Megan Wilcox

February 2025

Greenhouse Gas Emissions Analysis Summary: Carbon Dioxide and Methane

Context

Greenhouse gasses are the current, most significant drivers of climate change in the world (US EPA, 2024). Human and environmental activity contribute to the leakage of different greenhouse gasses into the atmosphere. To best mitigate climate change, climate scientists around the world track the leakage of different greenhouse gasses into the atmosphere and the gasses' effects. From this, scientists can deduce which gasses, specifically, have the most impact on climate change. To compare the impact of different gasses mathematically, scientists use a standardized unit—kilotons in carbon dioxide equivalent—that this analysis will refer to as a gas' relative emissions (US EPA, 2024).

Purpose

The purpose of this data analysis is to determine if there is significant correlation between large-scale changes in carbon dioxide and methane emissions.

Data

The data used in this analysis is from the United Nations Greenhouse Gas Inventory Data of the United Nations Framework Convention on Climate Change (UNFCCC), specifically the Land-Use, Land-Use Change and Forestry (LULUCF) sector (*UNdata | Explorer*, n.d.).

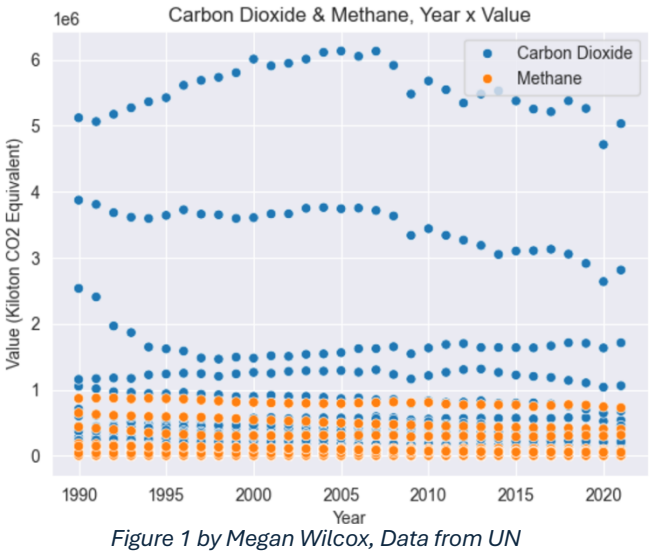

Figure 1 by Megan Wilcox, Data from UN

Two data sets are analyzed: relative carbon dioxide emissions without land use and relative methane emissions without land use (see Figure 1). The data sets describe the relative emissions of the same 43 areas from the years 1990 through 2021 inclusive. Of the 43 areas, 42 are countries and 1 is the UN itself. Going forward, the areas will be called countries for ease of understanding.

Analysis

One country is missing emissions data in the year 2021, so the analysis is performed on data from 1990 through 2020.

To find any correlation between the changes in the relative emissions of carbon dioxide and methane, a new dataset is created. For each country within said dataset, the change in relative emissions (2020 minus 1990) is marked for carbon dioxide and methane. Figure 2 (right) displays the changes in relative emissions for carbon dioxide (x-axis) and methane (y-axis). Visually, there seems to be a positive, linear correlation.

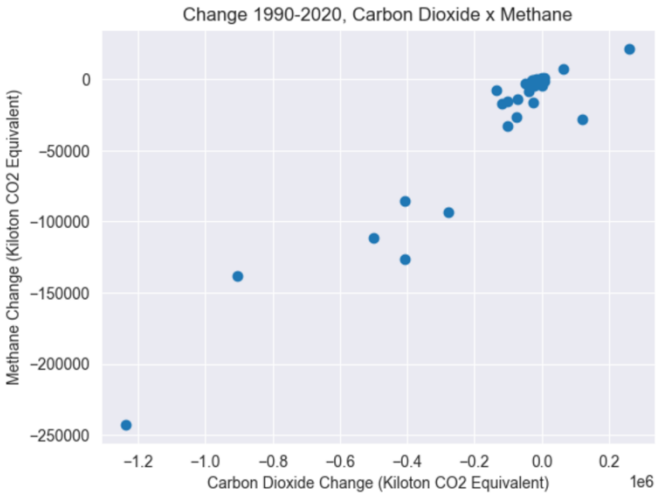

Figure 2 by Megan Wilcox, Data from UN

To mathematically calculate the significance of the apparent linear correlation, Pearson's correlation coefficient is applied to the new dataset to get 0.9546. The value indicates a strong, positive correlation between the changes in relative emissions of carbon dioxide and methane.

This document is meant to serve as a general summary of this analysis. For more details of this analysis, please see the presentation which can be found in the documentation for this analysis.

Conclusion

According to Pearson's correlation coefficient, there is more likely than not a strong, positive correlation between large-scale changes in relative emissions of carbon dioxide and methane.

The scope of this analysis is limited and cannot be applied outside of this specific scenario. Further, the aforementioned correlation does not indicate causation. Rather, more research is needed into the connection between large-scale changes in carbon dioxide and methane relative emissions. Additional research could provide insights into how climate scientists can most efficiently minimize both carbon dioxide and methane emissions.

References

UNdata | explorer. (n.d.). Data.un.org. Retrieved February 2025, from http://data.un.org/Explorer.aspx

US EPA. (2024, June 27). *Climate Change Indicators: Greenhouse Gases*. US EPA; United States Environmental Protection Agency. https://www.epa.gov/climate-indicators/greenhouse-gases