FIRE AND CLIMATE CHANGE

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A HISTORY OF FIRE SUPPRESSION

- ~1870 arrival of the railroad unleashed hundreds of thousands of cattle and sheep across the West.
- Livestock depleted fine fuels (grasses) through grazing, effectively crippling frequent, low-intensity surface fire regime.
- ~1900s – US Forest Service & timber industry advocated for full-suppression of all forest fires.
- 1935 – **“10:00am Policy”**
- 1960s-70s – NPS and USFS adopt policies to allow for backcountry fires to burn

Vulnerabilities of Navajo Nation Forests to Climate Change

Christopher H. Guiterman and Ellis Q. Margolis

2019

Final report to the Navajo Nation and Bureau of Indian Affairs Tribal Resilience Program

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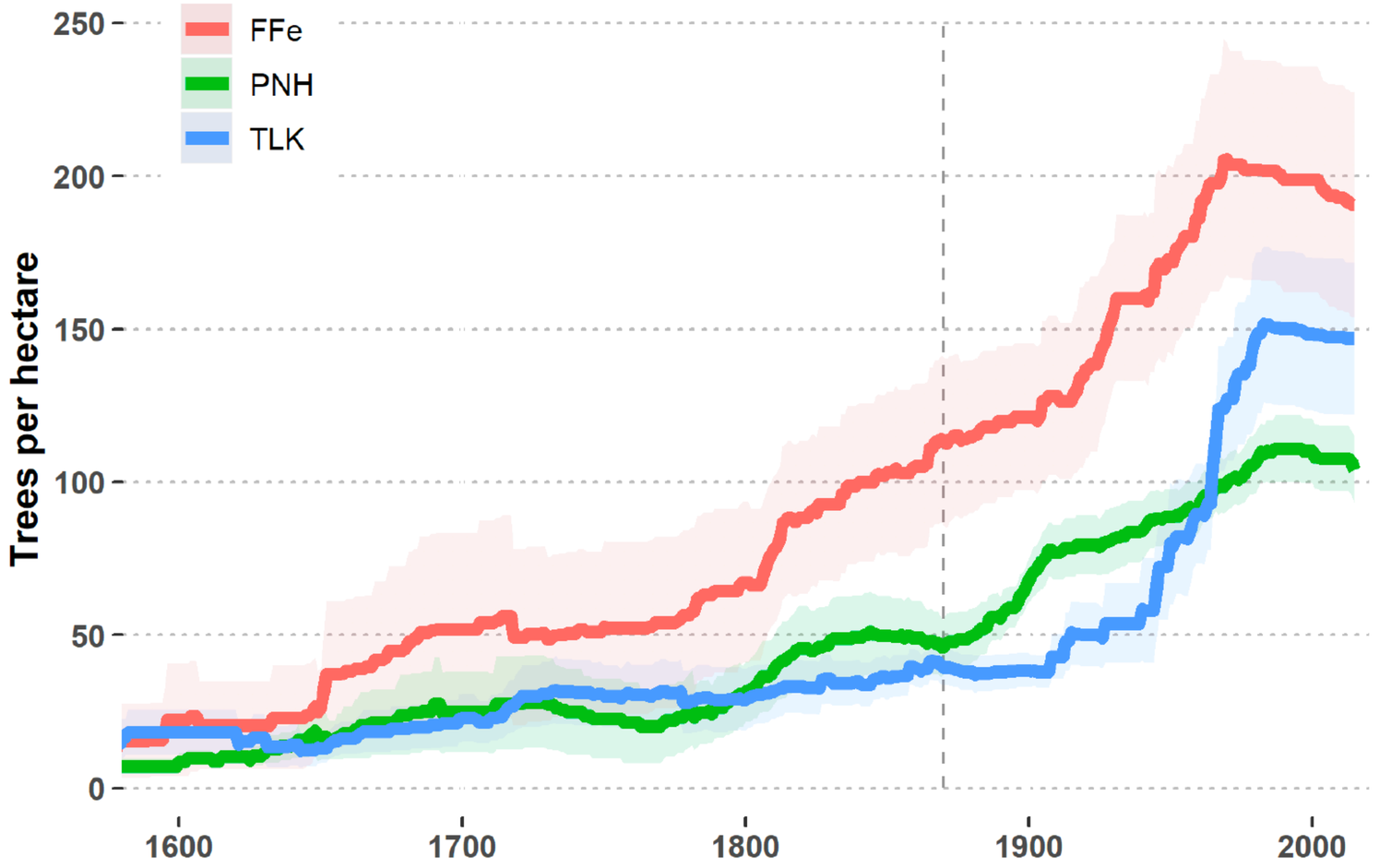
Tree recruitment

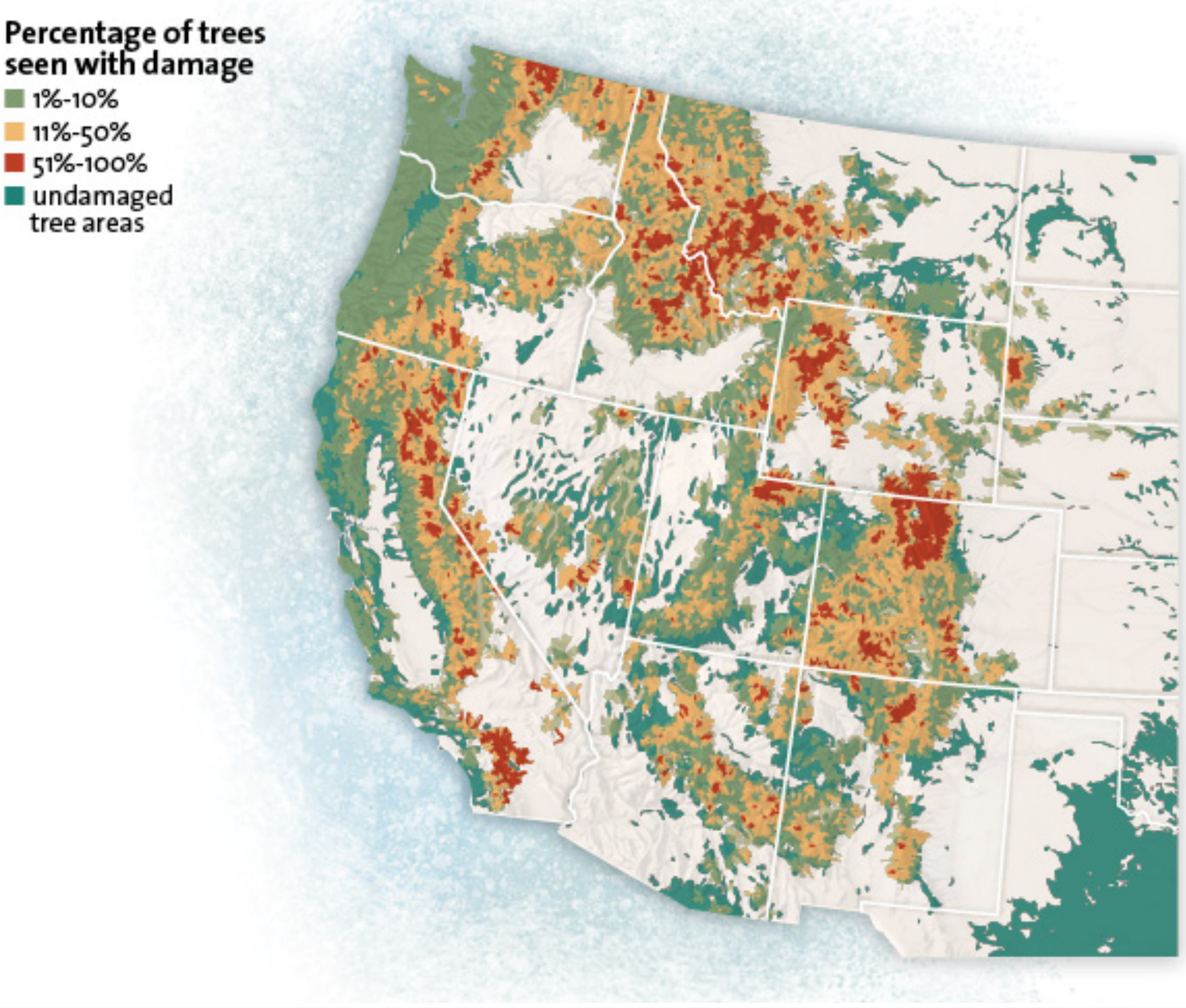


Guiterman & Margolis 2019

MOUNTAIN PINE BEETLE

- Across the West, most notably affecting Lodgepole Pine & Ponderosa Pine.

- Most susceptible stands contain over-mature, large diameter trees. (High tree densities).



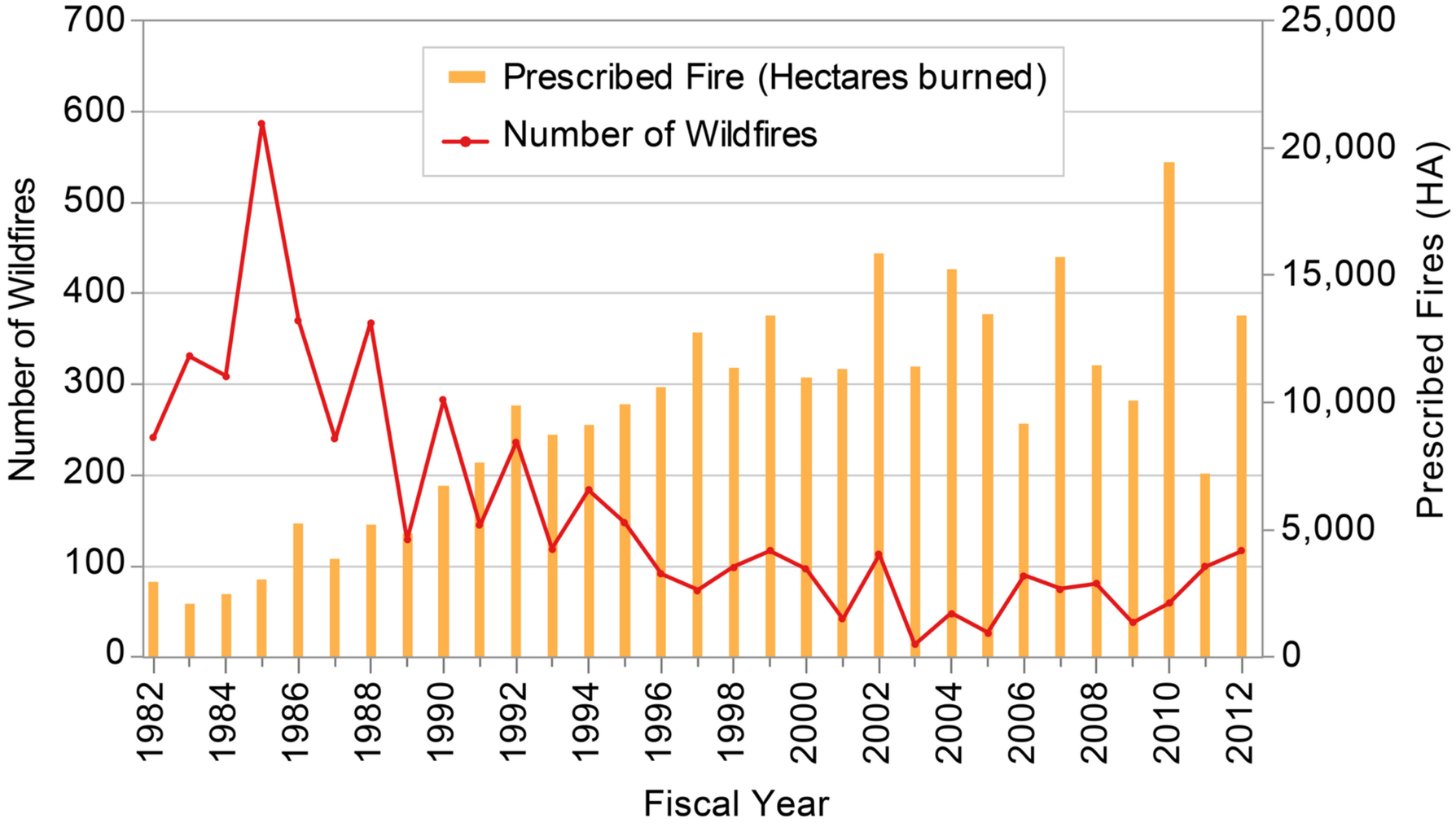
US Forest Service (2015)

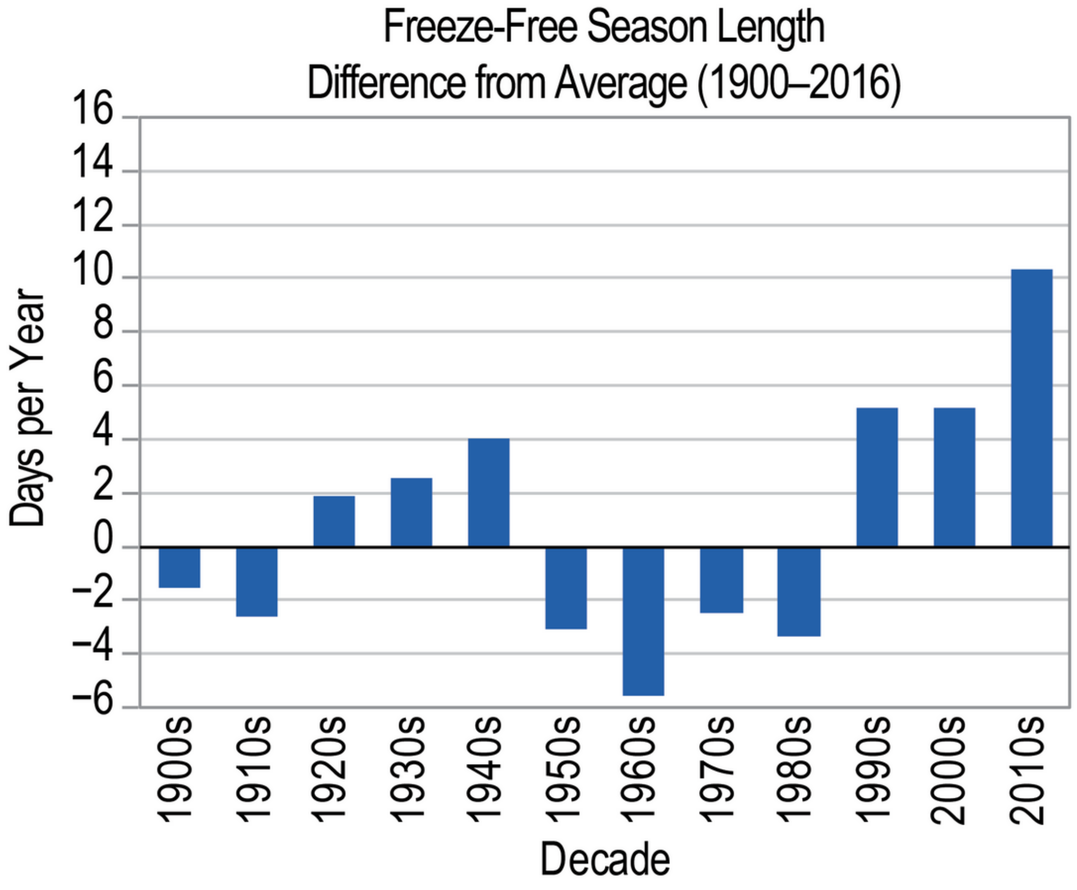
SOUTHEASTERN FORESTS

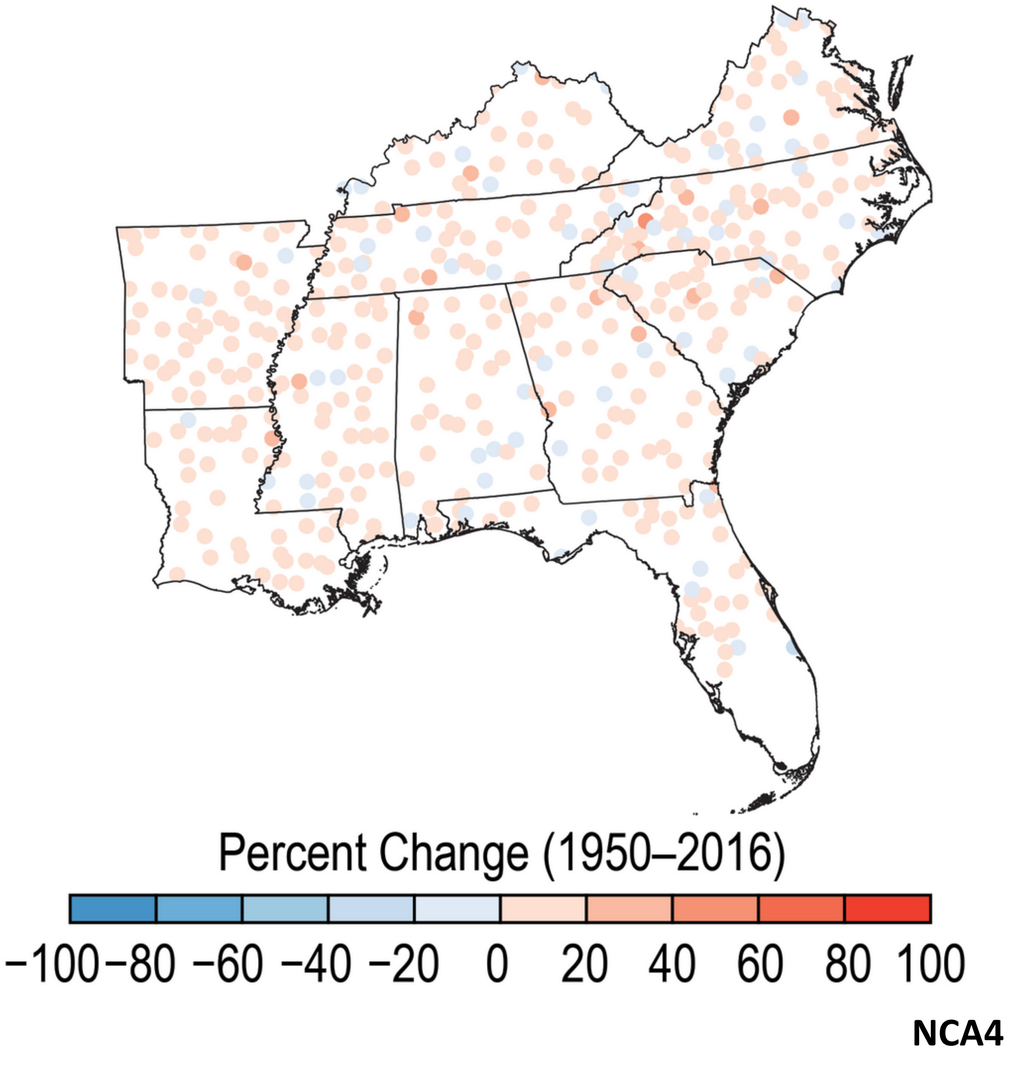
- A century of timber industry, invasive pests, and fire suppression have drastically change forest composition.

- Drought and increasing temperatures have cause cold-adapted boreal communities and fire-adapted tree species to be replaced by fire-sensitive tree species through **mesophication.**

The Southeast far exceeds the West in **acres of prescribed fire**




Freeze-Free Season Length
Difference from Average (1900–2016)
Days per Year
16
14
12
10
8
6
4
2
0
−2
−4
−6
1900s
1910s
1920s
1930s
1940s
1950s
1960s
1970s
1980s
1990s
2000s
2010s
Decade


Percent Change (1950–2016)
−100 −80 −60 −40 −20 0 20 40 60 80 100

NCA4

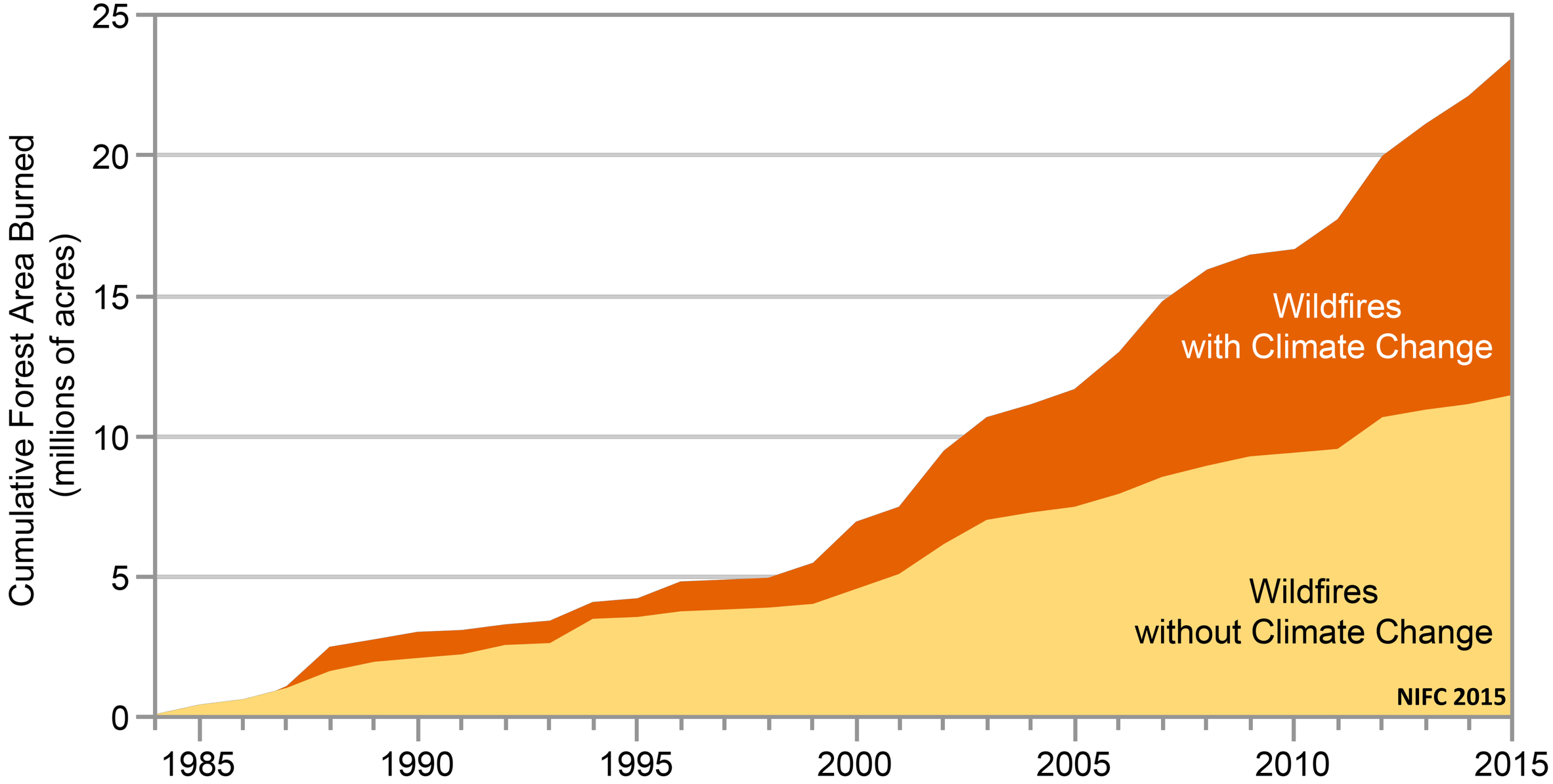
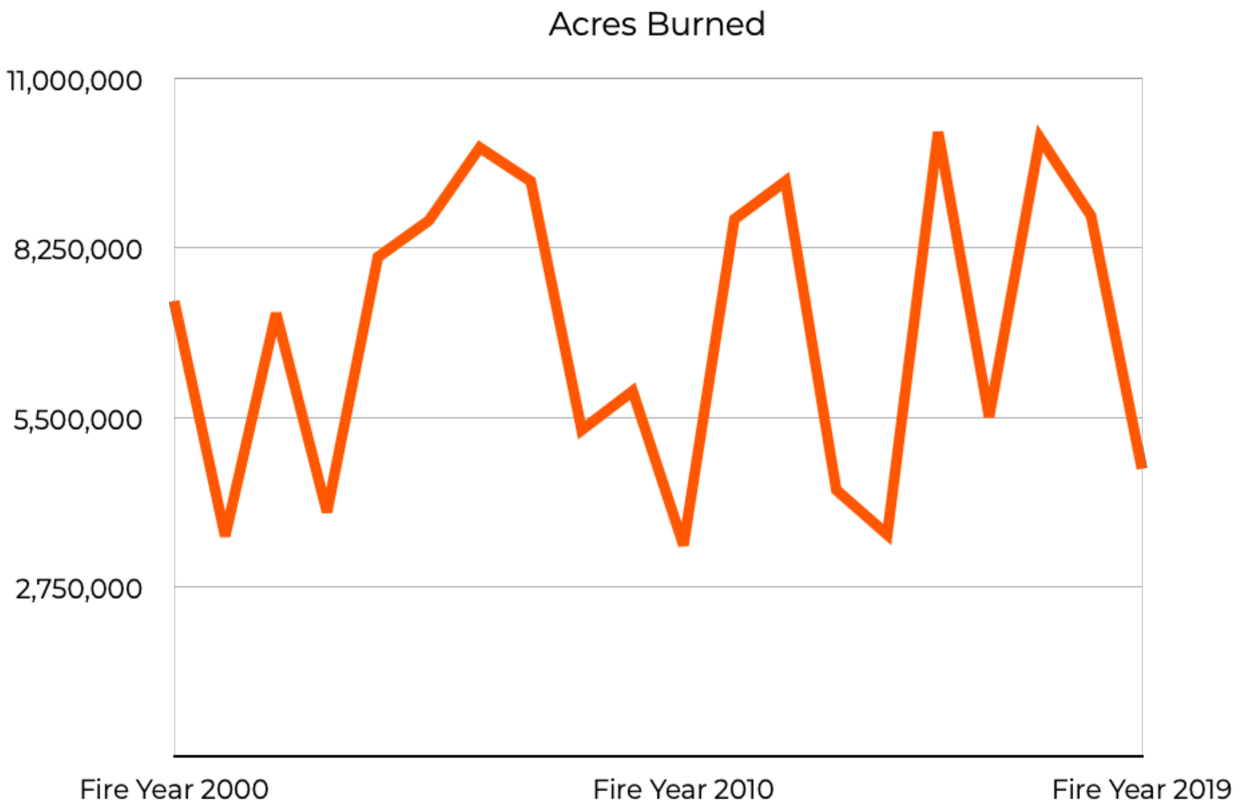

Cumulative Forest Area Burned
(millions of acres)
25
20
15
10
5
0
1985
1990
1995
2000
2005
2010
2015
Wildfires
with Climate Change
Wildfires
without Climate Change
NIFC 2015

Table 1. Annual Wildfires and Acres Burned

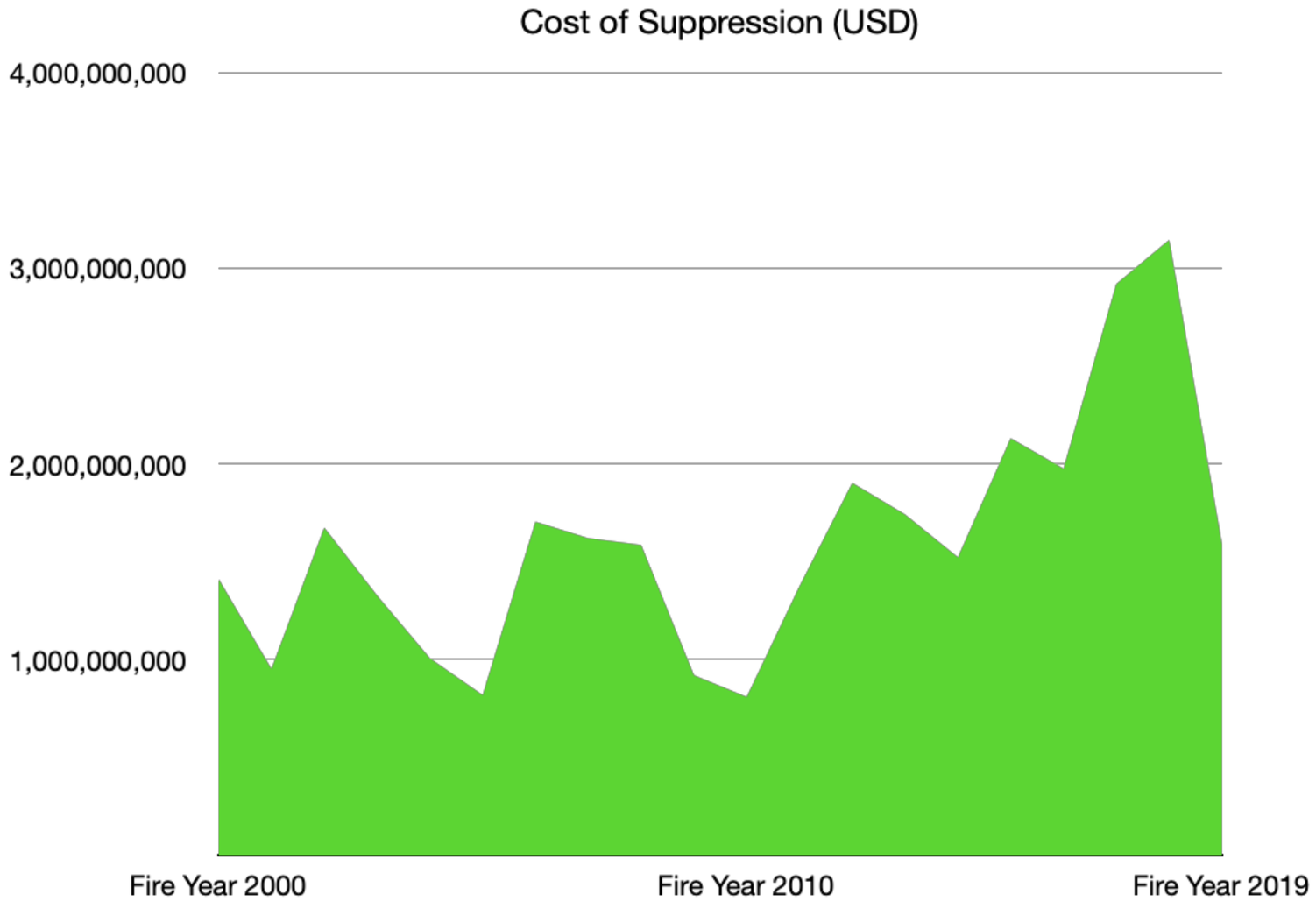
	2015	2016	2017	2018	2019
Number of Fires (thousands)					
Federal	13.8	12.6	15.2	12.5	10.9
FS	*7.1*	*5.7*	*6.6*	*5.6*	*5.3*
DOI	*6.6*	*6.8*	*7.3*	*7.0*	*5.3*
Nonfederal	54.4	55.2	56.4	45.6	39.6
Total	**68.2**	**67.7**	**71.5**	**58.1**	**50.5**
Acres Burned (millions)					
Federal	7.41	3.00	6.3	4.6	3.1
FS	*1.92*	*1.25*	*2.9*	*2.3*	*0.6*
DOI	*5.47*	*1.70*	*3.3*	*2.3*	*2.3*
Nonfederal	2.72	2.51	3.7	4.1	1.6
Total	**10.13**	**5.51**	**10.0**	**8.8**	**4.7**

Source: National Interagency Fire Center (NIFC).

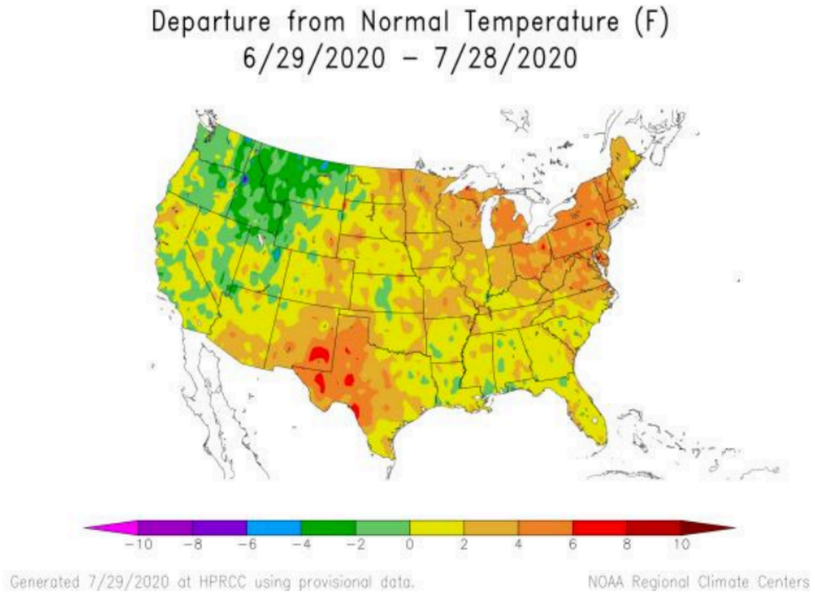


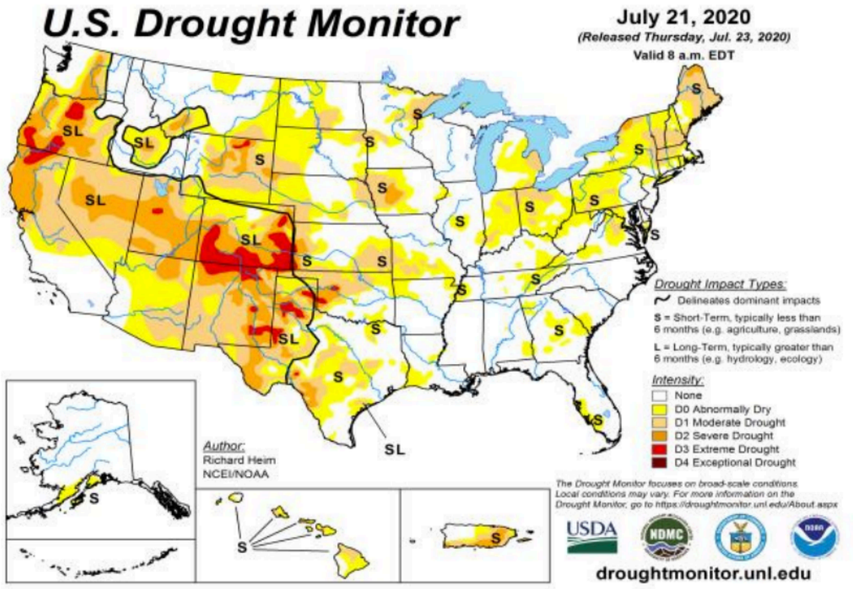
NIFC 2020

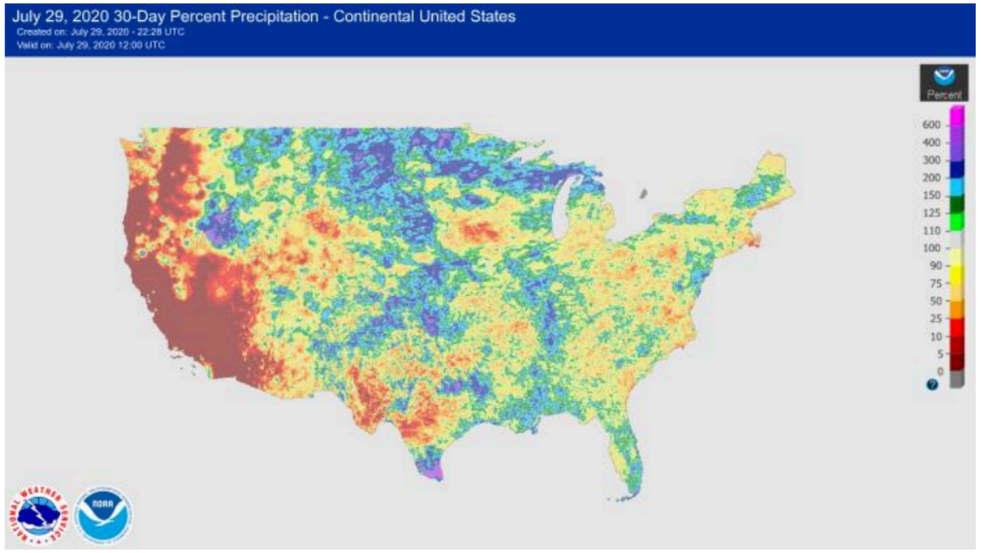
The annual cost of wildfire suppression has **drastically risen** over the last two decades.

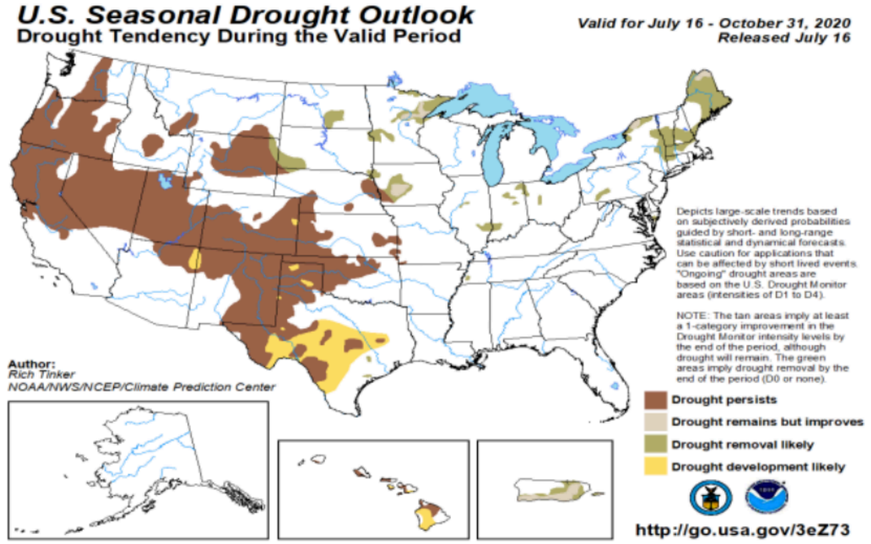


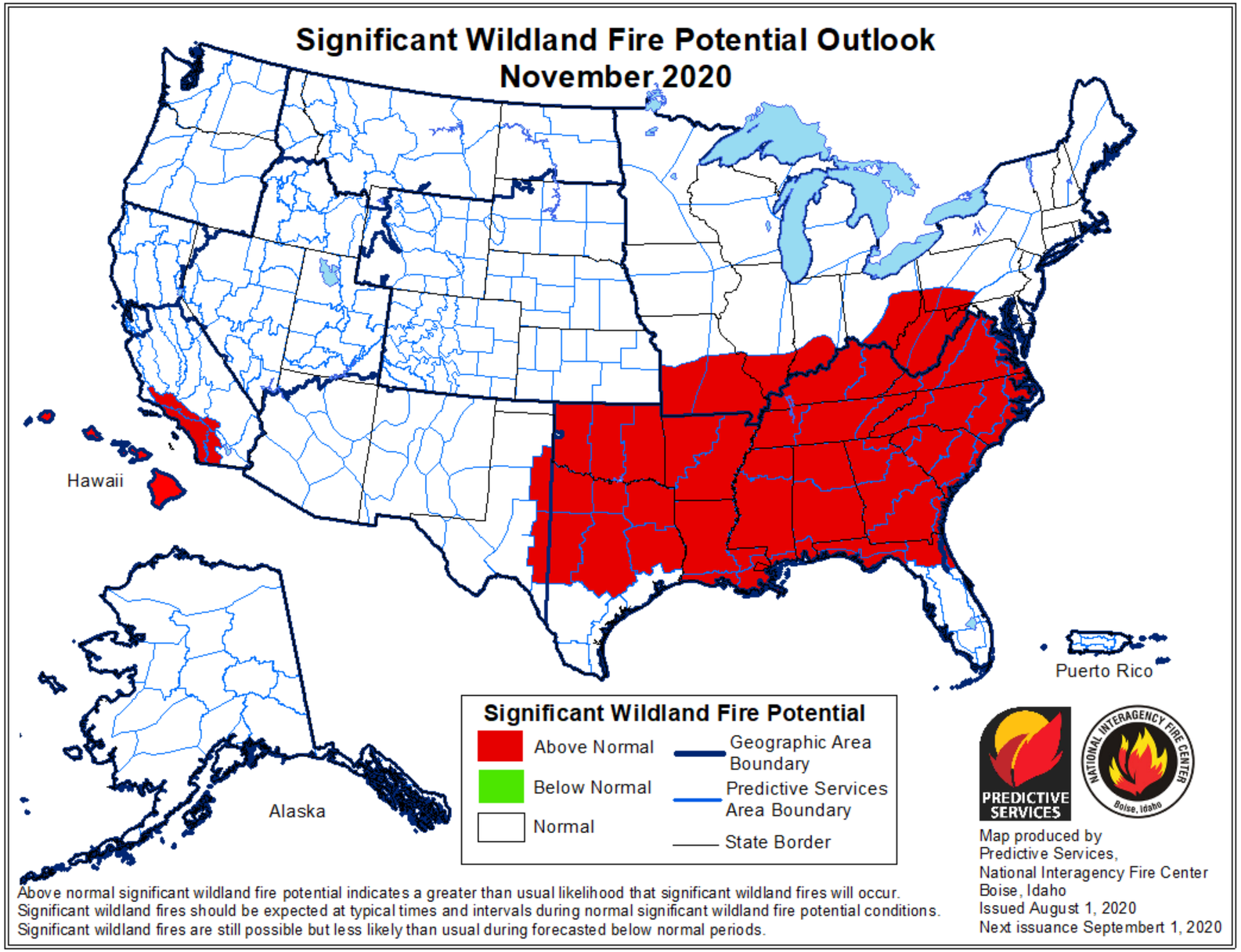
NIFC 2020


Departure from Normal Temperature (F)
6/29/2020 – 7/28/2020
−10 −8 −6 −4 −2 0 2 4 6 8 10
Generated 7/29/2020 at HPRCC using provisional data.
NOAA Regional Climate Centers


U.S. Drought Monitor
July 21, 2020
(Released Thursday, Jul. 23, 2020)
Valid 8 a.m. EDT
Drought Impact Types:
Delineates dominant impacts
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)
Intensity:
None
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought
Author:
Richard Heim
NCEI/NOAA
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to https://droughtmonitor.unl.edu/About.aspx
USDA
NDMC
droughtmonitor.unl.edu

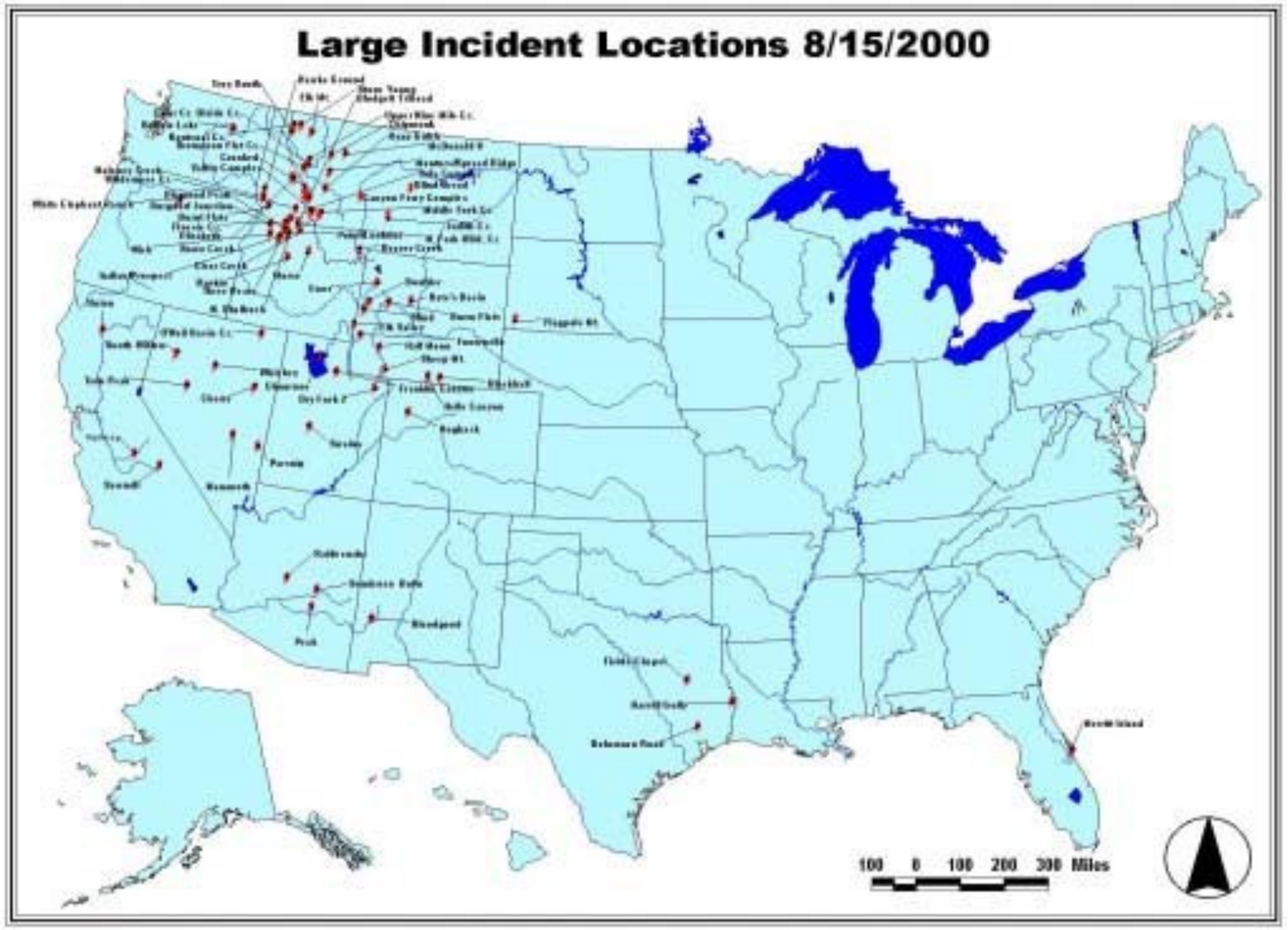

July 29, 2020 30-Day Percent Precipitation - Continental United States
Created on: July 29, 2020 - 22:28 UTC
Valid on: July 29, 2020 12:00 UTC
Percent
600
400
300
200
150
125
110
100
90
75
50
25
10
5
0


U.S. Seasonal Drought Outlook
Drought Tendency During the Valid Period
Valid for July 16 - October 31, 2020
Released July 16
Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Use caution for applications that can be affected by short lived events. "Ongoing" drought areas are based on the U.S. Drought Monitor areas (intensities of D1 to D4).
NOTE: The tan areas imply at least a 1-category improvement in the Drought Monitor intensity levels by the end of the period, although drought will remain. The green areas imply drought removal by the end of the period (D0 or none).
Author:
Rich Tinker
NOAA/NWS/NCEP/Climate Prediction Center
Drought persists
Drought remains but improves
Drought removal likely
Drought development likely
http://go.usa.gov/3eZ73

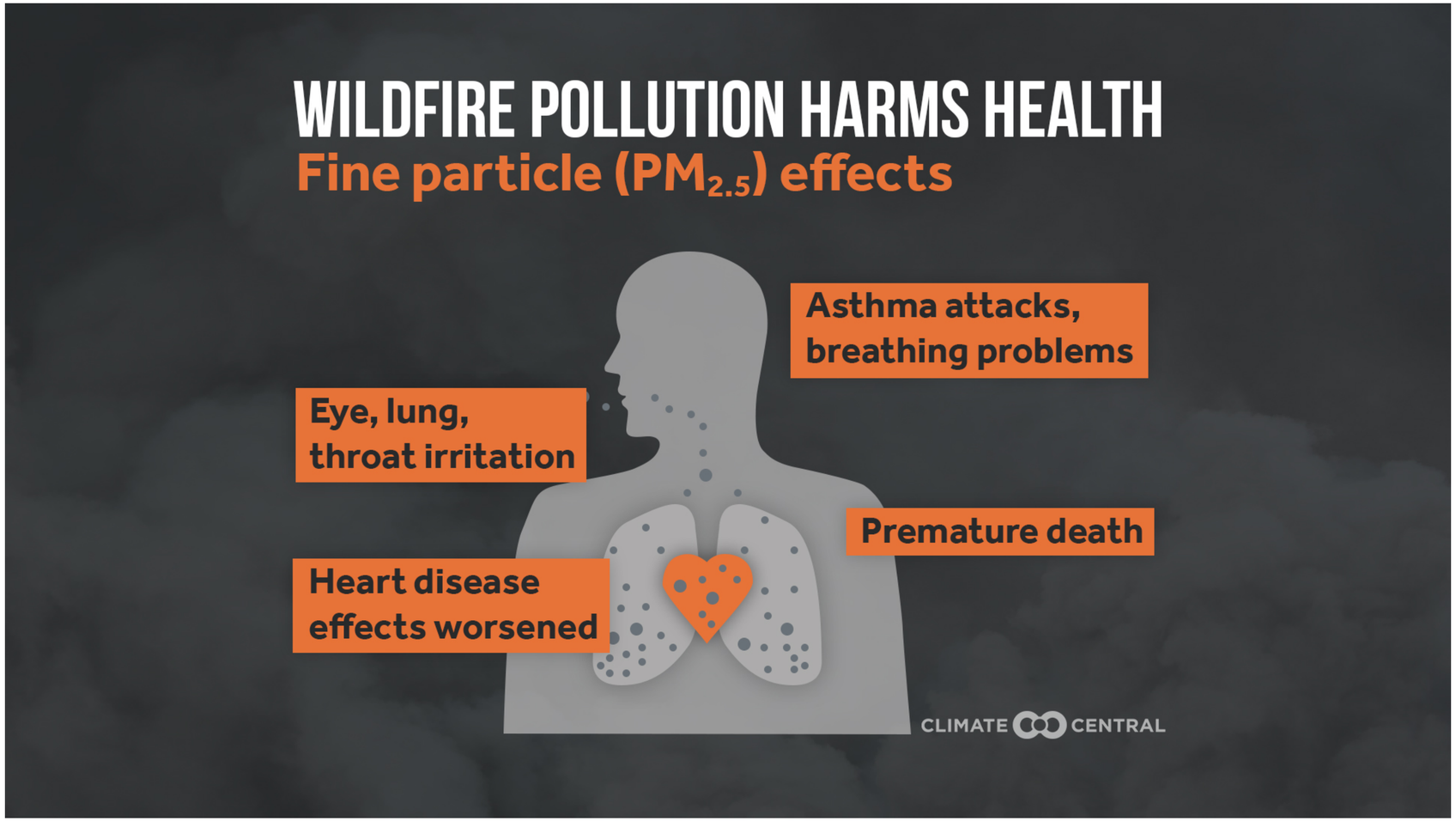

Significant Wildland Fire Potential Outlook
November 2020
Hawaii
Alaska
Puerto Rico
Significant Wildland Fire Potential
Above Normal
Below Normal
Normal
Geographic Area Boundary
Predictive Services Area Boundary
State Border
PREDICTIVE SERVICES
NATIONAL INTERAGENCY FIRE CENTER
Boise, Idaho
Map produced by
Predictive Services,
National Interagency Fire Center
Boise, Idaho
Issued August 1, 2020
Next issuance Septembert 1, 2020
Above normal significant wildland fire potential indicates a greater than usual likelihood that significant wildland fires will occur.
Significant wildland fires should be expected at typical times and intervals during normal significant wildland fire potential conditions.
Significant wildland fires are still possible but less likely than usual during forecasted below normal periods.

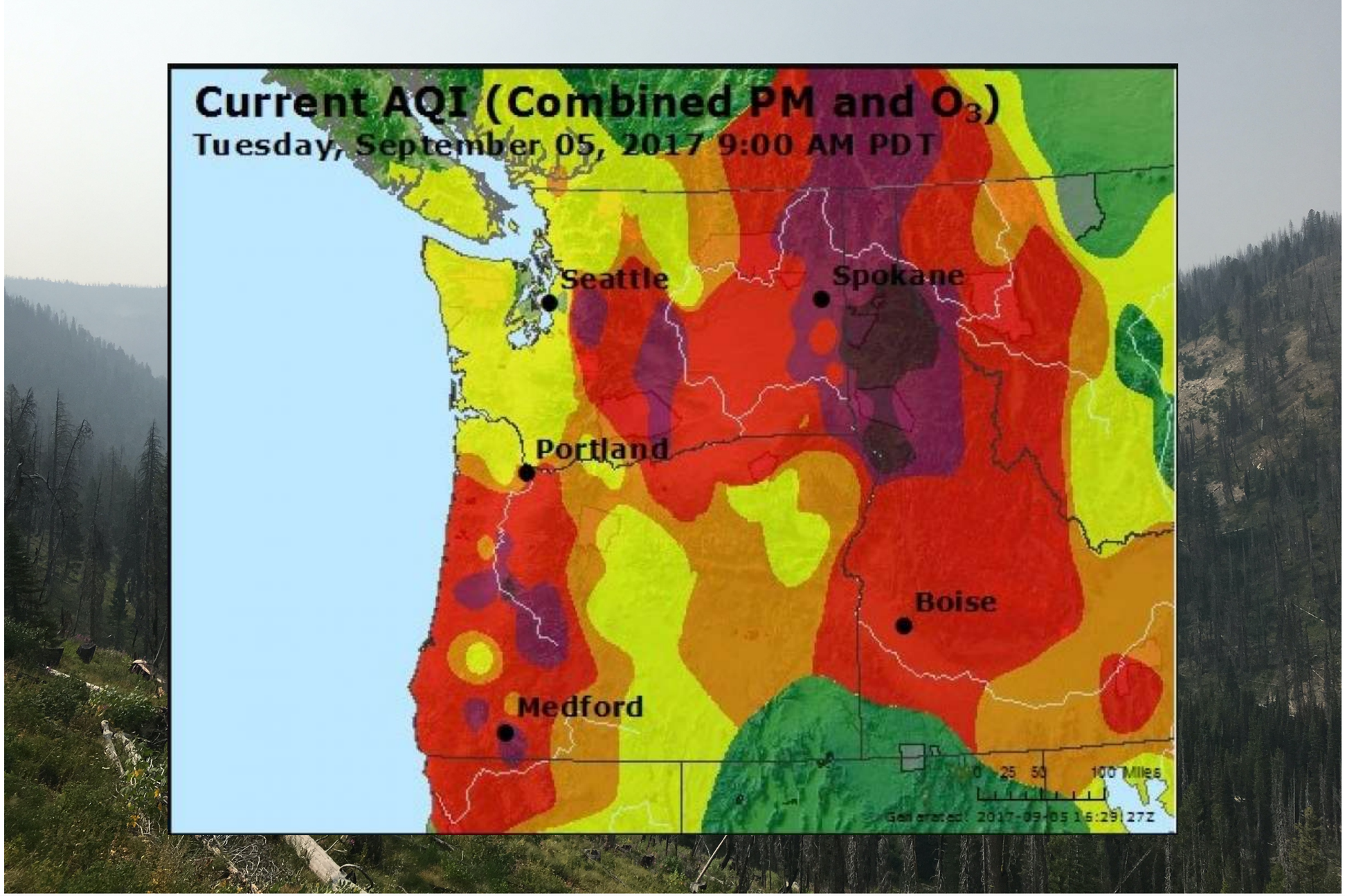
Fire Year 2000:
Northern Rockies reported between **70-100** new fires/day
53 days at **PL4** or higher

~1.8 million acres burned



WILDFIRE & AIR QUALITY





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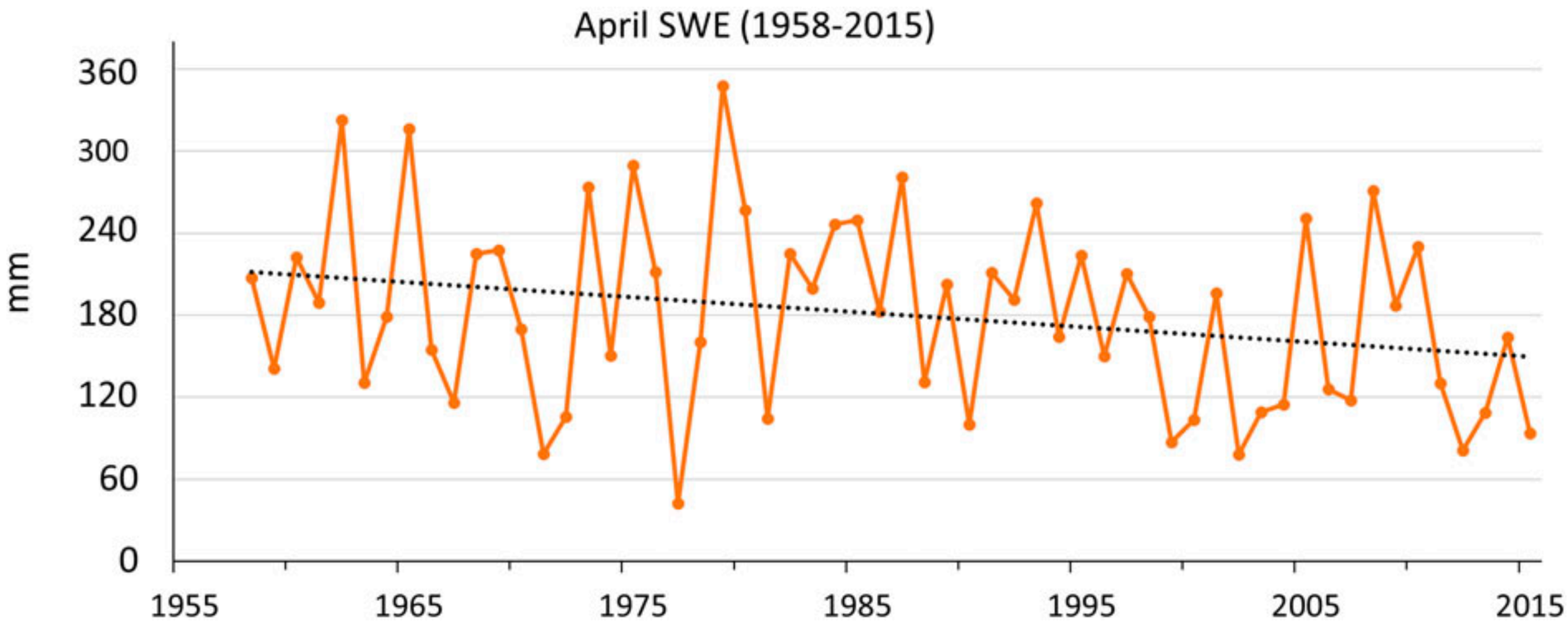
WILDFIRE IMPACTS ON WATER SUPPLY

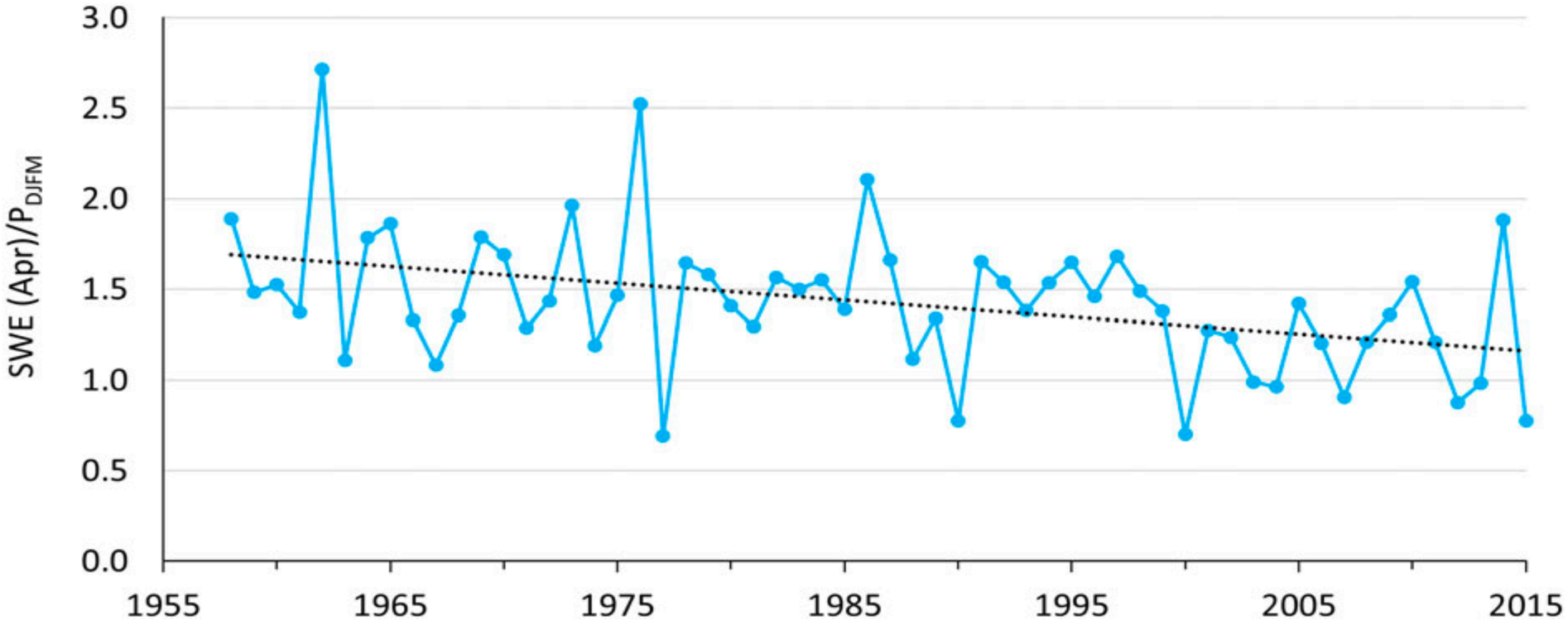
- High severity, stand-replacing fires affect timing of snowmelt and run-off, influencing availability of supply.
- Increased sediment loading of reservoirs shortens lifetime and increases maintenance costs.
- Increased loading of surface water supplies with nutrients, dissolved organic carbon, major ions, and metals may overwhelm treatment systems and increase treatment costs.
- Changes to water chemistry will also affect drinking water treatment.

Snowpack has **decreased** in the Upper RG Basin – April 1st SWE has **declined by approx. 25%** from **1958-2015**



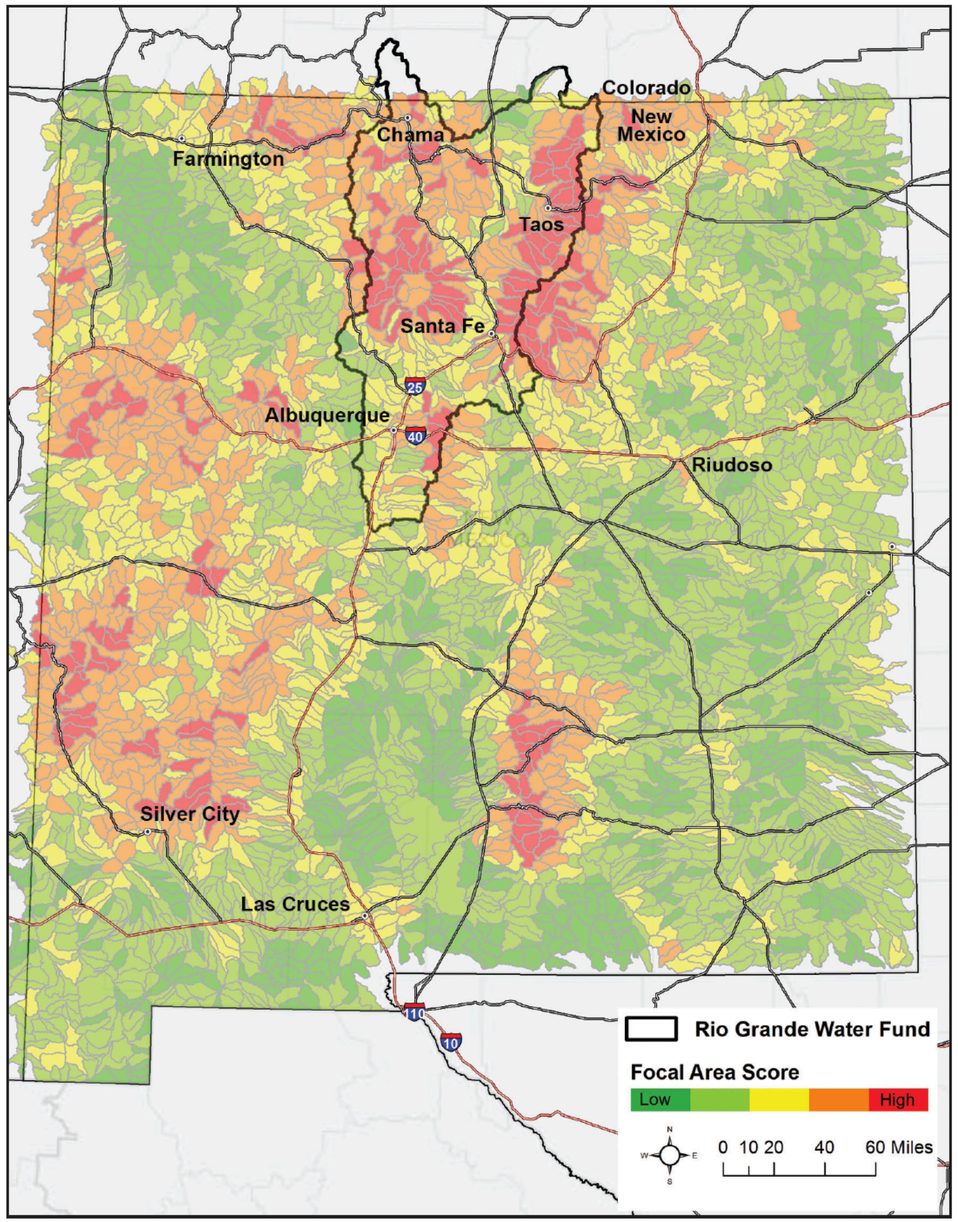
Chavarria & Gutlzer (2018)

A **decrease** in the ratio of SWE to winter precipitation indicates a **shift** from **snowfall to rainfall** in the Upper RG Basin

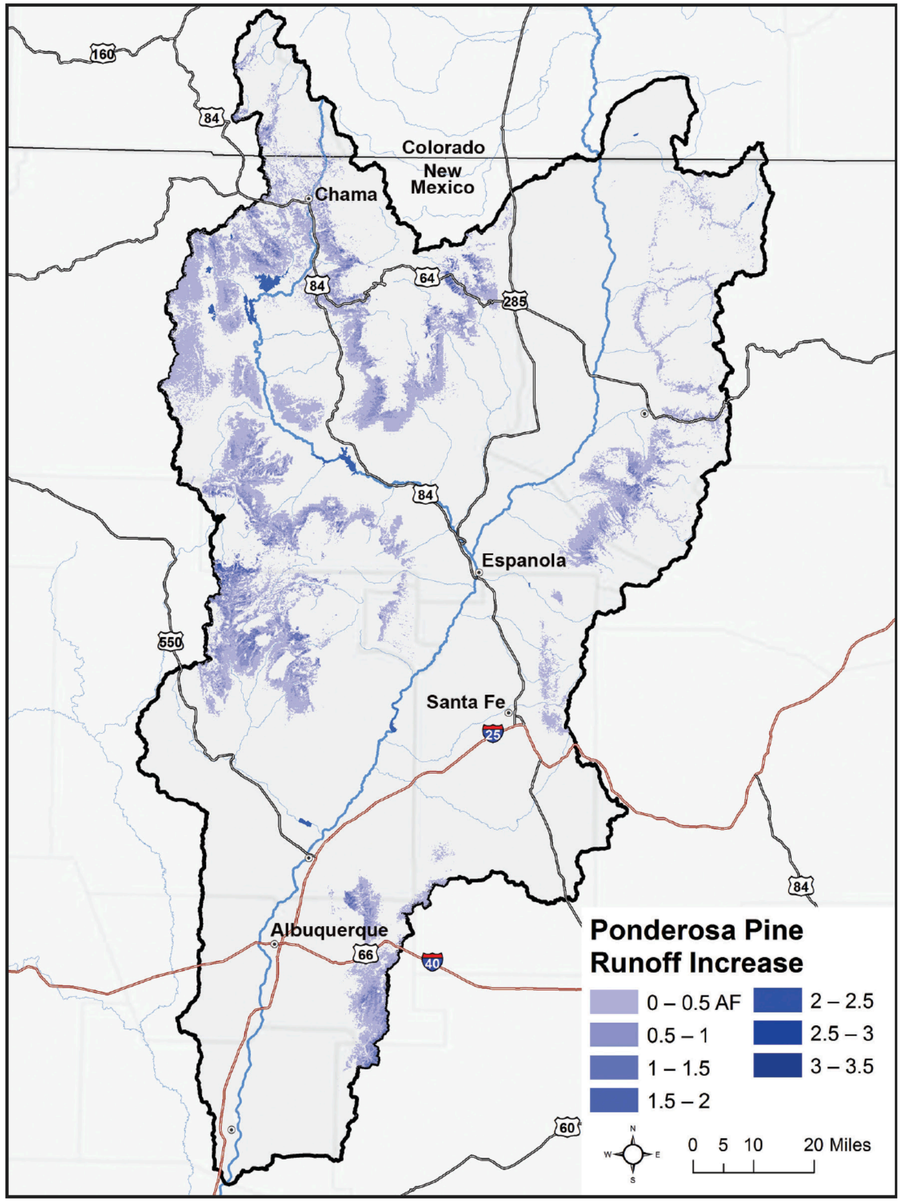


Chavarria & Gutlzer (2018)

Wildfire risk, water supply vulnerability, and forest health decline were used to identify **at-risk watersheds** in New Mexico.

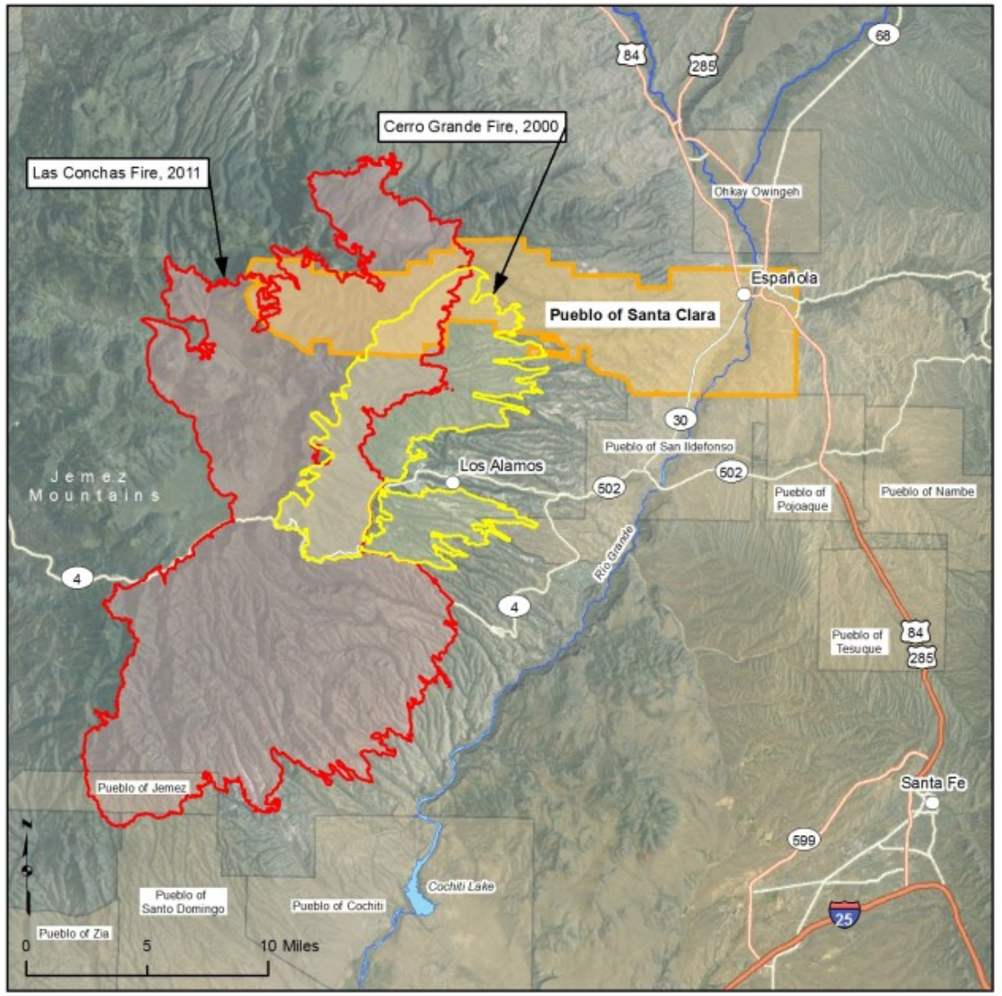


Increased mechanical thinning and prescribed fire can **increase snowpack storage, regulate run-off**, and promote forest resilience to drought.



LAS CONCHAS FIRE (2011)

- **150,000+ acres** burned.
- Over **50%** of the upper Santa Clara Canyon Watershed classified as high-severity burn.



POST-FIRE FLOODING

- High-severity burn left behind hydrophobic soils.
- ¼ inch of rain resulted in 5,000CFS flows down canyon.
- This, combined with the geologic composition of the area led to catastrophic erosion and sediment transport.

CONCLUSIONS

- Droughts are not new, high-severity wildfires are not new- but this pattern of more frequent and intense droughts, coupled with higher average temperatures is.
- Expected operating costs for fire suppression to increase.
- Number of high-severity, stand-replacing fires expected to increase.
- Landscape conversion post-fire may produce its own unique set of challenges.

CONTINUED

- Climate change brings an increased risk of high-severity wildfire that threatens water supply quality and availability.
- Increased prescribed fire, or the return of fire to the natural ecosystem may slow anticipated changes and reduce risk of catastrophic wildfire.
- Management of water resources may require collaborative forestry and fire management practices.

CITATIONS

- Chavarria, S. B., & Gutzler, D. S. (2018). **Observed changes in climate and streamflow in the upper Rio Grande Basin**. *JAWRA Journal of the American Water Resources Association*, *54*(3), 644-659.

- Guiterman, C., & Margolis, E. (2019) **Vulnerabilities of Navajo Nation Forests to Climate Change.** *The Navajo Nation & Bureau of Indian Affairs Tribal Resilience Program*.

- Marlon, J. R., Bartlein, P. J., Walsh, M. K., Harrison, S. P., Brown, K. J., Edwards, M. E., ... & Brunelle, A. (2009). **Wildfire responses to abrupt climate change in North America**. *Proceedings of the National Academy of Sciences*, *106*(8), 2519-2524.

- Rio Grande Water Fund. (2014). **Comprehensive Plan for Wildfire and Water Source Protection.** *RIOGRANDEWATERFUND.ORG*.

- Smith, H. G., Sheridan, G. J., Lane, P. N., Nyman, P., & Haydon, S. (2011). **Wildfire effects on water quality in forest catchments: a review with implications for water supply**. *Journal of Hydrology*, *396*(1-2), 170-192.

QUESTIONS?

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