

# Spatio-Temporal Trends of Historic Wildfires: Using the NASA RECOVER Historic Fires Database to Perform Long-term Analysis of Wildfire Occurrence in the Western United States



Jonah Davis, Idaho State University GIS TReC

## Abstract

An analysis of historic wildfires in the western United States provides discernment of long-term trends in historic wildfire occurrence. Understanding these trends and the spatial distribution patterns of wildfire aids in providing relevant decision support to both land management agencies and the public. The NASA RECOVER decision support system's historic fires database contains all fire areas documented between 1950 and 2017 for 11 western states. Statistical analysis of the spatio-temporal patterns of these wildfires was conducted using geographic information systems (GIS) software. Analysis of annual fire frequency and acres burned revealed a near exponential growth in fire frequency ( $R^2 = 0.74$ ) and size ( $R^2 = 0.68$ ) since 1950 across the western US. During this same time, the mean and median acres burned per year suggests the occurrence of mega-fire events is also increasing. The mean size of fires occurring in the 1950's was 1,550 acres. In the current decade, mean fire size has more than doubled, reaching an average of 3,478 acres. Similar analysis by state provides finer resolution and provides the most relevant decision support for a given state. This analysis revealed similar exponential trends in fire frequency and burned area with the exceptions of Idaho and California, which follow a linear trend. While wildfire events are increasing in all states, this result suggests Idaho and California have experienced more consistent fire events since 1950.

## Introduction

Fires over the past 67 years follow a semi-clumped distribution suggesting the occurrence of wildfires are not random. The tendency of a fire to occur is dependent on a host of complex and interacting factors like weather, previous-fires, vegetation, topography, and human activities. These elements combine to form complex systems that influence the wildfires occurrence.

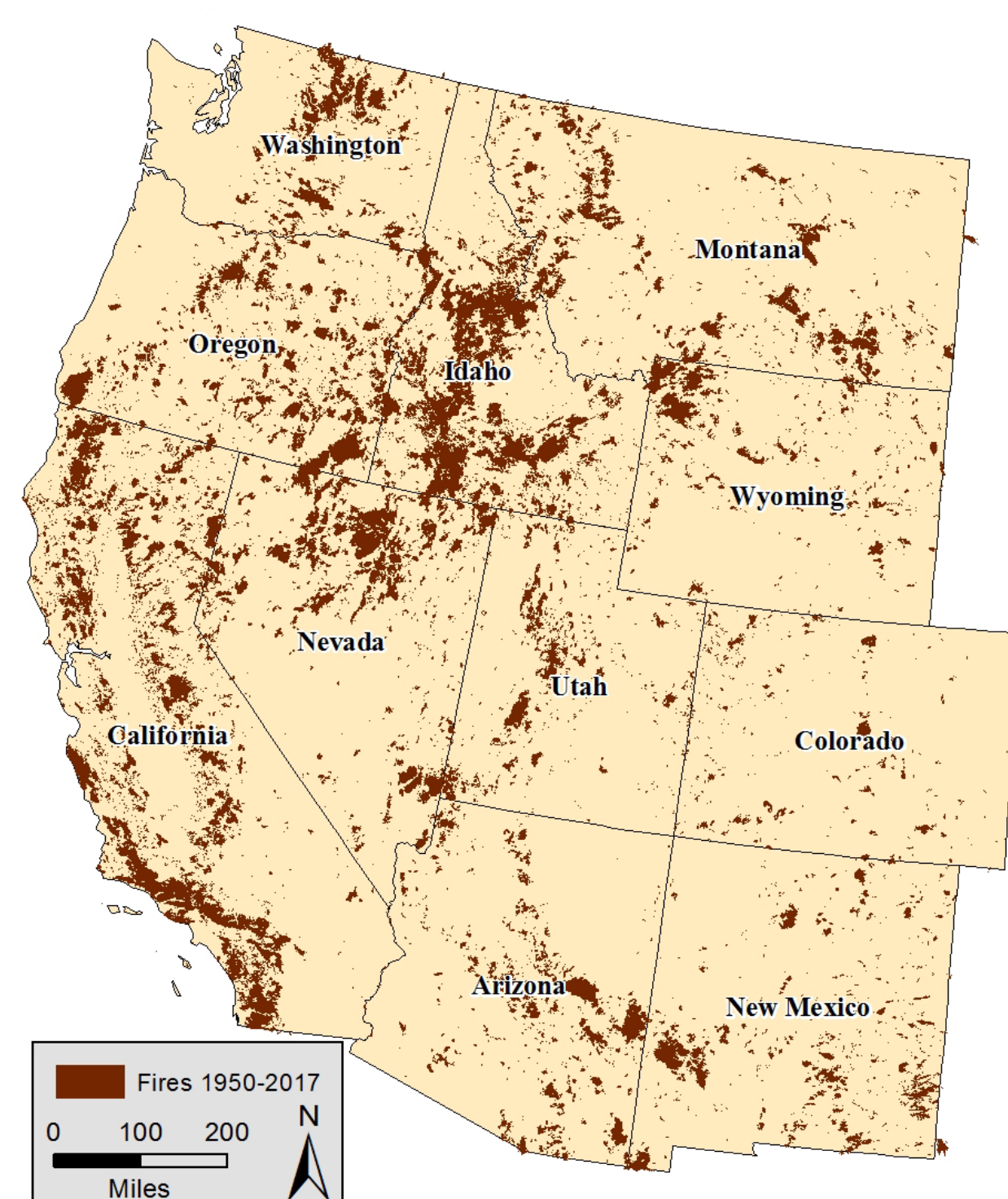


Figure 1. The spatial distribution of wildfires from 1950 to 2017 across the Western United States.

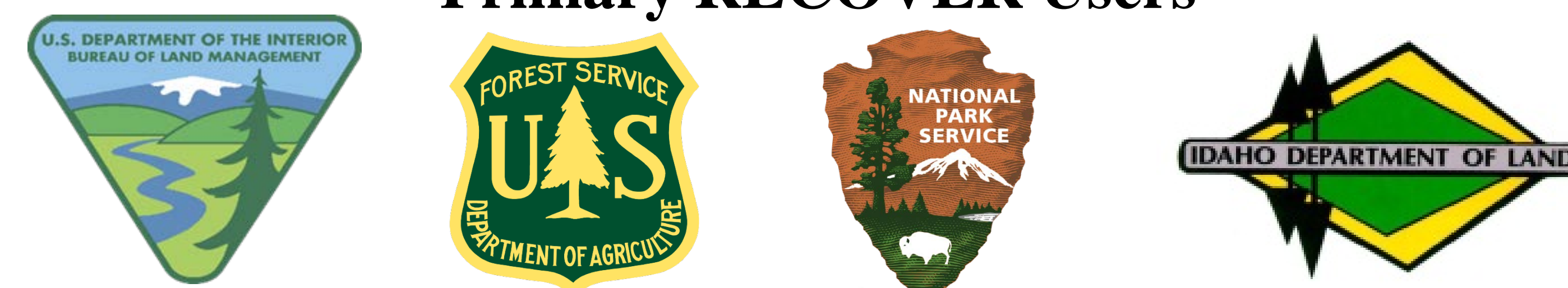
## Materials and Methods

- Analysis of spatio-temporal trends in wildfire occurrence were restricted to the Western United States (Figure 1).
- RECOVER's historic fires database contains fire perimeters from 1950 to 2017. It is likely the most comprehensive source for historic wildfire perimeters.
- Using the year that individual fires occurred and the size of those fires, fire frequency and total acres burned were graphed to illustrate the change in fire frequency and size over time.
- A trend line type was fitted to these data.
- Statistical analysis included a comparison of mean and median historic fire size.

## Results and Discussion

- Fire frequency is increasing throughout the Western United States and follows an exponential trend ( $R^2 = 0.74$ ; Figure 2).
- Not only are the number of fires increasing, but also the total area burned is increasing and similarly, follows an exponential trend ( $R^2 = 0.68$ ; Figure 3).
- There is a strong correlation (0.88) between fire frequency (Figure 2) and total acres burned (Figure 3).
- Total acres burned annually is highly influenced by the occurrence of mega-fire events (fires burning > 100,000 acres). The magnitude and frequency of mega-fires is increasing as seen by comparing mean and median acres burned per fire (Figure 4).
- Overall, the median size of fires in the Western US, has remained relatively constant through this historical record.

## Primary RECOVER Users



## Acknowledgement

This project was conducted with funding provided by the National Aeronautic Space Agency (NASA) Applied Science Program and Idaho State Universities Career Path Internship (CPI) program. Special thank you to Keith Weber, from the ISU GIS Training and Research Center (TReC), who served as an advisor and Principal Investigator.

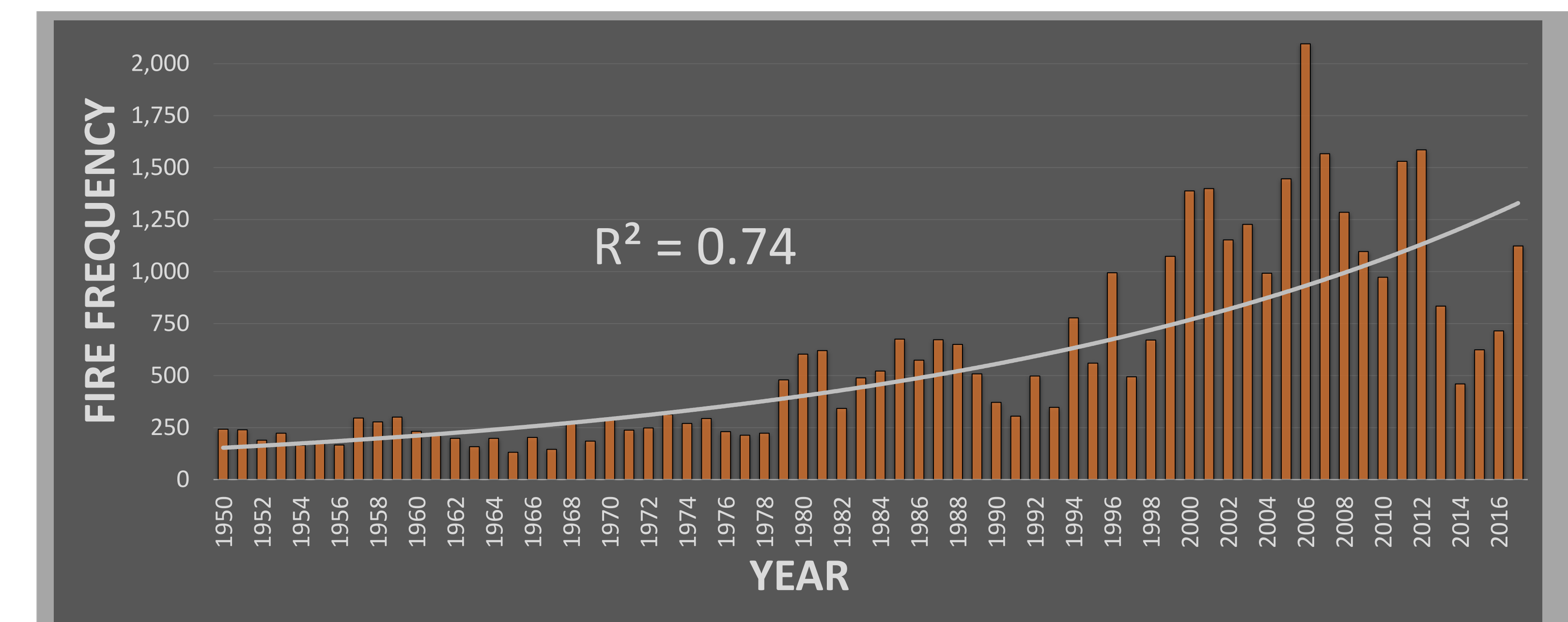


Figure 2. Fire frequency per year generated by counts of fire occurrence representing all documented fires occurring from 1950 to 2017 across 11 western states. Fire frequency best follows an exponential trend line with an R-squared value of 0.74.

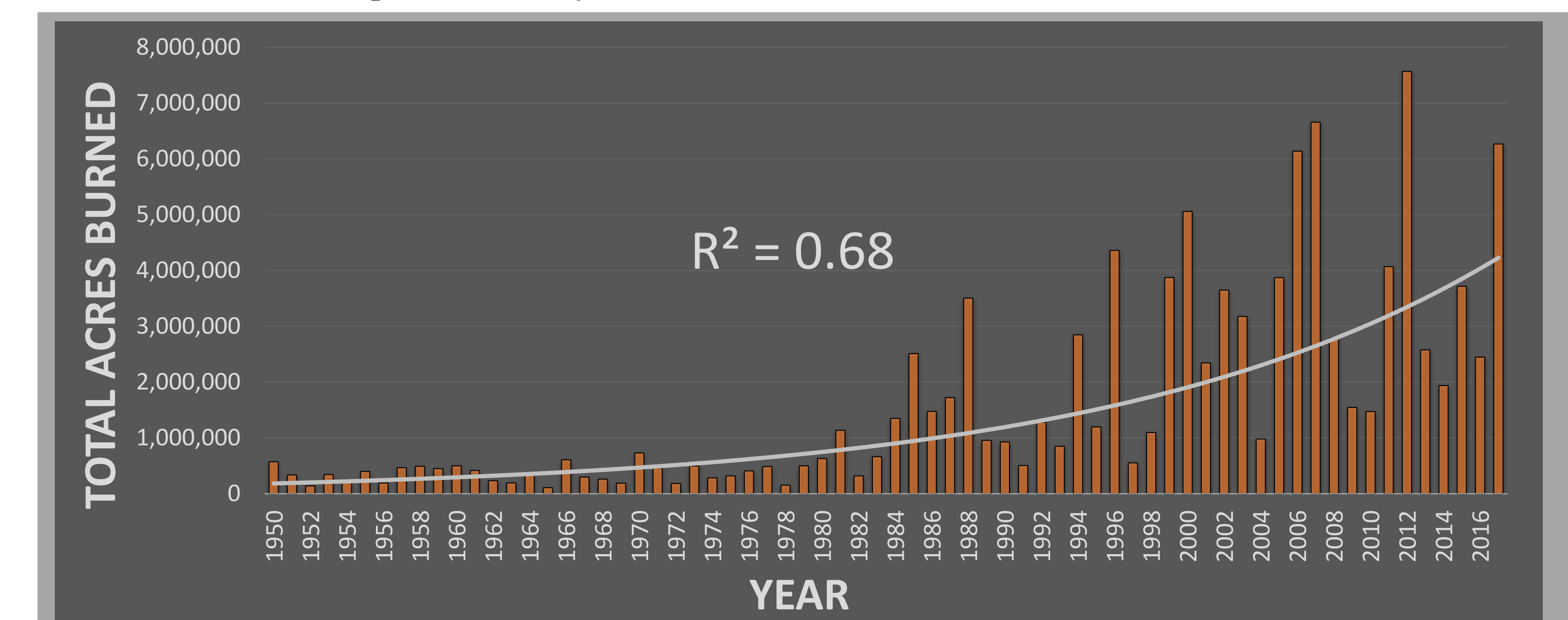


Figure 3. Total acres burned for a fire year summed for all 11 western states from 1950 to 2017. This follows an exponential trend with an R-squared value of 0.68.

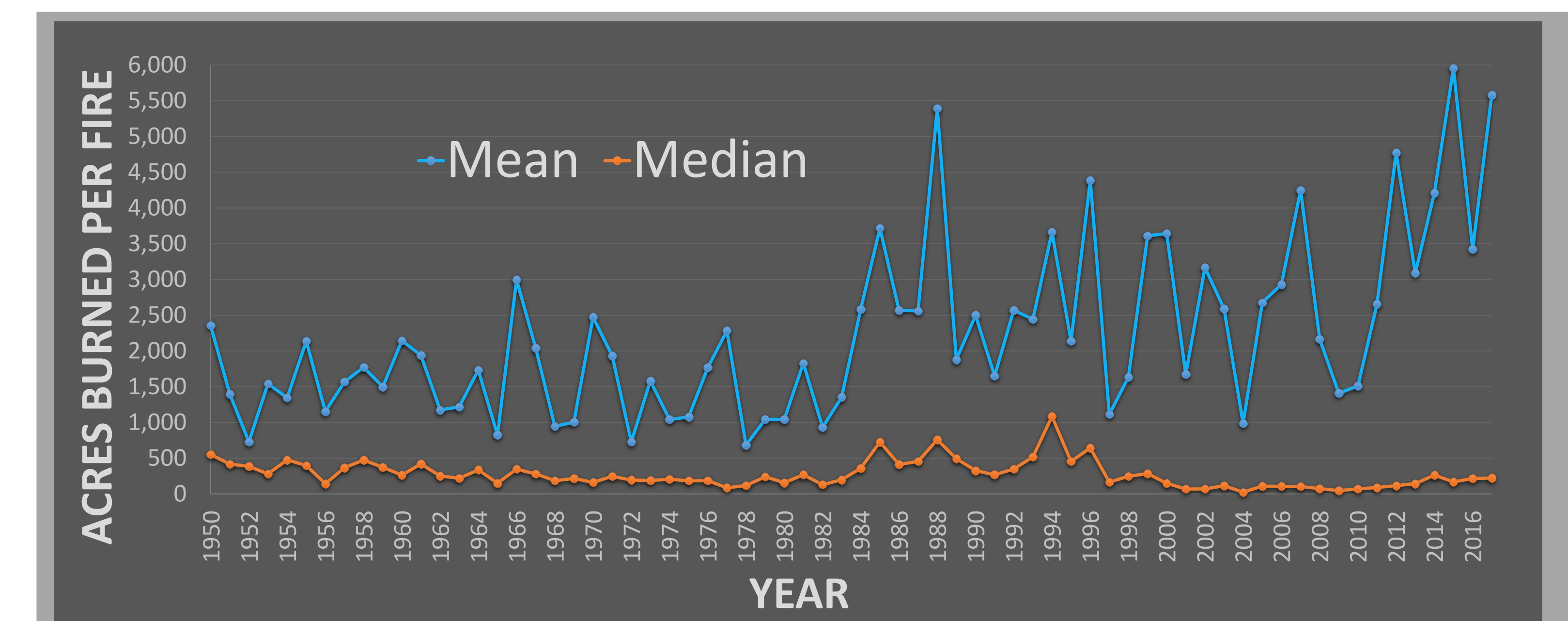


Figure 4. Average and median acres burned in the western United States from 1950 to 2017. Demonstrates the resilience of the median as a statistic, and the susceptibility of the mean.

