



JIMAR Plans for FY 2020

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Douglas S. Luther, PhD

Director

Joint Institute for Marine and Atmospheric Research
University of Hawaii at Manoa
1000 Pope Road, MSB 312
Honolulu, HI 96822
<http://www.soest.hawaii.edu/jimar>

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Ecosystem Forecasting

Open Source ADMB Project

P.I.: John R. Sibert

During the next fiscal year, the project will distribute another release of ADMB. The release will include bug fixes, added function documentation, software testing and improvements to ADMB runtime. A key development feature for the software is utilizing multiple system CPUs for faster runtimes. The software was originally developed to be used on a single CPU and supporting multiple CPUs has proven difficult. The project will also continue to investigate ideas to thread the computations in the software. Another key area for development is utilizing the current ISO/IEC C++ 17 standard into the ADMB. The software was developed before the older ISO/IEC C++11 standard. By using the current C++ 17 standard, ADMB can then use the built-in threading support, templates and other built-in functions to improve source code maintainability and runtime. There are plans for a Developers' Workshop in 2020 to be held at the University of Massachusetts Dartmouth, and hosted by Assistant Professor Dr. Gavin Fay. The workshop objectives will be similar to previous workshops where developers will discuss new ideas and work in small groups to resolve software issues.

Ecosystem Monitoring

Ecosystem Structure and Function

P.I.: Douglas S. Luther [JIMAR Project Lead: Melanie Abecassis]

Next year, JIMAR will hire a full-time laboratory technician to analyze a range of samples (lancetfish stomachs, zooplankton and micronekton) from previous and upcoming cruises, and continue assessing patterns in the biomass and distribution of mid-trophic level organisms in the Hawaii longline fishing ground and in Hawaii waters.

Ecosystems Observations and Research Program: Research Support Project

P.I.: Douglas S. Luther [JIMAR Project Lead: Jeffrey Hare]

Enhanced Environmental Data Management to Support Fisheries and Ecosystem Research. This project (led by Jesse Abdul) will continue building on progress made during the previous reporting period to provide data management, development support, and guidance to PIFSC data divisions and projects. JIMAR will identify collaboration opportunities between PIFSC divisions and programs and work to identify two or more data sets feasible for direct integration. A formal assessment of the state of data management within PIFSC divisions will be undertaken in collaboration with each division's data staff. The project will develop standards, best practices, data tools and procedures to improve the quality of PIFSC data management. JIMAR also plans to compile new employee orientation materials to streamline the process of getting started with PIFSC data systems and scientific data management.

Large Marine Ecosystem/Ecosystem-Based Fisheries Management Coordination. As information continues to be collated, the project will solicit management and scientific inputs from NOAA Pacific Islands Regional Office (PIRO), PIFSC and JIMAR staff to help determine where there are gaps in the layers of important ecosystem information so that a valuable resource is created for stakeholders. Given the value tied to key partner engagement, the project (led by Megan Asher) plans to reach out to additional stakeholders as the document continues to move forward.

Aquaculture System Management. For the upcoming year, JIMAR staff (led by Aaron Moriwake) will continue to provide system management support for the SWS facility, including coordinating activities, maintaining and repairing equipment, training staff on system operations, modifying facility to suit staff needs, and providing support for incoming animals.

Pacific Islands Region Fisheries Science Outreach and Education. Led by Ali Bayless, this project will support outreach and education activities such as community events, career fairs, and school programs on a quarterly basis representing PIFSC in partnership with JIMAR. The 2018 PYSO program is currently ongoing, with four new students working with JIMAR and PIFSC federal staff on research projects. JIMAR will also continue to develop and post online outreach products focused on current research and Science Center priorities that include Feature Stories, Science Blogs, and Story Maps coordinated with social media updates. In addition, the project plans to increase outreach collaborations and exchanges with scientists based at the University of Hawaii at Mānoa and its School of Ocean and Earth Science and Technology.

Ecosystems Observations and Research Program: Science Operations Project

P.I.: Douglas S. Luther [JIMAR Project Lead: Kyle Koyanagi]

Analysis and Evaluation of Fishery Independent Data and Collection Methods for Insular Fish Stocks in the Pacific Islands Region. Over the next year the Analysis and Evaluation Team will complete video analysis for fish abundance and lengths from the 2019 insular bottomfish sampling mission for new dataset products, and continue annual reporting on MOUSS performance and camera error issues. Next year, the team will also begin preliminary testing and training of the Video and Image Analytics for a Marine Environment (VIAME) open-source automated image analysis toolkit to determine if this new software would be useful in streamlining and increasing efficiency of video analysis workflow. The Analysis and Evaluation Team will also continue its MOUSS-360 comparison studies to improve understanding of how fish interact with the MOUSS and quantify fish that may go uncounted. Additionally, the team will continue testing and analysis of an artificial LED light prototype to enable bottomfish surveys beyond the current 250-meter depth limit.

Operations and Logistics Services to Support Pacific Islands Fisheries Science Center Research Missions and Projects. The SOD Field Operations Team will continue to provide high quality, effective logistical, operational, small boat, laboratory, and dive research support services while striving to ‘lead the standard’ in safety for PIFSC research activities.

Advanced Survey and Sampling Technology Development. Next year, JIMAR staff in the SSTP will begin lab and field testing a next-generation MOUSS DVR unit to eventually upgrade and replace the existing MOUSS DVRs at a lower price point. Development and field testing of custom LED lights and housings for MOUSS will be continued, and a comparison of field performance with existing underwater light technologies will be conducted. Ongoing MOUSS maintenance, error troubleshooting, and technology support, and Autonomous Underwater Vehicle (AUV) maintenance and support will be conducted.

Geospatial Products. The project will recruit a new JIMAR GIS Data and Web Specialist to continue developing innovative geospatial products for general research efforts. The project will also continue to maintain and expand the Pacific Marine National Monuments Web-Based GIS Mapping Pilot Project.

Marine National Monuments of the Pacific. During fiscal years 2015-2017, a project team successfully created and managed a series of four thematic online mapping applications. The four ‘apps’ (Fisheries Research, Coral Reef Ecosystems, Marine Mammals, and Research Cruises) provide public access to detailed information about PIFSC research activities in the Pacific Islands Region (PIR). These apps contain over 40 individual datasets collected throughout the region by PIFSC over the past several decades. After initially launching the apps with focus on the Mariana Archipelago, the team expanded the scope of the project by updating the applications to include additional data from the Marianas as well as other regions in the Pacific. The team also developed a new single application that combines the four thematic apps into a single interface. Efforts were also directed at capacity building and collaboration within PIFSC to improve workflows for inputting new data into the applications. Following the recruitment of a new JIMAR GIS Data and Web Specialist, efforts will continue to expand the project by focusing on Pacific Remote Islands Marine National Monument (PRIMNM), Rose Atoll Marine National Monument (RAMNM), and Papahānaumokuākea Marine National Monument (PMNM), providing access to more data and capabilities to meet the needs of PIFSC stakeholders.

Main Hawaiian Islands Commercial Fisheries Fast Track Data Project

P.I.: Douglas S. Luther [JIMAR Project Lead: Kimberlee Harding]

The 2018 PIFSC stock assessment determined the ACL for the federal fishing years 2018-2019, 2019-2020, 2020-2021 at 492,000 pounds with a 40% risk of overfishing. The new federal fishing year for 2019-2020 will begin on September 1, 2019 and JIMAR staff will continue real-time monitoring and entering fisheries data within two days of receiving fishing reports. They will also run daily error checks and provide fishery managers weekly summary updates. Error analysis reports containing discrepancies between fisher and dealer reports are created monthly and the report records are rectified by contacting fishers and dealers for corrections. JIMAR staff will follow up with dealers within three days to correct any discrepancies and/or blank data, and within one week with fishers for trip reports submitted online or through mail.

JIMAR staff will attend training on database functions and managing the new HDAR MySQL database. Staff will continue to support HDAR staff and Western Pacific Fisheries Information Network (WPacFIN) in developing the new Online Commercial Marine Dealer Reporting System (ODRS) expected to launch in July 2019.

NCRMP Pacific Reef Assessment and Monitoring Program (RAMP)

P.I.: Douglas S. Luther [JIMAR Project Lead: Brittany Huntington]

During the coming project year, the major objective is to plan and execute the Marianas Islands RAMP (MARAMP) cruise in spring 2020 aboard the R/V *Rainier*. Since this vessel is a new platform for RAMP cruise execution, additional planning efforts are anticipated to determine a feasible scope and scale of the field mission as well as safe operations. Secondly, the project plans to complete post-cruise processing of Phase II datasets from ASRAMP. A PIFSC cruise report will be finalized and submitted following the completion of the MARAMP cruise.

Ocean Remote Sensing

P.I.: Douglas S. Luther [JIMAR Project Lead: Melanie Abecassis]

In addition to maintaining operations and supporting users, during the next fiscal year the project plans to: organize another satellite course; develop python and Matlab scripts for the course; and add more data streams to the OWCP offerings including the newly developed NOAA sea surface anomaly dataset, salinity from SMOS and SMAP, the Coral Reef Watch dataset, and the ESA OC CCI v.4 datasets.

Pacific Fisheries Monitoring Program

P.I.: Douglas S. Luther [JIMAR Project Lead: Frances Tong]

The project will continue to monitor Hawaii's pelagic longline fishery at the same high level to allow completion of quarterly and annual reports within the allotted time. JIMAR staff will complete daily bigeye and striped marlin catch updates for entry into the fast track system. This system allows for timely and accurate forecasting and fishery closures in compliance with annual WCPFC and IATTC requirements. Additionally, as local and international management continues evolving to include tracking of more species of concern, the project will explore options for inclusion of these species.

The ER team will continue distributing tablets to the longline fleet and training captains in using electronic logs. It will also continue working with the application developer to address software issues, implement new features, and simplify equipment and deployment.

The JIMAR EM staff will start automating EM video review with machine learning by utilizing the 160TB of EM data collected from vessels. In addition to the technical memorandum completed earlier this year, EM staff will produce other documents, such as one that outlines review speeds for EM review as well as standard operating procedures for EM video review. In addition, EM staff will lead a steering committee with members of the fishing industry, WPRFMC, PIRO, and other partners, to implement EM in the Hawaii longline fishery.

The logbook archival scanning project will continue working on the American Samoa longline logbooks and

scanning the Hawaii logbooks as they are submitted. The team will continue to foster positive and cooperative relationships among PIFSC, the fishing industry, and other interested parties through daily onsite monitoring activities. The team will also continue to enter data for the Pacific tuna fishery purse seine fleet.

Pacific Islands Territorial Science Initiative (PITSI)

P.I.: Douglas S. Luther [JIMAR Project Lead: Frances Tong]

For the next report period the JIMAR Fisheries Database Assistant will continue with data entry. An anticipated staff resignation may require that brochure updates and maintenance be taken over by the new Guam DAWR Aquatics Education staff person.

The JIMAR Territorial Fisheries Data Specialist will complete the neutral landscape model and produce a manuscript comparing the value of several survey types across a range of effort levels. Work will also be undertaken on a Bayesian model to integrate data across three fishery and ecosystem surveys that are ongoing in the territories.

Pacific Tuna Fishery Data Management

P.I.: Douglas S. Luther [JIMAR Project Lead: Jesse Abdul]

The project will continue to enter SPTT data into the PIFSC enterprise database using the four data management applications and the recently developed data tracking application. The project will also continue to resolve data QC issues and work with the industry to help ensure the quality of the SPTT data.

Sustaining Healthy Coastal Ecosystems

P.I.: Douglas S. Luther [JIMAR Project Lead: Brittany Huntington]

The focus for the next year includes leveraging existing ESD monitoring and other available data to provide analyses to support jurisdictional and federal management agencies activities and serve as a resource on best practices, methods development, and analyses as applied to coral reef ecosystem research and management. In FY 2020, the project will focus staff time and efforts toward analyzing NCRMP data, producing a suite of reports, information products, and services to support ecosystem-based management and conservation of coral reefs across the Pacific Islands Region. Many of these information products, services, and analyses are aimed at responding to specific requests (i.e. Essential Fish Habitat, assessment of specific management actions, etc.) received during on-going collaborative discussions with local and jurisdictional partners in Hawaii, American Samoa, Guam, and the CNMI, and with NOAA and other federal partners.

Territorial Biosampling

PI: Douglas S. Luther [JIMAR Project Lead: Melanie Hutchinson]

Plans for next year focus on delivering research output describing life-history strategies of several commercially-harvested coral reef fish species and deep-water snappers from waters surrounding the U.S. Pacific Islands. The project anticipates one manuscript will be published documenting age, growth, and maturation of two goatfish species from Saipan, CNMI. Another manuscript documenting the age, growth and maturation of the blue trevally from CNMI is expected to be drafted from data generated during upcoming cruises. Project staff plan to continue sampling efforts for a deep-water snapper project specific to the MHI and complete a draft manuscript. The project is currently recruiting a fish reproduction expert to increase data output for reef fish species of interest and to facilitate communication with the Stock Assessment Program to fulfill data requirements. A PIFSC LHP research cruise to American Samoa is scheduled for 2020 and JIMAR staff will participate in research efforts during that cruise. Territorial Biosampling staff will also continue working with territorial partners to facilitate efficient data collection and processing.

West Hawaii Integrated Ecosystem Assessment

P.I.: Douglas S. Luther [JIMAR Project Lead: Jeffrey Hare]

The West Hawai'i IEA project will continue to conduct novel and interdisciplinary research to help elucidate key socioeconomic factors, oceanographic processes, and ecological interactions that drive nearshore and pelagic marine food-web dynamics.

JIMAR will continue to process and analyze the extensive amounts of biological samples and physical data collected during previous expeditions to the region. These efforts will be synthesized into a number of reports, peer-reviewed journal articles and outreach material, highlighting novel findings and key insights on food-web dynamics necessary to support ecosystem-based management in the region. JIMAR researchers supported by the West Hawai'i IEA have one manuscript in review and two manuscripts in preparation on surface slicks in West Hawai'i.

JIMAR researcher efforts will also continue to provide information and support the State's Marine 30x30 Initiative, whereby a statewide network of priority management areas will be identified that constitute at least 30% of nearshore waters by 2030. The West Hawai'i IEA will be closely involved in the Initiative, leveraging resources and conducting collaborative research to help bring to bear the best and most up-to-date information to support the development of the implementation plan.

Western Pacific Fisheries Information Network (WPacFIN)

P.I.: Douglas S. Luther [JIMAR Project Lead: Frances Tong]

The project will continue converting VFP database applications to MySQL and C# for WPacFIN Central and partner agencies. For DAR, the fish catch report module and dealer report module are slated for completion. Also, DAR's historical data for catch and dealer data will be cleaned up, converted, and imported to the MySQL database. Historical catch data is for the period 1948 – 2009 and dealer data is 2000 through June 30, 2019.

JIMAR and PIFSC staff will jointly overhaul WPacFIN Central database to conform to established standards of database design, administration and management. The project will redesign the database structure to accepted database conventions which involves data cleanup, code updates to reports, creation of documentation and other activities. Project staff will be expanded to include a database administrator/database programmer with a recruitment expected to open shortly after the new fiscal year starts.

Ecosystem-Based Management

Marine Debris Mitigation Project

P.I.: Douglas S. Luther [JIMAR Project Lead: Brittany Huntington]

As no formal marine debris mission is planned for FY 2020, the next year offers a prime opportunity to analyze the existing marine debris data collected collaboratively by ESD and PSD. Plans for data analysis entails reviewing, analyzing, and synthesizing nearly a decade of debris data collected within PMNM and the NWHI. The intent is to leverage this existing dataset by adding a quantitative scientific component to PIFSC's legacy of executing debris removal missions and to capitalize on the growing national visibility of marine debris issues. Outputs from the analyses will inform how marine debris accumulation impacts NOAA's managed habitats and protected species within the PMNM and NWHI. Additional outreach and mission planning efforts for FY 2021 mission execution will also begin in FY 2020.

Socioeconomics of Western Pacific Fisheries

P.I.: Douglas S. Luther [JIMAR Project Lead: Hing Ling Chan]

During the coming year, the project will continue providing support to the ongoing economic data collection programs for the American Samoa, Guam, and CNMI small-boat fisheries and database management for the cost data collected from the Hawaii and American Samoa longline fisheries. JIMAR will update the online data

summaries and seek publications through various outlets. In addition, thirteen project elements are planned for FY 2020. These include: 1) provide assistance to the National Community Social Vulnerability Indicators work plan; 2) conduct socioeconomic monitoring for resilient communities in the Pacific; 3) conduct a cost-earnings study of Hawaii longline fleet; 4) conduct a cost-earnings study of Hawaii small-boat fisheries; 5) implement a pilot project on the science of compliance to improve understanding of sensitive and non-compliant fishery activities; 6) evaluate interactions between oceanic whitetip sharks and small-scale fisheries in the Marianas Archipelago in a human dimension context; 7) analyze the impact of climate change on the economic viability of fishing for tuna and billfish; 8) model location choice in the deep-set and shallow-set fisheries; 9) model observer effects on fishing behaviors; 10) understand and improve engagement and communication with western Pacific fishing communities; 11) integrate social, economic, and cultural components into submodules for the Main Hawaiian Islands Atlantis Ecosystem Model; 12) incorporate spatially explicit sociocultural values in the west Hawaii IEA; and 13) examine the economic impacts of changes in fisheries management regulations through bioeconomic modelling.

Stock Assessment Research Program

P.I.: Douglas S. Luther [JIMAR Project Lead: Melanie Hutchinson]

In the next reporting year JIMAR researchers within the PIFSC Stock Assessment Program will be involved in investigations of insular and pelagic fishes. The pelagic fish group will focus on the stock assessment of the striped marlin, including analyses of spatially explicit length-frequency distributions using spatio-temporal statistics to generate a standardized abundance index and running an integrated assessment using stock synthesis software. Work will be completed on the uku (*Aprion virescens*) assessment in Hawaii. Several new R packages that are still in production will be made publicly available on Github once they have undergone final revisions. In the next year, the pelagic research will be focused on investigating stock structure for marlins and billfish in collaboration with NOAA Southwest Fisheries Science Center staff, and incorporating environmental variables into the swordfish stock assessment in collaboration with PIFSC scientists and scientists from Japan and Taiwan. No pelagic assessments are planned for next year; the focus will be on addressing concerns with the stock assessment models.

Protection and Restoration of Resources

Cetacean Research Program

P.I.: Douglas S. Luther [JIMAR Project Lead: Marie Hill]

In February 2020 the CRP will conduct a small-boat survey for humpback whales within the Mariana Archipelago. Additional plans for the next fiscal year include continued deployment of acoustic recorders on longline gear to assess the potential cues to false killer whales and continued maintenance and data collection of the HARP systems.

Effects of Nitrogen Sources and Plankton Food-Web Dynamics on Habitat Quality for the Larvae of Atlantic Bluefin Tuna in the Gulf of Mexico

P.I.: Karen E. Selph

Manuscripts highlighting the results of this project are currently being prepared and this work will continue through the next fiscal year.

Fishing Impacts on Non-target Species

P.I.: Douglas S. Luther [JIMAR Project Lead: Melanie Hutchinson]

During the next project year the project will expand its post-release mortality study to include additional species and fill data gaps identified during the course of the initial study. The project will also complete the gear trials

on the longline fishing vessel F/V *Gutsy Lady 4*. A report on the catch results from the four trips and telemetry data will be compiled. During the next year the project will continue engagement in the Hawaii Community Tagging Program, monitor tag deployments, and service receiver arrays at Oahu and Hawaii Island FAD locations. JIMAR staff will also continue its partnership with Hawaii Uncharted to create a photo identification library for oceanic whitetip sharks around Hawaii. The project is also recruiting staff to support electronic tag data analyses, illustration, and publishing data generated during the last four years.

Hawaiian Monk Seal Northwestern Hawaiian Islands Research Seasonal Support

P.I.: Douglas S. Luther [JIMAR Project Lead: Lizabeth Kashinsky]

Over the coming year, the JIMAR HMSRP staff will continue to collaborate with NMFS scientists to collect monk seal survey and life history data and conduct enhancement activities primarily in the NWHI. JIMAR staff will perform field studies, tag and mark animals for identification, collect specimens for genetic studies, conduct boating operations, collect non-invasive samples for foraging studies, and monitor for health and disease opportunistically through necropsies and non-invasive sampling techniques. Non-invasive specimens will also be collected for ongoing foraging studies. Ongoing survival enhancement activities may include collection of dangerous debris off beaches, disentanglement of seals, translocation of weaned pups within French Frigate Shoals (FFS), and reuniting mother-pup pairs. Special enhancement projects may include continuation of shark monitoring and removal, vaccinating seals against morbillivirus, and translocation of pups between breeding sites. Advanced technologies (remote cameras, rovers, Unmanned Aircraft Systems, etc.) may also be utilized to monitor the population. Field personnel may also perform vocalization studies and assist other programs and agencies which may include establishing and maintaining marine debris plots, conducting insect, plant, and Laysan duck surveys, and collecting sea turtle nesting data.

Hawaiian Monk Seal Research Program

P.I.: Douglas S. Luther [JIMAR Project Lead: Lizabeth Kashinsky]

Over the next reporting year, the JIMAR HMSRP will continue to collect survey and life history data on monk seals and conduct enhancement activities primarily in the MHI. JIMAR staff will collaborate with National Marine Fisheries Service (NMFS) scientists to conduct HMS field studies, analyze data and perform daily maintenance, operations, and training for field camps. JIMAR staff will coordinate and respond to stranded seals, conduct boating operations, train and lead field personnel, and continue to update and maintain existing databases. Foraging and dietary studies will be carried out in the MHI, and health and disease monitoring will occur opportunistically through necropsies and non-invasive sampling techniques in conjunction with foraging studies. Vaccination of wild seals against morbillivirus will continue. Ongoing survival enhancement activities may include collection of dangerous debris off beaches, disentanglement of seals, translocation of weaned pups, and reuniting mother-pup pairs. Special enhancement projects may include continuation of shark monitoring and removal, collection of undersized seals for rehabilitation, and translocation of pups between breeding sites. The program will continue to advance its behavioral research and may design studies to test techniques to modify monk seal behavior and develop tools and protocols for application in future management activities.

Marine Turtle Recovery in the Pacific Islands Region

P.I.: Douglas S. Luther [JIMAR Project Lead: Camryn Allen]

For FY 2020, Dr. Gaos will continue studies on the ecology of hawksbill sea turtles in the MHI. JIMAR field researchers at FFS will continue to monitor the nesting abundance of green sea turtles and return in the fall of 2019. JIMAR staff will participate in field captures of marine turtles on Oahu and periodically on the neighbor islands and will continue the utilization of the newly developed sea turtle endocrinology laboratory for research projects investigating sex, sex ratio, capture stress, and age of sexual maturity. JIMAR will conduct studies on age and growth of green and hawksbill sea turtles within the MHI as well as high seas populations through the Pacific Islands Regional Office (PIRO) Observer Program.

Pacific Islands Deep Sea Coral and Sponge Initiative

P.I.: Douglas S. Luther [JIMAR Project Lead: Virginia Moriwake]

For the next reporting period, JIMAR plans to provide updated images to the online Benthic Deepwater Animal Identification Guide; complete annotations of the video from 2018 Nautilus dives in PMNM and submit those records to the DSCRTP; and begin annotation and production of post-cruise data products of 2019 R/V *Falkor* and E/V *Nautilus* dives in the Pacific.

Papahānaumokuākea Marine National Monument Monitoring and Research

P.I.: Douglas S. Luther [JIMAR Project Lead: Brian Hauk]

During the next reporting year, JIMAR project staff will coordinate advanced survey trainings for student intern divers participating in the NWHI RAMP/BioGeo cruise (RA-19-02) scheduled for July and August 2019. Staff members who are also participating in RA-19-02 will monitor and characterize shallow and mesophotic coral reef ecosystems and quantify their benthic habitats in association with fish assemblages on this expedition. They will also perform follow-up surveys at the Lisianski mass bleaching and buoy grounding sites.

Project staff will begin coordinating logistics and planning for a multi-year mesophotic research project in American Samoa slated to begin early in 2020 and last for several years. Staff will also continue processing 3D models, begin analyzing data from the 2019 expedition and commence with manuscript preparations. The Resource Protection Program will continue to participate in activities to protect the marine ecosystems of the NWHI, including hull inspections, marine debris removal planning, and coordinating efforts to remove grounded National Weather Service buoys and assess damage caused by them.

Equatorial Oceanography

Optimizing Routine Ocean Current Measurements by the NOAA Fleet

P.I.: Eric Firing

The current project grant ends on September 30, 2019 and a proposal was submitted for renewal. If it is funded, the project plans to continue its work along the same lines as during the previous reporting period.

University of Hawaii Sea Level Center

P.I.: Philip Thompson

Modernization of the UHSLC's data acquisition, quality control, and archiving software will continue to be the priority focus during FY 2020, including an ambitious goal to move to a brand-new No-SQL database that allows for rapid and flexible subsetting, searching, and distribution of data. The website content will continue to be updated, and the project will continue to focus on developing content with real-world uses for stakeholders and researchers. UHSLC technicians nominally visit stations at approximately two-year intervals for normal maintenance and propose to visit 14 UHSLC core project stations and install one new co-located GPS receiver during FY 2020. UHSLC research in the coming year will consist of a variety of ongoing and new projects. Project researchers will continue to investigate the skill and usefulness of seasonal sea level forecasts around the United States, the frequency and statistics of future high-tide flooding across U.S. coastlines, and the dynamics and statistics of wave-driven and tidal flooding in American Samoa and the Pu`uhonua O Hōnaunau National Historical Park on the Island of Hawaii.

University of Hawaii Sea Level Center cGPS

P.I.: Philip Thompson, James Foster

A new GNSS site will be installed at an existing UHSLC tide gauge installation in the Pacific region. The project is searching for an opportunity to deploy the installation crew on a ship visiting Johnston Atoll allowing them to add GNSS to that tide-gauge. The equipment currently in Mexico for installation will be designated at a different tide-gauge site. Maintenance visits are planned to the GNSS sites in the Cape Verde Islands (site TGCV), and the Maldives (sites HULE and ADDU). Data from existing sites will be retrieved, archived locally, and transmitted to the international data archives for global public access.

Climate Research and Impacts

Analysis of Vulnerability of Military Installations in the Pacific Basin to Coastal Flooding

P.I.: Mark A. Merrifield

The project team will complete Regional Frequency Analysis (RFA) for both the Continental U.S. and the Pacific region. The team will also explore the application of mixed and other distributions to the analysis of lesser extremes. Distributions other than commonly used Poission-type distributions, such as the beta-binomial distribution, will be investigated and may offer a better representation of the probabilities of lesser extremes. The project team will also conduct an assessment of sources and ranges of uncertainty to better quantify precision/accuracy bounds associated with the various Extreme Value Analyses (EVA) methods that are being explored. Sources of uncertainty affecting estimates of the probability of extreme sea level events include: the quality of the sea level data; the selection of the extreme sample data; the selection of the extreme statistical model; the choice of the extreme sea level approach; the uncertainty of extreme sea levels associated with mid-long term global to regional climate change and variability; and the local causes of extreme sea level variations. The team will also complete a Level I analysis at the installation-level coastal flooding vulnerability assessment at NABC. This will include further site visits to ensure that this effort can be successfully completed and will result in tangible, quality products that show the value of the protocol and its outcomes and thereby, lay the groundwork for institutionalizing this approach within the DoD.

Atmospheric Gases in the Remote Pacific Marine Free Troposphere Measured in Hawaii

P.I.: Douglas S. Luther [Brian Vasel, Darryl T. Kuniyuki]

Dr. Akane Yamakawa from the National Institute for Environmental Studies (NIES), Japan, will collaborate with ARL and MLO personnel in the coming year. Dr. Yamakawa's research will focus on the collection and analysis of air samples for mercury isotope composition which arises from both mass-dependent and mass-independent fractionation. Competing processes (e.g., natural and anthropogenic emissions, transport, oxidation/reduction, deposition, and re-emission, etc.) are characterized by different fractionation mechanisms, and measuring mercury's isotopic composition at a number of locations can be a powerful tool to trace the sources, sinks, and transformational cycles of atmospheric mercury. This understanding is needed to better inform policy-relevant global mercury models, such as that developed at ARL, to explain spatio-temporal trends in atmospheric mercury deposition and provide scientifically robust information to aid efforts to reduce mercury contamination around the globe.

Enhancement of Data and Research Activities for Climate Studies at the International Pacific Research Center (IPRC)

P.I.: Kelvin Richards

This was a one-year grant, but a proposal was submitted to continue the APDRC data services for an additional year. If funded, the new grant will provide resources to fully develop the WMO RA-V Climate Monitoring Node.

Pacific ENSO Applications Climate (PEAC) Center

P.I.: James Potemra

As part of PEAC's current transition to the National Weather Service, the project will continue monitoring and providing feedback necessary to support the transition process. Extensive validation of PEAC products and activities must be conducted periodically and the process also needs to be debated within the context of user feedback. This year the PEAC scientists will monitor the performance of the various components of the transition activities and evaluate them for possible improvement. This is also important from the perspective of JIMAR to evaluate JIMAR's role in making 'climate applications research' instrumental for hazards management (Note that PEAC has been a JIMAR project for the last 25 years).

Plan for Applications Research: El Niño Impacts on the USAPIs. While the increasing frequency of El Niño is a major concern, recent observations revealed that in many cases the island-specific rainfall and sea level pattern appear to be different for the three different types of El Niño events, e.g., warm pool El Niño (WPE), cold tongue El Niño (CTE) and mixed El Niño (ME). Therefore, by synthesizing the findings in Chowdhury and Chu (2019), the project will conduct more detailed study on physical interpretations of three different types of El Niño on island-wide seasonal climate variability. This will significantly improve understanding on 'El Niño impacts on the USAPIs' and support the island-specific short-to-mid-term planning and management in climate-sensitive sectors.

Profiling CTD Float Array Implementation and Ocean Climate Research

P.I.: Douglas S. Luther [Gregory C. Johnson]

For the next project year, JIMAR collaboration with PMEL and other Argo partners will continue with testing, deployment, and performance monitoring for more core and Deep Argo floats. Ocean climate studies will continue using Argo data, including analysis of global ocean heat content and sea surface salinity variations with more work on delayed-mode quality control for the PMEL Argo floats. Work will continue towards building a regional deep Argo Array in the South Atlantic.

Transferal of Pacific ENSO Applications Climate (PEAC) Center Products and Services to Weather Forecast Office (WFO) Honolulu

P.I.: James Potemra

In the next and final year, the transition plan will be finalized and PEAC will train the NWS staff in the various activities so that the NWS can incorporate these into their work plan.

Tsunamis and Other Long-Period Ocean Waves

Archive of Rapidly-Sampled Hawaiian Sea Level

P.I.: Douglas S. Luther

The ongoing application of the rapidly-sampled sea level records in PacIOOS efforts to diagnose the causes of harbor sea level variations and coastal inundation events demonstrates that the collection, processing, archiving, concatenation, and dissemination (through ARSHSL) of rapidly-sampled Hawaiian sea level are important activities that will therefore be continued. As funding permits, the project will move forward with the re-establishment of the full ARSHSL archiving activities. Along with JIMAR funding, PacIOOS resources will be used to accomplish the resumption of real-time data acquisition from several PTWC's gauges for archiving in ARSHSL. However, the low priority and light funding of ARSHSL means this will be a multi-year activity.

Tsunami Research and Modeling

P.I.: Douglas S. Luther

Due to various delays in personnel recruitment the project work has been delayed until later in the calendar year 2019. A new position recruitment was launched, the selectee accepted the offer and is tentatively slated to begin work in September 2019.

The University of Hawaii Sea Level Center—Tsunami Research

P.I.: Philip Thompson

During FY 2020, the project plans to meet project objectives by servicing five Pacific Tsunami gauges and five Caribbean Tsunami gauges.

List of Acronyms

ACL	Annual Catch Limit
ADMB	Automatic Differentiation Model Builder
APDRC	Asia-Pacific Data Research Center
ARL	Air Resources Laboratories
ARSHSL	Archive of Rapidly-Sampled Hawaiian Sea Level
ASRAMP	American Samoa Reef Assessment and Monitoring Program
AUV	Autonomous Underwater Vehicle
CNMI	Commonwealth of the Northern Mariana Islands
CPU	Central Processing Unit
CRP	Cetacean Research Program
CTE	Cold Tongue El Niño
DAR	Hawaii State Division of Aquatic Resources
DAWR	Division of Aquatic and Wildlife Resources (Guam)
DoD	Department of Defense
DSCRTP	Deep Sea Coral Research and Technology Program
DVR	Digital Video Recorder
E/V	Exploration Vessel
EM	Electronic Monitoring
ENSO	El Niño Southern Oscillation
ER	Electronic Recording
ESA OC CCI	European Space Agency Ocean Color Climate Change Initiative
ESD	Ecosystem Sciences Division
EVA	Extreme Value Analyses
FAD	Fish Aggregating Device
FFS	French Frigate Shoals
FY	Fiscal Year
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
HARP	High-frequency Acoustic Recording Packages
HDAR	Hawaii Department of Aquatic Resources
HMS	Hawaiian Monk Seal
HMSRP	Hawaiian Monk Seal Research Program
IATTC	Inter-American Tropical Tuna Commission
IEA	Integrated Ecosystem Assessment
ISO/IEC	International Organization for Standardization/International Electrotechnical Commission
JIMAR	Joint Institute for Marine and Atmospheric Research
LED	Light Emitting Diode
LHP	Life History Program
MARAMP	Marianas Archipelago Reef Assessment and Monitoring Program

ME	Mixed El Niño
MHI	Main Hawaiian Islands
MLO	Mauna Loa Observatory
MOUSS	Modular Underwater Stereoscopic System
NABC	Naval Amphibious Base - Coronado
NCRMP	National Coral Reef Monitoring Program
NIES	National Institute for Environmental Studies
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWHI	Northwestern Hawaiian Islands
NWS	National Weather Service
OC CCI	Ocean Colour Climate Change Initiative
ODRS	Online Commercial Marine Dealer Reporting System
OWCP	Ocean Watch – Central Pacific
PacIOOS	Pacific Islands Ocean Observing System
PEAC	Pacific ENSO Application Climate (Center)
PIFSC	Pacific Islands Fisheries Science Center
PIR	Pacific Islands Region
PIRO	Pacific Islands Regional Office
PMEL	Pacific Marine Environmental Laboratory
PMNM	Papahānaumokuākea Marine National Monument
PRIMNM	Pacific Remote Islands Marine National Monument
PSD	Protected Species Division
PTWC	Pacific Tsunami Warning Center
PYSO	PIFSC Young Scientist Opportunity
QC	Quality Control
R/V	Research Vessel
RAMNM	Rose Atoll Marine National Monument
RAMP	Reef Assessment and Monitoring Program
RFA	Regional Frequency Analysis
SMAP	Soil Moisture Active Passive
SMOS	Soil Moisture and Ocean Salinity
SOD	Science Operations Division
SOEST	School of Ocean and Earth Science and Technology
SPTT	South Pacific Tuna Treaty
SSTP	Survey and Sampling Technologies Program
SWS	SeaWater System
TB	Terabyte
U.S.	United States
UHSLC	University of Hawaii Sea Level Center
USAPI	United States Affiliated Pacific Islands

VFP	Visual FoxPro
VIAME	Video and Image Analytics for a Marine Environment
WCPFC	Western and Central Pacific Fisheries Commission
WMO RA-V	World Meteorological Office Regional Alliance Five (Pacific Islands)
WPacFIN	Western Pacific Fisheries Information Network
WPE	Warm pool El Niño
WPRFMC	Western Pacific Regional Fishery Management Council