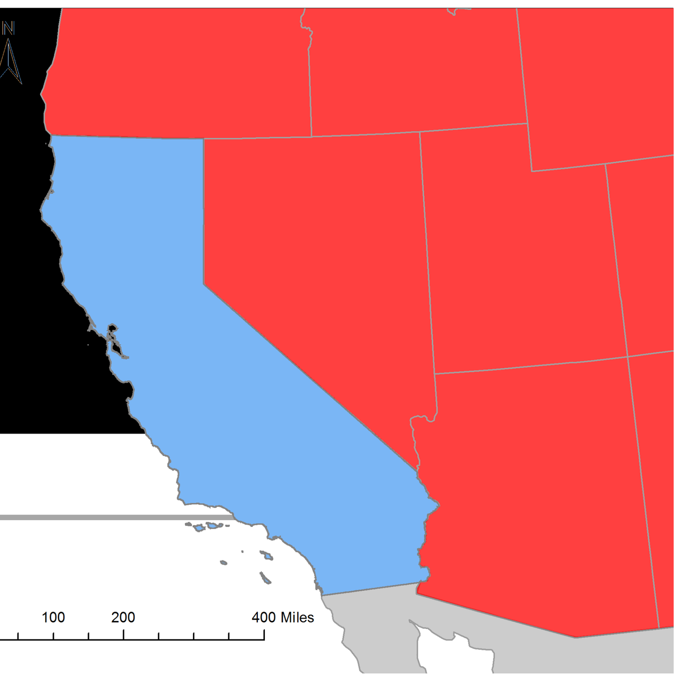
SPREADS LIKE WILDFIRE

A FIRE VULNERABILITY ANALSIS AND COMPARISON IN CALIFORNIA



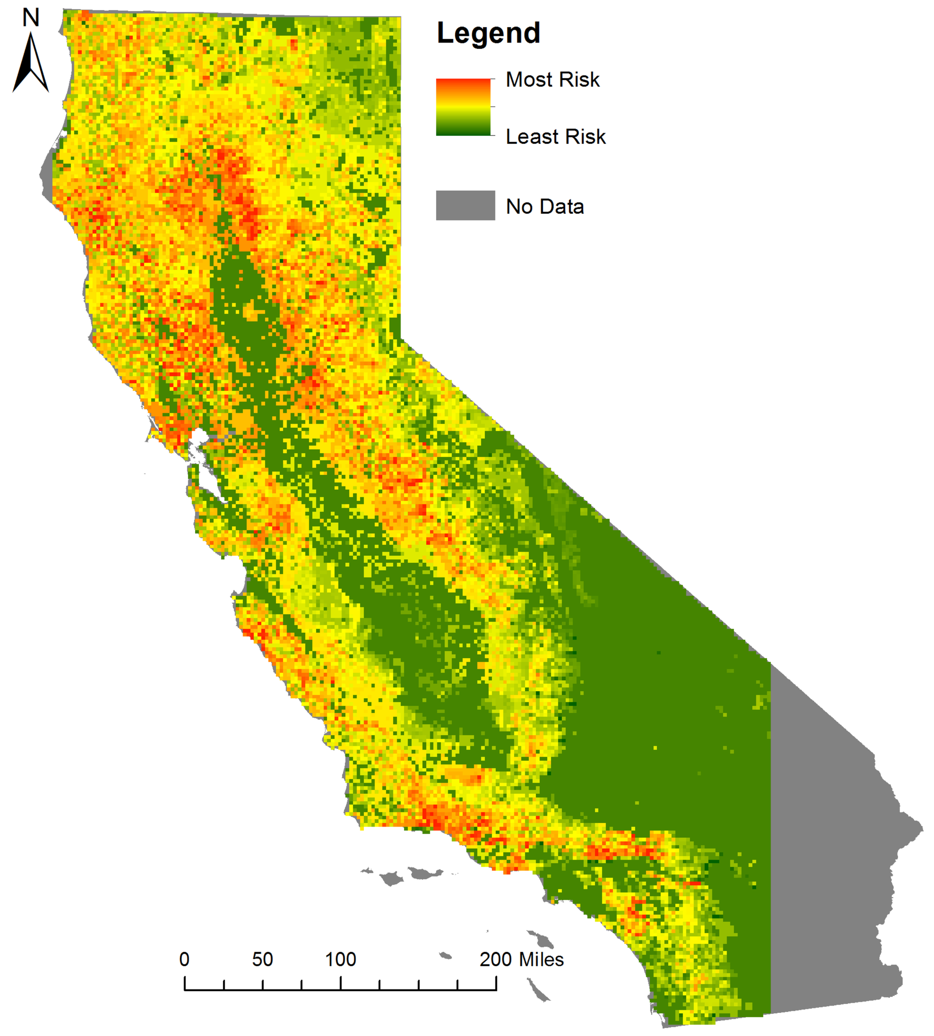
BACKGROUND

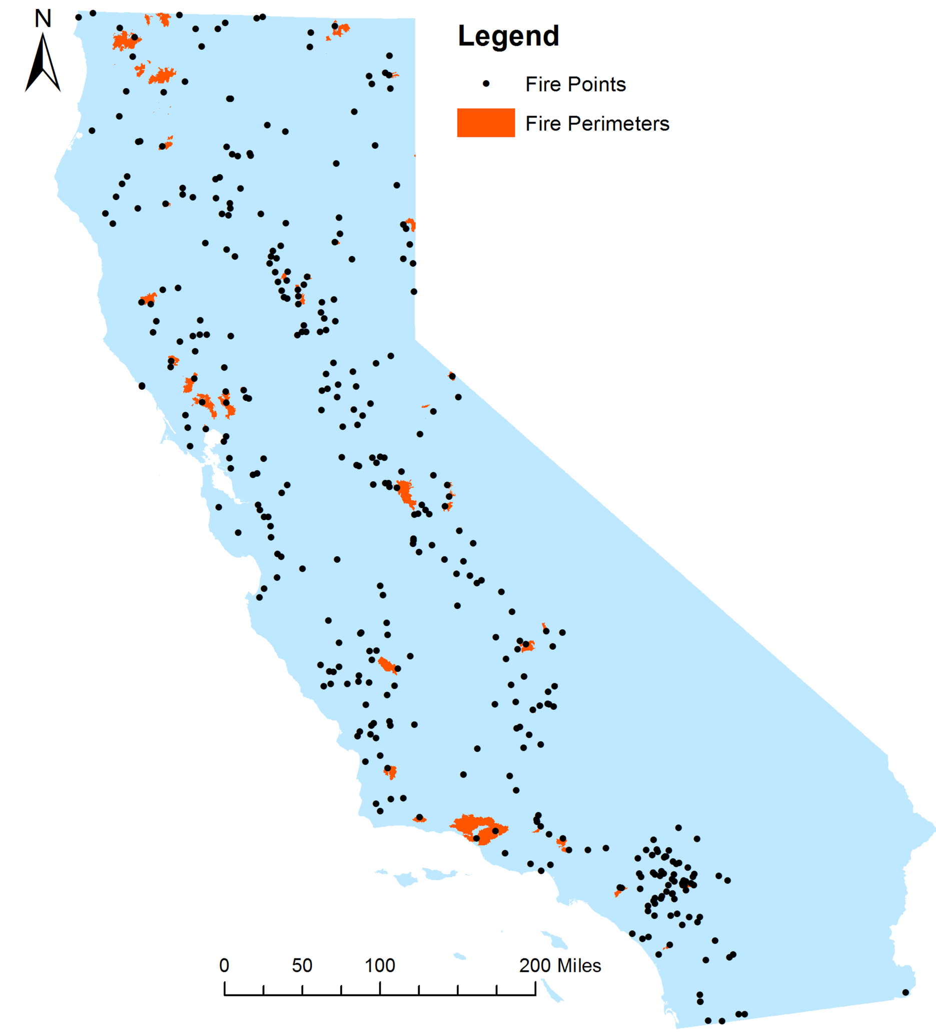
Burn scars—just one of the many remnants of wildfires
Photo: Kate Lamberti

Wildfires have occurred naturally for millions of years on Earth's surface, contributing to evolution of species, natural forest maintenance, and providing opportunity for new growth. Recently, some of the deadliest and costliest fires in history ravaged parts of Northern and Southern California, taking 45 lives and topping $9 billion in damages. Many attribute these fires to the heavy rains that followed a massive 5-year drought that devastated California, causing rapid growth of vegetation, as well as high wind (notably the Diablos in the north and Santa Anas in the south); but many other longer-term variables contribute to wildfire. Understanding factors that play into wildfire vulnerability on various timescales can help predict where fires will be, so that we can better prevent and safely contain potentially disastrous fires. This project considers fire return interval, severity of last burn, rainfall variability, and spreadability (fuel model type and slope).

METHODS

The fire return interval (FRI) map was based on a reclassification of pre-existing data for number of fires in a given area. Once this data was reclassed, the average FRI in California was calculated (55 years, represents existing data only). This number was used to select only burn scar data from the last 55 years, and the resulting layer was combined with burn severity data (since 1985). Over 1.5 million data points from hundreds of NOAA land stations across California for daily precipitation were processed in Excel to give an average annual rainfall variability at each station. These points were geocoded and interpolated to generate the rainfall variability map. Vegetation flammability was based on USFS standards for estimating fire behavior and fuel model data. Slope was calculated using SRTM elevation data and a slope analysis. These 5 layers were overlaid in a weighted analysis, with flammability of vegetation and FRI ranked the highest.





Can we predict where fires will go?

A Comparison of Predicted Vulnerability and Actual Fire Data:

The map on the left shows the overlay of factors that contribute to wildfire. A map of actual fire points and perimeters from September through mid-December can be seen on the right. The vulnerability map shows that the areas at the greatest risk include southern California and much of the central interior, where most of the fires took place this past season. The central valley area of California is essentially untouched, as predicted in the vulnerability analysis.

PROJECTION INFORMATION: 1984 CALIFORNIA TEALE-ALBERS EQUAL AREA CONIC

RESULTS AND DISCUSSION

Although the vulnerability map does closely line up with where fires took place this past fall, there are many other variables that are left out of this relatively simple analysis. The layers in the map are mostly long-term factors (i.e. southeastern California will always receive little rainfall, slope will remain constant), and although fire management considers these, there also needs to be consideration of short-term factors, like wind speed/patterns, wind gusts, summer cloud cover, and day-by-day rainfall. A source of error is the interpolation of rainfall variability, first because interpolation is inherently not entirely accurate, but also because the data points were concentrated in the western part of the state. For number of fires, No Data was assumed to be 0 in the overlay, which is not necessarily the case, especially in central California. Other than missing wildfire variables that should be considered for wildfire vulnerability (like current wind), the weighted overlay is most likely not true to how important each of the variables considered are. The initial motivation for this project was to see if we could use variables that we know contribute to wildfire to predict where fire will go. After performing the analysis, my conclusion is that with more data and time to consider more variables and error, fire risk can be accurately predicted. Fire research like this can contribute to continuous reevaluation of fires and improvement in fire management strategies, to ensure safety can remain a top priority.

SOURCES

Anderson, Hal E. "Aids to Determining Fuel Models for Estimating Fire Behavior." Apr. 1982, www.fs.fed.us/rm/pubs_int/int_gtr122.pdf.

CAL FIRE. *State of California*, www.fire.ca.gov/.

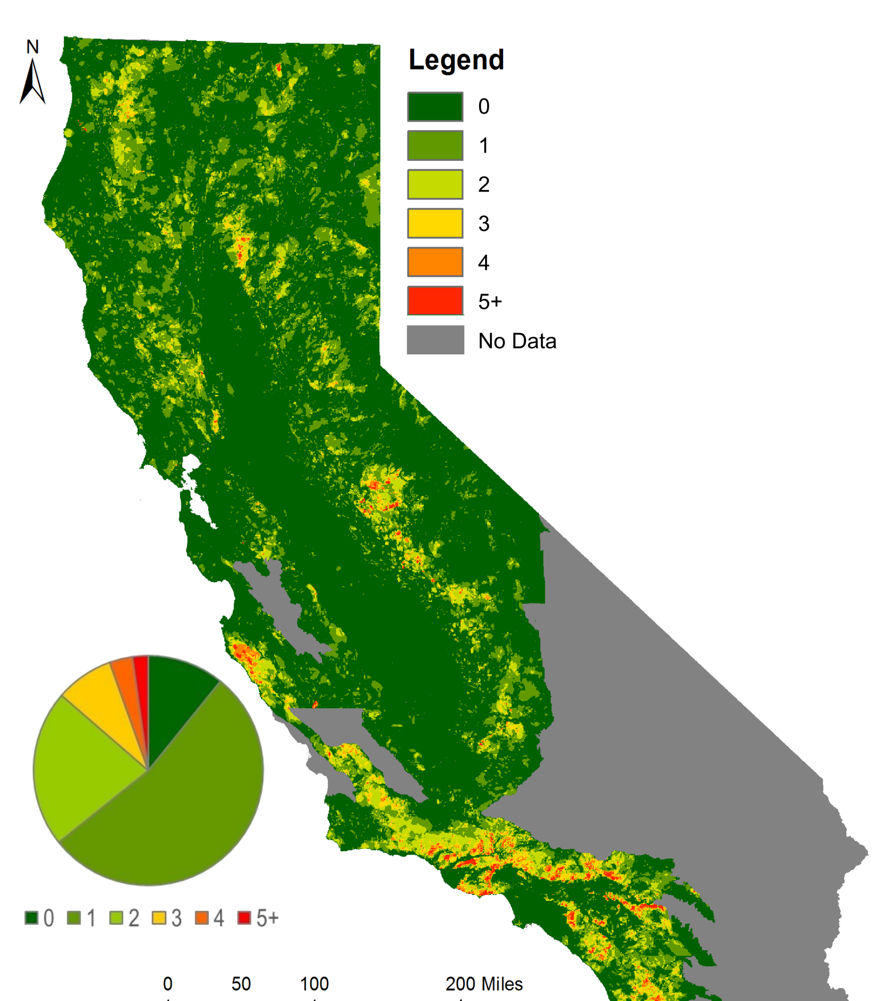
"Land & Resource Management (Region 5)." *United States Forest Service, United States Department of Agriculture*, www.fs.usda.gov/main/r5/landmanagement.

"National Centers for Environmental Information." *National Climatic Data Center*, www.ncdc.noaa.gov/.

KATE LAMBERTI **GIS 101 Fall 2017**

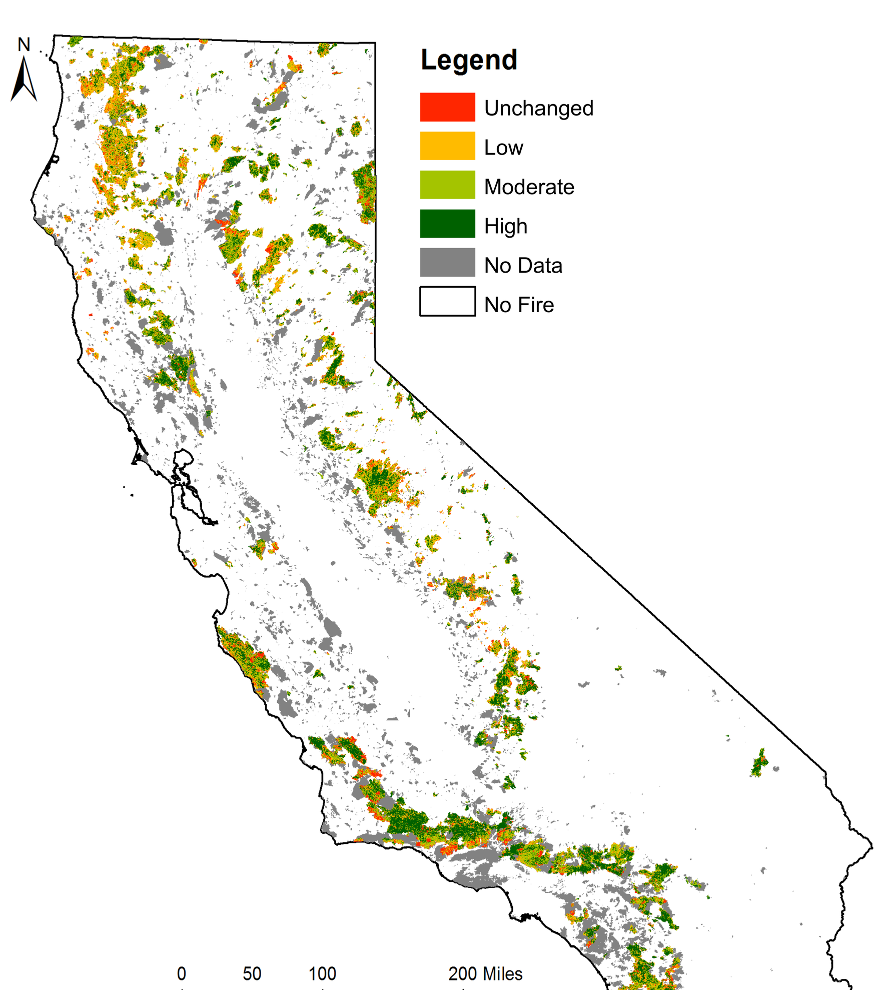
Tufts UNIVERSITY

WILDFIRE FACTOR MAPS



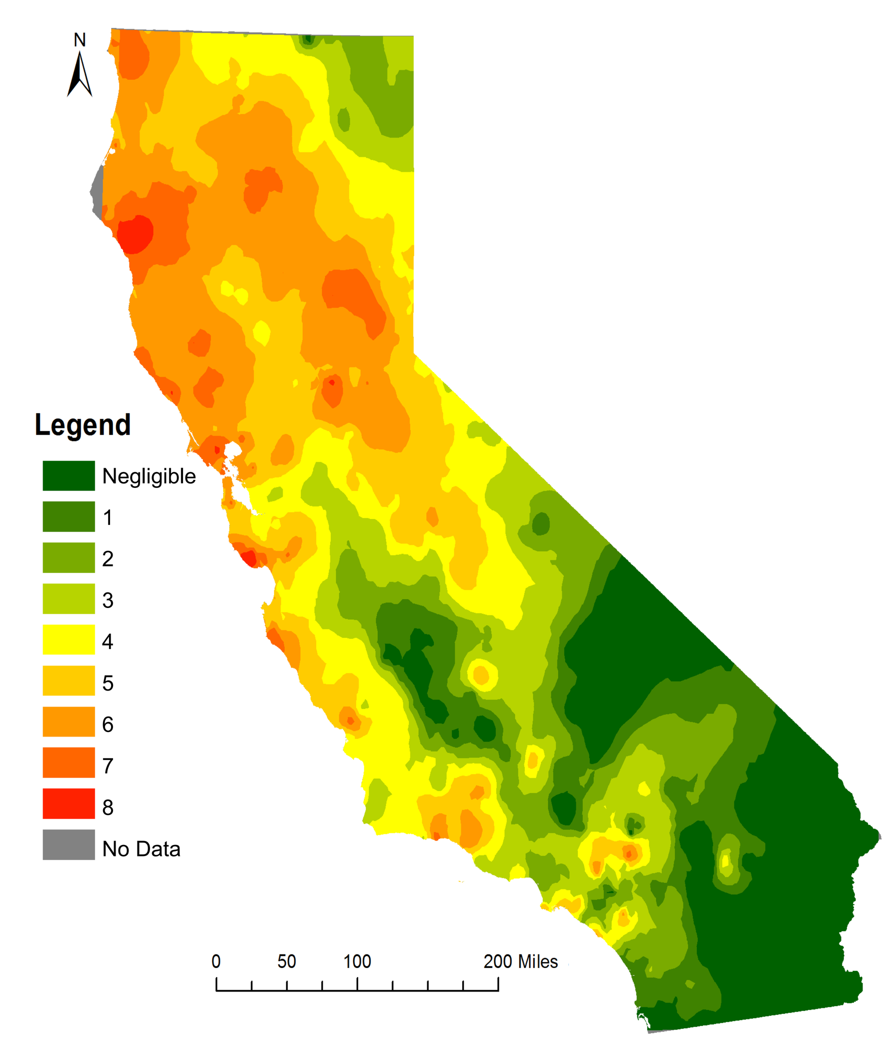
Number of Fires in Last 100 Years

The fire return interval is a way to determine how soon a fire will return to an area. Areas with a short return interval (i.e. many fires over last 100 years) is indicative of quick regrowth and high flammability—factors that make fire more likely to return. *Data: CAL FIRE*



Burn Severity and Burn Scars

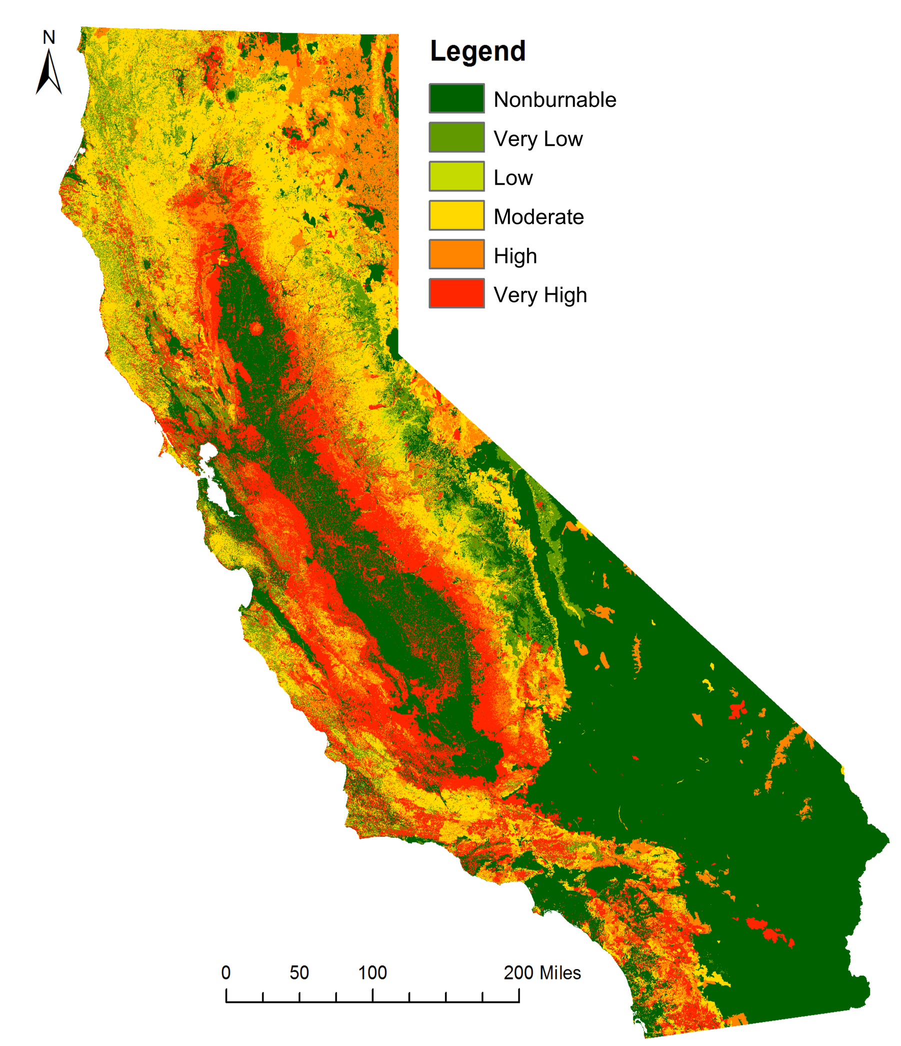
Burn scars are areas that have recently experienced a fire. This map takes into account burn scars since 1950 with a severity analysis since 1985. Fires with recent severe burning are not as likely to see another fire, due to lack of fuel. *Data: CAL FIRE and US Forest Service*



5-Year Rainfall Variability Rank

Areas with high rainfall variability are likely to see a rapid expansion of vegetation after a rainy season. This "bumper crop" generates fuel, making these areas more susceptible to wildfire.

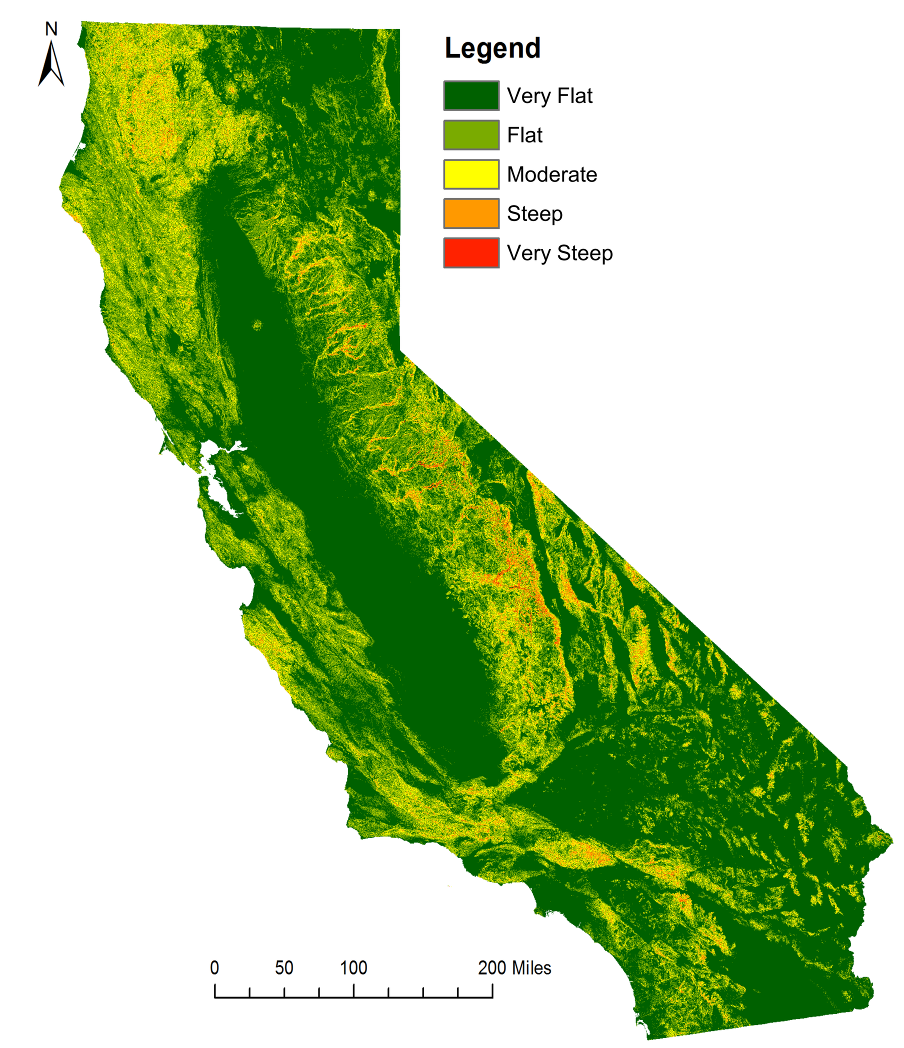
Data: NOAA



Flammability of Vegetation

Various vegetation types are an indicator of a fire's ability to light and spread. Barren rock or moist tall trees, for example, are considered "nonburnable", while dry shrubs will ignite and expand with relative ease.

Data: CAL FIRE



Slope

Another factor in spreadability is slope. As a general rule, fires burn faster uphill. A steeper slope means that flames can reach further, and that radiating heat from the fire preemptively warms fuel, increasing the speed and severity of burn. *Data: SRTM*