Explorative information visualization
Course project

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November 2025

1 What happens when the sea levels rise?

Recently, I have noticed that in my and my friends' conversations, a popular topic has been travel. More specifically, traveling and seeing countries and cities that are in risk of flooding before it is too late. Some of these countries and cities include the Netherlands, Venice, Hawaii, and many more.

I started thinking about the magnitude and consequences of this phenomenon and figured this could be the topic of my visualization, as for me at least, the magnitude and consequences of this phenomenon are still a bit unclear. This visualization could help people better understand the magnitude of climate change and possibly lead to people being more mindful about their choices regarding climate actions.

The sustainable development goal chosen for this project is the 13th that concerns climate change. The approach of this visualization is to show the rising of sea level as the climate warms up. In addition, the visualization shows the number of people affected by coastal flooding.

Link to visualization: https://maijatissarinen.github.io/explorativeinfovis/

2 Approach and Themes

The visualization is an animation that proceeds as time passes, that is, as the climate warms up. The visualization includes a globe, that slowly ends up under water as the sea level rises. It highlights those countries that are affected by this in terms of how many people are affected by the flooding. This theme was chosen because it provides a direct and tangible connection between climate processes and human consequences. By showing the amount of people affected by this phenomenon, viewers are expected broaden their thinking and putting themselves into those position.

Figure 1: Image of the visualization

Other aspects, such as effect on agriculture or economy, could be taken into consideration; however, too much information could make the visualization too complicated. The main goal of this visualization is to remain simple and easy to understand. In addition to keeping the visualization simple, I could not find suitable data for this purpose, thus the focus is on the number of people affected.

The visualization consists of an animated globe that focuses on Europe, combined with a dynamic indicator that shows how sea levels rise over time. In the map each country is colored green and the surrounding water is colored in blue to emphasize the contrast between land and water, similar to regular globe. As the animation progresses, regions that become affected by coastal flooding are highlighted in shades of red. Darker shades indicate more severe impacts, while lighter shades represent milder effects. The color gradient helps viewer to quickly understand which areas are facing challenges as the years advance.

The rise of sea level is visualized as if the globe would drown, similarly to the example showed during the first lecture. The vertical rising of water corresponds to projections of how the sea level rises, if we were continue to use fossil fuel based development pathway. This part of the visualization is crucial as it allows the viewer to connect the flooding to the map and ensures that the relationship between water height and land impact is easily understood without requiring additional explanation.

The first idea was to visualize how the coastlines retreat as sea level rises, however when inspecting the situation from 'outer space' at a global scale, the change does not seem as dramatic as it is meant to. That is why the sea level rise is visualized in a larger scale where the globe slowly ends up under water, as a consequence of flooding. Also, this is new approach, as I could not find similar when doing research for the data. I did find a visualization that focused on the retreat of coastlines, but I find them complicated to use and understand.

For now, the visualization focuses only on Europe due to limited amount of data. This suits well, as Europe does not face extreme consequences of climate change as, for example, Asia, which suffers from several natural disasters. Excluding the extreme heat that southern parts of Europe face, the coastal flooding is a real concern that is caused by climate change. The focus on Europe enables the impacts of this phenomenon become clearer and easier to interpret, and emphasizes that Europe also suffers from climate change.

3 Information usability and Interaction

As the visualization is an animation, the interaction with it is minimal. The intention is that the viewer primarily observes the progression of events over time. This low-threshold interaction approach ensures that the visualization is accessible to a wide audience including walk-by viewers in public spaces who may only engage with it for a few seconds.

As the visualization is planned so that it would be placed in public places with traffic, it is important that the message becomes clear quickly. The animation therefore highlights clear visual cues: the rising of sea level and the amount of affected population. This combination of spatial and quantitative information aims to communicate the message of visualization efficiently and effectively.

A limitation with a viewable visualization that lacks user interaction, is that the user or viewer may forget the information more easily, compared to interactive tools. However, the visual aids and clarity of the animation are intended to counteract this. The visual aspect of the animation must be stirring, so that it delivers a strong, memorable impression in a very short time.

4 Data

First dataset used for this project is provided by the European Comission's Joint Research Centre (JRC) and includes information about the median expected annual population exposed to coastal flooding, based on different emission scenarios. This information indicates how many people in each country, expressed in thousands, are projected to be affected by flooding events. It provides information, where populations are most vulnerable and how the exposure is expected to change over time.

This data was projected for most of the European countries for years 2000, 2050, and 2010. Thus some projection and extrapolation needed to be done. As these nature catastrophes seem to proceed exponentially, the data for the in between years was extrapolated exponentially. This extrapolation was made to enable smooth animation rather than precise predition, which is why the visualizatio should be interpreted as indicative rather than exact.

Second dataset is from the IPCC Sixth Assessment Report, more specifically the chapter on oceans, cryosphere and sea-level change. The report offers scientifically validated projections of global sea-level rise based on different emission scenarios. These projections serve as a foundation for understanding how rapidly sea levels may rise under different global development pathways.

For the animation of the rising sea level, the rising is not intended as a physically scaled representation. The height of the water block increases linearly with the projected global mean sea-level rise under the SSP5-8.5 scenario. The maximum level of water corresponds to the sea level that is expected to reach in 2100. This approach emphasizes the relative progression of sea-level rise instead of the absolute physical depth.

For this visualization, as the goal is to highlight severe but plausible future trajectory, the chosen scenario is RCP 8.5 / SSP5, also known as the fossil fuel-based development pathway. This scenario assumes that economic growth continues to rely heavily on fossil fuels, leading to high greenhouse gas emissions, accelerated global warming and consequently accelerated rising of sea level. Thus it is the basis for worst-case climate change scenarios. By selecting this scenario, the visualization presents a future that illustrates the potential consequences of insufficient climate action and emphasizes the urgency of mitigation efforts.

5 Time

Time is an essential element of this visualization. The animation is a condensed timeline that connects present-day measurements and future projections. By showing the development during decades, the visualization helps user to understand the scale as well as the speed of the phenomenon.

The decision to represent time in decades is due to two restrictions. First, the data for the evolvement of sea level was provided as decades. This combined to the lack of projected data points for the people affected data lead to reasonable choice to limit the data points to these ten. Second, the annual changes in sea level can be rather vague, an annual trends are more legible without exaggeration.

Second aspect of time, related to this visualization, is related to the viewers' experience. That is the time the user spends observing the animation. As the visualization is meant to be low-threshold and easy to approach to and understand, even in a hurry, the time frame is short. In this short time frame, the important message needs to be conveyed. On the other hand, the minimal interaction allows the visualization to reach more people.

In this information visualization, time functions on two levels: as the structure of the animation and as a constraint for effective communication. The intention is that as many viewers as possible leave with a clearer understanding of the urgency of climate change and its tangible consequences.

6 Space

In addition to time, spatial design plays a central role in this visualization. The visualization consists of a globe and focuses on Europe. This choice is made based on the audience. This visualization is expected to be shown to Europeans, but could also be extended to other people by retrieving the data and changing the angle of the globe. In theory, if there were data for all countries, the user could turn the globe around and see the consequences around the whole globe.

The spatial scale of the visualization is rather continental, as the countries are highlighted based on the people affected, rather than illustrating the retreat of coastal lines. This way viewers can easily recognize, for example their own country or any country of interest. It adds an extra layer of interest, as the viewer can focus on the consequences on a global level or on a country level.

The placement of the globe in the 'water' has to be also considered when discussing space. The drowning globe is expected to attract the users curiosity, as it is a rather unexpected placement.