Project Proposal

Visualizing the 2020 Wildfire Season in the US

Repository: https://github.com/reepoi/data-vis-2020-fires

Name	Taos Transue	Troy Saltiel	Huy Tran
Email	u1120140@utah.edu	u1268943@utah.edu	u1228479@utah.edu
UID	u1120140	u1268943	u1228479

Background and Motivation

Our project team has a mutual interest in creating a visualization involving natural disasters. We talked to a data scientist with the Pacific Northwest National Lab who works with natural disasters, and he recommended visualizing the current wildfire season because it was so significant. Troy is a graduate student in a lab that works with wildfires, so we have additional resources to inform our project. Taos is from California, one of the most impacted states from wildfires.

The 2020 US wildfire season has been one of the most destructive seasons on record. As of October 29th, 2020, over 13 million acres of land have been burned and suppression costs are over $3 billion (National Interagency Fire Center 2020). The previous record was 10.1 million acres in 2015, and since records began in 1960, the top 5 have all been since the turn of the century (Congressional Research Service 2020). Climate change is known to have a negative impact on forest resilience, or the ability of forests to recover post-fire (Stevens-Rumann et al. 2018), and climate change is expected to amplify in the coming decades potentially resulting in even more destructive fires.

A study by Abatzoglou & Williams (2016) found that warmer temperatures and an increased vapor pressure deficit, or the amount of moisture in the air compared to how much moisture the air can hold, has caused increased fuel aridity, or a measure of the lack of moisture, which can make fires burn more and last longer. They estimate that climate change has contributed to an additional 10.2 million acres of forest fires during 1984 through 2015 which is an equivalent area to the states of Maryland and Delaware combined. Therefore, it is important for the public to be aware of this rising issue, especially for those who are not impacted by wildfires.

Project Objectives

What is the visualization trying to answer?

- Show the extent and damage of the 2020 wildfire season, which was the worst on record
    - Make the data feel tangible; give the viewer visual references to show just how bad the damage is.
- That the 2020 wildfire season is not an outlier; wildfires have gotten worse recently
    - It won't be our goal to attribute wildfire growth to a single factor (that's more complicated and is a combination of factors like climate change, management, etc), but to show that it is a trend.

What are our learning goals?

- How to draw an interactive map, which could involve a custom D3 map or a JavaScript library such as Leaflet.
- How to tell a story with a map.
- What data is appropriate to be displayed on a map and what is not.
- How to balance the amount of information shown in a visualization, the amount of interactivity (learning curve), and 'cool' effects.
- How to find the appropriate information for the visualization. Especially for geographic data; the choice of point vs polygon data will change the direction of the design.

Data

We will use active fire data from the National Interagency Fire Center (NIFC). For the 2020 wildfire season map, we will use the current fire boundary polygons that include the name of the fire and the mapping method. We will enrich the polygon data using the data from the current wildfire statistics PDF which includes point location information. The PDF includes data that could be used in additional diagrams (optional features). In part 2 of our visualization, we will utilize the historical wildfire statistics data to show trends in wildfires over the past 30+ years. We also have data for contributors to wildfire growth, such as drought and above normal temperatures.

- Current Fire Boundaries (Polygons)
- Current Wildfire Statistics (PDF)
- Archived Wildfire Boundaries (Polygons)
- Historical Wildfire Statistics (HTML Table)
- Top 20 largest California wildfires (PDF)
- Historical data for climate extremes

Data Processing

- Polygon data
    - We will need to clean the polygon data before loading it into our code. There are many attributes for each polygon that are not needed for our work, and each fire may have several polygons. We'll need to simplify the data for our needs by removing unnecessary attributes and combining polygons to encompass a single fire. There may also be polygons for small, insignificant fires, so we will need to remove these to reduce clutter on the map. This data processing will likely take place in a geographic information system (GIS) like ArcGIS Pro. The data is currently stored in a file geodatabase, so we'll then need to convert this data into a GeoJSON file. ArcGIS Pro provides a built-in tool for converting file geodatabase features into GeoJSON format.
- Text data
    - We're having trouble locating the original data for some of the historical statistical data from the National Interagency Fire Center, so we'll have to scrape the information from the web or PDF file. We tested a web scraping tool online (PDF to Excel converter) and it works reasonably well to reformat the data. We'll still need to spend some time reformatting the file, doing a quality check, and getting it ready for a CSV data load into D3.

- Data Enrichment
    - The polygon data includes the spatial extent of each fire while the text data contains much of the information we want to attribute to each fire. Within the text data, there is included information for the fires' center point (latitude and longitude), so these data can be converted to point data on a map. We can use ArcGIS Pro to spatially join the point data to the fire boundary polygons. We can then export the joined and cleaned data to a GeoJSON file.

Visualization Design

At the top of our design, we'll show a simple scorecard to show the total number of acres burned, the total suppression cost, and total deaths. The rest of visualization design consists of two components. The first part of the visualization will include a map showing the fires of the 2020 wildfire season along with a coordinated view showing additional data such as acres burned, fatalities, structures destroyed, and fire suppression costs. This view will also include storytelling where the viewer can click next or back and see facts about this wildfire season. When clicked, the map will pan and zoom to the extent of the subject but the user will still be able to pan the map if they please. Some topics for the story telling include the largest fire, a comparison of the largest fire to a known place (i.e. projecting the fire polygon centered over Salt Lake City), the fire with the highest suppression cost, and the fire with the most fatalities. Within these views, the user can also select other fires from the coordinated view (bar chart) or select different fires as they pan the map. The map will also include a tooltip. The encodings are points with location on a map (zoomed out), polygons on a map (zoomed in), and length (bar chart). The points will remain static in size but be coded by color according to the dataset selected (yellow to orange to red, consistent with what a user would expect for fire) and will only be encoded by size and location (polygon) when zoomed, since it will be in focus and specific information will be displayed in the coordinated view.

The second part of our design will show how wildfires have gotten worse during recent history. We will display various charts including the total area burned per year since 1983, the top 20 wildfires in California, 4 of which from 2020 that are in the top 5, and other statistics. There will also be optional features included in this portion, depending on how much time we have, including showing other trends in data that may be contributors to the increase in wildfires (high temperatures, droughts, etc), and another map that overlays all of the fire perimeters in the 1960s (first layer) and 2010s (second layer) in California, to show how more area is burning now than before. As it stands, this part of the design will include length and position encoding for points, lines, and bars. We will avoid color here unless it is used to distinguish unique values.

We will include figures in an appendix at the end so you can judge the 5-6 page suggestion, but we linked them to Github here because it's easier to read.

Final Design (described above)
View full-res visualization design

Prototype Designs
Map view with state focus

- This design incorporates a single map view with a coordinated bar chart alongside the map.
- The data is encoded with location, size/shape, and length. Location on the map is important for wildfire boundaries because it gives context to what was affected. Shape will allow the viewer to directly see how big the fire is. However, for comparison purposes, we added a bar chart (length) so that the user can see which fire was the largest.
- The interactivity includes the ability to select a state or a fire within the state. On click, the map will auto zoom and pan to the fire/state extent.
- The data displayed will change according to the zoom level. Point data will be displayed for the fires when zoomed out while polygon data will be displayed when zoomed in. This change in encoding is important because when zoomed out, it may be impossible to see or select smaller fires, so a scalable point is more appropriate.
- An animation slider is included for the year.
- The Next/Back buttons will highlight major events of the season.

Map view with individual fire focus

- This design is similar to the above but will focus more on specific fires than the states. The encoding remains the same.
- The coordinated view will show sorted information for acreage burned, structures destroyed, fatalities, cost, etc. The fire can be selected from the map or bar chart. The data will change according to the story position, but the user can explore the map at any point in the story.

Map with fire overview, storytelling, animation

- This is a sample design of main visualization. A US map with red spikes indicating wildfires at the corresponding locations. Each spike's height specifies how severe the fire is (by acres or by number of active days).
    - Hovering on each spike will toggle a display box of brief information about the fire
    - Double click on the spike will toggle a zoom into that state and display the fire as an area of effect (polygons in geoJSON), and a display box to give more details about the fire
    - **Why the spikes?** I was inspired by this visualization: https://www.nytimes.com/interactive/2020/10/15/us/coronavirus-cases-us-surge.html
      Which is very eye-catching and I think the spikes can tell how serious wildfires are by the states.
    - **Why not the spikes?** We've discussed that with too many fires to visualize, there will be spikes overlapping each other, which can be an annoying issue to select them one-by-one
- There are also a slider to see cumulative fires by date starting in 2020 and a story-telling text box that lets the user navigate around the visualizations we want to show them. As a user experience practice the arrows at left and right ride should do the same function as the text box's back and next buttons.

    - For the story-telling box, I was inspired by the 3D visualization we had in class (about the yearly yield and long-term predictions), it would be great to tell a story in that box along with navigating through multiple views/visualizations.

Choropleth map with state and county view

- The goal of this design is to show a quick overview of the United States relative to fires and then provide more detail on demand.
- Some states have many fires so having icons for individual fires when viewing the country as a whole can get crowded. The choropleth United States map is colored darker when there are more fires, and lighter when there are fewer.
- The choropleth view removes the viewer's ability to find information about smaller regions within states and individual fires. To maintain this information access, the viewer can click on a state to view a choropleth map of the state's counties; further, they can click on a county to finally view the individual fires as polygons.
- The viewer can click on individual fire polygons to view information about that fire with an adjustable context: comparing to other fires in the county, other fires in the state, other fires in the country.
- Some states are similar relative to fire damage while others are very different. To help the viewer see how their selected region (state, county, or fire) compares, a 'Similar Regions' section will be displayed.

Must-Have Features

- Map to visualize the wildfires in the U.S. during 2020
- Coordinated view along with the map:
    - Bar charts alongside the map
- The ability to pan and zoom the map
- A tool-tip for the map.
- Storytelling within the map that updates the coordinated view, highlights certain fires, and adds additional context about the fire. This should be implemented with next and back buttons and the map will pan and zoom upon clicking these buttons
- Charts in a second section showing how fires have been getting worse in recent years
- A well-designed website to showcase the visualization - simple, clean, and not distracting from the data

Optional Features

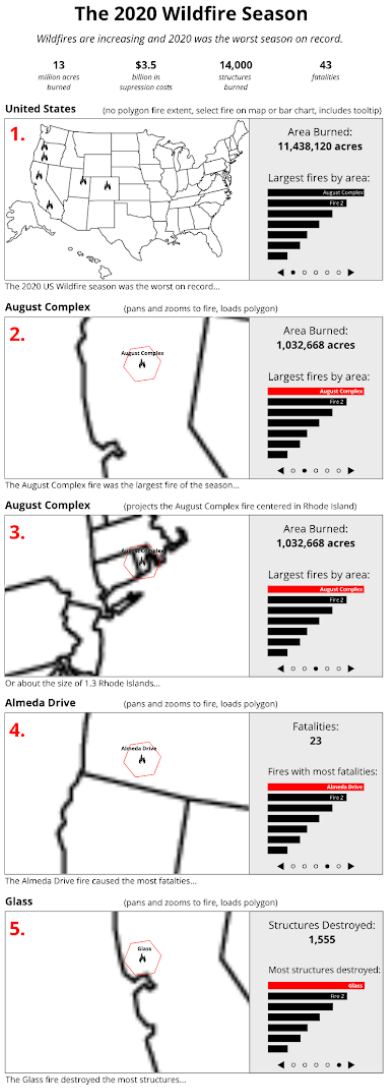
- A basemap (Leaflet), as opposed to plain state outlines and city labels.
- More charts to show trends in other factors that contribute to wildfires
    - Weather/climate based: temperatures, droughts, etc
    - Fire causes (human, lightning, powerlines, etc)
- A map that shows the extent of fires in the 1960s compared to the 2010s; two layers drawn on the map.
- The website is fully adaptive to changing window size and mobile devices
- Include state level information, i.e. summarize the fire season for California, Oregon, etc and allow the user to click the state and update the coordinated view to see that state's information.

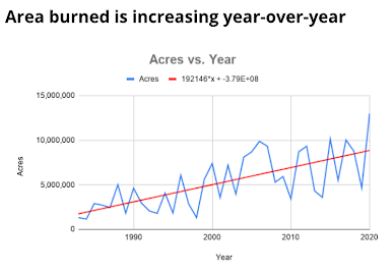
Project Schedule

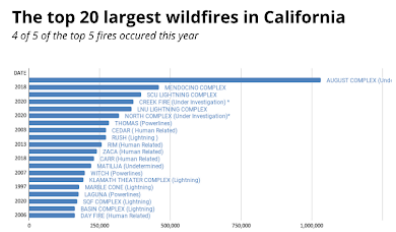
Note that delegated duties are likely to evolve as we progress in our project.

Date	**Description**
Mon, Nov 2	● Initial design finalized (Troy) ● Project proposal submitted (All) ● Website functions finalized (Huy) ● The basic framework of the website established (Huy) ● Start building the U.S. map (Taos)
Thurs, Nov 5 (Project Feedback)	● Project Peer Feedback (All) ● Data processed (Troy)
Mon, Nov 9	● Implemented a Leaflet and button zoom/pan function (Taos) ● Added data to the map (Taos) ● Historical fire data views (charts) created (Troy)
Sun, Nov 15	● Project Milestone (All) ● Add coordinated views
Mon, Nov 23	● Documentation (All) ● Debugging (All) ● Styling and refining website design (All) ● Any other catch up (All)
Mon, Nov 30	● Finalize project and have a meeting for final tweaks (All)
Wed, Dec 2	● Project Due

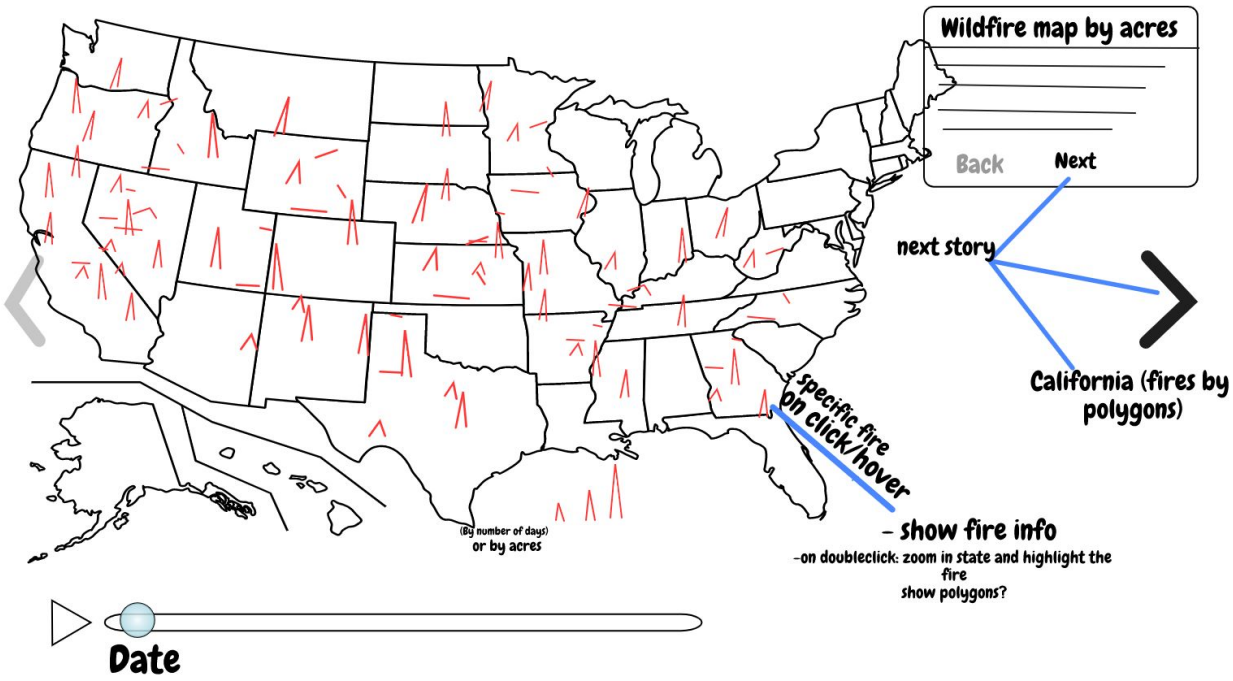
Appendix (figures)





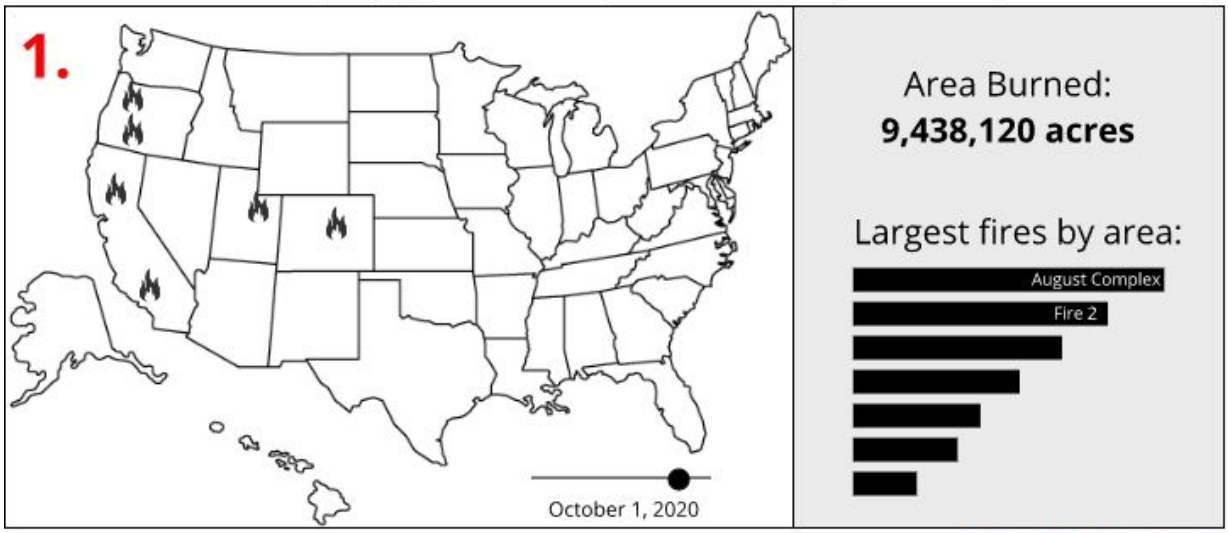


[Final visualization design]



[Map with fire overview, storytelling, animation]

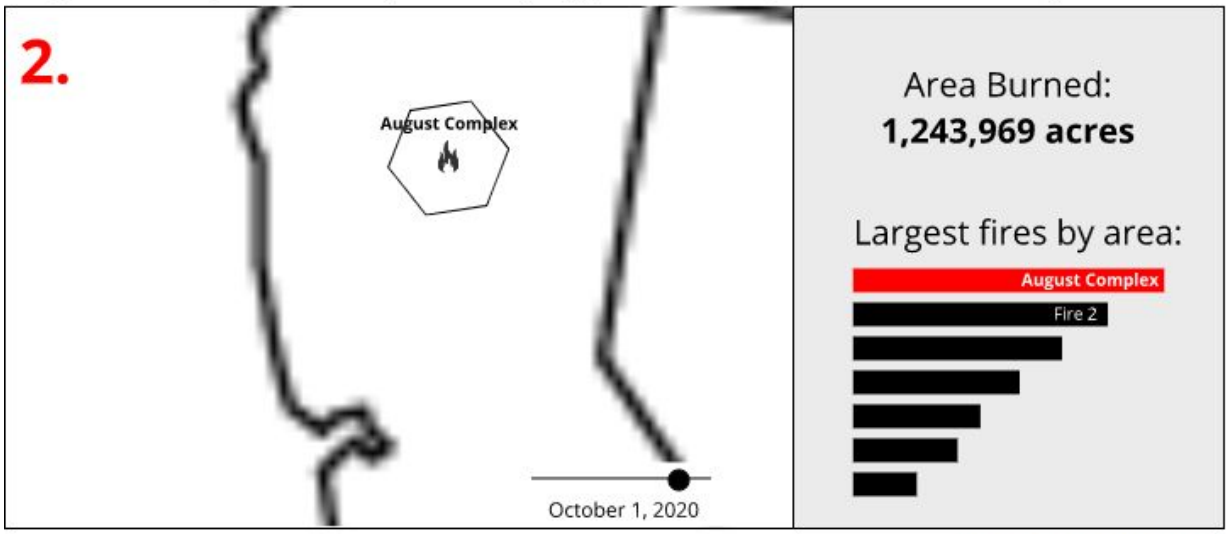
United States (no polygon fire extent, select fire on map or bar chart, includes tooltip)



The 2020 US Wildfire season was the worst on record...

Back Next

August Complex (loads fire polygon for that fire, transitions with time)

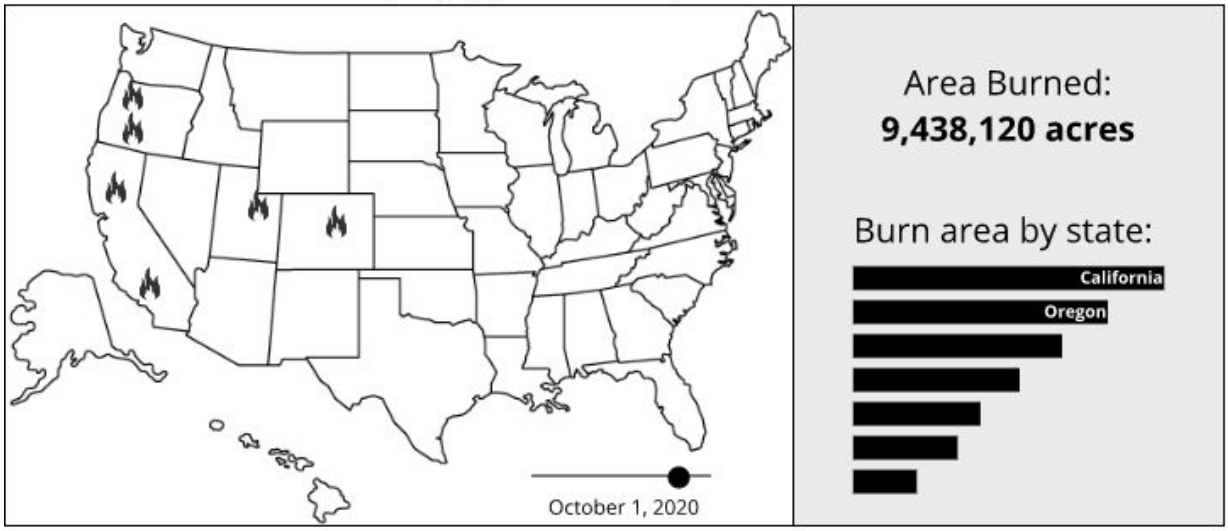


The August Complex fire was the largest fire of the season...

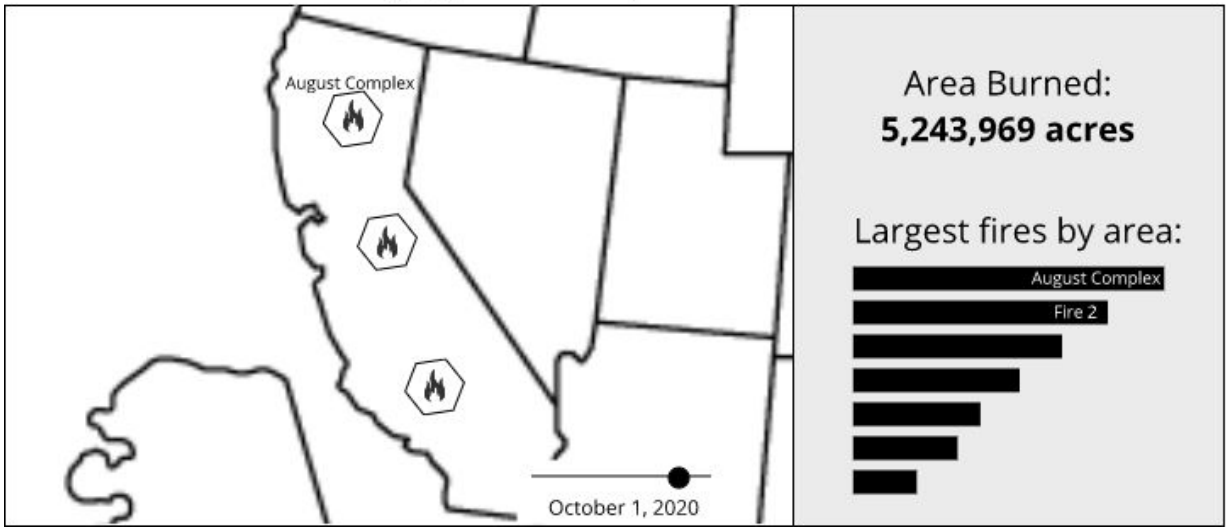
Back Next

[Map view with individual fire focus]

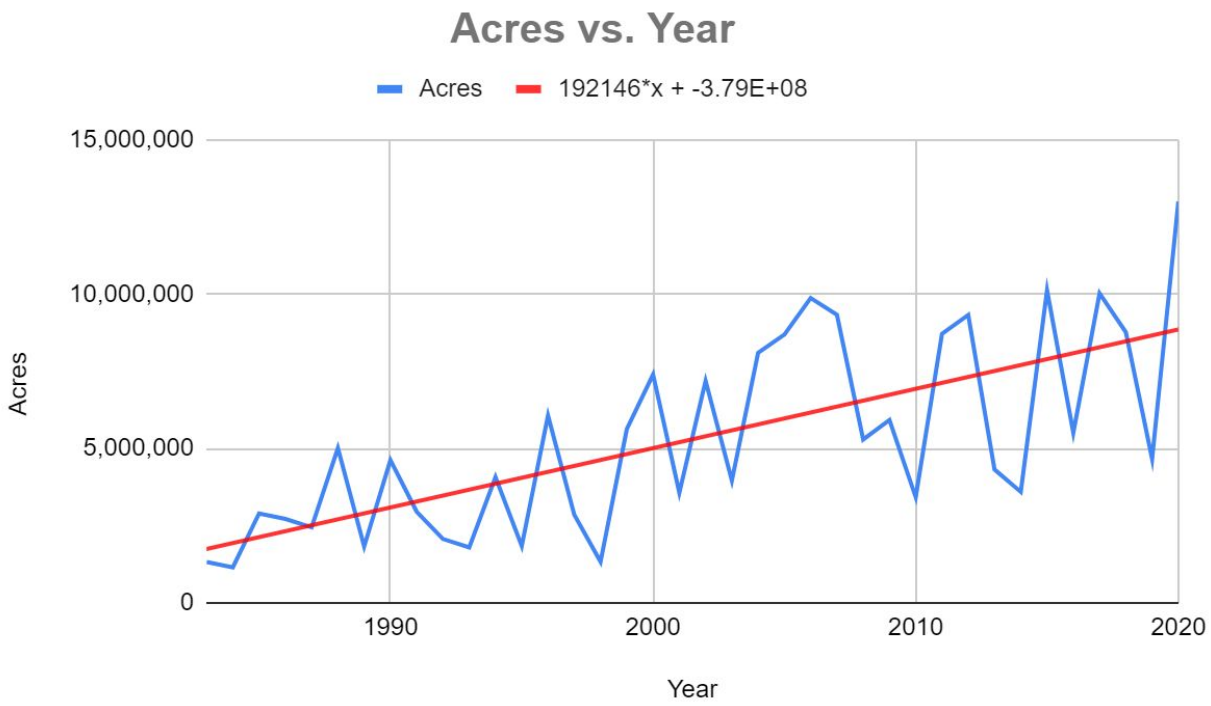
United States (no polygon fire extent)



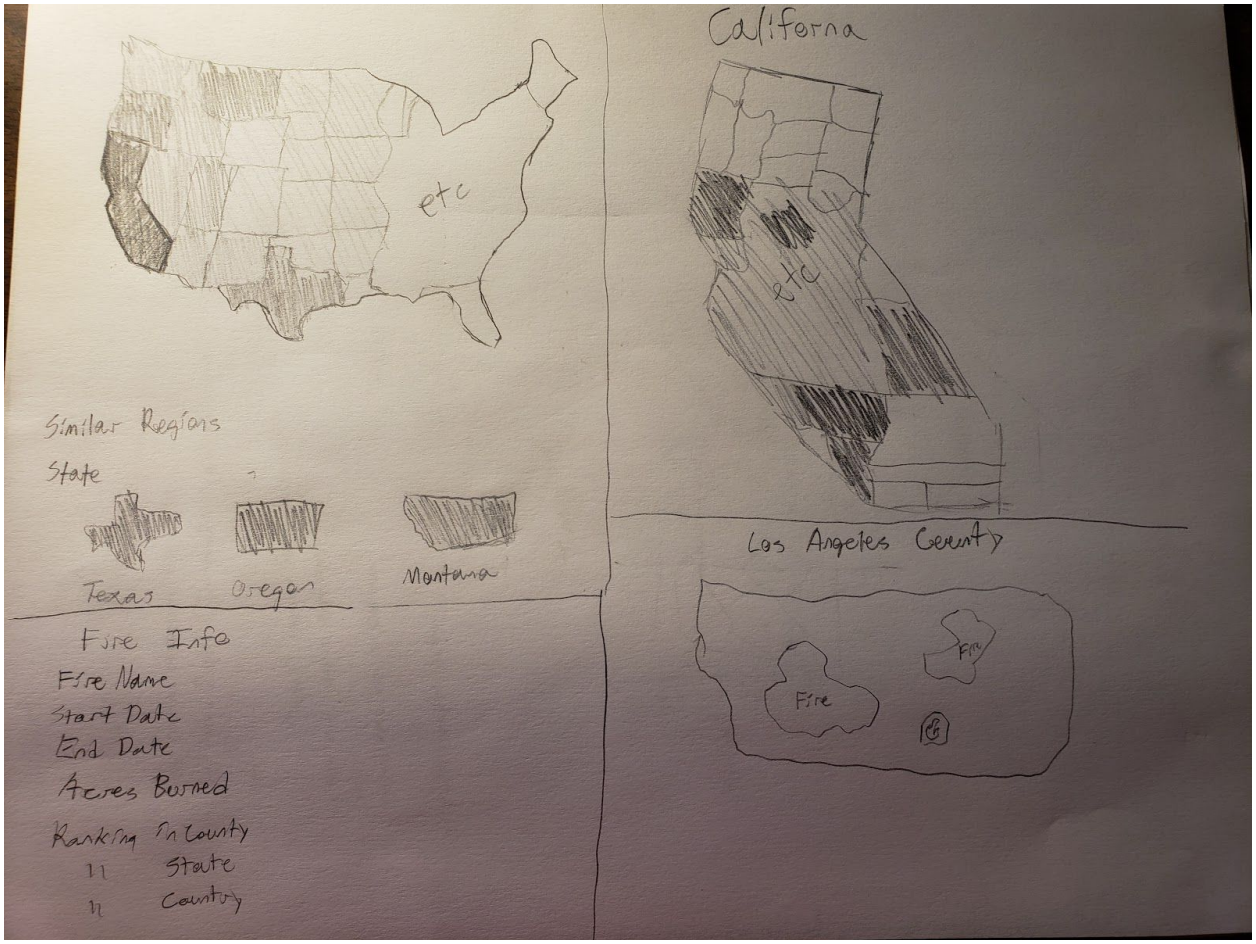
California (polygon fire extent)



Map view with state focus



Total acres burned per year



[Cloropleth map with state and county view]