

# Climate Change Science & Impacts - Northwest & Oregon

Philip Mote, David Rupp, Rianne Becraft, Sihan Li,  
Kathie Dello  
Oregon Climate Change Research Institute  
occri.net @pwmote

John Abatzoglou and Katherine Hegewisch, U  
Idaho

Bart Nijssen, U Washington

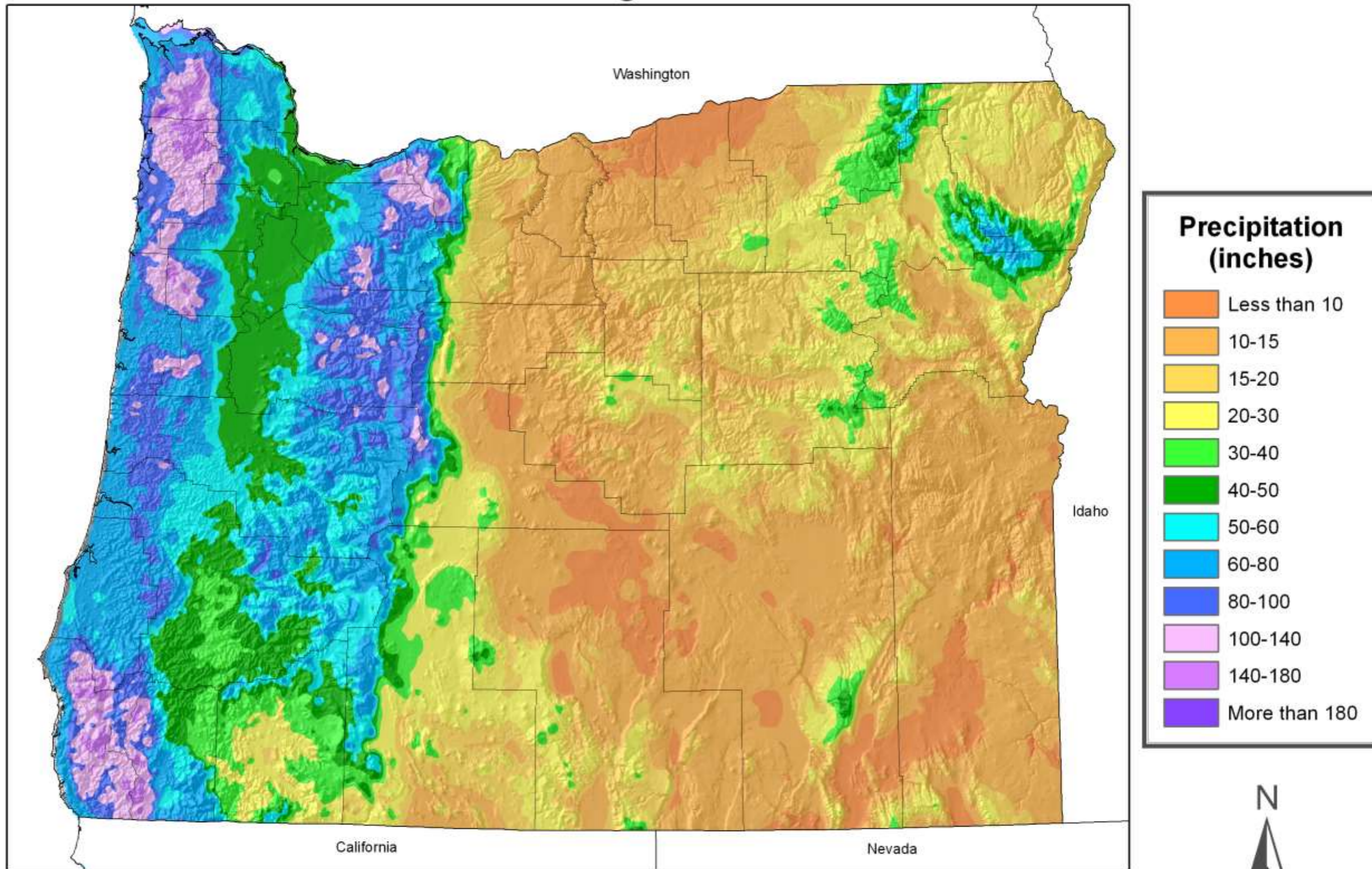


# Outline

- Regional climate change - observed & projected
- Hydrologic change - observed & projected
- The 2014-15 drought in Oregon



# Average Annual Precipitation, 1971-2000 Oregon



Map copyright (c) 2006 by the PRISM Group and Oregon Climate Service, Oregon State University.

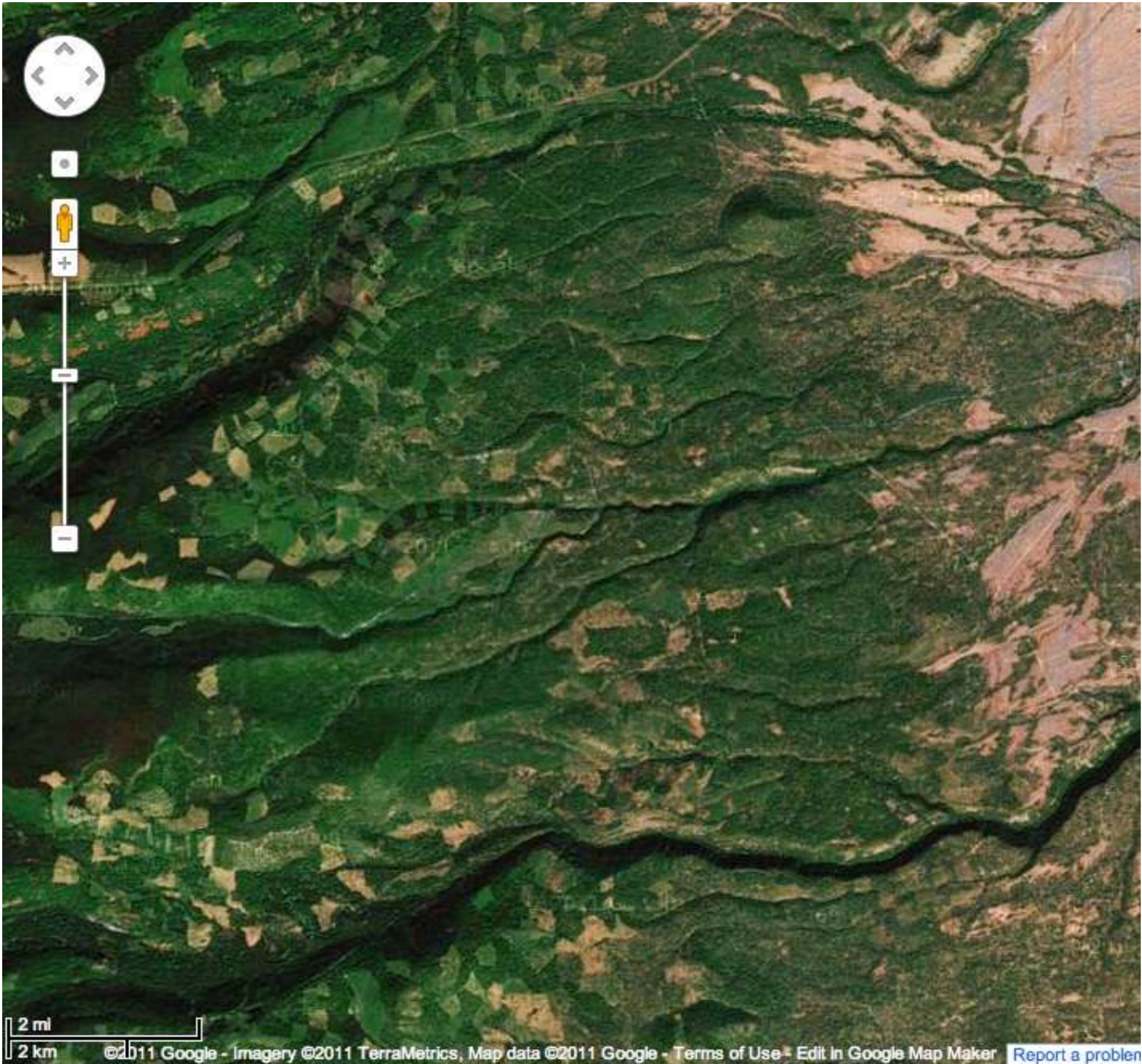
0 30 60 90 120  
Miles









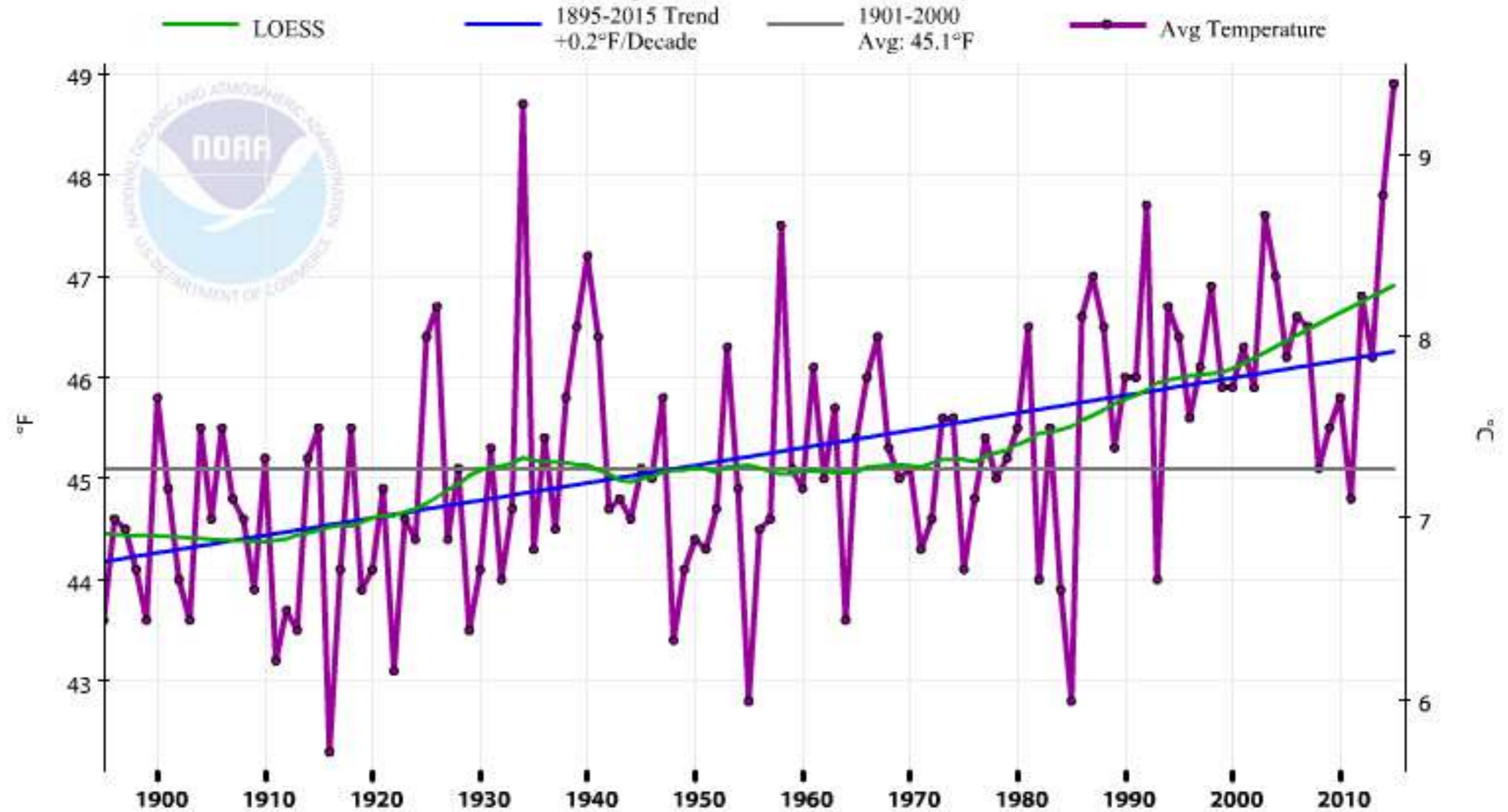


2 mi  
2 km

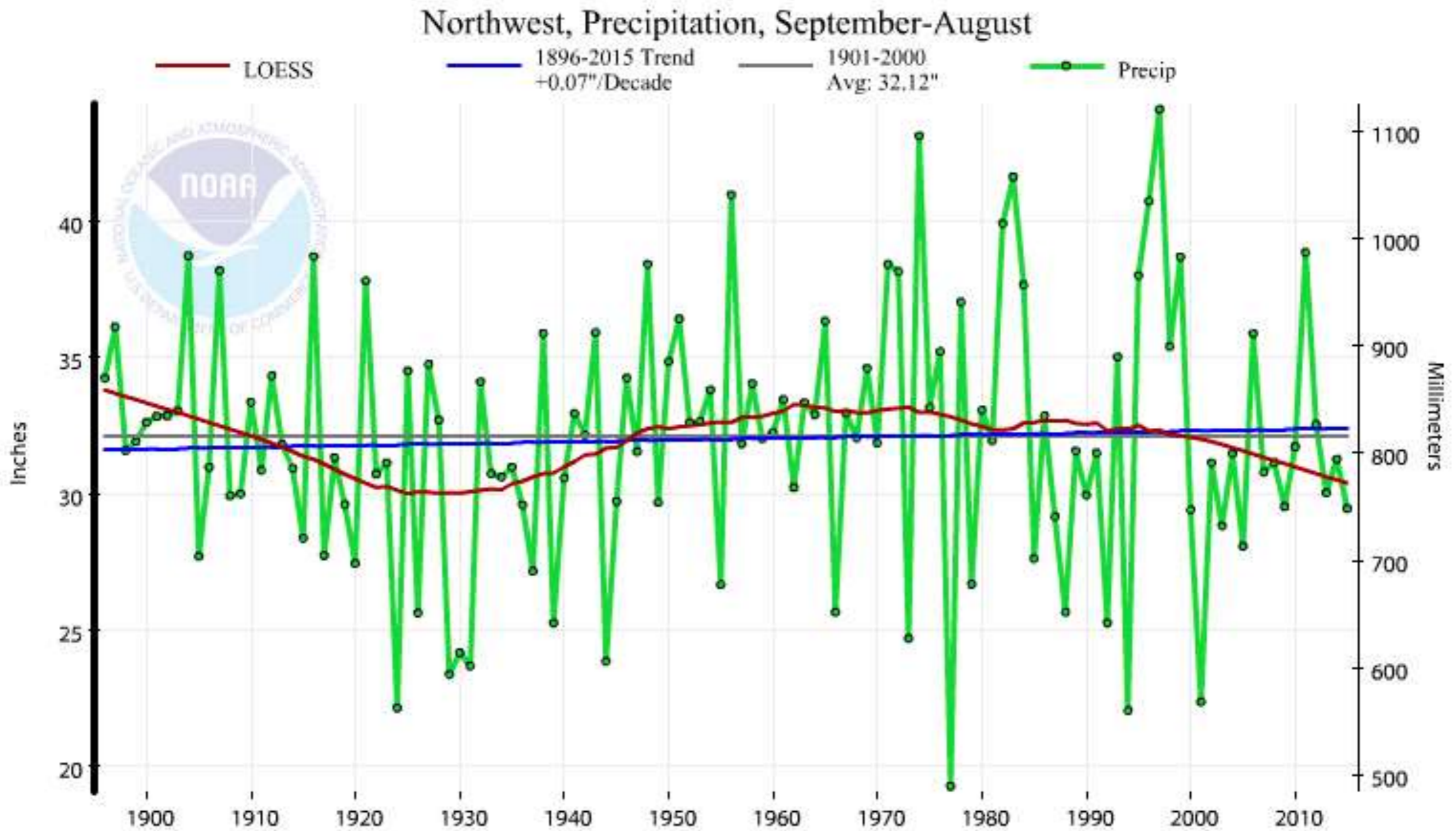


# Temperature

Northwest, Average Temperature, January-December

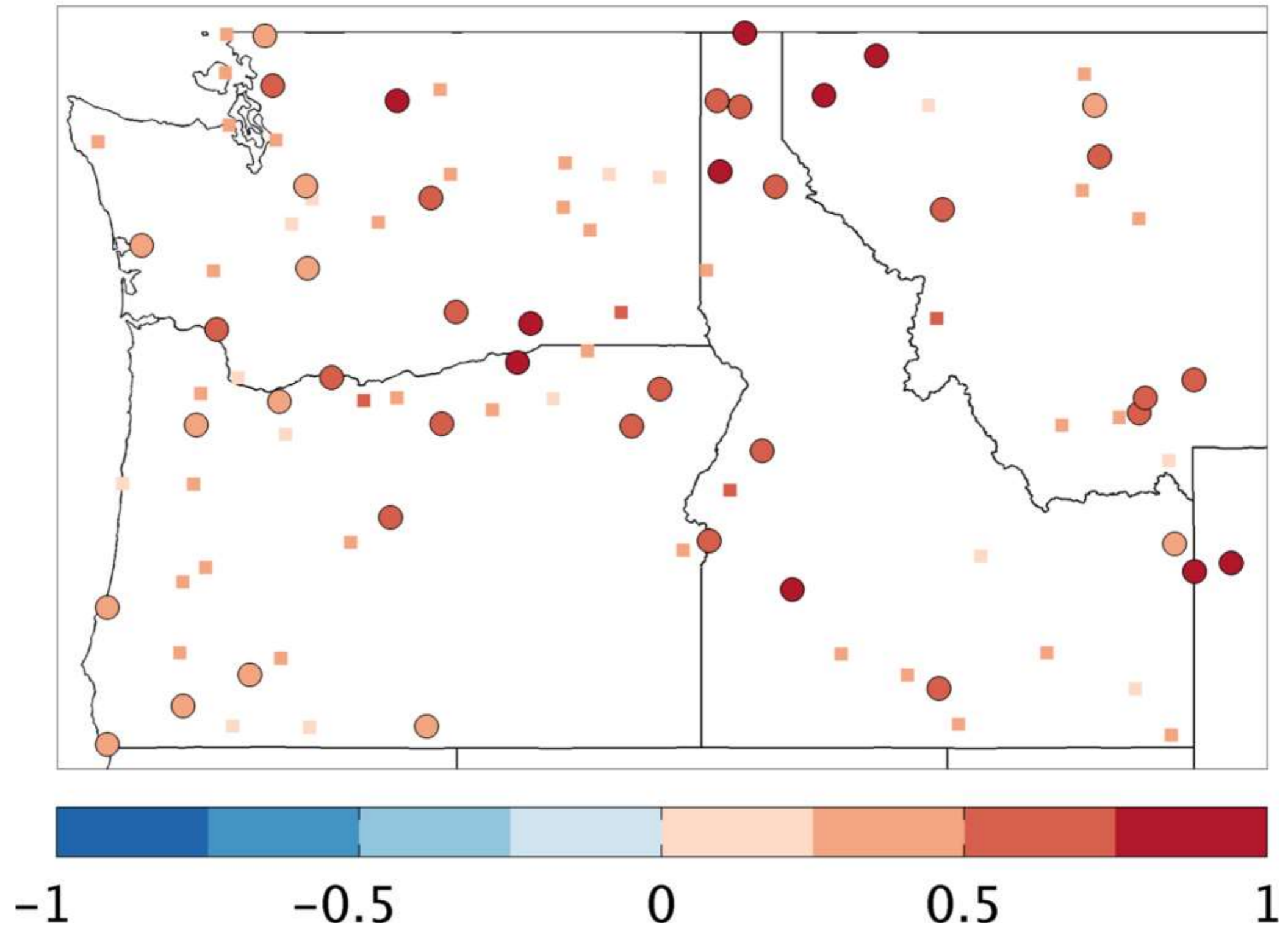


# Precipitation



# Coldest night per winter

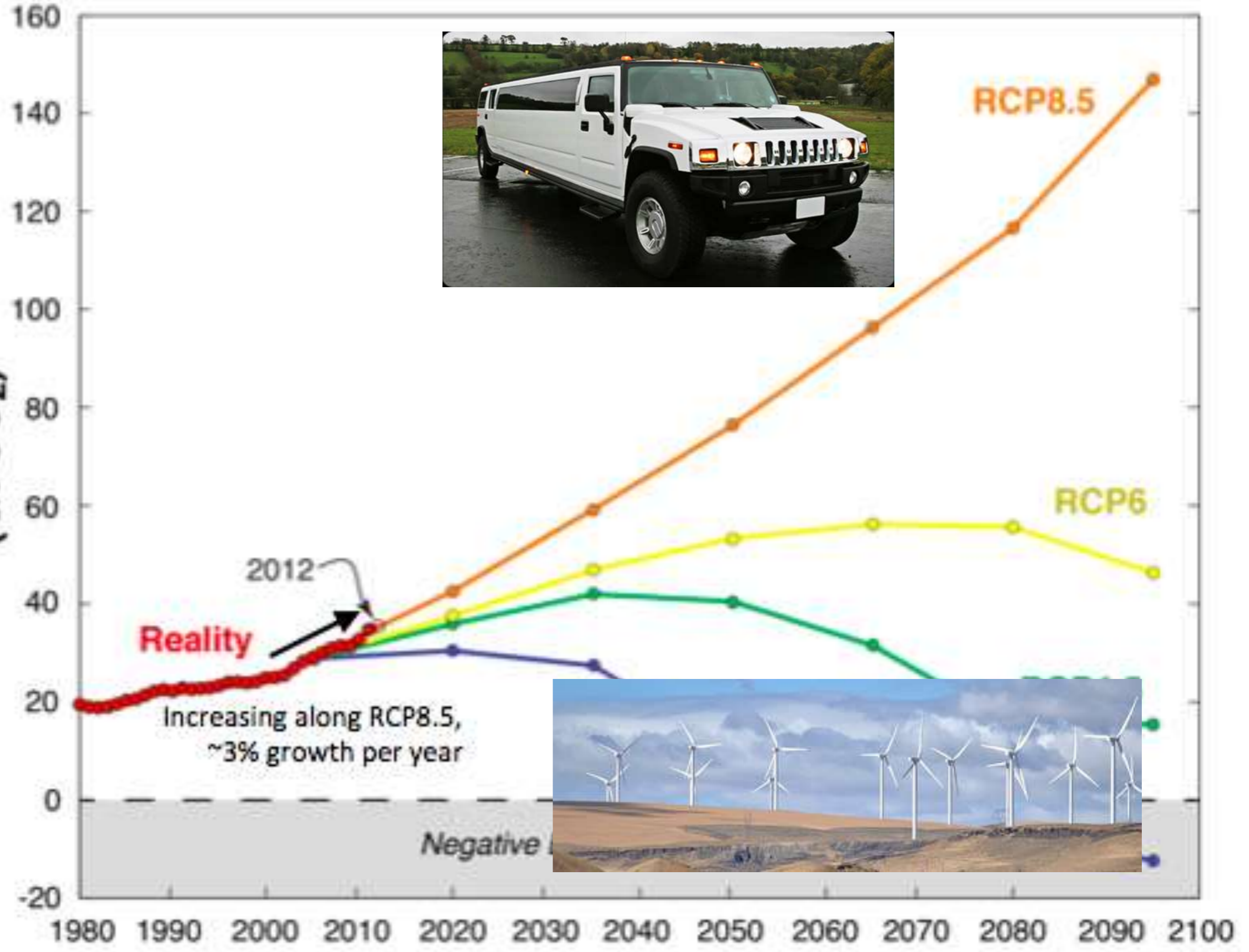
## Linear trend (°C/decade) 1920–2012







**Fossil Fuel Emissions  
(Gt CO<sub>2</sub>)**



**Reality**

2012

Increasing along RCP8.5,  
~3% growth per year

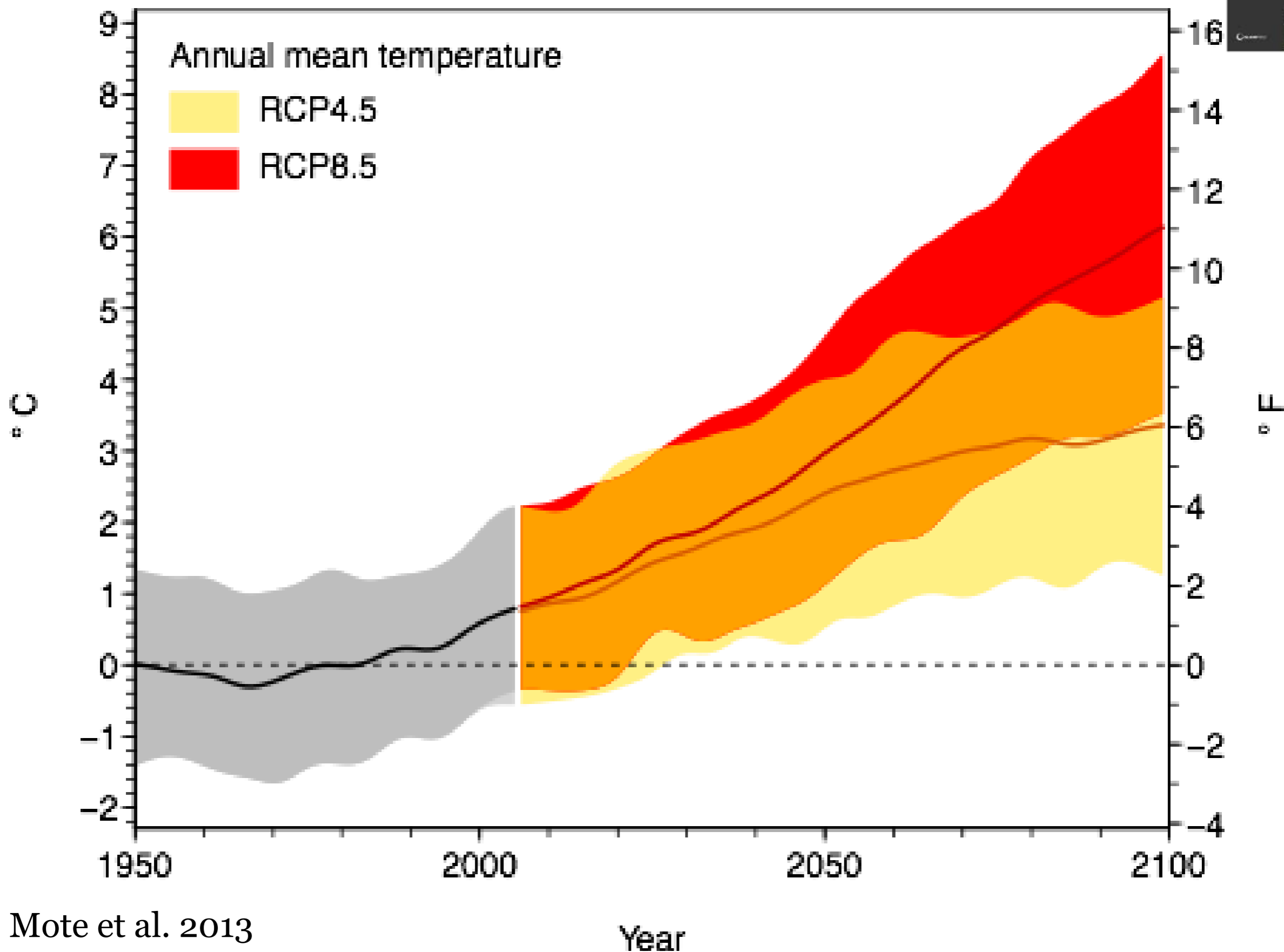
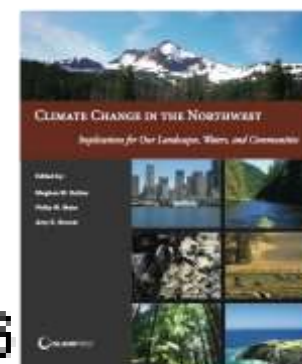
Negative

**Year**



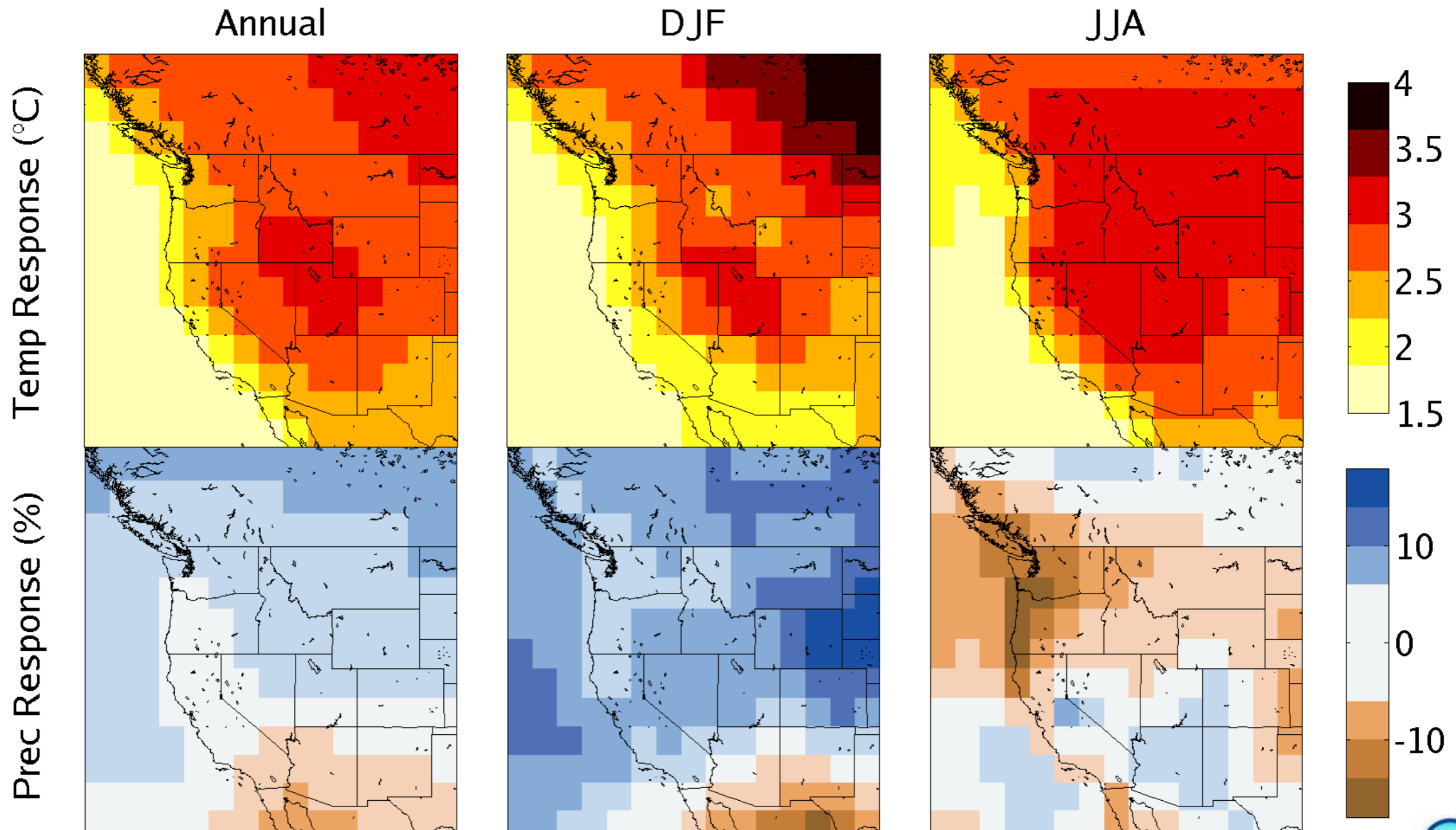
# PNW temperature

Difference from 1950-1999 average



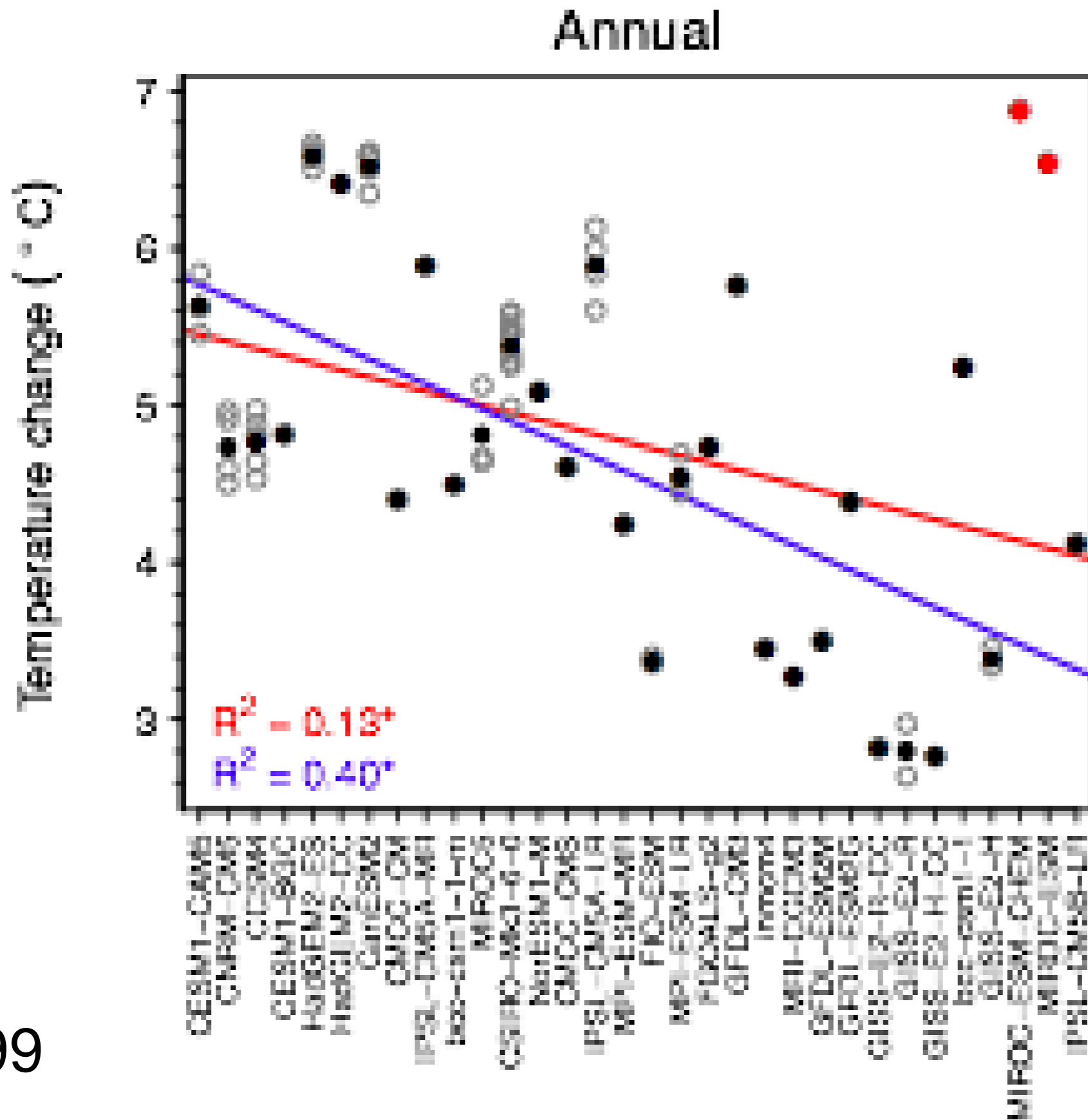


# CMIP5 RCP8.5 Projected Changes 2031-2060 vs. 1950-1999





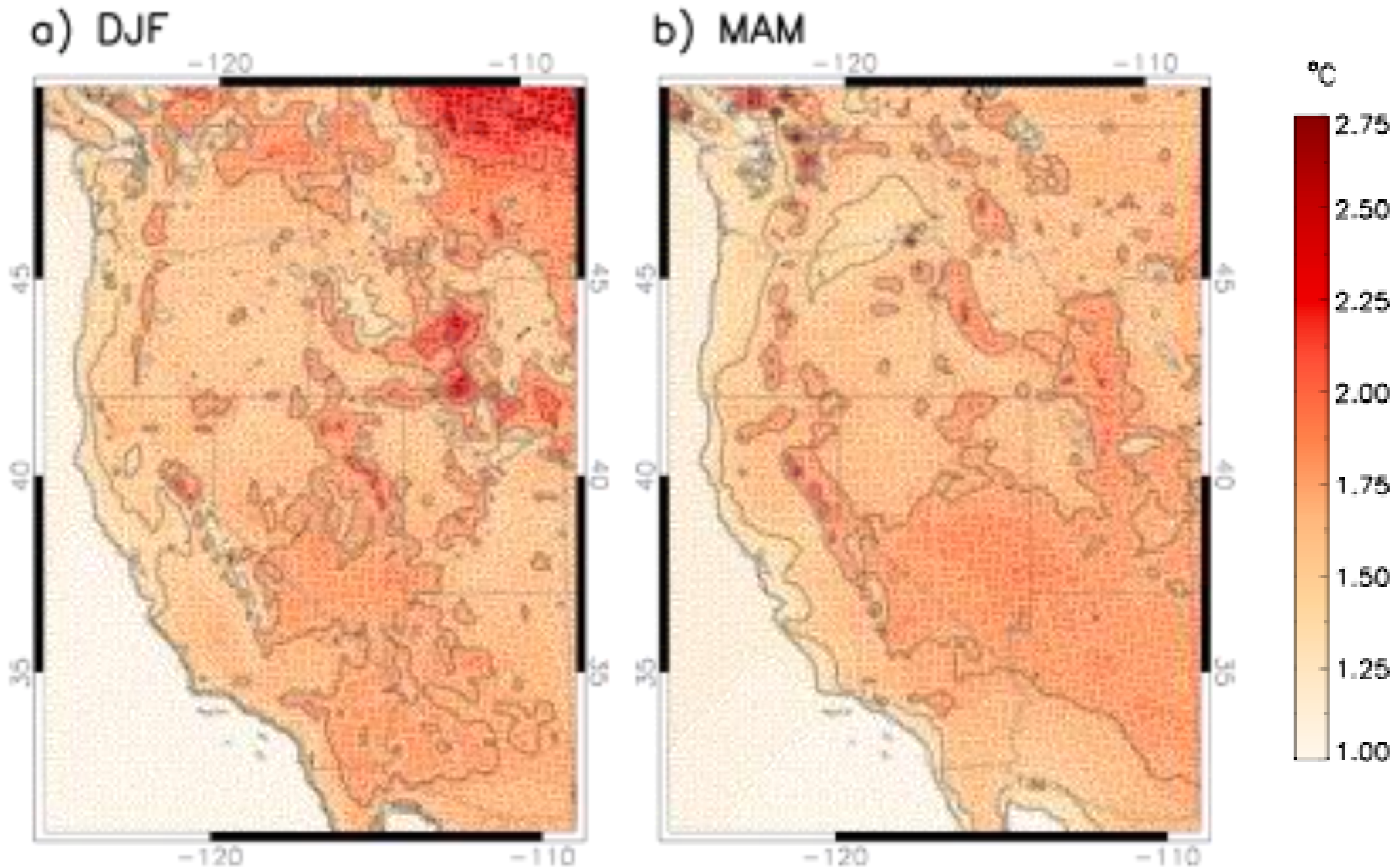
# better models predict more warming



2070-99

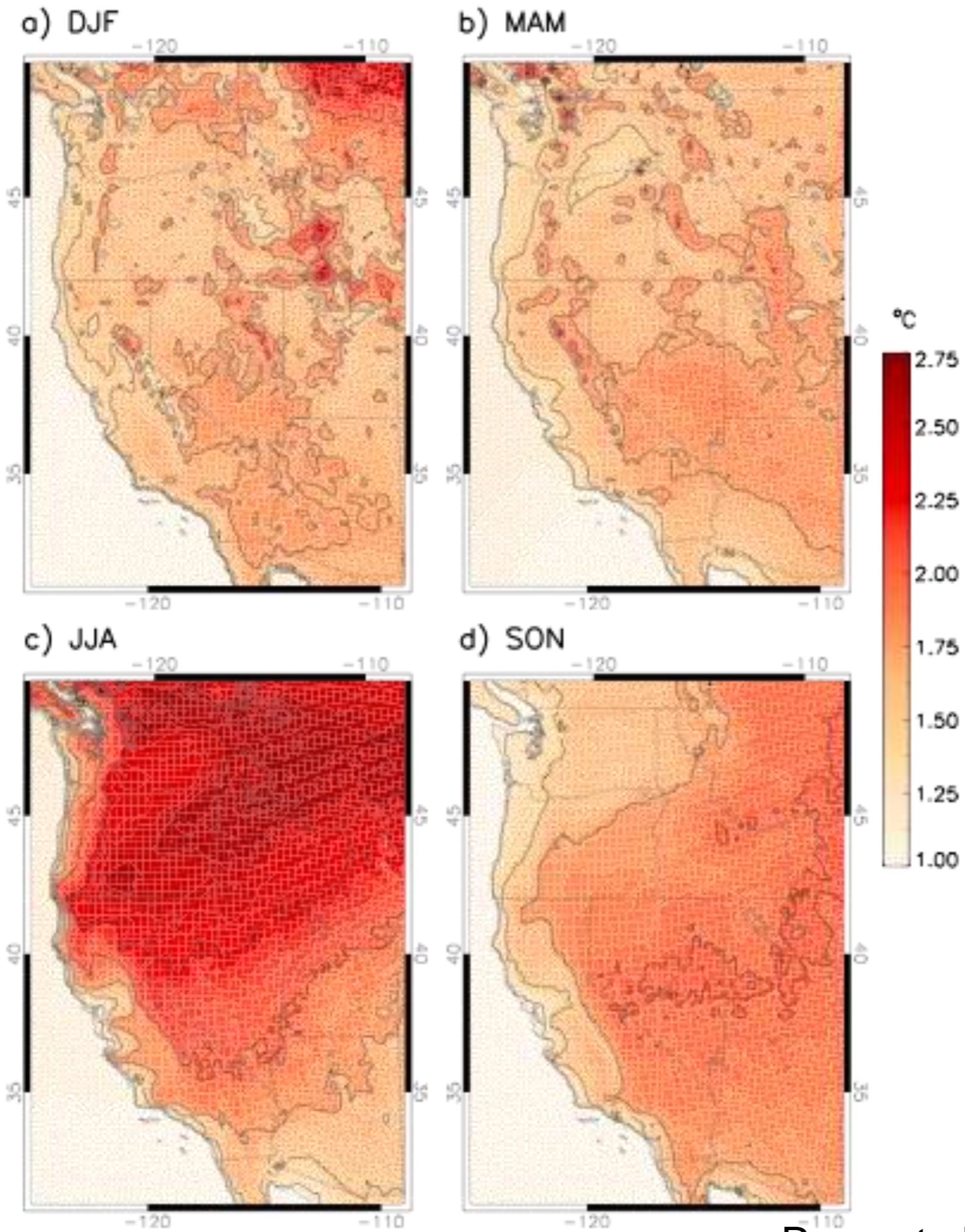
Rupp,  
unpublished

# Change in ensemble mean temperature, 1985-2014 to 2030-59 from a regional superensemble



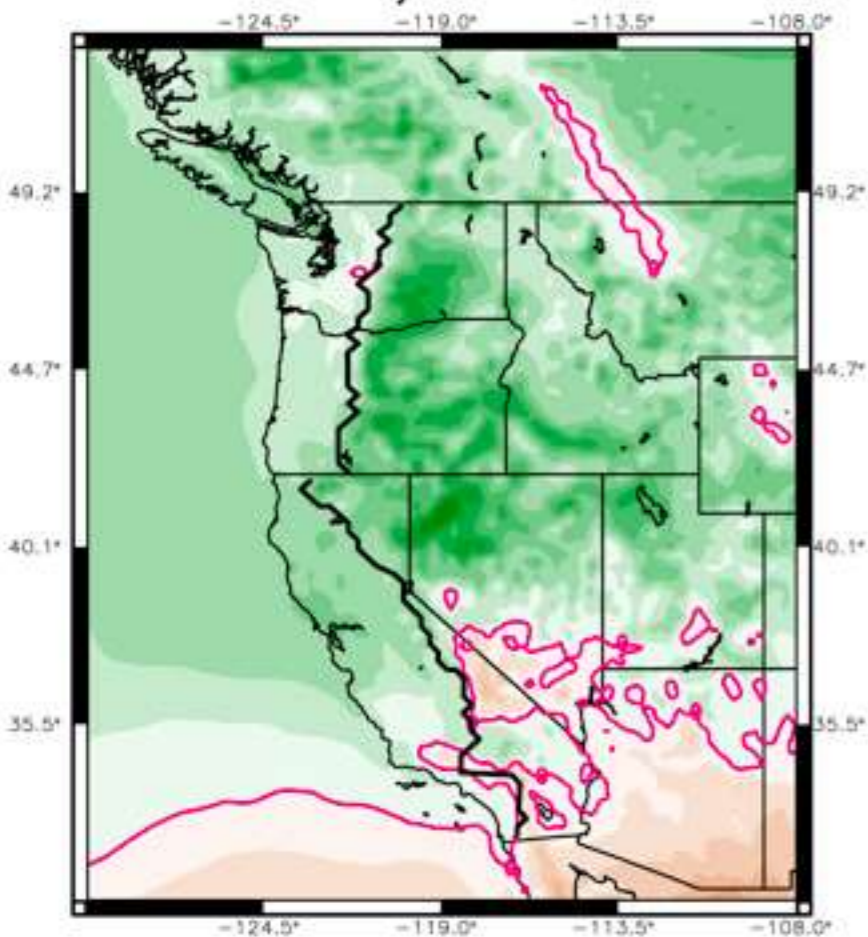


Change in ensemble mean temperature, 1985-2014 to 2030-59 from a regional superensemble

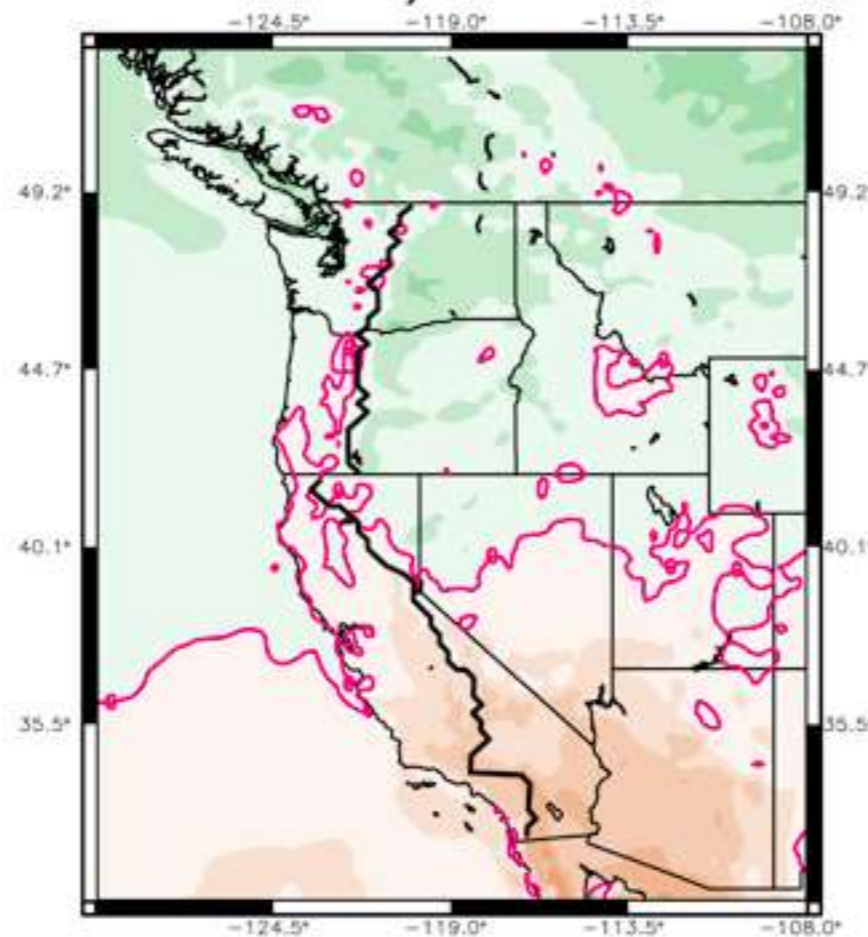




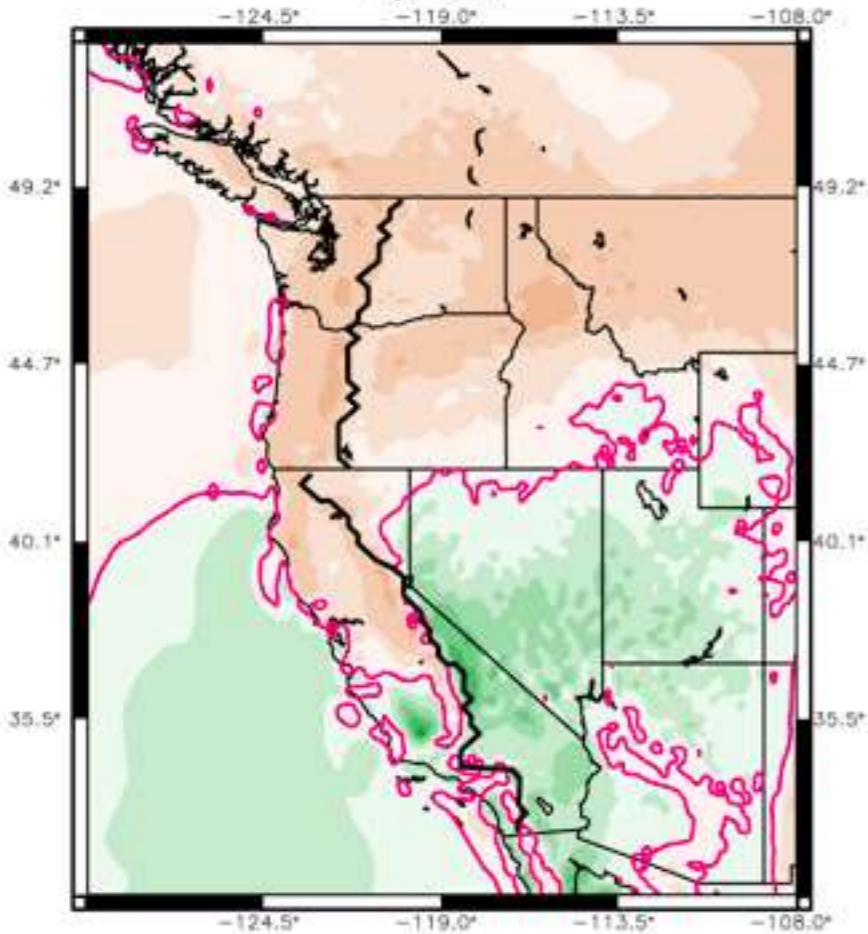
a) DJF



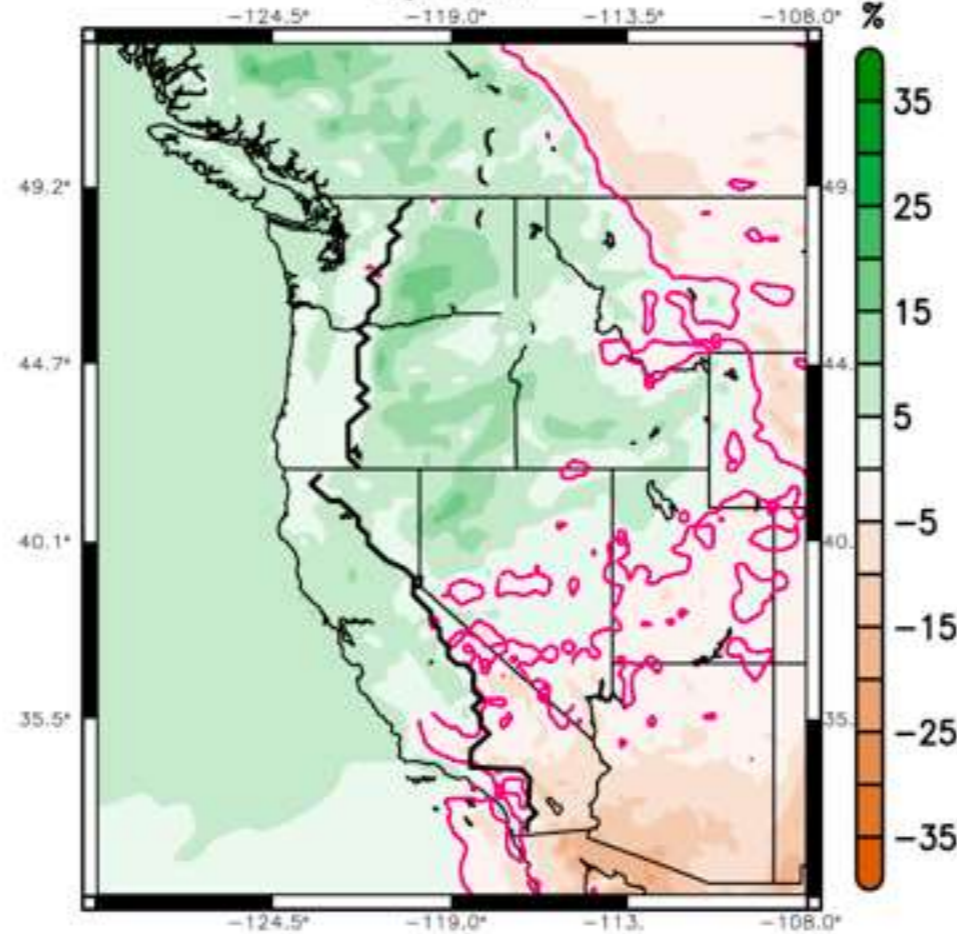
b) MAM



c) JJA



d) SON



Change in ensemble mean precipitation, 1985-2014 to 2030-59 from a regional superensemble

Li et al., in review



# Outline

- Regional climate change - observed & projected
- **Hydrologic change - observed & projected**
- The 2014-15 drought in Oregon



# UW Drought Monitoring System for the Pacific Northwest

- Home**
  - Current Conditions
  - Recent Change
  - Snow Observations
  - Monthly Variable
  - Sub-basin Time Series
  - Streamflow Forecast
  - Archive (1920-2010)
- Info**
- Links**
  - West Coast US Monitoring
  - CA and NV Monitoring
- Contacts**
- Disclaimer**

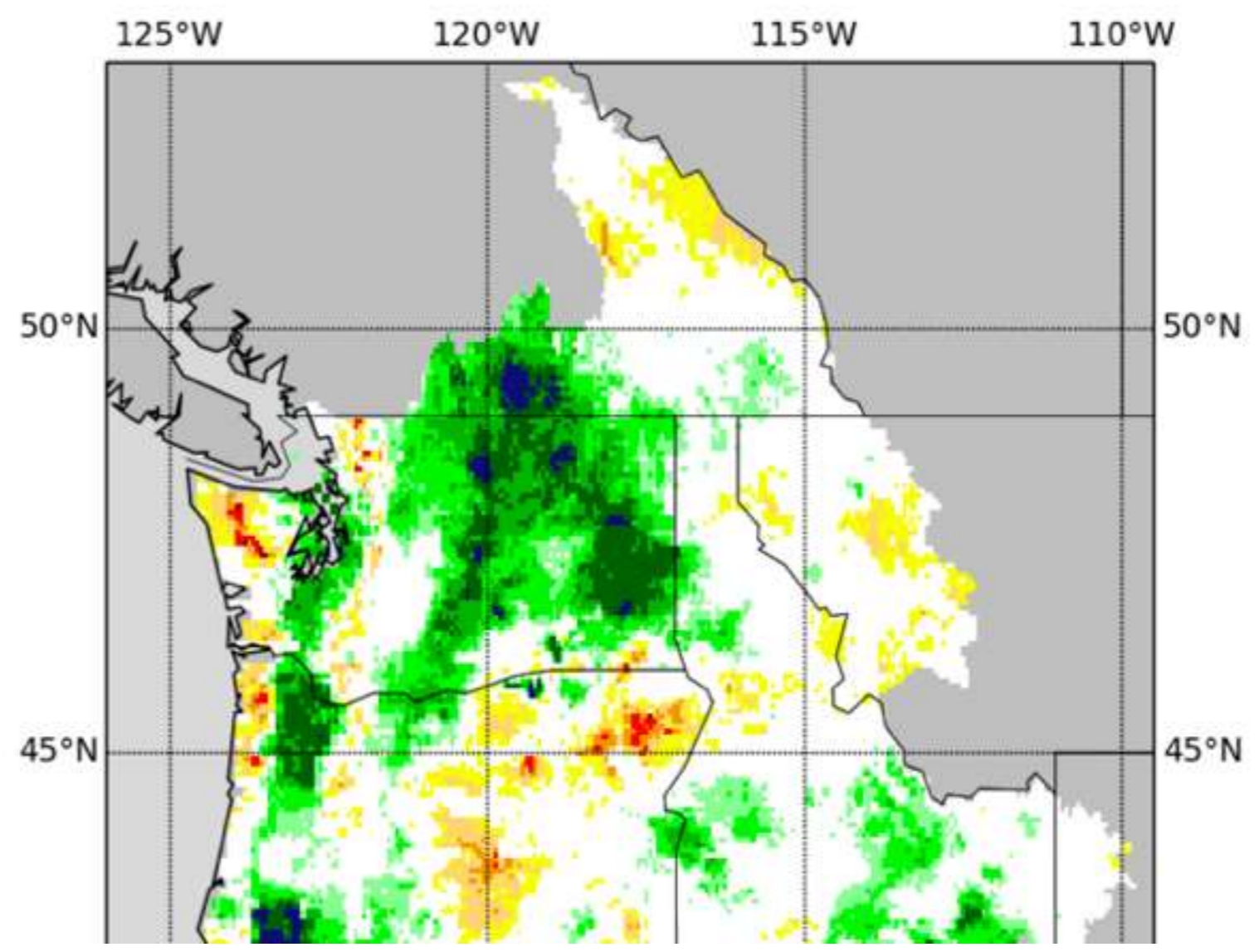
## Pacific Northwest (PNW) Current Conditions

Current percentiles for soil moisture, snow water equivalent and total moisture storage with respect to the climatological period from 1920 - 2010. These update daily by 3 pm and have a lag of 1 day. [Click here to see a detailed description of hydrologic conditions.](#)

- Total Moisture
- Soil Moisture
- Snow Water Equivalent

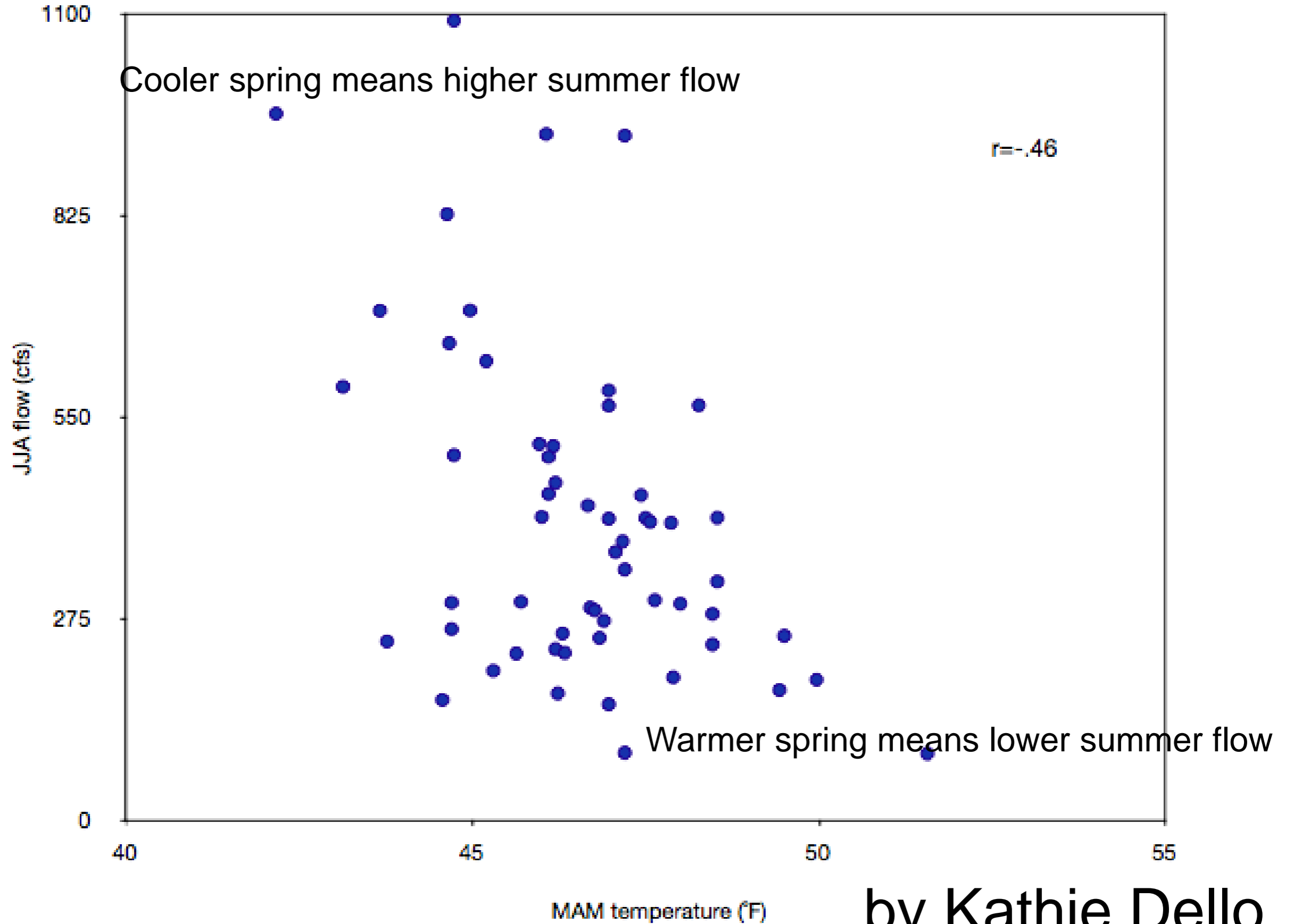
### Total Moisture Percentile

2016--05--01



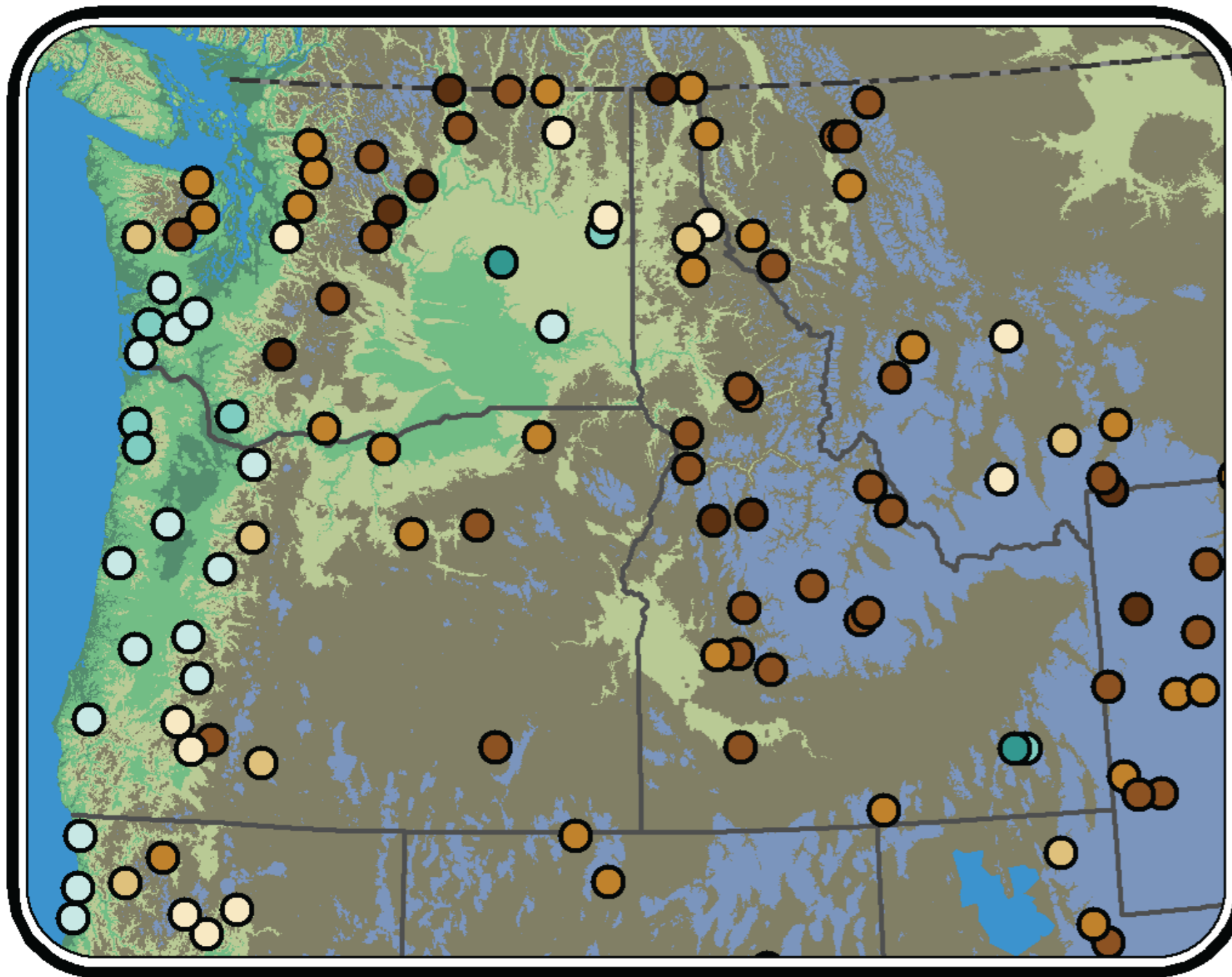
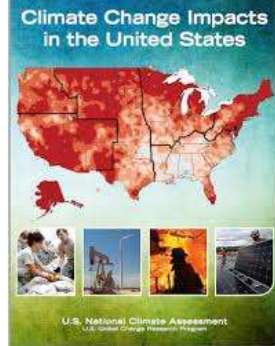


# McKenzie River near Vida



by Kathie Dello

# Decreasing summer flow in snowmelt watersheds



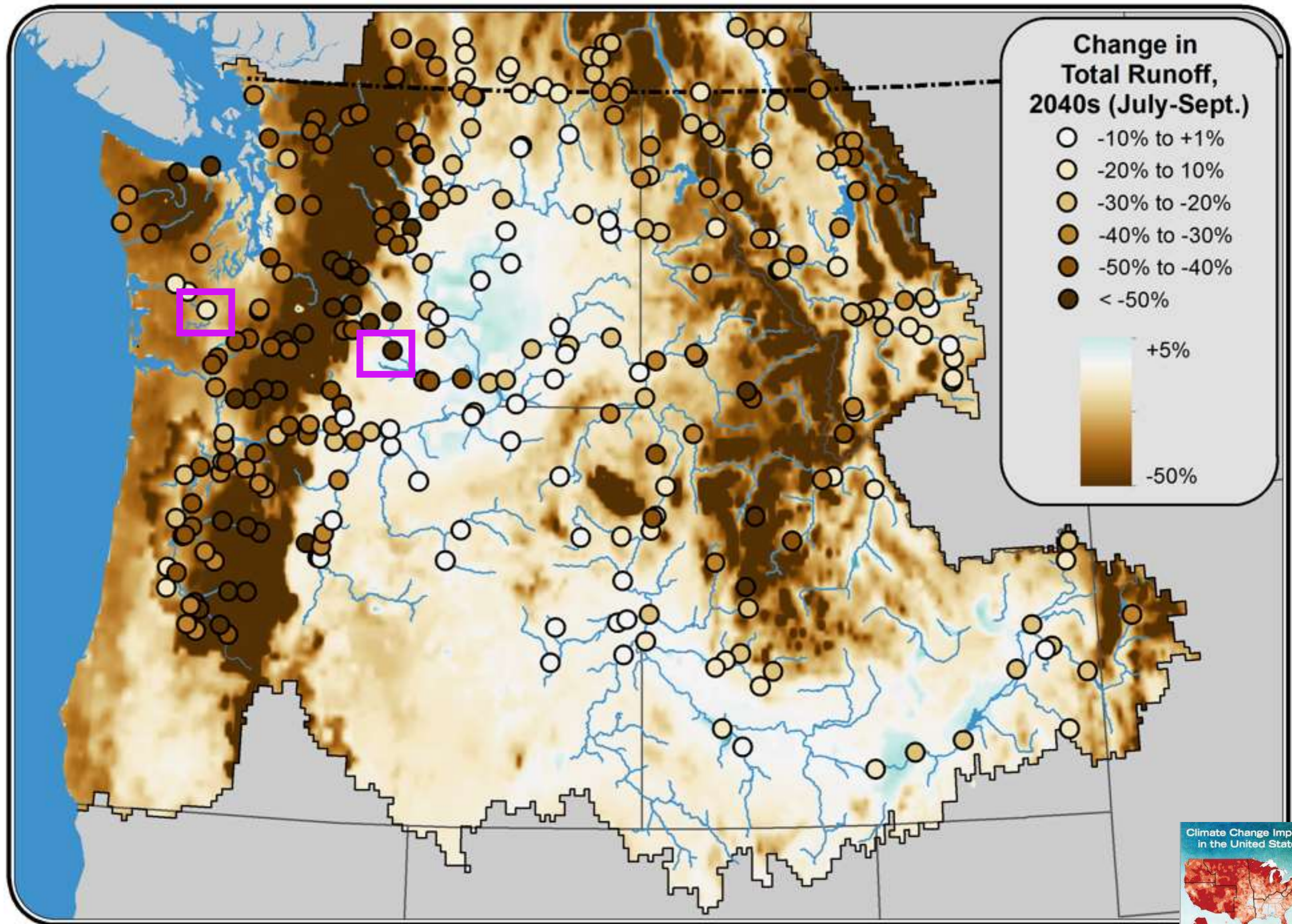
## June Streamflow Trends (fraction of annual flow) 1948-2008

- -15% to -8%
- -8% to -4%
- -4% to -2%
- -2% to -1%
- -1% to 0%
- 0% to +1%
- +1% to +2%
- +2% to +3%

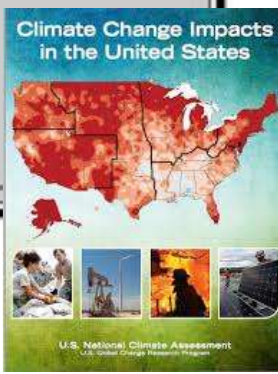
## Elevation

- < 300 ft
- 300 ft - 1500 ft
- 1500 ft - 3000 ft
- 3000 ft - 6000 ft
- > 6000 ft





Mote et al NCA Fig 21.2b



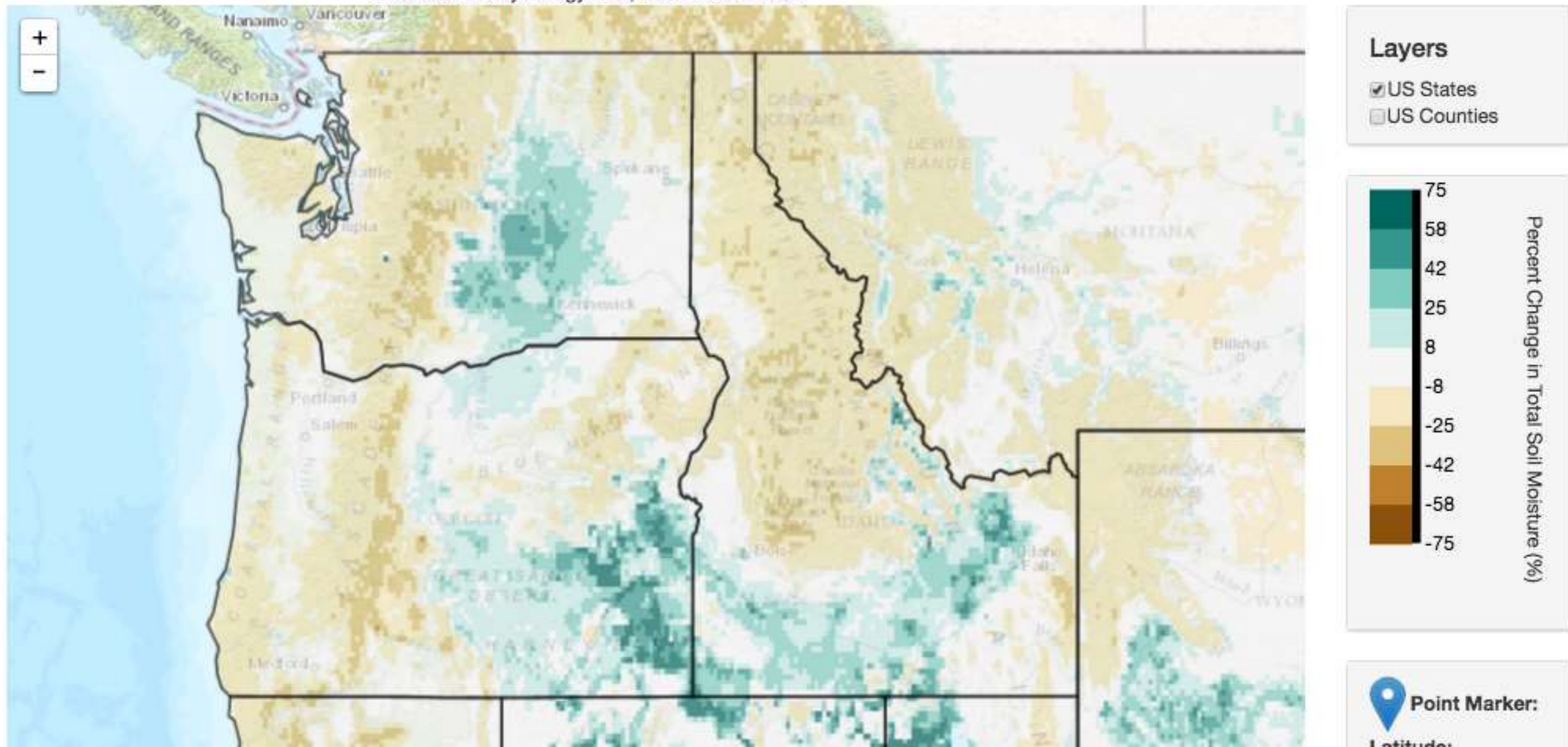


# Integrated scenarios project (UW-UI-OSU) CMIP5 climate & hydrology models

## Projected Changes in Summer (Jun-July-Aug) Total Soil Moisture (Percent Change)

RCP8.5 2070-2099 vs. 1971-2000

Data Source: Hydrology: VIC, Multi-Model Mean





# Outline

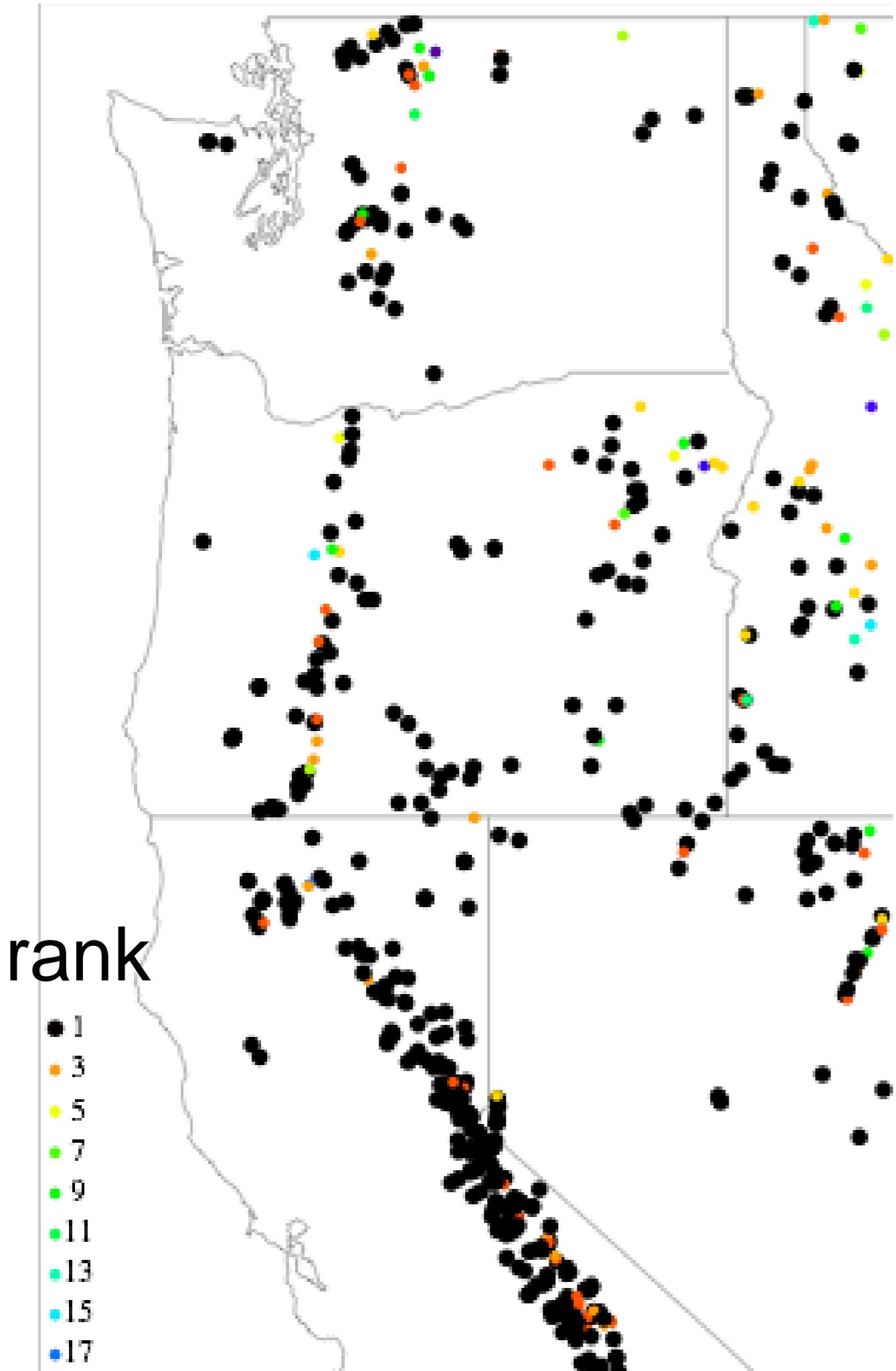
- Regional climate change - observed & projected
- Hydrologic change - observed & projected
- **The 2014-15 drought in Oregon**

2015 02/23 (Mon) 10:24:25 - Ed Chair top (Northeast view)



from Hoodoo web cam





April 1, 2015  
Record low at  
81% of sites

Mote et al. 2016

# What makes drought?

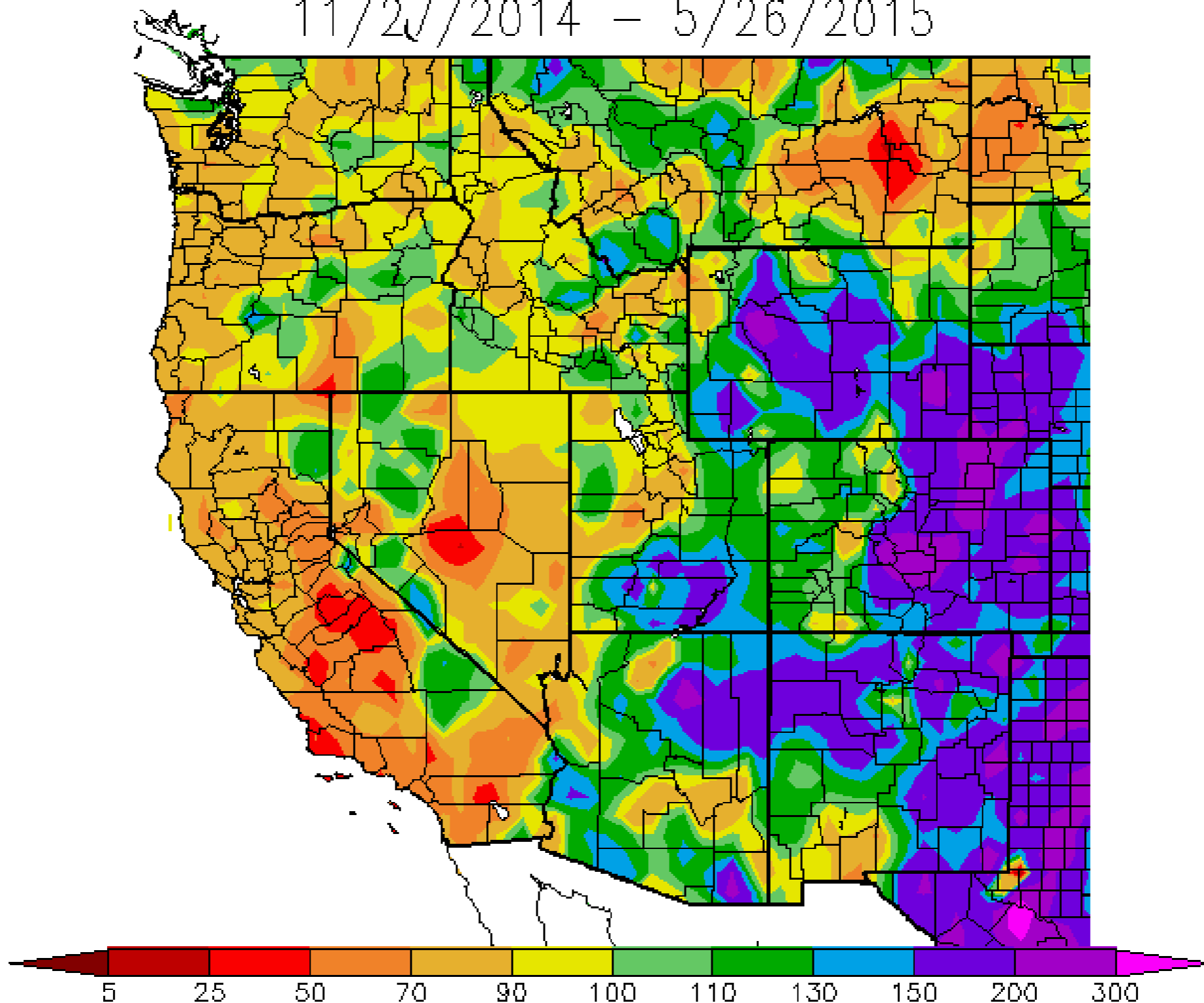
- Below-average precipitation
  - Winter
  - Spring
  - Summer
- Above-average temperature (affects SWE, ET, other demand)



# Winter 2014-15 precipitation

Percent of Average Precipitation (%)

11/27/2014 – 5/26/2015

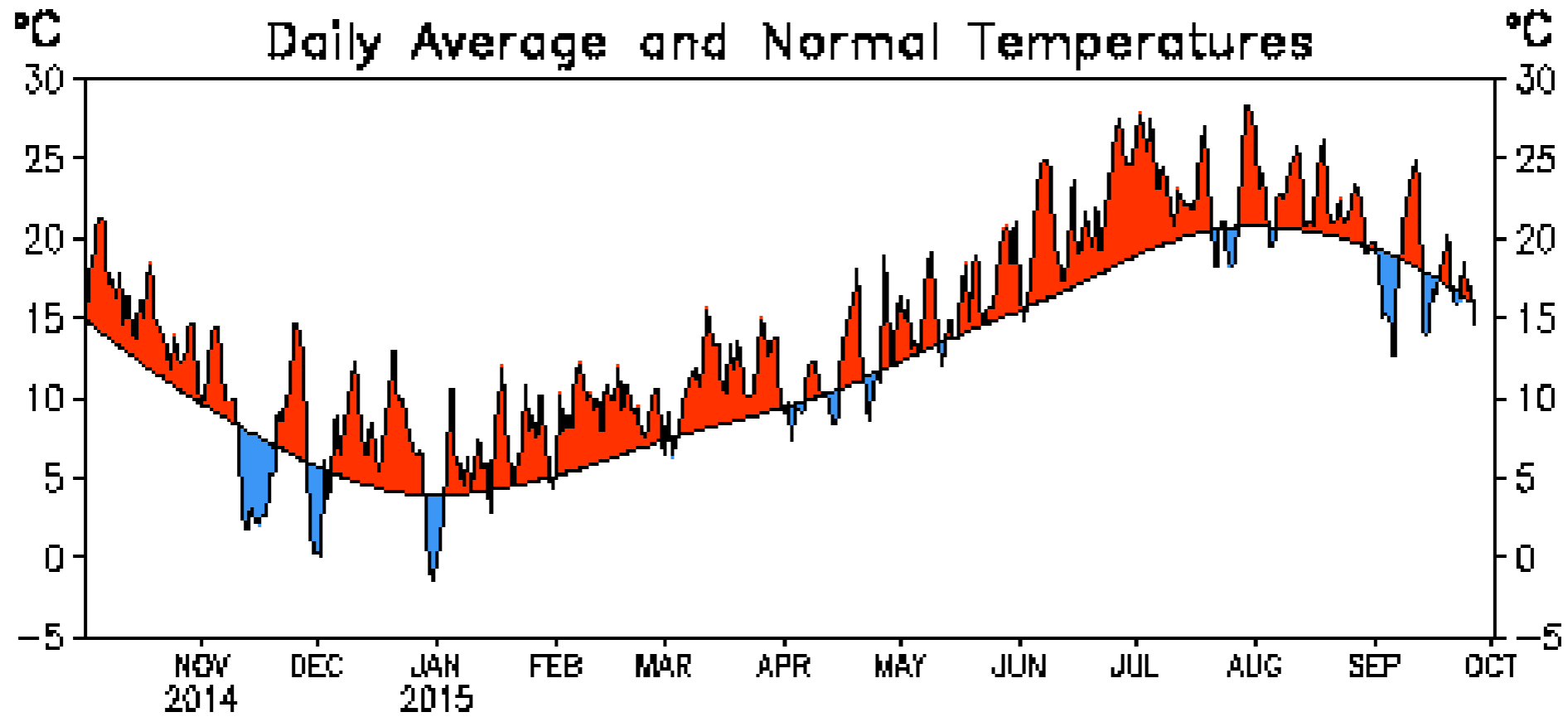


Generated 5/27/2015 at WRCC using provisional data.

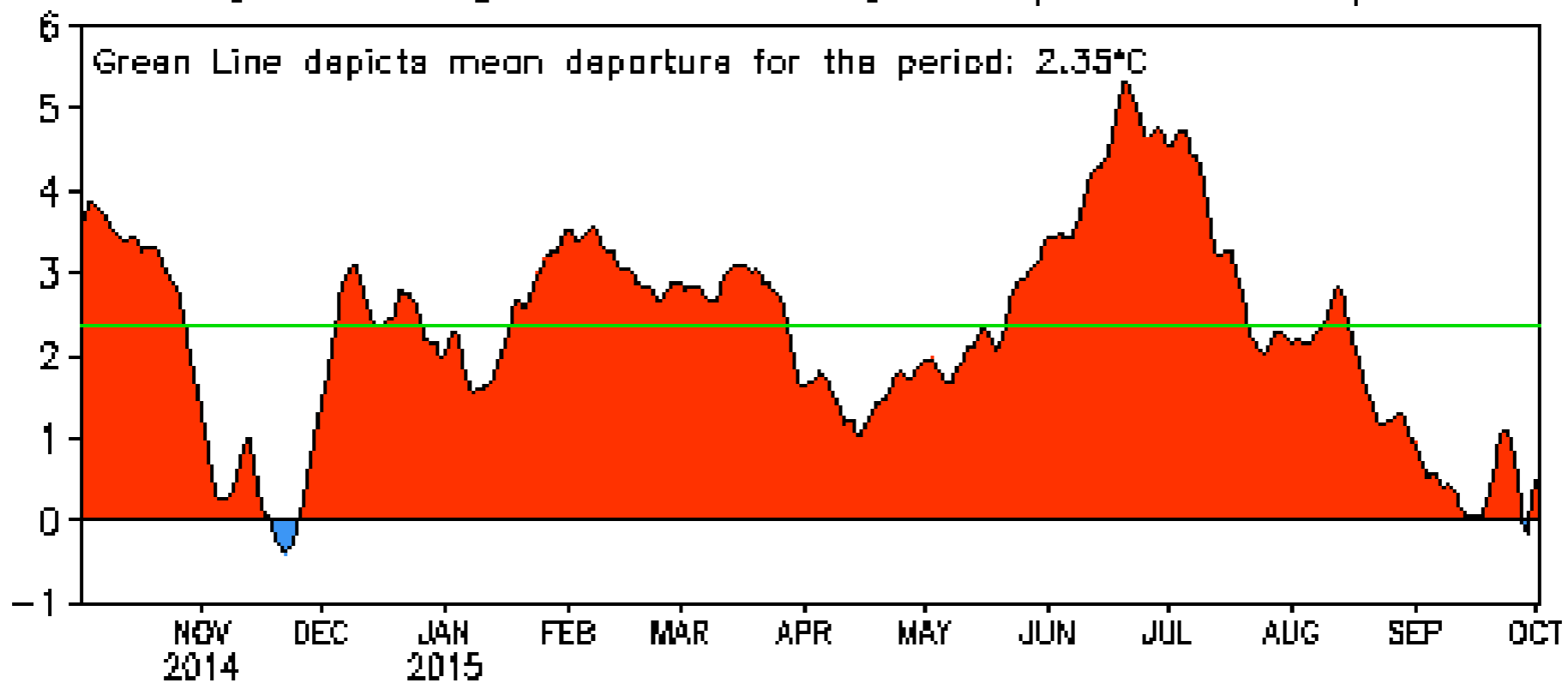
NOAA Regional Climate Centers

# WY2015

## PORTLAND, OREGON

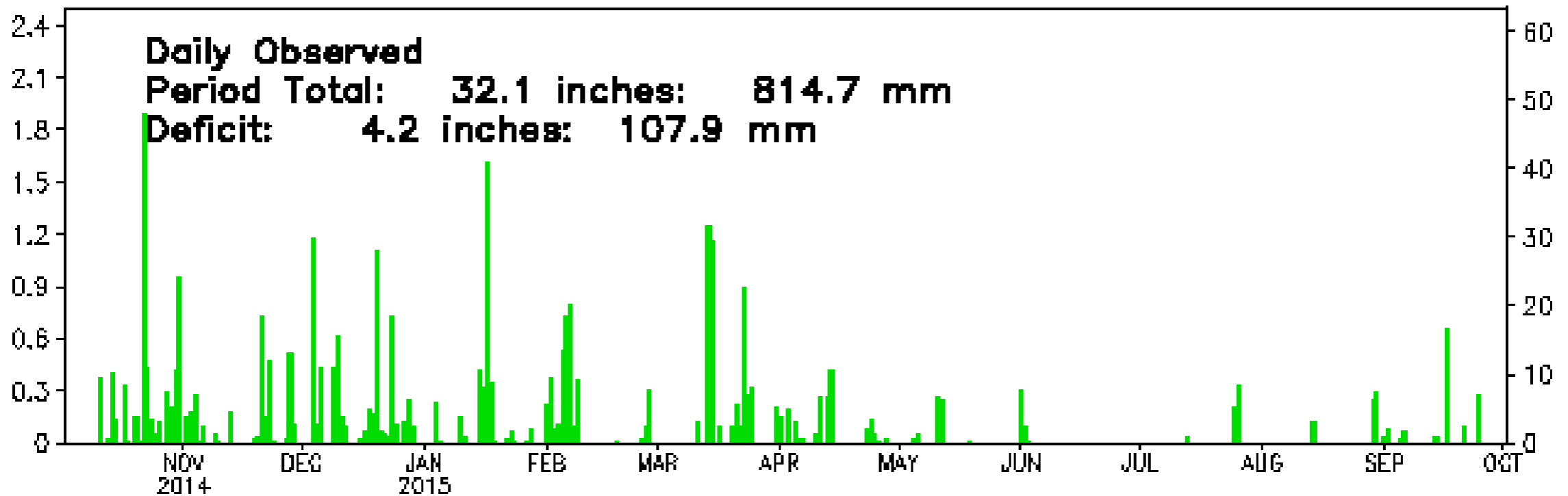
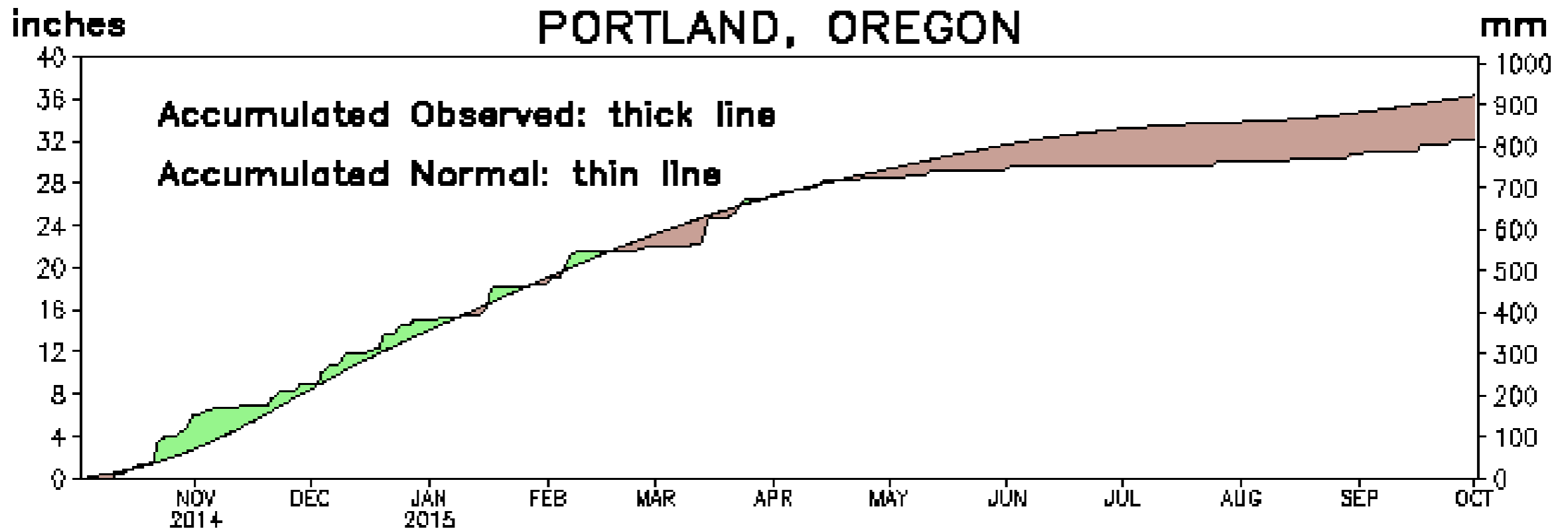


### 31-Day Running Mean of Daily Temperature Departures





# Precipitation PORTLAND, OREGON

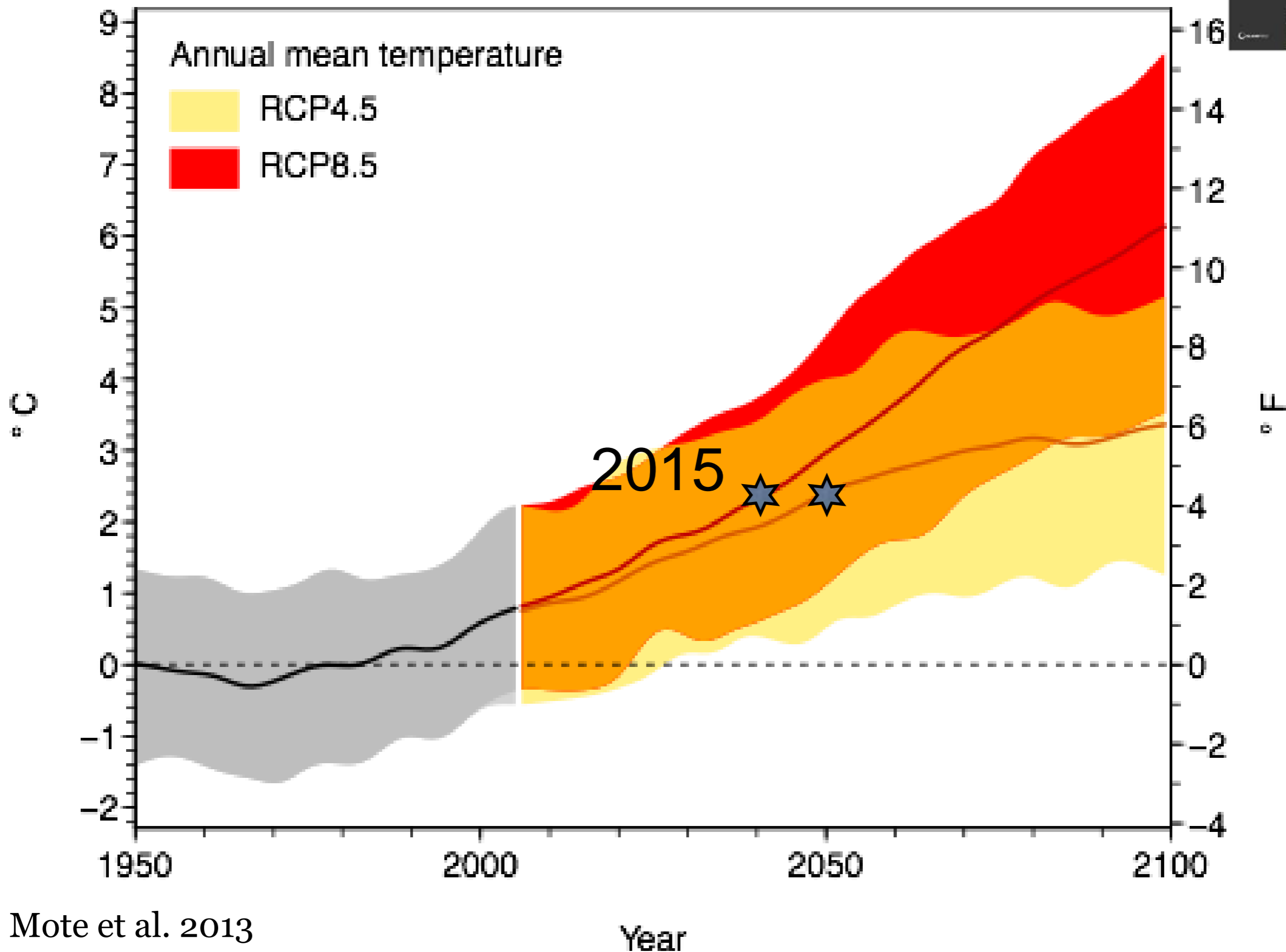
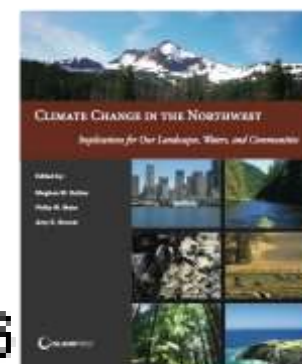


Data updated through 01 OCT 2015

CLIMATE PREDICTION CENTER/NCEP

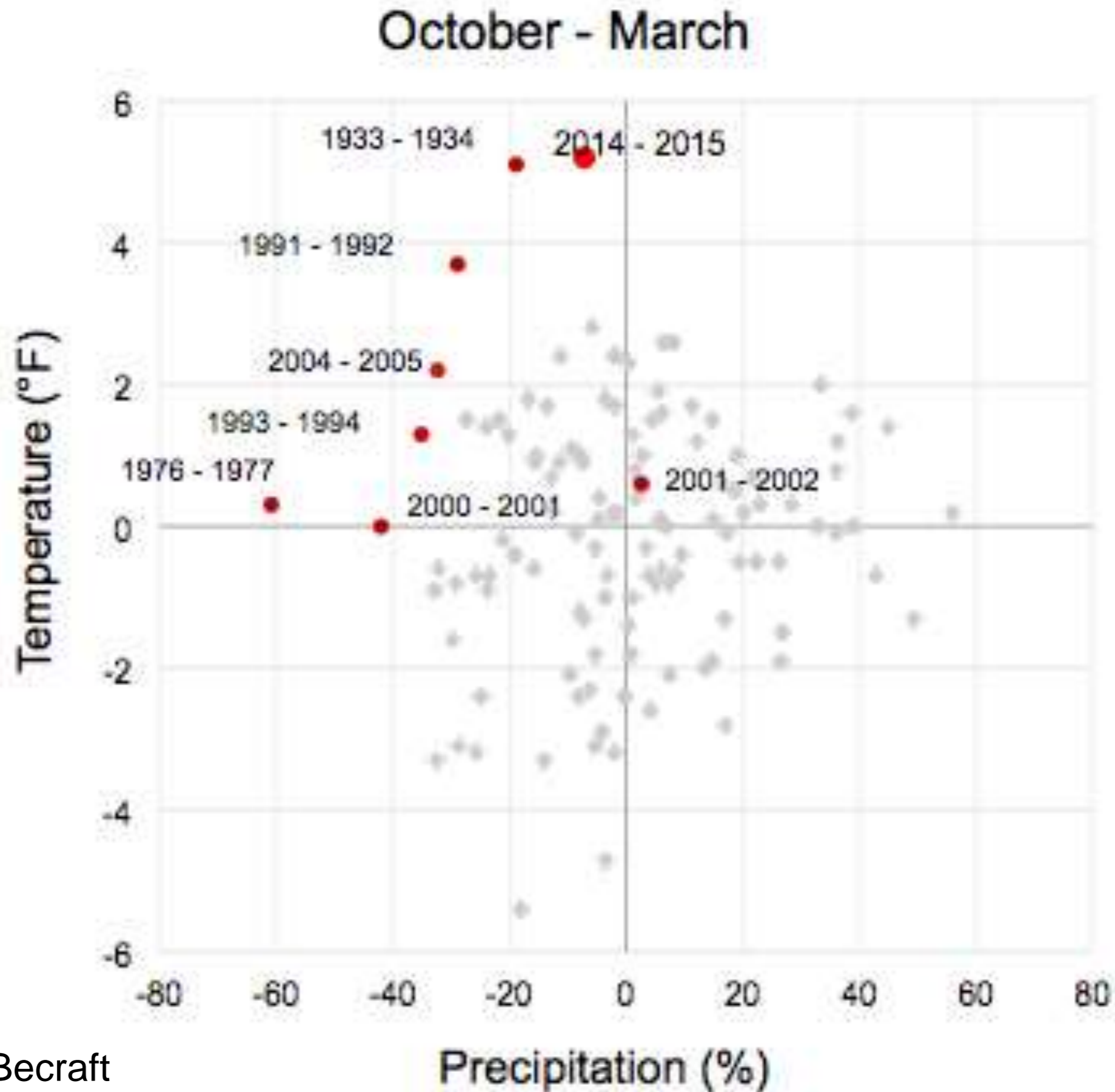
# PNW temperature

Difference from 1950-1999 average

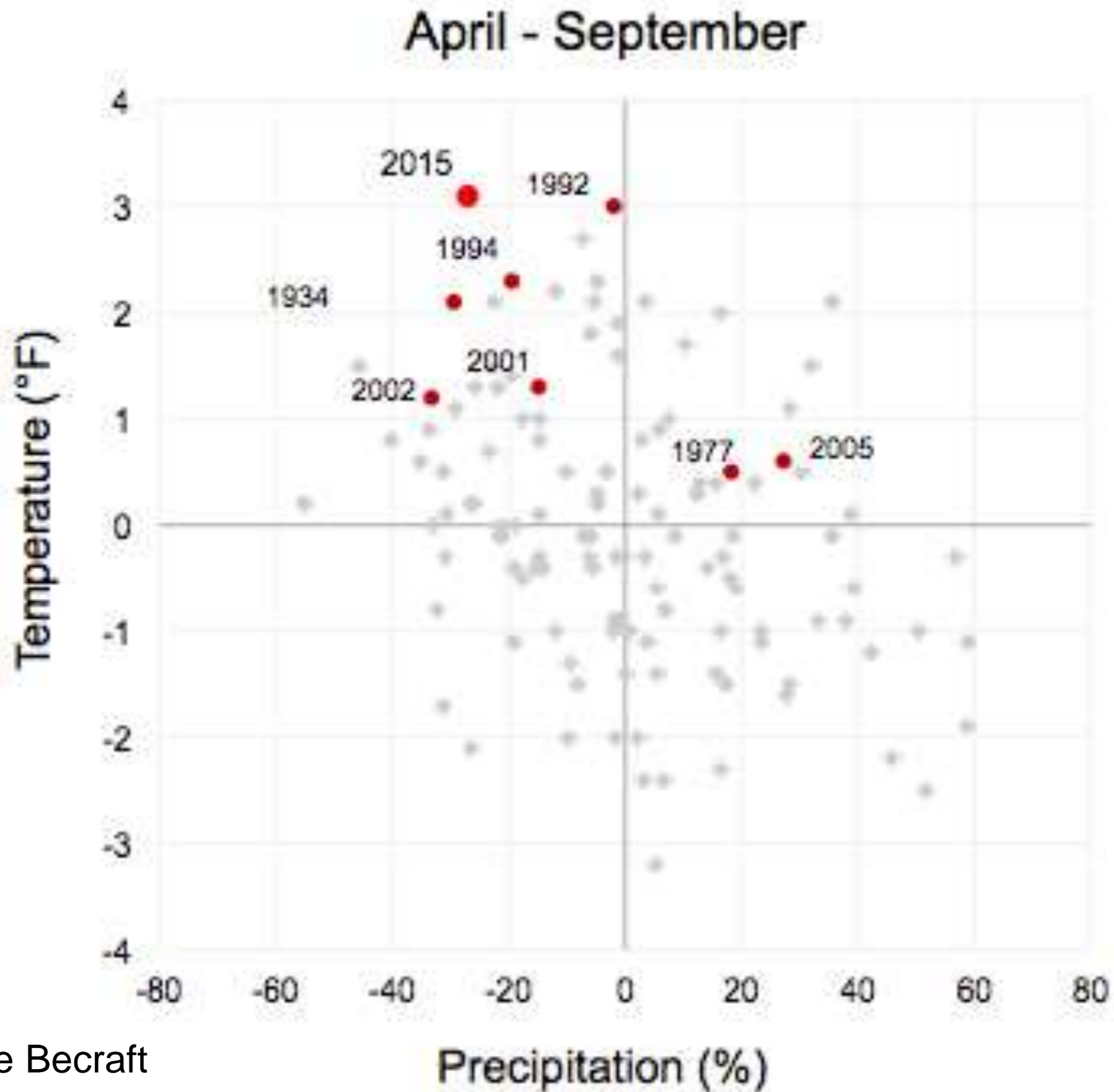




# Oregon statewide climate variability



# Oregon statewide climate variability





# 2015 vs climate projections

- NW avg 2014-15: +2.3°C, precip -8% compared to 20th century avg
- Exceptionally warm winter, fairly dry summer
- RCP4.5: ~2050 RCP8.5: ~2040

# Integrated Risk Management **ROADMAP**





# Tools

- <http://www.carpediemwest.org/resources/>
- [hydro.washington.edu/forecast/monitor\\_west/](http://hydro.washington.edu/forecast/monitor_west/)
- [climate.nkn.uidaho.edu/IntScenNew/vis\\_summarymaps.php](http://climate.nkn.uidaho.edu/IntScenNew/vis_summarymaps.php)

# Conclusions

- Warming is unfolding as predicted
- Primary hydrologic effect: reduced snowpack & summer runoff in those basins
- 2014-15 drought: big role for temp in Oregon, WA; resembles 2040s-50s