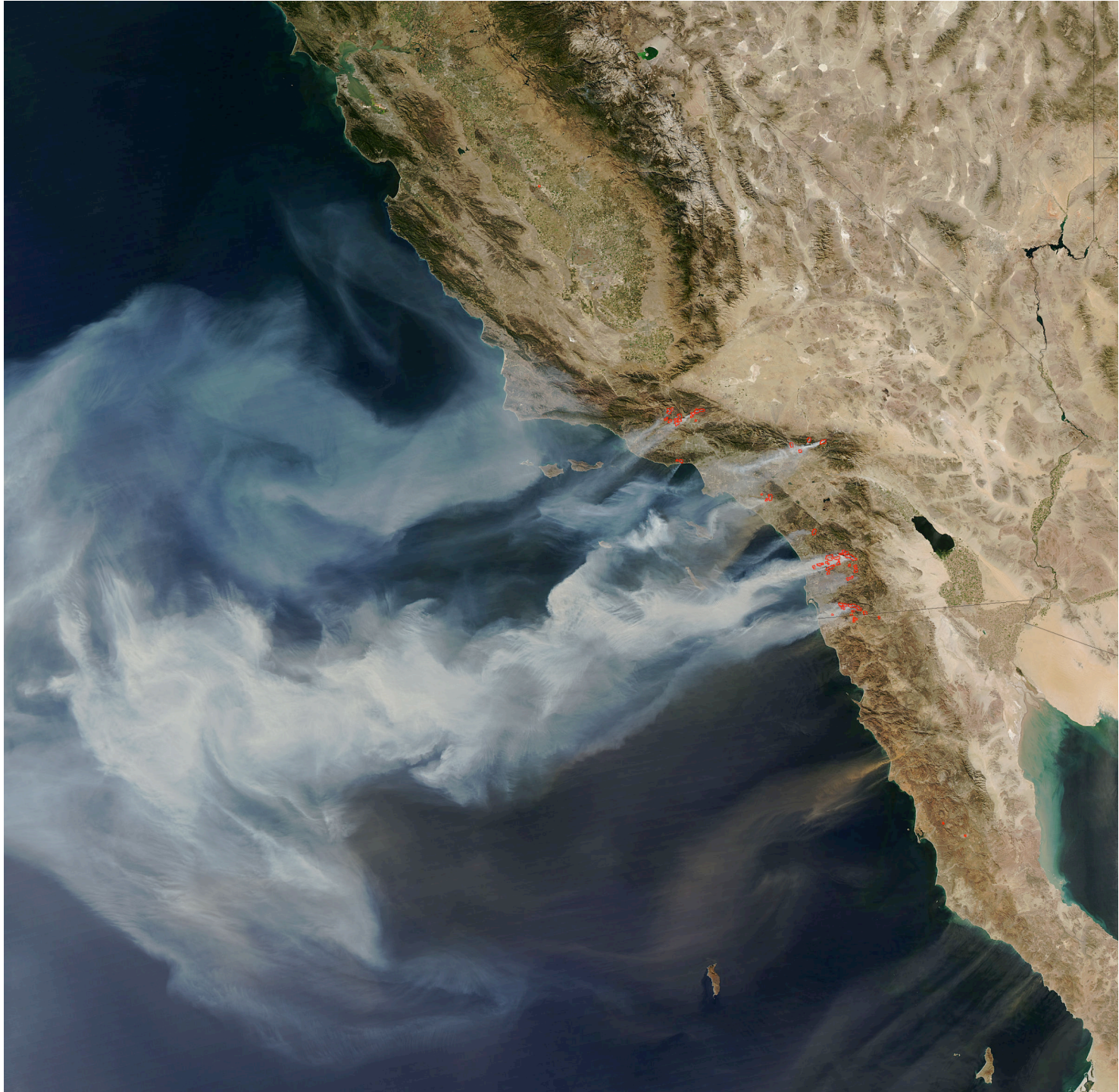


# California burns







# Santa Ana Winds





# Conditions for Santa Ana Winds

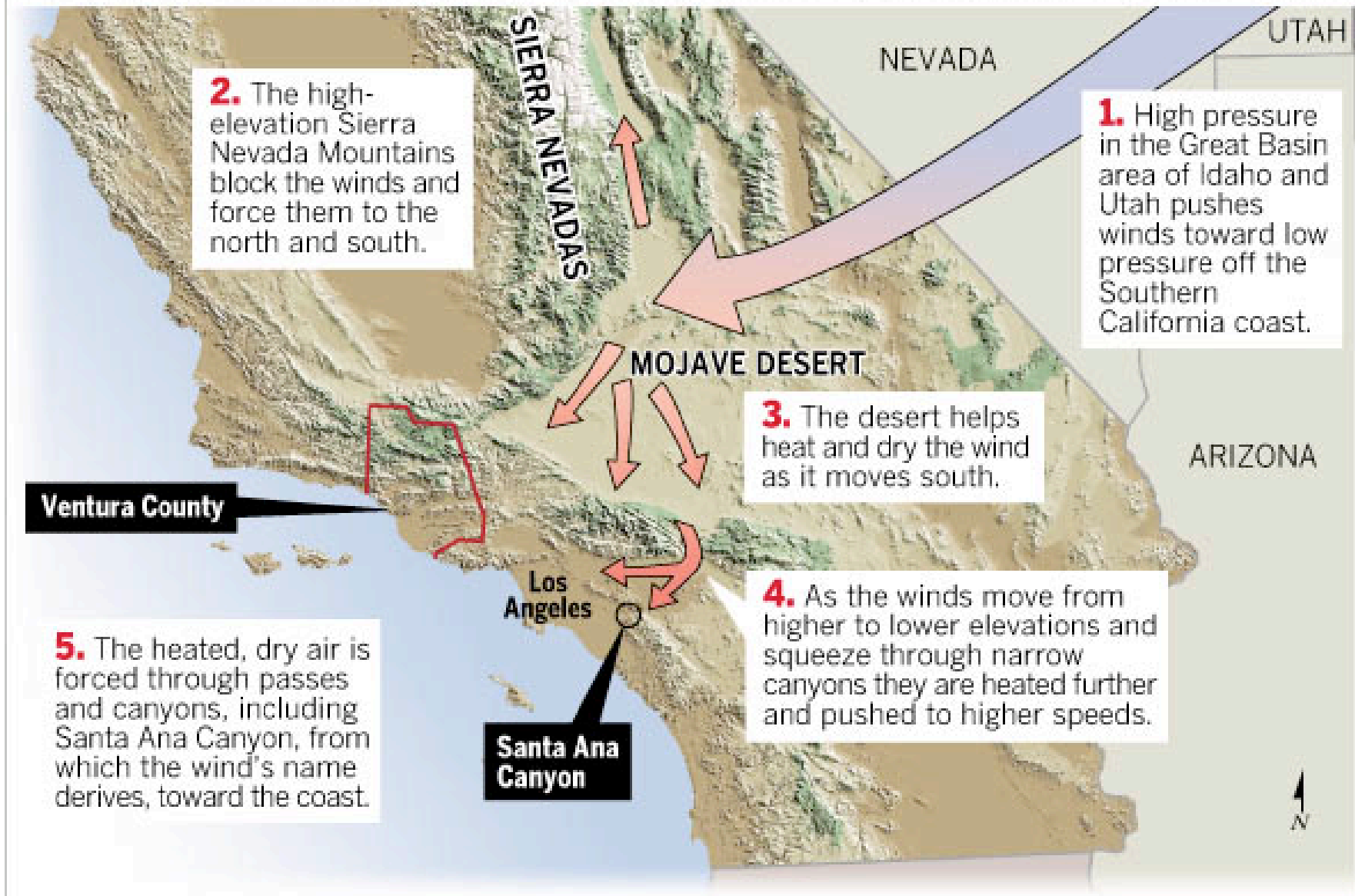
- High pressure over Great Basin region
  - Why its clear and warm here in Boulder
- Warm conditions in SoCal
  - Low pressure
- Wind moves towards SoCal
- Mountain Barriers
  - Funnel winds, increasing velocity

# Stronger at night

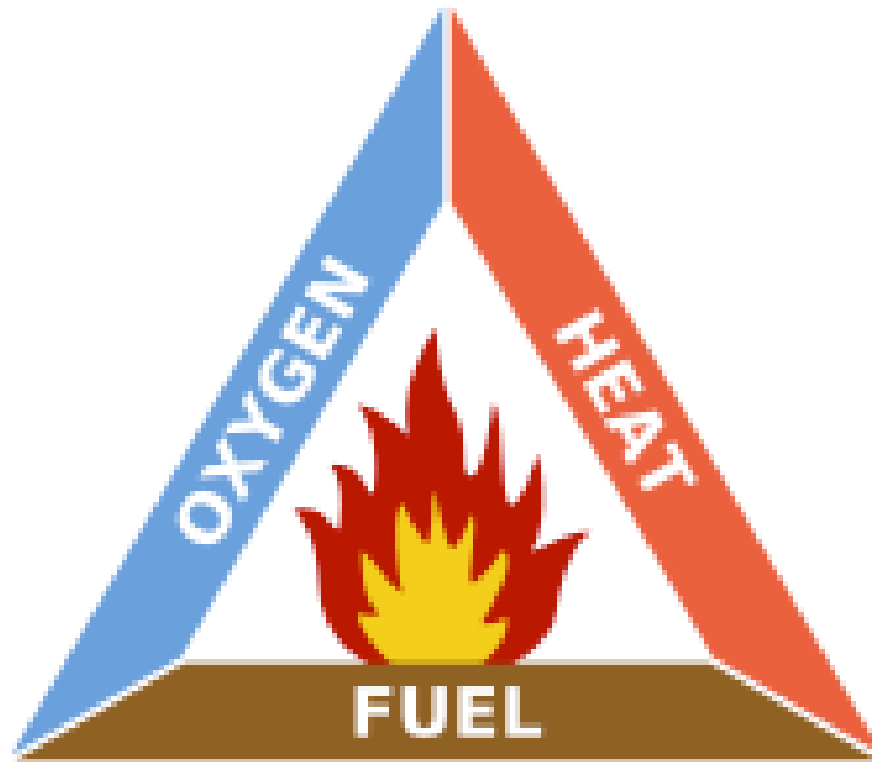
- The reason is that during the day, the downslope winds are often opposed by a sea breeze moving off the colder Pacific waters into the hot basin.
- At night, when the sea breeze dies, the Santa Ana winds may down the mountains unopposed.

# The Santa Ana winds

Santa Anas are dry, sometimes hot winds in Southern California that blow westward through canyons toward coastal regions. They typically occur from October through March, tending to peak in December, but often spread wildfires in the fall across areas that have gone for months without rain.



# Fire Triangle





# Fire Risk

- fuels
- terrain
- land management
- suppression
- weather.

# Fire and Climate Change

Has climate change resulted  
in changes in wildfire  
frequency and magnitude?

# Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity

A. L. Westerling,<sup>1,2\*</sup> H. G.  
Hidalgo,<sup>1</sup> D. R. Cayan,<sup>1,3</sup> T.  
W. Swetnam<sup>4</sup>

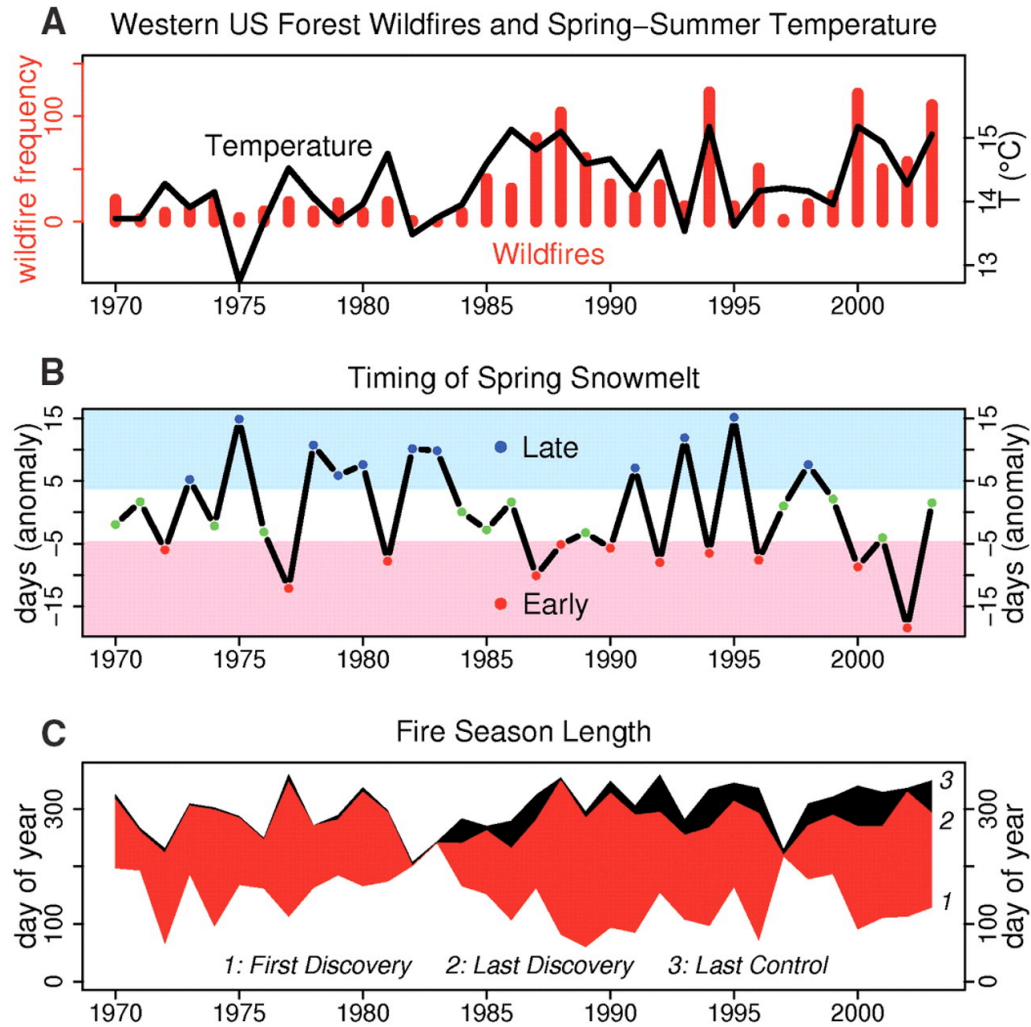
Science, 2006



# Overview

- Large wildfire activity increased suddenly and markedly in the mid-1980s, with higher large-wildfire frequency, longer wildfire durations, and longer wildfire seasons.
- The greatest increases occurred in mid-elevation, Northern Rockies forests, where land-use histories have relatively little effect on fire risks and are strongly associated with increased spring and summer temperatures and an earlier spring snowmelt.

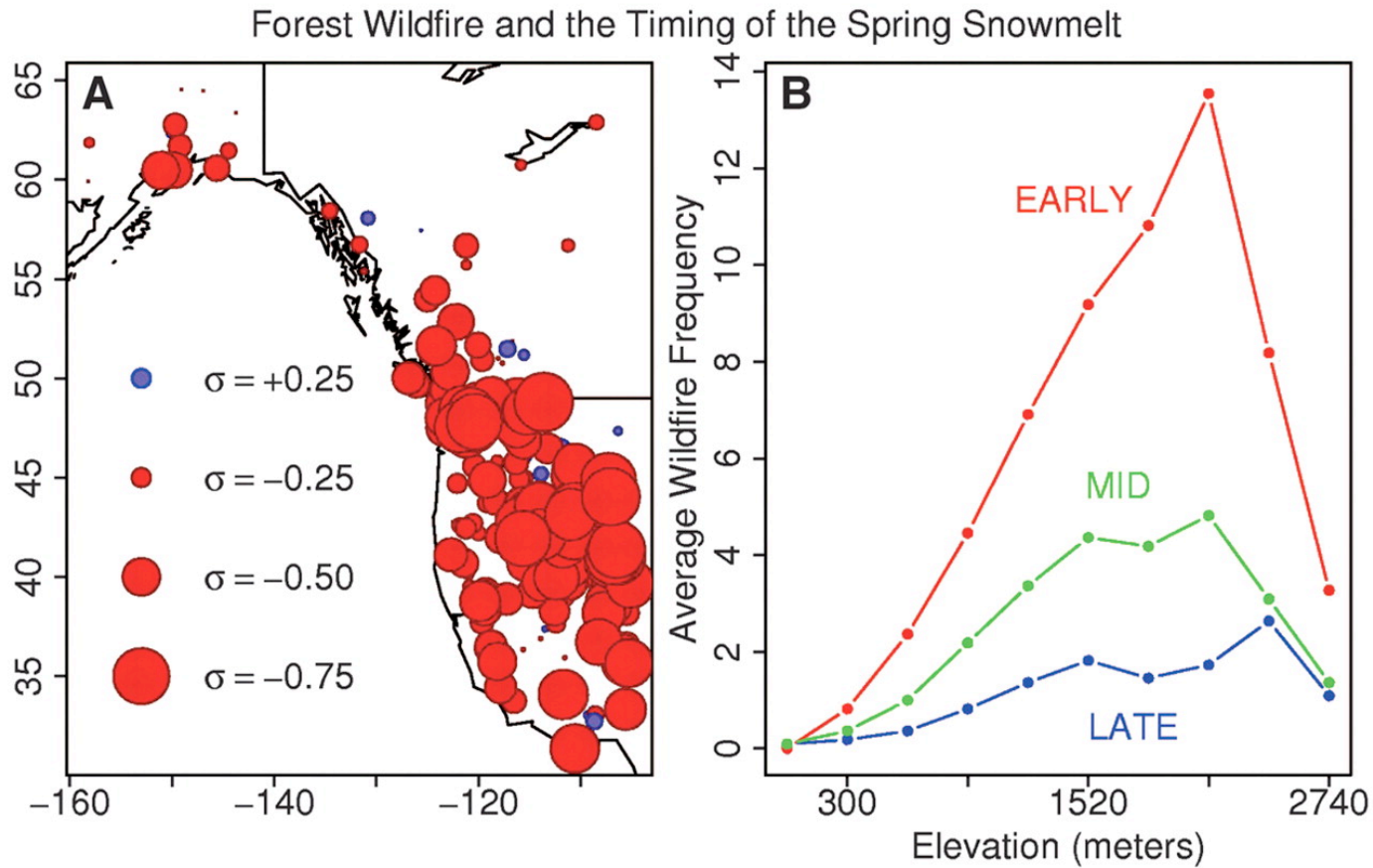
**Fig. 1. (A) Annual frequency of large (>400 ha) western U.S. forest wildfires (bars) and mean March through August temperature for the western United States (line) (26, 30)**



**A. L. Westerling et al., Science 313, 940 -943 (2006)**

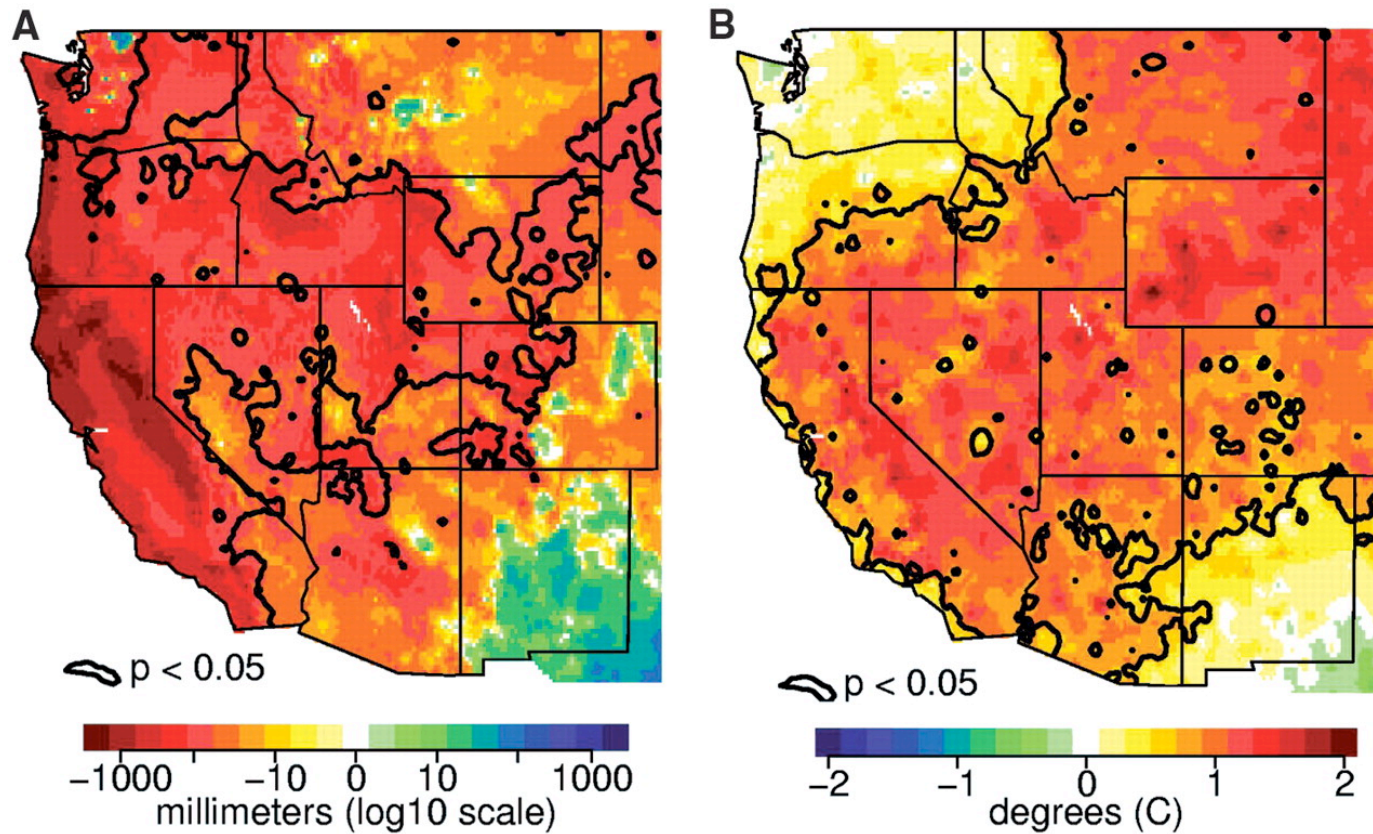


**Fig. 2. (A) Pearson's rank correlation between annual western U.S. large (>400 ha) forest wildfire frequency and streamflow center timing**



**A. L. Westerling et al., Science 313, 940 -943 (2006)**

**Fig. 3. Average difference between early and late snowmelt years in average precipitation from October through May (A) and average temperature from March through August (B)**

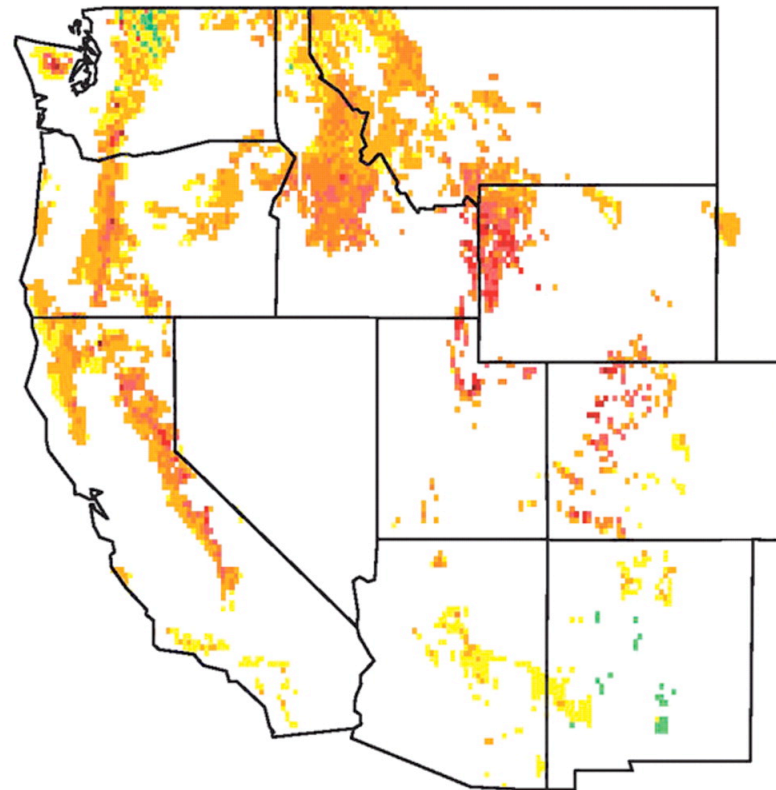


**A. L. Westerling et al., Science 313, 940 -943 (2006)**



**Fig. 4. Index of forest vulnerability to changes in the timing of spring: the percentage difference in cumulative moisture deficit from October to August at each grid point in early versus late snowmelt years, scaled by the forest-type vegetation fraction at each grid point, for 1970 to 1999 (26)**

Forest Vulnerability: Early – Late Deficit



-1   -0.5   0   0.5   1  
percent difference scaled by forest area

**A. L. Westerling et al., Science 313, 940 -943 (2006)**



# Conclusions

- Hence, the projected regional warming and consequent increase in wildfire activity in the western United States is likely to magnify the threats to human communities and ecosystems, and substantially increase the management challenges in restoring forests and reducing greenhouse gas emissions.