



Climate Change Impacts and Adaptation

Water Planning and Stewardship Committee
Item 6b
September 11, 2017

Overview

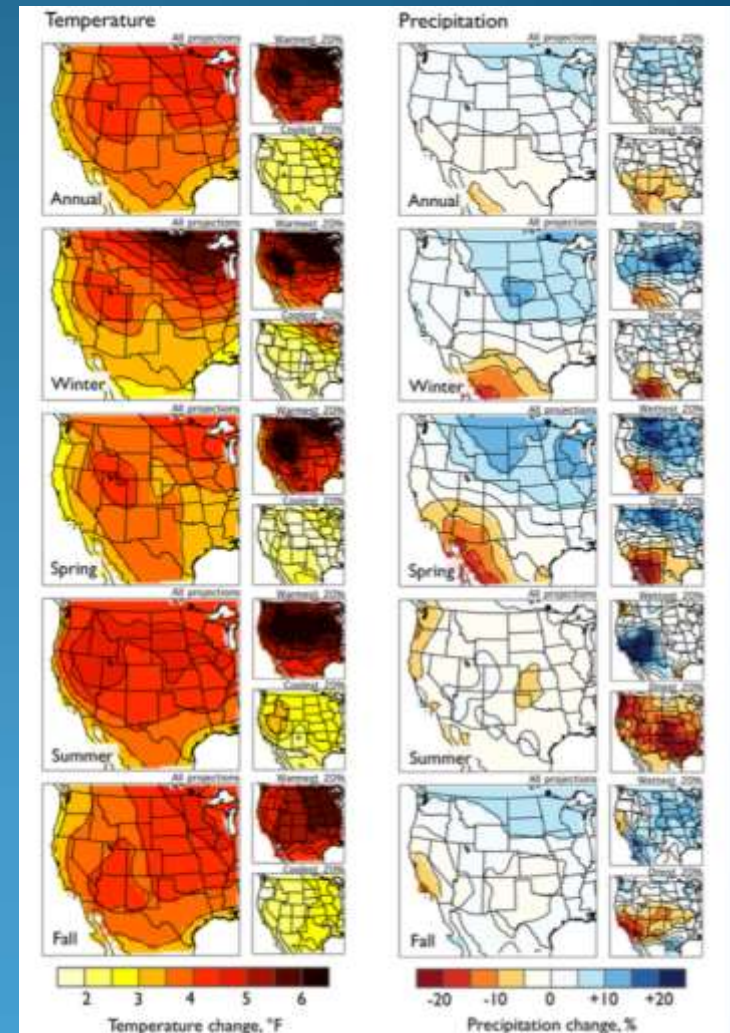
- Global Climate Models and Science
- Observations and the New Normal
 - Northern California
 - Colorado River
 - Southern California
- Metropolitan's Adaptation Approach

Overview of Climate Change Science and Potential Impacts

Western U.S. Climate Projections

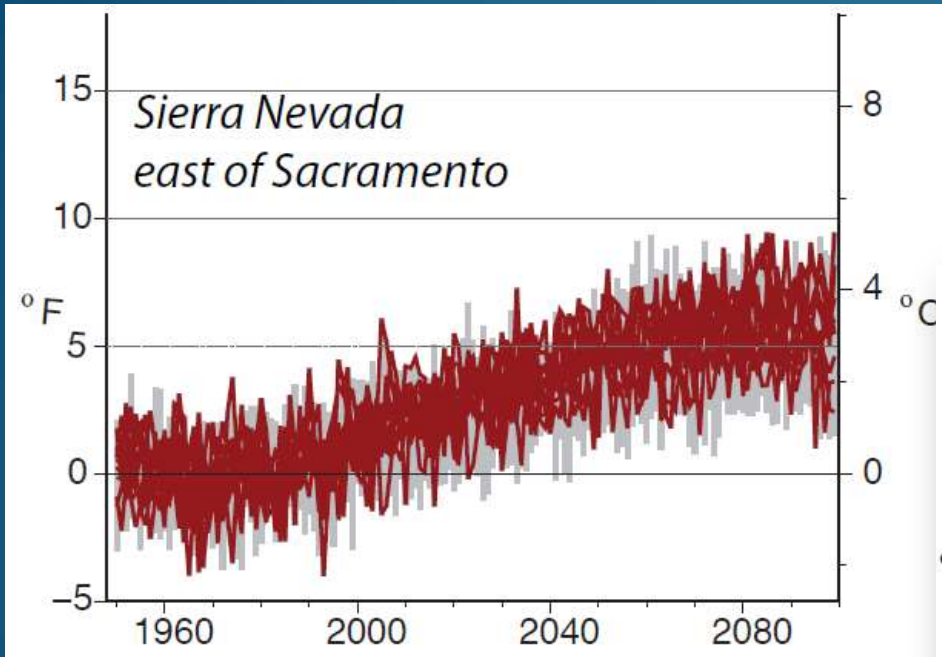
Mid-Century, Moderate Emissions

- Warming
 - All seasons warmer
 - Less warming on coast
 - Average warming 4-5°F
 - 2-3 times warming to date
- Precipitation
 - Little annual change
 - South drier, North wetter

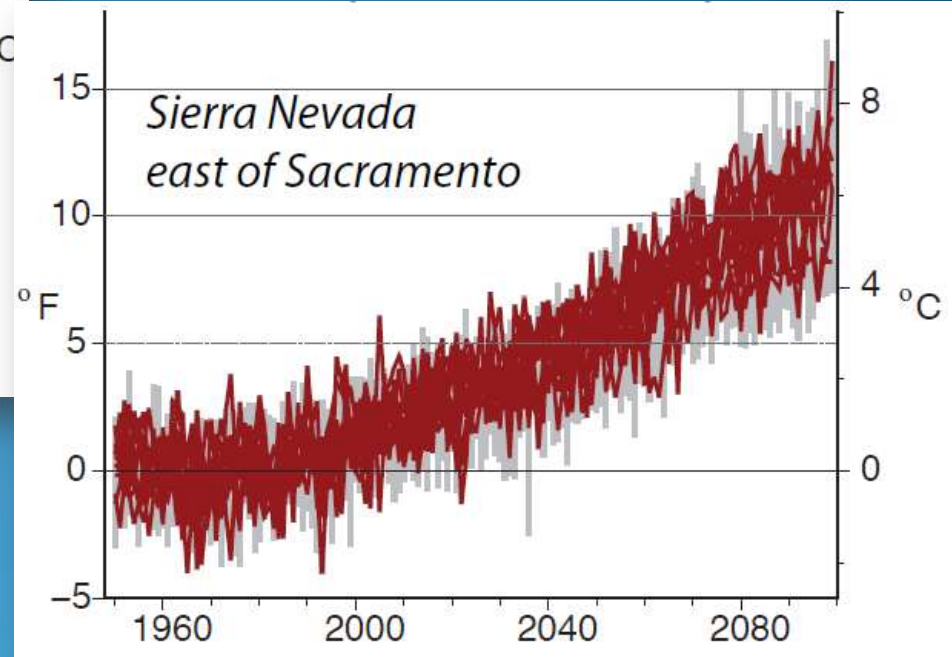


Climate Model Predictions Show Increasing Temperatures

Lower Future GHG Concentrations

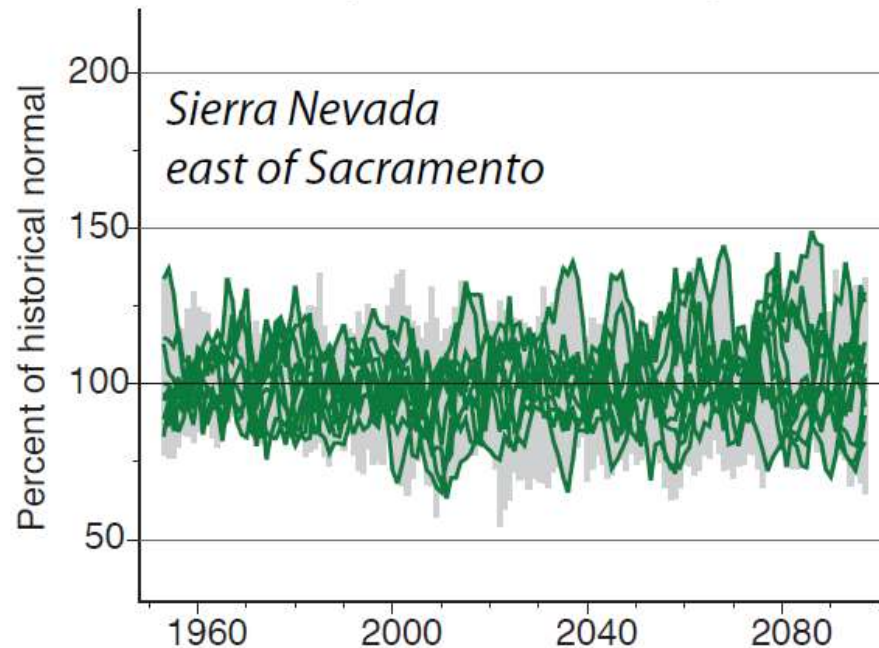


Higher Future GHG Concentrations

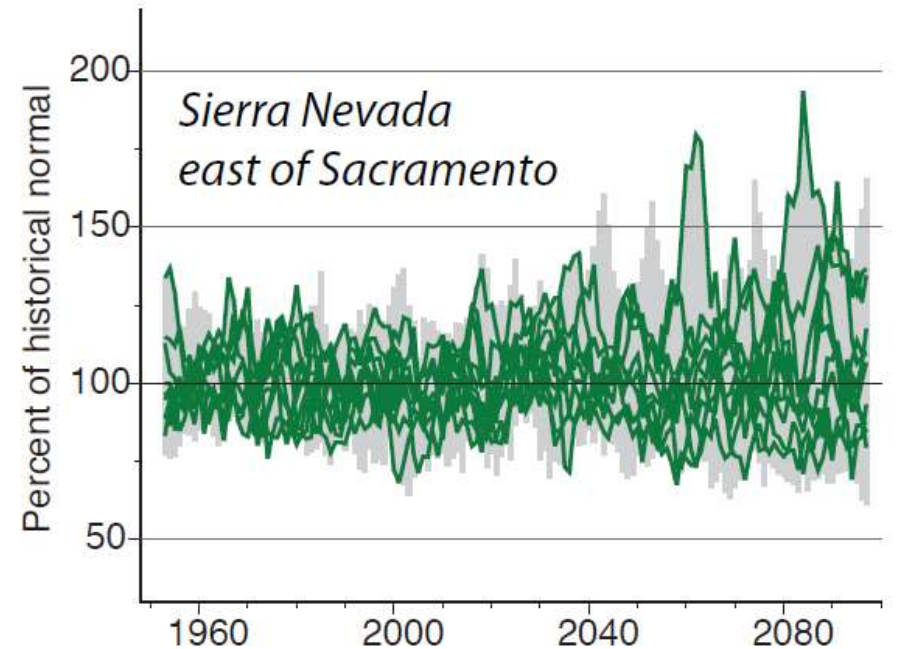


Climate Model Predictions of Precipitation are Less Clear

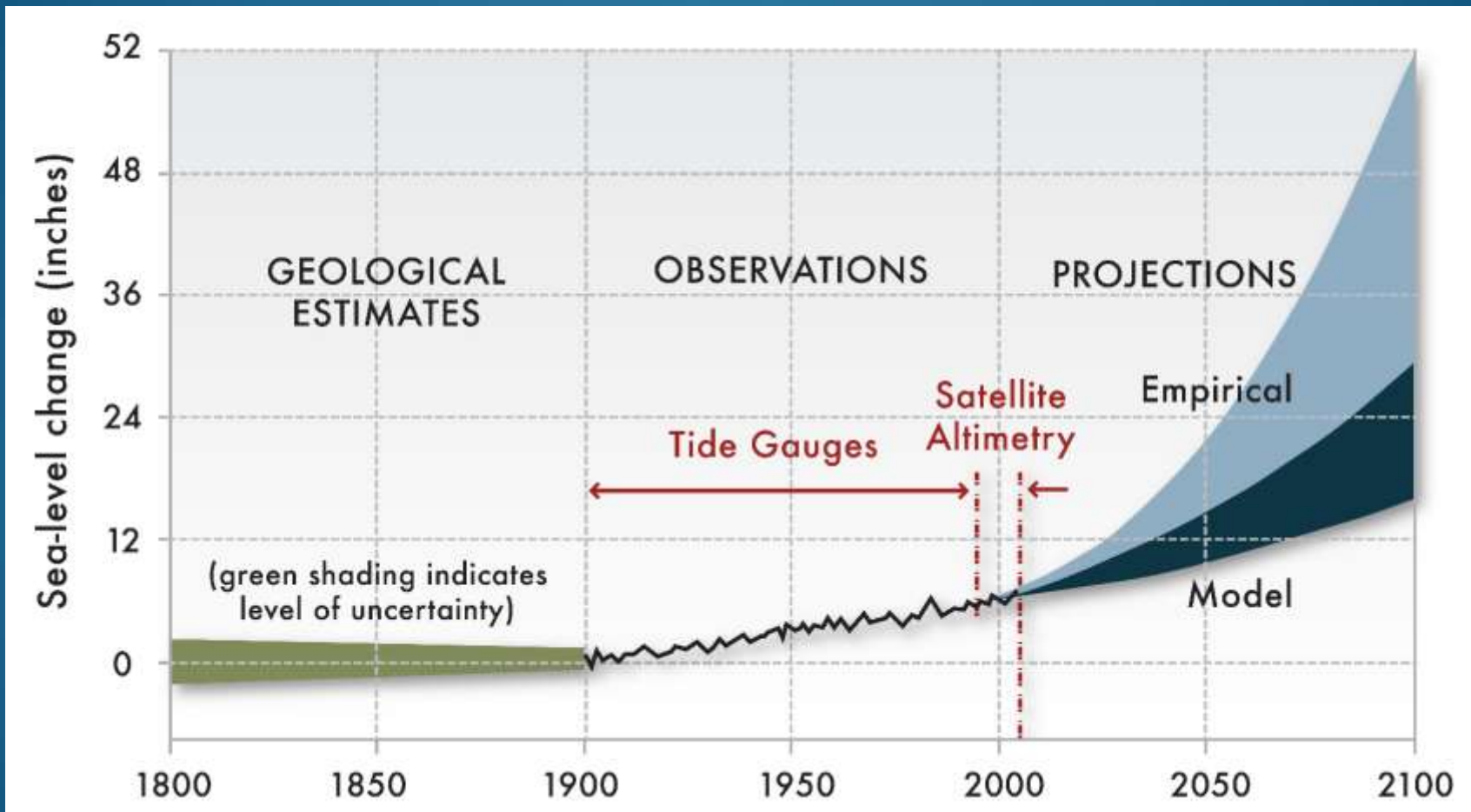
Lower Future GHG Concentrations



Higher Future GHG Concentrations



Climate Model Predictions Show Continued Sea Level Rise



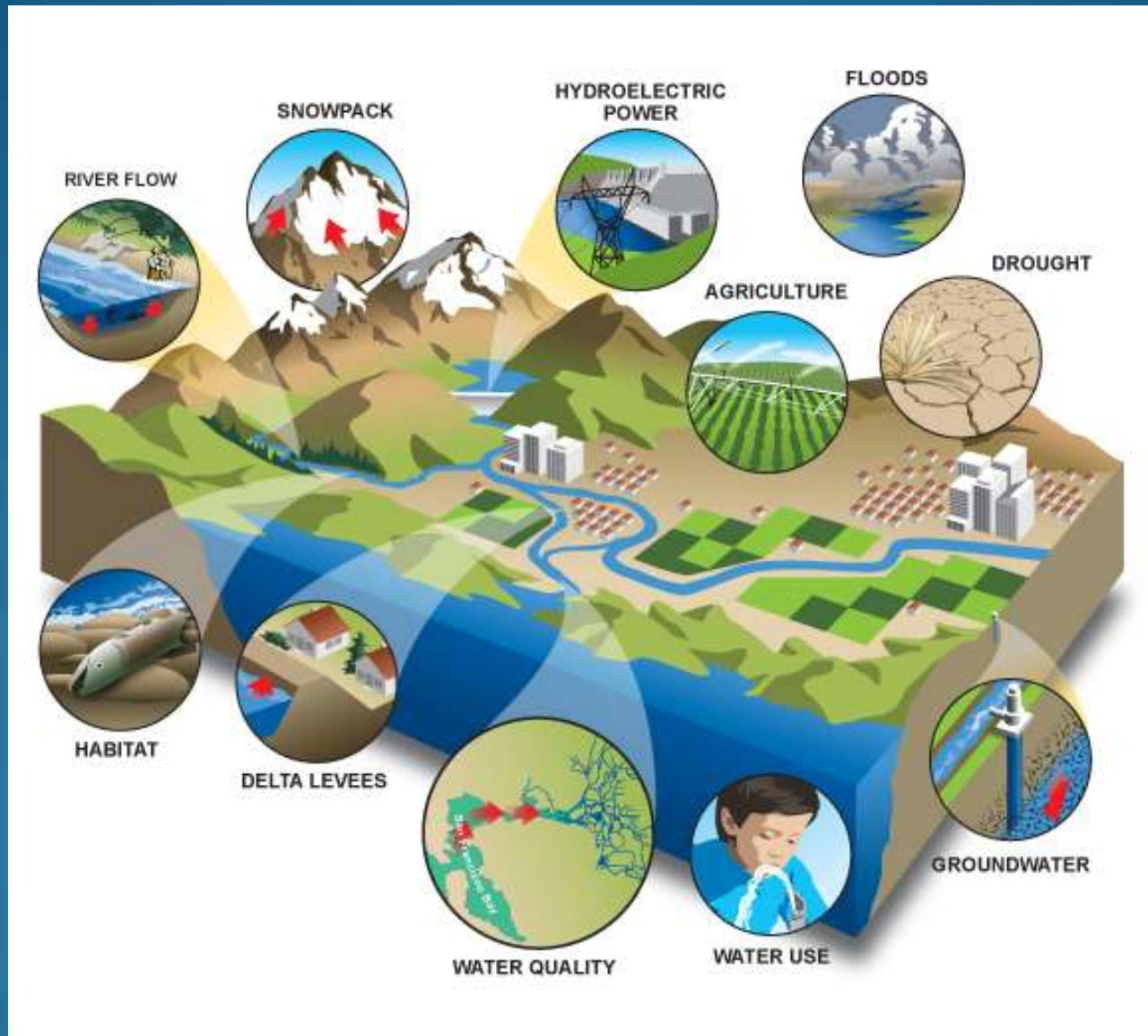
Temperature Increases Alone Will Impact the Hydrologic System

- Snow & Snowpack
- Runoff
- Droughts & Floods
- Evaporation & ET
- Groundwater Recharge
- Soil Moisture
- Wildfires
- Vegetation
- Dust
- Water Quality Degradation

Warming has an overall drying effect



Potential Water Resources Impacts



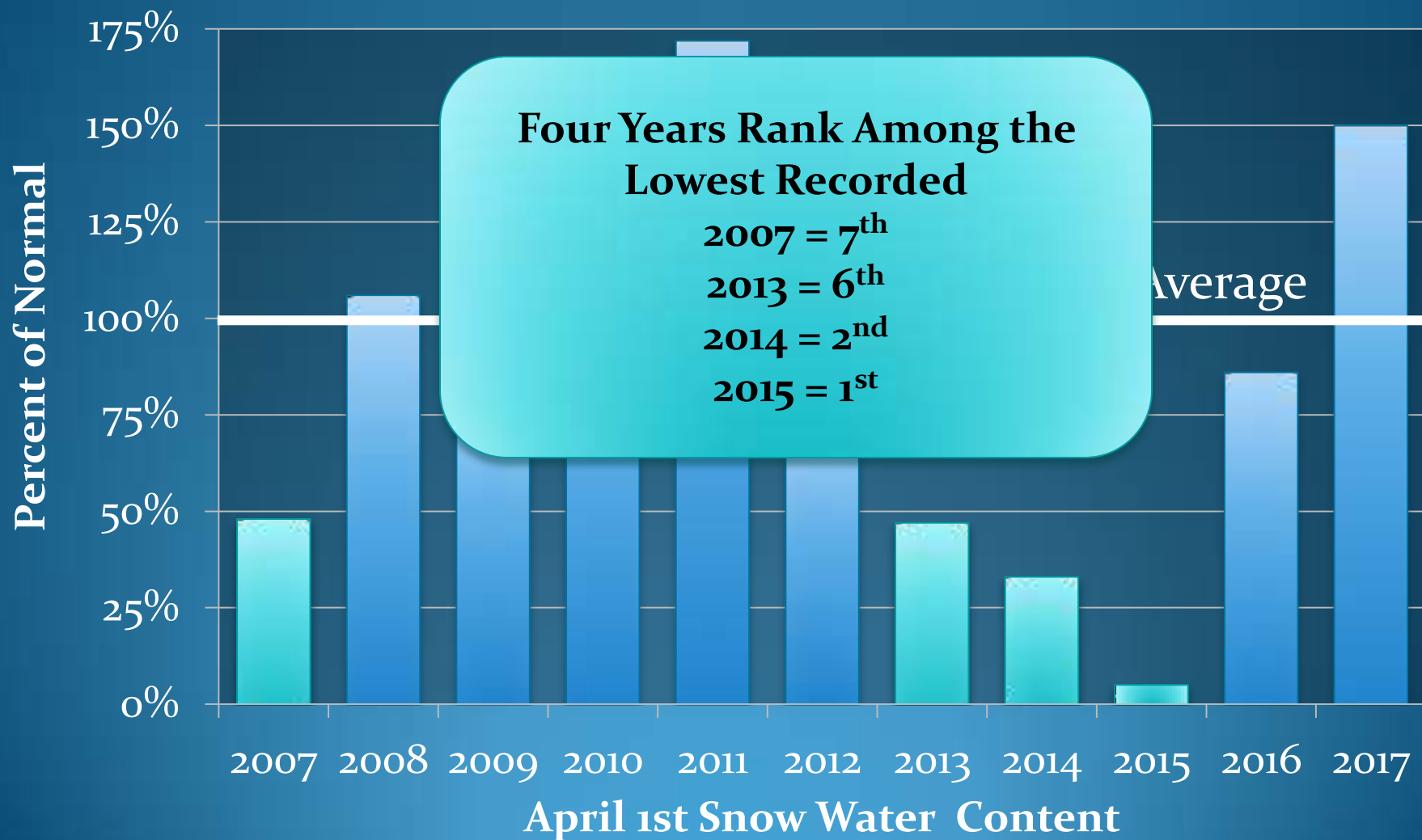
We are Already Seeing
“New Normal” Conditions

Climate Change Effects on Northern California

Higher temperatures have led to:

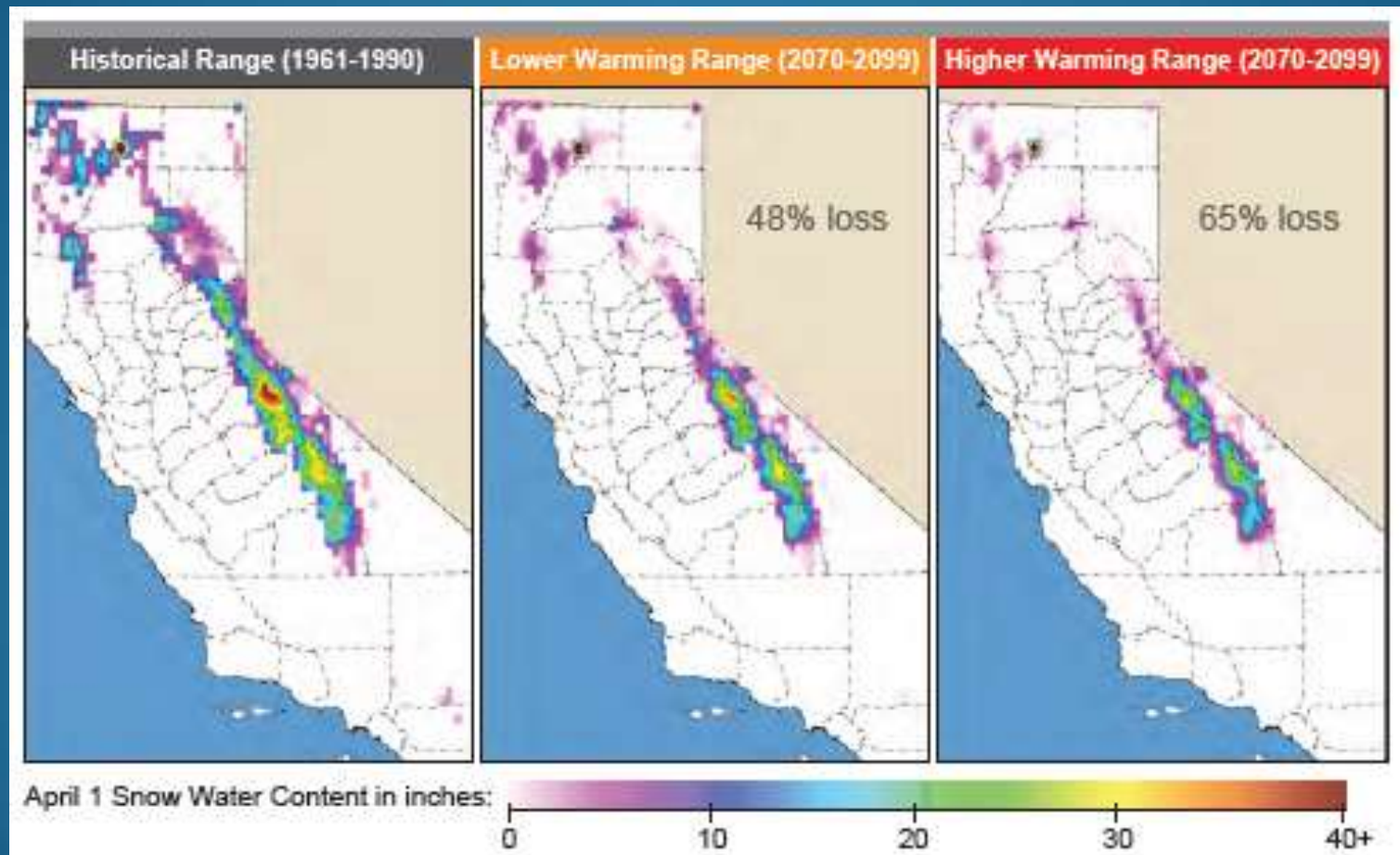
- Less Snowpack
- Changing Precipitation Patterns
- Changing Runoff Timing and Intensity
- Sea Level Rise
- Water Quality Impacts

Seven of Last Eleven Years Statewide Snowpack Below Normal



Decreasing Sierra Snowpack

- Sierra snowpack is projected to decrease by 48-65 percent by the end of this century



Snowpack Functions as California's Largest Reservoir

Sacramento Valley
~13.5 MAF
Avg. Storage
Capture

San Joaquin Valley
~11 MAF
Avg. Storage
Capture

Snowpack
~15 MAF/year
Natural Storage

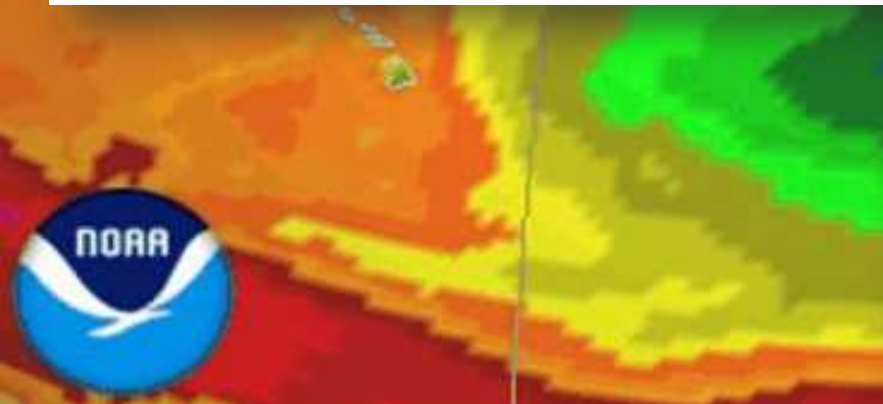
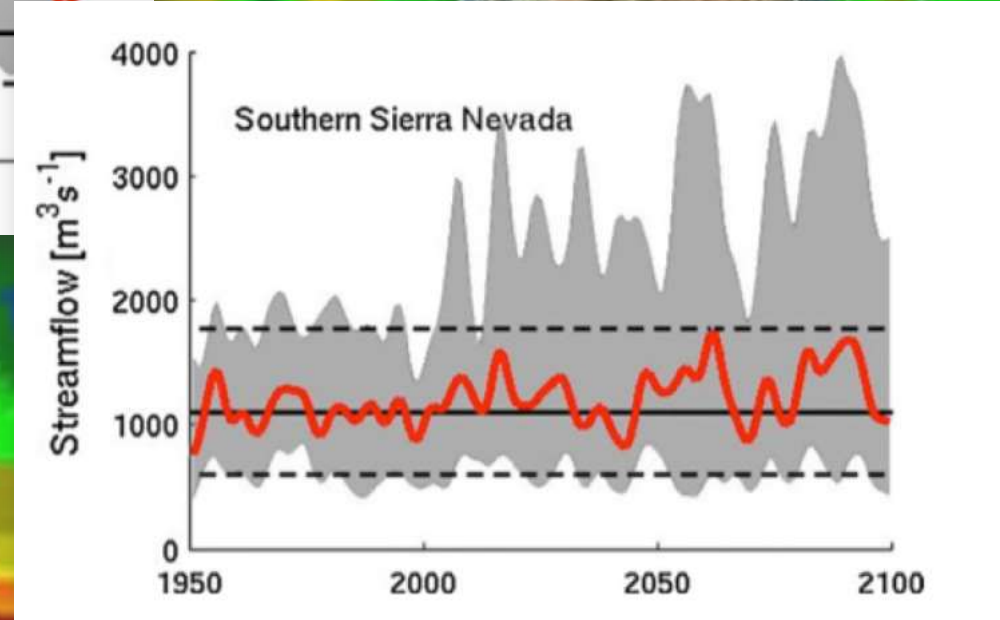
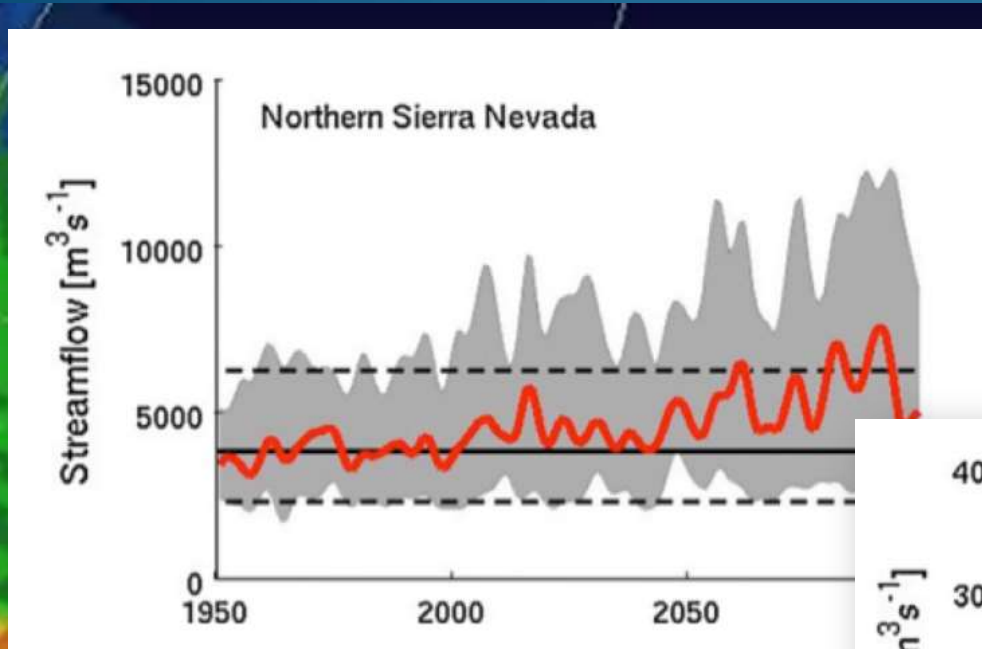


Changing Runoff Patterns

Less Snowpack and Earlier Runoff

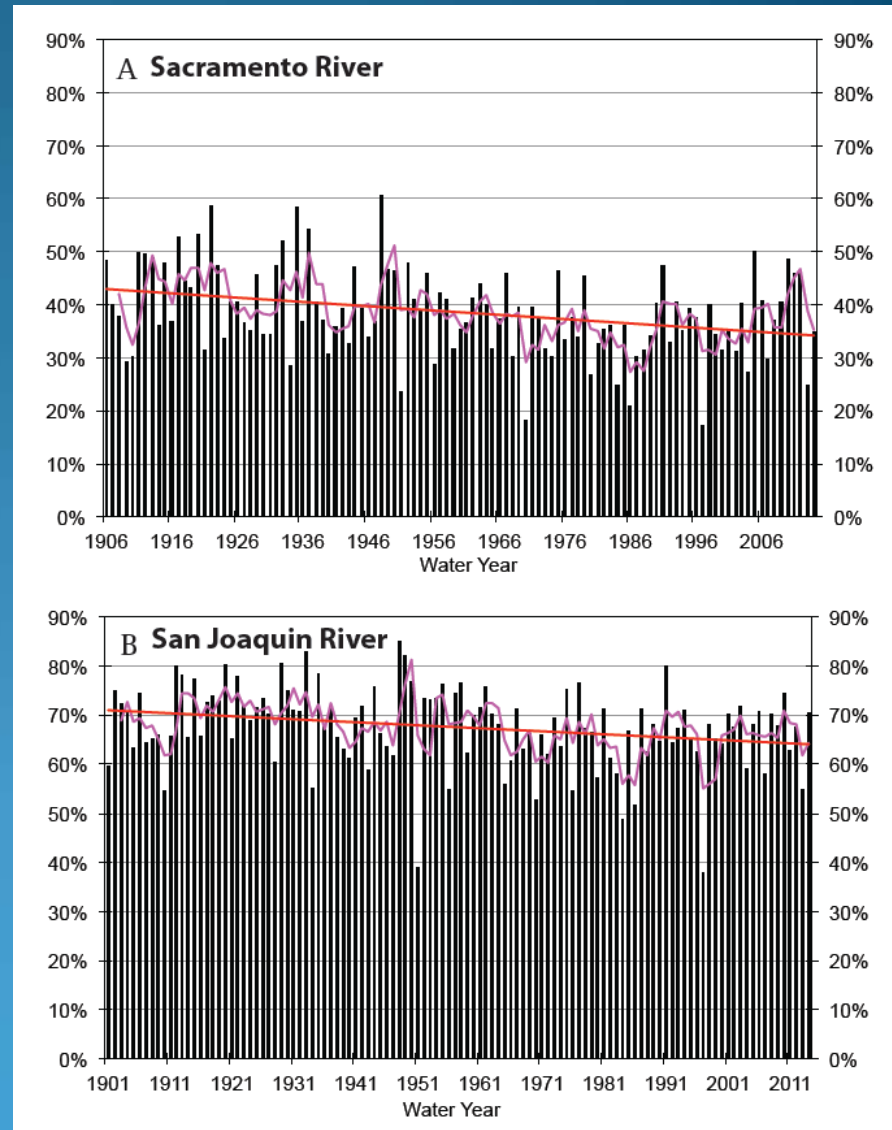


Increasing Extreme Precipitation Events and Runoff Variability



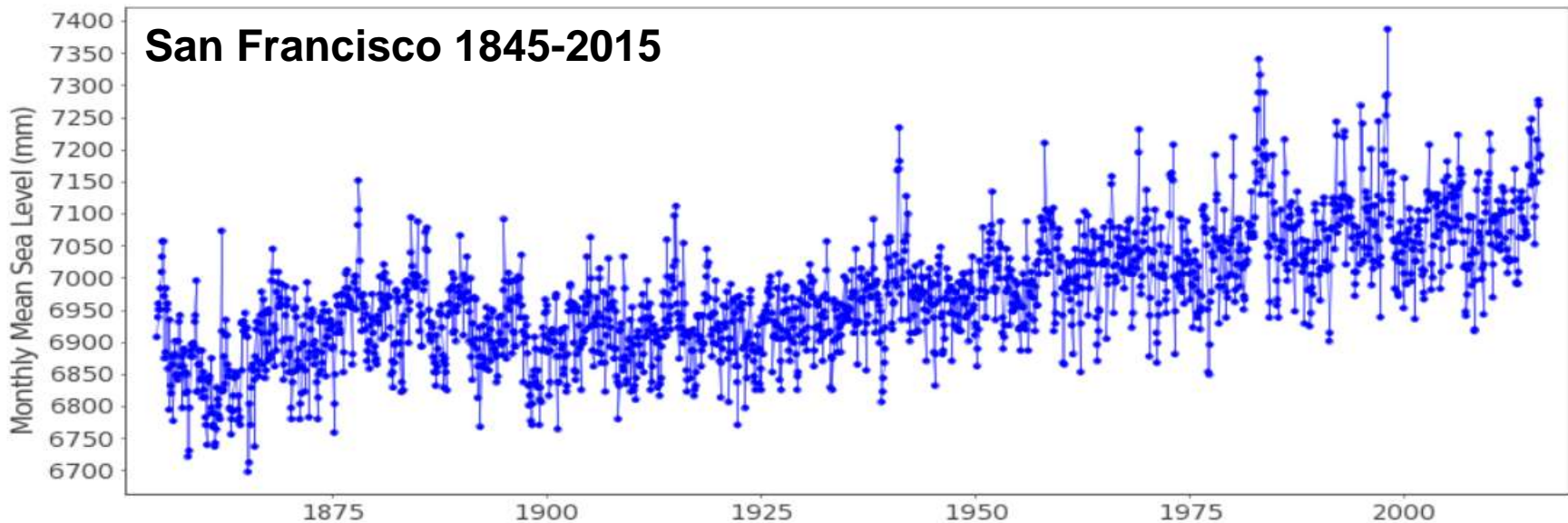
Changing Runoff Patterns

- Warmer winters yield rain instead of snow
- Earlier spring time warming and snowmelt
 - Lower April to July runoff
- Storage Impacts
 - More flood releases, less storage
 - Increasing summertime demand on storage



Rising Sea Levels

- Increasing seawater intrusion
- Increasing risk to levees from storm, tide and wave events
- Increasing erosion and sediment transport



Declining Water Quality

- Increasing salinity within Delta
- Additional freshwater releases needed to manage water quality



Additional Storage Releases Required

Water Quality, Temperature, Fisheries

Lake Shasta



Lake Oroville



Folsom Lake

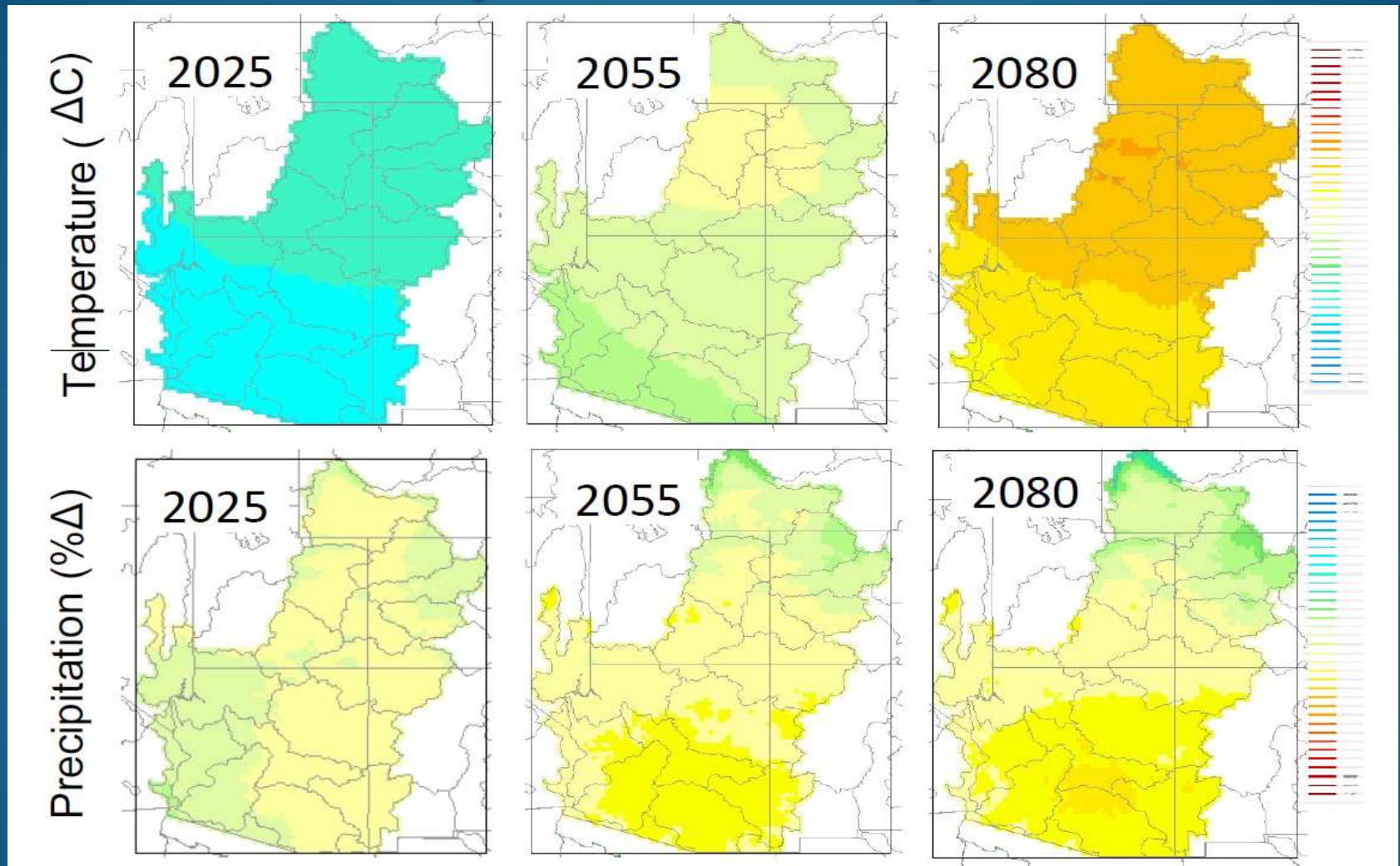


Climate Change Effects on the Colorado River Basin

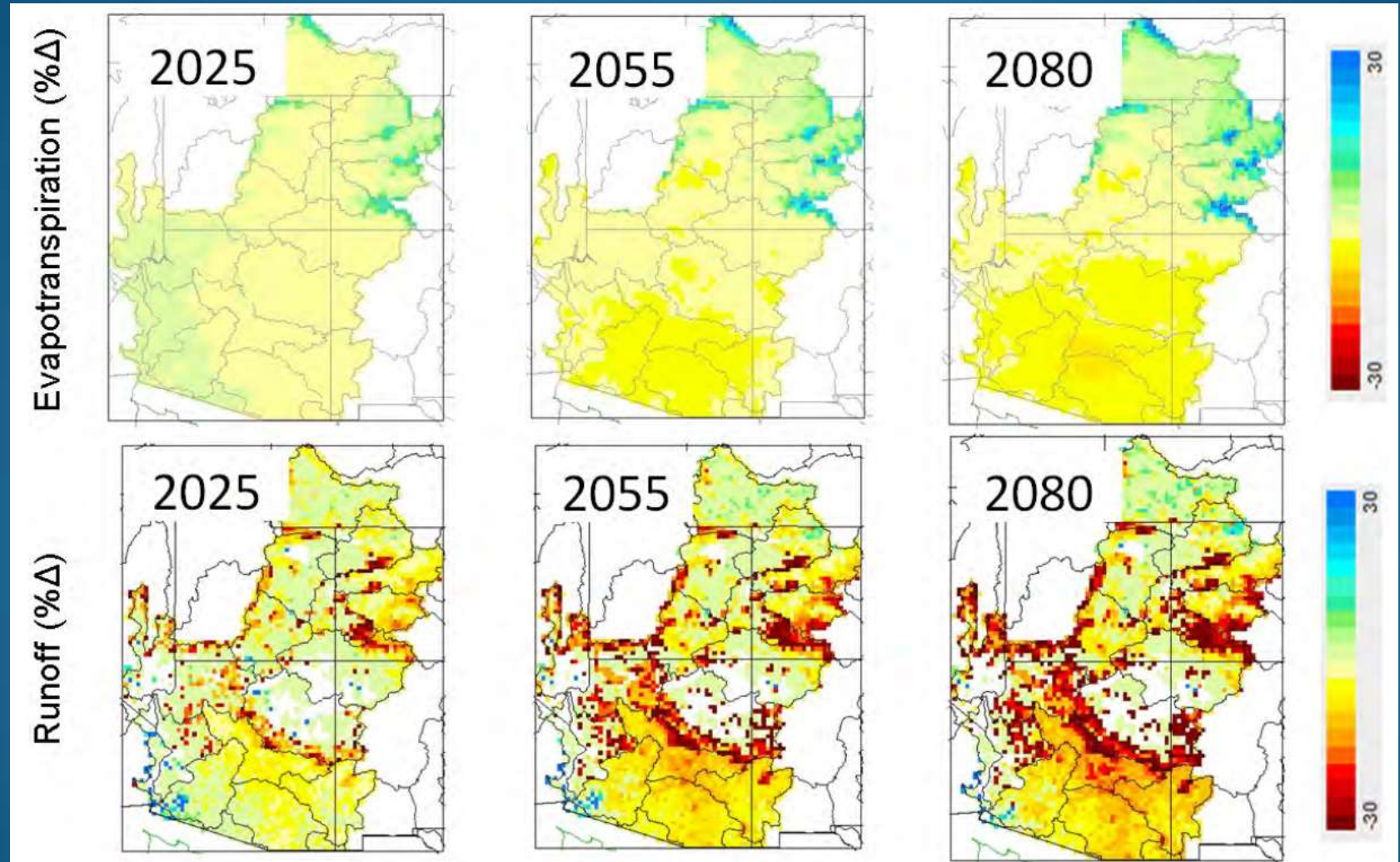
Higher temperatures have led to:

- Less Snowpack
- Changing Precipitation Patterns
- Changing Runoff Timing and Intensity
- Increasing Evaporation and Evapotranspiration
- Water Quality Impacts

Increasing Temperature and Variable Precipitation Impacts

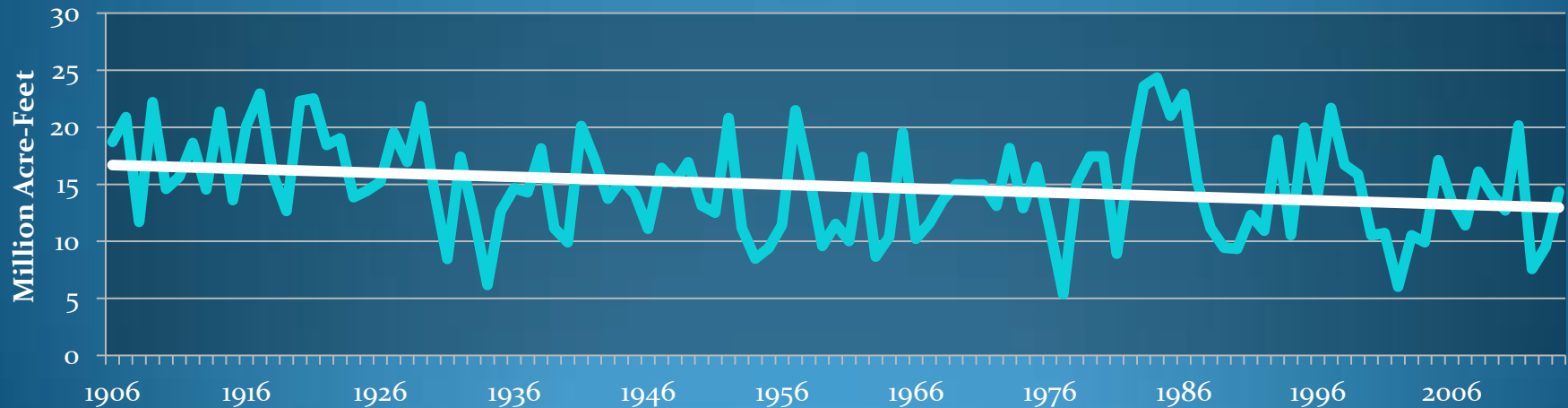


Increasing Evapotranspiration and Decreasing Runoff



Increasing Watershed Evaporation and Evapotranspiration

- Earlier leafing of alpine and sub-alpine plants
- Increasing vegetative growth
- Increasing loss of water from lakes and reservoirs

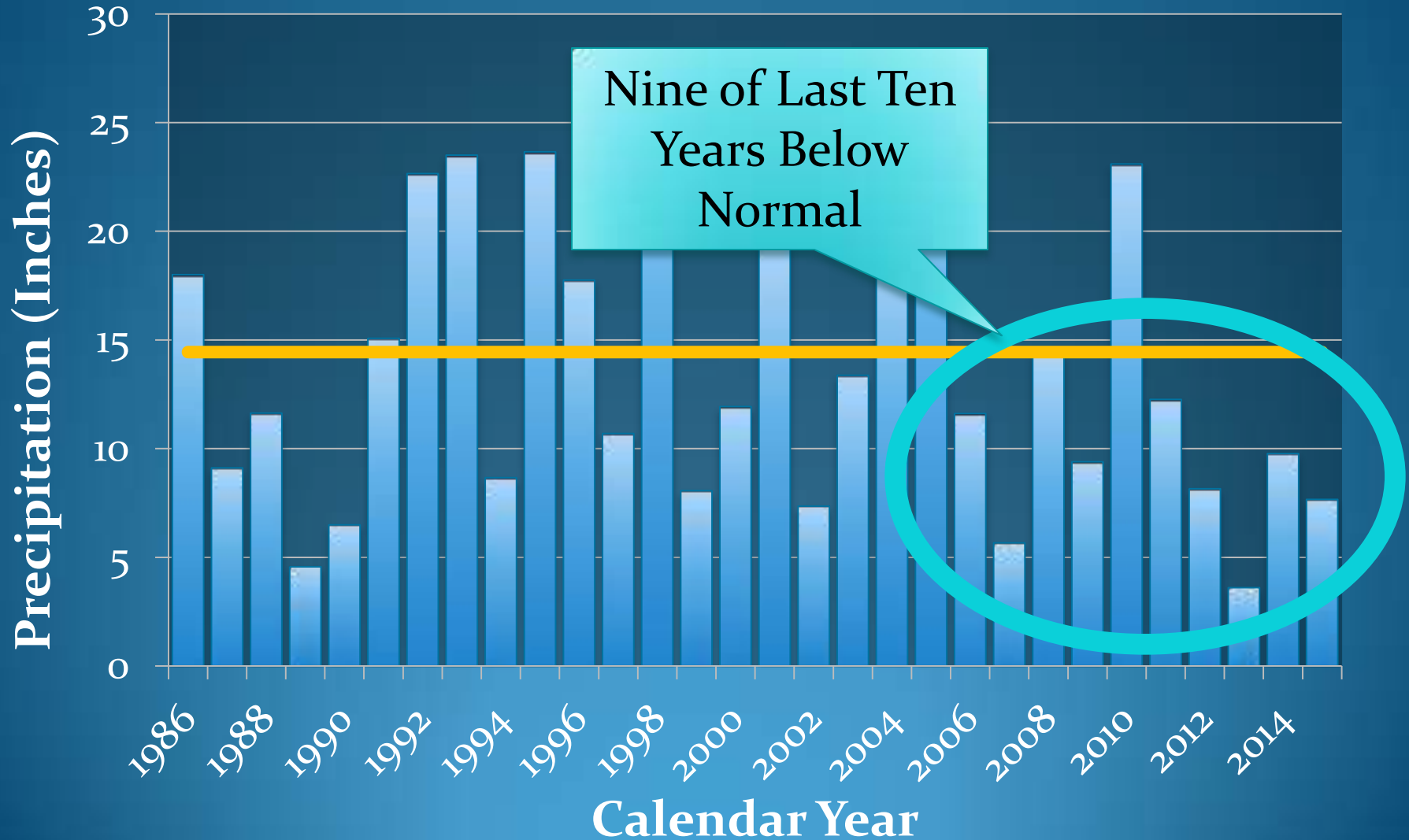


Climate Change Effects on Southern California

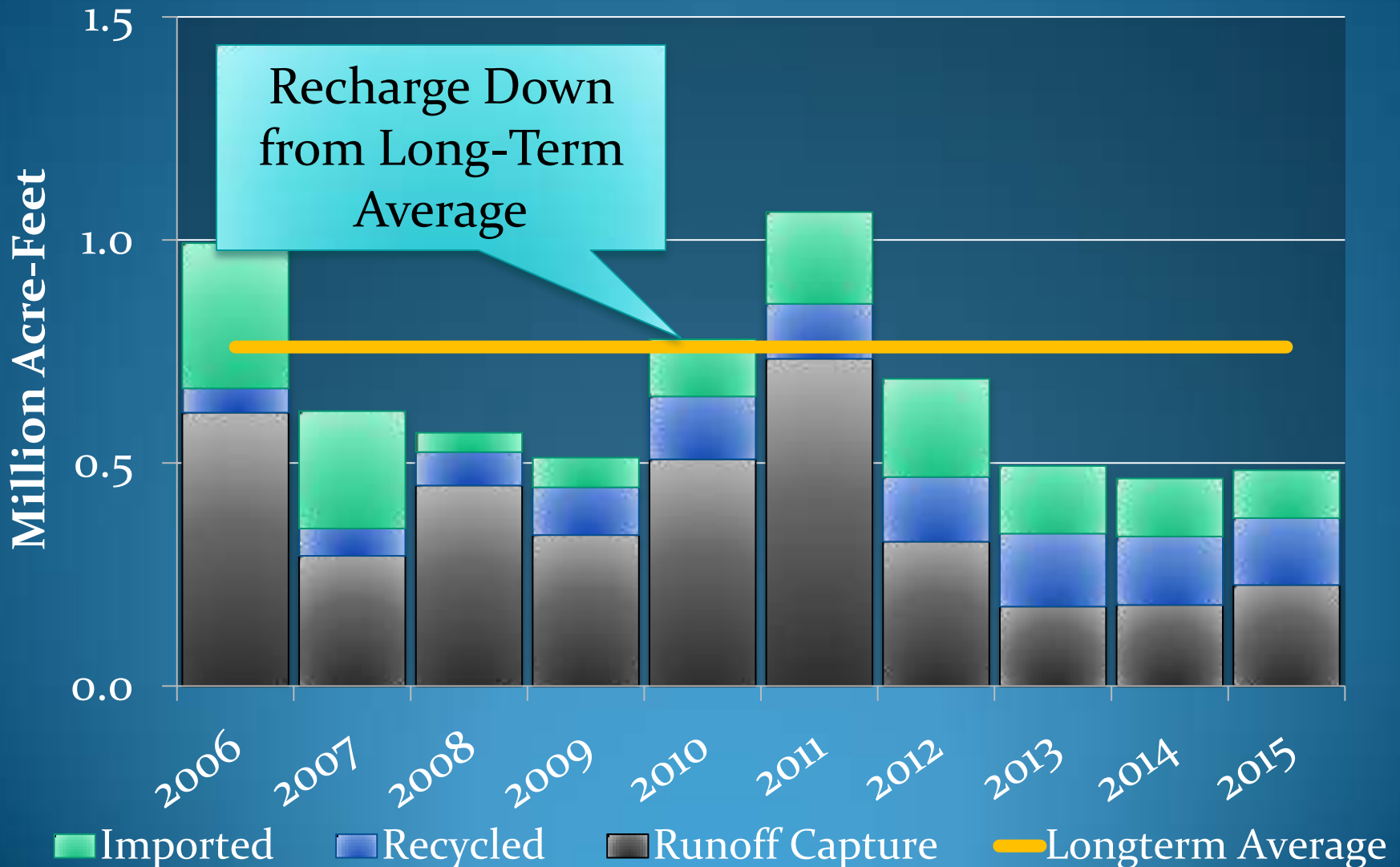
Higher temperatures have led to:

- Changing Precipitation Patterns
- Sea Level Rise
- Increasing Demand Variation
- Water Quality Impacts

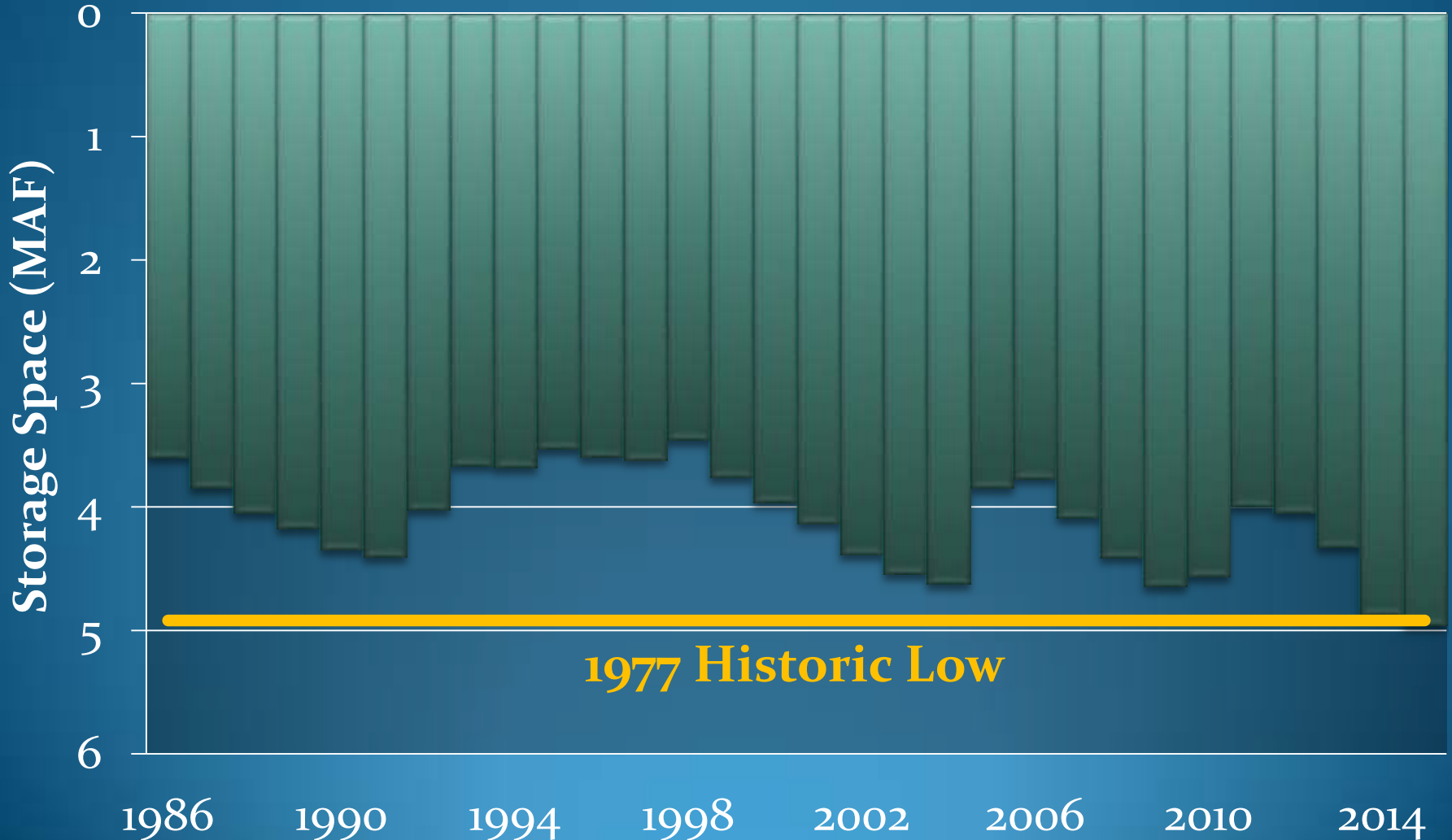
Decreasing Precipitation in Southern California



Declining Recharge of Groundwater Basins



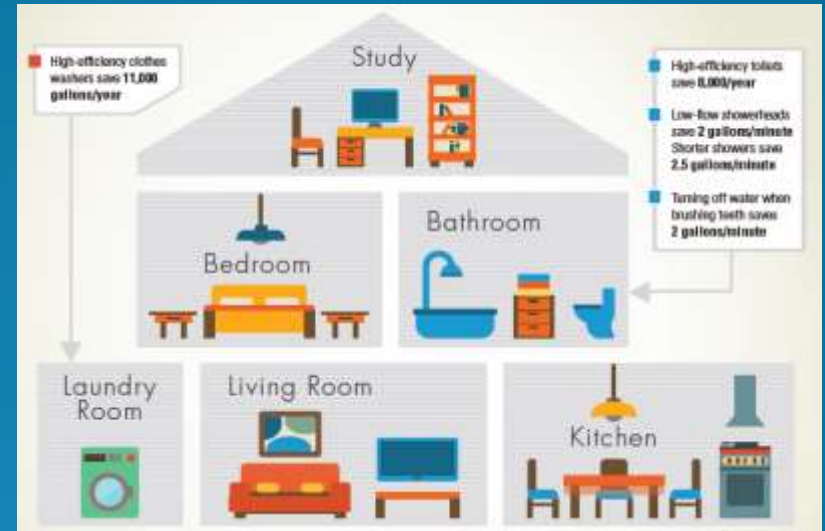
Falling Local Groundwater Basin Levels



Increasing Demand Variation

Indoors

- Little variation due to weather or climate
- Impacts availability of source water for recycling

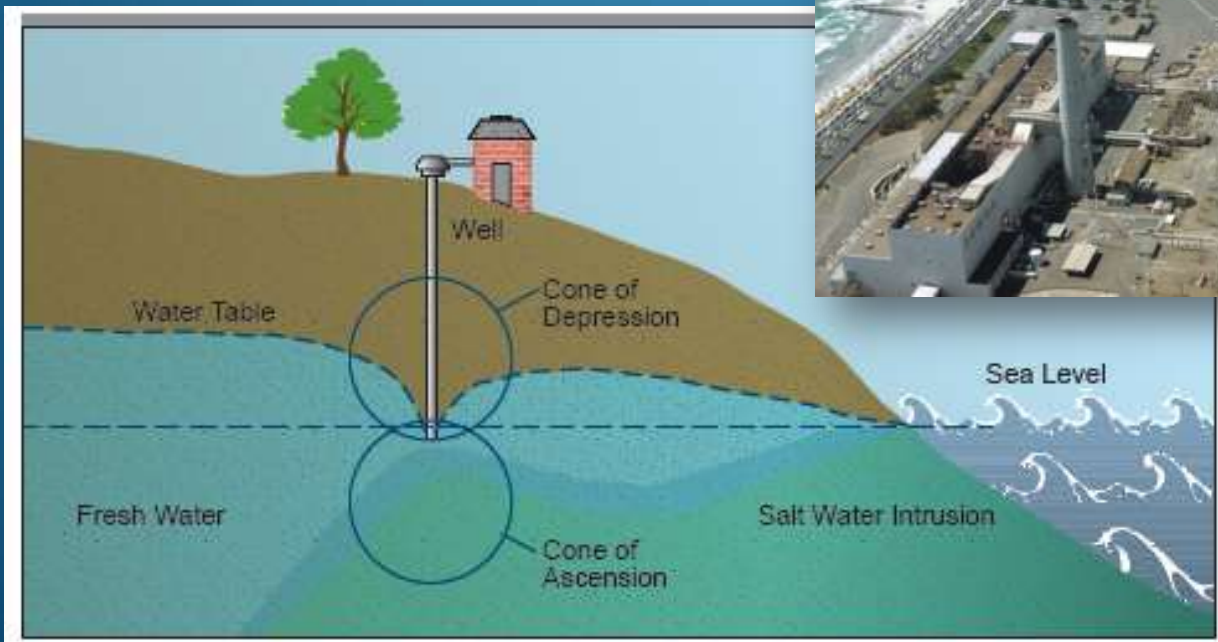


Outdoors

- Landscapes are subject to evapotranspiration
- High variation due to weather or climate

Rising Sea Levels

- Impacts to existing infrastructure and siting of future projects
- Increased salt water intrusion



Declining Water Quality

- Increasing salinity from imported source water
- Increasing frequency of algal blooms
- Increasing sedimentation from burned watershed areas



Strategies for Climate Change Adaptation

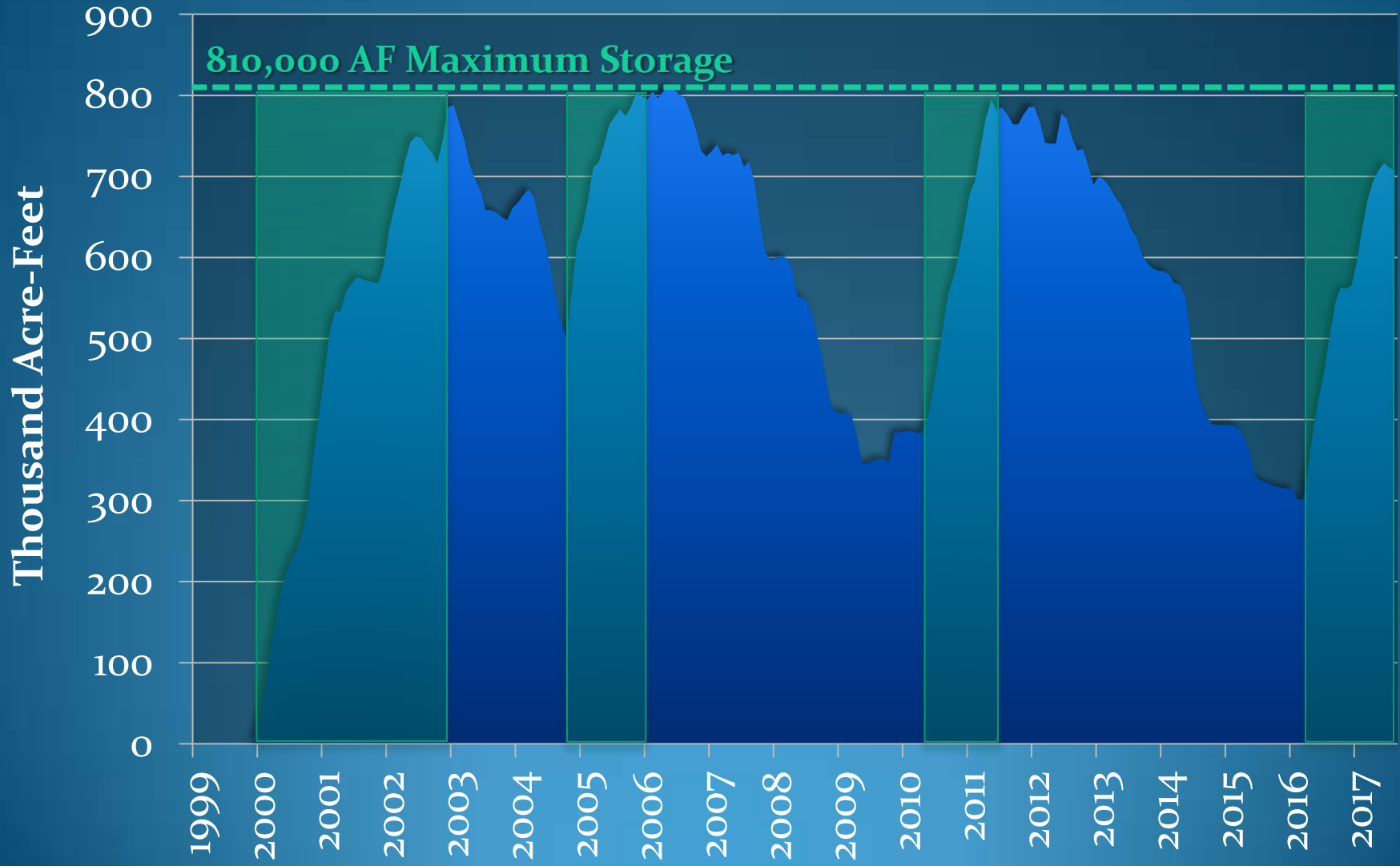
Key Climate Change Adaptation Strategies

- Smart Climate-Resilient Infrastructure Investments
- Demand Management with a focus on landscape
- Environmental and Habitat Restoration

Making Climate Resilient Infrastructure Investments



Maximizing the Storage of Water When its Available



New Storage Helps



Shasta



Sites



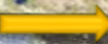
Sacramento

San Francisco

Los Vaqueros

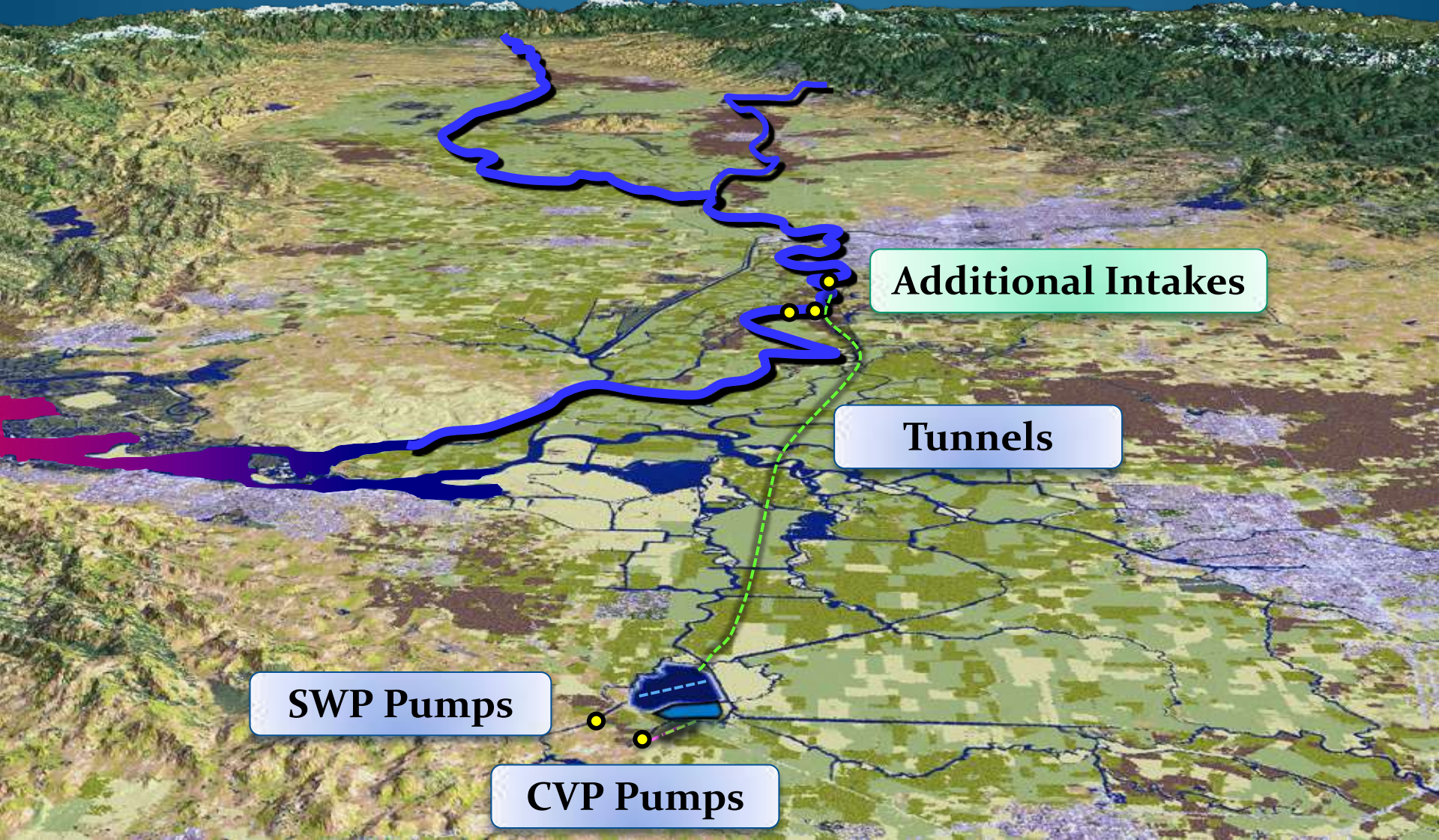


Temperance Flat



Modernizing the State Water Project

California WaterFix



Additional Intakes

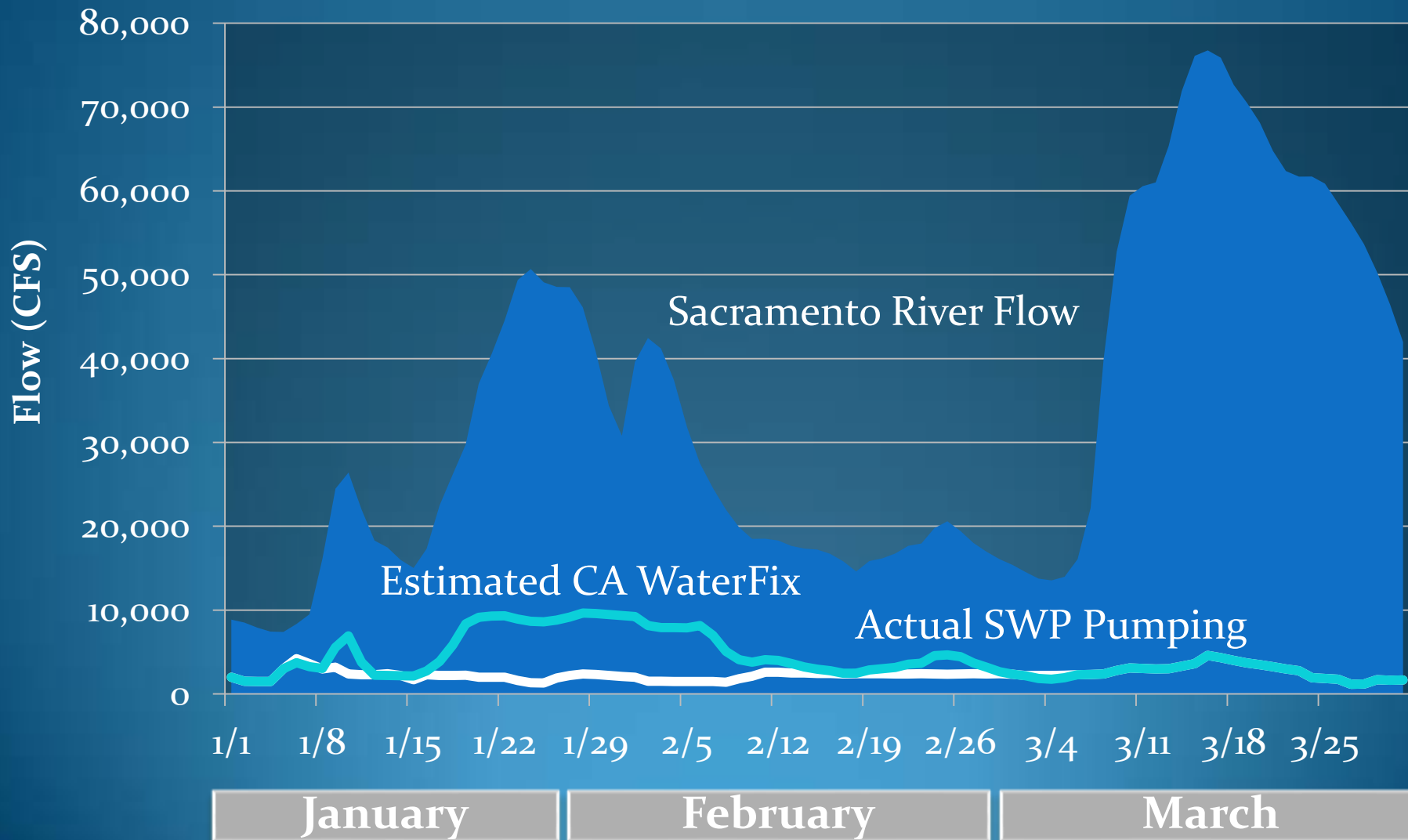
Tunnels

SWP Pumps

CVP Pumps

Capturing Flows from Extreme Events

2016 Winter Storms Example



Colorado River Programs

- Lower Colorado Basin Drought Contingency Plan
- Colorado River System Conservation Program
- Water efficiency projects
- Maintaining levels in Lake Mead



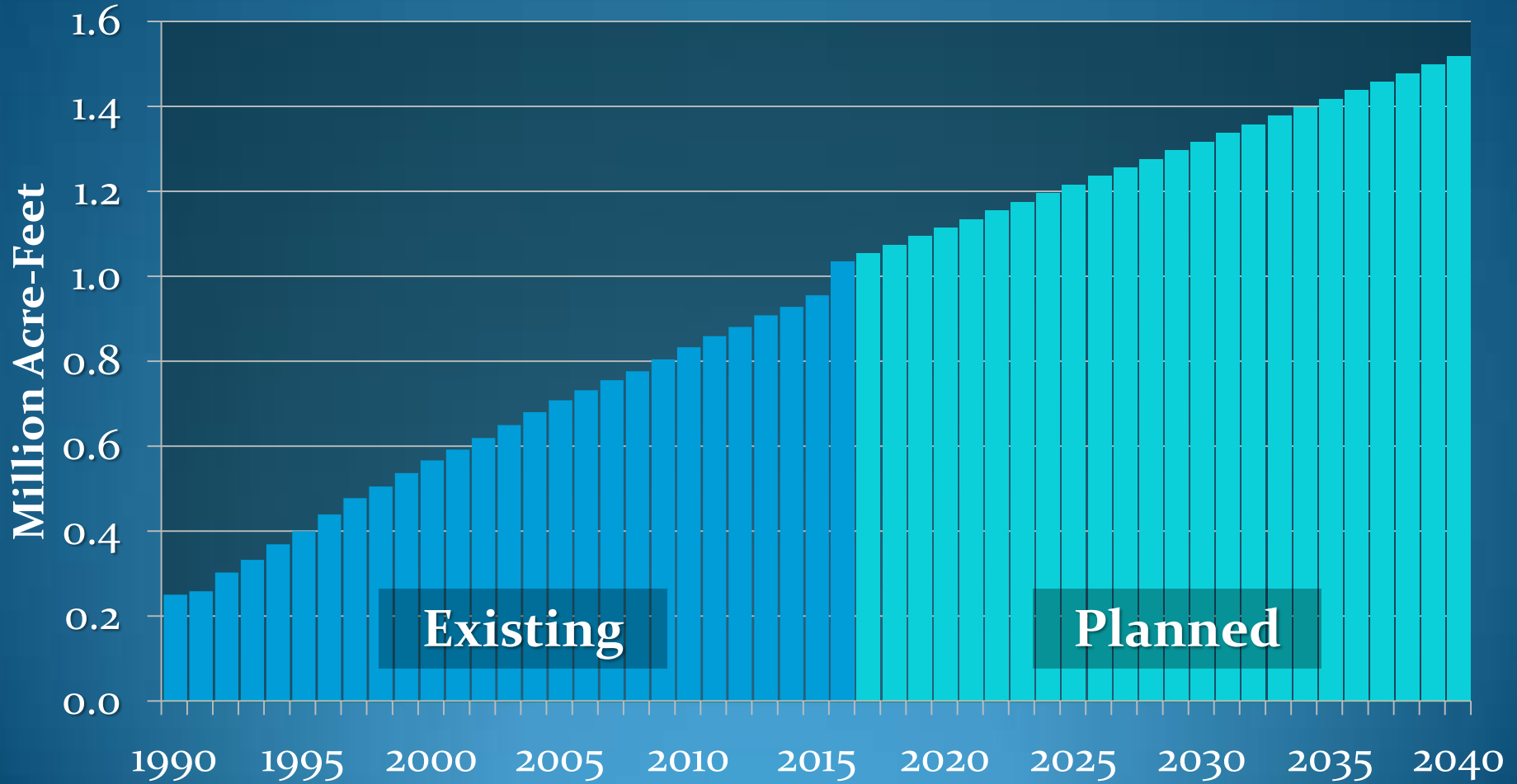
Adaptive Habitat Management

- Restoring critical habitat in the Bay-Delta
- Creating habitat for endangered species on the Colorado River
- Preserving sensitive habitat locally



Continuing Demand Management

Making Conservation a Way of Life



Emphasis is Shifting to Outdoors



Devices



Water Use Surveys



Landscaping



Smart Investments in Local and Regional Supply Projects



**Recycled
Water**



Stormwater



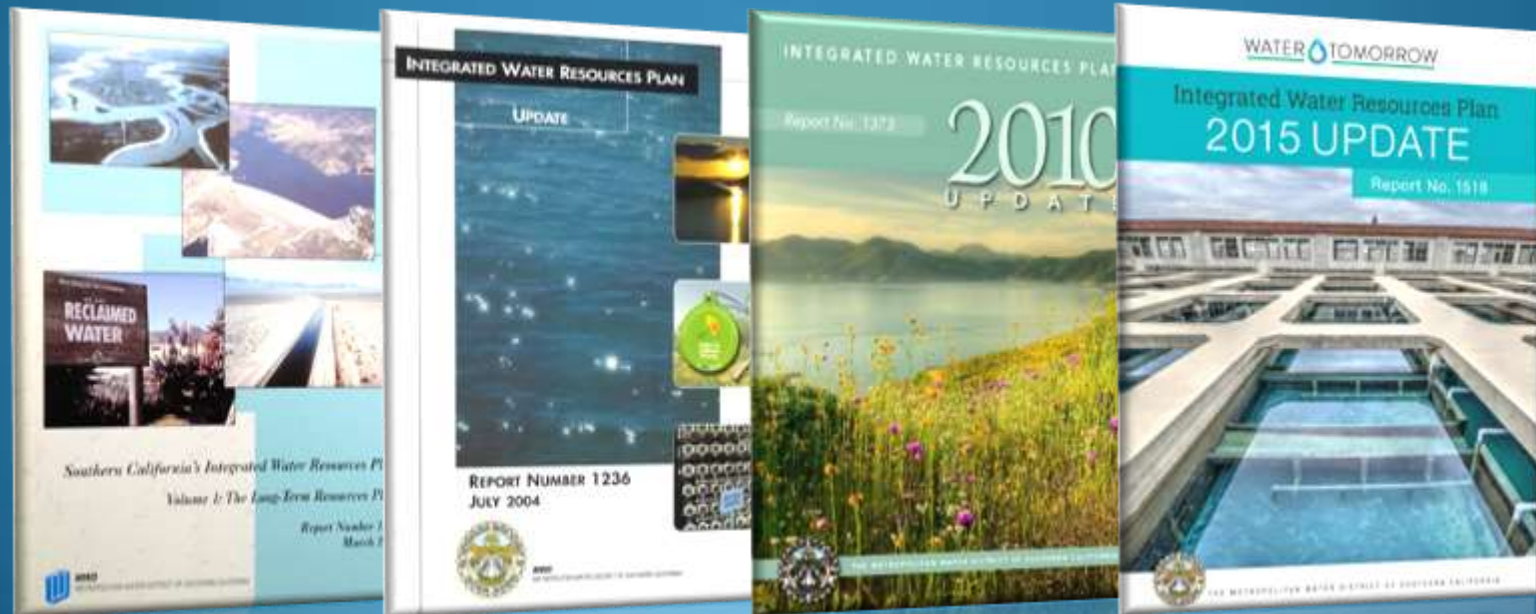
**Groundwater
Recovery**



**Seawater
Desalination**

Continuing to Plan for Climate Change

- Integrated Water Resources Plan
- Water Utility Climate Alliance
- Water-energy nexus



Building into modeling/planning

- Modeling inputs incorporate potential impacts of climate change and sea level rise
 - State Water Project Delivery Capability Report - CADWR
 - Colorado River Basin Water Supply and Demand Study studies – USBR
- Robust Decision Making Modeling in IRP
 - Evaluates multiple future climate scenarios
 - Incorporates additional uncertainties and vulnerabilities

Taking Actions to Mitigate and Reduce Our Carbon Footprint

- Investments in renewable energy
 - Solar power facilities
 - Pipeline hydroelectric power plants
- Facilities management and operations
 - Upgraded heating, cooling and ventilation systems
 - Hybrid fleet vehicles
 - Electric Vehicle Charging Program
 - Water treatment technologies
- Climate Action Registry reporting

Summary

- Climate change impacts are being seen now
 - Recent years show the “new normal”
 - Water resources are impacted by:
 - Increased temperatures
 - Less but more extreme rainfall
 - Loss of snow and storage from snowpack
 - Rising sea levels and salinity
- Flexible and adaptive strategies are essential
 - Demand management - especially outdoors
 - Smart climate-resilient infrastructure investment
 - Habitat and environmental restoration
 - Reduced energy and GHG impacts



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