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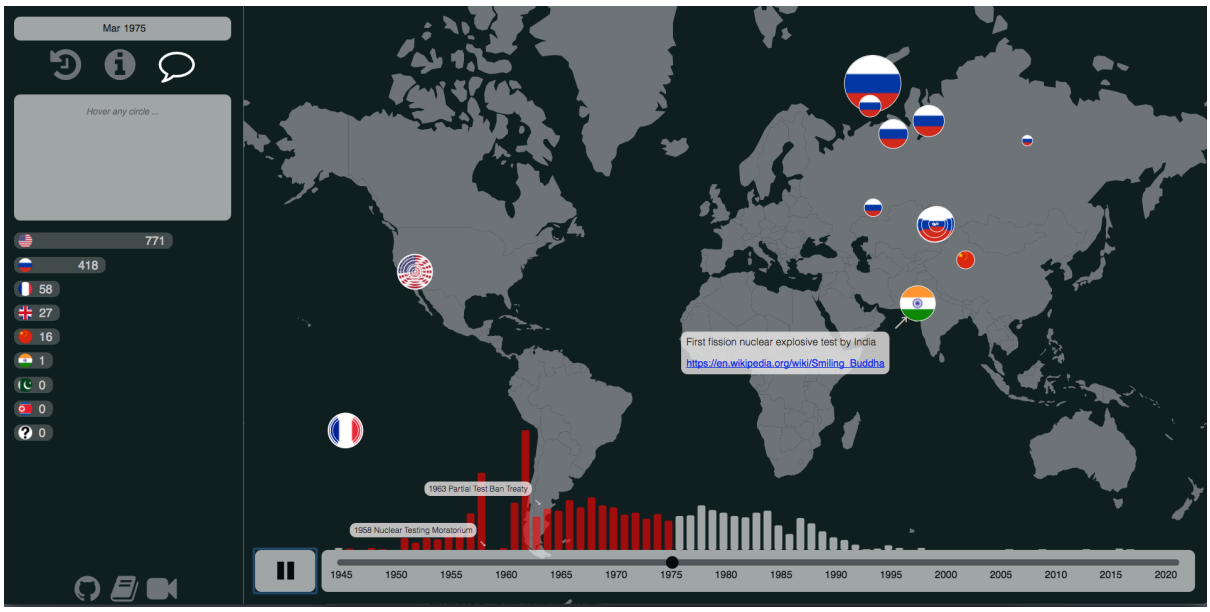
Nuclear Testing Visualisation

Process book



Overview

On the 16th of July 1945, the first ever nuclear device was detonated at the Trinity test site in the United States. Since then, at least 2121 nuclear tests have been conducted in the world, totalling a yield of 540,849 kilotons, or in other words, more than 30,000 times the yield of the Hiroshima bombing[1]. How many kilotons of explosions are being detonated each year? And by who? The aim of this visualisation is to show the repartition and rate of nuclear testing around the world using an interactive map, enriched with contextual informations, such as the name of the test (when available), the explosion yield, the type of explosion, and even a link to a relevant wikipedia page when possible. The visualisation also displays general statistics pertaining to nuclear weapons, such as per-country and global stockpiles of nuclear warheads.

[1] *List of nuclear weapons tests.* Retrieved from https://en.wikipedia.org/wiki/List_of_nuclear_weapons_tests on 26/11/2017

Related work

The idea for this work originally came from a video[2] created by the artist Isao Hashimoto. This video displays nuclear tests on a map of the world, using sonification on explosions to convey the density of tests. While the general idea is quite similar to our visualisation, we wanted to make something more interactive and informative than this.

Dataset

The main dataset comes from the nuclear explosion database from the Geoscience Agency of Australia. Surprisingly, the website has disappeared a few days after we scraped it. We reached out to the webmaster for more informations. The website consisted of a search form with fields to select a date range and to select one of the nine countries which have nuclear weapons. Once submitted, the form would return a list of nuclear tests, which the scraper would parse and save into a JSON file. To retrieve the data, we ran the scraper and the biggest date range possible (from 1945 to 2017, although data stops earlier than 2017) and we ran it once for each country.

This yielded 2065 data points with fields such as the time and date of the test, the magnitude of the explosion, the name of the site and its coordinates. Some of the tests did have a site but no coordinates were given. For those data points, the coordinates were either manually sourced, or extrapolated using the coordinates from other points in the dataset that happened at a site with the same name. One point had to be discarded because it had neither a site nor coordinates, nor any info that could have helped to identify it. Once cleaned, the data was then exported to a TSV file.

This data was augmented by additional data scraped from a table[3] on Wikipedia. This table contains informations on the most important nuclear tests, including for each test a short description of the test and a link to the Wikipedia page for this test.

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[2] *1945-1998* by Isao Hashimoto. Retrieved from http://www.ctbto.org/specials/1945-1998-by-isao-hashimoto/ on 26/11/2017

[3] Table *Milestone nuclear explosions.* Retrieved from https://en.wikipedia.org/wiki/Nuclear_weapons_testing#Milestone_nuclear_explosions on 20/12/2017

Questions and design decisions

Which countries conduct those tests? Where do they happen? How powerful are the warheads that are being tested? The questions which we try to answer in this visualisation are quite simple. However, representing their answer so that anybody can easily understand them is not so straightforward.

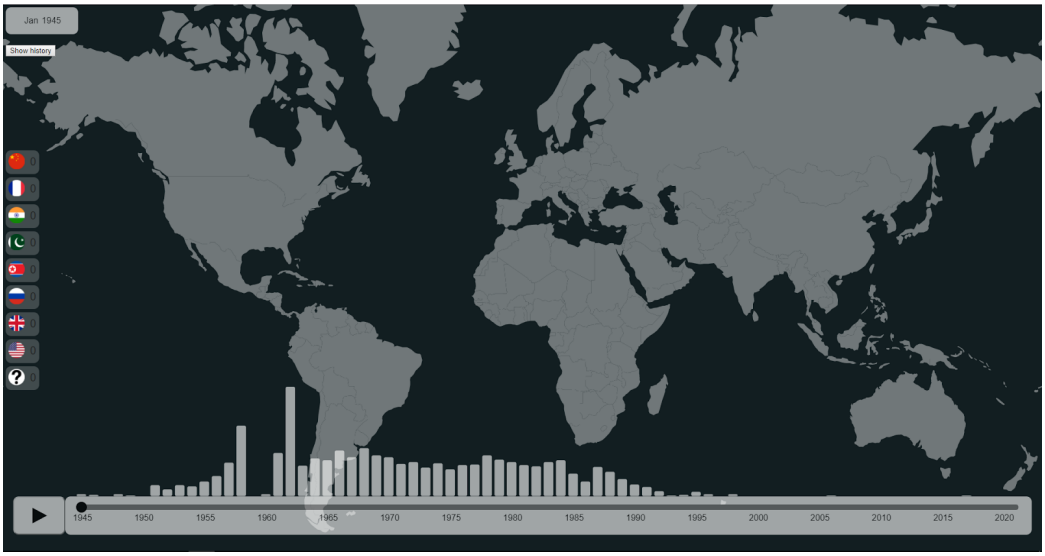
Initial sketch of the visualisation

Indeed, a quantity such as “5.9 seismic body-wave magnitude” is a somewhat abstract quantity to someone who is not a nuclear expert. To solve this problem, our solution is to display the magnitude of explosions in terms of the surface of each displayed points.

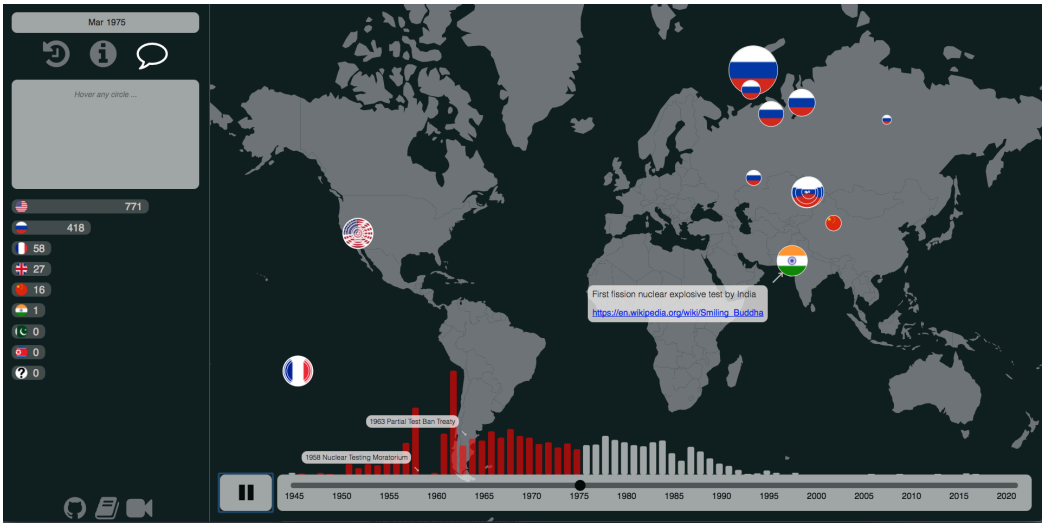
To answer the second question, it goes without saying that an interactive map is the only solution. But how to best convey the source countries of those nuclear tests? To identify the country, its flag is displayed on the explosion, and to compare countries against each other, we originally displayed counters but ended up with a bar chart to better convey the scale.

Last but not least, one of the most important dimension of the data is time. How has nuclear testing evolved over the past 70 years? Did nuclear treaties help to reduce nuclear testing? To answer those questions, we show a histogram at the bottom, which displays the amount of nuclear tests done in a year, and historical nuclear treaties. The histogram representing the amount of tests per year is laid out naturally on the slider, as their x-axis is the same.

Prototype version of the visualisation



Version without the left panel



Final version

Implementation

The map

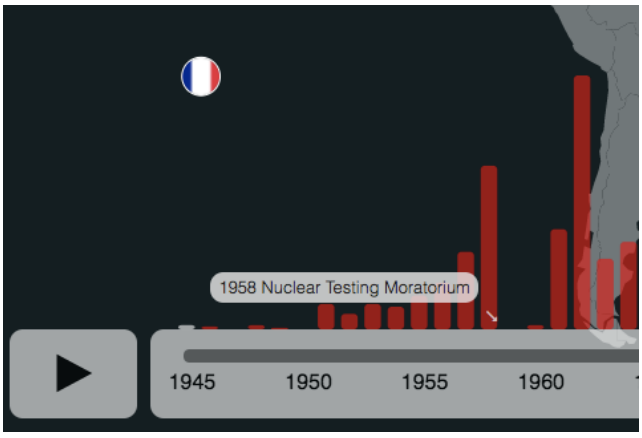
The first part of the visualisation is an animation which displays each nuclear tests on a map of the world, in chronological order. The explosions are colored according to the country which conducted the test. The animation can be started and paused with a dedicated play/pause button.

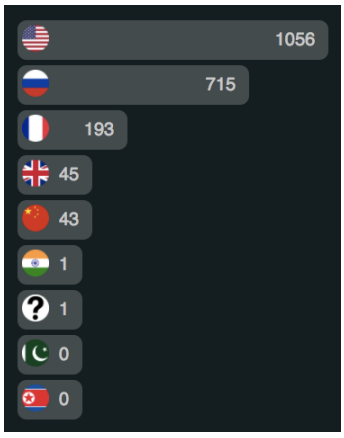
When hovering over an explosion, additional data about the test is shown on the left panel. We manually augmented the data for some historically important data points, adding Wikipedia links and one or two sentence describing the test. For those augmented data points, this contextual info is displayed in a bubble next to the explosion.

Slider and charts

At the bottom of the map, an histogram shows how many nuclear tests were conducted each year. The histogram also acts as a slider to go forwards and backwards in time in the main animation. Milestone nuclear treaties are also displayed on the histogram.

On the left panel of the visualization, a scoreboard/bar chart keeps track of how many tests have been carried out by each countries





Evaluation

What have we learned?

First, we can see that nuclear treaties do have an impact on slowing or stopping nuclear testing. The effect of the moratory of 1958[4] is especially visible, as is the effect of the Comprehensive Nuclear-Test-Ban Treaty[5]. Those treaties have been highlighted on the timeline histogram. The histogram makes it clear that since the latest treaty, almost no testing has been carried out, except by North Korea.

We can also see that in term of density and magnitude, the bombings of Nagasaki and Hiroshima, which are probably the only nuclear explosions that almost everybody has heard of, do not account for much compared the warheads 100 to 1000 times more powerful that have been routinely tested in the 30-40 years that followed.

Regarding the distribution by country, we can see that unsurprisingly it is the USA and the USSR/Russia who have done the vast majority of nuclear testing.

Further work

While we managed to convey most of the information we wanted to, due to the time limitations there are still some aspects in our visualisation which could be enhanced. For example, the box in the left panel which displays additional information is just empty space when not the cursor is not hovering over an explosion. A clever way to remove this space would be to merge this information with the contextual information for historical nuclear tests, and display it in the same way, as a bubble shown next to an explosion when hovering over it, and displayed by default for important points.

Another shortcoming of our visualisation is the bottom histogram, which does not give information about actual numbers. It does show the relative amount of tests per year compared to other years, but no axis or values are displayed. One way to fix this non-intrusively would be to display the number corresponding with a bar when hovering over it.

To make the actual explosions a bit more impressive than round flags, it could have been great to enrich the data with videos from recently declassified nuclear testing footage[6].

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[4] *The Partial Nuclear Test Ban Treaty*. Retrieved from https://en.wikipedia.org/wiki/Partial_Nuclear_Test_Ban_Treaty on 26/11/2017

[5] *The Comprehensive Nuclear Test Ban Treaty.* Retrieved from https://en.wikipedia.org/wiki/Comprehensive_Nuclear-Test-Ban_Treaty on 26/11/2017

[6] *62 Rare Nuclear Test Films Have Been Declassified and Uploaded to YouTube.* Retrieved from https://paleofuture.gizmodo.com/62-rare-nuclear-test-films-have-been-declassified-and-u-1821302584 on 22/12/2017

Peer Review

Alain Milliet

Preparation - were they prepared during team meetings? **Yes.**
Contribution - did they contribute productively to the team discussion and work? **Yes.**
Respect for others' ideas - did they encourage others to contribute their ideas? **Yes.**
Flexibility - were they flexible when disagreements occurred? **Yes.**

Semion Sidorenko

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