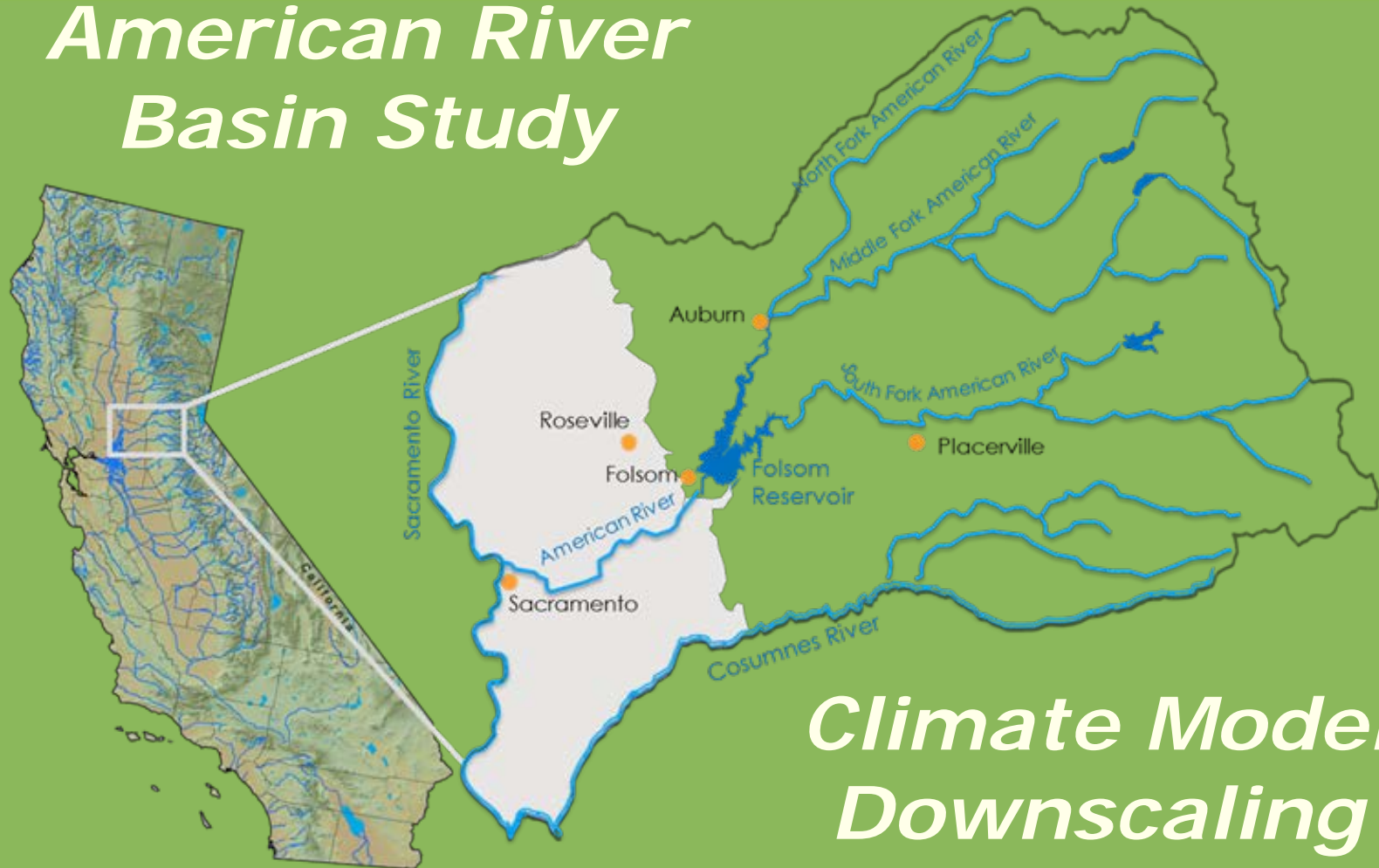


American River Basin Study



*Climate Model
Downscaling*



ARBS Study Objectives

- Further refine the assessment of water supplies and demands for the American River Basin
- Address regional **supply-demand imbalance** and infrastructure deficiencies under the existing and **future climate change conditions**.
- Improve **coordination of local and Federal water management**.
- Align **water management tools**, strategies, and planning efforts of Reclamation and water agencies in the basin.
- Identify water management strategies and actions which remain functional across multiple future potential climate and socioeconomic conditions to 2100 AD.



FOLSOM
DISTINCTIVE BY NATURE

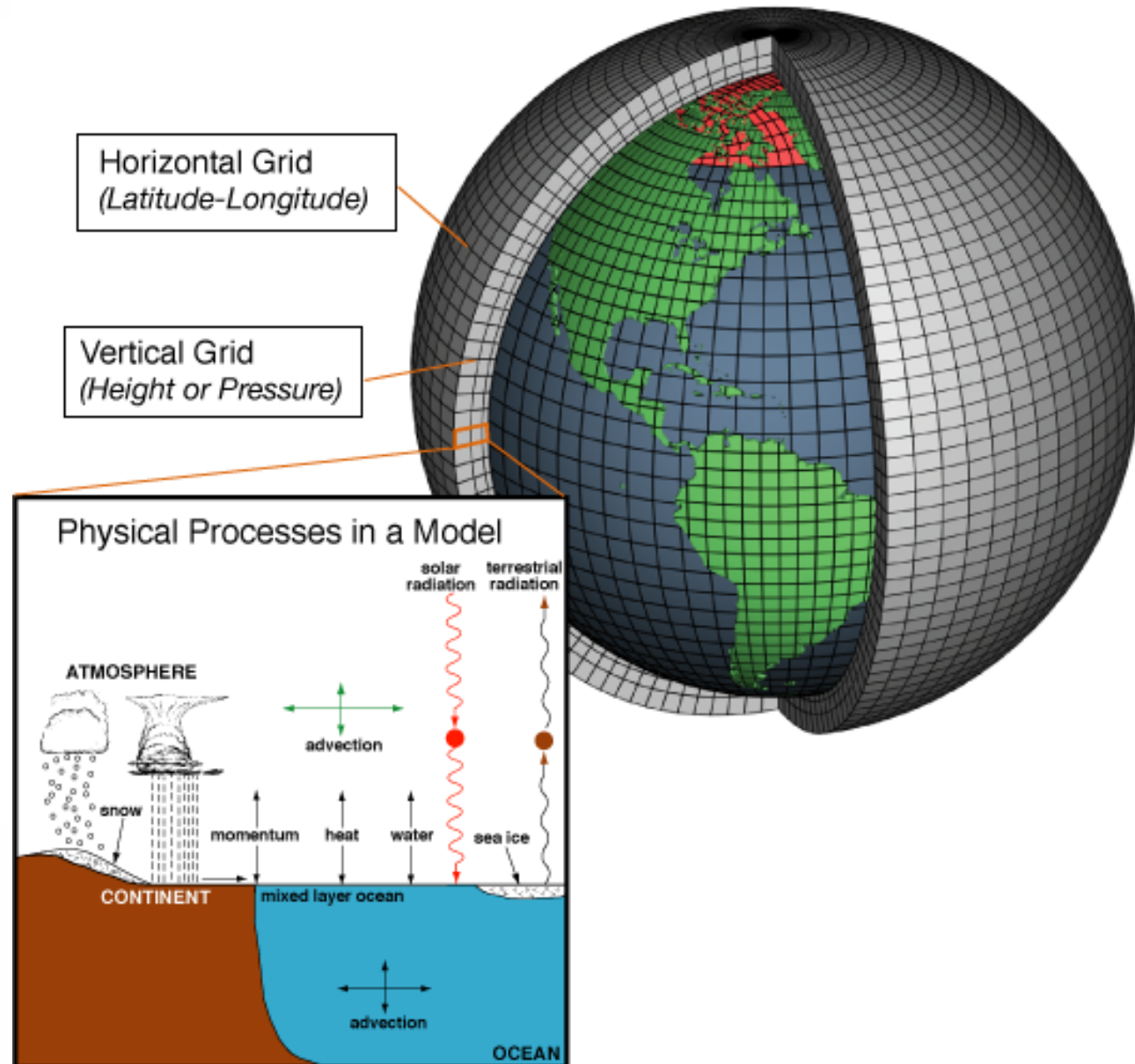


City of
SACRAMENTO



Coupled Model Intercomparison Project – Phase 5 (CMIP5) Multi-Model Dataset

- 61 Global Climate Models
- 4 long-term emissions scenarios
- Completed in 2012, used for IPCC Fifth Assessment Report
- Best available projections of future climate conditions.



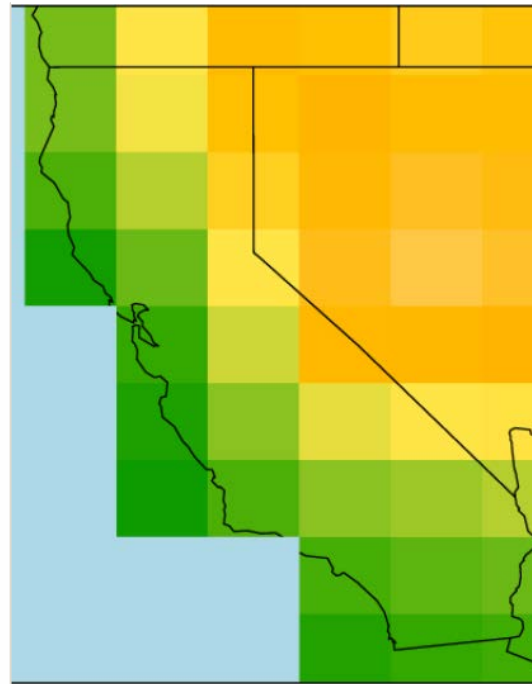


LOCA Multi-Model Dataset

- 32 Global Climate Models
- 2 long-term emissions scenarios
- Developed at Scripps, publicly available through web-portal
- Recommended by DWR and CWC for long-term planning in California

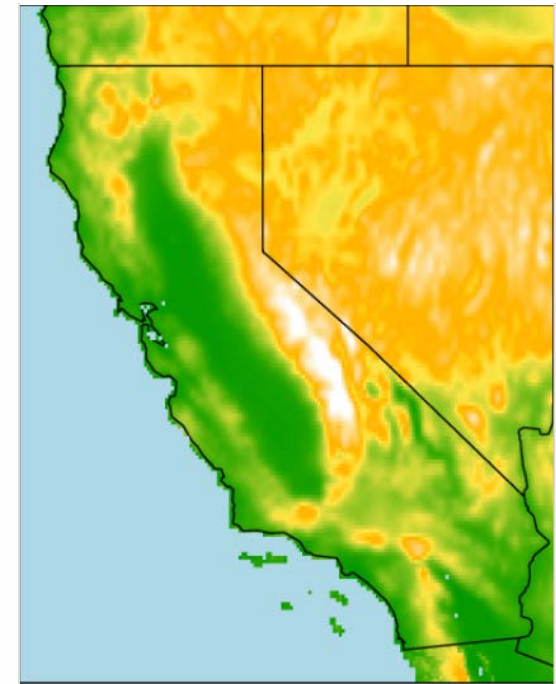
Spatial Downscaling

Typical GCM

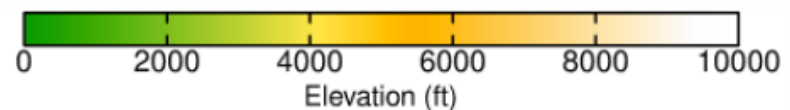


(~1.5° x ~1.5°)

LOCA



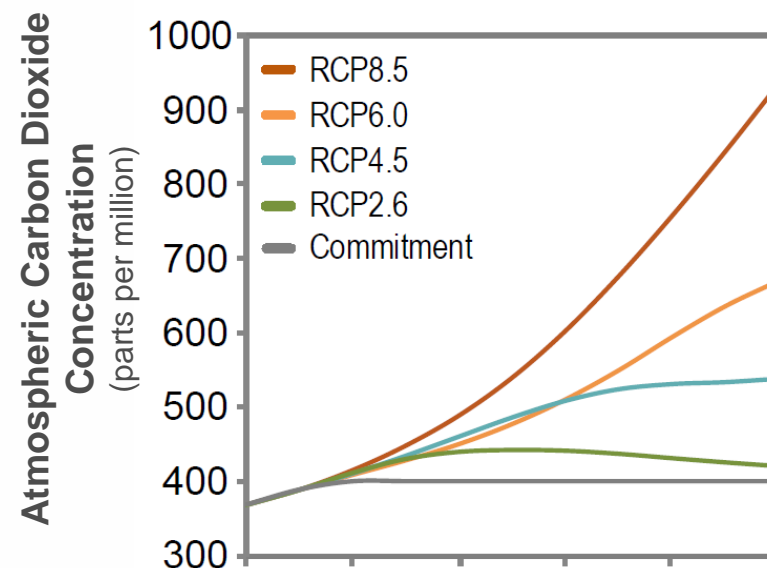
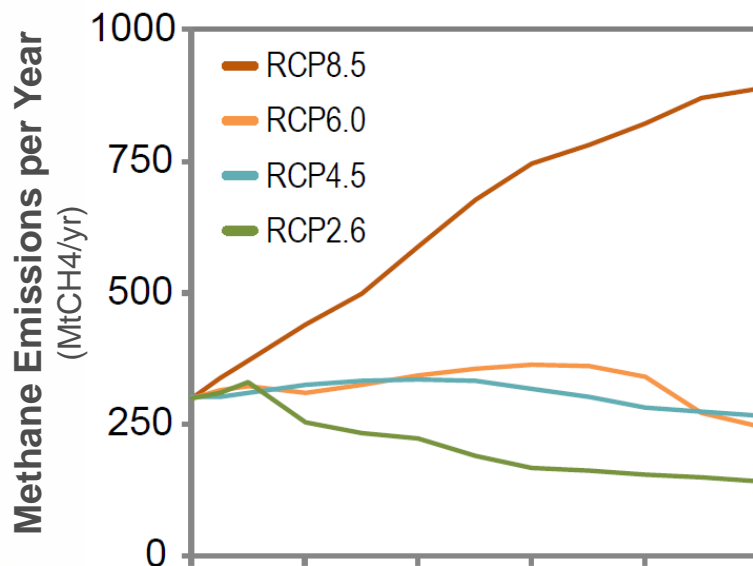
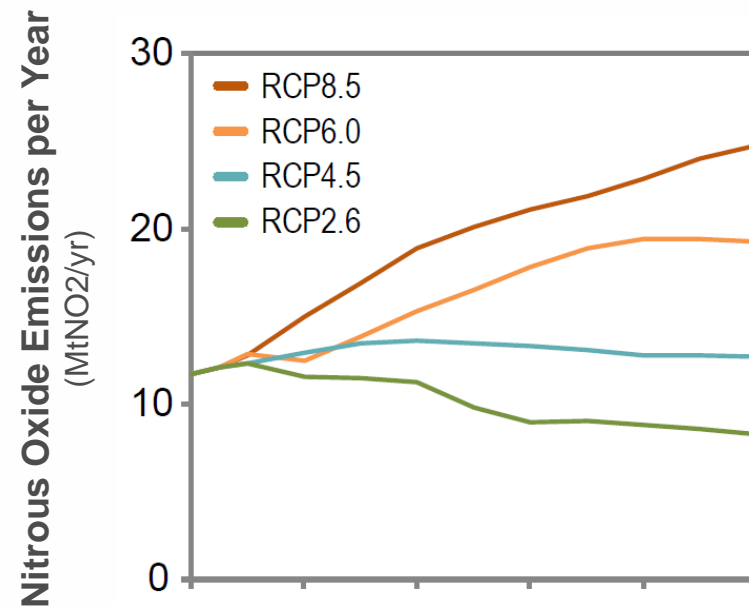
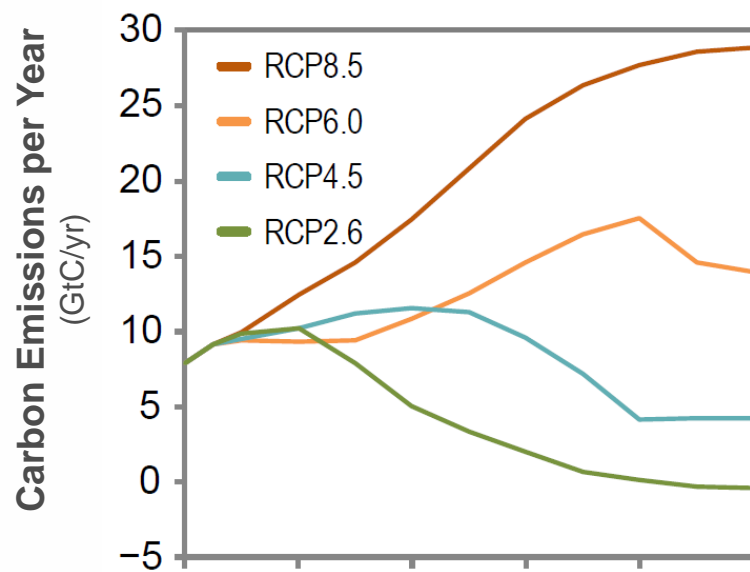
(1/16° x 1/16°)



Elevation (ft)



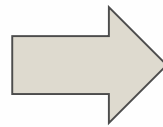
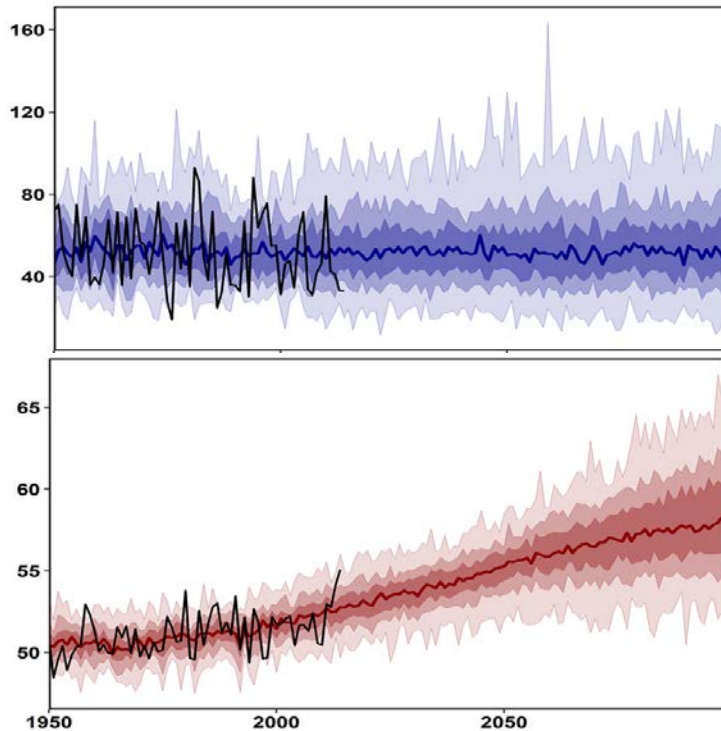
Representative Concentration Pathways (RCP) Emission Scenarios



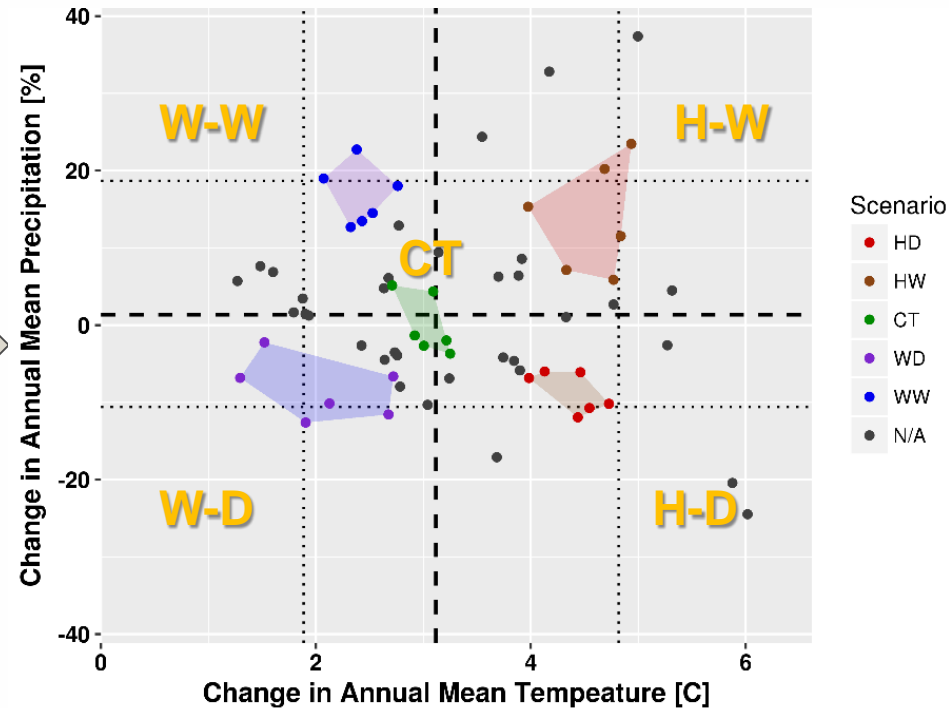


Development of Climate Scenarios for ARBS

Ensemble of 64 GCM Projections



Projection Selection for 5 Scenarios

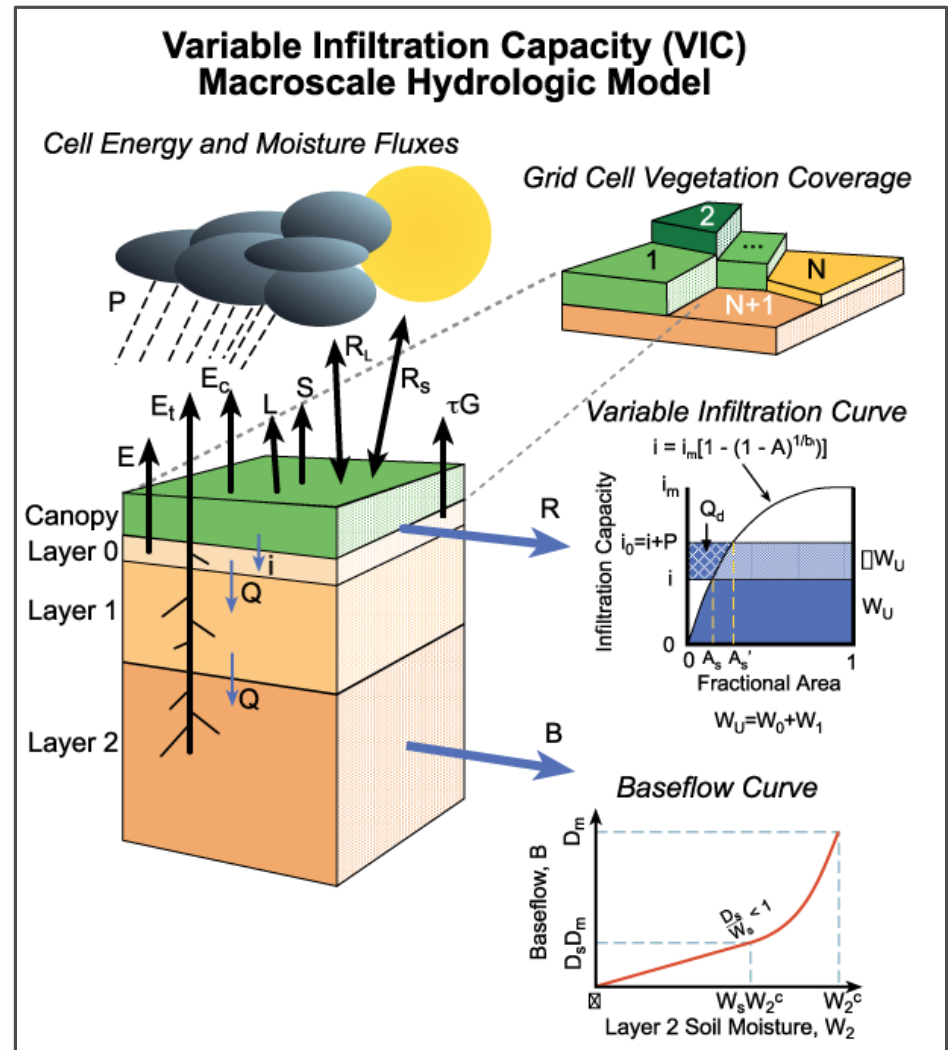


Hydrology Scenarios

- Climate scenarios used to force VIC Hydrology Model

CalSim Scenario Inputs

- Simulated runoff and potential ET used to re-scale CalSim3 inputs to reflect climate scenarios



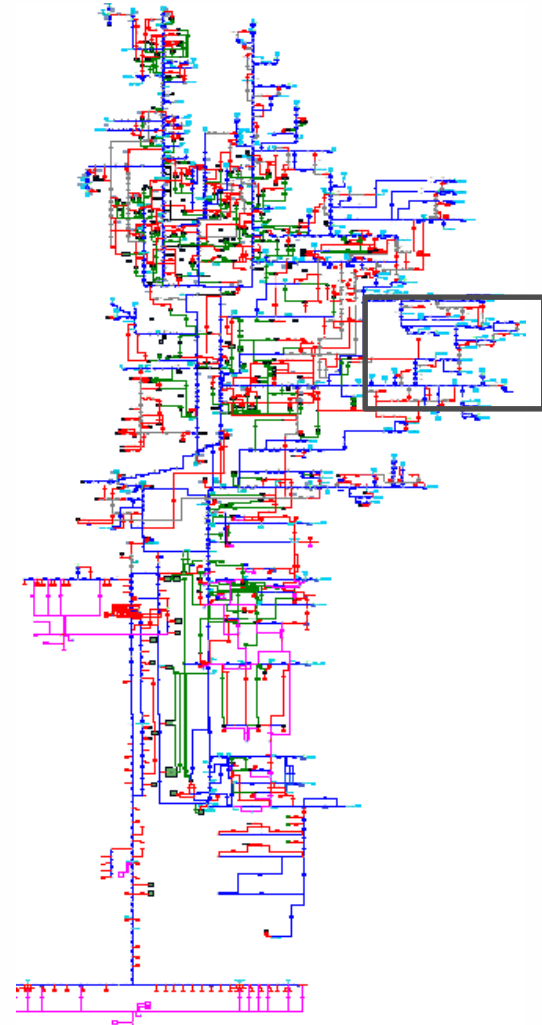
CalSim III American River Operations Module

Complete representation of operations in the American River Basin

CalSim III Domain

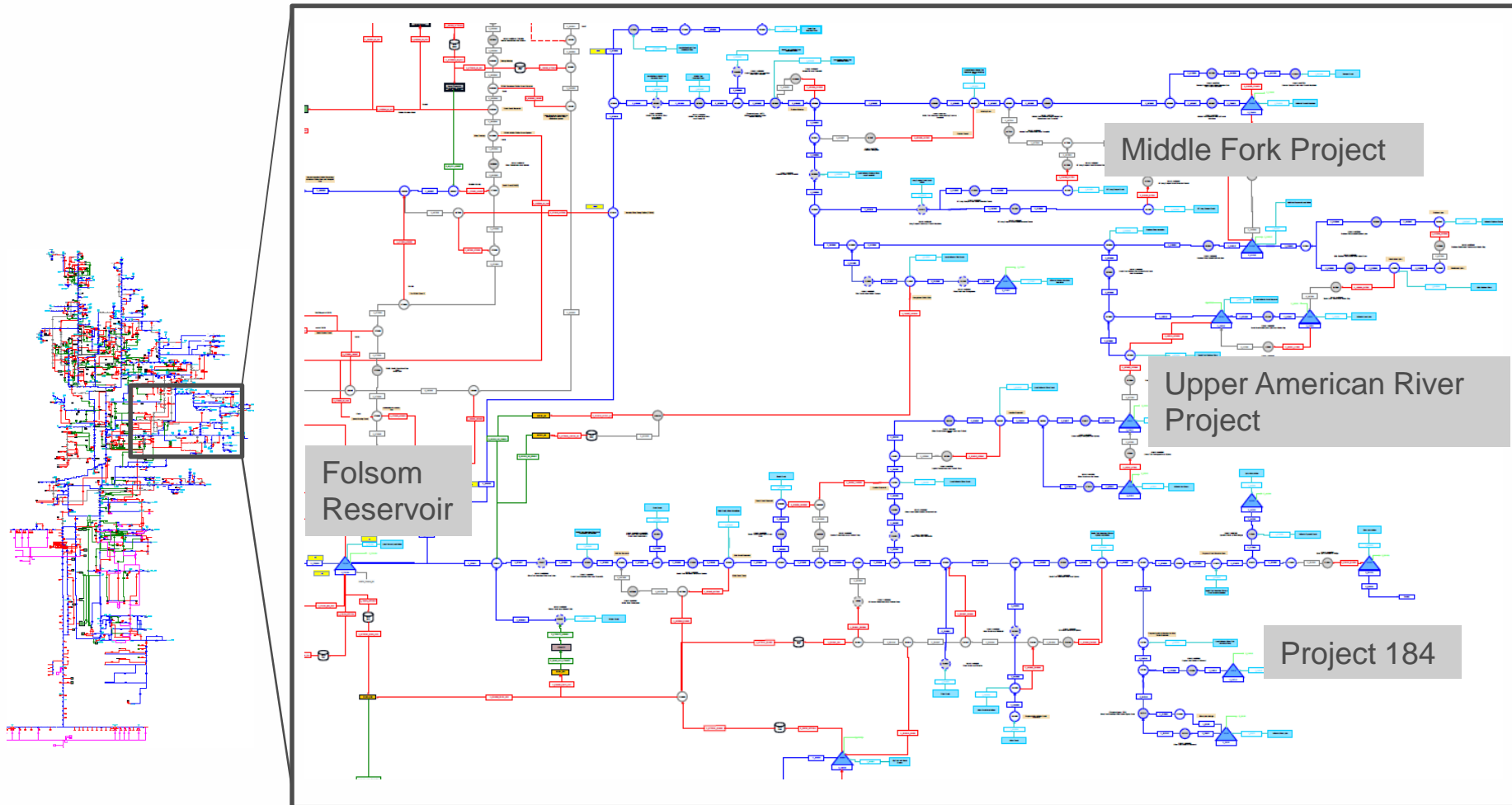


CalSim III Model Schematic



Complete representation of operations in the American River Basin

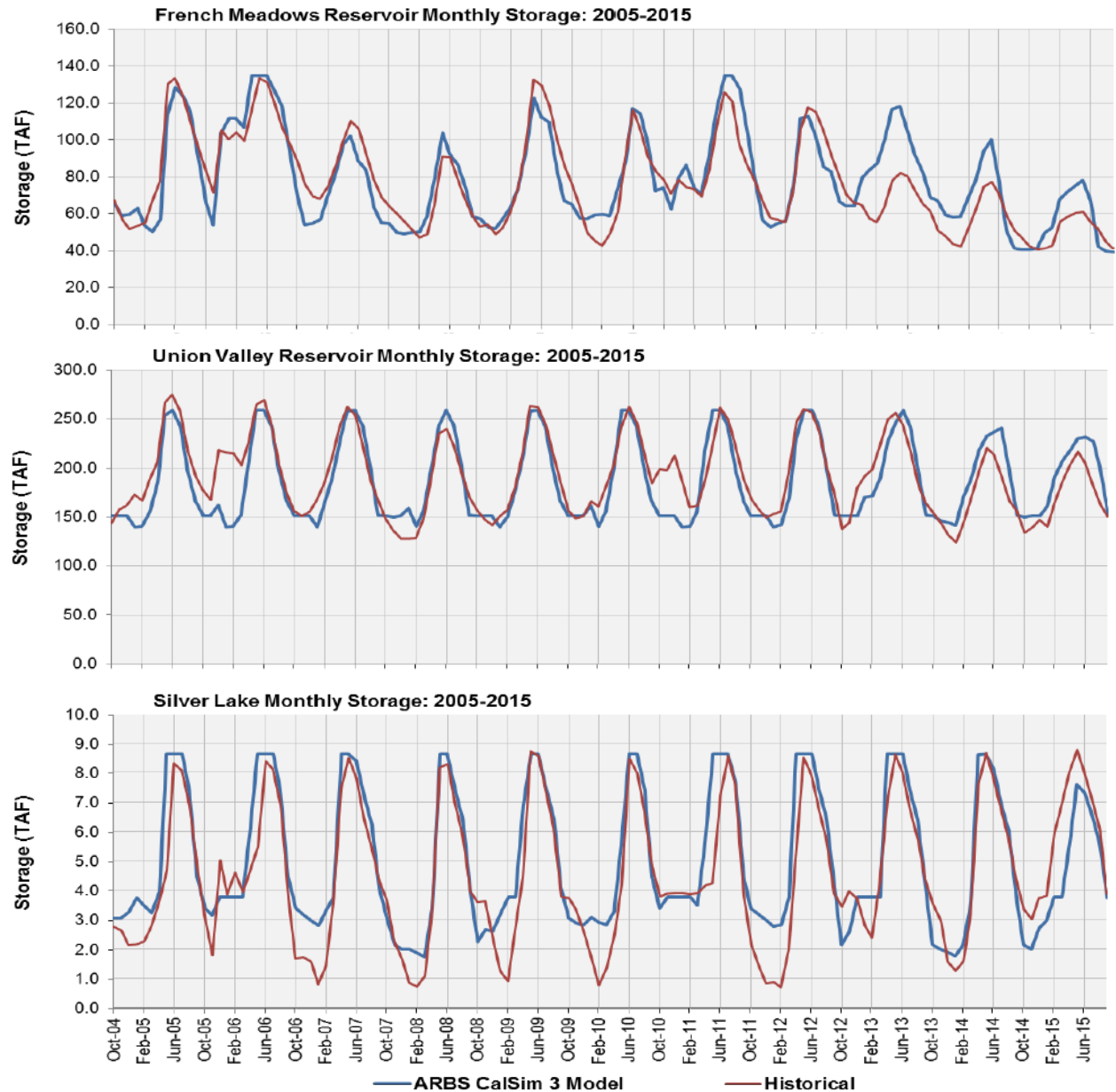
American River Basin Representation in CalSim III



Middle Fork Project

Upper American
River Project

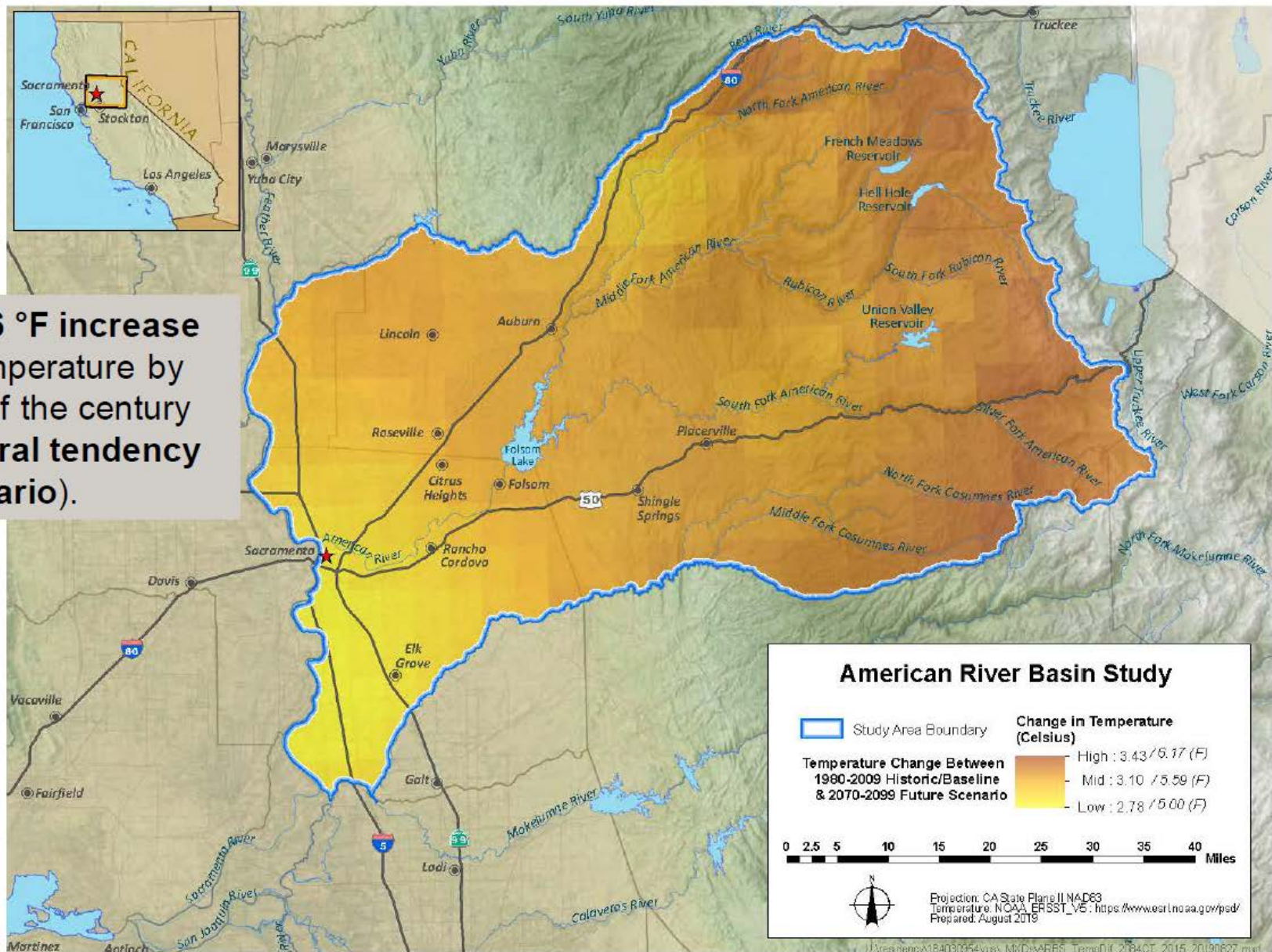
EID - Project 184



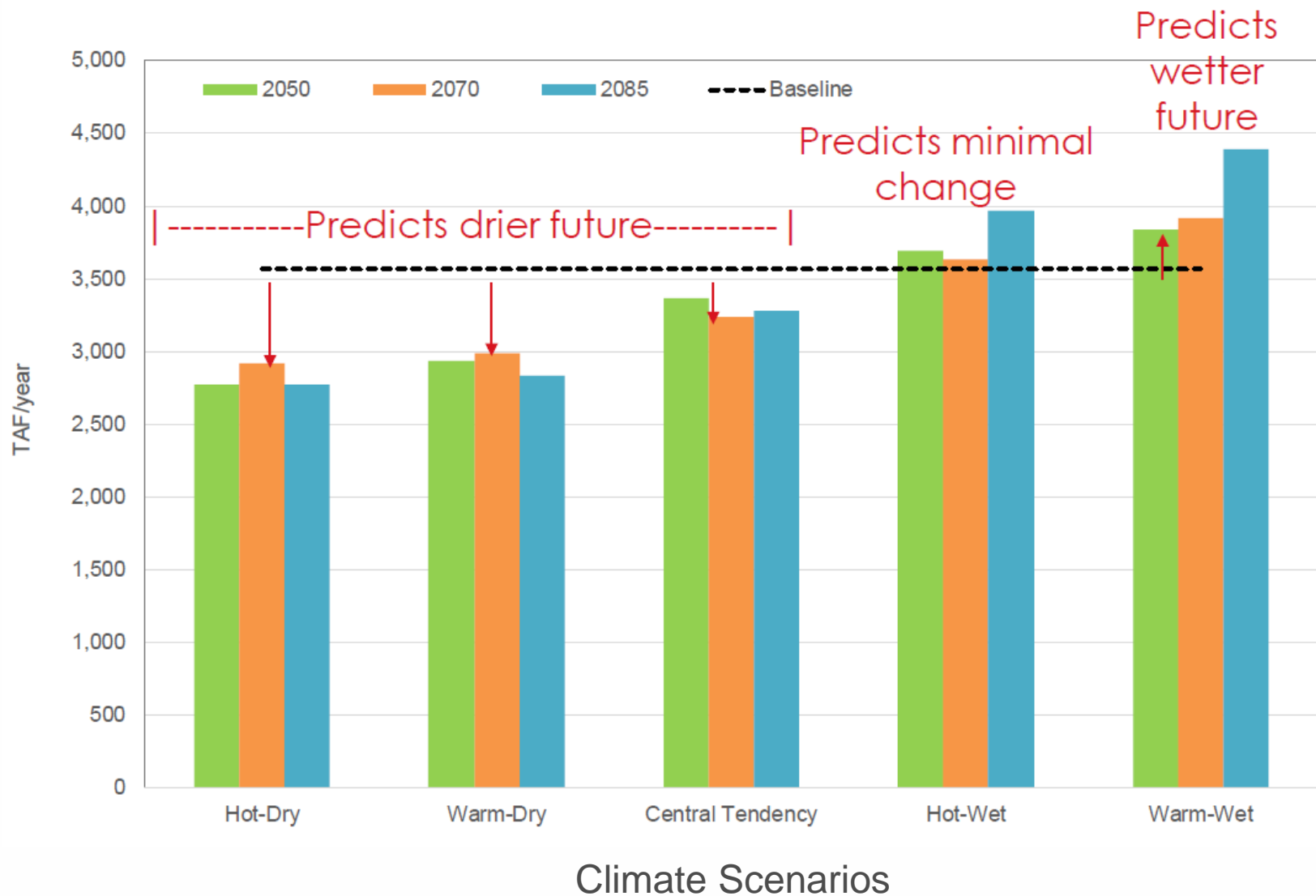
CLIMATE CHANGE PROJECTIONS

ARBS Projection of Temperature Increases by Elevation

5 to 6 °F increase
in temperature by
end of the century
(central tendency
scenario).



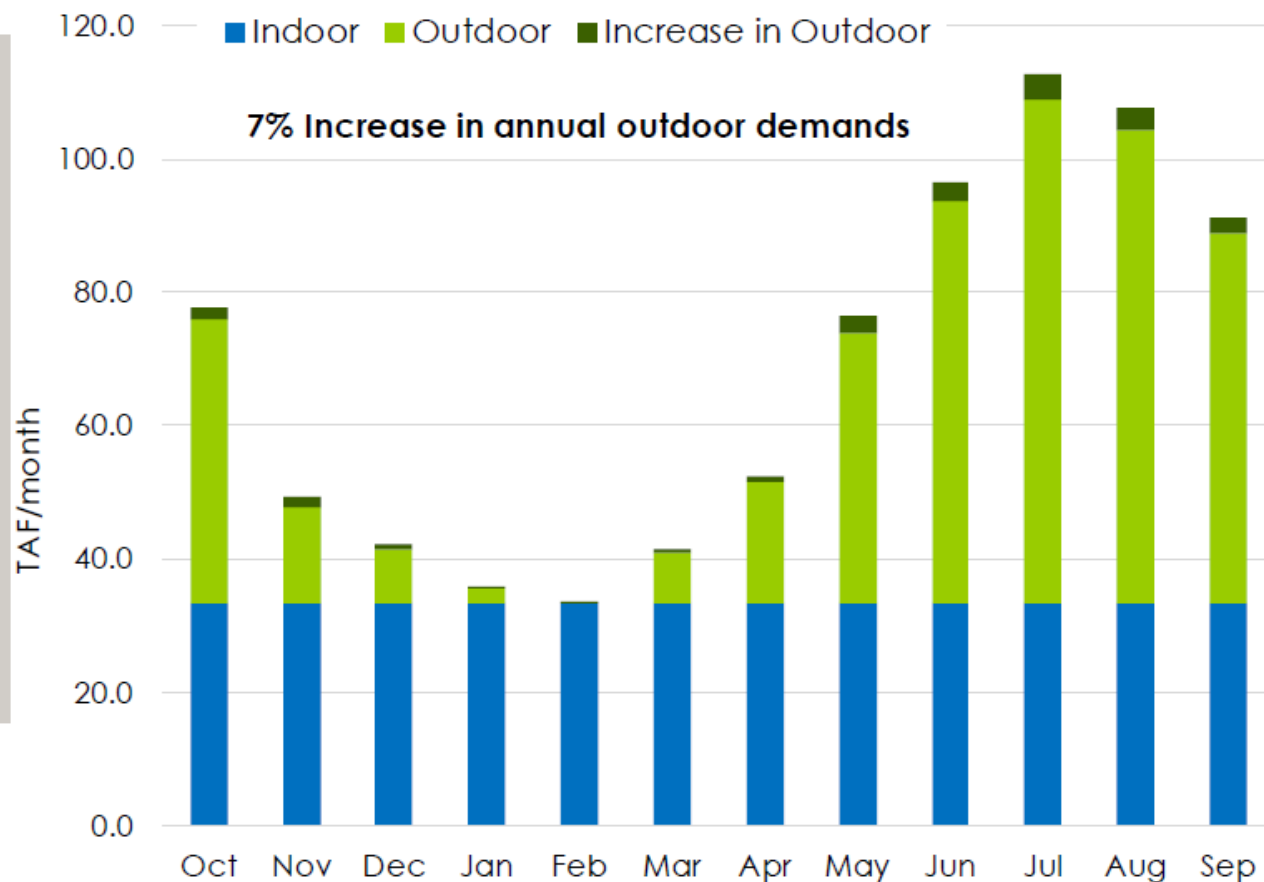
Supply: ARBS Projected Changes in Unimpaired Flow



Demands: Increase in irrigation

Higher evapotranspiration rate results in higher outdoor irrigation demand.

Under similar urban landscaping, irrigation water demands could increase up to 7%, about 3% in total demands (2050 Central-Tendency scenario)



Changes in Timing of Runoff

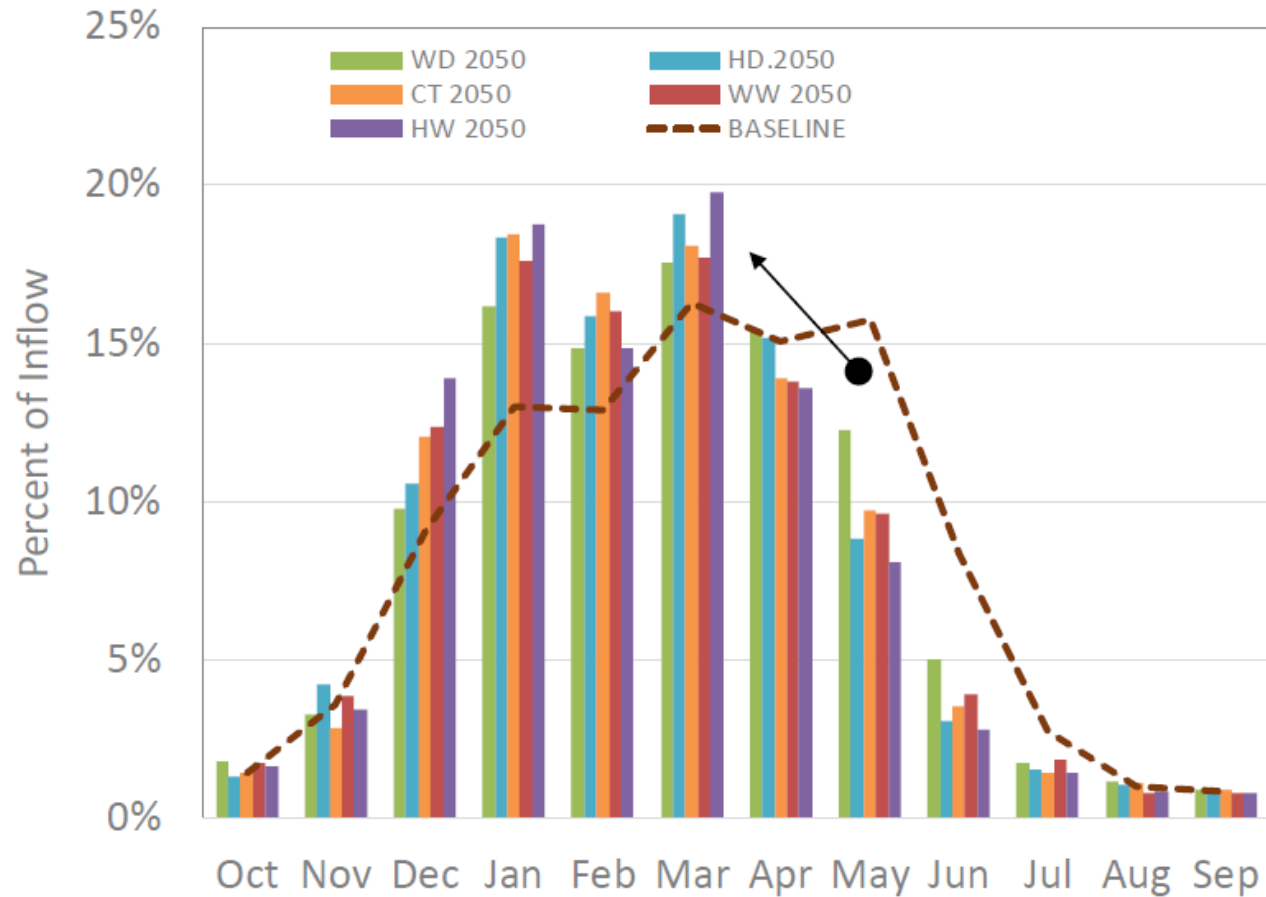
Early snowmelt and less precipitation as snowfall



Runoff will occur earlier in the year



Lower spring runoff

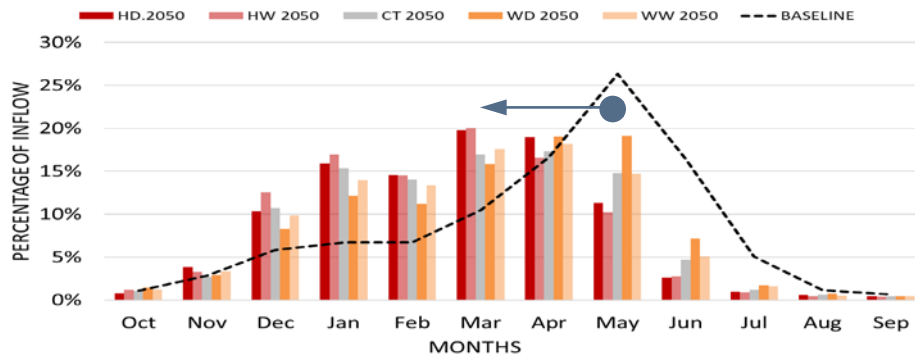


Earlier runoff would increase the chance of spills from Folsom reservoir during flood season.

Earlier runoff would reduce water supply available during summer and fall for M&I, ecosystem, hydropower, irrigation, recreation, etc.

Changes in Timing of Snowmelt

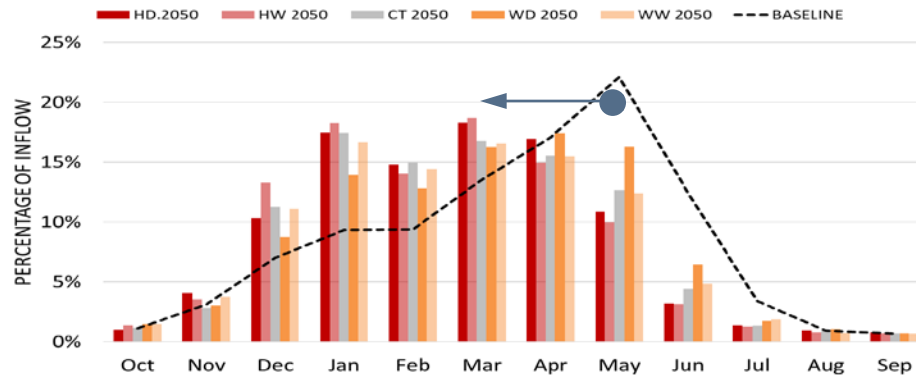
Elevation > 5,000 feet



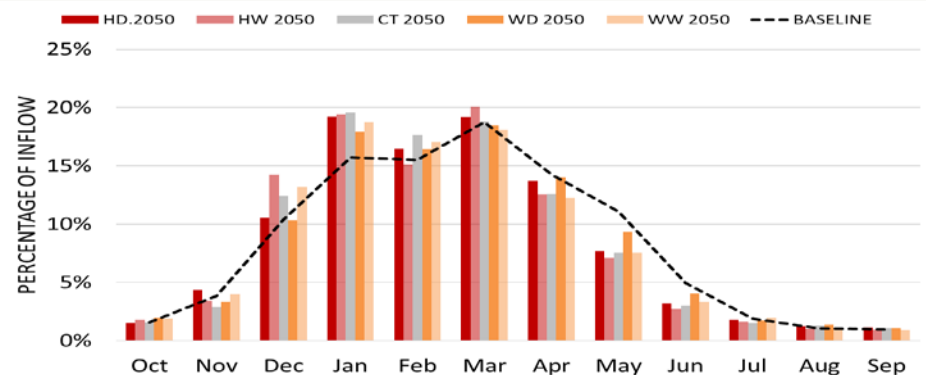
Under future conditions, runoff is expected earlier at elevations above 3,000 feet, with peak snowmelt 30-60 days earlier.

Under historical conditions, runoff occurs in late spring at elevations above 3,000 feet, peaking around May.

Elevation 3,000 to 5,000 feet



Elevation < 3,000 feet



ADAPTATIONS

Preparing for present-day droughts and preparing for a warming climate involve the same adaptations.

1. Improve Operational Flexibility

- Increase upstream storage
- Modified carryover storage targets and timing
- Develop groundwater bank
- Expand conjunctive use programs
- Relocate diversions to less sensitive locations
- Implement forecast based flood operations

2. Diversify Water Supplies

- Increase regional water reuse
- Implement stormwater capture

3. Improve Demand Management
 - Increase water use efficiency
4. Improve Resource Stewardship
 - Improve Headwaters and Forest Health
 - Improve Lower American River Ecosystem
5. Secure Institutional Agreements to Enable Flexibility
 - Resolve water supply contracts
 - Develop water marketing supporting tools and management framework

QUESTIONS?

