Overview of Climate Change in Ventura County

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Western Regional Climate Center

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California-Nevada Climate Applications Program

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Watersheds Coalition of Ventura County

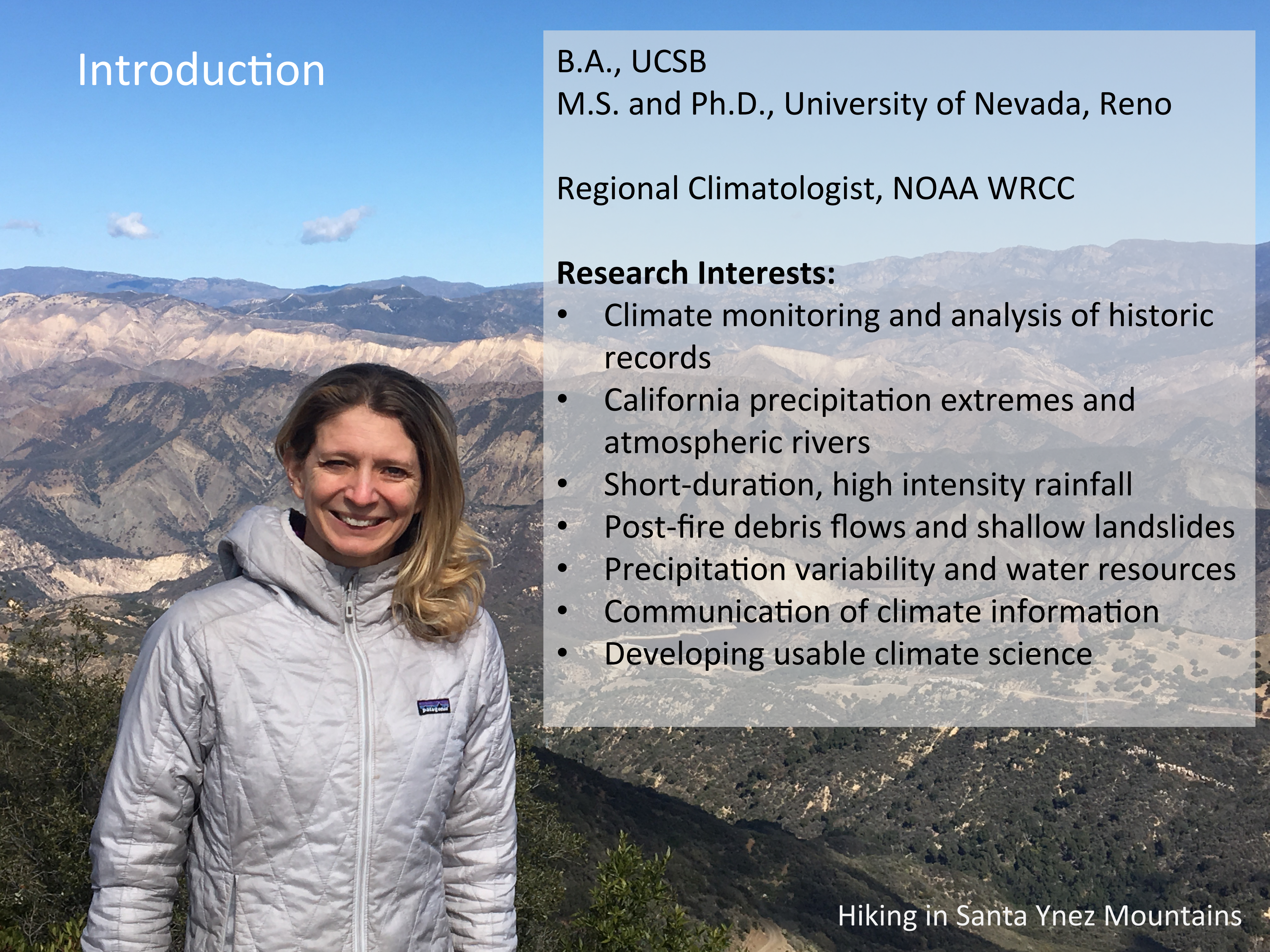
Introduction

B.A., UCSB
M.S. and Ph.D., University of Nevada, Reno

Regional Climatologist, NOAA WRCC

Research Interests:

- Climate monitoring and analysis of historic records
- California precipitation extremes and atmospheric rivers
- Short-duration, high intensity rainfall
- Post-fire debris flows and shallow landslides
- Precipitation variability and water resources
- Communication of climate information
- Developing usable climate science



Hiking in Santa Ynez Mountains

Ventura County faces many climate-related issues (we are only discussing 1-4):

1. Temperature changes
2. Precipitation changes
3. Flood hazard changes
4. Changes in wildfire characteristics
5. Surface water/groundwater changes
6. Sea level rise

Ozena, photo: G. McCurdy WRCC

Outline

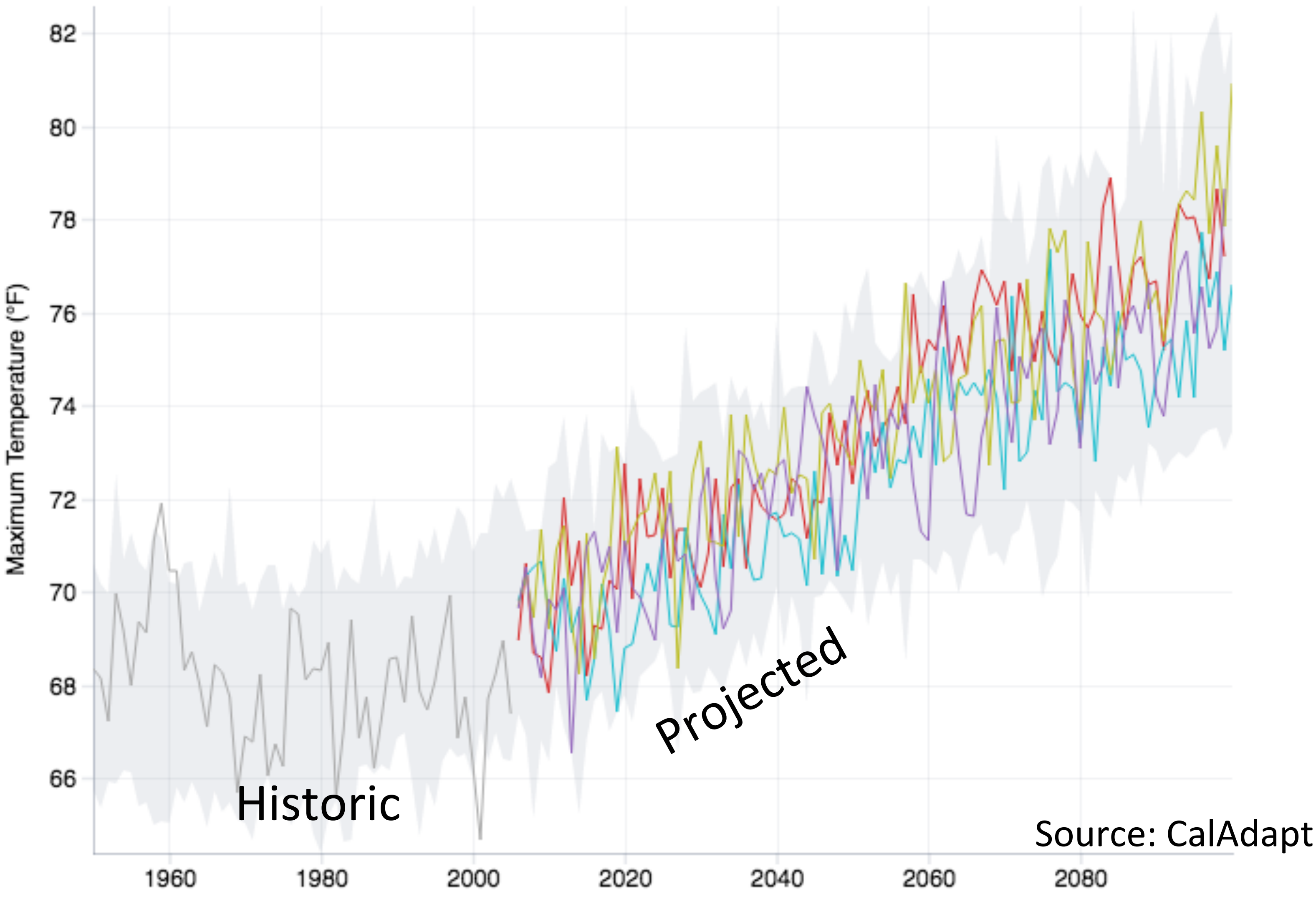
1. Temperature changes in model simulations
2. Precipitation: Complexities and representations in model simulations
3. High intensity rainfall and flash flooding
4. Wildfire in a changing climate
5. Summary

Ozena, photo: G. McCurdy WRCC

Temperature

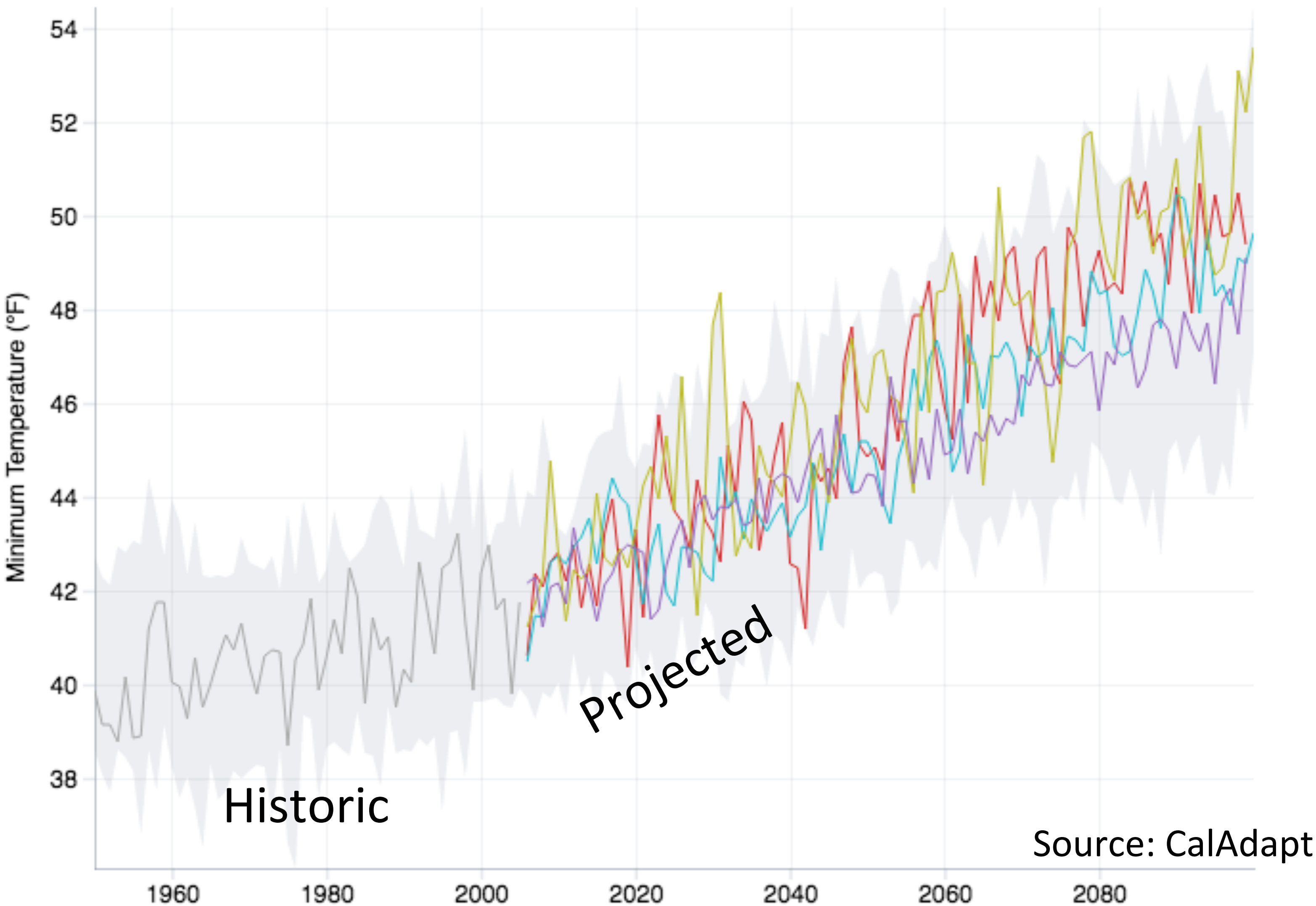
Maximum temperature

Ventura River Watershed – “business as usual” (RCP 8.5)

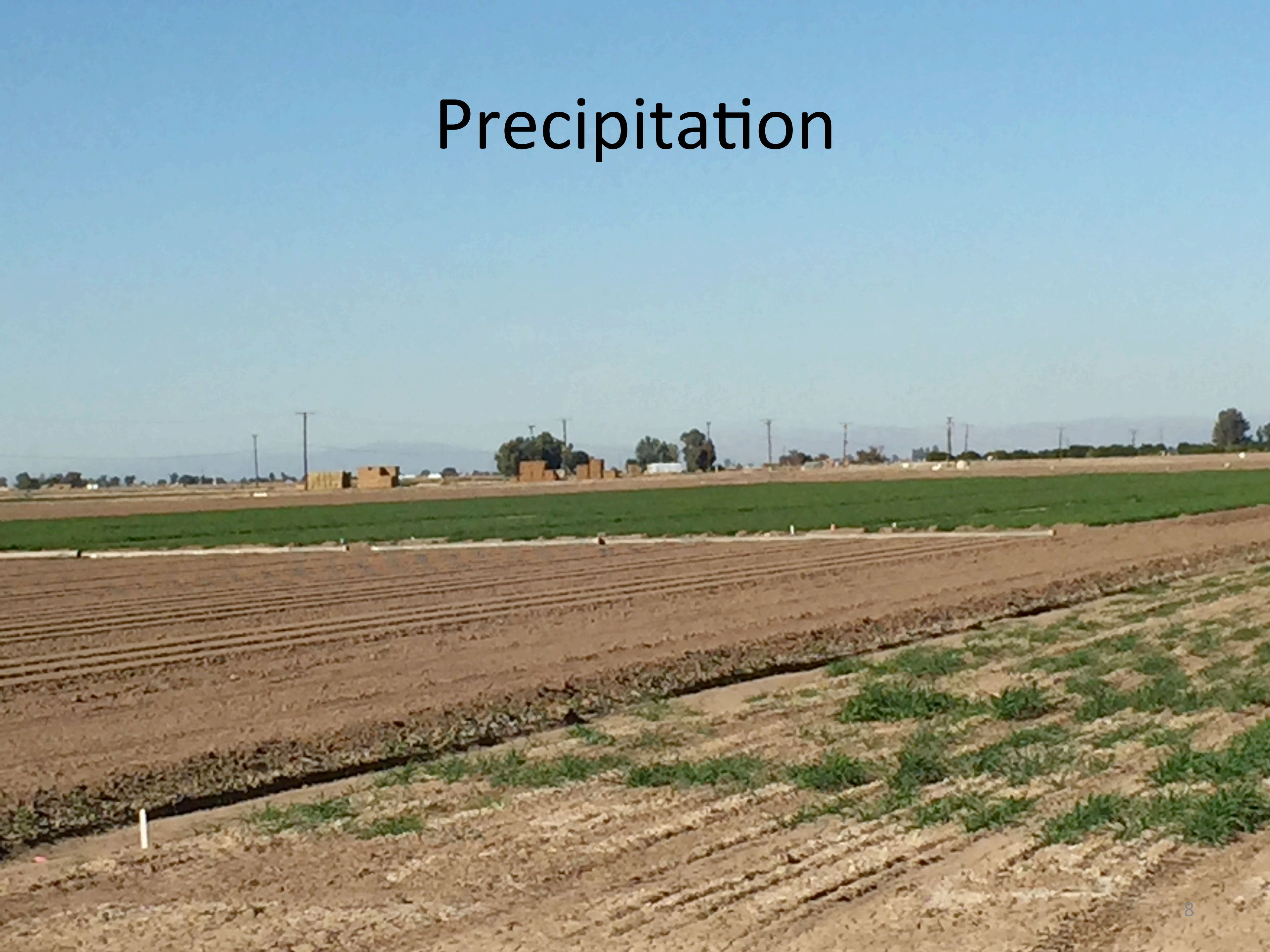


Minimum temperature

Ventura River Watershed – "business as usual" (RCP 8.5)

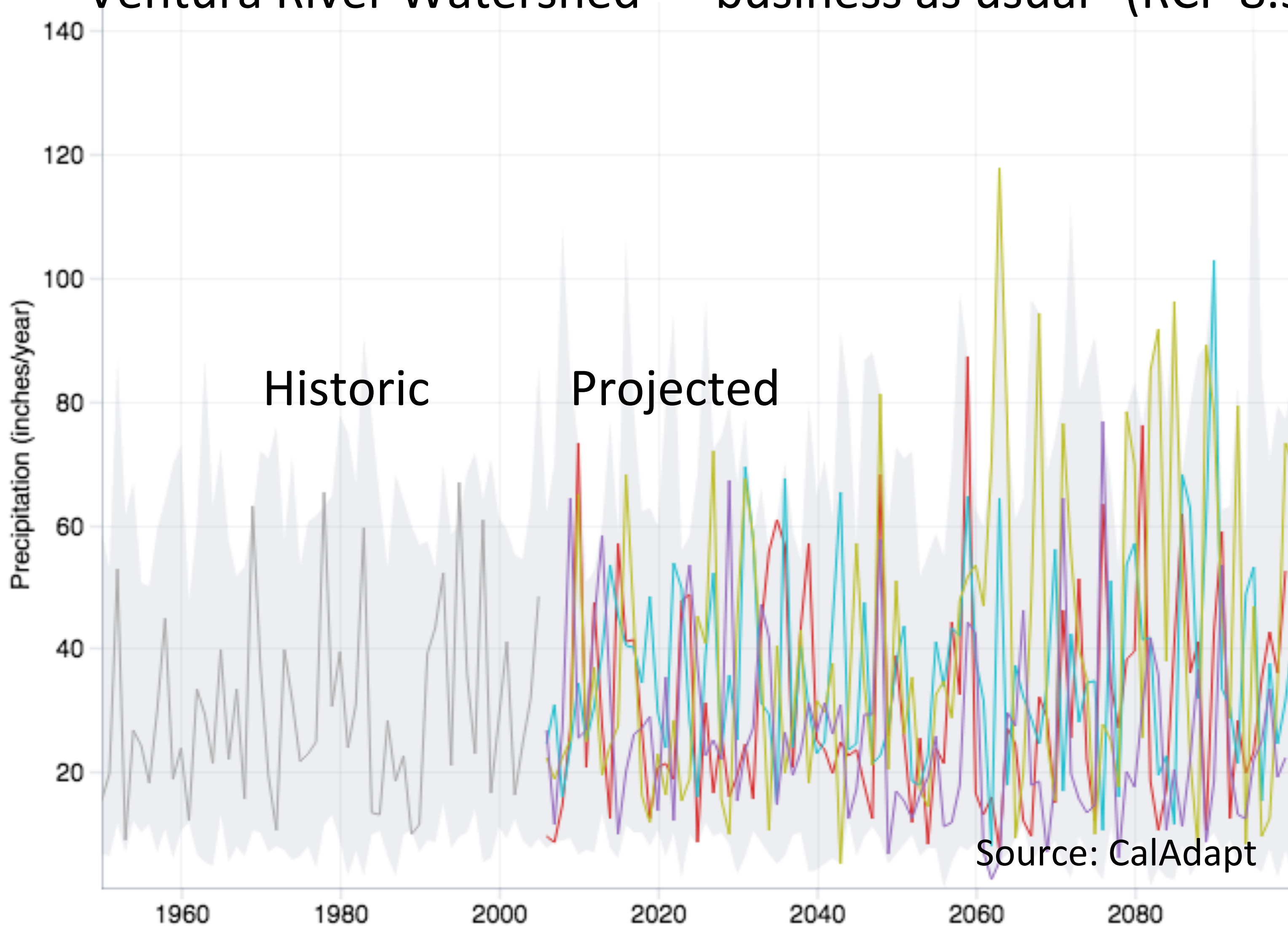


Precipitation



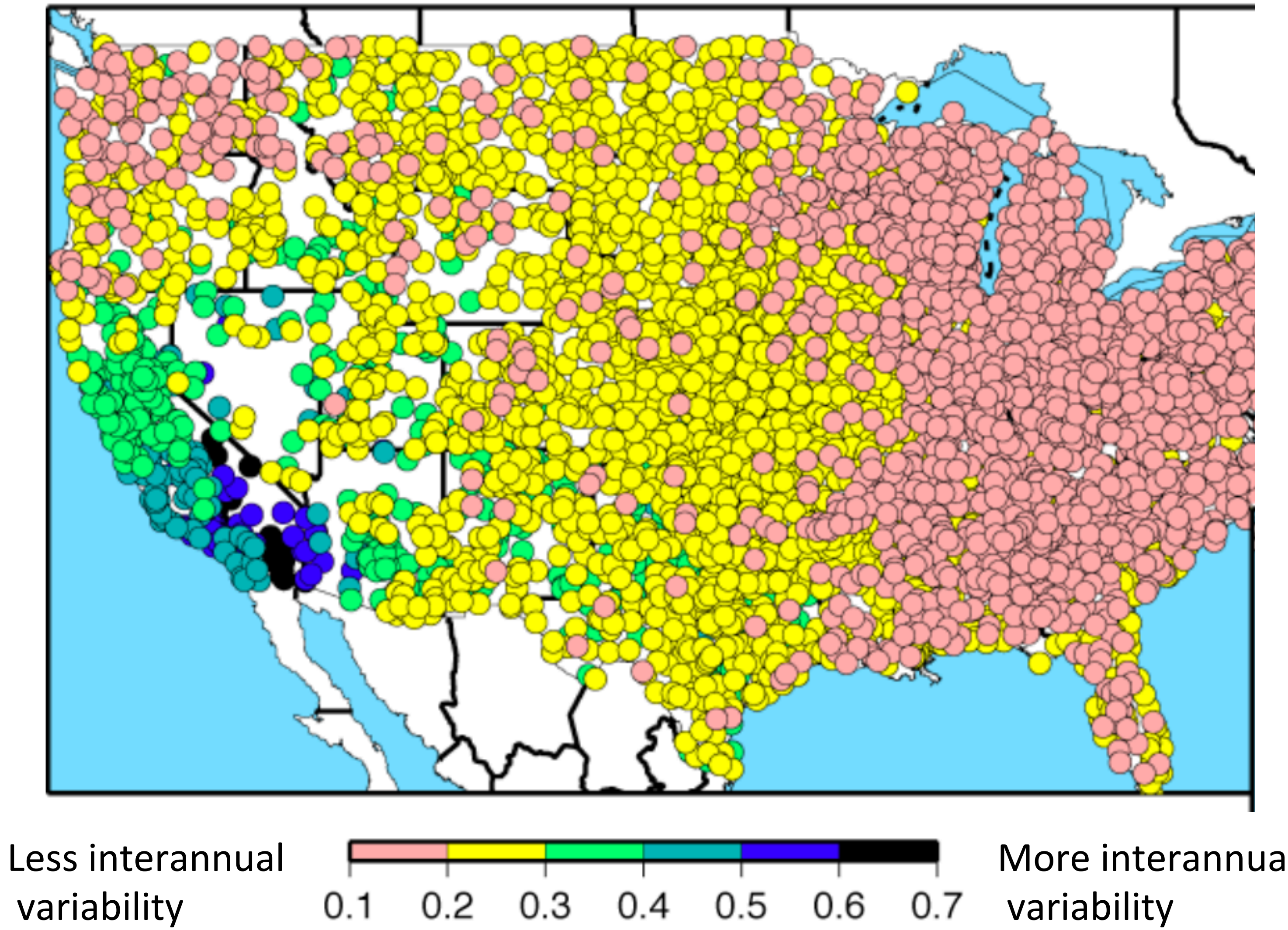
Precipitation

Ventura River Watershed – "business as usual" (RCP 8.5)



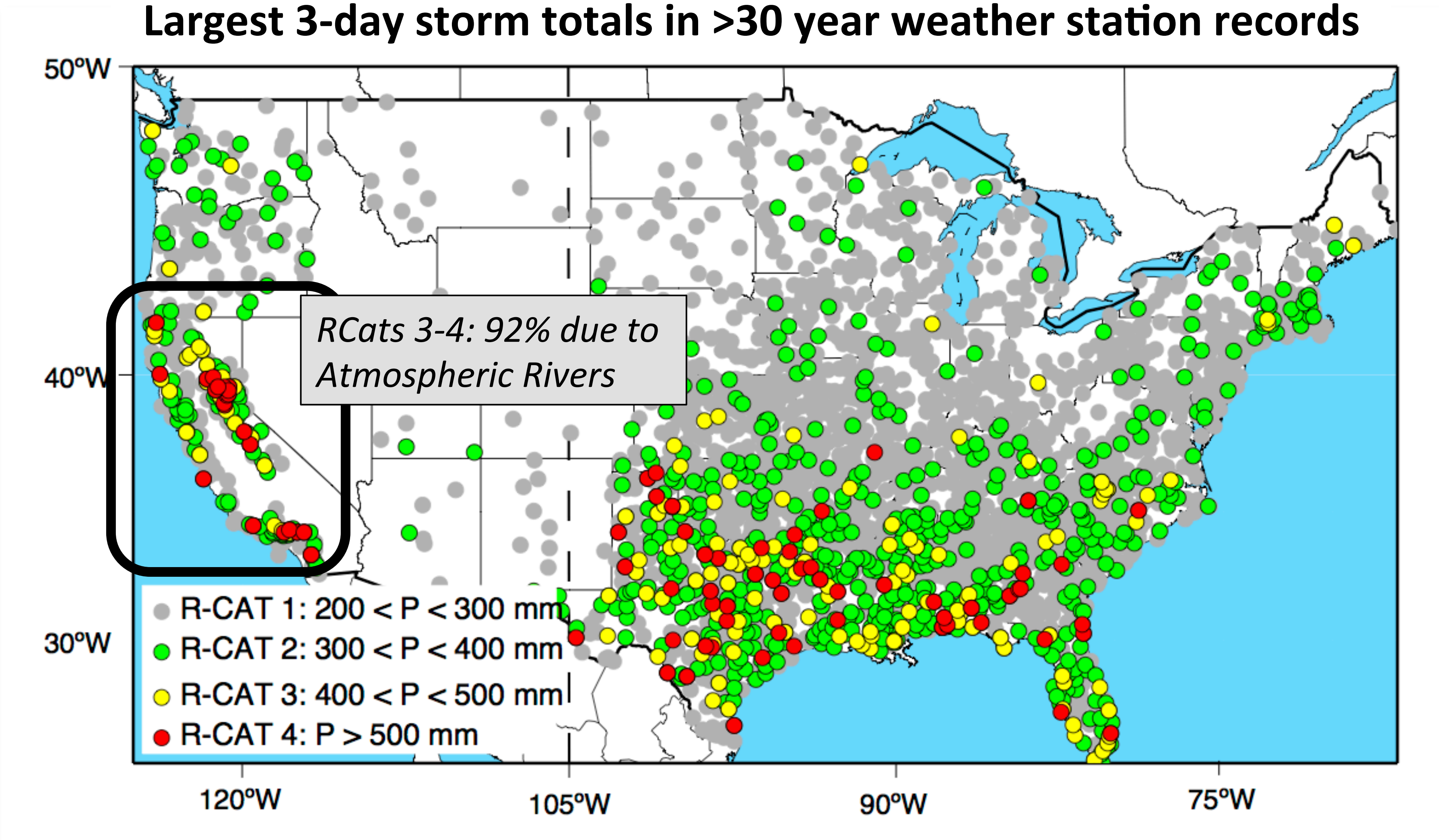
S. CA Exhibits high precipitation variability

Coefficients of Variation, Water Year 1951-2008



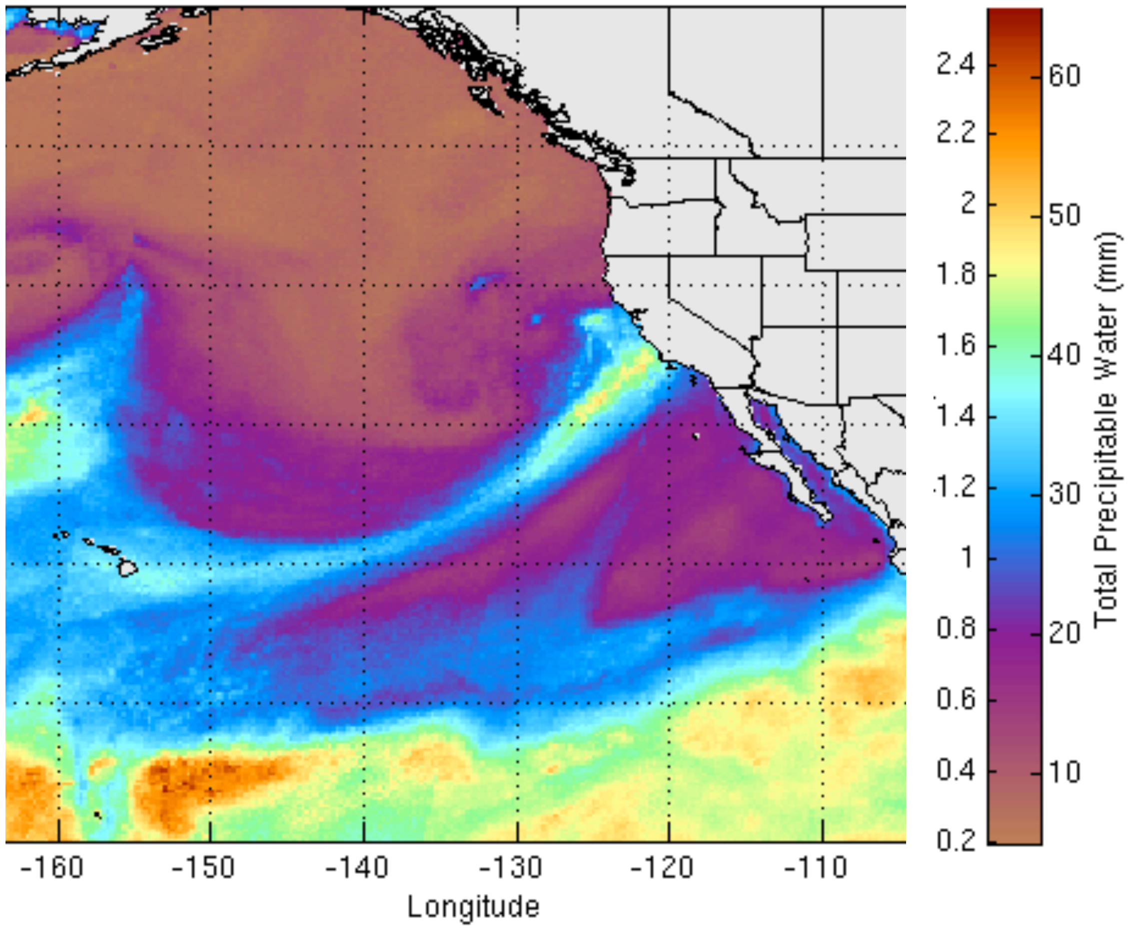
Dettinger et al. 2011, *Water*

S. CA has some of highest 3-day precipitation totals in US!



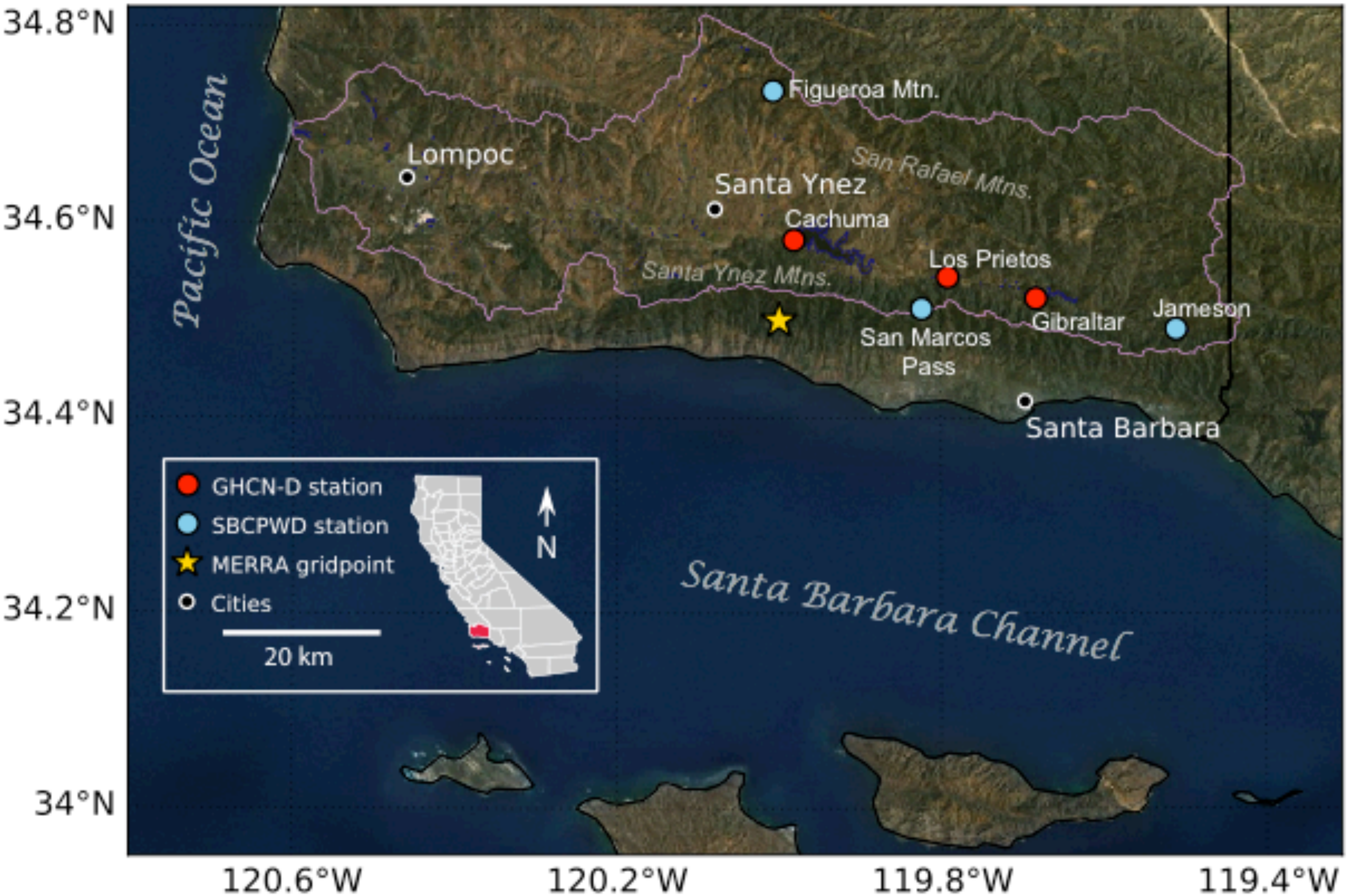
Ralph & Dettinger, BAMS, 2012

Atmospheric Rivers



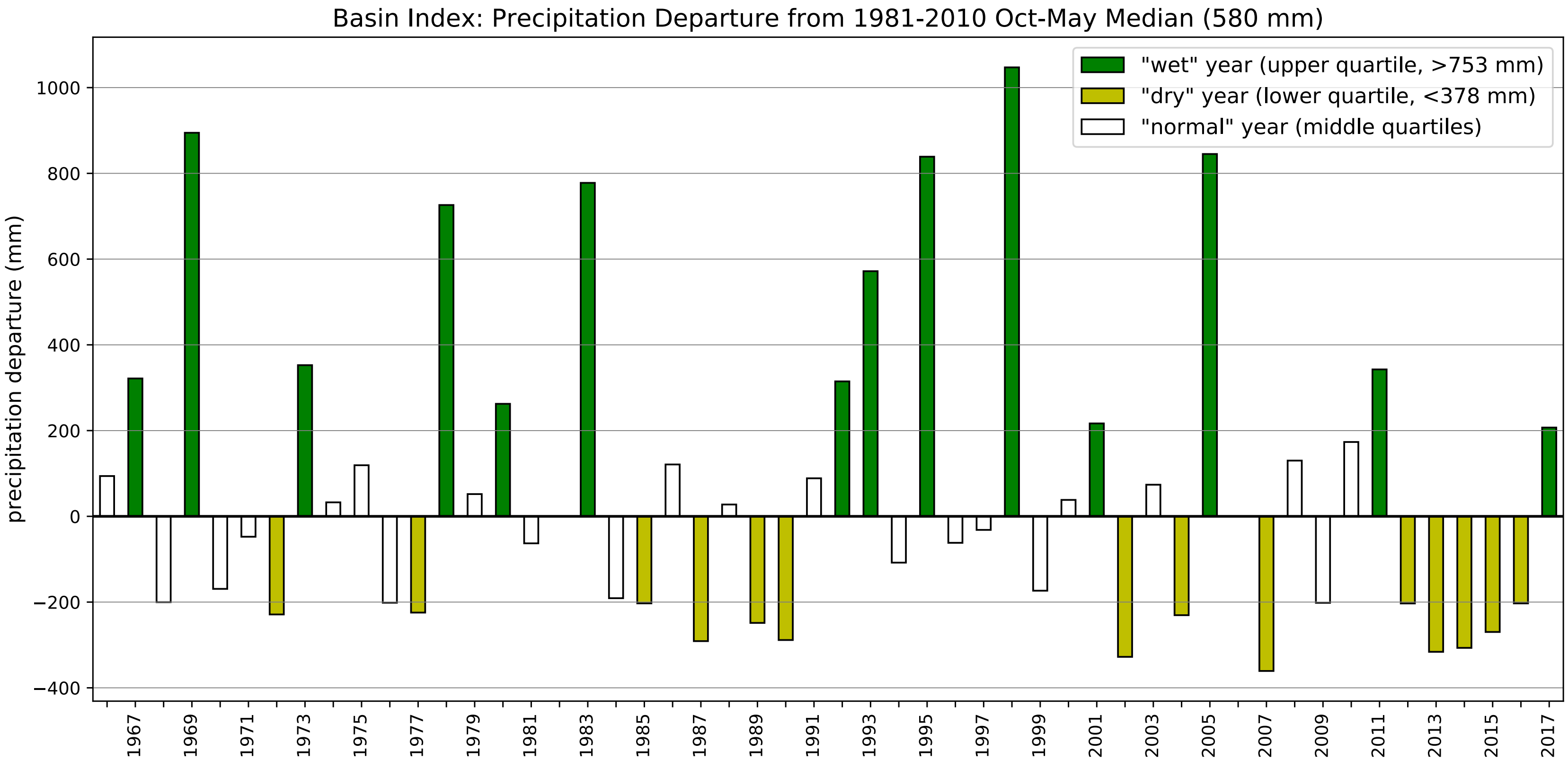
Source: CIMSS http://tropic.ssec.wisc.edu/real-time/mimic-tpw/global/main.html

Case Study: Santa Ynez River Basin



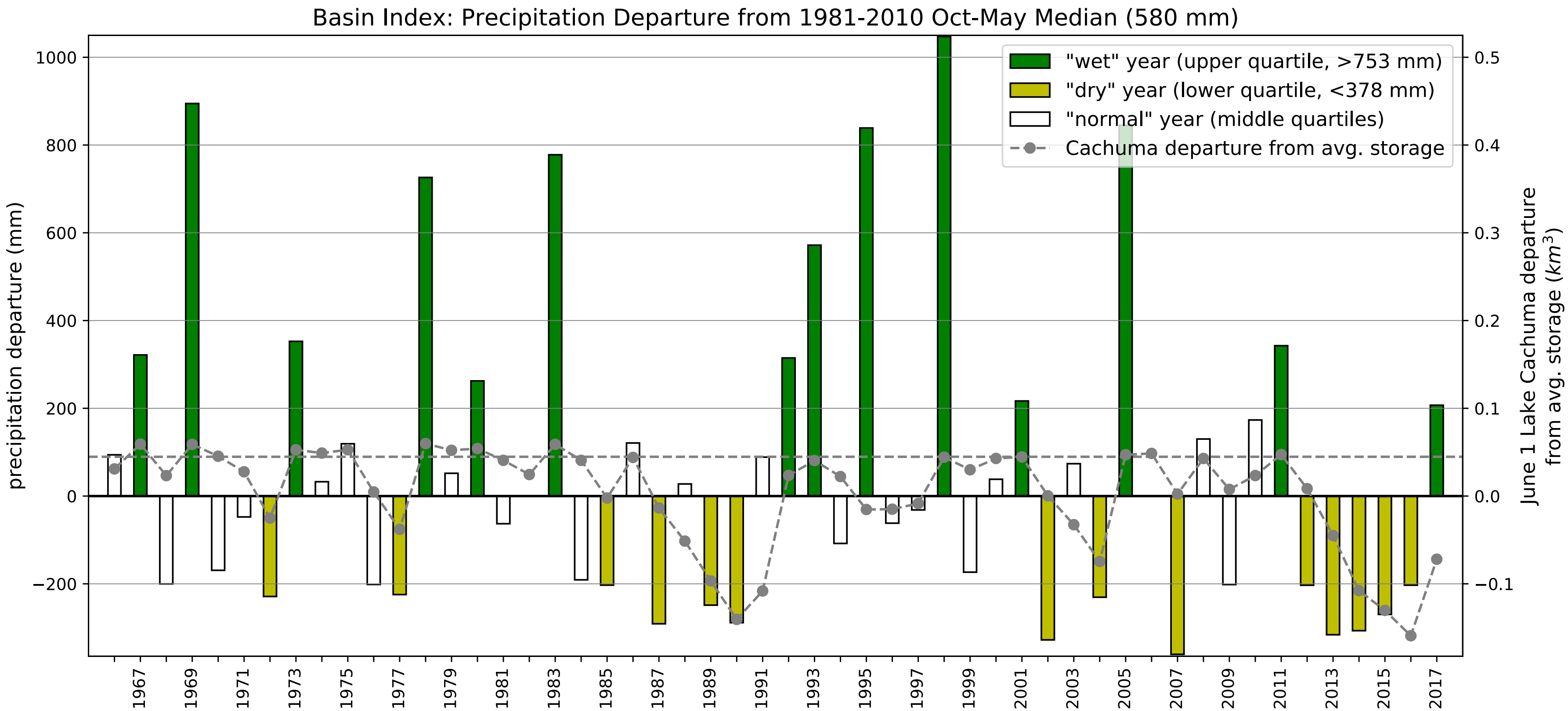
Oakley et al. 2018 *JHRS*

Wet and Dry Seasons



Oakley et al. 2018 *JHRS*

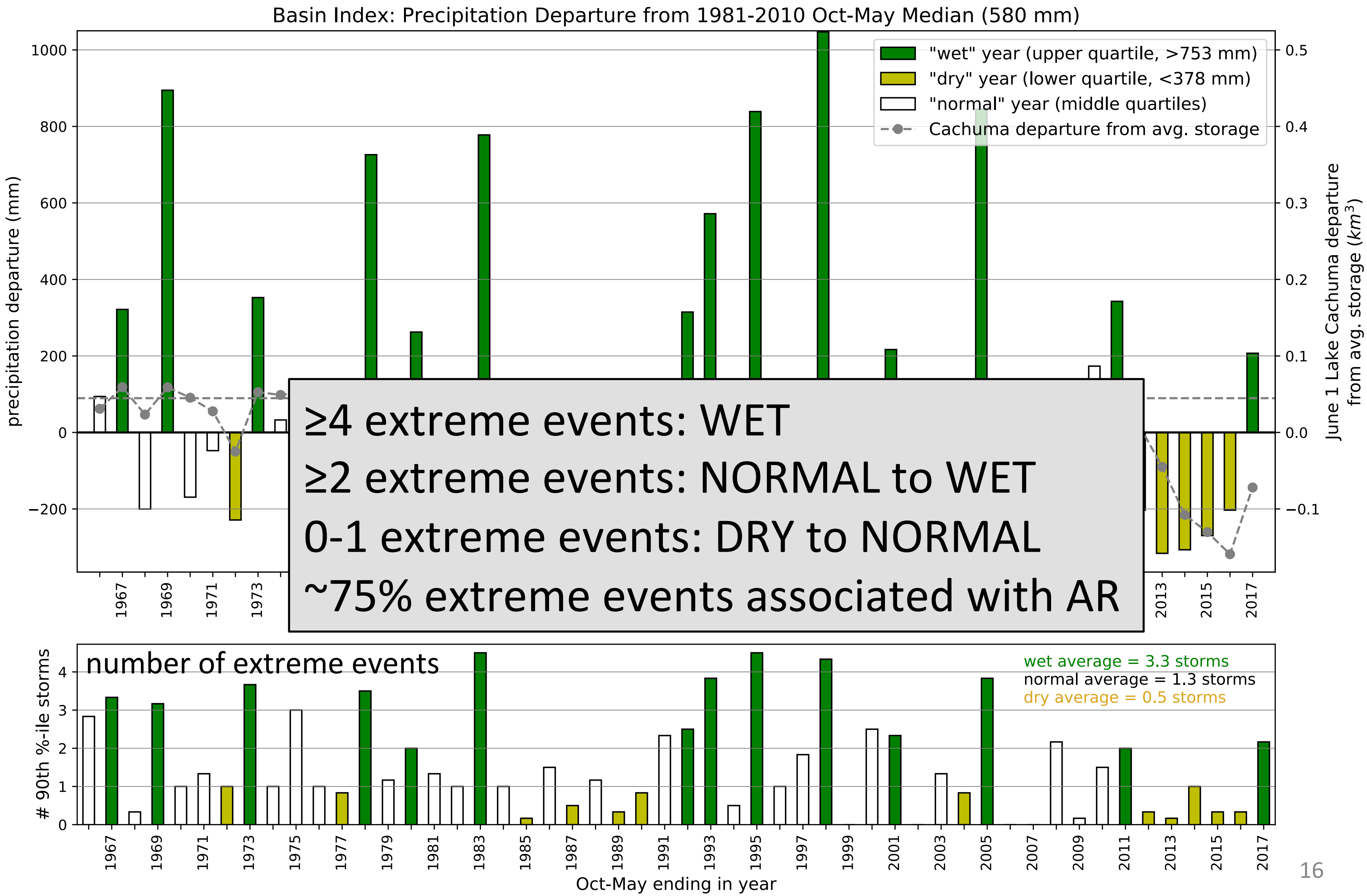
Wet and Dry Seasons



Extreme events: >90th percentile in a station record

Oakley et al. 2018 *JHRS*

Wet and Dry Seasons



≥4 extreme events: WET

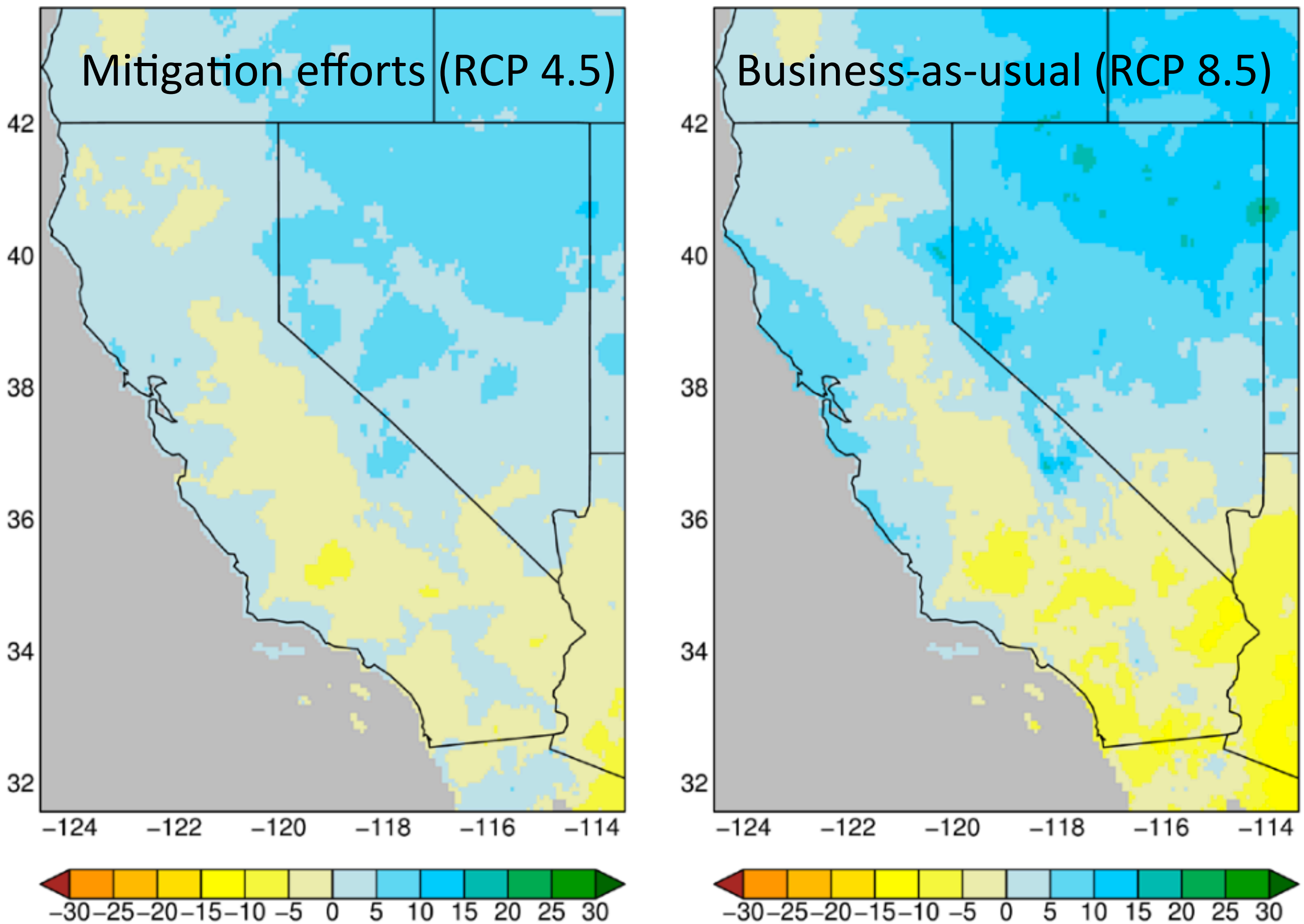
≥2 extreme events: NORMAL to WET

0-1 extreme events: DRY to NORMAL

~75% extreme events associated with AR

Models vary in depiction of S. CA precipitation changes

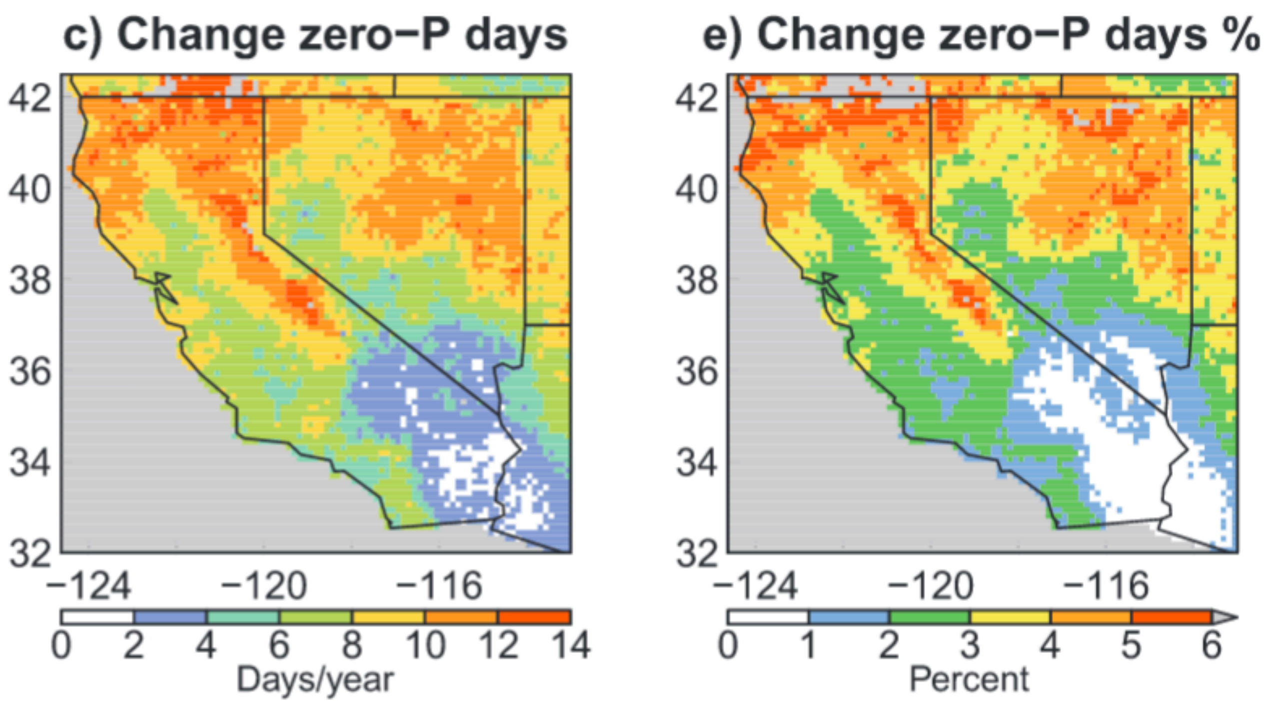
Change in average precipitation 2070-2100 relative to 1950-2005 from 10 models



Pierce et al. 2018, *CA 4th Assessment*

Decrease in Number of Precipitation Days

Future period: 2060-2069 Baseline period: 1985-1994

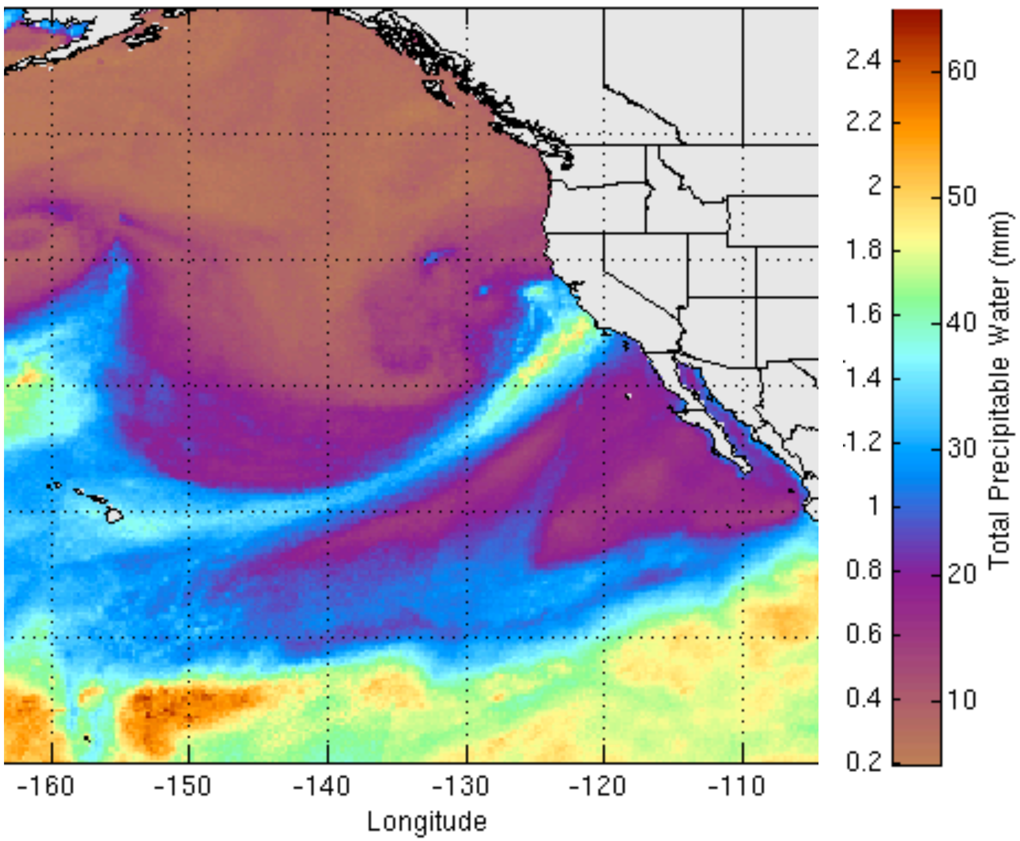


As an example, we will estimate 350 dry days per year for Ventura
Thus, all precipitation falls in ~15 days (365-350 = 15)
A 2-3% change (shown above) would mean 7-10 *less* precipitation days
For S. CA, projections show same amount (or more) precipitation
If comes in fewer days, achieved through stronger storms, greater moisture transport

Pierce et al. 2013, *J. Climate*; Polade et al. 2014, *Nature Sci. Rep.*

Role of Atmospheric Rivers

AR that impacted S. CA on Feb 17-18 2017

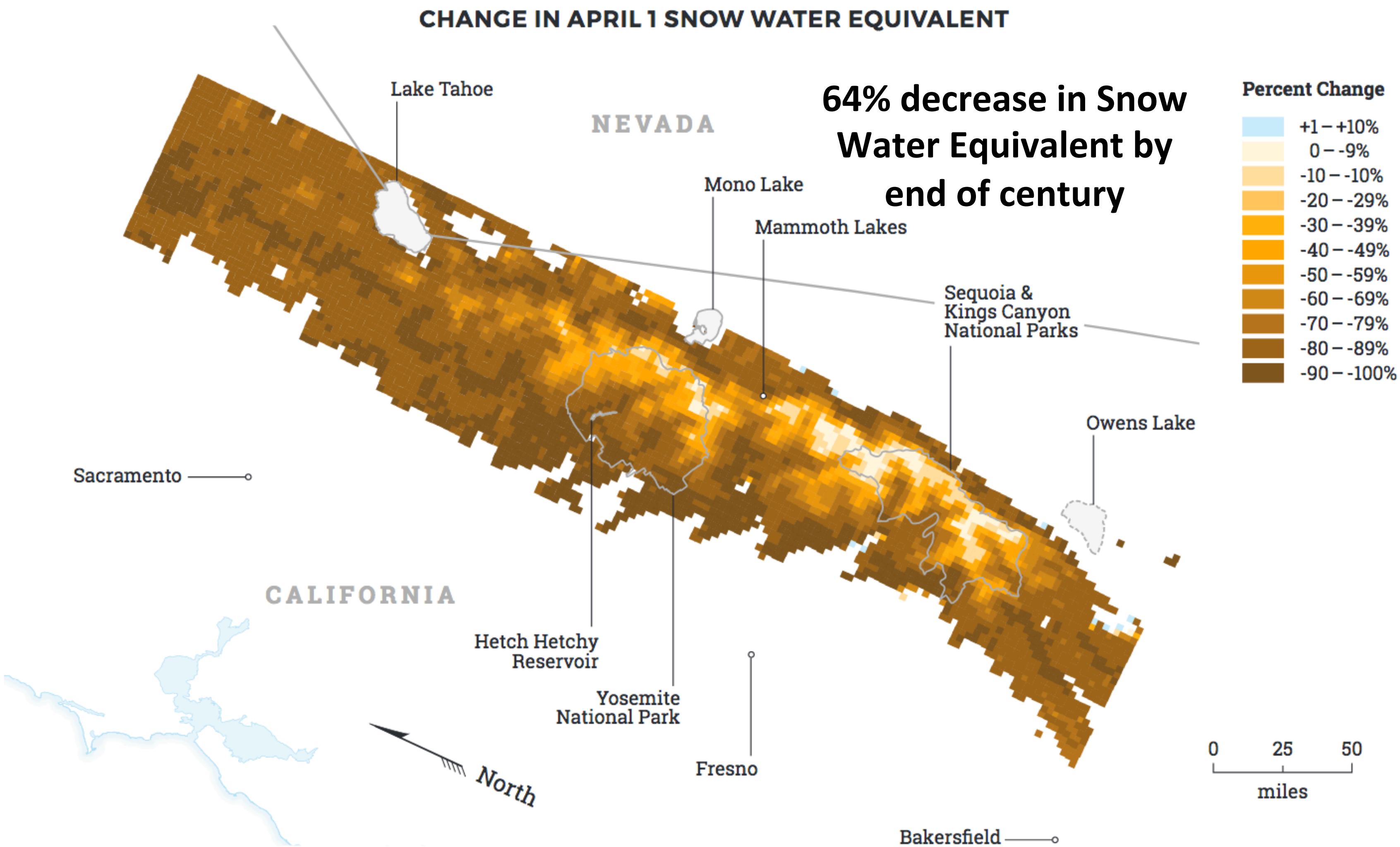


- 20-50% increase in frequency of AR conditions along US West Coast (across multiple studies)
- 10-30% increase in strength of ARs (across multiple studies)
- 60% increase in AR frequency, 20% increase in strength at southern mid-latitudes
- 10% global decrease in AR activity

Espinoza et al. 2018 *GRL*

Studies suggest fewer, but stronger and longer duration ARs for southern CA
Potential for increase of individual years with many ARs, small change in average number

Reduction in snowpack



64% decrease in Snow Water Equivalent by end of century

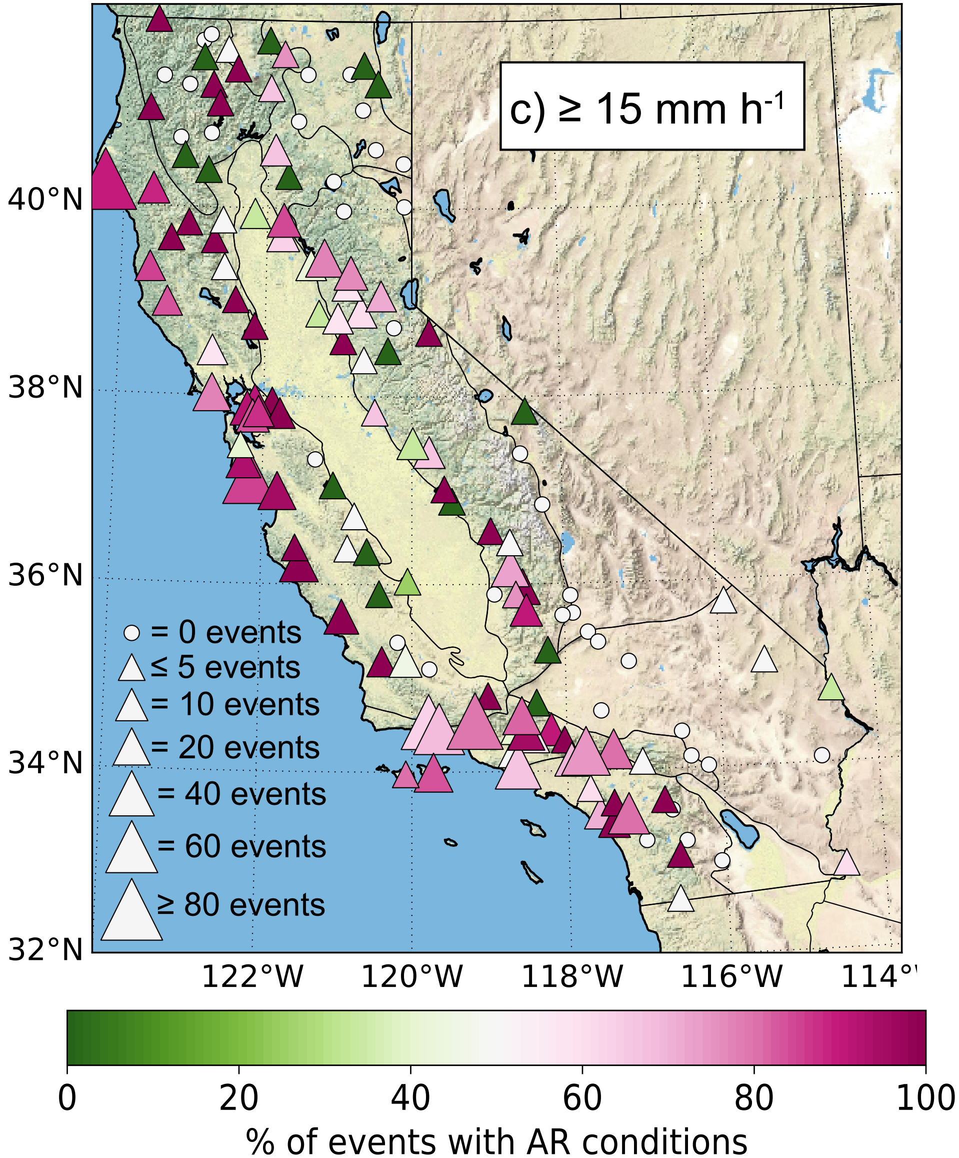
Baseline 1981-2000 Future period 2081-2100 Based on business-as-usual scenario

Reich et al. 2018: *Climate Change in the Sierra Nevada*, UCLA Report

High Intensity Rainfall and Flash Flooding

Post-fire debris flow in Camarillo Springs 12 December 2014

High intensity precipitation characteristic of S. CA



Study period: 1995-2016

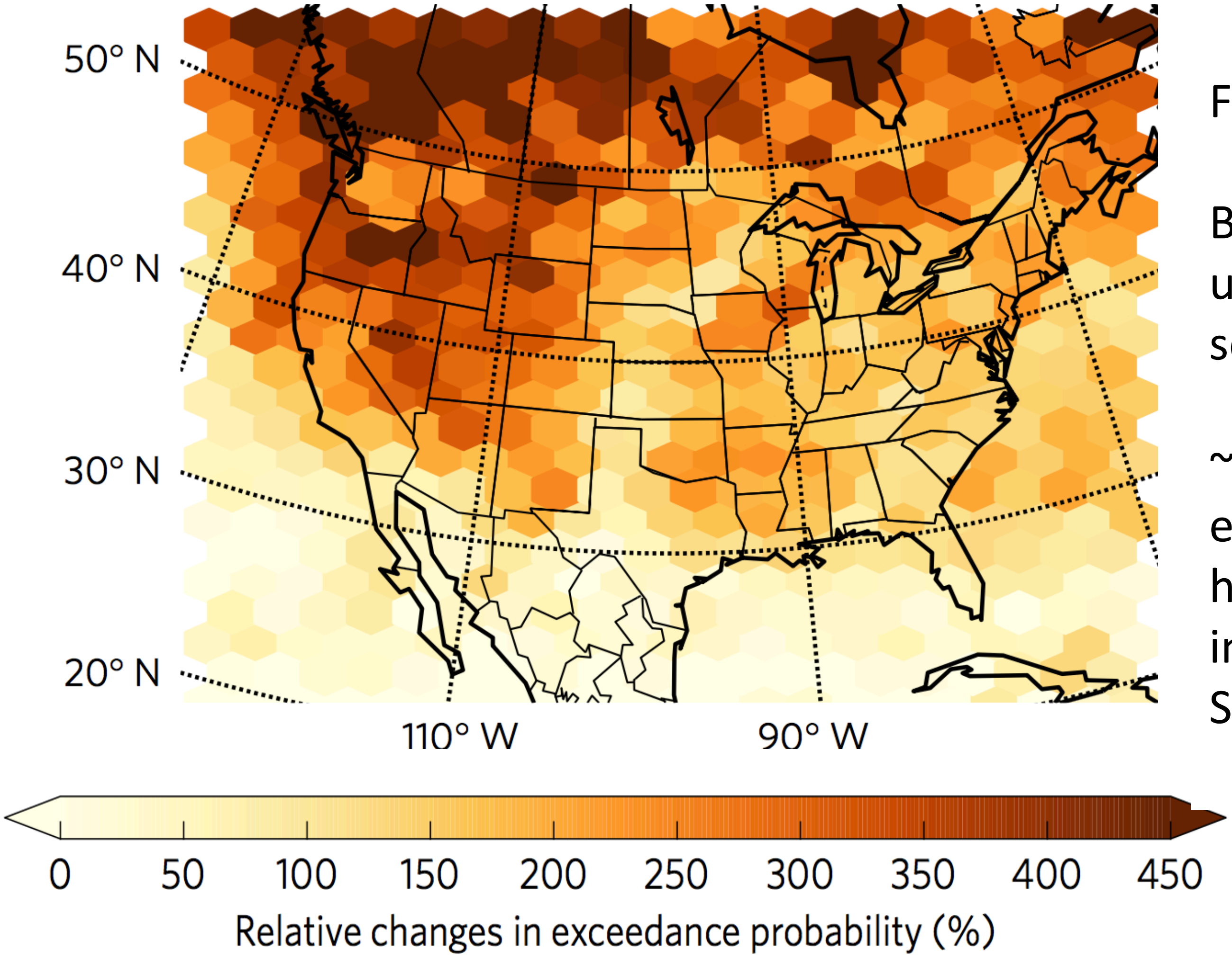
15 mm/h ~ 0.6 in/h

60-70% of events associated with atmospheric rivers (ARs)

Oakley et al. 2018, *Earth Interactions*

Future Hourly Precipitation Extremes

% change in exceedance of top 0.05% hourly precip. in future climate



For Dec-Jan-Feb

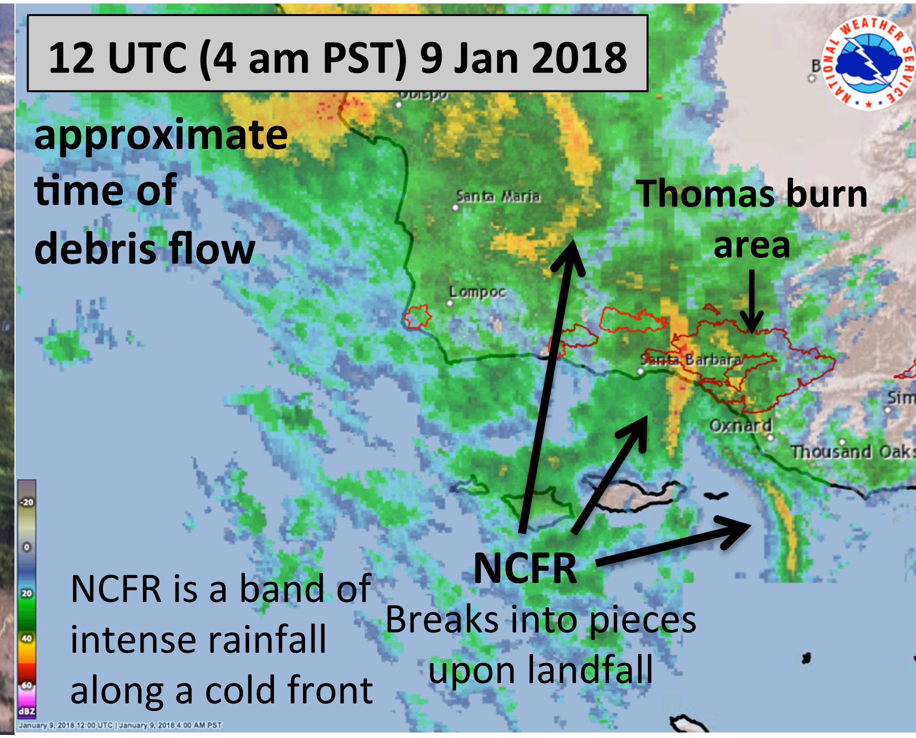
Based on business-as-usual (RCP 8.5) scenario

~2-3x more likely to exceed top 0.05% of historic hourly precip. in warmer climate in S. CA

Prein et al. 2017, *Nature Climate Change*

Post-fire debris flows

Montecito debris flow. *Photo: Ventura County Air Unit*



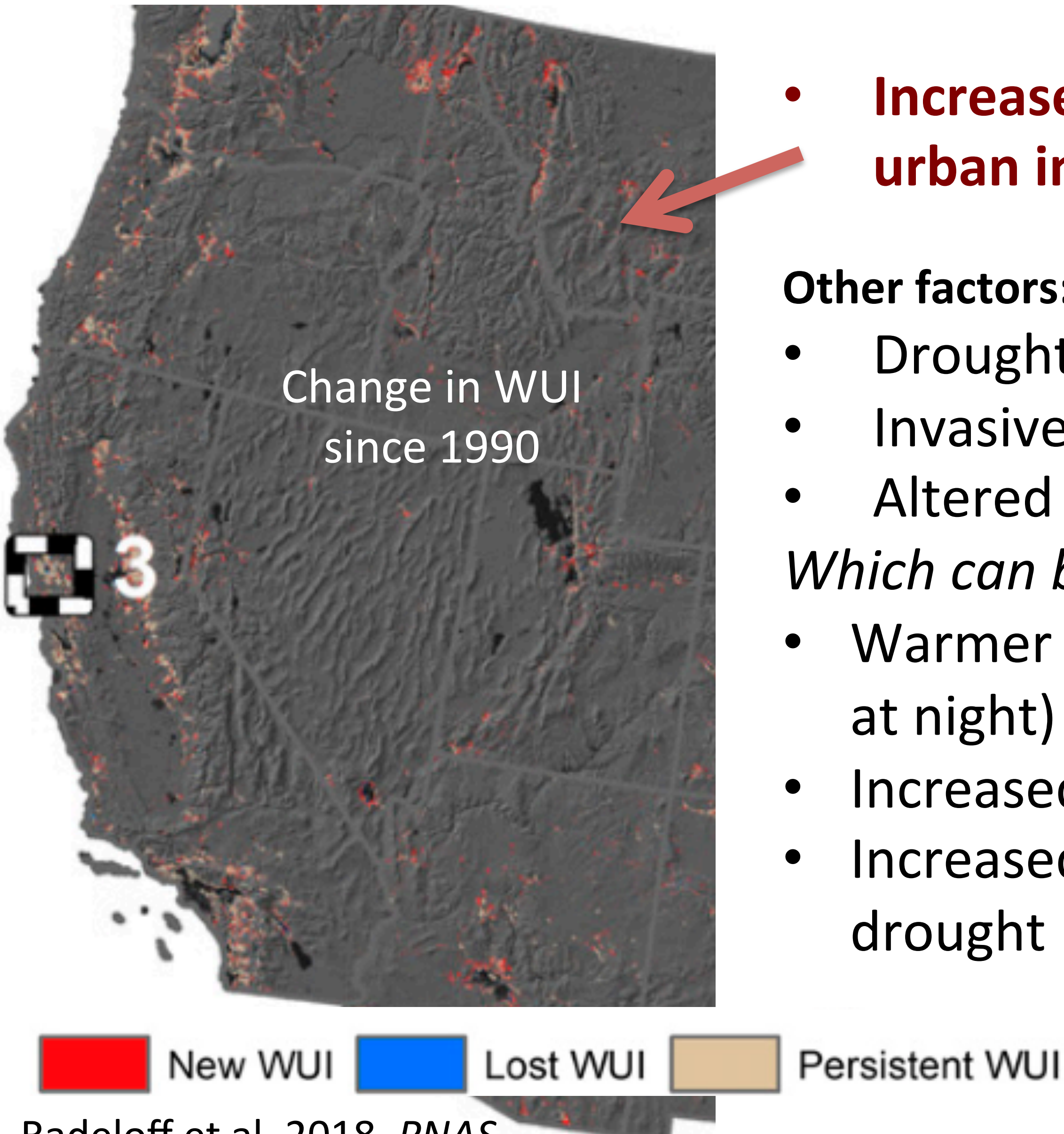
- 15-minute precipitation rate best predictor of post-fire debris flow activity
- Typically associated with small (mesoscale) features, can pose challenge to weather models and not really addressed in climate models

Oakley et al. 2018, *NHESS*

Wildfire

Thomas Fire, Dec 2017

Many factors influence wildfire activity



Radeloff et al. 2018, *PNAS*

- **Increased population in wildland urban interface (WUI)**

Other factors:

- Drought/insect infestations
- Invasive species
- Altered species assemblages

Which can be associated with:

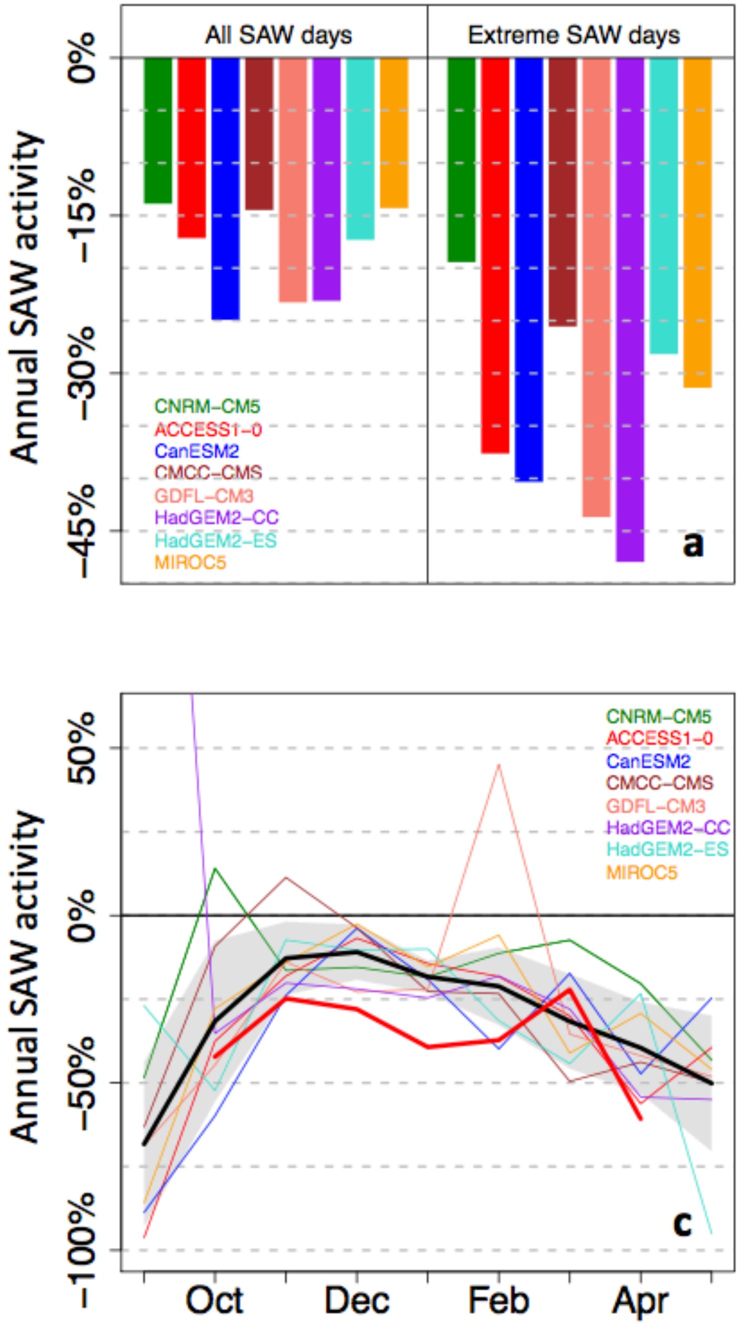
- Warmer temperatures (especially at night)
- Increased evapotranspiration
- Increased frequency/magnitude of drought

Important to look REGIONALLY in CA

Chaparral in Transverse Ranges

- Southern CA shrublands "ignition limited" ecosystem
- Unlikely climate change will shift towards more fire-prone (already fire-prone following dry season)
- Lengthened fire season possible
- Anthropogenic factors key in this area

Keeley and Syphard 2017, *IJWF*



Climate change and Santa Ana winds

- Reduction of Santa Ana wind activity ~14-22% of seasonal average
- Decrease of extreme Santa Ana activity 25-45%
- Decreases greatest in "shoulder season" events (Sept/Oct and Apr/May)
- Narrowing of Santa Ana window may favor Nov-Dec-Jan fire season?

Guzman-Morales 2018, *dissertation UCSD/SIO*

Case Study: Thomas Fire, Dec 2017-Jan 2018

Thomas burn area from Camino Cielo

- Prolonged drought dessicated vegetation; ample fuels
- Some of area hadn't burned since 1960s
- One of driest starts to water year on record
- Intense/prolonged Santa Ana event
- Older fuels burned at high intensity; increased debris flow susceptibility
- High intensity rainfall event

In summary…

- High confidence in increasing temperatures for region
  - Drives evaporative demand, key component of "drying"
- Uncertainty and model disagreement on precipitation, likely due to dependence on small number of events
- Tendency toward fewer, more intense storms and prolonged dry periods
- Hypothesize increased frequency of short-duration (≤1 h), high-intensity precipitation events but currently lack info
- Potential for increased length/shift of fire season due to longer dry periods
- Southern CA remains "ignition limited" in changing climate
- Climate change *enables* wildfires, weather and human activity *drive* them

Thank you!

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Questions?

NASA astronaut Randy Bresnik photographed the Southern California plumes of smoke on 5 Dec 2017 aboard the ISS

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