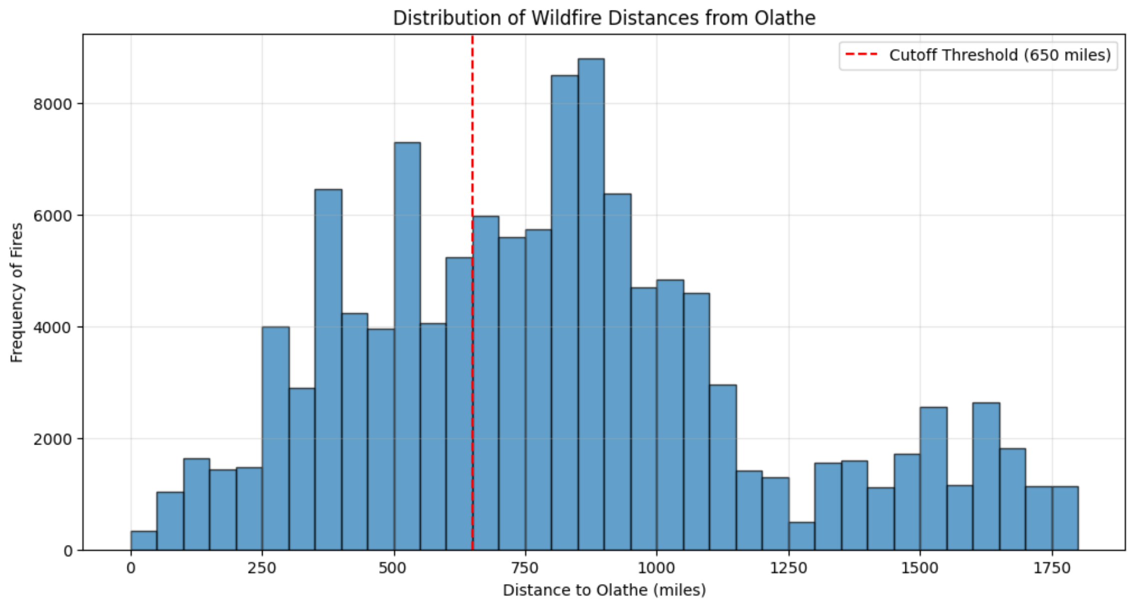
Visualization Explanations

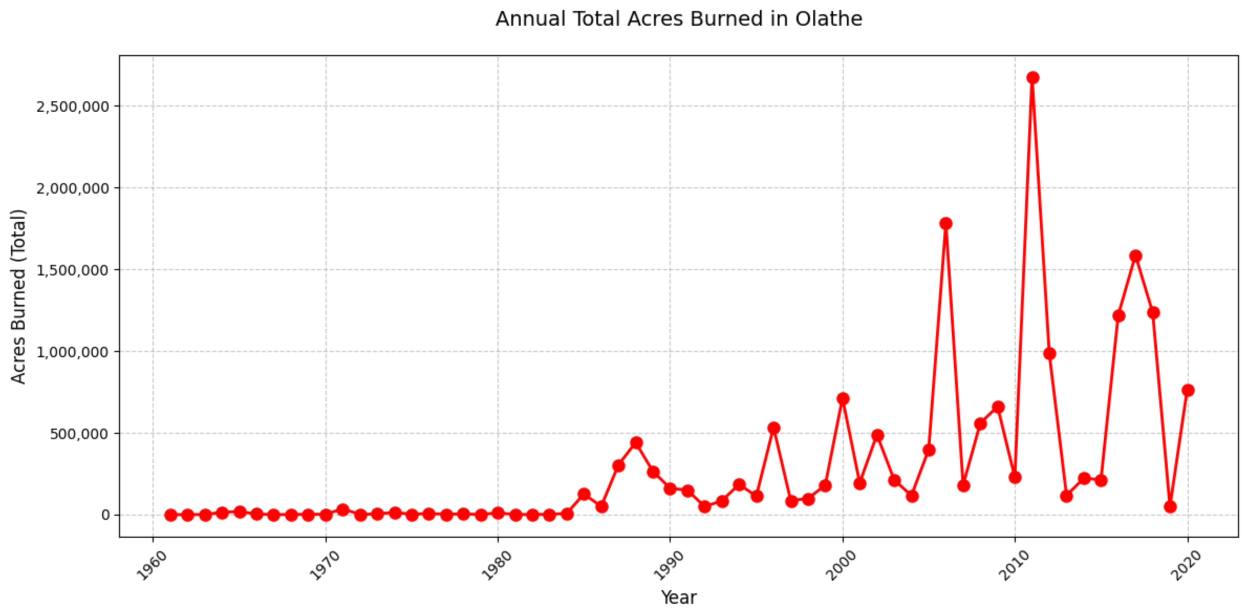
Visualization 1 : Histogram of Wildfires by distance from Olathe, Kansas



This histogram gives a clear look at how wildfires are spread across the United States in relation to Olathe, Kansas. The x-axis shows distances from Olathe, reaching up to 1,800 miles and divided into 50-mile intervals, while the y-axis shows the number of fires within each interval, with some intervals seeing over 10,000 fires. To calculate these distances accurately, the data was transformed from its original format to latitude and longitude coordinates, allowing precise distance measurements from Olathe's location (38.88°N, -94.81°W) using the geodesic formula.

Looking closer, we see three main patterns in the wildfire spread. First, there's a noticeable cluster around 500-600 miles, then another spike between 800 and 1,000 miles. These clusters likely reflect specific environmental or regional conditions that contribute to fire frequency at these distances. A red dashed line at 650 miles marks a boundary where the potential air quality impact for Olathe is considered significant, dividing the data into zones that highlight where nearby fires could influence local air quality. This histogram, with its 50-mile binning approach, provides an easy-to-understand visualization, helping fire management teams, air quality specialists, and emergency planners gauge wildfire risks and plan responses based on how close the fires are to Olathe.

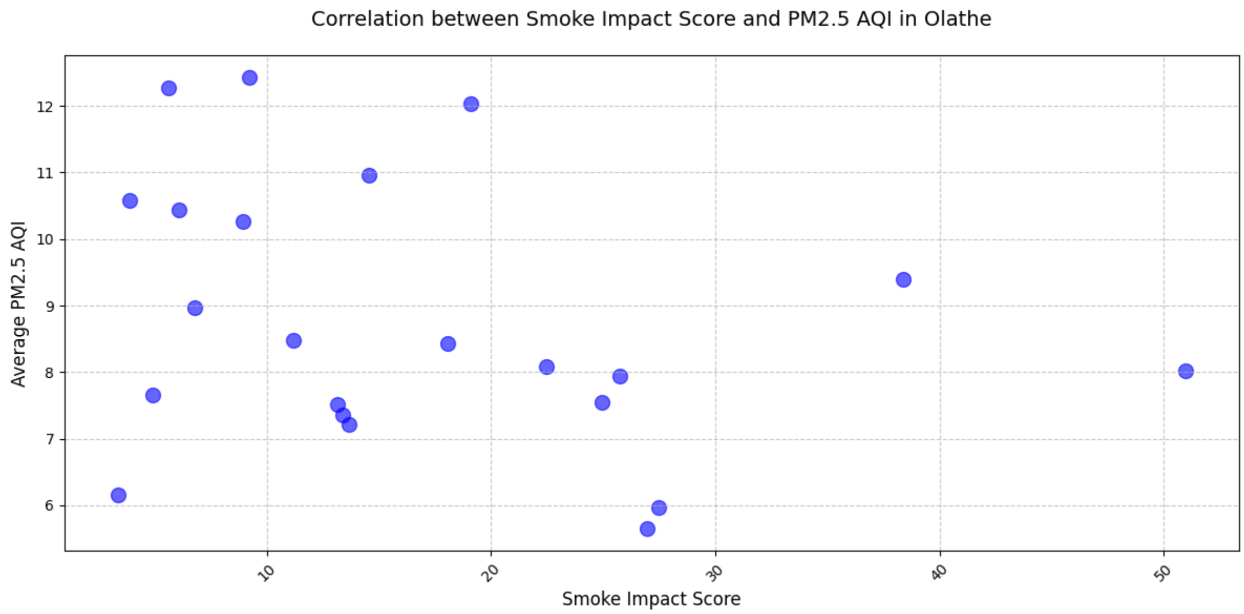
Visualization 2 : Wildfires Burn Trends over time in Olathe, Kansas



This line graph gives a clear picture of wildfire impacts near Olathe, Kansas, by tracking the annual total burned acreage from 1960 to 2020. The x-axis marks time in decades, while the y-axis shows acres burned, reaching up to 2,500,000 in some years. Each year's burned area is shown with green data points connected by lines, and a dashed grid overlay makes reading values easier. The data points to three key phases: a stable period from 1960 to the late 1980s with consistently low burned acreage, a period of variability in the 1990s with peaks around 600,000 acres, and a sharp increase from 2005 onwards, hitting unprecedented levels, especially around 2011.

Within a 650-mile radius of Olathe, these peaks likely indicate intense fire seasons with high smoke production, which could impact air quality in the region. The trend shows a marked rise in fire activity from the 2000s onward, likely due to climate change, shifting weather patterns, or changes in forest management. Tracking this historical trend is crucial for understanding potential smoke exposure in Olathe over time, and the graph serves as a useful tool for gauging long-term wildfire patterns and their possible impacts on local air quality.

Visualization 3 : AQI vs Smoke Impact Score in Olathe, Kansas



This box plot gives a clear look at the relationship between wildfire smoke impacts and air quality in Olathe, Kansas, by comparing Smoke Impact Scores with Air Quality Index (AQI) values for PM 2.5. On the x-axis, we have the Smoke Impact Score, a custom measure ranging from 0 to 50 that combines wildfire size and distance, while the y-axis shows AQI values for PM 2.5, ranging from 6 to 12, which reflect pollution levels. Each horizontal line represents a specific data point pairing, showing how the scores and AQI values line up across different measurements and revealing a complex, non-linear connection between them.

The Smoke Impact Score is calculated based on three main factors: (1) a distance weight that emphasizes fires within 250 miles of Olathe and decreases to zero by 650 miles; (2) a fire size adjustment using cube root scaling to keep extreme values manageable; and (3) a baseline impact threshold for fires over 100,000 acres. The data spread shows quite a bit of variability, with AQI values not always tracking directly with Smoke Impact Scores, suggesting that other factors, like weather and topography, also play a role. While higher Smoke Impact Scores often coincide with increased AQI levels, the scattered pattern across the plot highlights that Olathe's air quality is influenced by more than just wildfire proximity and size. This visualization helps provide a nuanced view of how different wildfire factors affect urban air quality in Olathe., making it a valuable tool for environmental scientists and public health officials who monitor and analyze air quality trends.

Calculation of the Smoke Impact Score

The Smoke Impact Score in this project was designed to gauge how wildfire smoke affects air quality in Olathe, Kansas. This custom score takes into account both fire size (in acres) and distance from Olathe, with a function specifically calibrated to match observed PM2.5 levels.

Key components:

1. **Distance Factor**: Fires within 250 miles have the highest impact, with influence gradually dropping to zero at 650 miles using a linear rather than an inverse-square relationship.
2. **Fire Size Scaling**: Fire size is scaled using a cube root, which keeps extreme values in check, and a scaling factor is applied to maintain consistency across different fire sizes.
3. **Baseline Impact**: Fires over 100,000 acres have a minimum impact level, ensuring that large fires contribute to the score even if they're farther away.

This method captures both the intensity and proximity of wildfires, aligning more closely with real air quality patterns than simpler distance-based models.

Insights from the Visualization

The scatter plot shows a non-linear relationship between the Smoke Impact Score and AQI values for PM2.5. Higher scores generally correspond to elevated AQI, but the spread of data points suggests other factors, like weather, topography, and local air regulations, are also influencing Olathe's air quality. This variability highlights that wildfire smoke impacts on urban air quality are more complex than distance and size alone.

Reflections on Model Development

Initially, I expected a straightforward relationship between fire characteristics and AQI, but further research showed that AQI is shaped by more variables like wind and atmospheric conditions. I used a geodesic calculation for distance, which was more precise than a simple Euclidean approach, especially over larger distances. Collaboration proved valuable; a peer's suggestion to use cube-root scaling for fire size was key to improving the model, making it align better with AQI data.

Findings and Next Steps

The less-than-expected correlation between the Smoke Impact Score and AQI highlighted the need to account for other factors, like wind and weather, which can impact smoke movement. Going forward, incorporating meteorological data could improve the model's accuracy and provide a fuller picture of how wildfire smoke affects air quality in Olathe. This project reinforced the importance of collaboration, detailed modeling, and flexibility in working with complex environmental data.