

Climate Change Research in Support of Hawaiian Ecosystem Management: An Integrated Approach

Principal Investigator: Oliver Elison Timm, Department of Meteorology, International Pacific Research Center, University of Hawai'i-Mānoa, now at the Department of Atmospheric and Environmental Sciences, University at Albany, Albany, NY

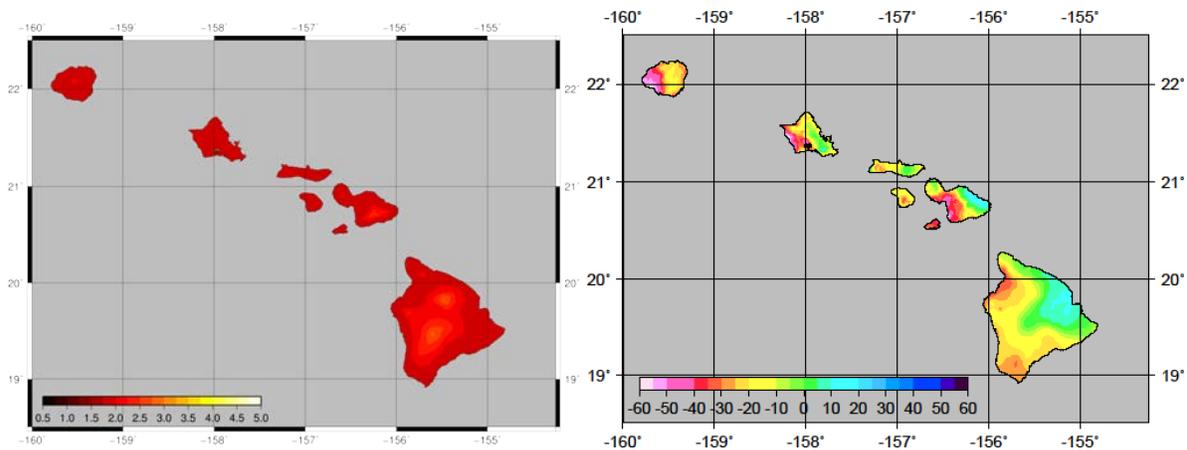


Topographical precipitation patterns create climatically wet (left) and dry (right) sides of islands in the Hawaiian archipelago, which are greatly affected by wet and dry seasonal differences in rainfall as well. *Left:* 'Akaka Falls State Park, Hawai'i Island; *Right:* Mo'omomi, Moloka'i

In the expectation that global climate will change steadily in the coming decades, this research project had the goal to obtain a more detailed view of the climatic changes that Hawai'i could experience by mid- and late-21st century. Given the importance of rainfall for Hawaiian ecosystems and freshwater reserves, the project team investigated past seasonal rainfall patterns and developed a statistical model to estimate future rainfall changes for the major islands. This empirical-statistical method relies on 900+ stations with more than 30 years of rainfall observations.

The team analyzed two different climate change scenarios for mid- to late-21st century. In general, the wet regions of the islands (windward sides) are expected to either receive higher precipitation or remain the same in both seasons in the future. On the drier, or leeward, sides of the larger islands, trends reflect drier conditions arising with climate change. Overall, the wet and dry regions are expected to exhibit even greater differences in rainfall.

New maps (next page) provide researchers with scenarios they can use as input in decision-support tools to study potential impacts on endangered species, such as forest birds. In a collaborative project, researchers modeled how changes in temperature and rainfall could affect the spread of avian malaria and interactions with endemic bird populations on the Island of Hawai'i.



Change in temperature (left) and rainfall (right) RCP 8.5 scenario maps for the wet season in the mid-21st century, main Hawaiian Islands. Map scales show temperature in Celsius and rainfall in percent relative to present-day values.

In order to better understand how climate change can potentially affect heavy rainfall events, the research team investigated in detail the role of Kona Lows in Hawai‘i. Kona Lows refer to storms that occur between the months of October and April. They usually form in connection with extratropical storms or fronts north of the Hawaiian Islands. When Kona Lows occur, the westerly, leeward coasts—where dry weather dominates the climate—receive much needed precipitation, albeit oftentimes the heavy downpours lead to flashfloods for the area.

This effort allowed for a first-time quantitative study of the contribution of Kona Lows at various rain gauge stations. As a result of this work, a 34-year database with occurrences of Kona Lows was created. These results indicate that our current understanding of future rainfall changes can be improved through the study of rain-generating weather systems, like the Kona Lows. According to the current global climate change scenarios, extratropical storm systems are likely to take a more northerly path in the future. How this will affect the local Kona Low systems is subject to further investigation.

Many climatic changes are expected to be related to extreme events such as long-lasting high temperatures, severe droughts, and high intensity and frequency of heavy rain storms. The research team developed statistical relations between seasonal rainfall amounts and wet and dry-spells. This information helps researchers and analysts to interpret the average rainfall changes with regard to the expected changes in extremes.

This project was supported by the Department of the Interior Pacific Islands Climate Science Center (Cooperative Agreement #G12AC20502 from the US Geological Survey). For more information about this research, please contact Dr. Oliver Elison Timm (uelisontimm@albany.edu). To learn more about climate science at the PICSC, contact Dr. David Helweg at dhelweg@usgs.gov or visit our website: doi.gov/csc/pacific



Image credits: Starr 050519-1786 *Heliotropium anomalum* var. *argenteum*" by Forest & Kim Starr. Licensed under CC BY 3.0 via Commons - https://commons.wikimedia.org/wiki/File:Starr_050519-1786_Heliotropium_anomalum_var_argenteum.jpg#/media/