

## Regional Climate Trends and Scenarios: Hawai'i and Pacific Islands

This document provides a brief overview of the observed changes in the climate of Hawai'i and the U.S.-affiliated Pacific Islands<sup>1</sup> as well as possible future climate conditions as simulated by climate models, based on two scenarios of future greenhouse gas emissions. It summarizes the detailed findings presented in one of nine regional and national climate descriptions created by the National Oceanic and Atmospheric Administration (NOAA) in support of the National Climate Assessment (NCA). It is also hoped that these findings are of direct benefit to decision makers and communities seeking to develop adaptation plans. The full Regional Climate Trends and Scenarios report is available at <http://scenarios.globalchange.gov/regions/hawaii-and-pacific-islands>, and should be cited as:

Keener, V.W., K. Hamilton, S.K. Izuka, K.E. Kunkel, L.E. Stevens, and L. Sun, 2013: Regional Climate Trends and Scenarios for the U.S. National Climate Assessment. Part 8. Climate of the Pacific Islands, NOAA Technical Report NESDIS 142-8, 44 pp.

### Observed Regional Climate Trends

This section summarizes the observed climate trends of Hawai'i and the Pacific Islands, focusing mainly on temperature and precipitation, as well as other climate features, including heat waves, extreme precipitation, and tropical cyclones.

#### Temperature

- Average annual temperature has generally increased over the past 50 to 90 years throughout the region. In Hawai'i, high elevation stations have been warming faster than low elevation stations over the past 30 years.

#### Precipitation

- Precipitation has trended downward over the past 100 years in Hawai'i. In the western Pacific, stations west of 150°E have become wetter while stations east of 150°E have been trending towards drier conditions.
- Large-scale El Niño-Southern Oscillation variations have substantial effects on interannual variations of rainfall for individual islands.

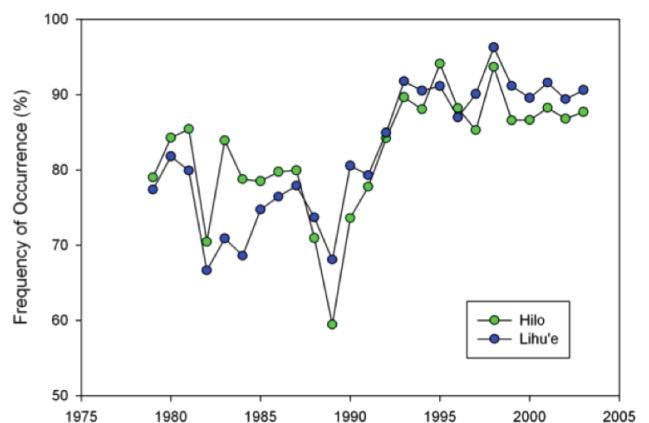
#### Extremes

- Hawai'i has experienced a trend toward increasing drought during the winter rainy season.
- For Hawai'i, there is an overall trend toward fewer extremely high rainfall events. Trends vary for individual islands.

#### Additional Climate Features

- There has been a decline of northeast trade-wind frequency in Hawai'i since 1973, and the frequency of trade-wind inversions in Hawai'i has increased over the past 20 years (see figure).
- The occurrence of tropical cyclones across the Pacific is consistent with findings of decreased activity over the past 20 years, with indications that there is an increase in the proportion of major storms over that same time period.

Annual Trade-Wind Inversion Occurrence over Hilo and Lihu'e, Hawai'i



<sup>1</sup> Hawai'i, Guam, Palau, Federated States of Micronesia (Yap, Chuuk, Pohnpei, Kosrae), Commonwealth of the Northern Mariana Islands, Republic of the Marshall Islands, American Samoa.



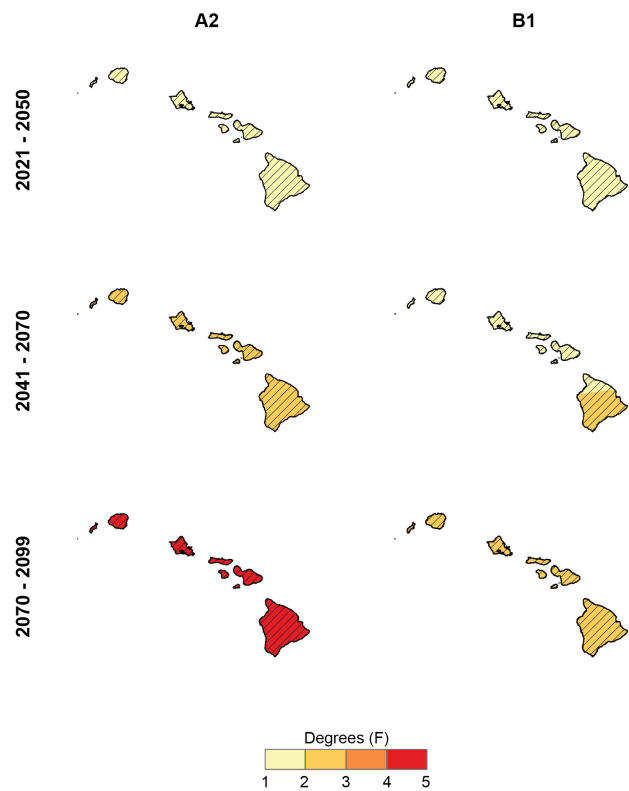
## Future Regional Climate Scenarios

This section describes projected future climate conditions based on climate model simulations using two emissions scenarios generated by the Intergovernmental Panel on Climate Change: the high (A2) scenario, in which emissions of heat-trapping gases continue to rise, and the low (B1) scenario, where emissions peak in the mid-21st century and decline substantially thereafter. These scenarios were chosen because they incorporate much of the range of potential future human impacts on the climate system, and are used in a large body of literature. These simulations incorporate analyses from multiple sources, the core source being Coupled Model Intercomparison Project 3 (CMIP3) simulations.

### Temperature

- CMIP3 simulations indicate a statistically significant increase in annual mean temperature for all three future time periods (see figure at right). Spatial variations are very small.

Simulated Change in Annual Mean Temperature



### Precipitation

- Changes in CMIP3 simulated precipitation are mixed. For Hawai'i, decreases in precipitation are simulated for the northern islands under the B1 scenario and during the early period under the A2 scenario. Increases are simulated for the southern islands under the A2 scenario. However, none of the changes are statistically significant.
- Preliminary CMIP5 projections show considerable variability on interannual to interdecadal timescales for both the Western Pacific and Hawaiian regions. However, a clear tendency for increased wet season rainfall in the West Pacific is apparent as the climate warms (see figure below).

### Additional Climate Features

- Most models simulate a weakening of the east-west sea surface temperature gradient along the equator and an associated weakening of the wind patterns, which has been characterized as a shift to more El Niño-like conditions.

Mean Wet Season (June-September) Rainfall  
for the Tropical Western Pacific  
(GFDL CM3 Model, RCP8.5 Simulation)

