HAWAII WATER RESOURCES RESEARCH CENTER

2023 FACTSHEET

WHO AND WHAT WE ARE

The University of Hawai'i (UH) Water Resources Research Center (WRRC) serves the State of Hawai'i, American Samoa, and other Pacific Islands. The Center was established in response to the Federal Water Resources Research Act of 1964 and the academic development plan of UH. The Center is part of a network of 54 Water Resources Research Institutes present in every State, Washington, D.C., and three U.S. territories.

Our mission is to conduct research that identifies, characterizes, and develops solutions for environmental problems; provide opportunities for graduate and undergraduate students to prepare them to be leaders in water and environmental research; assist communities to address water and environmental problems; and provide science-based information to support decision-making activities.

Federal grant funding from the Water Resources Research Act allows WRRC to leverage university funds, external grants, and contracts. WRRC receives approximately 80 percent of our annual support from external grants and contracts.

WRRC currently has ten faculty and project-supported researchers active in such fields as hydrology, ecohydrology, climate science, engineering, geology, geophysics, microbiology, economics, and social science. Our projects support undergraduate, master and doctoral students, and post-masters and post-doctoral researchers

FACULTY

Thomas Giambelluca
Director

Sayed Bateni
Hydrology

Leah Bremer
Social-Ecological Systems

Xiaolong Geng
Groundwater Hydrology & Hydrogeology

Aurora Kagawa-Viviani
Forest Restoration & Ecohydrology

Marek Kirs
Microbiology

Jonghyun Lee
Hydrogeology/Groundwater Engineering

Zhiyue Wang
Environmental Engineering

Tao Yan
Environmental Microbiology & Biotechnology

AFFILIATE FACULTY

Mia Comeros
Junior Marine Ecologist

Amanda Cording
Asst. Environmental Scientist

Henrietta Dulai
Assoc. Geochemist

Kim Falinski
Asst.Hydrologis

Abby Fraizer
Asst. Climatologist

Victoria Keener
Interdisciplinary Hydrologist

Keri Kodama
Asst. Atmospheric Scientist

Tomo'omi Kumagai
Biogeoscientist

Ryan Longman
Assoc. Climatologist

Xiao Luo
Asst. Atmospheric Scientist

Craig Nelson
Assoc. Geochemist

Alison Nugent
Assoc. Atmospheric Scientist

Kirsten Oleson
Assoc. Ecological Economist

Christopher Shuler
Asst. Hydrologist

Giuseppe Torri
Assoc. Atmospheric Scientist

Yinphan Tsang
Assoc. Hydrologist

Mehana Vaughan
Assoc. Community Natural & Cultural Res. Sp.

Donn Viviani
Asst. Geoscience Educator

Clifford Voss
Hydrogeologist

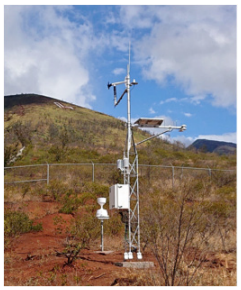
Robert Whittier
Appl. Research Hydrogeologist

Alan Ziegler
Environmental Scientist

Photos used in banner courtesy of Winston Kawamoto

2023 Hawai'i WRRC Research

from the mountains to the sea, preserving our natural water resources



• CLIMATE AND ECOHYDROLOGY •

Dr. Thomas Giambelluca, WRRC Director since August 2019, has published more than 150 peer-reviewed papers on topics related to the climate, hydrology, and ecohydrology of tropical environments. He developed and maintains widely used online climate data and mapping platforms including the Rainfall Atlas of Hawai'i and helped lead the development of the Hawai'i Climate Data Portal, an online climate data access and visualization resource. He is currently leading the creation of the Hawai'i Mesonet, a 100-station, statewide network of telemetered weather and climate monitoring stations providing real-time data for a wide range of research, resource management applications, and emergency management needs. Dr. Giambelluca's research is focused on land-atmosphere interaction under changing land cover and global climate. His work aims to improve understanding of Hawai'i's climate, how it has changed in the past and is likely to change in the future, and how the changes have and will affect hydrological processes and terrestrial ecosystems. He also studies the hydrology of tropical montane cloud forests and the effects of biological invasions, particularly by alien tree species in Hawai'i's forests, on water, soils, and carbon storage.

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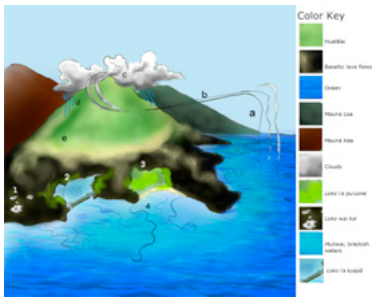


• WATERSHED POLICY AND MANAGEMENT •

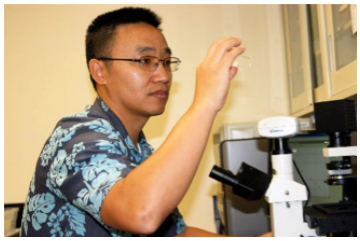
Dr. Leah Bremer conducts research on interdisciplinary, applied, and problem-driven research related to water and watershed policy and management. She views social and environmental challenges and solutions as intricately inter-connected and works with collaborative teams of researchers, community groups, agencies, non-profits, and others to achieve informed, effective, and equitable decision making. With this approach, she has conducted research on how to protect groundwater dependent ecosystems (GDEs) like fish ponds (loko i'a), anchialine pools (wai 'ōpae), and nearshore ecosystems. Protecting these systems requires understanding the multiple ways they are used and valued as well as the ways in which groundwater pumping, land management, and climate change might affect these systems through their influence on the quality and quantity of groundwater.

• WATER QUALITY •

Dr. Marek Kirs' current research is predominantly centered on water quality from the perspectives of human and environmental health. His projects aim to identify appropriate health-risk-based microbiological water quality standards to protect beachgoers, identify microbial contamination sources to support water management decisions, and explore groundwater ecosystem health and its post-disturbance recovery using the microbes thriving in deep and dark environments. The major goals of his studies are to (1) contribute to surface and groundwater quality management efforts in Hawai'i and other Pacific islands, (2) assist in the development of meaningful and protective recreational water quality standards for the state, and (3) assist the state with beach and groundwater monitoring. Current projects are collaborative efforts with the Hawai'i Department of Health, the City and County of Honolulu, and the Board of Water Supply.

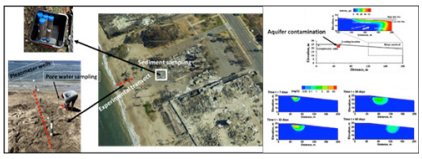
• WASTEWATER •

Dr. Zhiyue Wang is working on both centralized and onsite wastewater treatment systems. The main focus of his research is to develop cost-effective engineering solutions to reduce pollution, recover resources, and improve the sustainability of existing wastewater infrastructure. For centralized facilities, Dr. Wang is developing a novel biotechnology to convert waste nitrogen into nitrous oxide for energy recovery. Recovery of nitrous oxide, a potent greenhouse gas, can also lower the carbon footprint of treatment plants. For onsite systems, Dr. Wang is exploring algal-bacterial processes that can replace existing cesspools in Hawai'i.



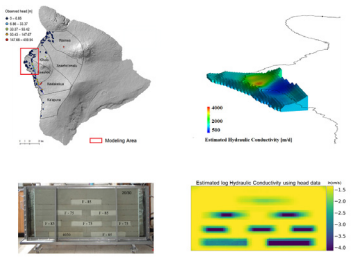
• WATER REUSE •

Dr. Tao Yan conducts research at the interface of water infrastructures, water quality, and human health. One area of research focuses on non-potable water reuse, where he works to address multiple key obstacles along the wastewater's life cycle in order to facilitate reclaimed water for agriculture and landscape irrigation. These include salt water intrusion into collection system in coastal regions, low cost treatment processes, and effluent quality risk quantification. He is a member of an EPA-funded consortia that works to understand the removal efficiencies of viral pathogens in wastewater treatment processes and to identify effective strategies to monitor viral concentration and to determine health risks for water reuse.



• GROUNDWATER DYNAMICS AND AQUIFER CONTAMINATION •

Dr. Xiaolong "Leo" Geng's current research is directed toward groundwater dynamics and the fate and transport of contaminants within coastal aquifer systems. His primary focus centers on (1) developing comprehensive groundwater flow and transport models to elucidate the intricate flow patterns of groundwater and (2) to predict the movement and reactions of contaminants. For his groundwater dynamics study, Dr. Geng has developed an innovative groundwater model that simulates the interactions between groundwater and surface water within coastal aquifer systems, which takes into account a wide range of hydrogeological and environmental processes. For his research on aquifer contamination, he is conducting a combined field and modeling study to investigate the contamination and salinization processes in coastal aquifers affected by the recent wildfires in Hawai'i.



• MODELING, UNCERTAINTY QUANTIFICATION, AND DECISION MAKING •

Dr. Jonghyun "Harry" Lee has developed numerical modeling techniques and uncertainty quantification methods for groundwater flow and contaminant transport, geothermal engineering, CO_2 sequestration, and river and nearshore hydrodynamics. He utilizes available hydrogeologic, geophysical, geochemical, and remote sensing data sets to characterize water resources systems, which will provide a better prediction of groundwater flow and solute transport for the subsurface structure of the aquifers. The modeling and uncertainty quantification results support the management decisions that contribute to sustainable supply of water resources, pollutant remediation, and military operations.

• REMOTE SENSING AND MACHINE LEARNING FOR NATURAL HAZARDS •

Dr. Sayed Bateni's research focuses on data assimilation, natural hazards, land-atmosphere interaction, remote sensing, and machine learning. He is developing a (1) near real-time wildfire prediction system for the State of Hawai'i, and (2) an artificial intelligence-enhanced weather-based irrigation software for farmers in Hawai'i. Dr. Bateni's other interest is in Hydraulic Engineering to predict the scour depth around bridge piers using machine learning approaches. His recently funded NSF project focuses on mapping inundated areas by using radar data and machine learning approaches. His future goal is to develop a flood forecast system for the State of Hawai'i.

• WATERSHED MODELING •

County planners and community organizations in northern Kaua'i are worried about how flooding could change with more intense rainfall and higher sea levels. As sea levels continue to rise and extreme rainfall becomes more common and severe due to climate change, it's important to update flood maps that are currently based on historical conditions. To do this, affiliate faculty member **Dr. Chris Shuler** and Pacific RISA researchers are using the 2D Gridded Surface Subsurface Hydrologic Analysis watershed model. This model is being used to create maps that show the severity of flooding from heavy rainfall and high sea levels in the Hanalei watershed in northern Kaua'i. By comparing the flooding from past extreme rainfall to what's expected in the future by using data from observations and climate change predictions, modelers can determine how the frequency of extreme rainfall and sea level events may change.

• WILD FIRES •

The devastating Maui wildfires of August 2023 were the worst natural disaster in Hawai'i's recent history. In addition to their direct effects, the fires also posed immediate and significant human health risks associated with potential contamination of drinking water from thermal degradation of plumbing

and water systems. Days after the fire, thousands of residents in Kula and Lāhainā returned to their homes with the tap water under a do-not-use advisory. During this emergency period, there was a lack of scientifically sound up-to-date information about the nature and extent of the potential contamination. To address this information gap, affiliate faculty member **Dr. Chris Shuler** helped to initiate the launch of the Maui Post-Fire Community Drinking-Water Information Hub and a community tap water sampling program to provide residents with free drinking-water testing for Volatile Organic Compounds—the chemicals of concern. The testing program is not part of the regulatory decision making, but will help to build community trust and contribute towards the process of providing the residents and the county the information they need to decide when it is safe to drink the water. Residents can see test results and request sampling on the information hub: https://www.wrrc.hawaii.edu/maui-post-fire-community-water-info-hub/

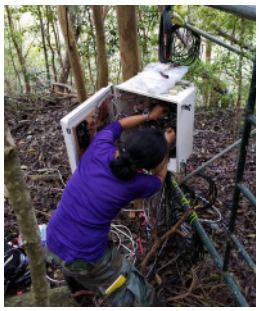
• RED HILL TASK FORCE •

As the Red Hill Research Project Coordinator and affiliate faculty member, **Mia Comeros** helped organize the University of Hawai'i Red Hill Task Force (RHTF), which was formed in December 2021 following the confirmation of contamination in drinking water supplied by the Red Hill Shaft on the island of O'ahu. The Task Force is coordinated through the WRRC and consists of University of Hawai'i faculty, staff, and students across the Mānoa campus and Leeward Community College, independent scientists, and community members. The RHTF leads analytical and laboratory methods development and plays an integral role in communication and making data and information available to the public. The RHTF also plays a central role in coordinating research and communication among researchers, government agencies, and the community.

In September 2023, the task force launched the Red Hill Information Hub in order to compile and share general information, data, and tools regarding Red Hill and the aquifer contamination resulting from the recent fuel spill that occurred in November 2021 and prior spills dating back to 2005.

About the Red Hill Information Hub

The hub is a UH system-wide effort, led by the UH Red Hill Task Force, and is envisioned to be a centralized source of Red Hill-related information with the goal of enhancing education, communication, and research. The hub links to other publicly-available websites and data from state and federal agencies including HDOH's Red Hill Water Information webpage and BWS's Red Hill updates page. It also points users to other available data portals including the JBPHH drinking water long-term monitoring dashboard. The hub features education resources for teachers, students, researchers, and the general public, a news feed, community resources (requests for tap water sampling, published CDC and HDOH surveys), and information on public meetings and events.



• RESTORATION ECOHYDROLOGY •

Dr. Aurora Kagawa-Viviani's research focuses on the interaction of changing terrestrial landscapes and hydrologic processes within the Hawaiian Islands. Landscapes are being transformed at unprecedented rates due to urbanization and other drivers of land use and ecosystem change. These interact with changing climates to produce new ecological and hydrologic regimes at the land's surface. How are flows of water and energy altered? What are the implications for human society? What has or what can society at large or local communities do to mitigate these changes or alter the trajectory of these new ecohydrologic regimes? Using the lens of change, she seeks to understand how plant and human

communities are affected by- and affect-hydrologic processes. Dr. Kagawa-Viviani's current research focuses on the restoration of native plant communities where the water limits their growth.

PHOTO CAPTIONS

Thomas Giambelluca:
The Hawai'i Mesonet weather and climate monitoring station recently installed near Lāhainā, Maui
Photo Credit: T. Giambelluca

Leah Bremer:
Figure and caption from Gibson et al. (2022). Island hydrogeology and groundwater dependent ecosystems (GDEs) represent a continuum of water flow from (a) evaporation over the ocean, (b) movement of moist air inland, (c) cloud formation, and (d) orographic rainfall, through (e) geological formations to create a subterranean gradient of fresh, brackish, and saline water, which flows into diverse types of GDEs (1. Loko wai kai, 2. Loko i'a kuapā, 3. Loko i'a pu'u one), and then move as submarine groundwater discharge (SGD) to the ultimate receiving waters in nearshore settings to create (4) muliwai, estuarine conditions of mixing fresh to brackish submarine groundwater discharge and receiving saline ocean water. Inspired by a figure from Wyban 1992.

Gibson, V.L., Bremer, L.L., Burnett, K.M., Lui, N.K., and Smith, C.M. 2022. Biocultural values of groundwater dependent ecosystems in Kona, Hawaii. Ecology and Society 27(3):18, https://doi.org/10.5751/ES-13432-270318 (2022)

Marek Kirs:
Collection (left) and analyses (right) of beach water samples for fecal indicator bacteria and coliphages
Photo credit: M. Kirs

Zhiyue Wang:
A pilot-scale system for nitrous oxide recovery from wastewater
Photo credit: Z. Wang

Tao Yan:
Microscopic examination of microbial pathogens in water
Photo credit: T. Yan

Xiaolong "Leo" Geng:
Field monitoring and modeling of aquifer contamination
Photo credit: X. Leo Geng

Jonghyun "Harry" Lee:
Example of subsurface characterization using indirect well water level measurements: Keauhou aquifer (top) and a lab-scale sand box with low permeable inclusions (bottom)
Photo credit: J. Harry Lee

Sayed Bateni:
Hawai'i Wildfires of 2023
Photo credit: Matthew Thayer/The Maui News
https://www.mauinews.com/news/local-news/2023/08/maui-on-fire/

Chris Shuler:
Brandon Bees sampling water, Maui (UH Mānoa's Dept of Earth Sciences graduate student)
Photo credit: C. Shuler

Mia Comeros:
Aerial view of Pearl Harbor, O'ahu
Photo credit: D. McManus, 2005, https://www.flickr.com/photos/rack-etrx/5942004654

Aurora Kagawa-Viviani:
Wiring sapflow sensors, Mākaha, O'ahu
Photo credit: A. Kagawa-Viviani