**Sky High Carbon**

**Addressing Europe's Airplane Emissions Challenge**

Carolina Chassi, Justin Liao, Kevin Ohgami, Roshan Peri

1. *Introduction*

Climate change is one of the most critical challenges of our era. For this article we have focused on a by carbon dioxide (CO2) emissions. Mitigating our carbon footprint is imperative for a sustainable future. This article underscores the crucial role of data science in analyzing global CO2 emissions, utilizing comprehensive datasets to derive insights and patterns that can inform policy decisions and foster further research.

This study focuses on Europe, employing data science methodologies to examine the monthly and yearly CO2 emissions of the countries; Iceland, Greece, Sweden, Spain, Georgia, Serbia, the United Kingdom, and Malta. Through the use of data science, we aim to identify trends and seasonal variations in emissions, thereby enhancing our understanding of each country's contribution to climate change. By analyzing both annual averages and monthly data, data science will facilitate the identification of significant patterns that reveal the unique environmental and economic factors influencing each nation's carbon footprint.

Data science is integral to achieving the ambitious targets for reducing greenhouse gas emissions set forth by the European Union and global agreements such as the 2015 Paris Agreement. Understanding the specific emission patterns of European countries through data-driven insights is essential for setting a global precedent. The capability to analyze vast datasets provides nuanced insights that aid in developing targeted strategies to address the root causes of emissions, thereby enhancing the efficacy of climate policies. Integrating data science into the study of CO2 emissions enables a more informed and strategic approach to combating climate change, supporting efforts to safeguard our planet for future generations.

1. *Data Source*

The Data used for this article has clear documentation.[2] The dataset is in CSV format and encompasses crucial information including year, month, country name, country code, CO2 quantity measured in tons, and traffic volume for each state. This study focused on data collected from 2020 to 2023.

The data used was supplied by the EUROCONTROL Aviation Sustainability Unit.[1] CO2 emissions were measured using the EUROCONTROL Small Emitters Tool (SET). In this case, we used data were SET estimated the fuel burned and the associated CO2 emissions of an entire flight with known aircraft type and actual flown distance (full trajectory from origin to destination). Each countries’ CO2 emissions were calculated based on the departing IFR flights billed by the EUROCONTROL Route Charges Office.[i] For reference, the CO2 emissions for a flight from Athens to Madrid would be a part of the results for Greece and not for Spain.

For this study, a preprocessing approach was applied to the annual CO2 emission data sourced from multiple countries. The process involved parsing a CSV file line by line, extracting country names and corresponding emission values, and normalizing country identifiers to ensure consistency across datasets. Importantly, data integrity was maintained by filtering out countries with incomplete annual emission records, ensuring that only those with complete data sets representing all twelve months were retained for further analysis. By doing so, the data became suitable for various statistical computations and numerical analyses, which are essential for gaining insights into annual emission trends across diverse nations. This approach not only ensured data accuracy but also facilitated a clearer understanding of how emissions varied over time and across different geographical regions.

1. Code

The Python script developed is designed to analyze and visualize CO2 emission data across different time scales for multiple countries. Paramount to the script is the function read\_file\_yearly(filename), which reads a CSV file of CO2 emissions and organizes it into a dictionary “year\_emission”. This dictionary stores each country's monthly emissions as lists, filtering out countries with incomplete data (less than 12 months). The visual\_yearly(year) function utilizes the data from read\_file\_yearly to compute and display the average yearly CO2 emissions per country using Matplotlib, presenting the data as a bar chart with countries on the x-axis and emission averages (in pounds) on the y-axis. Similarly, visual\_monthly(year, country) and visual\_seasonal(year, season, country) functions leverage read\_file\_yearly to visualize monthly and seasonal emissions respectively. These functions plot bar charts depicting emissions per month or season for a specified country, enhancing comprehension through visual representation. Overall, the script integrates file handling, data manipulation, and visualization to provide insights into CO2 emissions trends across different temporal resolutions.

<https://ansperformance.eu/csv/> <https://ansperformance.eu/reference/dataset/emissions/>