Visualizing the Impact of Global Climate Change

- Team S

Team Members

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Introduction

- Climate change represents one of the most pressing challenges of the 21st century, with extensive implications for environmental systems, economic structures, and societal well-being.
- Despite the abundance of scientific data, there remains a significant gap between expert understanding and public comprehension of the impact of climate change.
- This project aims to bridge this gap by developing an interactive visualization tool that processes multidimensional climate data into accessible, engaging, and informative visual representations.

Motivation

- **Complexity of Climate Change:** Climate change involves many interconnected factors, making it difficult to communicate its impacts effectively to non-experts.
- **Limitations of Existing Tools**: Numerous visualization tools exist, but they often focus on isolated aspects of climate change. These tools fail to provide a comprehensive view of the issue.
- **Project Aim:** Our project seeks to address these limitations by creating an interactive visualization platform. This platform will integrate diverse climate indicators into one cohesive tool.
- **Goal:** By providing a holistic view, we aim to help people better understand the connections between different climate factors and their overall impact on the world.

Project Significance

The significance of this project lies in its potential to:

- Enhance public understanding of climate change through intuitive visual representations of complex data.
- Facilitate evidence-based decision-making for policymakers and stakeholders.
- Contribute to climate change education and awareness initiatives.
- Provide a valuable resource for researchers studying the multifaceted impacts of climate change.

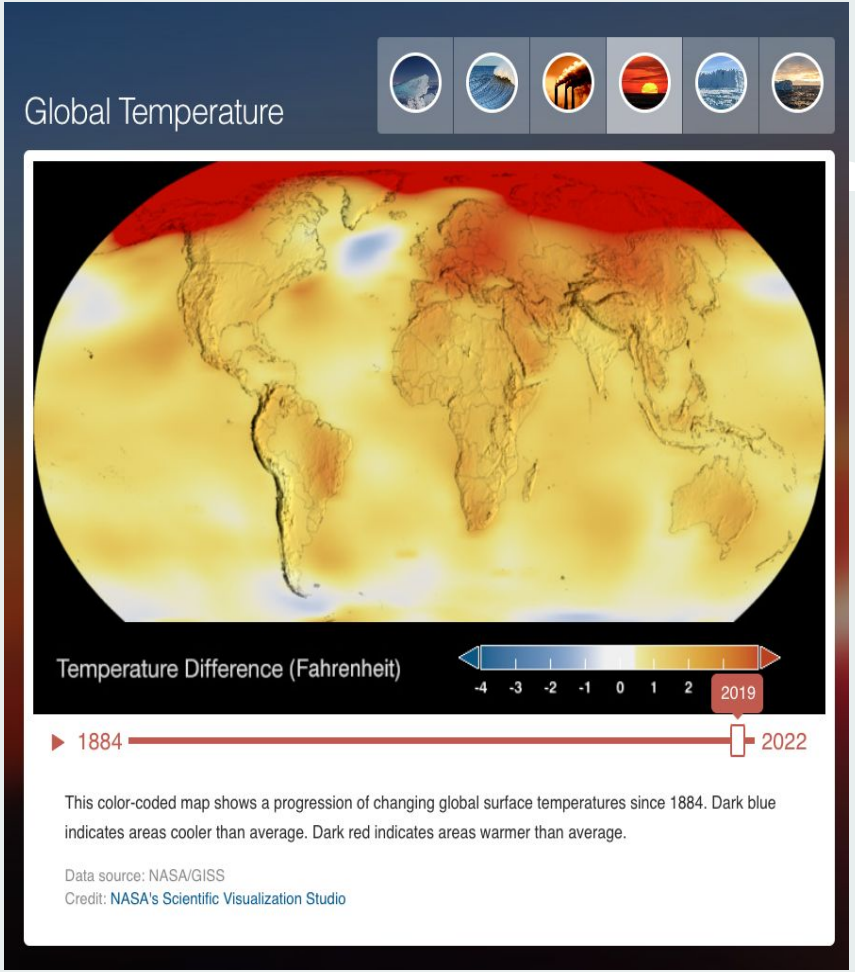
Background

Existing climate change visualizations have made significant strides in representing specific aspects of the phenomenon. For instance:

1. NASA's Climate Time Machine:

- This interactive tool allows users to visualize changes in sea ice, sea level, carbon dioxide, and global temperature over time.
- While comprehensive, it separates different climate factors into distinct visualizations, making it challenging to see interconnections between various aspects of climate change.

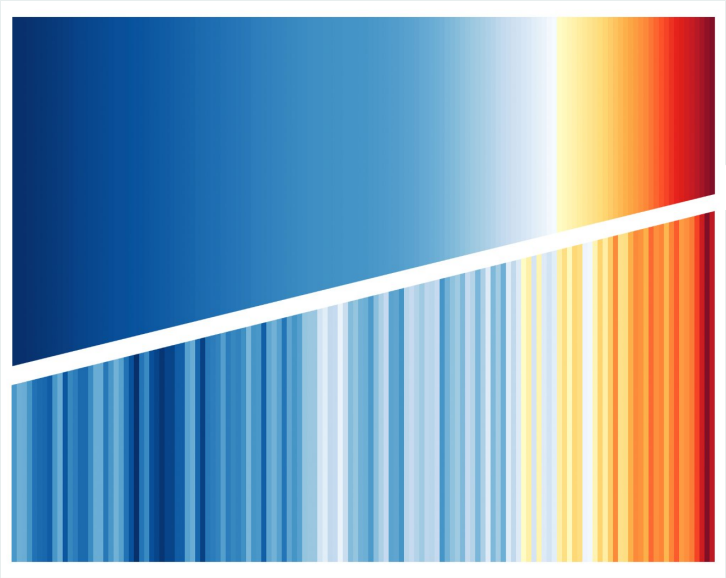
Source:https://climate.nasa.gov/interactives/climate-time-machine/?intent=021



Background

2. Ed Hawkins' "Warming Stripes" and Variations:

- These simple yet powerful visualizations show temperature changes over time using color-coded stripes.
- While visually striking and easily understood, they focus solely on temperature and don't provide detailed information or interactivity.



Source: https://emanuele.bevacqua.eu/climatevisuals/

3. IPCC Visualizations:

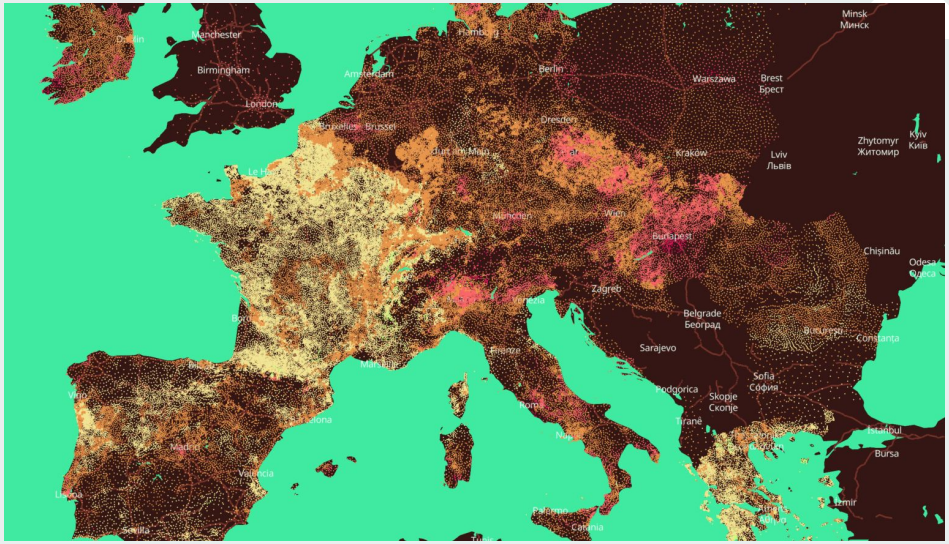
- The Intergovernmental Panel on Climate Change (IPCC) produces complex visualizations that depict various climate change impacts.
- However, studies have shown that non-scientists often struggle to interpret these visualizations correctly.
- The challenge lies in balancing scientific accuracy with accessibility for lay readers.

Source: https://arxiv.org/html/2211.10254v3

Background

4. Interactive Regional Visualizations:

- Tools like the European Data Journalism Network's map of rising temperatures in Europe provide detailed, localized information.
- While valuable for regional insights, such visualizations often lack a global perspective and don't clearly show interconnections between different climate factors.



Source: https://theglobalobservatory.org/2021/12/new-climate-data-visualizations-2021/

Questions and Goals

Questions:

1. What combination of key climate indicators provides the most comprehensive understanding of global climate change impacts?
2. How can diverse climate data be effectively integrated and visualized to illustrate the interconnections between different environmental and socio-economic systems?
3. What visualization techniques are most effective in communicating complex climate data to lay-man audiences?

Goals:

1. Develop a multi-dimensional, interactive visualization tool that integrates data from various climate indicators to provide a holistic view of global climate change.
2. Create engaging and accessible visualizations that enhance public understanding of climate change dynamics and impacts.
3. Facilitate the exploration of relationships between different climate indicators and their effects across various sectors.

Datasets

1. **Climate-related Disasters Frequency:**
   Provides country-level data on the frequency of climate-related disasters such as floods, storms, and droughts, with detailed statistics over time.
2. **Annual Surface Temperature Change:**
   Presents global surface temperature anomalies measured annually from 1880 to 2022, offering insights into long-term warming trends.
3. **Forest and Carbon Data:**
   Includes data on forest area and carbon stocks, showcasing the impact of deforestation and forest growth on global carbon levels.

Source: https://climatedata.imf.org/

Data Processing Methods

Data Cleaning:

- Handle missing values through interpolation or multiple imputation techniques.
- Identify and remove duplicate entries.
- Standardize country names and codes across datasets.

Data Integration:

- Develop a unified data model to integrate diverse climate indicators.
- Implement data normalization techniques to ensure comparability across different scales and units.

Feature Engineering:

- Create indicator variables that capture the correlation between different climate variables.
- Derive time-series features to capture trends and seasonality in climate data.

Statistical Analysis:

- Conduct correlation analysis to identify relationships between different climate indicators.
- Perform time-series analysis to detect long-term trends and anomalies in climate data.

Preliminary Exploration

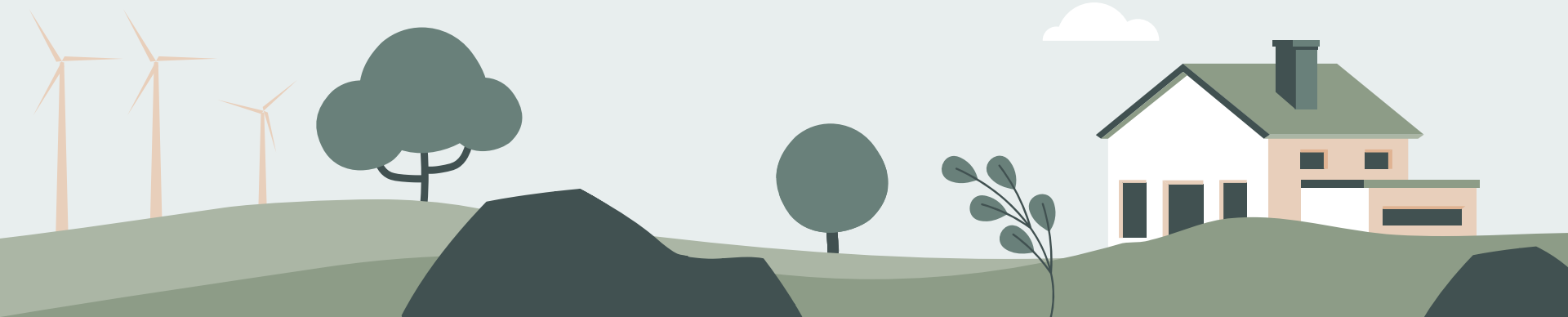
Climate related DIsaster Frequency Dataset:

- **Key Variables:**

  Country: Name of the country.

  Indicator: Type of climate-related disaster.

  Years (F1980 to F2022): Number of disasters recorded each year.



Preliminary Exploration

Forest and Carbon dataset:

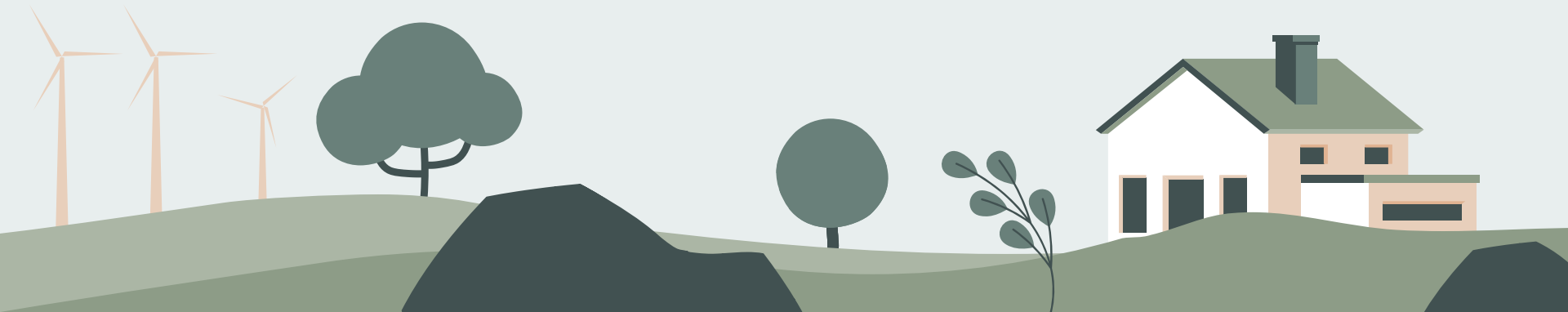
- **Key Variables include:**

  Country: The name of the country or region.

  Indicator: Type of data (e.g., carbon stocks, forest area).

  Unit: The measurement unit (e.g., Million tonnes, 1000 HA, Percent).

  Years (F1992 to F2022): Numerical values representing the data for each year



Preliminary Exploration

Annual Surface Temperature Change Dataset:

- **Variable Description:**

  Country and Code: The name of the country and their code where temperature changes are recorded.

  Indicator: Describes the specific climate indicator measured—temperature change relative to a baseline climatology.

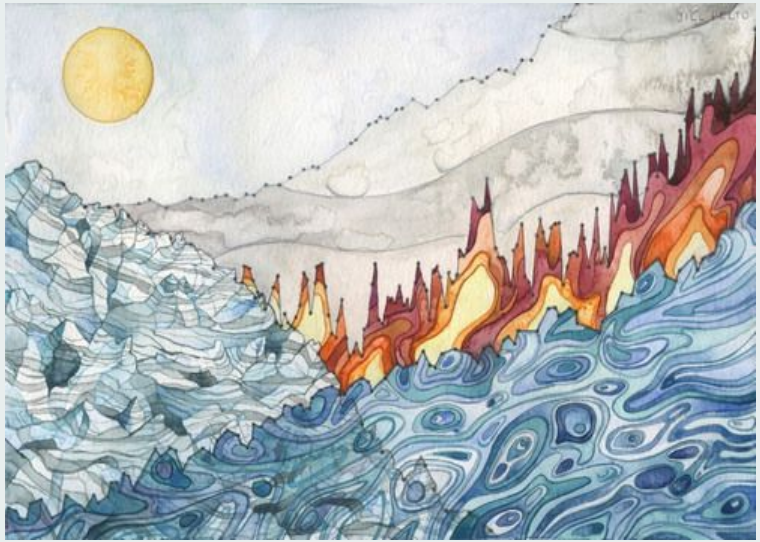
  CTS_Code: A code representing the climate change indicator.

  CTS_Name: The name of the climate change indicator and description.

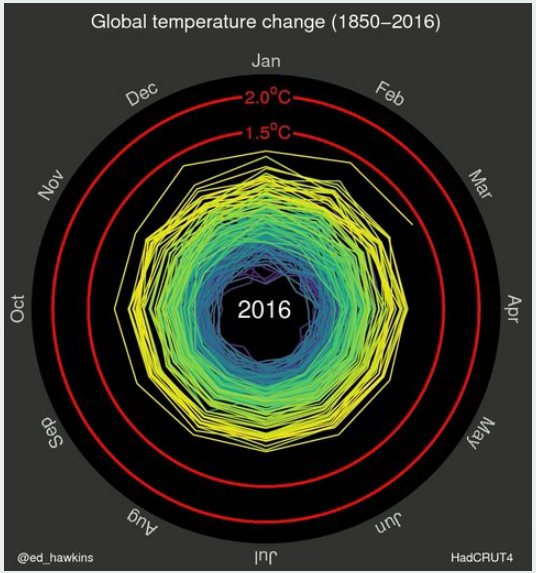
  F1961 to F2022: These columns represent annual temperature change values from the year 1961 to 2022, measured in degrees Celsius.

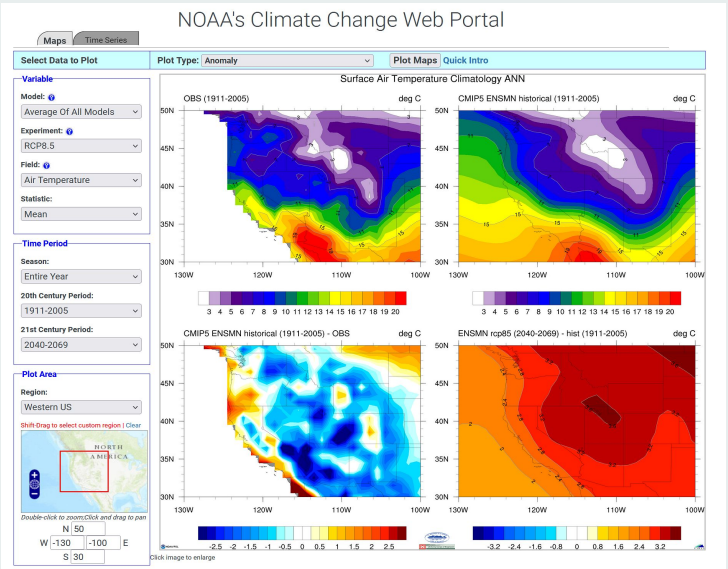
Visualization Plan

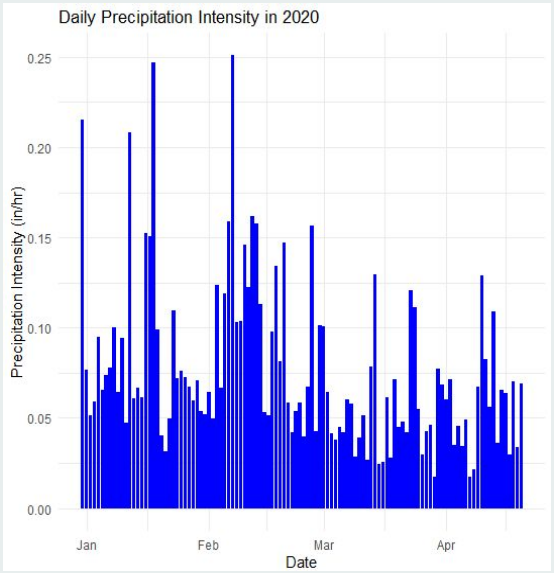
- We'll use a mix of geospatial graphs, radial charts, line charts, boxplots, and heatmaps to show different aspects of climate change.
- Boxplots will show the distribution of data, while heatmaps with geospatial graphs will help visualize data across different areas.
- Line charts and radial charts will illustrate how different factors relate to each other and their impacts over time.



Examples of Intended Visualizations







References

Papers and Websites:

- https://climate.nasa.gov/interactives/climate-time-machine/?intent=021
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- Nocke et. al.. (2008). Visualization of Climate and Climate Change Data: An Overview. in Ehlers et al. (Eds.) Digital Earth Summit on Geoinformatics 2008: Tools for Global Change Research (ISDE'08), Wichmann, Heidelberg.

Images:

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- https://images.app.goo.gl/MPBnvFJnR1YVXgQ59
- https://images.app.goo.gl/8qQLLrT541JmDi7YA
- https://images.app.goo.gl/r1xGJicwXz7w1FD89

Thank You

Any questions?