Wildfire and Landslide Risk Mitigation in Oregon

Ryan Shankar

CS 458 - I have not missed any classes yet

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Visualization Analysis

The datasets that I visualized were all based in Oregon. One dataset was about fires in Oregon, this includes wildfires and human caused fires. The dataset was created by the Oregon Department of Forestry and had over 70,000 records. This gave us a multitude of data, making it easier to assess patterns and correlations. This amount of records also makes it harder to complete certain visualizations as well, for example when I tried to make a scatter plot it was hard to find a pattern due to how much data there was. For this data I wanted to figure out if there was a trend with fires and the years they occurred. More specifically if fires have increased over the last decade compared to previous years. Have fires increased over the past 10 years and by how much? To visualize this, I used the “YEARS” category from the dataset and used Python to make a bar chart to show the number of fires every year. From this bar graph I could not find a distinct pattern and it seemed to be multimodal, the data proved that there was no correlation between the year and the amount of fires (Figure 1). But we cannot use this one graph as concrete evidence as there are many factors that could play into this that we did not account for. To try to find some sort of correlation I wanted to look at the amount spent on fires annually, but this dataset did not provide that level of depth.

The next dataset I visualized was landslide data, this dataset was provided by the Oregon Department of Geology and Mineral Industries. This dataset provided 15,000 records which

made it easy to visualize certain patterns. For this dataset I wanted to find out what is the main factor of landslides. What are the primary causes of landslides? To figure this out I created a pie chart based on the “TYPE_MOVE” part of the dataset. This gave me a way to see what factors cause landslides and what the most common factors are. When looking at this pie chart it is important to notice that there is one slice unaccounted for with no label. After combing through the dataset, I found that under the “TYPE_MOVE” header there were DFL (Debris Flow), EFL (Earth Flow), DSL (Debris Slide), Flow, and Slide. These were the main types of slides, there were many more, but they had little data, so I grouped these into another section. Looking at the pie chart this accounted for everything except one section which was 24.4% of the whole chart and was not labeled. Trying to find the label I found that this data was left blank in what I assume as an unknown movement type. To confirm this, I tried to use a different library in Python to visualize that just to see if it was an issue with the library I used, and it returned the same result. I chose not to omit the data as it would be irresponsible to not account or visualize this data as we do not know the possible role it plays especially since it is such a large piece of the visualization. Ignoring this data anomaly, we can see from the chart that Earth Flow accounted for over 30% of landslides which means it is the leading cause of movement for landslides (Figure 2). After doing some research on this topic I found that Earth Flow is the second leading cause of landslides in Oregon, the main cause is rainfall. Looking back at the pie chart it makes sense for the unknown part to be rainfall, and it could be merged with the flow category, but we cannot make that conclusion since nowhere in the paper does it say that this unknown data segment belongs to a group, it is just an educated assumption we could make.
To further analyze the landslides, I decided to assess the severity of the different landslide types through landslide length. I used a swarm plot to visualize this. Looking at the plot you can see that most movement types have concentrated data and are slide length less than 1000 feet (Figure 3). The most severe are flow type landslides and they have a decent amount of variability especially compared to the other movement types. Combining the two visualizations

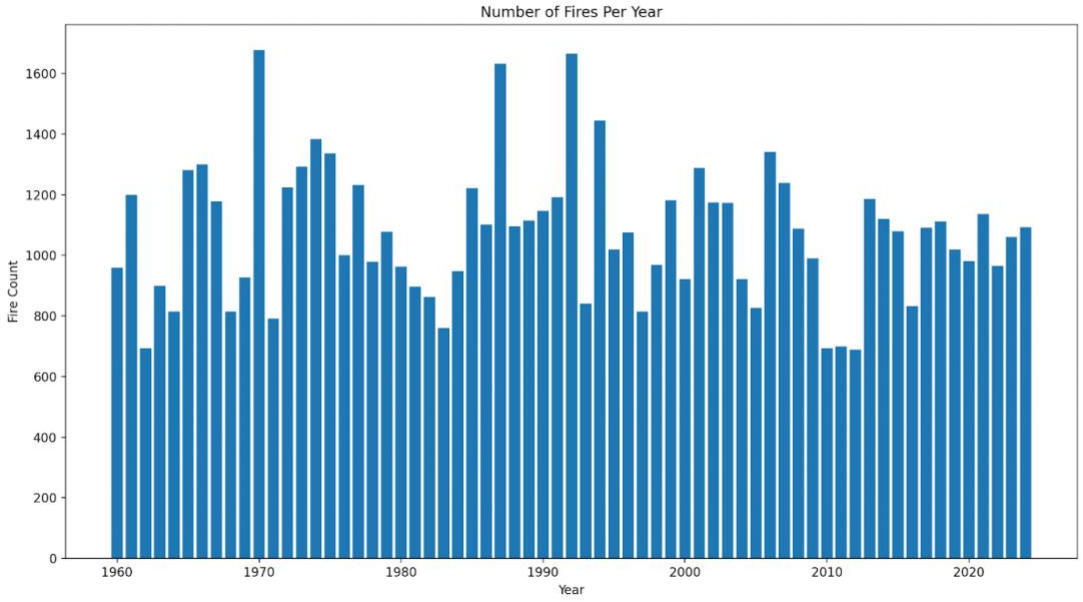
from the landslide data we can gather that Earth Flow landslides occur the most but are not as dangerous as Flow landslides.

Research Question/Goal

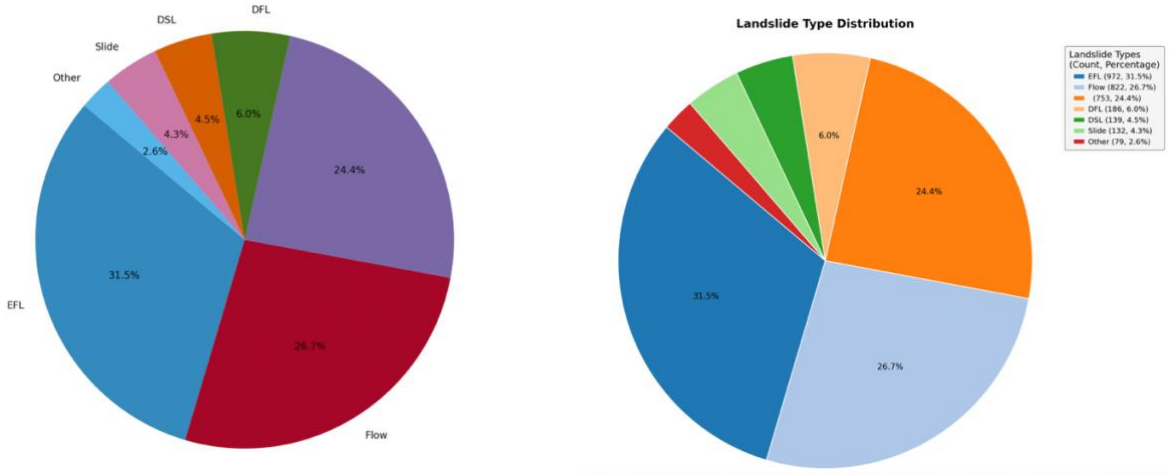
After making the first two visualizations I started to notice different patterns. I wanted to see if there was an area in Oregon where you would be the safest from both landslides and fires. What are the safest areas in Oregon from landslides and fires? To answer this question, I needed a map visualization of both data sets. I knew it would be hard to layer both datasets as there is a large difference in the sizes, so I decided to do each separately and then compare both with each other to find the safest area. Due to the size of the fire data I decided to make a heat map. This helped accurately show all the data in a way that is understandable. Looking at the heat map the areas with high fire density are orange and the other areas with less density are somewhere in between blue and green. From this heat map we can see that almost all of Oregon is green except a bit of the Northeast area, some of the Portland Metro area, and the Southeast area (Figure 5). This tells us that these regions mentioned earlier are the safest from all recorded fires provided in this dataset. The least safe area is Southwest Oregon near the California border, and this can be seen from the orange hue in that part of the heat map. For the landslide data I chose to use a cluster map as it would be easier to layer the maps over one another and see both datasets. The cluster map also visualized the data really well making it easy to understand. Each node on the map has a color ranging from green being a lower amount of landslides to orange being a higher amount of landslides, these nodes also have a number corresponding to the amount of landslides around that area. From this map we can see that the Western part of Oregon has far more landslides compared to the others, especially Northwest Oregon and Sutherlin area a bit below Eugene (Figure 4). Something interesting I noticed is that both maps follow a similar pattern. When looking at the heatmap for the fires we

gathered that the worst areas were Southern Oregon and most of the Western coast of Oregon, and this is the same for the landslide data and can be seen in the landslide cluster map. This leads me to believe that there could be a correlation somehow between these two events. To prove this even further I decided to layer the maps as best as I could, trying to see if we could see a clear “safe” zone between the two. After layering I saw that there were a few small areas near the Northeast part of Oregon and a bit of the metro area, but by far the safest area was the Southeast part of the state (Figure 6). After layering them together almost none of the two maps had data points in this area. Could this be a mistake in the data? Possibly based on what we were given, it seems this is the clear winner in terms of safety and mitigating the risk of encountering a landslide or fire.

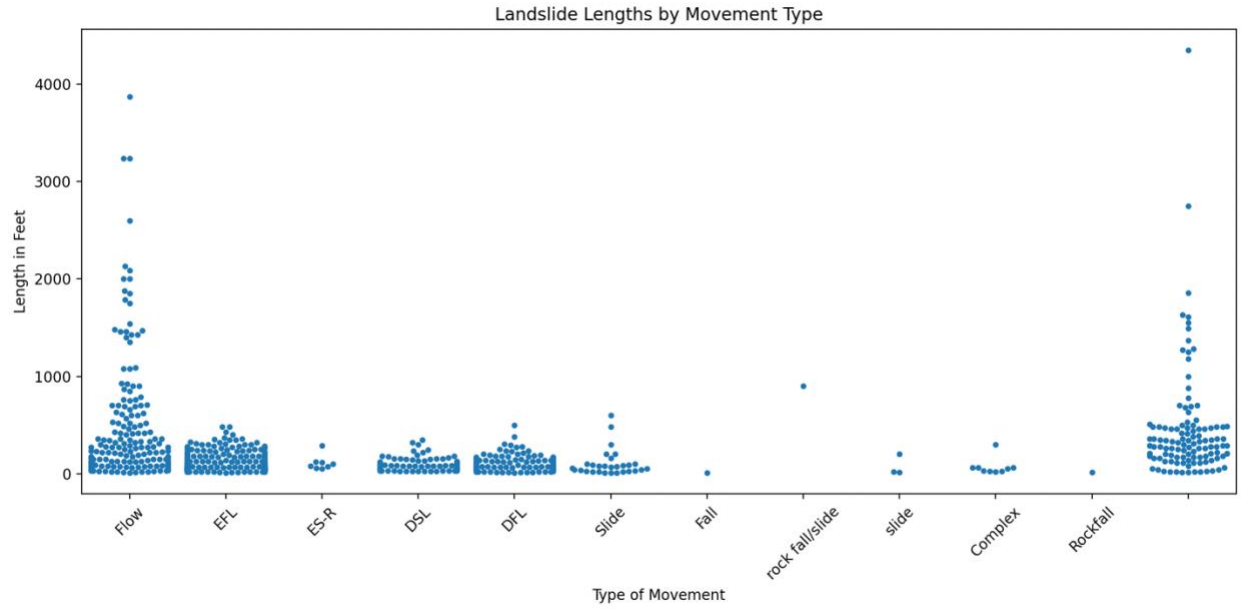
Visualizations



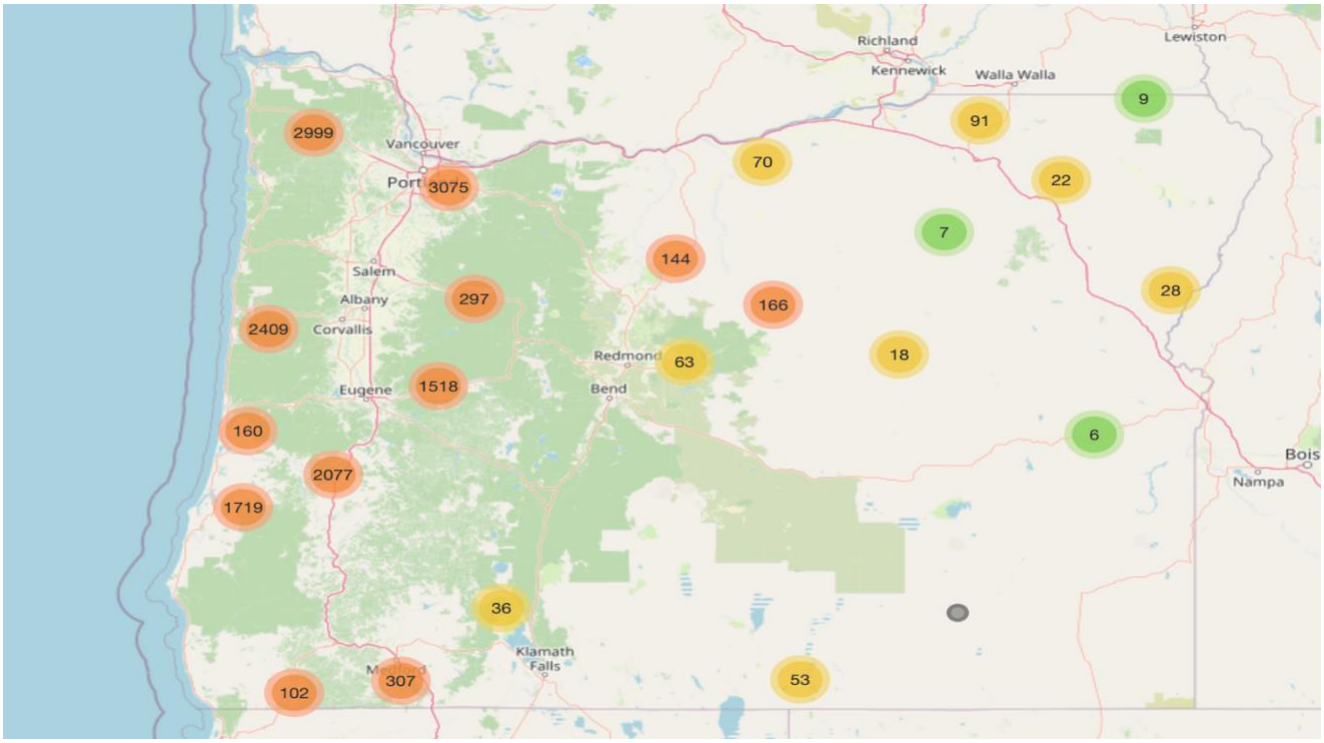
(Figure 1) Number of Fires per Year from 1960-2025



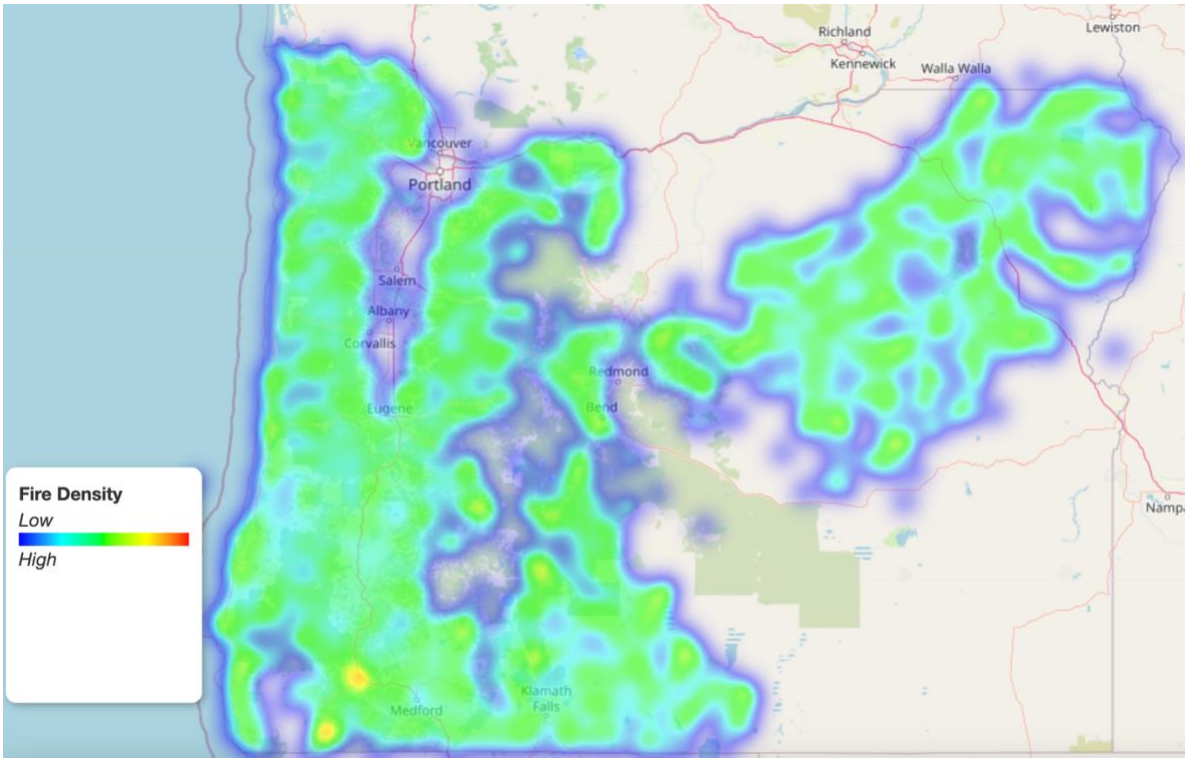
(Figure 2) Two Pie Charts showing Landslide Types and their Distribution



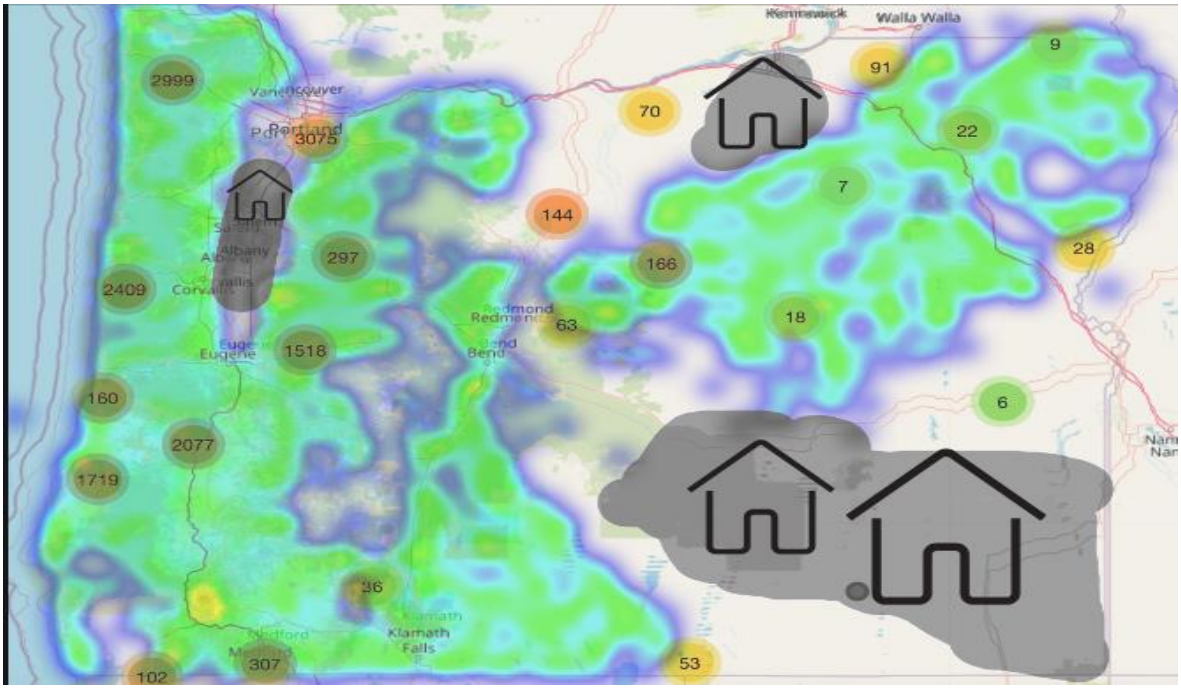
(Figure 3) Swarm Plot showing Landslide Lengths in Feet based on the Type of Landslide



(Figure 4) Cluster Map Showing Landslides in Oregon.



(Figure 5) Heat Map Showing Fires in Oregon. Fires tend to be concentrated around the West coast of Oregon while Southeast Oregon has no visible fires based on the dataset.



(Figure 6) Map Visualization Showing Safe Housing Areas in Oregon. The areas under the grey hue are areas where it is safest to live, lowering the risk of being in the middle of a fire or landslide. The larger the icon and more frequent is the safer the area is from fires and landslides.

References

"Bar Plot in Matplotlib." *GeeksforGeeks*, 10 Dec. 2024, www.geeksforgeeks.org/bar-plot-in-matplotlib/.

Fessel, Kimberly. " Seaborn Swarmplot | What Is a Swarm Plot and How Do You Make a Swarmplot with Python Seaborn?" *YouTube*, 30 June 2020, www.youtube.com/watch?v=5e9NBhGBVwk&ab_channel=KimberlyFessel.

"Landslides in Oregon." *Oregon Department of Geology and Mineral Industries : Landslides in Oregon : Landslides : State of Oregon*, Oregon Government, www.oregon.gov/dogami/landslide/pages/landslidehome.aspx#:~:text=Although%20earthquakes%20can%20initiate%20debris,and%20drainage%20may%20induce%20landslides.

Mcdonald, Andy. "Creating Geospatial Heatmaps With Plotly Express MapBox and Folium in Python - Data Visualisation." *YouTube*, 8 Nov. 2023, www.youtube.com/watch?v=vSGWmZre31A&ab_channel=AndyMcDonald.

"Pie Charts#." *Pie Charts - Matplotlib 3.10.1 Documentation*, matplotlib.org/stable/gallery/pie_and_polar_charts/pie_features.html.