Nexus Between Climate, Weather and Ignition Sources: Regional Patterns in California

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UCLA

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Conservation Biology Institue

The Santa Barbara Independent

Buck Fire
North Winds Oct 2017
Redwood Complex
Lobo Fire
McCourtney Fire
Sulphur Fire
Tubbs Fire
Nuns Fire
Partrick Fire
Atlas Fire
37 Fire
California
Lion Fire

Santa Ana Winds December 2017
NASA

Santa Barbara
Carpinteria
San Buenaventura (Ventura)
Santa Paula
Fillmore
Castaic
Stevenson Ranch
Moorpark
Oxnard
Camarillo
Port Hueneme
Simi Valley
Thousand Oaks
Oak Park
Agoura Hills
Calabasas
Los Angeles
USGS
science for a changing world

E&E NEWS

CLIMATE

Scientists See Climate Change in California's Wildfires

Strong winds and months of record-high temperatures have fueled the destructive fires

By Debra Kahn, Anne C. Mulkern, E&E News on October 12, 2017

News Outlets proclaimed: ***December wildfires are unheard of***

6 December 1903 San Bernardino, 40,000 acres

31 December 1917 [unnamed] 10,000+ acres

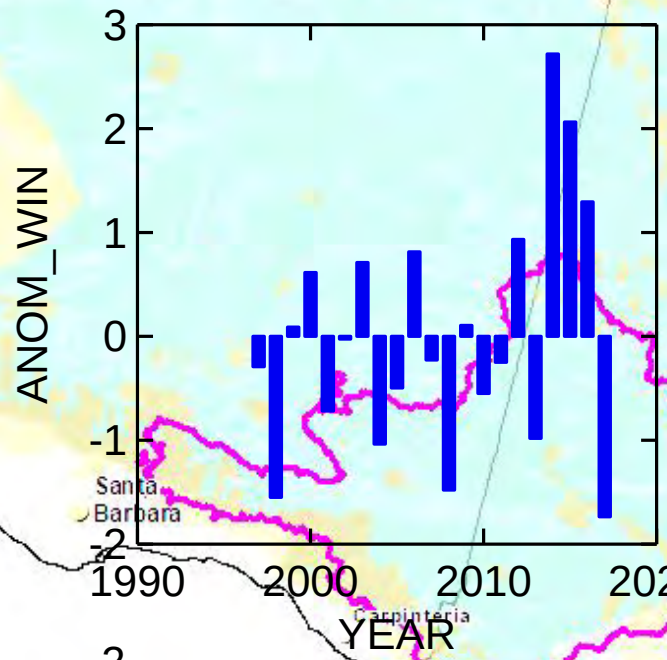
26 December 1956 Sherwood/Zuma, 35,000 acres

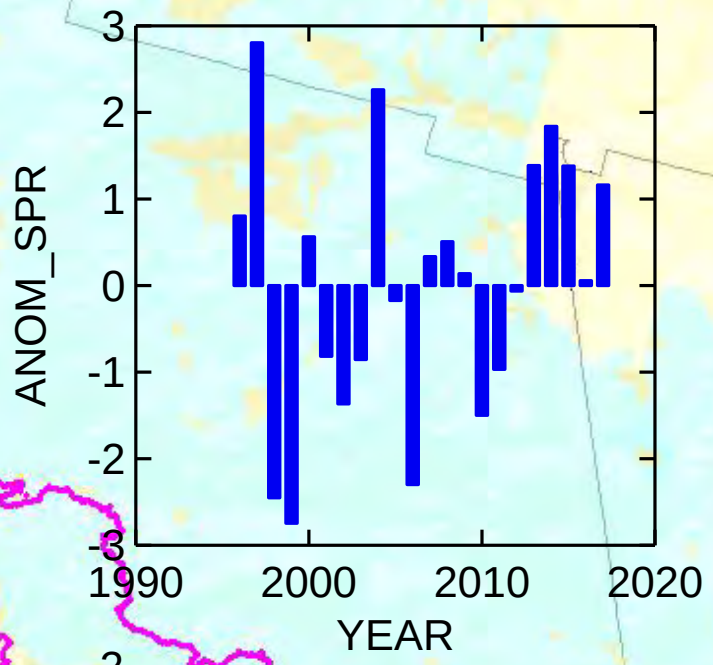
3 December 1958 Malibu Lake, 18,000 acres

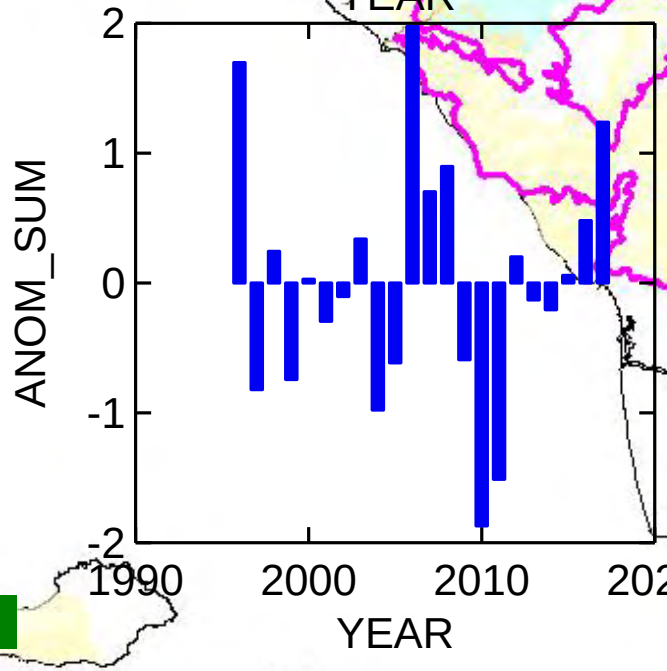
3 December 2006 Schekell, 13,600 acres

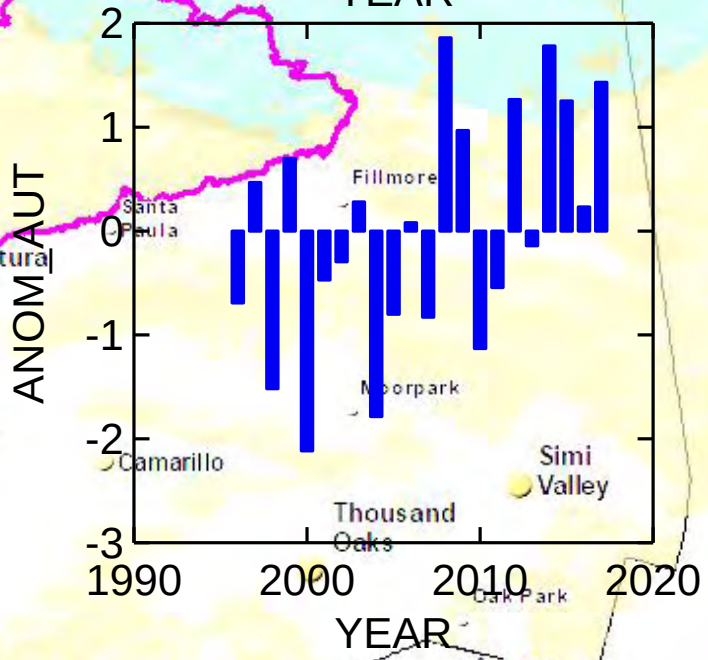
Los Angeles Daily News 20

Average Seasonal Temperature (ºC, Cheeseboro RAWS site, DRI)









Goleta
Isla Vista
Santa Barbara
Carpinteria
San Buenaventura (Ventura)
Oxnard
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Fillmore
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Moorpark
Camarillo
Simi Valley
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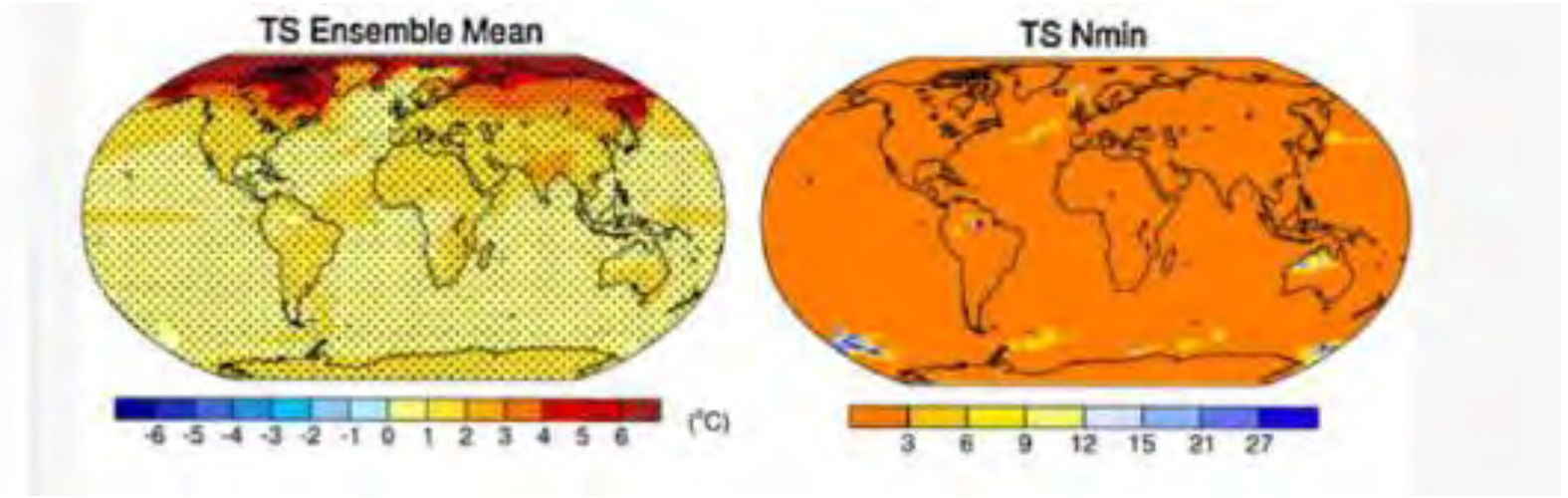
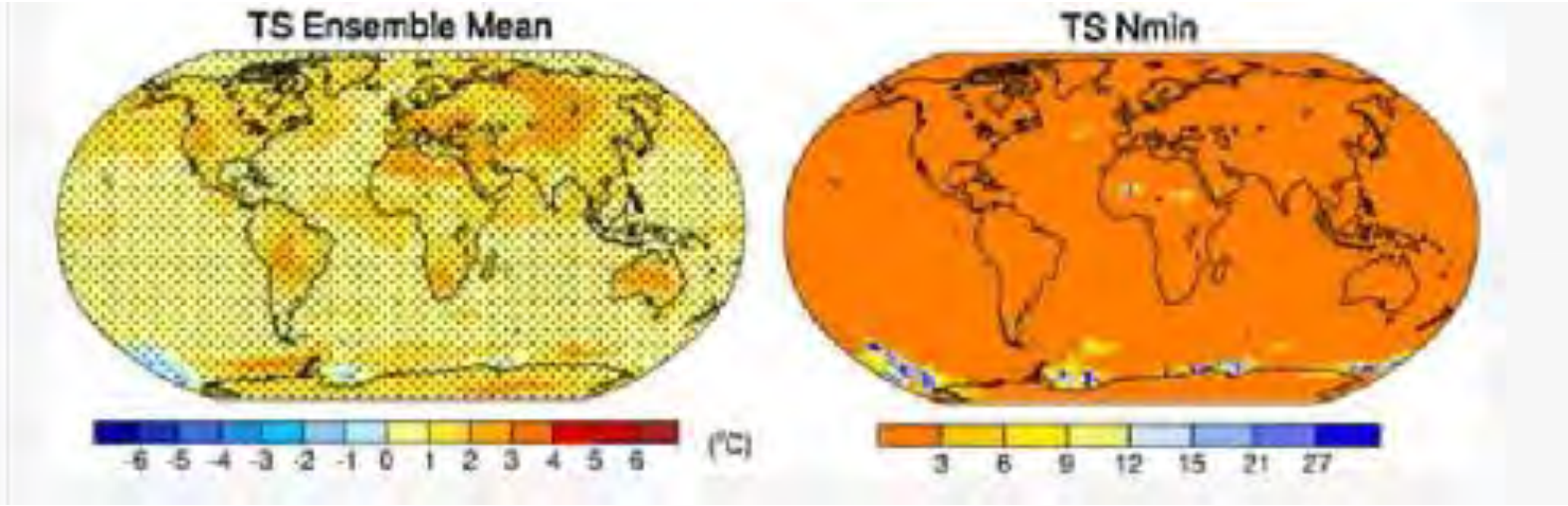
Agoura Hills
Stevenson Ranch
USGS science for a changing world

2060 projections for winter and summer surface temperature

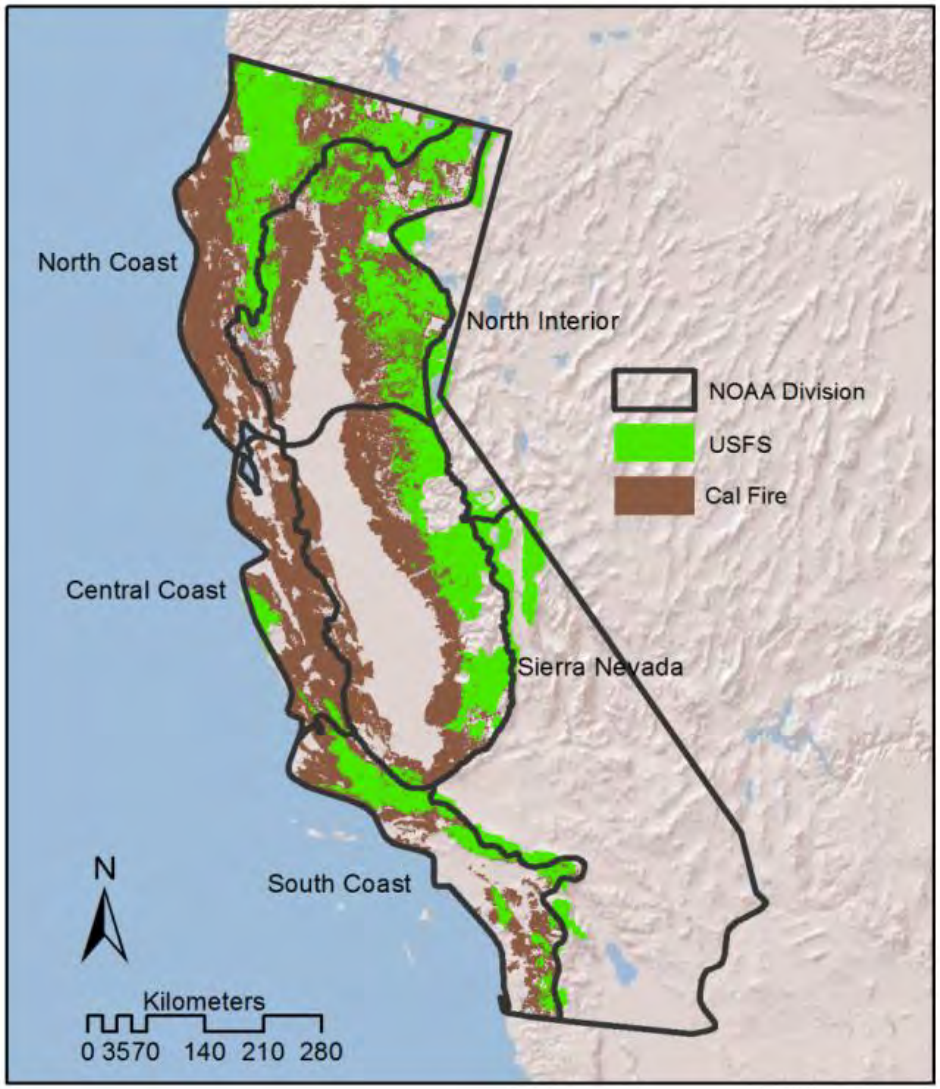
Winter

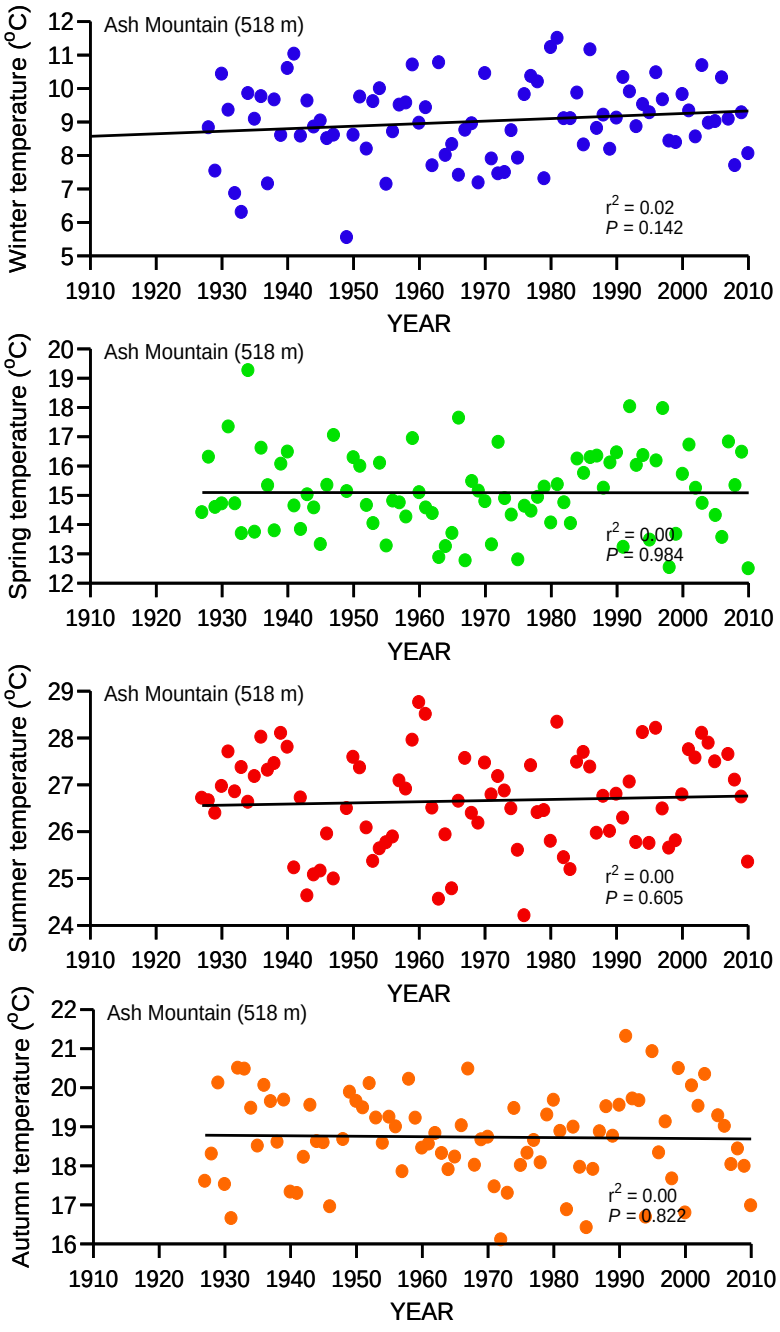


Summer



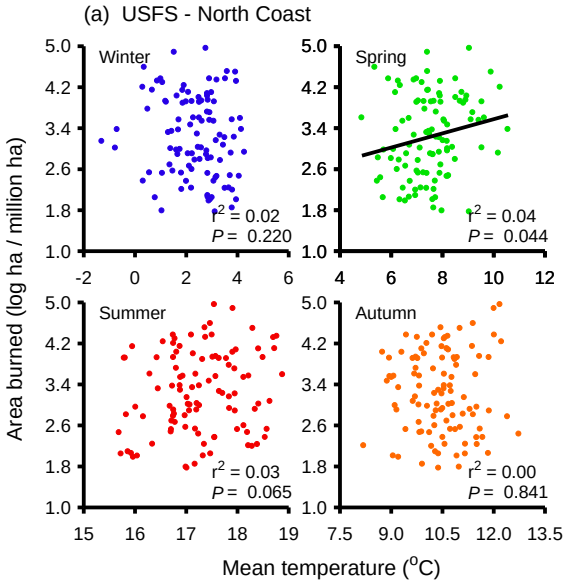
(Deser, Bourdette & Teng 2012)

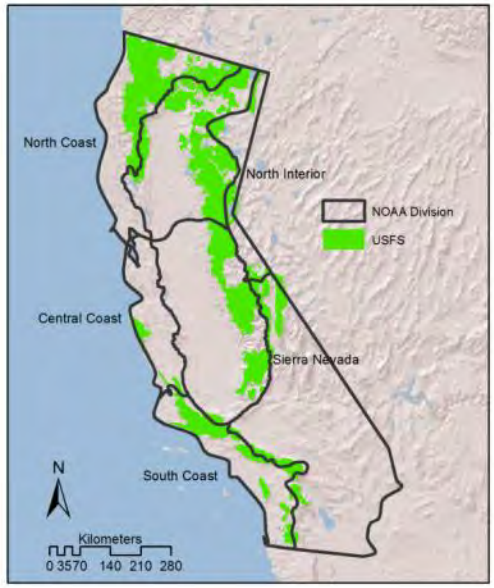


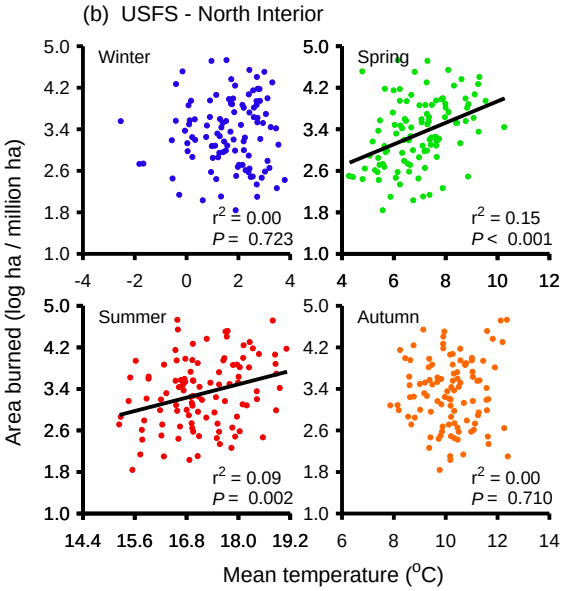


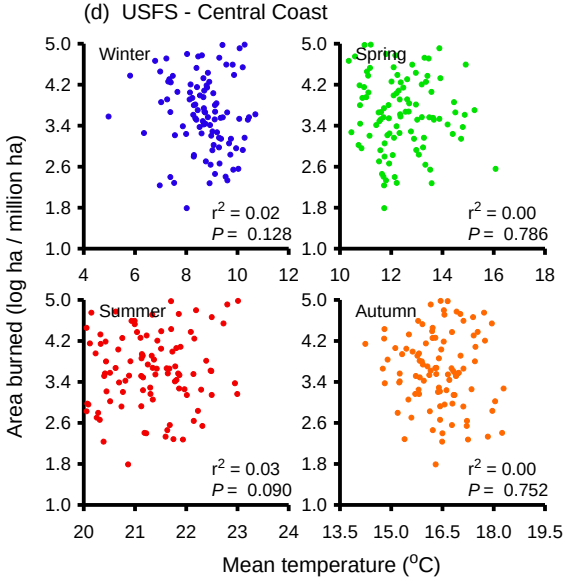
(Keeley & Syphard 2017)

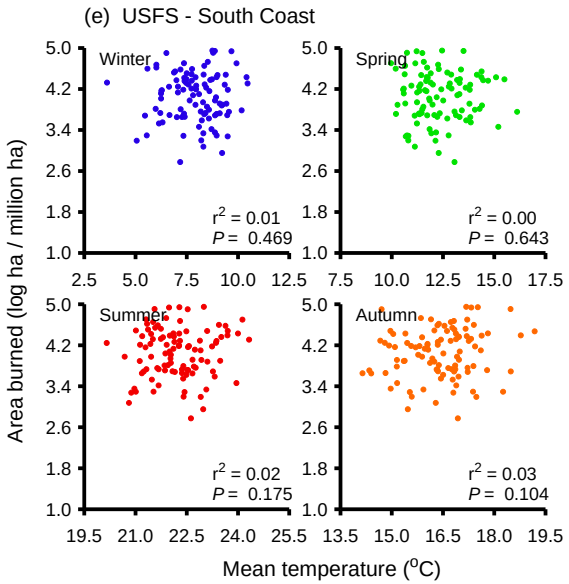
USFS

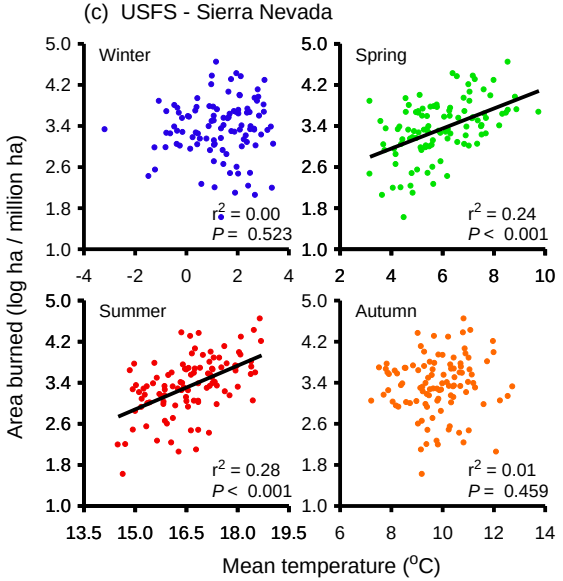






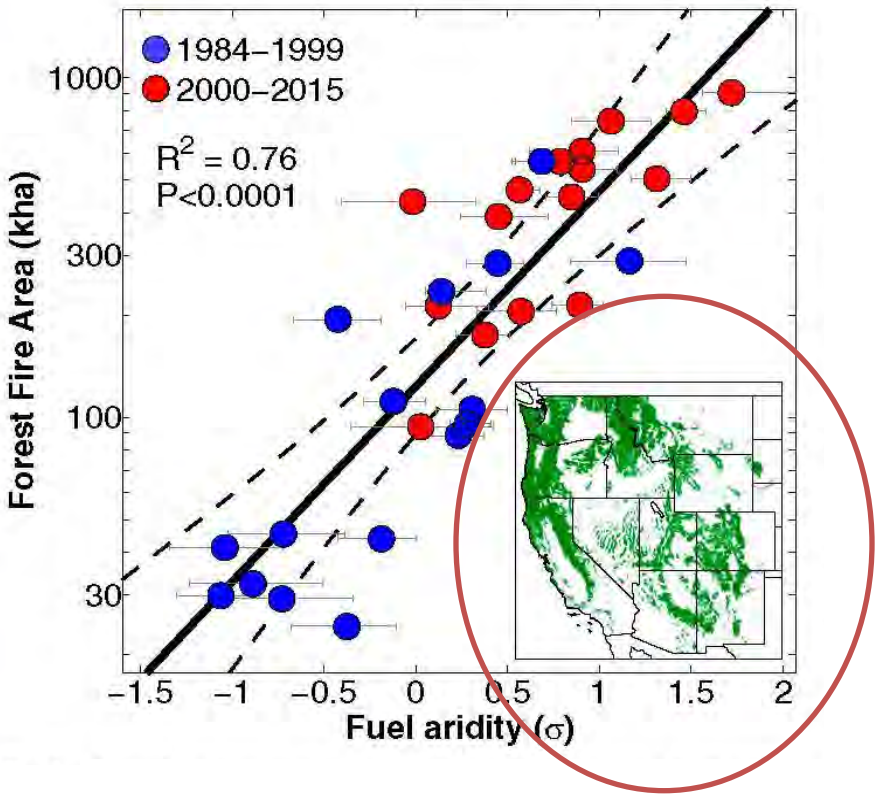


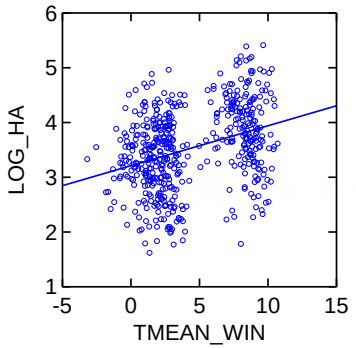


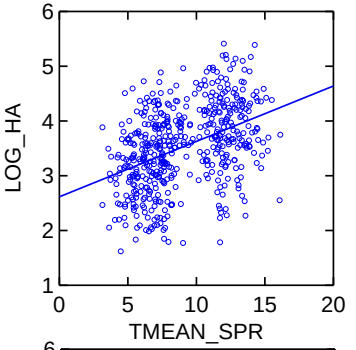


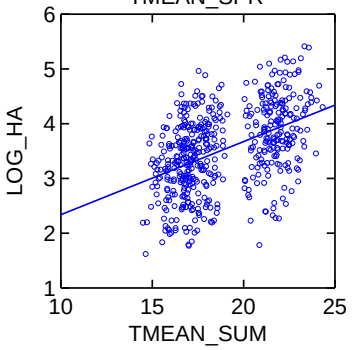
USGS science for a changing world

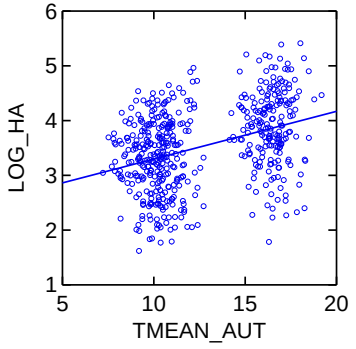
(Keeley & Syphard 2017)


1984–1999
2000–2015
R^2 = 0.76
P<0.0001
Forest Fire Area (kha)
1000
300
100
30
−1.5
−1
−0.5
0
0.5
1
1.5
2
Fuel aridity (σ)

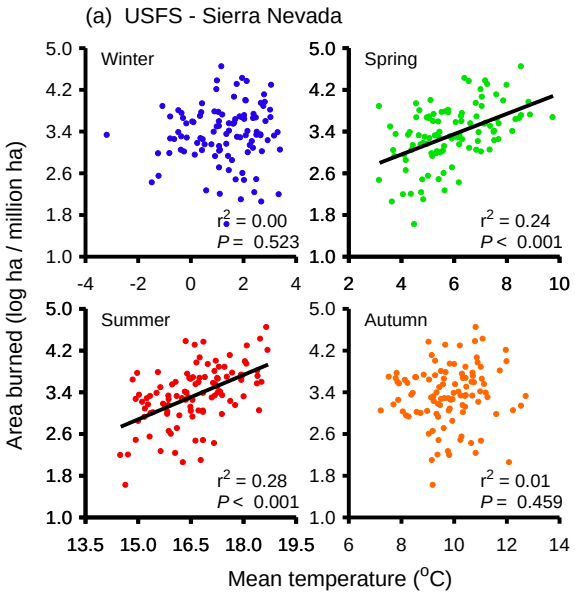

LOG_HA
TMEAN_WIN

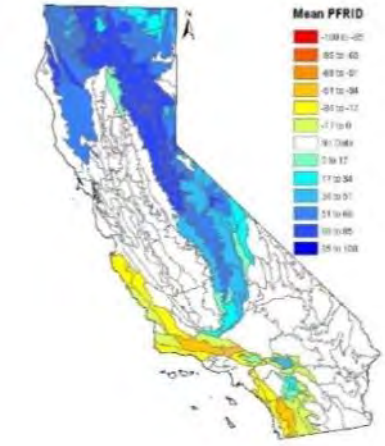

LOG_HA
TMEAN_SPR

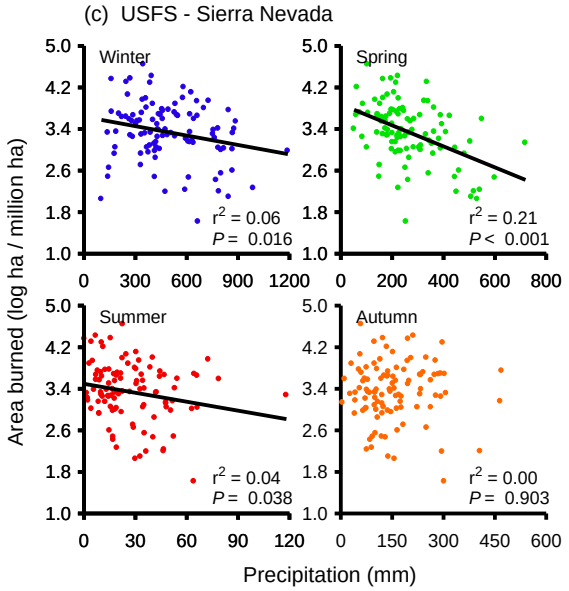

LOG_HA
TMEAN_SUM

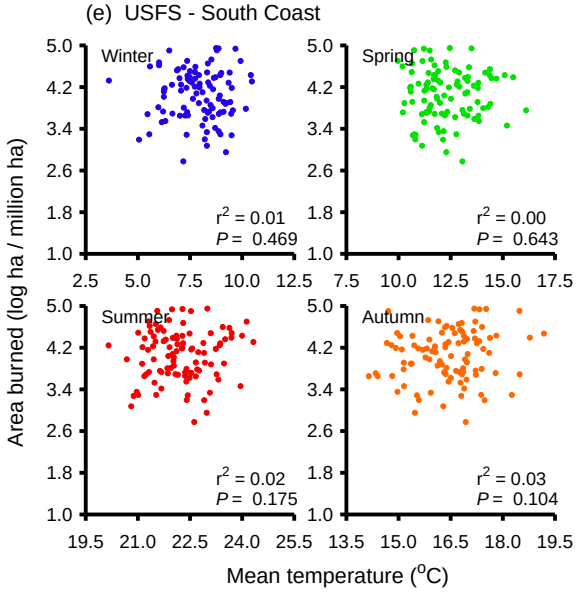

LOG_HA
TMEAN_AUT

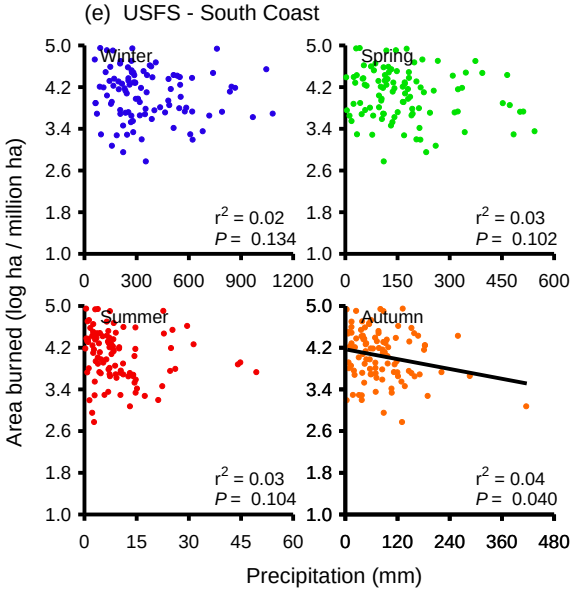
Seasonal Temperature and Precipitation: forests vs non-forested



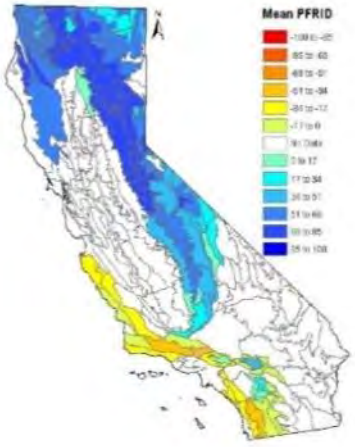


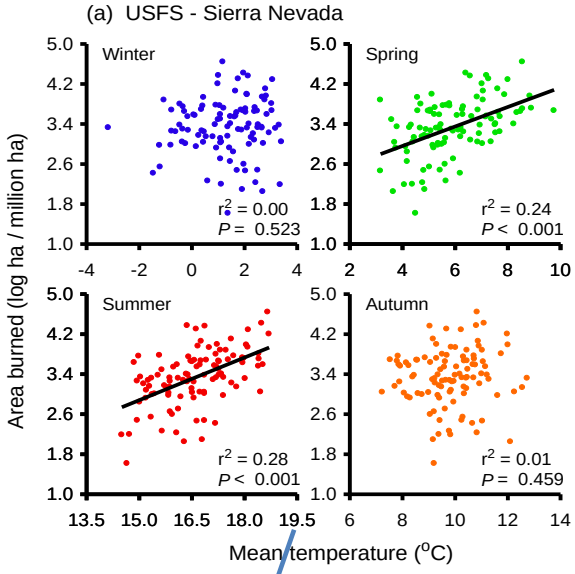


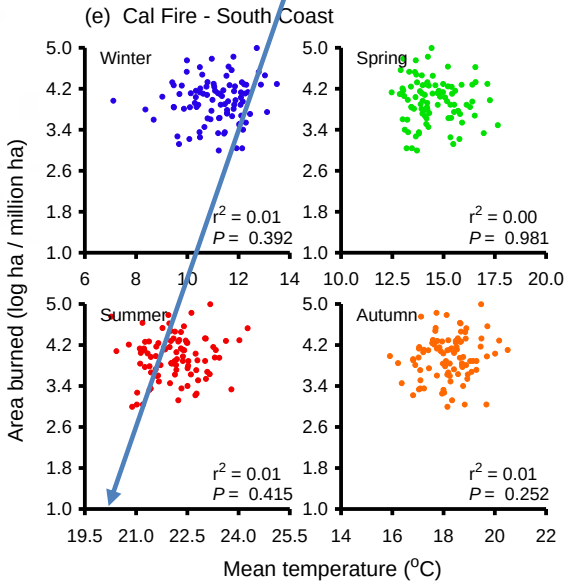




Why?



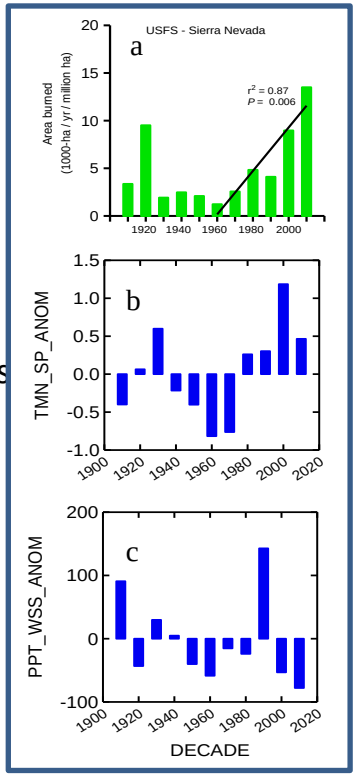


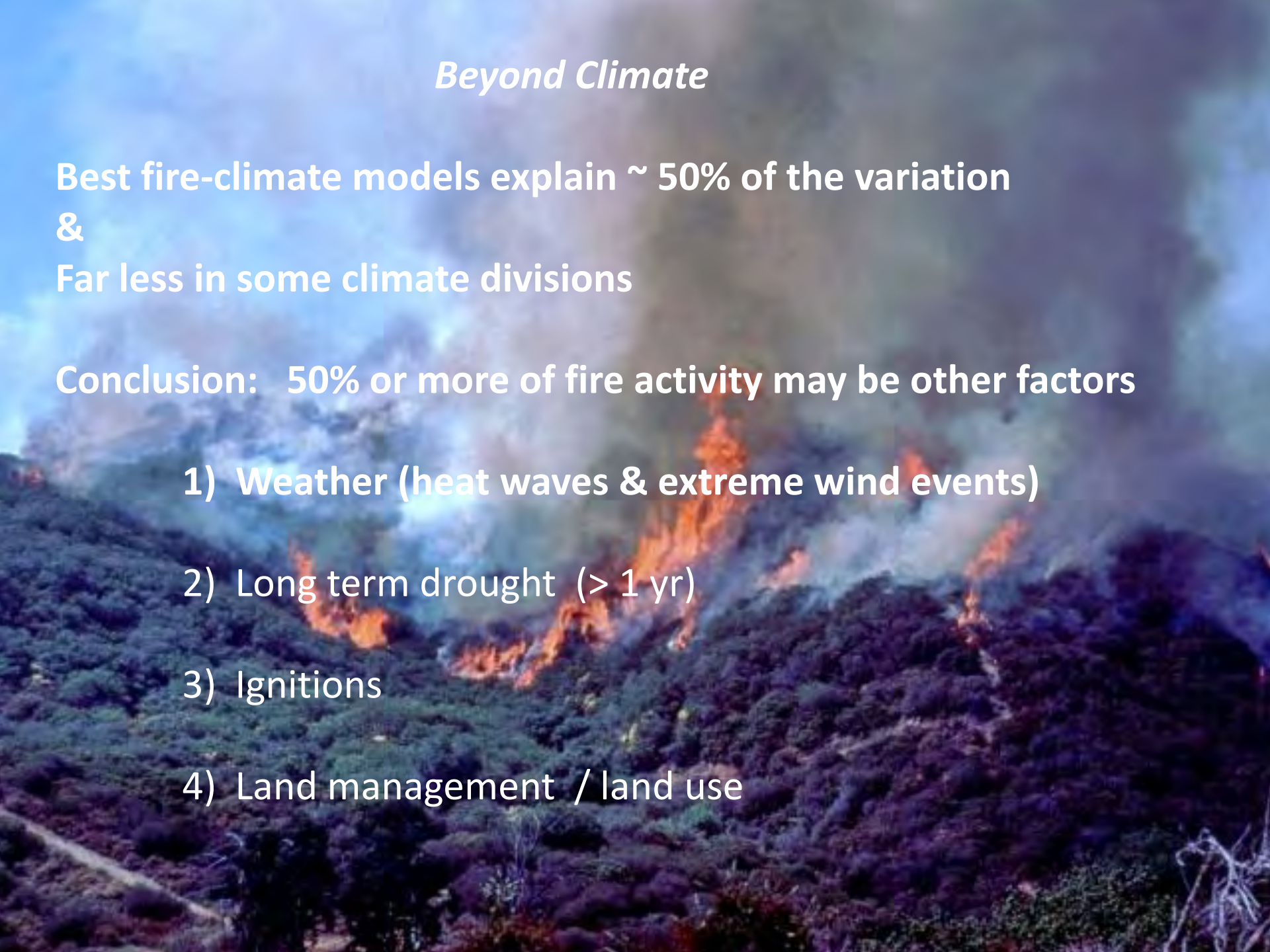


Akaike IC regression models

Sierra Nevada (USFS)	**r2**	
1910 - 2013	0.39	Temp
1910 – 1959	0.42	- Ppt s
1960 - 2013	0.52	Temp

South coast (Cal Fire)	**r2**	
1919 - 2013	0.00	
1919 - 1959	0.00	
1960 - 2013	0.25	Prior ppt-Ppt aut -Ppt sum





Beyond Climate

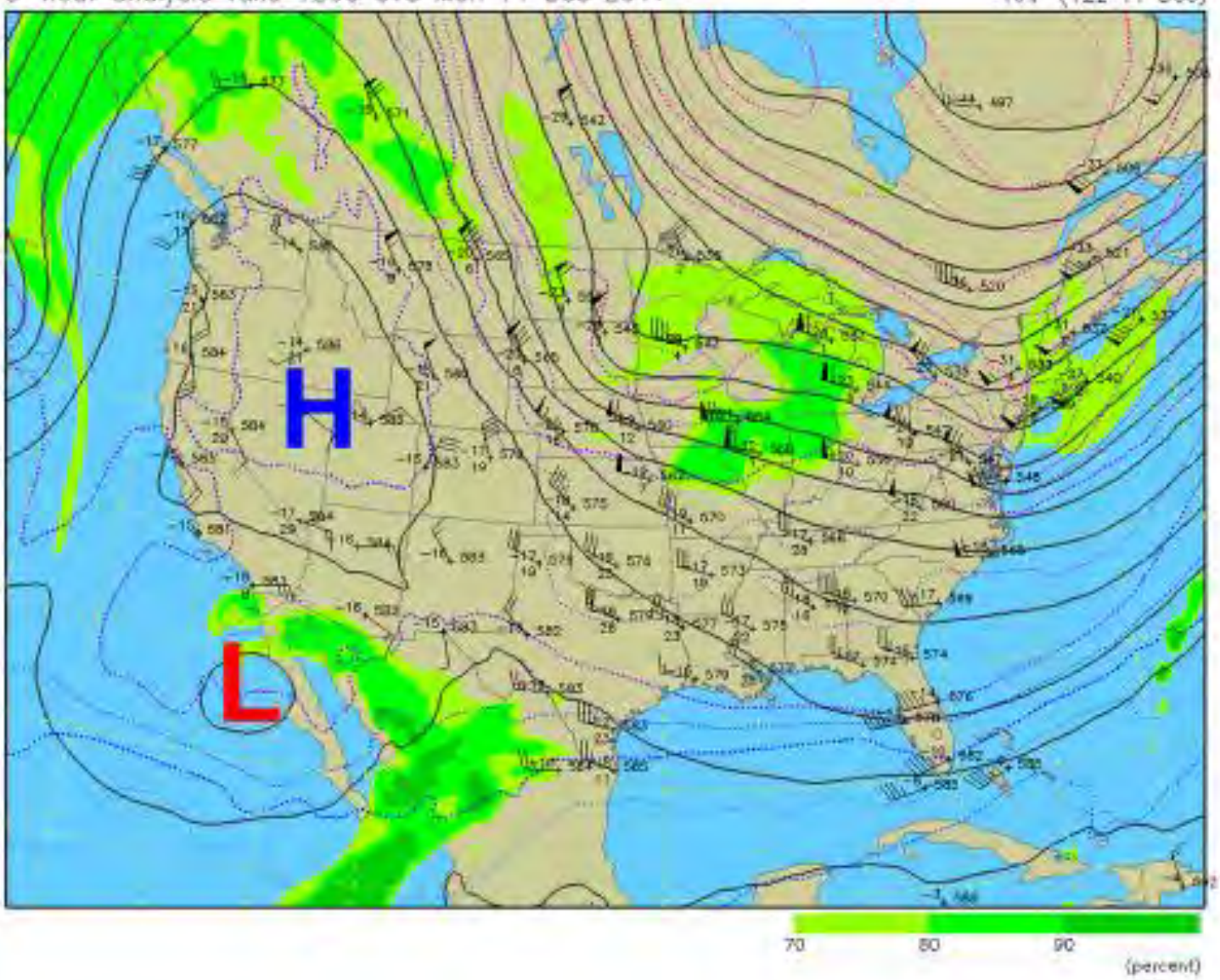
Best fire-climate models explain ~ 50% of the variation
&
Far less in some climate divisions

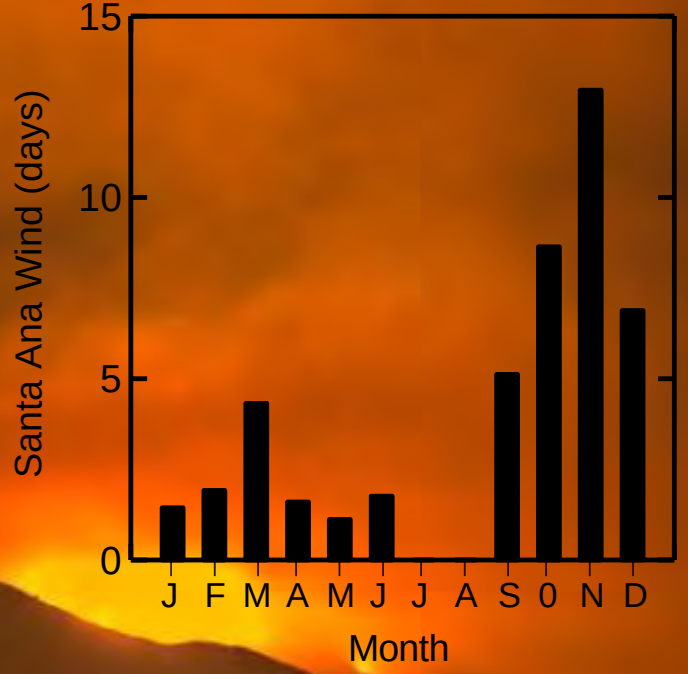
Conclusion: 50% or more of fire activity may be other factors

1) **Weather (heat waves & extreme wind events)**
2) Long term drought (> 1 yr)
3) Ignitions
4) Land management / land use

500 mb rawinsonde data 12z Mon 11 Dec 2017

500 mb Heights (dm) / Temperature (°C) / Humidity (%)

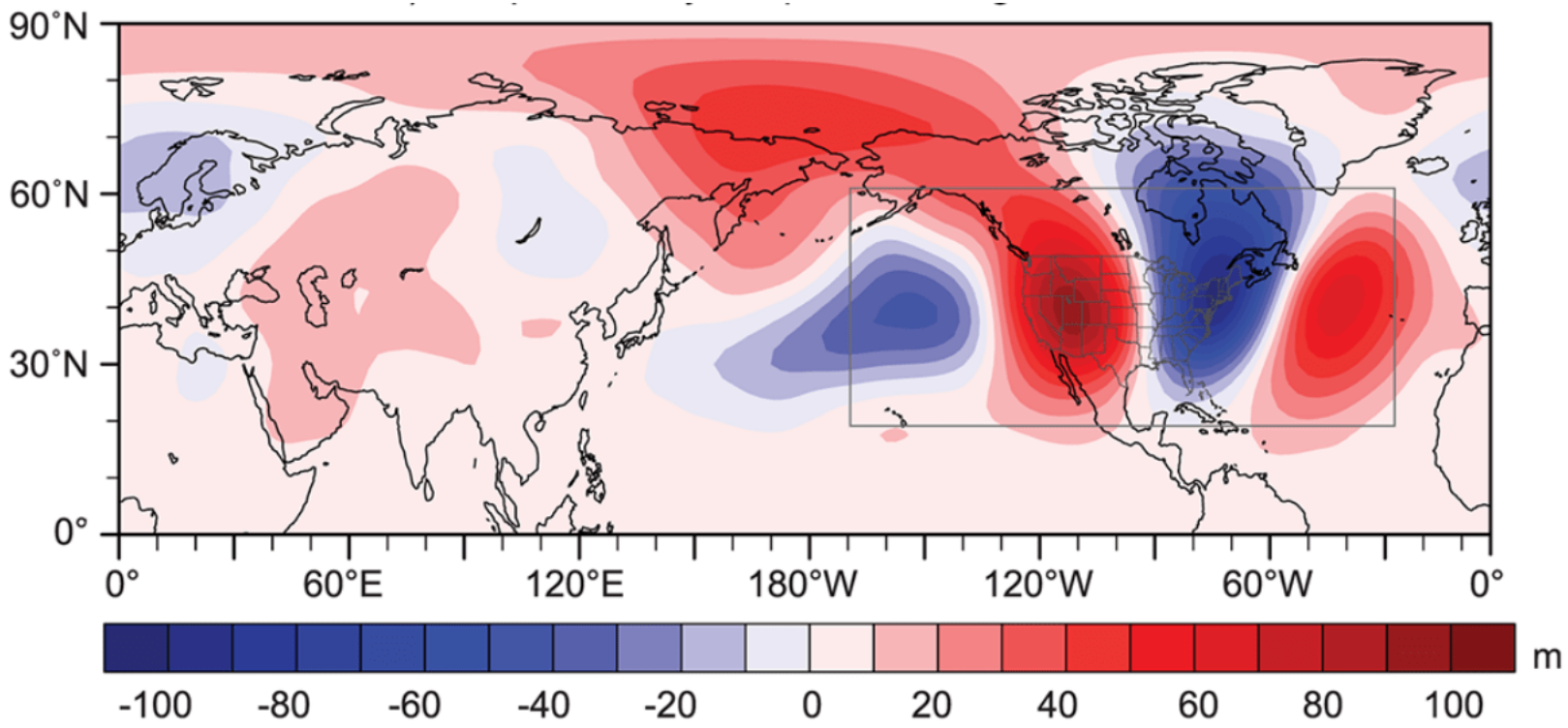




CNN.com1

USGS

Year	Fire	County	Month	Acres	SA days
1889	Santiago Cyn	Orange/R/SD	September	308,900	3
1932	Matilija	Sta Barbara	September	219,900	5
1970	Laguna	San Diego	September	174,200	3
1985	Wheeler #2	Ventura	July	122,800	-
2003	Cedar	San Diego	October	270,575	3
2006	Day	Ventura	September	161,850	2
2007	Zaca	Sta Barbara	July	240,425	-
2007	Witch	San Diego	October	198,175	2
2009	Station	Los Angeles	August	166,600	-
2017	Thomas	Ventura/SB	December	281,890	10



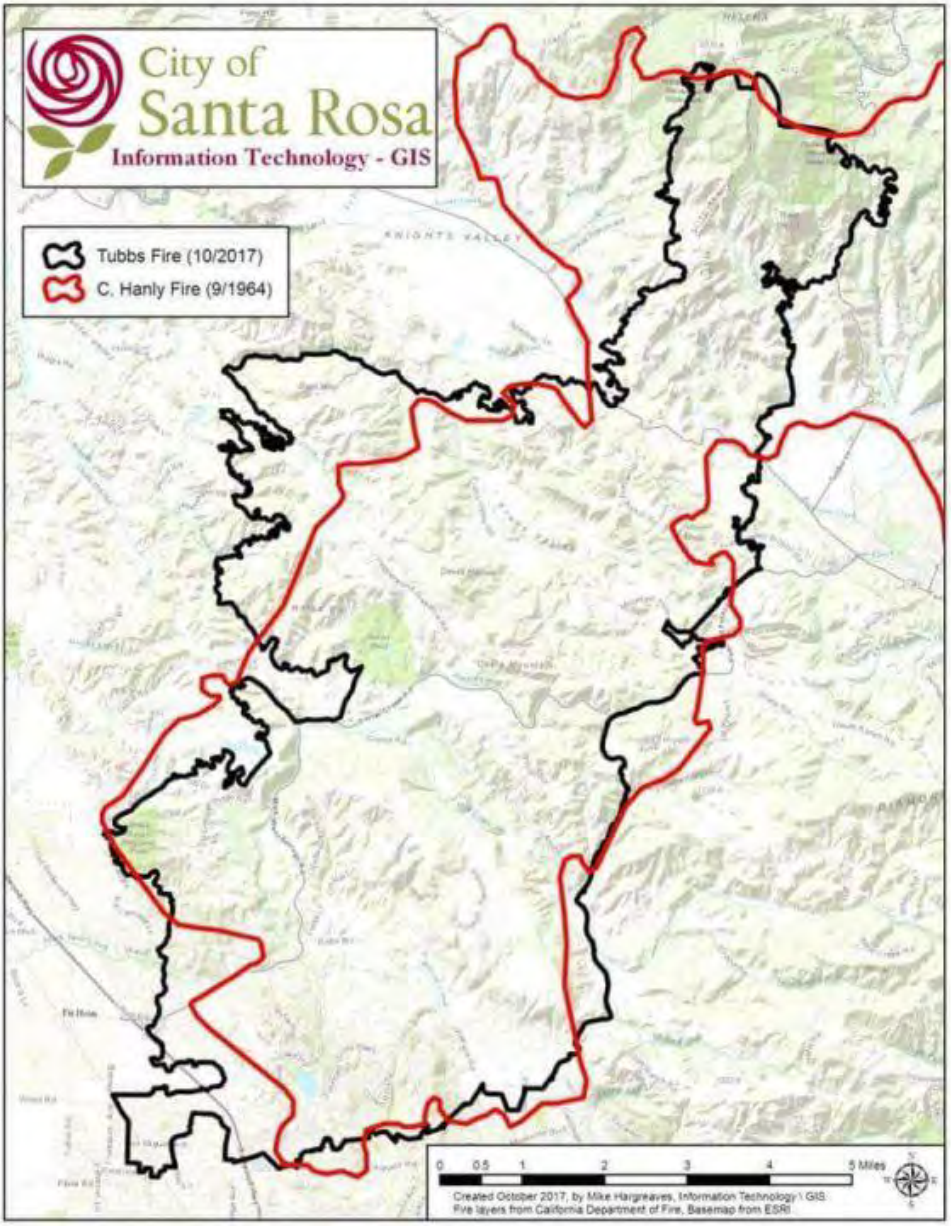
Dec 4, 2017

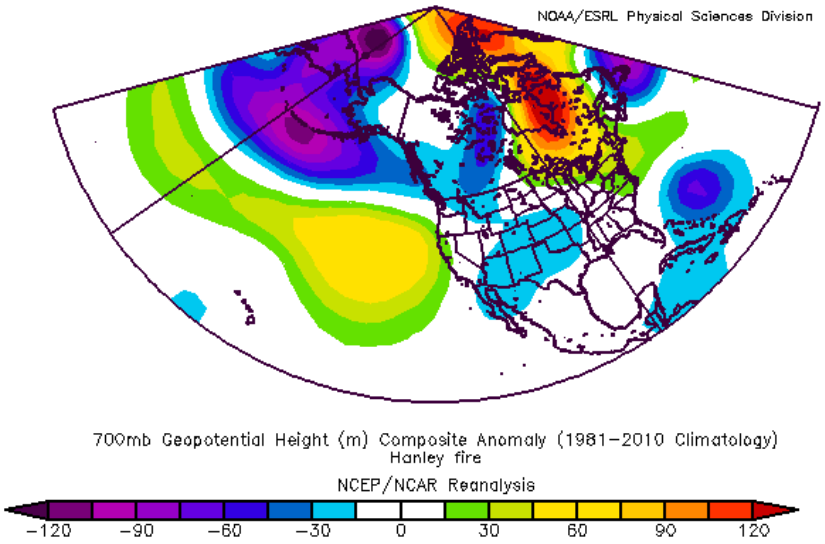
"In the coming days, a remarkably persistent weather pattern will begin to develop across North America and adjacent ocean regions. Characterized by strong high pressure near the West Coast and low pressure over the Eastern Seaboard, this 'quasi-stationary' high amplitude atmospheric wave pattern will essentially become locked in place for a least the next 2 weeks. … "

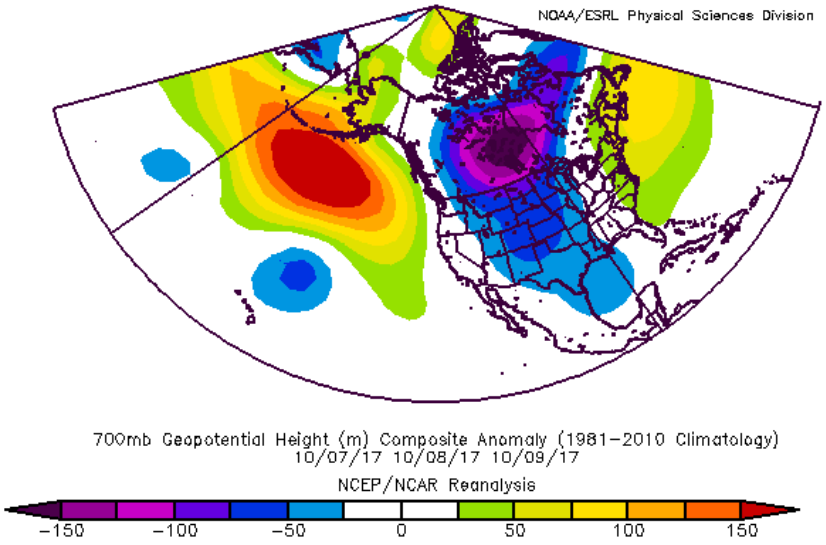
New Insights into the Ridiculously Resilient Ridge & North American Winter Dipole

Daniel Swain

USGS science for a changing world





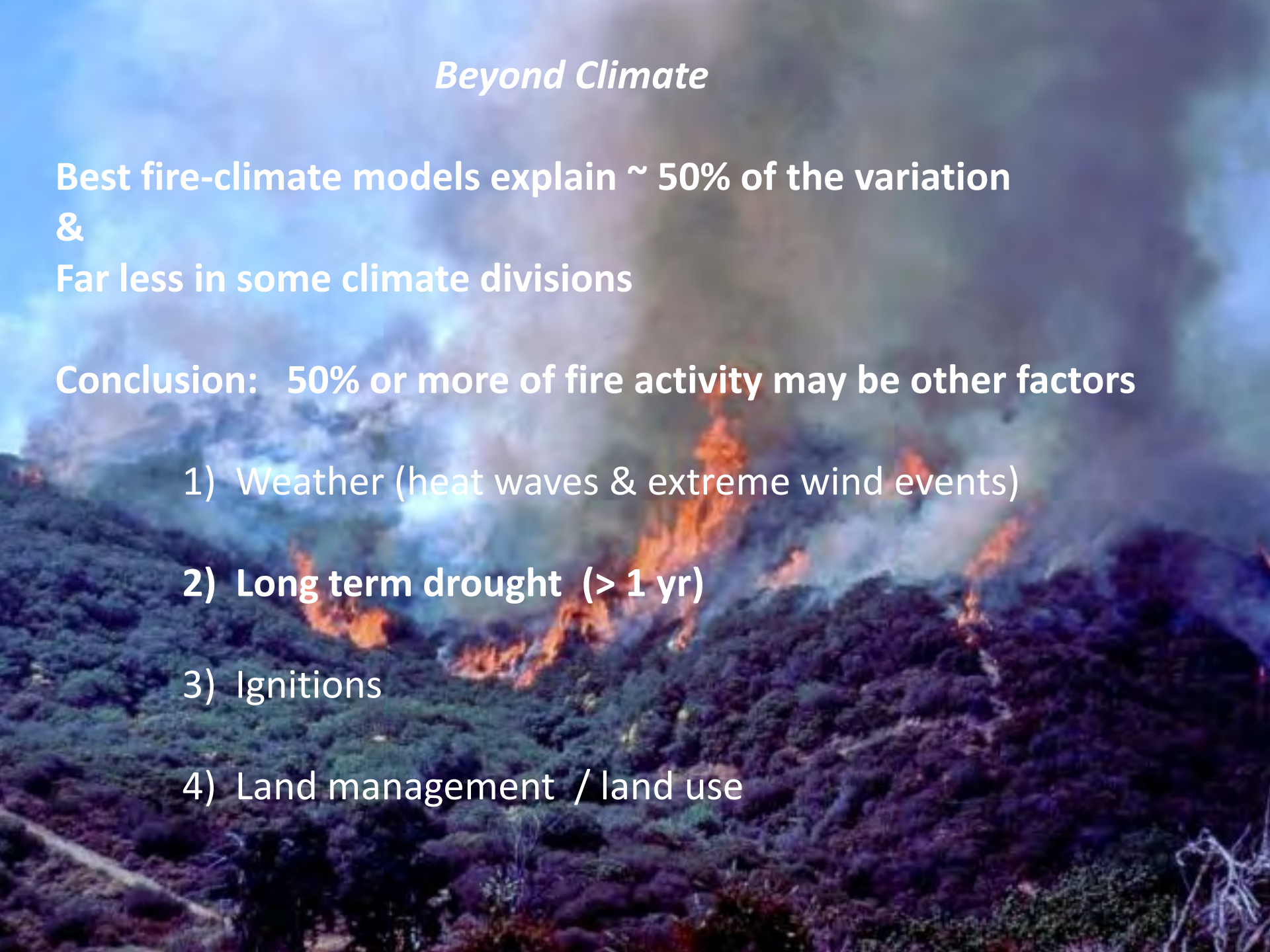


NOAA NCEP/NCAR Reanalysis, courstey of Dan Cayan, UCSD

USGS science for a changing world

Valley Turbulence

Great Bakersfield Dust Storm of 1977/ Arvin Wind Event of 19 Dec 1977
Estimated 192 mph winds with dust storm approaching thousands of feet
(coutesy of H.A. Mooney)



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2007	Zaca	Sta Barbara	July	240,425	20
2007	Witch	San Diego	October	198,175	17
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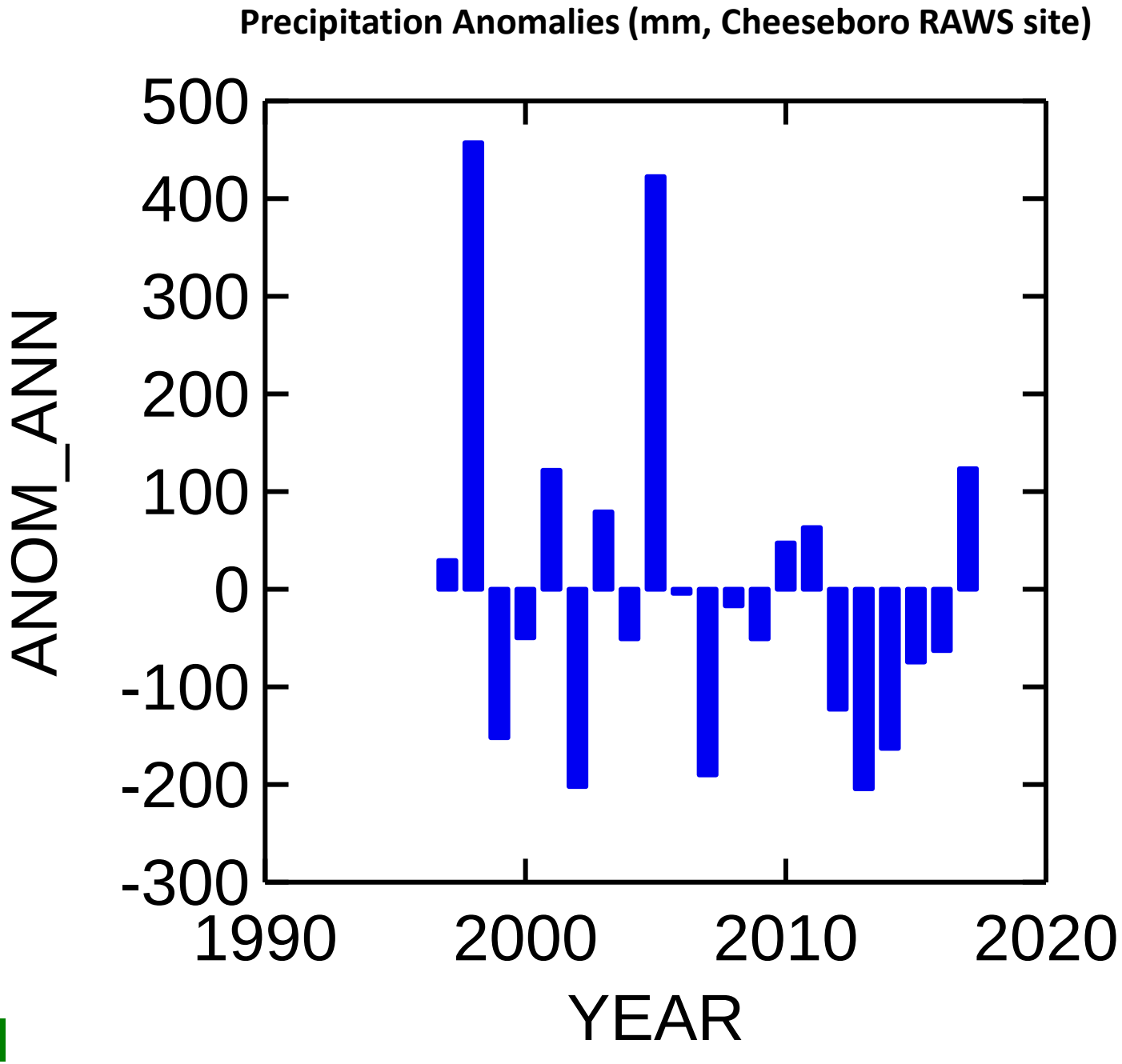
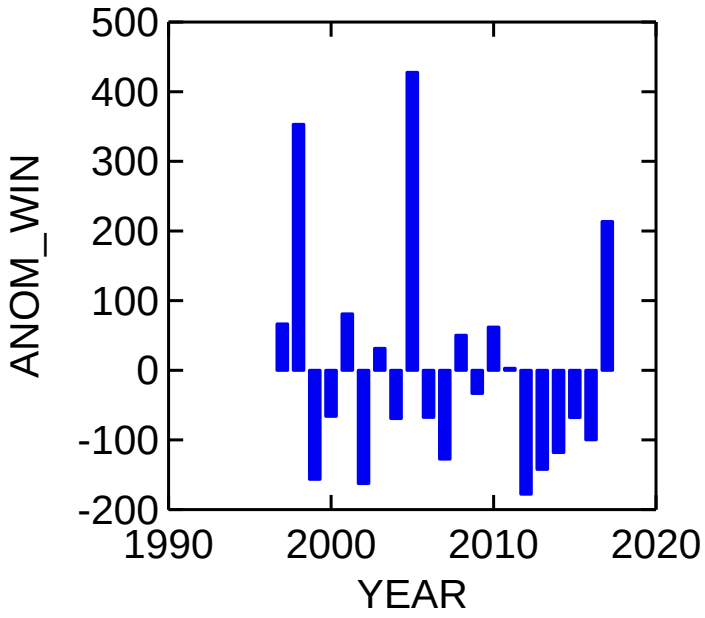
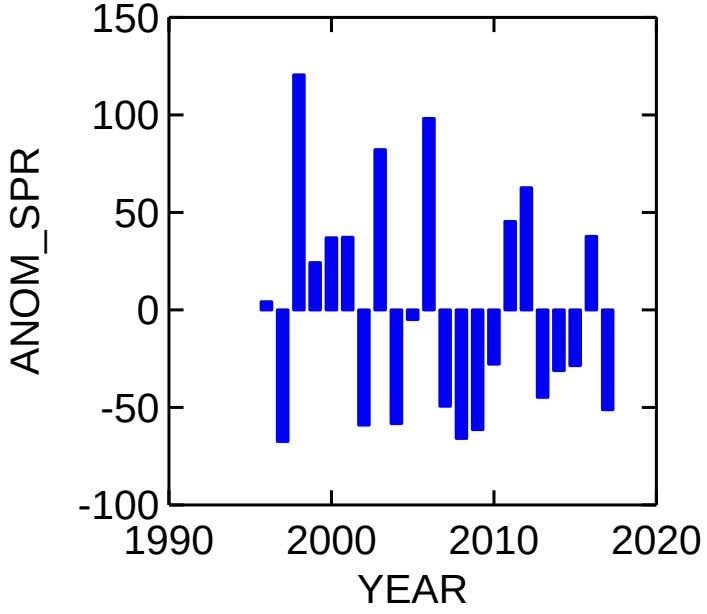
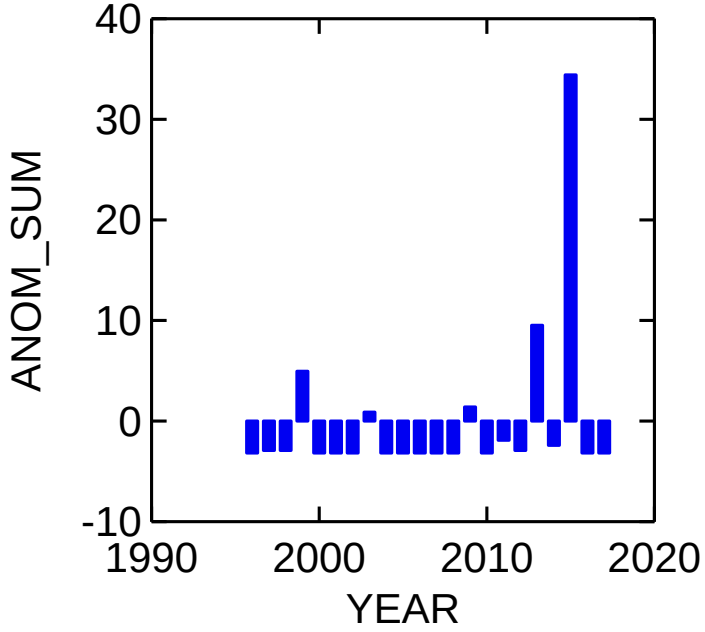
2017	Thomas	Ventura/SB	December	281,890	53/72

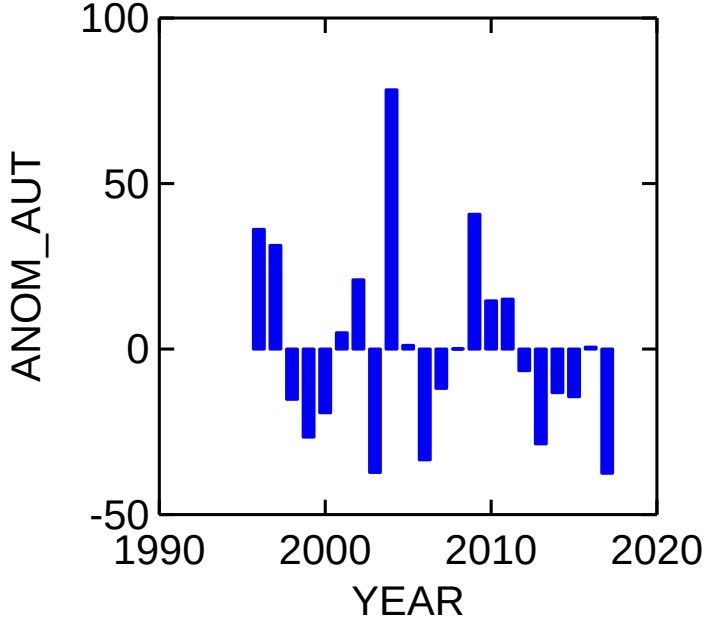

Precipitation Anomalies (mm, Cheeseboro RAWS site)
ANOM_ANN
500
400
300
200
100
0
-100
-200
-300
1990
2000
2010
2020
YEAR

Seasonal Precipitation (mm, Cheeseboro RAWS site, DRI)









Vegetation Management Program

Live Fuel Moisture 1981-2018

Santa Monica Mountains Chamise (Adenostoma fasiculatum)

Percent Live Fuel Moisture

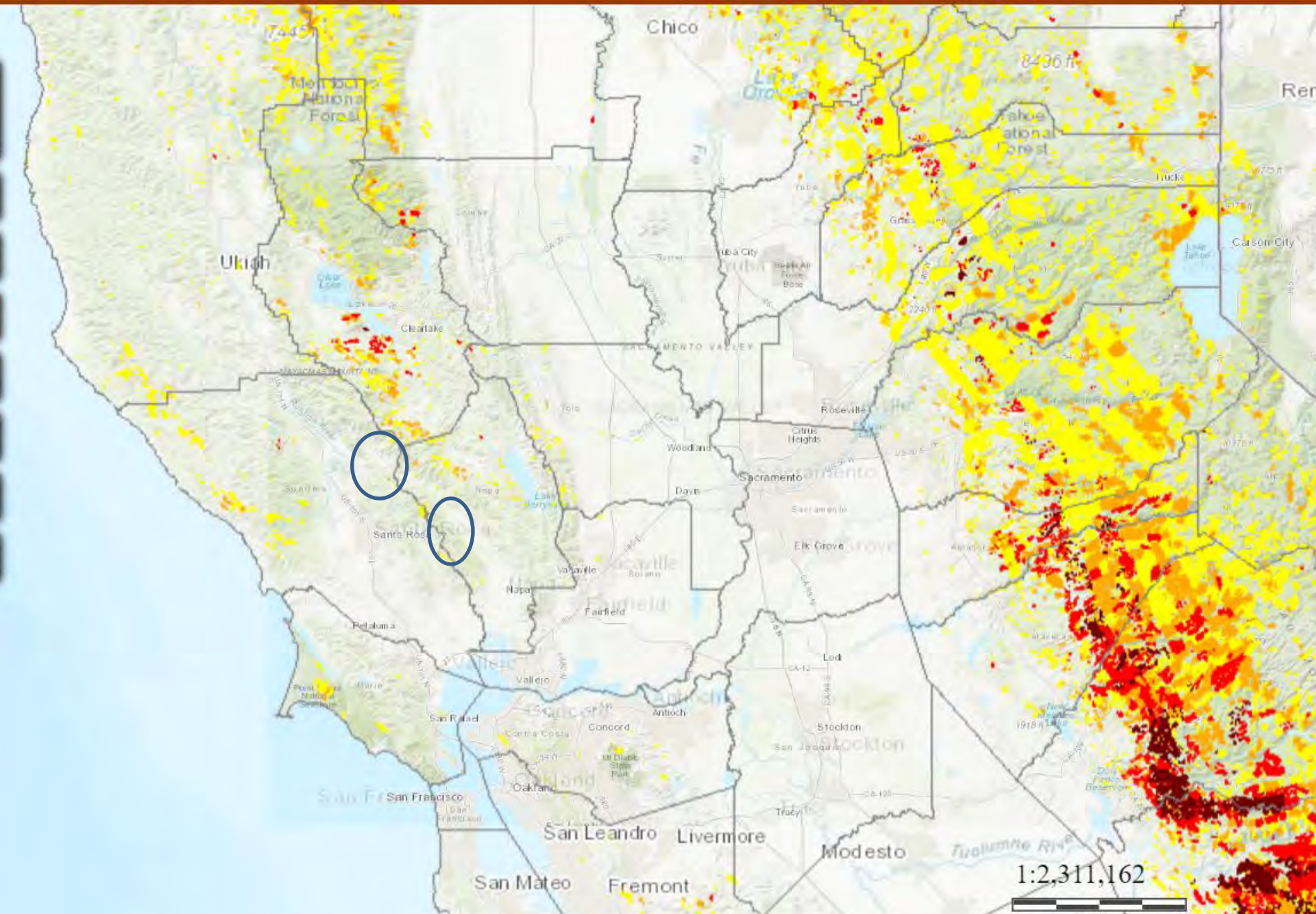
220
200
180
160
140
120
100
80
60
40

1-Jan 8-Jan 15-Jan 22-Jan 29-Jan 5-Feb 12-Feb 19-Feb 26-Feb 5-Mar 12-Mar 19-Mar 26-Mar 2-Apr 9-Apr 16-Apr 23-Apr 30-Apr 7-May 14-May 21-May 28-May 4-Jun 11-Jun 18-Jun 25-Jun 2-Jul 9-Jul 16-Jul 23-Jul 30-Jul 6-Aug 13-Aug 20-Aug 27-Aug 3-Sep 10-Sep 17-Sep 24-Sep 1-Oct 8-Oct 15-Oct 22-Oct 29-Oct 5-Nov 12-Nov 19-Nov 26-Nov 3-Dec 10-Dec 17-Dec 24-Dec 31-Dec

Critical | 2018 | 2017 | 1981-Present

USGS
science for a changing world

Tree Mortality Viewer



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Thousand Oaks
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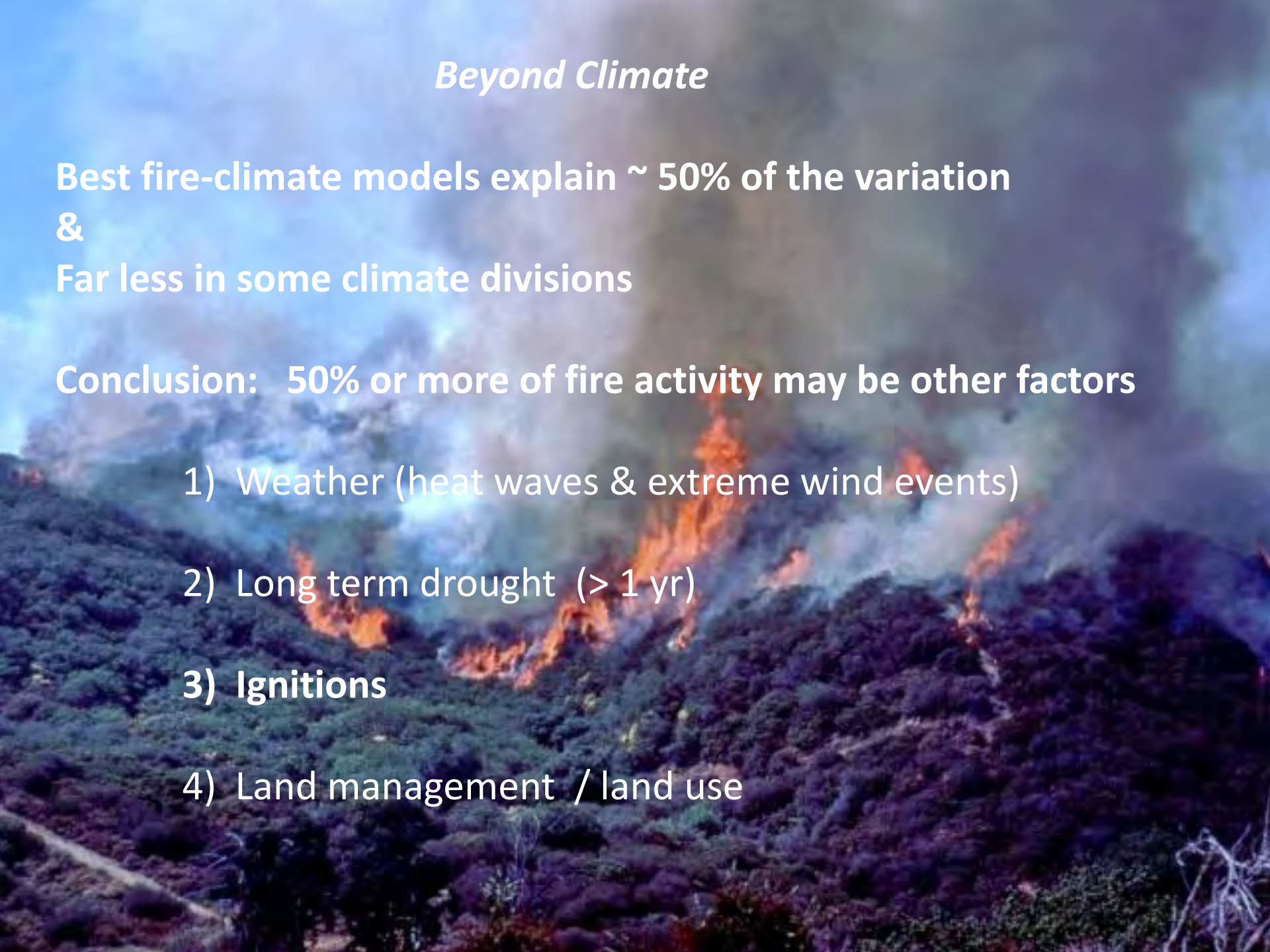
Agoura Hills
Calabasas
Los Angeles
USGS
science for a changing world

“One reason this fire became so large was every ember that blew down wind ignited a spot fire” **Rich Hawkins (FMO on Cedar Fire)**



Beyond Climate

Best fire-climate models explain ~ 50% of the variation
&
Far less in some climate divisions

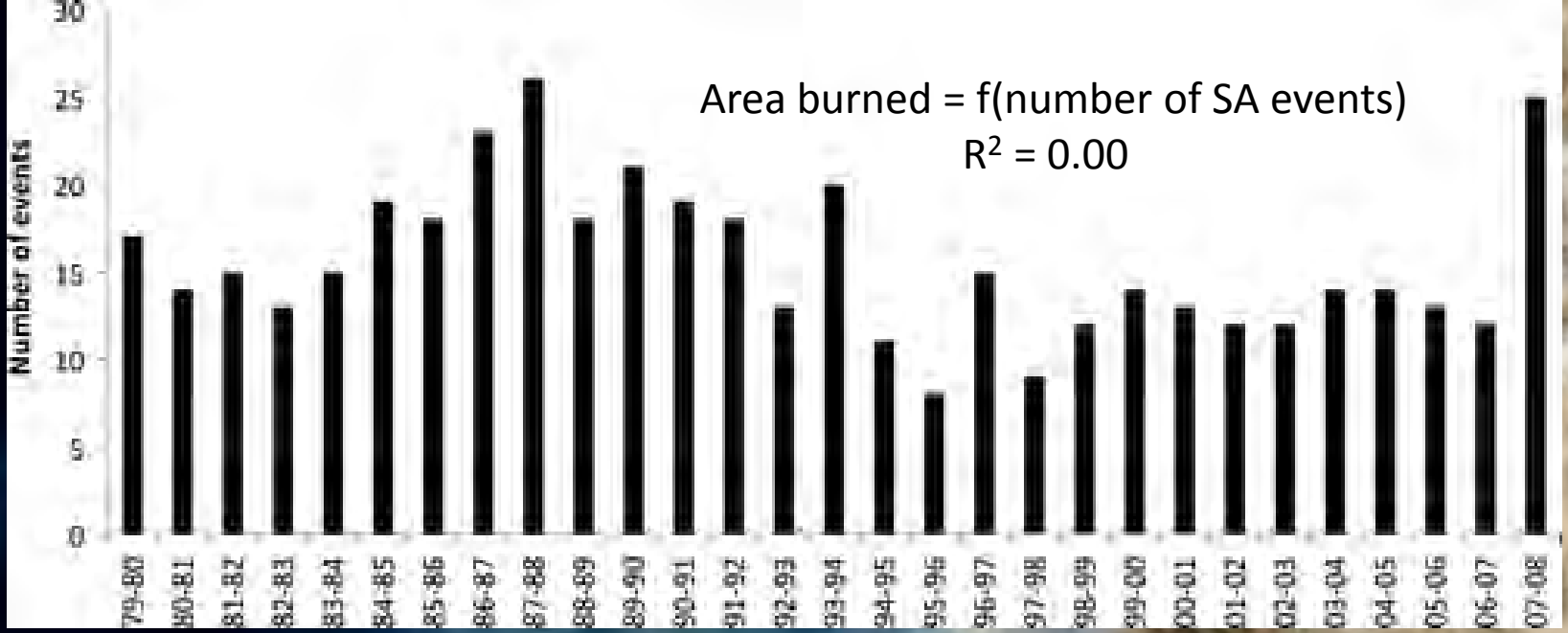
Conclusion: 50% or more of fire activity may be other factors

1) Weather (heat waves & extreme wind events)

2) Long term drought (> 1 yr)

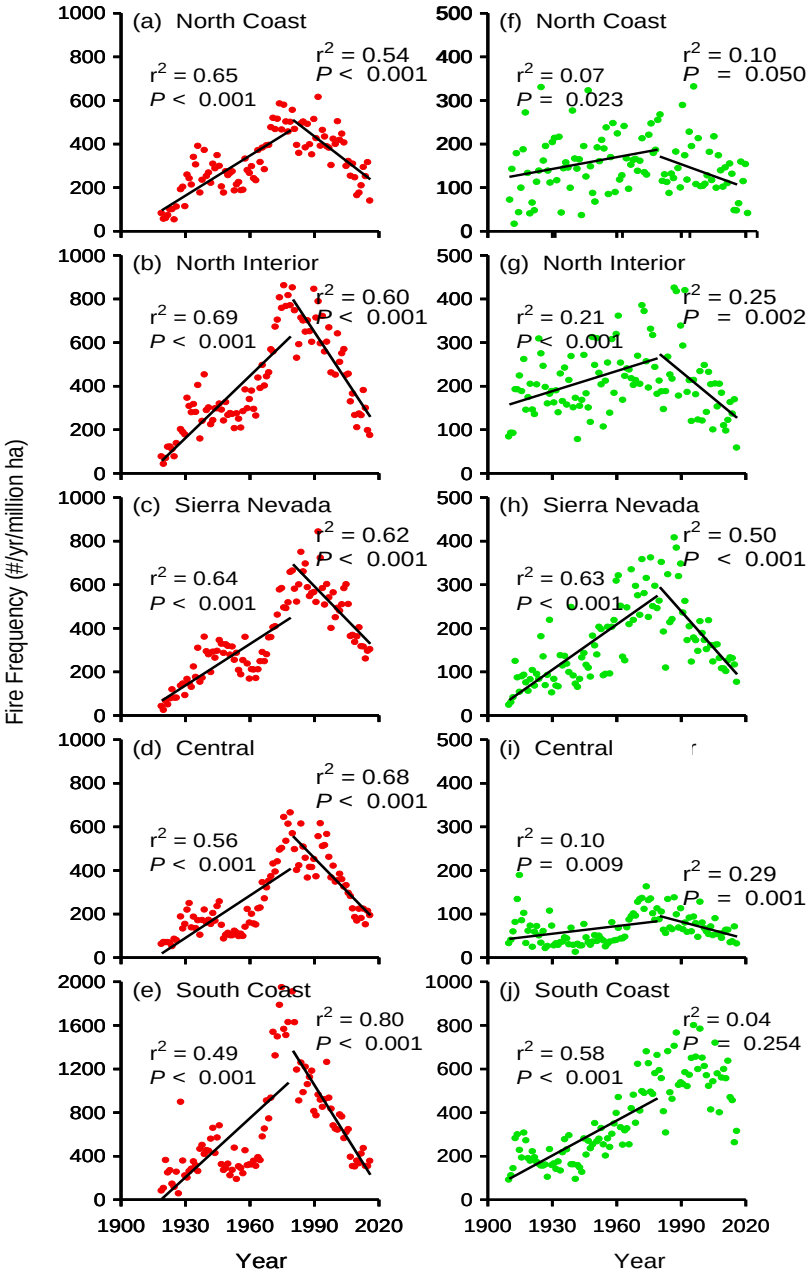
3) **Ignitions**

4) Land management / land use

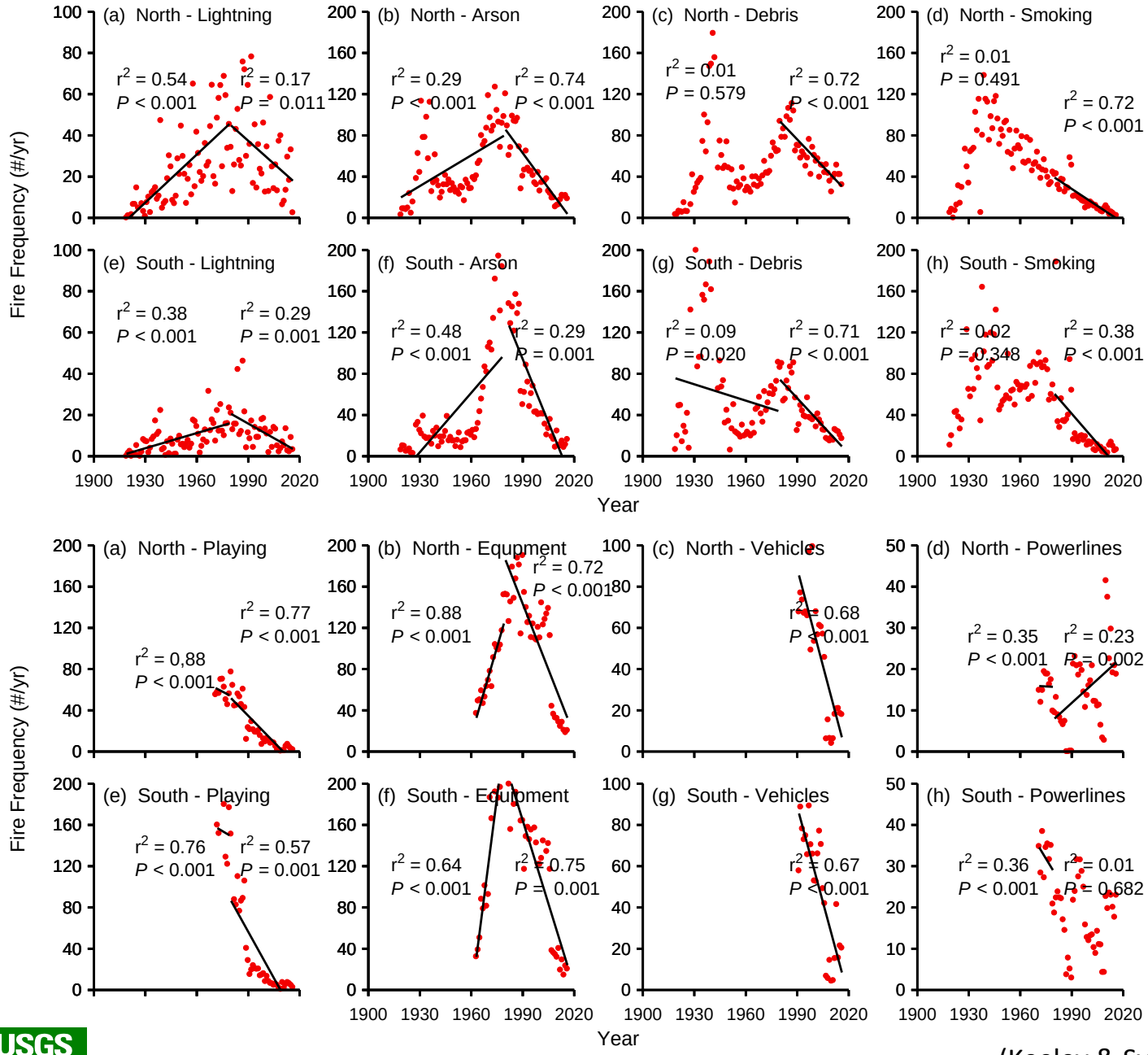


Area burned = f(number of SA events)

$R^2 = 0.00$

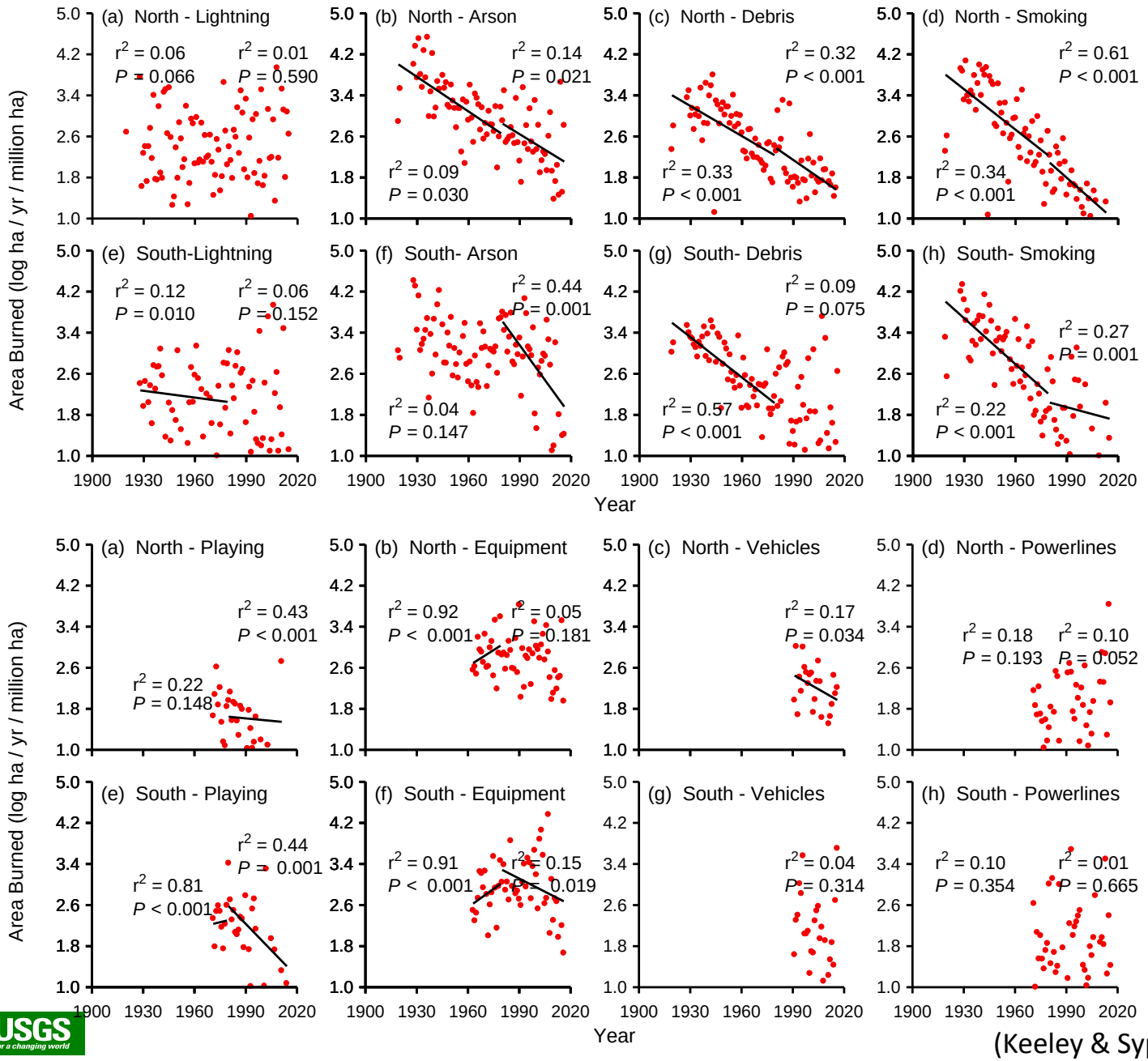


(Keeley & Syphard in review)



USGS science for a changing world

(Keeley & Syphard in review)



USGS science for a changing world

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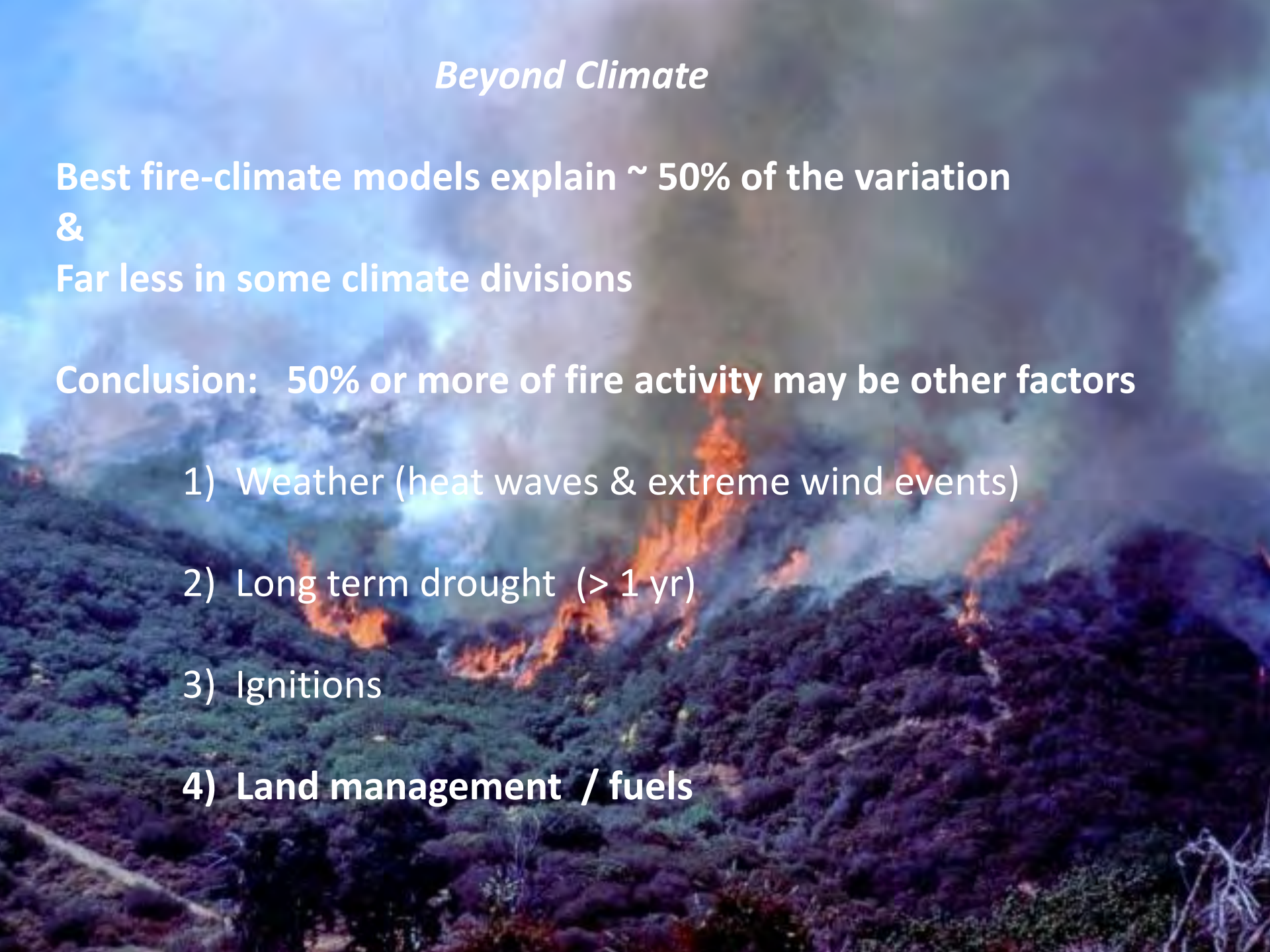

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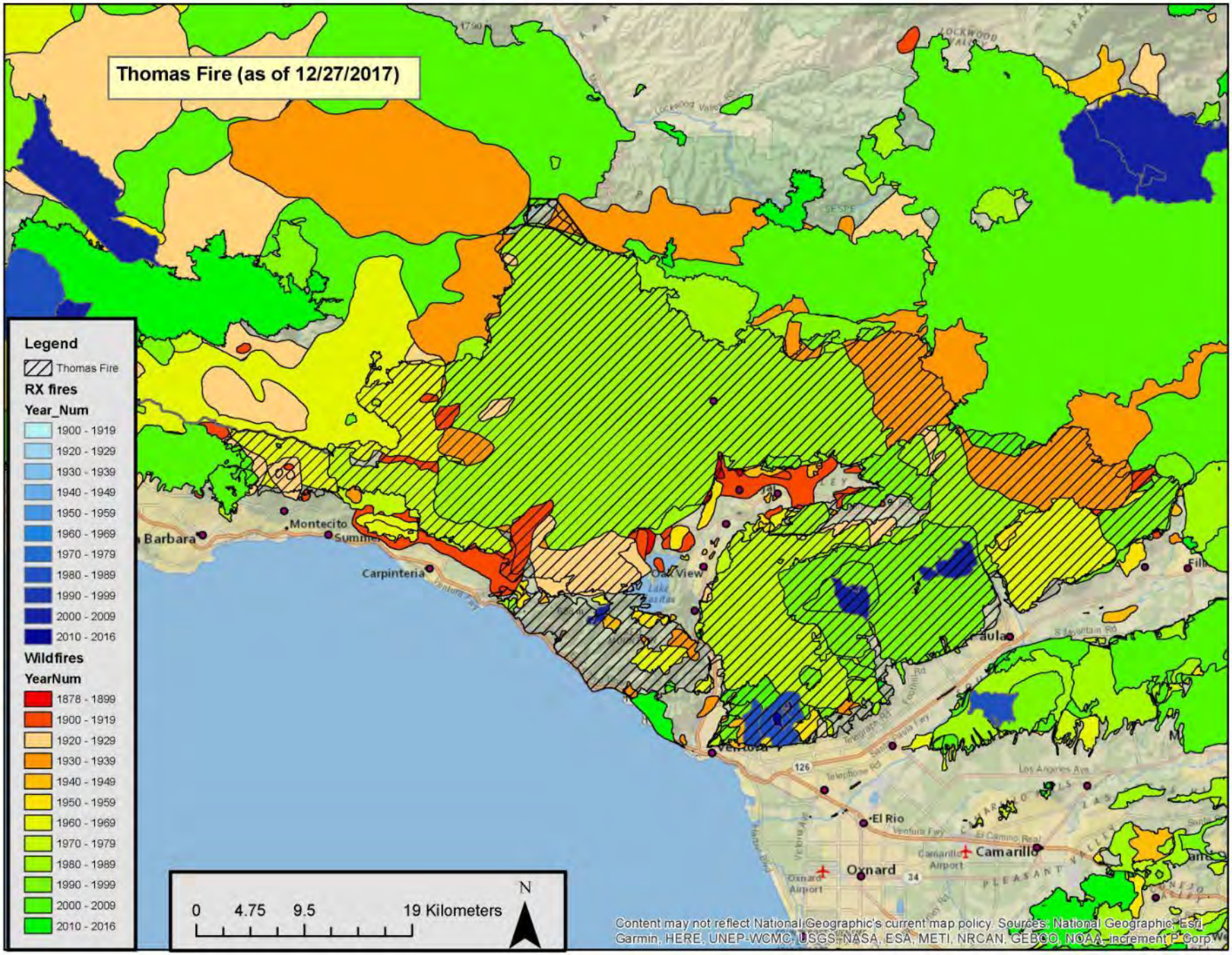
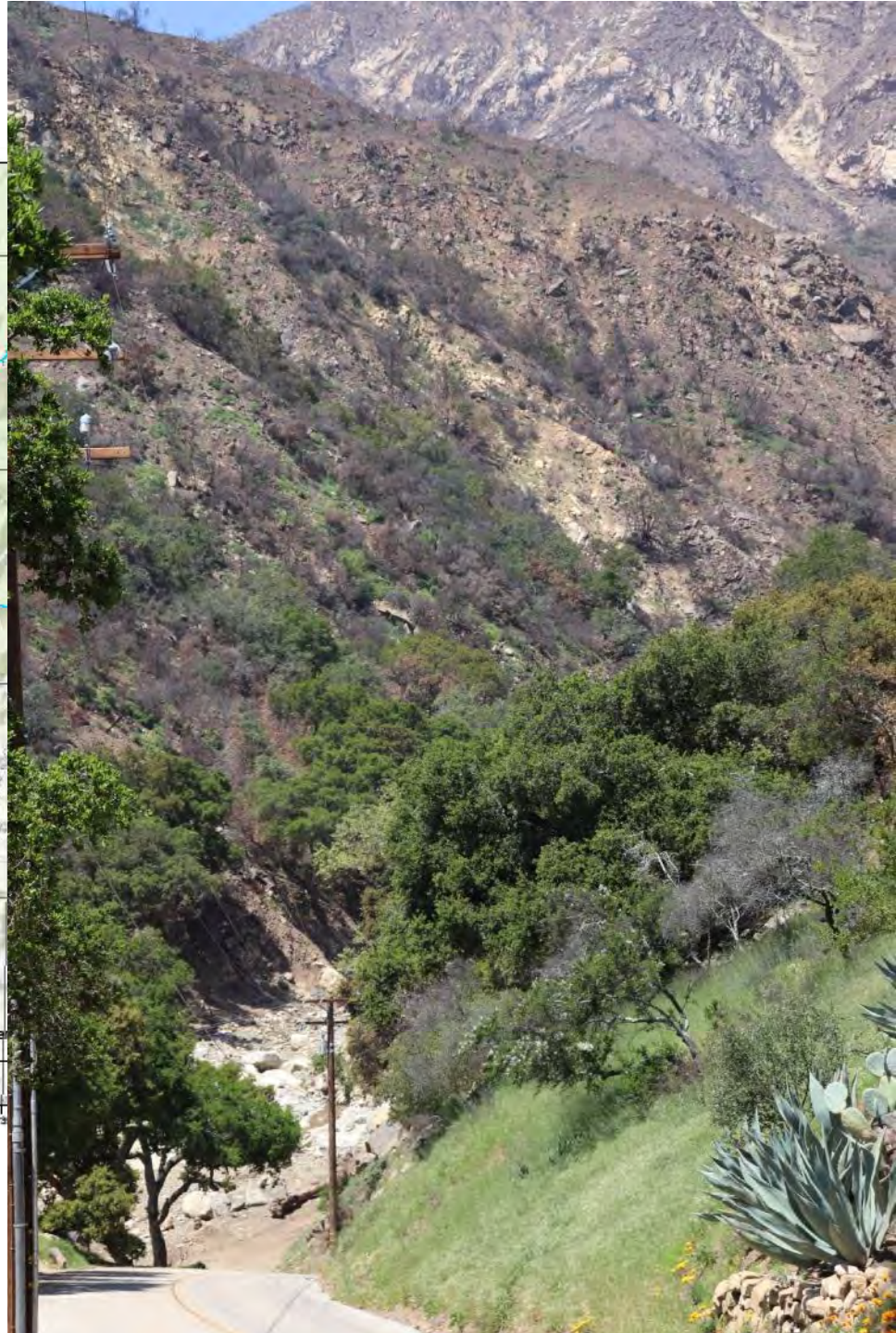
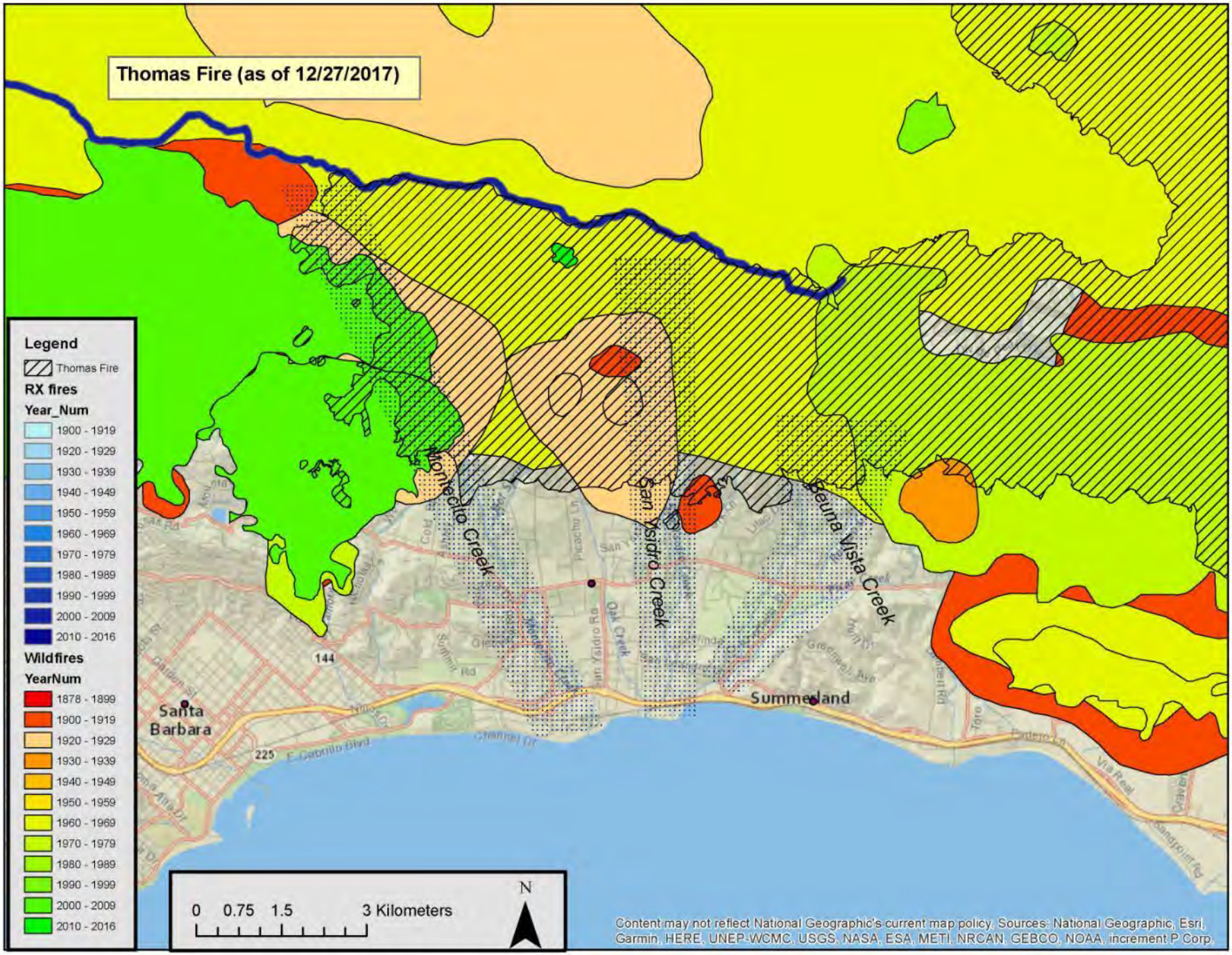
4) **Land management / fuels**


Thomas Fire (as of 12/27/2017)
Legend
Thomas Fire
RX fires
Year_Num
1900 - 1919
1920 - 1929
1930 - 1939
1940 - 1949
1950 - 1959
1960 - 1969
1970 - 1979
1980 - 1989
1990 - 1999
2000 - 2009
2010 - 2016
Wildfires
YearNum
1878 - 1899
1900 - 1919
1920 - 1929
1930 - 1939
1940 - 1949
1950 - 1959
1960 - 1969
1970 - 1979
1980 - 1989
1990 - 1999
2000 - 2009
2010 - 2016
Barbara
Montecito
Carpinteria
Ojai
Ventura
El Rio
Oxnard
Camarillo
Oxnard Airport
Camarillo Airport
126
34
0 4.75 9.5 19 Kilometers
N
Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp

Mudslides killed over 40 people in
early January 2018

Cold Springs, East
195,300 m³
Springs, West
195,700 m³
San Ysidro
276,000 m³
Romero
147,500 m³
Hot Springs
112,000 m³
Buena Vista
96,000 m³
Montecito
0 0.5 1 2 Kilometers
0 0.5 1
119°39'W
119°38'W
119°37'W
119°36'W

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1960 - 1969
1970 - 1979
1980 - 1989
1990 - 1999
2000 - 2009
2010 - 2016
Montecito Creek
San Ysidro Creek
Buena Vista Creek
Santa Barbara
Summerland
144
225
E Cabrillo Blvd
Channel Dr
Sheffield Rd
Oak Creek
San Ysidro Rd
Meigs Dr
Greenwell Ave
Ortega Hill Rd
Toro
Padero Ln
Vista Real
Sandpoint Rd
Olive Mill Rd
Coast Village Rd
Picacho Ln
Las Tunas Rd
Hendry's Beach
Arroyo Burro Beach
Santa Ana Dr
0 0.75 1.5 3 Kilometers
N
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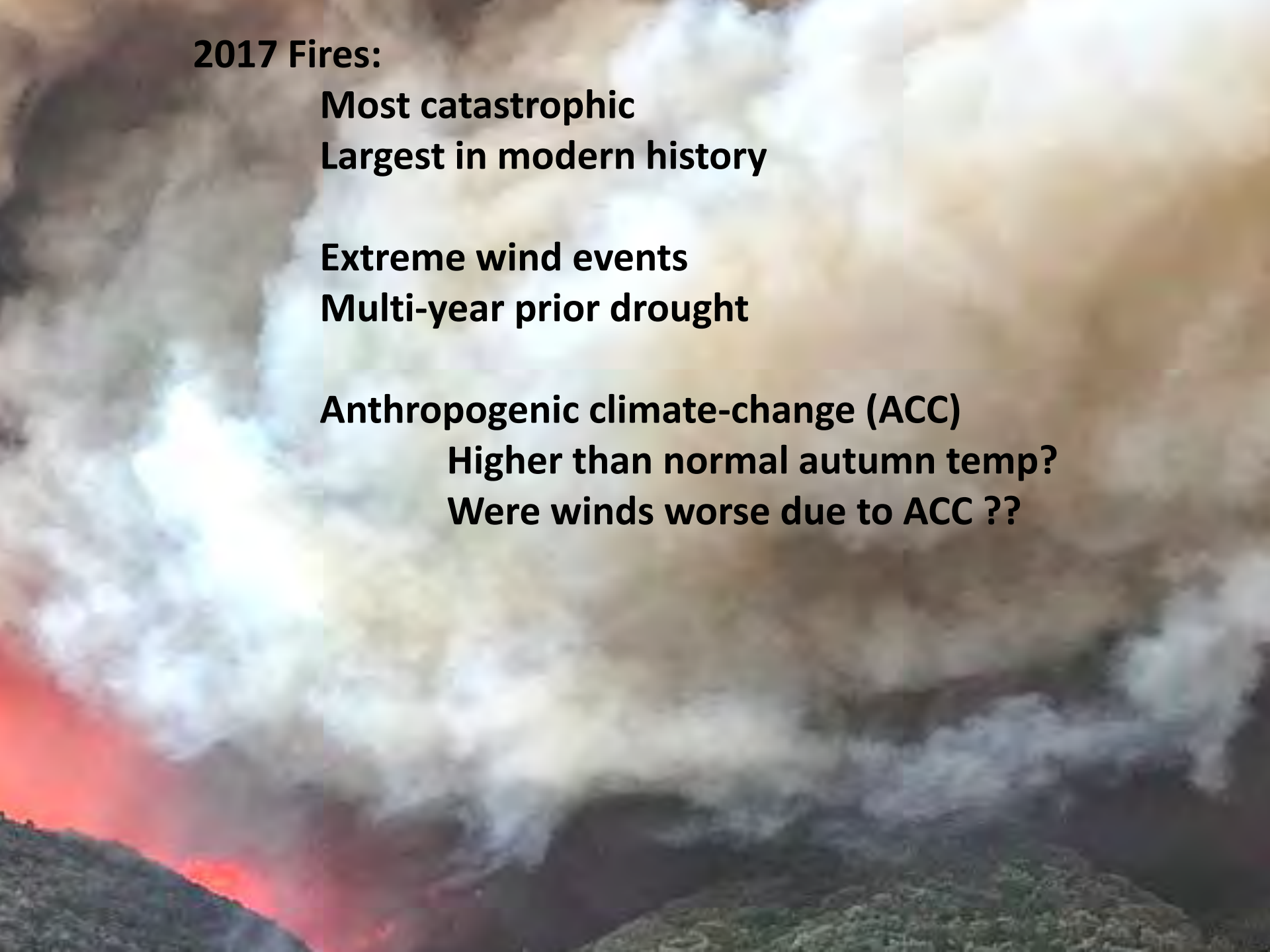

2017 Fires:

- **Most catastrophic**
- **Largest in modern history**

- **Extreme wind events**
- **Multi-year prior drought**

- **Anthropogenic climate-change (ACC)**
  - **Higher than normal autumn temp?**
  - **Were winds worse due to ACC ??**