The CliMappers

Empowering Communities with Personalized Climate Insights

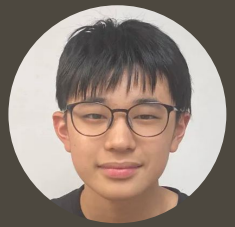
Banri (G12)

Semi-pro visual designer & dancer

Bird watcher/citizen scientist

Yuma (G11)

Studies an intersection of climatology, drought & geography in WA



Hiroki (G10)

Soccer and Kendo player

Dedicated volunteer for local farms

Shun (G11)

Soccer & baseball player

Semi-pro baseball stats analyst

Hanna (G9)

Tennis player

Studies piano at a local conservatory

Shun (G9)

Soccer player

Top 8 in '24 Youth World Cup

Community Mapping Challenge
October, 2024

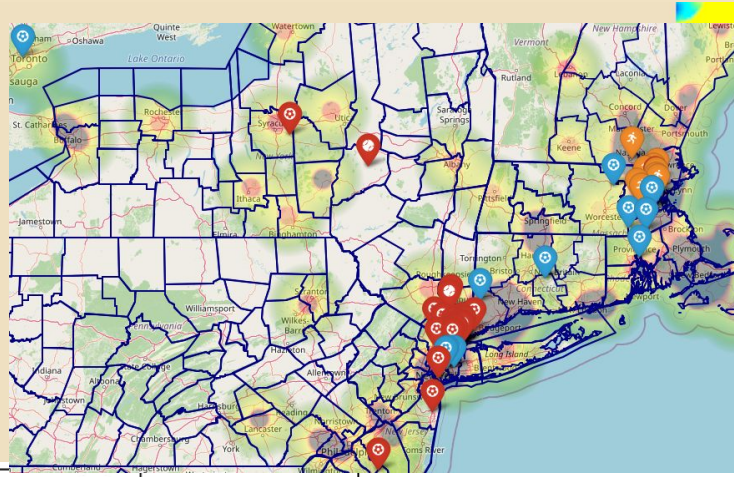
Boston, MA, Rye, NY, and Seattle, WA

https://github.com/HSSBoston/climappers

NASA INTERNATIONAL SPACE APPS CHALLENGE™

Mapping Heat Risk for Outdoor Athletes

- Heat stroke: #1 risk in summer
  - Increasing death and ER visit rates
- Wet Bulb Globe Temp (WBGT)
  - Indicates the heat stress on the body in direct sunlight
    - Takes into account temp, humidity, solar heat & wind speed.
  - Recommended as a risk indicator of heat stroke by pro/HS communities
  - Common heat policy w/ 5 alert levels
- WBGT-based heat risk map
  - Uses NASA's and NOAA's data.
  - Indicates alert levels with different colors.

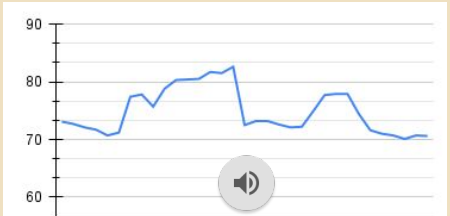


ALERT LEVEL	WBGT BY REGION (°F)			EVENT CONDITIONS	RECOMMENDED WORK TO REST RATIOS (ACTIONS & BREAKS)
	CAT 1	CAT 2	CAT 3		
BLACK	>86.2°	>89.8°	>92.0°	Extreme Conditions	No Outdoor Training, delay training until coo or Cancel Training.
RED	84.2-86.1°	87.8-89.7°	90.1-91.9°	High Risk for Heat Related Illness	Maximum of 1 hour of training with 4 by 4 minute breaks within the hour. No additiona conditioning allowed.
ORANGE	81.1-84.1°	84.7-87.7°	87.1-90.0°	Moderate Risk for Heat Related Illness	Maximum of 2 hours of training with 4 by 4 minute breaks each hour, OR a 10 minute br every 30 minutes of training.
YELLOW	76.3-81.0°	79.9-84.6°	82.2-87.0°	Less than Ideal Conditions	3 Separate 4 minute breaks each hour, OR a minute break every 40 minutes of training
GREEN	<76.1°	<79.8°	<82.1°	Good Conditions	Normal Activities. 3 Separate 3 minute brea each hour of training, OR a 10 minute break every 40 minutes

Estimating Heat Risk & Translating a Map to Sound

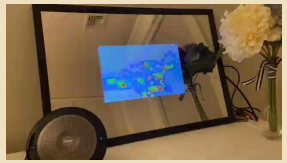
- WBGT thermometers are expensive.
  - Not commonly used in HS (>$350 ea.).
- Many math models exist to estimate WBGT from common weather params.
- Tried a different estimation approach:
  - ML-based classification of common weather params to an alert level
  - Decision tree and random forest algorithms
    - w/ hourly temp, humidity (%), cloud cover (%), precip (in/hr) and wind speed (kts) data.
  - 89% (DT) & 94% (RF) accuracy

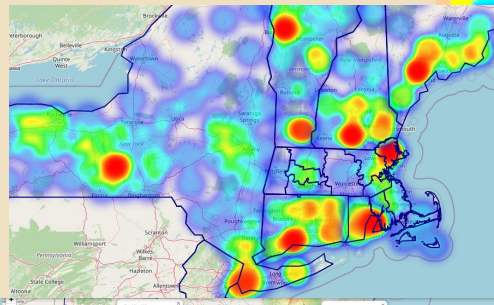
- Made a heat risk map audible.
  - Translated daily WBGT changes at the current location to an audio clip.
    - WBGT values as musical notes.
    - Value changes as musical pitch changes.
    - Risky conditions with a chord.
  - Easier to understand than visual.
    - Can recognize the current trend; e.g., going up or down, staying at a peak, etc.



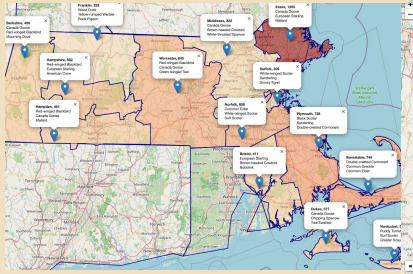
Mapping and IoT Dev for Bird Conservation

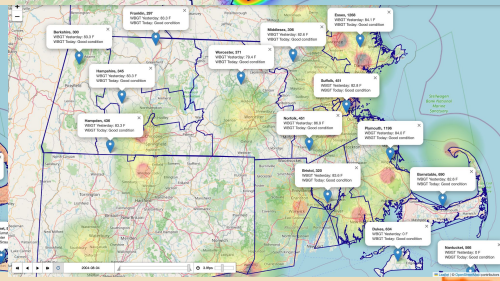
- Climate change affects the lives and migration patterns of birds.
  - Built a smart mirror of 3 maps and a portable bird monitoring system to help the bird conservation community
    - Used Cornell's eBird API and NASA's POWER API.



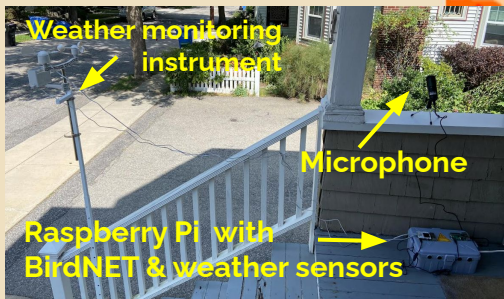


- Bird Heat Map
  - Overviews where birds are spotted.
- Choropleth Map
  - Helps explore observations in each county.



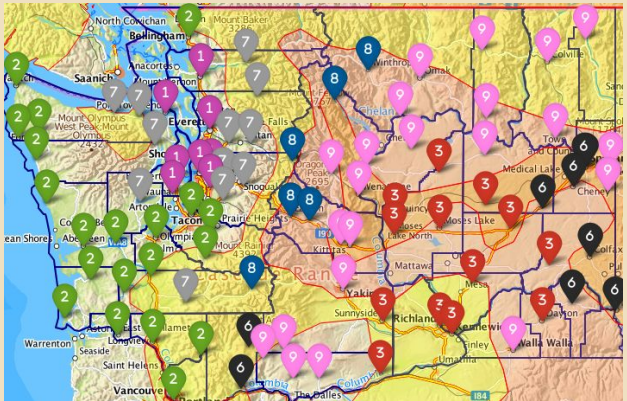


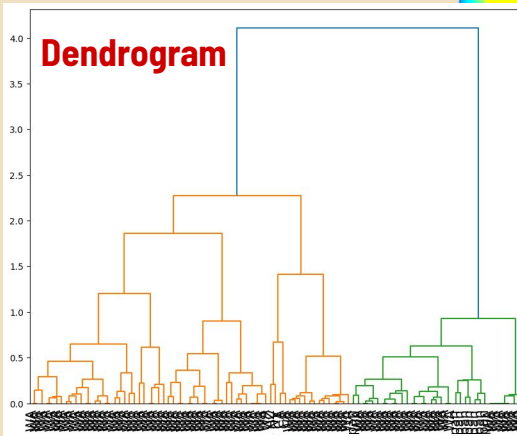
- WBGT-based Heat Risk Map
  - Highlights regions where birds are at risk of heat stroke in summer.
- Bird Activity and Environment Monitoring System
  - Detects and identifies birds based on their songs.

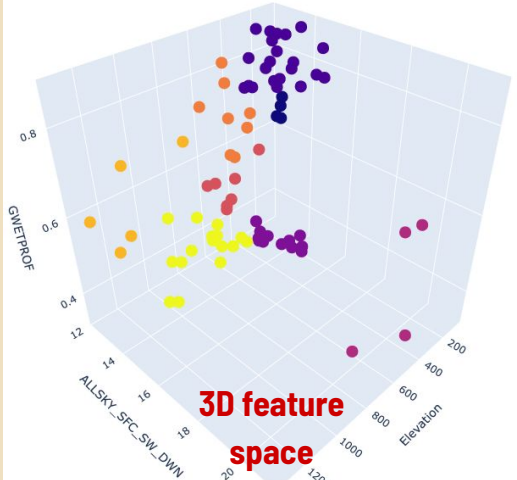


Analyzing Climates in WA

- Northern state, but faces drought every year.
- Decided to analyze climates in WA by clustering cities
  - Based on 3 features: irradiance, soil wetness & elevation
  - With 10-yr (2014-2023) data from NASA POWER API
- Chose 9 clusters with a dendrogram from bottom-up clustering
- Analyzed those cities in a 3D feature space
- Mapped
  - Cluster distribution
  - Drought severity levels from the US/Canada Drought Monitors
  - Köppen climate classification



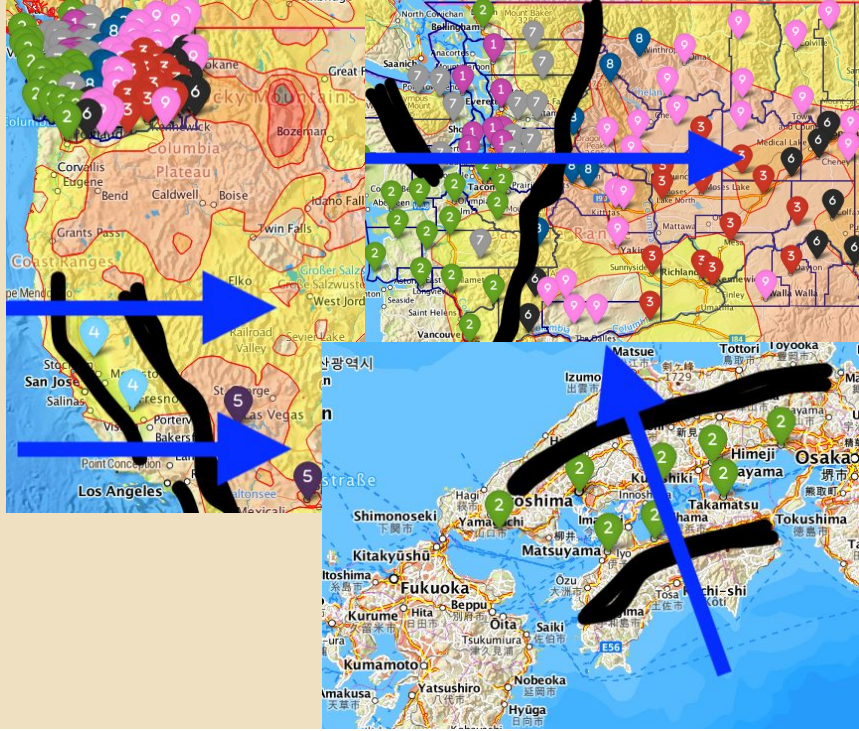


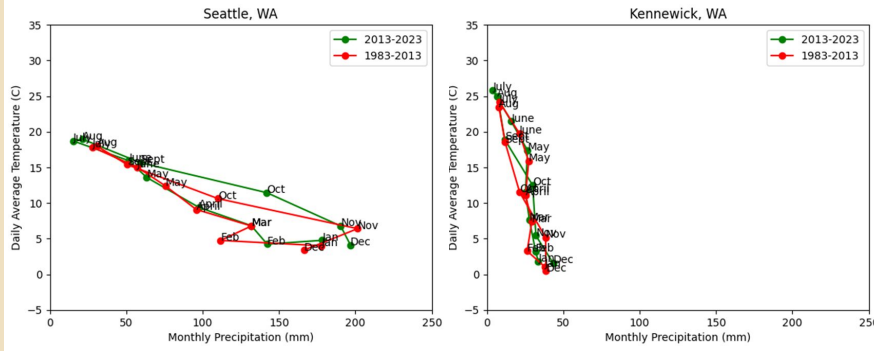


- Findings
  - Monsoon and the locations of mountain ranges have great impacts on climate.
    - WA, CA, AZ and Japan share the same climatological & geographical characteristics.
    - In fact, western WA and western Japanese cities are placed in the same cluster.

- Produced "hythergraphs" for individual cities for further analysis.
  - Monthly changes in temp and precip in recent 10 yrs ('14-'23) and extra 30 yrs ('84-'13).

- Findings
  - The climate of WA cities has changed to be warmer and drier.





Mapping and IoT Dev for Farming

- MA also faces drought once in a few years.
- Decided to help local farmers make informed decisions for their planning and operation.
  - e.g., when to and how much to water farm soil.
- Mapped regional weather info
  - Historical weather data ("hythergraphs")
  - Weather forecasts from NOAA
  - Drought severity levels from US Drought Monitor
- Built an in-situ farm monitoring device with:
  - Soil temp and moisture sensor
  - Air temp, humidity and atmospheric pressure sensor
  - Stores and graphs sensor data in the cloud.