

# WorldVis: A Visualization Tool for World Data

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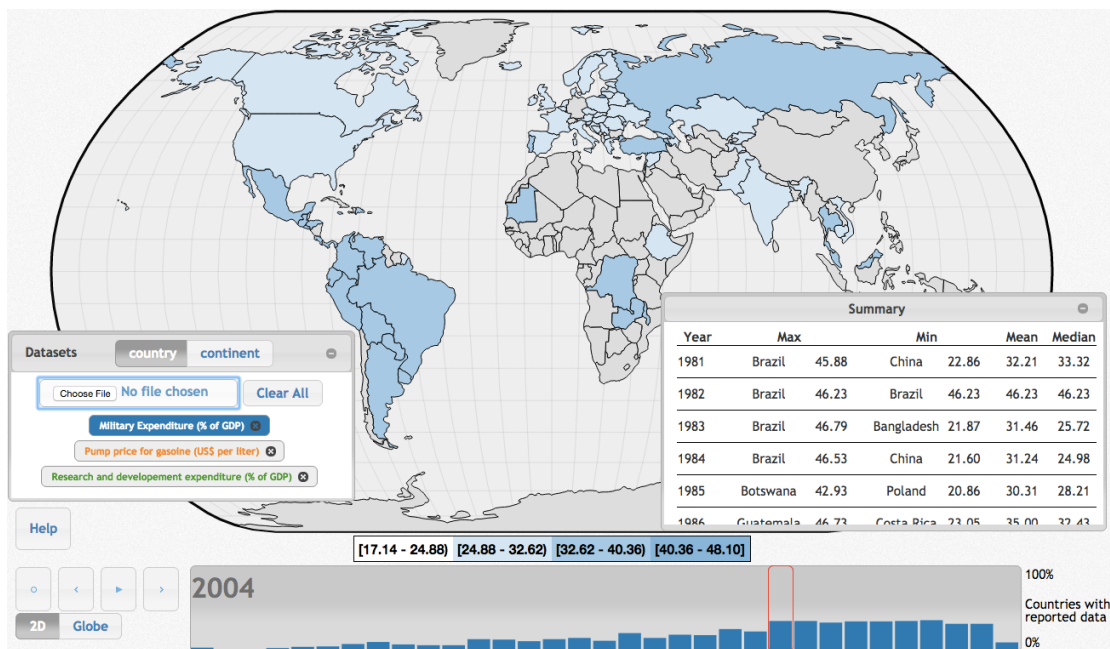


Figure 1: WorldVis Overview with choropleth map, summary table, and slider histogram

## Abstract

In this paper, we present our tool, WorldVis, a generalized tool for visualizing datasets of quantitative attributes per country over time via a choropleth map. The datasets for an individual country is visualized using small-multiples line graphs. We extend the functionality of the choropleth map to encode the attributes based on continent average. We restricted the number of saturation bins for the choropleth map to make the visualization more salient. A histogram was added to show how many countries had data for a particular year. Summary data is computed for each dataset for each year, so at a glance, the user can see statistical information including the country with the minimum and maximum value. Our focus is on providing a generalized visualization tool that is suitable for common task abstractions.

## 1 Introduction

Many researchers and organizations have developed a wide variety of interactive visualization tools, but many of them

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are too specialized. For this project<sup>1</sup>, we were motivated by a desire to have a more general visualization tool that is effective, easily expandable, and can handle any type of quantitative world data over time. WorldVis is an extension of the FluNet Visualization<sup>2</sup> developed in 2014 as an interactive visualization for data from The Global Influenza Surveillance and Response System. The areas of task abstraction that we are going to focus on are query actions, all data targets, attributes targets, analyze actions, and some search actions. The idea is to add many different options for functionality even if some options are ineffective or not applicable for a particular dataset. This is because we are not focusing on a particular task abstraction or domain, but providing a toolkit for common task abstractions for world data.

## 2 Related Work

A similar type of work can be found in the Gapminder tool [1], which uses bubble charts for visualizing the data. Multiple filters have been used in this tool to visualize information in an efficient way. An example of a tool that uses dynamic data for world visualizations is the Real-Time Web Monitor by Akamai [2], which monitors internet traffic using real-time data and visualizes it on the globe.

<sup>1</sup>Live version at <http://www.cs.odu.edu/~jpardue/WorldVis>

<sup>2</sup>Information at <http://ws-dl.blogspot.com/2014/10/2014-10-07-flunet-visualization.html>

### 3 System

Our WorldVis system allows for any quantitative world country data to be visualized. The components of our system, shown in Fig. 1, are the choropleth map, the slider histogram, the summary table, and the controls and datasets. The other component of our system is the small-multiples line graph view. Users can upload multiple datasets and remove datasets. The initial datasets we use, Pump price for gasoline (US\$ per liter), Military expenditure (%of GDP), and Research and Development expenditure (%of GDP), were obtained from the World Bank’s indicators [3].

When the user loads the tool, they are presented with a preloaded dataset. We restricted the number of uploaded datasets to be no more than ten because it will be difficult for the user to examine correlations and trends between this many line graphs in the small-multiples view, assuming that the user has enough screen real estate to visualize all line graphs at once. Controls are provided to navigate and animate the choropleth map and histogram slider.

There is a help dialog that gives the user information on how to use the system. We have also provided a few properly formatted, reference datasets so that the user can load these and see how the tool works. This also serves as an example of the expected format for our tool so that the user can format their own data to the expected JSON formatted tuples of country, year, and attribute value. We used the D3.js library<sup>3</sup> for the small-multiples line graphs, the slider histogram, and the categorical colors for the datasets. We used the jQuery library<sup>4</sup> for the user-interface.

### 4 Visual Encoding & Interaction Idiom

The selected dataset is encoded using sequential saturation on a global map, see Fig. 1. The encoding is limited to four saturation bins where the lowest bin is near white and the highest bin is the true color associated with the dataset. Countries that are greyed out do not have any data for the particular year. Continents that are greyed out have no data for the particular year for any of the countries that belong to the continent. The choropleth map is animated to show how the values change over the years. The user can switch between encoding the choropleth map based on country value or continent average.

When the user clicks on a country, all datasets are encoded using small-multiples of line graphs for the country, see Fig. 2. For consistency, we chose to have the color of each line correspond to the color of the respective dataset’s button. The user can also toggle whether to show the continent average and world average on the small-multiples view. The user may not want to see the continent or world average if it greatly increases the range of the values on the y-axis. This would cause features in the country’s line to be less prevalent. When the user hides the continent’s average, the y-axis resizes to only show the range of values for the country. The small-multiples view is responsive to the number of loaded datasets. When a user has one dataset loaded, the entire small-multiples view will be devoted to the single dataset’s line graph; however, when the user uploads multiple datasets, this view space will have to be shared by multiple line graphs, causing each line graph to have a fraction of the total screen real estate. This allows the user to view all of the datasets at the same time to identify correlations and trends.

<sup>3</sup><https://d3js.org/>

<sup>4</sup><https://jquery.com/>

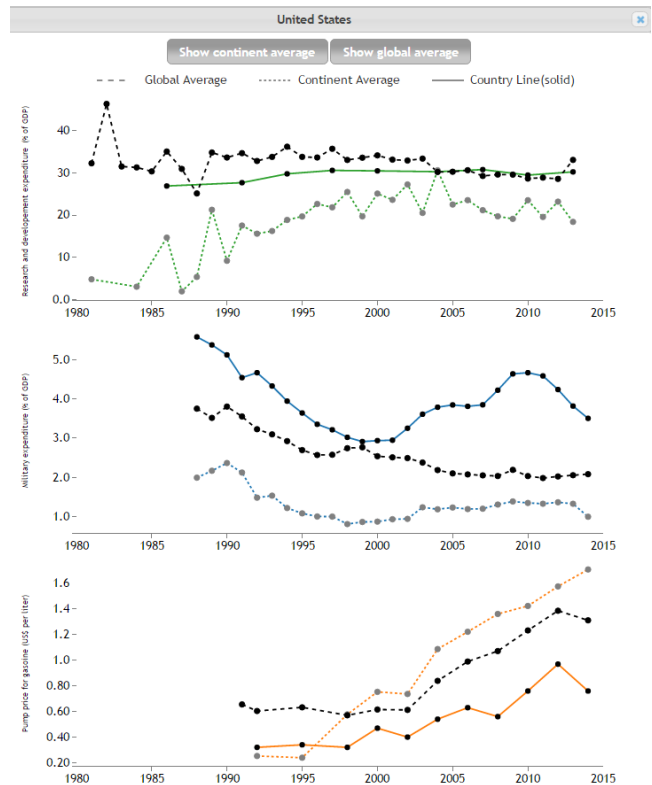


Figure 2: Small-multiples of line graphs

The slider histogram is a scented widget that shows how many countries have data for a given year. The user can also click a bar of the histogram to load the corresponding year on the choropleth map. The controls allow the user to play or pause the choropleth map animation or navigate to a certain year. The summary box and dataset box can be resized and minimized if it becomes distracting to the user.

### 5 Conclusions

We have created a tool that can handle any type of quantitative world data. Only one dataset can be visualized on the choropleth map at a time while the small-multiples of line graphs shows all of the datasets for a given country. The slider histogram shows the user how complete their dataset is. We also included aggregate functionality to visualize the choropleth map for continental averages instead of per country. These continental averages, along with the world average, can also be toggled in the small-multiples view. Our WorldVis tool allows users to visualize their own datasets and provides a toolkit for common tasks that users may want to perform on their datasets. We hope that our tool will be useful to others and will serve as the basis for many new interactive and flexible tools.

### References

- [1] O. Rosling, A. R. Ronnlund, and H. Rosling, “Gapminder: A fact-based worldview,” <https://www.gapminder.org>, 2005.
- [2] A. Technologies, “Real-time web monitor,” <https://www.akamai.com/us/en/solutions/intelligent-platform/visualizing-akamai/real-time-web-monitor.jsp>.
- [3] The World Bank Group, “Indicators - data,” <http://data.worldbank.org/indicator>, 2016.