OUR VISION

Resilient and sustainable Pacific Island communities using climate information to manage risks and support practical decision making about climate variability and change

Pacific RISA

PACIFIC REGIONAL INTEGRATED SCIENCES AND ASSESSMENTS

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NEWSLETTER INTRO

Year 4 of funding covers September 2018-September 2019

During Year Four of this grant cycle, the Pacific RISA continued to be a trusted source of climate information for planners, decision makers, and stakeholders in Hawai'i and the U.S.-Affiliated Pacific Islands (USAPI), and to support the effective utilization of climate science to manage the impacts of the changing climate across diverse sectors in the Pacific Islands region. During the current Year Five, as the world faces unprecedented challenges due to the COVID-19 pandemic, our researchers and students are continuing our work from home and doing our part to flatten the curve, while also exploring the parallels between the COVID crisis and the climate crisis. We have updated our website with a page of Climate and Coronavirus resources.

INSIDE THIS ANNUAL NEWSLETTER

Projects during this grant phase aimed to assess the impact of climate variability and change throughout Hawai‘i and the USAPI. The Pacific RISA team linked mid-range projections with end-of-century downscaled projections; conducted inclusive, place-based science to identify decision thresholds; and helped decision-makers assign value to resources to evaluate and select adaptation strategies. This grant designates sustained support for communities and research in Hawai‘i, the Commonwealth of the Northern Mariana Islands (CNMI), Guam, Federated States of Micronesia (FSM), Republic of the Marshall Islands (RMI), Republic of Palau, and American Sāmoa.

A major accomplishment of the Pacific RISA during Year Four was the release of the Fourth National Climate Assessment (NCA4), Volume II (NCA4; USGCRP, 2018), on November 23, 2018. “Chapter 27: Hawai‘i and U.S.-Affiliated Pacific Islands” provides an authoritative and inclusive examination of the risks and impacts of climate change and variability in the region. The chapter took over two years to complete, during which Pacific RISA, federal partners, and the US Global Climate Research Program (USGCRP) brought together the expertise of eleven authors and nearly eighty technical contributors from the region – representing more than sixty agencies, departments, and organizations. The findings are based on an assessment of peer-reviewed scientific literature and other sources, and they have undergone extensive review by experts and the general public, as well as the Federal Government. Since its publication, the chapter on Hawai‘i and the USAPI has been widely reported on and referenced in the region—arguably becoming the most trusted resource on the impacts of climate change in Hawai‘i.

RESEARCH UPDATES

Assessing Implications of Climate Variability and Change on Freshwater Resources, Flooding, and Hydrological Droughts, Faga’alu Watershed, American Sāmoa

Olkeba T. Leta and Aly El-Kadi

The geographically isolated island of Tutuila, American Sāmoa has limited land and water resources available for drinking water supply, food production, ecosystem services, recreational activities, and other uses. Climate change, caused by exponential population growth, industrialization, and greenhouse gas emissions, has caused global warming that exerts considerable pressure on water resources and coastal communities. Therefore, assessing the consequences of climate change on freshwater resource availability and sustainability is of paramount importance for regions like American Sāmoa.

In this project, we assessed the impact of climate change on the key elements of the hydrological cycle, such as rainfall, evapotranspiration, groundwater recharge, and streamflow, and on extreme events, such as peak and low flow events for the possible occurrence of floods and droughts. The study was conducted by collecting and analyzing geospatial data (e.g., land use/cover, soil, and digital elevation model (DEM)) and long-term hydro-meteorological data (e.g., streamflow, rainfall, temperature, etc.), to improve the existing watershed and hydraulic models and adapt them to the physical conditions of American Sāmoa. The specific objectives of this study were to (i) develop, calibrate, and validate hydrologic and hydraulic models for the watershed, and (ii) assess the implications of climate variability and change on freshwater resources, flooding, and hydrological droughts through the use of the developed models.

Figure 1: Location of Faga'alu watershed with its stream network on Tutuila Island, American Sāmoa

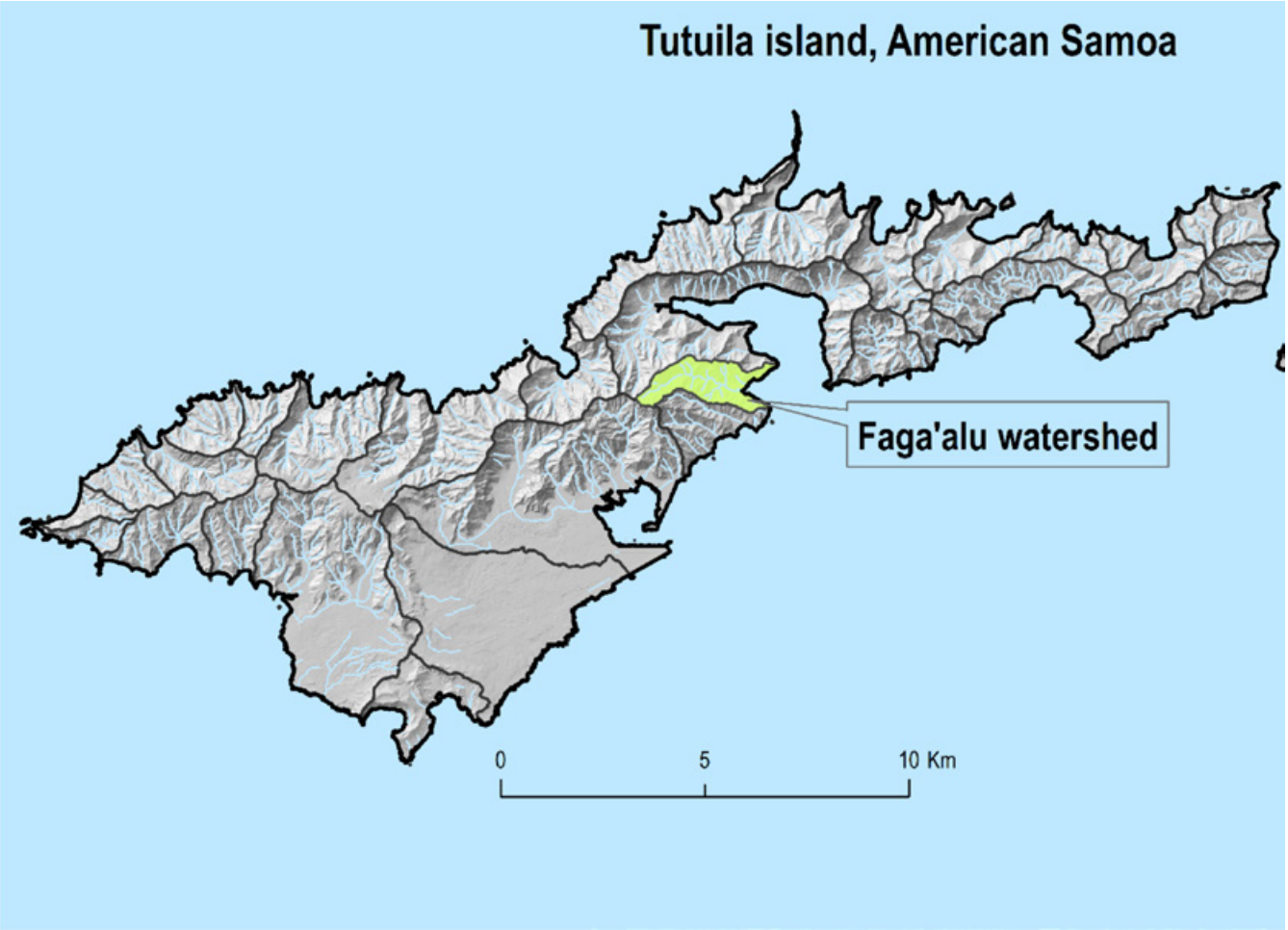


Table 1: Summary of climate change impact on water budget components of Faga'alu watershed under representative concentration pathways (RCP).

Scenario	RF [mm]	SR [mm]	LF [mm]	BF[mm]	Recharge[mm]	DP [mm]	PET[mm]	AET[mm]
Present [1990-2009]	2091.9	489.2	252.3	180.0	275.3	90.0	1902.1	1070.9
RCP4.5 [2080-2099]	2459.7	718.9	308.8	239.8	359.5	120.7	1948.5	1073.7
RCP8.5 [2080-2099]	2276.0	639.4	273.2	202.1	304.5	101.9	2011.1	1059.3
% change [RCP4.5]	17.6	**46.9**	22.4	33.2	30.6	34.1	2.4	0.3
% change [RCP8.5]	8.8	**30.7**	8.2	12.3	10.6	13.2	5.7	-1.1

Note: RF = Rainfall; SR = Surface Runoff; LF = Lateral Flow; BF = Base Flow; DP = Deep Percolation to deep aquifer; PET = Potential Evapotranspiration; AET = Actual Evapotranspiration

A Collaborative Modeling Framework for the American Sāmoa Power Authority and the University of Hawai'i's Water Resources Research Center

Christopher K. Shuler

Researchers Christopher Shuler and Aly El-Kadi from Pacific RISA and the University of Hawai'i Water Resources Research Center (UHWRRC) have teamed up with water resource engineers at the American Sāmoa Power Authority (ASPA) to develop a collaborative hydrologic modeling framework. The modeling framework developed for this project integrates weather station data, streamflow data, water budget modeling, future climate scenarios and groundwater modeling into a seamless data-to-model workflow. Recent advancements in cloud-computing technologies provide new opportunities for collaboration and communication between existing institutions that can more efficiently share resources, thereby allowing for direct application of models designed to solve water management challenges and to assist future climate adaptation efforts. This project applies methods developed from the participatory and collaborative modeling movement that has, in recent decades, become a well-used approach in environmental management. Participatory and collaborative goals are centered around addressing the need for enhanced research—stakeholder engagement and producing practical, defensible models that sufficiently address stakeholder needs and promote model use in guiding important water management decisions today and into the future.

Images 1 and 2: Installing weather stations with ASPA staff and student interns in Vaipito AS (via Chris Shuler)

The workflow is made entirely open-source, reproducible, and dynamic by using innovative cloud-computing tools such as Jupyter Notebooks, GitHub, and Binder/Azure. These tools manage the data-science infrastructure, so the project team can focus on communicating with each other and developing models that are scientifically relevant and useful for management. While this framework was deployed in American Sāmoa it could be easily scaled to other islands or localities.

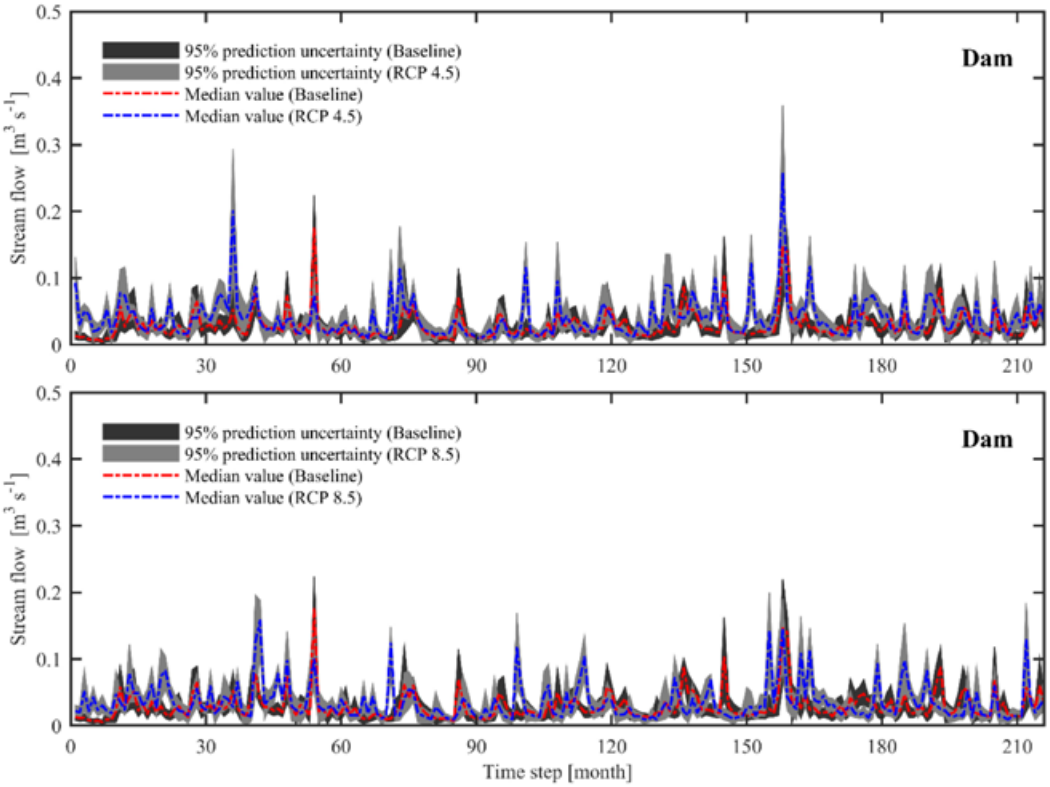
All the raw data, code, models, and results are publically available here. To learn more about the project please visit the project website.

Submarine Groundwater Discharge and Stream Baseflow Sustain Pesticide and Nutrient Fluxes in Faga'alu Bay, American Sāmoa

Eric M. Welch, Henrietta Dulai, Aly El-Kadi, and Christopher K. Shuler

It is increasingly recognized that groundwater discharge in the form of stream baseflow and submarine groundwater discharge (SGD) plays an important role in contaminant transport. This study seeks to demonstrate the importance of groundwater flow for the distribution and transport of selected pesticides and nutrients in the Faga'alu aquifer on the island of Tutuila in American Sāmoa. Field measurements, including seepage runs and analysis of stream and groundwater for pesticides and nutrients, were combined with hydrological modeling. Selected analytes were glyphosate (GLY), dichlorodiphenyl-trichloroethane (DDT), imidacloprid, and azoxystrobin for pesticides and chemical species of nitrogen, phosphate, and silicate for nutrients. Hydrological flow and transport models of the aquifer were built to simulate groundwater flow and to provide estimates of GLY and dissolved inorganic nitrogen (DIN) fluxes. Stream baseflow was responsible for 59% and SGD for 41% of groundwater flow to the bay, which totaled 6,550 ± 980 m3/d in the dry season when surface runoff was negligible. DDT was found in 85% and GLY in 100% of tested samples. SGD and baseflow thus delivered 9 ± 2 g/d of DDT, 0.9 ± 0.2 g/d of GLY, 570 ± 100 g/d of DIN and 840 ± 110 g/d of dissolved inorganic phosphorus (DIP) into Faga'alu Bay. While all pesticide levels are below environmental limits, their presence in baseflow and SGD, which discharge continuously year-round, result in sustained fluxes of GLY and DDT to the reef. The presence of DDT in groundwater decades after its last application confirms its long-term environmental persistence.

Figure 2: Simulated monthly streamflow at dam for baseline (1990-2009) and future (2088-2099) under RCP 4.5 and RCP 8.5 scenarios with 95% model prediction uncertainty for the Faga'alu watershed.



(Results of this study were published in the journal Frontiers in Environmental Sciences, Water and Wastewater Management in 2019.)

Estimated Groundwater Recharge from a Water-Budget Model Incorporating Selected Climate Projections, Island of Maui, Hawai‘i

Alan Mair, Adam Johnson, Kolja Rotzoll, and Delwyn Oki

Groundwater recharge on the Island of Maui is affected by changes in climate and agricultural irrigation. Agricultural irrigation decreased across central Maui after the cultivation of sugarcane ceased in December 2016. However, the County of Maui Department of Water Supply estimates that the demand for freshwater on Maui is expected to increase by 45 percent between 2015 and 2035. To help evaluate the availability of fresh groundwater to meet this increased demand, the United State Geological Survey (USGS) conducted a study to estimate groundwater recharge under future climate conditions and changing agricultural irrigation practices. In this study, a water-budget model was used to estimate the spatial distribution of recharge on Maui for one present-day and two future climate scenarios. All three scenarios used 2017 land-cover conditions that reflect the closure of sugarcane plantations in central Maui. The two future climate scenarios, including one drier than the present-day scenario and one wetter than the present-day scenario, were developed using available high-resolution downscaled climate projections from the International Pacific Research Center (IPRC) at the University of Hawai‘i at Mānoa.

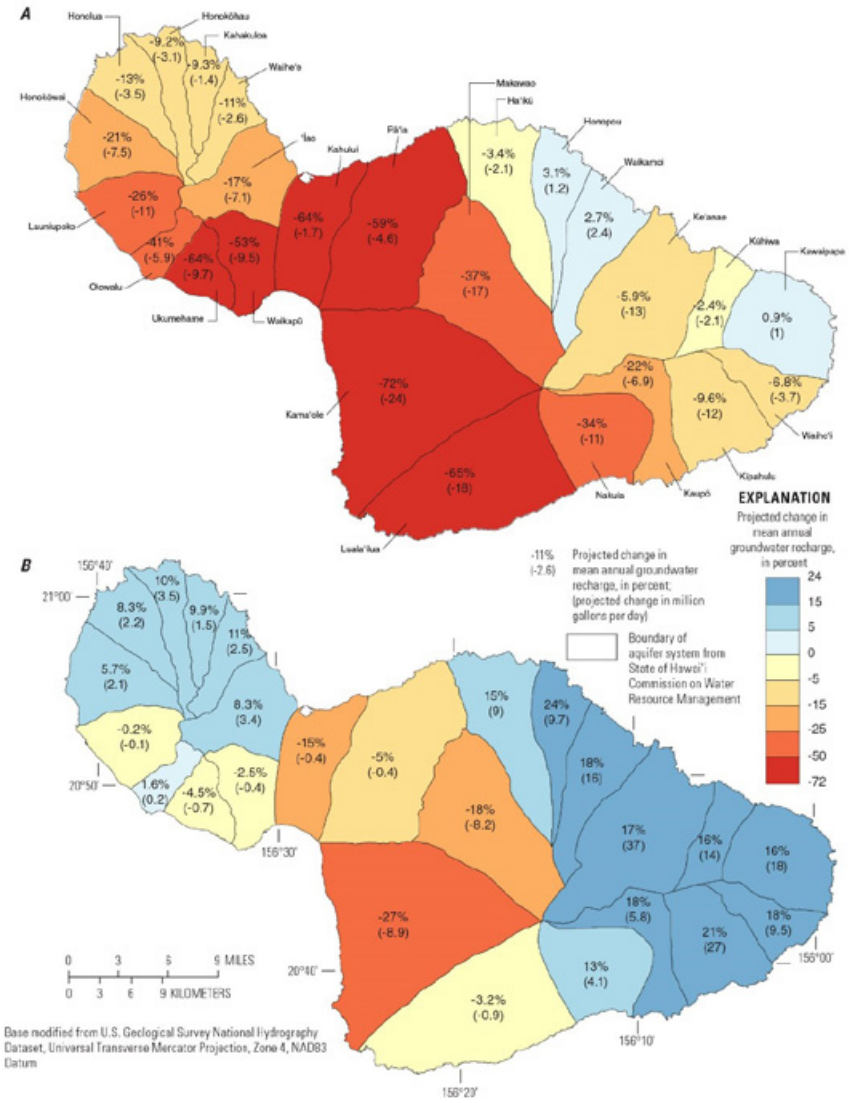


Figure 3: Projected change in mean annual groundwater recharge by State of Hawai‘i Commission on Water Resource Management aquifer system for two future climate scenarios for the Island of Maui, Hawai‘i. (A) dry climate scenario, (B) wet climate scenario. Projected changes are relative to mean annual recharge for a present-day scenario and given both as a percentage and as millions of gallons per day in parentheses.

- Study results indicate that for the dry climate scenario, estimated mean annual recharge for Maui decreases by about 172 million gallons per day (14 percent) compared to a present-day recharge estimate of 1,232 million gallons per day. Estimated recharge for the dry climate scenario decreases in 22 of Maui's 25 aquifer systems (see Figure 3A below).
- For the wet climate scenario, estimated mean annual recharge for Maui increases by about 144 million gallons per day (12 percent) compared to present-day recharge. Estimated recharge for the wet climate scenario increases in 17 of Maui's 25 aquifer systems (see Figure 3B below).

The results of this study are described in USGS Scientific Investigations Report 2019–5064 and three published geospatial datasets.

Simulating Impacts of Land Cover Change and Climate Change on Groundwater Recharge in Maui

Laura Brewington, Victoria Keener, Alan Mair

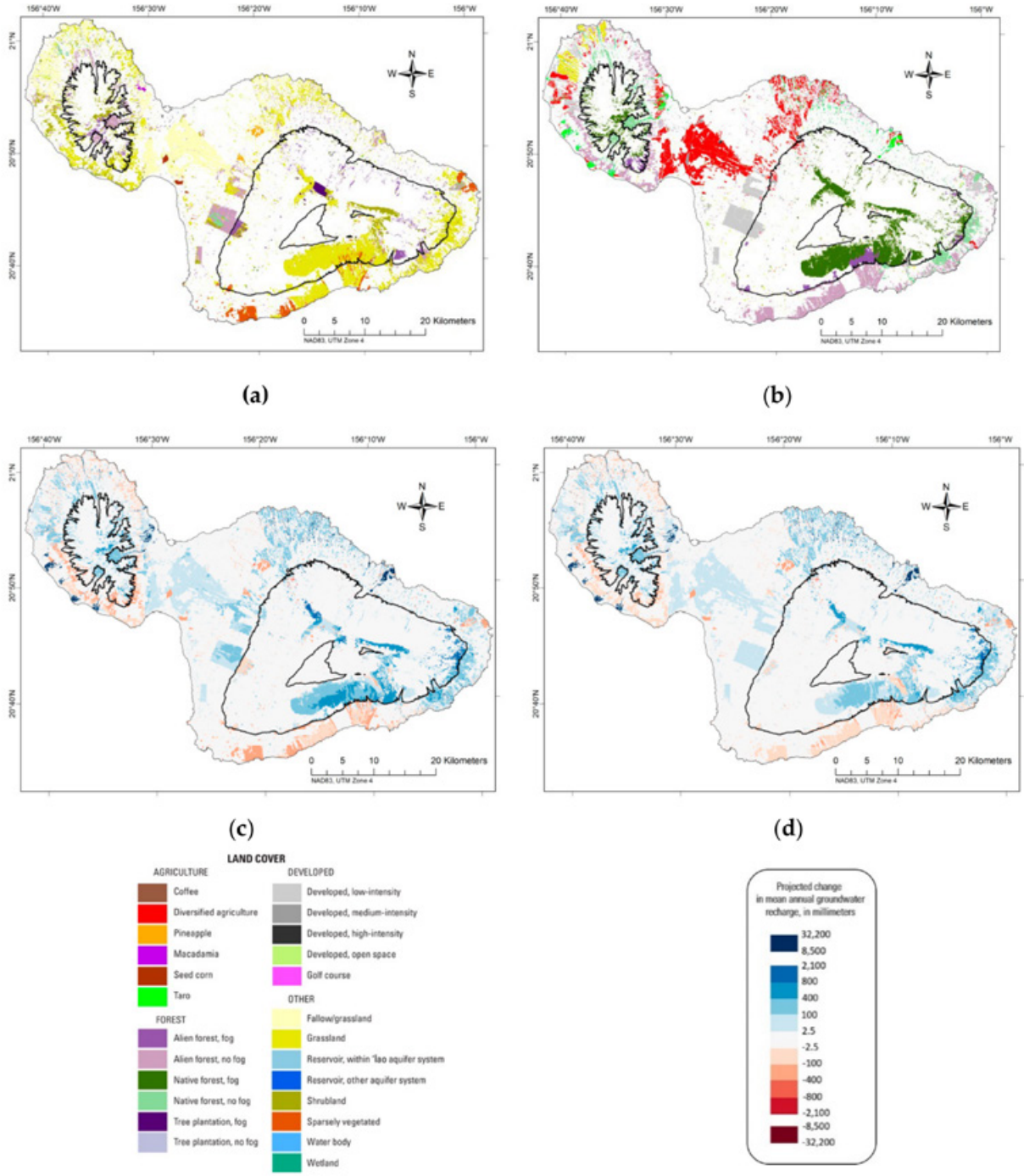
The objective of this study was to develop an integrated land cover/hydrological modeling framework using remote sensing and geographic information systems (GIS) data, stakeholder input, climate information and projections, and empirical data to estimate future groundwater recharge on the Island of Maui, Hawai'i. Four future land-cover scenarios and two downscaled climate projections were used to estimate the end of the century mean annual groundwater recharge. The future scenarios focused on (1) conservation, (2) maintaining the status quo, (3) development, and (4) balancing conservation and development. A dry future climate and a wet future climate represented the downscaled climate projections. To understand how the changing land management and climate could influence groundwater recharge, the results were compared to the estimated recharge using the 2017 baseline land cover. The estimated recharge increased island-wide under all future land-cover and climate combinations and was dominated by specific land cover transitions.

- For the dry future climate, recharge for land cover Futures 1 to 4 increased by 12%, 0.7%, 0.01%, and 11% relative to 2017 land cover conditions, respectively.
- Corresponding increases under the wet future climate were 10%, 0.9%, 0.6%, and 9.3%.

Conversion from fallow/grassland to diversified agriculture increased irrigation, and therefore recharge. Above the cloud zone (610 m), conversion from grassland to native or alien forest led to increased fog interception, which increased recharge. The greatest changes to recharge occurred in Futures 1 and 4 in areas where irrigation increased, and where forest expanded within the cloud zone. Furthermore, new future urban expansion is currently slated for coastal areas that are already water-stressed and had low recharge projections. Based on these findings, a spatially explicit scenario planning process and modeling framework would be able to communicate the possible consequences and tradeoff of land cover change under a changing climate, and can serve as a relevant tool for landscape-level management and decision making. The final future climate, land use, and groundwater recharge scenarios for Maui were published in December 2019.

Brewington, L.; Keener, V.; Mair, A. (2019) Simulating Land Cover Change Impacts on Groundwater Recharge under Selected Climate Projections, Maui, Hawai'i. Remote Sens. 11, 3048. https://doi.org/10.3390/rs11243048.

Figure 4. (a) 2017 land cover. Only areas subject to change in Future 1 land cover scenario are shown; (b) Future 1 land cover change from 2017 land cover conditions. Only areas with changes to land cover are shown. Change in mean annual recharge for Future 1 land cover and (c) Wet future climate; (d) Dry future climate. The solid contour lines represent the base (610 m) or top (2,500 m) of the cloud zone.



Modeling Unusual Climate Conditions During Fall and Winter (2019/20) Over Hawai‘i

H. Annamalai

During June-July 2019, observed equatorial sea surface temperatures (SSTs) were above average across most of the Pacific Ocean, and the pattern of anomalous weather patterns such as convection and winds were generally consistent with those seen during El Niño conditions. The National Ocean and Atmospheric Administration (NOAA) issued an El Niño advisory (July 8, 2019) that indicated that El Niño would persist through the Northern Hemisphere summer of 2019 (66% chance), with lower odds of continuing through the fall and winter (50-55% chance). During the summer of 2019, however, observed conditions suggested that warm SST anomalies in the subtropical North Pacific would persist. Climate models around the world, including the NOAA model, employed for seasonal prediction of precipitation and temperature collectively predicted (a robust signal) warmer than normal SSTs (hot) and increased rainfall (wet) conditions during the summer of 2019 and continuing into the winter season, particularly over and around the Hawaiian Islands. Recognizing that El Niño was expected to weaken and fade away during the winter of 2019, the team at the University of Hawai‘i at Mānoa IPRC studied the possible reasons for the predicted hot and wet conditions over the Hawaiian Islands (Figs. 5 and 6) and the implications for different sectors.

Researchers focused on predictions made in June 2019 by the NOAA model. Fig. 5 shows predicted three-month (August-October, 2019) averaged SST variations from long-term normal (climatological) conditions. Predicted variations in rainfall are shown in Fig 6 for the same period. Unusually warm (hot conditions) waters around Hawai‘i led to an influx of tropical moisture transported by the near-surface winds. These warm and humid conditions were highly favorable for increased rainfall. The unusual near-surface wind patterns indicated a reduction in trade-winds (strength and number of days). The predicted patterns in SST, near-surface winds, and precipitation were consistent with that of the Pacific Meridional Mode (PMM), another mode of natural climate variability (apart from ENSO) that could impact the seasonal climate over the Pacific Islands.

Consistent with the model predictions, observations during fall (September-November) of 2019, and winter (December-February) 2019/20, showed wetter conditions with less trade wind activity over the Hawaiian Islands (figures not shown). The IPRC team is engaged in analyzing past historical observations to assess and further understand the role of the PMM on the Pacific Islands' climate on seasonal to interannual time scales, which will have implications for a wide variety of resource managers in short to mid-scale planning.

Figure 5: Sea surface temperature anomalies. Warmer colors (yellow, red) indicate warmer than average SSTs, while cooler colors (blue, purple) indicate cooler than average conditions.

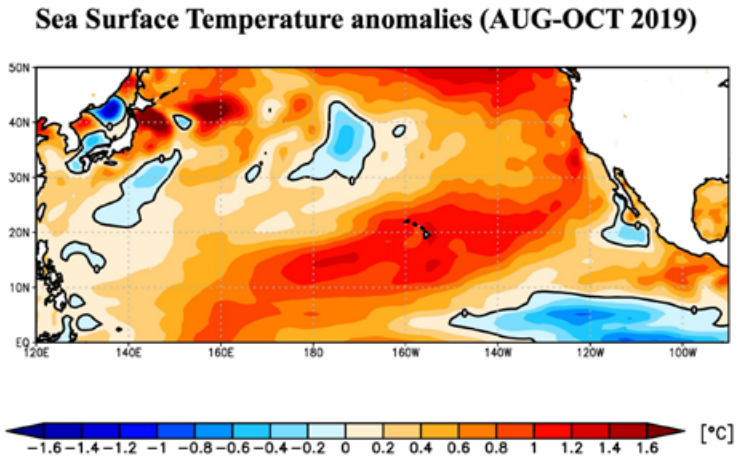
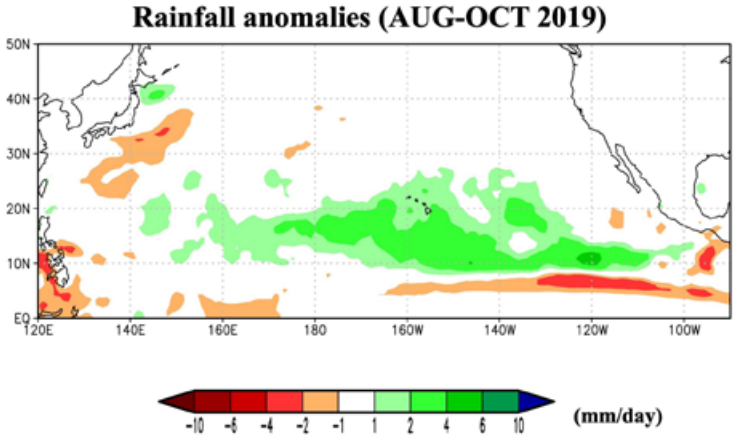


Figure 6: Rainfall anomalies. Warmer colors (red, yellow) indicate less than average rainfall, while cooler colors (blue, green) indicate greater than average rainfall.



Assessing Economic Impacts of Climate Change and Variability Planning

Kirsten Oleson and Carlo Fezzi

The benefits that people enjoy from Maui's natural environments will change as the landscape of the Island transforms from agricultural to urban development, and as the climate warms and becomes more variable. Good design of urban and coastal zoning, restoration plans, adaptation plans, and other land-use policies should consider trade-offs across a broad range of objectives – economic, environmental, and social. Analysis that looks exclusively at market impacts may miss critical non-market benefits or impacts. This project focuses on assessing how ecosystem services will be impacted by climate change in order to provide managers and policy-makers with a fuller understanding of the impacts and trade-offs of different management strategies.

The first study investigates the economic impact of brown water days. During brown water events, people are advised to stay out of flood and coastal waters due to possible overflowing cesspools and sewers, and the abundance of pesticides and pathogens. As rainfall becomes more intense, or if land use change intensifies runoff, Maui may expect to see more of these events. Using an economic method - travel cost modeling, we can estimate the cost of beach closures around Maui. A second project is evaluating the value of groundwater recharge under alternative land and climate change scenarios. A third project is using a water accounting framework to describe the water-economic system. The accounts can highlight economic vulnerabilities to water shortages, for instance, and identify inefficiencies and opportunities for adaptation. Finally, the team is partnering with other economists from RISAs across the country to write a white paper on how to assess the economic impacts of RISA network research efforts.

Image 3: Brown water event off the coast of West Maui (photo by Don McLeish)

Climate, Health, and Migration in Pacific Islands

Laura Brewington

The NOAA International Research and Applications Project (IRAP) project, "Climate, Health, and Migration in Pacific Islands," led by RISA PI Dr. Laura Brewington, was designed in 2018 in collaboration with the Marshall Islands Ministry of Health and Human Services, the U.S. National Oceanic and Atmospheric Administration, and the University of Hawai'i Sea Level Center to improve climate information delivery to the health sector in the RMI, and to inform health service providers in Hawai'i about migration, health, and environmental change in the Pacific Islands region.

Dr. Laura Brewington has conducted preliminary analysis of survey data collected in the RMI with 199 households, and in Hawai'i with 40 households. Analysis has focused on the health drivers of migration and findings were summarized for the RMI Ministry of Health and Human Services at the 2019 Association of State and Territorial Health Officials (ASTHO) in Honolulu, Hawai'i.

Pacific RISA also contributed to the "Climate, Migration, and Health Workshop" held May 17-18, 2019. The two-day workshop brought together researchers and policy communicators to discuss, and move forward, research on this important intersection. It identified knowledge gaps and beginning papers/proposals designed to fill those gaps. Contributors included members of International Union for the Scientific Study of Population's (IUSSP) Special Emphasis Panel on Climate, Migration and Health, and the East-West Center's Project Specialist on migration and health, Dr. Daniel Ervin.

Image 4: Project Specialist Dan Ervin attended the 2nd Symposium on Climate Change Adaptation in the Pacific Region, Lautoka, Fiji and presented preliminary findings from the Pacific RISA's Climate, Health, and Migration work. He also held meetings with the regional World Health Organization office, the Pacific Islands Forum, and the University of the South Pacific.

Analyzing Causes and Impacts of Climate-induced Migration in the U.S.-Affiliated Pacific Islands

Maxine Burkett

This study aims to clarify the extent to which Pacific Island people are already migrating because of climate change, and the role affected ecosystem services play in their migration decisions. The research also aims to better understand the effects of this migration on migrants and their communities, focusing on indicators of well-being in the RMI (in the capital of Majuro, and on Mejit and Maleolap) and in destination states (Hawai'i, Oregon, and Washington).

The project has produced four reports (a Summary for Policymakers, full Case Study Report, and two briefs on Compact of Free Association (COFA) and Marshallese Perspectives on Migration), all of which can be found on the project's updated website. The website also includes a Findings Snapshot, which highlights key findings from Marshallese responses to each of the three research questions, linking inter-related topics such as remittances and economic impacts on livelihoods, health and employment, and differing perceptions of environmental change. This snapshot also provides data on shared thinking across Marshallese communities regarding island habitability and adaptability, migration as a strategy in the present and the future, and cultural cohesion and loss. Some key findings include:

- Half of respondents in the RMI perceived a general negative trend in ecosystem services. Household members of these respondents are more likely to intend to migrate in the next 10 years.
- Many more respondents in the U.S.—and particularly in Hawai'i—cite environmental problems in the RMI as a driver for moving than those presently living in the RMI.
- 85% of respondents in the Pacific Northwest and 70% of respondents in Hawai'i reported sending remittances to the RMI.

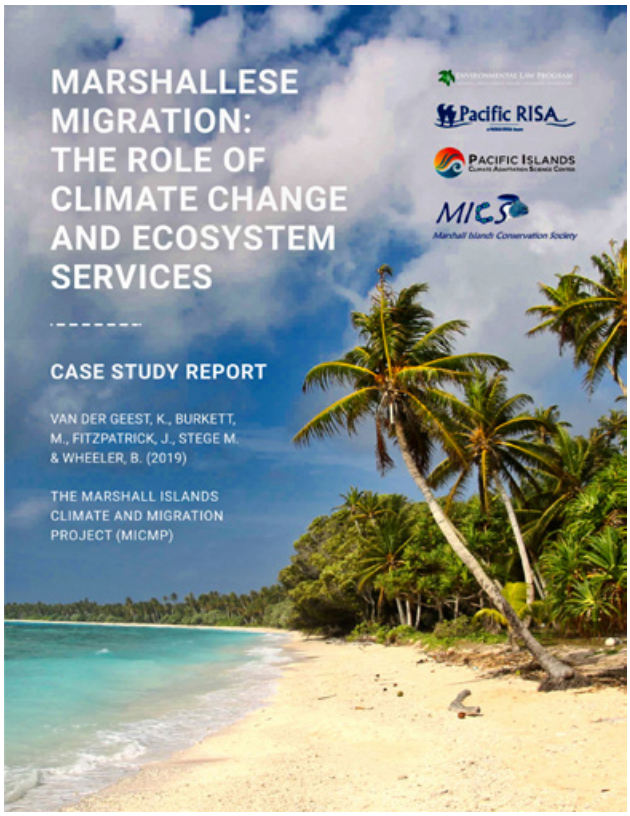


Image 5: Case Study Report on Marshallese Migration: The Role of Climate Change and Ecosystem Services. One of four new reports produced by the Marshall Islands Climate and Migration Project.

The project's final reports and findings have been cited in publications of the UNFCCC, shared by the UN humanitarian information service ReliefWeb, and reported by Marshall Islands-based journalists. Research findings have also been disseminated both in the region and internationally, most recently at COP25 in Madrid, in collaboration with the International Organization for Migration (IOM) in a publication on Marshallese perspectives on climate and migration, and in a post solicited by the Migraciones Climáticas project. Previous to this, work had been shared and ground-truthed with local partners at an RMI Information Sharing Workshop and with Marshall Islands' Chief Secretary Ben Graham in Majuro, and at a Honolulu Information Sharing Workshop

at the Pacific Island Health Officers Association (PIHOA) Board Meeting and the Annual Hawai'i Conservation Conference. Further international conferences have been sites of engagement, including Adaptation Futures (Cape Town, South Africa) and the TransRe Conference (Bonn, Germany) in 2018, and the International Student Festival (Trondheim, Norway) and the Jornada Desplazados Climaticos (Granada, Spain) in 2019.

Going forward, the Marshall Islands Climate and Migration Project (MICMP) will be researching issues affecting the legal futures of the Marshallese people at home and in the United States. This includes investigating policy landscapes in destination states, the role of reparative measures in Marshallese lives, and issues of small island sovereignty. This work will result in a forthcoming publication in the UCLA Journal of Environmental Law and Policy, "The Price of Sovereignty in the Era of Climate Change: The Role of Climate Finance in Guiding Adaptation Choices for Small Island Developing States," authored by affiliate Lauren Sancken, and other publications. The project's legal work will build on our research questions and findings concerning Marshallese well-being, and take into consideration the dual contexts of COFA's re-negotiation and continued environmental change in the RMI.

PIRCA Sustained Assessment Process and the Fourth National Climate Assessment

Zena Grecni, Victoria Keener, and Wendy Miles

In 2016, Pacific RISA hired a Sustained Assessment Specialist (SAS), Zena Grecni, who coordinates climate assessment activities across multiple programs in Hawai'i and the U.S.-Affiliated Pacific Islands region. Supported by SAS Grecni, a team authored a regional chapter ("Chapter 27: Hawai'i and U.S.-Affiliated Pacific Islands") that appeared in the Fourth US-National Climate Assessment (NCA4, released November 2018; read more in Publication Highlights, page 16).

Pacific RISA is leveraging the NCA4 regional chapter and working with partners across the region to update the 2012 Pacific Islands Regional Climate Assessment (PIRCA) and build a more robust and inclusive regional network. New, up-to-date local climate summaries are being developed in response to requests for country- and territory-specific products. Meetings and workshops were held in 2019 in American Samoa, the Republic of Palau, the Commonwealth of the Northern Mariana Islands (CNMI), and Guam to inform the development of PIRCA reports. Through this engagement, Pacific RISA is learning from constituents how to best tailor new informational products to local needs and create assessment summaries that consolidate scientific knowledge about climate change impacts and risks.

Pacific RISA continues to utilize the NCA and the sustained assessment process to support the development of a robust and inclusive regional network of scientists, resource managers, policy makers, non-profits, and local, state, and regional governments that are committed to understanding and addressing impacts from climate change.

Climate Dialogue with His Excellency, Anote Tong

In May of 2019, Pacific RISA and the East-West Center had the honor of hosting a leadership dialogue on addressing climate change in the Pacific Islands with His Excellency, Anote Tong, former President of the Republic of Kiribati. Twice nominated for the Nobel Peace Prize, President Tong has been on the forefront of raising awareness of the impacts of climate change. Joining this inspiring conversation were representatives from Hawai'i state and local government, international consulates, NGOs, and academia, as well as University of Hawai'i students hailing from Kiribati, Fiji, and Niue. Participants discussed the need to transform how we mitigate and adapt to the impacts of climate change in the Pacific Islands, and how to build resilience by finding innovative ways to meet future challenges.

Image 6: His excellency Anote Tong, former President of Kiribati, and Pacific Island climate leaders participate in a dialogue addressing climate change in the Pacific Islands.

NCA PIRCA Summary workshops

To build on findings from the 4th National Climate Assessment (NCA4), Pacific RISA is currently developing jurisdictional-level climate science summaries through the Pacific Islands Regional Climate Assessment (PIRCA). Pacific RISA, in collaboration with regional partners, convened a series of jurisdiction-level workshops. These workshops enabled stakeholders and technical experts to inform the development of the summaries for American Sāmoa (more information on the workshops HERE), the Republic of Palau, the Commonwealth of the Northern Mariana Islands (details on Palau and CNMI workshops HERE), and Guam.[1] Representatives from a range of sectors shared their input on how climate variability and change is affecting local sectors such as tourism, ecosystems, fisheries, health, agriculture, disaster management, infrastructure planning, cultural resources, and the economy.

[1] Although similar meetings in the Federated States of Micronesia, and the Republic of the Marshall Islands (RMI) were in the early planning stages when the COVID-19 pandemic started, those convenings were indefinitely postponed. Nonetheless, the project team identified key partners in national governments of the two countries, and a draft PIRCA summary for RMI was developed in close collaboration with a point-of-contact within the RMI National Disaster Management Office.

Pacific RISA National Meeting

Pacific RISA had the honor of hosting the annual RISA Network Meeting from September 18-20, 2019 at the Imin International Conference Center. Opening remarks were made by the East-West Center's Vice President and Director of Research, Karena Lyons, and Pacific RISA Principal Investigator, Dr. Victoria Keener. The keynote speaker was Honolulu's Chief Resilience Officer, Josh Stanbro. The RISA Network Meeting was followed by a tour of the Lyon Arboretum and Hawai'i Rare Plant Program.

- Dr. Laura Brewington co-organized the RISA Network Meeting's concurrent session, "Climate Migration", and Dan Ervin served as a speaker in this session.
- Zena Grecni and Benét Duncan organized and presented the RISA Network Meeting's Session on Sustained Assessment: Learning from Bright Spots (more info in Publication Highlights on page 16 of this newsletter).

Image 7: Annual RISA Network Meeting participants at the East-West Center's Imin International Conference Center, Sept. 2019.

United Nations General Assembly Climate Week

Dr. Keener attended meetings and events for United Nations General Assembly Climate Week and participated in the "Climate Strong Islands Dialogue" in New York City, NY from Sept 23-27, 2019. Island frameworks are providing a useful model for aggressive global climate adaptation and mitigation strategies that circular economies and the appropriate valuation of risk. Plenary discussions addressed global and regional circular economy initiatives, examples in Guam and Hawai'i and the Small Islands Developing States (SIDS) Accelerated Modalities of Action (SĀMOA) Pathway, an international framework in which member counties of the UN recognize the need to support and invest in SIDS so that they can achieve sustainable development. The Pathway recognizes SIDS ownership and leadership in overcoming sustainability challenges. Dr. Keener met with global partners interested in lessons from both Hawai'i and Pacific Islands.

Image 8: L to R: Makale'a Dudoit Ane, Environmental Coordinator, Mayor's Office of Economic Development at County of Maui; Dana Okano, Program Director at Hawaii Community Foundation; Rebecca Shute-Villegas, Hawai'i County Council; Victoria Keener, Lead Principal Investigator and Research Fellow, East-West Center; Celeste Connors, CEO and Exec Director, Hawai'i Green Growth

Learning from Success in Climate-Informed Decision-Making: Case Studies Across Three U.S. Regions

What motivates some organizations and managers to apply climate information when making decisions? And, what helps them to do this effectively? These questions guided a cross-RISA project led by Zena Grecni (Pacific RISA), Benèt Duncan (Western Water Assessment), and Leah Kos (formerly Southern Climate Impacts Planning Program), all part of the network of sustained assessment specialists within the NOAA RISA program.

In their report, Learning from Success in Climate-Informed Decision-Making: Case Studies Across Three U.S. Regions, released in September 2019 at the NOAA RISA Network Meeting, the sustained assessment specialists present five case studies of successful local responses to climate change that are supported by scientific information. Based in three regions—the USAPI, the South Central United States, and the Rocky Mountain West—the case studies in this report feature local managers who are providing and applying climate information, with valuable outcomes, across a range of geographic scales and sectors. These stories include improving local climate-adaptation efforts in San Angelo, Texas, enhancing the resilience of iconic coastal ecosystems on Hawai'i Island, managing water in the Colorado River Conservation District, increasing conservation resilience in the southern Great Plains, and using El Niño forecasts to plan for drought in the Pacific Islands.

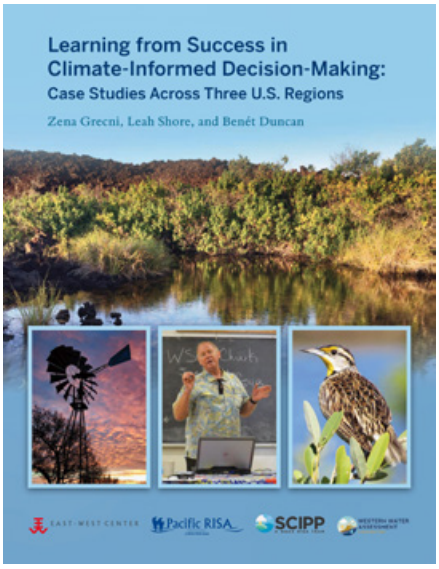


Image 9: The collaborative effort of the RISA Sustained Assessment Specialists produced this report that presents five case studies of successful local responses to climate change.

Release of the Fourth National Climate Assessment

In November 2018, the US Government released the Fourth National Climate Assessment, Volume II, Impacts, Risks, and Adaptation in the United States, the nation's most comprehensive, authoritative report on the effects of climate change on U.S. communities and the economy. More than 300 Federal and non-Federal authors representing a range of expertise worked on the report as a whole. Lead PI Victoria Keener served as the Chapter Lead for "Chapter 27: Hawai'i and U.S.-Affiliated Pacific Islands," and Ms. Maxine Burkett, Dr. Tom Giambelluca, Ms. Zena Grecni were chapter authors. In addition, the regional chapter had 77 technical contributors and was backed by more than 250 citations from published articles, reports, and books.

Image 10: Mayor Caldwell held a press conference at the release of the National Climate Assessment in November, joined by Chief Resilience Officer Josh Stanbro and National Climate Assessment Authors Chip Fletcher (University of Hawai'i School of Ocean and Earth Science and Technology) and Victoria Keener (East-West Center, Pacific RISA). (Source: Honolulu Office of Climate Change, Sustainability, and Resiliency)

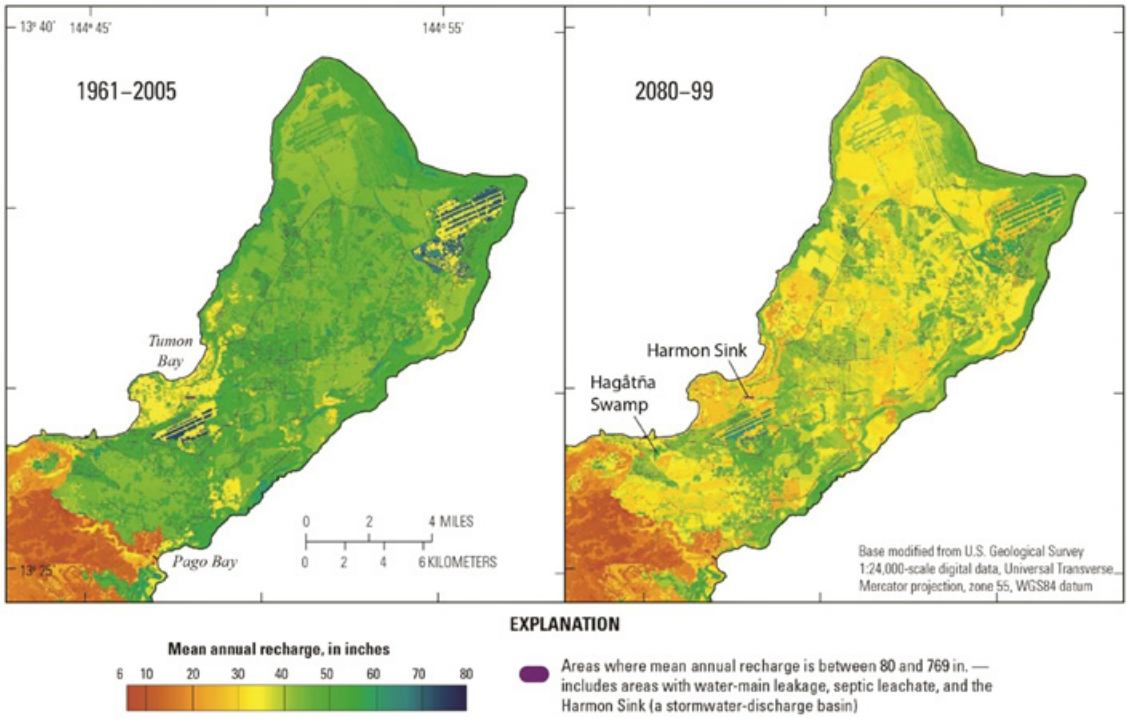
The report's findings appeared in more than 140 front-page newspaper stories in the U.S. At the release of NCA4, Honolulu Mayor Caldwell held a press conference with NCA4 authors at Honolulu Harbor to underscore the findings for Hawai'i. "There is no more important issue," Mayor Caldwell said at the press conference, speaking about climate change and what it means for O'ahu homes, roads, and other infrastructure. For Mayor Caldwell and other leaders in local government in Hawai'i, the findings of the report were sobering. Managing sea level rise is already a reality for the City and County of Honolulu, where coastal erosion and high tide flooding is worsening as a result.

Water Resources on Guam: Potential Impacts and Adaptive Response to Climate Change for Department of Defense Installations

Victoria Keener, Melissa Finucane, H. Annamalai, Steve Gingerich

The final report for this joint USGS, University of Hawai'i, University of Guam, University of Texas, and East-West Center study was completed and released to the public. The Pacific RISA contribution in the last year focused on creating an iterative stakeholder consultation process that translated the findings into two public fact-sheets for natural resource managers and decision makers in Guam.

Figure 7: The distribution of mean annual groundwater recharge (in inches) estimated for the Northern Guam Lens Aquifer for historic (1961–2005) and future (2080–99) climate conditions. Modified from Gingerich et al., 2019.



Guam's water resources in a future climate condition (2080–2099) are projected to diminish relative to current climate conditions. Future average temperature increases and average rainfall decreases will lead to reduced streamflow in southern Guam and reduced groundwater recharge to the NGLA. In the projected future climate, projected average temperatures in southern Guam will increase by about 3.2°C (5.8°F), overall rainfall will decrease about 7%, and, streamflow will consequently decrease 18% in the 12 modeled regions. Similarly, across the Northern Guam Lens Aquifer (NGLA), future annual groundwater recharge will be 19% less than current estimated recharge (Figure 7). Reduced future streamflow will decrease water availability from the Fena Valley Reservoir; however, the reservoir is ex-

pected to be able to supply water at current demand rates without lowering the reservoir level to the elevation of the water-supply intakes throughout the simulated period with a future climate. Proactive adaptive management strategies can help maintain adequate freshwater supplies. For the Fena Valley Reservoir, lowering the intake elevation and raising the spillway elevation would increase surface-water availability and lessen the time spent in critical water-conservation conditions, but the benefits must be considered relative to the costs. In the NGLA, reducing the depth and the withdrawal rates of high-salinity groundwater production wells penetrating near the freshwater/saltwater transition zone will reduce the number of negatively impacted wells. Links to articles about findings and to the public factsheets can be found here.

TEAM UPDATES

Pacific RISA welcomed two new members to our core team this year, Dr. Wendy Miles and Dr. Daniel Ervin.

Dr. Wendy Miles, Pacific RISA Research Fellow and Program Manager, holds a Ph.D. in Geography from the University of Hawai'i, and a M.Sc. in Biodiversity, Conservation, and Management from the University of Oxford. Dr. Miles comes to the East-West Center with 15 years of experience spanning the socio-economic, political, and ecological dimensions of environmental change. For the past decade, her work has focused on climate change planning and policies in the Indo-Pacific. Dr. Miles can be contacted at: MilesW@EastWestCenter.org.

Dr. Dan Ervin, Pacific RISA Project Specialist, contributed to work on climate, health, and migration in the Pacific Islands with Pacific RISA. Dr. Ervin can be contacted at: ErvinD@EastWestCenter.org.

Congratulations to Pacific RISA Researcher Christopher Shuler on the successful completion of his PhD! Dr. Shuler defended his dissertation and graduated in May 2019 with his PhD in Hydrology, specializing in island hydrology, primarily in Sāmoan and Hawaiian Archipelagos.

Read his dissertation here: Recharge to Reef: Assessing the Sources, Quantity, and Transport of Groundwater on Tutuila Island, American Sāmoa

Dr. Christopher Shuler

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Pacific RISA

The core office of the Pacific RISA is located at the East-West Center

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