



# CIMAR Plans for FY 2024

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## Ecological Forecasting

### Open Source ADMB Project

**P.I.: Erik Franklin**

Next year, the Open Source Automatic Differentiation Model Builder (ADMB) Project will have a final release of ADMB and wind down the project due to no further planned funding support from the National Oceanic and Atmospheric Administration (NOAA) after March 31, 2024. The project will provide a final ADMB version (release 13.2) with updated documentation on GitHub. The team will transition the project infrastructure into a storage phase on GitHub that assumes no future support and development. The project will implement software approaches that facilitate the long-term, stable use of the ADMB software using standard installers and Docker containers.

## Ecosystem Monitoring

### Ecosystem Structure and Function

**P.I.: Douglas S. Luther [CIMAR Project Lead: Justin Suca]**

Plans for the coming fiscal year include the conclusion of stomach collections for the mahi-mahi project, collection of ichthyoplankton tows for managed species throughout Hawai'i waters via the Hawaiian Islands Cetacean and Ecosystem Assessment Survey (HICEAS) cruise, and light trapping efforts to attempt to catch the settling stages of uku larvae on O'ahu. This large expansion of field work will allow the project to better characterize the early life stages of managed species and the environmental associations of their habitat. This coming year will also be spent developing manuscripts and technical reports for the larval dispersal modeling work, distribution modeling work for both Guam and the Main Hawaiian Islands (MHI), and the metabarcoding of micronekton stomach contents. Development of a data report is also expected for the results of the light trapping work that is planned to conclude in the middle of the fiscal year. A project will also be conducted assessing the utility of stationary satellite products for improving observations of trends and patterns in nearshore chlorophyll and turbidity patterns, with the expectation of a report or manuscript from this project.

### Ecosystems Observations and Research Project

**P.I.: Douglas S. Luther**

This project will support outreach and education activities such as community events, career fairs, and school programs representing the Pacific Islands Fisheries Science Center (PIFSC) in partnership with the Cooperative Institute for Marine and Atmospheric Research (CIMAR). CIMAR will continue to develop and post online outreach products focused on current research and Science Center priorities, including feature stories, science blogs, and story maps coordinated with social media updates. In addition, the project plans to continue the PIFSC Young Scientist Opportunity (PYSO) engagement which is generally viewed as a highly positive engagement for the students as well as the CIMAR and federal researchers in PIFSC.

### Electronic Monitoring and Bycatch Estimation in Fisheries

**P.I.: Douglas S. Luther**

The Electronic Monitoring (EM) program will continue to advance Artificial Intelligence (AI) development by continuing to add annotations to our image library focusing on data gaps, protected species, and common false

positives. This will allow for the continued development of more accurate and robust machine learning (ML) object detection models that can automate detection of catch on longline fishing vessels. The program will begin working on a report comparing automated detections using developed AI models with data collected by at-sea observers. Post-release mortality assessment will also continue for protected species interactions collected by EM data. EM staff will also work with PIFSC and the Pacific Islands Regional Office (PIRO) developers to build a database to allow for the integration EM and observer data.

## **Fisheries Monitoring Project**

**P.I.: Douglas S. Luther**

The project has closed, and no further work is planned.

## **Life History and Population Assessment Research**

**P.I.: Douglas S. Luther**

The next project year will include continuing to work toward the generation of life history traits (age distribution, growth, life span, and maturation schedules) of harvested species scheduled for assessment from Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands (CNMI). Particular focus will be given to preparing analysis and documentation of the sex-specific assessment of reproductive life history traits for *Etelis coruscans* from Guam and CNMI. If sample sizes and length ranges are sufficient, analysis will be completed for sex-specific reproduction characteristics in these regions. Work will continue on investigating the use of aquatic biochronologies to assess biological responses to climate change. Otoliths from fishes will be used to reconstruct past environmental conditions, identify thermal events, and thus predict how marine organisms may respond to a rapidly changing climate. Biochronologies from different species will be used in a complex approach to describe a change occurring across an ecosystem. The next step is to apply this innovative research to an appropriate management unit species (MUS).

## **National Coral Reef Monitoring Program – Pacific Project**

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

During the coming project year, the main objective is two-fold: (1) finish executing the American Samoa National Coral Reef Monitoring Program (NCRMP) cruise in late Summer 2023 aboard Research Vessel (R/V) *Rainier*; and (2) complete data archive for the 2022 NCRMP cruise datasets to the National Centers for Environmental Information (NCEI). Data collected from the Rainier Integrates Charting, Hydrography, and Reef Demographics (RICHARD) Fiscal Year (FY) 2023 mission will be process, annotated, and archived to meet NOAA reporting requirement. Lastly, mission planning for the FY 2024 NCRMP–Pacific cruise to the Hawaiian Islands will begin early next fiscal year with the field mission planned to begin in Spring 2024.

## **National Coral Reef Monitoring Program - PacIOOS Support for Annual Refurbishment of MAPCO<sub>2</sub> Buoy at Class III Site in American Samoa**

**P.I.: Melissa Iwamoto**

For the next fiscal year, the project will continue operationally, but with a transition of the Fagatele Bay moored autonomous partial pressure of carbon dioxide (CO<sub>2</sub>; MAPCO<sub>2</sub>) buoy ownership/responsibility shared between the Pacific Islands Ocean Observing System (PacIOOS) and NOAA Sanctuaries American Samoa versus NOAA's Atlantic Oceanographic and Meteorological Laboratory.

## National Ocean Acidification Observing Network - O'ahu's Linked Kāne'ohe Bay Observing Sites

**P.I.: Christopher L. Sabine**

The project's main focus for the next fiscal year will be on buoy support and maintenance activities at the coral reef instrumented platform-2 (CRIMP-2) and Kāne'ohe sites. This includes annual buoy housing and mooring maintenance, refurbishment of instruments, data quality control, and data management. Additionally, the team will continue biweekly calibration/validation sampling, laboratory analyses, data quality control, and data management for both sites. The goal is to submit the data collected in 2023 by March 2024. So far, the project has analyzed several months of validation samples for total alkalinity (TA), dissolved inorganic carbon (DIC), and nutrients.

Regarding data evaluation, the project is comparing reef data across sites in the Pacific and Atlantic and calculating net ecosystem calcification and net ecosystem production variations between the CRIMP-2 and Kāne'ohe moorings. The findings of the reef carbon system comparison will be published in a special issue of the journal *Frontiers in Marine Science* under the research topic Time-Series Observations of Ocean Acidification: A Key Tool for Documenting Impacts on a Changing Planet. The abstract title: "Detecting Anthropogenic CO<sub>2</sub> Signals in Island Reef Ecosystems: Insights from High-Frequency Measurements and Inter-Island Comparisons" was accepted and manuscript writing is underway.

## Science Operations in the Pacific Islands Region

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

*Analysis and Evaluation of Fishery Independent Data, Habitat, and Collection Methods for PIFSC Research Missions and Activities.* In the upcoming year the Marine Optical Imagery (MOI) Team will complete video analysis for fish abundance and lengths for the 2023 insular bottomfish survey with the resulting data set product delivered to the Fisheries Research and Monitoring Division (FRMD) Stock Assessment Program (SAP), and continue annual reporting on the Modular Optical Underwater Survey System (MOUSS) camera errors. The team will work with the Marine and Applied Knowledge for Ecosystem Research Laboratory (MAKER Lab) to analyze deployment videos comparing MOUSS/Robot Operating System (ROS) digital video recorders and forward looking infrared cameras to the standard MOUSS cameras. MOI CIMAR staff will continue testing and training of the Video and Image Analytics for a Marine Environment (VIAME) automated image analysis toolkit, using a new Windows-based Operating System (OS) and web-based Graphical User Interface (GUI) software enhancements for the creation of annotation training data. VIAME training data will come directly from the OceanEYES citizen science workflows. OceanEYES will also be used to verify abundance count methodologies to verify if there is an asymptomatic relationship in respect to true abundance. Finally, the team will assess the video analysis data set from the artificial light-emitting diode (LED) light deployed beyond the current 250-meter ambient light depth limit during the 2022 bottomfish surveys and further test lights to ensure the optimal lighting moving forward.

*Operations and Logistics Services to Support PIFSC Research Missions and Activities.* The Operations and Logistical Team will continue to provide high quality, effective logistical, operational, and small boat research support services while striving to 'lead the standard' in safety for PIFSC research activities.

*Advanced Technology, Marine Instrumentation, Design & Fabrication, Acquisition, and Infrastructure Support for PIFSC Research and Activities.* CIMAR staff in the MAKER Lab will continue to support the assessment of Hawai'i Deep 7 bottomfish stock with efforts to maintain and improve the existing MOUSS and develop the next generation stereo camera system. To support the effort the MAKER Lab has chosen the ROS in an attempt to make the system easily upgradeable and work across multimedia platforms. Two camera brands have been chosen for initial testing. ROS also will allow for additional sensor integration. The project will continue to assess the effectiveness of adding an artificial lighting system. More research and development in the lab and field will occur.

For the upcoming year, CIMAR staff will continue to assess and troubleshoot the new Supervisory Control and Data Acquisition (SCADA) system and provide infrastructure and system management support for the Marine Animal Recovery Facility (MARFAC). This includes coordinating and supporting day-to-day research activities,

ensuring operational readiness, **Standard Operating Procedure** (SOP) development, training staff on system operations, and providing subject matter expertise on MARFAC and system upgrades.

*Enhanced Fisheries Research Data Management to Support PIFSC Research Missions and Activities.* CIMAR staff will continue to build on the progress that has been made in previous years with providing support of software development, development of data stewardship standards and best practices, support and guidance on data integration, and development of software data tools.

## **Sustaining Healthy Coastal Ecosystems Project**

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

A final year of pilot assessments of carbonate budget methods in American Samoa and the Pacific Remote Island Area (PRIA) are underway as part of the 2023 NCRMP mission. Vital rate image collection will continue through September 2023, followed by the goal of extracting vital rate (growth, mortality and reproduction) data from ten fixed sites in the American Samoa and PRIA regions. The land-based sources of pollution project will focus on providing virtual training to monitoring teams from jurisdictional partners in American Samoa on water quality protocols and benthic survey methods.

## **Territory Electronic Reporting Project**

**PI: Douglas S. Luther**

The project has closed, and no further work is planned.

## **Ecosystem-Based Management**

### **Economics and Human Dimensions of Marine Ecosystems**

**P.I.: Douglas S. Luther [CIMAR Project Lead: Adam Ayers]**

*Hawai'i longline cost-earnings data collection and analysis.* CIMAR economists will complete cost-earnings surveys with the Hawai'i longline fleet and work with the National Marine Fisheries Service (NMFS) economist to analyze survey data and draft a report for publication.

*Regional Fisher observations data collection and analysis.* A CIMAR social scientist will attend quarterly Advisory Panel meetings for American Samoa, Guam, CNMI, and Hawai'i, collect fisher observations data, and also attend annual fisher observations meetings for the respective jurisdictions to collect fisher observations data. The CIMAR social scientist will analyze these data and publish them as PIFSC data reports and as narratives in the annual archipelagic and pelagic Stock Assessment and Fishery Evaluation reports.

*Guam Small Boat Fishery Cost-Earnings.* A CIMAR economist will analyze Guam Small Boat Cost-Earnings data and draft a report for publication along with some potential outreach and education materials.

*CNMI Small Boat Fishery Cost-Earnings.* A CIMAR economist will analyze CNMI Small Boat Cost-Earnings data and draft a report for publication along with some potential outreach and education materials.

*Hawai'i small boat uku (Aprion virescens) portfolio/diversification Ecosystem-Based Fisheries Management project.* CIMAR social scientists and economists will estimate the level of catch diversification of uku commercial fishers in Hawai'i and the role of uku in the overall catch portfolio of Hawai'i small boat commercial fishers using State of Hawai'i commercial marine license data, catch reports, and diversification measures.

*Hawai'i uku ecosystem and socioeconomic profile report card.* A CIMAR social scientist and an economist will integrate stakeholder input and complete a report card for the MHI uku fishery and report on relevant ecosystem and socioeconomic relationships and indicators. The report card will be shared with scientists, managers, and the fishing community. Progress will be shared at a national NMFS Ecosystem and Socioeconomic Profile (ESP) workshop and shared as an outreach component for the fishery.

*Hawai'i Deep-7 bottomfish ecosystem and socioeconomic profile report card.* A CIMAR social scientist and an economist will complete a report card for the MHI Deep-7 bottomfish fishery and report on relevant ecosystem and socioeconomic relationships and indicators. The report card will be shared with scientists, managers, and the

fishing community. Progress will be shared at a national NMFS ESP workshop shared as an outreach component for the fishery.

*Fish Flow.* CIMAR social scientist will work with NMFS social scientists to review NOAA forms and surveys across all regions in order to improve the comprehensiveness of longitudinal data surrounding fish catch, focusing on the role of fisheries in local and regional food systems, cultural practices, fishing community well-being, and non-market benefits.

*Cultural Prioritization of Marine Taxa.* A CIMAR social scientist will develop a culturally grounded process for discerning which marine taxa that fishing communities would like prioritized within marine research and management. The CIMAR social scientist will pilot test this process as part of the West Hawai'i Integrated Ecosystem Assessment to better ensure cohesion between NOAA science and management with community concerns and priorities, pursuant to informing in alignment with Equity and Environmental Justice (EEJ) mandates as well as the integrating roles of indigenous and cultural fishing within management

*Cultures of Governance.* The CIMAR social scientist will draft a manuscript for peer-review that analyzes several key case studies that illustrate the cultural dynamics embedded within environmental governance institutions and how those internal cultures impact efforts to efficaciously and ethically integrate indigenous and traditional ecological knowledge and engage generatively with stakeholders.

## Protection and Restoration of Resources

### Cetacean Research in the Pacific Islands Region

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

The next fiscal year will be dominated by HICEAS. This project is part of a greater collaborative effort. The Pacific Marine Assessment Program for Protected Species is a partnership among Federal Agencies (Bureau of Ocean Energy Management, NOAA Fisheries (Alaska, Northwest, Pacific Islands, and Southwest Fisheries Science Centers), US Navy, and US Fish and Wildlife Service) to conduct surveys to assess the abundance of multiple species and their ecosystem. HICEAS is a collaborative project with the Southwest Fisheries Science Center that will involve two ships conducting line-transect abundance surveys for cetaceans within the Hawai'i exclusive economic zone over a period of 5 months (5 legs). All CIMAR Cetacean Research Program (CRP) staff will participate in at least one leg of the project. Following the survey, the effort and data collection will be detailed and summarized in a NOAA Technical Memorandum by Kymberly Yano and Marie Hill. In addition, the visual and passive acoustic data will be processed by Kym, Marie, and Yvonne Barkley for further analysis.

The CRP will continue to maintain the Pacific Islands Passive Acoustic Network (PIPAN) deployments of High-frequency Acoustic Recording Packages (HARPs) and datasets and support development and use of acoustic analysis tools to enable efficient use of this dataset. The PIPAN dataset represents one of the longest passive acoustic time series in NMFS for examining cetacean occurrence and ocean noise metrics. The valuable dataset provides occurrence, seasonality, and relative abundance data for portions of our region that we cannot otherwise monitor, and will serve as a goldmine for new assessments.

Dr. Pina Gruden and colleagues will conduct additional testing of the code for automated tracking and localization of multiple acoustic sources. Dr. Barkley and colleagues will perform a sensitivity analysis on the false killer whale classifier and conduct additional testing. Additional SeaGlider missions will be planned.

### Fishing Impacts on Non-Target Species

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

During the next fiscal year this project will allow the tags currently deployed as part of the Hawai'i Community Tagging Program (HCTP) to continue to transmit data. The data will then be collated, analyzed, and published in scientific publications. The HCTP will continue to undertake outreach and education opportunities and continue our regular communications (i.e., social media and quarterly newsletters) with the HCTP participants. The data generated by the HCTP participants has greatly improved handling of a threatened species and has assisted regional fishery managers to meet conservation mandates and to create meaningful measures to reduce mortality to listed species.

The project also began a large collaborative study with researchers from over ten agencies to build species distribution models (SDMs) using existing telemetry data generated by this project and our partners for seven target and non-target key or management unit shark, marlin and tuna species. The SDMs will identify the environmental parameters that may predict hot spots or aggregation times or areas to assist fishers with avoidance of protected species. The results from this endeavor will then be integrated into climate change models to elucidate how changing oceanographic conditions will affect the availability of preferred habitat and how this may impact these species' vulnerability to fishery interactions.

## **Hawaiian Monk Seal Papahānaumokuākea Marine National Monument Research Project**

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

CIMAR staff will continue to collaborate with NMFS scientists to collect monk seal survey and life history data and conduct enhancement activities. A field technician conducted research and enhancement activities at Kuaihelani (Midway Atoll) in July and August to closely monitor seals and sea turtles during a US Fish and Wildlife Service mouse eradication project. Two to three field technicians participated on the ARC Light cruise from mid-August to mid-September at Kamole (Laysan), Kapou (Lisianski), and Manawai (Pearl and Hermes). CIMAR field staff will perform field studies, tag and mark animals for identification, collect specimens for genetic studies, conduct boating operations, 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.

Field staff may also participate in translocation and other recovery actions including hazing or removal of aggressive male seals, behavioral modification, collection of dangerous debris off beaches, disentanglement of seals, inter- and intra-atoll translocation, evaluation and capture of seals for rehabilitation, and feeding and soft release of rehabilitated seals. Ongoing survival enhancement activities may also include translocation of weaned pups, and reuniting mother-pup pairs. Additionally, under guidance of a veterinarian, staff may provide treatment for wounds or other health conditions (e.g., lancing abscesses, administering antibiotics or other drugs). Special enhancement projects may include continuation of shark predation mitigation and deterrence, vaccinating seals against morbillivirus, inter- and intra-atoll translocation, evaluation and capture of seals for rehabilitation, and feeding and soft release of rehabilitated seals. Advanced technologies (i.e., remote cameras) may also be utilized to monitor the population. Field personnel may also assist other programs and agencies which may include sound trap deployment/retrieval, turtle nesting and other turtle data, Kamole duck surveys and feather collection, collect shark bite DNA swabs, monitor for and report on invasive species, conduct insect surveys, and detect and mitigate wildlife entrapments primarily at Lalo (French Frigate Shoals).

## **Hawaiian Monk Seal Research and Recovery Project**

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

Over the next reporting year, plans for the CIMAR Hawaiian Monk Seal Research and Recovery Project include collecting survey and life history data on monk seals and conduct enhancement activities primarily in the Main Hawaiian Islands (MHI). CIMAR staff will collaborate with NMFS scientists to conduct Hawaiian monk seal (HMS) field studies, analyze data, and perform daily maintenance, operations, and training for field camps. Staff will recruit 2024 field staff, and CIMAR staff will coordinate and respond to stranded seals, provide veterinary care and other support for protected species, conduct boating operations, train and lead field personnel, and continue to update and maintain existing databases. CIMAR staff will conduct intermittent field work at Kalaupapa this summer, helping to monitor mother-pup pairs, assist with flipper tagging and vaccinations of weaned pups, and plan to deploy a sound trap to collect acoustic data on monk seals in the area. CIMAR staff will also participate in field research involving the deployment of seal-mounted cameras and vocalization recording devices on O'ahu.

Foraging and dietary studies will occur in the MHI and health and disease monitoring will occur opportunistically through necropsies and non-invasive sampling techniques in conjunction with foraging studies or via directed studies. Vaccination of wild seals against morbillivirus is also expected to 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. CIMAR staff may also participate in special enhancement projects that may include continuation of shark monitoring and removal, collection of undersized seals for rehabilitation, and translocation of pups between breeding sites. HMSRP plans to continue to advance 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 as well as continue with vocalization studies, unmanned aircraft systems (UAS) activities, and fish pen research that may involve CIMAR staff.

## **Marine Turtle Recovery in the Pacific Islands Region**

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

The CIMAR field researchers will deploy at Lalo again in the spring of 2024 to monitor turtle abundance via nesting and basking surveys, deploy nest temperature data loggers, and mitigate wildlife entrapment hazards. CIMAR staff will continue to support seasonal field staff through training, preparing equipment, analyzing data, and writing reports. CIMAR staff may participate in field captures of marine turtles on O‘ahu and periodically on neighbor islands, as well as during the annual rapid assessment of green sea turtles at Rose Atoll, American Samoa. CIMAR will conduct studies on age and growth of sea turtles within MHI 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. University of Hawai‘i (UH) students at UH Hilo and UH Mānoa will continue to support stranding efforts on Hawai‘i Island and O‘ahu, respectively. A stable isotope analysis (SIA) will be conducted on skin tissue samples obtained from Guam’s nesting green sea turtles (*Chelonia mydas*) to determine if stable isotopes can be used to predict foraging areas without having to utilize costly Global Positioning System (GPS) satellite tags.

## **Pacific Islands Deep-Sea Coral and Sponge Initiative**

**P.I.: Douglas S. Luther [CIMAR Project Lead: Jeffrey Drazen]**

During the next project year, CIMAR staff will continue to work to gather information on deep-sea coral and sponge communities and expand their annotation efforts to include other fauna as well. Annotation of animal observations from the 2023 Ocean Exploration US west coast expeditions will be undertaken.

## **Papahānaumokuākea Marine National Monument Monitoring and Research**

**P.I.: Douglas S. Luther [CIMAR Project Lead: Brian Hauk and Chelsie Counsell]**

CIMAR staff are currently preparing for a research expedition on a charter ship to Papahānaumokuākea Marine National Monument (PMNM) to monitor the spread of invasive algae, to characterize the spectral signature of invasive algae species to better inform remote sensing efforts, and to study how invasive algal species are impacting the coral reef ecosystem. As part of this expedition, CIMAR staff will also track resource recovery relative to Hurricane Walaka and mass coral bleaching, retrieve and deploy Ecological Acoustic Recorders (EAR), collect environmental DNA (eDNA) samples, and collect conductivity, temperature, and depth (CTD) casts to support the National Fish and Wildlife Foundation oceanography research. Project staff are also coordinating logistics and planning for a National Centers for Coastal Ocean Science funded multi-year mesophotic research project in American Samoa. CIMAR staff participated in the August 2023 research expedition supporting efforts to characterize the mesophotic reefs of American Samoa. Staff will continue processing three-dimensional (3D) reef models. Staff will continue analyzing data from research expeditions and summarizing findings in internal reports as well as in scientific manuscripts. CIMAR staff will continue to support the Resource Protection Program by participating in activities to protect the marine ecosystems of the Northwestern Hawaiian Islands (NWHI), including hull inspections, marine debris removal planning, and coordinating efforts to monitor damages caused by grounded National Weather Service buoys and to remove new buoys that are causing potential threats. The Papahānaumokuākea Remote Observation (PRO) Group will continue to develop remote sensing capabilities and to analyze satellite, UAS, and underwater imagery. CIMAR staff will participate in NOAA dive training courses, Motorboat Operator courses, and other training as needed to support PMNM research. In addition to training, the

project will continue to increase team capacity through proficiency field work, partnerships with other research groups, and expanding the team through hiring another research technician.

## **Oceanographic Monitoring and Forecasting**

### **Improving Ocean Current Measurements for Research: Maximizing Contributions from the NOAA Fleet**

**P.I. Julia Hummon**

The project is planning to work with the NOAA Office of Marine and Aviation Operations (OMAO) to expand acoustic Doppler current profiler (ADCP) NCEI data accession to two more ships within the year. Andrew Frambach plans to continue our practice of presenting at the annual NOAA Survey Tech. Monitoring and maintenance of our current systems and software, with upgrades and development of improvements as needed, will continue. The project has been working with NOAA OMAO on a planned tech refresh of all University of Hawai'i Data Acquisition System (UHDAS) server systems and equipment, to be completed over a long period, beginning with testing of the candidate model. There are also plans to work with the OMAO *Marine* and Aviation Cyber Center on cybersecurity enhancements for the new UHDAS servers. Twenty-four servers (two for each ship) will be ordered, built and delivered to 12 NOAA ships. A UHDAS staff member will travel to each ship for final installation and crew training when their schedule allows.

### **University of Hawai'i Sea Level Center**

**P.I.: Philip Thompson**

The plan for the next fiscal year is to make scheduled updates to Fast Delivery and Research Quality databases with incorporation of any new Global Sea Level Observing System (GLOSS) Core Network or Global Climate Observing System (GCOS) stations as they become available. The project plans to make maintenance visits to 14 core University of Hawai'i Sea Level Center (UHSLC) stations, five Pacific tsunami stations, and five Caribbean tsunami stations (24 total visits). Similarly, the team plans to install one new co-located GPS (cGPS) station and make maintenance visits to three existing cGPS stations. The project will begin the next phase of the database overhaul, which will center around a migration away from text-based data holdings to a structured modern database that supports improved versioning, archiving, and real-time serving of data. The team plans to continue updating products and tools that communicate sea-level information to stakeholders in scientific and coastal communities, including the sea-level section in the *Bulletin of the American Meteorological Society* State of the Climate Report; a tide-gauge index of global mean sea level for Climate.gov; monthly sea level forecasts for Pacific Islands; and the UHSLC Station Explorer for exploring data and metadata from UHSLC-operated tide gauges. The project plans to continue contributions to peer-reviewed literature concerning sea level trends, variability, extremes, and forecasting.

### **Utilization of Glider Observations for Environmental Prediction in Different Climate Regimes**

**P.I.: Douglas S. Luther**

The project anticipates that glider operations in the Solomon Sea will resume in early 2024 after a four-year hiatus. The plan is to restart the production and distribution of near-realtime Solomon Sea transport values. The team will also continue work on the Pacific-Arctic Exchange with the objective to relate recent changes and trends in the Alaskan Stream strength to variation in salinity and heat flux toward the Bering Sea and Arctic.

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## Climate Science and Impacts

### **Atmospheric Gases in the Remote Pacific Marine Free Troposphere Measured in Hawai'i**

**P.I.: Douglas S. Luther**

Now that additional solar power has been added to the Mauna Loa Observatory, plans are underway to resume measurements of elemental mercury to continue indefinitely until sufficient power is restored to allow the measurement of all mercury species. As an alternative, plans are being considered to install the mercury instrumentation at a suitable site on Mauna Kea, though this possibility is uncertain at the moment.

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

**P.I.: Niklas Schneider**

A proposal has been submitted to continue operations at the Asia-Pacific Data Research Center (APDRC) in the coming year. The proposal includes an increase in funds to replace aging hardware (machine and disk storage) and to support APDRC personnel. New data and updates to existing datasets will be done only as time and resources allow. The collaboration with NOAA Climate Services and the World Meteorological Office Regional Alliance Five efforts will hopefully continue via separate funding.

### **Increased Logistical Support for Dissertations Symposium in Chemical Oceanography (DISCO) XXVIII and Physical Oceanography Dissertations Symposium (PODS) XXII**

**P.I.: Christopher L. Sabine**

The workshops are held every other year so there are no plans for this project in FY 2024.

### **Profiling CTD Float Array Implementation and Ocean Climate Research**

**P.I.: Douglas S. Luther**

In the next fiscal year, CIMAR collaboration with the NOAA Pacific Marine Environmental Laboratory (PMEL) and other Argo partners will continue with testing, deployment, and performance monitoring for Core, Deep, and Biogeochemical 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.

## **Tsunamis and Other Long-Period Ocean Waves**

### **Tsunami Research and Modeling**

**P.I.: Douglas S. Luther**

Work for the upcoming fiscal year will focus on Pohnpei (Federated States of Micronesia) and Palau tsunami inundation modeling.

### **Tsunami Research and Modeling - United Forecast System (UFS)**

**P.I.: Douglas S. Luther**

During the next fiscal year, this project plans to work on Phase 2 of the Semi-implicit Cross-scale Hydroscience Integrated System Model (SCHISM) model evaluation, which includes adding tides and atmospheric forcing.

## List of Acronyms

3D	Three-Dimensional
ADCP	Acoustic Doppler Current Profiler
ADMB	Automatic Differentiation Model Builder
AI	Artificial Intelligence
APDRC	Asia-Pacific Data Research Center
cGPS	Co-located Global Positioning System
CIMAR	Cooperative Institute for Marine and Atmospheric Research
CNMI	Commonwealth of the Northern Mariana Islands
CO <sub>2</sub>	Carbon dioxide
CRIMP-2	Coral reef instrumented platform-2
CRP	Cetacean Research Program
CTD	Conductivity, temperature, and depth
DIC	Dissolved inorganic carbon
DNA	Deoxyribonucleic Acid
EAR	Ecological Acoustic Recorders
eDNA	Environmental Deoxyribonucleic Acid
EEJ	Equity and Environmental Justice
EM	Electronic Monitoring
ESP	Ecosystem and Socioeconomic Profile
FRMD	Fisheries Research and Monitoring Division
FY	Fiscal Year
GCOS	Global Climate Observing System
GLOSS	Global Sea Level Observing System
GPS	Global Positioning System
GUI	Graphic User Interface
HARP	High-frequency Acoustic Recording Package
HCTP	Hawai'i Community Tagging Program
HICEAS	Hawaiian Islands Cetacean and Ecosystem Assessment Survey
HMS	Hawaiian monk seal
IPRC	International Pacific Research Center
LED	Light Emitting Diode
MAKER Lab	Marine and Applied Knowledge for Ecosystem Research Laboratory
MAPCO <sub>2</sub>	Moored autonomous partial pressure of carbon dioxide
MARFAC	Marine Animal Recovery Facility
MHI	Main Hawaiian Islands
ML	Machine learning
MOI	Marine Optical Imagery
MOUSS	Modular Underwater Stereoscopic System
MUS	Management Unit Species
NCEI	National Centers for Environmental Information
NCRMP	National Coral Reef Monitoring Program

NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWHI	Northwestern Hawaiian Islands
OMAO	Office of Marine and Aviation Operations
OS	Operating System
PacIOOS	Pacific Islands Ocean Observing System
PIFSC	Pacific Islands Fisheries Science Center
PIPAN	Pacific Islands Passive Acoustic Network
PIRO	Pacific Islands Regional Office
PMNM	Papahānaumokuākea Marine National Monument
PRIA	Pacific Remote Island Area
PRO	Papahānaumokuākea Remote Observation
PYSO	Pacific Islands Fisheries Science Center Young Scientist Opportunity
RICHARD	Rainier Integrates Charting, Hydrography, and Reef Demographics
ROS	Robot Operating System
R/V	Research Vessel
SAP	Stock Assessment Program
SCADA	Supervisory Control and Data Acquisition
SCHISM	Semi-implicit Cross-scale Hydrosience Integrated System Model
SDM	Species distribution model
SIA	Stable isotope analysis
SOP	Standard Operating Procedure
TA	Total alkalinity
UAS	Unmanned Aircraft Systems
UH	University of Hawai‘i
UHDAS	University of Hawai‘i Data Acquisition System
UHSLC	University of Hawai‘i Sea Level Center
US	United States
VIAME	Video and Image Analytics for a Marine Environment