Carbon Dioxide Emissions and Mean Sea Level Pressure Analysis

1. Introduction:

Climate change is a real phenomenon whose impacts are felt in the natural environment and people's lives. Analyzing trends in carbon dioxide emissions and mean sea level pressure is crucial to develop risk management strategies adequately. This report aims to investigate the historical trends of carbon dioxide emissions in Europe from 1850 to 2022, the changes in global mean sea level pressure (MSLP) over time (1951-2021), and the interactions between these variables.

2. Used Data:

Data source	License	Year	Format	Unit	Source
Data source 1	CC BY 4.0	1850 - 2022	CSV	Milliontonnes (Mt)	Our World in Data
Data source 2	CC BY 4.0	1951 - 2021	TXT	hPa (Hectopascals)	Deutscher Wetterdienst

2.1. Pipeline Results:

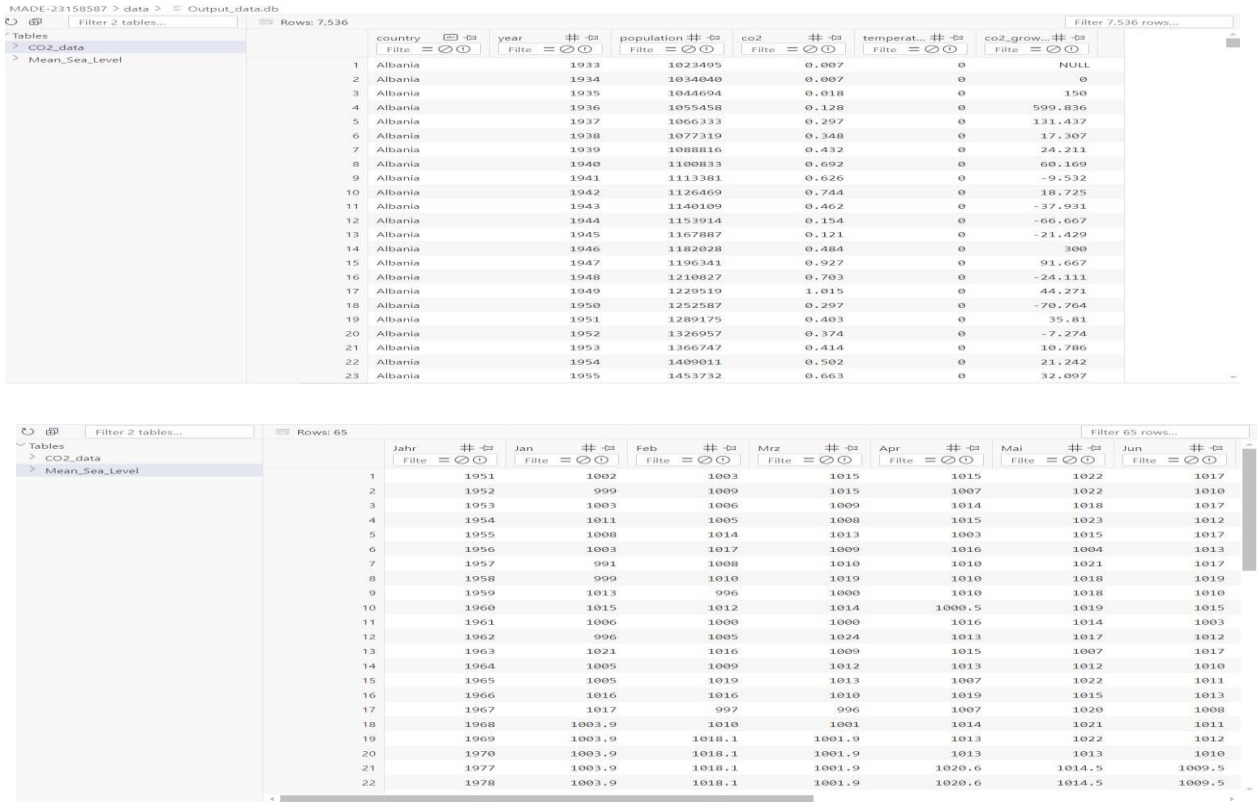

Figure 1: Local SQLite databases

3.1 What are the historical trends in carbon dioxide emissions in Europe from 1850 to 2022?

The report uses many Python libraries like pandas, mathplotlib, seaborn, sklearn, numpy, etc. for visualizing and finding correlations between two datasets. Jupyter Notebook which is a web-based interactive computing platform is used as a tool for visualizing the report. To analyze the historical trends in carbon dioxide emissions in Europe from 1850 to 2022, a comprehensive structure is followed. At first, we will examine the Carbon dioxide (CO_2) emission in Europe from 1850 to 2022 and its impact on Temperature increase, and later will find the sectors that contribute to increasing CO_2 emissions mostly**. Figure 2** shows that from the year 1850 to 1950 CO_2 emissions were relatively low and increased gradually. The period from 1975 to 2000 saw a sharp increase in emissions reaching approximately 8000 million tonnes by around 1990. Finally, from 2000 to 2022, emissions showed a declining trend after peaking around 2005. **Figure 3** shows the correlation coefficient between CO_2 emissions and temperature change from CO_2 is approximately 0.90. This indicates a very strong positive correlation, suggesting that as CO_2 emissions increase, the temperature also increases.

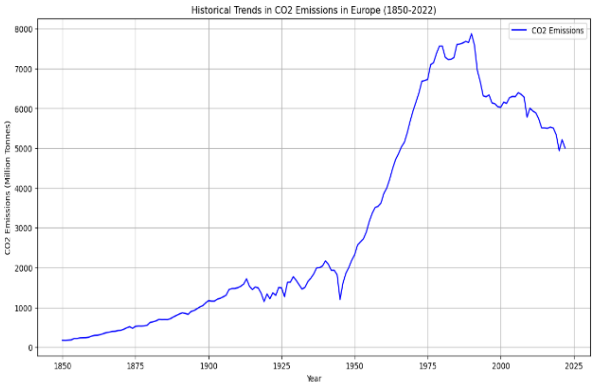

Figure 2: Historical Trends in CO_2 Emissions in Europe (1850-2022)

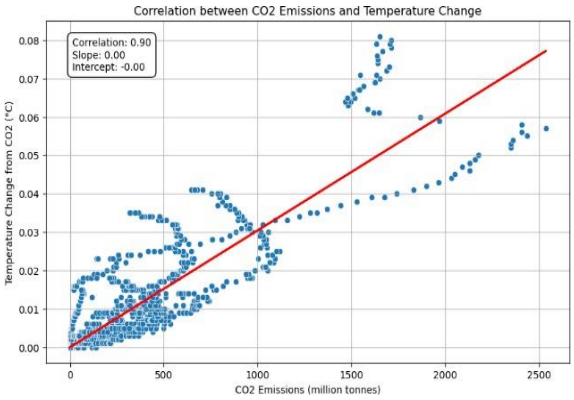

Figure 3: Correlation between CO_2 Emissions and Temperature Change

After that, we will try to find out which Countries and Sectors are highly responsible for emitting CO_2 in Europe.

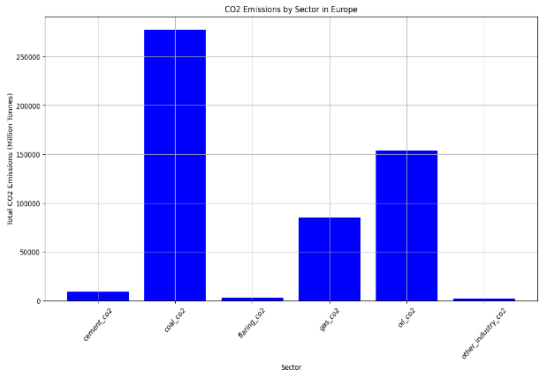

Figure 4: CO_2 Emissions by Sector in Europe

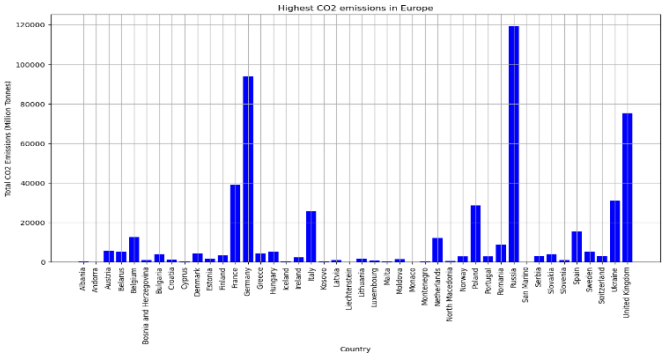

Figure 5: Highest CO_2 emissions by Country in Europe

Figure 4: Represents a detailed analysis of CO_2 emissions by sector in Europe. This shows that the coal industry has the highest emissions standing at 250,000 million tonnes, displacing the rest of the industries. The gas and oil sectors also have considerable outputs, but it is lower than in coal. On the contrary, the cement, flaring, and other industries are insignificant in their overall input in the CO_2 emissions intensity. On the other hand, **Figure 5:** A European form of the presentation of the compared rates of CO_2 emissions by country. Russia ends up emitting the highest amount exceeding 100, 000 million tonnes; this is followed by Germany. The United Kingdom and Ukraine also display reasonable amounts, which points towards their contributions to total emissions in the continent's Carbon dioxide total.

3.2 How has the mean sea level pressure changed globally over time (1951-2021)?

To address the question of how sea level pressure changes globally, some notable analyses have been done.

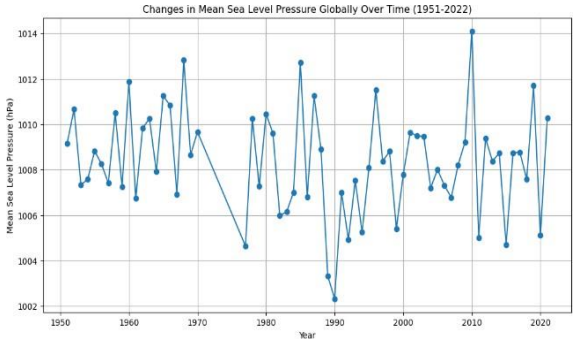

Figure 6: Changes in Mean Sea Level Pressure Globally Over Time (1951-2022)

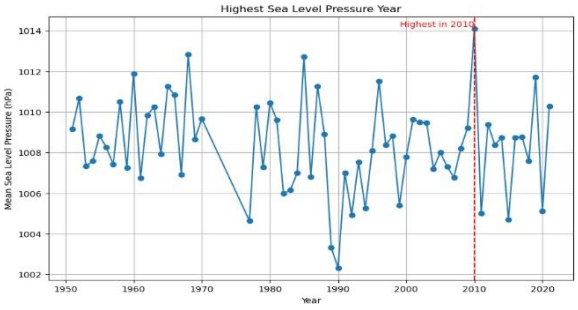

Figure 7: Highest Sea Level Pressure Year

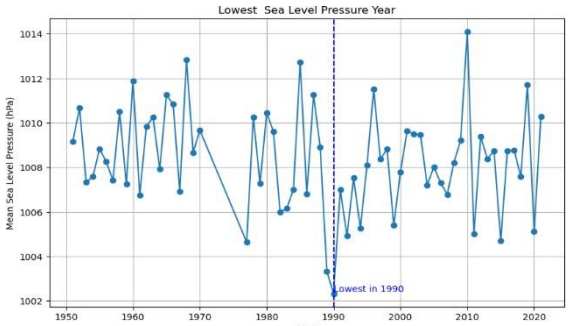

Figure 8: Lowest Sea Level Pressure Year

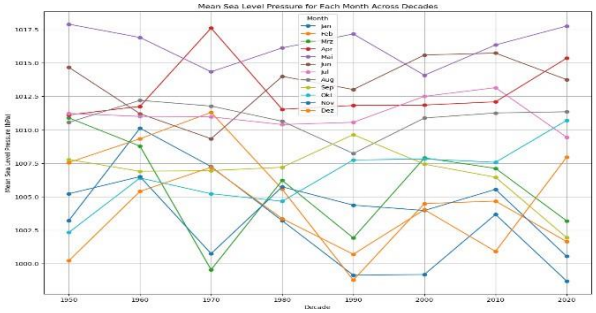

Figure 9: Mean Sea Level Pressure for Each Month Across Decades

As shown in **Figure 6**, it is possible to provide a general picture of different trends of the mean sea level pressure (MSLP) fluctuations for 71 years. This evidence proves that there are rising and falling trends as seen from high and low oscillations respectively. **Figure 7** shows the highest recorded MSLP in this area, which occurred in the year 2010. As shown in **Figure 8**, the lowest recorded MSLP was in the year 1990. **Figure 9** shows, the MSLP change of each month of the year has been classified in different decades. The dots in each line point to the individual months for which different values of the mean pressure are given. The graph shows that there is a different rate of pressure for every month of the year, where some months, for instance, January or December has a constant higher pressure while other months like August or September have fluctuating pressure.

3.3 How do CO_2 emissions and the increasing population make an impact on sea level pressure?

We will use a confusion matrix to analyze how sea level pressure correlates with CO_2 emissions and temperature increases.

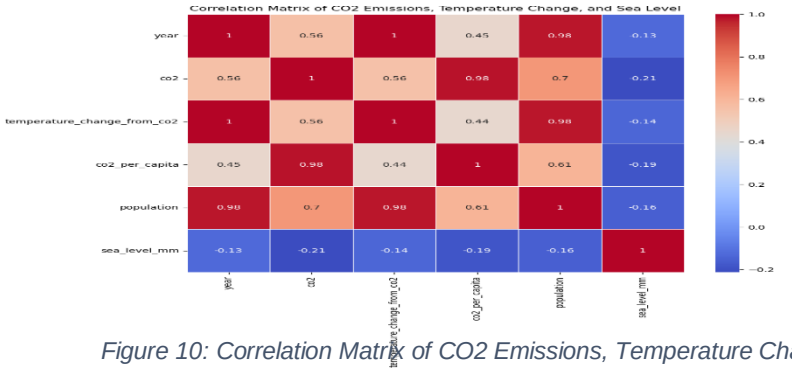

Figure 10: Correlation Matrix of CO2 Emissions, Temperature Change, and Sea Level

The correlation matrix (**Figure 10**) reveals significant relationships among CO_2 emissions, temperature changes, and sea level. There are strong positive correlations between the year and both temperature changes from CO_2 (1.0) and population (0.98), indicating that these variables have increased over time. CO_2 emissions are highly correlated with CO_2 per capita (0.98), reflecting the impact of population growth on emissions. Conversely, sea level shows weak negative correlations with all other variables, suggesting a more complex relationship. Overall, the matrix highlights how rising CO_2 emissions and population contribute to temperature changes, while the relationship with sea level rise is less straightforward.

4. Conclusion:

The analysis report is dedicated to the historical perspective of carbon dioxide emissions in Europe for the period between 1850 and 2022 and their relation to temperature and sea level pressure fluctuations. This pattern of CO_2 emissions was relatively stable from 1850-1950, rose rapidly to 2000 and fell after 2005. On a sectoral basis, the coal industry was the most emitting industry followed by the gas and oil industries; Russia and Germany were the most emitting nations. Mean sea level pressure has increased year by year and month by month from 1951 to 2021 all over the world. However, sea level rise showed low coefficients of determination with CO_2 emissions,temperature changes, and population.

4.1. Limitations:

The correlation matrix reveals some limitations in understanding sea level rise due to its weak negative correlations with other variables. Specifically, sea level shows a correlation of -0.21 with CO_2 emissions, -0.14 with temperature change from CO_2, -0.19 with CO_2 per capita, and -0.16 with population. These weak correlations suggest that sea level rise is not directly or strongly related to these variables within the data set. This complexity requires a broader range of data to fully understand its causes.