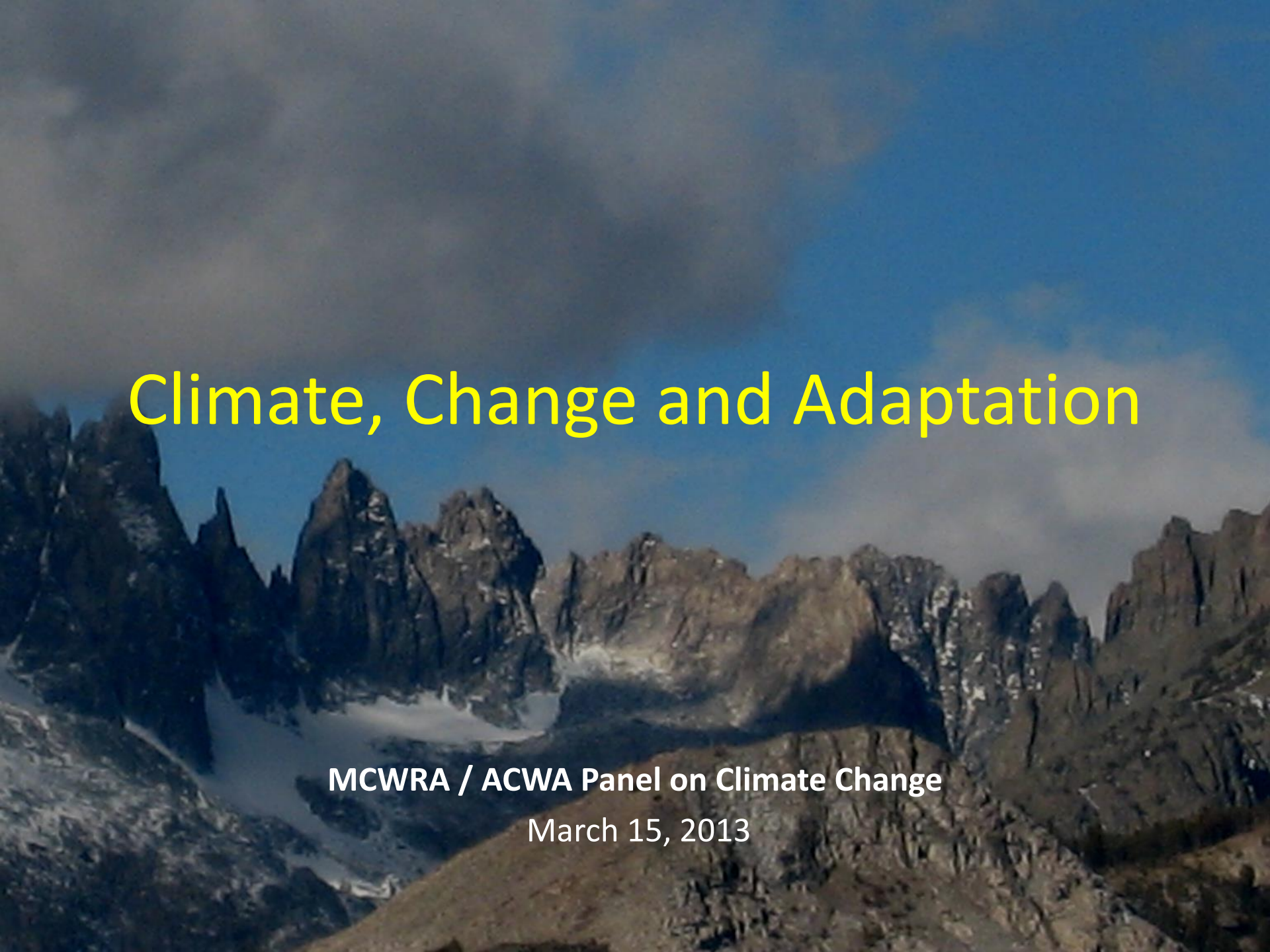


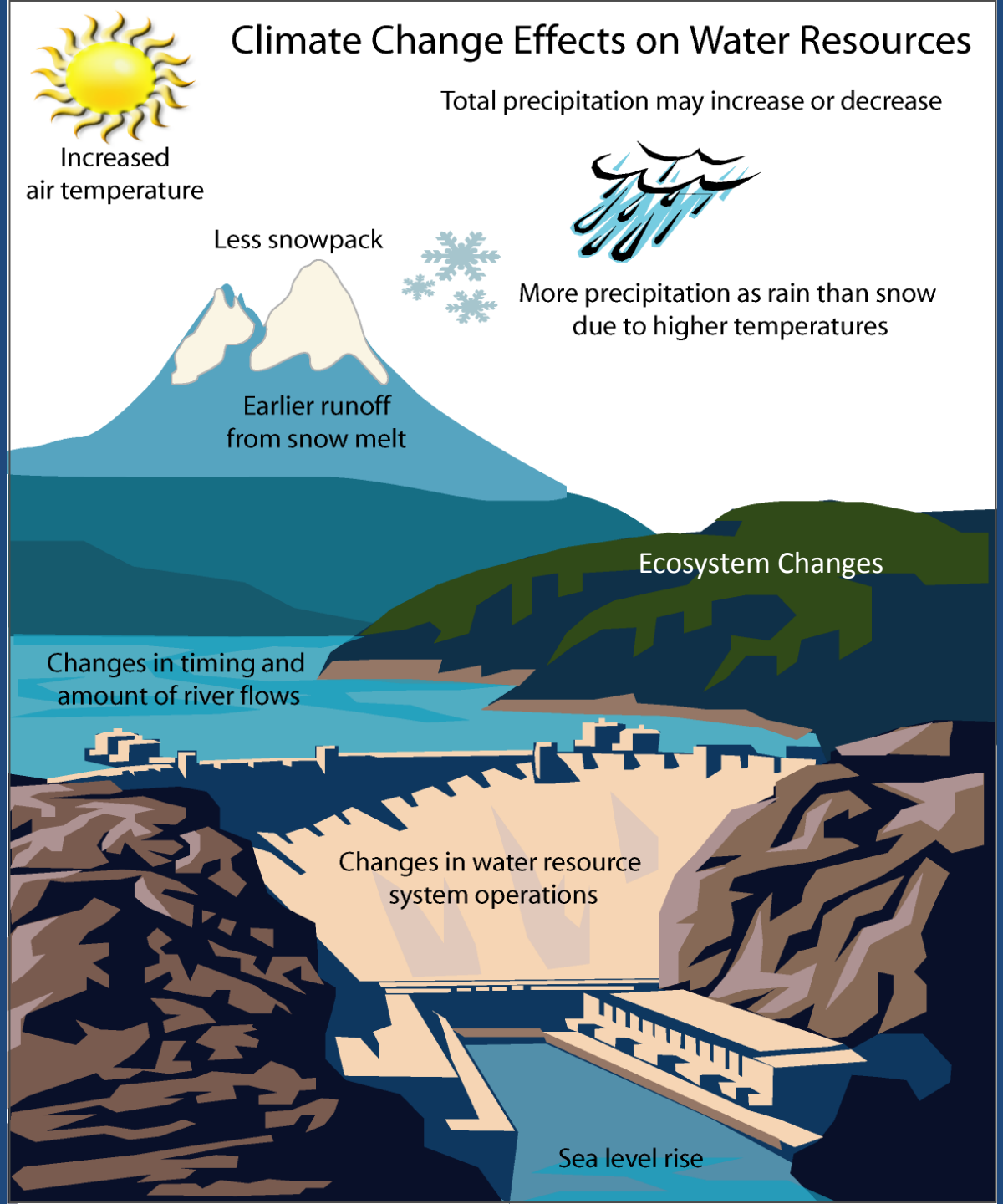
Climate, Change and Adaptation

MCWRA / ACWA Panel on Climate Change

March 15, 2013

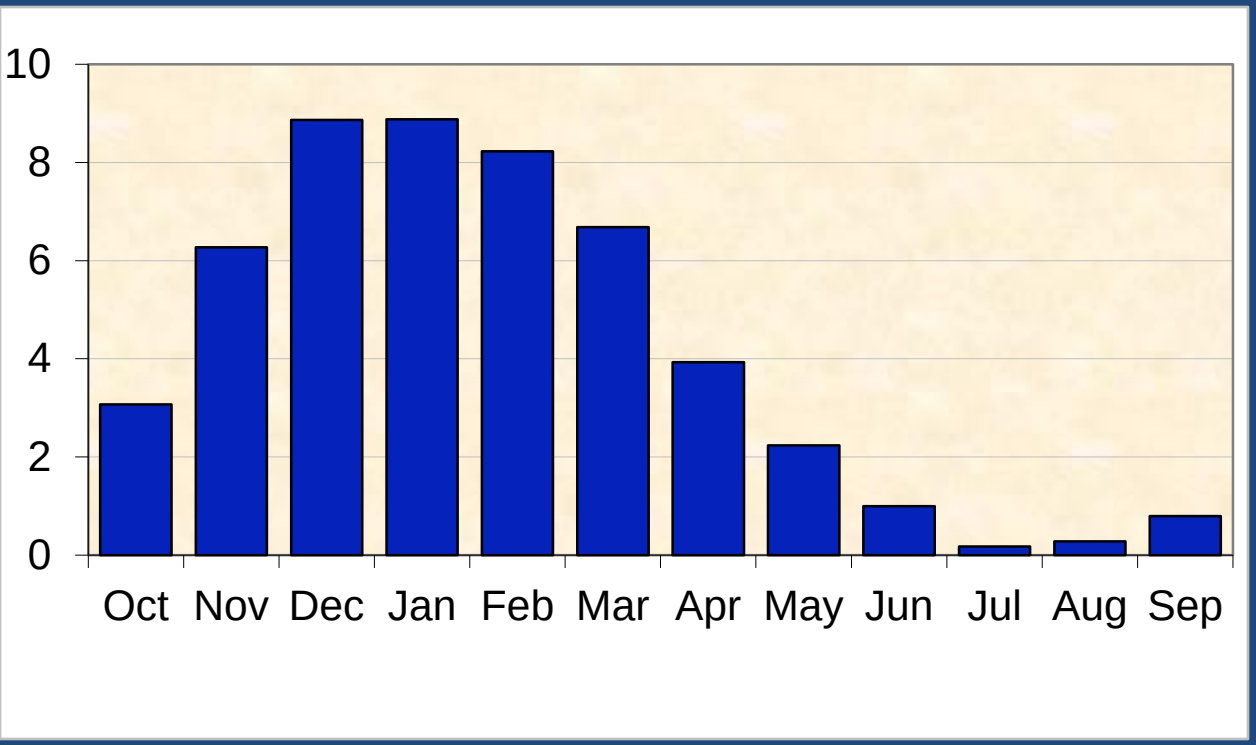
Talk Overview

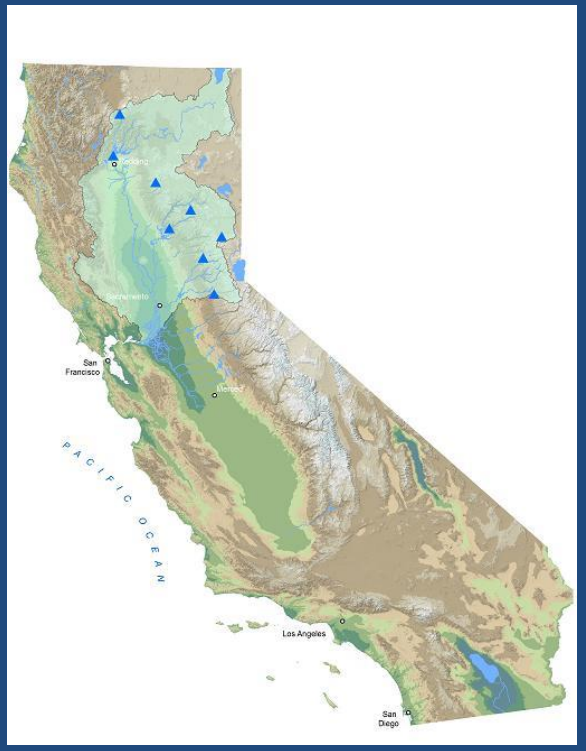
- Expectations for Change
- Variability, Vulnerability and Adaptation
- Available Resources



Slide from
Jamie Anderson
DWR- Bay Delta

Northern Sierra 8 Station Index

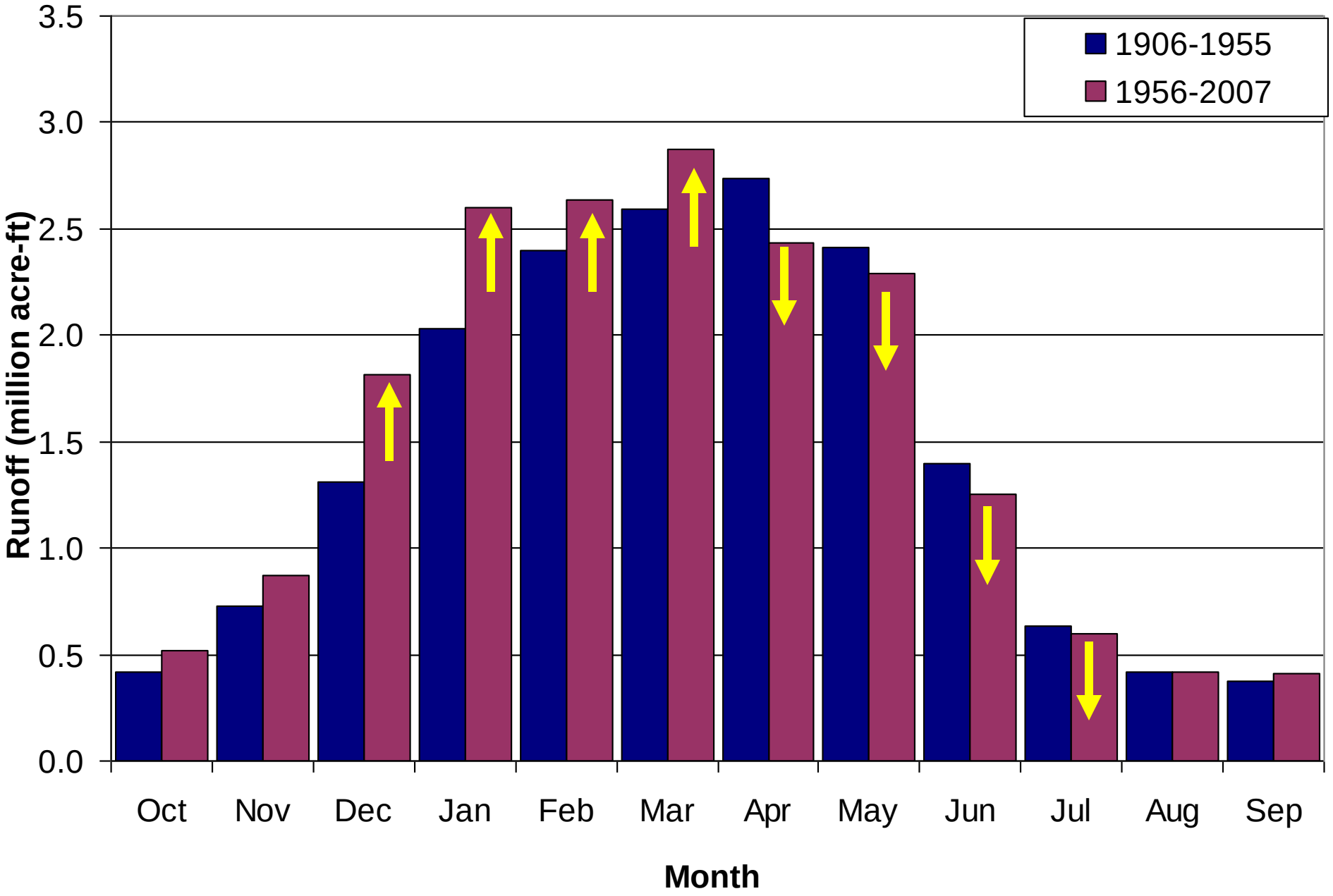




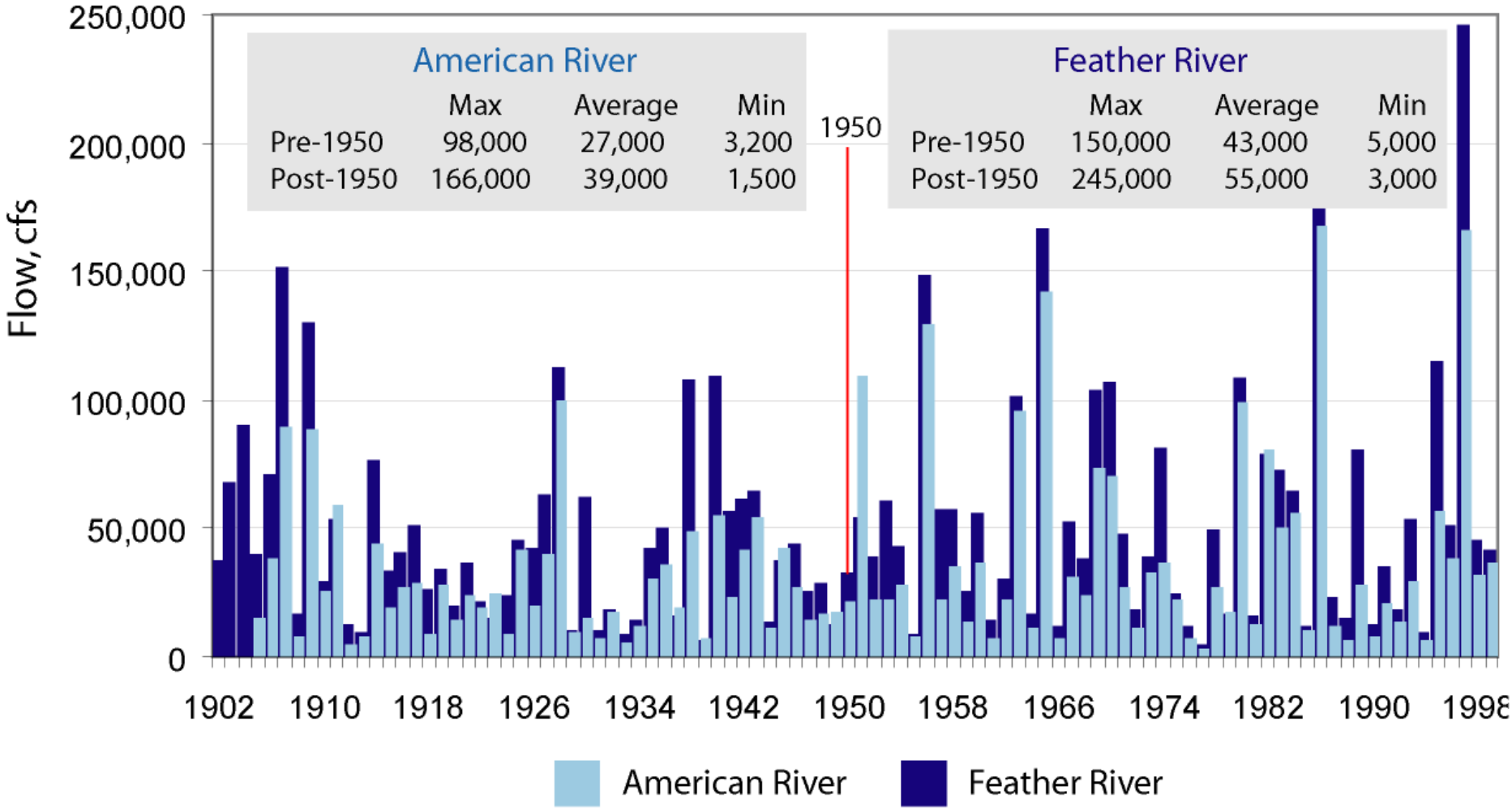
Annual Average: 50 inches
Maximum Year (1983): 88.5 inches
Minimum Year (1924): 17.1 inches
Period of Record 1921- Present

Average of:

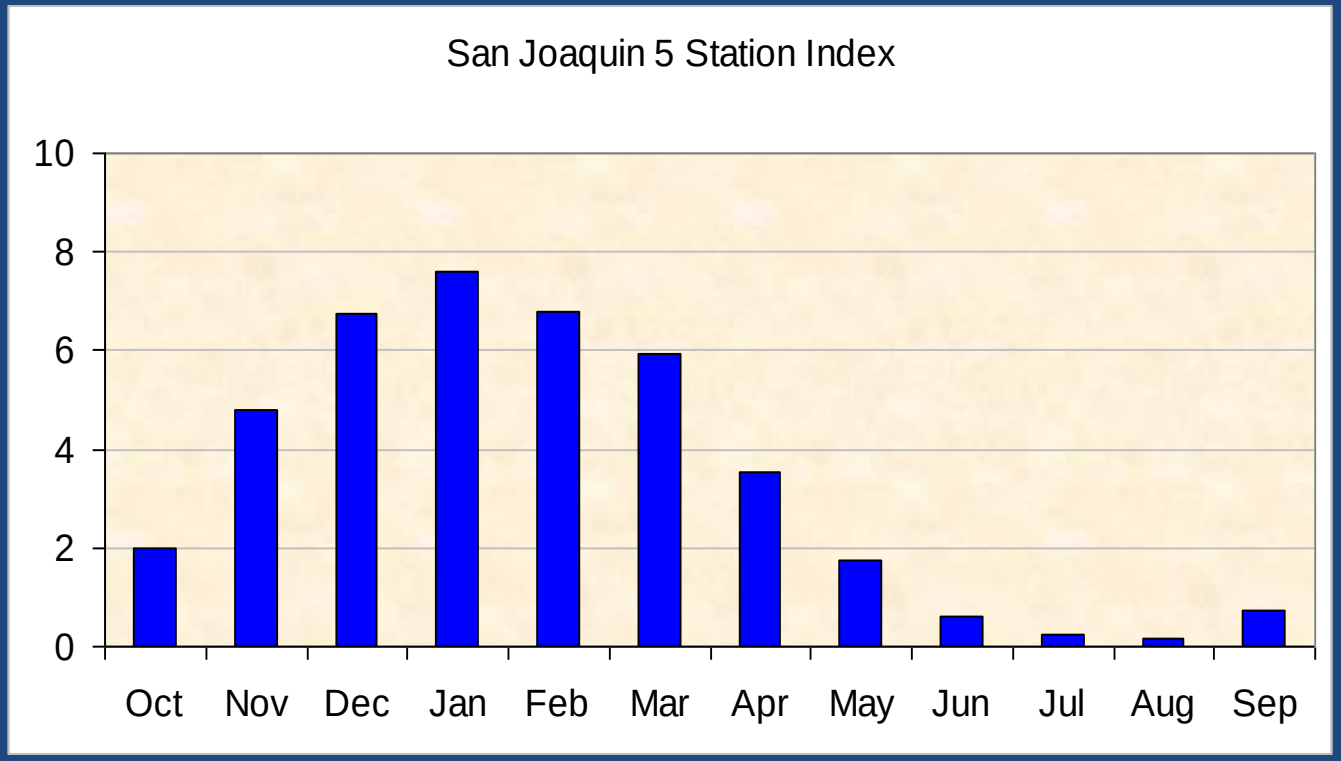
Mt. Shasta City	Quincy
Shasta Dam	Sierraville RS
Mineral	Pacific House
Brush Creek RS	Blue Canyon


Monthly Average Runoff of Sacramento River System
1906-1955
1956-2007
Runoff (million acre-ft)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Month

20th Century Annual Peak 3-Day Flows without the Influence of Reservoirs

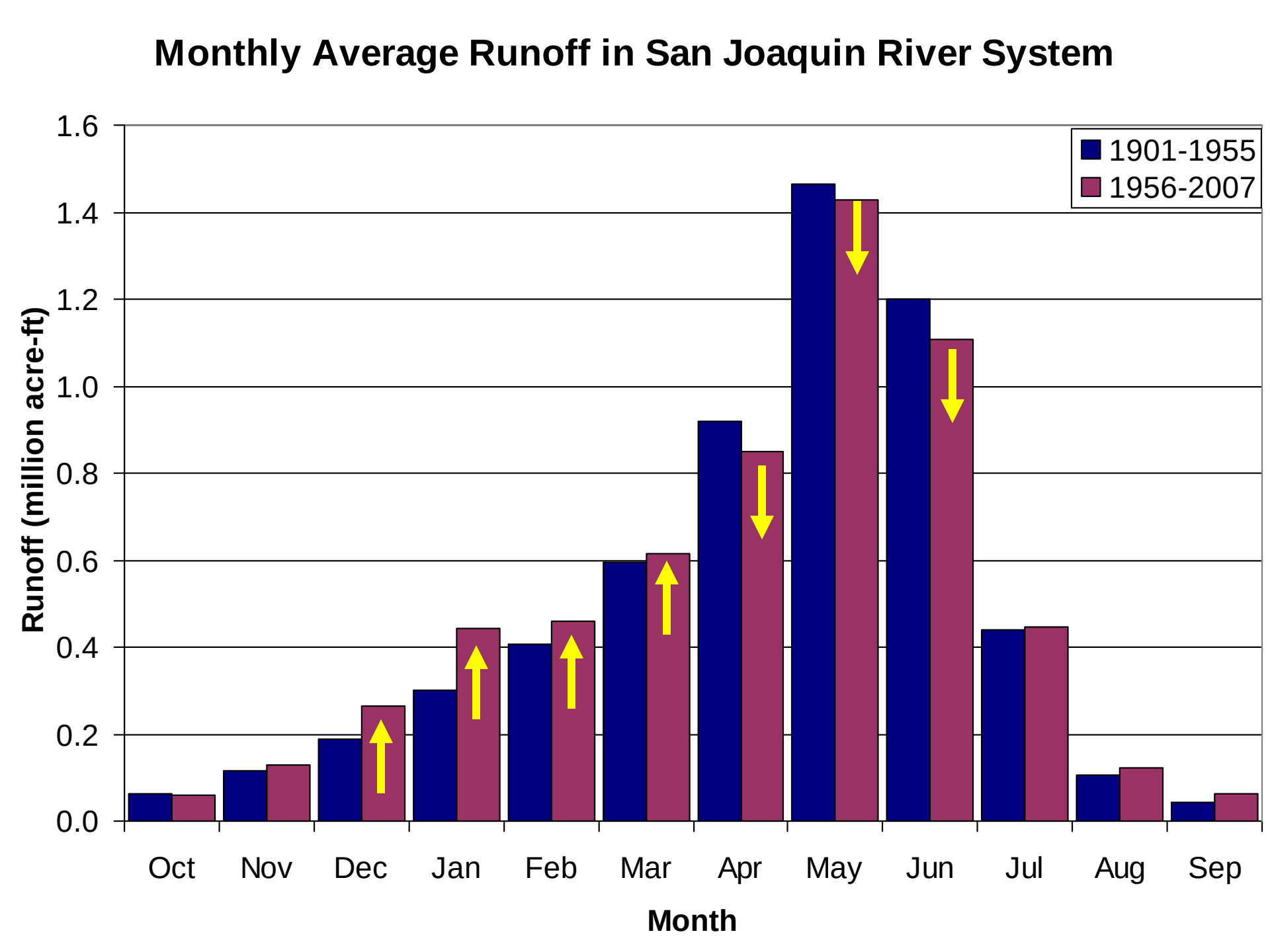


San Joaquin 5-Station Index



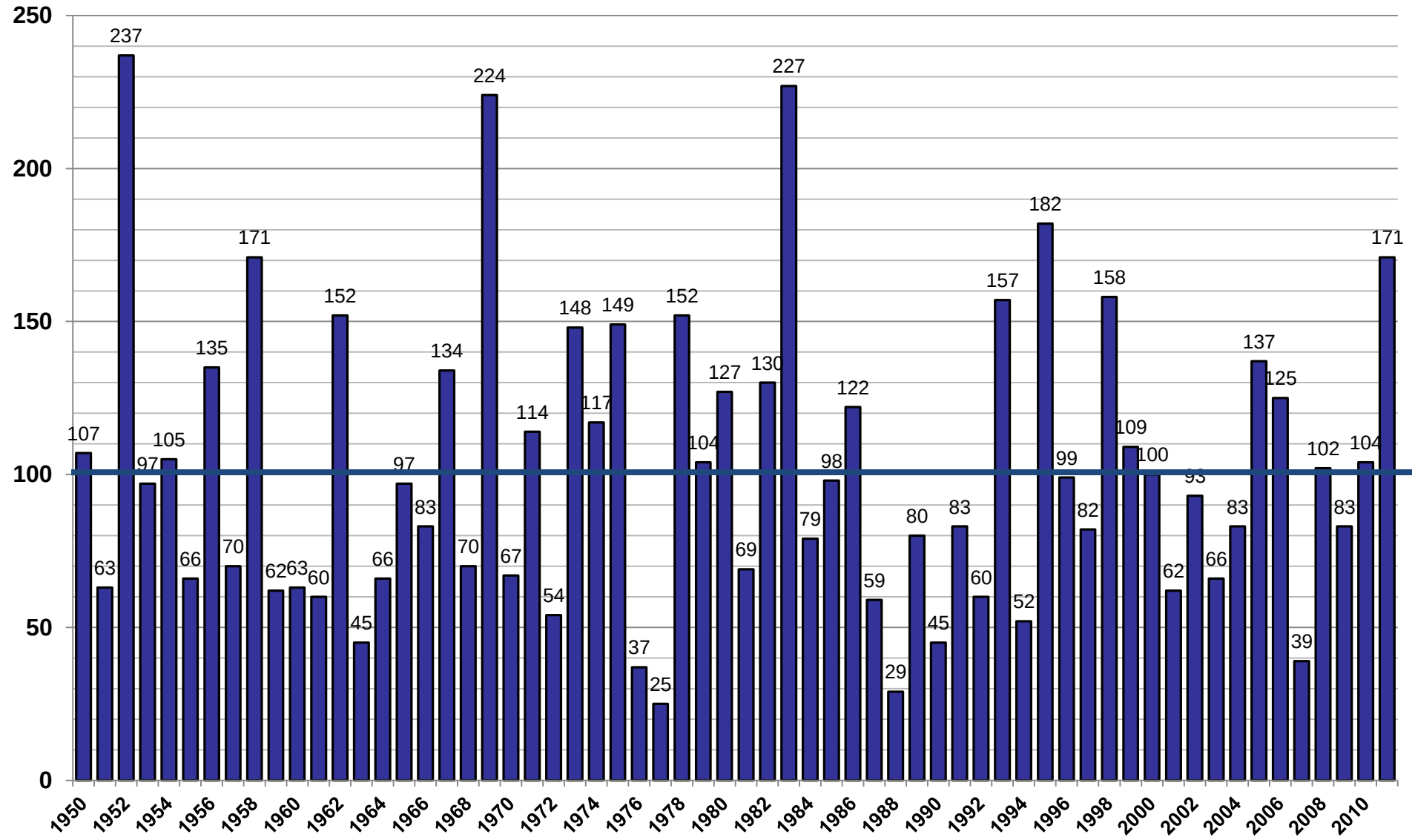
Annual Average: 40 inches
Maximum Year (1983) 77.4 inches
Minimum Year (1924) 14.8 inches
Period of Record 1949 - Present

Average of:
Calaveras Big Trees
Hetch Hetchy
Yosemite HQ
North Fork Ranger Station
Huntington Lake

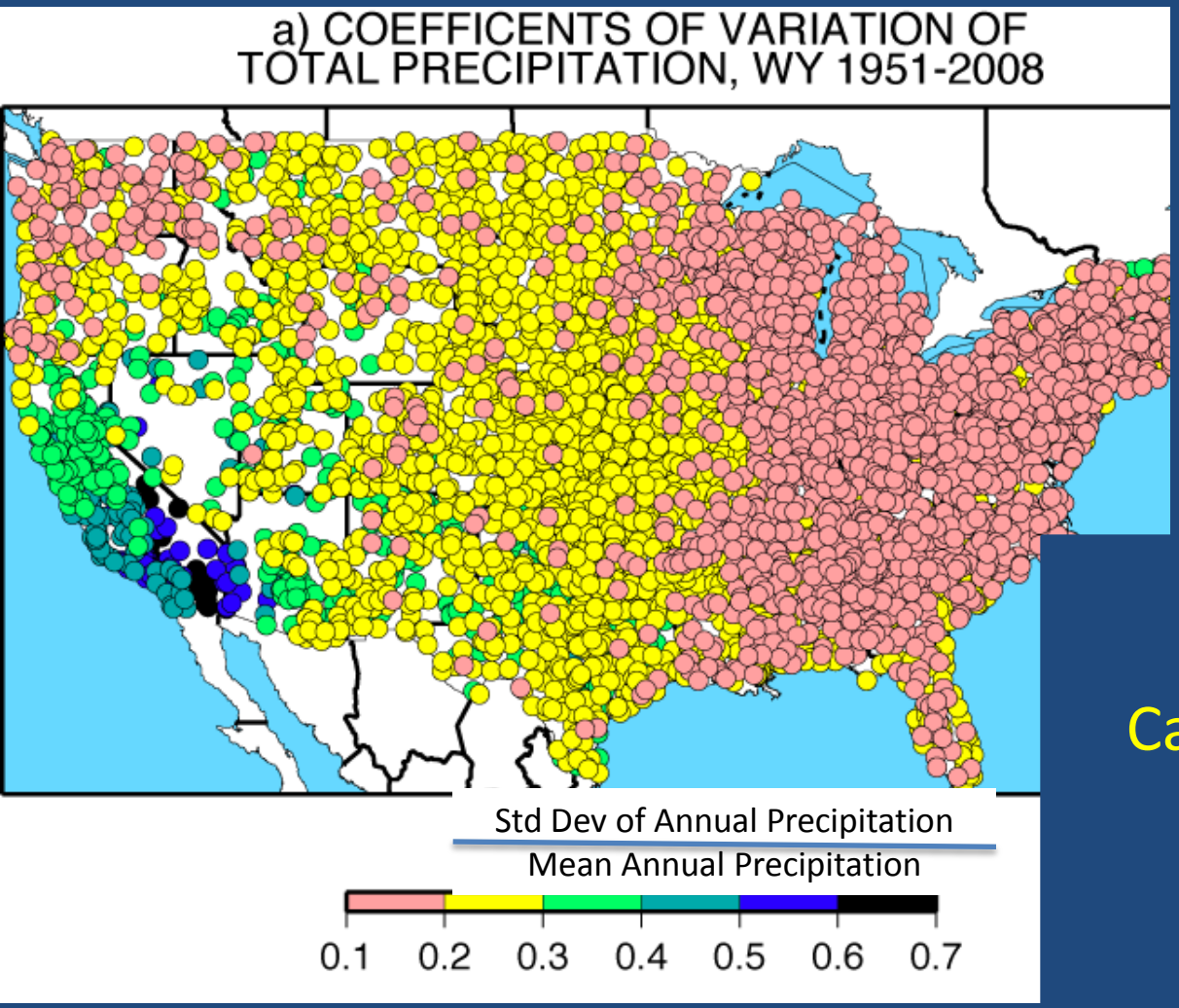

Monthly Average Runoff in San Joaquin River System
Runoff (million acre-ft)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1901-1955
1956-2007
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Month

April 1 Snowpack Water Content

Statewide Percent of Average



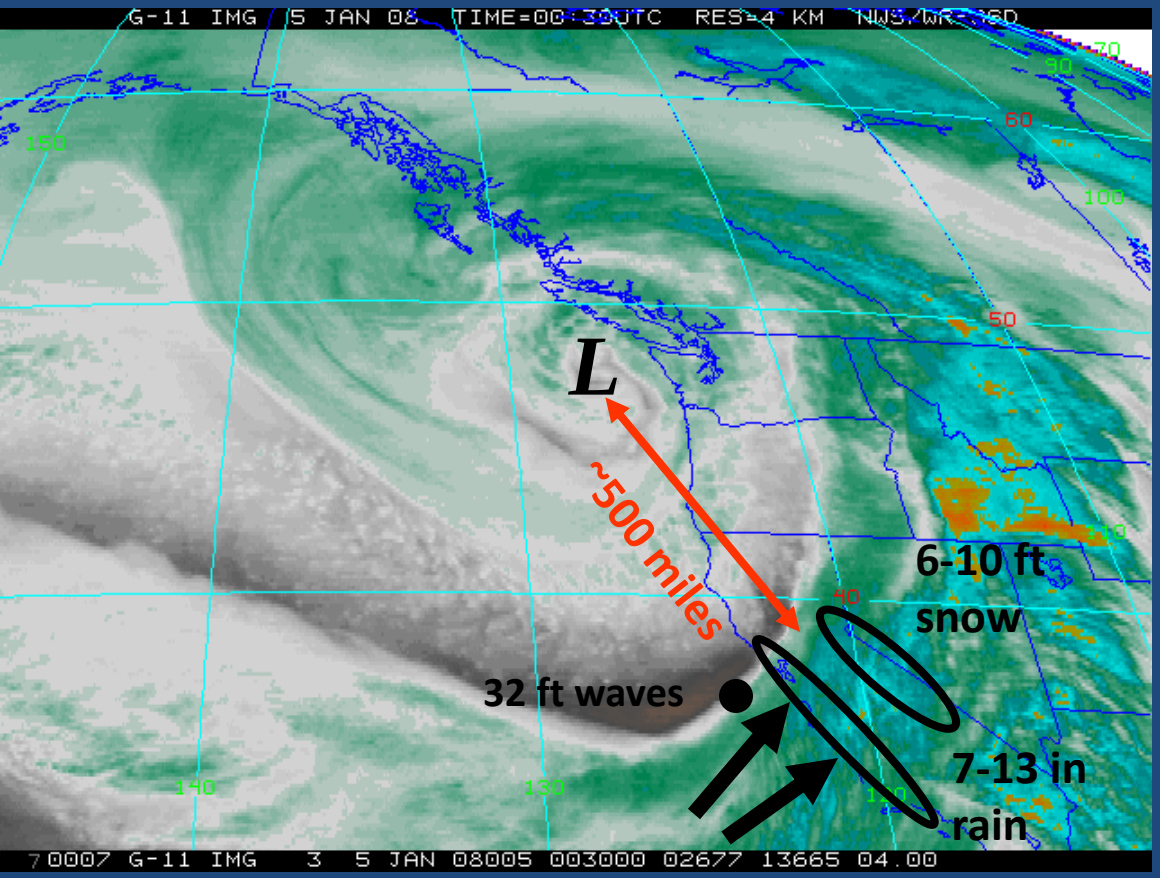
Year to Year Precipitation Variability



California precipitation is uniquely variable

Dettinger et al, 2011

The Storm of 4-5 Jan 2008



Atmospheric river

GOES IR image of major West Coast storm

- Time = 0030 UTC 5 January 2008
- Low pressure center is off WA coast

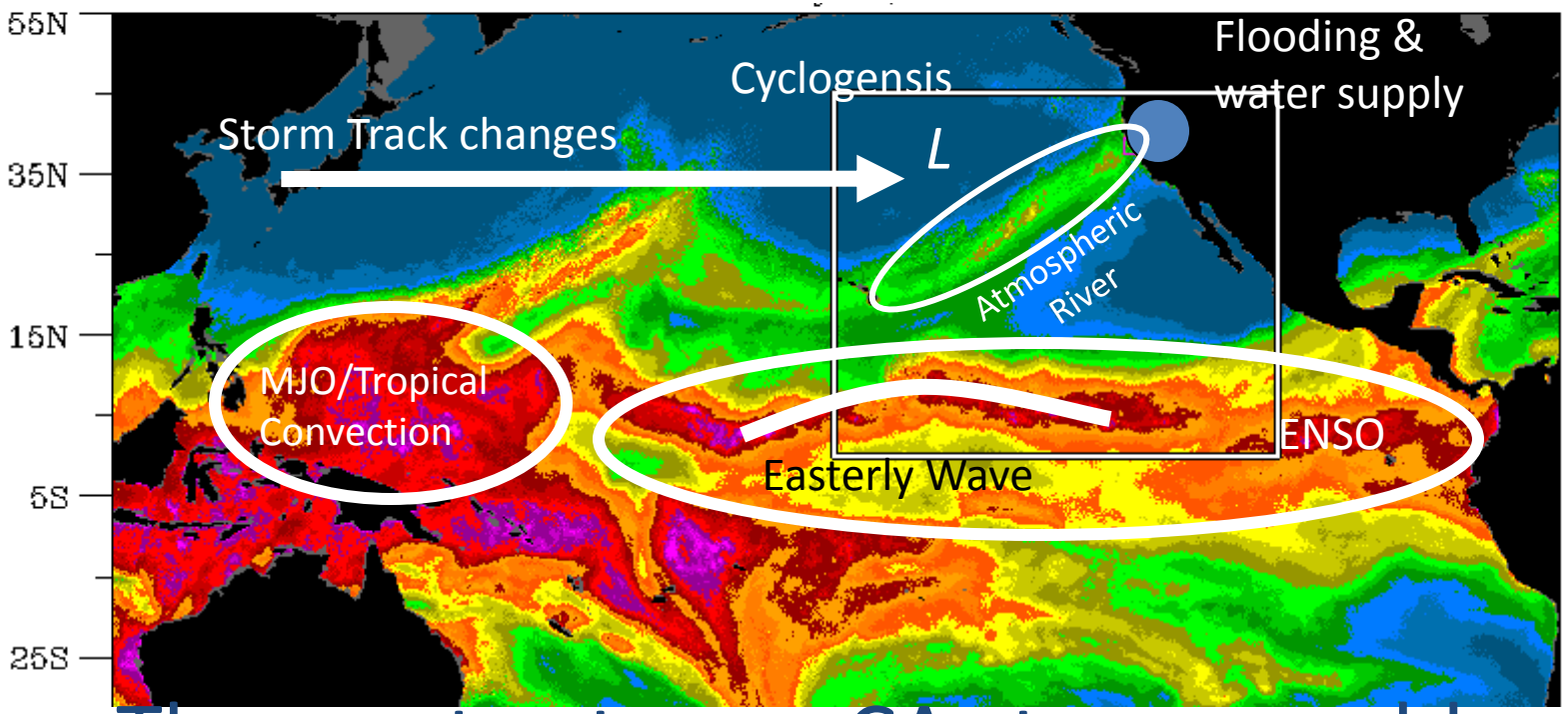
Note that major impacts were focused >500 miles south of the Low pressure center in this storm.

This differs significantly from hurricanes, but the impacts are enormous and spread over a large area

Many major impacts are associated with the landfall of the "atmospheric river" element of the storm, the precise characteristics of which are not operationally monitored offshore or onshore.

Slide from Marty Ralph, NOAA ESRL

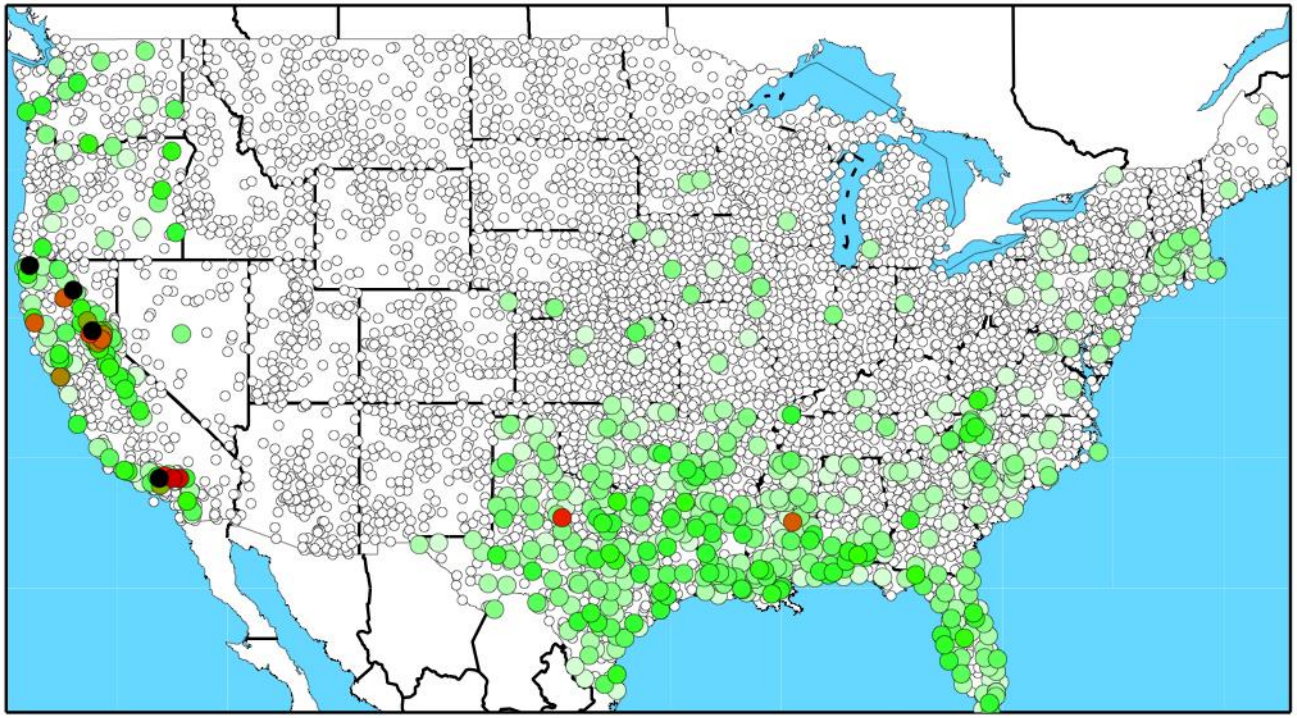
Key Phenomena Affecting California Water Supply/Flooding:

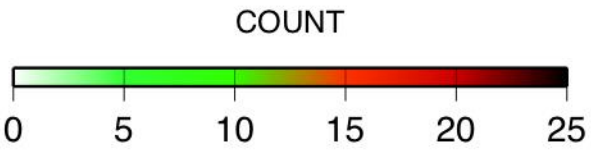


The most extreme CA storm would result from a rare alignment of key processes

Slide from Marty Ralph, NOAA ESRL

NUMBER OF HISTORICAL EPISODES W/ 3-DAY PPT
IN PPT CATEGORY 3

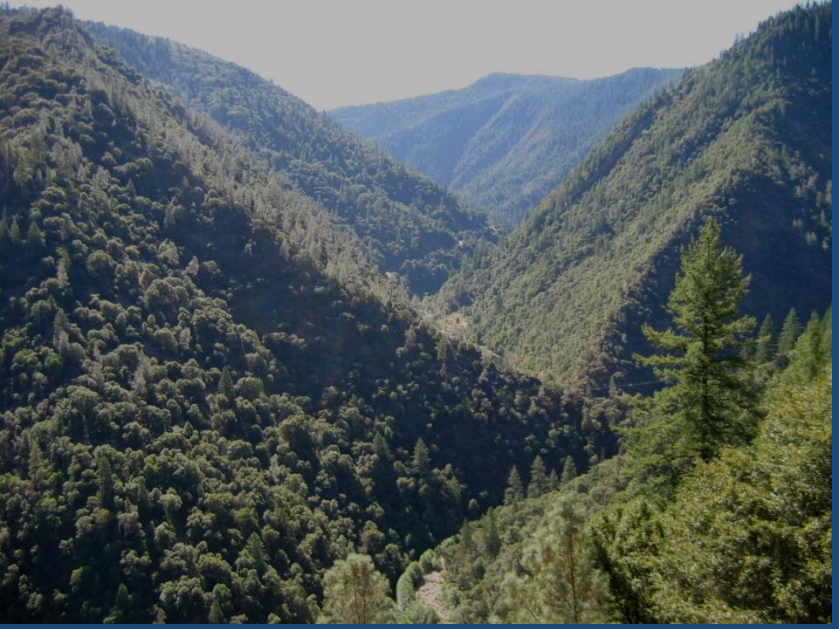




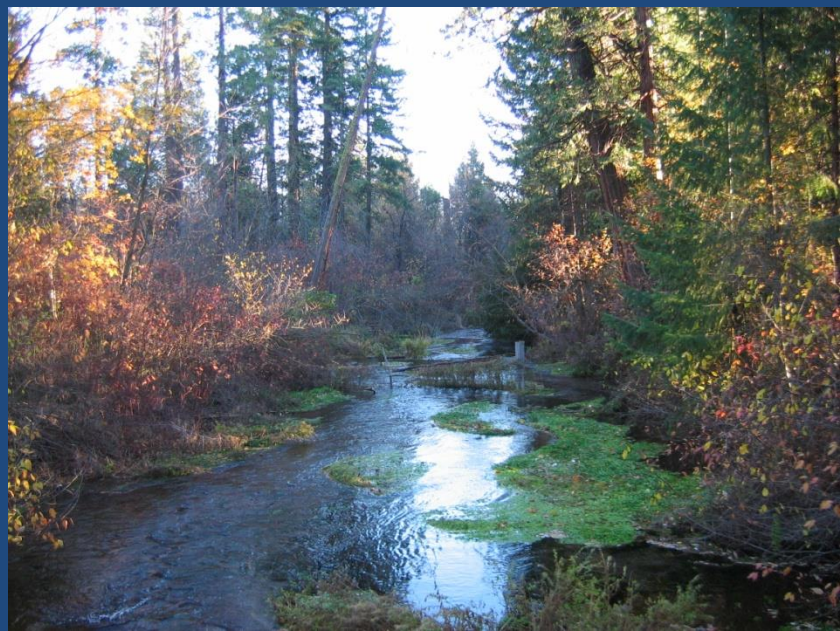
NOTE: Expanded color bar, but more sites still qualify

CAT 3 is > 30 cm (12 in) in 3 days

From M. Dettinger



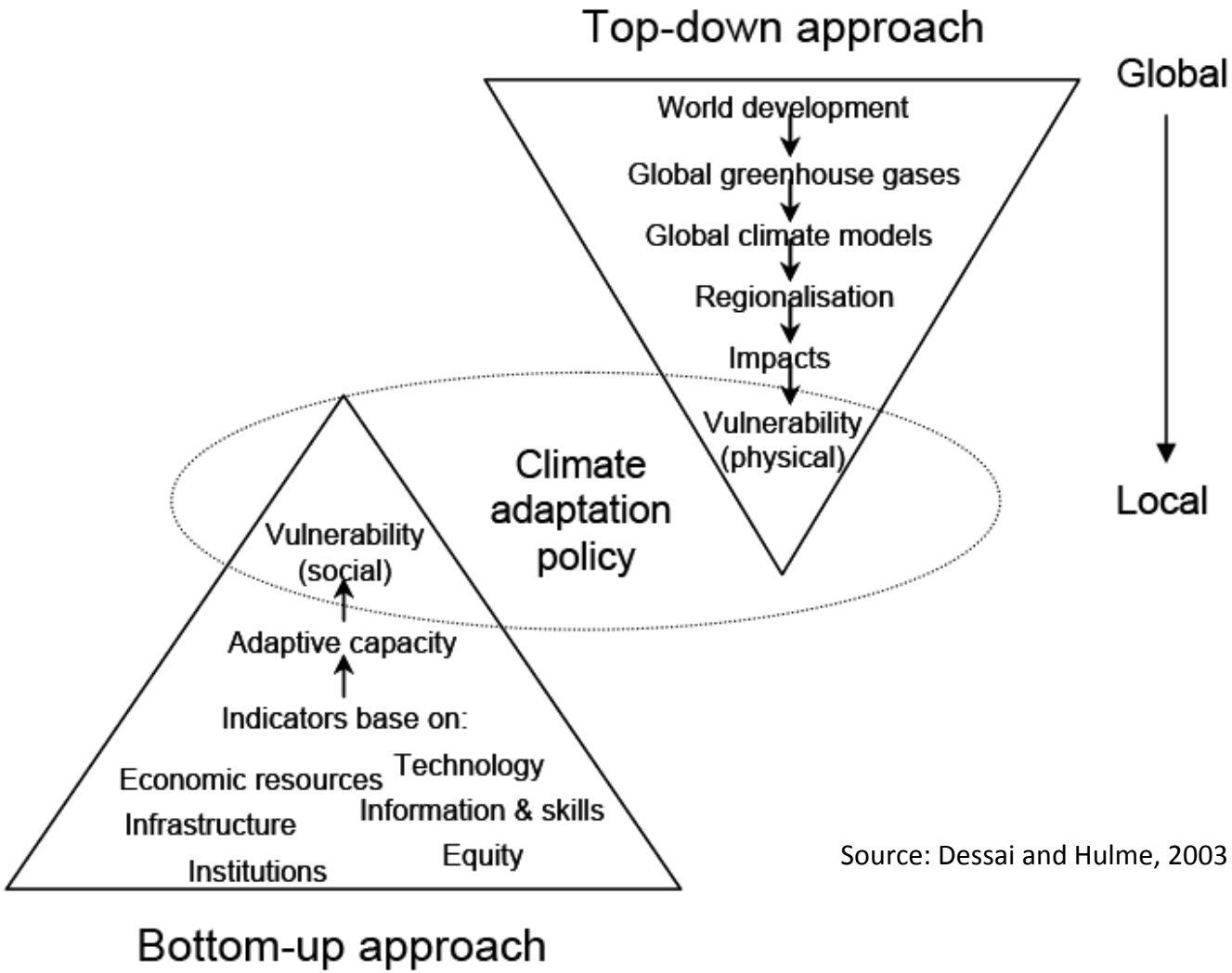
Know Your Watershed!



Climate Change Considerations

- How will atmospheric river/winter storm characteristics change in a warmer atmosphere?
- How will ocean temperature and circulation patterns impact storm tracks and storm number, size, intensity?
- How will temperature changes impact the land surface/watershed condition?
- Are we observing what we should for tracking climate change?

Determining Vulnerability



Source: Dessai and Hulme, 2003

Assessing Adaptation Capacity

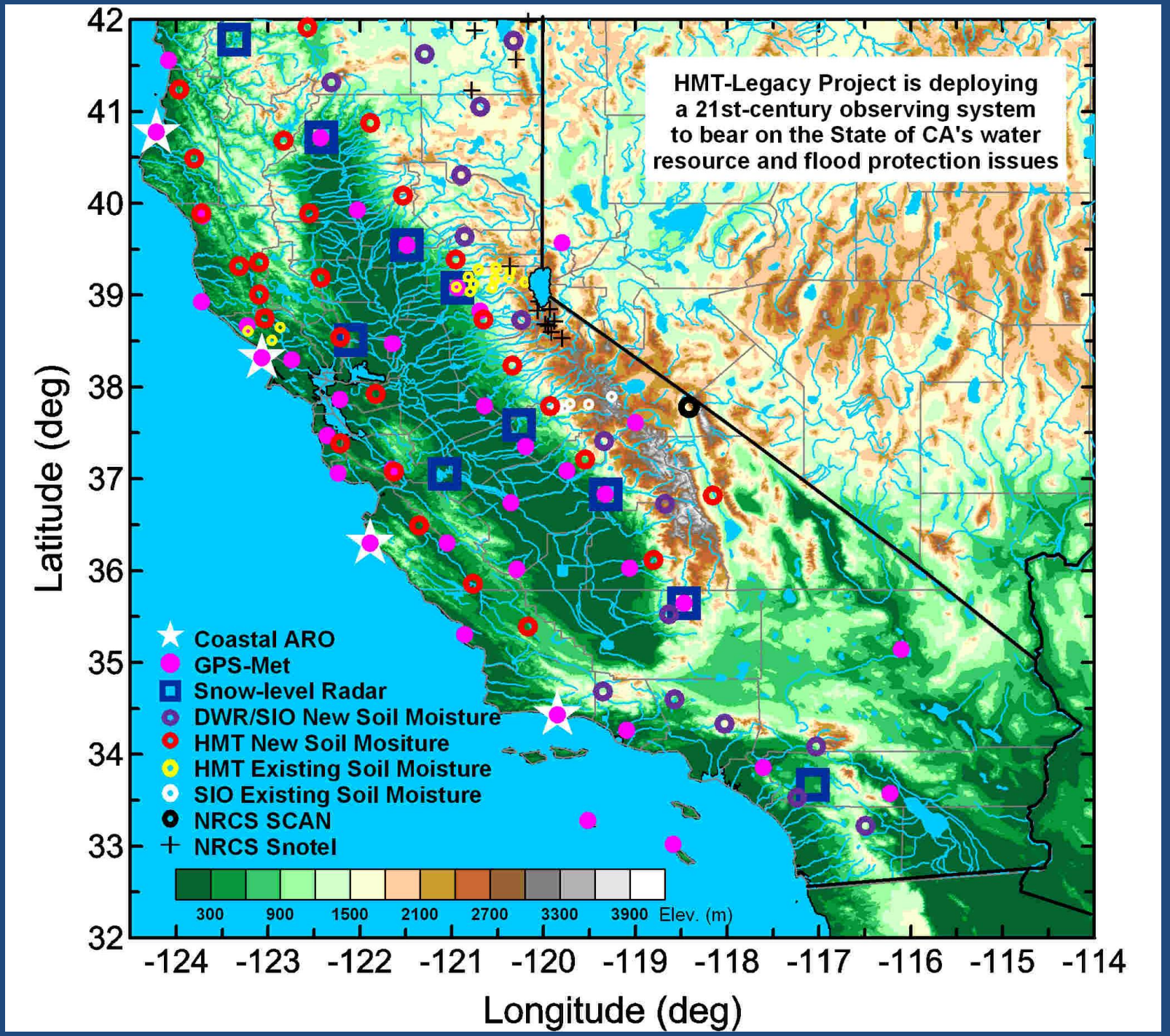
- Where , when, and how am I vulnerable?
- How does this vulnerability and timing of vulnerability intersect land use activities?
- How will climate change impact water resources at my location? (know your watershed)
- What action or investment changes the answer to any of the above and to what extent?

Resources to Inform

- Central Valley Hydrology Study
  http://cvhydrology.org

- Integrated Water Resources Management Handbook
  http://www.water.ca.gov/climatechange/CCHandbook.cfm

- Cal Adapt Tools
  http://cal-adapt.org/


HMT-Legacy Project is deploying a 21st-century observing system to bear on the State of CA's water resource and flood protection issues
Coastal ARO
GPS-Met
Snow-level Radar
DWR/SIO New Soil Moisture
HMT New Soil Mositure
HMT Existing Soil Moisture
SIO Existing Soil Moisture
NRCS SCAN
NRCS Snotel
300 900 1500 2100 2700 3300 3900 Elev. (m)
Latitude (deg)
Longitude (deg)
42 41 40 39 38 37 36 35 34 33 32
-124 -123 -122 -121 -120 -119 -118 -117 -116 -115 -114

Take Home Points

- Atmospheric Rivers are a fundamental element of California water resources
- Time and location are important
- Climate signals like PDO and ENSO are important for inter-annual variability – all years are not the same
- Climate change has possible impacts to magnitude, timing, and frequency of events through changes to land surface, atmosphere, and oceans

Take Home Points

- Climate change adaptation starts with vulnerability assessments
- Consequence and timing of adaptation measures are important – can phased implementation work?
- Resources to facilitate adaptation planning are available


Questions?
Michael.L.Anderson@water.ca.gov