Progress Report
Submitted **January 2024**
Empowering Ocean Stakeholders: Advancing the Pacific Islands Ocean Observing System (PacIOOS)
Award no. NA21NOS0120091

Period of Activity: July 1, 2023 – December 31, 2023
Principal Investigator: Melissa Iwamoto

I. Project Milestones

Milestone	Status	7/1/23 – 12/31/23	1/1/24 – 6/30/24
GOVERNANCE AND MANAGEMENT SUBSYSTEM			
Maintain NOAA certification	Ongoing		
Hold annual Governing Council meetings in HNL	Complete		
Hold annual ExCom meeting outside HNL	On track		
Partnerships to promote & enhance ocean observing in the region	Ongoing		
Hire communications specialist	Complete	Q2	
OBSERVING SUBSYSTEM			
HFR stations; data online & assimilated into ROMS	Ongoing		
Site selection and permitting for HFR in the Mariana Islands - in collaboration with planned UOG subaward	Delayed		
Existing 15 wave buoys across region; data & products online	Ongoing		
Deploy new King-Poloa wave buoy in American Samoa	On track		Q3
Transition new wave buoy team staff	On track		
Honolulu Pier 1 Weather Station	Ongoing		
Waikīkī Beach Camera	Ongoing		
Deploy new water parameter instruments (CTD and ADCP) in Guam; data online - subaward planned with UOG	Delayed		Q4
Long-term WQ sensors (9); data & products online	Ongoing		
WQSPP sites and services; data and products online	Ongoing		
Pilot project with Turner C3 fluorometer and optical sensors	Ongoing		
WQ coastal moorings (2); data/products online	Ongoing		
Undergraduate mentoring/capacity building w/ moorings	Ongoing		
Install acoustic receiver for shark ID on existing Hilo WQ mooring	On track		Q3
Generate near real-time ocean profiles with animal tags	Ongoing		
Establish efficient data dissemination for animal tag profiles	On track		
Maintain land-based "mote" stations for animal tag data collection	Ongoing		
Capacity building for Insular Pacific animal tagging	Ongoing		
Build capacity in regional communities for ciguatera sampling	On track		Q3
Baseline sampling in targeted locations for ciguatera	On track		Q3
MODELING AND ANALYSIS SUBSYSTEM			
Atmospheric model domains (HI, Mariana Is., Samoa, RMI, Palau, FSM)	Ongoing		

Upgrade atmospheric models	Ongoing		
Generate model output statistics for Palau	On track		Q3
Existing wave forecasts (HI, Mariana Islands, Samoa)	Ongoing		
Develop, implement, validate unstructured SWAN grids for HI	On track		
New wave model forecasts for the freely associated states	On track		
Develop, implement, and validate unstructured grids for Guam and CNMI wave forecast system	On track		Q4
Hale'iwa Harbor Surge Forecast	Ongoing		
Development of Kahului Harbor Surge Forecast (BOSZ)	On track		
Maintain ROMS circulation model for HI, Mariana Is., Samoa Is., Western Pacific	Ongoing		
Develop and deploy Western Pacific ROMS	Complete	Q1	
Expanded HI ROMS model	Delayed		
Develop PacIOOS ROMS climate survey	On track		
Develop coupled physical / biogeochemical model for HI	On track		
Expand operational ROMS server and software stacks	Delayed		
Develop new High(er) Resolution ROMS Forecasts for HI	On track		
High sea level forecasts (9 locations: HI, Guam, Am Samoa, Palau)	Ongoing		
Empirical wave run-up forecasts (HI, RMI)	Ongoing		
BOSZ wave run-up forecasts for West Maui	Ongoing		
Re-evaluate / calibrate Majuro wave run-up	On-track		Q4
Set up new thresholds for high sea level forecasts (Honolulu, Palau)	On-track		Q4
Set up multiple thresholds for Nawiliwili, Moku o Lo'e, Kawaihae, Hilo high sea level forecasts from citizen science photos	On-track		Q4
DATA MANAGEMENT AND CYBERINFRASTRUCTURE (DMAC) SUBSYSTEM			
Maintain PacIOOS DMAC infrastructure and data services	Ongoing		
Operate as a Regional DAC for the Pacific Islands	Ongoing		
Ingest large biological data sets & make widely accessible	Ongoing		
Hire a network and systems administrator	Delayed		
Hire a web portal developer	Complete	Q1	
Capacity building training on data access and use (virtual)	Ongoing		
Engage with IOOS DMAC, other RAs, etc. on DMAC and related issues	Ongoing		
Continue to collaborate with other PacIOOS teams to provide necessary DMAC services, develop products, and address stakeholder and partner DMAC needs	Ongoing		
Advance the development of a Pacific Islands Region Acoustic Telemetry (PIRAT) Node	Ongoing		
Form partnerships with current or prospective acoustic telemetry users in the region	Ongoing		
Build capacity for acoustic telemetry studies via workshops and Ocean Tracking Network equipment loan program	Ongoing		
Archive regional acoustic telemetry datasets in PIRAT database	Ongoing		

ENGAGEMENT SUBSYSTEM			
Communications & engagement across the region (hybrid & via local liaisons)	Ongoing		
Expand capacity sharing to include virtual meetings/webinars	On track		
Regional tech transfer & capacity sharing—subaward with MERIP	Ongoing		
Conduct one-on-one partner meetings to develop ciguatera network	On track		
Develop ciguatera network and stories online	On track		
Engage partners in cross-regional collaboration to learn from ciguatera research outside of the Pacific	Ongoing		
Ciguatera internship program at American Samoa Community College	Delayed		
Conduct regional engagement on ciguatera network	On track		

II. Progress and Accomplishments

A. Core funding update

Amount	Funding Area	Task
$8,867,036	Core	Sustained operational funding and service delivery. Allocations to HFR include Year 1: $331,540; Year 2: $346,263; Year 3: $414,239

High-Frequency Radars (HFRs)

Funds were provided in Year 3 to meet recapitalization needs for several system and infrastructure components. PacIOOS is working with USFWS on permitting to replace a fence around the Kalaeloa station. For the same location, core funds were provided to replace the AC and electrical infrastructure for the container that housed the data systems – the container has been upgraded and is awaiting new staff to come on board to execute the infrastructure swap.

In previous versions of this report, we described recapitalization needs for project components including data servers and the HFR service vehicle. We have removed these components from the table below, as IOOS funds have been obtained through the BIL. Recapitalizations are not final as procurements are still in process; future updates will be provided in BIL progress reports.

Existing and planned HFR stations	Status	Recapitalization needs

KAK (Kakaako)	System operating as planned with data transmitted to CORDC.	
KAL (Kalaeloa)	System operating as planned with data transmitted to CORDC.	PacIOOS is working with USFWS to permit a replacement fence for this site.
KAP (Kapolei)	System operating as planned with data transmitted to CORDC.	
KKH (Keaukaha)	System operating as planned with data transmitted to CORDC.	
KNA (Kaena)	System operating as planned w/ data transmitted to CORDC.	
KOK (Koko Head)	System operating as planned with data transmitted to CORDC.	
PPK (Pepeekeo)	Awaiting system maintenance.	
Ritidian, Guam (planned)	Tx and Rx to be located on Andersen AFB. Site visit scheduled for January 2024.	N/A
Rota, CNMI (planned)	Site identification delayed due to staff limitations. Site visit scheduled for January 2024.	N/A

* Regarding planned antenna calibrations: LERA HFR systems rely on antenna phase, not amplitude measures, and are extremely stable once cable and filter calibrations are performed, which is done at the time of installation. Extensive calibration exercises were conducted at KOK, KNA, KAK, and six other LERA systems globally; none required any processing correction. A reassessment of amplitude and phase for each system is anticipated to be done upon installation of upgraded/recapitalized component hardware.

Gliders and Other Uncrewed Systems (UxS)

Summary of glider activities over the reporting period: Please see the December 2023 PacIOOS Award# NA16NOS0120024 progress report for updates on glider efforts and calibrations. PacIOOS DMAC staff developed a new data processing and ingestion pipeline for PacIOOS glider data to be ingested into the national glider DAC. The 2023 mission data have

been accepted into the Glider Data Assembly Center (DAC), and older archived glider data is currently being processed for loading.

Other Core Observation Activities

Governance and Management Subsystem

Summary: PacIOOS had a busy summer and fall with the on-boarding of new staff, preparing for IRA proposals, hosting our annual governing council meeting, and thinking about growing our regional capacity and engagement over the next few years.

Accomplishments / successes:

- The PacIOOS deputy director traveled to Kosrae and Pohnpei, Federated States of Micronesia (FSM), where he helped to teach the "Ocean Science to Service" workshop - led by The Pacific Community (SPC) - to stakeholders from the National Weather Service, Office of Fisheries and Aquaculture (OFA), state government, the Pohnpei Tourism Office, non-profits, and more. The workshop built local capacity while also strengthening the PacIOOS relationship with our regional partner, SPC.
- Members of the PacIOOS Governing Council gathered in Honolulu in October for their annual meeting. Discussions focused largely on regional capacity building, potential synergies with the Department of Defense, and future improvements to internal governance.
- The PacIOOS director and deputy director traveled to San Diego for the IOOS fall meeting, focused primarily on pan-regional partnership building and discussions around the IRA funding opportunity.
- PacIOOS deputy director worked closely with university staff to submit and / or complete several large procurements to support expansion of oceanographic services in Palau.

Problems / delays

- Delays with the university's Office of Research Services, compounded with those from the eRA Commons system at NOAA have postponed the receipt of awards, approval / initiation of subawards, and general operational efficiency. These delays have been particularly problematic for purchasing and personnel costs associated with subawards and services contracts, especially our local liaisons, within those awards.

Observing Subsystem

Summary: This reporting period saw a number of successes for the wave buoy team in addition to a high level of asset uptime, growth of the Pacific Islands Regional Acoustic Telemetry (PIRAT) node, and preparations for new asset deployments in 2024.

Accomplishments / successes:

- Five nearshore sensors in Hawai'i (4 O'ahu, 1 Maui), and 3 additional sensors in the Insular Pacific (American Samoa, RMI, Guam) operated successfully.
- The wave buoy team continued to maintain and operate the existing PacIOOS array of wave buoys in the Hawaiian Islands, Guam, CNMI, American Samoa.

- Wave buoys were redeployed off O‘ahu, Maui, and the CNMI and necessary maintenance swaps occurred on multiple islands as well.
- The wave buoy team underwent a successful team transition, including promotion of an existing team member and successful recruitment of a new temporary oceanographic technician.
- PIRAT completed cleaning and archiving legacy acoustic telemetry datasets, for a total of 9M detections of ~1200 animals (43 species) dating back to 2007.
- PIRAT received approval for a loan of ~50 acoustic receivers from the Ocean Tracking Network in support of long-term monitoring across the TAO Array.
- PIRAT recruited two new projects (Niue and Molokini) for upload.
- Two water quality coastal moorings were maintained on Hawai‘i Island (as of writing, both sensors are undergoing routine maintenance).
- The Waikīkī beach web camera was remounted and leveled to ensure safety. The camera provides regular imagery, operationally, for shoreline managers and as one of the pilot cameras for WebCOOS.
- The MAPCO2 buoy in American Samoa is operating and transmitting data through continued partnership with the National Marine Sanctuary of American Samoa and the Pacific Marine Environmental Lab.
- The Shark Lab at the Hawai‘i Institute of Marine Biology deployed 4 beta oceanographic tags on tiger sharks off O‘ahu.
- The Hawai‘i Community Tagging Program swapped acoustic receivers on its Hawai‘i Island array and part of its O‘ahu array.
- Opportunistic samples were collected for laboratory analysis of ciguatoxin from fish in the RMI.

Problems/delays:

- Supply chain and engineering issues at the manufacturer have slowed expansion of shark tagging efforts.
- The wave buoy team exerted a lot of effort dealing with an inordinate number of wave buoy drifts that occurred during this and the prior reporting period. The team is nearly back on track.
- Staffing challenges in the FSM have stalled operations of the nearshore sensor deployments there. PacIOOS leadership is exploring new partnerships opportunities there.
- State of Hawai‘i FAD losses (with acoustic receivers) have impacted data collection for the Hawai‘i Community Tagging Program.
- The eRA Commons transition has postponed approval of subawards, leading to delays in several program components, including observation / data collection and the hiring of a HFR technician in Guam.

Modeling and Analysis Subsystem

Summary: PacIOOS modeling teams maintained a suite of their more recently expanded model domains while also preparing computational infrastructure for future expansions. Numerous discussions between PacIOOS leadership and the National Weather Service reinforced the

importance of our operational forecasts to the safety of coastal communities across the region.

Accomplishments / successes:

- Maintained WRF (atmospheric) forecasts of wind, rain, and air temperature for Hawai‘i, Mariana Islands, Samoan Islands, and the western Pacific, with ongoing model upgrades.
- A new PhD student completed a summer collaboration at UCAR developing an updated data assimilation scheme for atmospheric forecasting.
- The 7-day wave forecasts (WaveWatch III and SWAN) were maintained to provide daily wave forecasts for Hawai‘i, Mariana Islands, and American Samoan Islands.
- Continued developing (testing and validation) of a new Palau regional WAVEWATCH III forecast.
- Began developing a new LiDAR-derived DEM for Palau nearshore environments (for use in wave and wave run-up / inundation modeling).
- Began refining (testing and validating) an unstructured SWAN (wave) forecast for the Mariana Islands.
- Maintained the ROMS circulation models for Hawai‘i, Mariana Islands, Samoan Islands, and the western Pacific.
- Maintained the Ala Wai Turbidity Plume forecast.
- Maintained the 6-day high-water level forecasts in Hawai‘i, Palau, Guam, and American Samoa.
- Maintained the wave run-up forecasts for O‘ahu, West Maui, and the RMI.
- Maintained the Hale‘iwa Harbor Surge forecast.
- The coastal hazards group hired a new post-doctoral researcher while another member of the group completed her masters and is continuing on with the group for a PhD.
- New staff in the coastal hazards group have brought improvements to phase-resolving models that have improved both performance and model stability with implications for work in Palau and West Maui.
- Exploring a range of wave-scenarios for BOSZ model runs on a domain including Kahului Harbor to facilitate next steps for a new harbor surge model.
- Developed ROMS-derived climate projection scenarios for the Hawaiian Islands.
- Developed a draft ocean climate report for Hawai‘i’s projected impacts from changing temperatures, ocean acidification, and related parameters based on ROMS.
- Developed a coupled physical / biogeochemical ROMS model (though resources are insufficient presently for operational implementation).

Problems/delays:

- Reliance on international organizations to support sensors can negatively impact PacIOOS data tools. For example, the water level gauge at Uliga Dock in Majuro, RMI, is maintained by the Australian Bureau of Meteorology, which removes control over maintenance issues.
- Delays in IT procurement and installation of new servers has also delayed forecast expansions for WRF and ROMS.
- GFS under-estimates of large wave events impacts not only WaveWatch III and SWAN forecasts, but also affects downstream models like the PacIOOS high water level and wave run-up forecasts.

- The lead researcher for several components of the coastal hazards group unexpectedly passed away, leaving not only a hole in many hearts, but also in the group's technical capacity.
- Hiring delays impacted the coastal hazards group though a new researcher has been identified and is expected to start in February 2024.

Data Management and Cyberinfrastructure (DMAC) Subsystem

Summary: PacIOOS DMAC infrastructure and data services were maintained, and we continue to operate as a Regional Data Assembly Center (DAC) for the Pacific Islands. The PacIOOS DMAC team continues to collaborate with other PacIOOS technical teams to provide necessary DMAC services, develop products, and address stakeholder and partner DMAC needs. New hires during this reporting period helped to expand capacity and are poised to support new endeavors moving forward.

Accomplishments / successes:

- Maintained management of PacIOOS collected data and model forecasts via GeoServer, ERDDAP, TDS, and Voyager.
- All data appropriate for long-term archive are being sent to NCEI on a regular basis.
- PacIOOS hired a new Full Stack Developer.
- Added five new projects to the Pacific Islands Regional Acoustic Telemetry (PIRAT) Network.
- During this performance period, over 27 TB of data were accessed via PacIOOS TDS and ERDDAP servers.
- In partnership with PI-CASC, UH Sea Level Center, and American Samoa Community College, PacIOOS launched a new sea level rise viewer for American Samoa which allows viewers to explore a range of SLR scenarios throughout the territory.
- PacIOOS began providing visualizations of data served by PMEL for MAPCO2 buoys off of Maui and Kaua'i.
- A new data workflow was implemented for the nearshore sensor program, circumventing some longstanding issues with DataTurbine.
- PacIOOS hired a new Data and Products Developer and a new Data Management Specialist to support the Regional Ocean Data Sharing Initiative (RODSI).
- Through the RODSI, a new website and data portal are being developed for the Hawai'i Coral Bleaching Cooperative.
- A new data hub was created to centralize monitoring data in response to the Maui Lahaina fires. The site will grow as partners contribute new datasets.

Problems/delays:

- As new grids (including unstructured grids) are developed by our modeling teams, the DMAC team will have to work to handle and integrate the data in new ways, including having a full understanding of and sufficient capacity for storage needs.
- PacIOOS has been unable to refill the system administrator position for the PacIOOS servers, leaving the DMAC lead to fill the role.
- PacIOOS is reaching a crossroads for making a transition to the cloud or investing in more physical infrastructure. This is not currently a problem or delay so much as a

decision point that is influencing consideration of system recapitalization and investment.

Engagement Subsystem

Summary: Outreach and stakeholder engagement with partners is ongoing via email, phone calls, video conferences, and increasingly in-person activities. With new communications and engagement staff hired, much of this reporting period was spent onboarding new staff and preparing for upcoming engagements in the new year.

Accomplishments / successes:

- PacIOOS hired a full-time engagement coordinator and a part-time communications specialist.
- PacIOOS brought on two new liaisons for Palau.
- PacIOOS continues to publish and distribute monthly e-newsletters to a total of 2754 recipients, with a 51% open rate. Highlighting PacIOOS data users and their specific use cases helps to illustrate the breadth of our stakeholders.
- During this reporting period, the PacIOOS website was visited by over 82K unique visitors and had more than 350k page views.
- PacIOOS' Facebook page has more than 1,600 likes and 1,700 people following the page; PacIOOS Twitter has more than 600 followers.
- The Pacific Ciguatera Network hosted its first partner meeting, with ~40 attendees from Hawai'i, American Samoa, the Mariana Islands, RMI, and the FSM.
- Hired an undergraduate intern from American Samoa to support the Pacific Ciguatera Network.
- Curated relationships across the region toward development and expansion of a regional ciguatera network, including leveraging past work in the Caribbean.
- Continued capacity building of two undergraduates with the Hawai'i Island water quality moorings; one student graduated and a new student began.
- Continued community outreach in South Kohala and Kailua-Kona for water quality buoys off Hawai'i Island.
- With new engagement capacity, PacIOOS rekindled and bolstered relationships through regional efforts / entities like the Pacific Region Outreach Group, Ocean Discovery League, Pacific Islands Regional Climate Team, and the National Marine Sanctuaries of American Samoa.
- PacIOOS leadership and engagement staff continue to be part of the IOOS DEIA Committee.
- The PacIOOS leadership and DMAC team met regularly with NWS Pacific Region forecasters and data services personnel to identify opportunities to improve accessibility and utility of wave and atmospheric forecasts.
- Four members of the PacIOOS team participated in a three day Indigenous Knowledge Summit hosted by Conservation International's Hawai'i Program.
- During the previous reporting period, PacIOOS supported Shark Lab's workshop on shark tagging. During this period, a television series, Voice of the Sea, aired an episode ("Shark Depredation in Guam"), featuring the workshop and its participants from Guam and the CNMI.

Problems/delays:

- Personnel departures and challenges have challenged our regional engagement in the FSM; we are exploring a new liaison relationship there.
- New engagement and communications staff have been productive since starting during this reporting period, but onboarding takes time.
- The eRA Commons transition has postponed approval of subawards, leading to delays in several program components, including numerous aspects of RODSI regional engagement activities.

B. Non-core funding update

IOOS, NOAA, Other Agency Funding		
Funding amount spent	*Funding area / recipient*	*Task*
Provided: $738,604 (total for FY21 + FY22 + FY23) Spent + Encumbered: $13,789 Remaining: 98%	*Regional Ocean Partnership*	**Task**: Regional Ocean Data Sharing Initiative **Status:** Delayed, but getting on track. **Accomplishments:** *In 2022, ecoLOGIC, LLC (consultant) compiled recommendations for the region. A major conclusion was the need to hire a data management specialist and a web and products developer to build a geospatial data portal that connects the Pacific region. Both positions are now hired and the staff have quickly become productive on several regional priorities, including the development of centralized data hubs to support environmental monitoring for the Lahaina (Maui) wildfires, and the Hawai'i Coral Bleaching Cooperative.* *Meanwhile, PacIOOS is working with ecoLOGIC to move into a subrecipient partnership with more responsibilities and milestones addressing the purpose of the funding across the region. This partnership will benefit the intended audience of coastal managers and will lighten the load of PacIOOS staff considerably.* **Issue (if any):** We are awaiting operation of eRA Commons to approve our Year 3 descope workplan in order to process the ecoLOGIC subaward.
Provided: $530,000 (FY22 + FY23)	Harmful Algal Blooms (HABs)	**Task**: To further HABS understanding and prediction via a pilot project to support coordination between regional stakeholders and experts from other regions who are actively involved in addressing ciguatera fish poisoning.

Spent + Encumbered: $108,008 Remaining: 80%		**Status:** On Track **Accomplishments:** The Pacific Ciguatera Network hosted its first partner meeting online and had 40 attendees from Hawai‘i, American Samoa, Guam, CNMI, FSM, and the RMI. The audience was highly engaged in topics ranging from the science to sampling plans, to traditional knowledge, and moving forward to next steps. Meanwhile, project lead E. Nalley has hired an undergraduate intern from American Samoa to work with her on the project. The first in-person workshops are scheduled, and planning is underway for February 2024 in Majuro, RMI and Honolulu, Hawai‘i. Samples that were opportunistically collected are already being analyzed for ciguatera in the RMI. **Issue (if any):** Additional staffing assistance is needed to support collaborations and capacity building, so additional funds to support a technician / student are being sought.

III. Project Challenges/Modifications

- The UH Office of Research Services has been extremely short-staffed this year, leading to delays in accepting awards and issuing accounting codes.
- Issues with the eRA Commons system at NOAA have prevented us from moving forward with subawards, leading to several project delays.

IV. Publications

A. Publications and Reports

- Nalley, E. *Highlighting the impacts of ciguatera poisoning on fishers and fish consumers in Hawai‘i to inform future management strategies.* Marine Policy 159 (2024): 105875.

A. Notable Presentations

- Chen, Y. *Empowering Ocean Stakeholders: Advancing the Pacific Islands Ocean Observing System (PacIOOS): Atmospheric modeling component: A Kona Storm Case Study*. UCAR COSMIC Meeting. Boulder, CO. Aug 2023.
- Chen, Y. *Real-Time Operational and High-Resolution Model Forecasts of West Maui Fires on 8 August, 2023*. Seminar, Department of Atmospheric Sciences, University of Hawai‘i Mānoa. Nov 2023.
- Chen Y. and Flament, P. *Overview of the US Pacific Island Ocean Observing System and its oceanographic and atmospheric components*. Invited seminar,

National Central University of Taiwan. Taipei, Taiwan. Nov 2023.

- Chen, Y. *Empowering Ocean Stakeholders: Advancing the Pacific Islands Ocean Observing System (PacIOOS) – Atmospheric modeling component: West Maui Fires.* Invited seminar, National Central University of Taiwan. Taipei, Taiwan. Nov 2023.
- Chen, Y. *Impacts of data assimilation of GPSRO and unconventional data on the prediction of a Kona Storm over the Hawaiian Islands.* 2nd PAZ-Polarimetric Radio Occultations User Workshop. California Institute of Technology. Pasadena, CA. Nov 2023.
- Nalley, E. *Pacific Ciguatera Network*. NOAA National Harmful Algae Bloom Observing Network Panel; SACNAS Conference. Portland, OR. Oct 2023.
- Nalley, E. *Pacific Ciguatera Network*. Poster presentation at the Hawai'i Conservation Conference in Honolulu, Hawai'i. July 2023.
- Nalley, E. *Environmental Justice through the Lens of Coastal Health.* Leeward Community College. Pearl City, HI. Sept 2023.
- Tinhan, T. *Introducing the Pacific Islands Region Acoustic Telemetry (PIRAT) Network.* The Pacific Community Ocean Sciences Meeting. Suva, Fiji. Sept 2023.
- Tinhan, T. *Introducing the Pacific Islands Region Acoustic Telemetry (PIRAT) Network.* IndoPacific Fish Conference. Auckland, New Zealand. Nov 2023.

V. Product Delivery:

- American Samoa sea level rise viewer made public.
- A workflow was created to submit PacIOOS glider data to the DAC.
- PacIOOS began providing visualizations of data served by PMEL for MAPCO2 buoys off of Maui and Kaua'i.

VI. Certification Updates

- The PacIOOS Communications and Program Coordinator position has been filled with two new positions that divided up the responsibilities of the original position. These new positions are the PacIOOS Engagement Coordinator and the PacIOOS Communications Specialist.

VII. Education, Media Engagement, and Outreach Materials

For coverage of PacIOOS in the media, please refer to: *http://www.pacioos.hawaii.edu/media/*

VIII. Budget Summary

- There were no delays in invoicing or payment.
- No equipment purchases were made during this progress period.

Table of invoices for the entire award during the reporting period:

Cost Categories	Funding provided	Funds spent + encumbered	Funds remaining	Remaining %

Personnel	$4,008,292	$1,819,332	$2,188,960	55
Fringe Benefits	$1,202,705	$508,173	$694,532	58
Travel	$347,200	$162,769	$184,431	53
Equipment	$153,413	$101,057	$52,356	34
Supplies	$377,961	$299,330	$78,631	21
Contractual	$854,613	$100,994	$753,619	88
Other	$649,264	$394,077	$255,187	39
Total Direct Charges	$7,593,448	$3,385,733	$4,207,716	55
Indirect Charges	$2,542,192	$1,133,250	$1,408,942	55
Total Amounts	**$10,135,640**	**$4,518,982**	**$5,616,658**	**55**

IX. Success Stories

Success Story	Brief Description	Contact
Marine Island Ecology Course - Yap	PacIOOS was proud to support capacity building in Yap, Federated States of Micronesia (FSM), as our partners at the Micronesian Conservation Coalition (MCC) held their annual Marine Island Ecology Course (MIEC). For four weeks, students, alumni, and teachers from Yap Catholic High School joined in classroom lessons, labs, and field trips that highlighted the marine and terrestrial sciences that define their island and its surrounding waters. Students snorkeled through mangroves, visited clam and sea cucumber farms, conducted plankton tows, dissected fish, and helped deploy a weather balloon with the National Weather Service. Students created group video projects themed "What Does Marine Life Mean to You?" (Student videos: one, two, three, four, five, six). Caution: videos are inspiring; it's hard not to watch them all.	Jordan Watson

Community support for American Samoa wave buoys	In October, the mooring for our wave buoy in American Samoa separated, and our normal contact for rescuing the drifting buoy was unavailable. However, the American Samoa Department of Port Administration rapidly mobilized the *Manu'atele,* the 140' inter-island ferry. Before PacIOOS could make other arrangements, the crew of the *Manu'atele* was towing the drifting buoy back to Pago Pago Harbor. This was a recovery of expensive instrumentation, provided free of charge to PacIOOS. More importantly however, it demonstrated the importance of this asset to the local maritime community, it illustrated the value of our local partnerships on-the-ground, and it was an example of local stewardship of the resource.	Chip Young
Vanishing murals: data-driven art	Hawai'i-born artist, Jana Ireijo, intersects her art with ocean observing data to raise awareness and support for the environment and for endangered species. In her vanishing murals project, Ireijo created a set of non-fungible tokens (NFTs) that are linked to sea surface temperatures obtained through PacIOOS data services. The NFT images are updated twice daily; as the water temperature changes, so does the image seen by viewers. This tool for intersecting art and science is supported through IOOS ocean data and demonstrates how the freely available products of IOOS serve as a force-multiplier for efforts to foster environmental stewardship.	Meagan Curtis Hattori, Nicole Guiles
Model improvements are poised to support expanded coastal hazard forecasting	Forecasting wave-driven run-up and flooding of shorelines requires numerical models to represent complex coastal hydrodynamics. Many numerical approaches, e.g., the BOSZ code currently used by the coastal hazards group, are computationally slow, hampering proliferation for badly needed short-term run-up and flooding forecasts. A new member of the UH Coastal Hazards Group, Dr. Fatima-Zahra Mihami, developed a novel modeling approach ("BARRACUDA") that optimizes efficiency and accuracy in its representation of nearshore waves. Combining BARRACUDA with computational parallelization has yielded 10 to 100 times improvements in model speed. We are updating existing BOSZ models to BARRACUDA across our forecasting domains (W. Maui,	Dr. Douglas Luther, Dr. Fatima-Zahra Mihami

	North Shore of O‘ahu, Waikīkī) and for our planned forecasting efforts in Palau and American Samoa. This drastic improvement in computational capacity is poised to support a broader spatial extent for modeling efforts, preparing us to improve resilience and safety for more coastal residents.	