

Progress Report
Submitted January 2022

Empowering Ocean Stakeholders: Advancing the Pacific Islands Ocean Observing System (PacIOOS)
Award no. NA21NOS0120091

Period of Activity: **July 1, 2021 – December 31, 2021**

Principal Investigator: Melissa Iwamoto

I. Project Milestones

| Milestone | Category | 7/1/21 – 12/31/21 | 1/1/22 – 6/30/22 |
|--|----------|-------------------|------------------|
| GOVERNANCE AND MANAGEMENT SUBSYSTEM | | | |
| Operational Plan and 10-year Outlook | On track | | |
| 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) | On track | | |
| Expand partnerships to promote & enhance ocean observing in the region | On track | | |
| Participate in regional assessment of workforce development | On track | | |
| OBSERVING SUBSYSTEM | | | |
| Sustain HFR stations; data online & assimilated into ROMS | Ongoing | | |
| Sustain existing 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 | On track | | |
| Sustain long-term WQ sensors (9); data & products online | Ongoing | | |
| Sustain WQSP 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 | | |
| 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 | | |

| | | | |
|---|----------|--|--|
| 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 widely 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 | | |
| 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, which is done at the time of | | Requires replacement of UPS computer power backup (\$3k), signal generator (\$1.5k), and replacement of the A/D converter (\$8k). Anticipate upgrade in timing and GPS units to conform with FCC signal requirements (\$2k). |
| KAL | Offline | | | Requires replacement to UPS computer power |

| | | | |
|-----------------|---|--|---|
| (Kalaeloa) | pending hardware repair/replacement | 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. | backup (\$3k), cables (\$6k), signal generator (\$1.5k), and replacement of the A/D converter (\$8k). 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), replacement of the signal generator (\$1.5k), and replacement of the A/D converter (\$8k). 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) | System operating as planned with data transmitted to CORDC. | | Nearing need for replacement of UPS computer power backup (\$3k), replacement of the signal generator (\$1.5k), and replacement of the A/D converter (\$8k). Anticipate upgrade in timing and GPS units to conform with FCC signal requirements (\$2k). |
| KNA (Kaena) | Offline pending hardware repair/replacement | | Nearing need to update telecom hardware to operate at 5G (\$2k), replacement of the signal generator (\$1.5k), and replacement of the A/D converter (\$8k). 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), replacement of the signal generator (\$1.5k), and replacement of the A/D converter (\$8k). 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) | Offline pending | | Requires replacement to UPS computer power backup (\$3k), replacement of the signal |

| | | | |
|--------------------------|--|--|--|
| | hardware repair/replacement | | generator (\$1.5k), and replacement of the A/D converter (\$8k). 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) | Land use request submitted to NAVFAC staff at Marine Corps Base Camp Blaz. Expect to begin operation and data telemetering to CORDC fall 2022. | | N/A |
| Rota, CNMI (planned) | Site identification in progress. Expect to begin operation and data telemetering to CORDC fall 2022. | | 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 repairability. | Approximately \$30k |

Gliders and Other Uncrewed Systems (UxS)

Summary of glider activities over the reporting period: N/A for this award. Glider activity reported on in recent progress report for the PacIOOS NA16 award submitted December 2021.

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 Operations Guide](#) completed and posted on the website.
- The [Guam Coastal Management Program](#) (GCMP) signed on as a new PacIOOS Memorandum of Agreement ([MOA](#)) partner.
- Elections were held to fill six seats on the [PacIOOS Governing Council](#). New and returning members for these seats are: Commonwealth of the Northern Mariana Islands seat: Richard Salas, Bureau of Environmental and Coastal Quality; Federated States of Micronesia seat: Bertha Reyuw, Micronesia Conservation Trust; Guam seat: Dr. Jason Biggs, Division of Aquatic and Wildlife Resources; Hawai'i seat: Jennifer Conklin, U.S. Coast Guard, District 14; American Samoa seat: Scott Burch, National Park of American Samoa; Regional seat: Captain Mike Roth, U.S. Navy, United States Pacific Fleet. Elected for three-year terms, the incoming members join our diverse council with representation from across the Pacific Islands region.
- PacIOOS signed a new Memorandum of Understanding (MOU) with [The Pacific Community](#) (SPC). This MOU between two providers of ocean data and products serving the Pacific Islands encourages enhanced communication and will facilitate further joint ventures. Specifically, the MOU is envisioned to help maximize cooperation, eliminate undesirable duplication of effort, and ensure the efficient use of various technical personnel in order to address user needs.
- The PacIOOS Governing Council met virtually across six time zones for two days Nov/Dec of 2021. Members from across the region represent various sectors and provide valuable feedback to help guide the future of the program. The focus of the one-day (split into two half days due to time zone differences) video conference was to provide program updates, discuss Indigenous knowledge in ocean observing, review proposed updates to the 5-year strategic framework, review the draft 10-year outlook, discuss and key missing partners, and conduct council business.
- PacIOOS Governing Council member, Dr. Jason S. Biggs was recently appointed by the Under Secretary of Commerce for Oceans and Atmosphere to serve on U.S. Integrated Ocean Observing System Advisory Committee for 2021-2024. Jason has continually been involved in advising PacIOOS since 2007, and has over 25 years of experience facilitating research and collaborations across all sectors of coastal communities for the sustainable management of natural marine resources throughout the Pacific.

- PacIOOS participated on the IOOS Association DEI working group to help craft the scope of work for the IOOS Association DEI fellow.
- Participated in the IOOS Association Fall meeting.

Problems/delays:

- Having our Operations Coordinator on extended medical leave during this reporting period has created a backlog of management and operational objectives. While we are working on filling a Deputy Director position, the Human Resources department within the Research Corporation for the University of Hawai'i (RCUH) is also hindered by staff limitations. Unfortunately, the resulting process of hiring new staff is currently very slow.

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 team continued to maintain and operate the existing PacIOOS [array of wave buoys](#) in Hawaiian Islands, Guam, CNMI, American Samoa, and the Marshall Islands.
- The [Kāne'ohē Bay wave buoy](#) and the [PacIOOS wave buoy off Hilo, Hawai'i](#) were redeployed.
- The Marine Team of the National Park Service of American Samoa (NPSA) swapped the [PacIOOS wave buoy off Aunu'u, American Samoa](#), with a new one to ensure continuous data collection and streaming.
- The 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 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 key to keeping these sensors operational and data flowing.
- 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 wrapped up deployments in Ma'alaea Harbor in Maui, and Babeldaob, Palau. The Ma'alaea data is available on the PacIOOS [website](#). The Ma'alaea Harbor project was with the Maui Nui Marine Resource Management Council to monitor how tides, wind, and swell affect water quality in this highly used local harbor. The sensor rotated to new sites within the harbor every ~30 days. The Palau project was with a local non-profit organization, Ebiil Society, who was monitoring water quality downstream of a terrestrial/forest restoration site.
- Another WQSPP project is ongoing with 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 deploy a rain gauge system on Nahnalud, the highest peak of Pohnpei, FSM, and collect the data every six months. The data will help determine the amount of rainfall on the mountains of Pohnpei. Results from this effort will help to track rainfall movement from the peak of the island into the lagoon where other sensors are monitoring salinity and turbidity.

- Another current QSPP project is with Kaua‘i Sea Farms, who is deploying a water quality sensor for a one-year period 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.
- A draft data interpretation flyer for the American Samoa nearshore sensor has been developed. The next step is to review the draft with our local liaison.
- The [Pelekane water quality buoy](#) has been operational and maintained during the reporting period.
- Community meetings discussing moving the former Kiholo water quality buoy to Kailua Bay on Hawai‘i Island have been positive and helpful. One additional meeting will occur in early 2022 to finalize coordinates for permit applications.
- Continued maintenance of the weather [station](#) at the entrance of Honolulu Harbor.
- The team continued to maintain the existing array of land-based “mote” receivers for shark tags. Currently three are deployed on O‘ahu, and 2 are deployed on Maui, to collect and forward data from tagged sharks.
- The PacIOOS researchers and data management team successfully worked with the tag manufacturer to iron out details pertaining to quality control (QC). They have also now implemented a machine-to-machine solution for transferring oceanographic profiles into the PacIOOS data repository.
- The team has been collaborating with a key Guam partner for increasing tag capacity, including submitting a funding proposal with him to the Saltonstall-Kennedy Grant Competition after being invited to do so.

Problems/delays:

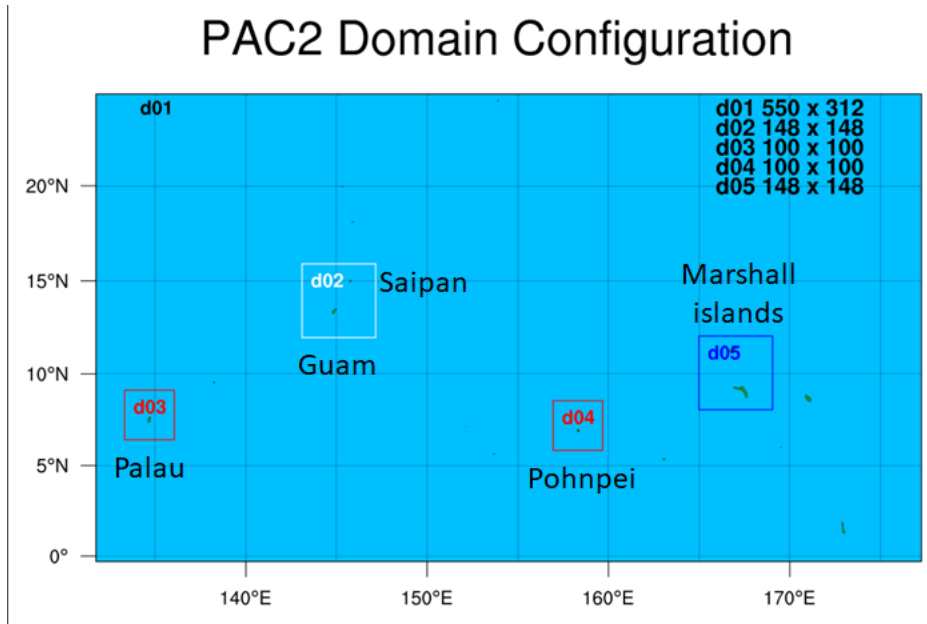
- The PacIOOS wave buoy team has had a rough six months (and indeed couple of years due to covid restrictions). We have numerous buoys out of the water for various reasons. We have had several instances of equipment failure, including with the wave buoys themselves and with the equipment we use to maintain the buoys (i.e., trailer). Staffing has also been an issue, as we were unable to successfully recruit a new hire for the wave buoy team due to administrative delays. A new recruitment is in process.
- The [Hilo water quality buoy](#) is still out of the water due to various set backs, including logistical and equipment/telemetry issues. The team hopes to get it back in the water in early 2022.
- We have not generated more near real-time ocean profiles with [animal tags](#) this reporting period because the team is awaiting receipt of redesigned tags from the manufacturer that will enhance the number of GPS quality fixes. Weather has also not been conducive to tagging.

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 (see image below). 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 in daily basis. The uptime for this reporting period has been about 95%.
- 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.
- [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.
- A higher resolution ROMS for the Main Hawaiian Islands (from 4km to 2km resolution) has been developed. It will become operational after the PacIOOS computing has been upgraded and the model is validated for operational use.
- The [Ala Wai Turbidity Plume Forecast](#) continues to be maintained.
- The [6-day high-water level forecasts](#) in Hawai‘i, Palau, Guam, and American Samoa continue to be maintained.

- The [PacIOOS Pago Pago High Sea Level Rise Forecast](#) is not only back up and running, now that there is again real-time water level data coming from the NOAA water level station, but it is also improved with thresholds and [examples](#) of the impact of high sea level events. The Six-Day High Sea Level Forecast is a tool to predict higher than usual sea level at locations such as protected harbors and atoll lagoons. The forecast provides information that contributes to safe and reliable operations by harbor users, and provides a benefit to residential and commercial property owners in surrounding low-lying areas.
- The [wave run-up forecasts](#) for O’ahu and the Marshall Islands continue to be maintained.
- PacIOOS now offers a new, high resolution [Wave Run-up Forecast for West Maui](#). The tool predicts high wave flooding for the upcoming six days along West Maui's shoreline to help increase preparedness and coastal resiliency. Due to the complexity and differences along the shoreline, the project team divided the shoreline into 12 regions. Each region has its own unique forecast with region-specific thresholds to describe the potential level of impact. The thresholds of *light*, *hazardous*, and *critical* impacts were established with the support of photo documentation that was collected by dedicated volunteer community scientists. The project was funded by NOAA's Regional Coastal Resilience Grants program, along with additional support from the Cooperative Institute for Marine and Atmospheric Research, University of Hawai‘i Sea Grant, and PacIOOS.
- The [Hale‘iwa Harbor Surge forecast](#) continues to be maintained.

Problems/delays:

- There is a potential for 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 has been 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. Efforts will commence on the Kahului forecast during the next reporting period.

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:

- The PacIOOS data management server migration is complete, including an upgrade to our Data Turbine instance.
- The team developed a new position description for a new data and products manager that is now under review by RCUH.
- During this performance period, over 150,640 unique visitors (via direct external access to our servers) accessed more than 33.5 million pages in our servers (TDS, ERDDAP) and transferred over 22 TB of data.
- A data manager for the Pacific Islands Regional Acoustic Telemetry (PIRAT) Node was hired in early December 2021, and he has begun key discussions with the PacIOOS data management team, Ocean Telemetry Network, FACT, and others to determine next steps and logistical needs.

Problems/delays:

- When the team migrated our data servers, there was a resulting temporary downtime of the [PacIOOS website](#), [Voyager](#), and [data servers](#). Subsequently, we also experienced issues with some of the PacIOOS models and data tools. The team addressed these problems as quickly as possible, and all services are back up and running.

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.

Accomplishments / successes:

- After launching the new PacIOOS Wave Run-up Forecast for West Maui in June, the project team continued to meet with relevant stakeholders to introduce the forecast. A virtual meeting was held with departments from the County of Maui to discuss possible applications for county procedures.
- Koden Lebehn was hired as the new Capacity Building Liaison Officer based in Pohnpei, Federated States of Micronesia (FSM), a new position developed through collaboration between the Micronesia Conservation Trust ([MCT](#)) and PacIOOS. In his new role, Koden will help build ocean observing capacity across Micronesia by training communities and interested agencies in the collection and analysis of oceanographic data. Born in the Marshall Islands and raised on the Island of Pohnpei, Koden completed his Associate of Science Degree in Marine Science from the College of Micronesia and earned his Bachelor of Arts Degree in Marine Science at the University of Hawai'i at Hilo.
- We implemented a new [Meet the Team](#) page on the PacIOOS website, consisting of the director, co-investigators, staff, and students. Approximately 40 team members are working in front and behind the scenes to provide daily coastal and ocean observations and forecasts.
- 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 NSF Convergence Accelerator project with a focus on the Pacific Islands.
- PacIOOS continues to publish and distribute monthly e-newsletters to a total of 2532 recipients, with a 42% 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 75K users and had more than 202K sessions.
- Page views for the PacIOOS wave buoys alone totaled at over 300K 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 1,555 likes and 1,658 people following the page; PacIOOS Twitter has 554 followers.
- Engaged via video conferences with stakeholders from various sectors to discuss collaborations, including agency partners (e.g., NOAA, USACE, Palau Office of Climate Change, Hawai‘i DOT Harbors, Maui County), non-profit organizations (e.g., South Kohala Clean Water Initiative, Mālama Maunalua), and other programs and partners (e.g., Hawai‘i Sea Grant, UH Coastal Geology Group, PI-CASC, The Pacific Community).
- Online participation with NOAA Pacific Regional Outreach Group (PROG), State of Hawai‘i Ocean Resources Management Plan (ORMP) Working Group and Ocean Council, IOOS Outreach Committee, IOOS monthly meetings, IOOS Association Policy Committee, IOOS Association DEI working group, and the IOOS Spring Meeting Series.
- The water quality teams continued to mentor undergraduate college students and high school students to support sensor and buoy programs.

Problems/delays:

- Having our Communications and Program Coordinator resign during this reporting period has created a backlog of engagement and program objectives. While we are working on filling the open position, as mentioned above the Human Resources department within the RCUH is also hindered by staff limitations. Unfortunately, the resulting process of hiring new staff is currently very slow.

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) for this project has completed a policy analysis of management and policy decisions related to data sets and tools needed by coastal zone managers in Hawai‘i, American Samoa, the Commonwealth of the Northern Mariana Islands, and Guam. The next step is to meet with the managers as a group to draft goals and action steps to address data challenges for priority management issues and determine next steps for implementation (and the use of these funds). The consultant is coordinating with PacIOOS and NOAA OCM staff to move this forward, and the plan is to gather the managers and liaisons in January 2022 to proceed. 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. For example, our PacIOOS liaison for the Marshall Islands was

finally able to return to Majuro in late October 2021. He was stuck in Hawai‘i since March 2020. Travel for non-residents to the Marshall Islands is still extremely limited and requires lengthy quarantines, often on both ends of the flight. Travel to other parts of the region is either still completely restricted, or severely restricted, making travel for operations, engagement, and outreach and capacity building 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

- Hsiao, F., Y.-L. Chen, H. V. Nguyen, D. E. Hitzl, and R. Ballard, 2021: Effects of Trade Wind Strength on Airflow and Cloudiness over Oahu, *Mon. Wea. Rev.*, 149, 3037-3062. ([DOI: 10.1175/MWR-D-20-0399.1](https://doi.org/10.1175/MWR-D-20-0399.1)). Published online August 26, 2021. Post-doctoral researcher Feng Hsiao maintains and validates [PacIOOS' real-time atmospheric forecasts](#) under the supervision of Dr. Yi-Leng Chen, PacIOOS co-investigator and Professor at the Department of Atmospheric Sciences, University of Hawai‘i at Mānoa.
- In a special issue of the Environment Coastal & Offshore (ECO) Magazine, *Rising Seas*, three regional associations contributed to the article [Helping Coastal Communities Adapt & Respond to Rising Seas](#). AOOS, SECOORA, and PacIOOS share how ocean observing enhances community resilience. PacIOOS has helped to increase preparedness by developing [wave run-up forecasts](#) for the Marshall Islands and other parts of the region.
- Jessica Bullington, a recent master's graduate from the Department of Oceanography at the University of Hawai‘i at Mānoa, investigated the microbial community in the Ala Wai Canal in Honolulu. The shallow, warm, and still waters in this channelized system facilitate the presence of the pathogenic bacterium, *Vibrio vulnificus*, which can cause serious infections in humans. Jessica studied the Ala Wai water chemistry, identified a correlation between water temperature, salinity, and *Vibrio vulnificus*, and was able to develop a predictive model for the presence of the bacterium. In summary, elevated water temperature and increased rain events raise the bacteria count. The [PacIOOS nearshore sensor](#) at the mouth of the Ala Wai served as an important data source for the development and validation of the model.

B. Notable Presentations

- PacIOOS provided presentations on wave buoys and [PacIOOS Voyager](#) during the 5th Data Buoy Cooperation Panel Pacific Islands Training Workshop on Ocean Observations and Data Applications ([DBCPI-5](#)). Representatives from 14 Pacific Island country meteorological services and other ocean observing agencies gathered on four days to enhance Pacific Islands Nations' capacity to apply ocean observations for social and economic benefit.
- Melissa Iwamoto was a panelist during the core event for the laboratory titled, [A Predicted Ocean](#), as part of the United Nations Decade of Ocean Science for Sustainable

Development, to support interaction and creative thinking for the Ocean Decade around the globe.

V. Education, Media Engagement, and Outreach Materials

- For coverage of PacIOOS in the media, please refer to: <http://www.pacioos.hawaii.edu/media/>
- Educational, or outreach materials related to this award are recorded within the master google [document](#) managed by IOOS.

VI. Product Delivery:

- A new, high resolution [West Maui Wave Run-up Forecast](#) is now available (details above).
- A new future scenarios tool with model results for a suite of wave and sea level conditions is in development for the West Maui project.
- A beta version of a new notification system is now available for the West Maui project.
- The [PacIOOS Pago Pago High Sea Level Rise Forecast](#) was upgraded (details above).
- A [new project page](#) is available on the PacIOOS website, featuring anthropogenic and environmental drivers that influence the status of coral reefs and the potential for degradation in American Samoa. Available in a [map viewer and for download](#), data layers include sea surface temperature, chlorophyll-a, photosynthetically active radiation, turbidity, wave power, and coastal habitat modification. Understanding the spatial distribution, intensity, overlap, and cumulative impact of human disturbances and environmental stressors helps to support resource management and conservation efforts. Led by the Ecosystem Sciences Division of NOAA's Pacific Islands Fisheries Science Center, this project was funded by NOAA's Coral Reef Conservation Program and supported by the American Samoa Division of Marine and Wildlife Resources and the American Samoa Coral Reef Advisory Group.
- Another project page for a partner project supported by PI-CASC and the Pacific Islands Regional Ocean Data Sharing Initiative is in development and will go live during the next reporting period. The project's objective is to identify areas of reefs with the most favorable environmental conditions for coral growth and survival under multiple climate scenarios in Guam and American Samoa.

VII. Certification Updates

- The [PacIOOS Operations Guide](#) (one of the three documents comprising the NOAA IOOS nomenclature of the Strategic Operational Plan) is now complete and available on the PacIOOS website under [Documents](#) and the PacIOOS certification [webpage](#).
- Fiona Langenberger, PacIOOS Communications and Program Coordinator, resigned and is no longer working for PacIOOS. We plan to replace Fiona's position with not one, but two refined positions: a Deputy Director and a Communications Coordinator. These new positions are currently being reviewed by RCUH. We will advertise for the positions as soon as possible and will submit an update to the certification webpage and to NOAA when the new hires are identified.

VIII. Budget Summary

- There were no delays in invoicing or payment.
- A data manager for the Pacific Islands Regional Acoustic Telemetry (PIRAT) Node was

hired in early December 2021: Dr. Thomas Tinhan.

- One Key Person (Fiona Langenberger, PacIOOS Communications and Program Coordinator) specified in the application has resigned and is no longer working for PacIOOS. We plan to fill Fiona’s position with not one, but two re-scoped positions: a Deputy Director and a Communications Coordinator as approved by the PacIOOS Governing Council during their Nov/Dec 2021 meeting. These new position descriptions are currently being reviewed by the Research Corporation of the University of Hawai‘i (RCUH). We will advertise for the positions as soon as possible and will submit an Award Action Request with NOAA at that time.
- Execution of the subaward with MERIP is in process. 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.

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 | \$ 106,802 | \$ 1,171,151 | 92% |
| Fringe Benefits | \$ 383,117 | \$ 32,662 | \$ 350,455 | 91% |
| Travel | \$ 43,900 | \$ 8,293 | \$ 35,607 | 81% |
| Equipment | \$ 115,223 | \$ - | \$ 115,223 | 100% |
| Supplies | \$ 151,215 | \$ 2,654 | \$ 148,561 | 98% |
| Contractual | \$ 174,500 | | \$ 174,500 | 100% |
| Other | \$ 150,736 | \$ 25,521 | \$ 125,215 | 83% |
| Total Directs Charges | \$ 2,296,644 | \$ 175,932 | \$ 2,120,712 | 92% |
| Indirect Charges | \$ 788,436 | \$ 63,996 | \$ 724,440 | 92% |
| Total Amounts | \$ 3,085,080 | \$ 239,928 | \$ 2,845,152 | 92% |

IX. Success Stories

| Success Story | Brief Description | Contact |
|---|--|--|
| Archived PacIOOS wave buoy data informed Guam Coastal Management Program’s (GCMP) recommendation for a large development application. | In a development application, a large hotel/condo complex was under review to be developed at a cliff line and highly exposed oceanfront area. In order to characterize the wave exposure and the associated hazard level, GCMP analyzed wave data from the PacIOOS Ritidian Point wave buoy to understand regular seasonal conditions and | Melissa Iwamoto and Edwin Reyes (GCMP) |

| | | |
|---|---|--|
| | <p>extreme typhoon conditions. The wave data allowed GCMP to back up the assumption of this high wave environment, which led to a recommendation that the applicant must implement and maintain a recreational water safety plan to ensure guests' safety.</p> | |
| <p>Community scientists provide valuable imagery to validate wave run-up forecasts.</p> | <p>Along with many other committed community scientists, Maui resident Don McLeish has provided invaluable photos of the Maui coastline to document impacts of wave run-up, including drone footage that offers a unique perspective. This photo database was the foundation to calibrate the newly developed PacIOOS Wave Run-up Forecast for West Maui.</p> | <p>Melissa Iwamoto and Don McLeish</p> |
| <p>Pacific International Training Desk utilizes PacIOOS data and tools to train weather observers and junior forecasters from the region on introductory and intermediate meteorology concepts and forecasting techniques for both weather and waves.</p> | <p>Jennifer Strahl has been the lead meteorology instructor for the Pacific International Training Desk since 2014. She utilizes PacIOOS wave buoy data to demonstrate how weather couples with the ocean, and to validate wave forecast models with real-time observing data. Participants view wave model output and marine forecasts in PacIOOS Voyager, zooming into their islands of interest and stepping through the forecast to see arrival times and heights of forecasted swells.</p> | <p>Melissa Iwamoto and Jennifer Strahl</p> |
| <p>O'ahu Ocean Safety and Lifeguards utilize PacIOOS data and forecasts</p> | <p>For the past 27 years, Ron Bregman has worked as a Beach Lifeguard and Water Safety Officer on O'ahu. Ron utilizes real-time wave buoy data on a daily (sometimes hourly) basis as a safety measure, along with other predictive tools, to warn the public of upcoming changes in ocean conditions which are likely to impact their recreational activities in and around the water. Wave forecasts and atmospheric forecasts are also useful to him in cases of upcoming extreme events, such as hurricanes, tropical storms, and large ground swells. Ron likes corroborating buoy data with actual wave observations at various site locations, and hindcasting predicted swells with actual buoy data.</p> | <p>Melissa Iwamoto and Ron Bregman (Ocean Safety and Lifeguard Services for the City and County of Honolulu)</p> |

End Report