Detailed Project Description: Get SARtsy

Motivation

“Get SARtsy” explored vegetation change of Santa Catalina Island, a small island off the coast of Southern California. It is home to about 4,000 across its two towns, Avalon, and Two Harbors (data from 2010 census), although easily 200 times that amount visit the quaint towns yearly via cruise ships or weekend get aways. The majority of the land on Catalina Island is protected by the Catalina Island Conservancy, uniquely locking the towns' borders to a fixed size. Isolated, the island must ship in all its resources from the mainland. Because of its unique geographical and geopolitical situation, the island's fresh water only has one source: rain.

The historic droughts of Southern California wreaked havoc on the islanders (my then 90-year-old grandmother was taking sponge baths in the kitchen sink). Residents got strict monthly allowances of daily water usage, likely to offset the lack of conservation efforts of ever-increasing tourism. As climate change worsens weather patterns, the residents of Catalina Island live in the constant fear of an imminent water shortage, and with the geographic isolation, this will have dire consequences on not only the residents and their livelihood, but also on conservation efforts of the island's delicate (and untraditional *(iykyk)*) ecosystem.

The goal of my participation in this hackathon was to learn more about working with geospatial data. This came to fruition in a 4-step process:

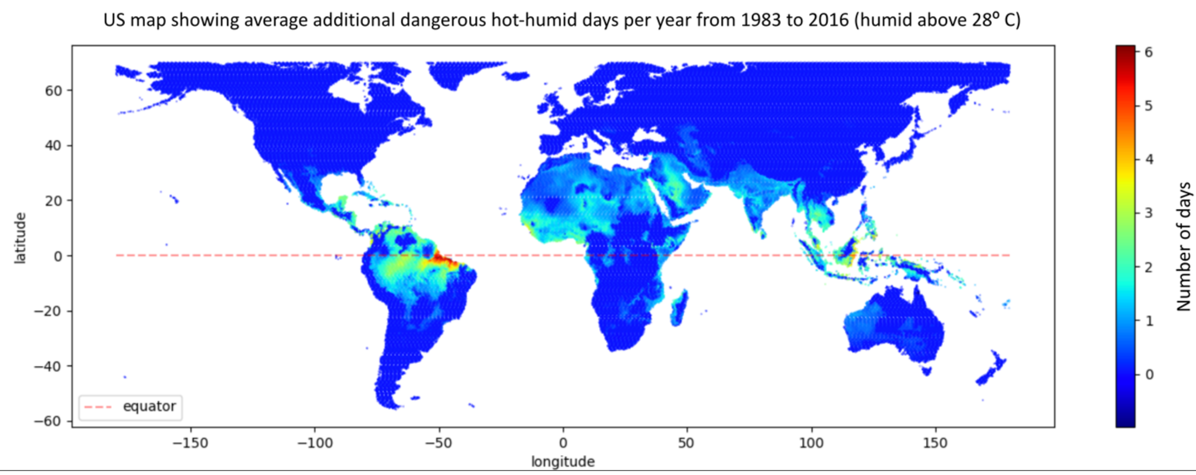
1. Plotting global map of data related to dangerous hot-humid levels.
2. Exploring SAR data of Catalina Island and comparing that to temperature data on the island.
    a. This is where I learned that the data didn’t separate just higher temperatures, but dangerously high humid-heat combinations. Catalina struggles with droughts. Humidity was zero.
3. Attempted to find other NASA affiliated open-source data that had temperature or rainfall data of Catalina Island.
    a. Ruin my computer’s hard drive space and memory in the process.
4. Inspect the vegetation change of Catalina Island between 2009 and 2022.

Plotting Global Map Data

Source:

- Socioeconomic Data and Applications Center (SEDAC).
    - [Annual Global High-Resolution Extreme Heat Estimates (GEHE), v1 (1983-2016)]
    - Tuholske, C., K. Caylor, C. Funk, A. Verdin, S. Sweeney, K. Grace, P. Peterson, and T. Evans. 2021. Global urban population exposure to extreme heat. *Proceedings of the National Academy of Sciences*, 118(41), e2024792118. https://doi.org/10.1073/pnas.2024792118.

The data set was explored using a python 3 jupyter notebook. The majority of my code wrangles the massive data sets into a workable format. There were 34 geotiff data files in total that were converted into .xyz files via python, then into workable panda data frames. A large world map uses a color scale bar to indicate which areas see the highest rate of increasing dangerous humid-heat threshold days per year; areas nearest the equator are understandably at the highest risk.



Given that Catalina Island is where a majority of my family is from/resides and is ecologically sensitive, I narrowed the data set into Catalina's coordinates to explore that temperature data.

Exploring SAR data of Catalina Island

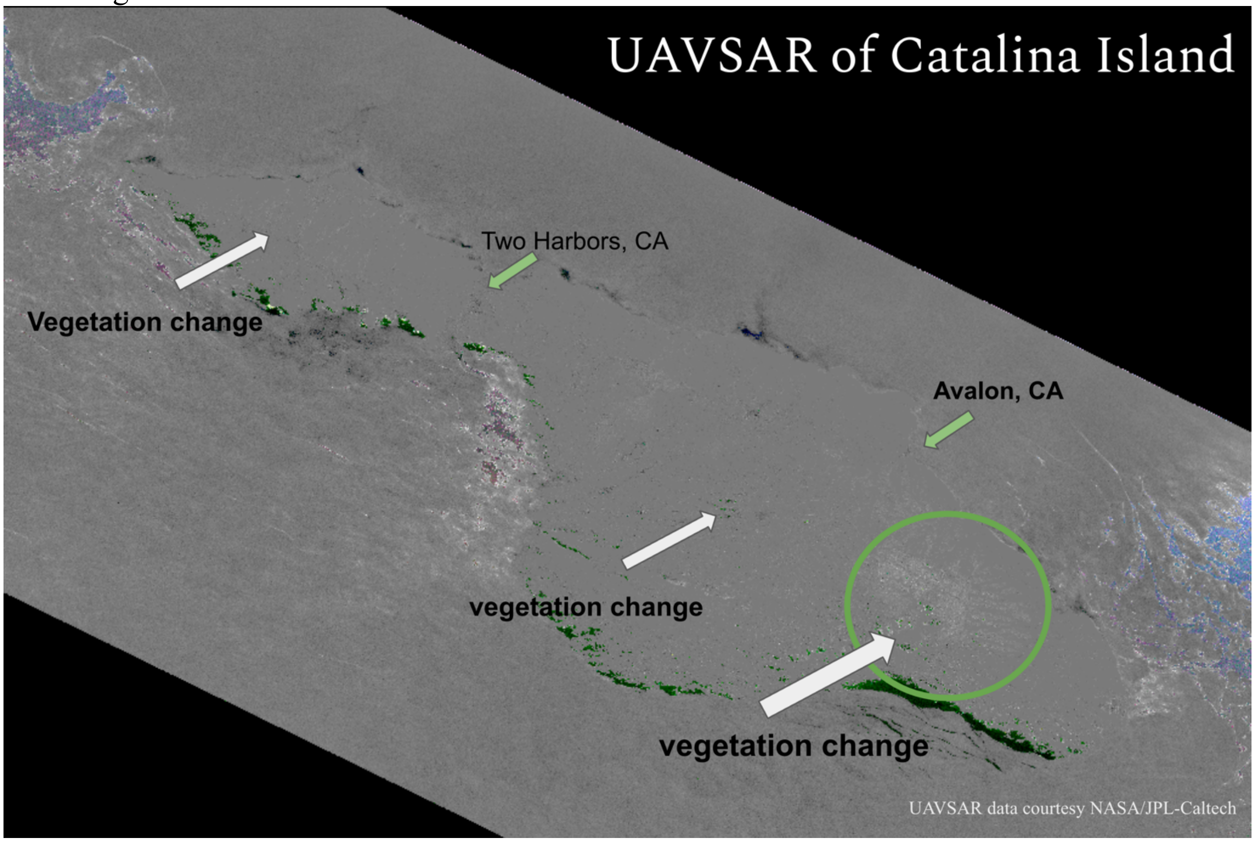
Sources:

- Catalina SAR 2009, Catalina SAR 2022 from JPL UAVSAR.
    - UAVSAR data courtesy NASA/JPL-Caltech
- QGIS.org (2023). QGIS Geographic Information System. Open-Source Geospatial Foundation Project. http://qgis.org

JPL UAVSAR data base has two data entries of the Channel Islands, mostly covering Catalina Island.

My initial goal was to use the SAR data to show Catalina's vegetation change paired with a nonlinear regression using Catalina's temperature data to predict future temperature trends. I then realized the SEDAC data took dangerous humidity levels into account and did not properly reflect what I was testing for. I attempted to find a NASA open-source dataset that recorded general heat temperatures and/or average rainfall. I learned why SQL is so important in working with geospatial data. These files are MASSIVE and my computer is *old*. Alas, I had to cut my losses as my main goal here was to learn how to work with SAR data.

And work with SAR data I did! Using QGIS I used the rasterization calculator to compute the logarithmic difference between each band (red/1, blue/2, and green/3) of 2022 to 2009 to highlight any changes from 2009. Multiple bands showed a scattered but light bright area in the center of the southwest part of the island, indicating that this area had a brighter backscattering intensity in 2022 than 2009. Well hydrated soil registers as brighter area compared to flooded plains as well as dry soil. This suggests that the bright areas on the SAR image are a result of moist vegetation.



Conclusions

1. A large amount of area of planet Earth (centered around the equator) can reasonably expect an increase in dangerous humid-heat threshold days every year, at a rate of 1 to 6 additional days a year for each year when comparing to the year previous.
2. Catalina Island has seen some recovering vegetation since 2009, with some smaller, more numerous pockets of worsened vegetation. More data needs to be collected before any conclusive explanations can be reasonably made.