



# PACIFIC PANDANUS

NAVIGATING WITH THE BEST CLIMATE SCIENCE

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## Aloha, Hafa adai, Yokwe, Talofa, Alii, Mogethin, Ran allim, Kaselehlle, Hello!

This issue focuses on the theme of **CLIMATE VARIABILITY** and how it affects the Pacific Islands region. This past year has given us ample opportunity to see how climate variability, in this recent case El Niño, affects us in our own communities.

The 2015–2016 El Niño has resulted in drought, sea-level change, prolonged coral bleaching, and other changes from normal throughout the Pacific Islands. The following pages will describe climate variability and the contribution of Kelvin waves to the El Niño -Southern Oscillation (ENSO) cycle. We will also highlight some of the ways that communities are being impacted by El Niño, and describe just a few projects that folks are working on to anticipate and address these changes.

Importantly, as we consider climate variability we must also reflect upon the ways in which climate change can combine with variability to give us a world in which there is no normal.



# All About El Niño

Human-induced climate change is one thing; but what about natural climate variability? This past year saw one of the strongest El Niño events ever recorded. We'll delve into the science and impacts in the Pacific here.

Climate is the average weather (rainfall, temperature, etc.) in a given place over the course of several decades. Within long-term climate, variability is caused by phenomena like the El Niño-Southern Oscillation (ENSO). ENSO is the main cause of year-to-year climate variability in the Pacific. The phases of ENSO (including El Niño and La Niña) come in irregular patterns, and can cause impacts as severe as droughts and floods. ENSO phases are illustrated below. Although the major effects that result from a phase of ENSO may disappear once that phase is over, the effects of climate change can be long-lasting and permanent.

What sorts of events have we witnessed with the El Niño phase of ENSO? Let's explore.

the Federated States of Micronesia as a result of the El Niño-induced drought. Guam and the Commonwealth of the Northern Mariana Islands are also experiencing low rainfall.

## Varying sea levels

El Niño events are not always so uniform in the region. While Hawai'i might see higher sea levels than normal during this phase of ENSO, throughout the west and south Pacific it can lead to much lower than normal sea levels. These low sea levels can become so extreme that they can cause coral bleaching and even mortality.

In American Sāmoa and Guam in particular, these low sea level events can reach 20-30 cm below average and expose coral heads to the sun and air. The term *taimasa* refers to these low levels as well as the odor resulting from dying fish and corals. See the box below for more details.

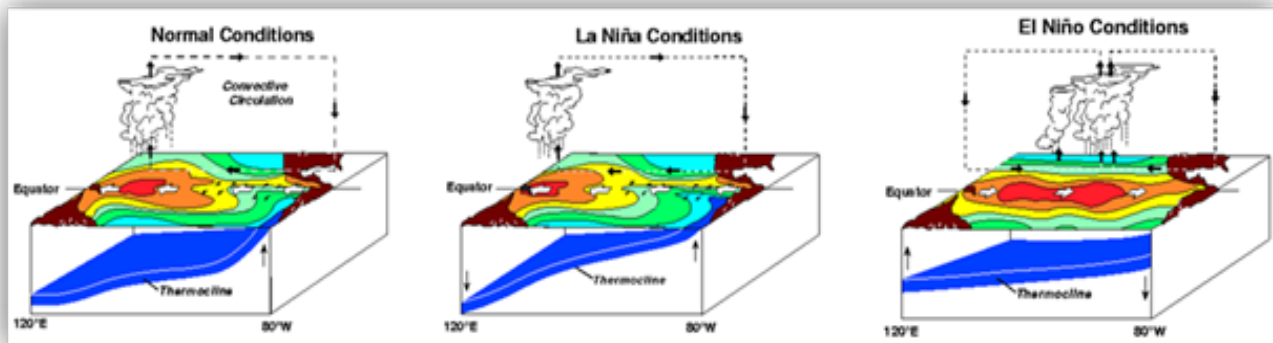


Image source: [NOAA Pacific Marine Environmental Laboratory](#)

## El Niño and drought

The recent El Niño has shown how strongly climate variability affects lives and livelihoods. While El Niño affects rainfall in various ways throughout the world during the course of its run, in the Pacific it typically results in dry conditions.

In the Marshall Islands for instance, El Niño has caused severe drought across the country's atolls. The President of the Marshall Islands, Hilda Heine, declared a [state of emergency](#) on February 4th in order to access greater international aid. The local government, meanwhile, has further restricted municipal water access on Majuro, increased freshwater storage, and installed reverse osmosis units on some atolls.

Meanwhile, similar states of emergency have also been declared in Palau and

## Taimasa

(kai' ma'sa)

Meaning: foul-smelling tide, which refers to the odor from decaying marine life.

Scientists have adopted the Samoan word in the term El Niño Taimasa to encompass the major sea level drop which can repeatedly expose the shallow reefs to air during low tide. The Taimasa events are associated with a southward shift of weak trade winds at the end of El Niño. The exposure of coral reefs to air can lead to coral and fish die-offs.

Scientists are currently using computer climate models to study how El Niño Taimasa might be transformed in the future with climate change. These drops in sea level may become more predictable in seasons ahead, which could help island communities prepare for the next El Niño Taimasa.

[Click here](#) to read more.



# El Niño continued...



Coral reef in American Samoa before and during the recent bleaching event (Source: XL Catlin Seaview Survey)

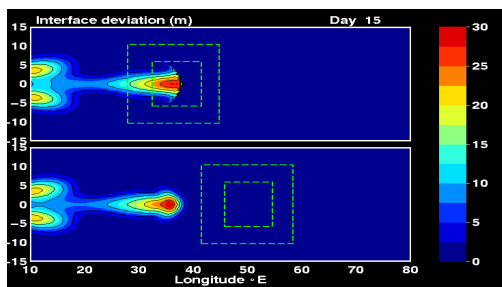
## Coral bleaching

El Niño has created a warmer sea surface, which has caused corals to expel or lose critical microscopic algae known as zooxanthellae. Zooxanthellae provide food for the coral, so a loss causes the coral to become stressed, susceptible to disease, and if the bleaching continues the coral is more likely to die.

While the global coral bleaching event which began in 2014 was already designated as the longest event ever recorded, El Niño has only prolonged the die-off. Thanks to El Niño, this event could last through 2017, affecting coral reefs that millions of people rely upon throughout the Pacific for fishing, recreation, and tourism income.

Climate variability and climate change alike affect people in ways that can sometimes feel overwhelming. But there are ways in which individuals, communities, even organizations are confronting the effects of El Niño. By understanding the major impacts and anticipating them (recall the [Pacific RISA fact sheets](#) from the [last newsletter](#)), communities throughout the world can prepare for these major variations in climate, protecting valuable resources.

Though El Niño is an example of natural climate variability, lessons learned from El Niño preparations and recovery can also be applied to human-influenced climate change.



## Climatology 101...Kelvin waves

El Niño and La Niña are focused in the tropical Pacific, and defined by the condition of the ocean near the equator. Over most of the tropical Pacific, winds blow from east to west (trade winds). These winds push ocean water westward resulting in a sea level about two feet higher in the far western than in the eastern Pacific, under normal conditions.

Picture a giant fan blowing on a long shallow bathtub and how the strong wind would cause water to pile up at the far side of the tub. If the fan were shut off, one could readily imagine a bulge of water moving toward the shallow end—lowering the depth of the deep end slightly and raising the level of the shallow end when it arrived there.

The oceanic **Kelvin waves** act in a similar way to the moving waves in the bathtub illustration. When trade winds slow down or reverse, the sea level changes so that it is lowered in the west and raised in the east. Because the earth is rotating, the water can't quite slosh like in a bathtub—the rotation of the earth constrains the slosh to a bulge near the equator.

There is a complication in that the ocean has a shallow surface layer of warm water underlain by a vast pool of very cold water. The boundary at this interface is known as the **thermocline**. It is possible for a wave of water, or Kelvin wave, to travel along the thermocline.

During the development stage of the El Niño, a series of strong westerly wind events trigger Kelvin wave that travel very slowly (about 3 m/sec) eastward to the South American coast. While traveling east, the Kelvin wave deepens the thermocline and pushes the cold waters down. This has the effect of raising the sea surface temperature by making the cold water less accessible at the surface. Warming of the sea surface to the east can lead to a positive feed-back that helps to move the western Pacific monsoon and storms farther to the east, creating more patches of weaker (or reversed) trade winds that set-off yet more Kelvin waves until the process leads to full-blown El Niño.

As a final word: El Niño can't last indefinitely. Once the trade winds increase again, water is shoved westward, raising the sea level there and lowering it in the east. This process can also be positively reinforced for a while so as to generate El Niño's opposite: La Niña!

Want to see Kelvin waves in action? [Click here](#) to locate a short video (kelvin2.fli) that demonstrates this wave movement.



### Sources for climate and agriculture information in the midst of deep drought for the Marshalls

Water and food security are at the top of every nation's list of concerns. And on narrow, low islands like the Republic of the Marshall Islands (RMI), water and crops are very much affected by climate and day-to-day weather. The wet season is essential for replenishing island groundwater lenses, municipal water sources, and family catchment tanks so that people can make it through the dry season with viable crops and drinking water. So, what happens if there is no wet season?

The current El Niño cycle has cut into the usual rainfall expected of during the wet season and created an intense drought, especially in the drier northern islands and atolls, even before the dry season has begun (see [RMI president's state of emergency](#)).



*Drought- and salt-resistant food crops for distribution.*

green panel, supported by the PICSC and the US Forest Service, delves into traditional atoll agriculture and forestry techniques plus new technologies that protect crops and water sources from flooding, sea spray, high winds, and drought. For the first time, shoreline stability techniques will also be integrated as a strategy for agricultural security.

### Bringing together a team

This project engages a team of Marshallese and US multi-agency researchers, managers, and community representatives working to provide timely information to stakeholders in RMI including water resource agencies, agriculture departments, women's groups, and farmers.

Stakeholder groups participated in foundational interviews with the project team. These interviews established known and rediscovered traditional agricultural techniques and climate knowledge, which will all be incorporated in the website and final products. In order to reach outer island farmers, products will be translated and adapted for better accessibility and utility. *Continued on next page....*



*Drought evident on Ailik atoll, Republic of the Marshall Islands*

In order to anticipate drying, extreme storms, flooding, and other weather forecasts, a project is underway to create a source for this information and its effect on food and water security for the Marshall Islands. The project consists of two sibling websites.

One website, or panel, will give RMI-specific weather and climate data using easy-to-understand graphics, much like a car dashboard. This blue panel is hosted by the National Oceanic and Atmospheric Administration (NOAA) and includes data from its National Weather Service.

Using information from the blue panel, the green panel addresses more of the food security side of things. The



*Foster Lanwe interviews an outer island farmer.*



# Climate Waves

Local agencies and community groups will be testing a first run of the panels this month to evaluate their effectiveness and usefulness before the team finalizes the websites. To read more about this project, visit [the project page](#) on the PICSC federal website.

## Going home to make a difference



Rufus Lajkit, pictured, translated and facilitated interviews with farmers and community members on outer atolls of the Marshall Islands for the agroforestry dashboard project (previous page). He will be working with the Ministry of Research and Development with the Marshallese Government as national consultant.

Lajkit's new project title is *Enhancing food and nutrition security in the Republic of the Marshall Islands through an integrated approach*. Lajkit described the project in terms of increasing food security and capacity through

targeting the densely populated capitol of Majuro and the communities of the outer islands, especially supporting women and vulnerable groups.

## His thoughts on the project...

*This project will support the private sector, households, and communities to process, prepare, and market nutritious and safe local food products.*

## On working in the Marshall Islands...

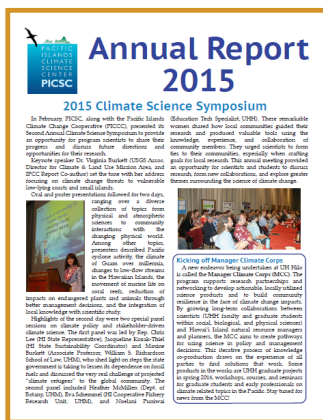
*Coming back to RMI is really great. I am glad I came here to serve my country and especially taking care of my parents.*

## Advice to other RMI students...

*Even though I've finished my bachelor degree, my goal is to go back to school and finish my master degree in the future. My advice to all the students in the RMI ... is to keep moving forward and never give up on their field of studies.*

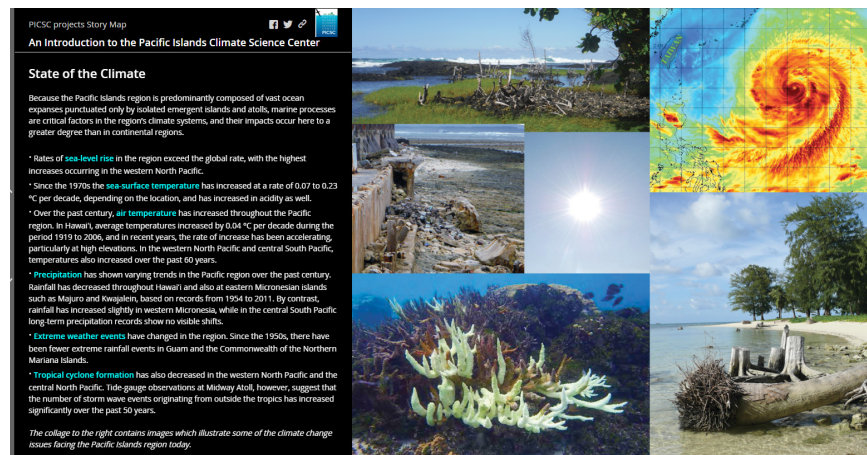


## New Products from the PI CSC



## 2015 Annual Report

Read about 2015's best and brightest, including graduate student research at our universities and collaborations with partners such as the Climate Science Symposium. You can also check out newly funded science and burgeoning programs in GIS and professional manager networks. [Read the report here.](#)



## Interactive Story Map

The PI CSC has released an interactive product called a Story Map, which provides a glimpse into the climate change impacts to the region and the climate science developing within the center. Using an ESRI platform, this multipage electronic brochure supports maps, images, and websites to illustrate what is happening at the PI CSC. Access the story map from the home page on our [federal website](#) or [university website](#).

# More Climate Waves

## Coordinating Climate Action in the U.S.-Affiliated Pacific

Climate variability and climate change affect people from across different walks of life. With this in mind, how do we come together to make decisions about the future and create resilience?

Members of the PICCC recently conducted coordination workshops in the Commonwealth of the Northern Mariana Islands, Guam, and American Sāmoa in order to engage local resource managers with varying jobs and responsibilities to discuss and coordinate climate change adaptation strategies. These workshops, which were requested by the Department of Interior's Office of Insular Affairs, provided an overview of the complexities of climate change and the various strategies available for enhancing the ability for local people to address climate change impacts.



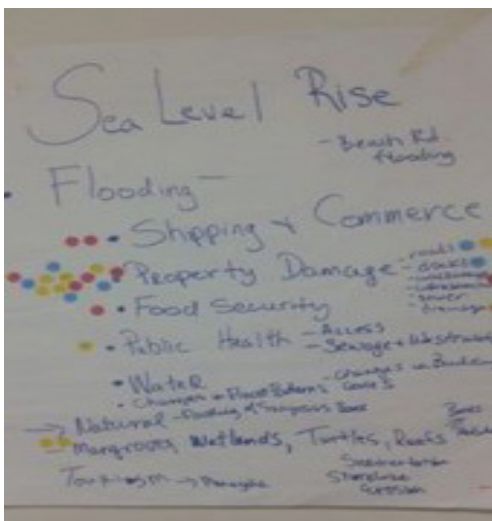
*A small group in American Samoa brainstorms about the how to address the major effects of climate change the Territory.*

The workshops asked participants to identify their greatest personal and professional concerns with regard to the many effects of climate change, including rising temperatures and sea level rise (below). Then, groups were formed to focus specifically on separate but intersecting matters like community well-being, infrastructure, and ecosystem management. These groups developed long-term, 15-year objectives to address climate change. Once these objectives were developed, the groups identified their current capacity to help to achieve the objectives over the course of 15 years. Participants realized that they already have a great deal of local capacity to confront climate change!

Once the groups established their existing capacity, they looked closely at the gaps in data and technical capacity that requires further assistance. Using these needs, each group developed near-term projects that would enhance resilience and put the jurisdictions on the path toward their long-term adaptation goals.

Several of the climate change adaptation projects identified during the workshops are now receiving support. In Guam, these projects include a vulnerability analysis of coastal infrastructure, a pilot climate GIS project headed by University of Guam, climate change training workshops for planners, and multi-sectoral resiliency workshops. American Sāmoa's projects include the development of a territorial climate change adaptation strategy and implementation plan, a territorial integrated geospatial framework, and vulnerability assessments of urban systems and infrastructure.

Read more about this project on the [PICCC's website](#)



*A small group identified the greatest impacts of concern to the CNMI to be sea level rise. The dots in yellow and blue represent agency and departmental concerns, while the red dots denote personal concerns.*



*A small group in Guam identifies projects related to the vital needs of data development/management and climate migration. (Credit: Tricee Limtiaco)*



# Climate In Action

## First Sea-level Rise Adaptation Workshop for Hawai'i

Hawai'i's first Sea-Level Rise Vulnerability and Adaptation Workshop was held on February 11th at the UH Mānoa campus. The workshop attracted climate change experts, state and county leaders, and members of the public in order to discuss the latest science surrounding sea level rise on Hawai'i and explore adaptation strategies for confronting these effects.



*Participants discuss the implications and plans for sea level rise in Ewa Beach during the sea level rise workshop.*

PICSC and PICCC-funded researcher Chip Fletcher (University of Hawai'i at Mānoa) was featured to present sea-level rise analyses for the Hawaiian Islands, entitled "Sea Level Rise Outlook: Global & Local Projections". Other speakers included Department of Land and Natural Resources Chair Suzanne Case, master navigator of the Polynesian Voyaging Society Nainoa Thompson, and co-chair of the [Interagency Climate Adaptation Committee](#) (ICAC) Sam Lemmo.

The engineering and consulting firm Tetra Tech also presented information about the projections of sea level rise in Ewa Beach. The anticipated three foot rise of sea level by 2100 could have more than \$50 million in costs to land and buildings due to coastal erosion, according to Tetra Tech. Participants were asked to work through the effects of sea level rise and what they could potentially mean for the residents and business entities of Ewa Beach. Then, working together in groups, participants made recommendations about actions the government should take to anticipate and confront the impacts.



*Sam Lemmo, Co-Chair of the Interagency Climate Adaptation Committee, introduces speakers at the workshop.*

The workshop allowed science and policy experts insight into the newest research to date on sea level rise, and their recommendations on adaptation actions will be incorporated into the coordinated ICAC report. The workshop was sponsored by the Department of Land and Natural Resources, and PICSC and PICCC team members and associated researchers were actively involved as participants.

With a [recent study](#) demonstrating the acceleration of sea level rise due over the last century and the major impacts on flooding along the coasts, the workshop came at the right time to address the needs of the residents, tourists, and other interests along Hawai'i's coastline.



*A sea wall along Ewa Beach (Credit: UH School of Ocean and Earth Science and Technology)*



## 11th Annual Island Sustainability Conference, Guam

This year, the University of Alaska Fairbanks joined the University of Guam Center for Island Sustainability as a co-host of the conference to explore topics pertinent to soft borders and remote regions. Both universities serve border regions far removed from the mainland US. The institutions are dedicated to supporting dispersed and disconnected “islands” within their regions and are committed to emergent research and awareness of sustainable practice and lifeways toward human survival.

The goals of the conference were to inspire change, facilitate action, and provide a venue for sharing, networking, and collaboration of sustainability issues related to economic, social/cultural, educational, environmental, or energy solutions. In line with the goals the conference hosts featured keynote speaker Tony De Brum, Minister-in-Assistance to the President of the Republic of the Marshall Islands.

A pre-conference climate change workshop took place on April 12th in which downscaled models and applications, inundation forecasts, climate science communication, and climate adaptation planning will be discussed. These sessions were led by many representatives from the PICSC, the Alaska Climate Science Center, partner research institutions and agencies, as well as climate change offices from Guam and Palau.

For more information on the conference proceedings, [visit the CIS conference website](#).



## Tackling Climate Change Globally and Regionally

Three Pacific Island nations—Fiji, Palau, and the Marshall Islands—recently became the among the first to ratify the Paris Agreement. The ratification of the Agreement highlights the amount of concern that all three island nations have over climate change and vulnerability within their borders. With recent natural disasters in each nation including cyclones, king tides and drought, the need for global climate commitments has been underscored time and time again.

The talks in Paris in December 2015 led to the climate deal, under which 195 countries agreed to keep global temperature rise to well below 2 degrees Celsius and make efforts to keep the temperature rise under 1.5 degrees Celsius. The Paris Agreement is set to go into effect in 2020, but only if 55 countries, representing at least 55% of the global emissions, ratify it first. For more on the Paris talks, see our [January 2016 newsletter](#).



*The leaders across Micronesia pose during the Micronesia Chief Executive Summit (Credit: myfsm)*

Meanwhile, [the 21st Micronesia Chief Executive Summit](#) was held in Koror, Palau at the end of February, 2016. The Summit is the annual gathering of the leaders from across Micronesia, including Palau, the Commonwealth of the Northern Mariana Islands, Guam, the Marshall Islands, and the Federated States of Micronesia.

Palau President Tommy Remengesau, the Chair of the Summit, used his opening remarks to discuss the need for Micronesia to tackle impacts from El Niño and climate change as a region. The Chief Executives discussed the funding opportunities available to help jurisdictions combat the effects of climate change. The Summit also provided an opportunity to discuss the new Micronesia Center for a Sustainable Future, which will help to coordinate climate change efforts throughout the region.



# Climate In Action



*Mastigias sp. in Jellyfish Lake, Palau (Author: CT Snow)*

## Gentle jellyfish numbers plummet with drought

Palau's marine lakes are famous for their gentle jellyfish that don't sting swimmers like other marine species. However, the numbers of these golden jellyfish (*Mastigias papua etpisoni*) are diving possibly due to the drought conditions brought on by El Niño. Coral Reef Research Foundation reports that the population has dwindled from 8 million to 600,000 since November 2015. A similar population plunge occurred during previous El Niños. Find out more on the [Jellyfish Lake fact sheet](#) or the [CRRF Think Big Palau blog on Facebook](#).

## Calendar

### Recent events...

#### January

- 21-22** PICCC Climate Change Coordination Workshop, CNMI (see page 6)
- 25-26** PICCC Climate Coordination Workshop, Guam (see page 6)
- 26-28** [Hawaiian Wetlands and Waterbird Workshop](#), Kaneohe, HI

#### February

- 3-5** PICCC Climate Change Coordination Workshop, American Samoa (see page 6)
- 11** Hawai'i Sea Level Rise Vulnerability & Adaptation Workshop, Honolulu, HI
- 23** PICSC Webinar: (Price) Epiphytes as bioindicators of climate change ([watch](#))

#### March

- 14-18** Pacific Risk Management Ohana (PRiMO) Conference, Honolulu, HI
- 15** PICSC Webinar: (Colbert) Impacts of groundwater on coral calcification, Hawaii Island (watch)

#### April

- 1** PICSC Webinar: (Bassiouni) [Sensitivity of low flows](#) to rainfall variability in Hawaiian streams
- 7** He'eia mapping project meeting with stakeholders
- 11-15** [11th Annual Regional Conference on Island Sustainability](#), University of Guam
- 26** PICSC Webinar: (Puniwai) [Recreational Seascapes](#): Integrating Human and Mechanical Observations on Hawaii Island ([Register here](#))
- 4** PICSC Webinar: (Samuel) [Trouble in Paradise](#): Avian malaria, climate change, and Hawaiian birds
- 11** [PICCC Steering Committee Meeting](#), Pier 38, Honolulu, HI

#### May

### Coming up...

#### June

- 19-24** [13th International Coral Reef Symposium](#)

#### July

- 6-8** [Rising Voices Workshop](#), Big Island, HI

#### September

- 1-10** [IUCN World Conservation Congress](#), Honolulu, HI
- 19-23** Coral Reef Task Force Meeting, CNMI and Guam
- 21-22** [International Conference on Sustainable Development](#), Columbia University, NY (see page 10)

# Opportunities

- ◆ The newest version of the **Climate Funding Opportunities document**, compiled for the National Oceanic and Atmospheric Administration's (NOAA) Office for Coastal Management can be found at: <https://adapt.nd.edu/resources/1672>. This document provides a snapshot of currently available, climate-related funding opportunities (as of January 15th, 2016). The document is posted on The Nature Conservancy's Collaboratory for Adaptation to Climate Change website. Follow the link and click the black "download PDF" box on the side of the page to view the document.
- ◆ The **Brower Youth Awards for Environmental Leadership** is now accepting applications for consideration. Young people between the ages of 13 and 22 (as of July 1, 2016) based in North America are eligible to apply. The awards are given to six young people each year who show outstanding leadership in their involvement with high impact, replicable & relevant environmental projects. The Brower Youth Awards prize includes a \$3,000 cash prize, a professionally produced short film, and a week long leadership trip in the San Francisco Bay Area culminating in a public award ceremony. [Apply here](#) by 16 May.
- ◆ If you are a recent PhD graduate, you could be the next winner of the **Science & SciLifeLab Prize for Young Scientists**. Four winners, in different categories, will be selected for this international award. Categories: Cell and Molecular Biology | Ecology and Environment | Genomics and Proteomics | Translational Medicine. Winners will be published in Science, share in the prize money, and be awarded in Stockholm, Sweden. Read more at the [AAAS prize website](#). Submission deadline is 1 August.
- ◆ **Kua'āina Ulu 'Auamo (KUA)** means: grassroots growing through shared responsibility. KUA is a Hawai'i-based non-profit organization created by a network of grassroots and native Hawaiian organizations called E Alu Pū (Move forward together) who desire to share lessons learned and to create a context more supportive of the collective vision they have for Hawai'i. This is a kāhea (call out) to our grassroots and indigenous peers who will attend World Conservation Congress 2016 to join us a few days pre-congress and for its opening days (August 28-Sept 3) for deep dialogue and reflection. Read more at [KUA's website](#).
- ◆ **PACE Fellowship**: Postdocs Applying Climate Expertise. The goal of this postdoctoral program is to grow the pool of scientists qualified to transfer advances in climate science and climate prediction into climate-related decision frameworks and decision tools. The program provides the opportunity for the PACE fellow to be immersed in a decision-making culture. [Learn more about the program here](#).
- ◆ The **International Conference on Sustainable Development** will take place September 21-22, 2016 in New York, New York. The five topics that the Conference will cover include: 1. Low Carbon Urban Development; 2. Socially Inclusive Economic Growth; 3. Agriculture, Food Security & Nutrition; 4. Disaster Resiliency and Adaptation; 5. Indigenous Innovations.



## Staff in Focus

**Sarah Nash**



Sarah Nash is in her third year as the Program Specialist for the PICSC. She spends her work time mostly puzzling out how to communicate the spectacular science from the center's research community. With a background in applied ecology and conservation and years of technical editing under her belt, she dove into climate science issues headfirst with unparalleled opportunities like facilitating stakeholder meetings in the Marshall Islands, writing about resource manager-researcher collaborations, and co-creating this newsletter. She is soon to live in Switzerland with her two creative children and fellow communicator husband where they will explore the land of chocolate.

**Whitney Peterson**



Whitney has spent more than four years in the Pacific, unraveling the sometimes complex science of climate change to transform it into actionable information for resource managers, decision-makers and members of the public. Prior to coming to the PICCC, she worked for the American Samoa Government to incorporate climate change adaptation and resilience into planning and community-based actions. Whitney has an interdisciplinary background focusing on scientific, social, and even psychological aspects of climate change, and is passionate about helping people understand and use information about climate change in order to make robust and proactive decisions.

## Who We Are

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[PICSC university website](#)

[PICSC federal website](#)

Missing our list of stakeholders and partners? Visit the PICCC and the PICSC websites to see the full lists and links to our partners' websites.

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**Do you have climate work that you would like us to highlight in our next quarterly newsletter? Please send submissions and mailing requests to the editors:**

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