The 420,002,023rd Year of Biomass Burning on Earth

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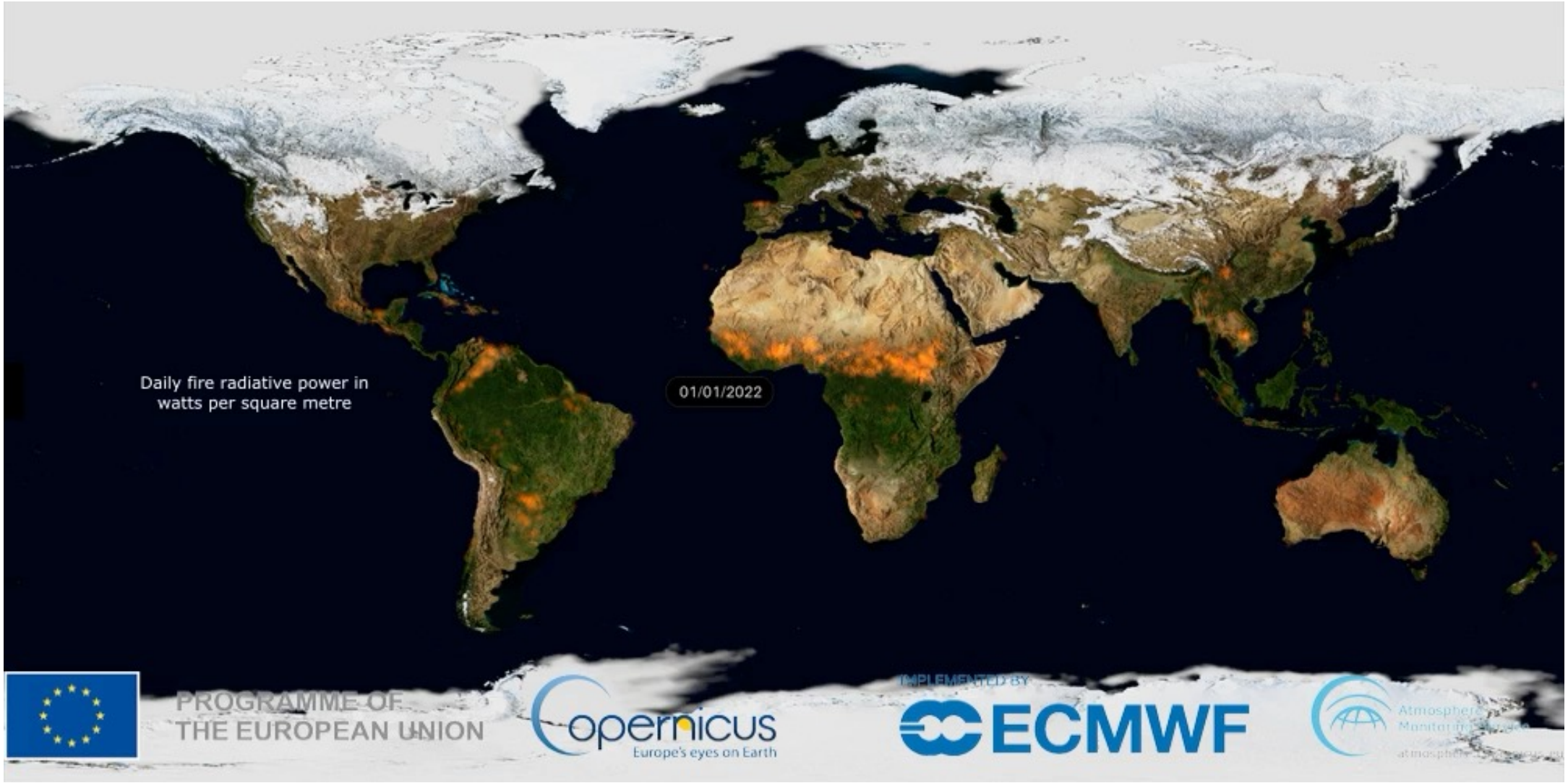
Desert Research Institute, Reno, Nevada

CoCoRaHS Webinar 29 June 2023

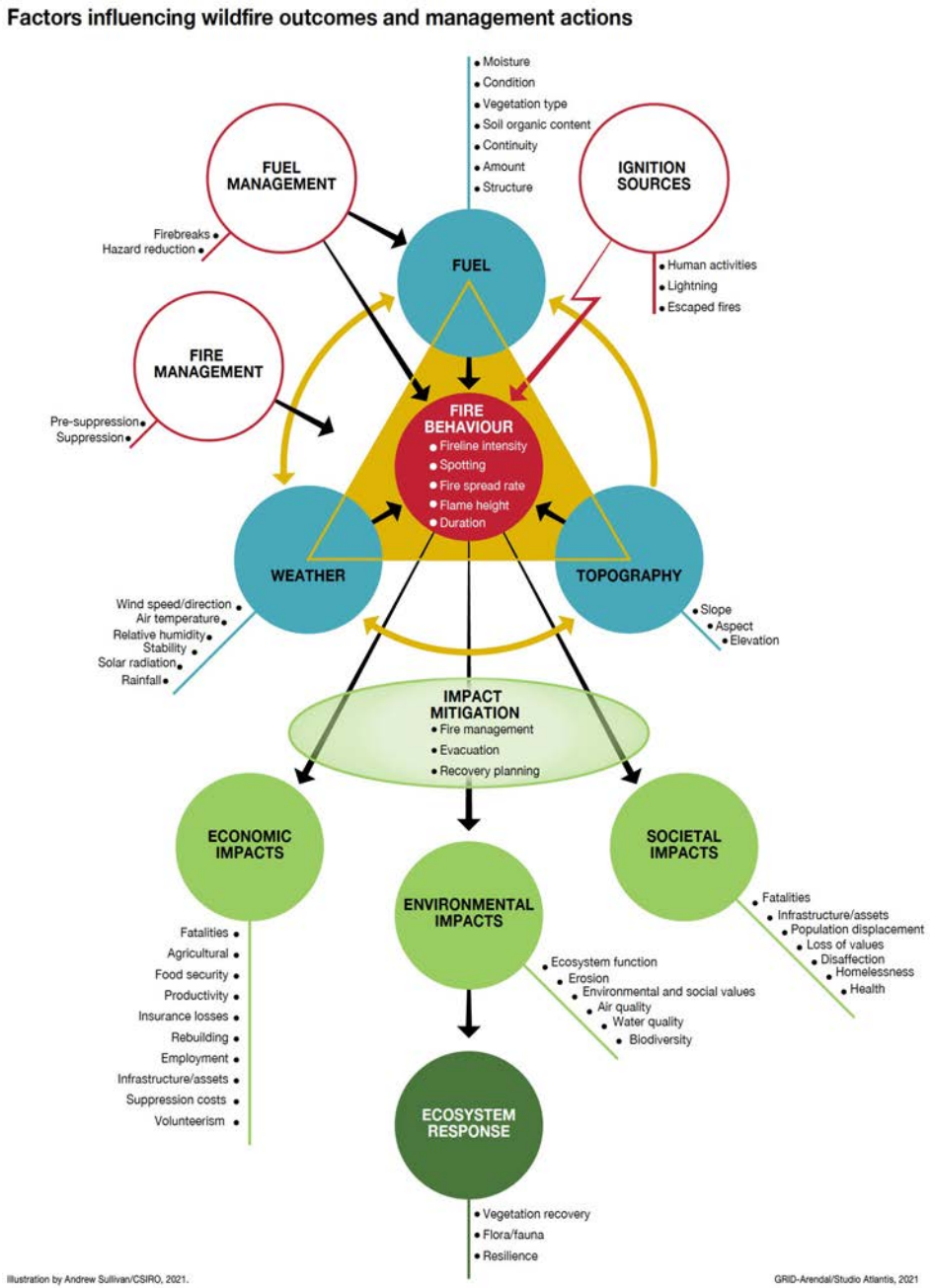
Welcome to the

420,002,023rd year of biomass burning on Earth



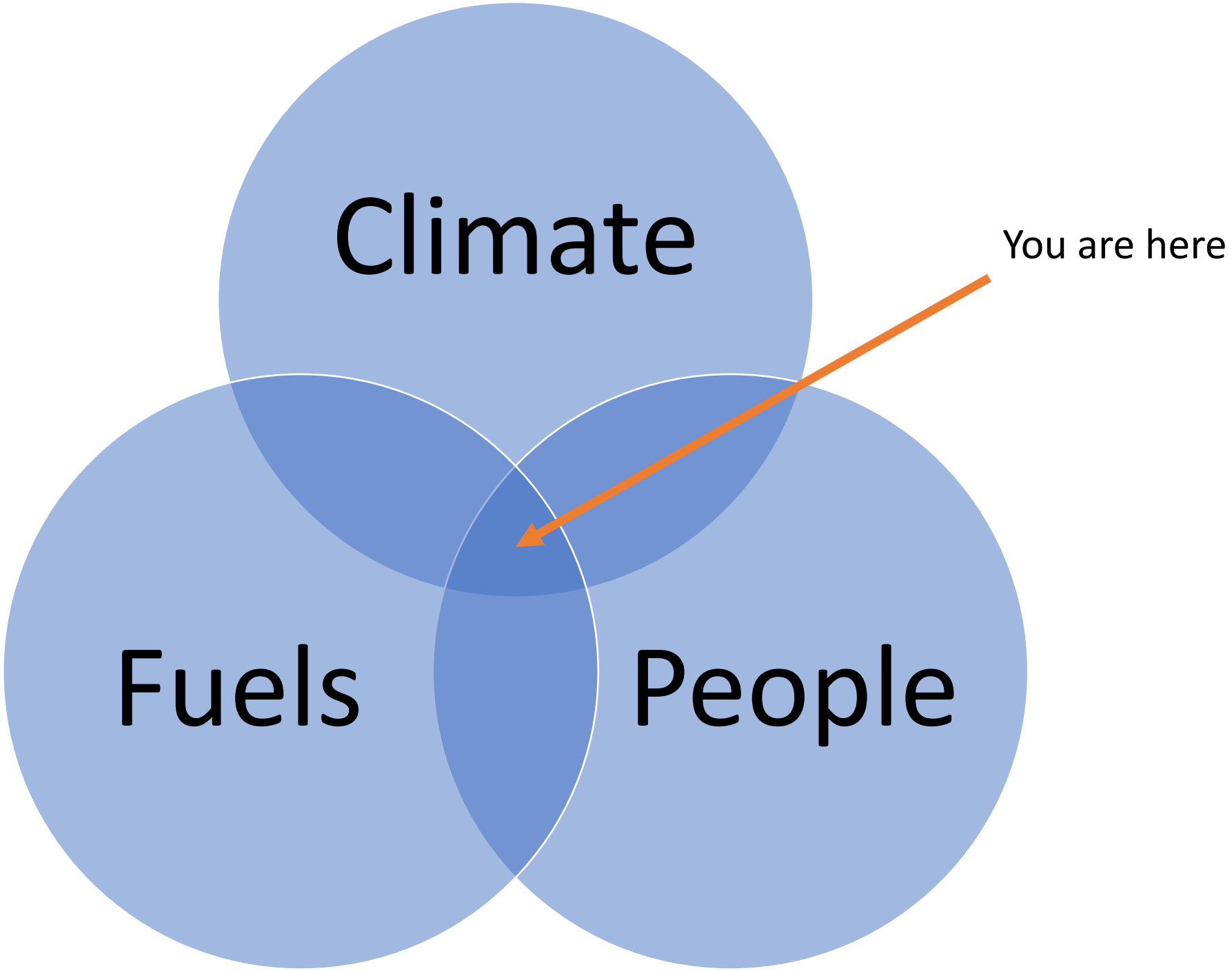
https://atmosphere.copernicus.eu/global-fire-monitoring

The complexity of fire

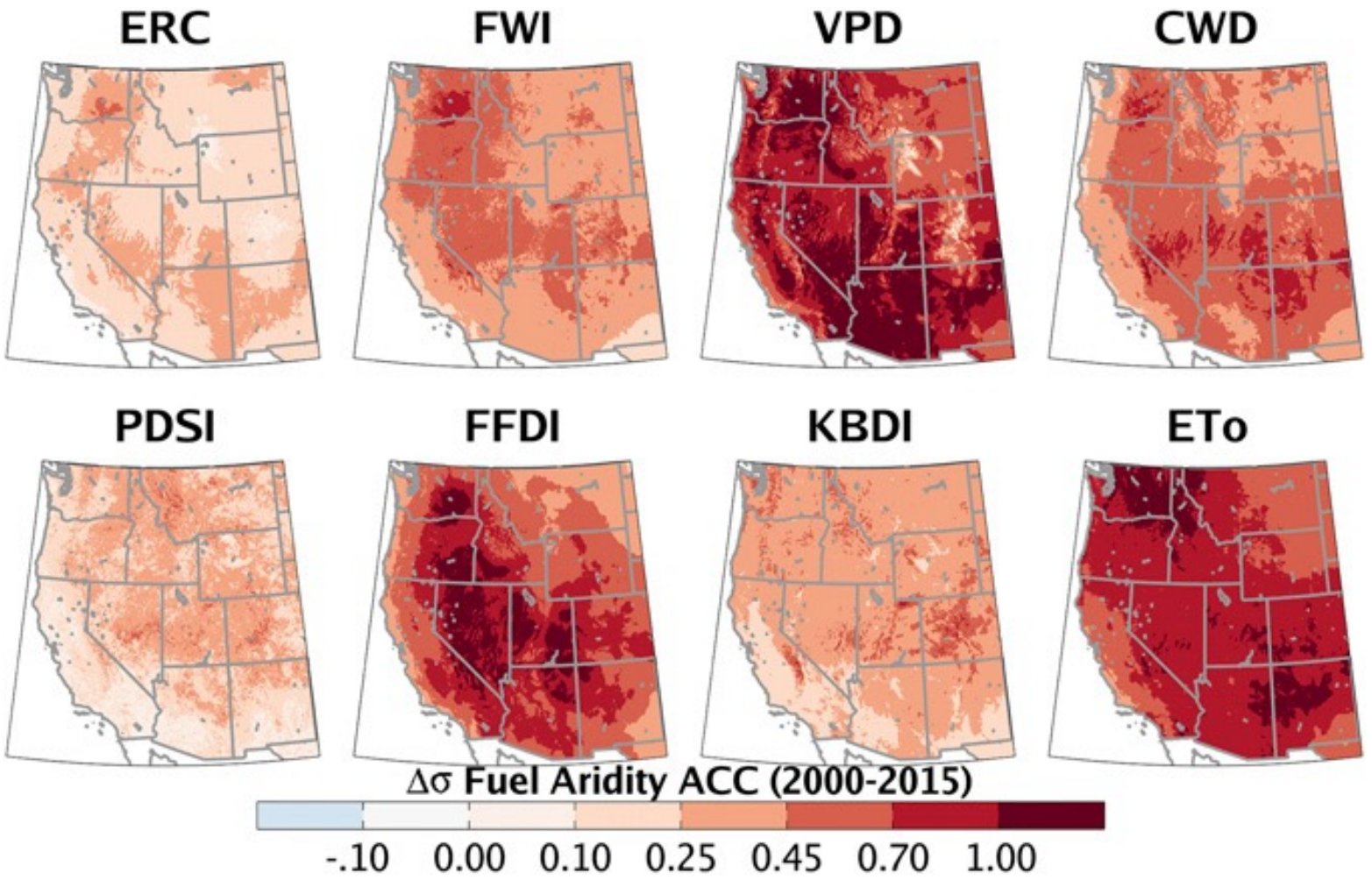


United Nations Environment Programme (2022)
Spreading like Wildfire – The Rising Threat of Extraordinary Landscape Fires

Chapter 1
A fire place for climate


Climate
You are here
Fuels
People

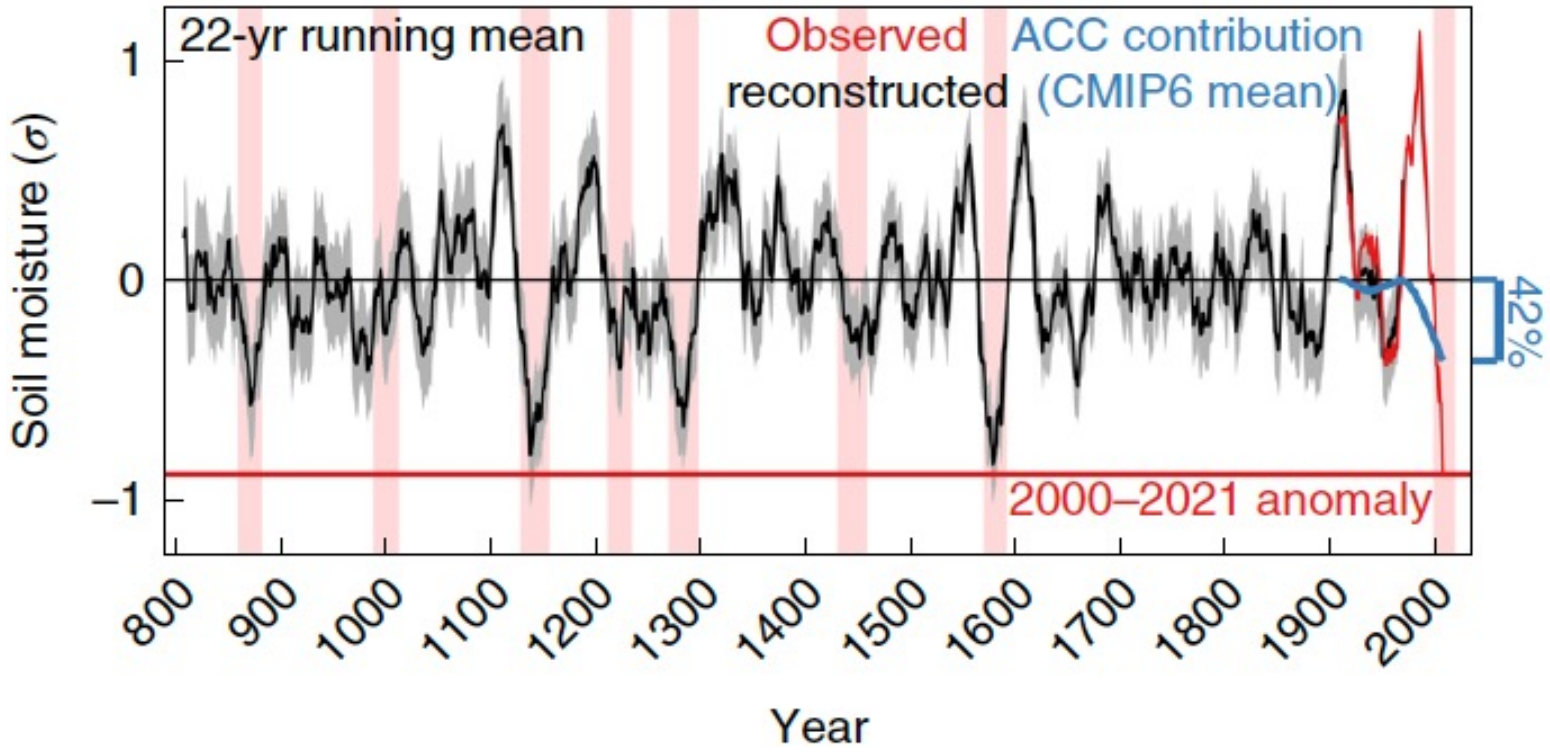
Changing climate – fuel aridity



Source: Abatzoglou and Williams, PNAS, 2016

Changing climate – fuel aridity

Megadrought



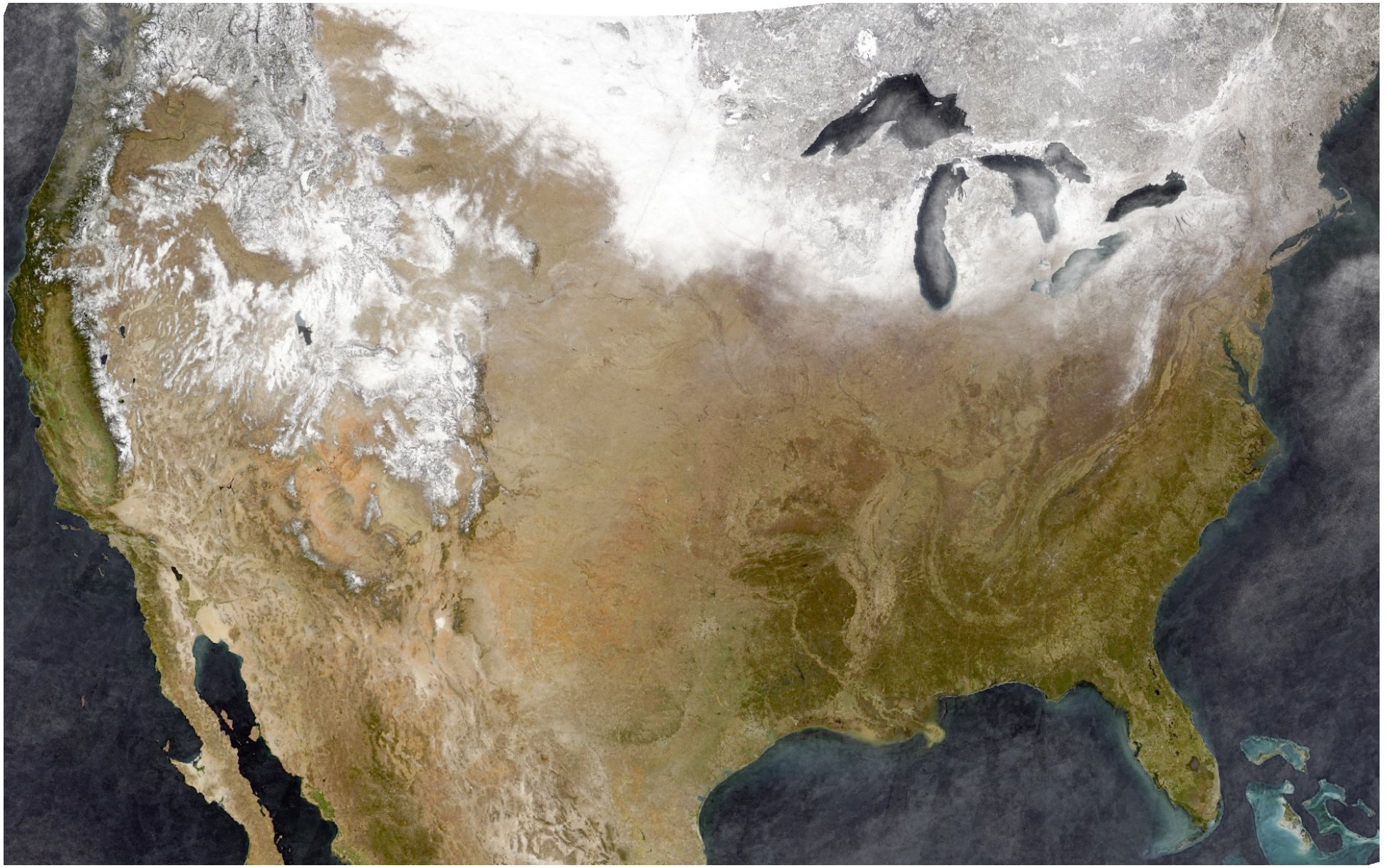
Source: Williams et al., Nature Climate Change, 2022

Atmospheric evaporative demand

Snow drought

Each image is a composite of about 60 satellite pictures taken between Feb. 1 and March 5

2013

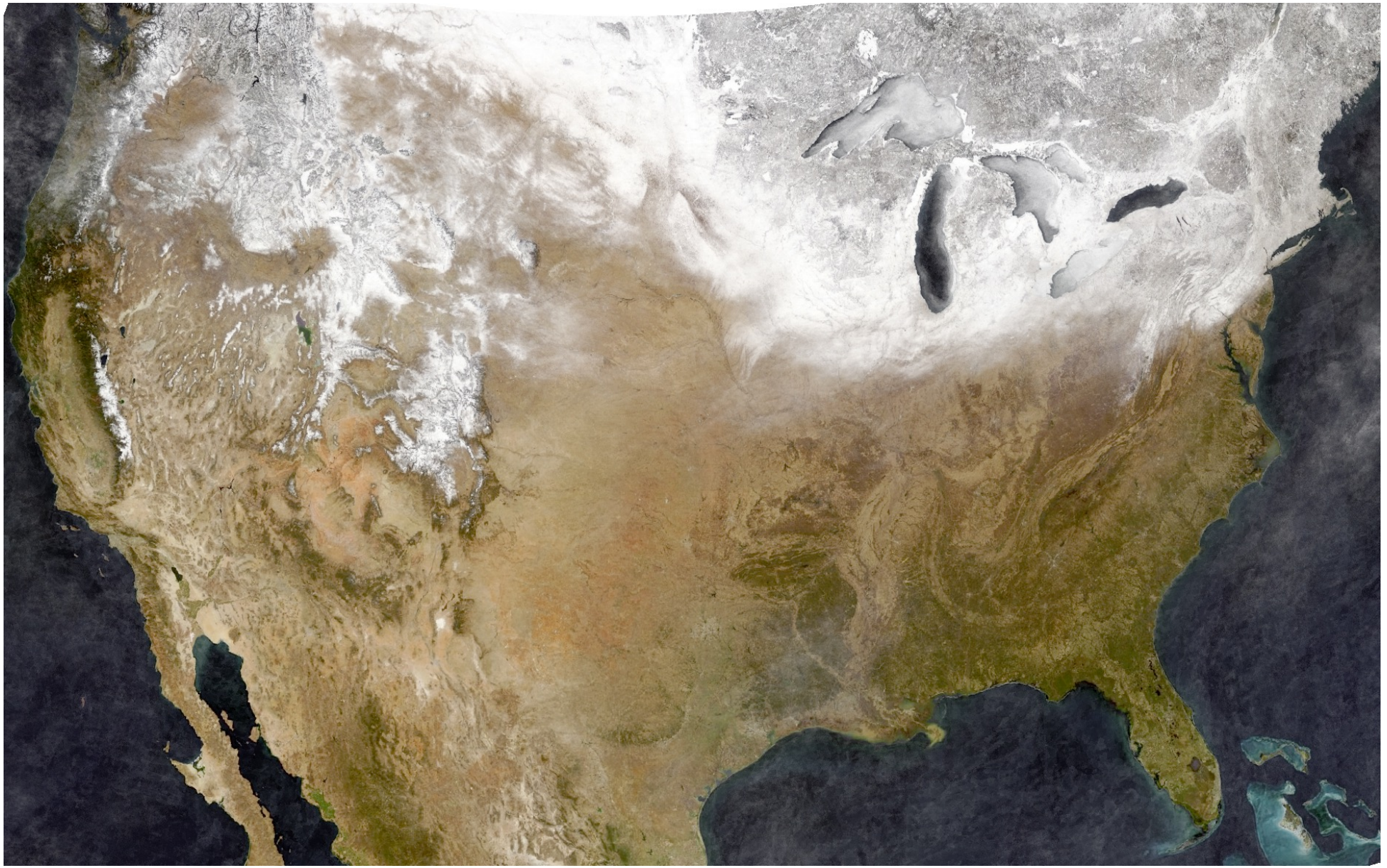


Composite of images from the MODIS Satellite by Tim Wallace/The New York Times

Snow drought

Each image is a composite of about 60 satellite pictures taken between Feb. 1 and March 5

2014



Composite of images from the MODIS Satellite by Tim Wallace/The New York Times

Snow drought

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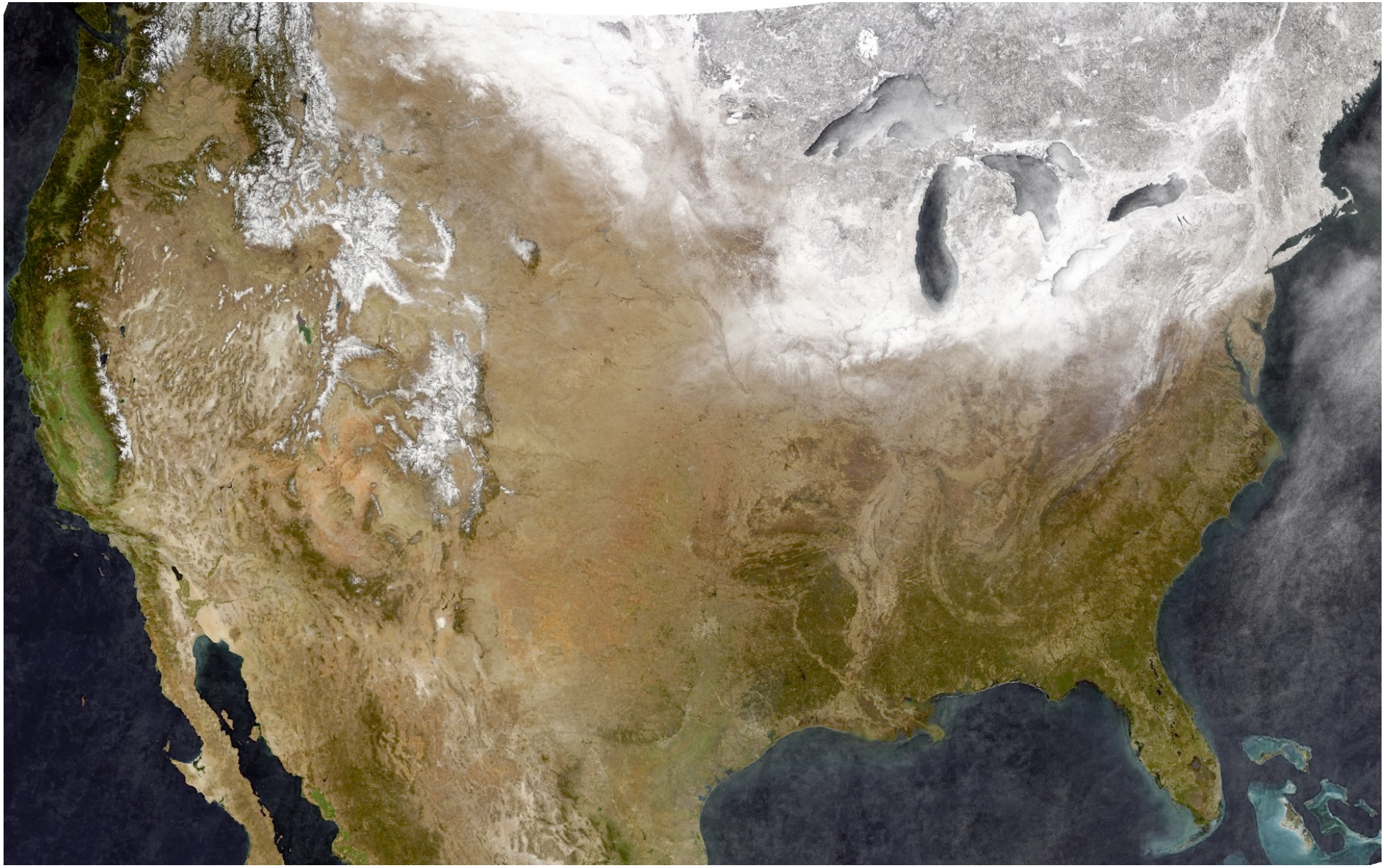
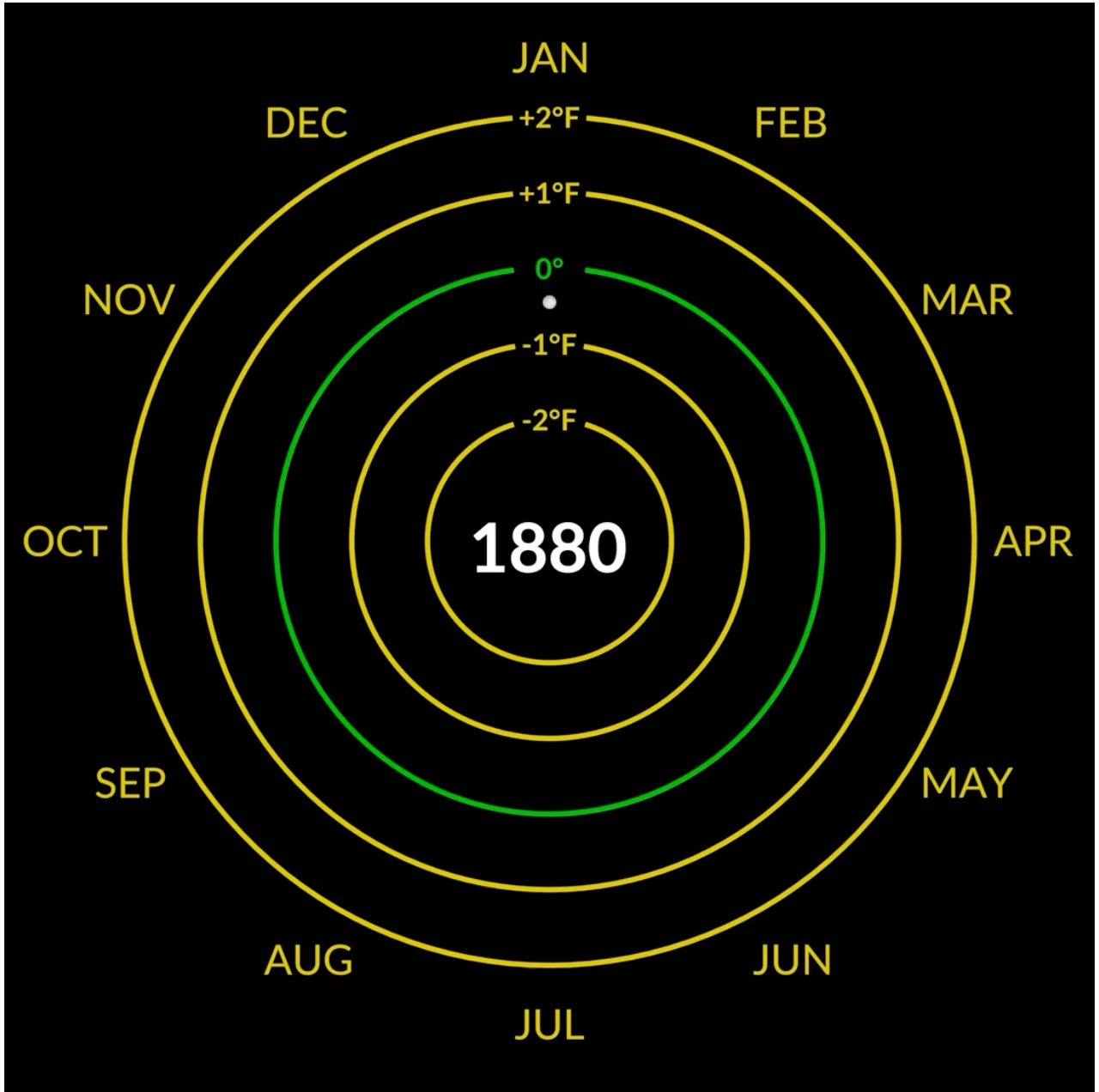
2015



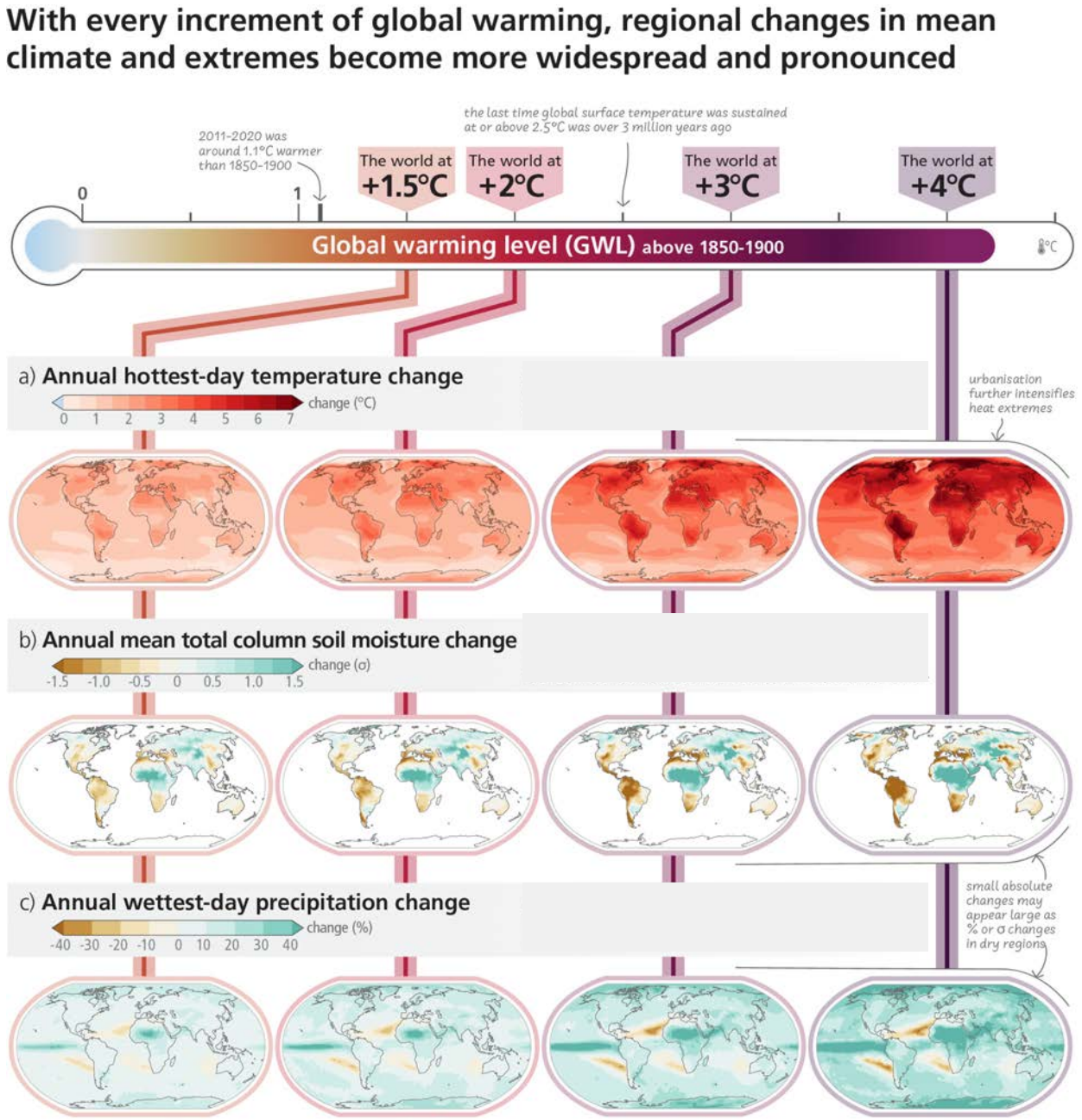
Composite of images from the MODIS Satellite by Tim Wallace/The New York Times

A warming planet



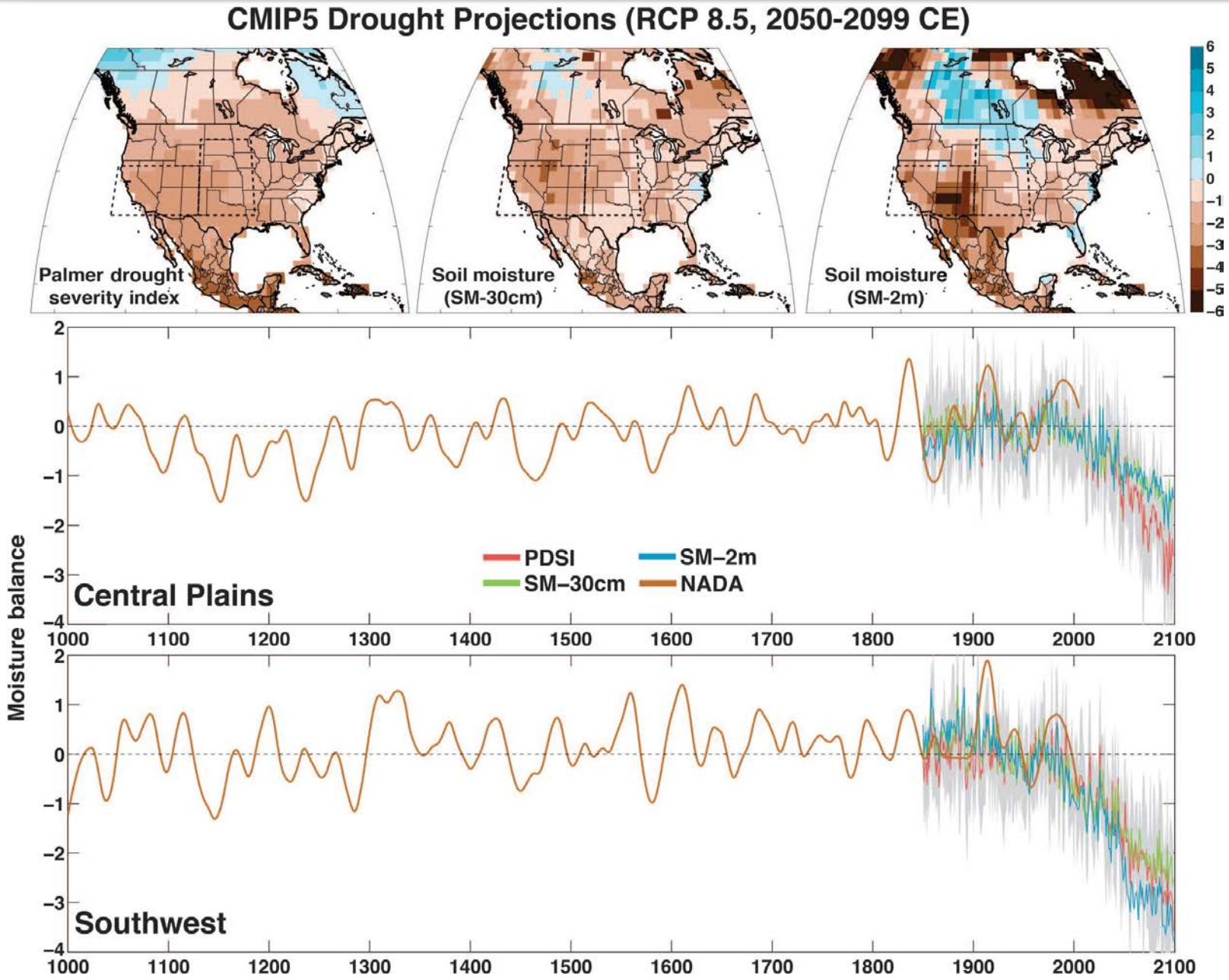
Source: NASA's Scientific Visualization Studio

IPCC AR6 synthesis report



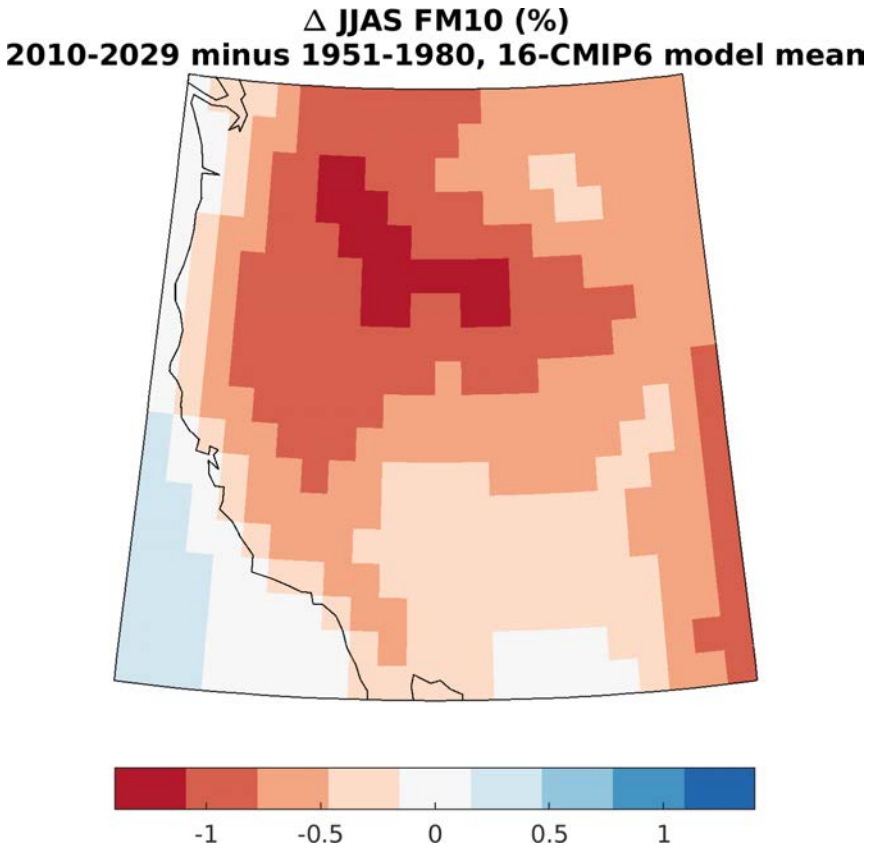
https://www.ipcc.ch/report/sixth-assessment-report-cycle

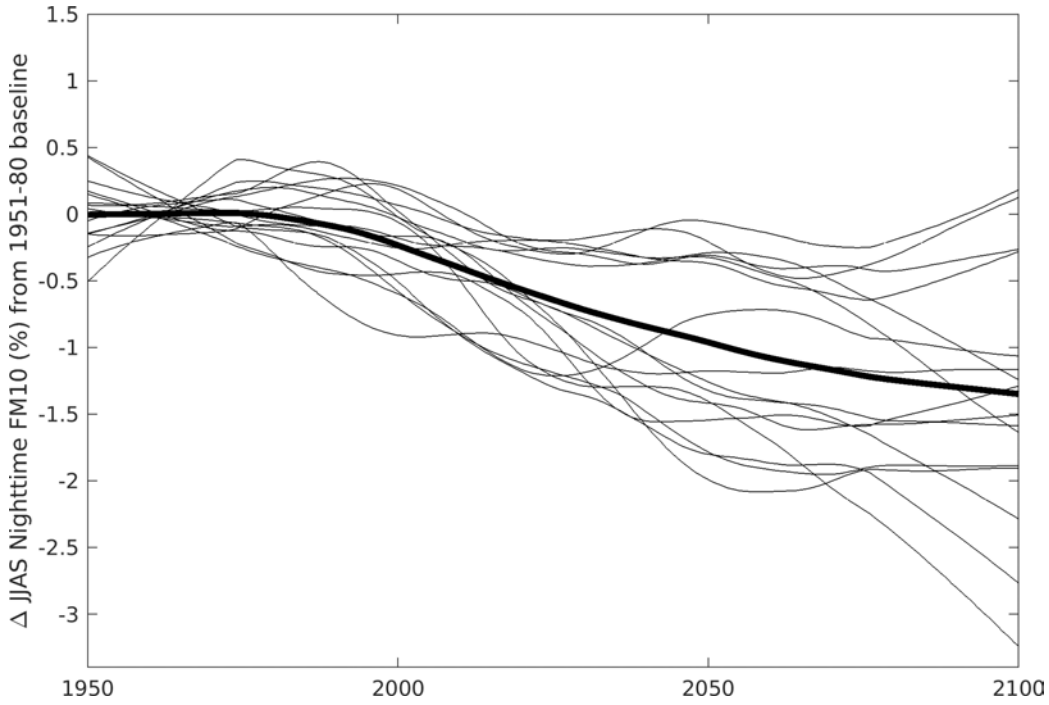
Drought projection



Source: Cook et al. 2015

Future nighttime fire

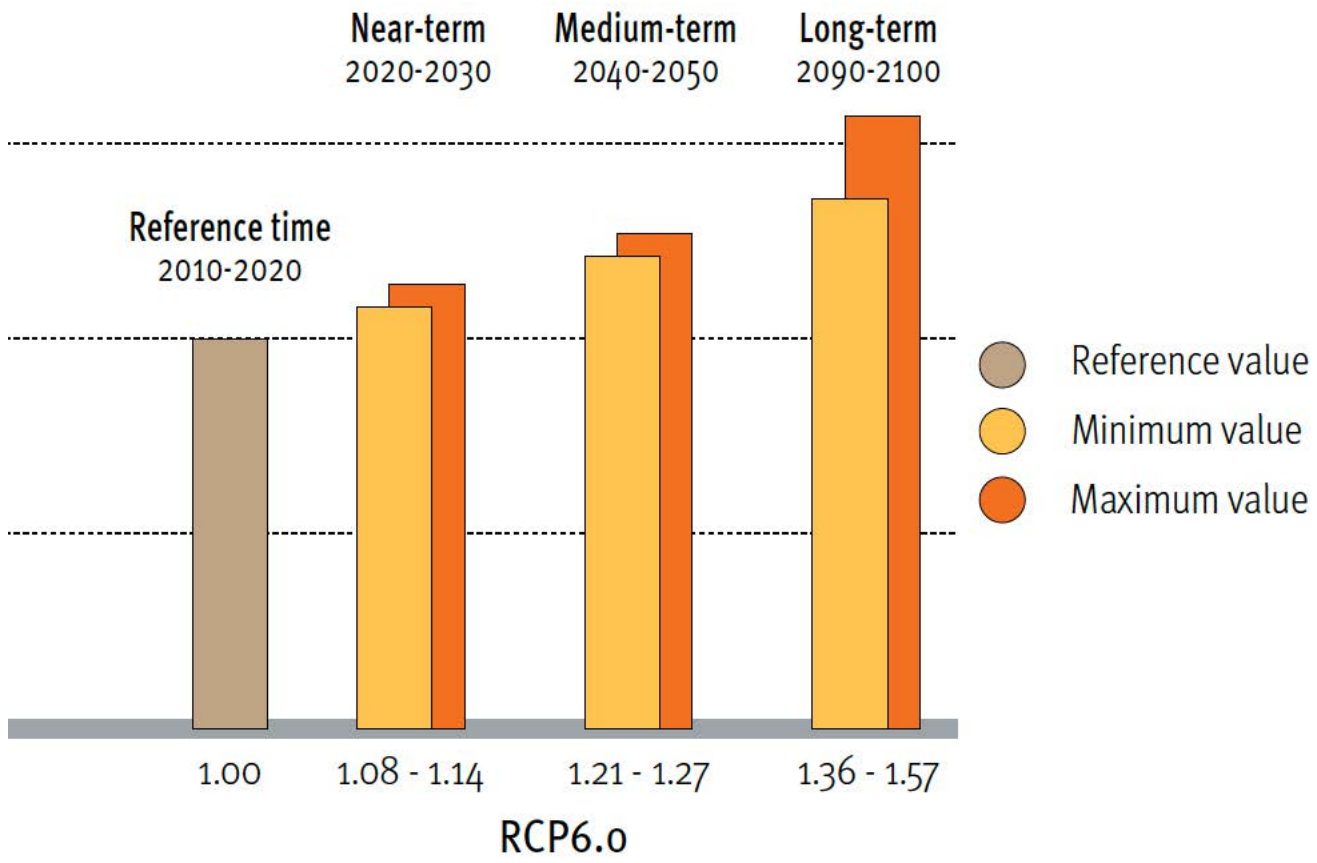




From Brown et al. in preparation

Future fire enabled by climate

Global change in wildfire events



Source: United Nations Environment Programme, Spreading like Wildfire, 2022

Chapter 2
How not to be seen

Effect of fire exclusion

1909

Bitterroot National Forest

Source: Gruell, USFS, 1983

Effect of fire exclusion

1948

Bitterroot National Forest

Source: Gruell, USFS, 1983

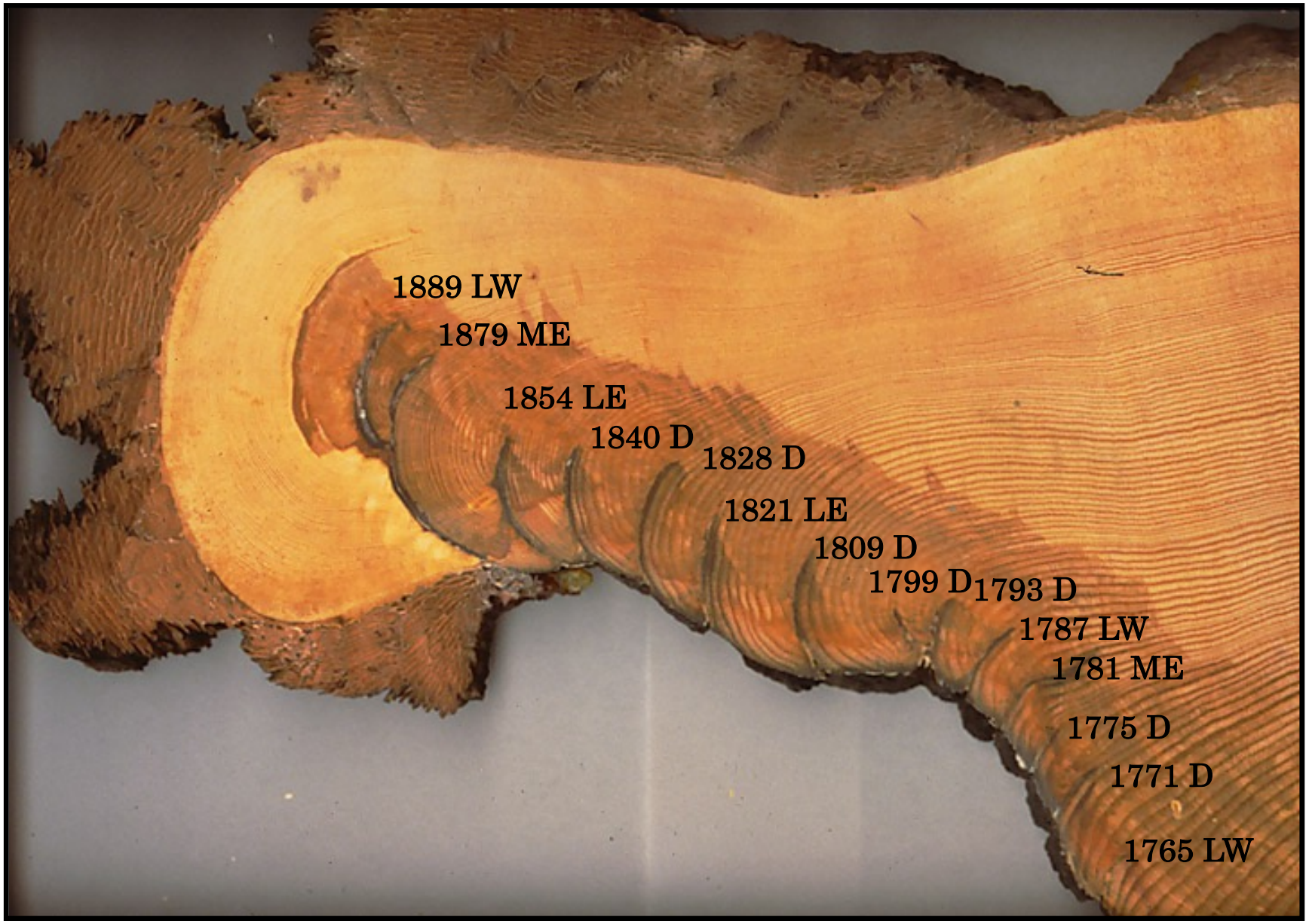
Effect of fire exclusion

1979

Bitterroot National Forest

Source: Gruell, USFS, 1983

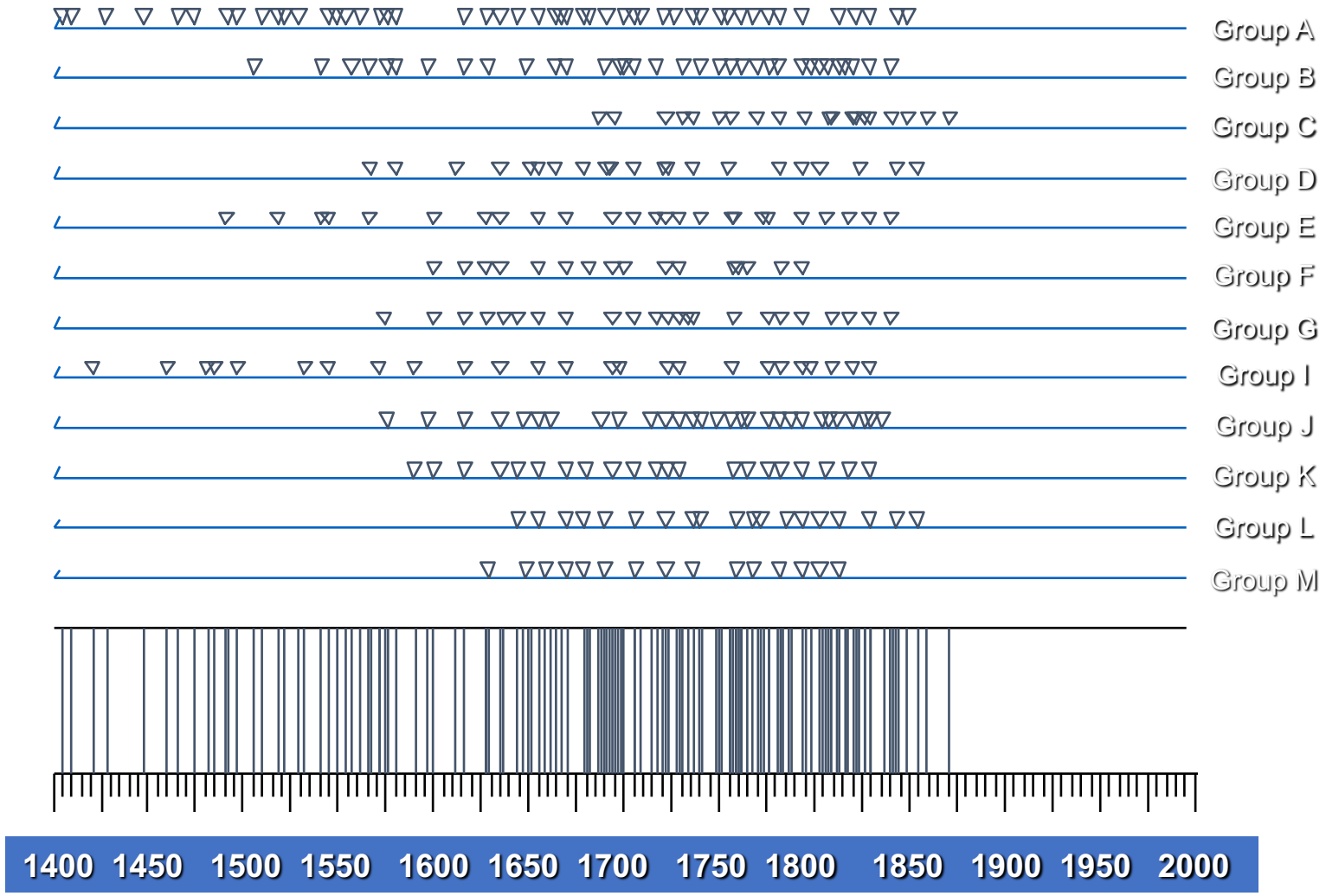
Fire scars



Source: Alan Taylor, Penn State University

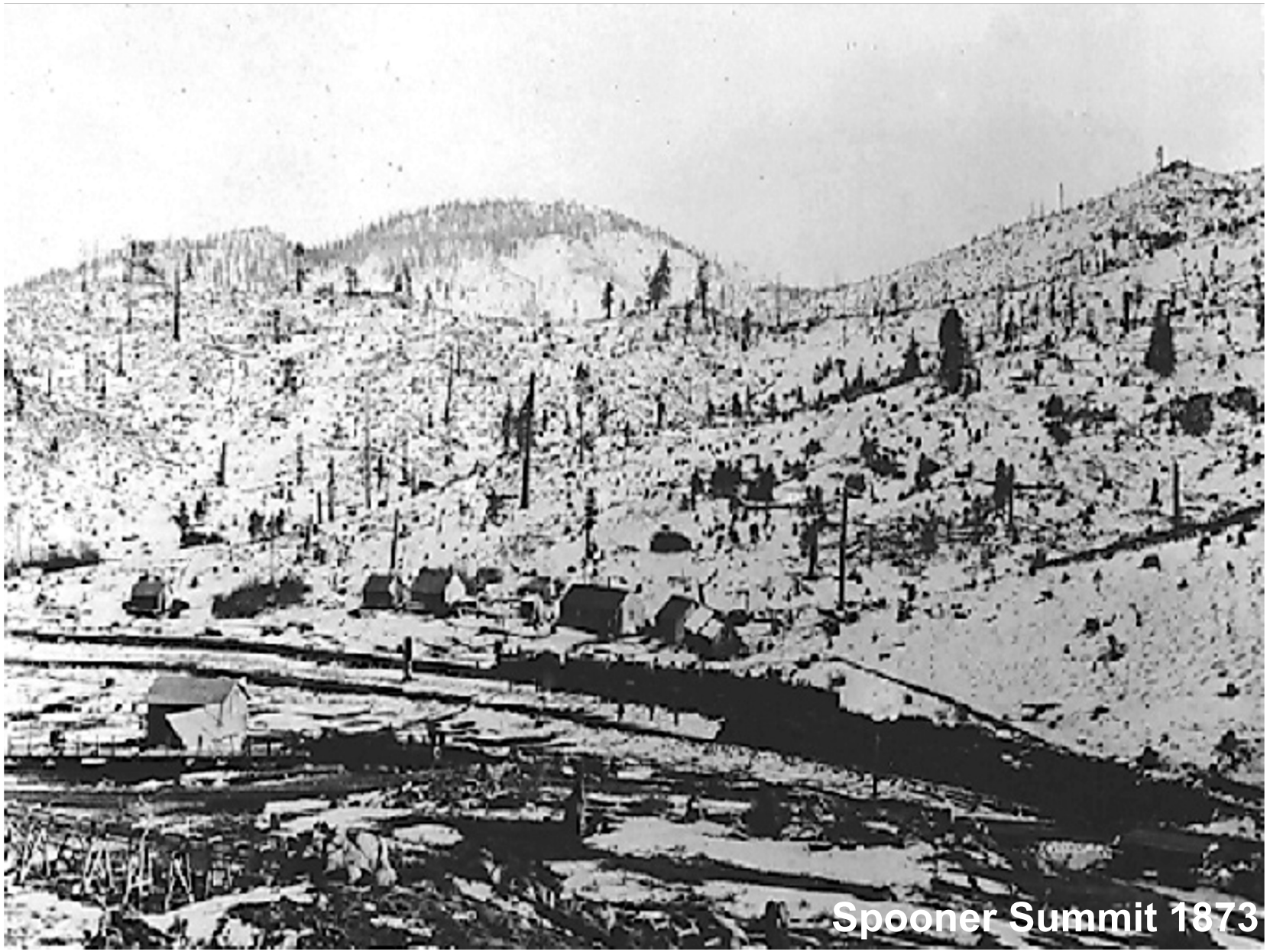
Pre-Euroamerican fire history

Jeffrey pine forests, Lake Tahoe Basin



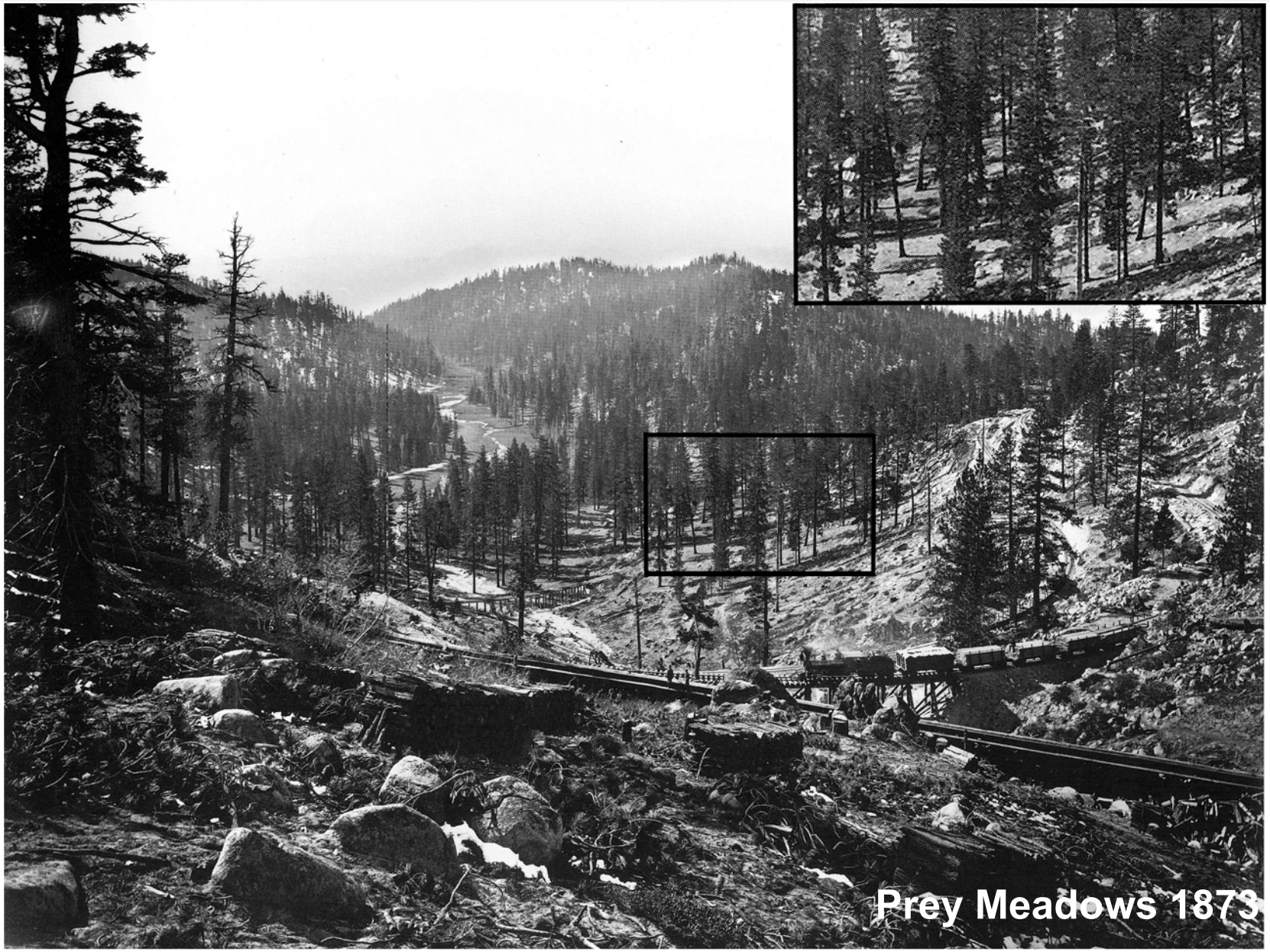
Source: Alan Taylor, Penn State University

Lake Tahoe Basin



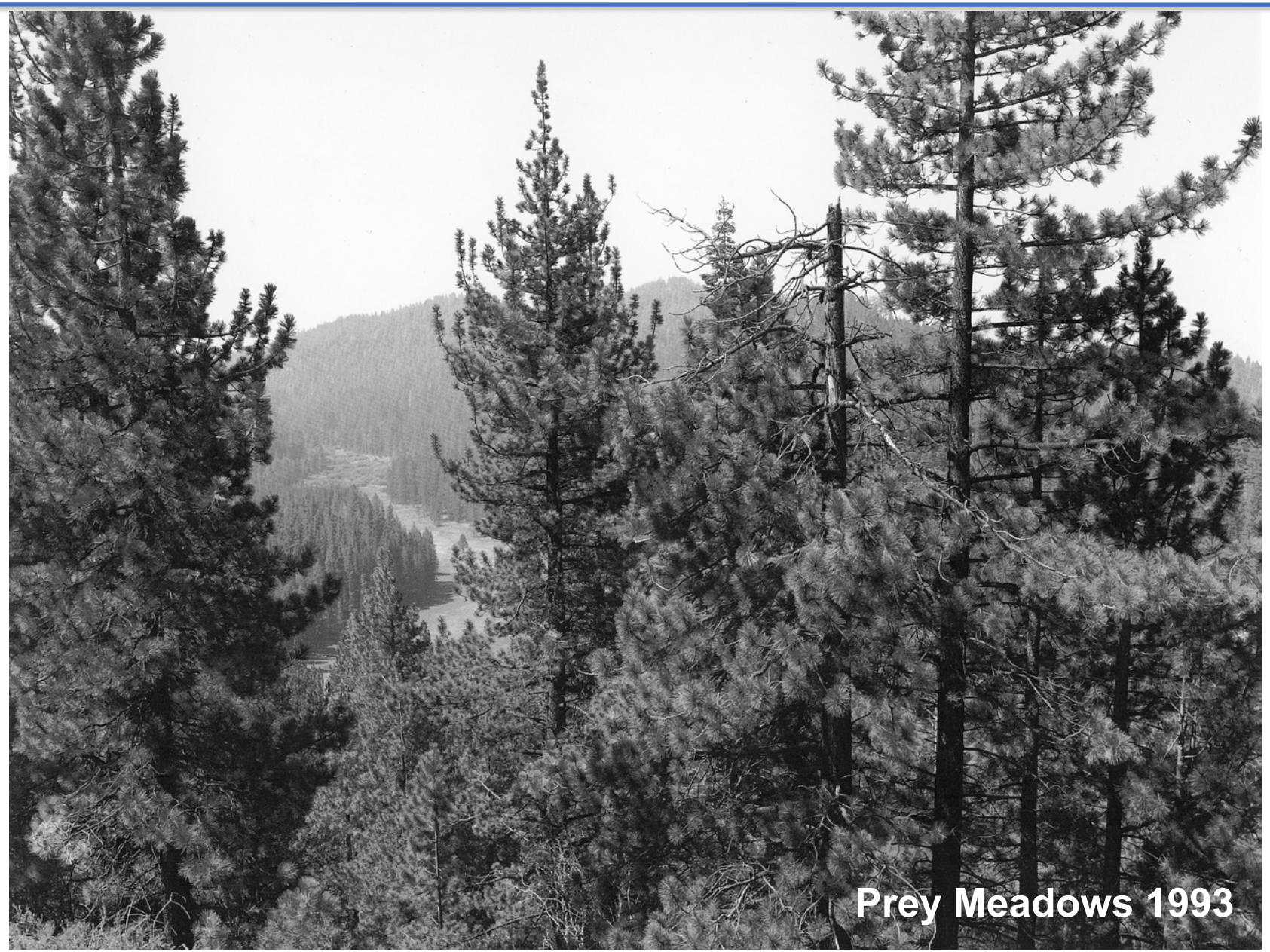
Source: Alan Taylor, Penn State University

Lake Tahoe Basin



Source: Alan Taylor, Penn State University

Lake Tahoe Basin

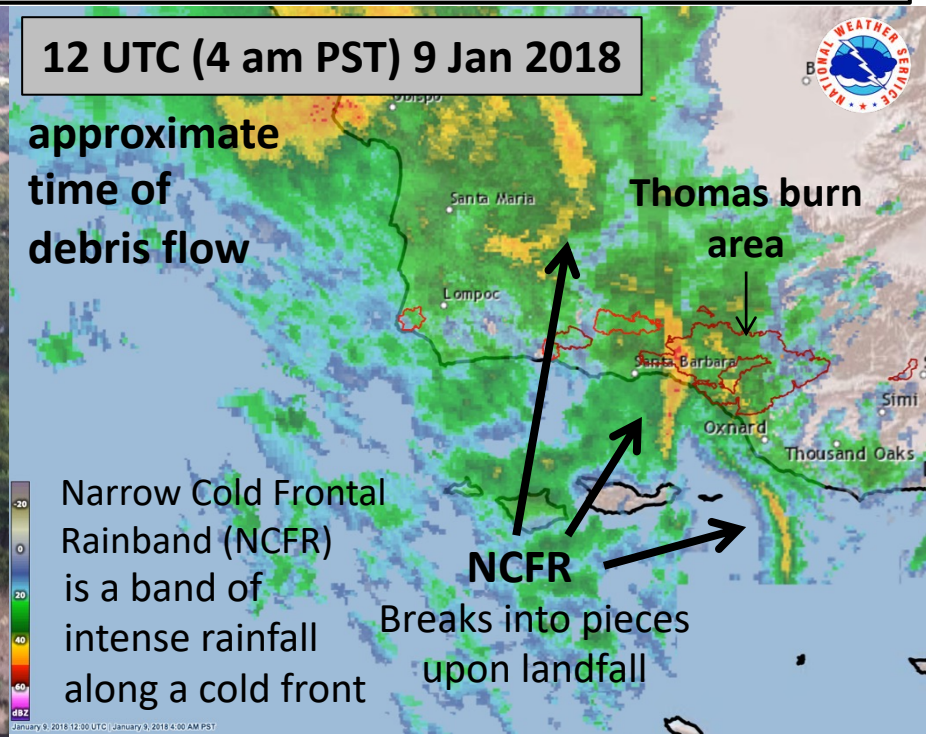


Source: Alan Taylor, Penn State University


Fuels: Mixed Conifer Diseased 50-70 tons/acre

Case Study: 1/9/18 Montecito post-fire debris flow

Photo: Ventura County Air Unit



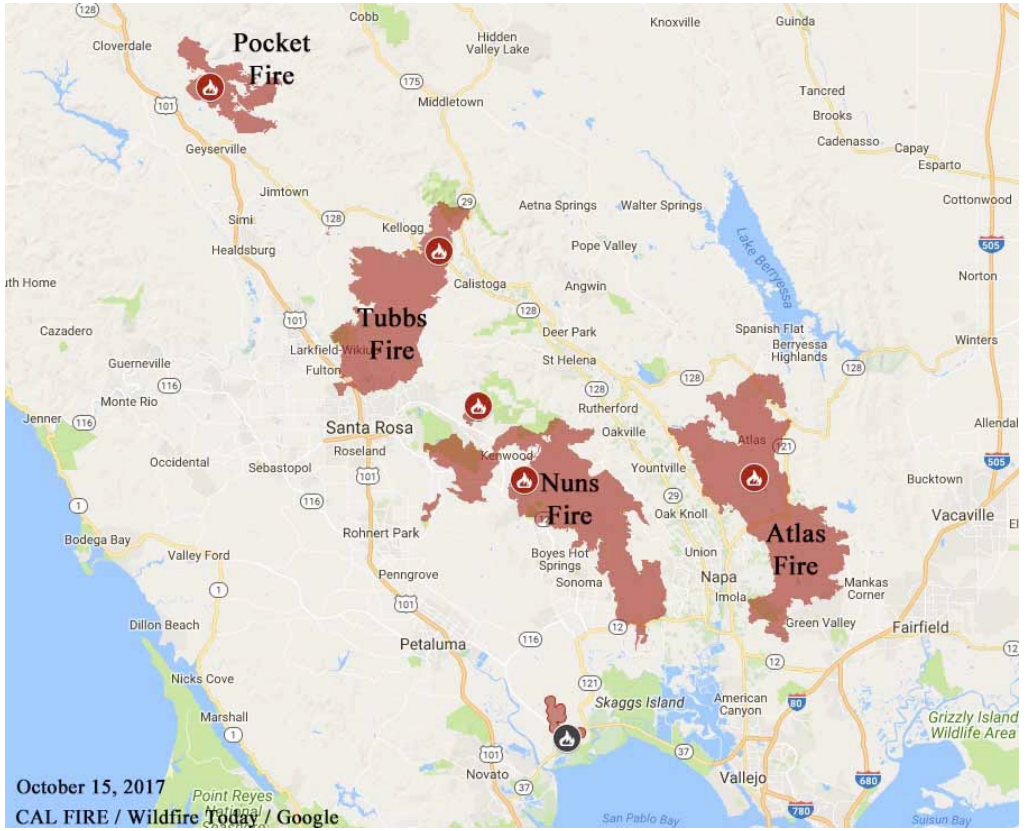
- Max 15-minute total 1.03 in, a 100-year ARI (NOAA Atlas 14)
- Death toll of 23, over 200 structures destroyed
- Two-week closure of Highway 101, major transportation artery
- Preliminary loss estimates for residential/commercial property alone exceed $421 million
- Damage to water conveyance infrastructure

Source: Nina Oakley, Scripps Institution of Oceanography

Chapter 3
How to be seen

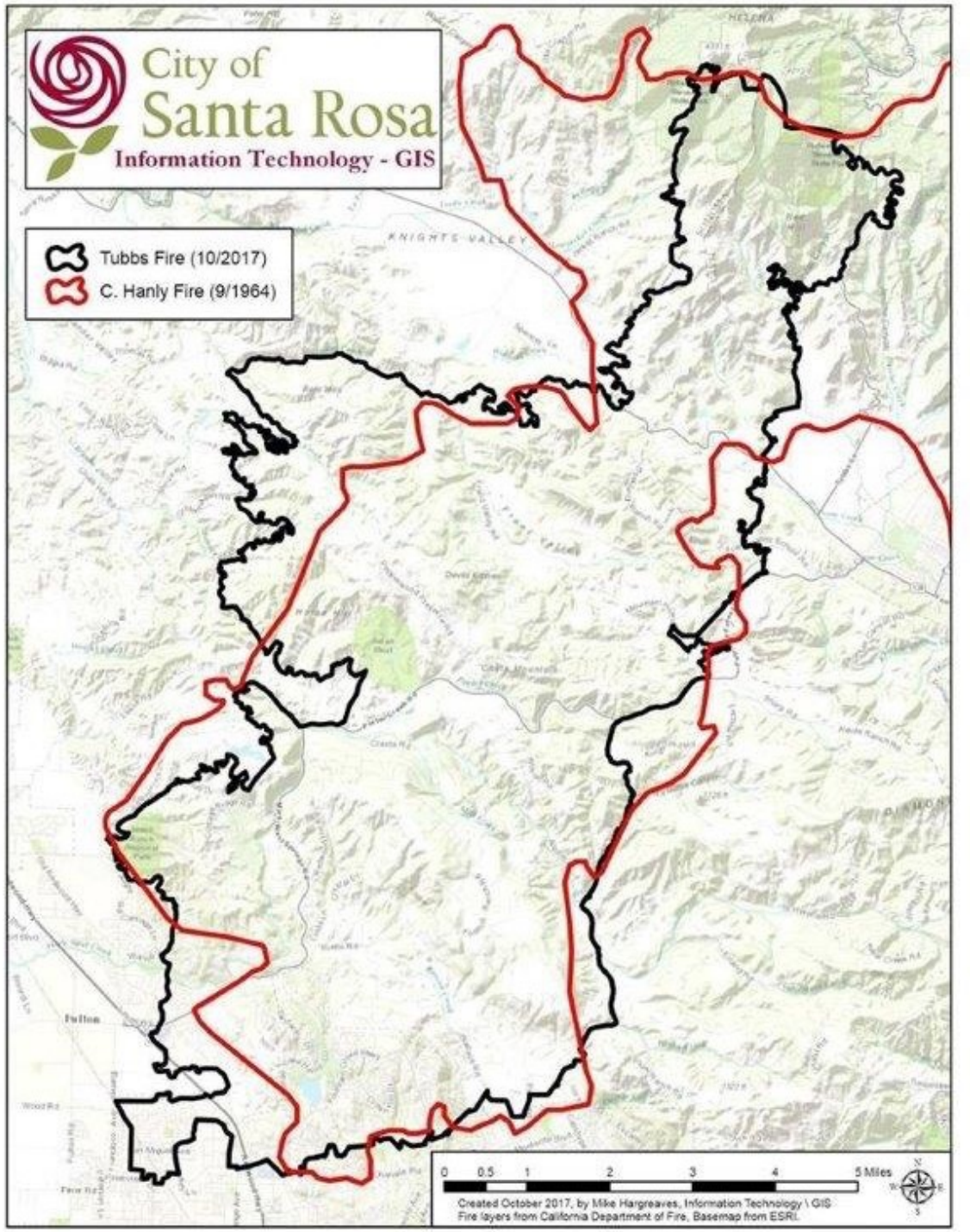
Napa fires (October 2017)

- 44 fatalities
- 8900 structures destroyed
- 90,000 evacuations
- 10,000 firefighting personnel at peak deployment
  - Including Canada and Australia
- At least $9B insured losses



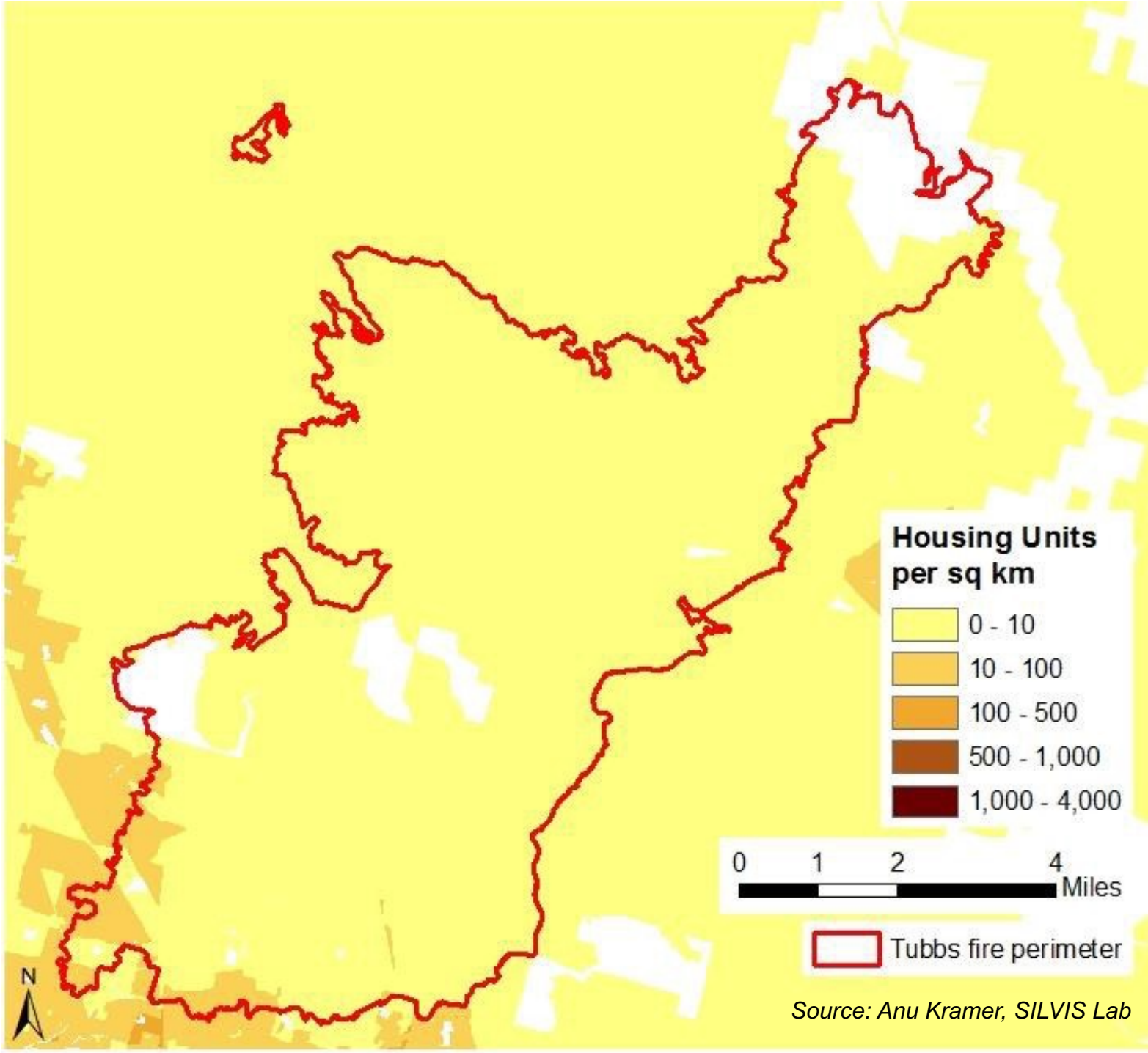
- 1964 fires
  - 306 structures destroyed
  - $4.75M damages

Two Santa Rose Fires 1964 and 2017



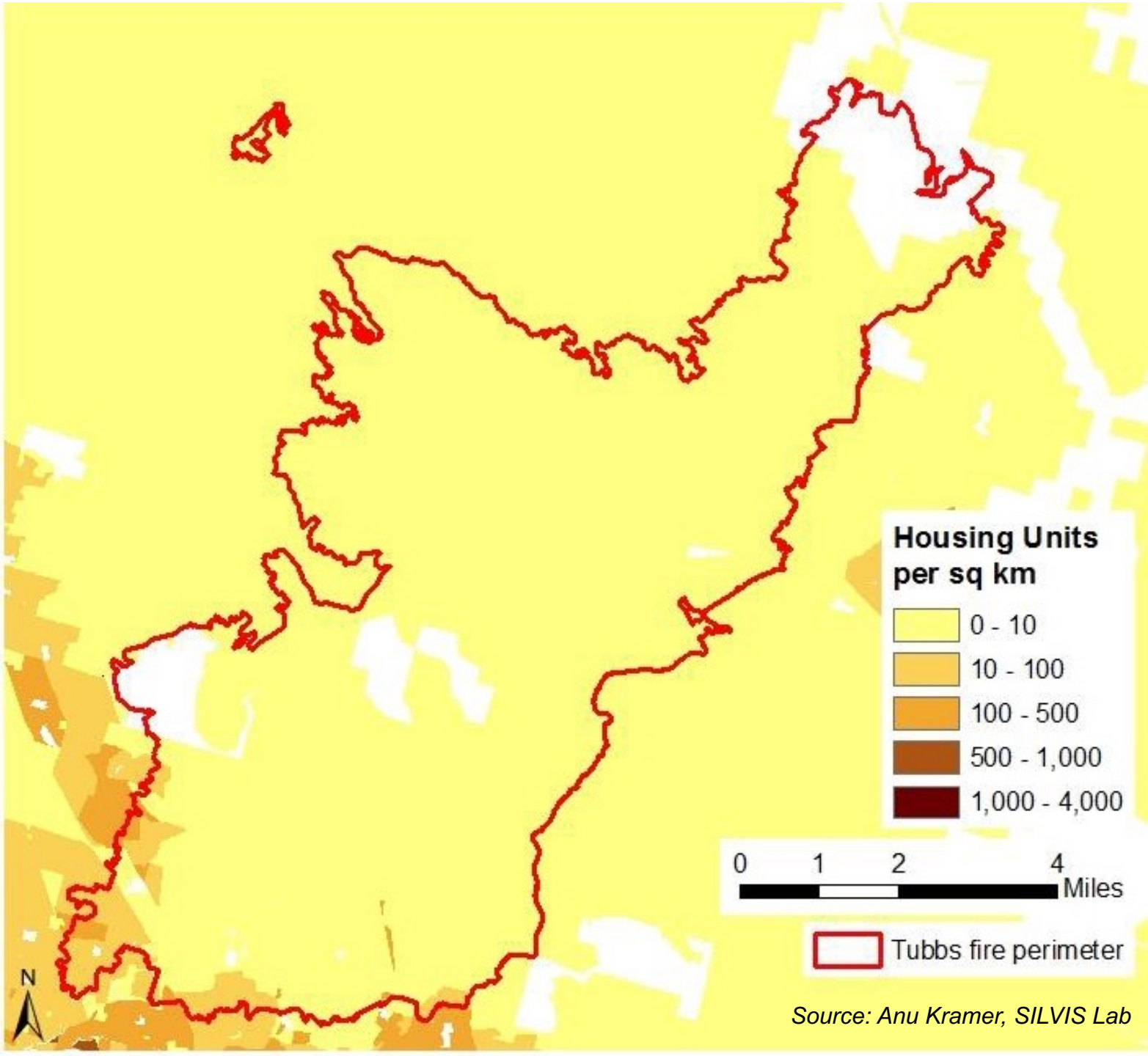
Moving into the fire

1940



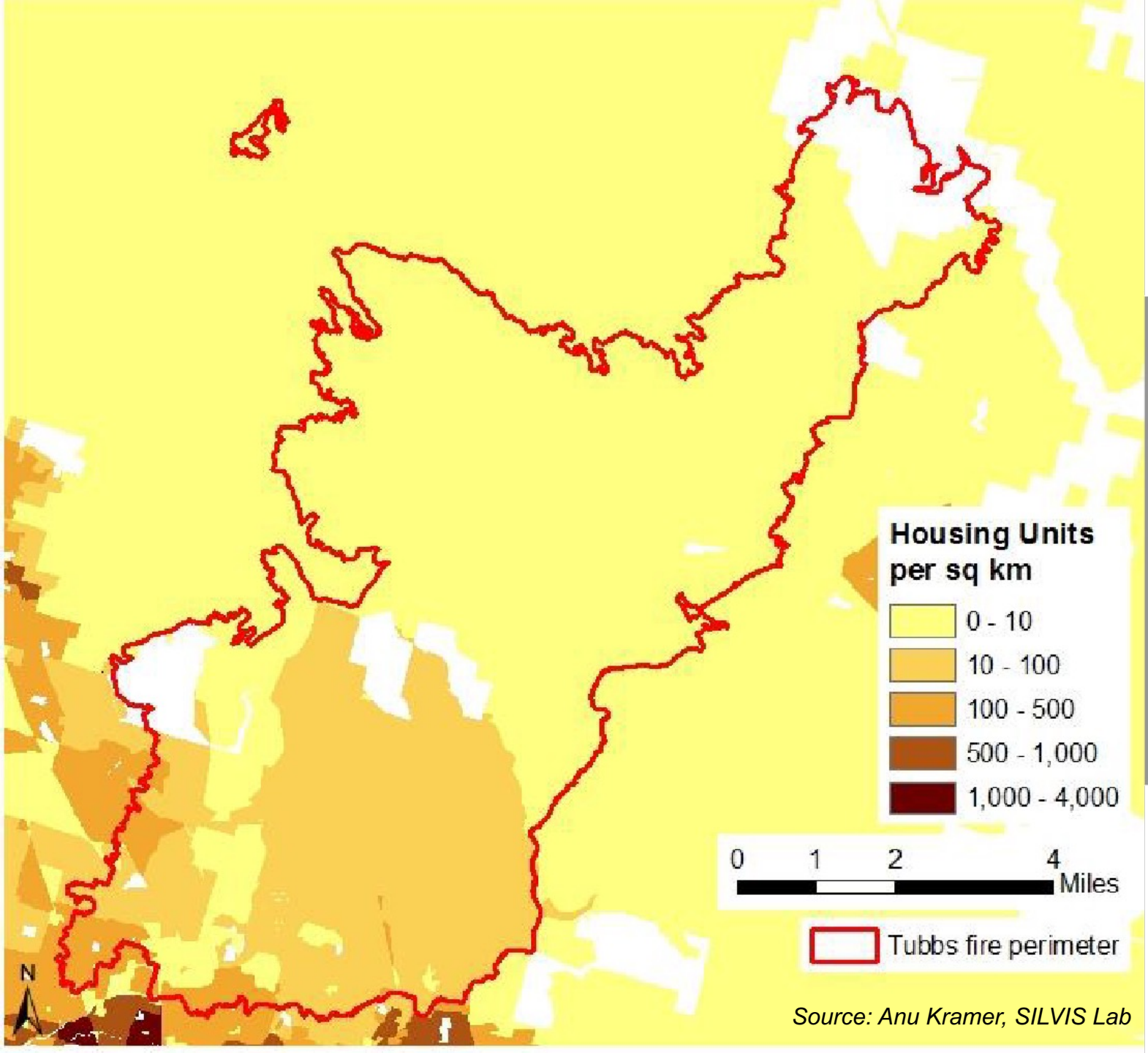
Moving into the fire

1960



Moving into the fire

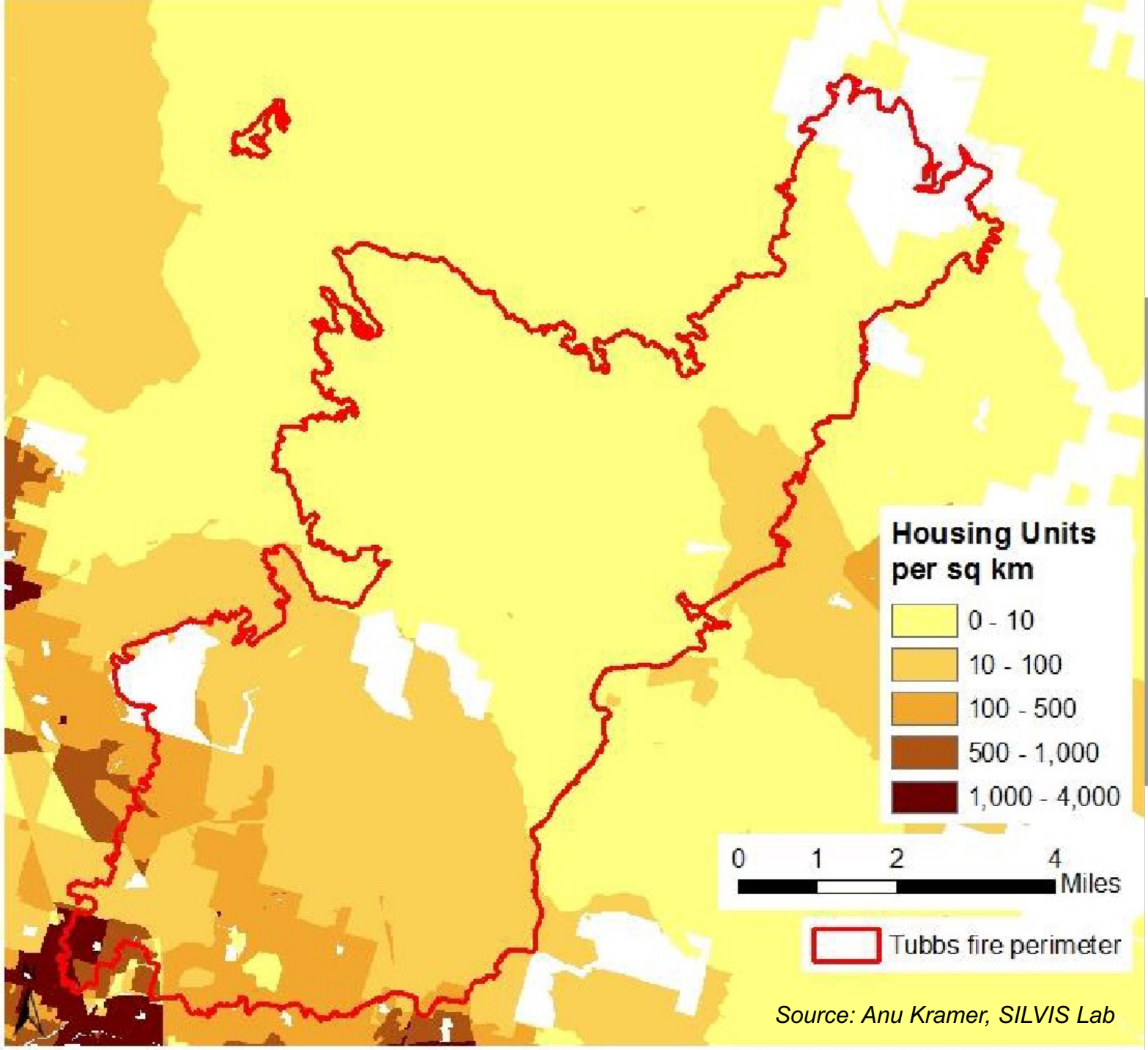
1980



Source: Anu Kramer, SILVIS Lab

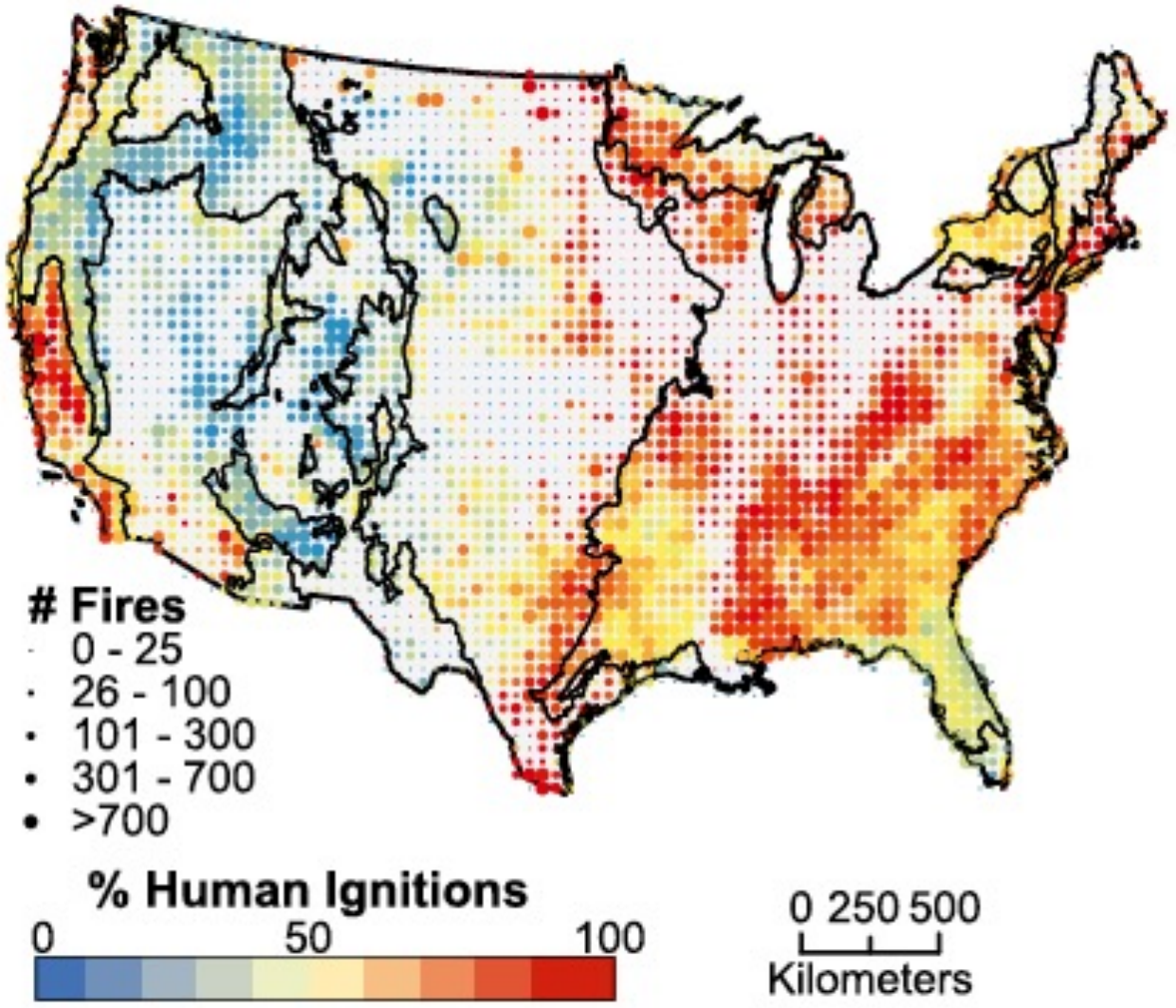
Moving into the fire

2010



Source: Anu Kramer, SILVIS Lab

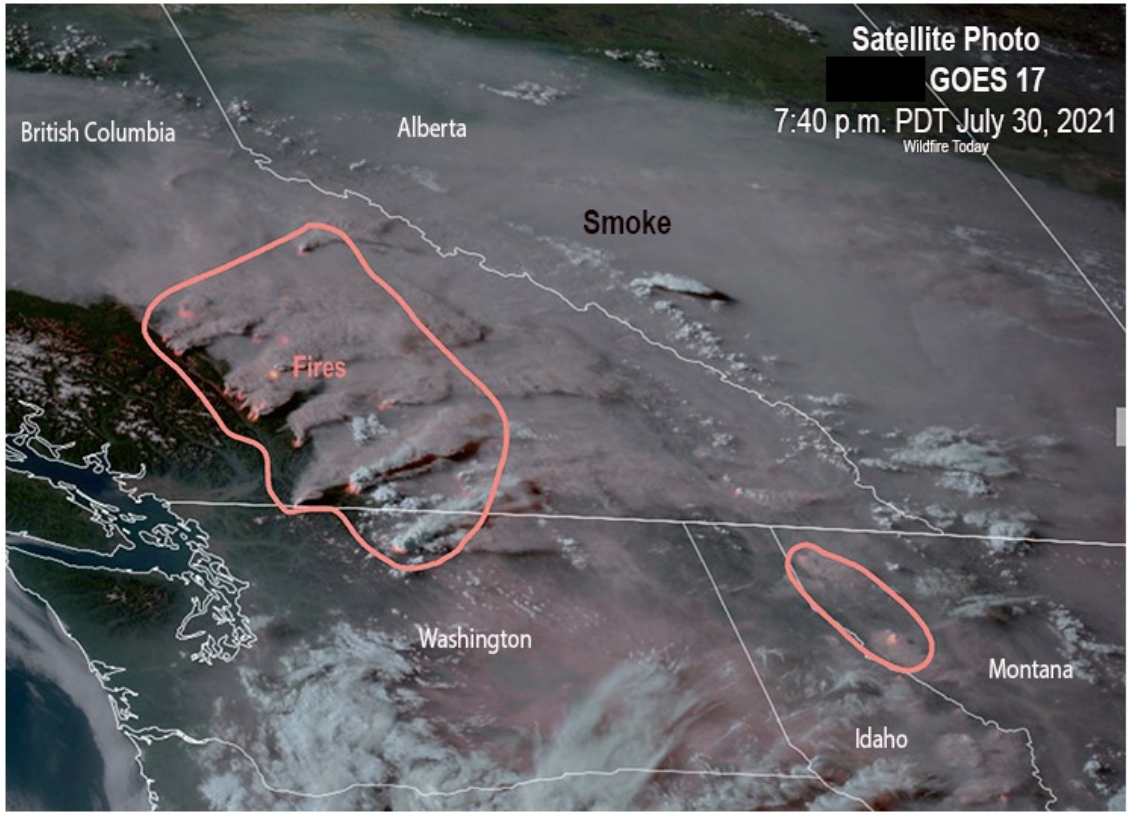
Human versus lightning ignitions

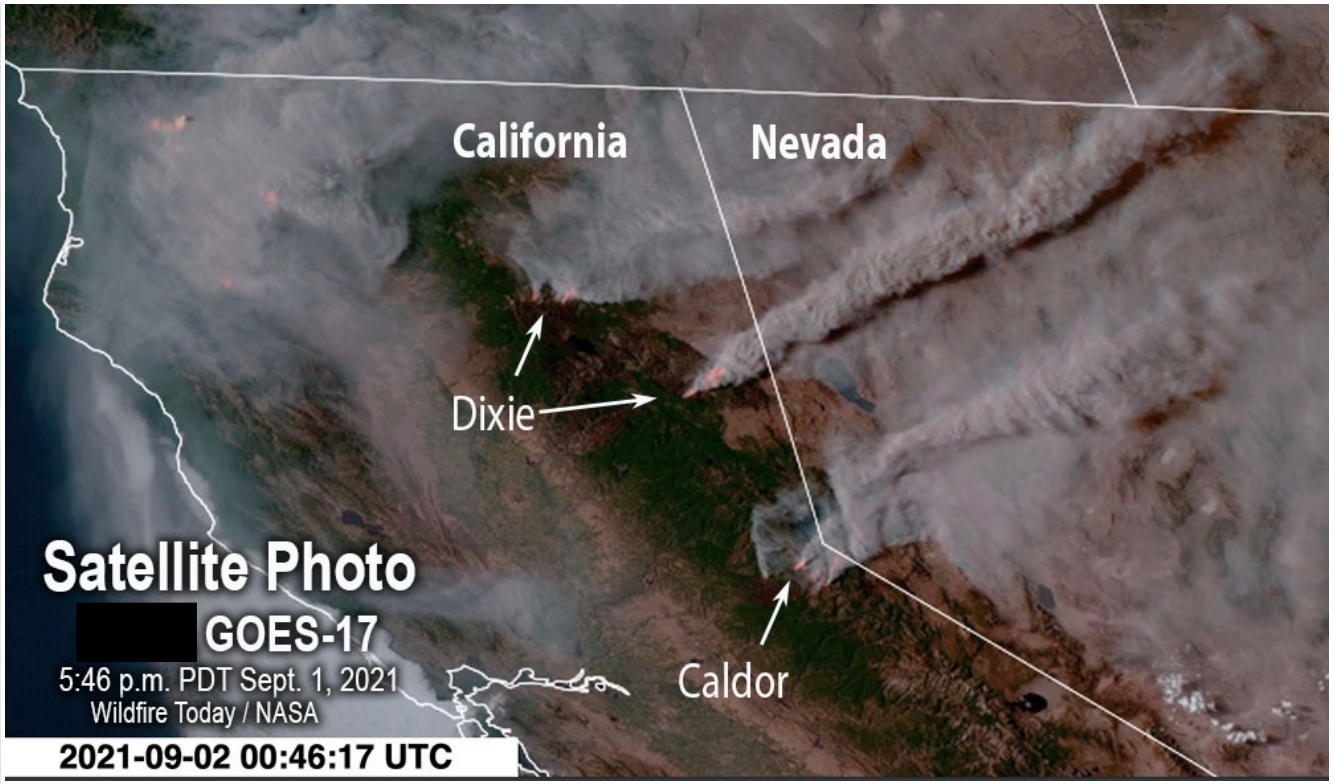


Source: Balch et al., PNAS, 2017

Chapter 4
Another way how not to be seen

Smoke

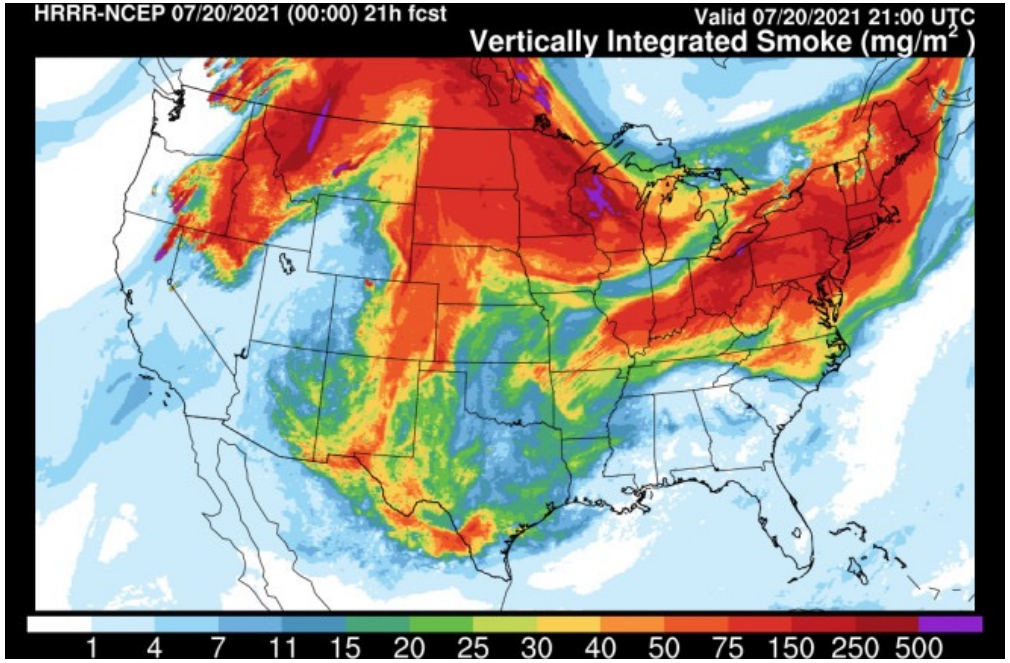




Satellite photo showing smoke from fires in BC and Montana at 7:40 p.m. MDT July 30, 2021.

Smoke

Shown on August 16, 2021, the U.S. EPA and Forest Service's Fire and Smoke Map combines AirNow air quality monitor readings with information from thousands of consumer-grade sensors. *Source: Fire.AirNow.gov*



Dixie fire 19 July 2021

Chapter 5
I'm at a loss

Cost of wildfire

Direct	Homeowners	Gov't/ tax payers	Citizens/ consumers/ occupants	Firefighters / fire department	Local business owners/ suppliers	Local employees
Deaths and injuries			X	X		
Psychological impacts (PTSD)			X	X		
Structure / infrastructure loss	X	X	X		X	
Environmental impact		X	X			
Timber loss		X	X		X	
Agriculture loss			X		X	
Remediation / cleanup	X				X	

Source: NIST Special Publication 1215

Cost of wildfire

Indirect	Homeowners	Gov't/ tax payers	Citizens/ consumers/ occupants	Firefighters / fire department	Local business owners/ suppliers	Local employees
Business interruption/ Tourism/ Supply chain		X	X		X	X
Evacuation costs	X	X	X	X	X	X
Accelerated economic decline of community		X	X		X	X
Utility and pipeline interruption		X	X		X	
Transportation interruption		X	X		X	
Government service interruption	X	X	X		X	
Psychological impacts (loss of natural amenities)	X		X			

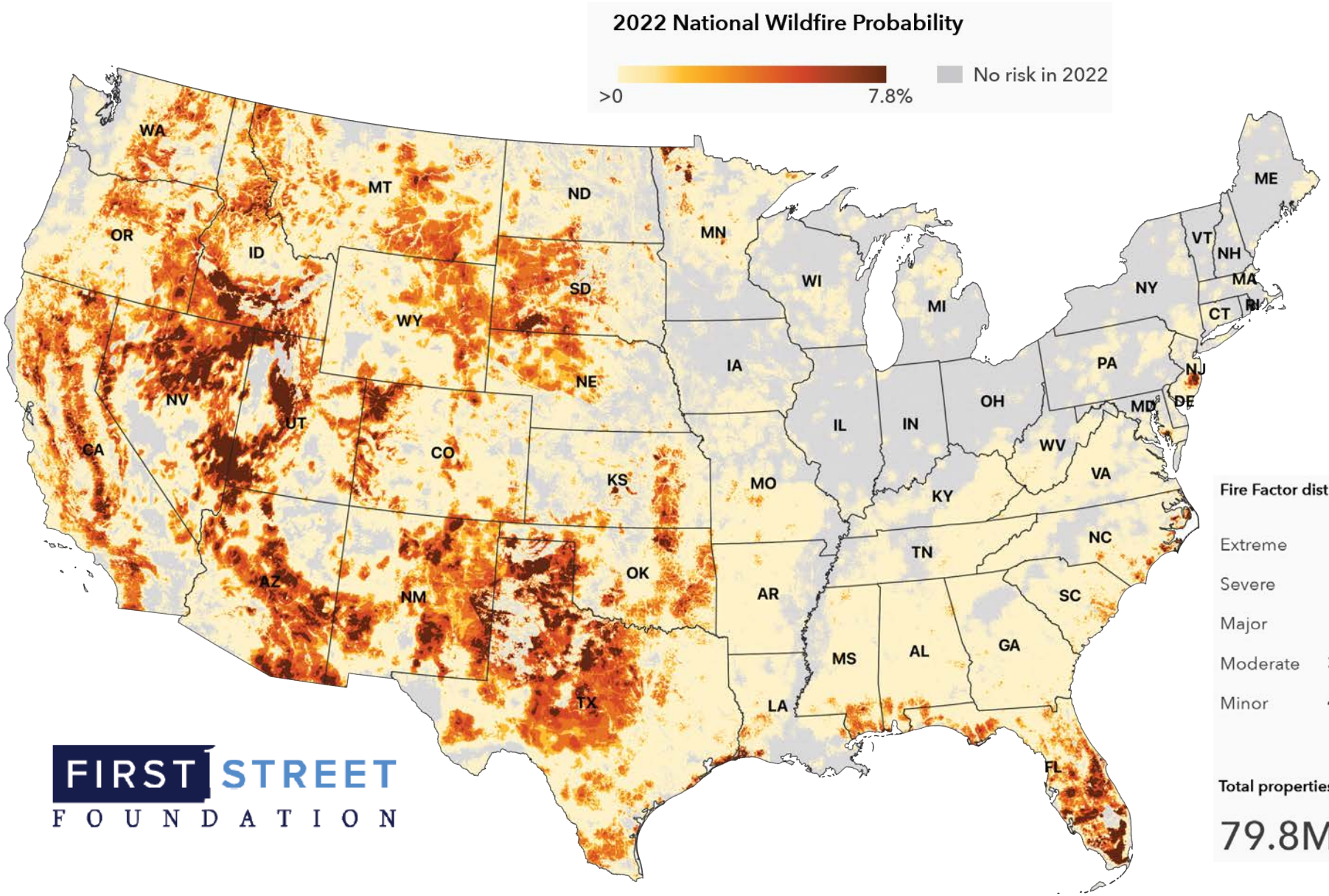
Source: NIST Special Publication 1215

Cost of wildfire

Indirect	Homeowners	Gov't/ tax payers	Citizens/ consumers/ occupants	Firefighters / fire department	Local business owners/ suppliers	Local employees
Housing market impact	X					
Interference with military operations		X				
Loss of ecosystem services		X	X			
Increased risk of other hazards (e.g., debris flow)		X	X	X		
Decrease in tax base (structure loss or decline in value)		X				
Decrease in government services	X	X	X	X	X	X
Health and environmental impacts from retardants		X	X			

Source: NIST Special Publication 1215

2022 Wildfire situation



FIRST STREET FOUNDATION

Fire Factor distribution of properties at risk*

Extreme	1.5M
Severe	2.7M
Major	6.0M
Moderate	20.2M
Minor	49.4M

Total properties at risk*

79.8M

Source: The 5th National Risk Assessment: Fueling the Flames

Steps to lessen exposure and losses

- Zoning
- Risk mapping
- Mitigation
- Public education and information
- Firefighter health and safety

Source: Brookings Institution “It Only Takes a Spark”

Caldor fire – 14 August 2021

Impacts

- 1003 Structures destroyed
- South Lake Tahoe evacuated
- 2nd fire known to cross over Sierra Nevada range

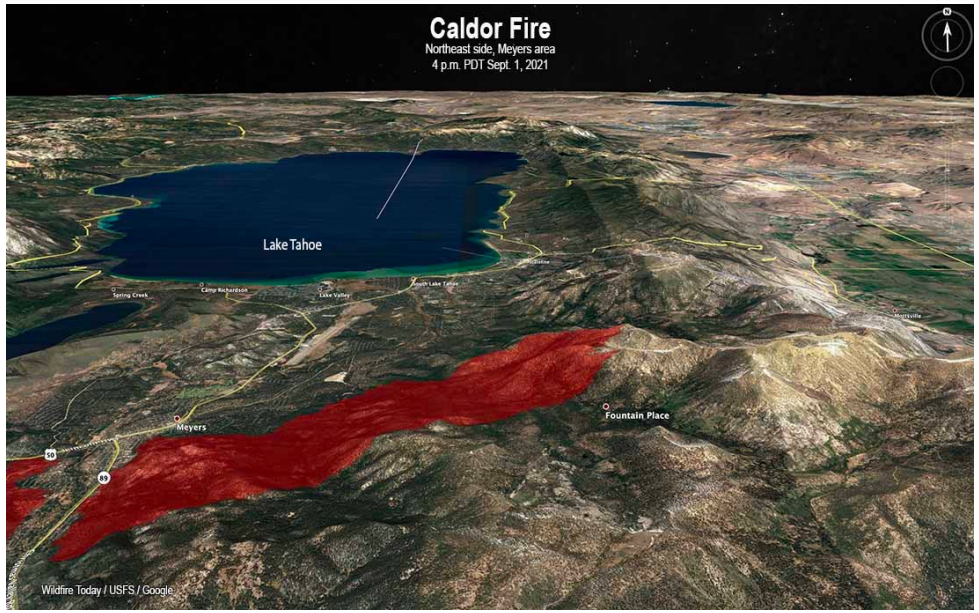


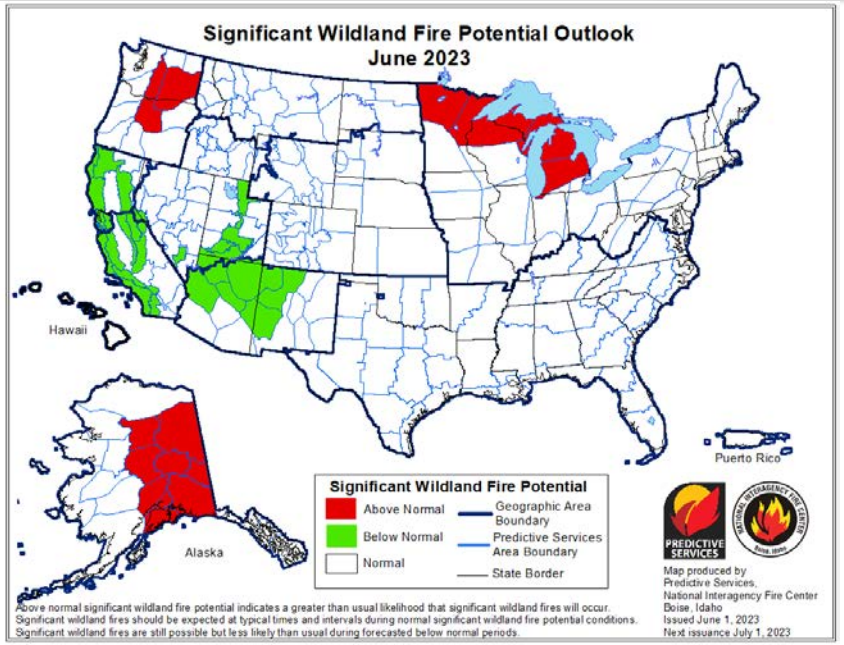
Photo: CAL FIRE Amador-El Dorado Unit

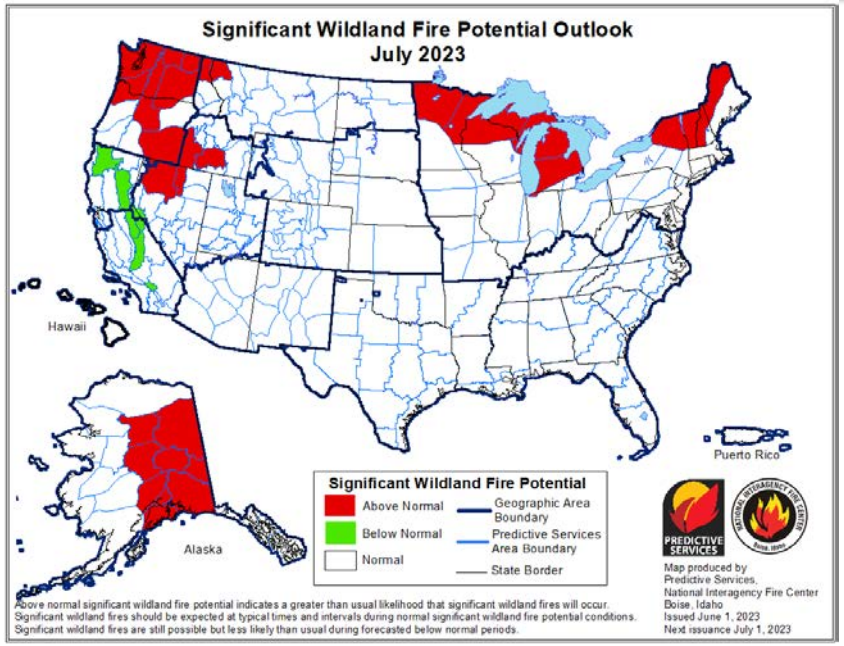
Caldor fire

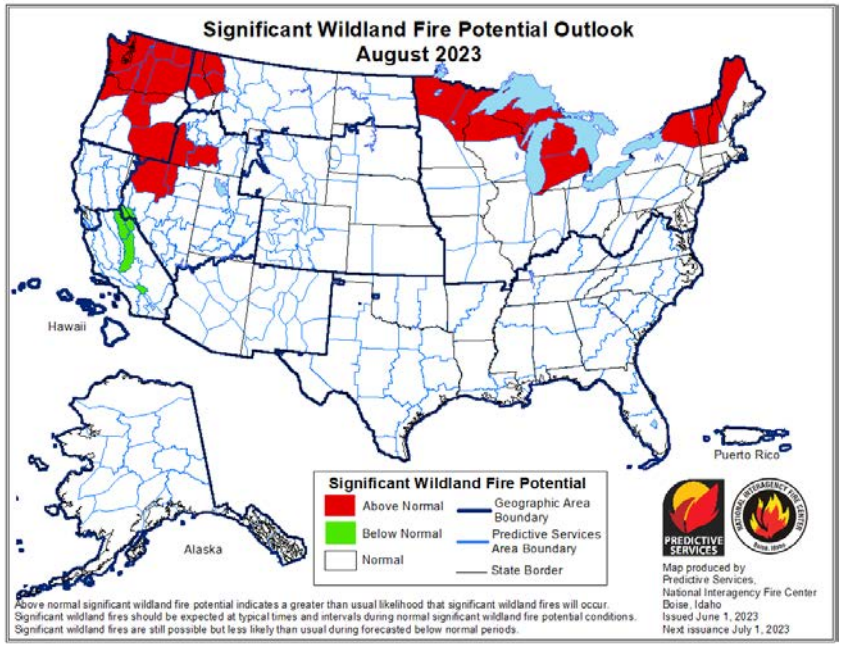
Source: USFS Lake Tahoe Basin

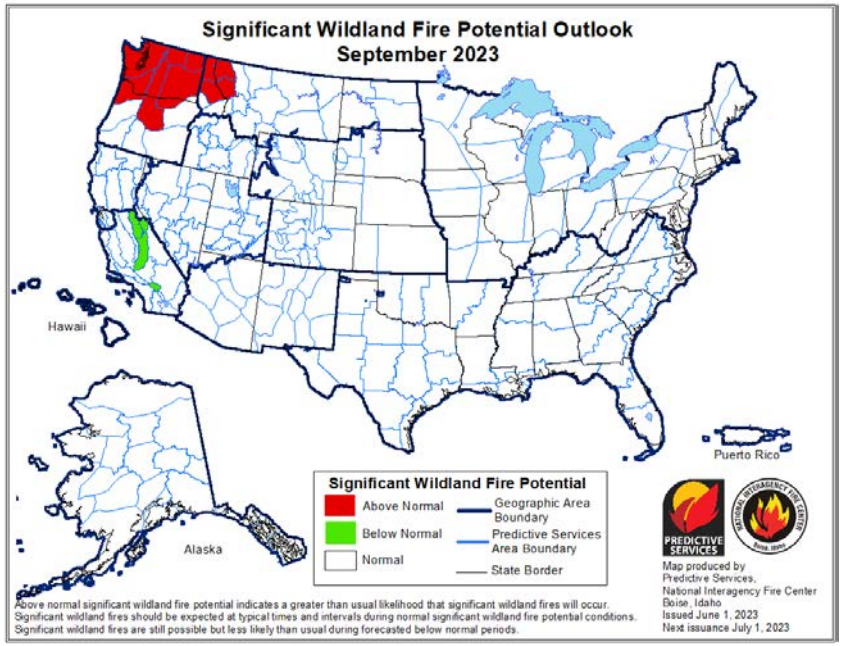
Chapter 6
Nearly the end of the story

2023 Wildfire situation







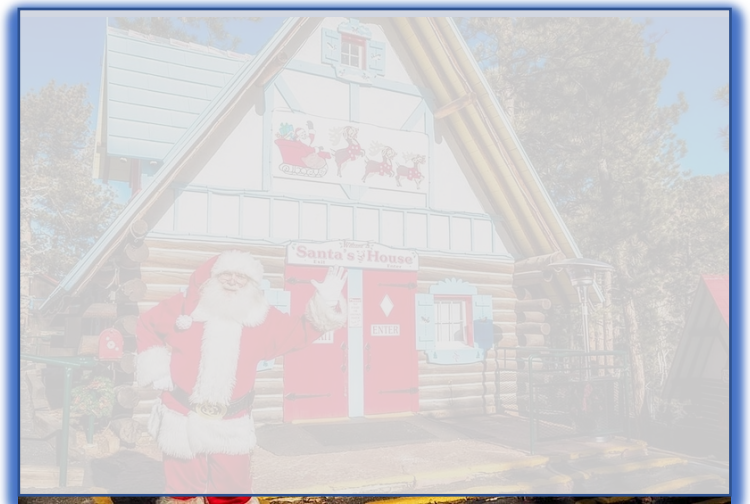


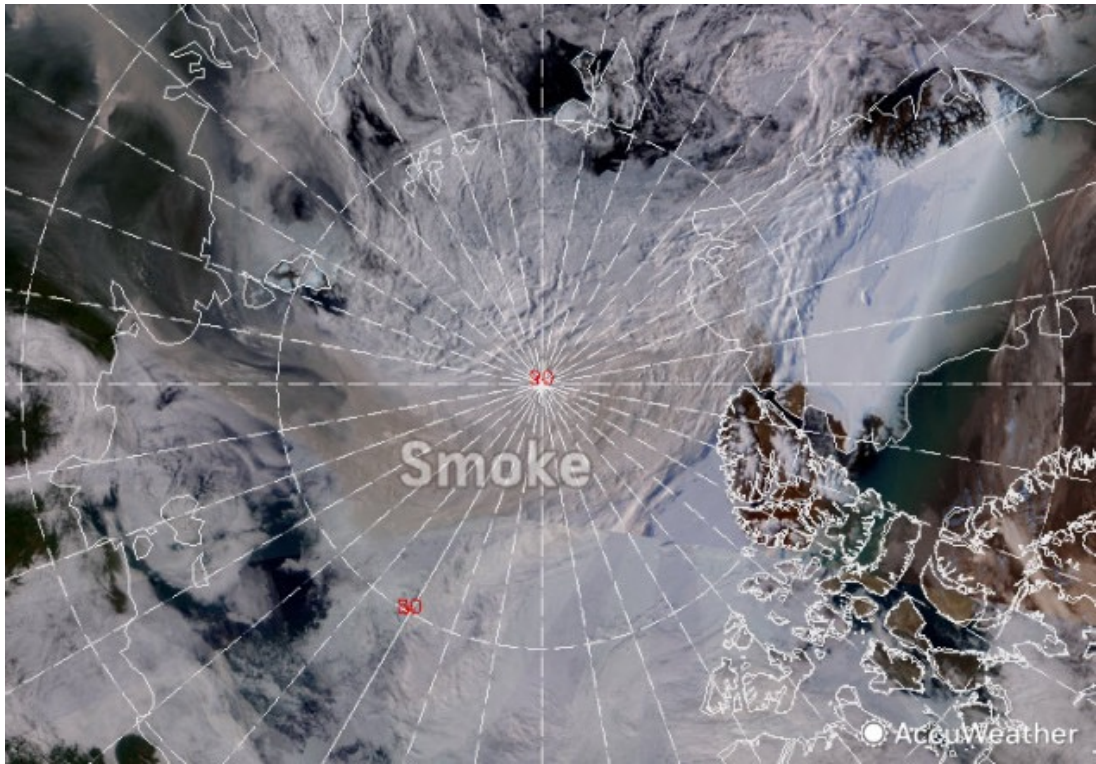
Headlines

FOX 35 ORLANDO

Wildfire smoke reaches North Pole for 1st time in recorded history

By Kelly Hayes | **Published** August 13, 2021 | Environment | FOX TV Digital Team





Can you see the forest for the numbers?

Tobia Ravà.
Codici Trascendentali