Progress Report

Project Title: Accelerate Improvements in Hurricane Intensity Forecasting Through Underwater Glider Field Campaigns

Award number: #NA22NOS0120178

Period of Activity: 09/01/2024 – 02/28/2025
Submission Date: 3/20/2025

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I. PROJECT GOAL:
The overall goal of this project is to conduct targeted and sustained underwater glider deployments during the 2023 and 2024 Atlantic hurricane seasons. Glider missions collect ocean observations that optimize the representation of ocean features in ocean-atmosphere coupled models used for hurricane intensity forecasts. The glider field campaign is designed to collect data in hurricane-prone regions of the U.S. (Caribbean Sea-Tropical Atlantic Ocean, Gulf of Mexico, and the South Atlantic Bight and Mid Atlantic Bight).

Objectives from the proposal are identified in Section II Progress and Accomplishments. High-level accomplishments and any issues identified by each project team member are included for each objective. Status of each deliverable is reported as complete, on-track, or delayed. If the milestone is delayed, a justification for the delay and description of activities employed or to be employed to mitigate the delay are provided.

II. Progress and Accomplishments

Objectives	**Status**
Objective 1: Coordinate IOOS Regional Association (RA) and OAR Atlantic Oceanographic and Meteorological Laboratory (AOML) glider sampling to measure subsurface temperature and salinity profiles during the Atlantic hurricane season.	
The following accomplishments detail glider deployments during the 2024 Hurricane Season and other work that is underway by each IOOS Regional Association (RA). Accomplishments:	On-track

• The following MARACOOS glider deployments have been completed to date:
  ○ Sylvia was deployed from 9/26/24 to 10/22/24 off the coast of Virginia.
  ○ MARACOOS_05 was deployed from 10/11/24 to 11/19/24 out of Tuckerton, NJ.
  ○ MARACOOS_01 was deployed from 10/22/24 to 11/19/24 out of Lewes, DE.
• The SECOORA glider team is comprised of members from UGA's Skidaway Institute of Oceanography (SkIO), University of South Florida (USF), and UNC-Chapel Hill. Two (2) glider missions were completed during this reporting period:
  • Unit_1091 was deployed from 8/20/2024 to 9/18/2024 off the coast of GA
  • Unit_1091 was redeployed from 9/20/2024 to 10/19/2024 off the coast of GA
• During the 2024 hurricane season, to date, CariCOOS and partners at NOAA-AOML, the US Navy, and OCOVI operated 8 gliders during the reporting period:
  ○ SG678 and SG630 were deployed 7/13/24 - 11/22/24 south of Puerto Rico, with SG678 ending the mission with a failed CT sail.
  ○ SG610 was 7/13/24 – 11/22/24 south of Puerto Rico, ending the mission with an issue with the roll motor.
  ○ NG656 was deployed 7/13/24 – 10/7/24 south of Puerto Rico, with an emergency recovery due to a vessel strike. NG278S (deployed 7/11/24) was also recovered due to a vessel strike.
  ○ SG649 was deployed 7/12/2024 – 11/23/2024 north of Puerto Rico.
  ○ NG738 was deployed 8/7/24 – 10/10/24 south of St. Thomas, USVI, and recovered due to an issue with the digital tail fin.
  ○ NG783 was deployed 8/7/24 – 11/19/24 south of St. Thomas, USVI.
• GCOOS is the glider mission planning leader for the Gulf of Mexico with collaborators from the Texas A&M Geochemical and Environmental Research Group (GERG), University of Southern Mississippi (USM), and USF. The team conducted 5 missions this season, to date:
  ○ GERG recovered Unit 308 on 11/7/24 and Unit 1148 on 9/13/24.
  ○ USM has two Hefring Seascout gliders (Ori, with a CTD and PAM, and Nori, with just CTD). Nori was recovered 9/2/24 and deployed on missions from 10/8/24 – 10/23/24 and 11/1/24 – 11/17/24. Ori was deployed 9/24/24 – 10/8/24, with PAM turned off the first day due to burning too much battery. Both gliders were sent back to the manufacturer for service and upgrades.	

Objective 2: Submit real-time ocean glider profiles to the IOOS National Glider Data Assembly Center (GDAC), where data are quality-controlled and harvested by the NWS for assimilation into the operational NOAA Real-Time Ocean Forecast System (RTOFS)	
Near real-time data from the above listed deployments were submitted to the IOOS GDAC. Additional data management accomplishments: • All glider missions are also available on GANDALF. • SECOORA glider operators are submitting delayed mode glider data to the SECOORA Research Workspace within 30 days of glider recovery. These data are then made available to the IOOS GDAC. • CARICOOS glider data undergo quality control procedures to ensure accuracy. Data is also archived/distributed through CARICOOS THREDDS/OPeNDAP and ERDDAP servers	On-track

for easy access and visualization. Additionally, the data are being used to monitor heatwaves, offering insights that can help mitigate their effects on coral nurseries and support coral reef restoration efforts.	
Objective 3: Coordinate IOOS Regional Association (RA) and OAR Atlantic Oceanographic and Meteorological Laboratory (AOML) glider sampling strategies with the IOOS Glider Lead and the National Weather Service (NWS) National Centers for Environmental Prediction (NCEP) Environmental Modeling Center (EMC) to improve model forecast accuracy	
Project team representatives from each RA participate on IOOS-led glider calls. These calls are hosted on Mondays and are bi-weekly during the non-hurricane season and weekly during hurricane season. Additional collaboration efforts are listed here: • Each RA coordinates with national efforts through participation in the Underwater Gliders User Group (UG2 - https://underwatergliders.org/event/ug2-workshop-24/) community with representatives from each RA participating in the September 2024 UG2 meeting in Michigan.	
Additional Areas of Success and CHAOS collaboration	
Project team success stories that are not specifically part of the proposal, but which contribute to the overall IOOS and project team missions, are provided below: • USF has worked with Teledyne Webb to procure the capability of replacing bellaframs in G1 gliders. • MARACOOS leveraged projects deploying gliders in the Mid-Atlantic including those funded by NJ Department of Environmental Protection, NY State Energy Research & Development Authority, NY Department of Environmental Conservation, Rutgers, Orsted, Invenergy, and the NJ Research Monitoring Initiative.	

III. PROJECT CHALLENGES/MODIFICATIONS:

- Unit_1091's forward pump was sent off to the manufacturer for routine maintenance in December 2024, along with the science bay for sensor calibrations. It is anticipated that maintenance will be complete by April 2025.

IV. PUBLICATIONS:

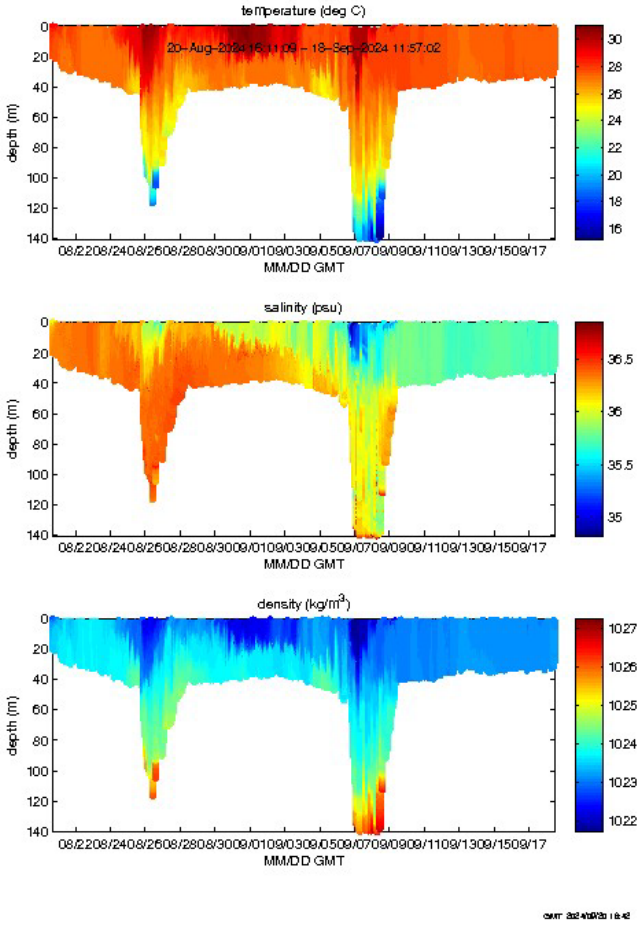
Broadbent, H., A. Silverman, R. Russell, G. Miller, S. Beckwith, E. Hughes, and C. Lembke. 2025. Monitoring ocean biology and natural resources autonomously and efficiently using underwater gliders. Frontiers in Ocean Observing, Oceanography 38(Supplement 1), https://doi.org/10.5670/oceanog.2025e102.

V. BUDGET SUMMARY:

- Were the oldest ASAP TAS BETC accounting lines invoiced first?
  - Yes
- Give details on any delays with initiating a contract/subaward. Note any issues with the previous year funds or other issues that occurred during the reporting period. Will this result with a work stoppage or cause significant problems with the partnership?
  - SECOORA has issued all subawards related to this award and all subawards have been fully executed.

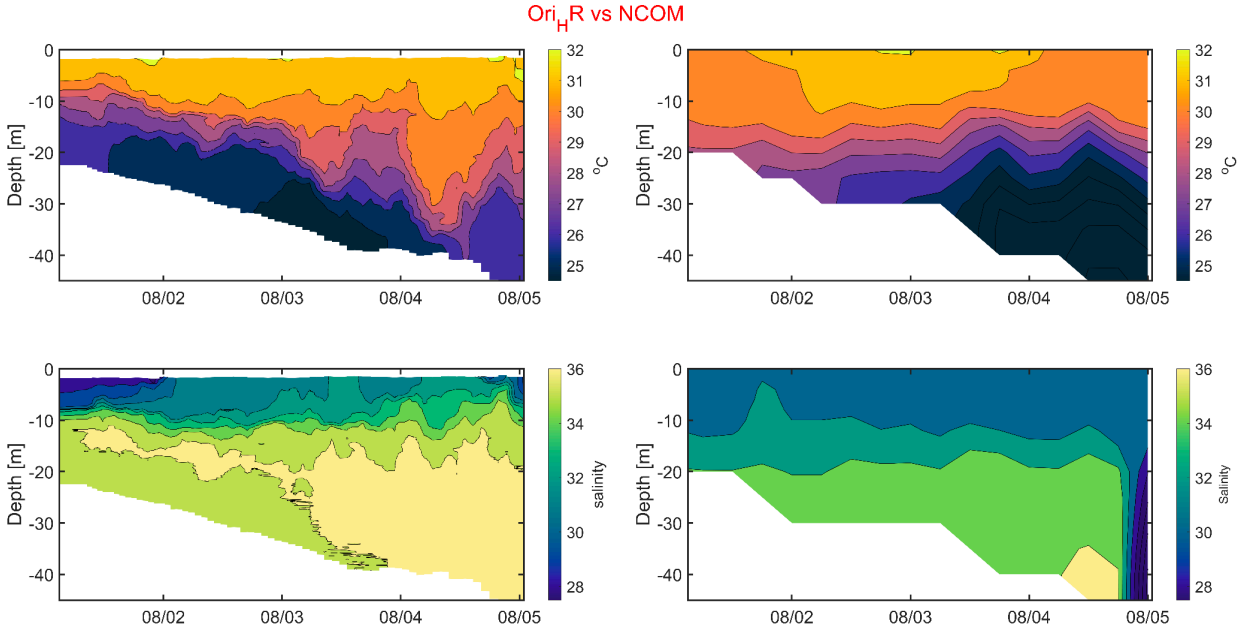
- Give a brief update on project invoicing for the reporting period. Were there any delays with invoicing or payment?
    - SECOORA is receiving invoices from all project team members for this award. Note that SECOORA receives quarterly invoices from subawardees; therefore, there is a delay between when a subawardee conducts work and when SECOORA is given an invoice for that work. SECOORA regularly monitors invoicing frequencies with subawardees.
- Provide details on any property or equipment charged directly to the award having a useful life of more than one year and an acquisition cost of $5,000 or more per unit during the period.
    - No equipment was purchased during this reporting period.
- Include changes in key scientific, technical or management personnel, not included in certification.
    - No changes
- Include changes to the organizational structure such as: changes in status or partners organizations and points of contact. As a reminder, a change to the award's Principal Investigator and a change in an award's Key Person Specified in the Application requires NOAA approval through Grants Online.
    - No changes to organizational structure
- Provide an update about travel completed during the reporting period.
    - SECOORA, the Lead PI for this award, does not have any funds for SECOORA personnel travel. Subawardees (i.e., other RA glider team members) are using travel funds to cover roundtrip travel to glider deployment/recovery locations.
- Are there any plans to initiate a new partnership (contract or subaward) during the next reporting period?
    - No

Appendix A



Temperature (upper, deg C), salinity (middle), and density (lower, kg/m3) from unit_1091 mission August-September 2024 in two round-trip cross shelf sections from the 20m isobath to the upper slope and back. Temperatures less than 20° C indicate water that has been upwelled onto the outer shelf and upper slope by frontal eddies that move northward along the edge of the Gulf Stream, bringing cool and nutrient-rich water into the photic zone.

Appendix B



CTD data for Temperature (top, left graph) and Salinity (bottom, left graph) for the Hefring Oceanscout Ori mission, operated by USM. The Ori temperature and salinity data is compared to the Navy Coastal Ocean Model temperature (top, right graph) and salinity (bottom, right graph) for the same ROI.