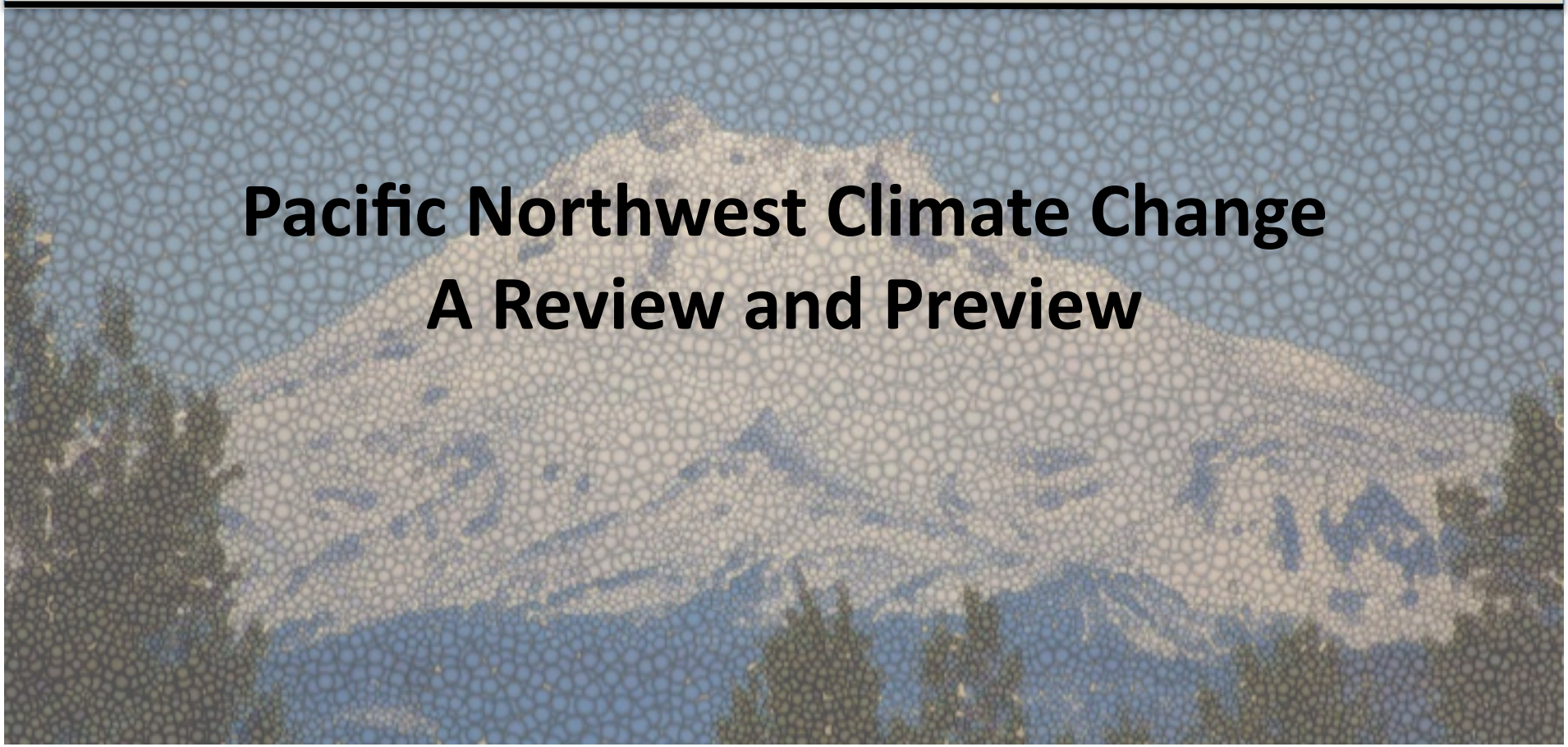


# Pacific Northwest Climate Change
# A Review and Preview

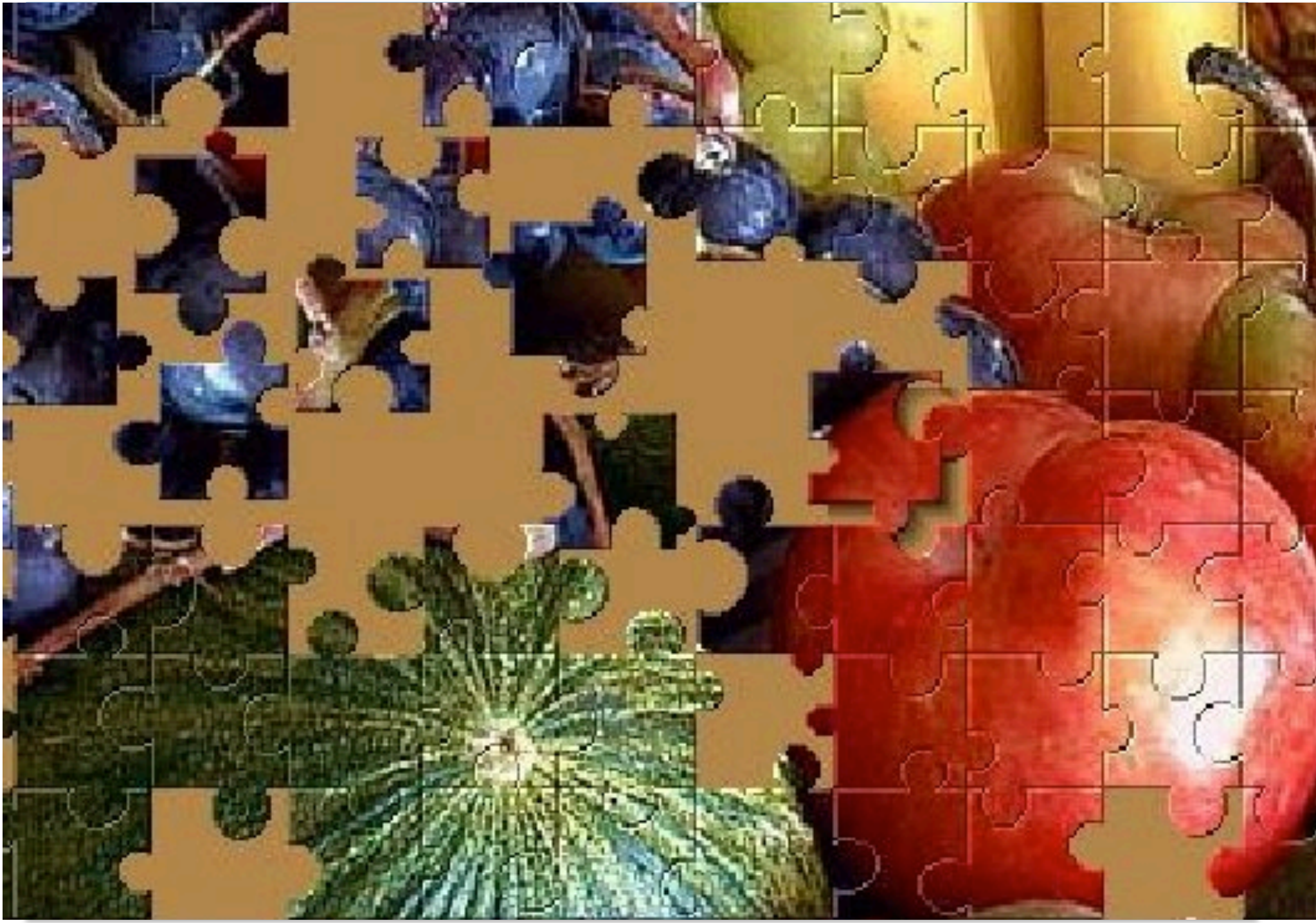

CIRC
Climate Impacts Research Consortium

**John Abatzoglou**

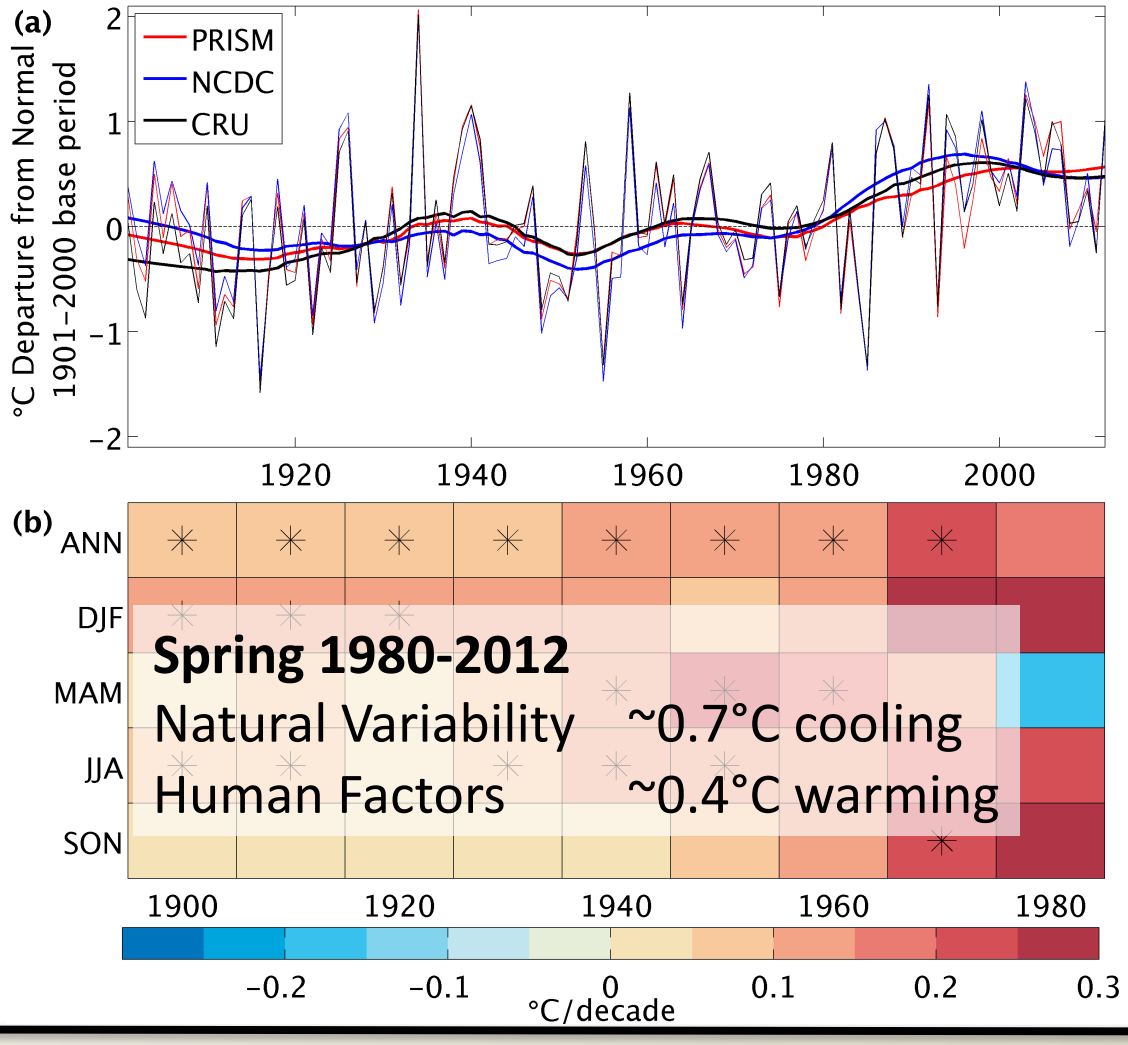
**Department of Geography**

REACCH
Regional Approaches to Climate Change – Pacific Northwest Agriculture

University of Idaho



# Observed Changes in Temperature US Pacific Northwest



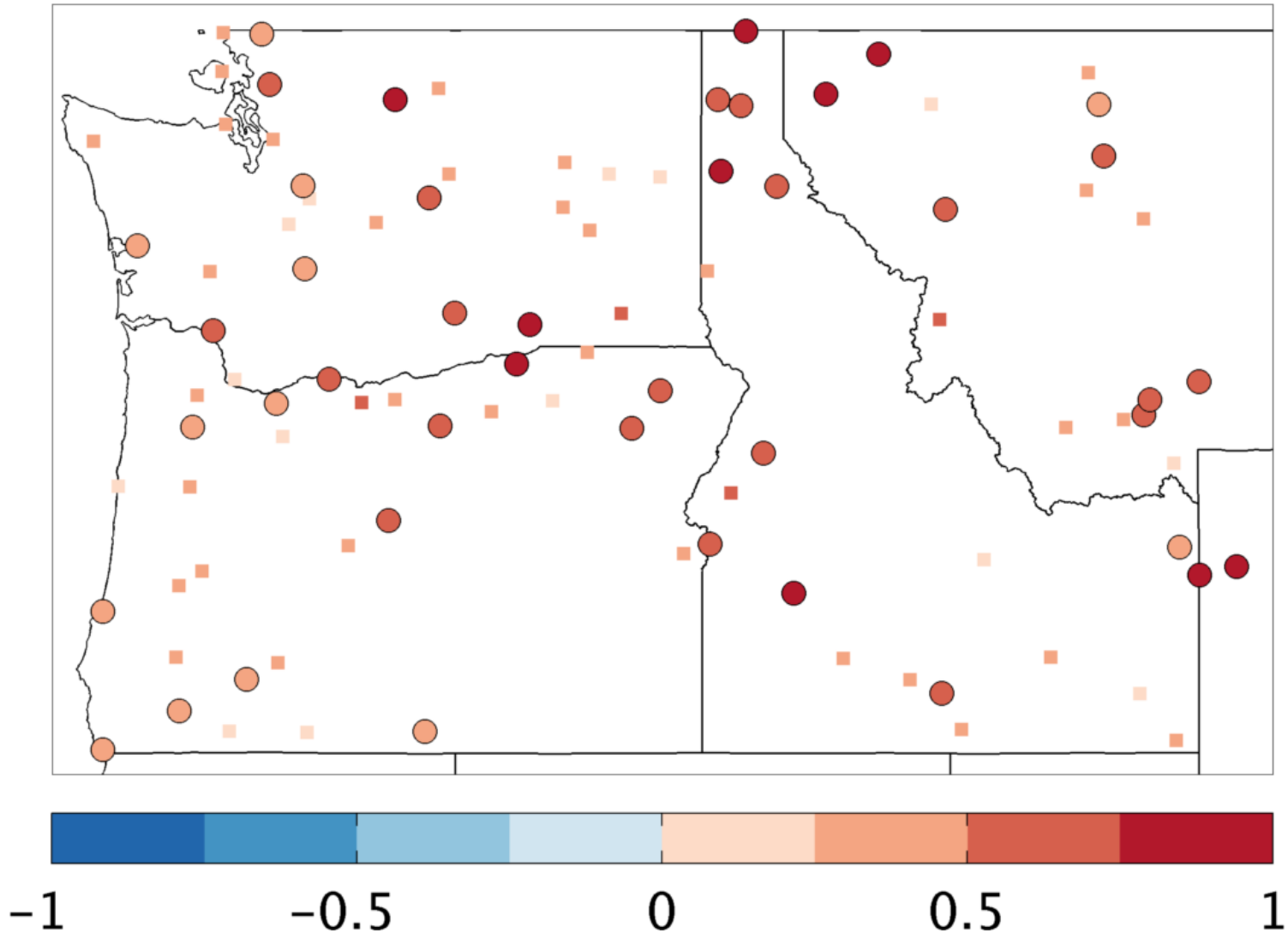

Linear trends for season through 2012 commencing at different decades

* Denotes statistically significant



Abatzoglou et al., 2014 JCLI

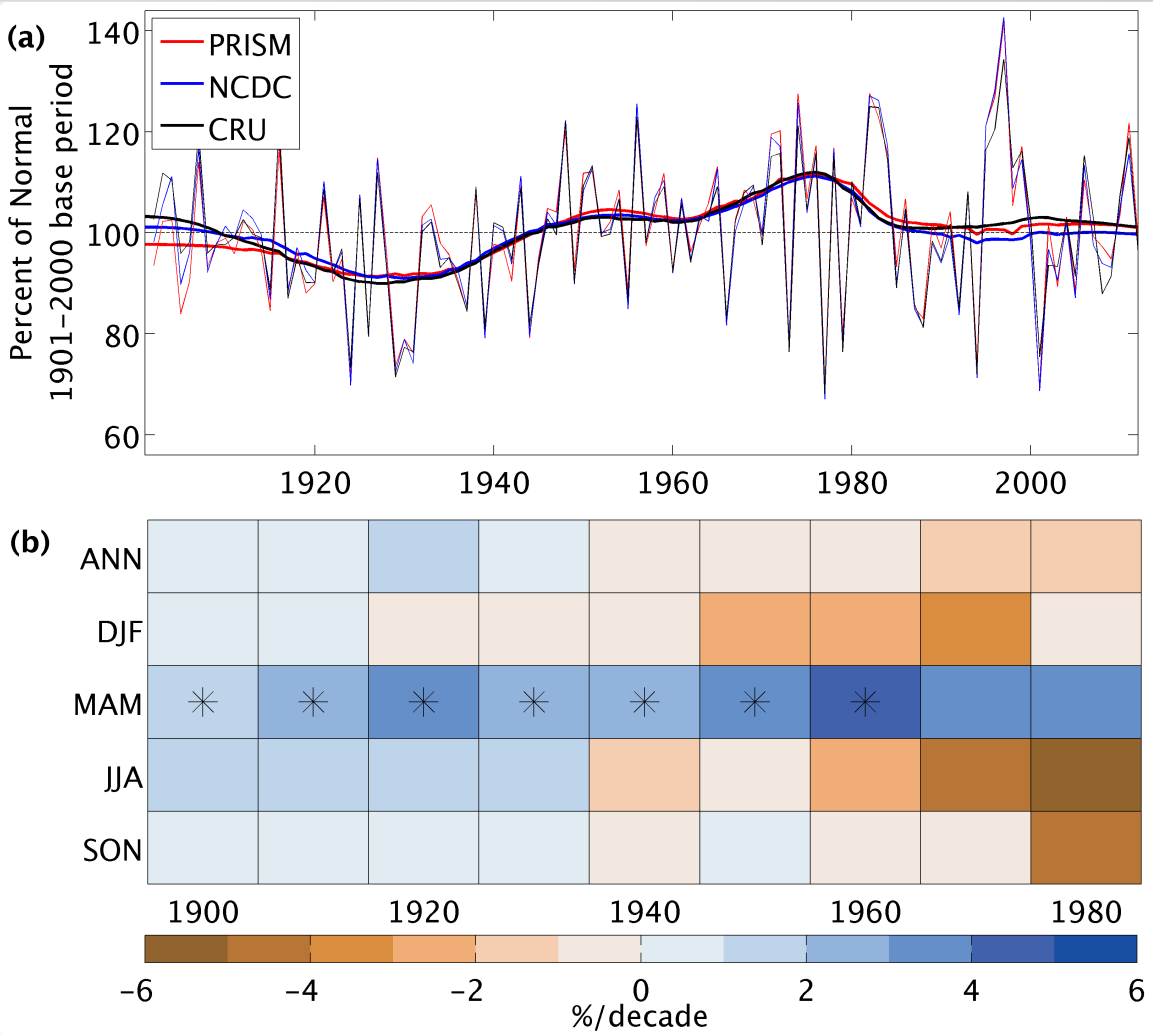
# Coldest night per winter
# Linear trend (°C/decade) 1920–2012




Circles = Statistically Significant

Abatzoglou et al., 2014 JCLI

# Observed Changes in Precipitation
# US Pacific Northwest




Linear trends for season with different starting years through 2012

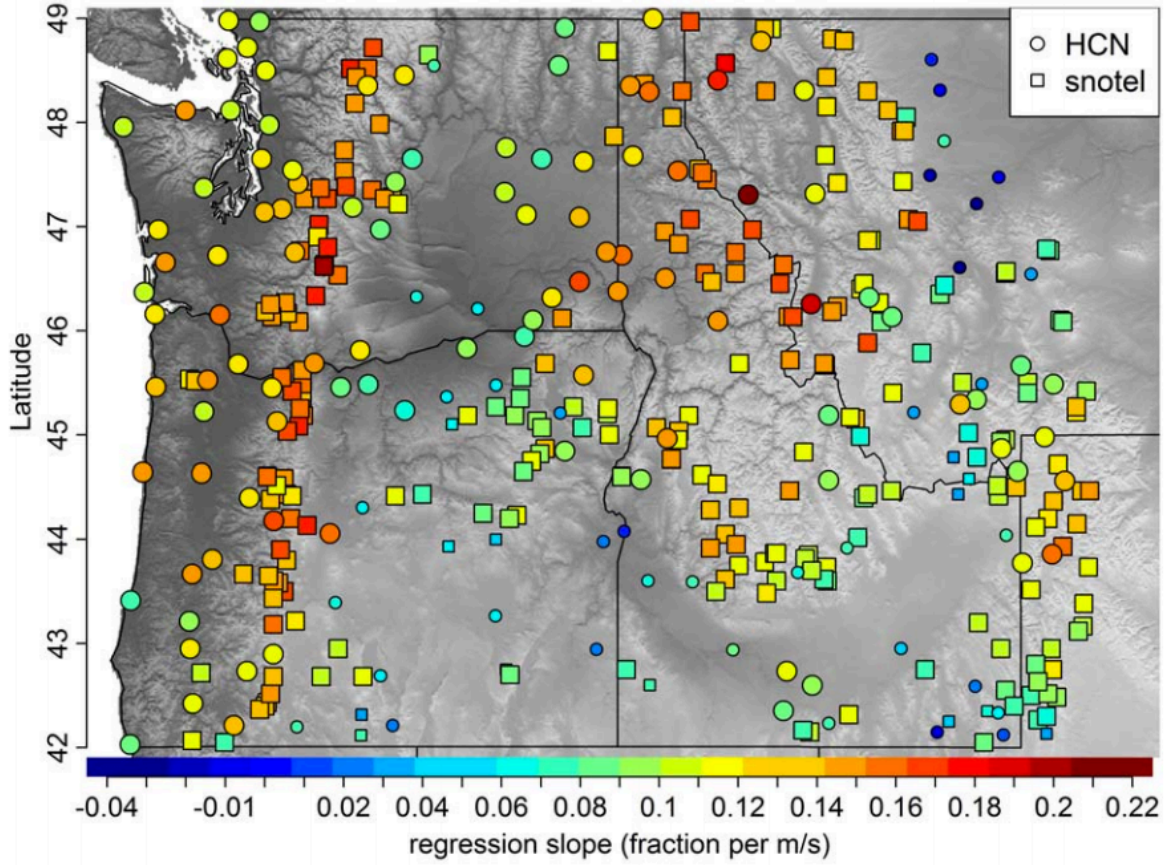
* Denotes statistically significant



Abatzoglou et al., 2014 JCLI

# Regional Sensitivity of Precipitation to Winds

Regression of Nov-Mar precipitation to 700hPa zonal winds (1982-2012)

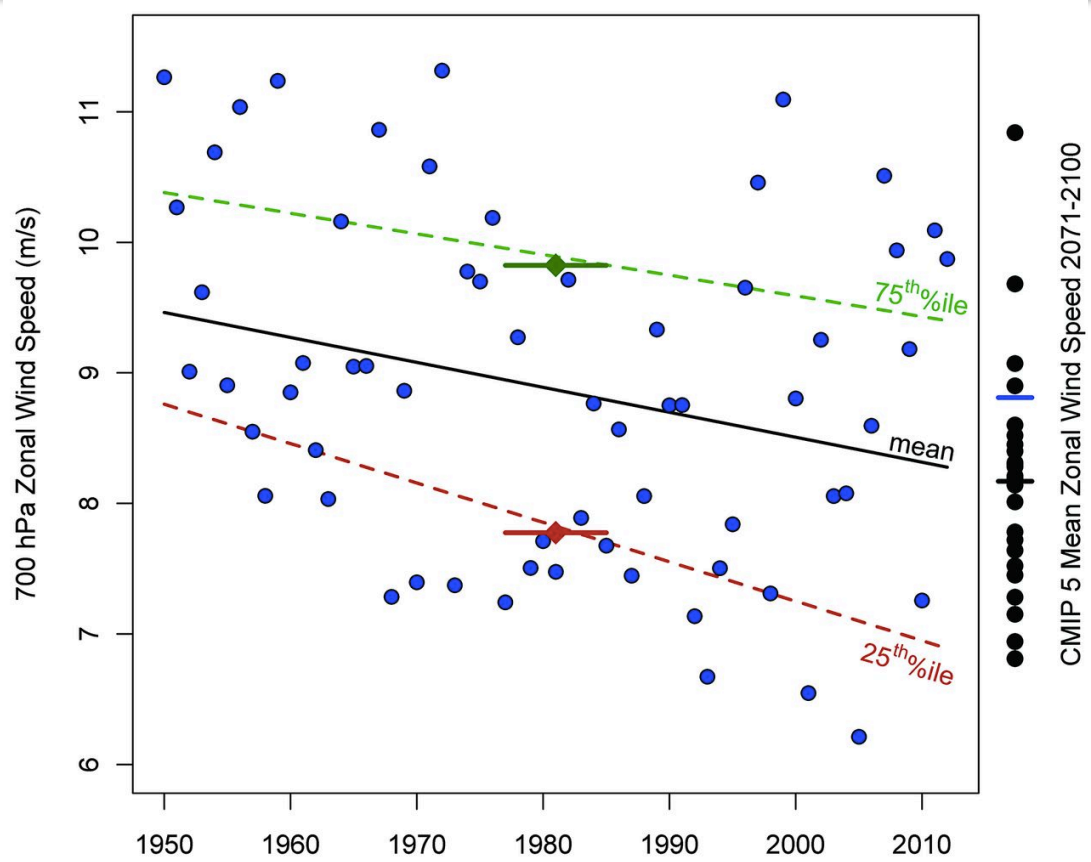



% change in precip per m/s change in zonal flow



Luce et al., 2013

# Declining Streamflow: Multiple Factors



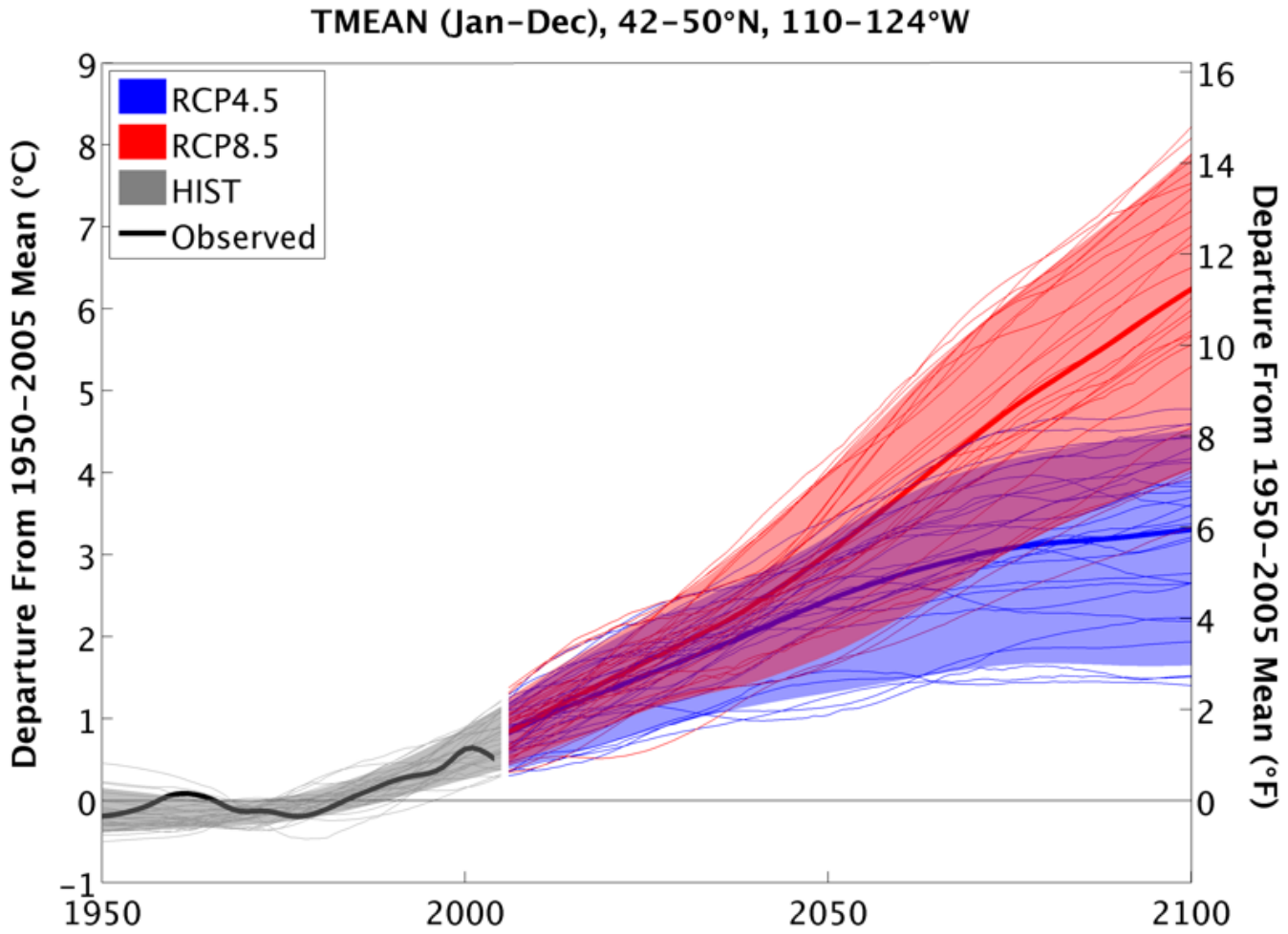

- Weakened zonal flow may contribute to reduced orographic enhancement
- Other factors: more water lost to ET, less precipitation falling as snow



Luce et al., 2013


Future
Present
Past

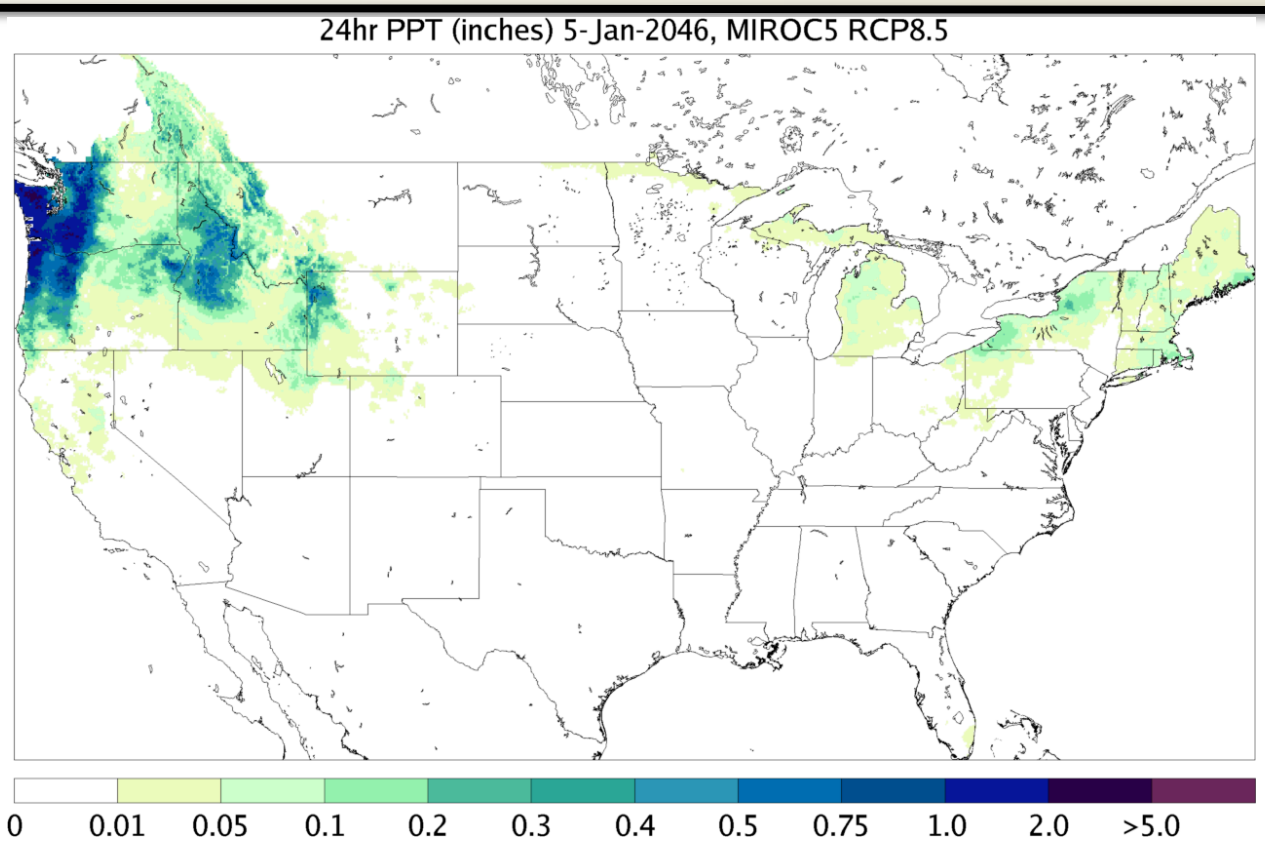
# Climate Projections CMIP5
# Mean Annual Temperature





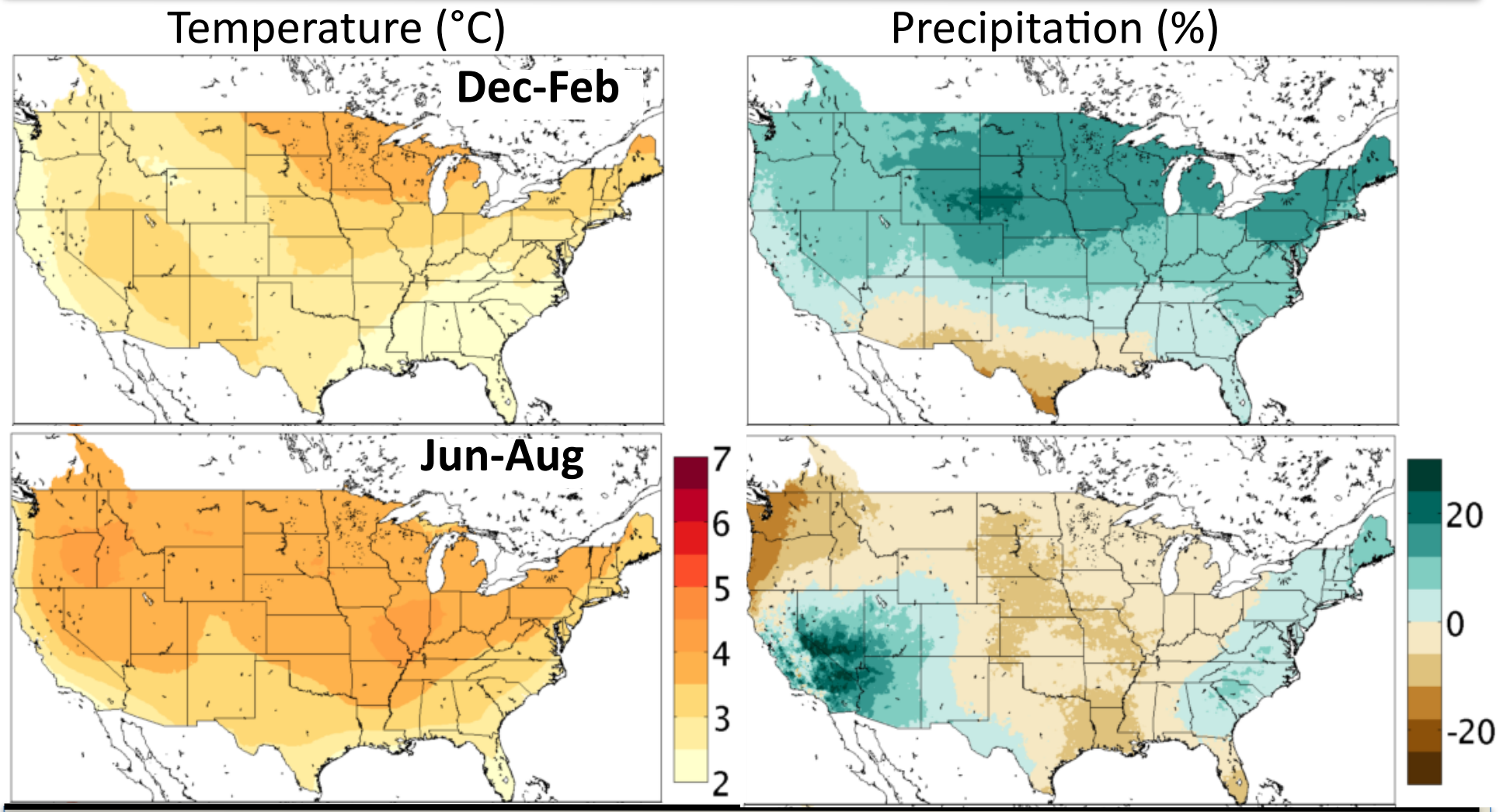

Dalton et al., 2013

# **M**ultivariate **A**daptive **C**onstructed **A**nalogs (MACA)




- Directly uses daily weather as simulated by climate models
- Preserves changes in statistical moments under future climate
- Extends to variables other than temperature & precipitation

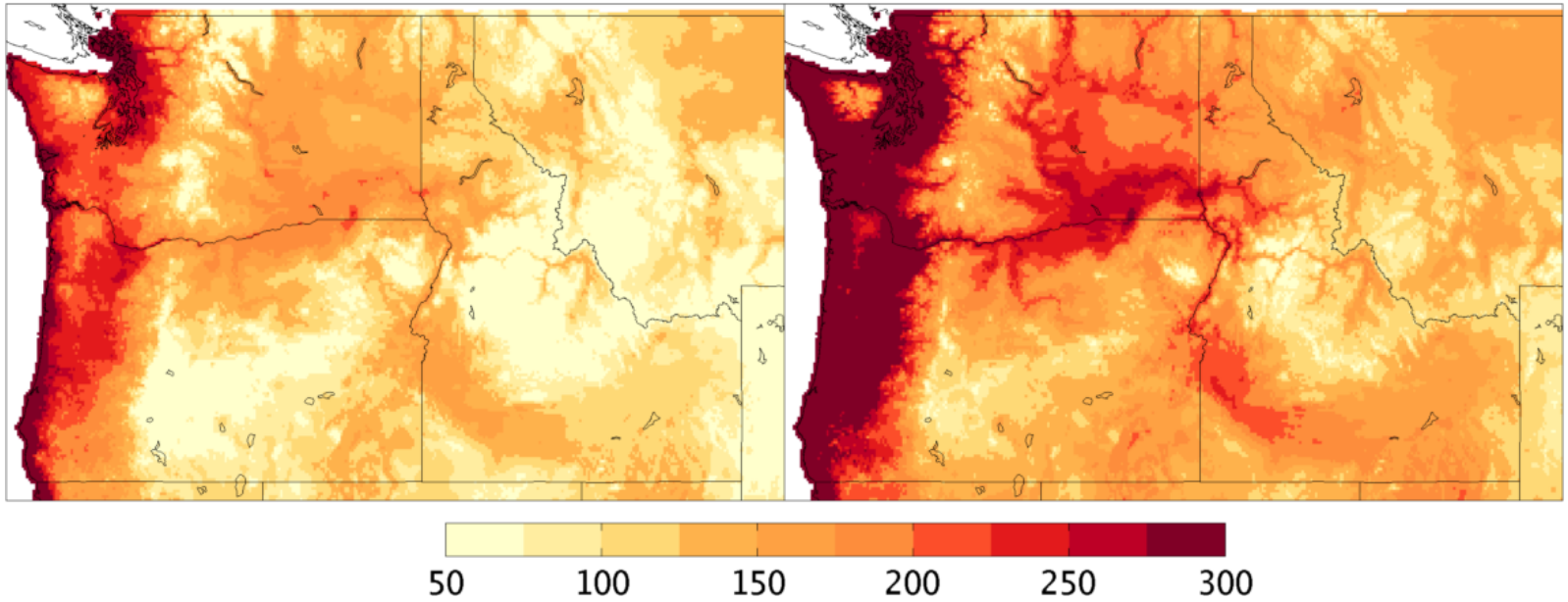
# Multi-Model Mean Change 2040-2069 RCP85



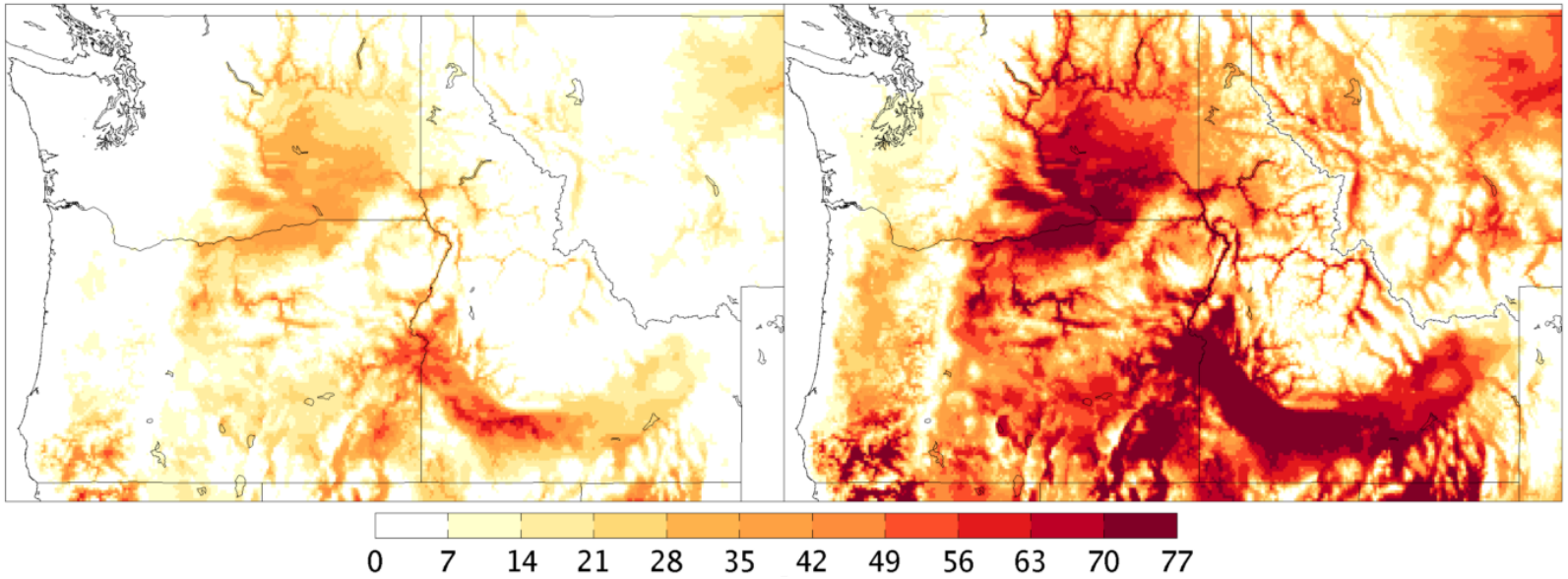
# More Hot, Less Cold

1971-2000 2040-2069 (RCP8.5)

Freeze-Free Season Length

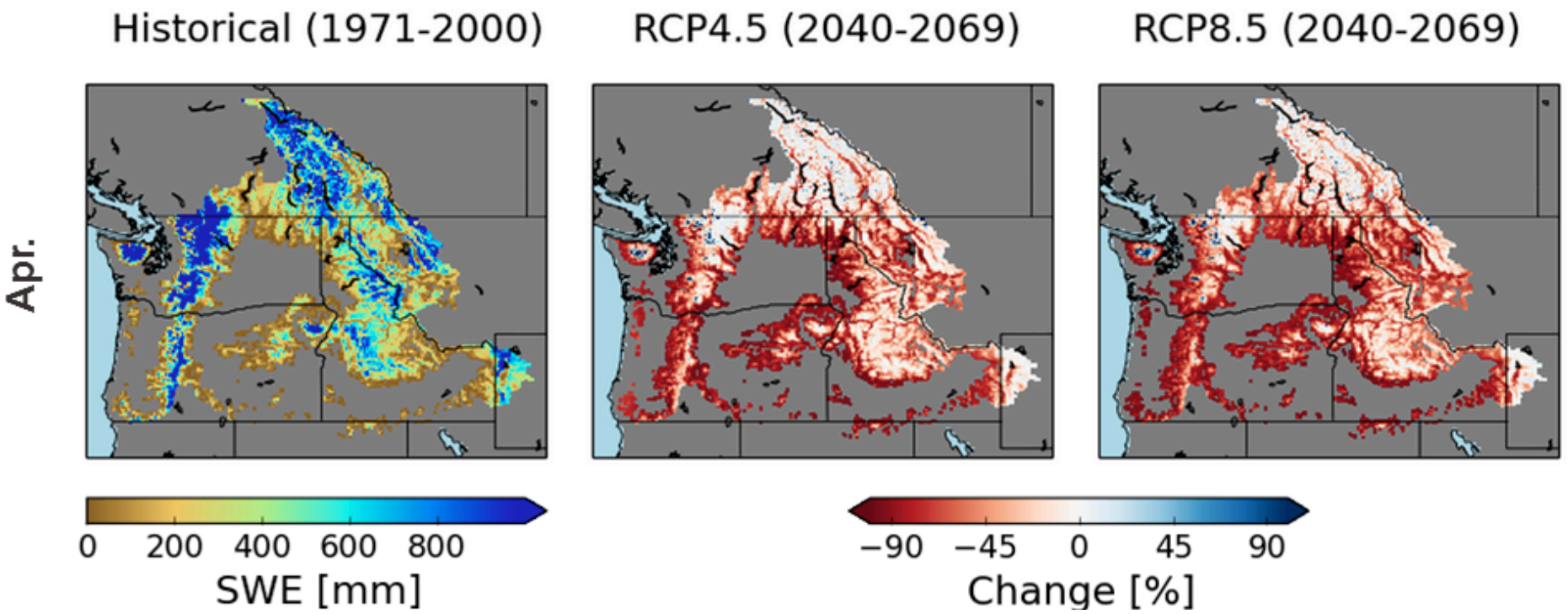



Days above 90°F



# Changes in Mountain Snowpack

## 10-model Average

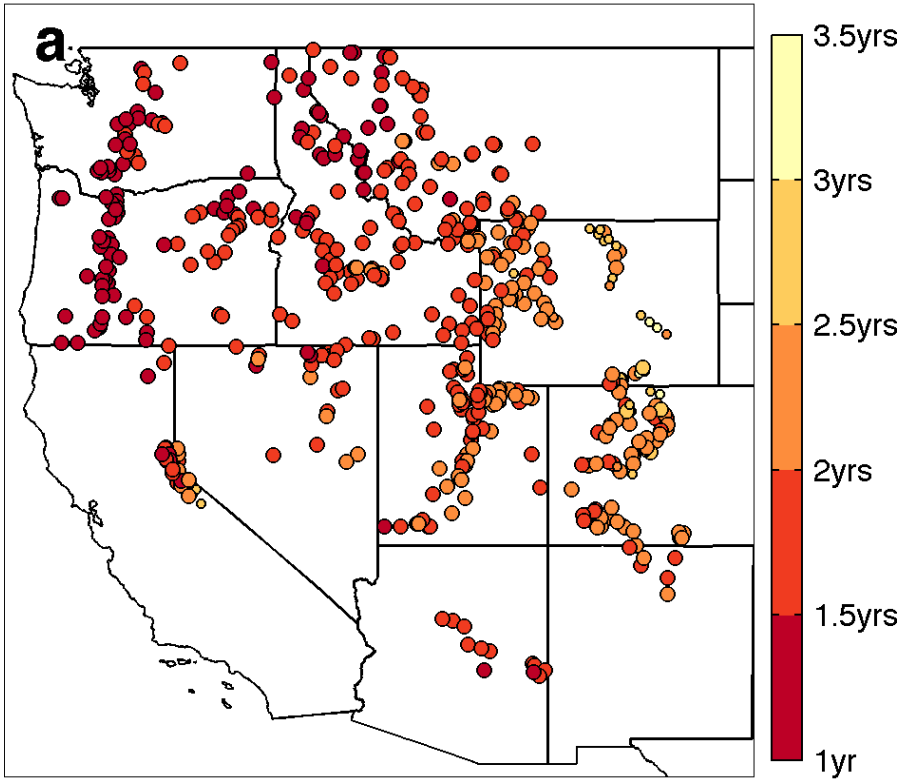



NW CSC
Northwest Climate Science Center

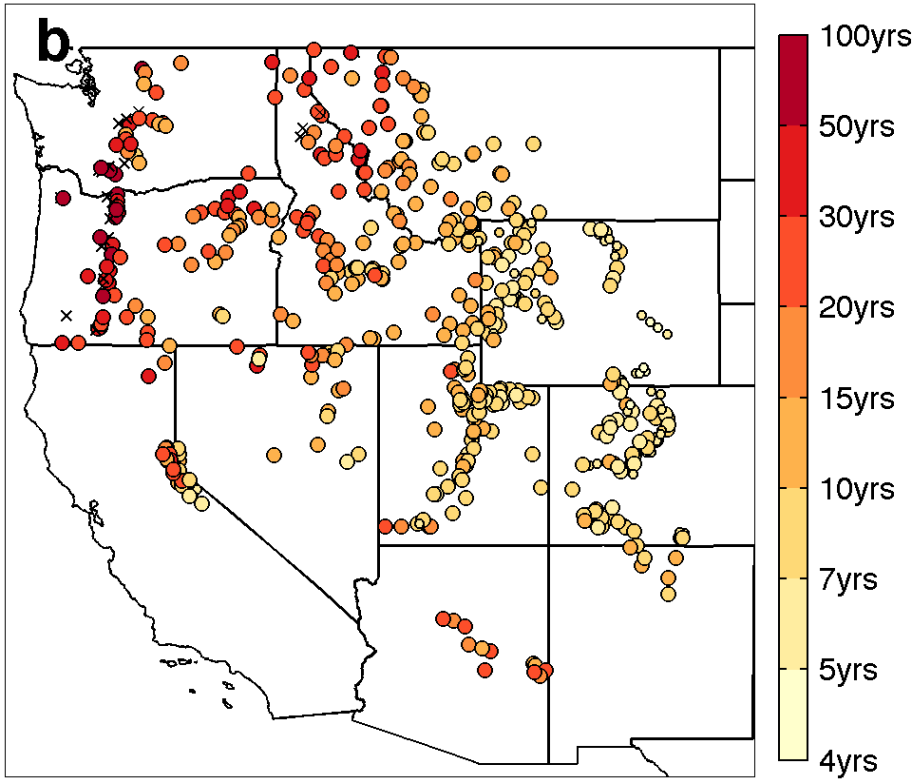
# Changes in High and Low Snowfall Years

## Multi-model mean return periods 2040-2069 RCP85

Historical Bottom Quartile




Historical Upper Quartile

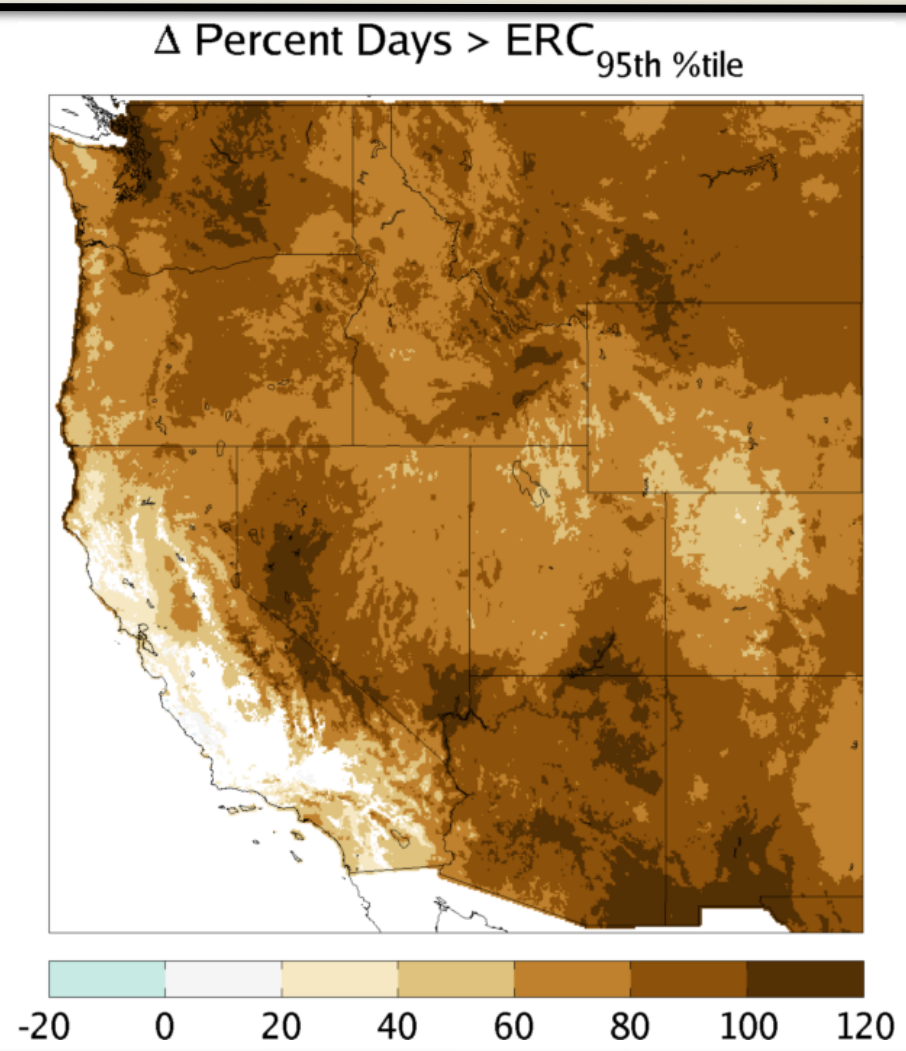



X denotes not a single model meeting threshold



Lute et al., submitted WRR

# Changes in Frequency of High Fire Danger

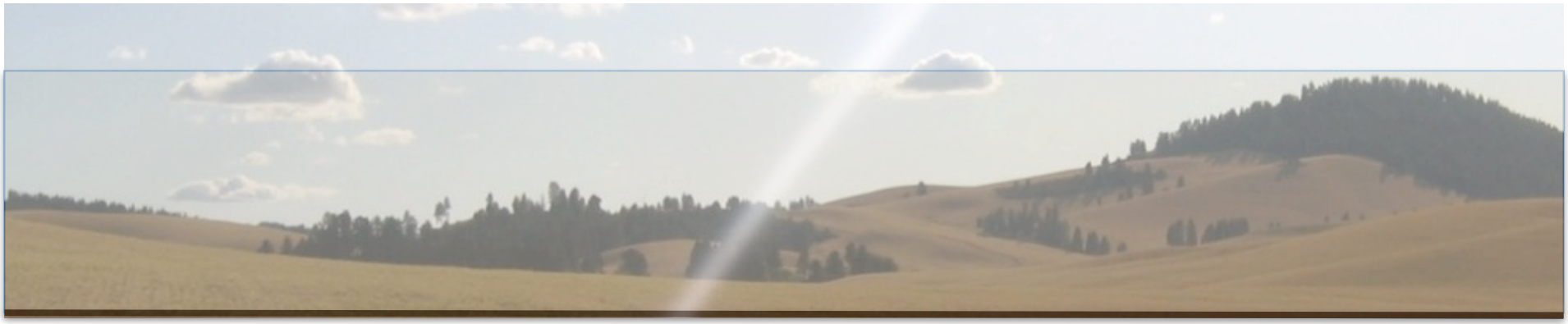





Shaded areas where >2/3 models agree

# The need for regional modeling

- **Changes in characteristics of key meteorological phenomena**
  - Atmospheric Rivers
  - Offshore winds
  - Air stagnation
- **Climate processes**
  - Orographic enhancement
  - Land-surface feedbacks (e.g., snow-albedo)
- **Coastal environment**
  - Upwelling
  - Coastal stratus/onshore flow



# Recap

- Climate change has been and will be a bumpy ride
- Regional warming by 2-7F by mid-21st century
- Implications for water availability in systems sensitive to water stress during the summer months including wildfire
- Regional modeling may unveil geographic differences

http://climateinw.wordpress.com

CIRC Climate Impacts Research Consortium

NKN Northwest Knowledge Network

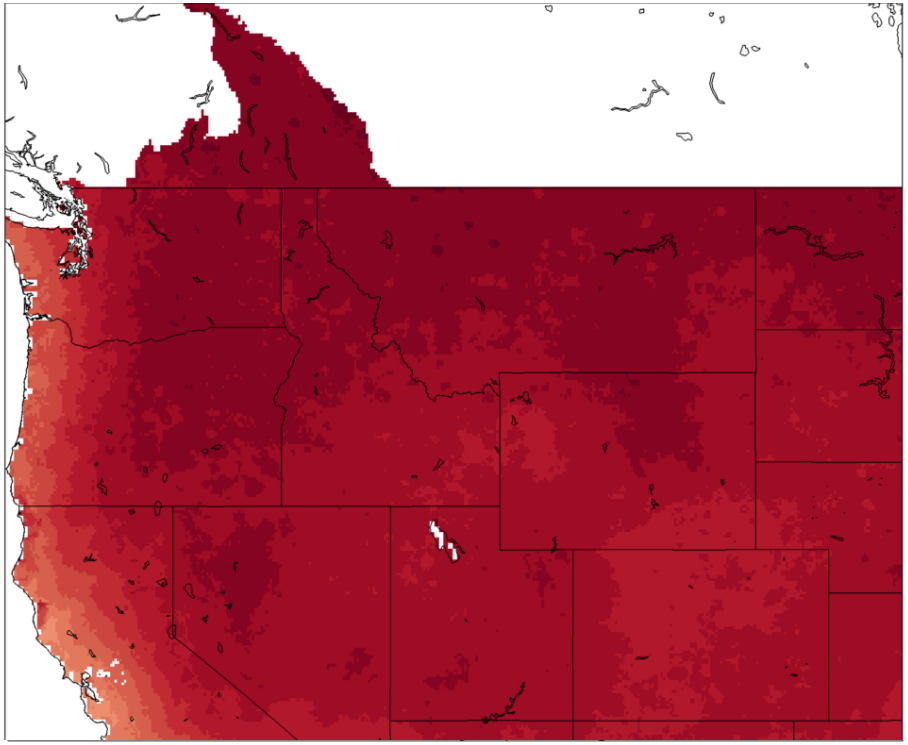
NW CSC Northwest Climate Science Center

REACCH Regional Approaches to Climate Change – PACIFIC NORTHWEST AGRICULTURE

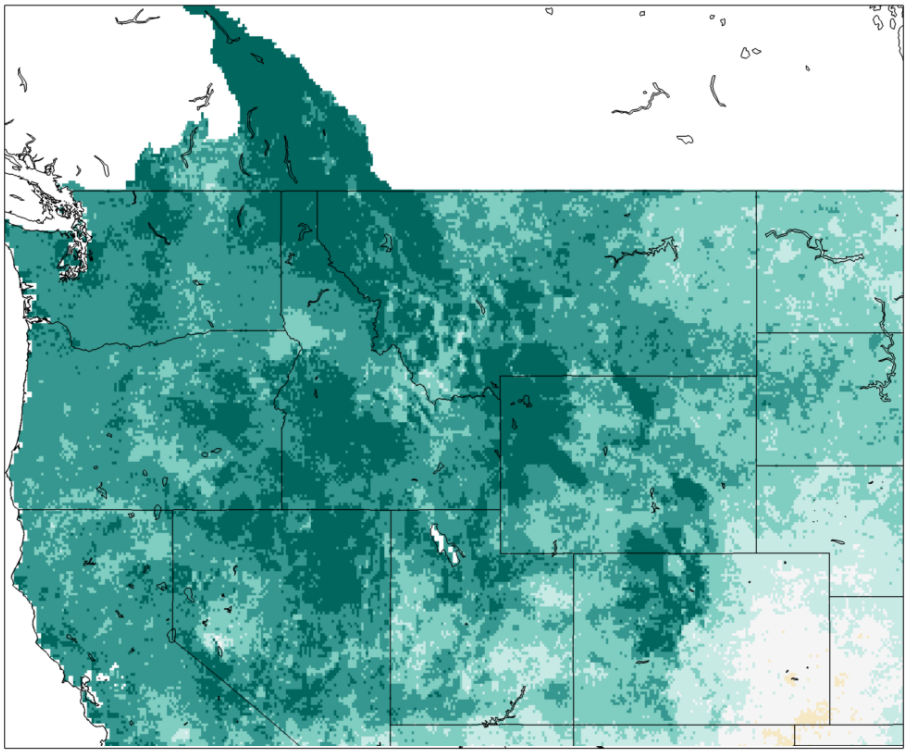
# Changing Extremes

See David Rupp's talk

99th percentile daily TMAX

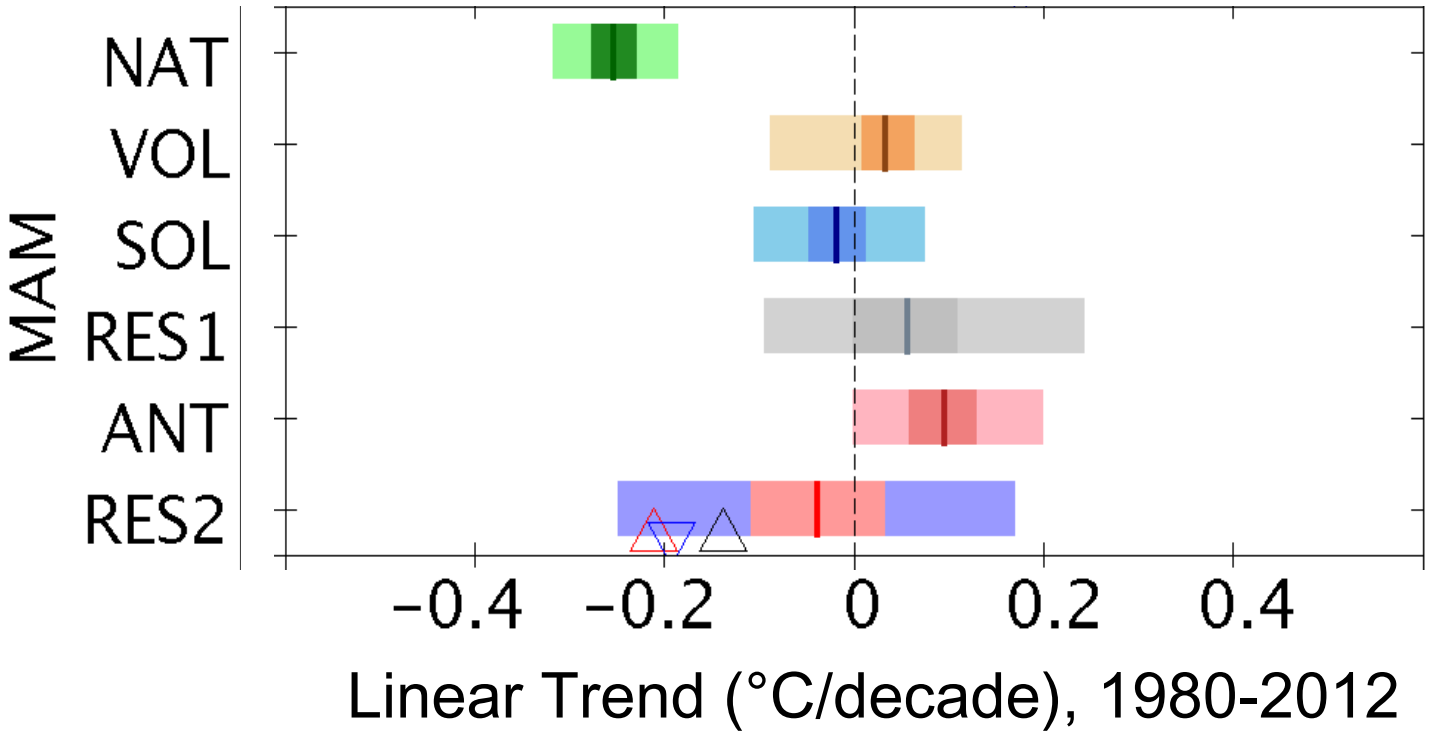


99th percentile daily PPT




2050-2099 (RCP8.5) vs. 1950-1999

# Behind the Spring Warming Pause

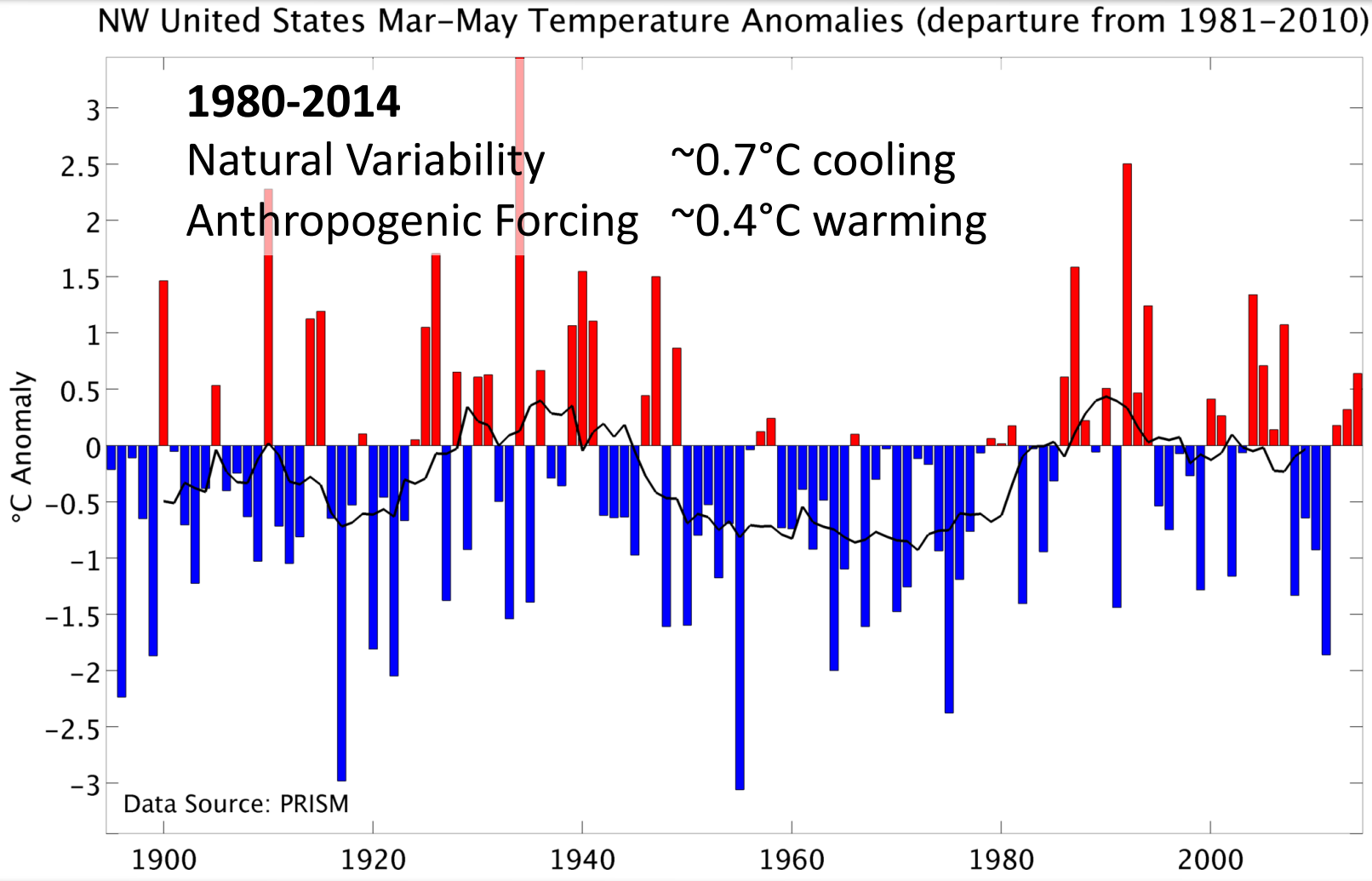


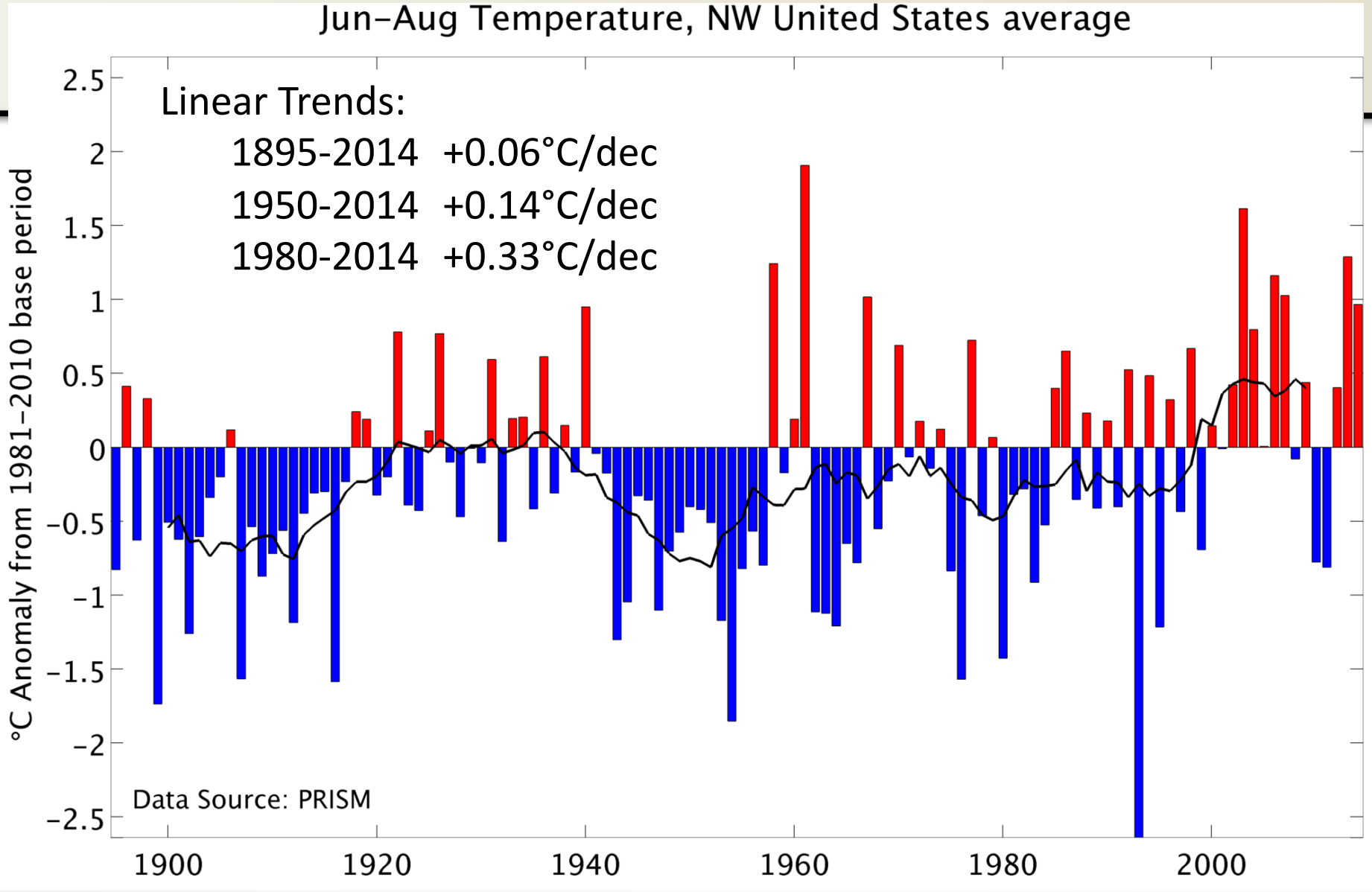

Natural atmosphere-ocean climate variability has buffered anthropogenic warming signal over last 3 decades



Abatzoglou et al., 2014 JCLI

# Behind the Spring Warming Pause




Jun–Aug Temperature, NW United States average
Linear Trends:
1895-2014 +0.06°C/dec
1950-2014 +0.14°C/dec
1980-2014 +0.33°C/dec
°C Anomaly from 1981–2010 base period
2.5
2
1.5
1
0.5
0
−0.5
−1
−1.5
−2
−2.5
1900
1920
1940
1960
1980
2000
Data Source: PRISM