

Performance Progress Report
Developing the Pacific Islands Ocean Observing System (PacIOOS)
Cooperative Agreement # NA16NOS0120024
Performance Period: December 1, 2019 through May 31, 2020

Submitted June 2020 by:
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This report covers activities conducted during the eighth 6-month performance period of this 5-year cooperative agreement. PacIOOS' estimated operating budget from NOAA IOOS for the fiscal year is \$3,249,398.

1.0 Progress and Accomplishments

REGIONAL GOVERNANCE AND MANAGEMENT SYSTEM

Convene PacIOOS Governing Council Executive Committee meeting; Original completion date: April 2020. **Status:** *Complete. April 2020. Members met remotely for their annual meeting via video conferencing due to the ongoing COVID-19 pandemic. In an abbreviated format, members learned about PacIOOS programmatic updates and reviewed the annual performance evaluation. The main discussion focused on the upcoming 5-year proposal, including regional needs and topics of interest, as well as how to adjust how our engagement with stakeholders, users and partners throughout the Pacific Islands region during travel restrictions.*

Internal PacIOOS Evaluation; Original completion date: February 2020. **Status:** *Complete. March 2020. The PacIOOS internal evaluation provides an informed review of what is going well and what needs more attention within the program. The results were presented to the PacIOOS Governing Council Executive Committee in April 2020, and were an important component of the 5-year proposal discussion.*

OUTREACH, STAKEHOLDER ENGAGEMENT, AND EDUCATION SUBSYSTEM

PacIOOS capacity building and stakeholder engagement meetings/workshops; Original completion date: May 2020. **Status:** *Delayed. A Capacity Building Workshop was held in Pohnpei, Federated States of Micronesia, to increase ocean observing capacity in the region. More than 30 participants from the states of Chuuk, Kosrae, and Pohnpei participated representing various sectors, including conservation organizations, state, national, and international agencies, industry partners, and more. The planned RMI workshop was postponed from January 2020, due to unforeseen circumstances with staff, and then the Palau workshop was postponed due to COVID-19. All workshops are now on hold due to the pandemic.*

Follow-up on DBCP PI-4 synergies & collaborations; Original completion date: Ongoing **Status:** *Ongoing. One collaborative partnership resulting from the DBCP PI-4 workshop is between PacIOOS and the Global Drifter Program funded out of the NOAA Climate Program*

Office and implemented by the Lagrangian Drifter Laboratory at Scripps Institution of Oceanography. Together we are strategizing locations for various types of wave buoys across the Pacific Islands. In addition, PacIOOS successfully helped facilitate two UNDP Letters of Agreement, with Palau and with the RMI, for funding of new Waverider buoys in the region.

Follow-up on OceanObs'19 synergies & collaborations; Original completion date: Ongoing
Status: *Ongoing. Initial discussions with Australia's IMOS that began during OceanObs'19 continued with their new director and will expand during the next reporting period. Support for the IOOS Grand Challenges and the UN Decade of the Ocean are provided where possible.*

Hold Regional Workshop with MERIP & NOAA; Original completion date: Summer 2020
Status: *Delayed. Initial planning phases have begun with PacIOOS, NOAA, and MERIP. Unfortunately, the pandemic forced major delays in all workshops and travel planned for 2020, including this workshop. We will regroup with partners soon to determine how to best proceed.*

Collaborate with NOAA OCM, other partners, and coastal management stakeholders to implement Data Ocean Sharing Initiative; Original completion date: July 2020. **Status:** *In progress. PacIOOS led the effort to work with partners to compile a list of target stakeholders (e.g., coastal resource managers, EPA directors, Department of Health staff, etc.) to learn more about and characterize specific management and policy decisions that could benefit from improved data sharing and/or new data sets. We developed and circulated an online survey to this list of target stakeholders, and we have begun early review of the survey results and discussions on common issues. A more comprehensive update on this project will be submitted in July to address the SAC associated with this project.*

Ongoing outreach and engagement with stakeholders and partners to ensure meeting ocean data needs; Original completion date: Ongoing. **Status:** *Ongoing. 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 were suspended for the majority of this reporting period due to social distancing requirements related to COVID-19. Specific activities during this reporting period are listed below.*

Outreach Efforts

- *PacIOOS continues to publish and distribute monthly e-newsletters; more than 270 new contacts were added to the newsletter mailing list, the majority of which signed up through the subscription form on the PacIOOS website. Over 2250 people receive monthly updates.*
- *Increased public awareness and interest throughout the region with targeted news releases, including ongoing operations during COVID-19 and how ocean observing benefits the shipping industry and delivery of goods; and equipping tiger sharks with a new generation of environmental tracking devices to have them serve as mobile "oceanographers."*
- *Increased number of web stories that are easy to share on social media, to provide PacIOOS updates, announce new tools and data sets. Coverage included monitoring sediment run-off in Palau, building regional ocean observing capacity in Pohnpei, new wave forecasts for the Mariana Islands and American Samoa, making biological data widely accessible, new comprehensive ecosystem model, and various updates to PacIOOS Voyager.*

- *The PacIOOS website was visited by over 58K users and had more than 191K sessions. This does not include direct hits to our buoy data on the CDIP or NDBC websites.*
- *PacIOOS continues its presence on social media, in particular on Facebook and Twitter. PacIOOS' Facebook page has more than 1,500 likes; Twitter following increased to over 490 followers.*

Stakeholder Engagement

- *Met with stakeholders from various sectors, including agency partners (e.g., Guam Coastal Management Program, NOAA leadership, U.S. Army Corps of Engineers, NOAA National Weather Service, State of Hawai'i Ocean Acidification Program, State of Hawai'i Office of Conservation and Coastal Lands); non-profit organizations (e.g., Micronesia Challenge Regional Support Team, National Fish and Wildlife Foundation); and academia (University of Hawai'i Sea Grant College Program; Hawai'i Institute of Marine Biology; Scripps Institution of Oceanography Coastal Data Information Program).*
- *Meetings with partners in Pohnpei, Federated States of Micronesia were conducted, including the National Weather Service Weather Service Office, Micronesia Conservation Trust, U.S. Embassy, and Conservation Society of Pohnpei.*
- *Targeted outreach to partners, stakeholders, and users in the U.S. Pacific Islands region to seek input and solicit ideas for upcoming 5-year proposal and 10-year build out plan.*
- *Outreach with congressional staffers in D.C.*

Collaborative Efforts, Events and Conferences

- *Participated in outreach and educational events, including ocean acidification lecture at Kaiser High School and presentation at Waikiki Swim Club Annual Membership Dinner.*
- *Presented at Pacific Risk Management 'Ohana (PRiMO) annual conference in Honolulu; participated in and presented at Ocean Sciences Meeting in San Diego.*
- *Participated with other IOOS Regional Association in economic evaluation survey.*
- *Mentoring of undergraduate college students and high school students by water quality team to support sensor and buoy program.*
- *Integration of PacIOOS data in UH Hilo Marine Science undergraduate projects.*
- *Continued participation on the NOAA Pacific Regional Outreach Group (PROG) and State of Hawai'i Ocean Resources Management Plan (ORMP) Working Group.*

OBSERVING SUBSYSTEM

Maintain and operate 7 HFR stations in Hawai'i, real-time surface currents data available online; Original completion date: Ongoing. **Status:** *Ongoing. Focus continues to be on operations and maintenance of 7 HFR stations on O'ahu and Hawai'i Island. Significant effort has gone into maintaining access and land use permits to the sites, particularly Ka'ena, Kapolei, and Kaka'ako during this reporting period. Issues are due to change in staffing and management of various land owners, renewal of permits, and in the case of Kaka'ako, the transfer of the park from the State to a county agency. The COVID-19 pandemic has also impacted maintenance on the Hawai'i Island HFR stations, resulting from travel and field work restrictions. <http://www.pacioos.hawaii.edu/currents-category/obs/>*

Conduct site visits for the new HFR sites in the Mariana Islands; Work with partners to submit permit applications for the new HFR sites; Original completion date: November 2019. **Status:** *Delayed. New target completion date:* October 2020. *Initial discussions with key partners on Guam, including with the multiple landowners, have begun. Due to COVID-19, our local liaison cannot access the site at the current status level, as it requires access through the U.S. military base. The team continues to strategize with partners the optimal configuration of the system to be deployed, based on needs and feasibility of the sites, particularly with regard to access issues with the U.S. military.*

Build and ship new HFR for Mariana Islands; Original completion date: May 2020. **Status:** *In progress. Both the HFR and the solar power plants have been procured and delivered to UH. We are delaying shipment to the Mariana Islands as we finalize the permitting, equipment placement on the sites, and deployment logistics.*

Maintain operations of Waverider buoys in Hawai‘i, Mariana Islands, American Samoa, and the Marshall Islands, real-time wave data and associated products online; Original completion date: Ongoing. **Status:** *Ongoing. The team redeployed the Hanalei buoy in January. Also in January, communications from the Waimea buoy were lost. The following day, a replacement buoy was swapped in. Two additional buoys parted from their moorings during this reporting period: Lāna‘i in December, and Mōkapu in March. The Lāna‘i buoy was redeployed in February, and the Mōkapu buoy was redeployed in April. The recovery of the Mōkapu buoy from its beached location relied on numerous local partners, including the City and County of Honolulu Department of Parks and Recreation and Department of Facility Maintenance. The Ritidian buoy redeployment was delayed due to travel restrictions for COVID-19 pandemic.*

Annual maintenance of our wave buoy vessel was completed during this reporting period. Buoys on Maui, Ipan (Guam), and Majuro have been placed on lower energy mode (one call/hour instead of one call/ half hour) to increase the length of battery life due to the uncertainties in travel produced by the pandemic. <http://www.pacioos.hawaii.edu/waves-category/buoy/>

Swap Tanapag buoy and Pearl Harbor Mooring; Original completion date: Feb 2020. **Status:** *In progress. The Tanapag (Saipan) buoy was swapped out in April for battery replacement and service, after some delays due to the pandemic. The Pearl Harbor mooring swap has been pushed back to the next reporting period. The Pearl Harbor mooring swap is a precautionary swap as the mooring is 3 years old.*

Swap Kalaeloa Barbers Point wave buoy; Original completion date: May 2020. **Status:** *Delayed. New completion date:* August 2020. *When estimating ‘weeks of life’ remaining for a buoy, the computer averages over the last 7 days of power consumption. The further away from end of life, the greater the error. Kalaeloa Barbers Point buoy currently shows 12 weeks of life so the wave buoy team is mobilizing to swap the buoy in July.*

Purchase new spare wave buoy and acoustic releases; Original completion date: Feb 2020 **Status:** *Complete. The new spare wave buoy and three acoustic releases have been purchased, received, and put into the PacIOOS rotation. These purchases were made possible with funding from the National Weather Service (NWS) OBS Marine Program.*

Maintain operations of nearshore water quality sensors, data online; Original completion date: Ongoing. **Status:** Ongoing. PacIOOS currently has 4 near shore sensors in Hawai'i (4 on O'ahu), and 4 operational in the Insular Pacific (American Samoa, FSM, RMI, and Guam).

Partners on the islands other than O'ahu are key to keeping these sensors operational, and data flowing. With new modems, telemetry for most of the real-time sensors in Hawai'i has stabilized. The team will continue exploring options for building redundancy into the telemetry network. After a two-year hiatus due to sensor damage and partner relocation, the Kalama Beach Park (Kihei, Maui) site will be back online by late June. The team is working with a local partner to deploy a SBE 16plus V2 Sea CAT at the site. The sensor will collect data on temperature, conductivity (salinity), pressure, chlorophyll and turbidity. Dynamic graphs and map viewers are on the PacIOOS website. <http://www.pacioos.hawaii.edu/water-category/sensor/>

The sensors in the Marshall Islands and Guam are being impacted by COVID-19. Our liaison (who also maintains the sensor for us) based on Majuro in the Marshall Islands has been stuck in Honolulu, HI since March 2020. For Guam, the sensor is at SeaBird Electronics for servicing, which has been delayed due to quarantine restrictions in Washington State during the pandemic.

Continue Water Quality Sensor Partnership Program, data online; Original completion date: Ongoing. **Status:** Ongoing. The PacIOOS Water Quality Sensor Partnership Program (WQSPP) continues to be popular with partners and the PacIOOS Governing Council. The sensor in Maunalua Bay was retrieved during this reporting period. The program currently has one sensor deployed (Babeldaob, Palau), and one project lining up (Maalaea Harbor, Maui). The Palau project is with a local non-profit organization, Ebiil Society, who is monitoring water quality downstream of a terrestrial/forest restoration site. The Maalaea Harbor project is with the Maui Nui Marine Resource Management Council to monitor conditions in this highly used local harbor. All WQSPP data of completed projects are now available on the PacIOOS website under archival sites: <http://www.pacioos.hawaii.edu/water/sensor-archive/>

Implement Pohnpei water quality monitoring with local partners; Original Completion date: Ongoing. **Status:** On hold. Before the pandemic, this project was experiencing some setbacks, due to a need for training on how to deploy and collect data from the rain gauges and river flow meter. The plans for the PacIOOS Operations Coordinator to meet with the local partners at the Conservation Society of Pohnpei (CSP; a local NGO) in January 2020, to provide capacity development and training were postponed to due an unforeseen unrelated accident of our team member. The team was reassessing how to address this need when the pandemic occurred, after which, it has become basically impossible to reach our partners at CSP, as their office seems to have shut down completely.

Upgrade water quality sonde for Pelekane Bay water quality buoy; Original completion date: February 2020. **Status:** Delayed. The water quality sonde for PBB was upgraded from a YSI 6600 to YSI EXO 2. The sonde upgrade for PBB was purchased in December and received at the end of February. Winter storms prevented deployment of the new sonde before the COVID-19 restrictions began. The old sonde stopped reporting at the end of March, and in mid-May the batteries died.

Maintain operations of Hawai'i Island water quality buoys, data online; Original completion date: Ongoing. **Status:** Ongoing. *Near the end of the last reporting period, the data telemetry for both buoys started experiencing issues due to problems with Xylem's Storm Central servers, which push data to PacIOOS, and the Hilo Bay buoy (HBB) batteries died and required a new switch for the solar charging system. Receiving new parts from off-island was delayed because of the busy holiday season shipping. During this time, HBB was re-painted. HBB was re-deployed in January. The batteries again began to fail at the end of May. From December through March, the Storm Central service was intermittent. In April, Xylem moved all accounts to the new Hydrosphere web service. This new service included new security measures that were inconsistent with the UH SOEST servers that receive the data (transition from FTP to SFTP). This required SOEST network managers to modify their system to allow for SFTP connections, which was completed in April. Data streaming from Hydrosphere to PacIOOS has been smooth since this time. <http://www.pacioos.hawaii.edu/water/wqbuoy-pelekane/>, <http://www.pacioos.hawaii.edu/water/wqbuoy-hilo/>*

COVID-19 impacts: In Mid-March, UH Hilo shut down due the pandemic; only essential research was permitted. The isolation and transition to online learning was also very challenging for the team's student employees. However, they were able to maintain regular trips to check the buoys and clean for biofouling. In May, UH Hilo added additional layers of institutional supervision on projects that halted all fieldwork until mid-June. Unfortunately, small boat training was canceled this summer due to COVID, so the team is working with the UH Hilo Boating Safety chair to develop alternative ways to train a new employee.

Manufacturer repair PacIOOS Seaglider; Original completion date: November 2019; and **Two 3-month glider runs; Original complete date:** May 2020. **Status:** Delayed. *The PacIOOS Seaglider was sent to Kongsberg for servicing and repair in November 2018. We anticipated receiving the repaired Seaglider during the spring of 2019, which got pushed back to November 2019 due to staffing shortage at Kongsberg. Now, due to company restructuring and COVID delays in 2020, we have yet to receive the Seaglider. Currently the Seaglider is on the calibration bench and being prepped for sea trials this summer. Kongsberg believes that we will receive the Seaglider (as it is now in the calibration pipeline) by the end of summer 2020.*

Additional activities not mentioned above that highlight regional observing system successes and occurred during this reporting period include the following:

- *Continued partnership with numerous NOAA and American Samoa partners to maintain the new MAPCO2 buoy in Fagatele Bay and conduct sampling protocol around the buoy, which is in the National Marine Sanctuary of American Samoa. All data can be viewed online on the PMEL and PacIOOS websites. <http://www.pacioos.hawaii.edu/latest-news/new-ocean-acidification-monitoring-station-american-samoa/>*
- *Continued maintenance of the new weather station at the entrance of Honolulu. Close communication with the main partner and user of the data, Hawai'i Pilots Association, illustrates high value for this data set. <http://www.pacioos.hawaii.edu/weather/obs-honolulu/>*
- *In January 2020, we finalized a site-license agreement between PacIOOS (RCUH), Pacific Wireless Communications, Kyo-ya and Marriott on an agreement to install a camera on the roof of the Sheraton hotel to support the Waikiki Beach Management Plan and other users.*

- *PacIOOS staff supported UH partners' successful effort to redeploy a shallow-water cabled ocean sensor network of Kaka'ako Park west of Waikīkī, O'ahu. The station is called the Kilo Nalu Nearshore Observatory. Led by the SOEST Department of Ocean and Resources Engineering, Kilo Nalu is collecting observations of waves, water properties, and currents.*
- *Continued our partnership with the State of Hawai'i Department of Health, Clean Water Branch that commenced during the last performance period to purchase, deploy, and maintain three new water quality sensors in Maunalua Bay, O'ahu.*

DATA MANAGEMENT SUBSYSTEM

PacIOOS server migration to new system; Original completion date: Feb. 2020

Status: *Delayed, in progress. New target completion date:* September 2020. *DMAC staff continue to migrate PacIOOS servers from a single server to a stack of servers running Virtual Machines (VM). The plan is to take advantage of VM management and parse different services to different VM's, thus eliminating single points of failure. The team has successfully migrated the main services, i.e., the PacIOOS web site, THREDDS, and ERDDAP. The final service to move is DataTurbine, which PacIOOS uses to manage real-time data from various in-situ platforms.*

Identify and ingest new biological data sets with regional partners; Original completion

date: May 2020. **Status:** *Complete/Ongoing. PacIOOS supported efforts to add data collected by the National Coral Reef Monitoring Program of NOAA's Pacific Islands Fisheries Science Center (PIFSC), Ecosystem Sciences Division to OBIS. Data of [stratified random surveys \(StRS\) of reef fish in the U.S. Pacific Islands](#) were collected between 2007-2019 and accounted for 828 different species. Data of [Rapid Ecological Assessments of Fish Large-Area Stationary Point Count Surveys \(SPC\) at Coral Reef Sites across the Pacific Ocean from 2000 to 2007](#), were collected by the Coral Reef Ecosystem Program of NOAA's PIFSC to catalog the diversity (species richness), abundance (numeric density) and biomass (fish mass per unit area) of diurnally active reef fish assemblages in shallow-water (typically 10-15m, always less than 30m) hard-bottom habitats. Both data sets were collected in the Hawaiian and Mariana Archipelagos, American Samoa, and the Pacific Remote Island Areas.*

In collaboration with Dr. Peter Houk from the University of Guam, PacIOOS supported efforts to align coral reef monitoring data from Micronesia with Darwin Core Standards, and make them available through OBIS. Three data sets can now be accessed through OBIS: (1) [fish](#); (2) [invertebrate](#); and (3) [benthic substrate](#). Spanning from September 2009 to September 2015, surveys were conducted at different sites in Micronesia, including Yap, Chuuk, Pohnpei, and Kosrae in the FSM, as well as Majuro in the RMI. The data were collected as part of the ongoing Micronesia Challenge to establish a shared, standardized monitoring program.

Hire data analyst to assist with QC and data ingest from new real-time data streams;

Original completion date: November 2019. **Status:** *Delayed. The anticipated data sources for this project have been delayed, due to our industry partner changing their course of action. In the meantime, PacIOOS is focusing on our internal migration needs.*

Additional activities for the data management subsystem that are not mentioned within the other subsystems but that highlight regional observing system success and occurred during this reporting period include the following:

- *Over 48,000 unique visitors (via direct external access to our servers) accessed more than 7.6 million pages in our servers (TDS, ERDDAP, and LAS) and transferred over 738 GB of data. These numbers serve as minimum metrics, but they are undercounted due to changes in our internal system linked to our server migration. The software for monitoring server statistics was migrated to the new servers and is operational since May 1. More robust statistics should be available by next reporting period.*
- *We added new functionalities to our dynamic website maps that accompany observational data. Under the Settings "wheel", users can now change map styles and toggle on and off various other layers and settings. When right-clicking into the map, they can Center here, Zoom in, Zoom out, Add marker, Search map, and choose between other options. Among other enhancements, hovering over the map now provides the coordinates of the cursor, and a full-screen view button is available in the top right corner.*
- *Data sets from a new regional tsunami model for the Mariana Islands with high-resolution data for three areas in Guam: Apra Harbor, Agana Bay, and Tumon Bay are now available for download in the PacIOOS data catalog, with links to THREDDS and ERDDAP. The data products (developed by UH Professor Cheung with funding from NOAA NWS) include offshore surge and currents based on Maximum Considered Tsunamis (MCT) as well as in-harbor hazard maps of surge, drawdown, and currents for hypothetical advisory and warning-level tsunamis from potential sources at the Mariana, Nankai, Philippine, and New Guinea subduction zones. These were also added to the PacIOOS data servers.*
- *Citizen Science Data: PacIOOS Voyager is now up to date with the latest quarterly water quality data sampled by the Hui O Ka Wai Ola. The hui, comprised of three local organizations (Maui Nui Marine Resource Council, The Nature Conservancy and the West Maui Ridge to Reef Initiative), active community volunteers, and scientists, collects samples of water temperature, salinity, turbidity, pH, dissolved oxygen, and nutrients (nitrogen, phosphorus, ammonia, and others).*
- *Real-time data plots (for wave parameters, water properties, and ocean currents) from the Kilo Nalu Nearshore Observatory are now accessible through PacIOOS Voyager's "Ocean Observatories" category.*

MODELING, ANALYSIS, AND PRODUCT DEVELOPMENT SUBSYSTEM

Maintain 6-day high-water level forecasts; threshold adjustments based on ongoing feedback; forecasts available online; Original completion date: Ongoing. **Status:** Ongoing. Continued ongoing maintenance of data.

<http://www.pacioos.hawaii.edu/shoreline-category/highsea/>

Maintain wave run-up forecasts; threshold adjustments based on ongoing feedback; forecasts available online; Original completion date: Ongoing. **Status:** Ongoing. Continued ongoing maintenance of data streams. PacIOOS continues to refine forecasts with user feedback and collaborating with partners to obtain on-the-ground validation during predicted events. The

work being conducted for the PacIOOS Coastal Resilience Grant project for West Maui will also provide a significant addition and upgrade to our published PacIOOS run-up forecasts in the future. <http://www.pacioos.hawaii.edu/shoreline-category/runup/>, <http://www.pacioos.hawaii.edu/pacioos-updates/data-collection-wave-dynamics-west-maui/>

Purchase and set up new server for the West Maui wave run-up forecast; New target completion date: March 2020. **Status:** Complete. *The initial order was delayed due to a delay in the FY19 funding and descope approval. We placed the order for the new server in mid-November, but the supplier experienced delays. The new server is now up and running and being used to generate the new West Maui wave run-up forecasts, which is running internally, but not yet being served to the public.*

Support the development of a new wave run-up forecast for West Maui; Original completion date: July 2020. **Status:** In progress. *PacIOOS continued to supplement support for the PacIOOS Coastal Resilience Grant project for West Maui, especially in terms of communications and data management. The forecasts are currently being produced in their operational modes for all twelve regions that cover the West Maui coast from Honolua Bay in the north to Palalaua Wayside Park in the south. These forecasts will go live after additional calibration and consistency checks specific to each region, and outreach with key stakeholders and users of the beta version of the webpages.*

Maintain harbor surge forecast; tailor based on feedback/new inputs; forecast available online; Original completion date: Ongoing. **Status:** Ongoing. *Work ongoing to refine harbor surge forecast and obtain non-IOOS funding to expand locations. With our partners, we continue to make progress toward the development of a harbor surge forecast for Kahului Harbor in Maui. A literature search and historical data/model identification are complete. Much of the historical data has now been acquired for re-analysis. Partners at the State of Hawai'i Harbors Division and USACE were consulted regarding their field experiences and conclusions from prior studies. From the prior studies, practical knowledge, and data re-analysis, the significant spatial variations of the different threats (e.g., swell wave heaving; long-period surges) to navigation and ships at dock (e.g., differences between Piers 1 and 2) are becoming clearer. The team held meetings with the Harbors Division staff, including the Kahului Harbormaster and his staff. They provided detailed narratives of wave and surge events in the harbor. They also provided protocols to access the harbor for instrument deployments and guidelines for how the instruments should be deployed. All this information, plus a guided tour of the entire harbor by staff, resulted in a plan for deployment of pressure sensors and current meters to quantify the different wave-generated threats and their spatial variations within the harbor, and to relate these threats to incident swell characteristics (e.g., significant wave height, peak period, and direction). This deployment plan will soon be submitted to USACE for permitting. A deployment date will be set after permitting and will also likely depend on the state of the pandemic.* <http://www.pacioos.hawaii.edu/shoreline-category/harborsurge/>

Maintain ROMS circulation models for Hawai'i, Mariana Islands, and Samoan Islands; Original completion date: Ongoing. **Status:** Ongoing. *PacIOOS ROMS is available for various areas and grid sizes in Hawai'i, the Mariana Islands, and Samoa.*

Observation analysis impacts for ROMS running operationally; Original completion date: Ongoing. *Status:* Ongoing. We assess the impact of every observation used to perform the daily analysis: we examine transport, Eddy Kinetic Energy (EKE), and isopycnal depth in HI; transport and EKE in Guam.

Observation forecast impacts for ROMS running operationally; Original completion date: Ongoing. *Status:* Ongoing. We now have an experimental setup that quantifies how each observation improved (or degraded) the forecast for a particular metric. Currently, we are using the transport metric in Hawai'i.

Development of coupled Physical/biogeochemical model for Hawai'i; Original completion date: Ongoing. *Status:* Ongoing. Model development of a coupled ROMS/COBALT model is complete, allowing for a seamless integration of physical and biogeochemical parameters. The goal is to incorporate the ecosystem output into PacIOOS' daily ocean modeling forecasts; however, the assimilation of biogeochemical data is a significant hurdle that we will need to work on in the coming years. We are collaborating with partners in CenCOOS on the work they are doing to incorporate biogeochemical data assimilation. We have received funding from NOAA MAPP to perform a suite of projections through the end of the century to examine the impacts of climate change on the fisheries around Hawai'i. Initial model results for the time period 2010-2017 have shown that the availability of light is the most significant driver in the seasonal cycle of organisms around Hawai'i.

<http://www.pacioos.hawaii.edu/new-tools/new-comprehensive-ecosystem-model-hawaii/>

Model data and products (including Ala Wai Plume Forecast) online; Original completion date: Ongoing. *Status:* Ongoing. All forecasts and data output are available via the PacIOOS website. <http://www.pacioos.hawaii.edu/currents-category/model/>, <http://www.pacioos.hawaii.edu/water/model-plume-alawai/>

Maintain wave (WW3 and SWAN) models for Hawai'i, Mariana Islands, and Samoan Islands; Original completion date: Ongoing. *Status:* Ongoing. PacIOOS maintained the operational wave forecast for the region with > 95% uptime during the performance period. With an additional grant from the office of Insular Affairs, we developed two new SWAN (Simulating WAVes Nearshore) forecast models in the Commonwealth of the Northern Mariana. The new model grids cover 1) the islands of Saipan, Tinian, and Aguijan, and 2) the island of Rota, with spatial resolution of 365 and 550 m respectively. This is a major upgrade from the regional 5-km WAVEWATCH III Mariana Islands forecast. The high-resolution grid in the new forecasts can better describe shallow water effects and nearshore coastal dynamics to provide more accurate wave prediction for the island community. The forecast is updated once per day and includes wave height, direction, and period in 1-hour intervals for up to 5 days into the future. As part of the QA, the daily wave forecast is compared with real-time measurements from the wave buoy deployed in the region by PacIOOS.

<http://www.pacioos.hawaii.edu/waves/model-saipan-tinian/>

<http://www.pacioos.hawaii.edu/waves/model-rota/>

<http://www.pacioos.hawaii.edu/waves/buoy-tanapag/#forecast>

RESEARCH AND DEVELOPMENT SUBSYSTEM

Transmitting tags (including ocean profiling tags) deployed on pelagics (sharks) throughout the year; Original completion date: Ongoing. *Status: Ongoing. We purchased additional oceanographic profiling satellite tags, but both the need to link up with the ATN DAC and restrictions on small boat use in the islands due to COVID-19 are pushing the deployment of these tags back. As we await a lift on the COVID restrictions, the team started using HIMB seawater facilities to test new tag antifouling products that will extend the operational life of transmitters deployed on sharks. They are also overhauling the electric fishing winch that is central to tagging operations. The team is developing data transfer protocols to allow transfer of ocean profiles to PacIOOS data portal. <http://www.pacioos.hawaii.edu/projects/sharks/>*

Maintain land-based receivers for shark tags throughout the year; Original completion date: Ongoing. *Status: Ongoing. Currently 3 land-based receivers are deployed on O‘ahu, and 2 are deployed on Maui. The team has spent this reporting period retrieving and servicing land-based receivers used to collect and forward data from tagged sharks. This includes sending units back to the manufacturer for repairs and upgrades. In addition, we are working with NERACOOS to secure additional land-based receivers to augment the current array in Hawai‘i.*

Continue to assist the IOOS ATN DAC with data ingest of ocean profiles from telemetered animals; Original completion data: Ongoing. *Status: Ongoing. The team is establishing an account at the ATN DAC to facilitate importation of historical shark tracks and ocean profiles. Initial importation is imminent.*

2.0 Scope of Work

No changes to the project scope of work are anticipated.

3.0 Personnel and Organizational Structure

No major personnel changes during this reporting period.

4.0 Budget Analysis

Spending for this award is on track with projected program expenditures. The University of Hawai‘i Office of Research Services submitted a semi-annual financial report for the period ending March 31, 2020, through Grants Online. That report showed total receipts of \$8,313,283.80.

As of May 31, 2020, internal budget tracking shows expenditures of \$8,704,724.36, representing a draw down of 79.14% of the Federal funding for this 5-year award.