Flood Detectives: Using AI to Combat Global Warming

New Mexico SuperComputing Challenge

Final Report

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Justice Code

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Executive Summary

Delaware, Florida, Louisiana, the District of Columbia, Rhode Island, New Jersey, Mississippi, Maryland, South Carolina, Alabama, Connecticut, and Massachusetts are states that flood often due to the fact that they are all at or below sea level (<500ft). This flooding is partially due to the melting of glaciers caused by rising global temperatures. Precipitation can also increase the water level, leading to flooding. Using this information, we decided that the variables for our machine-learning algorithm should be precipitation, glacial melting, and temperature. After evaluating our model, we came to the realization that we had an overfit model. To overcome this issue, we had to utilize a different regression statistic called a gradient-boosting regressor.

Statement of the Problem

The southern U.S. states, including Texas, Florida, and Louisiana, are increasingly susceptible to flooding due to climate change, hurricanes, and low elevation. Extreme weather events are becoming more frequent, necessitating advanced technologies for accurate flood prediction and prevention. This project aims to explore the application of artificial intelligence (AI) to solving the specific challenges associated with flooding in these states.

Background Research

Previous research has shown that artificial intelligence can be effective in a variety of environmental scenarios, including flood prediction. There is evidence that machine learning algorithms, particularly those based on neural networks, can interpret complex data patterns and generate accurate predictions. However, further research is needed to determine how AI may be used to address the specific issues associated with floods in these areas. If we can help forecast and prevent flooding, we will save many people's lives, especially in states like Michigan, in which nearly 600 people have died due to flooding. The states closest to the United States' borders are most vulnerable to floods as a result of global warming, which is a legitimate concern that must be addressed.

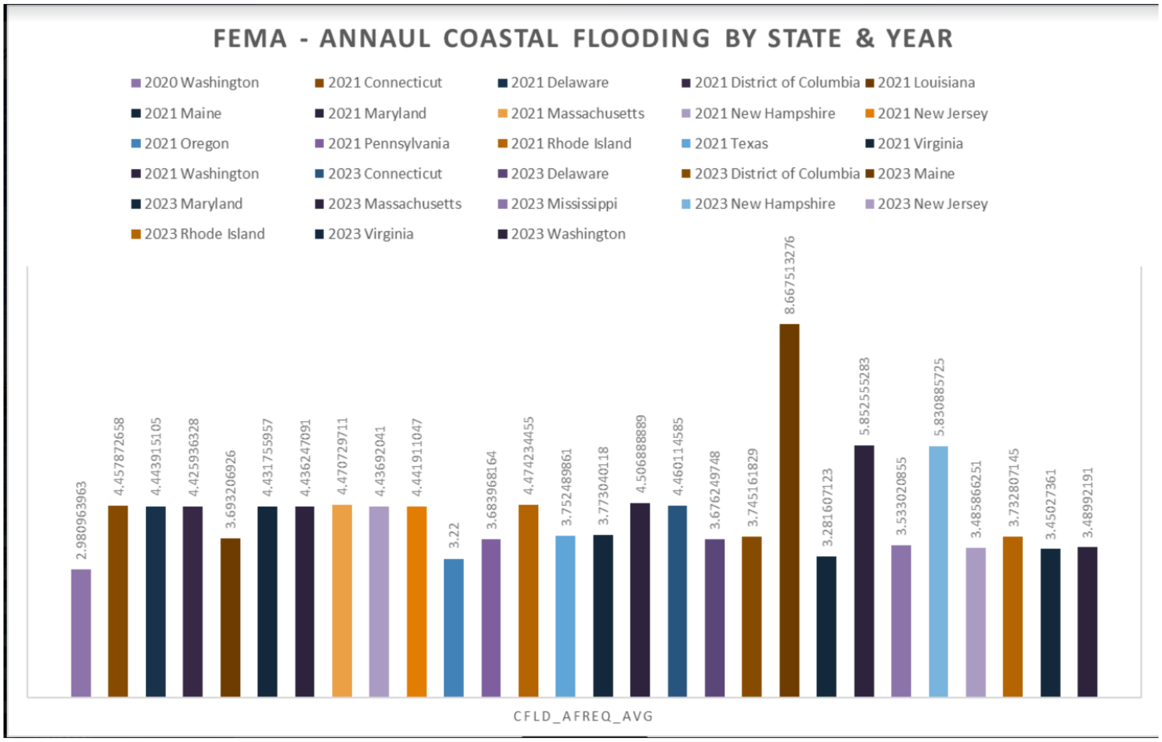

Figure 1. FEMA Graph of Annual Flooding - FEMA.gov

Method

Our initial model was a modified StarLogo Nova model “called Flood Detector”, from the Starlogo library. We changed our model to Netlogo so we could use Python to create a machine-learning model with our mentor’s help. After finding datasets, we added this data to our model. US/Canada glacier balance, shoreline in miles by state, miles squared of water by state, average precipitation by state, average wind in MPH by state, and Average low temperature by state. We found only three years of FEMA coastal flooding by state. Because of this, we were not able to use coastal-specific areas.

Computational Solution (Verification & Validation)

Our computational solution involves leveraging AI, particularly machine learning algorithms, to analyze complex data patterns for flood prediction. Additionally, we propose exploring the glacier-freezing strategy as a means to mitigate flooding risks because of how important this factor is to our model. The integration of AI technology into this project is a key aspect of enhancing its effectiveness. We believe that the integration of AI into flood prediction models will improve accuracy, provide timely warnings, and aid in preventative measures. When refined through environmental considerations and advanced cryogenic technologies, the glacier-freezing strategy is expected to contribute to flood prevention warnings, particularly in states vulnerable to global warming-induced flooding.

Conclusions

In conclusion, this project aims to explore the application of artificial intelligence (AI) to solving the specific challenges associated with flooding in these states. The southern region is most impacted by flooding in the U.S. The annual glacier balance is based on current data. Our predictions were pretty close since we researched real data. How can we turn it into a warning system in the future? Our model can predict flood patterns and detect the flood before it reaches the city. The flooding chances are heavily increased close to the Gulf Coast. The highest flood potential occurs in the southern Midwest and Texas, and along the West Coast, with the lowest flood potential in the Great Basin, Rocky Mountains, and northern Midwest.

Discussion

We believe our most significant achievement on this project is that we completed our project and created a functional model using the resources available to us. We also learned about linear regression in this project. (Fig. 2)

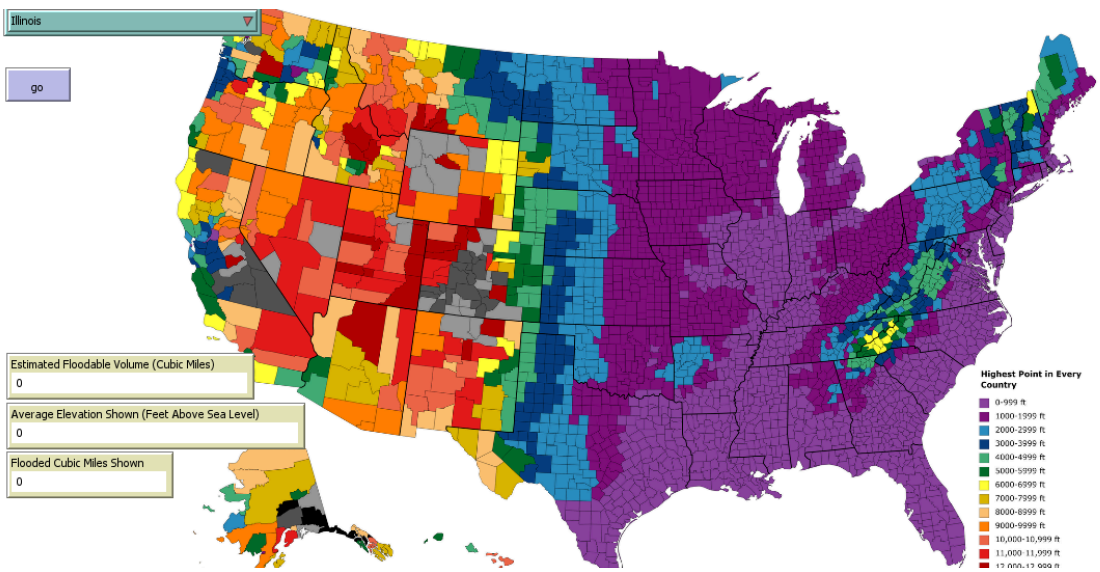

Figure 2. Map of the United States by elevation

Future Work

The project aims to integrate AI, particularly machine learning and algorithms, for accurate flood prediction. Additionally, the glacier-freezing strategy was our first strategy considered a means to prevent flooding risks, with the incorporation of AI being a crucial element for enhanced effectiveness.

Code

```
  to predict

 py:run "import pandas as pd"

 py:run "import numpy"

 py:run "from sklearn.linear_model import LinearRegression"

 py:run "from sklearn.model_selection import train_test_split"

 py:run "from sklearn.ensemble import GradientBoostingRegressor"

 py:set "ds" "C:\\Users\\Mekhi\\OneDrive\\Desktop\\JC6\\final_april_fools.csv"

 py:run "mod = pd.read_csv(ds)"

 py:run "X = mod[['Total_US_CA_Glacier', 'Shoreline_Miles', 'water_area_miles_sq', 'Avg_Precipitation',
'WindiestStatesAverageWindSpeedMPH', 'AverageTemperatureAvgLowF', 'exports_in_usd']]"
```

```
py:run "Y = mod['CFLD_AFREQ_AVG']"

py:run "X_train, X_test, Y_train, Y_test = train_test_split(X, Y, random_state=0)"

py:run "reg = GradientBoostingRegressor(random_state=0, loss='squared_error', n_estimators=1000)"



py:run "reg.fit(X_train, Y_train)"

py:run "Y_pred = reg.predict(X_test)"

py:set "TotalGlac" (glacier_balance * coeff)

py:run "print(TotalGlac)"

py:set "Shore" miles_shoreline

py:set "waSqMi" water_area_miles_sq

py:set "avgPrec" Avg_Precipitation

py:set "windMPH" WindiestStatesAverageWindSpeedMPH

py:set "avgLow" AverageTemperatureAvgLowF

py:set "expusd" exports_in_usd
```

Acknowledgments

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References

"Artificial Intelligence for Environmental Science" - National Center for Atmospheric Research: *This research explores the application of AI in environmental science, including flood prediction. It serves as a foundation for our project's computational solution.*

"Machine Learning Approaches for Flood Prediction and Susceptibility Mapping" - Journal of Hydrology: *The study investigates machine learning techniques for accurate flood prediction. We draw inspiration from their methodologies and findings.*

"Glacial Geoengineering: The Key to Slowing Sea Level Rise" - Earth and Space Science News: *This article discusses innovative strategies, such as glacier freezing, to mitigate sea level rise. Our project incorporates similar concepts to address flooding risks.*

"Climate Change and Coastal Flooding Impacts on Louisiana Highways" - Louisiana Transportation Research Center: *Understanding the impact of climate change on coastal regions is crucial. This research informs our approach to flood prevention in vulnerable states.*