Fuels and Fire Regimes of the Great Basin and Mojave Desert

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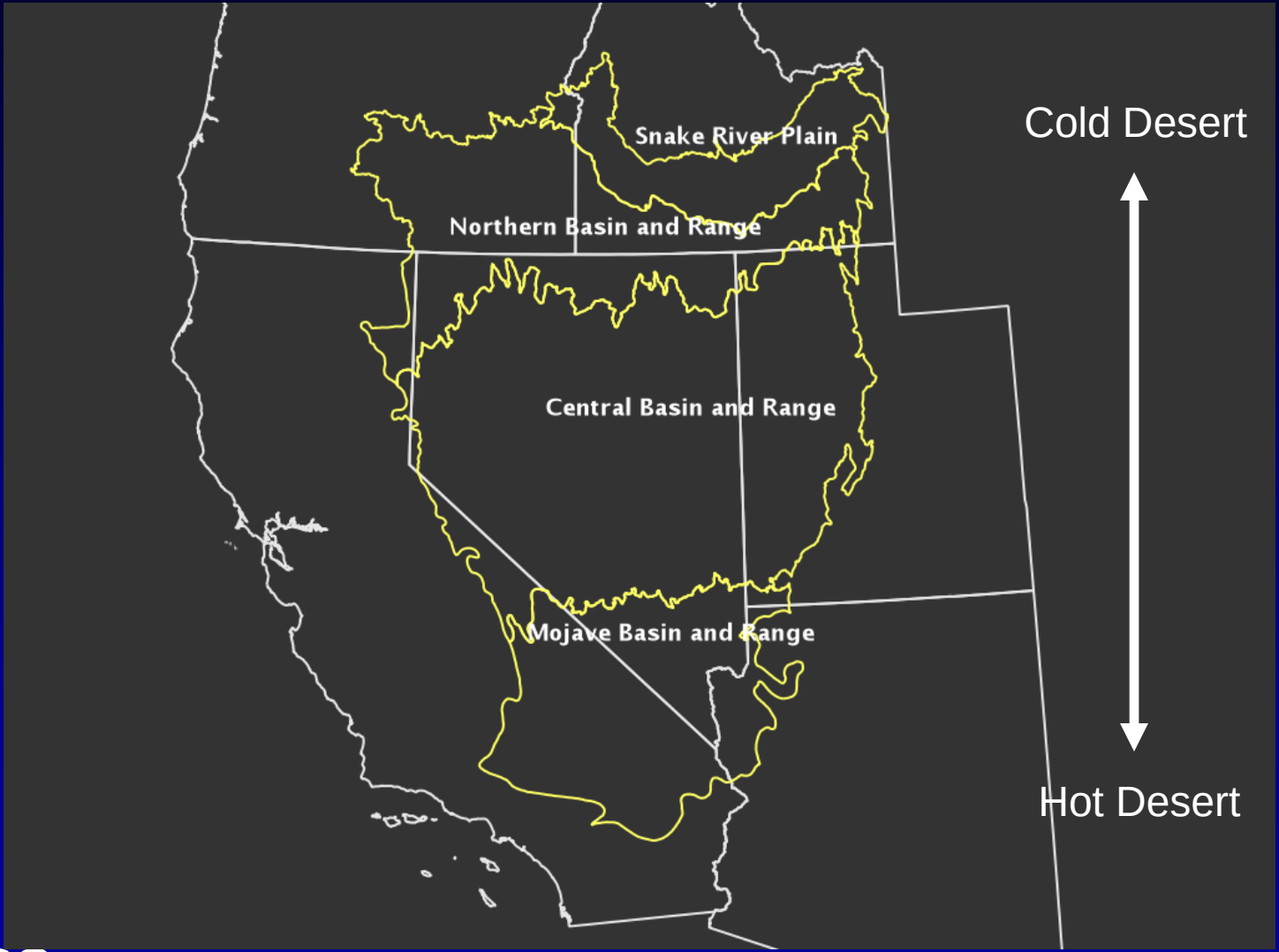
science for a changing world

Bioregional Scope



Outline

- Describe predominant fuels and fire regimes
- Report recent trends in wildfires
- Hypothesize how climate change might affect fire regimes

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Fuels and Fire Regimes

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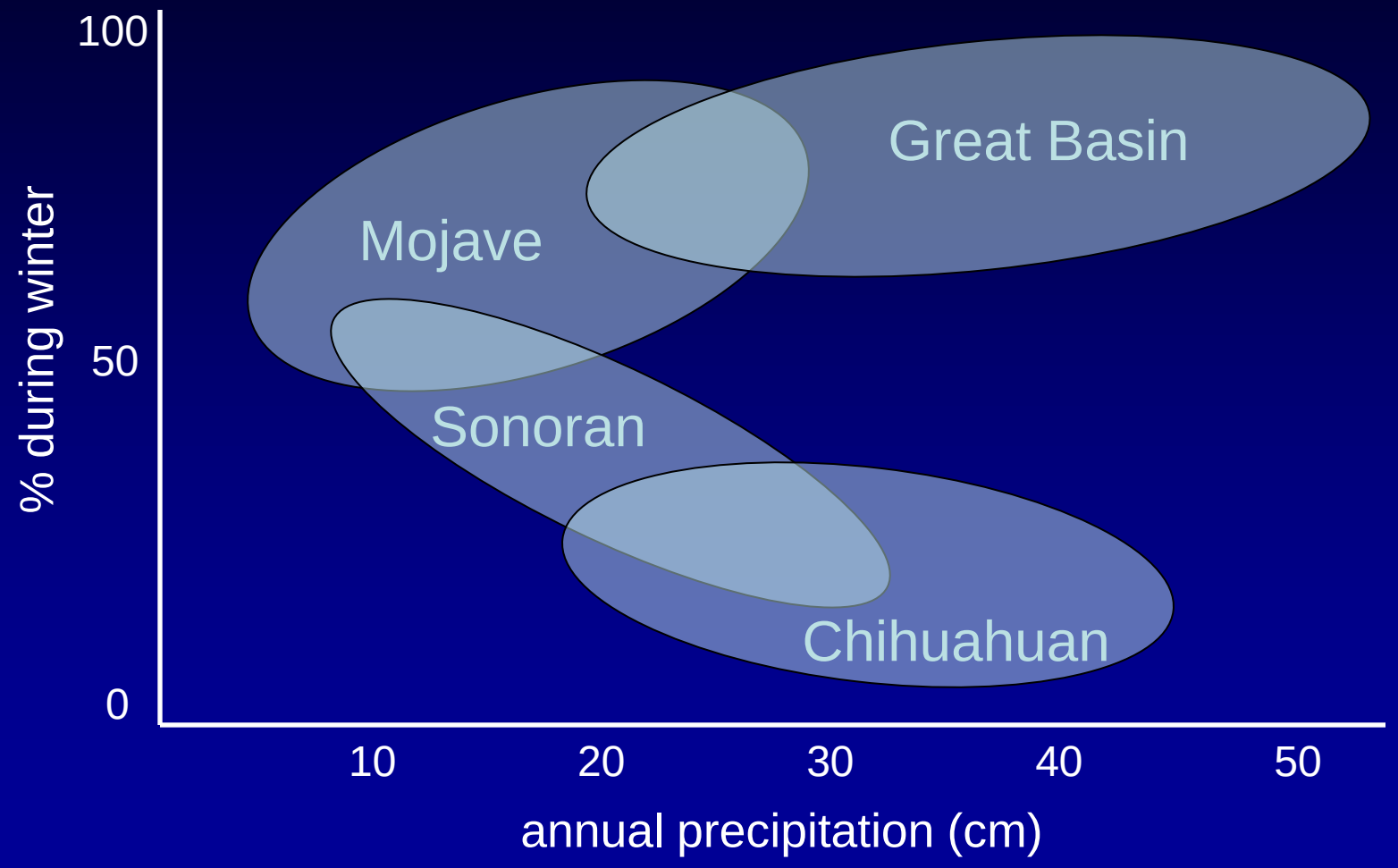
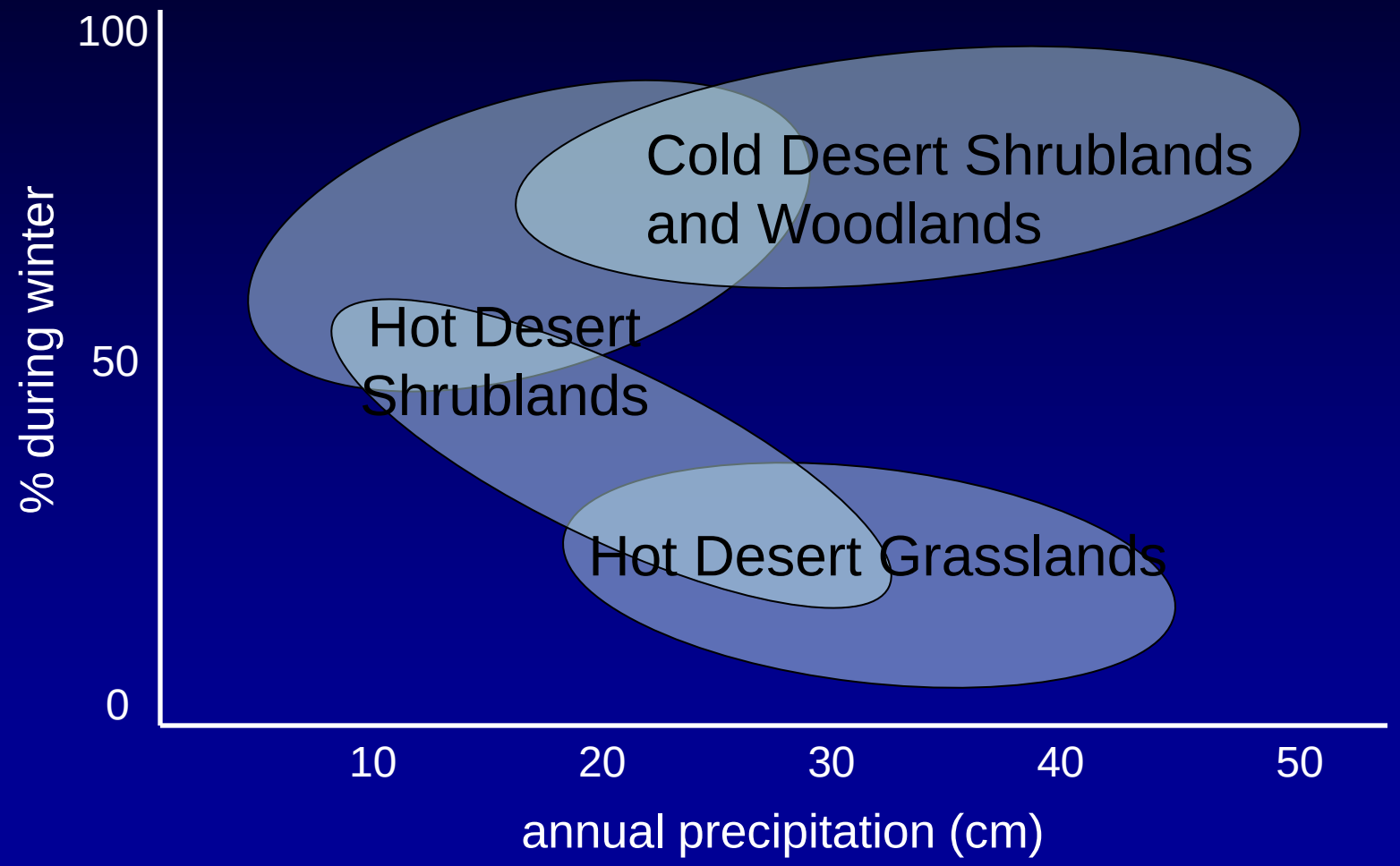
Deserts of North America



Brooks and Chambers in review

Deserts of North America

Native vegetation insufficient to fuel historical fires ⟷ Native vegetation sufficient to fuel historical fires



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Brooks and Chambers in review

Hot Desert Shrublands (Mojave Desert)

Low elevation shrubland

Middle elevation shrubland

High elevation shrubland/woodland

USGS

Brooks and Minnich 2006

High elevation

Middle elevation

Low elevation

Perennial fuel driven

Annual fuel driven

USGS

Brooks and Chambers in review

High elevation

Middle elevation

Low elevation

More resilient to fire

Less resilient to fire

USGS

Brooks and Chambers in review

Current Hot Desert Shrubland Fire Regimes

<u>Non-native Annual</u> Fuel Regime

- Low and middle elevations where native woody fuels are typically too sparse to carry fire
- Fires were historically rare to non-existent and native vegetation has low resiliency to fire
- Driven by single- or consecutive-year rainfall patterns causing episodic fine fuel buildup (e.g. due to ENSO)
- Significant fire management intervention may be warranted to break the invasive plant / fire regime cycle
- >95% of the Mojave Desert

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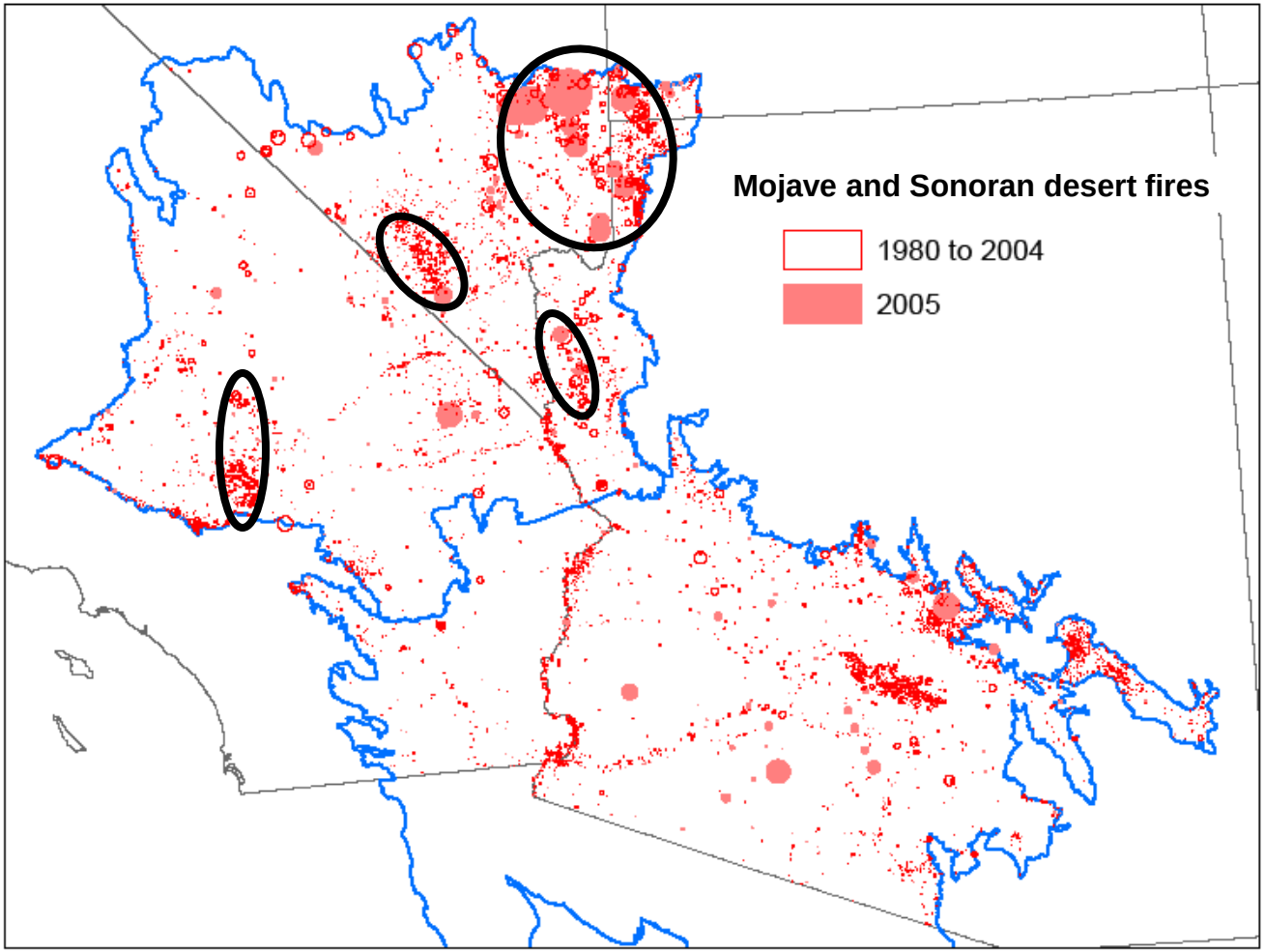
Brooks in prep

A non-native annual fuel regime is only manifesting itself in a few regions of the Mojave Desert



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Brooks *in prep*

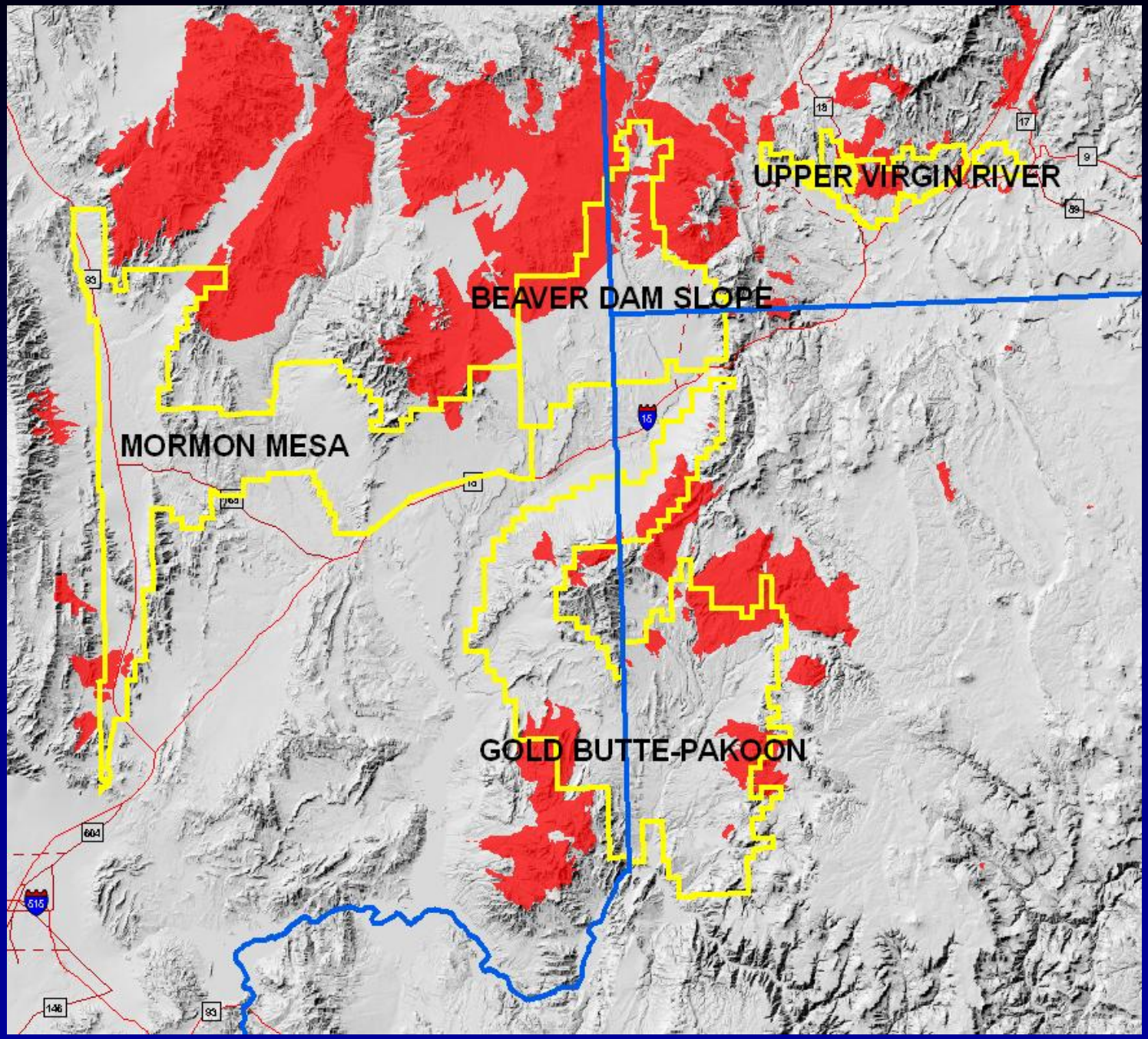
Desert tortoise Critical Habitat Units burned in 2005

24% of BDS

19% of UVR

14% of GBP

4% of MM



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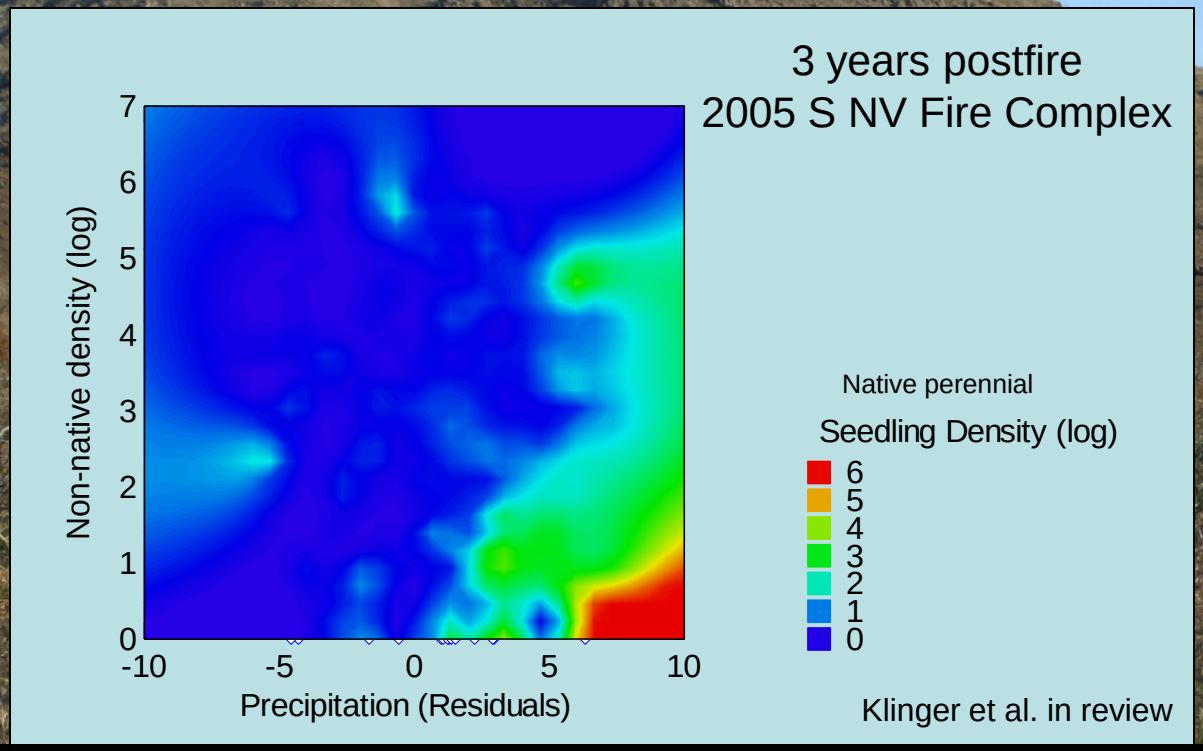
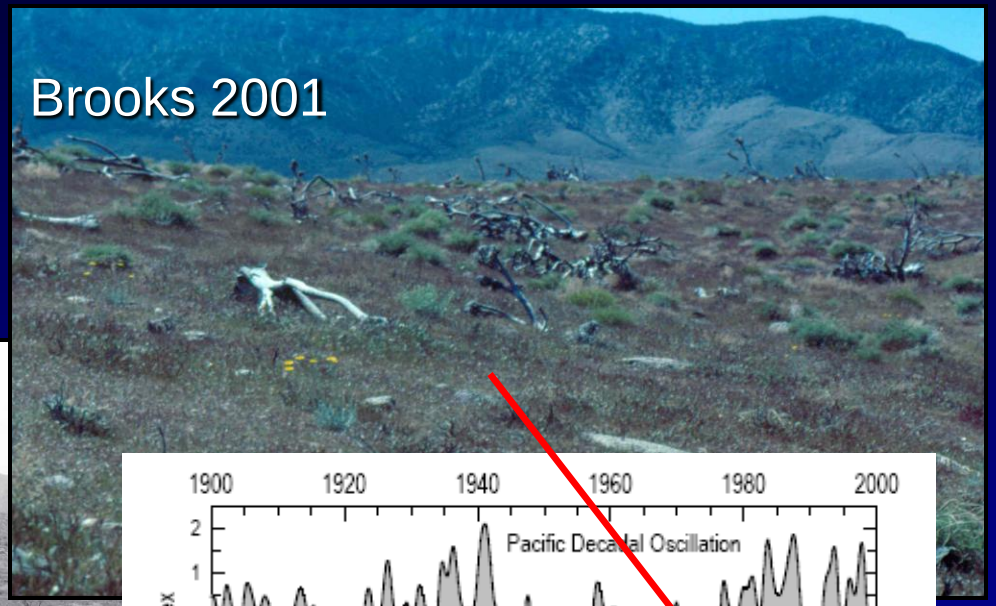
Native desert vegetation in the low and middle elevation shrubland zones is not resilient to the non-native annual fuel regime.

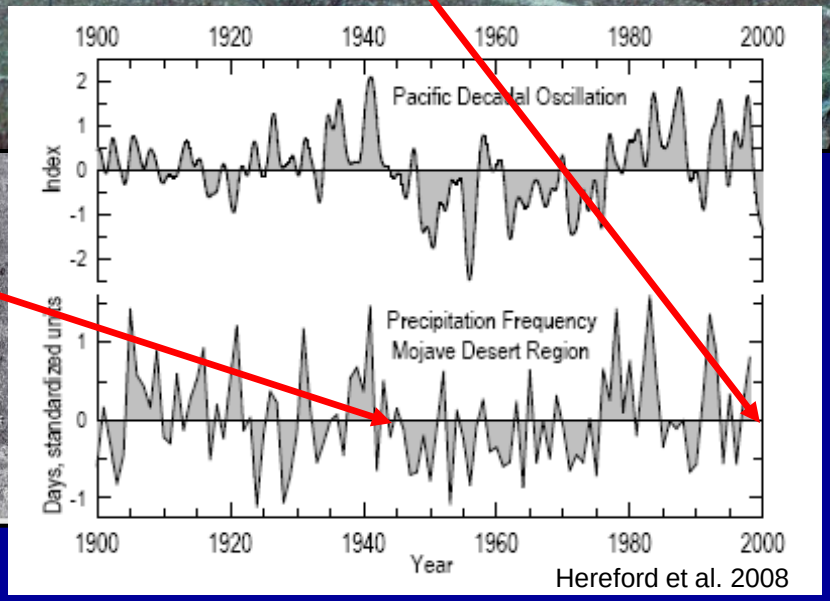


- These data span low, med, and high elevation zones
- Most of the highest seedling density is confined to high elevations

Postfire dominance of red brome is not new in the Mojave Desert

Beaver Dam Slope
NE Mojave Desert
(7 years postfire)





Hereford et al. 2008

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Current Hot Desert Shrubland Fire Regimes

<u>Native Perennial</u> Fuel Regime

- High elevations where native woody fuels carry fire
- Fires occurred historically and native vegetation has some resiliency to fire
- Driven by decade and century scales of rainfall patterns causing gradual woody fuel buildup (e.g. due to PDO)
- Fire suppression may be warranted at the WUI, but on a landscape scale periodic fire on 75-100+ years intervals may be desirable
- <5% of the Mojave Desert

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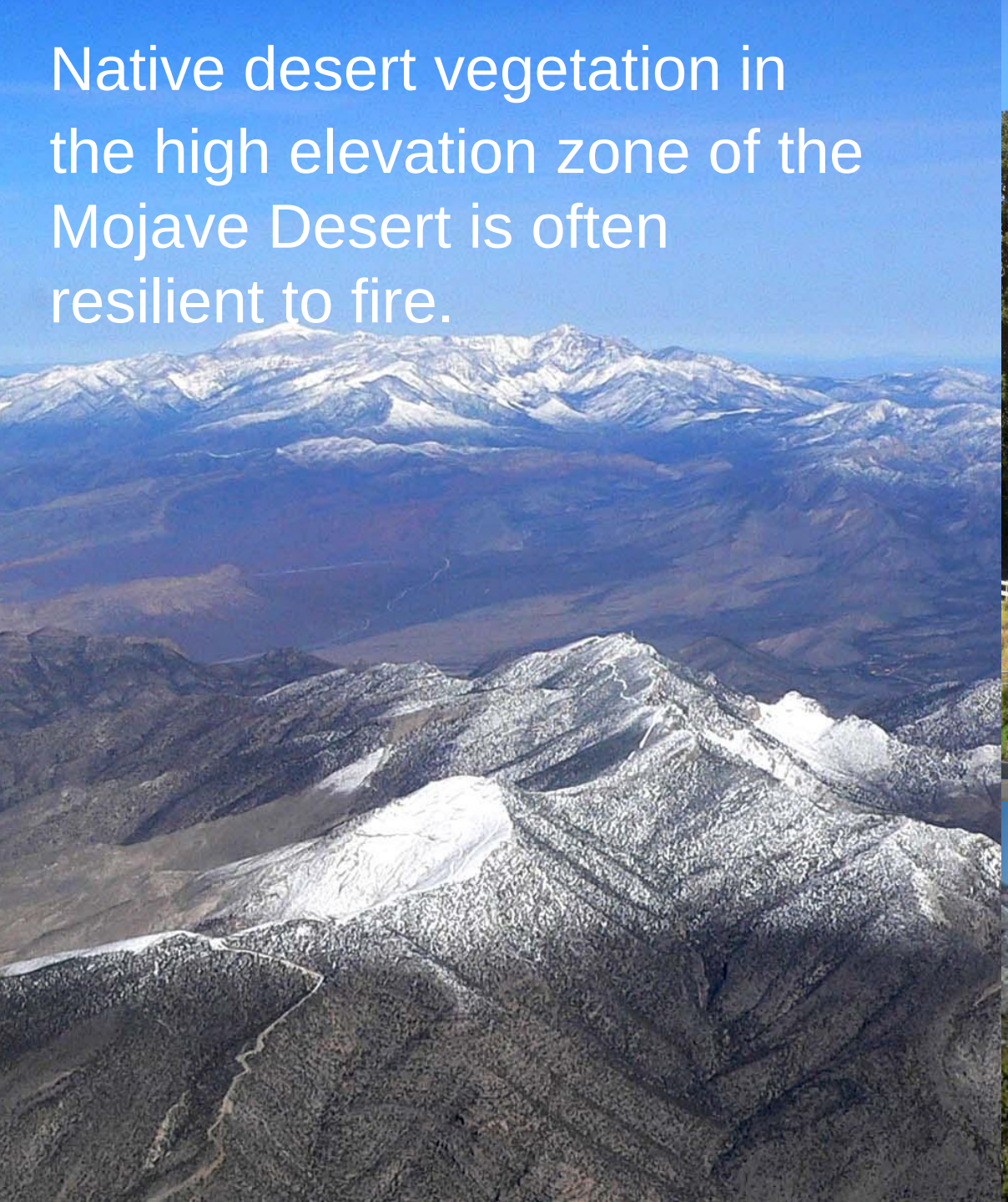
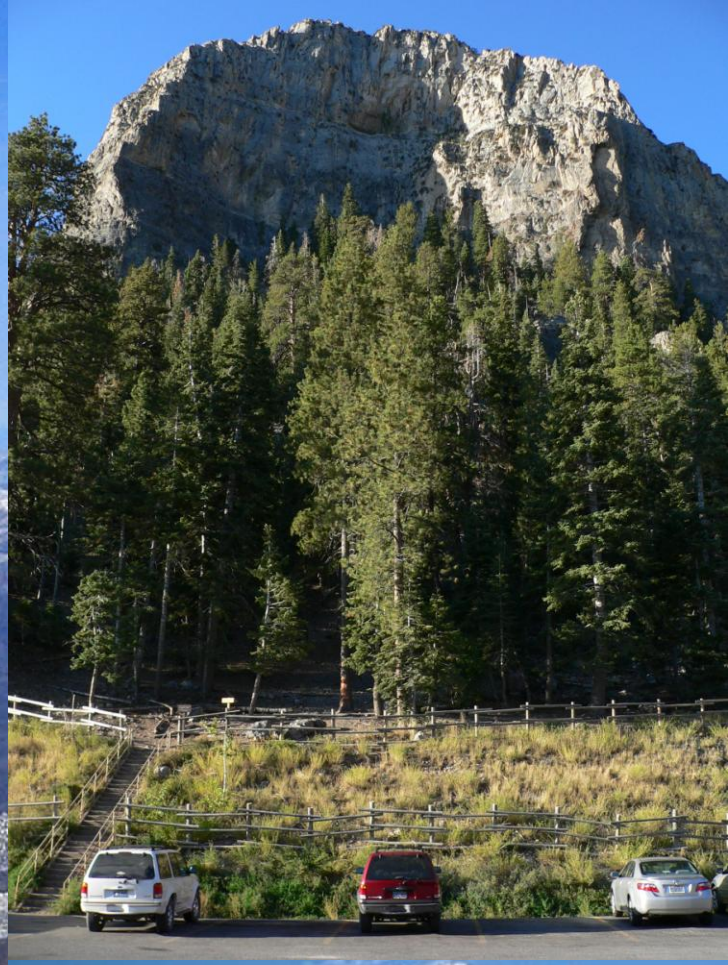
Brooks in prep

Native desert vegetation in the high elevation zone of the Mojave Desert is often resilient to fire.



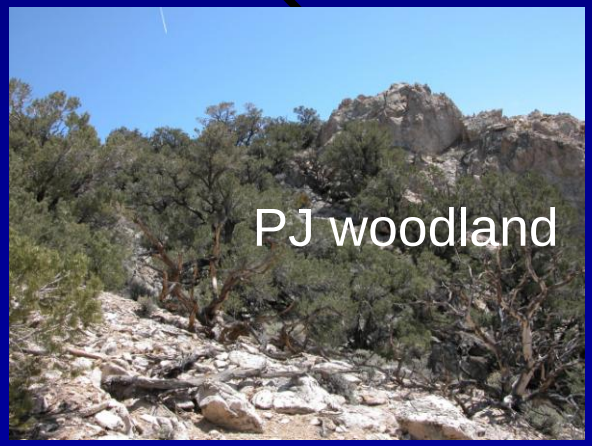


Cold Desert Shrublands and Woodlands

- Historically, salt desert shrublands (mostly chenopods) rarely if ever burned.

- In sagebrush types (*Artemisia* species), fire return intervals were moderate to long (~50 to 200++ yrs) depending on precipitation/ productivity. Fire size and patchiness were variable.

- Pinyon and juniper woodlands were largely restricted to “fire safe” sites on ridge tops and steep slopes.



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Pinyon-Juniper

Sagebrush

Salt Desert

Perennial fuel driven

Annual fuel driven

Brooks and Chambers in review

Pinyon-Juniper

Sagebrush

Salt Desert

More resilient to fire

Less resilient to fire

USGS

Brooks and Chambers in review

Altered Fire Regimes and Invasive Species

Low to Mid Elevations

- Invasive annual grasses (cheatgrass, red brome, medusa head) were introduced in late 1800s and rapidly spread. Increase in flammable fine fuels with high rate of spread.
- ➢ *Initiation of annual grass fire cycle - shorter FRIs, larger, more contiguous fires*
- ➢ *Other Factors - longer and more severe fire seasons, more human fire starts*

High Elevations

- Overgrazing by livestock beginning in mid-late 1800s decreased native perennial grasses and forbs (fine fuels).
- Decreased competition from herbs, favorable establishment conditions and fire reduction led to increases in shrubs and pinyon and juniper (woody fuels).
- ➢ *Less frequent fires until last decades – increased fire size and severity since then*

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Recent Trends in Wildfires

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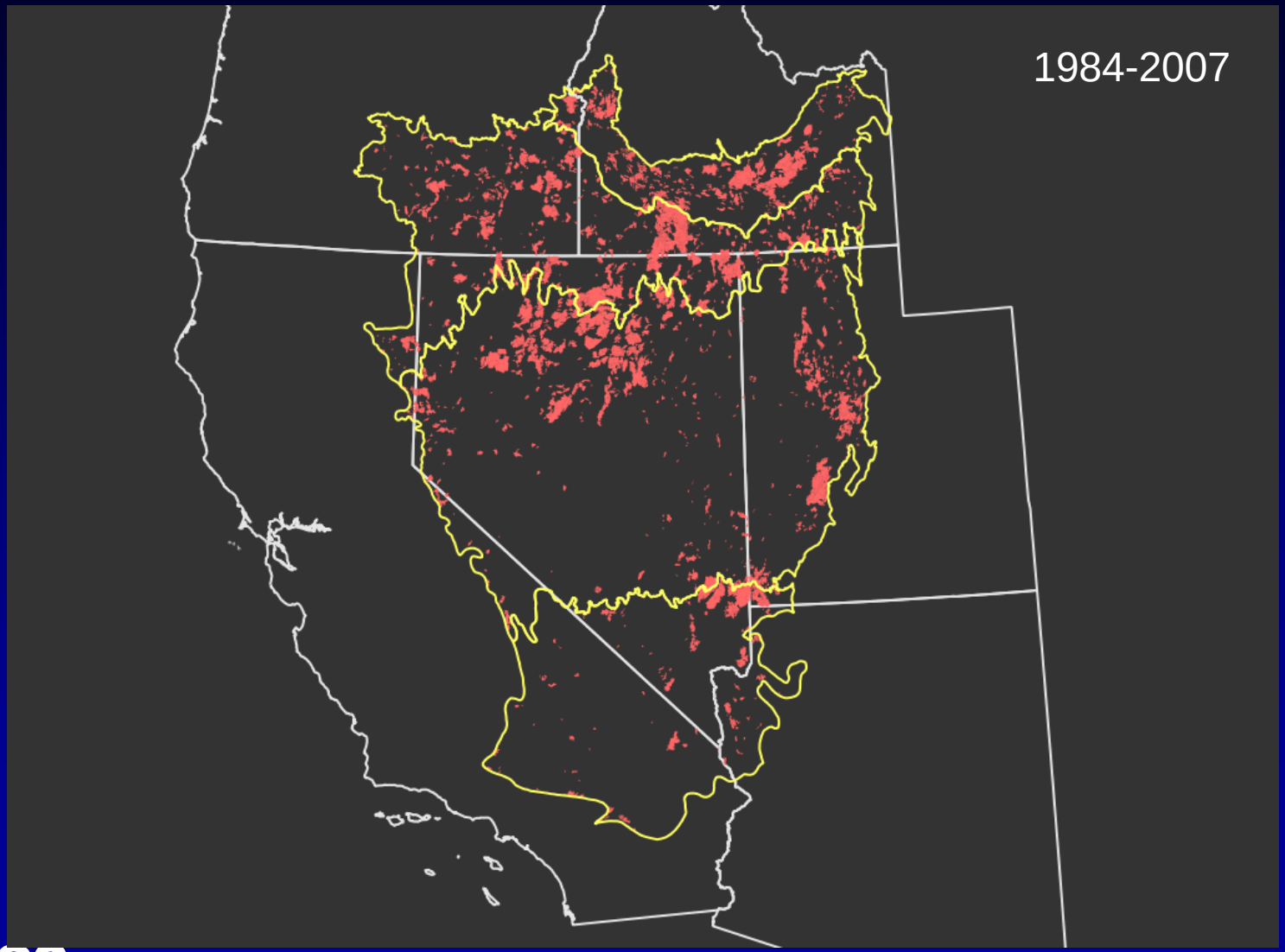
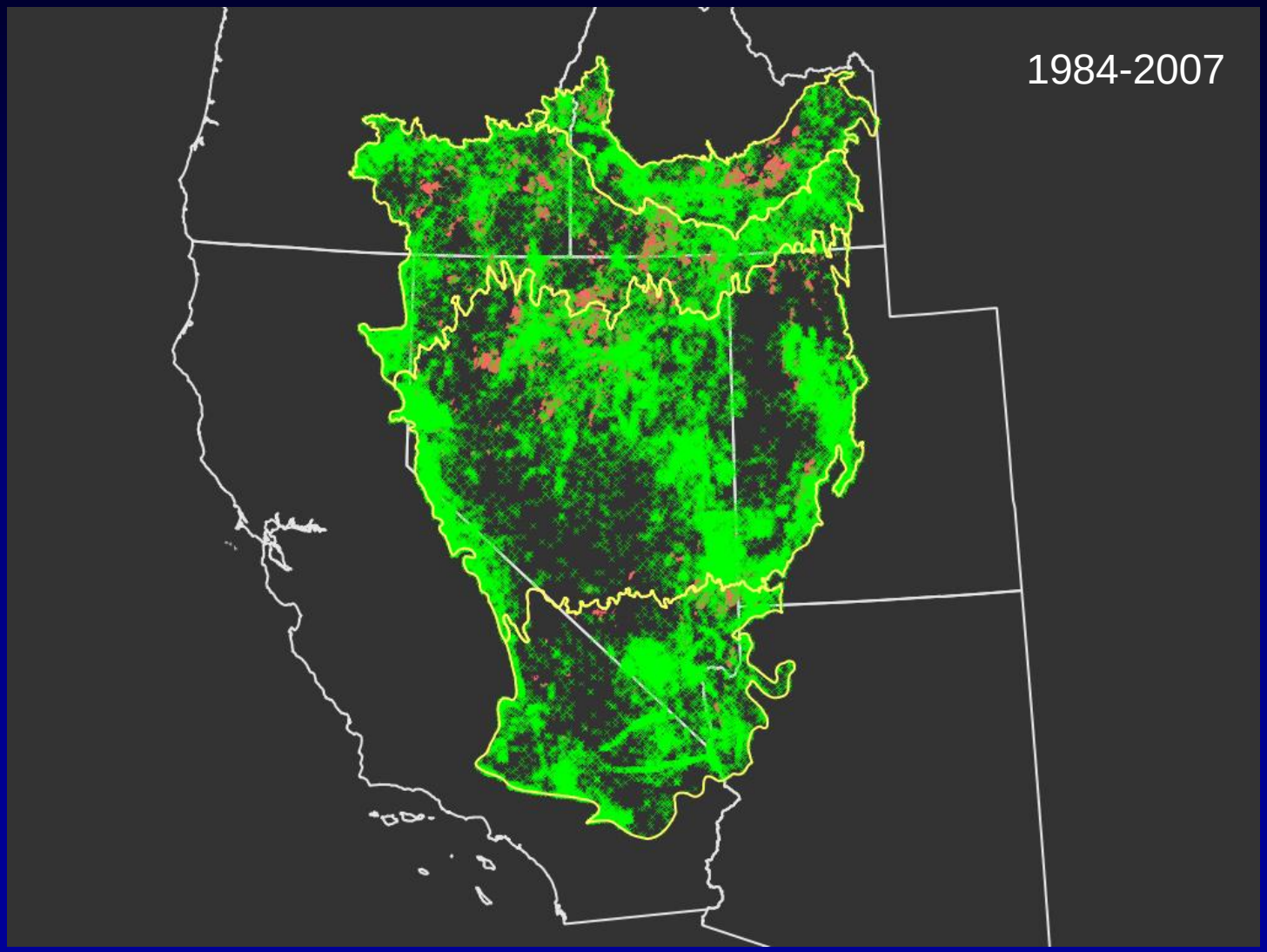
Large Fire Perimeters (>1,000 acres)

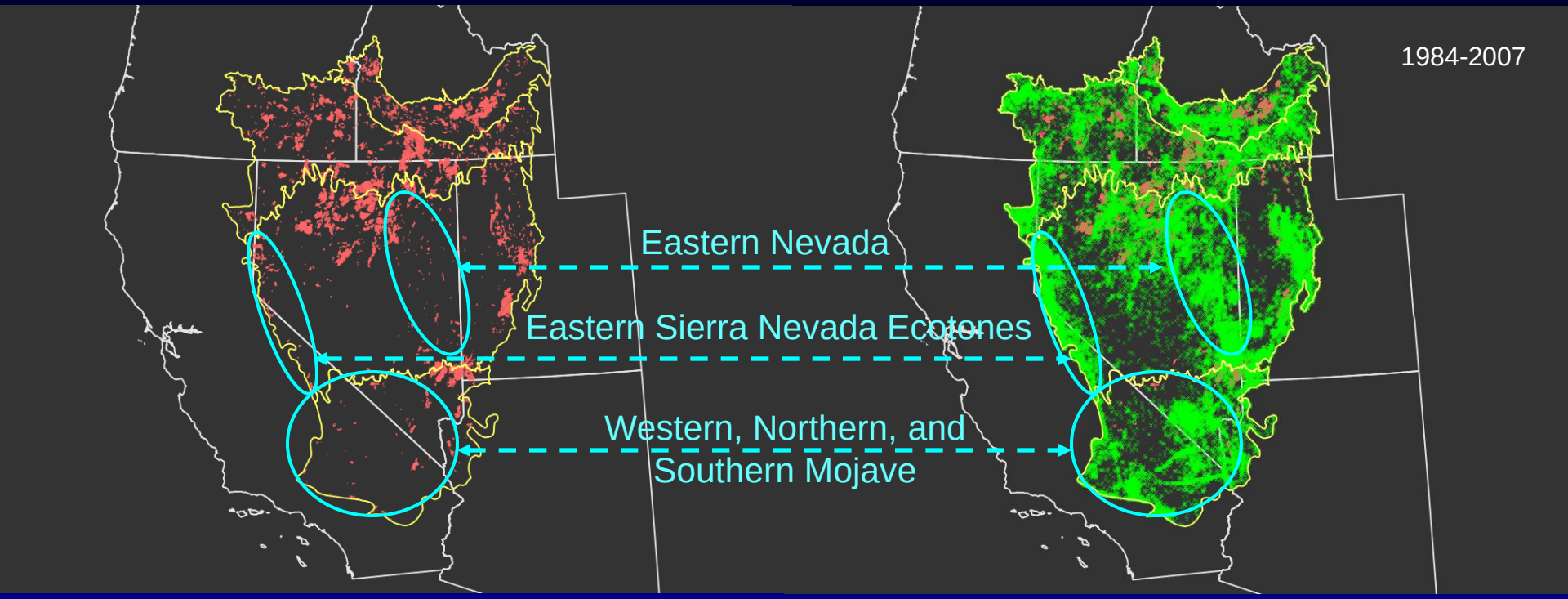


MTBS database

Point of Origins (all fires)



Federal fire records (DI-1202)



large fire perimeters

point of origins

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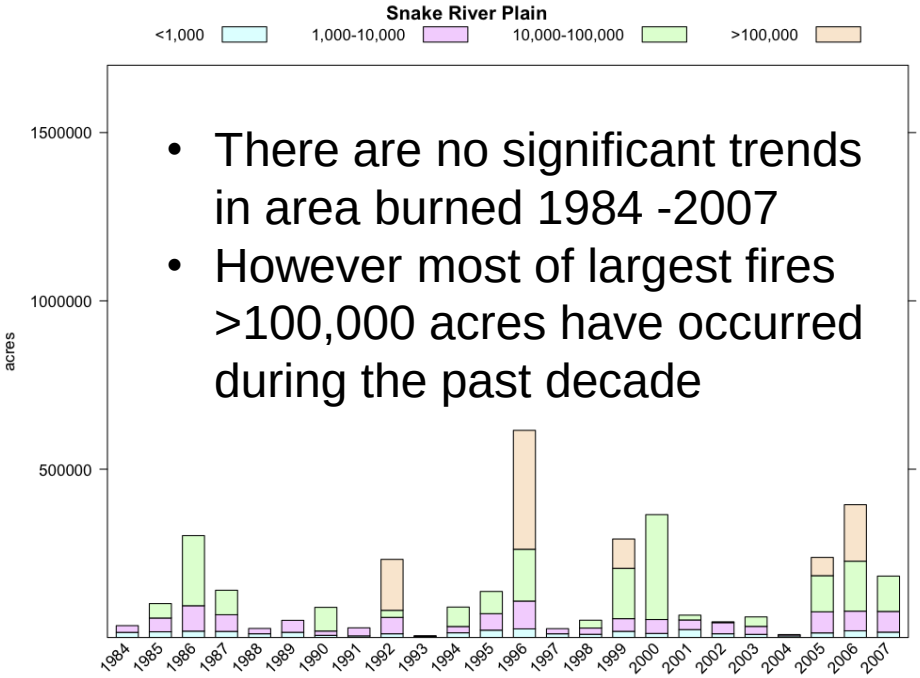
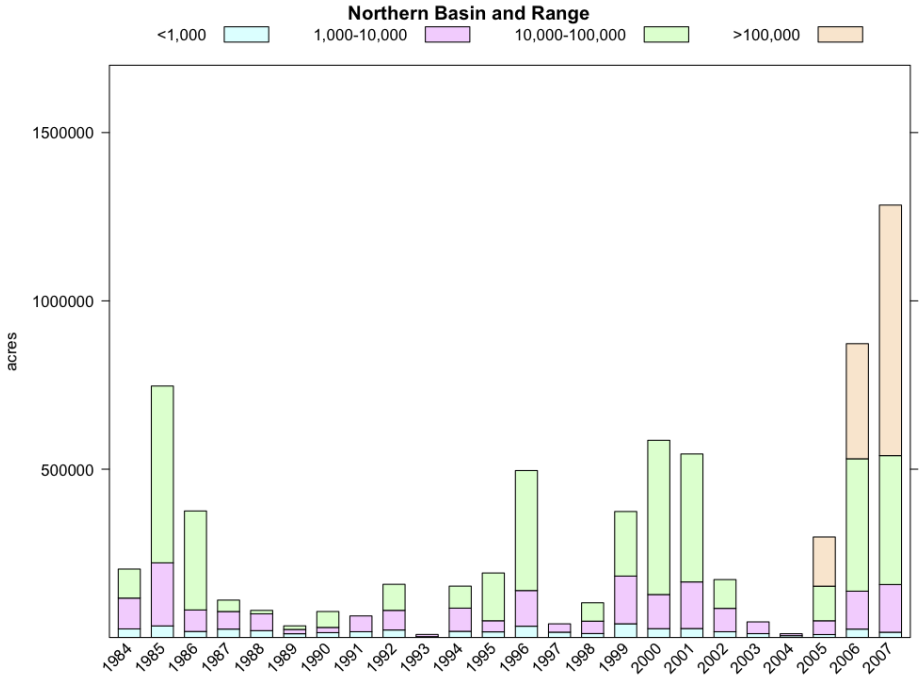
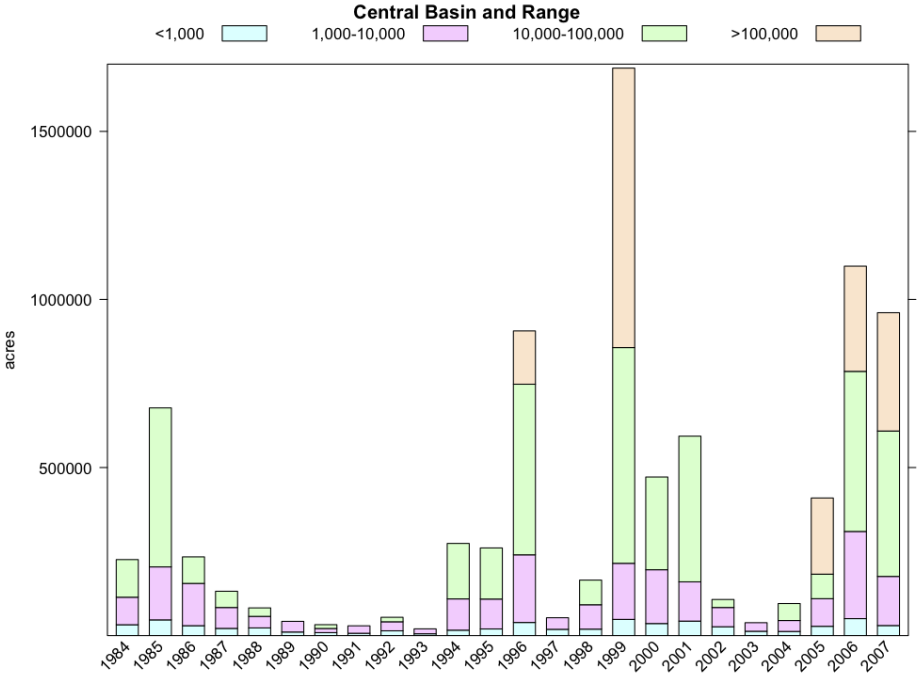
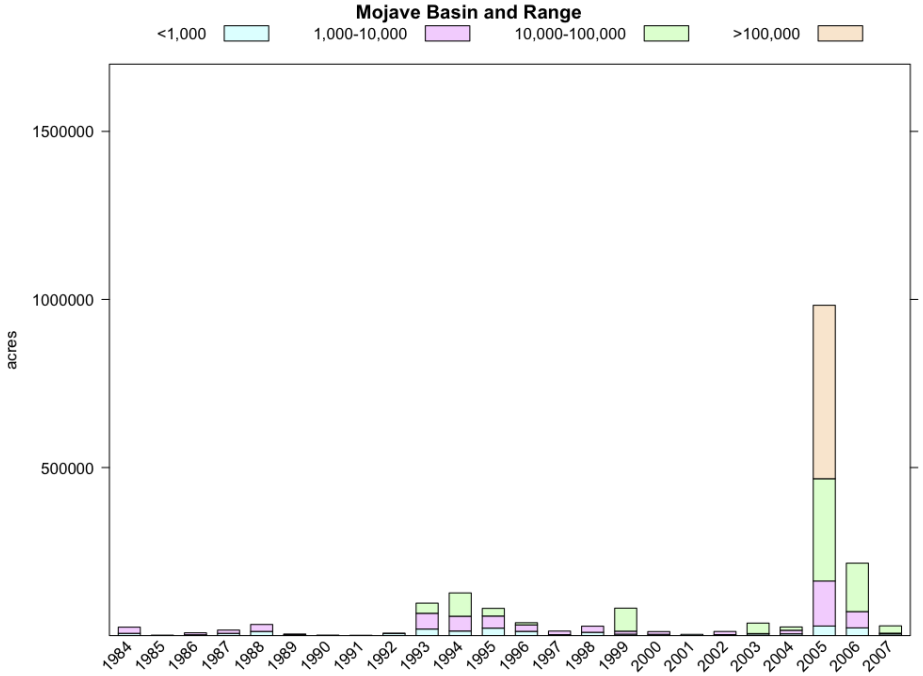
- There are no significant trends in area burned 1984 -2007
- However most of largest fires >100,000 acres have occurred during the past decade









Record rainfall levels led to high vegetation production prior to the 2005 Mojave Desert fire season

Wettest years in Las Vegas during the past century

1)	10.72 in.	1941
2)	9.88	1992
3)	7.96	1965
4)	**7.76**	**2004**
5)	7.65	1978
6)	**7.37**	**2005**
7)	7.35	1998
8)	7.30	1939
9)	**6.86**	**2003**
10)	6.85	1984

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High rainfall levels have preceded all periods of increase fire activity in the Mojave Desert since 1984

Wettest years in Las Vegas during the past century

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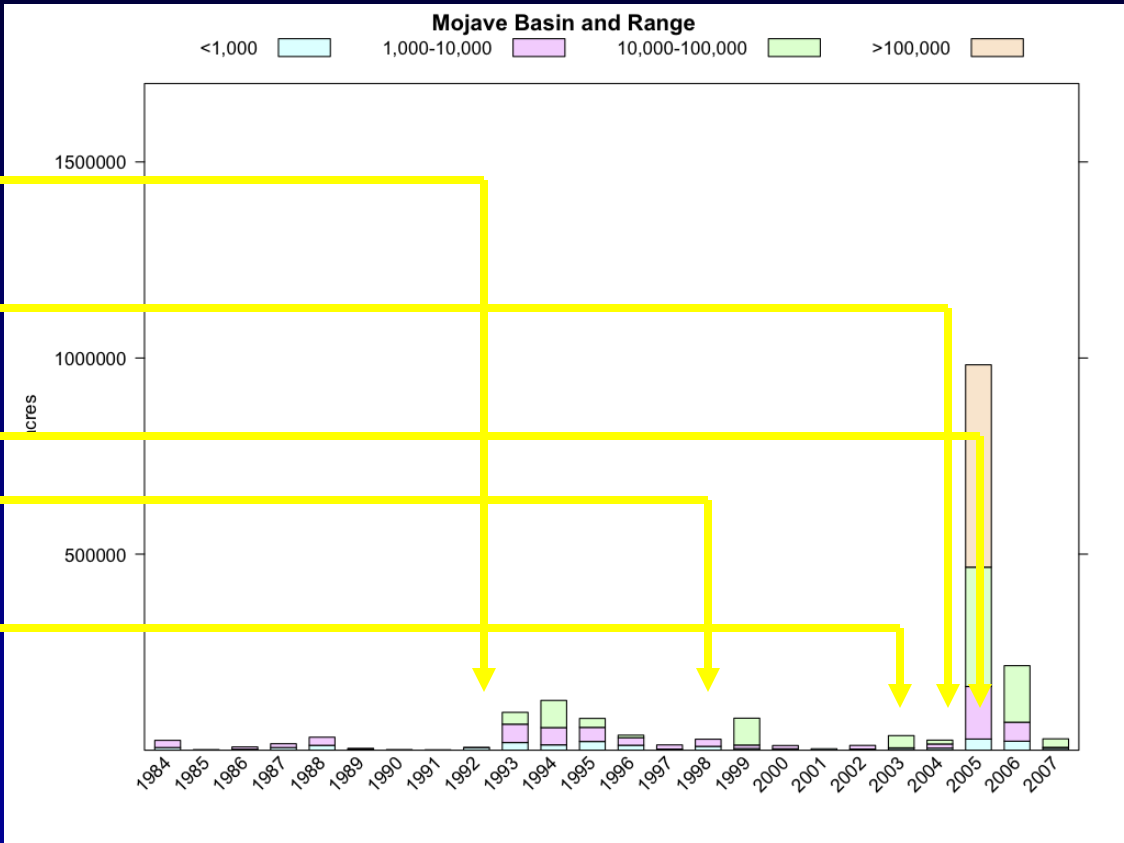

Half of the highest rainfall years in the past century occurred since 1992.

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Potential Climate Change Effects

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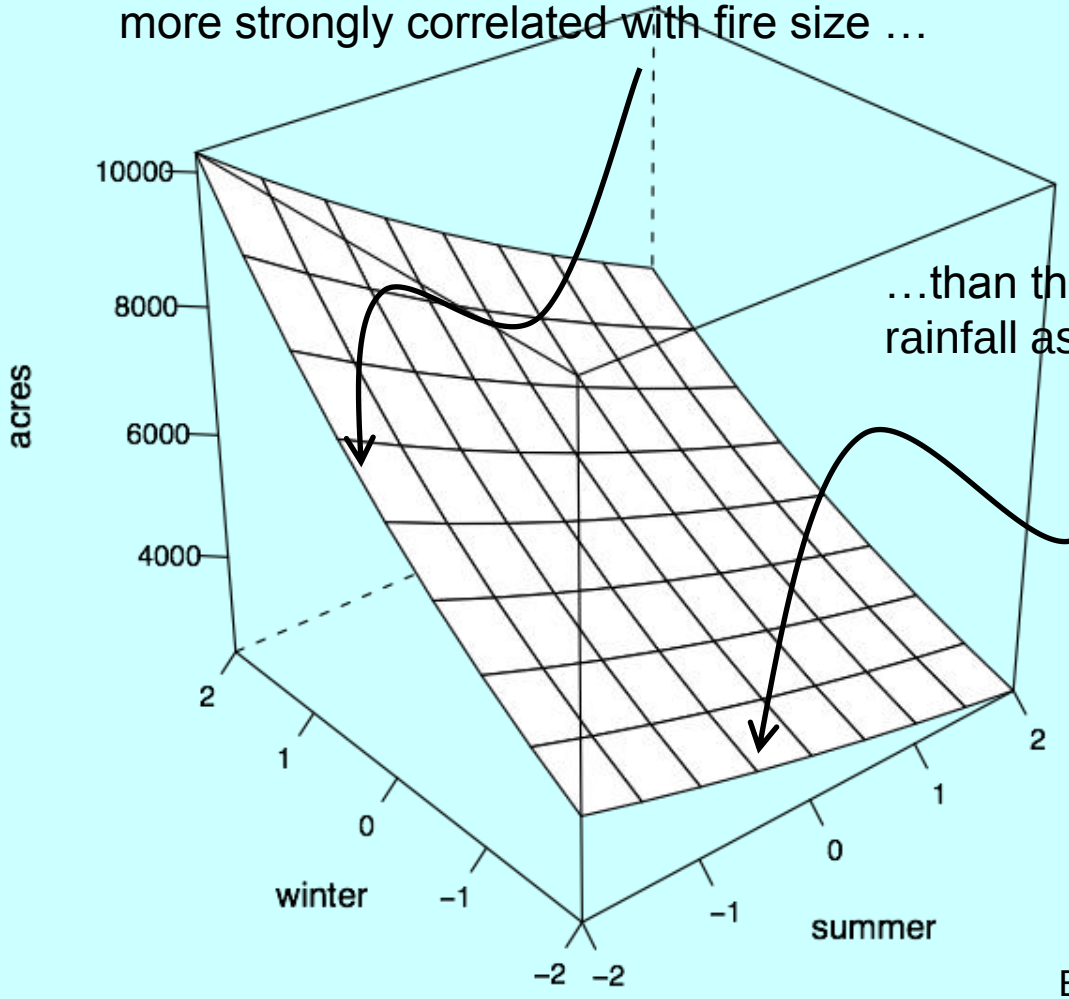
In the Mojave Desert
high winter rainfall was the primary predictor of large fires (1984-2007)

The positive winter rainfall association was much more strongly correlated with fire size …



…than the negative summer rainfall association.

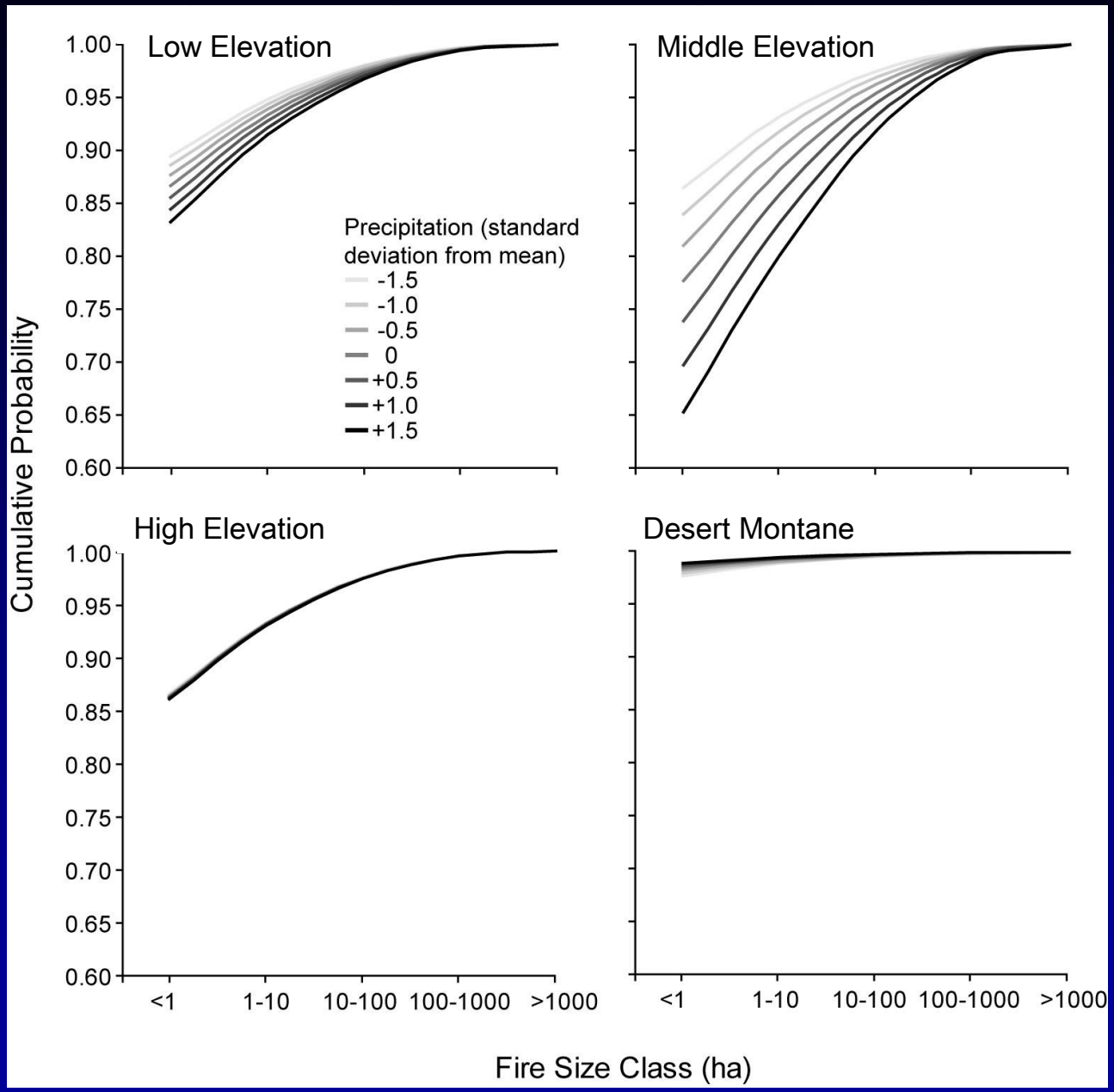
Brooks and Matchett in review

increased previous year rainfall = larger fires

non-native annuals affecting fire size

increased previous year rainfall ≠ larger fires

non-native annuals not affecting fire size



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Brooks and Matchett 2006

Current Mojave Desert Conditions

high winter rainfall
= high non-native annual grass biomass
= large fires during the current summer

Current fire size is dictated primarily by non-native annual grasses

Most fires are in the low middle elevation zones (creosote bush scrub and blackbrush)

USGS

Brooks and Matchett in review

Potential Effects of Future Climate Scenarios in the Mojave Desert

winter rainfall \ summer rainfall	lower	higher
lower	**Much Smaller Fires** native perennials ↑ non-native annuals ↓↓	**Smaller Fires** native perennials ↓ non-native annuals ↓
higher	**Much Larger Fires** native perennials ↑ non-native annuals ↑↑	**Larger Fires** native perennials ↓ non-native annuals ↑↑

Influence of native perennials and non-native annuals on fire size:
↑ = increases fire size, ↓ = decreases fire size

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Brooks and Matchett in review

High elevation

Middle elevation

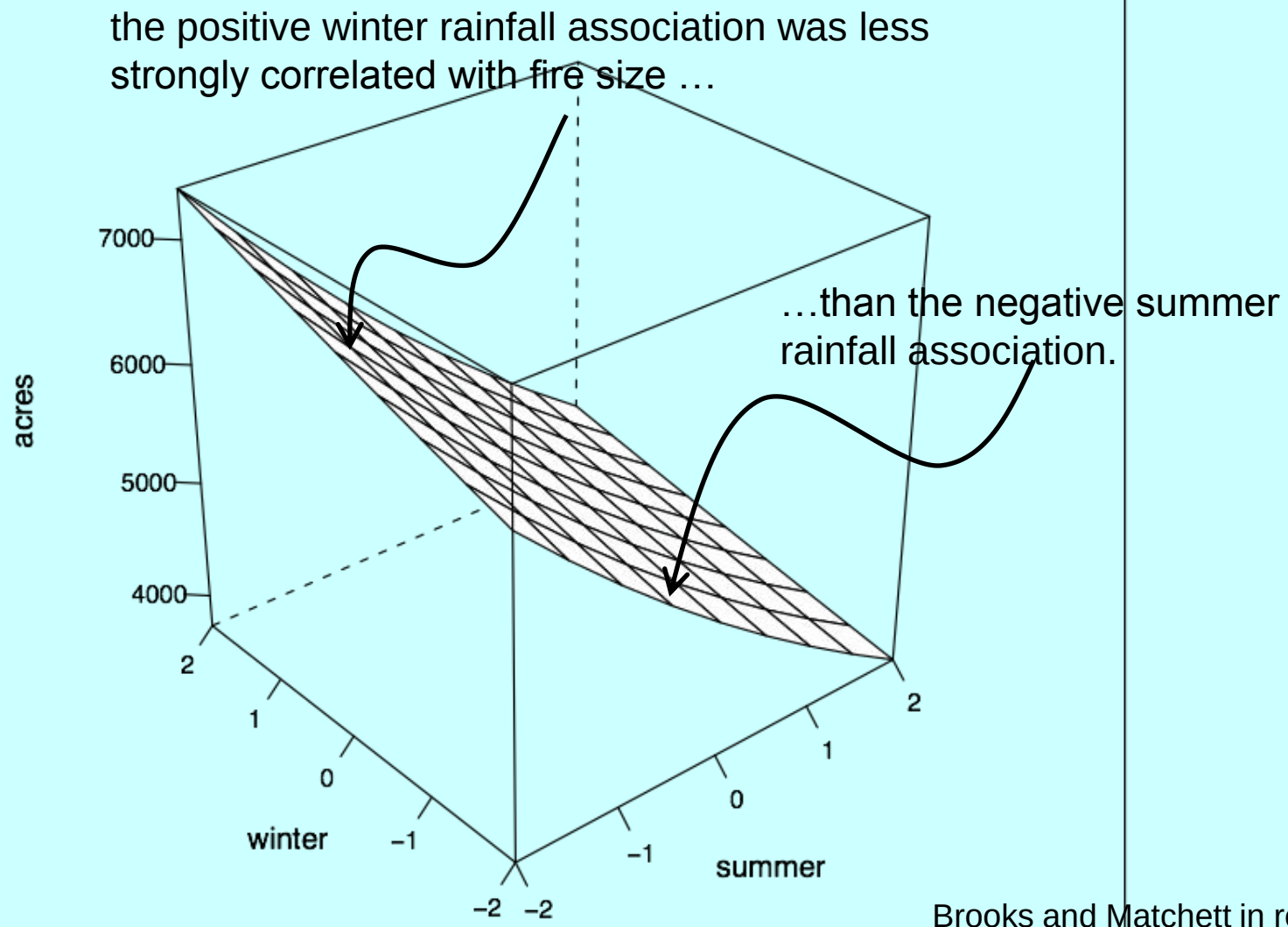
Low elevation

A warming climate may shift these vegetation types and their fire regimes upslope

USGS

Brooks and Matchett in review

In the Great Basin
high winter rainfall followed by low summer rainfall produced the largest fires



Brooks and Matchett in review

Current Great Basin Conditions

low summer rainfall + high winter rainfall
= low live fuel moisture of native perennials + high non-native annual grass biomass
= large fires during the current summer

Current fire size dictated primarily by native perennial fuels, and secondarily by non-native annual grasses

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Brooks and Matchett in review

Potential Effects of Future Climate Scenarios in the Great Basin

winter rainfall \ summer rainfall	lower	higher
lower	Larger Fires native perennials ↑↑ non-native annuals ↓	Smaller Fires native perennials ↓ non-native annuals ↓
higher	Much Larger Fires native perennials ↑↑ non-native annuals ↑	No Change native perennials ↓ non-native annuals ↑

Influence of native perennials and non-native annuals on fire size:
↑ = increases fire size, ↓ = decreases fire size

USGS

Brooks and Matchett in review

How might future increased temperatures affect hot and cold desert fire regimes?

- Climatic models predict increasing temperatures.
- May drive hot desert conditions more towards cold deserts.
- Conditions in higher elevation and more mesic shrublands may become more conducive to dominance by non-native grasses and the grass/fire cycle (move upslope).
- Start winter growing season sooner that should favor weedy non-native plants.
- Increase the length and aridity of the summer fire season.

USGS

Brooks and Matchett in review

How might future changes in precipitation affect hot and cold desert shrubland fire regimes?

- Potential future precipitation is much more difficult to predict than temperature.
- ➢ Proportions of summer:winter precipitation in addition to increases or decreases and interannual variations, all have differing implications for invasive plants, fire regimes, and interactions between the two.
- ➢ Increasing temperatures will mean decreasing effective precipitation available to plants and concomitant effects of fuelbeds.

USGS

Brooks and Matchett in review

summer rainfall

winter rainfall

Mojave Desert		
	lower	higher
lower	Much smaller fires	Smaller fires
higher	Much larger fires	Larger fires

Great Basin		
	lower	higher
lower	Larger fires	Smaller fires
higher	Much larger fires	No change

There is some indication that increased winter and decreased summer rainfall might be the most probable future,
but this verdict is clearly still out on this.

USGS

Brooks and Matchett in review

How might other future influences affect hot and cold desert shrubland fire regimes?

- Increased CO_2
  - favors growth by non-native annual grasses and could exacerbate fire management problems
- Increasing human populations
  - increase fire starts
  - promote the spread of new non-natives that may alter fire regime (e.g. purple fountain grass, buffelgrass)
  - increase the amount of roads
    - extend fire starts into more areas
    - promote invasive plant spread
    - facilitate the control of wildfires

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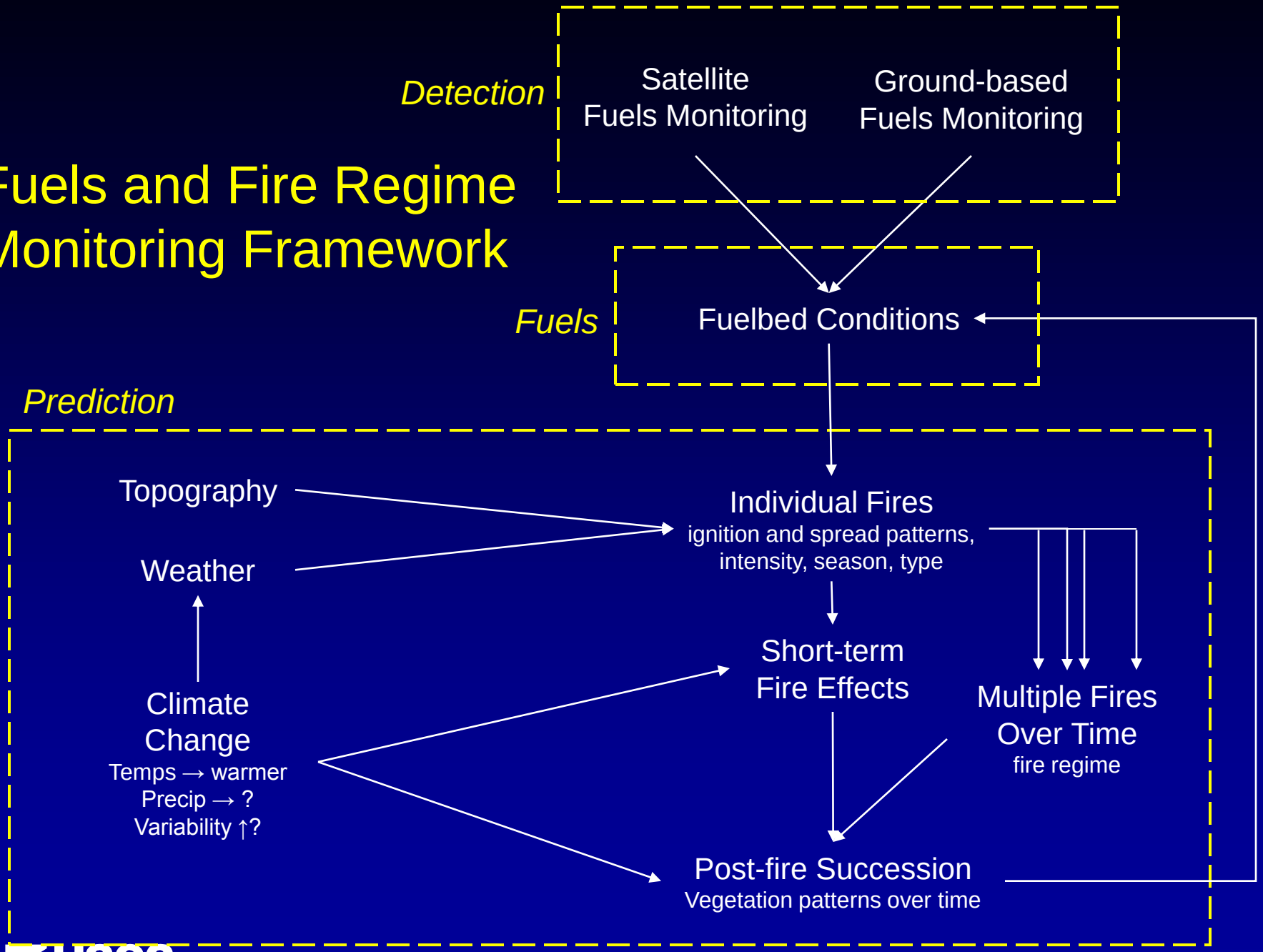
Brooks and Matchett in review

Fuels and Fire Regime Monitoring Framework



USGS

Brooks et al in prep

Cooperators and Supporters

- USGS
  - Earth Resources Observation Systems Data Center
  - Great Basin Integrated Landscape Monitoring Program
  - Vulnerability and Recoverability of Desert Ecosystems Program
- BLM
  - AZ Strip, Barstow, Bishop, Ely, and Las Vegas field offices
  - BAER Program
- NPS
  - Lake Mead NRA, Joshua Tree National Park, Mojave National Preserve
  - Pacific West Region Fire Program
- FWS
  - National Wildlife Refuge System
- USFS
  - Rocky Mountain Research Station
  - Spring Mountains NRA
- Others
  - Joint Fire Science Program
  - DOD Strategic Environmental Research and Development Program
  - DOE Pacific Northwest National Laboratory
  - Eastern Nevada Landscape Coalition
  - UC Riverside

USGS