Climate and Ecosystem Monitoring Network

Timeline

2007-2009

- Large HIPPNET plots established at Pālamanui and Laupāhoehoe
- MAT gradient initiated
- Climate stations installed at six locations

2010-2012

- Smaller HIPPNET plots installed at Māmalahoa and Pu'uwa'awa'a
- Annual re-measures in all existing plots
- All 8 climate stations installed and operational

2013 - Present

- Completed full 5 year re-census in large HIPPNET plots (2013-2014)
- Annual re-measure in all HIPPNET plots (2016)
- Installed Phenocam at Laupāhoehoe
  http://phenocam.sr.unh.edu/webcam/browse/laupahoehoe

Funding sources

- **NSF EPSCoR**
- **USDA Forest Service**
- **University of California—Los Angeles**
- **Center for Tropical Forest Science**

Publications

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For more information, please visit our website at:

www.hippnet.hawaii.edu

HIPPNET HAWAI'I PERMANENT PLOT NETWORK

UCLA

Smithsonian Tropical Research Institute
Center for Tropical Forest Science

EPSCoR HAWAI'I

2017

Climate and Ecosystem Monitoring Network

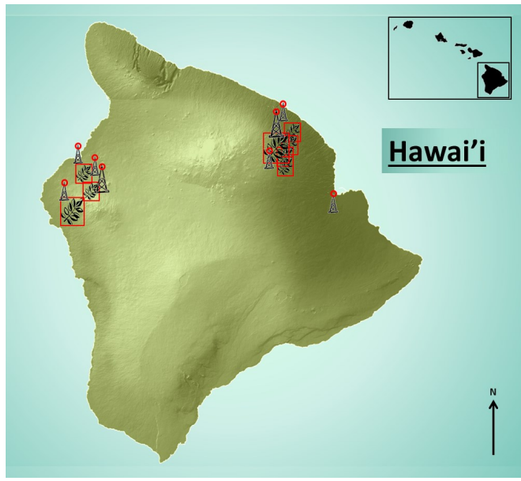
The Hawaii Ecosystem Climate Observatory (HECO)

The HECO network is Hawai'i's long-term climate and ecosystem observatory. Through a collaborative effort by faculty and research ecologists at the University of Hawai'i, USDA Forest Service, and University of California - Los Angeles, HECO is building infrastructure for studying the impact of climate on long-term forest dynamics in Hawaiian ecosystems. A series of permanent forest plots and remote climate stations have been established in native-dominated forests, across Hawai'i Island. As part of the Smithsonian's Center for Tropical Forest Science (CTFS) network of forest plots, the HECO network is involved in a world-wide effort to better understand tropical forests and how they are changing in the face of global change.

EPSCoR

EPSCoR is the National Science Foundation's (NSF) Experimental Program to Stimulate Competitive Research. EPSCoR funding has allowed several separate efforts at long-term ecosystem monitoring in Hawai'i to combine and create a more extensive and effective network.

Currently there are 13 permanent forest plots within the HECO network, and a total of 8 remote climate stations. Hawai'i's sharp elevational gradients and ecosystem diversity provide an excellent natural "laboratory" for investigating forest dynamics and how they are affected by changes in temperature and precipitation.



HECO forest plots and climate station locations on the Island of Hawai'i.

UNIVERSITY OF HAWAI'I

NSF

HETF Hawaii Experimental Tropical Forest

FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

IPIF Institute of Pacific Islands Forestry

Pacific Southwest Research Station

HECO component projects

The Hawai'i Permanent Plot Network (HIPPNET)

HIPPNET was initiated in 2007 to establish several large-scale, permanent plots in native-dominated forest across elevation and precipitation gradients in Hawai'i. Four plots have been established:

- Laupāhoehoe (4 ha) montane wet forest
- Pālamanui (4 ha) lowland dry forest
- Māmalahoa (1 ha) 'ōhi'a dominated dry forest
- Pu'uwa'awa'a (1 ha) montane mesic forest.

The HIPPNET plots are established following widely used protocols developed for tropical and temperate forests by the Center for Tropical Forest Science. Within each plot all free-standing native woody plants ≥1 cm in diameter are tagged, mapped, and measured. Plots vary in density, but the larger plots contain >10,000 trees. Smaller plots are re-cencused annually while the larger plots are partially re-measured annually with full re-measures every 5 years .

The data collected through coordinated projects carried out at the HIPPNET sites will enable the University of Hawai'i and collaborators to become leaders in numerous important areas of ecology and will add substantially to our understanding of forest dynamics in Hawai'i.

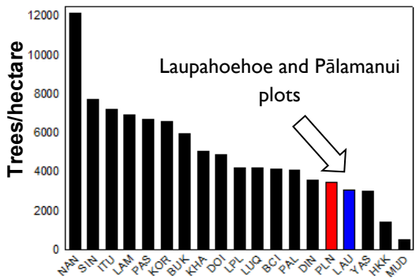
Global comparisons

The preliminary partial measurements of the larger HIPPNET plots give a glimpse of structure and dynamics of Hawaiian forests and how they compare to other tropical forests around the world.

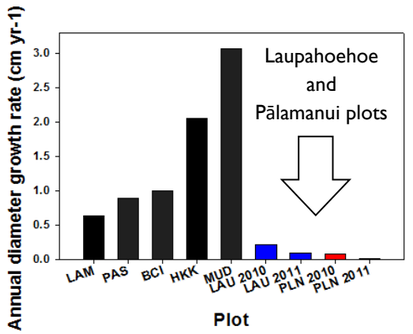
Overall, Hawaiian forests appear to have similar density to other well studied tropical forests, but diversity is very low and so are annual diameter growth rates.

Trees in Hawaiian forests are very slow growing and there are very few species. Mortality rates can be high for some species and recruitment is generally low.

These traits may make forests in Hawai'i particularly susceptible to climate change, invasive species and other disturbance.

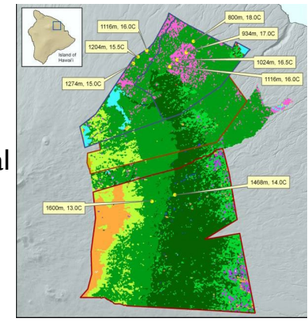


Density of trees in HIPPNET and other CTFS plots



Average annual diameter growth in HIPPNET and other CTFS plots

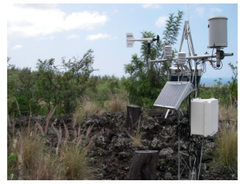
Mean Annual Temperature Gradient (MAT)



The MAT gradient is a series of 9 permanent forest plots established in 2009 on the windward side of Hawai'i Island. The MAT plots are designed to investigate how tropical forest ecosystems will respond to rising temperatures associated with climate change. They span an elevational gradient of 800 m and from the lowest plot to the highest have a mean annual temperature difference of 5.2°C. Among the plots, there is very little variation in the composition of canopy tree species, substrate type or age, history of disturbance, or precipitation, allowing the effects of temperature on forest dynamics and ecosystem processes to be isolated.

Work in the MAT gradient focuses on temperature effects on carbon cycling in tropical wet forests. Terrestrial ecosystems can contain large amounts of carbon stored as biomass, but small changes in basic forest processes have the potential to alter the amount of carbon stored in vegetation or the soil. Carbon that is lost from forest ecosystems enters the atmosphere and can exacerbate climate change. The MAT plots are 20 x 20 m and also follow CTFS protocol. The plots are re-censused annually but measurements of carbon flux (litter fall and soil-surface CO_2 efflux) are made monthly.

Climate stations



There are currently 8 automated remote climate stations in the HECO network. They are located nearby each of the HIPPNET plots and at points along the MAT gradient. Each station is situated to be unobstructed by canopy vegetation and is outfitted with an array of sensors for collecting local climate data. Dataloggers record the information, which is then routinely downloaded via wireless modem. HECO team members are currently working on an automated system to check the data for errors and then upload it to a publicly available webpage. Once completed, this system will not only help researchers pair cimate data with annual measurements from the forest plots, it will also provide a valuable and educational service to community.

Standard variables measured at HECO climate stations

- Temperature
- Relative humidity
- Solar radiation
- Rainfall
- Windspeed and direction
- Soil moisture and temperature

Example from the Laupahoehoe HIPPNET plot of how climate data can be examined relative to the timing and duration of plot re-measures (shaded areas).