Problem: Prediction of Wildfires in the United States

In the United States, wildfires cause billions of dollars in damage to property, the environment, and infrastructure every year. Wildfires are increasing in severity, burning more acres than ever, raising the question of whether current preventative measures in place are enough. In 2018 alone, California experienced one of the most destructive fire seasons to date. Cost estimates of damage remain unknown, but are predicted to be in the millions of dollars, with thousands of acres burned. While fire seasons are lengthening and increasing in severity, criticism is being placed on utility companies as the party responsible for starting the fires.

The recent Camp Fire in California that killed at least 88 people and destroyed the town of Paradise, has drawn national attention on what role utility company Pacific Gas and Electric (PG&E) played in the cause of the fire.[1] PG&E, California's largest investor-owned utility, faces $30 billion in exposure to liability for the fires that ravaged California in 2017 and 2018. Investigations have found that the utilities equipment was responsible for 18 of 21 major fires in California in 2017, and all fires in 2018, citing that the root cause was power lines coming into contact with trees.[2]

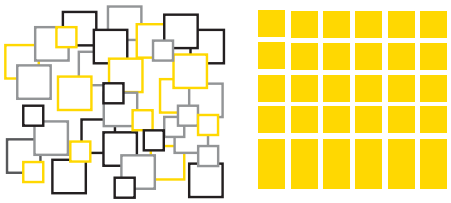
California is not the only state impacted by devastating economic and social costs of wildfires. Oregon hit a record high of $514.6 million worth of damage in 2018, with a total of 1,880 fires burning 846,411 acres, an area larger than the state of Rhode Island.[3] Wildfires are a national problem, worsening every season. While the West Coast is historically impacted by fires burning throughout the region, the East Coast is beginning to experience side effects of wildfires. Smoke particles from the 2018 fires in California traveled to states including, Missouri, Virginia, Oklahoma and even New York, impacting air quality.[4]

The complex interactions among fire, climate, weather, vegetation, and people make it difficult to predict where wildfires might start and how they may spread. Big data companies have made great strides in developing data analytics tools utilizing machine learning and geographical information systems (GIS) to predict fire spread, severity, and the path a fire will take. Interactive tools can assist users in analyzing long, medium, and immediate term data cases and highlighting risk. Technology is available to monitor trends in vegetation and weather patterns to determine what preventative measures (e.g. vegetation cutbacks) can be put in place to further mitigate the occurrence or severity of fires. Interactive tools can help empower businesses to utilize available data and unlock the power of predictive data science to address client needs.

Unlocking a Solution to the Problem through Data Science:

Guidehouse used a real-time Data Science Platform where complex technologies are abstracted away in a drag-n-drop UI, and easy to use widgets that help accelerate building of custom solutions. This Platform ingested structured and unstructured data that is publicly available to predict locations of potential fires, as well as define risk in a visual dashboard. The Platform helped ingest the data, transformed it to suit the models, helped with feature engineering and finally integrated with the right machine learning models to produce insights. These insights can be used to produce stunning visualizations to tell compelling stories for taking immediate actions.

Figure 1: Unstructured vs. Structured Data



[1] Sullivan, Emily, "88 Dead, 158 Still Unaccounted for After Camp Fire Contained", National Public Radio, November 27, 2018, https://www.npr.org/2018/11/27/671074763/88-dead-203-still-unaccounted-for-after-camp-fire-contained

[2] Penn, Ivan, "PG&E Chief is Out as Utility Faces California Fire Liability", The New York Times, January 13, 2019, https://www.nytimes.com/2019/01/13/business/energy-environment/pge-geisha-williams-wildfires.html?module=inline

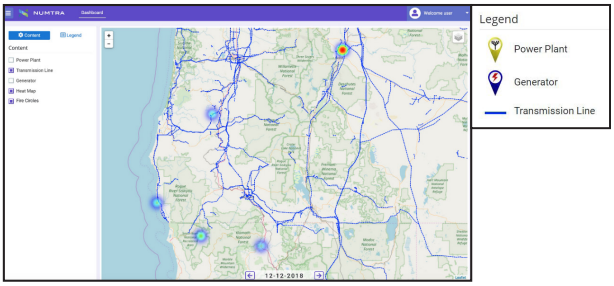
[3] "Oregon wildfire costs hit record high of $514 million in 2018", The Associated Press, October 11, 2018, https://www.oregonlive.com/wildfires/index.ssf/2018/10/oregon_wildfire_costs_hit_reco.html#incart_river_index.

[4] Calfas, Jennifer, "Smoke from California Wildfire is Reaching the East Coast: Here's What That Means for the Air Near You", TIME, August 10, 2018, http://time.com/5364151/california-wildfire-smoke-east-coast/

Using those insights, Guidehouse built an interactive web-based tool that allows users to track a fire by date and geographic region by selecting content to display on the map, with the option for a number of combinations. The back-end system continuously ingests and processes data and updates predictions. Predictions are turned into indicators that are converted to visual elements shown on the map pinpointing the location of potential fires.

The Fire Weather Index (FWI) System of the Canadian Forest Fire Danger Rating System (CFFDRS) is used to predict the weather inputs for the tool. The tool uses five main inputs to predict the weather: temperature, relative humidity, wind speed, rainfall (for the previous 24 hours), and the date of the data. The data goes through a number of stages before integrating with the machine learning model to do actual predictions, with the final stage being the interactive dashboard.

Figure 2: Interactive Dashboard



The dashboard provides the user flexibility, allowing them to choose from a dropdown menu from the left side and the map on the right side with a date picker on the bottom. The menu items are described below:

- **Power Lines:** Shows all the power lines on the map. This data is pulled from utility company websites.
- **Transmission Lines:** Shows all the power transmission lines on the web page, this data is pulled from the utility websites. In the picture above, the dotted blue lines are power lines.
- **Generators:** Shows all of the power generators on the map. This data is pulled from utility company websites.
- **Heat Map:** Show the magnitude in terms of distance of the fire spread on the map with a circular shade.
- **Fire Circle:** Depending on the color of the circle, it will show the intensity of the fire prediction. Intensity can be defined to mean potential economic impact, size, or other use cases that may be relevant to the user.
- **Wind Speed:** Show the wind speed of location if fire probability is higher user can estimate how fast fire will spread.
- **Precipitation:** Precipitation rate shows the anticipation of rain or snow fall in the region.

The above is a simplified view of some of the data elements capable of being brought into the dashboard. The dashboard is equipped to display other data elements customized for each client. The tool has proven to be successful at predicting fires and provide insight to users on what the immediate impact of a fire would look like on assets in the field. A case study that took place from July-December 2018 with the states of California and Oregon, the tool delivered real time predictions, resulting in a decrease of 5 minutes in user response time, 50% of fires being put out within two hours and an increase in advanced notifications by 100%.

Guidehouse (formerly part of the PwC network) is shining a light toward the future with actionable insights dedicated to inspiring breakthrough innovation. Helping achieve the mission of leadership teams across organizations with new levels of operational effectiveness.

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