Annual Report 2015

2015 Climate Science Symposium

In February, PICSC, along with the Pacific Islands Climate Change Cooperative (PICCC), presented its Second Annual Climate Science Symposium to provide an opportunity for program scientists to share their progress and discuss future directions and opportunities for their research.

Keynote speaker Dr. Virginia Burkett (USGS Assoc. Director for Climate & Land Use Mission Area, and IPCC Report Co-author) set the tone with her address focusing on climate change threats to vulnerable low-lying coasts and small islands.

Oral and poster presentations followed for two days,

ranging over a diverse collection of topics from physical and atmospheric sciences to community interactions with the changing physical world. Among other topics, presenters described Pacific cyclone activity, the climate of Guam over millennia, changes to low-flow streams in the Hawaiian Islands, the movement of marine life on coral reefs, reduction of impacts on endangered plants and animals through better management decisions, and the integration of local knowledge with scientific study.

Highlights of the second day were two special panel sessions on climate policy and stakeholder-driven climate science. The first panel was led by Rep. Chris Lee (HI State Representative), Jacqueline Kozak-Thiel (HI State Sustainability Coordinator) and Maxine Burkett (Associate Professor, William S. Richardson School of Law, UHM), who shed light on steps the state government is taking to lessen its dependence on fossil fuels and discussed the very real challenge of projected "climate refugees" to the global community. The second panel included Heather McMillen (Dept. of Botany, UHM), Eva Schemmel (HI Cooperative Fishery Research Unit, UHM), and Noelani Puniwai (Education Tech Specialist, UHH). These remarkable women shared how local communities guided their research and produced valuable tools using the knowledge, experience, and collaboration of community members. They urged scientists to form ties to their communities, especially when crafting goals for local research. This annual meeting provided an opportunity for scientists and students to discuss research, form new collaborations, and explore greater themes surrounding the science of climate change.

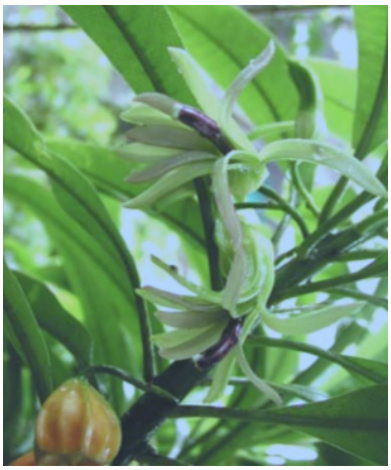
Kicking off Manager Climate Corps

A new endeavor being undertaken at UH Hilo is called the **Manager Climate Corps (MCC)**. The program supports research partnerships and networking to develop actionable, locally utilized science products and to build community resilience in the face of climate change impacts. By growing long-term collaborations between scientists (UHH faculty and graduate students within social, biological, and physical sciences) and Hawai'i Island natural resource managers and planners, the MCC aims to create pathways for using science in policy and management decisions. This iterative process of knowledge co-production draws on the experience of all parties to find solutions that work. Some products in the works are UHH graduate projects in spring 2016, workshops, courses, and seminars for graduate students and early professionals on climate related topics in the Pacific. Stay tuned for news from the MCC!

Creating online climate data sources for the Marshalls

Traditional agriculture and agroforestry are important for small Pacific islands to ensure food security (through self-sufficiency), improve human health, and even stabilize shorelines. However, farming is proving more difficult with unpredictable shifts in environmental conditions associated with climate change. **Maria Haws**, of the UH Hilo Pacific Aquaculture & Coastal Resource Center, and **Katie Friday**, of the USDA Forest Service, are working to produce an online "dashboard" and other outreach products to provide online data sources for those who work in agriculture and forestry on the Marshall Islands. The project team is participating with community members and extension agents to ensure that the results are relevant, accessible, and complete, and will help to improve food security and community resilience to climate change.

Evaluating impacts of climate change on flora of HAVO



Two important impacts of climate change predicted to be felt in the Hawaiian Islands are an increase in temperature and a decrease in precipitation, the perfect recipe for more frequent and intense droughts. **James Jacobi**, of the USGS Pacific Island Ecosystems Research Center, has partnered with natural and cultural resource managers at the Hawai'i Volcanoes National Park (HAVO) to model how climate change affects plant distribution and migration across the park. The results will help inform management strategies, such as where to focus restoration efforts for rare and endangered plant species, particularly in Special Ecological Areas. The results may also determine new areas in need of increased protection and management.

Protecting Hawaiian birds vulnerable to climate change

With the warming climate, mosquitoes and the diseases they carry are moving upward into the mountain forest habitats of endangered, endemic Hawaiian birds. **Michael Samuel**, of the USGS Wisconsin Cooperative Wildlife Research Unit, has been the team leader on a project which applies modeling to predict how the bird-mosquito-malaria system responds to climate change. The model outcomes will include details of bird demographics across varying elevations in Hawai'i and should provide managers with valuable information for creating measures that will help Hawaiian avian populations recover and become more resistant to diseases.

Measuring carbon levels around West Hawai'i coral reefs

Increased levels of CO_2 in the atmosphere trigger greater uptake of carbon by the ocean, shifting its fundamental chemical balance and leading to ocean acidification. Effects of increases in pH on carbonate-based ocean organisms are well documented, but to evaluate impacts on specific coral communities, baseline measurements are necessary. **Steven Colbert**, of the Marine Science Department at UH Hilo, has conducted a study measuring factors such as temperature, salinity, O_2 and CO_2 levels, and pH at three important sites in West Hawai'i. Results show that coral reefs around Hawai'i are currently experiencing ocean acidification conditions that previous predictions suggested would not occur for 40 more years. Regular monitoring of coastal groundwater inputs, and management changes to reduce their acidity, would help to stabilize local coral reef conditions.

Assessing effects of changing moisture on Hawai‘i forests

Baseline information of how dominant tree species take up and transpire water is necessary to predict accurately how climate change and vegetative invasion will affect the hydrological functioning of Hawai‘i’s watersheds. **Rebecca Ostertag**, of the Department of Biology at UH Hilo, is leading an effort to determine the extent, timing, and longevity of moisture effects on water use, water-use efficiency, and plant growth in a strongly water limited and non-limited forest. Using an established pair of research sites (one dry, one wet) located in the Hawai‘i Experimental Tropical Forest, the study examines stand water use as well as tree growth and mortality, based on sap movement and water-use observations. Ultimately, the results should help facilitate better management decisions for forested areas of Hawai‘i Island.

Combing newspapers and coring trees to study climate

Reliable instrument measurements of Hawaiian climate date back less than 150 years, hampering efforts to make accurate rainfall predictions that could be used to manage water resources in the long term. **Rosie Alegado**, a researcher in Oceanography at UH Mānoa, is leading a team in a two-part effort to extend our knowledge of Hawaiian climatic trends. One part is searching old Hawaiian language newspapers (1834-1949) for details of life and the environment. The second part exploits the presence of conifers, introduced in the late 1800’s, which grow annual tree rings, unlike most tropical trees. Coring the trees and examining their rings will yield additional important climate information from a variety of elevations and temperature regimes across the state.

Predicting Pacific sea level heights

Changing sea level height is one of the great uncertainties associated with climate warming over the next century. Two current projects focus on aspects of predicting sea level height for the Pacific Islands. **Axel Timmermann**, of the International Pacific Research Center (IPRC) at UH Mānoa, is leading a study to model the dynamics of sea level variability based on seasonal to decadal time-frame effects. The goal is to produce an effective early warning system of future sea level extremes for appropriate emergency agencies and managers. **Philip Thompson**, of the Joint Institute for Marine & Atmospheric Research (JIMAR) at UH Mānoa, leads a group quantifying the effect of local factors and Pacific climate variability on the frequency of inundation events. They plan to produce seasonal projections of the number of inundations in 3-6 month windows.

Documenting climate variable changes across Hawai‘i

As part of his PhD dissertation, **Ryan Longman**, with his advisor **Thomas Giambelluca**, of the Department of Geography at UH Mānoa, completed a project that examined historical climate data from across the state to detect climate changes at various spatial and temporal scales. Changes were identified in several climate variables, including precipitation, relative humidity, reduction of sunlight due to cloud density, solar radiation, and number of zero precipitation days. These shifts were attributed to increases in the frequency of the occurrence of the trade wind inversion, a thermal layering pattern which controls the maximum elevation of cloud growth. Understanding decadal changes in Hawai‘i’s climate will help managers to develop successful strategies for preserving ecosystems and managing freshwater resources.

Guam embarks on new GIS program

The Geography Department at the University of Guam is collaborating with the Center for Island Sustainability and PICSC to develop a robust Geographic Information Systems (GIS) academic program with a strong Micronesia-focused curriculum. GIS has the power to bring together seemingly disparate locational information sets, providing a basis for informed decision-making. Skilled personnel using sound data can improve spatial analysis for natural resource agencies, allowing them to better balance economic, social, and environmental concerns of the present population with sustainability issues for future generations. This program aims to increase GIS technical capacity for Guam and the entire region, ideally increasing the resiliency of small Pacific Islands to the impacts of climate change.

To promote the program, a pre-conference workshop is being planned, associated with the annual Center for Island Sustainability Conference in April 2016 in Tumon, Guam. The workshop will help identify geospatial data and training needs in the region and guide the geospatial framework for the US-affiliated Pacific Islands. GIS experts from various US federal agencies will present data for the region and solicit feedback from local agencies throughout Micronesia.

This first undergraduate GIS course will be offered at the University of Guam in the summer of 2016, with undergraduate degree programs expected to be approved by 2019 (minor) and 2021 (major).

PICSC Projects Funded for FY 2015

In keeping with the mission of PICSC, a number of new projects were selected for funding this year. All are now underway and answering key questions about climate change impacts in the unique environments of the Pacific Islands. New projects include:

Cloud water Interception in Hawai'i: Developing Capacity to Characterize the Spatial Patterns and Effects on Water and Ecological Processes. **Thomas Giambelluca**, UH Mānoa

Cloud Water Interception in Hawai'i: Building Spatial Pattern Maps for the Present-day Climate and Projected Changes by the Later 21st Century using the Hawai'i Regional Climate Model. **Yuqing Wang**, UH Mānoa

Mapping and Environmental Science to Support Clean Reefs of West Maui, Hawai'i. **Kirsten Oleson**, UH Mānoa

Assessing the Sustainability of Culturally Important Marine Sites in Guam and CNMI. **Laurie Raymundo**, U Guam

Diagnosing and Communicating the Effect of Climate Variability on Frequency of Coastal Inundation. **Philip Thompson**, UH Mānoa

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