Progress Report
Submitted **July 2022**
Empowering Ocean Stakeholders: Advancing the Pacific Islands Ocean Observing System (PacIOOS)
Award no. NA21NOS0120091

Period of Activity: **January 1, 2022 – June 30, 2022**
Principal Investigator: Melissa Iwamoto

I. Project Milestones

Milestone	Status	7/1/21 – 12/31/21	1/1/22 – 6/30/22
GOVERNANCE AND MANAGEMENT SUBSYSTEM			
Operational Plan and 10-year Outlook	Partially complete		
Maintain NOAA certification	Ongoing		
Hold annual Governing Council meetings in HNL (hybrid)	Complete	✓ Nov/Dec 2021	
Hold annual Excom meeting outside HNL (or virtual/hybrid)	Delayed		Delayed to July
Expand partnerships to promote & enhance regional observing	Ongoing		
Participate in regional assessment of workforce development	On track		
OBSERVING SUBSYSTEM			
Sustain HFR stations; data online & assimilated into ROMS	Ongoing		
Sustain 15 wave buoys across region; data & products online	Ongoing		
Sustain Honolulu Pier 1 Weather Station	On track		
Sustain Waikīkī Beach Camera	On track		
Low-cost water level station in West Maui for wave run-up forecast	To revise		TBD
Sustain long-term WQ sensors (9); data & products online	Ongoing		
Sustain WQSPP sites and services; data and products online	On track		
Develop data interpretation products for non-scientific WQ users	On track		
Pilot project with Turner C3 fluorometer and optical sensors	On track		
Sustain WQ coastal moorings (2); data/products online	Ongoing		
Sustain undergraduate mentoring/capacity building w/ moorings	On track		
Deploy new WQ mooring in Kailua Kona Bay	On track		
MAPCO2 buoy and partnership in American Samoa	On track		
Generate near real-time ocean profiles with animal tags	Delayed		In progress
Establish efficient data dissemination for animal tag profiles	On track		
Maintain land-based "mote" stations for animal tag data collection	On track		
Network building for Insular Pacific animal tagging capacity sharing	On track		
MODELING AND ANALYSIS SUBSYSTEM			
Sustain atmospheric model domains (HI, Mariana Islands, Samoa)	On track		
Upgrade atmospheric models	On track		
Expand ATM model grid include Palau, FSM, and RMI	Delayed		
Sustain existing wave forecasts (HI, Mariana Islands, Samoa)	On track		
Develop, implement, validate unstructured SWAN grids for HI	On track		
Sustain Hale'iwa Harbor Surge Forecast (Empirical)	On track		
Advance development of Kahului Harbor Surge Forecast (BOSZ)	Delayed		Next period
Sustaining existing ocean model (ROMS) domains	On track		

Develop new High(er) Resolution ROMS Forecasts for HI	On track		
Maintain Ala Wai plume forecast	On track		
Sustain high sea level forecasts (HI, Guam, Am Samoa, Palau)	On track		
Sustain Empirical wave run-up forecasts (HI, RMI)	On track		
Sustain BOSZ wave run-up forecasts for West Maui	On track		
DATA MANAGEMENT AND CYBERINFRASTRUCTURE (DMAC) SUBSYSTEM			
Maintain PacIOOS DMAC infrastructure and data services	On track		
Operate as a Regional DAC for the Pacific Islands	On track		
Sustain ingest of large biological data sets & make accessible	On track		
Advance the development of a Pacific Islands Region Acoustic Telemetry (PIRAT) Node	On track		
Sustain the development of stakeholder-driven data products	On track		
Expand web & product development services for partners/users	On track		
ENGAGEMENT SUBSYSTEM			
Sustain communications & engagement across the region (hybrid & via local liaisons)	On track		
Expand capacity sharing to include virtual meetings/webinars	Delayed		Next period
Regional tech transfer & capacity sharing—subaward with MERIP	On track		

II. Progress and Accomplishments

A. Core funding update

Amount	Funding Area	Task
$2,840,636	Core	Sustained operational funding and service delivery.

High-Frequency Radars (HFRs)

Names of RA's existing and planned HFR stations	Status	Date of most recent antenna calibration	Date planned for next antenna calibration	Recapitalization needs
KAK (Kakaako)	Offline pending hardware repair/ replacement	LERA HFR systems rely on antenna phase, not amplitude measures, and are extremely stable once cable and filter calibrations are performed,		Requires replacement of UPS computer power backup ($3k), and signal generator ($1.5k). Anticipate upgrade in timing and GPS units to conform with FCC signal requirements ($2k).

KAL (Kalaeloa)	System operating as planned with data transmitted to CORDC.	which is done at the time of installation. Extensive calibration exercises have been conducted at KOK, KNA, KAK, and six other LERA systems globally and 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.	Requires replacement to UPS computer power backup ($3k), cables ($6k), and signal generator ($1.5k). Upgrade is required for telecom hardware to operate at 5G ($2k). Air conditioning replacement is needed for processing hardware container ($3k). Anticipate upgrade in timing and GPS units to conform with FCC signal requirements ($2k). The fence that supports the antennas on USFW property is near end-of-life and will require approximately $80k to replace. Prior installation of the fence was a condition of site access permission from USFW.
KAP (Kapolei)	Offline pending hardware repair/ replacement		Nearing need to replace UPS computer power backup ($3k), and replacement of the signal generator ($1.5k). Upgrade is required for telecom hardware to operate at 5G ($2k). Air conditioning replacement is needed for processing hardware container ($3k). Anticipate upgrade in timing and GPS units to conform with FCC signal requirements ($2k).
KKH (Keaukaha)	Offline pending hardware repair/ replacement		Nearing need for replacement of UPS computer power backup ($3k), and replacement of the signal generator ($1.5k). Anticipate upgrade in timing and GPS units to conform with FCC signal requirements ($2k).
KNA (Kaena)	System operating as planned with data transmitted to CORDC.		Nearing need to update telecom hardware to operate at 5G ($2k), and replacement of the signal generator ($1.5k). Anticipate upgrade in timing and GPS units to conform with FCC signal requirements ($2k).
KOK (Koko Head)	System operating as planned with data transmitted to CORDC.		Nearing need for replacement of UPS computer power backup ($3k), and replacement of the signal generator ($1.5k). Upgrade will soon be required for telecom hardware to operate at 5G ($2k). Anticipate upgrade in timing and GPS units to conform with FCC signal requirements ($2k).
PPK (Pepeekeo)	Was repaired, but if currently		Requires replacement to UPS computer power backup ($3k), and replacement of the signal

	offline again		generator ($1.5k). Air conditioning replacement is needed for processing hardware container ($3k). Anticipate upgrade in timing and GPS units to conform with FCC signal requirements ($2k).
Ritidian, Guam (planned)	Tx array site permitted by USFWS, but the Rx array land use request to NAVFAC at Marine Corps Base Camp Blaz was rejected due to future plans for the site (firing range). Team needs to regroup and determined alternative site to request for permitting. Further site identification delayed due to covid travel concerns and staff limitations.		N/A
Rota, CNMI (planned)	Site identification delayed due to covid travel concerns and staff limitations.		N/A

Names of RA's HFR IT Systems and other cross-system needs	Status	Recapitalization needs
Data servers (x2)	Purchased in 2008 and 2013 and nearing end-of-life.	Approximately $40k
HFR service vehicle	23-year-old HFR service vehicle (a critical part for site maintenance since it is loaded with all our tools) is running out of reparability.	Approximately $30k

Gliders and Other Uncrewed Systems (UxS)

Summary of glider activities over the reporting period: N/A for this award. Glider activity was reported in the recent progress report for the PacIOOS NA16 award submitted June 2022.

Other Core Observation Activities

Governance and Management Subsystem

Summary: Especially in the face of the ongoing travel restrictions in the region and current staffing shortages that PacIOOS is experiencing, our well-established partners throughout the region are key to our success.

Accomplishments / successes:

- PacIOOS continued to participate and support the IOOS Association DEI working group.
- Participated in the IOOS Association Spring meeting.
- Successful recruitment of PacIOOS Deputy Director. Target start date is August 15, 2022. Caliber of applicants was quite impressive, including some key partners, reflecting well on the program as a whole.
- Progress toward recruitment of a PacIOOS Communications Coordinator. Applicant pool for this position was also quite impressive, reflecting well on the program as a whole.

Problems/delays:

- Not having a Communications Coordinator during this reporting period has been very challenging and delayed numerous engagement and outreach efforts and tracking.
- Having our Operations Coordinator on extended medical leave during this reporting period has created a backlog of management and operational objectives.
- The process of hiring new staff when extremely understaffed is currently very slow. While we have made great progress toward recruiting a Communications Coordinator, the process is still in progress.
- Without a Communications Coordinator, we are not able to finalize our updated 10-year build out plan, now called the PacIOOS 10-Year Outlook. This will be completed during the next reporting period, assuming a successful recruitment of the Communications Coordinator.

- Due to scheduling conflicts of the members, the PacIOOS Governing Council Executive Committee meeting will be held in July 2022, instead of during this reporting period.

Observing Subsystem

Summary: The teams are doing their best to keep the systems we have up and running, but many are aging to the point of failing, and personnel is stretched thin for various reasons, many of which stem back to complications due to the pandemic.

Accomplishments / successes:

- The wave buoy team continued to maintain and operate the existing PacIOOS array of wave buoys in Hawaiian Islands, Guam, CNMI, American Samoa, and the Marshall Islands.
- A new full-time oceanographic technician was hired to support the wave buoy team.
- Wave buoy redeployments were accomplished for Waimea Bay (Jan 2022); Mokapu (Feb 2022); Ritidian, Guam (Feb 2022); and Tanapag, Guam (May 2022).
- Wave buoy swaps were accomplished for Pearl Harbor (Jan 2022); Pauwela, Maui (Feb 2022); Kalaeloa Barbers Point (Mar 2022); and Ritidian, Guam (June 2022).
- Since the buoy swap in March, the Kalaeloa Barbers Point wave buoy now also provides surface current data. This information assists safe navigation into the harbor, which has very challenging and unpredictable currents.
- The near shore sensor team continued to maintain and operate the existing PacIOOS array of nearshore water quality sensors in the region. PacIOOS currently has 5 near shore sensors operational in Hawai‘i (4 on O‘ahu, 1 on Maui), and 4 near shore sensors operational in the Insular Pacific (American Samoa, the Federated States of Micronesia, the Republic of the Marshall Islands, and Guam). Partners on the islands other than O‘ahu are working with the PacIOOS team to keep these sensors operational and data flowing.
- A major milestone was reached in June 2022, with the ongoing maintenance of the PacIOOS water quality sensor transferring to a recent graduate from the College of the Marshall Islands, who was recently hired by the RMI EPA. This has been a key objective of PacIOOS after our MOA partner, RMI EPA, expressed interest in taking over this role several years ago. The new EPA hire completed an internship with the PacIOOS RMI Liaison and the sensor over the last few months, and as a result of his knowledge and experience, Voneric Boktok was able to secure an amazing opportunity to join the EPA with the possibility of a full-time position, which is very hard to come by for young graduates in the Marshall Islands. This is a success in terms of capacity development, blue economy workforce development, and empowering Indigenous communities to have more autonomy over ocean observing in their waters.
- A draft data interpretation flier for the American Samoa nearshore sensor has been developed and reviewed by our local liaison. It will be made available on the PacIOOS website during the next reporting period.
- The PacIOOS Water Quality Sensor Partnership Program (WQSPP) continues to be popular with partners and the PacIOOS Governing Council. During this reporting period, the program continued to support a sensor deployed by the Conservation Society of Pohnpei (CSP) in Dausokele Estuary to monitor sediment run-off from key watersheds onto the coastal coral reef habitat. CSP is also partnering with PacIOOS and the Marine and Environmental Research Institute of Pohnpei (MERIP), and Micronesia Conservation Trust (MCT), to

maintain a rain gauge system on Nahnalaud, the highest peak of Pohnpei, FSM, and collect the data every six months.

- Another current WQSPP project is with Kaua‘i Sea Farms, who is maintaining a water quality sensor at Nomilo Fishpond, Kaua‘i. The fishpond is a naturally formed resource within an ancient volcanic caldera located in Kalaheo, Kaua‘i and has a centuries long history of food production. The PacIOOS water quality sensor will be utilized to measure changes in three areas of the pond throughout the year, to assist with spatial planning and optimization of aquaculture activities, and to determine potential impacts of these activities on the aquatic environment of the fishpond.
- Interpretation flyers for past WQSPP projects can be found on the Nearshore Sensor Observations Archive sites. Interpretation sections include data at a glance, specific case studies, and concluding remarks from each partnership project.
- A new buoy technician was hired to assist with the ongoing maintenance of the water quality moorings around Hawai‘i Island.
- The Pelekane water quality buoy has been operational and maintained during the reporting period. Engagement with the South Kohala Coastal Partnership has continued and strengthened during the reporting period.
- The Hilo water quality buoy was redeployed in April and is reporting data online.
- Community meetings discussing moving the former Kiholo water quality buoy to Kailua Bay on Hawai‘i Island have been positive and helpful. Organizations engaged include the Rotary Club of Kona and the Keaukaha Community Association. The team is now working on the paperwork for the new location in Kailua Bay.
- Continued maintenance of the weather station at the entrance of Honolulu Harbor.
- Rather than deploy a low-cost water level station in West Maui, we have learned that the UH Sea Level Center will deploy a sea level gauge in the area. The planned low-cost water level sensor will now be deployed further north after a suitable location is identified.
- The team continued to maintain the existing array of land-based “mote” receivers for shark tags. Currently three are deployed on O‘ahu, and two are deployed on Maui, to collect and forward data from tagged sharks. Three additional receivers were successfully installed during this reporting period with funding from IOOS ATN through NERACOOS.
- One 290cm male tiger shark was successfully tagged off the West side of O‘ahu with a new bathygraph tag near the end of the reporting period. The tag is now reporting temperature/depth profiles.
- The team has been collaborating with a key Guam partner for increasing tag capacity, including recently received notice of funding of a Saltonstall-Kennedy Grant Competition proposal, which will focus on deploying an array of receivers around Guam, with a focus on protected areas.
- There is a high demand for fish tracking in the U.S. Pacific Island territories. Capacity development for Guam and Saipan are PacIOOS’ initial focus, and it has been determined to focus first on a flagship species of parrotfish to track for habitat movements and the creation of a receiver array.

Problems/delays:

- There were delays in deploying more near real-time ocean profiles with animal tags this reporting period because the team was awaiting receipt of redesigned tags from the

manufacturer for most of the reporting period. These new tags will enhance the number of GPS quality fixes.

Modeling and Analysis Subsystem

Summary: The teams are doing their best to keep the operational models up and running, but equipment (server) issues have arisen for several of our modeling teams. Supply chain issues (described in more detail below) are making it difficult to respond to these issues quickly.

Accomplishments / successes:

- The WRF (atmospheric) models for Hawai‘i, Mariana Islands, and Samoan Islands were maintained, with ongoing upgrades to the models continuing. Forecasts for wind, rain, and air temperature are offered.
- The model grid designs for new WRF modeling efforts in Palau, the FSM, and the RMI are complete. The grid size in d01 is 9km; and in d02-d05 is 3km. Total grid size will be about twice as large as the run we currently operate, which will require increased computing time. The team is working on upgrading the servers in order to be able to implement test runs.
- The 7-day wave forecasts (WaveWatch III and SWAN) have been maintained and operated on the PacIOOS OBSERVER server to provide daily wave forecasts for Hawai‘i, Mariana Islands, and Samoan Islands on a daily basis. The uptime for this reporting period has been about 89%.
- The wave modeling team built the framework for daily wave forecast with unstructured grids for Hawai‘i and is currently working on refining the grids in preparation for the daily operation.
- The new Hawai‘i SWAN forecast (unstructured grid for the main Hawaiian islands with grid resolutions increasing from ~400km at the open ocean to 100m near the shores) can better resolve the harbors, sea mounts, shorelines, coastal infrastructure, and small islands to provide valuable wave information for the coastal communities. Currently, the new forecast has been running in the background for testing and monitoring. The wave modeling team is working with the data management team to display the forecast data online soon. This new SWAN forecast is also extended from 7 to 10 days while maintaining the daily forecast update frequency.
- ROMS circulation models for Hawai‘i, Mariana Islands, and Samoan Islands were maintained.
- Observation Analysis Impacts are running operationally. The team assesses the impact of every observation used to perform the daily analysis: examining transport, EKE, and isopycnal depth in Hawai‘i; transport and EKE in Guam.
- The ROMS modeling team completed two 100-year Hawai‘i simulations for different climate scenarios; analysis will begin later this summer.
- The Ala Wai Turbidity Plume Forecast continues to be maintained. The team has also completed the Ala Wai outflow neural network prediction for *Vibrio vulnificus* and are working to turn it operational.
- The 6-day high-water level forecasts in Hawai‘i, Palau, Guam, and American Samoa continue to be maintained.
- The wave run-up forecasts for O‘ahu, West Maui, and the Marshall Islands continue to be maintained.
- The Hale‘iwa Harbor Surge forecast continues to be maintained.

Problems/delays:

- There have been delays to the planned modeling upgrades due to supply chain issues for the necessary equipment.
- The advancement of the development of a Kahului Harbor Surge forecast was initially delayed due to challenges presented by covid as well as a need for the team to focus on the West Maui long-term scenarios, which ended up needing more iteration than anticipated. In an effort to streamline efforts as well as create a more useful forecast, the plan for this forecast has shifted from an empirical-based forecast to a numerical-model based forecast. Efforts on this will commence in FY22.

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 teams to provide necessary DMAC services, develop products, and address stakeholder and partner DMAC needs.

Accomplishments / successes:

- During this performance period, over 78,315 unique visitors (via direct external access to our servers) accessed more than 31.22 million pages in our servers (TDS, ERDDAP) and transferred over 17.3 TB of data.
- The new PIRAT (Pacific Islands Region Acoustic Telemetry) Node is up and running! February-March 2022, PIRAT cyberinfrastructure went live; T. TinHan (node manager) attended a 1-week node management training workshop hosted by Ocean Telemetry Network (OTN), set up a cloud-server to host the PIRAT database, and successfully installed OTN-provided database software/QA-QC tools on the server.
- In April, the PIRAT Network website and data portal was launched (https://PIRATnetwork.org), where researchers can learn more about the network, view documentation such as data templates and the PIRAT User Agreement & Data Policy, and information about the projects hosted by PIRAT. This also serves as a secure data portal (submission/access) for PIRAT Network members.
- In May, a PIRAT announcement was sent out to over 50 researchers in the Pacific Islands Region who had previously voiced interest in joining a Pacific regional node – PIRAT leadership have had responses from several groups and are now working to get new data formatted and loaded into the database.
- In April, Sarah Bingo, a biological data standards specialist with PacIOOS, helped organize and lead a Marine Biological Data Mobilization Workshop aimed at migrating marine biological observation datasets to the Ocean Biodiversity Information System (OBIS). This workshop was a hands-on, interactive, virtual experience focused on helping data providers standardize their data using Darwin Core. Sixty participants attended the workshop.

Problems/delays:

- On June 2, there was a temporary downtime of the PacIOOS website, Voyager, and data servers due to a networking issue with our virtual machines. The team addressed these problems as quickly as possible, and all services were back up and running by the next day.

- Our instance of DataTurbine crashed during this reporting period. The consultant that initiated the work is no longer available, so the team has reinstalled the previous version. Unfortunately, the data for the near shore sensors going back to February 2022, needs to be reloaded to the system. This will be accomplished during the next reporting period.
- Two advertisements for new data management staff were unsuccessful. Hiring is challenging in the current environment where remote work and high salaries are expected. RCUH is very restrictive of remote hires. The PacIOOS management and data management team are determining how best to proceed, perhaps after a deeper discussion with RCUH on our requirements.

Engagement Subsystem

Summary: Outreach and stakeholder engagement with partners is ongoing via e-mail, phone calls, and video conferences. Stakeholder meetings and in-person community outreach and education efforts remained on hold due to covid restrictions and limited staff bandwidth.

Accomplishments / successes:

- A service agreement was established with Robbie Greene and Becky Skeele from the Pacific Coastal Research and Planning (PCRP) to serve as part-time PacIOOS liaisons in the CNMI.
- A service agreement was established with Julie Hartup and Belinda Baird from the Micronesian Conservation Coalition (MCC) to serve as part-time PacIOOS liaisons in Guam.
- A service agreement was established with Eugene Joseph and Jerry Route from the Conservation Society of Pohnpei to serve as part-time PacIOOS liaisons in the FSM.
- Koden Lebehn, Capacity Building Liaison Officer based in Pohnpei, Federated States of Micronesia (FSM) continued to learn about instrumentation with hands-on experience with the PacIOOS water quality near shore sensor and rain gauge.
- PacIOOS participated in the annual Pacific Symposium for Science and Sustainability, or PS3, on January 15-16. This event, run in part by the Hawai‘i Academy of Science, brings students from around the Pacific to share their research projects. PacIOOS data management co-investigator, Jim Potemra, served as a judge for the virtual presentations, as he has done for multiple years. Additionally, Sonja Giardina, an undergraduate student in the University of Hawai‘i Global Environmental Science program who works in the PacIOOS Ocean Modeling group, gave the guest presentation to kick things off.
- Through a new project funded by the National Science Foundation’s Convergence Accelerator program, PacIOOS is collaborating with partners in the Pacific Islands, the Pacific Northwest, and Alaska to improve access to ocean data for Indigenous coastal communities. The goal of the project is to get oceanographic data into the hands of communities in a way that takes advantage of existing, lower cost wave buoy technology and enables sustained community-led stewardship of the buoys. Through co-design, the team aims to revolutionize the status quo by providing new tools and new connections that will focus on the hyper-local scale.
- We implemented a press release for the deployment of the new wave buoy in Palau and received good local media coverage in Palau and Hawai‘i.
- PacIOOS continues to publish and distribute monthly e-newsletters to a total of 2614 recipients, with a 45% 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 79.9K users and had more than 227K sessions.
- Page views for the PacIOOS wave buoys alone totaled at over 336K for this reporting period. Data of CDIP website stats and NDBC website stats, data requests, and RSS requests are currently not available.
- PacIOOS' Facebook page has more than 1,578 likes and 1,723 people following the page; PacIOOS Twitter has 588 followers.
- Engaged via video conferences with stakeholders from various sectors to discuss collaborations and various projects, including agency partners (e.g., NOAA, Maui County, Hawai‘i Coastal Zone Management Program, National Park of American Samoa), non-profit organizations (e.g., South Kohala Clean Water Initiative, Mālama Maunalua, Conservation International Hawai‘i, Marshall Islands Conservation Society, Conservation Society of Pohnpei), and other programs and partners (e.g., Hawai‘i Sea Grant, PI-CASC, The Pacific Community, NOAA GOMO, PMEL).
- Virtual participation with the State of Hawai‘i Ocean Resources Management Plan (ORMP) Ocean Council, IOOS monthly meetings, IOOS Association Policy Committee, and the IOOS Association DEI working group.
- The water quality teams continued to mentor undergraduate college students and high school students to support sensor and buoy programs.

Problems/delays:
- Hiring a new Communications Coordinator has been extremely slow due to staff constraints in RCUH Human Resources and within PacIOOS management.

B. Non-core funding update

IOOS, NOAA, Other Agency Funding		
Funding amount spent	**Funding Area /Recipient**	**Task**
Provided: $244,444 Spent $0 Remaining: 100%	Regional Ocean Partnership	Task: Regional Ocean Data Sharing Initiative **Status:** On track. **Accomplishment:** The consultant (EcoLogic Consulting LLC) designed and built virtual templates and workspaces to support a virtual workshop with coastal zone managers and OCM staff in Hawai‘i, American Samoa, the Commonwealth of the Northern Mariana Islands, and Guam. The workshop had full participation from the region. Participants reviewed top coastal management issues across the Pacific, brainstormed potential opportunities and solutions, and ultimately came together to draft goals and action steps to address data challenges for priority management issues. The consultant is coordinating with PacIOOS and NOAA OCM staff to move these ideas forward into scopes of work for implementable contracts. **Issue (if any):** None.

III. Project Challenges/Modifications

- Work continues to be delayed across the system due to ongoing travel and operational restrictions due to covid. Travel to many parts of the region is either still completely restricted, or severely restricted, making travel for operations, engagement, and outreach and capacity building very challenges to virtually impossible.
- Many PacIOOS staff are on work visas, but the application process for the necessary visas is taking more than twice as long as usual due to closures of various offices due to the pandemic. The backlog seems to only be growing, causing major complications for the PacIOOS workforce.
- Supply chain issues for instruments and other equipment, such as computer servers, is also impacting PacIOOS operations considerably.

IV. Publications

A. Publications and Reports

- The PacIOOS Water Quality Sensor Partnership Program (WQSPP) was featured in Oceanography Magazine. This special issue of the magazine highlights the WQSPP’s collaborations with various organizations and individuals who need water quality data to inform their work. The program supports scientists, natural resource managers, and citizens to collect data for research, conservation, planning, and resource management projects. To date, partnership deployments extend throughout the PacIOOS region, including the

Hawaiian Islands (Maui, Oʻahu, and Kauaʻi); Palmyra Atoll; Pohnpei, Federated States of Micronesia; and Palau. Thus far, sensors at individual sites have provided insights into runoff patterns caused by heavy rainfall and progress in pollution cleanup, and they have clarified the impact from periods of in-water construction on local water quality.

B. Notable Presentations

- PacIOOS team members shared select PacIOOS-related data, forecasts and tools with an international audience at the virtual ASLO Ocean Sciences Meeting 2022. Two examples include:
    - Shaun Wriston, with the PacIOOS Nearshore Sensor Group, shared data from four sensors deployed along the south shore of Oʻahu, Hawaiʻi. This 12-year data set represents a critical component of understanding the status and driving mechanisms of coastal water quality and developing effective management strategies to respond to emerging environmental change. They observed an overall increase in temperature, an increase in pressure or water depth, and decrease in salinity over time. Statistical modeling of the data revealed that air temperature, precipitation, wind, waves and ENSO are significant drivers of daily, seasonal and interannual variability in temperature and salinity. Long-term monitoring is essential in order to gain a better understanding of the impact of climate variability and climate change on coastal environments in order to inform adaptation and resiliency.
    - Dr. Assaf Azouri presented inundation maps under future sea level scenarios for wave events plus background water levels representing nuisance flooding. The baseline for this study is a wave-driven run-up and inundation forecast particularly developed for West Maui, Hawaiʻi. In contrast to commonly used models, the dynamics resolved by this approach lead to a more complete picture of the nearshore wave processes, which contribute to realistic run-up and inundation scenarios. The high-resolution inundation maps will be used to understand how the wave-driven flood zones could change as sea level rises, and to better assess the associated risk for local communities.
- Yi-Leng ‘Dave’ Chen, PacIOOS co-investigator and lead for atmospheric modeling, was invited by the Joint Typhoon Warning Center to present at the 2022 Tropical Cyclone Conference on April 26-28.

V. Education, Media Engagement, and Outreach Materials

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

VI. Product Delivery:

- Several PacIOOS models (e.g., our ROMS forecasts) and in situ stations (e.g., wave buoys) have been included in the US Coast Guard’s operating system for search and rescue.
- The team has been working with NOAA NWS Pacific Island Regional Headquarters to get PacIOOS atmospheric and wave models for the territories directly into their AWIP systems for the regional forecast offices.

- A new future scenarios tool with model results for a suite of wave and sea level conditions for the West Maui project has been updated after beta testing with key partners and users. This will be released during the next reporting period.
- A new notification system for the West Maui project has been iterated and will be available during the next reporting period.
- PacIOOS is now serving a tsunami hazard tool that displays in-harbor hazard maps of surge, drawdown, and currents for hypothetical advisory- and warning-level tsunamis from potential sources around the Pacific. This decision-support tool, developed by researchers at the University of Hawai‘i at Mānoa with support from the National Tsunami Hazard Mitigation Program, allows users to select an appropriate scenario using the estimated earthquake magnitude and location during an actual event. More frequent advisory-level tsunamis can also cause dangerous flow conditions, pose navigational hazards, and damage ships and mooring systems despite having low potential for coastal inundation. A USCG working group defined the suite of data products for assessment of potential hazards in harbors during an advisory-level event. The newly-developed tool has enabled USCG to determine additional under keel clearance for safe passage in waterways, establish thresholds for channel closure and harbor evacuation, and update Sector Honolulu's Heavy Weather, Hurricane & Tsunami Plan.
- Beginning in August 2020, PacIOOS partnered with the USGS Western Geographic Science Center on a project to identify locations of current and future areas of coral reef resilience in Guam and American Samoa. This effort mapped overlapping environmental conditions associated with reef resistance to change or recovery from disturbance. The objectives of this project were to: 1) identify the locations of conditions supporting coral reef habitat suitability and survivability under multiple future climate scenarios; and 2) engage with coastal managers to identify where resilience-based management strategies or restoration activities could be suitable. This project received funding from the Pacific Islands Climate Adaptation Science Center (PI-CASC). The GIS layers from the mapping analysis and the virtual manager workshops are available for download on ScienceBase.gov. Also, for a user-friendly experience, PacIOOS built an interactive web map to view individual layers and zoom into the target geography. The web viewer with the maps from the Coral Resilience Mapping effort are now live on the PacIOOS website. These maps are interactive with the ability to pan and zoom.

VII. Certification Updates

- Dr. Jordan Watston was hired as PacIOOS Deputy Director during this reporting period. His start date is scheduled to be August 15, 2022.
- We are in the final stages of the recruiting process for the PacIOOS Communications Coordinator.
- We are awaiting the hire of our Communications Coordinator to finalize the updated PacIOOS 10-year Outlook (formerly called the 10-Year Build Out Plan), which has been reviewed by the PacIOOS staff and co-Investigators and the PacIOOS Governing Council.

VIII. Budget Summary

- There were no delays in invoicing or payment.
- Execution of the subaward with MERIP was processed during this reporting period. It was

delayed initially due to a delay in the approval of the descope, and then due to limited staff availability to work on the paperwork to execute it within the University system.

- Execution of the contract with UOG was processed after the end of the reporting period (July 19, 2022). It was delayed initially due to a delay in the approval of the descope, and then due to limited staff availability to work on the paperwork to execute it within the University system. Once the service agreement was sent to the University of Guam, there was a delay in obtaining the many signatures required. As a result, a confirming purchase order (PO) is required. The equipment being maintained under this services contract has been collecting a valuable data stream for more than ten years. The continued collection of these data adds to the value of the data set. Any interruption in the data would represent a significant and unrecoverable loss to the data set. Having to interrupt services to issue an amendment or new PO would be detrimental to the project as the data loss during this "down time" cannot be recovered.

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

Cost Categories	Funding provided	Funds invoiced	Un-invoiced funds remaining	Remaining %
Personnel	$1,277,953	$421,862	$856,091	67%
Fringe Benefits	$383,117	$125,629	$257,488	67%
Travel	$43,900	$8,795	$35,105	80%
Equipment	$115,223	$7,075	$108,148	94%
Supplies	$151,215	$32,403	$118,812	79%
Contractual	$174,500	$0	$174,500	100%
Other	$150,736	$61,543	$89,193	59%
Total Direct Charges	$2,296,644	$657,307	$1,639,337	71%
Indirect Charges	$788,436	$234,477	$553,959	70%
Total Amounts	**$3,085,080**	**$891,784**	**$2,193,296**	**71%**

IX. Success Stories

Success Story	Brief Description	Contact
PacIOOS wind forecasts enable safer oceanographic expedition	May 2022, Val Schmidt, lead robotics engineer at the Center for Coastal and Ocean Mapping at the University of New Hampshire, and Center director Larry Mayer were aboard the E/V *Nautilus* between Maui and Lanai on a cruise funded by NOAA's Office of Ocean Exploration. Their work was focused on	Melissa Iwamoto and Val Schmidt

	developing approaches for collaborative behaviors among multiple autonomous vehicles using the Center's DriX-8 autonomous surface vessel working in collaboration with two Woods Hole Oceanographic Institution autonomous underwater vehicles (AUV). Each day, they deployed the equipment and instruments from the ship. Schmidt and his team used the PacIOOS wind predictions to plan deployments in localized lulls in the wind that last only a few hours in the oscillating lee produced by the islands.	
PacIOOS helped partners deploy a new wave buoy with current meter in Palau	Through an international collaboration, a Waverider buoy was deployed in Palau to enhance disaster and climate resilience. The effort was led by the Palau National Weather Service Office through the United Nations Development Programme's Enhancing Disaster and Climate Resilience project, with PacIOOS serving as the technical partner. Additional partnerships with the Coastal Data Information Program and the Coral Reef Research Foundation on Malakal were integral to the successful deployment and data management.	Melissa Iwamoto and Maria Ngemaes (Palau NWSO)
PacIOOS undergraduate student selected for Prestigious NOAA Scholarship	UH Mānoa undergraduate student Sonja Giardina was selected for the prestigious NOAA Hollings Scholarship. As a double major in Global Environmental Sciences and Computer Science, Sonja hopes to be placed with the NESDIS branch of NOAA to learn about large-scale satellite monitoring of our oceans and hopefully get experience working with big data applications.	Brian Powell

End Report