

# Tracing the Climate Impact: Examining CO2 Emission Effects on Temperature Patterns in Brazil

Md Jubier Ali

Matriculation No: 23453618

## 1. Introduction

This project aims to explore the relationship between CO2 emissions and temperature patterns specifically in Brazil. The project utilizes datasets on CO2 emissions and temperature trends in Brazil to investigate this connection, providing localized evidence of climate dynamics. The goal of this study is to enhance understanding of the link between CO2 emissions and temperature changes specifically in Brazil by answering the question: “How do CO2 emissions in Brazil correlate with temperature trends over time?”

## 2. Used Data

Two primary datasets were used to analyze the relationship between CO2 emissions and temperature trends in Brazil:

**2.1.1 CO2 Emissions Data:** Annual CO2 emissions for various countries, filtered to include Brazil, with columns for country, year, and co2 (emissions in metric tons).

**2.1.2 Temperature Data:** Average annual temperatures for various countries, filtered to Brazil, with columns for country, year, and AverageTemperatureCelsius (converted from fahr to celcius).

**2.2 Data Pipeline Output:** By feeding the datasets to the ETL (Extract, Transform, Load) pipeline, we got our merged datasets into a unified structure with columns for country, year, co2, and AverageTemperatureCelsius. Each row represents the CO2 emissions and corresponding temperature for Brazil in a specific year, enabling a year-by-year analysis

	country	year	co2	AverageTemperat...
	Filter...	Filter...	Filter...	Filter...
1	Brazil	1901	2.103	22.265
2	Brazil	1901	2.103	22.856
3	Brazil	1901	2.103	22.649999999999995
4	Brazil	1901	2.103	21.807000000000002
5	Brazil	1901	2.103	20.513
6	Brazil	1901	2.103	19.317
7	Brazil	1901	2.103	20.343000000000004
8	Brazil	1901	2.103	22.108999999999998
9	Brazil	1901	2.103	23.697000000000003
10	Brazil	1901	2.103	23.617

**2.3 Data License:** The CO2 emissions data (from Our World in Data) and temperature data (from Figshare) are licensed under CC BY 4.0. I plan to follow the obligations of the CC BY 4.0 license by providing appropriate attribution to the original creators of the CO2 emissions and temperature datasets in all instances of use.

**2.4 Data Significance:** This processed data provides a comprehensive foundation for studying the relationship between emissions and temperature trends in Brazil, revealing how these variables have evolved together over time.

### 3. Analysis

The plottings are made with python libraries “*matplotlib*” and “*seaborn*” to visualize the data to find the correlation between CO2 emissions and temperature of Brazil.

#### 3.1 Correlation matrix:

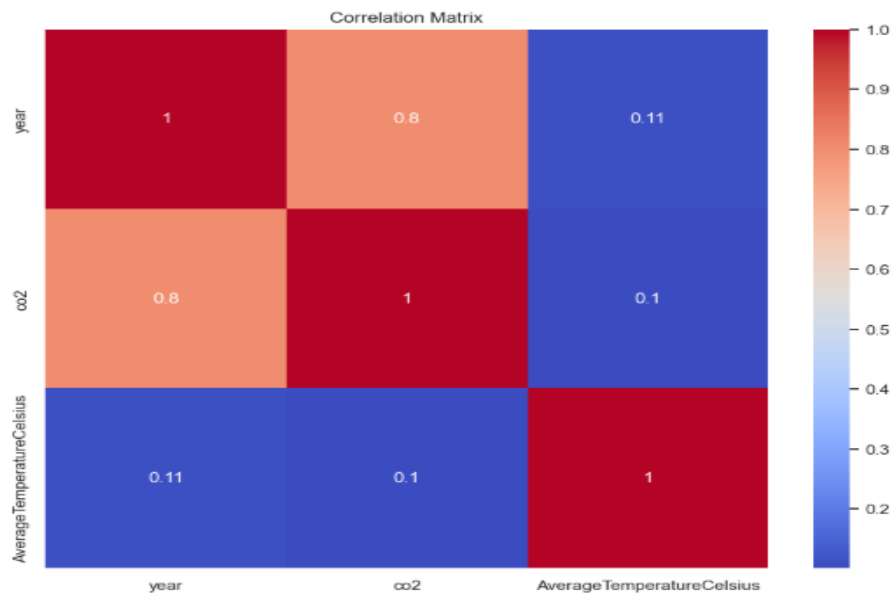


Figure: Correlation Matrix of *year*, *co2* and *AverageTemperatureCelsius* column

**3.1.1 Interpretation:** This correlation matrix shows the relationships between three variables: year, CO2 emissions (labeled as "co2"), and average temperature (labeled as "AverageTemperatureCelsius"). The correlation between year and CO2 emissions is 0.8, indicating a strong positive relationship. This suggests that CO2 emissions in Brazil have significantly increased over time. The correlation between year and average temperature is 0.11, which shows a weak positive relationship. This implies a slight upward trend in average temperatures over time,

though the relationship is not strong. The correlation between CO2 emissions and average temperature is 0.1, also reflecting a weak positive relationship.

In summary, this correlation matrix highlights a strong temporal increase in CO2 emissions but shows weak associations between CO2 emissions and temperature changes.

### 3.2 Rolling correlation plot over time:

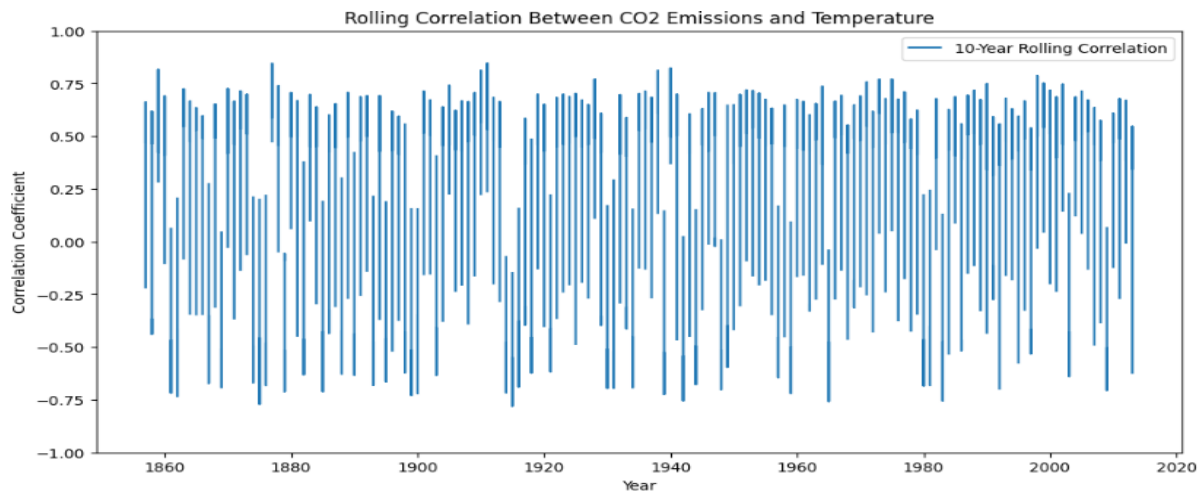


Figure: Yearly Correlation between co2 emissions and AverageTemperatureCelsius

**3.2.1 Interpretation:** This plot illustrates the 10-year rolling correlation coefficients between CO2 emissions and average temperature in Brazil over time. It reveals notable fluctuations, with periods of positive correlation, such as the early 1900s and after the 1980s, indicating that CO2 emissions and temperatures moved in the same direction during these times. In contrast, negative correlations during the mid-1900s suggest that CO2 emissions and average temperature trends moved in opposite directions. After 2000, it can be seen that the trends show a consistent upward pattern, which indicates a strengthening relationship between CO2 emissions and average temperature. This rise highlights the potential influence of increasing CO2 emissions on temperature trends in more recent decades.

Analysis of the rolling correlation shows that the relationship between CO2 emissions and temperature in Brazil has changed over time. Initially, they increased together, but later the connection weakened and even reversed. In recent decades, the link has strengthened, showing a clearer connection between rising CO2 and higher temperatures in Brazil.

### 3.3 Facet Grid plot:

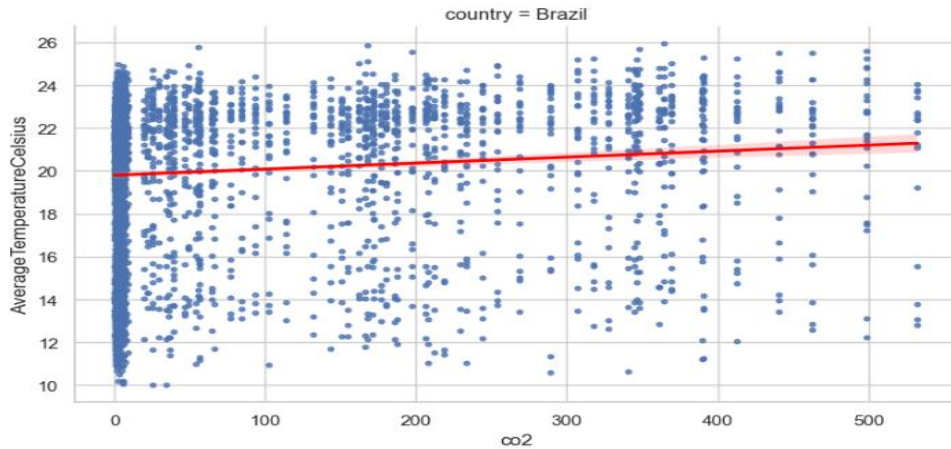


Figure: Facet Grid between CO2 emissions and average temperature

**3.3.1 Interpretation:** This facet grid plot shows the relationship between CO2 emissions (x-axis) and average temperature (y-axis) in Brazil, with a red regression line indicating the overall trend. The blue dots represent individual data points. The slight upward slope of the regression line suggests a weak positive relationship between CO2 emissions and temperature, meaning that as emissions increase, temperatures tend to rise slightly. This plot highlights both the general trend and the variability in the relationship between CO2 emissions and temperature. In summary, this visualization shows a positive correlation between CO2 emissions and average temperature, with higher emissions linked to higher temperatures.

## 4. Conclusions

The main question of the project is: "How do CO2 emissions in Brazil correlate with temperature trends over time?" With proper analysis of all the data, the conclusion we can make is, CO2 emissions correlate with Brazil's temperature trends in an increasing manner but not very strongly. As CO2 emissions have risen steadily over the past century, there is a slight but noticeable increase in average temperatures, especially in recent decades. This indicates that while CO2 emissions are likely a contributing factor to temperature changes, they are not the sole determinant. Further studies should include factors like deforestation and climate variations, along with detailed long-term data, for deeper insights into temperature trends.

So, the analysis demonstrates that higher CO2 emissions are associated with rising temperatures over time in Brazil, but the relationship is not very strong. Overall, higher CO2 emissions are associated with rising temperatures in Brazil.