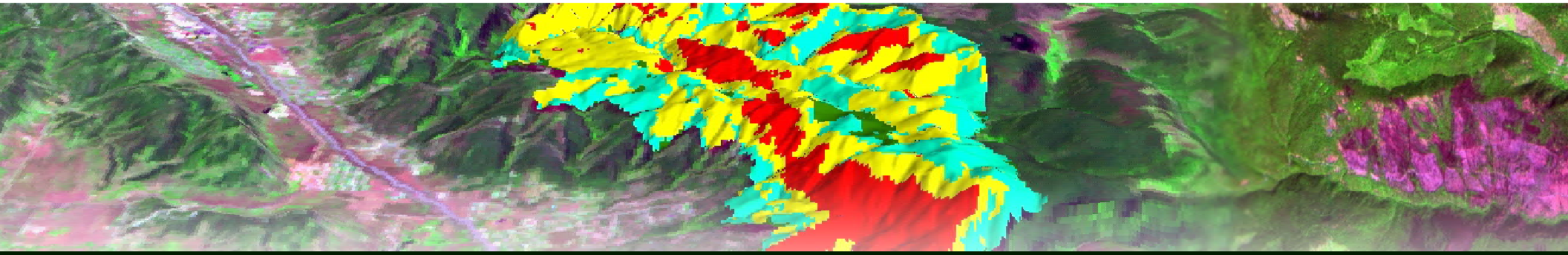

The Monitoring Trends in Burn Severity Project

Establishing a Nationwide Baseline of Historical Burn Severity Data to Support Monitoring of Wildfire Effects and National Fire Policies

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MTBS Background

- Sponsored by the Wildland Fire Leadership Council (WFLC)
  - One element of a strategy monitoring the effectiveness of NFP and HFRA
    - WFLC 2004 Monitoring Proposal, Module 2.1
  - Requires a consistent information base to synoptically assess environmental impacts and trends
  - Required for all lands in conterminous US, AK, and HI
- GAO recommendation that land management agencies develop and implement comprehensive burn severity assessments
- Jointly implemented by USGS EROS and USFS RSAC

MTBS Objectives

- Primary objective: Provide information for a national analysis of trends in burn severity for the NFP
- Secondary objective: Provide consistent and comprehensive data characterizing wildfire effects to land managers and the scientific community

MTBS Project Definition of Burn Severity

- National Wildfire Coordination Group (NWCG)
  - **Fire Severity**

    Degree to which a site has been altered or disrupted by fire; loosely, a product of fire intensity and residence time.

    see also: Burn Severity

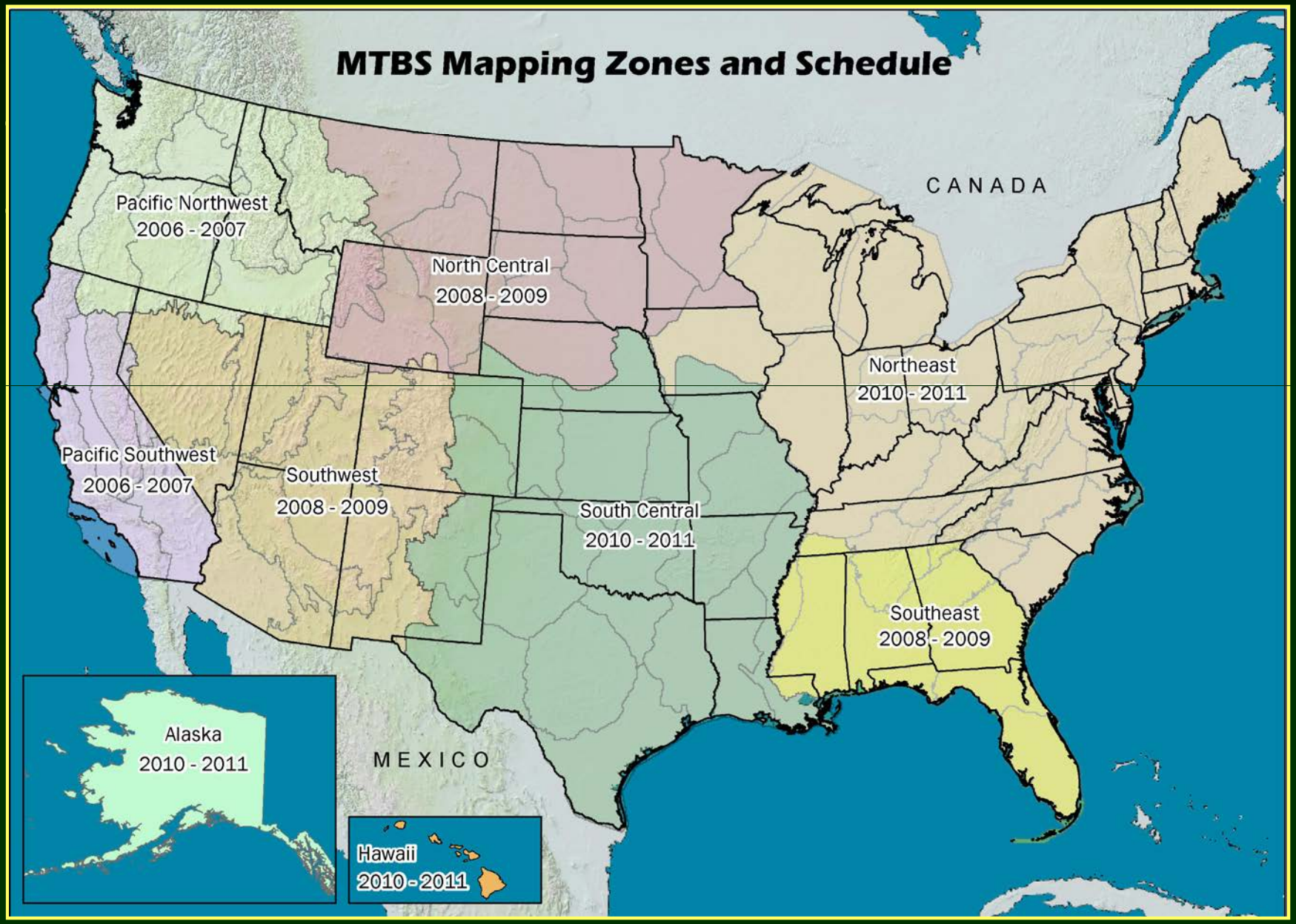
MTBS Project Definition of Burn Severity

- Additional Characteristics
  - Composite of 1st/2nd order fire effects on biomass
  - Occurs on a gradient or scale (ordinal)
  - Characterized w/n a fire perimeter
  - Occurs within strata
  - Longer term effects are complicated by multiple variables that MTBS is not characterizing
  - Map-able
  - Remote sensing provides a measurement framework

MTBS Products

- Burn severity data on all fires >1000 ac west of the 97th meridian and >500 ac east (1984-2011)
  - 16 bit continuous
  - 5 class thematic (unburned/undetectable, low, moderate, high, increased response)
- Fire perimeters
  - Shape files
- Tabular data summarizing burn severity acres by class
  - Additional stratification by vegetation type, treatment zones, condition classes, etc.
- Metadata
- 'normalized' historical fire history database
- Greatly expanded Landsat data archive

MTBS Schedule



MTBS Methods

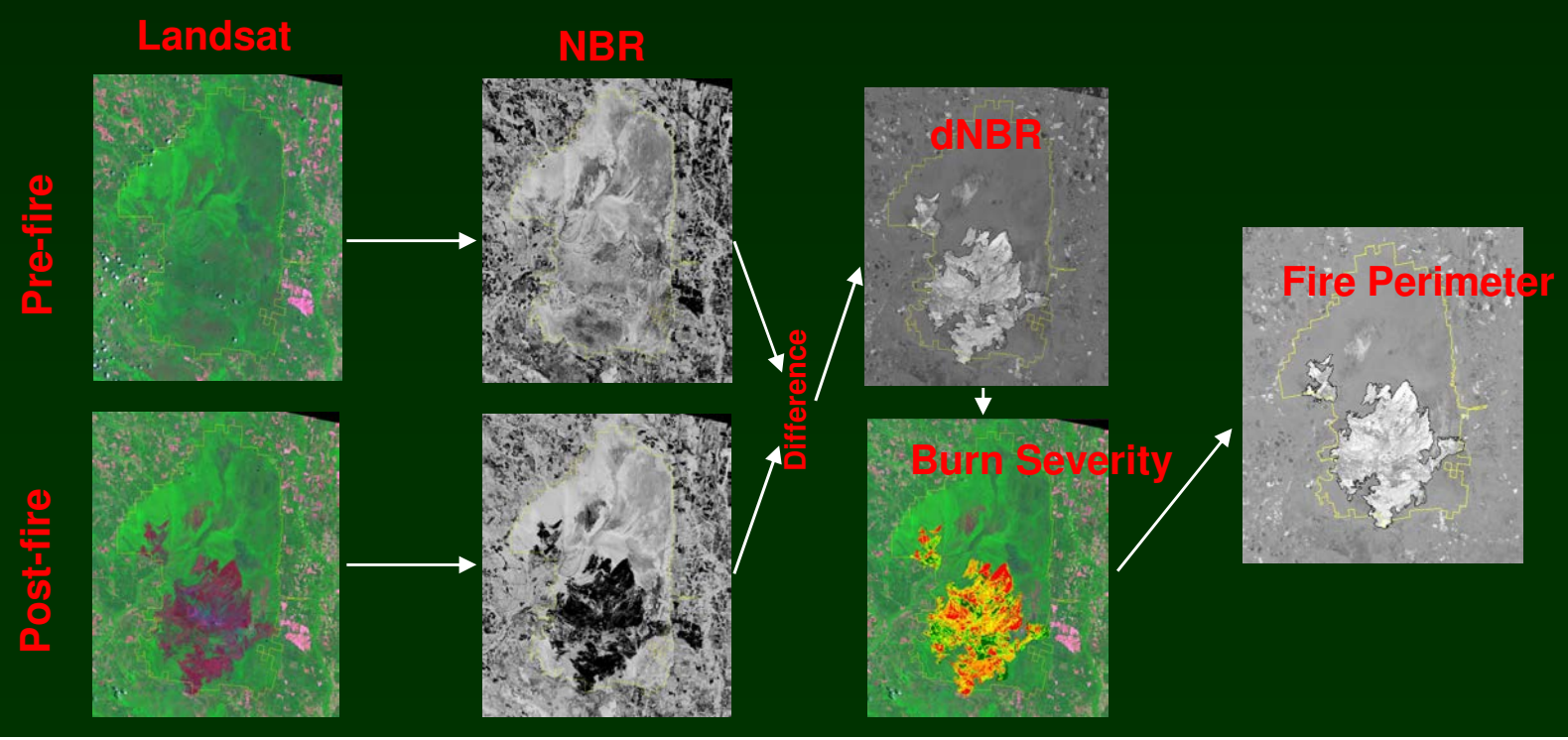
Burn severity products are based on Landsat data and the differenced Normalized Burn Ratio (dNBR) approach

NBR = (NIR – Mid IR) / (NIR + Mid IR)
dNBR = pre NBR – post NBR

- Mature science established in the literature
  - Lopez-Garcia and Caselles, 1991; Brewer et al., 2005; Cocke et al., 2005; others
- Operational precedent
  - Implemented by Key and Benson for development of NPS fire atlases
- Landsat data record
  - Consistent data record spanning ecologically and possibly climatically significant time frame
- Resolution synergy
  - Spatial and spectral resolutions comparable to other national scale data

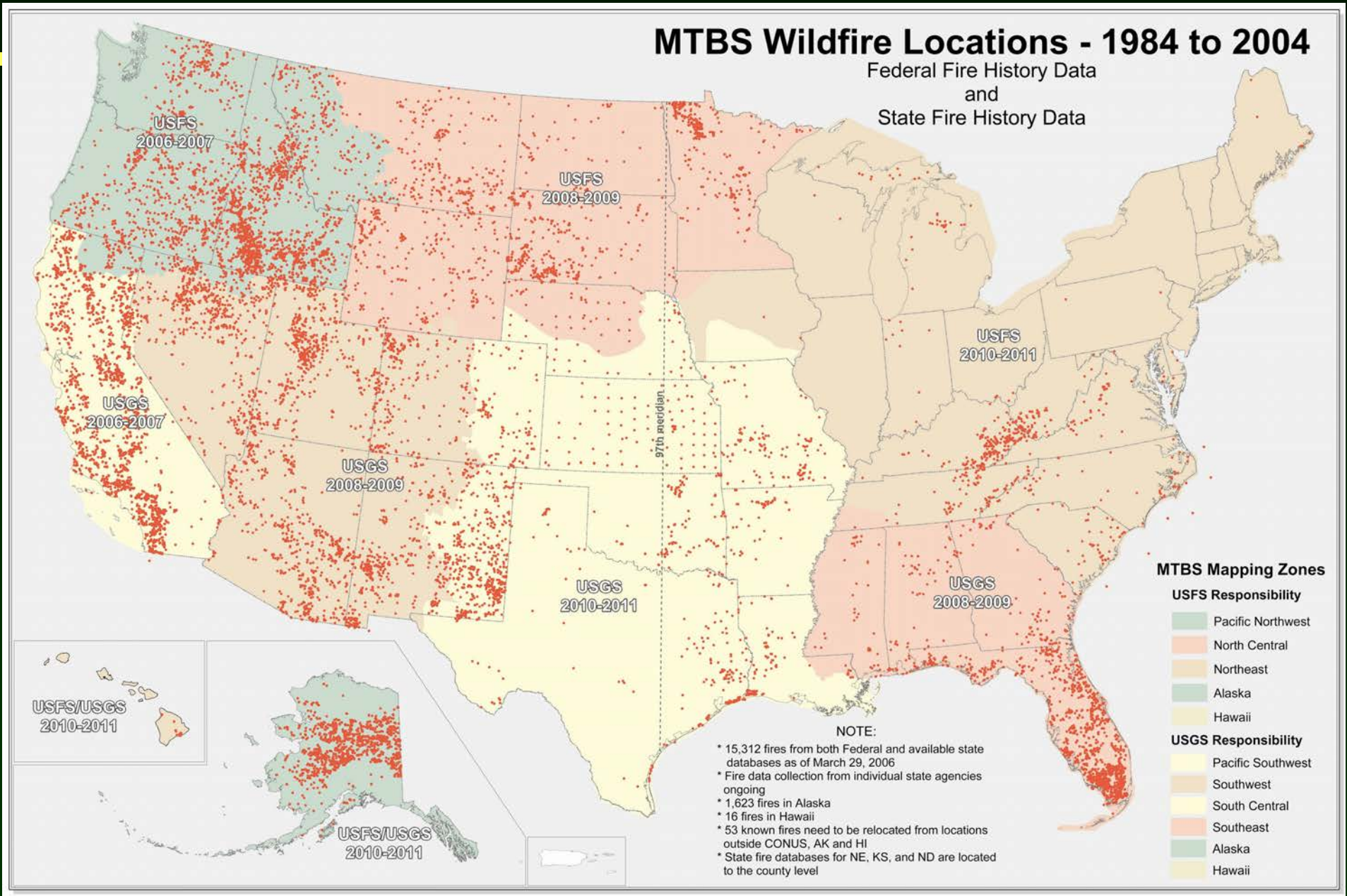
MTBS Method Outline

1. Compile a single MTBS fire occurrence database from existing sources
2. Based on fire occurrence database, select pre and post-fire Landsat scenes
3. Data processed at EROS-terrain correction through NBR calculations
4. EROS and RSAC analysts perform differencing, threshold dNBR images into burn severity classes, and delineate perimeters
5. Data summary trend analysis, and reporting



MTBS Method-Fire History DB

- Existing federal and state fire occurrence databases have been compiled
  - Federal fire history database (GTG)
    - Compiled from ICS209 database
  - Most state databases
- Standardized to address format and content variability
  - Core fire data harvested (fire name, database id, start data, containment date, fire size)
  - Unique MTBS id assigned that links to database of origin
- 15000+ records
  - Numerous duplicates and spatial anomalies



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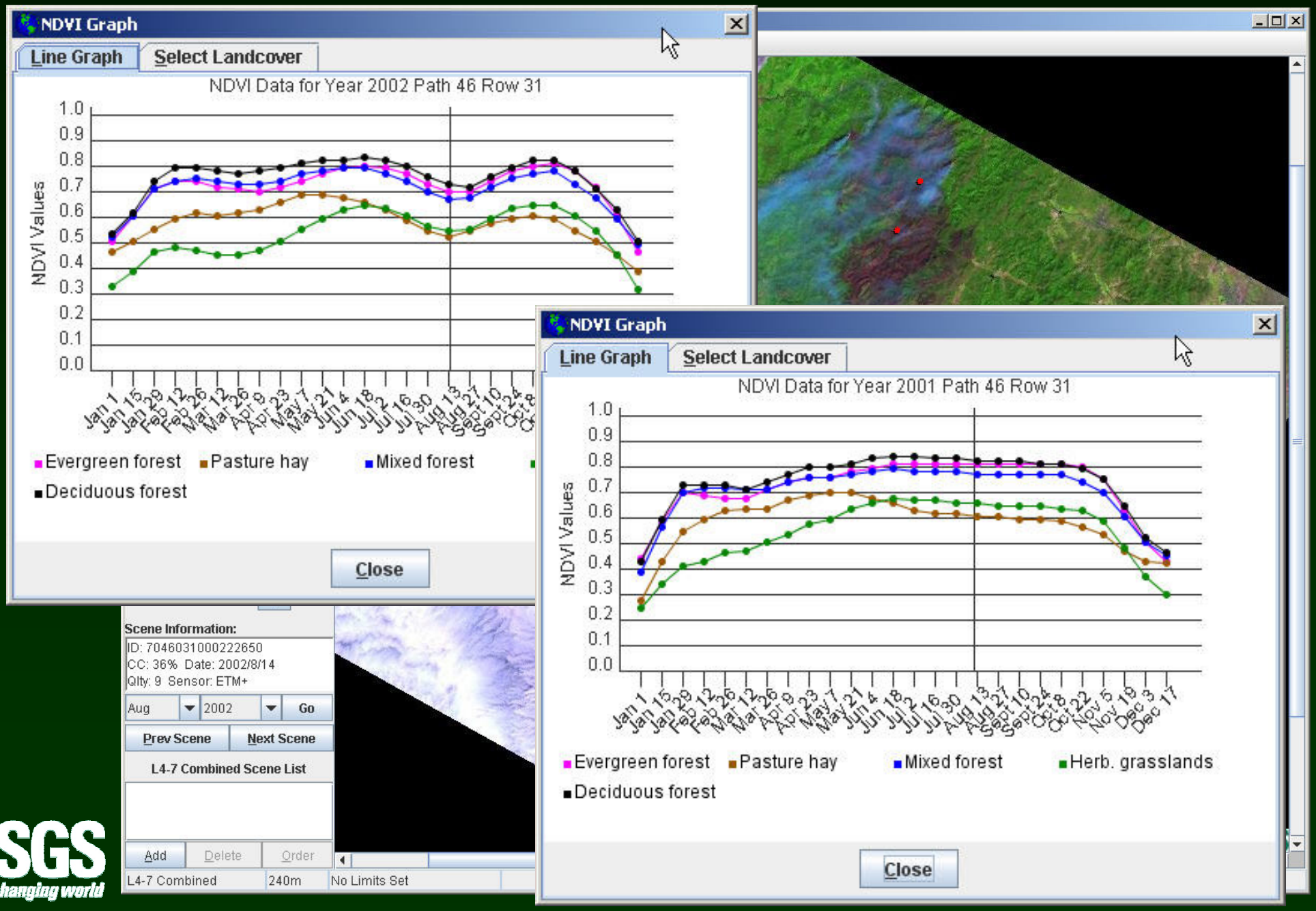
MTBS Method-Scene Selection

- Scene selection based on fire location/date, cloud-free availability, and optimal seasonality
  - Extended assessments on forest and shrublands
  - Grassland burn severity and perimeters based on immediate post-fire assessment
- USGS Global Visualization Browser (GLOVIS)
  - MTBS driven enhancements include input of user supplied shape files and dynamic NDVI graph popups

GLOVIS Scene Selection



MTBS Methods - Data processing

MTBS Analysts submit data orders to EROS

↓

Data are terrain corrected using National Land Archive Production System (NLAPS)

↓

NLAPS images calibrated to At-Satellite reflectance

↓

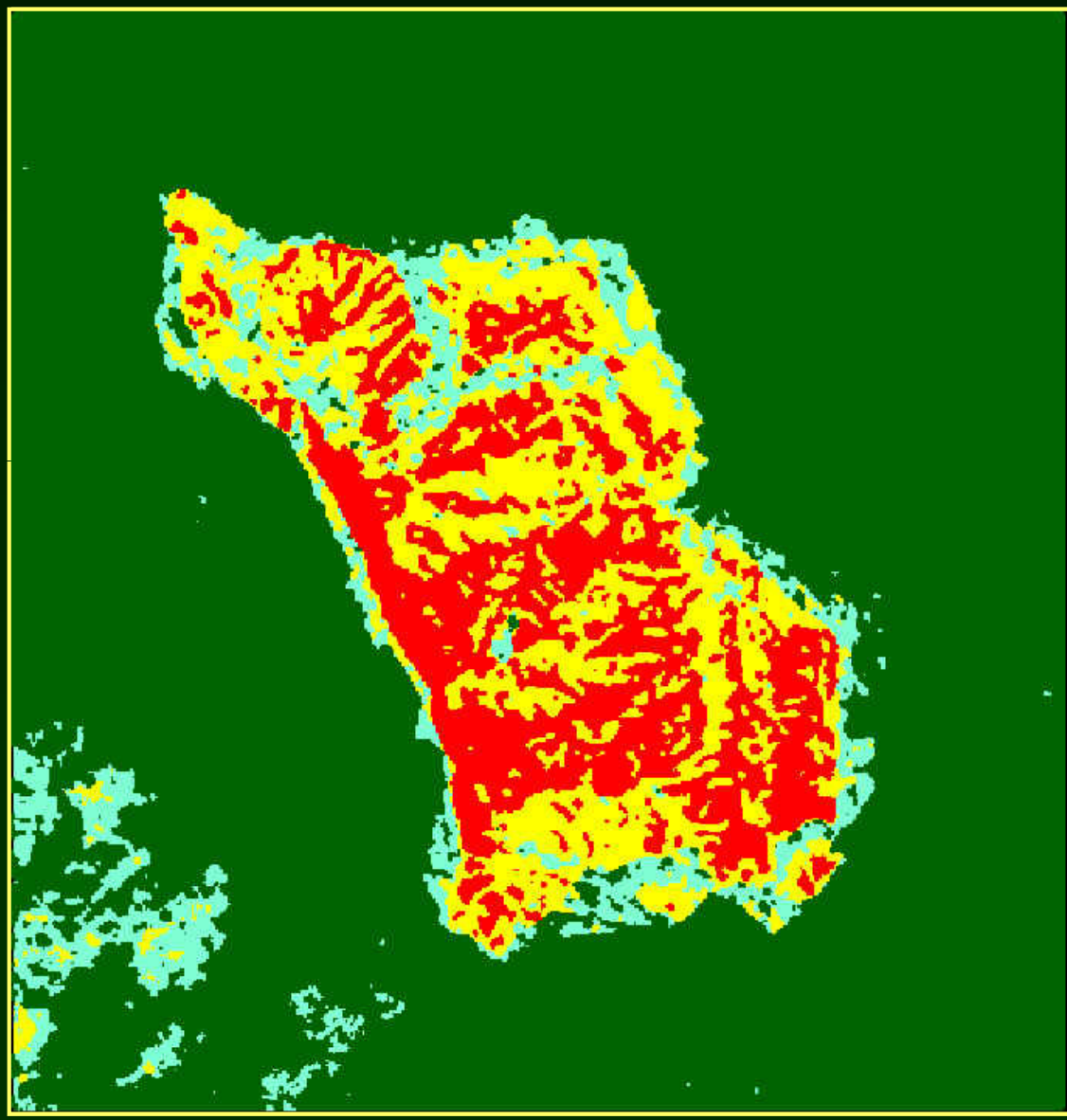
NBR images derived from reflectance images

↓

Data are delivered to MTBS analysts for mapping, analysis, and reporting

MTBS Methods - Burn Severity Map Development

- Differenced NBR images are interpreted to derive severity classes
- Analysts use existing Composite Burn Index (CBI) thresholds (Key, 2001) as guidance for choosing severity thresholds



MTBS Methods - dNBR Thresholding

Two approaches

- Thresholds based on ecological interpretation and use of existing ancillary data, e.g. CBI plots
  - Can be intuitive
  - Most subjective and dependent on familiarity with site ecology
  - Relevance of interpretations/thresholds is dependent on analysis and management objectives
- Arithmetic partitioning
  - Has no intended relevance to a specific management objective
  - Offers greatest flexibility for trend analysis
  - Offers greatest flexibility for consistent analysis of historic data

MTBS Methods - Perimeter Delineation

- Perimeters digitized around dNBR
- Incident perimeters do not directly affect delineation
- Goal is to utilize a consistent method and data to derive perimeters
- Perimeter confidence levels included as feature level metadata

MTBS Trend Analysis

Trend and Pattern Analysis Process

- Trends and patterns characterized across:
  - Time
  - Space
  - Policy
- MTBS analysis will focus on pattern characterization, summarization, and reporting
- Explanatory analysis and causation are longer term activities best handled by the research and specialized user communities

MTBS Technology Transfer, Training, and Feedback Opportunities

- Multi-faceted approach
  - Web availability of documents and powerpoints beginning in 06
  - Workshops to enhance understanding of burn severity maps and appropriate applications
  - Web-based modules to describe data and applications
  - Findings from analysis of national trends documented and published in peer-reviewed journals
  - Web and workshop environments in addition to ad hoc opportunities will be used as feedback mechanism to project team

MTBS Challenges and Limitations

- Continued availability of LANDSAT data
- Ability of dNBR to characterize fire effects across a wide range of ecological conditions
- Assessment timing relative to severity characterization and perimeter delineation
- Reporting unit sensitivity-minimum logical reporting unit?
- Accuracy assessment
- Large project responsiveness
- …

MTBS Potential applications

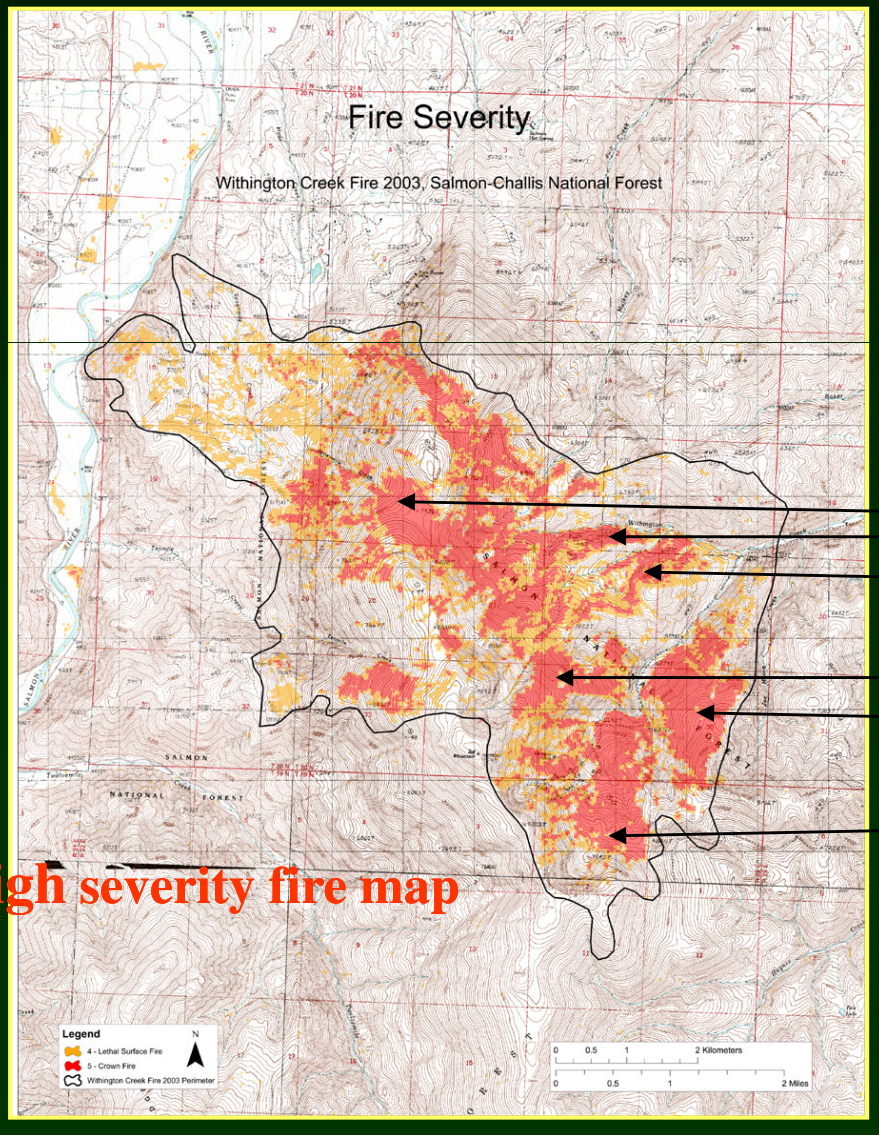
- Event specific fire effects analysis…?
- Land management impact assessment
  - Fuels and silvicultural treatments
  - Grazing
  - Prescribed and wildland use fires
- Post-fire habitat impact assessment
- Fire safety risk assessments
- Fire related change data for targeted updates of similar scale landcover and fuels layers
- On and on…

Example Application

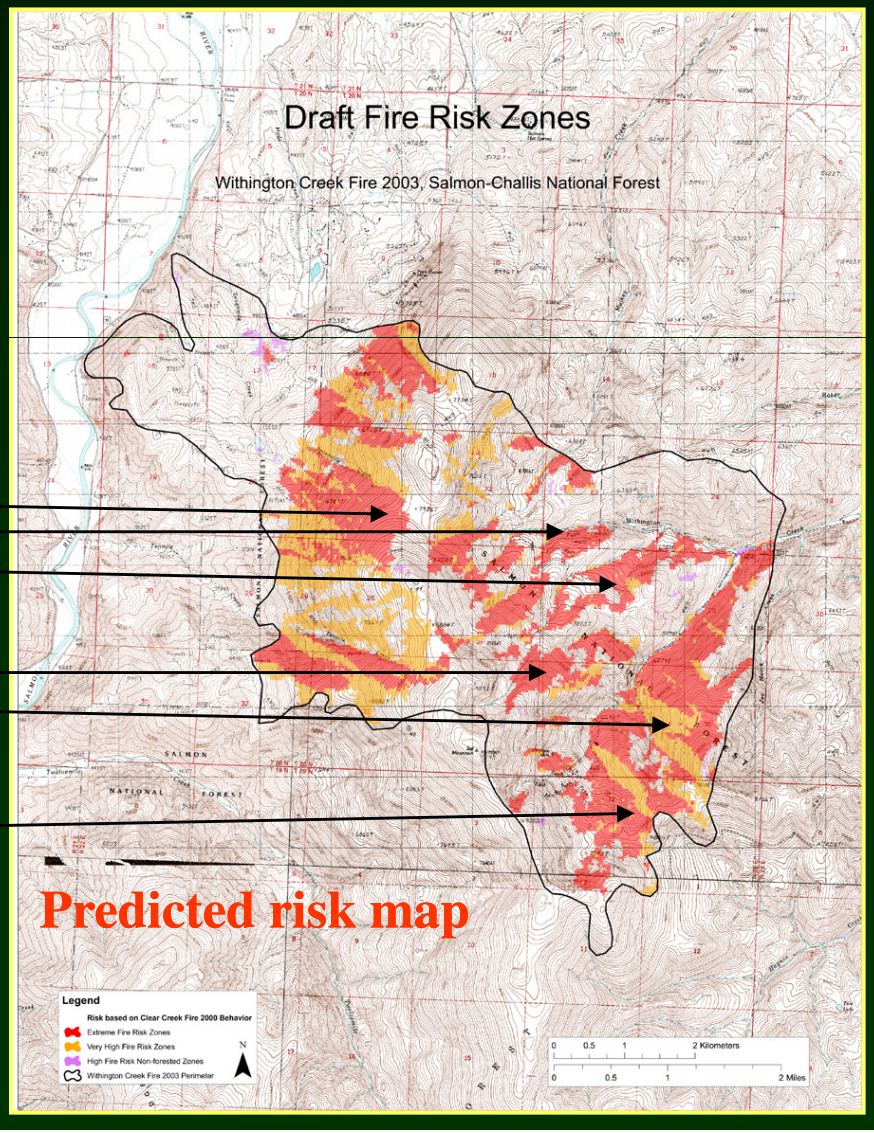
Using historical trends in burn severity, and existing fuel and landscape attributes, the Salmon-Challis NF is identifying some of the most dangerous wildland firefighting risks in the Western United States: crown fire and extreme fire behavior.

Example Application

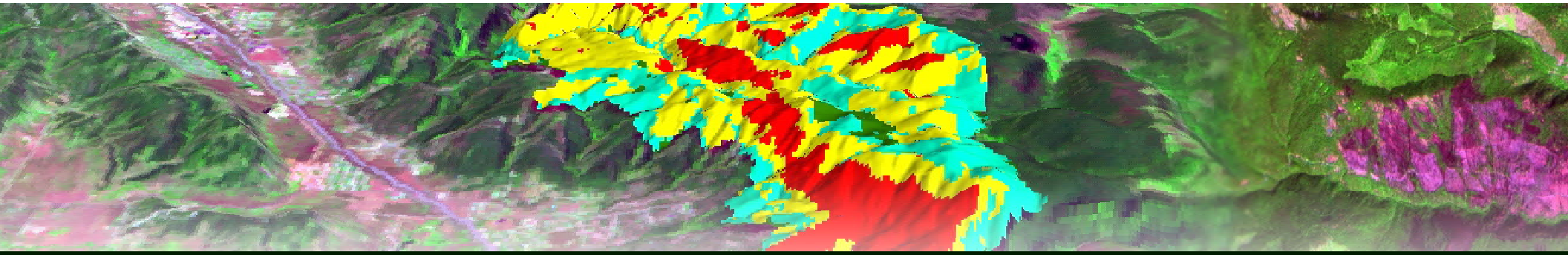
Withington Fire 2003: Very strong correlation of the predicted Extreme/High Risk Zones to actual lethal and crown fire occurrence.



High severity fire map



Predicted risk map



MTBS Contact Information

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Web presence coming soon...

http://www.fs.fed.us/eng/rsac

http://edc.usgs.gov

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