

Group 3 - Project 3

Analysis of Climate Change Impact on Temperature and Wildfire Patterns in California

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Abstract

This study investigates the impact of climate change on temperature variations and wildfire patterns in California. Utilizing geospatial data and advanced data visualization techniques, the analysis focuses on understanding the relationship between rising temperatures and the frequency and intensity of wildfires over time.

Introduction

Climate change is increasingly recognized as a significant factor influencing weather patterns globally, with particular emphasis on its role in exacerbating wildfire events. California, being one of the regions most affected by wildfires, serves as a critical case study for examining how temperature trends driven by climate change correlate with wildfire activity. This study employs a range of geospatial and statistical tools to analyze historical wildfire data alongside temperature records to uncover trends and potential causative relationships.

Data and Methods

Data Sources

The analysis is based on wildfire data sourced from the California Fire Perimeters dataset, which includes detailed information about the location, extent, and duration of wildfires in the region. Temperature data is integrated to assess the correlation between climatic conditions and wildfire occurrences.

Data Preparation

1. **Loading GeoJSON Data:** The wildfire data, stored in GeoJSON format, is loaded and processed using the `geopandas` library. This dataset includes the geometries of wildfire perimeters, along with attributes such as fire name, year, cause, and area burned.
2. **Loading, Transforming and Merging Multiple Temperature CSV Data:** In this project, multiple temperature CSV files were loaded and processed using the `pandas` library. The data underwent transformations to convert dates to datetime

format, split this into year and month columns, and incorporate city coordinates using [geopy](#). After renaming columns for consistency, the datasets were merged. Additionally, an average temperature dataset for California was combined with the wildfires database and converted into a table in the database using [sqlite3](#).

3. **Data Unzipping:** The wildfire data is initially stored in a compressed ZIP file, which is unzipped and extracted into a working directory for further analysis.
4. **Spatial Data Processing:** The geospatial data is transformed into a suitable format for analysis, with specific columns extracted for plotting and analysis, including [Latitude](#), [Longitude](#), [GIS Acres](#), [Fire Name](#), and [Temperature](#).
5. **Database Integration:** The data is stored and queried from an SQLite database to facilitate efficient data manipulation and retrieval. This allows for dynamic data filtering and aggregation based on user-defined parameters such as year or region.

Visualization Techniques

Several visualization techniques are employed to illustrate the impact of temperature on wildfire patterns:

1. **Heatmaps:** Heatmaps are generated to visually represent the spatial distribution of wildfires over time. These maps are enhanced by incorporating temperature data as a weighting factor, providing a visual correlation between higher temperatures and increased wildfire activity.
2. **Interactive Maps:** Folium, an interactive map visualization library, is used to create dynamic maps that allow users to explore wildfire events in relation to temperature. These maps are embedded within an interactive environment, where users can filter the data by year and visualize the corresponding changes in wildfire patterns.
3. **Temporal Analysis:** The analysis includes temporal visualizations, such as bar charts and line plots, to track changes in wildfire frequency, total area burned, and average temperatures over the years. This helps in identifying trends that may be attributed to climate change.

Results

The interactive maps and visualizations created in this study provide clear evidence of a strong correlation between rising temperatures and the increasing frequency and severity of wildfires in California. Areas with higher temperatures consistently show a higher intensity of wildfire events, suggesting that climate change plays a critical role in driving these destructive occurrences.

Conclusion

This analysis underscores the importance of addressing climate change as a critical factor in mitigating the increasing threat of wildfires in California. The use of geospatial data and interactive visualizations offers valuable insights into the patterns and causes of wildfires, paving the way for more effective prevention and response strategies.

- many different factors
- CA Sea Level Data (Jennifer/Wenli)
 - [Annual Sea level data](#) in Crescent City (1933-2023), San Francisco (1900-2023), and La Jolla (1925-2023)