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Artificial Intelligence & Business Analytics

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Final Project Report

Natural Disasters & Climate Change Impact on Economy

Data Visualization

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Introduction:

Natural disasters have always posed significant challenges to human societies, but in recent decades, their frequency and intensity appear to be escalating. Events such as hurricanes, wildfires, floods, and droughts have become more frequent, more intense, and more destructive, inflicting profound damage on human lives, infrastructure, and national economies. Alongside these natural hazards, climate change has emerged as a powerful, often indirect driver, influencing temperature patterns, sea levels, and weather extremes that intensify the scale of these disasters.

The economic consequences of such disasters are significant, often amounting to billions of dollars in recovery and reconstruction costs. These costs are not only financial but socially affecting employment, housing, healthcare access, and overall quality of life. The burden is disproportionately felt by vulnerable regions, particularly those lacking infrastructure, resilience planning, and insurance safety nets.

This project explores the evolving relationship between climate anomalies and economic damage from natural disasters. It seeks to reveal how rising global temperatures and shifting climate conditions may be amplifying disaster risks and financial impacts. By analyzing global datasets on disaster frequency, climate anomalies, and economic losses, this project provides a data-driven lens to assess the implications of a warming world on global stability.

Ambitiousness:

This project integrates five datasets from globally recognized sources, including EM-DAT, NOAA, the World Bank, Our World in Data, and a custom Weighted Climate Dataset. By combining disaster event records, economic indicators, greenhouse gas emissions, and regionally weighted climate metrics, the analysis offers a multidimensional exploration of the connection between climate change and economic vulnerability. The inclusion of both global and U.S.-specific datasets enables comparative insights, while the integration of GDP and emissions data allows for normalization and context-aware conclusions. This cross-sectional approach adds depth and credibility to the findings.

The project's design also emphasizes analytical richness through Power BI's advanced visualization tools. It features a mix of simple charts, drill-down visualizations, animated timelines, and map-based visualizations, all woven into dashboards that provide intuitive access to layered insights. The combination of diverse data sources, thoughtful normalization strategies, and meaningful interactivity reflects a deliberate attempt to go beyond surface-level trends and uncover systemic relationships. By analyzing both causes (emissions, temperature rise) and consequences (economic losses), this project addresses a globally relevant issue from multiple vantage points.

Methodology:

Dataset 1: EM-DAT International Disaster Database

https://www.emdat.be/

This dataset contains columns like Country, Year, Disaster Type, Total Deaths, Affected Population, and Economic Losses. It serves as the primary source for understanding global trends in disaster frequency, severity, and economic impact over time.

Dataset 2: NOAA Billion-Dollar Disasters

https://www.ncei.noaa.gov/access/billions/

This dataset contains fields such as Year, Disaster Type, Economic Losses (adjusted for inflation), and State (U.S. specific). It focuses on weather and climate disasters in the United States that have resulted in damages exceeding $1 billion, enabling deeper analysis of high-cost climate events.

Dataset 3: CO2 and Greenhouse Gas Emissions

https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions

This dataset includes columns like Country, Year, CO_2 Emissions (Methane, Nitrous Oxide, and Total Greenhouse Gas Emissions). It supports analysis of emission trends and potential links between environmental degradation and increasing disaster frequency.

Dataset 4: GDP (current US$)

https://data.worldbank.org/indicator/NY.GDP.MKTP.CD

This dataset contains Country Name, Country Code, Year, and GDP in current US dollars. To address the research questions, unnecessary columns were removed using Python and Excel. This dataset is used to normalize disaster losses in relation to a country's economic size.

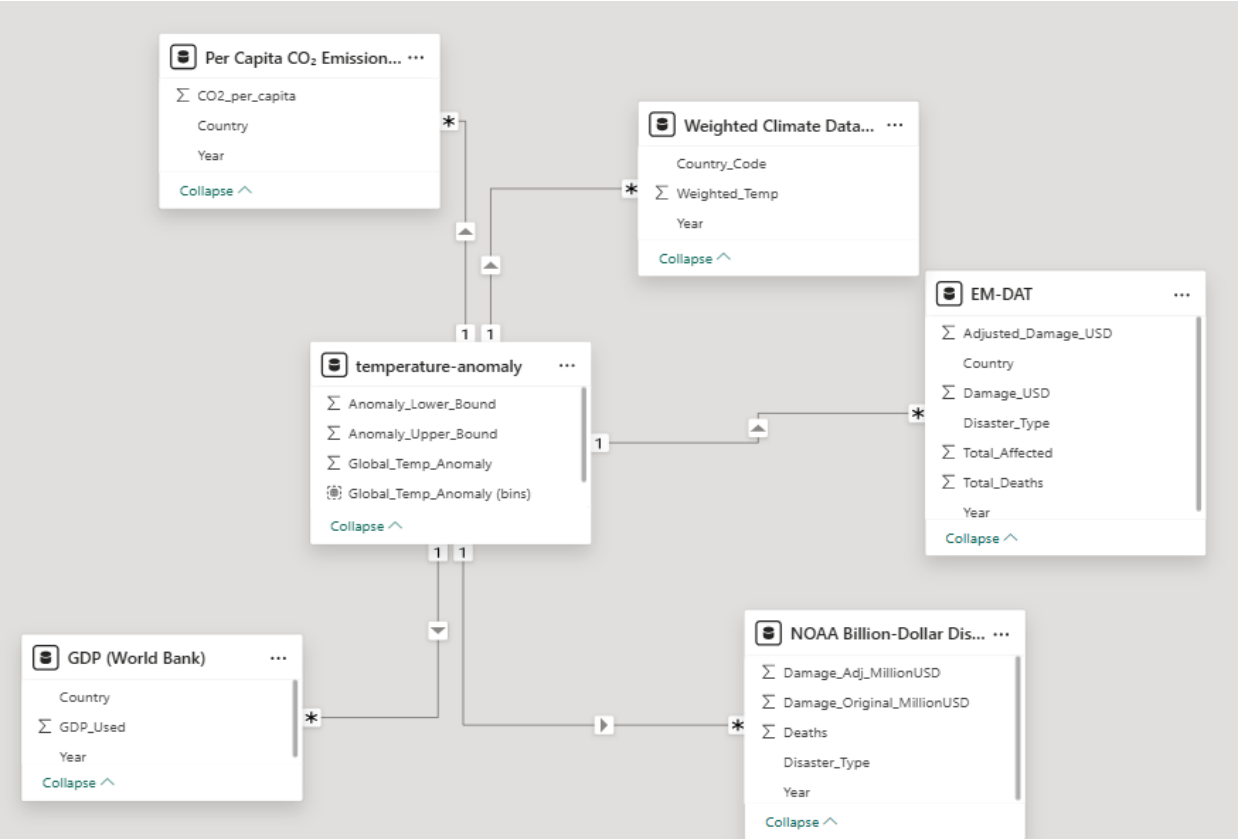
Dataset 5: Weighted Climate Dataset

https://weightedclimatedata.streamlit.app/

This dataset includes weighted indicators such as Temperature Anomalies, Precipitation, and Climate Vulnerability Index, adjusted by socioeconomic factors like population. It enables regional climate analysis in conjunction with disaster outcomes.

In total, the project utilizes five datasets spanning both global and U.S.-specific scopes, offering insight into climate variability, disaster trends, emissions, and economic losses. These datasets were preprocessed and merged based on common fields such as Country and Year. This integration enabled the development of relationships among climate indicators, disaster impact, and national economic data. The resulting model was used to generate interactive and multi-layered visualizations in Power BI, allowing for both historical trend analysis and regional comparisons across different climate and economic conditions.

Model View:



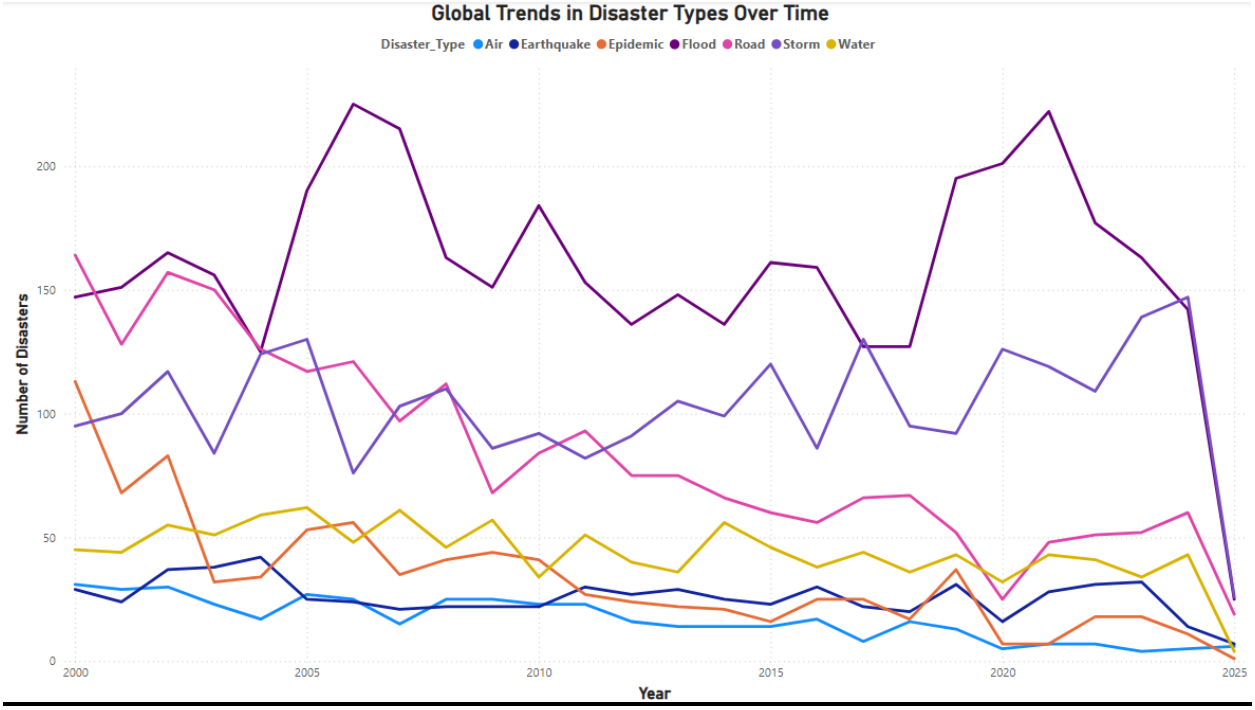
Research Questions:

1. What are the global trends in the frequency and severity of natural disasters from 2000 to 2024, and how have these trends differed geographically?
2. What has been the trend in global CO_2 emissions per capita over the past six decades, and which countries contributed the most to global CO_2 emissions in that period?
3. How have CO_2 emissions per capita and global weighted temperature trends evolved together over the last two decades?
4. How have economic losses and human fatalities from natural disasters evolved over the past two decades, and how do they relate?
5. Which countries dominate the global economy based on GDP levels, and how does the distribution of economic power appear among the top economies?
6. How has the frequency of billion-dollar natural disaster events in the United States changed over the last four decades?
7. How have disaster-related deaths varied across countries and disaster types from 2000 to 2022, and which regions experienced the highest human impact over time?

8. Which regions have experienced the highest weighted temperature anomalies over the past 20 years, and how has the global average weight temperature changed?
9. How has global temperature-anomaly evolved over the past century, and what are the major shifts observed?

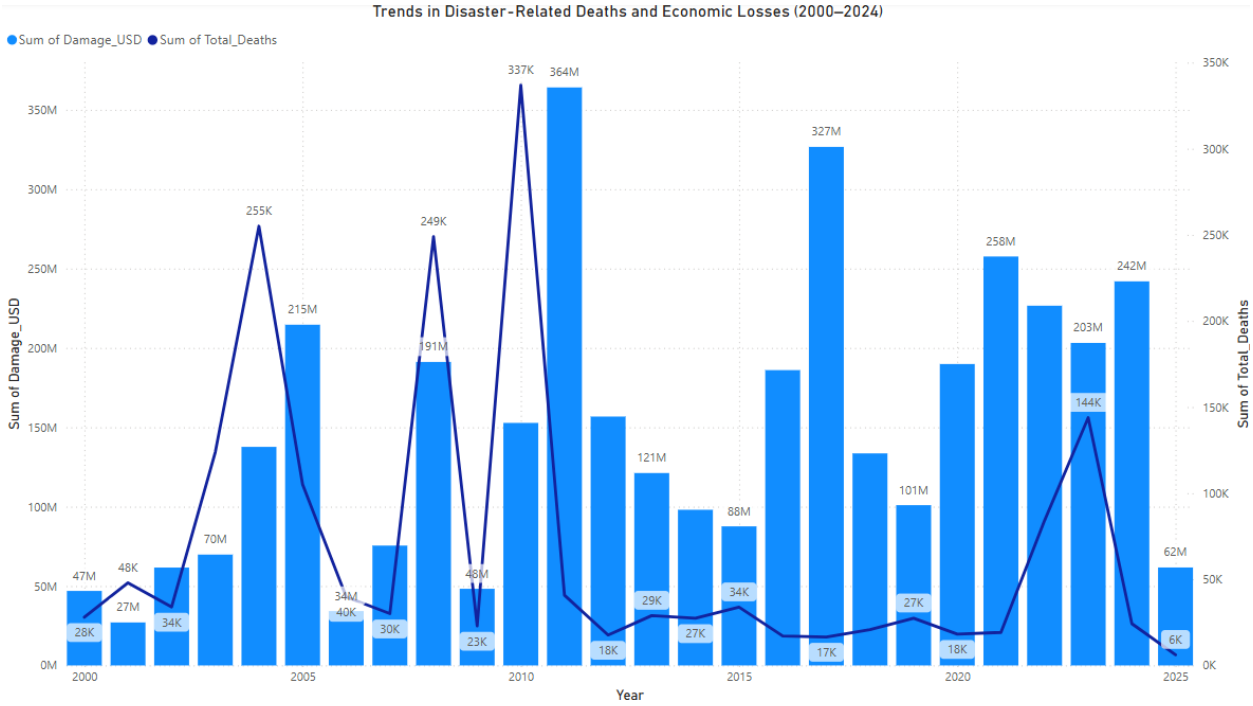
Analysis Performed:

Global Trends in Disaster Types Over Time:



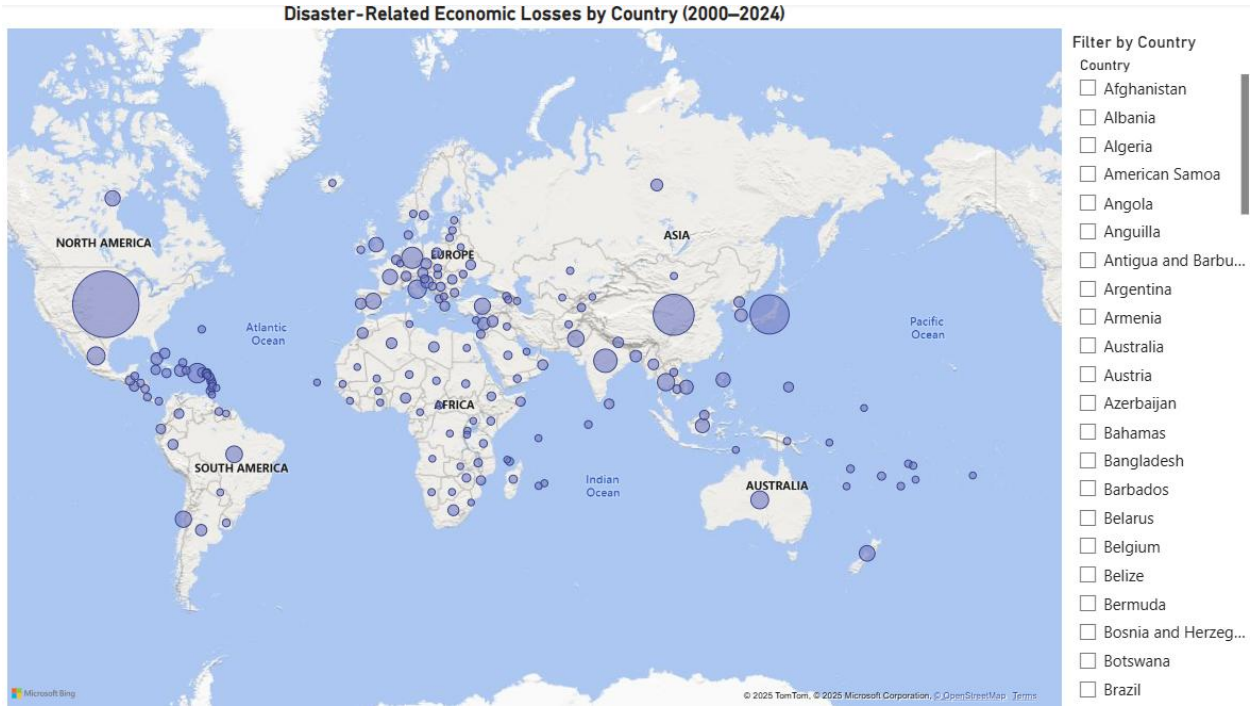
This line chart shows the frequency of different disaster types from 2000 to 2024. Floods and storms are the most frequent, while air and epidemic events remain less common, highlighting varying global disaster patterns.

Trends in Disaster-Related Deaths and Economic Losses (2000–2024):



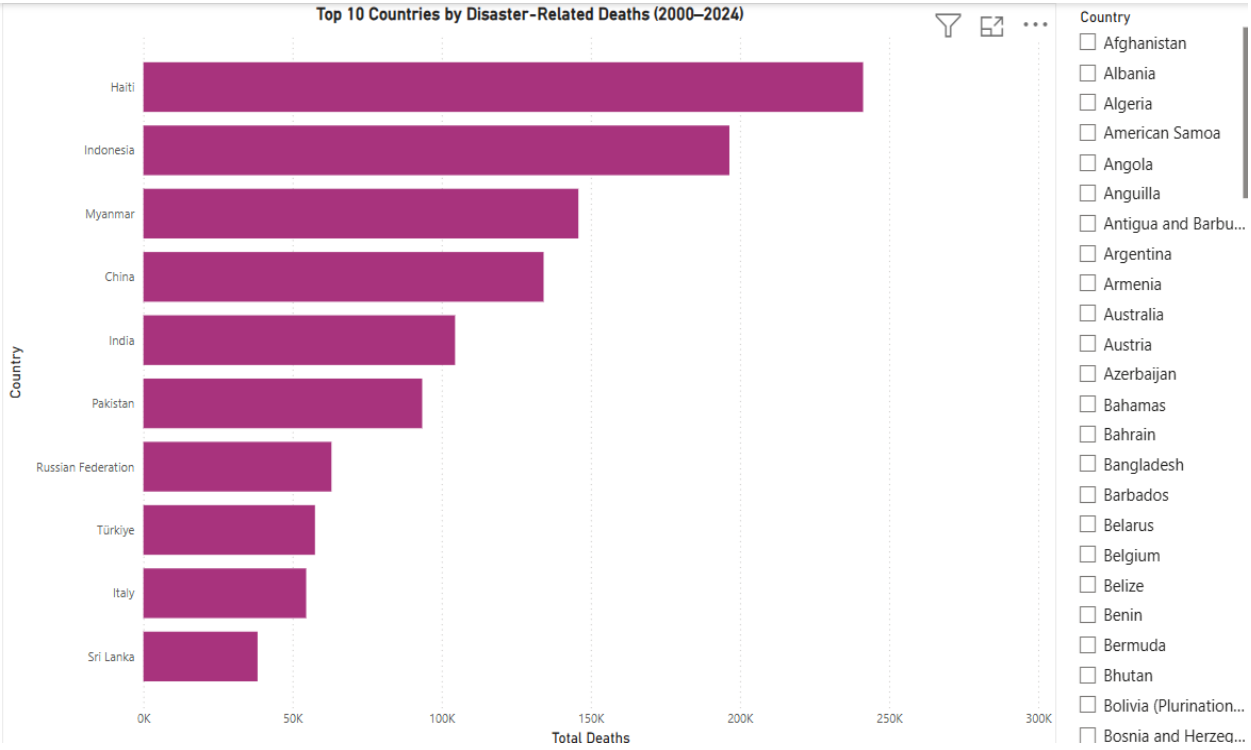
This combo chart compares total deaths (line) and economic losses in USD (bars) due to disasters over time. While losses have shown a rising trend in recent years, fatalities remain volatile, indicating varying disaster severity and preparedness across years.

Disaster-Related Economic Losses by Country (2000–2024):



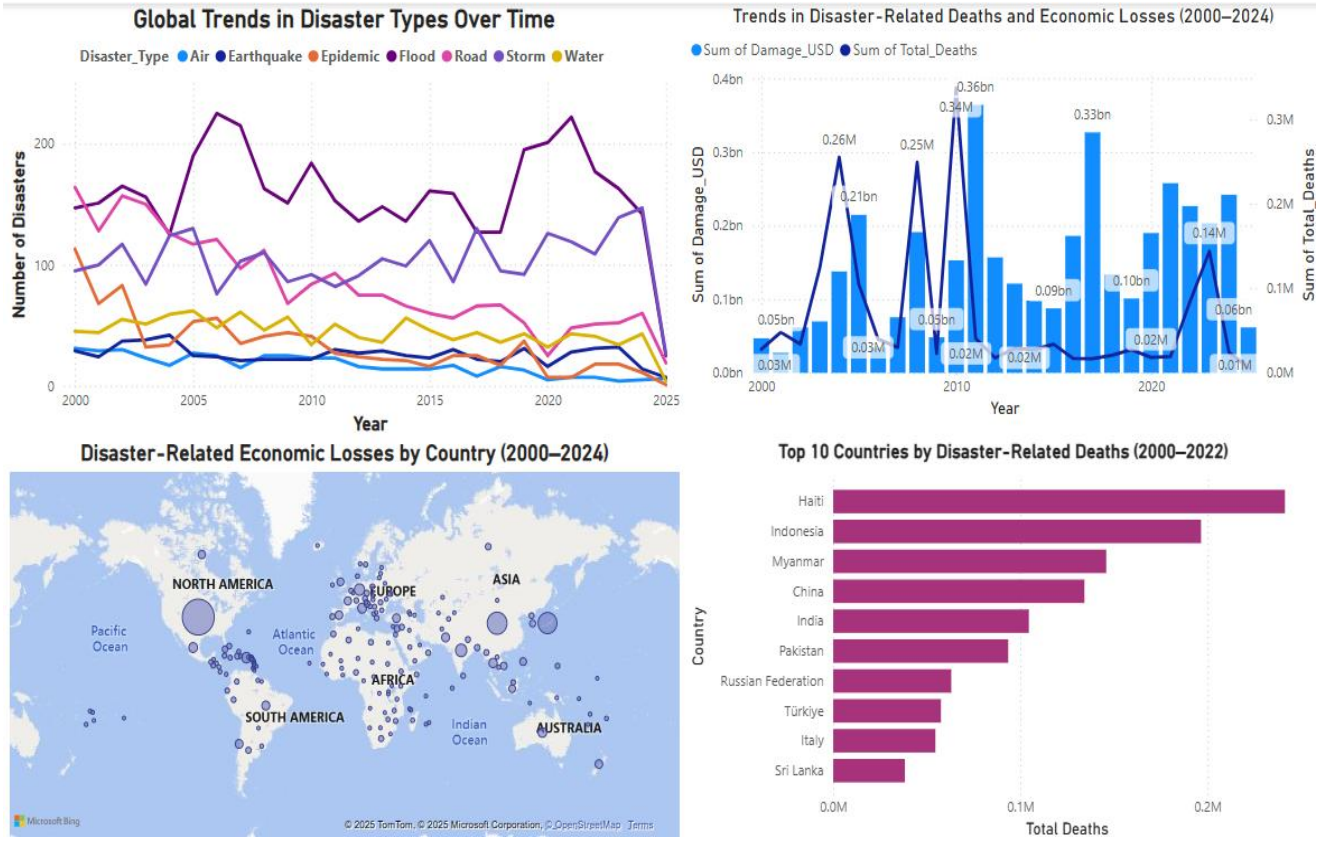
This map displays cumulative disaster-related economic losses by countries. Larger circles represent higher total damages, with countries like the United States, China, Japan and India experiencing the greatest losses. Visualization highlights regional disparities in financial vulnerability, emphasizing how disaster costs are unevenly distributed across the globe.

Top 10 Countries by Disaster-Related Deaths (2000–2024):



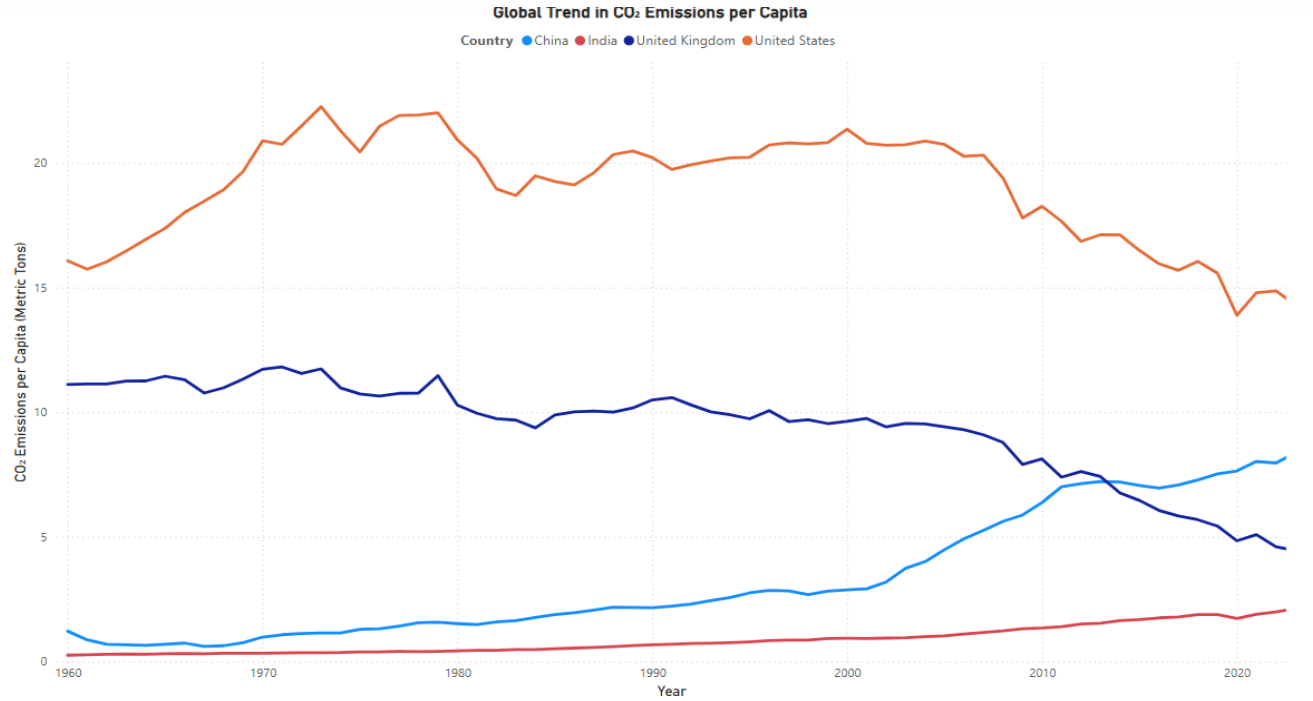
This bar chart ranks countries based on total disaster-related deaths over the past two decades. Haiti, Indonesia, and Myanmar lead the list, reflecting the severe human toll of large-scale disasters in these regions. Visualization underscores regional disparities in disaster impact and resilience, particularly in developing nations.

Dashboard 1: Global Trends in Disaster Frequency, Impact, and Geography (2000–2024)



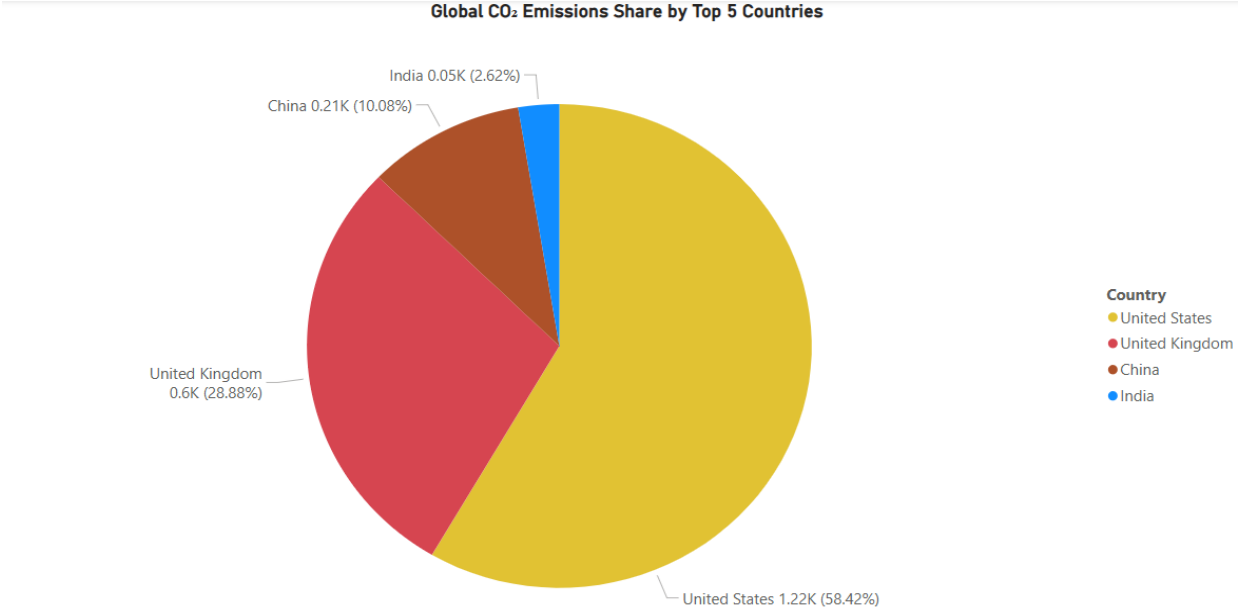
This dashboard integrates four visualizations to provide a comprehensive view of natural disaster trends globally. It highlights changes in disaster frequency, total economic damages, death tolls by country, and regional financial impact. Together, these views reveal how certain disaster types dominate globally, and how impacts vary dramatically across countries.

Global Trend in CO_2 Emissions per Capita:



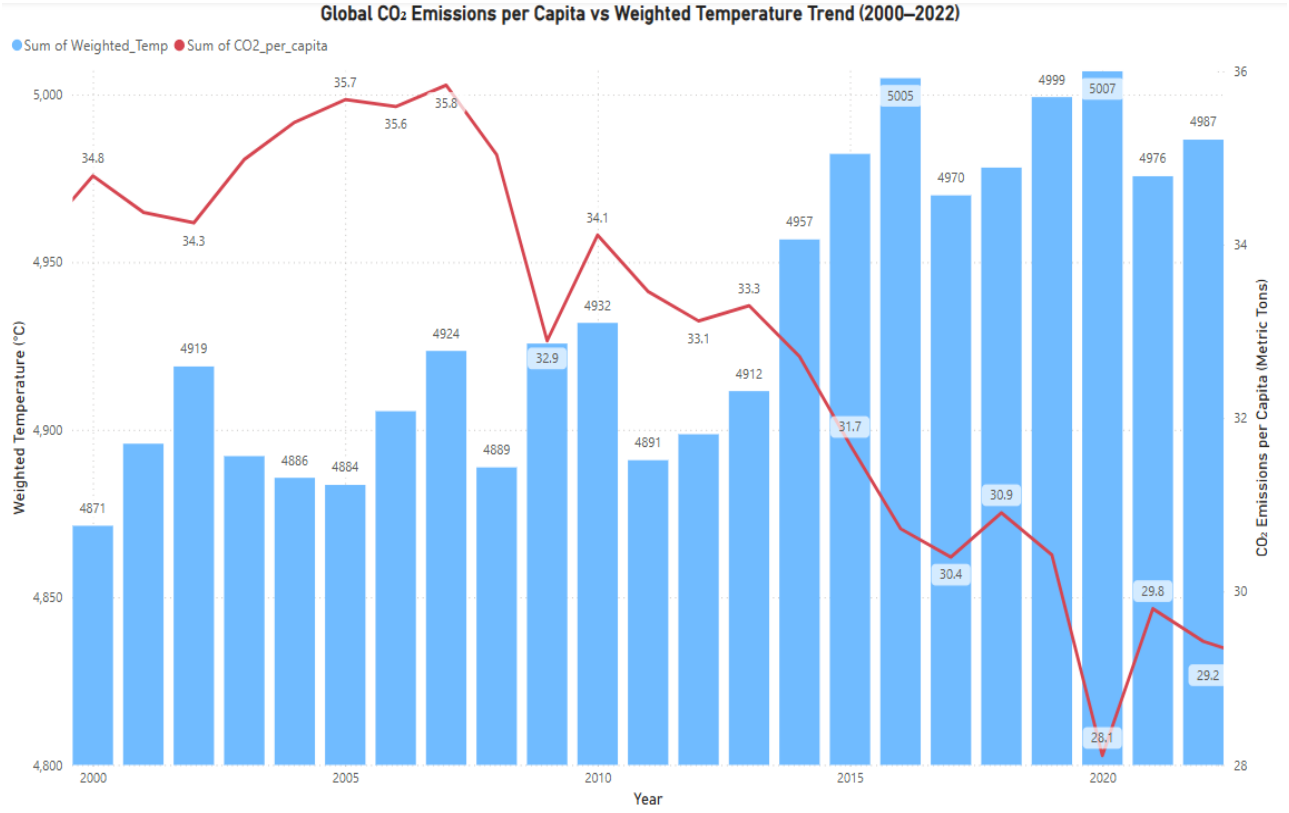
This line chart tracks CO_2 emissions per capita from 1960 to 2022 for the U.S., U.K., China, and India. The U.S. shows a long-term decline since 2000, while China exhibits sharp growth since the 2000s. India's and the U.K.'s trends remain lower, but India shows a gradual upward path.

Global CO_2 Emissions Share by Top 5 Countries:



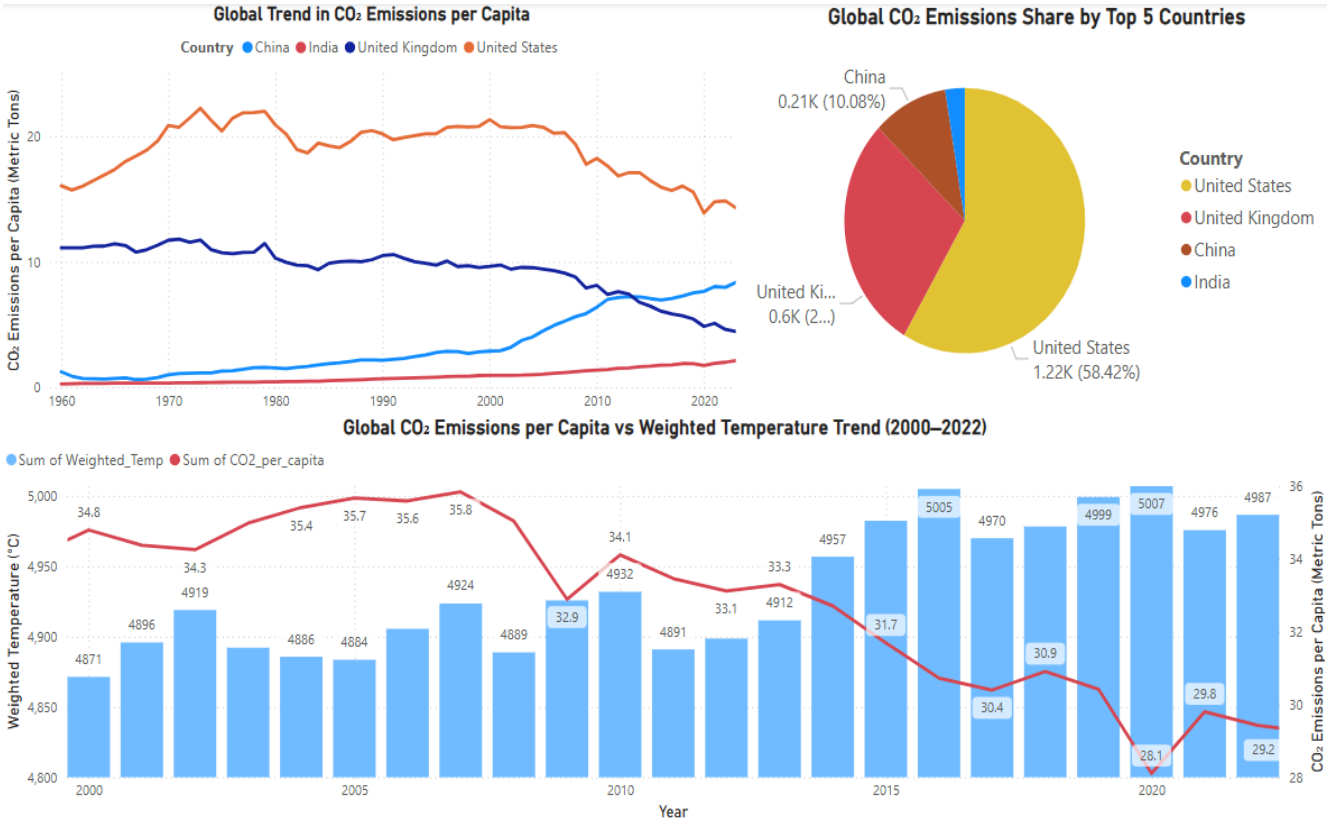
This pie chart shows the proportional CO_2 emissions among the top emitting countries. The United States dominates the share at over 58%, followed by the United Kingdom and China. This visualization emphasizes the concentration of global emissions among a few major economies.

Global CO_2 Emissions per Capita vs Weighted Temperature Trend (2000–2022):



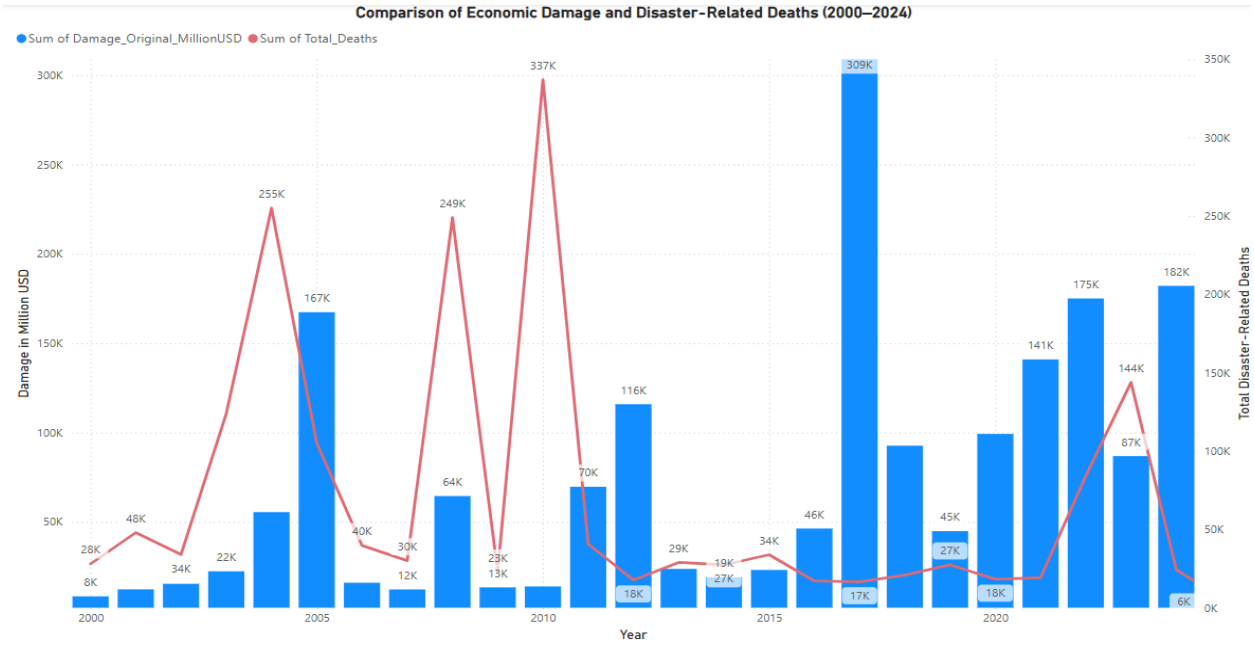
This visualization compares global CO_2 emissions per capita (line) with weighted global temperature trends (bars) over the last two decades. While weighted temperatures show a steady upward trend, emissions per capita fluctuate with an overall slight decline. The chart reveals a potential lagged or non-linear relationship between emissions and climate outcomes.

Dashboard 2: Global CO_2 Emissions and Climate Trends Overview



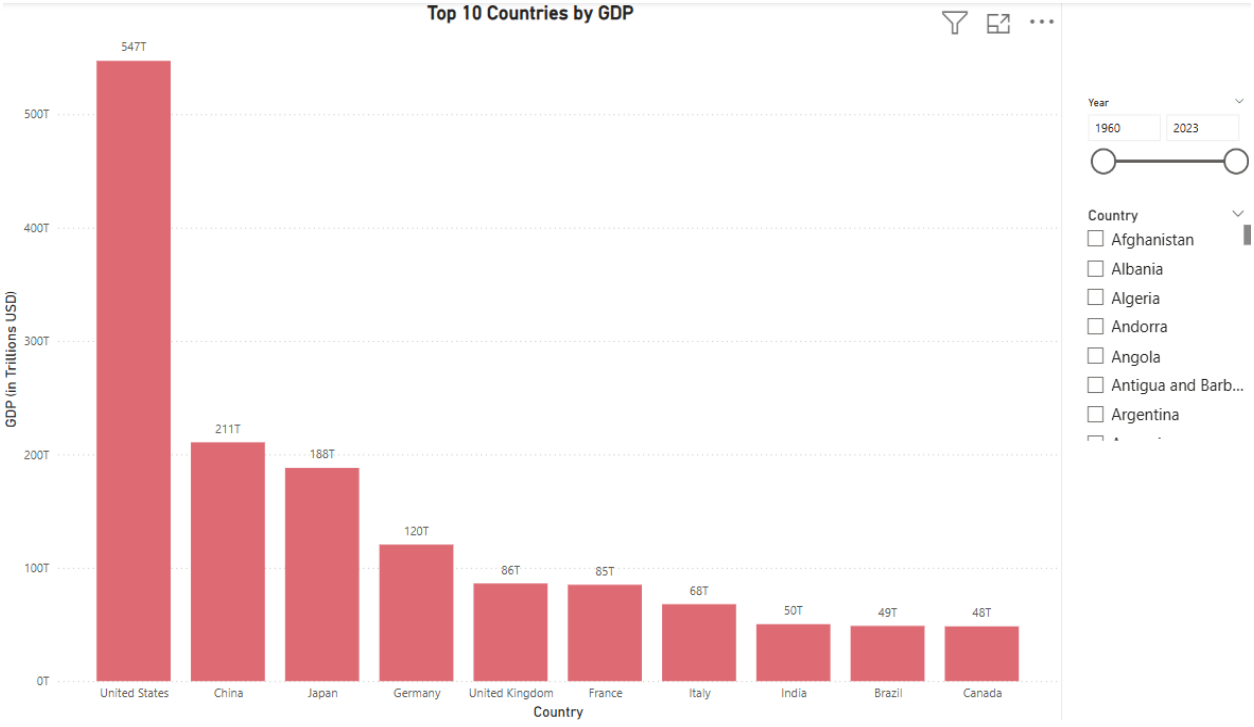
This dashboard combines three visualizations to show historical CO_2 emissions per capita, emission share by country, and how emissions correlate with weighted temperature anomalies. It highlights long-term trends, major contributors, and possible links between emissions and climate change. The integrated view offers both global context and comparative insights between countries and variables.

Comparison of Economic Damage and Disaster-Related Deaths (2000–2024):



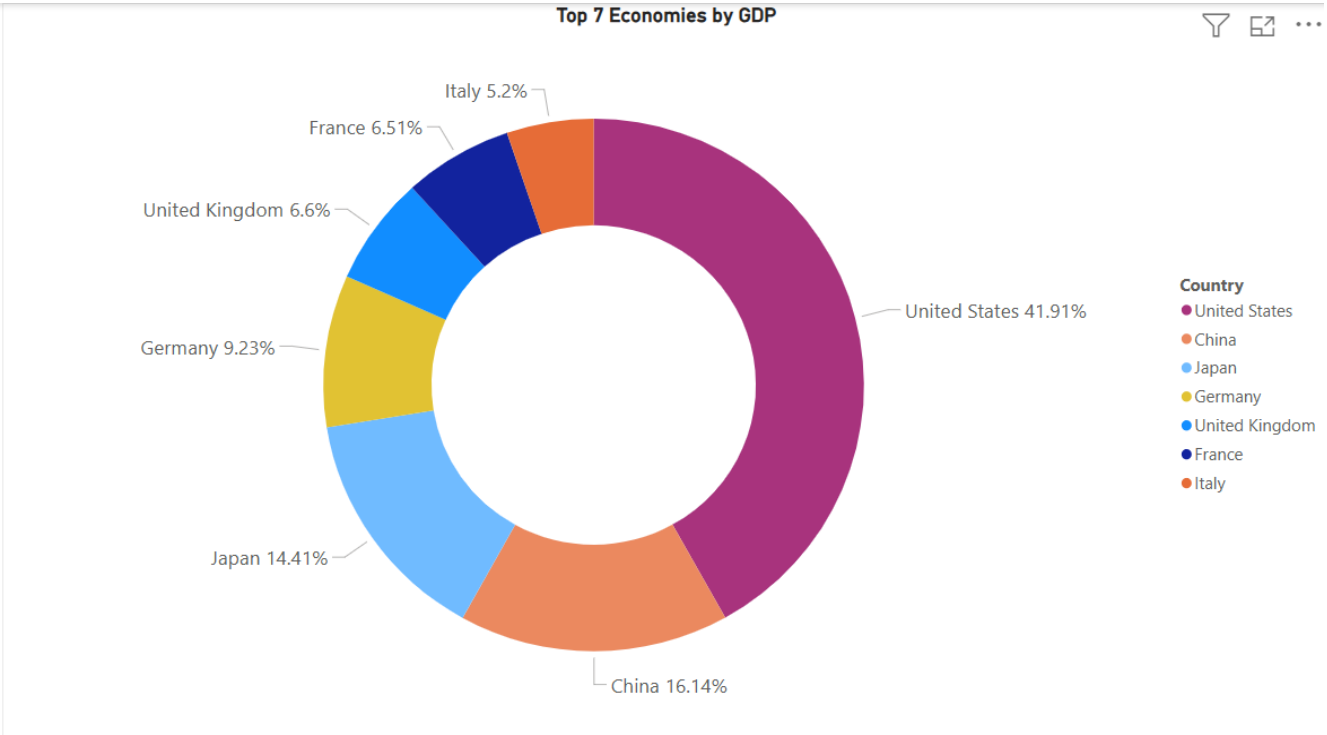
This combo chart compares yearly disaster-related economic damage (bars) with total deaths (line) over the past two decades. The two metrics do not always follow the same trend, some years show high financial losses but lower death tolls, and vice versa. This highlights how disaster impact varies by type, region, and preparedness levels.

Top 10 Countries by GDP:



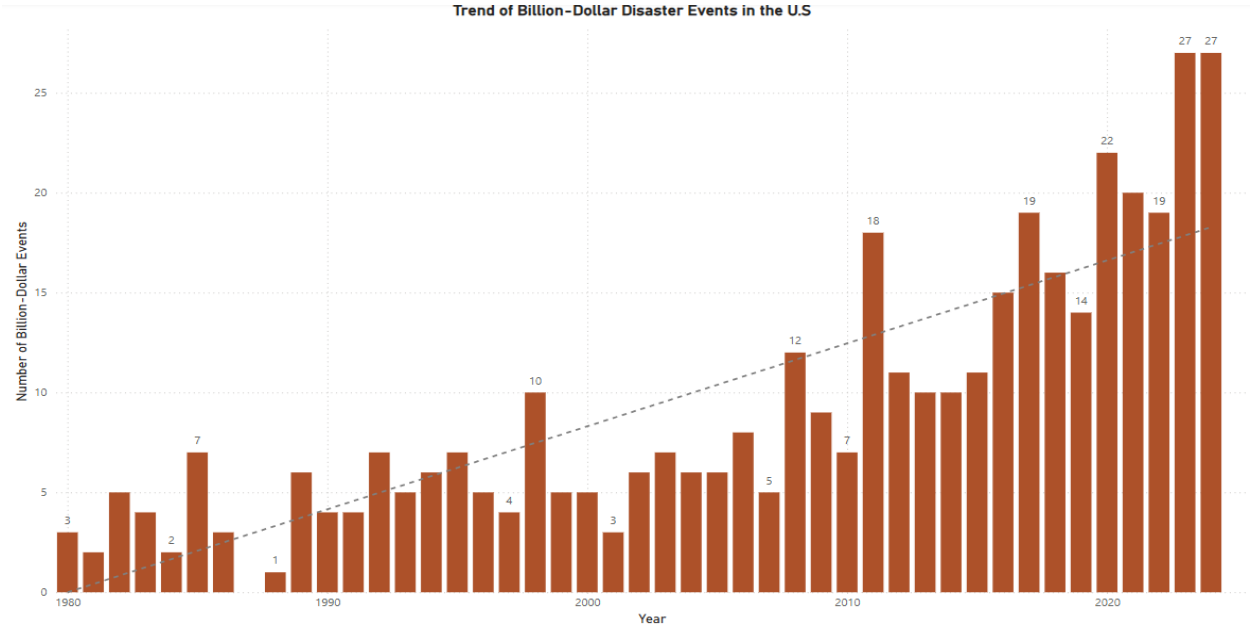
This bar chart displays the leading global economies based on total GDP. The United States far surpasses others with over $500 trillion, followed by China, Japan, and Germany. The chart highlights the concentration of global economic power among a few dominant countries.

Top 7 Economies by GDP:



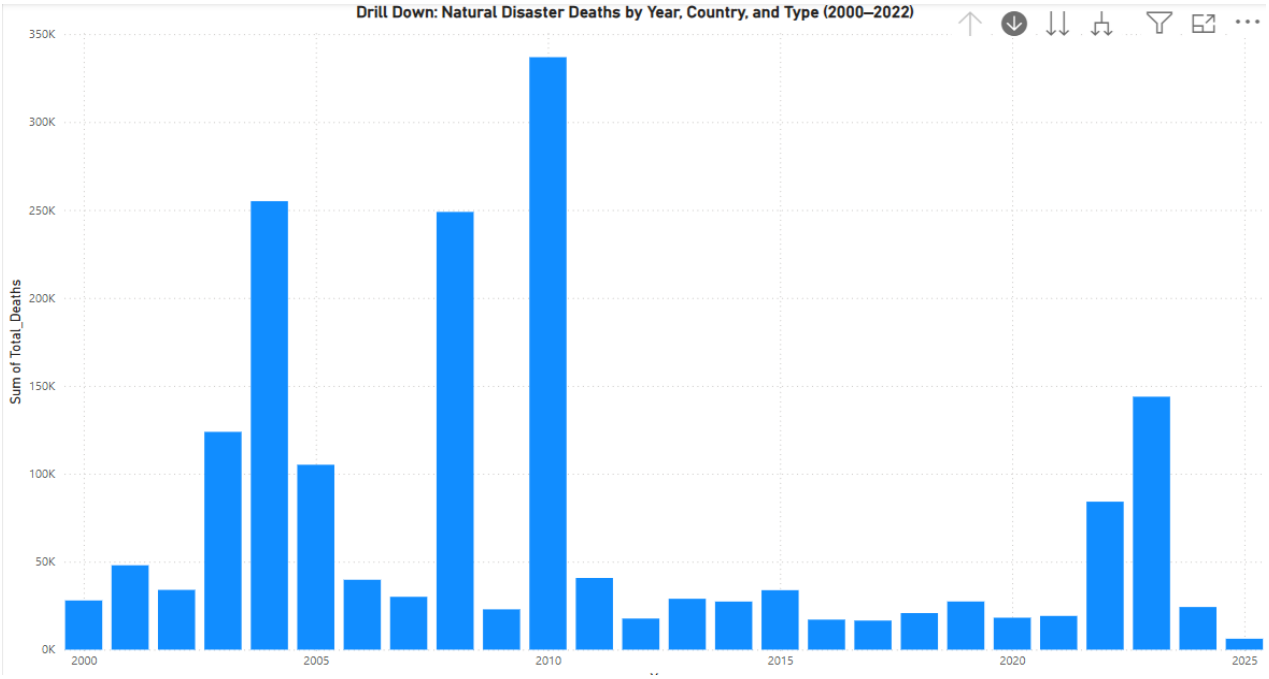
This donut chart shows the proportional GDP share among the top 7 global economies. The United States alone holds nearly 42% of the total, followed by China, Japan, and Germany. This visualization highlights the concentration of global economic output among a few dominant nations.

Trend of Billion-Dollar Disaster Events in the U.S. (1980–2023):

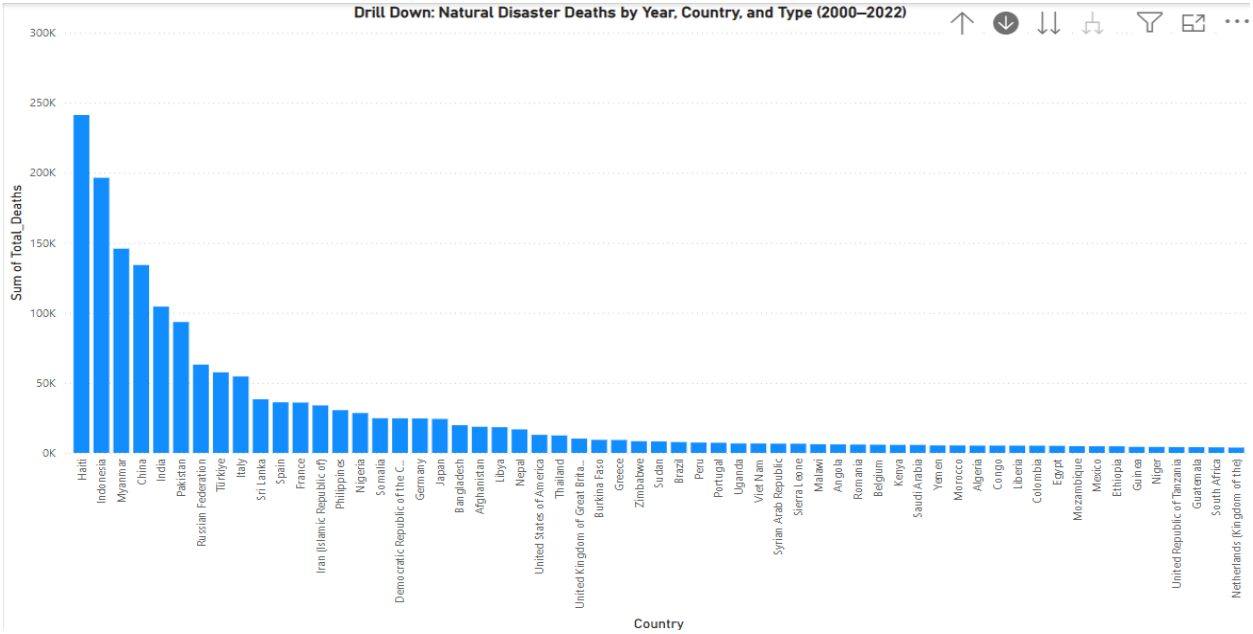


This bar chart visualizes the annual count of billion-dollar disaster events in the United States, showing a sharp upward trend over four decades. The dashed trendline highlights a consistent increase, particularly in the last 10–15 years. This visualization underscores the growing economic threat of climate-related events in the U.S.

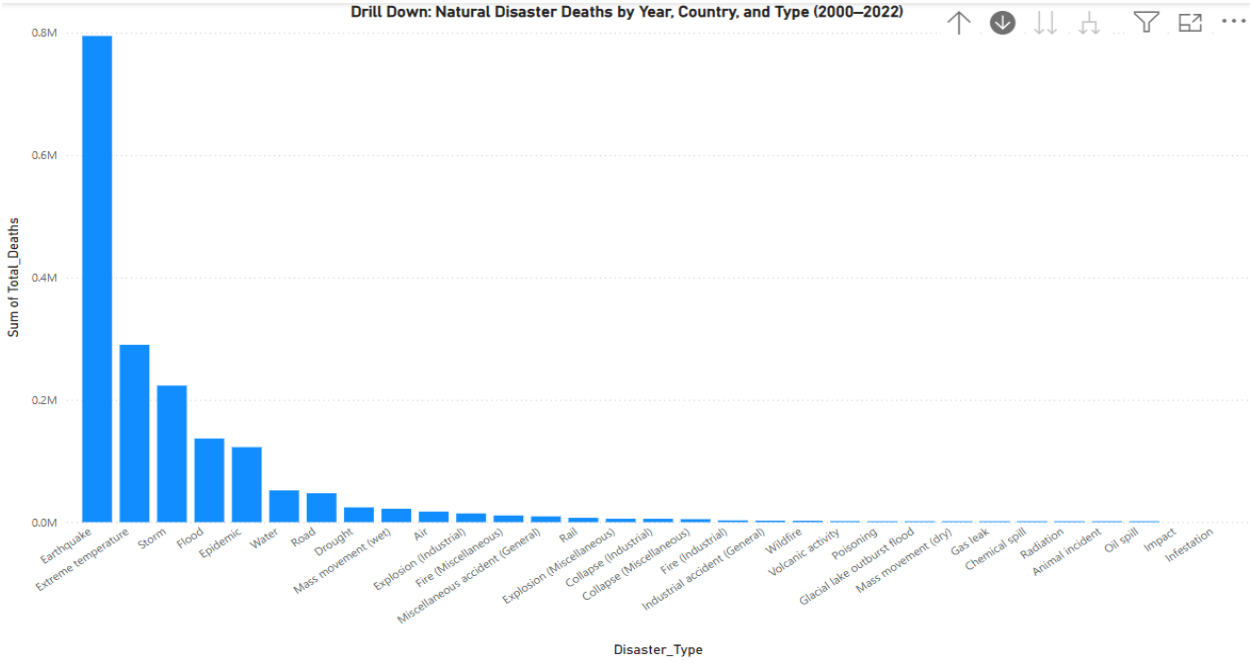
Natural Disaster Deaths by Year, Country, and Disaster Type (2000–2022):



This visualization reveals year-wise fluctuations in global disaster-related deaths, with major spikes observed in 2004, 2008, and 2010, indicating the occurrence of high-fatality events during these years. The trend suggests that while most years have moderate death counts, certain years stand out due to catastrophic disasters.

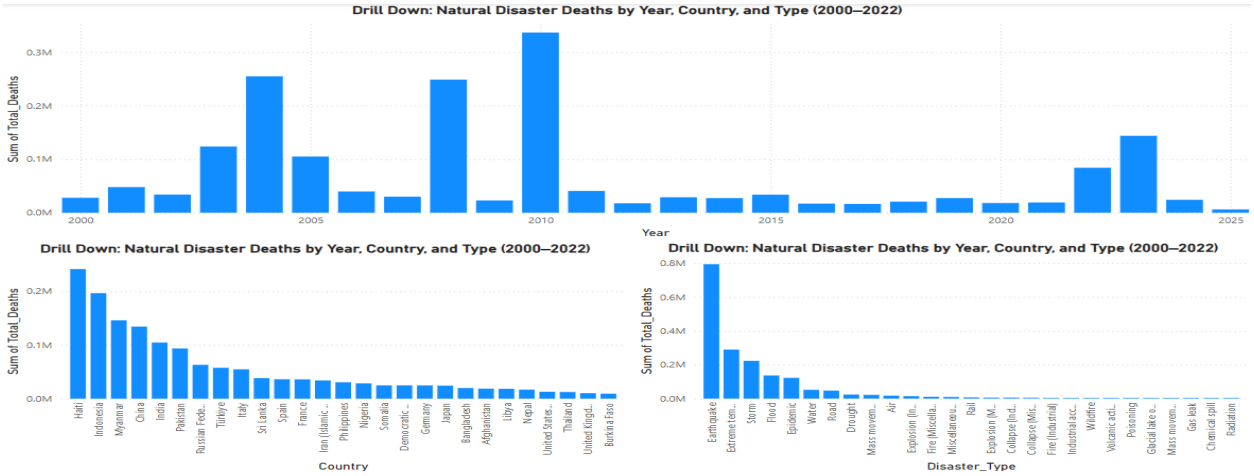


This bar chart highlights the countries most affected by disaster-related fatalities. Haiti, Indonesia, and Myanmar top the list, each having suffered significant human loss due to major earthquakes, tsunamis, or storms. It underscores geographic vulnerability and disaster response capacity disparities across nations.



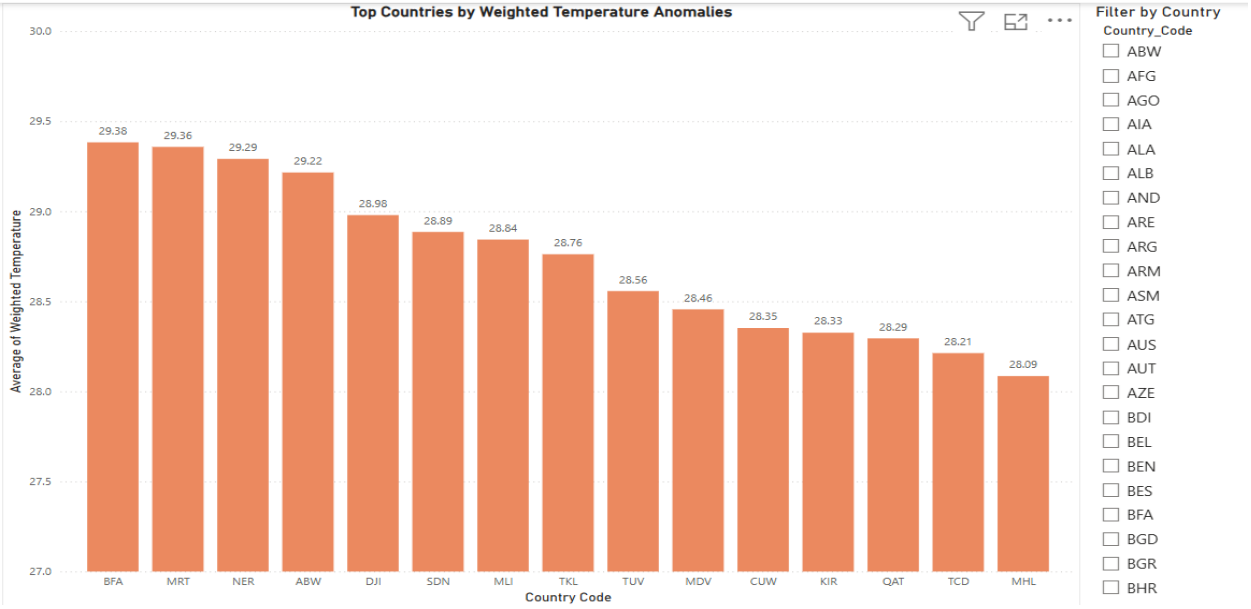
This chart shows the distribution of deaths across various disaster types. Earthquakes are by far the deadliest, followed by extreme temperatures, storms, and floods. The visualization emphasizes the disproportionate human toll certain disaster types have had globally over the past two decades.

Dashboard 3: Drill-Down Analysis of Disaster-Related Deaths by Year, Country, and Type (2000–2022)



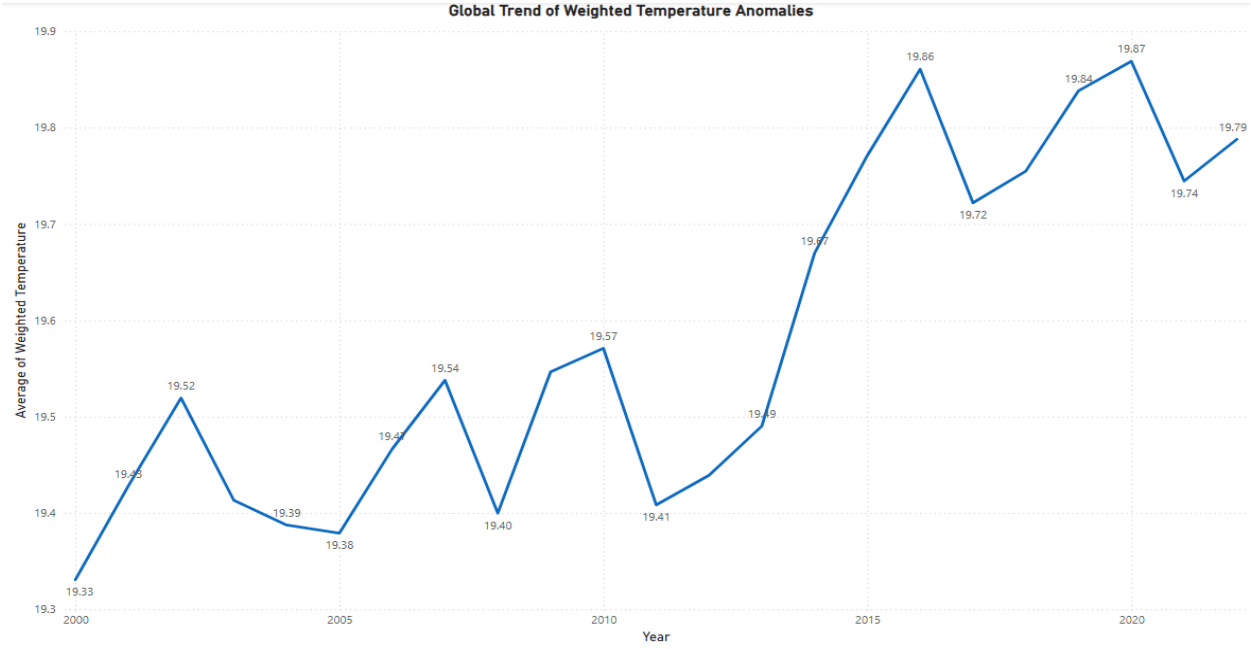
This dashboard offers a multi-dimensional drill-down view into global disaster-related deaths from 2000 to 2022. It highlights key spikes in fatalities by year, with massive loss events in 2004, 2008, and 2010. Country-wise, Haiti, Indonesia, and Myanmar are among the most affected. Earthquakes, extreme temperatures, and storms emerge as the deadliest disaster types, underscoring urgent global preparedness gaps.

Top Countries with Highest Weighted Temperature Anomalies (Past 20 Years):



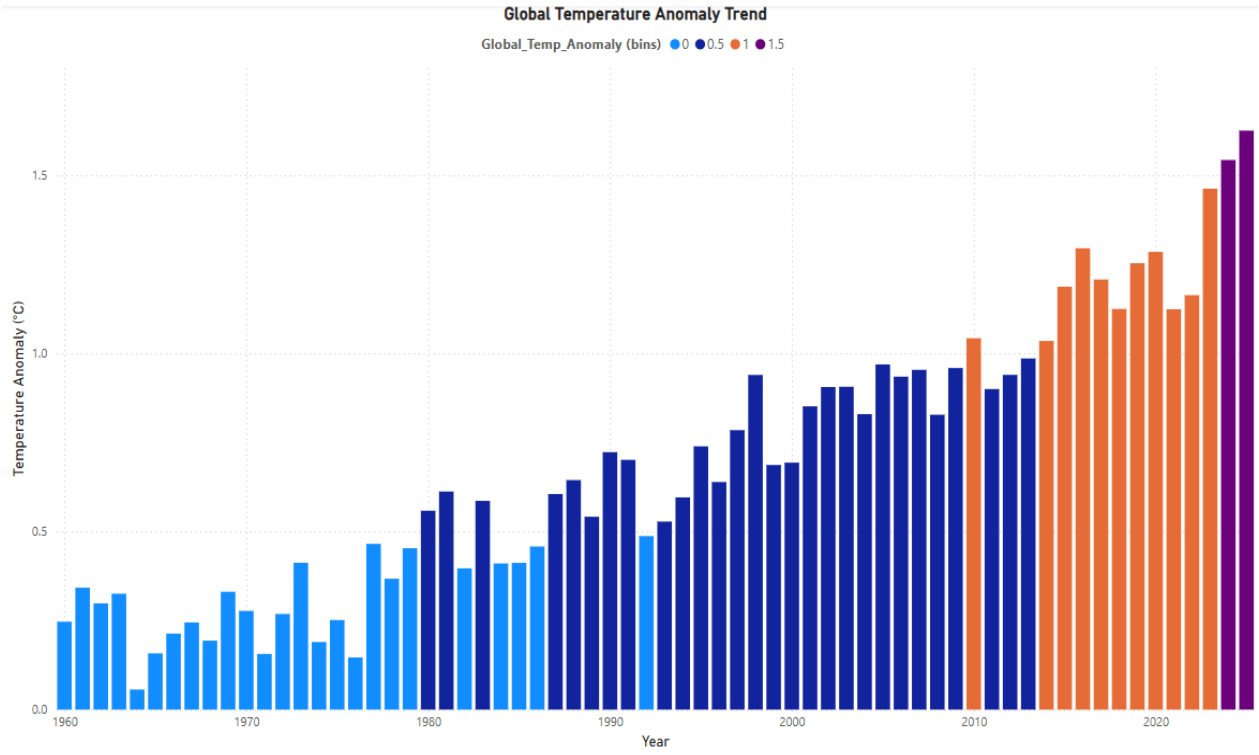
This bar chart highlights the countries experiencing the highest average weighted temperature anomalies over the past two decades. Notably, Burkina Faso (BFA), Mauritania (MRT), and Niger (NER) exhibit the most significant anomalies, indicating elevated climate stress. These high temperatures suggest intensified climate vulnerability, especially in already heat-prone regions.

Global Trend of Weighted Temperature Anomalies (2000–2022):



This line chart illustrates the yearly average of global weighted temperature anomalies from 2000 to 2022. A noticeable upward trend is observed post-2013, peaking in 2020 at 19.87°C. The overall pattern indicates escalating global temperatures, aligning with concerns about intensified climate change and its long-term environmental impacts.

Global Temperature Anomaly Trend (1960–2023):



This color-coded bar chart highlights the progressive rise in global temperature anomalies from 1960 to 2023. The bins reflect increasing anomaly ranges, with a significant shift into the 1.0–1.5°C and >1.5°C categories after 2010. This upward trajectory clearly signals intensifying global warming, reinforcing the urgency of climate action based on long-term temperature shifts.

Future Research Questions:

1. How do natural disaster frequencies correlate with population density across countries from 2000 to 2022?

2. Which types of natural disasters have caused the highest insurance-related economic losses globally, and how have these losses trended over time?

3. To what extent have renewable energy investments grown in countries most affected by climate-induced disasters?

4. Is there a temporal lag between CO_2 emission spikes and corresponding rises in global temperature anomalies?

Conclusion:

Based on the visualizations presented, I was able to successfully address all nine research questions related to natural disasters, climate change, and their economic and human impacts. From 2000 to 2024, floods and storms emerged as the most frequent disaster types globally, with considerable regional variation in impact and severity. CO_2 emissions per capita have risen steadily since 1960, with the United States and China leading overall contributions. A strong correlation between rising emissions and weighted temperature anomalies has been observed over the past two decades, supporting the connection between anthropogenic activity and climate change.

The comparison between disaster-related deaths and economic losses revealed a clear disparity—wealthier nations often report higher financial damage, while poorer countries suffer greater human losses. GDP-based visualizations showed that global economic power is concentrated in a few countries, with the U.S., China, and Japan dominating, which also affects their capacity for disaster response. In the United States, the number of billion-dollar disasters has increased sharply since the 2000s, reinforcing climate-driven financial risk. Globally, earthquake-related fatalities remain highest, particularly in countries like Haiti and Indonesia.

Temperature anomaly visualizations confirmed that regions in Sub-Saharan Africa and South Asia are experiencing the most significant climate shifts. Additionally, global temperature anomalies have shown a consistent upward trend, especially since the 2000s, often surpassing the 1.5°C threshold. These findings collectively emphasize the growing urgency for targeted mitigation strategies, equitable climate responsibility, and investment in resilience infrastructure worldwide.

Thank You