Analysis Report, Akash Yadav (23304362)

1. Introduction

In recent years(this year 2024 also), problems like drought, severe heat waves, ever-increasing temperatures, heavy rainfall causing floods, seasonal cycle inconsistency, and hunger crises have been escalating, highlighting the urgent need to understand the main causes of environmental damage. With the global population continuing to rise at an unpredictable rate, the increase in CO2 emissions from forest fires, crop cultivation, pesticide manufacturing, and agrifood waste disposal presents a significant challenge to sustainable development and climate stability.To understand the impact of CO2 emissions from all possible sources and the causes of increasing temperatures, deep data analysis has been performed on existing data to draw conclusions.

Main Question:

How does population distribution and density influence the climate impact of CO2 emissions across different regions?

2. Used Data

2.1 Data Source 1: Agri-food CO2 emission: The agricultural sector is a significant contributor to climate change. This dataset plays a crucial role in understanding and monitoring the impact of agricultural activities on CO2 emissions.The dataset used for the study on CO2 emissions and temperature change for each country from 1990 to 2020. It has 7k rows and 31 columns.

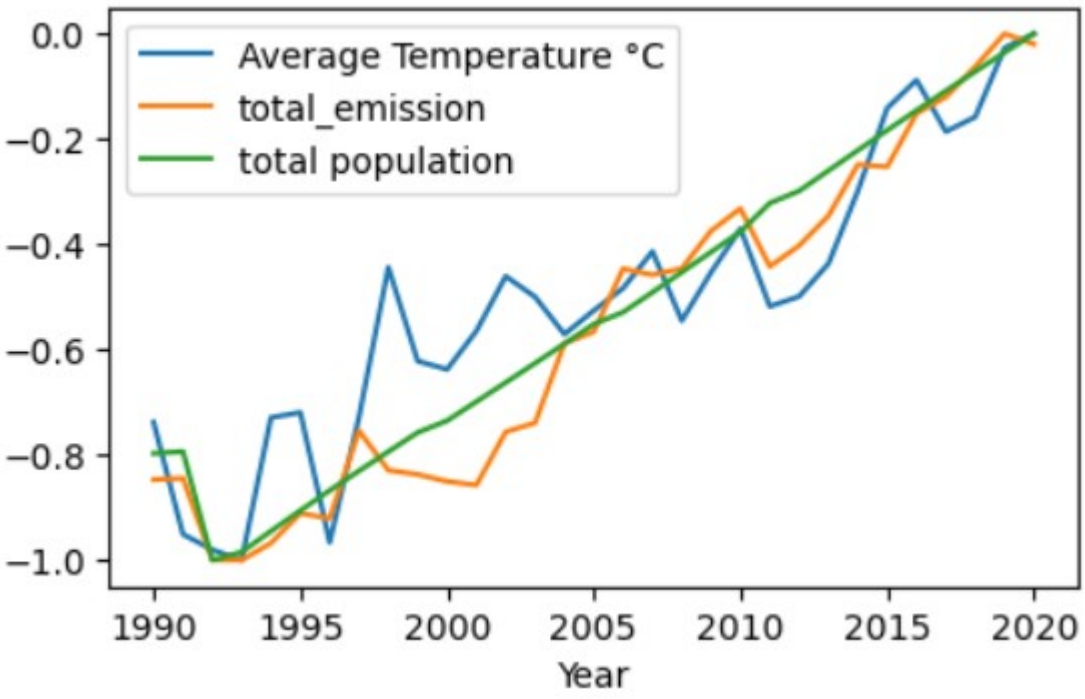
2.2 Data Source 2: World Population: The world population is continously increasing, this dataset has ranked data for all countries from 1980~2023. It has 234 rows and 19 columns.

Both Datasets are structured, available in Tabular format, adheres to all dimensions of data quality: **Accuracy, Completeness, Consistency, Timeliness, and Relevancy**. and used from Open Licenced Data: CC0: Public Domain.

3. Analysis

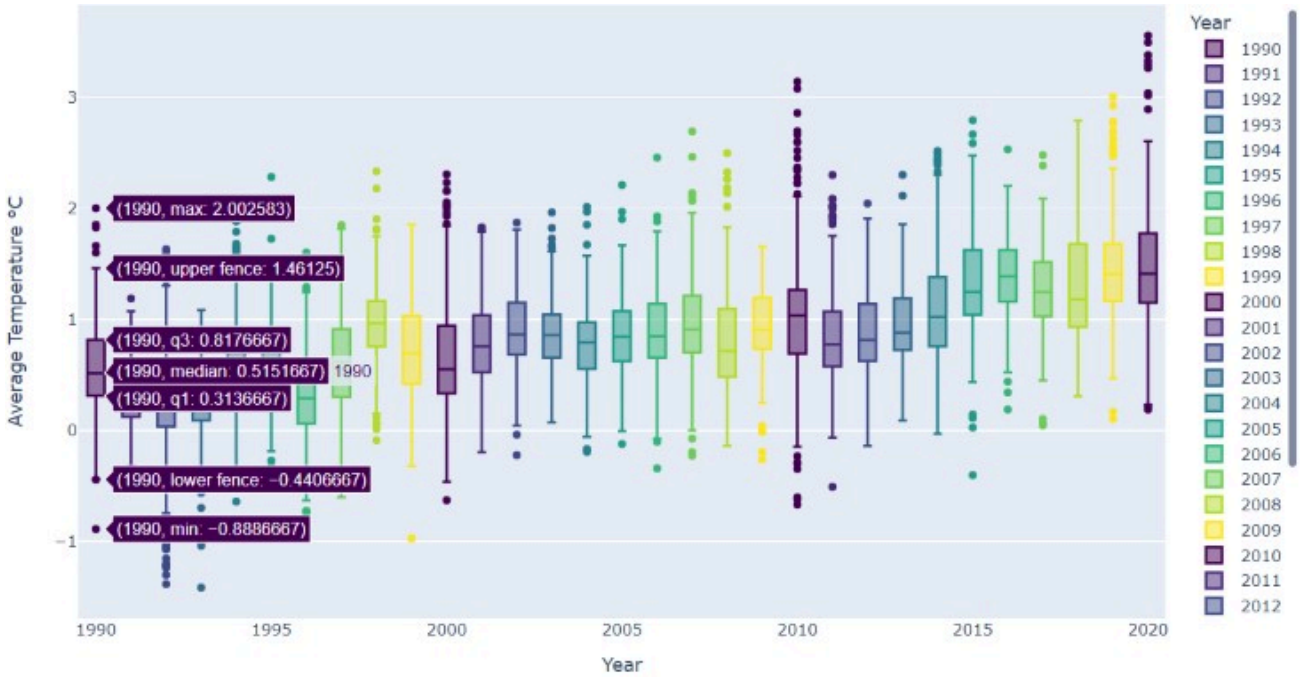
Temperature, Population and Emission trend

- This plot shows the trend of temperature, population, and emissions. The data is normalized on a yearly basis.
- From 1996 to 2004, there is an inverse relationship between emissions and temperature increase, but the reason cannot be determined from this dataset.
- It demonstrates that the increasing temperature is a combined effect of population growth and CO2 emissions.
- To strengthen this analysis performed further correlations.

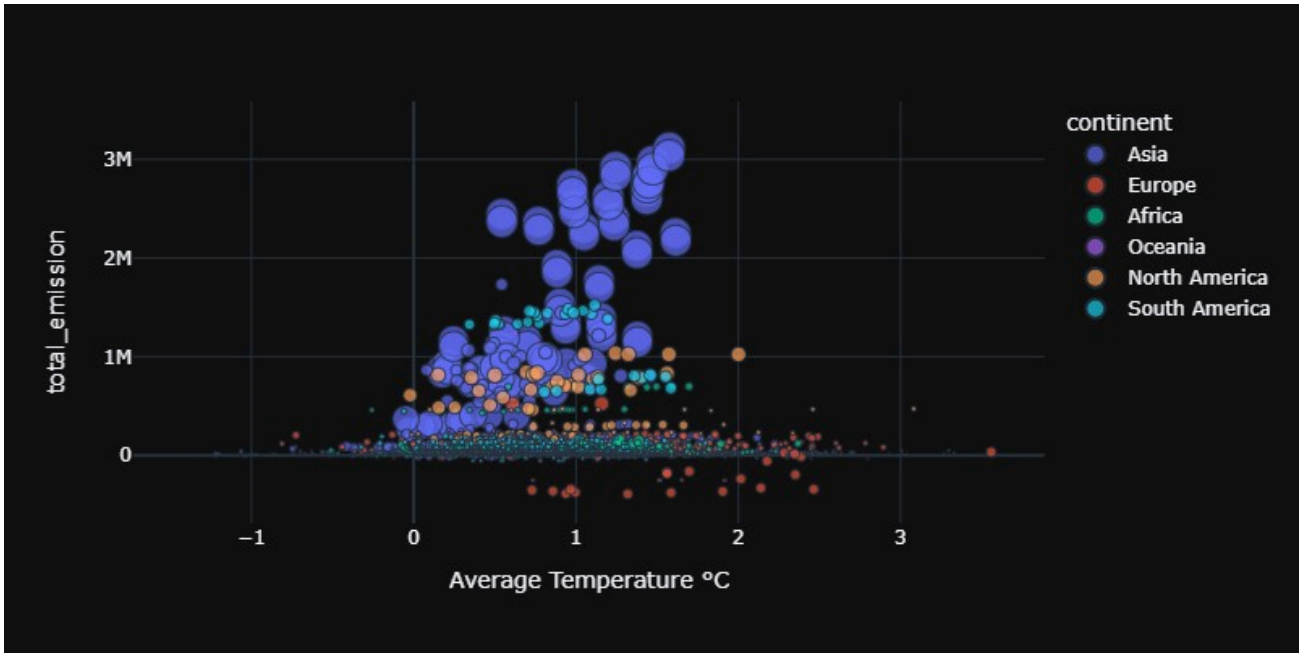


Average Temperature distribution by years:

- In 1990, as can be seen in the whisker box plot, the maximum rise was around 2°C and the minimum was -0.88°C. This increased to 3.55°C (max) and 0.189°C (min) in 2020.
- **Temperature Variability in Recent Years:** The range between the maximum and minimum temperatures has increased in recent years.
- **Temperature spikes:** Particularly in the years around 2000, 2010, and 2020. These outliers indicate periods of extreme heat, which have become more frequent and pronounced in recent years.
- **Median Temperature Shift:** Even if we exclude the maximum and minimum temperature shifts and look at the median from 1990 to 2020, it also jumped from 0.515°C to 1.412°C.

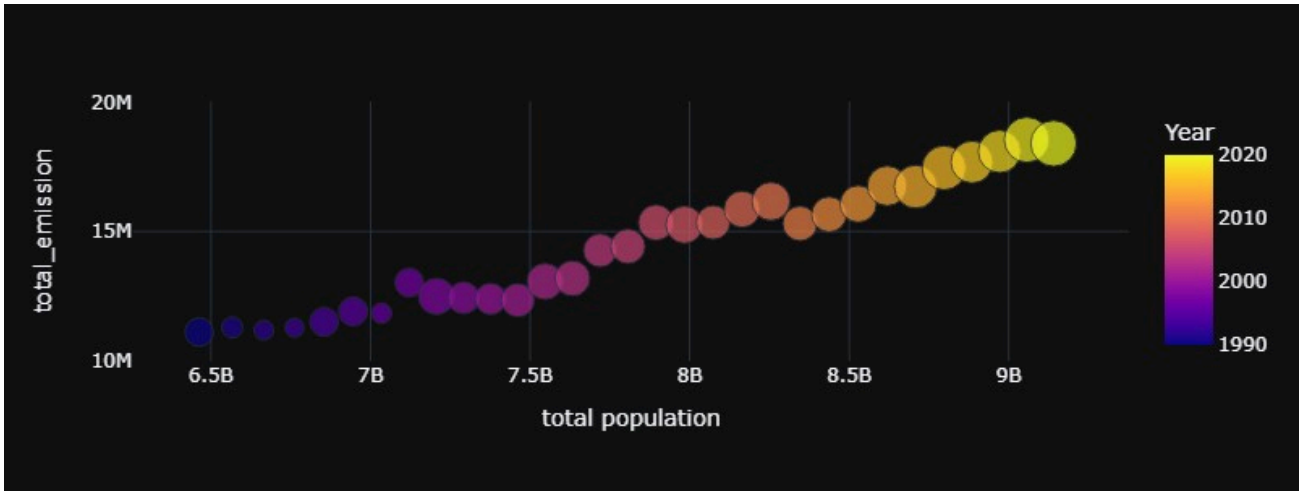


Co2 Emission & Avg. Temperature with population effect: *Bubble size represent to Population of continent*



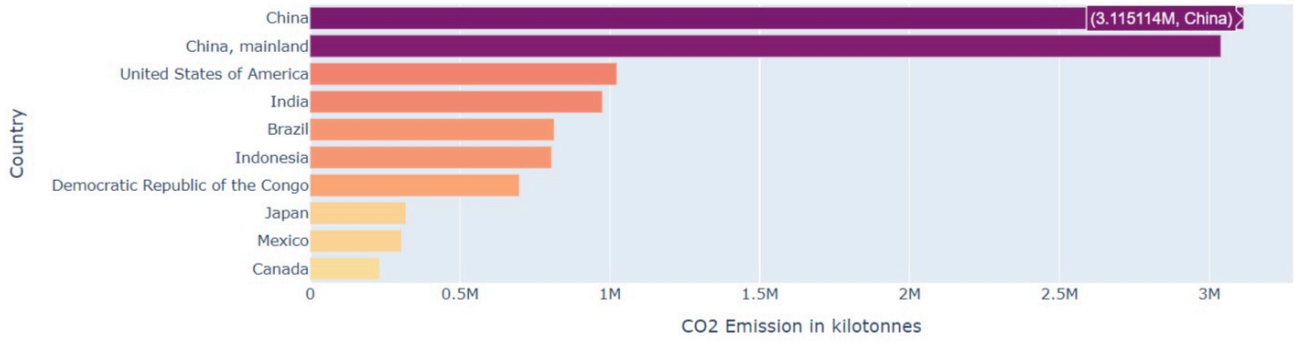
- **Correlation between CO2 Emissions and Temperature:** There is a correlation between total CO2 emissions and average temperature. As CO2 emissions increase, the average temperature also tends to rise, which is evident from the upward trend in the scatter plot.
- **High Emissions in Asia:** All the big blue circles are from Asia, indicating that this continent contributes significantly to global CO2 emissions. These data points also correspond to higher average temperatures. In the interactive notebook if you disable Asia then total emission drops at 1.5M which is direct 50% drop.
- Here different color circles represent population density there (Asia being the first).
- **Lower Emissions and Temperature in Africa and Oceania:** Smaller circles representing Africa and Oceania are generally clustered towards the lower end of the emission and temperature scales. This indicates that these continents have relatively lower CO2 emissions and average temperatures compared to other continents.

Population & Co2 Emission Correlation: Bubble size represent Avg. Temperature rise



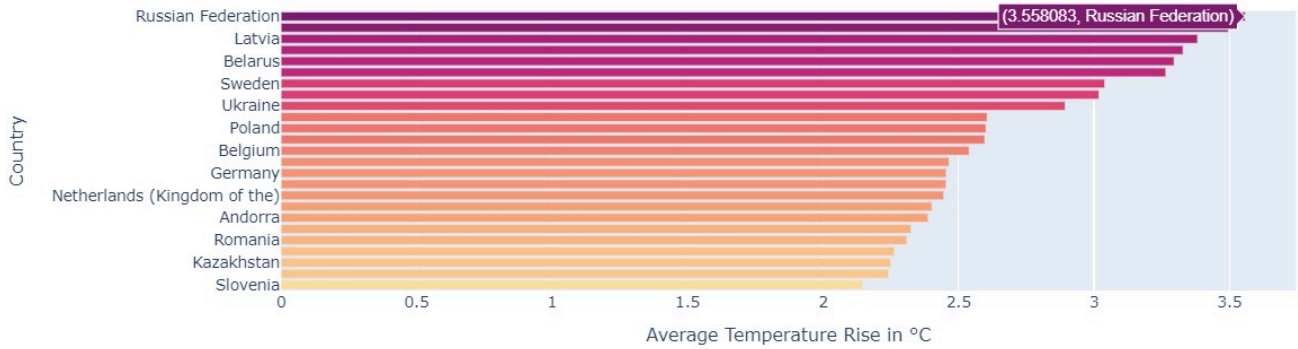
- can be easily observed that with increasing population Co2 emission is also increasing.
- at the very left bottom corner size of bubble was smaller compare to right top corner bubble (in yellow), shows temperature rise

Top 10 countries with high Co2 Emission:



- In 2020, China was the highest CO2 emitting country with a total of 6.15 million kilotonnes, followed by the USA with 1.02 million kilotonnes, and India with 977 thousand kilotonnes.

Before Concluding: Top 25 countries in 2020: Impacted by CO2 emissions



- Data shows that most impacted countries by Co2 emission which eventully leads to climate change.
- Russian Federation is the most impacted with avg. temperature shifted to 3.55'C.

4. Conclusion

To recapitulate, the above visualizations, analysis, and figures provide a thorough understanding of CO2 emissions and the impact of an increasing population on climate. At a high level, this analysis successfully answers the objective question. To support my initial hypothesis, I have provided an in-depth analysis and shown the correlation among population, temperature, and emissions. However, there were a few points where temperature and emissions had an inverse relationship, which requires additional information or may indicate that the data had some flaws.