Final Report: Interactive Climate Change Analysis Map

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Goal and Intended Audience

The goal of this project is to create an interactive tool that enables users to visualize historical temperature trends across the United States since 1900. This product is designed for individuals without coding or data-wrangling expertise who are interested in exploring the impacts of climate change. This could include educators, policymakers, researchers, and the general public seeking an accessible way to understand temperature trends and their implications for climate change. This will help the audience understand how their area or a specific area in the United States has been impacted relative to other areas.

Why It Matters

Climate change is a major issue and understanding historical temperature trends is a relevant and beneficial exercise when trying to understand it in a local context. By presenting the data in an interactive, user-friendly format, we aim to bridge the gap between complex datasets and actionable insights, empowering individuals to explore and interpret data independently. This also allows people to think about climate change at the local level, overcoming the instinct to dismiss it as something irrelevant to our daily lives.

Methodology

Data Sources

- **Primary Dataset:** Daily Global Historical Climatology Network (GHCN-Daily), containing temperature records from weather stations worldwide.
- **Random Sampling:** We selected 100 weather stations distributed across the United States to make the dataset manageable while preserving geographic diversity.

Data Cleaning and Preparation

1. **Date Range:** Eliminated all data from before 1900 due to inconsistent data start dates.

2. **Date Formatting:** Converted Julian days to standard date formats for year and month based analysis.
3. **Temperature Scaling:** Adjusted temperature values to celsius, had previously been formatted as celsius multiplied by ten (to eliminate decimals).
4. **Outlier Removal:** Excluded temperature values outside the range of -60°C to 60°C to ensure realistic data. The record for coldest and highest temperatures in North America are 58 degrees celsius and -63 degrees celsius, respectively.
5. **Handling Missing Data:** Removed records without complete date information and excluded incomplete daily temperature records from specific figures.

The Product

Description

The final product is an interactive map created using R and the Shiny package. Users can click on icons representing weather stations to access:

- Station name
- Airport ID
- State
- Two graphs displaying the station's daily high and low temperatures (monthly average) over the years, overlaid with every other station and averages across all those stations. The first graph displays this information for February and the second does the same for August.

Features

- **Interactive Map:** Provides a spatial visualization of temperature data, allowing users to explore trends for specific locations and providing a comparison relative to the average of the stations.
- **User-Friendly Interface:** Designed for individuals with no technical background, ensuring accessibility.
- **Embedded Insights:** Each graph highlights key trends, such as changes in seasonal temperatures or extremes, to aid interpretation.

AI Usage Disclosure

ChatGPT was used extensively in our project to:

- Create, perform, and troubleshoot all code produced in this project. Although much of the code is the result of our own work, ChatGPT was critical to guiding that work and resolving our errors
- Create the basic structure of this report, while the content is written by us, the formatting and structure originate with ChatGPT

GitHub Repository

The complete project, including scripts, inputs, outputs, and this report, is available on GitHub at: https://github.com/Tommy-Mellott-4/ECNS_Project_460

Note that at this time the product has not been uploaded to github due to size. The product can be created using our code, and has been emailed to our professor, Dr. Hagerty. If we discover a way to circumvent the size issue, we will upload it to the Github repository.