

Visualization Project Proposal

Basic Info

The title of our final project is: *Climate Change: Factors and Rates*. The people in this group are **Ellery Gresham, Luke Schreiber, and Jeremy Reynolds**. The email addresses of each group member are: ellerygresham13@gmail.com (Ellery), lucasjschreiber@gmail.com (Luke), and u0551837@utah.edu (Jeremy). The UID of each student is: u1276249 (Ellery), u1282370 (Luke), and u0551837 (Jeremy). The link to our github repository is [Github Repository](#).

Background and Motivation

This project topic was chosen due to climate change being a topic that has been discussed between scientists for years and will continue to be discussed for many more. Climate change affects every individual daily, whether they notice the change or not. Climate change is an interesting topic because even though there is an adequate amount of data that shows the rates of climate change, nobody seems to want to acknowledge it. Climate change affects a person's health, ability to grow, housing, safety, and work (United Nations).

The topic of climate change can also be a controversial one. It is an ongoing debate between scientists all over the world whether climate change is something we should worry about or not. The effects of climate change can become irreversible if something is not done soon to reverse the effects it has had the past few years. Since 1880, Earth's temperature has risen by an average of 0.14° F. per decade (Lindsey and Dahlman). The 10 warmest years that exist in the historical record have all occurred since 2010. While we know that the heat is increasing, what factors are contributing to this increase?

Our project is going to focus on the factors that contribute to the rise in Earth's temperature and at what rate each factor is affecting the atmosphere. The data we find will help us analyze the current factors that contribute to climate change and which factor is correlated to the most harm. Some of the factors we will focus on is the effect of CO₂ emissions, methane emissions, and deforestation habits.

Data

We will be collecting our data through the website Kaggle. Here are the data sets we are looking to use:

Kaggle: [Global Warming Trends \(1961-2022\)](#)

The dataset is stored as a .csv file containing attributes for Country, ISO2 (country code), Year, and Temperature from 1961 – 2022.

Kaggle: [CO2 Emissions](#)

The dataset is stored as a .csv file containing attributes for Country Code, Country Name, Year, and CO2 Emissions in kilotons (kt) from 1960 – 2019.

Kaggle: [Methane Emissions Around The World \(1990-2018\)](#)

The dataset is stored as a .csv file containing attributes for Country, Sector, Gas, Metric tons of carbon dioxide equivalent, and years from 1990 – 2018.

Kaggle: [Deforestation and Forest Loss](#)

The dataset is stored as a .csv file containing attributes for Entity (country), Code (ISO3 country code), Year, and Net Forest Coverage from 1990 – 2015.

Data Processing

Substantial data cleanup is not expected. A preliminary examination of the datasets indicate that the following cleanup is required.

- Global Warming Trends:
 - Convert the ISO2 country code to an ISO3 country code if required.
 - Remove ‘F’ from the Year values.
 - Convert Temperature values to Celsius if necessary.
- CO2 Emissions:
 - Convert the ISO3 country code to an ISO2 country code if required.
 - Impute missing CO2 Emissions values with averages where appropriate.
 - Convert CO2 Emissions to metric tons if necessary.
- Methane Emissions:
 - Add ISO2 or ISO3 country code.
 - Convert CO2 Emissions to kilotons if necessary.

- Convert Carbon Dioxide Equivalent to kilotons if necessary.
 - Melt the dataset to move the Year columns into rows.
 - Impute missing Carbon Dioxide Equivalent with averages where appropriate.
- Deforestation and Forest Loss:
 - Missing Net Forest conversion values may be difficult to impute since measurements were taken every 5 years, so fields may be dropped instead.

Derived Quantities

- Global Warming Trends
 - Annual temperature by country in Celsius.
- CO2 Emissions
 - Annual CO2 emissions by country in metric tons or kilotons.
- Methane Emissions
 - Annual carbon dioxide equivalent methane emissions in metric tons or kilotons.
- Deforestation and Forest Loss
 - Net forest coverage by country in square meters. Measurements are in 5-year increments.

For data processing, we will analyze, clean, and combine multiple datasets in Excel with supplemental assistance from Python as needed.

Visualization Design

We will display our data using D3 and Javascript to build an interactive visualization. We would really like to implement a world map of every country that shows each factor we are focusing on (**Figure 1**). We also want to have small graphs that appear when you click on specific countries (**Figure 2**). We will also want to have a click button that allows the user to view as little or as many factors as they would like to, all at once.

Three alternative prototype designs:

1. A world map of every country, with tabs for each of the four categories of change: Deforestation, Methane, CO2, Temperature. (**Figure 1**)
2. A heat map that shows each country and the darker red the country is, the higher the global temperature is for that country. This is also equipped with an interactive time change slider. (**Figure 1**).

3. General correlation graphs that show the correlation between each of our independent variables (CO₂, Methane, Deforestation) and our dependent variable (Temperature) (**Figure 4**).

Ultimately, we would like the full website design to contain an introduction, a conclusion, a world map visualizer, and graphs that demonstrate the factors which correlate to temperature change (**Figure 5 & 6**). We can either lay this information out in scrolling order, or in click-to-expand tabs (**Figure 6**). Prototype number two can also be modified to instead show change from the previous year (**Figure 3**) in either temperature, CO₂, Methane, or Deforestation. This can be accomplished with a click box.

While it's typically best to encode magnitude channels with something like position or size, we chose to use a world map with changing colors over time to indicate change in rates instead. The reason is that the image of a world map is visually recognizable and more memorable. However, our correlation graphs will be encoded with position and a line of best fit for clarity. Our final graph will show which factors correlate the greatest to temperature change (**Figure 5**), and this categorical data will be encoded using color and position.

Must-Have Features

One must-have feature we would like implemented in our final project visualization is a slider bar. Since we will be analyzing climate change through the years 1990-2015, we want to create a slider bar that changes the visualizations with the years. This allows the viewer to interact with the visualization and be able to see specific years that they choose. The visualization will change based on what year the slider is set to.

Optional Features

One optional feature we would like to implement is groupings of continent or broader region data, rather than individual countries. This is easier for the eye to parse the general changes in climate over the last 80 years.

Another optional feature we would like to implement is several different graphs depicting the factors along with the world continent graph. We want to have graphs that have several click-boxes that show each factor: methane, CO₂, and deforestation rates compared to the global

temperature for that year. There will also be a box that says “Show Previous Year” that when clicked will allow the viewer to compare the previous year’s rates with current year’s rates.

Project Schedule

Week 5: Project Review

GOALS:

- Have a rough draft of the start of our website
- Have at least one rough draft of a graph using D3 and Javascript

Week 11: Project Milestone

- GOALS:

- Have at least one graph perfectly working using D3 and JavaScript
- Have the final Website design and layout done

Week 12: Peer Feedback

- Have all visualizations and animations working properly
- Have website designed and information posted about the reason for our project and what climate change is

Week 15: Final Project Submission

- Have all final touches done
- Have visualizations working for all aspects
- Have website design perfected
- Submit the final project with time to spare

Figure 1

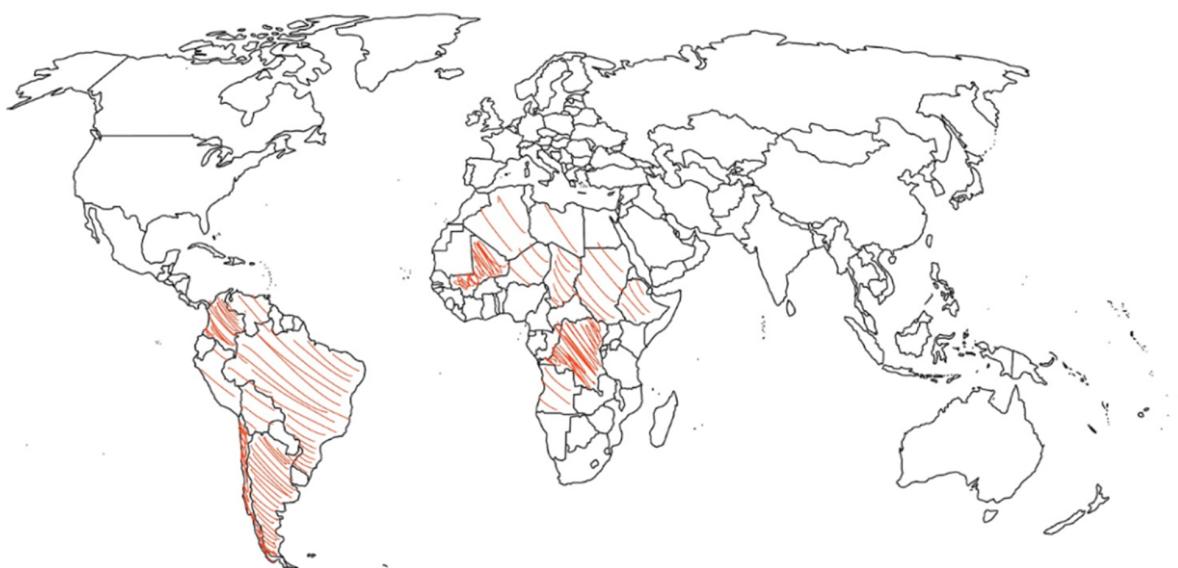
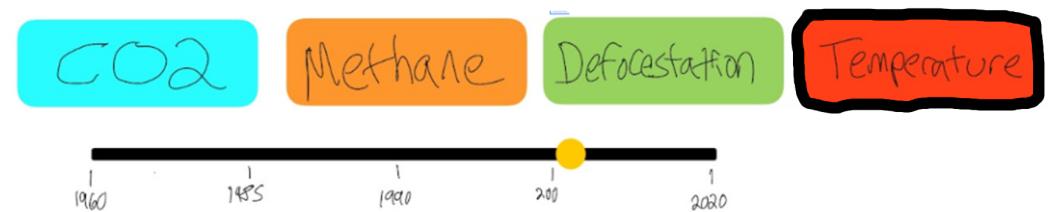


Figure 2

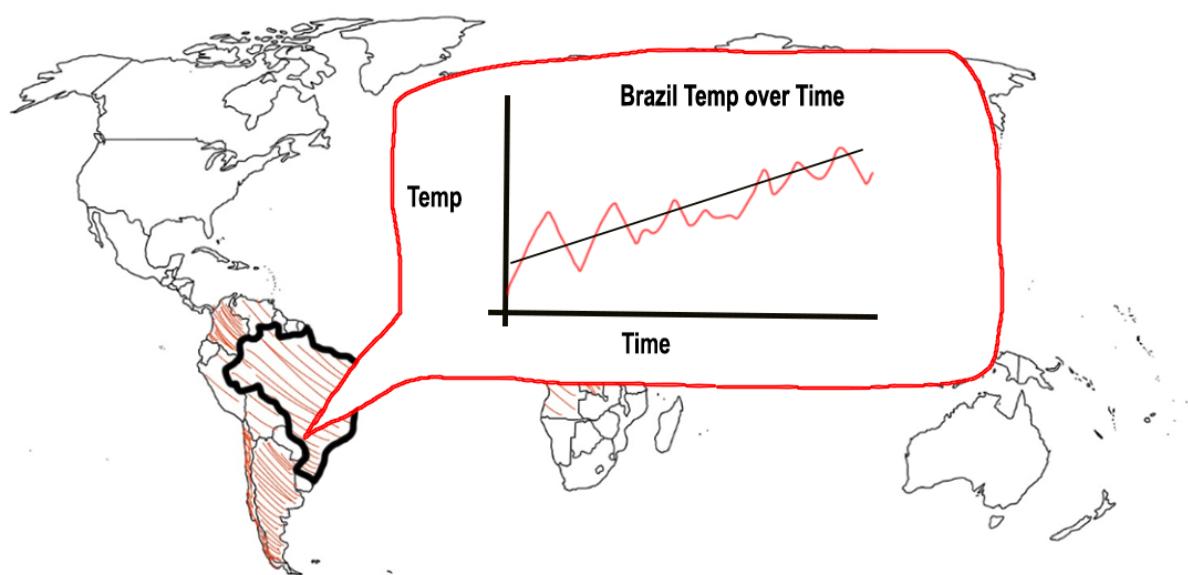
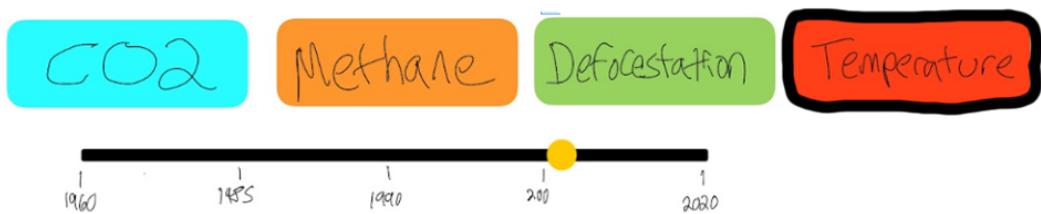


Figure 3

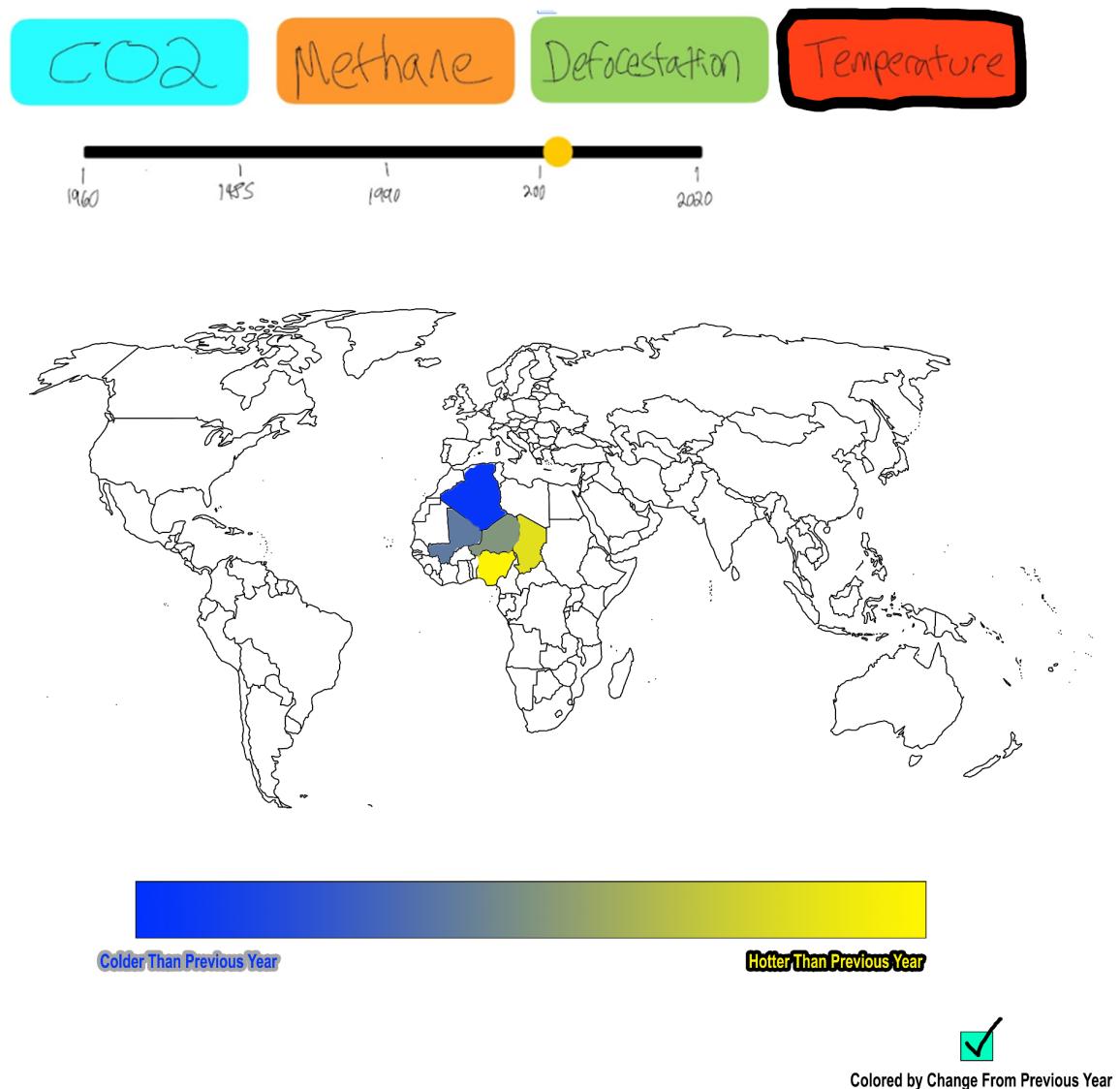


Figure 4

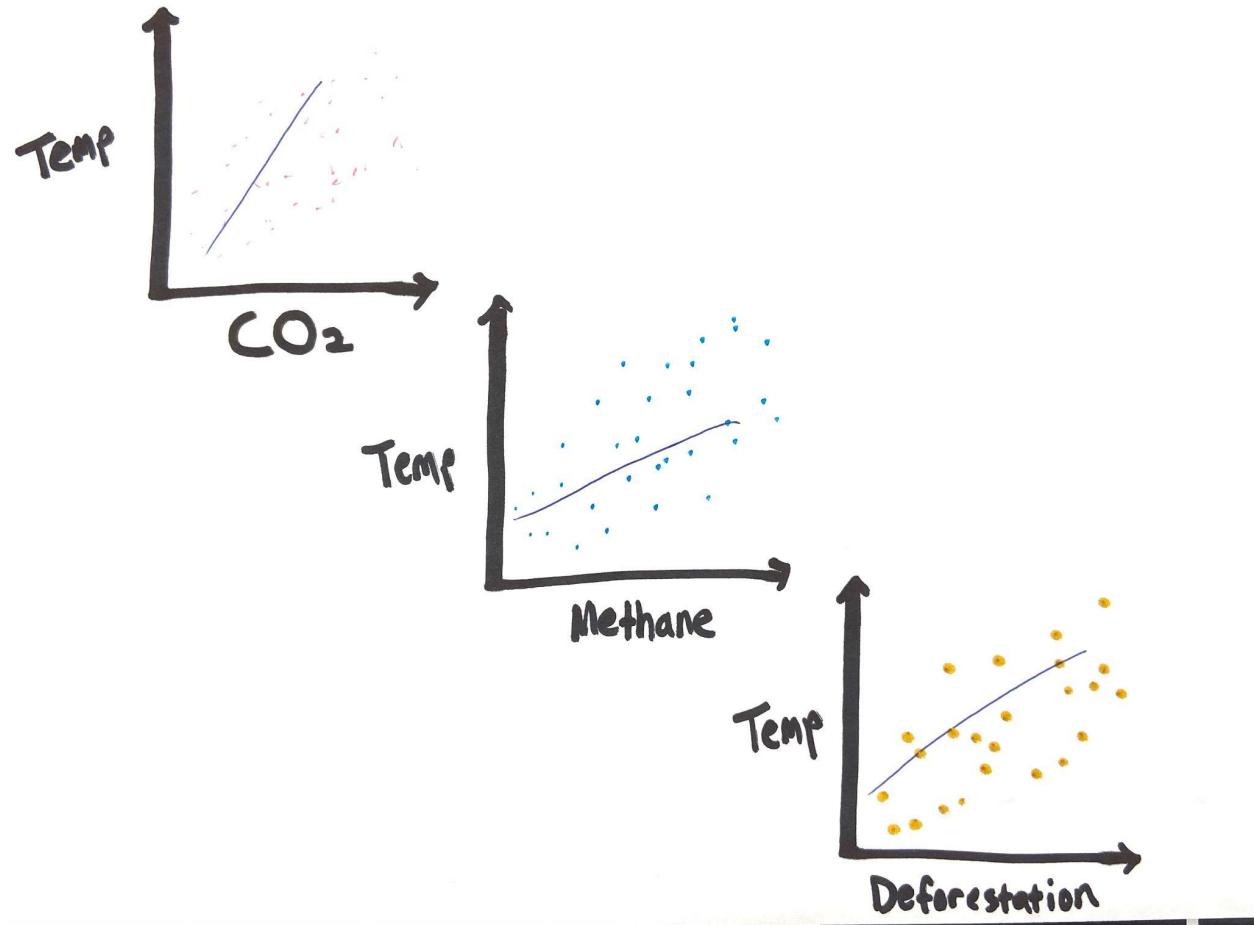


Figure 5

Factor Correlation Strength to Temperature

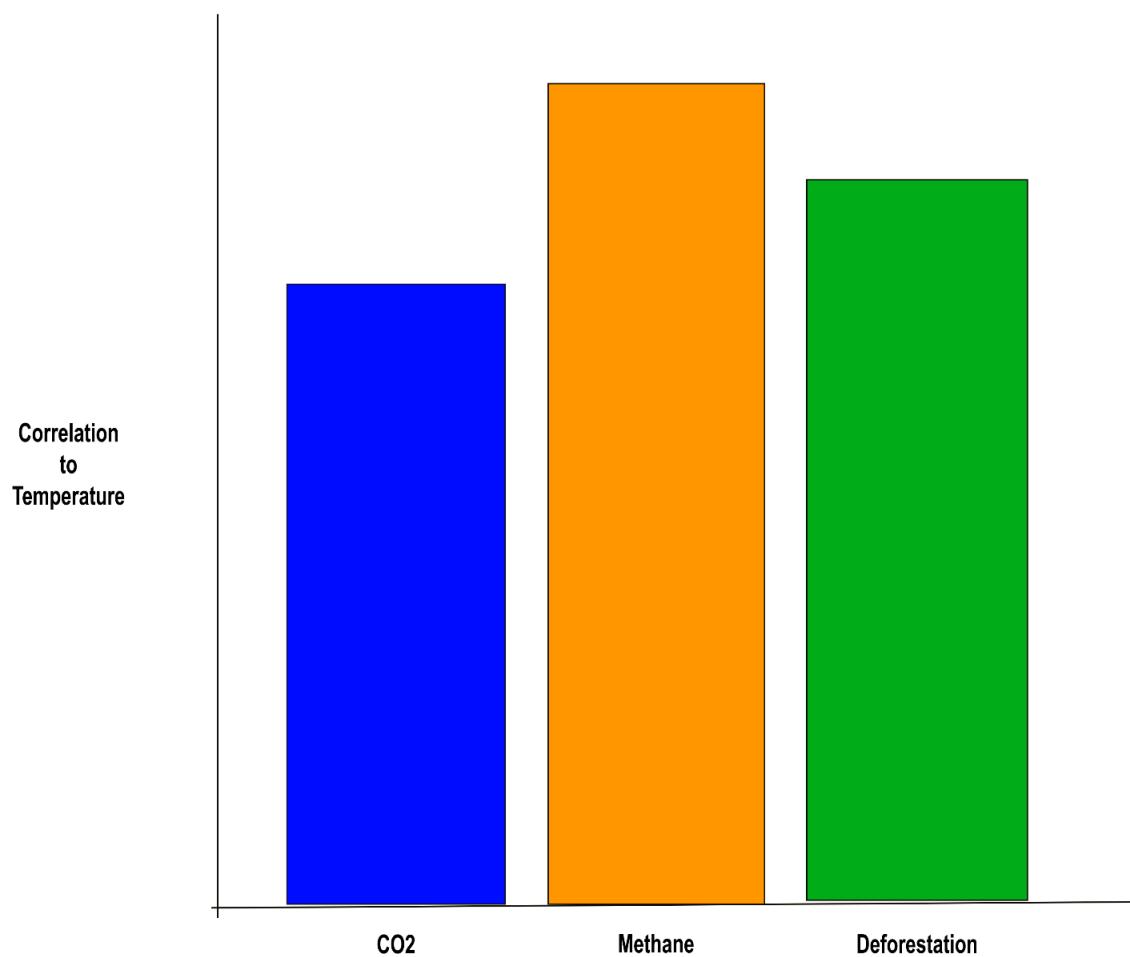
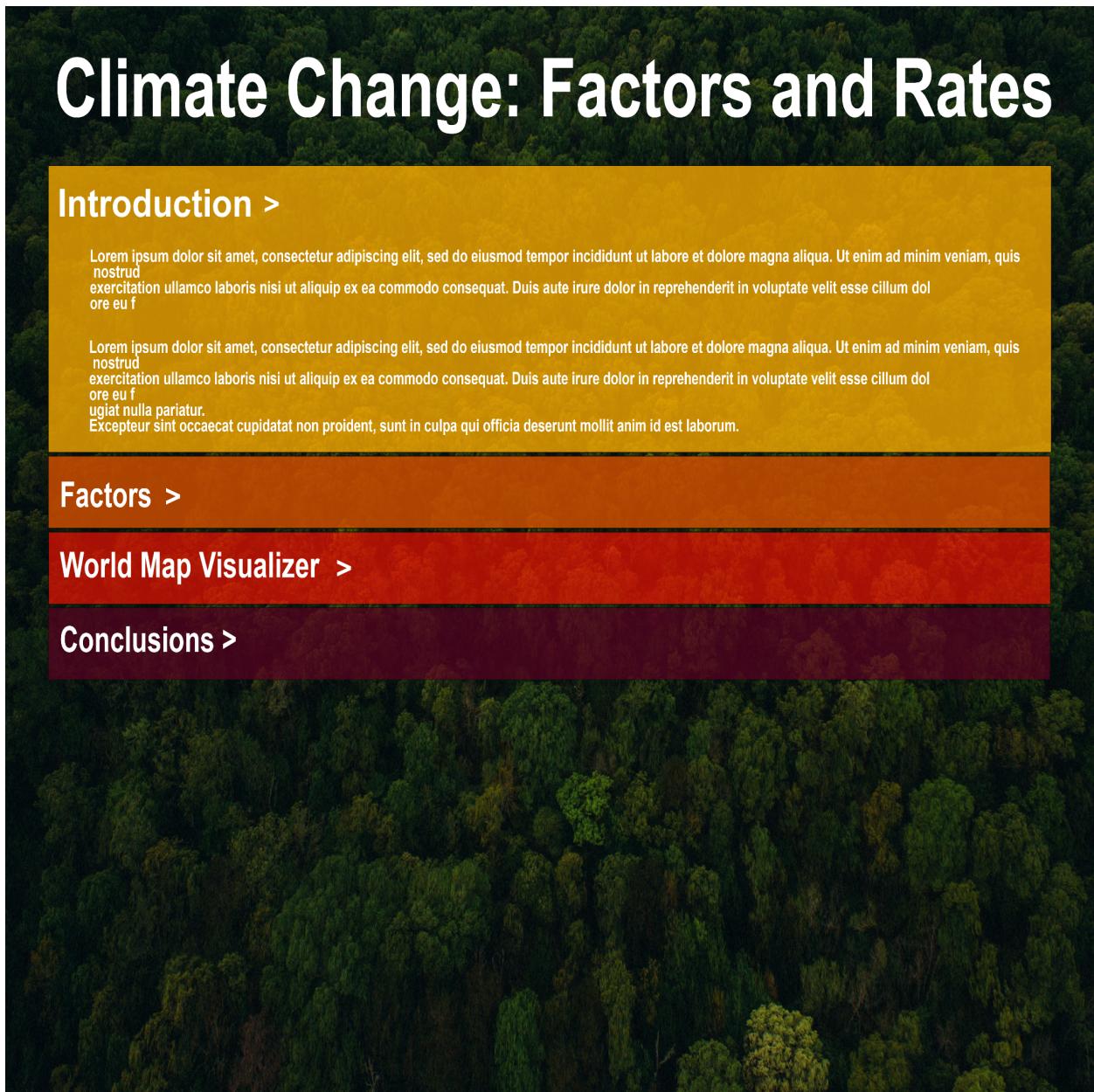


Figure 6



Works Cited

- Lindsey, Rebecca, and LuAnn Dahlman. "Climate Change: Global Temperature | NOAA Climate.gov." *Climate.gov*, 18 January 2023,
<https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature>. Accessed 12 September 2023.
- United Nations. "What Is Climate Change?" *United States | Climate Action*,
<https://www.un.org/en/climatechange/what-is-climate-change>. Accessed 11 September 2023.