Climate Change Impacts
~ Delta Hydrology ~

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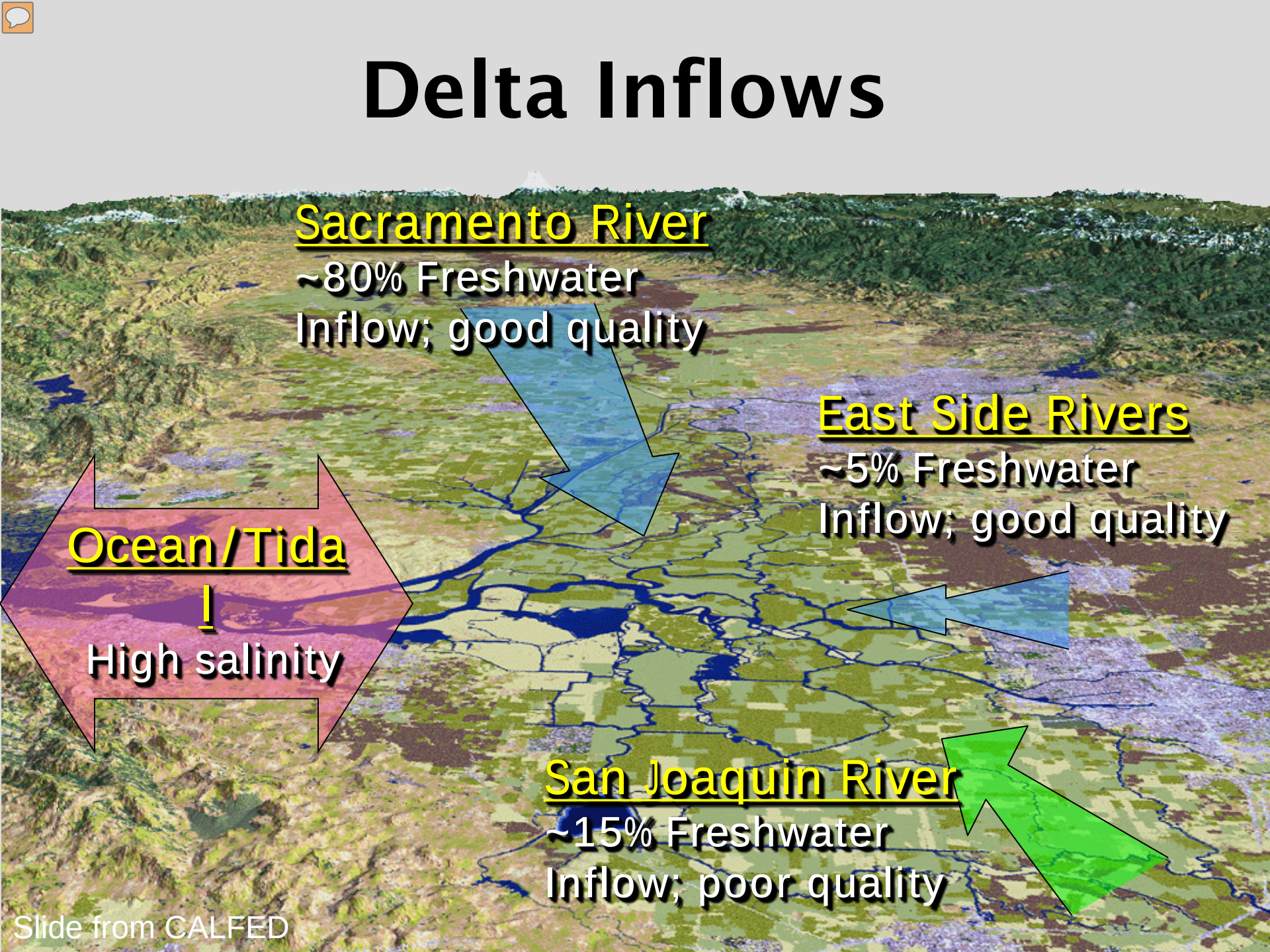
Overview

- Delta Hydrology
- Climate Change Projections
- Potential Impacts
- Take Home

Delta Hydrology

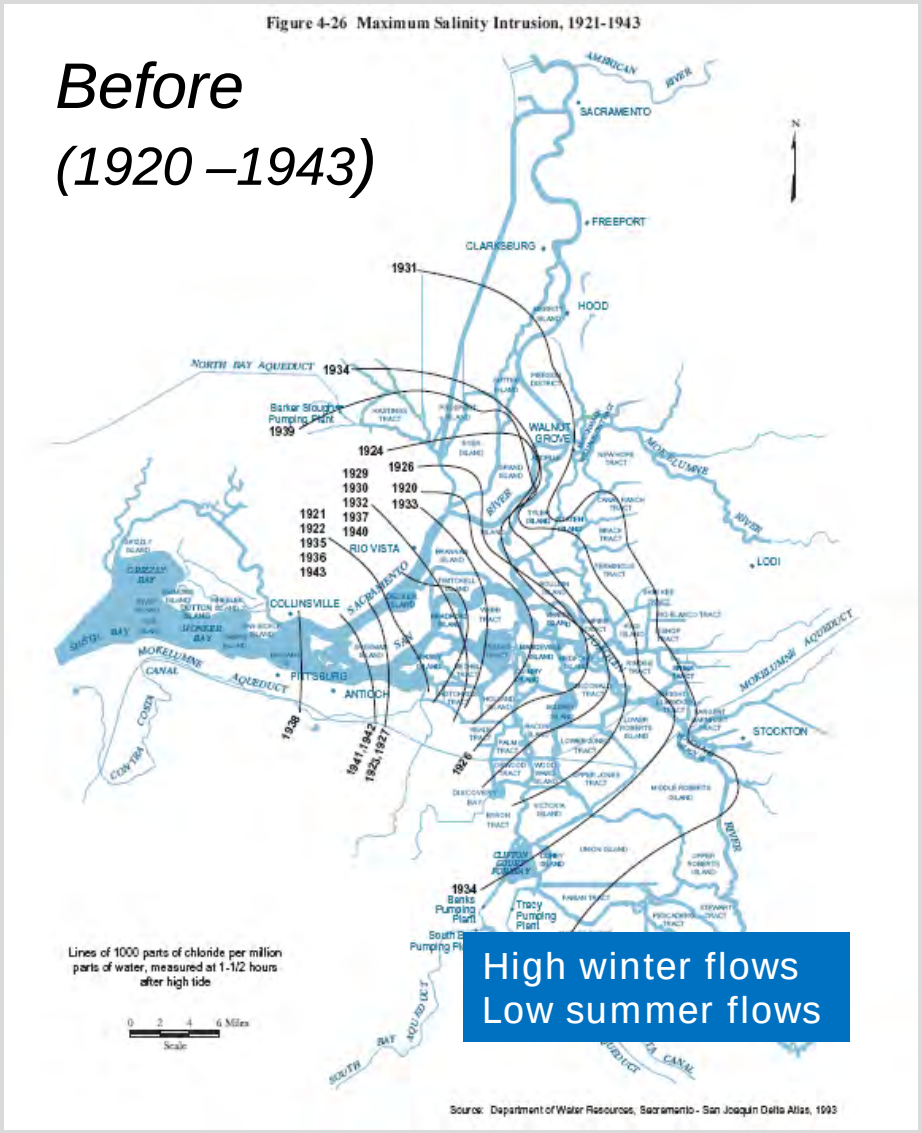
Delta Inflows



Slide from CALFED

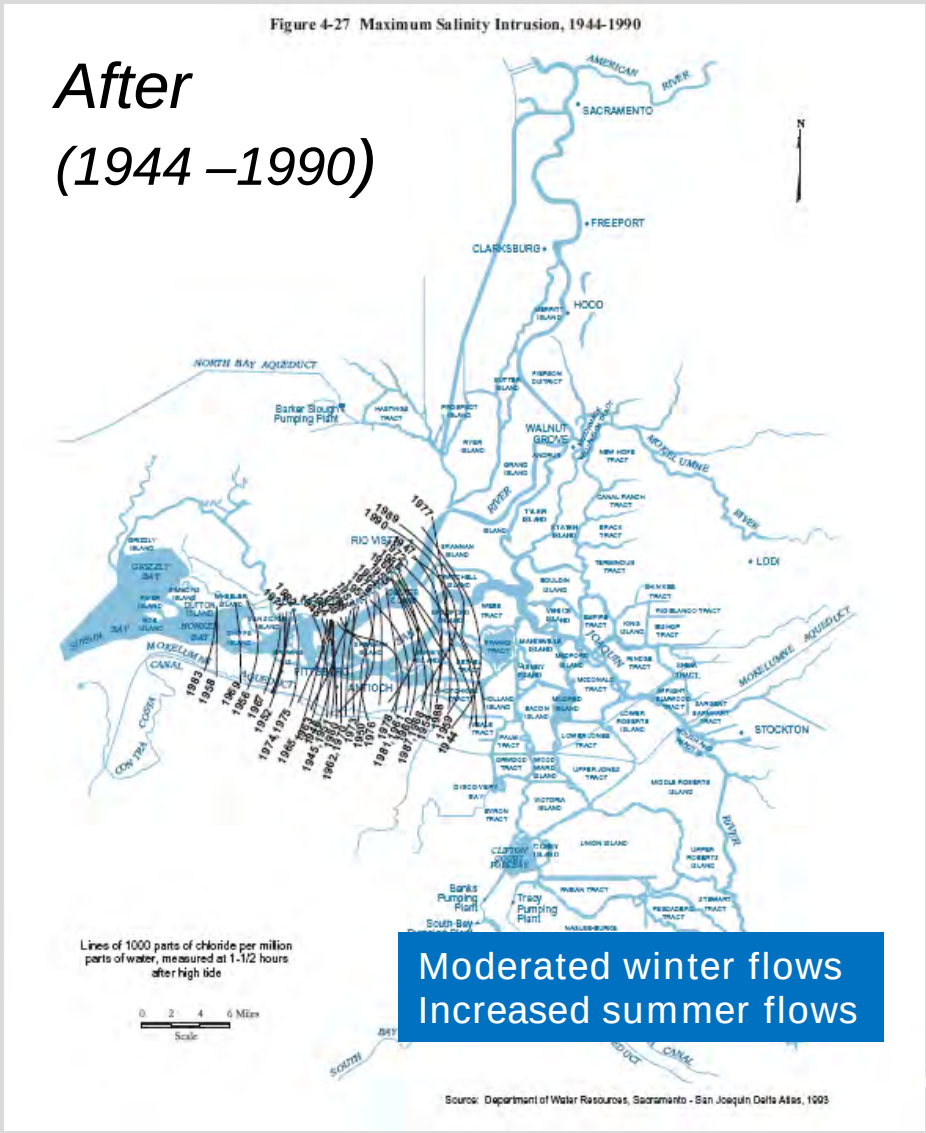
Salinity Intrusion Before and After Managed Upstream Reservoirs

Before
(1920 –1943)



High winter flows
Low summer flows

After
(1944 –1990)



Moderated winter flows
Increased summer flows

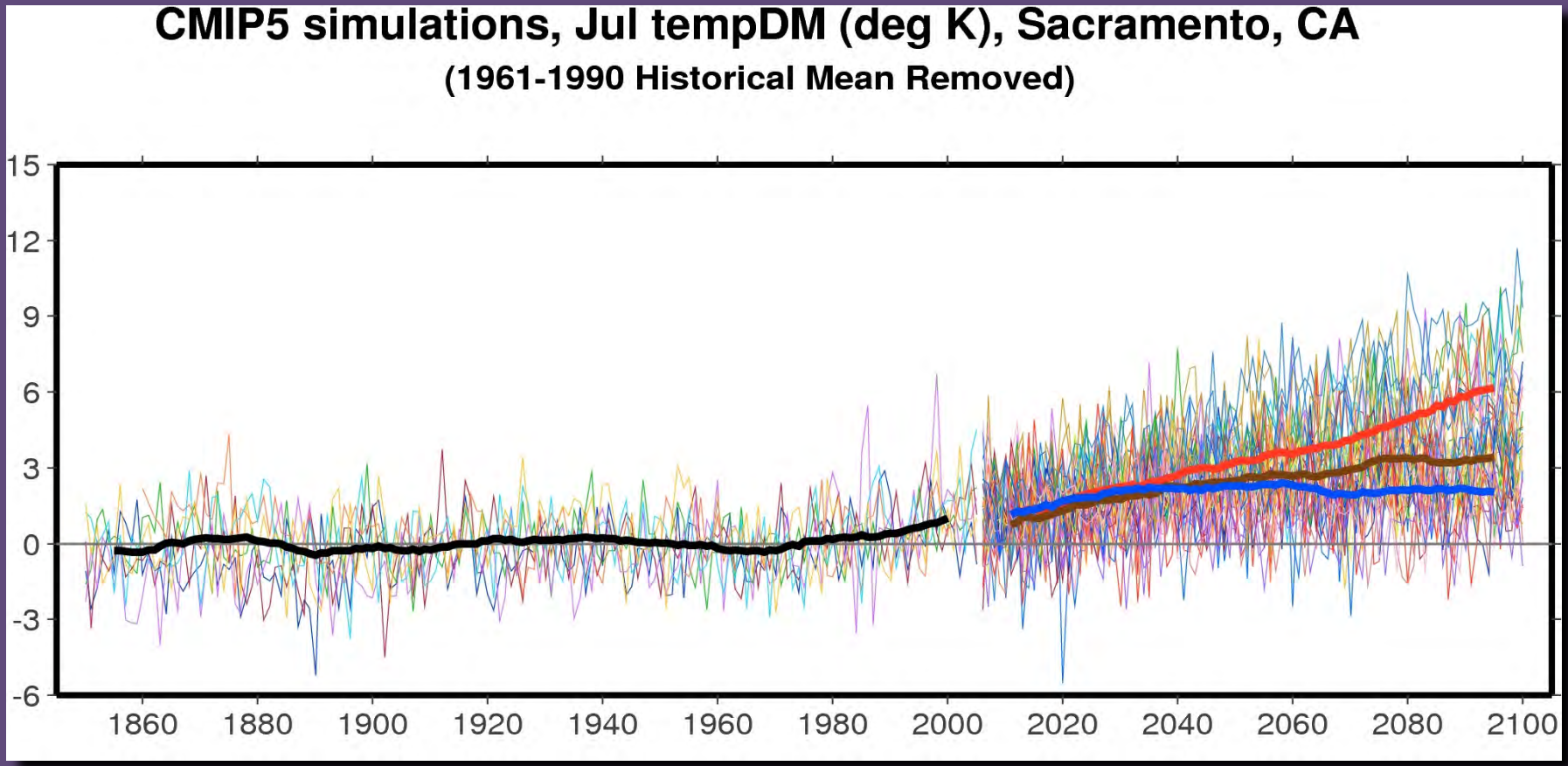
Climate Change Projections

Climate models are used to explore possible future changes in climate

Climate models don't predict future changes in climate

Scientists & planners use information from many models to make decisions

Temperature

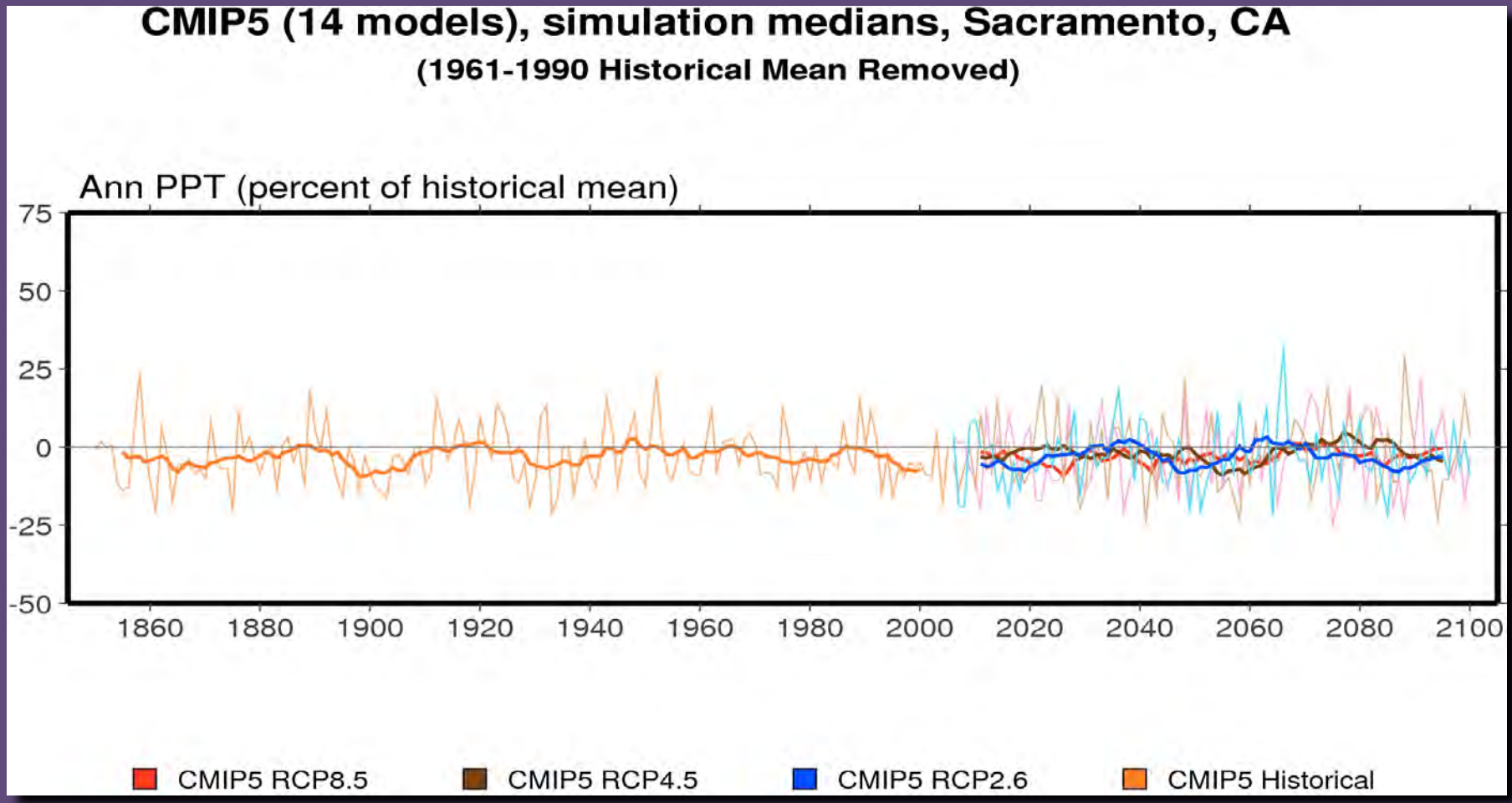


Cayan et al. Scripps/USGS 2013

Climate Warming:

Summer warming higher than winter
Interior warming greater than coastal/marine
Nighttime warming has exceeded daytime warming in last few decades
Heat wave incidence projected to become more frequent, intense, durable

Precipitation



Cayan et al. Scripps/USGS 2013

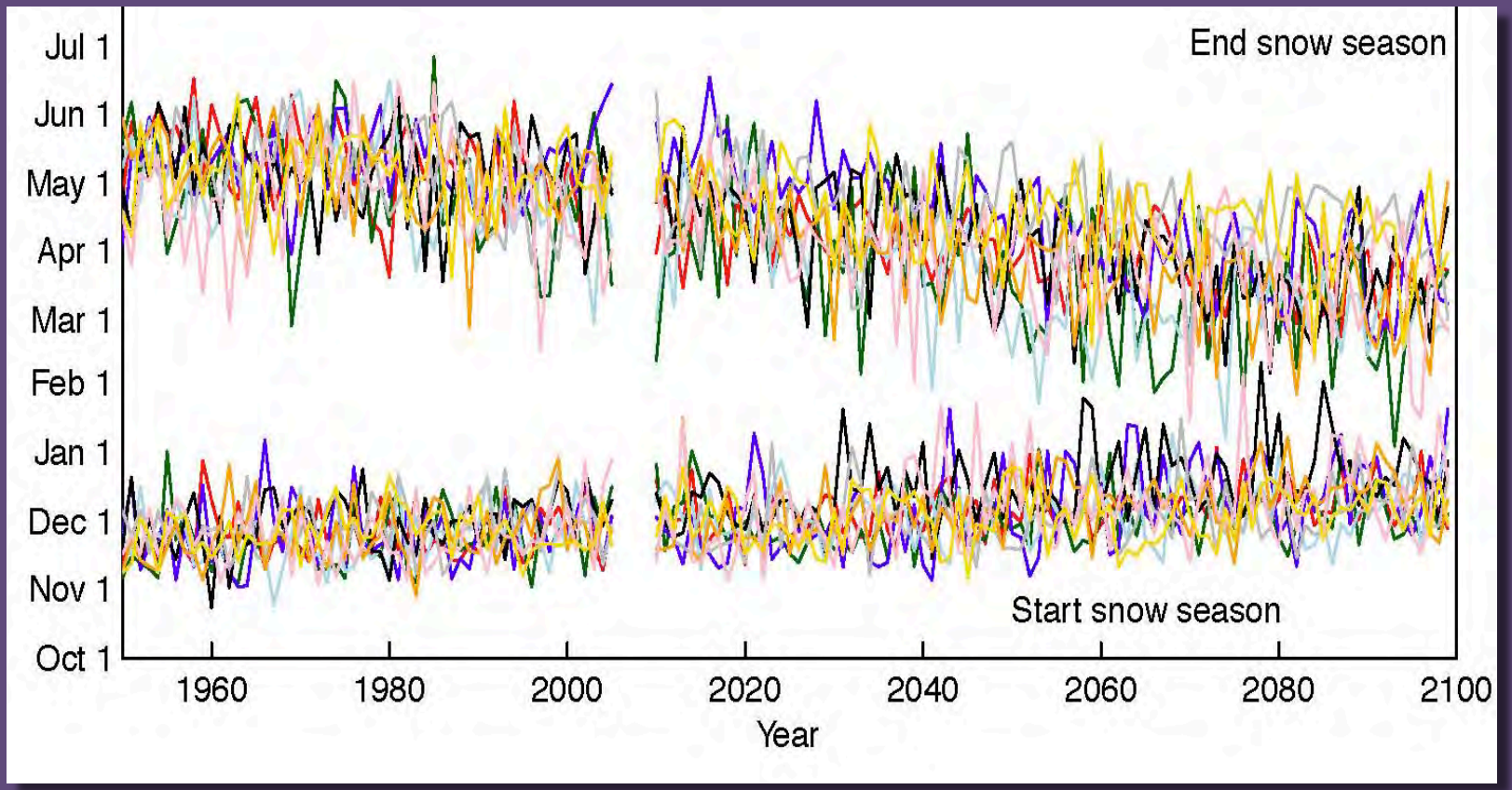
Precipitation probably will remain extremely variable

Consensus of CMIP5 models shows little change in Northern CA

Continued potential for extremely heavy events

Northern Sierra Nevada Snow Storage Season

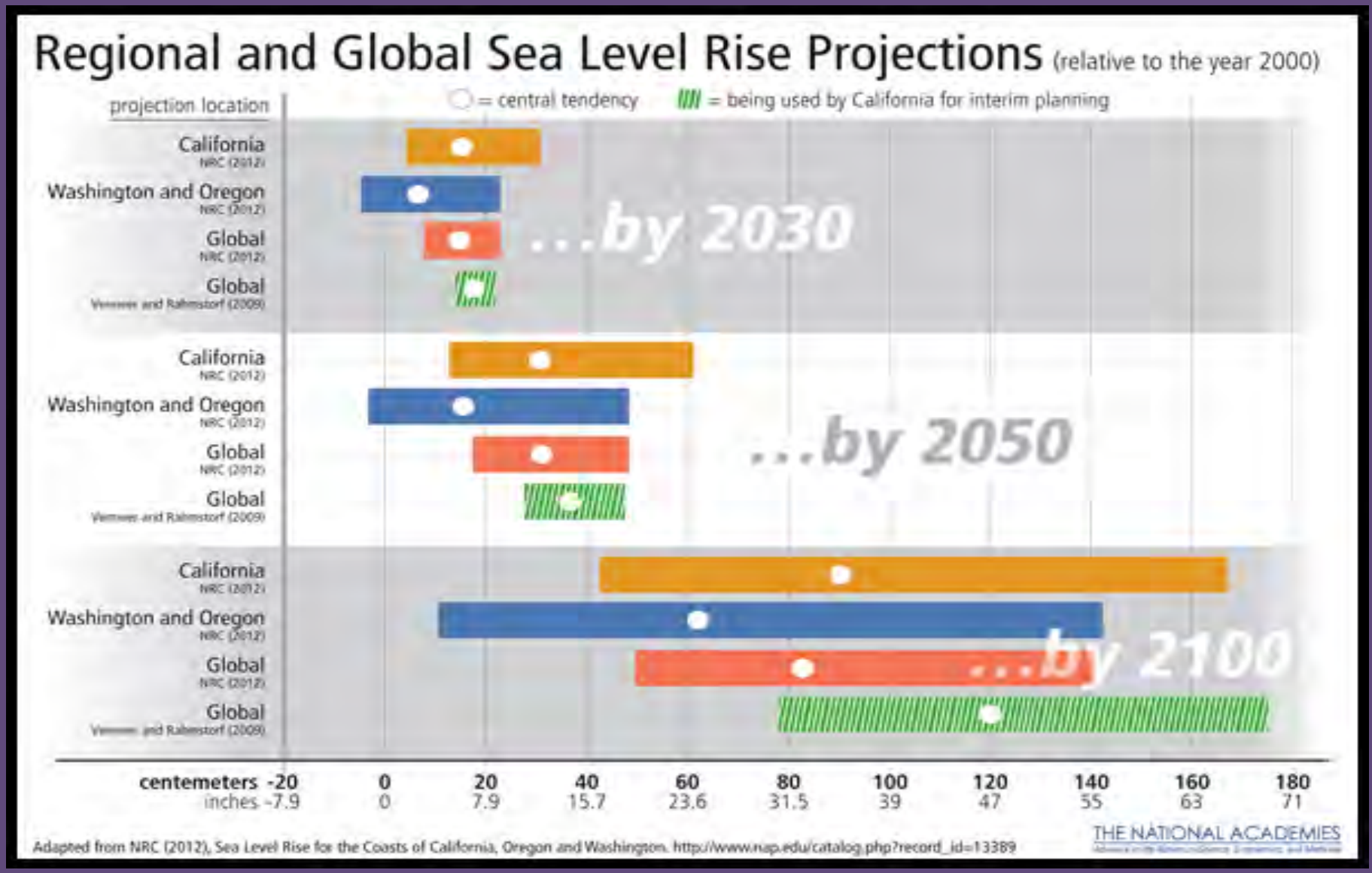
9 CMIP5 RCP4.5 GCMs BCCA downscaled, VIC snow simulation



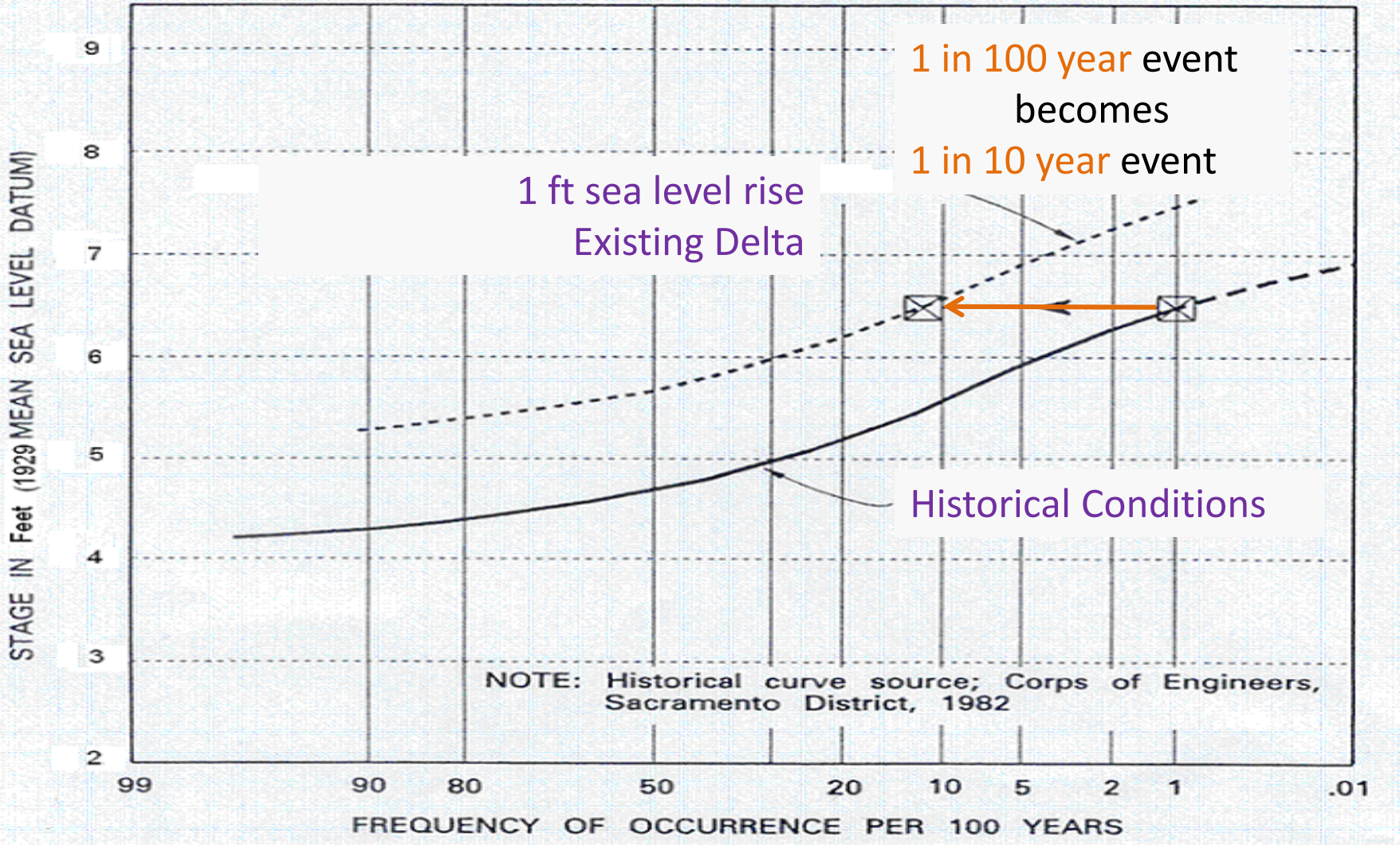
David Pierce

Length of snow season declines from ~6 months to ~3 months

Sea Level Rise

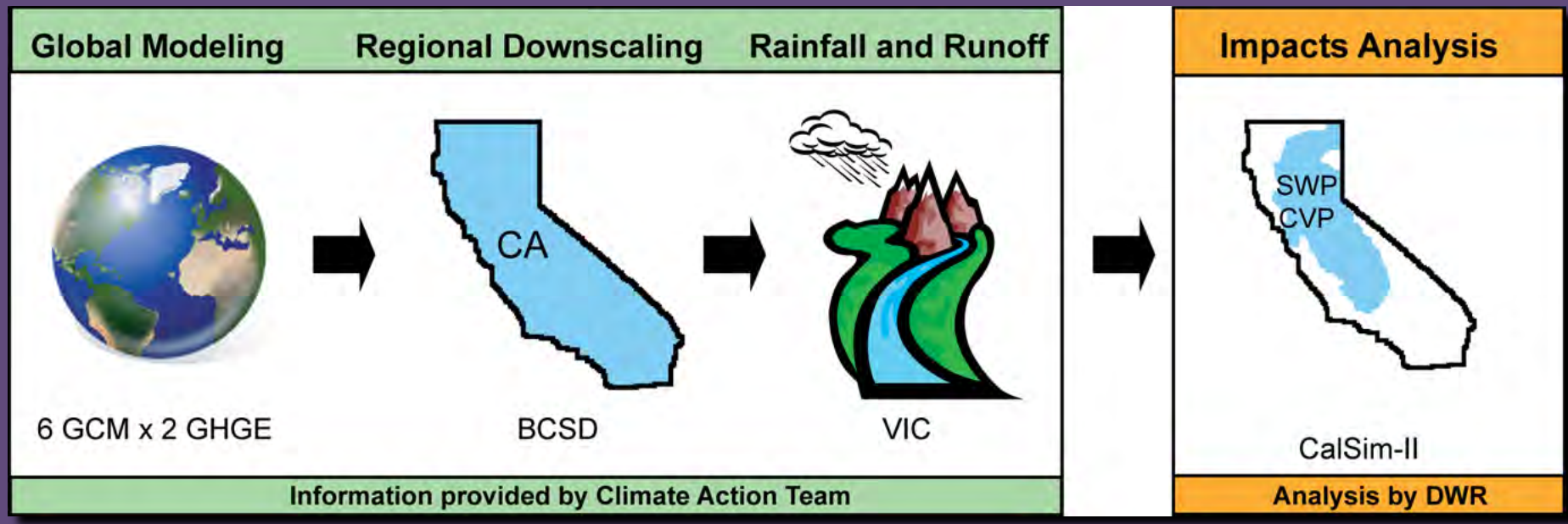


Stage Frequency Curve for Antioch, CA

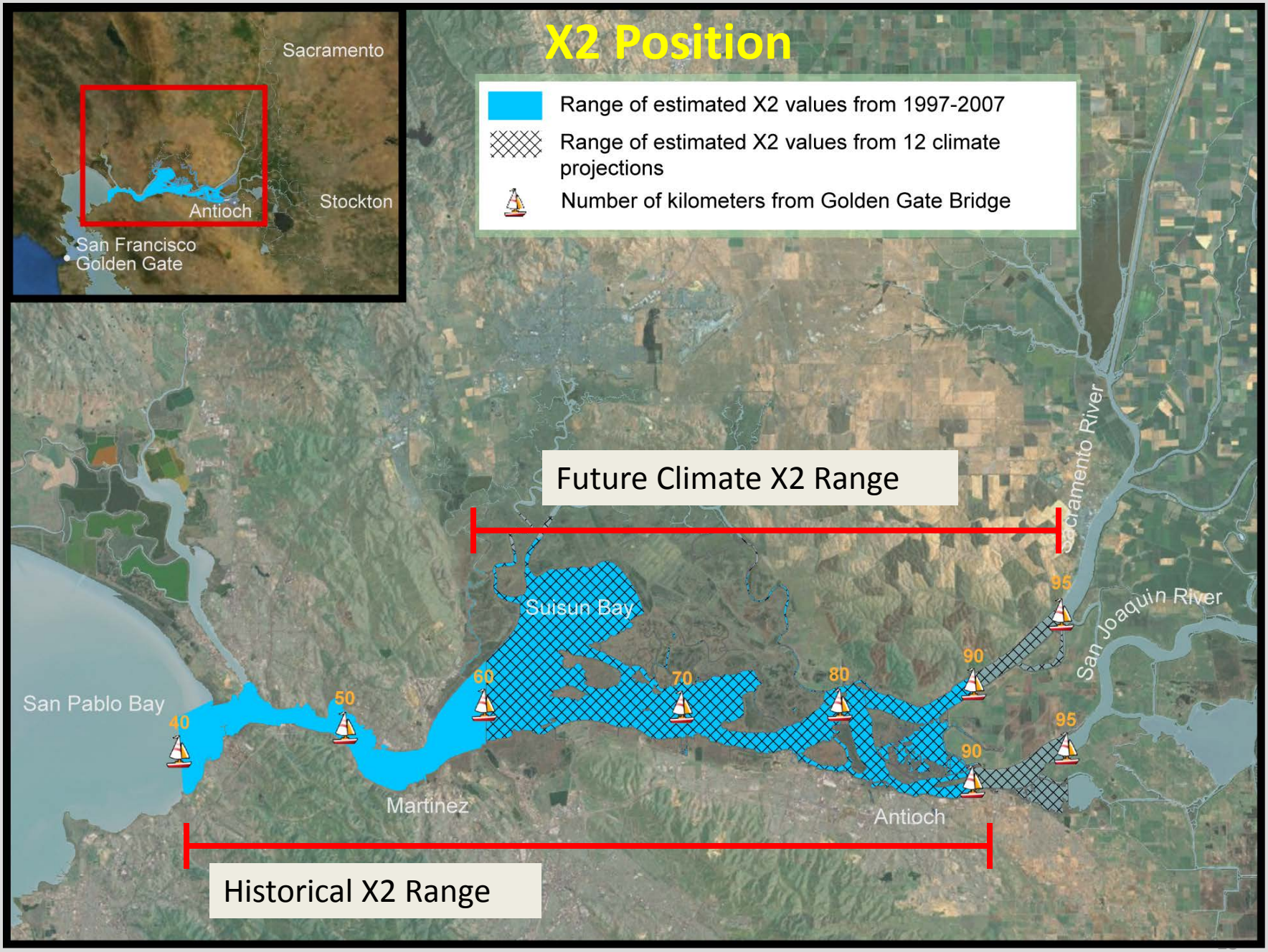


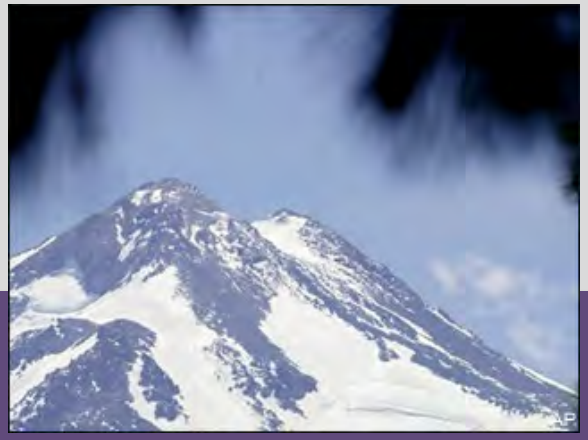
Modified from Maury Roos

Potential Impacts for the Delta



SWP= State Water Project CVP=Central Valley Project


X2 Position
Range of estimated X2 values from 1997-2007
Range of estimated X2 values from 12 climate projections
Number of kilometers from Golden Gate Bridge
Sacramento
Stockton
Antioch
San Francisco
Golden Gate
Future Climate X2 Range
Historical X2 Range
Suisun Bay
San Pablo Bay
Martinez
Antioch
Sacramento River
San Joaquin River
40
50
60
70
80
90
95
90
95



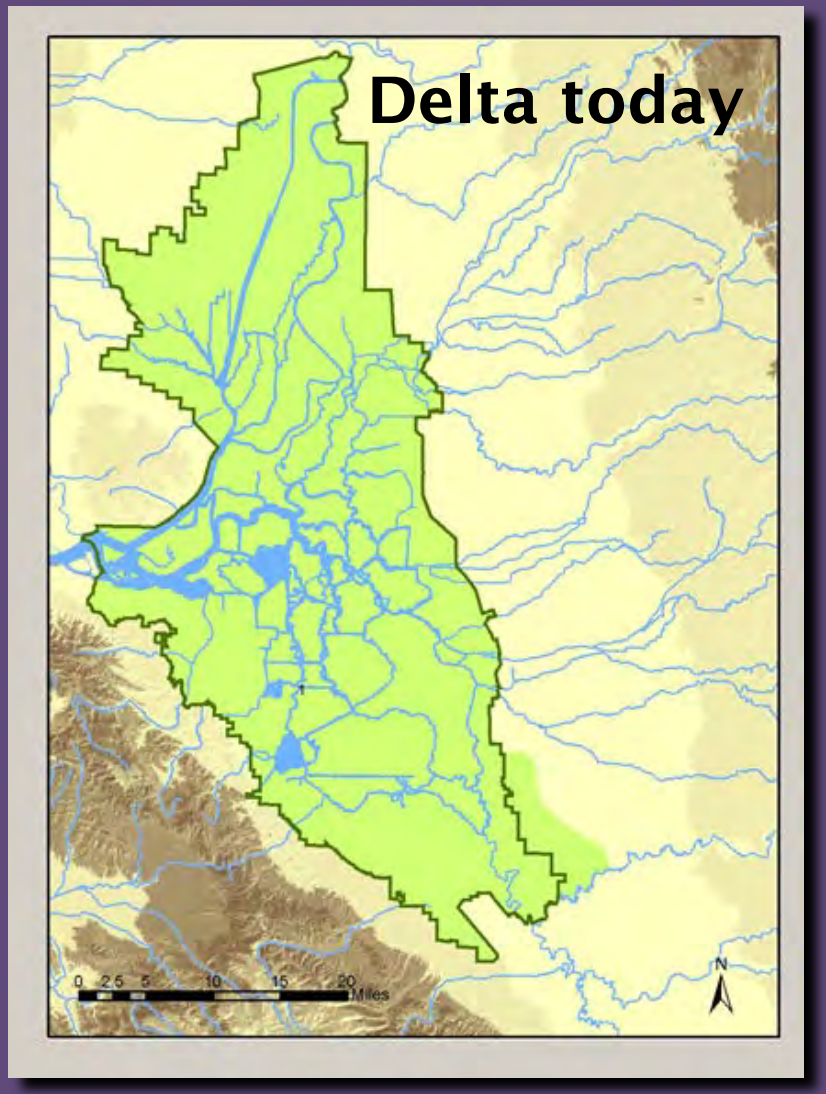
Potential Impacts
Reduced Snowpack

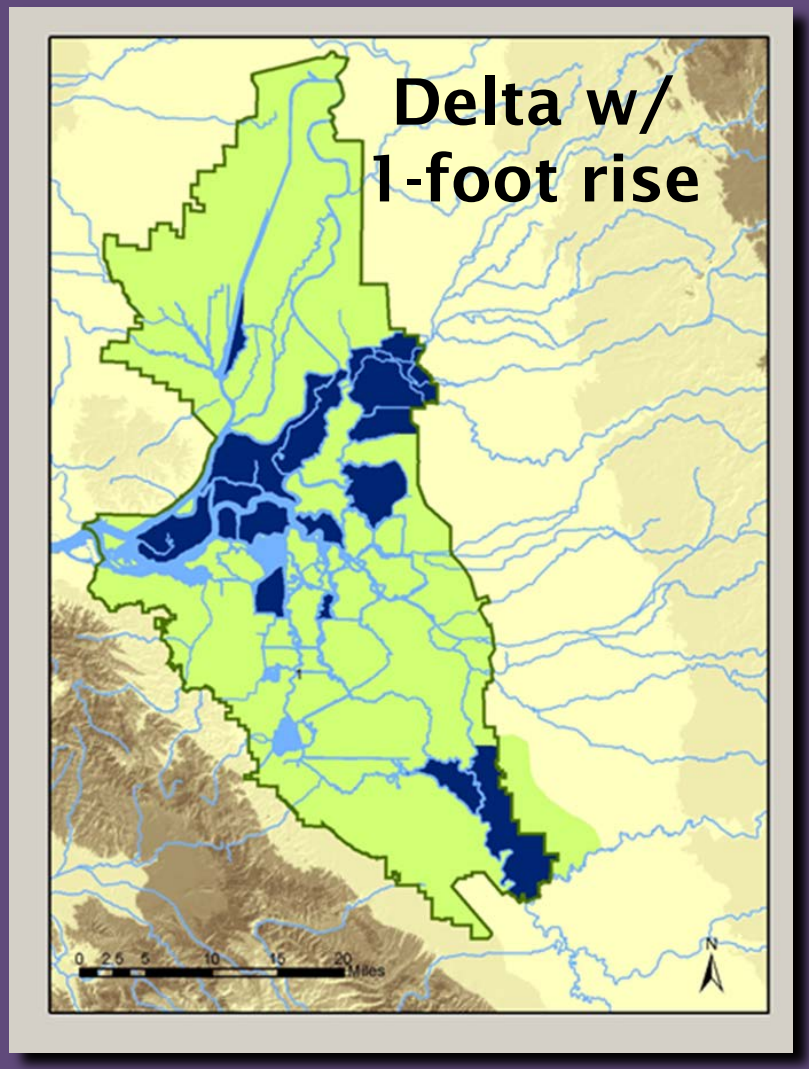
- **Some Increase in Delta Salinity Intrusion due to Reduced Snowpack**
  - Smaller snowpack mean less surplus snowmelt runoff at reservoirs and in the Delta in spring
  - Longer effective dry season for the Delta will require more freshwater releases to repel ocean salinity and maintain suitable water quality with some additional loss in average export yield

Potential Impacts
Sea Level Rise

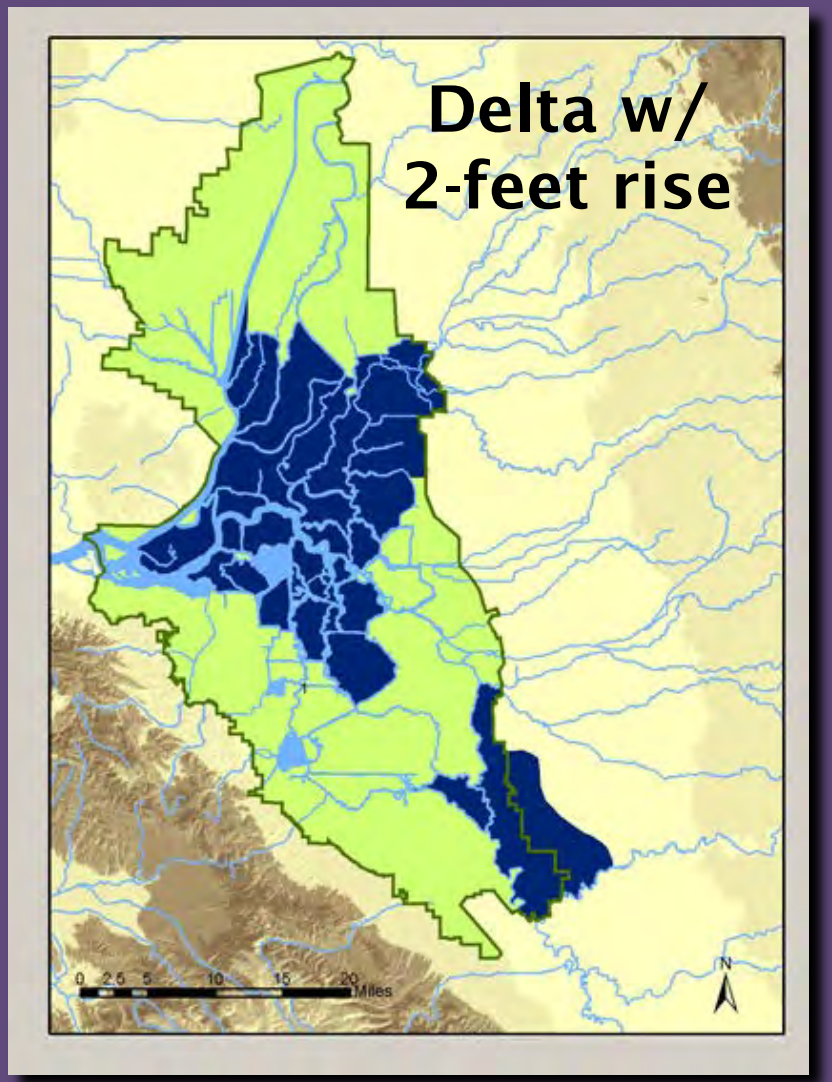
- **Increase in Flood Risk and Salinity due to Sea Level Rise**
  - Would require more freshwater releases from upstream reservoir to repel ocean salinity and maintain suitable water quality
  - Combination of rising sea levels and subsidence will increase pressure on Delta levees and contribute to higher risk of failure
  - Higher risk of overtopping or failure of levees when storm surges combine with rising mean sea levels
  - Bigger floods due to larger winter flood producing areas and more water vapor in atmosphere

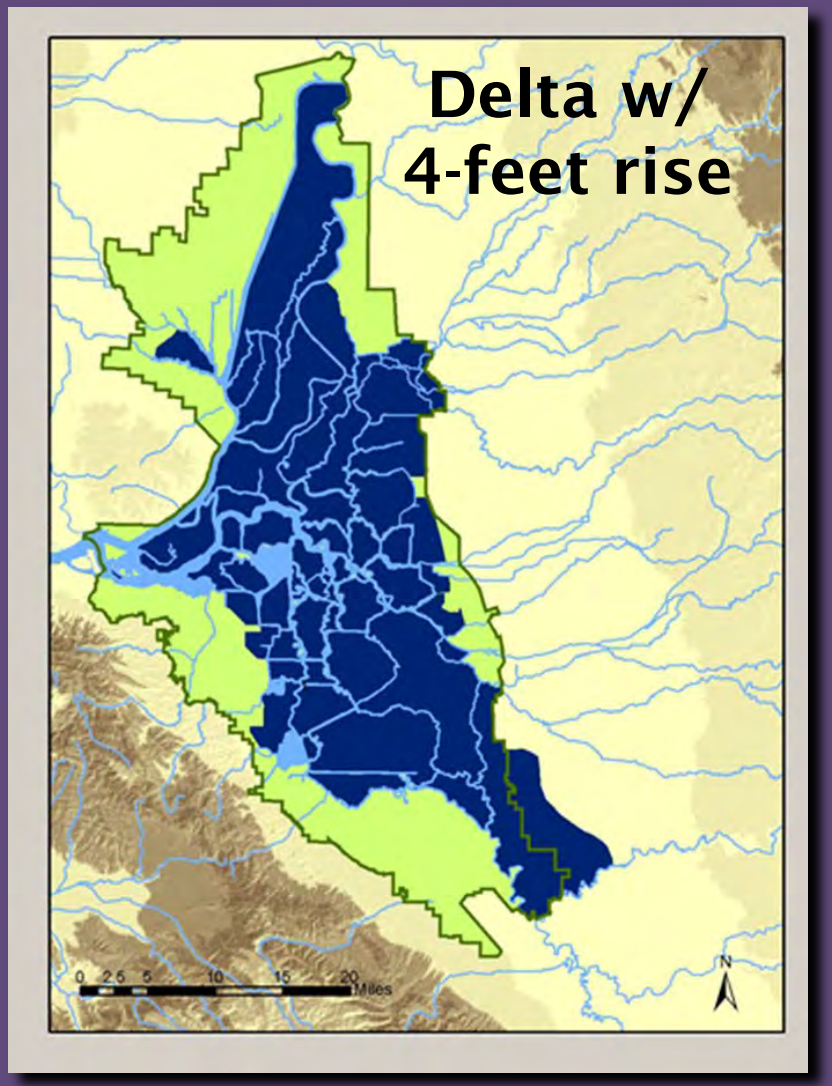
Sea Level Rise





Sea Level Rise





Potential Impacts
Water Use

- **Slightly higher water use**
  - Farm and landscape water consumption goes up with temperature; 10% for 3°C, other factors constant
  - Higher dew points reduce water use
  - Higher CO_2 reduces water use slightly for most plants
  - With warming, planting dates for annual crops will probably change

Potential Impacts
Water Temperature


Image from Middleton and Littschlager (1994). Witness: endangered species of N. Am. Chronicle Books, SF.

- **Warmer Water Temperatures**
  - Likely more problems for cold water fish from warmer temperatures
  - Warmer air temperatures mean warmer water temperatures in the Delta
  - Reduced and earlier snowmelt means less cold water pools behind major foothill reservoirs
  - Delta smelt are already near the top of their range

DWR Climate Change
Planning Efforts

- Climate Change Technical Advisory Group
- Integrated Regional Water Management
- California Water Plan
- Central Valley Flood Protection Plan

Climate Change

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Climate change is having a profound impact on California water resources, as evidenced by changes in snowpack, sea level, and river flows . These changes are expected to continue in the future and more of our precipitation will likely fall as rain instead of snow. This potential change in weather patterns will exacerbate flood risks and add additional challenges for water supply reliability.

The mountain snowpack provides as much as a third of California's water supply by accumulating snow during our wet winters and releasing it slowly when we need it during our dry springs and summers. Warmer temperatures will cause what snow we do get to melt faster and earlier, making it more difficult to store and use. By 2050, scientists project a loss of at least 25 percent of the Sierra snowpack. This loss of snowpack means less water will be available for Californians to use.

Climate change is also expected to result in more variable weather patterns throughout California. More variability can lead to longer and more severe droughts. In addition, the sea level will continue to rise threatening the sustainability of the Sacramento-San Joaquin Delta, the heart of the California water supply system and the source of water for 25 million Californians and millions of acres of prime farmland.

The Department of Water Resources (DWR) is addressing these impacts through mitigation and adaptation measures to ensure that Californians have an adequate water supply, reliable flood control, and healthy ecosystems now and in the future. Below are some of DWR's climate change activities.

- In May, 2012 DWR adopted phase 1 of its Climate Action Plan, a Department-wide Greenhouse Gas Emissions Reduction Plan
- In October, 2010 DWR adopted an Environmental Stewardship Policy which supports a "Total Resource Management" approach to planning activities and projects Department-wide
- DWR in cooperation with the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, and Resources Legacy Fund completed the Climate Change Handbook for Regional Water Planning (2011)
- DWR released summaries of its climate change achievements as a Poster and Brochure (2010)
- DWR adopted its own Sustainability Policy to promote a departmental change in the way DWR does business (2009), and established clear and measurable Goals for sustainability implementation (2010).
  Visit DWR's Sustainability Portal and Watch DWR's Sustainability Videos.
- In 2007, 2008, and 2009, DWR was a member of the California Climate Action Registry and made the list as a Climate Action Leader by reporting its GHG emissions and having the data verified through a third party audit. In 2010, DWR transitioned to The Climate Registry, a North America-wide climate registry, and continued to provide third party verified GHG emissions inventory data.
- DWR adopted a Climate Change Adaptation Strategy (2008)

Other Climate Change Activities

Adapting to the current and future effects of climate change is essential for DWR and California's water managers. DWR addresses climate change in its California Water Plan, which is updated every five years. The California Water Plan provides a framework for water managers, legislators, and the public to consider options and make decisions regarding California's water future. DWR continues to improve and expand the analysis of climate change in the California Water Plan. The 2009 California Water Plan Update includes multiple scenarios of future climate conditions and stresses the inclusion of uncertainty, risk, and sustainability.

Climate Change Technical Advisory Group

Featured Link

California Department of Water Resources Climate Action Plan Phase I: Greenhouse Gas Emissions Reduction Plan

DWR in an effort to reduce its impact on the environment and lead by example, has developed and adopted a Department-wide Climate Action Plan. The first phase of this Climate Action Plan is a Greenhouse Gas Emissions Reduction Plan, which will guide project development and decision making with respect to energy use and GHG emissions.

CLIMATE ACTION LEADER

CALIFORNIA Climate ACTION TEAM

Department of Water Resources

1416 Ninth Street
Sacramento, CA 95814

www.water.ca.gov/climatechange

Take Home Messages

- Delta hydrology primarily influenced by upstream management and tidal action
- Sea level rise could significantly affect the Delta in terms of water quality and flood risk
- Effects of climate change may be either mitigated or exacerbated by in-Delta and upstream management actions
- The decisions we make *now* will play a large role in determining the region's resiliency in the face of a changing climate