MEMBERS MEETING**

Kirsten Larsen welcomed participants and reviewed the agenda.

**CARL GOULDMAN**, IOOS Program Office, provided an update on the IOOS enterprise. See notes above from Wednesday's board meeting. The IOOS Advisory Committee has 17 federal and 11 non-federal partners. IRA five-year awards will be in two topic areas and will be made in October. Three IPO staff members attended the GCOOS meeting (Kellie Paige, Rosa Gonzalez and Rhyan Grech). There is a lot of demand on the small IPO staff and demand keeps growing. The main goals of IRA funding are to improve coastal observations, strengthen delivery of data and enhance partnerships. IOOS has ~$215M within Climate Ready Coasts and Communities; $100M of this is for the RAs. There's also $60M NOFO for the climate resilience accelerators; $40M in existing NOAA competitive funding, including MBON, and $15M for IOOS technical assistance, management and administration. Funding is to be obligated by the end of FY26. We need to focus on telling positive stories that demonstrate why what we do is important and only growing in importance as climate is changing.

**ANTONIETTA QUIGG**: TAMU-Galveston, welcomed everyone to the "Aggies By the Sea" campus and introduced Debbie Thomas, Executive Associate Vice President for Academic Affairs & Chief Academic Officer. Thomas gave a warm "Howdy and good morning" and shared that what GCOOS does impacts lives and livelihoods throughout the Gulf and nation. The College of Marine Science and Maritime Studies is coming to Galveston soon. Antonietta then shared the TAMU-G mission of innovation, education, service and communities of, for and by the sea. There are several departments including marine and coastal environmental science, maritime business administration, ocean engineering, maritime transportation, foundational sciences, liberal studies and marine biology. TAMU-G is one of only six maritime academies in the nation and the only one in the GoM. A new training vessel is being built and arriving in 2025. It is federally owned (FEMA) and will be able to accommodate 600 students. When needed, it will be used by FEMA for emergency response. The Strategic Plan is focused on the blue economy; offshore technology, sustainable oceans (diversity, ecology, pollutant impacts), maritime transportation (supply chains, logistics, cyber security of ports and vessels), coastal resilience (to hurricanes, surge, marine pollution, flood impacts on natural and social systems, trace changes to coastlines and people in face of climate change) and blue justice. There is a small faculty—only about 100 people. New partners and friends are needed. There is a new institute-the Gulf Research Institute for Highly Migratory Species and the Gulf Center for Sea Turtle Research which was moved from the nearby NOAA FGBNMS property. They are currently seeking funding for the new sea turtle hospital.

QUESTIONS: Steve DiMarco asked if there is a plan to replace the aging R/V Manta with a similar sized vessel. Antonietta said yes, there are plans on the books for a new vessel and they are looking for money. Suraida asked about the themes of the Blue Justice projects. Antonietta gave examples of current projects with UTMB that are looking at hidden jobs related to the massive cruise industry. A lot of local people support the industry with "alley wages". The ships are in and out of port a couple times per week. People often get paid cash and have no medical coverage. The university is working with the cruise lines to support people who work on the vessels, many who are not U.S. citizens. When they are ill, they can't leave the ship even when their needs exceed what the cruise doctor can handle. Other areas of engagement include studying how people in different communities understand pollution so they can better deal with threats like sewage overflow, fires and chemicals in the environment. Efforts merge science and social expertise--as a broker to inform understanding, not advocate for or against.

**THRESHOLDS PROJECTS**

**Jorge Brenner** introduced the session, sharing that the conversation started at the GCOOS Fall meeting with talks about Marine Heat Waves. There is interest in understanding thresholds at which some ocean parameters exhibit positive or negative impacts on the environment and society. What can GCOOS do to support information-based responses? The three breakout sessions are MHWs, Water Quality parameters and ocean currents, particularly those gathered from NTL data. The goals of the session are to learn, discuss and identify priorities, and to find "champions" to develop proofs of concept and design pilot projects.

**BRIAN DZWONKOWSKI**, Dauphin Island Lea Lab, provided an overview of the MHW session. We are expecting an active hurricane season related in no small part to heat in the Atlantic. The public is going to be increasingly concerned about this. Extreme ocean temperatures are a rapidly growing area of research. The motivation is that ecosystem and weather event impacts translate to economic, cultural, habitat loss and biodiversity impacts. To generate information needed for nowcasts and forecasts, we

need to know where we have data, how it might be useful and specific examples that decision-makers can use. There are different criteria for MHW depending who you ask. Hobaday et al (2016) describes these as five days above the 90$^{th}$ percentile. Jacox et al (2020) say it is a 3-month running mean above the 90$^{th}$ percentile. Definitions are developed from the impact perspective. The characteristics used to describe are useful or not depending on individual interests. The MHW conditions OISSTv2 product has limitations because it only includes surface water (SST anomaly). There are gaps in water temperature at depth in the coastal environment even though we have many coastal stations-some long in duration. Can we build climatologies from these to develop MHW forecasts? Would this be useful to the GCOOS community? Are others already doing this? The idea is to be able to "click-on a map" to get statistics on current vs historical conditions. What should we develop and who might use the information? Jeff Plumlee will talk about oyster recruitment and Scott Glen will discuss heat content and tropical cyclones.

**JEFF PLUMLEE**: LSU, Fisheries Extension Specialist, LASG. The oyster fishery in the GoM is historically large but there's been a dramatic decline over the past 70 yr. The industry peaked in 1950 then declined to historic lows from 2014-18. Trends correlate with environmental conditions, especially increasing anomalous temperature. Highest landings in 2021 corresponded to about $5M. The fishery is declining but at same time, seeing the highest value of all time. The frequency and duration of extreme heat events is increasing. Atmospheric heat waves are considered three consecutive days exceeding the daily maximum temperature- 90$^{th}$ percentile. Recruitment (i.e., new biomass as juveniles and larvae (spat) to be fished out and post-larval recruits) and life history are tied to temperature. Spawning typically occurs when temps drop 2$^{o}$C in 24 hr (see Gross et al 2022). What happens to recruitment when extreme conditions are occurring? Of all the parameters studied, consecutive days with extreme heat correlated closest with poor recruitment. Many parameters including predation, hypoxia, low salinity, metabolic stress, physiological stress track with extreme heat waves.

**SCOTT GLEN**, Rutgers Department of Marine and Coastal Sciences, provided a case study of heat content related to Hurricane Idalia. The work was a group effort that included NASEM GRP UGOS, the NOAA/Navy hurricane glider team, the IOOS hurricane model/data comparison team and others. H. Idalia was a Category 1 storm off Cuba that intensified to a Category 3 in two days before making landfall. It intensified first over the Loop Current then over the West Florida Shelf where there was high heat content. A new tool for time series analysis is the Hurricane Analysis and Forecast Model (HAFS). Scott outlined how a 3D ocean set up strong stratification that promoted intensification: 1) as the storm moved over the LC and WFS, there were deep warm layers that were weakly stratified; 2) Freshwater from the MS River plume intensified stratification via heat and salt gradients; WFS glider data showed FW offshore with salinity and density gradients and colder water 10-20 m below the surface. It was mixable but did not mix. Why? 3) There were strong surface currents favoring coastal downwelling conditions (similar to Sandy). The barrier layers that promoted stratification prevented mixing and promoted intensification via 3 processes co-occurring along the hurricane track. Results emphasize the need for subsurface T, S and essential ocean features to initialize realistic 3D ocean models. Oceans and hurricanes co-evolve—there is a feedback loop on intensity. Essential ocean processes affecting hurricane intensity were identified. This was a broad team effort and the IOOS community is needed to continue integrating data and people.

**GCOOS BOD Election Results**: Dr. Nick Shay (UM-Academia) and Dr. Kate Hubbard (FWC-Government) were re-elected. New members are Dr Emily Hall, Senior Scientist and Program Manager at MML; Dr. Rafael Ramos, Woods Hole Group; and Dr. Brian Roberts, LUMCON.

**JORGE BRENNER**: See updates above from Tuesday. Next year marks the 20th anniversary of GCOOS. A team will be planning activities for the year. New staff members Megan Howson and Xiao Qi were acknowledged. GCOOS held a staff retreat at the 20224 GOMCON meeting. Many members joined. Jorge reviewed the GCOOS budget. The IOOS main Y3 award is $3.6M ($2.4M core funding plus over $1M in add-ons). BIL modernization Y2 ($587K) ends Dec 2024. The data portal currently has 62 data partners and we are monitoring over 1700 sensors. NTL has 143 stations in inventory with 47 active stations, three of these recently added. Rutgers UGOS HFR data from Yucatan is now on ERDDAP. New OA data from FGBNMS is also available. 25,047 historical non-real-time oceanographic data sets are being curated. Megan has been mining cetacean population data and adding to the server. Reanalysis of TX shelf HFR for QA is underway. Cyberinfrastructure has been updated with new servers for CETACEAN and replacement of GCOOS4. New HPC/GPGPU is being tested at TAMU-CC using an AI-enabled WL quality control module developed jointly by NOAA CO-OPS and TAMUCC. For models, the GoM coastal hazards forecast system (GMx-CHFS) is now served on GCOOS THREDDS. GANDALF can now handle model comparisons. HABscope 2.0 with FWRI calibration is anticipated by Aug 2024. Dr. Ken Hoadley, DISL, is expected to complete the pier mounted ORION-IFCB by summer 2024. The All Things Beaches GIS-based app was released at the OEC meeting in December 2023. There is a joint GCOOS-SECORA webinar series under way with the focus of building stronger connections between the Marine Biodiversity Observation Network (MBON) and the Ocean Acidification Network Programs, specifically GCAN and SOCAN. A dashboard supporting Gray's Reef NMS Condition Reporting was developed as part of GCOOS MBON work, with plans to expand to the FL Keys and Flower Garden Banks. There is a range of marine life work underway including CETACEAN, sea turtle work and MBON. The 13th Radiowave Operators Working Group meeting will be 21-23 May at USM, Gulfport, MS. The DMAC team is looking for a new GIS manager, working on a cloud strategy, purchasing HPC hardware for AI and adding more models to the GCOOS model handler. GCOOS is working to nurture the next generation of ocean scientists and data managers via the 2024 Howard Scholarship recipients, NAS GRP Policy Fellows, and a student-led MHW project. SECOORA is working on WebCOOS—a camera observing network. GCOOS has plans for 6 web cams.

IRA funds will support coastal resilience via recapitalization and modernizing aging infrastructure and ESD activities. There are 20 projects, 12 subawards and six new PI institutions. The five-year project starts Aug 1, 2024 and has a budget of $8.2M (Topic 1 $5M; Topic 2 $3.2M). In the coming months, GCOOS will focus on IRA ESD planning that aligns with IOOS Association metrics. The scoping process was to look at previously unfunded projects, core needs for GCOOS, sustainability of current networks, existing observing gaps, organizational capacity, and needs identified by others (e.g., NERRS, NMS, NWS, native tribes). IRA Topic Area 1 has $5M for 16 "projects" including hiring GCOOS positions. Topic Area 2 has $3.2M for gliders & OHC, OA monitoring (Galveston Bay/Tampa Bay pilot study), a LUMCON Environmental Monitoring Network for water data critical to the PACIT, and an Animal Telemetry Network node (iTAG) to OTN that aggregates data from approximately 2,300 receivers.

**XAVIER FLORES VIDAL**, OORCO Director and UABC Professor, discussed the Mexican HFR Network and Ocean Drifters in the GoM. He engaged with GCOOS about six years ago to develop a plan for GoM HFR. A CIGOM-funded plan was finished in 2023. The University of Baja CA started its own radio oceanography lab in 2003, operating more than 27 radar sites and 3 brands of ocean radars since then. From 2009-2015, Mexican radar radial currents RUV files were shared with SCOOS. OORCO is talking with GANDALF. There are five radar sites operational today with a man power of one technician and one

PI (see https://oorco.ens.uabc.mx/). DORIS drifters were released into the GoM and in CA near Ensenada/CA Current. Mexican HFR is currently financed by the project "Implementation of the Strategic Action Program of the GoM LME" http://gulfmexico.org/ Rafael asked about the type of information being shared. Xavier said radials, cross-vectors, everything--whatever can be collected is being shared. Felimon said the data will all soon be on the GCOOS HFR site. Luz asked what Xavier needs from the GCOOS community. He replied an open bridge to sharing information. "Drifters don't know borders". He is not expecting anything specific, just that information sharing goes both ways.

**MEMBER TALKS**—11 speakers signed up for the session. Simoniello moderated the session so did not take notes. Briefly, the speakers were Kellie Paige, IOOS Program Office, speaking about Equitable Service Delivery; Jim Kendall, BOEM, talking about offshore energy and carbon sequestration; David Young, RoboNation, discussing STEM outreach that incorporates student-built ROVs; Chad Lembke, USF, providing an update on glider missions; Rosa Gonzalez, IPO, discussing IOOS compliance requirements; Luke McEachron, Florida FWC, talking about his Water Quality work; Suraida Nanez-James, Gulf Reach Institute, summarized her youth ESD work; Ruth Perry, Shell, talked about wind energy activities; Yun Liu, GERG, talked about the TXLA model; Chunyan Li, LSU, provided an update on WAVCIS; and Robert Moorhead, MSU, gave an overview of his PFAS/robot project.

**THRESHOLD PROJECTS BREAKOUT SESSION REPORTS**

**MHW**: Brian Dzwonkowski reported that the stressors identified included bottom and surface temperatures which are sporadically collected and not in uniform formats. For the upper ocean, it might be possible to use reanalysis data to fill gaps to get at broad spatial maps of MHW. We currently collect some upper ocean heat data from OISST buoys. Less information is available for subsurface waters. Information on species tolerance is very limited in the Gulf but has been demonstrated in other systems. There are opportunities to fill spatial and deep-water data gaps in general by bringing in different regularly occurring programs. Readiness level for buoy data is high. For examples of a real-time warning system application, participants acknowledged that there will be versions of products as the community defines definitions and impacts of MHWs. Temperature at depth (with reanalysis) and identification of hot spots were mentioned. Who would use the information? Examples included hurricane forecasting, preparation and response; fisheries management; HAB forecasting; and coral stress index/habitat management. How might the average Walmart shopper connect with these apps? Eric Milbrandt commented that we should be thinking about extreme events, not just heat, and gave example of cold stunning in sea turtles. Minimum winter temperatures really dictate the fate of some species in the NE and influence the zonation of tropical species. We need to determine the thresholds at which the intensity of events becomes critical—whether it is heat, cold, salinity, freshwater input, etc.

**NTL/CURRENTS:** Dave Driver reported that the Minerals Management Service, the predecessor of BOEM, required the oil & gas industry to measure deep currents in water depths of 400 m or greater in real-time. The industry has been doing this for ~20 yrs. The bulk of current data in the GCOOS portal is from Notice To Lessee activity. The WHG and Fugro have been able to take these data, fix problems and make it useful. There's some good data through hurricanes as well. There has been development of decent shallow water, near-shore HFR installations but these are limited in distance offshore. There are gaps in information at intermediate water depth ranges but T/S profiles from gliders can help drive the numerical models. Most modelers prefer T/S data to currents to feed into the models. Ideally, 15-20 gliders would be profiling in the GoM at any given time. Sven asked why HYCOM is not enough. Dave

said much smaller scale resolution is needed but there are issues because we lack density of measurements at depth. Steve DiMarco said that numerical models do well at the surface/nearshore but the shelf break has scale issues. More observations are needed there to stitch the onshore/offshore models. Deep water also has issues because bathymetry does not capture the environment. Subsurface profiles and velocity data are needed to validate models. Nick commented that MHW includes the ocean and the atmospheric boundary layer (surface fluxes, surface winds, etc) and that these are quite important for extreme events. EM-APEX floats measure velocity down to 2000m or more and deliver data in near-real-time.

**WATER QUALITY**: Kim Yates reported that the WQ parameters discussed included DO, pH, nutrients, salinity, freshwater influx and chlorophyll a. Drought events, HABS, bacterial stressors, multi-stressor interactions, emerging contaminants (e.g., endocrine disruptors), markers of human waste, PFAS and PAHs were some of the areas of information application. Many data parameters are collected by federal, state, local and other groups, but mainly at the surface. There are some inventories available. SEAMAP was given as an example. There is a lot of work needed before information can be used for nowcasts/forecasts. Methods and standards across labs need to be reviewed. Gap analysis and prioritization exercises are needed. In some cases, you need a proxy or sensor development to advance the science. For DO, species tolerance is well established with a biological standard of 2 mg/L. Other stressor standards are localized and vary by species. There are some EPA and state standards for nutrients. Other variables are difficult to standardize across regions and may need to be sub-regional.

Like temperature, more observations are generally needed throughout the water column and at the bottom. There are geographic gaps along coastlines and at the shelf. Existing inventories need to be synthesized to inform gap analysis (see CMAP gap analysis funded by the RESTORE council). Regarding readiness levels, some products exist for HABs in the GoM (satellite-derived), Hypoxia in the Great Lakes, and OA in the Pacific Northwest that can be used as models for the GoM. DO is ready for applications via well-established standard thresholds. Examples of use include helping EPA to update their thresholds for nutrients; expanding coastal salinity and real-time drought monitoring; informing the Texas Water Development Board about sensitive nursery areas; supporting decisions about water flow management; and having benthic indicators like oysters and seagrass in place. USGS and TGLO conduct near real-time monitoring. There are 12 stations along the Texas coast and many decades of data. EPA Beacon Beachwatch bacteria application is available through GCOOS. There are outreach and communication opportunities for GCOOS. For example, can GCOOS identify successful examples from Texas and determine how they can be applied across the Gulf region? Steve DiMarco asked about the SEASCORE oxygen model that was part of the NOAA hypoxia model. Can we build something around that as a product for the GoM? If we have a couple different models running, perhaps we can get a model ensemble of averages? Robust WQ observations would be needed for the models.

## FRIDAY MAY 10, 2024, OPEN MEMBERS MEETING

Kirsten welcomed participants back and reviewed the agenda for the day.

### BIODIVERSITY DATA and OPPORTUNITIES SESSION

Jen Vreeland introduced the speakers and the titles of their talks.
**Enrique Montes**, University of Miami CIMAS and NOAA's AOML: MBON Opportunities for Collaboration in the GoM; SE US MBON Goals. MBON is working on the co-design of biodiversity monitoring and

assessment. The USF lead, Dr. Frank Muller-Karger, serves as the national team leader. MBON is converging on subsets of Essential Ocean Variables and Essential Biodiversity Variables and contributing to protocols for the distribution of products. GCOOS and SECOORA are collaborating on the SE MBON project. Cross-MBON Work Group activities are focused on documenting case studies for indicators, stakeholder engagement (co-led by GCOOS and SECOORA), eDNA, animal tracking, biosound/passive acoustics, ecosystem function (functional traits), remote sensing/seascapes, DMAC, international GEOBON and Marine Life 2030. AOML conducts oceanographic surveys every ~6 weeks—hydrography, nutrients, chlorophyll, water chemistry, zooplankton and genetic work. Progress is being made in seascape classification-machine learning dynamic maps that represent biomes with unique biogeochemical properties. Luke Thompson recently presented results from the 2021 GoM Ecosystem and Carbon Cruise on a GCOOS webinar that is available online. Information for eDNA is being pushed to OBIS. Others should consider sharing relevant data in this public repository. Ben Best, lead for the Indicators Work Group, is building species distribution models at the national level. Dan Otis, Tylar Murray, Muller-Karger, Simoniello and Dorton are working with national marine sanctuaries in the southeast to co-develop data dashboards in support of management. MarineGEO activities focused on science to sustain ecosystems on the edge is being led by the Smithsonian's Emmett Duffy.

**Marissa Nutall**, Research and Management of Remote Offshore Resources at FGBNMS; The sanctuary is 70 to 120 nm offshore on the shelf edge and includes 17 banks/reefs. It is a dense, healthy reef systems that was expanded to its present size in 2021. There are coral reefs, communities that are sponge-dominated and mesophotic communities with black and octocoral communities. Long-term data sets are available as are data dashboards and data portals for benthic cover, water quality, water column profiles, fish communities, urchin surveys, nutrient profiles, carbonate data sets (~10 yr of data), benthic cover (coral, macroalgae, colonizable substrate, CCA, Sponge, sand). They have about 30 years of data to get online and to NCEI. The data dashboard serves as an early alert—it is set up with a ring of virtual buoys around the sanctuary. If conditions heading toward the reef are anomalous, alerts are given. Users can set time-specified periods for a particular variable. There is also the FGBNMS Ocean Conditions dashboard for users of the sanctuary. It provides SST, wave height, salinity, current speed, turbidity and wind. It is color coded—green (normal), yellow or red (anomalous). New GCOOS-funded buoys are providing wave height and period, and surface and bottom temperatures in near real-time. Data are hosted on the GCOOS portal. There used to be three sites with moored buoys. Without the moorings, there is currently no safe way to anchor. Two banks will be getting deep moorings (Bright and Rezak) which can also provide structure to add sensors.

**Kelly Martin**, NOAA Office of NMS: Mesophotic and Deep Benthic Communities Restoration Following the DWH Oil Spill. Martin is the project manager for one of the mesophotic and deep benthic community restoration projects. Following the DWH spill in 2010, NRDA described 13 restoration types. Mesophotic /deep benthic communities (MDBC) is one of them. The goal is to improve understanding of the system, restore animals and biomass, manage and provide a framework for monitoring, and develop education and outreach capacity. There aren't many examples of restoration in the deep sea to inform the project. As the science to inform is being developed, baselines must be established. The depth range is approximately 50-300 meters. This is one of four projects selected in 2019 by the OOTIG and includes data inventory workshop, prioritization and habitat data inventory reports, cruise reports, data summary reports and journal articles. Implementation phase activities consist of a wide range of activities: seafloor mapping, ground-truthing; habitat transects, biological sampling (genetics, isotopes,

microbiology), sediment samples (micro, macro, meiofauna), biogeochemistry, water sampling for eight parameters (eDNA, nutrients, POC, POM), benthic landers and Acoustic Resuspension Measurement System (ARMS) water column acoustics. The goals of this are to establish environmental baselines, understand who is using the habitat, and inform coral propagation in support of threat reduction (aside: marine debris is being annotated in ROV video). A threats database is being created and the institutional repository and data catalog are expected to be launched in June on the Gulf Spill Restoration website.

**David Wells**, TAMU-Galveston, Gulf Research Institute for Highly Migratory Species: Advances in Understanding the Population Connectivity of Ocean Predators; The GRI is a new institute being developed with Jay Rooker. The GoM is critical habitat and spawning grounds for many HMS. There is top down control of ecosystem health and structure dynamics. Significant declines have occurred for many species. People typically think of blue marlin and bluefin tuna but there are also HMS in nearshore habitats and reef environments (e.g., cobia, mackerel, tarpon). A variety of methods are used to assess migration ecology: natural tracers like delta 18 oxygen in hard parts (e.g., otoliths and vertebrae—ratio can provide information on spawning grounds—GoM vs. Mediterranean example provided), acoustic telemetry and satellite telemetry (PSAT-pop-up satellite archival tag vs SPOT-Smart position tag depending if species spends most time at surface or depth). Tags provide information about depth, temperature and location. A large network of tagged animals and receiver arrays is needed for an effective acoustic system. Marissa is using the acoustic arrays in FGBNMS for her PhD work. One challenge is maintaining long-term support and maintenance of the offshore acoustic network. Tags can last upwards of 10 years. Natural tracers in Yellowfin tuna show that about half of the GoM population is coming from Africa in the first year of life. David envisions development of O.C.E.A.N—Offshore Cooperative Ecosystem Assessment Network that includes acoustic receivers, satellite telemetry, time lapse cameras, passive acoustics, gliders, other technologies and a central DMAC like GCOOS.

**Grant Craig** provided a project update on CETACEAN—the Compilation of Environmental, Threat, and Animal Data for Cetacean Population Health Analyses Platform. This is a five-year NOAA-led project funded by the DWH OOTIG (Open Ocean Trustee Implementation Group). Initial data mining efforts include Rice's and sperm whales, and Risso's, beaked, oceanic bottlenose and pantropical spotted dolphins. GCOOS is supporting data acquisition, development of the data portal and creation of the metadata catalog. Efforts are being coordinating with AOML and the NOAA project management team. AOML is creating the visual products.

**BIODIVERSITY DATA AND OPPORTUNITIES DISCUSSION**

Chris Simoniello facilitated the discussion that was focused on how the GCOOS community can best work together to support development of an end-to-end IOOS Marine Life program. Are there synergies across projects? Are there case studies across indicators and species that demonstrate success?

Tony Knap asked if there is a relationship between heatwaves in the coastal zone and the decline of fisheries stocks. David said that there is technology enhanced GPS to address these issues. He stated that while numbers may decline for certain species from MHWs, there are many other issues that can contribute to decline. Most species will decline but not go extinct. Kerri Whilden asked if data are available for these variables. David replied that there is tagging data but that it won't be available until after it's been published. Steve DiMarco mentioned that the Flower Gardens buoys are sitting out at GERG collecting dust due to budget restraints and the need for funding. It was suggested that GERG come up with a budget and send it to the agencies participating, primarily to NOAA. Kirsten Larsen

mentioned the NOAA Data Assessment Plan with the Data Managers but also noted that this plan was still in its infancy. The discussion then led to the topic of fish aggregating devices but currently these are not located in the marine sanctuaries. The topic of Citizen Sciences was mentioned by David Young of RoboNation. Enrique Montes discussed the need for data collection standardization. Carl Gouldman reminded the group about a new technique for data collection that includes digital object identifiers and metadata. Kirsten said that NOAA is working on standardizing how data are accessed by the public and accelerating the timeline that information is made available. Pat Hogan mentioned the need for good data for climate ecosystem research. Simoniello reminded participants of Marine Life 2030 and how to achieve the biodiversity goals of the plan. Enrique sees approaches to solving these issues through science. He suggested that we reach out to Frank Muller-Karger for help with capacity building with developing countries. Kirsten requested clarification about MBON and OBIS data. Enrique explained that MBON encourages researchers to send data to OBIS. Felimon Gayanilo noted that he would also like for researchers to send their data to ERDAPP so that GCOOS can manage data collection sets for research conducted throughout the Gulf of Mexico.

**STEVE DiMARCO**—UGOS: Offshore Technology Conference-leading the global energy evolution. Steve shared results from the MASTR Experiment which integrated technology, ideas, methods and people to understand Loop Current dynamics. There is about $40M in funded projects that end in 2027. The goal is to improve forecasting and predictive skill of the LC and reduce risks to the offshore Energy sector, with emphasis on the Yucatan area. Tony Knap is the lead for stakeholder engagement (WG 1). See Steve's slide showing the road map of UGOS transition to operations readiness level T20. More than 60 researchers, 16 institutions and 3 countries have been involved. The 2024 MASTR elements main target is to quantify the GoM inflow through Yucatan. Methods included four gliders, floats, drifters, HFR, ROCIS flights, ARGO, operational numerical output, GOFS-Navy, CMEMS-EU, RTOFS-NOAA and TOPS-DA (CLS industry). Cooperation between the US State Department, Mexico and Cuba was required. Glider data are available on GANDALF. HFR data, updated hourly and archived with GRIIDC, can be accessed from Rutgers (rucool.marine.rutgers.edu/ugos-hfr/) and from the HFR DAC. See Steve's slide on UGOS MASTR Glider Statistics 1/18/2024 to ~5/02/2024 and video of glider transect set to music Density field drives the LC process. **The direction the LC flows relative to Banco Arrowsmith (BA) seems to be highly relevant**—there is a velocity peak in flow when the LC is west of BA. The work demonstrates the importance of in situ data to correct model forecasts. Operational circulation models show that the highest northward current velocity is to the east of BA. UGOS work is showing that when the models are corrected with in situ observations, the peak flow northward is to the west of Banco Arrowsmith. Results reveal a big variance in the current models vs what the team is measuring in the field. Glider pilots are using this info operationally to see where to fly their missions. GCOOS helped with the difficult data flow task—portal-products/graphics; open access/dissemination; models-numerical and statistical. The UGOS annual meeting is 30 September to 2 October 2024 in College Station. There is an iconic choke point in the LC system. Ruth asked if you can hindcast historical hurricane tracks to determine if/how they were affected by the narrow channel impacts. How fast or slow did they move through the choke point based on proximity to Banco Arrowsmith? Will trends in intensification be related to this? Scott said that like his talk about H. Idalia, these new insights lend themselves well to revisit past events through a new lens. Are there common features and processes at play in past storms (e.g., MS River plume and downwelling, orientation relative to BA)? Results can positively impact response times if relationships can be shown. Many new questions are arising from the project results. There is currently no funding to explore other ways to use the data but the team is discussing ideas. Tony said that the

work has demonstrated that radars are incredible tools, not just for SAR but current analyses. He wants to get these data to the GCOOS portal because they will lead to many new applications. Pat asked what horizontal resolution a model needs to resolve Banco Arrowsmith. Steve said 1 km and that most models resolve more on the order of 10 km. Chad agreed with Pat in that ensemble models can get down to small scales which is increasingly important when looking at the bottom. Seabed 2030 is integrating maps into models. The UGOS example shows why smaller-scale, high resolution structure work is so important.

Starting in 2024, GCOOS will conduct in-person Members meetings in the Spring and virtual Members meetings in the Fall.

End Notes