CAPP 30122 Project: Snow Laughing Matter

March 2023

Name of group members and CNetIDs

Jackie Glasheen: jglasheen
Harsh Vardhan Pachisia: harshpachisia
Shwetha Srinivasan: shwetha
Jennifer Yeaton: jkyeaton

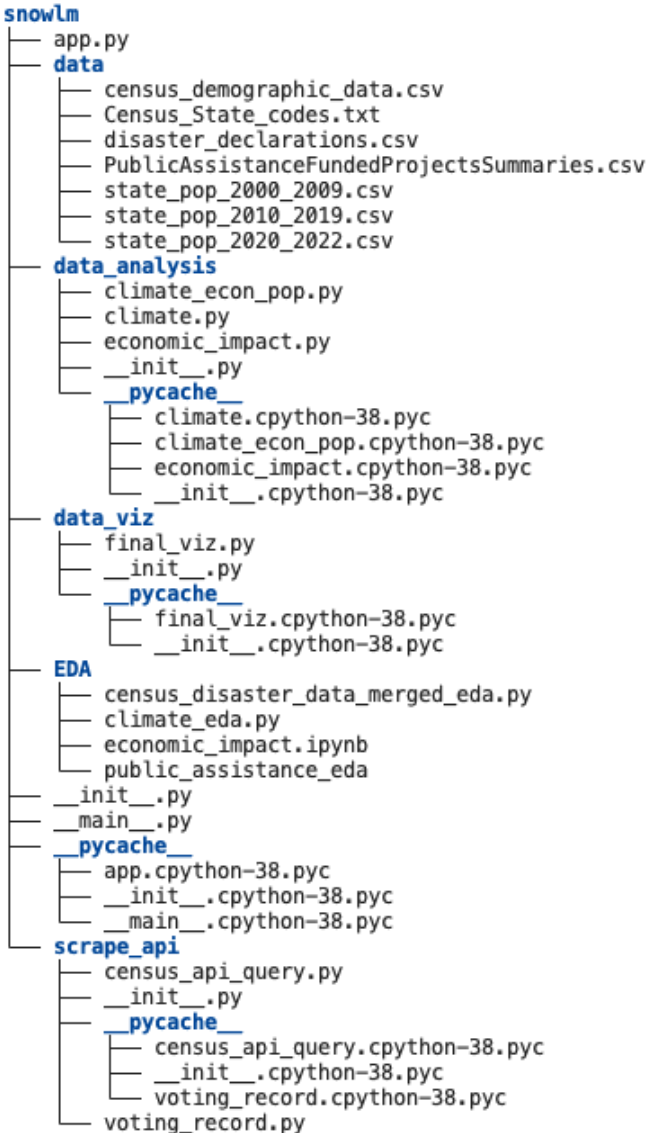
Project Abstract

Climate change and global warming are causing extreme weather disasters to occur with more frequency. While there are apparent long-term impacts of climate change, we investigated the recent increase in extreme weather disasters and analyzed such events through a geographic, political, financial, and socio-economic lens by integrating climate data with different datasets.

For our project, we made an interactive dashboard that highlights the overall trend of climate disasters increasing dramatically since 1980. Further, the dashboard allows users to interactively view disaster trends on a US-state map, and select geographic regions of interest to dive deeper into the climate trends. Once a state is selected, the webpage will be populated with graphics that show climate-related disaster patterns/metrics. We also highlight the link between disasters in a given state and socioeconomic indicators from the U.S. Census, political action vis-a-vis the climate bill, and funding from FEMA for disaster mitigation.

Overall structure of the software. A diagram of how the modules are connected with one another might be helpful, but is not required.

The first portion of our software loads in the data from our numerous data sources (FEMA Disaster Data, FEMA funding data, U.S. Census data - American Community Survey 5-year data, State Population Totals, and State codes, and congressional votes on the Inflation Reduction Act) through six static datasets, an API query, and crawling the web for roll call votes on the Inflation Reduction Act.



The scripts for running the API query and the web crawler for congressional votes on the Inflation Reduction Act are located in snowlm/scrape_api. Both of these files (census_api_query.py and voting_record.py) return pandas dataframes with the cleaned data. The raw static datasets are located in snowlm/data and the scripts for cleaning and analyzing the static datasets (climate.py, economic_impact.py, and climate_econ_pop.py) are located in snowlm/data_analysis. Each of the above scripts merges in snowlm/data/census_state_codes.txt so that the states can be compared within the same graphics. The data frames returned by each of the above files are the inputs for our visualizations.

The exploratory data analysis that was conducted to inform our analyses and visualizations can be found in the folder snowlm/EDA (climate_eda.py, economic_impact.ipynb, public_assistance_eda, and eda_census_disaster_data_merged.py).

The script for creating the visualizations are located in snowlm/data_viz/final_viz.py. This file visualizes the dataframes returned by each of the above files. The app is launched from the command line using app.py (located in snowlm) and runs final_viz.py.

Description of code responsibilities for each member. (Who was responsible for what tasks/code/etc.)

	Responsibilities Summary	Associated Files/Packages
Jen	Jen was primarily responsible for compiling and analyzing the Census data, including accessing the Census data via API.	• Census_api_query.py • census_disaster_data_merged_eda.py (Exploratory)
Jackie	Jackie was primarily responsible for compiling and analyzing the data for senator voting patterns on the IRA bill and processing the FEMA data for public assistance granted as a result of climate disasters. Jackie also drafted most sections of the project paper.	• economic_impact.py • voting_record.py • Public_assistance_eda (Exploratory)
Harsh	Harsh was primarily responsible for processing, cleaning, and analyzing the FEMA climate disasters dataset to provide the specific data frames required for each climate-related visual. He also organized the various components of the project into a suitable structure as a Python package with sub-packages for distinct components and dealt with all merge conflicts. He wrote the ReadMe file for the project.	• climate.py • climate_econ_pop.py • climate_eda.py (Exploratory)
Shwetha	Shwetha was primarily responsible for creating the web interface for the project in Dash, and developing the visuals based on data provided by other group members.	• final_viz.py

All group members played a role in outlining the workstreams and visuals, and regularly met to sync on progress and barriers.

Short guide on how to interact with the application and what it produces.

Instructions for running the software (the instructions are duplicated from the README file):
This project can be run using Poetry. The steps are outlined below.

1. Make a clone of the project repository
2. Go to the project directory: cd 30122-project-snow-lm
3. From the directory install virtual environment and dependencies: poetry install
4. Activate the virtual environment: poetry shell
5. Create an environment variable for the U.S. Census API key: export CENSUS_API_KEY=YOUR_KEY_HERE
6. Run the project: python3 -m snowlm

It will ask you to open the dash application in the browser to see the interactive dashboard.

Instructions for interacting with the application:
The application includes both static and interactive elements. Ideally, a viewer will look at the static (unchanging) Total Number of Disaster Events chart on the landing page to get a sense of the national, big-picture trend of increasing climate disasters, and then scroll down to look at the detailed, interactive charts. For all charts, hovering over a chat data point will show the viewer the exact value of the data point.

Map interaction guide: The viewer can choose the metric they want to view (either the number of disasters or the total FEMA public assistance for those disasters), and then toggle through the year slider to view the metric by the state over time. By clicking the "play" button, the application will cycle through all years of the time series.

Bubble chart interaction guide: By clicking the "play" button, the application will cycle through all years of the time series, testing the hypothesis: whether bigger states with higher populations and more disaster events received higher FEMA public assistance over time.

State-level charts guide: When a viewer chooses a state from the map, all of the remaining charts will populate with the relevant information for the state.

What the project tried to accomplish and what it actually accomplished.

The aim of "Climate Change Is 'Snow Laughing Matter' was to develop a resource for those interested in visualizing trends in climate disasters and to contribute to the narrative about the impacts of climate change. In focusing on the increase in climate disasters rather than global warming, we were hoping to highlight that global warming is not only a future-oriented problem; rather, even though it is undeniable that the most severe climate change impacts are yet-to-come, we are already experiencing an increase in the frequency and severity of climate-related disasters as a result of climate change[1], which has widespread impacts in the present.

Our project attempts to (1) establish the trend of increasing climate-related disasters, (2) give granular, state-level detail about the climate disaster trends in different geographies, (3) highlight how the FEMA public assistance grants (aid in disaster recovery) are growing, suggesting the severity of disasters and the financial burden of disasters is increasing, (4) find a relationship between senator voting behavior on the recent climate change legislation[2] with the states disproportionately experiencing climate disasters, and (5) highlighting any disproportionate impacts on certain demographic/socioeconomic groups (i.e., minorities, those without health insurance, etc.). By looking at the impact of climate disasters through a few different lenses, we were hoping to highlight relationships between climate disasters and politics, economics, and demographics.

The team was able to accomplish much of what we set out to do. We were able to establish the overall increase in climate disasters by showing the increase in climate disasters over time, breaking down that trend by geography, disaster type, and FEMA spending over time, and further listing the top 5 events by state and providing other metrics. In addition, we presented this data alongside information about how the senators in a state voted on the recent federal climate legislation and relevant demographic information for the various states and counties.

However, time constraints prevented us from fully developing the analytical connections between climate disasters and the other data sources. For example, we hoped to more clearly show if there was a connection between demographic indicators and climate disasters (i.e., are racial minorities disproportionately affected by climate disasters, etc). Likewise, we hoped to find a relationship between

[1] "We already see effects scientists predicted, such as the loss of sea ice, melting glaciers and ice sheets, sea level rise, and more intense heat waves. Scientists predict global temperature increases from human-made greenhouse gases will continue. Severe weather damage will also increase and intensify," https://climate.nasa.gov/effects/.
[2] The Inflation Reduction Act became law on 8/16/2023, https://www.congress.gov/bill/117th-congress/house-bill/5376/text.

senators who voted in favor of the recent climate bill and whether or not the states they represented were experiencing increases in extreme climate disasters[3]. If we were continuing this analysis, some adjustments to the data may be necessary. For example, we might want to inflation-adjust the FEMA money granted as a result of the climate disasters. We would also want to further investigate the relationship between some of the disaster types used in the FEMA data (i.e., fires) and global warming, and whether certain disaster types have been used consistently over time in the data.

[3] Notably, we instead found the vote was completely along party lines – all republicans voted against the bill, and all democrats (and independents) voted for the bill.