<div align="center">

MXB262 – Visualising Data
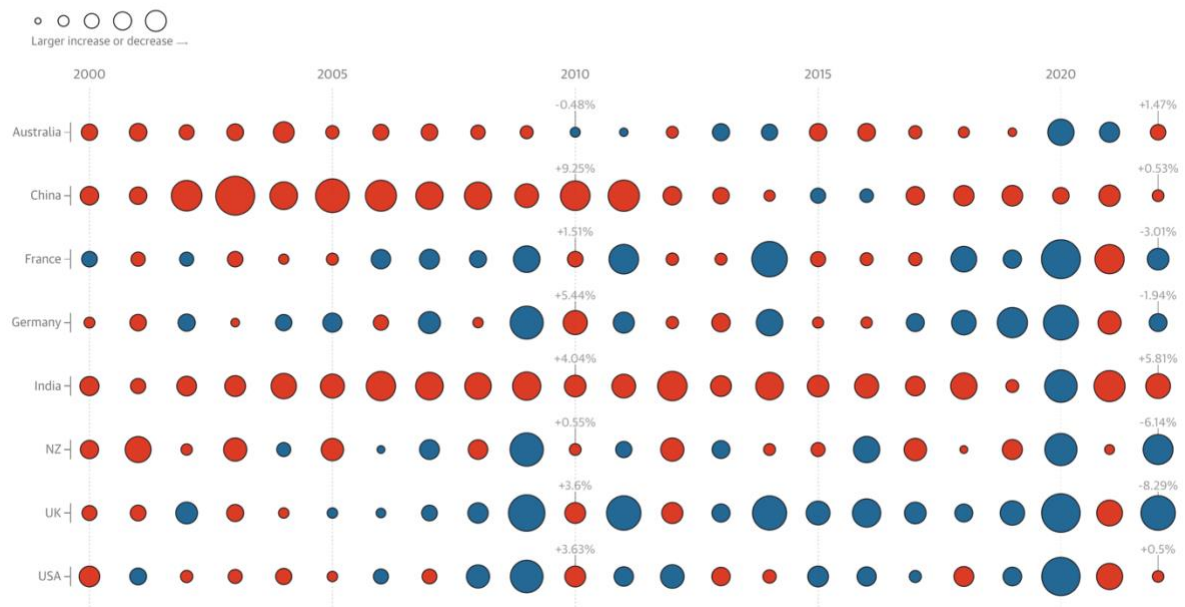
Case Studies Part A: Critical Analysis Report

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1.0 Visualisation 1

1.1 Visualisation Description

Visualisation 1, '*Yearly Change in Greenhouse Gases Emitted, by Country'*, is an area plot from a Guardian article released on 01 March 2024. This visualisation describes how emissions have substantially increased or decreased comparative to each country's previous emissions.

This visualisation's audience are individuals who are informed and concerned about climate change and are interested in emissions data and current climate action. This visualisation intends for the audience to **understand** emissions trends and **agree** that the rate of global emissions production is reducing. The visualisation uses preattentive attributes such as colour and size to communicate this message, highlighting that from 2009 onwards emissions production decreases substantially (blue, large) and increases at a smaller rate (red, small).

1.2 Visualisation Effectiveness

This visualisation is not effective, as it is difficult for an audience to decode, and has several encoding errors. The choice of an area plot to indicate rates of change can be difficult to understand visually, as using standard preattentive attributes, a smaller node would usually imply a smaller number of total emissions. However, in this visualisation, the total emissions production for years with smaller nodes can be much higher, but with smaller exponential increase. The use of only the previous year's data to decide the nodes also confuses the overall story, as it becomes heavily influenced by outliers in the data. For example, 2020 had fewer emissions for most countries, due to the COVID-19 pandemic. Trend-wise, 2021 was also comparatively low for most of the listed countries, however as it is being compared to just 2020, it appears as a substantial red increase (Ritchie et al, 2023). By only looking at the previous year, the visualisation invites greater fluctuation and fails to communicate the whole story effectively.

This miscommunication is amplified by some of the encoding errors for area node sizes. Change rates have not been created appropriately to scale, and nodes that should be ~2-10x larger appear as only slight increases.

0.05%   0.56%   1.06%

This is further highlighted across the different colours, where blue nodes (decreases) have also been encoded as a larger size:
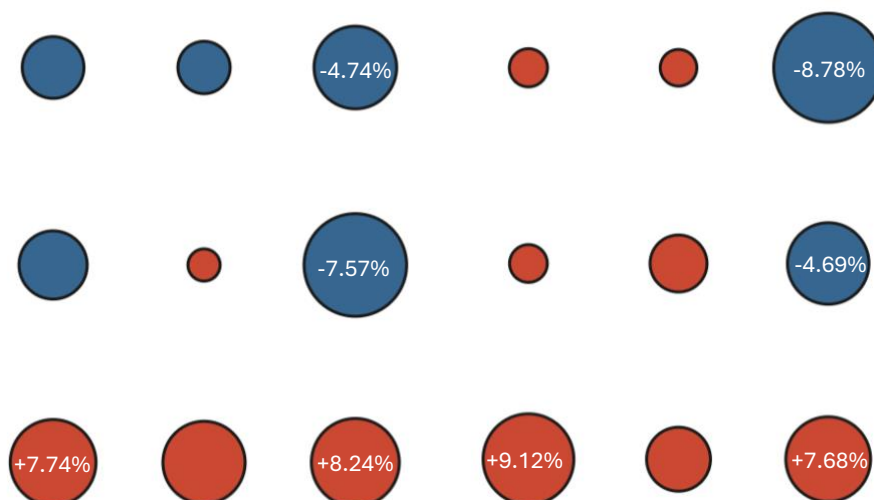
*Data from France, Germany, and India 2007-2009; 2012-2014*

The increase in area size makes decreases in emission trends appear more significant than they are. Overall, the ineffective plot choice, use of comparative data, and poor encoding make this graph difficult for an audience to decode and understand and this confuses the message that the author is trying to convey.

1.3 Recommendations

The following recommendations would allow for easier interpretation of the visualisation's message:

1. **Change data to reflect number of emissions instead of annual change**. Changing the data from increase/decrease percentages to amounts will make trends easier for an audience to understand and examine, rather than investigating year by year change.
2. **Change the visualisation from an area plot to a line chart.** To easily visualise trends and provide a clearer picture of the overall story, a different visualisation type should be used. This would also fix current encoding errors, as area sizing would no longer be required.
3. **Annotate to account for outliers and targets.** Annotate outlier years such as 2020, and an emissions reduction target, so the audience can understand the broader story of how much emissions production needs to decrease.
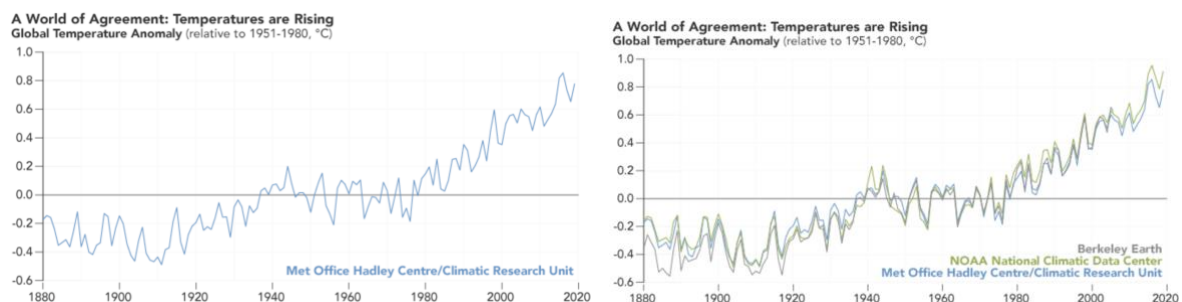
2.0 Visualisation 2
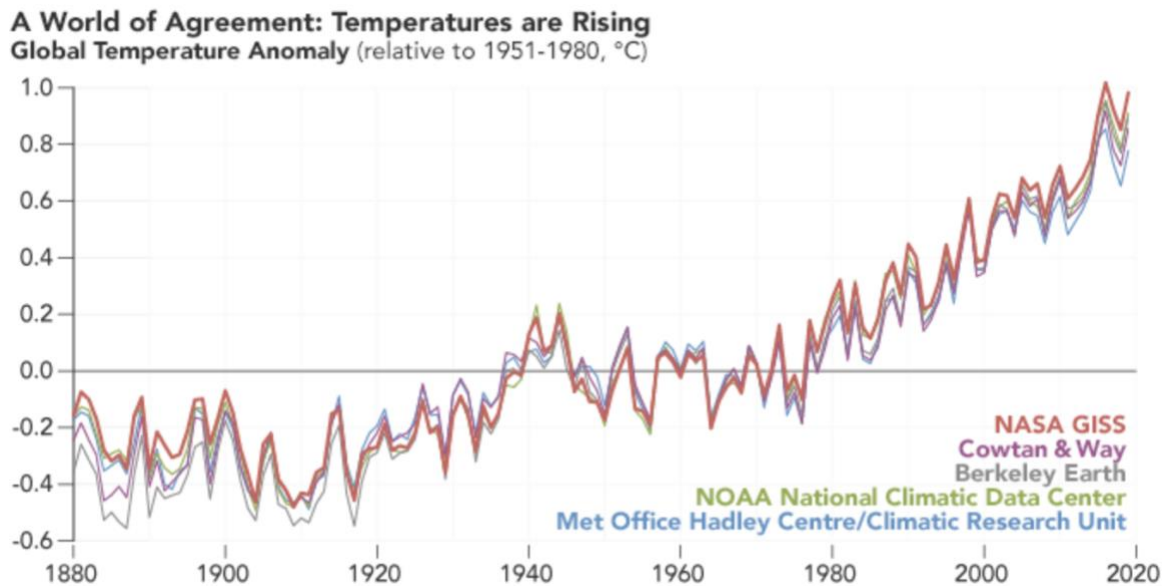
2.1 Visualisation Description

Visualisation 2, '*A World of Agreement: Temperatures are Rising*' is an animated graphic from NASA Earth Observatory, created in 2023. The visualisation looks at temperature anomaly levels compared to 1951-1980 and shows that temperatures are rising to a 1°C increase.

As part of the graphic, multiple graphs are drawn over the top of each other, to demonstrate an aligned view:

Graphs are drawn sequentially on top of each other.

This visualisation's audience are individuals who are interested in climate data or climate change, but don't hold a hugely scientific background, as well as journalists and climate change sceptics. Visualisation 2 intends to **educate** on the 1°C increase, **persuade** the

audience that this trend is occurring and **defend** against any arguments that this trend is disputed. It utilises order to communicate this message, showing each line graph one-by-one to display the same trend repeatedly. The title is also phrased to clearly indicate this message, using "A World of Agreement" rather than just "Rising Temperatures" to signify that this trend is well-documented and agreed upon.

2.2 Visualisation Effectiveness

The plot type used for this graph is appropriate, as it clearly illustrates the upwards temperature trend, and the data and message can be easily interpreted. The ordering by using video to layer each graph on top of the previous ones clearly supports the author's message that this is an undisputed trend. The use of colour in this graph aids the visualisation, as it distinguishes each of the data sources. The graph does not add smoothing, have nodes, or introduce specific figures as it intends to keep the message simple and easily consumable.

One area where the visualisation is not as effective is regarding the 1°C increase. This message is not clearly emphasised, and without the article's broader context, would only appear as a unit of measurement instead of a 'tipping point'.

2.3 Recommendations

The following recommendations would improve this visualisation's effectiveness:
1. **Add a line or annotation for the 1°C.** As a key message is the trend towards this 1°C increase, it would be useful to visualise that this is the 'tipping point'.
2. **Add °C to the Y-Axis.** To further illustrate the above message, the visualisation could be improved by including the °C metric description on the Y-Axis. As one of the identified audience groups is journalists, adding this descriptor would also remove any confusion should they choose to share this visualisation.
3. **Reduce the time series' length.** As the graph uses 1951-1980 as a baseline, it would make sense to either start at 1951 and highlight that this period is 'average', or cut the time series to 1981, and start the visualisation from there. The inclusion of 1880-1950 does not add much to this visualisation, and reducing the time series would help sharpen the overall message.

3.0 References

1. **Visualisation 1:** Evershed, N., Morton, A. and Nicholas, J. (2024) 'What's really happening with emissions and the climate crisis in Australia', *The Guardian*, 1 March. Available at: https://www.theguardian.com/environment/datablog/ng-interactive/2022/oct/03/tracking-australias-progress-on-the-climate-crisis-and-the-consequences-of-global-heating.

2. **Visualisation 2:** *World of change: Global temperatures* (2023) *NASA Earth Observatory*. Available at: https://earthobservatory.nasa.gov/world-of-change/global-temperatures

3. *Per capita CO_2 emissions*, part of the following publication: Hannah Ritchie, Pablo Rosado and Max Roser (2023) - "CO_2 and Greenhouse Gas Emissions". Data adapted from Global Carbon Project, Various sources. Retrieved from https://ourworldindata.org/grapher/co-emissions-per-capita