

What Factors Spur the Public Opinion About Climate Change?

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1. What affects the public's opinion of climate change?

1.1 Approach to exploring the question:

This is a presentation meant to show how the perception of climate related issues varies over different geographic and socioeconomic regions. The purpose of this exploration is to be able to predict how people in different areas will formulate an opinion on climate change. The predictions made by plots, regression models, and maps can provide intuition to policy makers about how to best approach climate change while remaining reasonable in other domains. Another key consideration is the geographic location of a country. Perhaps there is more merit for island countries to be concerned about sea ice declining as they could become submerged. So geographic data is also heavily considered.

1.2 Why is the public's opinion relevant to climate:

It is critical for anyone who is trying to understand data about climate change to also recognize that actions are ultimately backed by humans. When a country makes a policy about climate they must understand what impressions it will have on their residents. It is quite important to note that climate change is not the only narrative to consider when attempting to make beneficial decisions for a population. This report demonstrates that there are many countries that may need to address economic and social issues prior to considering major climate reform.

1.3 Theorized predictors for climate concern:

Before exploring the data these were some theorized predictors that were considered as likely candidates for causing climate concern. The GDP per capita seems like a probable predictor for climate concern as people who have all their needs satisfied should be able to allocate more consideration to the future and the future of their children. Coupled with GDP is the living conditions of a country. If they have a higher living standard then it seems likely that they will also be more concerned about the climate. Finally the frequency of hearing about climate should act as a fear mongering force which in turn makes people more concerned about the climate.

2. About the data

2.1 Rational for data set choice:

The data leans heavily on the social side of climate change because it is an attempt to understand what factors are actually changing opinion about the data. For this reason the primary focus is on the climate opinion data set and the GDP variable given in the world happiness data set. Some of the other country scores are considered the happiness data, but most of them were found to be relatively unrelated to climate opinion and were therefore disregarded.

The sea ice data was used as a more pragmatic grounding for the primarily opinion based world happiness data. The sea ice data is considered to determine whether the climate concerns and actions of people are primarily based on real data like sea ice slowly receding or if climate awareness and popular culture play a larger role.

2.2 Details about the world happiness data:

This data was given as a mostly tidy csv file.

Size: 2199 x 11

Columns:

- *life_ladder*: (double) A ranking from 1-10 that is a general measure of how good those who participated in the survey see their lives from the best being 10 to 1 being the worst.

- *log_gdp*: (double) This is the logarithm of the average gross domestic profit that each person in a given country has.
- *social_support*: (double) The average of the national survey where participants had the choice to indicate whether they felt that they had social support or not.
- *health_expectancy*: (double) National average of how long someone will live in somewhat capable state of being from the time they were born. This is given as an age in years
- *choice_freedom*: (double) Do the participants consider themselves as free to choose what they do. Average of those who selected satisfied or dissatisfied with their ability to choose.
- *generosity*: (double) The average of people who gave to a charity last month and their capita gdp
- *positive_affect*: (double) Considers how much people laugh, enjoy life, and do interesting things
- *negative_affect*: (double) How sad, worried, and angry people are

2.3 Details about the climate opinion data:

The climate opinion data was given in an excel sheet with a corresponding sheet for every different question that people were polled about. All these sheets were merged into one large sheet and each question and answer was combined into one string the placed in a *question_answer* column. The tidy data is detailed below.

Size: 10120 x 4

Columns:

- *question_answer*: (string) This is the poll question and answer category joined and separated by a “-”.
- *country*: (string) Name of the country that participated in the climate poll.
- *response_perc*: (double) The percentage to two decimal places of participants that answered in a given category.
- *unweighted_bias*: (integer) The number of people from the given country that participated in the climate poll.

2.4 Details about the sea ice data

The sea ice data is quite a large set of data, including over 32,000 entries across 45 years of daily measurements of the global ice extent. While the information is important, such specific information will make it hard to measure any trends, and so we have made the north and south data sets show the average ice extent per year. This will help visualize clearly the trend direction of the global ice extent.

Size: 16,836 x 5

Columns:

- Date: (date) Simply the date of which the ice extent was recorded. It is in YYYY-MM-DD form.
- (north/south)_sea_ice_extent: (double) The amount of ice which is covering the sea.

2.5 Details about the storms data

This is data about significant storms and hurricanes from 1850 to 2022

Size: 84,601 × 32

Columns :

- Basin (string) The ocean area in which the storm is found
- Number (int) unique identifier for the year
- NameYear (int) The year when the storm was named
- ObservTime (date) The time up to the minute when each measurement of the storm was made.
- Max wind (int) The highest wind speed that the storm reached in the time it was measured (knots)
- Latitude and longitude (int) The coordinates for the storm's position when it was measured

2.6 Data tidying process

2.6.1 Tidying of the climate data

As detailed above the climate data was in a quite untidy form and in many excel sheets each associated with a climate poll question. All the columns were countries with their answers to each answer category. The countries were then placed in a column with the corresponding questions, answers, response percentage and unweighted bias.

Scoring of the climate concern

Since there were multiple different answers to a given question about the climate it was difficult to numerically represent a country's concern for the given question. To solve this each answer to the question was ranked in order of most concerned to least concerned, converted to a factor, and assigned a level. To obtain a single number to model concern the level of the answer was then multiplied by the percentage of number of responses in that answer. Finally all these weighted values were summed together.

Climate scoring example

2.6.2 Merging the happiness data with climate opinion

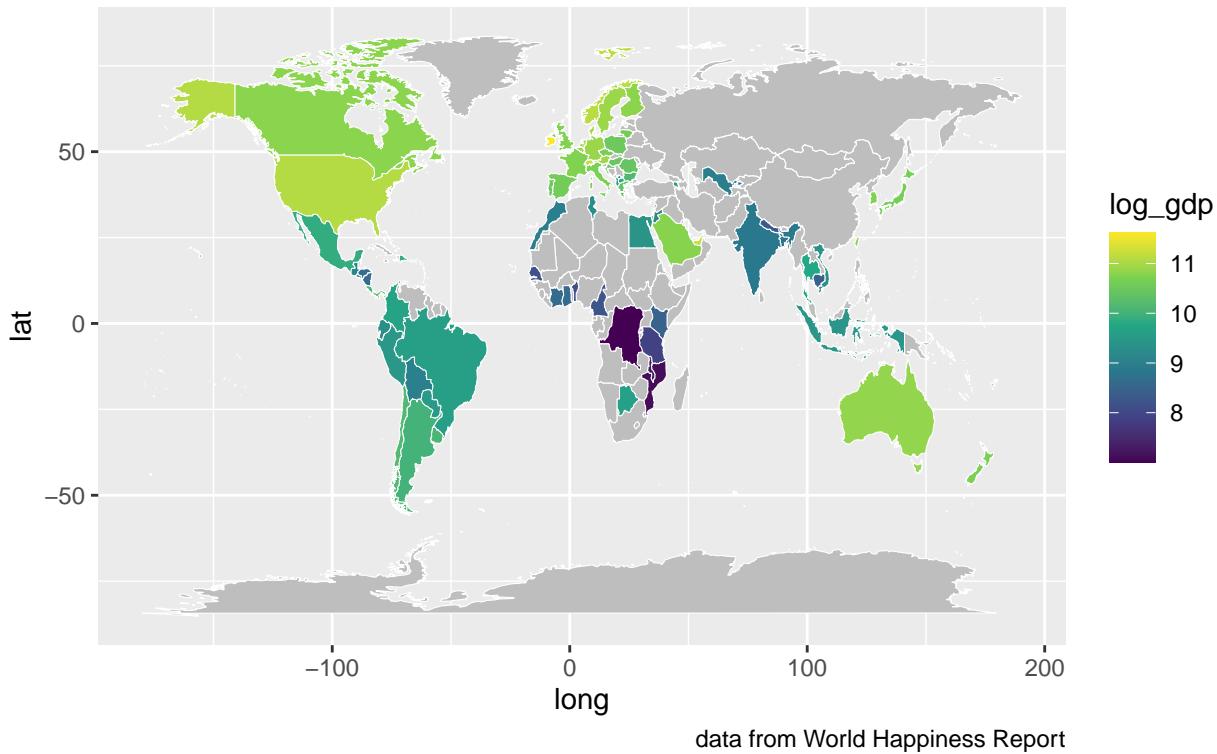
The data sets were merged by country and only the countries that were in the climate opinion data were merged and the rest were discarded. Since there is some ambiguity in country names (like Czechia and Czech Republic) all the country names in the happiness data were renamed to match the climate opinion data.

3 Analysis of GDP

Exploration of GDP and different forms of climate concern

3.1 Distribution of GDP

Figure 3.1.1 What surveyed countries by Gross Domestic Profit per capita
The gdp values are on a logarithmic scale



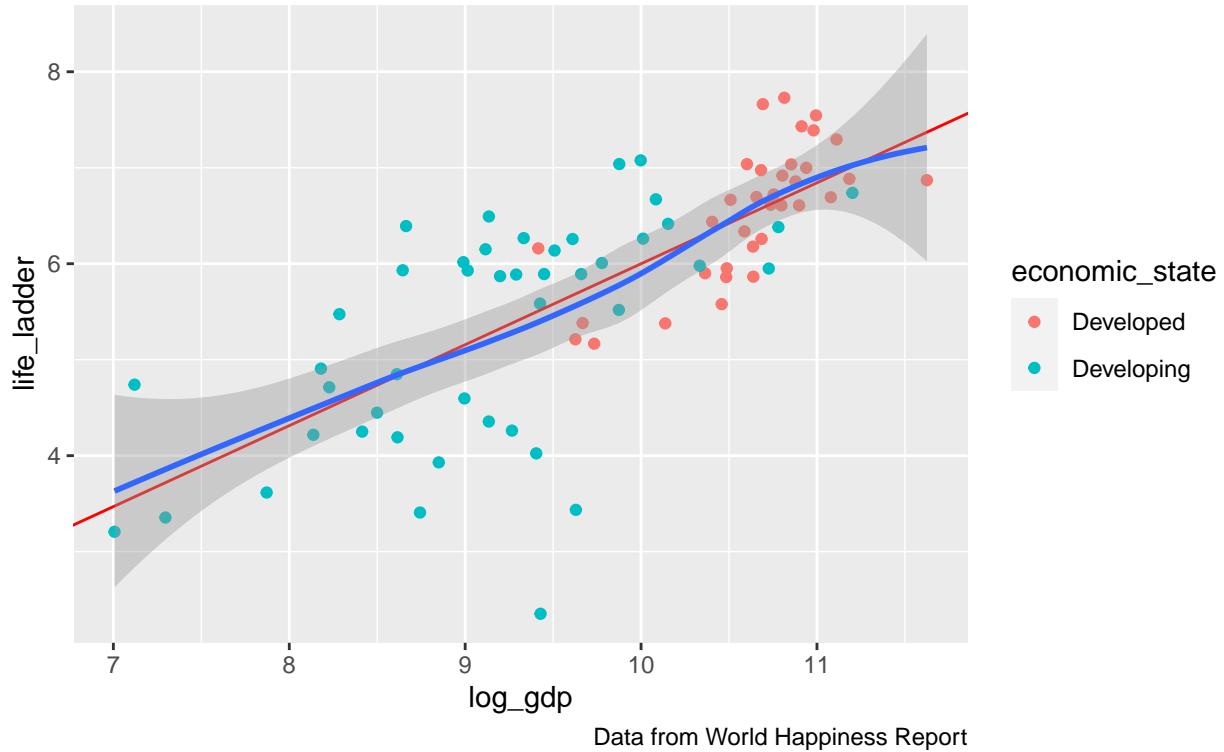
```
## # A tibble: 1 x 6
##   min_log_gdp max_log_gdp min_gdp max_gdp mean_gdp median_gdp
##       <dbl>      <dbl>    <dbl>    <dbl>     <dbl>      <dbl>
## 1       7.01      11.6    1104.  111850.   27403.    19437.
```

Although this map only includes 80 different countries it quite clearly shows some significant differences in the “wealth” per person across different countries. This difference spans 3 orders of magnitude with Ireland having the highest GDP per person per year of $e^{11.62} = \$111850.00$ down to the Democratic republic of the Congo with $e^7 = \$1103.97$. So given these disparities can a person’s concern for the climate be predicted by their wealth? Are wealthy countries more concerned because they have more to lose?

3.2 Why is GDP relevant to climate?

Why are people concerned about the climate? Why would someone care if the world climate becomes less habitable and life becomes harder for humans. Especially if the may not even be alive for any significant climate catastrophe. The answer is that there is ultimately something the people feel is worth preserving on the planet.

Figure 3.2 The relationship between a country's log_gdp and life ladder
 log_gdp and life_ladder have a correlation of 0.748597923794782



Since there is clear correlation of 0.748 between a country's GDP and their life ladder it seems reasonable to presume that people who have higher living conditions have more to lose if the climate does take a turn for the worse and therefore out to be more concerned about the climate. Is the solution to climate complacency simply to allow people to become more wealthy and satisfy the pressing needs of everyday life. Are climate fears really only harbored by people who can actually afford to worry about the long term future and preserving the human flame of consciousness?

4 How does a countries' GDP per capita affect their climate opinions

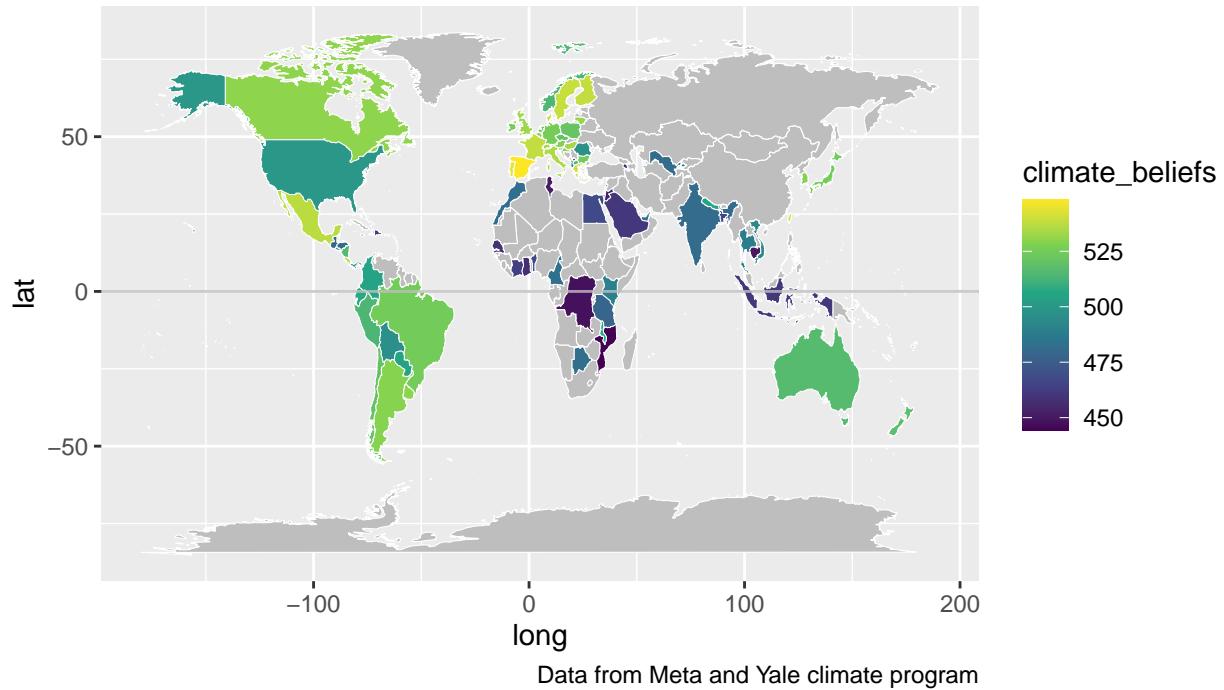
4.1 Maps of climate opinion

The scored climate opinions are mapped to show the distribution of concern about different climate related topics across the world.

4.1.1 Climate beliefs

Figure 4.1.1 Distribution of climate_beliefs across surveyed countries

Question categories: c("Caused mostly by human activities", "Caused about equally by human activities and natural changes", "Caused mostly by natural changes in the environment", "Refused", "None of the above because climate change isn't happening")

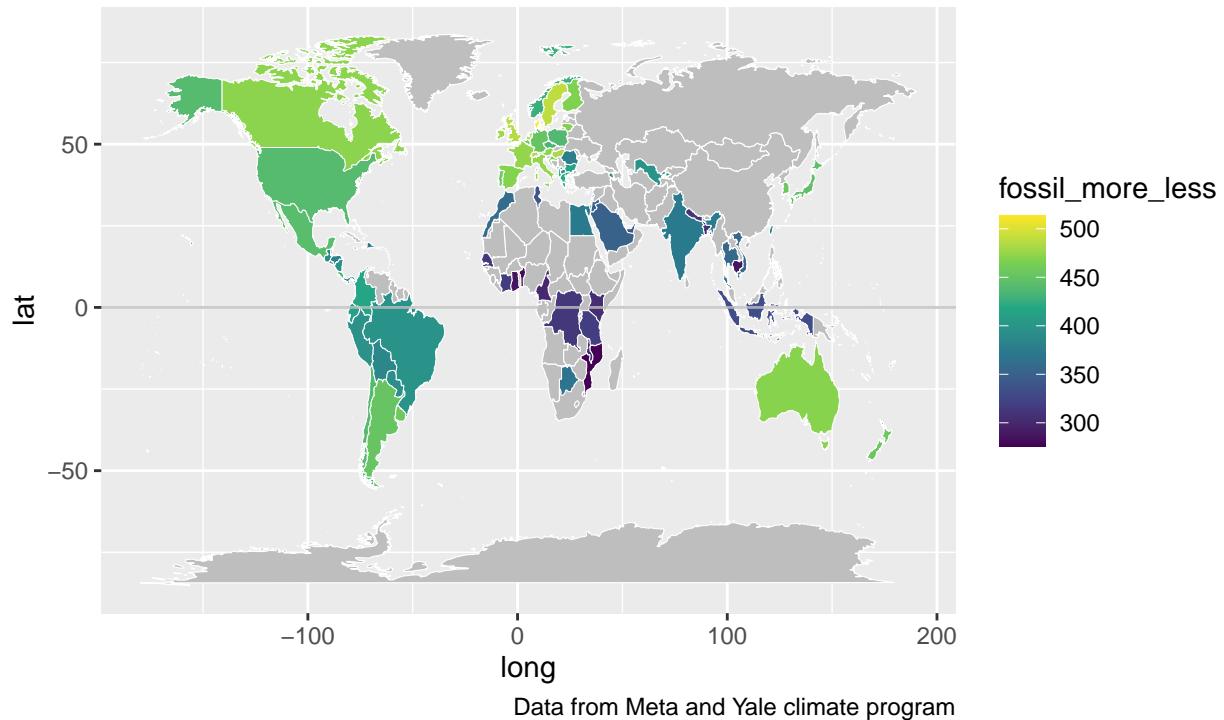


The scoring scale on displays the extent to which people feel that climate change is something primarily caused by humans versus the natural perturbations in earth's course of nature. From this map it seems that many of the developed countries consider climate change to be something as a direct consequence of human action. The more equatorial developing countries consider the climate be more natural.

4.1.2 Fossil fuel reduction

Figure 4.1.2 Distribution of fossil_more_less across surveyed countries

Question categories: c("Refused", "Much less", "Somewhat less", "Don't know", "Same a today", "Somewhat more", "Much more")

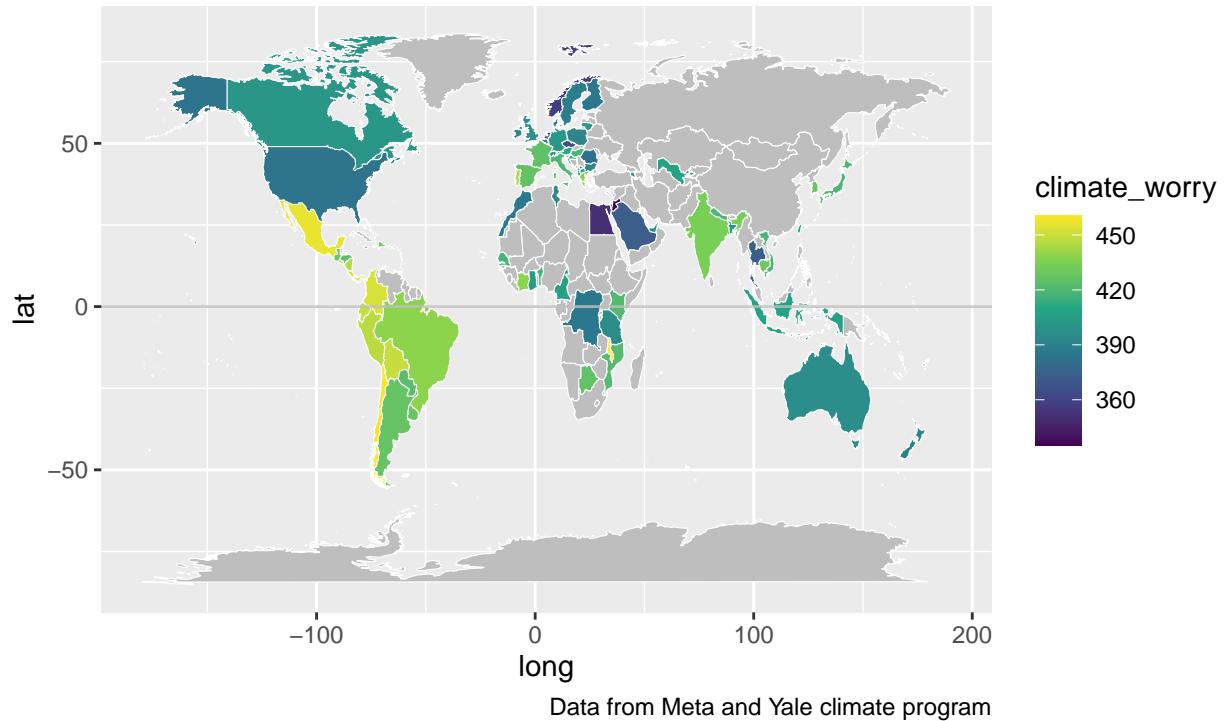


The countries that consider climate change to be a consequence of human activity also seem to be more willing to remove fossil fuels from their power diet. Are countries that are more concerned causes that humans may have on the climate also more willing to reduce fossil fuels. Perhaps there is something deeper underlying this issue. Notice that the countries more concerned about removing fossil fuels are also countries that have a high GPD per capita and higher standing on the life ladder.

4.1.3 Climate worry

Figure 4.1.3 Distribution of climate_worry across surveyed countries

Question categories: c("Very worried", "Somewhat worried", "Not very worried", "Not at all worried", "Refused")

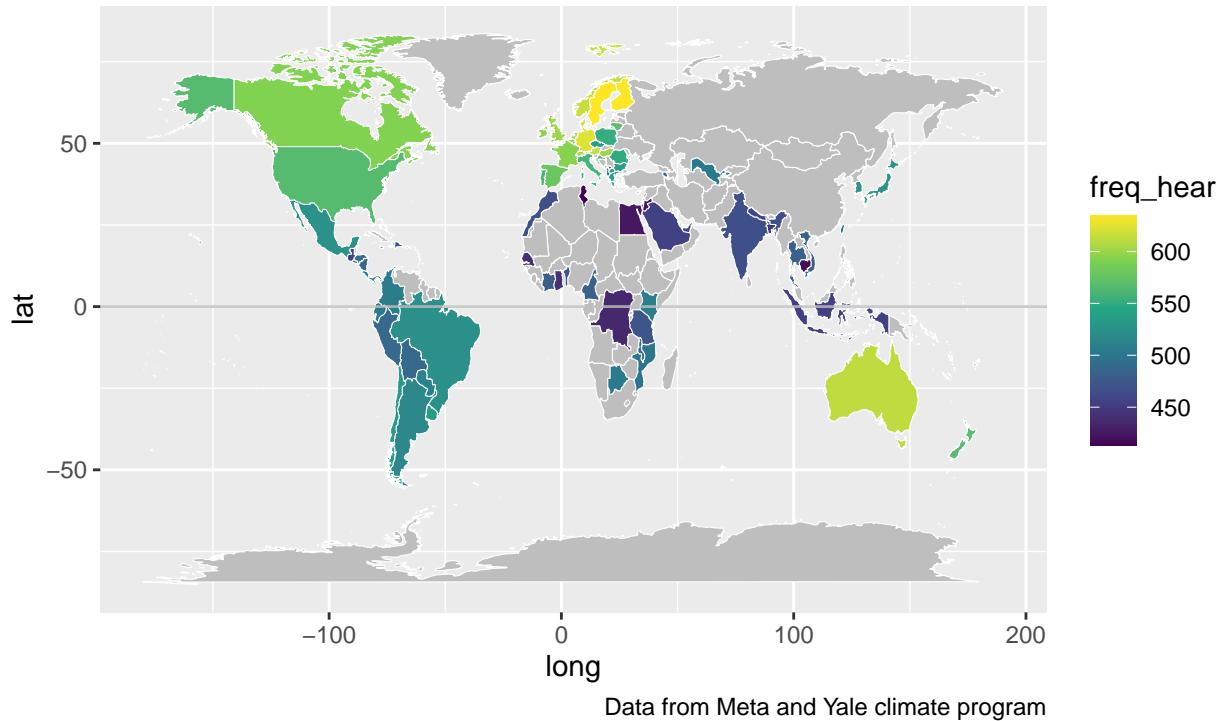


This map shows that many of the countries that believed that climate change is significantly caused by humans and want to get rid of fossil fuels are actually less worried about climate change than those who want to keep fossil fuels as a primary artery for power generation. Evidently fear of climate change does not seem to be the driving factor for the “green revolution”.

4.1.4 Frequency of hearing about climate

Figure 4.1.4 Distribution of freq_hear across surveyed countries

Question categories: c("At least once a week", "At least once a month", "Several times a year or less often", "Once a year or less often", "Don't know", "Never", "Refused")

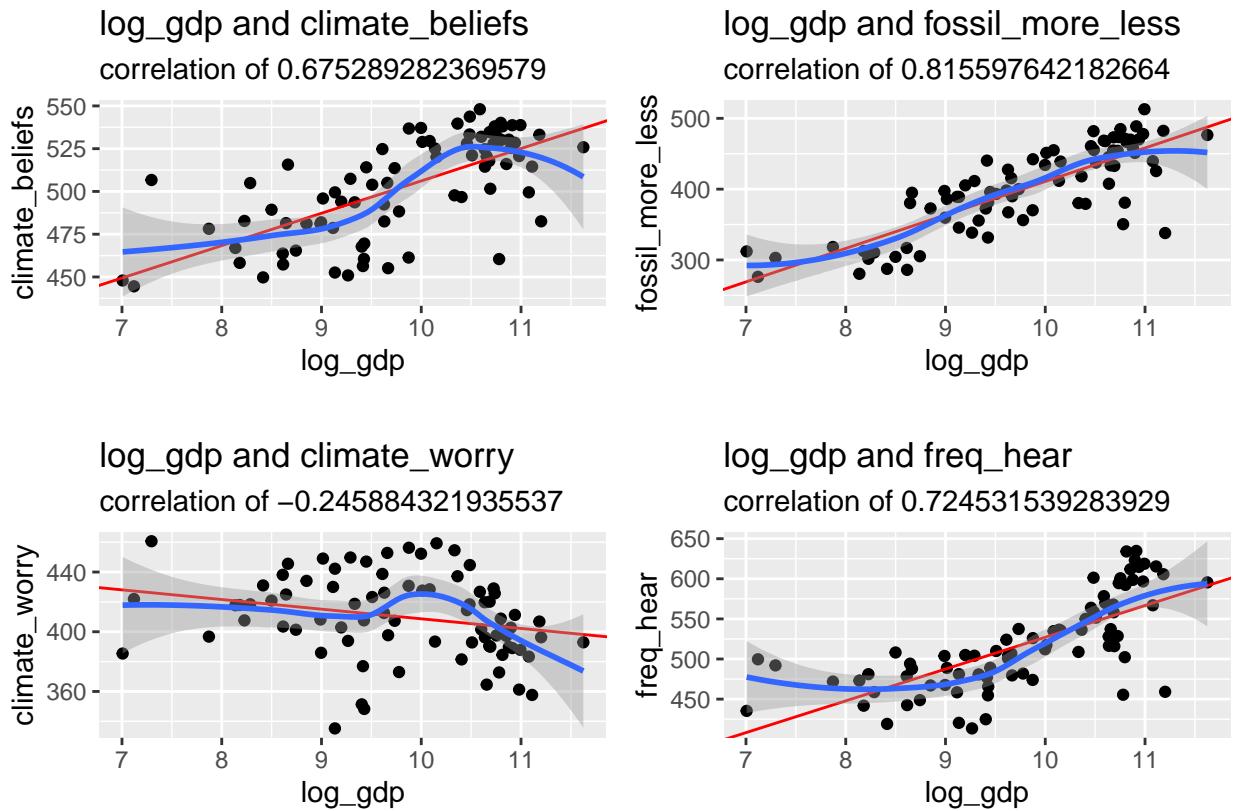


An objection may arise. How do you know that worry is generated by hearing about climate more often. Perhaps in the countries that are more worried also hear about the threats of climate change more often. Figure 4.1.4 refutes that claim and in fact shows that the less concerned countries are actually less worried about the climate than the ones that rarely hear about it. This brings into question the notion of “raising awareness”. Is making people more aware of climate actually helping to bring forward solutions?

4.2 How does economics infiltrates the climate opinion

4.2.1 GDP and climate opinion

Figure 4.2.1 How GDP affects climate opinion



A person's GDP holds little bearing on their worry about climate, but GDP does correlate with the willingness of people to do something about climate change. So it seems more probable that climate worry should be higher in places that are more susceptible to more severe weather and climate related events which is explored in more detail in section 5.

4.2.2 Affordability of reducing fossil fuels

On the other hand climate beliefs, fossil fuel reduction and frequency of hearing all are clearly related to a country's GDP per capita. It is quite clear that wealthier countries are more open to removing fossil fuels from their power production because they believe that that will make a difference. Not only that but until recently the only people who could afford to significantly replace fossil fuels with renewable sources of energy were the countries with a higher GDP per person. As shown in the figure from the Intergovernmental Panel on Climate Change (IPCC) report, it has only been a recent development that alternative sources of power production have become available at a cost comparable to fossil fuels.

The unit costs of some forms of renewable energy and of batteries for passenger EVs have fallen, and their use continues to rise.

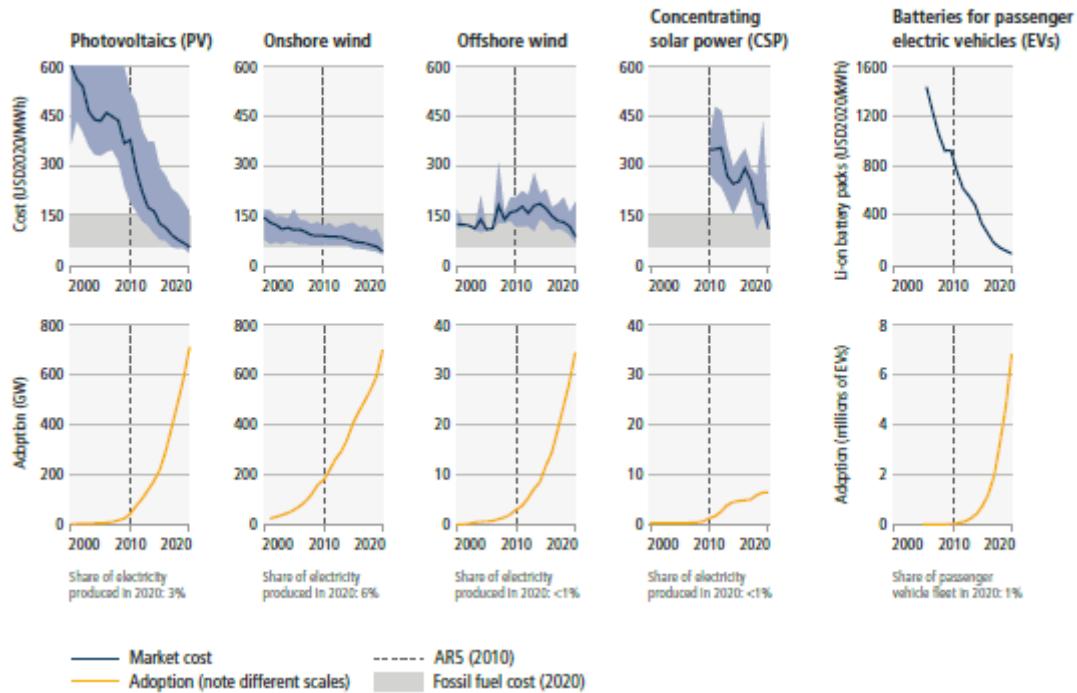
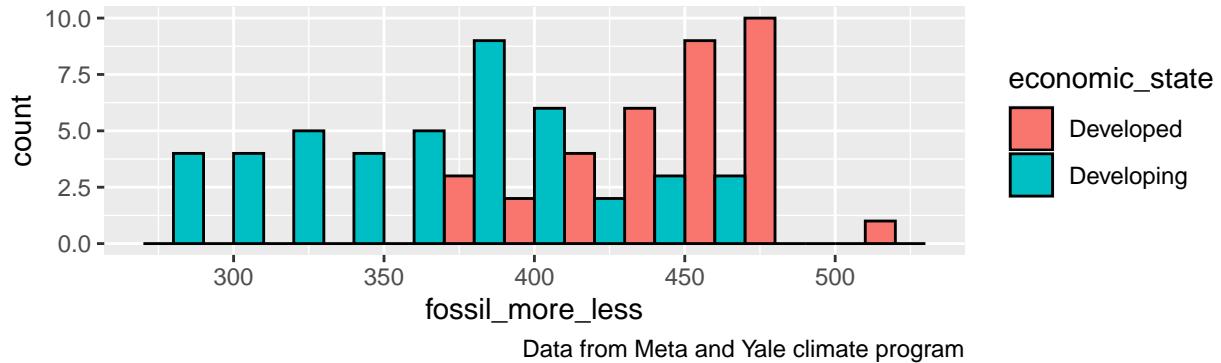


Figure 1: Figure 4.2.2 from IPCC 2023 report <<https://www.ipcc.ch/report/ar6/wg3/figures/summary-for-policymakers/figure-spm-3//>> ([{.uri}](https://www.ipcc.ch/report/ar6/wg3/figures/summary-for-policymakers/figure-spm-3//)>

5. What causes worry about climate

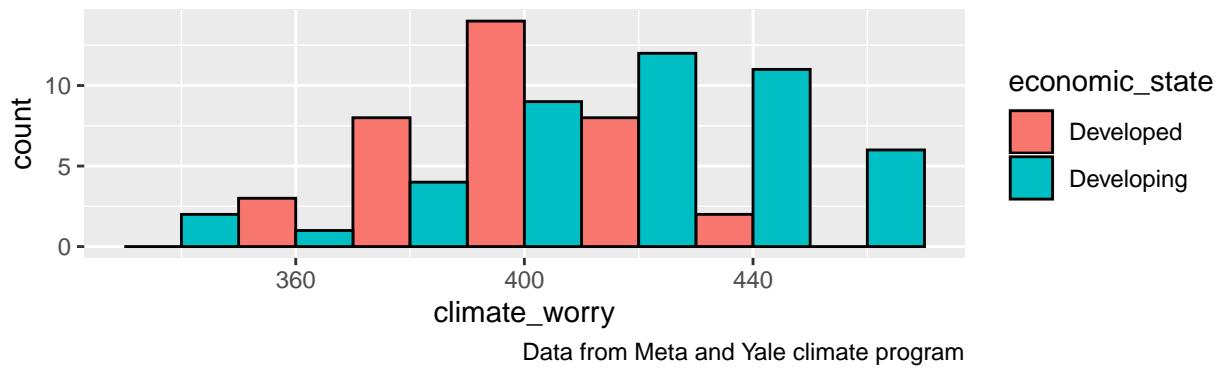
5.1 Climate worry is not related to relinquishing of fossil fuels

Figure 5.1.1 Country's economic state and perception of fossil fuels



Data from Meta and Yale climate program

Figure 5.1.2 Country's economic state and climate worry



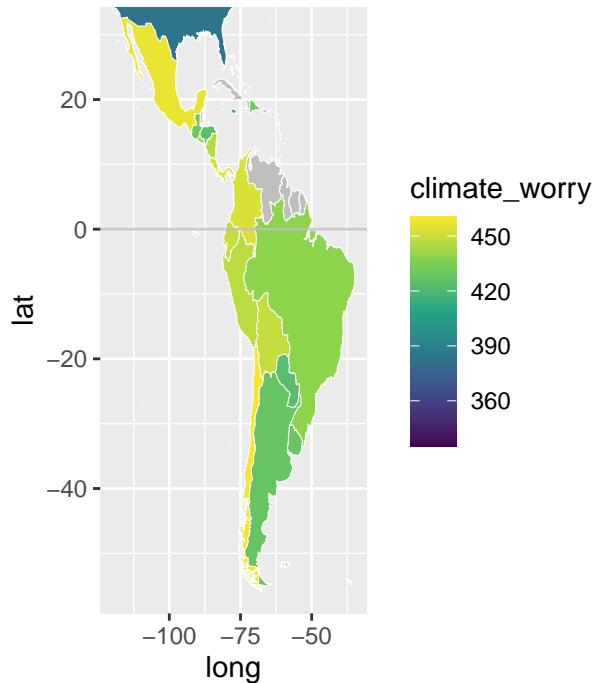
Data from Meta and Yale climate program

Figure 4.2.1, figure 5.1.1, and figure 5.1.2 show that climate worry does not immediately cause people to bring about a solution through reducing carbon emissions from fossil fuels. Therefore fear mongering about the climate is not the solution to fighting climate change. Really the a better approach to incentivizing people to actually do something about the climate is to make them more wealthy. Bring more of the countries from the blue developing category into the red developed class.

5.2 More worried countries are geographically at risk.

Figure 5.2.1 South/Central America

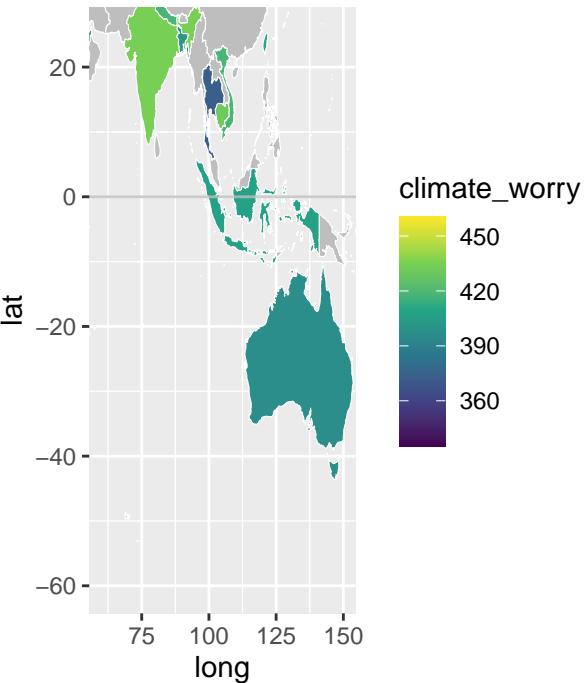
The recession of sea ice and increased storms is more concerning for coastal regions.



Data from Meta and Yale climate program

Figure 5.2.2 South Asia & Pacific

The recession of sea ice and increased storms is more concerning for coastal regions.

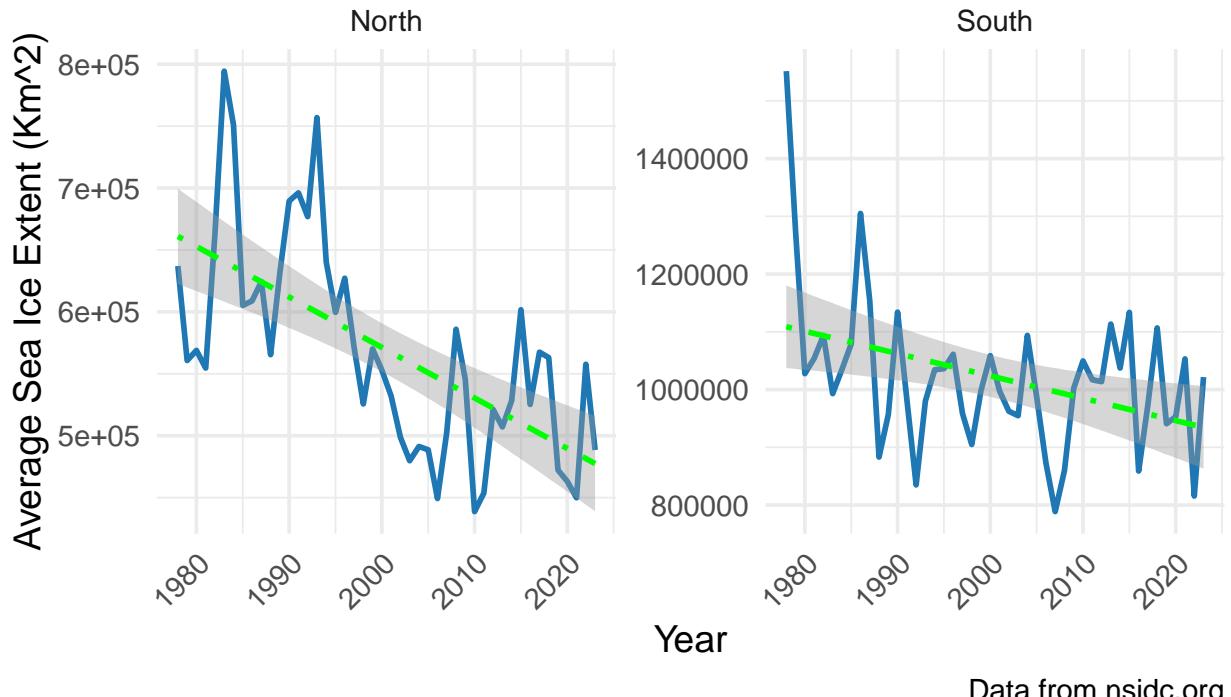


Data from Meta and Yale climate program

The tropical coastal countries appear to be more concerned about the climate than many of the more northern inland countries. Climate change will have the most significant impact on low-income tropical warm countries. Also it is interesting to note that even though both the Asia-Pacific and South/Central American countries are quite worried about the climate, however the South/Central American countries are much more worried.

Figure 5.2.3 Average yearly sea extent ice

The sea ice is declining in both the northern and southern hemisp

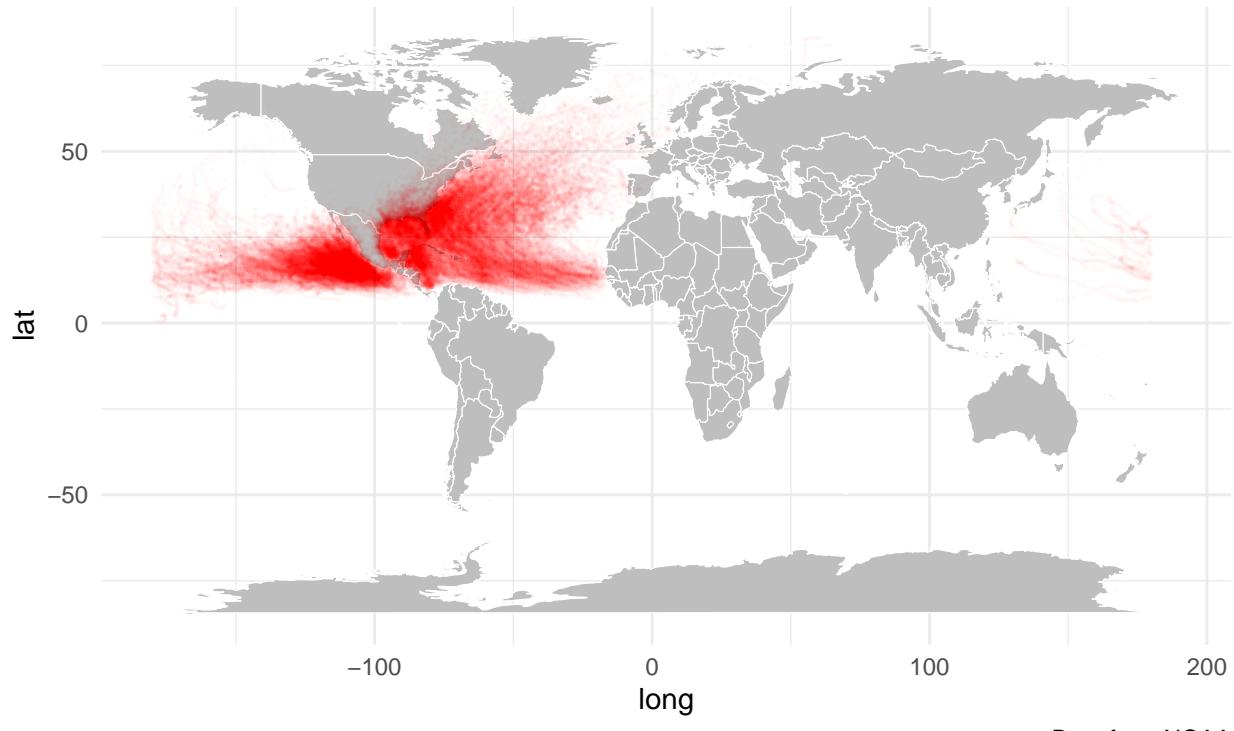


Data from nsidc.org

The downward trending sea ice provided good rational for the concern of that quite costal countries have about climate change. In the event of rampant loss of ice on both the poles islands could be completely engulfed by the sea and costal cities could become like Venice.

Figure 5.2.4 The distribution of major storms from 1850 – 2022

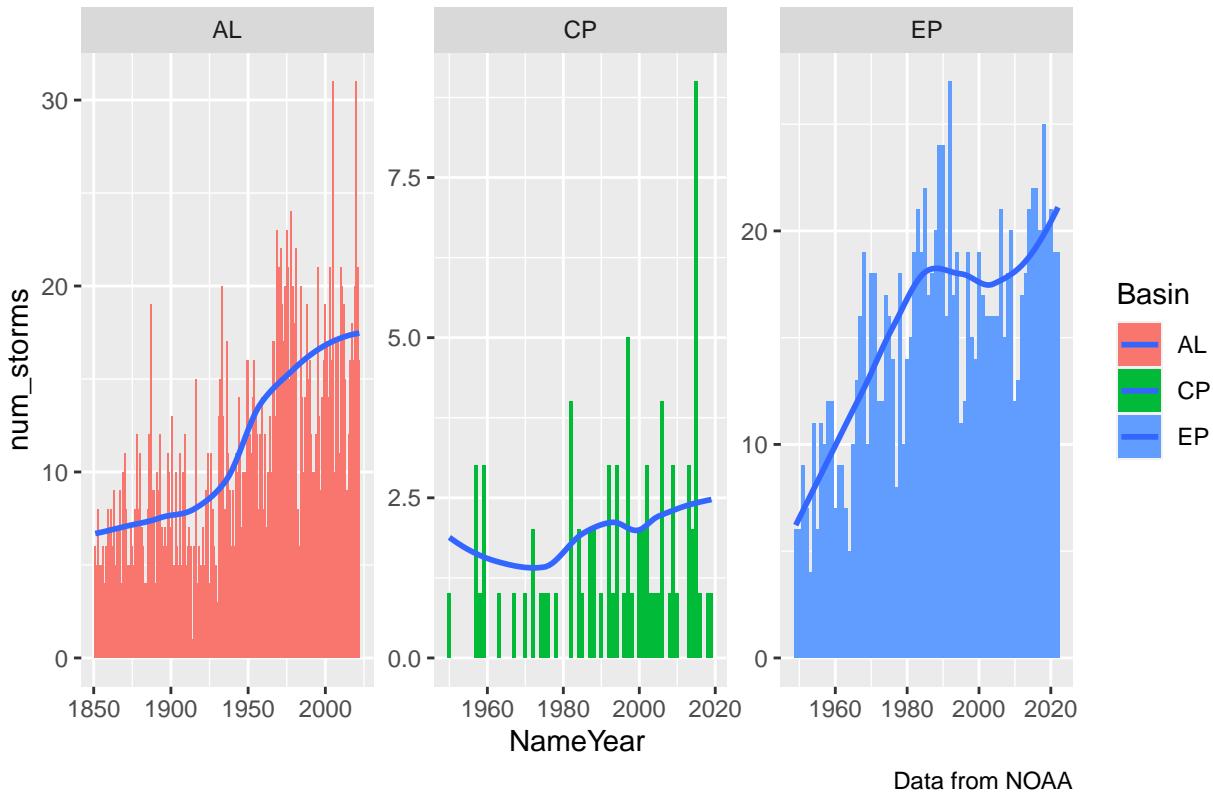
The tropical and coastal central American regions are affected most by increasing climate



Data from NOAA

This may suggest why there is much more climate worry in south/central America. Not only do they have sea ice to worry about, but every year they are pummeled with intense hurricanes and tropical storms.

Figure 5.2.5 The number of major storms per year is trending upwards



Data from NOAA

Another cause for climate concern in the central American region of the world is that there has been an uptick of intense hurricanes and storms. A country's concern for the climate seems very tied to its geophysical location rather than the GDP of that country. It is difficult to not worry about the climate when it continually comes knocking on your back door.

5.3 What can be done for the at risk countries

The declining sea ice and the increased storms pose a great threat to many tropical and coastal countries and hence why they are worried about exacerbating the climate. The best thing that can be done for these countries is allow them to buttress their infrastructure to be able to weather the storms and even a form of dikes for coastal cities that could become submerged by rising sea levels. This kind of preparation will require the country to have a stable economy built from cheap and reliable energy production. Ultimately the best preparation for the storm of climate is to invest heavily in infrastructure engineering to build countries able to handle climate change.

6 Conclusion a better approach to fighting climate change

6.1 Develop more countries

The prior sections have outlined how critical the wealth of a population is to their perception of climate and willingness to curb emissions. Therefore it seems that the best way to apply the brakes to climate change is to allow countries to develop and build strong economies.

The industrial revolution is often cited as the culprit for much of the world's carbon emissions and that is true, but along with emissions we also gained a much broader ability to manufacture and innovate. Todd Moss and Jacob Kincer (March 2023) in their article How does energy impact economic growth? An overview of the evidence show that energy is not only critical for economic

development, but that there are **no** countries that have a high GDP per capita and low energy consumption. Gita Smith another commentator in her article Are Fossil Fuel Resources Important for Economic Development? suggests energy affordability and reliability is critical to economic development and that this energy in the beginning must be fossil fuels. Now we are faced with what would appear to be a dilemma. Curbing global emissions could be done, but not without significant crippling to developing countries and prolonging poverty. Or instead we could allow developing countries to use fossil fuels until they have enough economic stability to transform their power grid.

6.2 Climate change is an engineering problem

Since increasing a country's GDP increases their desire to act about climate the best defense against possible climate change is to satisfy people's needs so they can work towards making a better future. In section 6.1 we saw that increasing GDP is a matter of making energy more available. As was discussed in the figure from the IPCC 2023 report, engineering from 2010 to the present has significantly decreased the cost of both solar and wind production of power to the point where they rival fossil fuels in inexpensiveness. Also battery technology is on the rise which will allow renewable sources of energy to be reliable in combination with inexpensive. Therefore instead of ensuring that developing countries remain poor by removing their access to reliable energy the developed countries should use their capabilities to help developing countries build better energy grids.

7.1 References

- Are fossil fuel resources important for economic development?. School of Economics. (n.d.). <https://econ.gatech.edu/projects/are-fossil-fuel-resources-important-economic-development>
- IPCC. (2021, August 9). Figure: SPM.3. IPCC Intergovernmental Panel on Climate Change. <https://www.ipcc.ch/report/ar6/wg3/figures/summary-for-policymakers/figure-spm-3/>
- Moss, T., & Kincer, J. (2023, June 12). How does energy impact economic growth? an overview of the evidence. Energy for Growth Hub. <https://energyforgrowth.org/article/how-does-energy-impact-economic-growth-an-overview-of-the-evidence/>