



Hawaii's Diverse Rainfall Patterns



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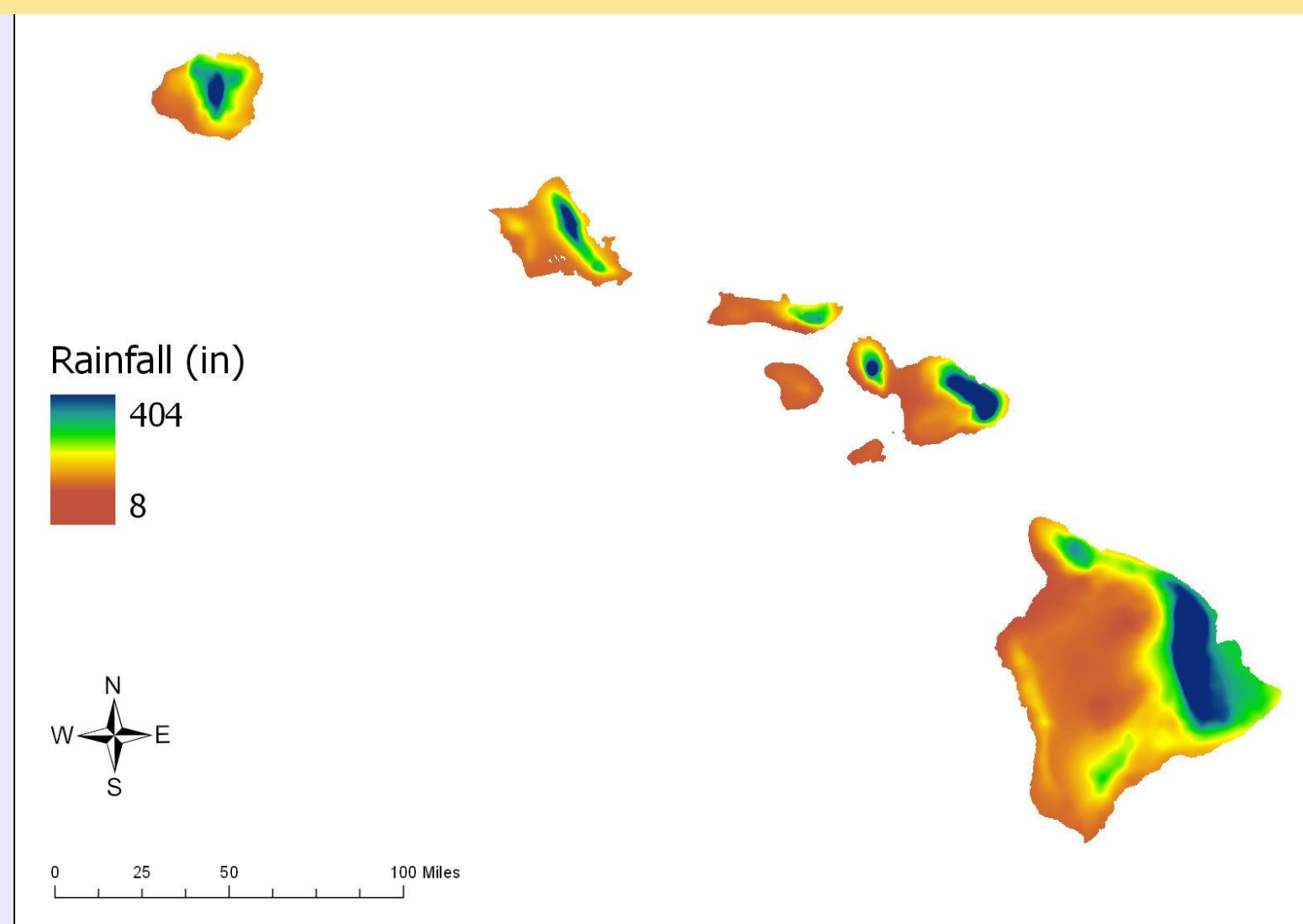
Problem Statement

Over the Hawaiian Islands, the interactions between the mountains and trade winds lead to dramatic differences in rainfall over short distances. Comprehension of Hawaii's distinct rainfall patterns is essential for outdoor activity planning, agricultural production, freshwater management, and climate change adaptation.

Research Questions

How are average annual rainfall amounts spatially distributed across Hawaii census blocks? Do most Hawaiian residents live in dry, moderate, or wet climates?

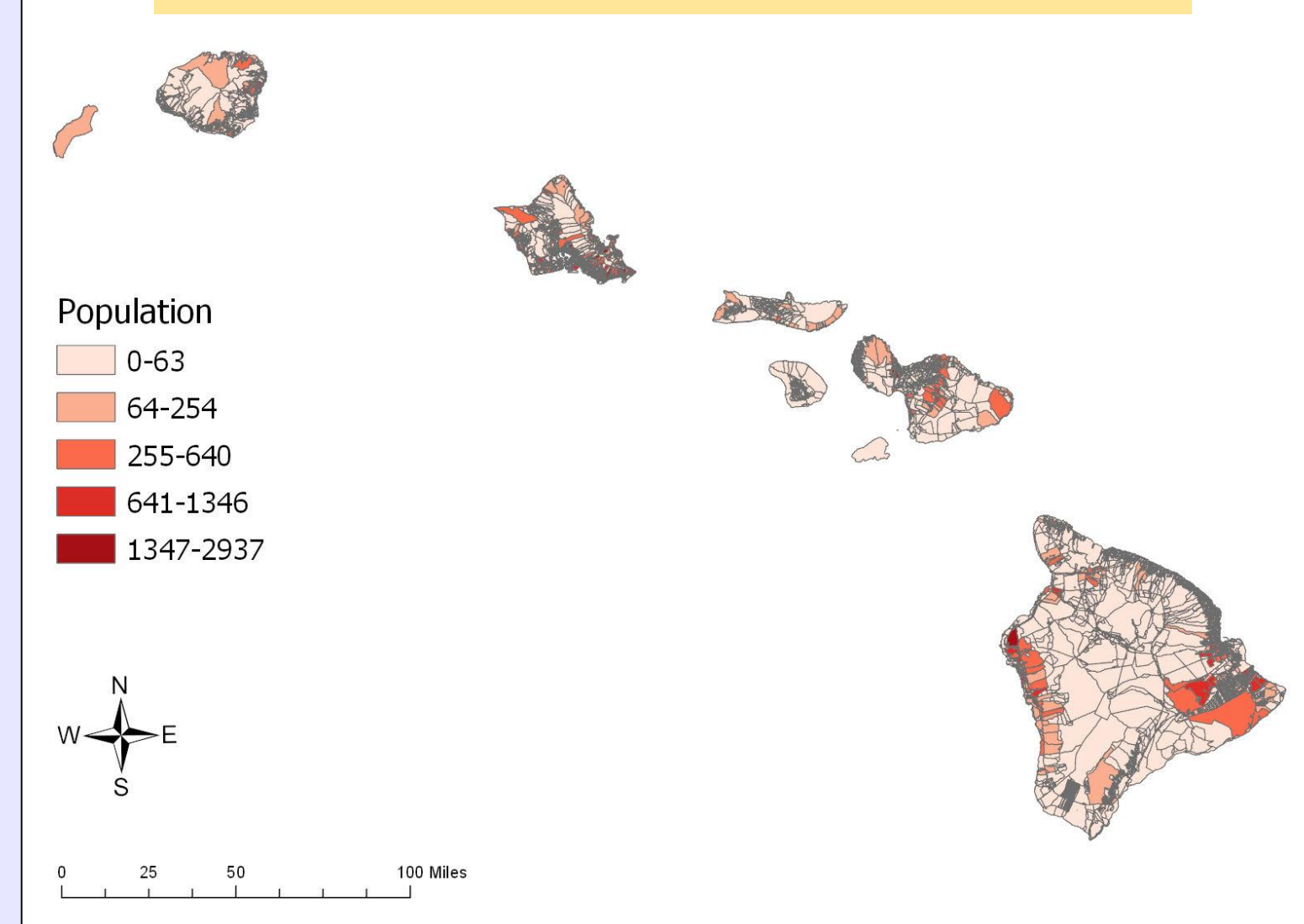
Raster Data – Mean Annual Rainfall (1978-2007)



Northeast trade winds and orographic lifting lead to high rainfall (blue/green) on the windward side. Sinking air and dissipating clouds lead to low rainfall (red/orange) on the leeward side.

Source: University of Hawai'i at Mānoa, Geography Department, ESRI Rainfall Grid (2011)

Polygon Data – Census Blocks (2010)



Collectively, census blocks with high population (darker reds) appear to cover less area than do census blocks with low population (lighter reds).

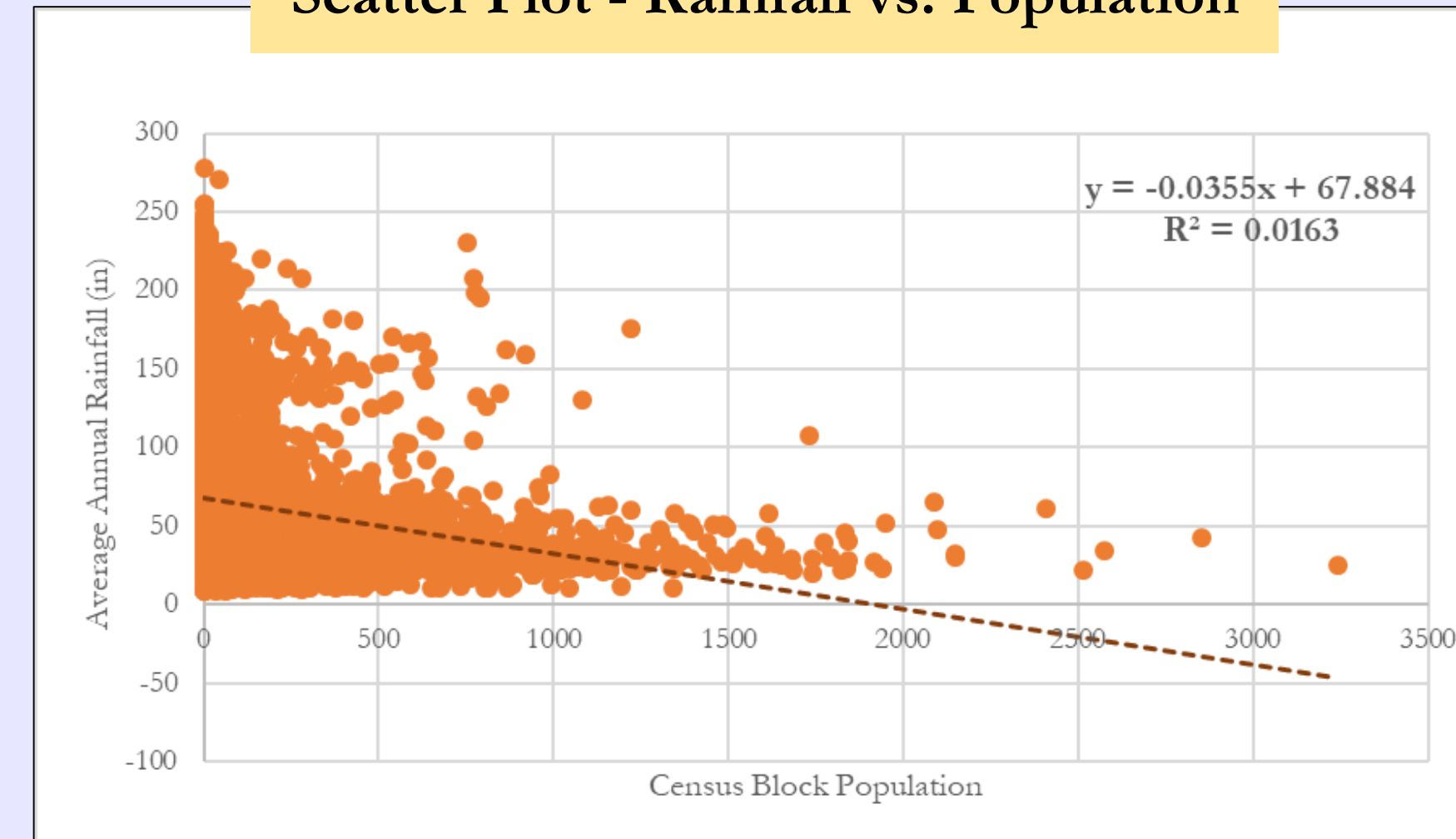
Source: State of Hawaii Office of Planning, 2010 Census Blocks (February, 2011).

Methods

- 1) Computed average rainfall values within census blocks using **zonal statistics** tool
- 2) Performed **table join** to census blocks shapefile and **copied rows** to CSV file
- 3) Used Excel **QUARTILE** and **SUMIFS** functions for scatter plot and bar chart
- 4) **Overlaid** rainfall layer with semi-transparent population layer for bivariate map

Results

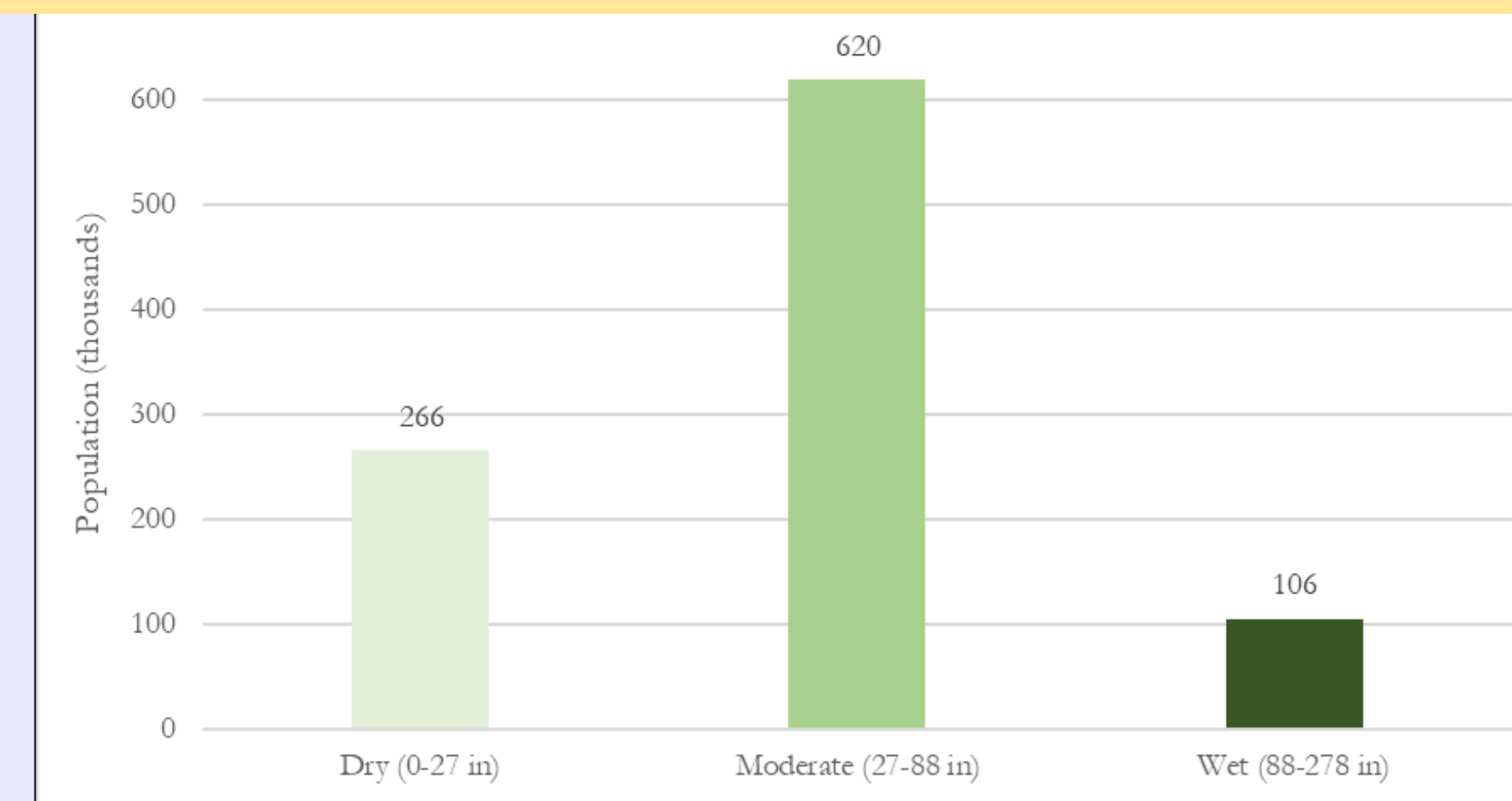
Scatter Plot - Rainfall vs. Population



As census block population increases, average annual rainfall decreases. Hawaiians living in more populated blocks, likely part of cities, stay relatively dry. Most Hawaiians live in less populated blocks, which greatly vary in rainfall values. The R^2 value of **0.0163** indicates a weak linear relationship.

Three rainfall categories—dry, moderate, and wet—are defined based on the minimum (0 in), first quartile (27 in), third quartile (88 in), and maximum (278 in) values. In terms of annual rainfall, **620,000** Hawaiians live in moderate climates, **266,000** live in dry climates, and **106,000** live in wet climates. The majority of Hawaiians residents experience moderate climates. More residents experience dry climates, compared with wet climates.

Bar Chart – Total Population for Each Rainfall Category



The combination of large block areas and low population suggests that much of the interior of the Island of Hawaii, which is dominated by volcanoes and forests, is sparsely populated. In the east, blocks tend to have both high population and rainfall. Along the west coast, the more populated blocks tend to have moderate rainfall. Few blocks with high population and low rainfall appear in the bivariate map. Therefore, low rainfall blocks with less population may be significantly contributing to the total population. Increasing the scale of the map to focus on specific regions of the island may lead to different conclusions. Due to climate change, these results may not hold for more recent or coming years.

Bivariate Map – Rainfall vs. Population (Island of Hawaii)

