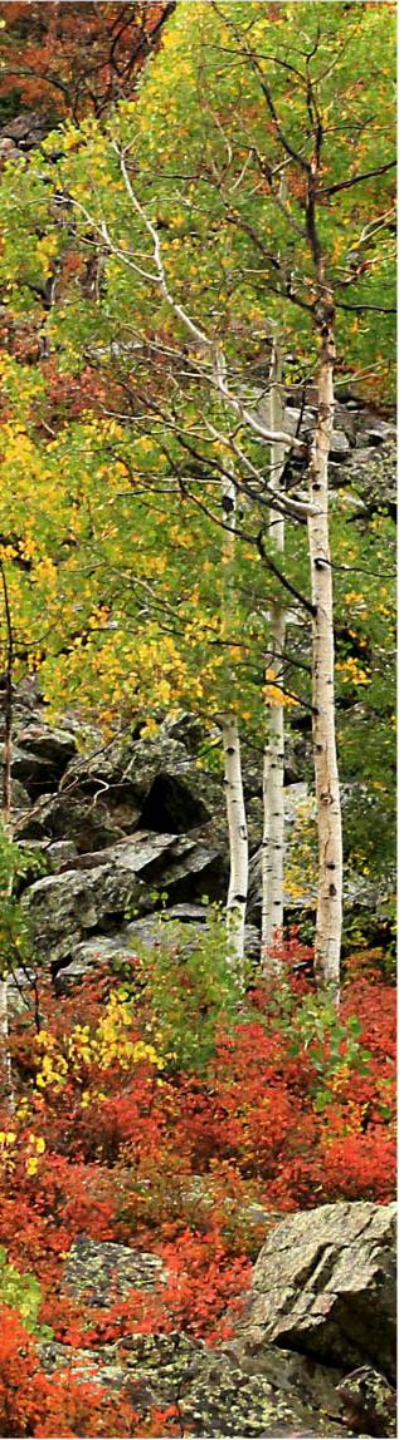


United States Department of Agriculture
Forest Service

Understanding & Using MTBS Data

2018 Annual Webinar

Seth Bogle
Remote Sensing Specialist, Redcastle Resources, onsite contractor
801-975-3788
msbogle@fs.fed.us

Geospatial Technology and Applications Center | GTAC
USDA Forest Service

GTAC Mapping Our Future Together

Webinar Housekeeping

- Adobe Connect
  - Pod visibility controlled by Pods menu in toolbar
  - Feel free to use chat
  - Closed captioning is available
- Conference call
  - All participants phones will be muted during presentation & GIS demo
  - To unmute or re-mute your phone press *6
  - Please don’t put your phone on hold
- Webinar/Instructor evaluation
  - SurveyMonkey link via email

Postfire Mapping Programs

1. BAER: Emergency assessment

   www.fs.fed.us/eng/rsac/baer

2. RAVG: Rapid/Initial assessment

   www.fs.fed.us/postfirevegcondition

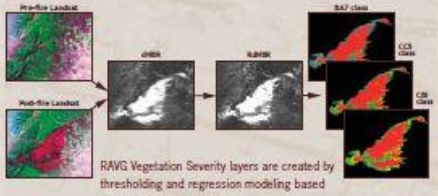
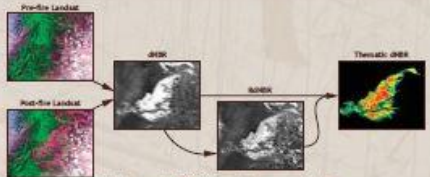
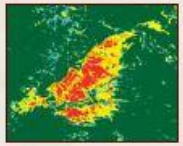
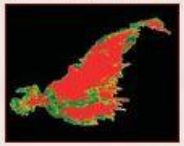
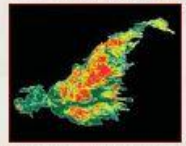
3. MTBS: Long-term/Extended assessment

   www.mtbs.gov

Postfire Mapping Programs

Post-fire Mapping Products: BAER, RAVG, and MTBS

The USDA Forest Service Remote Sensing Applications Center (RSAC) supports three major post-fire mapping programs

	BAER (Burned Area Emergency Response) www.fs.fed.us/eng/rsac/baer	RAVG (Rapid Assessment of Vegetation Condition After Wildfire) www.fs.fed.us/postfirevegcondition	MTBS (Monitoring Trends in Burn Severity) www.mtbs.gov
DESCRIPTION	The Burned Area Emergency Response (BAER) support at RSAC includes tracking fire progression, satellite overpasses, image acquisition, and Burned Area Reflectance Classification (BARC) creation. The BARC is a GIS layer used by BAER teams as they perform an emergency assessment of the burned area. The BARC is a first approximation at soil burn severity on the burned land.	The Rapid Assessment of Vegetation Condition after Wildfire (RAVG) program produces data describing post-fire vegetation conditions on National Forest System (NFS) lands. RAVG produces a suite of geospatial and tabular outputs that include standard vegetation mortality summary tables and maps. The tables and maps are produced by integrating existing vegetation maps and burn severity maps.	Monitoring Trends in Burn Severity (MTBS) is a multi-year program designed to consistently map the burn severity and burn area boundaries of fires across all lands of the United States for the period spanning 1984 through 2010. The data generated by MTBS will be used to identify national trends in burn severity, providing information necessary to monitor the effectiveness and effects of the National Fire Plan and Healthy Forests Restoration Act.
MAPPING METHOD	 The BARC256 is created by rescaling the dNBR from 16 - to 8-bit imagery. The BARC4 is created by recoding the dNBR into 4 discrete classes.	 RAVG Vegetation Severity layers are created by thresholding and regression modeling based on hundreds of field plots.	 The thematic dNBR is created by recoding the continuous dNBR after calibration from the RdNBR.
AUDIENCE	The BARC is delivered to BAER teams. These teams are dispatched to make an assessment of the burned area within seven calendar days from fire containment. One of their first tasks is to create a soil burn severity map. The BARC is used to create that map.	The primary audience for RAVG data and products are Regional Silviculturists who need to communicate yearly reforestation and restoration needs to the Washington Office and Congressional decision makers for specific funding requests.	The MTBS project serves four primary user groups: 1. National policies and policy makers 2. Field management units 3. Existing databases from other comparably scaled programs 4. Research and academic entities interested in fire severity.
TIMELINE	1 - 7 days after fire containment	30 - 45 days after fire containment	12 - 18 months after fire containment
DELIVERABLES	■ Pre- and post-fire satellite imagery ■ BARC layers (thematic and continuous) ■ Metadata ■ 3D image drape	■ Pre- and post-fire satellite imagery ■ Fire perimeter shapefile ■ dNBR and RdNBR (continuous) ■ Composite Burn Index (CBI) layer ■ % change in basal area layer ■ % change in canopy cover layer ■ Summary table and map ■ Metadata	■ Pre- and post-fire satellite imagery ■ dNBR and RdNBR (continuous) ■ 5-class thematic thresholded dNBR ■ Burn area boundaries ■ Data summaries ■ Metadata ■ 3D image drape
EXAMPLE **Trigo** **Ignition:** 4/15/2008 **Contained:** 5/11/2008	 **Perimeter Acres:** N/A **Assessment Type:** Emergency  **Pre-fire Image Date:** 5/21/2007 **Post-fire Image Date:** 5/15/2008 	**Perimeter Acres:** 14,297 **Assessment Type:** Initial  **Pre-fire Image Date:** 5/21/2007 **Post-fire Image Date:** 5/7/2008 	**Perimeter Acres:** 13,855 **Assessment Type:** Extended  **Pre-fire Image Date:** 7/8/2007 **Post-fire Image Date:** 7/29/2009 

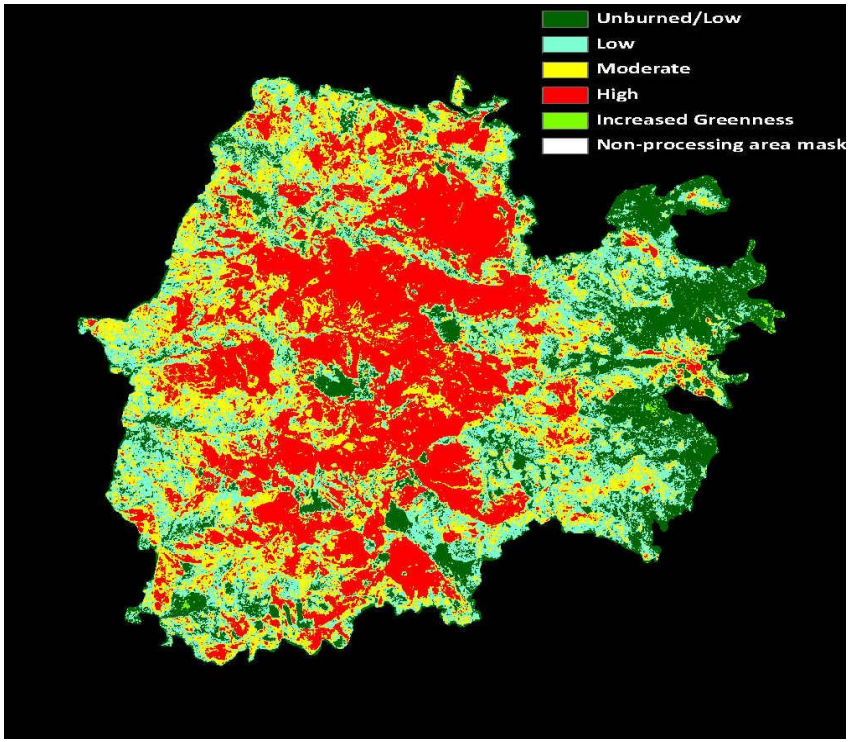
CONTACT ■ For more information about any of these programs, please contact the USFS Remote Sensing Applications Center (RSAC) at 801-975-3750

Today's Agenda

- MTBS Program Overview
  - Background and Methods
- MTBS.gov
- Program Challenges and Limitations
- Applications of MTBS Data at Grand Canyon National Park
- Q & A

****brief break****

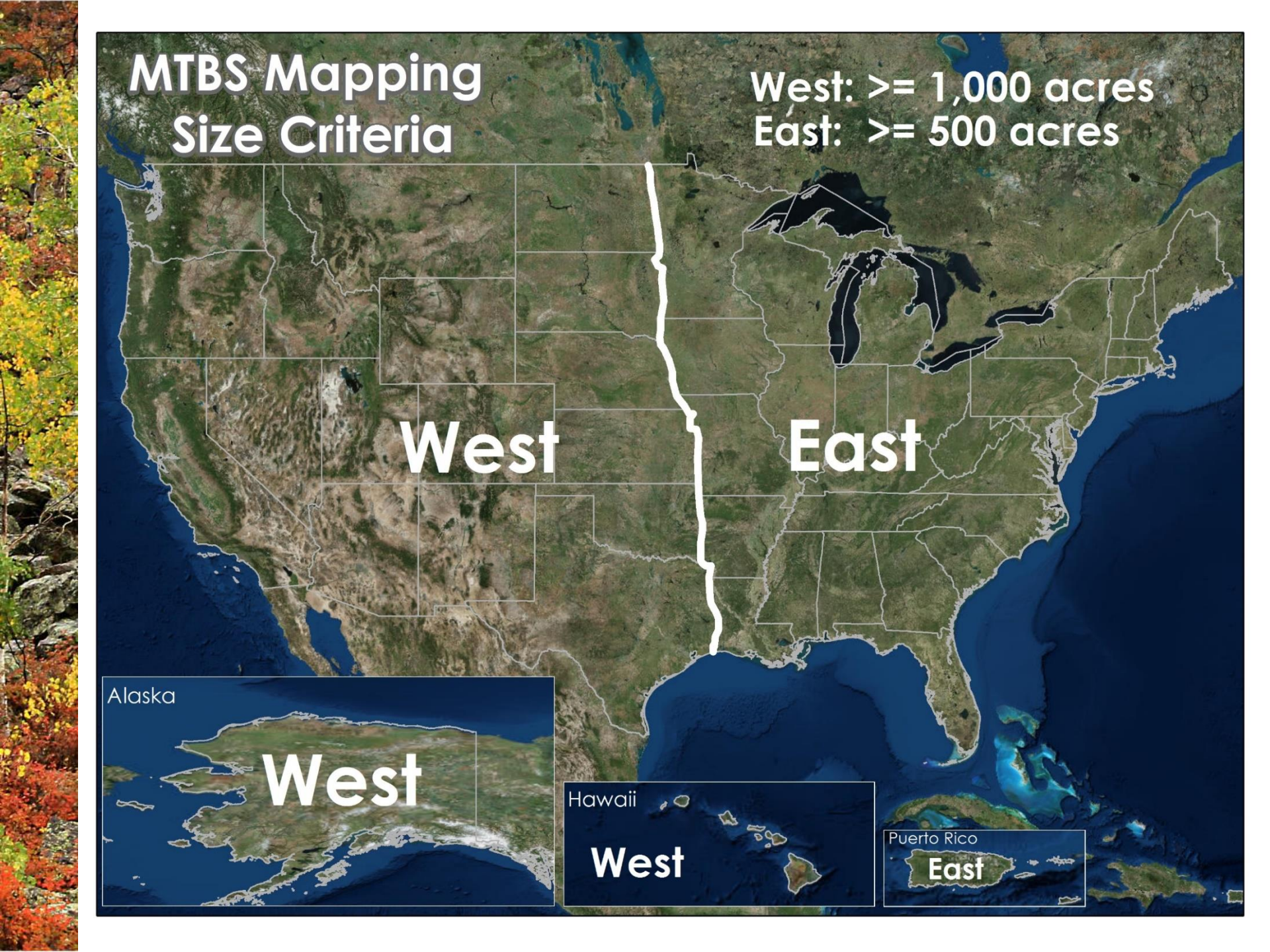
- GIS Exercise Demo: Habitat Management
- Work on GIS Exercise (instructor available for questions)



MTBS Background

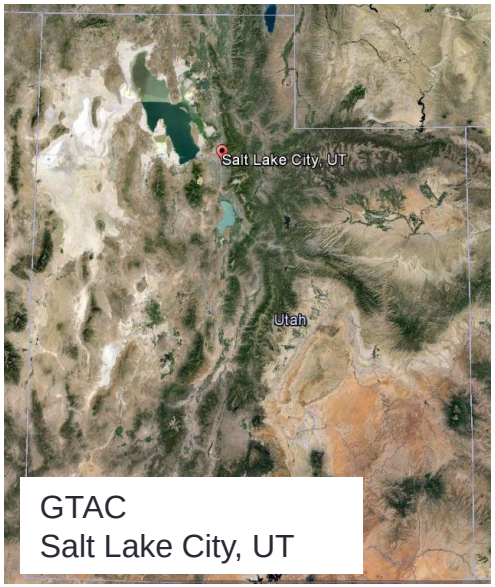
MTBS Objective

- Consistently map…
  - Location
  - Extent
  - Burn severity
- …of “large fires” on all lands across the United States from 1984 thru 2018 and beyond
  - CONUS, Alaska, Hawaii & Puerto Rico
  - All documented wildfires
  - All documented Rx fires on Federal lands


MTBS Mapping
Size Criteria
West: >= 1,000 acres
East: >= 500 acres
West
East
Alaska
West
Hawaii
West
Puerto Rico
East

MTBS Background

- Program duration
  - 1984 to 2010 data record completed between 2005 and 2012
  - Annual maintenance/updates planned for 2018 and beyond
- Jointly implemented by USDA Forest Service and Department of Interior
  - USFS – Geospatial Technology and Applications Center (GTAC)
  - USGS – Earth Resources Observation and Science (EROS) Center



GTAC
Salt Lake City, UT

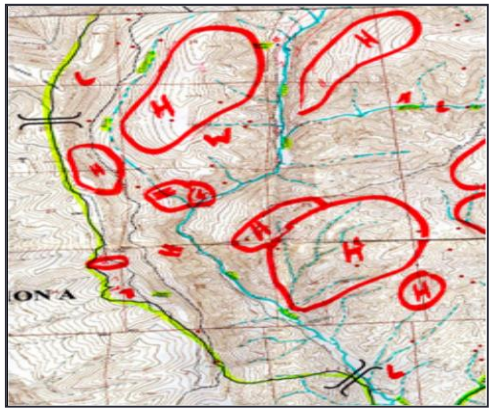
EROS
Sioux Falls, SD

MTBS Background

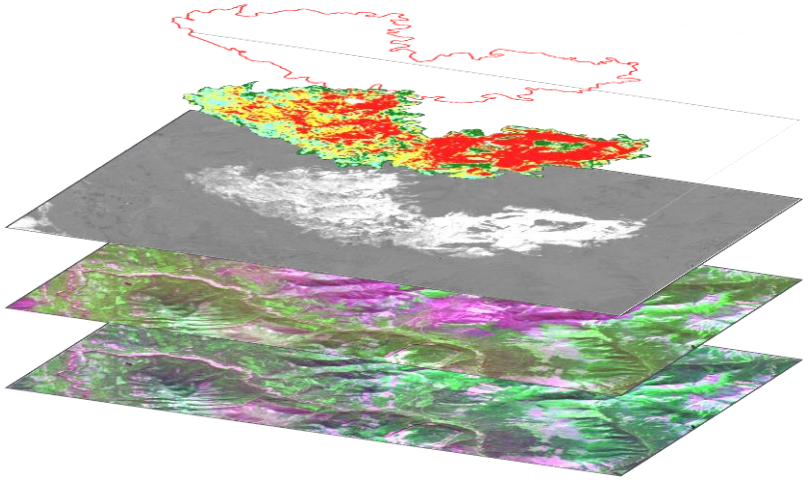
- One element of a strategy monitoring the effectiveness of the National Fire Plan and Healthy Forests Restoration Act
  - Provide an information base to synoptically assess environmental impacts and trends
  - Required for all lands in CONUS, AK, HI and PR

MTBS Background

- Addresses recommendations in GAO report GAO-04-705 “Environmental Effects of Wildland Fire” (2004)
  - Federal land management agencies need to systematically compile consistent and comprehensive fire data at a landscape and ecosystem scale that characterize wildfire effects



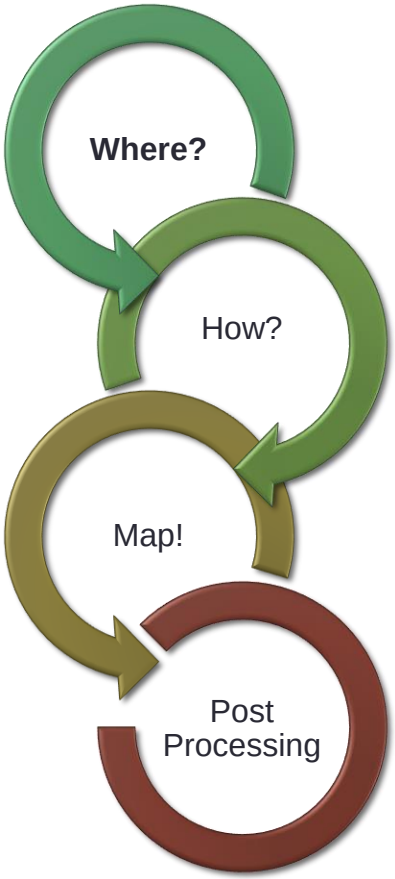
Inconsistent, inaccurate & not comprehensive



Consistent, accurate & comprehensive

MTBS Fire Mapping Methods

MTBS Fire Mapping Methods Overview



- Where are the fires to be mapped?
  - Compile a fire occurrence database (FOD) from existing data sources

U.S. Fire Occurrence Data

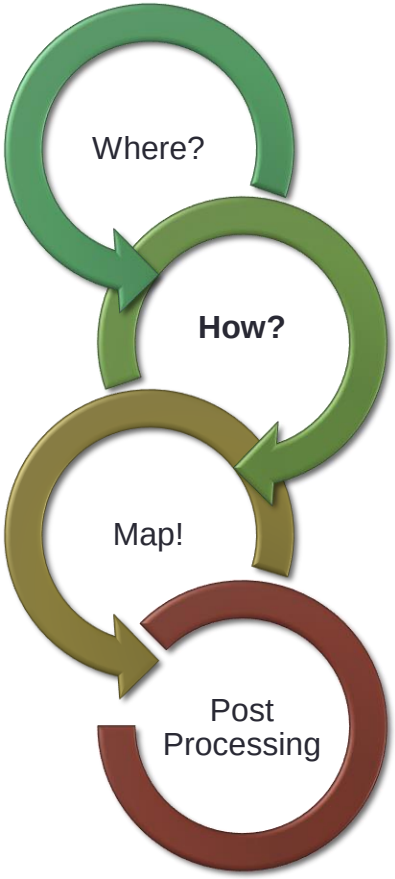
Integrated Reporting of Wildland Fire Information (IRWIN)

- Wildland Fire Information and Technology (WFIT) investment
- Not a system of record for fire occurrence data, but a “System of systems”
- Provide data exchange capabilities between new & existing applications used to manage data related to wildland fire incidents
- Reduce redundant data entry & identify authoritative data sources

Key IRWIN information for MTBS mapping

- Fire name/ID
- Fire size
- Fire location
- Fire ignition date
- Fire suppression date

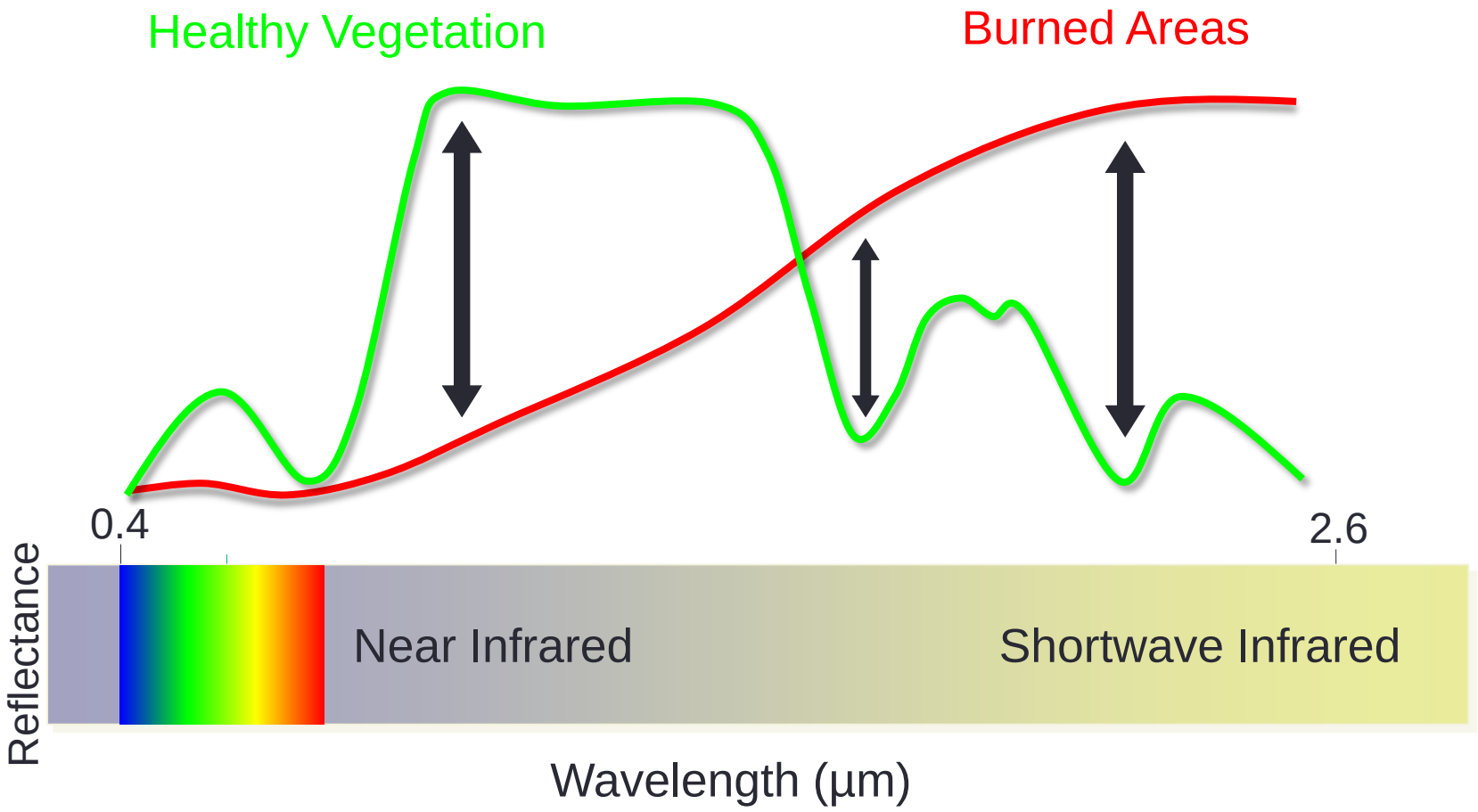
MTBS Fire Mapping Methods Overview



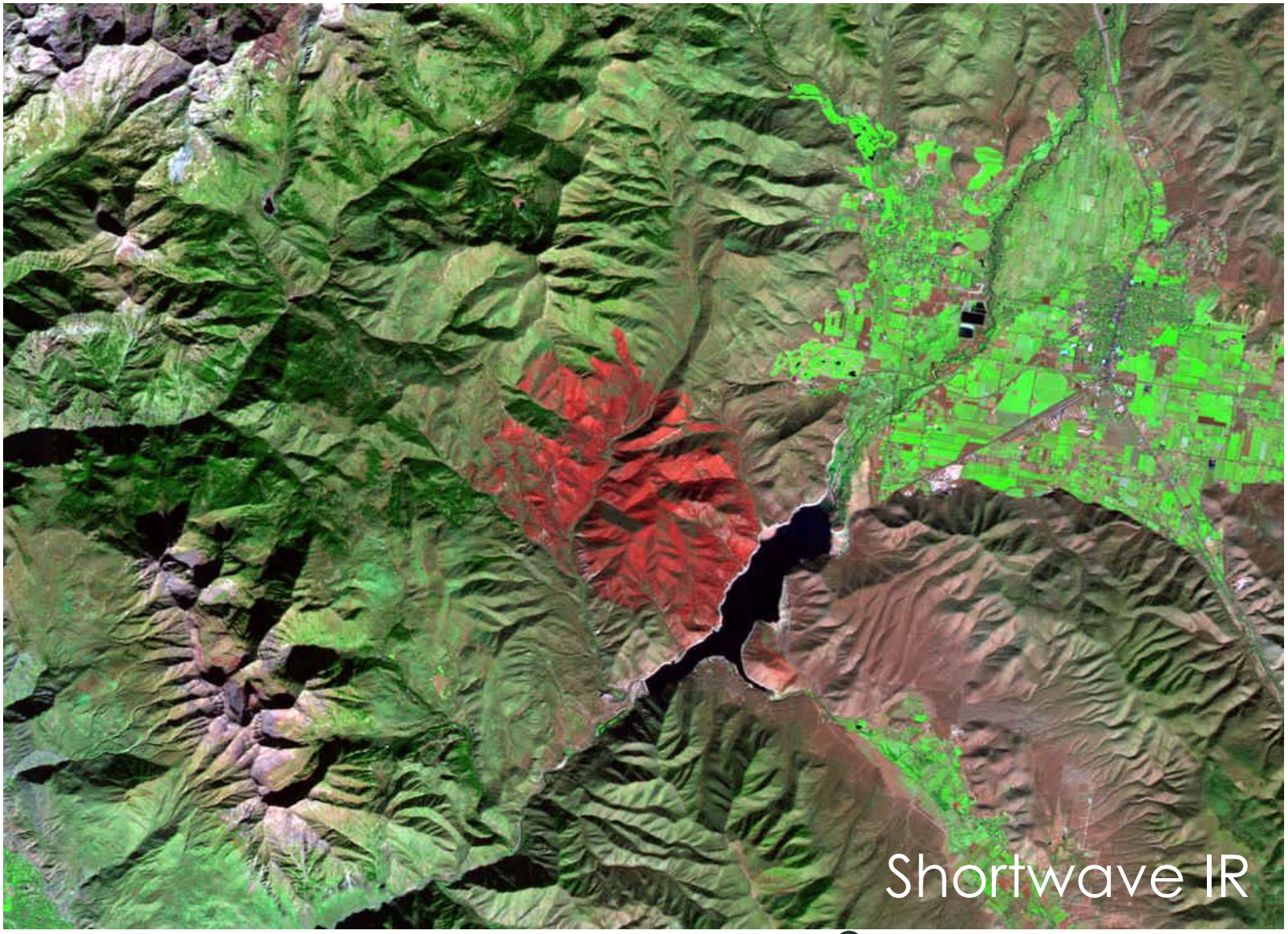
- How should I map the fire?
  - Determine appropriate assessment strategy
  - Select prefire and postfire scenes

Healthy Vegetation vs. Burned Areas

Exploiting Spectral Response Curves

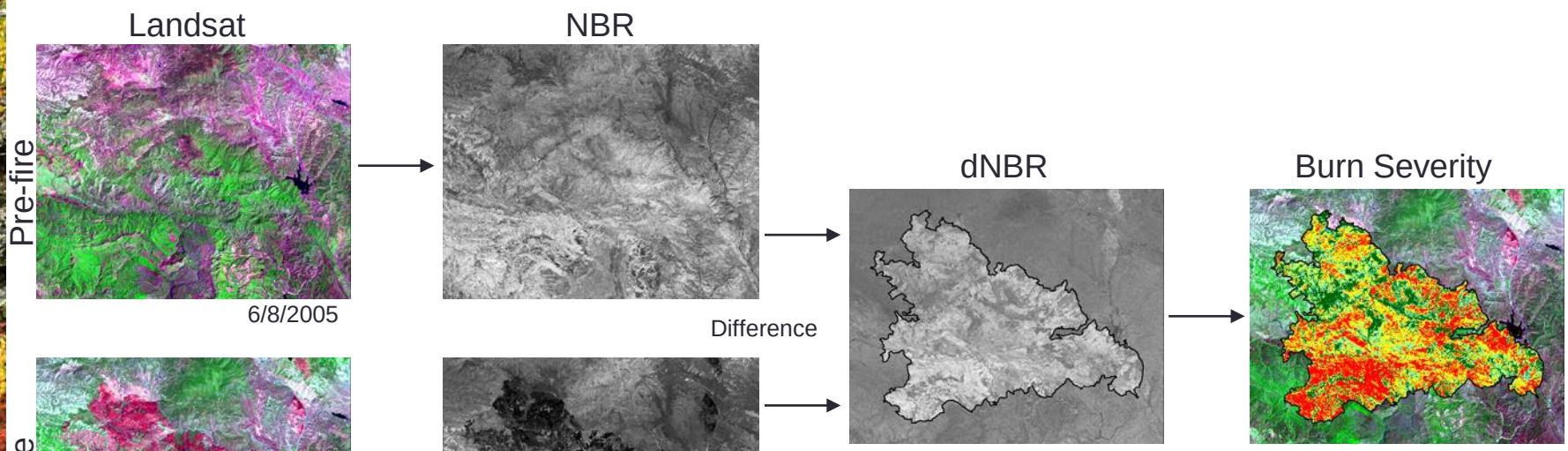


Where's the wildfire?



MTBS Fire Mapping Methods Overview

- Burned area perimeter delineation and severity assessments are conducted using pre/postfire Landsat TM/ETM/OLI image pairs
- Normalized Burn Ratio (NBR)/differenced Normalized Burn Ratio (dNBR)



Normalized Burn Ratio (NBR)

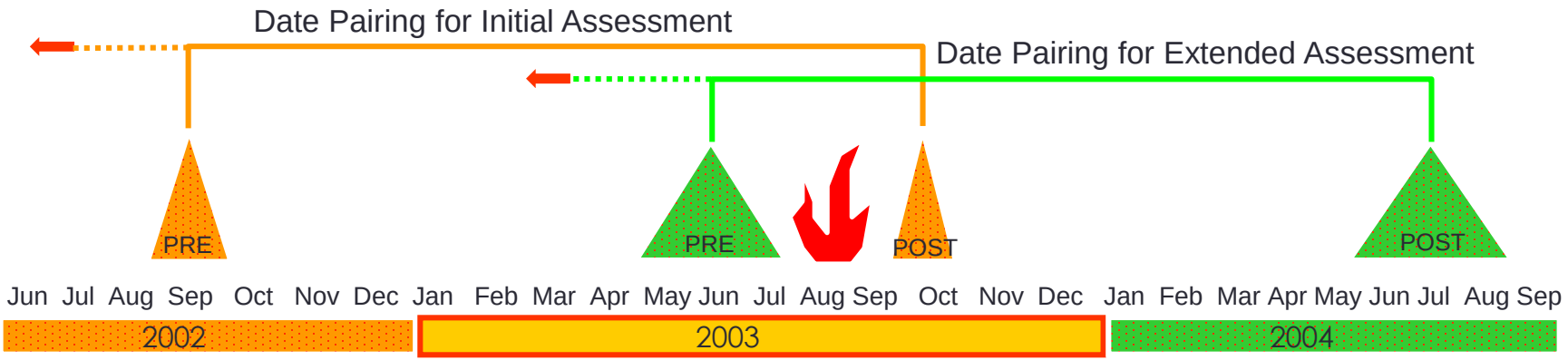
NBR = (NIR – SWIR) / (NIR + SWIR)

Differenced Normalized Burn Ratio (dNBR)

dNBR = Pre NBR – Post NBR

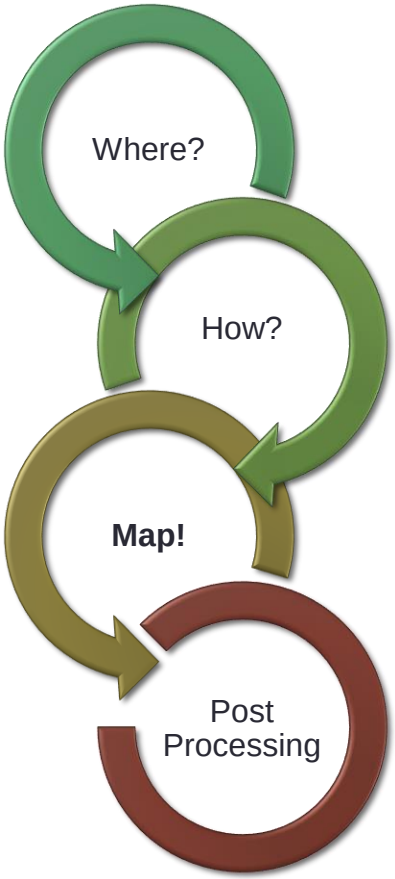
MTBS Methods – Assessment Strategy

- Based on biophysical setting and fire type (WF, RX)
  - Extended Assessment (EA)
    - Severity based on post-fire assessment at peak of green of next growing season
    - Forests/shrublands
  - Initial Assessment (IA)
    - Severity based on immediate post-fire assessment
    - Grasslands/shrublands
  - "Single Scene" Assessment
    - Lack of suitable pre-fire imagery or other factors; use post-fire NBR
    - Conducted on a limited basis (EAs and IAs)



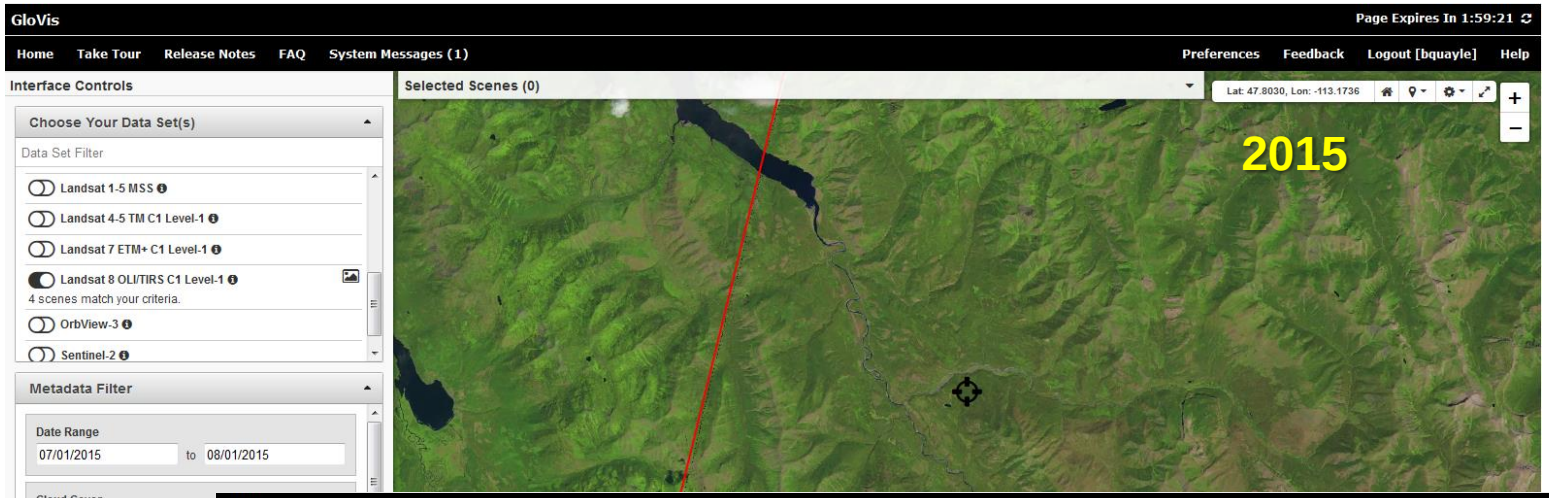
Carl Key 2006

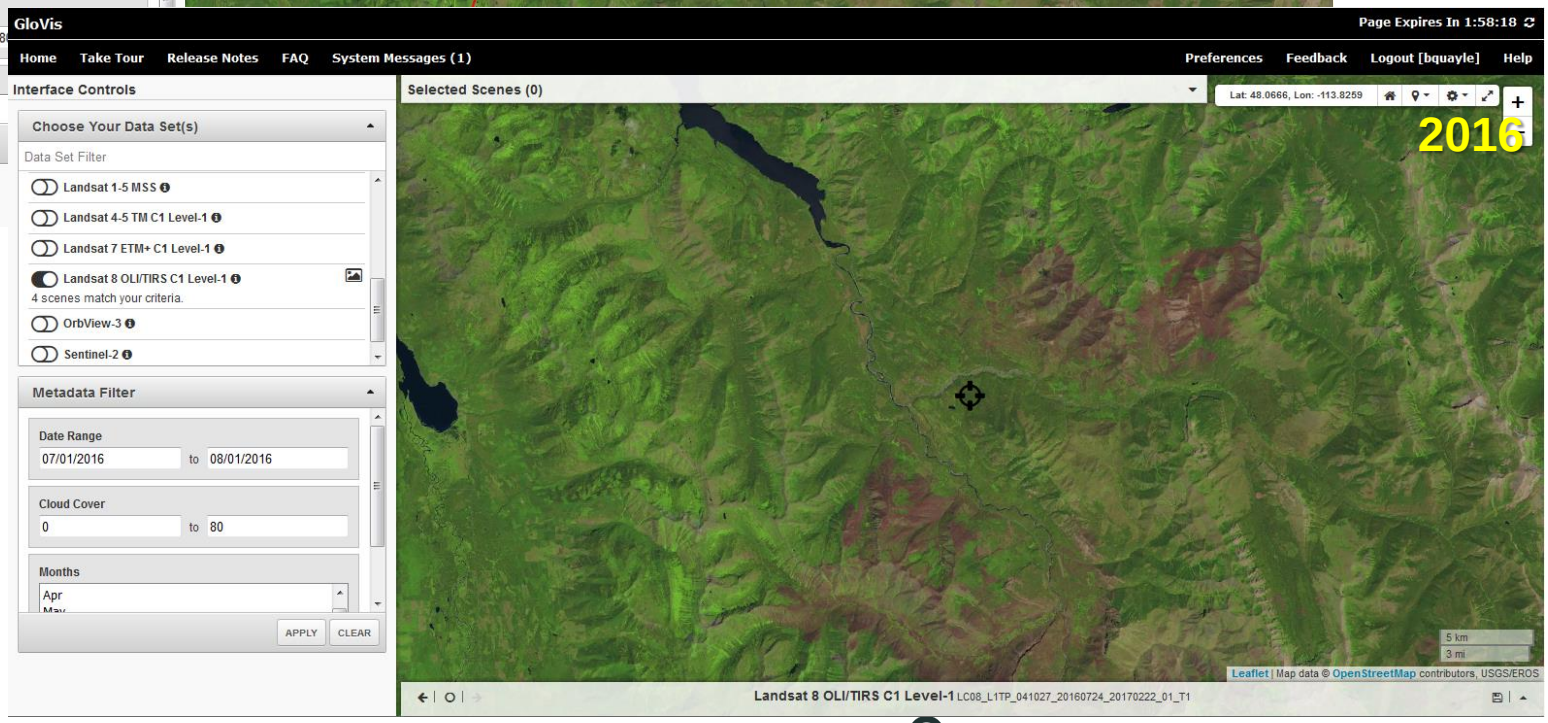
MTBS Fire Mapping Methods Overview



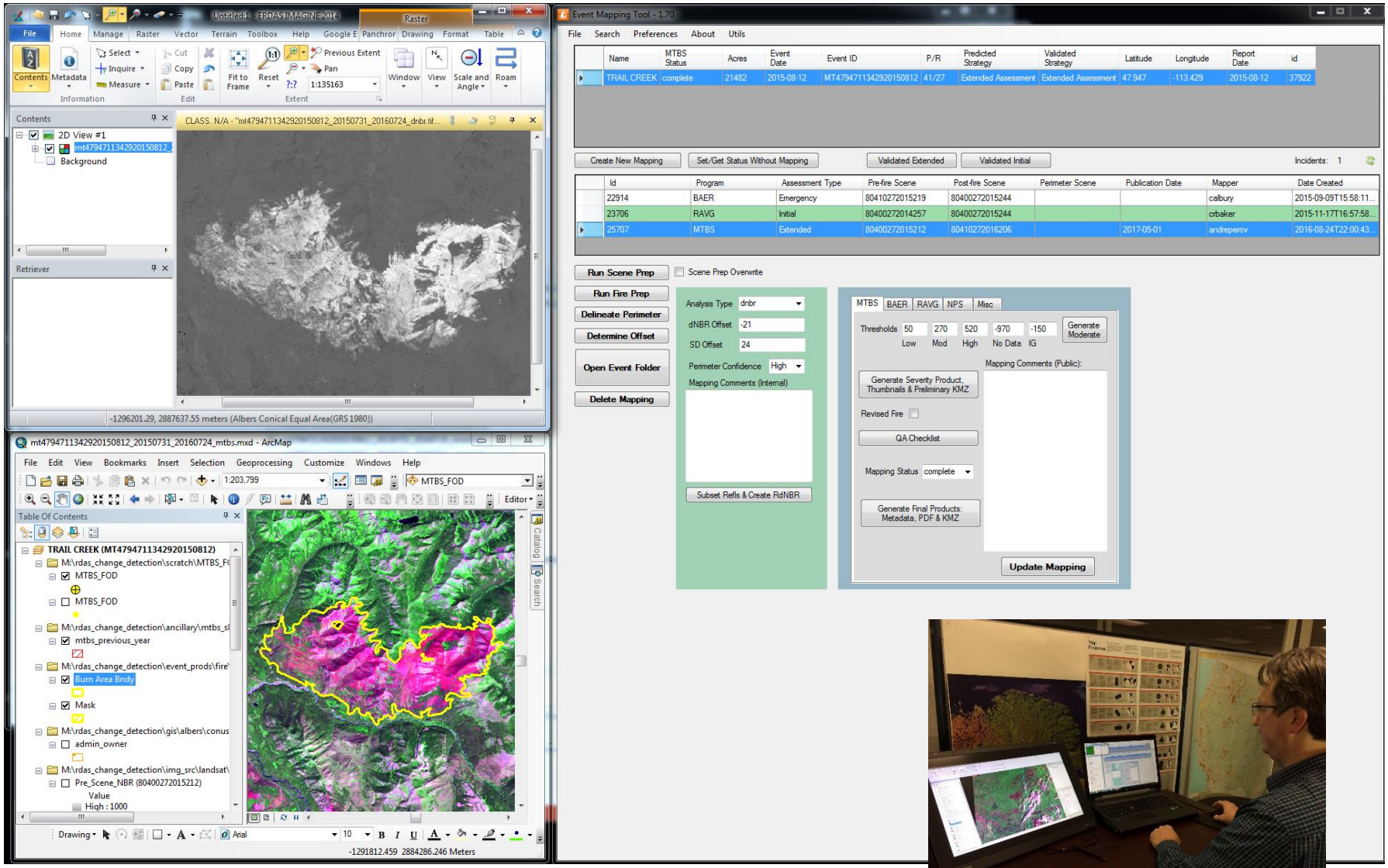
- Map the fire
  - Image selection
  - Perform image pre-processing
  - Perform image differencing
  - Delineate burned area
  - Threshold dNBR images into discrete burn severity classes.

Landsat Scene Selection

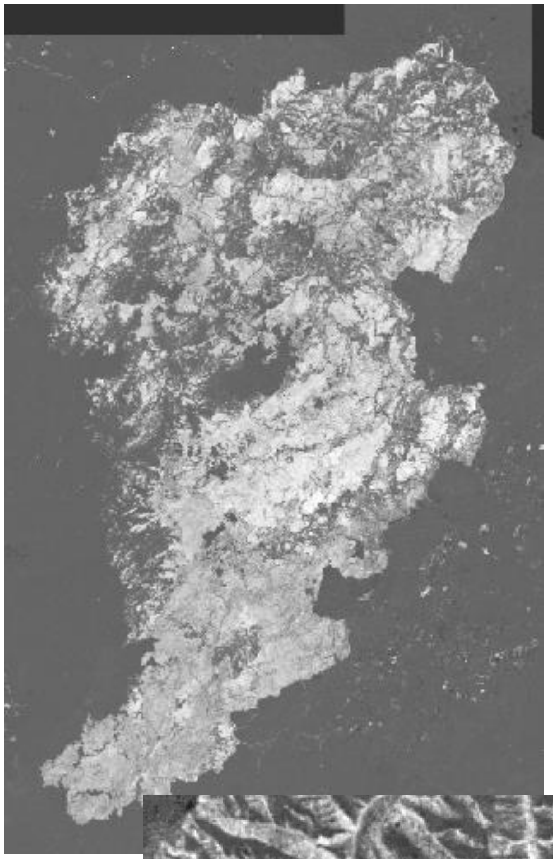




MTBS Mapping Interface



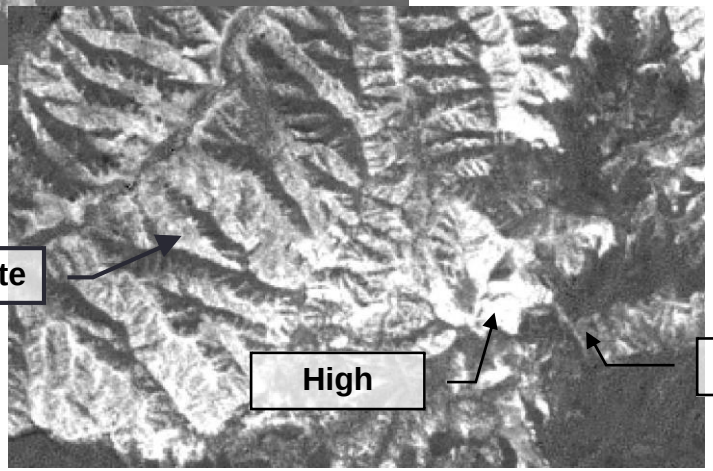
Burn Severity Thresholding

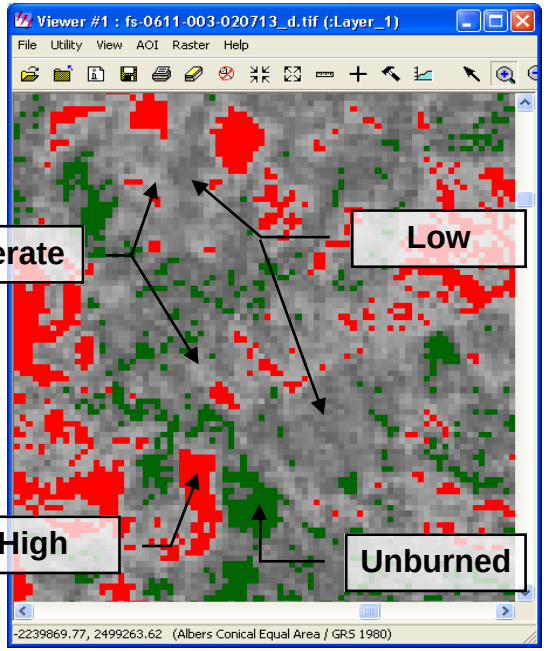


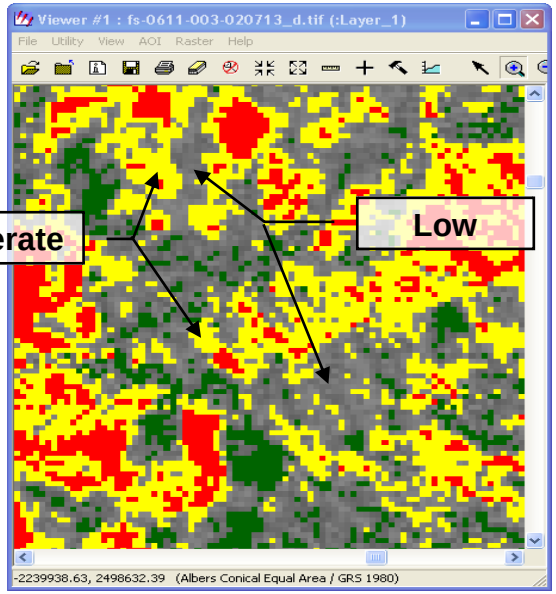
Mapping analyst identifies dNBR grayscale patterns to determine the low/moderate/high severity class thresholds

Lighter tones = higher severity
Darker tones = unburned/low

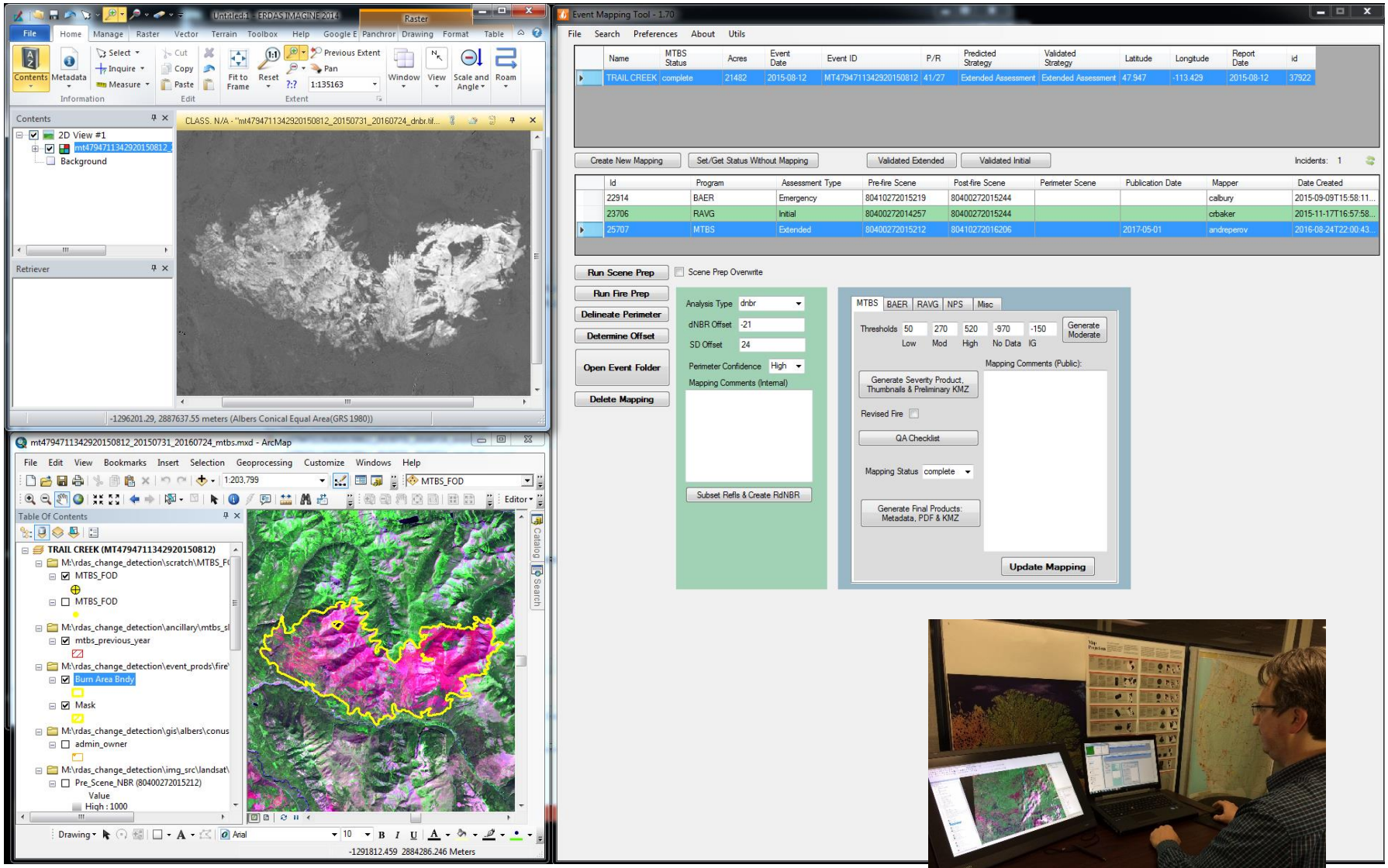
- Unburned/Low
- Low
- Moderate
- High
- Increased Greenness
- Non-mappable area



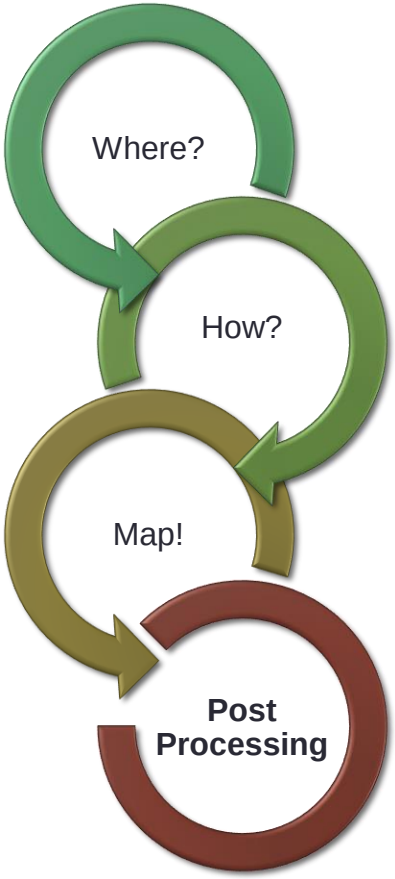




MTBS Mapping Interface



MTBS Fire Mapping Methods Overview

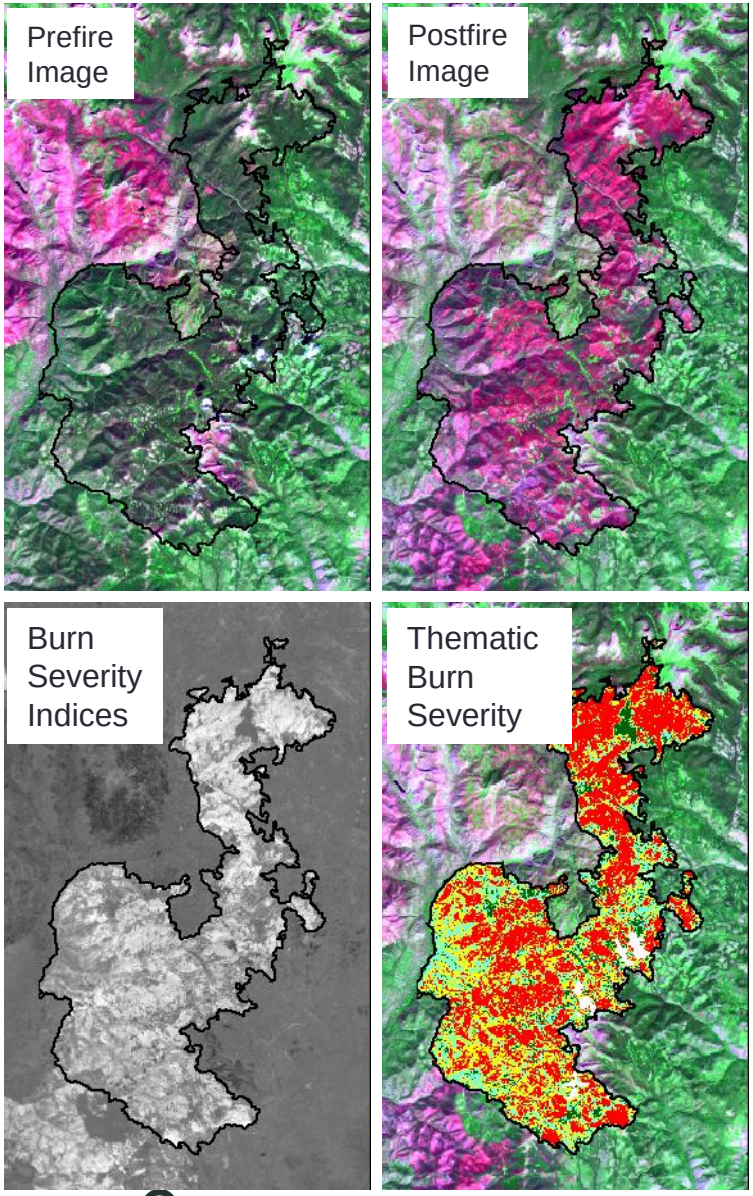


- Perform post processing
  - Create metadata
  - Create map products
  - Generate summary and reporting data
  - Products made available for download

MTBS Geospatial Products

Fire Level Datasets

- Available from http://www.mtbs.gov
- Pre/Post-fire Landsat imagery
  - Bands dependent on sensor
- Burned area boundary
  - Vector delineation of burned area extent based on image analysis
- Continuous burn severity indices
  - dNBR/RdNBR
- 6 class thematic burn severity data
  - Unburned/Low
  - Low
  - Moderate
  - High
  - Increased Greenness
  - Non-mappable area
- Map, visualization and reporting products

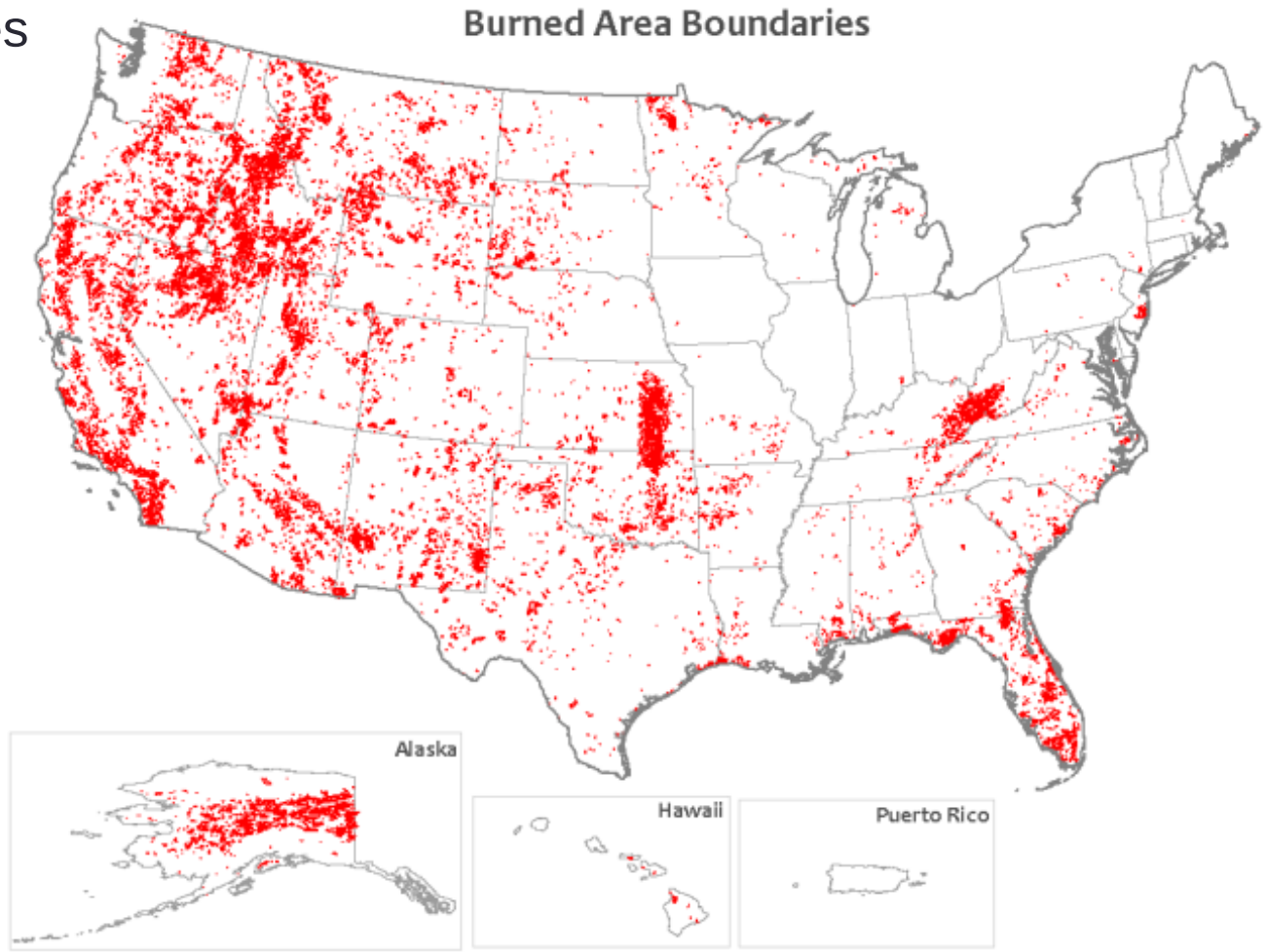


MTBS Geospatial Products

National Fire Data

Burned Area Boundaries

- Polygon Shapefile w/metadata
- Fire attributes

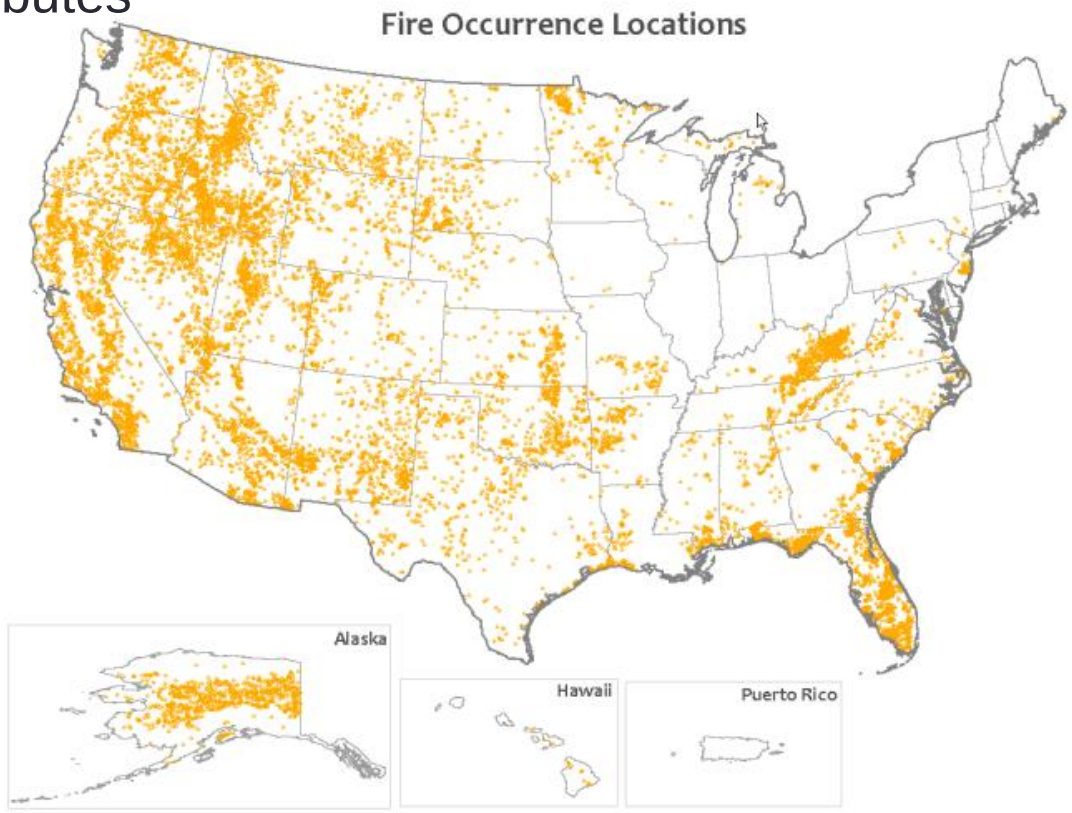


MTBS Geospatial Products

National Fire Data

Fire Occurrence Data

- Point Shapefile w/metadata
- Geographic centroid of burned area for each mapped fire
- Fire and mapping attributes

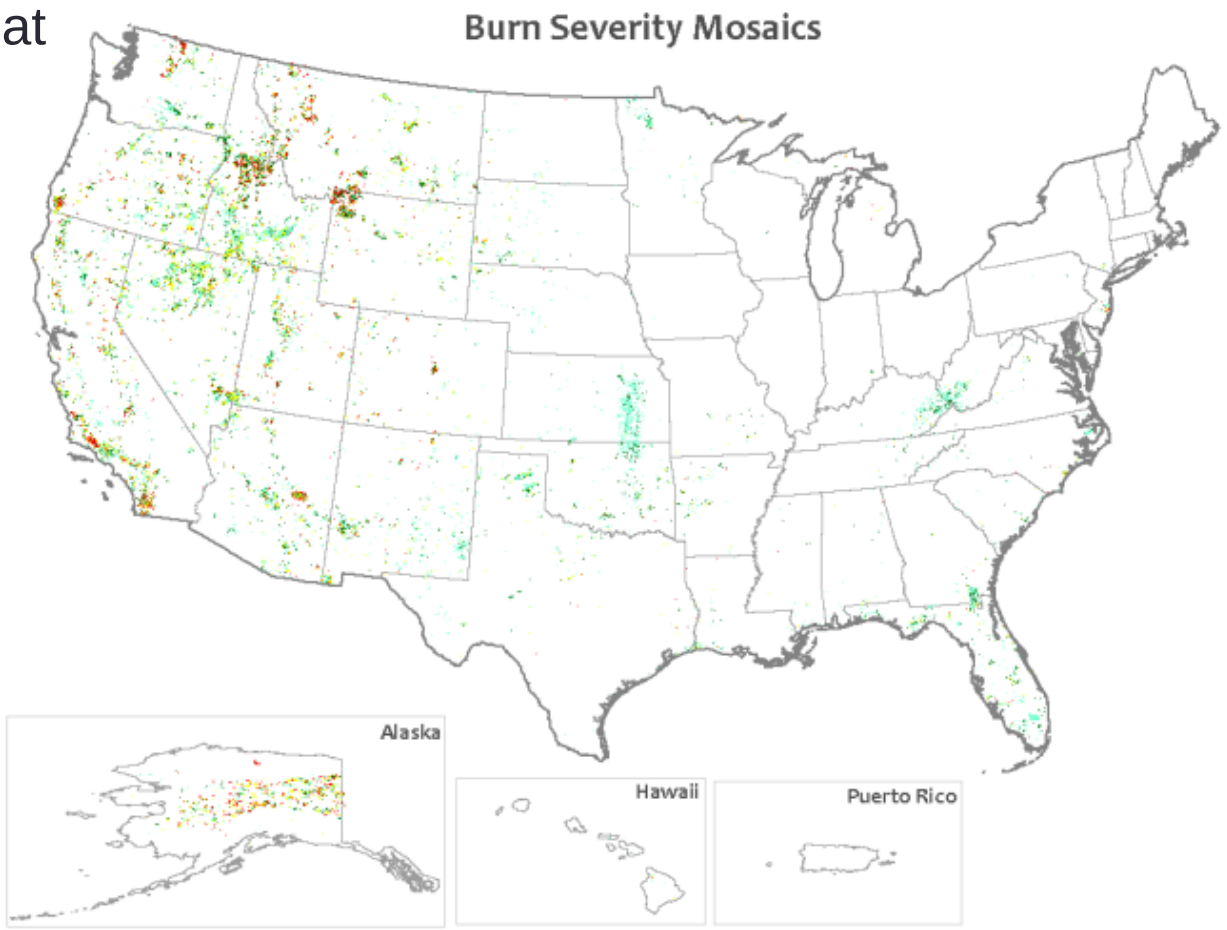


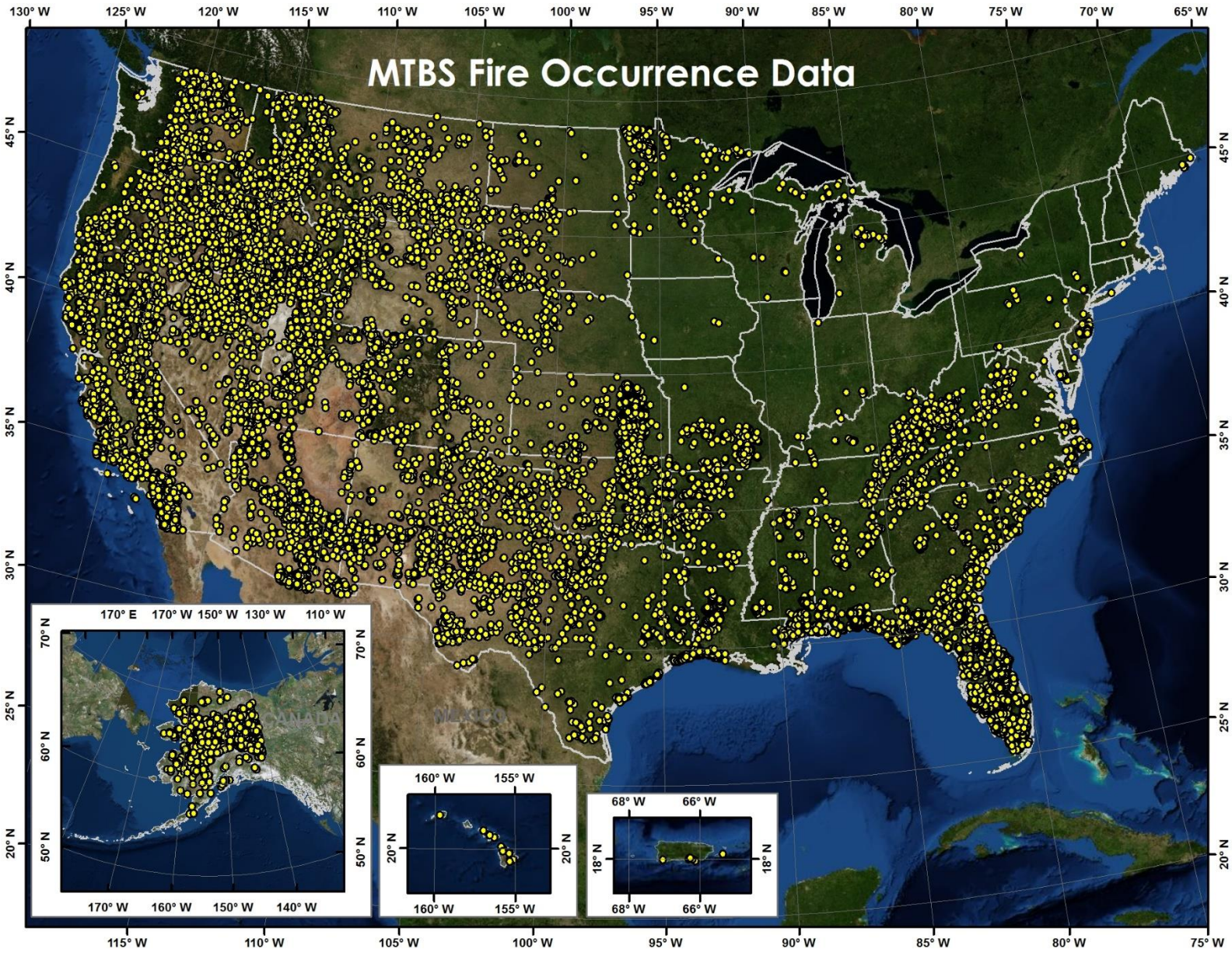
MTBS Geospatial Products

National Fire Data

Thematic Burn Severity Mosaics

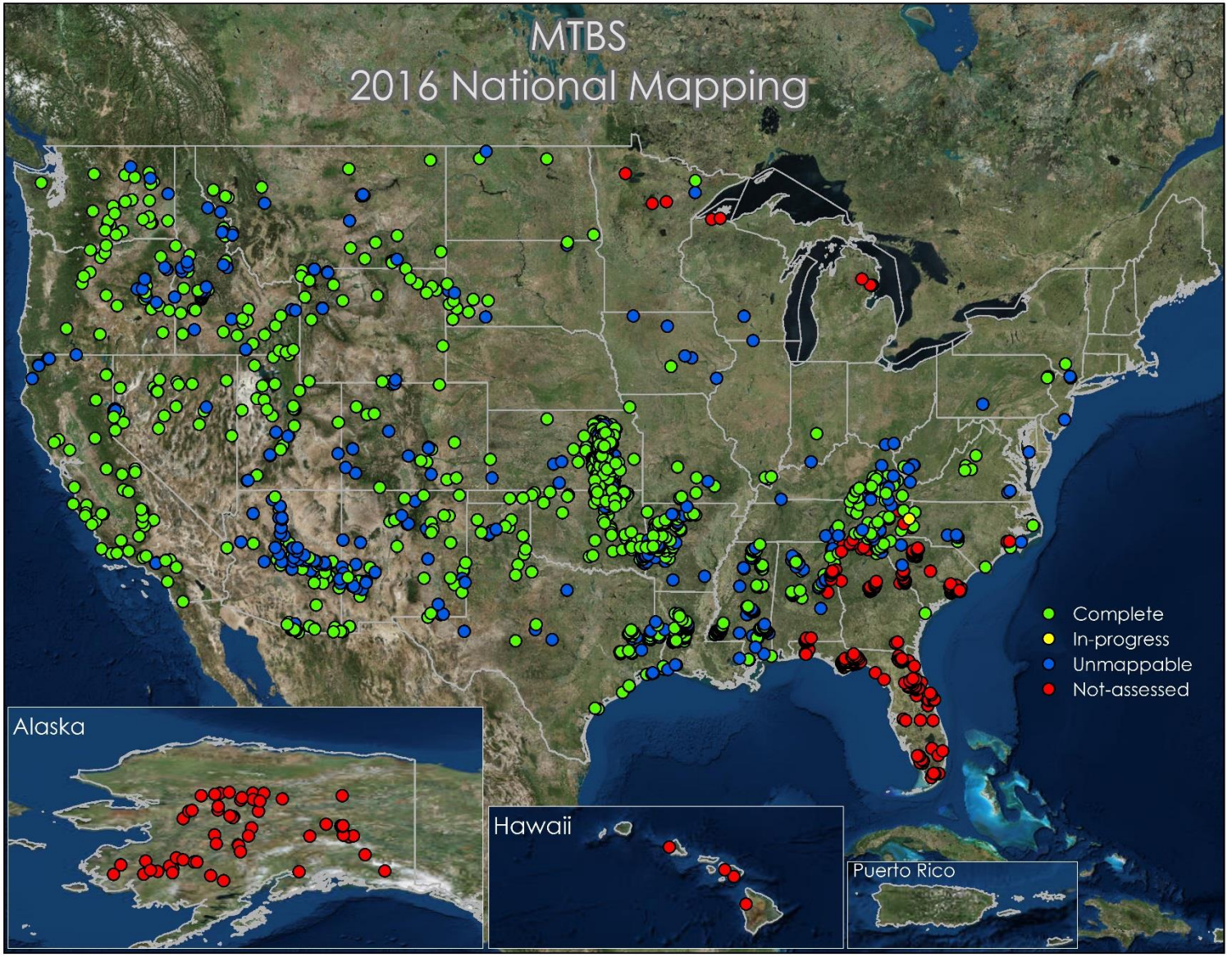
- Seamless, 6 class, thematic raster w/metadata
- GeoTiff file format
- Available on an annual basis by State and MTBS region (CONUS, AK, HI, Puerto Rico)





1984-2015 Complete

~20,000 fires mapped and available for download from MTBS.gov



2016

1,841 Fires

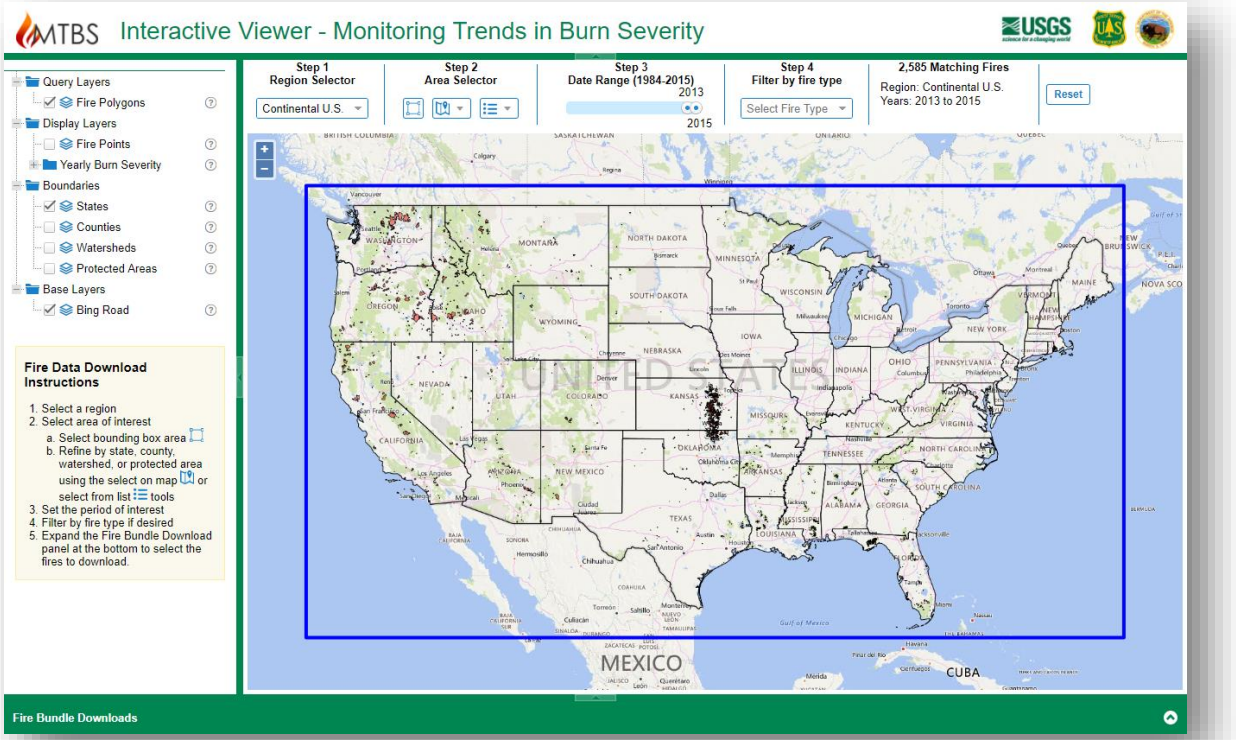
Mapping began: January 2017
Approx. 62% complete
Projected release: Summer 2018

MTBS Website Overview and Demo

MTBS website:
http://www.mtbs.gov

MTBS Website

- Product Descriptions
- FAQs
- Data Access



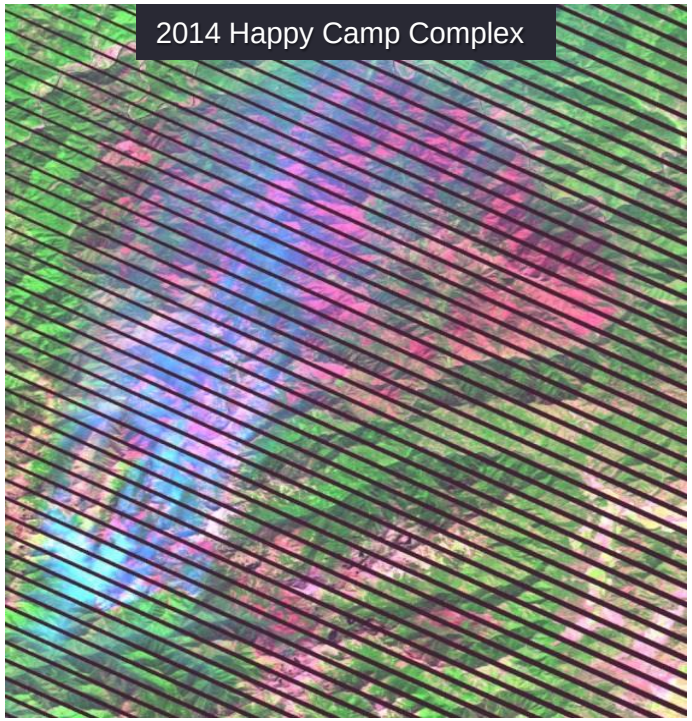
MTBS website:
http://www.mtbs.gov

Challenges and Limitations

MTBS Program Challenges and Limitations

- Consistency in thresholding severity classes
  - MTBS internal calibration
  - Apply regional threshold models calibrated using plot data
- Inclusion of “small” fires (< 500 and < 1,000 acre fires)
  - Significant costs involved to capture these additional fires
  - ~5% of the fire occurrences and ~95% of burned area is captured by MTBS

MTBS Program Challenges and Limitations



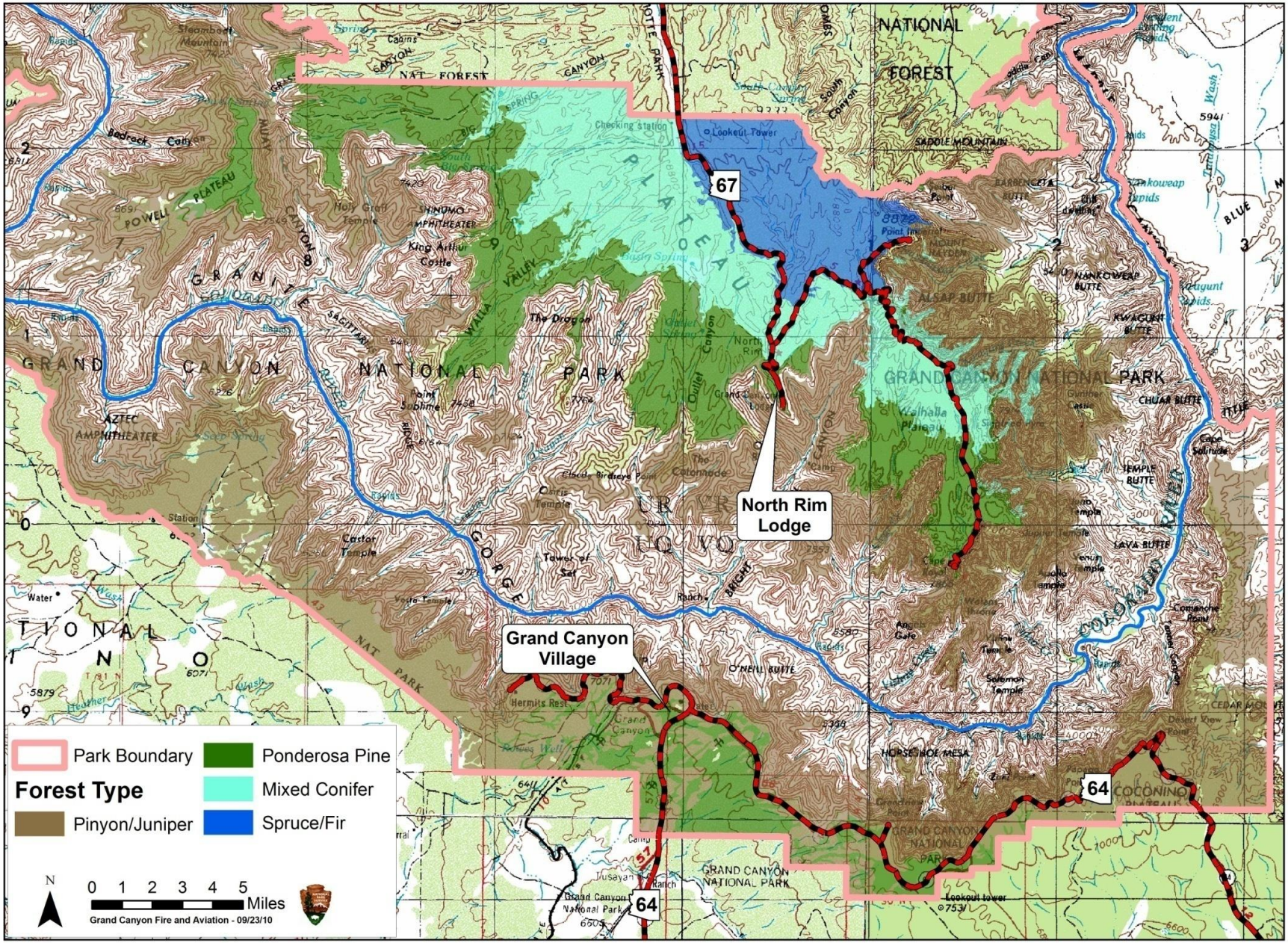
- FOD accuracy/completeness
  - Erroneous locations
  - Incorrect acreage reports
  - Source database revisions/updates
- Landsat data continuity/quality
  - L7 SLC-off data
  - Smoke, clouds, cloud shadows
  - Landsat 8 launched Feb. 2013
- Limitations of sensor characteristics
  - Detection of low intensity/understory fire areas
- Ability of NBR/dNBR to characterize fire effects
  - Adaptability to wide range of biophysical settings
  - Prefire/postfire imagery provided by MTBS to facilitate application of other methods

Applications of MTBS Data

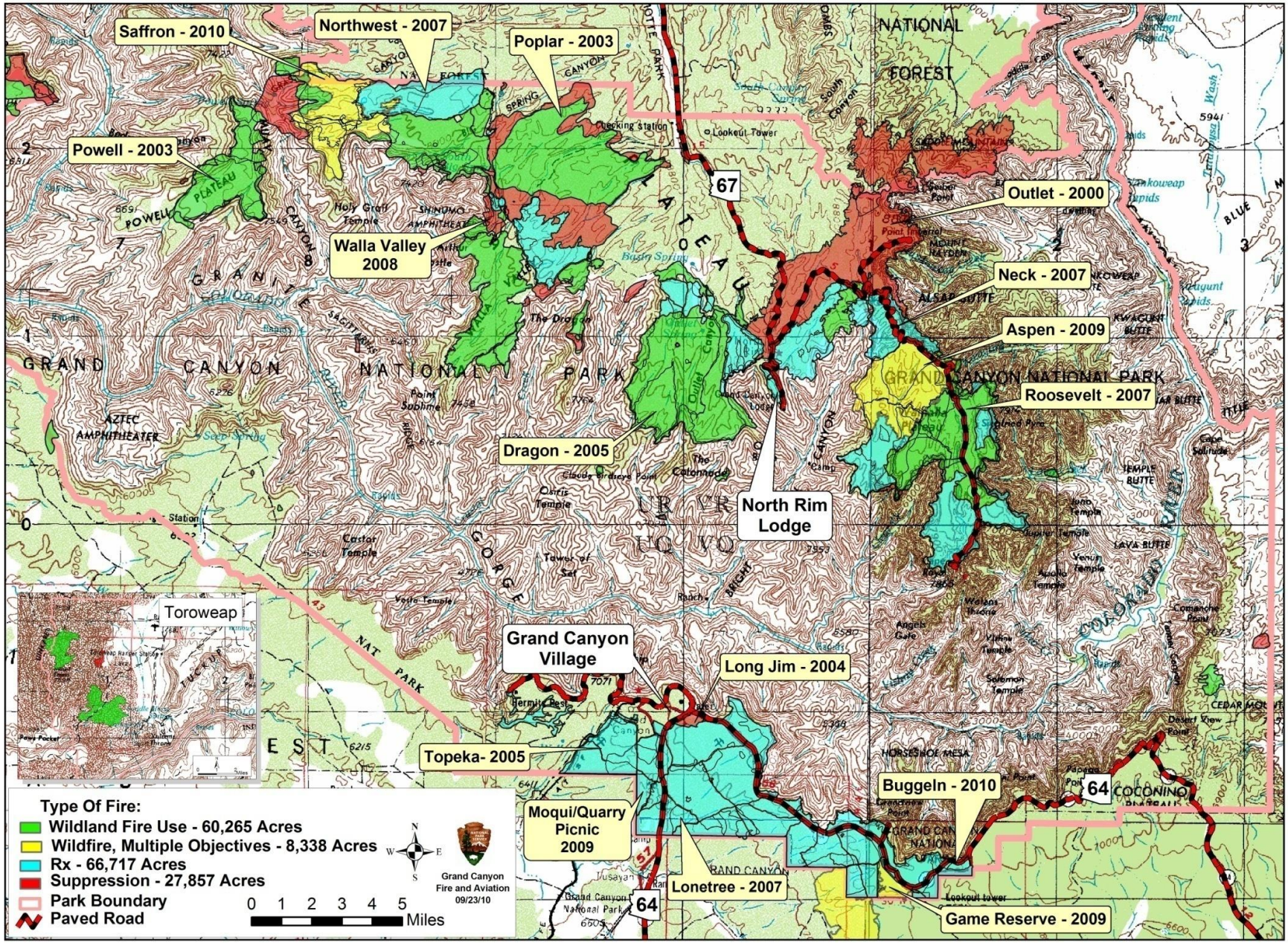
Applying MTBS Data

Slides courtesy of
Eric Gdula
Fire GIS Specialist
Grand Canyon National Park

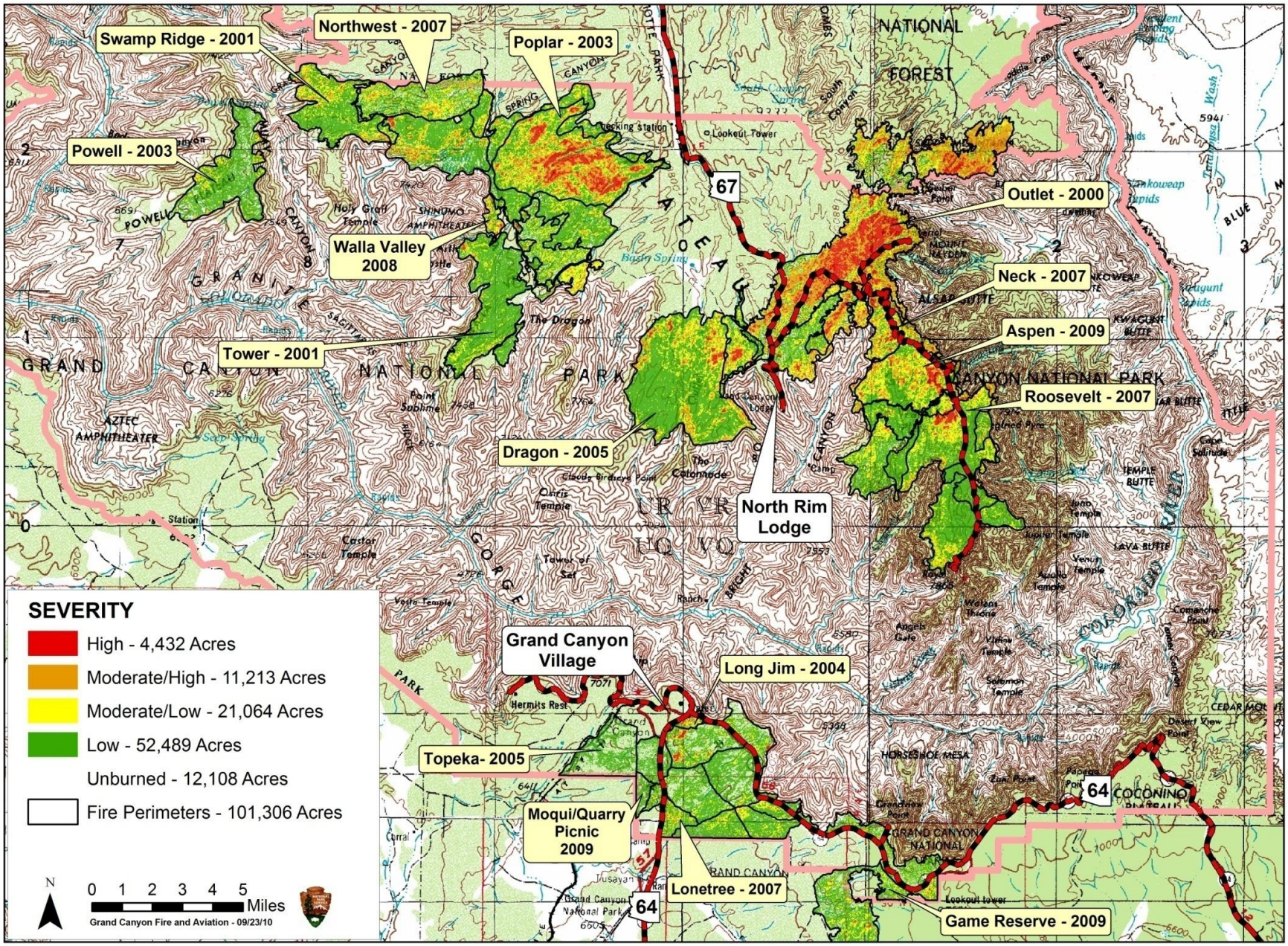
Major Forest Types - Grand Canyon National Park



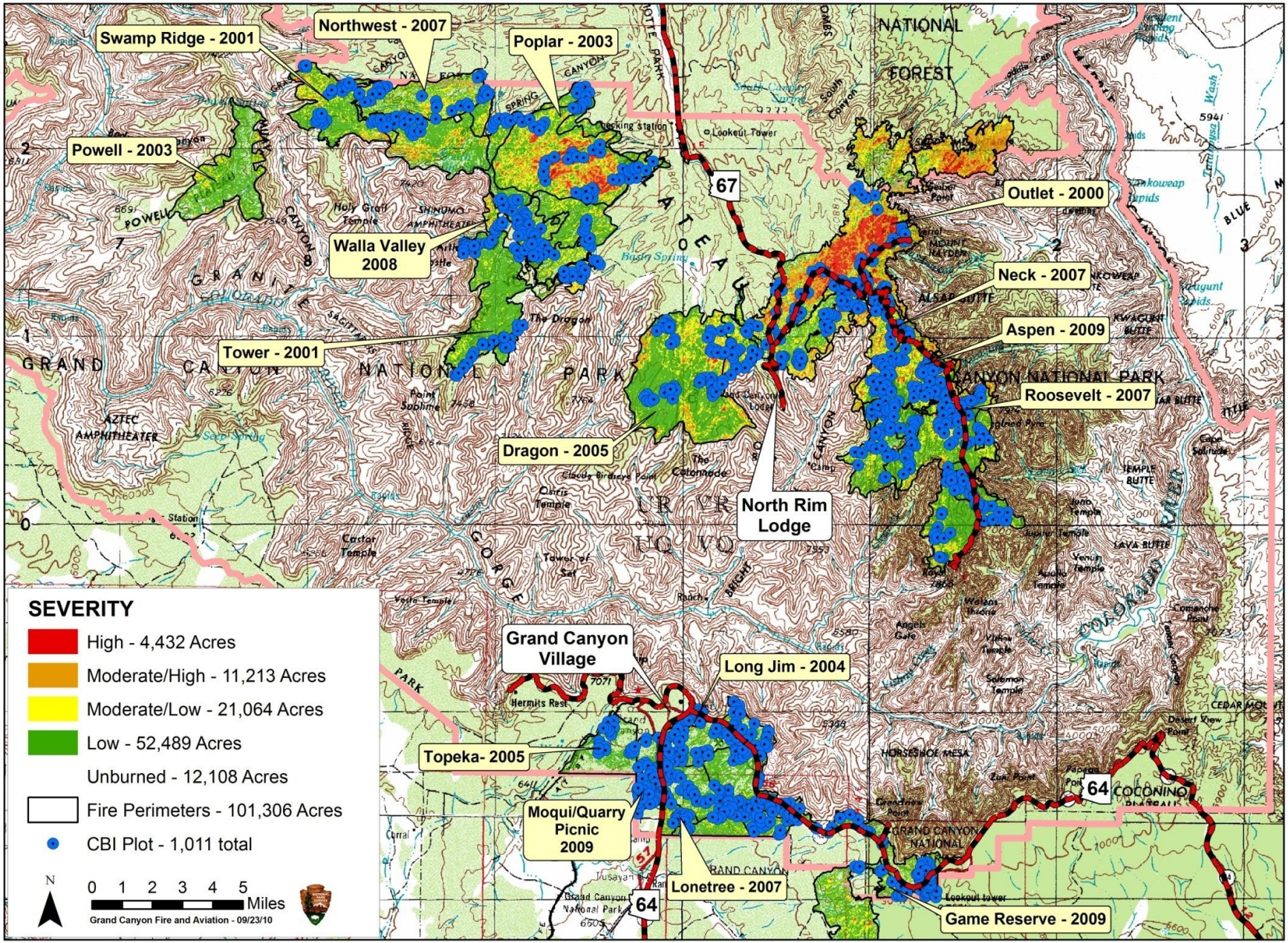
Fire History (1980-2010) - Grand Canyon National Park



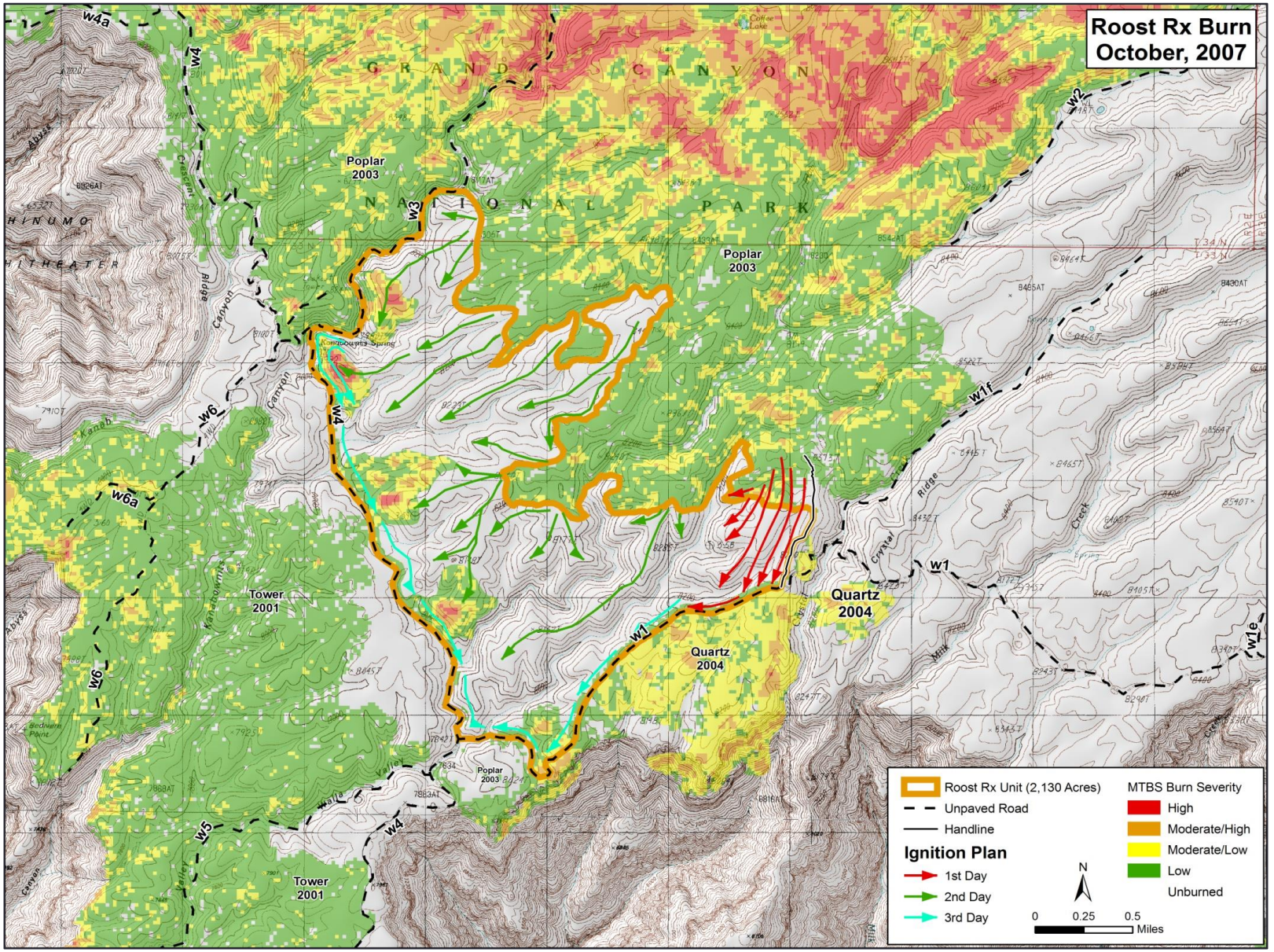
Burn Severity (2000 - 2009) - Grand Canyon National Park



Burn Severity (2000 - 2009) - Grand Canyon National Park



Applying MTBS Data



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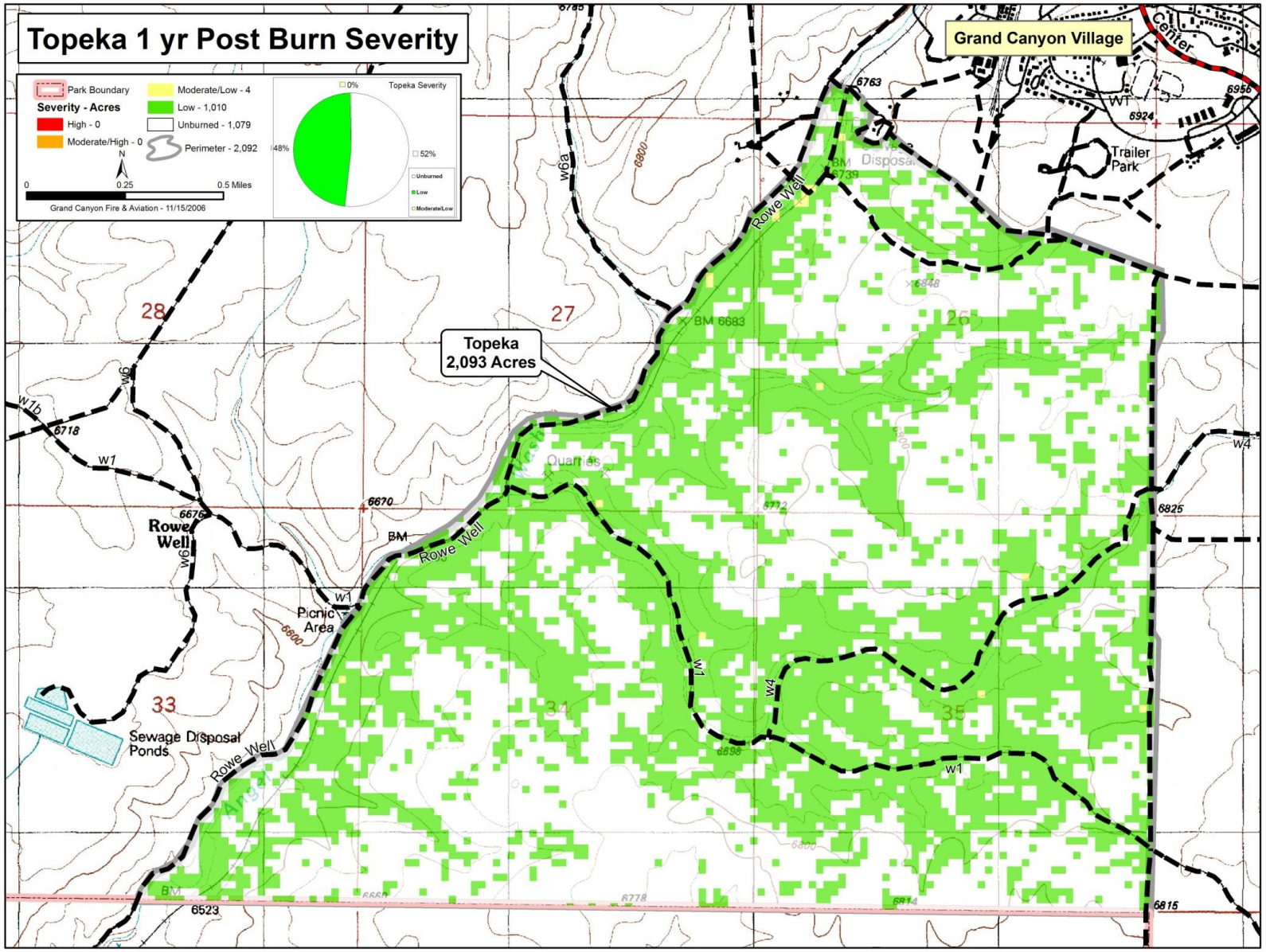

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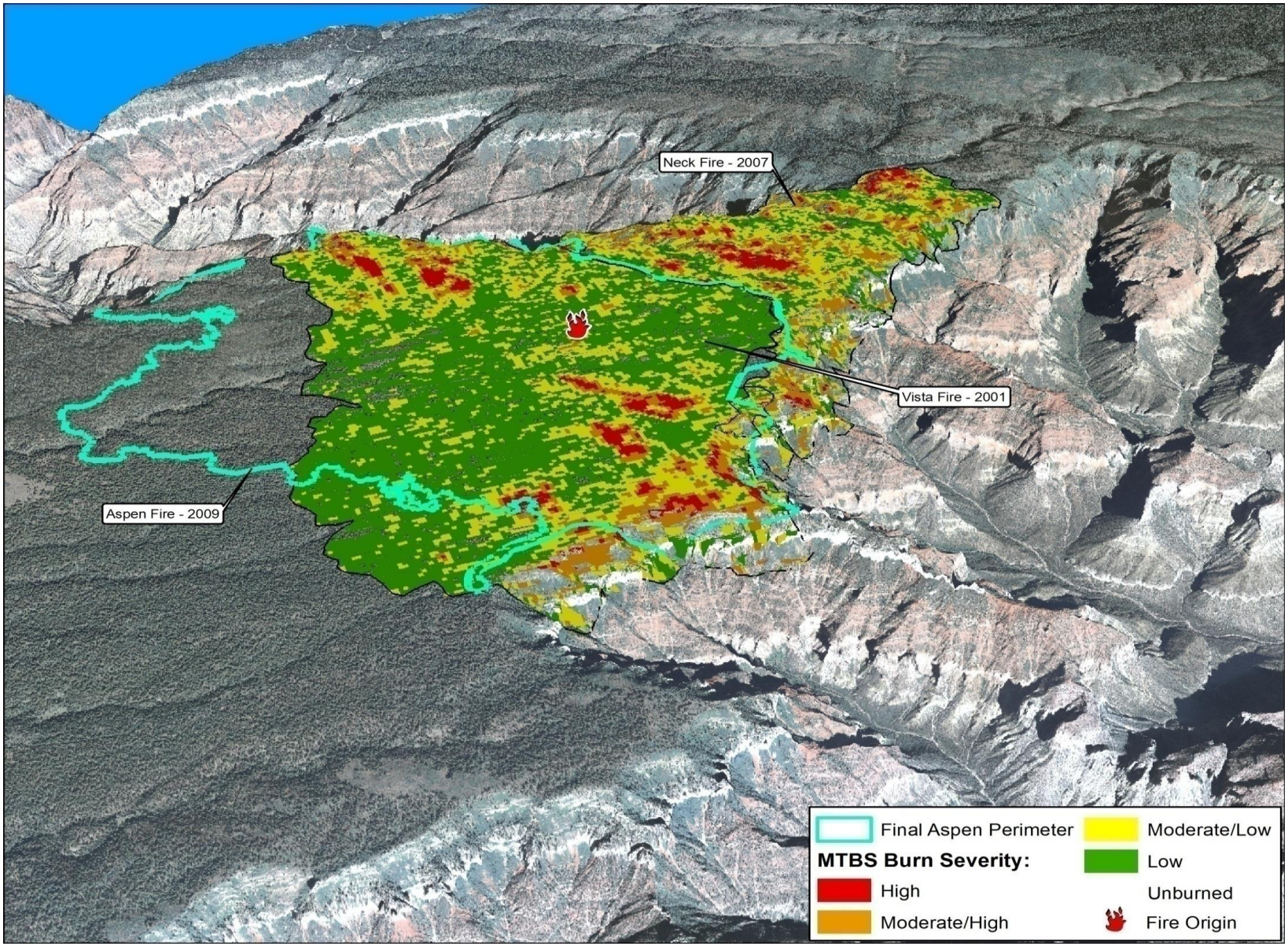

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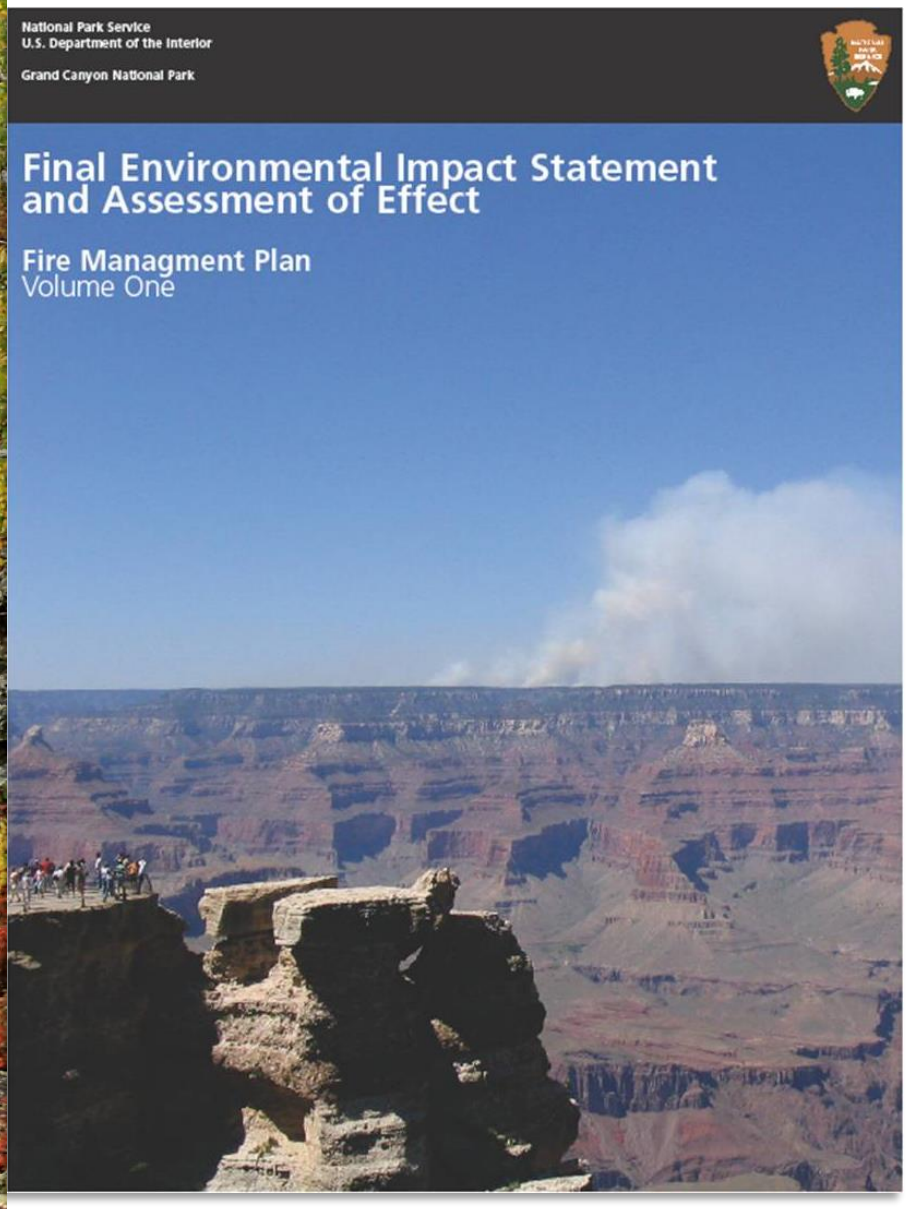
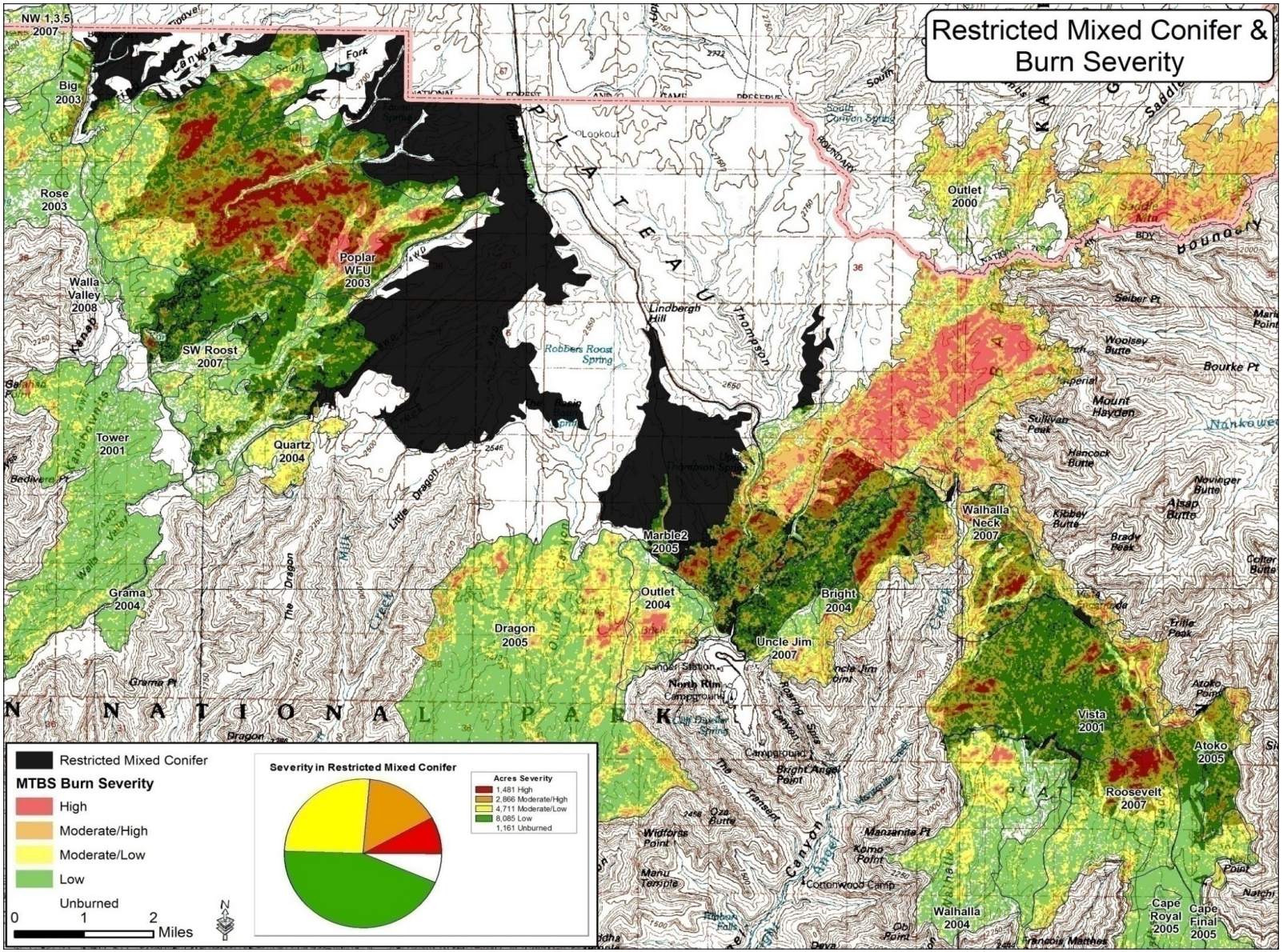


process will be critical to managing protection of habitat for a threatened species while restoring a mixed-severity fire regime. To reduce potential effects of fire on MSO habitat elements, Alternatives 2 through 5 include a mitigation measure to limit amount of moderate/high and high severity fire in the mixed-conifer forest type and MSO mixed-conifer restricted habitat to less than 30% across the landscape. The following adaptive management steps will be taken to ensure this mitigation measure is met.

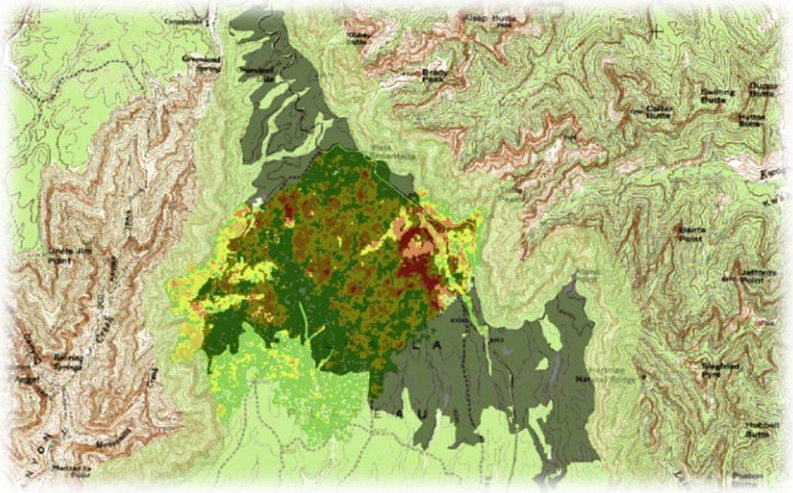
- **Assess Issue** Balance programmatic objectives (Section 1.4) of maintaining critical habitat for listed species, conducting fire management activities in proposed wilderness in a manner that will not diminish suitability for designation, minimizing smoke impacts on human health and air quality values, restoring and maintaining ecosystems within the range of desired conditions, and setting priorities for treatment activities based on departure from natural fire return intervals and desired conditions. Ensure effects to MSO restricted mixed-conifer habitat elements are minimized by limiting moderate/high and high severity fires to less than 30% of the mixed-conifer forest type and MSO mixed-conifer restricted habitat.
- **Plan Treatments and Design Monitoring** Treatment plans will be developed for prescribed fires in the mixed-conifer forest type. Plans will include the objective of minimizing moderate/high and high severity fire effects. Various implementation activities designed to reduce amount of moderate/high and high severity fire effects, such as developing prescriptions that meet burn objectives and reduce crown fire amount, developing ignition strategies likely to minimize head fires, and igniting fires at various times of day or in various seasons, will be considered during the planning phase. All treatment plans will be reviewed by a park interdisciplinary team prior to implementation. Severity percentages will be monitored using the national burn severity mapping protocol. In addition, with implementation of this Fire Management Plan, newly designed rapid assessment protocol (RAP) plots will be installed in mixed-conifer restricted habitat to provide unit-specific information on fire effects. Variables monitored with RAP plots will include tree basal area, canopy cover, tree size class distribution, and large downed woody debris.
- **Implement Treatments and Monitoring** Treatment implementation will follow the sequence outlined in the long-term treatment schedule described in Appendix D. Monitoring implementation and data management will follow guidelines in the revised GRCA Wildland and Prescribed Fire Monitoring Plan (NPS 2009). Possibility exists for unplanned ignitions in the mixed-conifer forest type prior to prescribed fire implementation. If this occurs, fire and resource managers will assess ignition location, time of year, location of fire sensitive natural and cultural resources, past seasonal precipitation amounts and precipitation forecasts, number and effects of past fire events in and near the fire area, potential for positive and negative effects on resources, and potential to meet programmatic objectives (including the limit on higher severity fire) prior to a decision to suppress or manage the fire. If a decision is made to manage an unplanned fire, fire managers may choose to use additional firing operations from defensible control lines to back fire into the wind or direct fire into previously burned areas to minimize potential for higher severity fire effects. Tactical areas may be created through fuel reduction projects near roads to create defensible areas to contain fire spread or facilitate potential firing operations. Containment and control operations may occur on sections of a fire with potential for higher severity effects. Burn severity monitoring will be completed for unplanned fire events, and plot-based monitoring may occur if there are established plots in the fire area.
- **Analyze Data and Communicate Results** Quantitative burn severity mapping data are available 8 to 13 months following fire; however, qualitative information on burn severity can be obtained through aerial reconnaissance during or immediately after fire events. RAP plot data on prescribed fires will be available by January of the year following the fire for variables assessed immediately post-fire. Some variables, such as overstory tree mortality, may be best assessed several years following fire, and data on those variables will be available when ecologically appropriate. During unplanned fire events, the park interdisciplinary team will be notified as the ground situation changes and will be updated on fire behavior, weather, and real-time fire effects observations. Information on burn severity and plot-based monitoring data in mixed-conifer restricted habitat will be included in the annual report to the U.S. Fish and Wildlife Service, and the annual Fire Ecology Program report.
- **Evaluate** Evaluation of treatment implementation and real-time fire effects will occur continuously during prescribed fires and unplanned events. Post-fire evaluations of treatment implementation and qualitative fire effects will occur during an AAR involving both fire and resource management personnel. Annual meetings will occur with USFWS to review and assess yearly and cumulative The

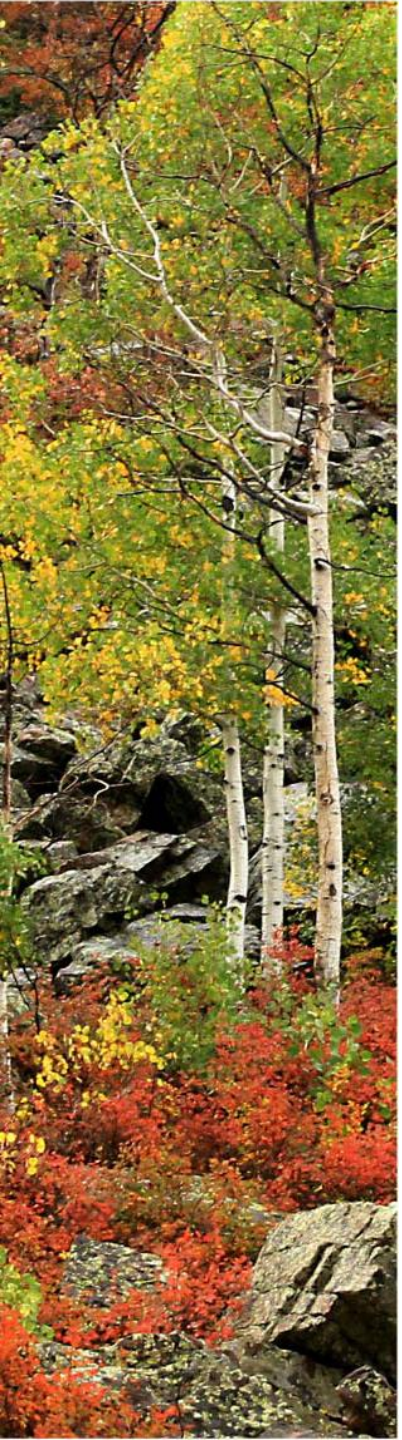
Applying MTBS Data



Habitat Management GIS Exercise

- Objective: Use MTBS data to determine the impacts of two fires on Mexican Spotted Owl (MSO) restricted habitat.
  - Load geospatial data into ArcMap
  - Prep MTBS data for Vista Fire
  - Analyze Vista Fire data and calculate summary stats
  - Prep MTBS data for Aspen Fire
  - Edit MSO data to reflect impacts from Vista Fire
  - Analyze Aspen Fire data and calculate summary stats
  - Edit MSO data to reflect impacts from Aspen Fire





United States Department of Agriculture
Forest Service

Thank you

Understanding & Using MTBS Data

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