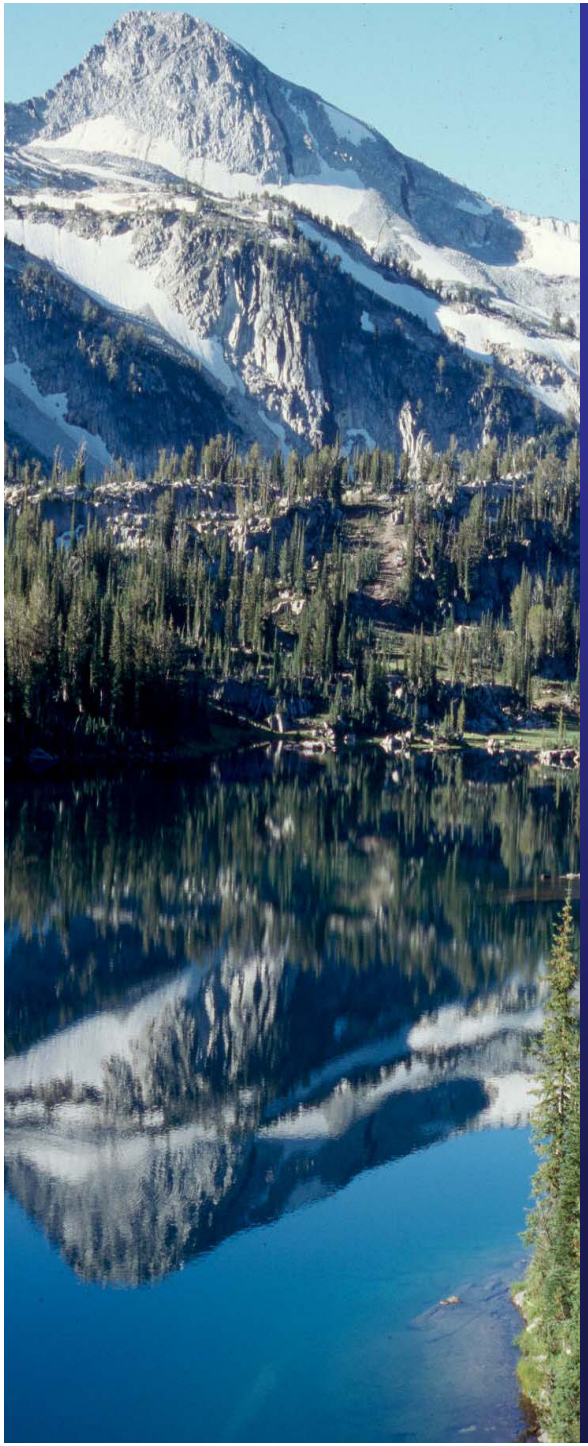

Research to Support Wildland Fire Use Decisions in Yosemite NP

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May 9th, 2006

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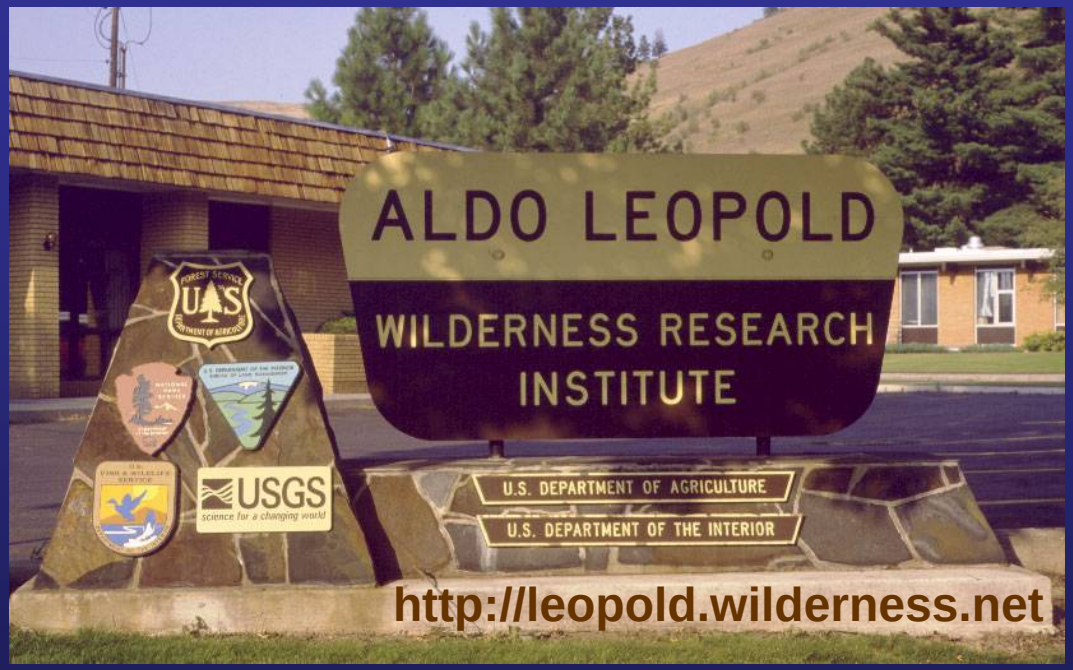
http://leopold.wilderness.net

About the Leopold Institute

- **Interagency Research Organization**
  - USFS, NPS, USGS, BLM & USFWS



- **Research emphases**
  - Human relationships
  - Recreation
  - Wildlife
  - Non-native
  - Water
  - **Fire**

Shift from fire *suppression* to fire *stewardship*

- **Fire regimes and their alteration**
- **Options and consequences**
- **Social and institutional factors**

Background

Restoration of natural fire regimes: has been a high priority, but has met with limited success

- Suppression is still common, even in the Fire Use Unit of the park
- Suppression outside the park means a loss of immigrating fire

Two research projects aimed at quantifying and evaluating the consequences of suppression:

1. 'An Analysis of the Feasibility of Wildland Fire Use for Restoring Natural Fire Regimes' (2004)

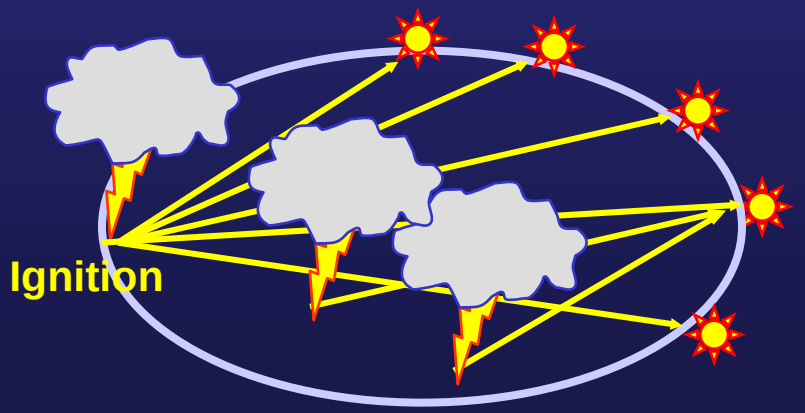
2a). Retrospective Analysis of Fire Behavior' (ongoing)

2b). A map library of potential fires developed to help support the WFU decision making process (complete).

An Analysis of the Feasibility of Wildland Fire Use for Restoring Natural Fire Regimes

1) What is the effect on the Park's fire regime of the suppression of ignitions both within and outside the Fire Use Unit?

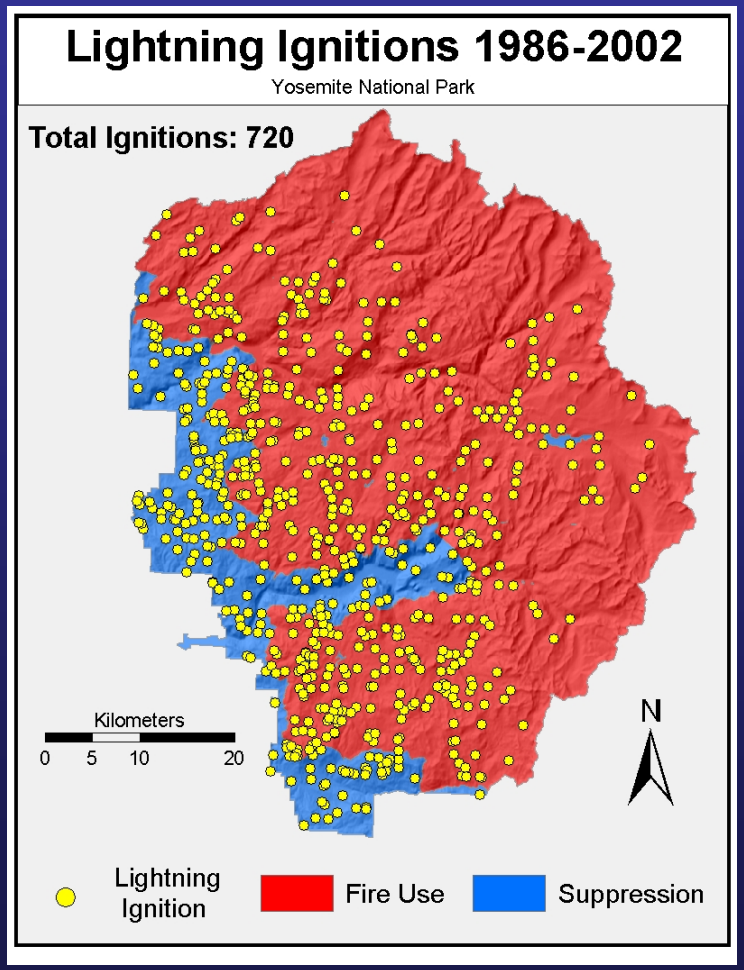
2) Which areas experience the greatest impact from the suppression of these ignitions?



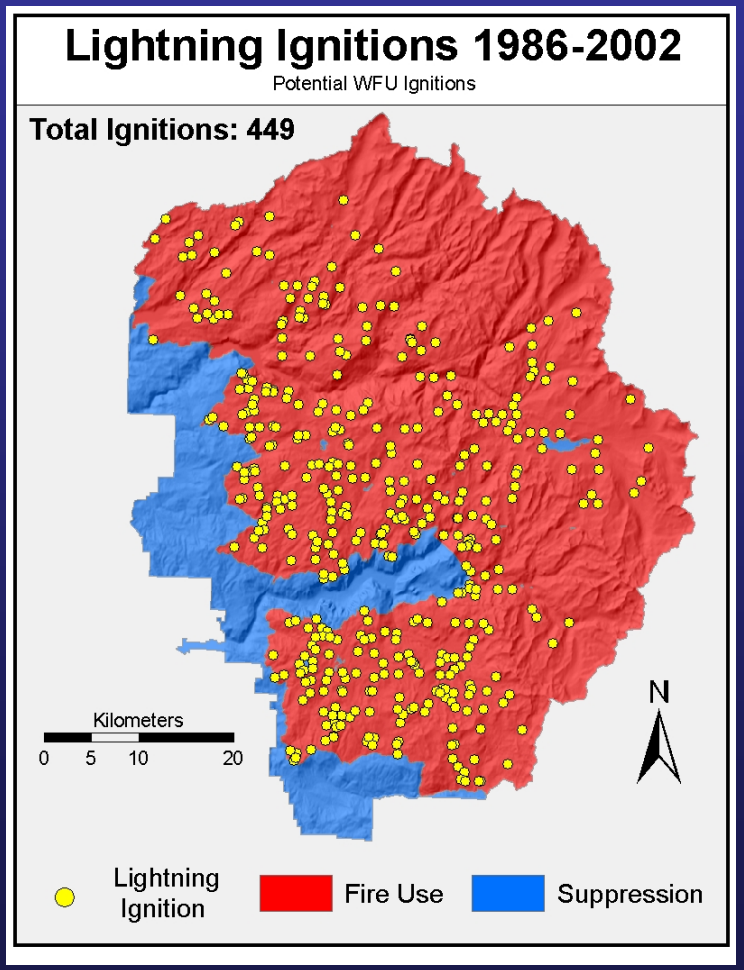
BurnPro:

Considers ignitions, rate of fire spread (fuels, topography, wind, weather), and time available for fire spread (length of fire season), all in a spatial context

To determine where probability is reduced due to suppression we ran BurnPro using two different sets of ignitions:

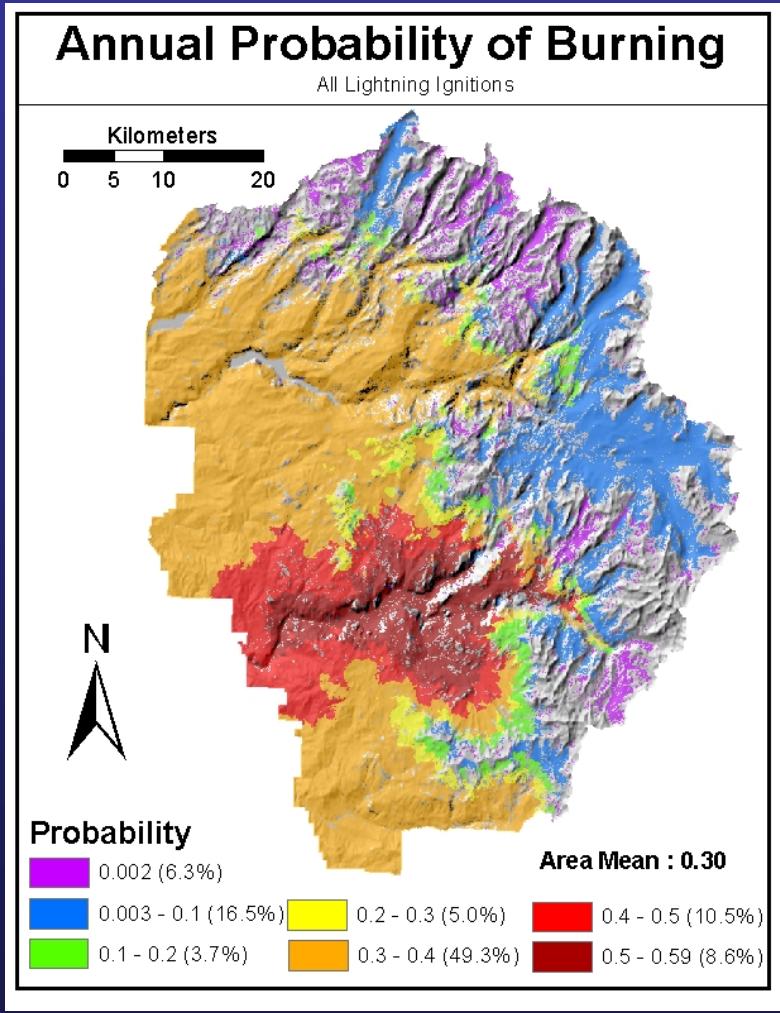


All Lightning Ignitions

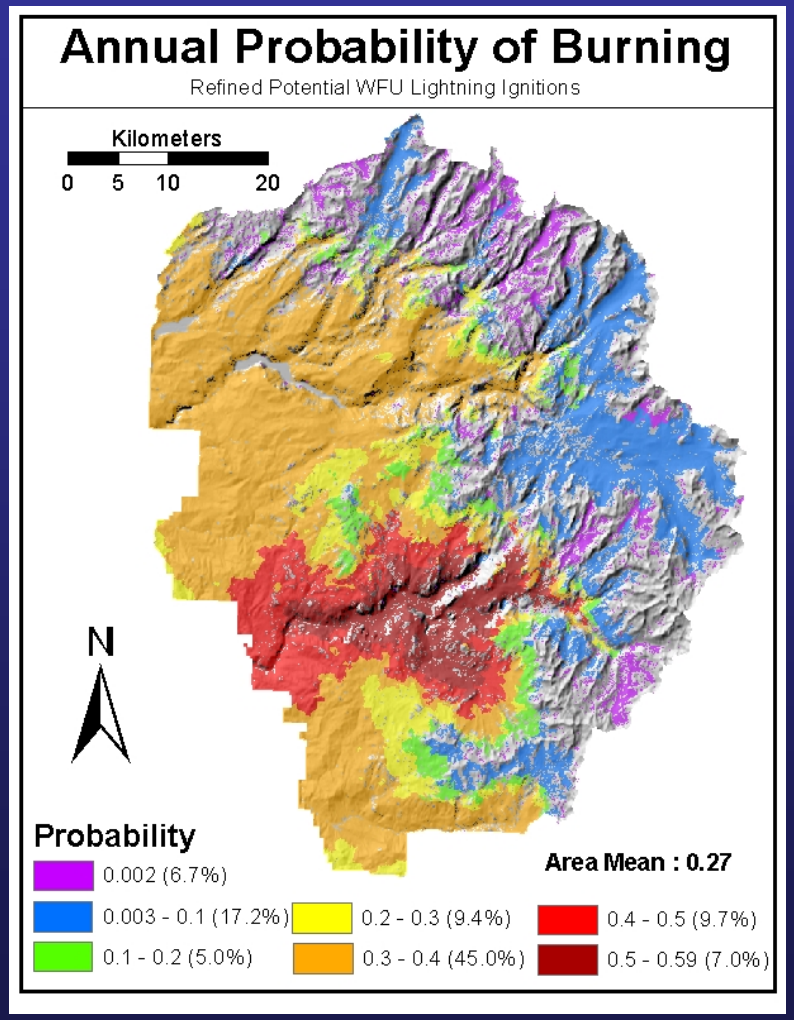


Potential WFU Ignitions

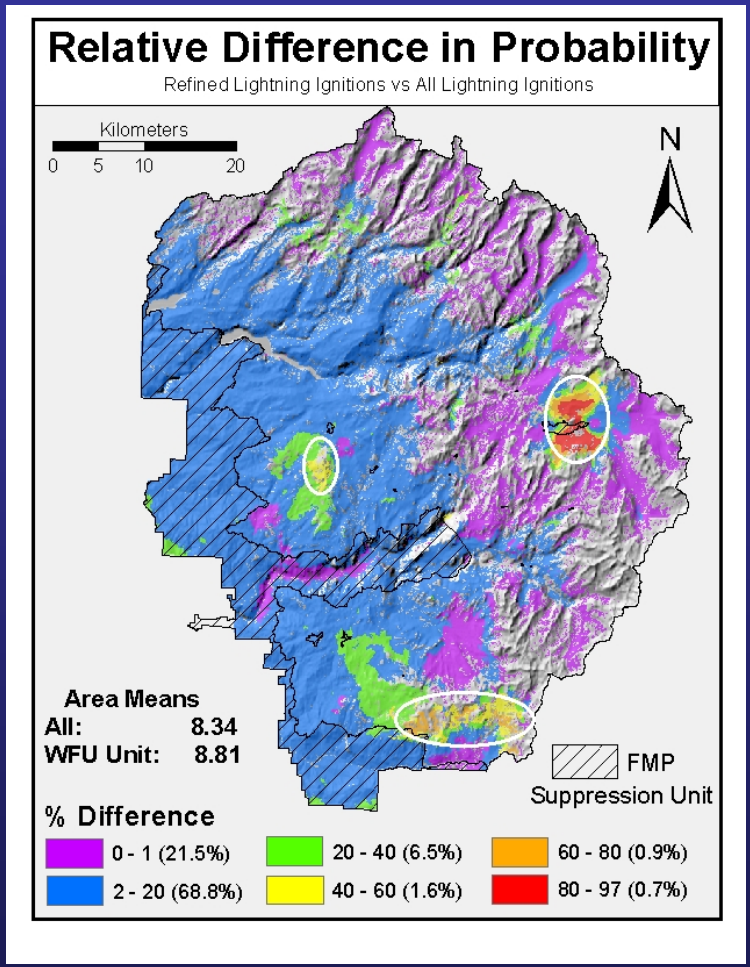
Resulting in two different probability of burning predictions:



All Lightning Ignitions



Potential WFU Ignitions



Overall - small differences

Certain areas with large differences

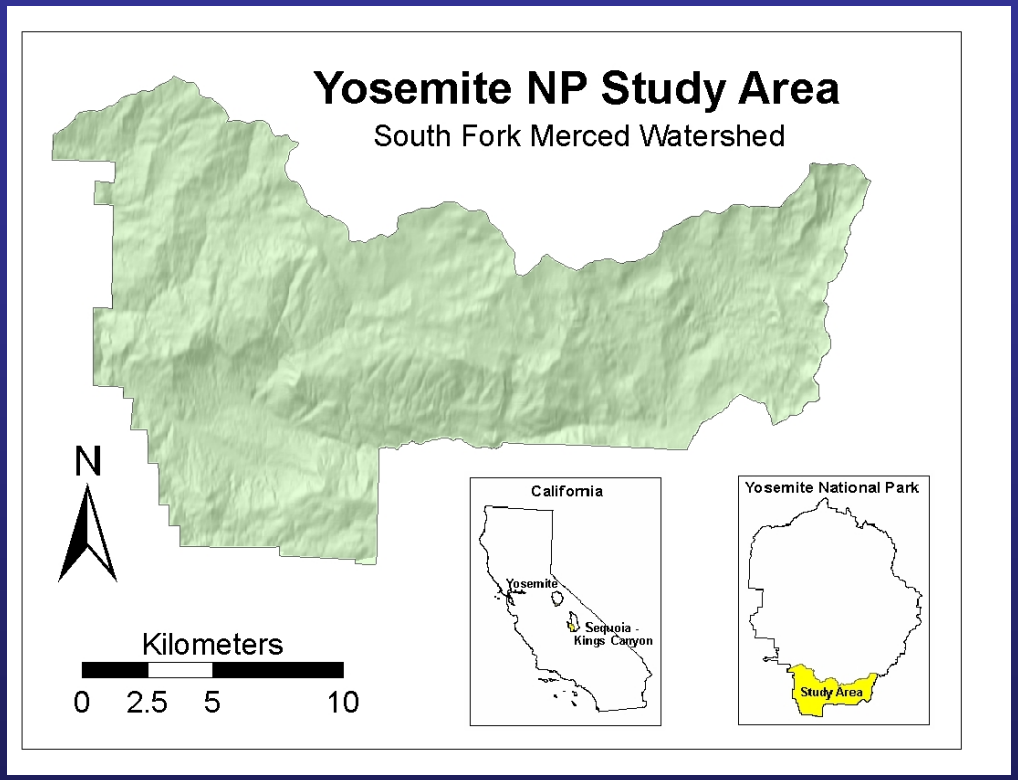
- Challenges for restoration

- Suppression effects bleed into adjacent areas

The relative difference in probability provides a means of quantifying suppression impacts

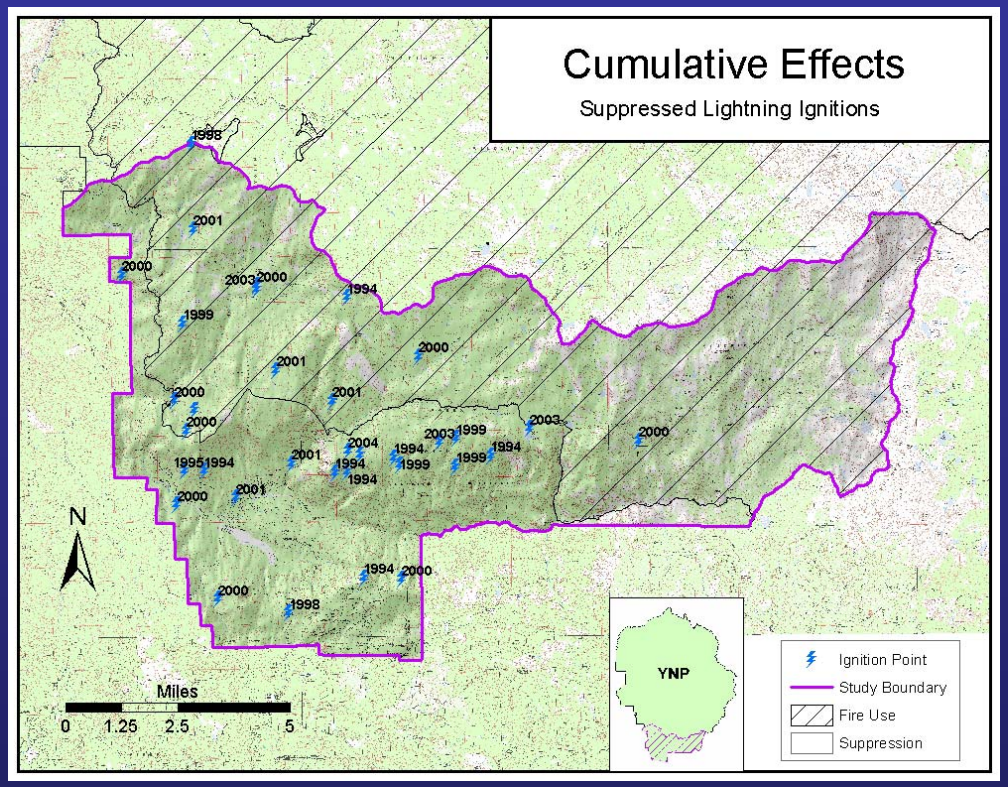
South Fork Merced watershed displays some of the higher relative differences in probability…..

Retrospective Analysis of Fire Behavior



- Sequentially model suppressed lightning ignitions (1994-2004)
- Quantify consequences of past suppression decisions
- Allow managers to track the cumulative effects of suppression

Retrospective Analysis of Fire Behavior …CUMULATIVE EFFECTS



STARTDATE	NAME	ACRES
5/31/1994	Turner	0.10
5/31/1994	Wawona Point	0.10
6/1/1994	Dome	10.50
6/2/1994	Camp	2.00
6/9/1994	Grouse	0.80
7/30/1994	Stream	2.00
9/21/1994	Crescent	1.00
5/27/1995	Turner	0.30
6/12/1998	Rain	1.79
9/3/1998	Bruin	0.10
7/11/1999	Alder	0.51
7/13/1999	Grouse	0.12
7/13/1999	Dome East	0.11
7/20/1999	Line	7.38
6/28/2000	Deer Camp	0.10
6/28/2000	Grove	0.10
6/29/2000	Alder	0.10
8/6/2000	Bug	0.10
10/10/2000	Bishop	0.10
10/10/2000	Alder	0.10
10/10/2000	Campground	0.10
10/10/2000	Savage	0.10
10/22/2000	Falls	0.10
9/1/2001	Mosquito	0.30
9/1/2001	Turner	2.50
9/24/2001	Chill	2.00
9/25/2001	Alder	0.20
9/25/2001	Clover	0.10
9/25/2001	Oak	0.10
7/19/2003	Dome	0.31
7/19/2003	Alder	0.25
7/19/2003	Crescent	0.20
6/2/2004	Wawona Dome	0.10
6/28/2004	Wawona Dome 2	0.40

Inputs

- 34 suppressed lightning ignitions (1994-2004)
- Hourly weather and winds
- Fuels - surface (expanded), crown and ground (CWD & duff) fuels

Analysis

Sequentially:

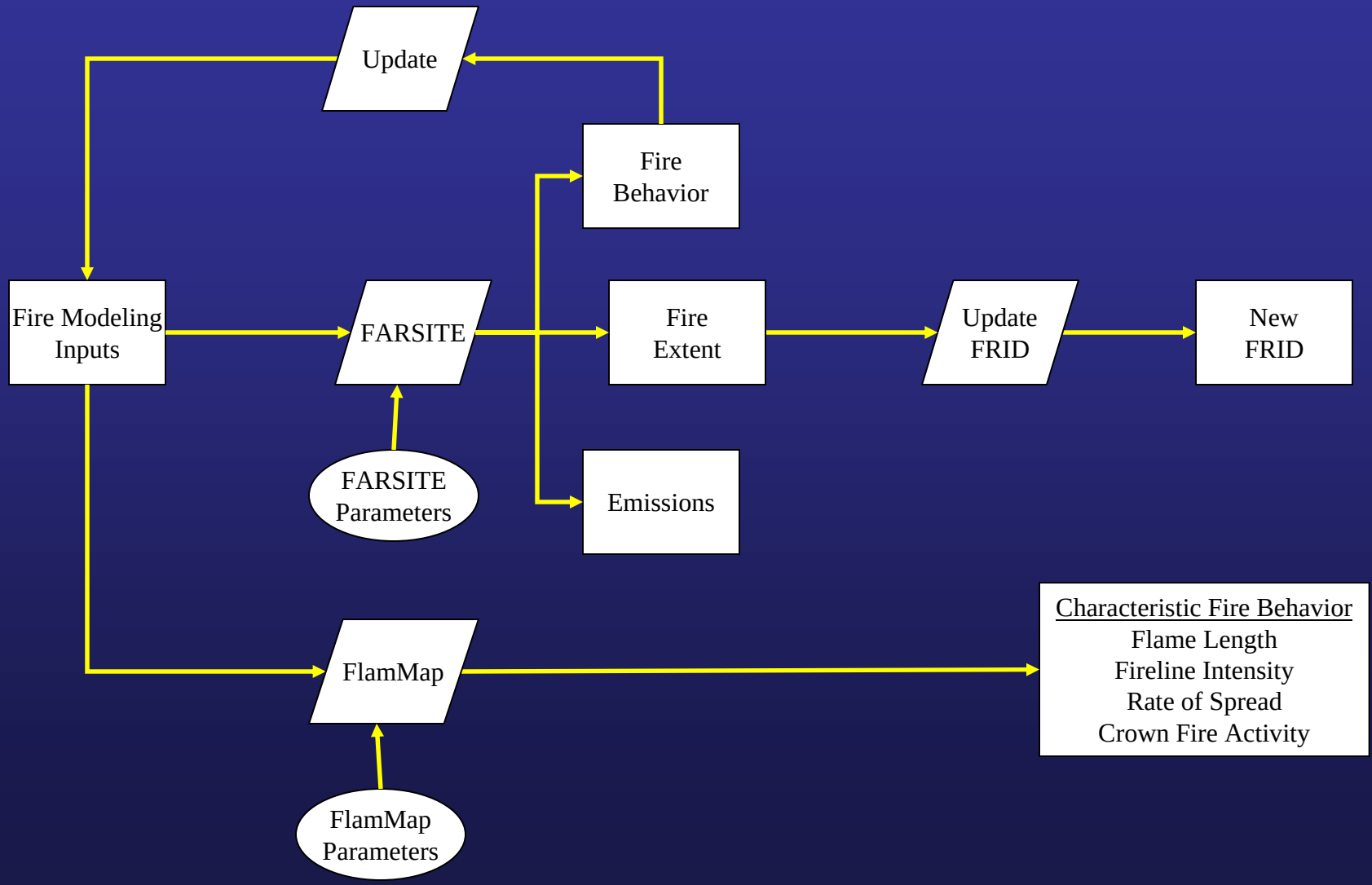
- Model fire using FARSITE → extent, emissions and behavior
- Update fire modeling inputs based on the modeled effects and any 'real world' fires that occurred
- Calculate the resulting change in FRID

Outputs

Yearly
- Individual fire perimeters
- Individual fire behavior (flame length, crown fire, etc.)
- PM 2.5 and PM 10 emissions

Final
- 10-year cumulative change in FRID and fuels
- Step-by-step guidebook for continuing analysis beyond 2004

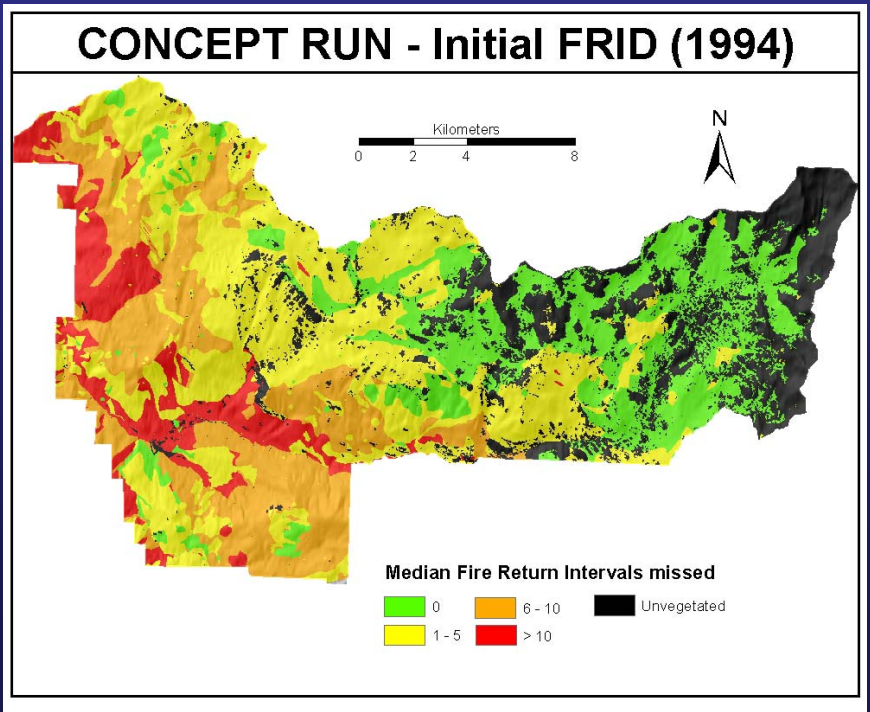
Sequential Modeling Overview

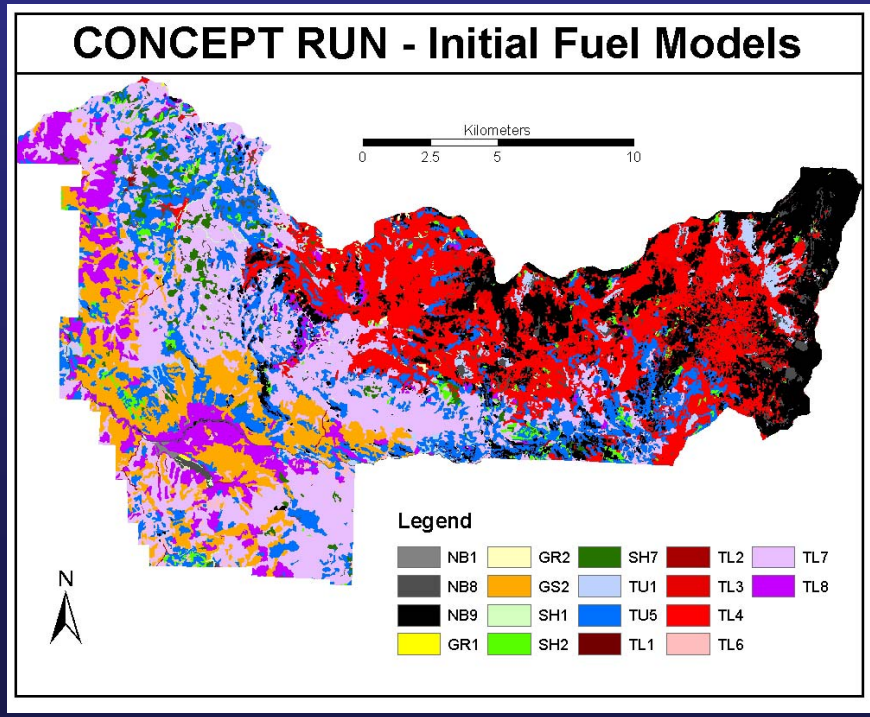


Concept Run

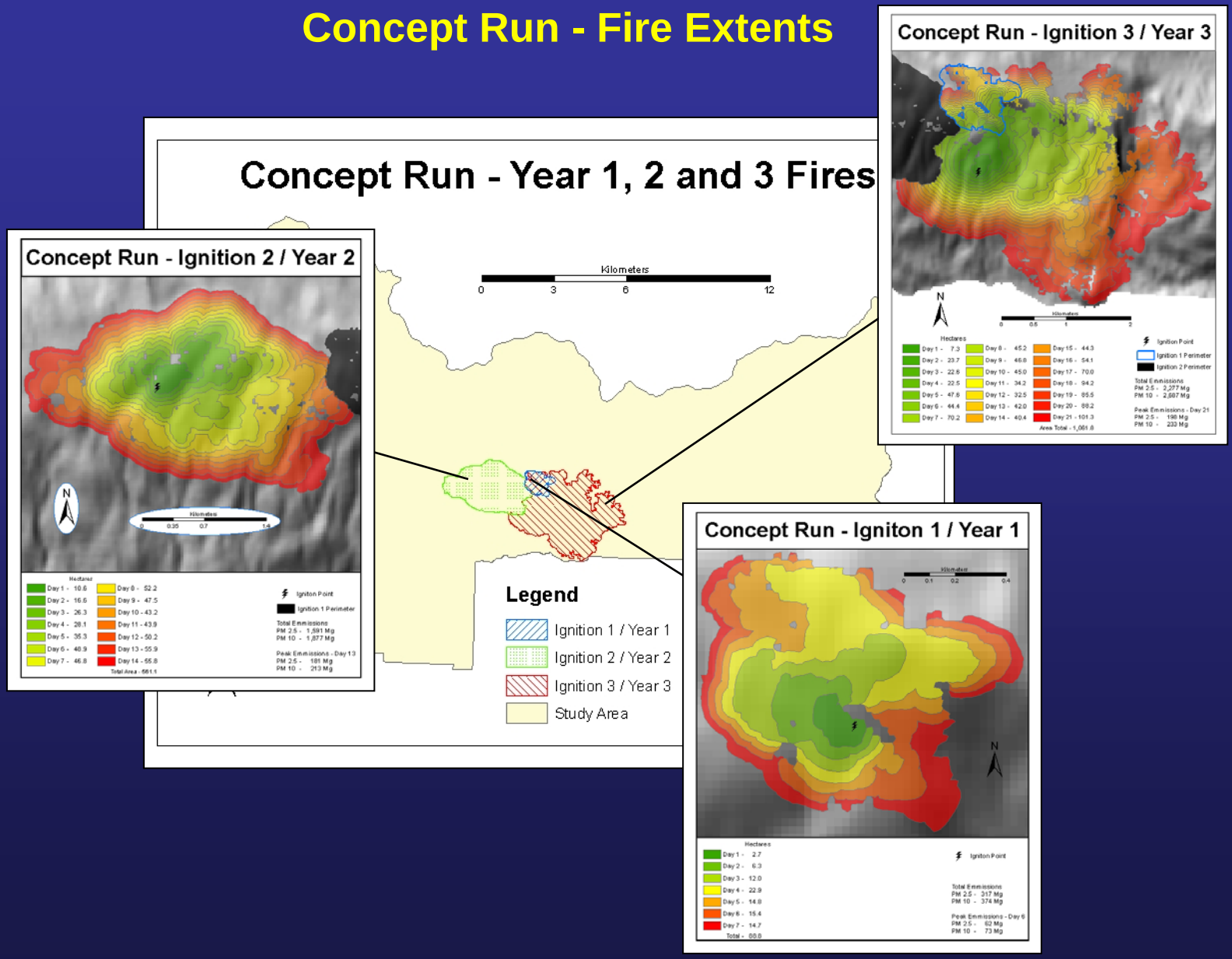
- Modeled 3 theoretical fires representing 3 years of suppression
- Updated inputs based on expert crosswalks and rules of thumb

- Final outputs: change in fuels and FRID



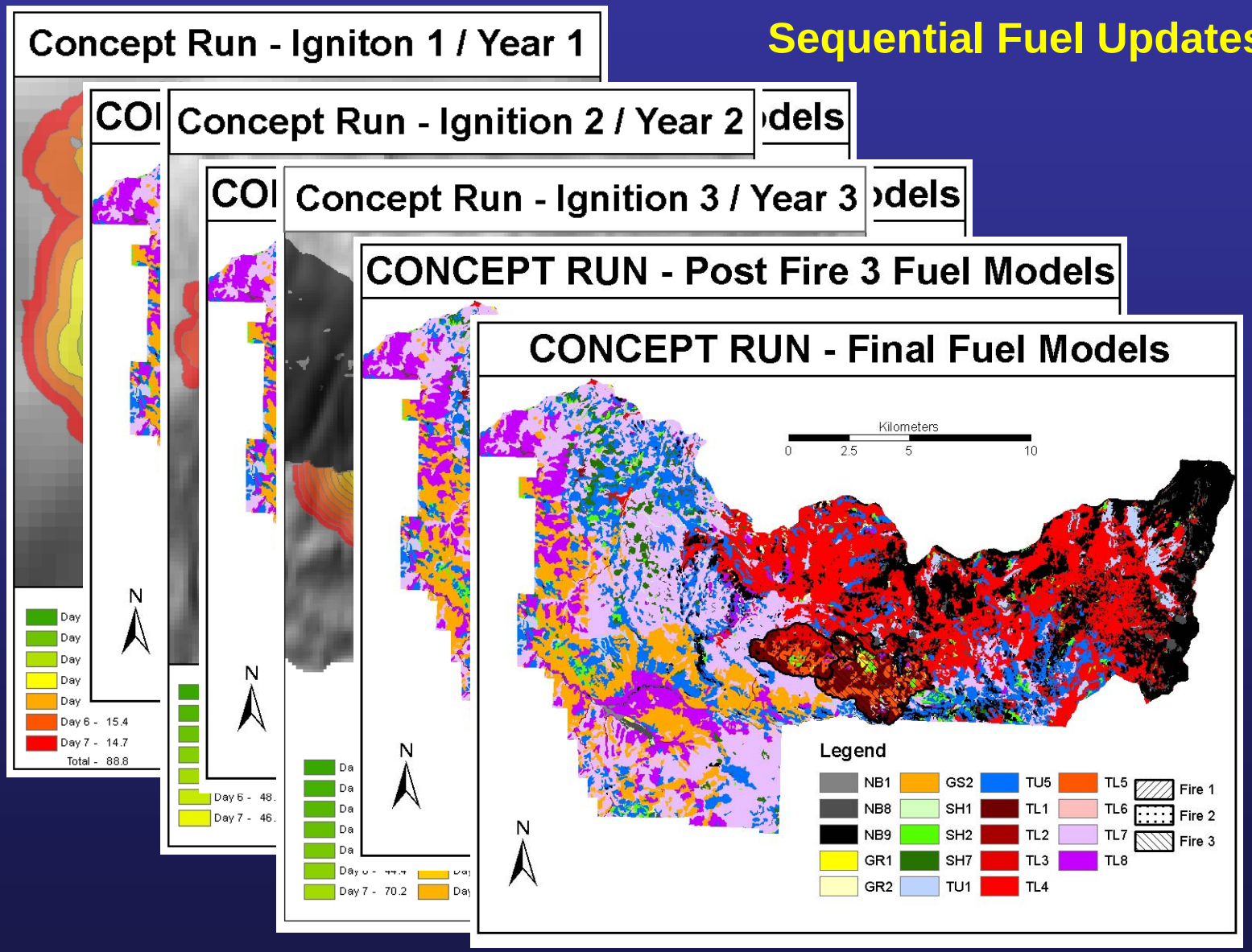


Concept Run - Fire Extents



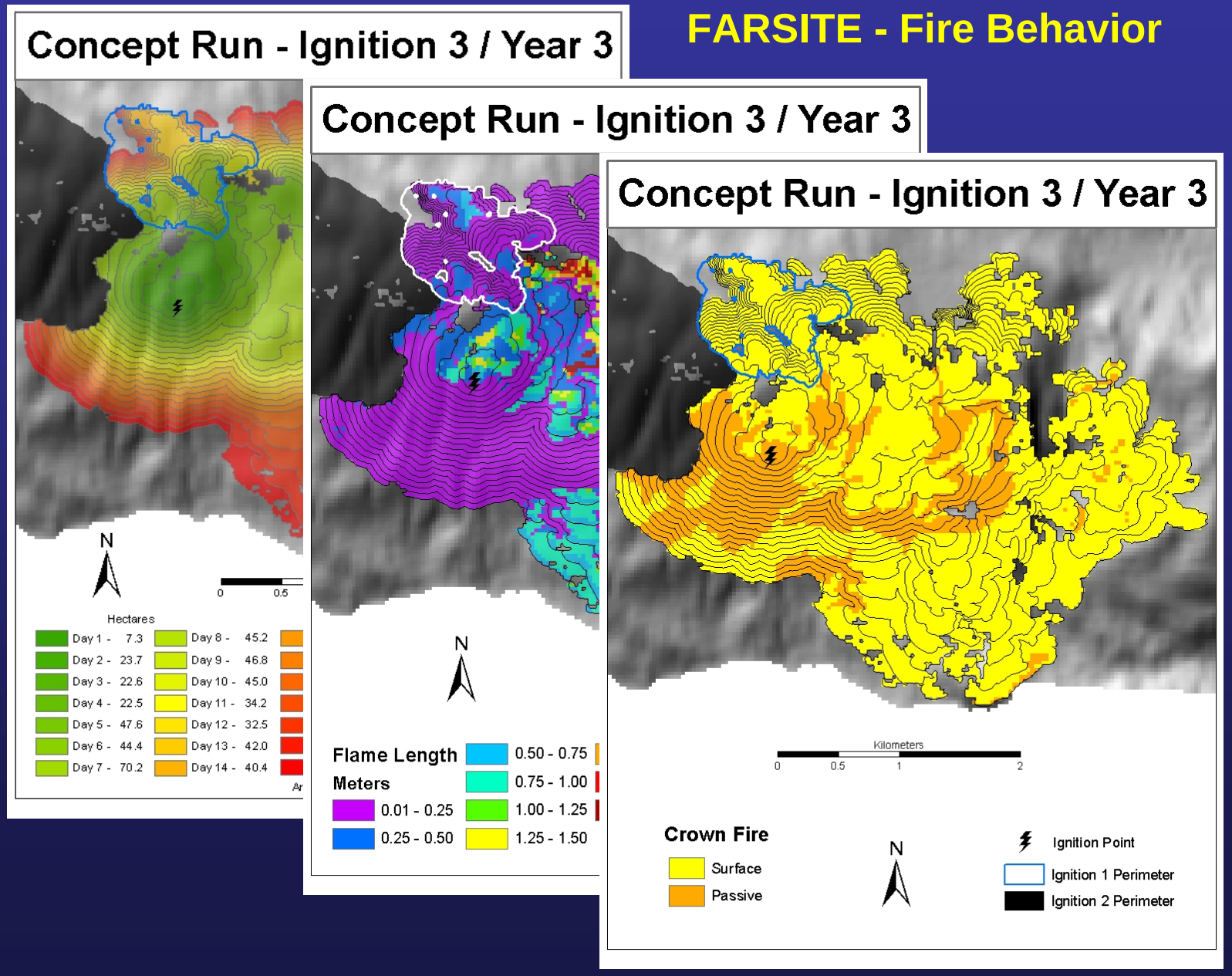
Retrospective Analysis of Fire Behavior …CUMULATIVE EFFECTS

Sequential Fuel Updates

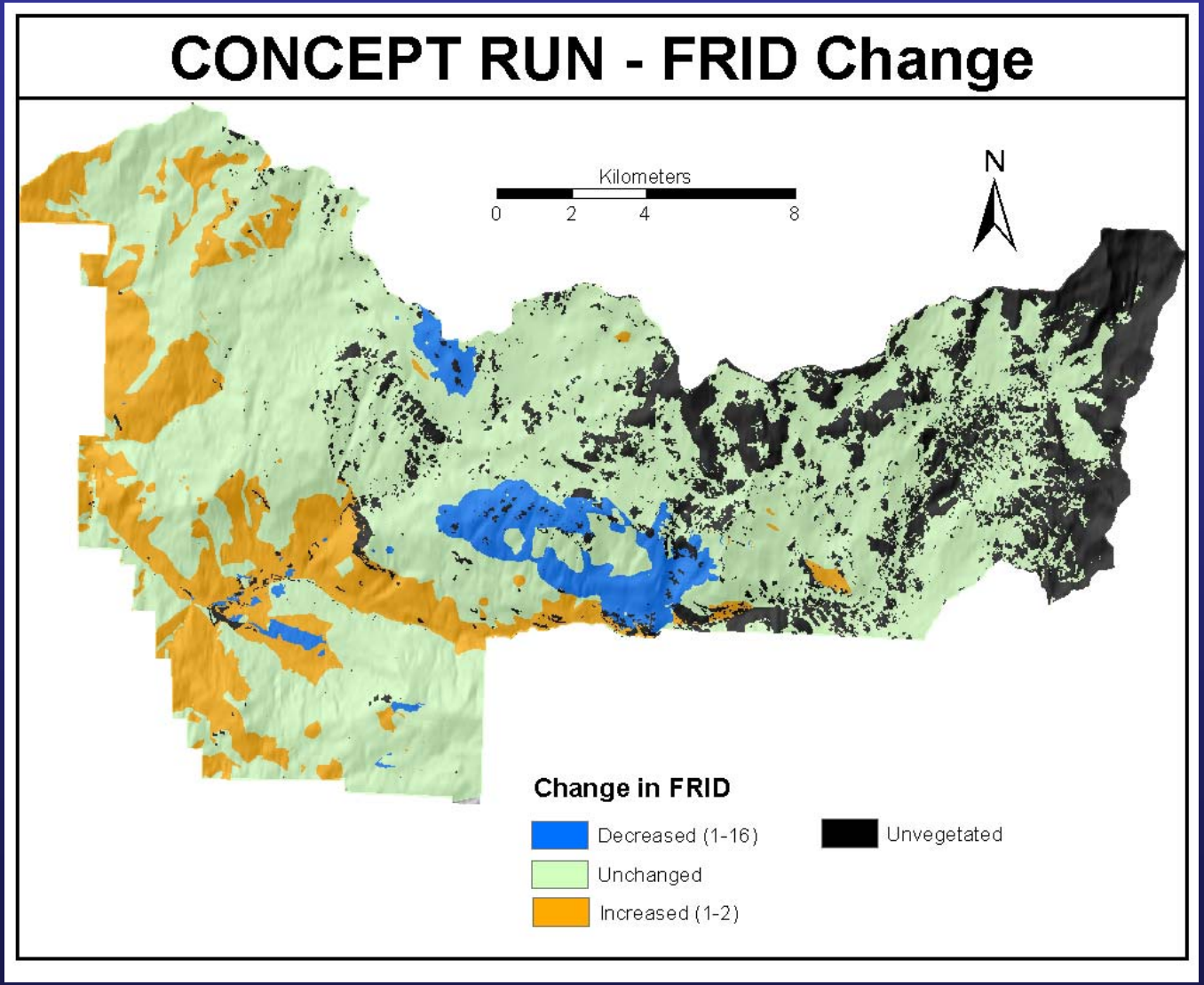


Retrospective Analysis of Fire Behavior …CUMULATIVE EFFECTS

FARSITE - Fire Behavior



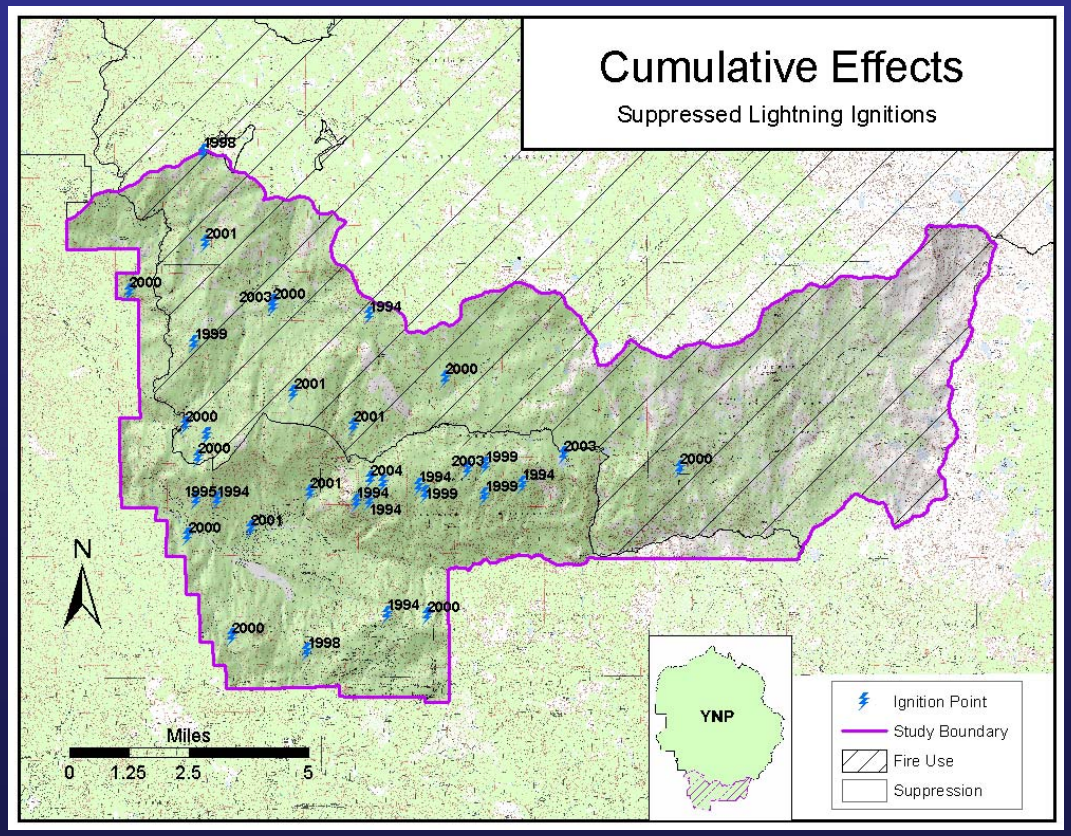
Consequences of Suppression on FRID



Cumulative Effects Uses/Conclusions

Method of quantifying cumulative consequences of suppression:

- FRID
- Potential Fire Behavior



Provides feedback on past management decisions

Helps frame future decisions and planning in the context of past experiences

Map Library Fire Modeling

Model a variety of potential ignitions under both average and extreme conditions

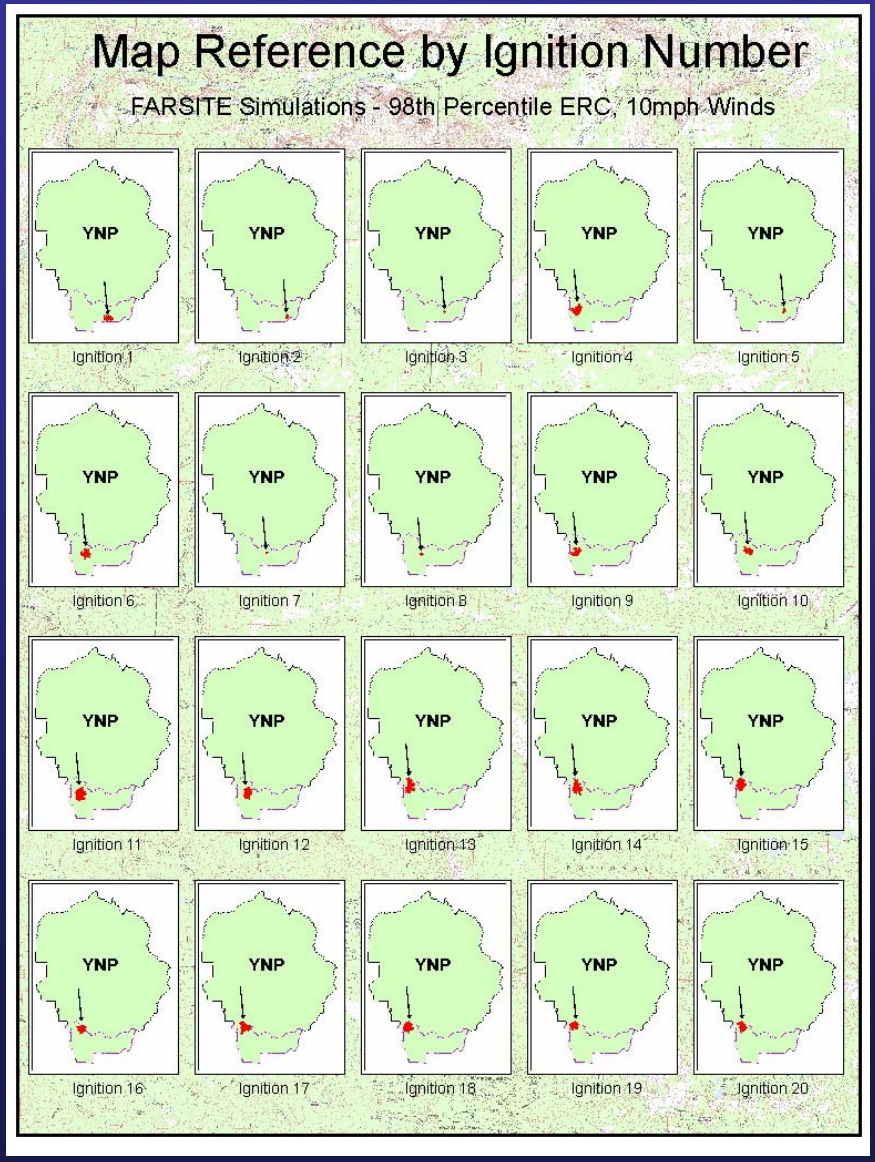
Purpose

Decision Support

- Inform ‘Go – No Go’ Decision
- Define MMA for WFIP Stage III
- Appropriate Suppression Response

Quick Reference

Risks/Benefits

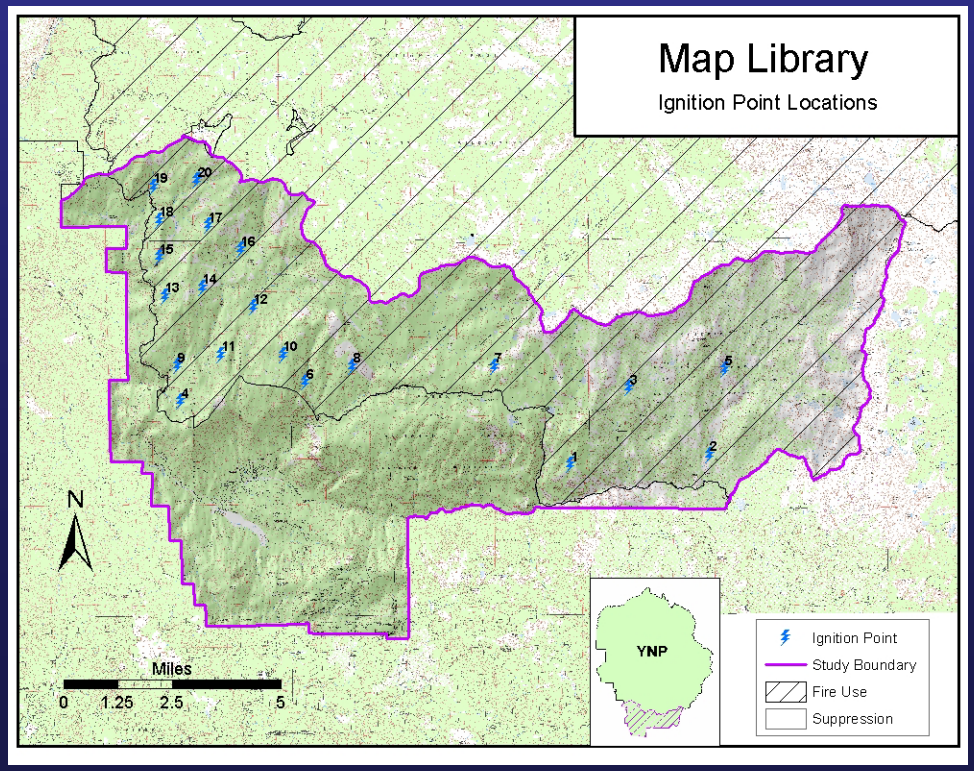


Inputs

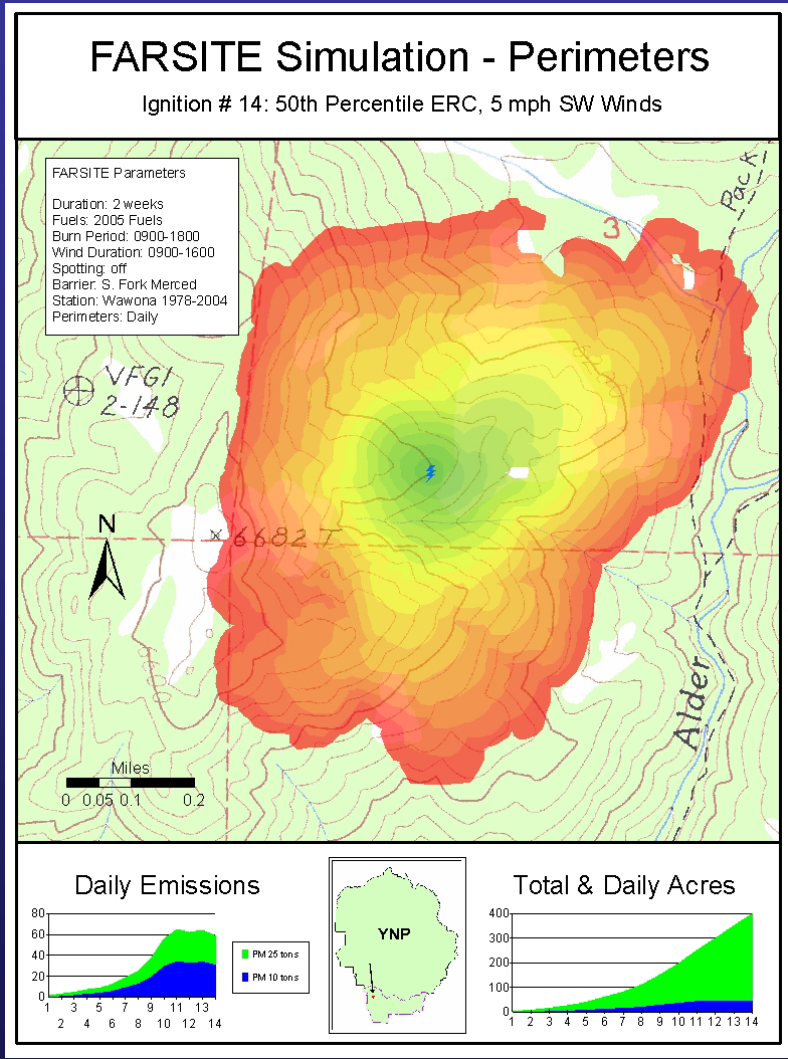
- 20 ignition points w/in the Fire Use Unit
- Surface (standard 13), crown and ground fuels
- Weather: 50th and 98th percentile ERC (Wawona)
- Wind: 50th & 98th percentile (Wawona)
- Duration
  - 50th -14 days
  - 98th - 7 days

Outputs

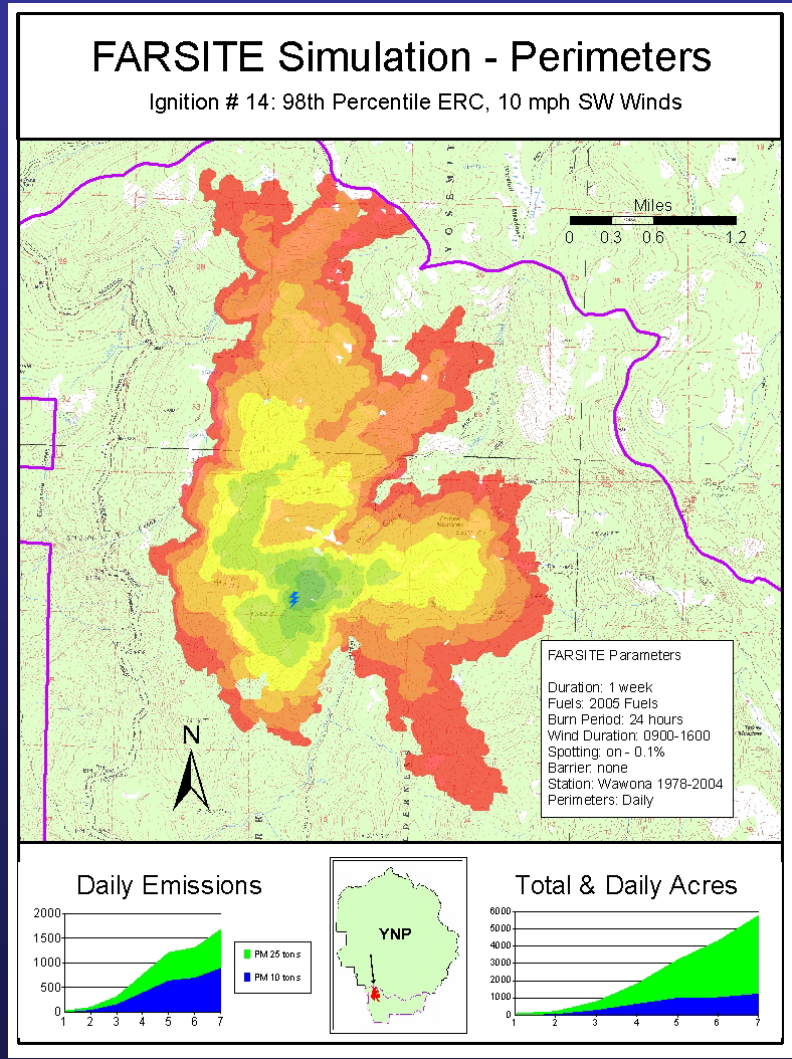
- Daily perimeters
- PM 2.5 and PM 10 emissions
- Fire Behavior (flame length, crown fire activity)
- FRID of area 'burned'



Daily perimeters / PM 2.5 and PM 10 emissions

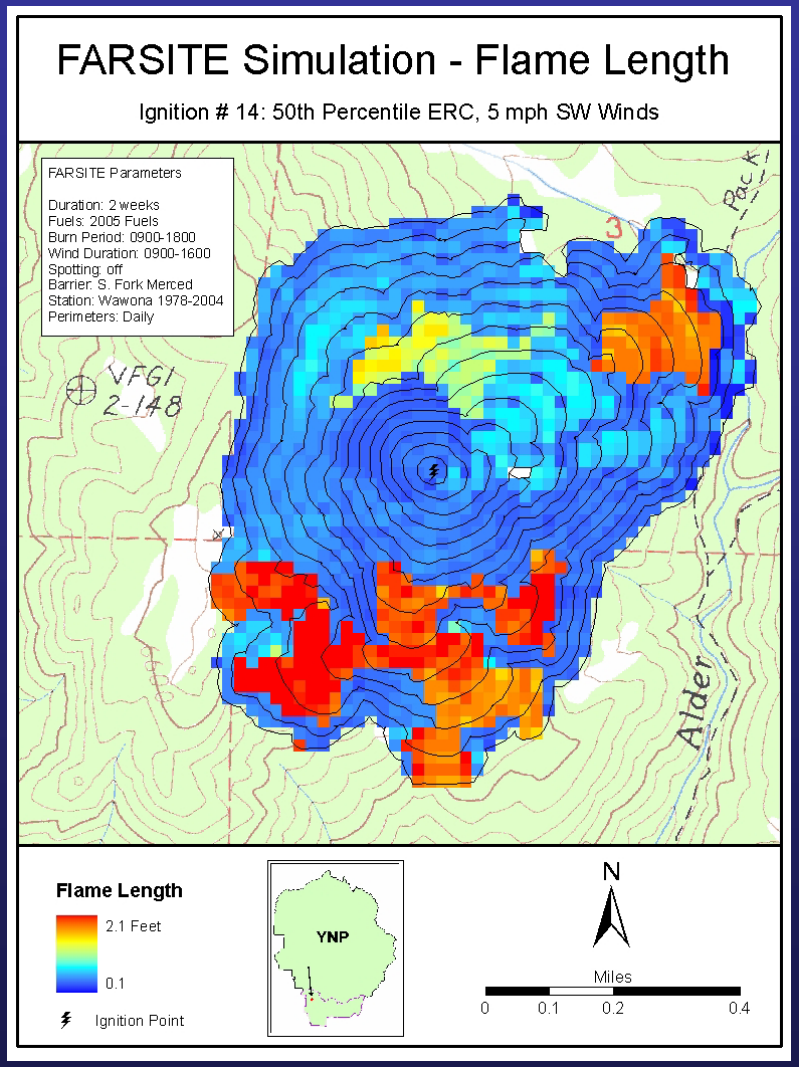


50th percentile ERC – 2 Weeks

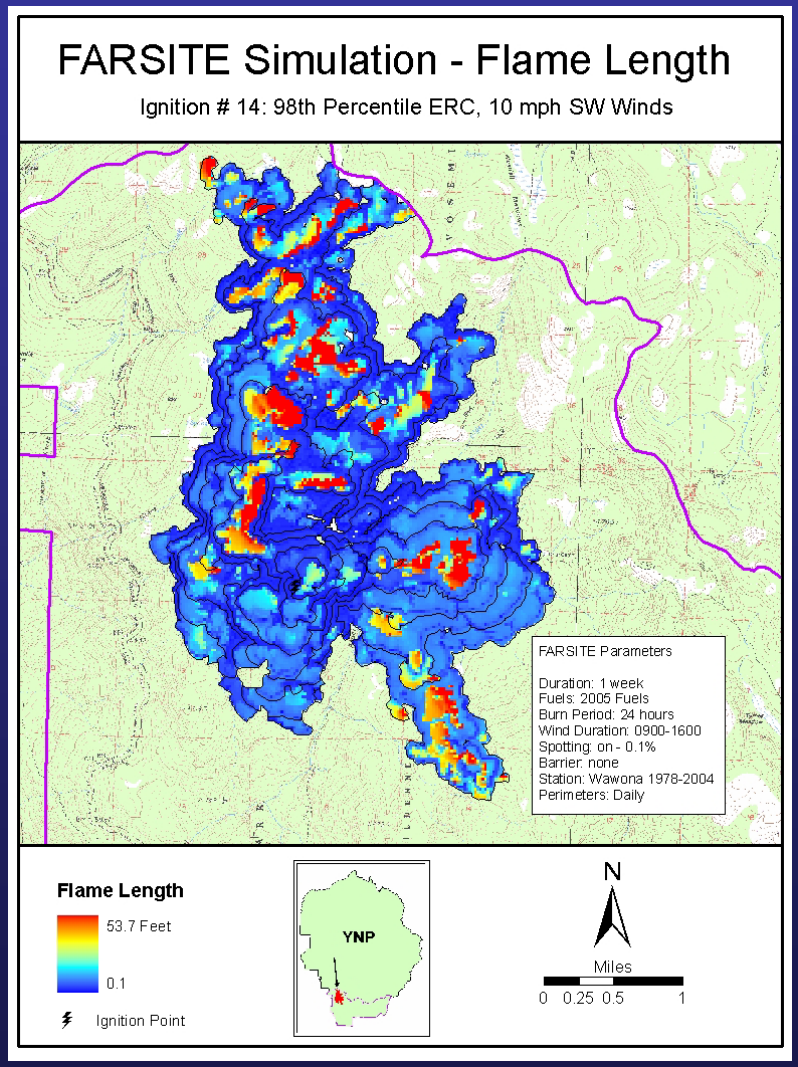


98th percentile ERC – 1 Week

Flame Length

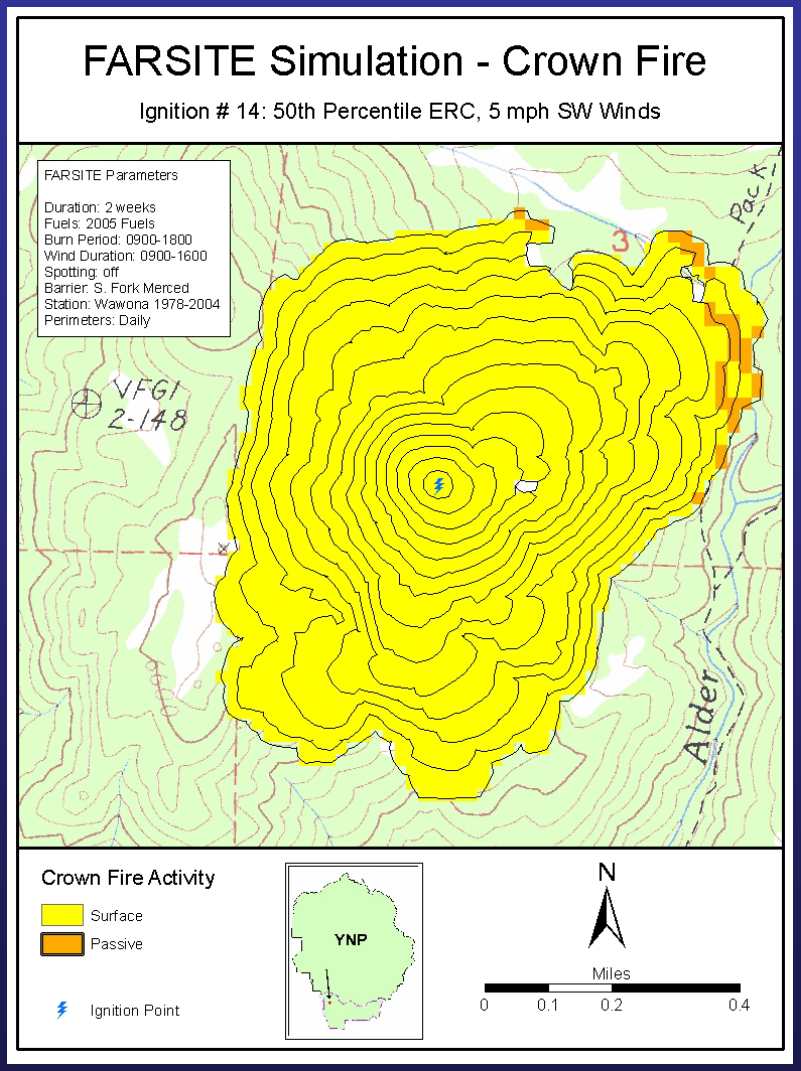


50th percentile ERC – 2 Weeks

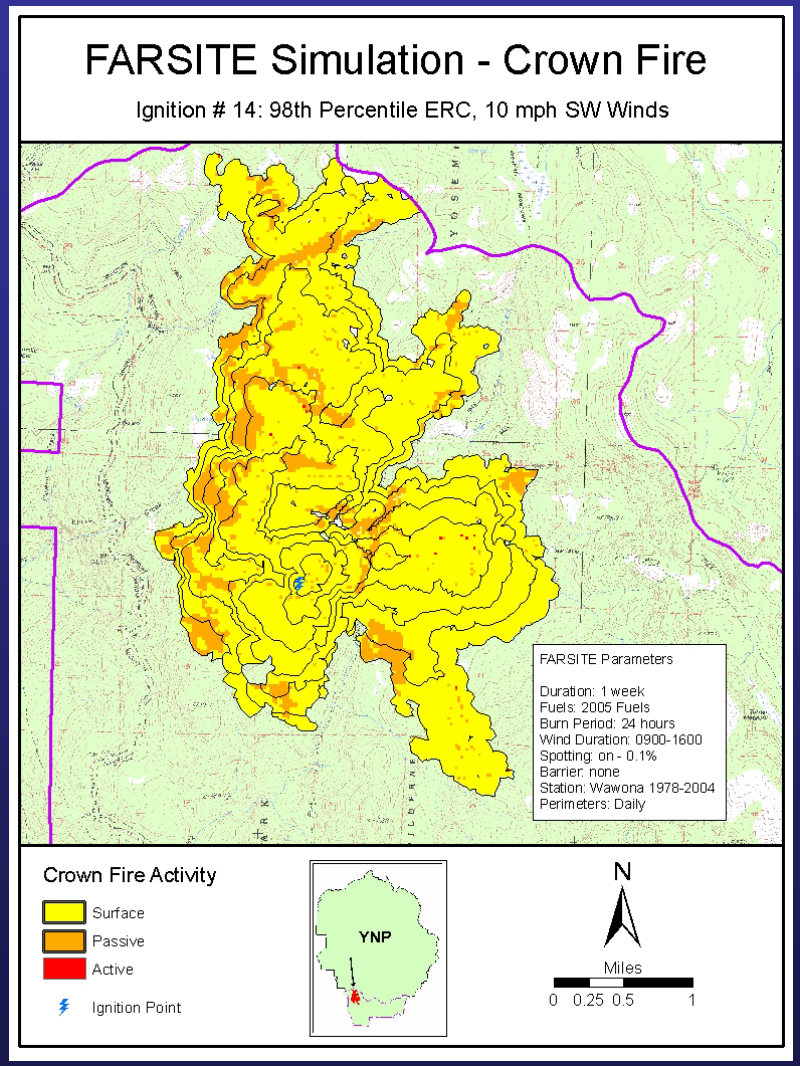


98th percentile ERC – 1 Week

Crown Fire Activity

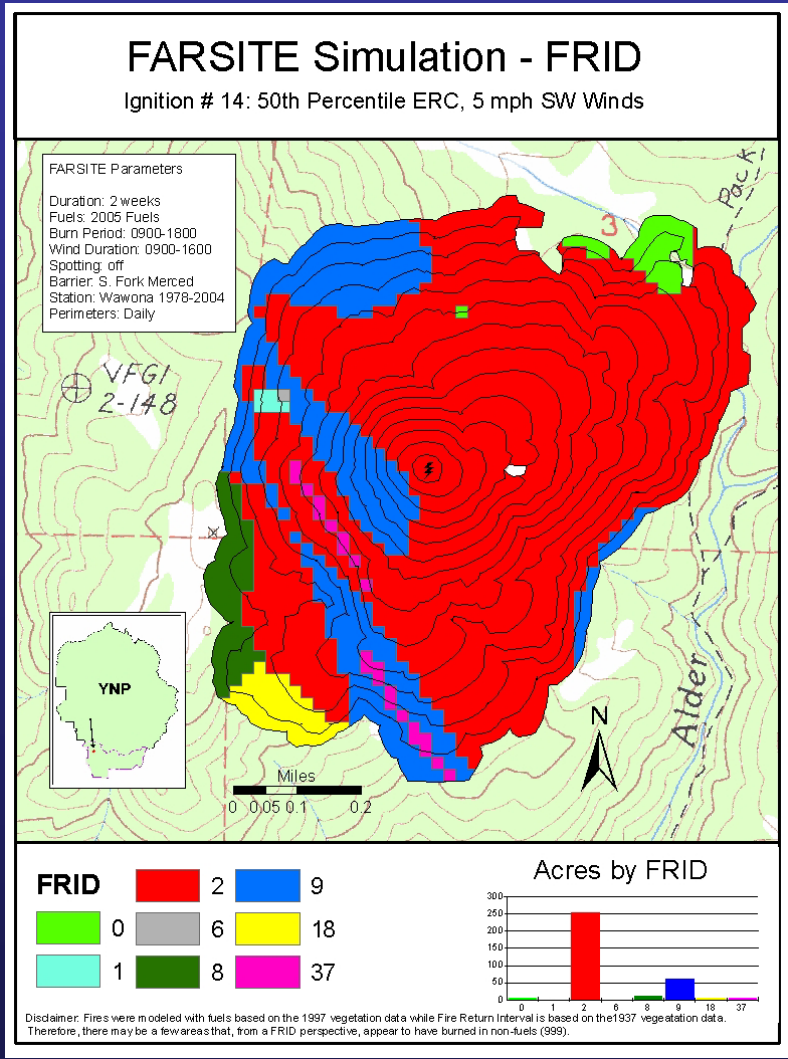


50th percentile ERC – 2 Weeks

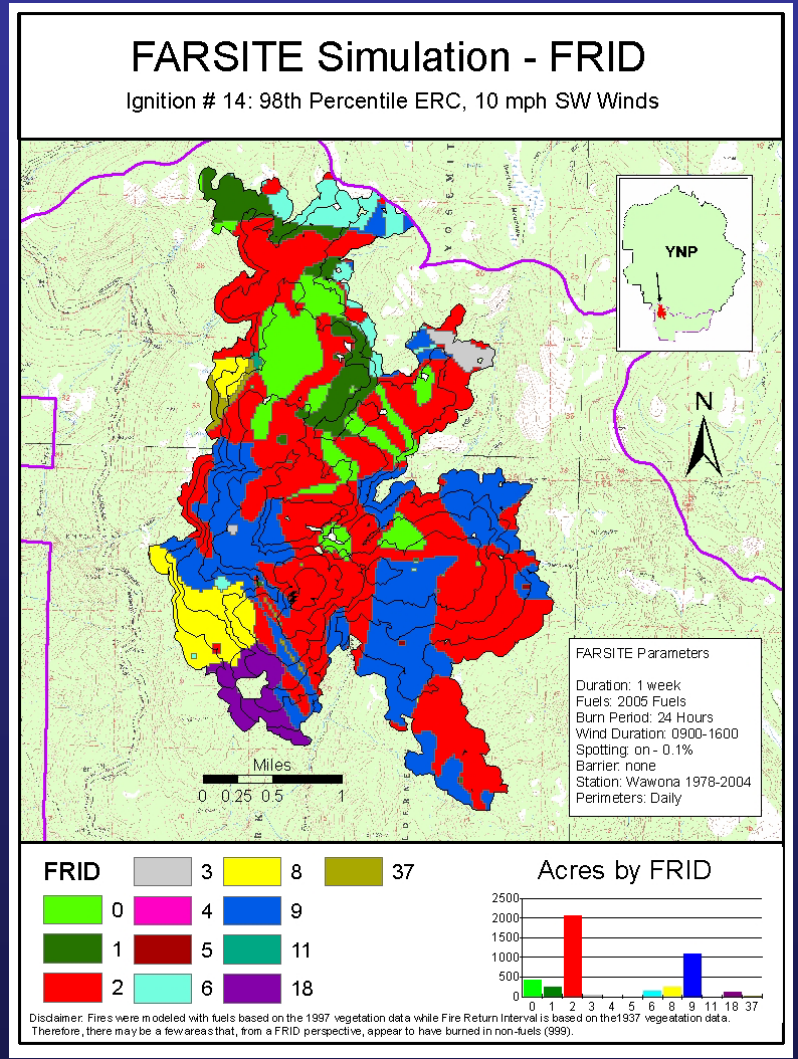


98th percentile ERC – 1 Week

Burned Area FRID



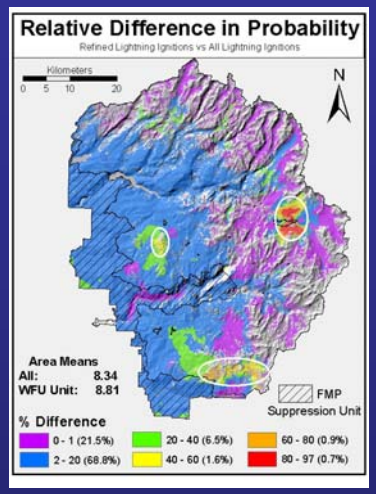
50th percentile ERC – 2 Weeks



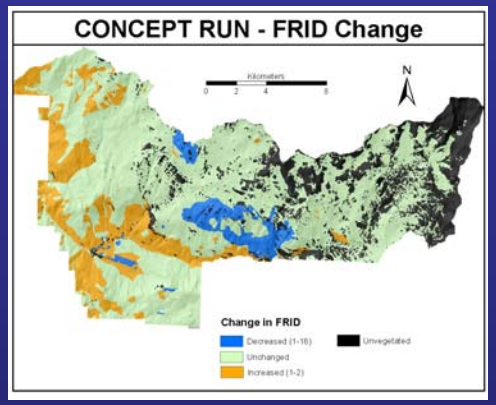
98th percentile ERC – 1 Week

Research to Support Wildland Fire Use in Yosemite NP

Quantifying the Consequences of Suppression

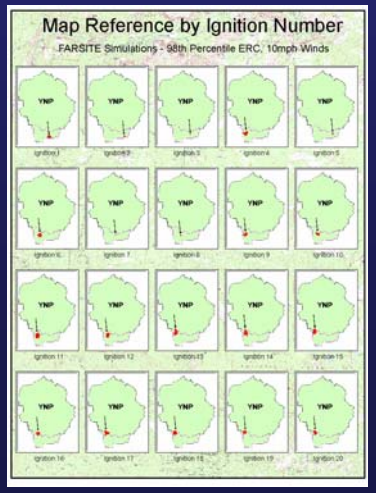


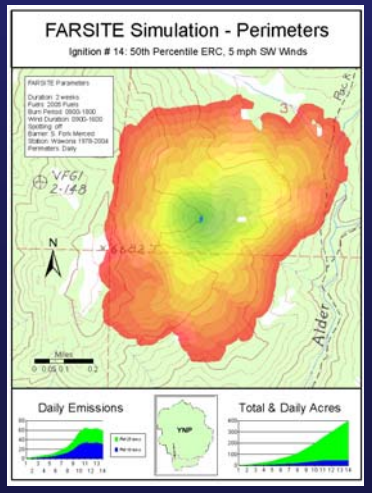
Relative differences in probability

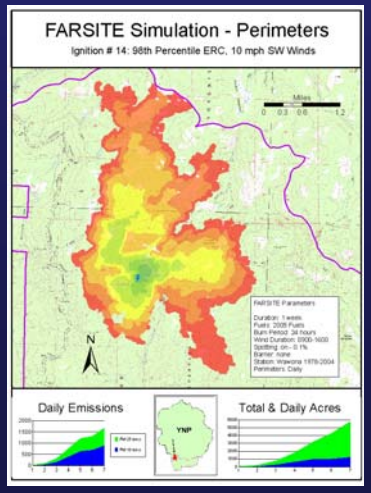


Cumulative impact on FRID

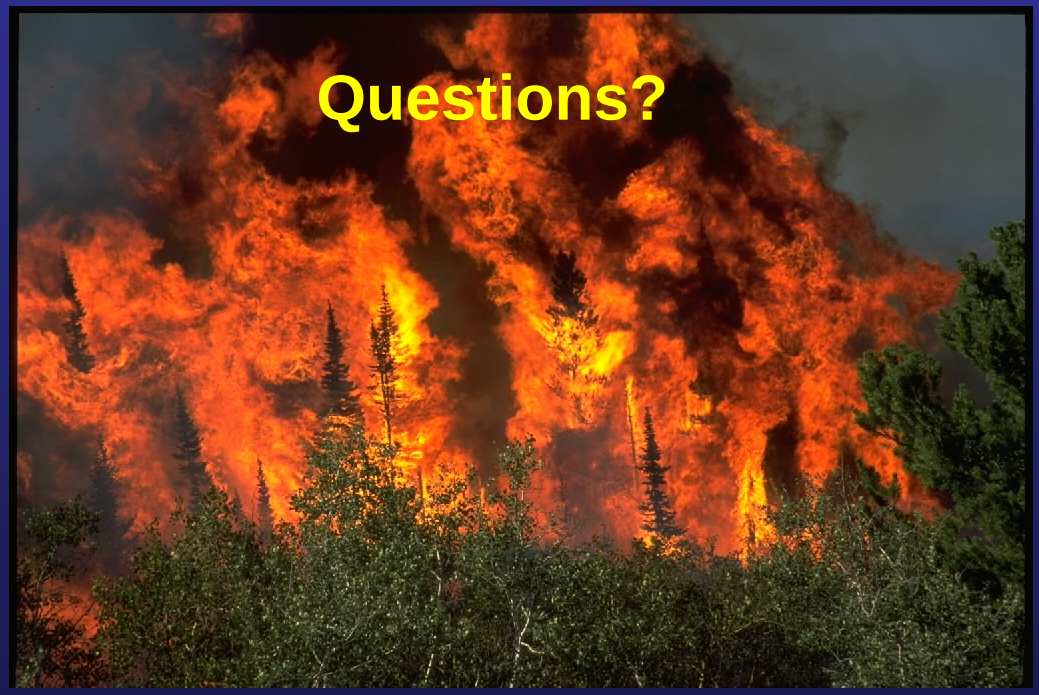
Map Library

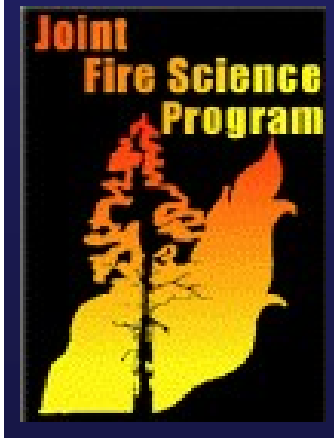






Special Thanks (in no particular order): Mike Beasley, Tony Caprio, Jan vanWagtendonk, Kent vanWagtendonk, Jen Hooke, Karen Folger, Ben Jacobs, Joe Scott, Monica Buhler, Pat Stephen, Corky Conover, Dave Bartlett, Suzanne Schwartz, Beth Hall, Andi Thode

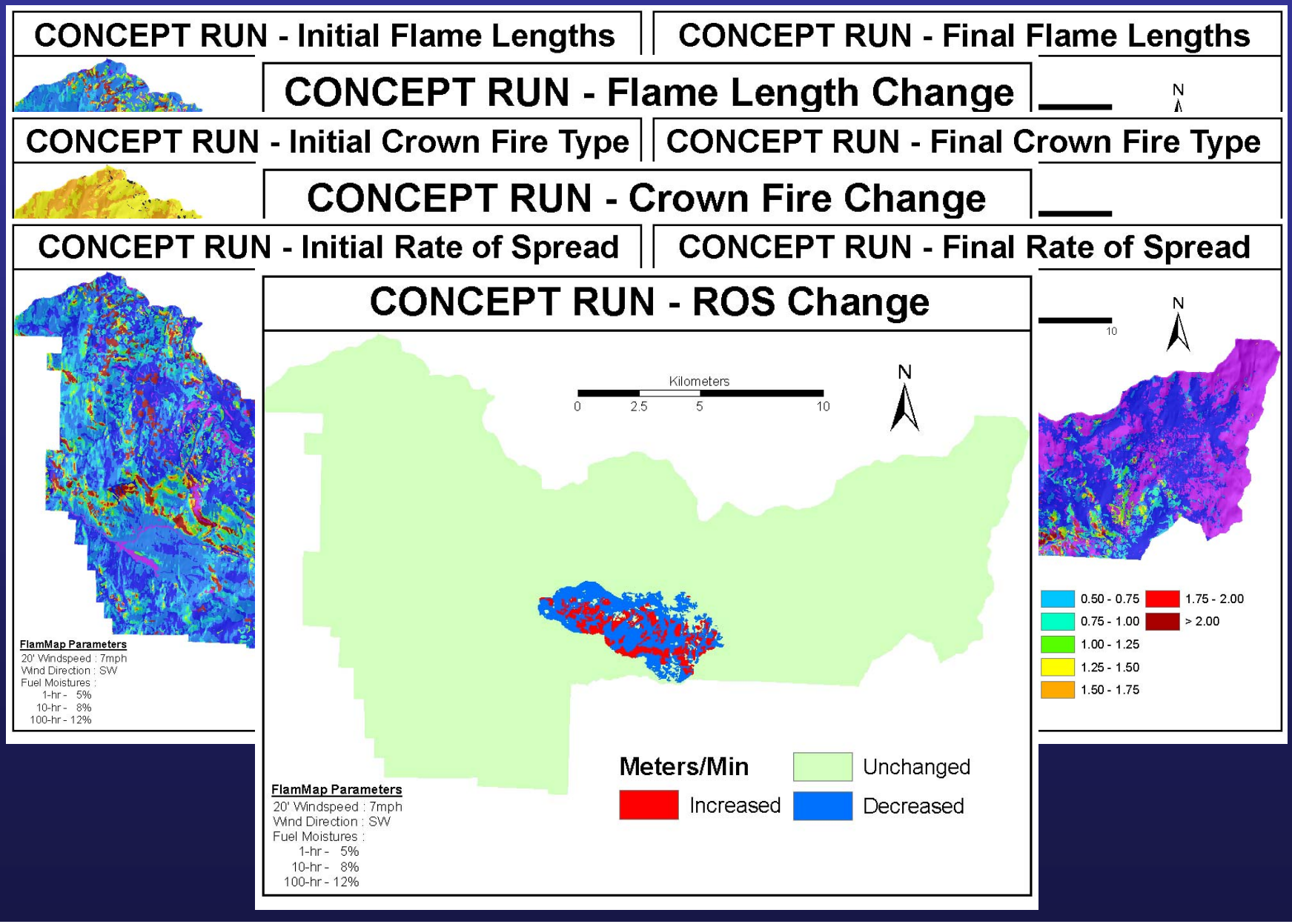




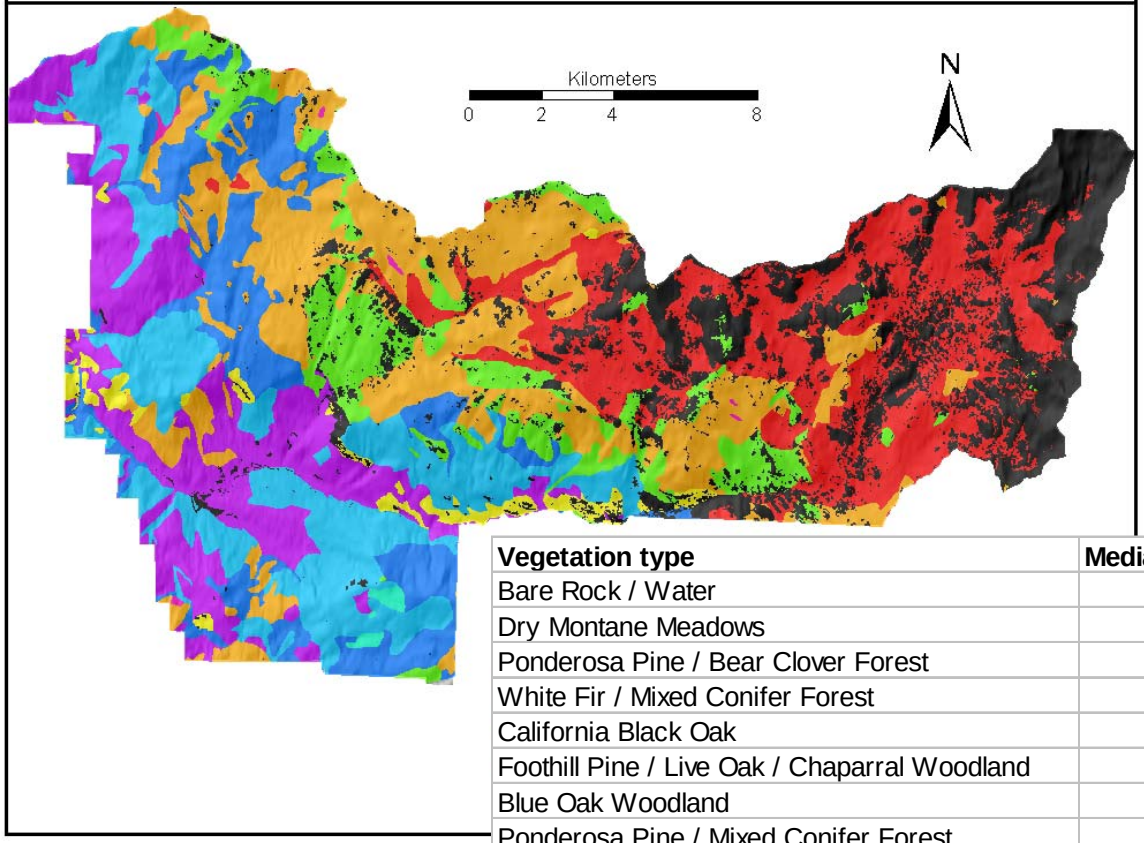
This research was co-funded by the

Joint Fire Science Program and National Fire Plan

FlamMap Runs – Initial (1994) and Final (1997)



Median Fire Return Interval



Vegetation type	Median FRI	Maximum FRI
Bare Rock / Water	0	0
Dry Montane Meadows	2	5
Ponderosa Pine / Bear Clover Forest	4	6
White Fir / Mixed Conifer Forest	8	35
California Black Oak	8	18
Foothill Pine / Live Oak / Chaparral Woodland	8	49
Blue Oak Woodland	8	49
Ponderosa Pine / Mixed Conifer Forest	9	14
Giant Sequoia / Mixed Conifer Forest	10	15
Western White Pine / Jefferey Pine Forest	12	96
Canyon Live Oak	13	39
Montane Chaparral	30	75
Red Fir Forest	30	92
Foothill Chaparral	30	60
Lodgepole Pine Forest	102	163
Whitebark Pine / Mountain Hemlock Forest	187	508

Fuel Model	Severity		
	Low	Moderate	High
GR1	GR1	GR1	GR1
GR2	GR2	GR2	GR2
GS2	GS2	GS2	GR2
SH1	SH1	SH1	SH1
SH2	SH2	SH1	GR1
SH7	SH7	SH2	SH2
TU1	TU1	TU1	TL4
TU5	TL1	TL1	GR1
TL1	TL1	TL1	TL1
TL2	TL2	TL2	SH2
TL3	TL3	TL1	GR1
TL4	TL3	TL1	GR1
TL6	TL6	TL6	SH1
TL7	TL5	TL1	GR1
TL8	TL8	TL1	TL1

Fuel Model Cross-walk

Crosswalk will eventually be based on fuel consumption

‘Severity’ based on crown fire activity

Attribute	Low	Moderate	High
Canopy Cover	none	-50%	0
Crown Bulk Density	none	-50%	0
Stand Height	none	none	none
Crown Base Height	none	+100%	infinite
Coarse Woody Debris	-50%	-75%	-90%
Duff	-50%	-75%	-90%