

## Topic 20: Wildfires



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## Topic 20: Wildfires



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HW7 video posted tonight  
Gradescope open after class

*all of this by this evening!*

Weekly test #7  
will include homework 5!  
Questions on geowiki under 'tests' tab

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## What Causes Wildfires?

### NATURAL CAUSES (15%)

- ~ globally ca. 2000 thunderstorms at any time
- ~ 8.6 Million lightning strikes on ground per day
- very few strikes spark wildfire



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### HUMAN CAUSES (85%)

- arson (26%)
- smoking, campfires, playing (11%)
- equipment (10%)

*BTW: all of current NE U.S. fires caused by people!*

Table 10.3 Causes of 2009 Wildfires in California<sup>(7)</sup>

Cause	% Fraction of Wildfires
<b>Natural</b>	
lightning	7
<b>Human</b>	
debris burning	12
equipment use	12
arson	4
smoking	2
vehicle	2
campfires	1
power lines	0.7
miscellaneous	30.5
undetermined	28.5
total (4736 fires)	100

2007+

Baja 2019

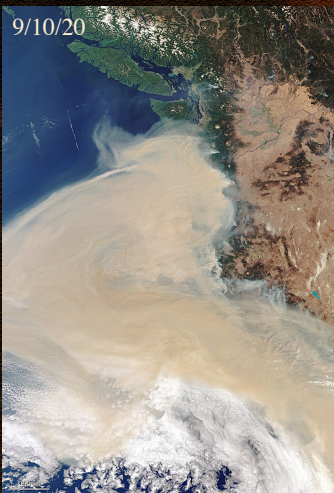
Cali 2019

## 2020 August/September Cali Fires

source: wikipedia

### CAUSE

lightning strikes



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S.F. Bay Bridge 9/9/20



record-breaking heat wave

Aug 16-17 remnants of Tropical Storm Fausto  
intense thunderstorms/lightning

August, CZU, SCU, LNU, North Complex:

Sep - strong Diablo winds

largest Cali wildfire season

9917 fires burned 4,397,809 acres

*still today*



## 2020 August/September Cali Fires

list compiled in 2020 – still current in 2023

2024 Park (429,603)

source: wikipedia

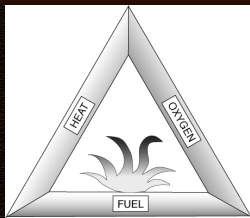
### California Top Ten Wildfires

August Complex	08/20	1,032,648	Glenn, Lake, Tehama, Shasta
Dixie	07/21	963,309	Butte, Lassen, Shasta, Tehama
Mendocino Comp	07/18	459,123	Mendocino, Lake, Glenn
SCU Lightning Comp	08/20	396,624	Sta Clara, Alameda, S Joaquin
Creek	09/20	379,895	Fresno, Madera
LNU Lightning Comp	08/20	363,220	Colusa, Lake, Napa, Sonoma
North Complex	08/20	318,935	Plumas, Butte
Santiago Canyon	09/1889	300,000	Orange, Riverside, San Diego
Thomas	12/17	281,893	Ventura, Sta. Barbara
Cedar	10/03	273,246	San Diego

2003 Cedar Fire top in modern times .... until 2017

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## Fire – The Basics



### Fire Triangle

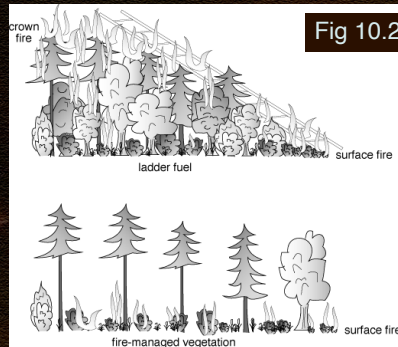
short video 10a

- heat ➤ water
- oxygen ➤ fire retardant (reddish)
- fuel ➤ clear vegetation, backfires

Take any of the 3 away to fight a fire.

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## Fire – The Basics



### Ladder Fuel

short video 10a

- fire can spread easily
- crown fires most intense

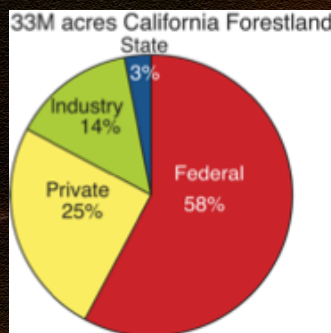
mitigation: 'raking' the forest

Cali: federal forest next to state forest  
(different funding/management)

2018 U.S. president to Cali governor:  
"rake your forest!"

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## Federal Support – or Lack Thereof



30 September 2014 S.D. Union Tribune  
"State exhausts fire fighting budget"

Peak of San Diego Fire Season:  
**OCTOBER**

Federal disaster emergency funds:  
-> hurricanes, tornadoes,  
earthquakes but not ~~wildfires~~

21 October 2017 S.D. Union Tribune  
"U.S. Forest Service spends increasing  
amount of money for fighting fires,  
cutting short prevention"

1995: < 17% of budget  
toward firefighting  
2017: 56% !!

raking the forest

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## Fire – The Basics

### Stages of Fire

- ❖ preheating phase (remove  $H_2O$ ; bring cellulose to  $300^{\circ}C/575^{\circ}F$ )
- ❖ pyrolysis (decompose wood  $\rightarrow$  flammable gases)
- ❖ flaming combustion (gases burn)
- ❖ glowing combustion (wood burns) – less hot

short video 10b

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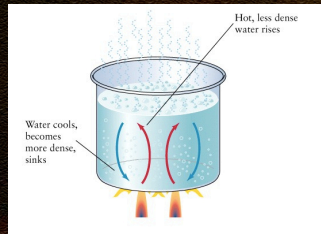
## Poll

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## Fire – The Basics

### Topic 2



Heat ascends

short video 10a

Fig 10.11



### Spread of Fire

- uphill
- unless pushed by winds

Topic 2: heat transported most effectively through convection (heat rises)

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## Plants and the Need for Wildfires

- some need heat or smoke to germinate
- recycle organic material
- control parasites
- influence insect behavior



Knobcone Pine



Lodgepole Pine

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## Native Fuel in Southern California

### chaparral:

- perennial evergreen brush, drought resistant
- grow shoots
- one of most flammable plant groups
- some plant need heat/smoke to germinate



Mt. Woodson after the 2003 Cedar Fire

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how do you 'rake the forest' here?

## Non-Native Fuel in Southern California

### took blame in 2003 Cedar Fire

#### eucalyptus:

- native to ..... Australia
- aromatic oils
- fast growing
- low-quality brittle wood



**S** trees in Scripps Ranch were still green while homes burned

#### palm trees:

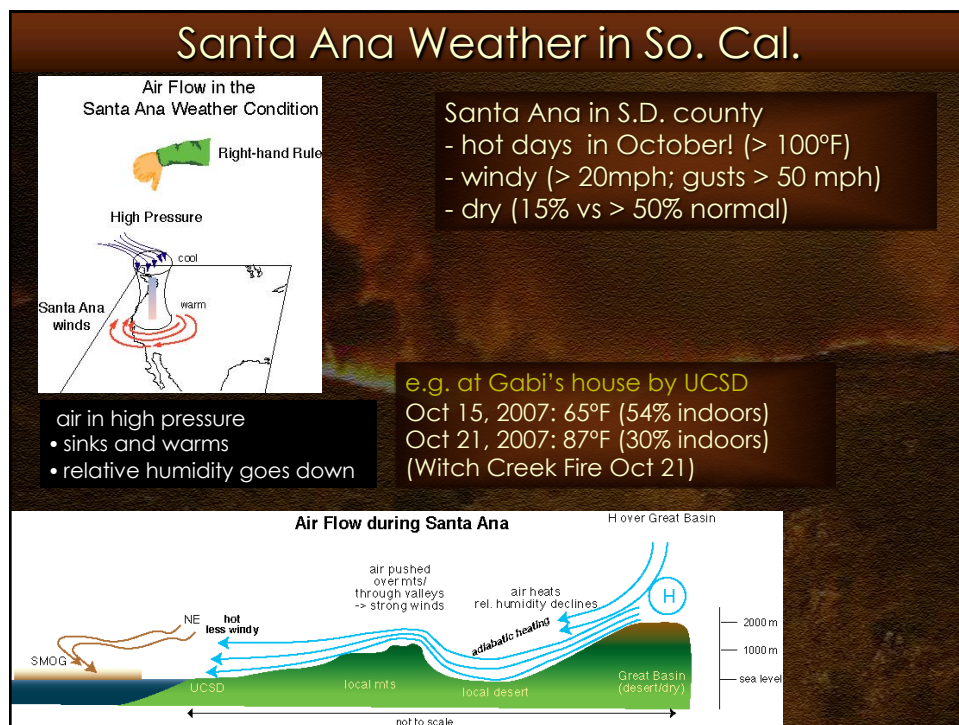
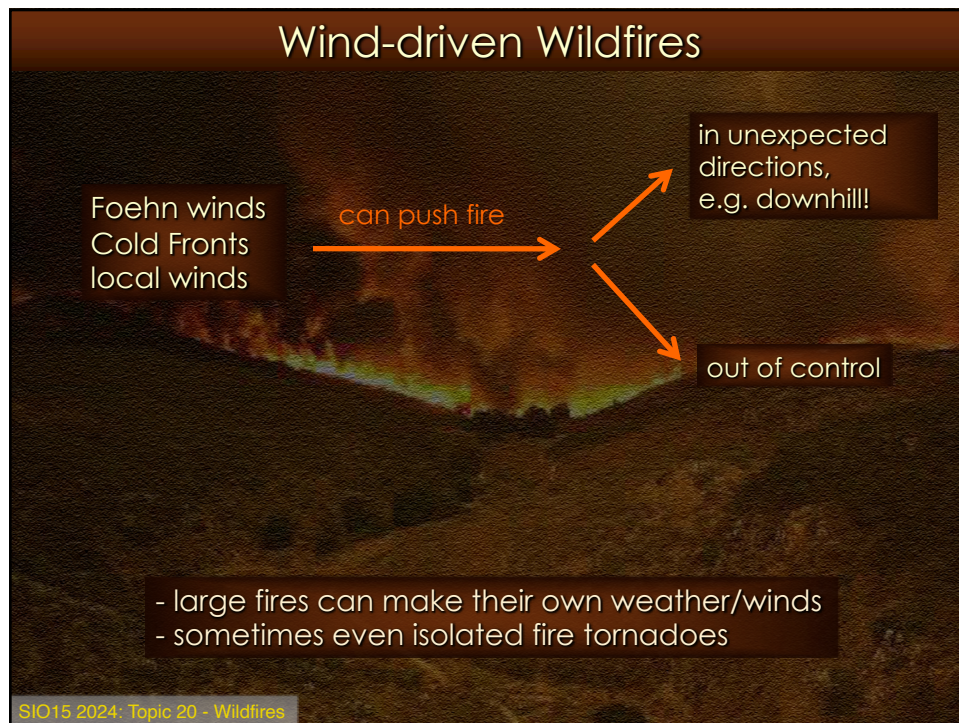
... unlikely ??  
2007: produced embers like sparklers



palm trees like sparklers  
flying embers ignite fires 5 mi ahead!

Fig  
10.10a





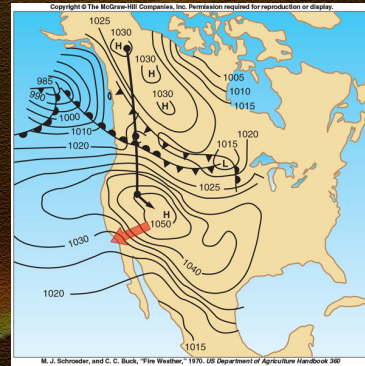
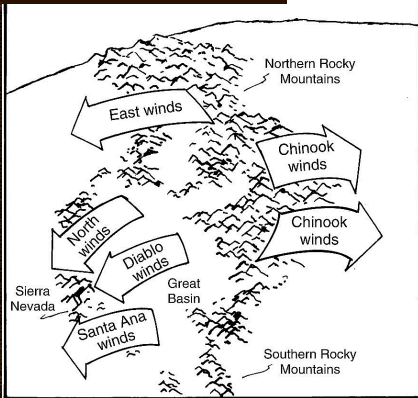


## Wind-driven Wildfires

### FOEHN WINDS

- high pressure system in Great Basin
- low humidity through adiabatic heating
- September - February (April)
- also in Australia!!

source: Abbott "Natural Disasters"



Santa Ana Fire Season Peak  
Oct - Nov



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Fig 10.23

## Poll



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## Fire – The Basics

### Stages of Fire

- ❖ preheating phase (remove  $H_2O$ ; bring cellulose to  $300^{\circ}C/575^{\circ}F$ )
- ❖ pyrolysis (decompose wood → flammable gases)
- ❖ flaming combustion
- ❖ glowing combustion

### Santa Anas (and other Foehn weather)

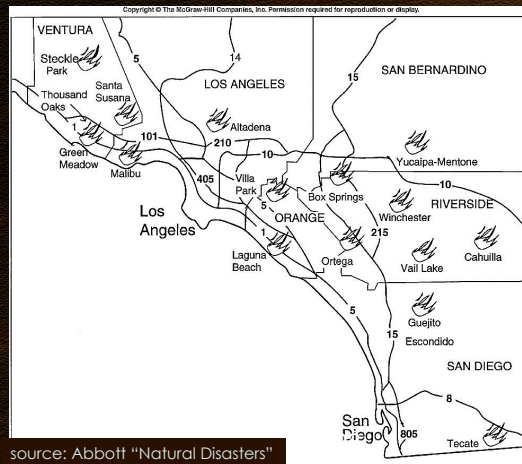
Santa Ana in S.D. county

- hot days in October! ( $> 100^{\circ}F$ )
- windy ( $> 20\text{mph}$ ; gusts  $> 50\text{ mph}$ )
- dry (15% vs  $> 50\%$  normal)

shortens  
pre-heating phase!

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## Santa Anas, SoCal ... and San Diego



source: Abbott "Natural Disasters"

2007  
12 fires in SoCal  
 $> 900,000$  evacuated

- fires come in clusters
- fire fighting resources are shared
- San Diego is last!
- 2003 and 2007 fire fighting slow start

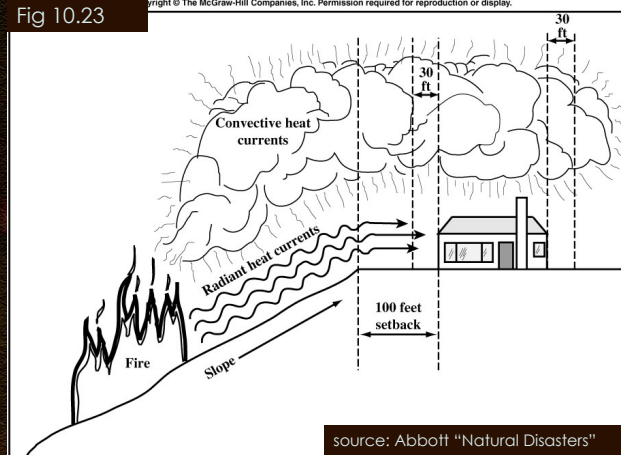
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## Some Precautions we can Take

Fig 10.23

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source: Abbott "Natural Disasters"

- clear brush around house
- clear brush on slope
- build house away from slope

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## Some Precautions we can Take



source: Abbott "Natural Disasters"

- plant trees away from house
- trim trees (no contact with chimney!)
- replace shake-shingle roofs
- clear hillsides
- store fuel/wood away from house

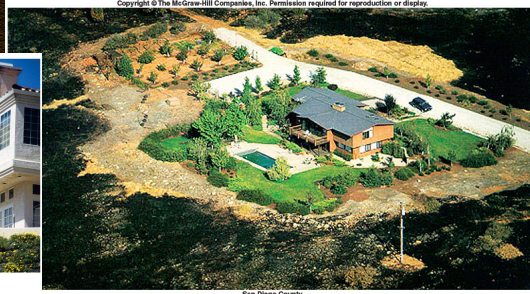
fire fighters will try to save these

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(b)



San Ramon County



## Some Precautions we can Take

2/15/22 SD Union Tribune

### CALIFORNIA SETS HOME, COMMUNITY STANDARDS TO LOWER WILDFIRE RISK

Agencies promote ways that people can harden homes

ASSOCIATED PRESS

#### SACRAMENTO

A fire-resistant roof, at least 5 feet of defensible space around a home, a clearly defined evacuation

wildfire risks.

"The framework will help me as a regulator of the nation's largest insurance market to expand insurance incentives to homes and businesses and that will save money and safety," he said.

The year of insurance companies state agencies

- fire-resistant roof
- > 5 ft of defensible space
- evacuation route in a neighborhood
- removal of vegetation overgrowth in a community

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## 2007 Witch Creek Fire – Rancho Bernardo

- sometimes, a little luck makes all the difference



source: lightstalker.org (Getty image)

many homes burned from the inside out  
(e.g. embers came in through chimneys)

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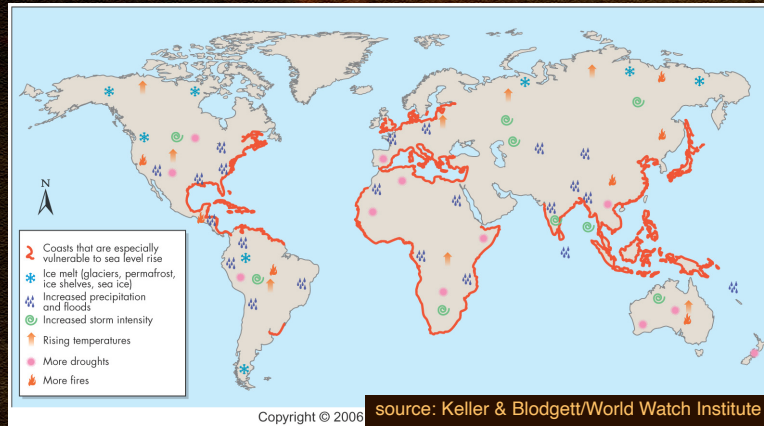


## Cali Wildfires and Climate Change

- earlier spring/late fall
- longer dry season
- more wildfires

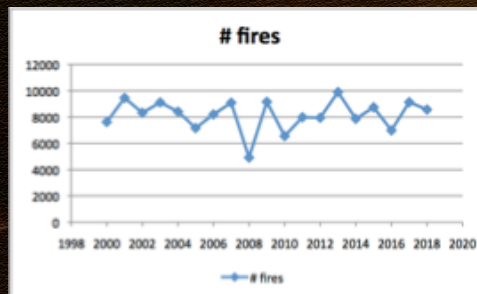
Santa Ana season  
Sep – Feb (peaks Dec)

Peak of SoCal Fire Season:  
OCTOBER

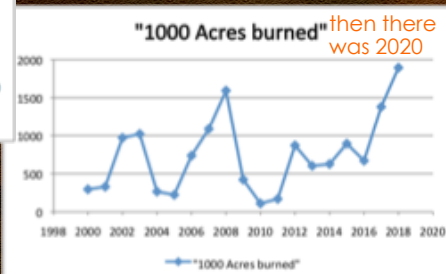


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## Cali Fires since 2000



info difficult to get:  
different fire agencies  
CalFire/Feds have  
different reporting



- # fires steady
- but size of burned area increasing
- recent years exceptional in acreage?

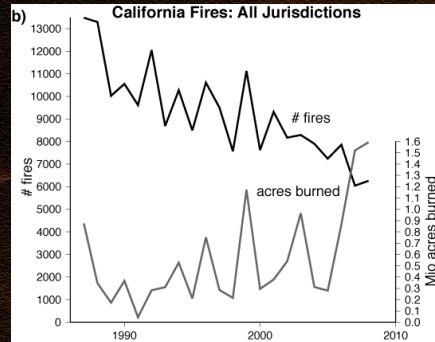
2019 0.3 M  
2020 4.4 M  
2021 2.6 M

single fires getting larger!!

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## Fire Suppression, Fire Fighting and the California Budget Crisis



- number of fires declining
- but size of burned area increasing

Cali (all jurisdictions):  
less fires but larger!!

Fig 10.25b

- 2000, nearly 1/3 was prescribed
- prescribed fires can get out of control!!!!
- prescribed fires get more expensive!

2022 New Mexico  
Apr-Aug (largest in  
modern NM history)

does fire suppression increase  
the risk of LARGE wildfires??

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## The Costs of Fire Fighting

fire fighting from the air particularly expensive

- DC-10: several \$10K/hour
- needed in remote areas/particular emergencies
- may not fly during Santa Ana fires!

new threat: interference by private drones

fire fighting helicopter, Bastrop County Fire 2011



source: wikipedia



## 2016 Cali Fires - State Resources



Canyon Fire near Vandenberg AFB; source: wikipedia

### 9/17 Canyon Fire

3rd Santa Barbara fire  
52,000 acres

### 8/16-23 Blue Cut

San Bernardino  
36,000 acres  
105 homes

### 7/22 Soberanes, Monterey

>125,000 acres  
1 fatality  
57 home

30 September 2014 S.D. Union Tribune  
*"State exhausts fire fighting budget"*

Peak of San Diego Fire Season:  
**OCTOBER**

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