Project Data Visualisation Deforestation

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1. Data Used

1.1 Dataset

There is a huge quantity of datasets from which we were able to extract the data associated with the visualization of the worldwide deforestation, but we needed to choose the one that was "more ready" to use and also that was having enough and extensive information.

With this aim, we have chosen as our main data provider, the web site:

Our World in Data (https://ourworldindata.org/.)

As it can be read in their webpage content is nourished by researchers of the University of Oxford and its maintenance is done by the Global Change Data Lab (Global Change Data Lab (global-change-data-lab.org) a non-profit organization registered in England and Wales. This foundation is supported by donations from reader of the web publication of Our World in Data, and also grants coming from the Bill and Melinda Gates Foundation and the Quadrature Climate Foundation, they also claim they have received past support from the World Health Organization, the Department of Health and Social Care in the UK and many other individuals.

We have used the date from https://ourworldindata.org/deforestation, more explicitly the csv files associated to:

1. The annual Net change in forest area: it measures forest expansion (either through afforestation or natural expansion) minus deforestation, called "Annual-change-forest-area.csv'
2. Share of land area that is covered by forest, named "forest-area-as-share-of-land-area.csv"

   In those datasets it is possible to explore long-term changes in deforestation, and the deforestation rates across the world today.

Also data from https://ourworldindata.org/forest-area, and in more details, the files:

1. A breakdown of global forest area by world region, called "Share-global-forest.csv"
2. The total of forest area by country, with the name of "forest-area-km.csv"

These two files let you see the distribution of global forests globally.

All the original sources (as raw data) can be found as data published by "UN Food and Agriculture Organization (FAO). Forest Resources Assessment 2020" with the associated link: https://fra-data.fao.org/WO/assessment/fra2020

The UN FAO publish forest area and forest change data as the annual average on 10 or 5 year timescale, therefore these are the year allocations that apply:

- The annual average over the period from 1990 to 2000
- The annual average over the period from 2000 to 2010
- The annual average over the period from 2010 to 2015
- The annual average over the period from 2015 to 2020

1.2 Some Definitions

In order to be able to reach some insights, it is needed to establish a basic conceptual framework, therefore, before applying any study on the data we are presenting, it is mandatory to clarify some definitions, so that the public that reach this publication is on the same page as that of the publishers.

Forest: Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10%, or trees to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use. So a forest is determined both by the presence of trees and the absence of other predominant land uses.

Net Change in Forest: it measures any gains in forest cover - either through natural forest expansion or afforestation through tree-planting minus deforestation.

Deforestation: The removal / cutting of trees in a forest from. There are two types of deforestation: human-driven and the natural one.

2. Aim of the project

2.1 Public concerned

Our data visualizations are aimed at the general public, so that awareness of deforestation - which has a direct impact on climate change and animal welfare - is raised. The objective of our story is therefore to make our viewers aware of this plant and animal destruction, by proposing powerful graphics and visualizations. Our visualization tools are intended to be used by novices related to data, and that understanding is possible for a person with no particular technical skills. We have therefore oriented our visualization tools towards a common design in computing (drop-down menus, checkboxes, sliders, multi-selection...)

2.2 Mentalities targeted

What is the user looking for and how your design may or may not help them?

The user who looks for information in our visualization is already aware of the existing problems related to deforestation. Our visualization will not convert a person who is not interested in environmental and animal causes. On the other hand, a person who already has some knowledge about the dangers of deforestation will be able to increase his general culture and his factual knowledge on this subject thanks to our visualizations.

3. Design

3.1 Used Technology

We used Altair to develop our main views and interactions. Our choice was mainly driven by the fact that the development on Altair is done in Python, and that we preferred to focus on creating content on the data visualization itself, rather than wasting time learning Javascript on which we are not yet fluent.

In more detail, we have used the version 3.7.6 of Python and that of the Altair 4.1.0.

For the publication in a dashboard, we have used vega-lite 4.8.1 and D3 7.0.0.

3.2 Technology pipeline

This is the workflow used to display the data in a dashboard using the technology already described:

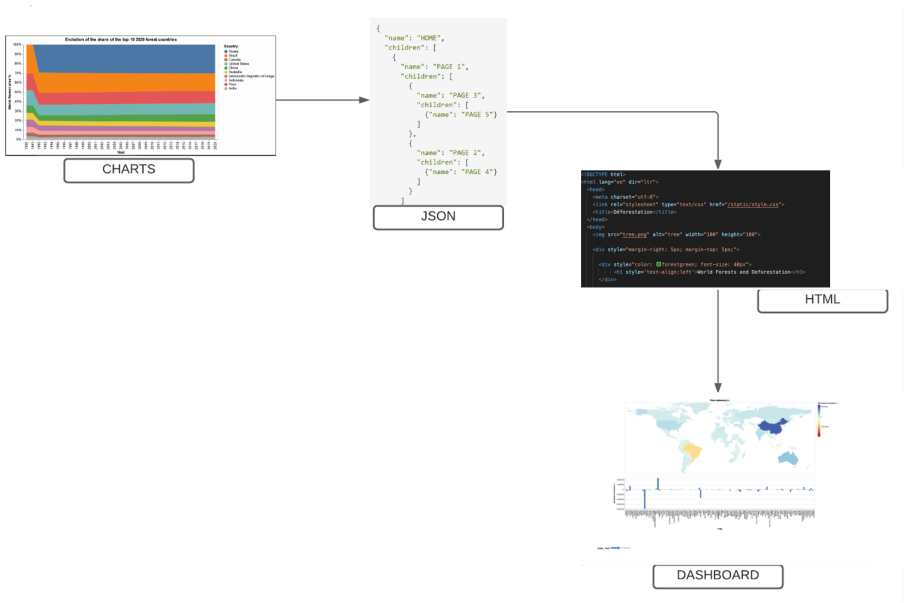

Figure 1: Workflow pipeline to display the data in dashboards

3.3 Views

In order to observe the variation of the forest/tree population in the world, we display a world map offering several visualizations. A choropleth map of the world map is very explicit and offers a clear visualization of the situation.

Below, we display the world map showing the distribution of forests and forest density per country.

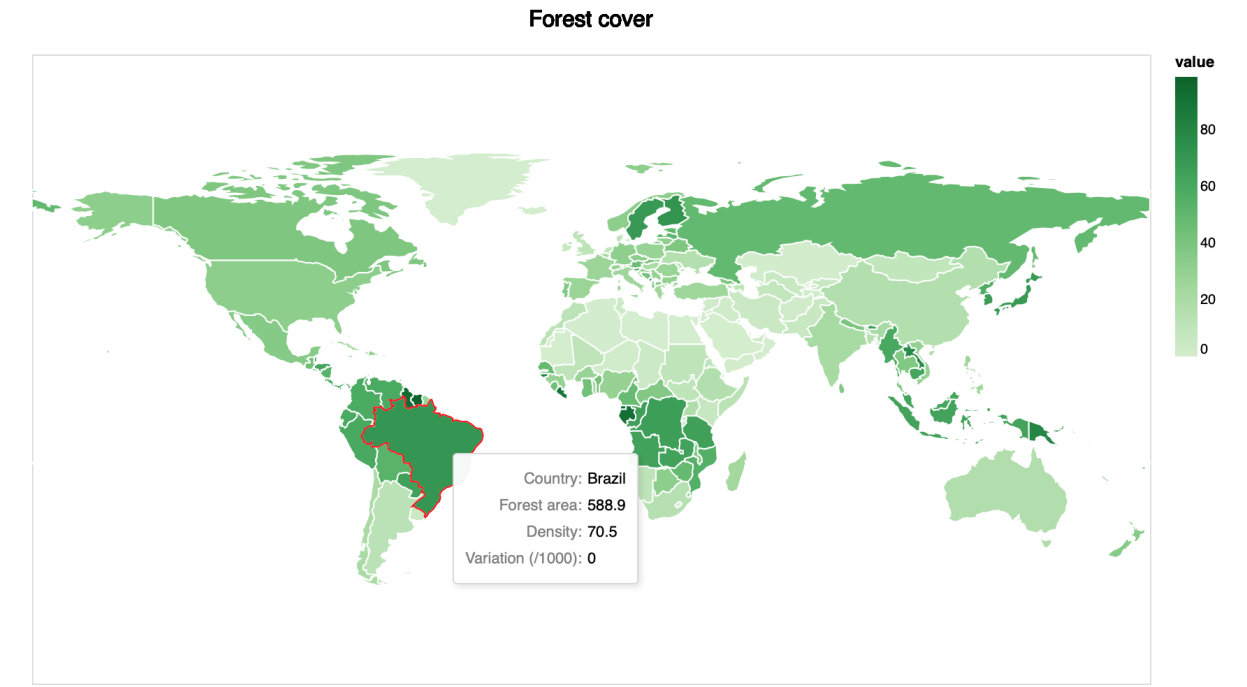

Figure 2: World map's heat map showing the forest distribution for each country.

Our choice to represent this contrast of population between countries is a choropleth map where darker the color higher the density of trees is on the territory.

A **choropleth map** displays divided geographical areas or regions that are coloured in relation to a numeric variable. It allows us to study how a variable evolutes (in time) along a territory.

It is a powerful and widely used data visualization technique. However, its downside is that regions with bigger sizes tend to have a bigger weight in the map interpretation, which includes a bias. It could also be misleading in the presence of outliers.

In the next series of maps, we show the evolution starting in 2000 and every 5 years (with a gap of 9 years between 2010 and 2019) of the change in forest cover across the world, in hot colors those countries where the change is negative and in green those with a positive change, meaning that these countries are gaining more than what they are losing.

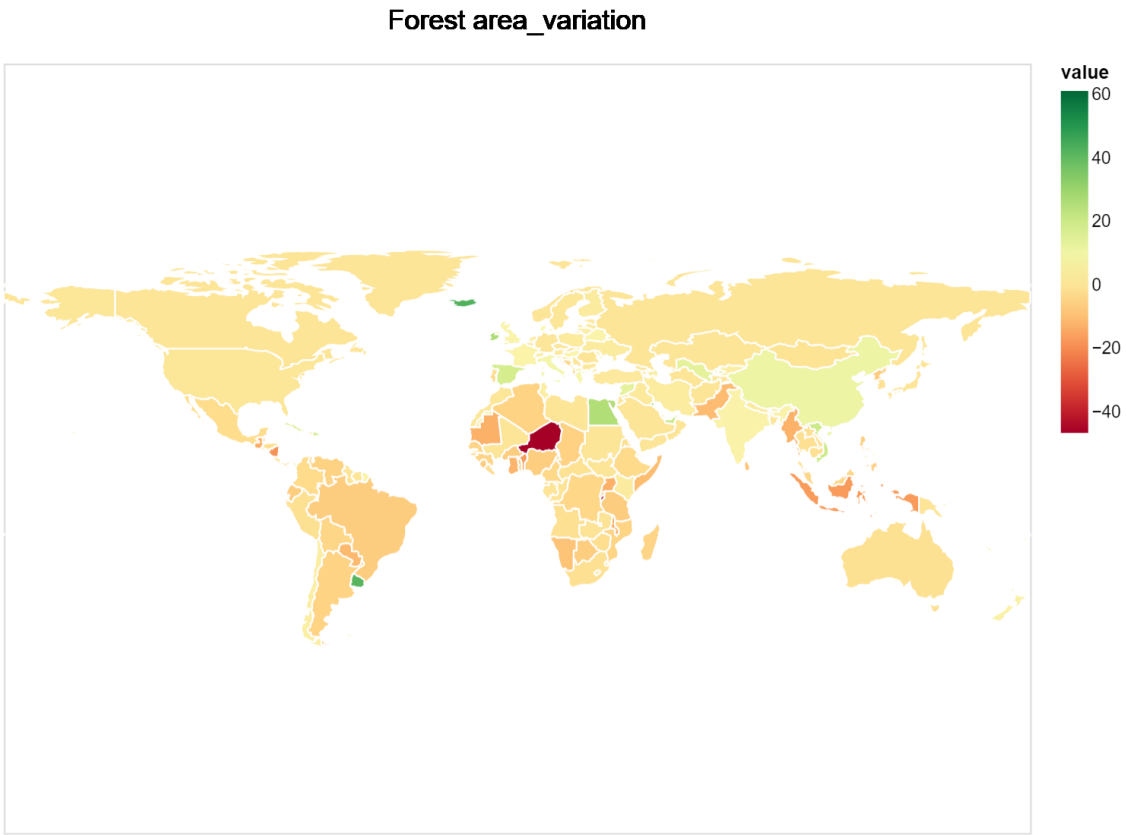

Figure 3: World heat map showing the change in forest for each country in 2000.

The losing countries for this year are Niger, Indonesia, Ghana and Nicaragua among others. Meanwhile, Iceland, Ireland,Spain, China, Uruguay and Egypt are good pupils.

It looks like in 2005, the mentality and the public politics have not reached their goals, because there had been a worldwide decrease in the change in forest as we can observe in this map:

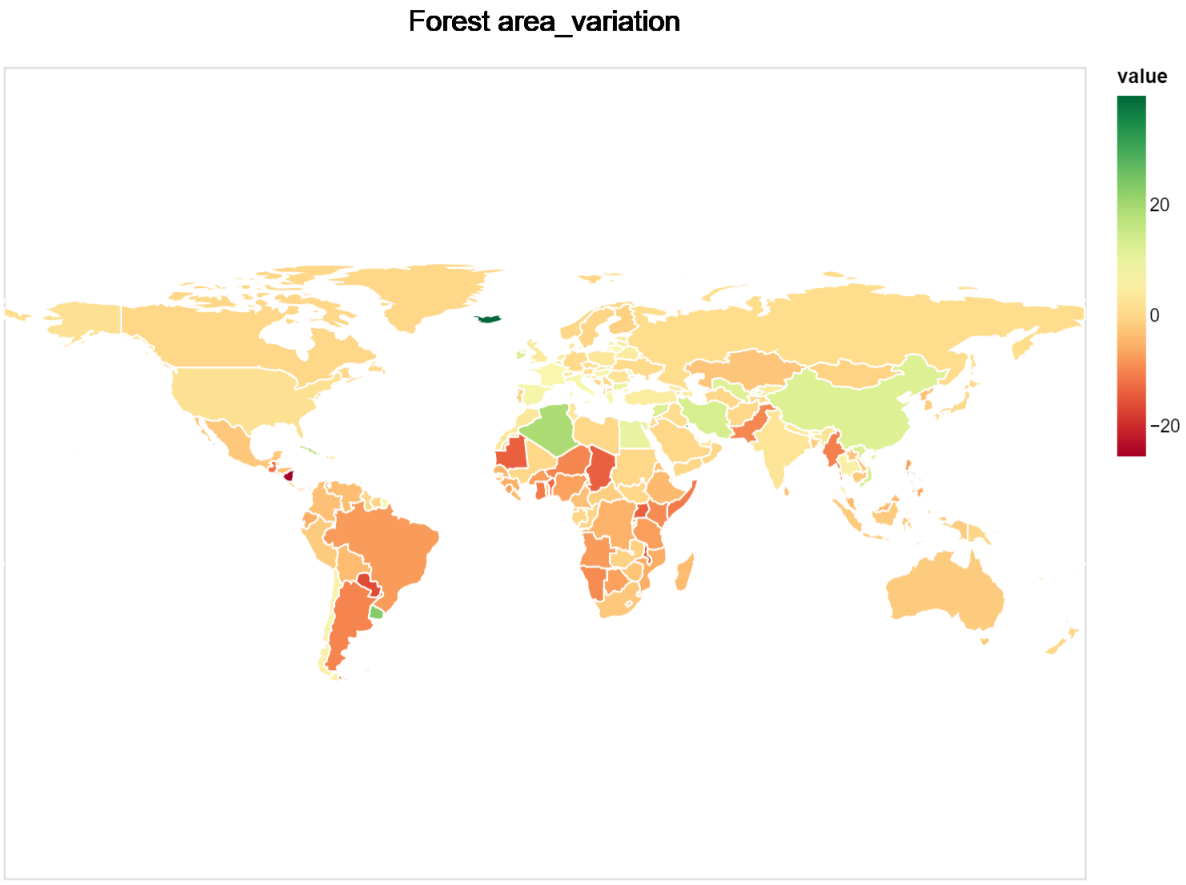

Figure 4: World heat map showing the change in forest for each country in 2005.

But looking much more in detail, we can see a change in the scale in both directions, so now the maximum change is of +40 and the minimum is of -20. We can observe some countries that have increase their forest area in relation to 2000 like Niger, changing from -46 to -10

In 2010, the scale keeps the same, but there are new countries that had still increased their change in forest positively, like Iran, Uzbekistan, China and Algeria and there are some other countries that have improved their situation, but are still in the yellow zone like USA, Peru, Colombia, Rusia, Australia and others. In general we observe an improvement, a positive change in forest.

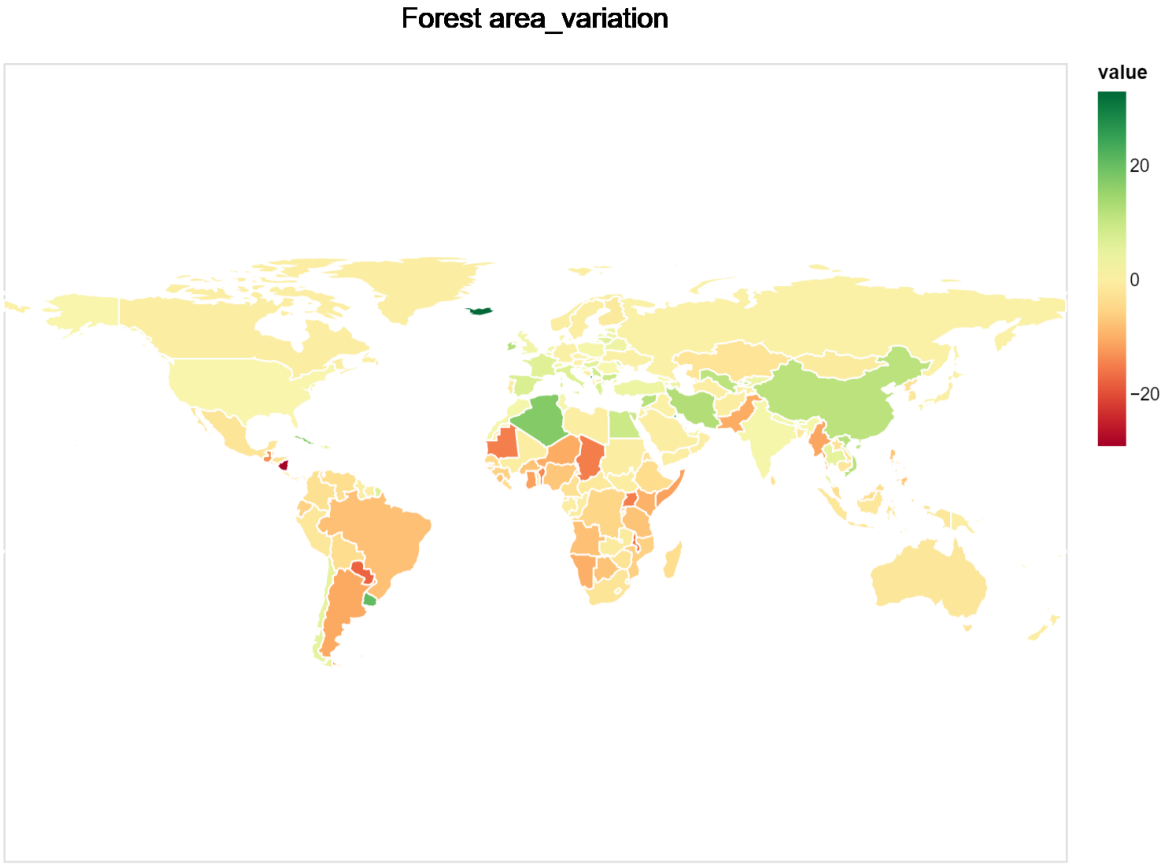

Figure 5: World heat map showing the change in forest for each country in 2010.

Checking the situation in 2019, we observe an improvement in the Brazil situation and also that of China, Russia and Kazakhstan and Paraguay, Nicaragua, Niger, Nigeria, Chad, Mauritania and Oman representing bad examples.

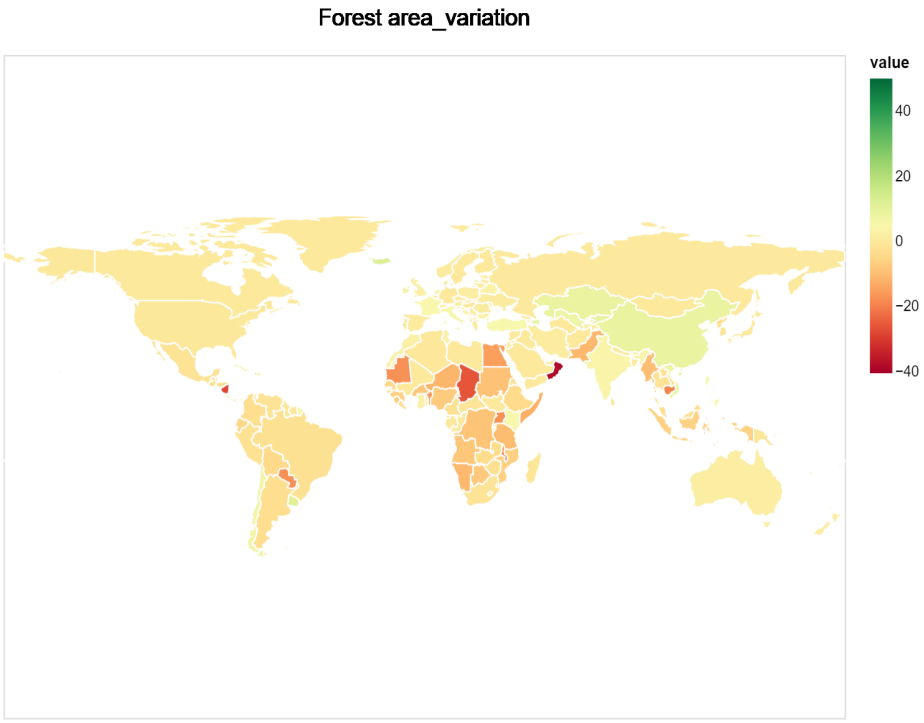

Figure 6: World heat map showing the change in forest for each country in 2019.

On these maps, we are able to select several countries and compare them in a chart, like in this example:

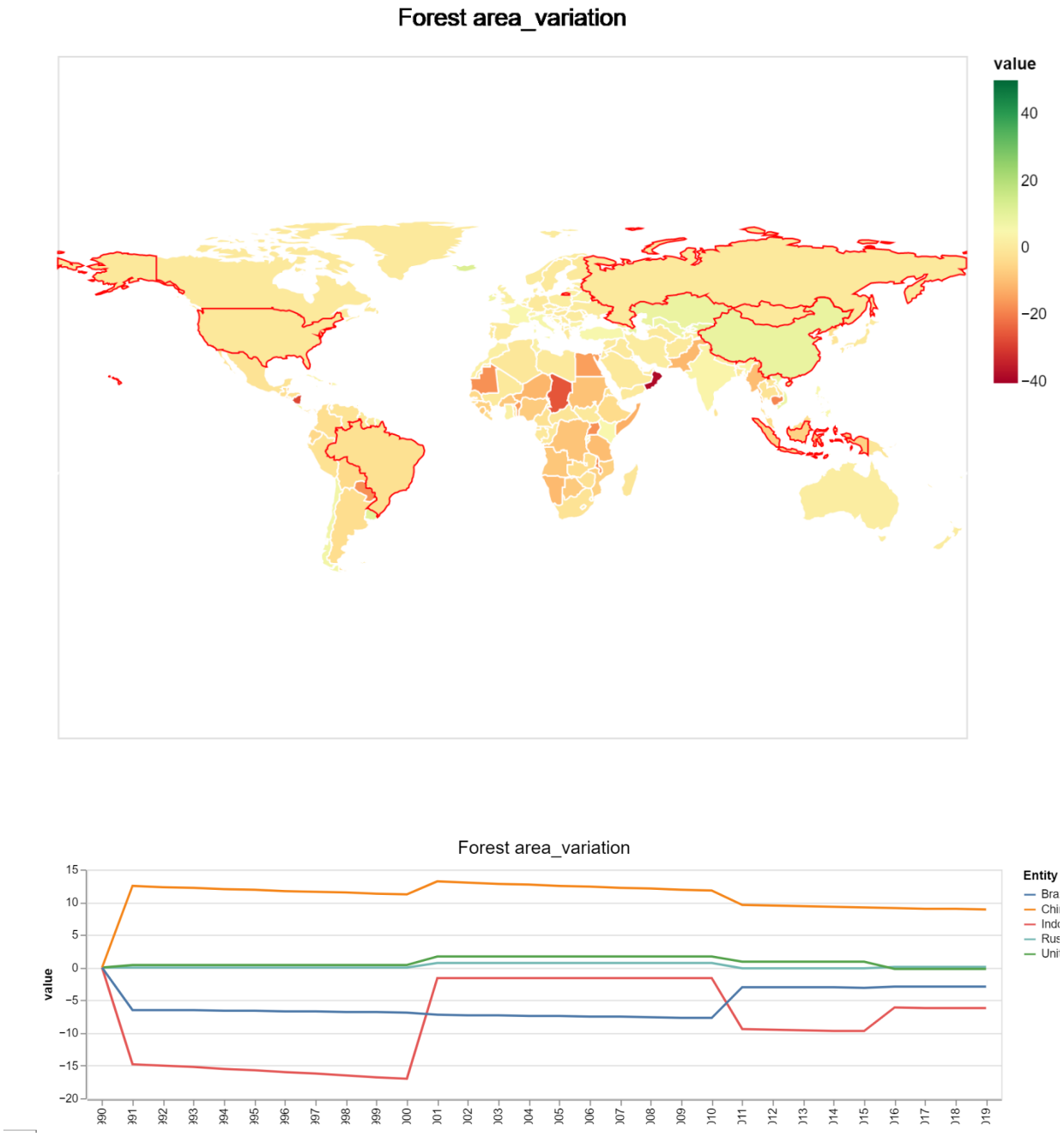

Figure 7: World heat map showing the change in forest for each country in 2019, with selected countries and the same information for those countries and their evolution in time.

In this way, it is possible to observe at the same time several countries and their evolution, while checking their situation at a specific point in time. From this graph we could say that the change in forest in Indonesia is drastic, which could lead to a

possible variable way of measuring or not realistic values, while the same curve for other countries is more stable and their changes more subtle.

Another way of visualizing the same date is with the use of Bar Plot for categorical data, like this:

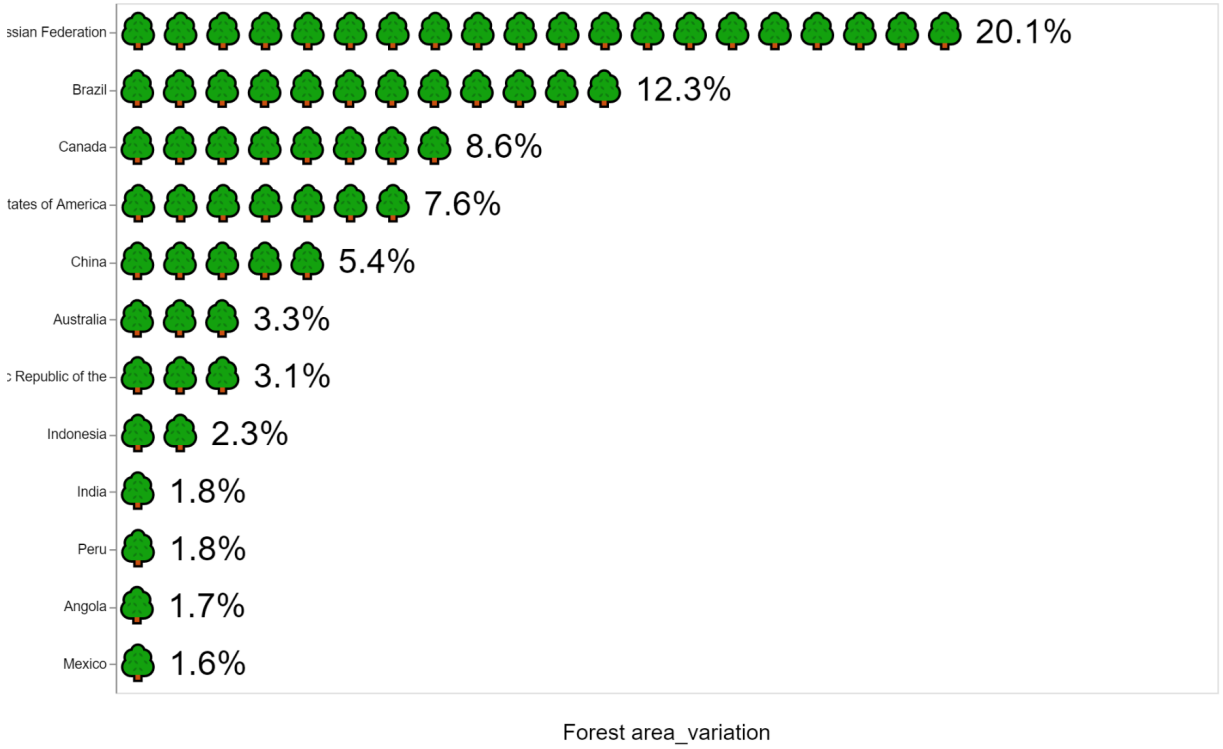

Figure 8: Top 10 countries with biggest change in forest in 2019.

A barplot is one of the most common types of graphics. It shows the relationship between a numeric and a categorical variable. Each entity of the categoric variable is represented as a bar. The size of the bar represents its numeric value.

An ordered barplot is a very good choice since it displays both the ranking of countries and their specific value.

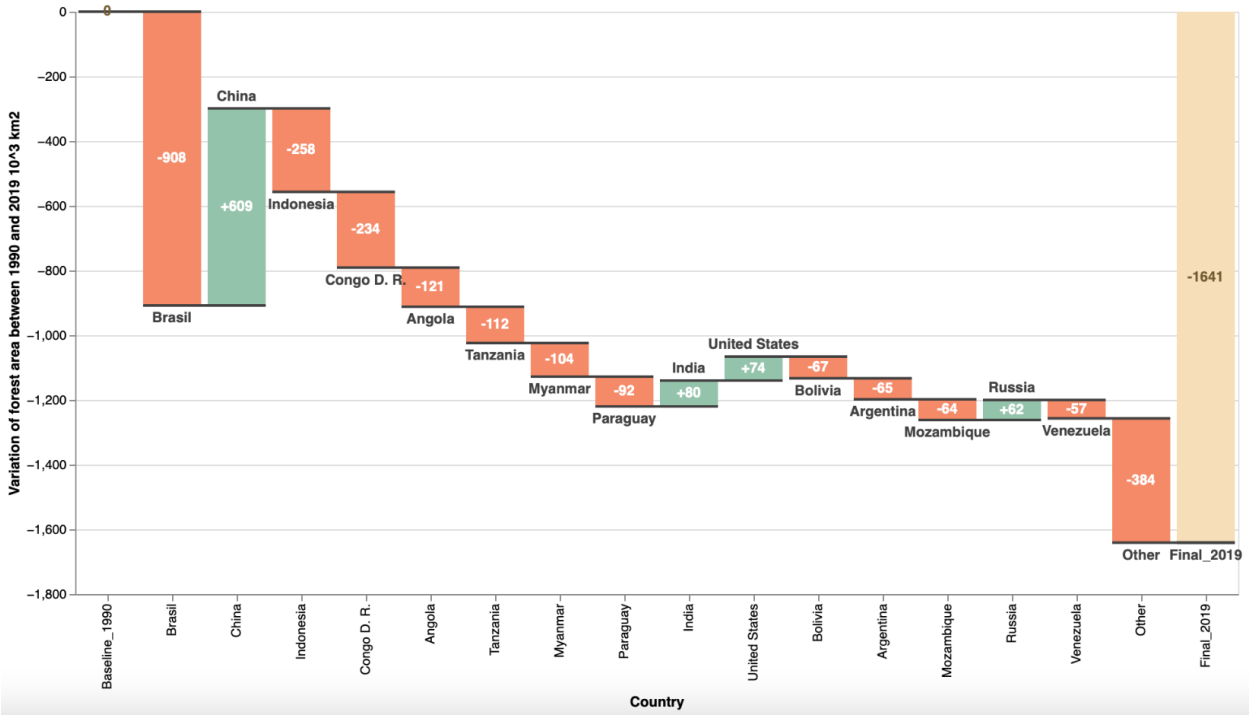

Figure 9: Contribution of the 15 most important contributors to global Forest area variation over the past 30 years.

This graph shows the action of different countries on deforestation or forestation over the last 30 years. We can see the starting point and the end point, and measure the impact of each country - positive or negative - on global deforestation. This graph allows us to draw up a general balance sheet while weighting the responsibility of each country during this period.

3.4 Interactions

Figure 10: Multi selection on the world map.

The multi selection of countries allows us to compare countries on a graph displaying the value of deforestation if negative value or forestation if positive value. This interaction aims to compare a limited number of countries from the display of all countries in the world.

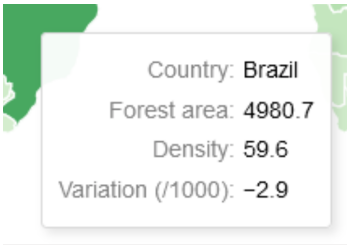

Figure 11: Mouseover tooltip for a country.

The mouseover interaction allows the user to quickly retrieve key information about a specific country from the global data display. It allows the user to explore the data by fetching specific information instantly.

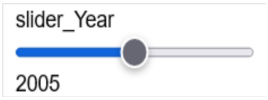

Figure 12: Slider for year variation

The slider allows the user to have an overview of the variations of the different countries over the years. The variation of the slider from right to left and then from left to right several times in a row gives an overview of the evolution of the world and the trajectory that certain countries are taking, especially those that are adopting forestation policies or those that are moving towards deforestation policies.

Figure 13: Drop-down menu for continent selection

This drop-down menu allows the user to select the continent on which to keep the data, in order to have an overview of the selected continent in relation to the world

data. This can be useful, for example, to observe the political orientation of certain groups of countries within a continent, such as South America which has been massively deforesting in recent decades.

3.5 Dashboards

The Dashboards are designed to dynamically display our graphs on a web browser page, in order to have an overview and to be able to quickly modify the inputs of our graphs. We made our main dashboard with Altair, exporting the graphs and visualizations in HTML, for a direct display on a browser. To realize our dashboard with Altair charts, we had to export charts and the data in json. Moreover, we use D3, vega, vega-lite and vega-embed scripts to parse the data and display it on the browser. Below we show some screenshots of our html site (Figure 13, 14 and 15).

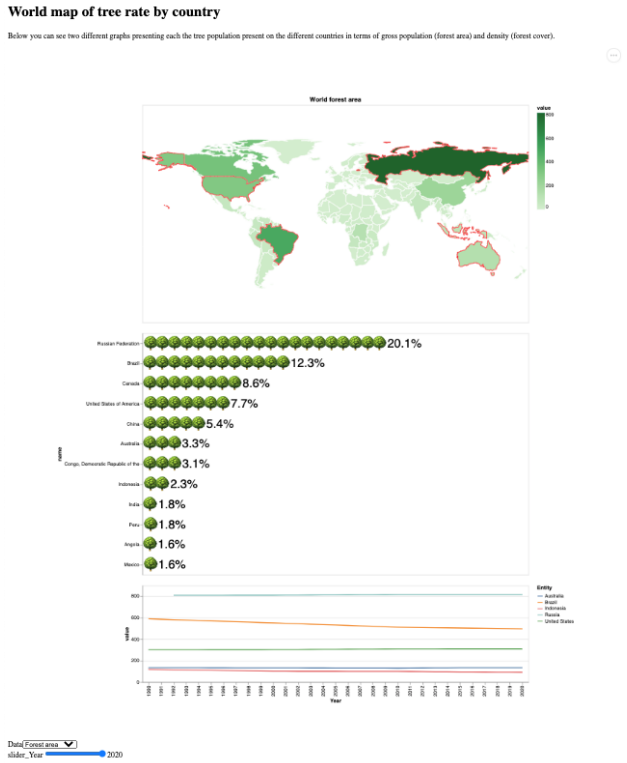

Figure 13: Dashboard showing the World forest Area with 5 countries selected for the plot.

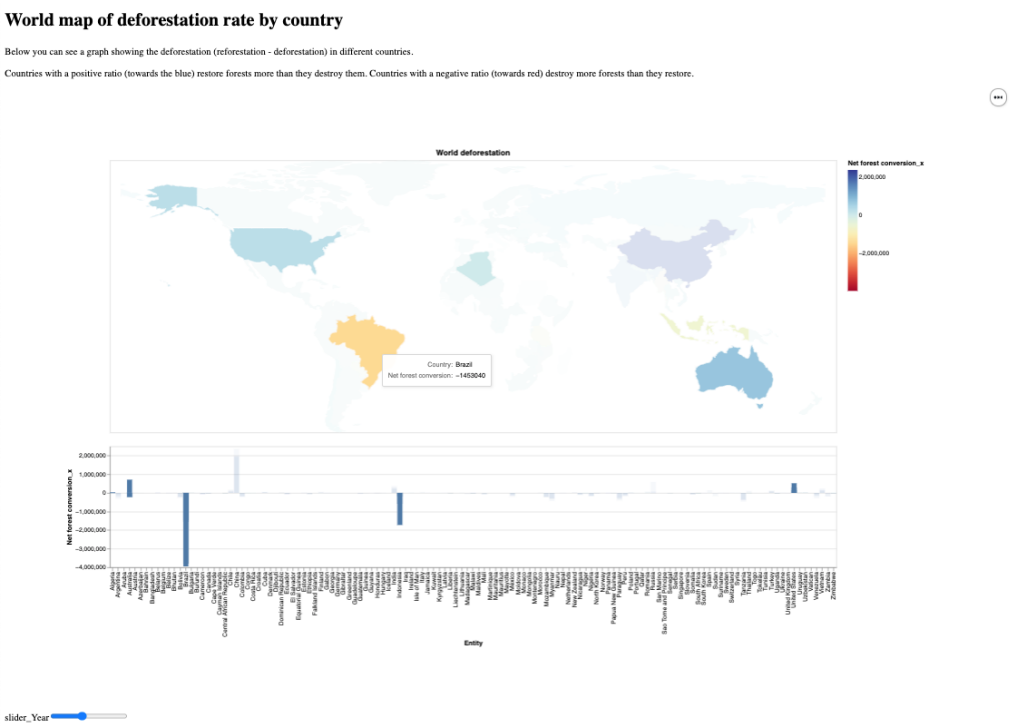

Figure 14: Dashboard showing the World Deforestation rate with 4 countries selected.

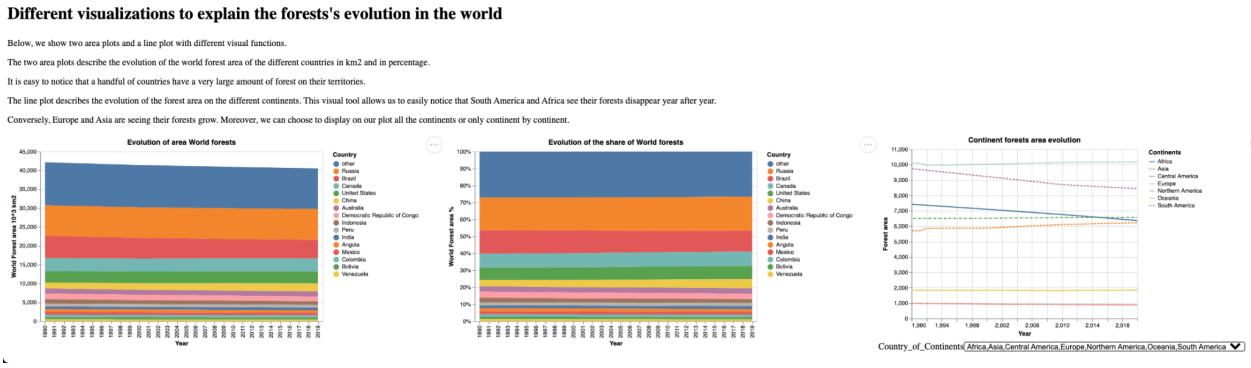

Figure 15: Dashboard showing different visualizations (area and line plots) to explain the evolution of forests in the world.

We decided to make an html page because we think it is a good way to present our different visualization results to non-technical as well as technical people. Moreover, we think it is more professional than a notebook.

Conclusion

As mentioned earlier, the design chosen will complement the general culture of users who already have an appetite for environmental topics and the animal cause. Our visualizations will be useful for these people since they require some digging to extract information. What our visualizations do not do is convert people who are not convinced that environmental and animal issues are major problems. An awakening and an awareness would be necessary before these visualizations in order to maximize their impact for this part of the population. The story will succeed in attracting the interest of the public only if it is already a minimum sensitive to the environmental cause and the stakes that it represents.

We elaborate our designs on Altair which allowed us to deepen our knowledge of this tool. The implementation of a dashboard via a python server to launch our graphics and their interactions from a web interface via a browser was also a way to complete the project in a presentation process to a non-technical person.