VIS-Assignment 4

Name: Bryan Yi Jue Tan
Student number: 11930138

1. Data, users, and tasks (25 points)

User Group 1: Service Providers for Greenhouse Emission Compensation

The members of user group Service Providers for Greenhouse Emission Compensation are committed to actively contributing to mitigating global climate change by providing innovative and sustainable solutions to reduce and compensate for greenhouse gas emissions. Their goal is to identify opportunities to mitigate the effects of climate change and provide viable options for individuals seeking to reduce their carbon footprint, especially frequent flyers.

Task 1. Investigate possibilities to mitigate climate change effects for frequent flyers
Overview:
As air travel increases, frequent flying will significantly contribute to climate change. The purpose of this task is to explore effective mitigation strategies so that frequent flyers can contribute to climate change without compromising travel convenience. The task aims to provide actionable insights to travellers, airlines and policymakers.

Dataset Connection:
For Task 1, we selected two datasets. The "Annual Surface Temperature Change" dataset was used to analyze global temperature change trends between 1961 and 2022. This helps identify areas affected by climate change, informing strategies to offset the impacts of air travel. Loading the data into Tableau, it was found that a few areas, such as Botswana, Zimbabwe had negative growth in surface temperature between 1961 and 2022, which is very interesting. In addition, the data records in some areas are incomplete (for example, the data records of Montenegro only start from 2005, and the data of Falkland Islands (Malvinas) are only recorded until 1981).

The “Atmospheric CO2 Concentrations” dataset (March 1958 to May 2023) provides insights into changing CO2 levels, supporting the exploration of sustainable solutions without compromising convenience. Different from the surface temperature data set, the CO2 concentration data set does not show the atmospheric CO2 concentration levels in different regions. There is only one global geographical unit, but the data value is still high because atmospheric CO2 concentration is closely related to frequent flights. In addition, the time unit of the surface temperature data set is “year” but the CO2 concentration data set is “month”.

Task 2: Evaluate the effectiveness of current mitigation strategies
Overview:
The task is to assess the actual effectiveness of current emissions reduction strategies at a time when climate issues need to be addressed urgently. A closer look at climate change data from recent years to measure the impact of current initiatives such as carbon offset projects, sustainable fuel use and energy efficiency improvements on greenhouse gas emissions and climate impacts. A thorough analysis can provide important insights to guide future climate action plans for a more effective response.

Dataset Connection:
To assess the effectiveness of current disaster reduction strategies, we also selected two data sets. The "Forests and Carbon" dataset (1992-2020) provides valuable insights into carbon stocks and forest impacts. For example, comparing carbon stocks in forests and forest areas in different countries can help to understand the forest carbon density in different countries and infer the climate change and ecosystem health of the region. When studying the data, I was surprised by the differences in forest area between countries. For example, the forest areas of Russia, Brazil, Canada, and the United States, which are major forest countries, account for nearly half of the total forest area in the world.

At the same time, the “Change in Mean Sea Levels" dataset enables detailed studies of sea level changes, which are critical for understanding the impact of mitigation strategies on vulnerable areas. Sea level rise is often linked to global warming, and this comprehensive dataset approach strengthens assessments and helps develop more effective climate action plans. What is interesting is that the historical records for the highest and lowest sea levels in the data were both set in the Baltic Sea, which were 945 Millimeters on January 15, 2005 and -625 Millimeters on December 23, 2022.

User Group 2: UN Commission on Climate Change

The user group United Nations Committee on Climate Change may refer to the United Nations Framework Convention on Climate Change (UNFCCC) and its affiliated Intergovernmental Panel on Climate Change (IPCC). The goal of the UNFCCC is to reach an agreement on the reduction of greenhouse gas emissions on a global scale and to promote measures to combat the adverse effects of climate change. The IPCC is an international organisation composed of scientists and government representatives responsible for assessing the scientific knowledge of global climate change and providing policymakers with a comprehensive assessment of the science, impacts and adaptation of climate change.

Task 1: Demonstrate which countries are affected most by climate change to debate strategies

Overview:
The impacts of climate change vary across countries. The task focuses on identifying the countries most affected by climate change. Members of the United Nations Committee on Climate Change need in-depth insights from climate change data sets to guide international policy discussions and decision-making. The aim is to prioritise areas requiring urgent attention and develop targeted strategies to mitigate the effects of climate change globally.

Dataset Connection:
Exactly like Task 1 of User Group 1, we selected the "Annual Surface Temperature Change" and "Atmospheric CO2 Concentration" datasets as data sources. The "Annual Surface Temperature Changes" dataset provides a comprehensive overview of annual temperature changes around the world (1961-2022). The data helps identify countries with significant temperature changes and is an important indicator of the impact of climate change. Different from Task 1 of User Group 1, the "Annual Surface Temperature Change" data set is presented here using a Tree Map. This is to more intuitively display surface temperature

changes in each region without being affected by its actual geographical location or data from its neighbouring countries.

Additionally, the "Atmospheric CO2 Concentration" dataset covers monthly global carbon dioxide levels from March 1958 to May 2023, providing a holistic perspective on carbon dioxide levels. This broader perspective enables researchers and policymakers to analyse collective impacts in different regions, informing strategies for global carbon reduction efforts. Also different from Task 1 of User Group 1, we chose to use a histogram to display the "Atmospheric CO2 Concentration" data set instead of a line chart in this task.

The interesting features, missing values and other information in the two data sets have been explained when introducing Task 1 of User Group 1, so they will not be repeated here.

Task 2: Assess the correlation between land cover changes and climate-related disasters
Overview:
This task involves assessing the correlation between land cover changes and climate-related hazards. Changes in a country's land cover not only affect climate-related disasters but also the provision of ecosystem services. Understanding the relationship between land cover change and climate-related disasters can help a country develop more accurate risk assessment and prediction models. Members of the UN Commission on Climate Change therefore seek to understand the relationship between the two in order to develop effective strategies.

Dataset Connection:
The Land Cover Accounting dataset contains annual land cover data. The higher the index value, the greater the impact of land cover type on climate, which may increase greenhouse gas emissions and climate change risks. This helps users accurately determine the extent and distribution of climate risks. An interesting observation is that although Indonesia has low land cover, the frequency of climate-related disasters is high. It can be seen that the causes of climate-related disasters in Indonesia have little to do with land cover.

At the same time, the "Climate-Related Disaster Frequency" data set from 1980 to 2022 is also crucial for understanding the frequency of climate-related disasters in different countries. Climate change has profound effects on the global climate system, leading to an increase in the frequency and intensity of extreme weather events. This includes, but is not limited to disasters such as heat waves, floods, hurricanes, droughts, etc. Develop and implement climate adaptation measures based on changing trends in the frequency of climate-related disasters to reduce the negative impact of climate change on society and ecosystems.

2. Task abstraction (6 points)

User Group 1: Service Providers for Greenhouse Emission Compensation
Task 1. Investigate possibilities to mitigate climate change effects for frequent flyers:
- Action: Investigate effective strategies to mitigate climate change effects related to frequent flying.

- Target: Provide actionable insights for travelers, airlines, and policymakers.
- Datasets: Annual Surface Temperature Change, Atmospheric CO2 Concentrations.

Task 2: Evaluate the effectiveness of current mitigation strategies
- Action: Assess the actual impact of current emissions reduction strategies.
- Target: Provide insights for future climate action plans.
- Datasets: Forests and Carbon, Change in Mean Sea Levels.

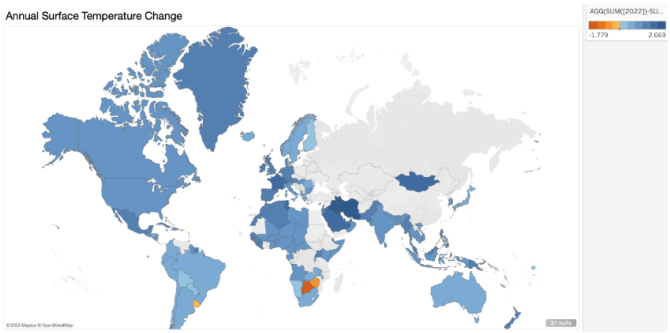
User Group 2: UN Commission on Climate Change
Task 1: Demonstrate which countries are affected most by climate change to debate strategies
- Action: Demonstrate countries most affected by climate change.
- Target: Inform international policy discussions and decision-making.
- Datasets: Annual Surface Temperature Change, Atmospheric CO2 Concentrations.

Task 2: Assess the correlation between land cover changes and climate-related disasters
- Action: Evaluate the correlation between land cover changes and climate-related disasters.
- Target: Develop accurate risk assessment and prediction models.
- Datasets: Land Cover Accounting, Climate-Related Disaster Frequency.

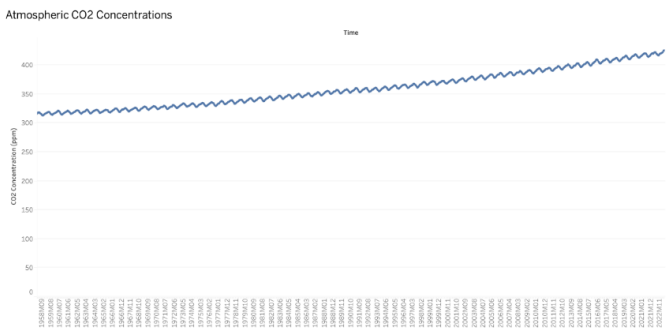
3. Designs (22 points each = 44 points)

Dashboard 1: Service Providers for Greenhouse Emission Compensation

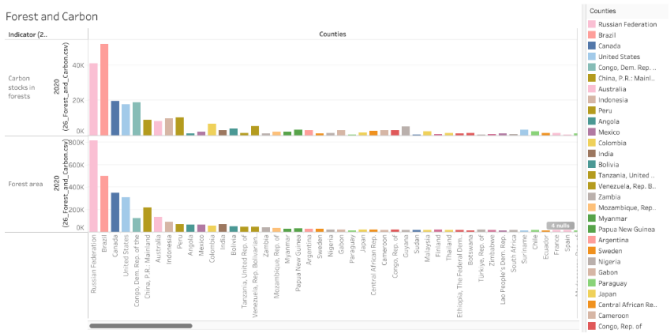
View 1



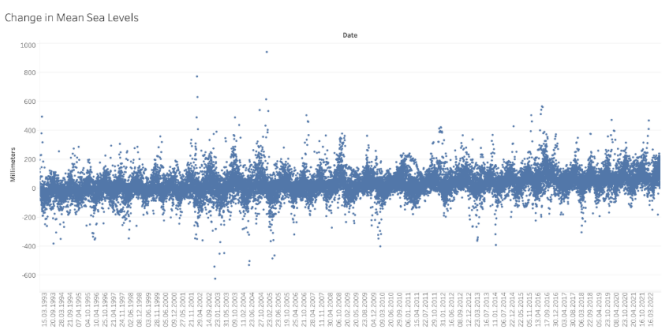
View 2



View 3



View 4



View 1: Choropleth Map showing annual temperature changes by country. By sliding the year slider, the colors of countries on the map will change as the data changes. Choropleth

maps were chosen to clearly see annual temperature changes and differences across countries.

View 2: Time Series Line Chart illustrating global CO2 concentrations over time. Ideally the corresponding year would change color as the year slider moves. At the same time, users can use sort to change the order of views. Since there is no need to consider different countries/regions, using a time series line chart is the simplest and most effective way to display changes in global CO2 concentration at different times.

***Note: The time unit of the original data set is months, but because I am not familiar with the use of Tableau, I failed to integrate the time units of view 2 into years. Ideally all views across the entire dashboard would have a unified time unit - year.*

View 3: Histogram showing the carbon stock in forests and forest area changes over the years for different countries. The histogram will also change according to the movement of the year slider. The same user can use sort to change the order of the view. Here we need to display two types of data: forest carbon storage and forest area. Selecting a histogram can visually compare the relationship and difference between the two.

View 4: Scatter Plot indicating the distribution of sea level changes globally. Similar to view 2, the corresponding year will change color when the year slider moves. The user can also use sort to change the sorting of the view. Users can additionally view data on sea areas they care about. Since the sea levels of each sea area are displayed separately, the small size of the scatter plot allows people to easily and clearly distinguish the location of each sea area.

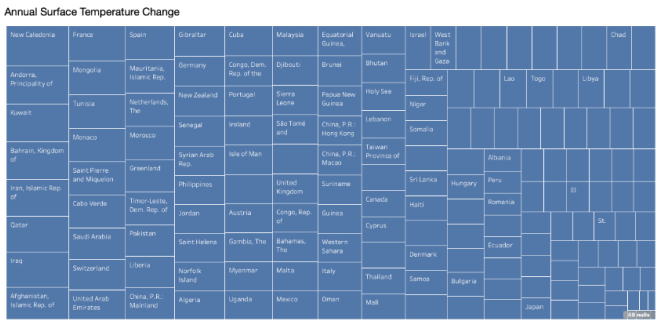
*** Note: Have the same time unit issue as view 2, the time unit of the original data set is days, but should be years.*

Interactivity and Linking:

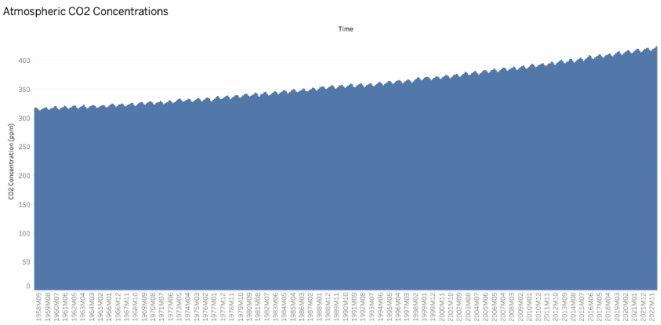
- Ideally all views would have a shared year slider similar to A3 which interactively changes the data displayed in the views across the entire dashboard.
- Ideally all views across the entire dashboard would have a unified time unit - year
- Users can select a specific country and it will update the other views (except Atmospheric CO2 Concentrations), providing detailed information for the chosen area.

Dashboard 2: UN Commission on Climate Change

View 1

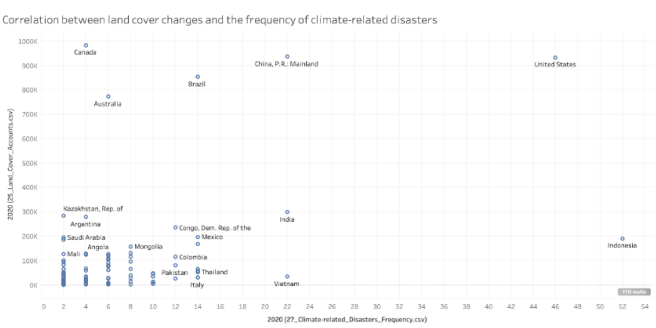


View 2



View 3

View 4



View 1: Treemap highlighting countries with significant temperature changes. Ideally the corresponding year would change color as the year slider moves. Users can click on a specific country to change its color. The purpose of using a dendrogram representation is to more intuitively display surface temperature changes in each region without being affected by other factors such as actual geographical location or data from neighboring countries.
View 2: Histogram illustrating global CO2 concentrations over time. The corresponding year changes color as the year slider moves. At the same time, users can use sort to change the order of views. By using histograms, people can intuitively feel the changes in global carbon dioxide concentration over time, and they can feel the extent of data changes better than line charts.
*** Note: Have the above mentioned time unit issue, the time unit of the original data set is months, but should be years.*
View 3: Choropleth Map illustrating the frequency of climate-related disasters globally. The circle changes size as the year slider moves. Users can click on a specific country to change the color of the circle. Choropleth Map are used here because climate-related disasters often affect more than one country at the same time, so using Choropleth Map makes it clear how countries impact each other.
View 4: Scatter Plot representing the correlation between land cover changes and the frequency of climate-related disasters. As the year slider moves, the position of the scatter points changes with the data. Users can click on a specific country to change the color of the circle. To compare the correlation of two data at the same time, I think scatter plot is the best choice (or heat map but I think scatter plot is clearer)

Interactivity and Linking:
- Ideally all views would have a shared year slider similar to A3 which interactively changes the data displayed in the views across the entire dashboard.
- Ideally all views across the entire dashboard would have a unified time unit - year
- The user can select a specific country and it will update the other views (except atmospheric CO2 concentration) by highlighting the selected area and then providing its details.

4. Reflection (20 points)

Dashboard 1: Service Providers for Greenhouse Emission Compensation

Pros:
Efficiency: Each view can well display the changes in its data according to the year slider, users can easily identify areas with significant changes. View 3 and View 4 also provide intuitive comparison methods for various data.
Balanced Visual Encodings: The visual encodings, including Choropleth Maps, Time Series Line Charts, Histograms, and Scatter Plots, effectively balance the need for diverse representations of data attributes. Each visualization type is selected based on the data's nature and the user tasks.
Overview and Detail Views: Choropleth Map and Time Series Line Chart serve as overview views, offering a high-level understanding of temperature and CO2 trends. Histogram and Scatter Plot act as detail views, providing more in-depth insights into carbon stock changes and sea level variations.
Interactivity and Linking: Year slider and sorting enables dynamic updates, promoting user engagement and enhance their control and exploration.

Cons:
Time unit differences: Inconsistencies in time units (for examplemonths vs. years) between different views can cause confusion and hinder seamless integration.

Limited detail view: While the dashboard provides an overview view, the details of a specific variable may require the user to explore multiple views individually. Also some intricate relationships may be oversimplified. For instance, the Scatter Plot offers a global perspective on sea level changes but lacks detailed regional insights.

Dashboard 2: UN Commission on Climate Change

Pros:
Efficiency: Users can efficiently demonstrate countries most affected by climate change and assess the correlation between land cover changes and climate-related disasters. The views offer quick insights into each other by year slider or countries.
Balanced Visual Encodings: Treemaps, Histograms, Choropleth Maps, and Scatter Plots effectively balance the need for diverse representations of data attributes. Each visualization type is chosen based on the data's nature and the user tasks.
Overview and Detail Views: Treemap and Histogram provide overview views, allowing users to quickly identify countries with significant climate changes. Choropleth Map and Scatter Plot act as detail views, offering more nuanced insights into global disaster frequencies and their correlation with land cover changes.
Interactivity and Linking: Year slider and sorting enables dynamic updates, promoting user engagement and enhance their control and exploration.

Cons:
Time unit differences: Similar to Dashboard 1, inconsistencies in time units (months vs. years) between different views can cause confusion and hinder seamless integration.
Limited detail view: While the dashboard provides an overview view, the details of a specific variable may require the user to explore multiple views individually.

5. Conclusion (5 points)

Honestly, if I could, I would like to implement a combination of Dashboard 1 and Dashboard 2 in A5. The specific idea is that I really like View 1 and 4 from Dashboard 1 and View 4 from Dashboard 2 (View 2 from both Dashboard are same good). And I believe the combination will have better results.
But if I have to only choose one complete Dashboard, I would ultimately choose Dashboard 1 as the object implemented in A5. Because its coherence, consistency and efficient user interaction are overall a bit better than Dashboard 2, it also conforms to the design principles, and the climate-related data provided are also connected, which increases the friendliness and motivation of user exploration.