Comparison of the Relationship of Weather to Fires in California in 2103, 2015, and 2018

Team 7 – Ben, Lori, Alimi

Hypothesis & Questions

2018 was the worst year of fire damage, with more than 1.8 million acres burned by wildland fires. That's the highest number of acres burned in the recorded history of California. 2018 was also one of the hottest years on record.

- Is there a relationship to climate, more specifically the daily weather, and the date a wildfire starts?
- Looking at locations by latitude and longitude and by year, are there patterns that exist between weather and fires?
- How does temperature, humidity, wind speed, and wind gust factor into the start of a fire? How did the weather influence the severity of the fire (based on the numbers of acres burned)?
- Are fires more severe in certain locations and at certain times in the year?

We asked these questions to determine some of the factors that can contribute to a fire breaking out.

Data Sources

For a list of recorded fires from 2013, 2015, and 2018, we used the incidents archive from CAL Fire (https://www.fire.ca.gov/). For historical weather by location (pulled from the locations of the fires listed on CAL Fire), we used the World Weather Online API (https://www.worldweatheronline.com/).

Data Exploration & Cleanup

The exploration process was the biggest part of the work we did. Getting the data from CAL Fire took a few tries as we needed to get the data from the website and format it in a way we could use it with the weather data. Getting the historical data was an elaborate process as we were unable to get data from the first source we identified (NOAA) and had to switch to a new source (the World Weather Online API). Then we had to match up the datasets so we could perform our analyses.

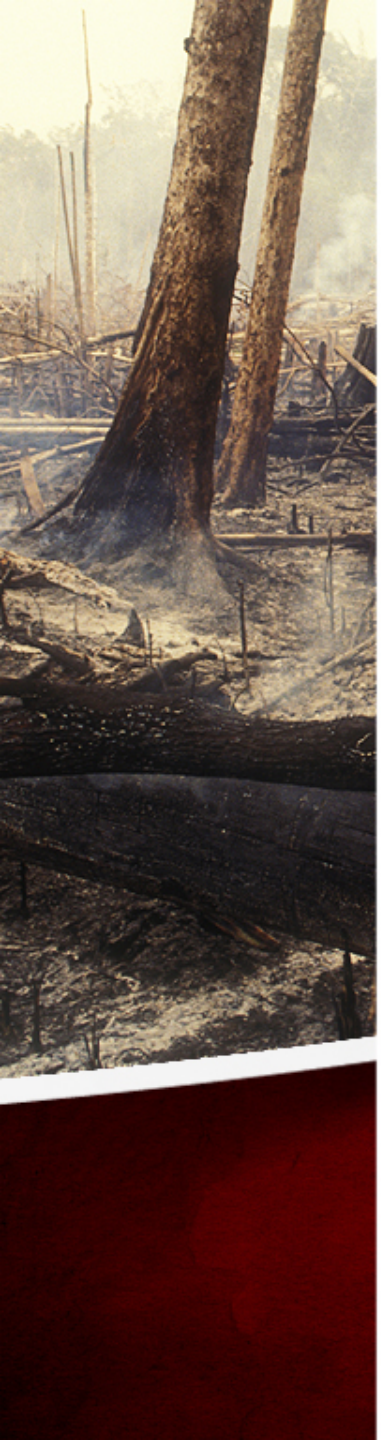
Summary of Findings

Our findings confirmed some of our assumptions, but not all of them. We found a relationship of temperature and humidity to the likelihood of a fire starting. We also found a correlation between temperature and the size of the fire. We did not determine a pattern influenced by location, wind speed, or wind gust.

However, because we compared the weather data on the date the fire started, we lost a lot of valuable data in regards to how the weather changed throughout the duration of the fire and what effect that had on the fire.

Data Analysis

To analyze the data we collected and answer the questions we asked, we created several charts and plots to compare weather variables with fire statistics. Some of our assumptions were validated, while others were not. Overall, we did find a positive relationship of weather to both the date a fire started and to the size of fire.



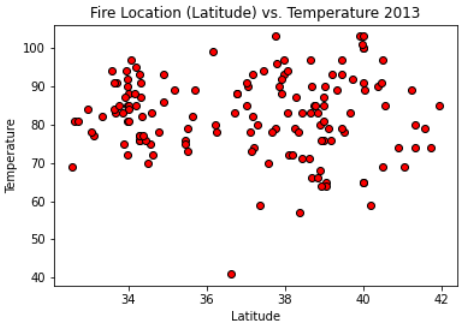
Plotting the Data: Location of the fire by Latitude vs. Temperature on the date the fire started

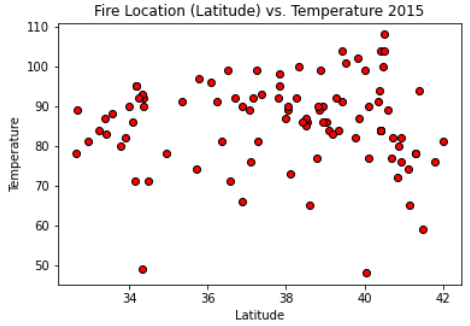
- Is there a relationship of the high temperature to the date a fire breaks out?
- How do the temperatures by latitude (north vs south) impact the start of a fire?
- Do higher temperatures lead to more fires?

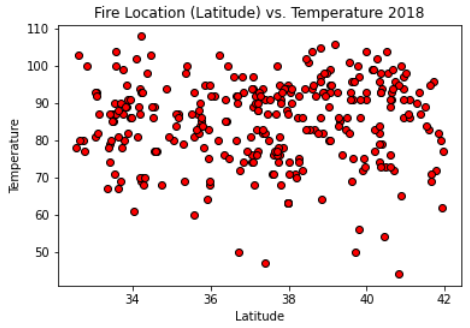
Conclusion:

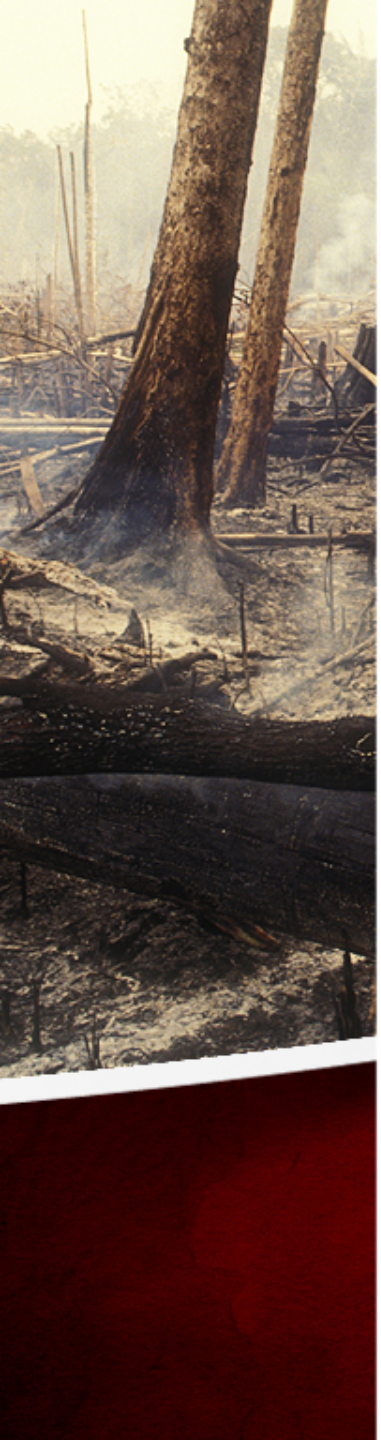
Yes, based on this data, higher temperatures can contribute to the start of a fire.

Lower latitudes = Southern California
Higher latitudes = Northern California









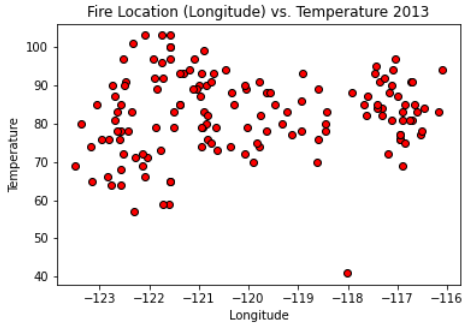
Plotting the Data:
Location of the fire by Longitude vs. Temperature on the date the fire started

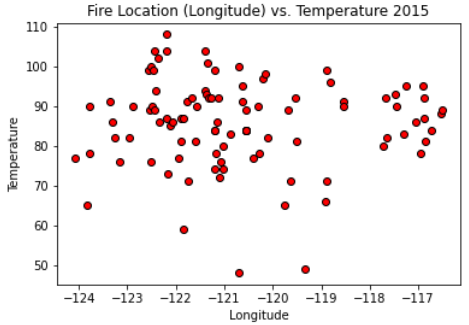
- Is there a relationship of the high temperature to the date a fire breaks out?
- How do the temperatures by longitude (east vs west) impact the start of a fire?
- Do higher temperatures lead to more fires?

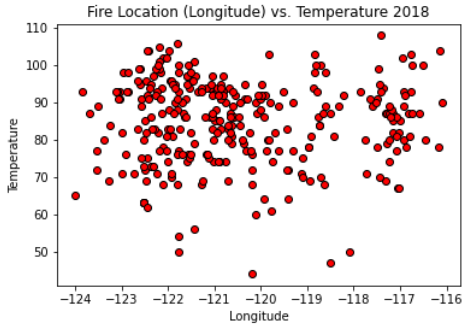
Conclusion:

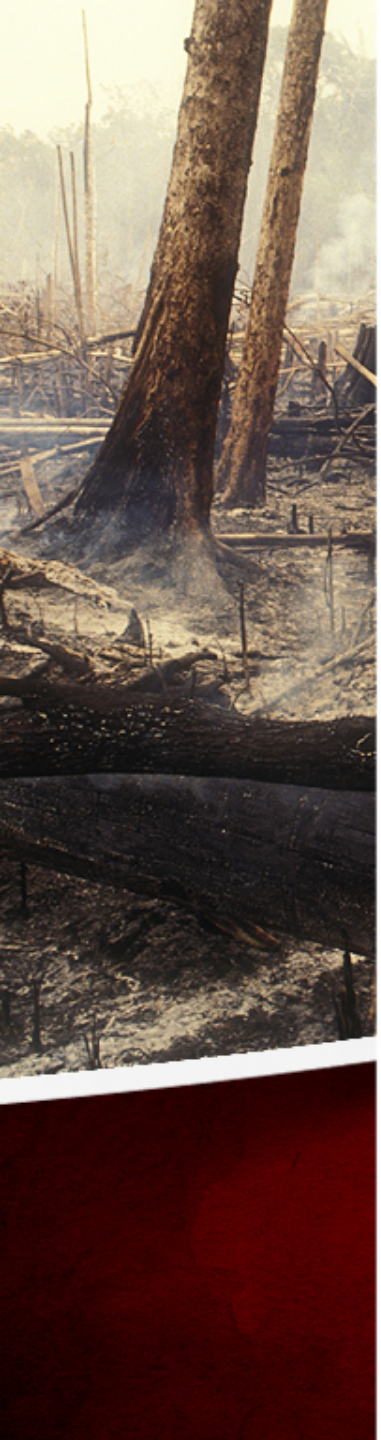
Yes, based on this data, higher temperatures can contribute to the start of a fire.

Lower longitude = Western California
Higher longitude = Eastern California









Plotting the Data: Location of the fire by Latitude vs. Humidity on the date the fire started

- Is there a relationship of humidity levels to the date a fire breaks out?
- How does humidity by latitude (north vs south) impact the start of a fire?
- Do lower humidity levels (drier conditions) lead to more fires?

Conclusion:

Yes, based on this data, lower humidity rates in 2013 and 2018 did contribute to the start of a fire. However, the data is not consistent for 2015.

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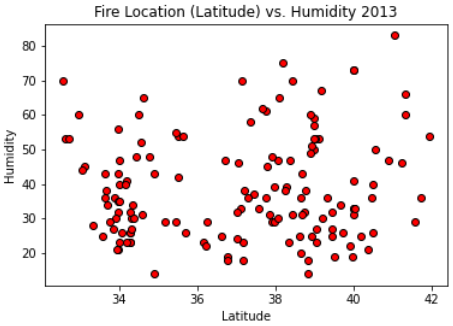

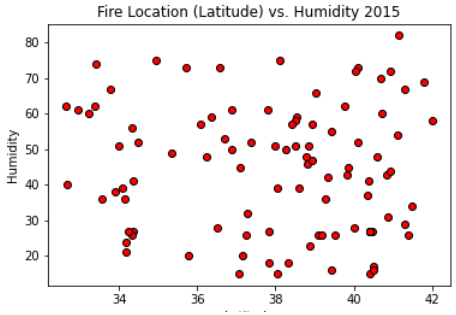

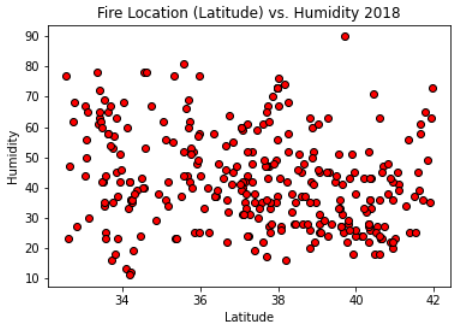

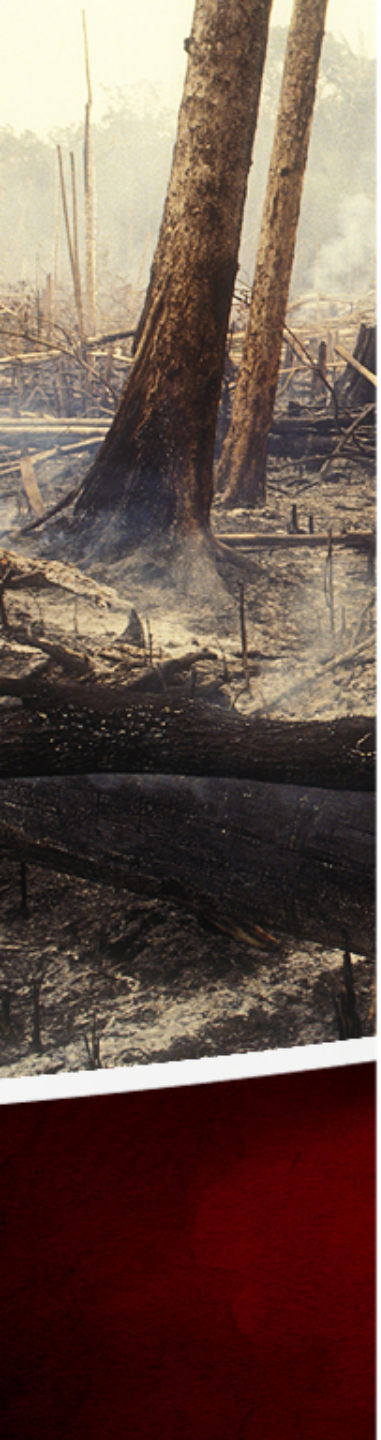

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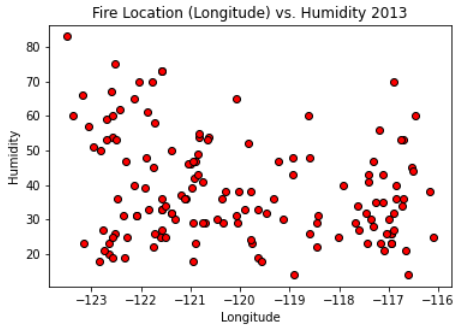
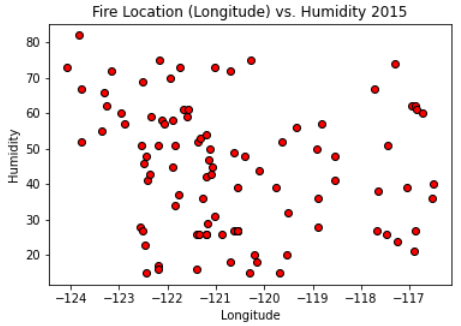
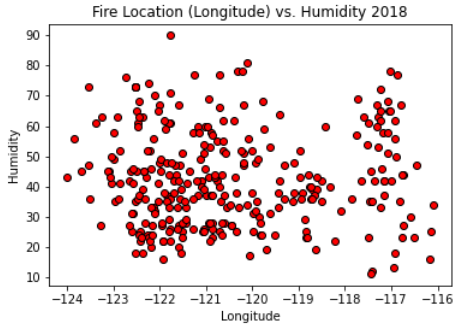
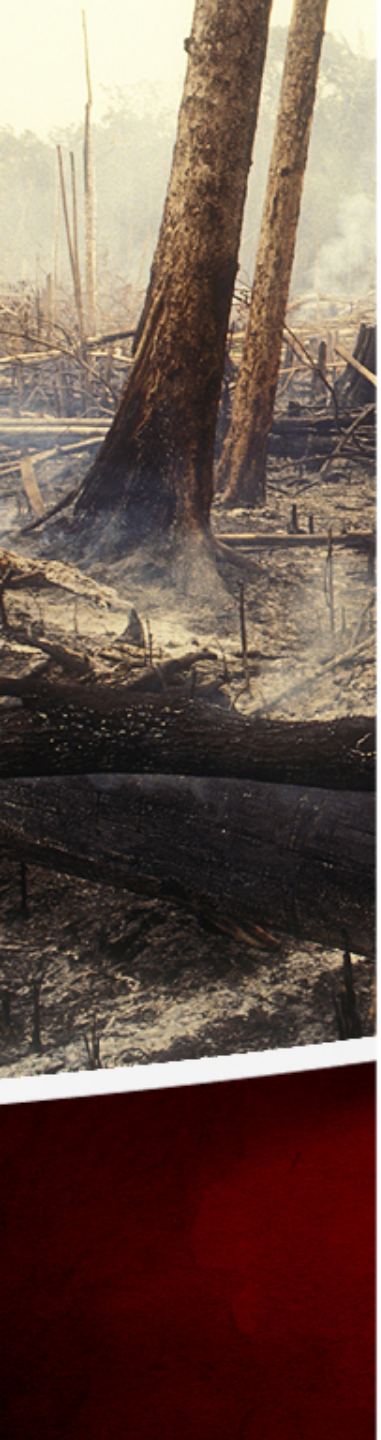






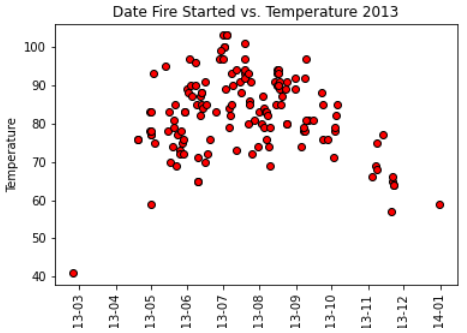


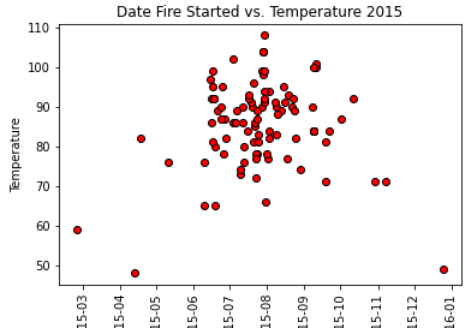
Plotting the Data: Weather Conditions the Day a Fire Starts - Temperature

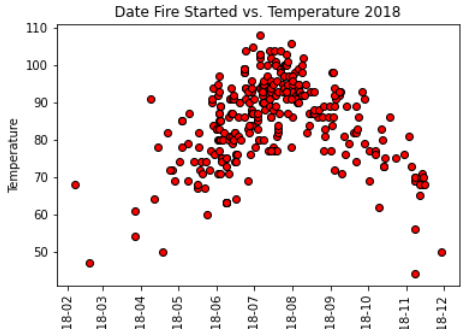
- Does the daily weather conditions increase the likelihood a fire will break out?
- Do higher temperatures lead to fires?
- Is there a “fire season” when fires are more likely to break out?

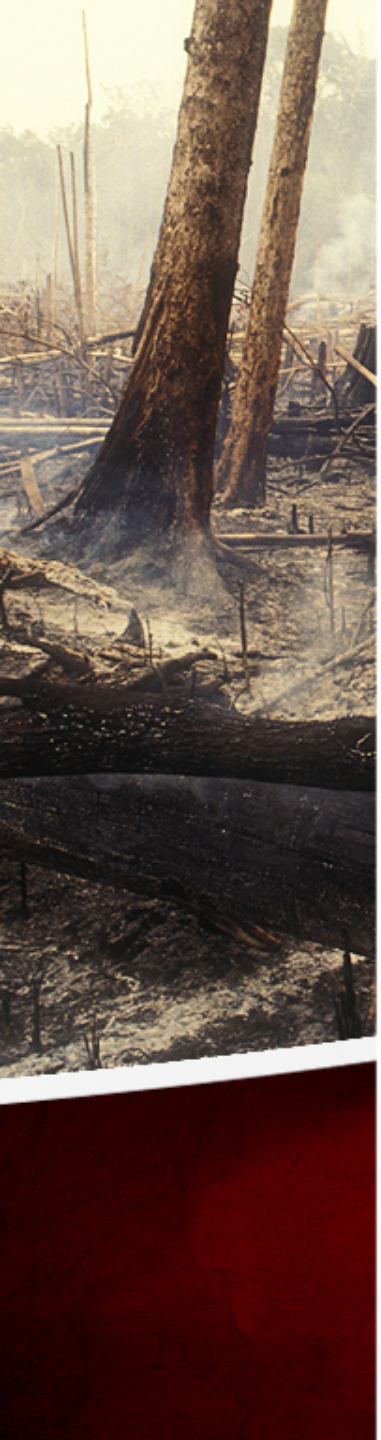
Conclusion:

Fire season was contained to a handful of months in the year. However, during the worst year ever of fires in California (2018), fires broke out every month, especially when the temperatures were higher.







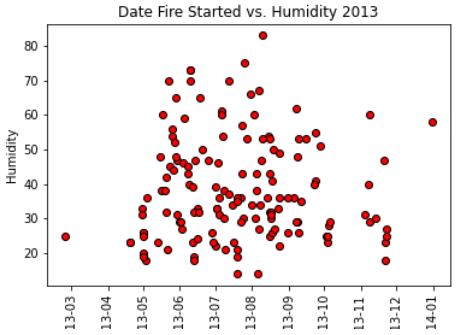


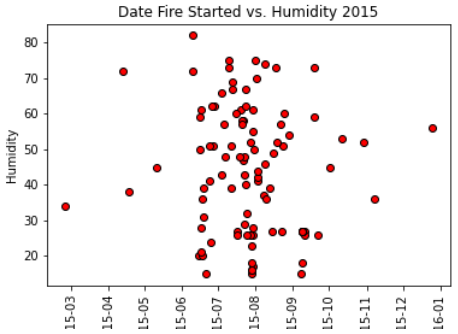
Plotting the Data: Weather Conditions the Day a Fire Starts - Humidity

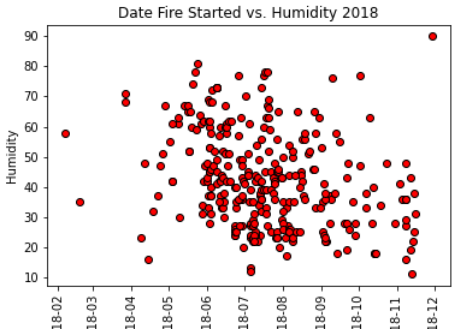
- Does the daily weather conditions increase the likelihood a fire will break out?
- Do humidity levels lead to fires?
- Is there a “fire season” when fires are more likely to break out?

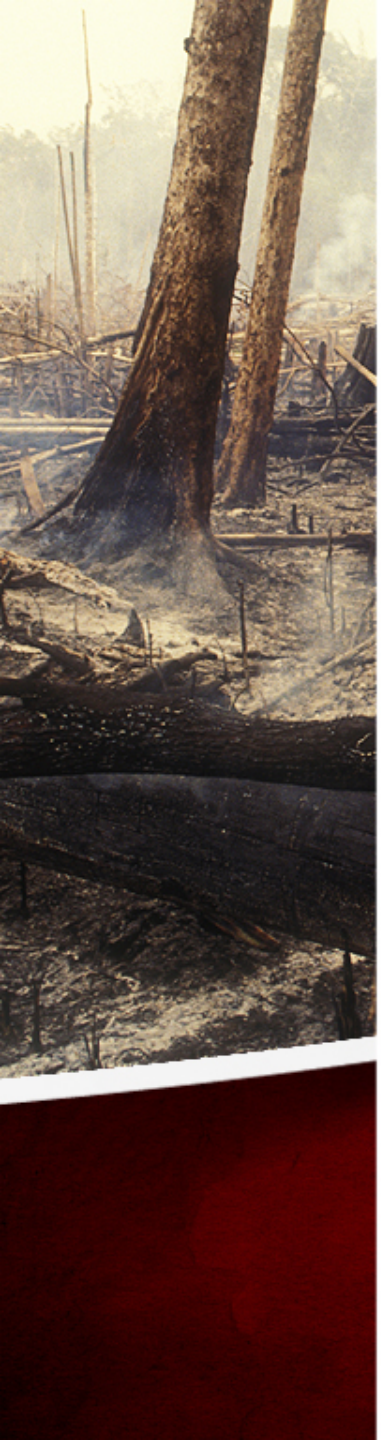
Conclusion:

Lower levels of humidity do have some effect on fires breaking out.







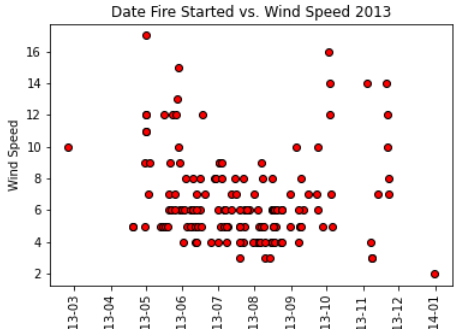


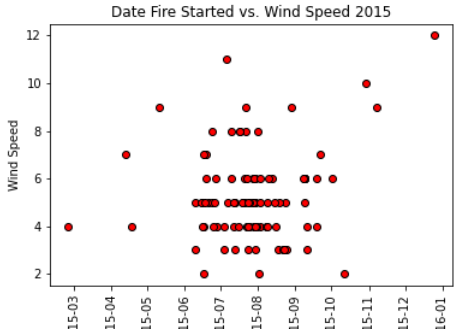
Plotting the Data: Weather Conditions the Day a Fire Starts – Wind Speed

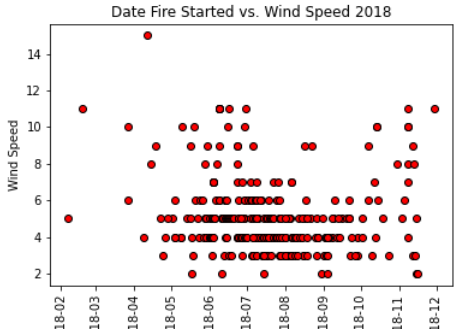
- Does the daily weather conditions increase the likelihood a fire will break out?
- Do higher wind speeds lead to fires?

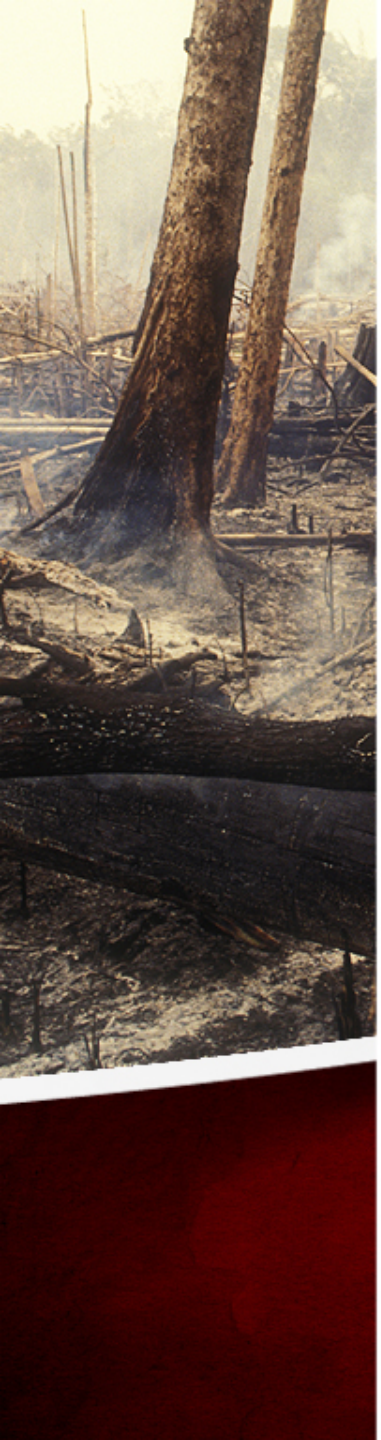
Conclusion:

No, higher wind speeds do not lead to a greater chance a fire will break out.







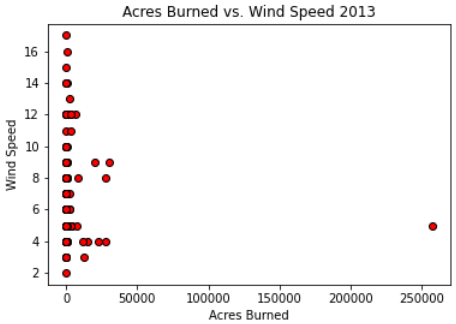


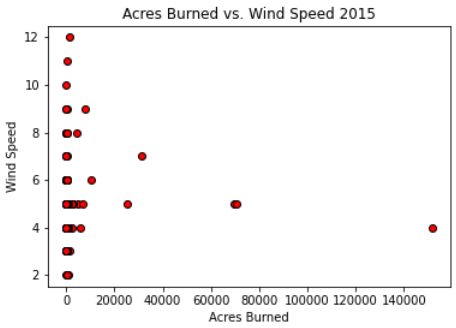
Plotting the Data: Size of Fire vs Wind Speed

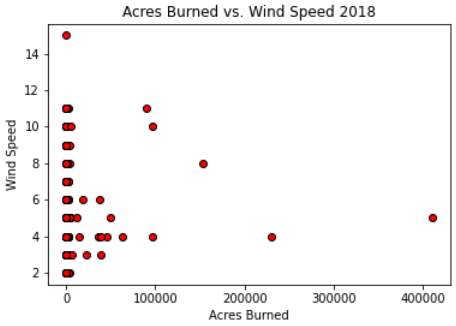
- Is there a relationship of wind speed on the day a fire starts to the size of a fire in acres burned?
- Do windier conditions lead to larger fires?

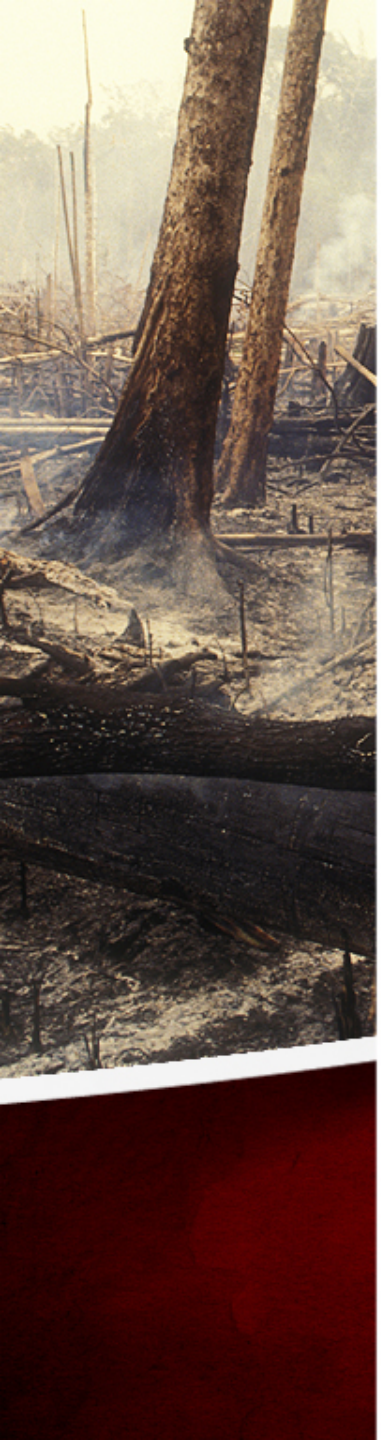
Conclusion:

No, based on this data, higher winds do not lead to larger fires.







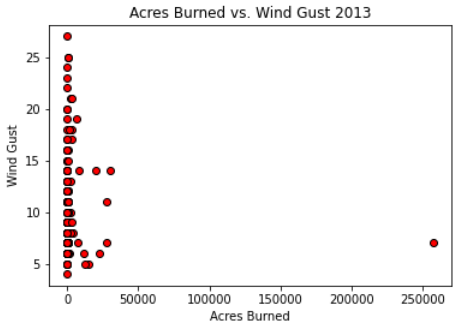


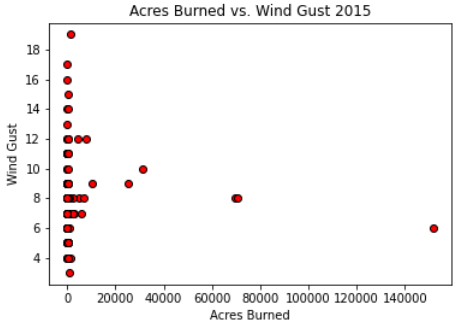
Plotting the Data: Size of Fire vs Wind Gusts

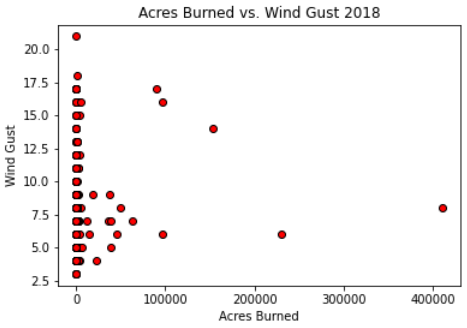
- Is there a relationship of wind gusts on the day a fire starts to the size of a fire in acres burned?
- Do higher wind gusts lead to larger fires?

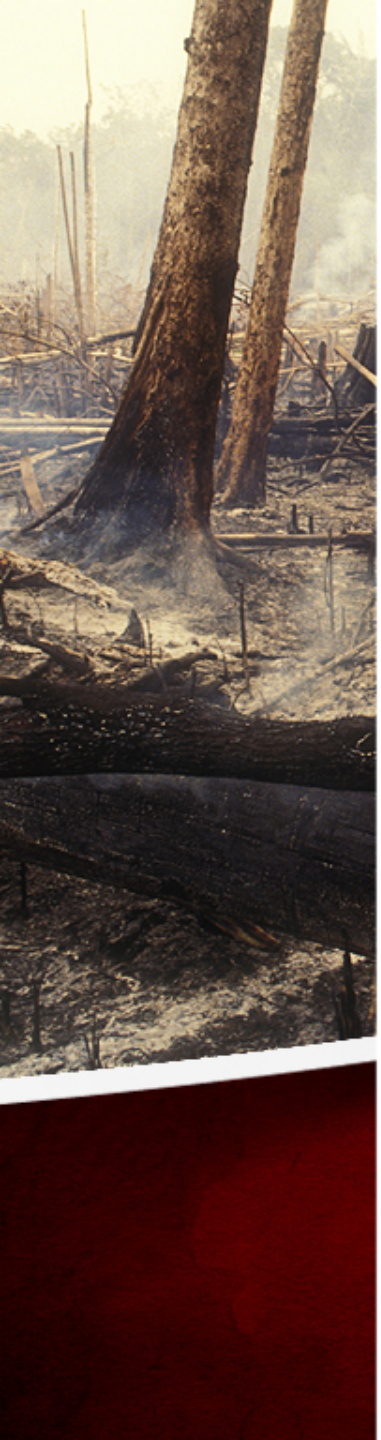
Conclusion:

No, based on this data, higher wind gusts do not lead to larger fires.

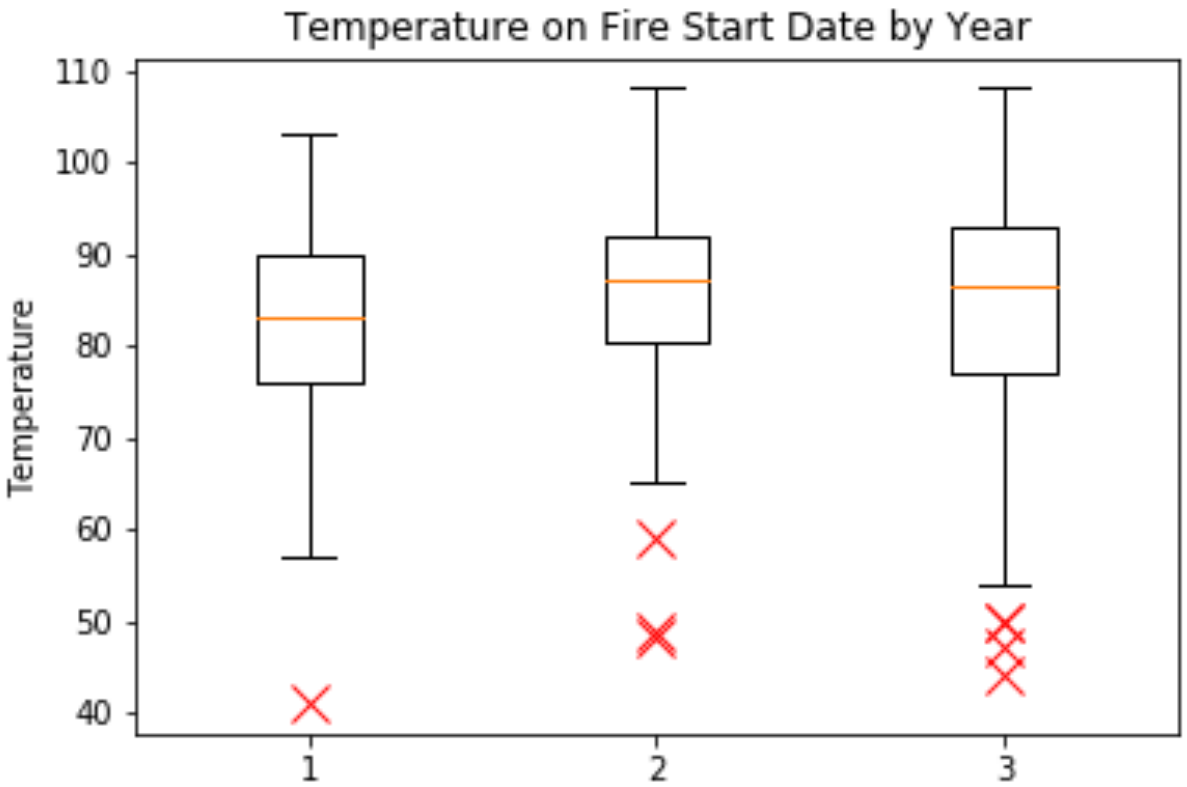


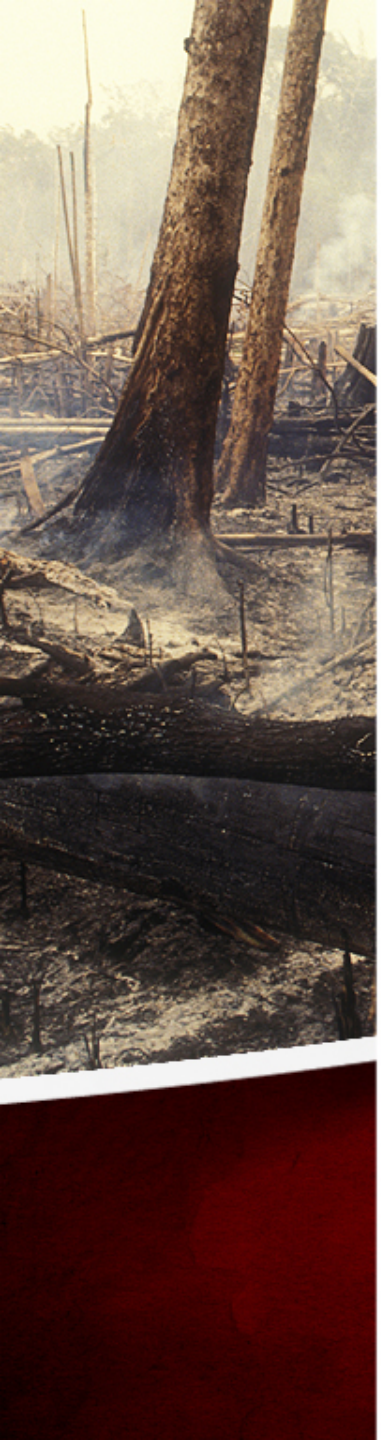




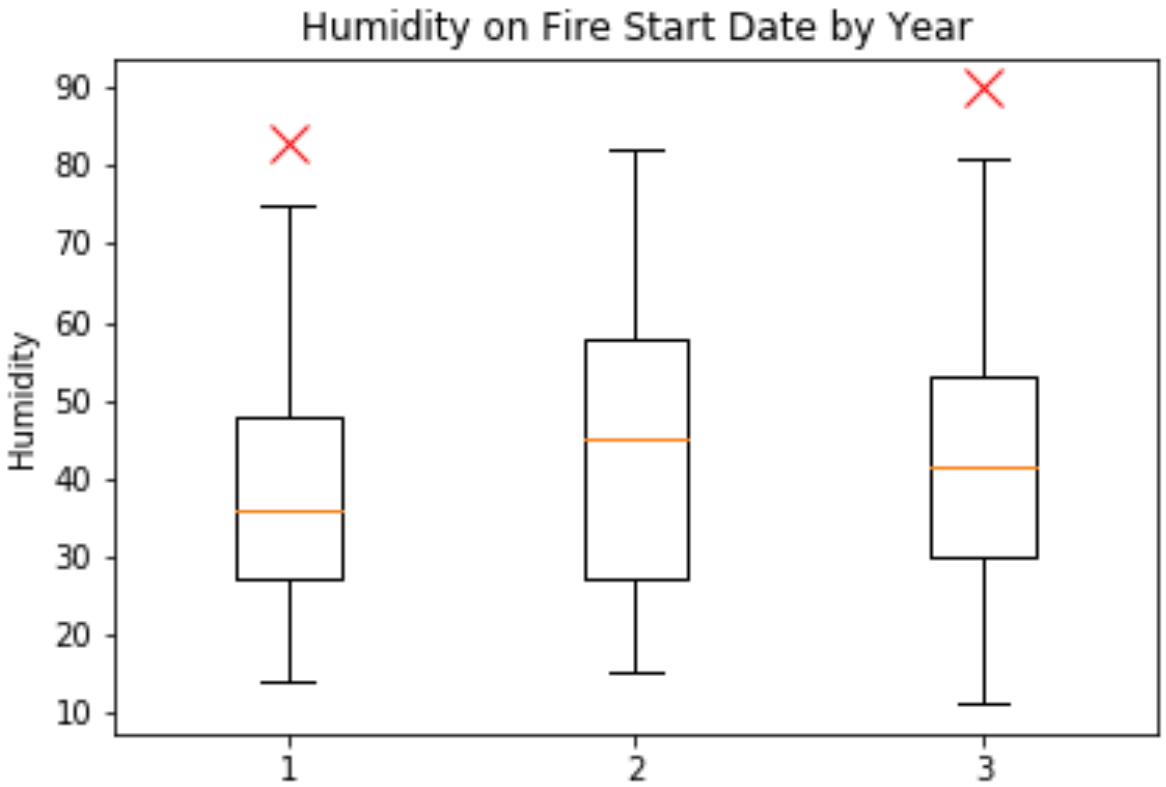


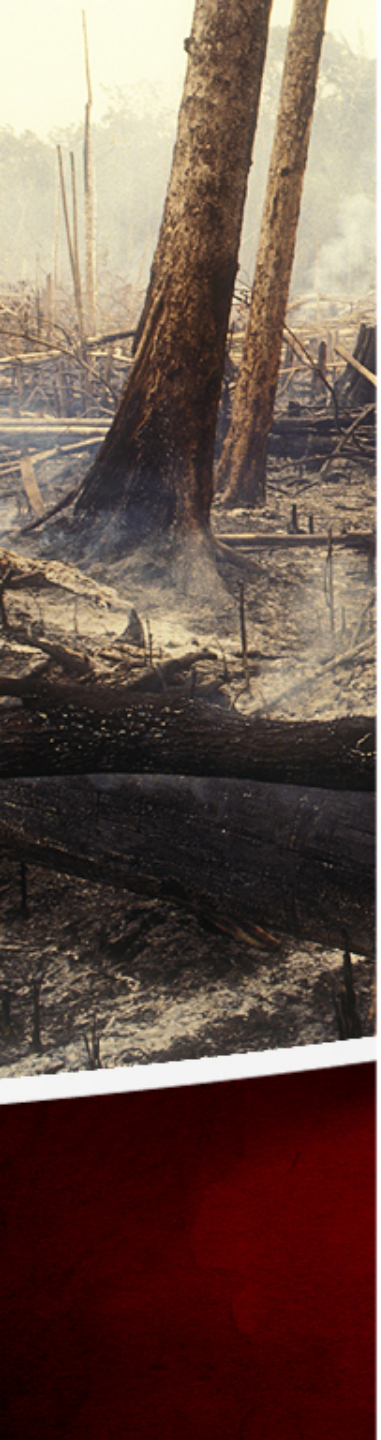
Plotting the Data:
Comparing Temperature by Years





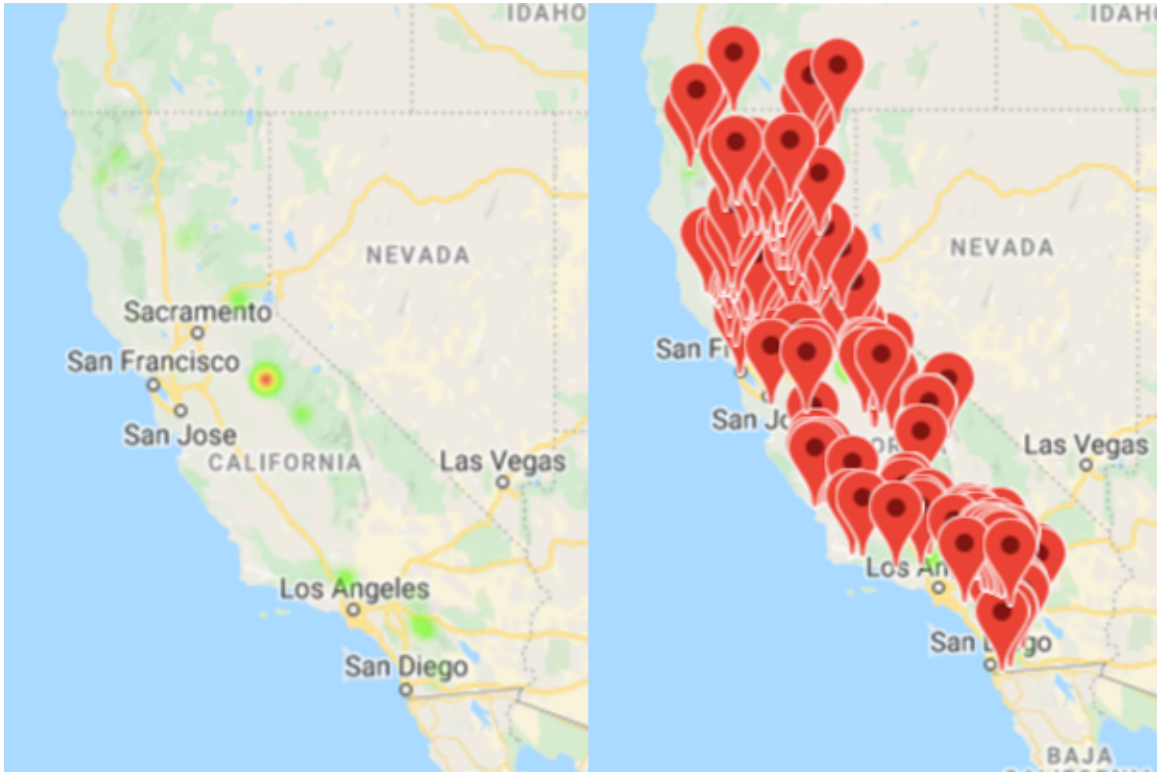
Plotting the Data:
Comparing Humidity by Years

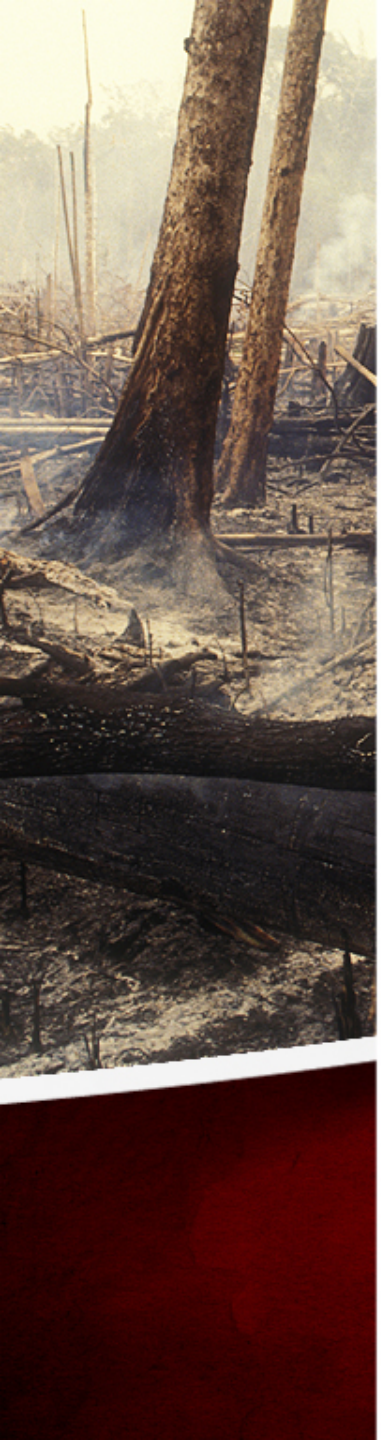




Visualizing the Data – 2013

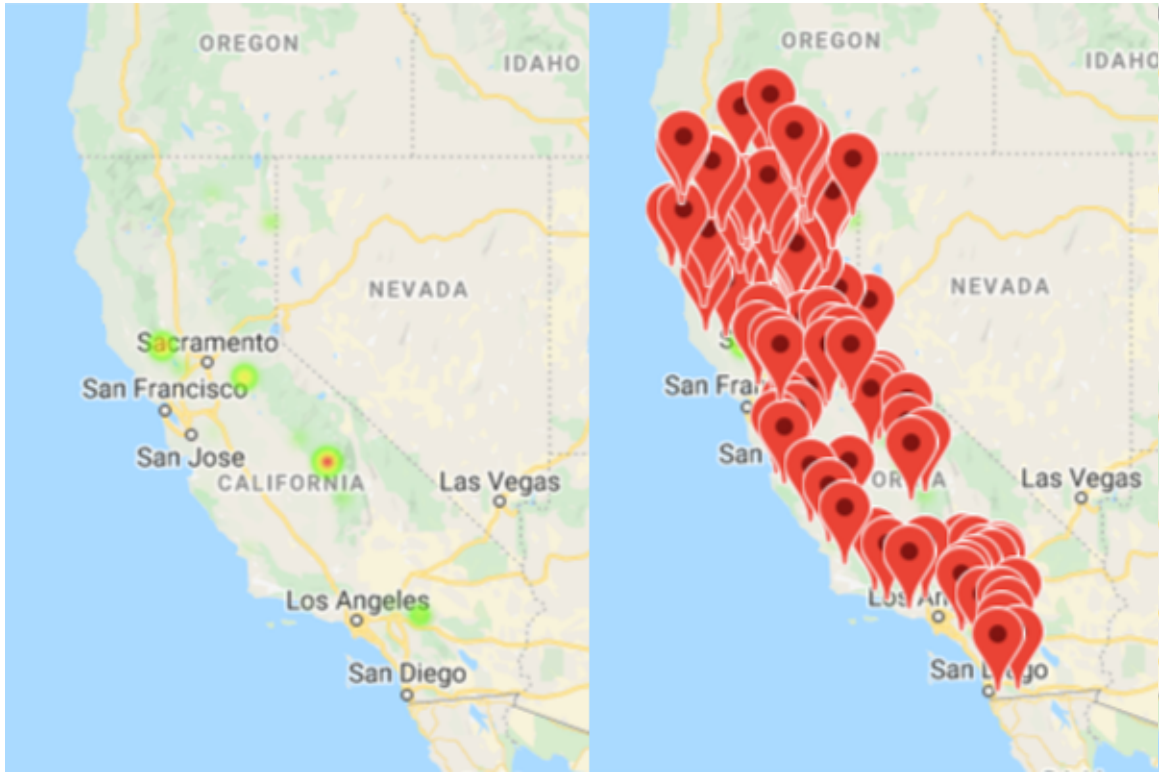
Illustrations of fire sizes and locations

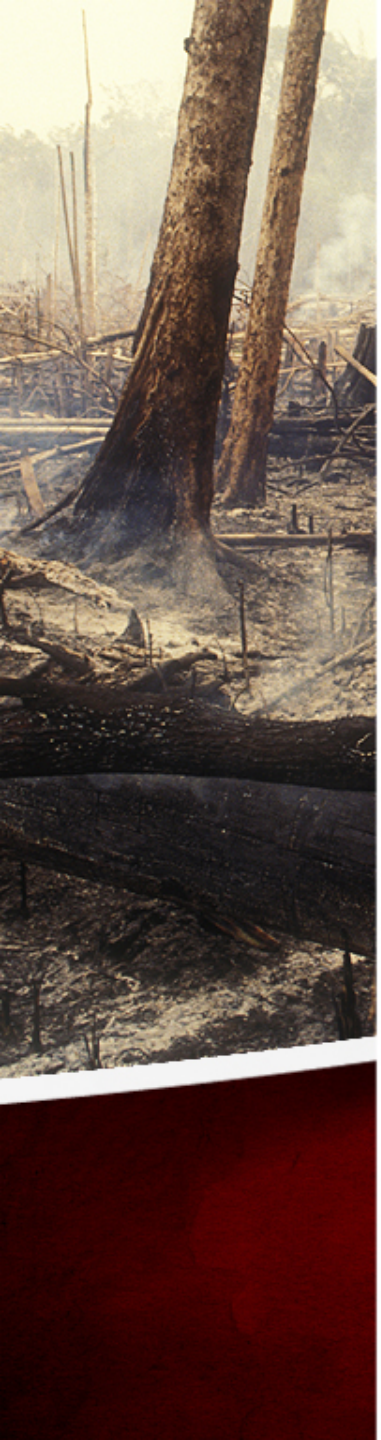




Visualizing the Data – 2015

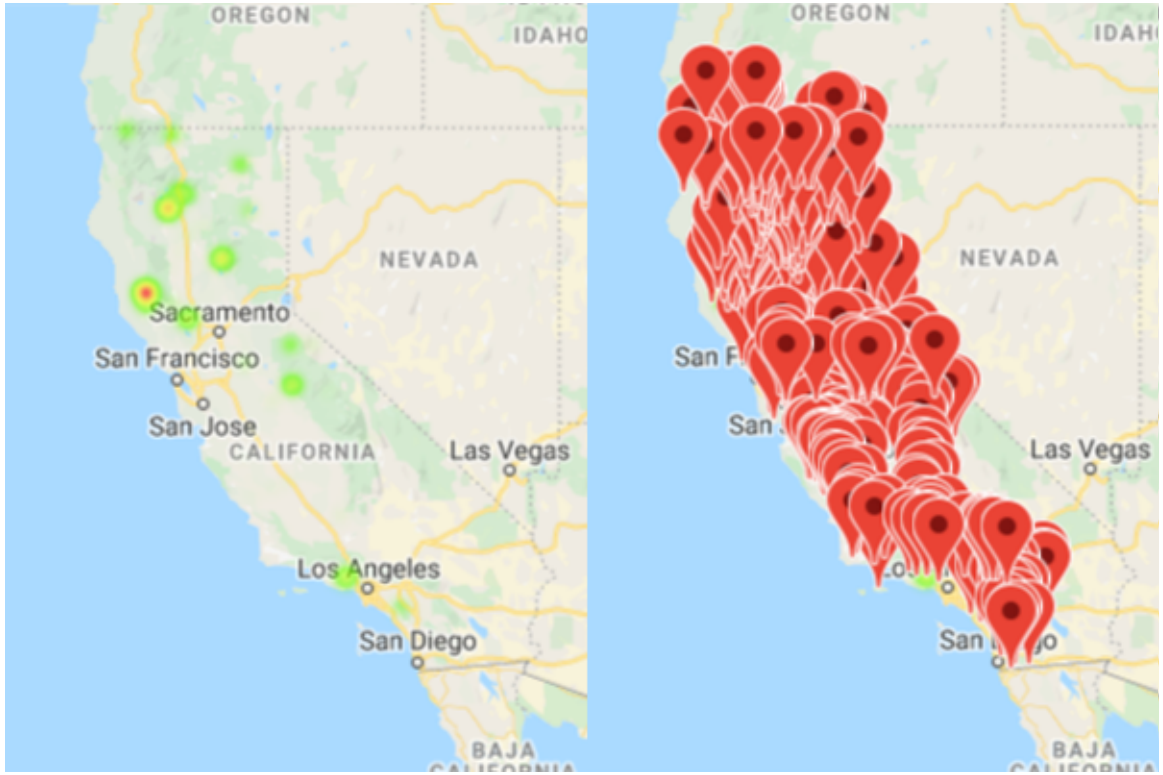
Illustrations of fire sizes and locations

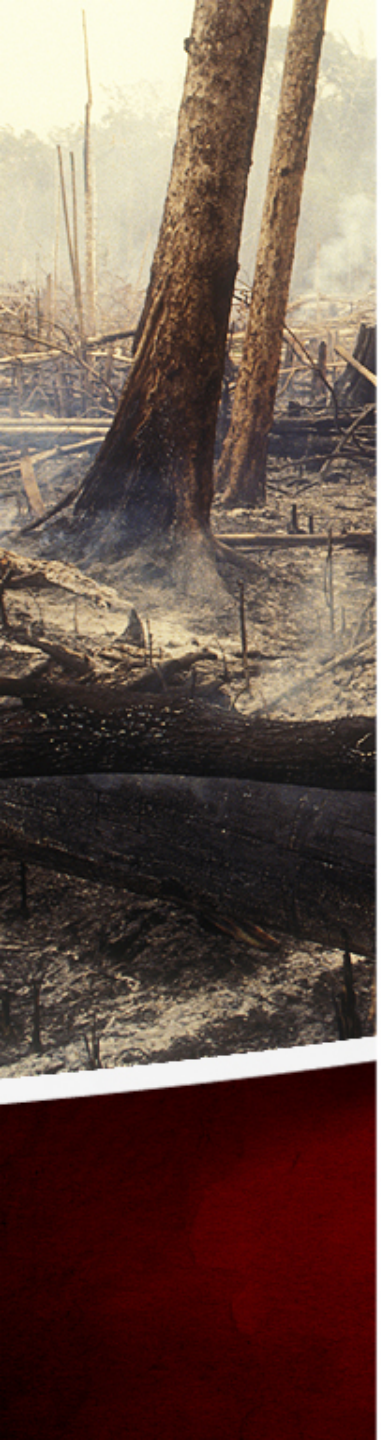




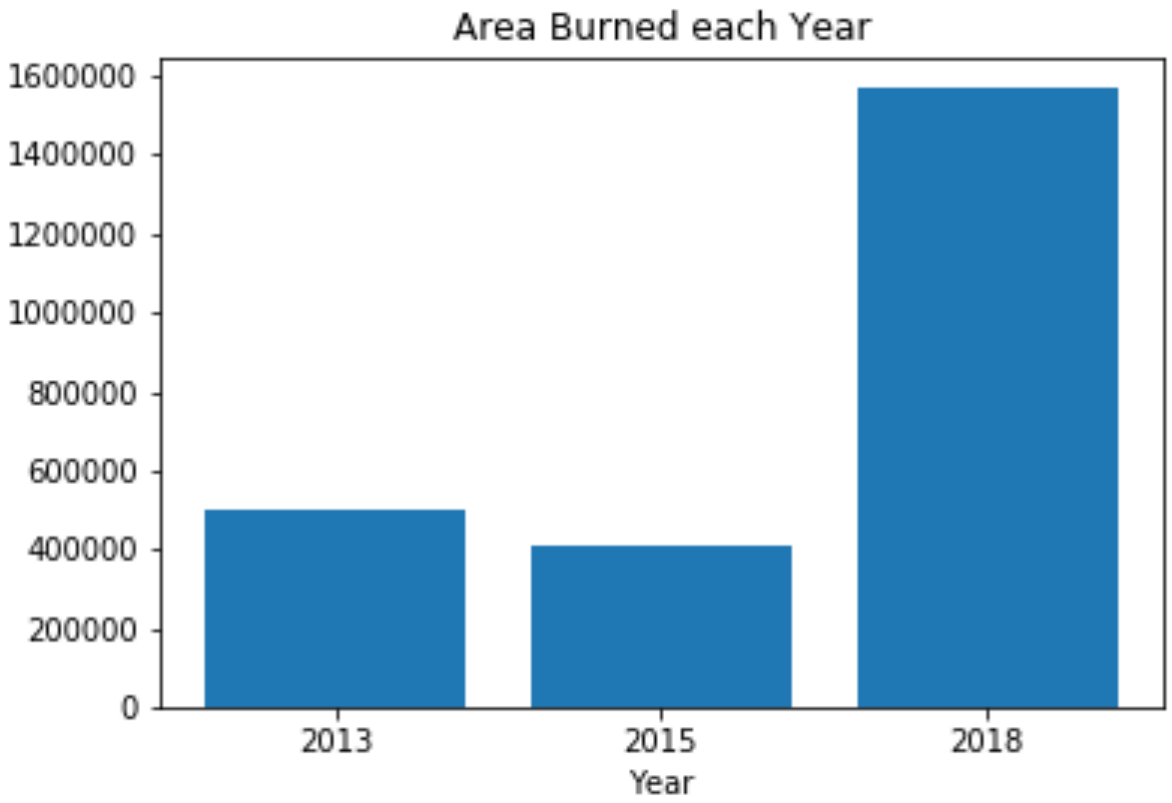
Visualizing the Data – 2018

Illustrations of fire sizes and locations





Visualizing the Data



Discussion & Post Mortem

Our findings confirmed some of our assumptions, but not all of them. We found a relationship between temperature and humidity to the likelihood of a fire starting. We also found a correlation between temperature and the size of the fire. We did not determine a pattern influenced by location, wind speed, or wind gust.

Given more time to gather additional data and conduct further analysis, we would look at weather throughout the entire duration of each fire incident. We believe there would be benefits at looking at the weather variables during a fire to see how those variables impacted fires, and, in turn, if fires change the weather.

Questions?

Questions, comments, or concerns?

Thank you!