

Exploring the relationship between climate attitudes and extreme weather events - S&DS 625 Final Project

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1 Introduction

1.1 Contextualizing and motivating

Climate change and environmental degradation is one of the most existential crises of our time, if not the most existential. Unfortunately, many Americans do not agree with this statement and/or do not fully comprehend the implications of our global future if we do not address the causes of climate change. Without recognition of the seriousness of climate change, harmful consumer habits perpetuate, eco-friendly policies falter due to lack of support, and the industries and corporations that negatively impact the environment are not held accountable nor pressured to abandon the status-quo. Climate communication is a field that works with these issues, and in particular, with how to educate and persuade individuals about climate change and the necessity of acting to reduce it. The hope is that the more people there are that recognize climate change as a serious threat, the more likely we are to have politicians and corporations that are pressured to use their positions of power to enact positive change when it comes to the environment.

This contextualizes the goal for this final project - to better understand some aspects of climate change beliefs at the county-level. If we don't understand the beliefs that people currently have about climate change, and what factors might influence those beliefs, then we will be less effective at trying to persuade those people than if we can be understanding and empathetic at the same time as being convincing. In particular, this report investigates how local extreme weather events relate to county-level climate change beliefs. Perhaps personally experiencing one of the widely broadcasted affects of climate change - increased extreme weather events such as drought, hurricanes, wildfires, winter storms, etc - would cause a person to take climate change more seriously, compared to someone who just hears about these things happening on the news. However, there are other cultural and demographic factors that are expected to have an effect on climate change opinions that also need to be controlled for, such as political leanings and age.

1.2 Data sources

To explore the relationship between extreme weather events and climate change opinion with consideration given to the additional impact of political leanings and demographics on climate change beliefs, the analysis draws on information from multiple data sources.

Data collected and processed by the Yale Program on Climate Change Communication is used to understand climate change belief (the response variable of this analysis). This data consists of US county-level estimates of climate change beliefs, i.e. x% of the population in New Haven County believes that climate change is happening. These estimates are calculated from a large-scale nation-wide survey (n > 25,000) conducted in spring of 2020, and were "derived from a statistical model using multilevel regression with post-stratification (MRP)". Though using individual-level data could be more convincing for arguing existence of a relationship between extreme weather event experiences and climate change beliefs (the unit "county" does not itself have a climate change belief), actually obtaining the supplementary data at this level was not feasible for this project due to data privacy issues.

Supplementary demographic data at the county level was collected from the Census Bureau's ACS 2019 estimates using the R package 'tidycensus'. To understand the political leaning of each county, 2020 general election results were obtained at the county level. These came from a data set containing general election results from 2000-2020 maintained by the MIT Election Data and Science Lab and accessed via the Harvard Dataverse.

Identifying counties that experienced an extreme weather event around the time of the climate opinion survey is not cut-and-dried. How should one define "extreme weather"? There may be multiple reasonable responses to this question, but this report defines "extreme weather" as weather events that were declared disasters by FEMA (Federal Emergency Management Agency). Records of these events from 1953 to 2021 are recorded in the online OpenFEMA Data Sets at the state and county level. FEMA disasters were chosen as the indicator of extreme weather because they signal a disaster beyond what state governments typically expect and are prepared to handle. This accounts for the fact that independently

of climate change, some parts of the country naturally experience - and are used to experiencing - more severe weather than others.

2 Data Preparation

Merging these data sources required considerable cleaning and quality assurance checks of each individual source.

2.1 Climate change opinion survey data

Because the providers of the climate change opinion survey already processed the individual responses into county-level estimates, this data is very clean to begin with. Data is available for every county reported on by the Census in 2020, there are no duplicate rows, and the response variable ‘happening’ (indicating the proportion of county population that believes climate change is happening) is relatively Normal in distribution. Note that the original survey file contains data for many different climate-related questions asked in the survey, but for this analysis I am just focusing on the high level question of existence of climate change.

2.2 Election data

This data set required a little more work to clean up. Data was reported for one county that was not recognized as a by the Census, and was dropped. For some reason, San Joaquin County CA had missing data, which I was able to manually find from the county website and replace. Votes were sometimes recorded by the mode in which they were received (ex. “Early Vote”, “Absentee”, “Election Day” etc.) and sometimes in total, so aggregation to the total county level had to be standardized between counties. I was able to rectify all differences in county names between this source and the Census Bureau (which I regarded as ground truth for standardizing all sources to use FIPS codes for future merging) except for voting districts in Alaska. I was unable to find a way to map voting districts to Census-reported counties, so I dropped Alaska from the analysis. Although the other data sources do have information on Alaska, I found political leaning to be such a strong indicator of climate change belief that I think it is preferable to drop it entirely from the analysis rather than introduce missing values for political leaning. Figure 1 shows the geographic distribution of the county-level 2020 election results, while also indicating whether that county has above or below average belief in climate change (compared to the political group average, not the overall average).

2.3 Census demographic data

The ACS 2019 estimates obtained through the Census were very clean and required almost no cleaning aside from reshaping the data and renaming one county to be consistent with a recent name change. I began the analysis with information about the gender, race, and ethnicity breakdowns of each county, along with the median income and age of each county. I calculated population proportions to use in the analysis instead of the raw total counts.

2.4 FEMA weather data

Given the choice of the FEMA data set, there remains a tension between the ideas that experiencing multiple events over a longer time scale would have a larger impact on people’s mindsets, but also that it is harder to safely assume that the same individuals are remaining in the same county over a longer time scale. In an attempt to balance these competing interests, counties are flagged as “affected by extreme weather” if they experienced a FEMA declared event in 2019 (the closest data to when the climate opinion survey was collected), and also experienced at least 2 FEMA declared events between 2015-2018. This second requirement is an attempt to capture counties where extreme weather is more likely to be seen as recurrent rather than a fluke. 511 (a little over 16%) US counties meet this requirement. Note that the original data sets include FEMA disasters that are non-weather related, such as earthquakes, biological disasters, chemical disasters, terrorist disasters, etc. This analysis considers hurricanes, floods, severe storms, fires, snow, tornados, severe ice storms, coastal storms, typhoons, and droughts. Figure 2 displays all FEMA declared weather disasters from 2015-2019, as well as highlighting the counties which meet the requirements outlined above to be considered as “affected by severe weather” in the analysis.

Interaction of 2020 election results and county climate change belief estimates

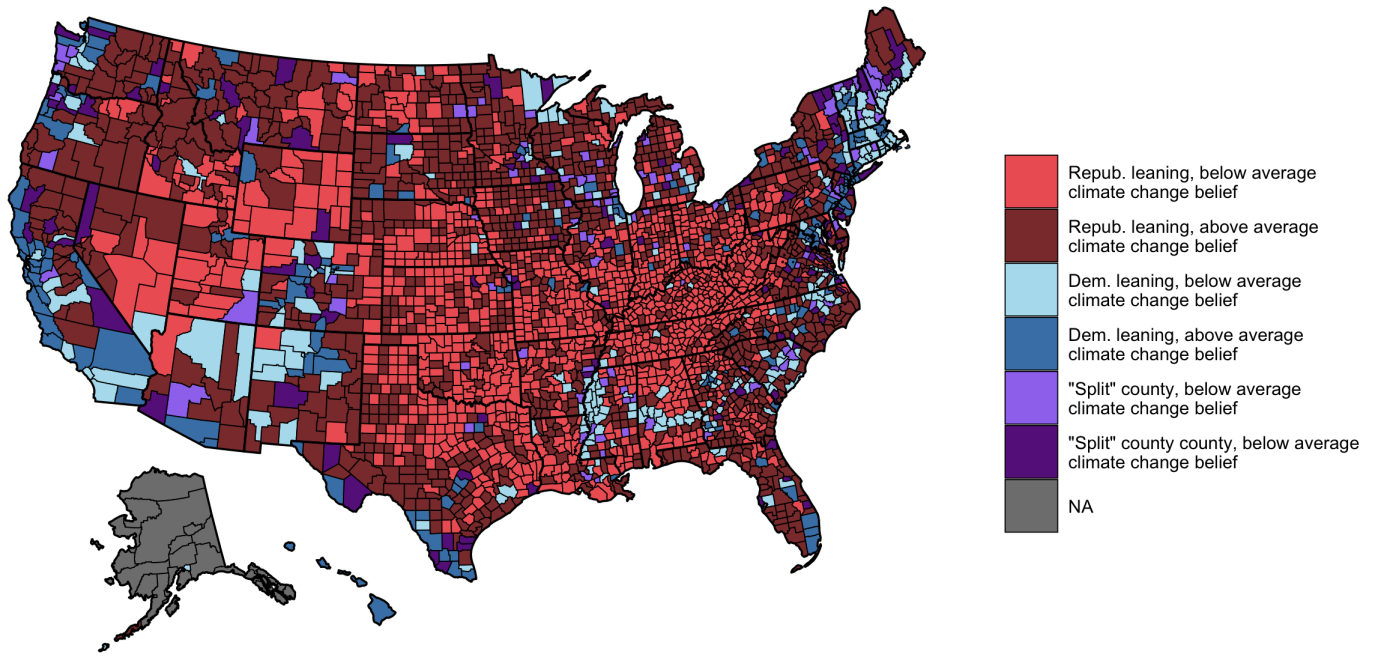


Figure 1: This figure shows the 2020 presidential election results at the county level while also showing whether these counties have climate change belief above/below average compared to their political group. "Split" counties refers to counties where neither Democrats nor Republicans won more than 52.5% of the vote.

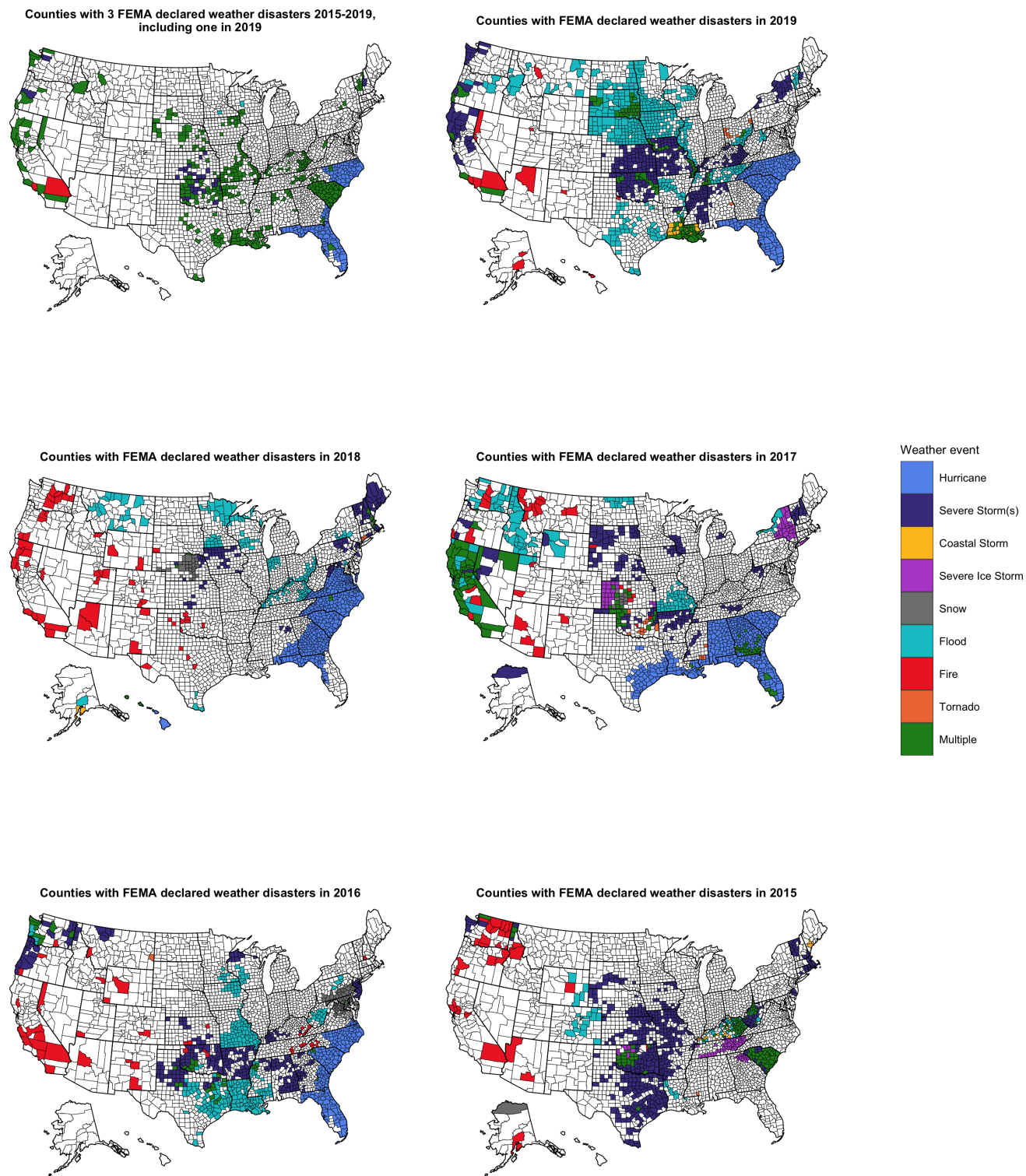


Figure 2: Upper left: counties with FEMA declared disasters that are flagged as "affected by severe weather" in this analysis. The rest of the plots show all FEMA declared weather disasters from 2015-2019. Larger plots are available in code directory.

3 Analysis

Remember to discuss ideas inspired by Causal Inference but not actually valid in that framework Furthermore, it is difficult to guarantee that an individual experienced an extreme weather event, even if they are recorded as living in the county where one occurred, and "treatment" of experiencing a weather event is not randomized.

Try repeating analysis with just hurricanes

4 Results

5 Conclusion

6 References

6.1 Contextualizing the problem of climate change and climate change communication

- Guardian article about current climate change crisis: <https://www.theguardian.com/environment/ng-interactive/2021/oct/14/climate-change-happening-now-stats-graphs-maps-cop26>
- Organization for climate change communication: <https://climate-xchange.org/communicating-the-climate-crisis/>

6.2 Data sources

- Yale Climate Communication Group: <https://climatecommunication.yale.edu/>
- Climate change opinion data: <https://climatecommunication.yale.edu/visualizations-data/ycom-us/>
- Election data: MIT Election Data and Science Lab, 2018, "County Presidential Election Returns 2000-2020", <https://doi.org/10.7910/DVN/VOQCHQ>, Harvard Dataverse, V9, UNF:6:qSwUYo7FKxI6vd/3Xev2Ng== [fileUNF]

6.3 Analysis documentation

- MatchIt package: https://kosukeimai.github.io/MatchIt/reference/method_optimal.html
- TidyCensus package: <https://cran.r-project.org/web/packages/tidycensus/tidycensus.pdf>