CALIFORNIA FIRE SCIENCE CONSORTIUM

JOINT FIRE SCIENCE PROGRAM

Research Brief for Resource Managers

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Early Stages of Remote Sensing of Burn Severity

Rogan, J. and J. Franklin. 2001. Mapping wildfire burn severity in southern California forests and shrublands using enhanced thematic mapper imagery. Geocarto International 16(4):89-99.

When John Rogan and Janet Franklin tried to improve the accuracy of remote sensing satellite images of burn severity across different vegetation types in southern California, there were four main problems: 1) burned vegetation patches can be confused with non-vegetated surfaces because of terrain-induced shade and smoke plumes, 2) incompletely burned patches are often confused with unburned patches, 3) sub-canopy burns are hard to detect, and 4) canopy consumption in sparse, rocky ground is difficult to map because of soil and rock reflectance.

This 2001 study represents one of the early attempts to assess the value of remote sensing for the purpose of mapping fire or burn severity of large wildfires. The investigators used **Landsat TM** to evaluate detection of fire severity across different vegetation types on two Cleveland National Forest, San Diego County fires.

Spectral mixture analysis (**SMA**) using five endmembers (green vegetation, non-photsynthetic vegetation, bare soil, shade, and charcoal-ash) was used to extract sub-pixel values for each endmember (Figs. 1&5).

In the field, fire seventy was estimate for five vegetation types: chaparral, conifer, hardwood, scrub, and grassland. Field crews classified each 30-m plot into one of the five fire severity classes based on descriptors in Table 1.

Management Implications

- Satellite imagery has potential for assessing fire severity across broad landscapes and diverse vegetation types.

Two thirds of the plot data points from each burn severity class were used to train the decision tree and create burn severity maps for the two fires (Figure 7). The remaining third of the data points were used to test the accuracy of the maps. Kappa statistics (a measure of "reproducibility") were used to test the accuracy of the decision tree-classified fire severity maps. The La Jolla Fire classification was considered to be excellent (Kappa=0.85) and the Laguna Fire good (Kappa = 0.71). Kappa values among severity classes ranged from 0.90 in the La Jolla fire severe burn class to 0.52 in the Laguna MBPHV class.

The authors concluded that SMA "provided a robust technique for enhancing fire-affected areas due to its ability to extract sub-pixel information and minimize the effects of topography on single date satellite data." However, the bare soils in the xeric areas can cause error because of soil and rock "brightness," or reflectance.

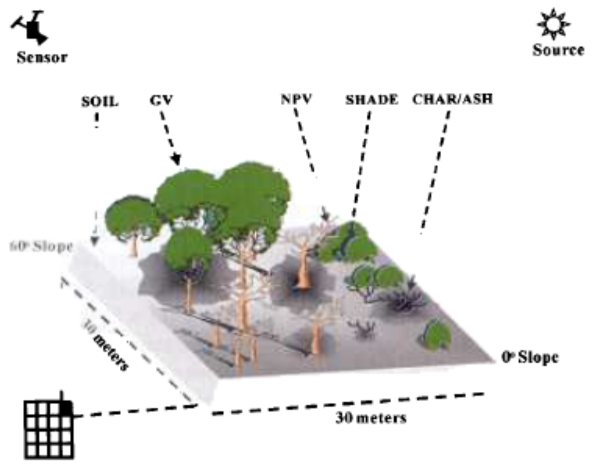

Figure 1 Scene model of fire severity mapping in southern California forests and shrublands using Landsat Enhanced Thematic Mapper Data. Abbreviations are as follows: SOIL (Bare soil), GV (Green Vegetation), NPV (Non-Photosynthetic Vegetation), SHADE (within-pixel and topographically induced shade) and CHAR/ASH (post-burn charcoal and ash deposition)

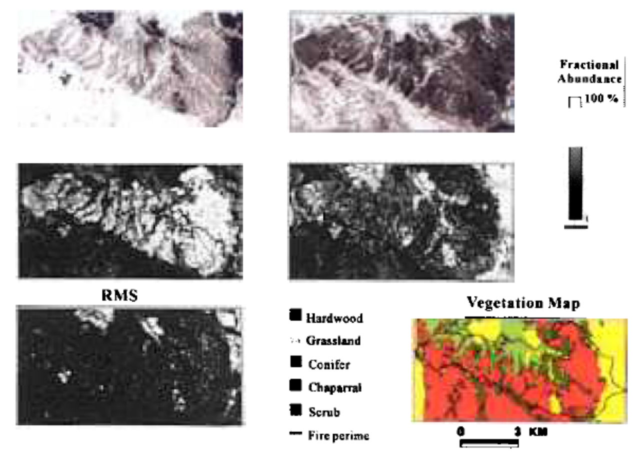

Figure 5 SMA fractions, RMS and vegetation map for the La Jolla burn scar

Table 1 Wildfire severity classification scheme

FIRE SEVERITY CLASS	FIELD DESCRIPTION		
	Substrate (litter/duff)	Understory Vegetation (brush and herbs)	Overstory Vegetation (shrubs and trees)
Unburned Vegetation (UV)	Not burned	Not burned	Not burned
Bare Soil (BS)	N/A	N/A	N/A
Mixed Burned Pixels with LOW (<50%) Vegetation Cover (MBPLV)	Litter consumed	Foliage and stems consumed	Shrubs in sparsely vegetated areas and open-canopy trees: Completely consumed
Mixed Burned Pixels with HIGH (>50%) Vegetation Cover (MBPLV)	Litter charred Duff layer burned Wood structures burned Light ash (coarse)	Foliage and stems scorched to partially consumed	Shrubs partially consumed Closed-canopy stands partially burned
Severe Burn (SB)	Litter consumed Fine white ash visible Mineral soil visibly altered (red in color)	Completely consumed	All plant arts consumed leaving some or no major stems/trunks

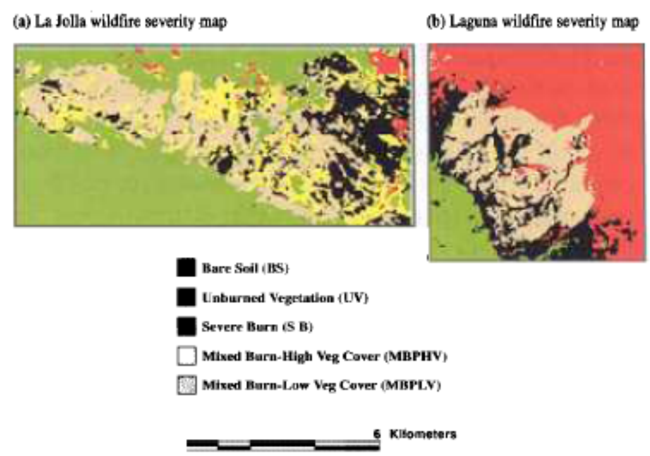

Figure 7 Decision tree classification for (a) La Jolla wildfire and (b) Laguna wildfire