Environmental Trends Over the 21st Century

Chiara Adjoh-Davoh, ID: 004002088

**Objective**

The objective of this data analysis is to examine how certain environmental trends have moved over the past 25 years, with the goal of seeing the tangible effects of climate change.

**Introduction**

Climate change affects us all. Whether you believe it or not, the signs are there that the planet's climate is changing in ways that are harmful to not only our lives, but the lives of every living thing. There's not just one data point that can be used to see climate change in action, but rather many data points and trends that point to the world's climate heading in a bad direction. It is also important to see how the trends vary from country to country. This data set uses data across a number of climate related measurements including average temps, CO2 emissions, rainfall, etc. to show the environmental trends from 2000 to 2024 in 14 countries. The data is collected from [Kaggle](https://www.kaggle.com/datasets/adilshamim8/temperature?resource=download).

**Method**

The dataset did not have any empty or null rows, so those did not have to be addressed. However, some countries had multiple rows for the same year, which can be quite confusing. For example, South Africa had 7 entries in the year of 2000. With no month being listed, it can be hard to tell which should be used. To make it easier and only allow one row per country per year, we grouped by Year and Country (which automatically arranges the data from oldest to most recent for easier visual clarity), and then aggregated the data, using mean and max when appropriate. ​For example, Average Temperature used mean to aggregate, as it felt appropriate when we did not know the month of the temperature reading, but Rainfall used max because it was assumed that the value point with the max was likely the latest in the year.

​

Before consolidation, some countries had as much as 70 entries while others only had 50. However, after consolidation, most countries had around 24 entries, one for each year. It should be noted that after this consolidation, there were still some countries that did not have data at all for some years.

**Storytelling**

The data and its visualizations tell an interesting story about climate and how not everything is what it may be assumed to be. The boxplot of CO2 emissions grouped by region and further divided by the number of extreme weather events reveals that North America, Europe, and South America have the widest ranges in emissions, while Oceania and Africa show minimal variation, likely due to their underrepresentation in the dataset, each consisting of only one country. Interestingly, regions with above-average extreme weather events generally exhibit lower average CO2 emissions, while those with below-average events display greater variance. The barplot of country-level CO2 emissions, adjusted to better show differences, highlights Australia’s notably low emissions, followed by a significant jump to the next country. There are also clusters of countries with similar emissions rates, suggesting links to other outside factors such as industrialization and import behavior. The scatter plot examining sea level rise over time with a filter for extreme weather events shows that data points with above-average extreme events increasingly cluster at higher sea levels over time, implying a potential but weak correlation. Meanwhile, the chart of extreme weather events by climate and region indicates that temperate zones experience the most extreme events, followed by warm and cold climates. Cold climates, though less associated with extreme events, display more year-to-year variability. Lastly, the correlation matrix confirms strong relationships between sea level rise, rainfall, and extreme weather events, as well as inverse correlations between average temperature and renewable energy usage, and surprisingly, between population size and renewable energy percentage. These trends show the complex, interrelated climate dynamics and challenge many of the notions I went into the project with. While there is a lot that could be left up to the data collection and its problems, it’s possible that not everything is as dire as it may seem.

**Conclusion**

Overall, the visualizations highlight complex but meaningful relationships between CO2 emissions, extreme weather events, climate types, and other environmental factors across regions. Patterns suggest that higher emissions do not always align with more extreme weather, and variables like renewable energy usage and population size influence climate outcomes in unexpected ways. These insights show that there is always more to the story when analyzing something as complex and worldwide as climate, and there is always more to learn and research. While I don’t think my very amateur sleuthing has disproved anything we know about climate change, more data should be collected, properly stored, and shared to the public.

**Acknowledgements**

This project was created in collaboration with Bella Primus, Keon K., Olivia Lastique, Shreeya Gautam and Halia Benn​ and under the guidance of Dr. Meenakshi Nerolu.

​