Pacific Islands Climate Change Cooperative

PACIFIC ISLANDS CLIMATE CHANGE COOPERATIVE

Reading the past from tree rings creates a "virtual weather station" for Hawai'i

Understanding the natural range of precipitation and temperature variability before weather stations were in place is crucial for Hawai'i and many Pacific islands whose sensitive forest ecosystems and diverse wildlife will be facing novel weather conditions as a result of climate change. Results from a study sponsored by the Pacific Islands Climate Change Cooperative have shown that carbon and oxygen taken from tree rings can be analyzed together to describe the seasonal climate in which the trees lived. This is the first method identified for developing reliable and detailed estimates of past precipitation variations in places without weather data.

Scientists analyzed samples from the māmane tree (*Sophora chrysophylla)*, a long-lived evergreen that is one of the only Hawaiian trees to lay down yearly rings. They analyzed the chemical composition of individual tree ring samples to measure changes in the relative abundance of carbon and oxygen isotopes (forms of elements that differ in mass) taken up by the trees during photosynthesis at high elevation sites on Mauna Kea. By slicing the rings extremely thinly, they could track monthly changes over many years. They found that the level of these isotopes reflect the precipitation and temperature under which the trees lived, allowing a reconstruction of relative changes in climate extending back approximately 130 years.

Understanding regional effects of large-scale ocean climate patterns

Results of this study indicate that changes in precipitation measured over decades correlate well with large-scale ocean patterns that

dominate much of the Pacific. The regional effects of these patterns, such as the El Niño-Southern Oscillation (which involves fluctuating ocean temperatures in the equatorial Pacific), are not well understood.

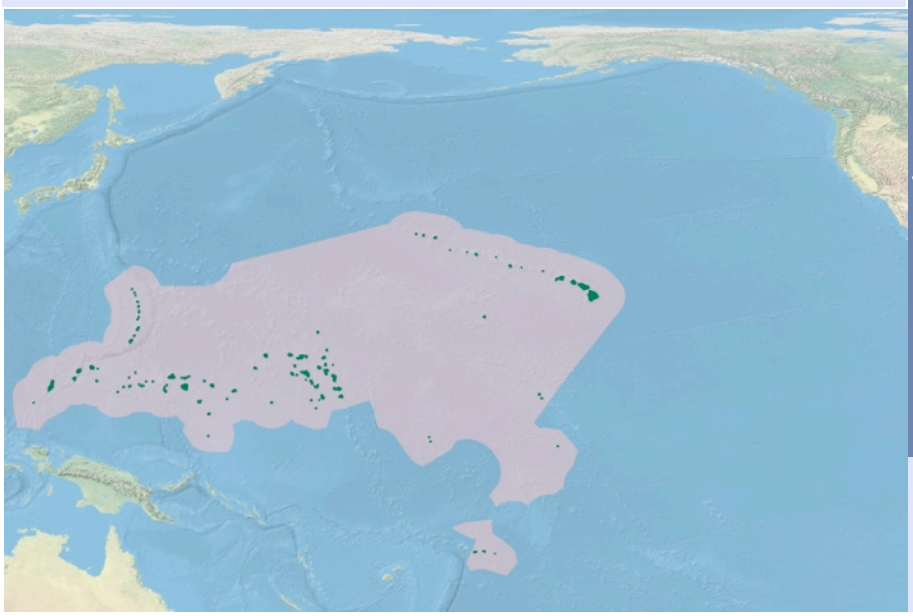
The tree-ring isotope data showed a general decrease in precipitation since the 1920s that is consistent with rain-gauge measurements. The long-term climate record also correlated well with measurements showing a decrease in snow cover on Mauna Kea. These results demonstrate how detailed measurements of the wood chemistry of māmane trees can be

used to extend the record of natural climate variability in Hawai'i to a wider geographic extent and across longer time periods than the instrumental record allows.

Implications for conservation

This new climate record can be used to understand the degree of change that fragile upland tropical ecosystems of Hawai'i are facing. This novel analysis of combined carbon and oxygen isotope records can be used to accurately reconstruct summer and winter precipitation amounts, as well as maximum and minimum growing season temperatures. Globally, these techniques can be applied to a wide range of tree species in any climate environment in which trees live today. This has important implications for quantifying climate change in remote regions of the world, where records are lacking.

The map below depicts the PICCC geography, which includes Hawai'i, American Sāmoa, Guam, the Northern Mariana Islands, the Marshall Islands, the Federated States of Micronesia, Palau and 4 Marine National Monuments.



Principal Investigators

A. Schubert
Dr. A. Hope Jahren
*Univ. of Hawai'i - Mānoa

*co-funder

The Pacific Islands Climate Change Cooperative (PICCC) was established in 2009 to assist those who manage native species, island ecosystems, and key cultural resources in adapting their management to climate change for the continuing benefit of the people of the Pacific Islands. The PICCC provides a range of services and tools to help managers in Hawai'i, the Mariana Islands, American Sāmoa, and other Pacific Island groups make informed decisions for conservation of natural and cultural resources including climate models at the scale of islands and archipelagos, ecological response models, and implementation and monitoring strategies for island species, resources, and communities. Our goal is to help managers reach explicit biological and cultural conservation objectives in the face of climate change and ongoing threats such as fire, land conversion, and invasive species.

Contact:
Jeff Burgett
PICCC Science Coordinator
jeff.burgett@piccc.net
677 Ala Moana Blvd., Suite 320
Honolulu, HI 96813
Phone: 808-687-6175
Fax: 808-664-8510

Banner photo of taro by Starr Environmental; Slab taken from a dead māmane on Mauna Kea and Brian Schubert dissecting tree rings, by Schubert