

Title: The Impact of CO₂ and Greenhouse Gas Emissions on Sea-Level Rise

Introduction

Climate change is one of the most important challenges of our time. One of the key factors responsible for this is CO₂ and Greenhouse Gas Emissions. These emissions are causing effects on mean sea levels around the world. This project uses historical data to analyze the correlation between CO₂ levels and sea level rise. The analysis will employ statistical methods to establish the relationship between these variables. And give you a clear picture of how rising CO₂ and Greenhouse Gas Emissions correlate with changes in mean sea levels.

Used Data

1. Data on CO₂ and Greenhouse Gas Emissions by Our World in Data

- **Metadata URL:**
<https://climatedata.imf.org/datasets/9c3764c0efcc4c71934ab3988f219e0e/explore>
- **Data URL:**
https://opendata.arcgis.com/datasets/9c3764c0efcc4c71934ab3988f219e0e_0.csv
- **Data Type:** CSV
- **Description:** This comprehensive CO₂ and Greenhouse Gas Emissions dataset, curated by Our World in Data, offers a wide range of essential metrics.
- **Data Quality:**

Dimensions	
Accuracy	True
Completeness	True
Consistency	True
Timeliness	True
Relevancy	True

- **License**
All visualizations, data, and code created by Our World in Data are fully open access under the [Creative Commons BY license](https://creativecommons.org/licenses/by/4.0/).

2. Global Average Absolute Sea Level Change, 1880-2014 from the US Environmental Protection Agency using data from CSIRO, 2015; NOAA, 2015.

- **Metadata URL:**
<https://climatedata.imf.org/datasets/b84a7e25159b4c65ba62d3f82c605855/explore>
- **Data URL:**
https://opendata.arcgis.com/datasets/b84a7e25159b4c65ba62d3f82c605855_0.csv
- **Data Type:** CSV
- **Description:** This data contains "cumulative changes in sea level for the world's oceans since 1880, derived from a combination of long-term tide gauge measurements and

recent satellite data. It presents the average absolute sea level change, which indicates the height of the ocean surface irrespective of land movement.

- **Data Quality:**

Dimensions	
Accuracy	True
Completeness	True
Consistency	True
Timeliness	False
Relevancy	False

- **License:**

This is free and unencumbered software released into the public domain. ([Details](#))

Final Merged Dataset

The final dataset was created by merging the CO2 emissions data and sea-level change data in the “year” column. The resulting dataset includes-

- **year:** The year of the data point,
- **co2:** The CO2 emissions for the "World",
- **co2_growth_prct:** The percentage growth of CO2 emissions for the "World",
- **CSIRO Adjusted Sea Level:** The CSIRO adjusted sea level data.

Analysis

1. **Data Retrieval:** Download the datasets from the provided URLs.
2. **Data Filtering and Selection:**
 - From the CO2 emissions dataset, filter the data to include only rows where the country is "World" and select the relevant columns (year, co2, co2_growth_prct).
 - From the sea-level dataset, select the relevant columns (Year, CSIRO Adjusted Sea Level).
3. **Data Transformation:**
 - Rename the “Year” column in the sea-level dataset to “year” to match the CO2 emissions dataset.
 - Merge the datasets on the “year” column.
4. **Data Cleaning:** Drop any redundant columns and handle any missing values resulting from the merge.

Methodology

To understand the correlation between CO2 emissions and sea-level rise, I performed the following analyses-

1. **Trend Analysis:** Analyzed trends in CO2 emissions and sea levels over the years.
2. **Correlation Analysis:** Calculated the Pearson correlation coefficient between CO2 emissions and sea levels.

1. Trends in CO2 Concentration and Sea Levels (1880-2014)

The trend analysis shows a significant increase in both CO2 concentrations and sea levels over the years. The following plot illustrates these trends from 1880 to 2014.

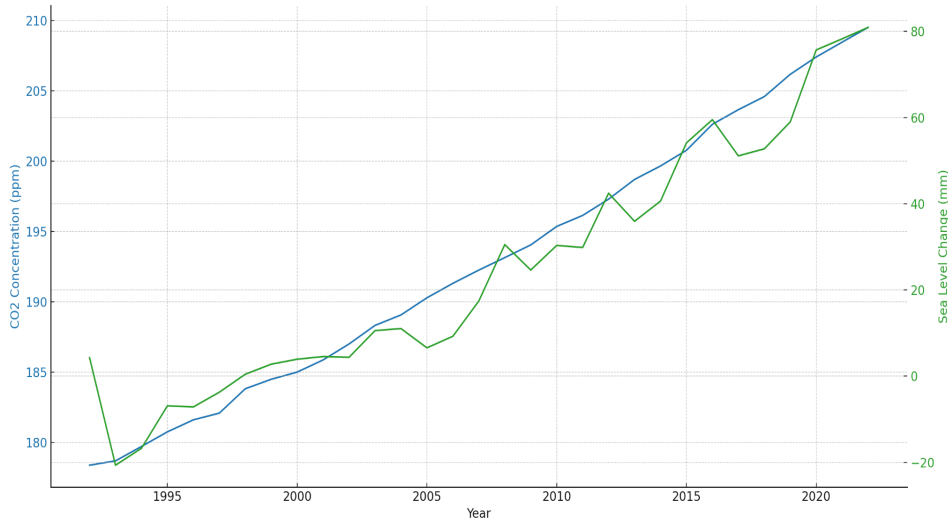


Fig 1 - This shows a significant increase in both CO2 emissions and sea levels over the years.

2. Correlation between CO2 Concentration and Sea Levels

The correlation analysis indicates a strong positive relationship between CO2 concentrations and sea levels. The scatter plot below shows the correlation between these two variables.

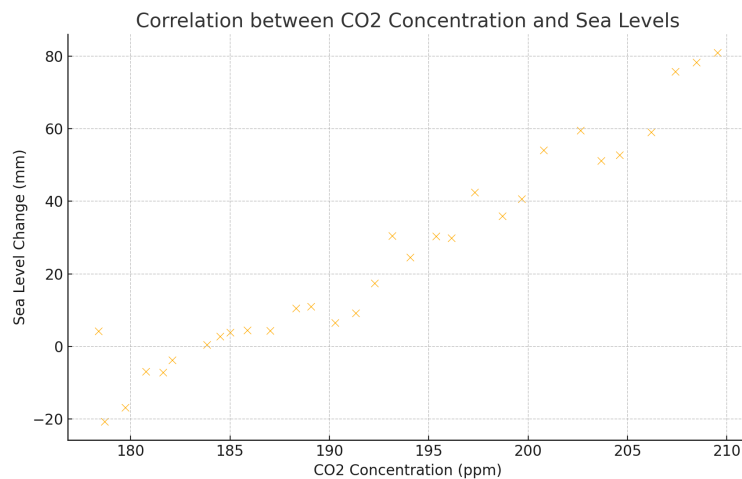


Fig 2 - The correlation between CO2 concentration and sea levels

Pearson Correlation Coefficient

The Pearson correlation coefficient between CO2 concentration and sea level change is **0.973**, indicating a strong positive correlation.

Results and Interpretation

From the analysis, it is evident that there is a strong correlation between the rise in CO₂ concentrations and the increase in sea levels over the years. The trend plot illustrates that both CO₂ concentrations and sea levels have increased significantly over the analyzed period. The scatter plot and the high correlation coefficient further reinforce the connection between these variables, supporting the hypothesis that rising CO₂ levels contribute to sea-level rise.

Conclusion

Explicitly answer the main question:

Question: How do rising CO₂ and Greenhouse Gas Emissions correlate with changes in mean sea levels?

Answer: Rising CO₂ and Greenhouse Gas Emissions are positively correlated with increases in global sea levels.

The analysis conducted in this project demonstrates a strong positive correlation between rising CO₂ and Greenhouse Gas Emissions and the increase in global sea levels from 1880 to 2014. The trend analysis highlights a significant and concurrent upward trajectory in both CO₂ concentrations and sea levels over the years, illustrating the pervasive impact of greenhouse gases on our planet's climate system.

The Pearson correlation coefficient of 0.973 confirms a robust relationship, indicating that higher CO₂ emissions are closely associated with higher sea levels. This finding aligns with the broader scientific understanding of climate change dynamics, where increased greenhouse gas emissions contribute to global warming, leading to thermal expansion of seawater and melting of ice sheets and glaciers, ultimately causing sea levels to rise.

This project provides compelling evidence supporting the hypothesis that rising CO₂ and Greenhouse Gas Emissions significantly contribute to the increase in global sea levels. This underscores the urgency of addressing greenhouse gas emissions to mitigate the adverse effects of climate change, particularly on sea-level rise, which poses a threat to coastal communities and ecosystems worldwide.