

Diurnal Variations of Island-Scale Weather Over Oahu

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In this study, the diurnal variations of precipitation and surface winds under different wind conditions during summer months are analyzed from 60 hourly rainfall stations and 13 wind stations over the island of Oahu. Four wind categories (strong ENE trade winds, normal ENE trade winds, weak ENE trade winds, and variable winds) are used to determine the influence of synoptic winds on island-scale weather, as well as improve the understanding on the relationship between wind and rainfall.

Most stations east of the Waianae mountain range have an early morning rainfall frequency maximum with an afternoon minimum under the prevailing trade-wind flow. In the early morning hours, the temperature of the land is cooler than the ocean. The trade-wind flow over the ocean decelerates as it approaches the more stable air over the land, and this convergence enhances cloud development.

Under weak ENE trade-wind conditions, an afternoon rainfall maximum occurs in the Waianae region as sea breezes develop along the lee-side coast. In the absence of trade winds, Central Oahu shows an afternoon rainfall maximum. This afternoon maximum is due to the sea breeze convergence in Central Oahu.

The correlation between daily wind and daily rainfall total is the greatest ($R = 0.3$ to 0.4) over the mountain peaks, and insignificant along most coastal areas. Under strong ENE trade-wind conditions, high daily rainfall frequency extends from the windward slopes of the Koolau mountain range farther to the west as compared with weak trade-wind conditions. It is apparent that drifting of orographic trade-wind showers to the lee side of the Koolau mountain range is more frequent when trade winds are stronger.