Economic Development and Climate Change

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Greenhouse Gases Relationship with Climate Change and GDP Growth

Between 1990 and 2012, CO_2 levels increased by **40 parts per million** (ppm), reflecting the ongoing trend of increasing global temperatures likely influenced by industrialization and fossil fuel consumption (Figure 2). Oceans have heated up by **20 zettajoules** in the last 30 years and sea levels have also increased steadily, as oceans absorb excess heat from global warming and melting ice adds freshwater, impacting global sea levels (Figure 3). Both CO_2 and methane exhibit seasonal patterns linked to the growth and decay of vegetation. Notably, CO_2 emissions are highest in the second quarter (2.66 ppm above average), while methane peaks in the fourth quarter (4.91 ppm above average), as shown in Table 1.

CO_2 emissions have doubled since 1970, strongly correlating with the consistently increasing GDP worldwide. However, GDP per capita worldwide does not correlate as strongly with emissions per capita, suggesting that as wealth increases, countries may invest more in emissions-reducing technologies (Figure 4). Figure 5 further shows a close link between global GDP growth and greenhouse gas emissions, likely due to the energy and resource demands of expanding economies.

Figure 1 reveals how increasing CO_2 and global temperature levels are both increasing over time, but Figure 2 highlights the almost direct relationship between the two measurements, allowing for an easier, more accurate interpretation of the long-term connection between CO_2 and global temperatures.

Conclusion

The data demonstrates a clear upward trend in greenhouse gas emissions, resulting in increasing sea levels, ocean heat, and global temperatures. This relationship is closely tied to global economic growth, due to industrialization and fossil fuels. While per capita emissions remain similar, global emissions continue to rise due to population growth and increased demand for energy and resources. This highlights the importance of sustainable development practices that can meet human needs without exacerbating climate impacts. To mitigate climate change while supporting economic growth, a transition to **low-carbon economies is essential.**

Table 1: Seasonal Greenhouse Gas Emissions

Quarter	Seasonal CO_2 Adjustment	Seasonal Methane Adjustment
1	0.801	1.62
2	2.66	-1.72
3	-1.37	-4.76
4	-2.03	4.91

Figure 1: CO_2 and Global Temperatures Over Time

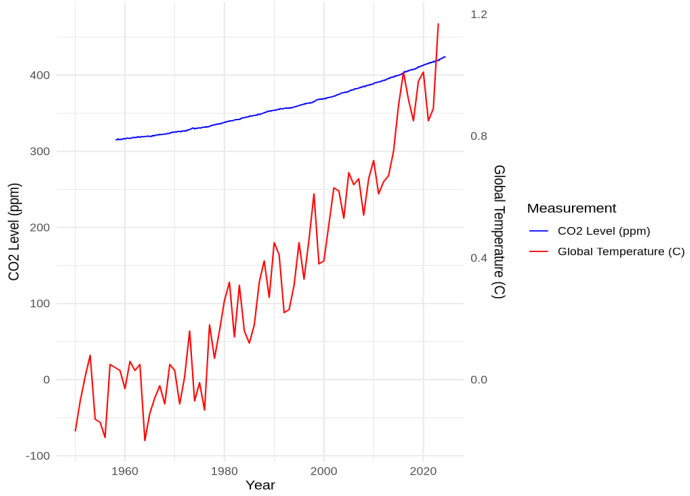

Figure 2: Changes in CO_2 levels with Global Temperatures Over Time

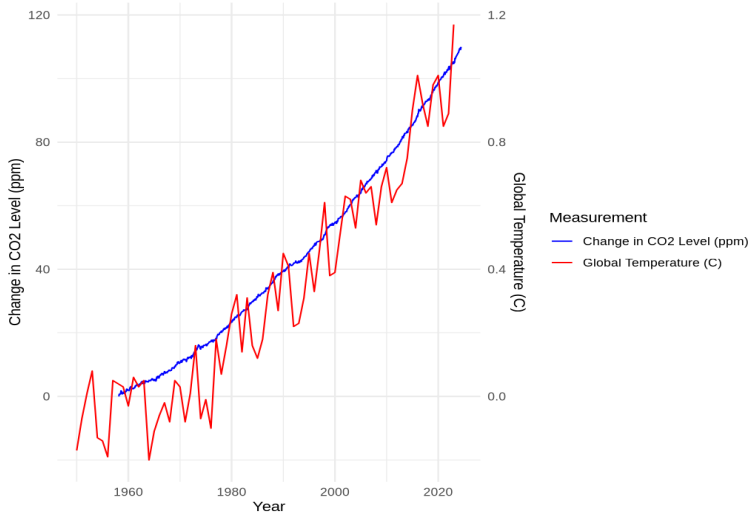

Figure 3: Average Sea Levels and Ocean Heat Over Time

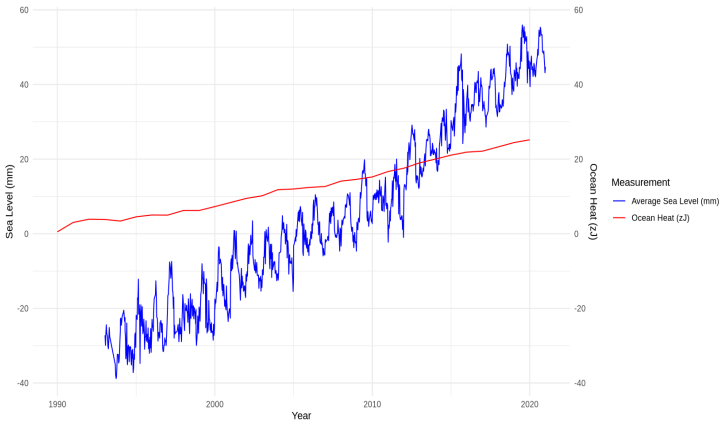

Figure 4: GDP and CO_2 Emissions - Raw and Per Capita

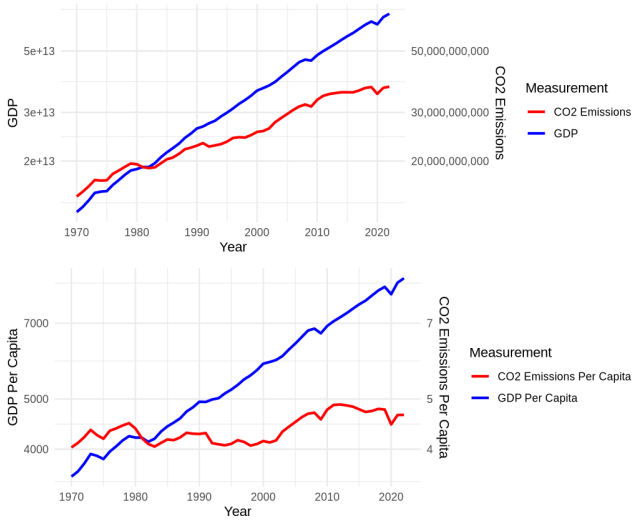

Figure 5: Changes in GDP and Greenhouse Emissions in Countries and Worldwide