Future Climate Projections
at Hawai'i Volcanoes National Park

The park is expected to become drier and hotter by the end of the century

What is Climate Downscaling?

Future projections of both rainfall and temperature are available for most of the Earth's surface from a wide variety of global climate models. These models use mathematical equations to characterize how energy and matter interact in different parts of the ocean and atmosphere over time. Climate downscaling, is a technique used to translate the global model projections at a finer resolution. A range of future climate projections (that use different downscaling methods) for both rainfall and temperature are available for Hawai'i for two distinct future climate scenarios. These scenarios include: 1) a future in which societies work together to reduce the amount of greenhouse gases (GHGs) in the earth's atmosphere ("Low Emissions" scenario), and 2) a future where no effort is made to reduce GHGs ("High Emissions" scenario).

Understanding how climate is projected to change under different scenarios is critical to an effective management response that incorporates a wide range of adaptation options, for example, ecosystem-based adaptation, ecosystem restoration to avoid degradation and deforestation, biodiversity management, and incorporating local and indigenous knowledge into decision making. Adapting to a changing climate helps to reduce the risks to both natural and managed ecosystems.

Future Climate Change in Hawaii Volcanoes National Park

Future rainfall extremes for both the low and high emissions scenarios for Hawai'i Island are shown in Figure 1. For the low emissions scenario, Hawaii Volcanoes National Park (HAVO) is projected to see a moderate, 7% (-4 inch) decline in average annual rainfall by the end of the century. The driest projections are for the windward (eastern) areas of the park. For the high emissions scenario, HAVO is projected to see a 38% (22 inch) reduction in rainfall. In this scenario, pronounced drying is projected for both windward and leeward (western) areas and most pronounced low elevations (<5000 ft) across the park.

For temperature (Figure 2), accelerated warming is expected under both future scenarios. For the low emissions scenario, end-of-century average temperatures

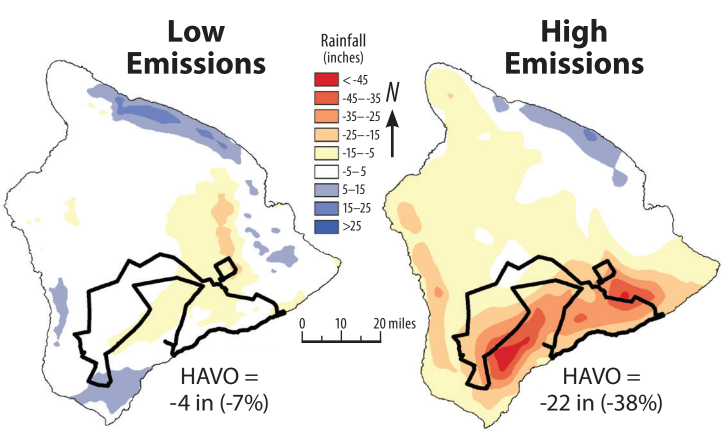

Figure 1: Future projections of rainfall on Hawai'i Island for year 2100, under a low[1] (left) and high[2] (right) emissions scenario.

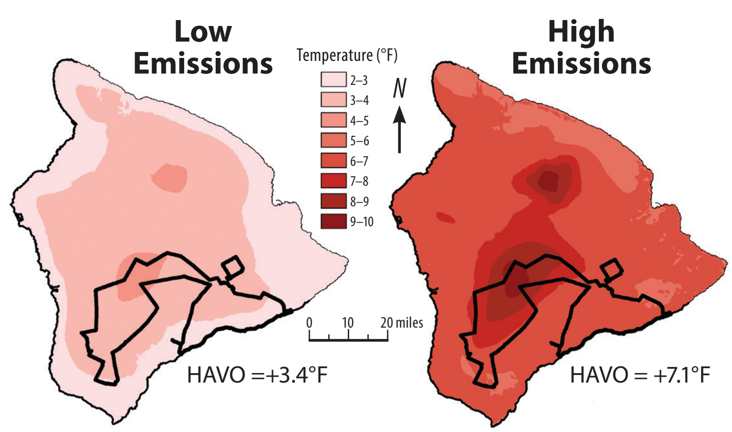

Figure 2: Future projections of temperature on Hawai'i Island for year 2100, under low[2] (left) and high[1] (right) emissions scenarios.

across the park are projected to be 3.4°F warmer than temperature today. For the high emissions scenario, average temperatures across the park are projected to be 7.1°F warmer. For both scenarios the highest warming rates are projected for the highest elevations. For example at the Mauna Loa unit (~10,000 ft), an additional 4.0°F to 8.6°F of warming is projected under the low and high emissions scenarios respectively.

Why is This Important?

A Range of Impacts Across the Park

Future changes in temperature and rainfall will undoubtedly affect the plant and animal species that reside in the park. As the climate becomes warmer and drier a range of impacts are expected including dramatic range shifts of native and non-native species, increased wildfire risk, expansion of disease and increased risk of extinction. It is also important to understand that climate change is not just a future scenario, as many of these impacts are being realized today.

The primary threat to native Hawaiian forest birds is avian malaria, which is transmitted by the bite of non-native mosquitoes. In the past, low temperatures at high elevations created disease free forest refuges. However, environmental warming allows the mosquitoes to move further upslope thus reducing the area of safe habitat and resulting in population declines. Current climate based population models predict approximately 1/3rd of all Hawaiian honeycreepers will lose more than 90% of their current range by 2080[3]. The iconic ʻIʻiwi (Figure 3) now only persists in a narrow band of forest between mosquito range and sparsely forested sub-alpine lava flows of Mauna Loa. In the absence of significant intervention, many native Hawaiian species will suffer major population declines or extinction due to increasing risk from avian malaria during the 21st century[3].

Understanding how climate is projected to change is critical to an effective management response that incorporates a wide range of adaptation options to promote healthy ecosystems. Land managers are working to build climate resilient native ecosystems by excluding invasive species, partnering with researchers to investigate strategies for reducing mosquitoes on a landscape scale, seed banking, and restoring rare plant species across the ecological range. Actions such as these, combined with new innovative approaches and working with our partners beyond park boundaries, will increase the potential that our native plants and animals will persist for future generations.

Figure 3: Picture of the endemic scarlet ʻIʻiwi in Hawaii Volcanoes National Park. At present ʻIʻiwi are restricted to elevations above 5,000 ft where the disease vector mosquito for avian malaria is absent. ʻIʻiwi are present at low densities relative to most species across the park with evidence of declining populations in areas of Kahuku and ʻŌlaʻa[4]. Credit: J. Jeffrey

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[2] Statistical downscaling RCP 8.5; Elison Timm et al. (2015) https://doi-org.eres.library.manoa.hawaii.edu/10.1002/2014JD022059

[3] Fortini et al. (2017) https://doi.org/10.1371/journal.pone.0140389

[4] Judge et al. (2017) https://irma.nps.gov/DataStore/Reference/Profile/2239426

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