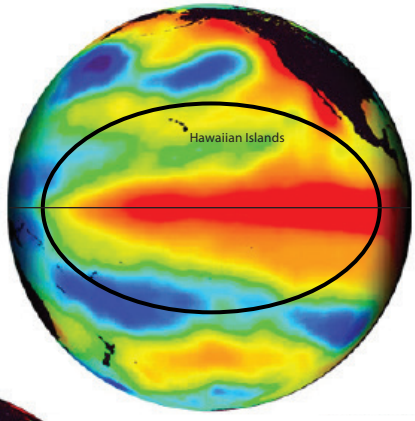
Impacts of El Niño on Climate at Pu‘u Wa‘awa‘a

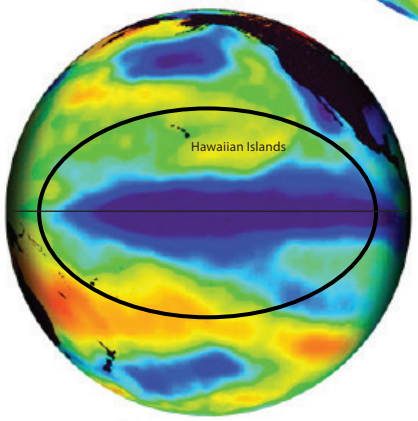
Understanding and anticipating climate variation during El Niño events allows us to protect the area’s resources

El Niño vs. La Niña

The **El Niño-Southern Oscillation** (ENSO) is a naturally recurring feature in the Earth’s climate system that involves a change in sea surface temperatures in the eastern and central tropical Pacific Ocean. This change in temperature is brought on by changes in surface winds that move water from east to west across the Pacific basin. During the **La Niña** (cool) phase of ENSO, strong winds move cool water quickly from east to west across the basin, resulting in cooler water temperatures around Hawai‘i. During the **El Niño** (warm) phase winds are weaker, so the slower moving water has the ability to absorb more heat energy, resulting in warmer sea surface temperatures.

El Niño means **Warmer** than average ocean temperatures along the equator





La Niña means **Cooler** than average ocean temperatures along the equator

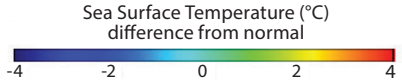


Figure 1 (left): Ocean temperatures during the El Niño and La Niña phases of ENSO. **Credit: Steve Albers, NOAA**

El Niño Weather in Hawai‘i

In Hawai‘i, both rainfall and temperature are strongly influenced by both El Niño and La Niña events. El Niño events are typically associated with less rainfall and warmer temperatures during the traditional wet (winter) season (November to April) while La Niña events are associated with greater rainfall and cooler temperatures during this season. During the dry (summer) season (May to October) these rainfall patterns are reversed: El Niño summers are typically wet, and La Niña summers are typically dry.

Individual El Niño and La Niña events can vary in strength and are often classified as either strong or weak depending on how warm or cool the sea surface temperatures are. Winters in Hawai‘i are almost always drier than normal during a strong El Niño event, while during a weak El Niño we see a range of conditions (dry and wet).

Wet season climate characteristics during the ENSO phases

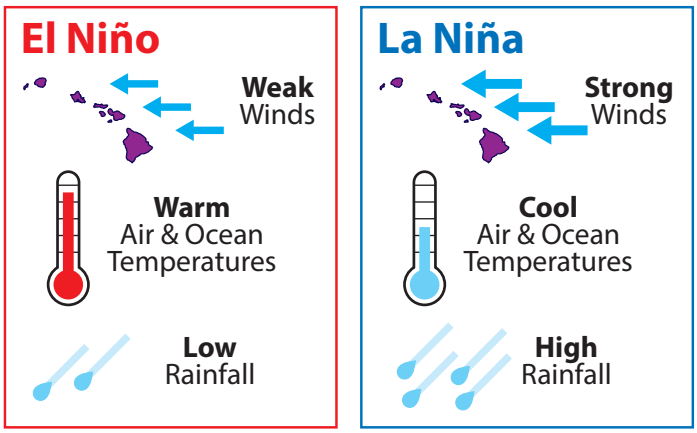


Figure 2 (above): Average wet season (November–April) climate conditions during El Niño and La Niña phases of ENSO.

The Effects of El Niño at Pu'u Wa'awa'a

Average monthly wet season rainfall is about 3 inches per-month at Pu'u Wa'awa'a, but during a Strong El Niño event, it is possible to have less than an inch. During the strong El Niño in January 2010, rainfall was 0.4 inches which was 86% drier than the long-term January average and maximum temperatures were 1.3˚F warmer than normal that month.

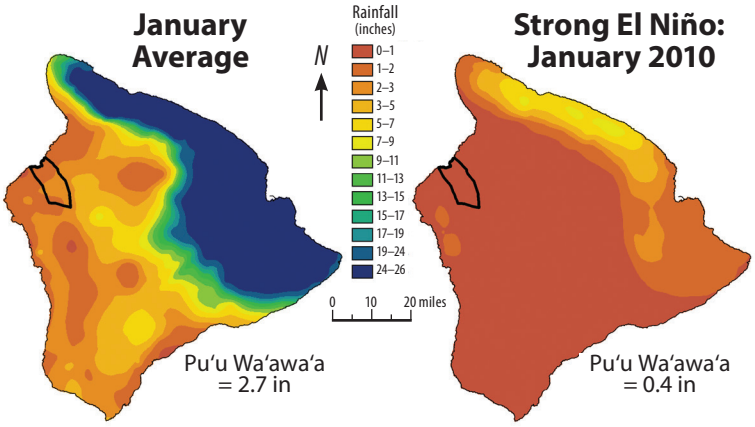


Figure 3: January average rainfall (left)[1] and January 2010 rainfall (right).

Why is This Important?

A Range of Impacts Across the Area

Some of the most intense droughts observed at Pu'u Wa'awa'a have been associated with El Niño events that have occurred during the wet season. These extreme changes in seasonal rainfall can result in a range of direct and indirect impacts on natural resources including reduced survival of native plants (seedlings and adults), invasive plant expansion, and harm to endangered species. In addition, decreases in rainfall accompanied by decreases in relative humidity are conducive to wildland fires (with an ignition source). In late March of 2016, during a strong El Niño, a fire burned approximately 1,800 acres in Pu'u Wa'awa'a. This fire was ignited by lighting and spread during a period of extremely low relative humidity and strong winds. In addition, rainfall leading up to the fire event was extremely low.

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In fact, during a consecutive 3-month period leading up to the fire, total rainfall was 40% less than normal, maximum temperatures were 1.4˚F warmer, and relative humidity was 6% lower. The resulting warm/dry conditions allowed the fire to burn for four days and suppression costs exceed 135 thousand dollars[2]. The primary fuel type was identified as fountain grass which is a non-native and heavily invasive grass that does well in dry-conditions and is difficult to control[3].

Understanding the timing, intensity, and duration of an El Niño event is critical to an effective management response, which can include securing resources (equipment and staff), growing seedlings for restoration, invasive species control, and saving seeds of rare species[4]. The phase of ENSO and the strength of the event can usually be identified several months in advance, therefore, resource managers can make the necessary adjustments in restoration schedules or take the necessary precautions in fire management activities.

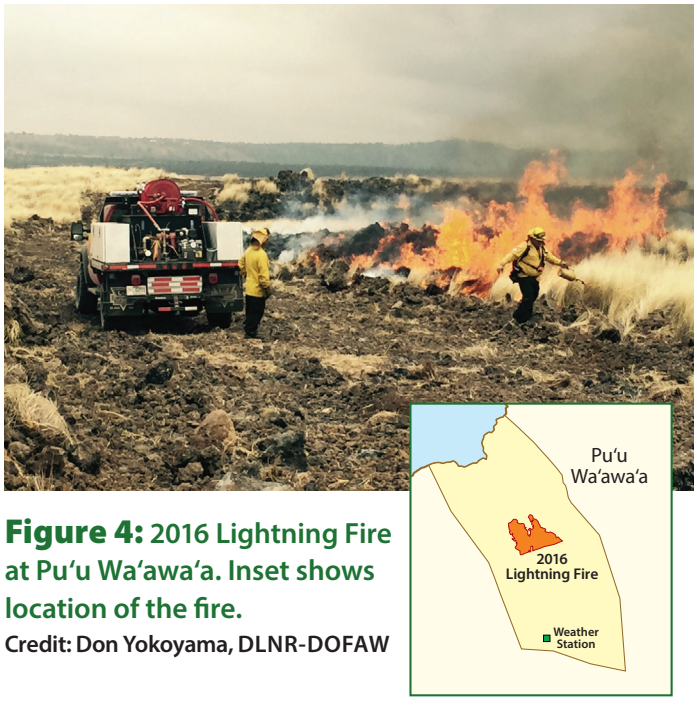

Figure 4: 2016 Lightning Fire at Pu'u Wa'awa'a. Inset shows location of the fire.
Credit: Don Yokoyama, DLNR-DOFAW

[1] Giambelluca et al. (2013) https://doi.org/10.1175/BAMS-D-11-00228.1

[2] DLNR (2016) Fire Report, Puu Waawaa Lightning Fire, HA-16-0003

[3] Wada et al. (2017) https://doi.org/10.2984/71.4.2

[4] Management Plan for the Ahupua'a of Pu'u Wa'awa'a and the Makai Lands of Pu'u Anahulu, https://dlnr.hawaii.gov/forestry/files/2014/06/PuuWaaWaaplanv6.pdf

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