Modern Trends in California Wildfire: amount, type, and ecological implications

--Dave Sapsis

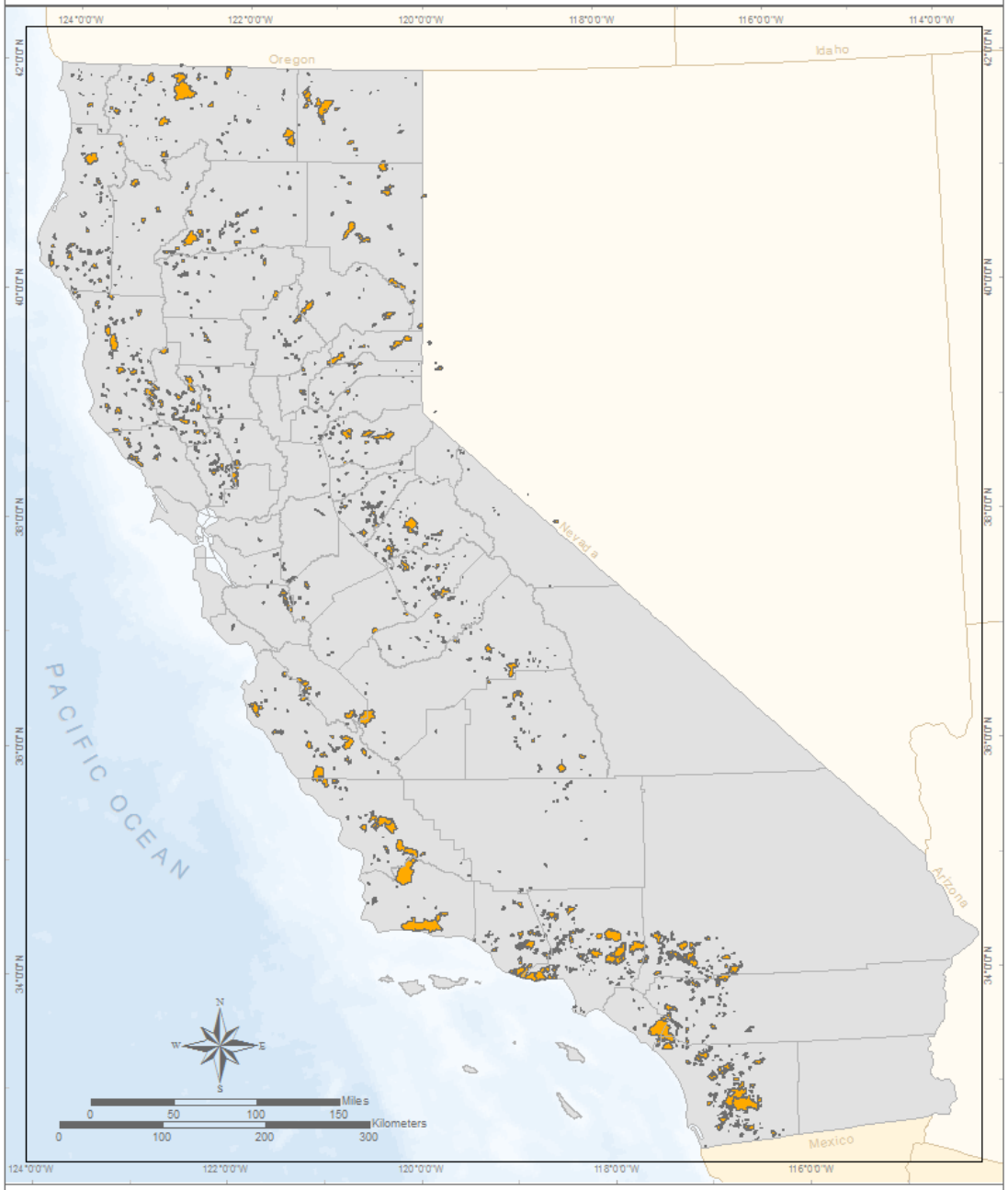
June 17, 2015

Fire and Resource Assessment Program
California Department of Forestry and Fire Protection

What Do we know?

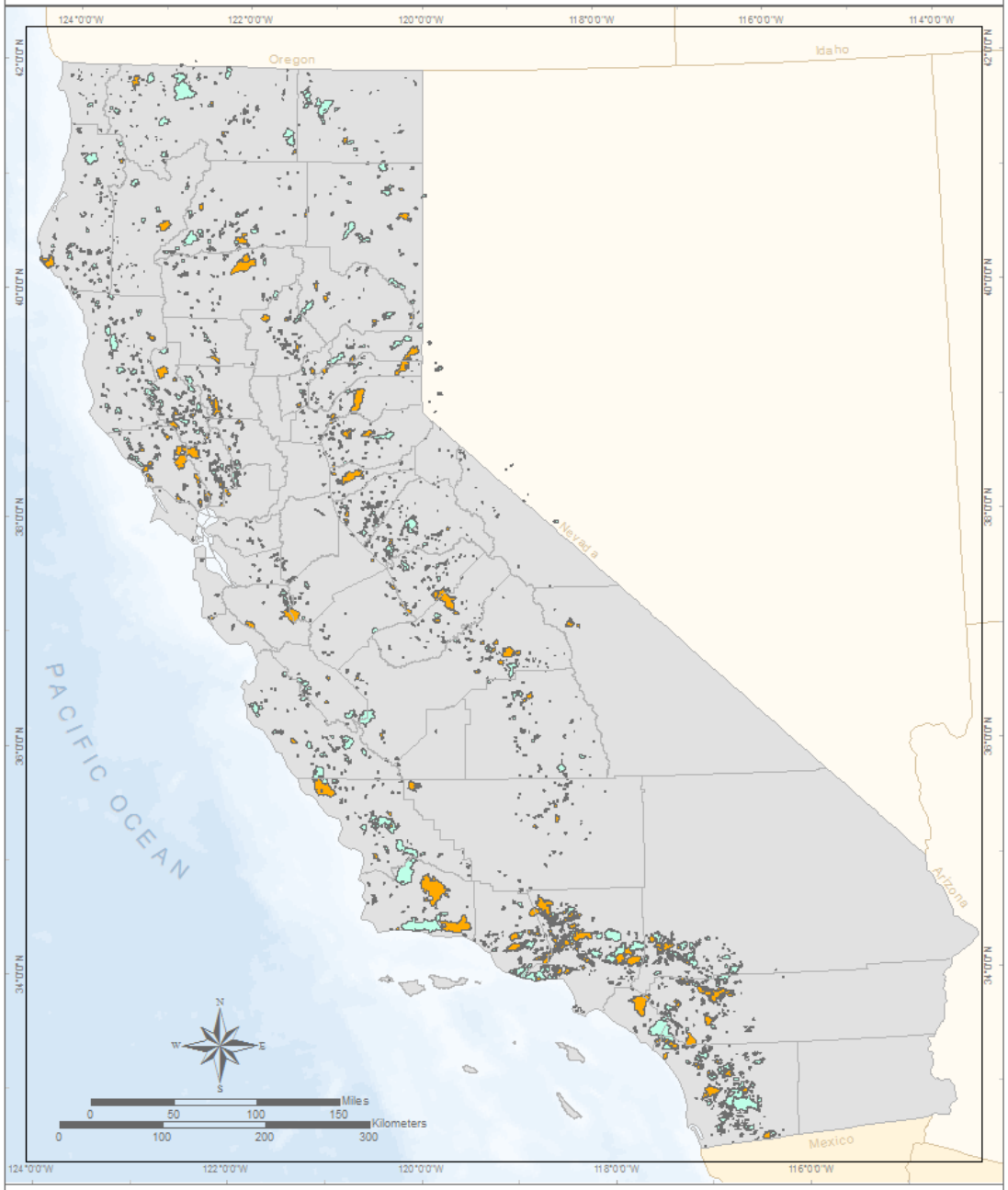
- California is “fire-prone”

Fire History 1950-59



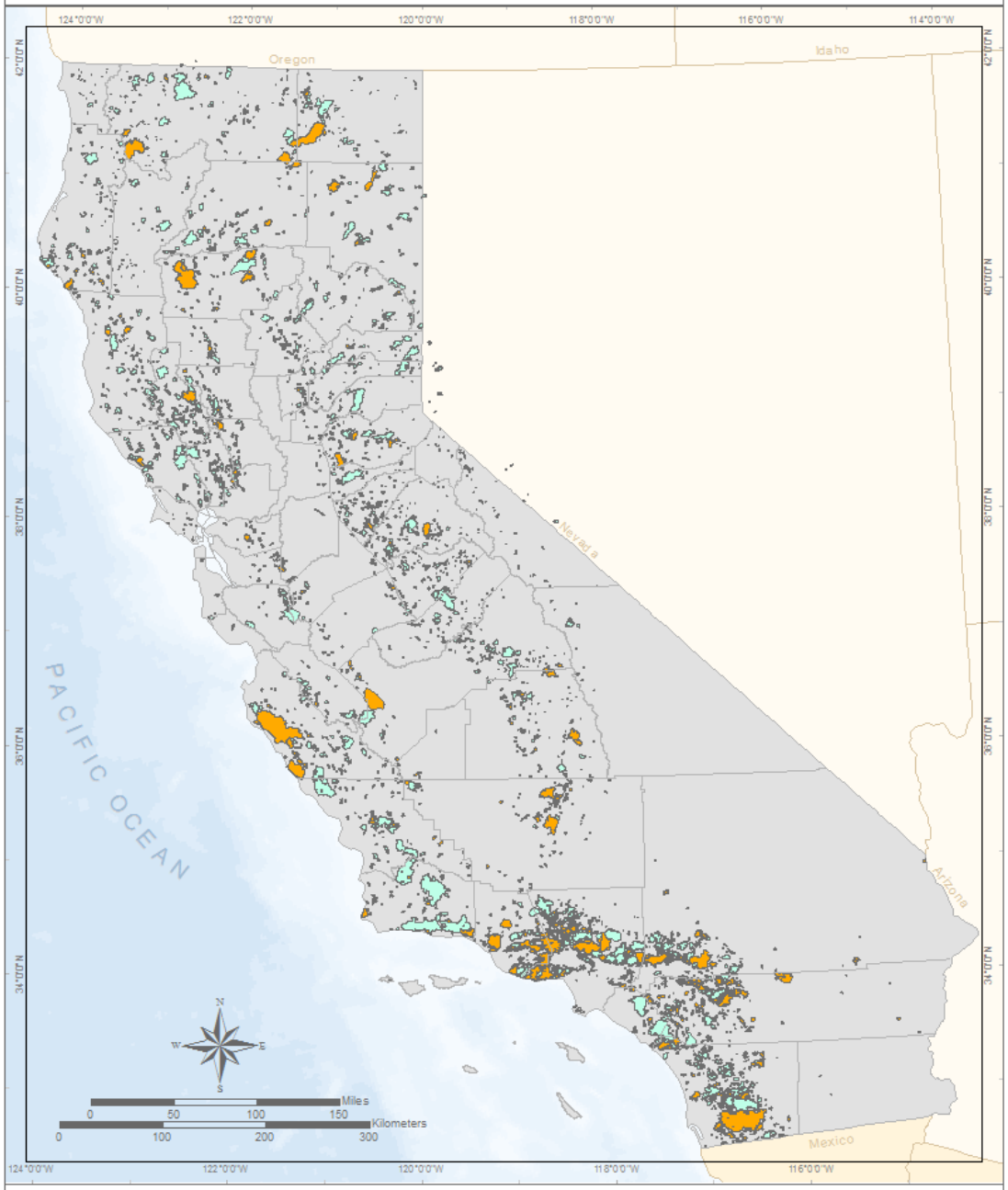
FRAP, 2013

Fire History 1960-69



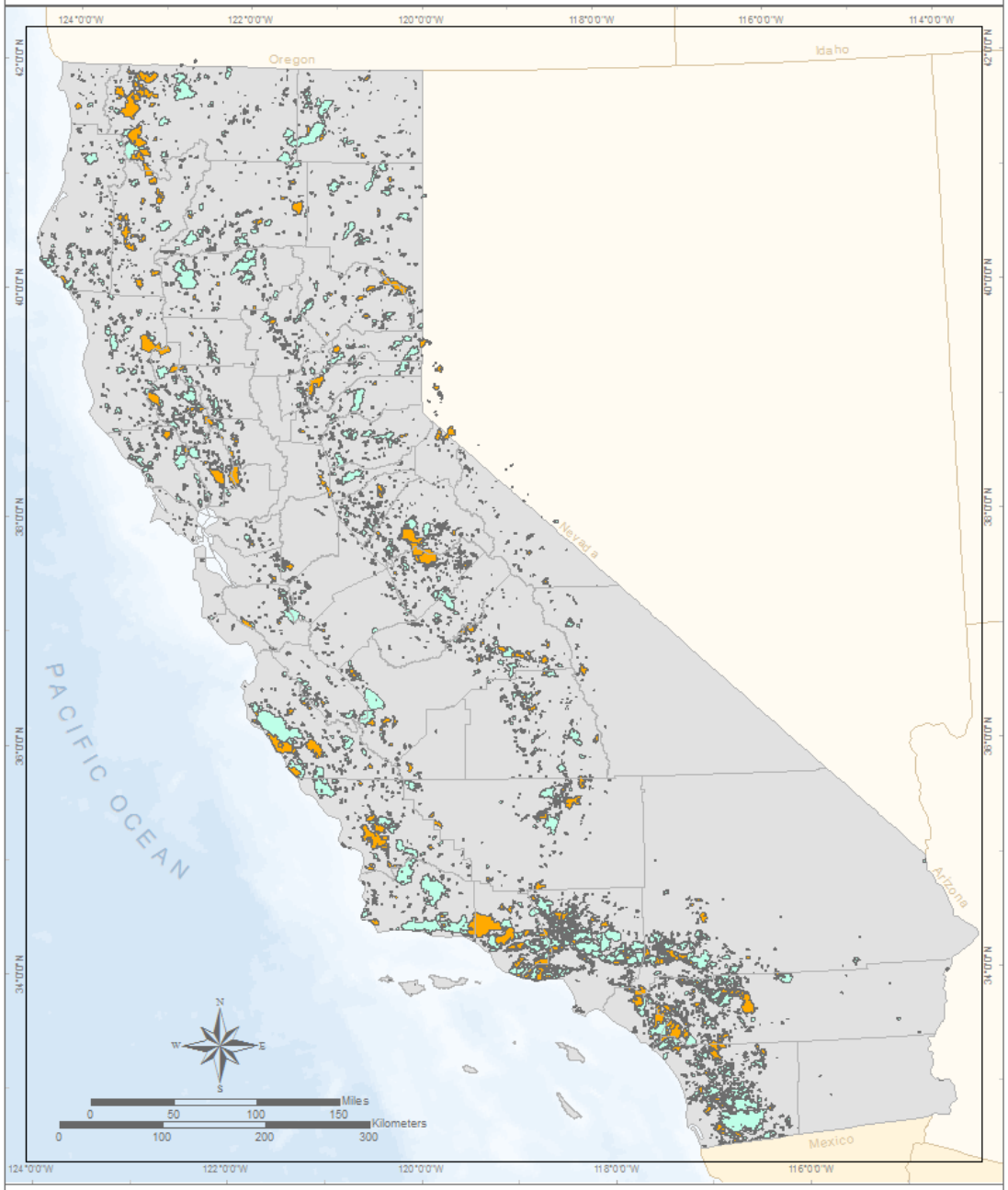
FRAP, 2013

Fire History 1970-79



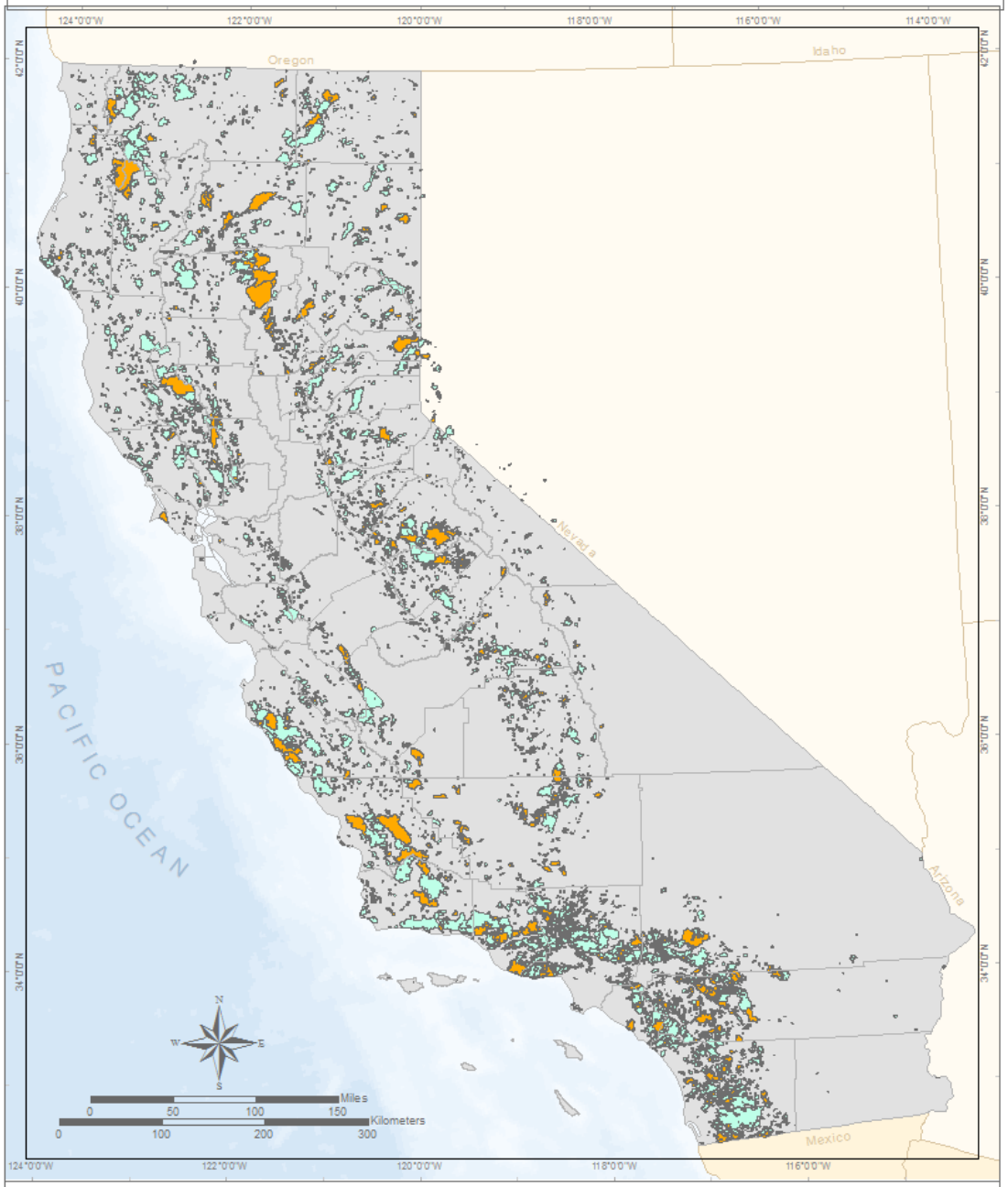
FRAP, 2013

Fire History 1980-89



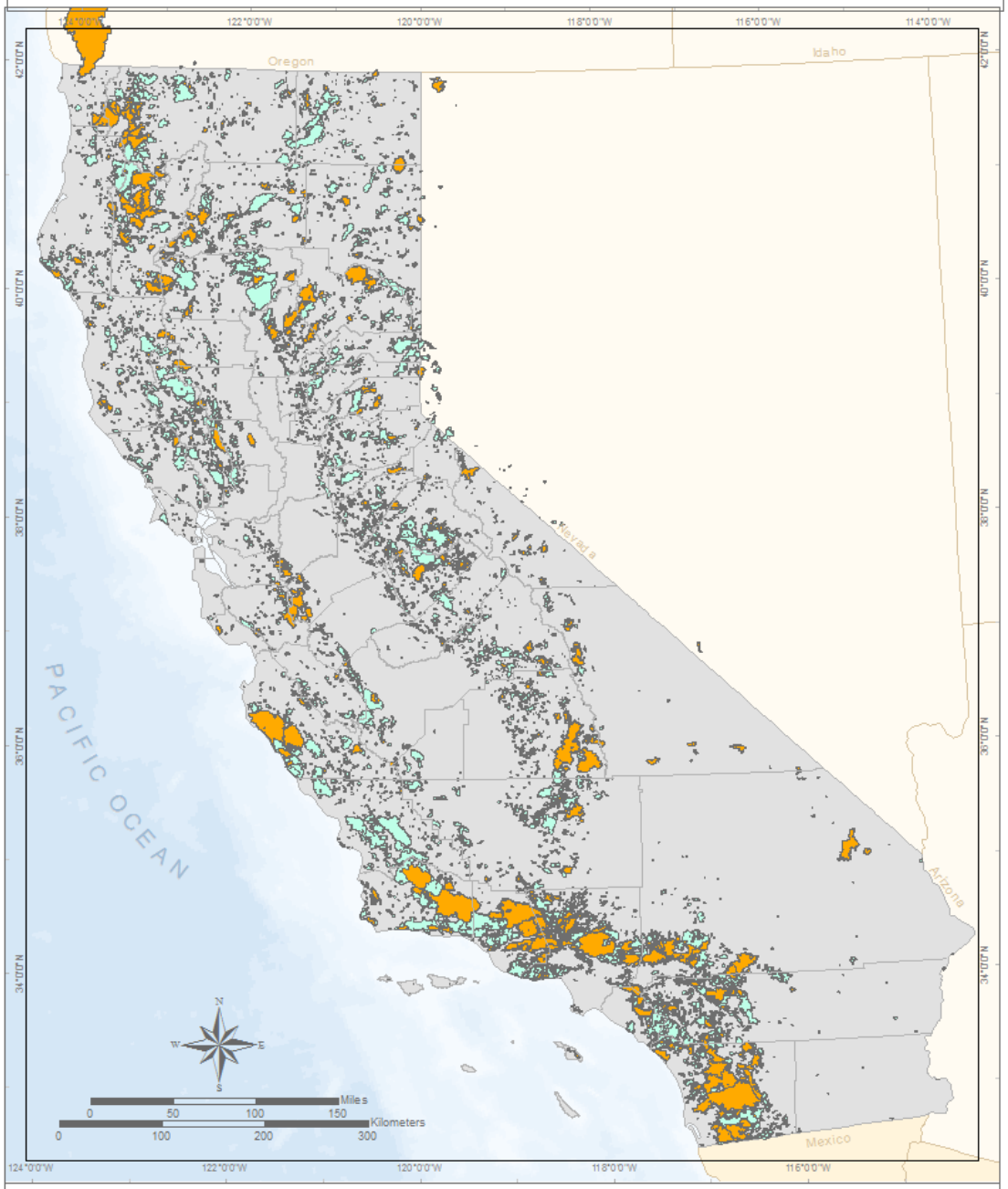
FRAP, 2013

Fire History 1990-99



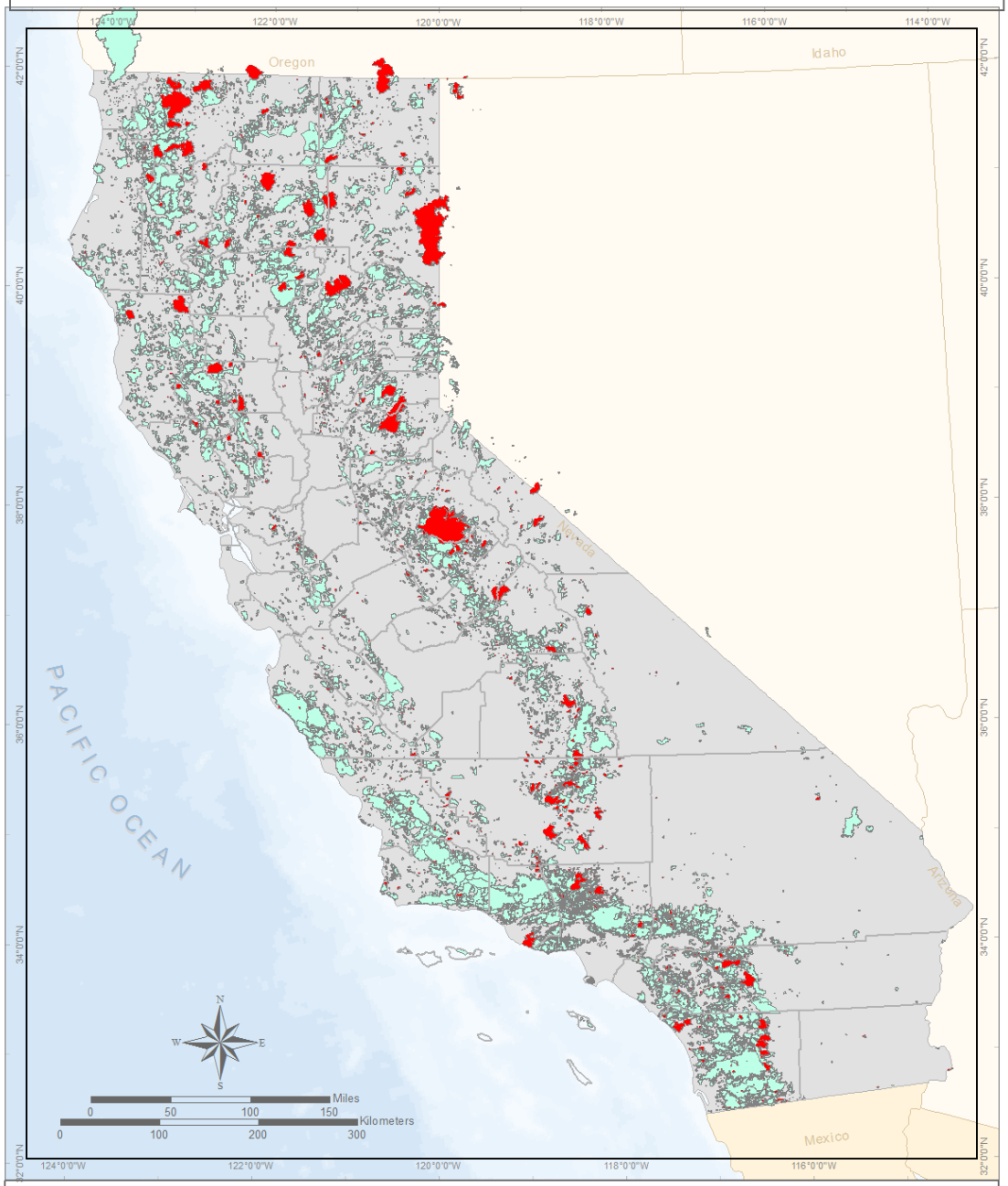
FRAP, 2013

Fire History 2000-2009



FRAP, 2013

Fire History 2010-2014

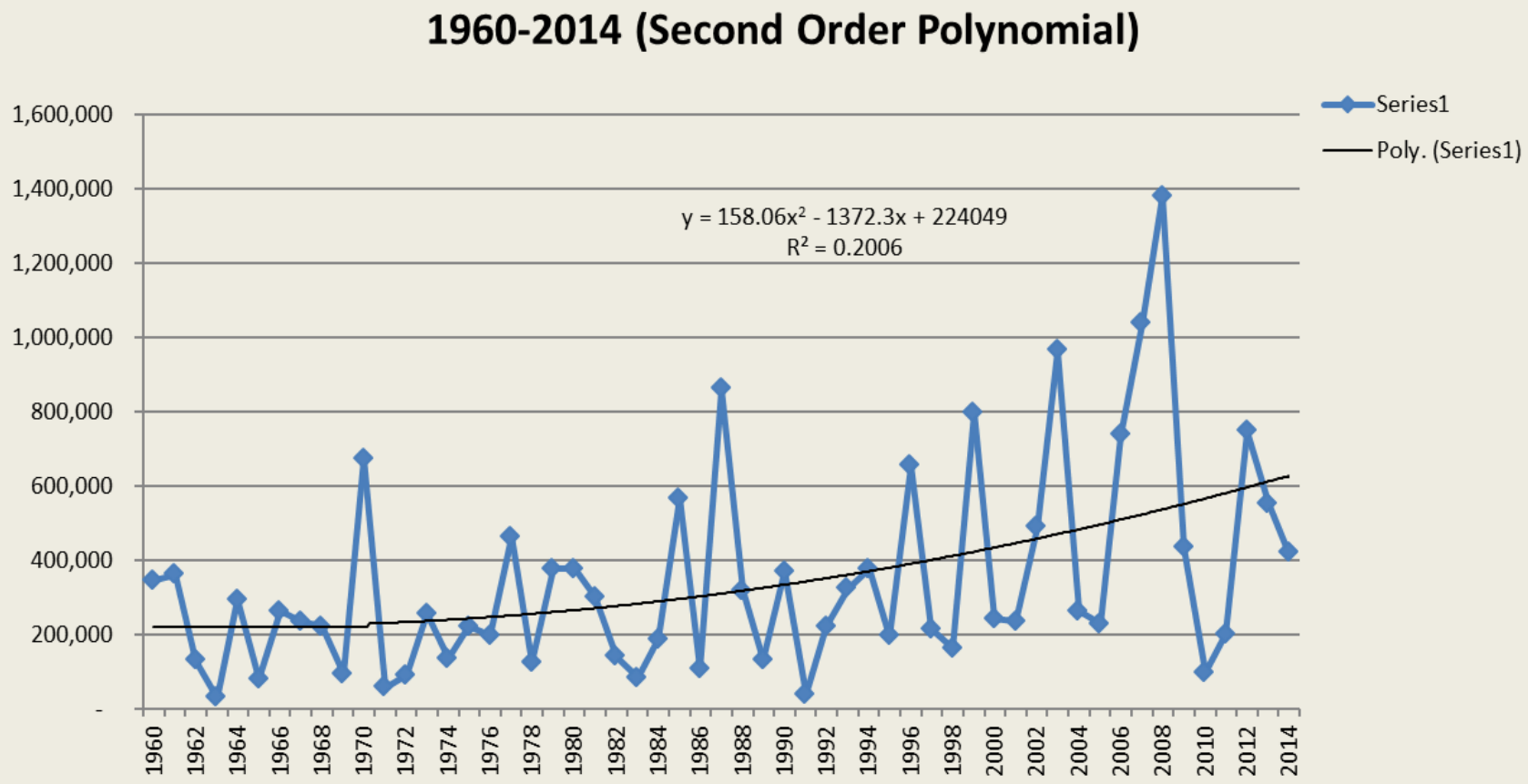


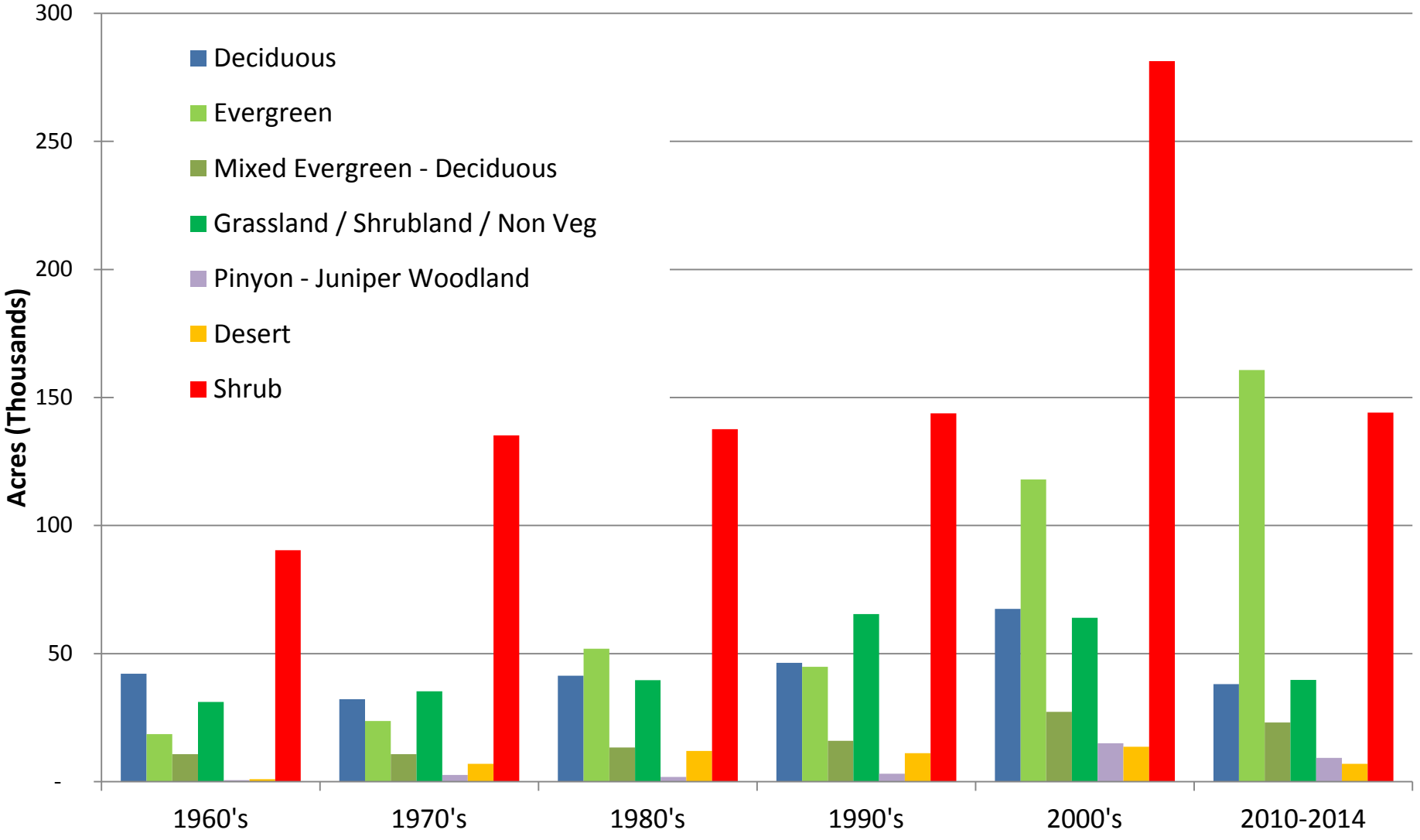
FRAP, 2015

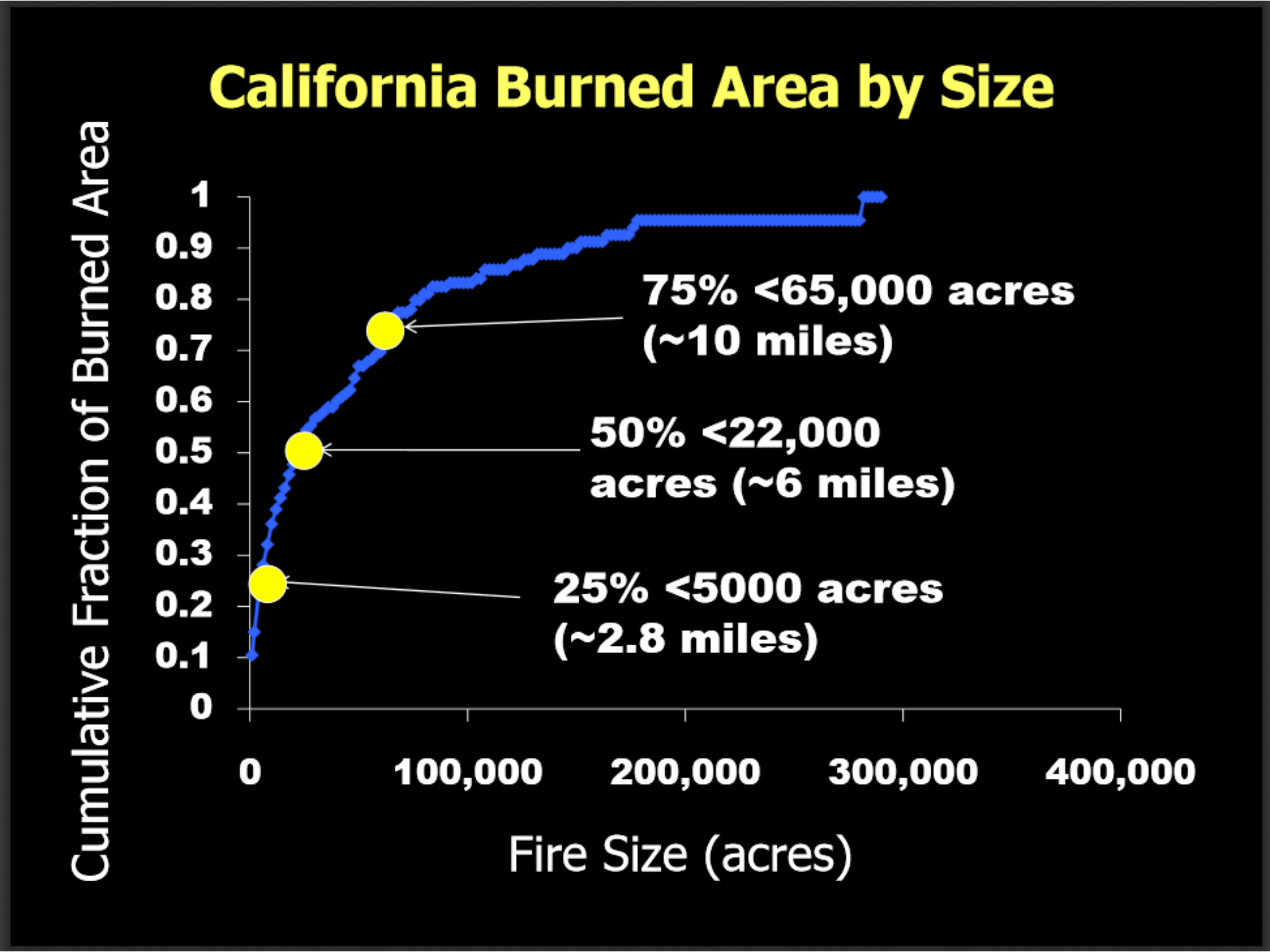
What Do we know?

- California is “fire-prone”
- Some patterns and trends are evident

Acres over Time




300
250
200
150
100
50
-
Acres (Thousands)
Deciduous
Evergreen
Mixed Evergreen - Deciduous
Grassland / Shrubland / Non Veg
Pinyon - Juniper Woodland
Desert
Shrub
1960's
1970's
1980's
1990's
2000's
2010-2014

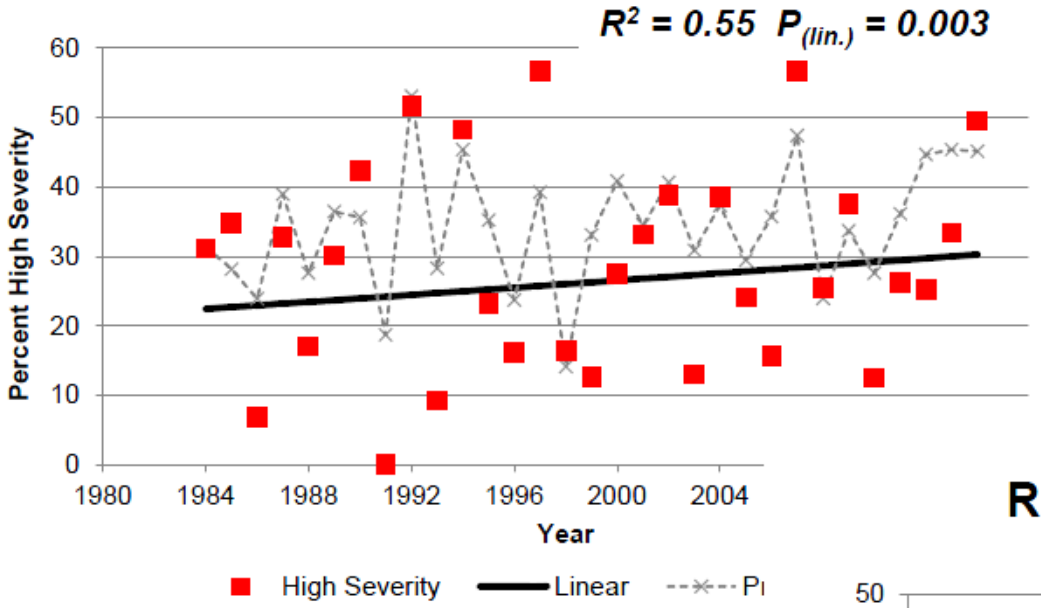

California Burned Area by Size
Cumulative Fraction of Burned Area
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
75% <65,000 acres
(~10 miles)
50% <22,000
acres (~6 miles)
25% <5000 acres
(~2.8 miles)
0
100,000
200,000
300,000
400,000
Fire Size (acres)

What Do we know?

- California is “fire-prone”
- Some patterns and trends are evident
- Amount of fire doesn’t say much about ecological impacts – so let’s talk severity

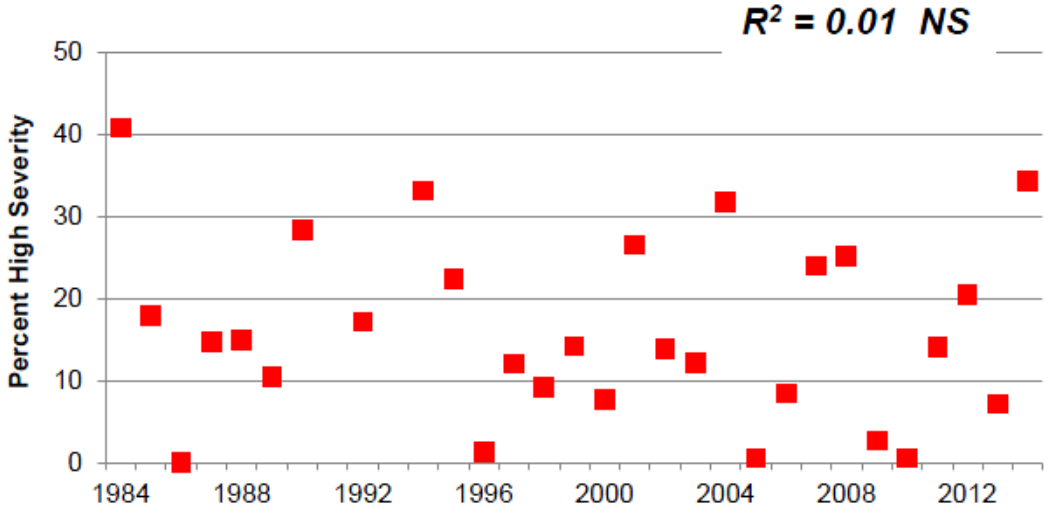
Fire severity: increasing in lower elevation forests, not in higher elevation forests

Yellow pine/mixed conifer



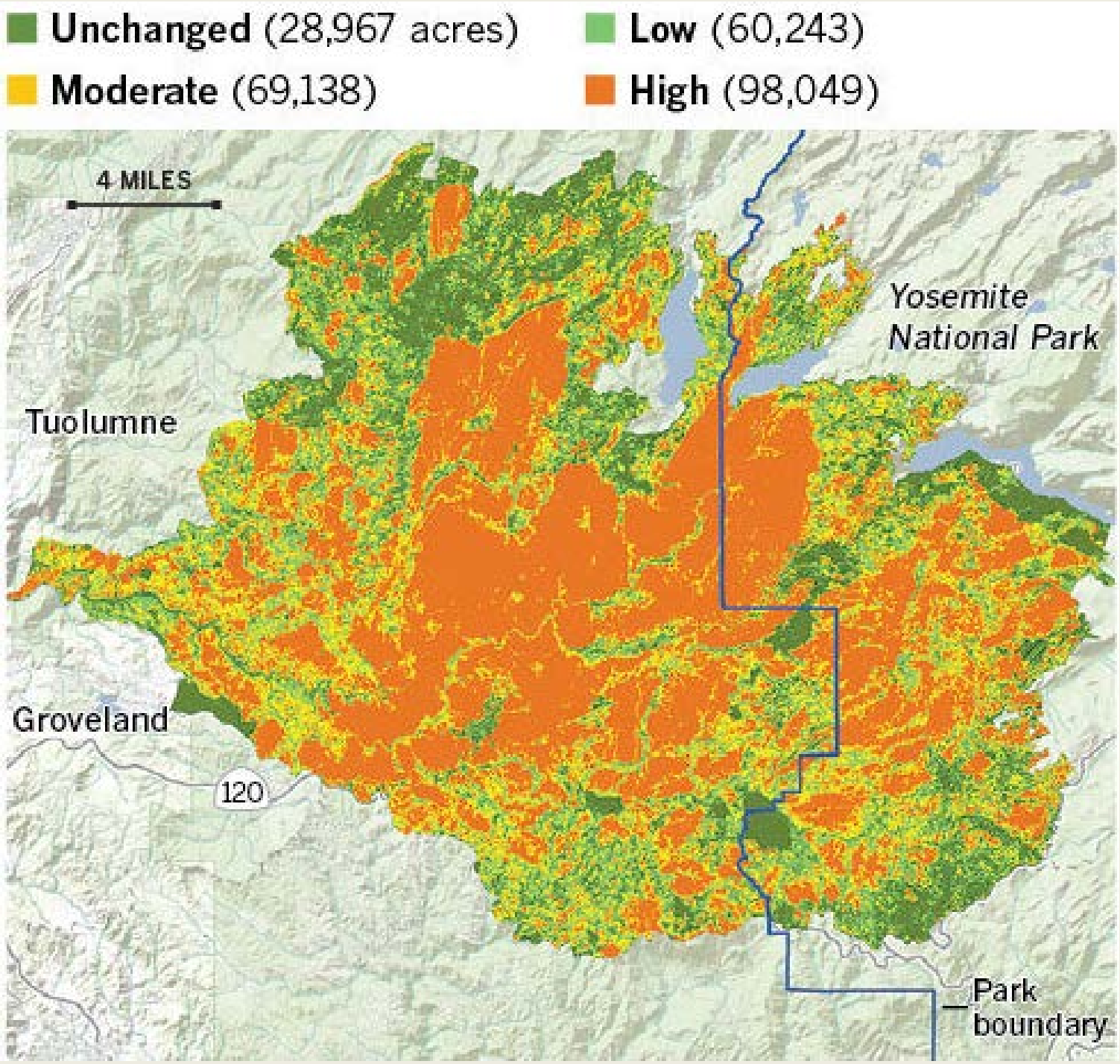
On Forest Service lands: Fire severity is increasing in low elevation forests (yellow pine, mixed conifer) but not in high elevation forests

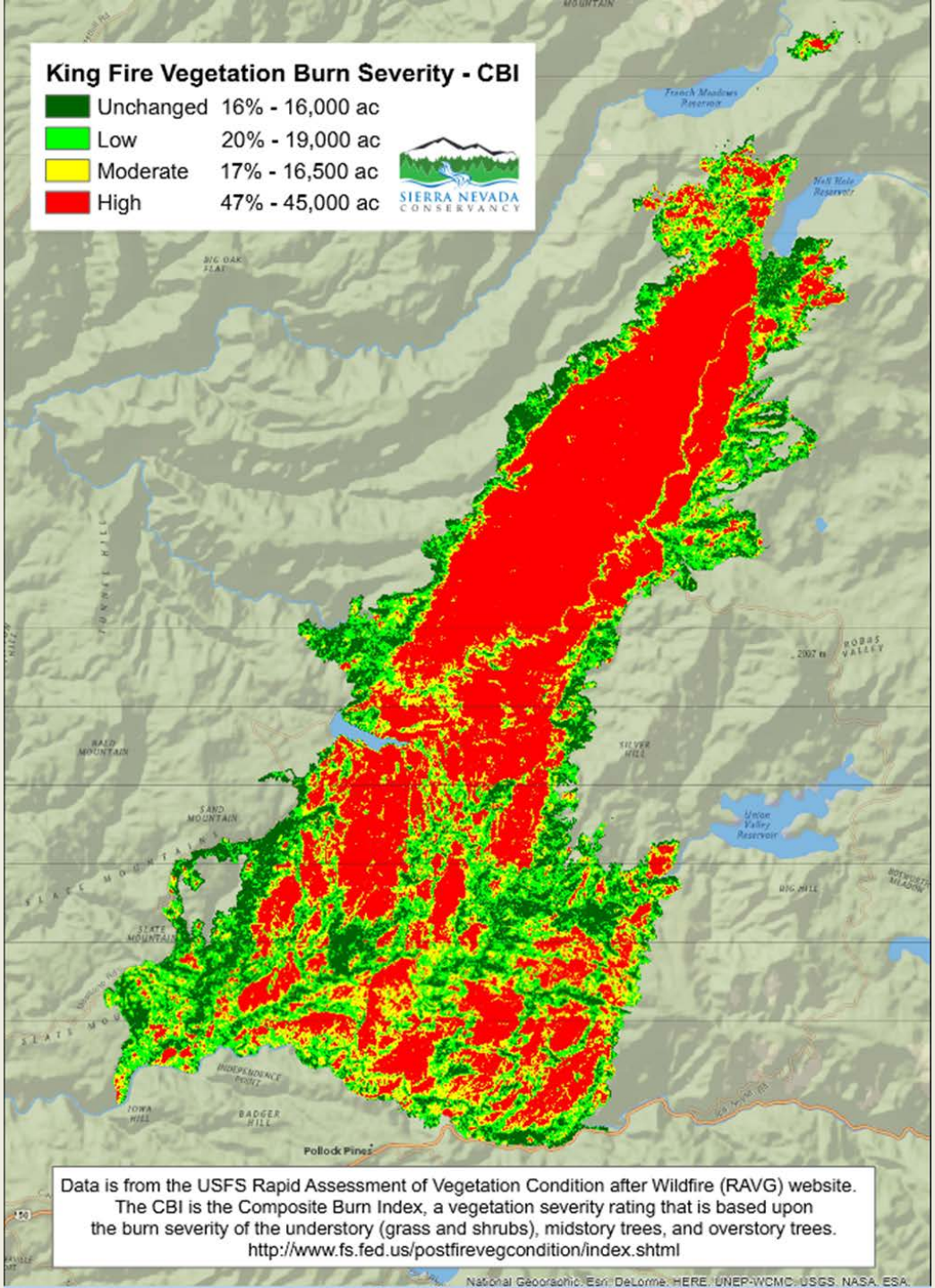
Red fir/lodgepole/subalpine



Percent of annual area burned where tree mortality is ≥95%

Miller et al. 2009, Miller & Safford 2012, Mallek et al. 2013


Unchanged (28,967 acres)
Low (60,243)
Moderate (69,138)
High (98,049)
4 MILES
Yosemite National Park
Tuolumne
Groveland
120
Park boundary


King Fire Vegetation Burn Severity - CBI
Unchanged 16% - 16,000 ac
Low 20% - 19,000 ac
Moderate 17% - 16,500 ac
High 47% - 45,000 ac
SIERRA NEVADA CONSERVANCY
Pollock Pines
Data is from the USFS Rapid Assessment of Vegetation Condition after Wildfire (RAVG) website.
The CBI is the Composite Burn Index, a vegetation severity rating that is based upon
the burn severity of the understory (grass and shrubs), midstory trees, and overstory trees.
http://www.fs.fed.us/postfirevegcondition/index.shtml
National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA

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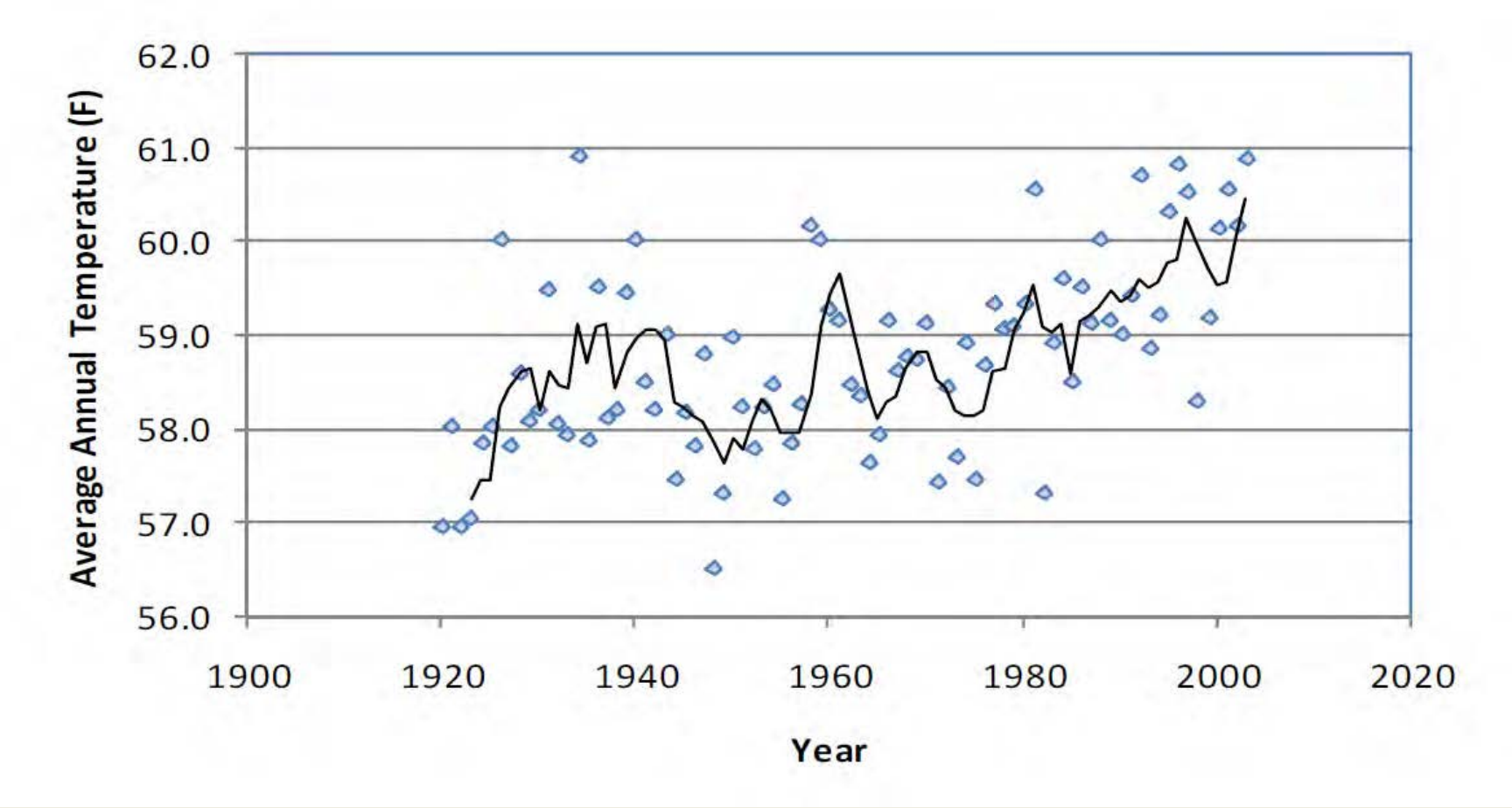
Climate change is driving a lot of fire trends

Wildfire and Climate

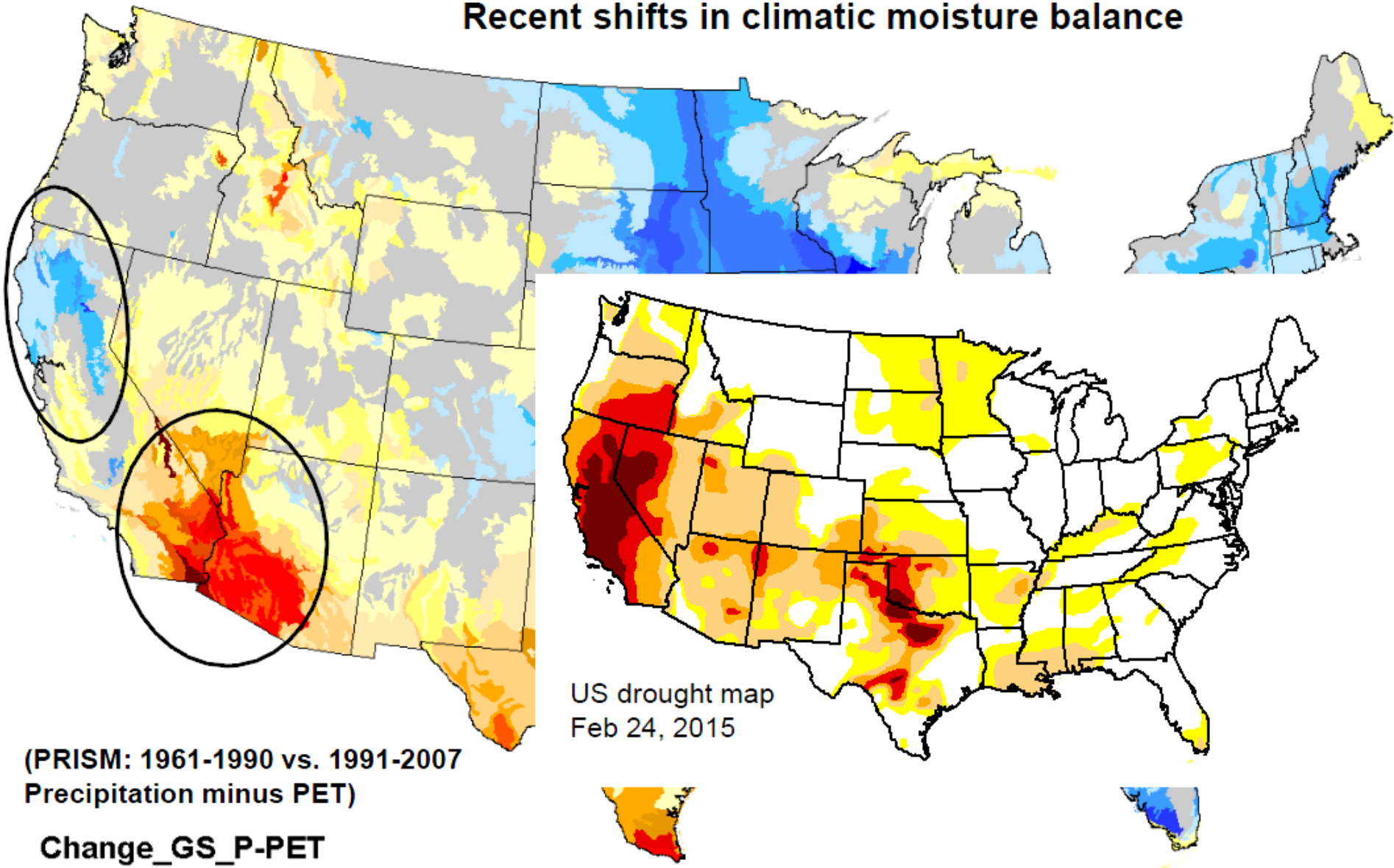
- Increased temperatures, potential for increased frequency of drought; leading to more frequent and more severe wildland fires; increased length of fire season
- Changes in snowpack
- Changes to fire return intervals – effects on severity
- Ultimately: Vegetation/Fuel changes in distribution (with interaction from fire)

Temperature Up



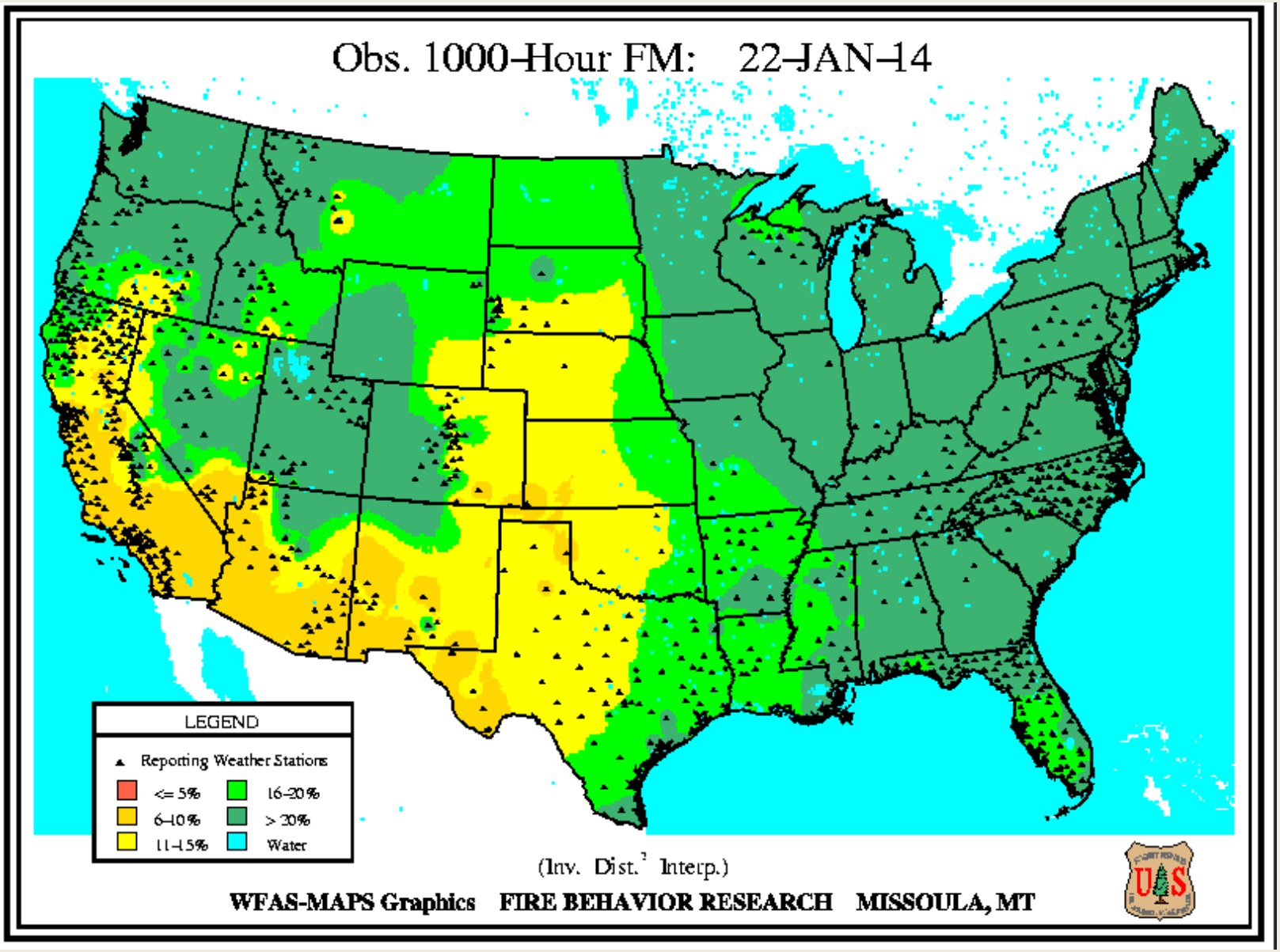
Moser et al. 2009

Recent shifts in climatic moisture balance



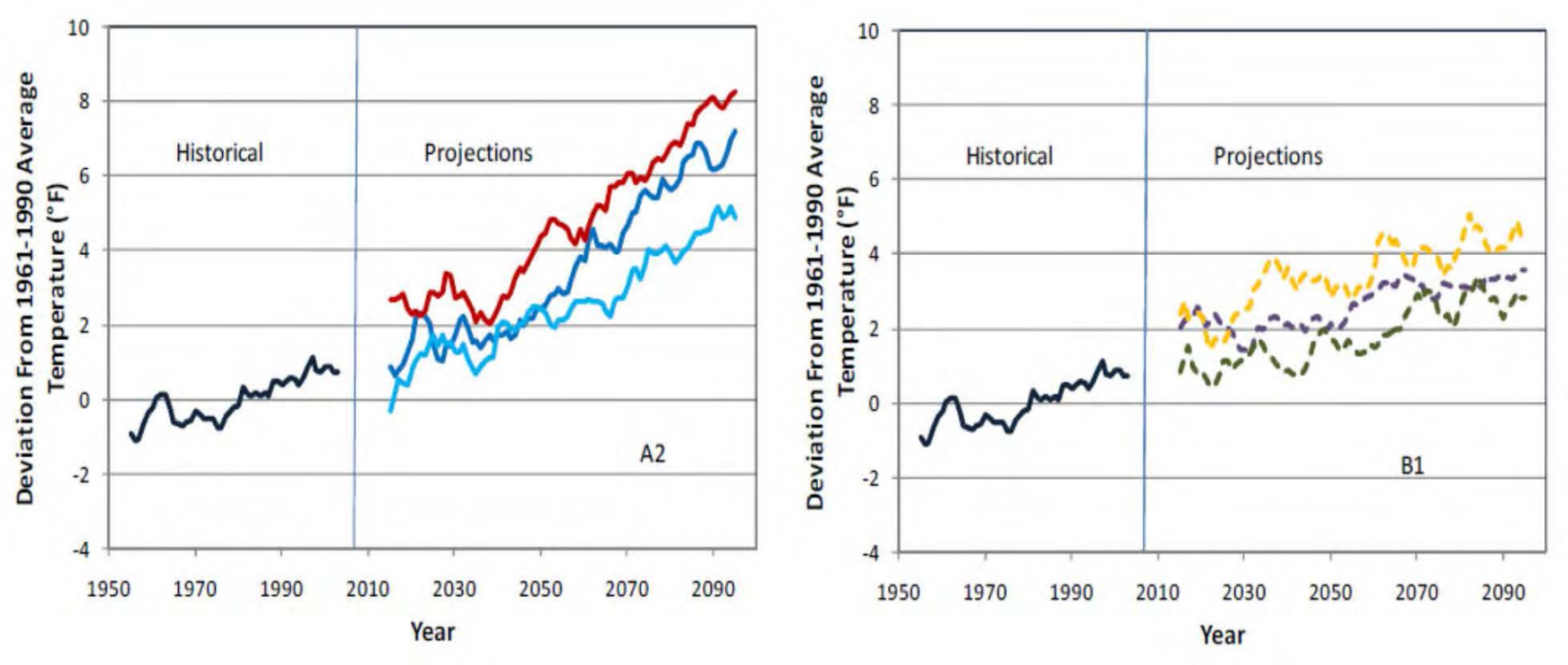
Graphic courtesy of D. Cleland, N. Research

Fuel Moistures



Future Climate: More of the same

Cal mean annual temperature



Moser et al. 2009

Summary

- Wildfires are becoming more frequent and larger
- Annual burned area is increasing across most vegetation types and areas (forest in Sierra Nevada show sharpest increase)
- Fire severity in semi-arid forestlands is increasing; signal not yet detected in wetter types and S. Cal chaparral
- Future projections are for more frequent, larger, and more intense wildfires

LAND USE

Managing Forests and Fire in Changing Climates

Policy focused on fire suppression only delays the inevitable.

S. L. Stephens,[1]* J. K. Agee,[2] P. Z. Fulé,[3] M. P. North,[4] W. H. Romme,[5] T. W. Swetnam,[6] M. G. Turner[7]

With projected climate change, we expect to face much more forest fire in the coming decades. Policymakers are challenged not to categorize all fires as destructive to ecosystems simply because they have long flame lengths and kill most of the tree
logical context
high-severity r
mate change r
and ecosysten
impacts may b
global strategi
based on a forest's historical fire regime.

"Fire policy that focuses on suppression only delays the inevitable, promising more dangerous and destructive future forest fires"

[1]University of California, Berkeley, CA 94720, USA. [2]University of Washington, Seattle, WA 98195, USA. [3]Northern Arizona University, Flagstaff, AZ 86011, USA. [4]U.S. Department of Agriculture Forest Service, Pacific Southwest Research Station, Davis, CA 95618, USA. [5]Colorado State University, Fort Collins, CO 80523, USA. [6]University of Arizona, Tucson, AZ 85721, USA. [7]University of Wisconsin, Madison, WI 53706, USA.

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Fire regimes are commonly characterized by burn frequency and severity within a given area. Severity is often estimated as the proportion of overstory trees killed by fire. In general, as frequency increases, fuels have less time to accumulate, reducing intensity

Globally, fire frequency and severity vary among forest types. Essentially all fires have high-severity effects, where most of the trees are killed, at some spatial scale and patch size. The critical issue is whether tree mortality patch sizes (and their temporal and spatial frequency) allow recovery of the same or similar vegetation types. If high-severity patch sizes are too large, microclimates and regeneration mechanisms (e.g., seed abundance and dispersal) can limit tree reestablishment (see the figure). Large high-severity patches may produce vegetation type changes, especially in forests adapted to frequent, low- to moderate-severity fire regimes or in forests that lack in situ propagule

derosa) and semiarid mixed-conifer forests. A central concern is whether high-severity patches in wildfires are too large, which results in undesirable ecosystem changes (see the figure). Rising temperatures, related drought stresses, and increased fuel loads are driving high-severity patches to extraordinary sizes in some areas (*3*).

In contrast, forests adapted to low-frequency, high-severity regimes such as Rocky

High-frequency, low-severity fire

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