



Annual Report

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Cover photo: An endangered endemic land snail on Mount Ka'ala, O'ahu Hawai'i. (Laura Brewington)

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ABOUT PACIFIC RISA

The Pacific Regional Integrated Sciences and Assessments ([Pacific RISA](#)) program supports Pacific Island and coastal communities in adapting to the impacts of climate variability and change. We strive to enhance Pacific communities' abilities to understand, plan for, and respond to changing climate conditions. Our work is conducted through interdisciplinary research and partnerships with local, national, and regional stakeholders. As one of 11 RISA programs, Pacific RISA emphasizes the engagement of communities, governments, and businesses in developing effective policies to build resilience in key sectors such as water resource management, coastal and marine resources, fisheries, agriculture, tourism, disaster management, and public health.

Vision—Resilient and sustainable Pacific communities using climate information to manage risks and support practical decision-making about climate variability and change.

Mission Objectives

- Meet critical climate information needs in the Pacific Region through multidisciplinary climate research, assessment, education, and training;
- Provide integrated, locally relevant climate information to decision-makers and communities;
- Enhance regional and local capabilities to manage climate risks, build resilience in key sectors, and support sustainable development;
- Promote collaboration among Pacific regional, US national, and international institutions and programs providing climate information products and services.

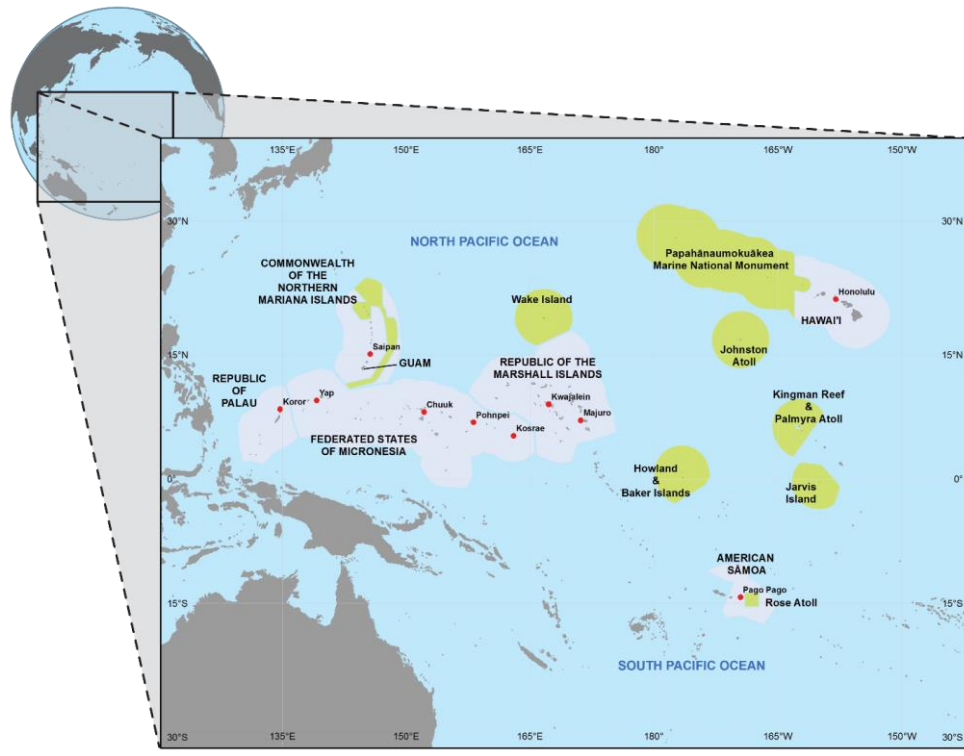


Figure 1: Pacific RISA serves the US Pacific Islands region, which includes Hawai'i, Guam, American Sāmoa, the Commonwealth of the Northern Mariana Islands, the Republic of Palau, the Federated States of Micronesia, and the Republic of the Marshall Islands. On this map, shaded areas indicate the exclusive economic zone of each island, including regional marine national monuments (in green). (From: Keener et al., 2018)

FEATURED ACCOMPLISHMENT

Peer-to-Peer Learning Exchanges on Climate Resilience Planning

The extent to which resilience planning best practices are shared among decision-makers across different sectors and regions depends on multiple factors, including the availability of human and financial resources and the relevance, legitimacy, and accessibility of the knowledge. Within the Pacific Islands region, governments and organizations have made varying degrees of progress using climate knowledge to inform planning and policy at different decision scales, but cross-sectoral exchange of knowledge between counties or governments in different island jurisdictions has been limited. The island of Kauai is a small and rural island that is often overlooked with respect to well-funded climate science modeling and impact studies. It has also recently experienced major catastrophic flooding events, which washed out roads and bridges and cut off the island's North Shore as recently as 2018 (Image 1). The County of Kaua'i and Kaua'i Mayor's Office are developing an island-wide climate resilience plan and are keen to learn from the experiences of other coastal cities facing similar climate impacts and policy debates.



Image 1: Extreme flooding on Kauai, April 2018. Rain gauges measured at almost 50 inches, a new record for the highest 24-hour rainfall total in the United States (photo via Anthony Quintano, Honolulu Civil Beat).

In June of 2021, Pacific RISA sponsored 40 participants from the County of Kaua'i to virtually attend Columbia University's "At What Point Managed Retreat?" conference. Participants from the Kaua'i Mayor's Office, Planning Department, Attorney's Office, Emergency Management Agency, Parks & Recreation Department, Finance Department, Boards and Commissions, Office of Economic Development, Agency on Elderly Affairs, Transportation Agency, Water Department, Public Works, Housing Agency, and County Council participated in a cross-agency discussion space to familiarize county representatives around the concept of managed retreat and how these decisions are made nationally and globally. A post-conference survey indicated

that attendees were the most interested in outcomes from the Equitable Retreat workshop, case studies from peers in New Orleans and Boston, and keynote speakers. Topics of the economics of managed retreat and buyouts, legal frameworks, and communication were found to be the most helpful for cross-agency participants.

As a result of the managed retreat conference and at the request of Kaua'i County decision-makers, PI Dr. Victoria Keener, with partners from CCSR, is facilitating a series of peer-to-peer (P2P) exchanges with agency officials in Boston. The exchanges are helping inform and accelerate strategic guidance that will help Kaua'i County officials identify key strategies, gaps, and methods for an inclusive and effective island resiliency plan. In December 2021, representatives from multiple County of Kaua'i agencies met virtually with representatives from the City of Boston Planning & Development Agency, Climate Change & Environmental Planning, and Climate Ready Boston. The County has since utilized information from the exchange and the Boston Sea Level Rise (SLR) Zoning Ordinance to craft a similar policy for Kauai. County staff wants to meet again in-person with Boston representatives to discuss implementation of the plan when COVID numbers allow. We are starting to explore facilitating new P2P exchanges across

the greater USAPI region, focusing first on climate hazard training in the Commonwealth of the Mariana Islands and on nature-based solutions for climate impacts in American Sāmoa.

NEW PROJECTS & PARTNERSHIPS

Pacific Islands Regional Climate Assessment for the Federated States of Micronesia

The Pacific Islands Regional Climate Assessment (PIRCA) project team, including PIs Keener and Grecni and Project Assistant Chelsey Bryson, have turned their focus to the Federated States of Micronesia (FSM) as they work to develop the next in a series of regional climate assessments. The team, including interns Risa Mariana Oue and Elaine Chugen, completed a First Order Draft of the assessment and are now in the process of gathering input. External evaluation has shown that Pacific RISA stakeholders want assessments to reflect inclusively the needs and input of decision-makers from diverse sectors and stakeholders across the region. Although in-country activities are not possible due to continuing border closures, the team continues to build a list of contacts within the FSM and who have expertise related to climate change risk in the FSM and co-development of assessment sections will involve FSM-based authors and technical contributors. By developing a PIRCA report for each US-Affiliated Pacific Island (USAPI) country and territory, including the FSM, PIRCA is strongly focused on climate-related issues of importance to the wider US-Affiliated Pacific Islands beyond Hawai'i, an area that is historically underserved and often overlooked when it comes to climate adaptation and policy.

Regional Climate Change Policy Working Groups

Recently, new working groups to accelerate climate adaptation policy development and implementation have formed, and Pacific RISA PIs have accepted appointments to serve on several of them. Regionally, PI Dr. Laura Brewington serves on the Pacific Regional Invasive Species and Climate Change (RISCC) council, which is focused on increasing Pacific Island resilience to the interacting threats of climate change and invasive species. PI Keener accepted an invitation to serve on the US INDO-PACOM Climate Change Impacts (CCI) working group, which identifies key risks and impacts of climate change relevant to environmental and mission security for the Commander of the Pacific Fleet. Jurisdictionally, Dr. Keener was appointed to serve on the American Sāmoa Marine Sanctuary Climate Change Working Group (CCWG), which summarizes observed and projected climate risks to the Marine Sanctuary and prioritizes adaptation needs and funding for the Governor's Resilience Office, created in January of 2022. PI Keener continues to serve as an appointed Commissioner to the Honolulu Climate Change Commission, informing the Mayor and City Council and Departments about local climate impacts and policy relevant to both adaptation and mitigation planning. This increase in local and regional climate change guidance groups is a positive indicator that governments are eager to implement climate solutions, while the presence of RISA PIs on these bodies demonstrates the continued relevance and importance of our work as a climate science boundary organization.

Other New Partnerships

- In coordination with the University of Hawai'i at Mānoa (UHM) and the East-West Center (EWC), the Pacific RISA engaged three graduate interns on projects relevant to their interests and education on climate research in the region. Interns Risa Mariana Oue and Elaine Chugen both hail from the FSM and are enrolled in programs in business and social sciences at UHM. Guided by PI Grecni, Risa and Elaine conducted a literature review, gathering reports, studies, and articles, and helped to form an outreach strategy to support the development of the FSM PIRCA report. Keoni Williams, a J.D. Candidate at the University of Hawai'i William S. Richardson School of Law, is working with Dr. Keener this summer to write a policy paper addressing the question of

environmental federalism and local authority with respect to the issue of adapting to and mitigating climate change impacts in the Pacific Islands (Image 2).

- PI Grecni and the Sustained Assessment Specialist (SAS) network have partnered with the Science for Climate Action Network (led by Drs. Kathy Jacobs and Richard Moss) to plan a workshop, or series of workshops, that aim to increase understanding of sustained assessment in theory and practice. The first workshop was targeted toward the NOAA RISA Network and partners in the US Global Change Research Program (USGCRP) and the interagency Sustained Assessment Working Group (SAWG) and took place in



Image 2: Dr. Victoria Keener and University of Hawai'i William S. Richardson School of Law JD Candidate Keoni Williams at the Rayburn House building in Washington DC, May 2021.

- June 2022. Core goals of the new partnership are to expand the network of professionals across the nation conducting sustained assessment activities to build capacity within RISAs, accelerate the pace of adaptation, and promote cross-regional learning.
- PIs Dr. Chris Shuler and Dr. Tom Giambelluca formed a new partnership with Haleakalā National Park on the island of Maui to assist their climate change planning team in completing a future climate scenario assessment for the park. The Shuler and Giambelluca labs are assisting Haleakalā National Park based on their existing knowledge of local climate models and data, much of which was developed through RISA funded work. The assessment is slated to be completed in 2023-2024.
- PI Shuler also partnered with PI Giambelluca to contribute to work on the Hawai'i Mesonet project, where Shuler will assist with installation, maintenance, and stakeholder coordination of climate monitoring infrastructure in Maui County, Hawai'i (Image 3). Data from this project will help researchers better understand and forecast the complex weather and climate of the Hawaiian Islands and will also contribute to the [Hawai'i Climate Data Portal](#), where users—including weather forecasters—can receive real-time data. Data will also be submitted to the National Mesonet Program supported by the National Oceanic and Atmospheric Administration (NOAA).
- The Shuler lab and the Pacific RISA are continuing a long-standing partnership with the American Sāmoa Power Authority (ASPA). In partnership, they have developed a new level of institutional collaboration, hiring the first joint hydrologic technician physically based at ASPA and funded 50% by the UH Water Resources Research Center (WRRC) and 50% by ASPA. Planned renewal and long-term funding would enable the technician to work on climate data monitoring, address UH research needs and ASPA operational needs, provide greater continuity between ASPA operations and the American Sāmoa Hydrological monitoring network, and communicate between ASPA engineering and operations staff and research expertise. American Sāmoa is underserved, as demonstrated by both socio-economics and the lack of availability of climate and hydrological monitoring and forecasts. For example, ASPA is currently struggling with high salinities in wells on the Eastern side of Tutuila, a critical water supply and quality issue at present as well as a future

climate issue identified in previous Pacific RISA research. The Shuler Lab is collaborating with the joint-technician and the engineering staff in the ASPA water department by facilitating an in-house salinity monitoring program that both leverages UH research capacity and will directly apply to and inform water management of the affected wells.

- PIs Shuler and Widlansky are collaborating to apply data analysis and data science techniques to freshwater reservoir data collected by the University of Hawai'i Sea Level Center (UHSLC). Additional insight into the reservoir data may help provide new tools for flood-hazard management for coastal communities and ecosystems.



Image 3: A Hawai'i Mesonet climate monitoring station on the slopes of Haleakala, Maui County (Chris Shuler).



Figure 2: Each new tide gauge station will include a radar sensor to measure water level, solar power, and satellite telemetry (yellow, blue, and gray shapes, respectively), as well as long-term leveling controls.

- PI Dr. Matthew Widlansky is collaborating with UHSLC Director Phil Thompson to implement a new tide gauge network in Hawai'i. Additional tide gauges will be installed at recreational harbors throughout the Hawaiian Islands (HI-DLNR-DOBOR) to complement the existing network of tide gauges in Hawai'i (NOAA-COOPS-NOS, NOAA-NWS-PTWC, and UHSLC). The new tide gauges are designed for long-term sea level monitoring (vertical leveling controls). The RISA-funded projects are working to utilize sea level data from these tide gauges, as well as other sources, and provide information to coastal communities about the local sea level conditions. Pictured above is the design plan for a tide gauge at Keehi Harbor on O'ahu (Figure 2).

RESEARCH HIGHLIGHTS

Pacific Islands Region

Assessing Regional Climate Education and Training Needs

In partnership with PI Keener and the Pacific RISA, the UH Institute for Sustainability and Resiliency, and the Aspen Global Change Institute, a regional landscape assessment was performed to explore gaps in professional and educational curricular pathways and opportunities in climate change adaptation. The resulting landscape assessment (Coffman and Schjervheim 2022) includes a summary on climate adaptation capacity building needs from key informant interviews of climate change adaptation professionals in Pacific Islands, a review of existing climate change adaptation-focused programs in the Pacific region, as well as a selection of U.S. programs, and a summary of initial conversations with UH

and EWC faculty and staff that work in the Pacific Islands and teach in the field of climate change (Figure 3). These findings will shape recommendations for potential next steps regarding climate change pedagogy and programs at UH and the East-West Center to which Pacific RISA can facilitate or contribute.

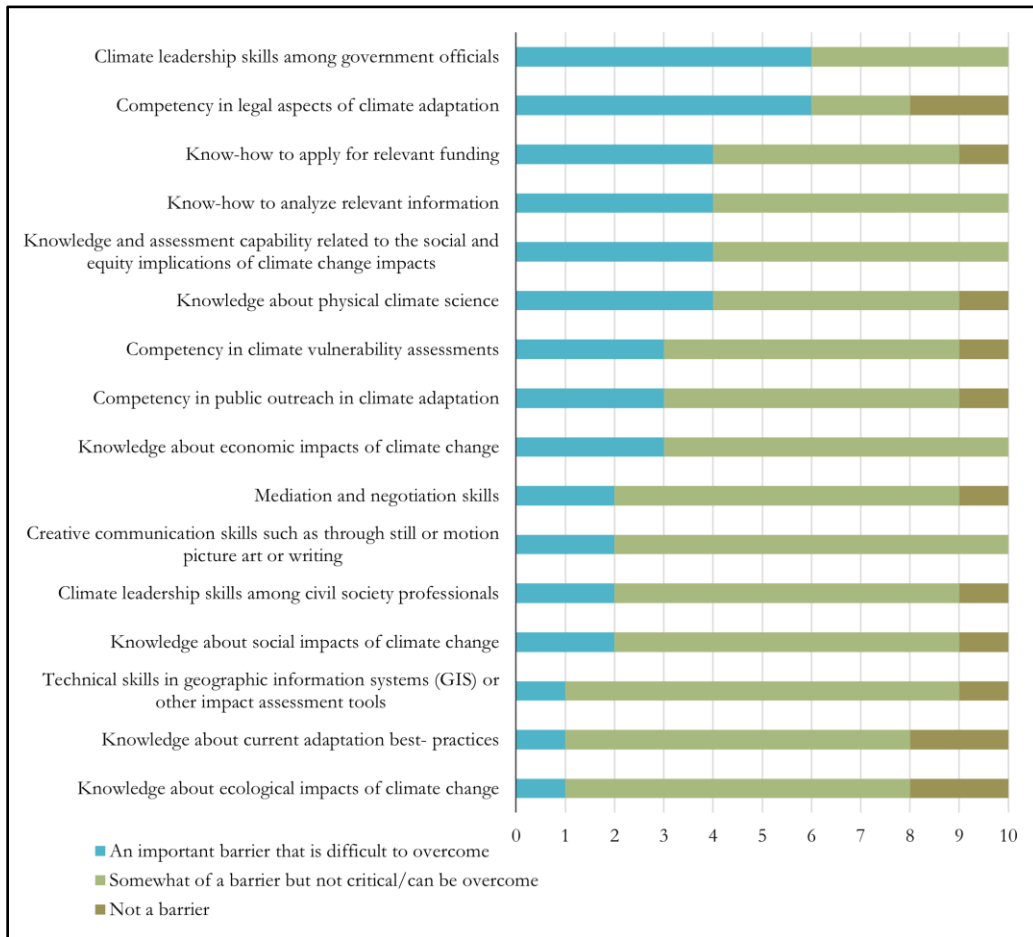


Figure 3: Interviewee evaluations of particular capacity/knowledge shortages in regional climate adaptation (Coffman and Schjervheim 2022).

Some of the key findings are as follows:

- There is a strong and broad need for climate adaptation knowledge and skill sets among small climate adaptation networks in the Pacific.
- A climate adaptation focused curricular program aimed at serving the Pacific and beyond should be focused on social science and natural resource management aspects of adaptation and ensure that students gain a foundation of the physical science of climate change.
- To-date only a few courses offered at UH have an explicit climate adaptation focus. There are a range of courses offered that cover climate change adaptation partially or indirectly that could fill climate adaptation curricular needs as identified through conversations with climate adaptation professionals and a review of existing programs.
- A few key courses would need to be developed – most critically in principles of climate change vulnerability as well as key approaches to adaptation in natural and human made systems.

- To make a climate adaptation program accessible to potential students across the Pacific, as well as non-traditional students who might already be professionals working in the field of climate change, curricular programs should be offered with a virtual and part-time option.
- There are a range of short-term programs that could be offered by the EWC in collaboration with UH that center on climate change leadership; climate change data, policies and impacts; resources and grant mechanisms; and climate change communication.

Climate, Health, and Migration

Residents of the Marshall Islands are experiencing climate-related health impacts associated with drought, sea-level rise, heat stress, and extreme events (Image 4); healthcare systems in the Marshall Islands are under-resourced and unprepared to confront these impacts; and the movement of people from the Marshall Islands to the US has impacts on health systems in both sending and receiving locations. PI Brewington and "Climate, Health, and Migration" project consultant David Krzensi analyzed survey data from households in the Marshall Islands, Hawai'i, and the Pacific Northwest, along with literature on the intersection of climate change, health, and migration. Two reports and one publication

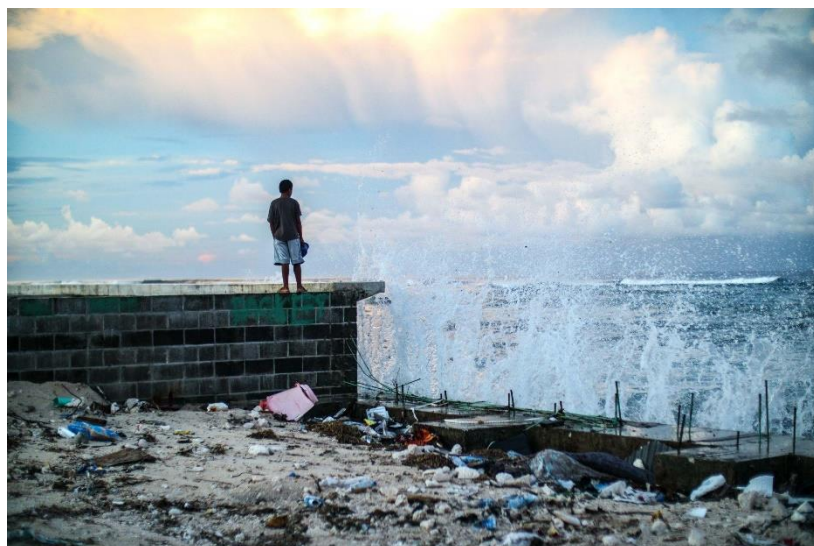


Image 4: A man observes a King Tide event in Majuro, Republic of the Marshall Islands (David Krzensi)

have been prepared or published as a result (Brewington, Kokame, and Lewis 2021 and Krzensi and Brewington 2022). Additionally, PIs Marra and Brewington finalized two "Climate Stories" based on the dialog that focused on the relationship between drought and water- and vector-borne diseases. The stories describe climate-related health events and the conditions that surrounded them, and were published in 2021 as part of a complete set of stories from around the Pacific in an updated version of NOAA's "[Pacific Climate Storybook](#)".

Also, as part of the "Climate, Health, and Migration" project, a sea level training module was developed specifically for the Marshall Islands context but is applicable Pacific-wide. In-country it will support organizations such as the Marshall Islands Environmental Protection Agency, the National Disaster Management Office, and the Majuro Weather Service Office. It consists of two parts: a "Sea Level 101" module focuses on access/use of sea level data and tide gauges, and the second output supports decision-making with a health focus using two case studies on inundation early warning and groundwater quality, both of which have long-term impacts under a changing climate.

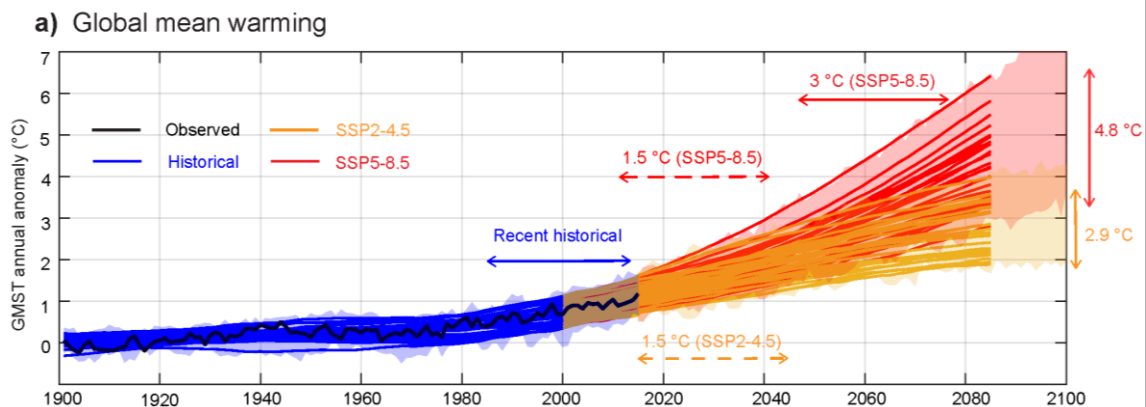
The American Sāmoa PIRCA Report

The Pacific Islands Region lacks detailed climate projections and a body of consensus findings about sector-specific impacts, and there is a need for actionable, culturally cognizant, translated climate information suitable for integration into operations and management, budgeting, funding proposals, and domestic and international policy. The ongoing PIRCA process seeks to engage decision-makers and stakeholders from diverse sectors in the region in a collaborative process to fill these gaps and help inform and prioritize their activities in the face of a changing climate. [The American Sāmoa PIRCA report](#)

(Keener et al. 2021) built upon a workshop held in American Sāmoa in 2019, convened in collaboration with American Sāmoa Community College. Local authors and technical contributors were involved in writing, editing, and outreach surrounding the release of the PIRCA report. The PIRCA coordination team facilitated iterative rounds of review of the report, consolidating the resulting input from co-authors, technical contributors, and the Advisory Committee. This co-development process strengthened the report with locally specific information and considerations for managers in key sectors. To further increase reach and accessibility, and at the request of stakeholders, [a summary of the report](#) was published in Sāmoan.

Other USAPI Research Highlights

- PIs Shuler and El-Kadi have developed a groundwater model and water table elevation calculations for different SLR levels in American Sāmoa that can be used and modified in consultation with ASPA to inform planning and infrastructure design activities (Shuler et al, 2020, 2021). All files will be made available through an open-access repository, and a journal article is in progress.
- PI Widlansky, Marra, and Frazier are developing web tools to communicate about changing climate conditions, such as a new "CMIP6 atlas" for the tropical Pacific, hosted by the University of Hawai'i Sea Level Center. PI Widlansky is coauthor on a recent publication in *Earth's Future* (Dhage and Widlansky, 2022) that investigates CMIP6 projections for the tropical Pacific Islands, and recently presented these findings to the Pacific Climate Change Forum. This project assessed climate change projections as a function of differing global warming amounts (Figure 4), which may help improve science knowledge related to topics being considered by the National Climate Assessment.



b) SST change for 3 °C of global warming (November–April)

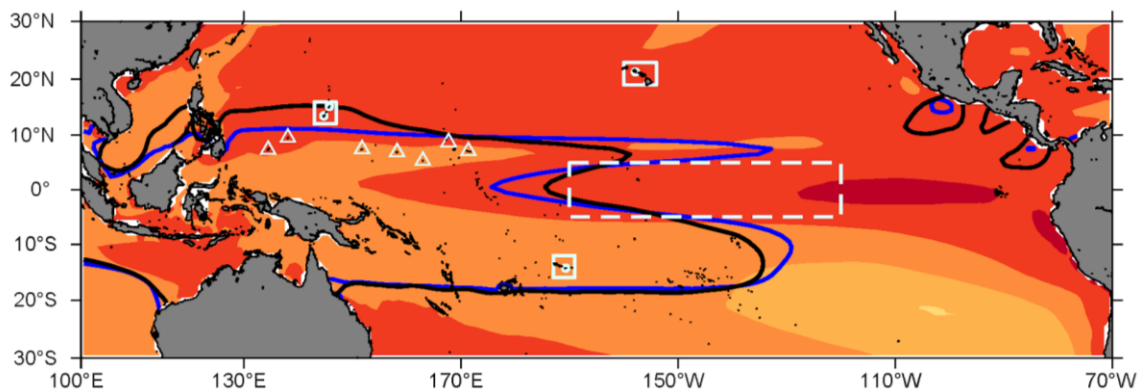


Figure 4: CMIP6 projections are unequivocal that the global mean surface temperature will increase during the 21st century, however, the rate and amount of future warming are uncertain in the climate models (a). A new assessment of CMIP6 provides regional projections for the tropical Pacific Islands concerning the future changes in sea surface temperature (b), rainfall, and sea level that are likely for different amounts of global warming. Figure adapted from Dhage and Widlansky (2022, Earth's Future).

Hawai'i

- PI Oleson's lab has developed an ecological-economic model capable of predicting the welfare gains and losses from watershed management. The model forecasts change in welfare from beach recreationalists from environmental quality changes, such as brown water events. The economic model is open source, coded in R software, with underlying datasets that will be freely available to any interested users. The linked watershed model (used to predict sediment loads) is based on SWAT (Soil & Water Assessment Tool). This model informs cost-effective planning, as it helps the Department of Aquatic Resources, Maui County Office of Planning, and other decision-makers to identify where effort pays off, now and under climate futures.
- As part of the Natural Capital Informed Decision-Making Guide project, the Oleson lab pulled data from for 10 years from multiple sources to create water supply and use tables for the islands of O'ahu and Maui, which link water in the environment to its economic uses through to its disposal as wastewater. The Oleson lab also piloted quality and emissions accounts for the islands, finding serious data gaps. The findings were presented to stakeholder groups in technical meetings.

OUTREACH & ENGAGEMENT

Local 2030 and the 2022 Our Ocean Palau Conference

Pacific RISA Project Specialist Paula Moehlenkamp attended the Our Ocean Palau in April 2022, where she represented the collaboration between Pacific RISA and the [Local2030 Islands Network](#). As the first small island developing state to host the Our Ocean Conference, Palau highlighted the specific challenges that islands face due to the ocean-climate crisis. In Palau, Ms. Moehlenkamp met with diverse representatives from organizations across the Pacific Islands region and helped present initial efforts on identifying climate and ocean impact metrics as part of a network of Sustainable Development Goal (SDG) Dashboards (see Societal Impacts, Page 20). In Palau, Ms. Moehlenkamp and the Local2030 Island Network team were involved in facilitating three sessions which featured updates and achievements of the Local 2030 Network.

"The Local 2030 Island Network Inaugural Members Roundtable," featuring opening remarks by US climate envoy Secretary John Kerry and President of Palau Surangel Whipps, was the first in-person high-level meeting convened by the Local2030 Islands Network. President Whipps and Secretary Kerry were joined at the in-person gathering by world leaders, ministers and other senior officials from island economies, where they discussed taking concrete action in support of joint objectives, including positioning the Network to support policies and steps to achieve the SDGs through island values and innovation; growing Network membership to represent the global diversity of island economies; and launching Communities of Practice (CoPs) to build local capacity around high-priority issues.

The “Data for Ocean & Climate Resilience” side event featured a panel to discuss the Hawai’i Aloha+ and Guam Green Growth framework and the utility of dashboards and data to track local progress towards Sustainable Development Goals (SDGs). Gov. Lourdes Leon Guerrero of Guam provided opening remarks and spoke about the process of building the Guam Green Growth action framework to stand up the dashboard for tracking progress towards Guam’s Sustainable Development Goals. Members agreed that a dashboard mechanism for tracking progress can be key to promoting transparency and accountability.

The successful impact of the Micronesia Challenge to 2020 was showcased at the “Micronesia Challenge 2030: Ocean People Leading Ocean Action” side event. The

Micronesia Challenge has so far expanded conservation of marine and terrestrial environment, leveraged significant resources, and scaled leadership in technical capacity across Micronesia, inspiring global commitment from other regions, including Hawai’i. This side event formally launched the Micronesia 2030 Challenge to spearhead a blue recovery and a decade of action to achieve the UN2030 Sustainable Development Goals. Pacific RISA’s Paula Moehlenkamp engaged with Micronesia Challenge stakeholders and discussed how the 2030 goals could be highlighted and tracked through dashboards.

The Hawai’i delegation also held a briefing for President Whipps on the Palau dashboard, highlighting key data tracking progress towards SDG 14 – Life Below Water (Image 5). They discussed the construction of a Palau Green Growth framework and a Palau Dashboard. The President identified 5 focus areas to highlight on the dashboard: Strengthening the Palauan Workforce, Protecting Livelihoods, Investing in Our Children, Taking Care of Our Health and Social Services, and Ensuring Security and Safety. While in Palau Ms. Moehlenkamp and Local 2030 Data & Innovation Director Kaimana Bingham also met with Charlene Mersai of the National Environmental Protection Council, Mr. Ngirabelas Tmetuch, Director of Palau Visitors Authority, and Elbuchel Sadang, Minister of Finance to discuss leadership and options for the dashboard. The importance of designating a local dashboard coordinator that convenes stakeholders from diverse sectors across Palau to identify relevant data sets and appropriate SDG impact metrics that are inclusive, stakeholder-driven, and will meet community needs was discussed.

The Adaptive Mind

Tending to our whole selves as we tend to others: A restorative weekend workshop for climate professionals. The confluence of accelerating climate change, frequent and severe natural disasters, widespread systemic injustice and oppression, a global pandemic, and a world on the brink of war is creating an unprecedented crisis of individual and collective physical and mental health. Along with vulnerable individuals and communities, climate and environmental professionals charged with addressing these interlocking crises must perform their essential work in the context of repeated trauma and constant uncertainty. The Pacific RISA and East-West Center collaborated with the Adaptive Mind Project with the goal of providing support to adaptation professionals who are themselves providing



Image 5: The Local 2030 Islands Network team meets with President Whipps of Palau to discuss the Palau dashboard and Green Growth framework. From left to right: Jabal Hassanali, Paula Moehlenkamp, President Whipps, Celeste Connors, Kaimana Bingham, Minister Steven Viktor.

support to communities dealing with rapid environmental change. In a survey of 49 of these professionals from across Hawai'i and the Pacific Islands, 62% reported being emotionally drained by their work monthly or more frequently, but 94% are equally determined to succeed in their work because of what they know about climate change and potential impacts.



Image 6: Participants in the adaptive mind conference were all asked to bring “a beautiful object of meaning” to contribute to a centerpiece. Image by Krista Jaspers.

This restorative workshop was designed as a pilot of the Adaptive Mind program to offer a supportive environment and safe place for climate and environmental professionals to: talk story; share their experiences of working on the frontlines of climate change; gain helpful frameworks and resources to better understand and cope with the pressures they face; participate in exercises to rejuvenate themselves professionally; and connect to and feel supported by others who are in similar need for self- and community care. This free 2-day workshop gathered 18 climate professionals from across O’ahu and aimed to create a restorative experience in which participants

created a community and learned skills to increase their personal resilience through peer-to-peer learning and exchange, network building, critical thinking skills and exercises, active listening, storytelling, and nature-based activity (Image 6). Participants were 55% female/45% male, represented academia, government, NGOs and non-profits, community groups, undergraduate students, activists, and facilitators, came from diverse ethnicities, and spanned ages from students to late-career professionals. 100% of participants requested additional Adaptive Mind workshops, with suggested focus on training local facilitators in Adaptive Mind skill sets, including climate decolonization strategies and workshops to specifically support youth and activists in the climate space.

The 2021-2022 *Hā O Ke Kai* Collection

For the past several years, the Pacific RISA has collaborated with the State of Hawai'i Climate Commission in the Department of Land and Natural Resources to plan and host a public, free, climate conference. In the past, these events have focused on communication and equity. Due to restrictions on gathering in person, in lieu of the annual Hawai'i Climate Change Conference, the Hawai'i Climate Commission partnered with Pacific RISA and the UH Better Tomorrow Speaker Series (BTSS) to organize a series of smaller free and public events (virtual and in-person) on climate action. The collection of events, titled “*Hā O Ke Kai*,” meaning “Breath of the Sea,” (Image 7) is paired with the Commission’s statewide conference series of the same name, and led up to a strong Hawai'i presence at the 2021 United Nations Climate Change Conference. Diverse speakers were selected for their work in different aspects of the climate crisis: physical science, political science, and diplomacy and advocacy. Dr. Keener interviewed [Dr. Kim Cobb](#), a paleoclimate expert, oceanographer, and lead author of the IPCC AR6 report about global and regional climate impacts and needed adaptation and mitigation actions. Dr. Cobb also spoke with a group of high-level decision-makers about needed climate actions. Next, Dr. Keener spoke with [Tina Enomoto Stege](#), Climate Envoy for the Government of the Republic of the

Marshall Islands, about her experiences negotiating for climate justice for Pacific Islands at the global level. Finally, author, political scientist, and energy scholar [Dr. Leah Stokes](#) discussed how Hawai'i could accelerate its transition to clean energy and meet its goals. Interviews, panels, webinars, and smaller meetings were arranged with various state energy policy professionals and decision-makers. All public talks are available online at the [Hā O Ke Kai Collection website](#).



Image 7: The 2021-2022 Hā O Ke Kai Collection featured public events and lectures around different aspects of climate adaptation in the Pacific Islands.

Pacific Islands Climate Change Forum

PIs Marra, Keener, Brewington, Grecni, and Widlansky organized and presented at the Pacific Islands Climate Change Forum (PICCF), which took place virtually from April 27-29, 2022. Pacific RISA has been helping to develop this forum and the related writing and launch of the Pacific Climate Change Monitor (PCCM) Report (Marra et al., 2022). The PCCM and PICCF have been developed in collaboration with the Secretariat of the Pacific Regional Environment Programme (SPREP) and the World Meteorological Organization (WMO), with technical support provided by the Australian Bureau of Meteorology (BOM), National Institute of Water and Atmospheric Research (NIWA), APEC Climate Centre (APCC), Meteo-France, US National Oceanic and Atmospheric Administration (NOAA), Pacific Community (SPC) and the University of Hawai'i in partnership with the Pacific Islands Climate Services (PICS) Panel, representing the Pacific Islands Meteorological offices. The three-day forum presented an updated analysis and peer-reviewed report of Pacific regional climate trends by physical indicators, projections, and impacts organized using the framework from the SPREP Climate Service Roadmap. Students from the East-West Center's Pacific Islands Development Program (PIDP) were critical in recording and editing video interviews with meteorological services representatives and running the tech for the virtual conference.

Pacific RISA at the IUCN

PI Brewington led [two sessions](#) on the climate crisis and impacts to ecosystems and resilience in the Pacific Islands region at the International Union for the Conservation of Nature (IUCN) World Conservation Congress (WCC) in Marseille, France from September 3-11, 2021 (Image 8). Held every four years, the WCC is the world's largest conservation event and environmental decision-making forum. Sessions featured updates and achievements toward the Honolulu Challenge that were made by Pacific partners at the 2016 Congress, the synergistic effects of climate change and invasive species and the

Pacific RISCC management network, and partnerships for Pacific Island resilience to climate change. The Hawaii delegation was instrumental in establishing the IUCN’s new Climate Crisis Commission.



Image 8: PI Dr. Laura Brewington at IUCN in Marseilles, France, September 2021. (Photo via Laura Brewington)

Fifth National Climate Assessment: Pacific Islands Chapter Workshops

Pacific RISA PI Abby Frazier is the Hawai’i and the US Affiliated Islands chapter lead for the U.S. Global Change Research Program (USGCRP) 5th National Climate Assessment (NCA5), with PIs Keener, Oleson, Grecni, and Shuler serving as chapter authors. In January 2021, PI Frazier coordinated a virtual public engagement workshop to solicit and incorporate public input into the chapter draft, including breakout sessions led by the RISA chapter authors to hear from members of the public about critical content they would like to be included in the chapter for the key sectors (such as human

health, food, water resources, cultural and historical resources, the built environment, and ecosystems and biodiversity). Sessions within the workshop were highly interactive, utilizing several online platforms including Mentimeter polls, Jamboards, and Google forms to showcase real-time survey results. The workshop drew over 160 registrants from across the greater USAPI region.

Five additional technical meetings were also held throughout January and February 2022, totaling over 150 participants from across the Pacific Islands region. A highlight of this process was the inclusion and engagement of the new Health sector, led by PIs Grecni, Keener, and Oleson, and the inclusion of new Technical Contributors that were not included in previous assessments. A wide range of health-related roles were represented, from public health advocates, medical students, Pacific Island health officers, and health researchers, and participants hailed from all jurisdictions in the region, and represented diverse career stages.

Linking Pacific Islands Climate Science and Policy in Washington, DC

PI Keener traveled to Washington DC in May 2022 to meet with collaborators and present on different aspects of Pacific RISA’s work. On May 17, she participated in a panel with House staffers during the Environment and Climate session of the East-West Center’s Congressional Staff Program on the Pacific (CSPP). On May 25, she joined the ASU Center for Science and Policy Outcomes (CSPO) for their New Tools for Science Policy seminar series and delivered a talk titled “Advancing Climate and Natural Resource Policy through Peer-to-Peer exchange”. The following day, she presented on “Participatory scenario planning for future climate change and groundwater recharge in Maui, Hawai’i” for the CSPO Conversations series. Stakeholders present at these talks included Pacific Islands congressional staff, undergraduate students, USGCRP, and interdisciplinary researchers interested in transferrable methodologies.

RESEARCH IMPACTS

Evaluation

The evaluation component of the Pacific RISA project encompasses both internal and external projects that continually evaluate and learn from Pacific RISA’s role in advancing adaptation planning in the Pacific region and thus contribute to assessing the value of the overall program. External evaluation has shown that Pacific RISA stakeholders want assessments to reflect more inclusively the needs and input

of decision-makers from across the region (Moser 2013). Between Fall 2021 and January 2022, evaluation was conducted to assess how the ongoing PIRCA process is evolving and responding to expressed stakeholder needs. The evaluation process involved data collection from two principal sources: a survey and interviews with assessment participants and beneficiaries. The majority of respondents were based in Hawai'i, but all jurisdictions for which the [Fourth NCA chapter](#) and [PIRCA reports](#) had been prepared were represented, as well as a few continental U.S. respondents.

The survey questions were prepared by Dr. Suzanne Moser in collaboration with the Pacific RISA team and focused on the Fourth NCA chapter and the jurisdictional assessments that comprise the second PIRCA, inquiring about people's involvement and contributions, their perceptions of the report's relevance, usefulness, legitimacy and credibility; the uses of the report; future assessment needs; and for respondents who knew of the first PIRCA, about improvements made based on the feedback received from evaluation conducted in 2012-13. In comparison to the first PIRCA, survey respondents were 5.7 times more likely to agree than disagree that the second PIRCA provided more information on what can be done to adapt to climate change (Keener et al. 2022; Moser 2022 *forthcoming*). More than 62% of survey respondents noted that they now have a better understanding of what climate change means to their region, and 26% felt they can now take climate change into account in their work (Keener et al. 2022; Moser 2022 *forthcoming*). Following the survey, Moser conducted in-depth interviews with 21 assessment contributors and observers who responded favorably and made themselves available for an interview. As one participant put it, "I now have [a] credible reference document I can use in my work and studies that talks about my island home." (Keener et al. 2022; Moser 2022). The evaluative white paper will be completed and delivered to the Pacific RISA team in August 2022.

Evidence of Societal Impact

Expanding Integrated Climate Dashboards in the U.S. Freely Associated States

The Local2030 Islands Network brings together a diverse set of developed and developing island economies - nations, states, and communities - from all regions of the world. The Network promotes island solutions and leadership based on shared experiences and island culture and aims to create a community of practice around localized tracking and implementation of both Sustainable Development Goals (SDGs) and climate metrics. The Climate Dashboard is a mechanism for tracking progress and can be key to promoting transparency and accountability as these goals are achieved. Through the Local2030 Island Network's new centralized Data Hub in partnership with Esri, the SDG Data Alliance, and NOAA, island member states will receive assistance with licensing geospatial frameworks and data collection and be supported in the creation of data dashboards to track individual island priorities. Members will also have access to the "Train the Trainer" program and support in communicating island solutions through Esri story maps. Through development of climate indicators and metrics for the SDG dashboard, Project Specialist Paula Moehlenkamp and partners at the Local 2030 Islands Network will build capacity, enhance climate data, and bring more stakeholders to the Dashboard platform.

PIRCA Reports Catalyze New Policy Measures in Guam and American Sāmoa

The [Guam PIRCA](#) responded to the need for science-based guidance to inform new legislation in Guam. Inspired by an adaptation option presented in the PIRCA, one novel statute created the Tumon Bay Insurance Task Force, comprised of Guam Government representatives, to examine the prospect and evaluate the feasibility of parametric insurance for the beaches and coral reefs of Tumon Bay (*Guam Public Law 35-107, 2020*). Another new law established a task force to explore the possibility of establishing conservation regions to select Guam Government properties that overlay the Northern Guam Lens Aquifer to protect the island's main freshwater aquifer, considering future drought

projections (*Public Law 35-141 2021*). Although the bills were introduced and passed in the previous reporting period, the PIRCA team recently learned of their going into effect as laws.

As a member of the American Sāmoa Marine Sanctuary Climate Change Advisory Working Group (CCWG) and the lead author of the [American Sāmoa PIRCA](#) report, released in June 2021, PI Keener was invited to present on PIRCA findings relevant to implementing climate hazard Nature Based Solutions on August 25, as well as on “Findings from the American Sāmoa Pacific Islands Regional Climate Assessment (PIRCA)” to the other CCWG members in September. Soon after, in December 2021, the Governor’s Office of American Sāmoa released Executive Order 010-2021, which established a territorial Climate Resilience Office intended to coordinate climate adaptation projects across departments and better access federal funding. Local stakeholders and PIRCA technical contributors agreed that the PIRCA was a key document in informing the EO, and PI Keener and the Pacific RISA remain active in project prioritization and risk evaluation through the CCWG and other projects.

American Sāmoa Hydrologic Monitoring Network

The American Sāmoa Hydrological monitoring network organized by PI Shuler continues to produce climate and hydrological data at a total of 11 sites throughout Tutuila. These data are regularly used for ASPA internal operations such as engineering design of water, power, and wastewater infrastructure and assessment of water resources availability. While travel disruptions caused by the pandemic have continued to isolate American Sāmoa, PI Shuler and his team have been able to expand their footprint there by hiring remote employees already based in American Sāmoa. The best example of how this integration is benefitting RISA objectives is through the establishment of a joint-hydrologic technician position. Not only is this technician responsible for maintaining monitoring equipment, but they also act as a communications conduit between ASPA engineering and operations staff and the expertise contained at UH Manoa. 25% of the tech’s job duties are focused on addressing ASPA needs and meeting their operational goals, which often defaults to tasks which foment research collaboration. For example, ASPA is struggling with high salinities in wells on the Eastern side of Tutuila, which is a critical water supply and quality issue presently as well as a critical future climate issue. Together with the joint-technician and the engineering staff in the ASPA water department, the team is facilitating an in-house salinity monitoring program that both leverages UH research capacity and will directly apply to and inform water management of the affected wells. All project work in American Sāmoa works directly with agencies and communities in the territory which is underserved in terms of both socio-economics as well as availability of climate and hydrological monitoring and forecast availability.

FUTURE PLANS & NEXT STEPS

- Outcomes from the “Climate, Health, and Migration” project contributed to a successful proposal submission by the UN Environment Programme to the Green Climate Fund, within which Pacific RISA will create climate early warning systems for specific sectors in the Marshall Islands and Palau, one of which is health. The 5-country Pacific Islands focused project emphasizes end-to-end climate services delivery and a kickoff meeting was held in May 2022. The International Organization on Migration Majuro office is using the survey data analysis report from the RMI to inform their assessments of recent migration trends in the country and highlight vulnerable and underserved populations. This information is also informing the Marshall Islands National Adaptation Plan health sector working group.
- To improve the visibility and impact of the National Climate Assessment, PI Frazier and the NCA5 author team will likely hold additional virtual public outreach meetings during the open public comment period at the end of 2022. The National Climate Assessment is committed to diversity,

equity, and inclusion at all stages of the report and all efforts will be made to include voices from across the Pacific Islands.

COVID IMPACTS

Although PIs Keener and Grecni are moving forward with developing assessments for the FSM and RMI, they have faced several delays in finishing the reports (particularly conducting the needed stakeholder engagement) due to the ongoing COVID pandemic and associated travel restrictions affecting the Pacific Islands. Currently, both countries are effectively closed to inbound travel, with only limited repatriation flights. Engagement to further develop the assessments will take place via online meetings, calls, and emails with partners able and willing to work together through those channels. Continued border closures in FSM and RMI have continued to delay progress in developing climate indicator dashboards in collaboration with the Local2030 Island Network. It has been especially difficult to forge new relationships with partners in sectors we have not worked in before, such as ocean resource management, and those in underserved communities that may not have high-speed internet connections. Due to ongoing travel restrictions in Palau and throughout the Pacific, the Pacific Ecological Security Conference (PESC), a major input for PI Brewington's Pacific Ecological Security project, could not be held in 2021.

PUBLICATIONS

Featured Publication 1

Bremer, L.L., Elshall, A.S., Wada, C.A., Brewington, L., Delevaux, J.M.S., El-Kadi, A.I., Voss, C.I., & Burnett, K.M. (2021). Effects of land cover and watershed protection futures on sustainable groundwater management in a heavily utilized aquifer in Hawai'i (USA). *Hydrogeology Journal*. <http://dx.doi.org/10.1007/s10040-021-02310-6>.

PI Brewington and co-authors from the University of Hawai'i published a paper on the trade-offs between forest protection, urbanization, and groundwater recharge in a heavily utilized aquifer on the Island of O'ahu under a changing climate. Sustainable yield estimates and resulting differences in replacement costs were estimated for six land-cover scenarios crossed with two water demand scenarios in a context of a dry future climate. Land-cover change was found to be an important, though less significant driver of changes in groundwater recharge than climate change. The degree of watershed protection, through preventing the spread of high-water-use, invasive plant species, was projected to be a much stronger land-cover signal than urban development. Specifically, full forest protection increased sustainable yield by 7–11% (30–45 million liters per day) and substantially decreased treatment costs compared with no forest protection. This study demonstrated the hydrologic and economic value of watershed protection in a context of a dry future climate, providing insights for integrated land and water policy and management in Hawai'i and other regions, particularly where species invasions threaten source watersheds. The paper was also selected as a 2021 Editors' Choice article in *Hydrogeology Journal*.

Featured Publication 2

Keener, V., Grecni, Z., & Moser, S. C. (2022). Accelerating climate change adaptive capacity through regional sustained assessment and evaluation in Hawai'i and the U.S. Affiliated Pacific Islands. *Frontiers in Climate*, 4. <https://doi.org/10.3389/fclim.2022.869760>.

The Pacific Islands region lacks detailed climate projections and a body of consensus findings about sector-specific impacts, and there is a need for actionable, culturally cognizant, translated climate information suitable for integration into operations and management, budgeting, funding proposals, and domestic and international policy. The Pacific Islands Regional Climate Assessment, or PIRCA, is the

subject of this decade-long case study illustrating the need, development, and benefit of creating and sustaining a nuanced, collaborative, and deliberately inclusive climate assessment effort among researchers and practitioners in Hawai'i and the US-Affiliated Pacific Islands (USAPI). Using external evaluations done in 2013 and 2021, and our observations as participants in the process, we describe regional adaptive capacity challenges—an important component of the decision context for PIRCA stakeholders—and analyze the role of the PIRCA network in accelerating climate adaptation. We also examine how regional and national assessments complement each other, and how assessment processes can aid in translation to sub-national decision-making across the climate science-policy interface. Results reveal components of the PIRCA that are foundational to its effectiveness: framing climate information in human and decision-centric ways; use of inclusive and non-extractive methods; willingness to shift approaches to meet stakeholder objectives; leveraging the resources of the Pacific Regional Integrated Sciences and Assessments (RISA) and other boundary organizations; taking the time to build relationships; and creating a dedicated position to sustain collaborations and relationships within the region and at larger assessment scales. Our experience and the feedback received through the evaluation suggest that these lessons are transferable to other regions and scales.

Attias, E., Constable, S., Sherman, D., Ismail, K., Shuler, C., & Dulai, H. (2021). Marine electromagnetic imaging and volumetric estimation of freshwater plumes offshore Hawai'i. *Geophysical Research Letters*, 48(7). <http://doi.org/10.1029/2020GL091249>.

Bremer, L.L., Elshall, A.S., Wada, C.A., Brewington, L., Delevaux, J.M.S., El-Kadi, A.I., Voss, C.I., & Burnett, K.M. (2021). Effects of land cover and watershed protection futures on sustainable groundwater management in a heavily utilized aquifer in Hawai'i (USA). *Hydrogeology Journal* 29, 1749–1765. <http://doi.org/10.1007/s10040-021-02310-6>.

Brewington, L., Kokame, K., & Lewis, N. (2021). Climate change, health, and migration in the Pacific: A case study of the Marshall Islands. *AsiaPacific Issues*, 149: 1–8. Available at: <https://bit.ly/3A9lnqf>

Brewington, L., Burgett, J., Martin, C., Kerkering, H., & Arnott, C. (2021). When Invasive Species and Climate Change Intersect: Survey of Hawai'i Natural Resource Managers. Honolulu: The Pacific Regional Invasive Species and Climate Change Management Network. Available at: https://pi-casc.soest.hawaii.edu/wp-content/uploads/2022/01/Pacific_RISCC_2021_Survey_Report_FINAL_web.pdf

Coffman, M. & Schjervheim, M. (2022). Climate change adaptation across the Pacific: A landscape assessment for curriculum development. UHM Institute for Sustainability and Resilience, Honolulu, HI.

Comeros-Raynal, M.T., Brodie, J., Bainbridge, Z., Choat, J.H., Curtis, M., Lewis, S., Shuler, C. & Hoey, A.S. (2021). Catchment to sea connection: Impacts of terrestrial run-off on benthic ecosystems in American Sāmoa. *Marine Pollution Bulletin*, 169, 112530. <https://doi.org/10.1016/j.marpolbul.2021.112530>.

Dhage, L. and M. J. Widlansky. (2022) Assessment of 21st century changing sea surface temperature, rainfall, and sea surface height patterns in the tropical Pacific Islands using CMIP6 greenhouse warming projections. *Earth's Future*, 10, e2021EF002524. <http://doi.org/10.1029/2021EF002524>.

Fandrich, K. M., O. Elison Timm, T. W. Giambelluca, & C. Zhang: Moisture Budget Analysis for the Hawaiian Islands Region Using Dynamically Downscaled WRF Simulations, poster presentation, A55N-1592, AGU Fall Meeting ("online everywhere"), New Orleans, U.S.A., Dec. 17th, 2021.

Hoffmann, B., Faulkner, C., & Brewington, L. Field quantifications of probability of detection and search patterns to form protocols for the use of detector dogs for eradication assessments. *Ecology and Evolution*, 12, e8987. <https://doi.org/10.1002/ece3.8987>.

Keener, V., Grecni, Z., & Moser, S. C. (2022). Accelerating climate change adaptive capacity through regional sustained assessment and evaluation in Hawai'i and the U.S. Affiliated Pacific Islands. *Frontiers in Climate*, 4. <https://doi.org/10.3389/fclim.2022.869760>.

Keener, V., Grecni, Z., Anderson Tagarino, K., Shuler, C., & Miles, W. (2021). Climate Change in American Sāmoa: Indicators and Considerations for Key Sectors. Report for the Pacific Islands Regional Climate Assessment. East-West Center. Available at: <https://eastwestcenter.org/PIRCA-AmericanSamoa>

Krzesni, D. and Brewington, L. (2022). Climate Change, Health, and Migration in the Marshall Islands: Profiles of Resilience and Vulnerability. Honolulu: The East-West Center.

Long, X., Widlansky, M.J. and Coauthors. (2021) Seasonal forecasting skill of sea level anomalies in a multi-model prediction framework. *Journal of Geophysical Research: Oceans*, 126, e2020JC017060. <http://dx.doi.org/10.1029/2020JC017060>

- Longman, R.J., Peterson C.L., Baroli M., Frazier A.G., Cook Z., Parsons E.W., Dinan M., Kamelamela K.L., Steele C., Burnett R., Swanston C., & Giardina C.P. Climate Adaptation for Tropical Island Land Stewardship: Adapting a Workshop Planning Process to Hawai'i. 2022, *Bulletin of the American Meteorological Society*, 103(2), E402-E409. <http://doi.org/10.1175/BAMS-D-21-0163.1>.
- Marra, J., Courtney, C., & Brewington, L. (2021). *The Pacific Islands Climate Storybook*. Honolulu, HI: The Pacific Regional Integrated Sciences and Assessments Program. Available at: www.pacificcrisis.org/pacific-islands-climate-storybook/
- Marra, J.J., Gooley, G., Johnson, M-V, Keener, V.W., Kruk, M.K., McGree, S., Potemra, J.T., & Warrick, O. (2022). *Pacific Climate Change Monitor: 2021. Pacific Islands - Regional Climate Centre Network (PI-RCC) Report to the Pacific Islands Climate Service (PICS) Panel and Pacific Meteorological Council (PMC)*. Available at: https://www.pacificmet.net/sites/default/files/inline-files/documents/PICC%20Monitor_2021_FINALpp_0.pdf
- Oji, R., Hesam, M., Keener, V. (2022) Using social network analysis to assess climate change professionals' communications in Iran. *Weather, Climate, and Society*, 14(1), 349-363. <https://doi.org/10.1175/WCAS-D-21-0002.1>.
- Okuhata, B.K., El-Kadi, A.I., Dulai, H., Lee, J., Wada, C.A., Bremer, L.L., Burnett, K.M., Delevaux, J.M.S., & Shuler, C.K. (2021) A density-dependent multi-species model to assess groundwater flow and nutrient transport in the coastal Keauhou aquifer, Hawai'i, USA. *Hydrogeology Journal*, 30, 231–250. <https://doi.org/10.1007/s10040-021-02407-y>.
- Okuhata, B.K. (2022). *Assessment of Groundwater Age and Transport in West Hawai'i Aquifers*, PhD Dissertation, University of Hawai'i, Honolulu, Hawai'i.
- Sanfilippo, K., O. Elison Timm, and T. W. Giambelluca: Quantifying model uncertainty in projected circulation change and downscaled precipitation for a 27-member ensemble over the Hawaiian Islands, poster presentation, A55T-1701, AGU Fall Meeting ("online everywhere"), New Orleans, U.S.A., Dec. 17th, 2021.
- Shuler, C. K., Brewington, L., & El-Kadi, A. I. (2021). A participatory approach to assessing groundwater recharge under future climate and land-cover scenarios, Tutuila, American Sāmoa. *Journal of Hydrology: Regional Studies*, 34, 100785. <https://doi.org/10.1016/j.ejrh.2021.100785>.
- Shuler, C. K., Mariner, M. (2020). Collaborative Groundwater Modeling: OpenSource, Cloud-Based, Applied Science at a Small-Island Water Utility Scale. *Environmental Modeling and Software*. 127(1). <https://doi.org/10.1016/j.envsoft.2020.104693>.
- Stewart-Ibarra, A.M., Hewitt, C., Winarto, Y.T., Walker, S., Keener, V.W., Bayala, J., Christel, I., Bloomfield, H., Halsnæs, K., Jacob, D., Brasseur, G.P., Haigh, T., & van den Hurk, B., 2021. Resilience through climate services. *One Earth*. 4(8): 1050-1054. <https://doi.org/10.1016/j.oneear.2021.08.002>.
- Thompson, P. R., & M. J. Widlansky, et al. (2021) Sea level variability and change [in "State of the Climate in 2020, Global Oceans"]. *Bulletin of the American Meteorological Society*, 102(8), S143-S198. <https://doi.org/10.1175/BAMS-D-21-0083.1>.
- Thompson, P.R., & M.J. Widlansky, et al. (2021) Rapid increases and extreme months in projections of United States high-tide flooding. *Nature Climate Change* 11, 584–590. <https://doi.org/10.1038/s41558-021-01077-8>.