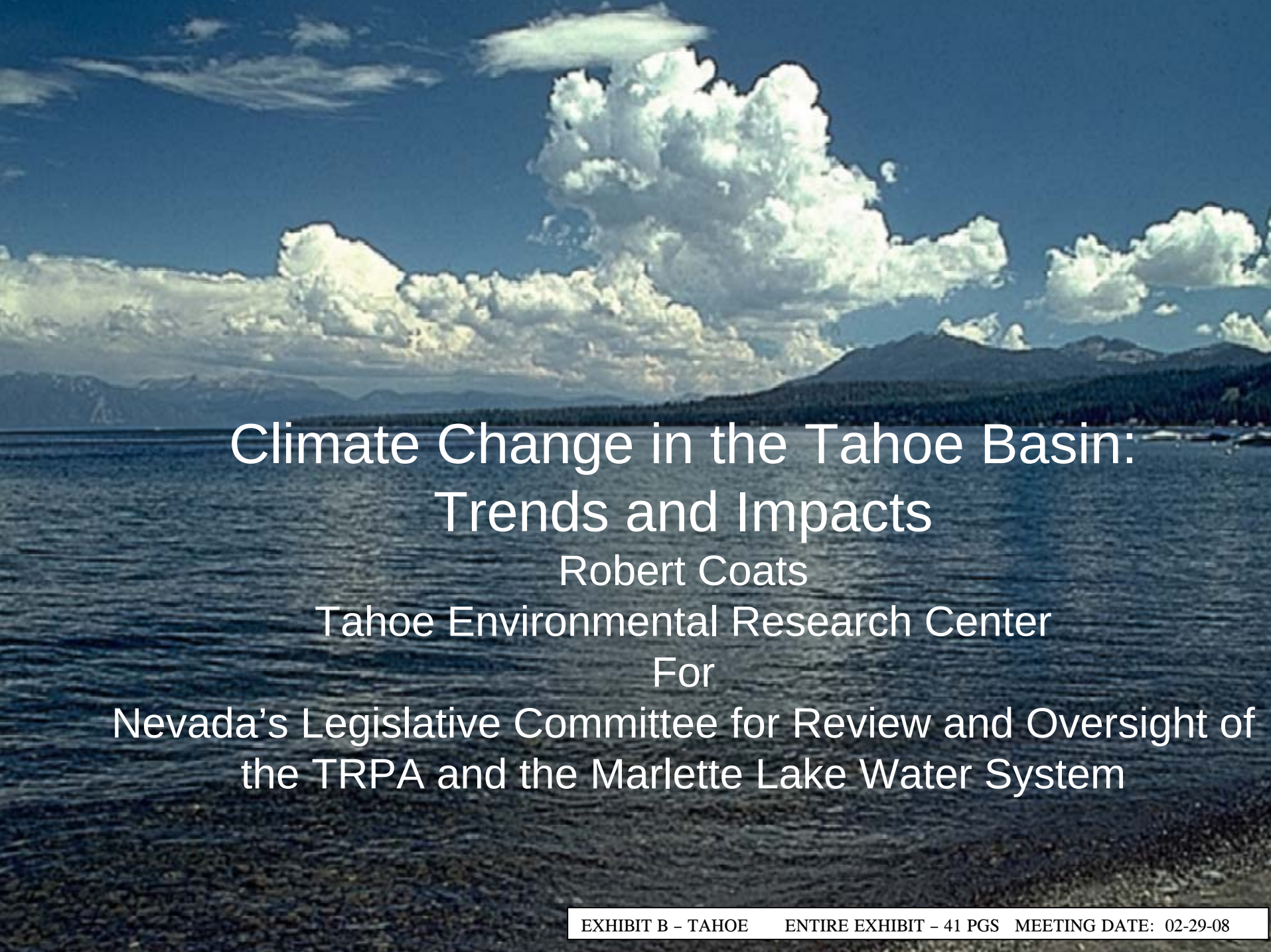


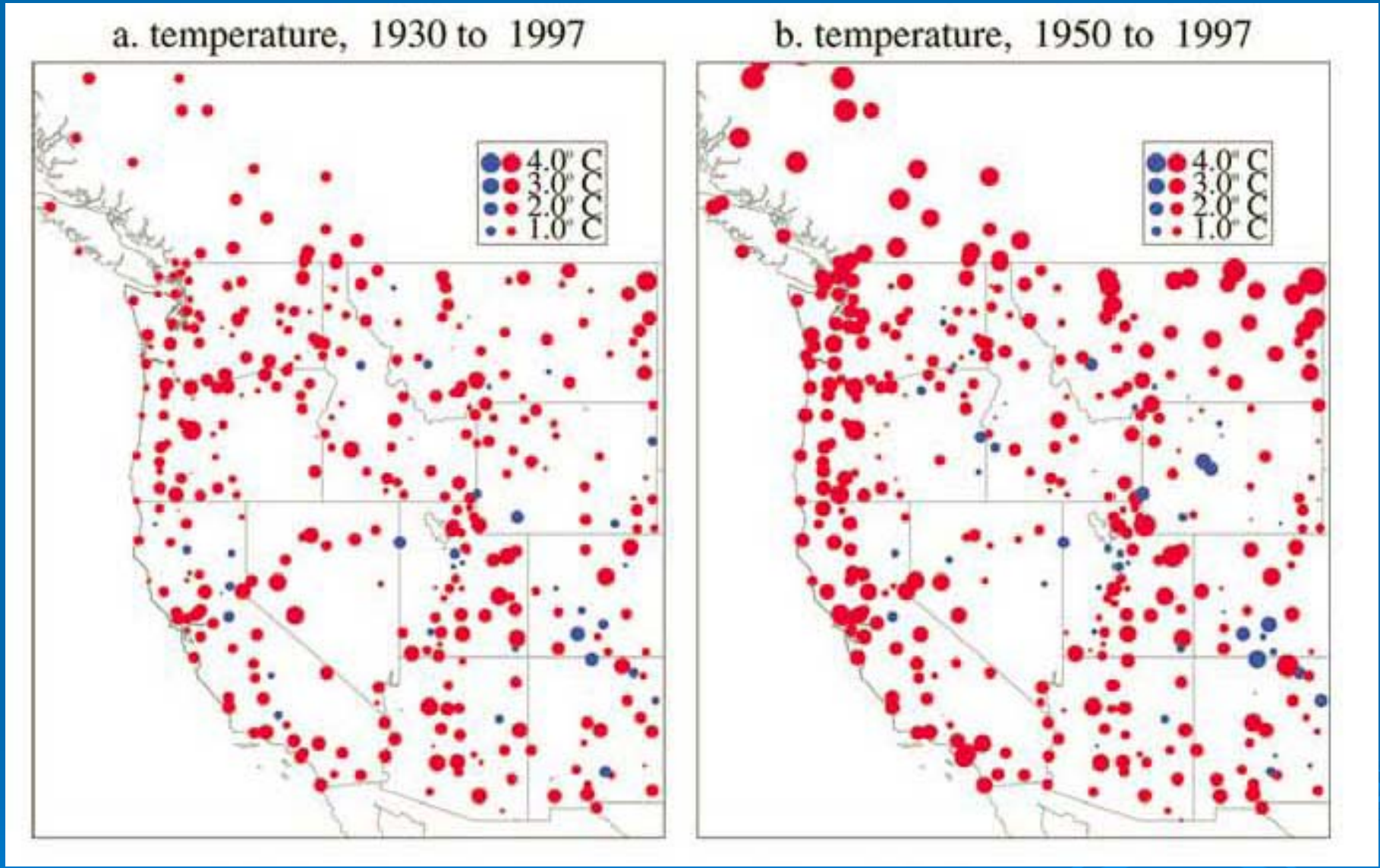
# Climate Change in the Tahoe Basin: Trends and Impacts

Robert Coats
Tahoe Environmental Research Center

For

Nevada's Legislative Committee for Review and Oversight of the TRPA and the Marlette Lake Water System

EXHIBIT B – TAHOE ENTIRE EXHIBIT – 41 PGS MEETING DATE: 02-29-08




Linear trends in Nov-Mar temperature in $^{o}$C/100 yrs. Blue circles are negative, red circles positive. From: Mote et al., 2005. *Bull. Am. Met. Soc. 86:30-45*

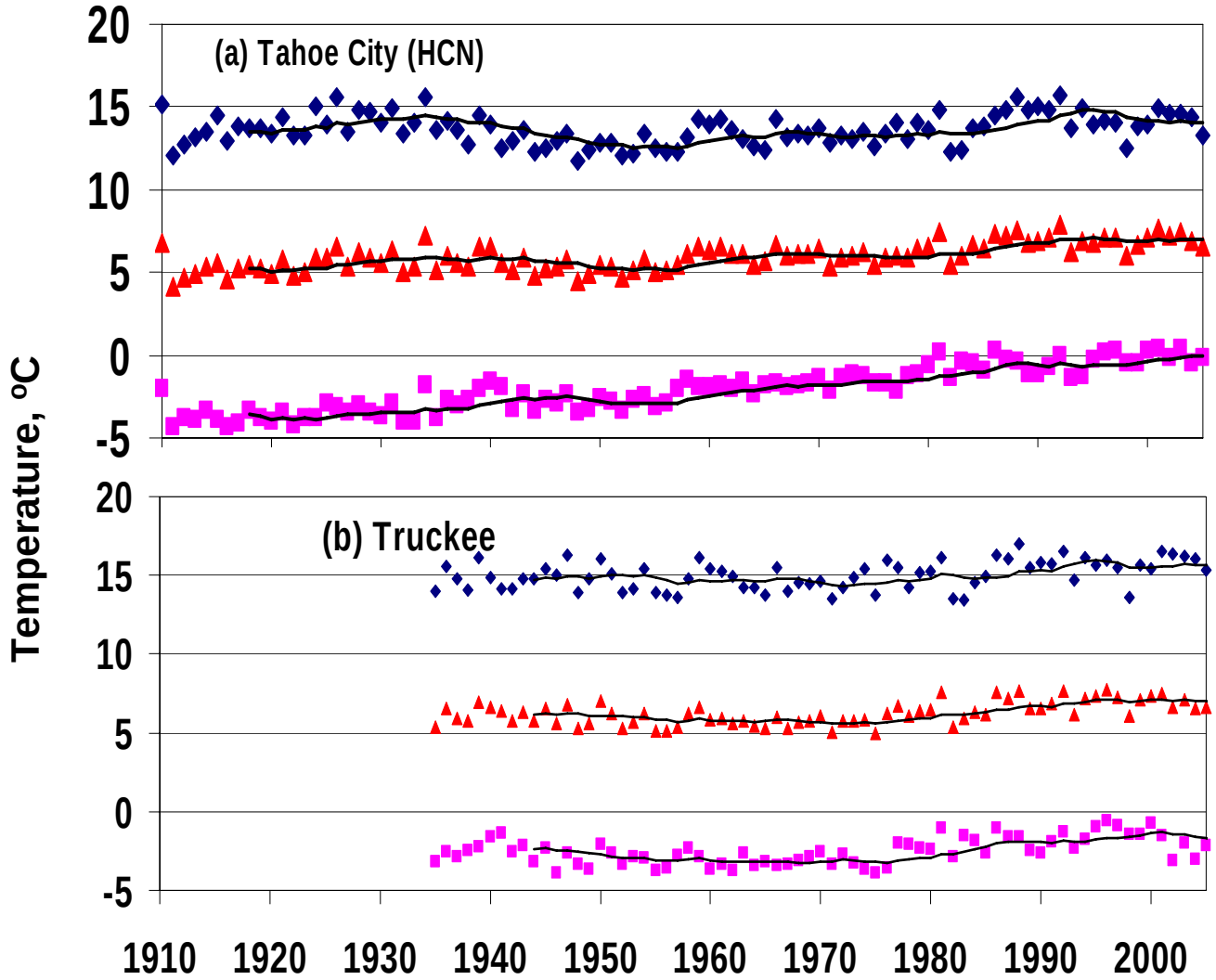
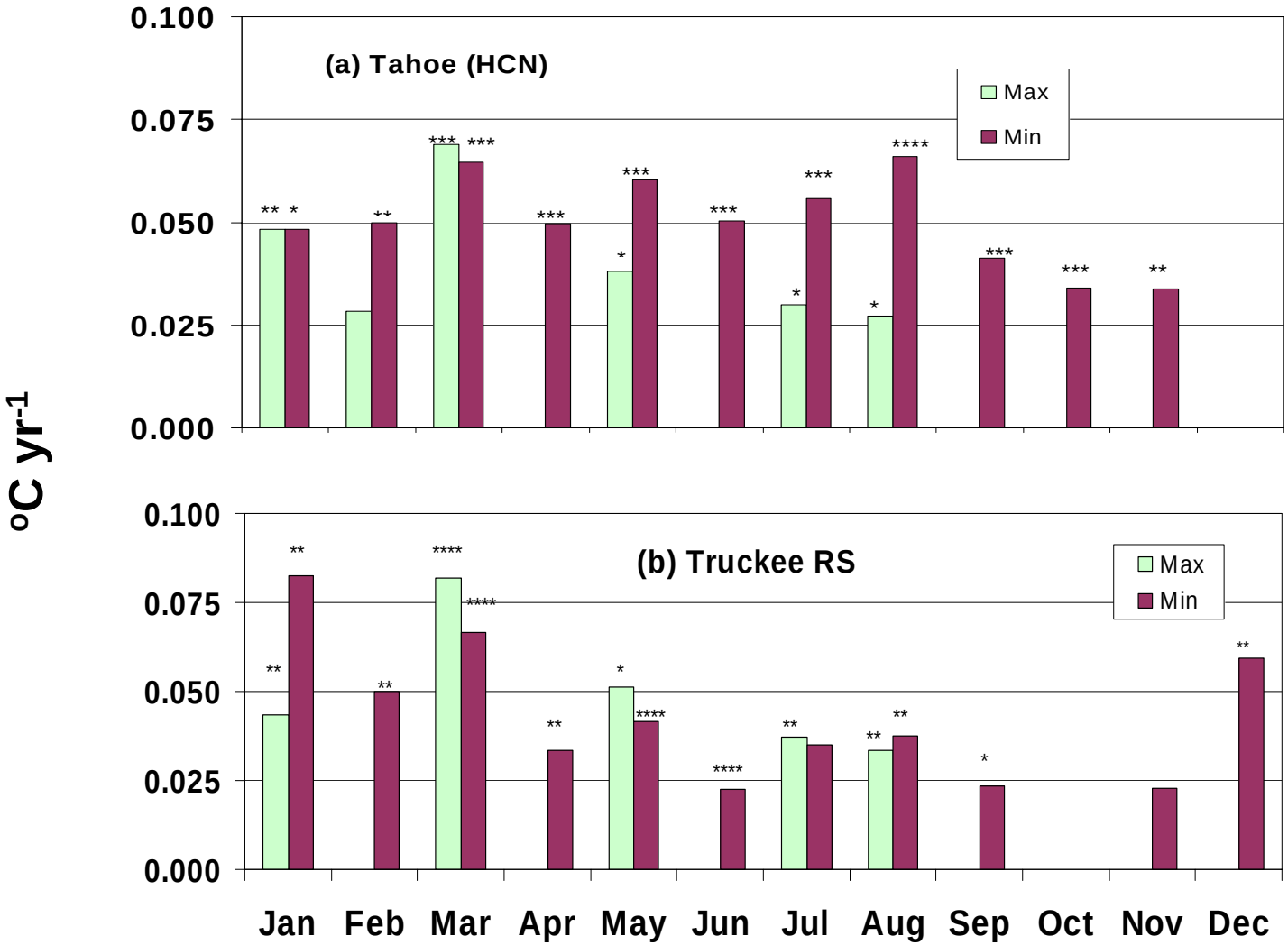
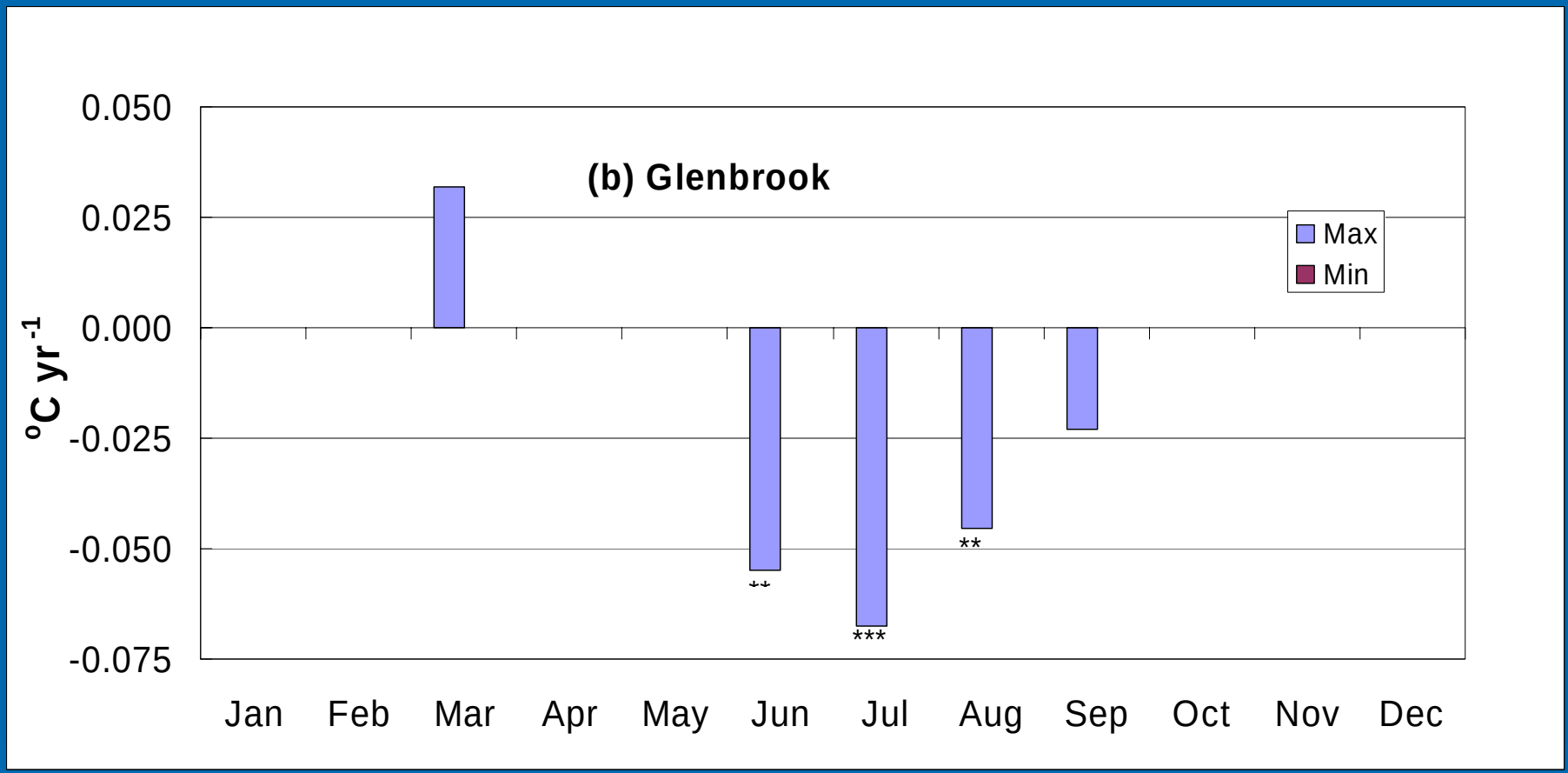



Figure 2. Annual average of max, ave. and min daily temperature at (a) Tahoe City and (b) Truckee. Curves are 10-year running averages

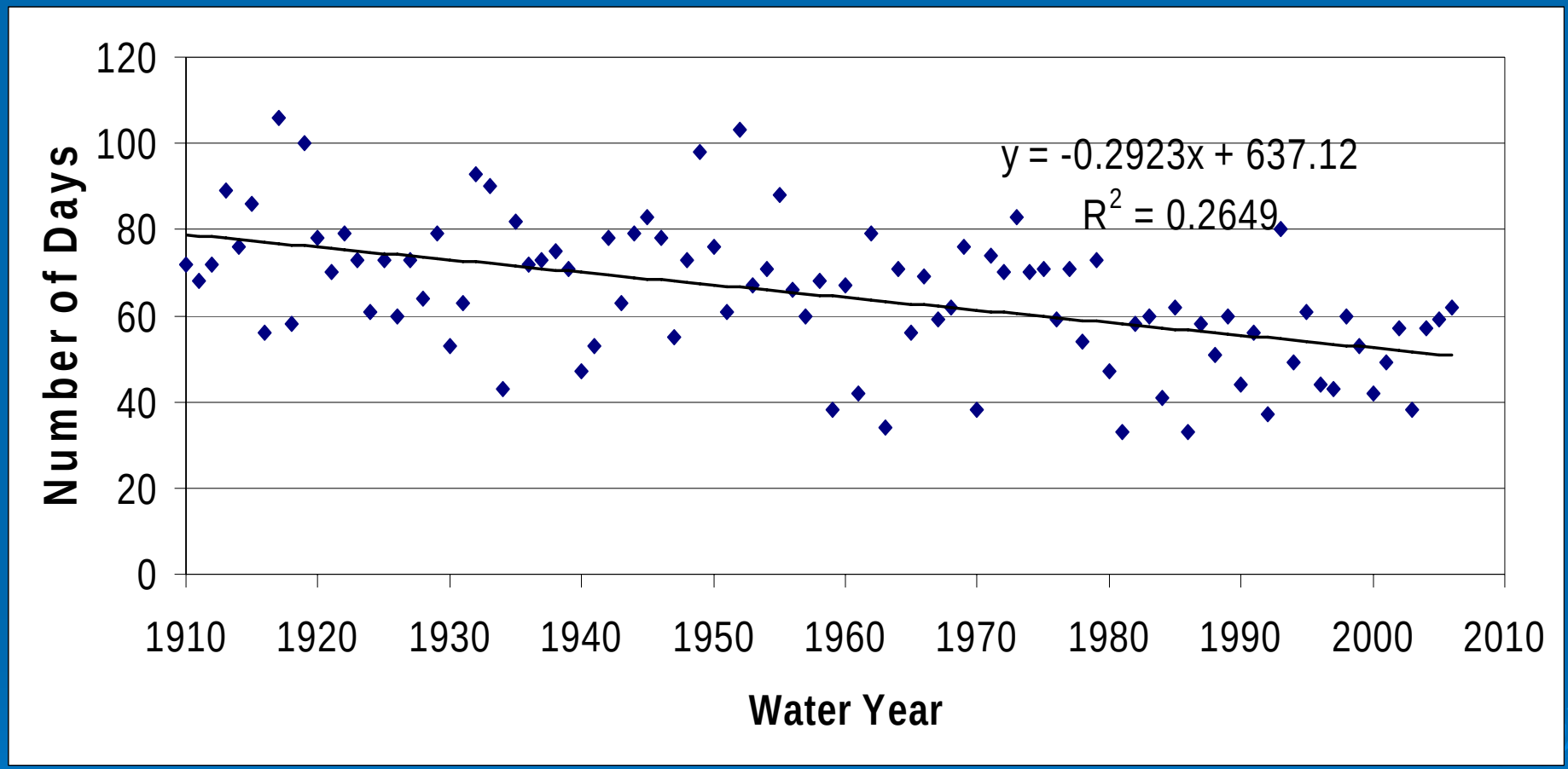



Slope of trend in monthly averages of max and min daily temperature at (a) Tahoe City and (b) Truckee, 1956-2005

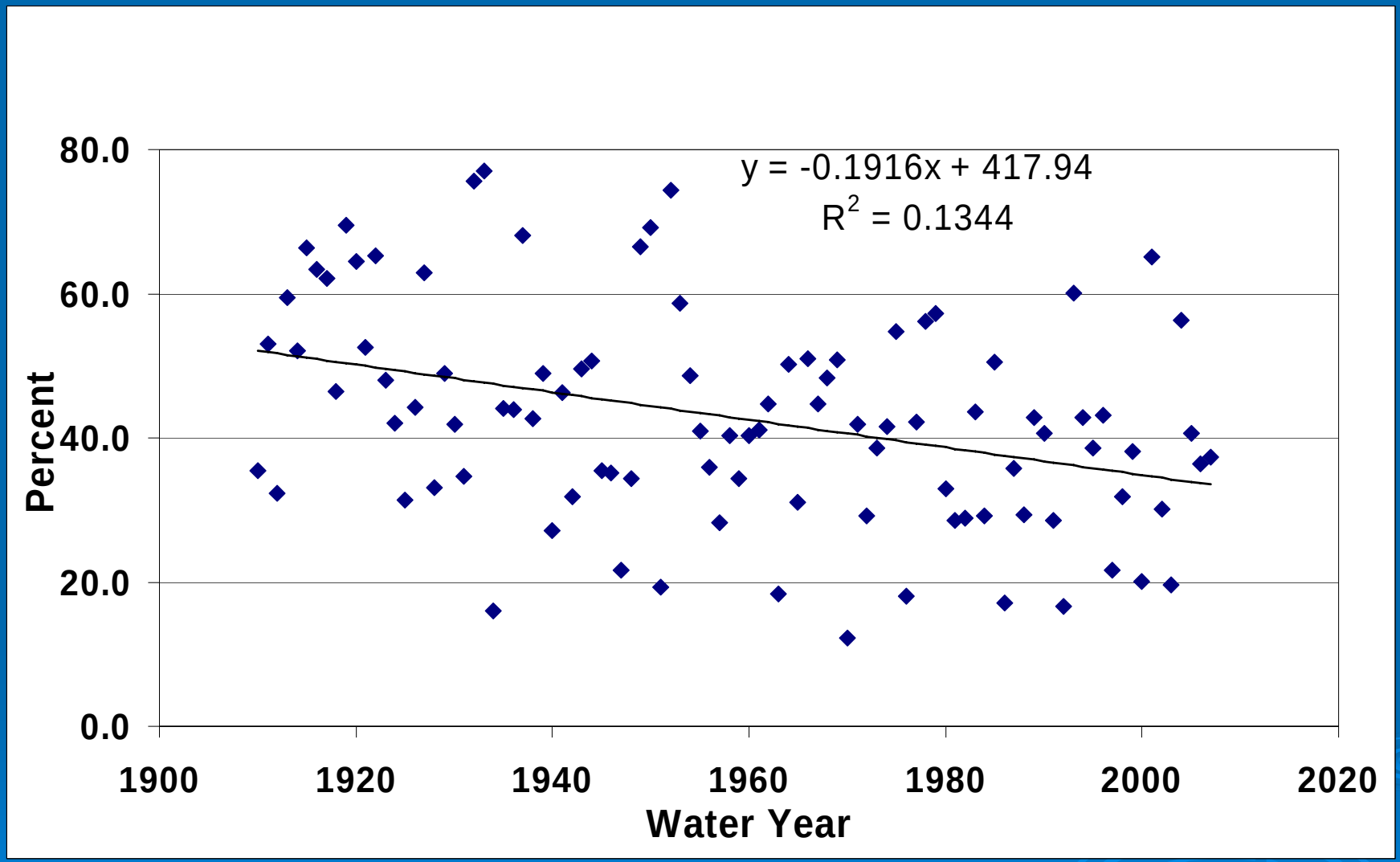



Slope of Trend in Monthly Average of Maximum Daily Temperature, 1956-2005 at Glenbrook.

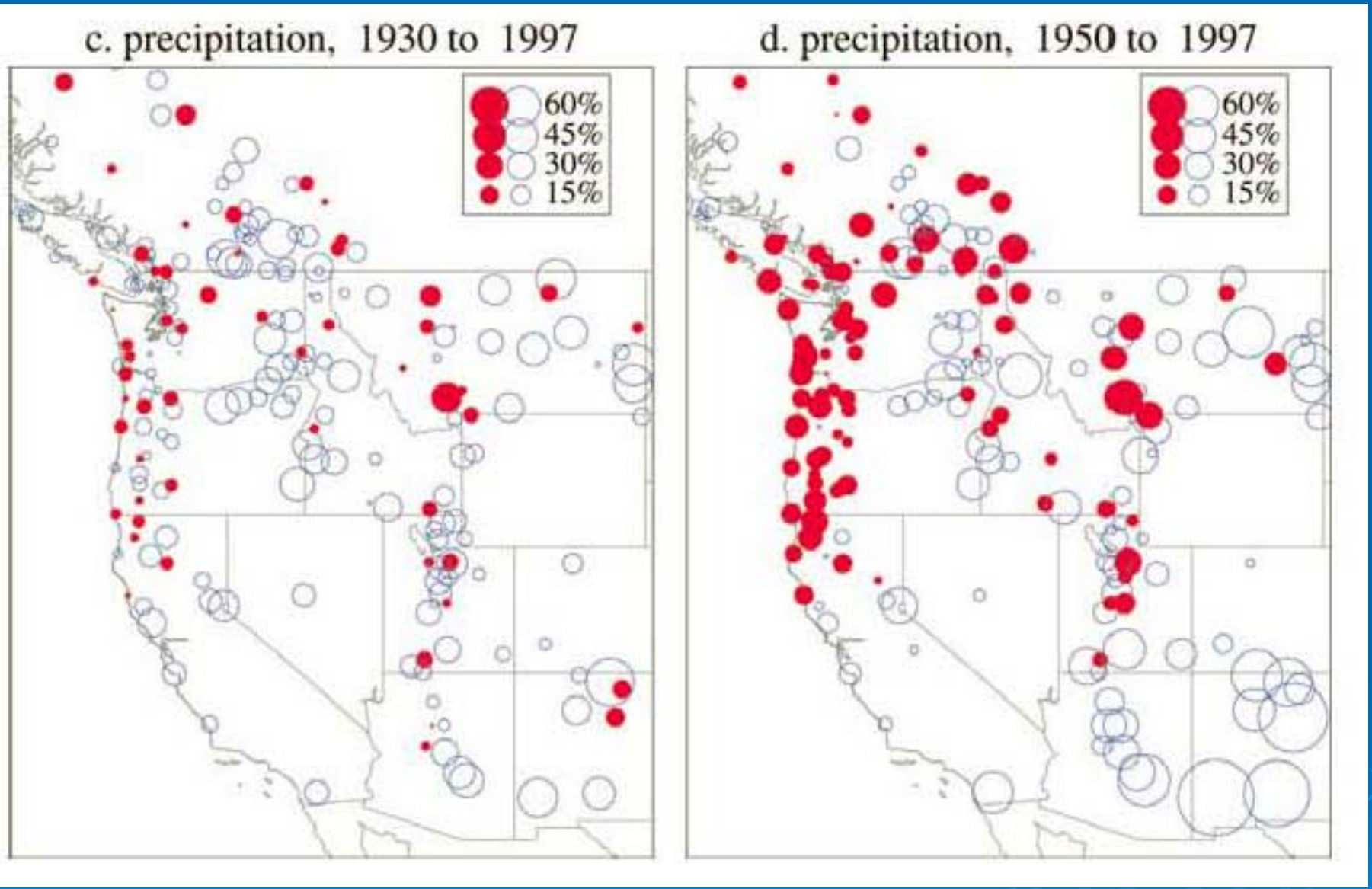
Is an increase in afternoon westerly winds causing a cooling trend?




Number of days with average temperature below freezing at Tahoe City, Dec.-March

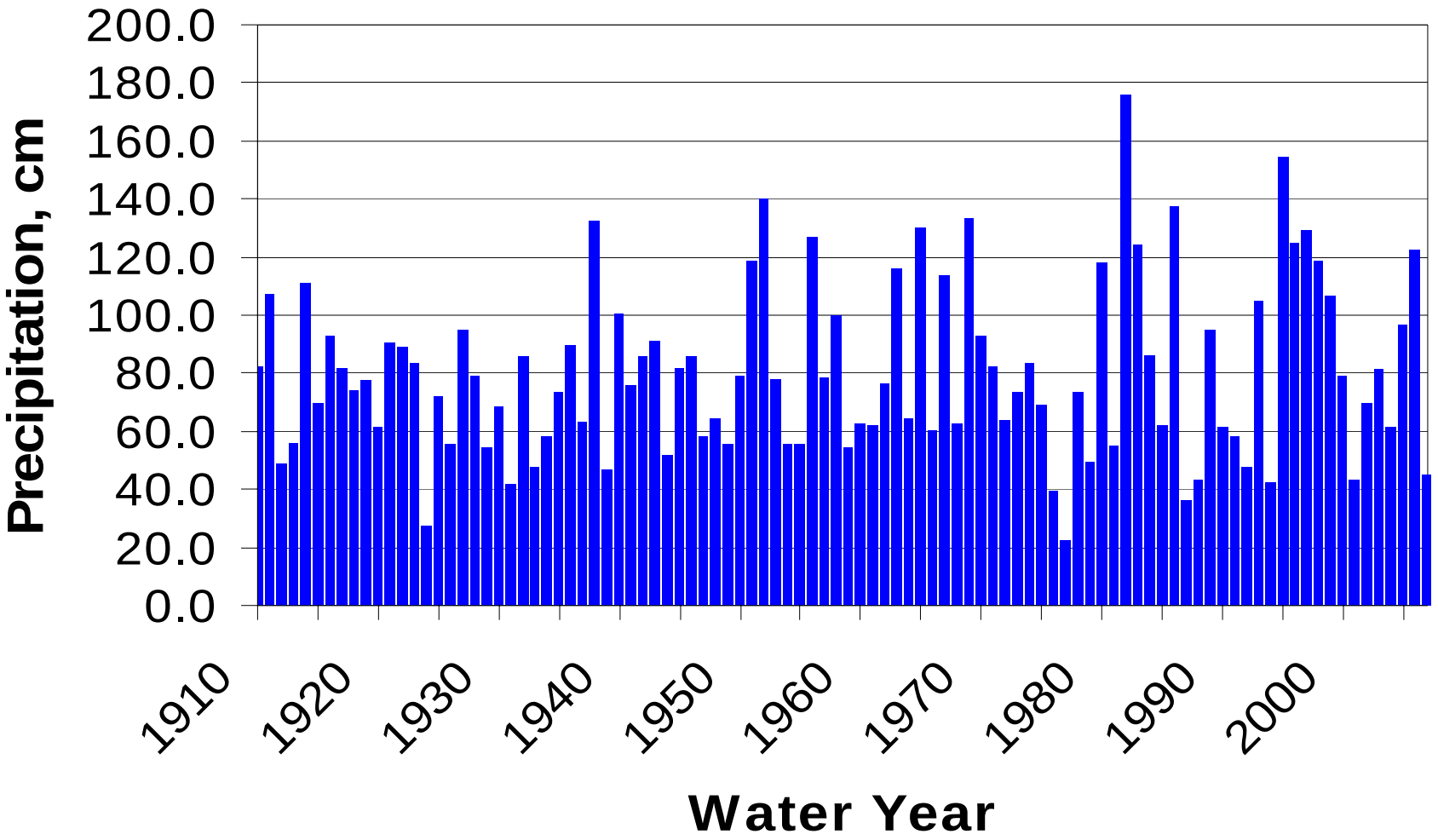



Percent of total annual precipitation as snow, based on Tahoe City precipitation and temperature data

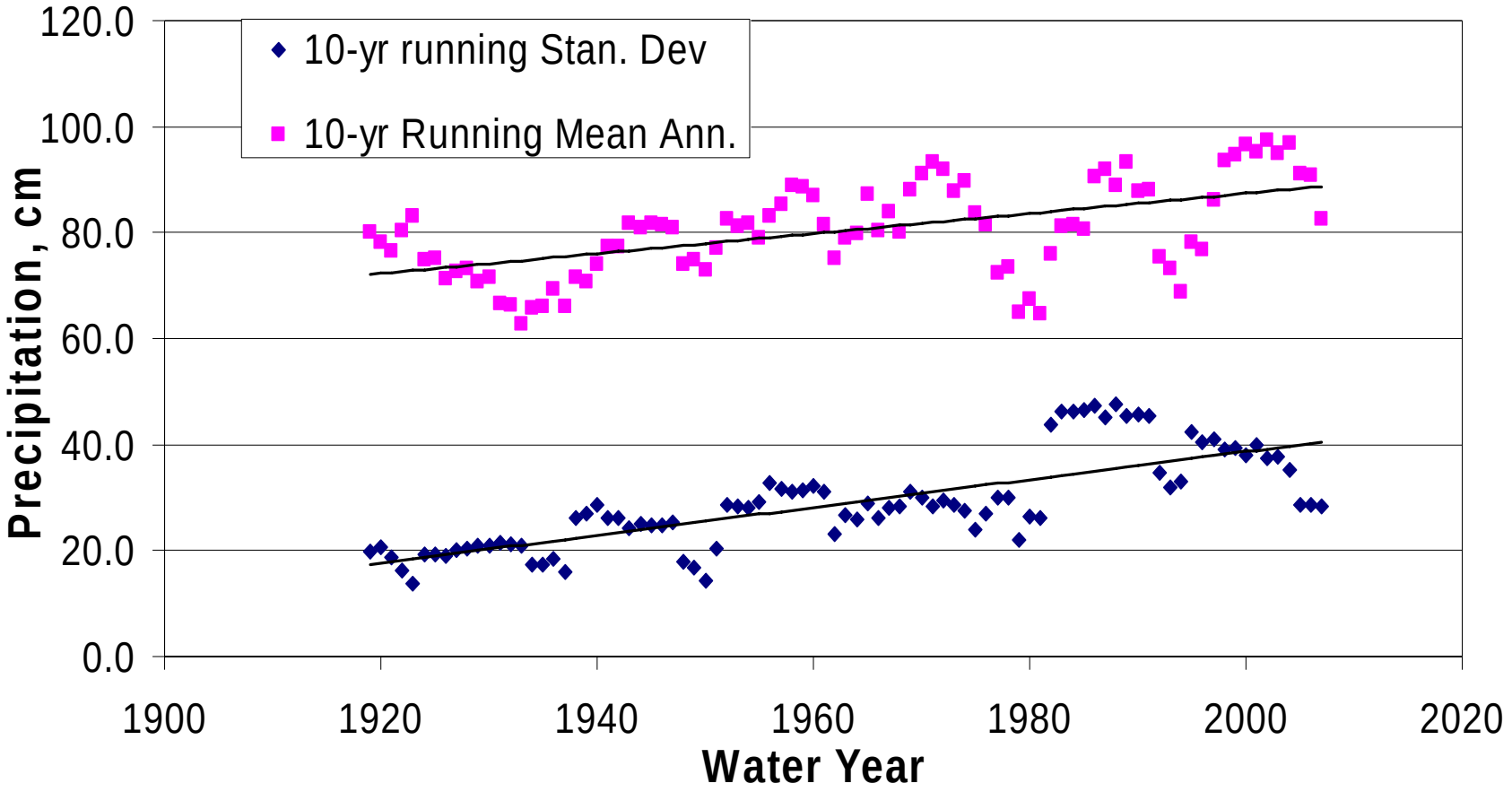


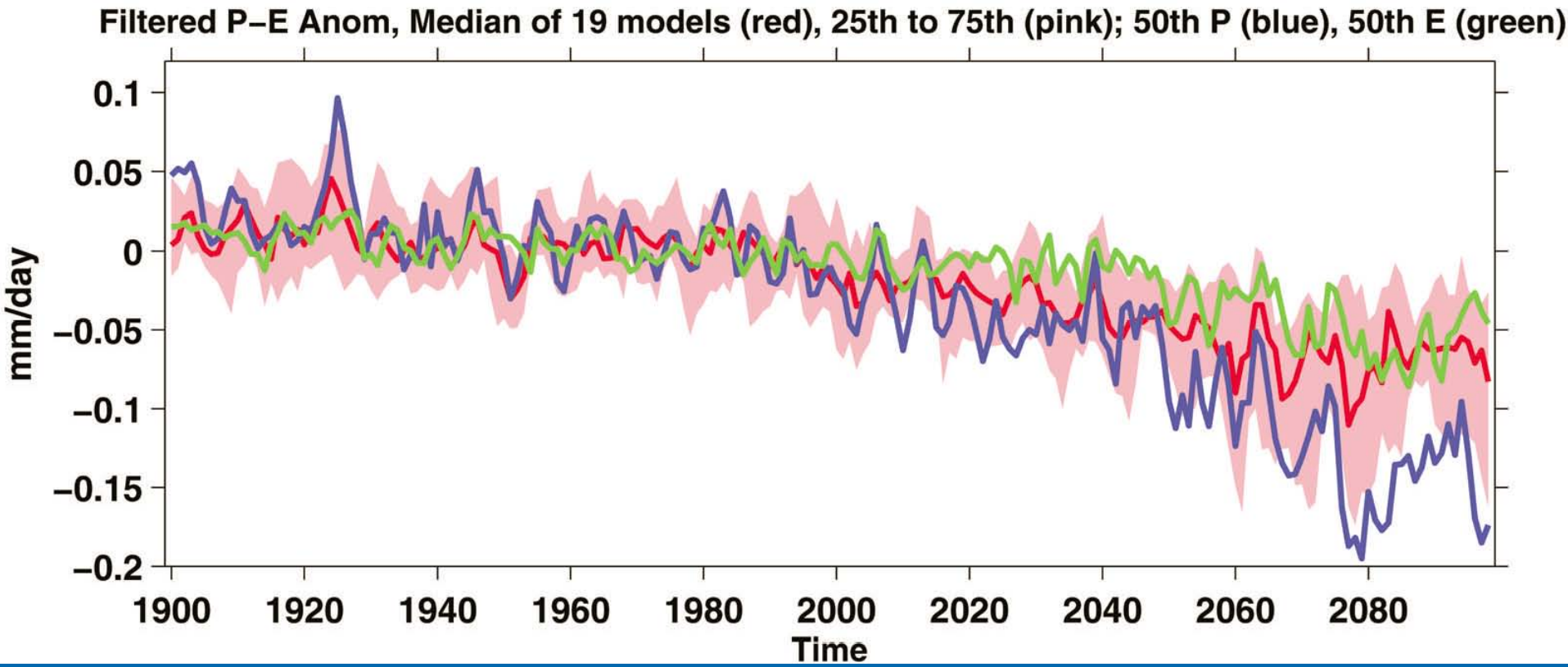

Linear trends in Nov-Mar total precipitation. Blue circles are positive, red circles negative, as percent change from predicted value at start of time period. From: Mote et al., 2005. *Bull. Am. Met. Soc. 86:30-45*

# Total Annual Precipitation at Tahoe City



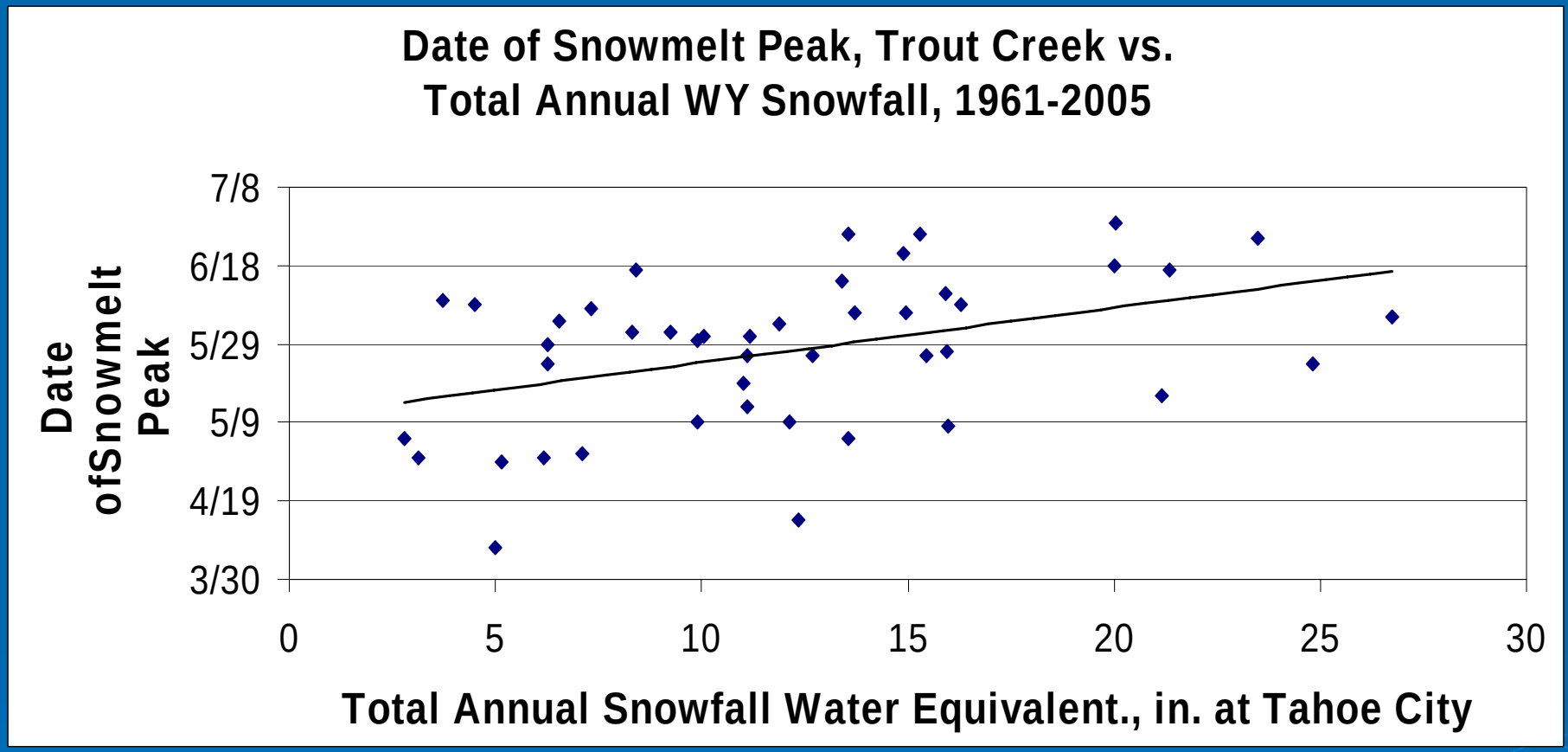
## 10-year Running Standard Deviation and Average of Total Annual Precipitation



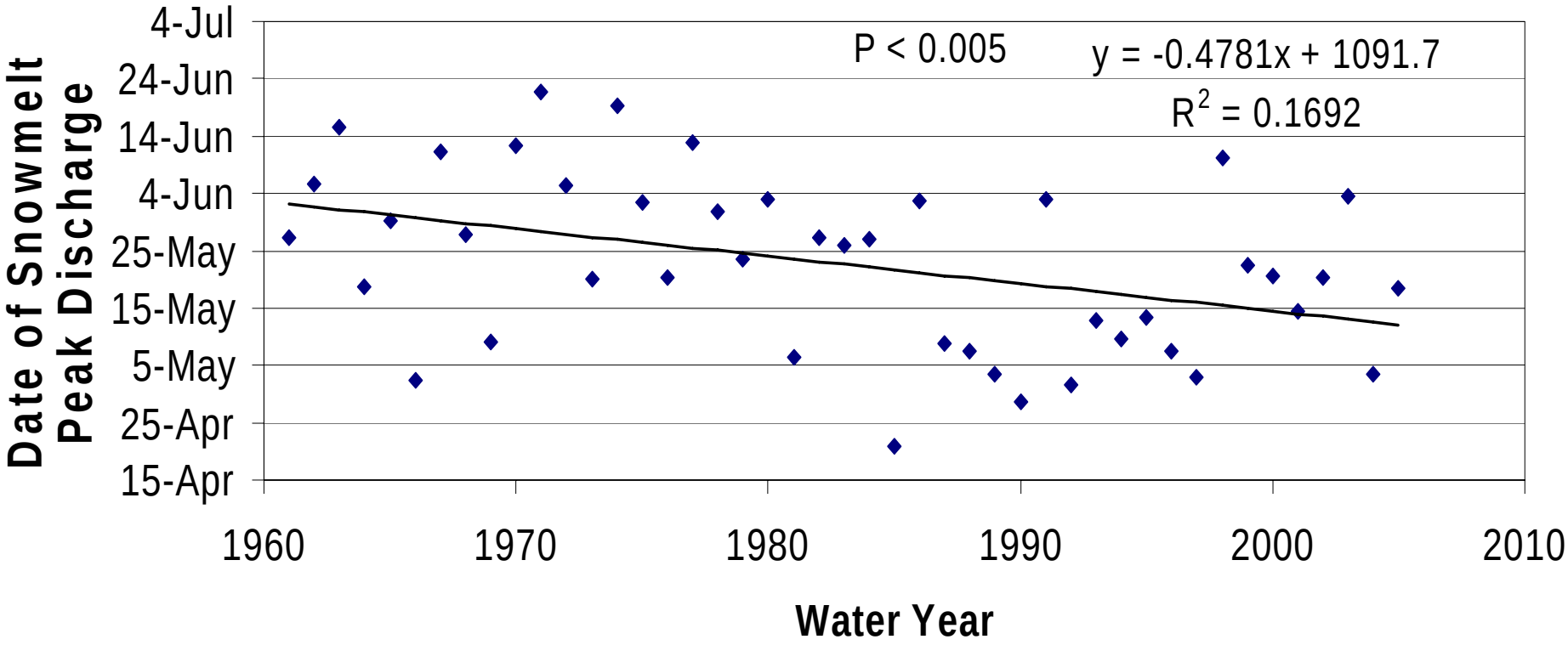



# Model Projections of an Imminent Transition to a More Arid Climate in Southwestern North America

Richard Seager,[1] Mingfang Ting,[1] Isaac Held,[2,3] Yochanan Kushnir,[1] Jian Lu,[4] Gabriel Vecchi,[2] Huei-Ping Huang,[1] Nili Harnik,[5] Ants Leetmaa,[2] Ngar-Cheung Lau,[2,3] Cuihua Li,[1] Jennifer Velez,[1] Naomi Naik[1]


Date of Snowmelt Peak, Trout Creek vs.
Total Annual WY Snowfall, 1961-2005
Date ofSnowmelt Peak
7/8
6/18
5/29
5/9
4/19
3/30
0
5
10
15
20
25
30
Total Annual Snowfall Water Equivalent., in. at Tahoe City

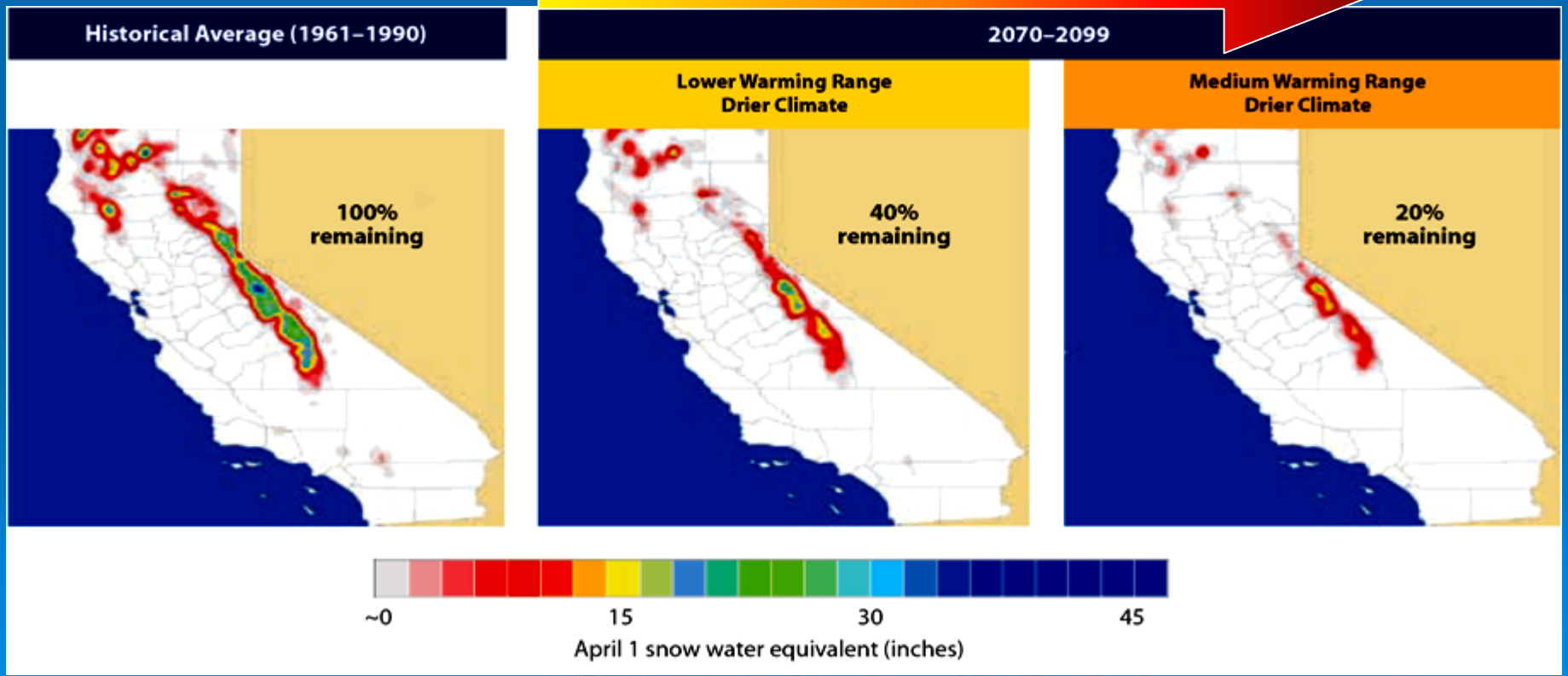
## Residual Snowmelt Peak for 5 Tahoe Basin Streams after removal of total annual snowfall effect




The date of the Snowmelt Peak is shifting toward earlier dates by about 0.5 days/yr (Ward, Blackwood,Trout, Third Creeks & U. Truckee R.)

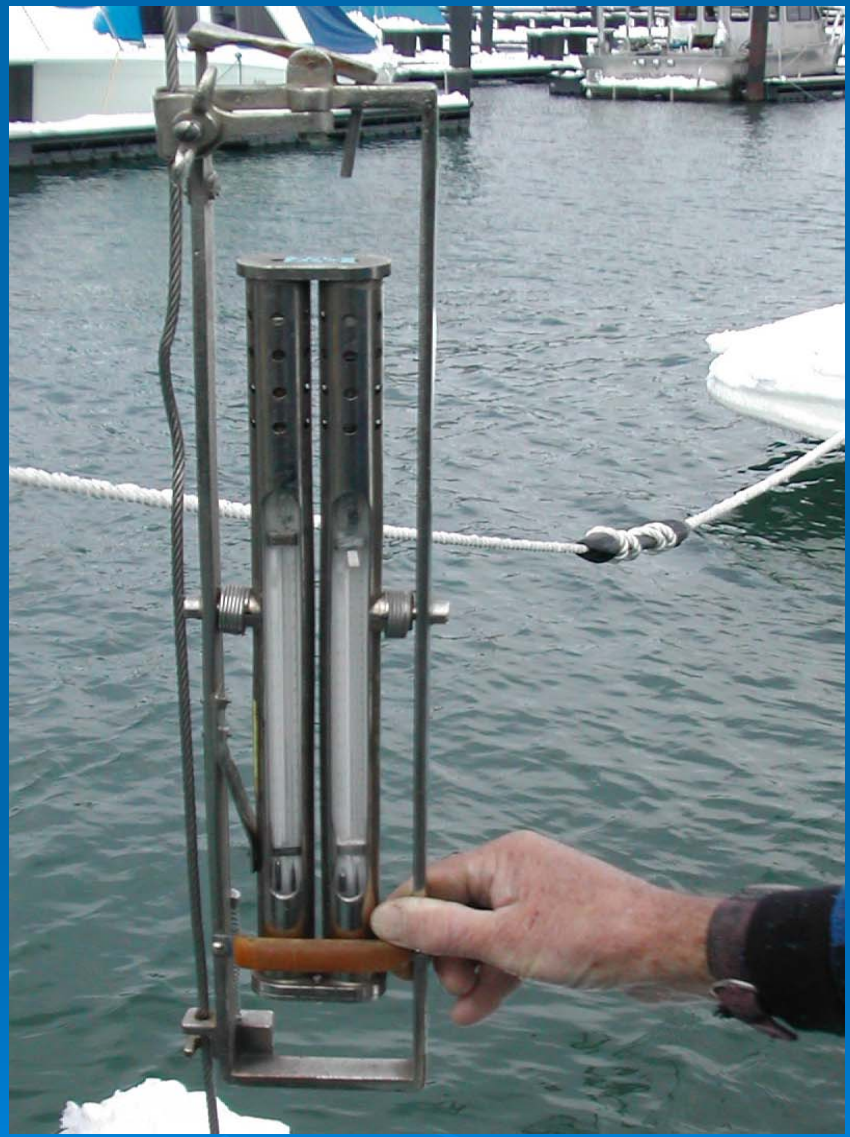
# Decreasing Snowpack

*Increasing Warming*



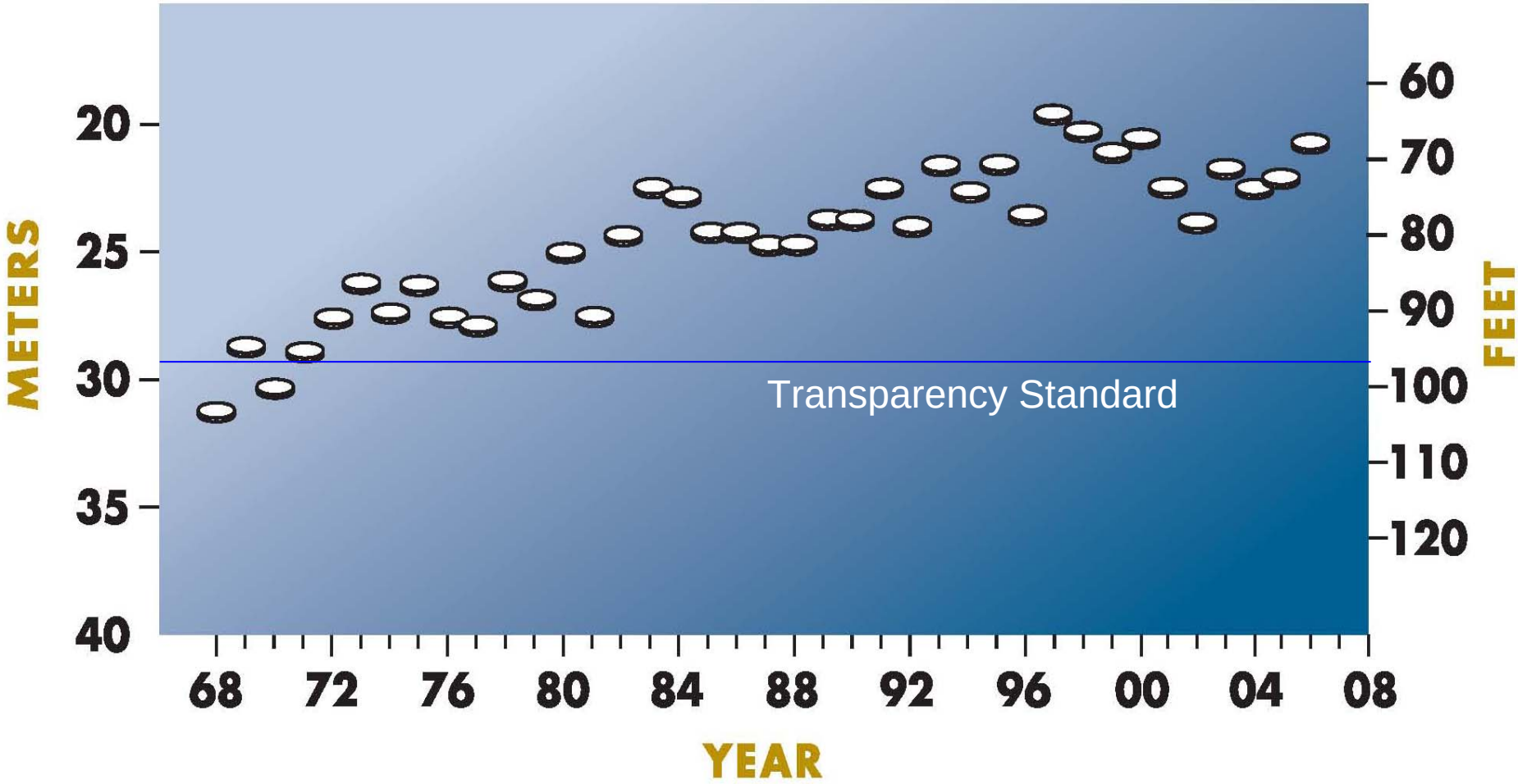

CA Climate Change Center Summary Report (2006)

The *R.V. John LeConte*

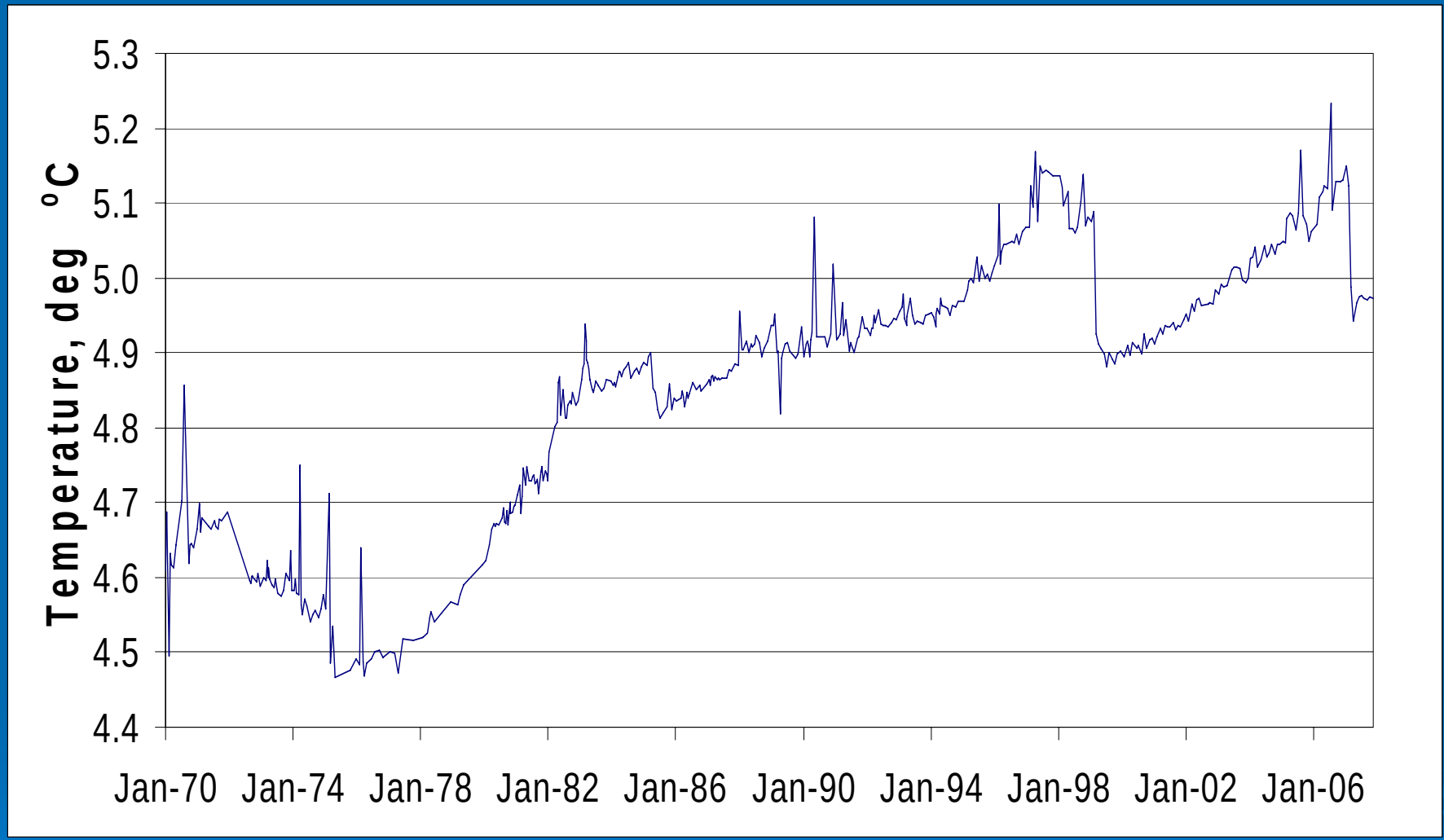


A reversing thermometer,
accurate to +/- 0.02 deg. C

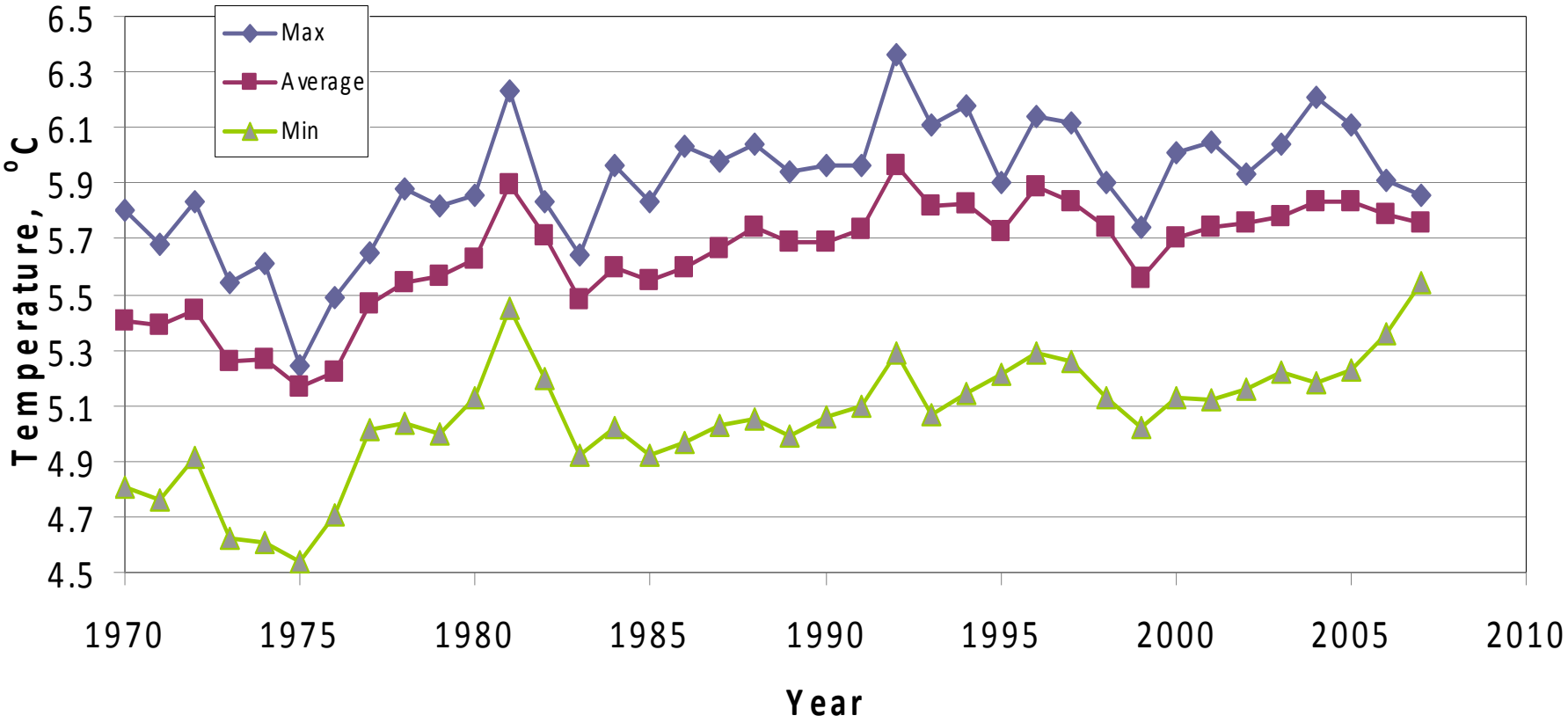
UCDAVIS
TAHOE ENVIRONMENTAL
RESEARCH CENTER



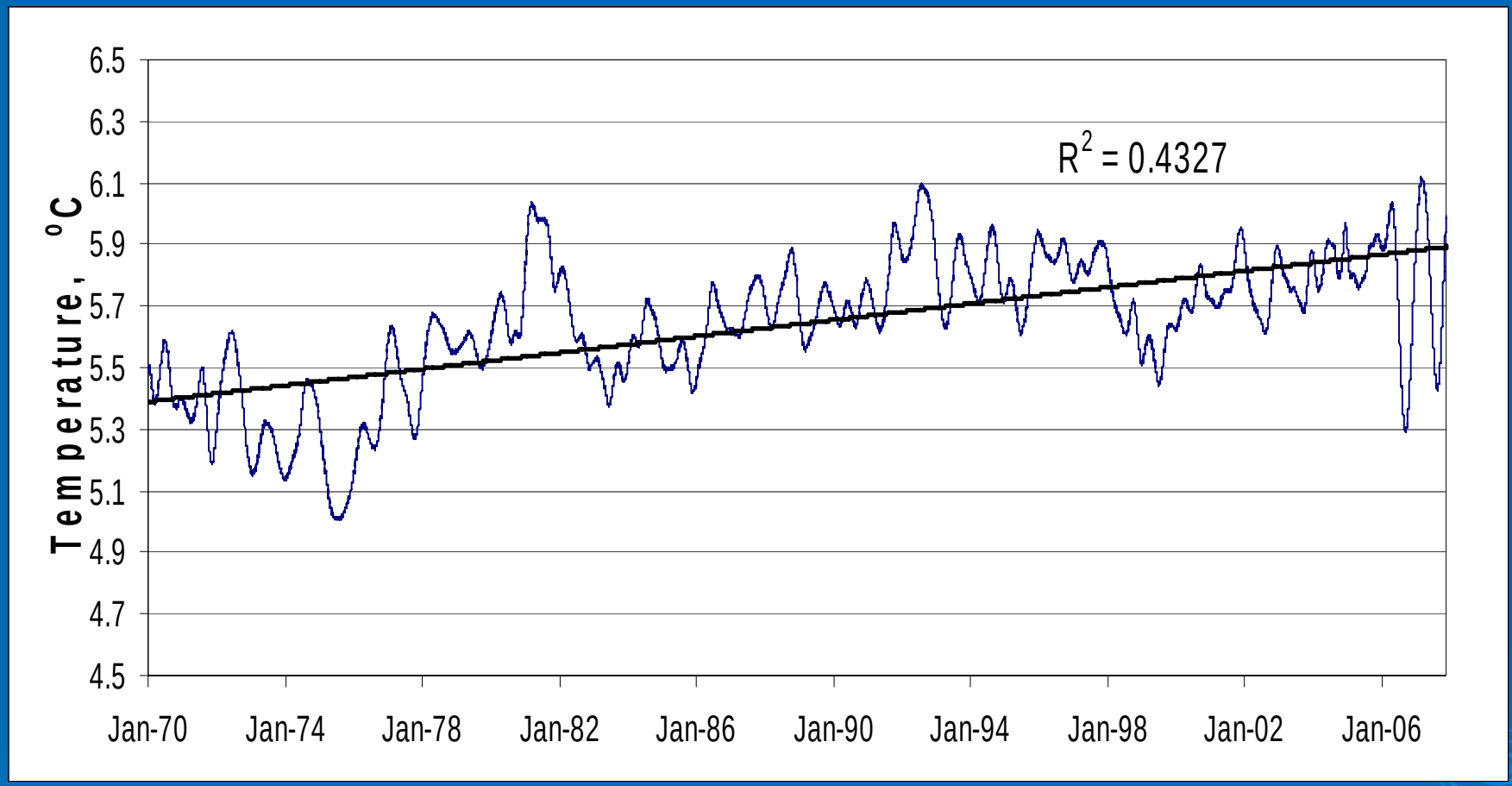

Lake Tahoe Secchi Depth—A measure of lake clarity



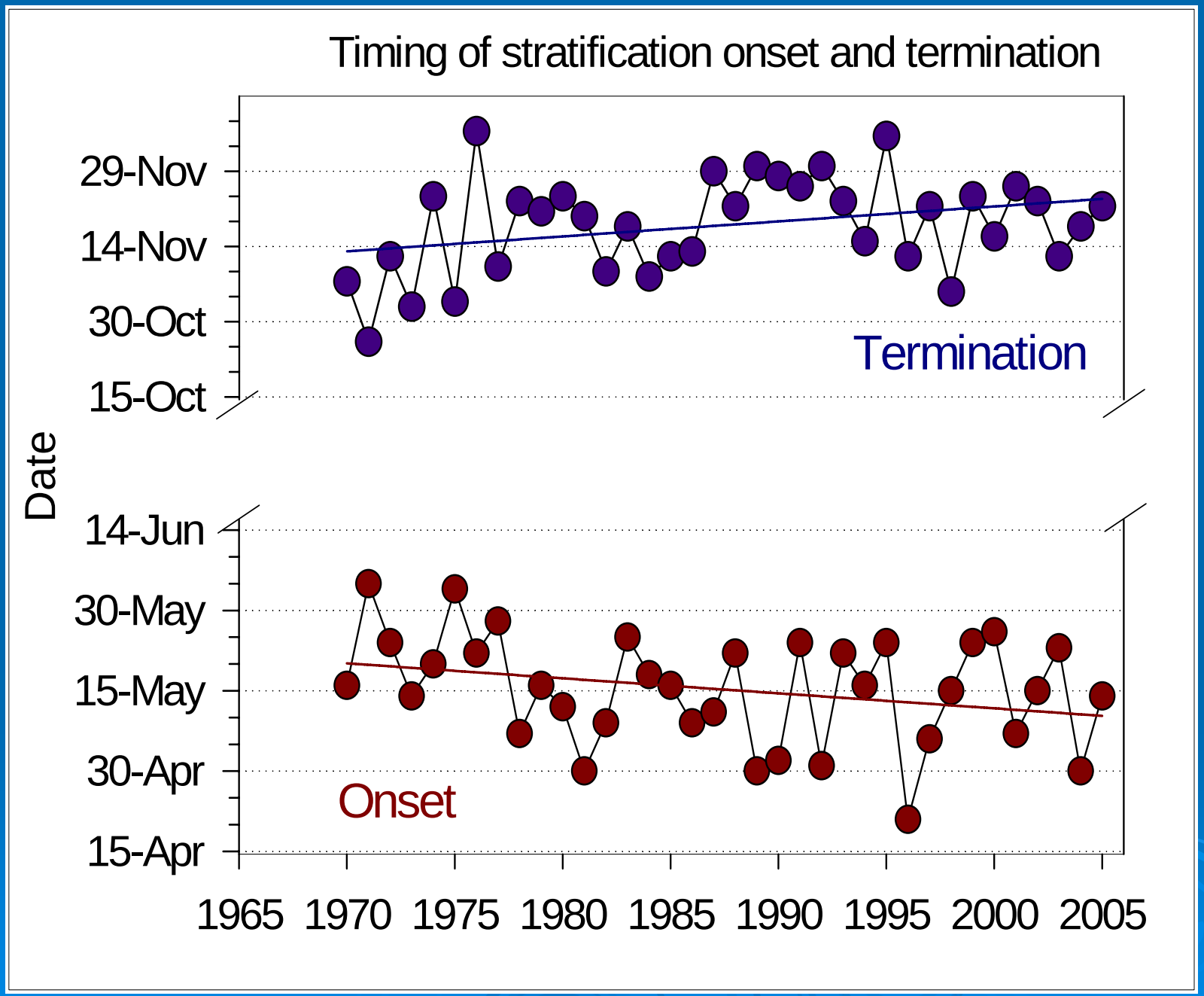

Temperature at 400 +/- 20 m in Lake Tahoe



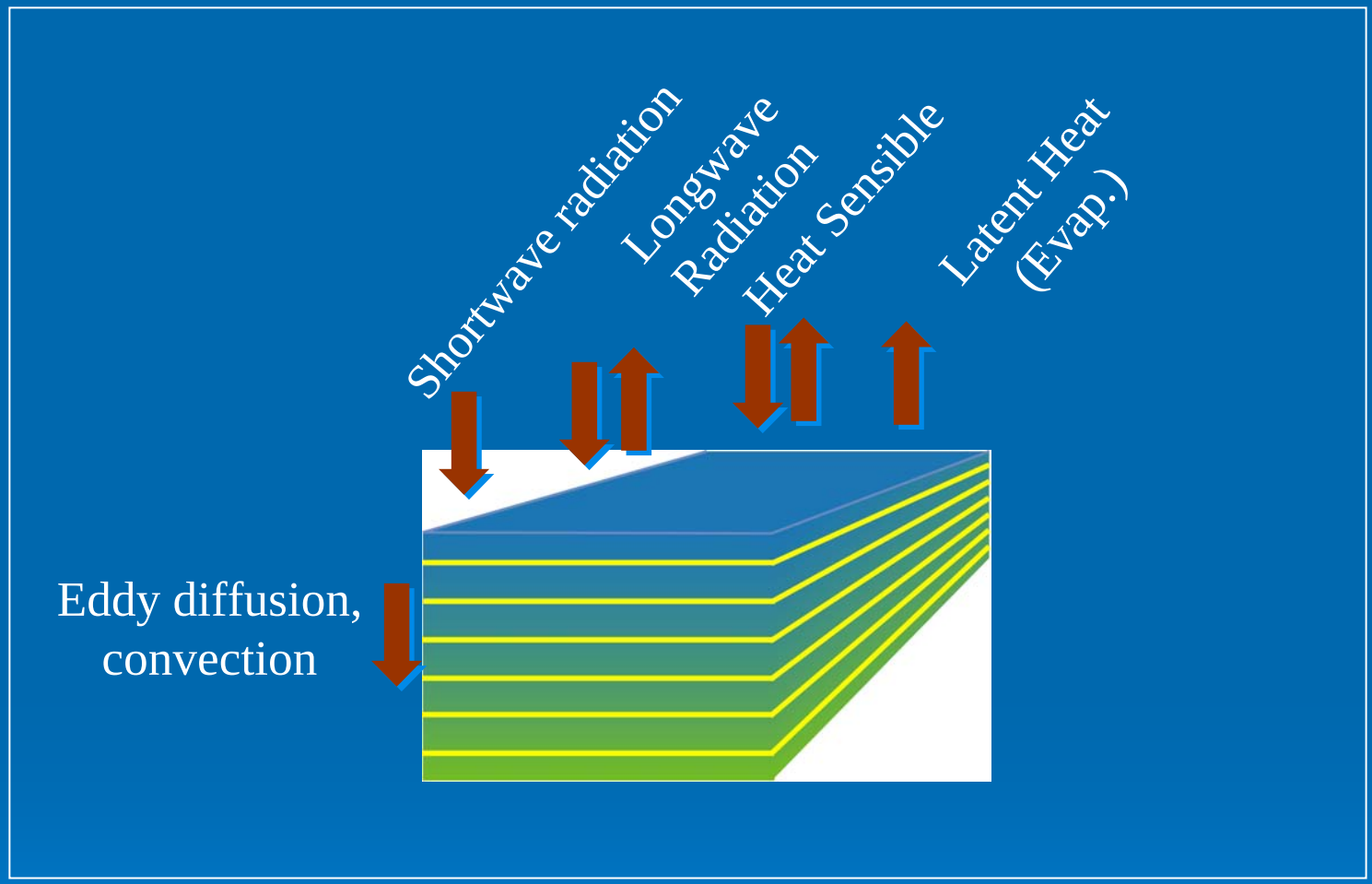

Annual maximum, average, and minimum of volume-averaged daily temperature of Lake Tahoe, 1970-2006




Volume-averaged daily temperature of Lake Tahoe, de-seasonalized




Source: Monica Winder



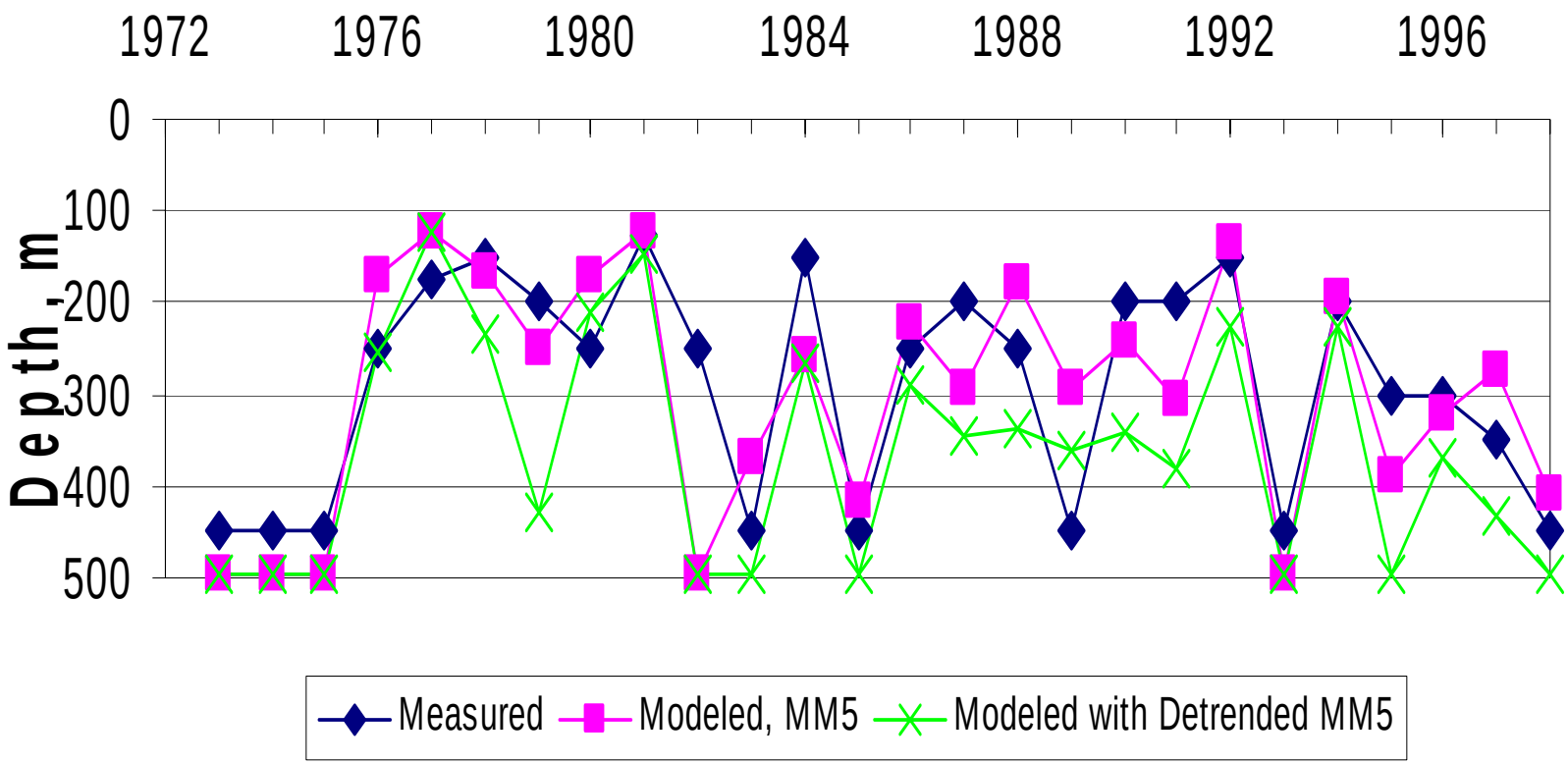

Schematic of Dynamic Lake Model

# Detrending Experiments with DLM

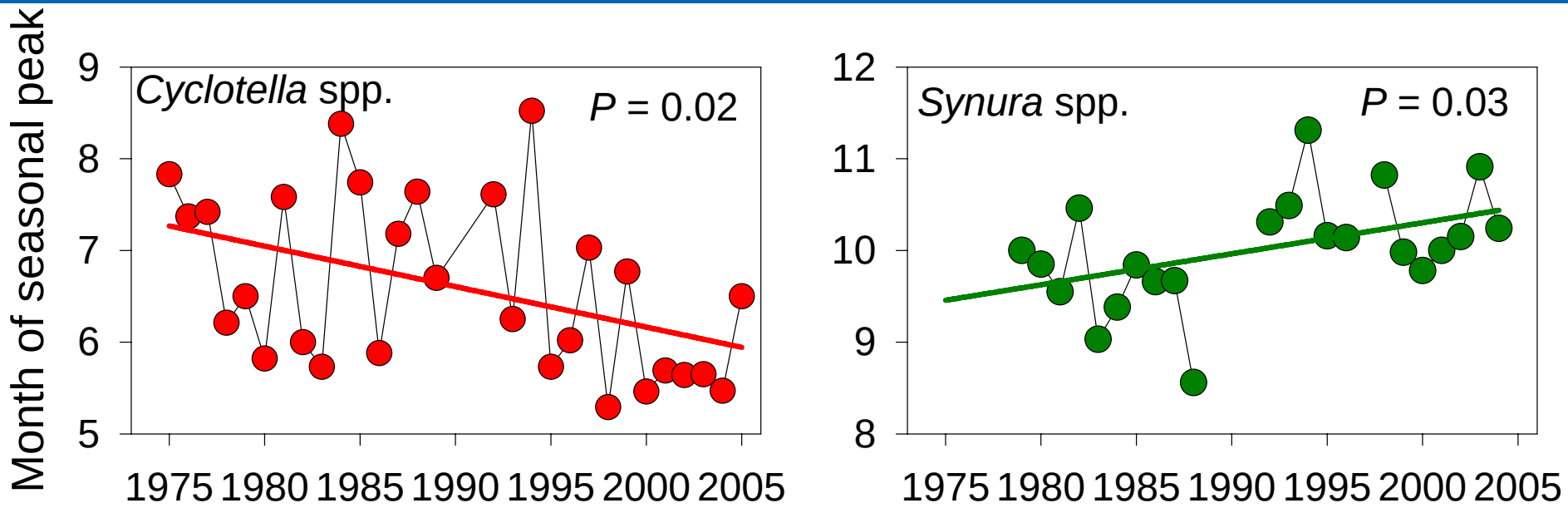
30-yr change in ave. lake temperature (ºC) with:

| | |
|---|---|
| Longwave rad trend only: | 0.17 |
| Air temp. trend only: | 0.38 |
| Both factors: | 0.44 |
| Neither factor: | -0.08 |
| Measured increase: | 0.52 |

# Maximum Mixing Depth , Measured and Modeled



# Change in timing of spring and fall peaks of most dominant phytoplankton genera in Lake Tahoe




Source: Monica Winder

# Possible Implications of Increased Temperature and Thermal Stability in Lake Tahoe

- Increased residence time of fine particulates in epilimnion
- Increasing decline in lake clarity
- Decreased downward flux of DO
- Ultimately, anoxia at sediment surface, and release of SRP to the water column
- Thermal refugium for Cladocerans
- Changes in timing of phytoplankton blooms
- Alien invasions

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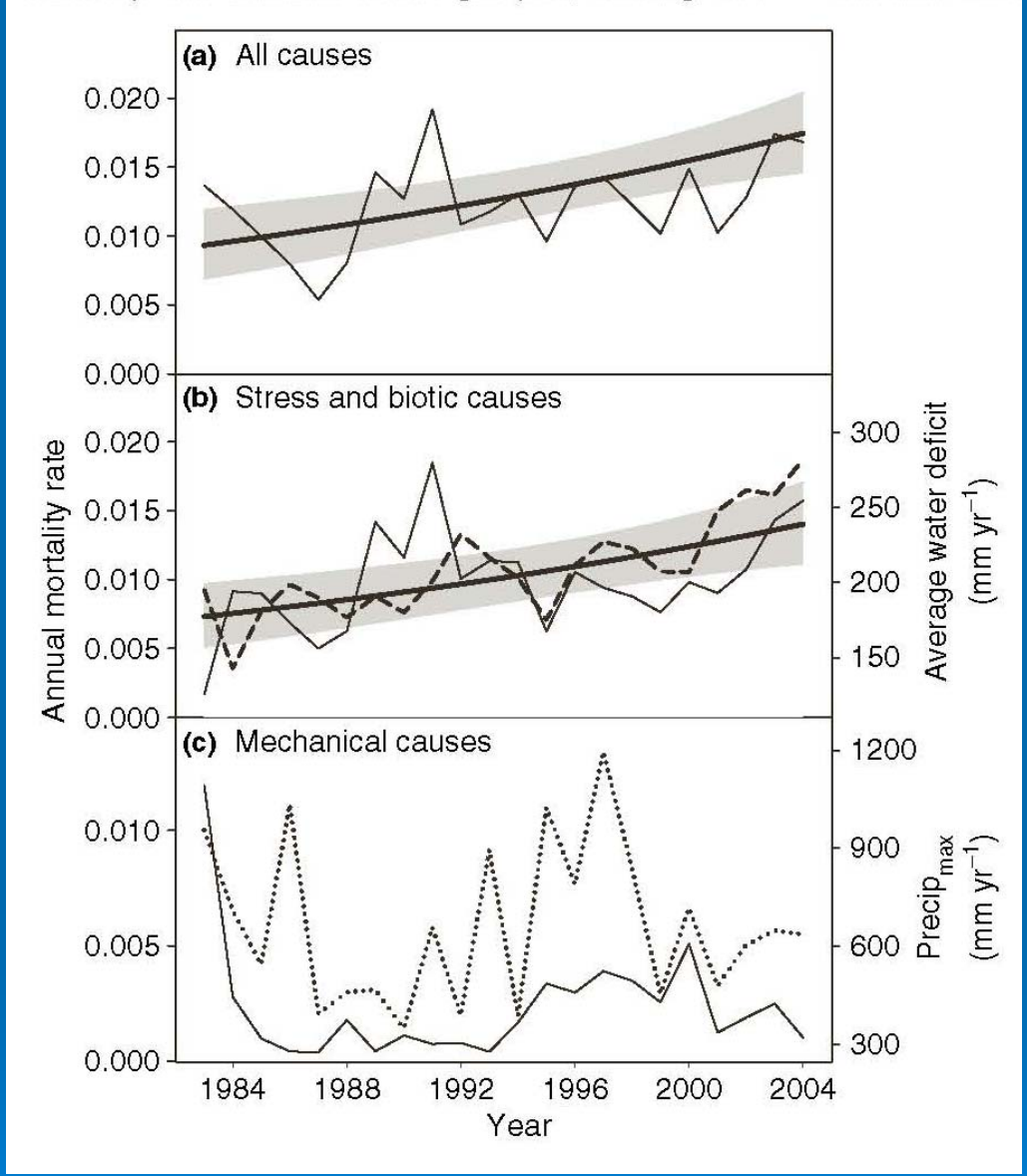
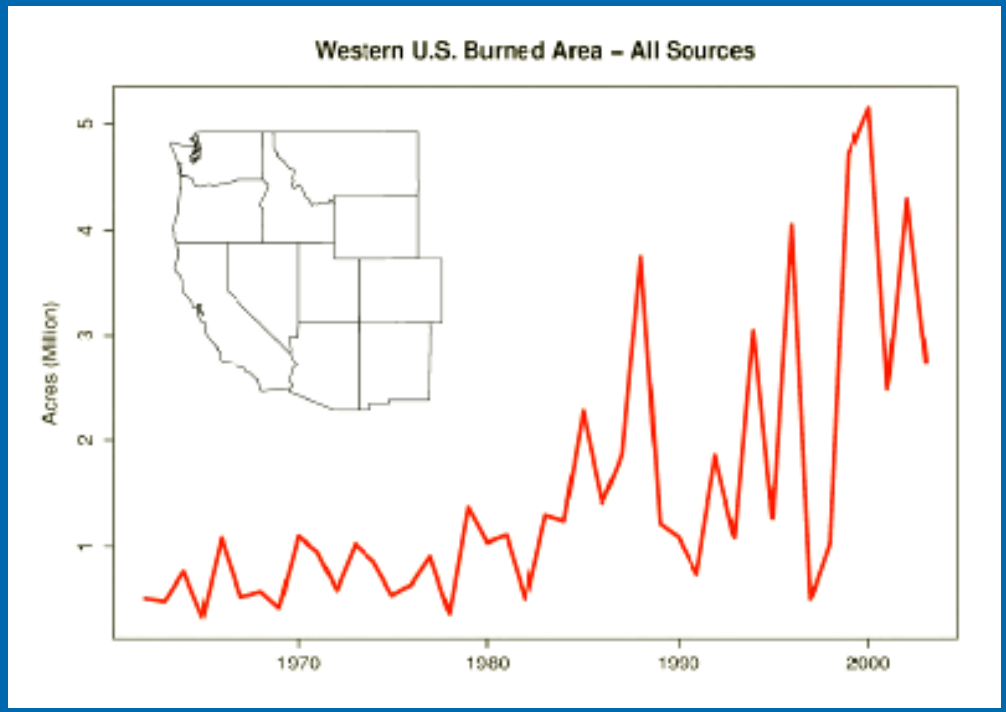
Photo by Steve DeVries

# The Angora Fire, 2007

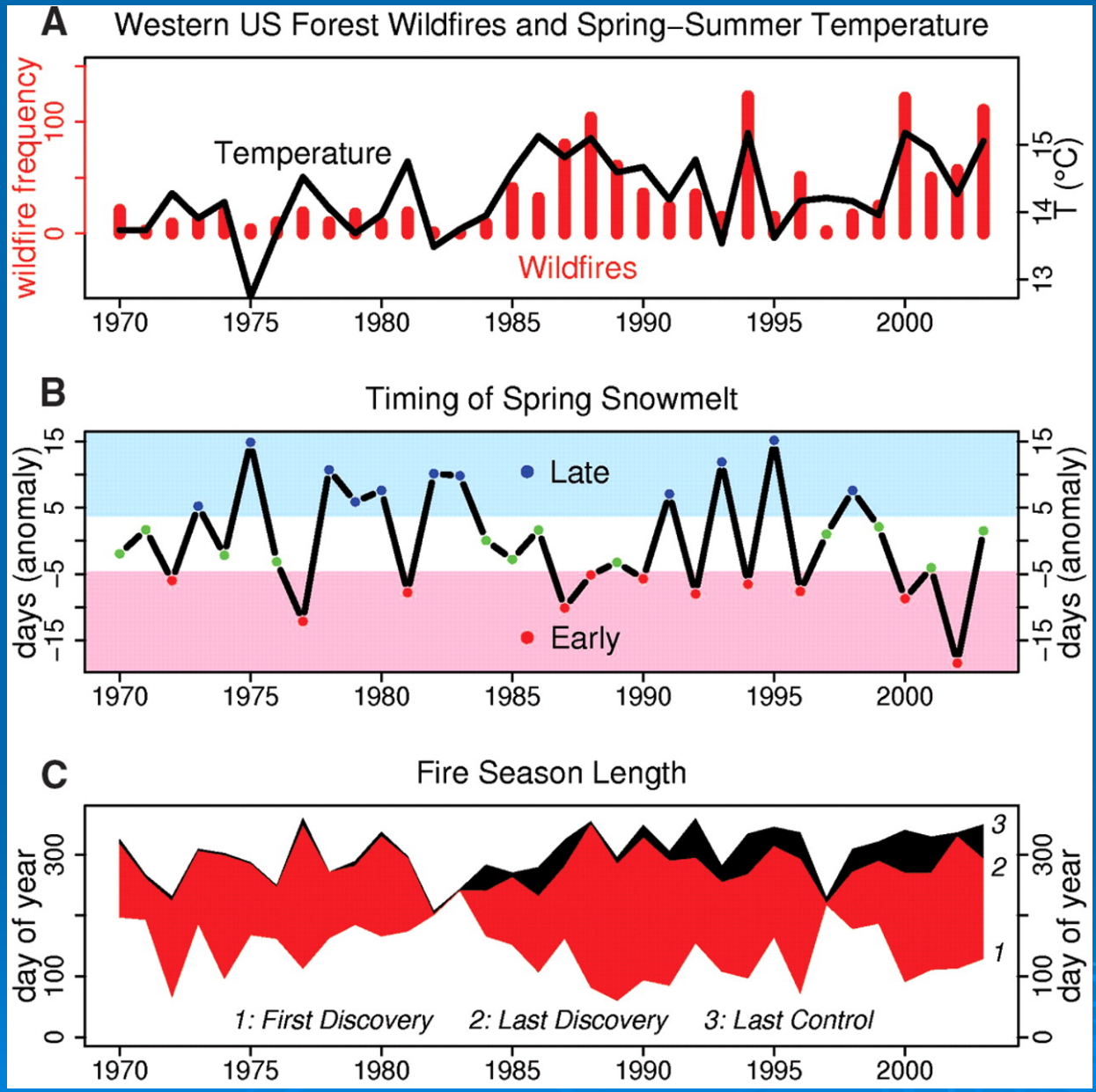



----- water deficit
____ mortality
…… precip

Tree mortality in the Sierra Nevada is sensitive to a temperature-driven index of drought. From: van Mantgem & Stephenson, 2007. *Ecology Letters* 10: 909-916

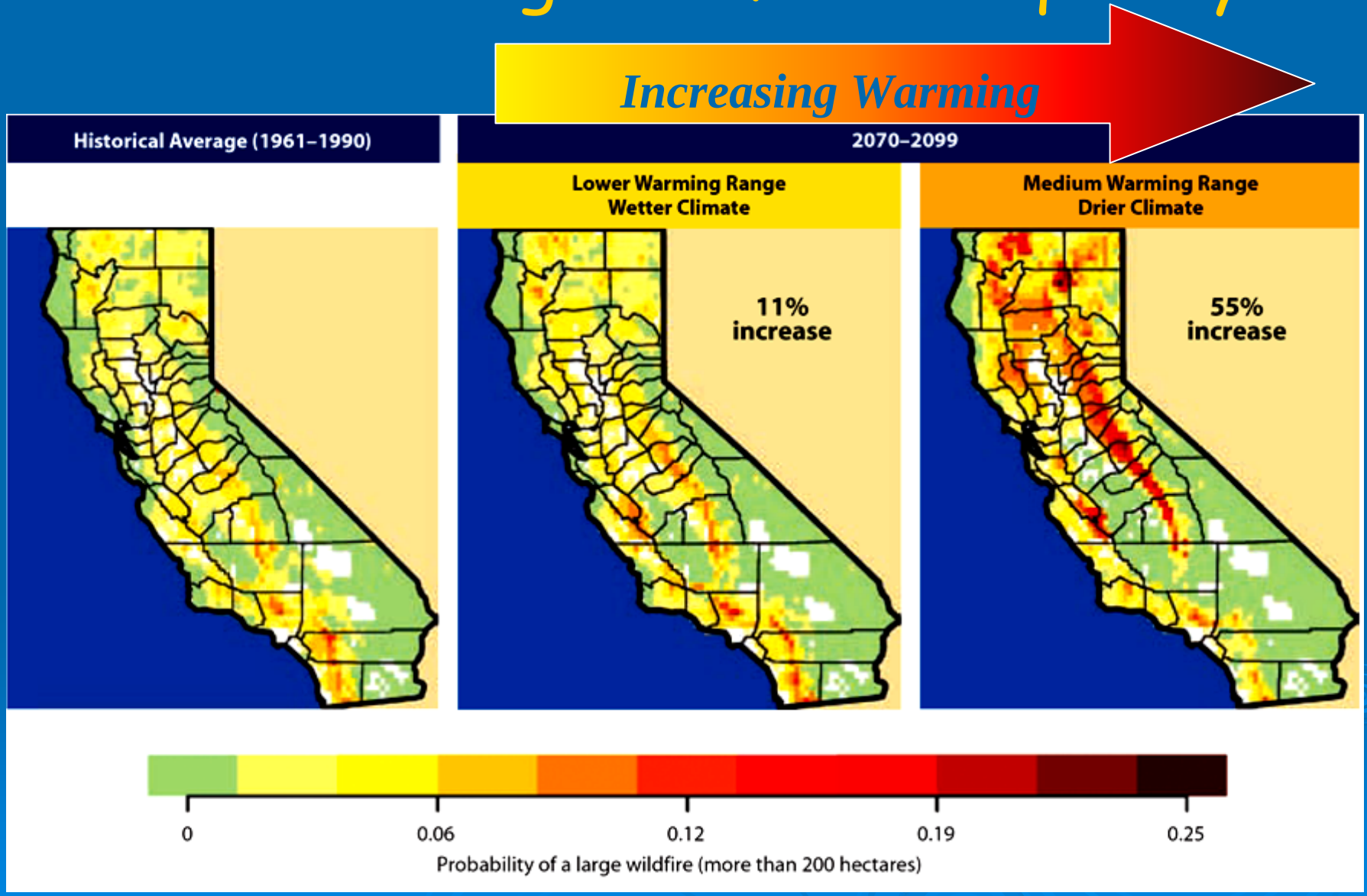




Westerling et al. 2006. Warming and early spring increases western U.S. Wildfire activity

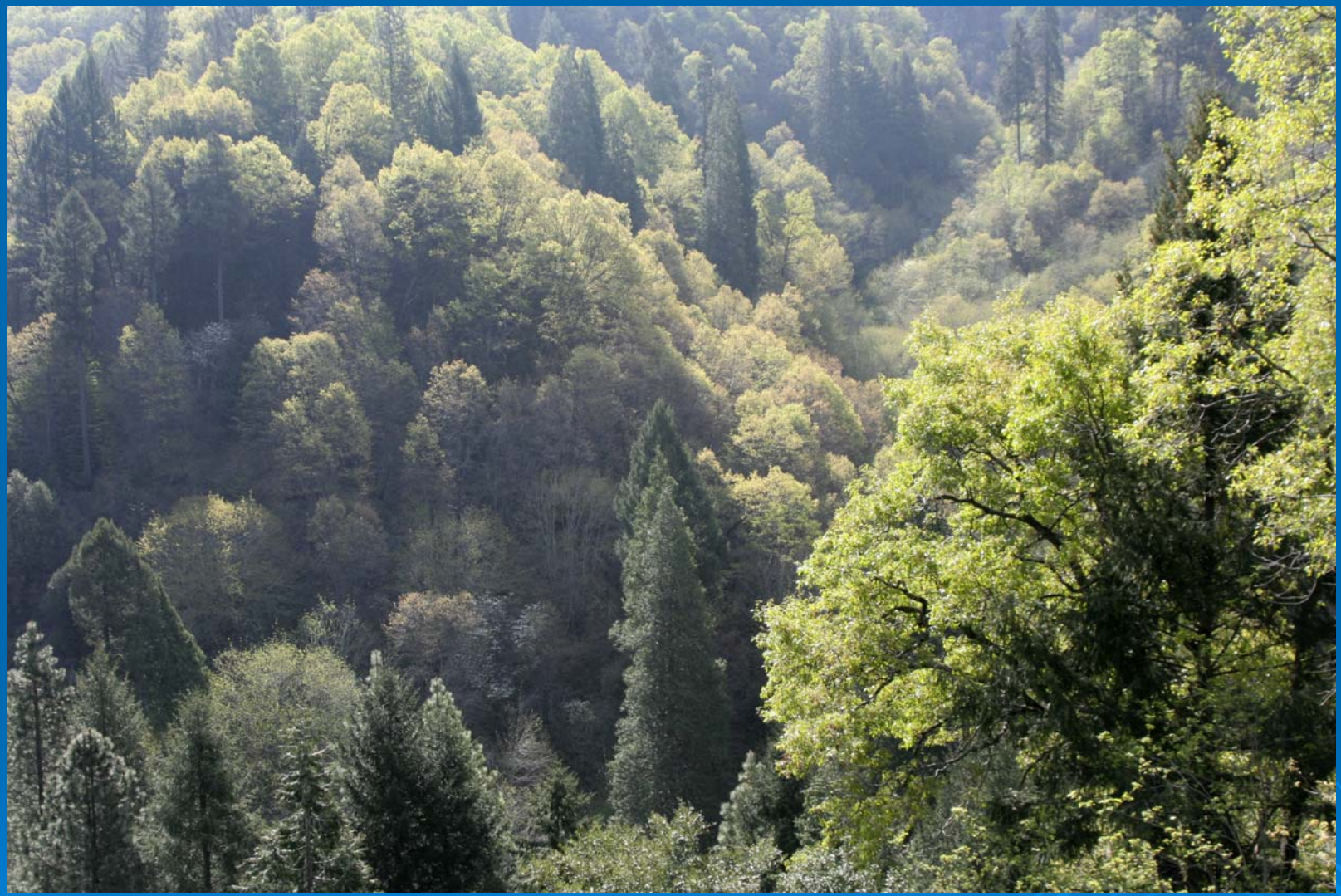



Westerling et al. (2006) Warming and early spring increases western U.S. Wildfire activity

# Increasing Wildfire Frequency

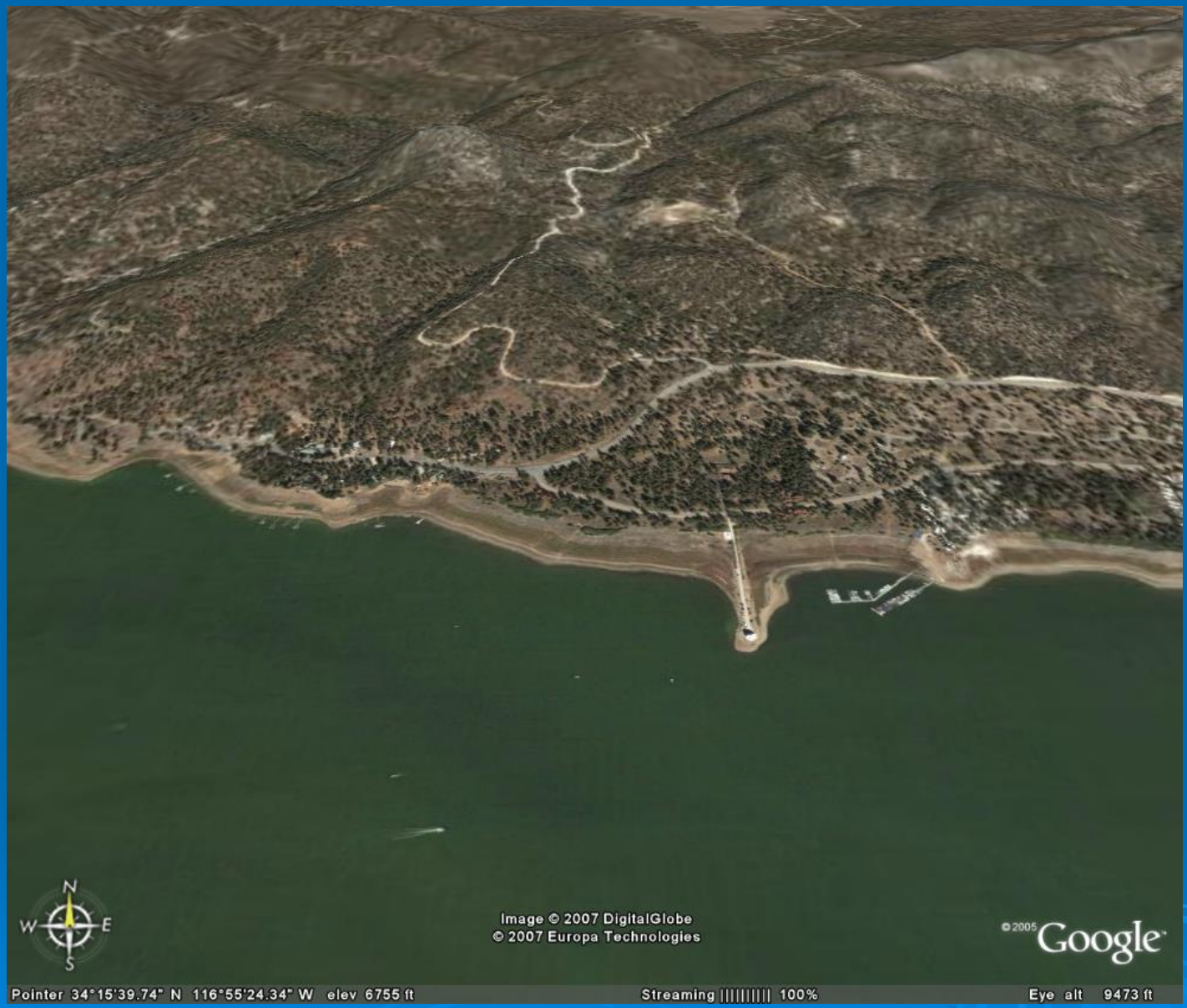



CA Climate Change Center Summary Report (2006)



Is This the Future Tahoe Forest??

Or this?


N
W
E
S
Image © 2007 DigitalGlobe
© 2007 Europa Technologies
© 2005 Google
Pointer 34°15'39.74" N 116°55'24.34" W elev 6755 ft
Streaming 100%
Eye alt 9473 ft

Or This?

# What Can We Expect in the Future?

- Diminishing snowpacks, earlier snowmelt
- Wetter wet years, drier dry years
- Stressed vegetation
- Increased risk of wildfire
- Increased sediment load to the lake; longer retention near surface
- Invasions by alien species, both terrestrial and aquatic

# What Should We Do in the Tahoe Basin to Get Ready for a Warmer Future?

- Operational studies for small water systems (Marlette Lake) w/o snowpack
- Aggressive vegetation management to reduce fuel loads (not cheap!)
- Begin planning for the future forest
- Develop programs to control alien invasions
- Reduce $CO_2$ emissions (public transit, etc.)

# Some Resources on Climate Change

- http://www.climatechoices.org
- http://www.climatecrisiscoalition.org
- http://www.ipcc.ch
- http://www.climatechange.ca.gov
- ftp-dom.earthlink.net

  User ID = ftp@hydroikos.com

  Password = spartina

  Path = /Public/Climate Change