

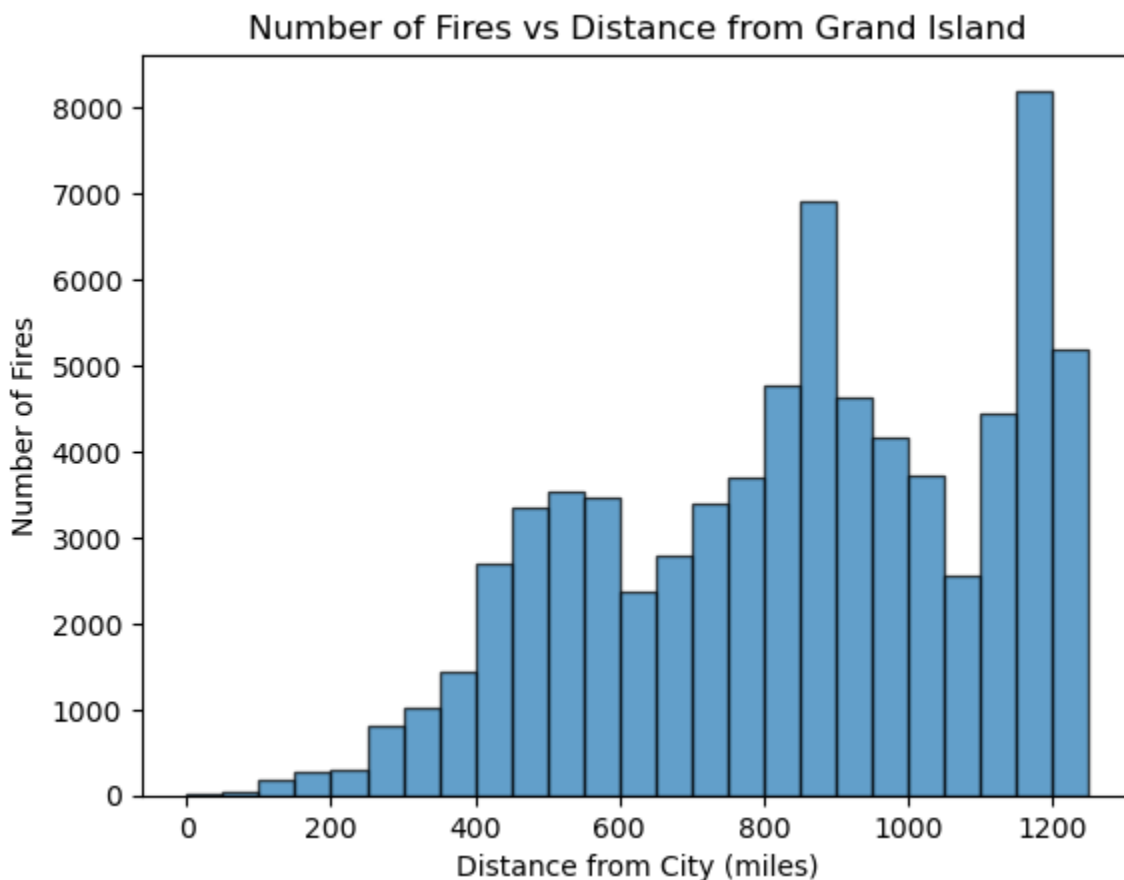
# Wildfire Smoke Estimation

## Part 1 - Common Analysis and Reflection

For this project, I was researching the wildfire smoke impact on Grand Island city located in the Hall County of Nebraska. The wildfire data extracted is based from 1963-2020.

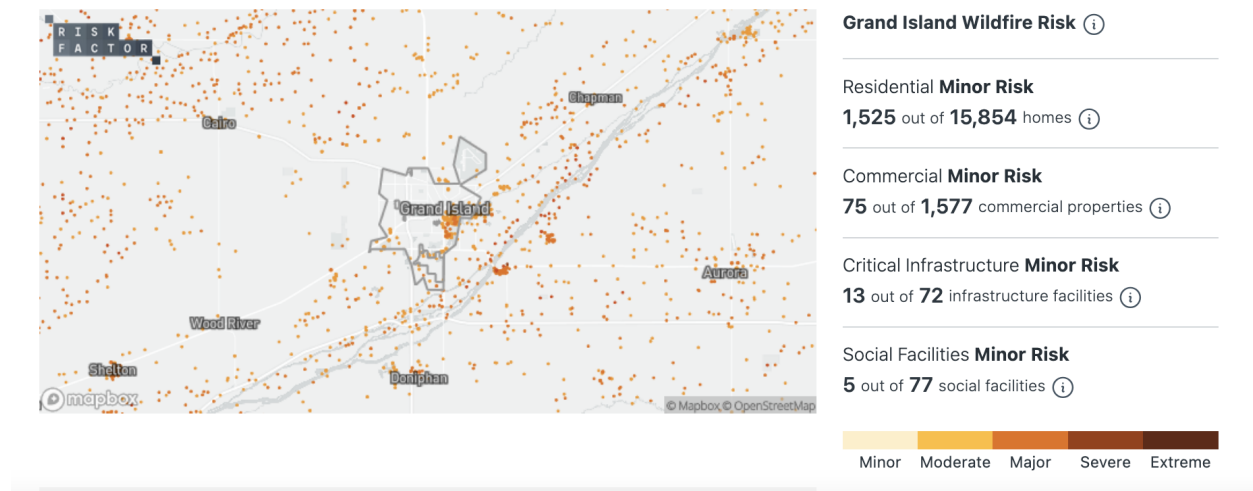
While doing the exploratory data analysis, I explored these 4 visualizations and tried to gain insights from it.

- A histogram showing the number of fires occurring every 50 mile distance from your assigned city up to the max specified distance



In the histogram above, the y-axis denotes the number of fires and x-axis represents how far from the city the wildfire occurred. The x-axis is broken up into segments of 50 miles. We observe that as the distance from the city increases, there is an upward trend in the amount of fires increasing.

According to this [website](#), the risk factor for wildfire indeed increases as distance from the city increases. The image below is sourced from the same website. See the orange and red spots near the city.



This can happen due to a lot of reasons, mainly areas within the city will have lesser vegetation and more commercial/residential buildings made of concrete. These factors can influence the spread of a wildfire:

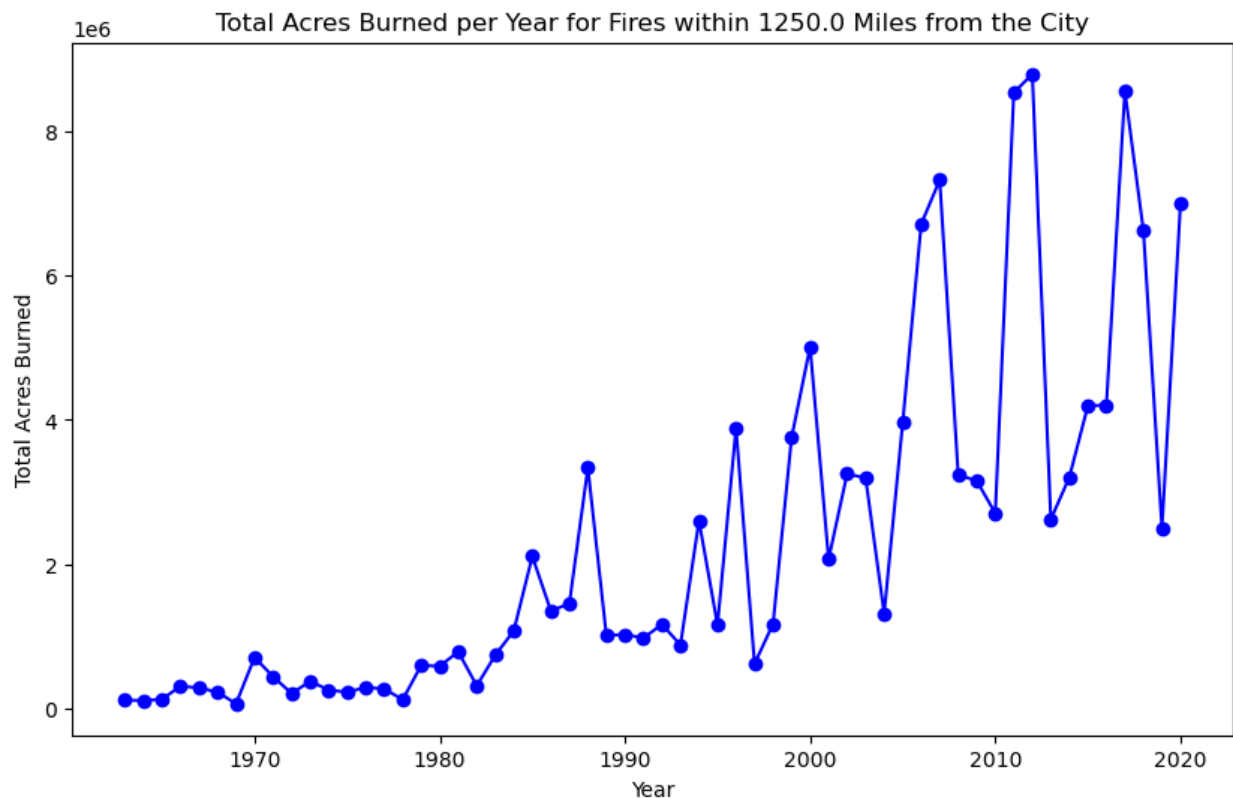
**Climate and Weather Conditions:** Dry and hot weather conditions increase the risk of wildfires. Factors such as low humidity, high temperatures, and extended drought periods contribute to the likelihood of wildfires.

**Vegetation Type:** The type and condition of vegetation in an area play a crucial role. Dry and dead vegetation is more susceptible to ignition, and areas with a high density of flammable vegetation pose a higher risk.

**Topography:** The landscape and topography can influence the speed and direction of a wildfire. Steep slopes and canyons, for example, can accelerate the spread of fires.

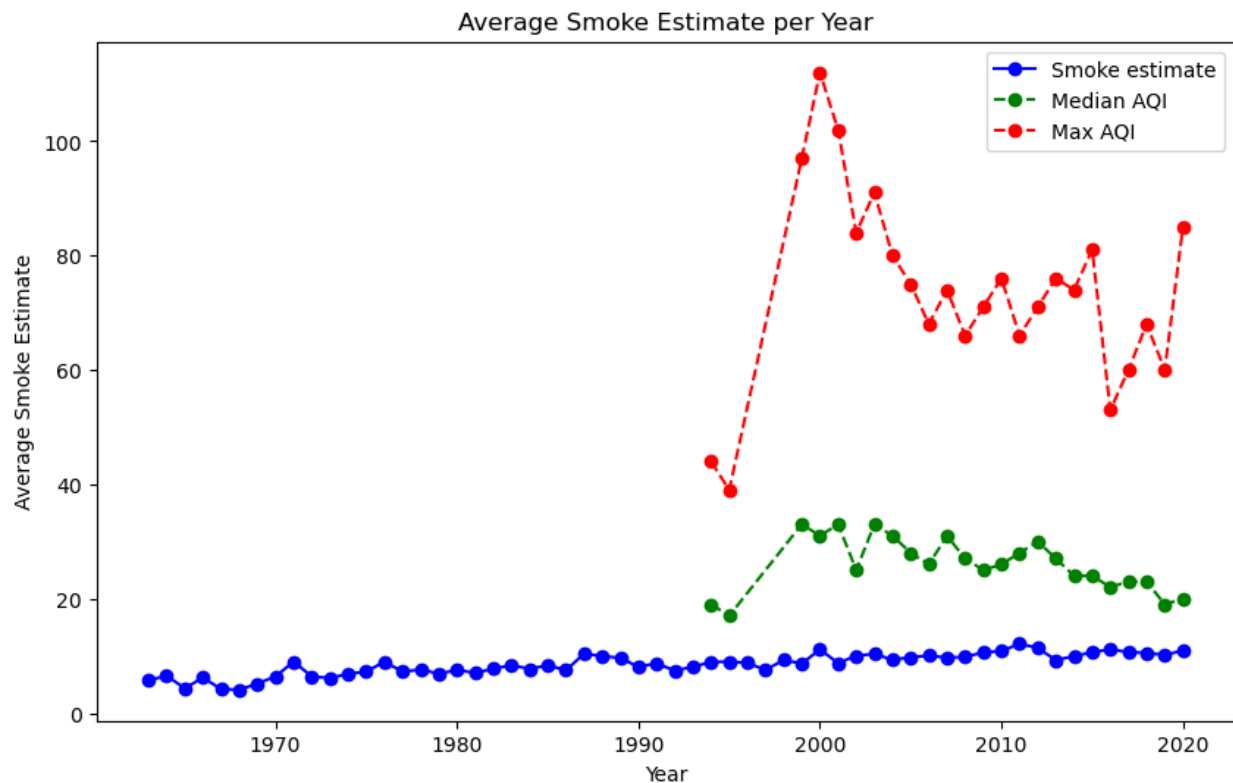
**Human activities,** including campfires, discarded cigarettes, and equipment use, can be significant contributors to wildfires.

- A time series graph of total acres burned per year for the fires occurring in the specified distance from your city



The above graph represents a time series analysis of total acres burned (y-axis) vs Year of wildfire (in x-axis). All of these wildfires were reported within 1250 miles radius of the city of Grand Island. We notice that the acres burnt by wildfire have significantly risen in the last 20 years. One reason for this may be attributed to climate change. According to this [website](#), the extent of area burned by wildfires each year appears to have increased since the 1980s. According to National Interagency Fire Center data, of the 10 years with the largest acreage burned, all have occurred since 2004, including the peak year in 2015 (see Figure 2). This period coincides with many of the warmest years on record nationwide (see the U.S. and Global Temperature indicator). The largest increases have occurred during the spring and summer months. Drought conditions have persisted in eastern and central Nebraska and harvest and hunting activities can present an increased risk for wildfires. In 2020, Nebraska experienced a significant number of wildfires, due to drought conditions and increased wildfire risk statewide.

- A time series graph containing your fire smoke estimate for your city and the AQI estimate for your city



The time series graph above shows the Average Smoke Estimate and AQI per year for the last 60 years. For Grand Island city, we note that the AQI measure is available from 1994.

I calculated the average smoke estimate based on size of acres burnt (fire\_size) and proximity to Grand City. I assigned a higher weight to fire\_size because the larger the fire the more smoke it will generate even though its far from the city.

#### **# Define a weight for fire size and proximity**

fire\_size\_weight = 0.7

proximity\_weight = 0.3

#### **# Calculate normalized values for fire size and proximity**

normalized\_fire\_size = fire\_acres / wf\_size\_max

normalized\_proximity = (distance\_max - distance\_to\_city) / distance\_max

#### **# Calculate smoke estimate based on weighted average**

smoke\_estimate = (fire\_size\_weight \* normalized\_fire\_size + proximity\_weight \* normalized\_proximity) \* 100

We notice that as the number of fires increases over time , the smoke estimate also increases.

The average smoke estimate is also different from the AQI (Air Quality Index) which is based on the particulate pollutant in the air. According to this [website](#), "The higher the AQI value, the greater the level of air pollution and the greater the health concern. For example, an AQI value of 50 or below represents good air quality, while an AQI value over 300 represents hazardous air quality".

AQI Basics for Ozone and Particle Pollution			
Daily AQI Color	Levels of Concern	Values of Index	Description of Air Quality
Green	Good	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Yellow	Moderate	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Orange	Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Red	Unhealthy	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Purple	Very Unhealthy	201 to 300	Health alert: The risk of health effects is increased for everyone.
Maroon	Hazardous	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

Image Source: [AirNow.gov](#)

The AQI data that I curated for Grand Island is based on the Annual AQI estimate for Hall County. Based on the metrics collected from 1994 -2020, we notice that the median AQI is well below 50, but the max AQI sometimes went into Orange zone (above 100) in the 1998 and then steadily became better between 2000-2010. So air quality is between Good and moderate zones in the last decade. The Average smoke estimate slightly increases over the years, it does impact Air Quality Index.