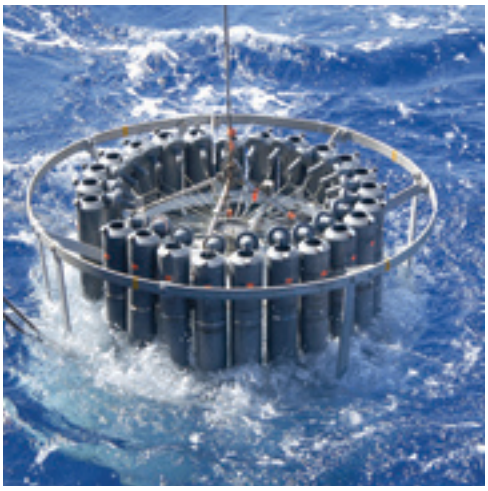
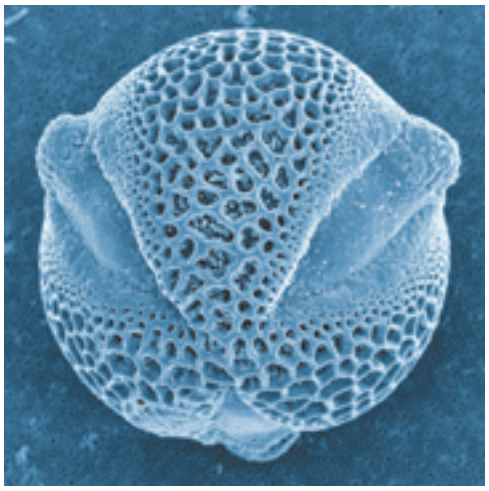
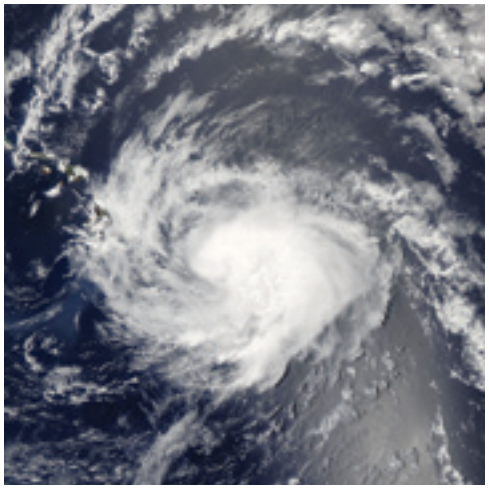
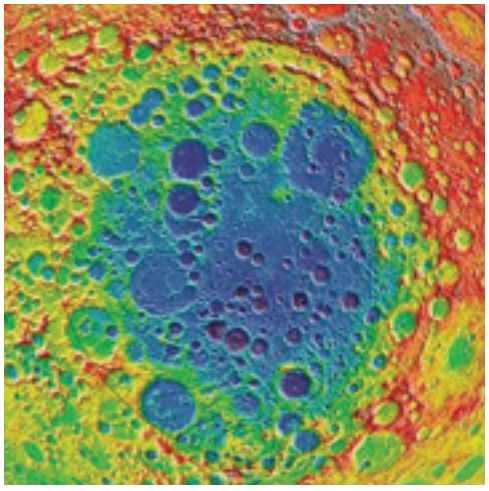




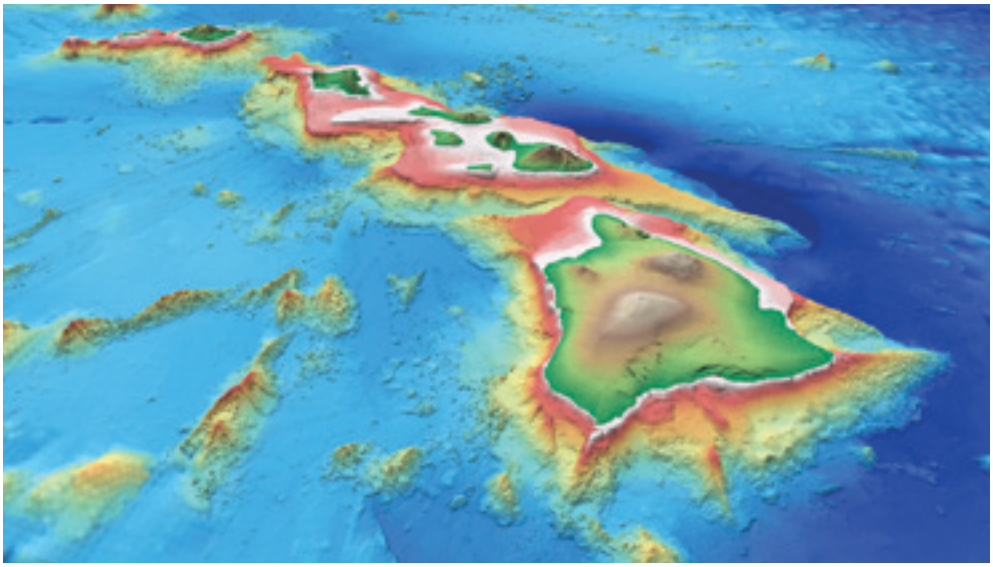



SOEST

SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY

UNIVERSITY OF HAWAI'I AT MĀNOA

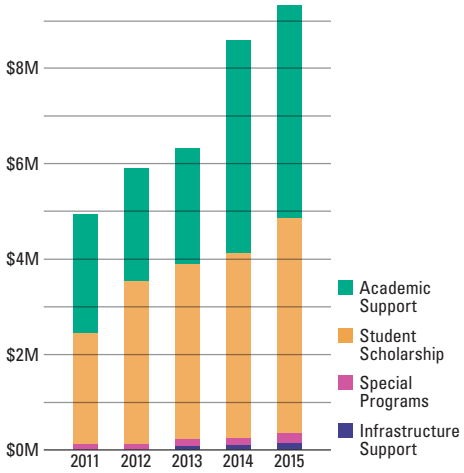


Extramural and private revenue since the school was established:
over $1.6 billion with
more than $100 million from private donors

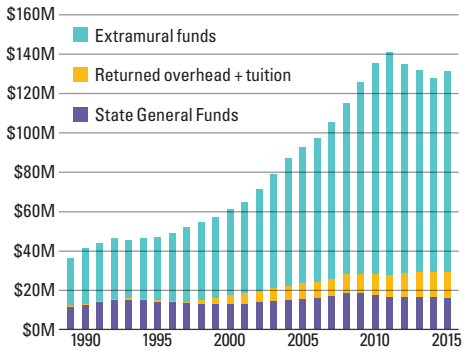
Global School Ranking in Geosciences: **13**
NTU 2015

The Dean's Introduction

Endowment value



Funding by year



Over the past three decades the School of Ocean and Earth Science and Technology (SOEST) has grown to be the largest research unit within the University of Hawai'i, with annual expenditures of $125 million and over 1000 employees. It is a driving engine for business development and fundamental research that matters to the people of the islands. Our staff live and work in each district, on each island, throughout the State — and across the Pacific. We strive to innovate and discover new knowledge, while educating and training the next generation of high-tech professionals.

The vision of the School's founding 27 years ago called for the development of new centers and the combination of previously stand-alone units within UH Mānoa, to create a whole greater than the sum of its parts — a School of geosciences that today stands among the top twenty in the world. Notable areas of excellence include oceanography, climate, volcanology, renewable energy, coral reefs, remote sensing, conservation biology, and planetary exploration.

Our mission is to enhance the quality of life in our state and nation by creating new knowledge, providing world-class undergraduate and graduate education, contributing to a high-tech economy, and promoting the conservation and sustainable use of the environment.

Using field measurements and models, SOEST provides daily forecasts of vog, beach safety, and surf and ocean conditions, and creates products that inform our health, support our recreation, and protect our safety. Partnering with industry and the Public Utilities Commission, we've added megawatt battery systems to the island power grids on Molokai'i, Hawai'i, and O'ahu to improve electric grid stability and the penetration of solar and wind energy. We search for and discover new sources of underground water and geothermal energy; we design, build and launch satellites to observe our planet; and we work to enhance local food supplies through aquaculture and sustainable fishing.

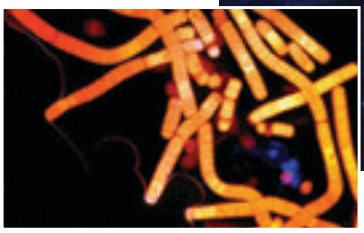
Over the past quarter century, SOEST has delivered on the promise of its creation. Our reach and renown is global but we remain firmly rooted in the Hawaiian Islands, where every day the products of our research, training, and discovery impact lives and livelihoods.

Brian Taylor
Dean of SOEST

RESEARCH

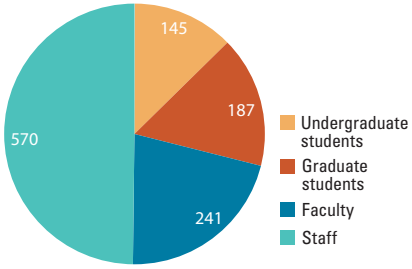
Total extramural funding in 2015:
$100,796,658

Research Vessel *Kilo Moana*



Microbial oceanography

Total students, faculty, and staff



Located in the heart of the Pacific Ocean, SOEST research facilities provide convenient access to active volcanoes, deep ocean habitats, vibrant coral reefs, and some of the most isolated terrestrial ecosystems in the world.

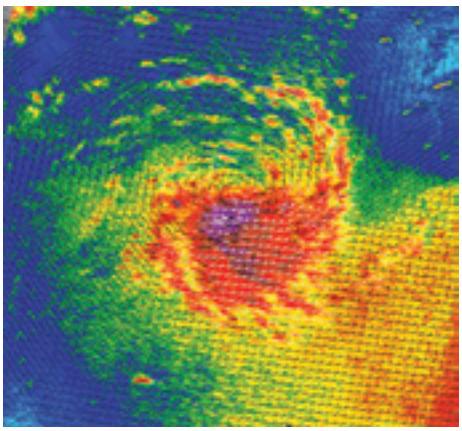
SOEST faculty and staff are recognized as international research leaders on topics as varied as renewable energy, oceanography, coral reef ecology, volcanology, remote sensing, cosmochemistry, tropical meteorology, and climate modeling. SOEST is the research powerhouse of the University, generating fully one third of the total extramural funding received by UH Mānoa — more than any other unit in the University system. The School is operational 24/7/365, with programs and people across all the Hawaiian Islands and around the globe.

Total number of publications (2000–2014): **4359**

SOEST faculty work with community groups and agencies at local, state, and federal levels to perform the fundamental research that underlies policy development in water quality, renewable energy, natural hazard management, climate change impacts, sustainable ecosystems and train the next generation of State professionals in these fields.

Fellows of the National Academy of Sciences: **4**

Thin-film research



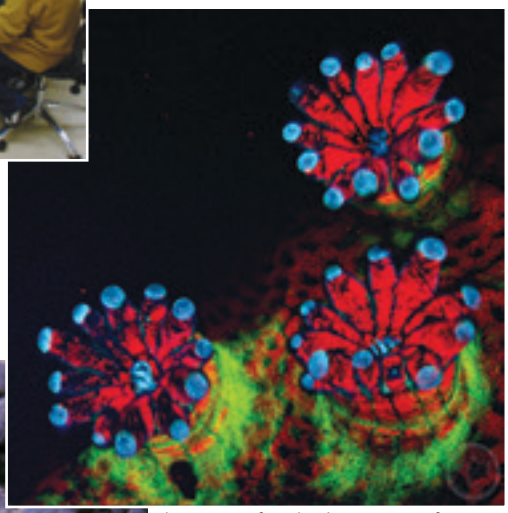
Modeling winds in a tropical storm

Cosmogeochemical analysis of meteorites

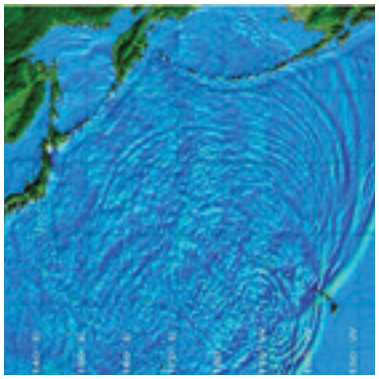
Fellows of the American Association for the Advancement of Science: 3

Laboratory analysis of samples

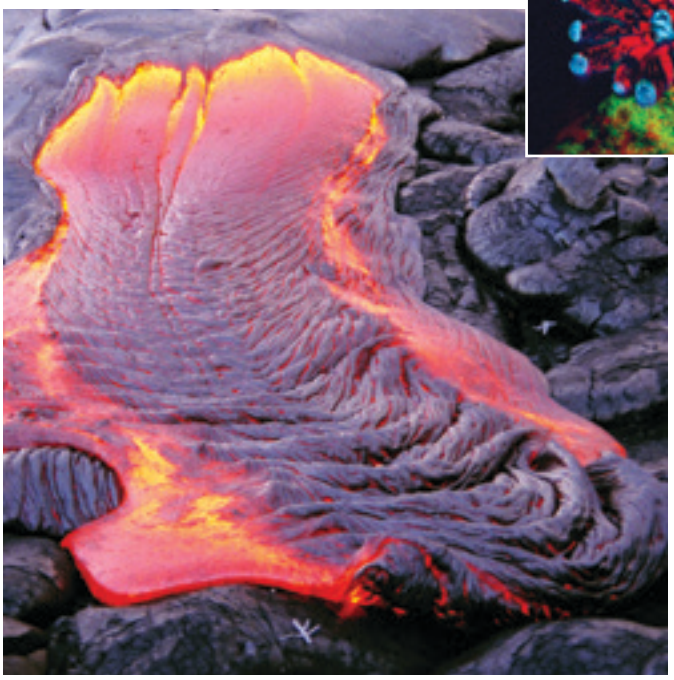
American Academy of Arts and Sciences Members: 5



Laser confocal microscopy of living coral



Modeling earthquake-generated tsunamis



Geochemistry of the Hawaiian Islands

Collecting open-ocean water samples

Marine ecology (Hawaiian bobtail squid, *Euprymna scolopes*)

Methane hydrate as an alternative fuel

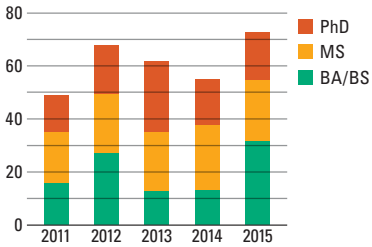
Depth of Aloha Cabled Observatory (ACO): 4728 m

EDUCATION

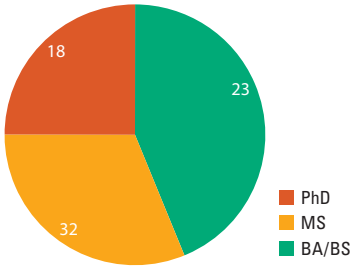
Annual visitors to SOEST websites:
over 700,000

Celebrating graduation

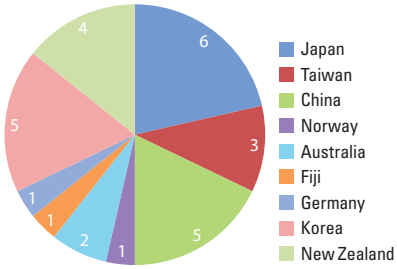
Degrees awarded by type: 2011–2015



Degrees awarded by type: 2015



Academic partner universities by country



Volcanology fieldwork

Outreach to high school students statewide

Number of student majors (graduate and undergraduate):
332

SOEST faculty teach undergraduate students in atmospheric sciences, geology and geophysics, and global environmental sciences, and master's and doctoral students in atmospheric sciences, geology and geophysics, oceanography, marine biology, and ocean and resources engineering.

With two large research and several coastal vessels, two submersibles, a deep-ocean cabled observatory, a satellite fabrication facility, a private island devoted to marine biology research, and dozens of other specialized laboratories, students within SOEST are trained on state-of-the-art facilities and mentored to "find their passion" by leading researchers and educators as much in the field and lab as in the classroom.

In the last decade, the rigorous B.S. degree in Global Environmental Science has developed a national reputation for preparing students for careers in the ocean and earth sciences. Fall 2012 inaugurated the graduate degree program in Marine Biology, joint between SOEST and the College of Natural Sciences. The Department of Geology and Geophysics now offers a Master of Geoscience professional degree to meet demand for expertise in applied geosciences.

Students taught in the Fall 2015 semester:
1526

STUDENT PROFILE

Haunani Kane

PhD Candidate

Geology & Geophysics

I just completed my MS in Geology and Geophysics where I worked with local wetland managers to investigate how coastal wetlands in Hawai'i may be impacted by sea-level rise. I received a BS in Global Environmental Science in the Department of Oceanography, and I am currently pursuing my PhD in Geology & Geophysics.

My undergraduate degree provided a foundation in math and ocean sciences that greatly helped me in graduate school. Although the classes were tough they pushed and challenged me to work hard toward the end goal. I think one of the greatest things about my undergrad years was the relationships I made with both the students and the faculty. A few of my classmates and professors continue to provide support and guidance in my graduate studies.

Graduate degree programs:
11

Through our four departments and in partnership with our own research centers, and other units across the Mānoa campus, SOEST offers undergraduate and graduate degree programs covering a wide range of ocean, earth, and atmospheric science disciplines.

Internships with government agencies

From Death Valley…

Under-graduate degree programs:
4

… to urban waterways…

… to Antarctica

Over 6000 students and community members visited SOEST's 2013 Open House

Foreign partner universities students can attend: **28**

Oceanography fieldwork

STUDENT PROFILE

Elinor Lutu-McMoore

Meteorologist

National Weather Service

As a meteorologist at the Weather Service Office in Pago Pago, American Samoa, I am responsible for issuing daily weather forecasts for all of the American Samoan islands and coastal waters and issuing timely weather watches, warnings and/or advisories to alert residents and mariners of any hazardous weather that may affect life and property. I also work on marine and climate programs and perform outreach activities that contribute toward American Samoa's continuous goal of being a "Weather-Ready Nation."

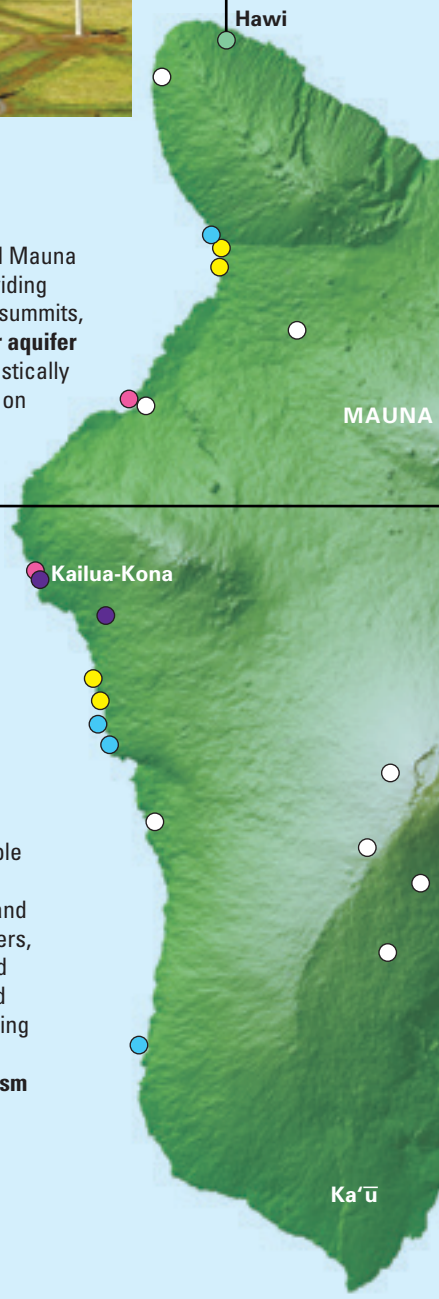
My degree program in meteorology definitely prepared me for my career. The lessons learned from courses were invaluable as were the helpful professors and staff whose goal is student success. The strong partnership with the NWS Honolulu Forecast Office was a vital component toward my transition to becoming a meteorologist for the National Weather Service.

Hawai'i Island residents and businesses continue to add more renewable energy resources to the island grid, meaning HELCO needs less conventional electricity generation to accommodate customer demands. Renewable energy resources do not generate consistent power to the grid and require batteries to augment the production of power when renewables decrease production (lack of wind, clouds covering sun, etc.). Large-scale batteries are expected to play an increasingly important role for these new modes of grid operations. Through the Hawai'i Natural Energy Institute, SOEST has invested over $6 million in research and development of battery solutions, including the installation of a **1MW battery near the Hawi wind farm**, integrated into the grid with HELCO partnership. This battery complements the power generation from the wind farm, ensuring smooth, consistent power is provided to the grid—modulating natural variations in wind-farm production.

As the use and occupancy of higher elevation areas of Mauna Kea and Mauna Loa have increased in recent decades, the cost and complexity of providing water to permanent and temporary activities in the Saddle, and on the summits, has increased. SOEST researchers recently discovered a **groundwater aquifer more than a mile above sea level** at Pōhakuloa has the potential to drastically reduce the cost of operations and occupancy at Pōhakuloa, as well as on Hawaiian Home Lands ranch properties.

With arrays on Hawai'i Island, Maui, and Palau, the **Infrasound Laboratory** (ISLA) uses very sensitive microphones to listen to low-frequency sounds in the atmosphere. These sounds, known as "infrasound" because they are too low in frequency to be audible to the human ear, can carry through the atmosphere for thousands of kilometers. As part of the International Monitoring System of the Comprehensive Nuclear-Test-Ban Treaty, ISLA also conducts research into acoustic source processes, propagation, instrumentation, signal and array processing, and software development.

The UH Sea Grant College program within SOEST employs multiple staff on Hawai'i island focused on extension work designed to improve the public's understanding and stewardship of coastal and marine resources, as well as empowering communities, volunteers, organizations, agencies and policymakers to make well-informed decisions, participate and collaborate. Extension staff in Hilo and West Hawai'i organize and conduct activities islandwide pertaining to **sustainable coastal development, fisheries, climate change, hazard-resilient coastal communities, sustainable coastal tourism and coastal ecosystem health.**



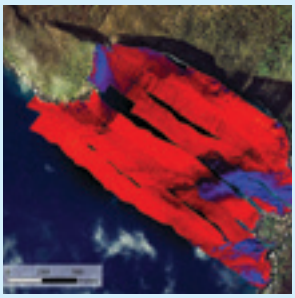
SOEST offices, field study sites, buoys, systems

- 1 HNEI facility
- 1 science center
- 8 Hawai'i Beach Safety sites
- 20 GPS stations
- 6 coral reef sites
- 1 PacIOOS wave buoy
- 2 surface current radars
- 3 water quality buoys
- 3 infrasound arrays
- 4 other facilities

Staff and Faculty

26 Hawai'i residents employed by SOEST

2 UH Hilo Faculty receive funding from SOEST

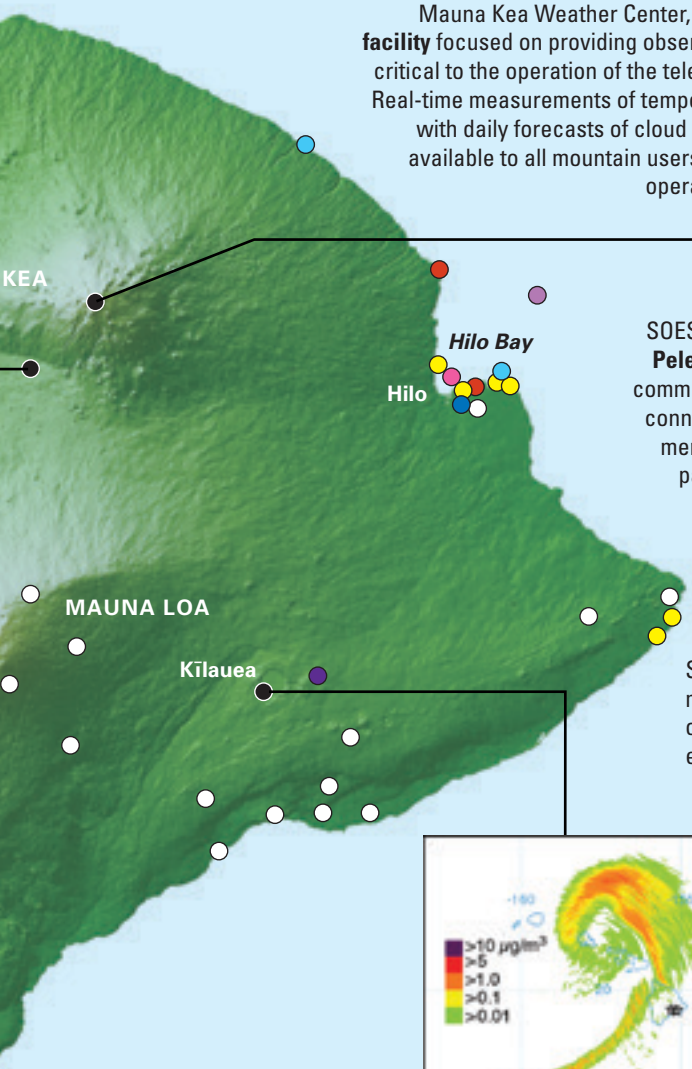


Submarine groundwater discharge is part of the cycle in which water flows between land and sea, entering the near-shore ocean below the surface and adding nutrients, organics, metals, and other dissolved materials to coastal waters. Research uses a combination of aerial thermal infrared thermometry and land- and ocean-based direct observation approaches to quantify and model the response and environmental impacts of these processes in Hawai'i's coastal zone.

Hawai'i County

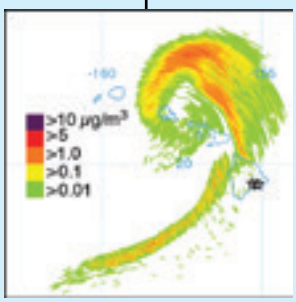
Modeling done by SOEST faculty on tsunami wave propagation, based on highly resolved seafloor elevation measurements made by SOEST research ships, has led to the recent update of state-wide tsunami evacuation zones. The **new tsunami inundation and evacuation zones**, which are accurate down to individual street level, are available online and in the front of island phone books.

With the Institute for Astronomy, SOEST faculty and staff operate the Mauna Kea Weather Center, a **weather research and forecast facility** focused on providing observations and forecasts of weather critical to the operation of the telescope facilities atop Mauna Kea. Real-time measurements of temperature, wind, and humidity, along with daily forecasts of cloud cover, precipitation, and wind are available to all mountain users and ensure the smooth and safe operation of facilities on the mountain.



SOEST water quality buoys in **Hilo Bay, Kiholo Bay, and soon Pelekane Bay** are being used by researchers at UH Hilo and community stewardship groups across the island to help draw connections between events on land (storm events, development, community-based stewardship activities). Measuring parameters such as salinity, temperature, turbidity (water clarity), chlorophyll-a, and depth, these instruments are helping to increase understanding of these systems, to inform the efficacy of land-based stewardship and to make connections mauka to makai.

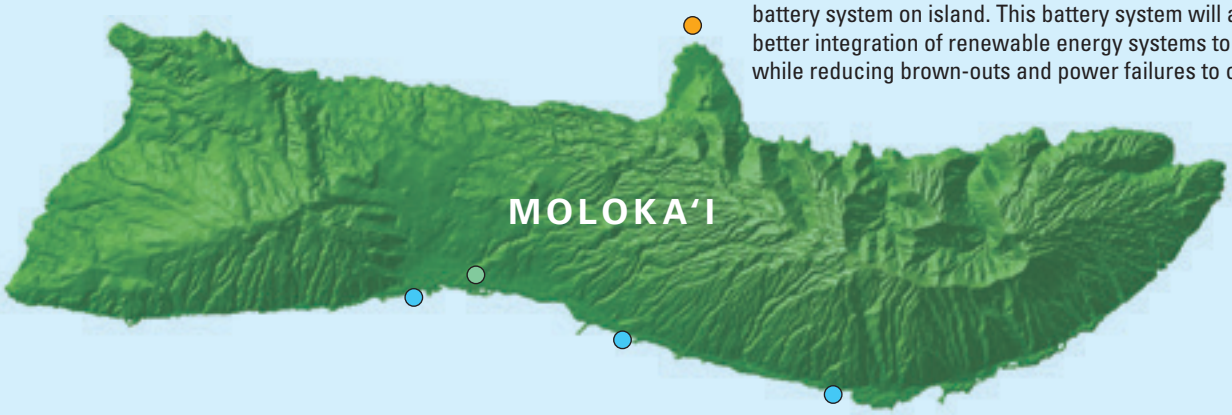
SOEST researchers maintain a system of **GPS stations** on Hawai'i Island to measure earthquakes and volcano inflation/deflation to aide in the understanding of island subsidence, landslide monitoring, and prediction of forthcoming eruptions from Kīlauea and Mauna Loa.



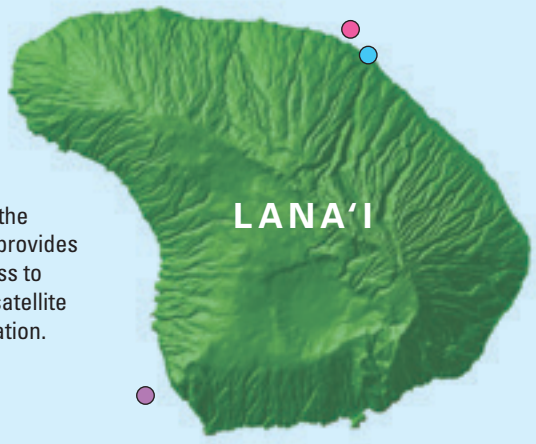
SOEST researchers measure, monitor, and report **concentrations and coverage of vog emissions from Kīlauea**. Real-time measurements of sulfur dioxide gas and sulfate particles from venting are available online, and spatial models of vog concentration are shown nightly on local television stations as part of the evening weather report. Additionally, through the Center for the Study of Active Volcanoes, SOEST and UH Hilo researchers work closely with the USGS to monitor the ongoing eruption and inform emergency managers of emerging hazards.

Using ships, manned-submarines, remotely operated vehicles, and high-resolution mapping systems, SOEST researchers continue to **explore the development of Lō'ihi as the next Hawaiian Island**. Ongoing underwater eruptions and seismic activity, deep-ocean algal maps and bacterial populations, and unique hydrothermal activities occur nowhere else in the State other than Lō'ihi and studying them allows scientists to better understand how the Hawaiian Islands were formed, and how they will continue to change.

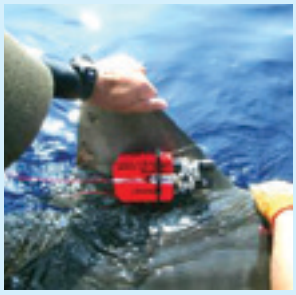
SOEST researchers with the Hawai'i Natural Energy Institute are working with MECO to increase the **reliability and stability of the Moloka'i energy grid**, through the installation of a 2MW battery system on island. This battery system will allow for better integration of renewable energy systems to the grid while reducing brown-outs and power failures to customers.



SOEST Researchers at the Hawai'i Institute of Marine Biology maintain a network of 32 **coral reef ecosystem long-term monitoring sites** throughout the State. These sites represent a diverse range of pristine and impacted reef systems; with data collection aimed at developing the knowledge required to effectively manage and sustain coral reef productivity and health.



The **Hawai'i Flash Flood Response Tool** is made available by the School in partnership with NOAA. It is a web-based tool that provides emergency managers on all islands within Maui County access to real-time precipitation and stream flow data, radar, weather satellite imagery, and alerts and warnings in a central web-based location.



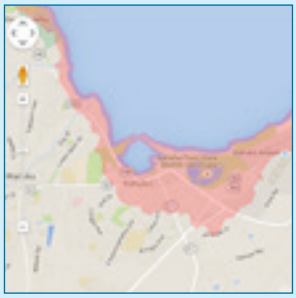
Maui has witnessed a higher number of unprovoked shark attacks than in previous years, and local spear fishers report increasing boldness of large sharks encountered in Maui waters. In order to select appropriate management responses to these events, SOEST researchers **regularly track tiger sharks** using a variety of acoustic and satellite systems. This information helps understand the behavior of sharks within the County, and informs potential management of animals by the State and County.

SOEST offices, field study sites, buoys, systems

- 2 HNEI facilities
- 2 wave buoys
- 3 water quality buoys
- 10 Hawai'i Beach Safety sites
- 14 coral monitoring sites
- 4 'opihi monitoring sites
- 1 infrasound array

Staff, Faculty, and Students

3 Maui County residents employed by SOEST



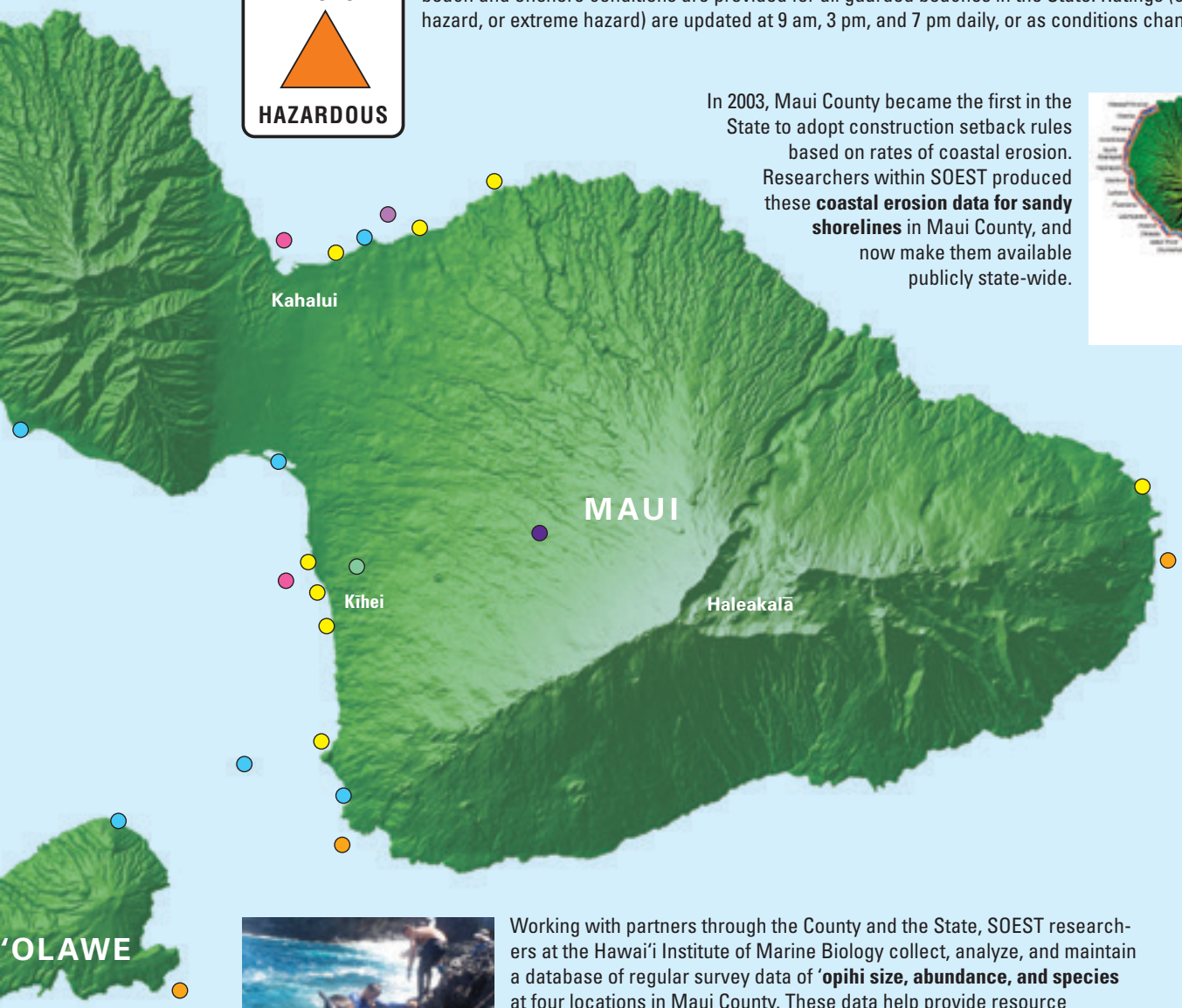
Modeling done by SOEST faculty on tsunami wave propagation, based on highly resolved seafloor elevation measurements made by SOEST research ships, has led to the recent **update of state-wide tsunami evacuation zones**. The new tsunami inundation and evacuation zones, which are accurate down to individual street level, are available online and in the front of island phone books.

Maui County

The Hawai'i Natural Energy Institute, with MECO, DBEDT, and Hitachi, are developing **new ways to control and regulate power distribution systems on Maui**. Hitachi and partners have invested in electric vehicle charging stations, centralized energy control systems, storage batteries, and distributed power management systems, to help Maui residents conserve energy, increase renewable production, and increase grid stability and security.

The **Hawai'i Beach Safety** website was established through cooperation between SOEST and partners throughout the state as a non-profit venture. The aim is to provide beach users with timely and accurate information for choosing a beach destination appropriate to their ocean skill level. Updated beach and offshore conditions are provided for all guarded beaches in the State. Ratings (caution, high hazard, or extreme hazard) are updated at 9 am, 3 pm, and 7 pm daily, or as conditions change.

In 2003, Maui County became the first in the State to adopt construction setback rules based on rates of coastal erosion. Researchers within SOEST produced these **coastal erosion data for sandy shorelines** in Maui County, and now make them available publicly state-wide.



Working with partners through the County and the State, SOEST researchers at the Hawai'i Institute of Marine Biology collect, analyze, and maintain a database of regular survey data of **'opihi size, abundance, and species** at four locations in Maui County. These data help provide resource managers with an important knowledge necessary to understand 'opihi well enough to manage it, and to ensure that there are 'opihi for present and future generations.

Located approximately 60 miles north of O'ahu, **Station ALOHA** is one of the longest serving open-ocean research sites on Earth. SOEST researchers, and teams of scientist from around the globe sail to Station ALOHA each month to collect a wide-range of scientific data. Complemented by continuous data from the **Aloha Cabled Observatory** (ACO) on the ocean floor, the scientific information collected at Station ALOHA is defining our understanding of climate change, open-ocean chemistry, and how the Earth will respond to continued human-caused environmental stress.

Modeling done by SOEST faculty on **tsunami wave propagation**, based on highly resolved seafloor elevation measurements made by SOEST research ships, has led to the recent update of state-wide tsunami evacuation zones. The new tsunami inundation and evacuation zones, which are accurate down to individual street level, are available online and in the front of island phone books.

The **Hawai'i Natural Energy Institute** (HNEI), with facilities in Mānoa and Kaka'ako, is working to accelerate the development of fuel cells, batteries, and grid technology for home, government, and commercial operations. HNEI is the State's energy research authority, and is focused on reducing Hawai'i's dependence on fossil fuels through the modernization of Hawai'i's electrical grids, and the development of sustainable power and fuel resources.

Based in Mānoa, with support facilities on all islands, the **Hawai'i Space Flight Lab** (HSFL) is an engineering and research facility developing, launching, and operating small spacecraft from Hawai'i. HSFL provides workforce training on all aspects of unmanned space missions and is working to position the State as a low-cost gateway to space. As a result of HSFL's efforts, the University of Hawai'i is the only university in the world with both satellite fabrication facilities and unique, direct access to orbital space.

SOEST maintains **wave buoys** off Kāne'ohe, Kailua, Barber's Point, and Waimea Bay which provide information to commercial and recreational boaters on ocean conditions to assist in their safe and efficient operation of vessels in the coastal and open ocean. The buoys also provides real-time data on wave heights to assist the public, emergency responders, and county officials with preparing for and responding to big wave events that have been known to overtop and close coastal roads as well as impact homes and businesses. In addition, the buoys are useful for fishermen, the many paddling clubs on the island, and surfers on all shores of O'ahu.

SOEST offices, field study sites, buoys, systems

- 2 HNEI facilities
- 2 marine centers
- 25 Hawai'i Beach Safety sites
- 5 surface current radars
- 4 PacIOOS wave buoys
- 2 marine labs
- 7 coral monitoring sites
- 11 water quality buoys
- 7 invasive species surveys/monitoring sites
- 2 HSFL facilities
- Hanauma Bay Education Program (Sea Grant)

Staff, Faculty, and Students

42 undergrad students from O'ahu high schools at UHM/SOEST

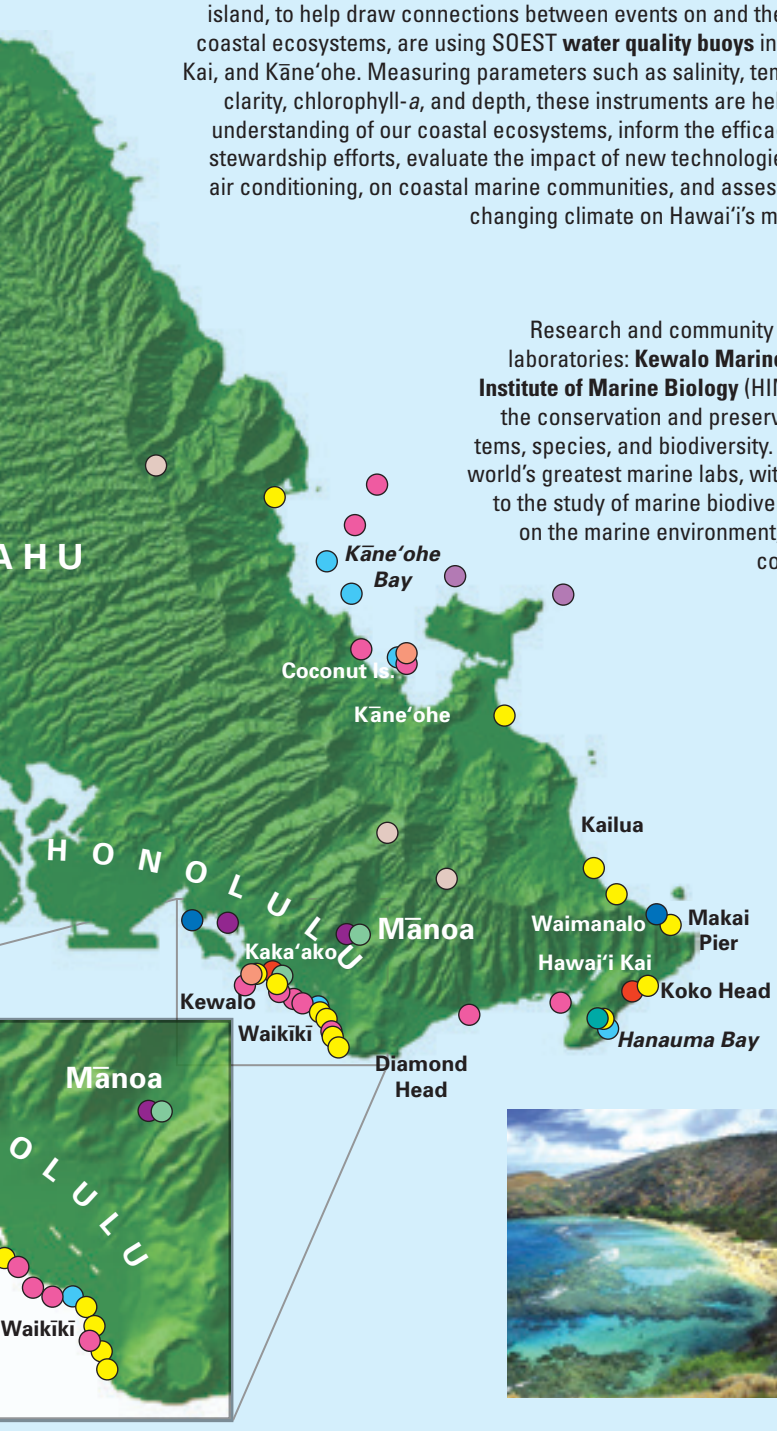
9 graduate students from O'ahu at UHM/SOEST

834 O'ahu residents employed by SOEST

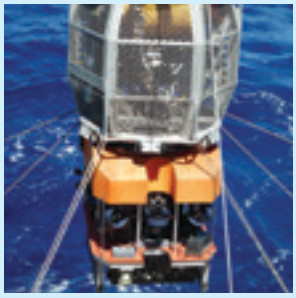
City & County of Honolulu

SOEST researchers measure, monitor, and report concentrations and coverage of **vog emissions from Kīlauea**. Real-time measurements of sulfur dioxide gas and sulfate particles from venting are available online, and spatial models of vog concentration over O'ahu are shown nightly on local television stations as part of the evening weather report.

Agencies, research staff, and community stewardship groups across the island, to help draw connections between events on and their impact on our coastal ecosystems, are using SOEST **water quality buoys** in Waikīkī, Hawai'i Kai, and Kāne'ohe. Measuring parameters such as salinity, temperature, water clarity, chlorophyll-*a*, and depth, these instruments are helping to increase understanding of our coastal ecosystems, inform the efficacy of land-based stewardship efforts, evaluate the impact of new technologies, like seawater air conditioning, on coastal marine communities, and assess the impact of a changing climate on Hawai'i's marine resources.

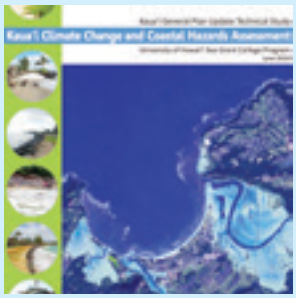


Research and community education at SOEST's two marine laboratories: **Kewalo Marine Lab** in Honolulu and the **Hawai'i Institute of Marine Biology** (HIMB) at Coconut Island focuses on the conservation and preservation of Hawai'i's unique ecosystems, species, and biodiversity. HIMB and Kewalo are among the world's greatest marine labs, with world-class facilities dedicated to the study of marine biodiversity, the impact of human activity on the marine environment, and explorations of deep-ocean, coastal, and coral reef ecosystems.



The SOEST fleet of **ships, submersibles, and small boats** are based at two marine centers on O'ahu: at Pier 45 in Honolulu Harbor and at the Makai Research Pier in Waimanalo. SOEST's two open-ocean research ships, two deep-water manned submarines, and remotely operated submarine are capable of working in all of Earth's oceans, and reaching 90% of the ocean sea floor.

UH Sea Grant, based within SOEST, works with the City and County of Honolulu to administer and manage the **Hanauma Bay Education Program**. Reaching nearly 1 million visitors annually, the award-winning program educates visitors and local residents on the value of marine resources and reef etiquette. The Program also teaches visiting school groups and hosts marine- and conservation-related evening presentations for the public.



The **UH Sea Grant College Program** within SOEST employees multiple staff on Kaua'i island focused on extension work designed to improve the public's understanding and stewardship of coastal and marine resources, as well as empowering communities, volunteers, organizations, agencies and policymakers to make well-informed decisions, participate and collaborate. Extension staff in Kapa'a and Līhu'e organize and conduct activities island-wide pertaining to sustainable coastal development, fisheries, climate change, hazard-resilient coastal communities, sustainable coastal tourism and coastal ecosystem health.

Modeling done by SOEST faculty on **tsunami wave propagation**, based on highly resolved seafloor elevation measurements made by SOEST research ships, has led to the recent update of state-wide tsunami evacuation zones. The new tsunami inundation and evacuation zones, which are accurate down to individual street level, are available online and in the front of island phone books.

SOEST researchers measure, monitor, and report concentrations and coverage of **vog emissions from Kīlauea**. Real-time measurements of sulfur dioxide gas and sulfate particles from venting are available online, and spatial models of vog concentration over Kaua'i are shown nightly on local television stations as part of the evening weather report.

In 2008, Kaua'i County adopted **the most aggressive shoreline building setback law** in the state, based on historical and current coastal erosion data. Researchers within SOEST produced these coastal erosion data for all sandy shorelines in Kaua'i County, and now make them available publicly state-wide.

The **Hawai'i Space Flight Lab**, with facilities at Kaua'i Community College and the Pacific Missile Range Facility (PMRF) is an engineering and research facility developing, launching, and operating small spacecraft from Hawai'i. HSFL provides workforce training on all aspects of unmanned space missions and is working to position the State as a low-cost gateway to space. As a result of HSFL's efforts, the University of Hawai'i is the only university in the world with both satellite fabrication facilities and unique, direct access to orbital space.

SOEST offices, field study sites, buoys, systems

- 3 HNEI facilities
- 1 wave buoy
- 10 Hawai'i Beach Safety sites
- 19 coral monitoring sites
- 2 HSFL facilities

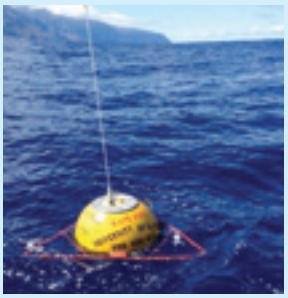
Staff and Faculty

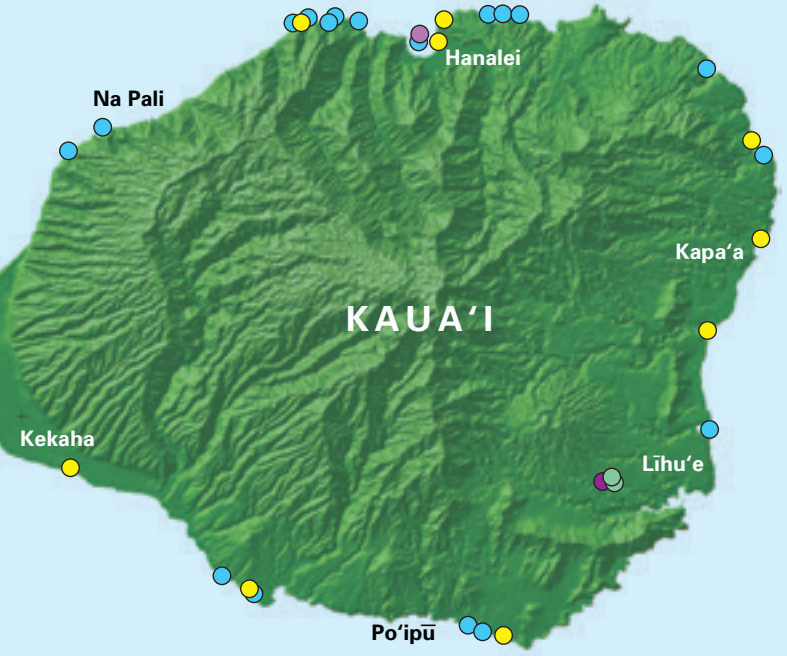
3 Kaua'i residents employed by SOEST

SOEST researchers at the Hawai'i Institute of Marine Biology maintain a network of 32 **coral reef ecosystem long-term monitoring sites** throughout the State, including 5 around Kaua'i. These sites represent a diverse range of pristine end impacted reef systems; with data collection aimed at developing the knowledge required to effectively manage and sustain coral reef productivity and health. On Kaua'i, research and monitoring in recent years has focused on the increases in coral disease on the north shore of Kaua'i, with 14 additional sites regularly surveyed by coral biologists to better understand disease distribution, and potential treatment options to save our reefs.

Kaua‘i County

SOEST maintains a **wave buoy** off Hanalei, which provide information to commercial and recreational boaters on ocean conditions to assist in their safe and efficient operation of vessels in the coastal and open ocean. The buoy also provides real-time data on wave heights to assist the public, emergency responders, and county officials with preparing for and responding to big wave events that have been known to overtop and close coastal roads, as well as impact homes and businesses. In addition, the buoy is useful for fishermen, the many paddling clubs on the island, and surfers on Kaua‘i.



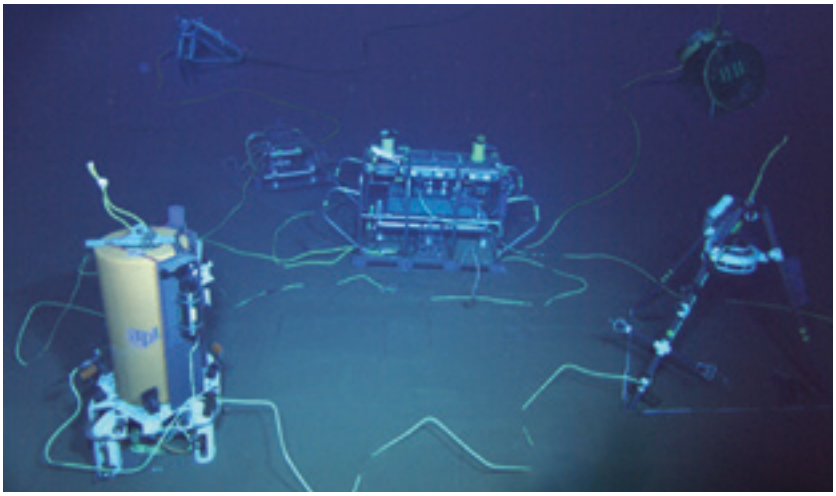


The **Hawai‘i Natural Energy Institute**, with projects at Kaua‘i Community College, Pacific Missile Range Facility (PMRF), and Kawaikini School in Lihu‘e (shown here), is working to accelerate the development of fuel cells, batteries, and grid technology for home, government, and commercial operations. HNEI is the State’s energy research authority, and is focused on reducing Hawai‘i’s dependence on fossil fuels through the modernization of Hawai‘i’s electrical grids and the development of sustainable power and fuel resources.

The **Hawai‘i Beach Safety** website was established through cooperation between SOEST and partners throughout the state as a non-profit venture. The aim is to provide beach users with timely and accurate information for choosing a beach destination appropriate to their ocean skill level. Updated beach and offshore conditions are provided for all guarded beaches in the State. Ratings (caution, high hazard, or extreme hazard) are updated at 9 am, 3 pm, and 7 pm daily, or as conditions change.

The **Hawai‘i Flash Flood Response Tool** is made available by SOEST in partnership with NOAA. It is a web-based tool that provides emergency managers on all islands access to real-time precipitation and stream flow data, radar, weather satellite imagery, and alerts and warnings in a central web-based location.

OCEAN



ALOHA Cabled Observatory is the world's deepest cabled observatory at 4728 m

National Department Ranking:
7

From the seafloor to the ocean surface, and from the coast to the open ocean, SOEST researchers are global leaders — advancing knowledge of the physical forces, complex chemistry, and extremely diverse biology that exist in the ocean near Hawai'i and around the globe.

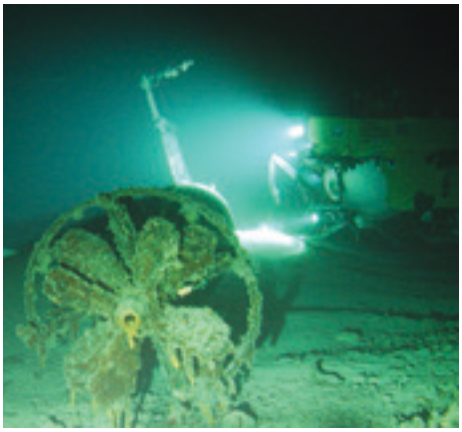
As a wholly coastal state, with an economy that is dependent upon safe and efficient marine transfer of goods and services, the ocean is Hawai'i's lifeline.

Using ships, submersibles, satellite, remote vehicles and a range of oceanographic sensing systems, students and faculty study circulation, nutrient cycles, and marine organisms large and small — from microbes to whale falls.

Our scientists explore coral reefs, hydrothermal vent systems on the ocean floor, examine the interplay between complex planktonic, fishery, and microbial food webs; and lead the global research community in microbial ecology and biology. Discoveries at SOEST enhance our understanding of the role of the ocean in driving local weather and global climate, and the human impact on ocean chemistry and ecosystem productivity.

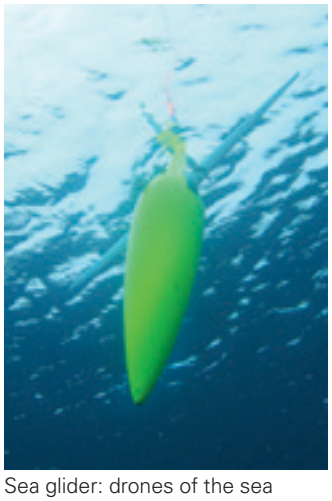
Oceanographic research pursuits are both theoretical and applied at SOEST, with efforts ranging from modeling ocean circulation and tsunami inundation, to the provision of coastal ocean wave, pollution, and safety information to members of the general public.

Further, the ocean presents huge potential for yielding energy sources. Research within SOEST investigates the harvest of deep water methane hydrates, the generation of electricity from wave energy systems and ocean thermal energy conversion (OTEC), and the cooling of metropolitan areas using seawater air conditioning (SWAC).



Pisces V submersible discovers sunken WWII Japanese mini-sub off Pearl Harbor

Manned submersible dives since 1980:
over 1900



Sea glider: drones of the sea

Fisheries and resource management

LIFE

Flora and fauna native to Hawai'i

Collecting deep-ocean fish

The largest ocean on the planet, the Pacific Ocean is home to the world's largest collected biomass of marine life.

Hawai'i is situated within one of the richest marine ecosystems on earth. From the tops of volcanic mountains to the deepest ocean trenches, students and researchers in SOEST are performing world-class research within ocean and terrestrial ecosystems around the globe.

Focused on scales ranging from individual genes to entire ecosystems, SOEST researchers are gaining new insights into the vital role of healthy ecosystems in sustaining our planet, and pioneering approaches to conserve their biodiversity. Our scientists and students maintain extensive field operations, utilize genetic and chemical analyses, and develop laboratory experiments to reveal the hidden worlds of marine and land-based life.

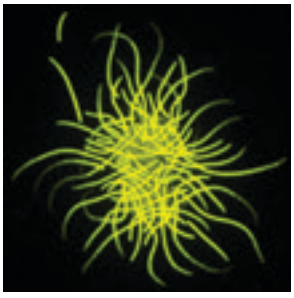
As a global leader in microbial oceanography, we have helped clarify the importance of marine microbes, which dominate our planet and inhabit every drop of seawater.

We are pioneering efforts to save coral reefs, pristine forests, and native fauna from the impact of global climate change, developing methods to manage invasive species, and conducting research to support management of coral reefs, fisheries, and forests that support tourism, underpin local island economies, provide food and protection to communities, and serve as enduring conservation zones in areas of the planet inaccessible to humankind.

Invasive species monitoring sites in Hawai'i: **7**

Coral reef monitoring sites around the islands: **36**

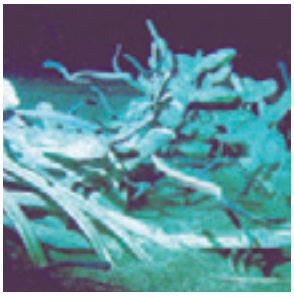
Video camera and data recorder are attached to the fin of a sixgill shark



Microbial oceanography

Marine microbes, which make up most of the biomass in the ocean, contribute half of the Earth's daily production of oxygen.

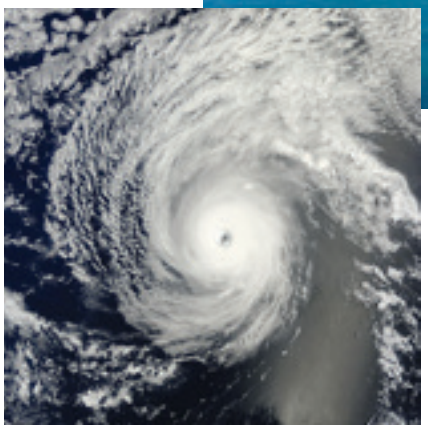
Echolocation of toothed whales



Ecology of whale carcasses

CLIMATE

Finding stress-resistant corals

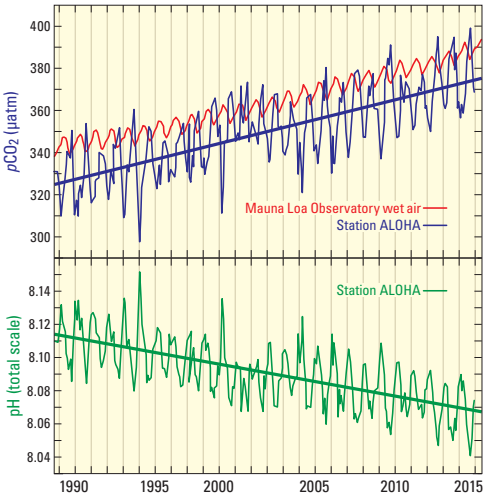


Effects of climate change on tropical storm strength and frequency

Sea level rise and threats to coastal property

Coastal erosion in the state of Hawai'i is predicted to double by 2050.

The Station ALOHA Curve



The longest continuous record of oceanic pH shows a clear and compelling acidification of the ocean as atmospheric carbon dioxide levels grow virtually unabated.

Climate change will impact the social, environmental, economic, and political infrastructures of nearly every nation on Earth. Understanding the complexities of the global climate system and predicting future changes requires detailed knowledge of large-spatial data sets and a robust numerical modeling capability that can accurately detail the interplay between the world's oceans, atmosphere, polar regions, ecosystems, and land masses.

The long and distinguished history within SOEST in modeling climate variability has led to greater understanding of probable longer-term climate trends and how that may affect the occurrence of extreme events such as monsoons, tropical cyclones, storms, droughts and floods.

Additionally, SOEST has world-renown expertise related to a number of urgent issues associated with climate change:

- The International Pacific Research Center is producing forecasts of likely changes to rainfall patterns and strength necessary in forward planning of water resources, as well as changes to tropical cyclone frequency and intensity likely to impart the islands.
- The Hawai'i Ocean Time-Series at Station ALOHA, the longest continuous record of oceanic pH, shows a clear and compelling acidification of the ocean as atmospheric carbon dioxide levels grow virtually unabated. This has implications for a variety of marine life — from coral reefs to globally-important fisheries.
- As sea-level rises around Hawai'i and the Pacific, communities and infrastructure (hospitals, schools, roads, public utilities, communication systems) are increasingly vulnerable to coastal flooding and erosion. Across SOEST, students and faculty are exploring solutions to mitigate climate impacts in the islands and increase adaptive ability to sea level rise and coastal hazards.

ENERGY

Research into alternate fuels for automobiles

Advancing solutions to solve current and future energy needs of the State and the nation is both an urgent requirement and a complex task. Development of technologies and policies that will have significant positive impact on the State of Hawai'i's energy mix requires the integration of analysis, research, engineering, economics, and policy. Experts from across SOEST, and staff teams within the Hawai'i Natural Energy Institute (HNEI) develop, test, and evaluate novel renewable energy solutions and build public-private partnerships to demonstrate real-world integration of solutions onto energy grids.

The Hawai'i Natural Energy Institute (HNEI) within SOEST has established a major fuel cell research and development program – building on HNEI's highly successful research on hydrogen production from renewable resources. Further, SOEST departments and centers conduct research and testing of alternative fuels including biomass and biofuels, solar fuels, and methane hydrates; while also assessing the potential for alternative fuels, including the use of liquefied natural gas (LNG), to meet Hawai'i's energy needs.

SOEST works with local utilities and commercial partners across the globe to safely and effectively integrate renewable energy systems onto existing island-scale electric grids. SOEST staff and students are addressing the challenges associated with this integration and formulating potential solutions, including use of renewable energy storage systems and implementation of smart grid technology.

Wave energy device off Kāne'ohe Bay, O'ahu

Wind farm at Hawi, Hawai'i Island

The Hawai'i Sustainable Energy Research Facility is a partnership with Hawaiian Electric Company to accelerate acceptance and deployment of fuel cells for commercial and military applications.

"Smart building" design and construction

HNEI operates the Hawai'i Hydrogen Power Park, wherein electrolyzers operating on solar and wind energy generate hydrogen, which can be stored and then used to drive fuel cells for generating energy.

Flash Carbonization™ producing charcoal from biowaste

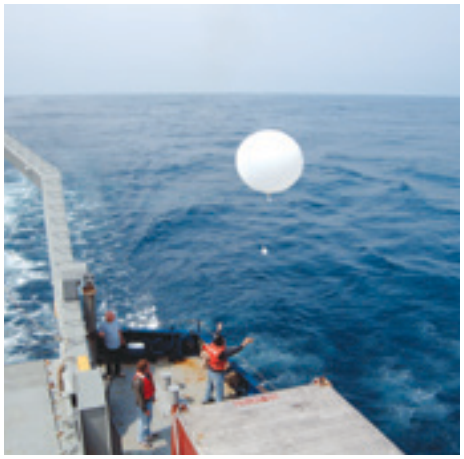
ATMOSPHERE

Pao-Shin Chu, professor of Atmospheric Sciences, is Hawai'i State Climatologist.

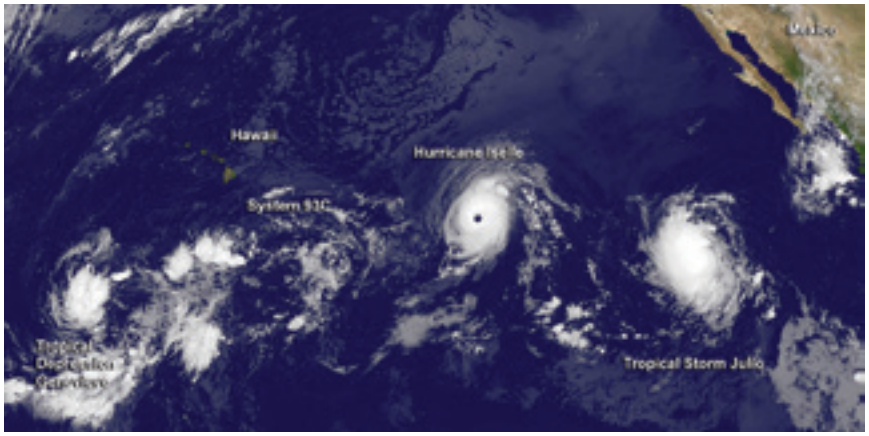
SOEST has maintained the vog prediction model for the Hawaiian Islands since 2010.

Monitoring and modeling vog — fumes from volcanic vents — across the state

Installing a weather station on O'ahu



Releasing a weather balloon from a ship at sea



Two tropical storms and a hurricane near the Hawaiian Islands on 04 August 2014

Research and education in atmospheric sciences is entering its second half-century at the University of Hawai'i. Scientists and staff at SOEST work to understand and predict weather phenomena and climate trends in the Pacific and across the globe.

Rainfall and snow associated with storms, monsoons, and longer term processes such as El Niño impact the social, environmental, economic, and political infrastructures of nearly all nations on Earth. SOEST students and staff study changes in the Asian monsoon, the physics governing storm generation, and the impact of climate change on rainfall, droughts, and floods.

Students and staff at SOEST develop and maintain a wide range of climate, weather, and atmospheric forecast models to advance understanding of climate variability; assist the National Weather Service with providing accurate extended range weather forecasts; and assist emergency managers with assessing brush/forest fire risk, health impacts of volcanic gas, and flooding potential from monsoons and storms.

Further, SOEST researchers are improving predictions of the creation, movement, and intensity of tropical cyclones (known as typhoons, cyclones, and/or hurricanes), among the most destructive natural hazards in the world.

SOEST researchers and students advance the scientific understanding of climate dynamics through sustained and detailed data collection, analysis, and modeling of climate systems – projecting climate change and associated impacts from the global to the local scale.

National department ranking: **12**

EARTH

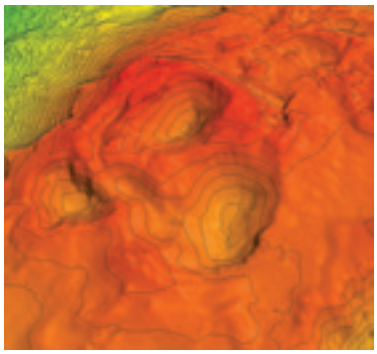
From volcanic mountaintops to the deepest submarine trenches, SOEST's earth scientists seek to understand the complex physical, chemical and biological processes shaping our planet, both at the surface, and deep within.

Within the School, students and faculty pursue research topics such as volcanoes, coastal to deep-ocean geochemistry, and global tectonic activity. SOEST scientists seek to understand the processes responsible for the creation and destruction of important natural resources including groundwater and geothermal energy. Earth science research is advanced using SOEST's ship and submersible capabilities, experimental and theoretical developments, field-based observations, and computer simulations.

Studies of the physical structure and dynamic forces of Earth provide students with a background that combines both geology and geophysics for technical and professional work at industrial, governmental, and academic institutions. Further, the study of high-pressure mineral physics and materials science (e.g., synthesis of diamonds, mineral transformation in Earth's interior) are key subjects of scientific research and have great potential for application in high-tech industries in Hawai'i.

Hawai'i's beaches and reefs are recognized around the world for their beauty; understanding the processes that shape them helps us preserve their splendor. Coastal geology research within SOEST focuses on coastal erosion, geologic history of Hawaiian reefs, and Pacific basin sea level history – providing crucial knowledge to aid mitigation and adaptation to future climate changes.

Field work in the American Southwest…



The submarine summit of Lō'ihi

Collecting lava samples on land…

… and rock samples on the sea floor

… and on Hawai'i Island

Global School Ranking: **15**
Nature Index for Earth & Environment

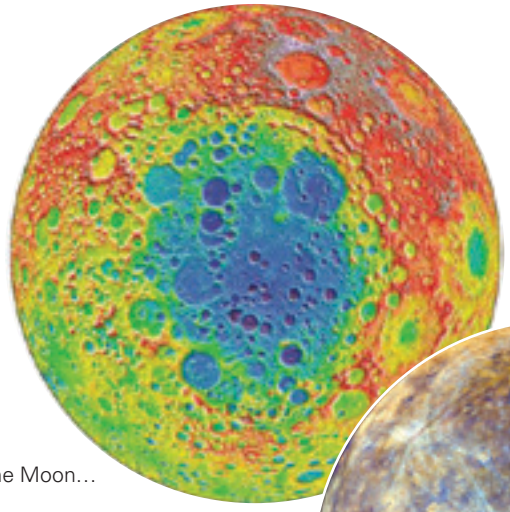
Kīlau'ea, on the slopes of Mauna Kea on the Island of Hawai'i, is one of the most active volcanoes on Earth.

The land-sea interface

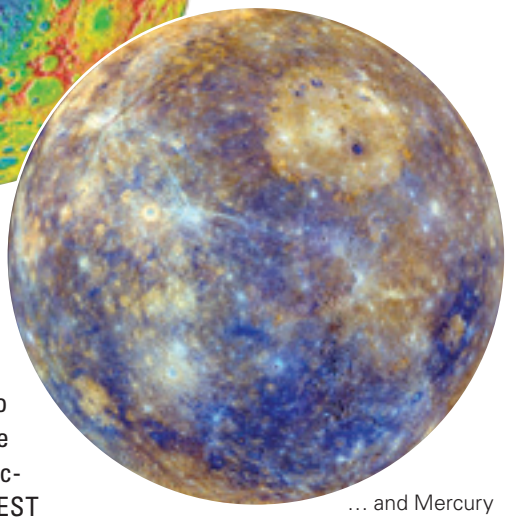
Bruce Houghton, Gordon A. Macdonald Professor of Volcanology in the Dept of Geology & Geophysics, is Hawai'i State Volcanologist.

SPACE

Interplanetary dust particles could have delivered water and organics to Earth.



Mapping the Moon…



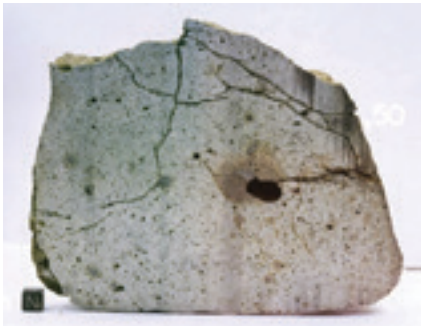
… and Mercury

From space flight to instrument development to chemical analyses of extraterrestrial material, SOEST scientists and students are enabling new understanding of the origin and evolution of our solar system.

Hawai'i is located in a unique position to become a low-cost gateway to space and to place the University of Hawai'i as the only university in the world to have both satellite fabrication capabilities and unique, direct access to orbital space. Through the Hawai'i Space Flight Laboratory, SOEST students and staff are engaged in ongoing satellite fabrication, launch, and mission operations of satellite systems.

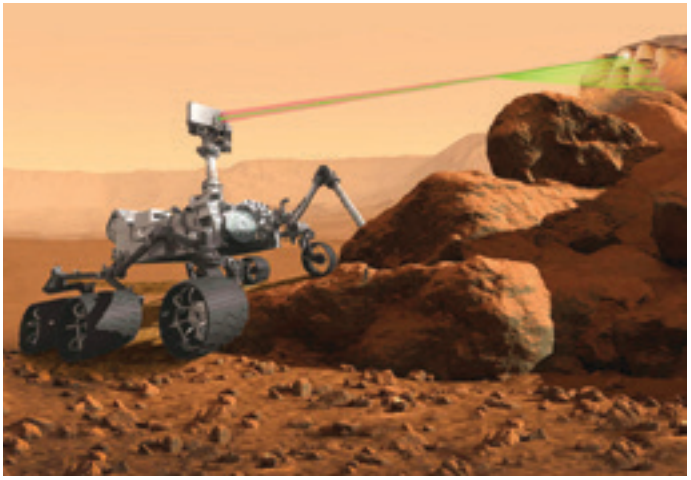
The origin and evolution of our solar system has preoccupied human observers for centuries. SOEST personnel design and build instruments for remote sensing systems for Earth and planetary exploration; and study Solar System objects with a variety of approaches including spacecraft data analysis, theoretical and computational modeling, and laboratory analysis of presolar grains from meteorites, interplanetary dust particles, and comet samples returned by the Stardust mission.

The discoveries to be made in studying meteorites and the chemistry of the cosmos are fundamental to understanding planetary evolution and exploring the processes linking the distribution of water and life in the Universe.

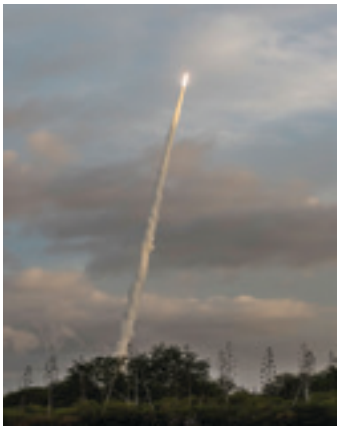


Using meteorites to determine the age of the Moon

UH has a rocket launch pad and rail launcher; clean-room facilities and test equipment for small-satellite production; satellite tracking, communications and mission control.



SOEST researchers are on the team designing the Mars 2020 Rover



Super Strypi launch from Kaua'i, November 2015

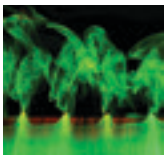
SOEST

Academic Departments

Atmospheric Sciences
www.soest.hawaii.edu/MET

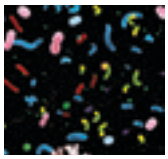
Geology and Geophysics
www.soest.hawaii.edu/GG

Ocean and Resources Engineering
www.ore.hawaii.edu



Oceanography
www.soest.hawaii.edu/oceanography

Research Centers and Institutes



Center for Microbial Oceanography: Research and Education (C-MORE)
cmore.soest.hawaii.edu

Hawai'i Institute of Geophysics and Planetology (HIGP)
www.higp.hawaii.edu

Hawai'i Institute of Marine Biology (HIMB)
www.hawaii.edu/HIMB

Hawai'i Natural Energy Institute (HNEI)
www.hnei.hawaii.edu

Hawai'i Sea Grant College (UH Sea Grant)
seagrant.soest.hawaii.edu

Hawai'i Undersea Research Laboratory (HURL)
www.soest.hawaii.edu/HURL

International Pacific Research Center (IPRC)
iprc.soest.hawaii.edu

Joint Institute for Marine and Atmospheric Research (JIMAR)
www.soest.hawaii.edu/jimar

Pacific Biosciences Research Center (PBRC)
www.pbrc.hawaii.edu/

SOEST

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