California Wildfires

This last summer, Californians experienced some of the worst wildfires on record. Not only were the fires more frequent, they were also more intense, burning more acreage, destroying more buildings, and taking more life. There are many visualizations to show how over time fires have gotten larger and more destructive, however many of these visualizations leave out a key component. Where are these fires happening?

Being able to see where these fires are occurring in conjunction with their size, as well as where fires are happening over time can be useful for a few different reasons. First, CalFire can use a visualization like this to easily see which counties/areas are hit the hardest and allocate resources to those areas before fire season begins. Additionally, someone hesitant about moving to the California area will be able to see if the area that they are moving to is historically high risk for wildfire damage. Lastly, someone unfamiliar with California and the history of wildfires who perhaps has only heard about the recent wildfires in the news, could use this application to do some easy data exploration to better understand where and when these fires are occurring.

Dataset

Primary Dataset

The primary dataset used to create this visualization was a dataset with the historical list of wildfires in the state of California and some of the immediate surrounding areas. CalFire provides this historical record of wildfires, including information about when they occurred, how many acres were burned, the latitude and longitude values, and which counties each fire affected. The fires are recorded from 2013 to present.

The website provides some map/querying capabilities but it's very hard to use. For example, to see different years of data plotted on the map, the user has to reload a completely new web page. Consequently, the user can't see all years on the same map. Additionally, a user can query the data based on keywords but only a list/table of data output is available. There is no interaction between the querying and each map.

This poor experience was one of the driving reasons for creating the visualization that I did for this assignment.

Secondary Datasets

There were also some secondary datasets used to create the map. The data to draw California and the surrounding states was taken from the Github repository here. I just loaded the state data for California, Nevada, Oregon, Utah, and Idaho. This was done so that the states could

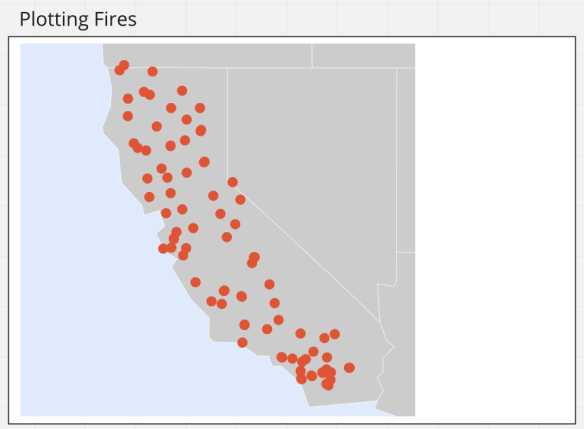
have nice details, but to not overwhelm with extremely large amounts of geographic data for states that weren't visible.

The data for the county lines was taken from Open Data Soft here. Additionally, the major city data was collected from Maps of the World here. However, for this source I did not download the data directly, and instead just created my own JSON of the cities that I wanted to display on the map so as to not overwhelm the user of my visualization with too many city points and to keep the focus on the wildfire data.

Visual Application Storyboards

The primary interaction technique I am going to implement is dynamic queries. In this section I will discuss the specific features of the application. While I include each storyboard here for reference, a link to a Miro with all storyboards is provided here.

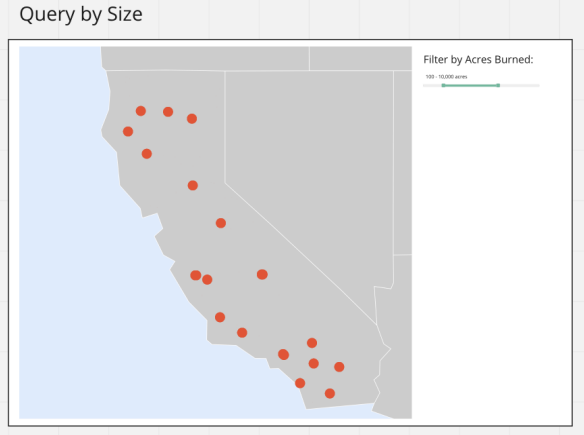
Plotting Fires



First, I am going to describe the base layout for my interactive visualization. The visualization will consist of two main parts, the map and the interaction pane. The map will start with showing all fires plotted as small circles at the latitude and longitude points that are given in the dataset. There is bound to be some overlap between the circles, so they will be semi-transparent (not shown in the picture).

The map loads into this state initially to give users a chance to see all of the fires in one view. It could be overwhelming at first, and impossible to do any analysis from this view, but that is why we add the interaction pane to allow for dynamic querying shown in the next few sections.

Query by Size

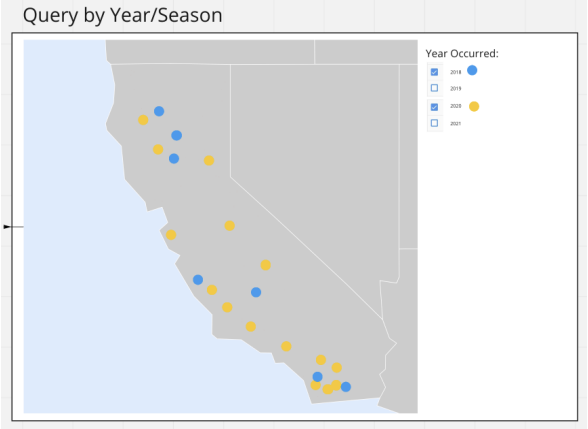


The first query type to support is querying by the fire size. Specifically for this dataset, this is represented by the total acres burned. For this, we will make a range slider so the user can filter down the range on either end of the spectrum.

This feature is motivated by the first two usage examples given in the introduction. The CalFire organization could use this feature to filter out the small fires and see if there are any patterns

in where the largest complex fires are occurring. Additionally, since the largest fires are the ones that make the most news and media attention, someone moving to California could use this feature to actually filter out the largest fires and see where the small/medium fires are occurring that didn't necessarily make the news.

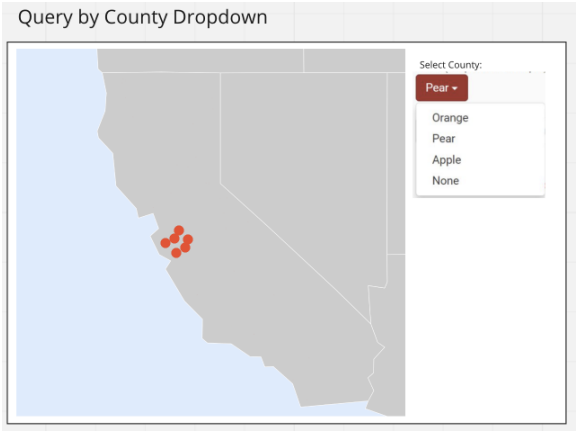
Query by Year/Season



The next query type to support is querying by the year/season that the fire occurred. While the dataset provides exact dates for when the fires started and were contained, I thought it would be more helpful to have this filter be just by the year since each year represents a new fire season. The year selection is done with checkboxes instead of a slider so that a user could compare a few different years on the same map, even if those years are not sequential.

There are 9 different years represented in the dataset, so having all of the fires colored by their years all the time would lead to a lot of noise in the map if the user did not care about the year comparison. However, I want to support easy comparison across the years if the user wants to see that comparison. To solve this, I plan to only show different colors for the different years if the number of years selected is below a certain threshold (i.e. 5 years selected) and otherwise the fires will all be shown in one color as an aggregate.

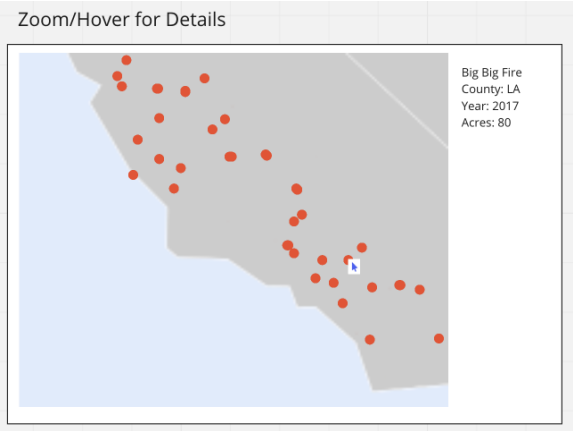
Query by County Drop Down



The next query type to support is querying by the county that the fire occurred. This feature is motivated by the example of the user wanting to move to California, so they can easily select the county that they are interested in moving to and the fires that affected that county are highlighted on the map.

The storyboard on the right shows a rough drawing of what the map would look like if the user selected Santa Clara County in the county selection dropdown. While in this image the dropdown contains fruits, for the actual implementation the dropdown would contain all counties in California plus an option for "All".

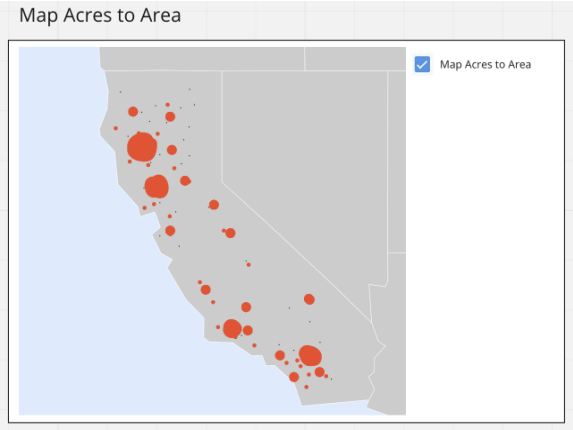
Zoom and Hover for Details



The next few features are not specific to dynamic queries, but are available to aid with overall ease of analysis. The first is just basic panning and zooming with the map portion of the visualization. This allows the user to navigate around the map with the same controls that they would use with Google Maps (an application that many are already familiar with).

I also included a hover for details feature that allows a user to see the details about a fire in the interaction pane. It has the name of the fire, the county or counties it affected, the year it occurred, and the numbers of acres it affected. This feature was mostly for the curious user, who may want to explore the details of the fires on the map. While this feature doesn't necessarily help to see trends across different variables, the way that it is designed allows for these details to be present without being in the way.

Map Acres to Area of Circle



Because this dataset doesn't include the geographic information for the fire perimeters, but fire size is such an important variable, I plan to add a toggle on the interaction pane to map the number of acres burned in a fire to the area of the circle.

This is an extremely important feature for a user if they care to investigate trends regarding fire size. This feature will make small fires essentially disappear from the map, and the location and impact of the largest fires will become very apparent. This helps to compare fire size across different years, and also helps to highlight fires in different areas across the state.

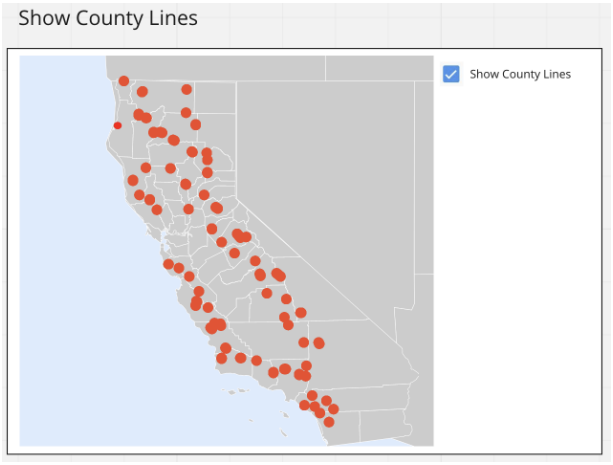
While the area of the circle is proportional to the acres burned, it is not exactly proportional to the area covered in the map. This is a substitute for having fire perimeter data. This means that the circle areas can definitely be compared against each other, but the circle area compared to the area the circle covers in the map is an estimation.

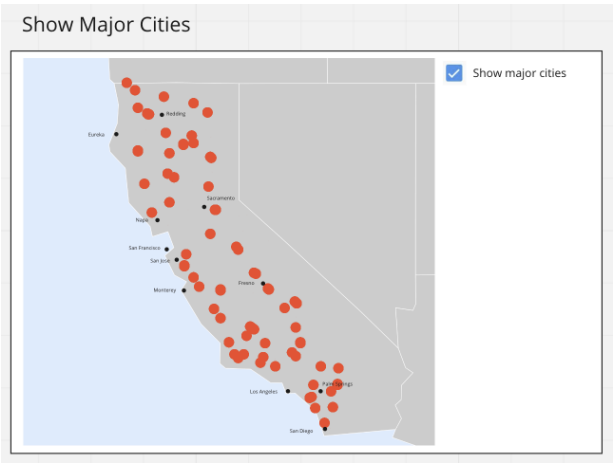
Show County Lines/Cities

The last feature that is included to help give the user some perspective while zooming and panning around the map is adding toggles to show and hide different landmarks. There will be a toggle for both showing county lines as well as for showing major cities.

Mapping the cities is important because they help orient a user and provide context as to where these fires are happening in relation to where people live, if they aren't already familiar with where population centers are in the state. Additionally, mapping the counties can help an organization like CalFire easily see how the fires affect different counties and allocate resources accordingly.

These landmarks are added as a feature to be toggled on and off so that they can just be shown when needed, and don't add unnecessary complexity to the map when a user does not want to see them.





Final Visualization

Link to the final visualization: https://alexkgrimes.github.io/map.html

Description

The final visualization that I constructed with D3 and JQuery components is very similar to the storboards that are shown above. The information pane has all of the different querying capabilities showing at the same time, while in the storyboards I just showed one feature at a time in the pane for simplicity. The main interaction technique I implemented was dynamic queries across the primary features available in the dataset (fires size, year, county).

I also included a few other interactions to help aid analysis. This includes panning and zooming so a user can navigate the map similar to how they would navigate Google Maps, mapping area of circle to the number of acres burned in the fire, and showing county lines and/or major cities

to provide some context for users unfamiliar with California geography. Some key changes and additions to the visualization after the storyboarding phase are described below.

Changes and Updates

Show cumulative info

This was one of the largest additions to the design, which now includes a section on the interaction pane which shows basic aggregated information about the fires that are currently showing on the map. I thought this was important to add for ease of comparison, so that the number of fires showing and the number of acres burned with a particular selection could be easily recorded.

Add colors for year as a user-togglable feature

This was implemented due to feedback that I received from the walk through with my small group. Since it might be confusing for users to just have colors for years appear and disappear without explanation, I decided to make this a user-controlled feature that a user can turn on or off depending on how they want to use the visualization.

Years that aren't applicable with other current selections are greyed out

This is a small detail that I added to the visualization that I hadn't considered until during implementation. In order to keep consistency between the interactions and the map, I added year checkboxes that weren't applicable to be selected given the other current selections to be in the "disabled" state.

Log scale on the slider

This was another small change that wasn't realized until actually plotting the data. I found that most fires are very small, and the largest fires are magnitudes bigger than the medium fire size. Because of this, I changed the slider to be on a logarithmic scale. The values that are displayed in the range are still the actual values, but the slider moves on a logarithmic scale.

Tooltip for the county names when counties are showing

This is a small, quality of life addition which just included a small tooltip that shows the county name when hovering over a county (when county lines are shown to be on).

Development Process

Because I had never used D3 or built any real projects with JavaScript in the past I used various resources to help with development, including the sample project that Hyeok posted on Canvas, the JQuery documentation, and lots of stack overflow examples to figure out how to implement specific interactions. However, any code snippet I used had to be modified for my own use cases.

In total, I spent about 25-30 hours on this project. Having the example code for how to elegantly handle multiple query types was incredibly helpful, and saved a great deal of time figuring out a way to do this myself. So while setting up the map and first slider took a lot of time to get started because I had to figure out how to work with my datasets and put them all together, since I had good (and up to date) reference code this wasn't too painful.

Given that, the aspects of the project that were the most frustrating were the parts that we weren't given explicit examples for, and these also seemed to take a lot of time. For example, setting up the filtering for the years with the checkboxes and integrating them to update with the other selections took about 6-8 hours.

In all, the way that I designed this visualization led for manageable scoping of the project. For example, having only 2 interactions wouldn't have made the visualization useless but just less powerful. Then, as I had more time I could add features and details to aid analysis and make a more polished final product.