Pacific Islands Climate Change Cooperative

PACIFIC ISLANDS CLIMATE CHANGE COOPERATIVE

Predicting future cloud forest movement in response to climate change: up-slope or down-slope?

High mountains in Hawai‘i are warming faster than the rest of the islands due in large part to climate change, and scientists have now modeled what this means for sensitive cloud forests and their species. With support from the Pacific Islands Climate Change Cooperative, researchers have provided insight into the future of Hawaiian cloud forest ecosystems by (1) using detailed information from an array of climate-vegetation monitoring stations on Haleakalā, (2) applying new regional data that indicates how local climate in Hawai‘i will change, and (3) analyzing “paleorecords” to create a timeline of tree line movements on Haleakalā over the past 3,300 years.

The big question for many species is whether cloud forest will move uphill in response to warming, or downhill in response to increasing dryness?

Because ecosystems can respond to cyclical change at time scales too long to study directly, scientists consulted paleorecords (i.e., fossil pollen, charcoal accumulation). The paleorecord revealed that the mountain’s forest line has been dynamic over the last three millennia, migrating upslope at least three times when El Niño events became rare and higher levels of rainfall prevailed.

High risk of climate impacts at high altitudes

Tropical high mountain ecosystems are particularly vulnerable to climate change because of the intensified warming occurring at high elevations. Across the tropics, this warming has driven the freezing point uphill. At high elevations in Hawai‘i, surface temperatures are warming six times faster than at low elevations and 1.6 times faster than the mean global rate. Rainfall is also decreasing at higher altitudes.

Hawai‘i’s high-elevation cloud forest is the last remaining intact habitat for many endangered forest bird species threatened by non-native avian malaria. As temperature increases, malaria will move uphill. These high-elevation closed-canopy forests also absorb and store vast amounts of rainfall, providing immense supplies of water to downstream users, including indigenous and conventional agriculture. The water yield from these ecosystems is becoming increasingly relevant as precipitation declines in arid parts of the islands.

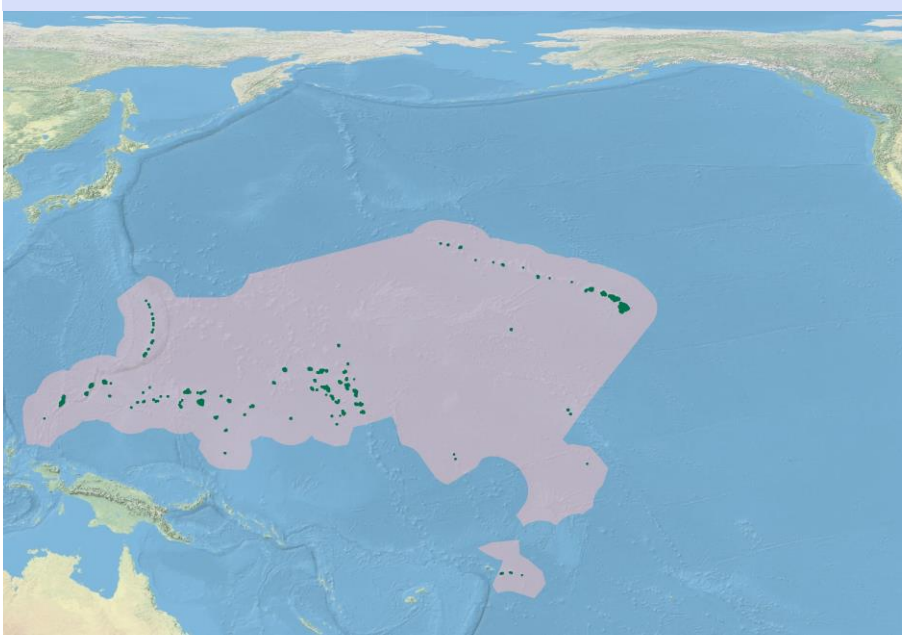
Incorporating climate change into on-the-ground conservation practice

Conservation biologists everywhere are grappling with how to incorporate climate change into conservation practice. This project -- a collaboration of researchers from the University of Wisconsin, the University of Hawaiʻi-Mānoa and University of Colorado-Boulder -- seeks to inform natural resource management decisions at a level of detail that is actionable. For example, should high-elevation forests on Mauna Kea that have been converted to pasture be restored? The study also has yielded additions to the Halenet climate monitoring network and an associated database of climate measures; a model that predicts vegetation in response to climate means and extremes; and a model that relates vegetation patterns over 3,300 years to large-scale climate events in the tropics.

Research results from this study cast doubt on a common expectation that Haleakalā volcano's cloud forest will migrate upslope with rapid warming. The elevation, extent, and composition of the cloud forest responds to both temperature and rainfall, and is apparently sensitive to prolonged periods of drying. Predicting tropical ecosystem response to global change may instead rely heavily upon forecasting large-scale events such as El Niño, as well as rainfall and other climate features that control moisture availability.

For more details about this project, visit the PICCC projects page: piccc.net/our-projects.

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



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Project Partners

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CIRES, Univ. of Colorado - Boulder

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 Hawaiʻi, 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.

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Banner photo of taro by Starr Environmental; cloud forest by Miquel Vieira on Flickr