
NO
TRESPASSING

Tulare Basin Watershed Overview

Presented at Climate Change Workshop

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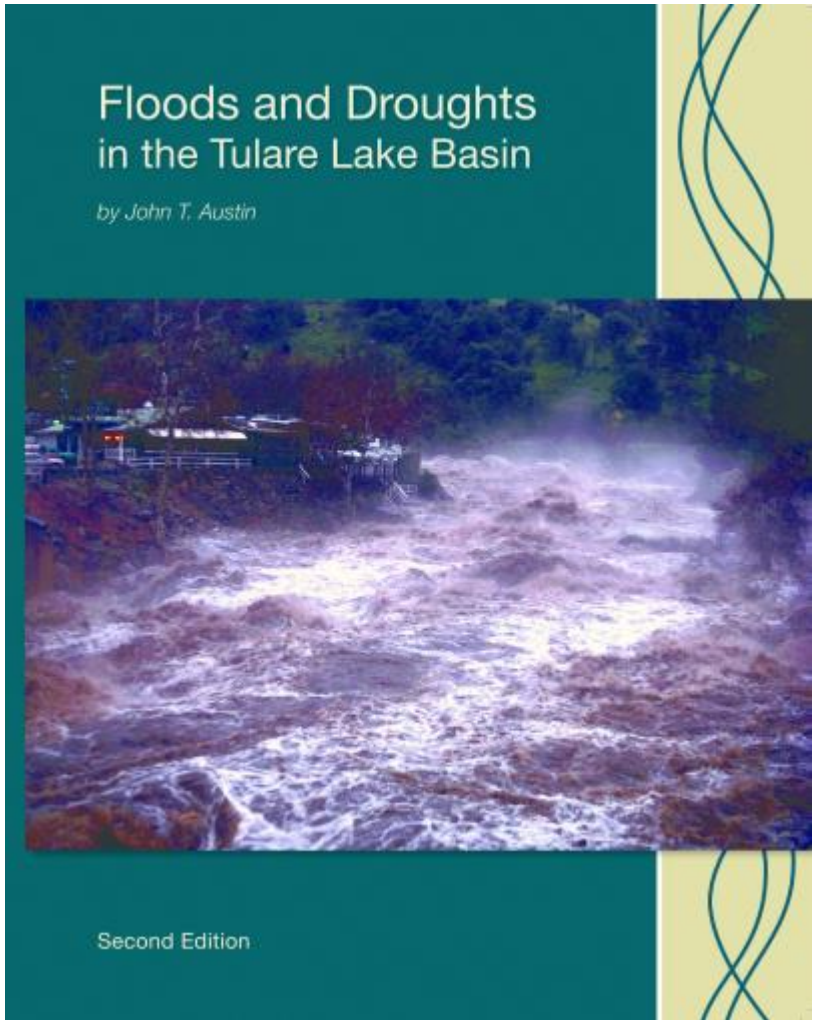
September 29, 2016

Draft of September 29, 2016

Central Valley Basins

Floods and Droughts in the Tulare Lake Basin



Snowmelt floods – large runoff years

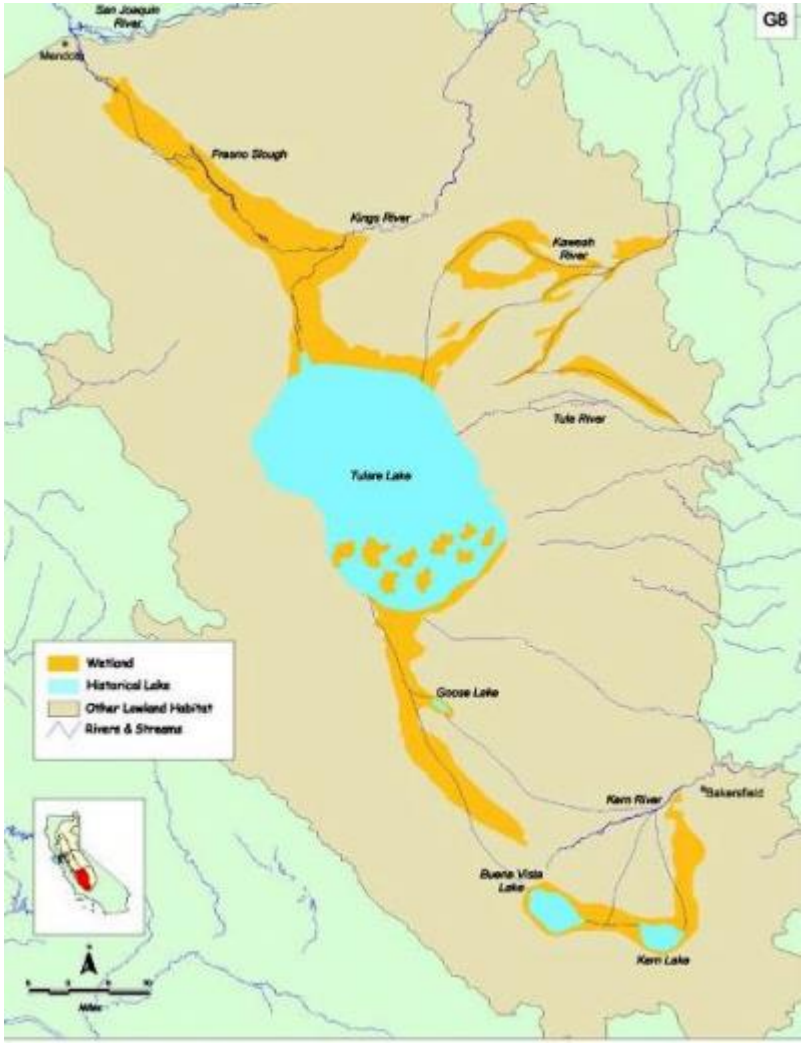
1853 – Theft of a Whaleboat in SF Bay

Hoist the Sail – Take Advantage of NW Winds

The San Joaquin Valley

Summit Lake
North end of Tulare Lake

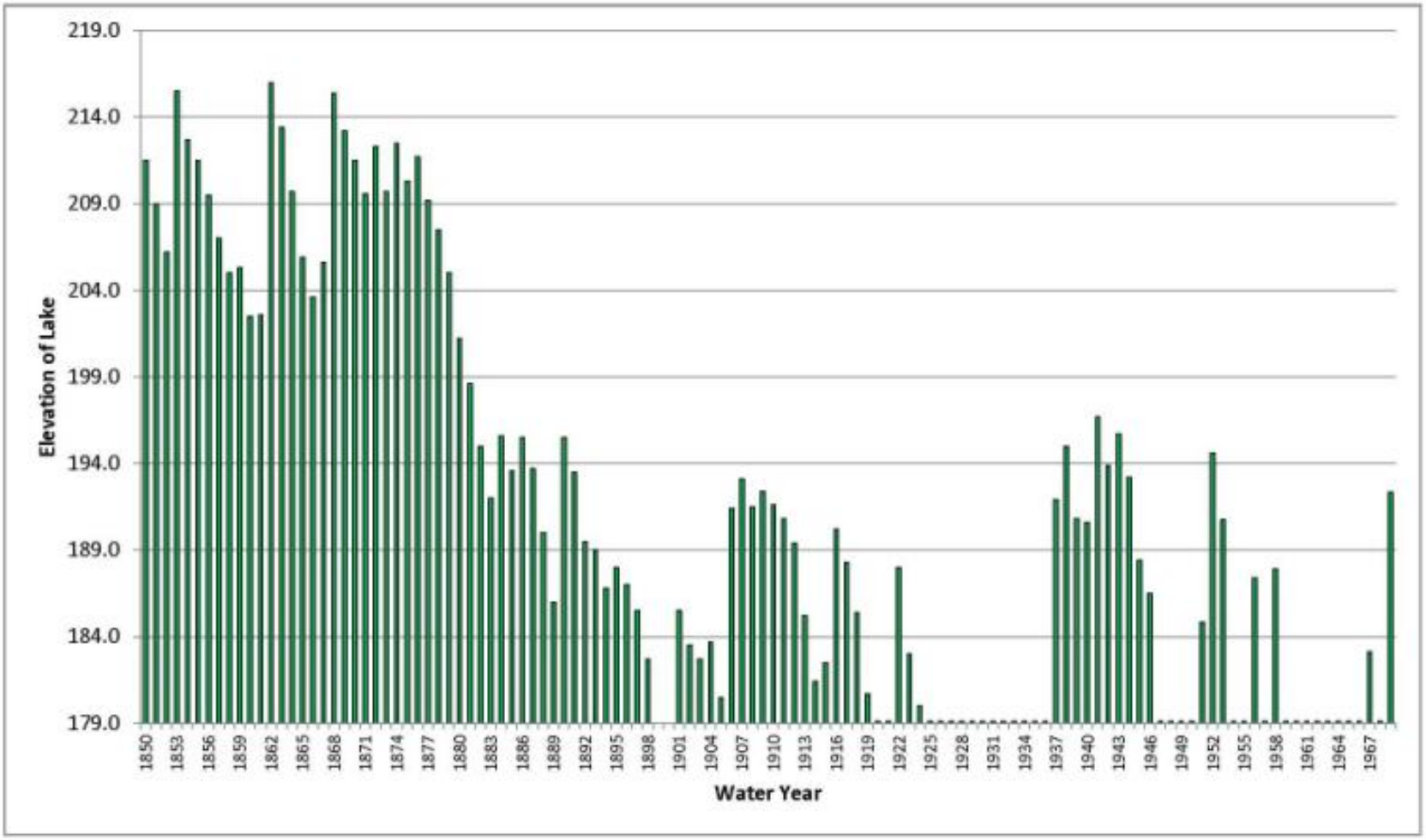
Tulare Lake Basin natural communities
Historic wetland connections



5 Documented Trips between Tulare Lake and SF Bay

- 1853 — Whaleboat from San Francisco Bay to Tejon Ranch
- 1868 — 16-foot scow with a one-ton cargo of honey to SF Bay
- 1938 — Bakersfield to Treasure Island to see the Worlds Fair
- 1969 — 2 farmers & their 3 teenage sons from Bakersfield to SF Bay
- 1983 — 2 guys kayaked from Bakersfield to SF Bay

Elevation of water in the Tulare Lakebed for 120 years: 1850–1969.
Cycle of lake during 1850s and 1860s.

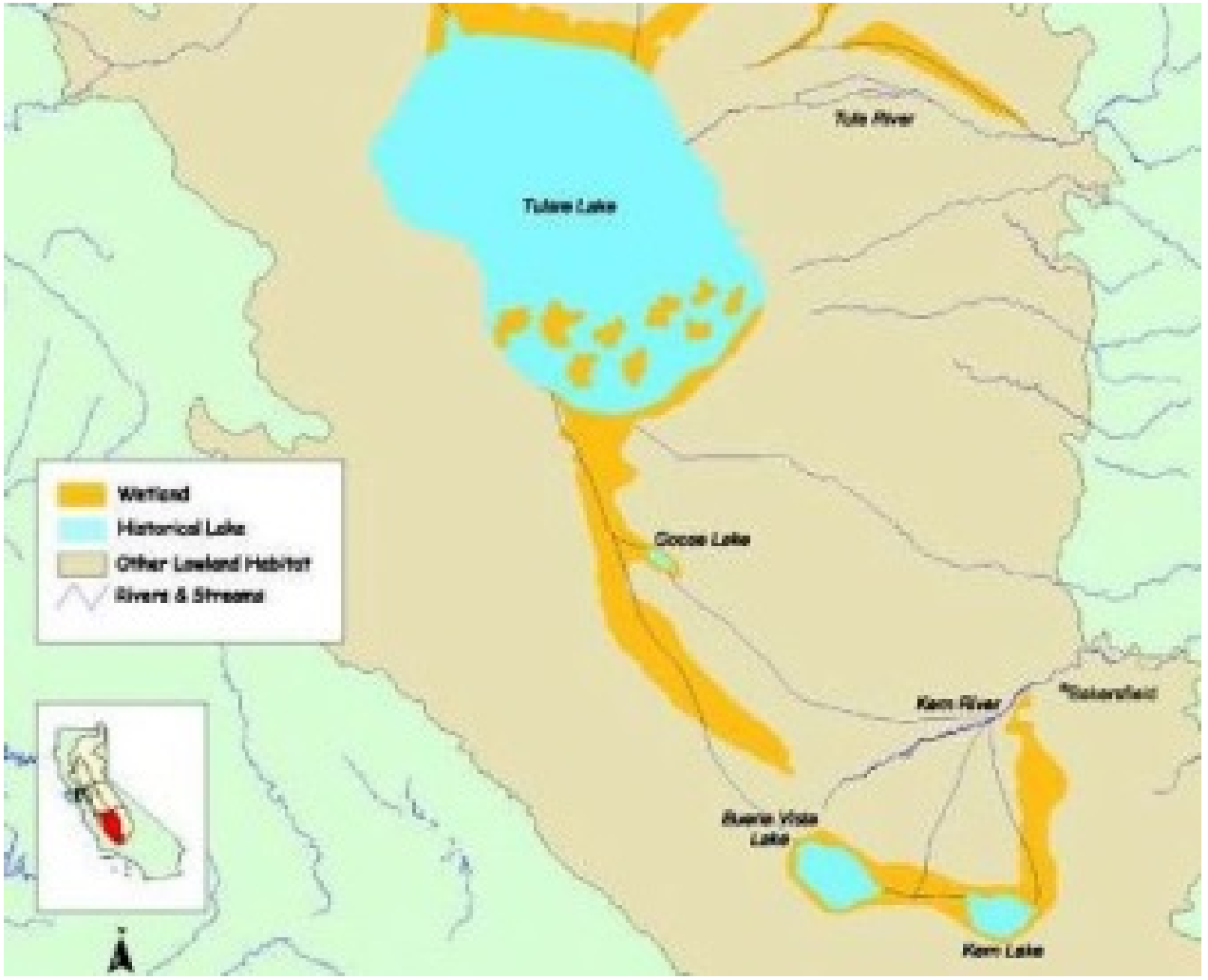


A Water Hole 40 Miles Long

A feeding ground for condors and vultures

Hydrologic connection of Tulare Lake Basin

Tulare Lake Basin natural communities
Historic wetland connections - South



How big was Tulare Lake?

- It was the largest freshwater lake west of the Mississippi
- When it was full, it was 4 times larger than Lake Tahoe.

Tulare Lake in 1970

Sample of fishes in the Tulare Lakebed

Terminus of North America's southernmost (chinook) salmon run

Sample of fish eaters in the Tulare Lakebed

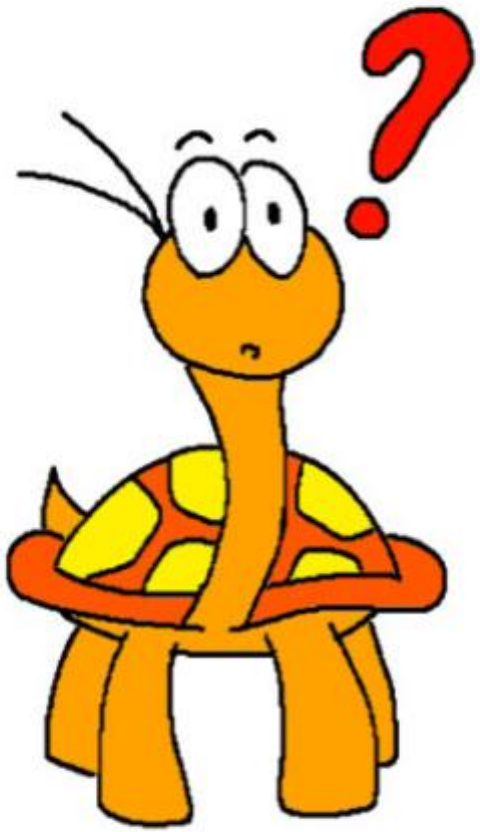
Marine mammals: sea otters, harbor seals, and sea lions

Tulare Lake Ecosystem — 1850

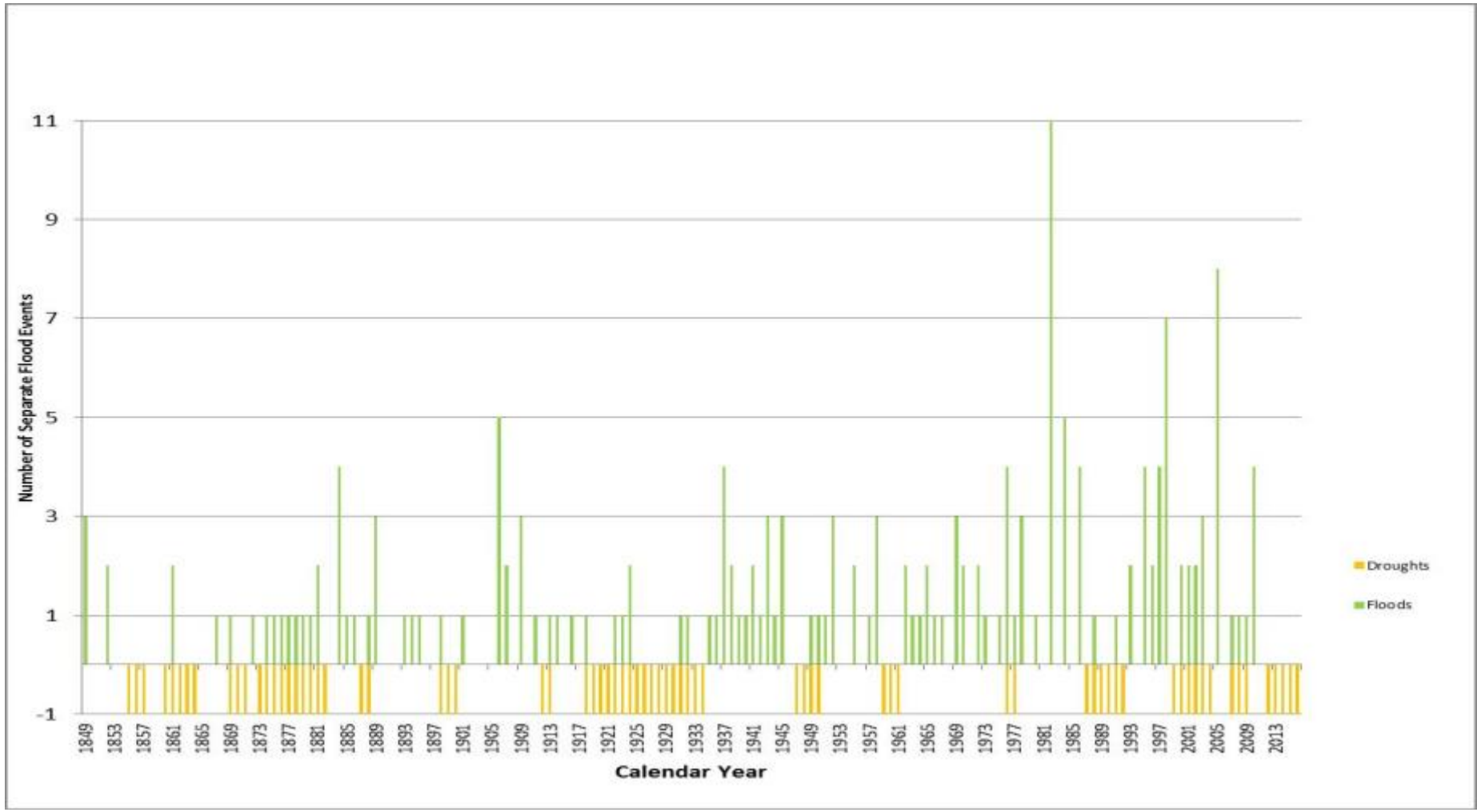
Yokuts tribesmen built tule balsa (rafts)
Reminiscent of the reed boats on Lake Titicaca in Bolivia

Navy Seaplane Landing Base during WWII
PBY Catalina taking off

What happened to Tulare Lake?

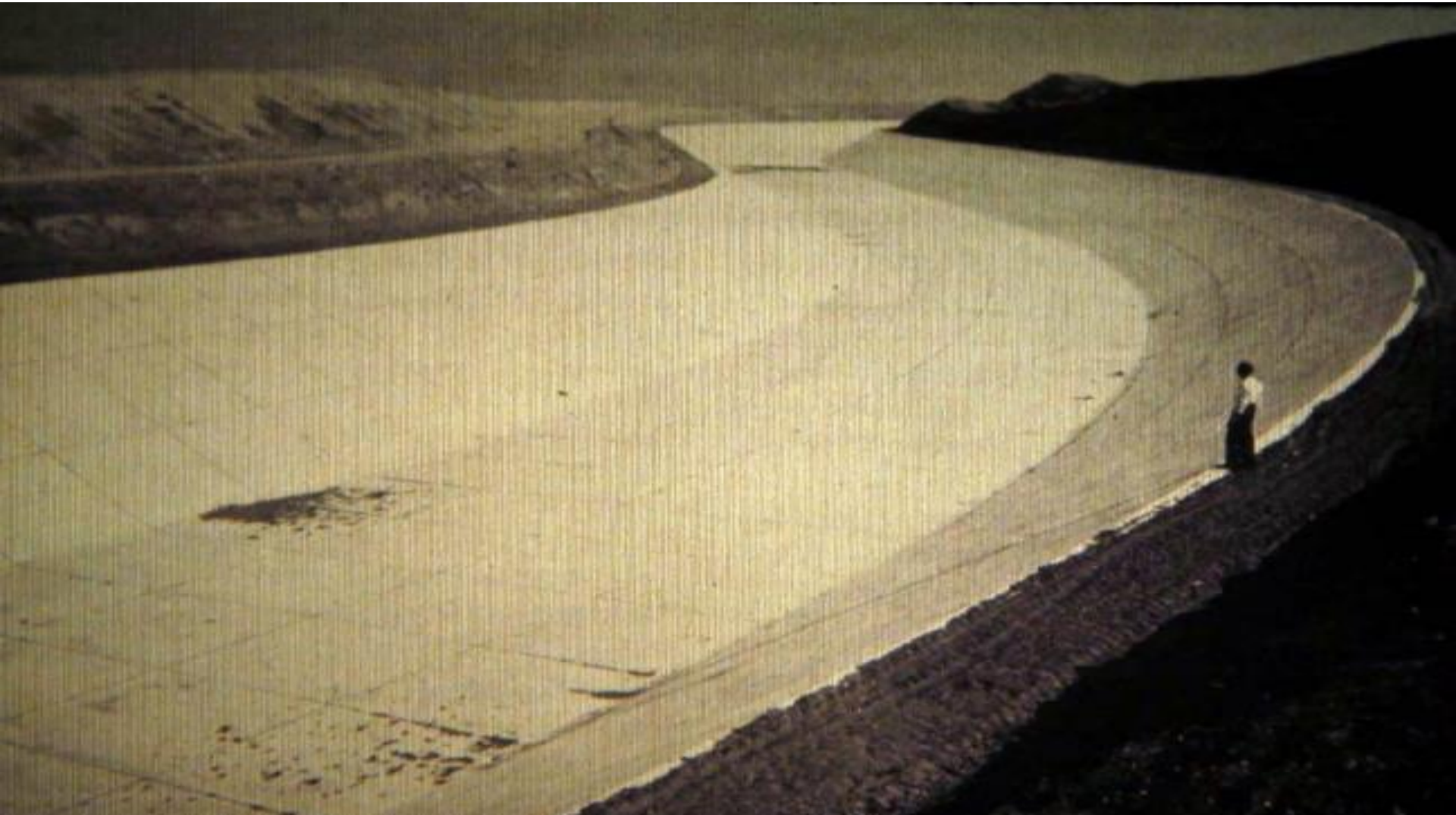


Known floods and multi-year droughts for past 168 years: 1849–2016

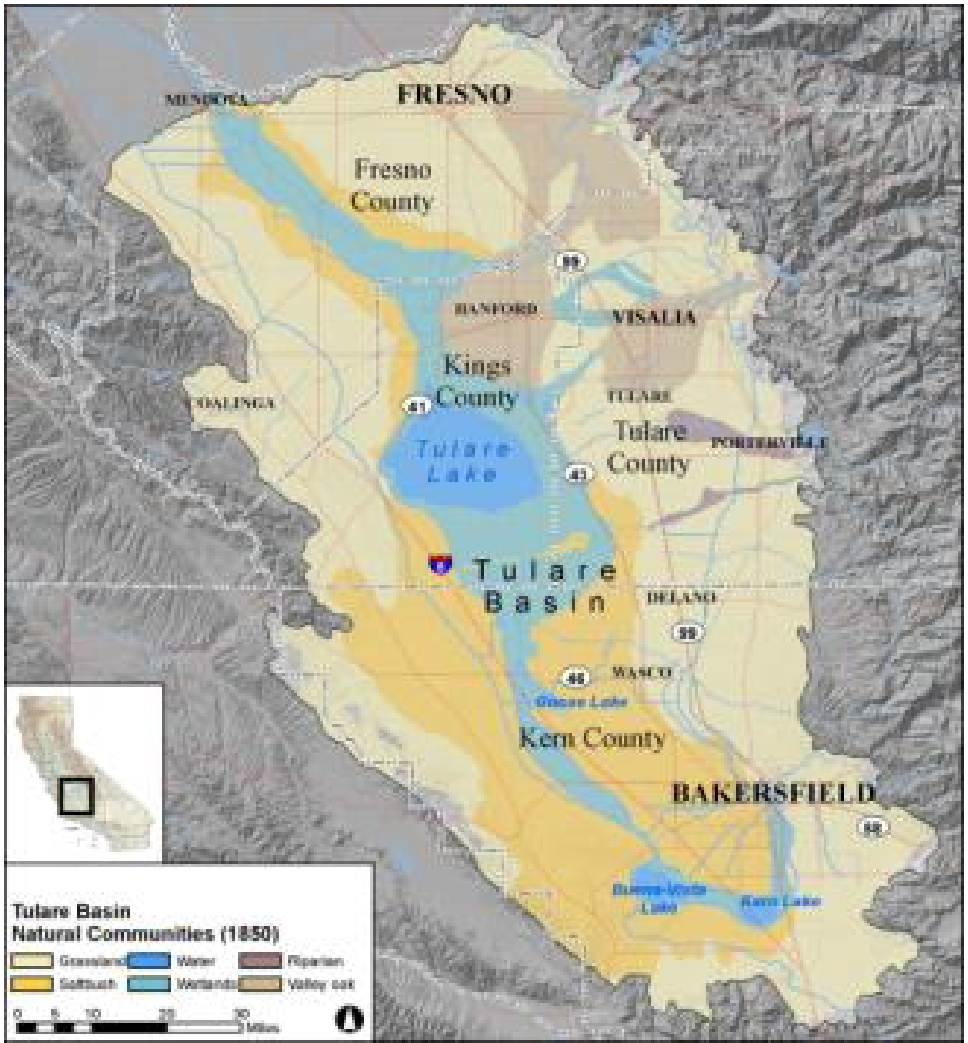


Mules doomed Tulare Lake
Fresno Scraper invented in 1883

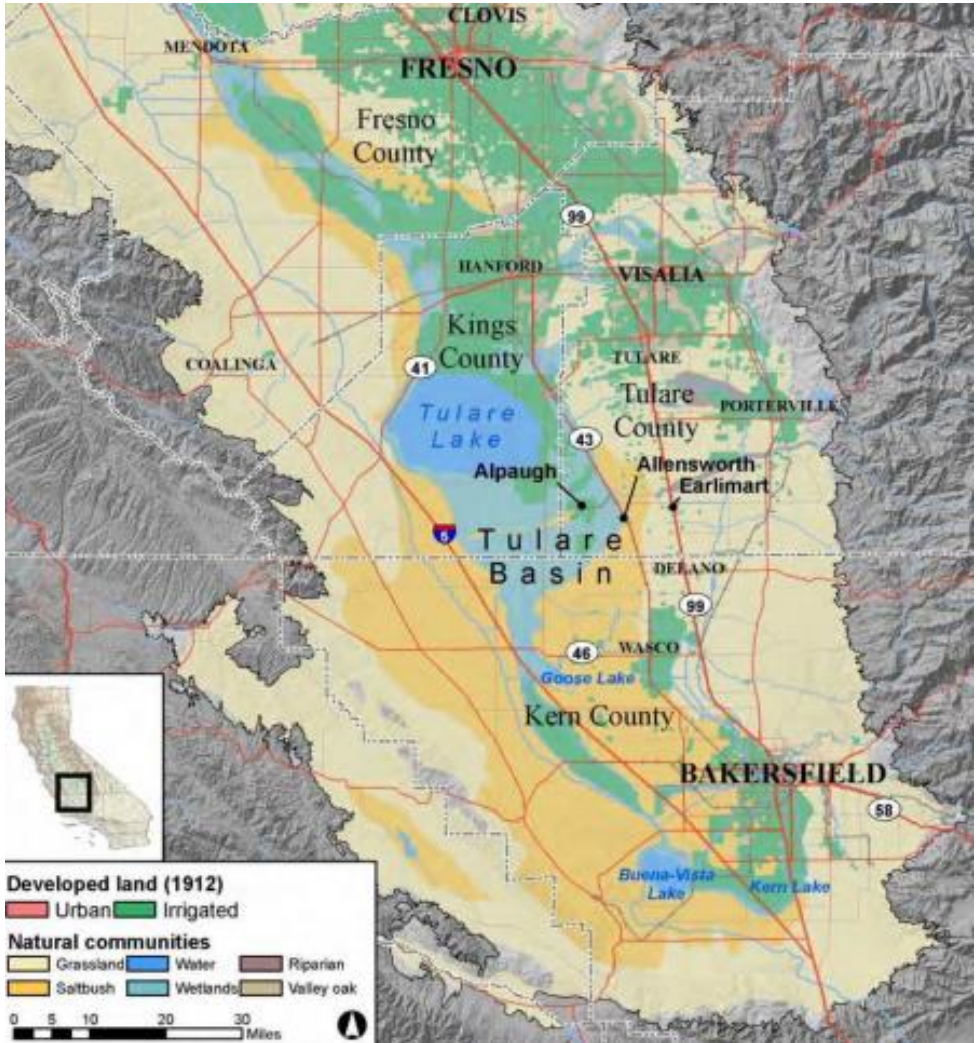
The coming of the canals



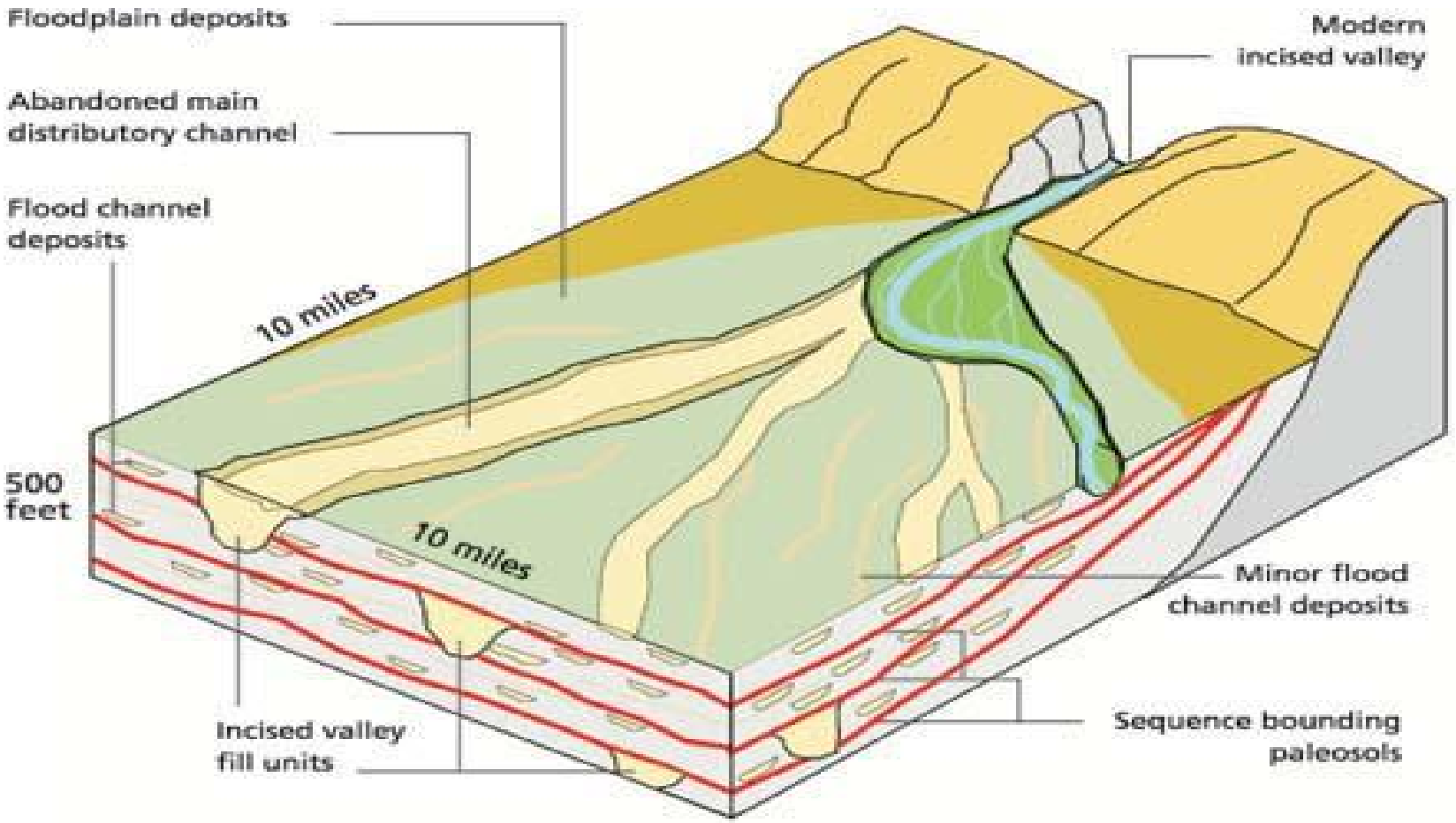
Tulare Lake Basin natural communities
The San Joaquin Valley Desert — 1850



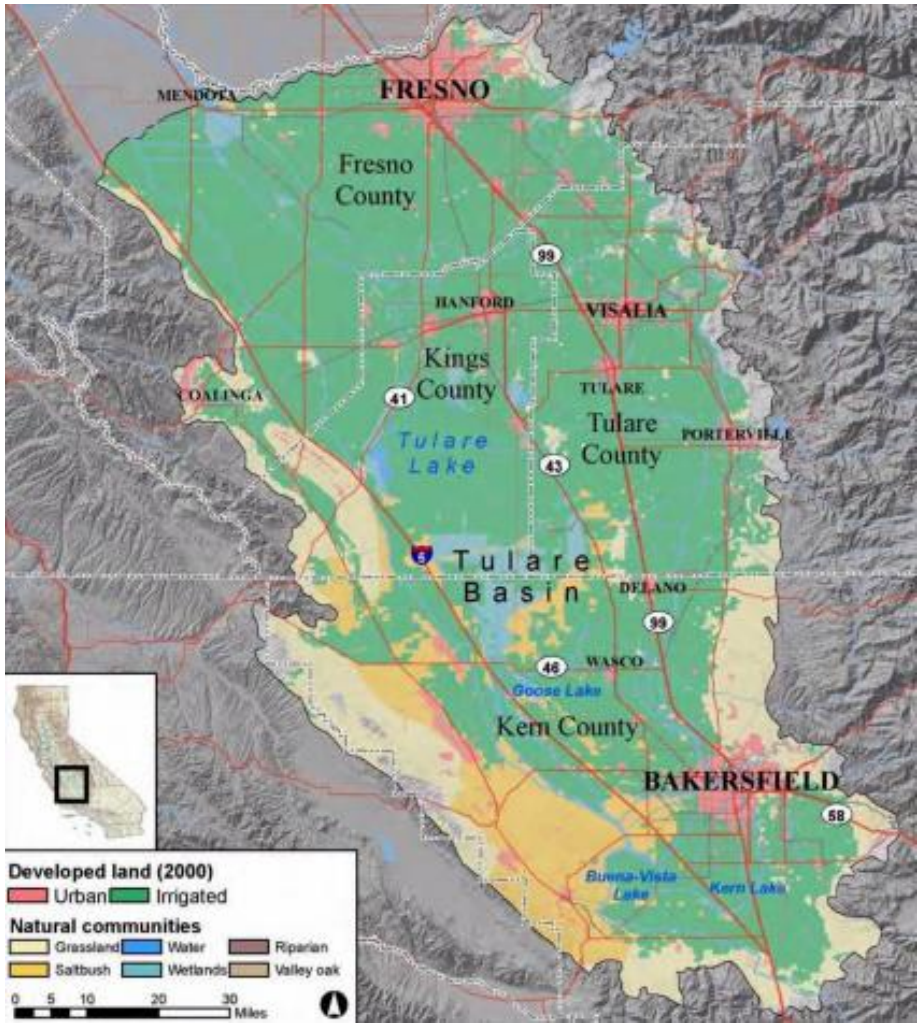
Tulare Lake Basin
Landuse — 1912



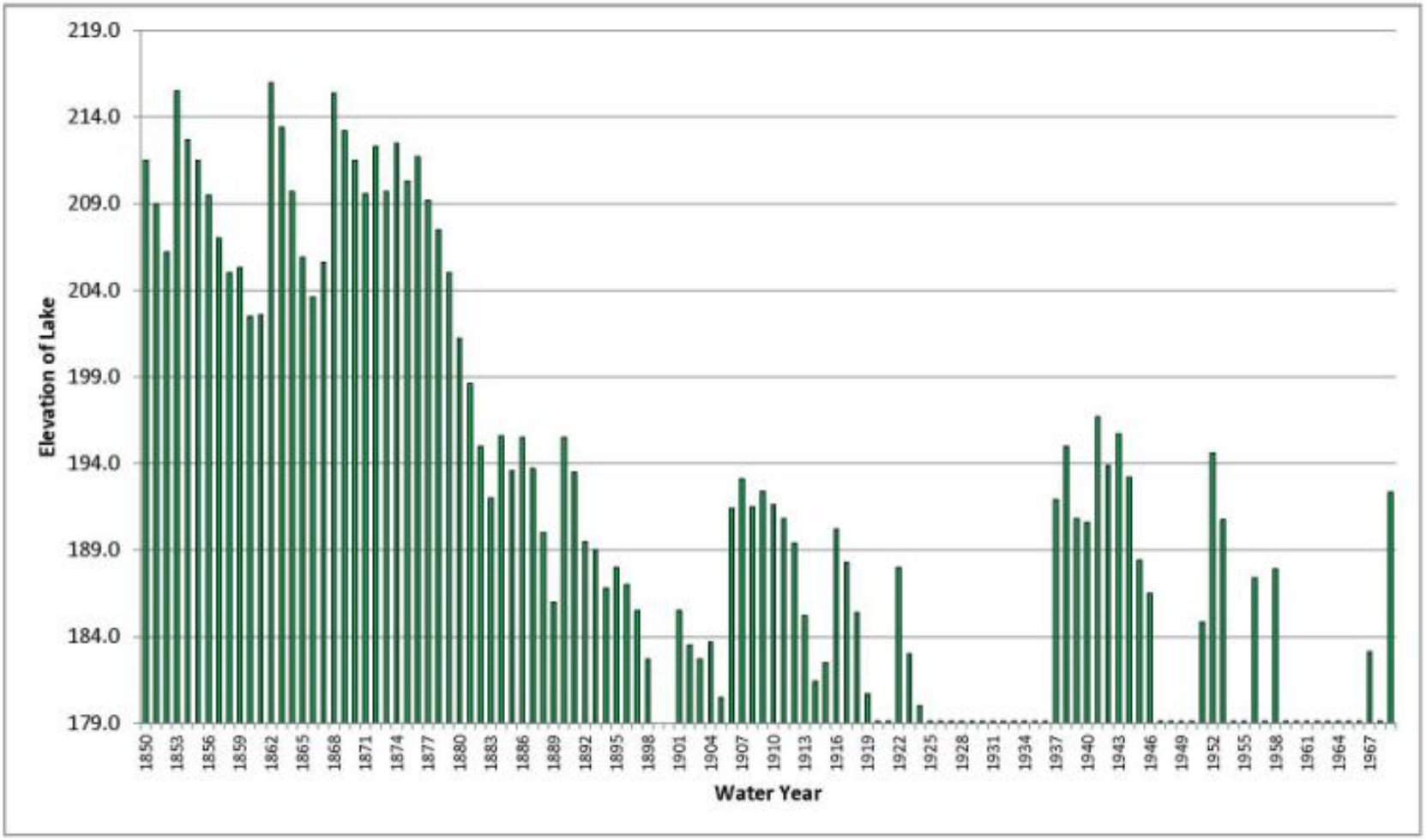
Kings River Delta Fan



Tulare Lake Basin
Landuse — 2000



Elevation of water in the Tulare Lakebed for 120 years: 1850–1969.
Tulare Lake Basin has functioned as a closed basin since 1878.



How does your typical plants view drought?

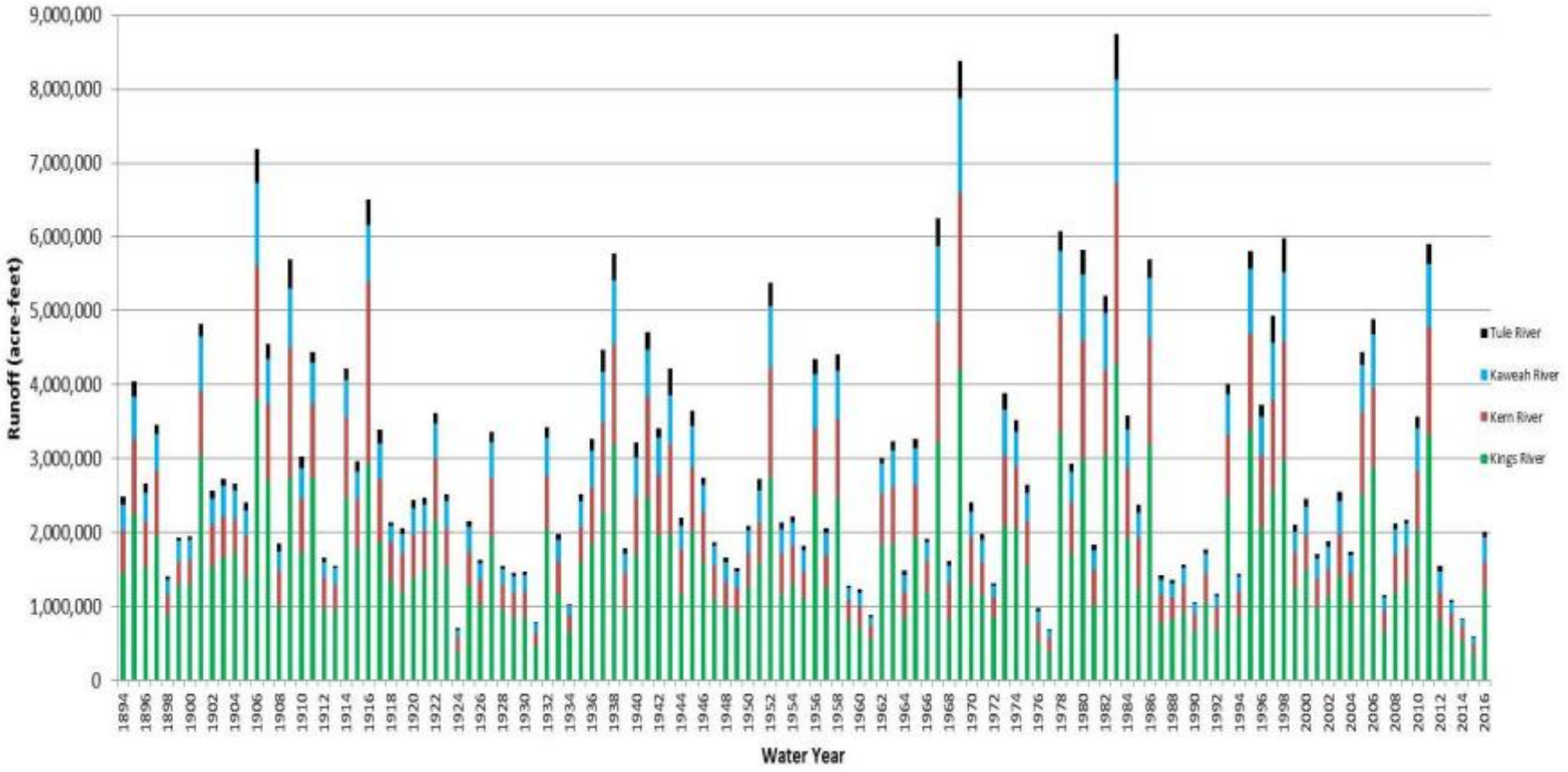
Current drought from perspective of plants
Topics to be addressed

1. Increase in temperature, potential evapotranspiration, and frequency of severe droughts since the mid-1980s.

2. Apparent decrease in frequency of rain-producing weather types and precipitation since the mid-1980s.

3. Decrease in average runoff since the mid-1980s.

Variation in runoff over past 123 years: 1894–2016
The change that occurred 30 years ago



Drought terminology
From perspective of plants

1. Decrease in precipitation and runoff
2. Increase in temperature
3. Increase in actual evapotranspiration (ET)
4. Increase in potential evapotranspiration (PET)
5. Palmer Drought Severity Index (PDSI)

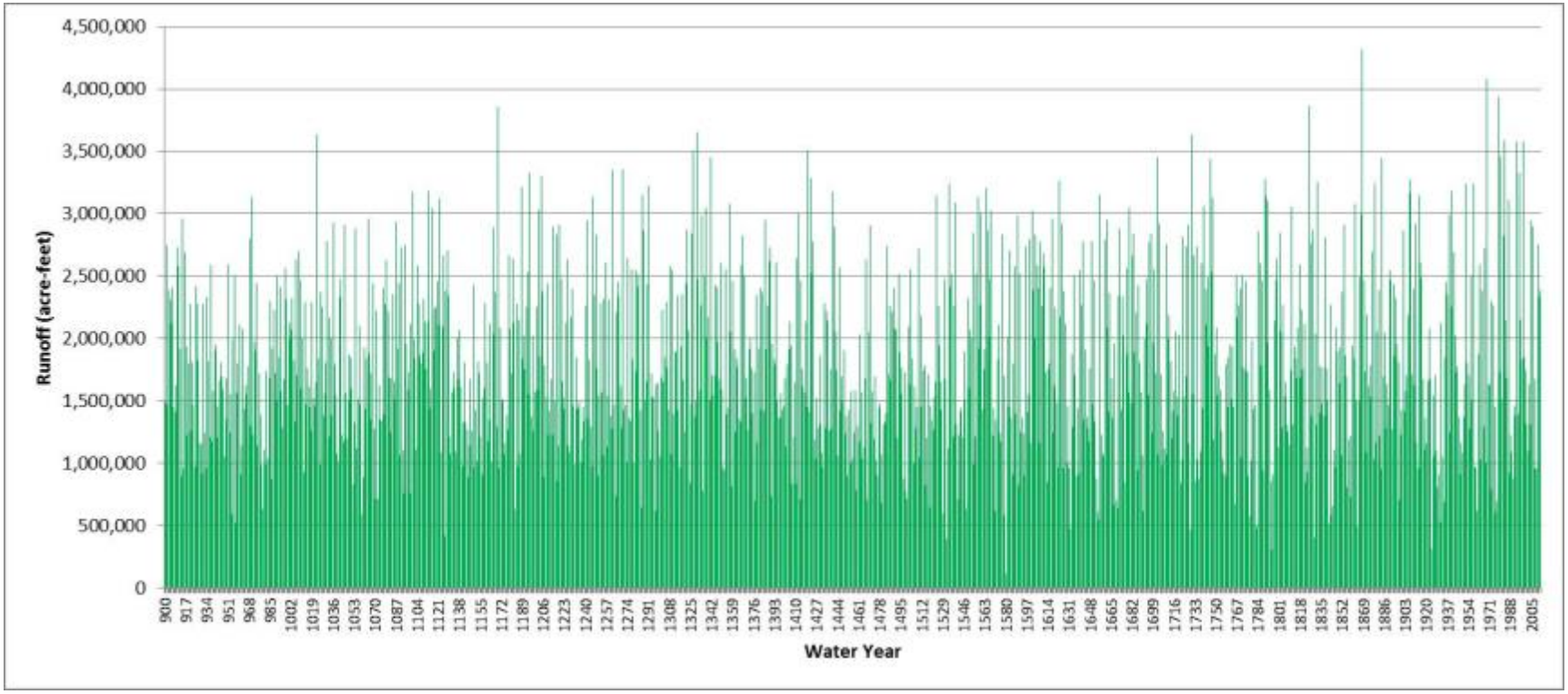
Valley oak mortality
Mooney Grove

Drought in Blue Oak woodland

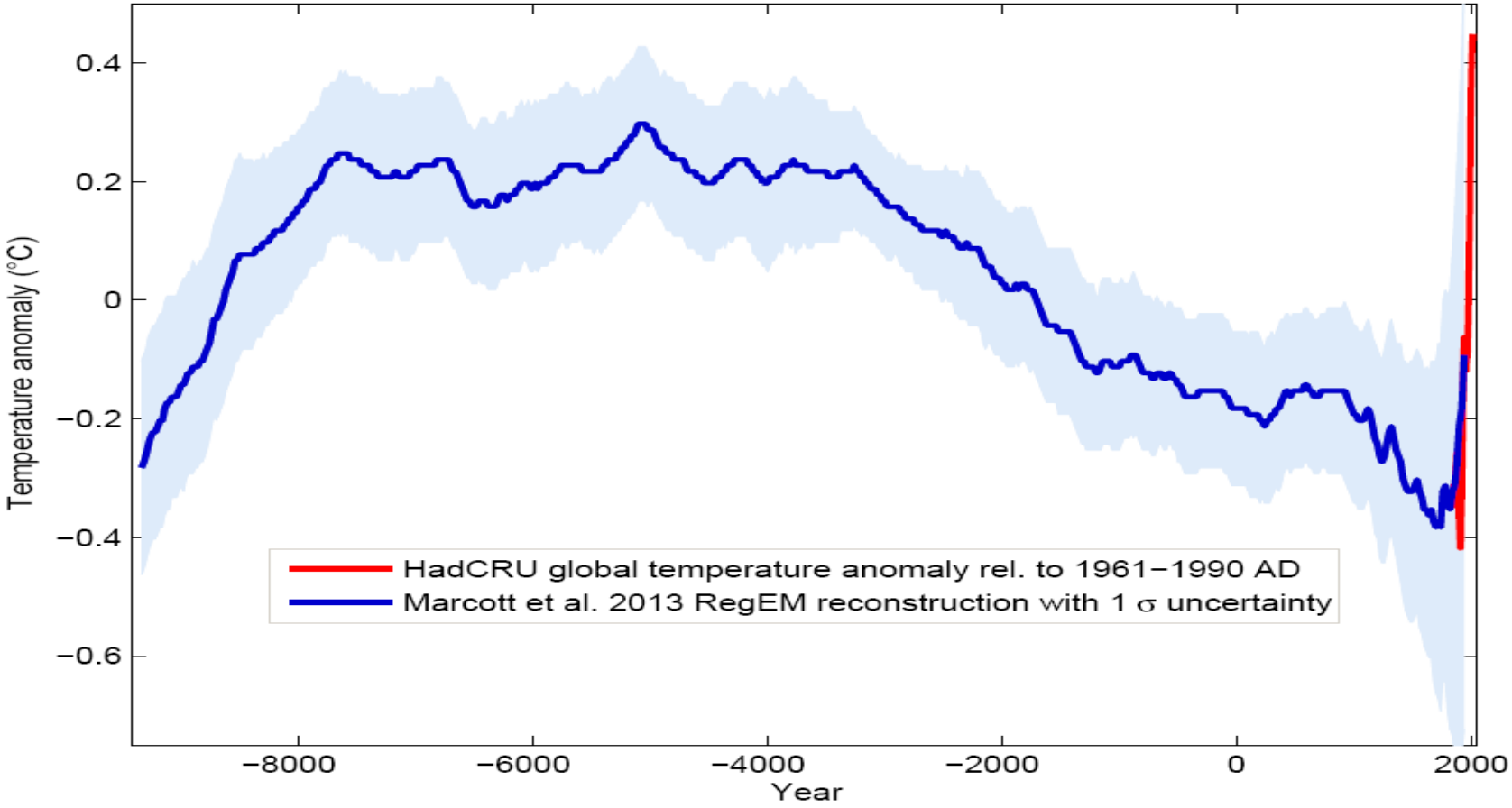
Conifer mortality

Rough Fire
September 1, 2015

Variation in runoff over 1113 years: 900–2012
Upper San Joaquin River — Millerton Lake



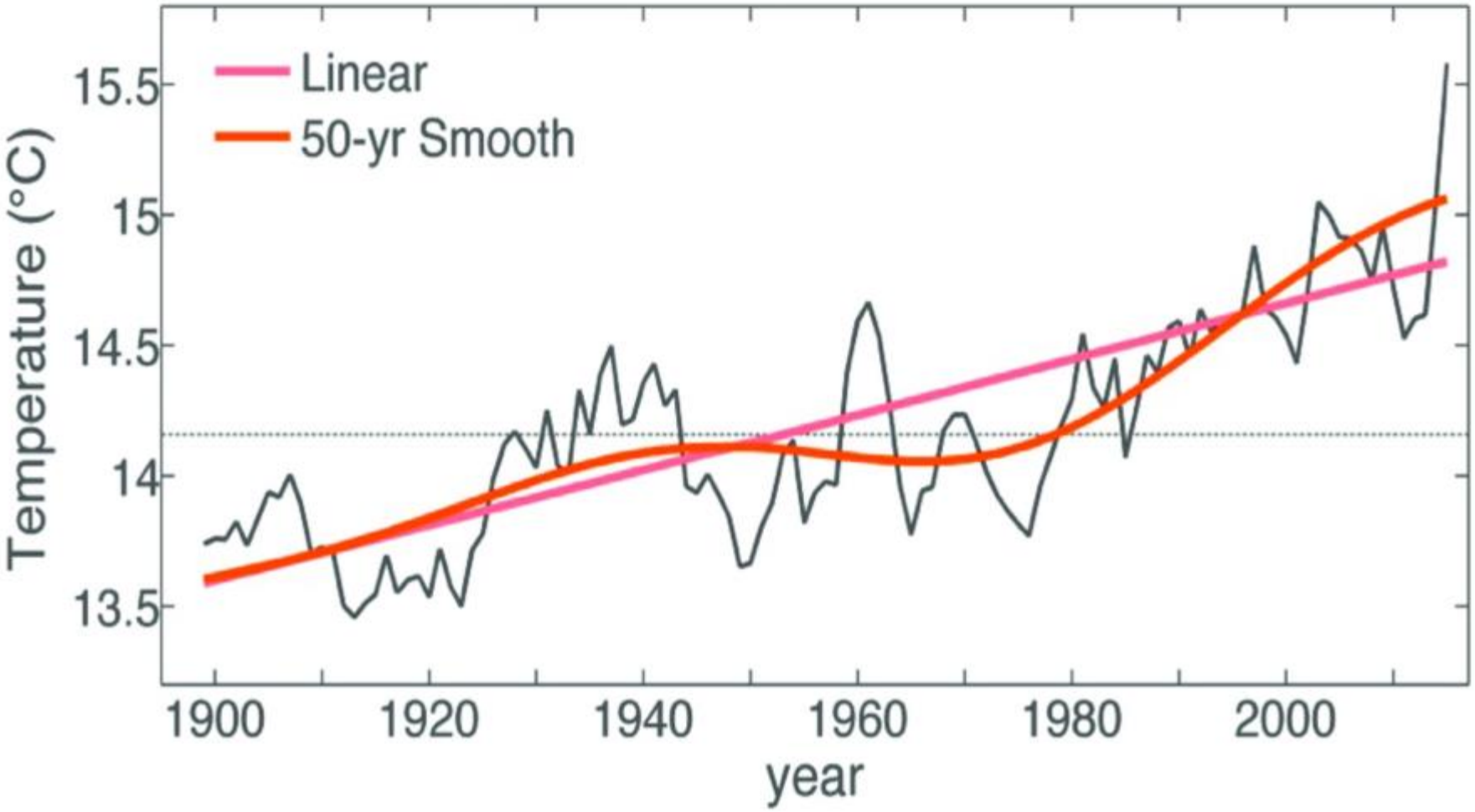
Change in global temperature for 11,000 years



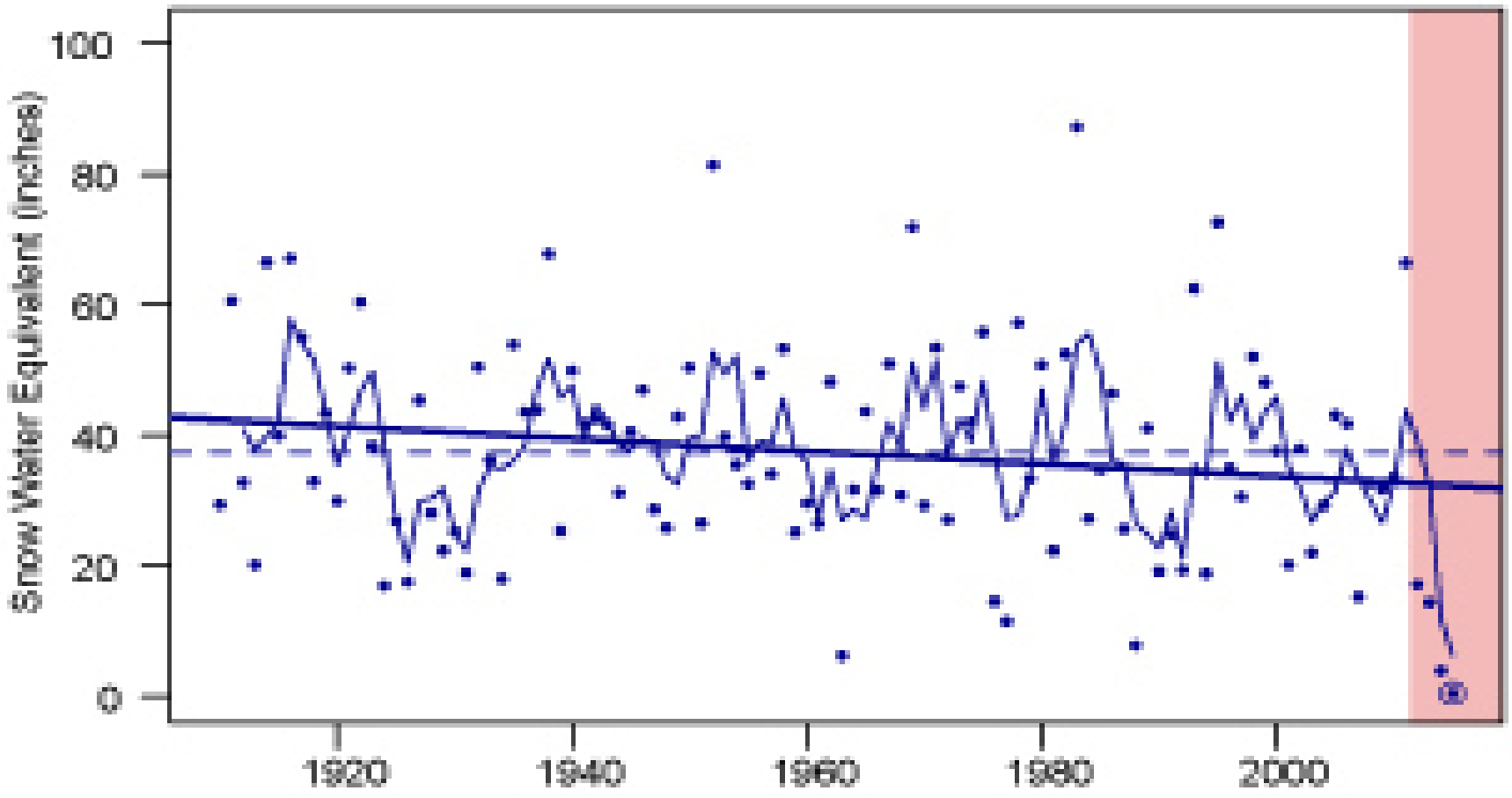
Melting of Sierra glaciers
Lyell Glacier 1883 - 2015

Accounts of conditions in California in Little Ice Age 1542, 1579, 1602, 1769, and 1831

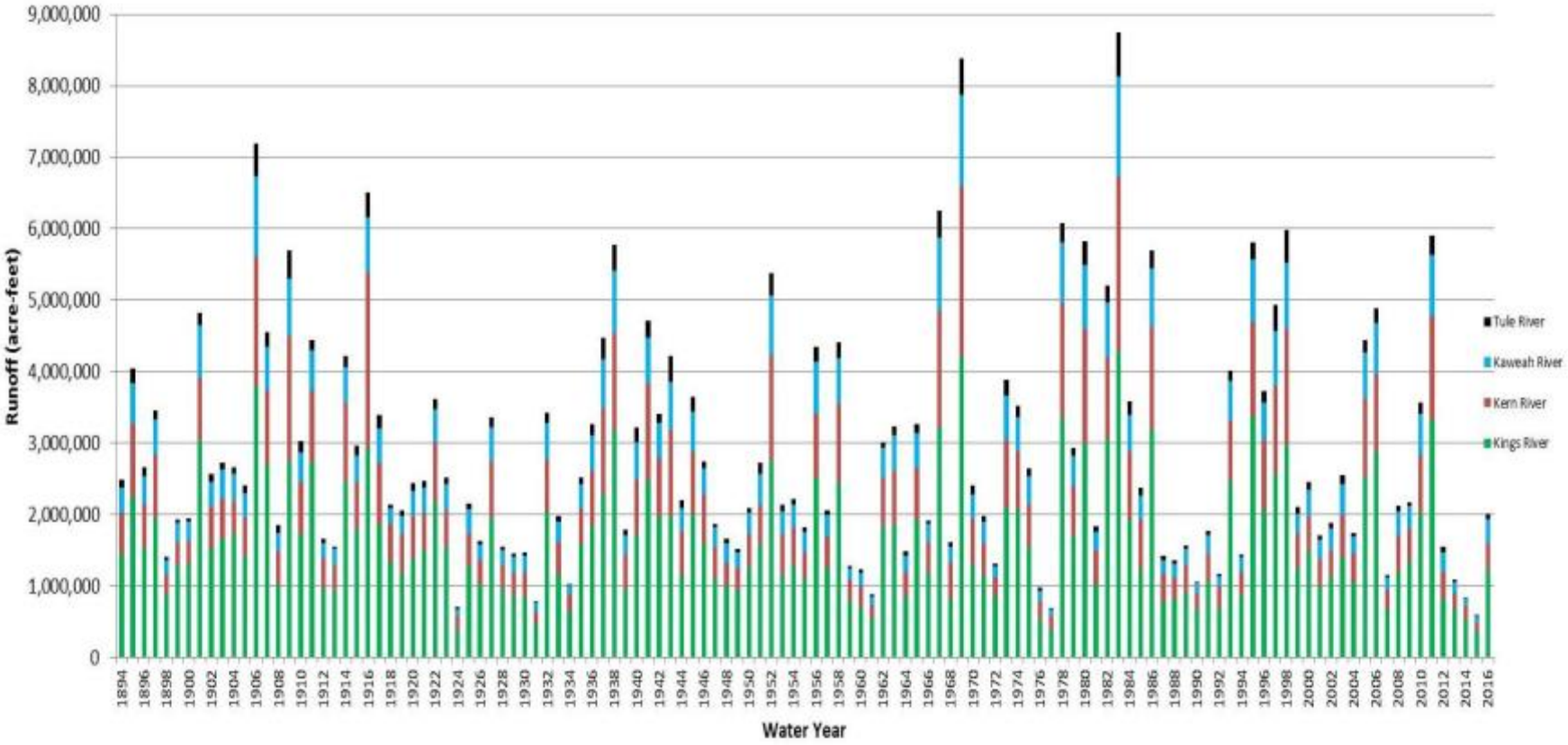
Changes in California average temperature for 120 years: 1895–2015



Water stored in Sierra snowpack at Donner Pass for 120 years: 1896–2015



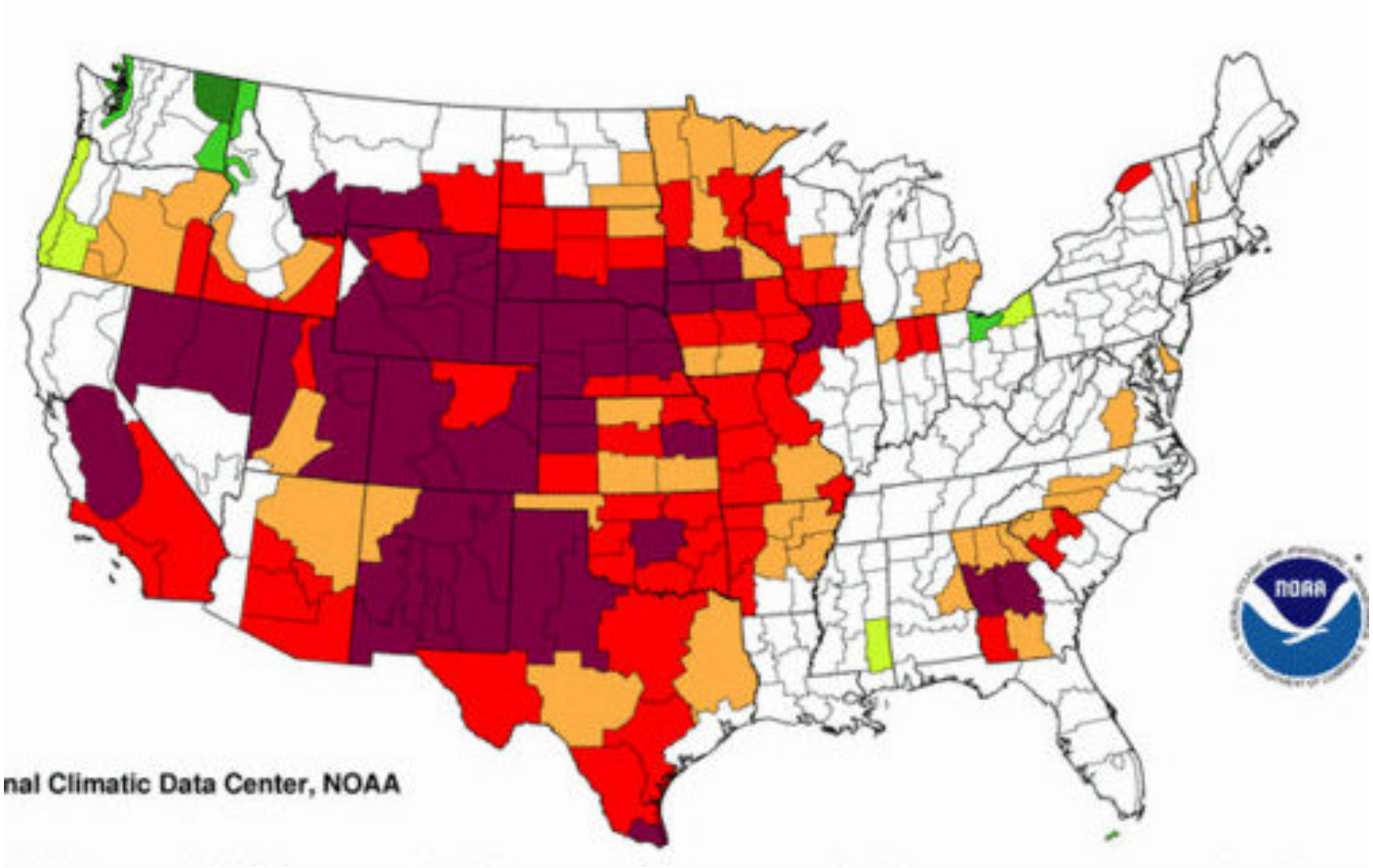
Variation in runoff over past 123 years: 1894–2016
How to view the dry spell that began in 2000



California Drought Monitor
October 2014

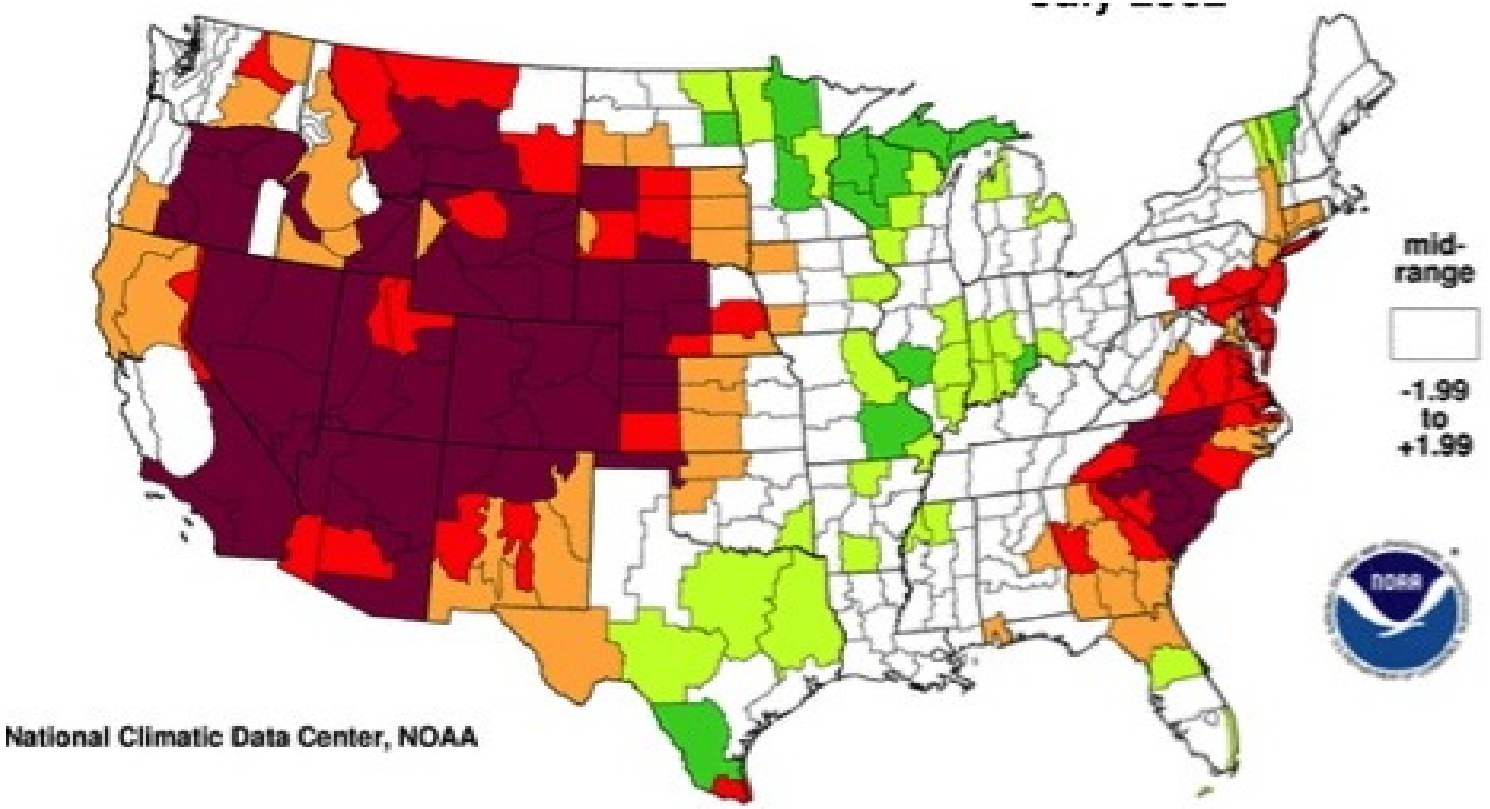
16-year megadrought in western U.S. (2000–15)

2012

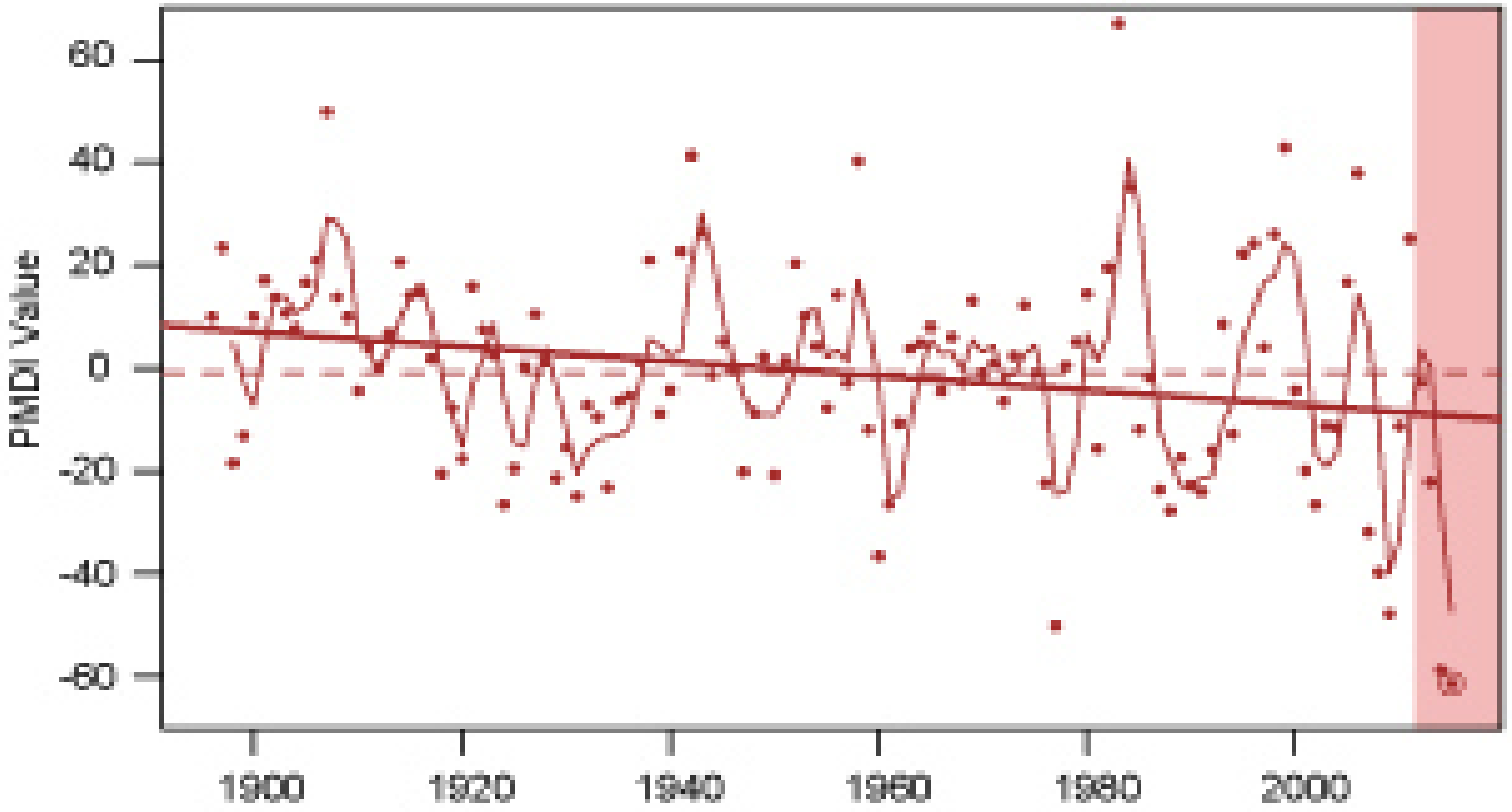


16-year megadrought in western U.S. (2000–15)

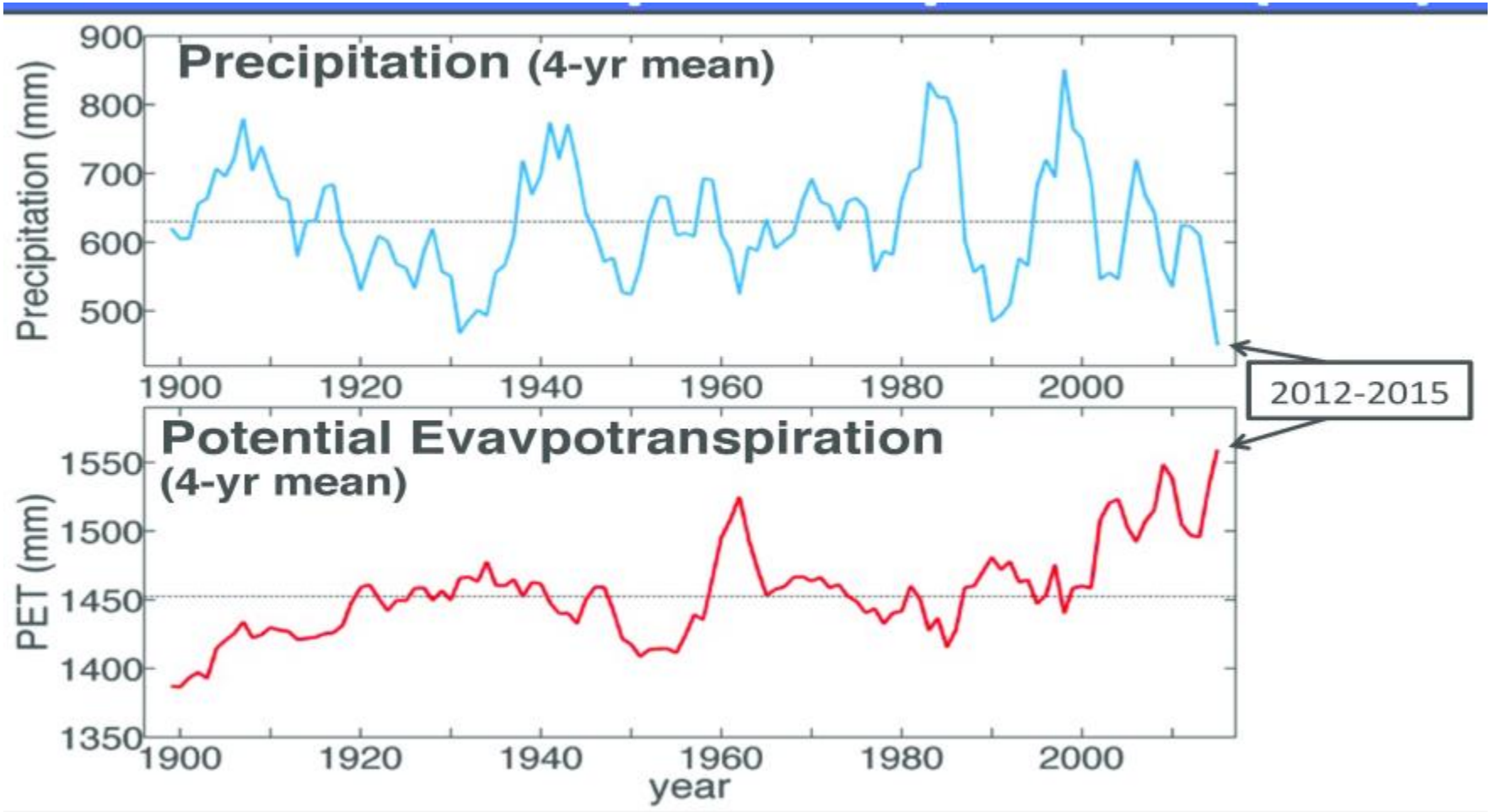
2002



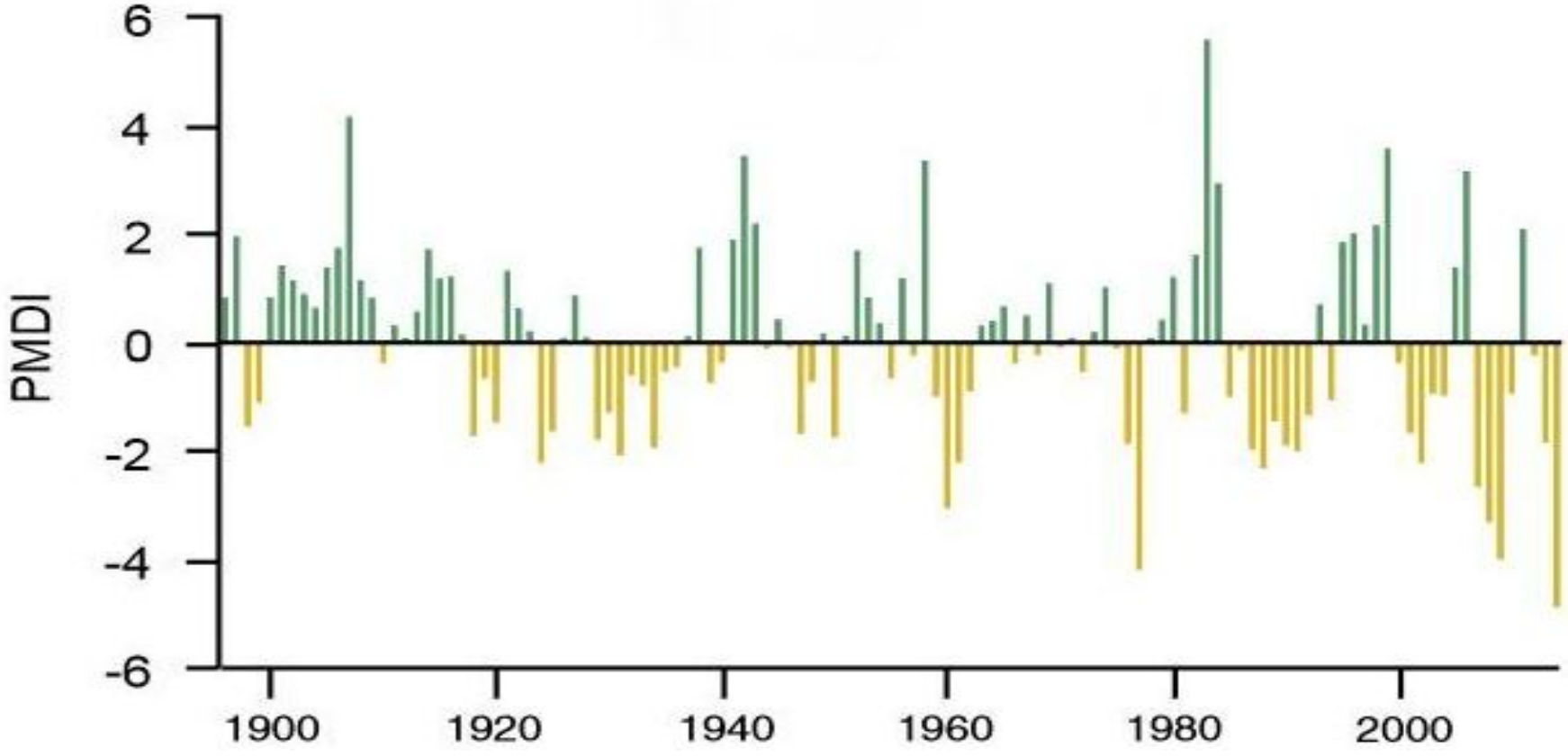
Changes in California drought severity for 120 years: 1896–2015



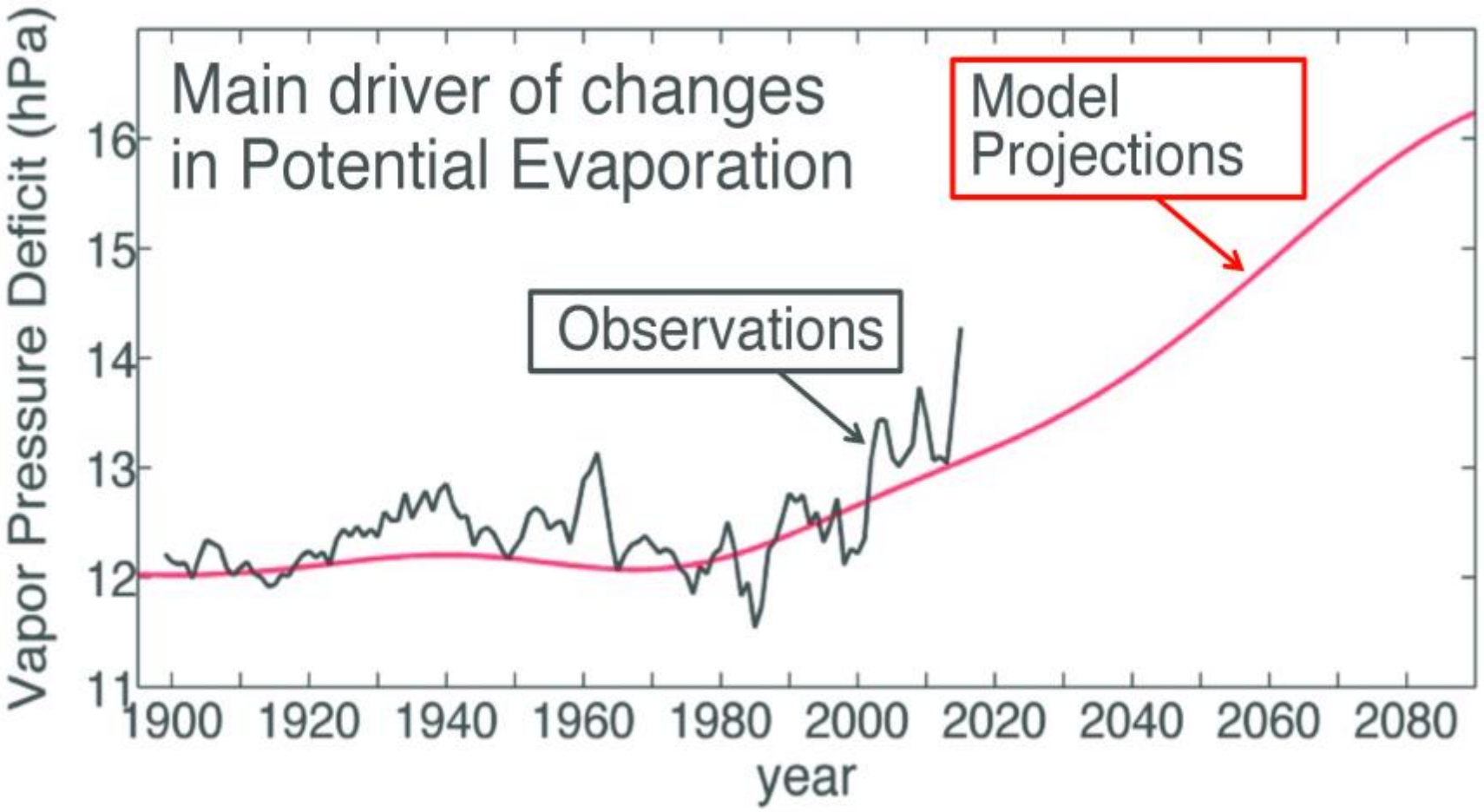
Changes in California precipitation and PET for 115 years: 1901–2015



California drought severity for past 119 years: 1896–2014



Changes in California PET
1901–2080



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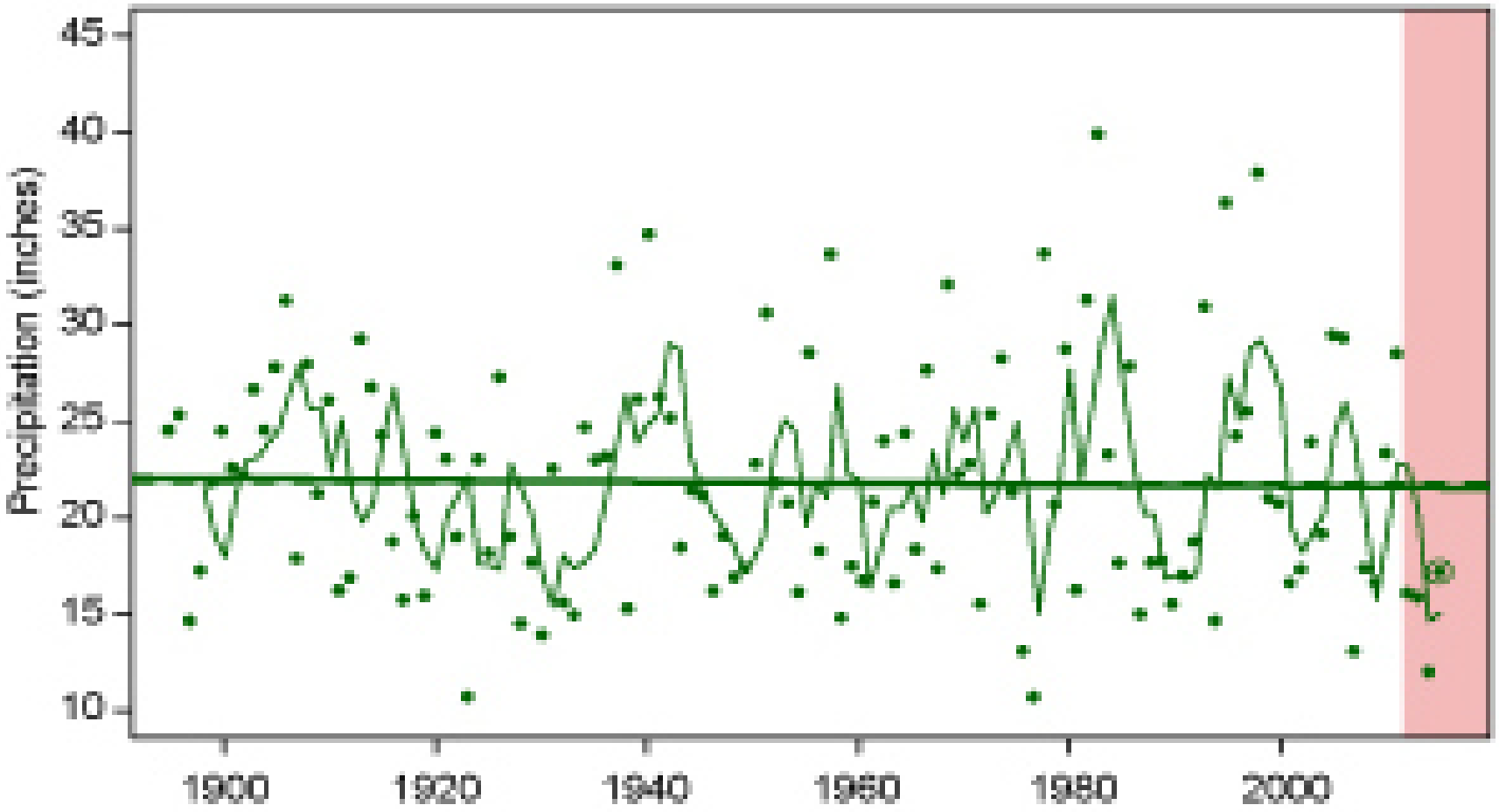
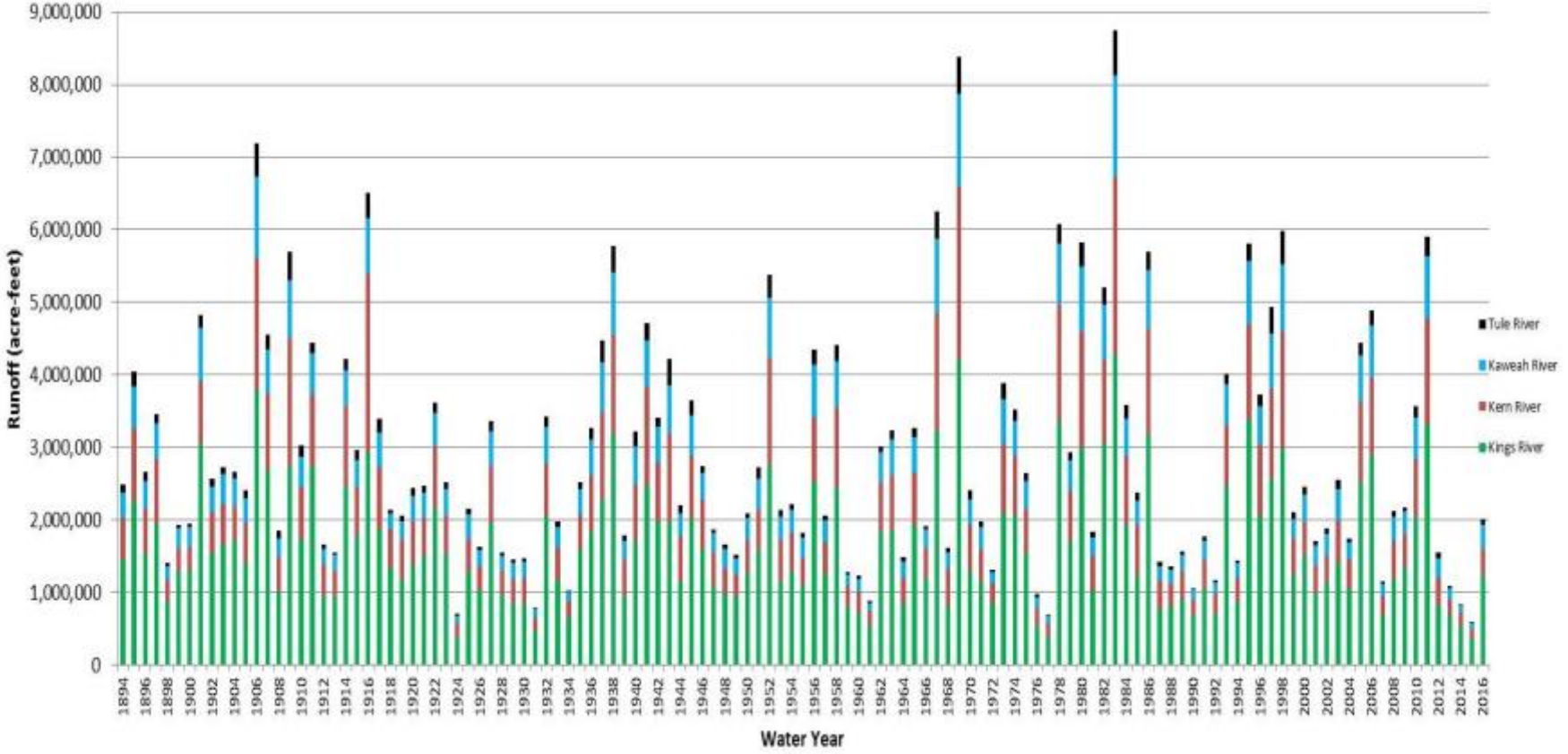
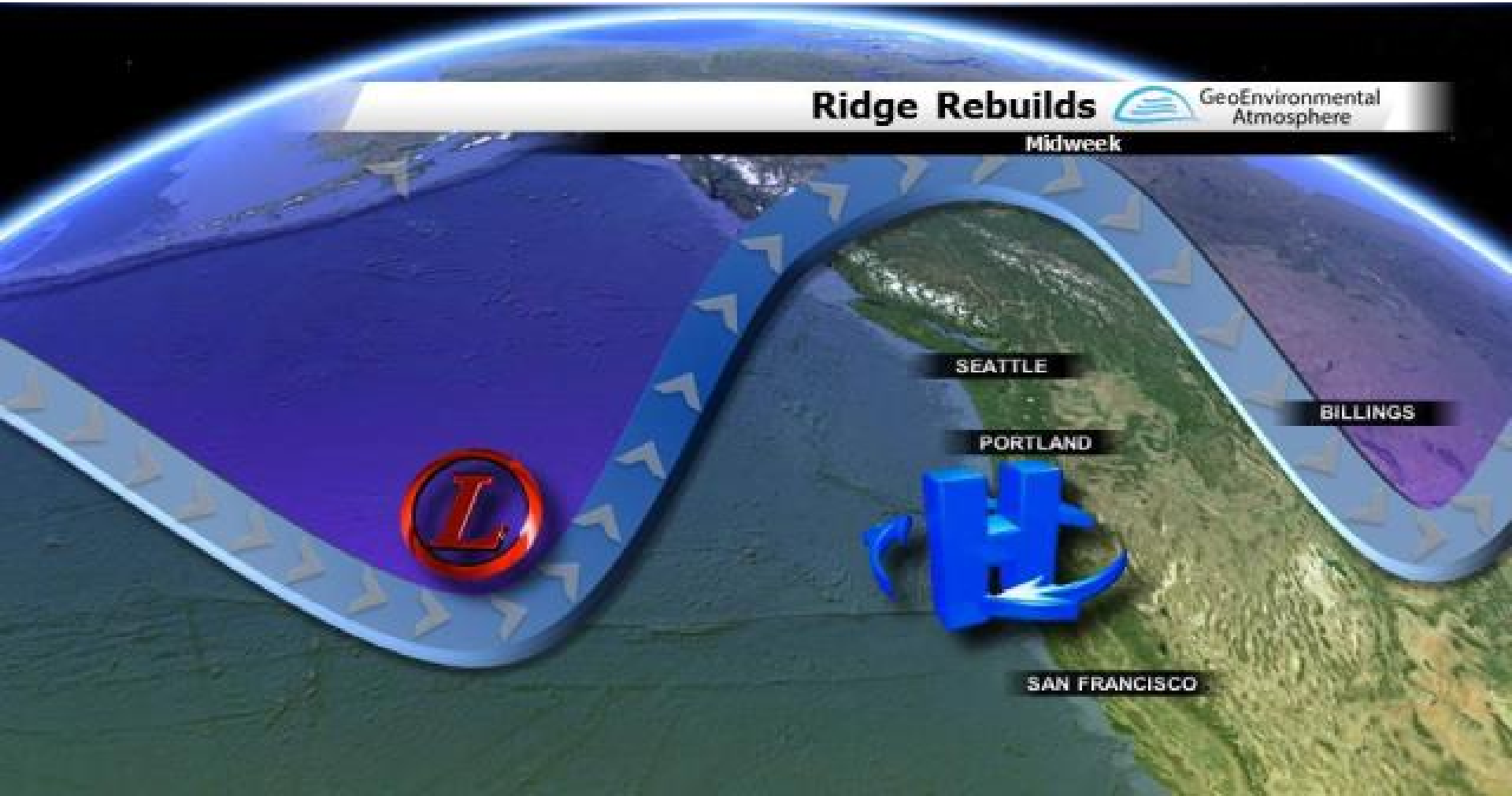


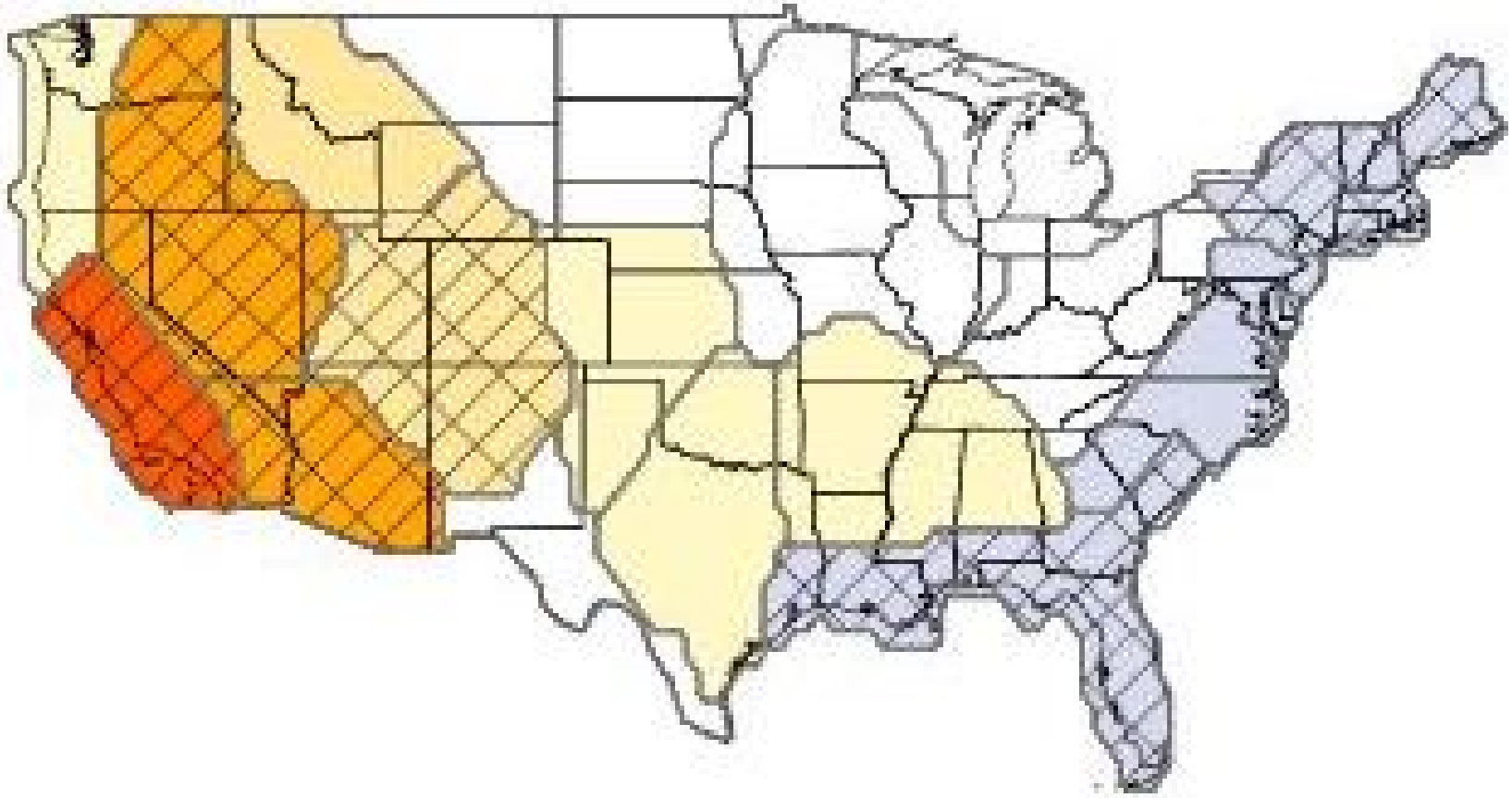
Variation in runoff over past 123 years: 1894–2016
Atmospheric patterns have caused our major droughts



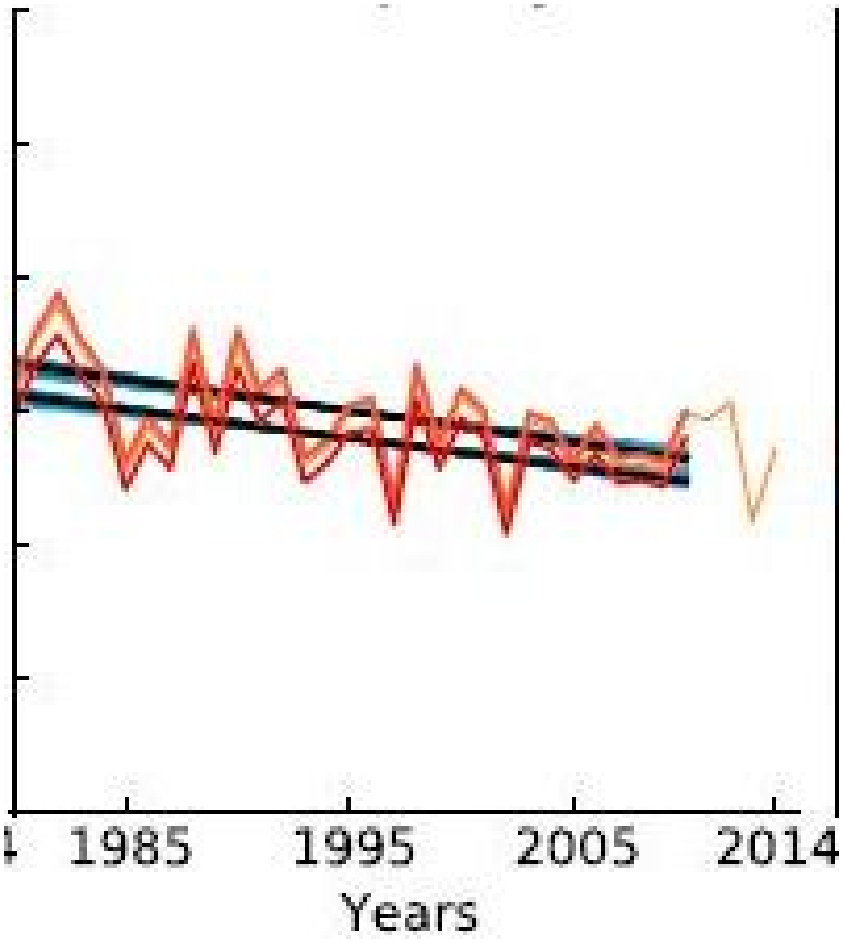
High pressure ridge
The cause of our biggest droughts



Change in frequency of rain-producing weather types (1980-2010)



Change in frequency of rain-producing weather types Pacific Southwest Subregion (1980-2010)

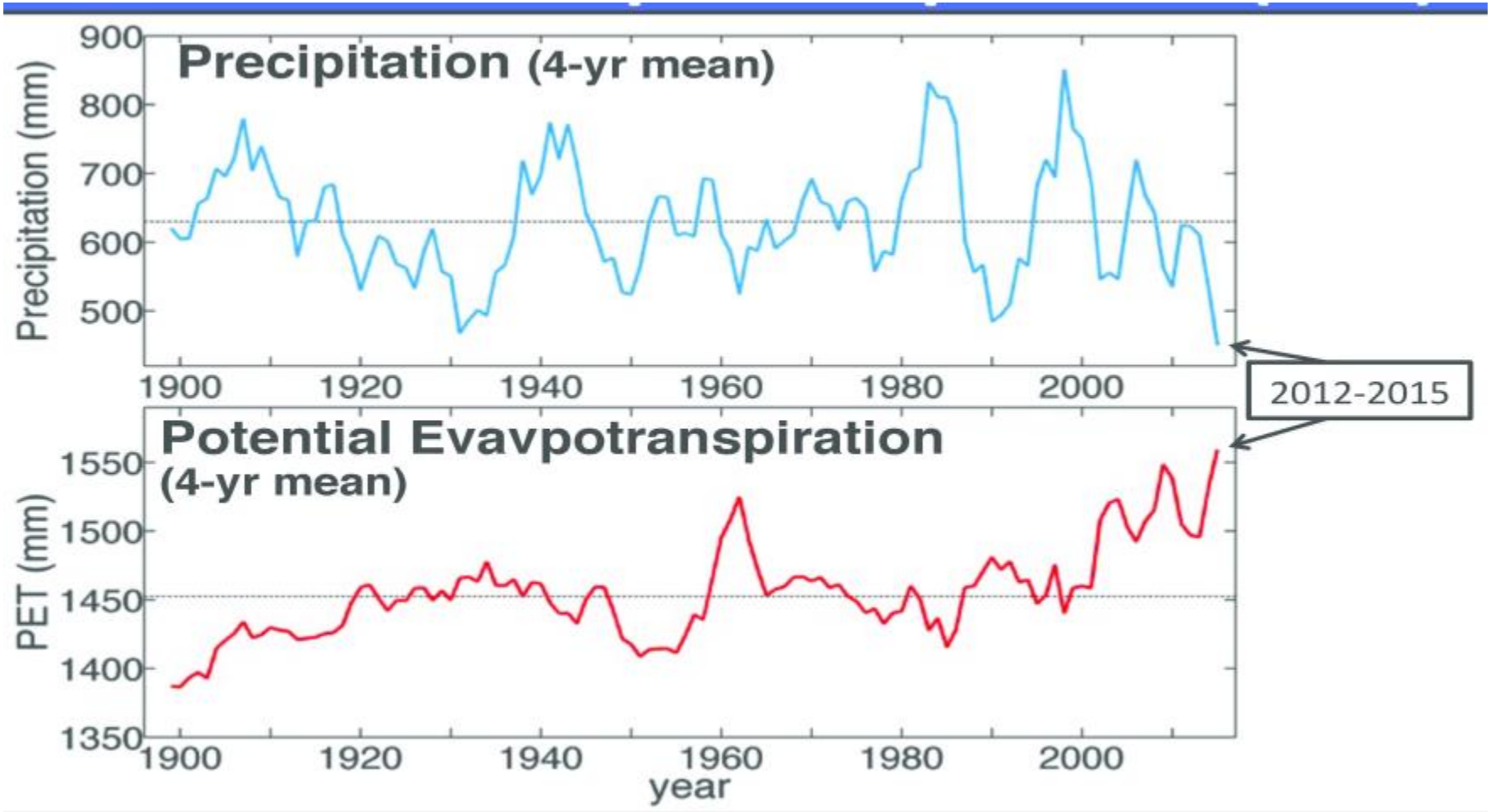


Decrease in runoff — last three decades

Basin	Average Runoff (acre-feet) 1894-1986	1987-2016	Decrease
Upper San Joaquin	1,849,987	1,575,063	-15%
Kings	1,702,431	1,473,552	-13%
Kaweah	434,906	378,027	-13%
Tule	142,671	114,820	-20%
Kern	746,250	601,763	-19%

2016 flows are based on May 1 DWR estimates.
Flows for Upper San Joaquin River only available for 1901–2016.

Changes in California precipitation and PET for 115 years: 1901–2015



Take-away messages
Current drought from the perspective of plants

1. Plants have required more water to avoid stress since the mid-1980s. Increase in PET driving increase in significant droughts. Trend seems bad.

2. Apparent decrease in frequency of rain-producing weather types and precipitation since the mid-1980s. Trend seems bad.

3. Runoff has been reduced since the mid-1980s. Three plausible explanations.

4. Current drought began in 2000. Two brief interruptions caused by short bursts of intense rainfall.