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Wai Halana
Hawaii Flood News

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

Hawaii Climate Adaptation Initiative Act (Act 83)

Andy Bohlander, University of Hawaii Sea Grant Program

The Hawaiian Islands are vulnerable to a variety of natural hazards including hurricanes, tsunamis, severe weather, flooding, and erosion. Climate change and projected future sea level rise have the potential to exacerbate these hazards and increase the threats to people, property, economies, infrastructure, and the natural environment. Sea level rise is one of the greatest concerns associated with climate change, particularly in Hawaii where the majority of development is concentrated in low-lying coastal plains. Through recent legislation, the State of Hawaii recognizes the importance of taking a proactive approach to addressing the potential impacts of future climate change and sea level rise.

Act 86 (2012) established priority guidelines in the Hawaii State Planning Act (HRS §226) for climate change adaptation to prepare the State and Counties to begin addressing the impacts of climate change. Act 86 requires all county and state action agencies to consider climate change in policy, land use, capital improvement projects, and program decisions. The State of Hawaii has recently taken another major step forward in addressing the future impacts of climate change. On June 9, 2014, Governor Neil Abercrombie signed into law the Hawaii Climate Adaptation Initiative Act (Act 83), which will support the development of adaptation strategies to address the effects of climate change through 2050 to protect the State's economy, health, environment, and way of life.

Act 83 establishes an Interagency Climate Adaptation Committee to coordinate the development of a sea level rise vulnerability and adaptation report for Hawaii through the year 2050. The Committee will be attached administratively to the Department of Land and Natural Resources (DLNR), and headed jointly by the State of Hawaii Office of Planning (OP). The report will consider multiple sea level rise scenarios to assess potential vulnerabilities to various sectors including but not limited to infrastructure, agriculture, water resources, tourism, ecosystems, and natural resources. The report will also identify adaptation measures to reduce or mitigate the potential impacts of climate change and sea level rise.

The sea level rise vulnerability and adaptation report will provide a framework for the development of a larger statewide climate adaptation plan. The statewide plan will provide a holistic framework for climate adaptation with the primary goal of increasing Hawaii's resilience to climate change. A total of $567,748 has been allocated to support these efforts, which must be completed by the December 2017.

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www.hawaiinfip.org

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Upcoming Events

10th Annual Hawaii Floodplain Managers Conference

August 13 - 14, 2014: The 10th Annual Hawaii Floodplain Managers Conference will be held at the Manoa Grand Ballroom in the Japanese Cultural Center, Honolulu.

Conference Agenda includes:

- *Sea Level Rise in Hawaii*
- *Hydrological Trends and Climate Impacts and Projections*
- *Act 83 - Climate Change Adaptation*
- *Panel Discussion: Hawaii's Counties Long Range Planning for Sea level Rise in Hawaii*
- *Hawaii's FEMA Flood Insurance Rate Map Mapping Updates*
- *Hawaii Flood Hazard Assessment Tool Reboot*
- *FEMA Lamp Process - Kaunakakai Pilot Project*
- *USACE Levee Program*
- *Ala Wai Canal Flood Study*
- *Makaha Flood Study*
- *Hawaii General Flood Control Plan Update*
- *National Flood Insurance Program's FAQ Answered*
- *Flood Insurance (BW-12/HFIAA) Updates*

To register for this valuable conference, visit:
http://dlnreng.hawaii.gov/nfip/nfip-home/conference/

Sea Level on the RISE

Dr. Chip Fletcher
School of Ocean and Earth Science and Technology
University of Hawaii at Manoa

http://www.soest.hawaii.edu/coasts/sealevel/

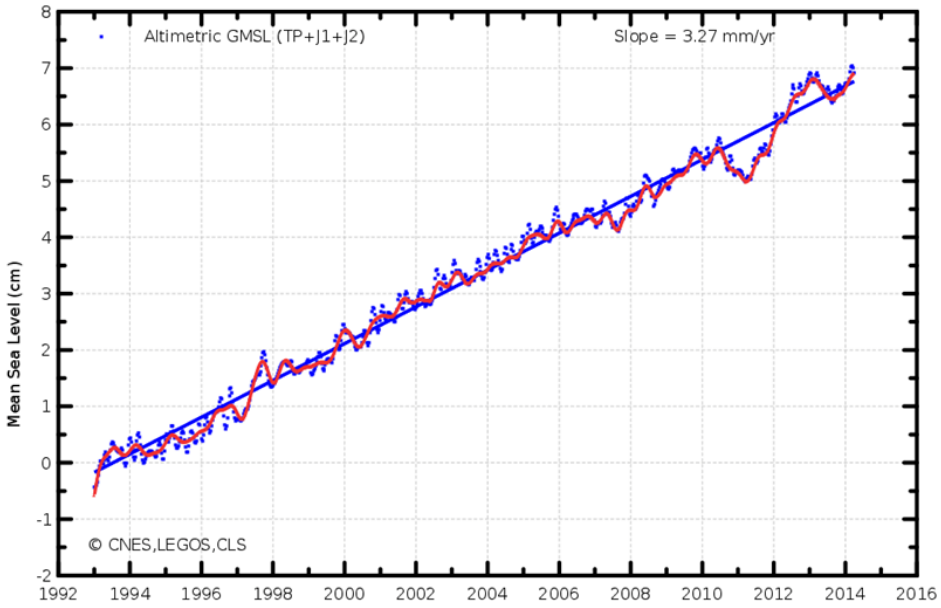


FIGURE 1 Global mean sea level, measured by satellite altimetry since 1993, is rising at over 3 mm/yr (1 ft/century). (*http://www.aviso.altimetry.fr/en/data/products/ocean-indicators-products/mean-sea-level.html*)

Global mean sea level over the past two decades has been rising at a rate of over 3 mm/yr (1 ft/century; **FIGURE 1**). This is faster than the 6 inches of rise estimated for the 20th Century. Scientists who study sea level rise (SLR) have projected that by the end of this century, the ocean may range from 1 ft to more than 3 ft above its present level, depending on intensities of future global warming.

Global SLR is a result of oceanic thermal expansion due to warming as well as melting of the world's glaciers. There is recent news that the West Antarctic Ice Sheet is in a state of accelerated and "irreversible" decline. Also, researchers have strong new evidence that melting of Greenland ice is going to speed up more

Continued on Page 3

than previously forecast. These new findings indicate that our current estimates of future SLR will likely be revised upward and that SLR will continue to be a problem for several centuries.

The level of the ocean around Hawaii is highly variable. Tides rise and fall twice daily, and there are variations in sea level related to monthly and seasonal effects, the ENSO phenomenon, patterns in ocean circulation, and even changes in the trade winds. This means that as the ocean rises due to global warming, it will advance and retreat for many decades before we witness permanent inundation.

FIGURE 2 *Prior to storm drain retro-fitting, Mapunapuna experienced flooding due to seawater intrusion during high tide. The problem was compounded at times of heavy rainfall. (photo by D. Oda)*

Our exposure to SLR is also varied. Coastal erosion is likely to increase, and we will be exposed to greater danger from tsunami and hurricane storm surge because water levels will be higher around the islands. At high tide we will see saltwater emerging with increasing frequency out of storm drains along low-lying parts of Hawaii's roads.

The groundwater table in low lying areas will break the land surface at high tide and retreat at low tide marking a new reality of intermittent wetlands and expanding flood-prone areas. Roadbeds will be exposed to higher water tables, the primary cause of potholes and road deterioration. During heavy rainfall events, at high tide, drainage will be poor in low lying areas and flooding at these times will spread beyond historical levels (FIGURE 2).

These are not insurmountable problems. But to meet them in the most efficient and effective manner requires advance planning. An obvious first place to develop the necessary engineering and policy tools is at locations that are already vulnerable to these problems. Roads and other infrastructure that are currently exposed to marine flooding, high water tables, and poor drainage are "low hanging fruit" where we can develop and test various adaptation approaches to sea level rise.

How do we move forward on these issues? On June 9, 2014 the Governor signed into law Act 83 which establishes an interagency Climate Adaptation Committee under the joint coordination of DLNR and Office of Planning. The Committee is charged with producing a report over 3 years that will articulate the details of adapting for SLR in Hawaii. In support of this effort, researchers at the University of Hawaii are mapping future erosion and flooding vulnerability, and the NOAA sea level viewer is a great tool to identify low-lying areas exposed to SLR.

SPOTLIGHT

A Video on Climate Change and Sea Level Rise in Hawaii

PBS Hawaii - Insights: Climate Change

http://www.youtube.com/watch?v=7ghy7ArhCvg

Dan Boylan moderates this discussion on climate change, an issue that is climbing the local and national political agenda. Science indicates that global warming is causing a rise in sea levels and temperatures, extreme weather and a loss of rainfall that could threaten our water supply. Some of Hawaii's top climate experts will examine this complex issue from scientific, environmental and policy perspectives.

Featured guests: William Aila, Chair of Hawaii's DLNR; Stanton Enomoto, Cultural Adaption Coordinator at Pacific Islands Climate Change Cooperative; Charles Fletcher, Associate Dean for Academic Affairs and Professor of Geology and Geophysics at the UH Manoa School of Ocean and Earth Science and Technology; and Victoria Keener, East-West Center Fellow and Editor of Pacific Islands Regional Climate Assessment.

Original Air Date: February 14, 2013

NOAA Sea Level Rise Viewer

www.csc.noaa.gov/digitalcoast/tools/slrviewer

NOAA's sea level rise viewer allows community planners, city officials and coastal residents the opportunity to identify floodprone locations in their area. This tool is distinct from those provided by the Federal Emergency Management Agency (FEMA) because, rather than focusing on what has flooded in the past, the sea level rise viewer shows potential future inundation from daily tides along U.S. coasts if global sea level rose up to six feet.

The tool offers hard-to-find data and information regarding the flood risks due to various possible scenarios of sea level rise. Community planners can assess what infrastructure is vulnerable under these conditions, and the tool enables business and homeowners along the coasts to make decisions regarding their livelihoods and see how rising sea levels may affect them in the future.

Source: NOAA

When Retreat is the Best Option: Flood Insurance after Biggert-Waters and Other Climate Change Puzzles

A working paper that's been accepted for publication in the spring edition of the "John Marshall Law Review" focuses on the shortcomings of BW-12 and Homeowner Flood Insurance Affordability Act, and what legislators should consider when developing future flood insurance reforms.

The paper, "When Retreat is the Best Option: Flood Insurance after Biggert-Waters and Other Climate Change Puzzles," is written by Professor Robert R. M. Verchick, Gauthier-St. Martin Chair in Environmental Law, Loyola University New Orleans College of Law, and senior fellow at the Disaster Resilience Leadership Academy, Tulane University; and Lynsey R. Johnson, CFM and a J.D. candidate, Loyola University New Orleans College of Law. She also served as disaster response and recovery planner for the state of Wisconsin from 2007 until 2011.

The authors' **abstract** states: Commentators argue, with good reason, that flood risk polices are soft on retreat. We Americans are more interested in fortifying our castles or building them higher than in moving out of harm's way. And that is despite warnings of rising seas and stronger storms associated with climate change. But the impulse to stay put may be eroding. In particular, the practices and policies of FEMA are gradually encouraging retreat over other alternatives. As one example, FEMA's current Mitigation Best Practice Database, the agency's new National Disaster Recovery Framework, now contemplates retreat mechanisms. For a while, Congress, too, beat the drums of retreat. The Biggert-Waters Insurance Reform Act of 2012, promised to remove important insurance subsidies for flood-prone homes, forcing some residents to consider relocation as a cost-saving option. Two years later, in response to public backlash, Congress repealed the law's strongest retreat-based incentives. Congress is expected to reform the insurance program once again by 2017.

In this article, we consider retreat as a strategy of hazard-risk reduction, with reference to the developments in FEMA practice and legislation listed above. As the effects of climate change increase the risks of floods and other extreme events, we also see FEMA's evolving retreat strategies as an important part of the nation's climate adaptation efforts. Unfortunately, initiatives like the new NDRF and Congress's insurance reforms are developing piecemeal, with blind spots large enough to drive a tornado through. We believe that policy makers would do better to have a set of principles to guide them when considering and implementing strategies that are intended or will have the effect of encouraging retreat. In particular, we think Congress could have avoided the embarrassing BW-12 failure if lawmakers had more fully recognized the complex issues at stake in retreat-based policies. One aim of our analysis is to suggest what a successful reform of the NFIP might look like, setting the foundation for more detailed conversations about flood insurance as the 2017 deadline approaches.

The entire working paper can be downloaded **here**.

Source: ASFPM News & Views April

USACE- The Responses to Climate Change Program

Source: USACE

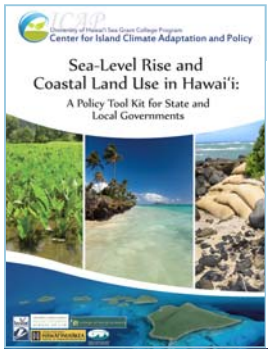
Climate change has the potential to affect all of the missions of the U.S. Army Corps of Engineers. The Responses to Climate Change Program develops and implements practical, nationally consistent, and cost-effective approaches and policies to reduce potential vulnerabilities to the Nation's water infrastructure resulting from climate change and variability. IWR works in partnership on this effort with other Federal science and water management agencies, and other stakeholders.

Comprehensive Evaluation of Projects with Respect to Sea-Level Change Tool Box

Sea-Level Change Calculator
http://www.corpsclimate.us/ccaceslcurves.cfm

Sea-Level Calculator for Non-NOAA Long-Term Tide Gauges
http://www.corpsclimate.us/ccaceslcurves_nn.cfm

USACE operations and water management control activities provide the largest challenge given future climate change and variability. In order to ensure continued effective and efficient water operations in both the short (5-10 years) and longer term (10—50 years), nationally consistent but regionally tailored water management adaptation strategies and polices are needed. Such policies must balance project operations and water allocations within authorized project purposes with changing water needs and climate-driven changes to operating parameters. This must be accomplished while working in close coordination with a wide variety of intergovernmental stakeholders and partners. To learn more about the program visit: http://www.corpsclimate.us/index.cfm



Sea-Level Rise and Coastal Land Use in Hawai'i:

A Policy Tool Kit for State and Local Governments

Rising sea levels along Hawai'i's shorelines call for state and local governments to take action by means of a wide range of coastal land use policy tools designed to help Hawai'i successfully adapt to climate change. Hawai'i is expected to experience sea-level rise of one foot by 2050 and three feet by the end of the century. Sea-level rise of this magnitude poses significant economic, social, and environmental challenges requiring leadership and bold action by state and local governments, which are uniquely positioned to implement land use policy tools to shape Hawai'i's efforts to successfully adapt to rising sea levels in the coming decades.

The purpose of this Tool Kit is to identify and explain key land use policy tools for state and local government agencies and officials to facilitate leadership and action in support of sea-level rise adaptation in Hawai'i. Across the United States and around the world, governments are developing policy tools to proactively adapt to threats from rising sea levels. For example, the U.S. Army Corps of Engineers now requires consideration of sea-level rise impacts to coastal and estuarine zones in all phases of its civil works programs. In addition to incorporating projected sea-level rise in land use decision-making, experts also recommend that governments locate coastal development where it is protected from hazards, and ensure structures are resilient to flooding and other coastal hazards exacerbated by sea-level rise.

Accordingly, this Tool Kit surveys state adaptation plans, federal efforts, and other key sources to identify and discuss important land use policy tools for Hawai'i and suggests how these policies can be used by state and local governments to avoid or lessen the impacts of sea-level rise and related coastal hazards. Adaptation planning for sea-level rise and climate change is necessary to protect public health and safety, both now and in the future, and it is widely acknowledged that proactive planning can be more effective and less costly than responding reactively to climate change impacts as they occur. Because sea-level rise and climate change exacerbate existing coastal hazards, adapting now ultimately will lessen future economic, social, and environmental impacts of rising sea levels.

This Tool Kit first reviews scientific research showing that climate change is causing sea-level rise in the Hawaiian Islands and around the world. The physical and environmental impacts of rising sea levels – including coastal erosion, flooding, wave inundation, and rising water tables – are chronicled, as well as the economic and social impacts. The necessity for "adaptive management" in the face of uncertainty is noted, as is the important role to be played by state and local governments in implementing adaptation measures.

Source: UH Sea Grant College Program, Center for Island Climate Adaptation and Policy
Download Toolkit at: http://seagrant.soest.hawaii.edu/sea-level-rise-and-coastal-land-use-hawaii-policy-tool-kit-state-and-local-governments

Planning for the Impacts of Changing Rainfall and Hydrology in Hawai'i

Victoria Keener, Ph.D.
Research Fellow, East-West Center

It can be difficult and time consuming for natural resource managers, planners, developers, and homeowners to keep track of and integrate the numerous new studies that come out about future climate impacts on the water resources of Hawai'i. Understanding the different patterns and variables that affect past climate trends and future projections can be confusing because we live in a region with high **natural** climate variability, which makes it more difficult to observe and predict long-term future trends. The term "climate change" refers to the changes in long-term climate caused by the burning of fossil fuels and addition of greenhouse gases to the atmosphere. Shorter-term inter-annual "climate variability" refers to climate cycles over recent years and is defined in Hawai'i by regional-scale ocean-atmosphere phenomena like the El Niño-Southern Oscillation (4-7 year cycle), and the Pacific Decadal Oscillation (20-30 year cycle), which have strong seasonal impacts on precipitation amounts.

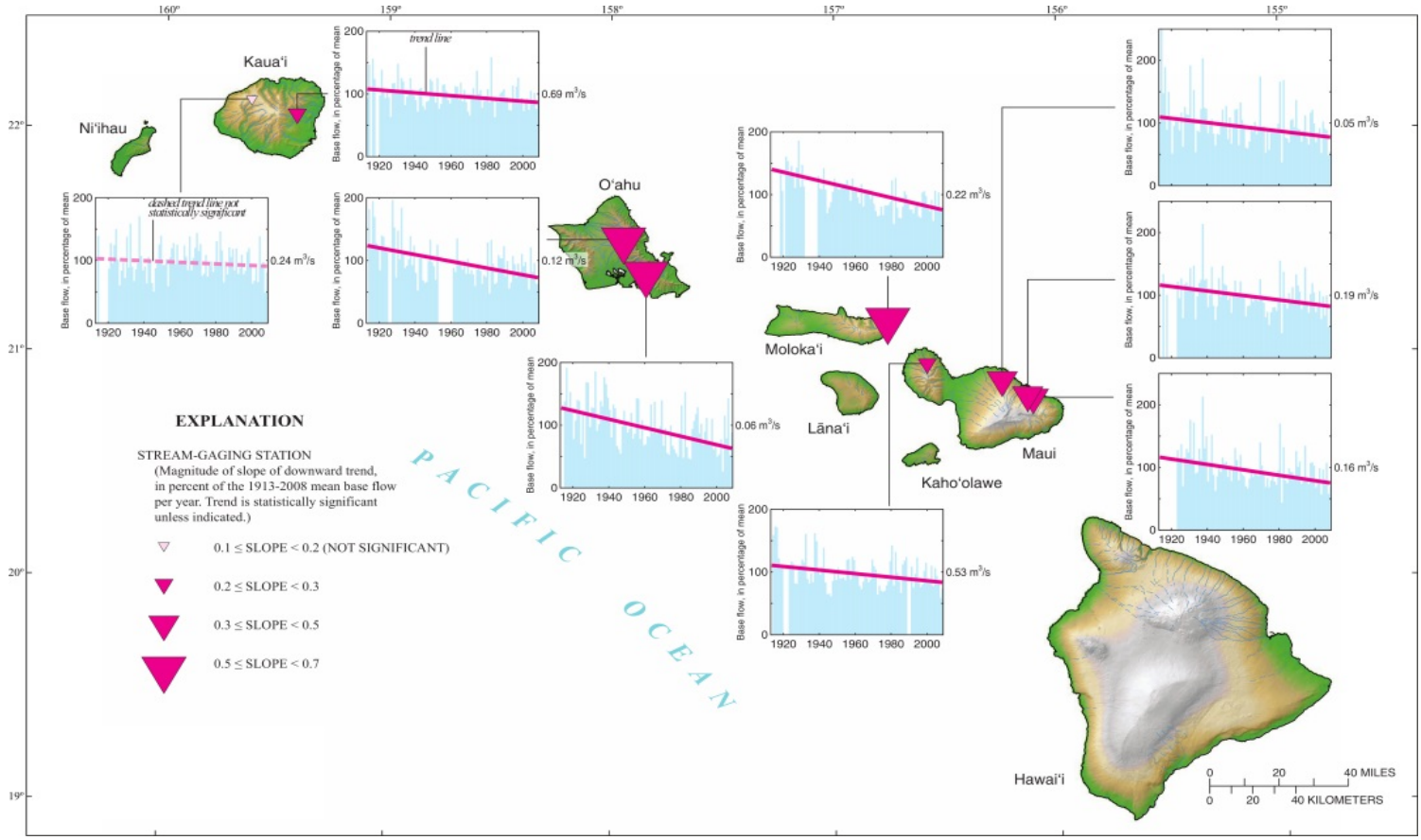


Figure 1. Base flow at eight out of the nine long-term streamflow gages in Hawai'i shows significant decreases of 20% to 70% over the past 100 years. This downward trend is consistent with significant decreases in rainfall in Hawai'i. Because base flow comes from groundwater, decreasing base flow indicates decreasing groundwater resources (Oki, 2004; Bassiouni & Oki, 2012).

The past century of observed data in Hawai'i shows increasing air temperatures - especially at high elevations – decreasing annual statewide precipitation, and decreasing baseflow trends (the groundwater component of streamflow) – a serious implication for a state in which 99% of our drinking water is groundwater (As shown in Figure 1). However, some models of future climate change in Hawai'i predict an overall increased amount of rainfall averaged over the State in the long-term. These climate change models are not as skilled at simulating climate variability, meaning that predictions of regional hydrology are more uncertain in the short-term.

The NOAA funded Pacific Regional Integrated Sciences and Assessments (Pacific RISA) team is conducting interdisciplinary research to inform decisions about the sustainability of groundwater resources on the island of Maui under future climate conditions. The preliminary findings from this research show future potential changes in seasonal rainfall on the island of Maui (Fig. 2).While more rain is expected overall, seasonal patterns appear in which already

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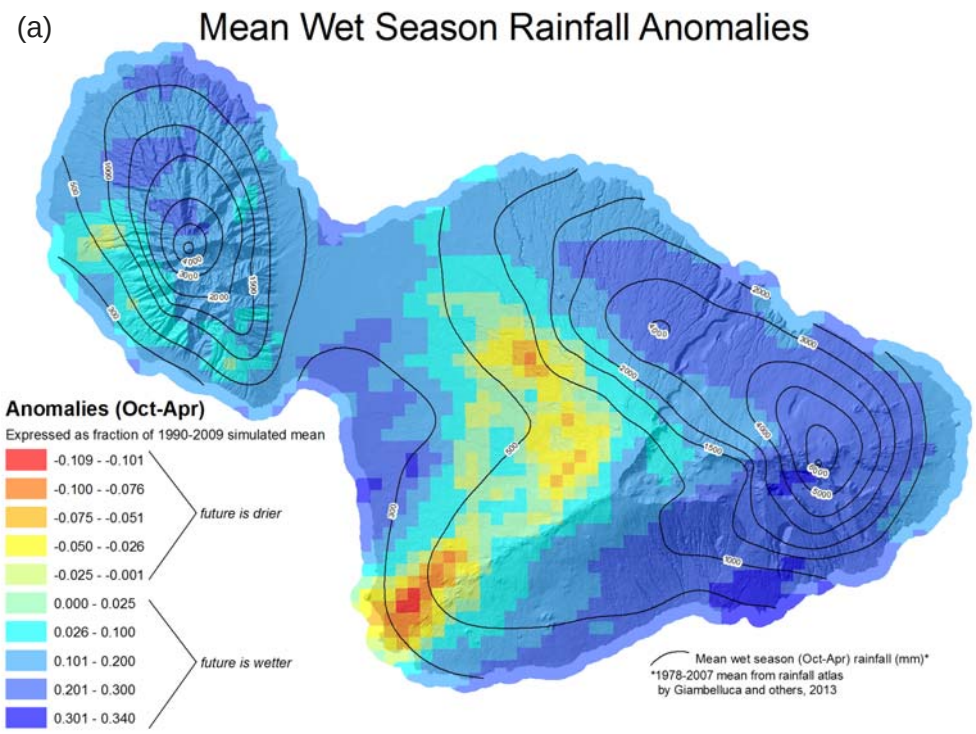

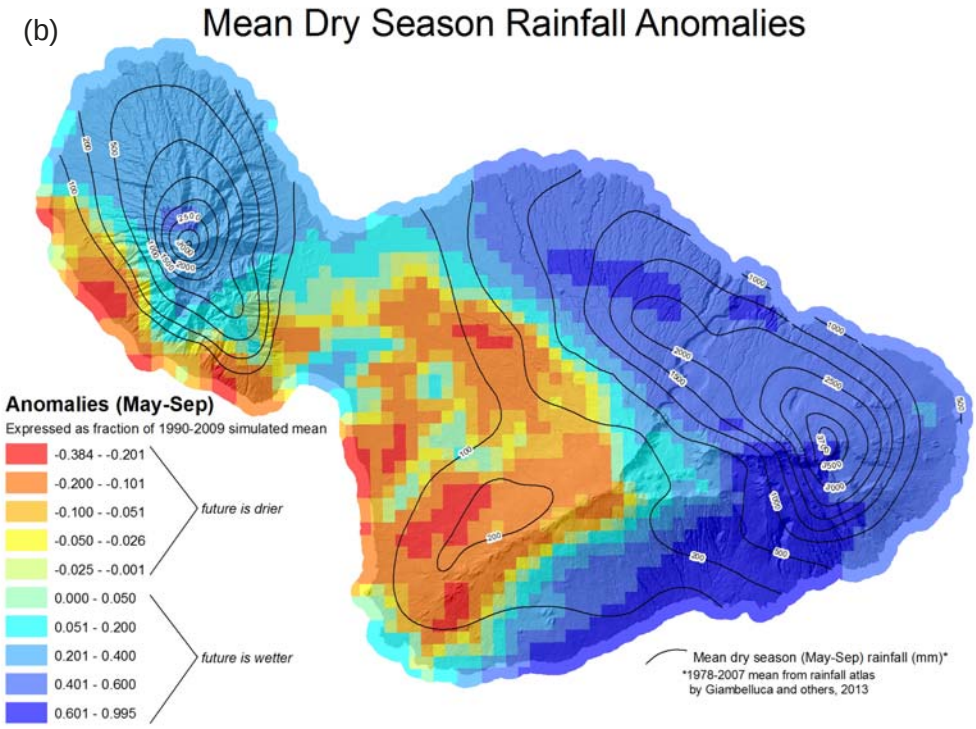

Figure 2. These maps show preliminary research estimating the projected fractional change in seasonal rainfall anomalies in (a) the wet season (Oct-Apr) and (b) dry season (May-Sept) in Maui at the end of this century as compared to historical rainfall from 1990 - 2009 due to projected global warming. Cool colors (greens, blues) indicate a future that is **wetter** than the past, while warm colors (yellows, reds) indicate a **drier** future.

dry areas become drier and wet areas receive more rain during the dry season between May to September, and almost all areas become wetter during the wet season between October to April. In the next year, Pacific RISA researchers hope to produce detailed maps of how future climate change may impact groundwater recharge and runoff patterns under different land use scenarios in Maui.

These patterns have implications for planners and resource managers, who need to know when, where, and how much rainfall is expected, and if we are able to retain it or if it will runoff into the ocean or create flooding problems on land. If, as the models show, the wettest places on Maui receive significantly more rain during the dry season, it may impact the ability of the soil to absorb and retain increased rain in those areas during the wet season – leading to increased potential for damaging runoff and erosion.

While the information and timelines on these maps are uncertain and shows potential changes in rainfall due to long term climate **change** rather than less predictable climate variability, some immediate win-win adaptation measures on Maui might be to be to plan for both increased storage of rain in areas where we already see flooding issues, and identify the most drought-vulnerable areas in places that are already stressed, while supporting policy initiatives that stabilize areas prone to erosion and prioritize community safety. Information on this research is on the Pacific RISA website and project fact sheet. (http://www.pacificrisa.org/wp-content/uploads/2014/02/)

References and for information, please see:
Bassiouni, M., & Oki, D. S. (2012). Trends and shifts in streamflow in Hawai'i, 1913–2008. *Hydrological Processes*. doi:10.1002/hyp.9298

Keener, V. W., Marra, J. J., Finucane, M. L., Spooner, D., & Smith, M. H. (Eds.). (2012). *Climate Change and Pacific Islands: Indicators and Impacts. Report for The 2012 Pacific Islands Regional Climate Assessment*. Washington, DC: Island Press. Download at: *http://www.pacificrisa.org/projects/pirca/*

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Sea-Level Rise and Hazard Mitigation Assistance Programs

As part of the President's Executive Order on Climate Change, the President's Council for Environmental Quality (CEQ) developed "Implementing Instructions for Federal Agency Climate Change Adaptation Planning" to address climate change resiliency. In support of the Instructions, FEMA issued a policy statement, 2011-OPPA-01, "FEMA Climate Change Adaptation Policy" (http://www.fema.gov/media-library/assets/documents/33082), which outlines seven initial actions to help integrate climate change adaptation considerations into FEMA programs, policies and operations. To implement this policy, FEMA is developing a Climate Change Adaptation Implementation Plan. One of the seven initial actions as part of the Plan is to "evaluate how climate change considerations can be incorporated into grant investment strategies with specific focus on infrastructure and evaluation methodologies or tools".

Pursuant to the FEMA directive to integrate climate change adaptation into its programs, policies and operations, FEMA will fund cost effective hazard mitigation projects that include sea-level rise estimates. The National Oceanic and Atmospheric Administration and the U.S. Army Corps of Engineers have recently released sea-level rise estimates for various coastal areas. These tools will allow applicants to determine the projected sea-level rise at a specific site for various time horizons.

In order to use the FEMA Benefit Cost Tool to calculate the benefit cost ratio for a mitigation project that includes sea-level rise, the user should add the estimated sea-level rise to the current 10-, 25-, 50-, and 100-year flood elevations for the area. In jurisdictions that have adopted a freeboard requirement, the amount of freeboard should be added to the flood elevations as well. The FEMA Benefit Cost Tool contains depth-damage curves for certain facilities and will calculate the benefits associated with mitigating to higher elevations.

The following link (http://www.fema.gov/es/media-library/assets/documents/89659) provides a list of Frequently Asked Questions on incorporating sea-level rise into Hazard Mitigation Assistance projects.

Source: FEMA