

**Progress Report**  
**Developing the Pacific Islands Ocean Observing System (PacIOOS)**  
**Cooperative Agreement # NA11NOS0120039**  
**Performance Period: June 1, 2013 through November 30, 2013**

**Submitted by**  
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### **1.0 Project Summary**

The Pacific Islands Ocean Observing System (PacIOOS) is the Regional Association (RA) for Hawaii and the Insular Pacific region being developed as part of the national Integrated Ocean Observing System (IOOS). The primary goal of the work proposed under this award is to continue the development of an operational ocean monitoring and forecasting system that provides integrated, customized, and timely products that enable an ocean-literate and well-informed public and policy makers in the Pacific Islands. PacIOOS is being planned and implemented through the collective efforts of a consortium of users, signatories to the Memorandum of Agreement, and 17-member Governing Council. PacIOOS has focused initial development on water quality sensing, ocean-state and forecasting, the provision of marine ecosystem information, prediction of coastal hazards, and the development of integrated data visualization capabilities to inform marine spatial planning, operations, commerce, and recreation. Through the efforts proposed under this award, PacIOOS will enhance development of observing and product suites in each of the aforementioned focus areas and will continue to engage users, stakeholders, and system partners in the use, extension, education, and outreach of technical capacity, data visualization, and ocean information.

This report covers activities conducted during the fifth 6-month performance period of a 5-year award. Currently in Year 3 of the 5-year award, PacIOOS is operating with an annual budget of \$2,371,488.

### **2.0 Progress and Accomplishments**

#### **2.1 User Needs, Stakeholder Input and Partnerships**

- New Signatories to the MOA:
  - o Commonwealth of Northern Mariana Islands Department of Environmental Quality (DEQ);
  - o Republic of the Marshall Islands Office of the Environment Planning and Policy Coordination (OEPPC) within the Office of the President;
  - o NOAA National Weather Service (NWS), Pacific Region;
  - o Marine and Environmental Research Institute of Pohnpei (MERIP);
  - o Conservation Society of Pohnpei (CSP); and
  - o Micronesia Conservation Trust (MCT).

- Participation in the BOEM Task Force, NOAA Pacific Island Regional Team (PIRT), NOAA Sentinel Site Program, NOAA Pacific Regional Outreach Group (PROG), NOAA Aquaculture Group, NOAA Habitat Blueprint Program, and State of Hawaii Ocean Resources Management Plan (ORMP) Working Group and Policy Group.
- In their new partnership, PacIOOS and the NOAA NWS are exploring options to move PacIOOS forecasts into an experimental guidance product with hopes to transition them to operational capacity within AWIPS.
- Attend Pacific Islands Regional Planning Body (RPB) meetings and calls to promote PacIOOS data services role for the region.
- Before the August Governing Council meeting in Guam, Melissa Iwamoto met with partners and conducted site visits on Guam (University of Guam and University of Guam Sea Grant) to learn about local issues and strengthen relationships. PacIOOS also held a partner reception in Guam to foster relationships with local partners and organizations.
- Melissa Iwamoto met with current and potential partners in Palau to learn about local needs, highlight PacIOOS activities, form new and strengthen existing relationships. Meetings were conducted with the following organizations: Palau Community College, PALARIS, Palau International Coral Reef Center, Palau Conservation Society, Coral Reef Research Foundation, Palau Weather Service, and The Nature Conservancy.
- PacIOOS continues two collaborative projects with the Hawaiian Islands Humpback Whale National Marine Sanctuary. We are providing geospatial and data expertise, space, and assistance for the Niihau Management Project. Additionally, our modelers provided ocean circulation information for a West Maui discharge study.
- PacIOOS and the local Alliance for Coastal Technology program continue to partner to explore ocean acidification sensors and research.
- Discussions with PacIOOS and the US Navy (Pacific Command, PacFleet, and 3<sup>rd</sup> Fleet) focus on identifying areas for future collaboration and mutual benefit.
- Increasing numbers of researchers from the Hawaii Institute of Marine Biology (HIMB) are looking to PacIOOS to serve their research data to the public in a user-friendly manner.
- Continued to foster partnerships with the Waikiki Aquarium, CNMI NOAA Coral/CZM, State of Hawaii Office of Planning and CZM, NOAA Sanctuaries, Pacific Disaster Center, NOAA Pacific Services Center.
- Strong partnership forged with NOAA CO-OPS and our Water Quality team. CO-OPS is assisting with deployments, permitting, and other logistical issues.
- Continue to strengthen partnerships between Scripps Institution of Oceanography, CDIP, NOAA PMEL, and other core contributors to IOOS.

## 2.2 Governance and Administrative Structure

- New Governing Council representatives include PALARIS (Palau seat); NOAA NWS (Regional seat); and CNMI DEQ (CNMI seat).
- PacIOOS hosted Governing Council Meeting in August in Guam to review and evaluate the strengths of PacIOOS in order to strategically plan for a successful FY13.
- PacIOOS Governing Council elected a new Executive Committee: SOEST/PacIOOS PI (chair); Liquid Robotics; Government of Guam; Hawaii Marine and Coastal Zone Advocacy Council (MACZAC); and College of Marshall Islands.

- Co-PI meetings are held frequently to engage and update all recipients of IOOS funding through the PacIOOS cooperative agreement.
- Continue to participate in national IOOS activities that provide direction on the development of PacIOOS.

### 2.3 Business/Operations Plan

- Operations and future plans continue to be informed by PacIOOS 5-year Strategic Operational Plan.
- Continued to work with COL and IOOS Association to promote results from IOOS Summit.
- Leveraged funding and partnership opportunities with NOAA CSC, NOAA Coastal Storms Program, City and County of Honolulu, State of Hawaii, US Army Corps of Engineers, US Navy Pacific Command, EPSCoR, UH Sea Grant, and NOAA PMEL.
- Created a revolving account within the University of Hawaii at Manoa as a mechanism to bring in additional funds for requested data management services above and beyond normal operations and responsibilities of PacIOOS (e.g., PacIOOS Project Pages).

### 2.4 Planning, Design, and Implementation

- New wave buoy deployed off Hanalei, Kauai; reporting data through PacIOOS webpage and CDIP.
- Coordinated with and trained PACOM to deploy wave buoy in American Samoa. Recovery of wave buoy from US PACOM after failed deployment.
- Successful redeployments of wave buoys off Ipan, Guam (August); Mokapu; Hilo; and Lanai.
- Emergency recovery of wave buoy off Ipan, Guam (October).
- Successful wave buoy swap off Barber's Point.
- Developed a system to provide two WW3/SWAN wave forecasts per day.
- Developed system to compile WW3 input files from original NOAA NCEP sources to bypass WW3 FTP site, which was experiencing frequent delays and a long outage.
- Collected necessary bathymetry data for new location for WW3/SWAN wave forecast: Northwest Hawaiian Islands in order to address stakeholder needs.
- PacIOOS wave forecasts validated daily with measurements from NDBC buoys.
- Expanded PacIOOS Weather Research and Forecasting (WRF) model to CNMI (12km resolution); Guam (2km resolution); and Samoa (3km resolution). 7-day forecasts of surface air temperature, wind, rain, humidity, and air pressure; updated hourly.
- Expanded PacIOOS Regional Ocean Modeling System (ROMS) to CNMI (4km resolution); Guam (2km resolution); and American Samoa (3km resolution). Seven-day forecasts of water temperature, currents, salinity, and sea surface height at various depths.
- New Harbor Surge Forecast Tool released for Haleiwa Harbor.
- Multiple current meters and a pressure gauge deployed on North Shore of Oahu to improve physical understanding of the processes creating the surge in Haleiwa Harbor and to improve the accuracy of the surge forecast.
- Deployed and recovered two sub-surface moorings (Hanauma Bay and Honolulu Harbor) with McLane Moored Profilers, Acoustic Doppler Current Profilers (ADCPs), and various temperature and conductivity sensors. Data to serve multiple objectives,

including model validation for PacIOOS and evaluation of environmental variability for the Seawater Air Conditioning project in Honolulu.

- Re-analysis of PacIOOS Wave Run-Up Forecasts along the North Shore of Oahu in order to improve forecast process for multiple locations along the coast.
- PacIOOS High Sea Level Forecast for Majuro adjusted to reflect a possibility of flooding if the largest swell heights at the time are at a minimum height.
- Global comparison of time spectra of satellite vector wind products, based on collocated observations from QuikSCAT and ASCAT. This study is important for numerous applications, including construction of seamless win climatology.
- Kaena Point High Frequency Radio (HFR) operational. Extended coverage of real-time surface currents along west coast of Oahu.
- One of two Hilo HFR installations completed. Funding provided by NOAA Coastal Storms Program (CSP). Second system to be operational during next reporting block.
- Testing of prototype pop-up satellite tags capable of measuring oxygen concentrations throughout the water column. Initial test results look good.
- Participation in the IOOS Ocean Tracking Network (OTN): Retrieval and redeployment of the 3-unit 'Kipapa String' of OTN acoustic receivers. All 3 successfully recovered after 50 weeks of deployment. Data currently being analyzed.
- Continued tagging effort leveraged with State of Hawaii funding: 15 tiger sharks tagged off Maui. All implanted with acoustic transmitters; 8 equipped with fin-mounted 'SPOT' satellite transmitters. Data available on PacIOOS website.
- Continual service and maintenance of all water quality sensors (NSS) and buoys (WQB) throughout PacIOOS region.
- Deployment of new water quality near shore sensor (NSS) in Wailupe, Oahu.
- Redeployed NSS in American Samoa, Kilo Nalu WQB, and Hilo WQB.
- Received final permits for two new Maui NSS locations. Deployments planned for next reporting period, in partnership with NOAA CO-OPS and UH Maui College.
- Trained new personnel on how to service, maintain, and download data from NSS in insular Pacific.
- Developed new Ala Wai Turbid Plume Forecast – partnership between PacIOOS water quality group and PacIOOS modeling group. Continued bottle sampling for model validation.
- As part of the IOOS Marine Sensor Innovation project, expanded ocean acidification capabilities with the first remotely deployable, prototype Dissolved Inorganic Carbon (DIC) analyzer, developed by NOAA PMEL. The buoy was deployed next to Kilo Nalu WQB in October. When operated in conjunction with pCO<sub>2</sub> monitoring equipment, mineral saturation state can be calculated in real time.
- Alliance for Coastal Technologies (ACT) pH sensors installed on Kaneohe Bay CRIMP buoys. CRIMP buoys are a collaboration between UH Sea Grant, NOAA PMEL, and PacIOOS (maintenance support).
- Manual water sampling next to DIC and ACT pH sensors to ground-truth data.

## 2.5 DMAC

The PacIOOS data management group (DMG) is tasked with ensuring the data collected by PacIOOS is stored and accessible to users via standard services. In addition, the DMG develops

tools and products based on the collected data. Accomplishments by the DMG during this reporting period include the following:

- PacIOOS is now offering a new data management service called “Project Pages” to serve as a repository of ocean and coastal program and project data collected by researchers, NGOs, community groups, and partners throughout the Pacific for a service fee.
- New “project page” on Hawaii Tiger Shark Tracking developed in partnership with Hawaii Institute of Marine Biology (HIMB) researchers funded by the State of Hawaii to display near real-time tracks and locations of tiger sharks tagged off Maui.  
<http://pacioos.org/projects/sharks/>
- Three other new projects pages developed:
  - o Hawaiian Islands Sentinel Site Cooperative (NOAA PSC);
  - o Radionuclide levels around the Hawaiian Islands (UH Manoa); and
  - o Waianae Ordnance Reef Current Study (NOAA ORR and NOAA ONMS).
- An additional project page for the City and County of Honolulu Mamala Bay study is in progress.
- Development and release of New Water Quality Web Pages that streamline all PacIOOS water quality assets, the new Ala Wai Turbid Plume Model, and State of Hawaii Clean Water Branch alerts and beach monitoring results.
- Collaborated with Liquid Robotics to provide real-time displays on a wave glider deployed in the Northwest Hawaiian Islands on PacIOOS Voyager. The display includes location as well as measurements made by the glider instruments.
- Development and release of a mobile version of PacIOOS Voyager with map tools to support mobile users.
- New data holdings added to the PacIOOS Voyager, our data visualization and download tool, include:
  - o Insular Pacific and Northwest Hawaiian Islands benthic habitat maps;
  - o Atmospheric forecast model output for three new regions: CNMI, Guam, and American Samoa;
  - o Ocean circulation model output for two regions: CNMI and Guam;
  - o Updated State of Hawaii flood hazard zones and evacuation centers.
  - o Auto-select of nautical charts;
  - o Corrections to vector displays; and
  - o New marine organism tracking features.
- Development of a catalog web service to allow users to search the vast PacIOOS data holding in an automated fashion (near completion).
- Added GIS layers from the Environmental Protection Agency of the Republic of the Marshall Islands to the PacIOOS data holdings.
- The UH Coastal Geology Group provided PacIOOS with Sea Level Rise Scenario and Historical Shoreline map layers as part of a partnership to develop a tool that addresses requests by county planners. The Sea Level Rise/Shoreline Change tool provides easy access to shoreline change rates and potential impacts of sea level rise in relation to a particular parcel. The tool is currently in beta testing.
- Work continues on incorporating a Sensor Observation Service (SOS) into the PacIOOS suite of data services. The particular implementation is based on THREDDS OPeNDAP server (TDS), and PacIOOS has been working with both Unidata (TDS) and ASA (SOS) to enable this service. At present, PacIOOS has two test data sets being served by SOS.

Once the service bugs are worked out, the plan is to add all the PacIOOS point measurements (near-shore sensors and water quality buoys) to this service.

- Working with NOAA CSC and contractor to provide real-time flash flood alerts to county and state emergency managers.
- In collaboration with NOAA Hawaiian Islands Humpback Whale National Marine Sanctuary, developed an interface for targeted users to explore geospatial data related to the management of Niihau.
- Continue to enhance user interface and experiences on the web page.
- Continuously work with data and technical staff in each of the focus areas to improve user experiences and access to products and data.
- All of DMG continues to work toward meeting all of the IOOS goals and requirements.

## 2.6 Education, Outreach and Public Awareness

- During this reporting period, the PacIOOS website had 490,789 page views from 84,238 unique visitors----**an increase of 59%**.
- In collaboration with COSEE Island Earth, PacIOOS kiosks have been developed and shipped to multiple locations. Kiosks are up and running at University of Guam, Maui Ocean Center, Dolphin Quest (Kohala Coast, Big Island), and Whalers Village (Lahaina, Maui). Others are in the process of being deployed at the following locations: UH Maui College, Windward Mall (Kaneohe, Oahu), Mokupapapa Discovery Center (Hilo).
- Collaboration with UH Maui College to develop classroom activities using data available on PacIOOS Voyager, focusing on data relevant to student experiences and real-world decision-making.
- Presentations for numerous organizations, groups, and events, including NOAA PSC, Area Committee Meetings, Guam Coral Reef Symposium, Maui Ocean Awareness Trainings, NOAA Science Teachers Workshop, etc.
- Exhibits at multiple local events, including Hawaii Conservation Conference, UH Career Fair, SOEST Open House, World Oceans Day and Ocean Literacy Day events at Waikiki Aquarium, Friends of Kewalos Beach Clean Up day, etc.
- Continue to produce updated and relevant flyers and materials for workshops, conferences, partner meetings, and general outreach.
- Continue to publish and distribute monthly e-newsletters.
- Enhanced presence on social media, especially Facebook, but also including new PacIOOS Twitter and Instagram accounts.
- Collected and published success stories illustrating value of PacIOOS data, tools, and services.
- Increased public awareness and interest in PacIOOS with targeted, engaging press releases.

## 2.7 National and International Collaborations

- PacIOOS continues to participate in all IOOS and IOOS Association conference calls and workshops.
- Heather Kerkering remains a member of the Finance Committee of the IOOS Association Board. Chris Ostrander also remains a member of the board.
- Chris Ostrander continues to exercise his role in the IOOS Federal Advisory Committee.

- Chris Ostrander continues to serve on the Indo-Pacific Oceanography Reference Group (UNESCO-IOC).
- Jim Potemra participates in all monthly DMAC conference calls, as well as the marine portal forum. Jim attended the IOOS DMAC and Product Development workshop in Silver Spring, MD in September.
- Jim Potemra and Melissa Iwamoto represented PacIOOS at the IOOS Association annual meeting in La Jolla, CA in November for Chris Ostrander and Heather Kerkering.
- PacIOOS is collaborating with west coast RAs and IOOS Association to coordinate an IOOS exhibit at the AGU Ocean Sciences meeting in Honolulu in February 2014.
- PacIOOS participated in September Ocean Acidification meeting.

### **3.0 SCOPE of WORK**

#### 3.1 User Needs, Stakeholder Input and Partnerships

- Continue to work with Pacific Regional partnerships and NOAA Pacific Regional Team.
- Continue to advocate for PacIOOS as a data provider for Pacific regional efforts.
- Develop tutorials focused on specific user groups and management questions.
- Visit Insular Pacific Islands. Planned visits: Palau; American Samoa.
- Increase engagement of insular Pacific stakeholders through Governing Council members and PacIOOS liaisons.
- Continue to explore options to move PacIOOS forecasts into NOAA NWS AWIPS.
- Forge partnership with Conservation International Hawaii Fish Trust to support project community coastal restoration project on Lanai seeking to reduce sedimentation of nearshore reefs.

#### 3.2 Governance and Administrative

- Host Governing Council Executive Committee meeting in Honolulu in March 2014.
- Continue to participate in national IOOS activities that provide direction on the development of PacIOOS.
- Continue to meet frequently with PacIOOS PIs and focus area groups.
- Conduct PacIOOS administration and staff evaluations.

#### 3.3 Business/Operations Plan

- Complete an internal performance evaluation strategy in relation to PacIOOS 5-yr Strategic Operational Plan to help guide future proposals and establish priorities.
- Continue to identify and leverage funding and partnership opportunities with partners.
- Hire a consultant to help prioritize and maximize efficiency of communication efforts.

#### 3.4 Implementation Activities

- Wave buoy deployment planned for American Samoa in April 2014 (*Unfortunately, failed deployment by US Navy cost PacIOOS time and money to repair.*)
- Wave buoy redeployments planned for Majuro, Marshall Islands and Ipan, Guam. (*Frequent mooring failures due to entanglement and line chafing have led to higher than expected maintenance costs for wave buoy program.*)
- Wave buoy swaps planned for Saipan, Ritidian Point (Guam), Kaneohe, Lanai, and Mokuapu.

- Mooring swap planned for Hilo wave buoy.
- Expansion of PacIOOS Wave Forecast to Northwest Hawaiian Islands.
- Upgrading PacIOOS ROMS ocean forecast model and changing the format of the way data is shared with DMG in order to make the data more accessible.
- Upgrading resolution of PacIOOS WRF models for Guam, CNMI, and Samoa with updated surface conditions.
- Continued analysis of data for improving the PacIOOS wave run-rup forecast tool and adding new locations along the North Shore of Oahu.
- Continued data collection of harbor data to improve the PacIOOS harbor surge forecast tool in Haleiwa Harbor.
- Develop a harbor surge forecast for Hilo Harbor (*Opportunity to leverage US Army Corps of Engineers -USACE- project studying surge phenomenon in Hilo Harbor starting January 2014. USACE will deploy 6 current meters and wave sensors in Hilo Harbor; PacIOOS will have access to all data. Barber's Point Harbor Surge Forecast tool development pushed back to FY14*).
- Finalize installation of Keaukaha (Hilo) HFR; Install second Hilo HFR at Hamakua (*awaiting permits*). Funding for Hilo HFR provided by NOAA CSP.
- Installation of HFR at Kapolei, Oahu at Chevron Refinery (*awaiting permits*).
- Upgrades to HFR installations on Oahu, including more antennae, wind turbines, and Faraday shielding.
- Address backlog of quality-controlled and reprocessed HFR data (*backlog due to new installations and replacements of WERA radars*).
- Continued testing of prototype pop-up satellite tags measuring oxygen (on top marine predators).
- Continued participation in IOOS OTN Initiative with acoustic receivers.
- Increased number of tagged animals, especially off Maui, leveraged with State of Hawaii funding. Continue to provide near real-time shark tracks on PacIOOS website.
- Deploy two new Maui water quality NSS (*deployment dates postponed until January 2014 to coincide with NOAA CO-OPS travel schedule*).
- Launch upgraded Ala Wai Turbidity Plume Map in Spring 2014.
- Service, ship, and redeploy Majuro and Wailupe NSS (*Majuro NSS had loose connectors, causing water to enter electronics; Wailupe installation set-up inadequate and needed to be reconfigured*).
- Redeploy Kiholo Bay (Big Island) water quality buoy (*Satlantic technical issues with the buoy have kept it out of the water for some time now*).
- Deploy new YSI water quality buoy in Pelekane Bay (Big Island), purchased with EPSCoR funding.
- Continue participation in NOAA PMEL ocean acidification efforts, including maintenance, water sampling, and other efforts related to DIC buoy and pH sensors on PacIOOS and CRIMP WQBs.
- Deploy a Sea pHox instrument in collaboration with ACT and Scripps to measure pH and oxygen.
- Participate in new Kilo Nalo underwater, cabled observatory process.
- Purchase 10 pressure sensors and temporarily deploy 2 Seabird NSS on Lanai to support short-term data needs of community-based coastal restoration project.

### 3.5 DMAC

- Continue to add additional tiger sharks to Hawaii Tiger Shark Tracking project page, as data become available.
- Finalize and release PacIOOS SLR/Shoreline Change tool for Hawaii Planners.
- Finalize and release PacIOOS catalog web service.
- Continue to work with the City and County of Honolulu on the Mamala Bay project page.
- Continue to work with NOAA CSC and contractor to bring NOAA Flash Flood Tool back online for emergency managers.
- Continued expansion and addition of data into PacIOOS Voyager and Voyager mobile.
- Continue meeting IOOS DMAC protocol, specifically for SOS compliance.

### 3.6 Education, Outreach and Public Awareness

- Continue working with COSEE to code and deploy PacIOOS kiosks to College of Marshall Islands, Windward Community College, Hawaii State Art Museum, and NOAA Sanctuaries Center (Kauai).
- Continue to present and participate in local events (AGU Ocean Sciences Meeting, NOAA PRiMO, etc.).
- Continue to provide and create electronic and printed outreach materials (newsletters, flyers, fact sheets, etc.).
- Continue to publish and distribute press release on compelling aspects of PacIOOS.
- Refine classroom activities using PacIOOS Voyager to raise awareness and enthusiasm for ocean data in secondary and undergraduate classrooms.
- Continue to identify and publish PacIOOS success stories.
- Examine options for refining website for a more user-friendly experience.
- Target outreach efforts on specific agencies to help address PacIOOS goals.

### 3.7 National and International Collaborations

- IOOS Association meeting in Washington, D.C. in March 2014.
- Continued participation in IOOS Association, PI-GOOS, IOOS FAC.
- Exploring Voyager license agreement with Okinawa Institute of Science and Technology (OIST).
- PacIOOS and UH Center for Island, Maritime, and Extreme Environment Security (CIMES) collaborating with Liquid Robotics and USSI to develop, test, and deploy passive acoustic sensors for ship detection and tracking---with specific application to IUU fishing in the PacIOOS region.

## **4) Personnel and Organizational Structure**

No changes in key scientific or management personnel occurred during this reporting period.

- New PacIOOS liaisons hired for American Samoa and Marshall Islands, in collaboration with UH Sea Grant.
- PacIOOS hosted its first summer intern through July.
- PacIOOS hired two part-time, undergraduate student assistants.

## **5) Budget Analysis**

Spending is on track with projected program expenditures, with full draw down of funds

anticipated by the conclusion of this 5-year funding agreement.

The University of Hawaii Office of Research Services submitted a semi-annual financial report for the period ending 9/30/13, through Grants Online, dated 10/23/13. That report showed total receipts of \$4,748,183.61, representing a draw down of 66% of the Federal funding for this award, over 47% of the performance period.

As of December 1, 2013 internal budget tracking shows receipts of \$5,269,499.35, representing a draw down of 74% of the Federal funding for this award, 50% of the way through the performance period.

## Semi-Annual Supplemental Information

### 1. Products and Services

- Regional Products or Services
  - Developed new **PacIOOS Voyager Mobile** version released in September 2013, less than one year after Voyager release. <http://pacioos.org/voyager/mobile/>  
Highlights include:
    - Optimization for touch screen devices and small screen sizes.
    - Simplified interface highlights the components most critical for on-the-go monitoring;
    - Accessed through a web browser, so available for use on any brand of mobile device with Internet access;
    - Users can identify their current location to better orient themselves on the map;
    - Ruler to measure the distance between two locations;
    - Click a point on the map to get its ocean depth or land elevation.
  - **PacIOOS Voyager** improvements include:
    - Insular Pacific and Northwest Hawaiian Islands benthic habitat maps;
    - Atmospheric forecast model output for three new regions: CNMI, Guam, and American Samoa;
    - Ocean circulation model output for two regions: CNMI and Guam;
    - Updated State of Hawaii flood hazard zones and evacuation centers.
    - Auto-select of nautical charts;
    - Corrections to vector displays; and
    - New marine organism tracking features.
  - New PacIOOS service called “**Project Pages**” to serve as a repository of ocean and coastal program and project data collected by researchers, NGOs, community groups, and partners throughout the Pacific for a service fee. New “project pages” include:
    - Hawaii Tiger Shark Tracking developed in partnership with Hawaii Institute of Marine Biology (HIMB) researchers funded by the State of Hawaii to display near real-time tracks and locations of tiger sharks tagged off Maui. <http://pacioos.org/projects/sharks/>
    - Hawaiian Islands Sentinel Site Cooperative (NOAA PSC);
    - Radionuclide levels around the Hawaiian Islands (UH Manoa); and
    - Waianae Ordnance Reef Current Study (NOAA ORR and NOAA ONMS).
  - Development of a catalog web service to allow users to search the vast PacIOOS data holding in an automated fashion (*near completion*).
  - Development of Sea Level Rise/Shoreline Change tool to provide easy access to shoreline change rates and potential impacts of sea level rise in relation to a particular parcel (*currently in beta testing*).
  - Working with NOAA CSC and contractor to provide real-time flash flood alerts to county and state emergency managers.

- In collaboration with NOAA Hawaiian Islands Humpback Whale National Marine Sanctuary, developed an interface for targeted users to explore geospatial data related to the management of Niihau.
  - Developed a system to provide two WW3/SWAN wave forecasts per day (*to address requests from NOAA NWS*).
  - Developed system to compile WW3 input files from original NOAA NCEP sources to bypass WW3 FTP site, which was experiencing frequent delays and a long outage.
  - Expanded PacIOOS Weather Research and Forecasting (WRF) model to CNMI (12km resolution); Guam (2km resolution); and Samoa (3km resolution). 7-day forecasts of surface air temperature, wind, rain, humidity, and air pressure; updated hourly.
  - Expanded PacIOOS Regional Ocean Modeling System (ROMS) to CNMI (4km resolution); Guam (2km resolution); and American Samoa (3km resolution). Seven-day forecasts of water temperature, currents, salinity, and sea surface height at various depths.
  - New Harbor Surge Forecast Tool released for Haleiwa Harbor.
  - PacIOOS High Sea Level Forecast for Majuro improved to reflect a possibility of flooding if the largest swell heights at the time are at a minimum height.
  - Extended coverage of real-time surface currents along west coast of Oahu.
  - Developed new Ala Wai Turbid Plume Forecast.
  - New Water Quality Web Pages that streamline all PacIOOS water quality assets, the new Ala Wai Turbid Plume Model, and State of Hawaii Clean Water Branch alerts and beach monitoring results.
- National Products or Services
    - Continue to make regional assets available to national data centers and repositories.

## 2. Data Management

PacIOOS is continuously working toward a standards-based foundation for DMAC capabilities. The PacIOOS data management group (DMG) is tasked with ensuring the data collected by PacIOOS are stored and accessible to users via standard services. The utilization of standard web services, in particular OPeNDAP, SOS, and OGC, ensure that PacIOOS has DMAC capabilities that are compatible with the larger IOOS effort. All PacIOOS data services are standards-based, all data are open (although some are redistributed), and the PacIOOS system is service-oriented and uses common vocabulary.

Updated progress:

- Continued work on incorporating a Sensor Observation Service (SOS) into the PacIOOS suite of data services. The particular implementation is based on the THREDDS OPeNDAP server (TDS), and the PacIOOS DMG has been working with both Unidata (TDS) and ASA (SOS) to enable this service. At present, PacIOOS has two test data sets being served by SOS and once the service bugs are worked out, the plan is to add all of

the PacIOOS point measurements (water quality near-shore sensors and water quality buoys).

- Open Data Sharing. PacIOOS Voyager continues to be the main data viewer for PacIOOS and portal for open data sharing to PacIOOS stakeholders. The DMG has made several improvements including auto-select nautical charts and NWHI benthic habitat maps; corrections to vector displays; and new marine organism tracking features. Two major enhancements over this reporting period include: 1) the development of a mobile version of PacIOOS Voyager; and 2) the addition of map tools to support mobile users. In addition, PacIOOS has almost completed the development of a catalog web service to allow users to search the vast PacIOOS data holding in an automated fashion.
- Provision of data to WMO GTS. PacIOOS relies on NDBC to put data on the GTS. Whatever data NDBC receives from PacIOOS servers goes to the GTS. At this point, in this includes HFR and wave buoy data.
- Implementation of a service-oriented architecture. Architecture is the same as before, and is considered SOA.
- Use of common vocabularies and identifiers. All PacIOOS data are netCDF CF compliant. When there are no appropriate CF names, the PacIOOS DMG uses community standards.
- PacIOOS continues to use standard metadata conventions.
- Data storage and archiving continued throughout the reporting period. New holdings include benthic habitat maps for the Insular Pacific and the Northwest Hawaiian Islands; atmospheric forecast model output for three new regions: CNMI, Guam, and American Samoa; ocean circulation model output for two regions: CNMI and Guam; and State of Hawaii flood hazard zones and evacuation centers.

Examples of on-going program-level participation in data management planning and coordination include:

- Monthly IOOS DMAC conference calls.
- Annual IOOS DMAC Annual meeting in Silver Spring, MD. September 2013.
- IOOS National Product Development workshop in Silver Spring, MD. September 2013.
- IOOS Association Annual Meeting in La Jolla, CA. November 2013.
- Member of IOOS Glider Plan Development Team.
- Member of IOOS Biological Data Working Group.
- Numerous local meetings with regional stakeholders and data providers.

### 3. Observing Assets

- ‘Platforms of opportunity’ used to support monitoring of ocean acidification:
  - DIC sensor near Kilo Nalu water quality buoy (S. Shore of Oahu)
  - Ala Wai water quality buoy
  - Kilo Nalu water quality buoy
  - CRIMP and Kaneohe water quality buoy – both with new ACT pH sensors.
  - Hilo Bay water quality buoy
- Please see included excel spreadsheet for detailed list of observing assets.