Process Book

Visualizing US Wildfires in 2020

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

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1. Project Proposal

1.1 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 from 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.

1.2 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.

1.3 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

1.4 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.

1.5 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 the 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 storytelling 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 a 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 the length and position encoding for points, lines, and bars. We will avoid color here unless it is used to distinguish unique values.

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.

Cloropleth 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.

1.6 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

1.7 Optional Features

- A base map (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.

1.8 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

2. Related Work

2.1 Examples

Fire Weather and Avalanche Center Web App
https://www.fireweatheravalanche.org/fire/
The Fire Weather and Avalanche Center map displays a large variety of data and is more of a web application. It's messy, but it displays many of the data that may be available for our project.

Incident Information System (InciWeb) Web App
https://inciweb.nwcg.gov/
InciWeb shows very similar data to what we want to use in our map view, except the fire point data are only for current fires, not all fires for this year. It also follows a similar behavior to our idea to only display polygon data when zoomed in.

New York Times Fire Tracker
https://www.nytimes.com/interactive/2020/us/fires-map-tracker.html

The NYT Fire Tracker displays previously burned areas, areas burned recently (past 7 days), and areas actively burning (past 24 hours). They also have an air quality map with color encoded point data.

Our World in Data
https://ourworldindata.org/natural-disasters#us-wildfires
There are several bar charts that show the number of fires, the number of acres burned, and the number of acres burned per fire. We have access to this same data, so we'll likely use a similar chart to show historical trends for wildfires.

Esri ArcGIS StoryMap
https://storymaps.esri.com/stories/usa-wildfires/
Esri, the makers of ArcGIS, created an interactive StoryMap that displays major fires from 2020. There is a coordinated view that shows a timeline, this view updates according to which fires are in the map extent. The fires are displayed in a heatmap style where larger fires are encoded by larger circles. The data includes the fire name, acres burned, and percent contained.

New York Times Interactive Story
https://www.nytimes.com/interactive/2020/09/24/climate/fires-worst-year-california-oregon-washington.html
This NYT story titled "Record wildfires on the west coast are capping a disastrous decade" features an eye-catching visualization of major fires burning. The visual shows several satellite images and animates fires burning, encoded by orange dots. It's a beautiful visualization but it does not give the user any usable information. The story goes on to show several simple charts about how fires have been getting worse with time.

NBC News Fire Extent Comparison
https://www.nbcnews.com/news/us-news/map-compare-west-coast-wildfires-2020-n1240011
This visualization projects a fire extent over a user-input location. There is also text showing how large the fire is, and how much larger the fire is than the location. There is a dropdown box that allows the user to select which fire to project on the map. This visual is very impactful to show the user just how large the fires are, especially for those who don't live in a region where fires occur. This is something we're considering borrowing as a part of our storytelling.

National Geographic Burn Area Comparison
https://www.nationalgeographic.com/science/2020/09/western-wildfires-have-now-burned-area-bigger-than-new-jersey/
This visualization compares the total area burned in California, Oregon, and Washington to common places, like a tennis court, a track, Central Park, Manhattan, and the state of New Jersey.

3. Project Peer Feedback Session

Classmates Giving Feedback: Joachim Meyer, Abishek Krishnan

3.1 General Questions

- Are the objectives interesting to the target audience?
  - Yes, as a fire educational website, to show a map and a static number allows the user to get the full picture of where and how much area was burned.
- Is the scope of the project appropriate? If not, suggest improvements.
  - Yes, it gives enough information for the user but not too much to overwhelm them
- Is the split between optional and must-have features appropriate? Why?
  - Yes, there are many possible extensions to the visualization, but they aren't completely necessary to the story/data. These optional features are more of 'wow' factor items than showing meaningful data.
- Is the visualization innovative? Creative? Why?
  - Yes, the visualization has several avenues for storytelling, from navigating current fires, to viewing the history, to exploring causes.
- Does the visualization scale to the used dataset? Could it handle larger but similar datasets?
  - This may be the main challenge of this project - there is a lot of data but it needs to be balanced to show the data while not throwing many large datasets at the user. The current visualization design should scale well, but larger polygon datasets will need to be reduced in size (reduce vertices, or load subsets at one time).
- Is the project plan detailed enough? Is a path to the final project clear?
  - Yes, there is a path to the must-have features and the optional features are only added if time allows.
- Is an interesting story told?
  - Yes, the visualization guides the user through the story with direct navigation and gives interesting facts and meaningful data.

3.2 Visual Encoding

- Does the visualization follow the principles used in class?
  - Yes, the visualization shows the data and only the data. Design is clean and uses proper encodings.
- What is the primary visual encoding? Does it match the most important aspect of the data?
  - Location and size are two of the primary encodings, as well as length and position for any additional charts or views. Since the fire data is location specific, it makes sense to put this data on a map.
- What other visual variables are used? Are they effective?
  - Color will be used to encode the active metric (acres, cost, etc). The color scheme is graduated. This seems to be effective when used on a map.
- Is color sensibly used? If not, suggest improvements.
  - The color scale is graduated and follows a yellow to red scheme that seems fitting for a visualization about fire. The color encoding is good for getting a general idea of where the worst fires are. This seems to be the best encoding for

this, as the other option is 3D.

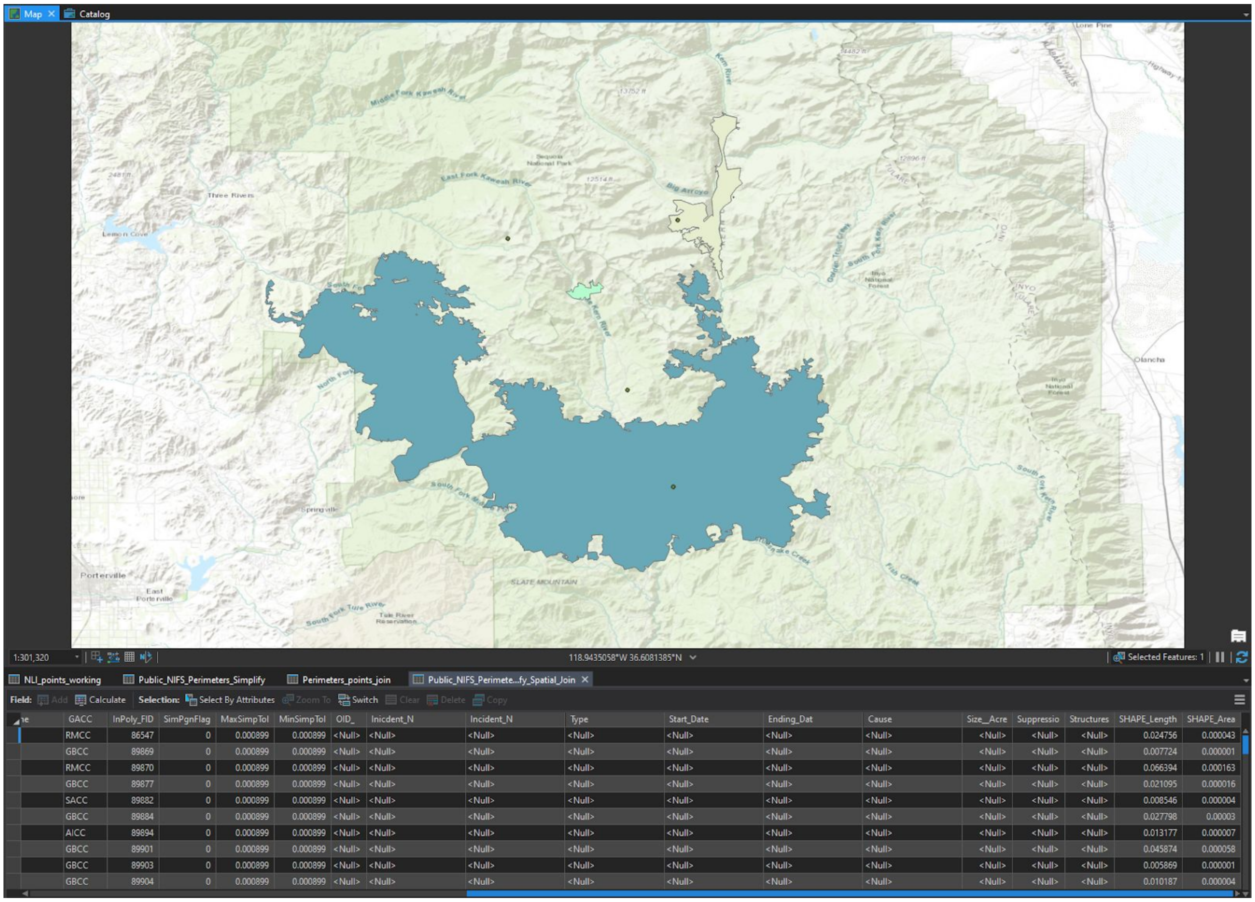
3.3 Interaction and Animation

- Is the interaction meaningful? If not, suggest improvements.
    - Yes, the main interactions are panning and zooming and selections. The viewer is able to select either coordinated view and the map updates to that feature. This is pretty intuitive and interesting.
- If multiple views, are they coordinated? If not, would it be meaningful?
    - There are multiple views where the map view is the center piece, the left are charts, and the right is selection information. The chart coordinated with the map gives the viewer an idea of how the selected fire compares to other fires.
- Is there any animation planned? Is it clear? Is it intuitive?
    - Yes, at least for the map. The storytelling will jump to specific areas of interest, and an animation will provide context.

Other comments:
Add copyright information to map

4. Data Processing

We decided the best way to display our data was to use a combination of point and polygon data. We found direct sources for this data, however, they were compiled by different institutions and, while the essential information was the same (name, size, acres, etc), the locations and organization of the data was different. In an ideal situation, the point and polygon data could be joined based on primary keys or a combination of foreign keys. In this case, the point and polygon layers only shared names in common, but many were not exact matches. Some data named the fire complex while others named the individual fires. This leads to another problem; in some cases, the polygon data grouped some fires as a complex while the point data had several individual points that are part of that complex. To address these issues, we had to manipulate the data. Our thinking was to first enrich the polygon data with the point data. We accomplished this by spatially joining (if the point intersects the polygon, the point data is joined to the polygon data). There were some mismatches in location, so there were some cases where we had to move the point data to fall within the polygon after we confirmed they were the same fire and the data (acres lost) matched. Once the data were joined, we removed the original point data and created new points centered in the middle of each polygon. In the end, the point and polygon data contain the same information except the point data will be shown when zoomed out and the polygon data when zoomed in.



A screen capture showing polygon and point data in a California forest. In some cases, points did not correspond to polygons, and some small polygons did not have point data.

Due to the data inconsistency, we will add a disclaimer to the project that the data within the map view does not include every single fire. The map view is intended to show the user major fires only. Summary statistics will include all of the data. It also must be noted that the 2020 wildfire season was not complete at the conception of this project, so this visualization is representative of most, but not all, of the 2020 wildfire season.

5. Data Ambiguity

5.1 Summary

Over the course of this project, we've had difficulty searching for data. Not that we could not find data; this was not an issue, but that the quality of the data and its format was questionable. Since we are covering the 2020 wildfire season, there was no expectation that we would have all of the data, not to mention scientific quality data. The main goal of this project was to show the extent of the 2020 wildfire season and historical trends. Our analysis has shown that there are not more fires, instead fires are increasing in size and total area burned is increasing. The data we have will accurately portray this. At the same time, we want to have as accurate of data as possible. Fortunately, we were able to contact a Bureau of Land Management (BLM) Public Affairs Specialist who is affiliated with the National Interagency Fire Center (NIFC). She provided us with excellent insights on the datasets we're using for our project. This will allow us to accurately display our data with the proper disclaimers, and has opened communication for us to improve or update our visualization after this class ends if our team wishes to pursue this. We also found the discussion interesting and worth adding to our process book, included below.

5.2 Conversation with the NIFC

Troy 11/10/20:
"I am creating a visualization about the 2020 wildfire season and am gathering statistics from the NIFC. I found the National Large Incident YTD Report for specific fires on the GACC website and the fire info page on the NIFC website.

The Large Incident Report lists the cumulative area burned as 13.5 million acres while the NIFC fire info page lists 8.7 million acres burned. I would like to know, what are the differences between these figures? Why is one significantly larger than the other?"

BLM/NIFC Employee 11/12/20:
"I was asked to respond to your recent inquiry about the difference in total year to date acres burned from the two reports you were viewing. I forwarded your question to our Intelligence desk at the National Interagency Coordination Center. They develop the Incident Management Situation Report (IMSR) where the numbers come from for the National Fire News reports. They provided a little background in our fire reporting systems which may help explain why the data is different.

The IMSR is pulled from Fire and Aviation Management Web Applications (FAMWEB), which generates reports from the fire reporting systems federal agencies use (from where the GACC is also generating it's report). The IMSR is based on what is inputted into the Incident Situation Report (SIT-209). The SIT-209 is used to collect intelligence information related to the wildland fire management incidents and resources. SIT collects daily fire activity and initial/extended attack resource information during the active fire season for the local dispatch office. 209 is used to collect and store ICS-209 large Incident Summary information. This intelligence information is used to support the decision making process related to wildland fire resource placement and use.

The SIT-209 program is an Interagency FAMWEB application with two distinct functions. The 'SIT' side of the application captures Fires and Acres burned by protecting and ownership agencies as well as a mechanism to report prescribed fire statistics. This data is entered by dispatchers manually at local dispatch centers throughout the country. These statistics are meant for fire managers at the local, geographic and national level and are not official statistics for any federal, state or local fire entity.
The '209' side of the application is a situational document meant to capture incident specific data for large or locally significant wildland fires and all risk emergencies. The 209 captures over

50 data elements that are entered either by the local dispatch center or incident personnel that captures incident size, complexity, critical resource needs, weather, projected activity, etc... The situational nature of this document does not reflect fire reporting for a given incident (even after the incident is contained and the 209 is finalized).
Utilizing summary report data from multiple 209's within the 209 application will result in erroneous data as many incidents are complexed or merged into other incidents and double reporting is frequent. An example of this would be on November 12 2020, where summing all acreage burned in the 209 application exceeds 13 million acres while statistically only 8.7 million acres have actually burned nationally.
Therefore, this data is not used for official agency statistics, only for a snapshot into situational awareness for that time. All final reporting is supposed to be completed by the end of the calendar year when we can confirm actual fire numbers and fire acres within each agency's reporting systems. With that said, some fires may not be out by the end of the year, so incident reporting continues into the next year.
I hope this makes sense. That was a very long explanation as to why the numbers don't match."

Troy 11/12/20:
"Thank you for the very thoughtful and informative response. This makes sense and lines up with my expectation for preliminary data while the season is still active. I've been developing my visualization with the understanding that the data is not of scientific quality. I'm using the wildfire perimeter data available from the NIFC as the primary visual and have enriched this polygon data with suppression costs and structures destroyed from the IMSR.

I have two more questions:

Once the season has completed and the data has been reviewed, is there a primary source where this data is made available? By this, I mean will final data for each named fire incident be published somewhere as either point or polygon data, or in a text report?

Does the duplication of records also apply to the total fire suppression cost which is currently listed as ~ $3.4 billion? If so, is there an unofficial total for 2020 so far?"

BLM/NIFC Employee 11/13/20:
"NIFC doesn't maintain records for every individual fire. Final fire reporting information is held at the agencies responsible for managing the fires. With that said, the information you are looking for should be available in the fire reporting system once fire reports are finalized and vetted which is generally by the end of January.

This year, however, is going to be a little tricky as several agencies have moved to a new fire reporting system named InFORM, Interagency Fire Occurrence Reporting Modules. Since InFORM is still in the development phases, I have not heard how/where final report data will be stored or how to access it. We do have some data analysts that can pull data, if needed, so keep in touch for that.

As far as suppression costs, the totals currently in the reporting system are estimated and there could be some duplication as well. Costs are tricky, too, as NIFC only tracks federal costs nationally as a whole, not individual fires. The agency who is responsible for managing the fire would track the actual costs at the local regional level and should include all costs federal, state and local. The estimated costs in the reporting system are inputted by the dispatch or incident personnel responsible for the fire (as with the other information), so they would be estimated based on resources used.

For FY2020, nationally the Department of Interior has spent $510 million while the US Forest Service has spent close to $1.8 billion. Again, that does not include state and local costs.

I know CalFire reports their costs of their website for the state of California. Other states may have something similar for their Forestry Divisions, but you may have to do some searching.

I will check with the U.S. Fire Administration and National Association for State Foresters representatives here, to see if they have totals for state and local costs. Or if there is somewhere you could find those.

Sorry I wasn't able to give you a complete answer. Wildfires are multijurisdictional with a lot of moving parts and they can be complicated.

As far as the reporting, stay in touch. I will find out more as the year comes to an end."

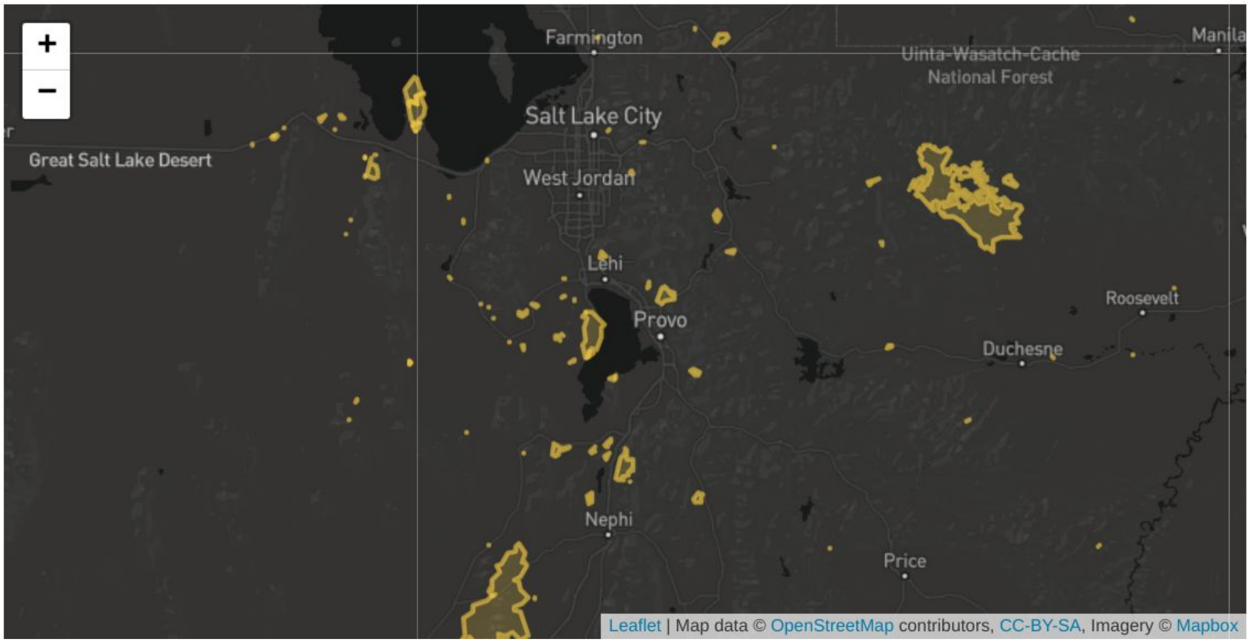
6. November 10th Project Update

6.1 Progress Update

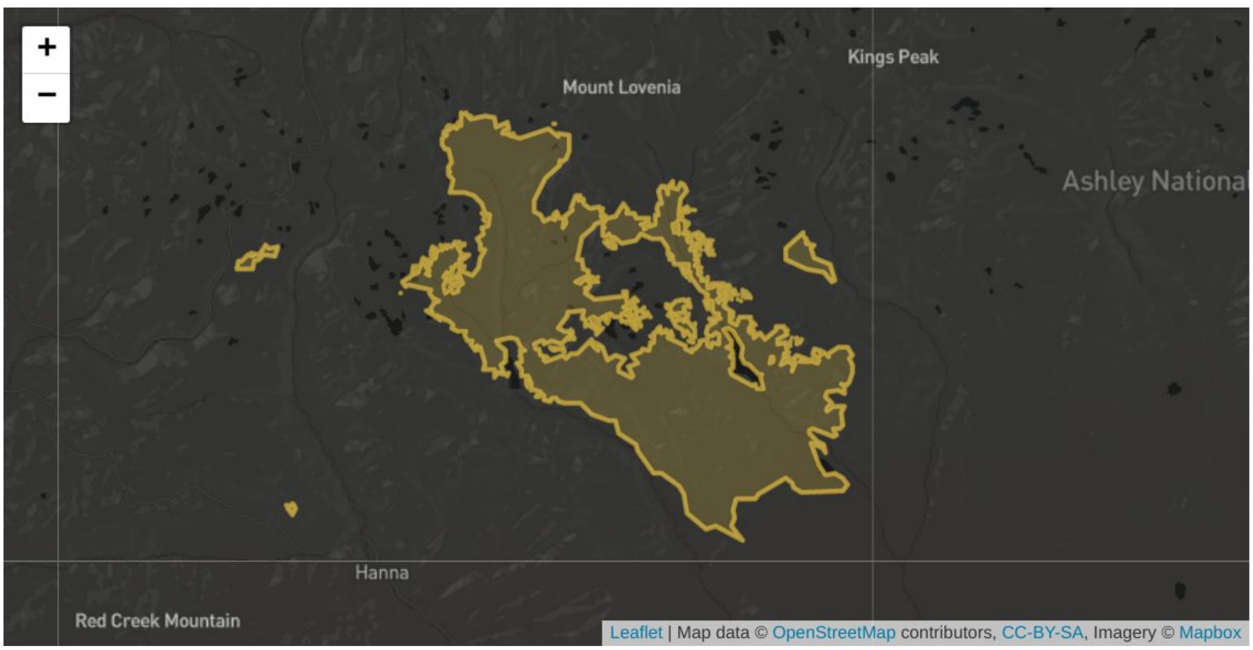
Our team met on November 10th to discuss our initial progress with the visualization. At this point, we've finalized the point and polygon wildfire datasets, implemented the web page structure, and added the map with data to the page.

The visualization upon first load.

We are on schedule at the moment and haven't had any major issues so far. In the current implementation, fire points are displayed when the map is zoomed out. The user can either zoom in or click on a fire point and the map will zoom to an extent where fire polygons (perimeters) are now visible, centered at the clicked point. Now, the user can click a specific fire polygon to zoom further. Since it may be difficult to select a specific point when fully zoomed out, we see the two step zoom behavior as desirable and more user friendly. Polygons also change color when hovered. The website structure consists of 4 panels and 3 tabs. The left panel displays statistics and charts, the right panel displays fire information, the main panel shows the map view, and the bottom panel shows text information. The tabs will update the views. In the compare years view, we intend to plot fires from the 1960s to fires in the 2010s on the same map (California only, they have reliable data). The third tab is where we may add charts with historical data, such as a bar chart showing the acres burned per year nationwide since 1983, when reliable records began for wildfires.



A point near Salt Lake City was clicked; the map zooms to show the wildfire perimeters in that area.



The East Fork fire, in the Uinta Mountain Range, was clicked and the map zooms to show its perimeter.

6.2 Next Steps

6.2.1 Map View

Much of the map view has been implemented, but there are several tweaks that can improve the user experience.

- Add custom icons for the point data. Instead of orange dots, add fire symbols (such as the favicon for the website) and color them according to fire size. We're thinking of creating a scale that adjusts the opacity (100% is the largest fire, 50% is the smallest fire). Ideally, we would use a color scale, but that may require us to hardcode a range since we're using a custom icon. For example, we would need to create icons for each: red (1,000,000 - 250,000 acres), red-orange (250,000-100,000 acres), orange (100,000-50,000 acres), yellow-orange (50,000-10,000 acres), and yellow (<10,000 acres). We may need to experiment with our options to figure out which is best. The opacity option may create issues with overlapping points.
    - The Beautify Icons Leaflet plugin may solve these issues. There is potential that we can apply a color scale to Font Awesome icons. L.BeautifyMarkers.
- When a fire polygon is selected the polygon remains colored differently than the other polygons.
- When a fire point is hovered, it changes color. We would need to use a color that is distinguishable from our color scale. Light blue is a common color used in mapping programs.
- Add a widget to reset the zoom extent. Built-in function to Leaflet. L.zoomhome.
- Add a search widget so users can search for a fire. Built-in Leaflet function. L.search.
- Add a minimap widget so the user can get additional context when zoomed into a polygon. Built-in Leaflet function. L.minimap.

6.2.2 Coordinated View

We haven't implemented the coordinated view at this stage. We're still thinking of displaying bar charts showing the top fires where the selected fire gets updated to the top of the bar chart so the user can compare it to other fires. We hope to complete a prototype of this before the milestone.

6.2.3 Fire Information View

We intend for the tooltip to display only basic information, such as the fire name. The rest of the information will be contained in the fire information view (right panel) such as the number of acres, structures destroyed, suppression cost, fatalities, etc. This is not implemented yet and we hope to prototype this before the milestone.

6.2.4 Text (bottom) View

The bottom view will be a simple text paragraph that gives the user a short summary of the data.

6.2.5 Compare Years Tab

At this meeting we decided that the 'Compare Years' tab would show a map view with the fires from the 1960s and 2010s in California, shown on the same map. These layers will be added with a set opacity so the user can see both fires where they overlap as well as see if multiple fires occurred in the same location (this is common). This data is made available by CalFire. This component was inspired by this visualization by Capradio. In our visual, we want to make it easier to compare past years to current years. Capradio's visual has a continuous scale making it difficult to know which year the polygons are.

7. Project Milestone

7.1 Summary

To do:

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7.2 Team Meeting - November 15th, 2020

7.3 Meeting with Jeff - November 18th, 2020

Design Process