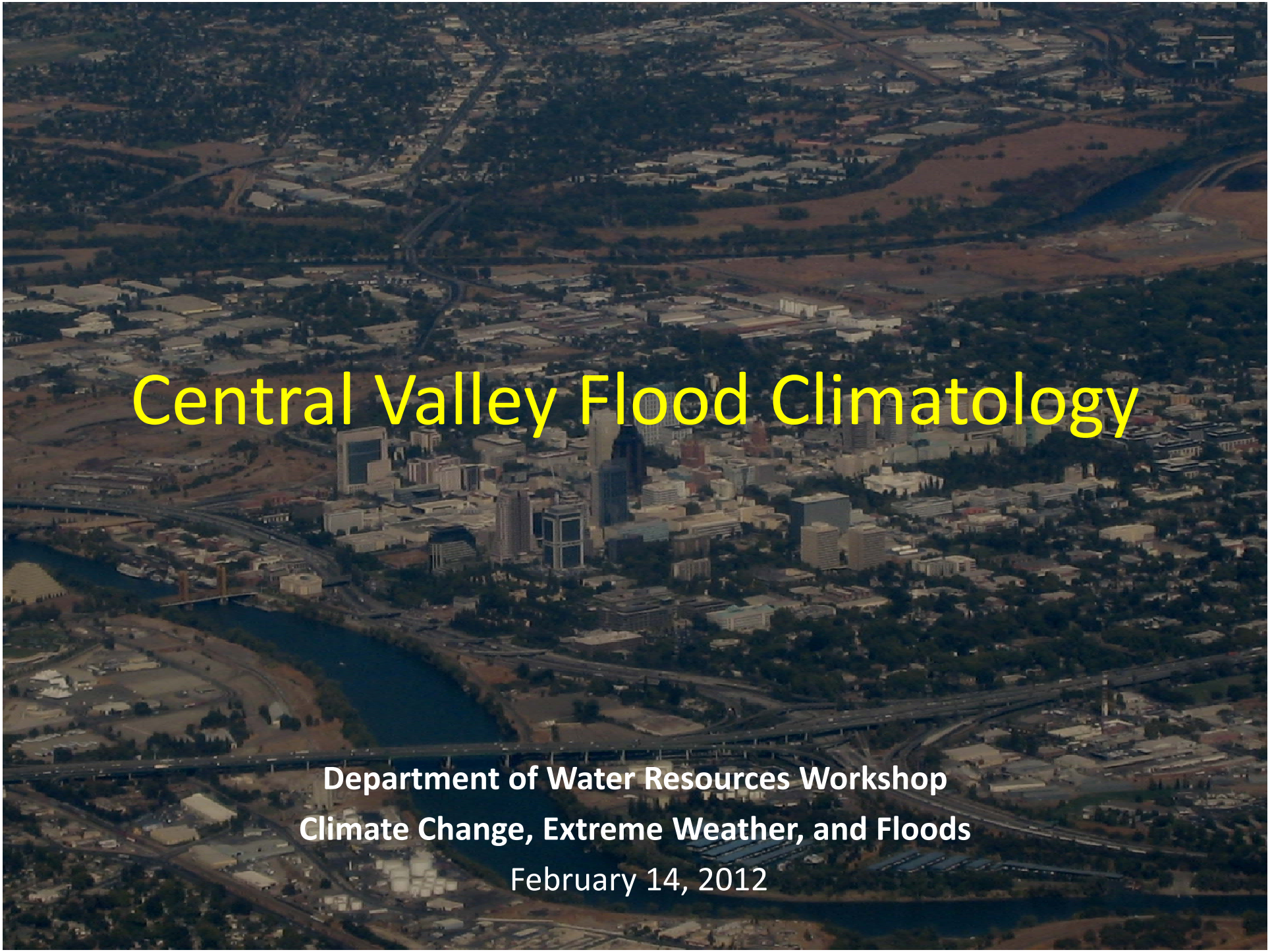


Central Valley Flood Climatology

Department of Water Resources Workshop

Climate Change, Extreme Weather, and Floods

February 14, 2012

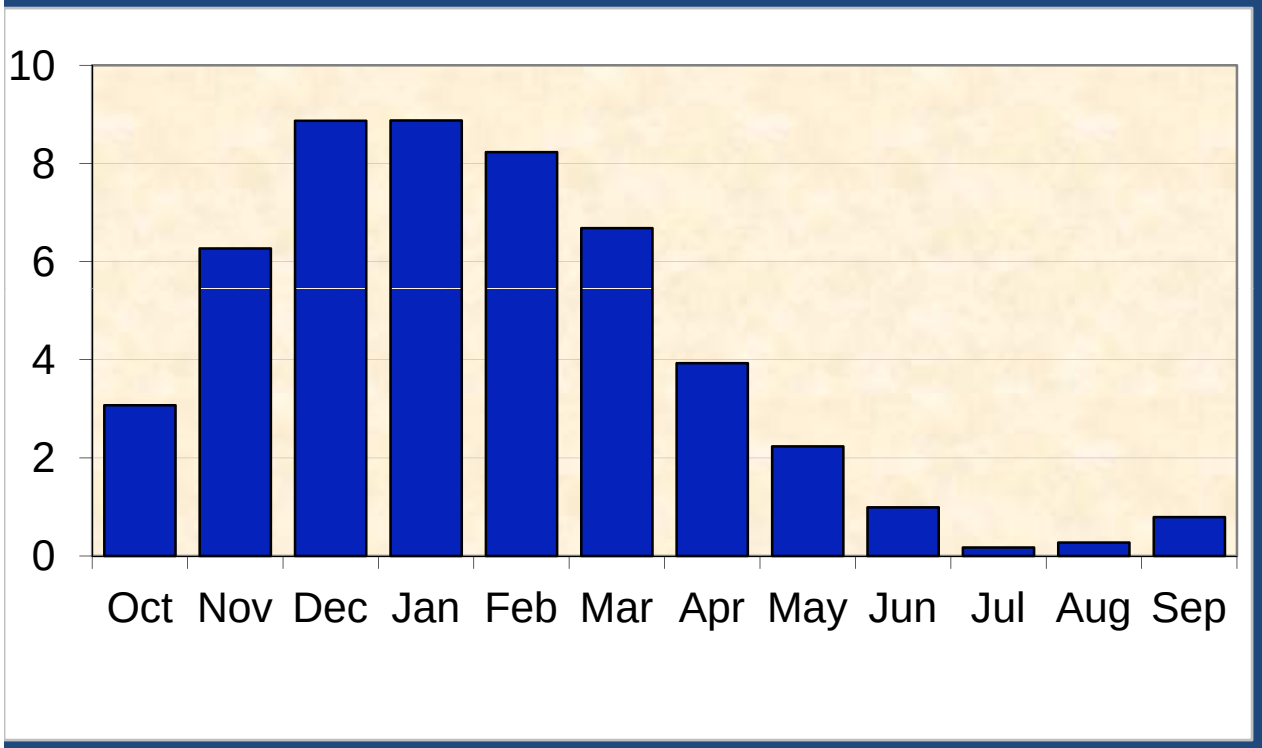
Talk Overview

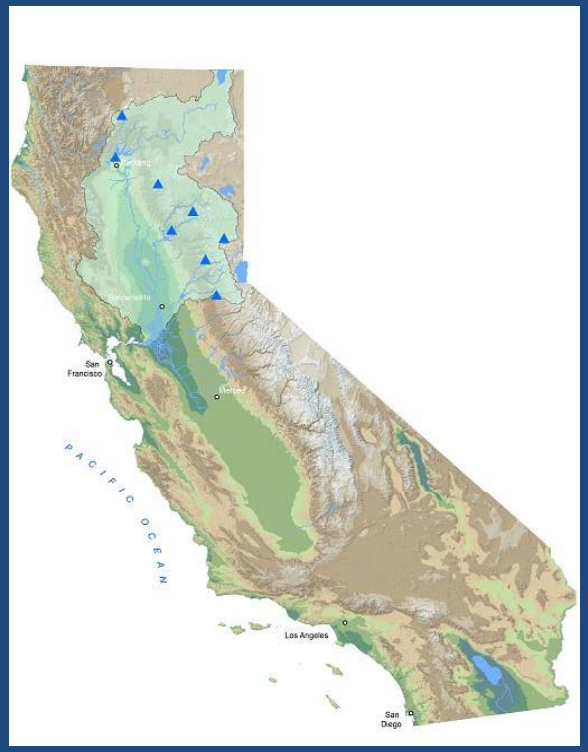
- Ingredients for a Central Valley Flood
- Historical Floods of Note
- Inter-annual Variability and California
- Bulletin 17B
- Climate Change Considerations

Ingredients for a Flood

- CA flood regime relies on both atmosphere and the interaction of the atmosphere with the land surface and the state of the land surface
- Time of Year Matters
- Location Matters – Know Your Watershed!

Northern Sierra 8 Station Index

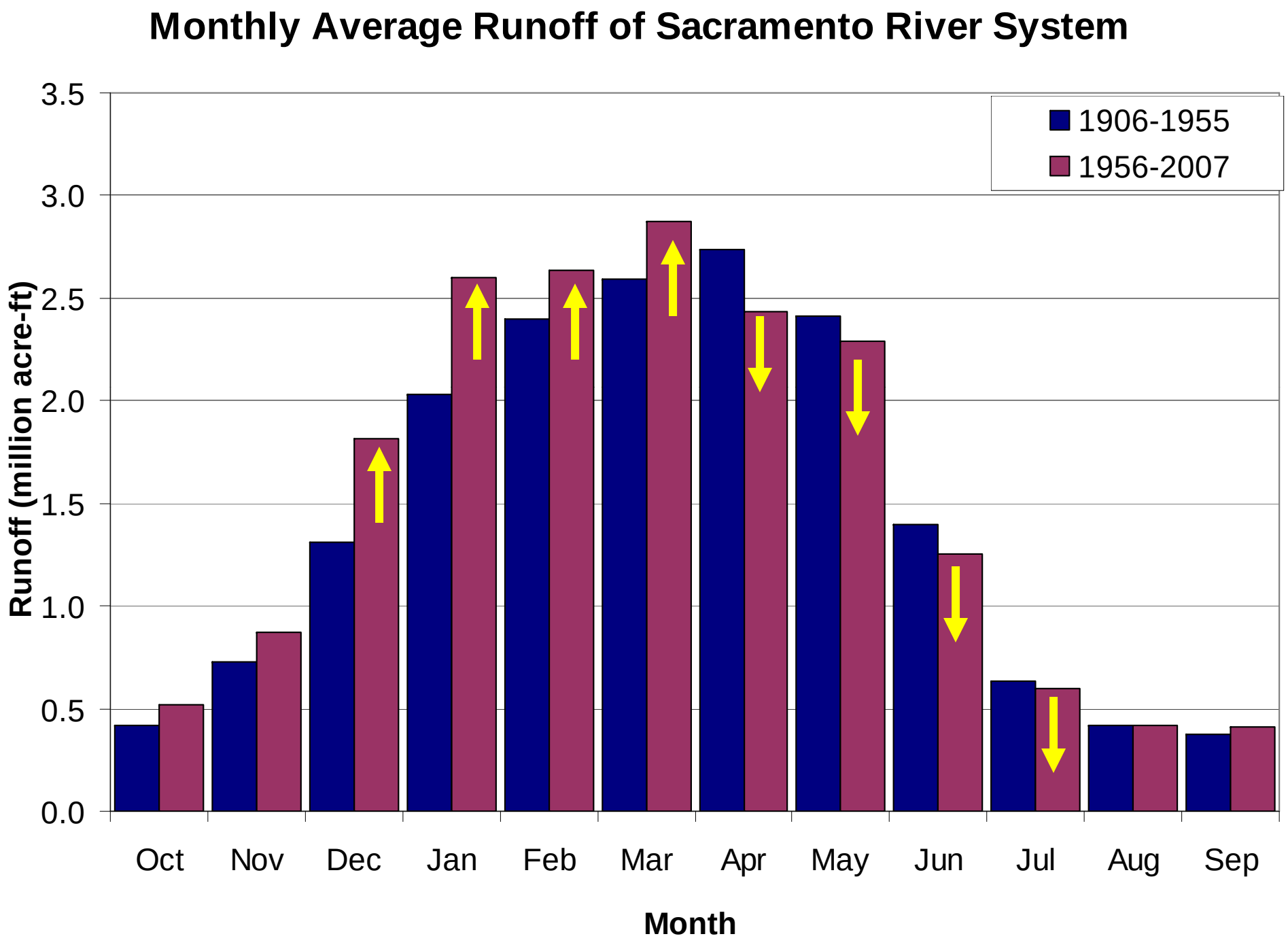




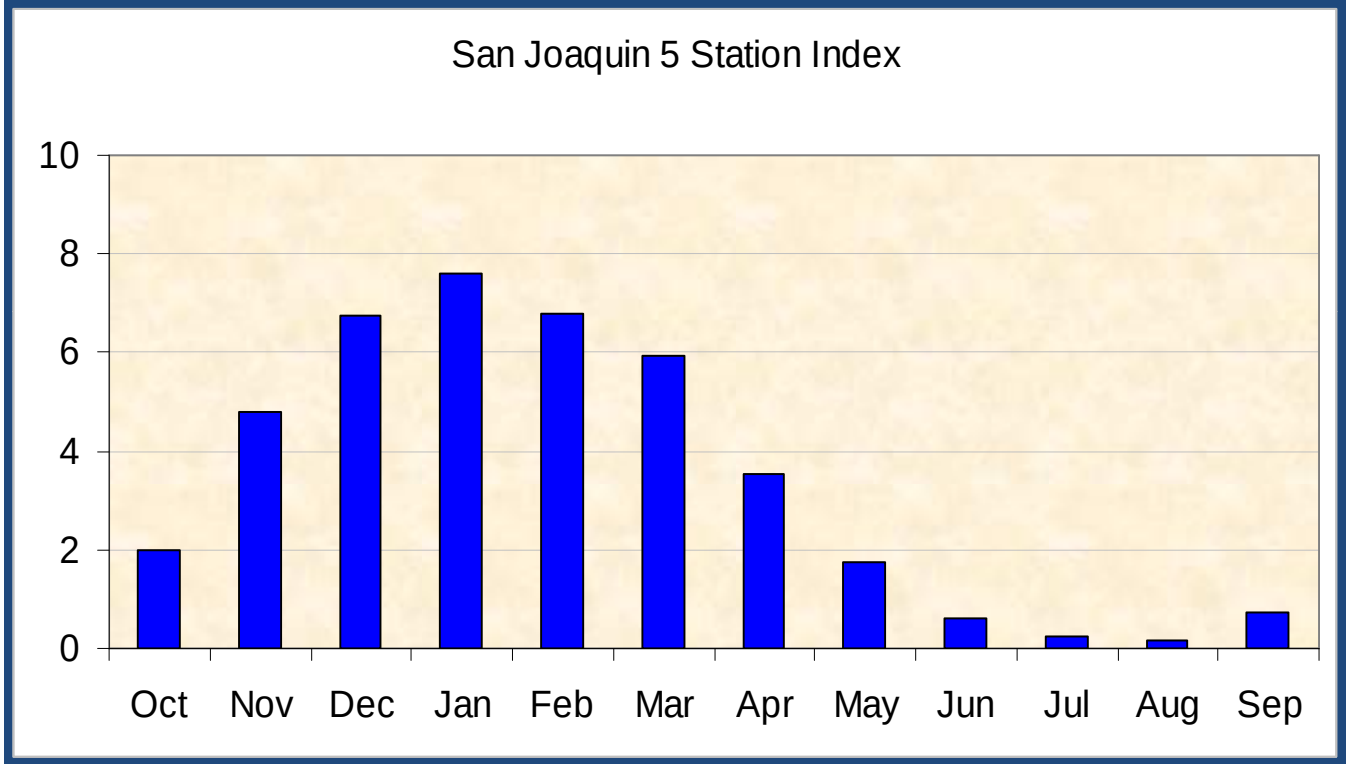
Annual Average: 50 inches
Maximum Year (1983): 88.5 inches
Minimum Year (1924): 17.1 inches
Period of Record 1921- Present

Average of:

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

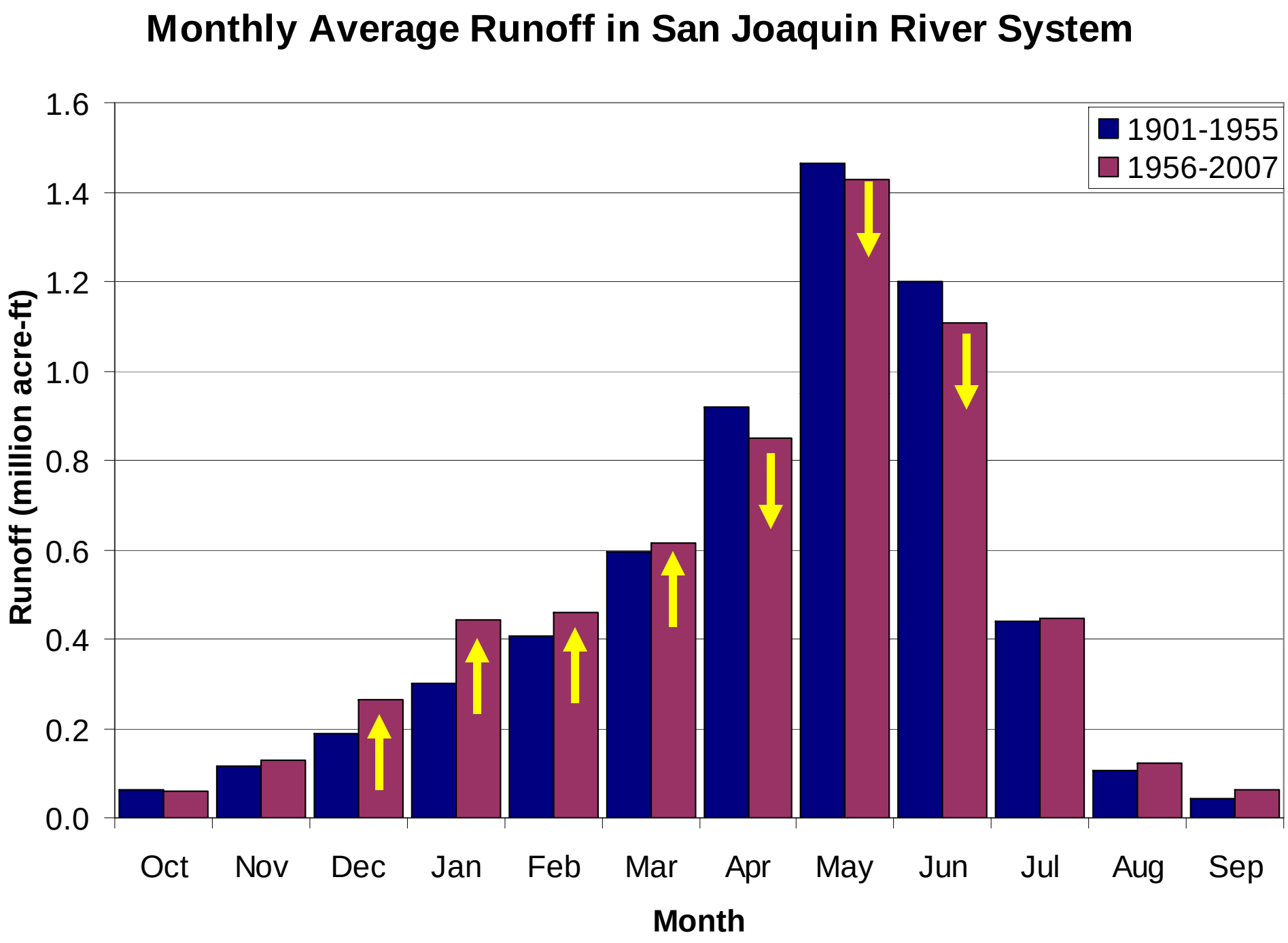

Monthly Average Runoff of Sacramento River System
1906-1955
1956-2007
Runoff (million acre-ft)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Month

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

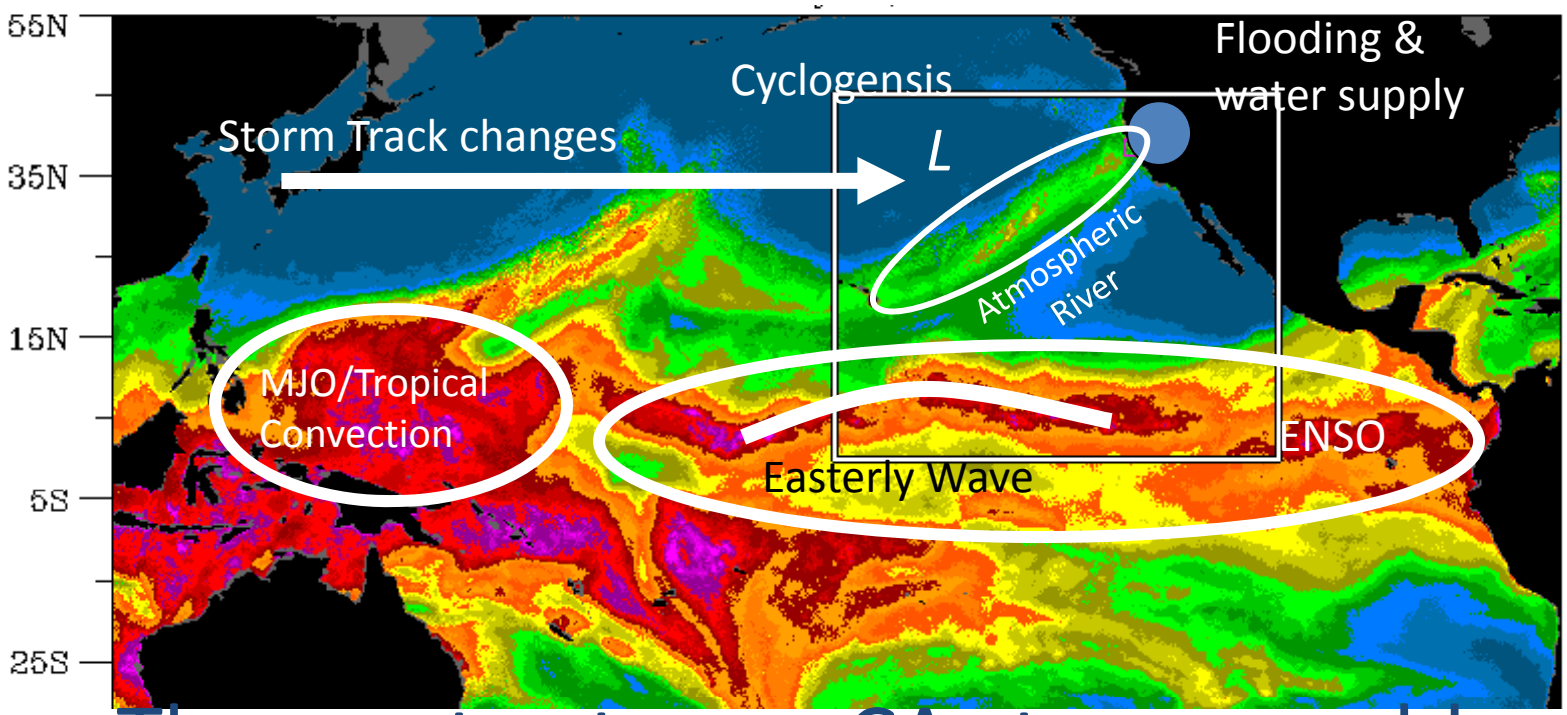
Average of:
Calaveras Big Trees
Hetch Hetchy
Yosemite HQ
North Fork Ranger Station
Huntington Lake


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

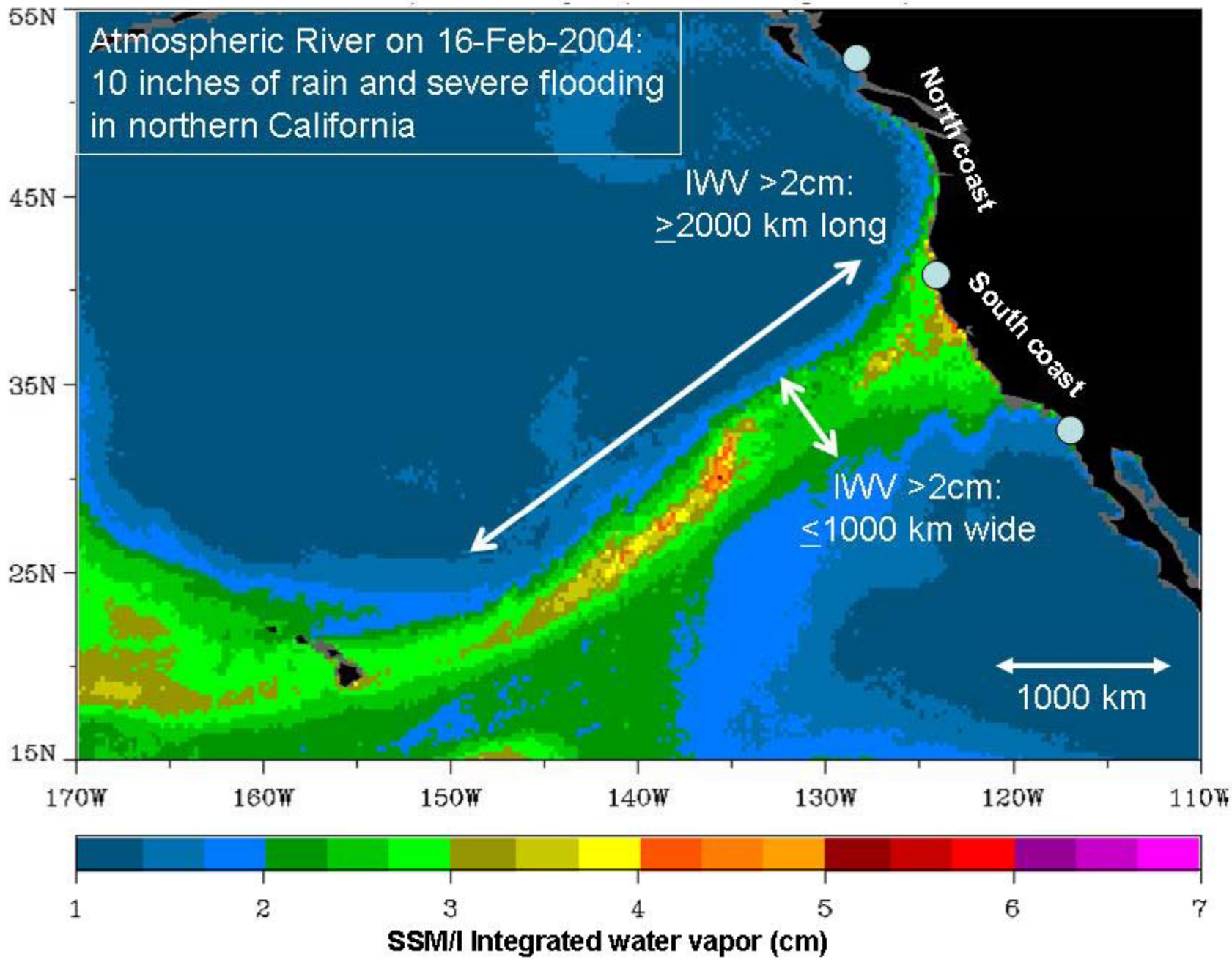
Winter Floods

- October through March “wet season”
- Atmospheric River Events
- ENSO State Matters

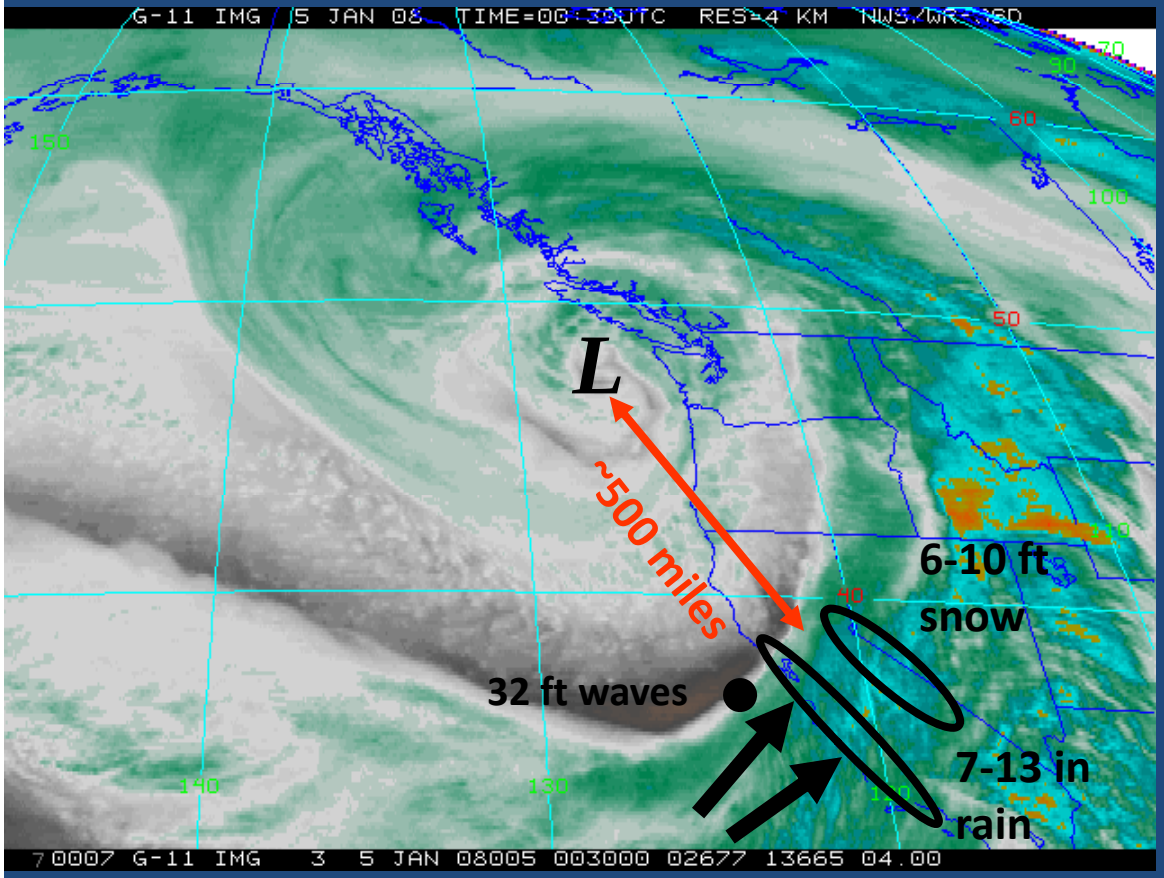
Key Phenomena Affecting California Water Supply/Flooding:



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


Atmospheric River on 16-Feb-2004:
10 inches of rain and severe flooding
in northern California
IWV >2cm:
≥2000 km long
IWV >2cm:
≤1000 km wide
North coast
South coast
1000 km
55N
45N
35N
25N
15N
170W
160W
150W
140W
130W
120W
110W
1
2
3
4
5
6
7
SSM/I Integrated water vapor (cm)

The Storm of 4-5 Jan 2008



Atmospheric river

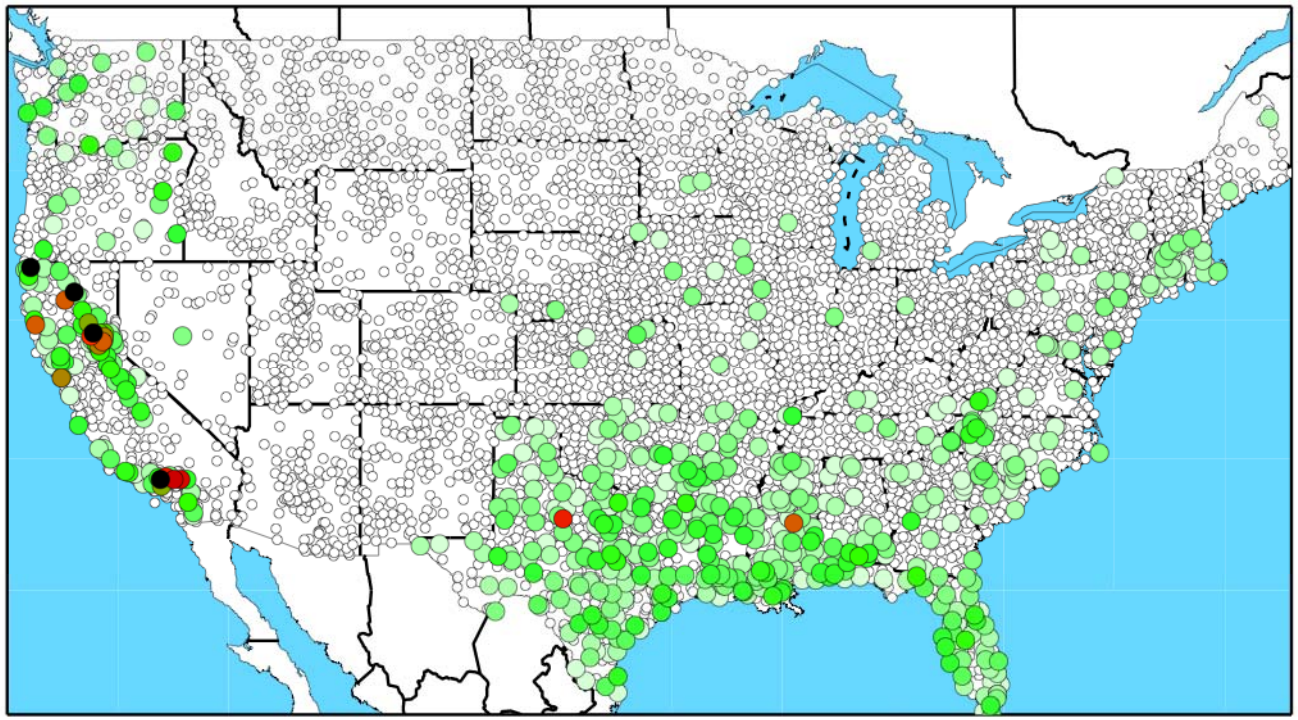
GOES IR image of major West Coast storm

- 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.

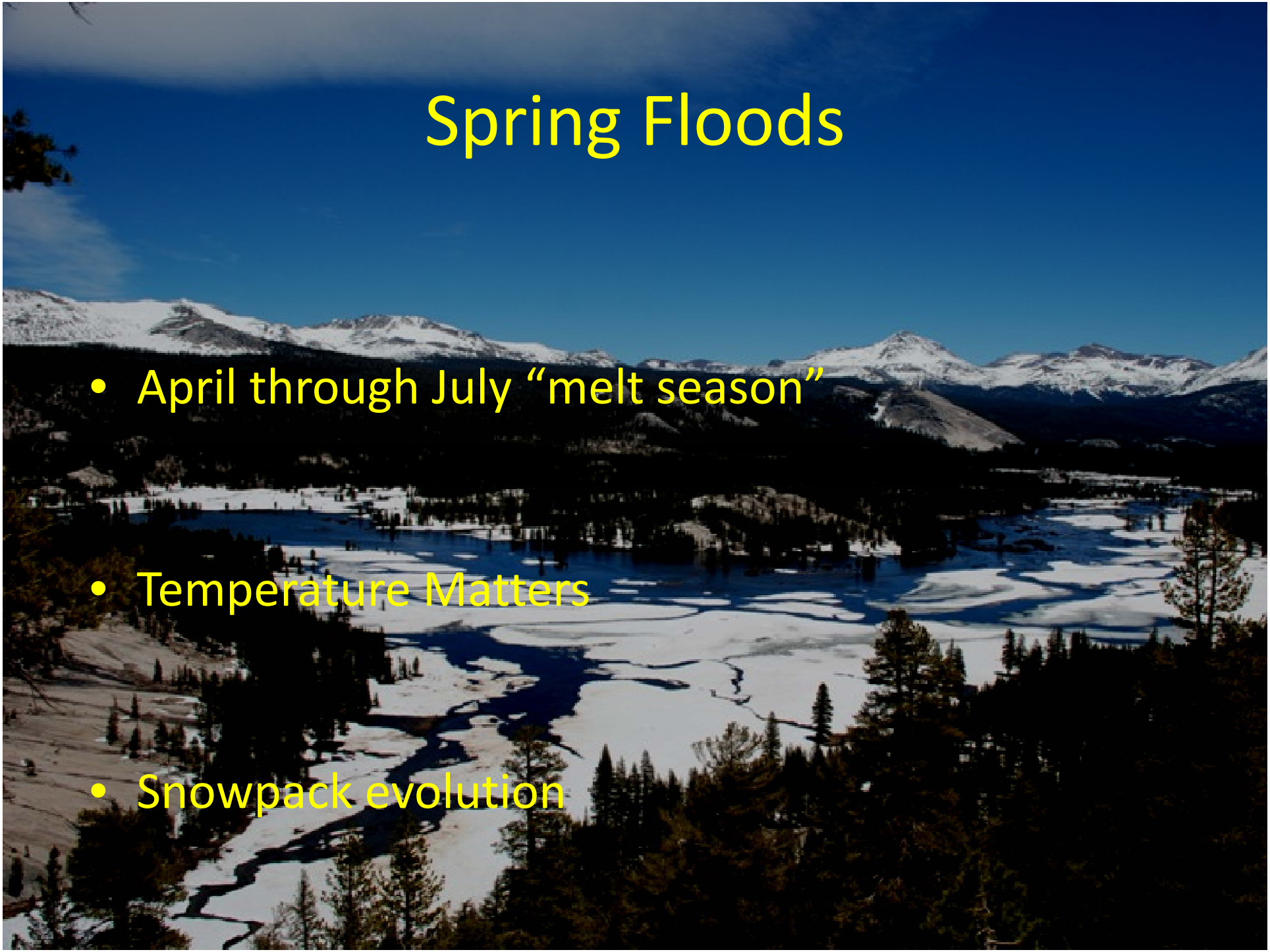
This differs significantly from hurricanes, but the impacts are enormous and spread over a large area

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.



NOTE: Expanded color bar, but more sites still qualify

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

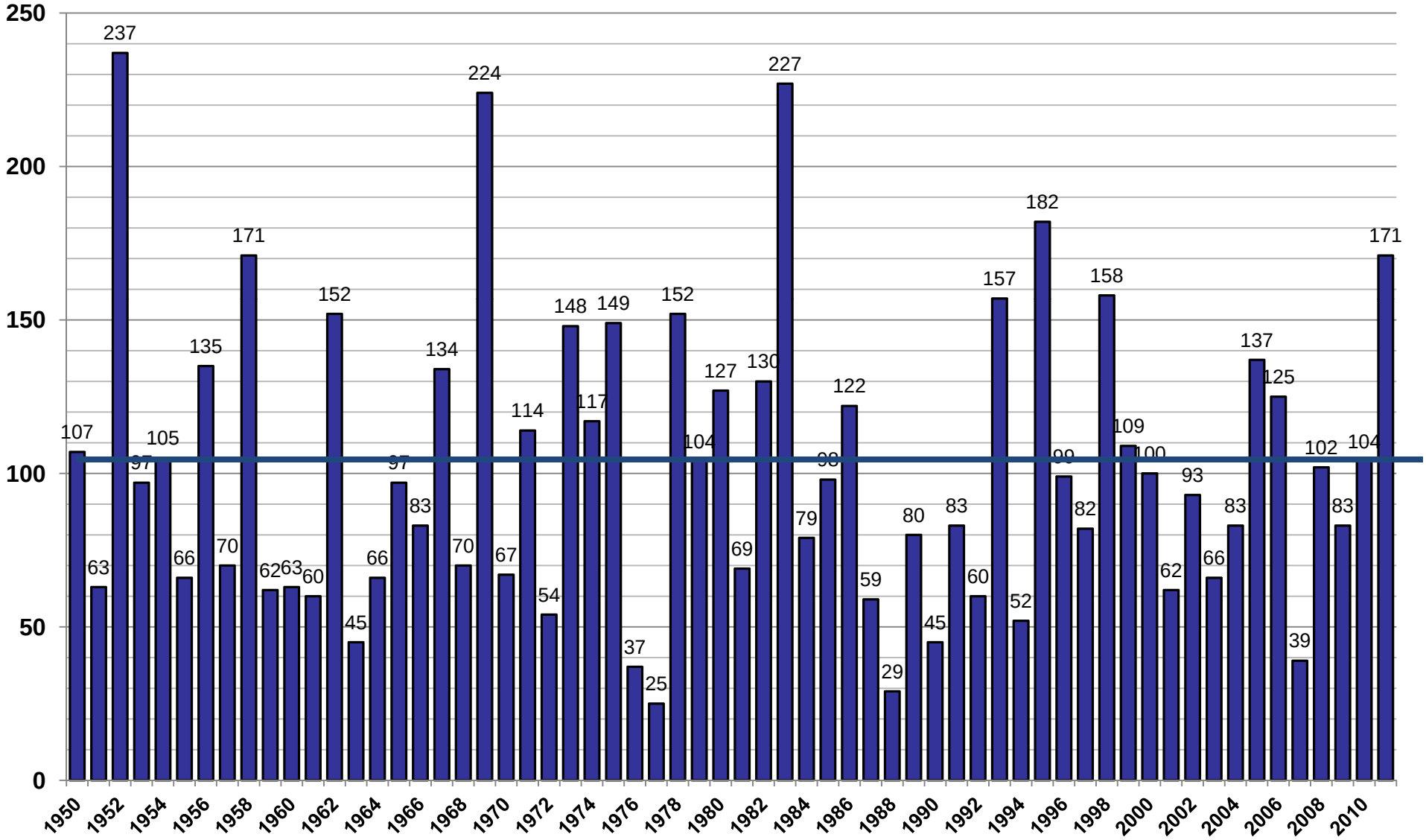


Spring Floods

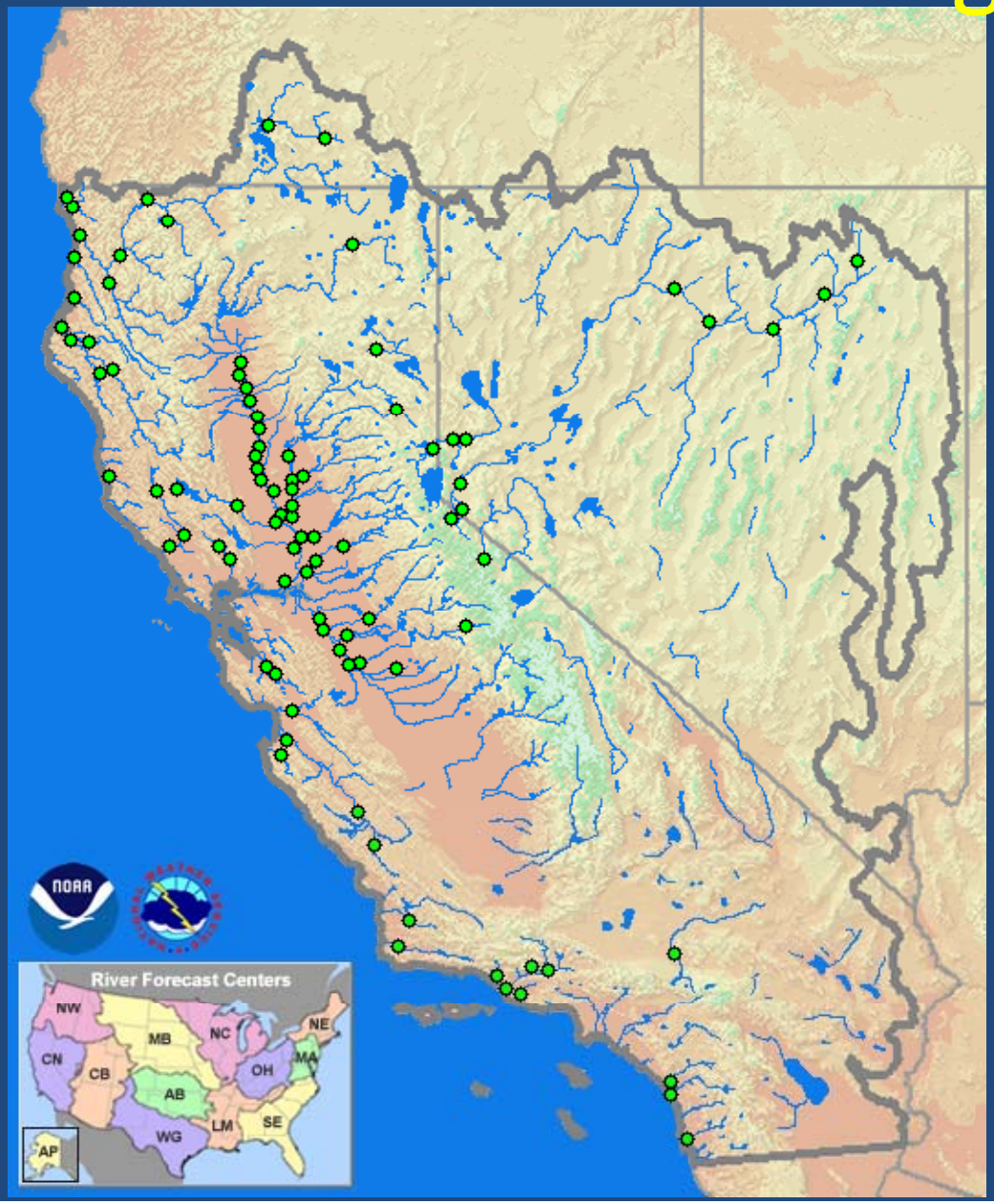
- April through July “melt season”
- Temperature Matters
- Snowpack evolution

April 1 Snowpack Water Content

Statewide Percent of Average



Flood Events and Timing



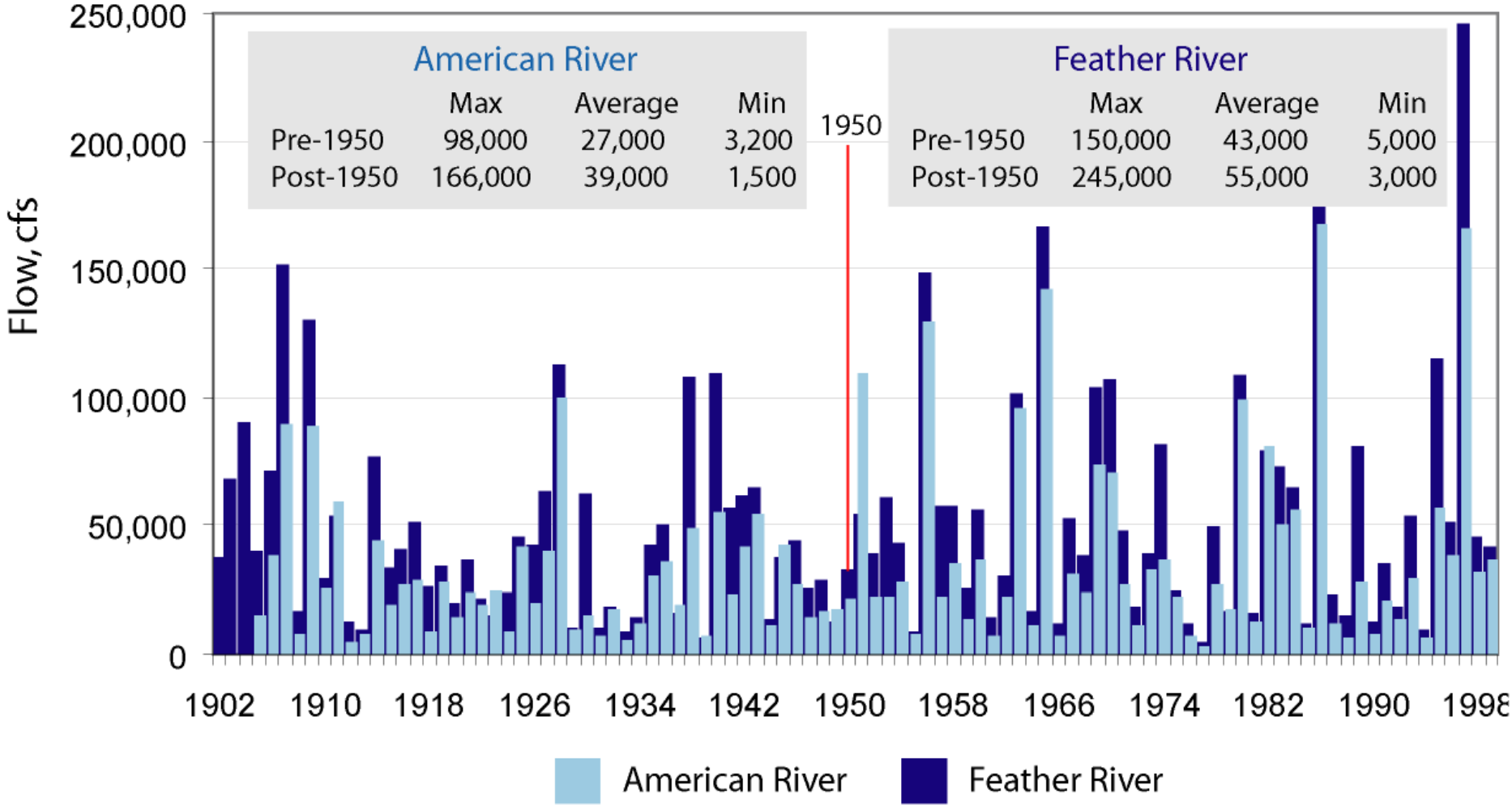
Flood Years of Note

- Dec 1851
- Jan 1862
- 1907
- 1909
- Dec 1955
- Dec 1964
- Jan 1969
- Feb 1986
- Jan 1997
- Dec 2006

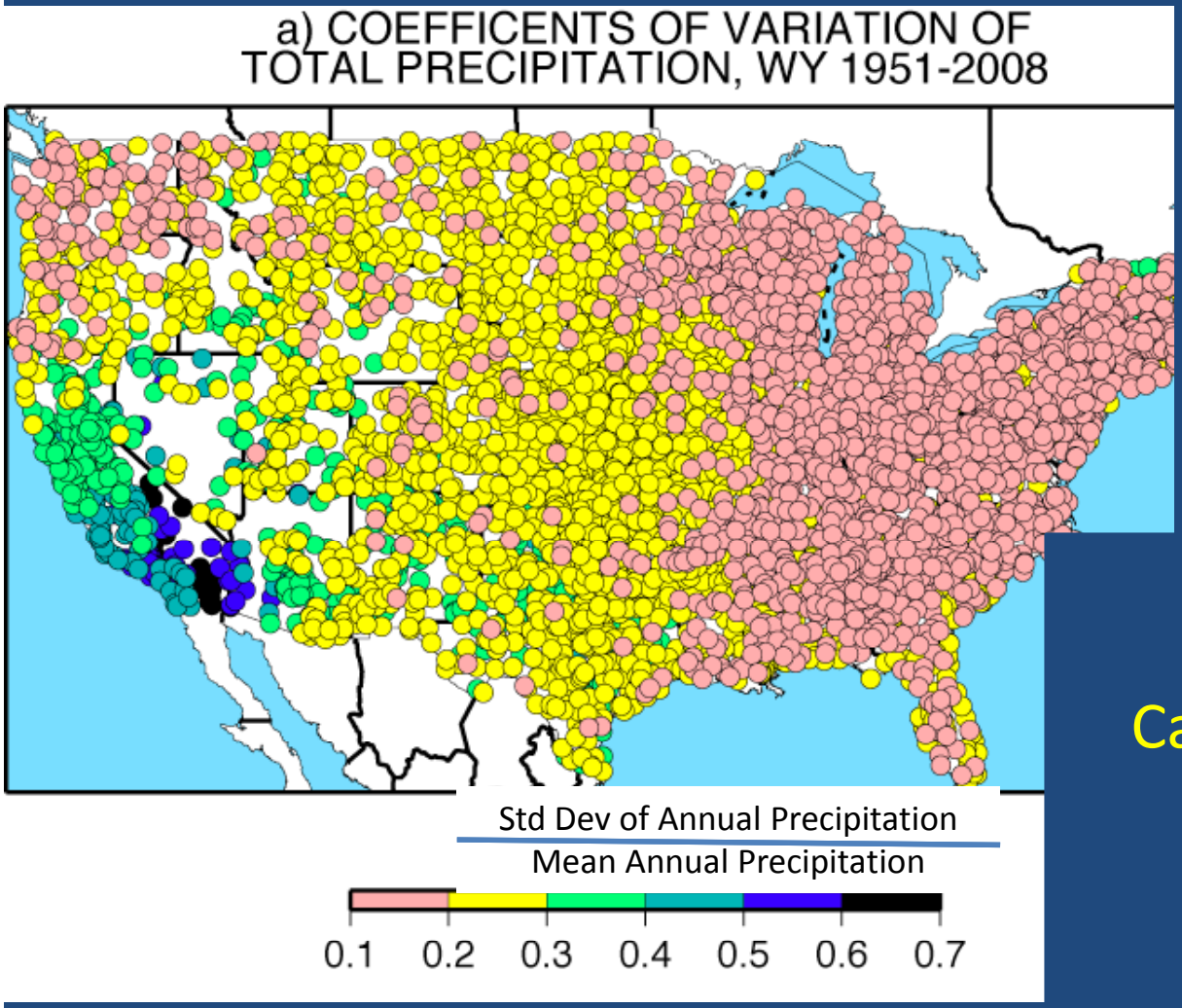
Bulletin 17B Considerations

- Infrastructure design for floods relies on the methods for estimating flood size found in the Bulletin 17B
- Key assumptions in the Bulletin 17B are independence and identically distributed needed to generate statistically relevant sample size
- Mean, Variance, and Skew are important characteristics of probability distribution
- Flood size estimates are based on historical observation – as new, larger floods are observed flood estimate size changes

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



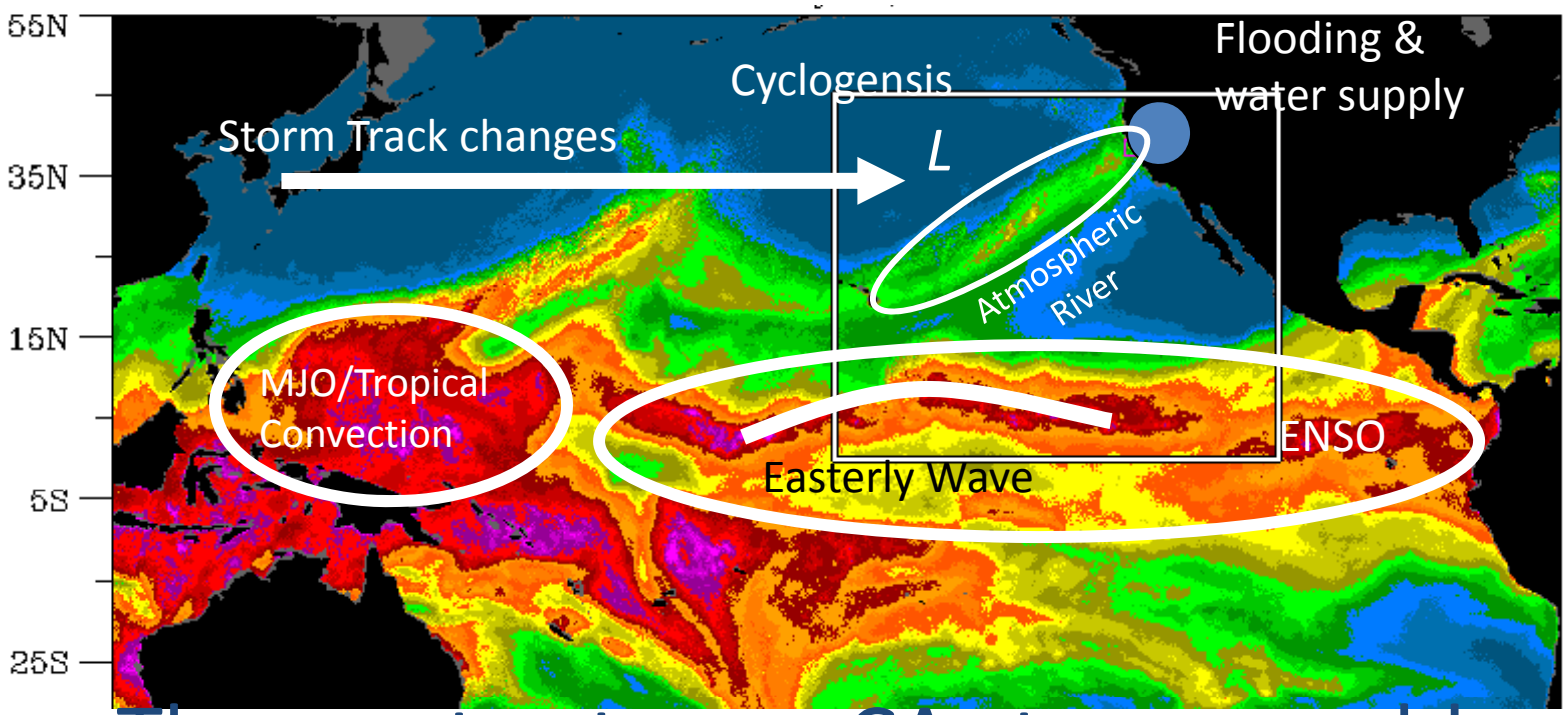
Year to Year Precipitation Variability



California precipitation is uniquely variable

Dettinger et al, 2011

Key Phenomena Affecting California Water Supply/Flooding:



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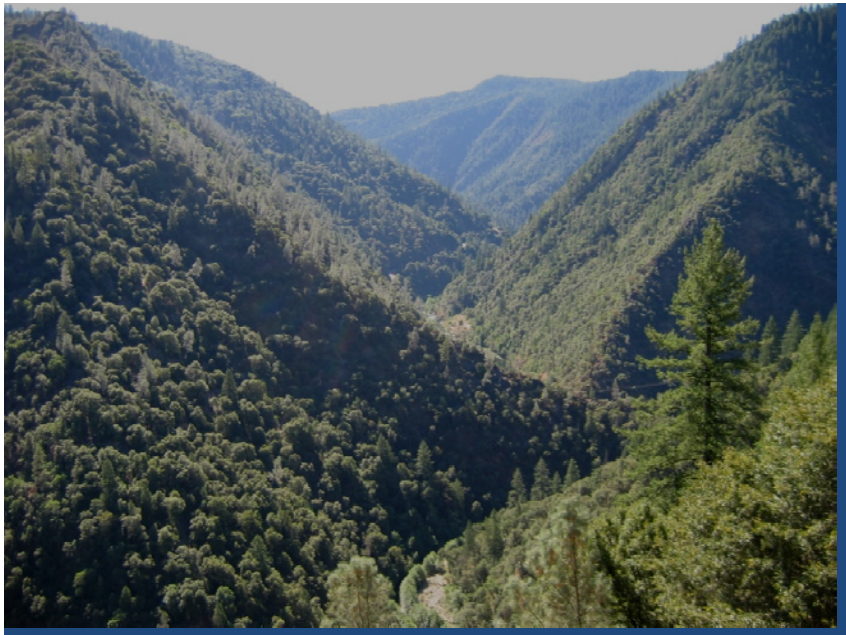
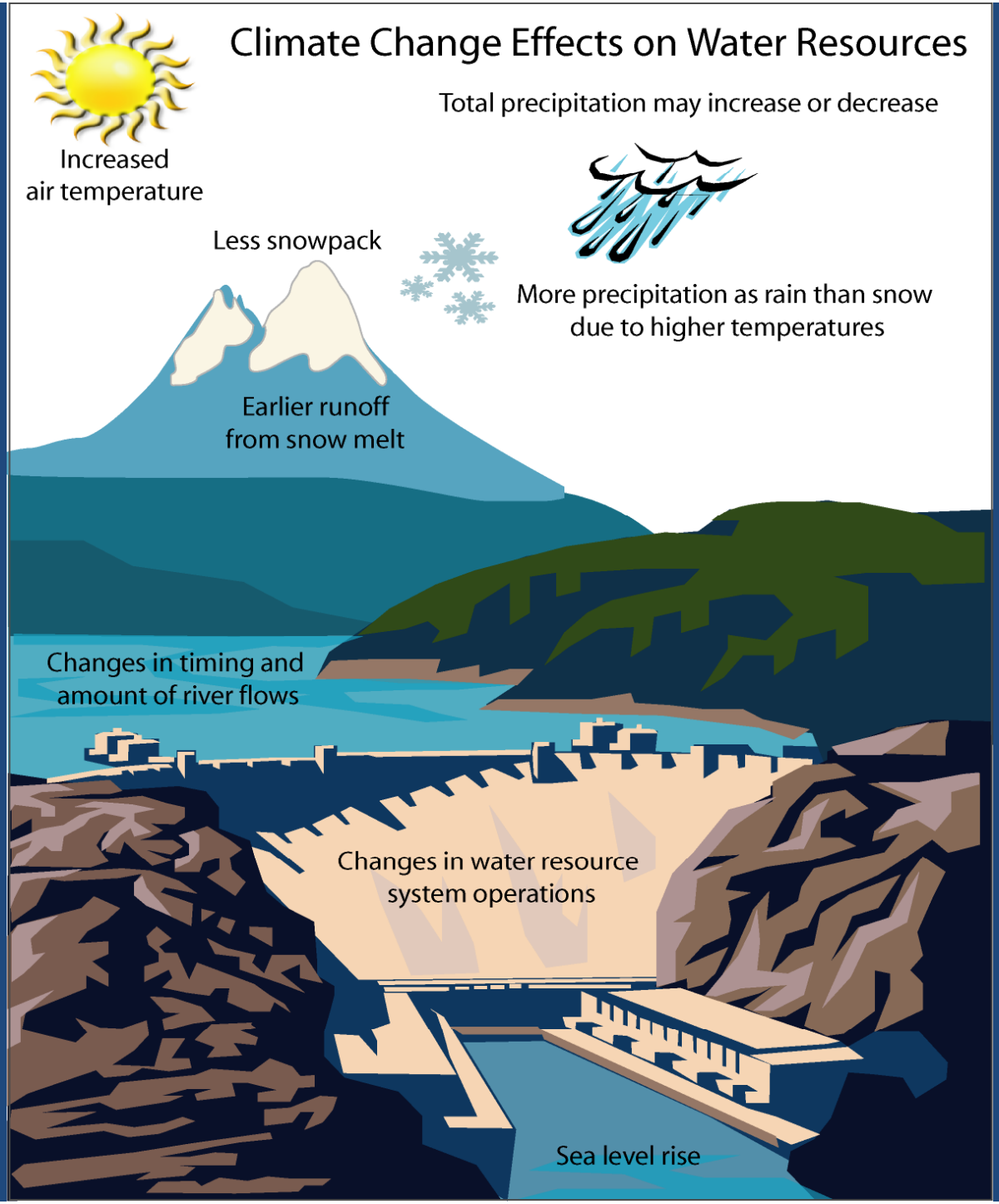


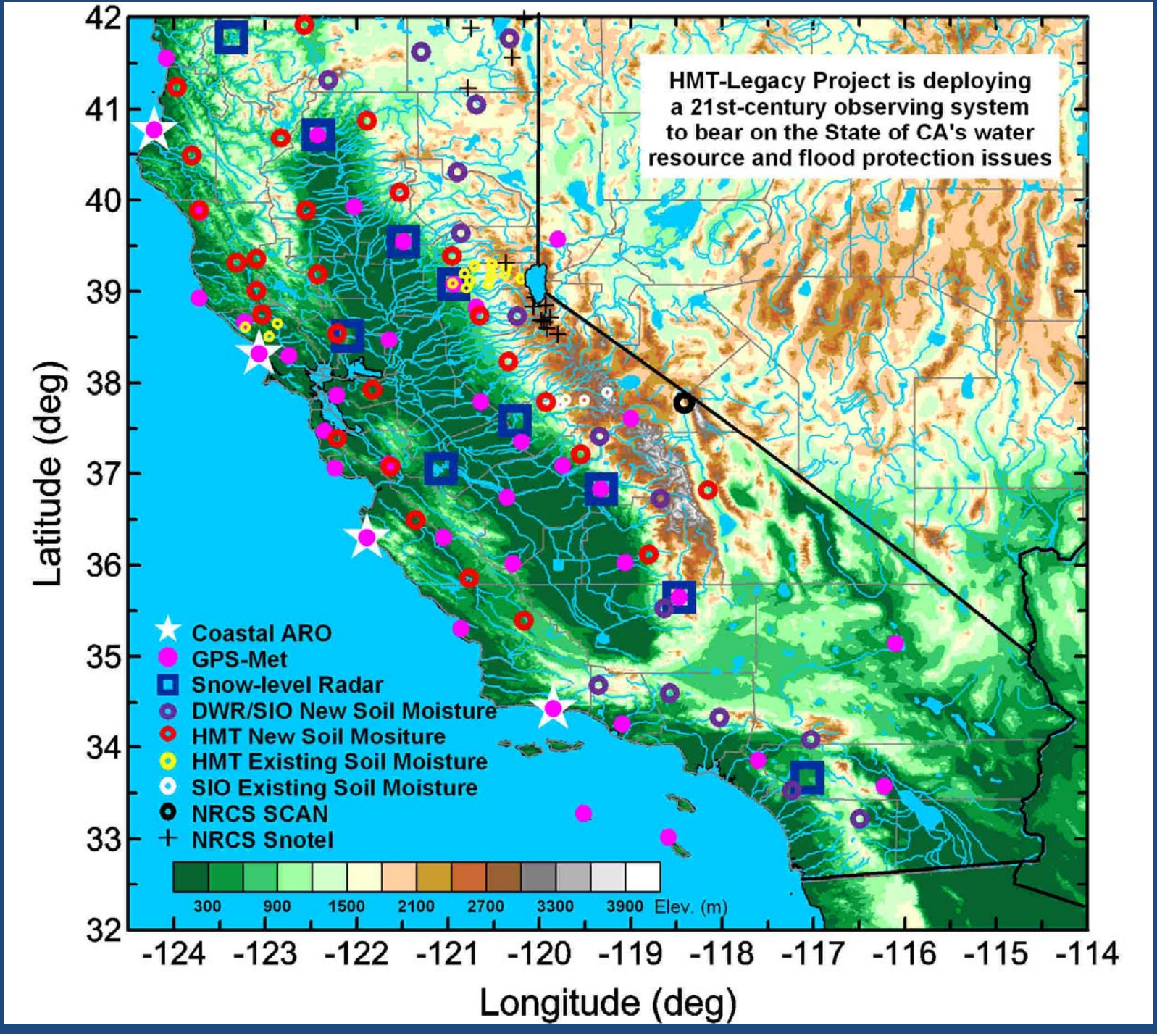
Know Your Watershed!



Slide from
Jamie Anderson
DWR- Bay Delta

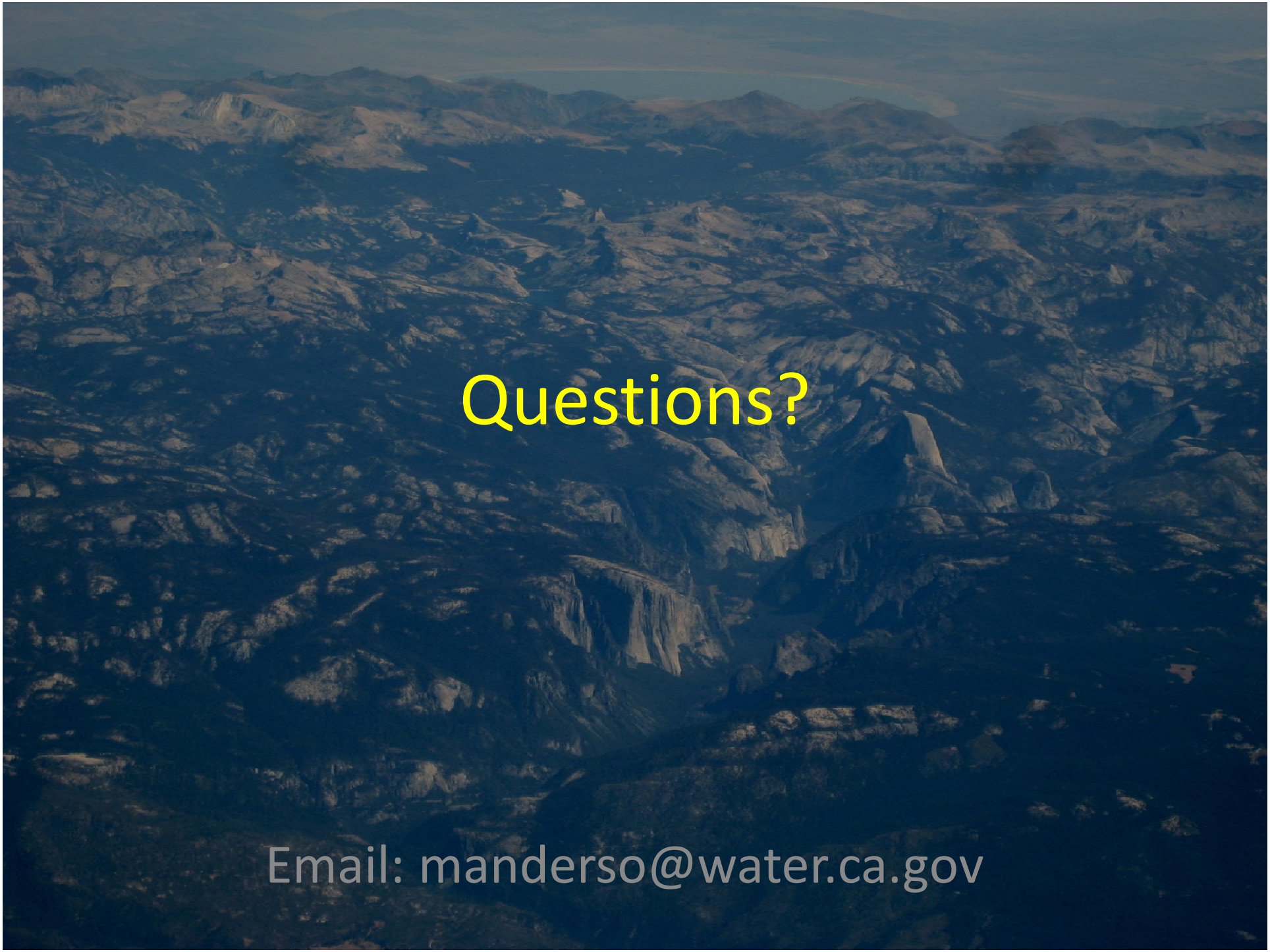
Climate Change Considerations

- How will temperature changes impact the land surface/watershed condition?
- How will atmospheric river characteristics change in a warmer atmosphere?
- How will ocean temperature and circulation patterns impact storm track formation?
- Will year to year variability increase?
- Are we observing what we should for tracking climate change?


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 winter floods
- Time and location are important
- Climate signals 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, atmosphere, and ocean



Questions?

Email: manderso@water.ca.gov