Shifts in Fire Regime Characteristics Driven By Human Land Use Patterns

Carl N. Skinner
Research Geographer PSW (Retired)

Taylor et al. 2016. Socioecological transitions trigger fire regime shifts and modulate fire-climate interactions in the Sierra Nevada, USA, 1600-2015 CE.
PNAS 113(48): 13684-13689

Acknowledgements
Co-authors

- **Alan Taylor**
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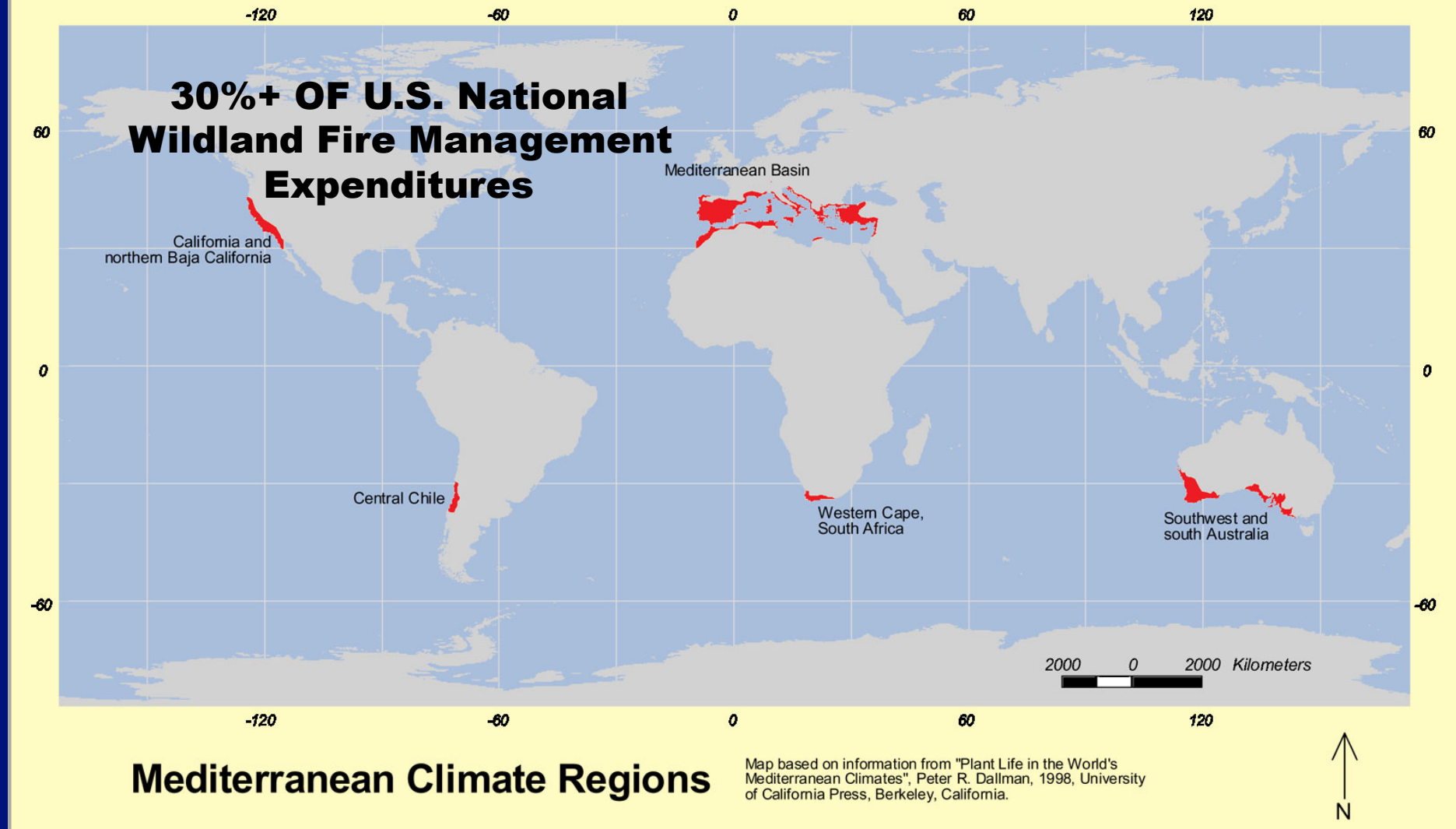
- **Valerie Trouet**
  Tree-ring Laboratory
  Univ. Arizona
- **Scott Stephens**
  Univ. Calif., Berkeley

JFSP Project

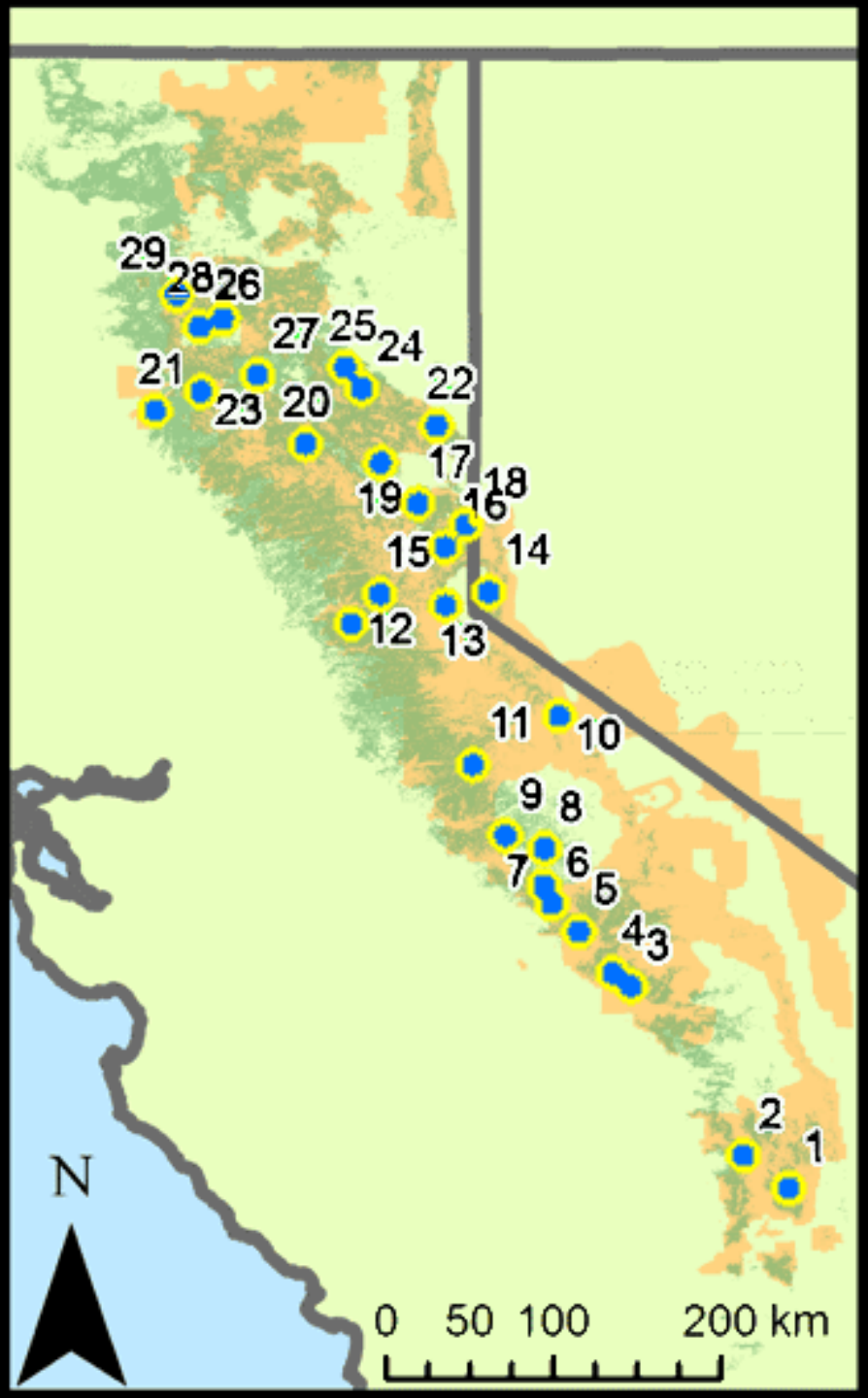
Fire/Climate Relationships in the Mediterranean Climate Area of North America



Mediterranean Climate Regions

Map based on information from "Plant Life in the World's Mediterranean Climates", Peter R. Dallman, 1998, University of California Press, Berkeley, California.

Study Area
Cascade Range
Sierra Nevada
~~~
29 Sites
1,948 Samples
Avg 67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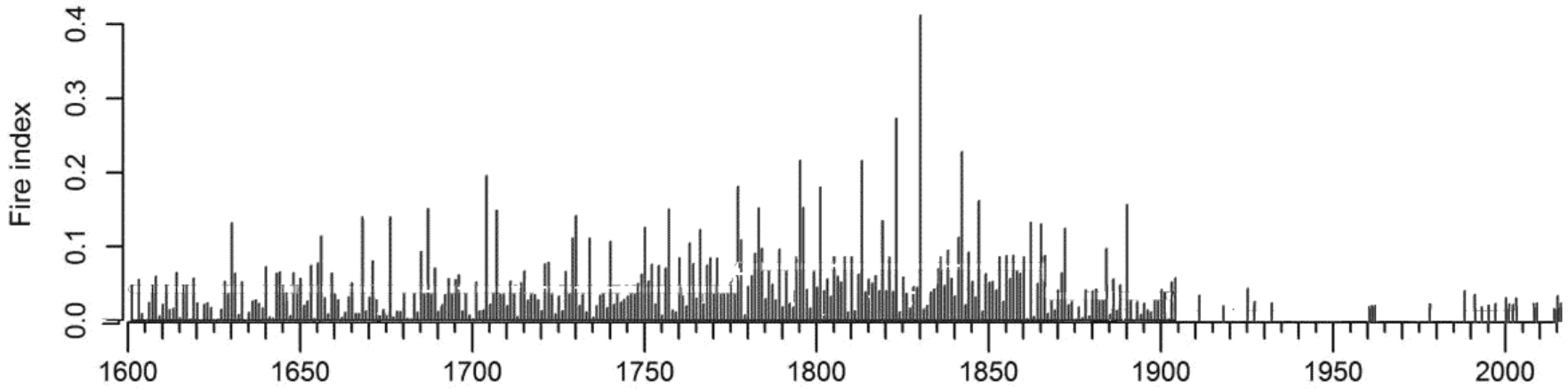
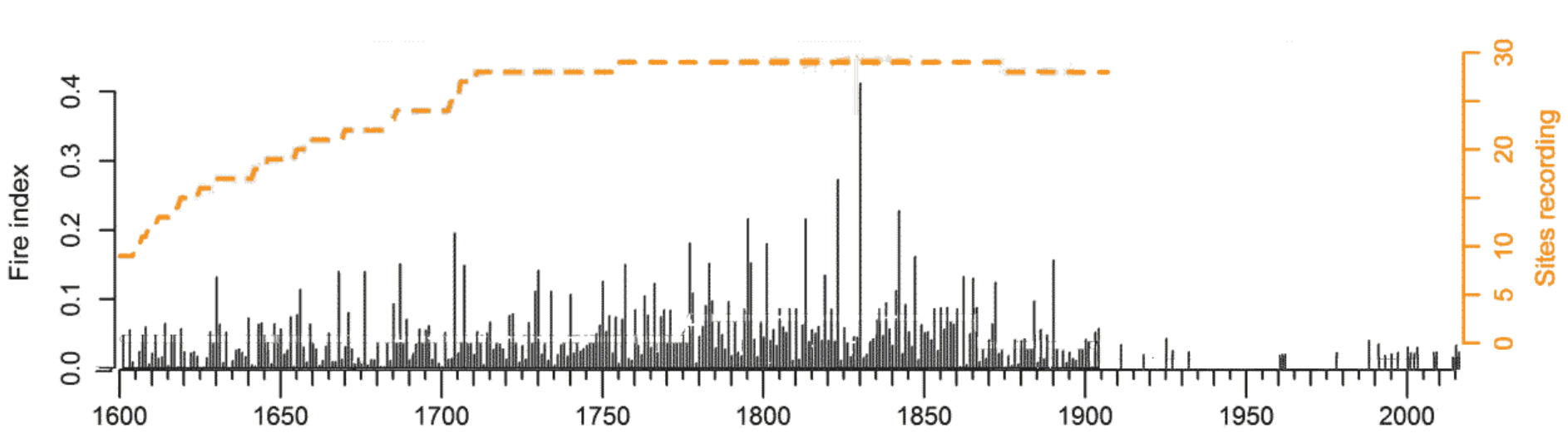
Sierra Nevada/Cascade Range

Fire Activity Index

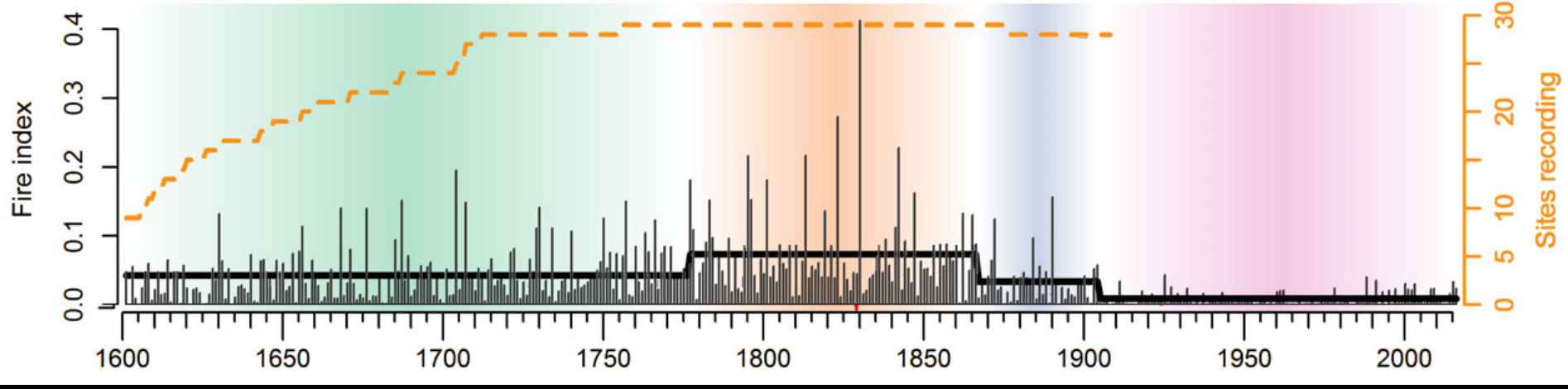
1st Look



Sierra Nevada/Cascade Range
Fire Activity Index
Number of Recording Sites?

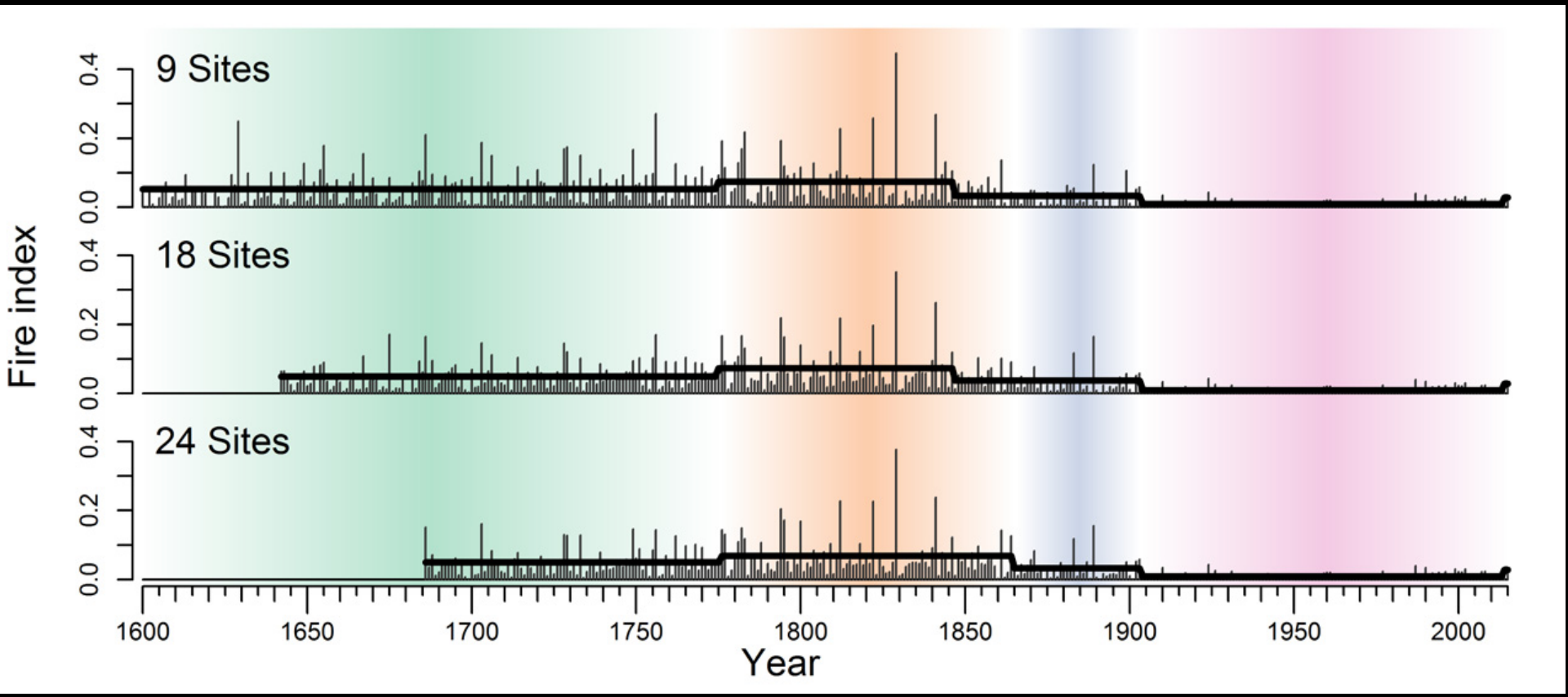


Sierra Nevada/Cascade Range
Fire Activity Index
Fire Regime Periods

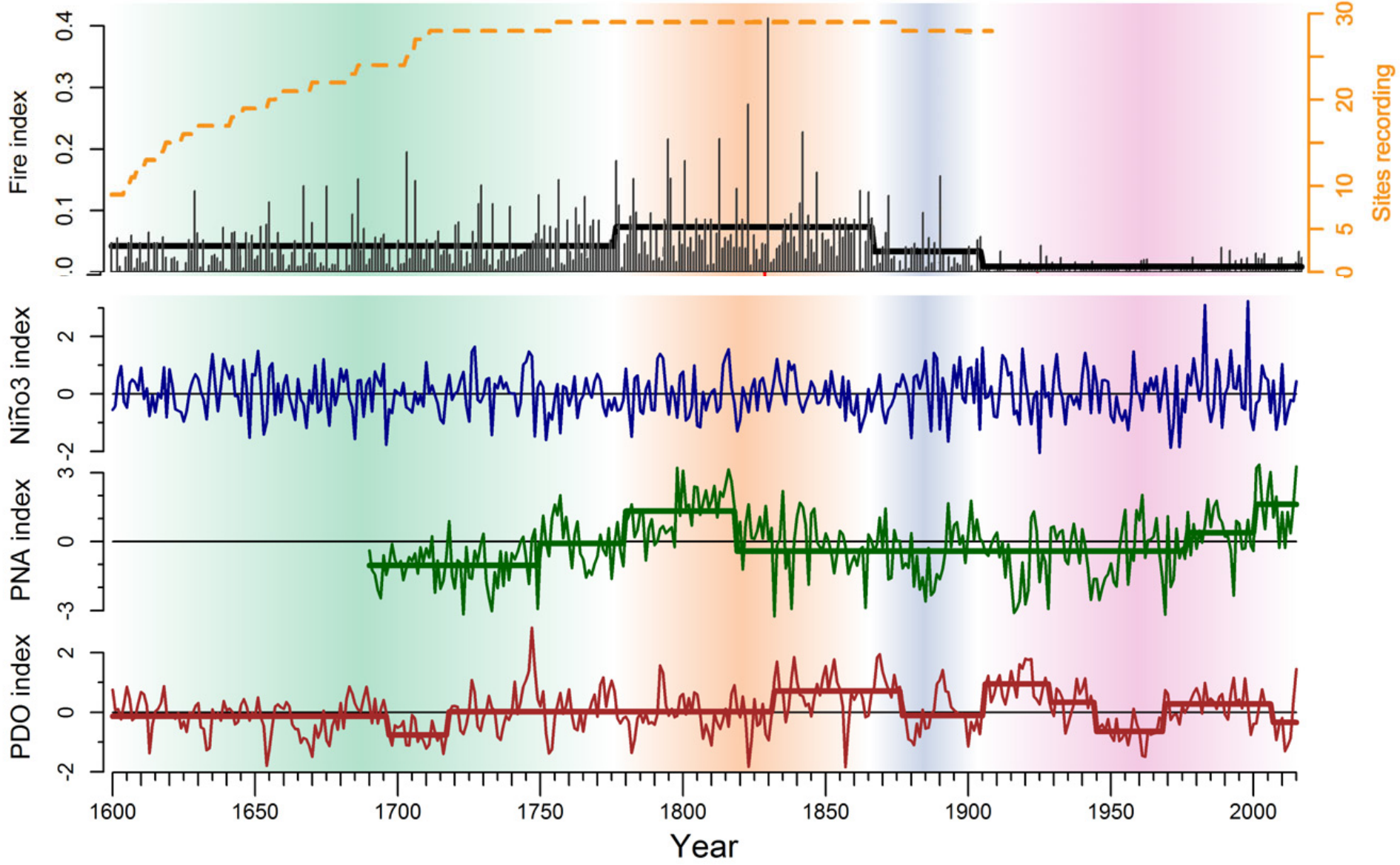


Rodionov, S.N. 2004. A sequential algorithm for testing climate regime shifts. Geophysical Res. Let. 31(L09204)

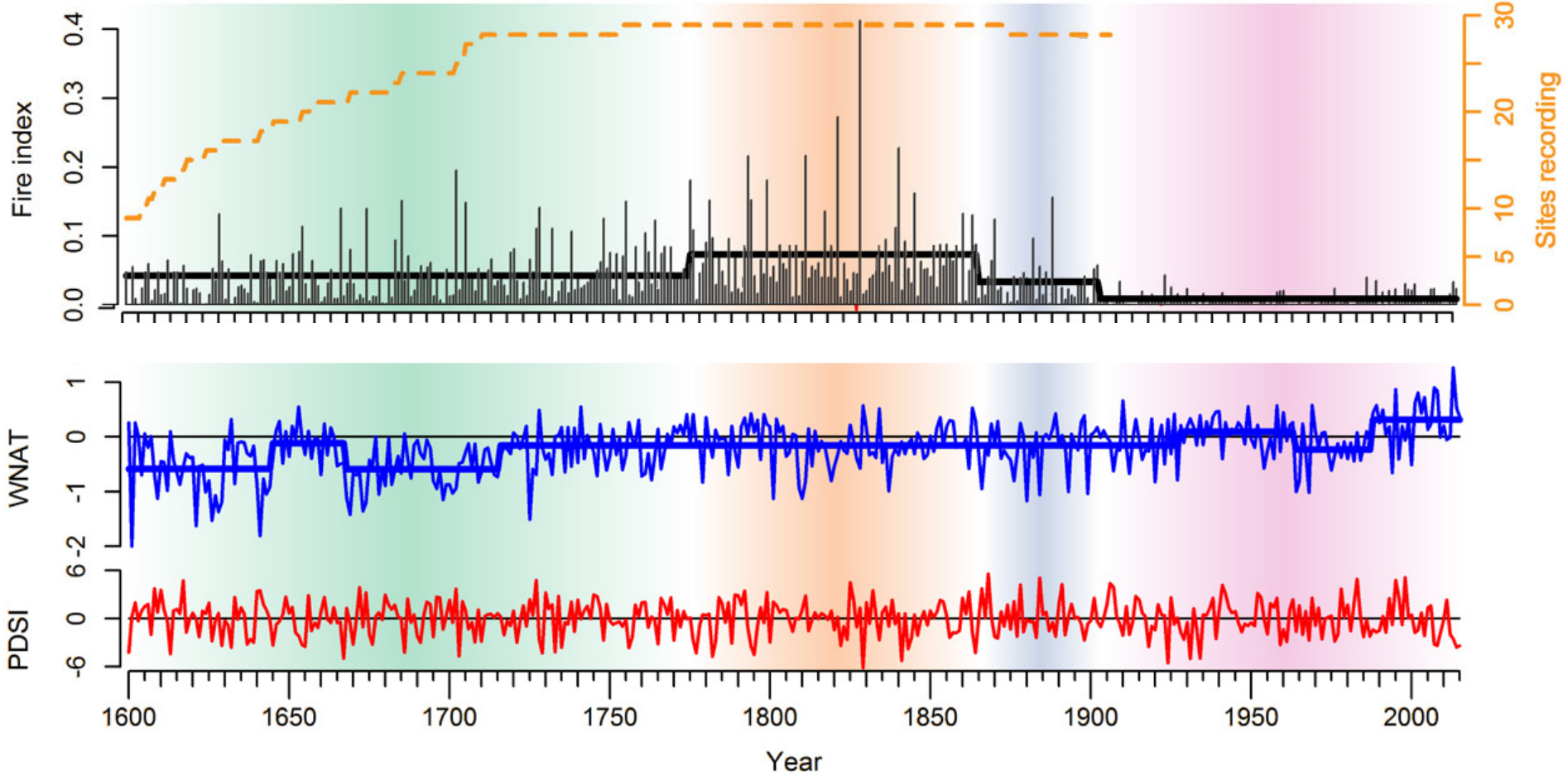
Fire Indices
&
Number of Recording Sites



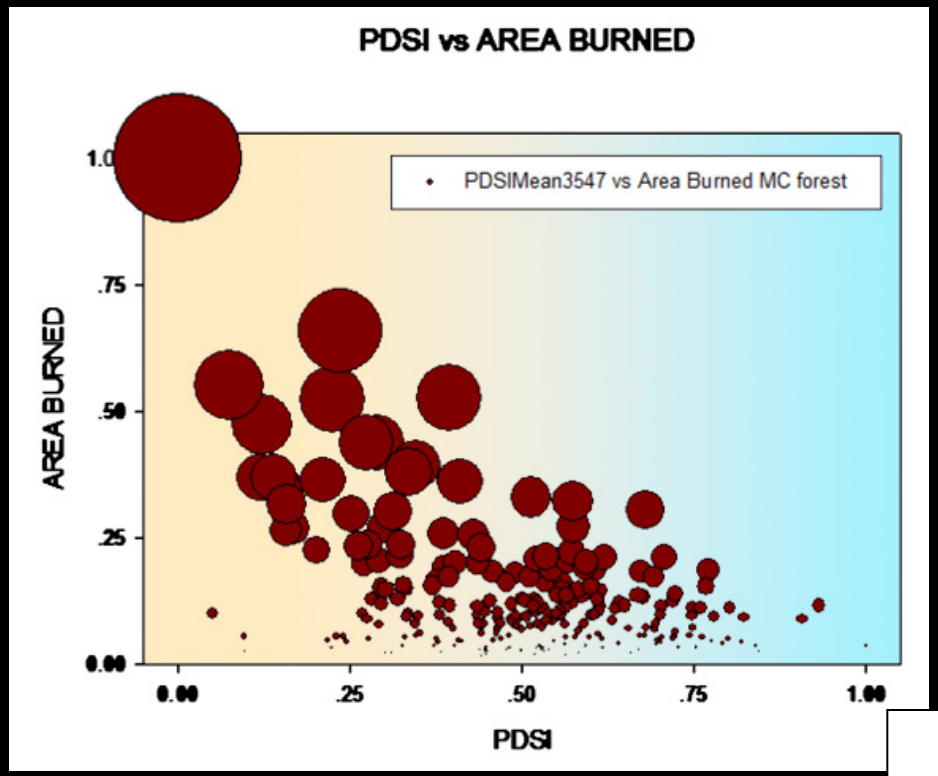
Climate Indices



Fire Regimes Shifts
vs.
Climatic Shifts

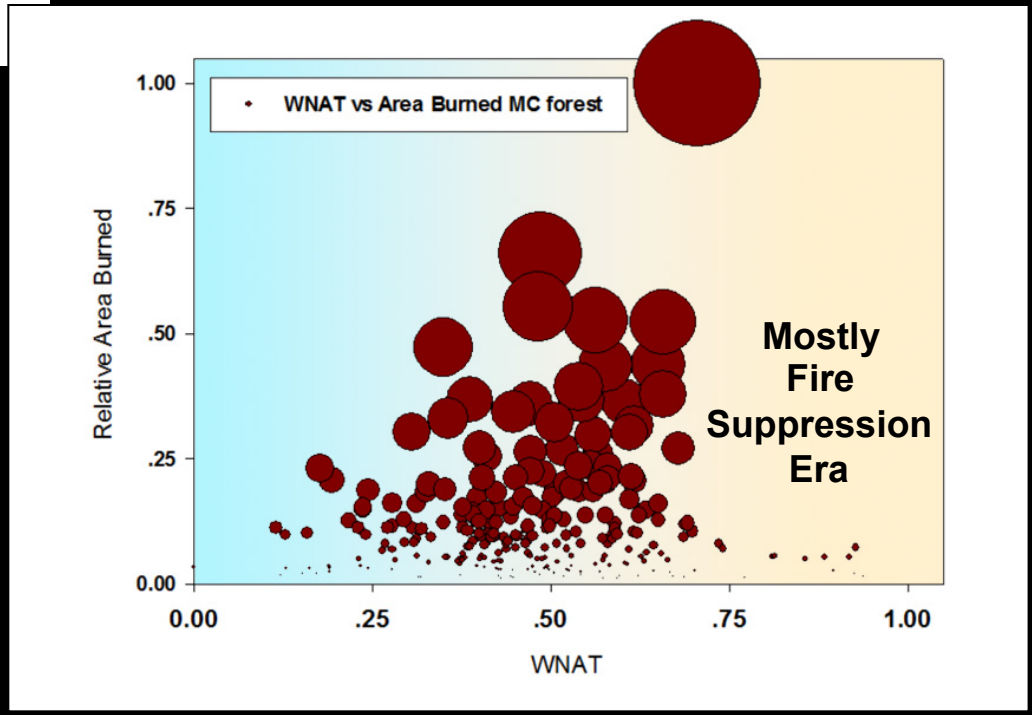


Fire Activity & Climate



PDSI vs. FAI

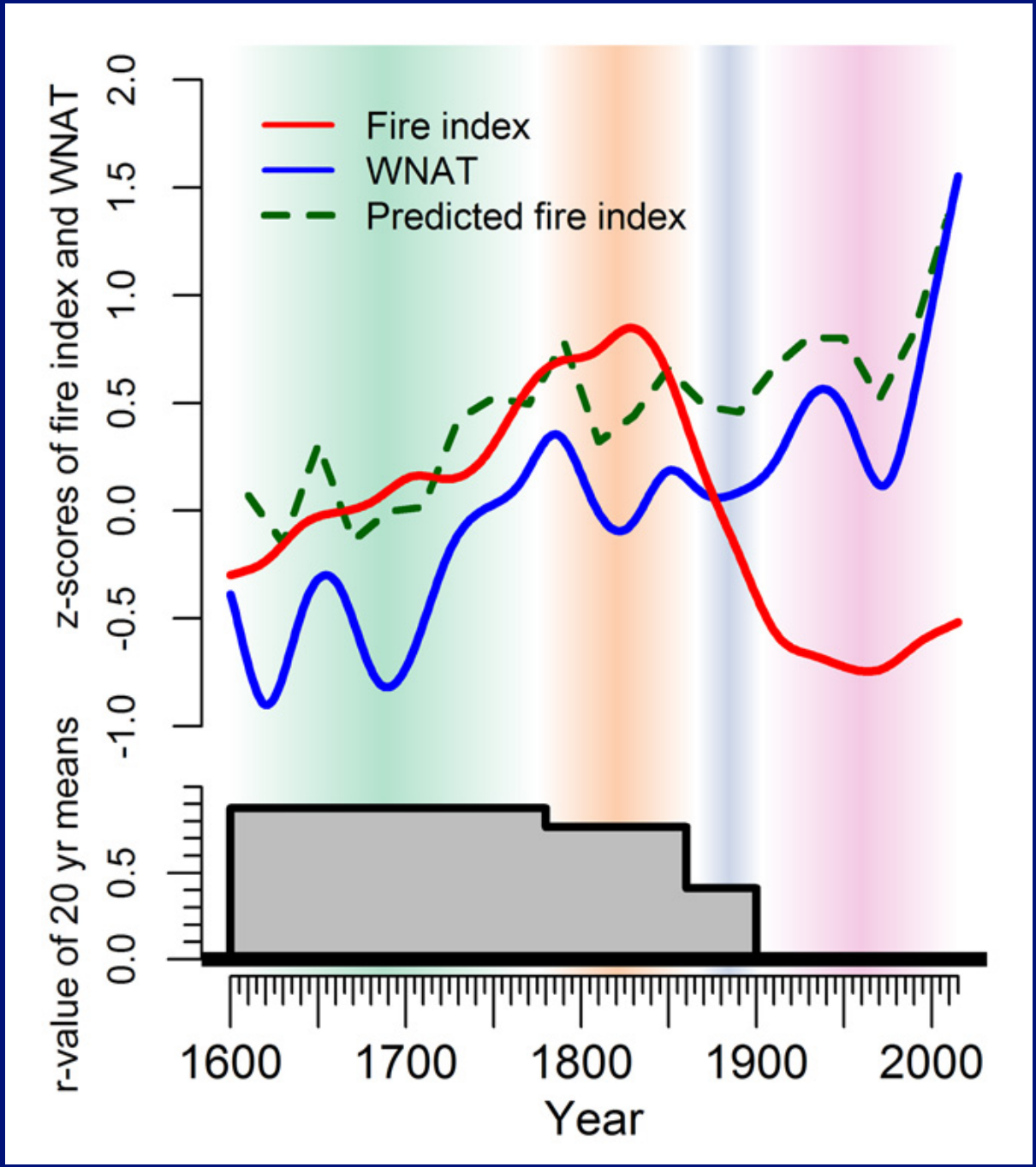
WNAT vs. FAI



Fire Index

vs.

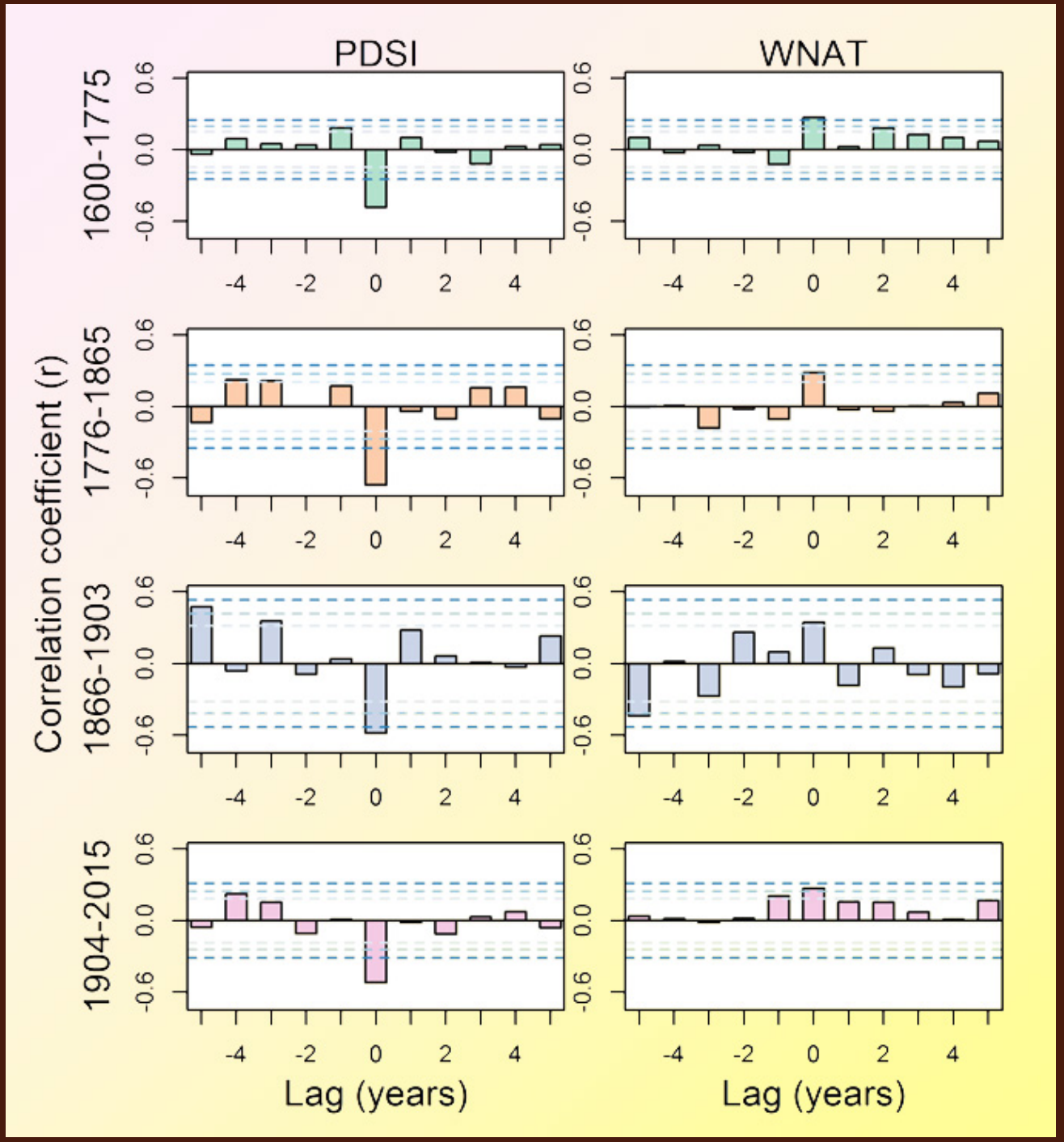
WNAT



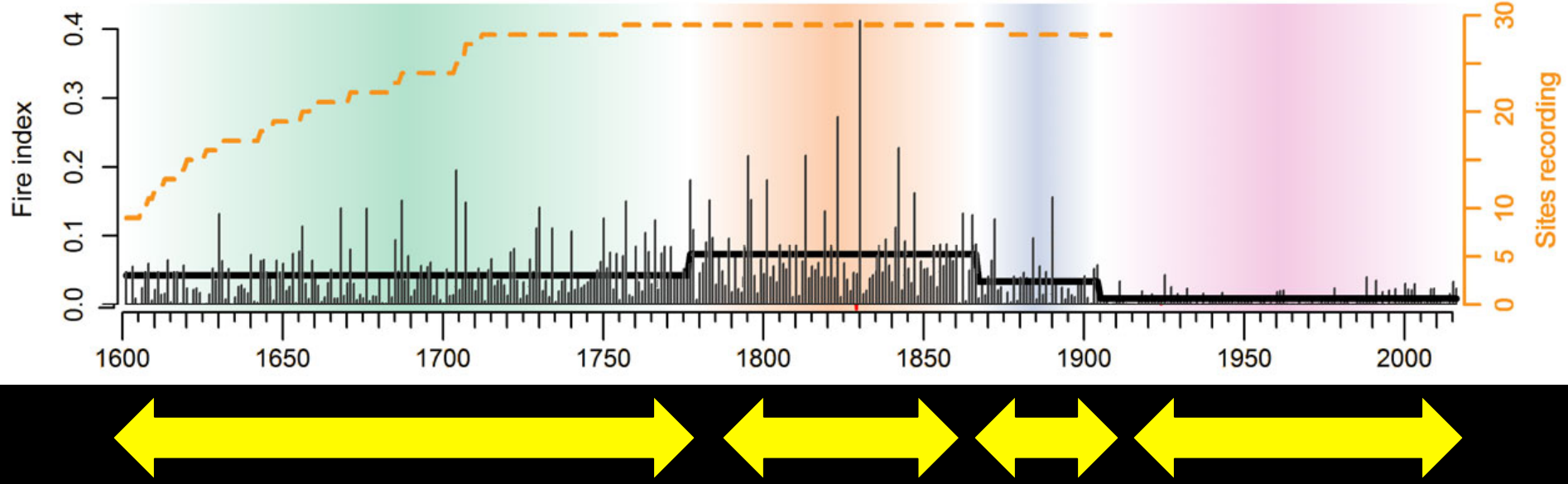
Fire Regimes Xcorrelation

PDSI

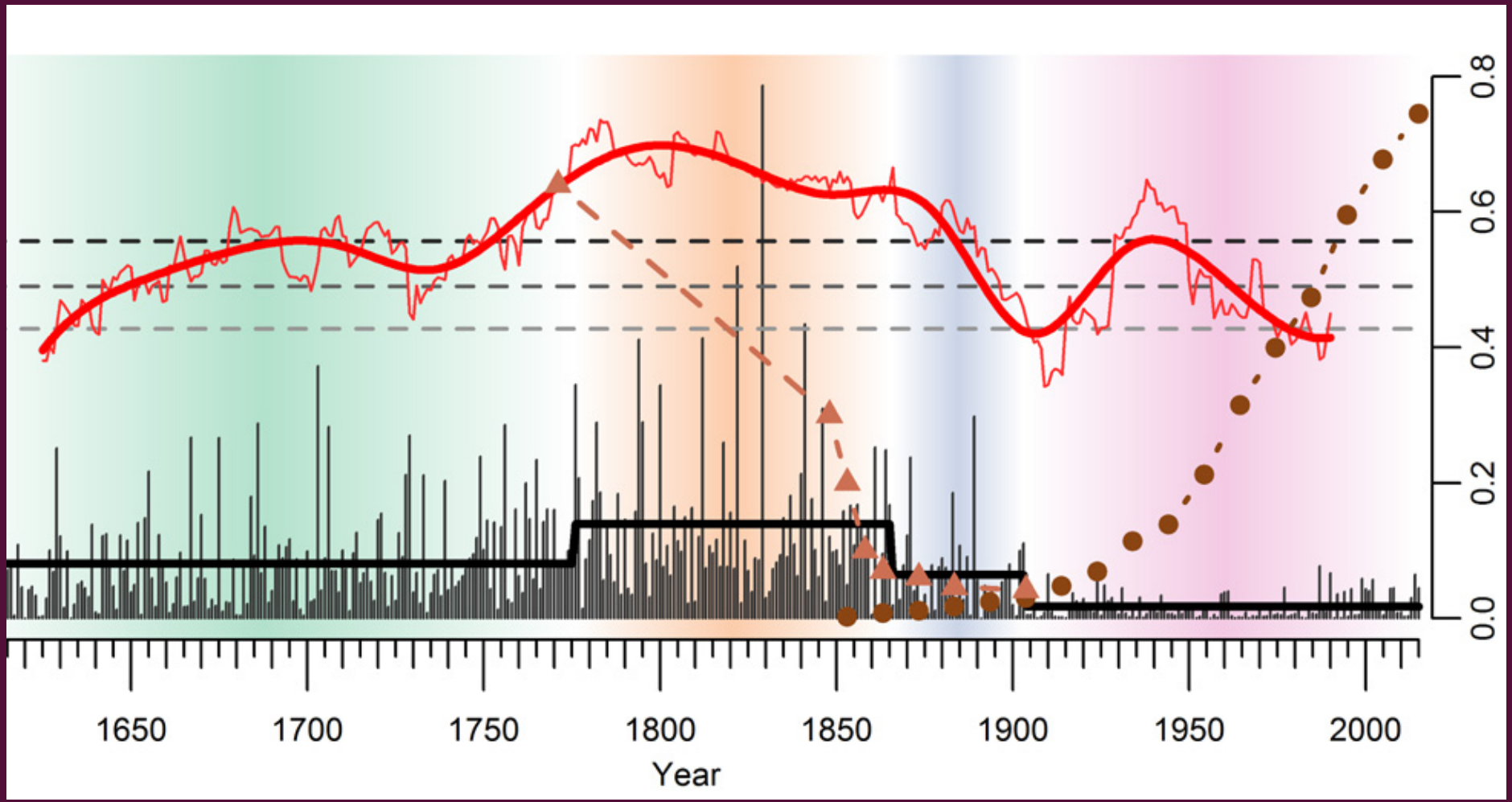
WNAT



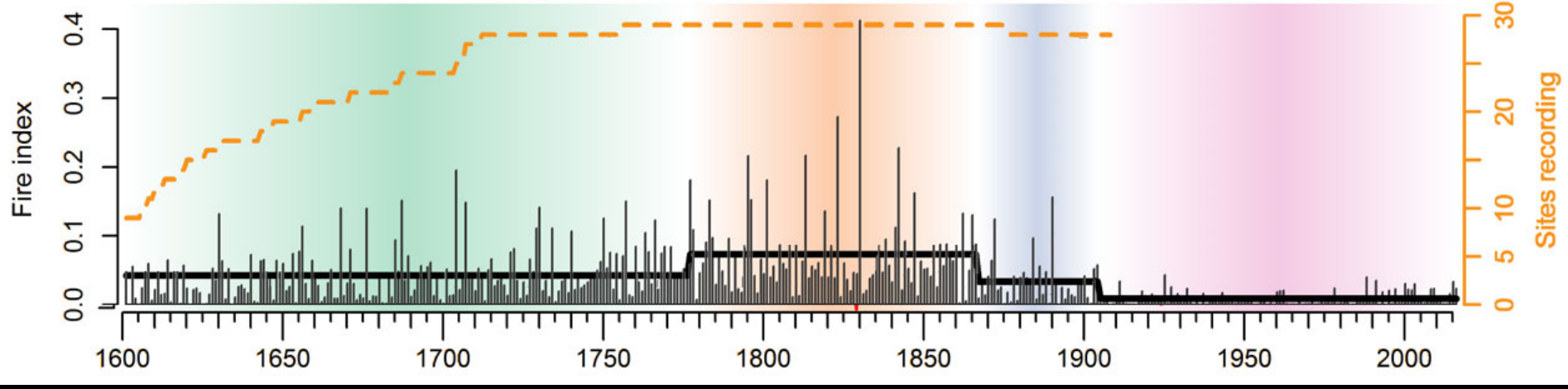
Sierra Nevada/Cascade Range
Fire Activity Index
Fire Regime Periods



Fire Regime Shifts
vs.
Human Population

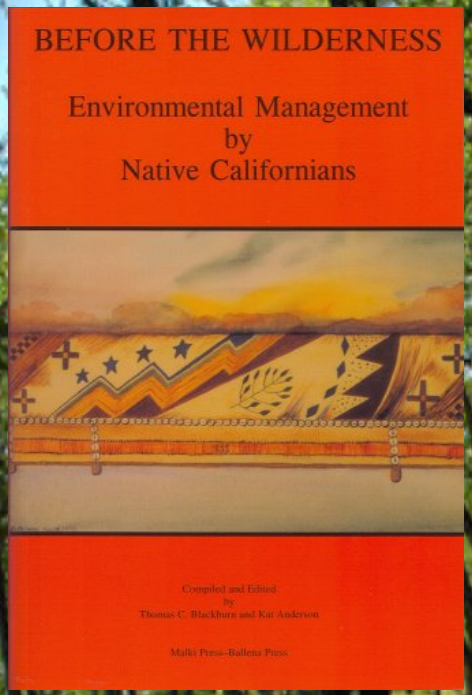


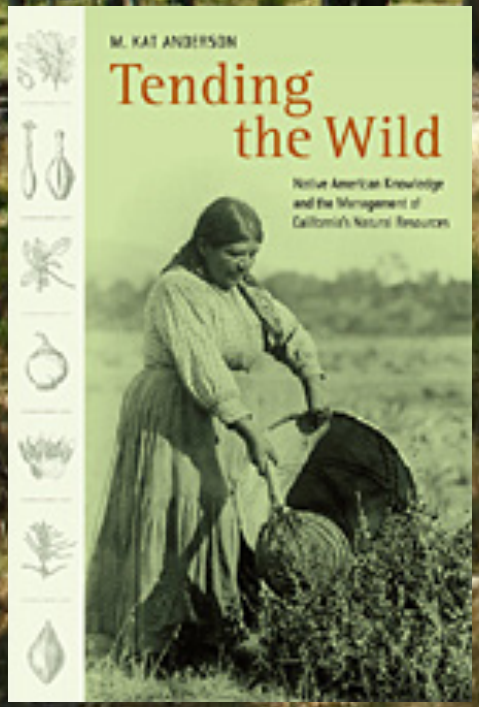
Sierra Nevada/Cascade Range
Fire Activity Index
Fire Regime Periods

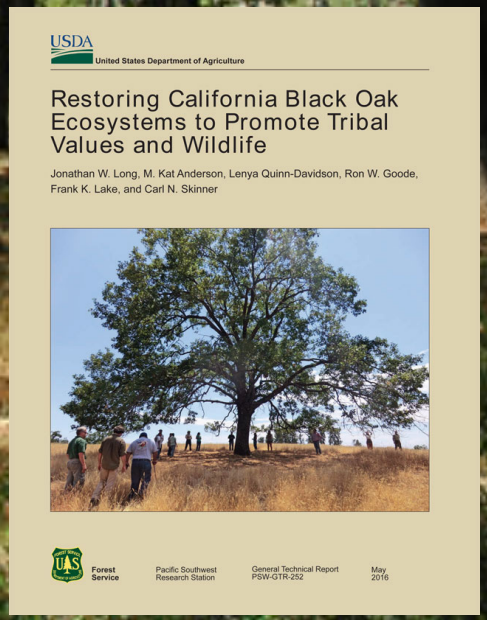


Native American | Hispanic | Gold | Fire Suppression

Native Peoples' Uses of Fire





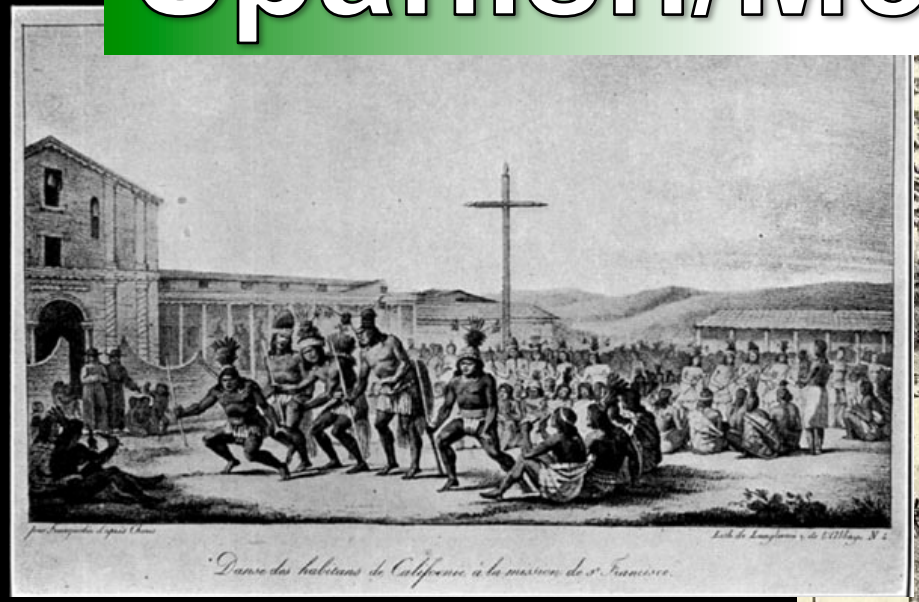


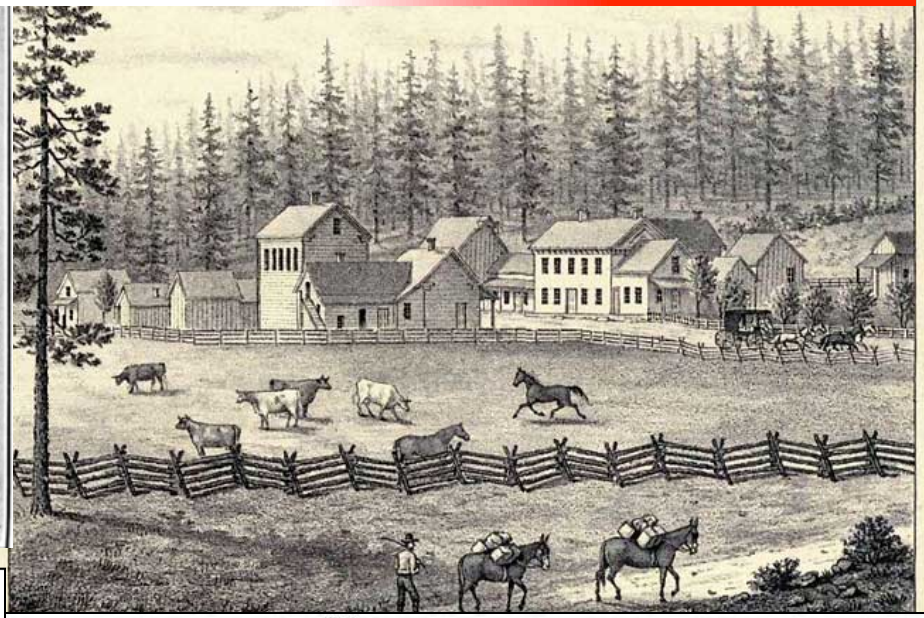
Native Peoples' Uses of Fire

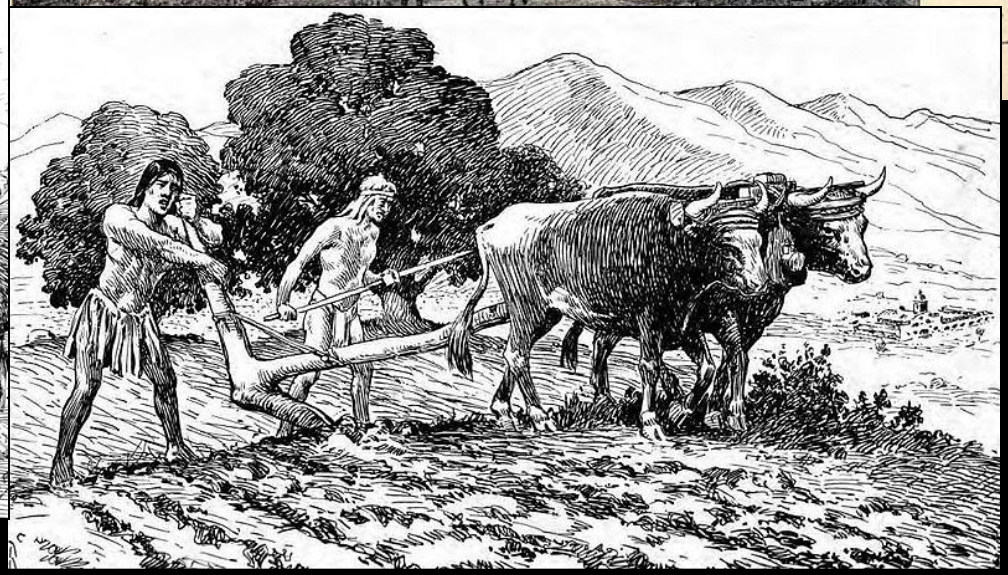
Food, Fiber, Hunting

Fires become self-limiting

Spanish/Mexican Period







Spanish/Mexican Period

Less frequent fire

Fires Declared Illegal

Fires no longer self-limiting

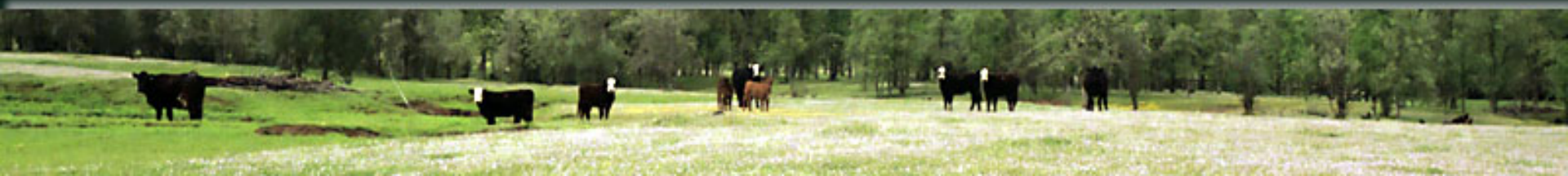
Gold Rush

Settlement by Others

Gold Rush

Less frequent fire

Fires become more limited due to less fuel



Fire Suppression Era

Fire Suppression Era

Less frequent fire

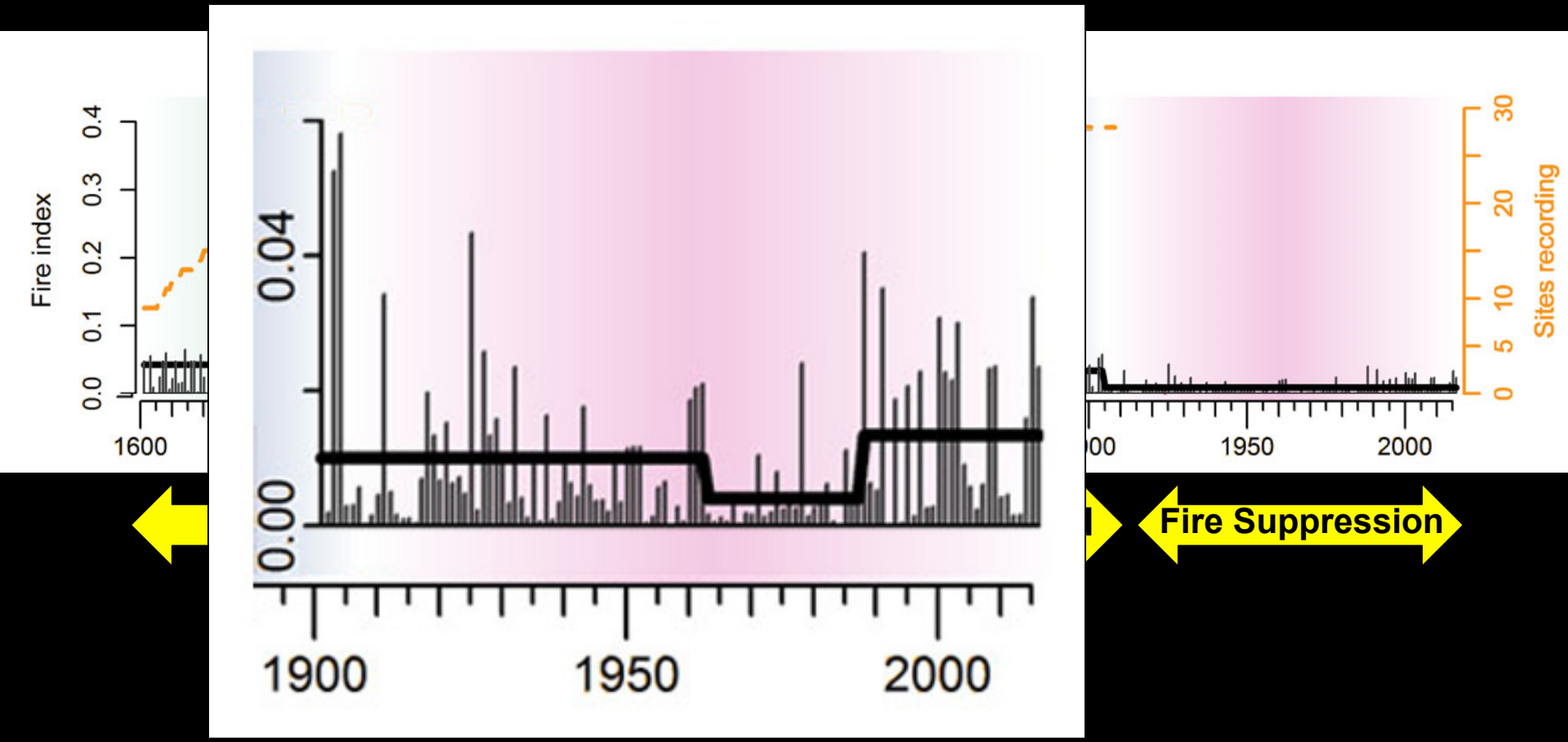
Fires cease to burn in low & moderate severity conditions

Fuels build up leading to increase in fire sizes and size of high severity patches in periods of severe burn conditions

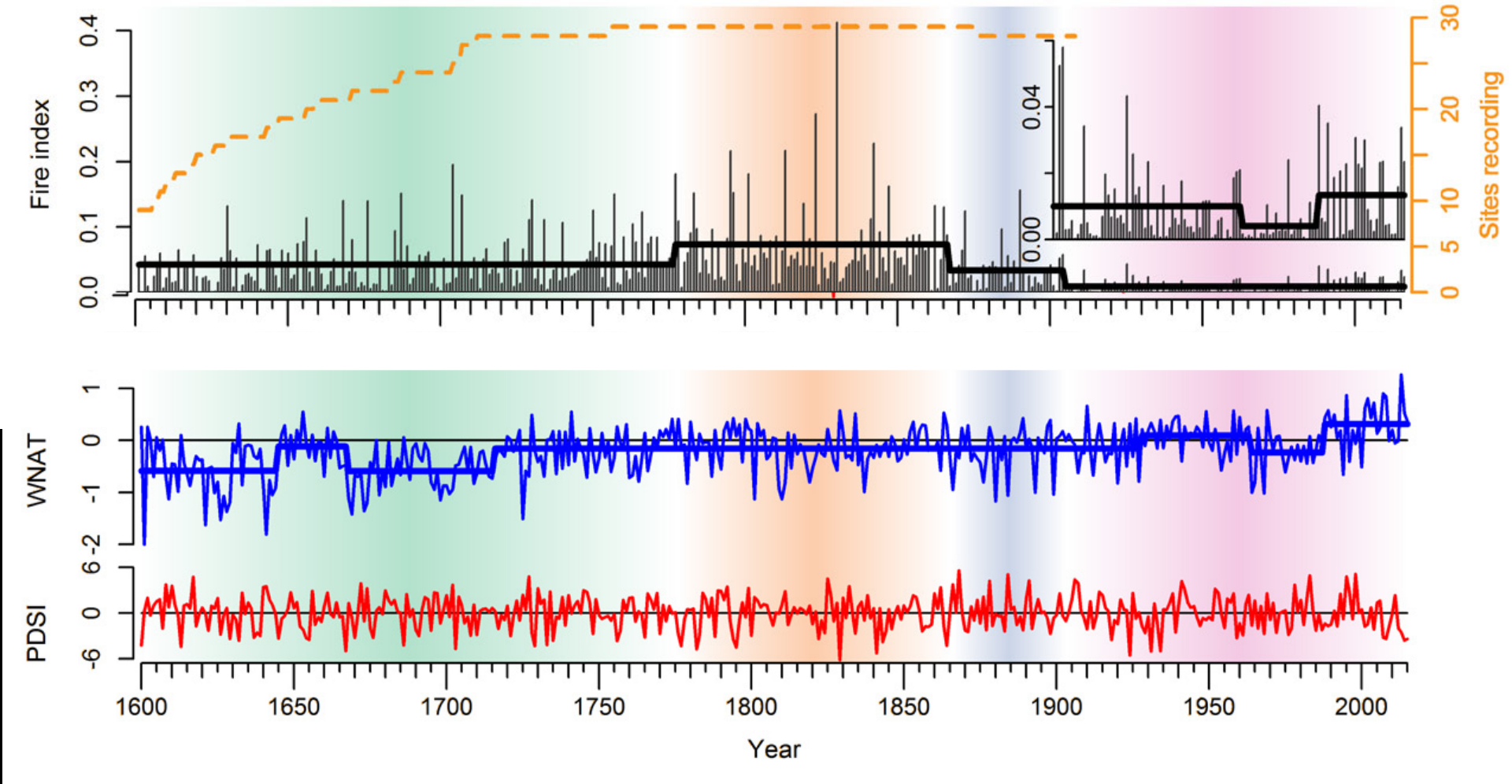
Sierra Nevada/Cascade Range

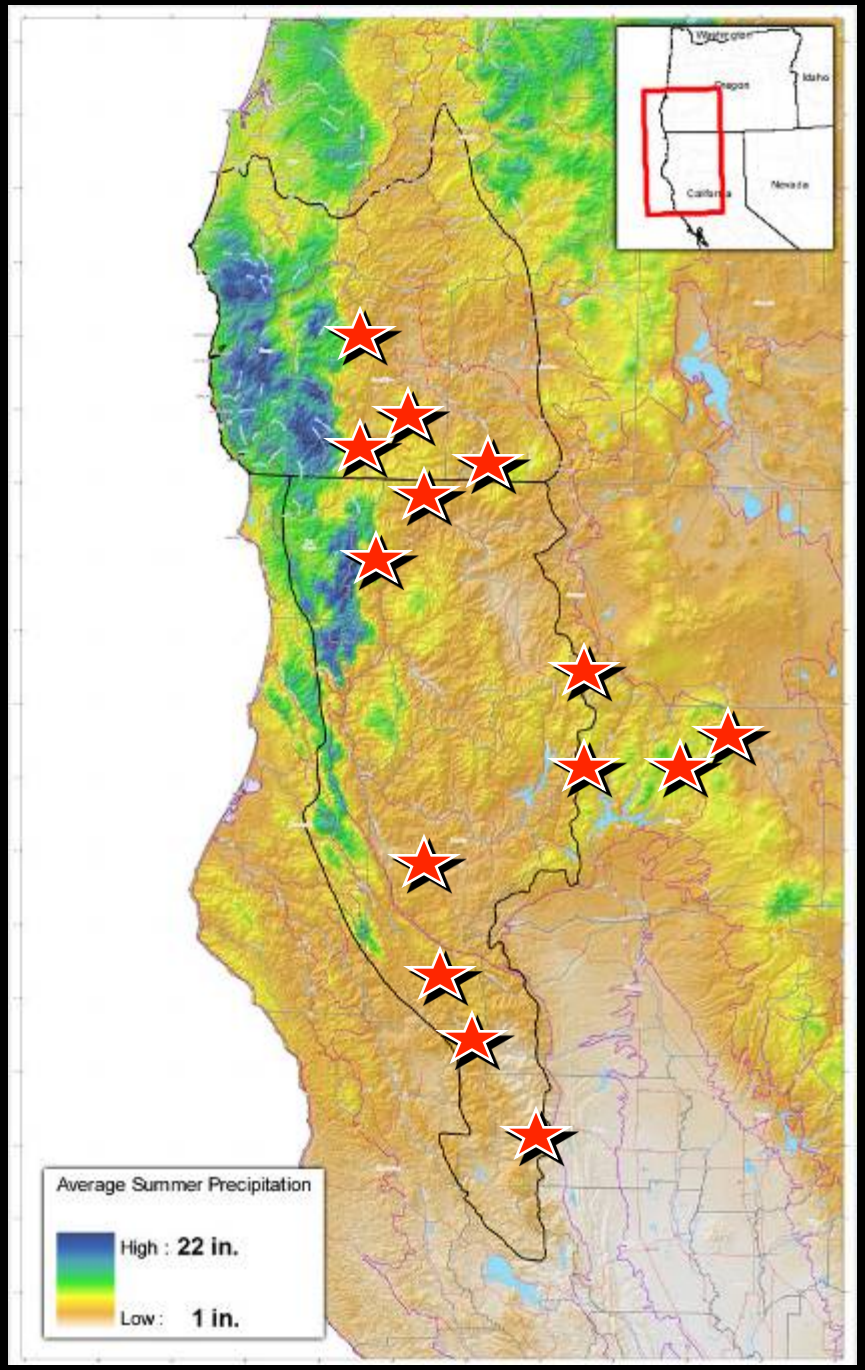
Fire Activity Index

Fire Regime Periods



Sierra Nevada/Cascade Range
Fire Activity Index
Fire Regime Periods





Fire History Studies

Fire Scar Dendrochronology Studies

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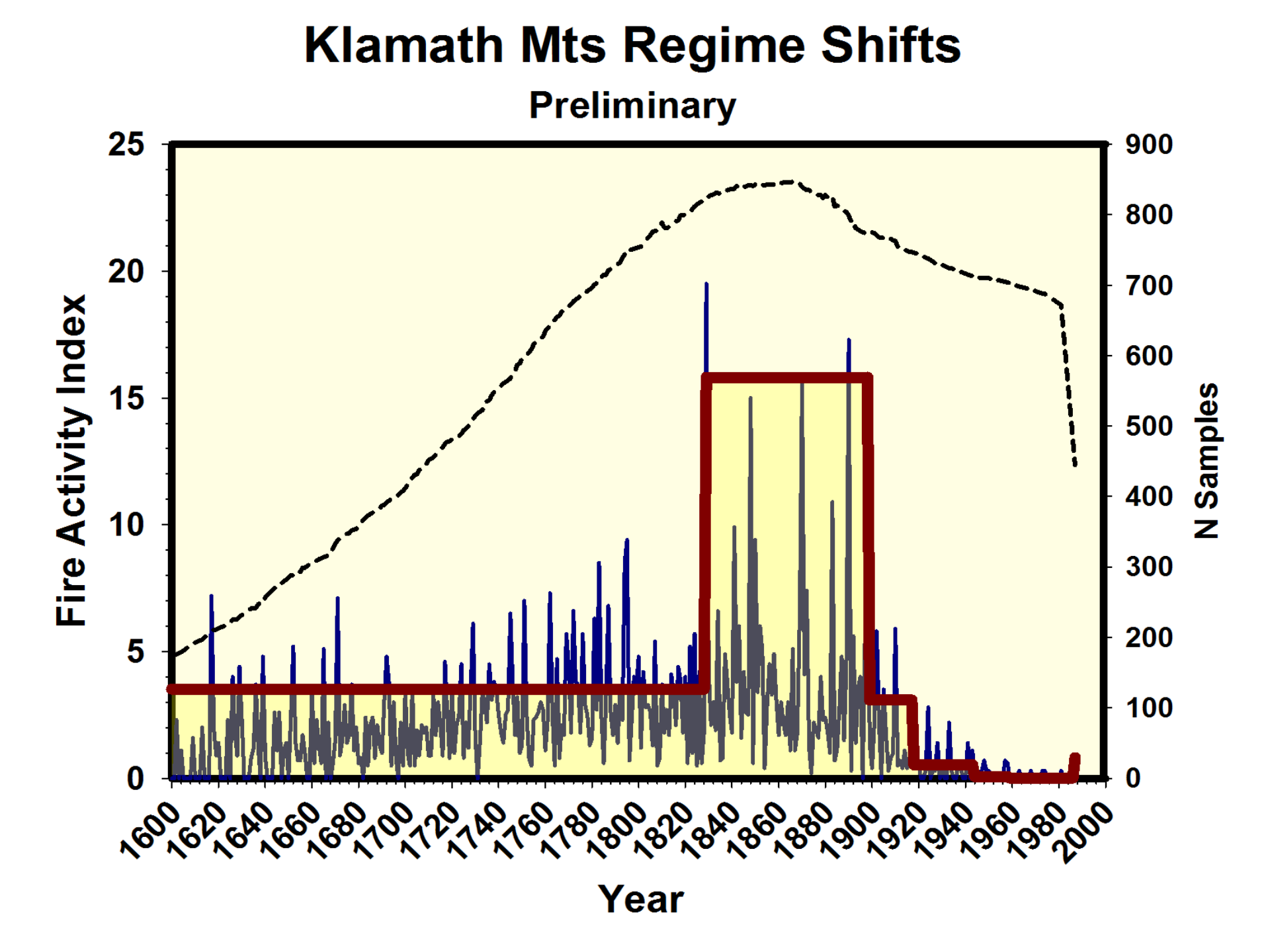
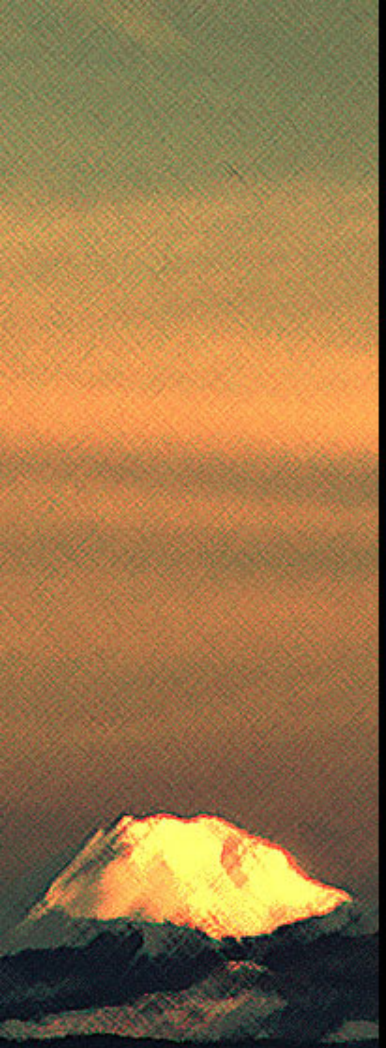

Klamath Mts Regime Shifts
Preliminary
Fire Activity Index
N Samples
Year
0
5
10
15
20
25
0
100
200
300
400
500
600
700
800
900
1600
1620
1640
1660
1680
1700
1720
1740
1760
1780
1800
1820
1840
1860
1880
1900
1920
1940
1960
1980
2000



Climate Change & Fire?
Hasn't Climate Warmed Before?

Never

when accompanied by

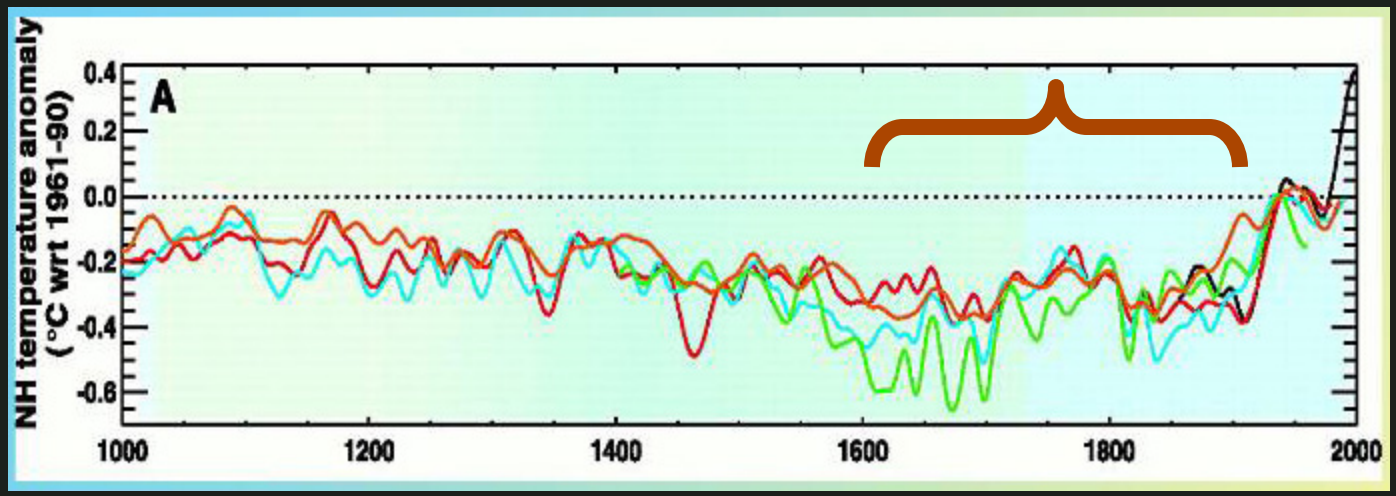
50-100 Yrs of

fire suppression!

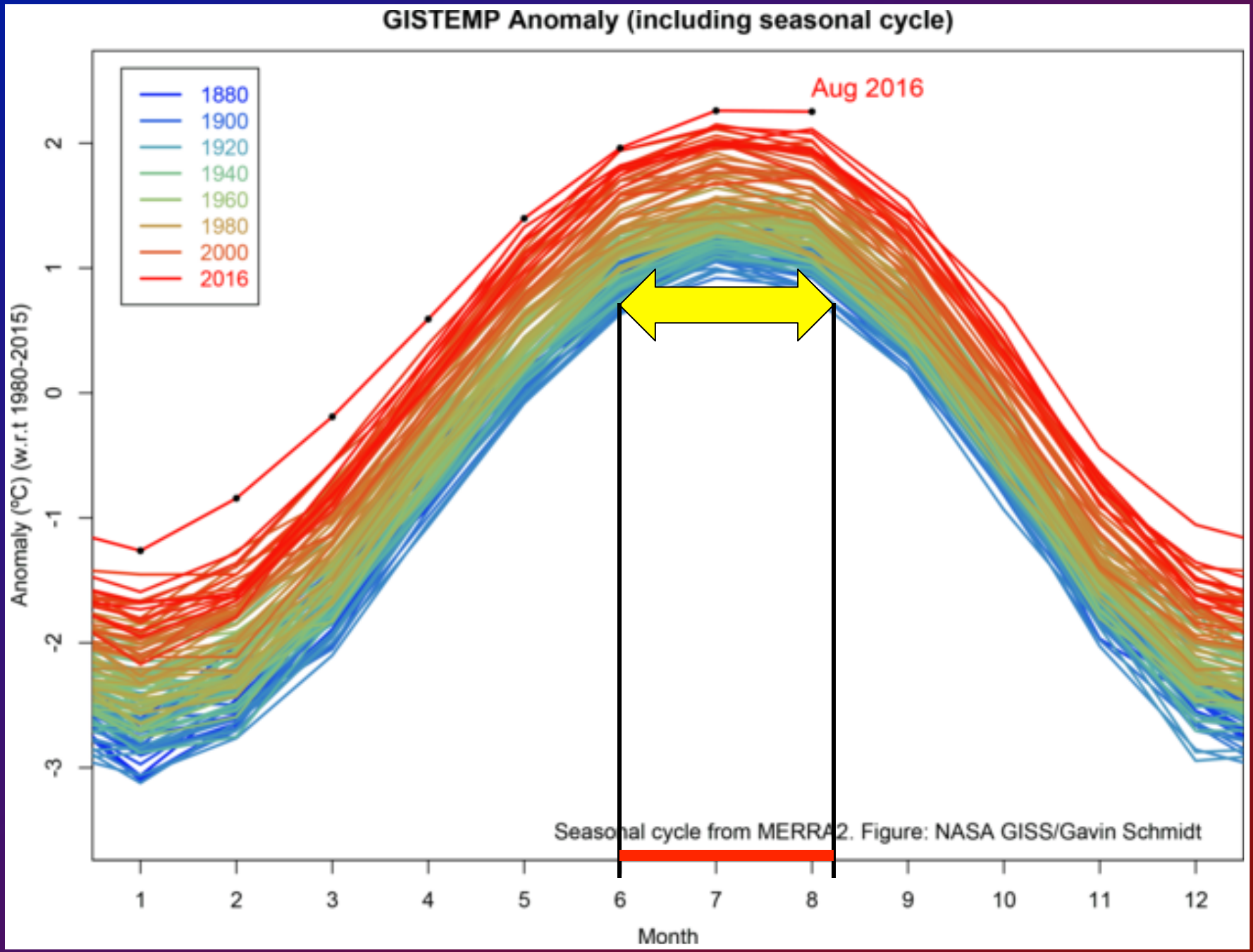
Tree-ring Based Fire Histories

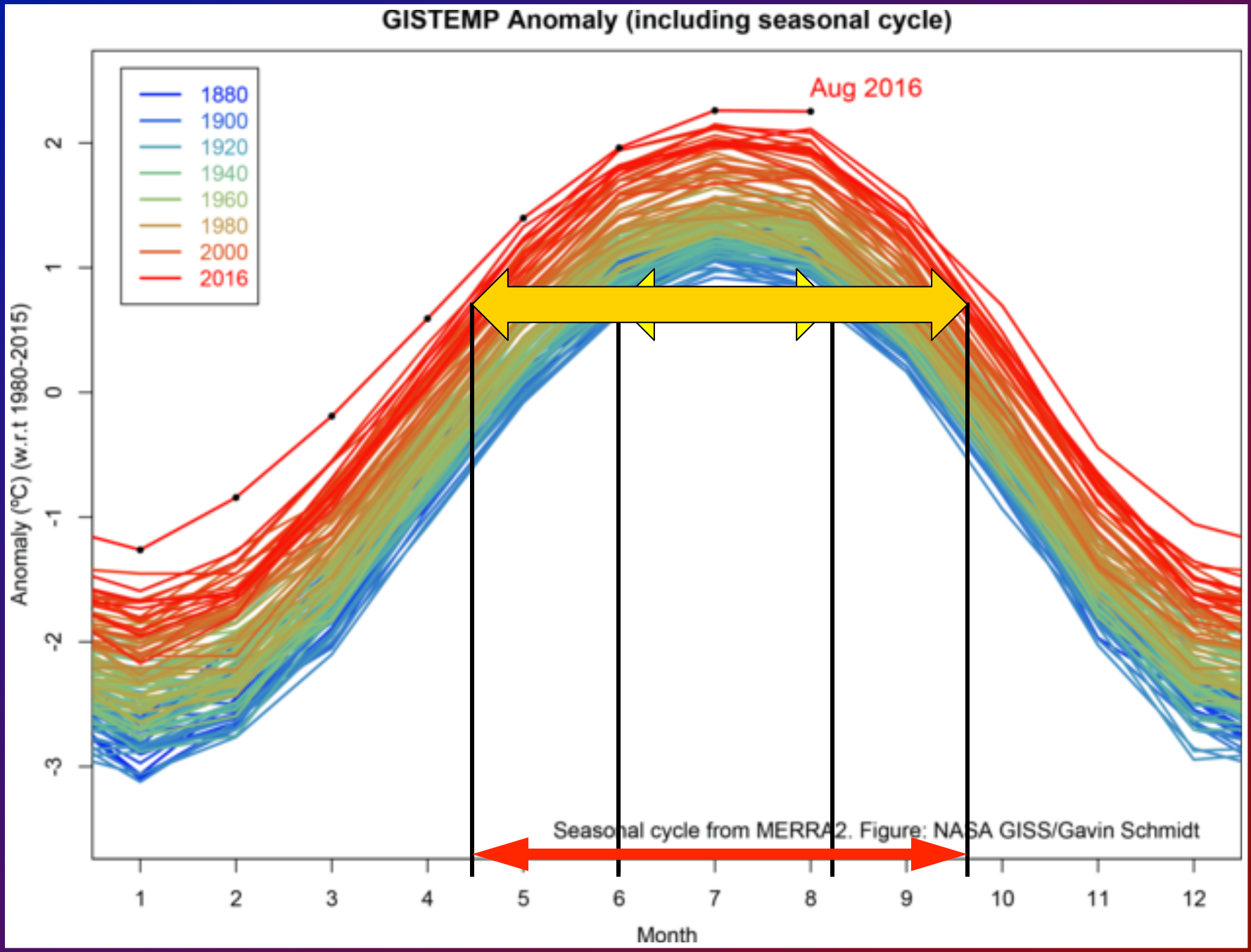
Mostly cover the period of ~1600 to 1900

Much colder than 20th or 21st Century.



From: Jones et al. 2001 Science 292: 662-667


GISTEMP Anomaly (including seasonal cycle)
1880
1900
1920
1940
1960
1980
2000
2016
Aug 2016
Anomaly (°C) (w.r.t 1980-2015)
2
1
0
-1
-2
-3
Seasonal cycle from MERRA2. Figure: NASA GISS/Gavin Schmidt
1
2
3
4
5
6
7
8
9
10
11
12
Month


GISTEMP Anomaly (including seasonal cycle)
1880
1900
1920
1940
1960
1980
2000
2016
Aug 2016
Anomaly (ºC) (w.r.t 1980-2015)
2
1
0
-1
-2
-3
1
2
3
4
5
6
7
8
9
10
11
12
Month
Seasonal cycle from MERRA2. Figure: NASA GISS/Gavin Schmidt

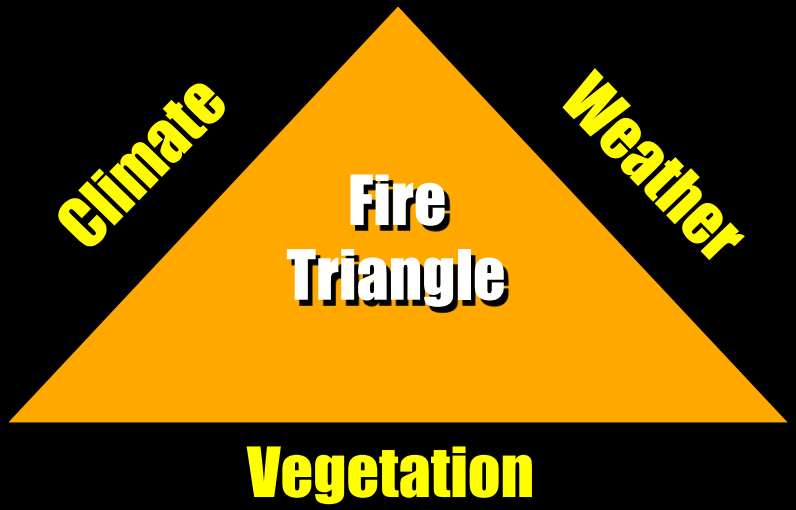
Reconstruction of North Pacific Jet variability and its influence on Sierra Nevada fire regimes

Trouet & Others

S. Belmecheri et al. 2015.
Multi-century evaluation of Sierra Nevada snowpack.
Nature Climate Change 6: 2-3

Where are we headed?

- Fire season getting longer.
- Vegetation keeps growing (fuel).
- Greater probability of intense fires.



Bounded Range Of Variation

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Thresholds & Tipping Points

Moritz et al. 2013.
Ann. NY Acad. Sci. 1286: 92-107
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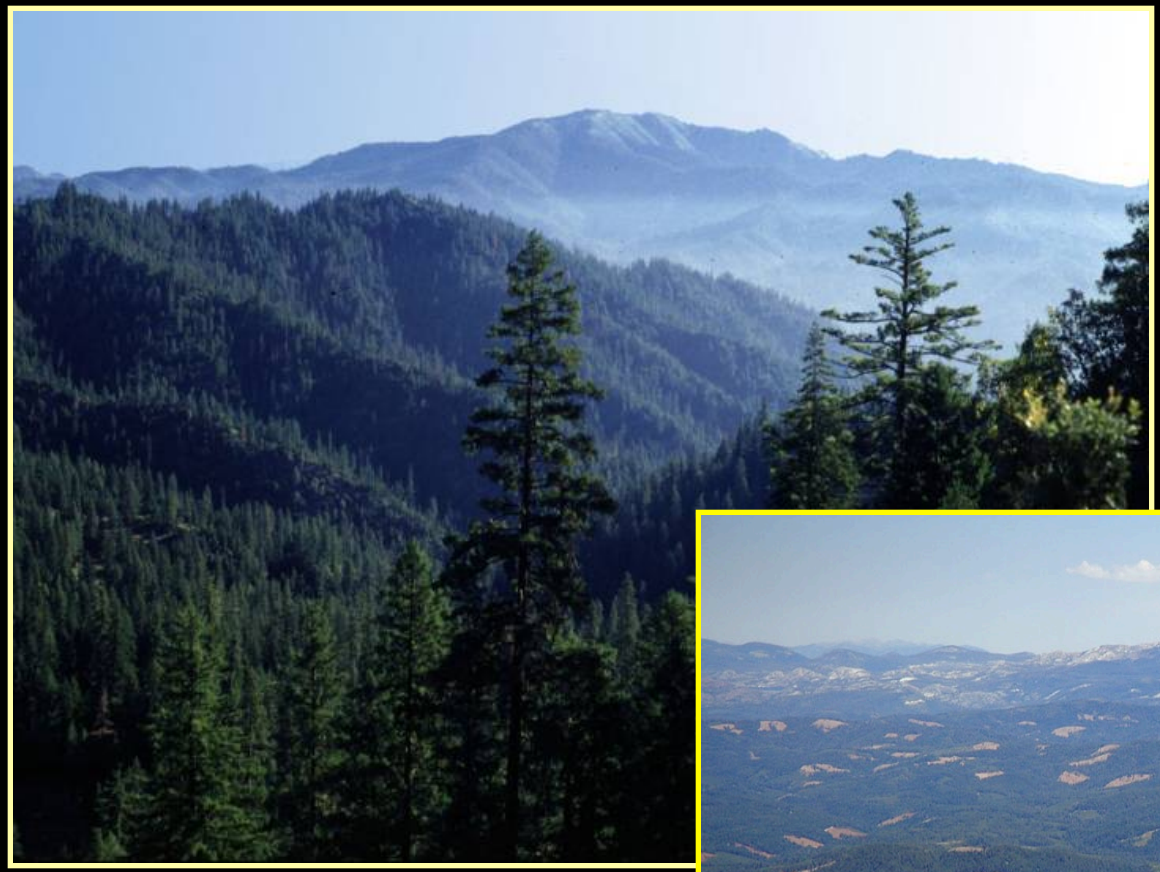

Landscapes:

Diversity & Management Options?

Landscapes:

Diversity & Management Options?

Fire:
A catalyst for change under a changing climate!

Using Managed Wildfire

2006 Fires
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Klamath & Six Rivers National Forests
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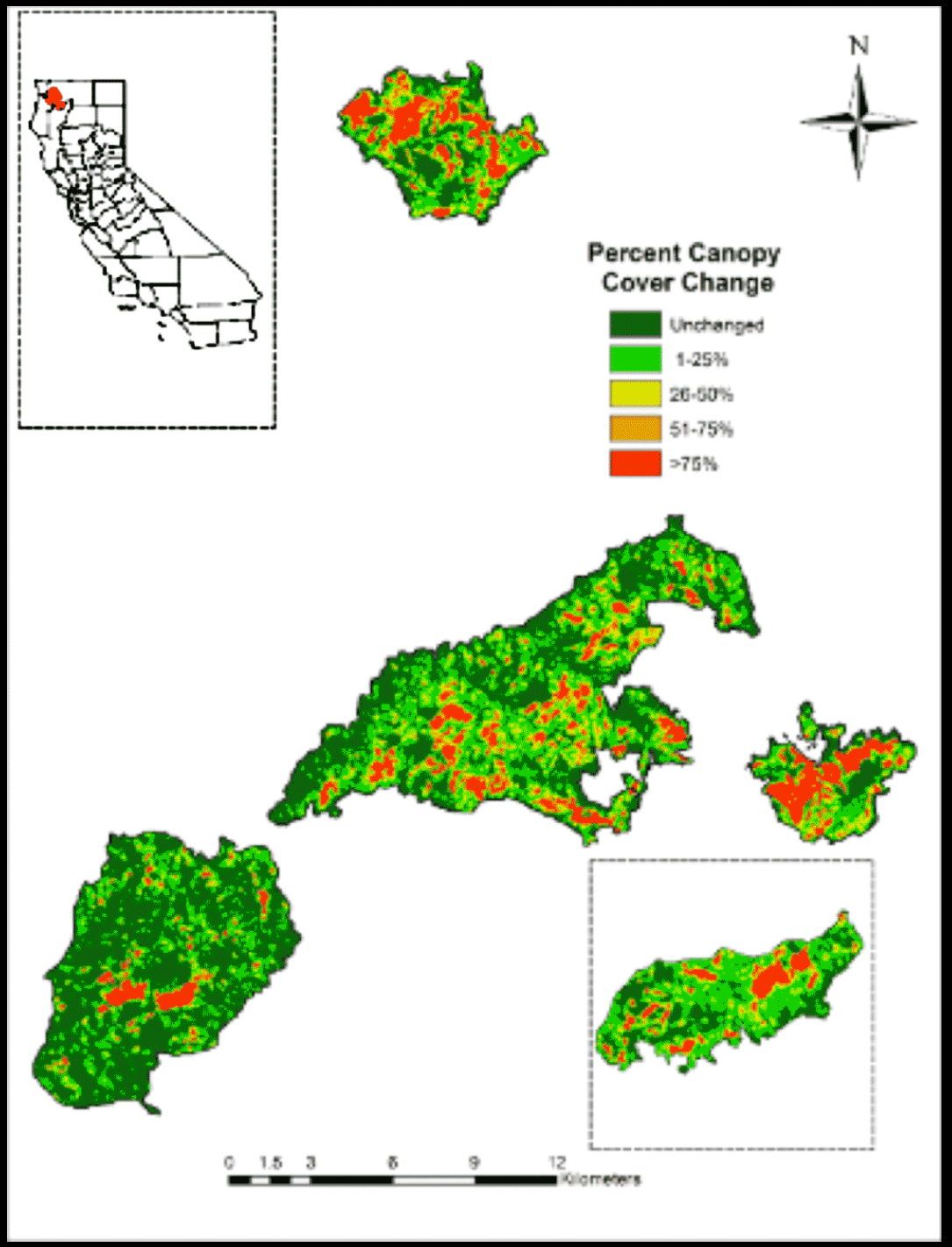
Moderate Burning Conditions

Estes et al.
2017 *Ecosphere*



Inversions
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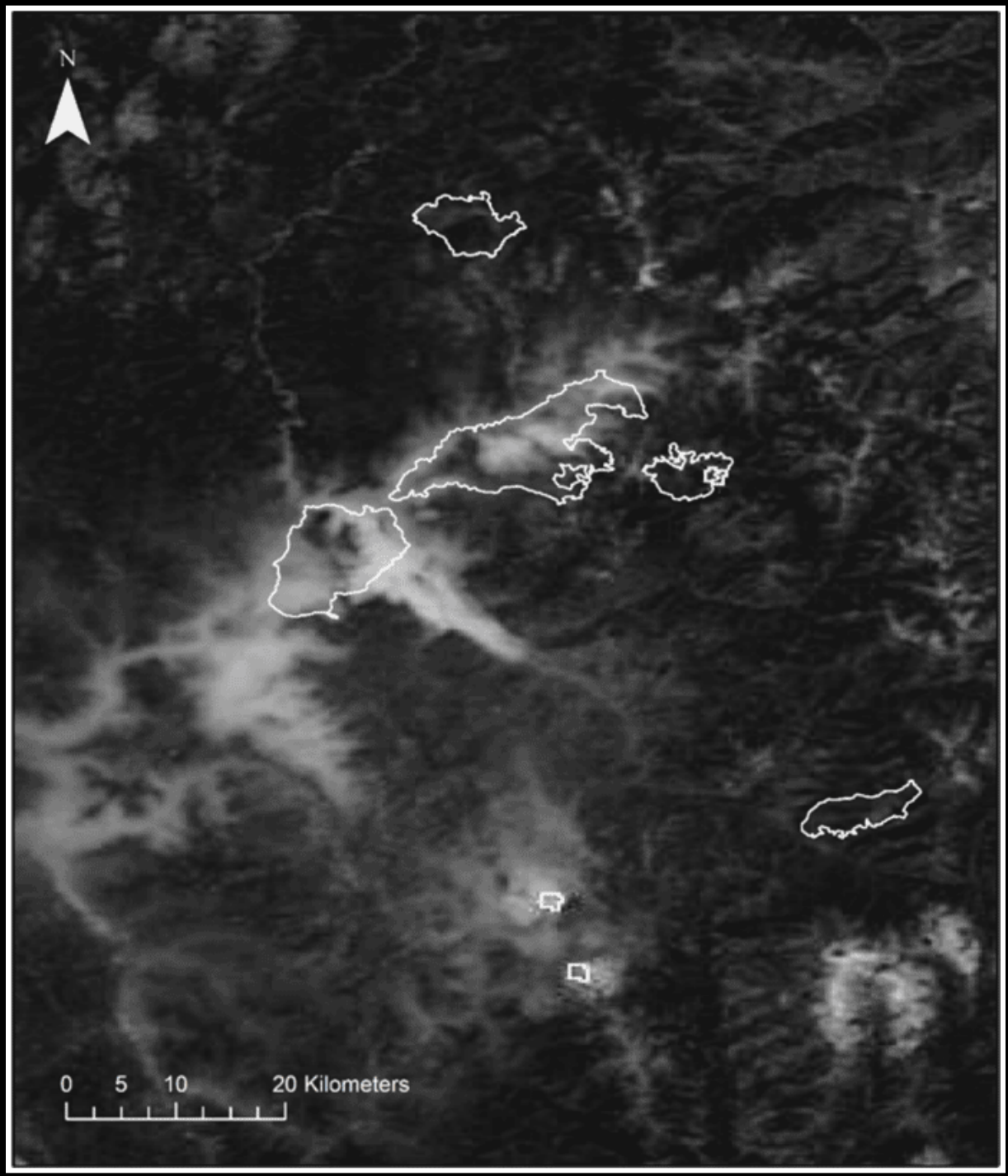
Smoke Trapped In Canyons

Estes et al.
2017 *Ecosphere*



Fire Severity Patterns

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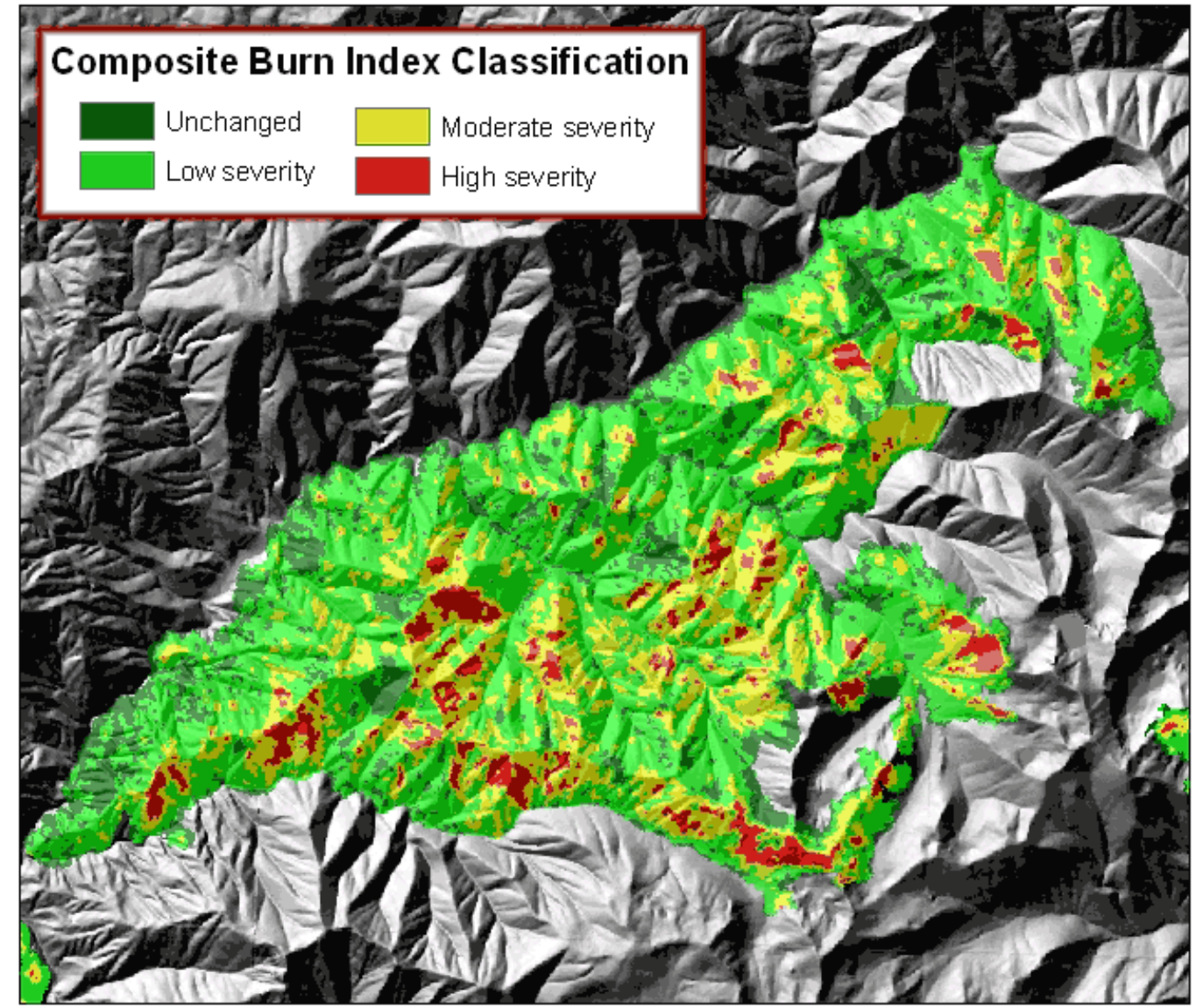
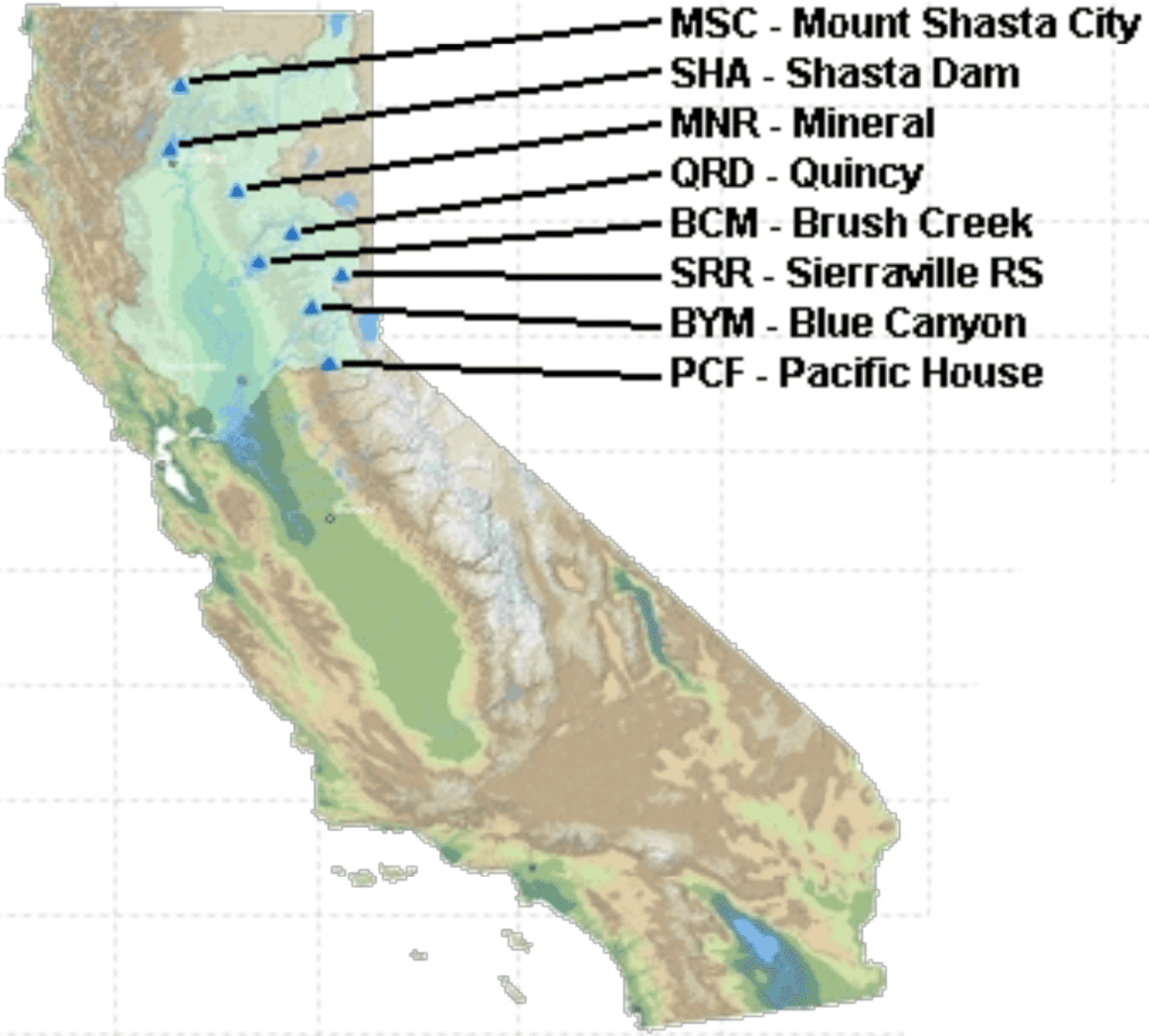
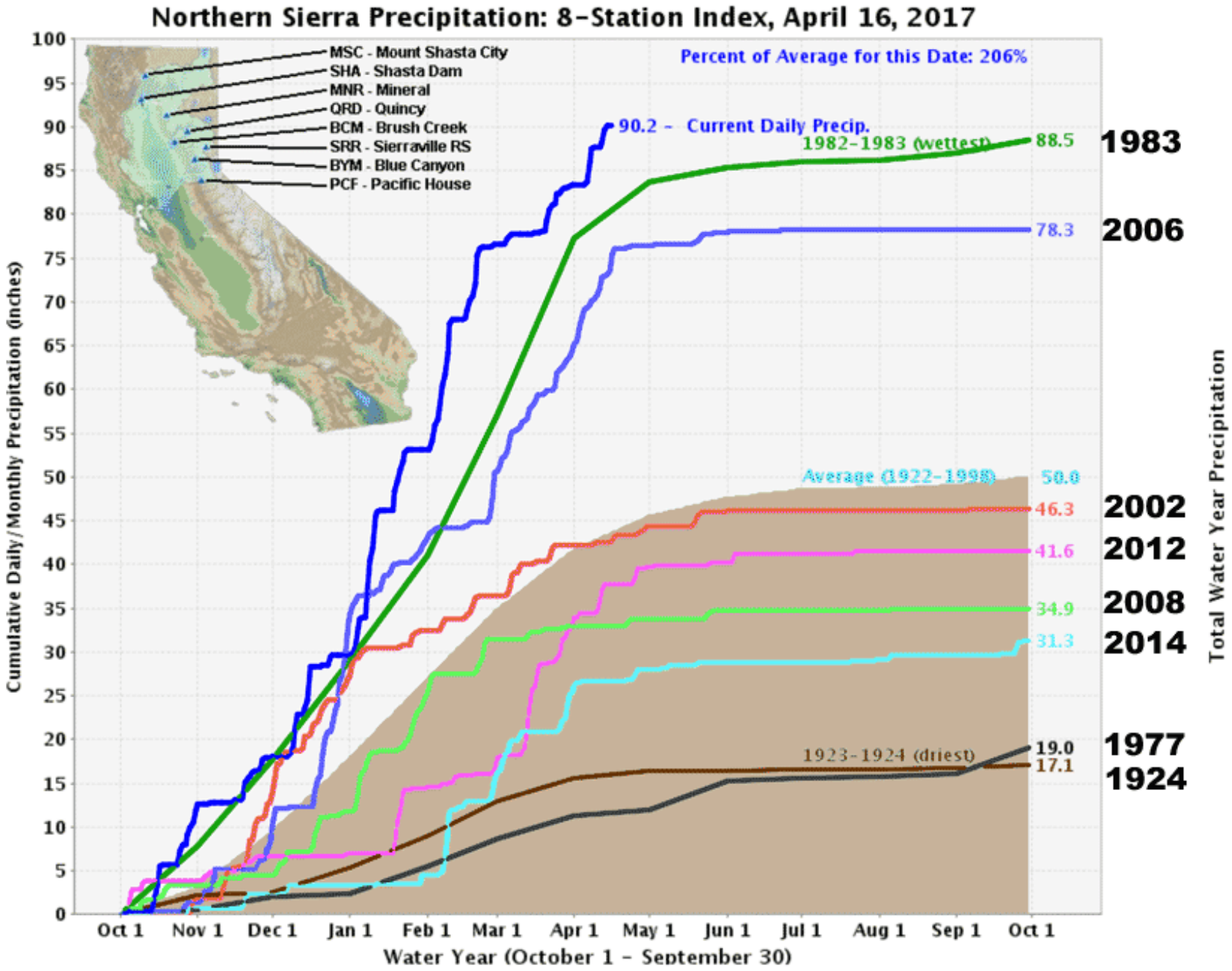
Hancock Fire

Estes et al.
2017
Ecosphere




MSC - Mount Shasta City
SHA - Shasta Dam
MNR - Mineral
QRD - Quincy
BCM - Brush Creek
SRR - Sierraville RS
BYM - Blue Canyon
PCF - Pacific House

California Data Exchange Center - Precipitation




Thank You!