

Progress Report
Submitted January 2023

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

Period of Activity: July 1, 2022 – December 31, 2022

Principal Investigator: Melissa Iwamoto

I. Project Milestones

| Milestone | Status | 7/1/22 – 12/31/22 | 1/1/23– 6/30/23 |
|--|----------|-------------------|-----------------|
| GOVERNANCE AND MANAGEMENT SUBSYSTEM | | | |
| Operational Plan and 10-year Outlook | Complete | ✓ Dec 2022 | |
| Maintain NOAA certification | Ongoing | | |
| Hold annual Governing Council meetings in HNL | Complete | ✓ Nov/Dec 2022 | |
| Hold annual Excom meeting (hybrid) | Complete | ✓ July 2022 | |
| Expand partnerships to promote & enhance regional observing | Ongoing | | |
| OBSERVING SUBSYSTEM | | | |
| Sustain HFR stations; data online & assimilated into ROMS | Ongoing | | |
| Update HFR station hardware | On track | | |
| Conduct site visits for new HFR sites in Guam / Mariana Islands | Delayed | | Feb 2023 |
| Sustain 16 wave buoys across region; data & products online | Ongoing | | |
| Deploy new wave buoy in American Samoa | On track | | |
| Sustain Honolulu Pier 1 Weather Station | Ongoing | | |
| Sustain Waikīkī Beach Camera | Ongoing | | |
| Low-cost water level station in West Maui for wave run-up forecast | Delayed | | Summer 2023 |
| Sustain long-term WQ sensors (9); data & products online | Ongoing | | |
| Sustain WQSPP sites and services; data and products online | Ongoing | | |
| 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 | Ongoing | | |
| Network building for Insular Pacific animal tagging capacity sharing | On track | | |
| MODELING AND ANALYSIS SUBSYSTEM | | | |
| Sustain atmospheric model domains (HI, Mariana Islands, Samoa) | Ongoing | | |
| Upgrade atmospheric models | On track | | |
| Sustain existing wave forecasts (HI, Mariana Islands, Samoa) | Ongoing | | |
| Develop, implement, validate unstructured SWAN grids for HI | On track | | |
| Sustain Hale'iwa Harbor Surge Forecast (Empirical) | Ongoing | | |
| Advance development of Kahului Harbor Surge Forecast (BOSZ) | Delayed | | Pending hires 2023 |
| Sustaining existing ocean model (ROMS) domains | Ongoing | | |
| Develop new High(er) Resolution ROMS Forecasts for HI | On track | | |
| Sustain Ala Wai plume forecast | Ongoing | | |
| Sustain high sea level forecasts (HI, Guam, Am Samoa, Palau) | Ongoing | | |
| Sustain Empirical wave run-up forecasts (HI, RMI) | Ongoing | | |
| Sustain BOSZ wave run-up forecasts for West Maui | Ongoing | | |
| Roll out upgraded notification system for coastal hazards | Complete | ✓Fall 2022 | |
| Advance high sea level thresholds using citizen science photos | On track | | |
| DATA MANAGEMENT AND CYBERINFRASTRUCTURE (DMAC) SUBSYSTEM | | | |
| Maintain PacIOOS DMAC infrastructure and data services | Ongoing | | |
| Operate as a Regional DAC for the Pacific Islands | Ongoing | | |

| | | | |
|---|----------|------------|------------------|
| Engage with IOOS DMAC, other RAs, etc. on DMAC and related issues | Ongoing | | |
| Sustain ingest of large biological data sets & make accessible | Ongoing | | |
| Advance the development of a Pacific Islands Region Acoustic Telemetry (PIRAT) Node | On track | | |
| Hire a software and products developer | Delayed | | Planned Feb 2023 |
| Continue to collaborate with other PacIOOS teams to provide necessary DMAC services, develop products, & address stakeholder and partner DMAC needs | Ongoing | | |
| Capacity building training on data access and use (virtual) | Ongoing | | |
| Expand web & product development services for partners/users | Ongoing | | |
| ENGAGEMENT SUBSYSTEM | | | |
| Sustain 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 | On track | | |
| Engagement Workshop with stakeholders in Saipan | Complete | ✓ Oct 2022 | |

II. Progress and Accomplishments

A. Core funding update

| Amount | Funding Area | Task |
|-------------|--------------|---|
| \$5,736,400 | Core | Sustained operational funding and service delivery. \$346,263 allocated to HFR. |

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) | System operating as planned with data transmitted to CORDC. | 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 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. | | |
| KAL (Kalaeloa) | System operating as planned with data transmitted to CORDC. | | | Requires replacement cables (\$6k) from antennas to computer/hardware container. Air conditioning replacement is needed for processing hardware container (\$3k). The fence that supports the antennas on USFWS 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 USFWS. |
| 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) | System operating as planned with data transmitted | | | |

| | | | |
|--------------------------|---|--|-----|
| | to CORDC. | | |
| Ritidian, Guam (planned) | Tx and Rx to be located on Andersen AFB. Final site identification to occur Q1/Q2 2023. | | N/A |
| Rota, CNMI (planned) | Site identification delayed due to 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 the HFR tools) is no longer running and cannot be made State of Hawai'i Safety Check compliant due to the unavailability of engine parts. | 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 December 2022.

Other Core Observation Activities

Governance and Management Subsystem

Summary: PacIOOS had a busy reporting period with on-boarding of new staff and the return of in-person meetings and travel. The value of and appreciation for in-person meetings and engagement was voiced repeatedly by staff and partners during this reporting period.

Accomplishments / successes:

- PacIOOS has a new MOA signatory partner in the CNMI: 500 Sails. They are a non-profit organization dedicated to reviving, promoting, and preserving the maritime cultural traditions of the Mariana Islands through community engagement in canoe cultural values and activities. 500 Sails' vision is a healthy thriving native community that has successfully integrated traditional cultural values into modern life.
- Members of the PacIOOS Governing Council Executive Committee came together virtually for their annual meeting in July. Members discussed approaches to incorporate Indigenous knowledge and community-led conservation into ocean observing and approaches towards co-development, co-design, and community stewardship of ocean instrumentation.
- PacIOOS hired a new Communications Coordinator, Jesi Quan Bautista. Jesi was born and raised in Hawai'i and Guam and she brings a fresh ocean-loving perspective to the team (August 2022).
- Also in August, PacIOOS hired a new Deputy Director, Dr. Jordan Watson. Jordan joins us after a career as a fisheries data scientist, most recently from NOAA Fisheries.
- Elections were held to fill five seats on the PacIOOS Governing Council. Returning members for these seats include: Moriana Phillip, Marshall Islands Environmental Protection Authority (RMI seat); Erbai Xavier Matsutaro, Palau Office of Climate Change (Palau seat); Billy Middleton, Liquid Robotics, Inc. (Hawai'i seat); Ray Tanabe, NOAA National Weather Service Pacific Region (Regional seat); and Matt Ramsey, Western Pacific Regional Fishery Management Council (Regional seat). One of our Regional seats was also updated with Captain Kenneth Wallace, 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.
- The PacIOOS Governing Council met in-person for the first time since 2019, for two days Nov/Dec of 2022. Members from across the region represent various sectors and provide valuable feedback to help guide the future of the program. The focus of the two-day conference was to provide program updates, discuss top-of-mind issues across the region, explore engagement and capacity building opportunities, and conduct council business.
- Four members of PacIOOS staff (Director, Deputy Director, Communications Coordinator, Operations Coordinator) traveled to Puerto Rico for in-person participation in the IOOS fall meeting.
- PacIOOS finalized and published its 10-year outlook (formerly known as - and referred to in the certification documents as - our 10-Year Build Out Plan) on our website. This dynamic, interactive web document is a result of the extensive input we received compiling our recent 5-year proposal, follow-up discussions, and vetting and revisions by PacIOOS staff, researchers, collaborators, and the PacIOOS Governing Council.

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. The Bipartisan Infrastructure Law (BIL) funding for spares and replacement equipment will be helpful to address some of these issues. Personnel are also stretched thin for various reasons, some of which stems back to complications due to the pandemic.

Accomplishments / successes:

- A nearshore sensor was deployed in Awak, U, Pohnpei (Federated States of Micronesia).
- Five [nearshore sensors](#) in Hawai‘i (4 O‘ahu, 1 Maui), and 4 additional sensors in the Insular Pacific (American Samoa, FSM, RMI, Guam) operated successfully.
- The water quality sensor partnership program (a sensor loan program) has two sensors deployed in the Federated States of Micronesia.
- 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 wave buoy swap was performed in Ipan, Guam and the wave buoy in Pauwela, Maui was recovered after a mooring broke.
- Continued deployment of “bathygraph” shark tags for collecting oceanographic data and validation of ROMS outputs using those data.
- Installed an additional land-based “Mote” receiver on the Kona Coast (Hawai‘i Island).
- Outfitted the majority of the permanent fish aggregating devices (FADs) on Hawai‘i and O‘ahu with acoustic receivers for detecting tagged sharks.
- Through the Hawai‘i Community Tagging Program, deployed acoustic tags on 13 silky and 3 oceanic whitetip sharks to greatly expand behavioral observations for these two species, which are known to be highly interactive with local fisheries.
- Developed a program for acoustic tagging equipment loans in cooperation with the Animal Tracking Network in support of pilot tagging studies in the region.
- Contributed to the development of the IOOS National HAB Observing Network (NHABON).
- Curated relationships across the region toward development and expansion of a regional ciguatera network, including benefiting from past work in the Caribbean.
- Two water quality coastal moorings are deployed and collecting [data](#) off Hawai‘i Island.
- Capacity building of undergraduates with the Hawai‘i Island water quality moorings has continued with two former undergraduates gaining full-time employment, another undergraduate using buoy data for a research project, and three new undergraduate students being trained.
- Community outreach has continued in South Kohala and Kailua-Kona for water quality buoys off Hawai‘i Island.
- The Waikīkī beach web camera was sustained to provide regular imagery, operationally, and as one of the pilot cameras for WebCOOS.

Problems/delays:

- The MAPCO2 buoy is operating though some sensors are currently disabled while awaiting maintenance (battery change), which is scheduled for early 2023.
- Supply chain and engineering issues have slowed expansion of shark tagging efforts.

- Storms led to the loss of several FADs and with them, acoustic receivers.
- COVID travel restrictions reduced the number of available acoustic telemetry datasets for ingestion into PIRAT.
- University rules for boat charter operations have led to delays in buoy installations and swaps in some more remote regions.
- The data driver (DataTurbine) for real-time data acquisition from nearshore sensors is reaching its end of life and has required manual workarounds.
- Hawai‘i Island research vehicle and vessel are out of commission for an extended period, leading to diminished response for buoy or other unanticipated emergencies.

Modeling and Analysis Subsystem

Summary: PacIOOS modeling teams are doing their best to keep the operational models up and running, but sometimes issues with upstream data streams impair our models. High-resolution models, both for short-term and scenario-based forecasts, continue to provide important information to partners and stakeholders for planning and response. Requests for our modeling services also continue to increase.

Accomplishments / successes:

- Maintained WRF (atmospheric) model forecasts of [wind](#), [rain](#), and [air temperature](#) for Hawai‘i, Mariana Islands, and Samoan Islands, with ongoing model upgrades.
- Developed new higher resolution atmospheric model domains for Palau, the Federated States of Micronesia, and Republic of the Marshall Islands.
- Improved atmospheric model code for 12-hour data assimilation (ready to deploy).
- The 7-day [wave forecasts](#) (WaveWatch III and SWAN) have been maintained and operated on the PacIOOS server to provide daily wave forecasts for Hawai‘i, Mariana Islands, and American Samoan Islands on a daily basis. The uptime for this reporting period has been about 94%.
- Wave model (SWAN) forecasts for new unstructured grids for the main Hawaiian Islands have been developed and are ready for operational implementation.
- [ROMS circulation models](#) for Hawai‘i, Mariana Islands, and Samoan Islands were maintained.
- Developed a new ROMS grid to cover most of the PacIOOS region in the western Pacific and Palau.
- Purchased a new computing cluster to support ROMS models.
- 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.
- Maintained the [Ala Wai Turbidity Plume forecast](#).
- PacIOOS launched a [new tool](#) to plan for flooding on West Maui, including wave run-up and sea level rise.
- 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 and Kwajalein (Marshall Islands).
- Maintained the [Hale‘iwa Harbor Surge forecast](#).
- The success of PacIOOS [inundation forecast tools](#) led to funding for the development of similar tools across the coastlines of the Hawaiian Islands.

Problems/delays:

- The water level gauge at Uliga Dock in Majuro, RMI, is necessary for the Majuro wave run-up forecast, and it has failed. The gauge is maintained by the Australian Bureau of Meteorology and is scheduled to be repaired by them in February 2023.
- Moving a new ROMS computing cluster to a different IT facility has delayed cluster installation and deployment of a new Western Pacific grid.
- Deployment of the low cost water level station for West Maui was delayed due to difficulties identifying a suitable location.
- Threshold upgrades for 6-day high sea level forecasts and additional harbor surge forecasts have been delayed due to a combination of factors, including difficulty finding staff.
- Atmospheric model computational limitations led to some delays that have been mitigated through collaboration with the NCAR computing facility.
- Staffing and funding limitations are preventing full execution of atmospheric modeling requests from the National Weather Service.

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:

- Maintained [management](#) of PacIOOS collected data and model forecasts via GeoServer, ERDDAP, TDS, and Voyager.
- Plans are in place for archiving with NCEI.
- PacIOOS posted a position for a new Web Data / Product Developer position. Several qualified applications were received and interviews have begun but due to scheduling around the holidays, a selection will not occur until January 2023.
- PacIOOS has posted a job for a graduate research assistant to support the Pacific Islands Regional Acoustic Telemetry (PIRAT) network. The position should begin in early January 2023.
- Recruited four new regional project members to the [Pacific Islands Regional Acoustic Telemetry \(PIRAT\) Network](#).
- During this performance period, over 121,000 unique visits (via direct external access to our servers) accessed more than 47.9 million pages in our servers (TDS, ERDDAP) and transferred over 24 TB of data.

Problems/delays:

- DataTurbine, our system for acquisition of real-time data from our nearshore sensor network, experienced several glitches throughout the year. The system is no longer supported and we are able to circumvent some issues by working off of a previous version. However, an alternative solution is needed. We have discussed options in use by other RAs (e.g., SECOORA), but we are still evaluating the costs of a transition and do not currently have the staff to implement a new system.

- Two advertisements for new data management staff were unsuccessful. A position was re-posted in late 2022 and several qualified candidates applied, though end-of-year schedules have bumped the hire into early 2023.
- As new grids (including unstructured grids) are developed by our modeling teams, the DMAC 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.

Engagement Subsystem

Summary: Outreach and stakeholder engagement with partners is ongoing via email, phone calls, and video conferences. In-person meetings, including for the PacIOOS Governing Council, resumed in Hawai'i in September, and other parts of the region in subsequent months. However, travel in the region is still limited due to fewer flights.

Accomplishments / successes:

- Eugene Joseph and Jerry Route from the Conservation Society of Pohnpei were contracted as new FSM liaisons (through our MERIP subaward and subsequent contracts).
- A new regional liaison for Palau has been identified and paperwork is being finalized (through our MERIP subaward and subsequent contracts)
- PacIOOS continues to publish and distribute monthly e-newsletters to a total of 2669 recipients, with a 44% 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 480K users and had nearly 1M sessions.
- Page views for the PacIOOS wave buoys alone totaled at over 679K 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 1,675 people following the page; PacIOOS Twitter has 598 followers.
- In July, PacIOOS director, Melissa Iwamoto, served as a stakeholder for the NOAA Global Ocean Monitoring and Observing (GOMO) Program Review.
- PacIOOS is also in the early stages of developing a collaboration with GOMO and PMEL on the implementation of a U.S. State Department funded project in the FSM called the Pacific Partnership.
- In August, M. Iwamoto and PacIOOS co-Investigator Steven Colbert joined a NOAA NOS delegation on Hawai'i Island to conduct outreach to highlight partnership successes along the South Kohala coast, where the PacIOOS Pelekane Water Quality mooring is located.
- PacIOOS presented a program overview and an introduction to PacIOOS data services to the Western Pacific Regional Fishery Management Council, which led to invitations for targeted fisheries specific data tool tutorials for the Council's advisory panels in Hawai'i and American Samoa (September 2022).
- M. Iwamoto moderated a panel for the NOAA Hydrographic Services Review Program, which included high-level NOAA and industry representatives seeking to bolster U.S. readiness around operational oceanography and the necessary data (September 2022).

- PacIOOS was invited to present to the International Visitors Leadership Program at the University of Hawai‘i. The group of distinguished leaders from New Zealand, Australia, and India were particularly interested in how PacIOOS tools could be used to support climate resilience and maritime security (October 2022).
- Ocean Observing Workshop held in Saipan, CNMI (October 2022). Final workshop report [here](#).
- M. Iwamoto continued to serve on the IOOS Associated DEIA working group.
- The Hawai‘i Community Tagging Program (HCTP) presented to the West Hawai‘i Explorations Academy high school and also participated in an outreach event at the Hawai‘i Marine Education and Research Center event, both of which occurred in December in Kona, Hawai‘i.
- Abi Campbell (HCTP Master’s student) presented her thesis results at the Australian Society for Fish Biology Conference, Surfers Paradise, Gold Coast, Australia, 6-10 November 2022. Her presentation was titled "Assessing fisheries interactions and population demographics of oceanic whitetip sharks through citizen science and photo identification."

Problems/delays:

- COVID-19 related travel delays and restrictions continued to hamper in-person engagement but the region is largely open now and we intend to pursue more activities throughout the region in the next reporting period.

A. Non-core funding update

| IOOS, NOAA, Other Agency Funding | | |
|---|----------------------------------|---|
| Funding amount spent | Funding Area /Recipient | Task |
| Provided: \$488,844 (total for FY21 and FY22) Spent \$0 Remaining: 100% | Regional Ocean Partnership | Task: Regional Ocean Data Sharing Initiative Status: On track. Accomplishment: <i>The consultant (ecoLOGIC Consulting) 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. PacIOOS, OCM, and the consultant met with the coastal managers as a group and drafted goals and action steps to address data challenges for priority management issues and determine next steps for implementation. The consultant drafted a report based on the workshop. The report was approved by the steering committee and was distributed to all participants via email and made available on the PacIOOS website. The workshop resulted in two top-line project concepts to address data challenges: a data visualization tool (i.e., data portal) and new data requests (i.e., specific datasets and data collection technology).</i> |

| | | |
|---|------------------------------------|---|
| | | <p><i>The report developed by the consultant is guiding the further implementation of the project. The top-line project concepts from the workshop were a data visualization tool (i.e., data portal) and new data (i.e., specific datasets and data collection technology). Next steps to further develop the concepts included data follow ups, geoportal follow ups, and training follow ups. During this reporting period, PacIOOS and the consultant connected with workshop participants who cited datasets needed and explored the possibility of purchasing needed datasets. Additionally, the team connected with past and present OCM and PacIOOS geospatial data experts to explore and ultimately craft two position descriptions to build a geospatial data portal that connects the Pacific region.</i></p> <p>Issue (if any): None.</p> |
| <p>Provided: \$130,000</p> <p>Spent: \$0</p> <p>Remaining: 100%</p> | <p>Harmful Algal Blooms (HABs)</p> | <p>Task: To further HABS understanding and prediction via a pilot project to support coordination across the region to bring together regional stakeholders with experts from other regions who are actively involved in addressing the issue of Ciguatera fish poisoning.</p> <p>Status: Delayed.</p> <ul style="list-style-type: none"> ● Contributed to the development of the IOOS National HAB Observing Network (NHABON). ● Curated relationships across the region toward development and expansion of a regional ciguatera network, including leveraging past work from the Caribbean. <p>Issue (in any): While some accomplishments were made during the reporting period, some personnel delays led to a slow start; the project is on track again.</p> |

III. Project Challenges/Modifications

- Work continued to be delayed across the system due to ongoing travel and operational restrictions due to covid. Travel to many parts of the region only resumed late in 2022, making travel for operations, engagement, and outreach and capacity building very challenging 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.
- Hiring this year was very difficult with increased wage expectations, worker shortages, and restrictions from UH on remote work, which has become an increasingly valued option for employees.

IV. Publications

A. Publications and Reports

- Holland, K., Meyer, C., Potemra, J. et al. Ocean depth–temperature profiles for operational oceanography from a shark-borne transmitter. *Anim Biotelemetry* 10, 34 (2022). <https://doi.org/10.1186/s40317-022-00306-x>
- Frazier, A. G., C. P. Giardina, T. W. Giambelluca, L. Brewington, Y.-L. Chen, P.-S. Chu, L. B. Fortini, D. Hall, D. A. Helweg, V. W. Keener, R. J. Longman, M. P. Licas, A. Mair, D. S. Oki, J. Reyes, S. Yelenik, C. Trauernicht. A century of Drought in Hawaii: Geospatial Analysis and Synthesis across Hydrological, Ecological, and Socioeconomic Scales. *Sustainability*, 14(19), 12023 (2022). DOI:10.3390/su141912023.

B. Notable Presentations

- Pacific Islands Region Acoustic Telemetry (PIRAT) Node manager participated in a panel on International Research Programs at the 2022 Ocean Tracking Network (Halifax, Canada), where he introduced the PIRAT Network, PacIOOS, and their role in supporting and advancing efforts to monitor movements of marine fauna in the Pacific Islands region.
- PIRAT node manager, Tom Tinhan, introduced the PIRAT network to the Scientific and Statistical Committee at the Western Pacific Regional Fishery Management Council in September.
- M. Iwamoto gave an overview of PacIOOS and its data services to the Scientific and Statistical Committee at the Western Pacific Regional Fishery Management Council in September.
- J. Watson gave an overview of PacIOOS and its data services to the full council at the Western Pacific Regional Fishery Management Council in September.
- J. Watson and J. Potemra gave an in-depth tutorial of PacIOOS Voyager to the Hawai‘i Advisory Panel of Western Pacific Regional Fishery Management Council in October.
- M. Iwamoto moderated a panel for the NOAA Hydrographic Services Review Program, which included high-level NOAA and industry representatives seeking to bolster U.S. readiness around operational oceanography and the necessary data (September 2022).
- PacIOOS staff was invited to present to the International Visitors Leadership Program at the University of Hawai‘i. The group of distinguished leaders from New Zealand, Australia, and India were particularly interested in how PacIOOS tools could be used to support climate resilience and maritime security (October).
- Molly Scott presented a poster, “Hawai‘i Community Tagging Program: A citizen science initiative identifying strategies to reduce mortality to threatened sharks in small-scale fisheries in Hawai‘i”, at the Sharks International Conference in Valencia, Spain, in October.
- Abi Campbell, a masters student with the Hawai‘i Community Tagging Program, presented her thesis results at the Australian Society for Fish Biology Conference, Surfers Paradise, Gold Coast, Australia, November 2022. Her presentation was titled "Assessing fisheries interactions and population demographics of oceanic whitetip sharks through citizen science and photo identification."

- Tara Owens, UH Sea Grant extension agent and key partner for the West Maui project, gave a community presentation for Leilani's On the Beach restaurant, December 2022 - "The Climate Crisis is At Our Shores: Managing Maui's Dynamic Shorelines"
- T. Owens presented a talk titled, "Bridging the Gap Between Science and Coastal Management in Hawaii" at the NOAA Hydrographic Services Review Panel in September 2022, in Honolulu.
- T. Owens presented on the release of the West Maui Wave Flooding Tool at a community meeting on Maui in August 2022.
- T. Owens presented to the Maui Huliau Foundation Teacher Professional Development meeting in July 2022 on "The Climate Crisis is At Our Shores: Planning for Coastal Resilience on Maui."
- John Maurer, PacIOOS Data Systems Administrator, presented "King Tides Project: Mobile GIS for Collecting and Mapping Photos" to the Hawaii Geographic Information Coordinating Council Honolulu Geospatial Expo in August 2022 in Honolulu.

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. The wave models are now fully integrated.
- A new future scenarios tool with model results for a suite of wave and sea level conditions for the West Maui project was launched (<https://www.pacioos.hawaii.edu/shoreline/slr-westmaui/>), including a new notification system.
- Added a new tsunami model for Merizo, Guam to PacIOOS [data services](#)
- A newly tagged tiger shark was added to the online [Shark Tagging Tracking Tool](#) and temperature-depth profiles can be accessed for this shark via [ERDDAP](#).

VII. Certification Updates

- Dr. Jordan Watson was hired as PacIOOS Deputy Director and commenced work on August 15, 2022.
- Jesi Quan Bautista was hired and commenced work as the PacIOOS Communications Coordinator in August 2022.
- Finalized the updated [PacIOOS 10-year Outlook](#) (formerly called the 10-Year Build Out Plan), which was a result of the extensive partner and stakeholder input provided developing the current 5-year proposal, as well as from PacIOOS staff, co-Investigators, and the PacIOOS Governing Council.

VIII. Budget Summary

- There were no delays in invoicing or payment.
- Year 2 of the contact with UOG was processed in September 2022.

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

| Cost Categories | Funding provided | Funds invoiced | Un-invoiced funds remaining | Remaining % |
|-----------------------------|-------------------------|-----------------------|------------------------------------|--------------------|
| Personnel | \$2,803,855 | \$919,765 | \$1,884,090 | 67 |
| Fringe Benefits | \$819,490 | \$258,575 | \$560,915 | 68 |
| Travel | \$121,209 | \$65,559 | \$55,650 | 46 |
| Equipment | \$115,223 | \$101,057 | \$14,166 | 12 |
| Supplies | \$265,195 | \$127,803 | \$137,392 | 52 |
| Contractual | \$228,400 | \$40 | \$228,360 | 100 |
| Other | \$346,814 | \$162,137 | \$184,677 | 53 |
| Total Direct Charges | \$4,700,186 | \$1,634,936 | \$3,065,250 | 65 |
| Indirect Charges | \$1,655,058 | \$553,710 | \$1,101,348 | 67 |
| Total Amounts | \$6,355,244 | \$2,188,646 | \$4,166,598 | 66 |

I. Success Stories

| Success Story | Brief Description | Contact |
|--|---|-------------------------------|
| PacIOOS ocean forecasts assist NTSB find airplane wreckage and victims | In December 2022, a small plane crashed in the water between Hawai'i and Maui islands. The National Transportation Safety Board (NTSB) contacted PacIOOS for any information we might provide to help them find the wreckage of the plane and the victims. UH ocean modeler and PacIOOS co-Investigator, Dr. Brian Powell, provided the investigator with bathymetry and ocean current information from the day of the crash. The NTSB used the data from Dr. Powell to set up their search grid; the wreckage and all victims were found on the first pass through the area with AUVs. | Jordan Watson Brian Powell |

| | | |
|---|---|--|
| <p>PacIOOS-supported intern gets full-time agency job in the Republic of the Marshall Islands</p> | <p>Capacity building efforts in the Republic of the Marshall Islands (RMI) proved successful when an intern working with the PacIOOS RMI liaison was able to leverage his new water quality instrumentation skills to acquire a full-time job with the RMI EPA Water Quality Division. These types of positions are hard to come by in the islands. The RMI EPA director has acknowledged the collaboration with PacIOOS as the successful type of model that she would like to utilize to build more capacity in her region.</p> | <p>Melissa Iwamoto Chip Young</p> |
| <p>West Maui wave-driven flooding with sea level rise project expanding in Hawai'i</p> | <p>The West Maui Wave-Driven Flooding with Sea Level Rise Tool and the modeling behind it have proven to be such a success that the modeling group has been invited to be part of the UH Climate Resilience Collaborative. Under this effort, ONR funds are anticipated to support an expansion of wave-driven inundation and sea level rise tools for the all coastlines of the main Hawaiian Islands. This project provides forecasts that enable coastal managers, emergency management personnel, property owners, and the general public to make more informed decisions about how to prepare for and respond to coastal erosion and flooding impacts.</p> | <p>Melissa Iwamoto Doug Luther</p> |

End Report