

Climate Change, Fuels, and Wildfire

November 29, 2011

Partners in Environmental Technology
Technical Symposium & Workshop
SERDP | ESTCP

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NOAA OGP USDA Forest Service



Report Documentation Page		Form Approved OMB No. 0704-0188
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1. REPORT DATE 29 NOV 2011	2. REPORT TYPE	3. DATES COVERED 00-00-2011 to 00-00-2011
4. TITLE AND SUBTITLE Climate Change, Fuels, and Wildfire		5a. CONTRACT NUMBER
		5b. GRANT NUMBER
		5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER	
	5e. TASK NUMBER	
	5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) University of California, Merced, Sierra Nevada Research Institute, 5200 N. Lake Road, Merced, CA, 95343		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited		
13. SUPPLEMENTARY NOTES Presented at the Partners in Environmental Technology Technical Symposium & Workshop, 29 Nov ? 1 Dec 2011, Washington, DC. Sponsored by SERDP and ESTCP. U.S. Government or Federal Rights License		
14. ABSTRACT Climate affects both fuel availability and flammability on multiple time scales, and the relative importance of availability versus flammability as limiting drivers of wildfire activity varies across ecosystem types. Climatic controls on fuel flammability during the peak fire season dominate in dense forests with characteristically infrequent, high severity fire, while the effects of antecedent moisture on the availability of fine surface fuels may also play a role in forests with more frequent, lower severity fire regimes. Changes in future temperatures and in precipitation amounts, form (rain versus snow) and timing can all potentially alter fuels, fire regimes, and emissions. We will describe the primary drivers of fire activity in very diverse ecosystems in California and the Northern Rockies, and summarize how climate change may affect these. In order to assess changes in wildfire and emissions, it is particularly important to use modeling methods that demonstrably capture extreme events, as well as to model at spatial resolutions that can capture topographic influences on temperature and precipitation. We demonstrate probabilistic statistical models that are designed to meet these requirements in California and Northern Rockies. We demonstrate methods that allow the estimate of fuels management on vulnerability to climate change in diverse ecosystems. Altered climate may drive changes in burned area and fire severity may in turn profoundly impact emissions from wildfire in some areas of the western US. We demonstrate the production of emissions scenarios for approximately 2000 future climate and development scenarios in California, and discuss the important drivers of differences in emissions across a wide range of scenarios.		
15. SUBJECT TERMS		

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 28	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

CLIMATE CHANGE, FUELS, AND WILDFIRE

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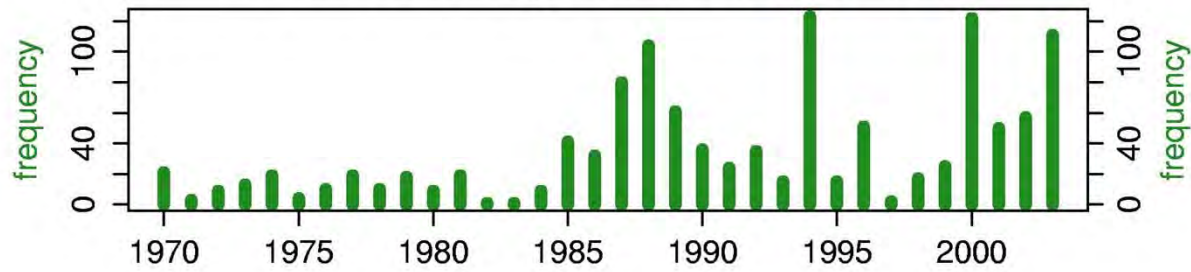
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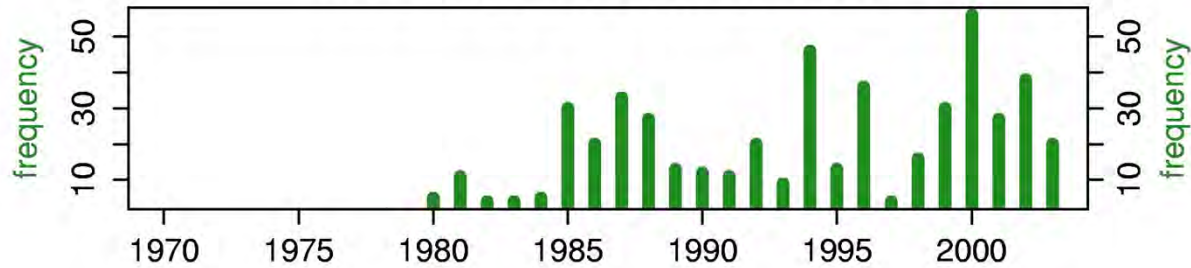
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USF & NPS Large Forest Fires per Year

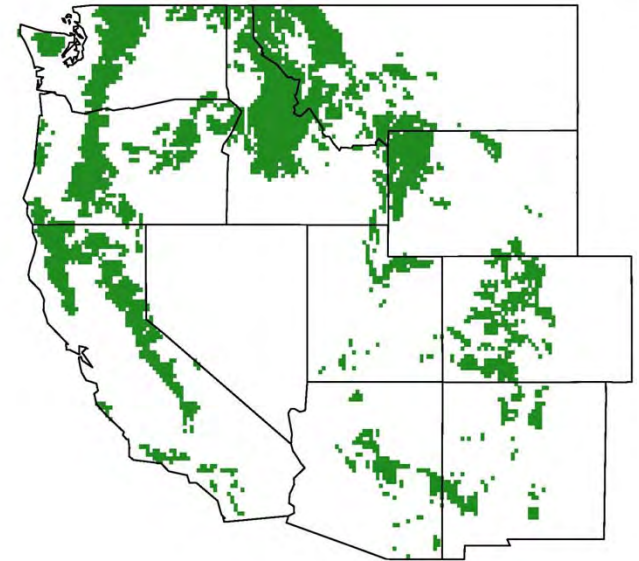


BLM Large Forest Fires per Year

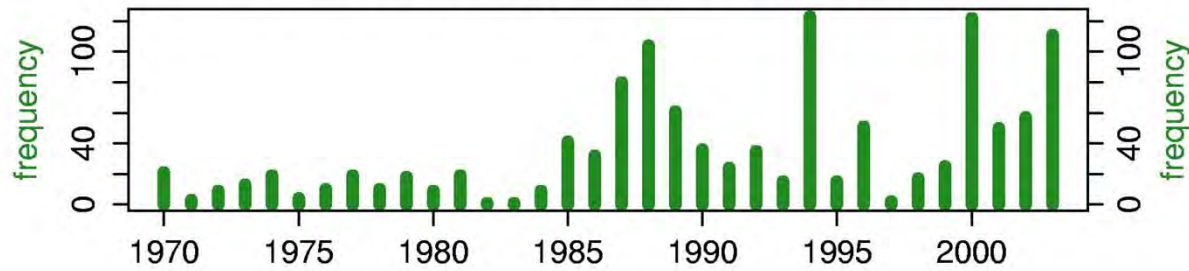


Since the mid-1980s

*Large Forest Wildfires
Have Increased ~300%*



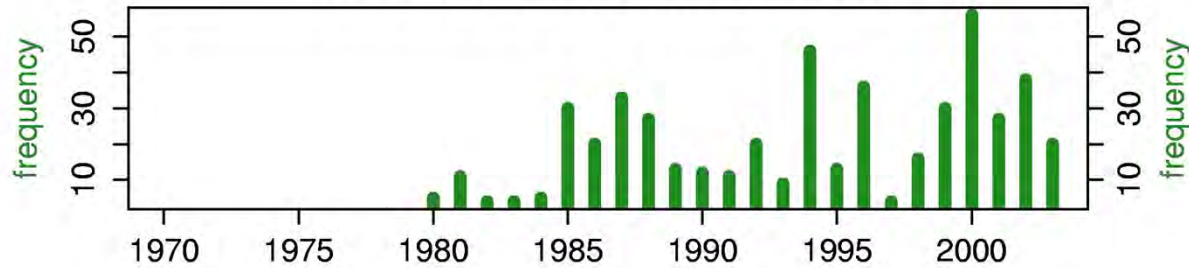
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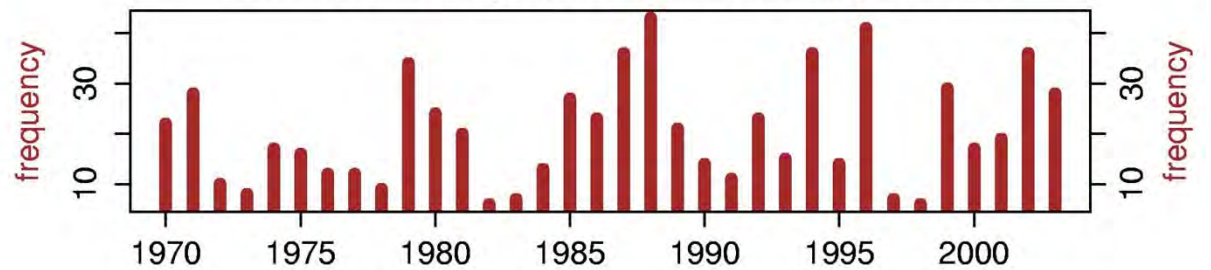
*Large Forest Wildfires
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BLM Large Forest Fires per Year

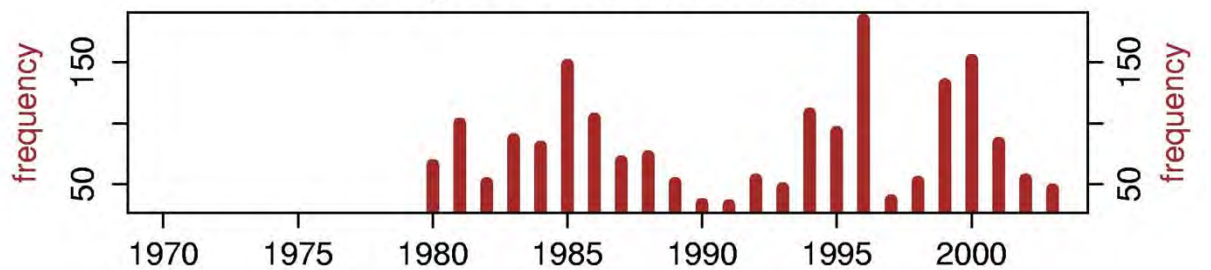


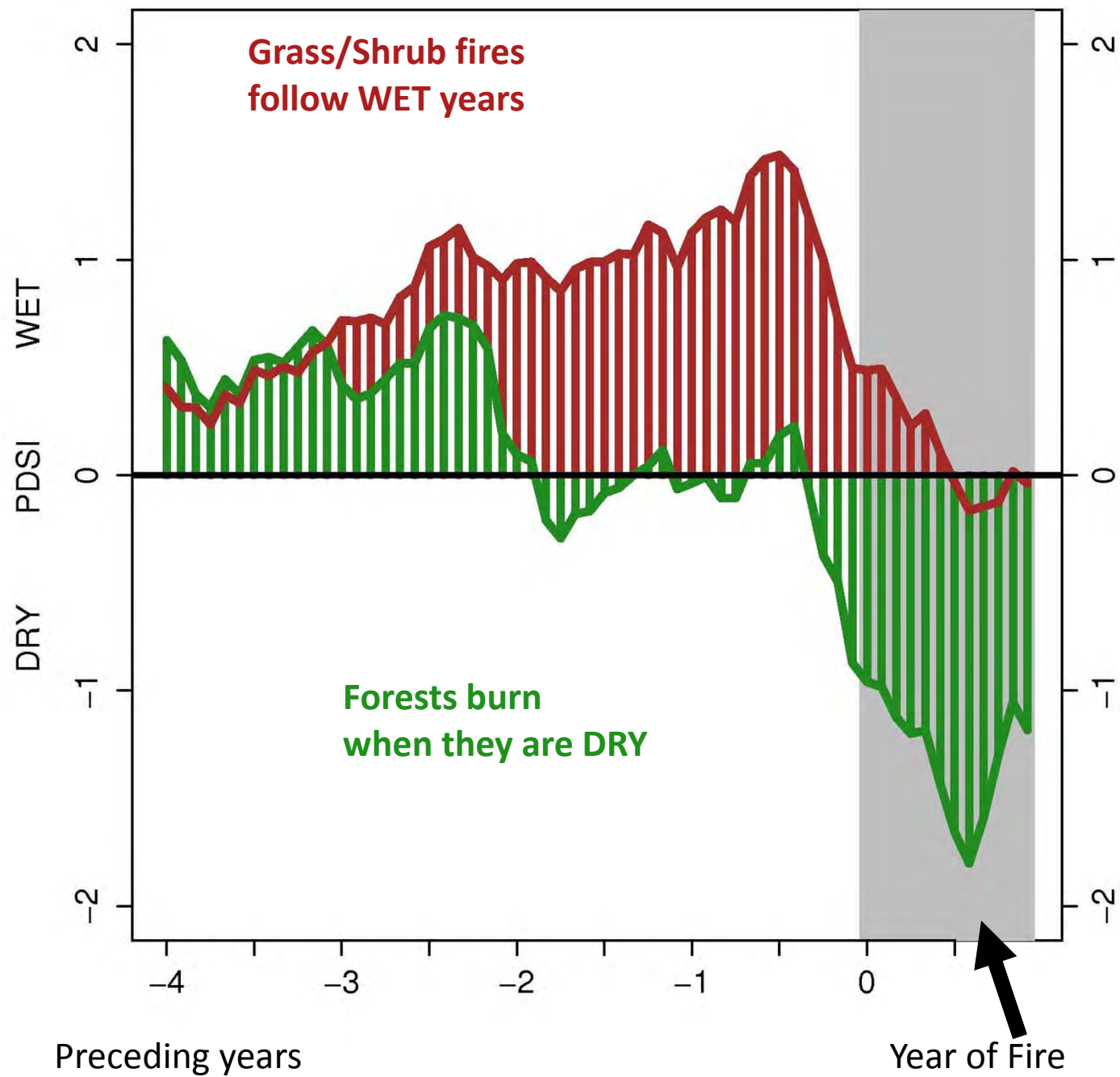
*Other Large Wildfires
Have Not Changed
Substantially*

USF & NPS Large non-Forest Fires per Year

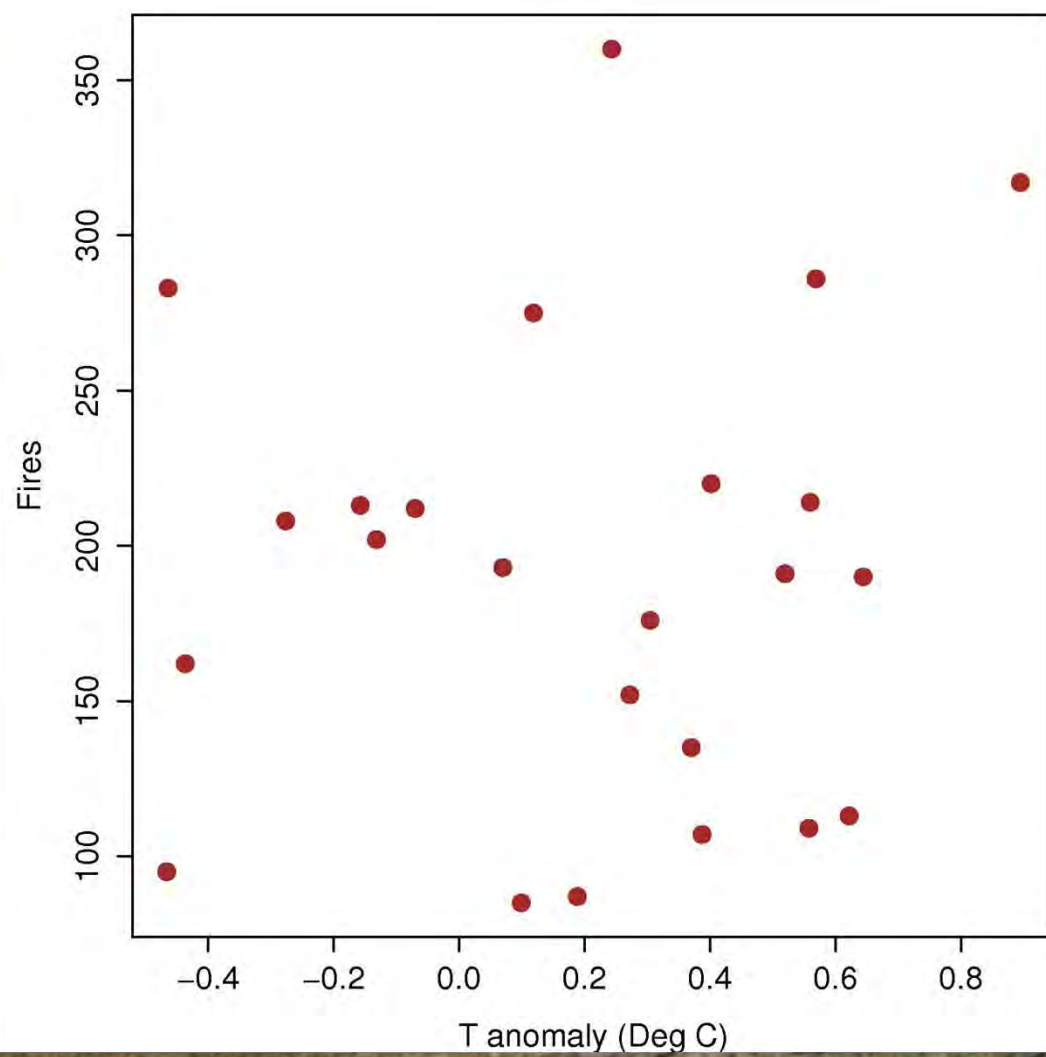


BLM Large non-Forest Fires per Year



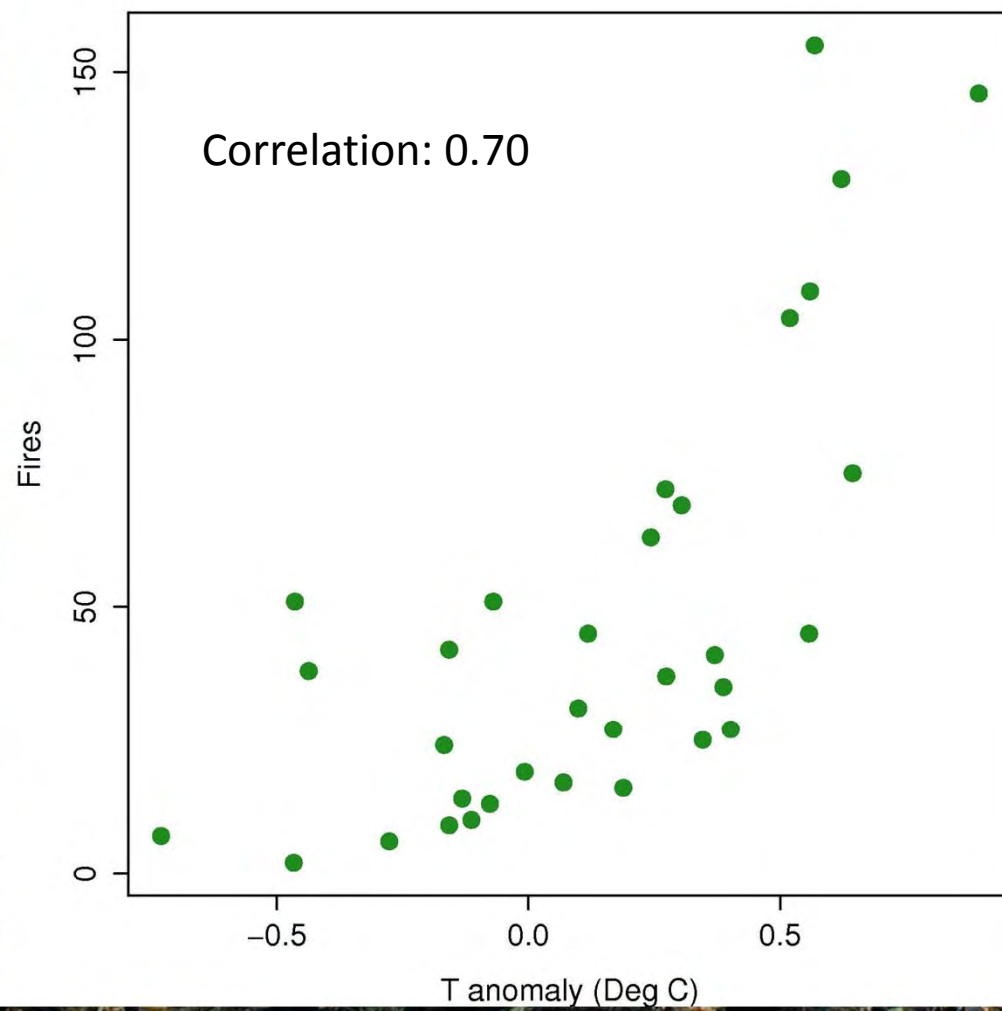


Grass/Shrub Fires and Temperature

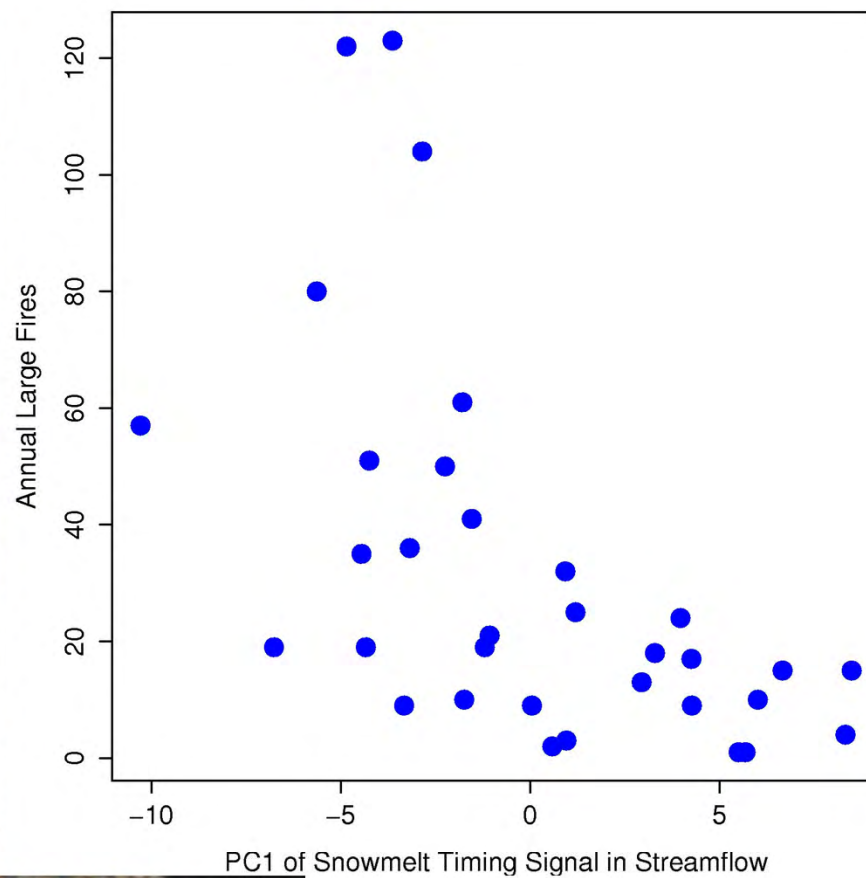


Correlation: 0.08

Forest Fires & Temperature

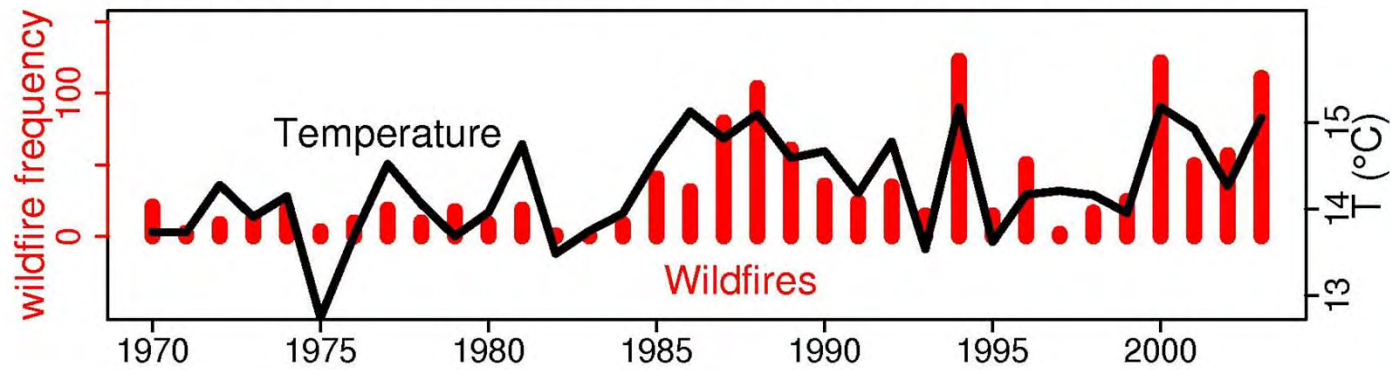


Forest Fires & Timing of Spring

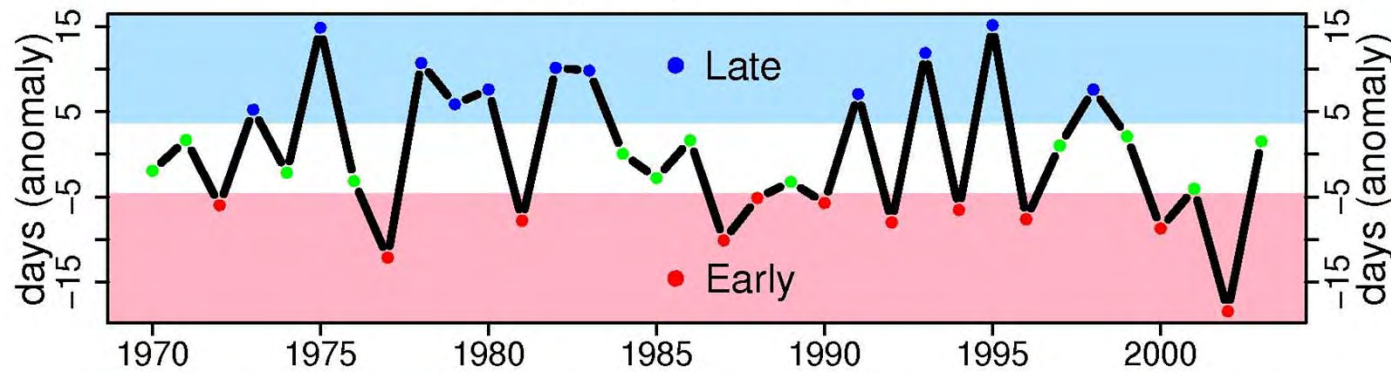


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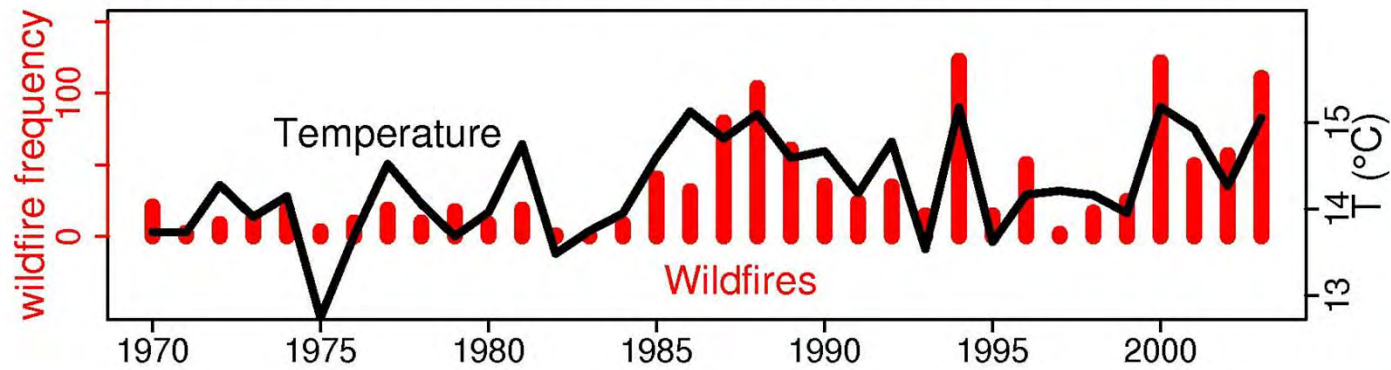
Western US Forest Wildfires and Spring–Summer Temperature



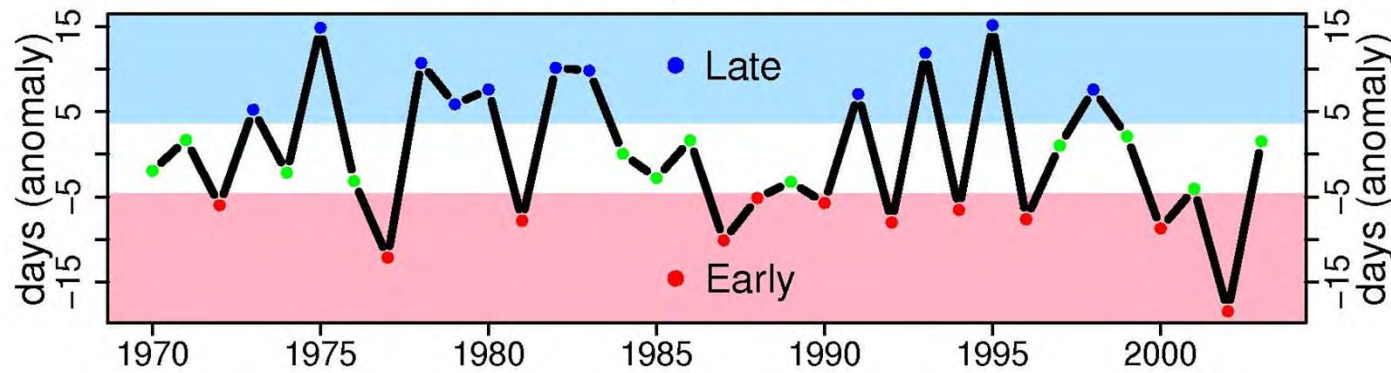
Timing of Spring Snowmelt



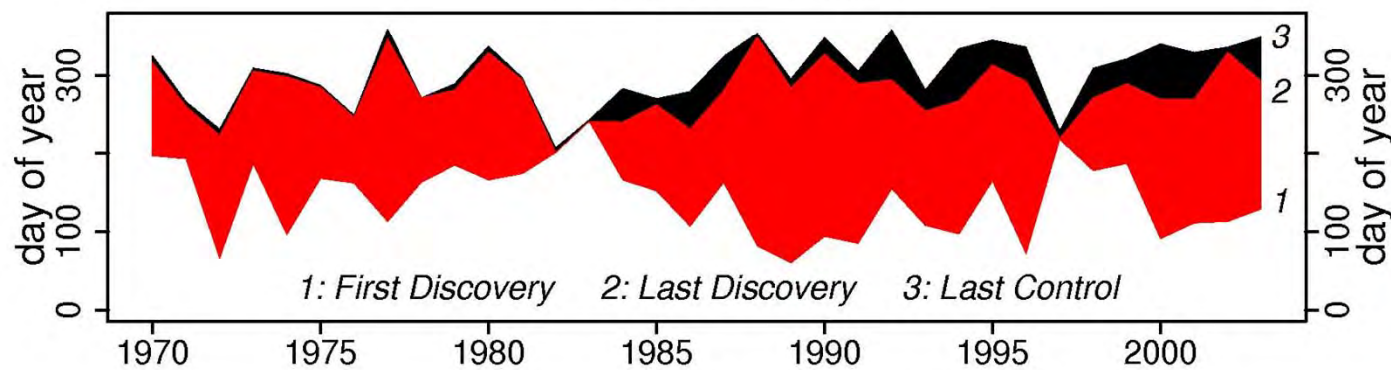
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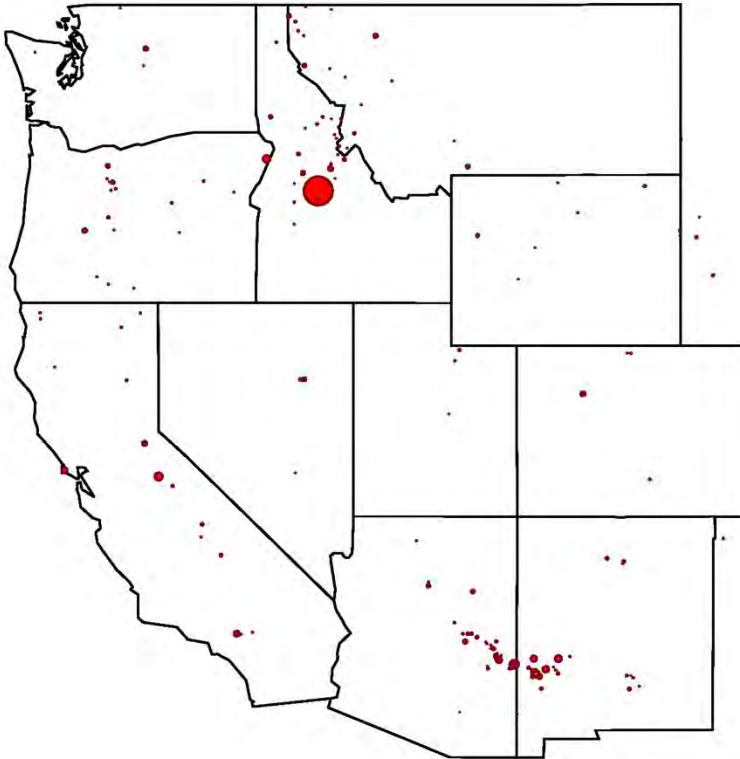
Timing of Spring Snowmelt



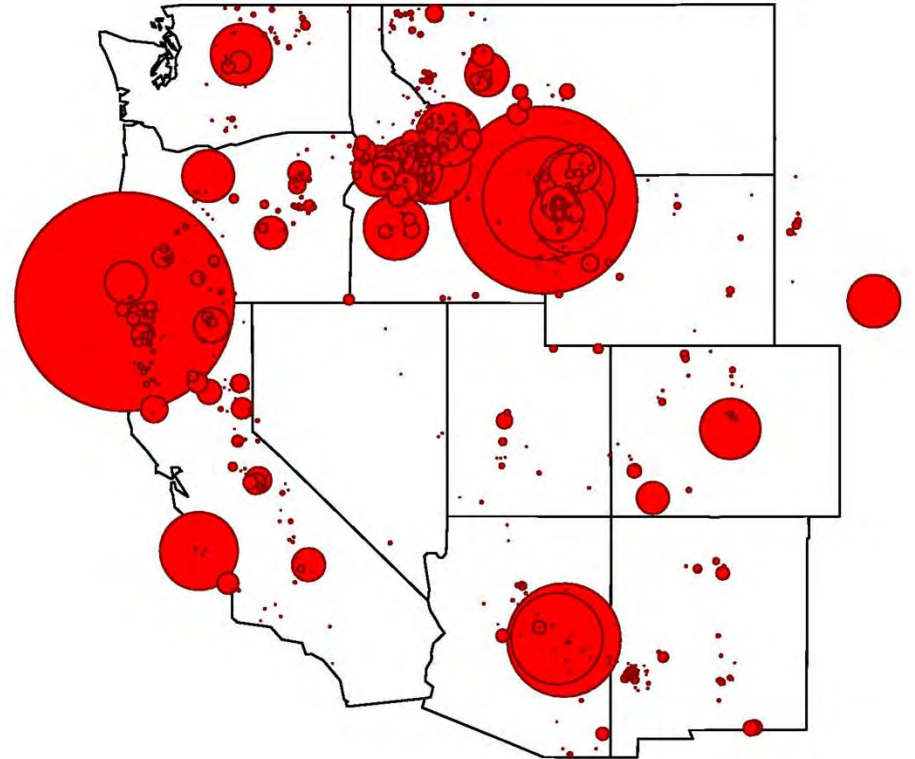
Fire Season Length



Late Snowmelt Years



Early Snowmelt Years



1972 - 2003, NPS, USFS & BIA Fires over 1000 acres

Understory Fire Regimes

- Fire suppression has increased amount and connectivity of fuels
 - Unnatural increase tree density
- Fire regime has changed
 - Fires are less frequent and more severe
 - Increased risk of severe fire

1867

American River



1993

American River



Stand-replacement Fire Regime

- Fire suppression has had little effect
 - Tree densities changed little over last century
- Fire regime has not changed
 - Infrequent, severe crown fires are natural and still dominate

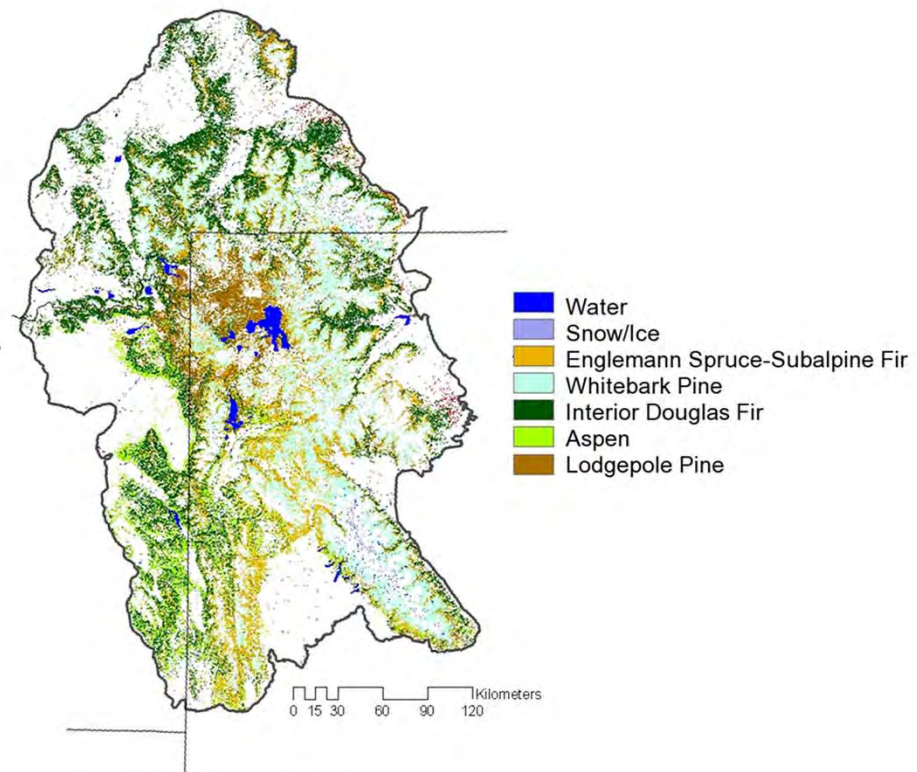
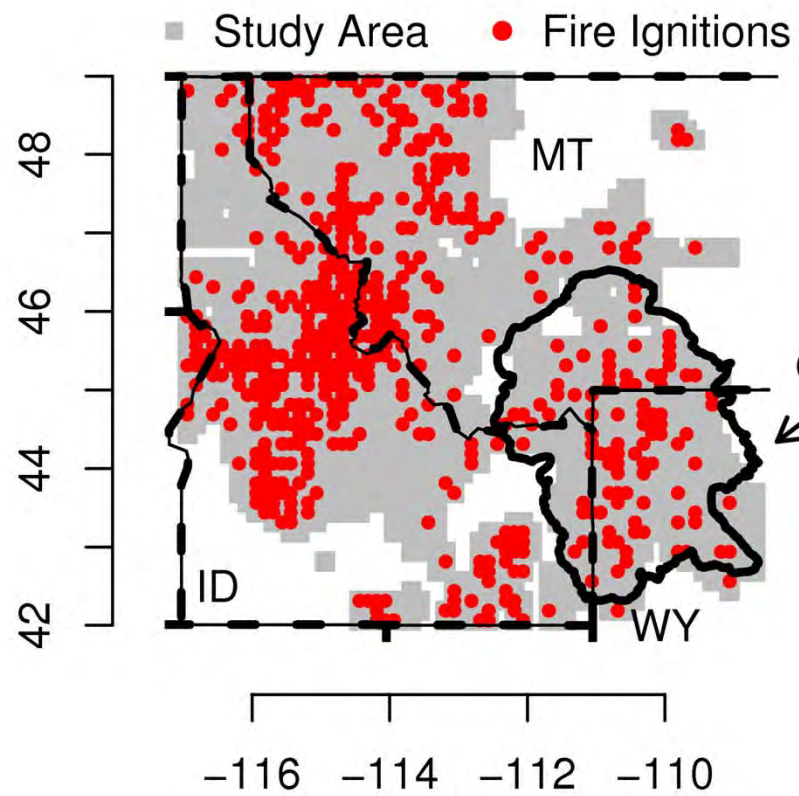


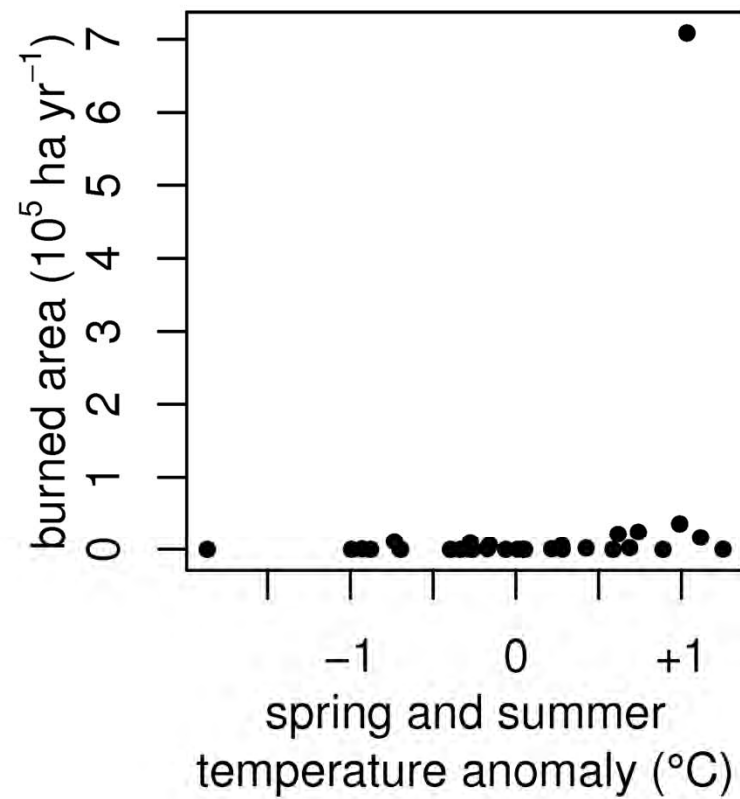
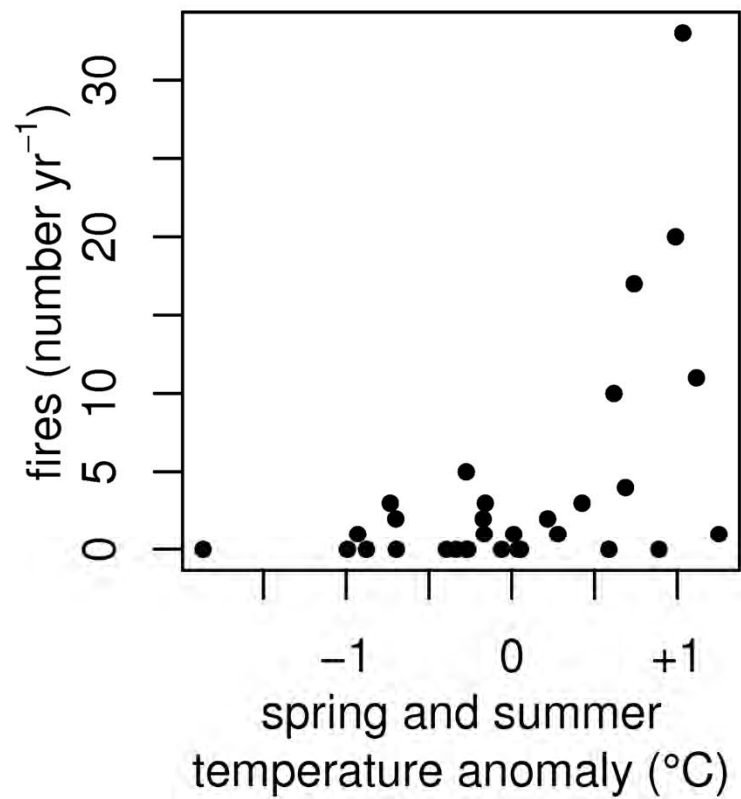
1916

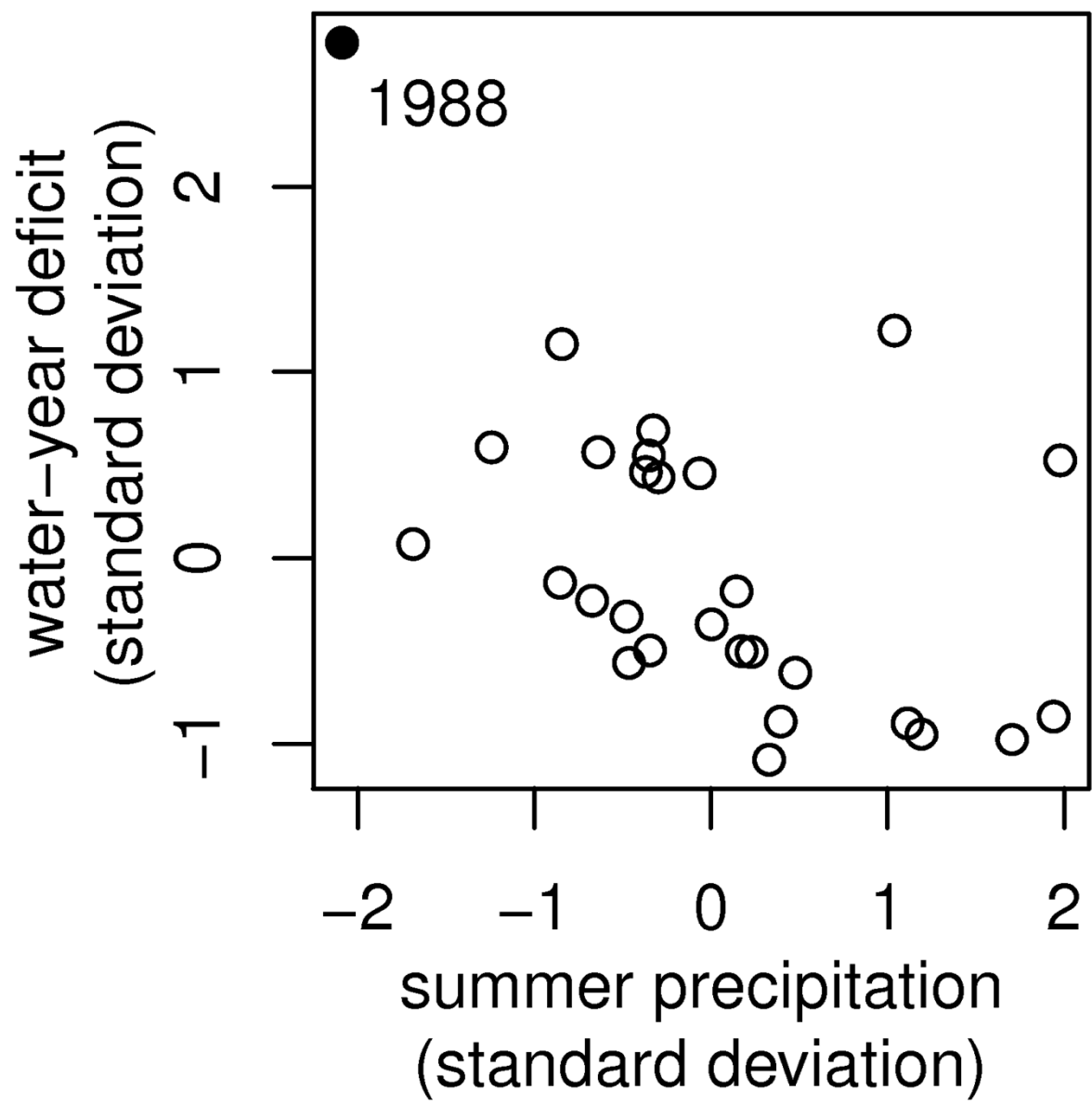


1986

Veblen and Lorenz



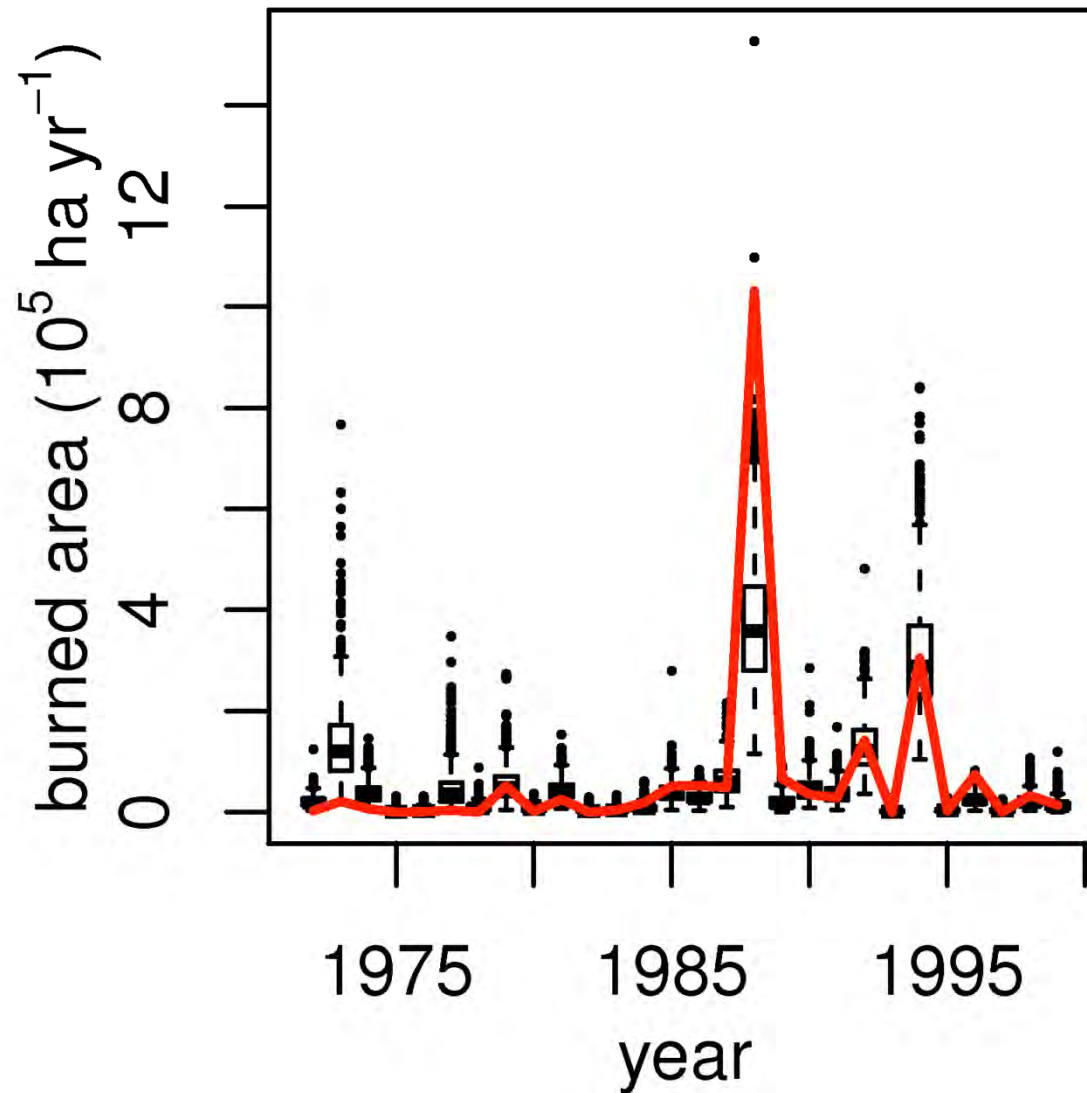


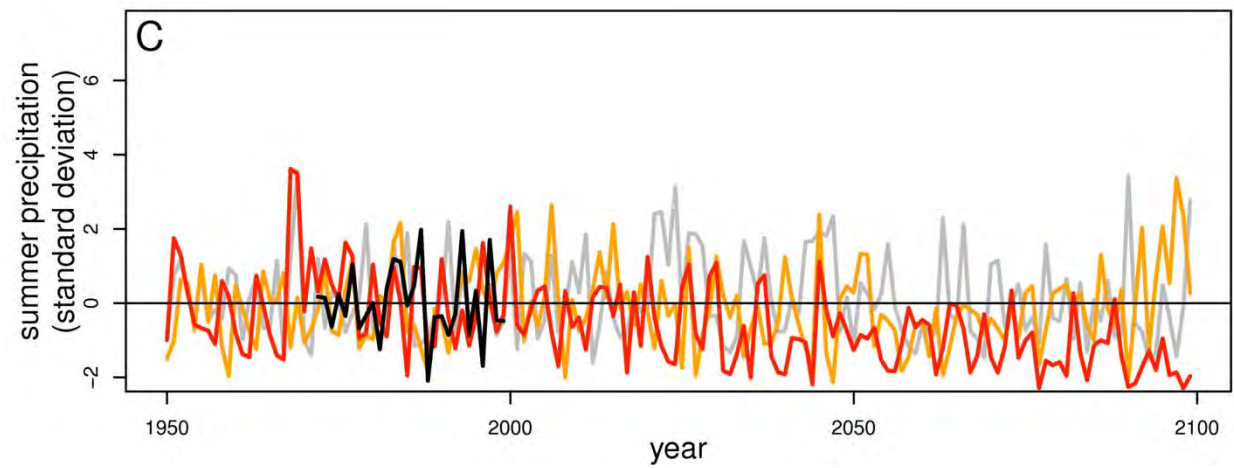
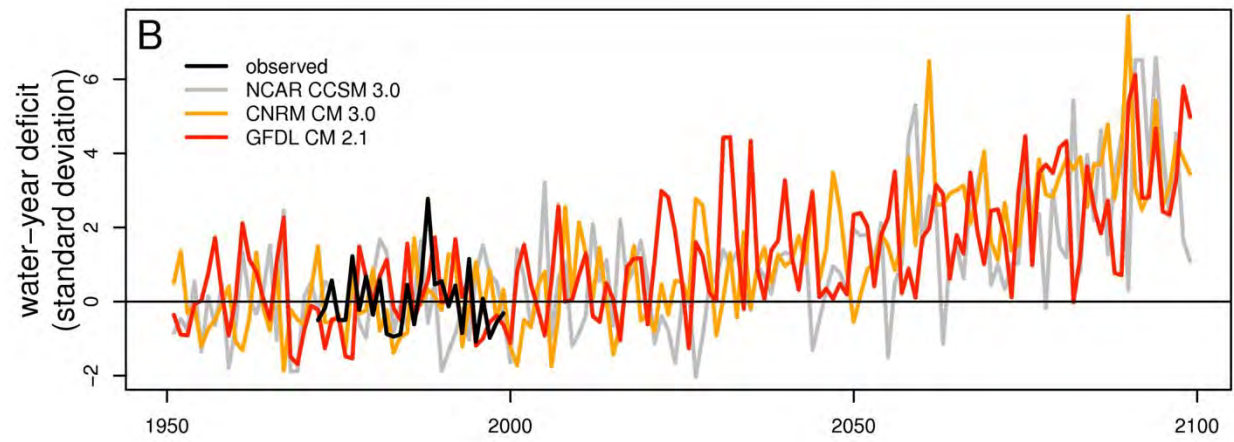
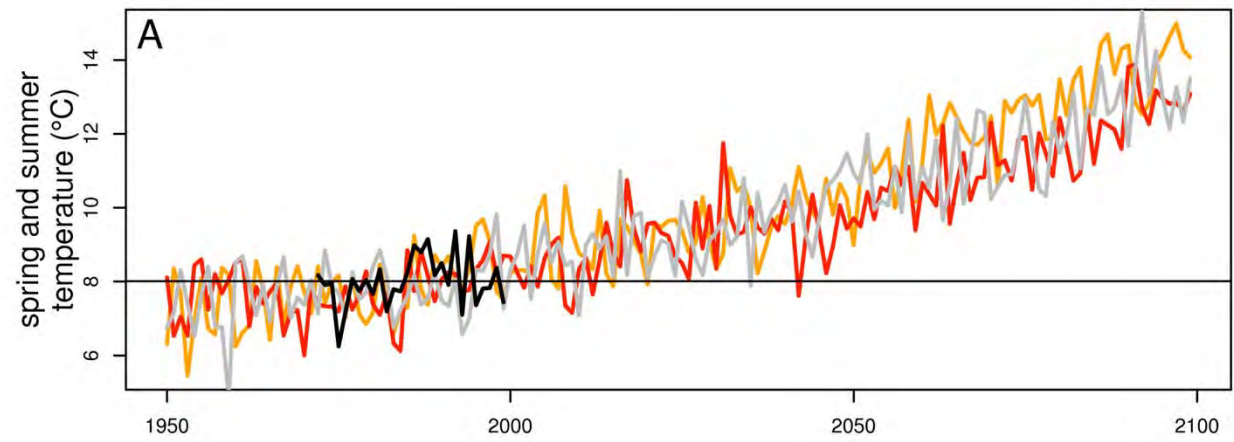


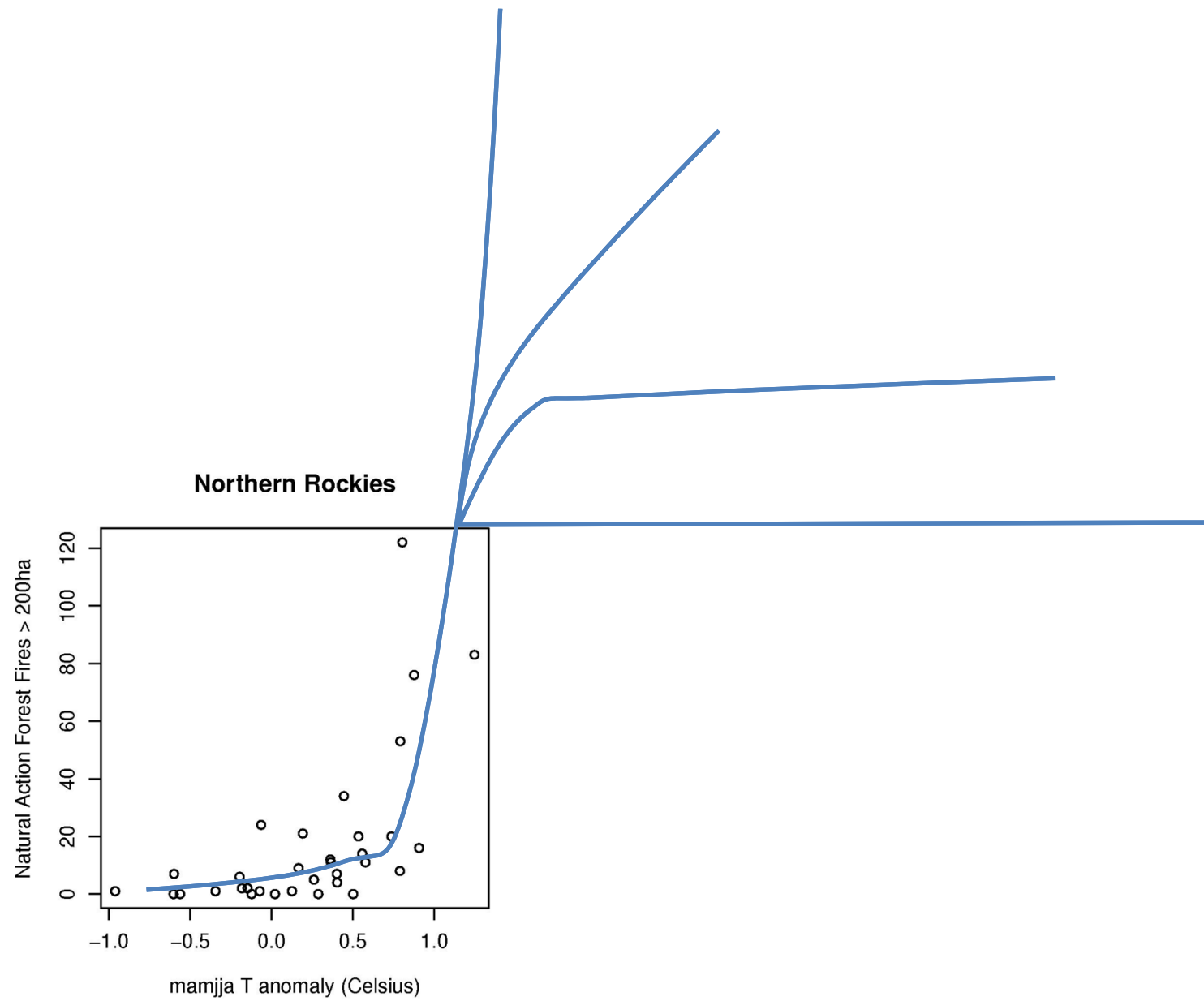
Fire Modeling

Fire Presence/Absence	Conditional Fire Number	Conditional Burned Area
Logit Model	Poisson Lognormal	Generalized Pareto
Temperature Precipitation Moisture Deficit Topography Location & Month	Temperature Precipitation Moisture Deficit Topography Location & Month	Moisture Deficit
Grid/Month	Grid/Month/Presence	Grid/Month/Fire

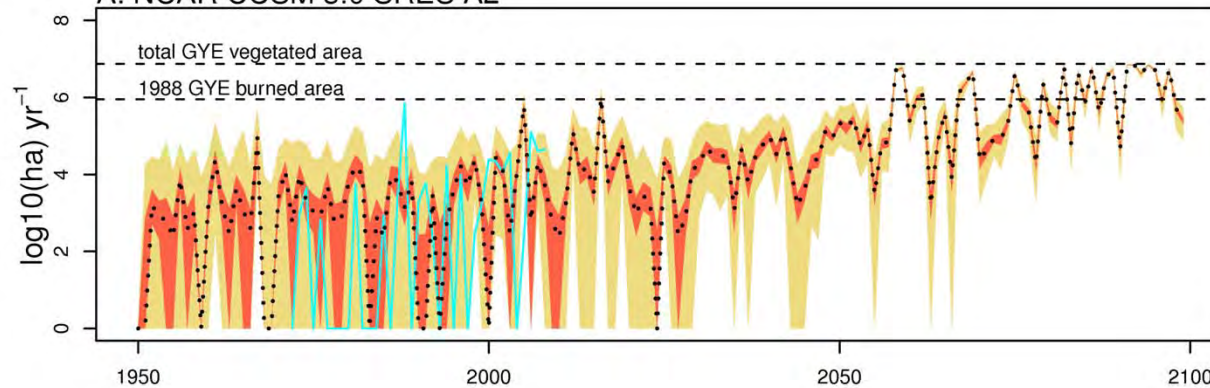
Combined models: Burned Area



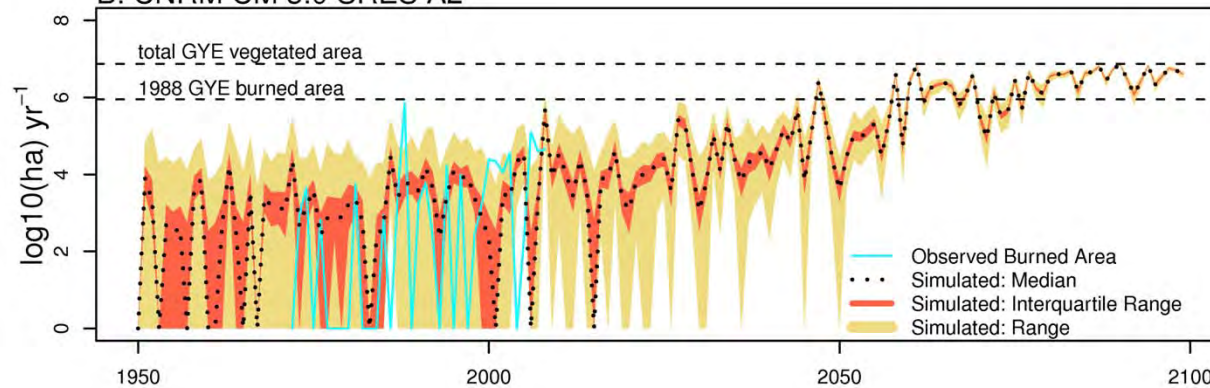




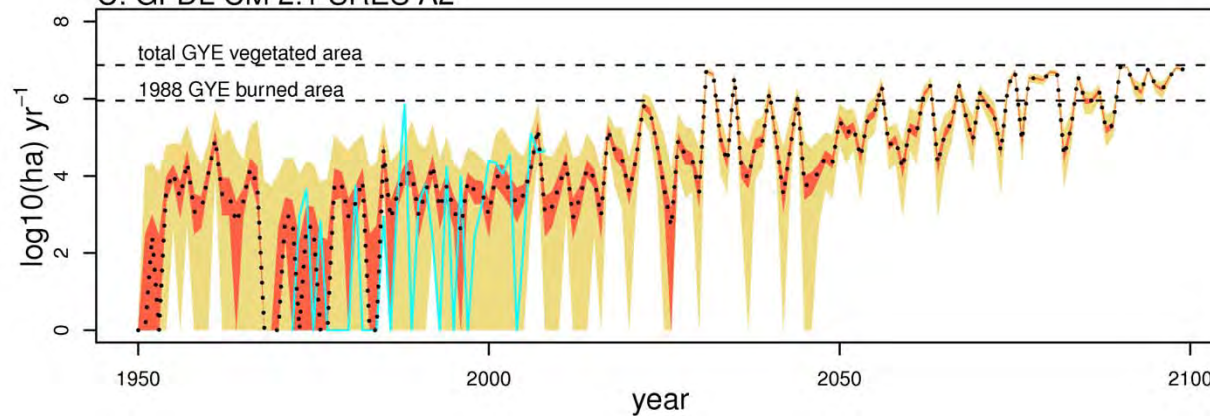
A: NCAR CCSM 3.0 SRES A2

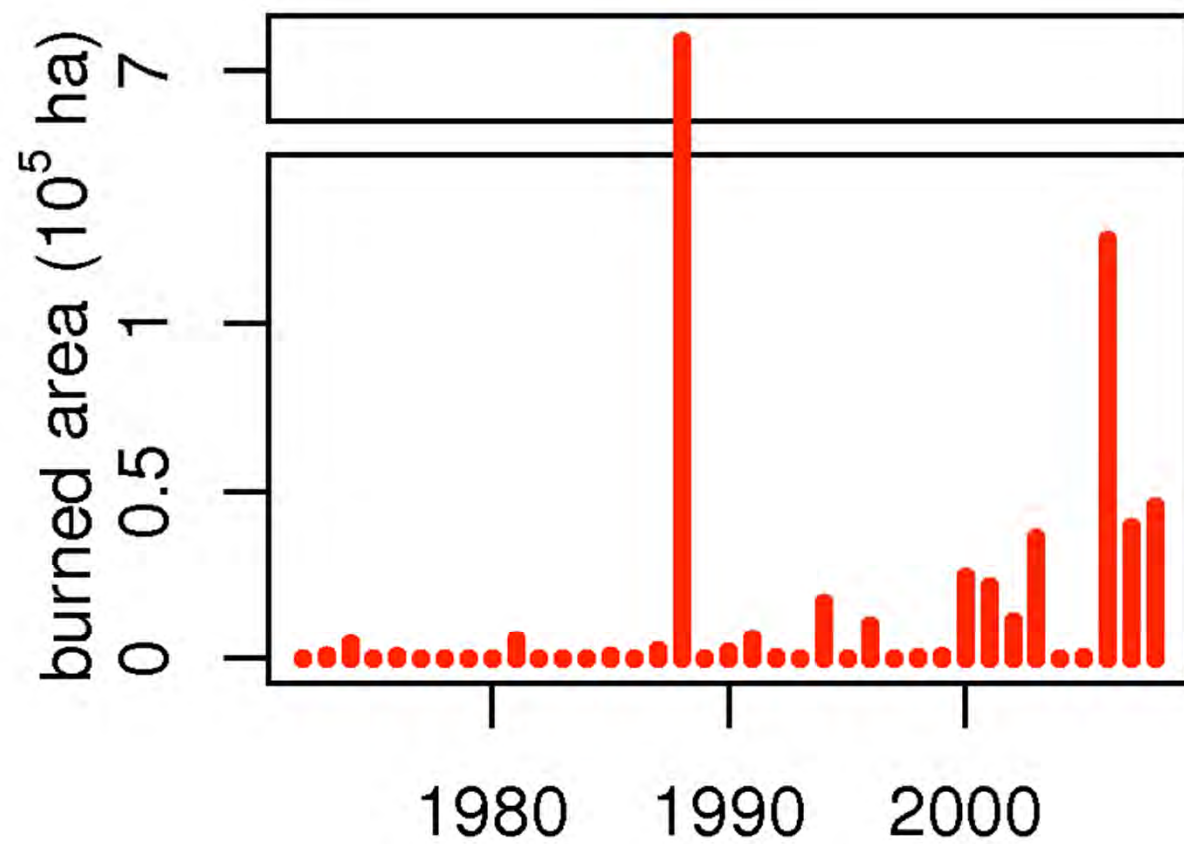


B: CNRM CM 3.0 SRES A2



C: GFDL CM 2.1 SRES A2





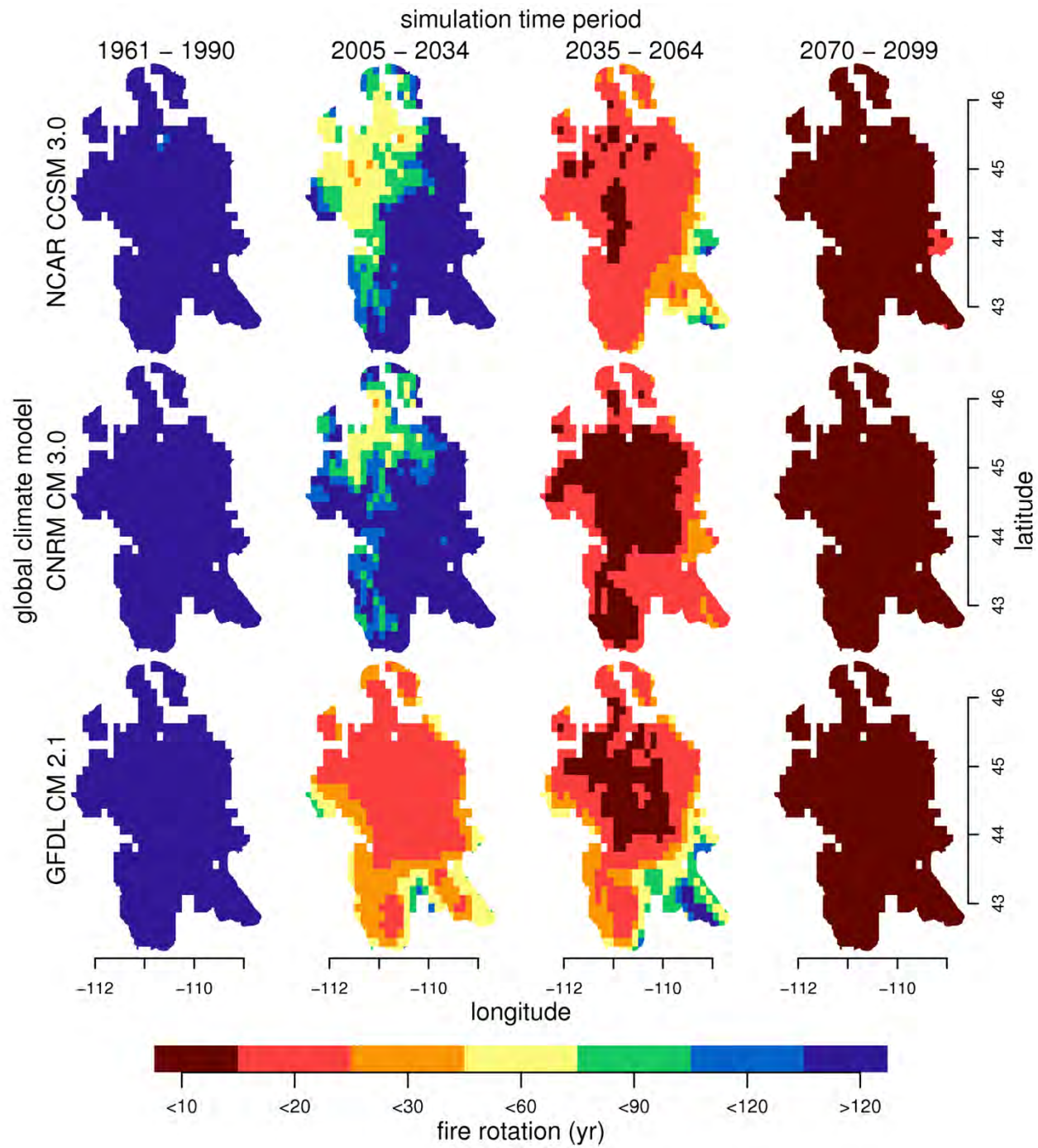
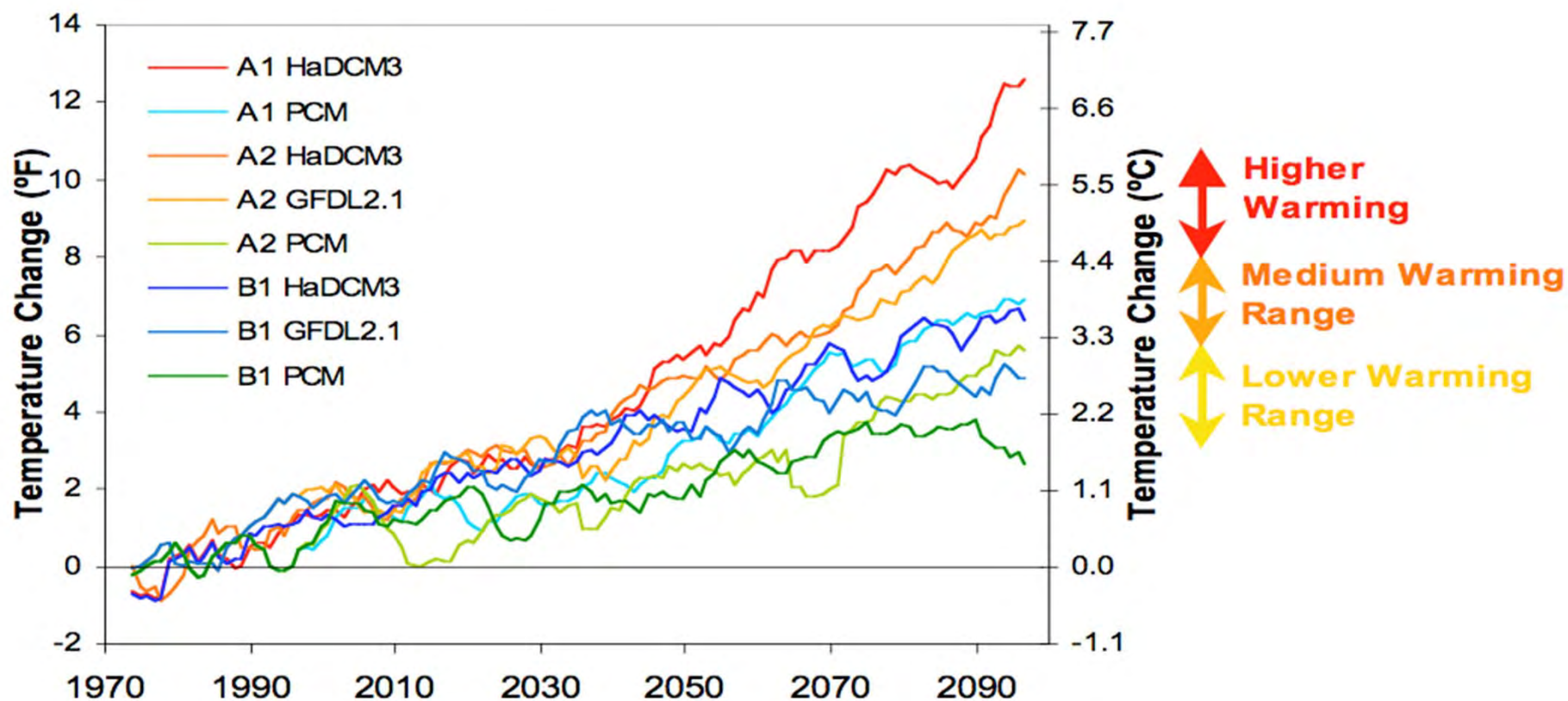


Figure 4-2. Change in California Annual Average Daily Mean Temperature Relative to 1961-1990



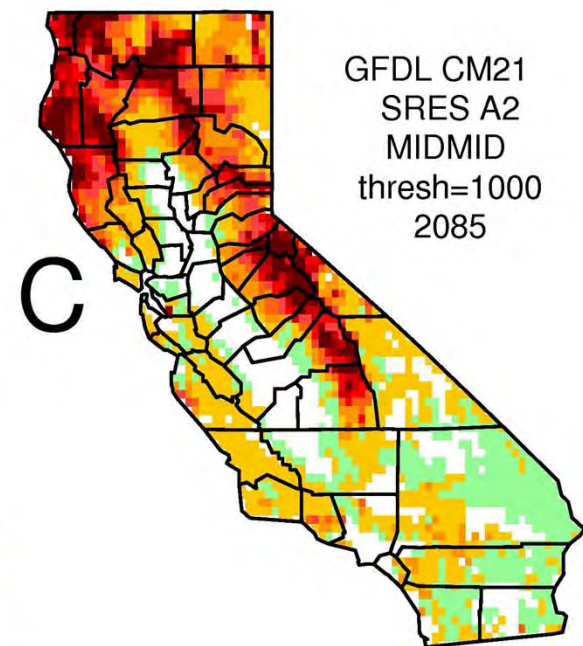
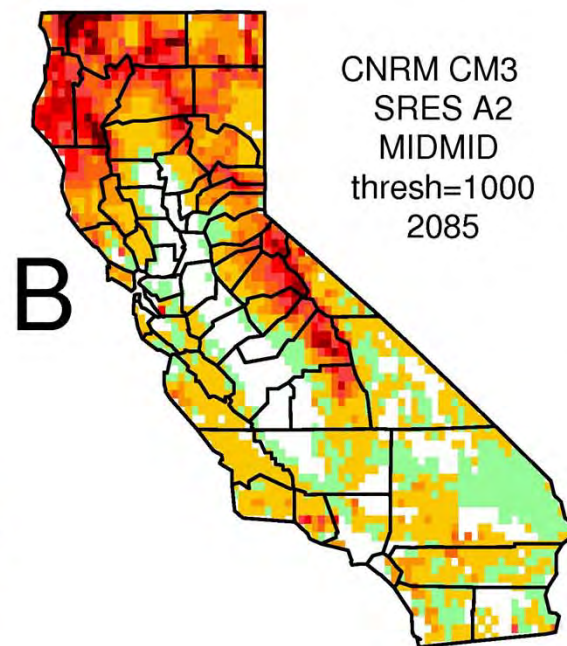
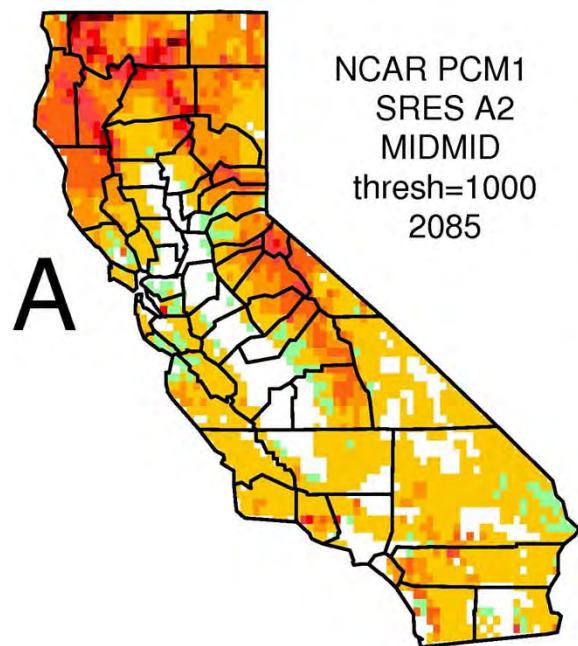
Change in California annual mean temperature (°F and °C) by year from 1961 to 2100 relative to 1961–1990 average—7-year running mean.

HadCM3 = Hadley Climate Model version 3

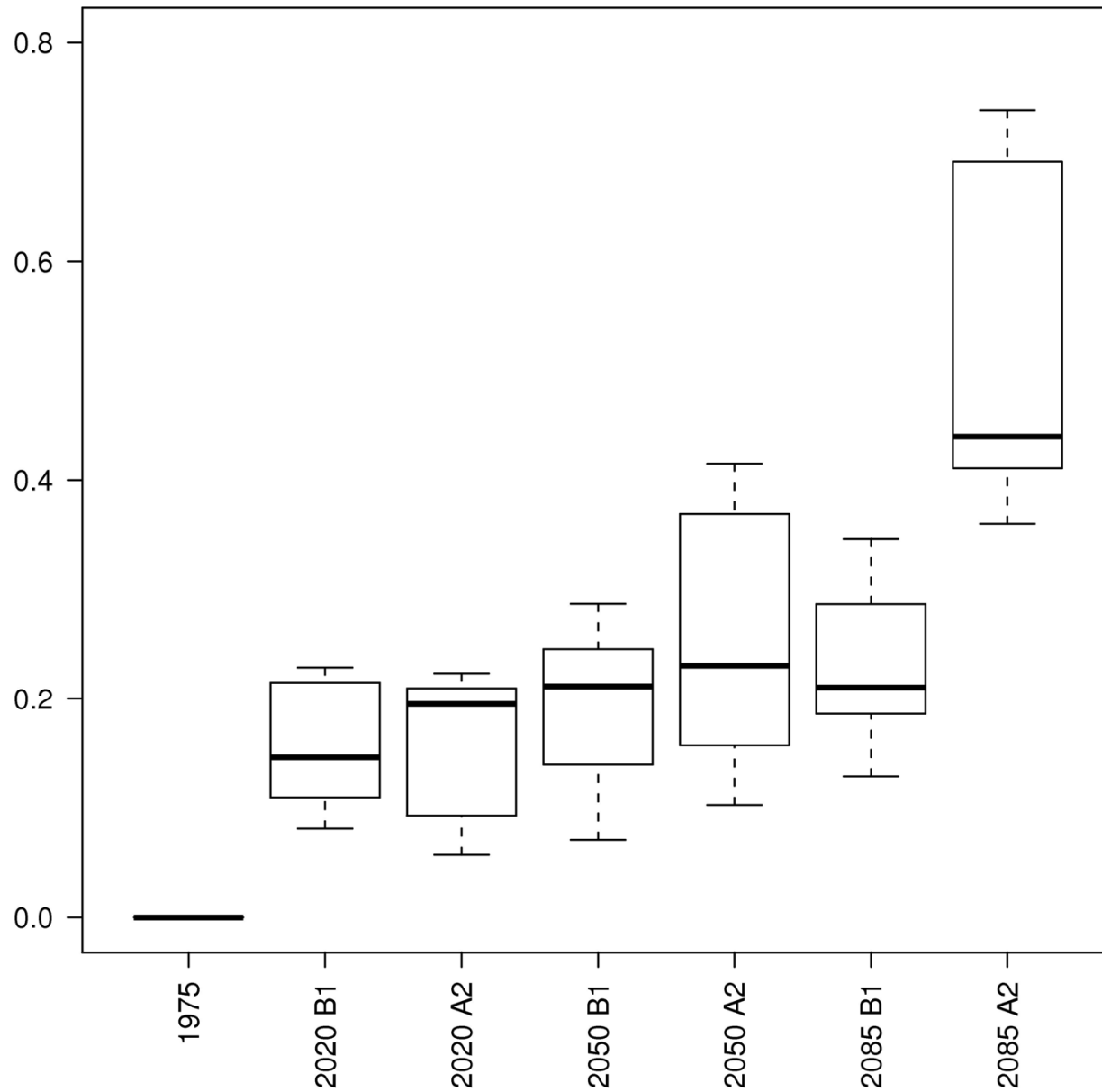
PCM = Parallel Climate Model

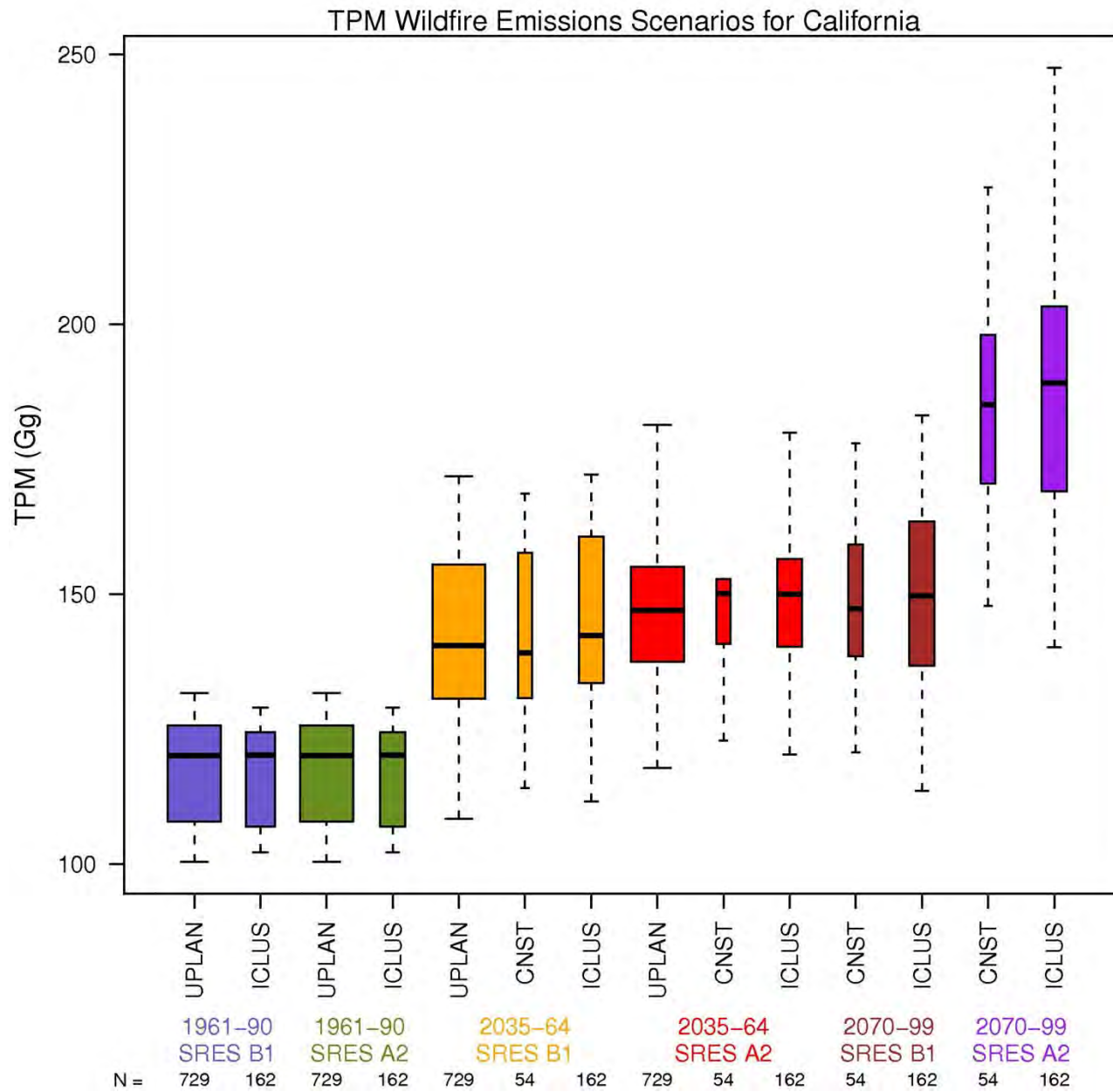
GFDL2.1 = Geophysical Fluid Dynamics Laboratory model 2.1

A1, A2, and B1 refer to global emission scenarios explained in Section 4. They are higher (A1), medium-high (A2), and lower (B1) emission scenarios.



**Change in Mean Expected Burned Area
by Emissions Scenario**





Average annual wildfire CO2 Emissions

