

Living With Wildfire

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Since the year 2000, over 13 million acres have burned from wildfires in California.

This is double the acreage burned in the prior 20 years.

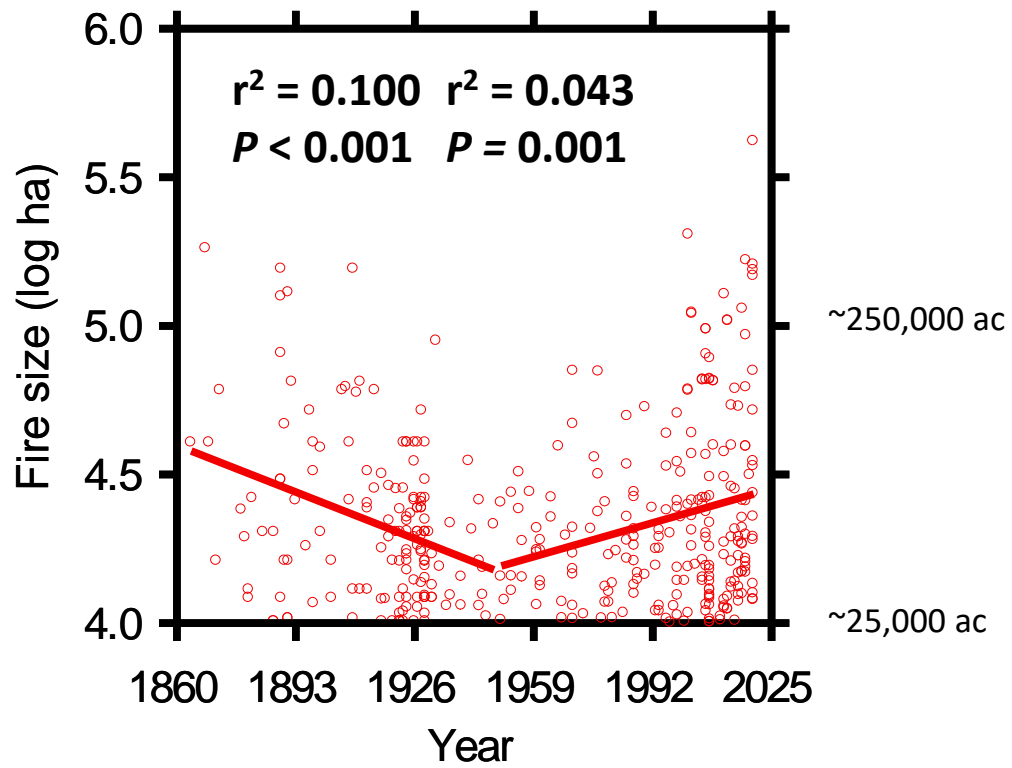
Many claim it is an inevitable response to climate change and represents the “New Normal”



2020: (The Urban Dictionary defines it as 'Hell')

- **4 million acres burned in California surpassing any previous year by > 3-fold**





The 2020 fire season was the “perfect storm” particularly for the northern part of the state comprising the nexus of:

Low rainfall year in the north

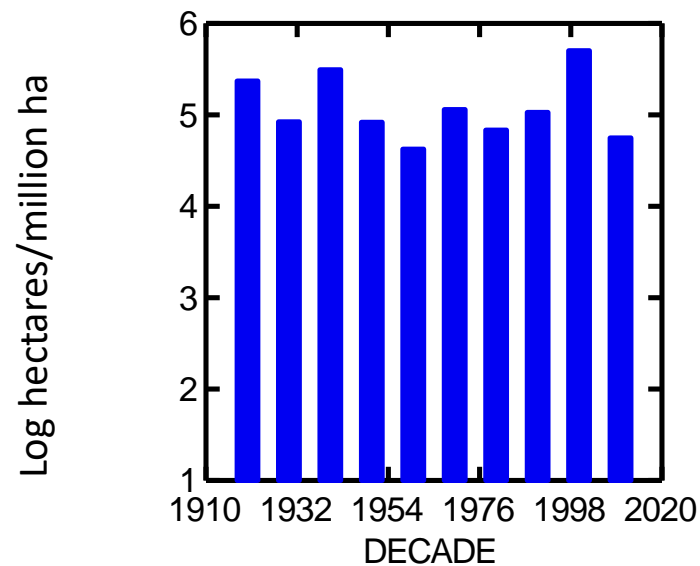
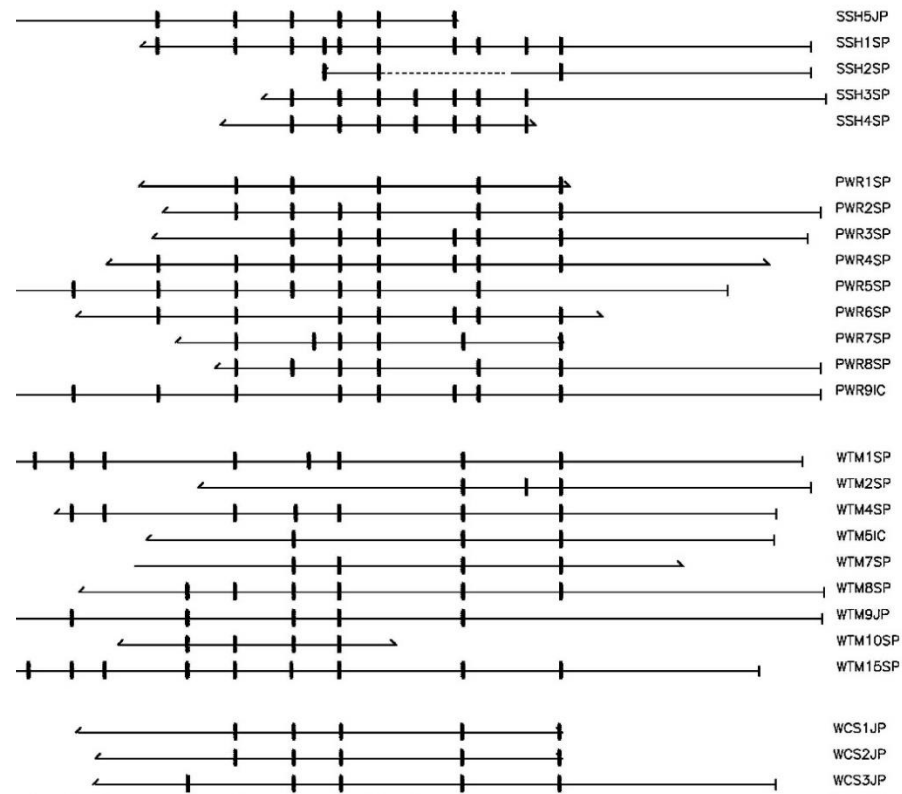
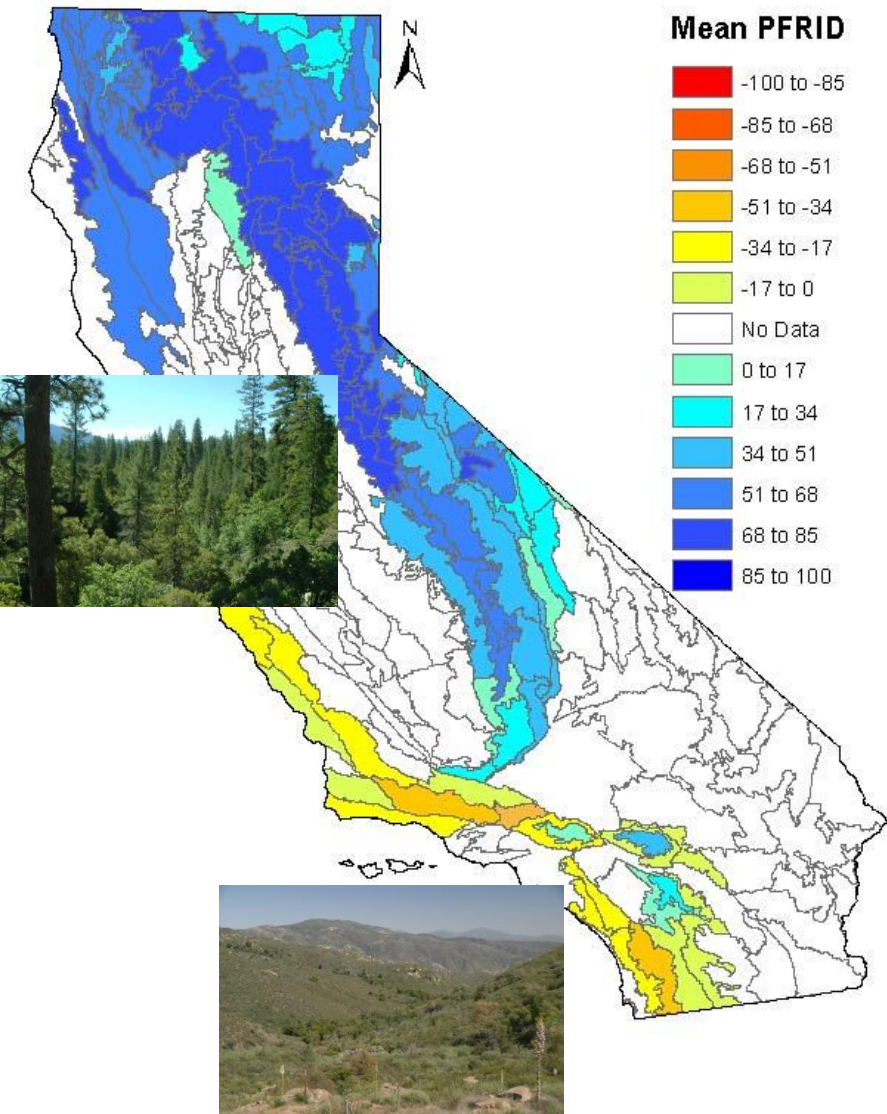
Extraordinary lightning storm

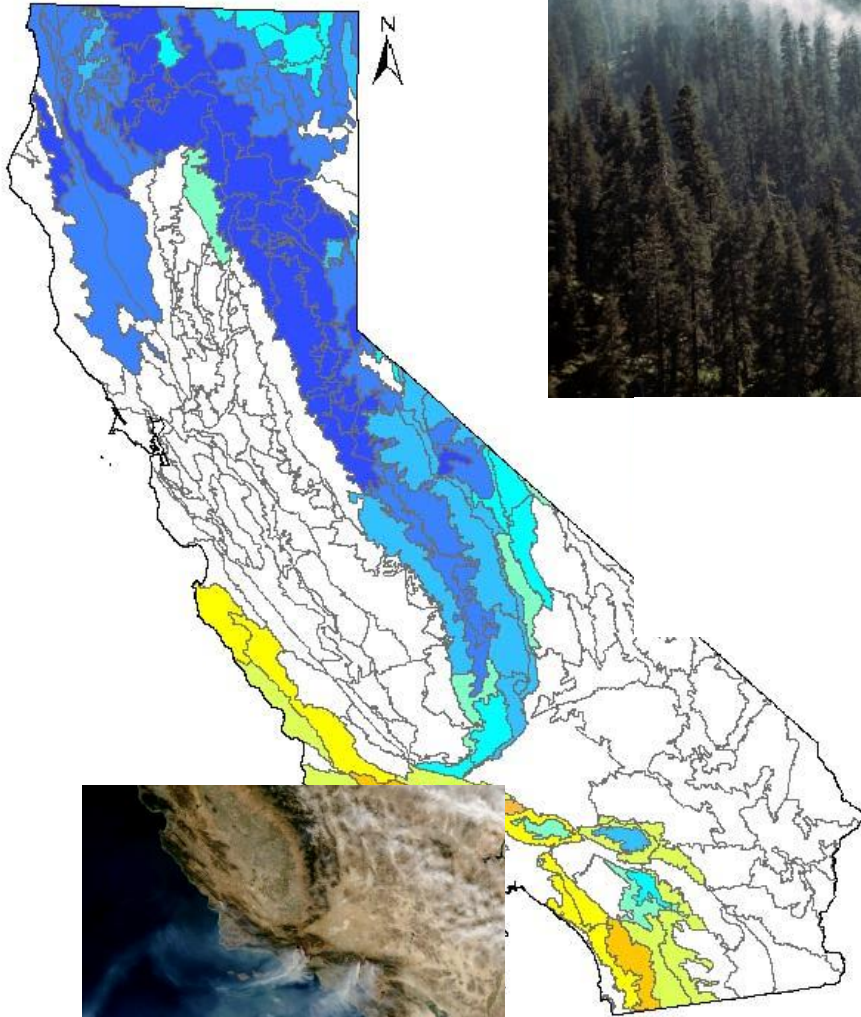
Long and intense heat wave

Fire suppression in forests = 5x greater fuels

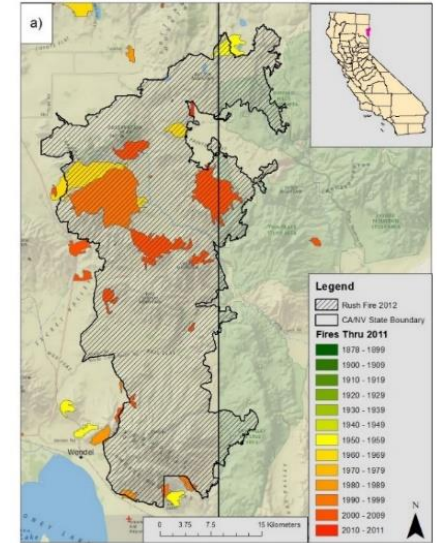
Long drought 2012 – 2017 = Vegetation dieback



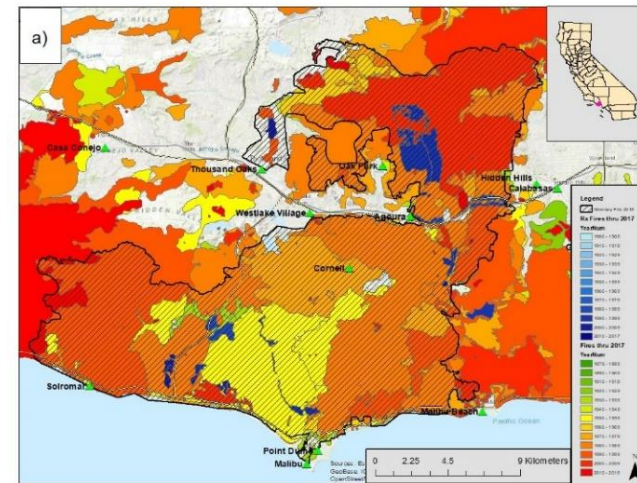




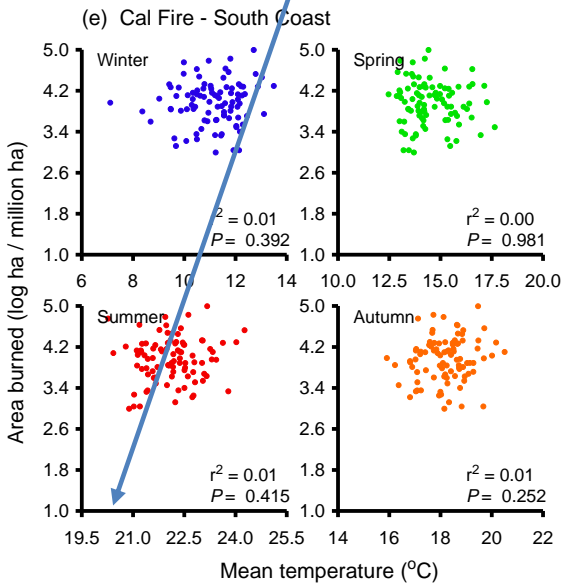
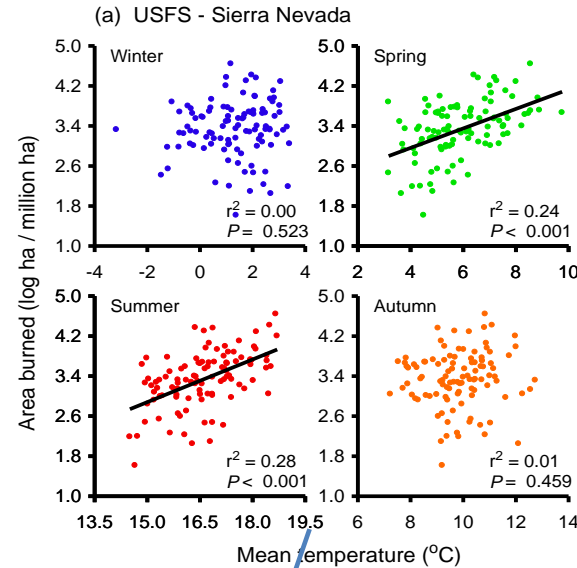
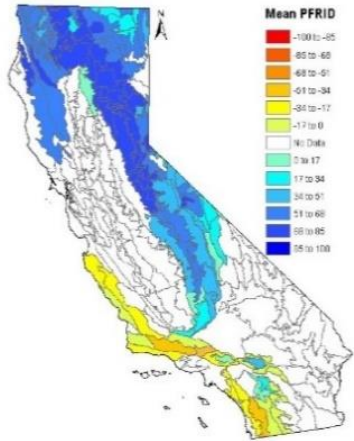
Due to a century of successful fire suppression, fires are the result of high fuel accumulation
Fuel-Dominated Fire Regimes



Due to high population density coupled with excessive human ignitions, fuel load is not an issue,
Wind-Dominated Fire Regimes



Historical Fire-Climate Analysis



Akaike IC multiple regression models

(winter, spring, summer, autumn temp & ppt)

Sierra Nevada (USFS)

1910 - 2013

r^2

0.39

Temp spr+Temp sum-Ppt spr

Flammability-Limited

1910 - 1959

0.42

- Ppt spr - Ppt win

1960 - 2013

0.52

Temp spr + Temp sum

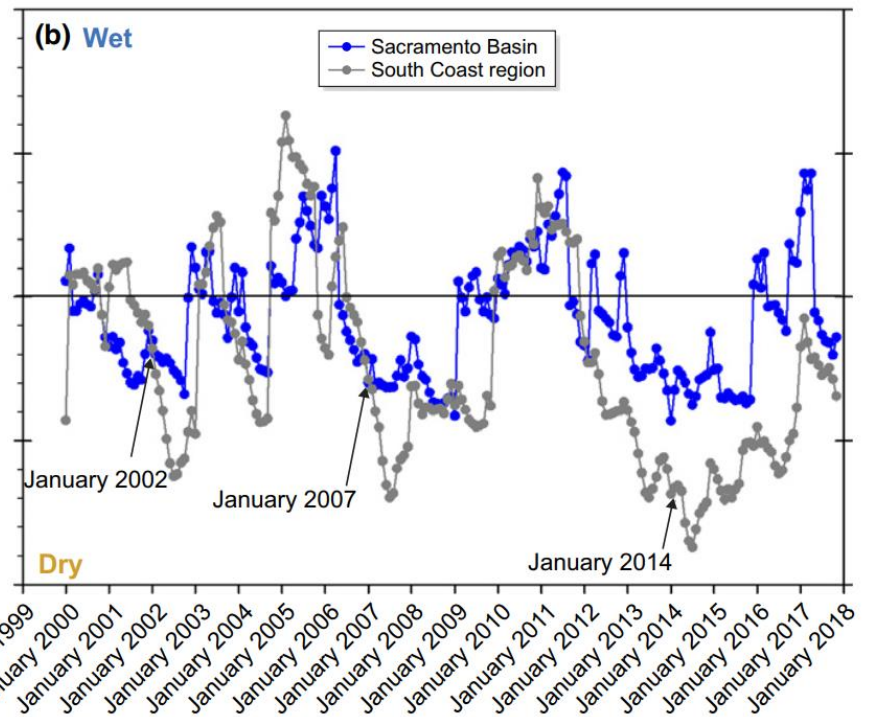
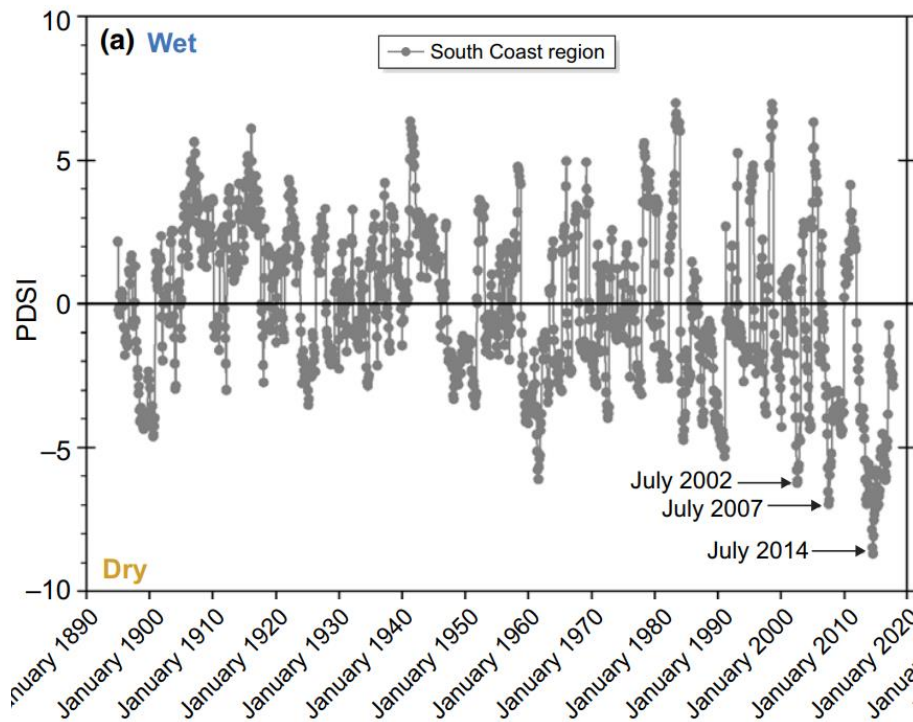
South coast (Cal Fire)

1919 - 2013

r^2

0.00

(Keeley & Syphard 2017)



(Jacobsen & Pratt 2018)

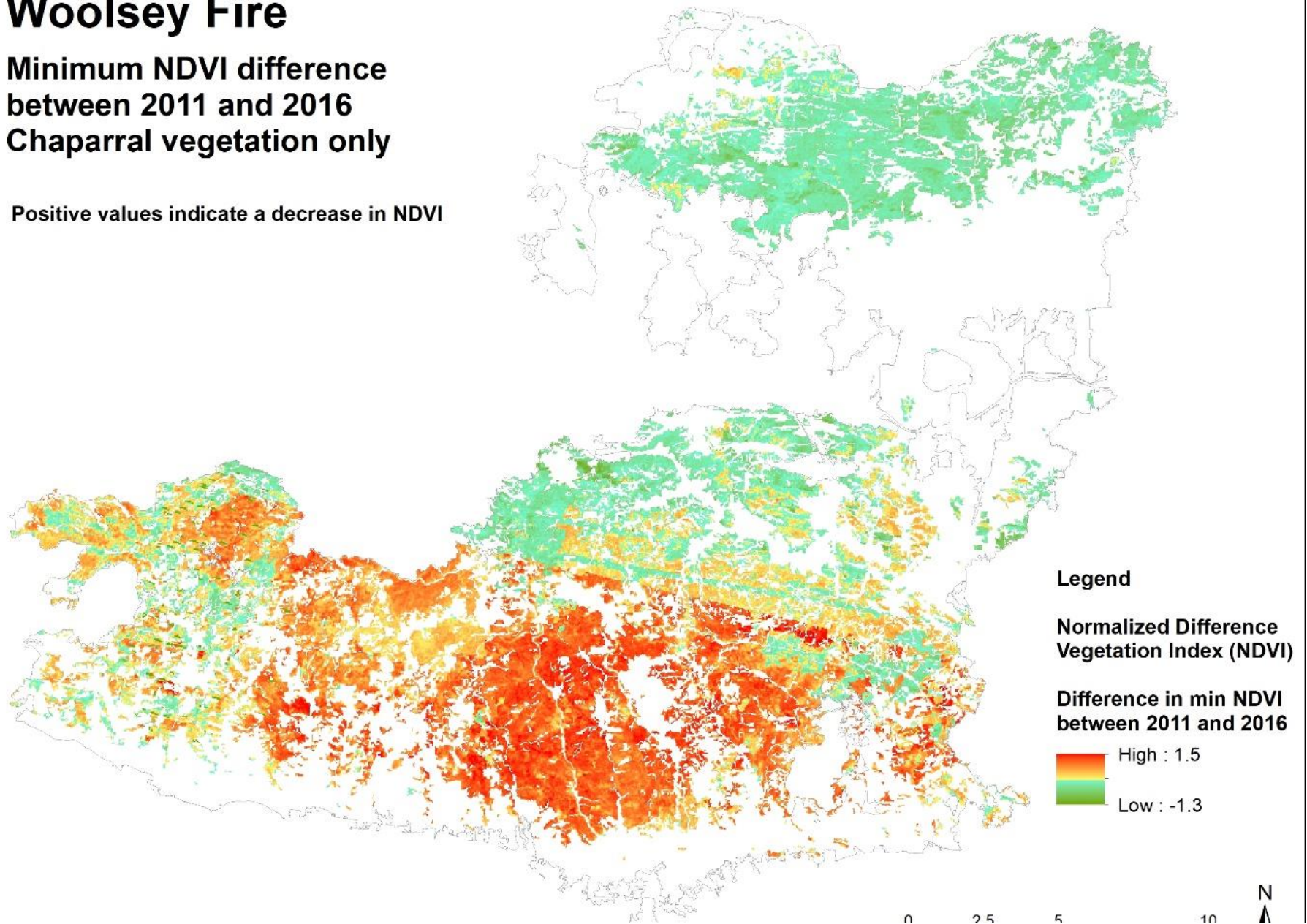




Woolsey Fire

Minimum NDVI difference
between 2011 and 2016
Chaparral vegetation only

Positive values indicate a decrease in NDVI



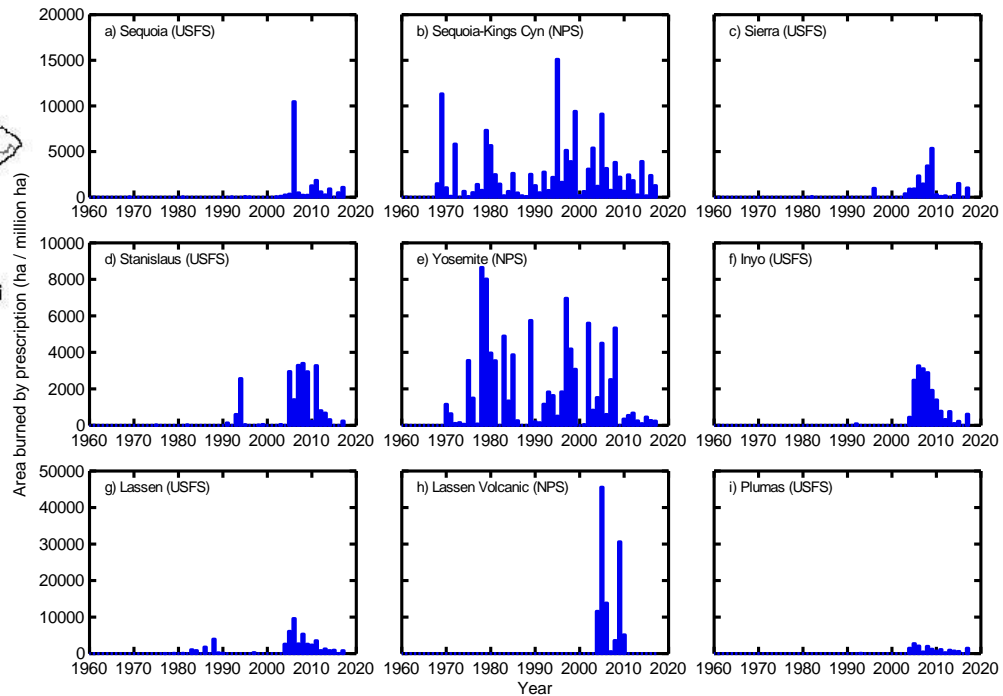
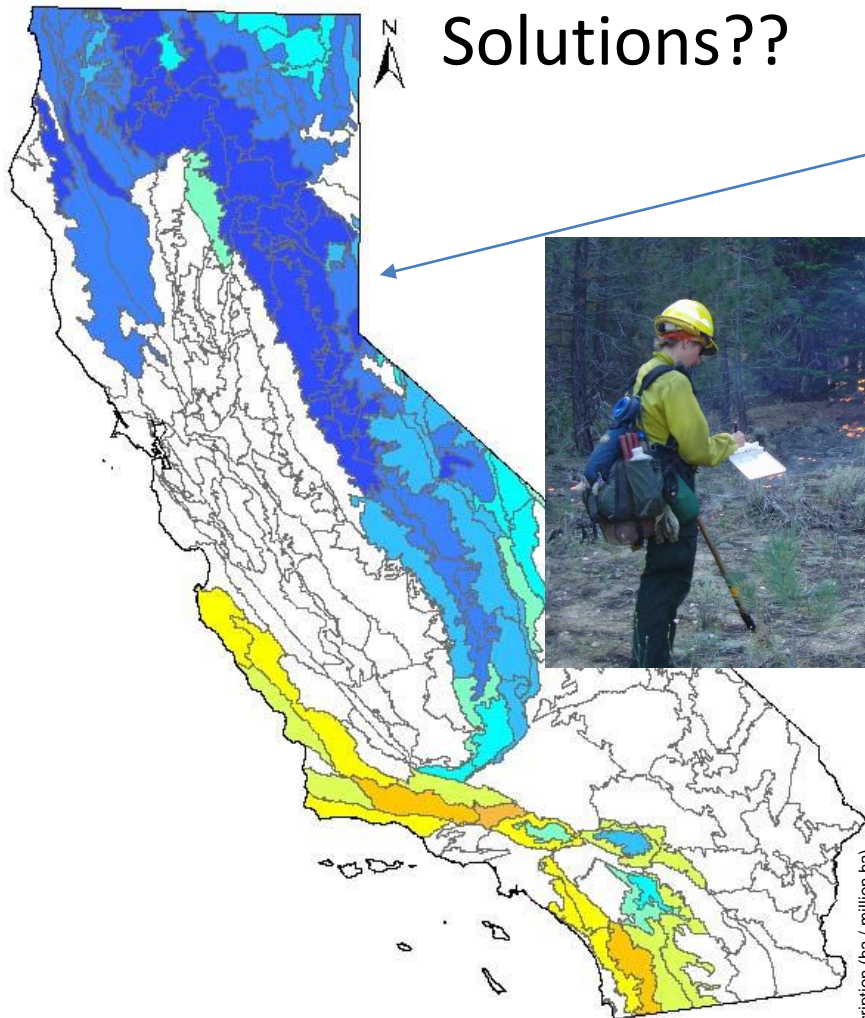
Fuel vs Wind Fires: Differ in month, cause and destruction

Year	Fire	County	Mon(days)	Hectares	Cause	Lives	Structures
<i>Fuel-Dominated Fires:</i>							
1977	<i>Marble C</i>	Monterey	July -	71,980	Lightning	0	0
2012	<i>Barry Point</i>	Modoc	Aug	37,630	Lightning	0	3
2012	<i>Rush</i>	Lassen	Aug -	110,080	Lightning	0	1
2013	<i>Rim</i>	Stanislaus	Aug -	104,220	Campfire	0	112
2014	King	El Dorado	Sep	39,260	Arson	0	80
2015	<i>Rough</i>	Fresno	July -	61,360	Lightning	0	4
<i>Wind-Dominated Fires:</i>							
1889	<i>Santiago</i>	Orange	Sept (3)	125,000	Campfire	0	0
1970	<i>Laguna</i>	San Diego	Sept (3)	70,500	Powerline	5	382
2003	<i>Cedar</i>	San Diego	Oct (3)	109,500	Flares	15	2,820
2007	<i>Witch</i>	San Diego	Oct (2)	80,200	Powerline	2	1,265
2017	<i>Tubbs</i>	Sonoma	Oct (2)	14,900	Powerline	22	5,643
2017	Thomas	Ventura	Dec (10)	114,080	Powerline	2	1,063
2018	Camp	utte	Nov (2)	62,060	Powerline	88	18,804
2019	Kincade	Sonoma	Nov (5)	31,470	Powerline	0	374

Solutions??

Fuel-Dominated Fire Regimes

Requires investments in prescription burning & other treatments



Santa Ana Winds in southern California

Santa Barbara
Los Angeles
San Diego

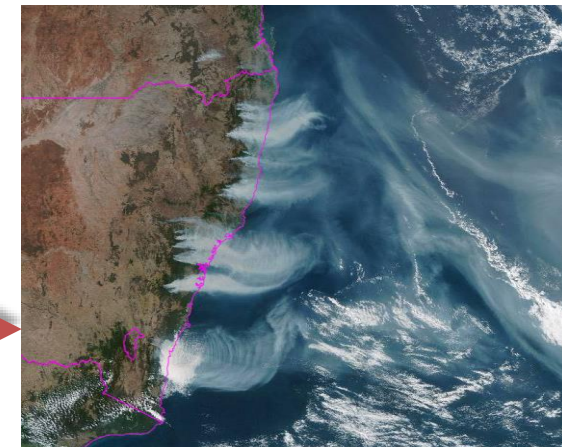
North Winds in northern California

Mendocino
Sacramento
Santa Rosa
San Francisco

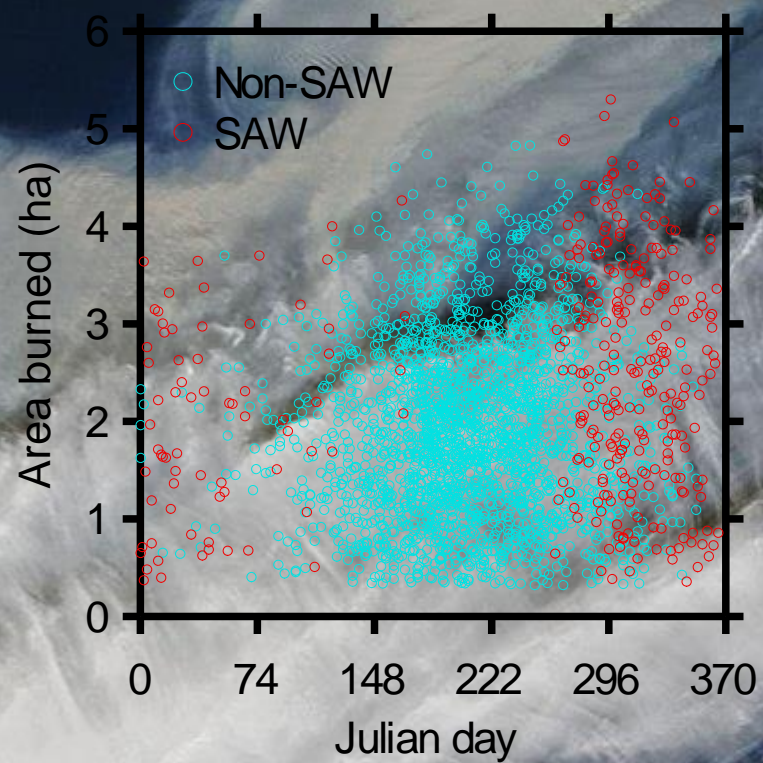
Smoke trails w/ offshore flow from foehn winds;
> 70mph & RH < 10%; annual events.

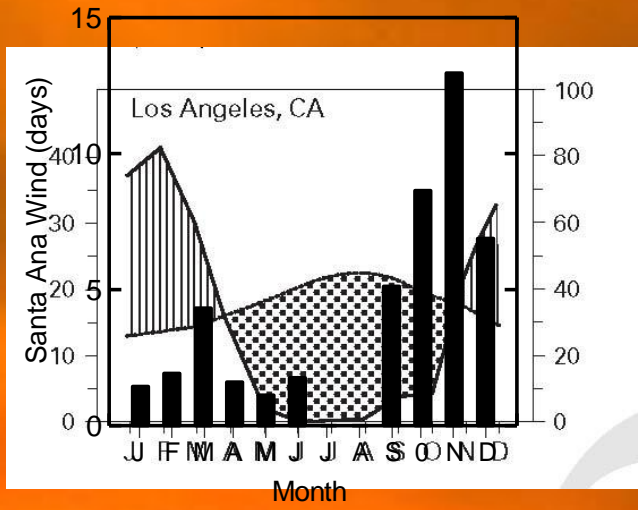
Other regions, e.g. 2016 Chimney Tops Fire in
Gatlinburg, TN (14/1600)

NSW Australia 2019-2020



Southern California





CNN.com



The 5 Ps of Wind-Dominated Fires:

- 1) *People*:** This is more a people problem than a fuel problem. 100% of these fires are ignited by people and increased fire activity since 2000 may be accounted for by the additional 6 million people; population growth may be a greater threat than global warming for these types of fires.
- 2) *Prevention*:** Rather than focusing on fuel treatments we need put much greater emphasis on fire prevention. However, it is not just a numbers issue; ignitions have declined radically since the mid-1980s, but area burned has increased. In the last decade the majority of large fires have been ignited by powerline failures. Option: shut down power grid during high wind events.
- 3) *Planning*:** Community planning needs to give fire similar recognition as other hazards. We have limited ability to control earthquakes and floods, so we have zoning restrictions. Fires have been perceived as controllable, but history reveals we are vulnerable. There is a need for greater focus on *fire-zoning* and consideration of replacing community planning with regional planning.
- 4) *Protection*:** Focus needs to be on the 'house out', i.e., greatest effort near homes and less as one moves further into the wildlands. Reducing fuels within 100' is important for defensible space, however, most homes burn from **embers** and thus reducing litter on roofs, adequate eave vent covers, double-pane windows and roof sprinklers may make a difference.
- 5) *Prediction*:** Real time prediction of wind patterns and communicating that information to fire-fighting agencies and homeowners could save lives.



Buck Fire

Redwood Complex

Sulphur Fire

Tubbs Fire

Nuns Fire

Partrick Fire

37 Fire

Atlas Fire

Lobo Fire

McCourtney Fire

California

Fog Returning?

REDWOOD EMPIRE — Fair except local morning coastal fog; coastal winds northwest 10-25 mph. Low humidity. Highs and lows: Ukiah 104 and 58; Santa Rosa 95 and 53. (Statistics, Page 2.)

Telephone Liberty 6-2020

THE PRESS DEMOCRAT

HOME

The Redwood Empire's Leading Newspaper

SANTA ROSA, CALIFORNIA — The City Designed for Living — THURSDAY AFTERNOON, SEPTEMBER 24, 1964

10 cent

Dry Winds Pose Threat To Empire Fire Lines



North State Fires Total 83,000 Acres

The Redwood Empire situation today looked relatively good—but continued bad weather and several vicious fires posed constant threats.

In all, the Division of Forestry said, 2,400 men are working out of division fire camps on Northwestern California fires since Saturday a total of 83,000 acres have been burned over.

No break in the hot, dry weather and high, gusty winds was in sight; predictions were for 100 degree-plus temperatures and ridge winds peaking at 50

the blaze, the current battle in the rugged, rocky ridges east and west of Mount St. Helena lookout.

Small aerial tankers are operating from the ridge-top at Angwin airport, bombing the fire in the brushy ridges while ground crews attempt to encircle the blaze.

Containment is not expected until tomorrow morning "at the earliest."

That fire started Saturday on the eastern slopes of Mount St. Helena. It broke out Sunday and



50 Homes Believed Lost to Flames

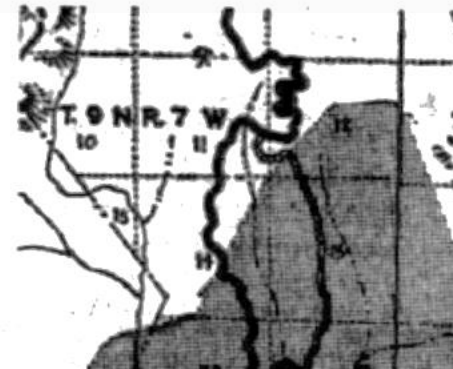
A deadly formula of high winds, soaring temperatures and dry timberlands today force-fed out-of-control

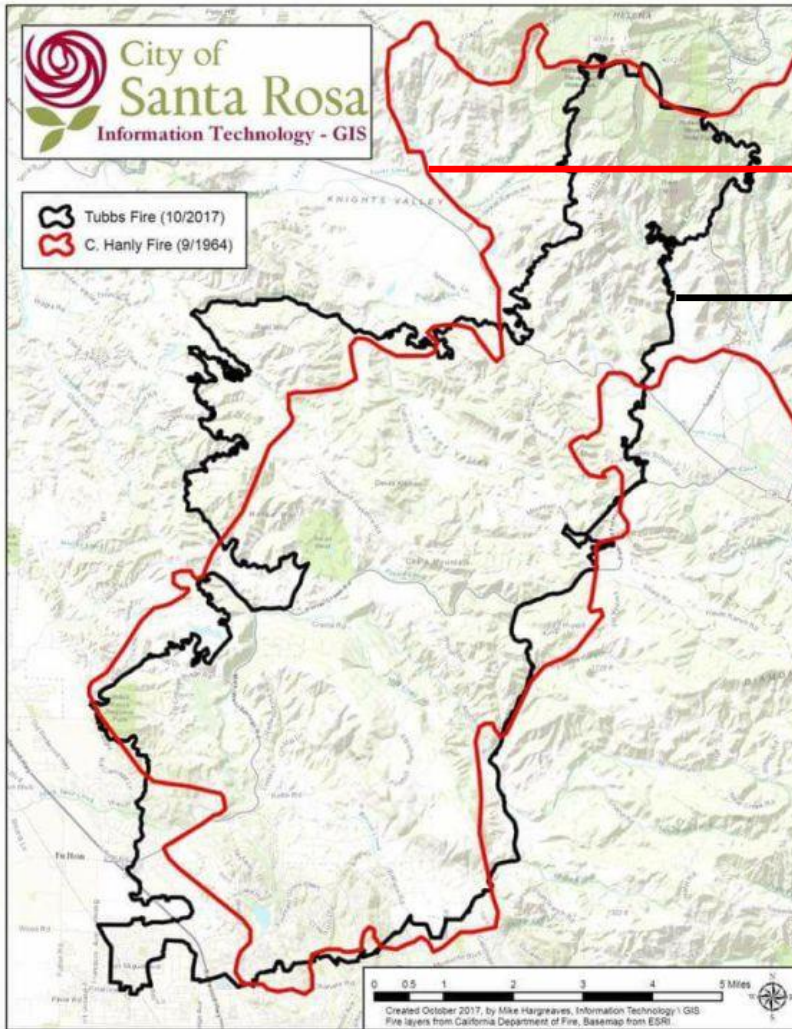
tains northeast of Kenwood continued to elude control.

Winds kicking up to 80 miles an hour splashed the flames

No relief from the extreme fire danger in the Redwood Empire is in sight, according to the weatherman.

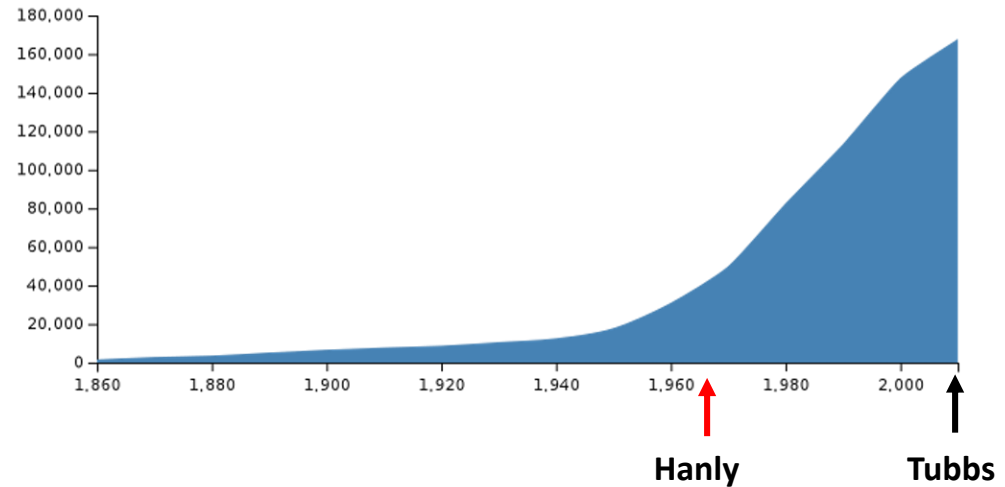
Joe Ganser, fire weather supervisor from Sacramento who is serving with a mobile fire weather unit at St. Helena, said no change in the



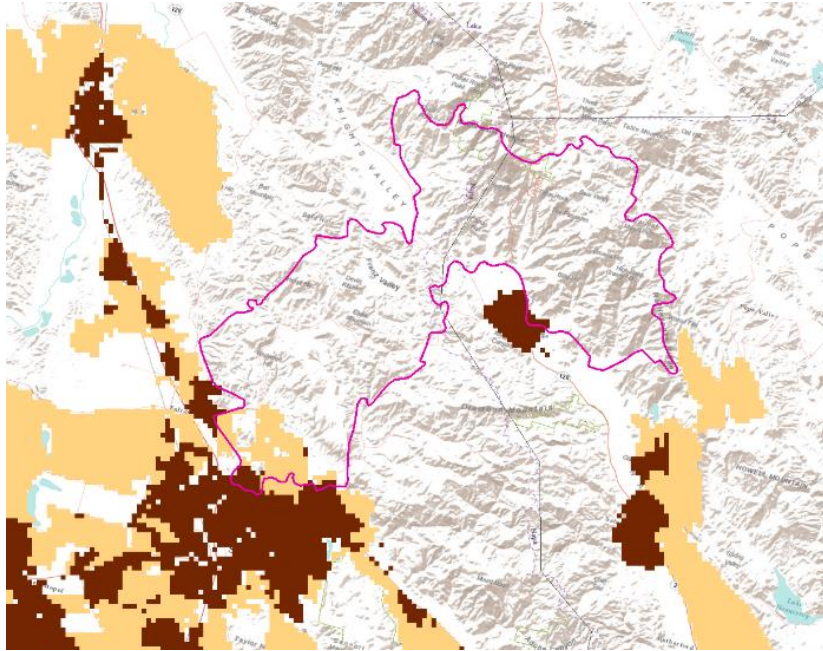


1964 **Hanly Fire** 83,000 acres
(no fatalities/~100 structures lost)

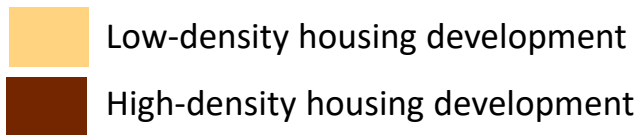
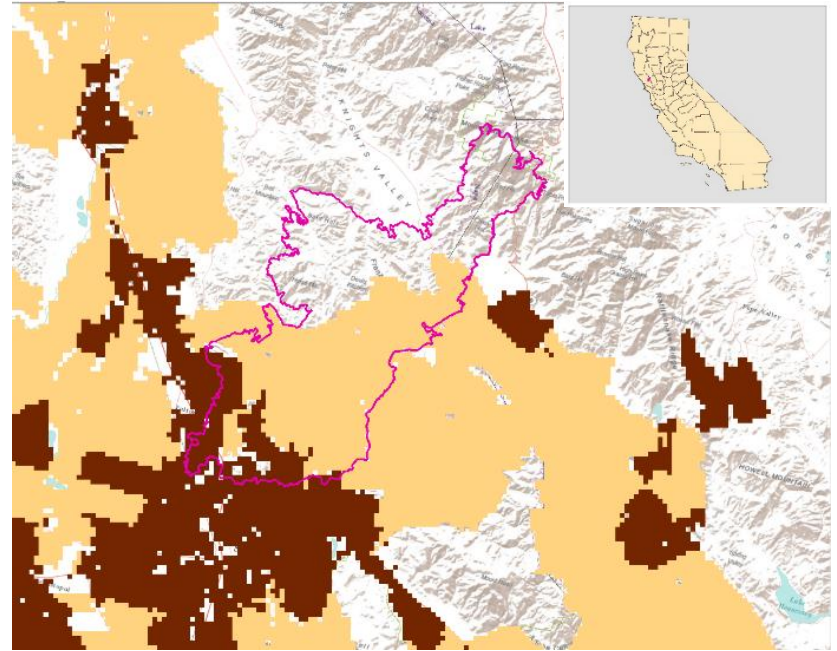
2017 **Tubbs Fire** 36,800 acres
(22 fatalities / 5,643 structures lost)



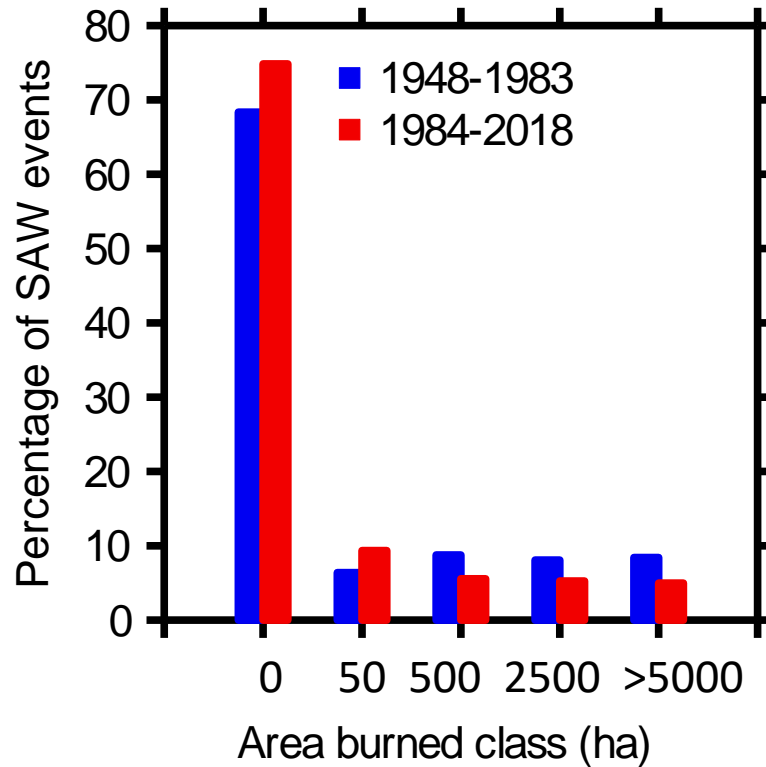
a) 1964 Hanly Fire



b) 2017 Tubbs Fire



Santa Ana Winds and fire



Oct: $\text{Log ha} = \text{Ignitions} + \text{SAWmax} + \text{Prior 5yr drought} - \text{PPT}$

Nov: $\text{Log ha} = \text{Ignitions} + \text{SAWdays}$

Dec: $\text{Log ha} = \text{Ignitions} + \text{SAWmax} + \text{SAWdays}$

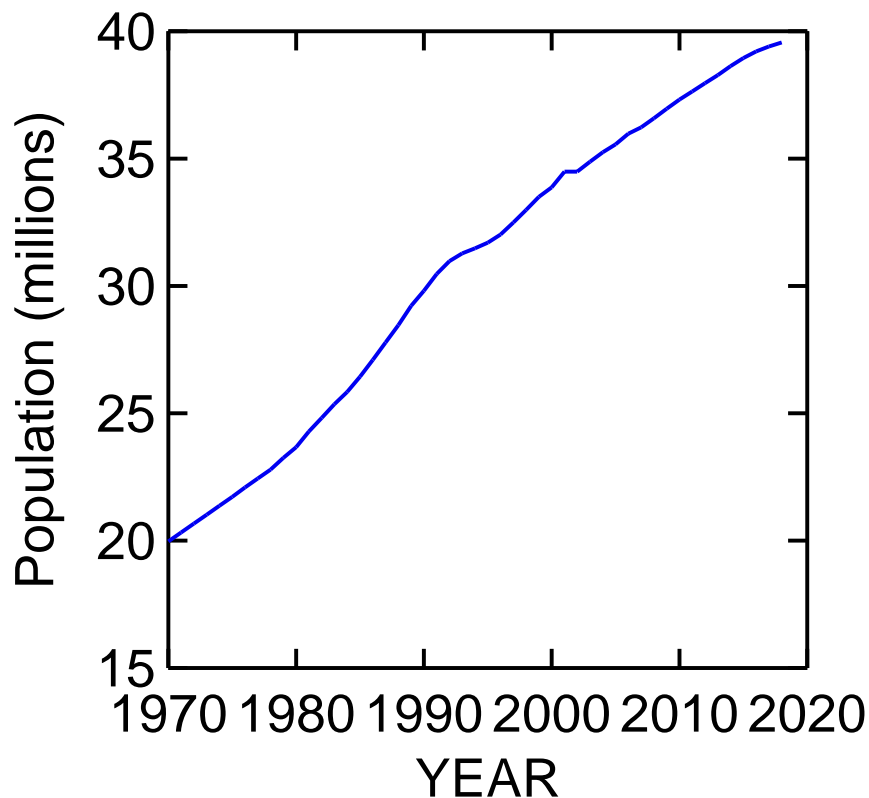
Jan: $\text{Log ha} = \text{Ignitions} + \text{SAWdays}$

	r^2	P
Oct	0.420	<0.001
Nov	0.298	<0.001
Dec	0.480	<0.001
Jan	0.668	<0.001

**Since 2000 area burned has more than doubled
-- this is often attributed to ~ 0.4 °C increase in temperature**

**However, Santa Ana Wind driven fires are limited
by human ignitions**

**Since 2000 California has grown by 6 million people
increasing ignition sources
increasing people at risk**



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- 2) *Prevention*: Rather than focusing on fuel treatments we need to put greater emphasis on fire prevention. However, it is not just a numbers issue; ignitions have declined since the mid-1980s, but area burned has increased. There has been a shift towards most area burned by powerline failures. Option: shut down power grid during high wind events.
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Powerline ignited fires in California

1981 – 1999

2000 – 2018

45,700 ha

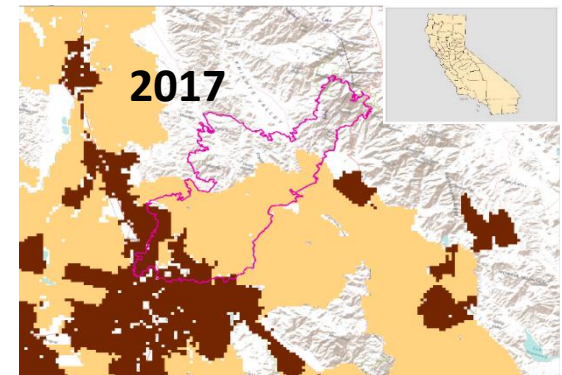
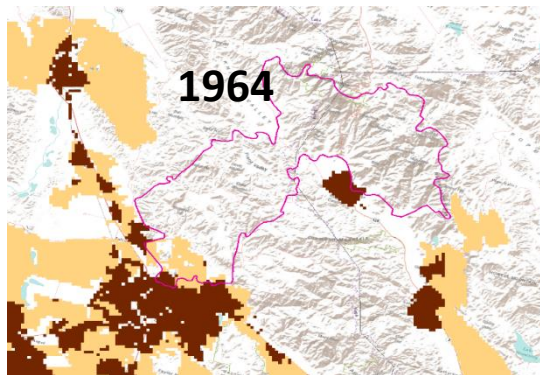
224,200 ha

Causes

Increase in electrical grid
Poor maintenance

Solutions

Addressing population growth
Improving maintenance
PSPS program



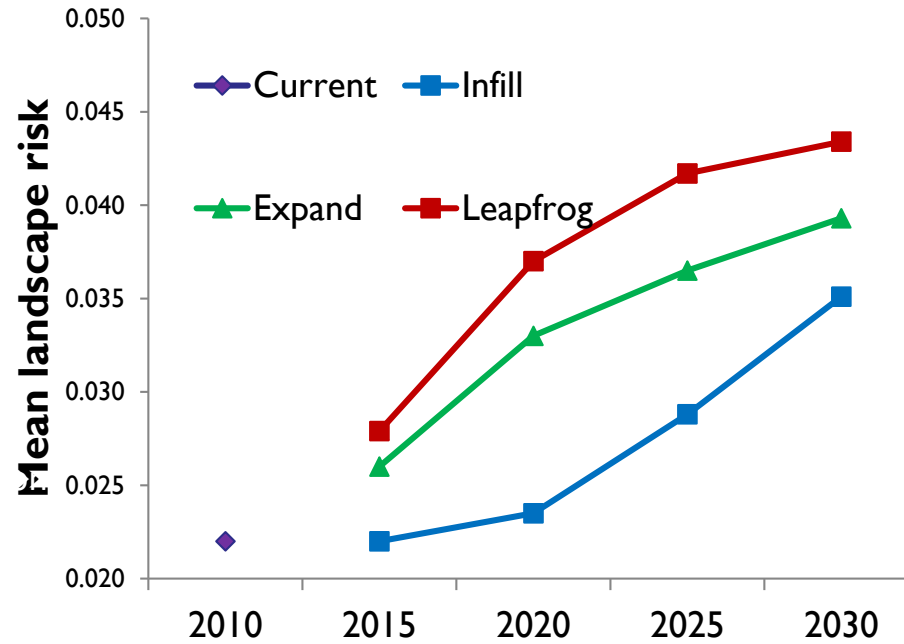
Low-density housing development
 High-density housing development

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Altering Fire Outcomes Through Land Planning



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Defensible Space:

CA law - 100 ft, but to many “more is better”

Issues:

erosion

invasive grasses fill ecological vacuums

loss of dwindling natural resources

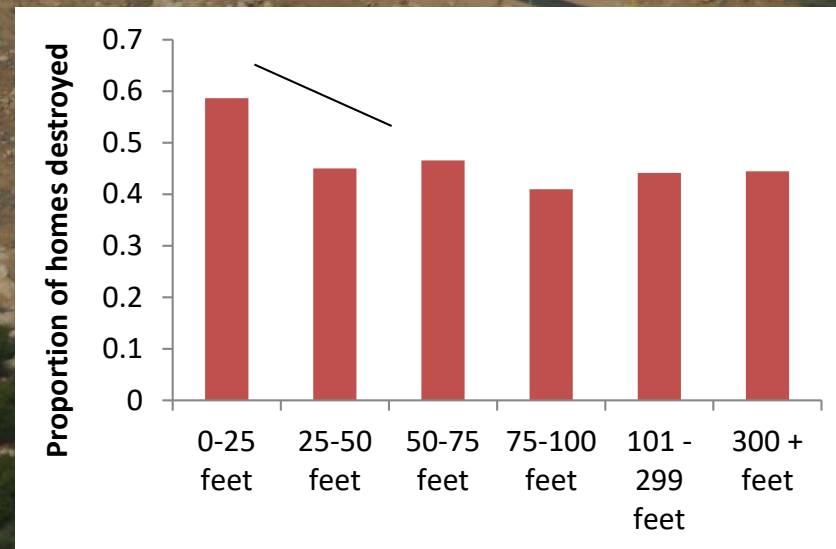




Table 5.1. *Comparison of characteristics of burned and unburned houses in a portion of the 2003 and 2007 fires. Clearance is for a subset of homes on the periphery of urban development. P values for Mann-Whitney test (C. J Fotheringham and J. E. Keeley, unpublished data)*

	Burned		Unburned		<i>p</i> -value
	Mean (S.E.)	N	Mean (S.E.)	N	
Clearance width (m)	9.38 (1.27)	83	12.45 (1.41)	82	0.115
Tree canopy overlap (m)	10.79 (1.01)	150	5.37 (0.81)	160	0.00001
Tree ground surface cover (m ²)	146.74 (13.43)	150	97.75 (9.22)	160	0.021
Patio (m)	4.82 (0.45)	150	3.59 (0.35)	160	0.051
Deck windward side (m)	0.87 (0.20)	150	0.383 (0.10)	160	0.069

(Keeley et al. 2012)



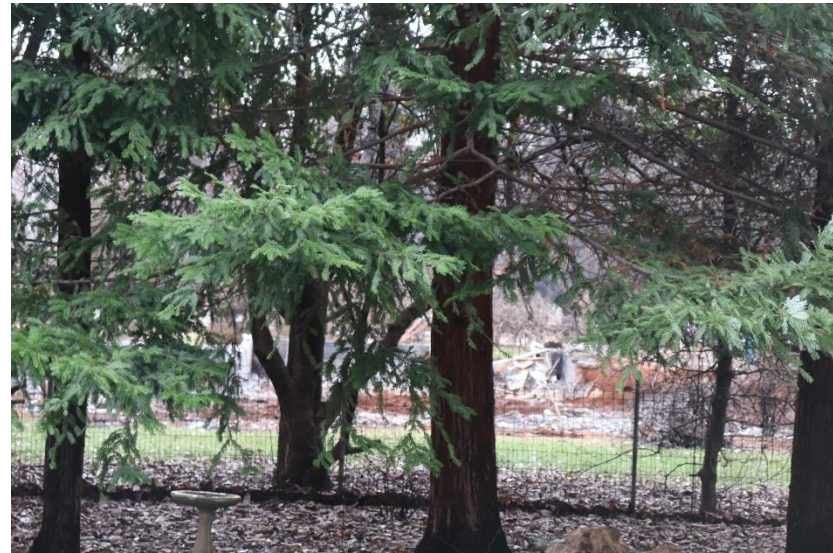


Defensible space does not mean total 'clearance'



With extreme winds, total clearance may enhance laminar flow of winds ensuring home destruction

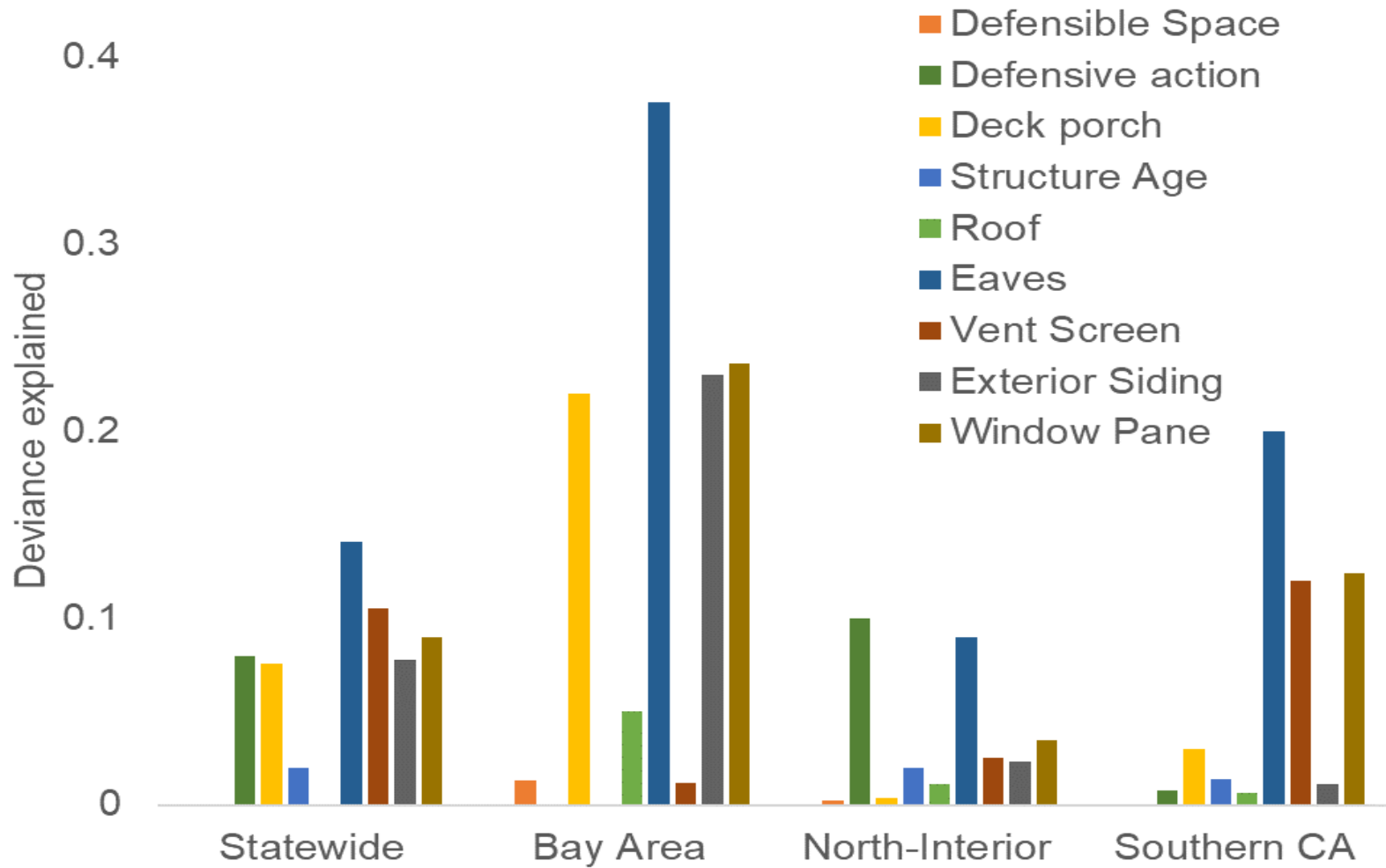
Trees may play a critically important role as 'ember catchers'



DigitalGlobe

A MAXAR COMPANY



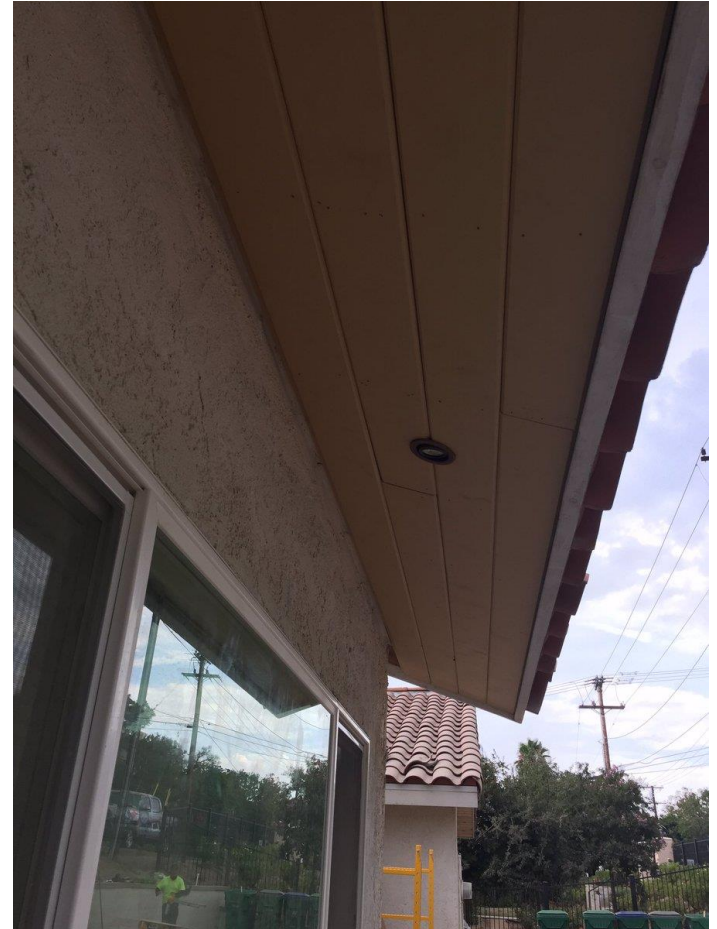


Open vs Closed Eaves



Vent mesh size

Double pane windows



Roof top sprinklers



Requirements:

Planning ahead

Power source

Water source

**Directional spray that avoids
loss due to high winds**

Financial commitment

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The Poetry of D.H. Rumsfeld

—Feb. 12, 2002, Department of Defense news briefing

The Unknown

*As we know,
There are known knowns.
There are things we know we know.
We also know
There are known unknowns.
That is to say
We know there are some things
We do not know.
But there are also unknown unknowns,
The ones we don't know
We don't know.*

