ALASKA BURN SEVERITY WORKSHOP

The USGS/USFS Monitoring Trends in Burn Severity (MTBS) project and the USGS Alaska Science Center hosted a burn severity mapping workshop in Anchorage Alaska on February 20–21, 2008. The main objective of this workshop was to bring together key players in developing and using MTBS to answer the following questions: 1) What questions are the Alaska community (in the broad sense) trying to address with burn severity data and what are the successes and failures; 2) What is the MTBS methodology and what are known strengths and weaknesses; 3) How could burn severity information be improved to better answer the major questions facing Alaskans; and 4) Are there projects that individuals from academia and the different agencies can collaborate on in the near future? The desired outcome of the workshop is an understanding among the broad Alaska user community and MTBS to improve burn severity mapping for Alaska.

The workshop began with a review of the current understanding, associated burn severity mapping activities, and research activities making use of satellite observations and burn severity measurements in Alaska. The workshop objectives were to:

- Review federal, state, academia, and others (Canada) burn severity mapping and application activities in Alaska. Focus was given to detailing agency needs for burn severity data, what aspect of "Burn Severity" is important to their management needs
- Review MTBS objectives and methodology
- Consider the relationship of MTBS to other Alaska activities to identify the similarities and differences between MTBS and the other activities
- Discuss differences and adjustments that could be made to improve the generation and application of burn severity data. Issues such as timing of pre and post fire imagery, initial or extended assessments, field validation, technique development
- Review collection of field data (CBI and other metrics)
- Identify potential collaborations and studies to advance burn mapping in Alaska.

The first objective of the workshop was to review federal, state, academia, and others (Canada) burn severity mapping and application activities in Alaska. Focus was given to detailing agency needs for burn severity data, what aspect of "Burn Severity" is important to their management needs. Several presentations were provided on the application of burn mapping and relevant issues from each agency and organization. The main agency speakers and summaries of their presentations (if available) were:

Brian Sorbel and Jennifer Allen, National Park Service
Assessing dNBR in the boreal forest and tundra ecosystems of Alaska's national parks
(No presentation summary available at this time)

Ron Hall, Northern Forestry Centre, Canadian Forest Service

Remote Sensing of Burn Severity in the Canadian Boreal: Results and Lessons Learned
(No presentation summary available at this time)

Karen Murphy, Fish and Wildlife Service
Applications of burn severity mapping on Alaska National Wildlife Refuges
(No presentation summary available at this time)

Parker Martyn, Bureau of Land Management
Fire Perimeter Mapping at the Alaska Fire Service

The Alaska Fire Service provides wildland fire suppression services for all Department of Interior and Native Corporation Lands in Alaska. Each fall AFS updates a historical large wildland fire database for Alaska with perimeters from fires that occurred during the preceding summer. These perimeters are collected from a variety of "best available sources" that may include a combination of GPS, IR, hand drawings on paper maps collected during aerial reconnaissance, and satellite imagery, to name a few. Sometimes, these final fire perimeters may not precisely match the actual burned area of fires. Perimeters may include suppression containment lines (e.g., hand lines, dozer lines) that tend to generalize area burned, and often do not identify unburned islands. When drawn by hand and/or heads-up digitized from satellite imagery, perimeters may be approximated simply due to the observer's subjective interpretation. Therefore, to improve fire perimeter mapping efforts, the Alaska Fire Service is exploring new mapping techniques and sources of perimeter information.

The Monitoring Trends in Burn Severity Project offers several possible near and long-term advantages for the Alaska Fire Service's perimeter mapping effort.

Near-term benefits may include the following:
1. Perimeters collected by the MTBS project could be used to validate, and/or correct some of the perimeters in the Alaska Large Wildfire Database as far back as 1984.
2. The MTBS project may also help to map areas of unburned islands within existing perimeters that have not already been mapped.
3. The MTBS project may also provide an opportunity to "data mine" satellite imagery collected through the project using the USGS GloVis interface.

Longer-term benefits of the MTBS Project may also include:
1. Creating additional opportunities to collaborate and develop fire danger and fire potential models using the burn severity products for Alaska.
2. Development of post fire monitoring and assessment models using MTBS data in combination with the Alaska large wildland fire database published each year by the Alaska Fire Service.

Additional burn severity mapping presentations were made by invited scientific investigators:

Nancy French, Michigan Technological University

Severity Mapping for Estimating Fire Emissions:
Remote Sensing Advantages and Issues in the Boreal Region

The main points of the presentation were: 1) the use of severity data for estimating carbon emissions and 2) the issues of dNBR-derived and CBI-derived severity estimates in Alaskan sites.

dNBR-derived fire severity has been evaluated for use as a measure of fuel consumption in Alaskan black spruce sites. Inconsistent results when comparing the remote sensing-derived severity to field-derived severity has lead to us not using the dNBR as a measure of severity for use in fuel consumption and fire emissions studies in Alaska. The fire perimeter information, which includes maps of unburned islands, is of great help for fire emissions work. The burn/unburn maps are used to help set the boundary of area used to locate hot spots to date fire occurrence from MODIS and is use to more accurately account for the area burned in a fire. The perimeter is used to define the area burned to compare with forest/fuel maps so we can better know the type of fuel burning.

Crystal Kolden, U. of Nevada-Reno
Understanding climate drivers of wildfire severity in Alaska boreal forests
(No presentation summary available at this time)

The second objective of the workshop was to review and discuss MTBS objectives and methodology. Carl Key demonstrated and discussed the background, basis, application and validation of dNBR and CBI. The main content of the demonstration was 1) a general timeline beginning in 1994 that showed continuity for dNBR and CBI development, testing and implementation leading to MTBS; 2) the specific burn severity niche these data are designed to fill; 3) Landsat bandwidth reflectance responses over burned areas, which underlie the selection of bands used in dNBR, and are consistent for Alaska burns; 4) spatial and informational content of NBR and dNBR images that can define landscape burn severity when suitable Landsat source data are used; 5) the nature and variation of composite ground effects that define CBI and potentially influence dNBR; 6) characteristics of post-fire imagery timing that capture varying degrees of delayed vegetation mortality or survivorship, and demonstrate differences between initial and extended assessments; 7) examples of validation results from over 80 fires that showed generally good correlation of dNBR with CBI; 8) example differences between dNBR and dNDVI, showing superior overall performance of dNBR considering seasonal influences and the magnitude and variation of mapped response, along with correlation to ground data; and 9) examples of how the overall balance of CBI is important to maintain in the field, since dNBR relationships to ground effects generally change and become successively poorer as the overall CBI rating is disaggregated into its constituent hierarchical components, ending with individual effects.

Brad Quayle (USFS) presented the overview of the MTBS project (**Mapping the Location, Extent and Severity of Fires in the United States – The Monitoring Trends in Burn Severity Project**). Key points of the presentation were 1) an overview of the MTBS methodology including the selection and timing of the pre and post fire imagery

and the development of burn severity class thresholds; 2) the types of geospatial products generated by the MTBS project; 3) of the scope of effort and the substantial variety of activities that go into production and delivery of MTBS data; and 4) a demonstration of the capabilities of the MTBS website including MTBS data distribution and summary reports.

The third objective of the workshop was to consider the relationship of MTBS to other Alaska activities and to identify the similarities and differences between MTBS and the other activities. The approach taken was to review the mapping process for three example Alaskan fires. The three fires were:

- The 2004 Winter Trail extended assessment, Yukon Flats NWR, demonstrated by Carl Key
- Middle and Preacher Creek demonstrated by Stephen Howard
- The 2004 Central Complex (Bolgen Creek) BAER Assessment, demonstrated by Randy McKinley

Each presentation reviewed the selection of imagery (timing of assessment), landscape characteristics, and establishment of burn severity thresholds. Carl Key and the group interactively explored pre-fire and post-fire Landsat scenes in false color, discussing changes evident after fire, and their relationships to the dNBR image. The focus was on the large degree of spatial variation in the dNBR that was evident within the burn, compared to outside the burn. Relatively little variation in dNBR was observed outside the burn, indicating that a reasonably accurate perimeter could be derived, and the comparatively large detected variation within the burn must have been caused by the fire. Islands within the burn that appeared unchanged or unburned in the post-fire Landsat scene could be identified in the dNBR, exhibiting dNBR values comparable to unburned areas outside the burn. Throughout the burn, an association was seen between low levels of dNBR within the burn and levels of apparent greenness in the post-fire Landsat scene. Higher levels of dNBR were associated with high band 7 reflectance (red), but no apparent band 4 reflectance (green) evident in the post-fire scene. The pattern of dNBR was not always associated with pre-fire vegetation, such that areas of apparently similar pre-fire vegetation could display markedly different levels of dNBR. The location and distribution of Karen Murphy's plots were also shown in relation to the pattern and extent of the whole burn.

Stephen Howard’s presentation followed the routine procedure used by MTBS and demonstrated how different image pairs can affect the resulting dNBR and burn severity estimates.

Randy McKinley’s presentation addressed DOI Burned Area Emergency Response (BAER) team requirements for mapping burn severity. He summarized BAER team support provided by USGS EROS after the extensive Alaska fires of 2004 and 2005. He also addressed the potential use of AWiFS imagery for future burn mapping in Alaska

and the existence of recently digitized historical aerial photography for Alaska, available through Earth Explorer (http://earthexplorer.usgs.gov).

It was evident in all presentations that the analyst plays a significant role in defining the burn severity thresholds for a fire. A comprehensive look at characteristics within the fire helps identify the range of severity across various landscape conditions. Individual thresholds must take into account an integration of a wide range of possible impacts. Generally the thresholds are set to represent to the most widespread and significant impact.

The fourth objective of the workshop was to discuss differences and adjustments that could be made to improve the generation and application of burn severity data, timing of pre and post fire imagery, initial or extended assessments, field validation, and technique development.

The timing of the assessment, referring to initial or extended, can have significant affect on the burn severity characterization. It has been noted that fires in regions dominated by tundra are best characterized by an initial assessment. Post fire recovery in tundra regions makes determination of burn severity difficult if the post-fire imagery comes from the later portion of the growing season following the fire occurrence. It was decided to use an acceptable ecosystem map to identify regions dominated by tundra and to designate initial assessment for fires in those regions. It was also noted that Landsat data availability in Alaska, including snow-, cloud-, and haze-free scenes, can be a major issue, not to mention periodic dependence on Landsat 7 SLC-off data. Moreover, Landsat acquisitions with low sun angle can be very problematic (e.g. before June or after mid-August), essentially restricting the window of time for optimal data. Remote sensing results will successively degrade as timing extends outside that window, so the content of burn severity information may become limited to the general distribution of the burn scar.

The fifth objective was to review collection of field data (CBI and other metrics). Several of the workshop participants had experience collecting composite burn index (CBI) data for fires. Also, some field data had been collected from the air (helicopter) where observers made calls on the degree of burn severity of an observed location. However, the amount of field data is meager relative to the number of acres and the variety of landscapes affected by fire. Ground access is severely limited due to the remote nature of the region and cost. These factors will continue to limit the availability of ground data. Still, there are plans to collect more field data in 2008. These data will help validate and understand burn severity characteristics.

The last objective was to identify potential collaborations and studies to advance burn mapping in Alaska.

The workshop discussion identified the requirements for burn severity information in Alaska. The availability of Landsat imagery provided by the MTBS project was identified as a major benefit, both in cost savings for data purchases by agencies and

providing a substantial data source for burn severity assessments. However, issues were also noted regarding the use of the normalized burn ratio for characterizing burn severity.

One obvious limitation for ongoing studies is funding for data and field studies. One of the key points for collaboration is the use of Landsat imagery. MTBS will work with the agencies and organizations to obtain and process Landsat imagery in support of ongoing studies. Requests for pre-fire and post-fire Landsat imagery will be served by MTBS.

Another concern which was expressed is the suitability of dNBR for characterizing a wide range of fire effects that occur in boreal regions. It is evident that there is no one size fits all solution to characterizing burn severity. The agencies expressed a desire to continue to evaluate the use of Landsat imagery for mapping burn severity. However, they also expressed a need for more investigation of other spectral combinations or indices that may be more appropriate for characterizing burn severity in boreal ecosystems. So whenever feasible MTBS and the agencies and organization will collaborate to obtain research funds to conduct field studies and validation efforts.

Alaska Burn Severity Workshop: Attendees List

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Thanks,
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