Global Temperature Dataset

1) **<u>Data Table:</u>**

index	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	J-D	D-N	DJF	MAM	JJA	SON
0	1880	-0.18	-0.24	-0.09	-0.16	-0.1	-0.21	-0.18	-0.1	-0.15	-0.23	-0.22	-0.17	-0.17	***	***	-0.12	-0.17	-0.2
1	1881	-0.2	-0.14	0.03	0.05	0.06	-0.19	0	-0.04	-0.15	-0.22	-0.19	-0.07	-0.09	-0.1	-0.17	0.04	-0.08	-0.19
2	1882	0.16	0.14	0.04	-0.16	-0.14	-0.22	-0.17	-0.08	-0.15	-0.24	-0.17	-0.36	-0.11	-0.09	0.07	-0.09	-0.16	-0.19
3	1883	-0.29	-0.37	-0.12	-0.18	-0.18	-0.07	-0.07	-0.14	-0.22	-0.11	-0.24	-0.11	-0.18	-0.2	-0.34	-0.16	-0.1	-0.19
4	1884	-0.13	-0.09	-0.37	-0.4	-0.34	-0.35	-0.31	-0.28	-0.27	-0.25	-0.33	-0.31	-0.29	-0.27	-0.11	-0.37	-0.31	-0.29

This table displays global temperature anomaly data organized by year and month, along with seasonal and annual averages. Here's a breakdown of each column:

1. **Year**: The specific year of the data entry.
2. **Monthly Columns (Jan - Dec)**: Temperature anomalies for each month of the year, relative to a baseline average. Values are in degrees Celsius and represent how much the temperature for that month deviated from the long-term average.
3. **Annual and Seasonal Averages**:

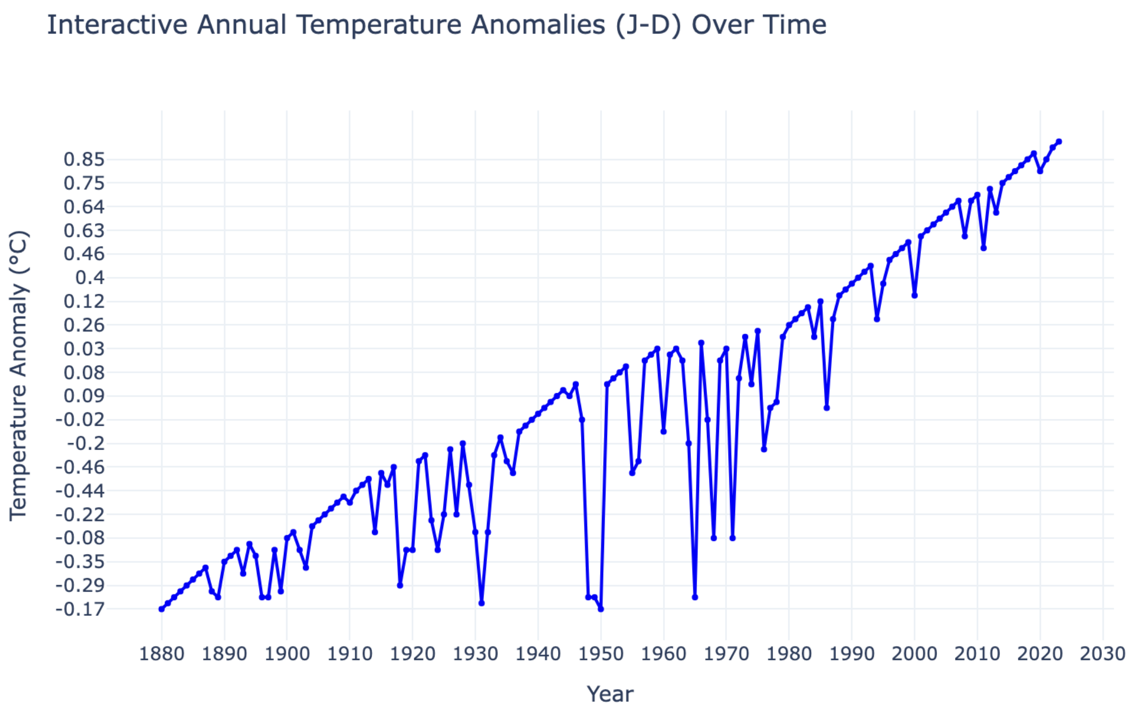
- **J-D**: Average anomaly for the full calendar year (January to December).
- **D-N**: Anomaly averaged from December of the previous year through November of the current year.
- **DJF, MAM, JJA, SON**: Seasonal averages:
    - **DJF**: Winter (December, January, February).
    - **MAM**: Spring (March, April, May).
    - **JJA**: Summer (June, July, August).
    - **SON**: Fall (September, October, November).

2) I analyzed a heatmap that shows the relationship between August and July temperature anomalies across various years. In this heatmap:

1. The X-axis represents temperature anomalies for July in different years, showing deviations from a baseline.
2. The Y-axis represents August temperature anomalies for those same years.
3. The Color Bar indicates the magnitude or intensity of the anomalies, with colors showing the strength of the relationship between July and August anomalies.

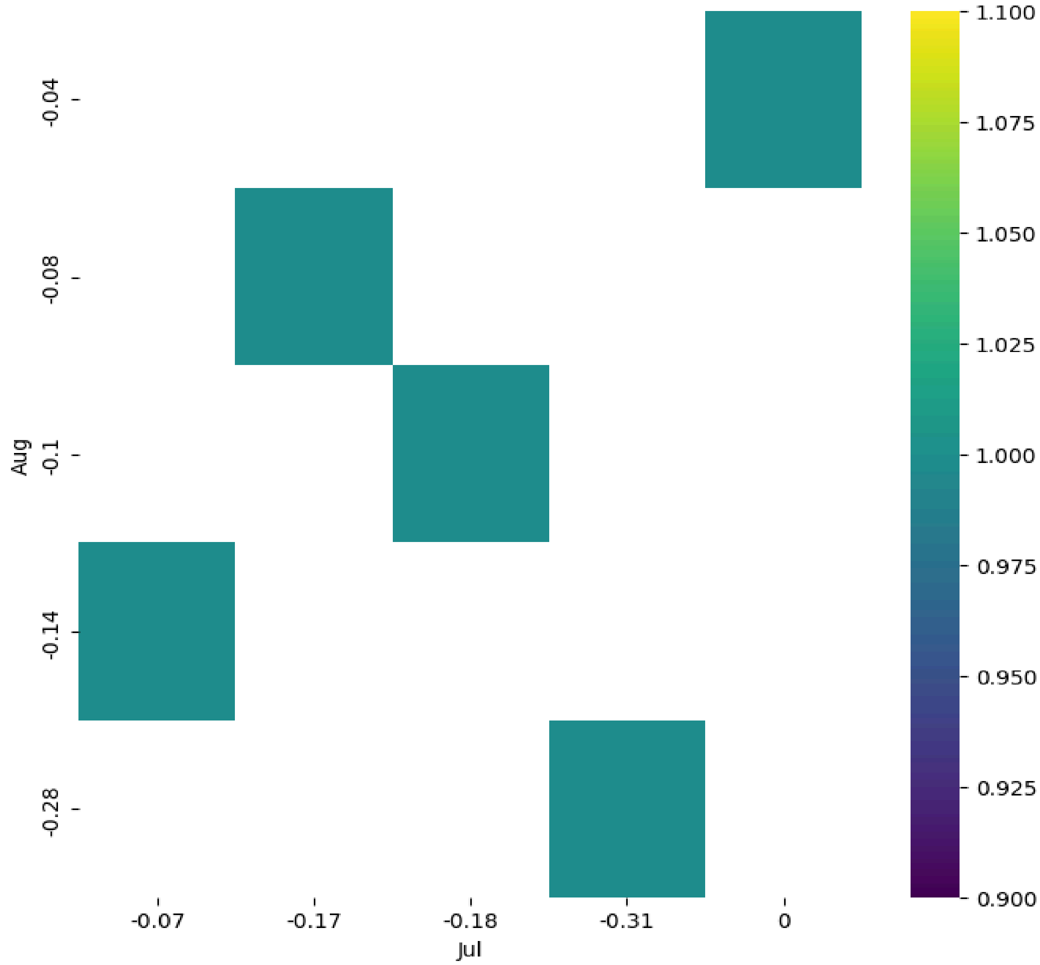
This heatmap helps visualize patterns or correlations between July and August temperature anomalies, potentially highlighting whether certain years experienced similar temperature deviations across these consecutive months.

Initial graph using parameters:



This interactive chart displays annual global temperature anomalies from 1880 to recent years, with each point representing the yearly average temperature deviation from a historical baseline. The X-axis shows the years, while the Y-axis measures the temperature anomaly in degrees Celsius. Positive values on the Y-axis indicate years warmer than the baseline, and negative values indicate cooler years. A clear upward trend is visible over time, especially post-1950, suggesting a consistent warming pattern associated with global climate change. Users can hover over data points to see precise values for each year and use zoom and pan controls to explore specific periods in detail.

To create this chart, I used Plotly, a Python library for interactive visualizations. I imported the temperature anomaly data, configured the X-axis to display every 10 years for readability, and added hover functionality to display exact values. The line and markers visually connect the yearly data, making the long-term trend more prominent. Plotly's interactive features allow users to zoom in, pan, and hover, enhancing the exploration of specific trends and individual years.



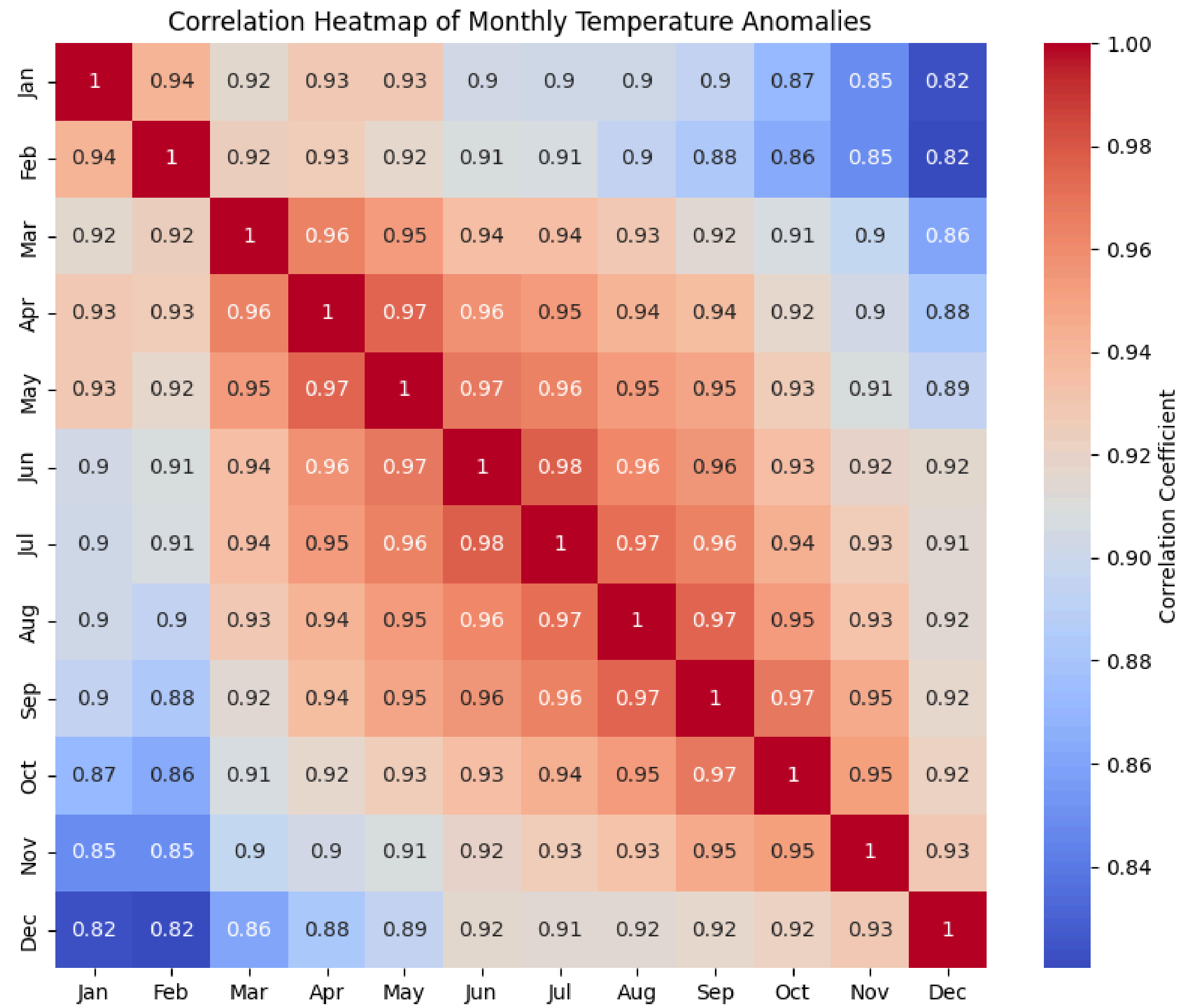
2) <u>Heatmap-1</u>

I analyzed a heatmap that shows the relationship between August and July temperature anomalies across various years. In this heatmap:

4. The X-axis represents temperature anomalies for July in different years, showing deviations from a baseline.
5. The Y-axis represents August temperature anomalies for those same years.
6. The Color Bar indicates the magnitude or intensity of the anomalies, with colors showing the strength of the relationship between July and August anomalies.

This heatmap helps visualize patterns or correlations between July and August temperature anomalies, potentially highlighting whether certain years experienced similar temperature deviations across these consecutive months.

3) <u>Heatmap-2</u>



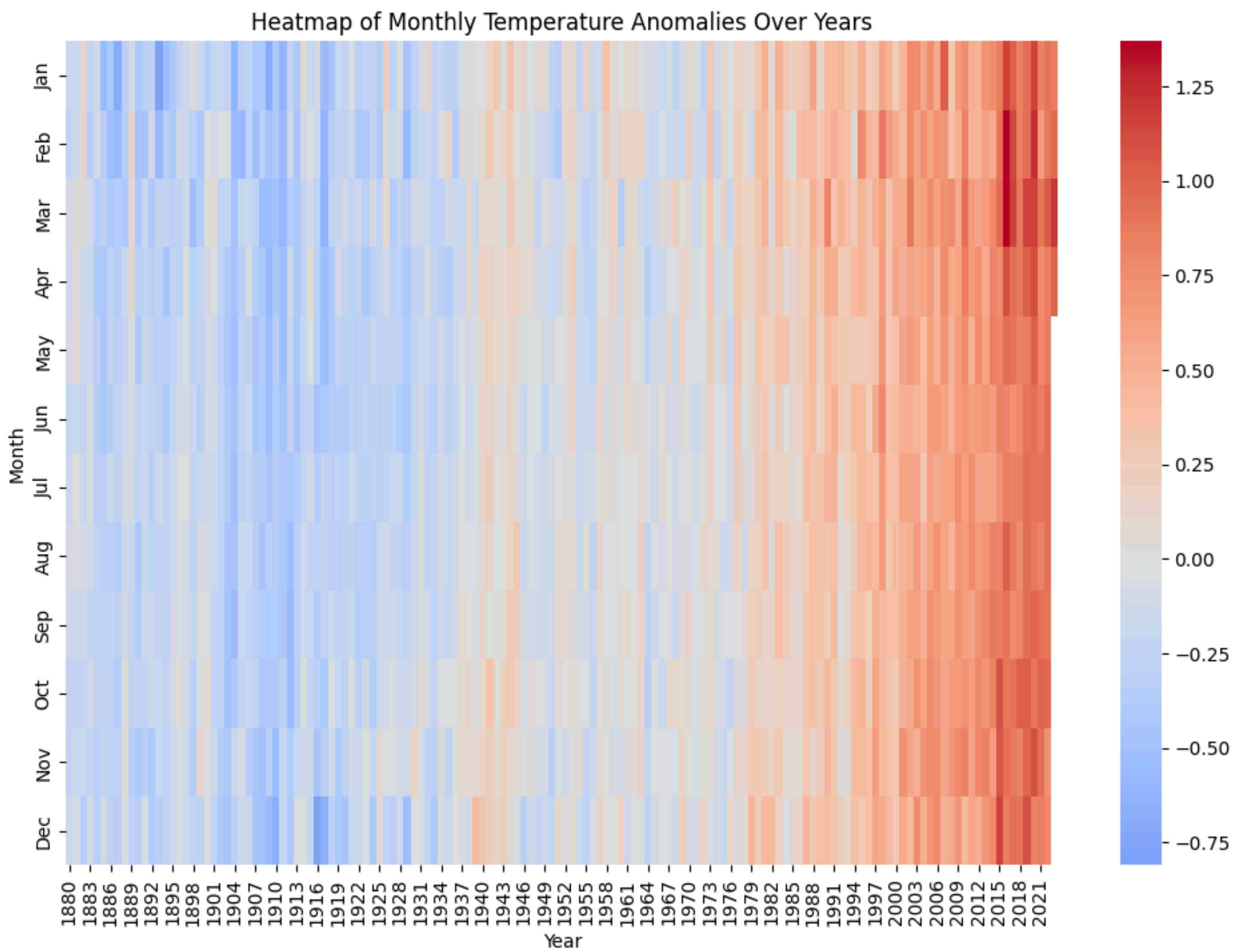
I analyzed the dataset and came up with a correlation heatmap, which examines how temperature anomalies for each month relate to one another across all years in the dataset.

1. **Color Scale**:
    - The colors range from deep blue (negative correlation) to bright yellow (positive correlation). Positive correlations (close to +1) mean that two months usually follow similar anomaly patterns (both warm or both cool). Negative correlations (close to -1) suggest that when one month is warm, the other is more likely to be cool.
2. **Diagonal Line (Perfect Correlation)**:
    - The bright yellow diagonal line represents perfect correlations, as each month is, of course, fully correlated with itself. This diagonal line serves as a baseline for interpreting other relationships.
3. **Seasonal Patterns**:

    - I can see stronger correlations between adjacent months, especially within the same season. For instance, if **June, July, and August** have high correlations, it suggests that if June is warmer than average, July and August are likely to follow a similar pattern. This reflects the cohesive nature of seasonal climate patterns.

4. **Cross-Season Relationships**:
    - When I look at months farther apart, such as **January and July**, the correlations are weaker or even negative, likely due to differences between winter and summer temperature dynamics. These weaker relationships show that temperature anomalies in one season don't necessarily predict those in another.

4) <u>Heatmap-3</u>



In this heatmap, I tried to see how monthly temperature anomalies have changed over time, covering more than a century of data. Each column represents a year from 1880 to the present, and each row corresponds to a month from January to December. The colors range from blue (cooler anomalies) to red (warmer anomalies), with darker shades indicating more intense deviations from the baseline. In the early years, the chart shows more blue, indicating cooler-than-average temperatures. As we move towards recent decades on the right side, the colors shift predominantly to shades of red, signaling a consistent warming trend across nearly all months. This gradual transition from blue to red highlights a long-term global warming trend, affecting temperatures every month. The heatmap visually emphasizes how widespread and persistent temperature increases have become, underscoring the impact of climate change throughout the year.

5) Distinction between heatmap-1 & 2

The first heatmap illustrates the correlation between monthly temperature anomalies, with both axes representing months from January to December. Dark red areas indicate strong positive correlations, especially among adjacent months within the same season, showing that anomalies in one month often align closely with anomalies in nearby months, particularly within seasons like summer or winter. In contrast, the second heatmap provides a temporal perspective, displaying monthly temperature anomalies over years from 1880 onward. Here, the X-axis represents years, while the Y-axis represents months. Blue shades dominate the earlier years, indicating cooler anomalies, whereas recent years shift to warmer red tones, highlighting a clear warming trend over time. Together, these heatmaps reveal both the seasonal coherence of temperature anomalies and the long-term global warming trend affecting all months.