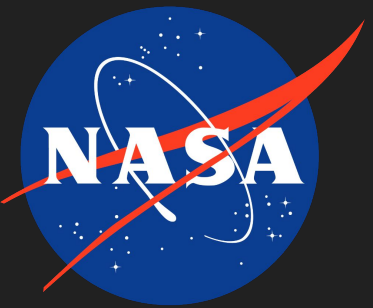
Predictive Modeling to Forecast Mosquito Outbreaks

By: Ashlee Ajala, Chris Ho, and William Li



Background

Mosquitoes lay their eggs in standing water. Factors that affect mosquito oviposition rate include temperature, amount of precipitation, humidity, and wind.

- The progression of climate change contributes to the expansion of both the range of mosquito growth and length of the mosquito breeding season
- More disease spread: Zika, West Nile, malaria, dengue
- The presence of standing water near houses is indicative of a greater potential to spread diseases.

Centers for Disease Control and Prevention. (2016, March 21). *Mosquito-borne diseases*. Centers for Disease Control and Prevention. https://www.cdc.gov/niosh/topics/outdoor/mosquito-borne/default.html.

Day, J. F. (2016, November 18). *Mosquito oviposition behavior and vector control*. Insects. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5198213/#:~:text=Meteorological%20conditions%20including%20temperature%2C%20rainfall,flight%20and%20oviposition%20%5B2%5D.

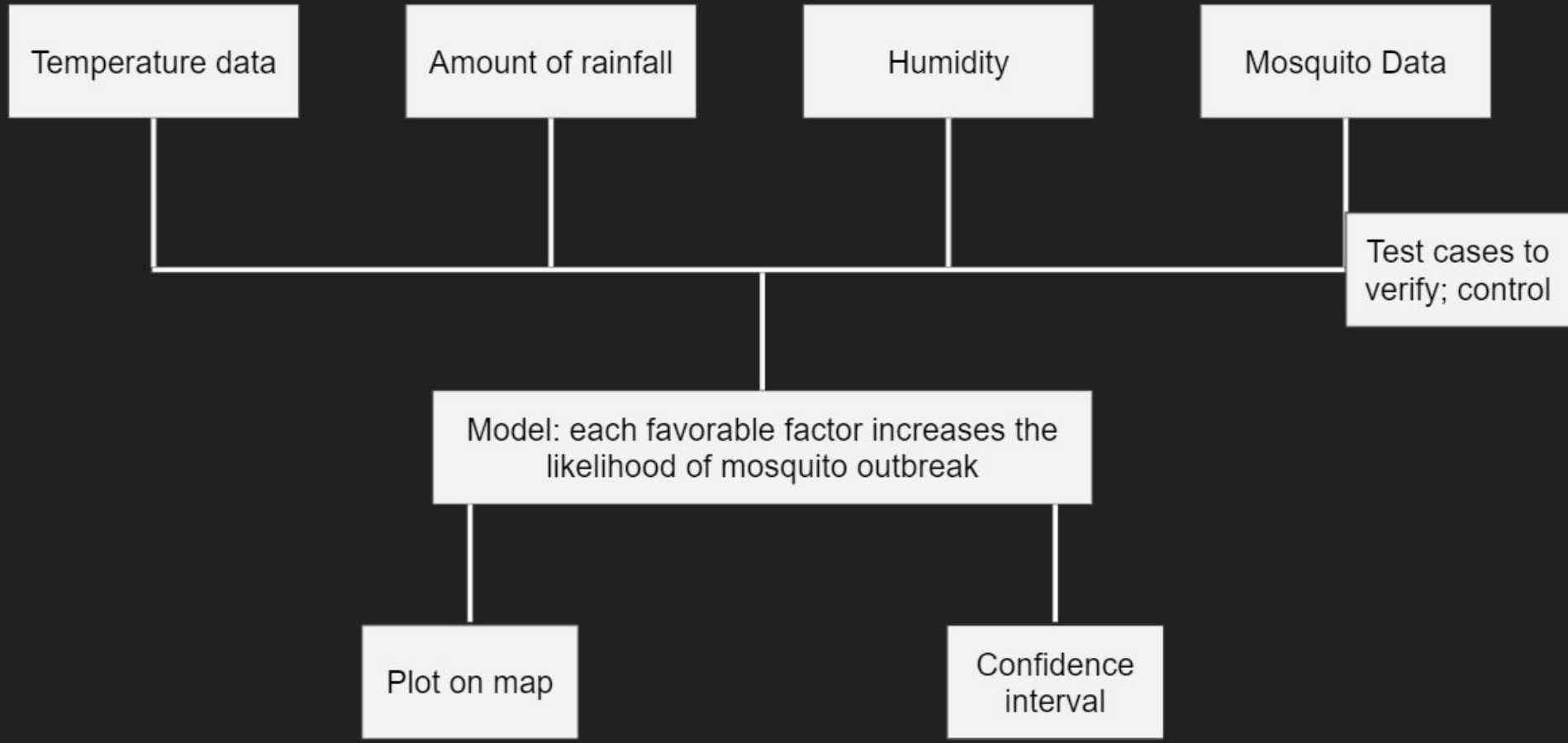
Our Idea

Can we forecast mosquito outbreaks in a large area given weather and climate data?

- Make a predictive model to forecast mosquito outbreaks
- Use temperature and precipitation data for a 4-year time frame in Texas
- Wanted to corroborate results with those observed in fieldwork
- Utilize statistics to find patterns in the data and infer conclusions from those patterns

Methodology

1. Obtain data: we used NASA POWER data alongside data from Google Earth Engine, and data obtained in fieldwork
2. Format data: get data as CSV, remove unused data
3. Iterate through the data, looking for factors that could contribute to mosquito outbreaks
    a. This process is currently hard-coded, but we hope to utilize a more efficient method in the future
4. Refine model as needed, verify with known data
    a. Known data comes from our own fieldwork data, and we can find the weather and climate data for those days
5. Plot the data points on a visual map and create a confidence interval


Temperature data
Amount of rainfall
Humidity
Mosquito Data
Test cases to verify; control
Model: each favorable factor increases the likelihood of mosquito outbreak
Plot on map
Confidence interval

Data

We obtained rainfall data from NASA POWER, temperature and humidity data from Google Earth Engine, and mosquito data from SEES fieldwork data.

- Eastern Texas only
  - Reduce complexity
  - Reduce variations due to geography
- Major population centers of Texas: DFW, Houston, San Antonio, Austin

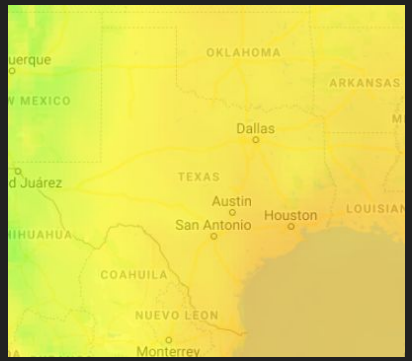


Image Source: ECMWF ERA5 Daily

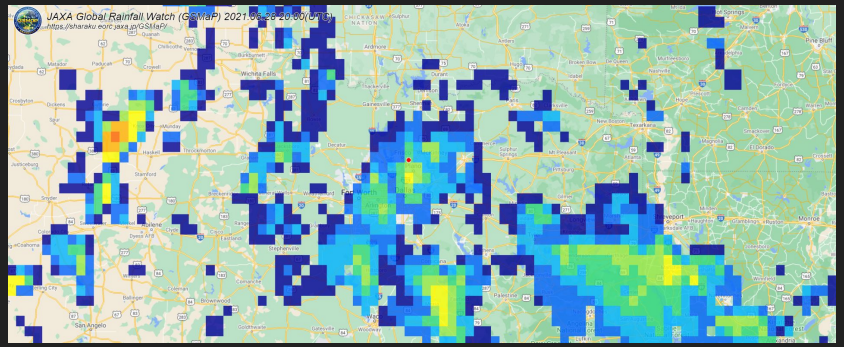


Image Source: JAXA Realtime Rainfall Watch

Results

The development of our prototype afforded us insight into the process of making a predictive model.

- Large quantities of data
- Many variables

Limitations include:

- Scarcity of time
- Model Simplification

Broader Implications

A predictive model to forecast mosquito outbreaks can be used to give advance warning of disease outbreaks in an area

- Awareness
- Effective resource allocation and preparation
- Correlation with Local Climate

Acknowledgements

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