Estimating Future Floods to Manage Flood Risk

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Extreme Precipitation Symposium 2012

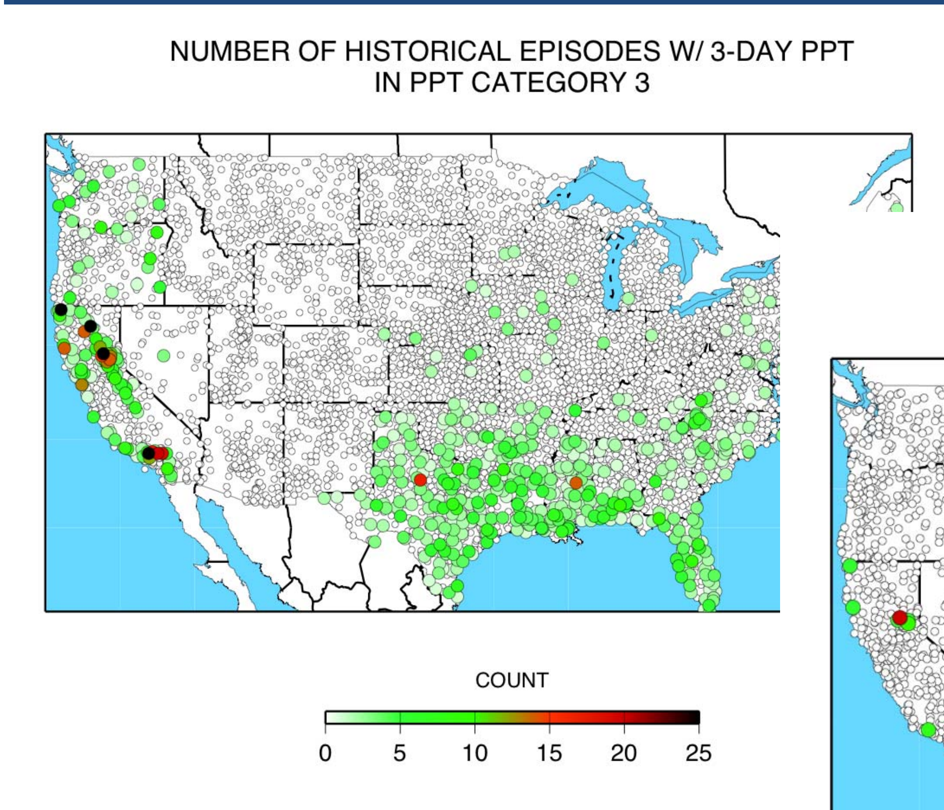
Talk Overview

- Statistics
- Physics
- Climate Change
- Flood Management and the 200-year Event
- Panel Discussion Set-Up

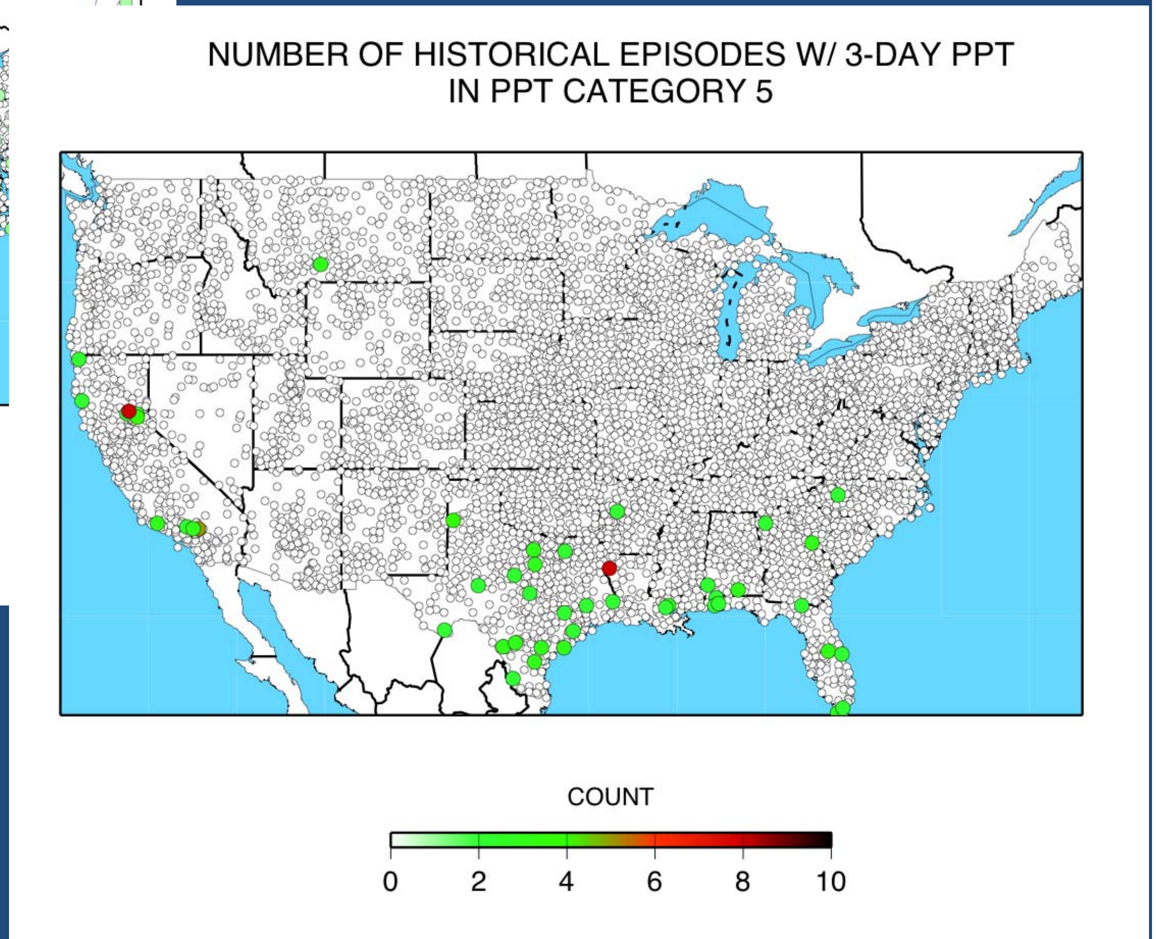
The 200-Year Event

A State mandated target threshold for flood peak and volume for a critical duration to use for flood management planning for current and future climate conditions

What does a 200-year Event Look Like?



Buck's Creek NOAA Atlas 14
200-Year 3-Day Estimate 23.5 inches
(18.4-30.6 inch 90% confidence interval

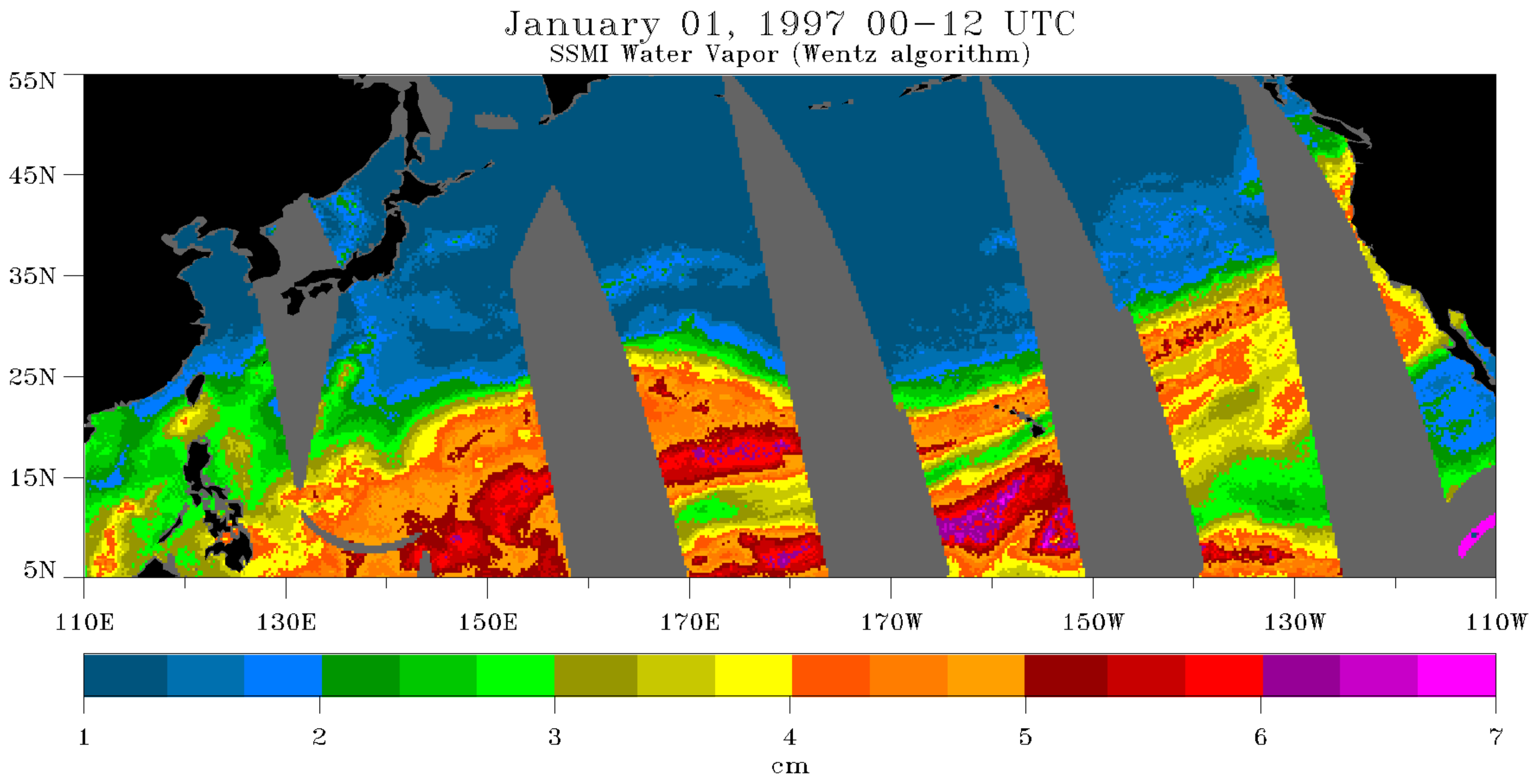


CAT 3 is > 30 cm (12 in)
in 3 days

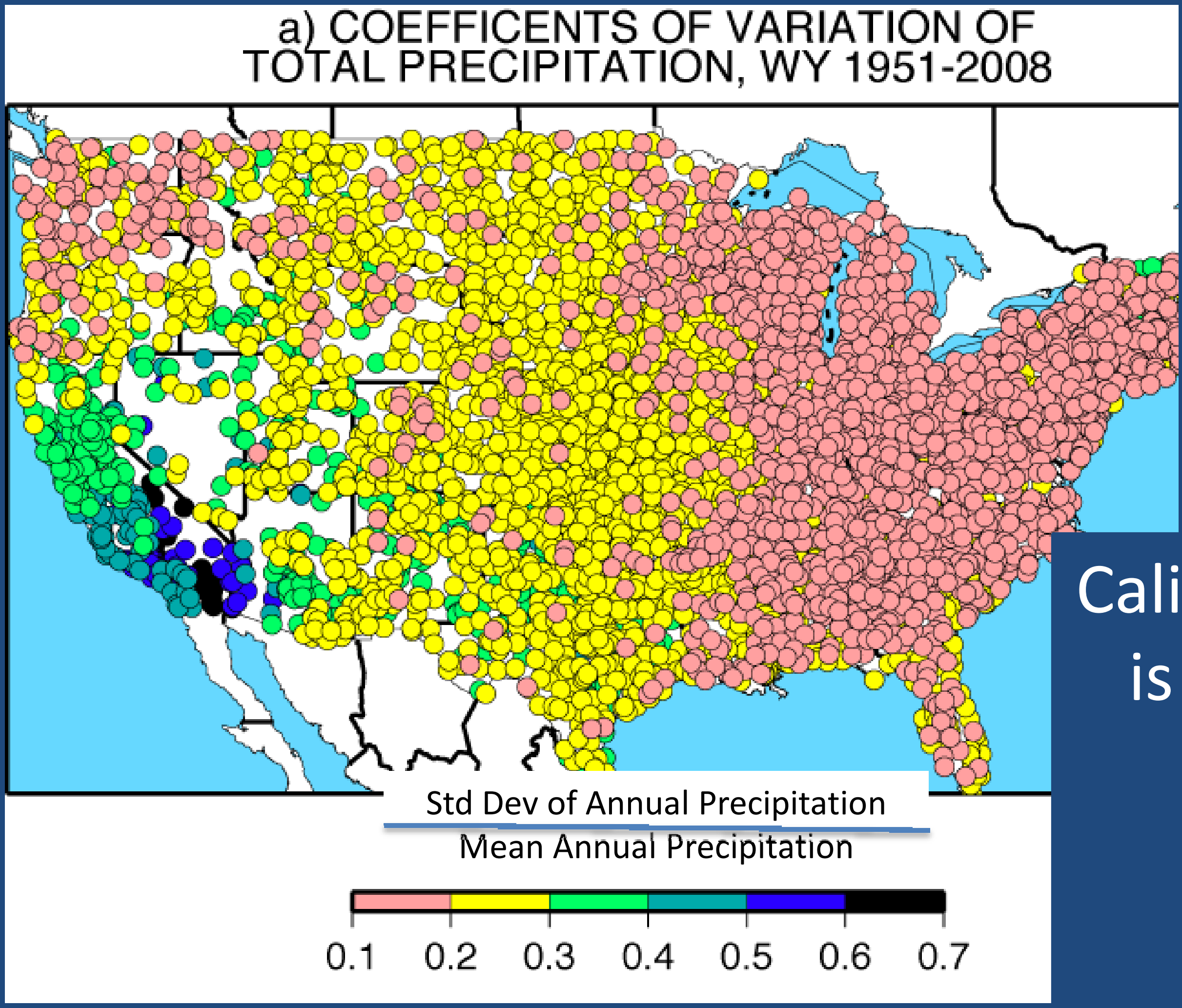
Blue Canyon NOAA Atlas 14
200-Year 3-Day Estimate: 24.4 inches
(19.1-31.9 inch 90% confidence interval)
HMR 58/59 3-Day PMP Estimate : 37.8 inches

CAT 5 is > 50 cm (20 in.) in 3 days

What does a 200-year Event Look Like?

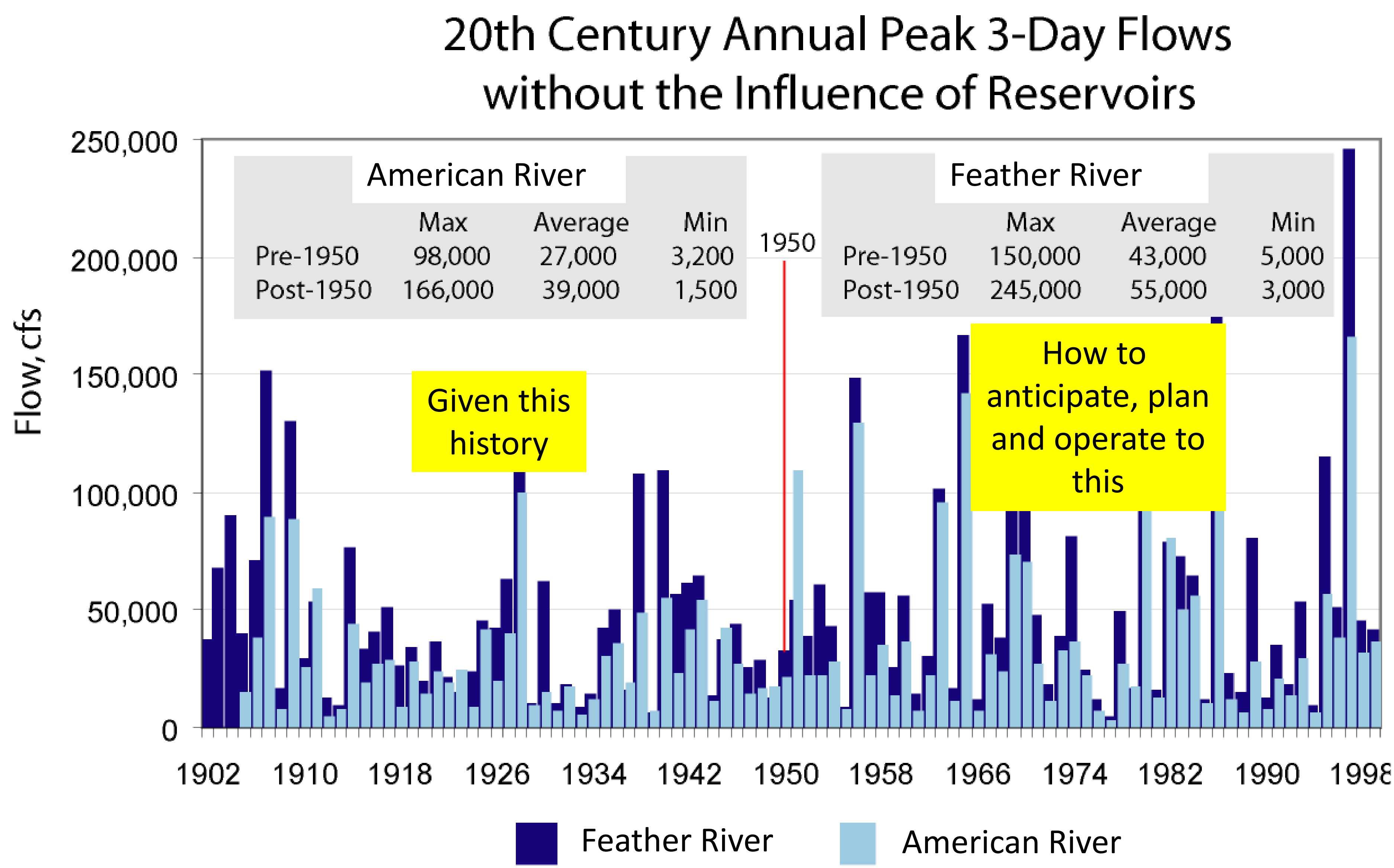


California's Wild Precipitation Regime



California precipitation is uniquely variable

Dettinger et al, 2011

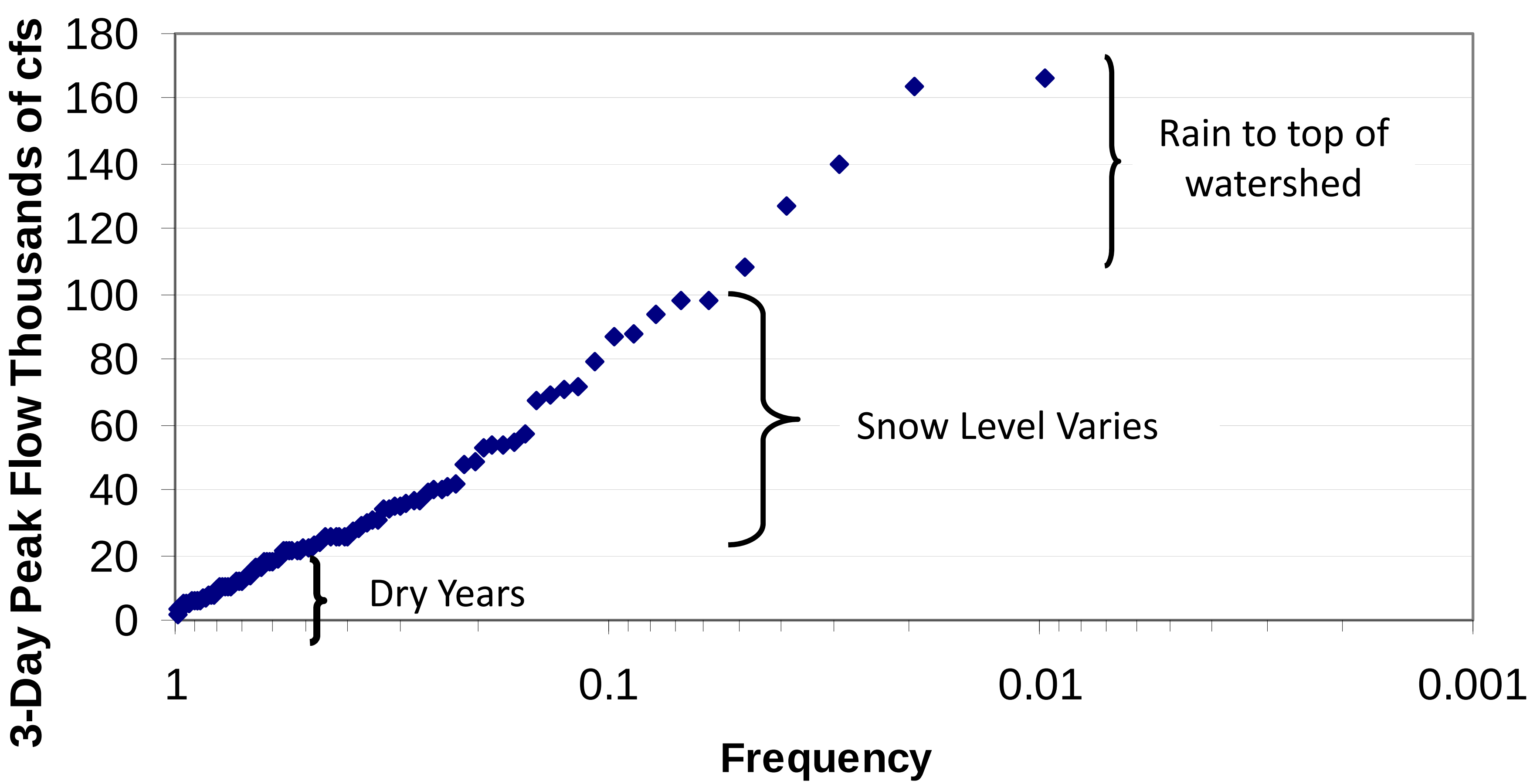

20th Century Annual Peak 3-Day Flows
without the Influence of Reservoirs
American River
Max Average Min
Pre-1950 98,000 27,000 3,200
Post-1950 166,000 39,000 1,500
Feather River
Max Average Min
Pre-1950 150,000 43,000 5,000
Post-1950 245,000 55,000 3,000
1950
Given this history
How to anticipate, plan and operate to this
Flow, cfs
250,000
200,000
150,000
100,000
50,000
0
1902 1910 1918 1926 1934 1942 1950 1958 1966 1974 1982 1990 1998
Feather River
American River

More Statistics –
3-Day Peak Flows

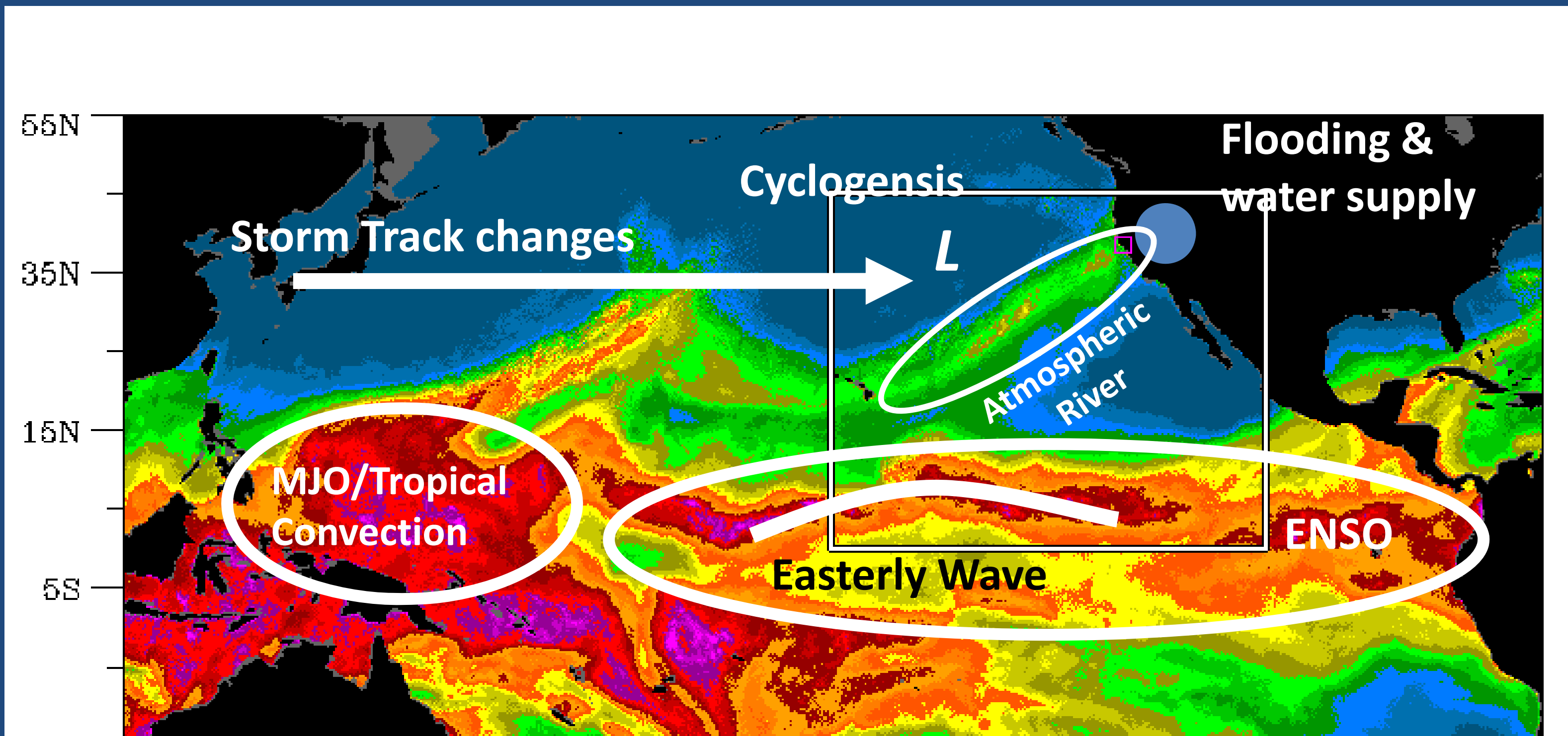
	Pre-1955			Total Period		
	Q10	Q50	Q100	Q10	Q50	Q100
American	58,002	103,569	126,185	71,937	149,980	194,349
Feather	88,380	148,413	176,040	100,752	178,094	215,266

	Extrapolation – 50 years out		
	Q10	Q50	Q100
American	89,219	217,189	299,334
Feather	114,857	213,710	263,232

Flood Frequency Curve

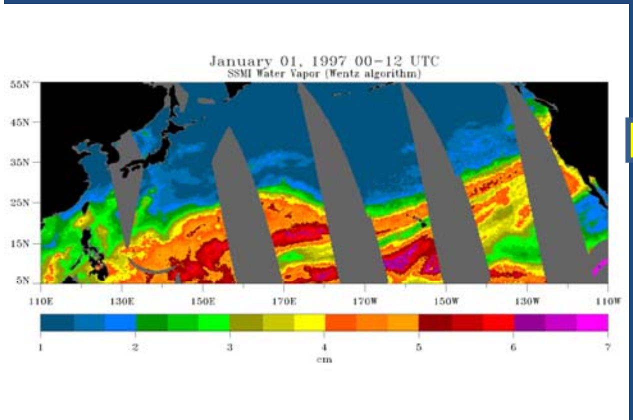


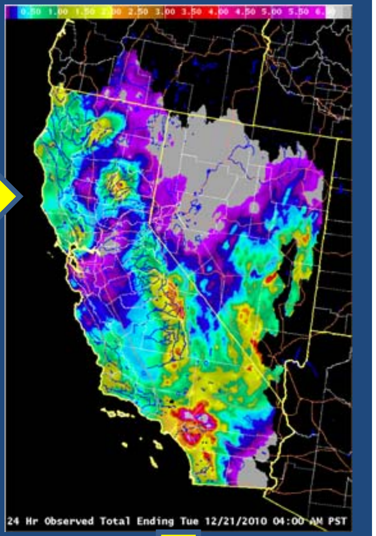
Key Phenomena Affecting California Water Supply/Flooding:



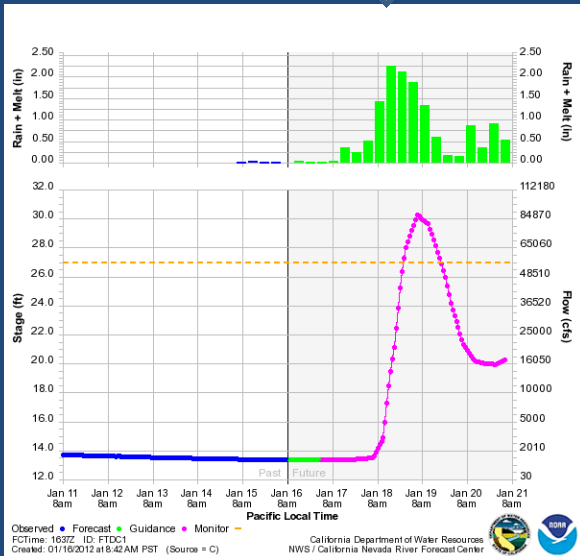
The most extreme CA storm would result from a rare alignment of key processes

From AR Flux to Runoff





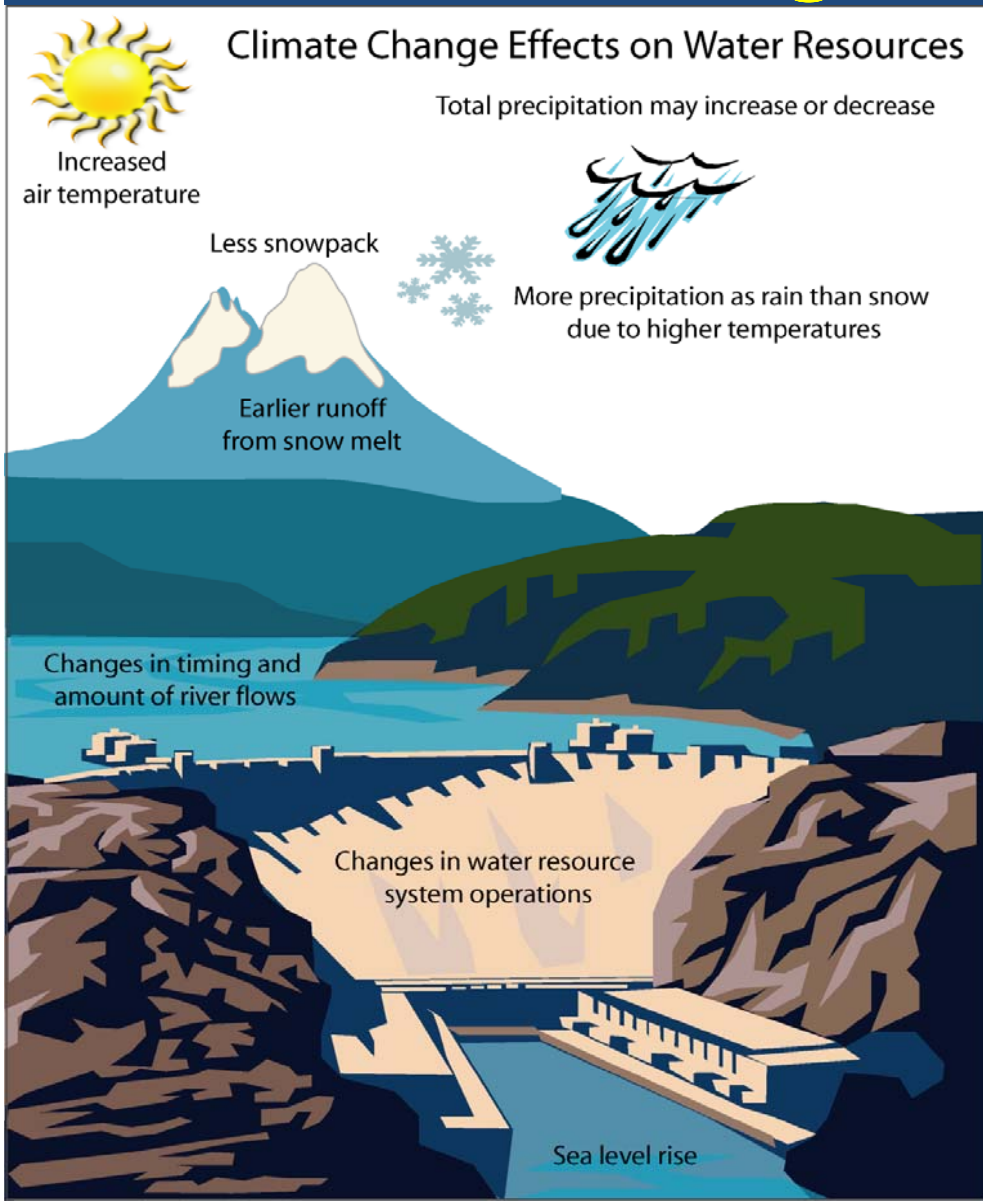
How does a flux of moisture impacting a watershed translate
Into a runoff hydrograph?

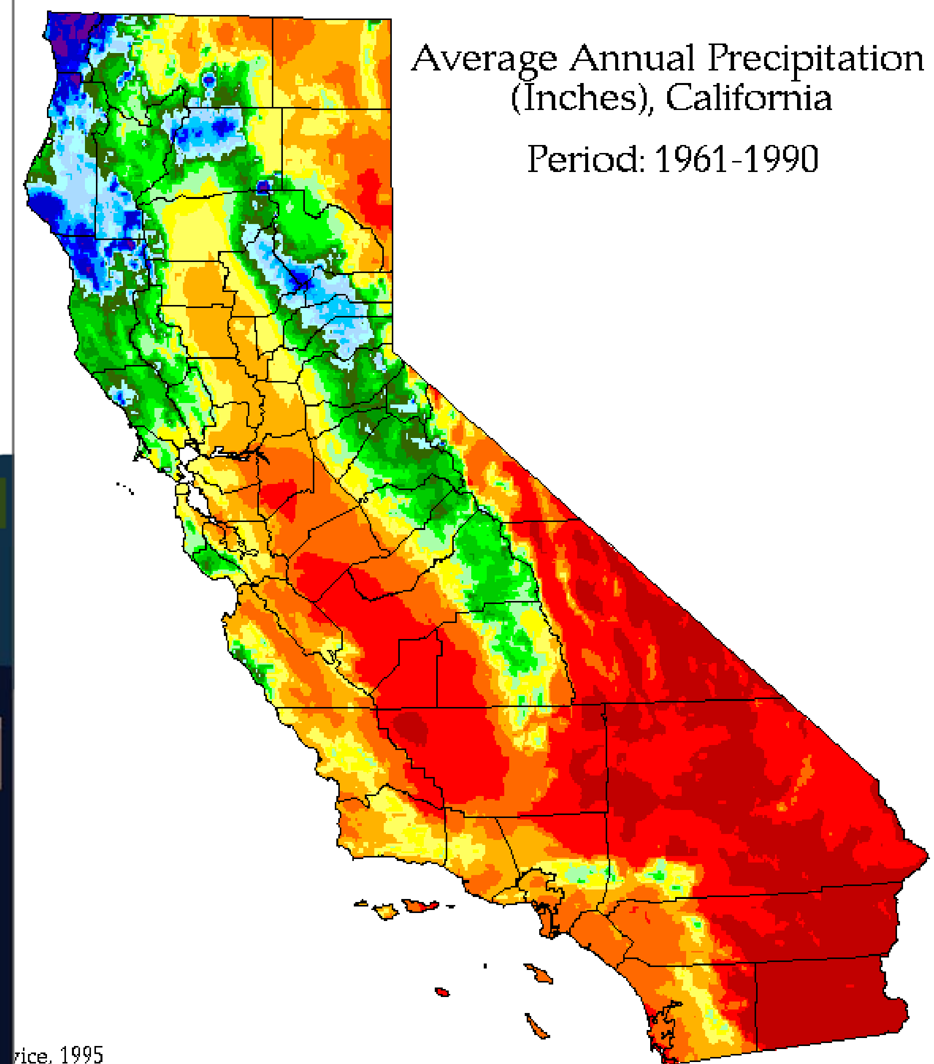


Physical Boundaries

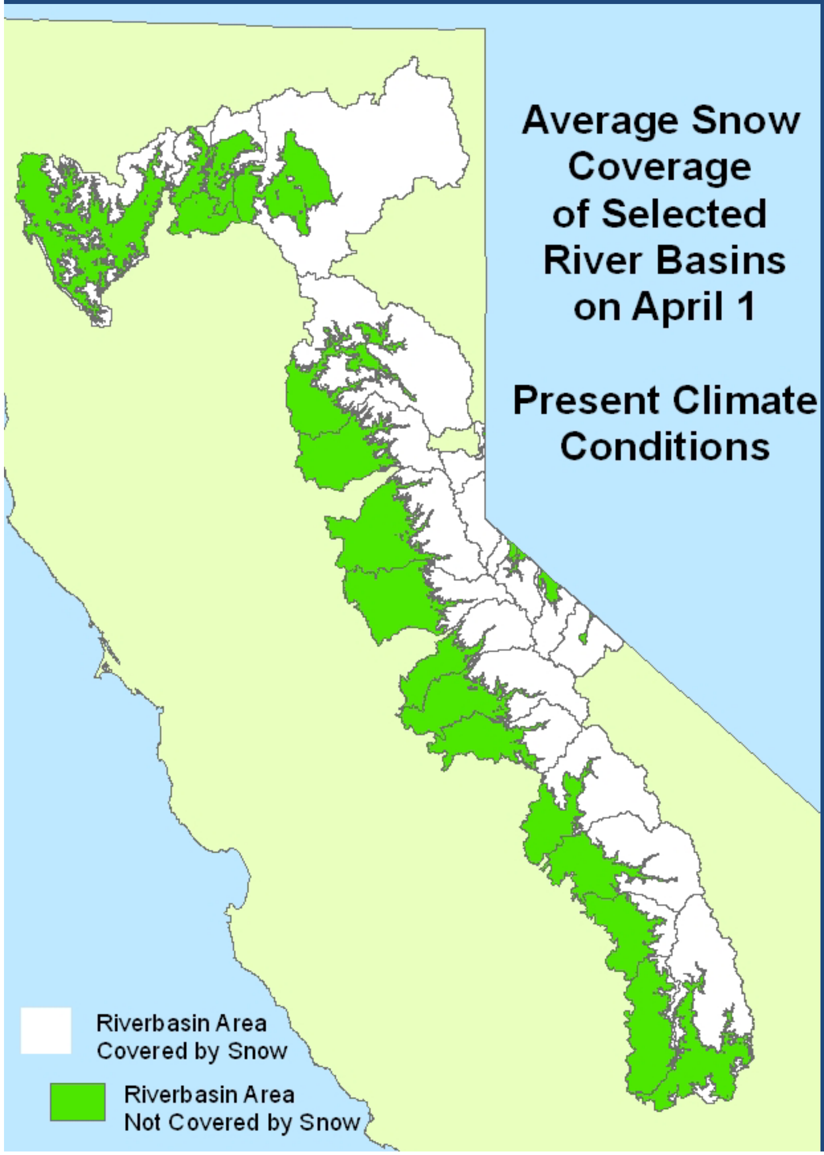
- Watershed Size and Elevation
- Atmospheric River Event Duration
- Atmospheric River Flux Limits
- Limits on Flux to Precipitation Conversion Process

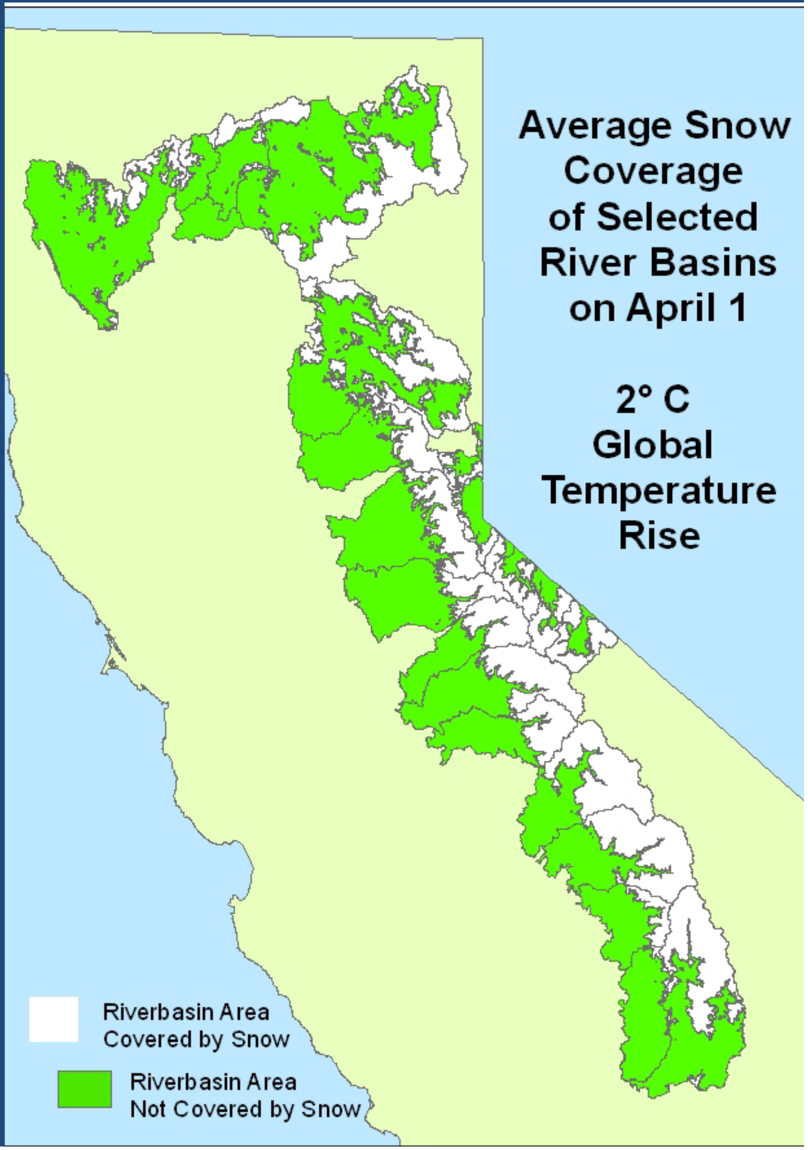
Climate Change and CA Hydrology



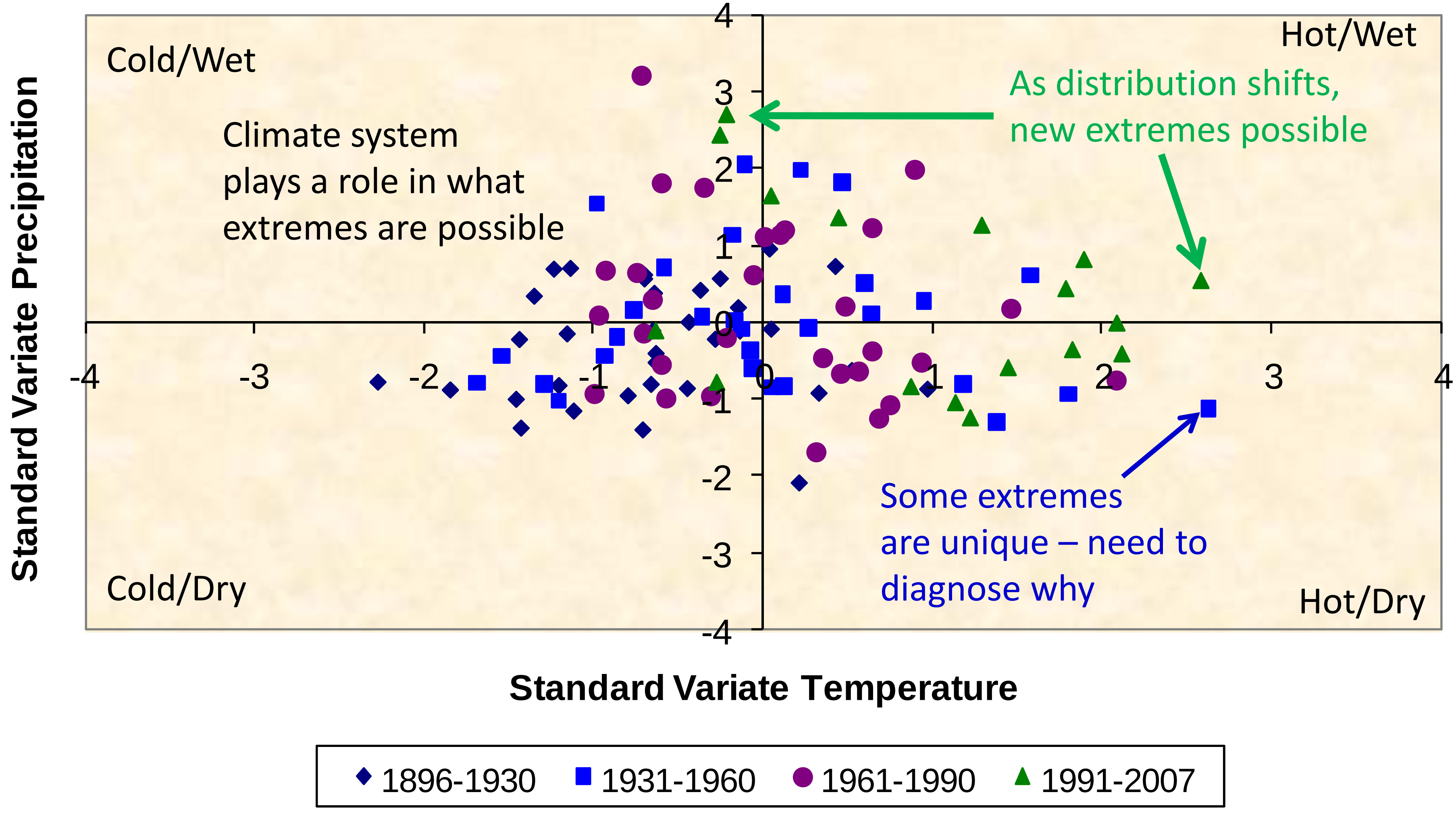


Climate Change and CA Hydrology – Snow Lines

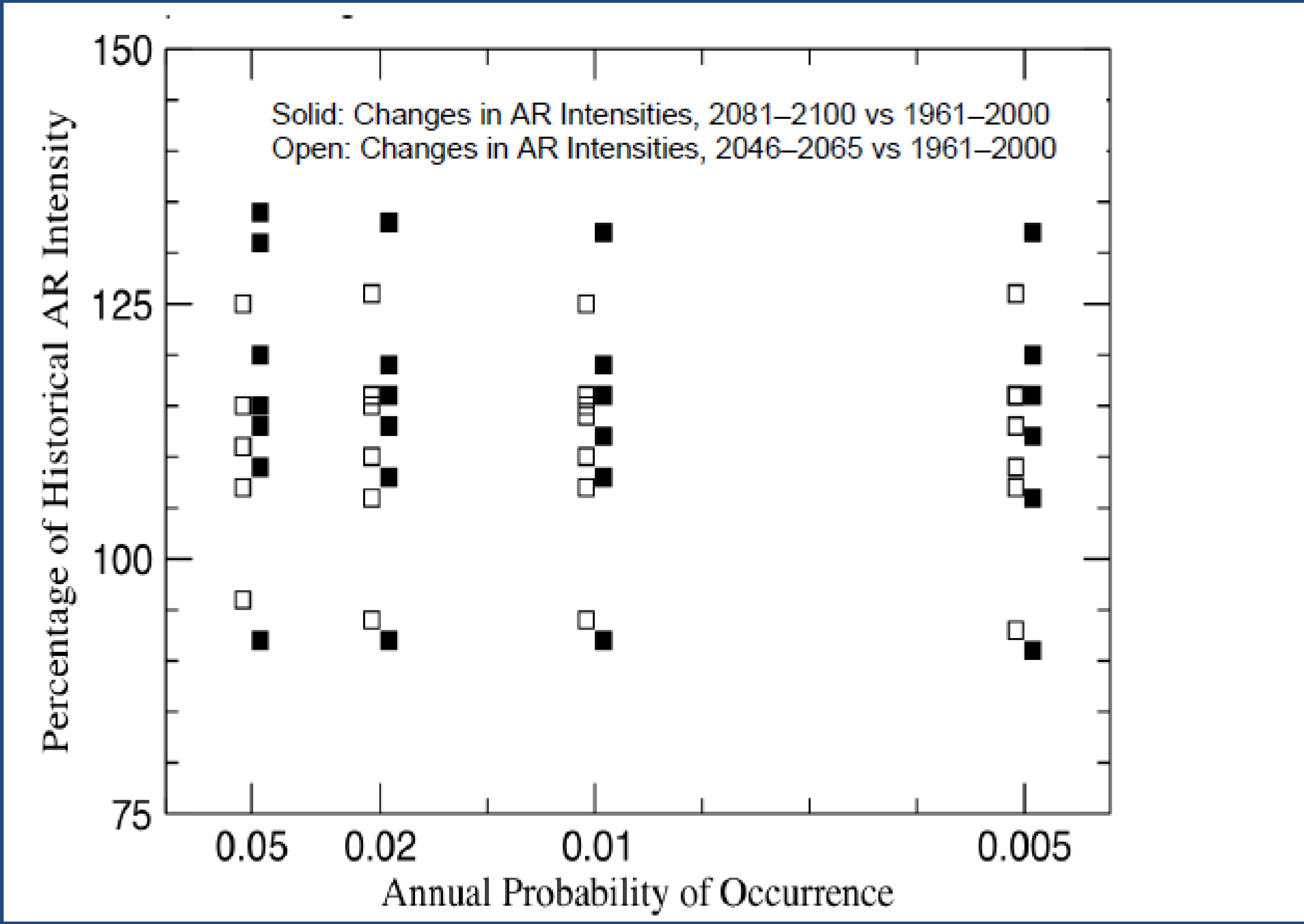




Precipitation/Temperature Distribution Plot

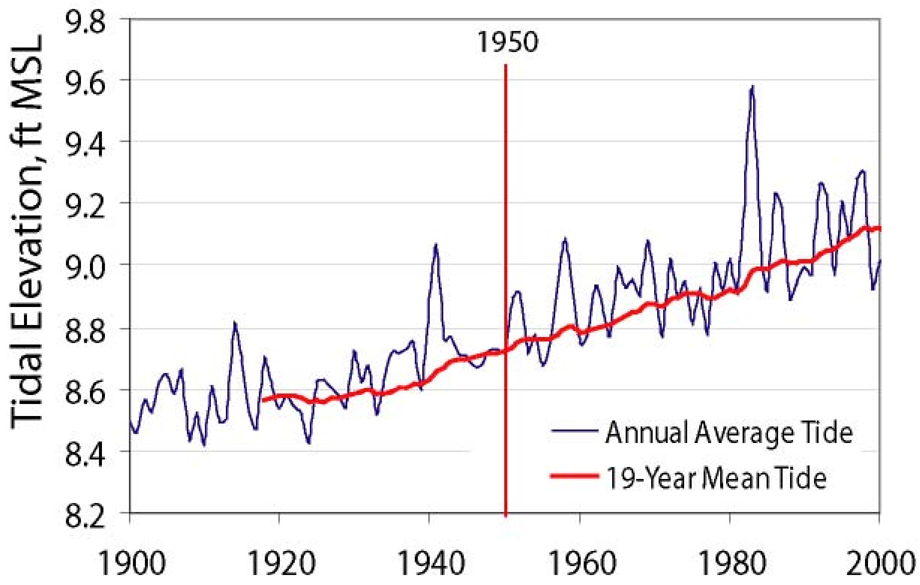


Climate Change and AR Flux

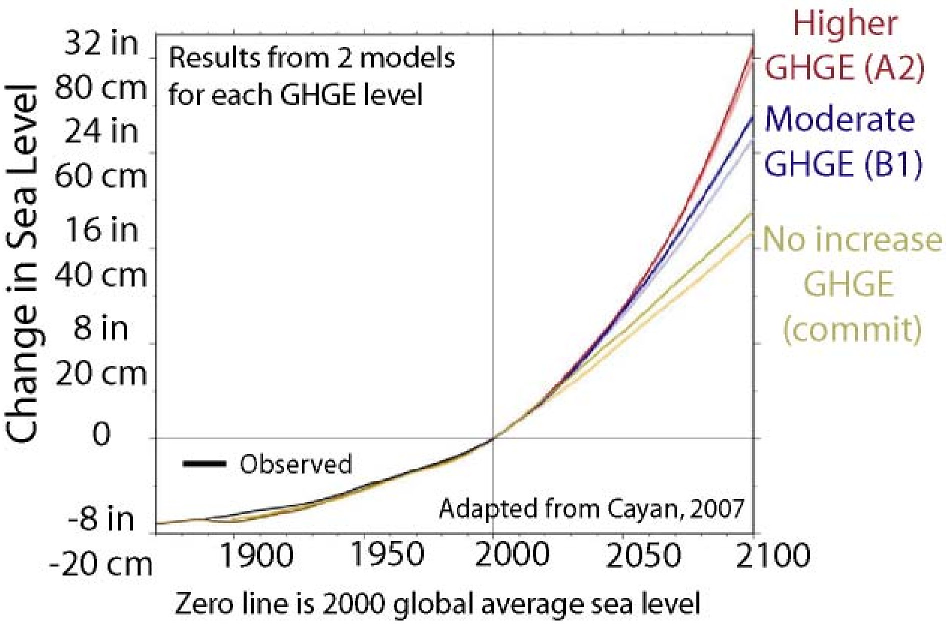


Sea Level Rise

20th Century Tidal Elevations at Golden Gate



Historic and Projected Global Sea Level Rise



Changes in 19-yr Trend

	Total Rise	Rate of Rise
Pre-1950	1.9 in	0.060 in/yr
Post-1950	4.6 in	0.095 in/yr

Abbreviations:
GHGE=Green House Gas Emissions
MSL=Mean Sea Level

Managing Floods and the 200-year Event

Components of Managing Floods

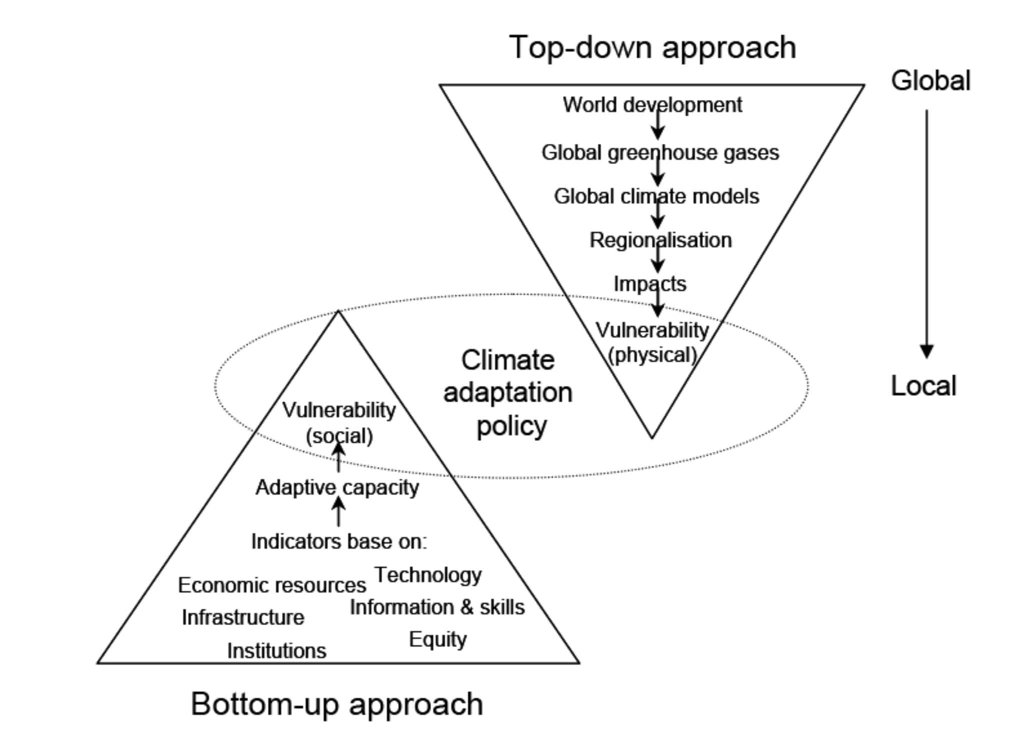
- Monitoring Networks
- Reservoirs – Designated Flood Storage and Incidental Flood Space
- Levees
- Control Structures/Urban Drainage
- O&M Considerations
- Critical Event Duration Determination

Climate Change and Flood Planning

Flood	Component Type: Structural	Component Type: Non-Structural	Example of Climate Change Impact
Monitoring Network		✓	Data Collection in Wrong Place
Reservoirs	✓	✓	Increased Uncertainity in Inflow Forecasts
Levee System	✓		Water Heights & Volume (Stress) Different Than Design
Weirs & Control Gates	✓		Water Heights & Volume (Stress) Different Than Design
Flood Bypasses & Diversion Canals	✓		Innudation Arrival & Duration Times Different
Sediment & Debris Control	✓		Increased Flow Volume Transports More Material
Maintenance, Evaluation, & Repair Programs		✓	Old Data Not Represenative of Future Trends & Reliability

Threshold Analysis Approach

- Combination of approaches
- Begin with a "Bottom-up" approach – Vulnerability assessment at critical system thresholds
- Work at Developing "Top-down" approach to define physical conditions for flood event



Source: Dessai and Hulme, 2003

Developing a Strategy

- Identify target flood peak, volume, and duration
- Identify critical thresholds
- Identify timing of transition points
- Identify adaptive capacity
- Identify capital investments needed for present and future conditions

Adaptive Management for a Changing Climate

- Planning Process and Policy
- Monitoring Change
- Thresholds, Timing, and Transitions
- What About Forecasts?

UNCERTAINTY

Climate Projections

Converting GCM data to watershed scales and event runoff

Water cycle changes

$$$$

Ecosystem response

Future Mandates

Future Watershed Conditions

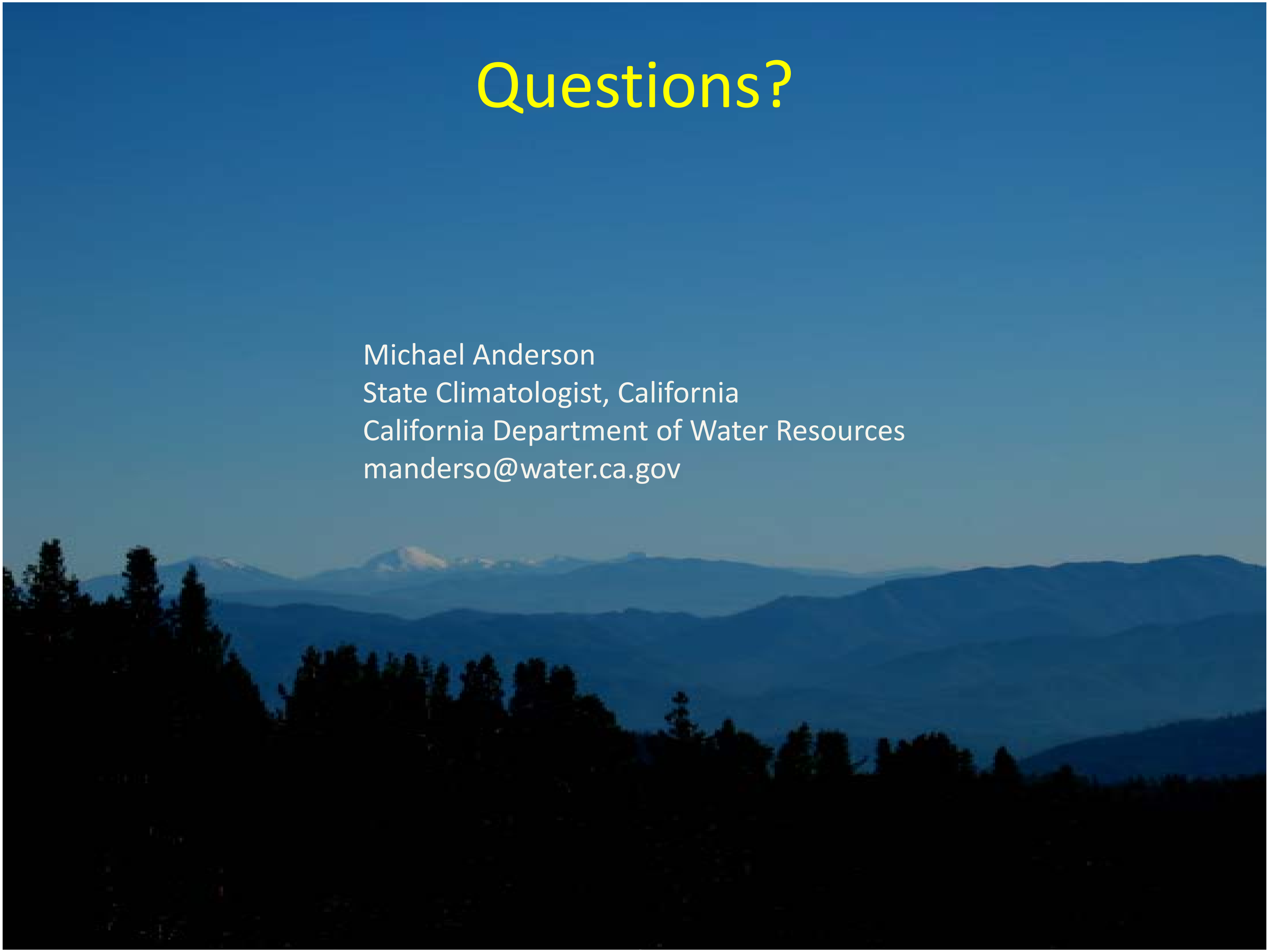
Adaptation Strategies

Sea level rise

Changes in societal values

Panel Discussion

- What information is available/needed?
- What are important knowledge gaps?
- What are challenges to adapting existing methods?
- What is missing from the discussion?


Questions?
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