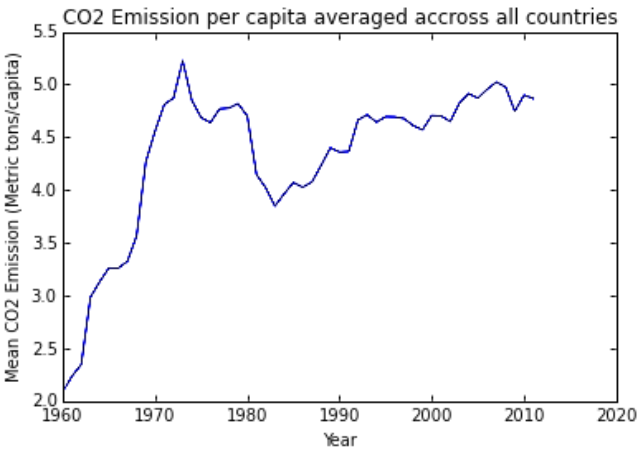
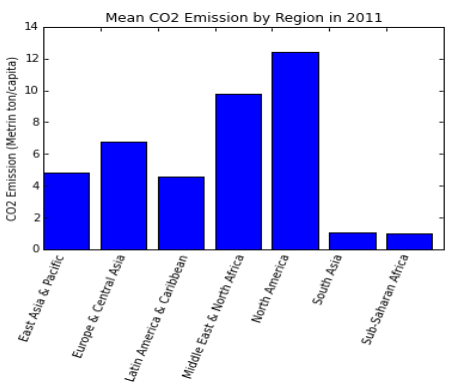
Exploring and Visualizing of World CO2 Emission Dataset Using Python

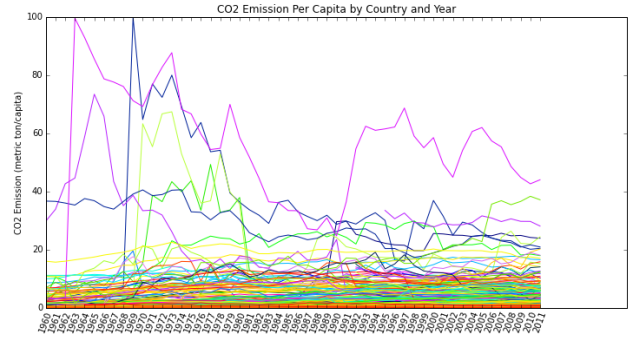
Because of some unknown reason, global warming has been receiving a great deal of attention lately. It is particularly important to understand the relationship between global warming induced by the greenhouse effect and carbon dioxide emissions from a variety of sources such as automobiles, industrial facilities, ships, and planes. The graph above displays global short-cycle carbon dioxide emissions, which were created using data from the year 2018. Additionally, it provides critical context for where the world's emissions originate, in addition to being visually striking and almost artistic in its execution. The picture indicates that the United States, Europe, China, and India are responsible for the vast bulk of global greenhouse gas emissions. As one travels over different parts of the world, several interesting aspects emerge, such as bright patches highlighting major cities and bright areas corresponding to major highways in North America and Europe. There are unique maritime routes at sea, such as the China–Singapore–Malacca Strait–Suez Canal route, that may be seen plainly from the surface of the water. As a bonus, several curved lines are visible, each of which corresponds to one of the world's most important aviation routes. Although the population density may be explained by this map, there are a few obvious outliers from the norm. Compared to other regions of the world, South America appears brighter than expected, but West Africa appears darker. However, the Nile, which is home to 95 percent of Egypt's population and is decked out for the holidays, is a whole other story. Because these maps are mostly qualitative rather than quantitative, it is important to proceed with caution when taking any conclusions from them.



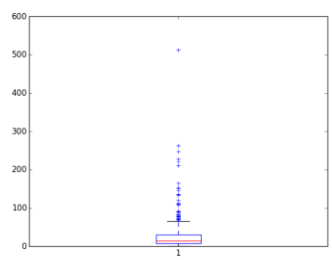
CO2 emissions per capita across the globe have changed over time. To begin, the annual average concentration of CO2 is rising year after year after year after year after year. Burning fossil fuels, as well as deforestation, are to responsible for this. Second, the pace of growth in CO2 has risen in line with the rise in human-caused emissions. From 1986 to 2011 there was a 25 percent gain in the percentage of the population.



From 1960 to 2011, plot the global trend in CO2 emissions for all countries. The map is starting to take shape, and it's time to look ahead to see what's coming next. It is usually considered that the Robinson projection, which is the type displayed in the opening image, is the most accurate of the various forms of geographic projections, except the Mercator projection. Until now, we've been using a standard scatter plot to depict the data in our study (which vaguely corresponds to the Mercator projection). We should avoid using this method for emissions data to achieve a good geographic projection. The latitude and longitude numbers must therefore be converted into shapely points that can subsequently be utilized to build the projection we desire.



A library known as cartopy can be used to reproject data within the subplots function, which is part of the plots function. To use a dark mode, you can change the background color to black and invert the colormap so that large values are lighter in color than small values are. Even though I was delighted with the outcome of the map when I initially started working on it, I decided to compare it to the plot of the original publisher's book to make sure I was on the right route. When this item was first published, the image you see here was made by the publishers of the article. In their color scale, they've chosen an unusual series of values, including 0.0, 0.06, 6, 60, 600, 3000, 6000, 24000, 45000, and 120000, for reasons that I'm not entirely sure of. They've also chosen a strange series of values for their font size and style. Even though the plot's lack of explanation made me wonder why it was established, I assumed there must be a solid rationale for it given that these people are climate experts and I know far less than they do about the subject. The illustration above provides a rudimentary representation of what is taking place in this situation. The colormap is created using a palette of 10 colors, and each of the values in our emissions dataset is assigned a color depending on the values shown in the figure above, resulting in the final colormap. Values greater than 120000 tonnes of carbon dioxide per year will be highlighted in white text.



References

Crippa, M., Guizzardi, D., Schaaf, E., Solazzo, E., Muntean, M., Monforti-Ferrario, F., Olivier, J.G.J., Vignati, E.: Fossil CO2 and GHG emissions of all world countries — 2021 Report, in prep.

Crippa, M., Solazzo, E., Huang, G., Guizzardi, D., Koffi, E., Muntean, M., Schieberle, C., Friedrich, R., and Janssens-Maenhout, G.: High-resolution temporal profiles in the Emissions Database for Global Atmospheric Research. Sci Data 7, 121 (2020). doi:10.1038/s41597–020–0462–2.

IEA (2019) World Energy Balances, www.iea.org/data-and-statistics, All rights reserved, as modified by Joint Research Centre, European Commission.

Jalkanen, J. P., Johansson, L., Kukkonen, J., Brink, A., Kalli, J., & Stipa, T. (2012). Extension of an assessment model of ship traffic exhaust emissions for particulate matter and carbon monoxide. Atmospheric Chemistry and Physics, 12(5), 2641–2659. doi:10.5194/ACP-12–2641–2012

Johansson, L., Jalkanen, J.-P., & Kukkonen, J. (2017). Global assessment of shipping emissions in 2015 on a high spatial and temporal resolution. Atmospheric Environment, 167, 403–415. doi:10.1016/j.atmosenv.2017.08.042