Burn Vulnerability Analysis in Northern New Mexico

Pinpointing Areas for Forest Fire Management

Background

Fire is a natural part of many forest ecosystems. Low intensity fire clears out dead plant material that accumulates in the understory, and returns nutrients back to the soil. However, increasing temperatures, drought, and fire suppression by humans living near fire-prone areas have contributed to wildfires that reach a size and intensity far beyond the natural level. While many aspects of fire behavior are out of the control of humans, certain forest management practices can lessen the severity of forest fires that do break out. These practices include prescribed burning, forest thinning, and clearing of hazardous fuels. These management practices can be most effective when applied to areas of forest that are most vulnerable to fire.

Image 1: Las Conchas Fire, June 2011

This project uses GIS to create a burn vulnerability map for an area in northern New Mexico that burned in the Las Conchas Fire in June, 2011 (Figure 1). It takes into account several of the major factors contributing to burn vulnerability including vegetation type, slope, aspect, and elevation. This analysis only included data that was collected in the years prior to the Las Conchas Fire so that the theoretical burn vulnerability map could be compared to a map showing the actual burn severity of the Las Conchas Fire. This burn vulnerability analysis can be used in the future to pinpoint areas that are most vulnerable to forest fire, and thus are the best locations for forest fire management.

Figure 1: Location of Las Conchas Fire

Methods

The major tools used for pre-processing the four analysis factors included Composite Bands from a LandSat image, Iso Cluster, Slope, Aspect and Mask. Each data layer was then reclassified on a burn vulnerability scale of 1 to 4, with 1 being the lowest vulnerability and 4 being the highest vulnerability (See Table 1).

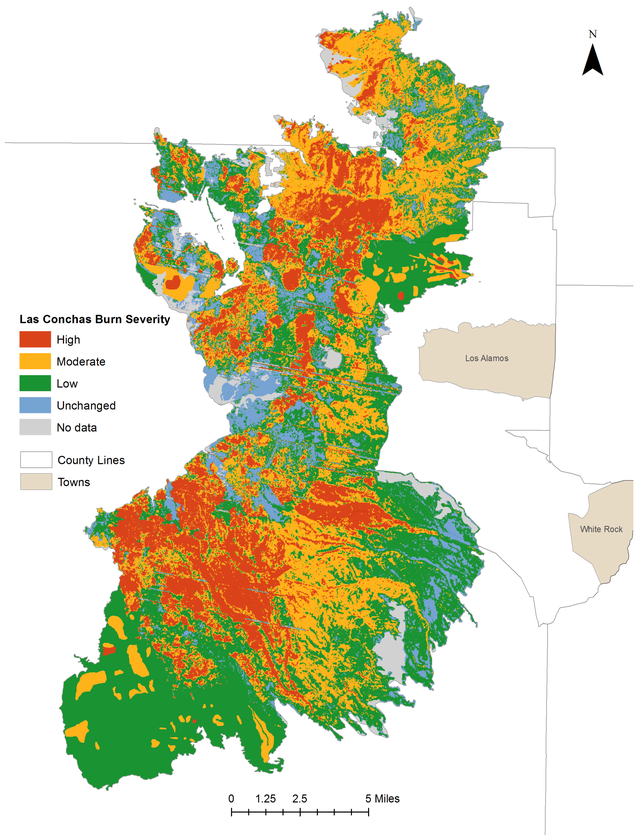
Reclassification Scheme

Factors	1 = Low Vulnerability	2	3	4 = High Vulnerability
Vegetation Type	Unvegetated, Grassland	Piñon, Juniper	Aspen, Birch, Oak	Fir, Spruce, Ponderosa Pine
Slope (% Rise)	0 - 2,250,000	2,250,000 - 4,500,000	4,500,000 - 7,500,000	7,500,000 - 26,250,000
Elevation (m)	1,700 - 2,000	2,000 - 2,500	2,5000 - 3,000	3,000 - 3,500
Aspect	Flat, N, NE	W, NW	SE, E	S, SW

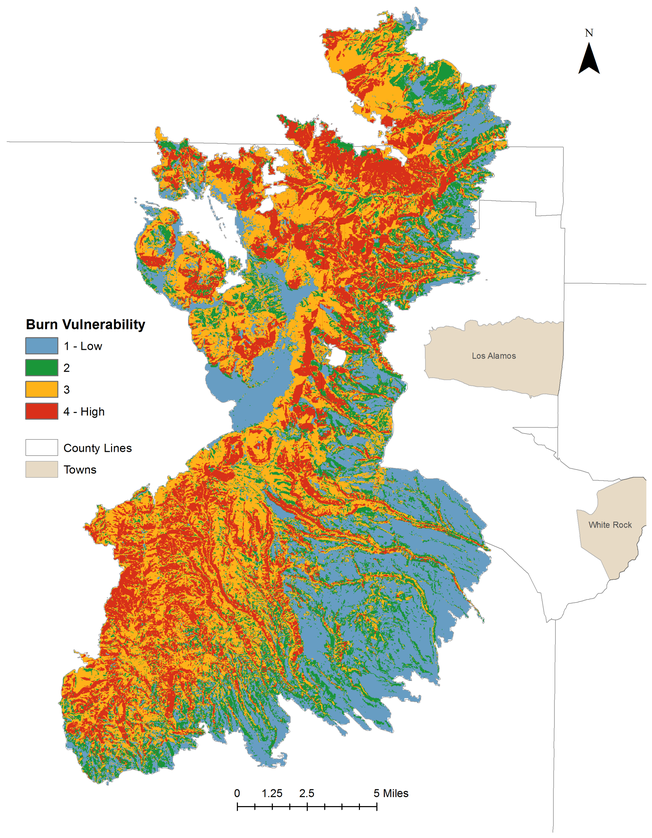
Table 1: Reclassification scheme for analysis factors

Once the factors were reclassified, the final burn vulnerability was calculated using the raster calculator. Vegetation type and slope were weighted at 35%, while elevation and aspect were weighted at 15%. The accuracy of the burn vulnerability map was calculated by subtracting the theoretical burn vulnerability map from the actual burn severity map.

Las Conchas Burn Severity

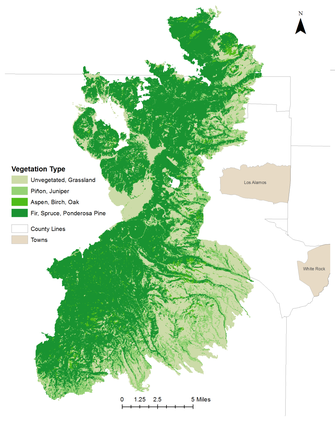


Burn Vulnerability Analysis

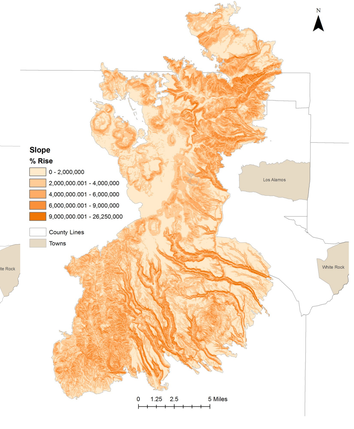


Analysis Factors

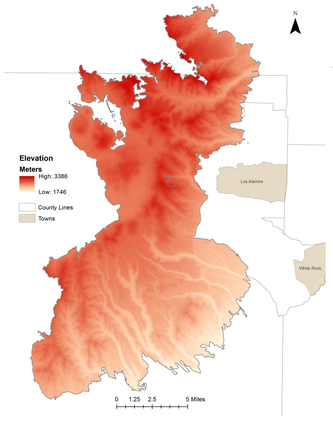
Vegetation Type



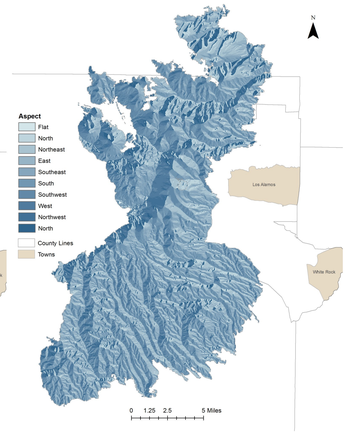
Slope



Elevation



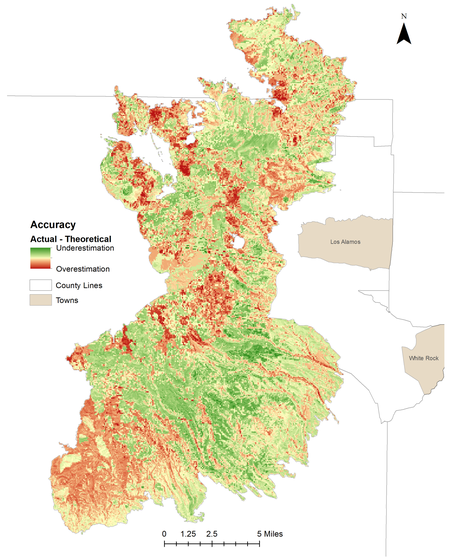
Aspect



Results

Of the four factors used in this analysis, vegetation type and slope had the greatest impact on burn vulnerability. The map below shows the accuracy of the theoretical burn vulnerability analysis compared to the actual burn severity that occurred during the Las Conchas Fire. The green represents areas where my analysis underestimated burn severity, while the red represents areas where my analysis overestimated burn severity. The tan colors in between show areas where the actual burn severity and the theoretical burn vulnerability were similar.

Accuracy of Vulnerability Analysis



Conclusions

Forest fire intensity can be minimized by using forest fire management practices, especially if they are used in areas of high burn risk. This burn vulnerability analysis maps out areas that were at higher burn risk prior to the Las Conchas Fire in 2011. If forest management practices had been used in these high-risk areas before the Las Conchas Fire broke out, the burn severity could have been reduced, allowing vegetation to bounce back more quickly.

In the future, burn vulnerability analyses should be used to inform forest management practices in fire-prone areas. In order to improve the accuracy of burn vulnerability analyses, other factors such as vegetation density, soil moisture and weather patterns could be included in addition to vegetation type, slope, elevation and aspect.

Image 2: Post-fire regrowth

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Intro GIS, Fall 2013

Projection: NAD 1983, UTM Zone 13N, meters, **Scale** 1:175,000

Data Sources: NMRGIS, NM Forest Service, Earth Explorer

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