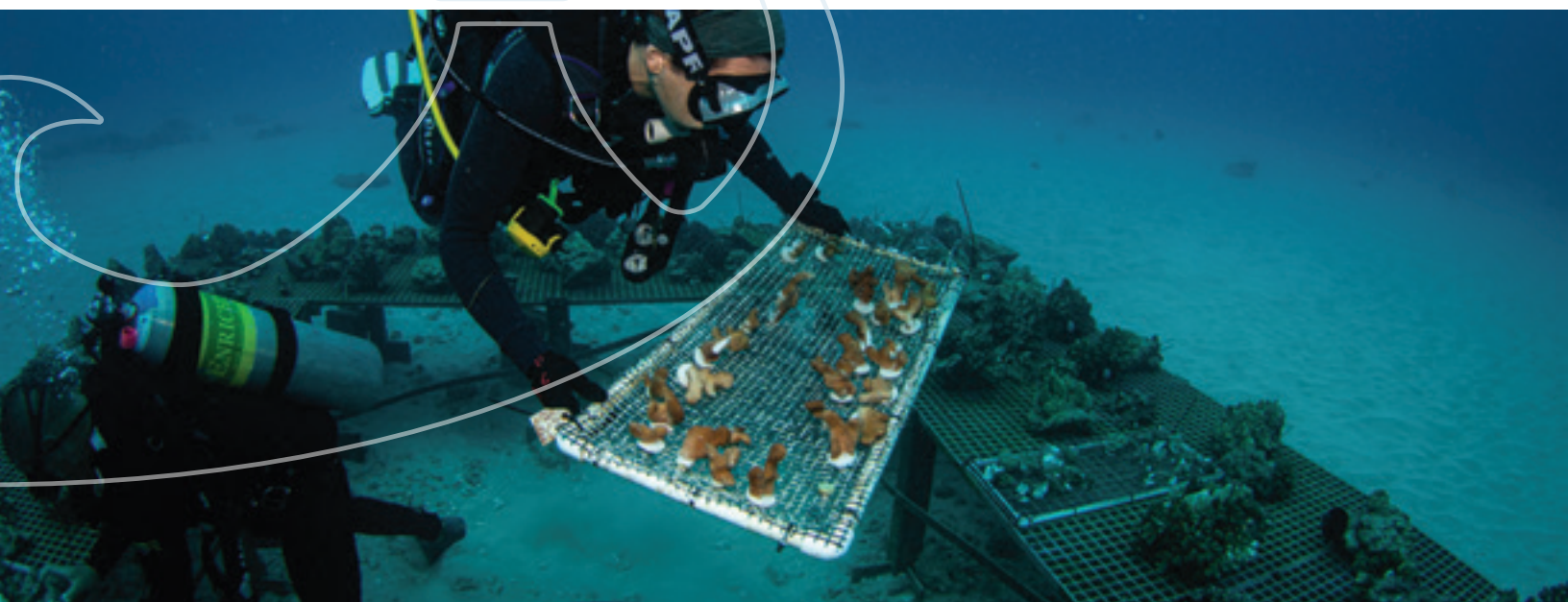




SOEST

School of Ocean and Earth Science and Technology
UNIVERSITY OF HAWAI'I AT MĀNOA



The School of Ocean and Earth Science and Technology at the University of Hawai'i at Mānoa is located on the traditional 'āina of the Kanaka 'Ōiwi, who never ceded their sovereignty to the United States. We recognize that her majesty Queen Lili'uokalani yielded the Hawaiian Kingdom under violent duress and protest to the US to avoid the bloodshed of her people. We further recognize that Hawai'i remains an illegally occupied state of the US.

Generations of Indigenous Hawaiians and their knowledge systems have sustainably cared for Hawai'i and still continue to do so. We are grateful to occupy this space and learn the ways in which we can contribute. As a school, we seek to support the varied strategies that the Indigenous peoples of Hawai'i are using to protect their land and their communities, and commit to dedicating time and resources to working in solidarity.



SOEST

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FRONT COVER

Top: SOEST students at Ka Papa Lo'i 'o Kānewai, a taro patch at UH Mānoa.

Middle: Divers working on an HIMB coral restoration project in nearshore Hawaiian waters. (Image © Richard Chen.)

Bottom: ORE graduate student Nic Ulm demonstrates a wave tank to elementary school students and their teachers at a SOEST Open House.

BACK COVER

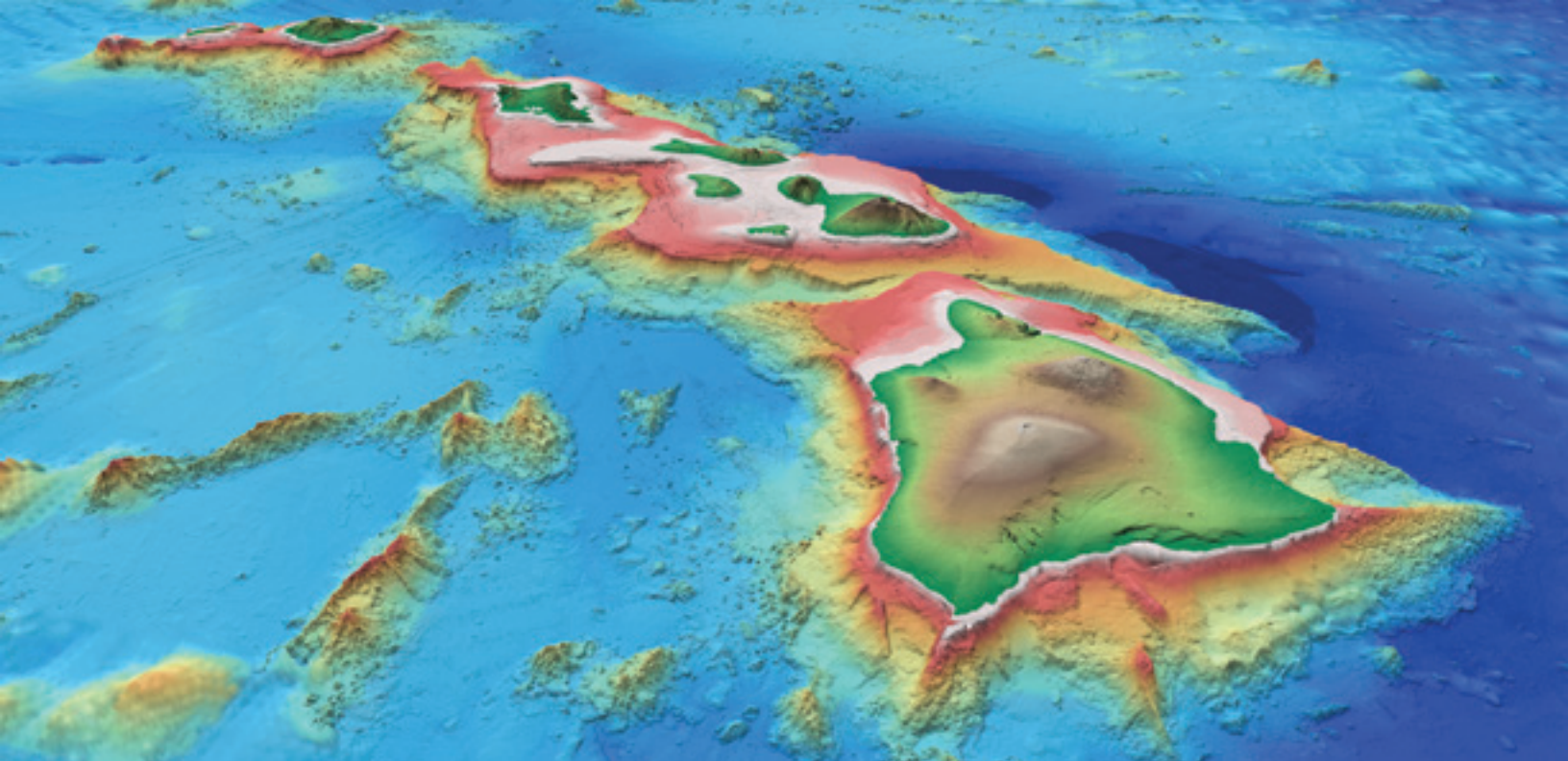
Top: PBRC's Research Experience for Undergraduate interns Macy Nagata and Keke Masga perfect environmental DNA extraction protocols at Kewalo Marine Lab.

Middle: Students and teachers survey rocky intertidal areas with the Hawai'i Sea Grant-funded OPIHI project.

Bottom: HIGP's NASA-funded Biofinder instrument will find evidence of ancient life by detecting biofluorescence, such as on this 50 million year old fossil, or on other planets.

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Topographic and bathymetric image of the main Hawaiian Islands.

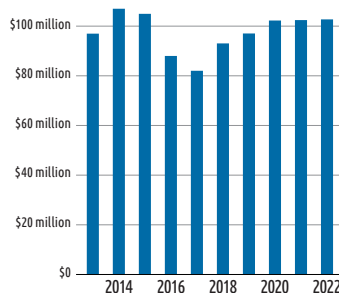
Dean's Message

Aloha kākou! Welcome to SOEST, the School of Ocean and Earth Science and Technology at the University of Hawai'i at Mānoa. SOEST has a tradition of innovation and excellence as an international leader in many diverse fields that are important in Hawai'i and throughout the world. SOEST scientists are global experts in environmental science, marine and terrestrial biology, planetary exploration, geophysics, geology and hydrology, oceanography, climate science and meteorology, alternative energy and natural resource sustainability, and many more. These disciplines overlap with Hawaiian culture and Indigenous ways of knowing and doing. Through a variety of research, education, and community-oriented activities, we are exploring and embracing the synergy between Indigenous and western science.

SOEST celebrates its 35th anniversary in 2023. We are proud of our past and we are excited about the future. Over the past decade, SOEST has brought in over \$976 million in extramural funds and private revenue. We are an excellent investment for the State of Hawaii. In FY2022 SOEST received \$36 million in state general funds and generated \$103 million in extramural funds for research and training.

SOEST is home to a vibrant community of students, staff, faculty, and volunteers. We are

SOEST extramural funding: 2013–2022



a diverse, student-centered, research and education institution focused on advancing solutions to living on Planet Earth in ways that conserve natural ecosystems; promote just, healthy communities; and foster a high-tech economy in which future generations will thrive.

SOEST is widely recognized as a world-class research and academic institution. We are ranked in the top 1% globally for Marine Sciences, and top 3% for Earth Sciences. Closer to home, we are responsive to the needs of Hawai'i and engaged in finding solutions to our most pressing socio-environmental problems. Climate change, biodiversity loss, pandemics, pollution, and injustice are overlapping global crises that demand our full and immediate attention.

As UH Mānoa strives to become a Native Hawaiian Place of Learning, SOEST continuously works to infuse our research, teaching, and service with the Indigenous concept of aloha 'āina. We value diverse voices, and we are dedicated to the idea that future generations have a right to a world that is just, sustainable, and resilient.

We are excited to share with you who we are, what we've done, and where we are headed!

Chip Fletcher
Interim Dean of SOEST



SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY
UNIVERSITY OF HAWAII AT MĀNOA



Academics and Student Services

Degrees

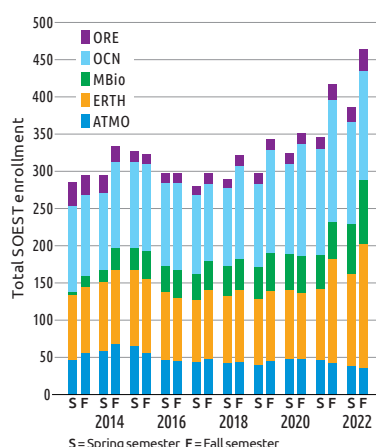
Undergraduate

- Atmospheric Sciences (BS)
- Earth Sciences (BS)
- Environmental Earth Science (BA)
- Global Environmental Science (BS)

Graduate

- Atmospheric Sciences (MS & PhD)
- Earth and Planetary Sciences (MS & PhD)
- Marine Biology (MS & PhD)
- Ocean and Resources Engineering (MS & PhD)
- Oceanography (MS & PhD)

Enrollment by degree-granting program: 2013–2022



Opportunities and Experiences

SOEST students are provided training opportunities with cutting-edge research tools. As the only deep water oceanographic institution in the US, students have access to a large oceanic and several coastal vessels, remotely operated vehicle, ocean gliders, deep-ocean cabled observatory, and Station ALOHA — the longest continuously operating ocean time series in the world. SOEST research includes a satellite fabrication facility, a private island devoted to marine biology research, and dozens of other specialized laboratories. Students are trained on state-of-the-art facilities and mentored to “find their passion” by leading researchers and educators.

We prepare students for careers in research, education, and public and private professions. SOEST alumni can be found around the world working in the deep sea, monitoring volcanoes, modeling climate change, managing water resources, tracking weather systems, and observing planets, moons, asteroids, and other planetary bodies. SOEST alumni are pursuing graduate degrees in a variety of fields and work as postdoctoral researchers, faculty, and government researchers around the world. Many of our former students have applied the skills from their geoscience degrees to become high school teachers, college professors, business managers, medical doctors, environmental lawyers, urban planners, engineers, and many other professions.

Services and Activities

Through academic advising, all students are encouraged to participate in our annual welcome orientation, join the SOEST club, attend workshops or seek out internships to enhance their degree. SOEST offers in-house tutoring for math, chemistry, and physics as well as a course, OEST 100: The College Experience, designed to increase student success.

Students engage with their peers during activities such as beach clean ups and attend professional development events, such as workshops, to learn about resumes, applying to graduate school and numerous government opportunities.

Student Support

SOEST Student Academic Services (SAS)

The SOEST Student Academic Services team offers support for current and future undergraduate students and provides a variety of services to ensure student success including advising, community-building, and career planning.

SOEST Maile Mentoring Bridge

The SOEST Maile Mentoring Bridge Program pairs Native Hawaiian undergraduate mentees with a mentor who is an underrepresented SOEST graduate student, postdoctoral research associate, or recent graduate. This program fulfills a broad desire to inspire Native Hawaiians, kama‘āina, and individuals of other underrepresented ethnicities into ocean, Earth, and environmental science professions.

Graduate students

Graduate students are mentored by diverse teams of award-winning faculty and staff. Individual Development Plans help graduate students and postdoctoral scholars set and achieve their academic and career goals by helping trainees to be proactive and purposeful about their professional development.

A: Proud and happy SOEST graduates!

B: SOEST courses engage students in a variety of collaborative learning opportunities.



Community Outreach and Student Recruitment

Community Outreach

Through our community outreach activities we share the latest scientific discoveries and highlight the invaluable information and services we provide to address complex issues faced by people in Hawai'i and around the world.

- The **biennial SOEST Open House** is a two-day event wherein we open our doors to host approximately 6,000 people — 4,000 students and 2,000 community members. During this exciting event, SOEST students, faculty, and staff share their research and passion for science through hands-on activities, demonstrations, and displays.
- **Public presentations** at the Hanauma Bay Education Program and the HIMB Coral Resilience Laboratory's partnership with Kahala Hotel allow our students and researchers to share their latest findings; and we co-host renowned international speakers with the UH Better Tomorrow Speakers Series
- **Citizen science initiatives**, such as the University of Hawai'i Sea Grant College Program's Hawai'i and Pacific Islands King Tides Project, engage the community in collecting critical data to help understand and adapt to rising seas
- Participate in **community events** including at the Waikiki Aquarium and local fairs, and family STEM events at schools
- **Sci-Art collaborations**, such as Hawai'i Sea Grant's *ResilienSEA: a Celebration of Science, Education and Art*, showcased artwork by local artists inspired by ongoing research and education activities



Student Recruitment

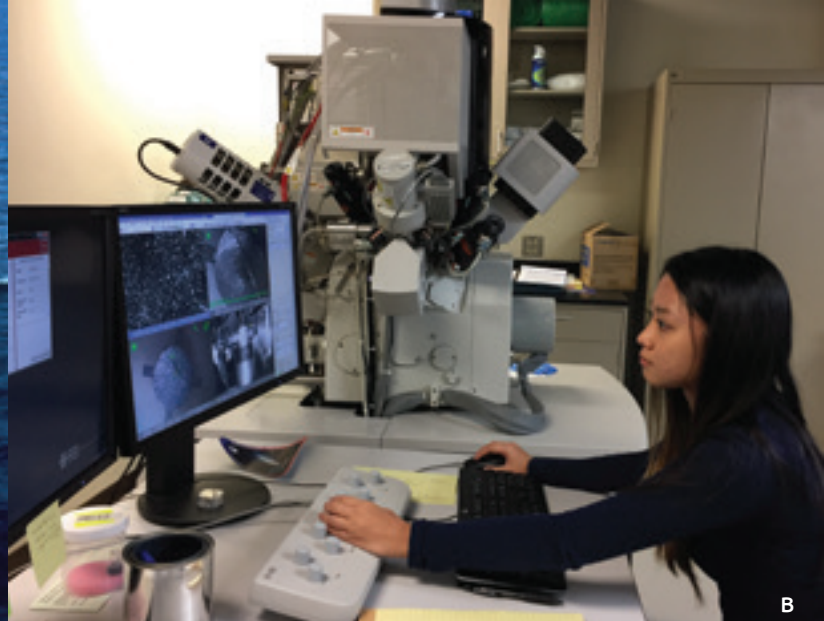
Recruitment activities are designed to promote student enrollment and diversity in the geosciences and increase accessibility to higher education.

- SOEST faculty, staff, and students **visit with Hawai'i high school students** in person and virtually to share the latest scientific discoveries and academic opportunities available at SOEST
- We attend **college and career fairs at high schools** across the State and participate in transfer fairs at University of Hawai'i Community Colleges to share the path to becoming an undergraduate student
- We offer **tours of SOEST facilities and laboratories** for high school students to experience camp life, view working spaces, and meet current students, staff, and faculty
- During the **Mānoa Experience**, prospective students from Hawai'i and beyond learn about all that SOEST and UH Mānoa have to offer
- Day-long to multi-week **experiential programs for high school students** immerse participants in field and lab activities and data analysis

A: Local artists Michelle Schwengel-Regala, Boz Schurr, and Sheanae Tam (L to R) at the opening of *ResilienSEA*.

B: University of Hawai'i "Mānoa Experience."

C: SOEST Open House.



Ship Operations and Facilities

SOEST faculty and staff are recognized as international research leaders on topics as varied as renewable energy, oceanography, coral reef ecology, volcanology, remote sensing, cosmochemistry, tropical meteorology, and climate modeling. Enabling this work are the world-class vessels and facilities housed within the School.

Vessels and Underwater Vehicles

The UH Marine Center maintains and operates a capable and nimble fleet of ships and other underwater vehicles.

- R/V *Kilo Moana*— 186-ft Small Waterplane Area Twin Hull (SWATH) vessel transits the deep waters near Hawai'i and across the Pacific Ocean (*photo above left*)
- R/V *Kaunānā*— 40-ft aluminum hulled catamaran workboat, used for coastal research in the main Hawaiian Islands
- R/V *Imua*— 68-ft aluminum catamaran supports the management and conservation of Hawai'i's marine resources
- At the Hawai'i Institute of Marine Biology, 17' and 22' Boston Whalers and the *Kilo Kai* are used for nearshore field work
- R/V *Lu'ukai*— 6000 meter-rated remotely-operated vehicle performs science operations at the seabed or throughout the water column
- Towed sonar systems — three sidescan sonar systems provide mapping and ocean sensing capabilities
- Ocean Gliders — buoyancy driven autonomous underwater vehicles fly through water with extremely modest energy requirements
- REMUS AUV — Remote Environmental Monitoring Units are equipped with sensors to assess nearshore waters

Ocean Observatories

Remote and cabled ocean observatories extend investigations beyond human capabilities. The systems provide a window into ocean conditions such as water quality, ocean acidification, waves, and currents nearshore to Hawai'i and the US Affiliated Pacific Islands as well as in the deep Pacific Ocean.

- ALOHA Cabled Observatory — world's deepest cabled observatory
- Kilo Nalu Nearshore Reef Observatory — just offshore of Kaka'ako, O'ahu

- Pacific Islands Ocean Observing System — network of sensors and moorings provide ocean conditions and forecasts
- Station ALOHA — focal point of the Hawai'i Ocean Time-series and other long-standing investigations

Specialized Facilities

With an array of scientific instrumentation and exceptionally talented technicians and researchers, SOEST facilities enable scientists to peer into a wide range of nature's mysteries — from the Solar System's oldest mineral grains to the ocean's tiniest creatures.

- Advanced Electron Microscopy Center (*photo above right*)
- Biogeochemical Stable Isotope Facility
- Biological Electron Microscope Facility
- Confocal Microscope Facility
- Electron Microprobe Facility
- Evolutionary Genetics Core Facility
- Flow Cytometry Facility
- Geological Sample Facility
- Glider Facility
- Hawai'i Sustainable Energy Research Facility
- Hawai'i Tree Snail Conservation Laboratory
- Hawaiian Drosophila Research Stock Center
- Lapidary Facility
- MC-ICP-MS Laboratory
- Olinda Rare Plant Facility
- SOEST Laboratory for Analytical Biogeochemistry
- Volcano Rare Plant Facility

A: SOEST's Research Vessel *Kilo Moana*.

B: HIGP undergraduate research assistant prepares comet-dust samples for further analysis.



A B



C



MBIO

Marine Biology Graduate Program

The Marine Biology Graduate Program is an interdisciplinary program co-administered by the College of Natural Sciences and the School of Ocean and Earth Science and Technology, offering master's and doctoral degrees in Marine Biology. The Marine Biology Graduate Program provides graduate students access to faculty in marine biology across disciplinary boundaries.

Research Highlights

- Marine biological studies at UH Mānoa have a long history of excellent research in Botany, Microbiology, Oceanography, and Zoology
- Focus on broadening our understanding and appreciation of marine organisms and their interrelationships with their biotic and physical environments
- Research spans the study of marine organisms, ecosystems, and biogeochemical processes, and how humans affect and manage these systems

Academics

- The MBIO Program offers MS and PhD degrees in Marine Biology
- Graduate students are well trained in a range of disciplines for field and laboratory research and provided with the right combination of tools, training and research opportunities to become experts in their fields
- Prepare students for successful, productive postgraduate and professional careers wherein they can serve as trained managers and policy makers
- Students trained in a place-based approach to research with a focus on Hawai'i, encouraging students to understand their role as scientists in a broader context

Community impact and contributions

- Students prepared for successful, productive postgraduate and professional careers where they can serve as technically trained scientists, managers, and policy makers
- Research findings contribute science-based knowledge for managing marine resources as stressors increase from human exploitation and global climate change
- Partner with state and federal agencies, such as NOAA's Pacific Islands Fisheries Science Center, Hawai'i Department of Land and Natural Resources, and non-governmental organizations
- Nearly half of the 53 MBGP graduates currently work in positions that serve the State of Hawai'i

A: A diver collects a sea urchin for study.
B: A humpback whale slaps the water with its tail flukes.
C: Patch reef in Kaneohe Bay, O'ahu.

MBIO by the numbers

Faculty: 49
Affiliate faculty: 22
Graduate students: 85
Staff: 1



ATMO

Department of Atmospheric Science

Research highlights

- Unraveling El Niño/ENSO dynamics and predicting future phenomena; El Niño is a major driver of water temperature, rainfall, and trade winds across the Pacific Basin
- Focus on tropical meteorology including tropical cyclones, which impact security, economy and well-being of people in Hawai'i and beyond
- Understanding climate variability and dynamics empowers communities to prepare for the future
- Investigating paleoclimate and climate change provides context for our changing world
- Clouds, aerosols, and precipitation
- Extreme weather and hazards including drought and flooding
- Pioneered the use of GPS in water vapor measurements and long-range lightning detection

A: A nearly-complete circle rainbow over O'ahu.

B: Fieldwork in the clouds on Mount Ka'ala — the highest peak on O'ahu.

C: In the National Weather Services offices on the UH Mānoa campus.

ATMO by the numbers

Faculty: 11

Researchers: 6

Undergraduates: 18

Graduate students: 22

Staff: 2

Funding during past decade: \$14M

Weather and changing climate have a significant influence on the well-being and future of our communities. ATMO faculty, students, and graduates make an impact through their award-winning research and teaching at the University and working at government agencies and private industry.

Academics

- The ATMO Program offers BS, MS, and PhD degrees in Atmospheric Sciences, and a combined BS + MS five-year degree
- Combined Bachelors and Masters — five-year program saves students time and financial resources, and readies them for the workforce
- State-of-the-art weather lab prepares students for working in the National Weather Service
- Field work opportunities for undergraduates and graduates provide real-world experiences
- Practical computing and modeling courses

Community impact and contributions

- Vog Measurement and Prediction Program provides real-time vog conditions statewide that can impact community health and create a visibility hazard for general aviation
- Hawaii State Climatologist Office — modeling, predicting extreme events; empowering community preparation
- Nimbus AI Start-up — accurate cloud predictions improve solar energy production; in support of the Hawai'i Clean Energy Initiative of 100% renewable energy by 2045
- Expanding Your Horizons — Women in Science Outreach and Mentoring help pave the way for the next generation of atmospheric scientists

ERTH

Department of Earth Sciences

The Department of Earth Sciences acquires new knowledge and educates future professionals about volcanic, plate tectonic, and earthquake processes, water resources and water quality, and coastal changes in Hawai'i, the Pacific Basin, and around the world.

Research highlights

- Eruption history and dynamics of volcanoes in Hawai'i and beyond
- Monitor earthquakes and landslides in Hawai'i; evaluate risk of mega earthquakes and tsunamis
- Origin and evolution of the Moon, Mars, and Earth-like bodies
- Protecting Hawai'i's freshwater resources from human impacts, sea level rise, and climate change
- Climate change impacts on rainfall patterns and mega-droughts
- Modeling impacts of sea level rise — urban flooding and coastal erosion

Academics

- The ERTH Program offers a BA in Environmental Earth Science, a BS in Earth Sciences, and MS and PhD degrees in Earth and Planetary Sciences
- Students gain professional training in monitoring Earth's surface and interior, tracking contaminants in freshwater, and assessing climate change impact on groundwater and shorelines
- Graduates become leaders in state and federal agencies addressing volcanic hazards, tsunamis, and water, land and natural resources
- Alumni lead local and national companies focused on land management, environmental and geotechnical consulting, public utilities, geophysical surveying, and mineral and energy resources
- They lead schools and universities as STEM educators and researchers

Community impact and contributions

- Partner with USGS Hawaiian Volcano Observatory during 2018 Kilauea eruption crisis
- Serve as Science Director at National Disaster Preparedness Training Center; Hawai'i State Volcanologist
- Serve on the Honolulu Climate Change Commission to guide city departments and state agencies to mitigate and adapt to climate change and sea level rise
- Support K-12 education in STEM and Earth Sciences; summer course for local high school students
- Partner with communities and small farmers to assess climate impacts on freshwater supply

A: Instructors and students on a field trip to lava flows at Kilauea volcano, Hawai'i Island.
B: Remote sensing of groundwater affecting waters near Honokohau Harbor, Hawai'i Island.
C: Simulated flooding of Waikiki, O'ahu, by 2100 with a sea level rise prediction of 3.2 feet.

ERTH by the numbers

Faculty: 18

Researchers: 5

Undergraduates: 115

Graduate students: 58

Staff: 5

Funding during past decade: \$29M

ORE

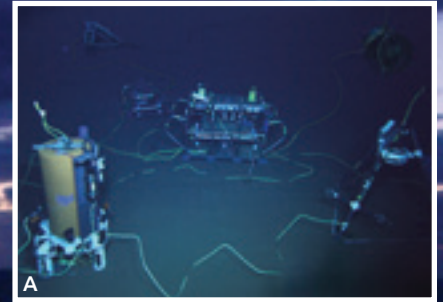
Department of Ocean & Resources Engineering

Research highlights

- Hydrodynamics and fluid-structure interactions — applications wave energy, aquaculture, and more
- Tsunami modeling and wave forecasting
- Underwater acoustics: detect, classify, and localize marine life from sounds recorded on hydrophones (underwater microphones)
- Aloha Cabled Observatory, deepest observatory in the world: real-time observations of the deep ocean north of O'ahu
- Assessing risk for ships and offshore structures in the harsh and changing conditions of the Arctic
- Remote sensing and autonomous instruments: develop sensors to measure seawater CO₂ chemistry and advance glider technology
- Robotics and propulsion: improve stability, control dynamics, and propulsion of autonomous vehicles; bio-inspired improvements to performance
- Nature-based shoreline protection via an engineered coral reef ecosystem

A: Aloha Cabled Observatory, deepest cabled observatory in the world.

B: Seagliders used in data collection.



In the Department of Ocean and Resources Engineering, we educate top quality ocean and resources engineers; conduct and disseminate research in the fields of coastal, offshore, ocean resources and oceanographic engineering; and serve the ocean engineering needs of the State of Hawai'i and the Pacific Basin.

Academics

- The ORE Program offers a PhD degree, and an MS in Ocean and Resources Engineering that is accredited by the Accreditation Board for Engineering and Technology (ABET)
- Kilo Nalu Nearshore Observatory off O'ahu's south shore: field testing site for state-of-the-art underwater robotics innovations
- Year-round access to sea-going activities involving undersea vehicles, marine observatories, and marine testing capability
- Student internship opportunities with local marine engineering companies

Community impact and contributions

- ORE research underpins the tsunami inundation/evacuation maps in Hawai'i and the Pacific Basin
- Provide to Hawai'i communities: wave forecasting, coastal hazard assessment and mitigation, environmental impact assessment and mitigation, and climate resiliency
- Collaborate on ocean energy initiatives: Wave Energy Test Site, Kāne'ohe Bay
- Furthering SMART Subsea Cables for disaster risk reduction and ocean observing
- Prepare needed marine technical workforce in Hawai'i

ORE by the numbers

Faculty: 8

Cooperating/affiliate faculty: 17

Researchers: 6

Graduate students: 30

Staff: 3

Funding during past decade: \$22M

OCN

Department of Oceanography

As a world leader in oceanographic research and education, we engage in diverse projects from the tropics to the poles and from above the sea surface to deep within the seafloor. We build on our unique location in the Pacific Ocean and serve our diverse communities and cultures with respect and aloha.

Research highlights

- Biological oceanography: microbes, coastal water quality, impacts of deep-sea mining, pollutant transport, and fisheries
- Marine geology and geochemistry: climate change, ocean acidification, past and future changes in cycles of carbon, oxygen, and nutrients
- Ocean physics: dynamics of the ocean — from small-scale mixing, waves and storms, to El Niño and climate change
- UH Sea Level Center: tide gauge network provides data for scientists, policy-makers, and communities
- World-renowned Hawai'i Ocean Time-series: over 30-year record of biology, chemistry, and physics in the open ocean

Academics

- The OCN Program offers MS and PhD degrees, and a BS in Global Environmental Science that is the world's first accredited environmental science degree (Accreditation Board for Engineering and Technology; ABET)
- Combined Bachelor's and Master's accelerated pathways, with focus on public health, finance, urban planning, and teaching (Grade 6–12 science)
- Faculty incorporate Native Hawaiian knowledge and cultural practices into course curricula in support of UH's mission of becoming a Native Hawaiian Place of Learning
- Graduate program trains STEM educators that support higher education system in Hawai'i

Community impact and contributions

- Investigating environmental impacts of prospective deep-sea mining industry
- Models of ocean dynamics inform search and rescue missions, preparations for sea level rise and coastal flooding
- Workshop for Hawai'i teachers: "Deep Sea Discovery: revealing Hawai'i's biggest ecosystem to its students"
- Partner with Paepae o He'eia to track influence of restoration, storms, and climate on fishpond health
- Serve on city, state, and federal government boards and commissions to adapt and mitigate climate change; and on the US National Committee for the UN Decade on Sustainable Ocean Development
- NSF-funded Hālau Ola Honua grant supported OCN201 Mauka to Makai summer course created pathways for Native Hawaiian Pacific Islander students from community colleges to four-year degrees in geosciences
- Home to the Uehiro Center for the Advancement of Oceanography

A: Diver assists with deployment of a 60,000-liter mesocosm in support of ocean research.

B: Postdoctoral Fellow Sonia Romero inspects deep-sea animals as part of a food web study.

C: A new microscopy-based imaging system to study movement of organisms in open ocean.

OCN by the numbers

Faculty: 26

Researchers: 4

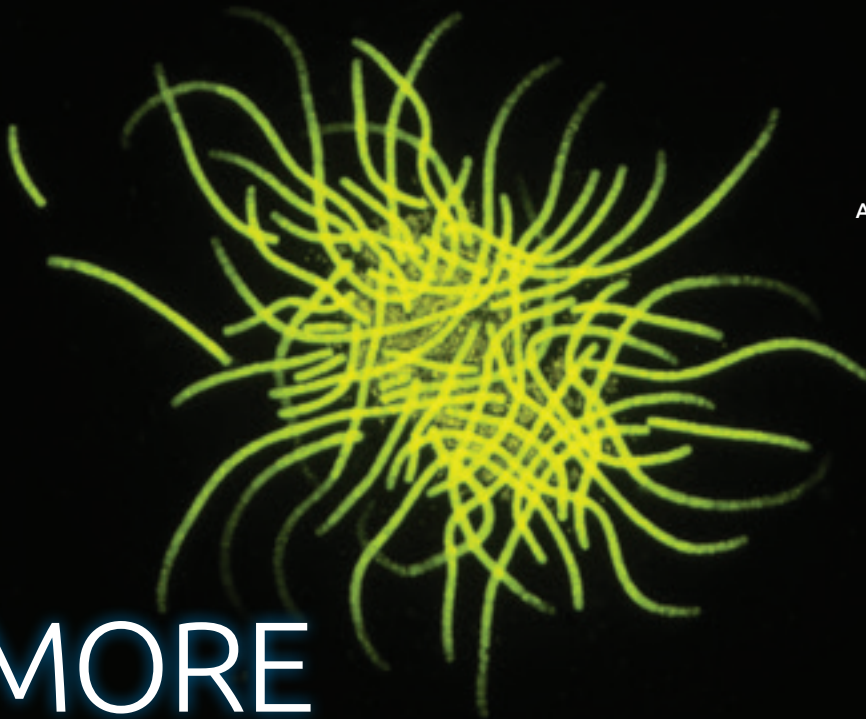
Undergraduates: 88

Graduate students: 58

Staff (science and support): 37

Funding during past decade: \$85M





C-MORE

Center for Microbial Oceanography: Research and Education

Research highlights

- Focus on investigating diverse assemblages of microorganisms in the sea
- Assessing the genetic basis of marine microbial biogeochemistry including the metabolic regulation and environmental controls of gene expression
- Applying advanced molecular techniques for an unprecedented view of the structure, diversity, and possible function of sea microbes
- Investigating processes that underpin the movement and storage of carbon, related bioelements, and energy in the marine environment
- Combining novel approaches with more well-established techniques in microbiology, oceanography, and ecology
- Developing a meaningful understanding of the ocean with respect to carbon sequestration, bioelement cycling, and the probable response of marine ecosystems to global environmental variability and climate change

C-MORE by the numbers

Faculty: 6

Researchers: 2

Graduate students: 8

Staff (science and support): 14

Funding during past decade: \$50M

The Center for Microbial Oceanography: Research and Education (C-MORE), established in 2006, aims to develop a more comprehensive understanding of the biological and ecological diversity of marine microorganisms — the most abundant life forms on Earth.

Academics

- Undergraduate and graduate students are trained on the latest genomic techniques and chemical, biological, and physical oceanography approaches
- Postdoctoral researchers are trained in all aspects of the discipline as well as in academic and community leadership for their future careers in science

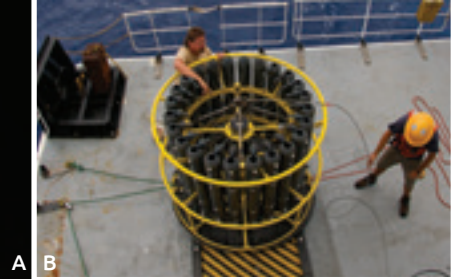
Community impact and contributions

- C-MORE brings together teams of experts — scientists, educators, and community members — facilitating the creation and dissemination of a new understanding of the critically important role of marine microbes in global habitability
- K-12 teachers have access to hands-on science kits, microscopes, and small grants to foster awareness in microbial science at all level of education

A: Fluorescence microscopic image of *Trichodesmium*, an iconic nitrogen-fixing microorganism common in Hawaiian waters.

B: A conductivity-temperature-depth (CTD) rosette on the deck of the R/V *Kilo Moana* ready for deployment to the ocean.

C: Scientists preparing to deploy an array of sediment traps to collect sinking particles on an expedition to Station ALOHA.



CIMAR

Cooperative Institute for Marine and Atmospheric Research

CIMAR, a NOAA Cooperative Institute, was created to support innovative research for understanding and predicting environmental change in the tropical Pacific, for conserving and managing coastal and marine resources in island environments, and for supporting economic, social, and environmental needs of island communities.

Research highlights

- Improving ecological forecasting: fish recruitment and productivity, sustaining protected species, and human health (e.g., fish contaminants; harmful algal blooms)
- Ecosystem-based management: understanding interconnections and effects of land management practices, terrestrial inputs, and climate change
- Protection and restoration of resources including endangered species, habitats, and ecosystems
- CO₂ exchange between atmosphere and ocean; water column CO₂ distributions and transport, and the ocean's role in sequestering anthropogenic CO₂
- Tsunamis and long-period ocean waves: improving predictability of tsunamis and wind wave-driven coastal flooding, hazard risk assessment, mitigation, and preparedness

Academics

- Support for undergraduate and graduate students, and postdoctoral investigators in the Life, Ocean, and Earth Sciences
- Co-sponsor (with NOAA) of the Pacific Islands Fisheries Science Center (PIFSC) Summer Intern Program for undergraduate students; immersive research experiences and training under PIFSC and CIMAR mentors

A



Credit: Steven Grun/NOAA/CIMAR

B



C

Community impact and contributions

- Promote the transition of research to operational products and services that benefit Pacific Islands communities
- Collaborate with Pacific Islands Ocean Observing System (PacIOOS), which also provides real-time wave, current, water quality data, and wave-driven flooding forecasts to communities in the US-Affiliated Pacific Islands
- CIMAR staff regularly share their knowledge and experiences with K-12 students and community members. Topics include marine mammal research; protection of Hawaiian monk seals; marine turtle biology and ecology; coral reef ecosystem health and vitality; fish and fisheries research; shark and other bycatch mortality; and marine debris impacts on the environment.
- Meet regularly with fishermen and fisheries observers in the Pacific Islands Region to discuss and promote conservation and bycatch mitigation efforts for protected species

A: Male blue shark tagged with a survival PAT by Hawaii Community Tagging Program member Deron Verbech.

B: The NOAA PIFSC/CIMAR Marine Debris team works to remove a large derelict fishing net from Midway Atoll within the Papahānaumokuākea Marine National Monument.

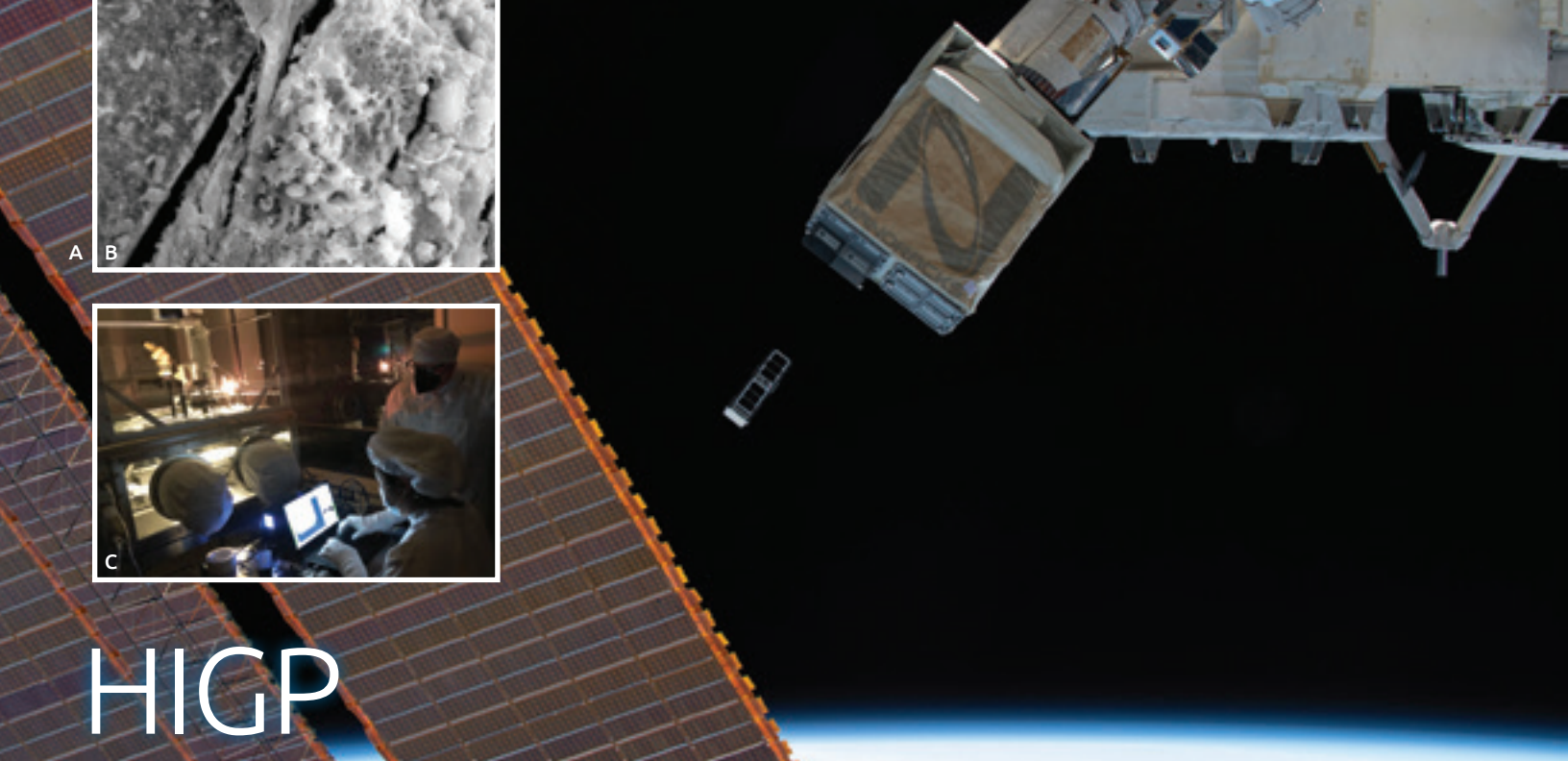
C: Specialist Erin Reed (left) leads her group in fish dissection at the NOAA Pacific Islands Fisheries Science Center Teacher Workshop, O'ahu, HI.

CIMAR by the numbers

Employees within NOAA labs and at UH (scientists, economists, engineers, and more): 117

Administrative staff: 10

Funding during past decade: \$166M



HIGP

Hawai'i Institute of Geophysics and Planetology

Research highlights

- Discovered water on the Moon — essential for NASA's plan to return humans to the lunar surface
- Part of NASA's Mars 2020 Team as *Perseverance* Rover searches for ancient life
- Developed a novel biological sensing fluorescence imaging instrument which can detect life on other planets, as well as explosives and pollutants on Earth
- Discovered a vast store of freshwater in submarine rocks offshore of Hawai'i
- Developing high performance materials for applications including energy storage, environmental pollutant removal, abrasives, and semiconductors
- Launched a satellite into orbit in 2020 and plan to launch another in 2023, designed, built, and tested in Mānoa; Hawai'i Space Flight Laboratory is a catalyst for Hawai'i's aerospace industry
- Analyzed priceless samples of 4.6 billion year-old asteroid *Ryugu*, unraveling mysteries surrounding the origin and evolution of our Solar System

A: NEUTRON-1 satellite being launched from the International Space Station, Nov. 5, 2020.
B: Grains from asteroid *Ryugu* surface; image is about one-fifth the width of a human hair.
C: HIGP scientists analyze samples of the Moon collected during the Apollo 17 mission.

HIGP by the numbers

Faculty: 17

Researchers/specialists: 9

Postdoctoral researchers: 8

Graduate students: 30

Staff (science and support): 36

Funding during past decade: \$97M

HIGP explores the Earth and planets. As a team of scientists, engineers, and technologists — students alongside faculty — we invent and apply state-of-the-art instruments and data analysis techniques to discover more about our islands, our planet, and our neighbors in space.

Academics

- Undergraduate certificate in Earth and Planetary Exploration Technology
- Home to graduate students pursuing degrees in Earth Science, Engineering, and Computer Science
- Host to the NASA Hawai'i Space Grant Consortium, awarding about 70 fellowships and traineeships each year to UH students to pursue research projects with faculty mentors

Community impact and contributions

- Hawai'i Space Grant Consortium shares space science with ~2000 teachers and 20,000 students in Hawai'i each year through K-12 programs and events, and funding to Community Colleges
- NASA-funded *Ka mālamalama o ka mahina* project pairs Native Hawaiian undergraduate and high school students with scientists at UH Mānoa to conduct lunar science research
- HIGP faculty fund nine scientists to support the work of the Hawaiian Volcano Observatory
- Putting Cube Satellite kits into Hawai'i's middle and high school classrooms via Project POKE (Providing Opportunities for Keiki in Engineering), and training the teachers to help their students use them
- HIGP faculty serve on the Hawai'i Earthquake and Tsunami Advisory Committee, the Research Advisory Committee of the Natural Energy Laboratory of Hawai'i Authority, and the University of Hawai'i Red Hill Task Force

HIMB

Hawai'i Institute of Marine Biology

Based on Moku o Lo'e and surrounded by coral reef in Kāne'ohe Bay, HIMB embraces a Native Hawaiian Sense of Place and a local-to-global focus with cutting-edge science, technology, and education aimed at understanding and conserving tropical marine and coastal ecosystems.

Research highlights

- Coral reefs: investigating threats to and sources of resilience, developing novel solutions for long-term health, including selective breeding and reef restoration
- Fisheries studies: ecology, oceanography, social science, and traditional knowledge to ensure sustainability in Hawai'i and across the Pacific
- Sharks: researching sensory biology and movement patterns to promote their conservation
- Marine mammals: sperm whale foraging patterns, humpback whale songs and nursing behavior, and discovery of toxoplasmosis in Hawaiian spinner dolphins
- Learning from Indigenous resource management, promoting ahupua'a resilience
- Advise local, national, and international conservation and regulatory organizations on fisheries, marine protected areas, and threatened species

Academics

- Home to graduate students pursuing degrees in Marine Biology, Zoology, Botany, Oceanography
- Collaborate with College of Education to prepare early career science instructors
- Keaola Lo'e REMS Lab and partners developed an early-college, dual-credit program to support Hawai'i high school students' pathways in marine STEM
- Applications of Kūlana Noi'i and Indigenous methodologies in community-embedded research

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Community impact and contributions

- Teach marine science and conservation to over 6,000 community members and K-12 students per year
- HIMB and He'eia NERR programs engage Native Hawaiian communities in collaborative research, management, and education focused on Kāne'ohe Bay
- Nā Kilo 'Āina program empowers Native Hawaiian communities to strengthen reciprocal pilina (relationship) between people and place, and to better understand 'āina momona (fertile land)
- Trained over 500 fisheries scientists, managers, and students from Hawai'i, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands
- Restore with Resilience, the first community coral restoration project in Hawai'i, partners with federal, state, non-profit and community groups
- Serve on state and federal governments boards, and commissions to address reef health, whale and dolphin population numbers, fisheries, and nearshore water quality

A: Humpback whale mother and calf swimming off Maui, Hawai'i. Image collected via a drone under NNMFS permit # 21476.

B: Confocal image of the lace coral, *P. acuta*, showing coral (red) and algal (blue) cells.

C: HIMB Marine Science High School Club analyzing coral using the confocal microscope.

HIMB by the numbers

Faculty: 22

Postdoctoral researchers: 26

Undergraduate interns: 64

Graduate students: 77

Staff (science and support): 39

Funding during past decade: \$57M



Hawai'i Natural Energy Institute

Research highlights

- Advanced sustainable energy development in grid technology, energy storage, fuel cells, ocean energy, alternative fuels, and energy efficiency
- Received six patents for work in fuel cells, batteries, grid systems, and biocarbons
- Deployed an electric vehicle charging system that optimizes fleet usage
- Developed novel tools for diagnosis and prognosis of battery degradation, state of charge, and state of health tracking
- Developed novel printing processes for fabrication of solar cells and other electronic devices
- Discovered and developed efficient, low cost, and safer hydrogen storage materials; and methods to reduce fuel cell contamination
- Assessed feedstock availability for renewable bioenergy and biofuel products for Hawai'i
- Commissioned a hydrogen station on the Big Island to support fuel cell electric buses for the County of Hawai'i's public transit system
- Provided technical support to the Navy's Wave Energy Test Site to facilitate testing of wave energy prototypes
- Built two net-zero energy classrooms on UH Mānoa campus for energy efficiency research and teaching

HNEI by the numbers

Faculty: 19

Graduate students: 15

Staff: 13

Funding during past decade: \$126M

HNEI conducts research, development, and testing of advanced energy technologies; and provides technical and policy analyses to inform decision makers on cost-effective pathways to achieve Hawai'i's 100% clean energy goals. HNEI also works closely with international partners to support the development of resilient, sustainable energy systems in the Asia-Pacific region.

Academics

- Funding and training to over 80 undergraduate and graduate students; and more than 15 postdoctoral researchers (past five years)
- Provided training to engineers from the Provincial Electricity Authority of Thailand and to governments and utilities in the Asia-Pacific region on renewable energy technologies, integration and procurement, power system management, and energy policy and regulation
- Licensed battery modeling toolbox to more than 100 organizations (academic and private) worldwide

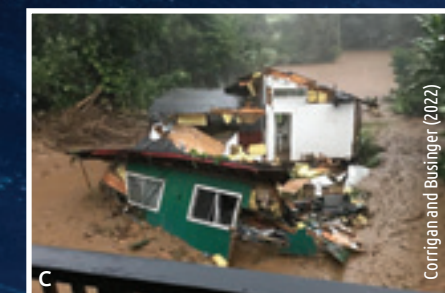
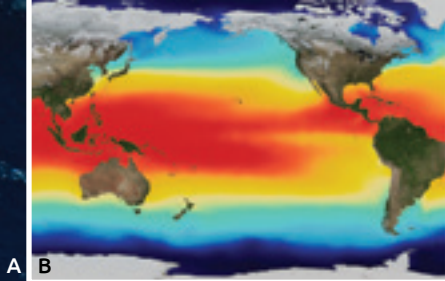
Community impact and contributions

- Supported the County of Hawai'i's Mass Transit Agency proposal that resulted in a \$23 million grant for hydrogen fuel cell electric buses and infrastructure
- Partnered with local utilities and commercial partners to help integrate renewable energy and promote resiliency for communities
- Advised State and HPUC during retirement of the AES coal plant
- Shared renewable energy technology and innovation with Hawai'i schools, from elementary to high school

A: Northwest Energy Innovations' Azura wave energy converter in Kāne'ohe Bay, O'ahu.

B: UH Mānoa net-zero energy classrooms for energy research and teaching.

C: Hydrogen fueling station at NELHA on Hawai'i Island.



Ben Lecomte and The Swim team

IPRC

International Pacific Research Center

Research highlights

- With expertise in meteorology and oceanography of the Asia-Pacific region, IPRC's scientific focus on the Asian-Pacific region is unique for a US institution
- Assess climate variability and change over the Asia-Pacific — monsoons, El Niño-Southern Oscillation, Madden-Julian oscillation, and Hadley and Walker Circulations
- Investigate extreme rain events (e.g., April 2018) over the Hawaiian Islands and the role of warm ocean temperatures surrounding the islands
- Employ high-resolution global and regional climate modeling to assess climate change over the region including the Hawaiian Islands
- Reveal decadal variability in the North Pacific climate system
- Determine the impact of small scale processes on the climate system
- Develop marine debris transport models to identify sources, pathways, and sinks of natural and anthropogenic marine debris
- Assess impacts of long-living plastic debris on large-scale ecological connectivity and biological invasions, and the establishment of the new, debris-associated open ocean ecosystems
- Assess factors affecting the intensity and duration of droughts over Hawai'i and the US-affiliated Pacific Islands, and develop seasonal predictions of rainfall, including floods and droughts

Academics

- IPRC makes an important contribution to the international climate research enterprise through training of students and young scientists — both from UH and international institutions
- IPRC hosts postdoctoral students and long-term visiting scientists to advance collaboration and state-of-the-art computational facilities and observational systems

The International Pacific Research Center (IPRC), established in 1997, operates under a cooperative agreement between UH and the Japan Agency for Marine-Earth Science and Technology. The IPRC mission is to improve understanding of the nature and predictability of climate variability and change in the Asia-Pacific region, and develop innovative ways to utilize knowledge gained for the benefit of society.

Community impact and contributions

- Assessing local and global impact of climate variability empowers communities with data to prepare and possibly mitigate effects
- IPRC's data center makes atmospheric and oceanic data of relevance to the Asia-Pacific region readily available to its own researchers, the broader climate research community, policy makers, and the general public
- Seasonal climate prediction and future climate projections over the Pacific Islands (collaboration with the Pacific RISA program)

A: Anthropogenic debris (including derelict fishing gear and other plastics) accumulate in oceanic "garbage patches" that can drift great distances and alter pelagic ecosystems.

B: NASA global sea surface temperature map centered on the Pacific Ocean.

C: House destroyed by floodwaters near Waipā Garden, Kaua'i.

IPRC by the numbers

Faculty: 7

Researchers: 2

Postdoctoral researchers: 2

Staff (administrative and technical): 4

Funding during past decade: \$33M



PBRC

Pacific Biosciences Research Center

PBRC's transdisciplinary research and training integrates the islands' unique living laboratories and emphasizes the Hawaiian concept of ahupua'a, the self-sustaining interrelationship between land and sea, adaptations to the changing environment, and the ethic of communal responsibility and respect for the culture and natural resources of Hawai'i.

Research highlights

- Integrates molecular, cellular, and developmental biology, neurobiology, parasitology, ecology, evolution, conservation and sustainability, and the environment-microbiome interface
- Focus on local and global issues, including climate change, ecosystem collapse, nutritional challenges, invasive species, and zoonotic diseases
- Kewalo Marine Laboratory, a leading institution in exceptional marine biology, celebrated its 50th anniversary in 2022
- Home to two prestigious NIH-funded Centers of Biomedical Research Excellence (COBREs), focused on (i) integrative studies of the environment, microbiomes, and human health, and (ii) integrating basic science in nutrition with health and well-being in the Native Hawaiian-Pacific Islander community

PBRC by the numbers

Faculty: 14

Researchers: 8

Postdoctoral researchers: 6

Undergraduates: 14

Graduate students: 19

Staff (science and support): 51

Funding during past decade: \$60M

Academics

- A leader in the UH mission of being a Native Hawaiian Place of Learning, PBRC has supported >1000 underrepresented minority students in NIH/NSF-funded research, predominantly Native Hawaiians and Pacific Islanders
- Sponsors an NSF Research Experience for Undergraduates Program in Environmental Biology for Pacific Islanders
- Two Native Hawaiian faculty incorporate Hawaiian language and cultural concepts in their curricula
- Workshops for instructors from community colleges in American Samoa, Marshall Islands, Micronesia, Northern Marianas, and Palau provide training in marine microbiology, molecular biology, and genetics

Community impact and contributions

- Engage K-12 students in scientific research and provides tours of laboratories. A network of 35 K-12 schools conduct research in the Ala Wai watershed addressing water quality
- Provide scientific support to the Office of Hawaiian Affairs, the Native Hawaiian Legal Corporation, traditional practitioners, and the Polynesian Voyaging Society, addressing health-related challenges — water quality, rat lungworm, mosquito-borne diseases, and box jelly toxins
- Graduate students form the leadership base of the 'Ilima Society for the Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) Chapter at the University of Hawai'i
- Diversity, Equity and Inclusion: over 60% of PBRC faculty are women and 48% are minorities

A: Dr Kiana Frank, left, engages students to promote kilo skills for stewarding Muliwai'olena.

B: Scanning electron micrograph of *Pleuromamma xiphias*, a planktonic copepod.

C: Adult rat lungworms in a rat's heart; females (~35 mm) have "barber-pole" appearance.



A



C



Hawai'i Sea Grant

University of Hawai'i Sea Grant College Program

The University of Hawai'i Sea Grant College Program supports an innovative program of research, education, communication, and engagement services directed to increasing sustainability of coastal and marine resources, and resilience of coastal communities of the state, region, and nation.

Research highlights

- Healthy coastal ecosystems: protecting and restoring habitats
- Resilient communities and economies: preparing for and adapting to changing conditions
- Environmental literacy, workforce development, marine science education
- Sustainable fisheries and aquaculture: working to ensure food and economic and cultural benefits
- Smart building and community design
- Sustainable coastal tourism
- Coastal and climate science and resilience
- Ulana 'Ike, weaving together knowledge systems

Academics

- Numerous fellowship programs support the training of undergraduate and graduate students pursuing careers in government, academia, non-profit organizations, and more, focusing on marine and coastal science and policy
- Graduate fellows gain experience in science communication via written articles, oral presentations, and community outreach

A. "King Tides" caused flooding and coastal inundation in Waikiki, O'ahu in 2018.

B. Limu huluhuluwaena is part of integrated multi-tropic aquaculture at Waikalua Loko I'a.

C. Learning about pua (juvenile fish) ponds at He'eia Fishpond, O'ahu.

Community impact and contributions

- Hanauma Bay Education Program educates over 800,000 visitors every year
- *Voice of the Sea*, award-winning weekly television series, airs across the Pacific; won 40 Telly Awards—the premier award for regional television
- PUA Bootcamp forms a partnership with loko i'a (fishponds) to successfully transition hatchery-produced 'ama'ama pua into the fishponds
- Na Kilo 'Āina network works with community members of all ages to care for the shoreline and marine environment through monthly monitoring activities and training
- Building collaborative partnerships at Waiale'e, O'ahu to develop community-based and community-supported education, research, and resilience for the North Shore community and beyond
- Collaboration with non-profit Kua'āina Ulu 'Auamo and community members in developing Kūlana Noi'i, guidance for collaborative and equitable partnerships between university-based researchers and community that recognizes the scientific importance and contributions of Indigenous knowledge

Hawai'i Sea Grant by the numbers

Specialist faculty: 6

Extension faculty: 28

Coastal Resilience and Sustainability (CREST) faculty: 6
(joint appointments with UH Mānoa departments)

Undergraduates supported (2018–2022): 74

Graduate students supported (2018–2022): 163

Staff: 7

Funding during past decade: \$58M



SOEST

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