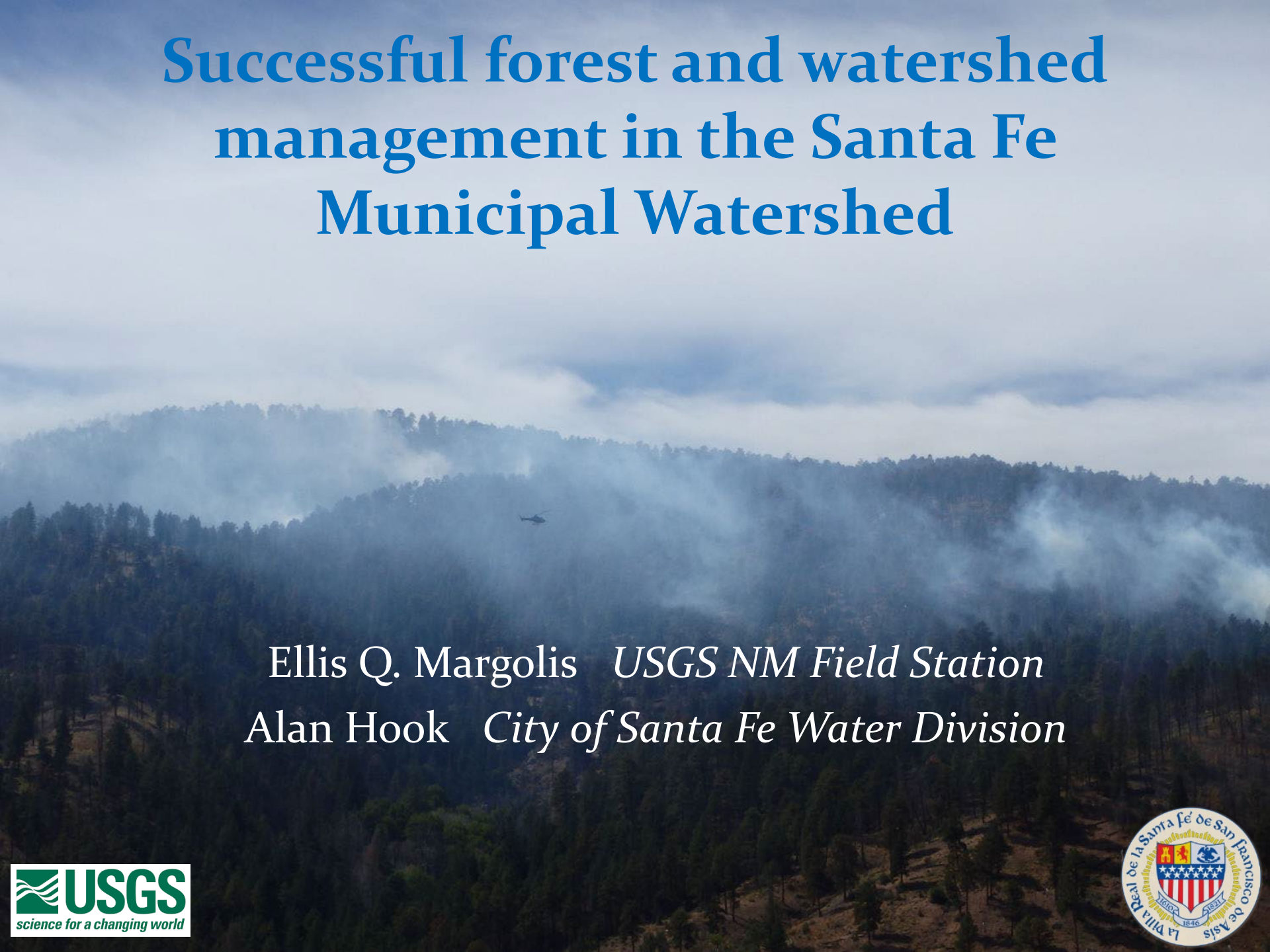
Successful forest and watershed management in the Santa Fe Municipal Watershed



Ellis Q. Margolis *USGS NM Field Station*

Alan Hook *City of Santa Fe Water Division*

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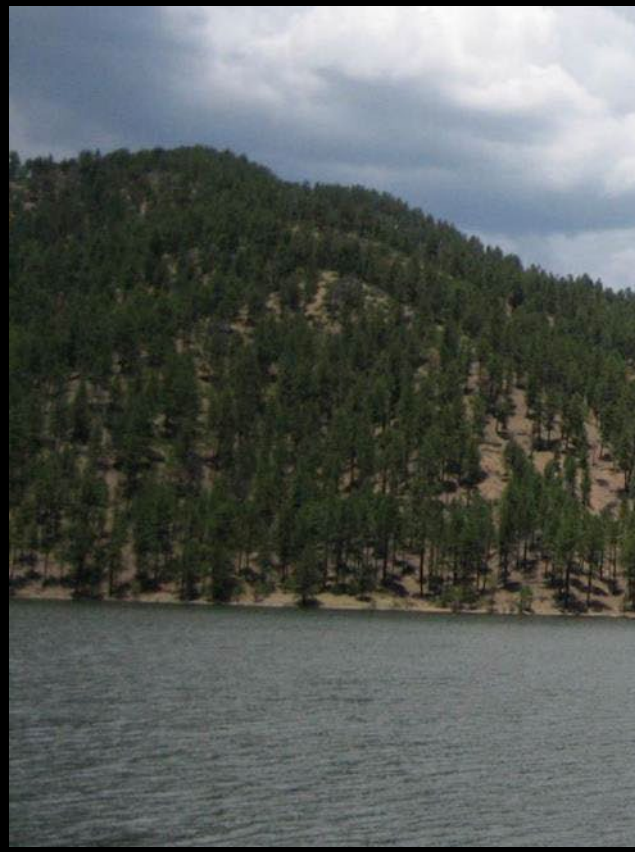
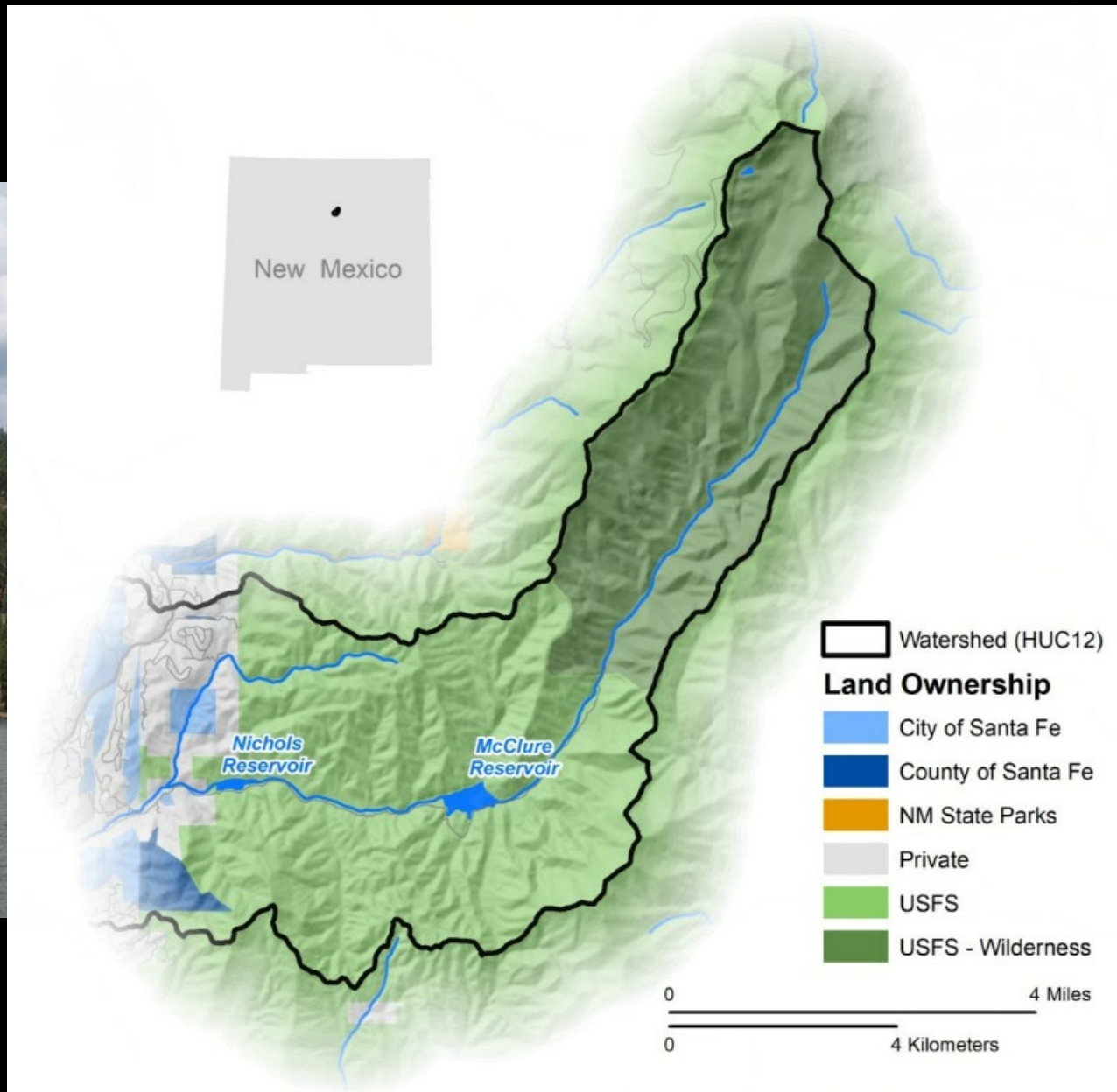
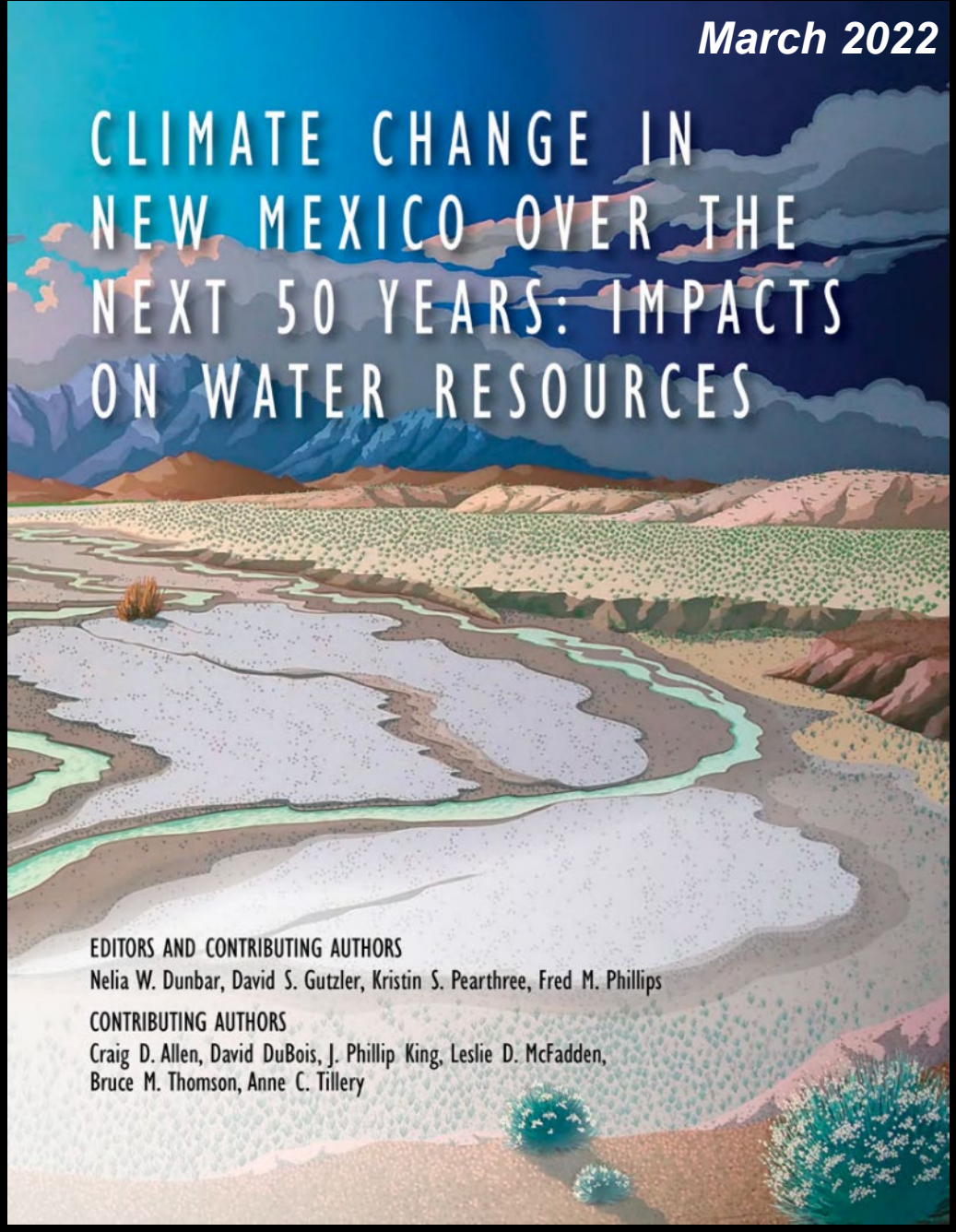
Forests, fire, and water are connected

Over the last decade 33% of Santa Fe's **water** came from the forested Santa Fe Watershed

Management of the links between forests, fire, and water

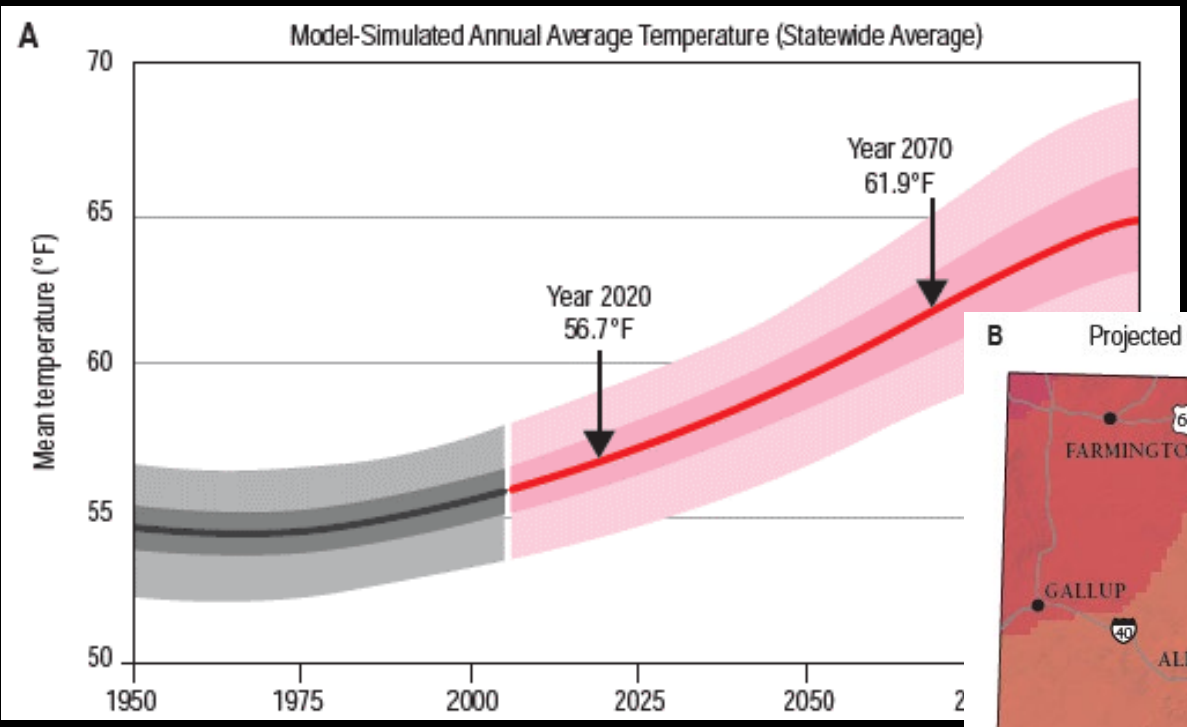


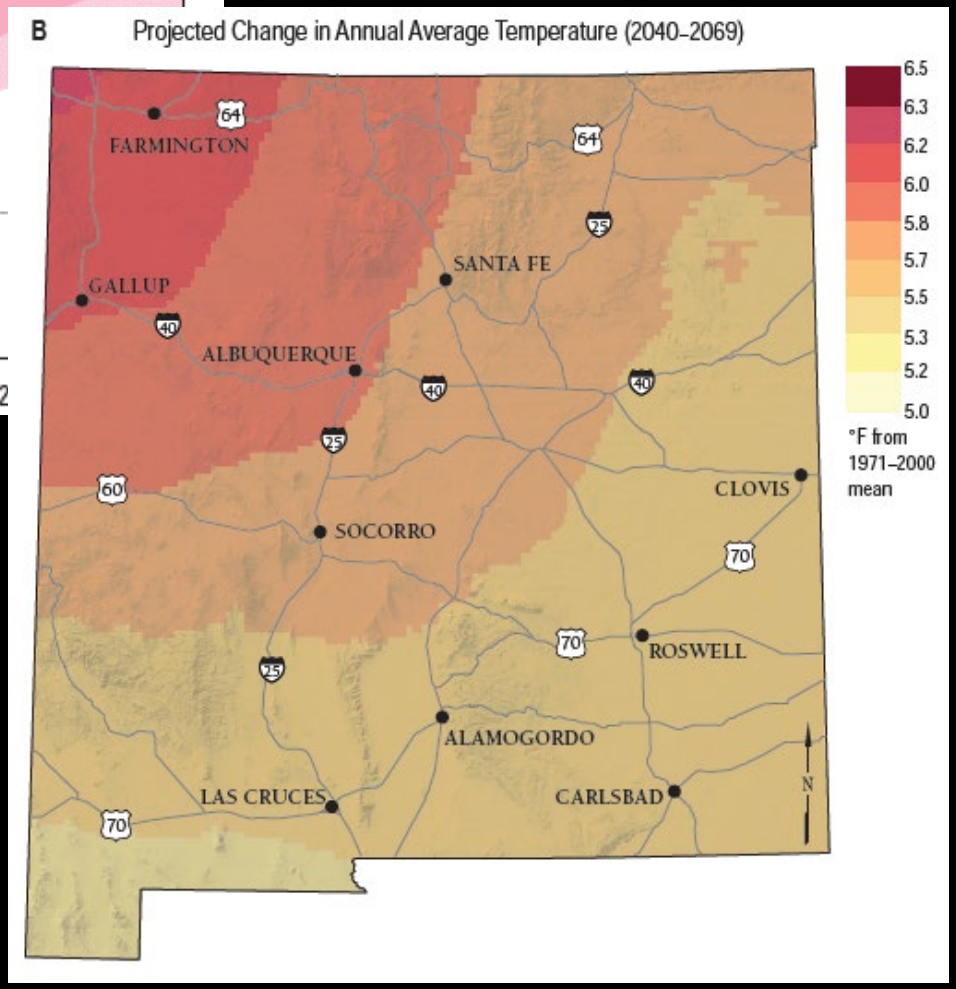




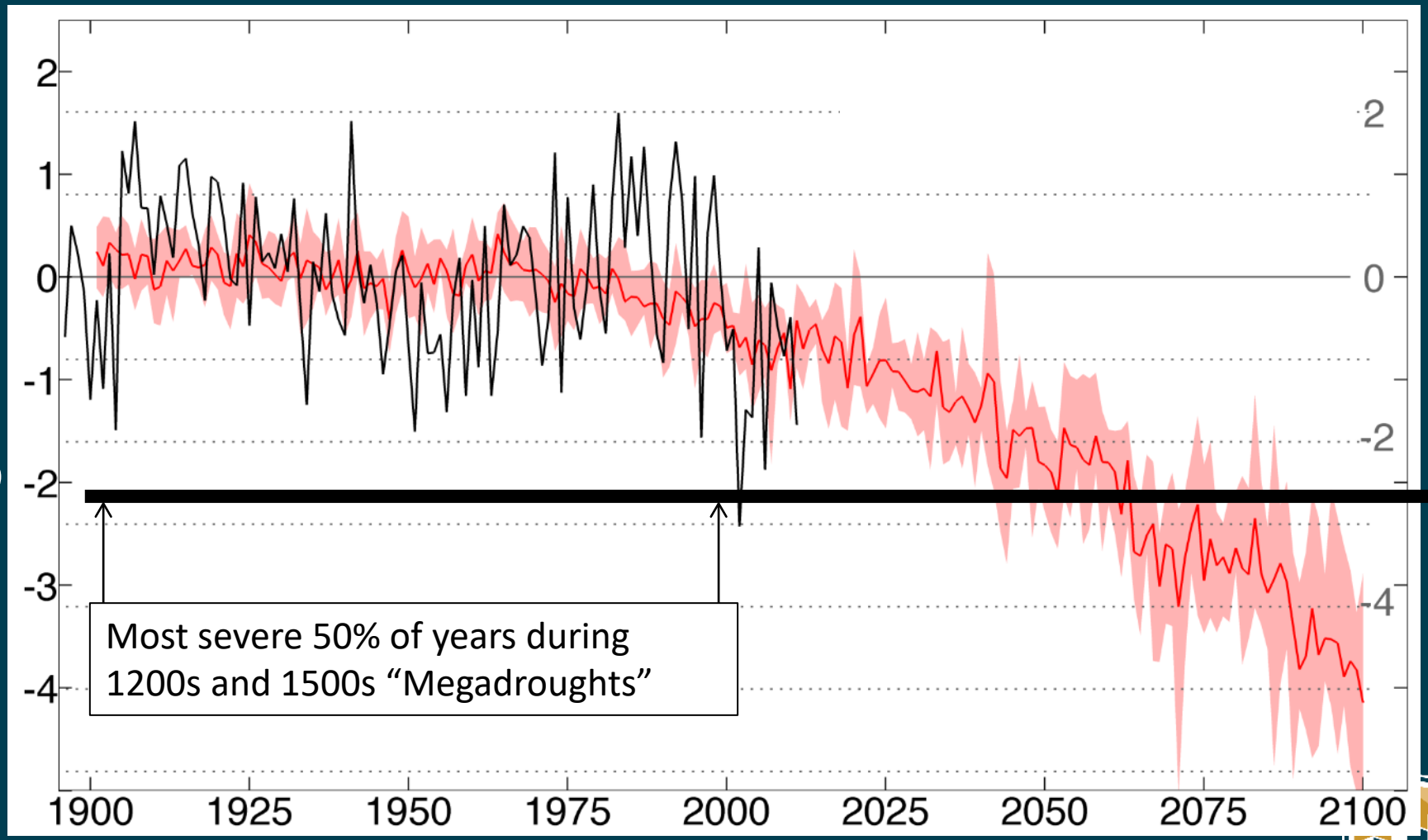
https://geoinfo.nmt.edu/ClimatePanel/report/home.html

Climate Change





Climate Model Projections of Forest Drought-Stress Index (FDSI) through 2100

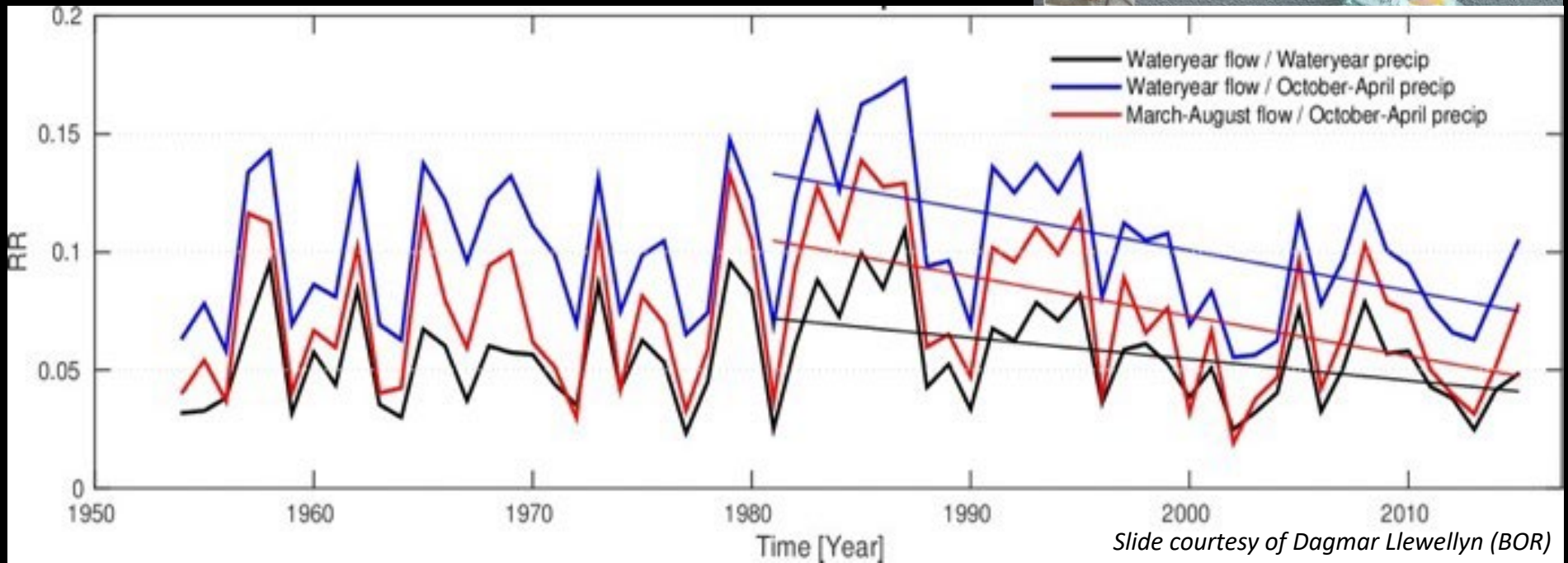


Source: Park Williams, currently of Lamont-Doherty Earth Observatory

Declining runoff efficiency: less streamflow from precipitation

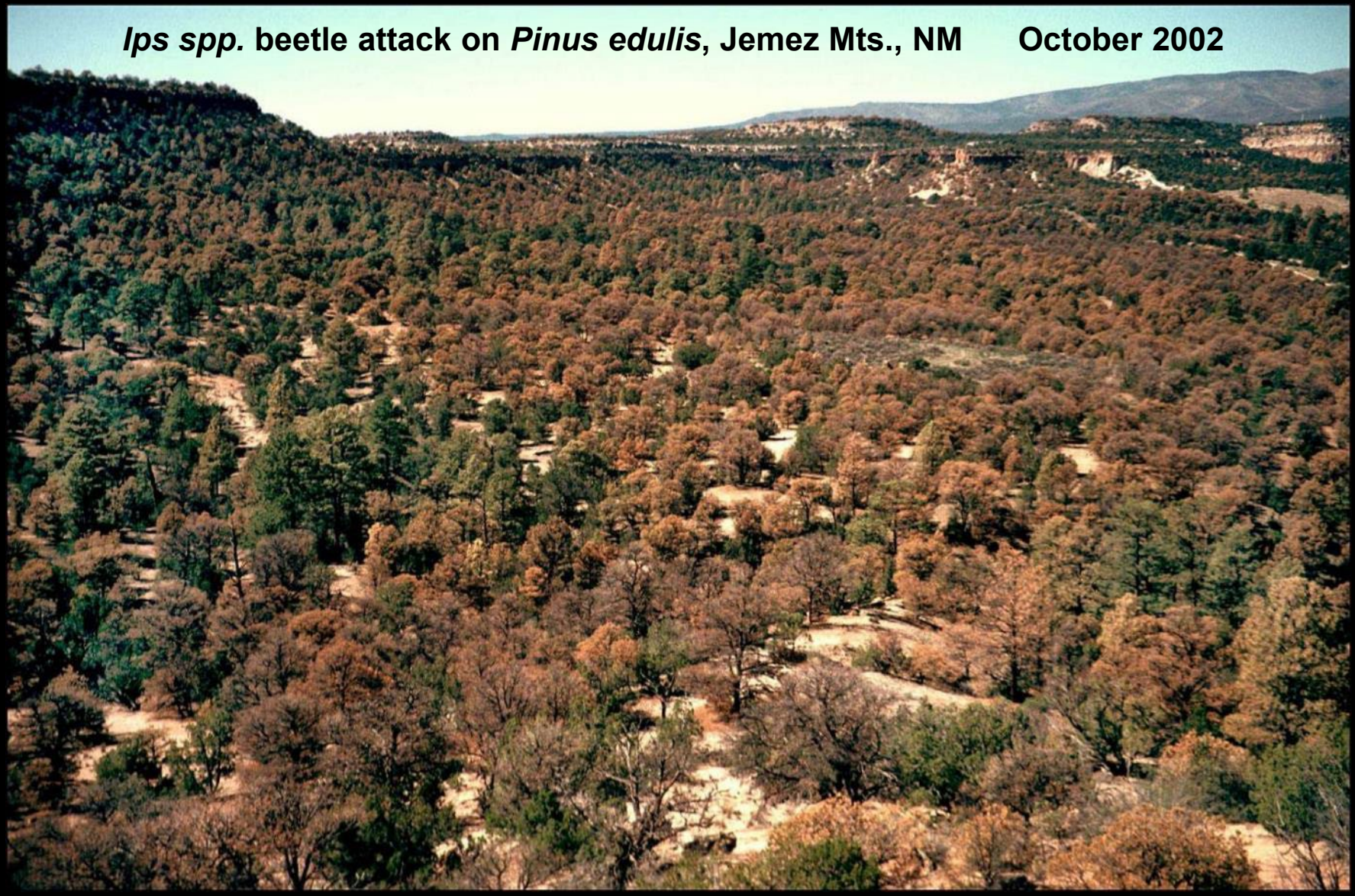
Upper Rio Grande

Lehner et al. (2017a)



Slide courtesy of Dagmar Llewellyn (BOR)

Warming is driving increased tree mortality



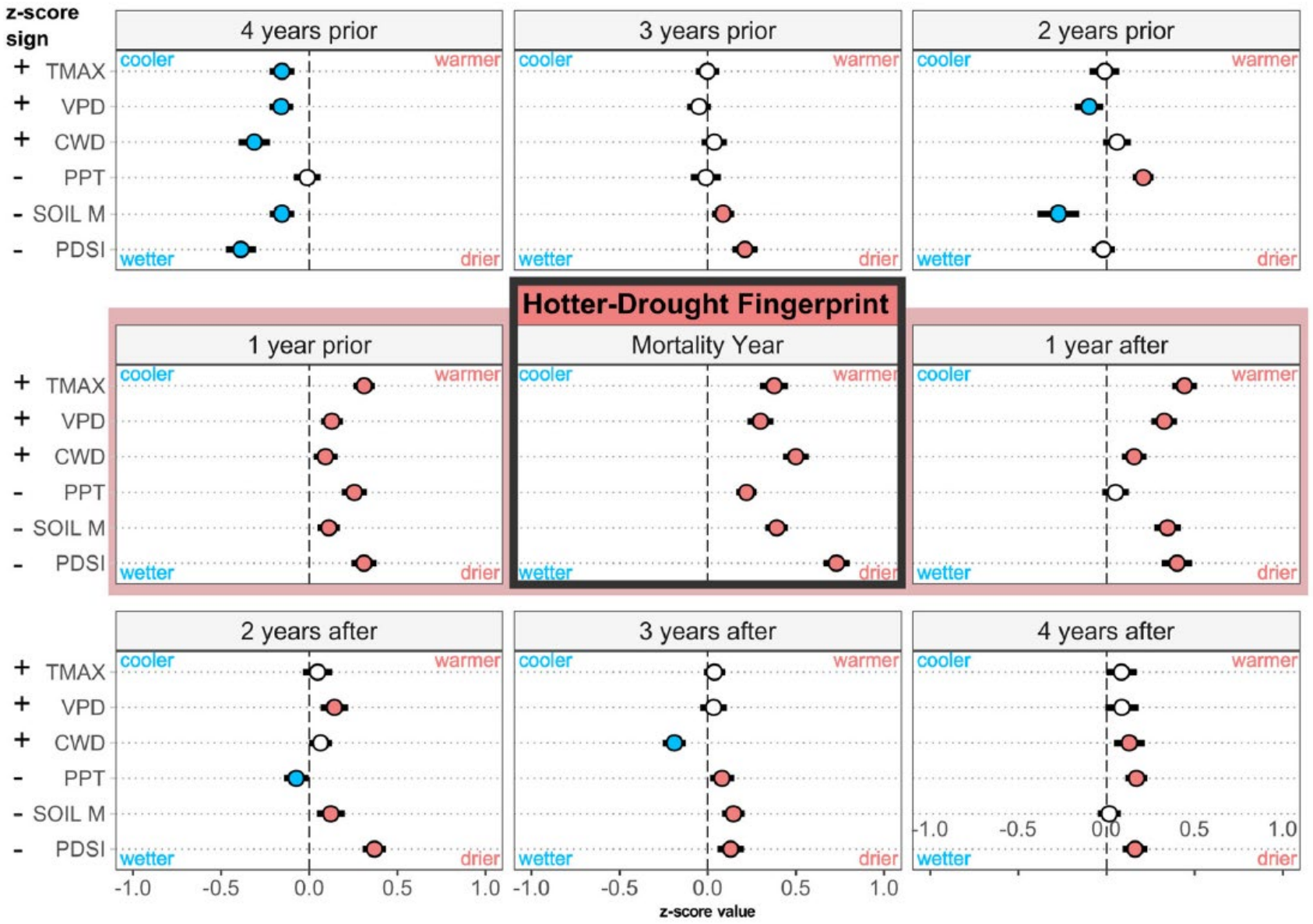
ARTICLE

https://doi.org/10.1038/s41467-022-29289-2 OPEN

nature COMMUNICATIONS

Check for updates

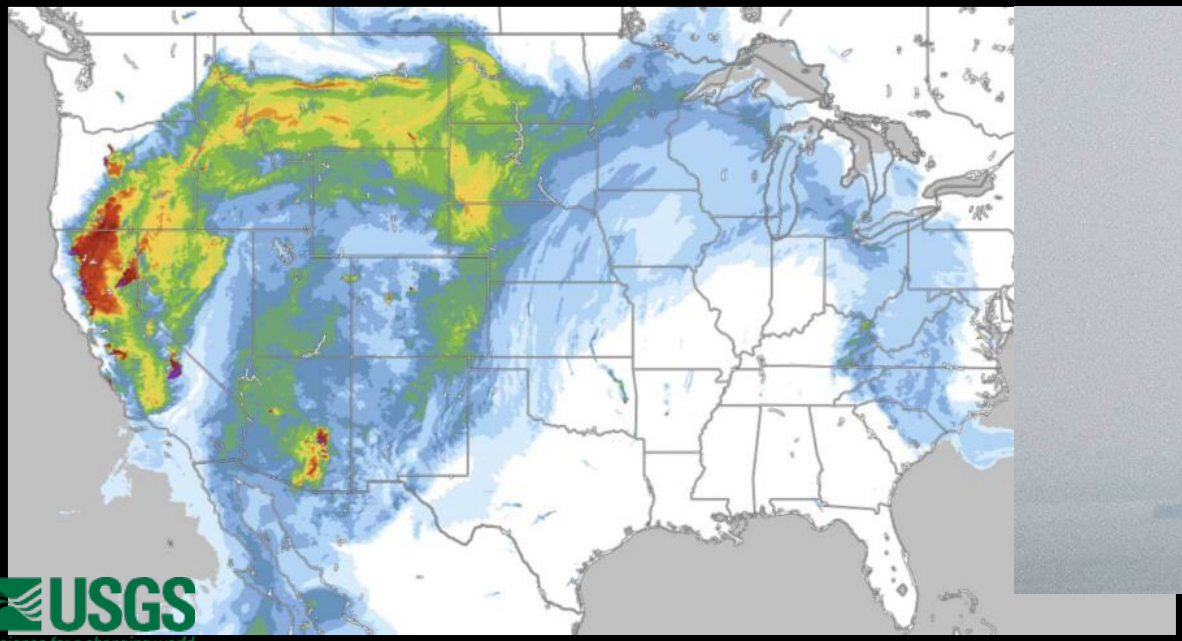
Global field observations of tree die-off reveal hotter-drought fingerprint for Earth's forests



Warmer drought is increasing fire across the West

> 400 structures burned in NM in 2022

Smoke affects public health near and far from fire occurrence*



Spencer Platt/Getty Images

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Perspective is important

The increase in fire has occurred over the last 20 – 30 years

How do these “record” changes in fire look in a long-term perspective?

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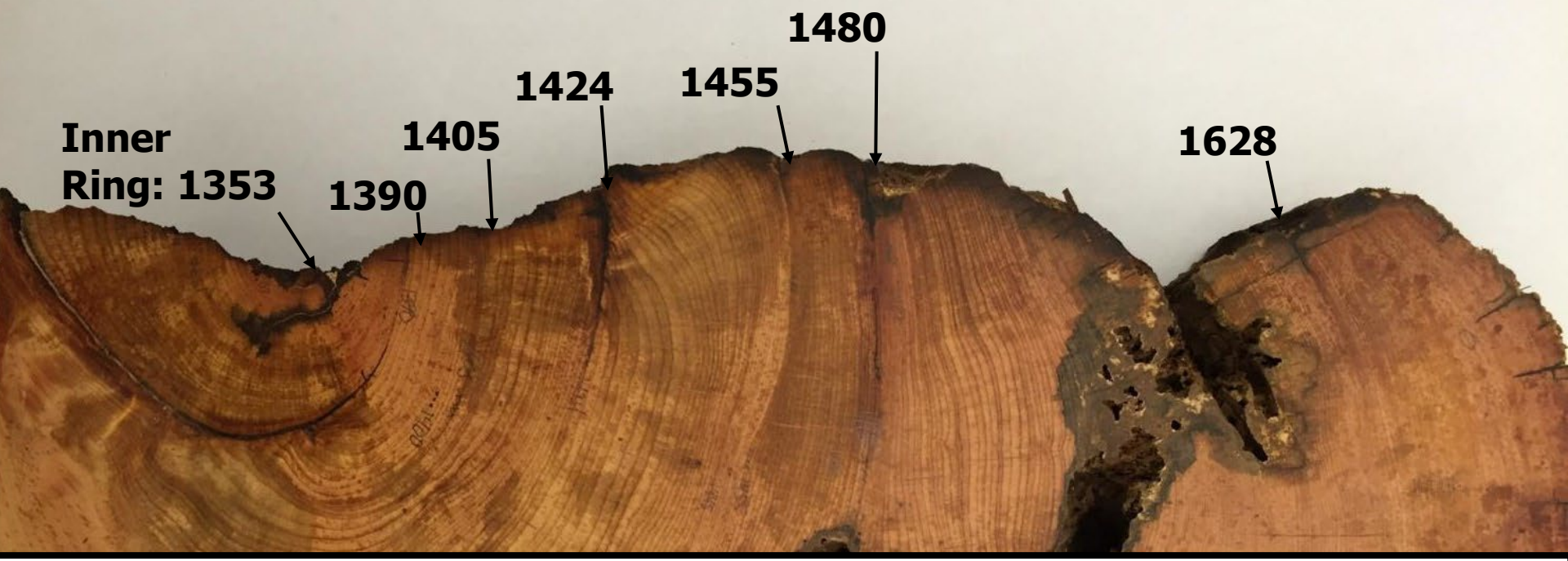
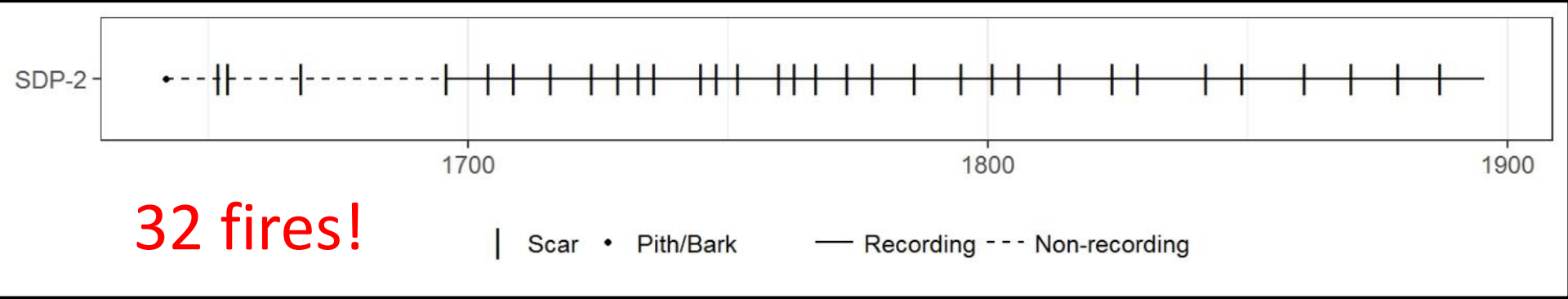
Tree-ring fire scars provide long records of fire

Tree-ring fire scars provide long records of fire

650-year-old white pine log - Manzanita Canyon, Rio Hondo, NM

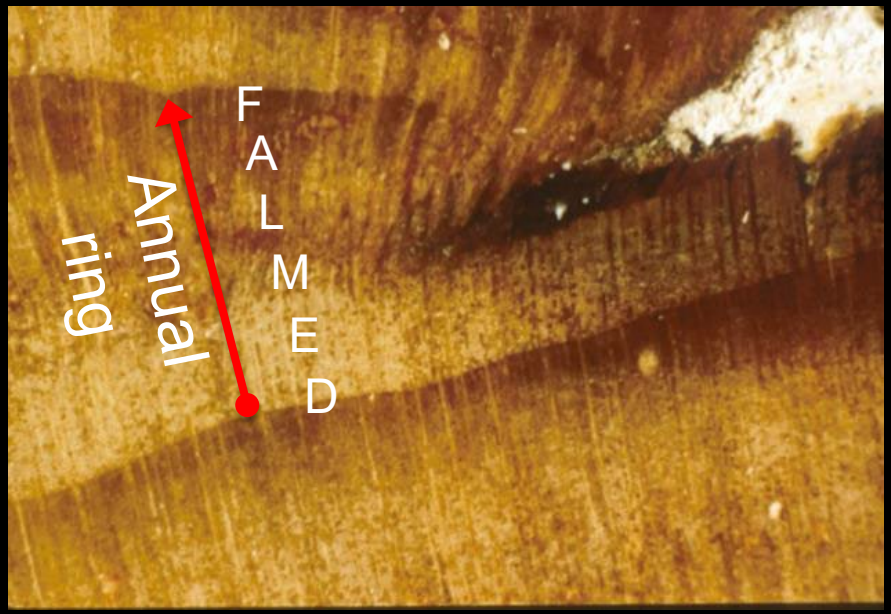




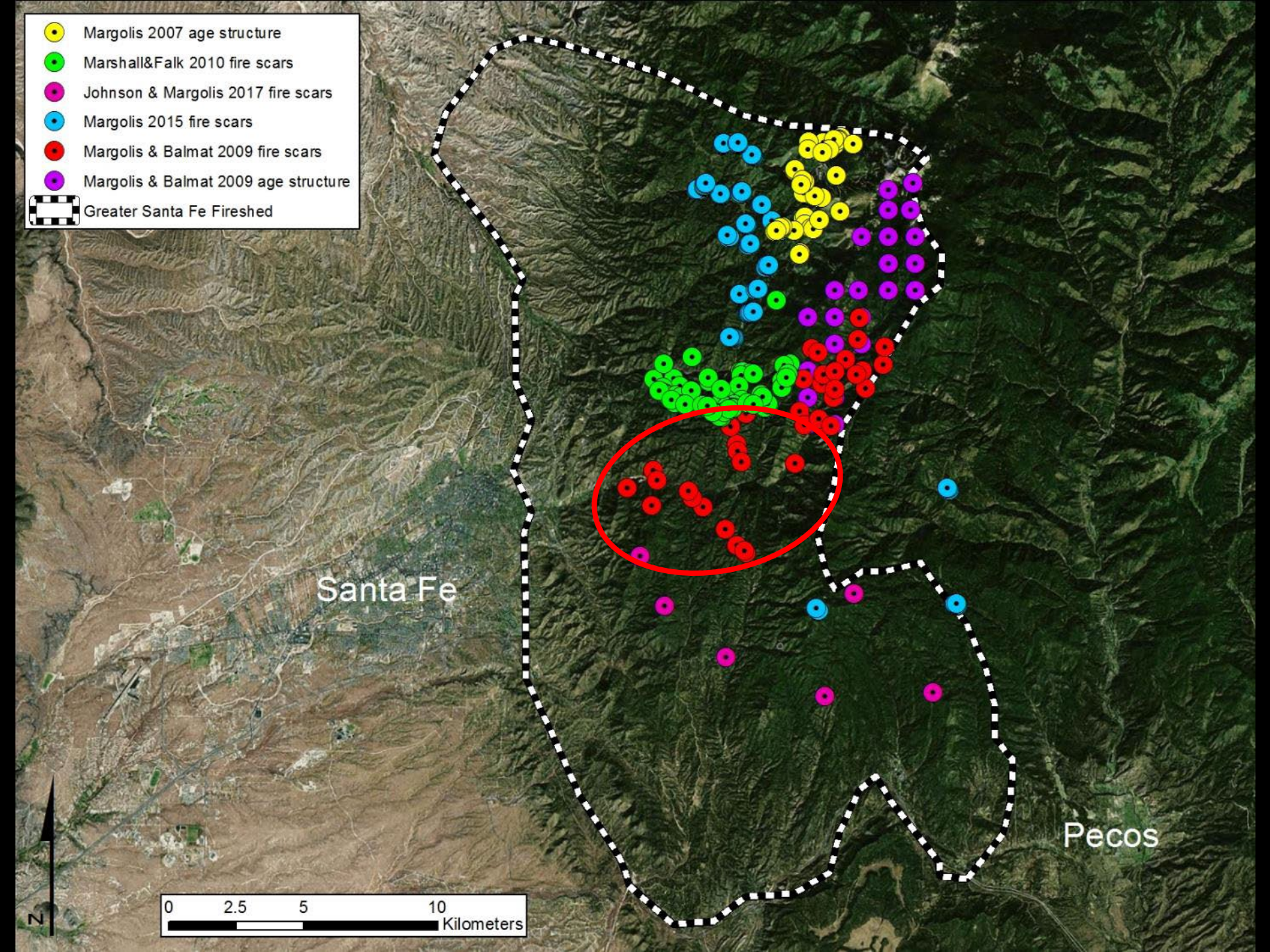
32 fires!

Johnson & Margolis 2019, *Fire*

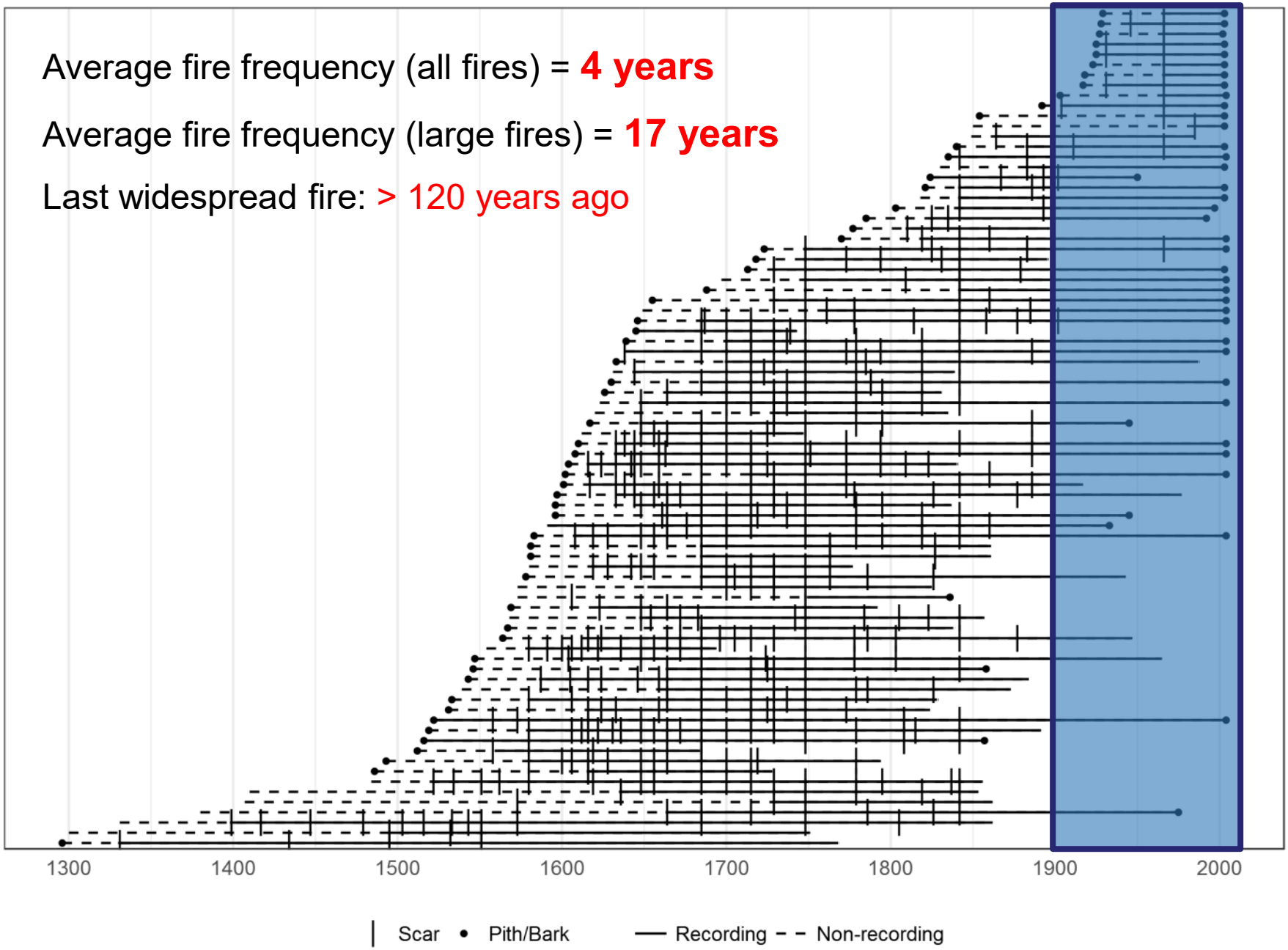
Fire season

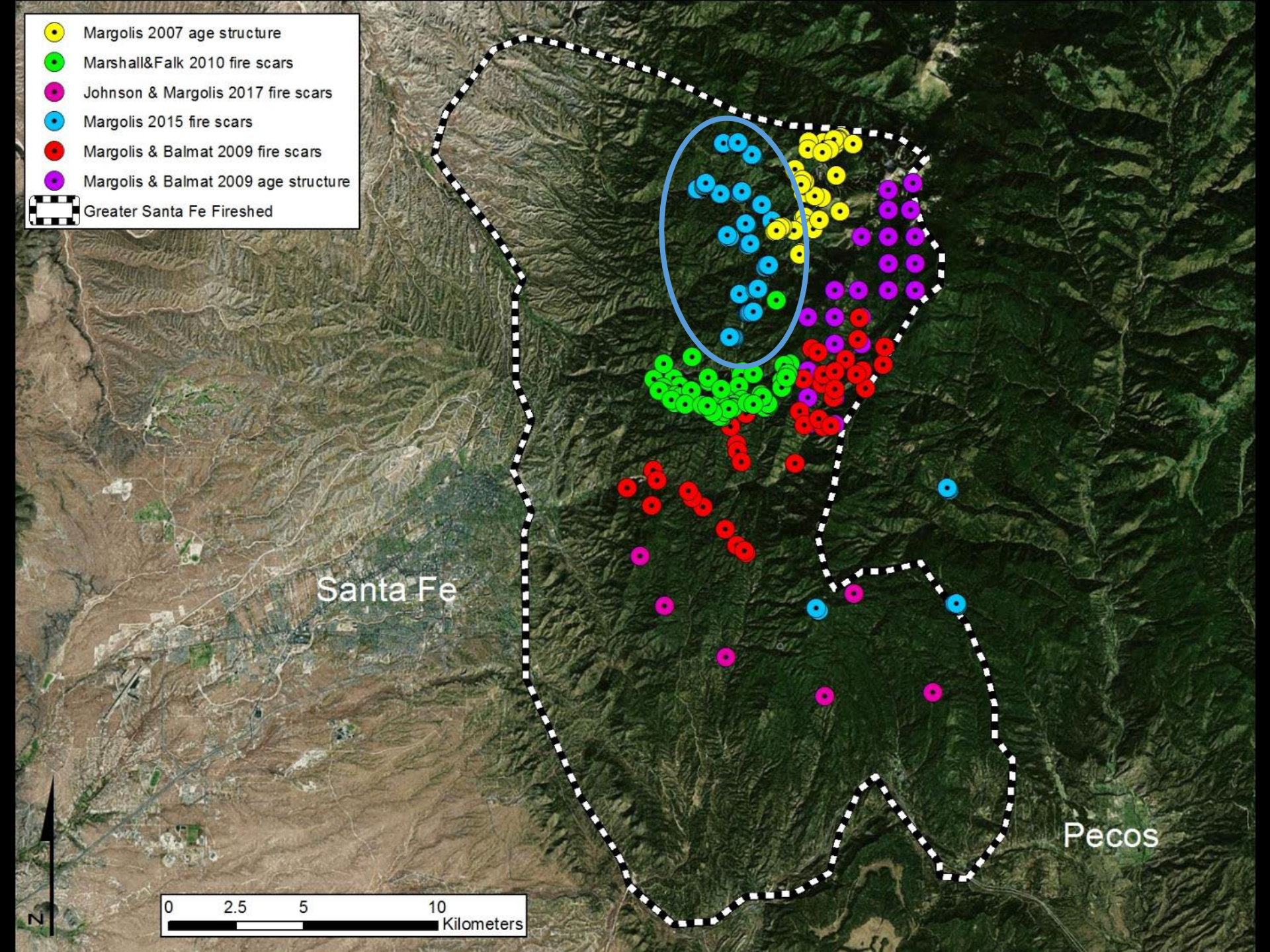


Margolis et al. 2017, Climatic Change


Margolis 2007 age structure
Marshall&Falk 2010 fire scars
Johnson & Margolis 2017 fire scars
Margolis 2015 fire scars
Margolis & Balmat 2009 fire scars
Margolis & Balmat 2009 age structure
Greater Santa Fe Fireshed
Santa Fe
Pecos
N
0
2.5
5
10
Kilometers

Santa Fe Watershed Ponderosa Pine

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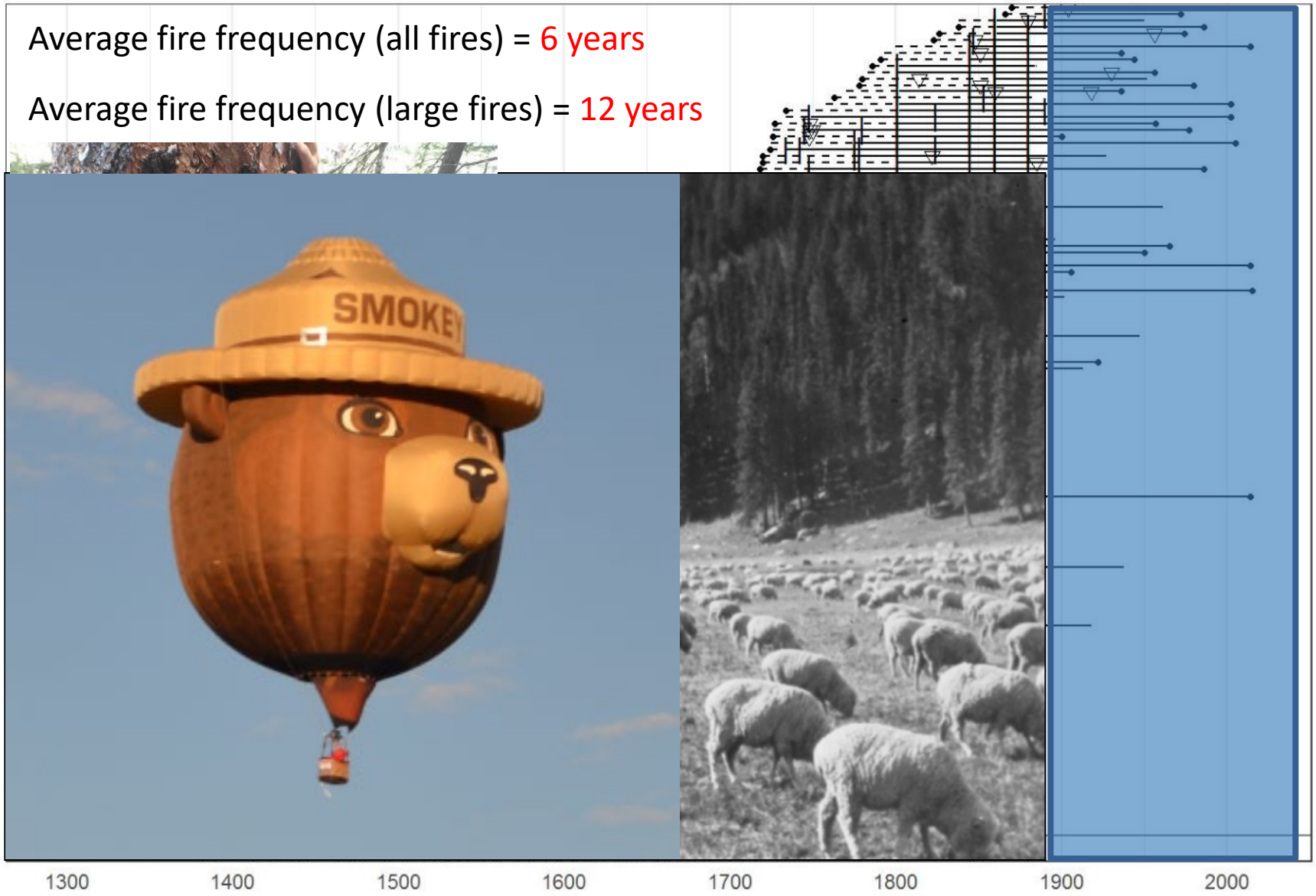
Margolis & Balmat 2009 age structure
Greater Santa Fe Fireshed
Santa Fe
Pecos
N
0
2.5
5
10
Kilometers

West slope watersheds - ponderosa pine and mixed conifer

Average fire frequency (all fires) = 6 years

Average fire frequency (large fires) = 12 years



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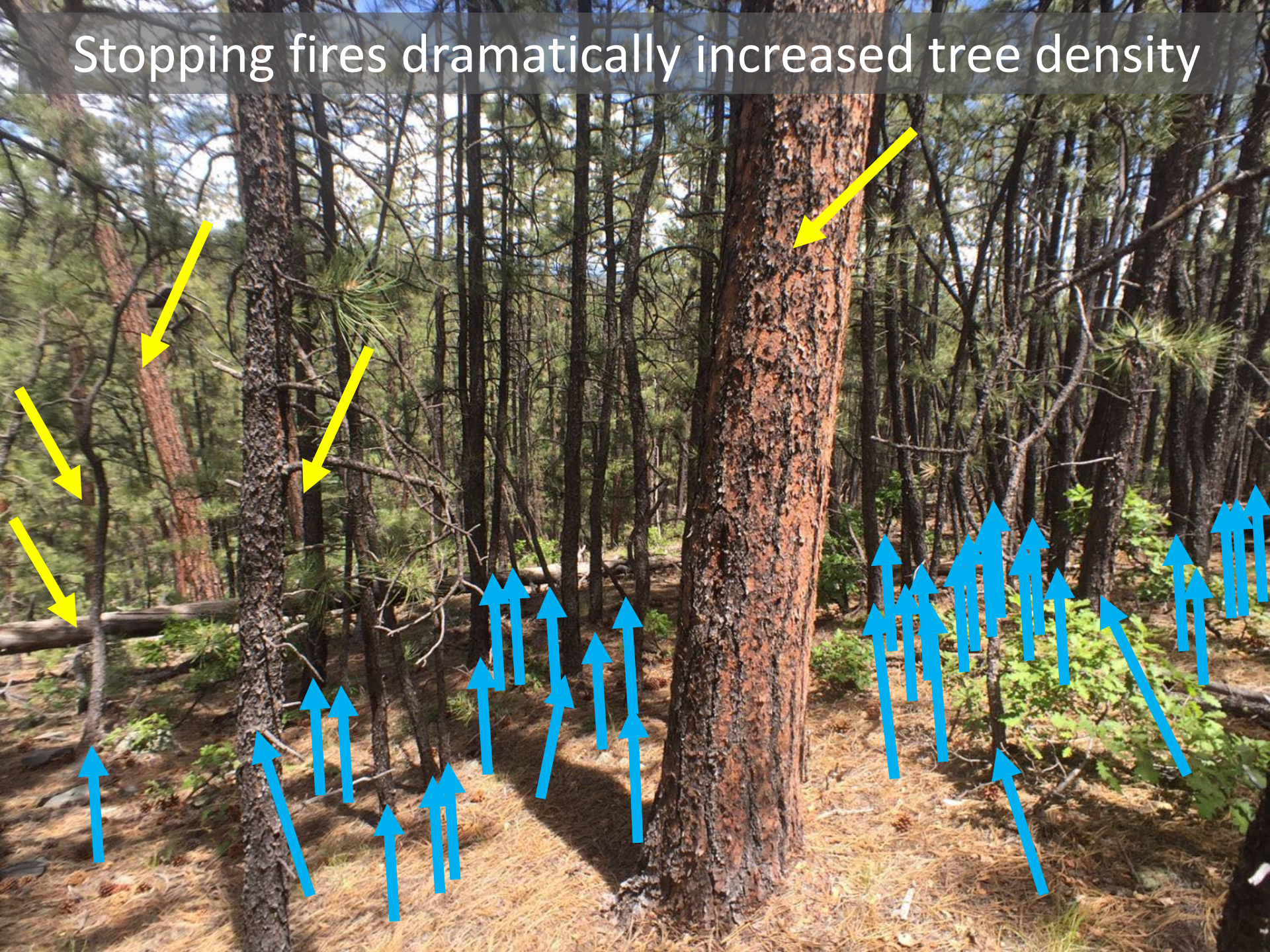
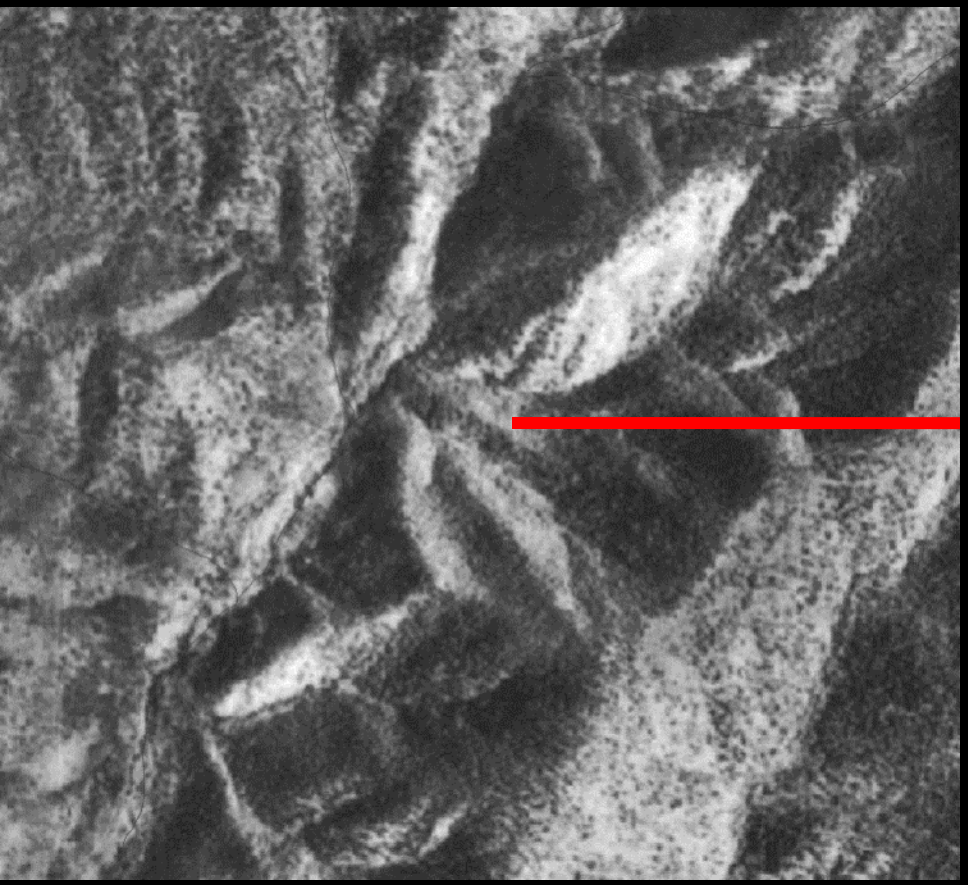
Margolis and Balmat 2009, FEM

Stopping fires dramatically increased tree density



Increased forest density and connectivity: = greater area at risk of high severity fire

1935



Margolis and Balmat 2009, FEM

“The Las Conchas Fire, now the largest in New Mexico’s history”

July 1, 2011 – NY Times

Photo by Craig Allen

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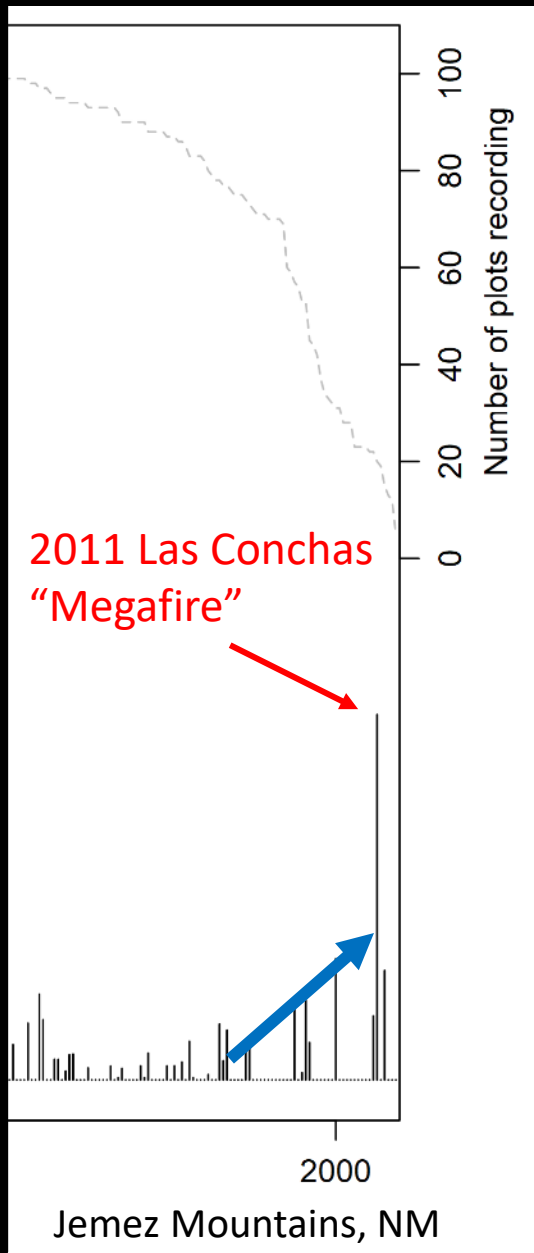
Modern area burned in a 400-year perspective: Jemez Mtns



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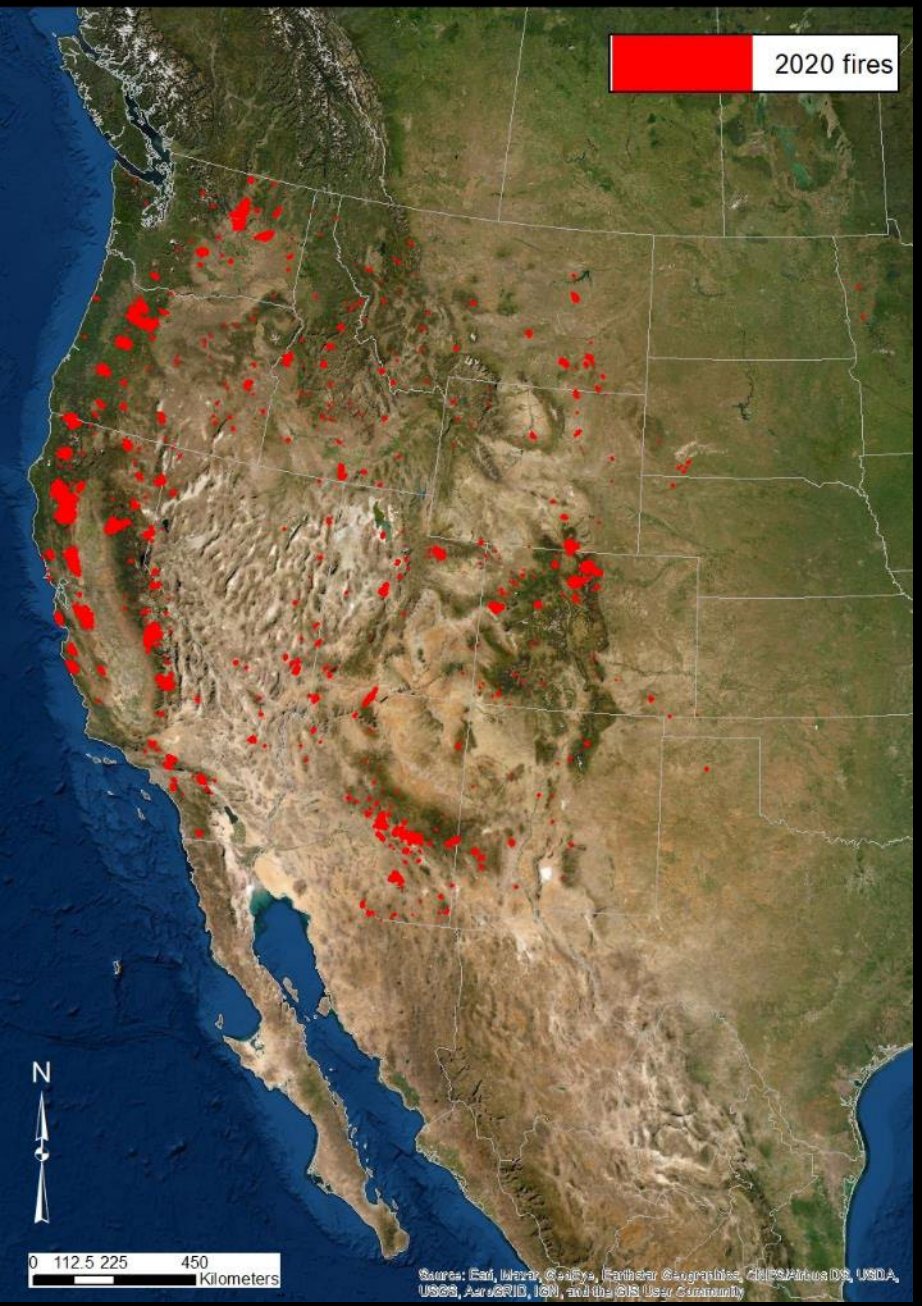

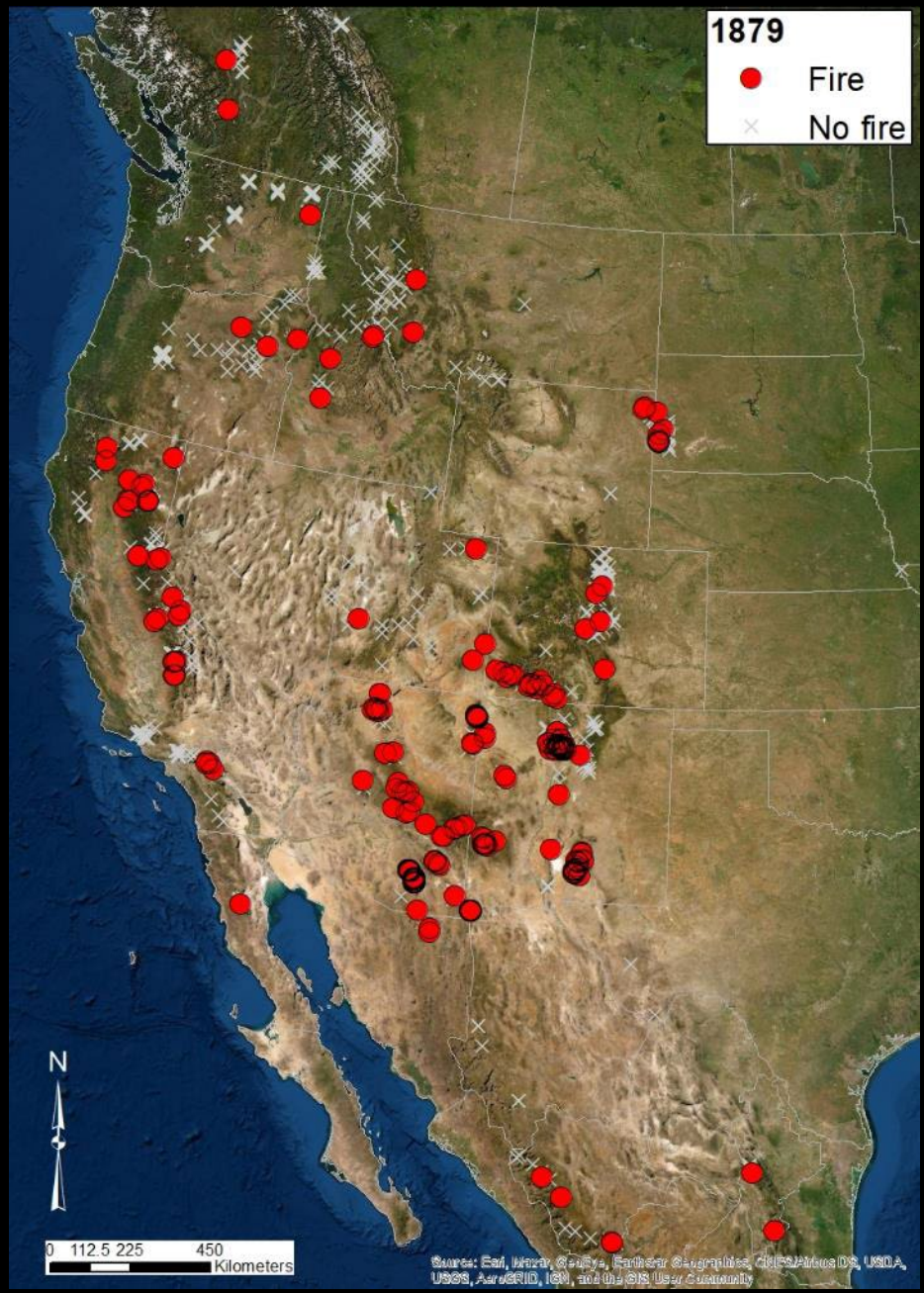

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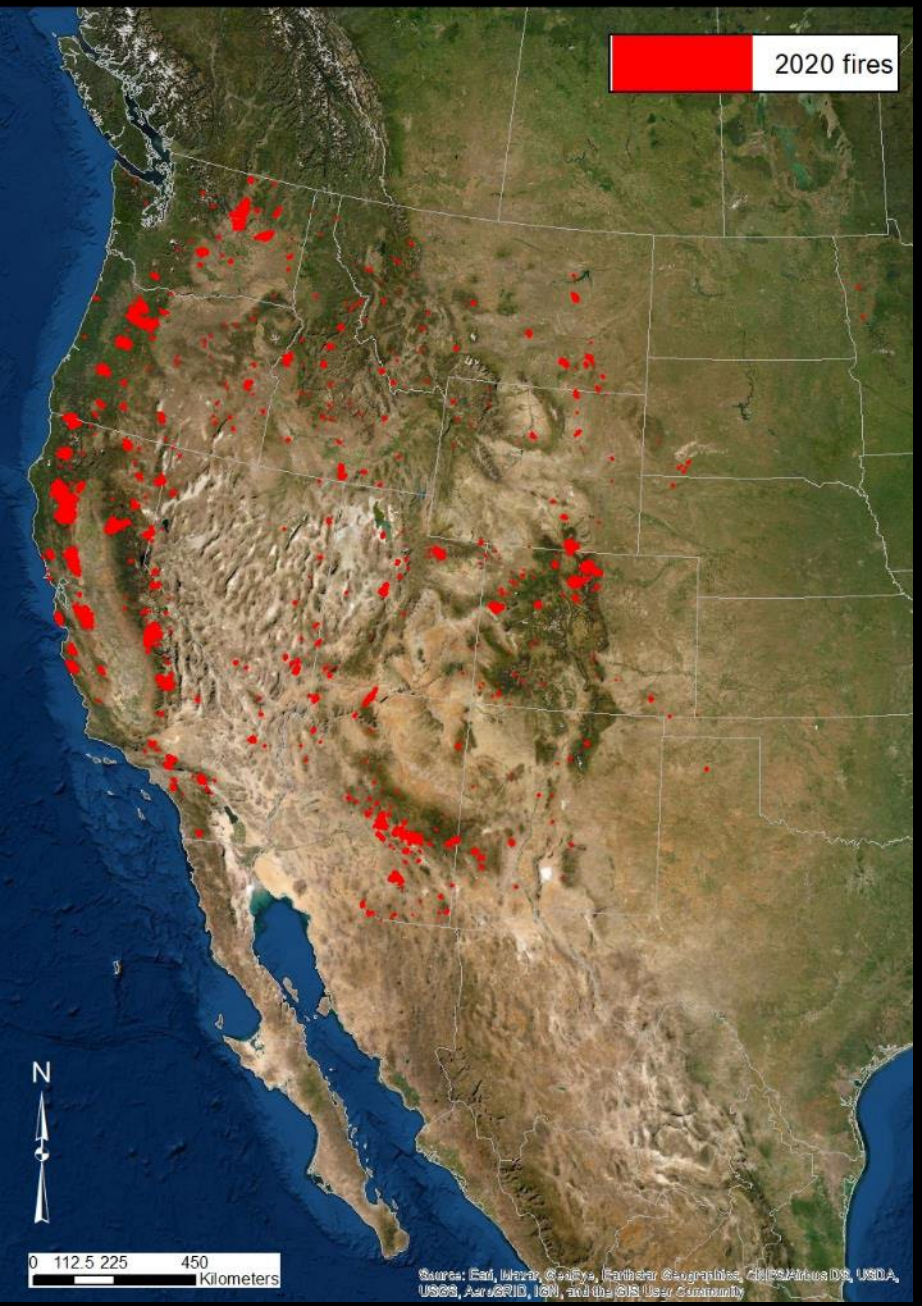
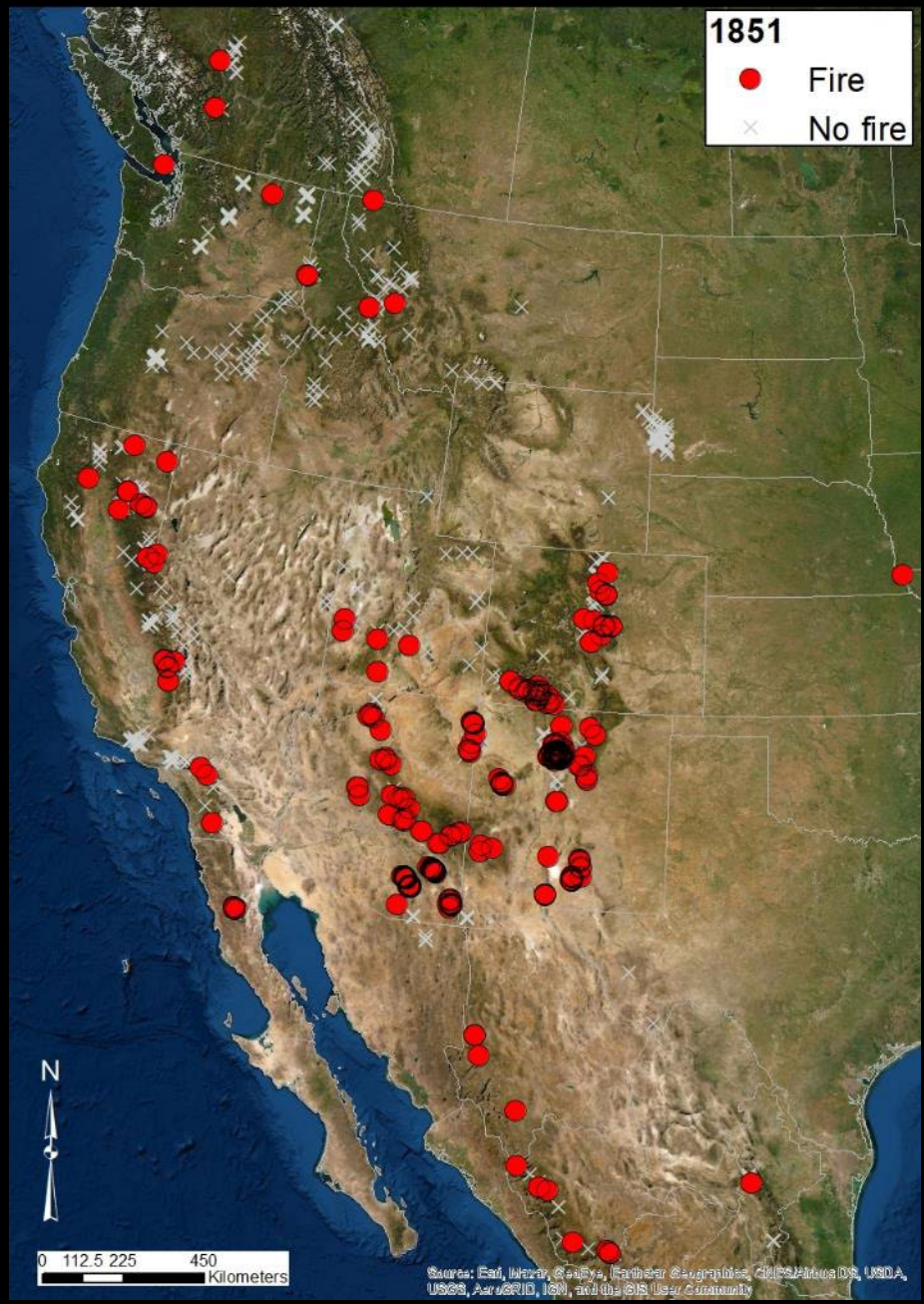
Preliminary Information-Subject to Revision. Not for Citation or Distribution.





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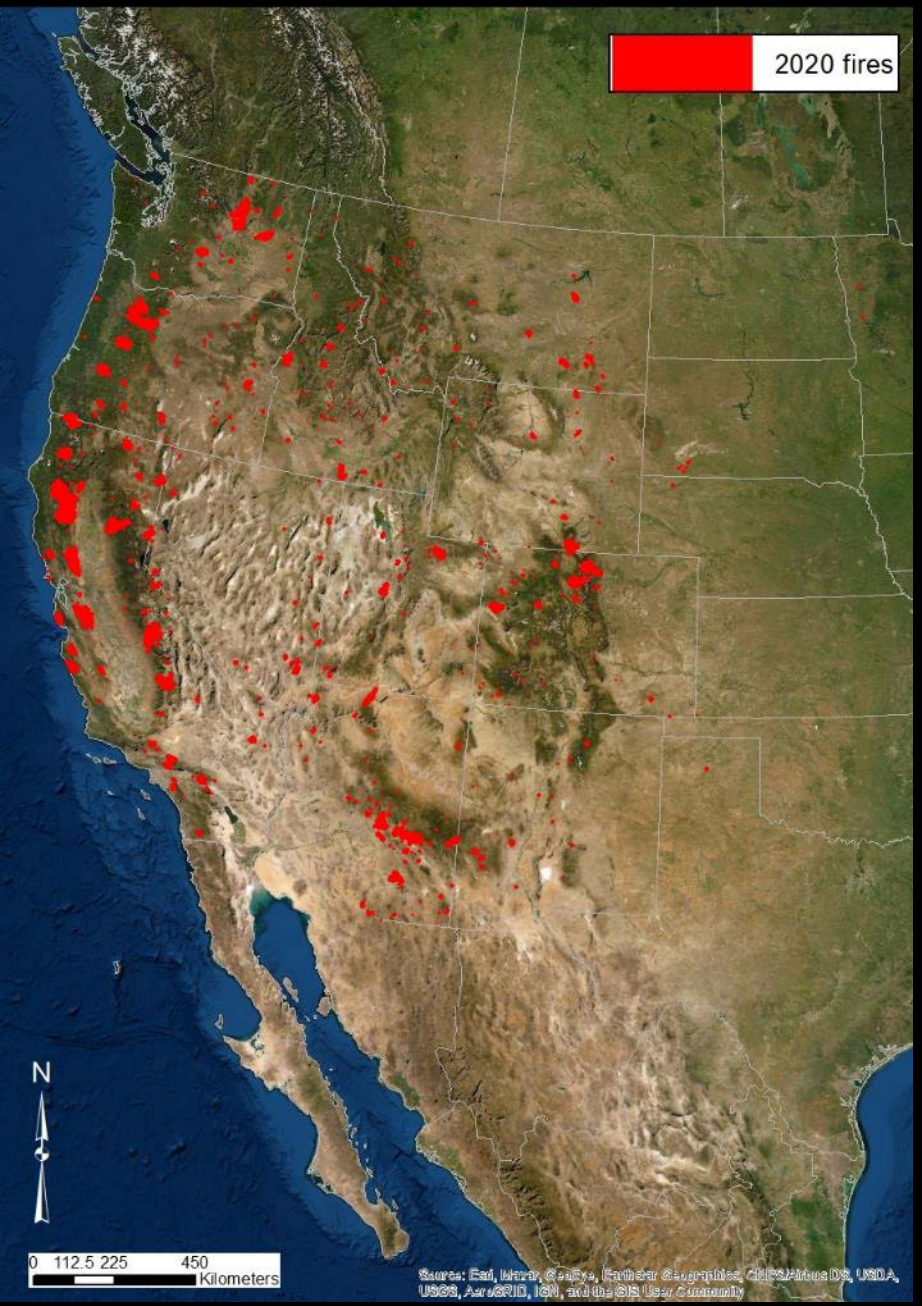

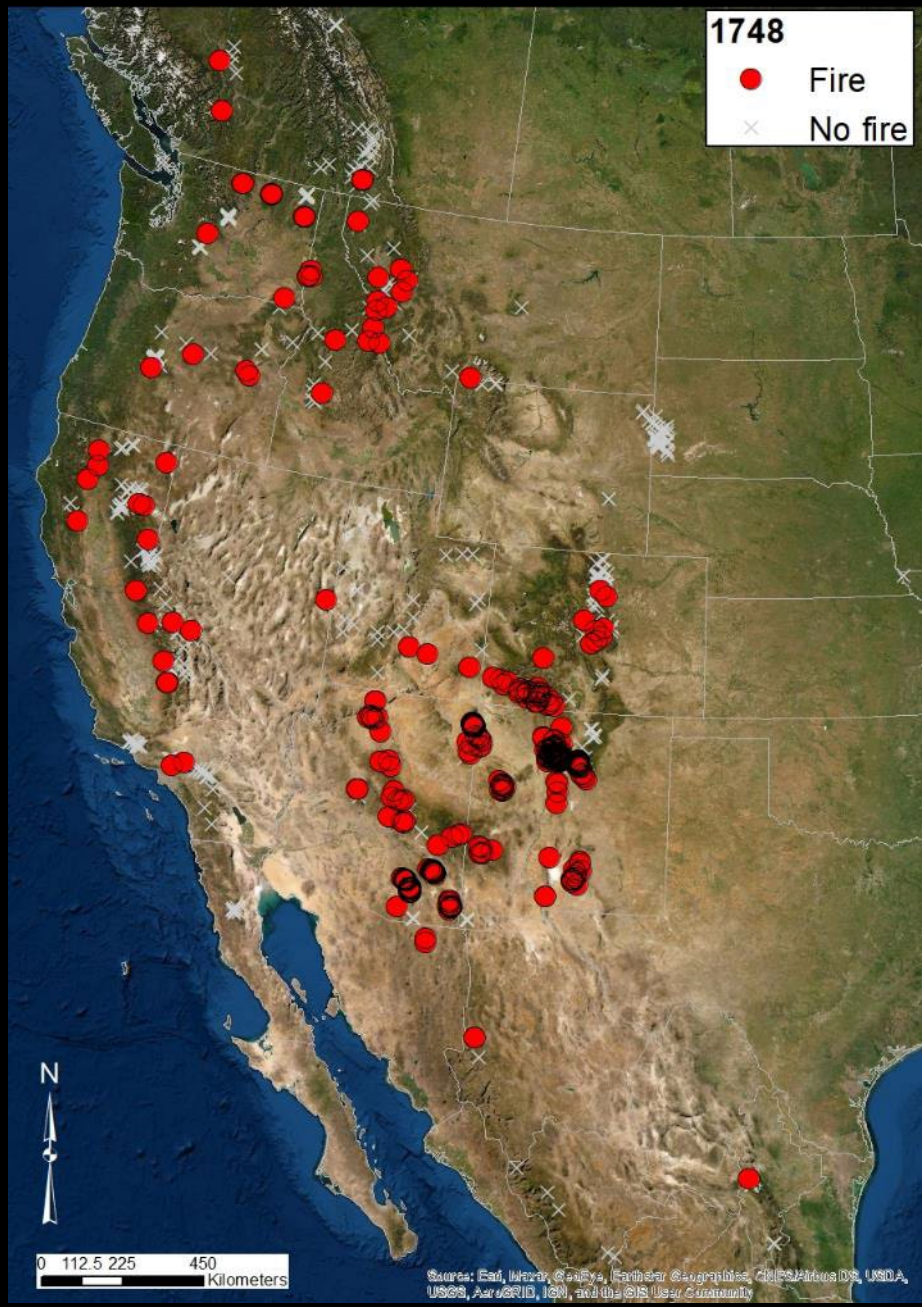

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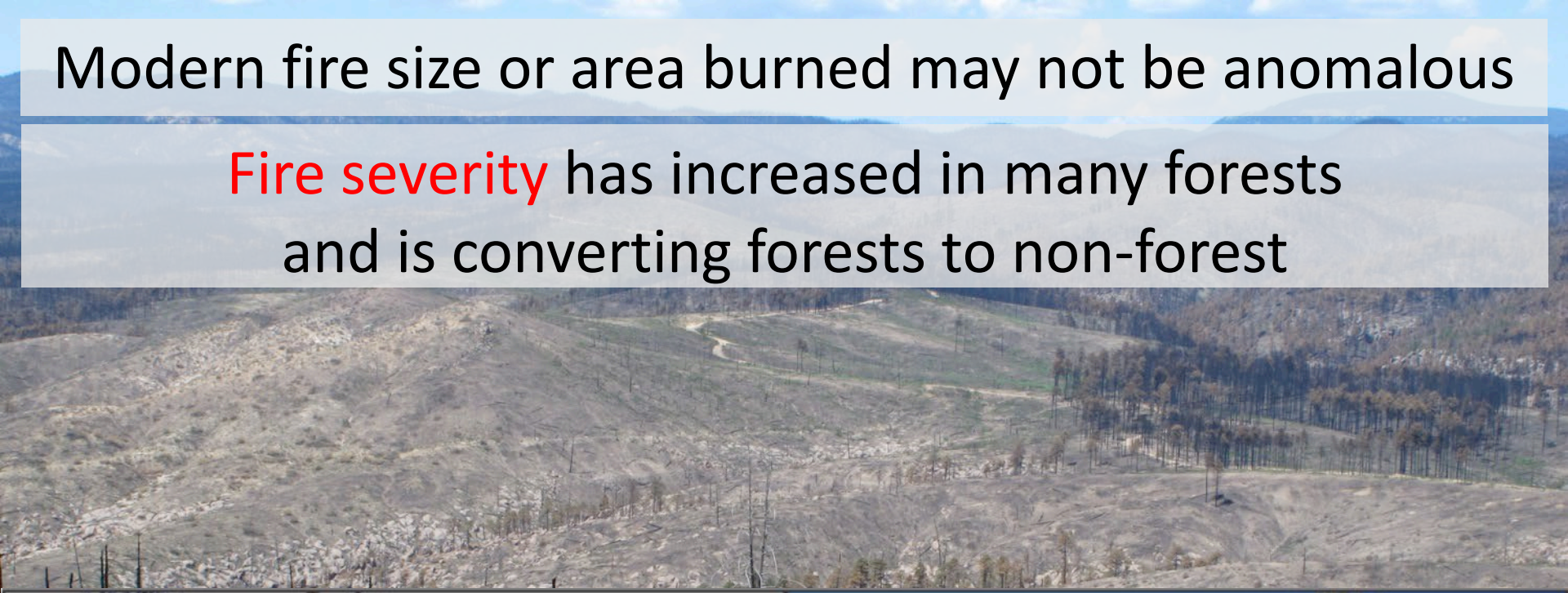
Preliminary Information-Subject to Revision. Not for Citation or Distribution.

Modern fire size or area burned may not be anomalous

Fire severity has increased in many forests
and is converting forests to non-forest

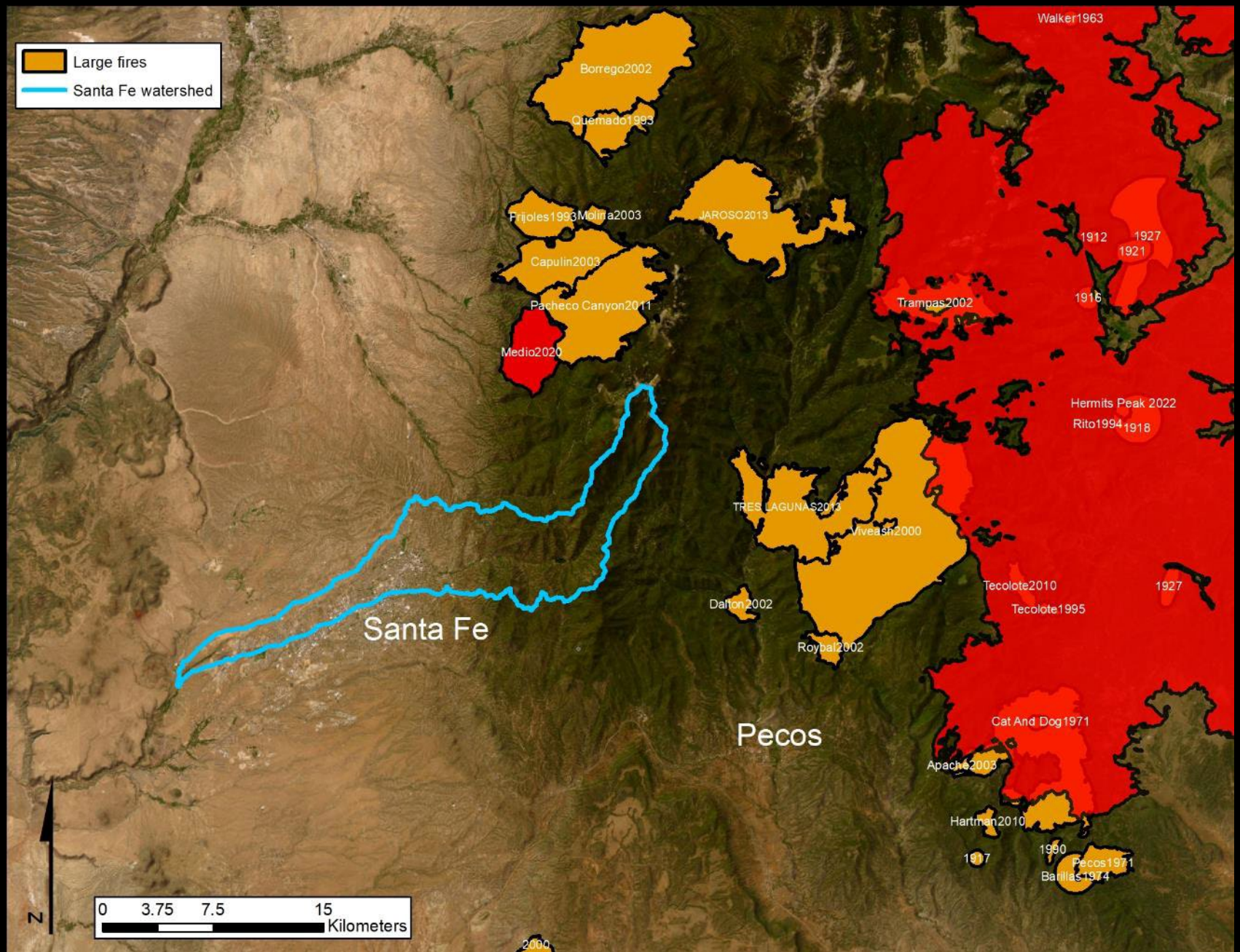


Guiterman et al. 2018, Ecosystems, Coop et al. 2020, Bioscience

It’s not a matter of if it will burn, but when and how hot?

En Medio Fire August, 2020

Large fires near the Santa Fe Watershed

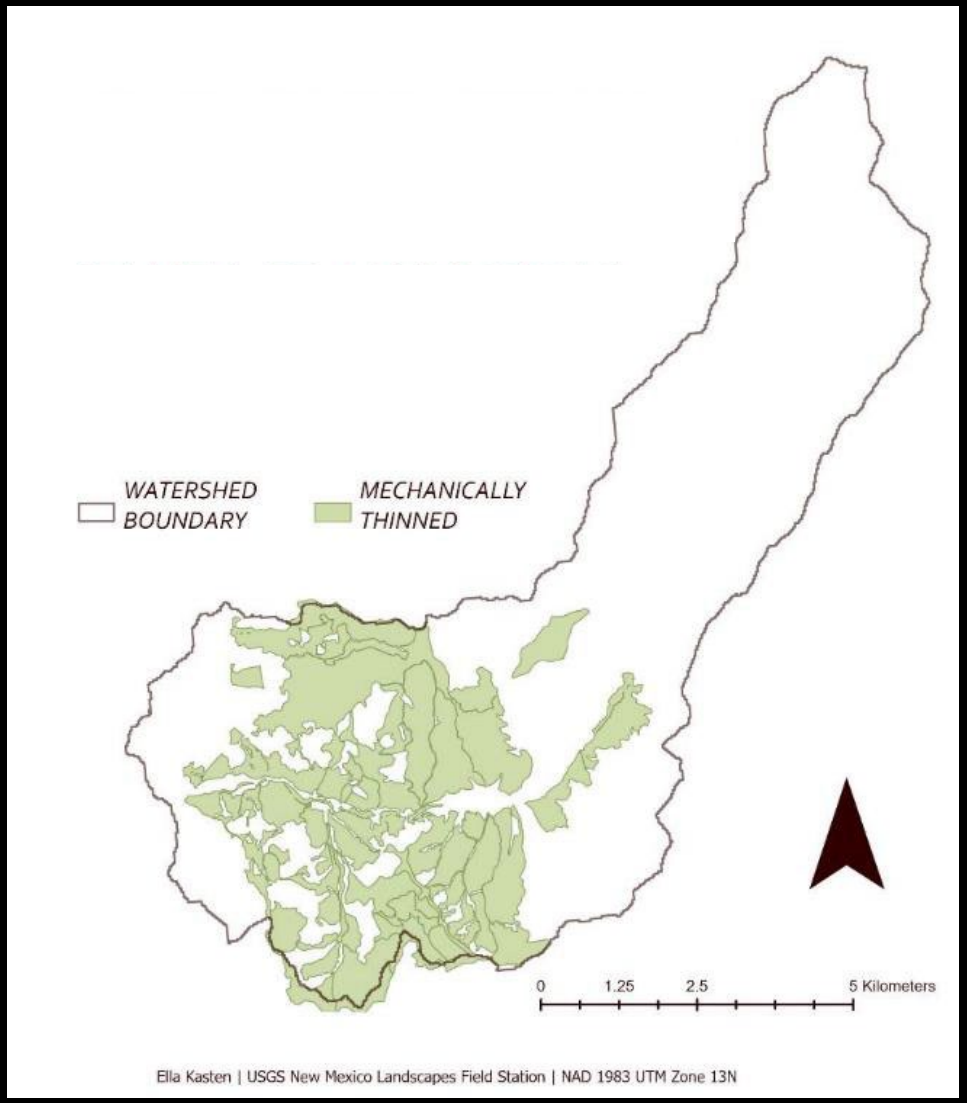


Mechanical treatments

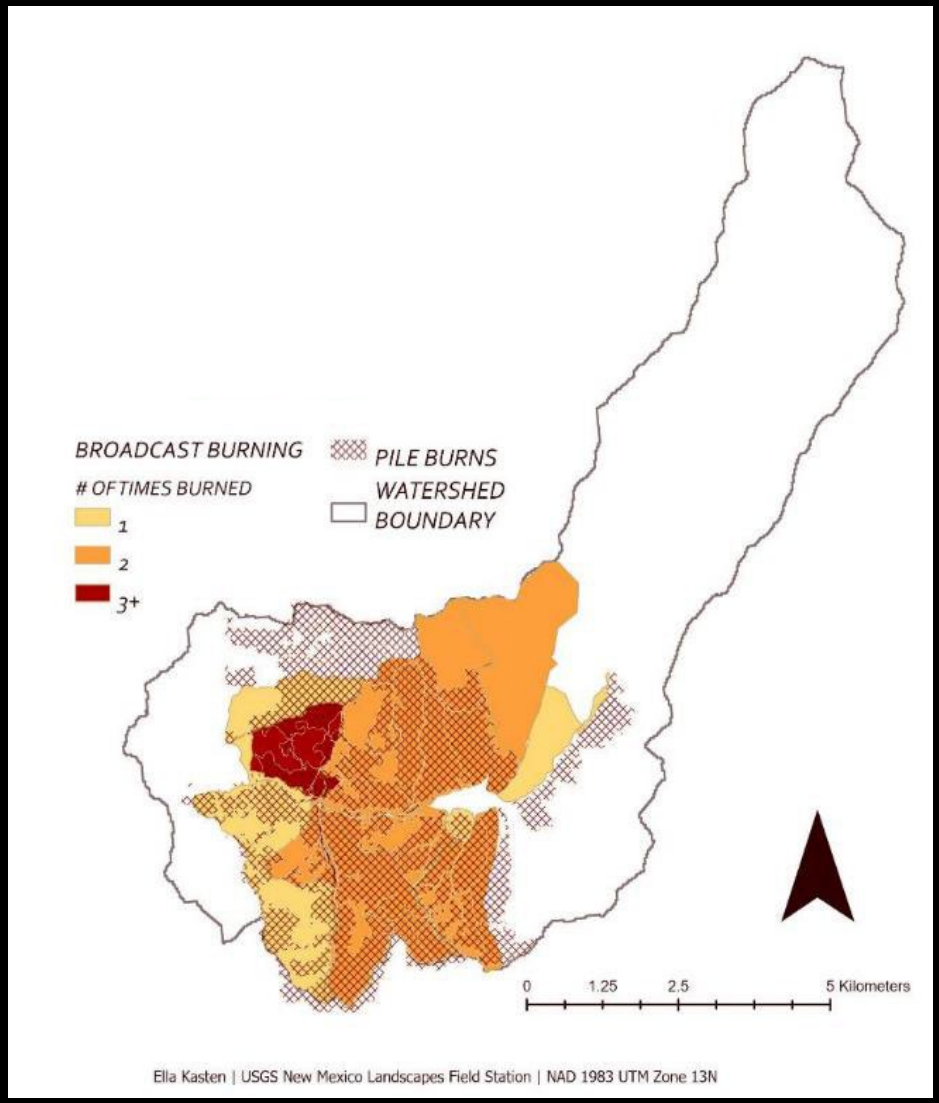
Prescribed low-severity fire

20 years of forest treatments in the Santa Fe Watershed

Thinning and mastication



Prescribed fire



Fire behavior

Photos courtesy of Santa Fe National Forest

Fire behavior

Photos courtesy of Santa Fe National Forest

Fire effects: reducing fine fuels

Photos courtesy of Santa Fe National Forest

Fire effects: reducing heavy fuels, patchy mosaic

Photos courtesy of Santa Fe National Forest

Fire effects: reducing heavy fuels, overstory intact

Photos courtesy of Santa Fe National Forest

Fire effects: retain organic layer in soil

Note intact needles under charred surface

Photos courtesy of Santa Fe National Forest

- 80% of the lower watershed has been broadcast burned.
- Some locations have burned 3 times since 2005 – 4 – 12 yr intervals!

Twice burned forest

50% more understory plant species in burned vs untreated areas

Photos courtesy of Kara Fox

Managing to reduce the probability and effects of post-fire debris flows

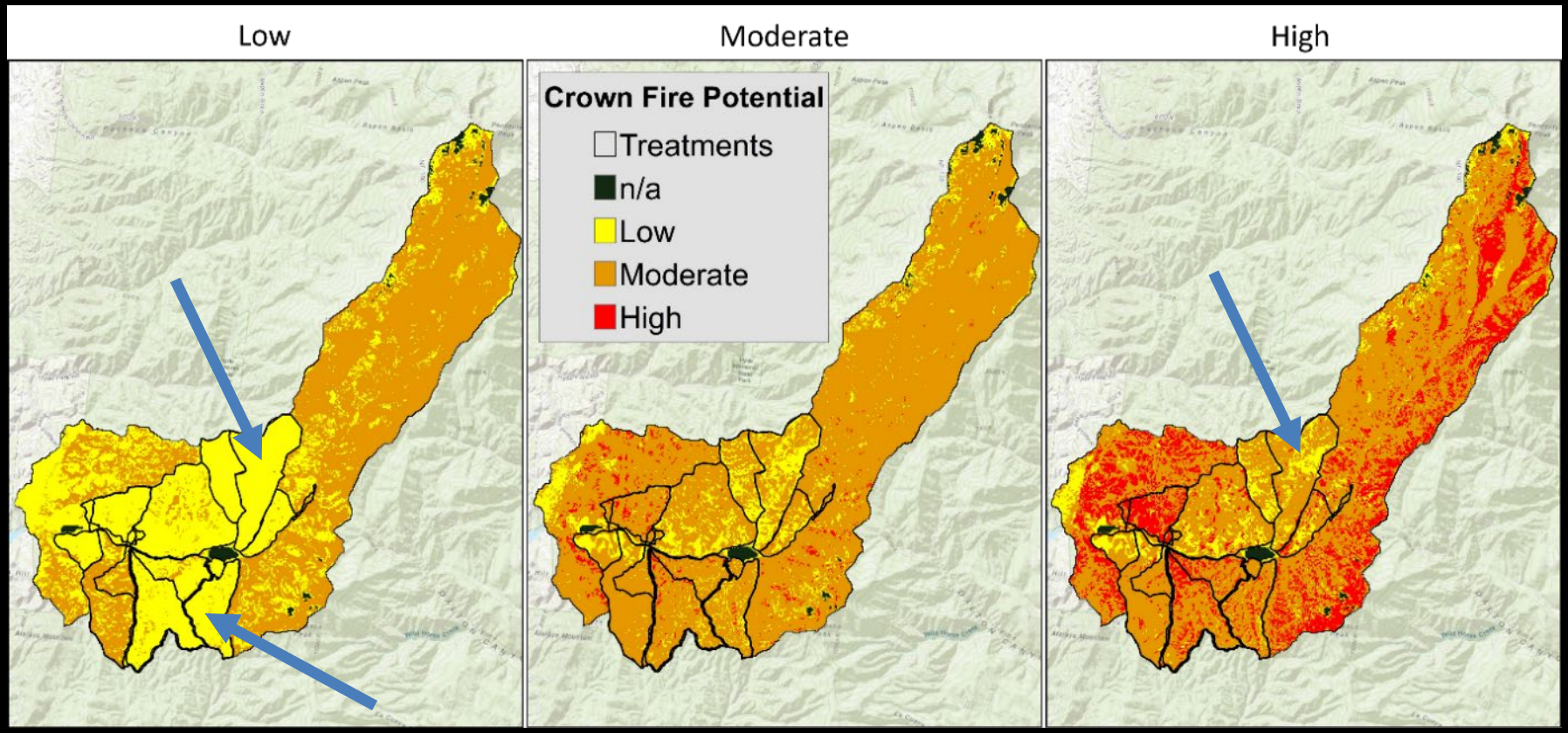
Gila NF, NM (USGS)

Frijoles Canyon, NM (USGS)

Photos by Anne Tillery (USGS)

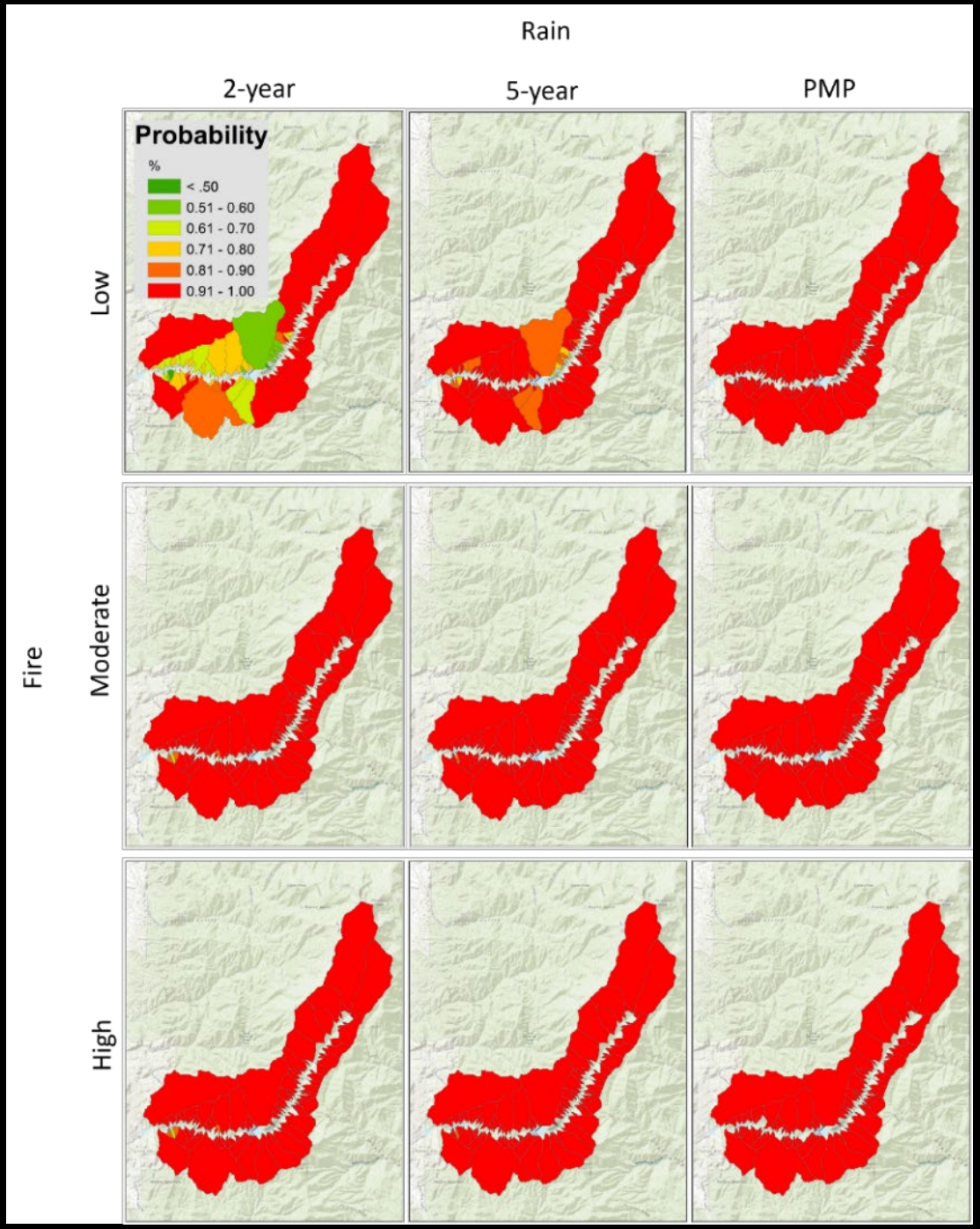
Modeled Fire Severity

- Note the decreased fire severity in treatments



Debris Flow Probability

- Debris flows WILL happen WHEN it burns
- Lowest probability in treated areas



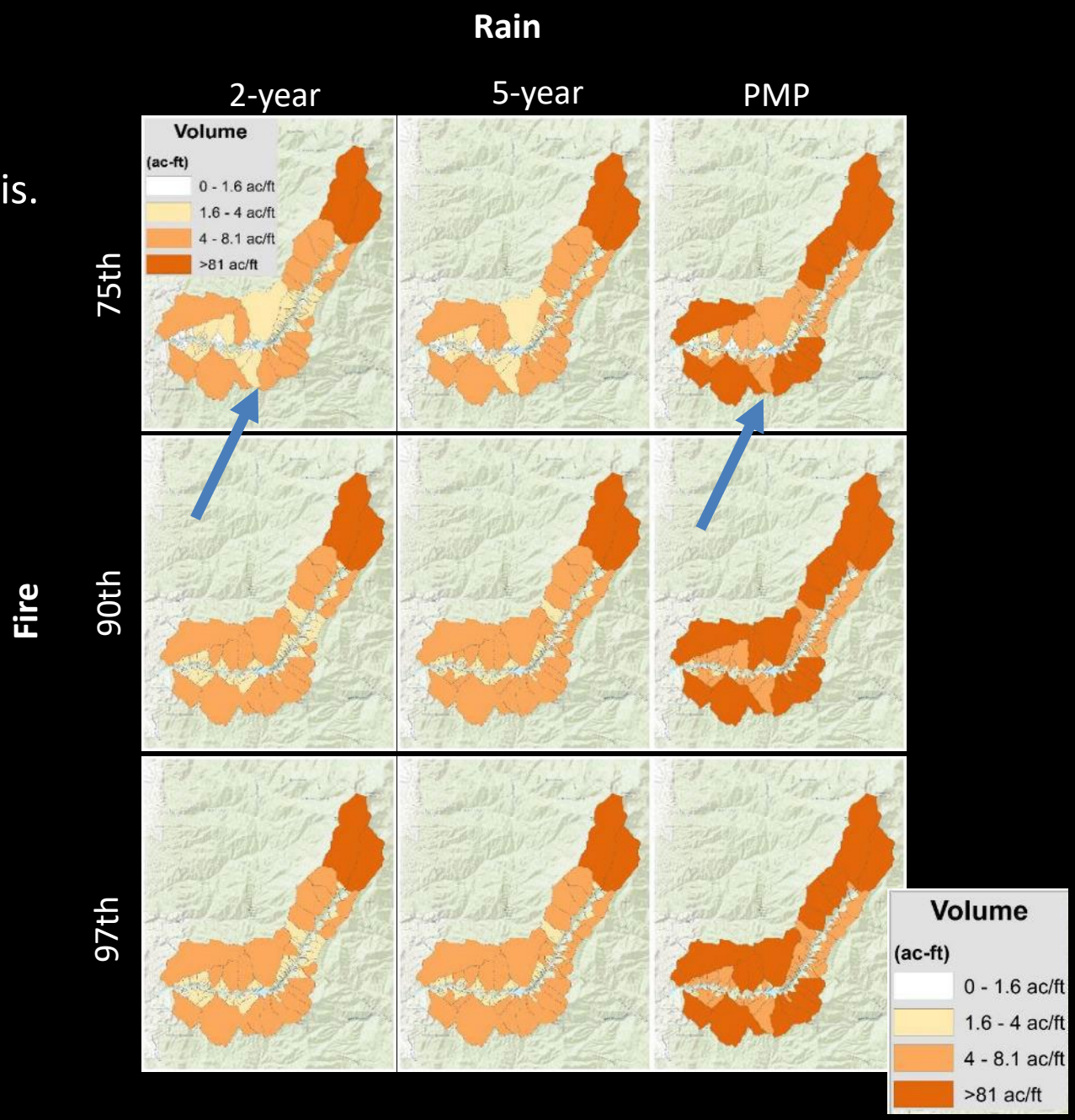
Debris Flow Volume

Moderate fire + moderate rain = 1,180 acre-ft of debris.

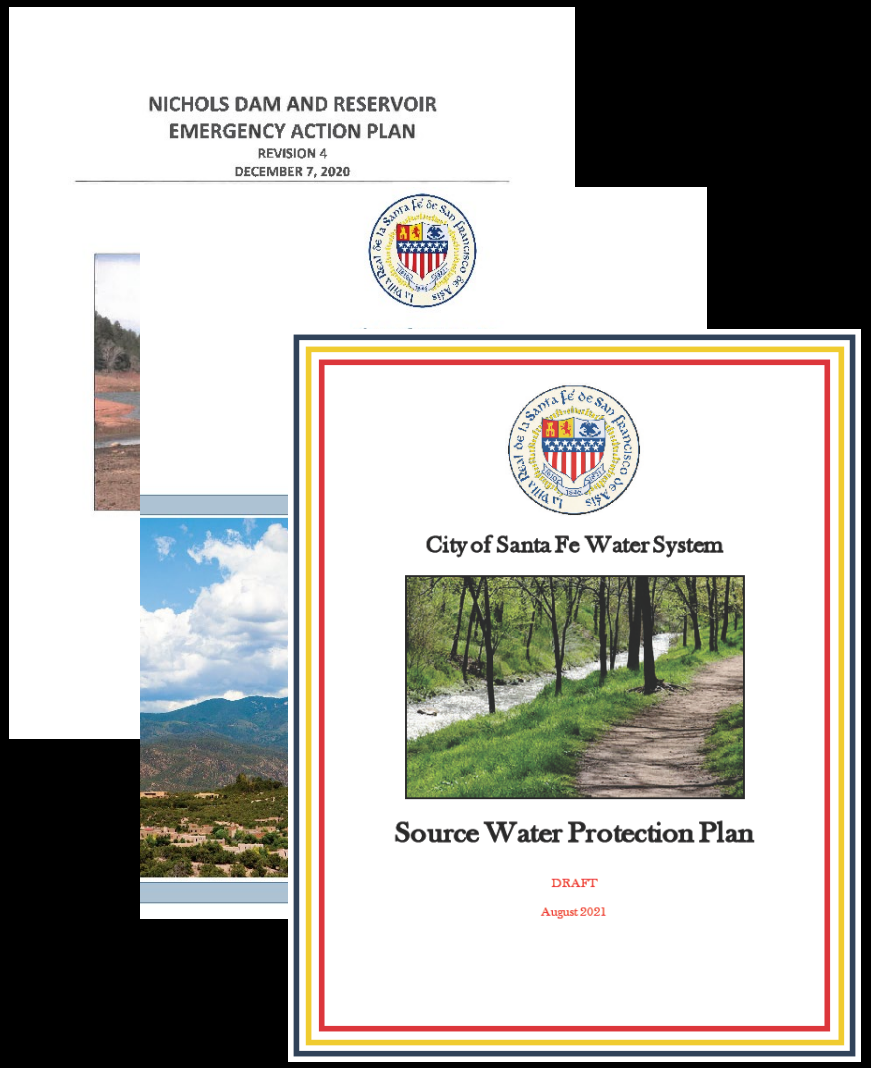
Potential effects on dam operations.

Extreme scenario could fill both reservoirs

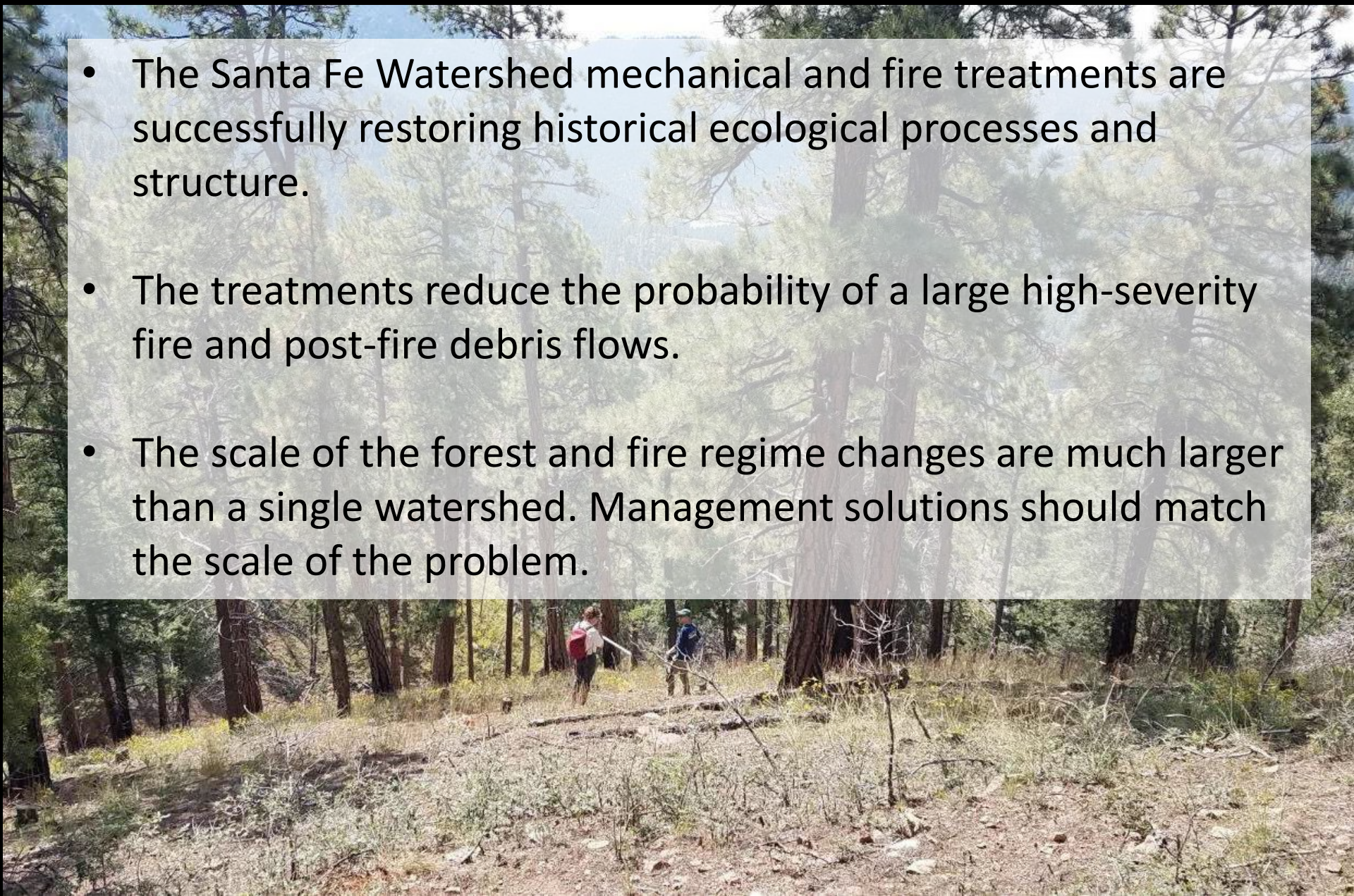
Treated basins modeled to produce less sediment than similar untreated basins.



City of Santa Fe
Post-fire hazard planning



Conclusions



- The Santa Fe Watershed mechanical and fire treatments are successfully restoring historical ecological processes and structure.
- The treatments reduce the probability of a large high-severity fire and post-fire debris flows.
- The scale of the forest and fire regime changes are much larger than a single watershed. Management solutions should match the scale of the problem.

Support provided by: USGS Climate R&D and City of Santa Fe

Thanks!

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Craig Allen, UNM
Calvin Farris, NPS W Region
Lane Johnson, Univ of Minnesota
Don Falk, Univ of AZ

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