Project: Visualization of California Water

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Git Repository: https://z109620@bitbucket.org/z109620/project.git

Visualization:

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1 Introduction

California has been experiencing a drought since the onset of 2012. Over this time LIST BAD SHIT THAT HAPPENED. In an effort to convey the magnitude of this persistent drought the United States Geological Survey (USGS) generated an interesting visualization[1]. While this visualization helps to illuminate the magnitude of the California drought, it focuses almost exclusively on surface water reservoir levels. Surface water reservoir levels only tell part of the story of the California drought. Clearly, an thorough understanding of California water consumption, stream flows, the depth of ground water wells are all important. The current project, therefore, will generate visualizations[2] which will depict each of these aforementioned water metrics and is therefore meant to compliment the existing USGS visualization.

All visualizations within the project are generated with the R package shiny. For a proficient R user utilizing the shiny package is relatively straightforward. At a minimum a shiny application consists of a user-interface (ui.R) script for the front-end and a server script (server.R) for the back-end. Each of these scripts are written in R. Consequently, the shiny packages provides some of the elegance of JavaScript without needing to know HTML, CSS or even JavaScript itself!

[1] The USGS visualization: http://cida.usgs.gov/ca_drought/
[2] Our visualization: INSERT THE ADDRESS TO OUR VISUALIZATION

Three distinct visualization are generated within the project. The first depicts California water consumption by county and sector. The next depicts discharge rates of streams and rivers. Finally, the last visualization depicts the ground water depth of wells. In what follows, we will discuss each of these visualization separately within sections 2, 3 and 4.

2 Water Consumption

As water becomes scare, it is essential to understand both the industries as well as the areas within California that consume the most water. These sectors and areas are those most likely to bare the brunt of the hardship that is the California drought.

The USGS visualization does provides a pie chart of water consumption by industry. However, in the current project we expand this by depicting the water consumption by county by year for 2000, 2005 and 2010[3]. Unfortunately, the 2015 data is not currently available. Additionally upon a click of a county, a graph appears which displays the water consumption by sector for that county.

Since the data set for water consumption is small, we store all the data remotely on our Git Hub page. Intentionally we wanted to host our shiny application on shinyapps.io, however, the only way to host data on this website is to pay $30 a month, which is a lot of money for a group of graduate students.

The code to generate this visualization is contained the in R scripts plot.R and functions.R. The color.map function within functions.R generates the plot of California. This is essentially a wrapper of the map function from R's maps package. Upon clicking on a county, a graph of the consumption by sector for that county is generated with the ggplot wrapper gg.wrapper. Notice that when a users clicks the map, longitude and latitude coordinates are passed to server.R, however we don't want to pass longitude and latitude coordinates to the gg.wrapper, we want to pass a county name. Consequently, we must convert these longitude and latitude coordinates to a county. This is done with the latlong2county function within functions.R[4].

3 Stream flow

In the current context stream flow is measured by the discharge rate. The discharge rate is the volume of water moving down a stream or river per unit of time, in our context the discharge rate is measured in cubic

[3]Data source: http://water.usgs.gov/watuse/data/

[4]The latlong2county function draws heavily from the following StackOverflow thread: http://stackoverflow.com/questions/13316185

feet per second.

The USGS visualization implicitly depicts stream flows insofar as the different drought categories within their visualization - No Drought, Abnormally Dri, Moderate Drought, Severe Drough, Extreme Drought and Exceptional Drought - are defined by varying stream flows. However, it is not possible to obtain, from their visualization, the actual stream flow from participial streams. Consequently, our visualization depicts the discharge rate read from each surface gauge monitored by the USGS

In this context we have utilized the leafet function in the R package of the same name to draw our map of California, see the R script server.R. Like D3, leafet is a JavaScript library. The leafet package, which is similar to shiny in this regard, introduces some of the functionally of JavaScript without the need to know how to write JavaScript code. The main reason for invoking leafet here is that this function makes it straightforward to create a map which the user can zoom in and out on. Given the numerous observation, to insure clarity, it was necessary that user have the ability to zoom. Another interesting feature of this visualization is that unlike the visualization of water consumption, the data on discharge rates are not stored remotely on Git Hub. This data is expansive and consequently we opted to load data upon a click. This is made possible by the R package dataRetrieval. This packages allows users to query the expansive hydrological data provided by USGS. Consequently, when a user clicks a site, the corresponding site number is passed to dataRetrieval. The data is in turn passed to plot wrapper functions in USGSplot.R.

4 Ground Water

Ground water wells are not currently depicted within the USGS visualization. Despite this fact, ground water is essential to California's water supply as it comprises 30% of the California water supply. Consequently, we provided a visualization of water well depth for all wells currently monitored by the USGS.

The approach used to generate the ground water visualization is very similar to the stream flow visualization. As above both, the leafet and dataRetrieval packages are utilized. However, one additional feature of this visualization is that for each successive on a well sites the well depth accumulate on the plot. This is helpful for comparisons across wells. The action bottom below the plot, clears all but the last plot.

5 Conclusion

This project compliments the USGS visualization. It does so by visualizing water consumption, stream flows and ground water elevation. In this project we opt to use the R shiny package. Clearly, this assignment

could have been done using JavaScript, however, shiny is capable to generate some very nice looking graphics and only requires a knowledge of R. That withstanding, a fun summer project would be do redo some of this project in JavaScript to understand the differences between these two approaches.

Appendix

ui.R

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server.R

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functions.R

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plot.R

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USGSplot.R

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readUSGSData.R

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