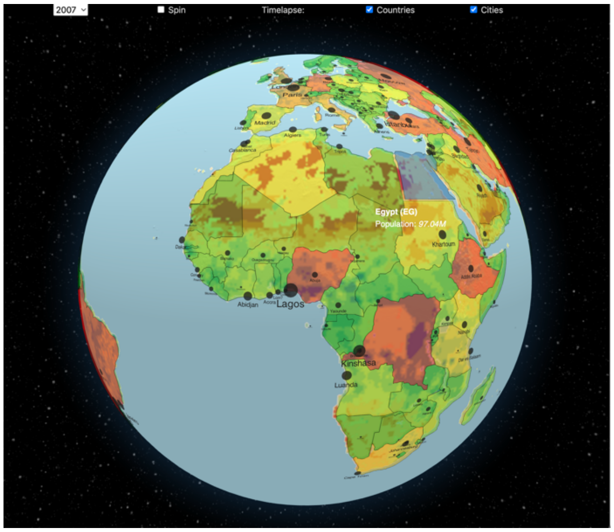
Introduction: Addressing the Sustainable Development Goals (SDGs).



- All three SDGs of this competition have one core component in their foundation: WATER. Without access to water, we can't fight hunger, since water access is required for the crops irrigation, livestock, and even for the modern indoor food and artificial meat farms to grow their produce.
- We, obviously, need water to provide access to clean water and sanitation.
- This visualization also shows how the dramatic changes in the climate during the last decades affected the Terrestrial Water Storage

For this reason, I decided to focus this visualization on availability to the main supply of water: terrestrial water and how this availability overlays with the most populated areas on earth, both in terms of the largest cities and most populated counties.

With the help of this visualization, it would be possible to get a good idea about

- How much water is available near most populated cities of the world (using different technological approaches for extraction such as condensation, artesian well drilling etc)?
- What large cities in the world are in potential danger of running out of water (take a look at Riyadh, Saudi Arabia or Los Angeles, USA)?
- Do most populated countries of the world have adequate access to the terrestrial water supply?
- What are the global trends to the terrestrial water availability?
- Are there any unusual trends in the terrestrial water storage levels (I'm definitely seeing some cyclicity in this visualization)

Technology: How This Visualization Was Created

For this visualization I decided to use Globe.gl, a 3D visualization library that allows mapping data on the globe. The main reason for this decision (vs the map, for example) is that it provides a lot more accurate representation of the countries and continents sizes than the existing 2D maps projections. One example would be a massive misrepresentation of the size of Africa on most maps published in the United States and Europe. Misrepresenting the size of Greenland, a key ground water resource would be another example.

The data on this visualization is GLDAS_CLSM025_DA1_D: GLDAS Catchment Land Surface Model L4 daily 0.25 x 0.25 degree GRACE-DA1 V2.2 from GES DISC. I chose this dataset because it accurately represents a large range of dates from 2003 to 2023 covering the entire world and illustrating a very important parameter of global water supply: Terrestrial Water Storage. This is a perfect dataset for illustrating the changes in the terrestrial water in the last two decades, known for accelerated climate change.

The data was rendered using NASA Earth Data Giovanni visualization tool into a set of images. I had to adjust the parameters to make the images fit my vision of this visualization:

- Remove all titles, subtitles, legend, and other non-informational parts of the image.
- Adjust the scale to 100-5000, which seemed to be a good fit for the data from the last 20 years.
- Change scaling to logarithmic, to make it more visually appealing (the linear scaling painted everything into red-yellow shades)
- Generate the images for the same date: February 1st, for consistency.

Even though the resulting images are in the same equidistant cylindrical projection used by Three.js, they appeared to be not compatible with the Globe.gl. After diving deeper into this problem, I came up with an algorithm that converts Giovanni output into something that could be used by Three.js:

- Crop the image width to 1024 pixels, cutting 13 pixels from the left and the entire right side. It seems like there is a bug in Giovanni image render which renders the legend even when the Decorations group is turned off.
- Stretch the image to 2048x854
- Pad at the bottom of the image with 1024-854=170 pixels to make the overall image fir the 2048x1024 size required by Three.js
- Replace white with appropriate color (I chose light-blue, to show the oceans as a source of water, matching the palette in Giovanny images)

All these operations would take too much time to perform manually on the images, so I used ImageMagick command-line tool and a bash wrapper script available in the project's GitHub repository.

Finally, I added a menu at the top of the data visualizations to allow the user to adjust different layers of the visualization.

All code necessary to reproduce this visualization is available at https://github.com/rtfms/pale-blue-dot-nasa-challenge under MIT license.

The visualization itself is also available at https://andrey.mikhalchuk.com/pale-blue-dot-nasa-challenge, if you want to try it in action.

Motivation

I work in Data processing and visualization, it's not just my business, but also a hobby and a passion (I'm very lucky that all three converged in dataviz). For business I develop and use a lot more flexible and powerful tools, but for this challenge I had to stick exclusively to open data and opensource software, so I wrote this code from scratch.

Being a big fan of NASA work I just couldn't resist participating in one of NASA challenges, and, after reviewing the rules for all challenges I decided to work on this one since its closest to what I like to do: dataviz.

As for the data selection, I'm very concerned about what's happening with the palnet and all the anthropogenic changes humans caused to nature. Making raw numbers more visual, dynamic, and interactive will help us to understand the full impact of mankind actions, and, hopefully, convince sceptics that we need to do something about our reckless treatment on natural resources.

Finally, I decided to focus on water for reasons listed above (because water is the common core of all 3 SDGs of this competition). After all, humans can only survive for 3 days without water, so having access to is if crucial for the survival of the mankind.

Learning the broader context

I can't say that I ever lived in an area with a limited access to water. But I vividly remember a lot of documentaries and movies showing the struggle of getting this precious resource in places that have limited supply of ground water: Saudi Arabia, Most of Australia, large parts of China and Mongolia, and, above all, Northern Africa. All these movies made me think "what if...". What if we will continue misusing water like we currently do and there will be none left for all the people on Earth. Postapocaliptic Sci-Fi movies draw a grim picture of this world. For this reason, we need to start monitoring access to this precious resource and spread the information about the state of things among all people. We can't continue the current path of destruction of our precious water supplies.

Ethics and Equity

This visualization makes it obvious that the most prosperous countries of the world have the best access to the terrestrial water. In the US, Europe, most populated parts of Australia and other rich regions we do have access to water. But a lot of people in Africa don't have this access and don't have alternative means for fulfilling the basic need of water access.

This obviously raises the question of what we can do about this. I don't have the answer. At the moment, nobody does. But a few things we must try are

- Keep monitoring all parameters of the water supply. This includes

    - Monitoring the freshwater pollution
    - Monitoring precipitation in different regions
    - Evaluating the changes of patterns caused by the climate change
    - Predict (to a degree possible) upcoming problems with the water supply
    - Use this information to correlate with the population density to minimize the impact of water shortage starting with the most populated areas (but not limiting to these)
- Explore new technologies expanding access to water:
    - Desalination
    - Better water treatment
- Establish international programs ensuring access to water and technologies for producing fresh and drinkable water to all people. Access to water is not a privilege, it’s a right.

Links

The project visualization is available here: https://andrey.mikhalchuk.com/pale-blue-dot-nasa-challenge.

Here are some additional screenshots for the reference: