The Fire Problem

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Pre-Historic Fire Area in CA

- Estimate fire area from California before the influences of Euro-American settlement (pre 1800)

- Provides an idea of what fire once did in the area we call California today

- Include lightning and Native American ignitions

  - *Stephens et al. 2007 (Forest Ecol. Manage.)*

Results

Before 1800 annual area burned in California approximately 4.5 million acres (2.5 million ha)

This is 88% of annual area burned in the entire US from 1994-2004

California annual area burned from Cal Fire statistics from 1950-1999: 260,000 acres

6% of the pre-historic fire area

Increased since 2000, < 10% today

Gives a perspective of what fire once did

Past CA Fire Summary

- Regardless of possible errors we have to conclude that fire once was a dominant process in California ecosystems
  - Currently burning about 6-10% of this area
  - Agriculture, land use change, and urbanization have modified a great deal of California
- Urbanization of California wildlands huge issue for state
  - Places additional assets at risk and reduces management options
- Changing climates makes this more difficult

Fire Suppression

- Begins around 1905 in most of CA
- Smokey Bear in 1942 (still here)
- Approximately 100,000 fires/year today
- 96-99 percent of all wildland fires out at less than 0.5 acres in size
  - Initial attack system very efficient
  - Highly trained units, dispersed across US
- 95% of area burned today is from 1-3% of the fires that escape initial attack

Federal Fire Area in US

Wildfire Area (acres) 1960-2012
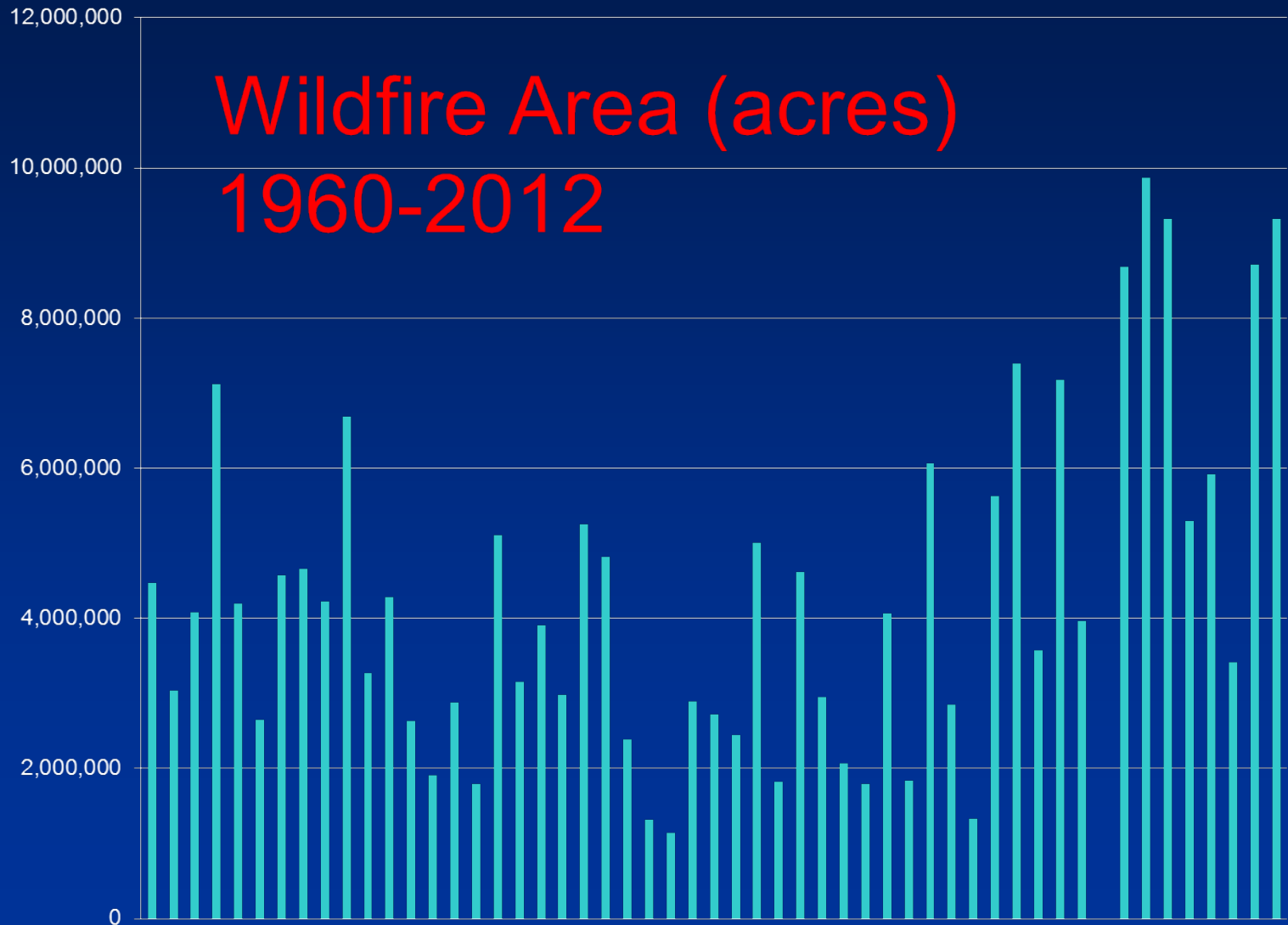
Federal Fire Suppression Costs

Suppression Cost
1985-2012
(Hundred of $Millions)
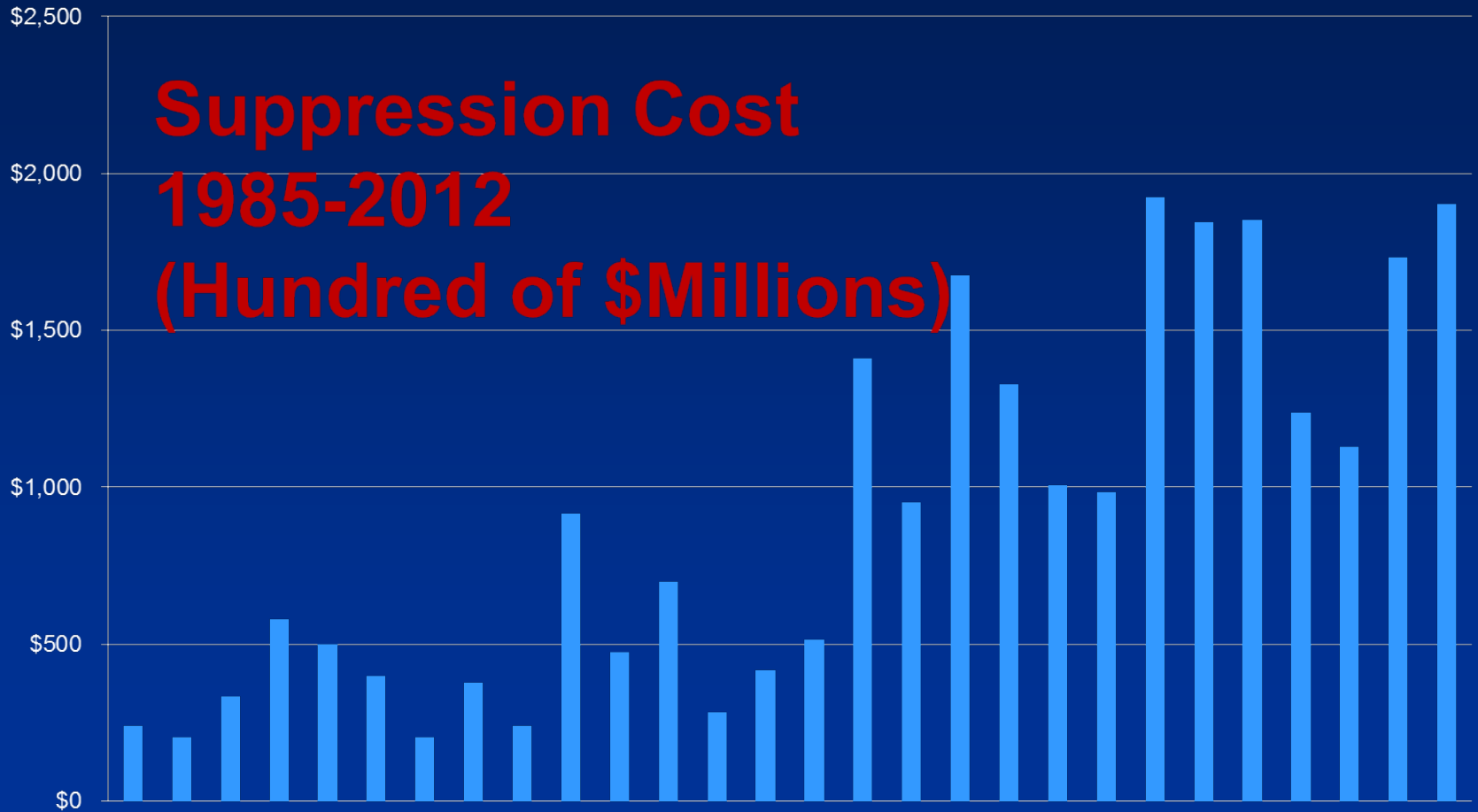
Fire Management Options

- Fuel treatments
  - Diverse methods that include prescribed fire and mechanical methods
    - Fire and fire surrogates
  - Goal is to reduce potential fire behavior and effects in treated areas
- Managed wildfire
  - Can be used in remote areas
  - Manage lightning fires for ecological benefit

2001 Hoover Fire, Yosemite

Wildfire Simulations

- **Fire behavior modeling:**
  - FARSITE (Fire Area Simulator by Mark Finney (UCB alumni))
    - Simulates an individual fire event based on a weather stream, topography, and fuels
    - Very good at predicting fire size and shape in wildland areas
      - Fires burning for months or a few days
      - Previous models were not spatial
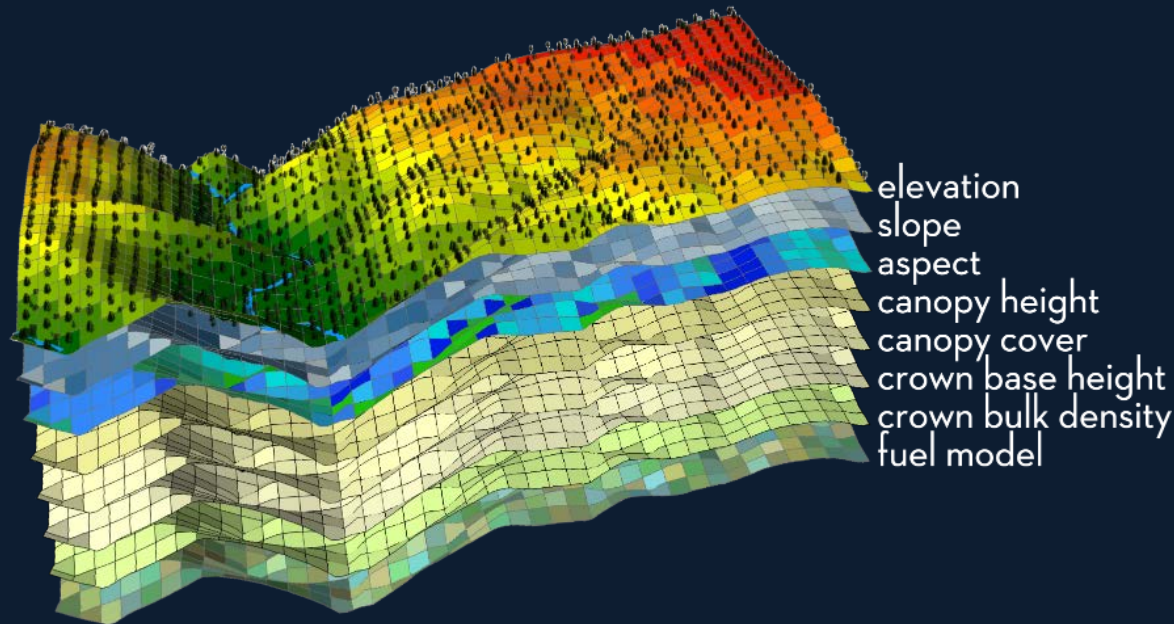
- **Weather:**
  - Uses hourly wind velocity and
  - direction, max and min temp
  - and humidity

- **Analysis:**
  - Useful information for managers
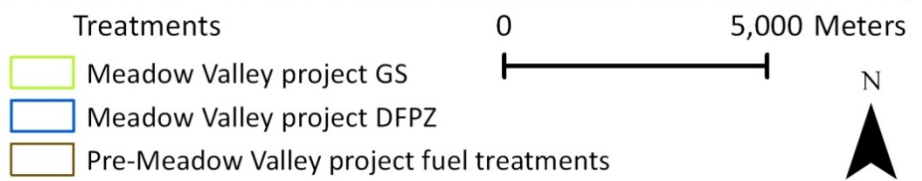 - Normally used on all large fires
  - today

GIS Fire Behavior Data Requirements
for FARSITE

elevation
slope
aspect
canopy height
canopy cover
crown base height
crown bulk density
fuel model

FARSITE

FlamMap

Eight layer
sandwich of data

lidar
basics

wildfire   backgro   meth   resul
modeling { und → od → ts }

wh   ho   resul
density{ y → w → ts }

Problem fire FARSITE fire simulation
(fire coming up from Middle Fork Feather River Canyon)

Flame length (m)

< 1.2	2.4 to 3.3	Meadow Valley study area
1.2 to 2.4	> 3.3	Lookout fire (1999)

Treatments

0   5,000 Meters

Meadow Valley project GS

Meadow Valley project DFPZ

Pre-Meadow Valley project fuel treatments

N

Moghaddas et al., 2010 *Can. J. For. Res.*
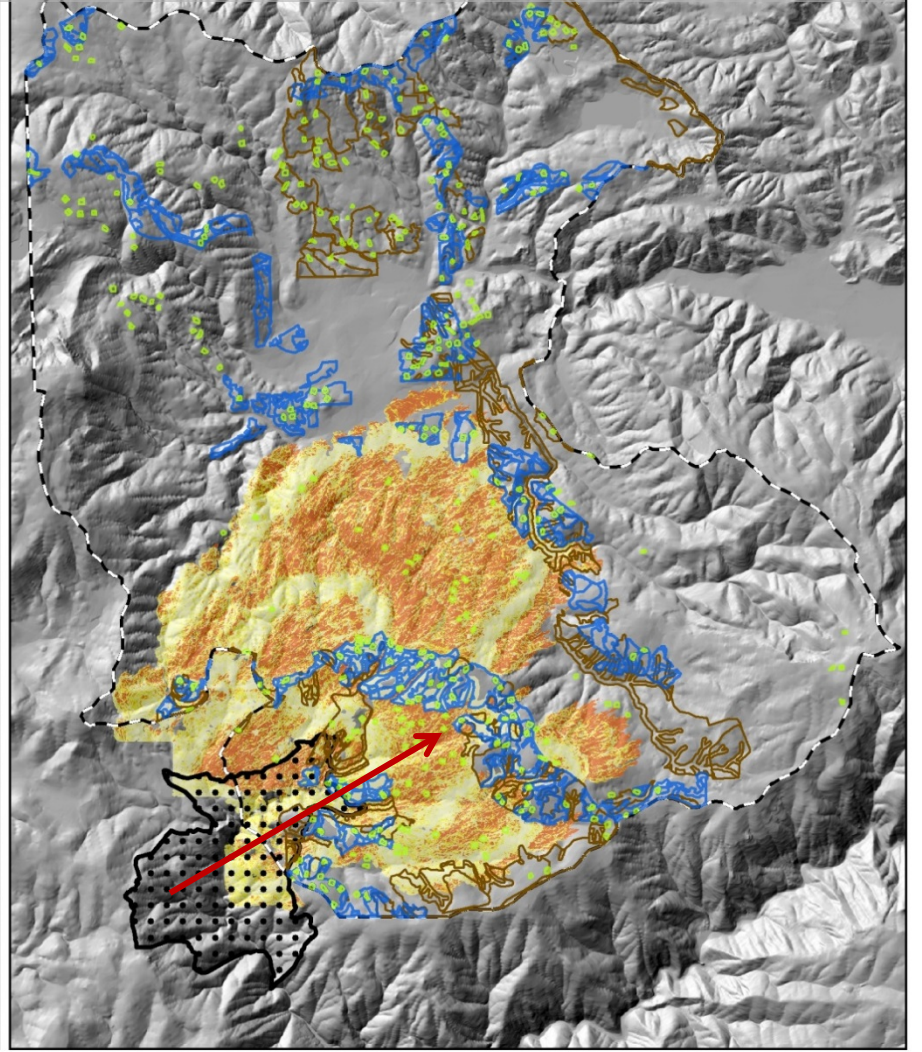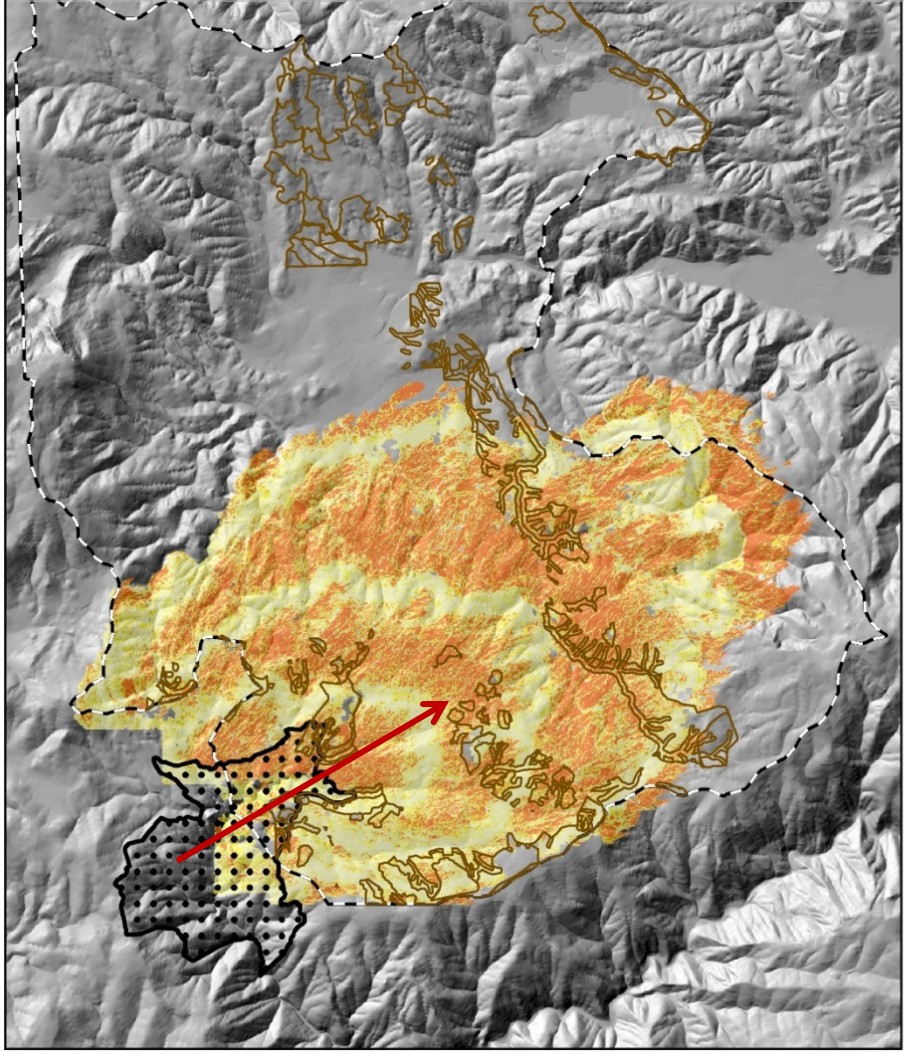
Problem Forest Fires

- Moonlight Fire
- Fall of 2007
- 65,000 acres in the Plumas National Forest east of Quincy
- Over 60% of the area burned at high severity (> 95% of trees killed)

Wildfire Effects

- Sever fires at large spatial scales
- Areas of high severity fire > 4000 acres
- In Yosemite maximum high severity fire patches were 150 acres in fire use area
  – Managed wildfire can be effective
- Dramatic contrast to severe wildfires such as this years Rim Fire (> 250,000 acres)

Early Detection of Fires

- Useful to all fire managers
  - Both suppression and fire use
- Today fires are detected using
  - Lightning detection network
    - Private company provides service
    - Send crews to see if fire ignited
  - Cell phone calls from public
  - Professional crews
  - Some fire lookouts still operating
    - Once thousands of them in western US

Operational Fire Detection System

- Many countries would be interested
  - US, Australia, Russia, China, Mediterranean Europe, Canada, Mexico, Brazil, more.
- Detecting fires early gives managers the most flexibility in response
- Areas near urban interface or other infrastructure could be prioritized for response
  - Some areas, fire use would be appropriate
- Test detection system

Prescribed fire in California Chaparral

UC Hopland Research Center

Russell Reserve

Blodgett Forest

Research Study Area

Mayacamas Mountains, North Coast Range
UC ANR Hopland Research and Extension Center
BLM South Cow Mountain Recreation Area

Chaparral Prescribed vs. Modeled Fire Comparison

- Rate of Spread
- Flame Length
- Stephens, S.L., Weise, D.R., Fry, D.L., Keiffer, R.J., Dawson, J., Koo, E., Potts, J., and Pagni, P. 2008. Measuring the rate of spread of chaparral prescribed fires in northern California. Fire Ecology 4: 74-86.

**Additional Chaparral Prescribed Fires
Could be Done to Test Sensor and Algorithms**

**Open Conditions and Large Flame Lengths
Typical of Southern California Wildfires**

**Forest Prescribed Fires
can also be done**

Summary

- Technology has the potential to improve fire management in many countries
- Climate change is already increasing wildfire occurrence in Australia, US, Canada, Russia, China
  - This will further impact fire suppression and management programs
  - Costs will continue to increase, huge problem for governments
  - Unfortunately more people will be put in harms way by increased wildfire
- Early detection when fires small is key