Northern Rocky Mountain Science Center
U.S. Department of the Interior
Geological Survey

Post-fire Burn Assessment by Remote Sensing on Federal Lands

Background:

Wildfires shape landscapes throughout the western United States. When a wildfire burns, people often think of the loss of green forests and, in some cases, loss of human life or property. Yet many plants and animals are adapted to fire. Thus, fire often is required to maintain healthy ecosystems. Scientists work to understand the role of fire as a natural process and its effects on soil, water, animals, plants, and people.

The ecological significance of wildfire is now recognized globally, and needs to monitor and predict variations due to fire are widely accepted. Goals to sustain natural systems and biodiversity, enhance habitat, and mitigate unnatural fuel buildups are tempered by potential impacts from global biomass burning, and risks to human life and property where developments encroach on large natural areas. Required levels of information are often difficult to obtain, however, especially where fire size, remoteness and rugged terrain impede direct observation of burned areas. Thus, land managers increasingly must turn to remote sensing technologies to extend knowledge and quantify the role of fire in today's ecosystems. To those ends, a functional methodology to assess burn impacts is crucial; and efficient, conventional procedures are needed for integrative study.

The USGS Northern Rocky Mountain Science Center (NOROCK) is building capabilities for the remote sensing and evaluation of burns. Working with diverse institutions and individuals in fire science and information technology, we advance mutual interests of fire science partners by undertaking relevant research, and by disseminating findings through coordination and technology transfer.

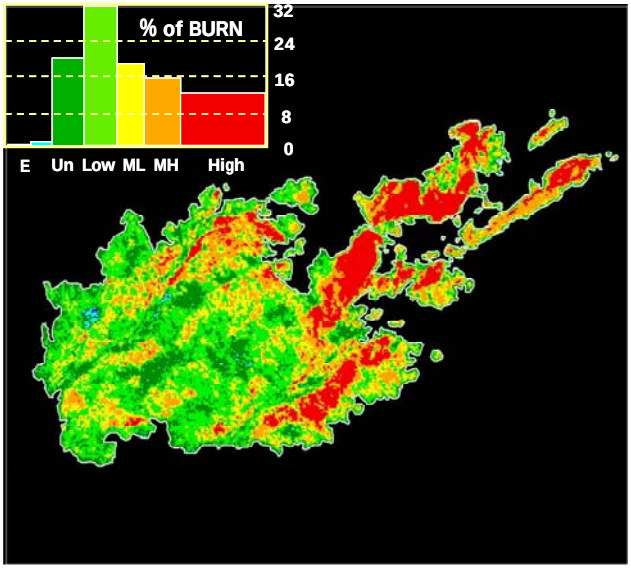

Figure 1. Example of burn data extracted by perimeter including burn severity levels or classes.

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USGS-NPS Burn Severity Mapping

Remote sensing and field sampling techniques to support national assessment of burned areas was under development from the mid-1990's by collaborators at USGS and NPS. At the time, there was no standard approach to broadly quantify and spatially represent burn severity or the ecological effects of fire within the NPS. Researchers pursued a number of strategies to initiate a national program for burn severity mapping and monitoring within NPS and USGS. These strategies included:

- Landsat-based change detection approach and formulation of the differenced Normalized Burn Ratio (dNBR).
- Development of the Composite Burn Index (CBI), used to summarize the fire effects on a site for validation, calibration and understanding of remotely sensed data.
- Enlisting support of the NPS and USGS Center for EROS to implement the program on a national scale beginning in 2001.
- Engage in education and field sampling missions principally with NPS fire personnel stationed around the country, but also including individuals from other agencies and universities.

Around 2001, methods were transferred to the US Forest Service where, along with the US Department of Interior, remote sensing techniques were adopted for use in Burned Area Emergency Rehabilitation (BAER) assessments. Current emphasis is to complete publication on evaluation results across the U.S., to demonstrate useful applications of the extensive data holdings, and to derive new information on trends and the landscape ecology of fire.

Monitoring Trends in Burn Severity-MTBS

In June 2004, the Government Accountability Office (GAO) recommended that all federal land management agencies adopt the USGS-NPS burn severity mapping protocol as a monitoring mechanism to assess fire effects and broader wildland fire patterns and trends. Soon after, the program was supported under the National Fire Plan, which established Monitoring Trends in Burn Severity (MTBS) in late 2005.

MTBS covers all fires over a minimum size on Federal or State lands throughout the U.S. Current and future fires are included, as well as past fires back to about 1982. The main goal of MTBS is to generate standard, comparable data to monitor fire trends and management effectiveness on a national level, in contrast to direct emergency response applications.

Current products are based on Landsat imagery and the dNBR obtained during the growing season after fire for an extended assessment on most burns. In addition, investigations that use the burn severity time-series in landscape and fire ecology are of interest, including relationships to climate, trends and modeling of fire behavior, and responses of vegetation and wildlife.

Current MTBS outputs include:

- Instructional materials and guidance, for example on scene selection, severity classification and thresholding, image processing, and dNBR normalization.
- Training and assistance in field sampling using CBI.
- Creation of a photo series of the burn severity continuum in key ecosystems of the U.S.
- Scientific or technical leadership and review of procedures and products.

The Northern Rocky Mountain Science Center is located in Bozeman, Montana and includes three field stations in Montana and one duty station in Wyoming. For more information on NOROCK's research, please visit http://nrmsc.usgs.gov or contact the Center Director: Jeff Kershner 406-994-5304 or jkershner@usgs.gov