Project Proposal Group 3

Wildfire Risk Evaluation and Impact Prediction

1. RESEARCH TOPIC

As climate change contributes to an increased frequency and severity of climate disasters, harnessing geospatial science and predictive models is becoming increasingly and urgently important for identifying at-risk areas for preventative and responsive measures. Existing literature on wildfire mapping identifies numerous variables that contribute to identifying risk and impact, including: weather conditions, topography, fuel moisture, vegetation type, land management, and fire history. Utilizing such variables in combination of geospatial data identifying critical habitat, infrastructure, housing, and population can model the type of impact and extent of the impact that wildfires could or would have on regions.

For the purposes of this project, the scope of analysis will be limited to the state of California, and potentially scaled upwards. California is prone to wildfires due to its climate and environmental conditions. There is a historical record of displacement, loss of life, habitat, structures, and high economic costs associated with wildfires in California.

This project aims to create a Multi-Criteria-Evaluation utilizing identified variables that are typically assessed during wildfire mapping or wildfire management / response to assess the severity of ongoing wildfires. These variables will be assessed for each ongoing fire event, and a weight will be added to each variable and then a total risk score will be calculated. For example, proximity to development would be a variable, and it could be weighted highly (0.50) so that if proximity to development is close then that wildfire instance would be given a higher risk score. This can be used to build out the MCE to assign scores to reported wildfires.

Following this assessment, the MCE will be used to create a model that could simulate a wildfire event, and depending on the variable conditions in those areas, the wildfire would be given a score to that area, and then building footprint and population data will be added to estimate how many buildings would be affected and how many people would be displaced. The predictive modeling process will not only enhance the risk assessment capabilities but will also offer proactive planning and response support to emergency managers and first responders. In consideration of the project's time constraints, scale and variable selection can be adjusted to strike a balance between model complexity and precision.

2. SMART QUESTIONS

Specific: How can we predict/estimate the displacement caused by wildfires in California by harnessing GIS and predictive modeling in Python?

Measurable: How do different variables contribute to the risk score associated with a wildfire event? What is the risk associated with different wildfire events?

Action Oriented: Can we create an MCE that scores the potential risk associated with an ongoing burning event? What should be included in such an MCE?
Relevant: What is a useful deliverable of wildfire risk assessment for emergency managers/first responders?
Timebound: How detailed/holistic of an MCE could we create given the time constraints of this project? What are important variables to keep and which can be scaled back?

3. METADATA
    a. Wildfire risk datasets: https://wildfirerisk.org/download/
        i. Risk to Potential Structures
        ii. Burn Probability
        iii. (Selecting California regions)
    b. Real time wildfire instances: https://www.nifc.gov/fire-information/maps
    c. Weather conditions: https://www.ncei.noaa.gov/cdo-web/datasets/
        i. Daily temperature
        ii. Daily precipitation
        iii. Humidity
        iv. (Selecting multiple weather stations across California)
    d. Land cover: https://data.ca.gov/dataset/nlcd-2021-land-cover-california-subset
        i. (Subset to California)
    e. Building footprints in California
        i. https://datadryad.org/stash/dataset/doi:10.7280/D16387
    f. Population count / density by census tract
        i. https://data.census.gov/table?g=040XX00US06,06$1400000&d=DEC+Demographic+Profile
4. GITHUB REPOSITORY
    - https://github.com/CharanReddyKumar/Wildfire-Risk-Evaluation-and-Impact-Prediction

5. MODELING METHODS

Predictive modeling will be instrumental in assessing and quantifying wildfire risk and its potential impact in California, leveraging geospatial data and a comprehensive set of variables encompassing weather conditions, topography, land cover, proximity to development, and more. In addition to the Python-based Multi-Criteria Evaluation (MCE) model that assigns weighted scores to each of the identified variables, this project will create a model that simulates wildfire scenarios based on the variable conditions in specific areas, we can provide quantitative estimations of the potential displacement of people and the number of buildings at risk.

The method of modeling will likely be forecast or prediction modeling, which uses current and historic data fed into the model and predicts values based on observed trends in the data.