

Hawaii's Climate

THE COCORAH'S 'STATE CLIMATES' SERIES

Hawaii's Climate

By Pao-Shin Chu and Ying R. Chen, Hawaii State Climate Office and Univ. of Hawaii

Hawaii is noted for its equable temperatures and abundant sunshine with low day-to-day and month-to-month variability. However, the complex, mountainous topography makes it one of the most spatially diverse on Earth. The summit of Mt. Waialeale on Kauai is known as the world's wettest spot with annual rainfall of 450 inches per year, while the leeward coast area of Kauai receives less than 30 inches per year. Similarly, the average annual rainfall on the Waikiki beach of Oahu is 20 inches, and 160 inches of rain fall each year at the summit of Tantalus, just 4 miles from Waikiki.

Hawaii is located in the descending branch of Hadley circulation, which inhibits the formation of deep clouds. Therefore trade wind orographic lifting and thermally-forced diurnal circulations play major roles in generating rainfall. In addition, synoptic systems such as mid-latitude fronts, Kona storms, upper level disturbances, and tropical cyclones may enhance the orographic rainfall.

With a steady northeasterly trade winds, the maximum rainfall centers are located at lower elevations (approximately 2000 to 4000 feet) along the windward slope of high mountains such Mauna Kea on the Island of Hawaii and Mt. Haleakela on Maui. Thermally-forced diurnal circulations, such as land-sea breezes and mountain-valley winds, enhance orographic vertical motions. These in turn induce low-level convergence with the trade winds and produce precipitation in these regions. This accounts for the intense precipitation at lower elevations of the windward slope of high mountains. Hilo is one of the wettest cities in the U.S. On the other hand, the leeward sides of the islands are generally dry (rain-shadow effect). At higher elevations (e.g., Mauna Kea) the trade inversion acts as a lid to vertical motion and convection, inhibiting precipitation development there and resulting in arid climate. A secondary-maximum rainfall center is found in the southeastern flank of Mauna Loa. Synoptic disturbances induce southeasterly winds in this region in the wet season, which in turn lead to intense precipitation. For mountains with moderate heights, such as the West Maui Mountains, the Koolau Range of Oahu, and Mt. Waialeale on Kauai, maximum rainfall centers are found near the summit. The heights of these mountains are below the trade-wind inversion, which usually occurs at 2,000 m. On the Kona coast area of the Island of Hawaii, a unique summer maximum rainfall pattern exists. Here the trade wind is blocked by the high mountains, so rainfall is related to thermally-forced diurnal circulations. Surface heating causes an upslope sea breeze during the daytime, which gives rise to convective rainfall in the afternoon. In summer, increased surface heating intensifies this thermal process with a summer maximum in this area.

In Hawaii, CoCoRaHS began in 2009 and has 20 stations; however, some of these stations are located in areas with limited NCDC Cooperative stations and NWS Hydronet stations. This addition may help to improve the stations' coverage.

For more information on Hawaii's Climate please visit the Hawaii State Climate Office website at: <http://lumahai.soest.hawaii.edu/Hsco/>