**Analysis of Climate Change and Its Impacts on Nature**

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*Abstract*— Climate change has emerged as one of the most important issues confronting our planet, with substantial ramifications for different areas of the natural world. This study delves into the connection between climate change and its enormous consequences on nature, including ecosystems, biodiversity, and ecological processes. This study seeks to offer a complete overview of the effects of climate change on the environment and the implications for the planet's future by reviewing scientific research and empirical data.

Keywords—ecosystems, nature, biodiversity

# Introduction (*Heading 1*)

Climate change is one of the most pressing global challenges of our time, with far-reaching implications for nature and the environment. This study will analyze climate change and its various effects on nature using various types of sources and visualization techniques, which will be combined to derive both descriptive and inferential statistical conclusions. Climate change refers to long-term shifts in temperature and weather patterns caused primarily by human activities, such as the burning of fossil fuels and deforestation. These activities release greenhouse gasses into the atmosphere, trapping heat and leading to a rise in global temperatures. As a result, the Earth's ecosystems are experiencing significant changes, which can have profound consequences for biodiversity, ecosystem services, and human well-being. This analysis will focus on several key parameters to assess the impacts of climate change on nature.

II. HYPOTHESES

H1: Carbon Dioxide Levels in Atmosphere

H2: Annual Surface Temperature Change

H3: Rainfall in Istanbul

H4: Change in Mean Sea Levels

H5: Living Planet Index

III. METHODOLOGY

As emphasized before, this paper focuses on analysis of climate change and its impacts on nature.Technically speaking, to evaluate the complex link between climate change and its effects on numerous facets of the natural world, this research combines observational data analysis, climate modeling, and ecological modeling methodologies. This study attempts to give a rigorous and thorough knowledge of how climate change affects ecosystems, species dynamics, and ecological processes by combining numerous lines of evidence. The technique described here makes it possible to look at long-term trends, geographic patterns, and probable future scenarios, enabling a more detailed investigation of the intricate relationships between climate change and nature. By using this methodical approach, we want to add to the body of information on the effects of climate change, ultimately assisting in the creation of well-informed plans for biodiversity conservation and ecosystem management.

The datasets used from Kaggle.com cover a wide range of quantitative and qualitative data sources, giving a thorough investigation of climate change and its effects on the environment. Measurements of climatic variables, such as temperature, precipitation, sea-level rise, and atmospheric CO2 concentrations, taken by meteorological stations, satellites, or climate models, are included in the quantitative data. For analyzing patterns and changes over time, these data provide exact and unbiased information. Comparatively, qualitative data sources include ecological surveys, biodiversity evaluations, field observations, and expert views, which offer insightful information on the intricate ecological responses to climate change.

This study can reflect the multifaceted features of climate change consequences by integrating scientific information with contextual understanding and subject-matter expertise by using both types of data. This all-encompassing strategy enables a more thorough and rigorous investigation, allowing researchers to understand the complex connections between climate change and the natural world.

The sampling techniques and measurement units used in the other datasets that we downloaded from /www.cbs.nl, climatedata.imf.org, and kaggle.com are diverse. The datasets were cleansed of missing data and outliers before to the analytical step. After that, we implemented R codes in RStudio and displayed the graphs to show the data.

IV. CARBON DIOXIDE LEVELS IN ATHMOSPHERE

This section is created for providing a descriptive analysis of the data that we have used for this study. Table 1 demonstrates the Descriptive Statistics Carbon Dioxide PPM Values Between in 1970-2015. The data is derived from kaggle.com.

In figure 1, we can display the mean value of Carbon Dioxide PPM Values Between in 1958-2017.

Which has an increasing trend over the years. Which means that, due to air polution, our health may be in danger after 10-20 years.

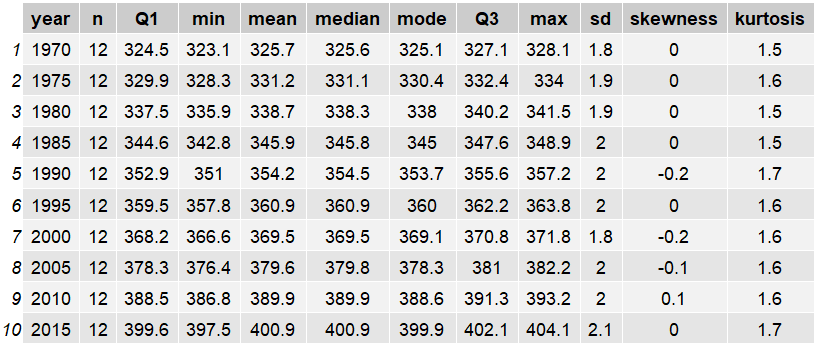


Table 1. Descriptive Statistics Carbon Dioxide PPM Values Between in 1970-2015 [1].



Figure 1. Carbon Dioxide PPM Values Between in 1970-2015 [dataset1].

V. ANNUAL SURFACE TEMPERATURE CHANGE

In figure 2, as we can see the annual surface temperature change in the UK and the United States has exhibited distinct patterns and trends over the years.

Over the past few decades, there has been a noticeable warming trend in the UK. Data from the UK Met Office show that the yearly average temperature has increased by about 1 degree Celsius during the pre-industrial period. Recent years have seen several of the hottest years on record, along with a rise in heat-related severe occurrences like heatwaves. Ecosystems, agriculture, and water resources are only a few of the environmental effects of these temperature fluctuations in the UK.

The United States has also seen a noticeable warming trend, albeit there have been regional variances. Since the late 19th century, the nation's yearly temperature has increased by around 1.8 degrees Fahrenheit (1 degree Celsius) on average. In contrast to the national average, other areas, including the Arctic and Alaska, have experienced more dramatic temperature rises. Additionally, the United States has seen an increase in extreme weather phenomena, such as heatwaves, wildfires, and hurricanes, which have had a major effect on various regions of the nation. Planning for infrastructure and other fields like agriculture and public health are impacted by these temperature fluctuations. Especially after 2000, there is a serious temperature increase in both countries.

In figure 3, we can see the temperature changes in Austria, Canada, Finland, Sweden, the UK, and the United States, The enormous nation of Canada, which has several different climate zones, saw temperature variations that differed greatly among its provinces and territories. Similar to Finland, Sweden too experienced temperature variations that were unique to their various regions due to their diverse climates from north to south. Additionally, temperature fluctuations were seen in Austria, the UK, and the US, with local variations determined by local weather patterns and geographic location. However, if we look at the table in general, it is not difficult to see the difference between temperature changes in the United States and Finland.

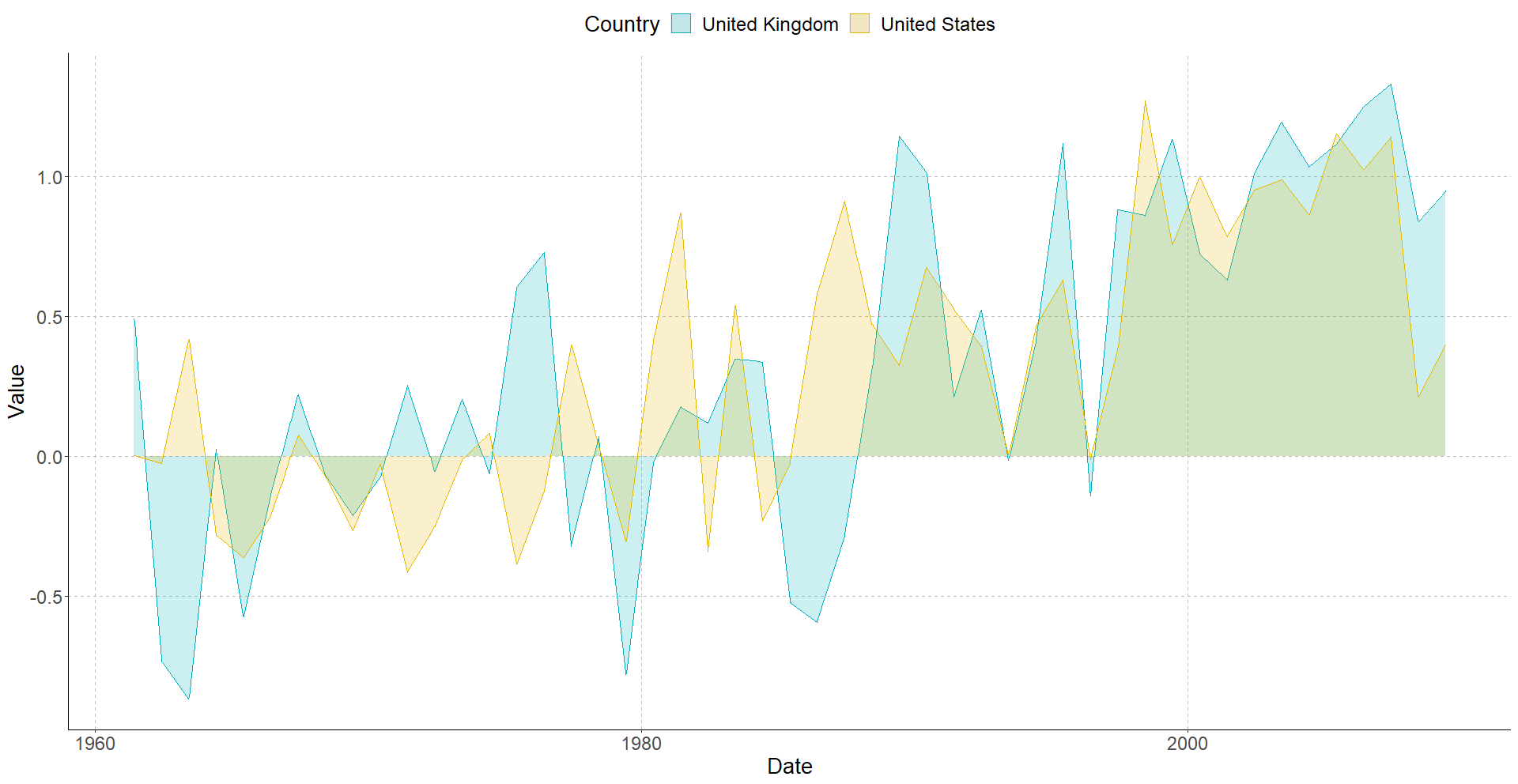


Figure 2. The temperature change in the UK and US, with respect to a baseline climatology, for the years between 1961 and 2009, is measured in degrees Celsius. [dataset2]

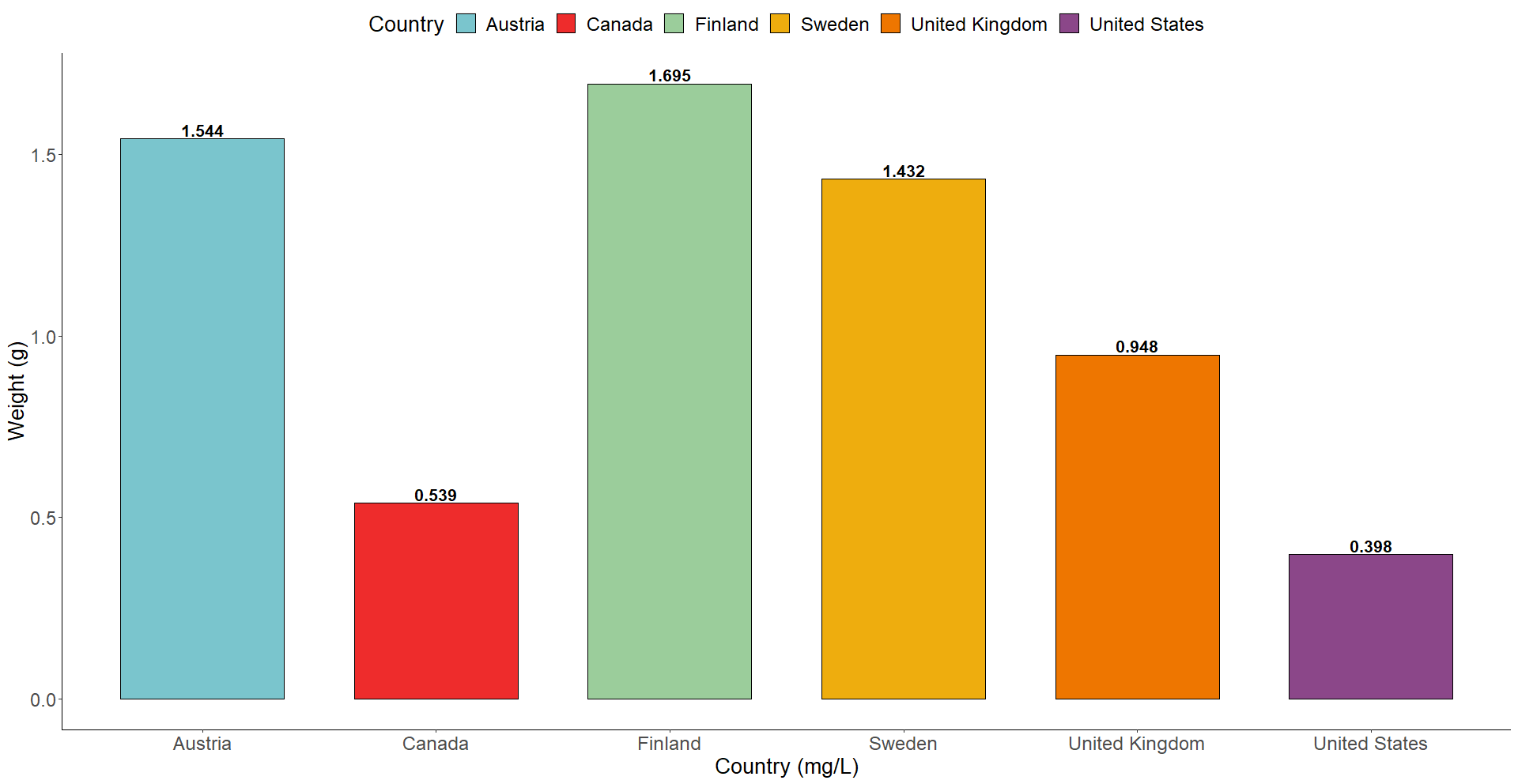


Figure 3. The temperature change in the specified countries in the year 2009, with respect to a baseline climatology, is measured in degrees Celsius. [dataset2]

VI. RAINFALL IN ISTANBUL

In figure 4, we can display the weather conditons in Istanbul , between the years 2009-2019, Throughout the year, Istanbul receives a reasonable amount of precipitation, with the winter and late autumn months often being the wettest. Istanbul receives an average of 844 millimeters (33 inches) of precipitation per year. The distribution and intensity of precipitation can change from year to year, and certain weather patterns might affect these factors.

The wettest months are typically December, January, and February, with irregular periods of heavy rain and increased storm danger. In the spring (March to May) and fall (September to November), there is a fair amount of rain, including both small showers and prolonged rainstorms. The summer months (June to August) are frequently drier than the rest of the year since there is less chance of significant rainfall. That’s how we understand more then 58% of the 10 years, Istanbul is Sunny and dry.

In the figure 5, we can see the precipitation ratio in Istanbul between the years 2009 – 2019. It gives a decreasing trend for 10 years, with the highest in 2010 and the lowest in 2013.

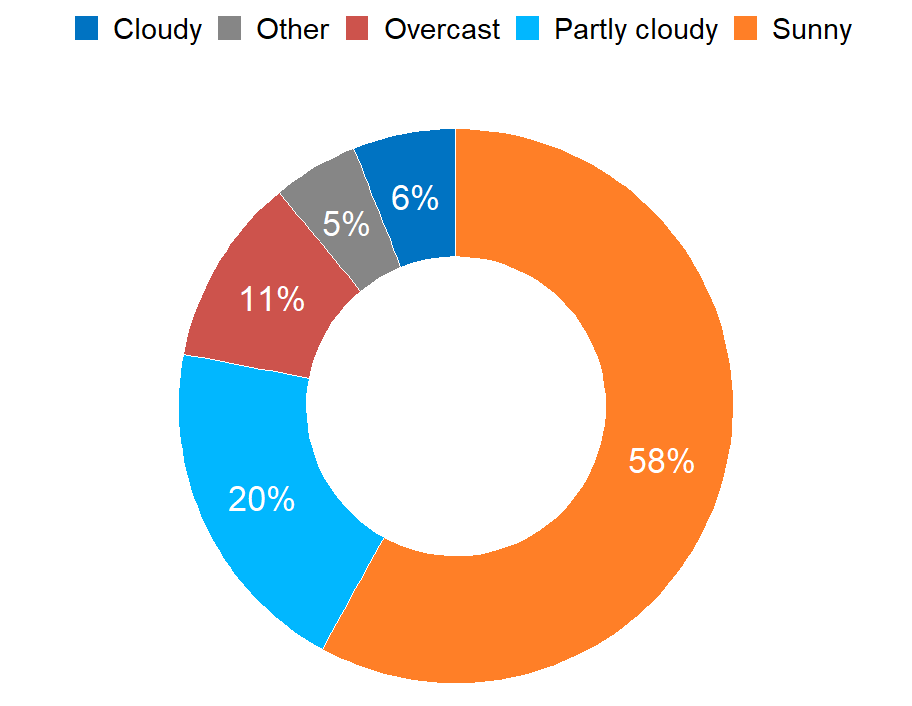
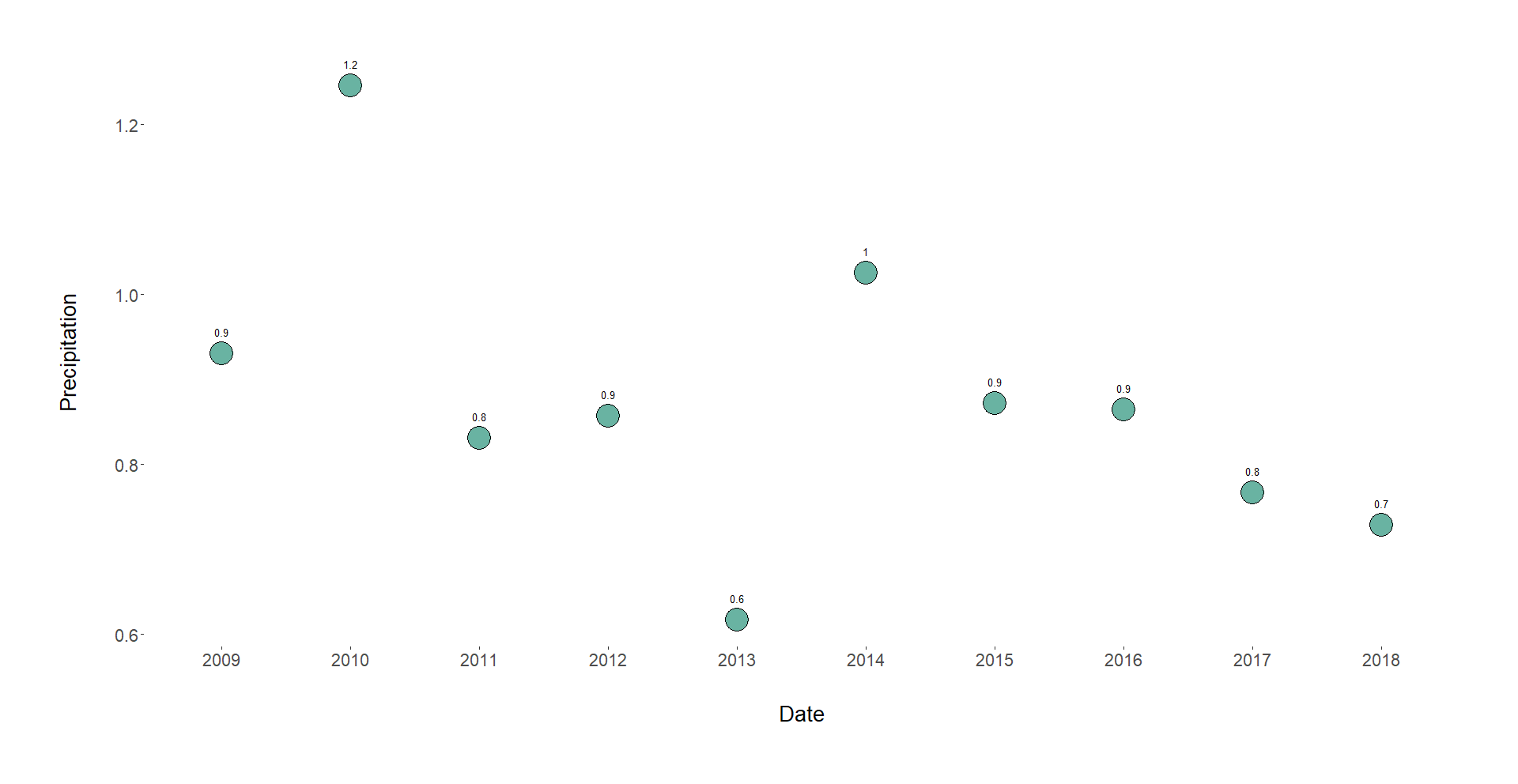


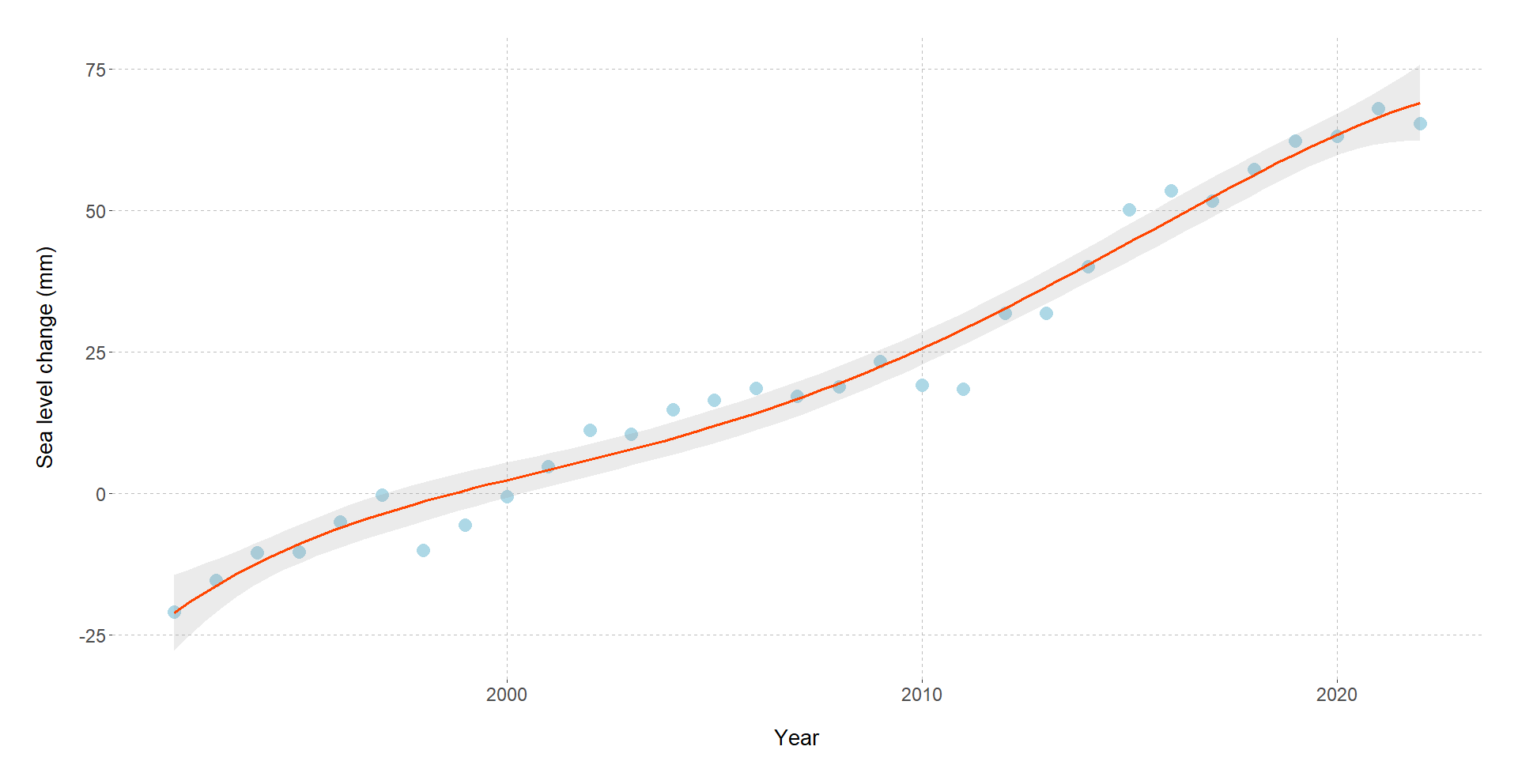
Figure 4. The weather conditions in Istanbul from 2009 to 2019 [dataset3]

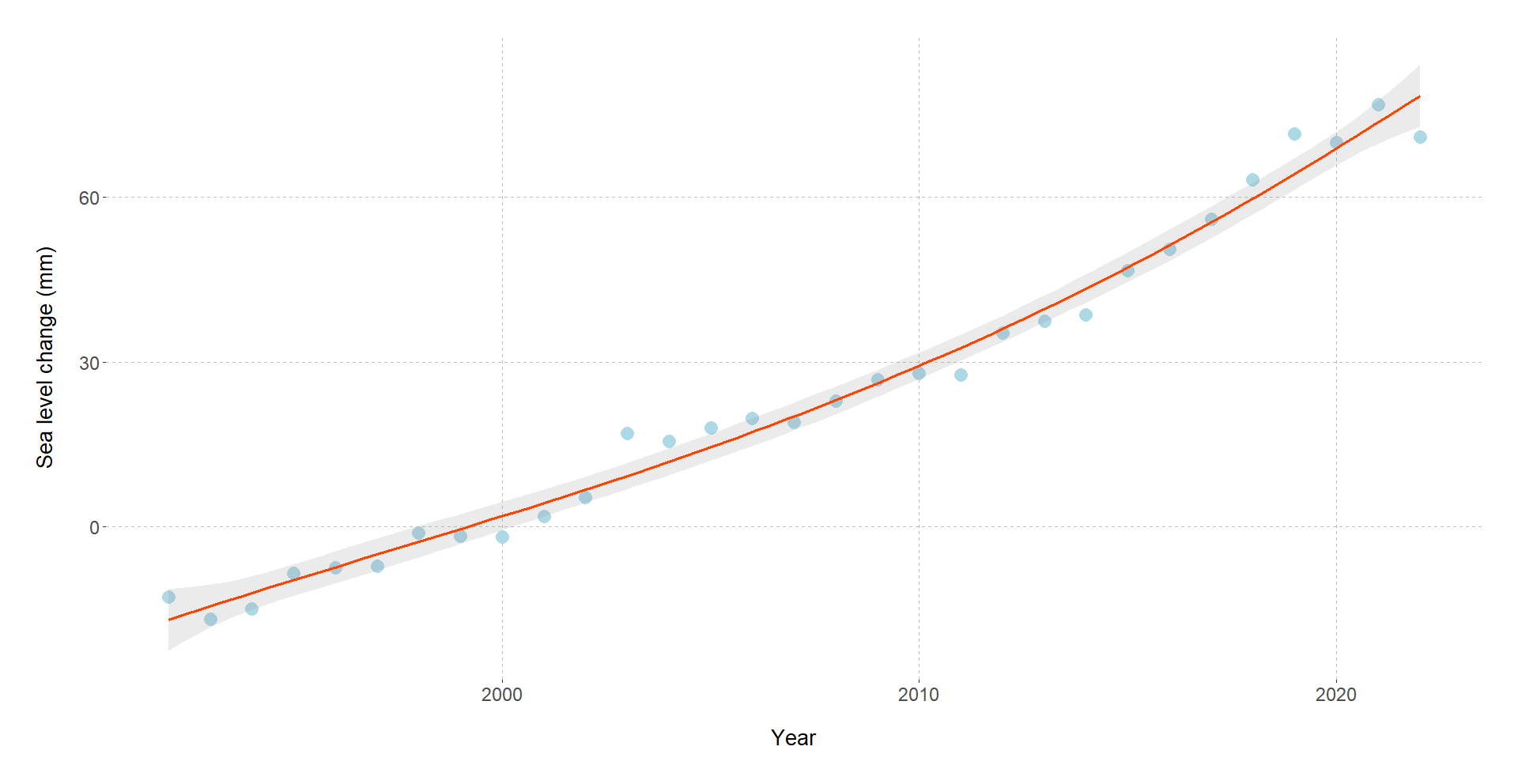
Figure 5. Precipitation ratio in Istanbul between the years 2009 - 2019 [dataset3]

VII. CHANGE IN MEAN SEA LEVELS

The change in mean sea level in the Pacific Ocean and Atlantic Ocean has been monitored and studied over the years.

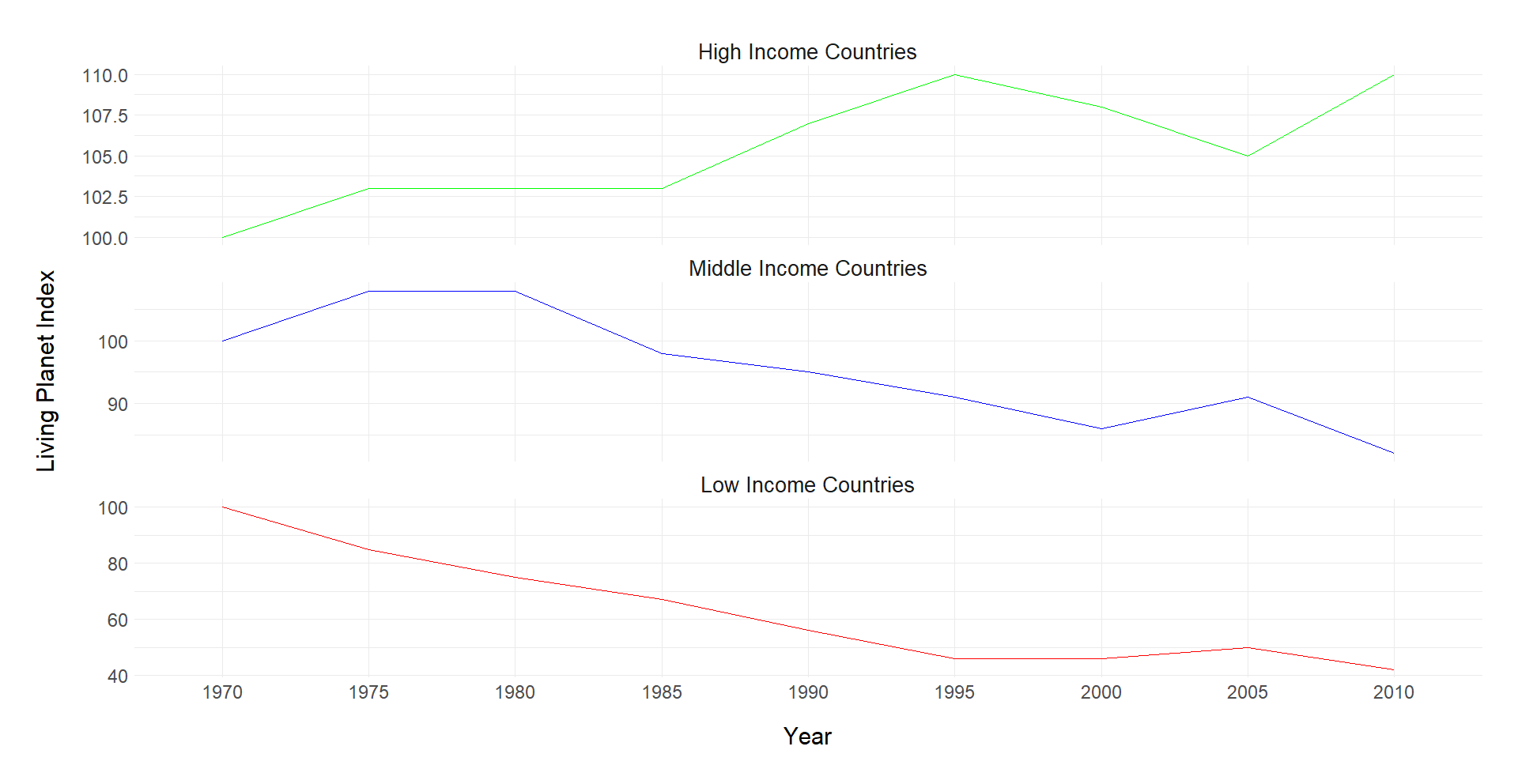
As we can see from the figure 6 and figure 7 both Pacific and Atlantic Oceans mean sea level has increased over the years between 1992 to 2022 because of the climate change. It is not hard to understand that these charts which displays the sea levels won’t stop showing us to increasing trend even after 20 years

Figure 6. Change in mean sea level in the Pacific Ocean from 1992 to 2022.[dataset4]

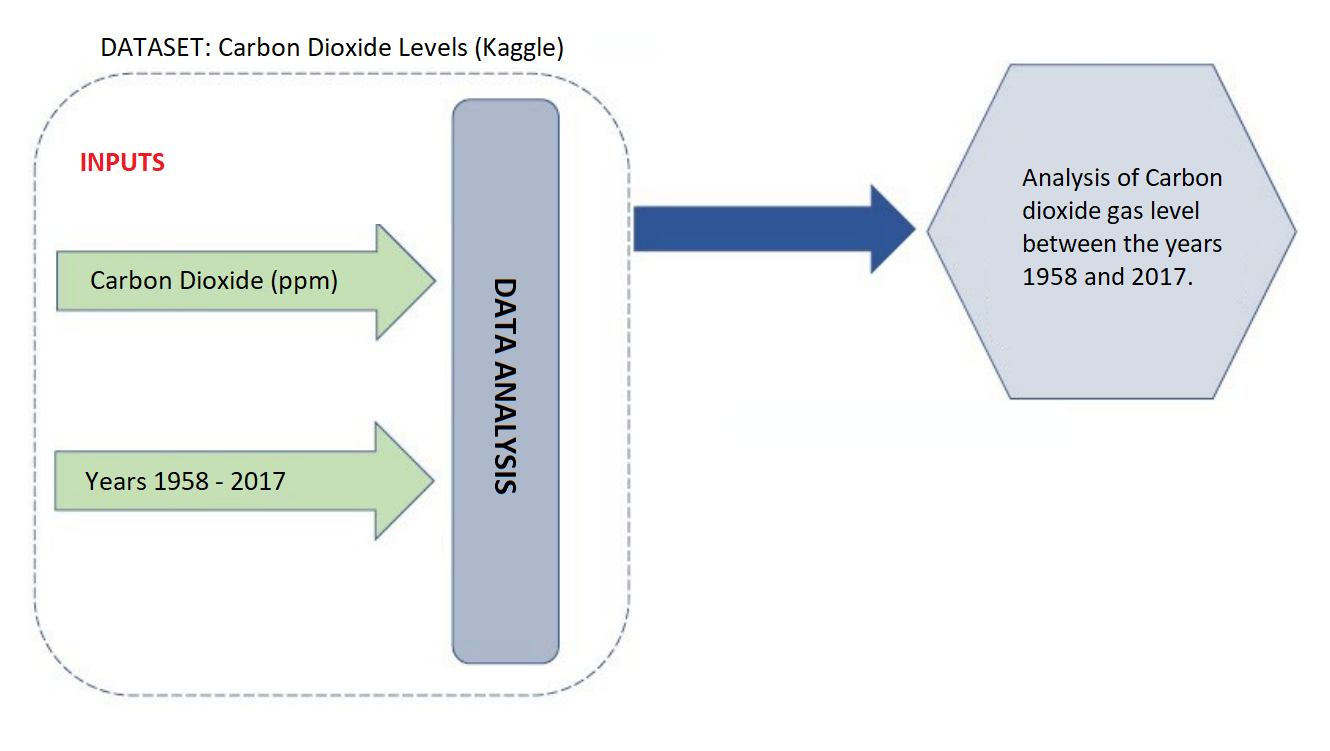
Figure 7. Change in mean sea level in the Atlantic Ocean from 1992 to 2022.[dataset4]

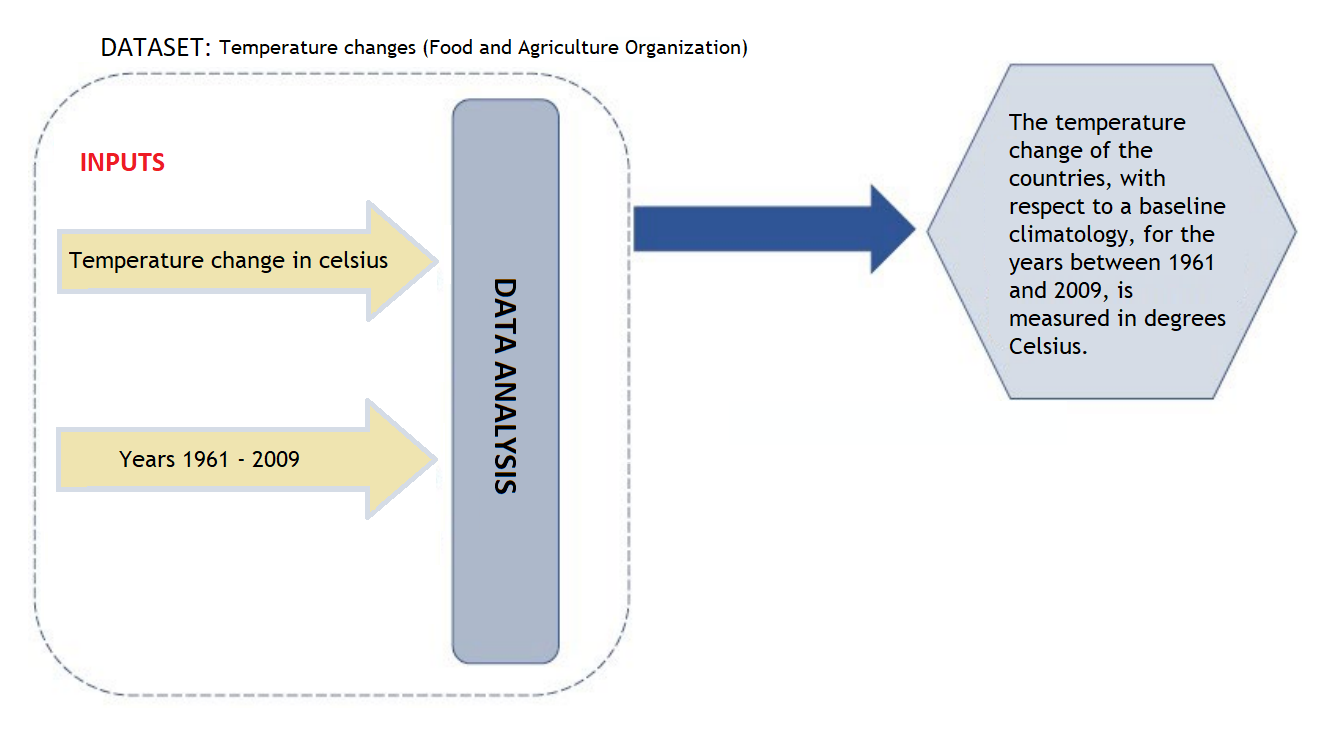
VIII. LIVING PLANET INDEX

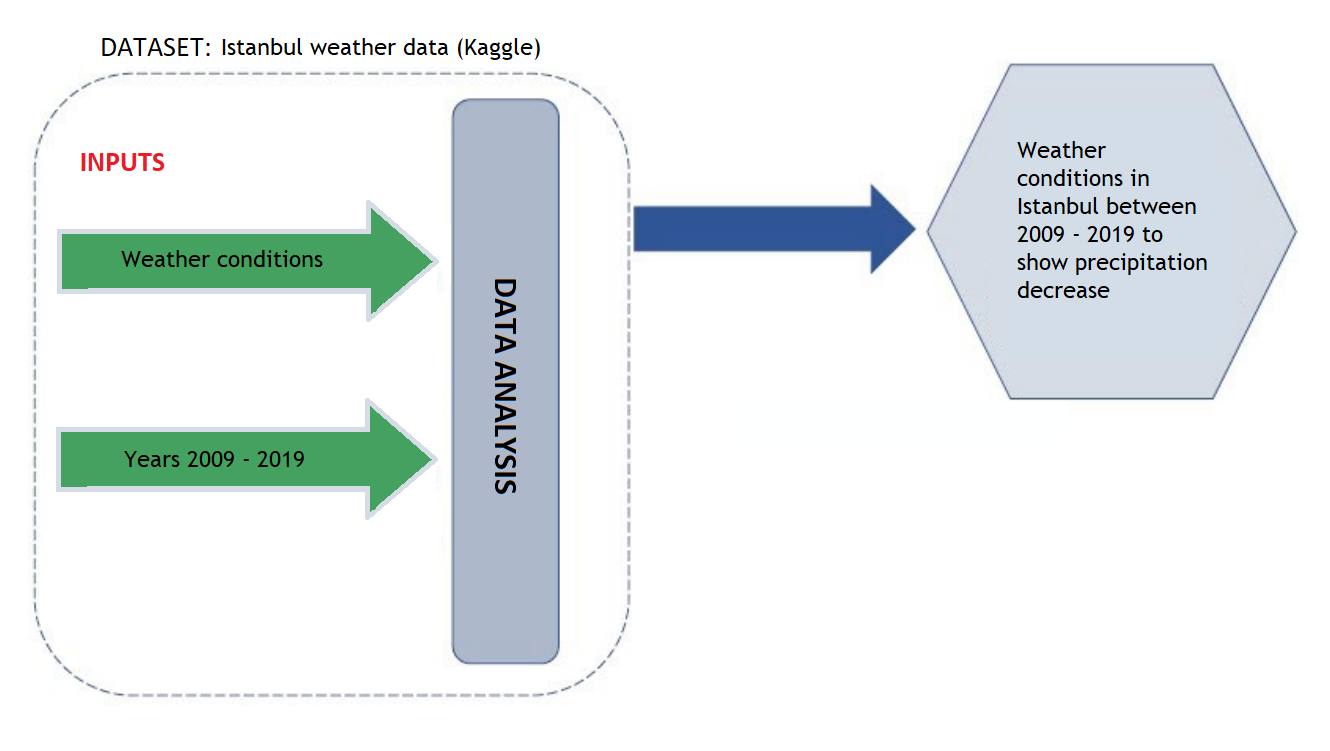
If we checked the figure 8, it shows us the living Planet Index from 1970 to 2010, categorized by different income categories of the countries. The population patterns of hundreds of vertebrate species throughout the planet are evaluated using the Living Planet Index (LPI), a metric. It gives a sign of the general strength and quantity of biodiversity throughout the world. It can possible to understand that the countries with the high income average has better LPI then the poor countries with lower income average over the past few decades.

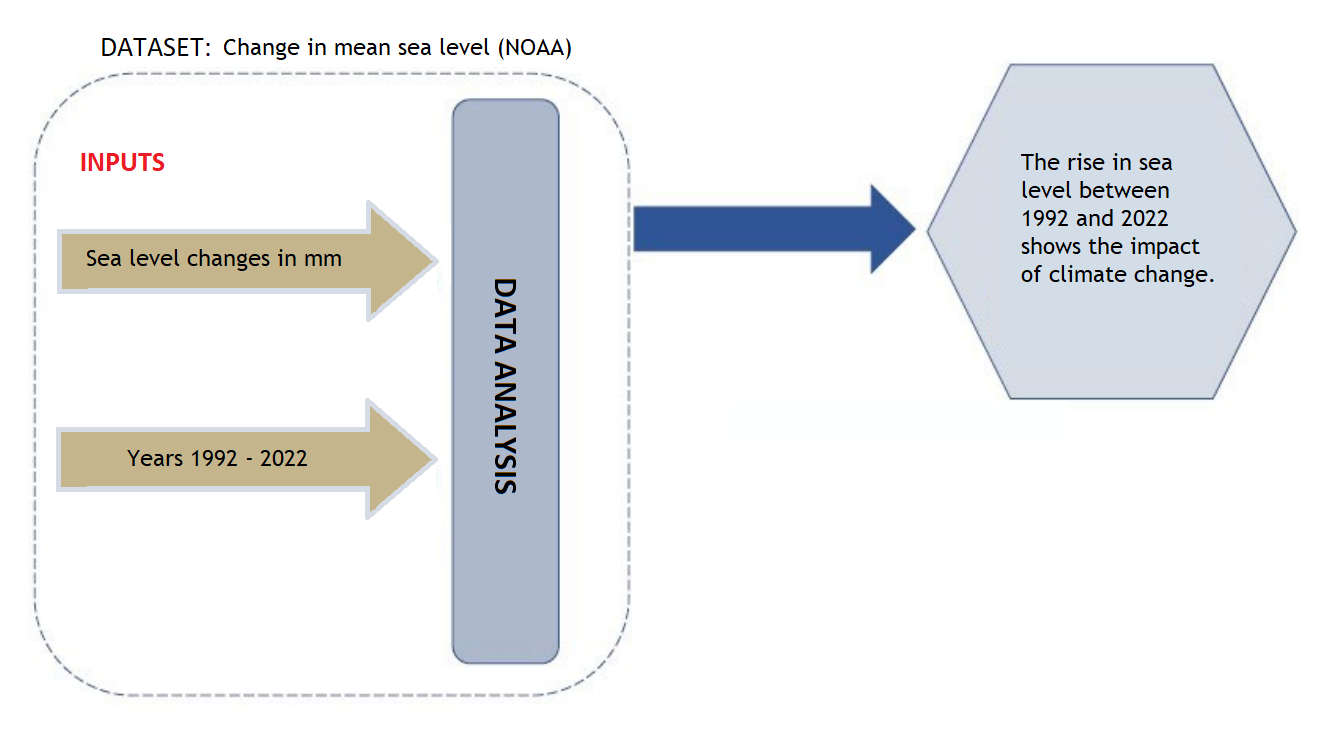
Figure 8. Living Planet Index from 1970 to 2010, categorized by different income categories of the countries.[data5]

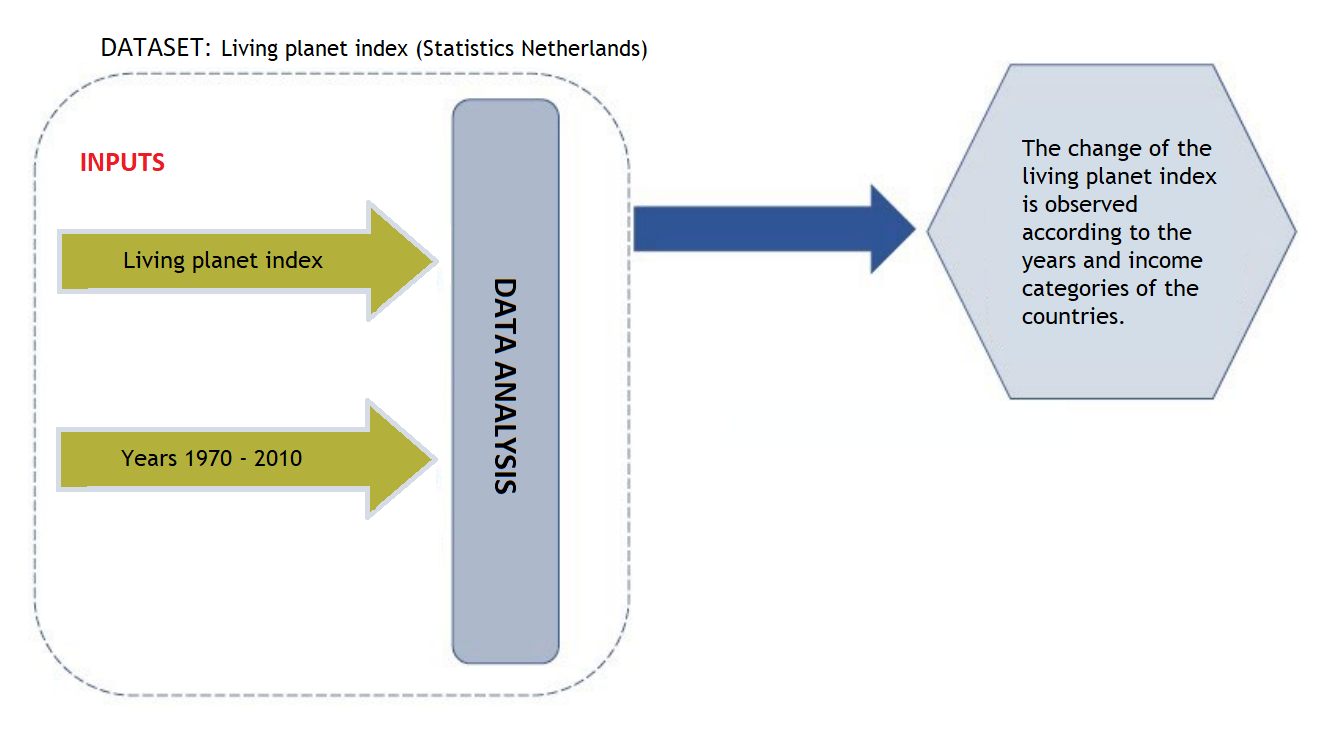
IX. GRAPHICAL ABSTRACTS











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