analysis-report-final

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1 Analyzing the Impact of CO2 Emissions on Temperature Change

1.1 Table of Contents

1.2 Introduction

Climate change is a critical global issue because of its effect on environment, human health, and economies. This project investigates the relationship between temperature changes and CO2 emissions through statistical analysis. The results are expected to show how much CO2 emissions contribute to tmperature change. They may be used as information for future policy decisions related to greenhouse gas emissions .

In this report, analysis are performed on following topics:

- How Have Temperature Changes and CO2 Emission Varied Over the Years ?
- What is the Impact of CO2 Emissions on Temperature Change Globally ?
- What is the Impact of CO2 Emissions on Temperature Change in Individual Countries ?

1.3 Used Data

Data Source 1 : FAO Temperature Change

- **Why Chosen:** The dataset provides annual temperature change for various countries and it's from trustworthy source.
- **Source:** Food and Agriculture Organization (FAO)
- **Data Contains:** The FAOSTAT Temperature change on land domain disseminates statistics of mean surface temperature change by country.
- **Metadata URL:** FAO Temperature Change Metadata
- **Data URL:** FAO Temperature Change Data
- **Transformation steps on FAO Temperature Dataset:**

- Only keeping the records where there is a temperature variation remove standard daviation category.
- Eliminate not useful columns like "Area Code," "Area Code (M49)," "Element Code," "Months Code," "Unit," and "Element as these columns have no real purpose in the analysis"
- Use `pd.melt()` to reshape the data from wide to long format as it will be useful to time series analysis.

Data Source 2: World Bank CO2 Emissions Dataset

- **Why Chosen:** This dataset offers extensive CO2 emissions data yearly for various countires
- **Source:** World Bank
- **Data Contains:** CO2 emissions data (in kilotons) for various countries.
- **Metadata URL:** World Bank CO2 Emissions Metadata
- **Data URL:** World Bank CO2 Emissions Data
- **Transformation steps on World Bank CO2 Data:**
  - Rename columns (such as "Country Name" to "Area") to maintain consistency between datasets.
  - Eliminate columns like "Indicator Code" and "Indicator Name as they they serve no usecase in our analysis"
  - Use `pd.melt()` to reshape the data from wide to long format useful for time series analysis.
  - Remove records where the CO2 emission numbers are absent.
  - Convert the 'year' and 'co2_emissions' data types to achive consistancy.

1.3.1 Pipeline Output :

```
[29]: #display merged table results
```

```
[29]:          Area  Year     Change country_code  co2_emissions
      0  Afghanistan  1990   0.714000          AFG        2046.87
      1  Afghanistan  1991   0.138333          AFG        1941.37
      2  Afghanistan  1992  -0.185917          AFG        1525.47
      3  Afghanistan  1993   0.163000          AFG        1527.89
      4  Afghanistan  1994   0.469667          AFG        1493.59
```

1.4 Analysis

Method The analysis aimed to determine if there is a significant impact of CO2 emissions on temperature changes, both globally and for individual countries.

1.4.1 Individual Analysis

Before Analyzing the for Correlation between temperature and CO2 it is important to analyze how these have varied over the year thus a line plot is used to simultaneously represent both CO2 emissions and temperature change. The line in each plot indicates the average (mean) value for each year, while the shaded area around the line represents the range of variability for each year, offering more insights.
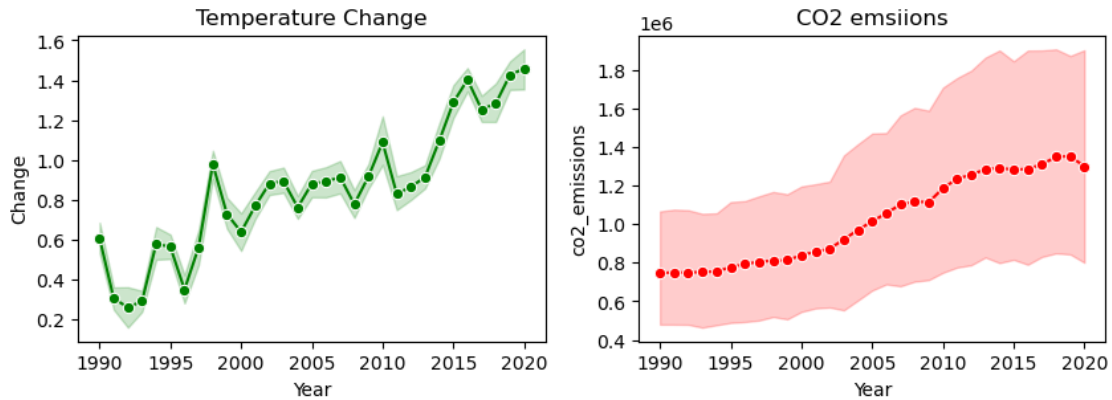
- There's been a noticeable increase in temperature over the recent years. This trend was foreseeable, as climate change gets more drastic.

- CO_2 emission has shown an steady but constant upward trend

- As CO_2 emissions have increased, there has been a corresponding increase in global temperatures.
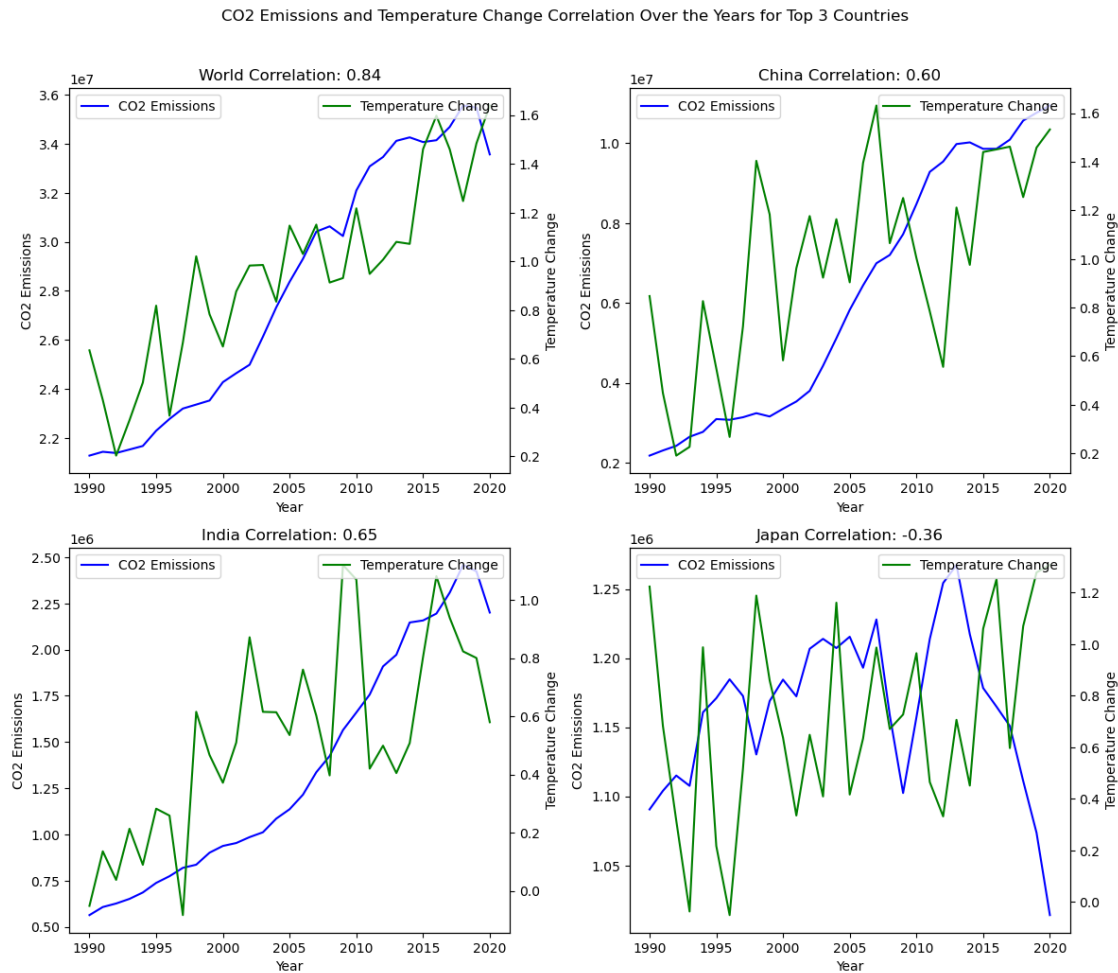
1.4.2 Correlation Analysis:

In order to examine the correlation relationship between CO_2 emsiion and temperture change Pearson Correlation was used. The `Pearson Correlation` measured the linear relationship between CO_2 emissions and temperature changes. The coefficient ranges from -1 to 1, stating a negative to positive correlation, respectively. A positive value indicates that as CO_2 emission increases, so will the temperature change. Figure 2 : Bar Graph dissplaying Pearson Correlation for top 10 countries from Dataset
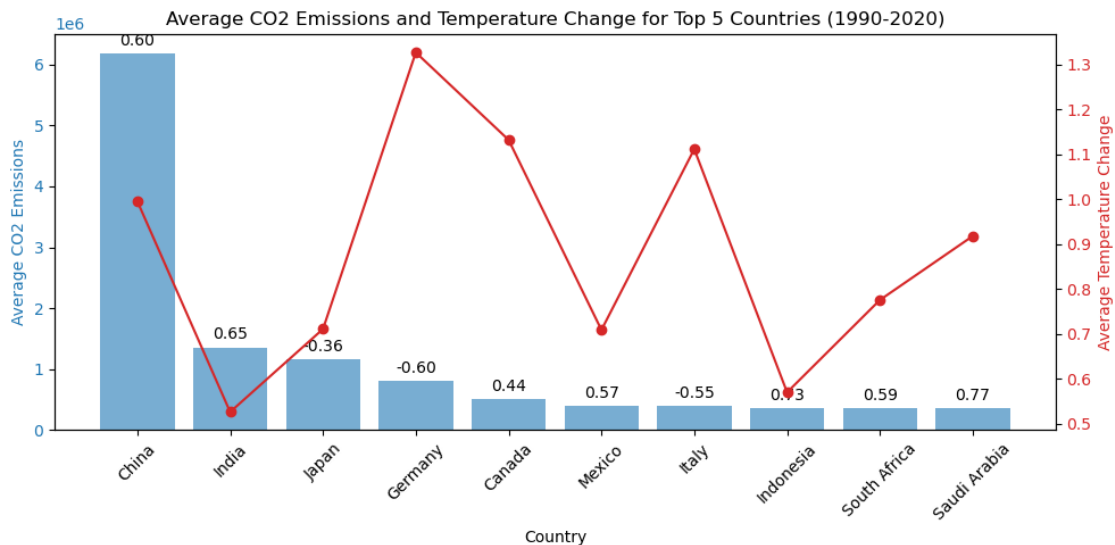
Country-Specific Analysis: To delve into the specifics of how CO2 emissions correlate with temperature change on a Country-Specific basis, The dataset was segmented to each country included in the study. For each country the trends was displayed using `line plots` and `Pearson's r correlation coefficient`. This approach allowed to explore whether there is a notable correlation between temperature changes and CO2 emissions within individual countries.

[33]: *#Figure 3: Line plots showing country-specific relationship over the year span↵*
     ↪(1990-2020)

CO2 Emissions and Temperature Change Correlation Over the Years for Top 3 Countries

- Global Analysis:

    - Correlation Coefficient: The global analysis displayed a significant positive correlation between CO2 emissions and temperature changes. This suggests that CO2 emissions are associated with greater temperature changes globally.

    - The strong positive correlation on a global scale highlighted the importance of addressing CO2 emissions to mitigate climate change.

- Country-Specific Analysis:

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- Varying Degrees of Correlation: Some countires show positive corraltion with while other show negative correlation but the values show the CO2 emissions impact the temperture change to some degree.

- The analysis confirms a significant relationship between CO2 emissions and temperature changes for various individual countries.

This finding supports the hypothesis that CO2 emissions are a major driver of global warming.

Conclusion Based on the analysis it is evident that the correlation between CO2 emissions and temperature changes varies by country. Some countries show a strong positive correlation, suggesting that higher CO2 emissions are associated with significant temperature changes. In contrast, others show weak or no correlation, indicating that there might be other factors which influence temperature changes in those countries.

Limitations:

- **Linearity:** The study assumes a linear relationship between CO2 emissions and temperature holds in the model—which does not account for most of the dynamics involved in climate change.

- **Quality of Data:** Different countries may have reported or documented data in inconsistent or using different measures, thus resulting in inconsistency in data.

- **Resolution Time:** There is no possibility of doing a short-term analysis as the dataset offers only annual data.

- **Application and Use:** Dataset sources for non-commercial use limit the data from being used for commercial application ideas.

Future Outlook:

- **Other Factors:** Other greenhouse gases and factors, like deforestation and industrial activities, may provide more inclusive information on climate change.
- **Mitigate Emissions:** The following report provides an excellent foundation to relate the rise of temperatures to CO2 emissions, underpinning that more extraordinary efforts on mitigating emissions are needed if climate change is going to be fought.