Water Resources Research Center
University of Hawaii

Annual Technical Report
2019

Product:

Bareford, K., 2019, Bridging the water information gap: The National Water Extension Program in "Proceedings of the 2019 UCOWR/NIWR Annual Water Resources Conference," June 11–13, 2019, Snowbird, Utah, USA.

Barling, N., J.L. Blaha, L. Ellison, J. Mason, C.M. Smith, and C.R. Glenn, 2019, "Using in-situ collections of reef algae to examine land-based sources of pollution in Kaneohe and Waialua Bays on Oahu, Hawaii," Abstract submitted for 2019 AGU Fall Meeting, San Francisco, CA, December 3–9, 2019.

Blaha, J.L., N. Barling, L. Ellison, J. Mason, C.M. Smith, and C.R. Glenn, 2019, "Inter-calibration of common bio-assey species: D15N and %N parameters of algal tissues as biogeochemical indicators on Oahu," Abstract submitted for 2019 AGU Fall Meeting, San Francisco, CA, December 3–9, 2019.

Brennis, Theodore, and N. Lautze, 2019, Analysis of stable isotopes in rainwater to understand groundwater recharge and flow-paths within the Pearl Harbor Aquifer, Oahu, in Watersmart Innovations Conference and Exposition, Las Vegas, NV.

Donohue, M.J., E.A. Greene, and D.T. Lerner, Water Resources Research Act Program Current Status, Development Opportunities, and Priorities for 2020–2030, U.S. Geological Survey Circular. (in review)

Donohue, M.J., D.T. Lerner, and E.A. Greene, 2019, National Institutes for Water Resources USGS Water Mission Area Workforce Survey. Presented at the National Institute for Water Resources 2019 Annual Meeting, February 24–27, 2019, Washington, D.C., USA.

Donohue, M.J., and D.T. Lerner, 2019, A trans-disciplinary faculty cluster hire in energy and water sustainability: Developing actionable scholarship via collaboration and diversity in "Proceedings of the 2019 UCOWR/NIWR Annual Water Resources Conference," June 11–13, 2019, Snowbird, Utah, USA.

Ellison, L., C.R. Glenn, J.P. Mason, C.M. Smith, and V. Gibson, 2019, "Assessment of land use impacts on the coastal waters of Waialua Bay, North Shore of Oahu, Hawaii," Abstract submitted for 2019 AGU Fall Meeting, San Francisco, CA, December 3–9, 2019.

Greene, E.A., 2019, The USGS Water Resources Research Act Program, integrating university and federal research, outreach, and education in "Proceedings of the 2019 UCOWR/NIWR Annual Water Resources Conference," June 11–13, 2019, Snowbird, Utah, USA.

Hawai'i Water Resources Research Center, 2020, "2020 Hawai'i WRRC Research (fact sheet)," Honolulu, HI, February 2020.

Lerner, D.T., M.J. Donohue, E.A. Greene, and K. Bareford. 2019. The NOAA National Sea Grant College Program and USGS Water Resources Research Act Program – A natural partnership. Oral presentation by D.T. Lerner, Universities Council on Water Resources/National Institutes for Water Resources 2019 Conference, June 11–13, 2019, Snowbird, Utah, USA.

Shuler, C.K., 2019, "From recharge to reef: Assessing the sources, quantity, and transport of groundwater on Tutuila Island, American Samoa," Ph.D. dissertation, Department of Geology and Geophysics, School of Ocean and Earth Sciences Technology, University of Hawai'i at Mānoa, Honolulu, HI, 301 p.

Shuler, C. and A.I. El-Kadi, 2018, "WRRC-ASPA hydrologic monitoring network handbook," WRRC Special Report SR-2018-02, University of Hawai'i at Mānoa Water Resources Research Center, Honolulu, HI, 58 p.

Tachera, D., 2020, Hawai'i 'Ike Wai Project, in NSF EPSCoR Site Visit, Honolulu, Hawai'i.

Tachera, D., 2020, Panelist, in Society for Advancement of Chicanos/Hispanics and Native Americans in Science Conference, Honolulu, Hawai'i.

Tajfar, E., S. Bateni, E. Heggy, and T. Xu, 2020b, Feasibility of estimating turbulent heat fluxes via variational assimilation of reference-level air temperature and specific humidity observations, Remote Sensing, 12(7), 1065. https://doi.org/10.3390/rs12071065

Tajfar, E., S. Bateni, V. Lakshmi, and M. Ek, 2020a, Estimation of turbulent heat fluxes via assimilation of land surface temperature, and air temperature and specific humidity into a coupled land surface-atmospheric boundary layer model, Journal of Hydrology, 583, 124577. https://doi.org/10.1016/j.jhydrol.2020.124577

Tajfar, E., S. Bateni, St. Margulis, P. Gentine, and T. Auligne, 2019, Estimation of turbulent heat fluxes via assimilation of air temperature and specific humidity into an atmospheric boundary layer model, Journal of Hydrometeorology, 21(2), 205–225. https://doi.org/10.1175/JHM-D-19-0104.1

Information Transfer Program:

Results of many of the projects are disseminated by journal papers, conference abstracts, dissertations and theses, and the PIs University of Hawaii's (UH) departmental websites. Course work for UH MIC485 Microbes and Their Environment (Spring 2020 and 2021) is also using the research results from the "Evaluation of Pepper mild mottle viruses as a sewage marker in Hawaii" WRRI project. Data for several projects are also available to the public and science community via online data repositories.

Joint regional leadership meetings were held of programs of the NOAA National Sea Grant College Program and the USGS Water Resources Research Act to foster collaboration and enhance services and products provided to constituents. These meetings included directors of state programs in the regions identified as well as national leadership of NOAA and the USGS and in part funded by the grant.

Special sessions were held during the Universities Council on Water Resources/National Institutes for Water Resources 2019 Conference, June 11–13, 2019, Snowbird, Utah, USA for the following topics:

- "Informing the future of water resources programming through integration of the social and natural sciences and enhanced trans-organization collaboration."
- "The USGS Water Resources Research Act National Competitive Grans Program (104G): What have we learned in the last 10 years?"

Student Support:

6 Undergraduate students, 3 Masters students, and 4 PhD students supported by Section 104 Base Grant

Notable Achievements and Awards:

Two graduate students worked on the WRRI project "Integrated approach to better understanding groundwater flow in Hawaii: Oxygen/hydrogen stable isotopes and continuous water level monitoring," which provided opportunities for scholarships and awards to further their studies (i.e., UCAR Next Generation Fellowship, and SMART Department of Defense Service). This project also produced the first thermal infrared maps of Waialua Bay on the north shore of O'ahu revealing the locations of previously unknown diffuse and point-sourced submarine groundwater discharge, as well as detailing how these waters mix and interact with both river runoff and seawater.

Outcome of the WRRI projects have also laid the foundation for several $100K grants with local government agencies and a possible $1M grant with the USEPA to research viral pathogens and surrogates for wastewater reuse on tropical islands.

Economic Activity, Technological Progress, And Water Resource Utilization On Oahu

Project Type: Annual Base Grant
Project ID: 2019HI081B

Project Impact:

Project Investigator: Peter Fuleky. This grant has supported valuable work on measuring the economic conditions in Hawai‘i. Following a ten-year expansion, global and local economic conditions have now become more volatile. Hawai‘i’s tourism-dependent economy is especially vulnerable to economic fluctuations. We have already found evidence of weaker growth in recent quarters, which does not bode well for local economic performance ahead with a global slowdown on the horizon. The novel indicators of economic performance we developed will help to identify the state of the economy and should be very useful for the local community.

The next phase of our study is to estimate the impact of economic activities and technological progress on water demand on O‘ahu. Our results will promote sustainable coastal development by quantifying water consumption as a function of economic fluctuations. This will help stakeholders to assess the impact of future developments on water demand and sustainability.

Evaluating Student Training And STEM Workforce Development At The National Institutes For Water Resources (NIWR)

Project Type: Coordination Grant
Project ID: 2015HI478S (Darren T. Lerner, PI)

Project Impact:
Student training and workforce development are key academic, social, and economic metrics valued by society and of interest to: industry, universities and colleges, the United States (US) Congress, the US Office of Management and Budget (OMB), and the United States Geological Survey (USGS), among others.
A major component of the Water Resources Research Act (WRRA) is to provide for training of the next generation of scientists and engineers through the USGS National Institutes for Water Resources (NIWR). The National Institutes for Water Resources has a demonstrated record in this area having trained 25,000 students in its first 50 years while currently supporting or training approximately 1,000 students annually at more than 150 universities, as well as mentoring USGS interns. However, the compilation, analyses, and presentation of these data to better understand and document NIWR's contributions to education and workforce development at has been modest to date. Further, exploration on the workforce placement of students supported by NIWR will clarify the value of this investment to society as well as the USGS.
This research investigated the education and training activities and outcomes of the National Institutes of Water Resources (NIWR) through the Water Resources Research Act (WRRA) and the role of these efforts in our Nation's Science Technology, Engineering and Mathematics (STEM) workforce with a focus on the U.S. Geological Survey. Findings may inform understanding of NIWR's student support, and the role this support plays in training the next generation of federal water scientists and managers.

Development Of Regional Strategic Visioning At The USGS WRRA Program And Coordination And Collaboration Among WRRA Institutes And NOAA Sea Grant College Programs

Project Type: USGS Cooperative Agreement
Project ID: G18AC00353 (Darren T. Lerner, PI)

Project Impact:
The University of Hawai'i Water Resources Research Center (WRRC) assisted the U.S. Geological Survey (USGS) in planning, coordination, and execution of activities that provided an opportunity for, facilitated, and successfully achieved:

A) Connectivity among state programs of the Water Resources Research Act Program (WRRA) and National Sea Grant College Program (Sea Grant) toward collaborative, coordinated, and enhanced service to our constituents and stakeholders at the state, regional, and national level, and

B) Strategic visioning of the WRRA Program and associated Water Resources Research Institutes.

Specifically, the WRRC assisted the USGS in the successful administration, development and implementation of activities which achieved the following:

- Enhanced understanding of the missions and mandates of the WRRA Program and Sea Grant between these programs.
- Enriched mutual knowledge of the current and planned work of state WRRA and Sea Grant programs.
- Increased awareness of existing collaborations among WRRA and Sea Grant programs.

Characterizing The Impact Of Advection On Evapotranspiration In American Samoa

Project Type: Annual Base Grant
Project ID: 2019AS485B (Sayed Bateni, PI)

Project Impact:
The main objective of this study was to evaluate the performance of a novel variational data assimilation (VDA) model at six sites (Arou, Audubon, Bondville, Brookings, Desert, and Willow Creek) with contrasting climate and vegetation conditions. The developed VDA approach takes advantage of the synergistic assimilation of land surface temperature (LST), air temperature, and specific humidity into a coupled land surface-atmospheric boundary layer model to partition the available energy between the sensible (*H*) and latent (*LE*) heat fluxes. The unknown parameters of the VDA model are neutral bulk heat transfer coefficient (C_{HN}) and evaporative fraction (*EF*). The estimated *EF* agreed with the observations in terms of magnitude and day-to-day fluctuations in all the study sites. In addition, the variations in the C_{HN} estimates and leaf area index (LAI) were consistent in all the study sites. This showed that the proposed approach outperformed the previous VDA system, which assimilated only the state variables of atmosphere (i.e., reference-level air temperature and humidity) and performed well in both water- and energy-limited evaporation regimes. Comparison of the estimated *H* and *LE* with the corresponding measurements at the six sites indicated that the VDA system can accurately estimate turbulent heat fluxes over a wide variety of environmental conditions. Compared to Tajfar et al. (2020b), this study reduced the root-mean-square-error (RMSE) in half-hourly sensible and latent heat flux estimates over the six study sites on an average of 23.5% and 26.0%, respectively.

Integrated Approach To Better Understanding Groundwater Flow In Hawaii: Oxygen/Hydrogen Stable Isotopes And Continuous Water Level Monitoring

Project Type: Annual Base Grant
Project ID: 2019HI481B (Nicole Lautze, PI)

Project Impact:
This project successfully deciphered general groundwater flow directions within the central corridor of O‘ahu using drinking water monitoring data from USGS National Water Quality Assessment (NAWQA) and Hawai‘i Department of Health (HDOH). By examining legacy data from 2000–2002, the study focused on spatial relationships between concentrations of pineapple production agrochemicals in groundwater. This created a new cost-effective methodology for discerning groundwater flows paths. The methodology to process the data included (1) identification and exclusion of outliers, (2) normalization by calculation of standard scores, (3) spatial plotting of concentration values using GIS software, and (4) interpolation to an aquifer-wide scale. Overall, this method was successful at a low resolution, and results generally agreed with O‘ahu’s existing groundwater flow models.
In partnership with the National Science Foundation EPSCoR ‘Ike Wai project, we deployed precipitation collectors across Central O‘ahu, including the island’s tallest peaks, and over a broad area of West Hawai‘i. Experimental designs for fog collectors are ongoing and the data will be compared to elucidate the input of fog to recharge and measured in water wells. In turn, results from precipitation and fog collection will be compared with historical NAWQA groundwater well data to assess groundwater recharge and flow. Combined with funding from HDOH, soil moisture monitors to measure recharge have been installed in conjunction with select O‘ahu rainfall collectors. A comprehensive understanding of recharge values to our groundwater system should result from studying the O and H isotope value of precipitation, fog, soil, and groundwater aquifers.

Technology Transfer and Communications – American Samoa

Project Type: Annual Base Grant
Project ID: 2019AS489B (Thomas W. Giambelluca, PI)

Project Impact:
Due to the transition of the University of Hawaii (UH) WRRC directors in Fall 2019 there are no activities to report for the first portion of the reporting period.
Web Redesign. Previously allocated funds from within the UH budget were frozen due to the COVID-19 related fiscal crisis for the institute web redesign. Work was delayed until additional funding was allocated. The institute website is being designed to include our partnership with American Samoa-WRRC.

Technology Transfer and Communications – HI

Project Type: Annual Base Grant
Project ID: 2019HI484B (Thomas W. Giambelluca, PI)

Project Impact:
Technology Transfer activities for the period of 18 June 2019 to 31 December 2020 included disseminating information on water resources through our bimonthly seminars and meetings, project reports and published journal articles; and the institute website where our research, publications, and other activities are made available to the University of Hawaii (UH), government agencies, the private-sector researchers, and general public with an interest in water-resource issues. Several well attended strategic meetings with stakeholders and researchers were hosted by UH-WRRC in 2020 to bring awareness to our research on water quality, groundwater modeling, water resources sustainability, and wastewater treatment; and to endorse future collaborations (January 28, 2020 UH WRRC and Chuo University Research Support Office meeting; February 20, 2020 ‘Ike Wai – WRRC Stakeholder Workshop). A new logo was created in Fall 2019 to rebrand the relevancy of our mission, and reflects the research vision of the incoming Director Tom Giambelluca.
In response to the COVID-19 pandemic, the Spring 2020 seminar series ended in February (instead of the end of the semester in May). Following the UH safety protocols, the Fall 2020 seminars were held as virtual meetings due to the uncertainty of the pandemic. This platform allowed us to invite leading experts—from the U.S. and other countries—representing a diverse field of expertise (e.g., environmental impact, groundwater engineering and hydrogeology, HYDRUS modeling, hydrology and precipitation, etc.). These well-attended virtual events included participants from the local, state, federal, and international communities. It allowed our graduate students to gain valuable knowledge beyond their stated fields of interest.