WATER RESOURCES

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Broad Research Effort

Report here on studies by

- DWR Chung et al., “Progress in Incorporating Climate Change into Management of California’s Water resources”
- UC Davis Medellin et al., “Climate Warming and Water Supply Management in California”
- UC Berkeley/Natural Heritage Institute

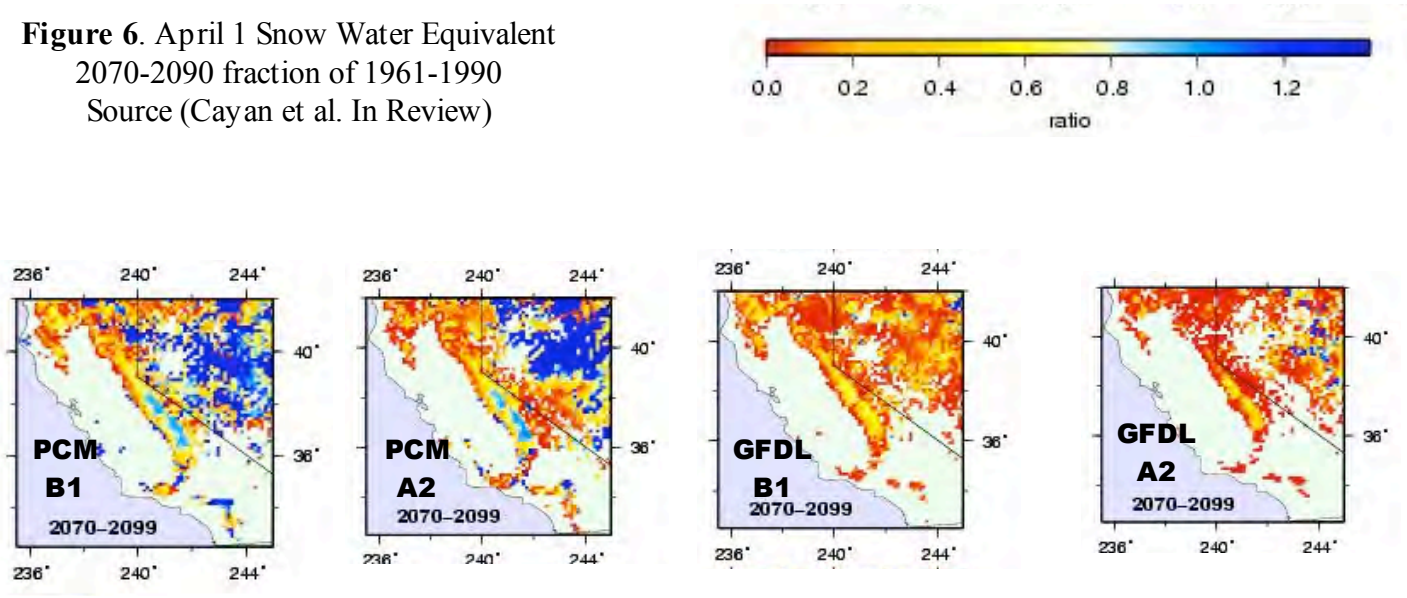
  Joyce et al., “Climate Change Impacts on Water for Agriculture in California: A Case Study in the Sacramento Valley”

  Vicuna, “Predictions of climate change impacts on California water resources using CalSim-II: A Technical Note

Impact on Sierra snow pack

- Although precipitation is projected to change only modestly, rising temperatures will lead to a diminished Sierra snow pack.
- More rain, less snow in the winter. The snow that does fall will melt in early spring rather than late spring and summer.
- Full effect of these changes depends on whether reservoirs can be managed to capture earlier snowmelt and maintain water supply without losing flood control and hydropower capacity.

Figure 6. April 1 Snow Water Equivalent 2070-2090 fraction of 1961-1990
Source (Cayan et al. In Review)



Low Temperature Scenarios

Medium Temperature Scenarios

Flooding

- Increasing temperatures push the snow level to higher elevations, leaving more of the watershed available to contribute to direct winter runoff.
- A simulation using a simple hydrologic model of the Feather River watershed shows that, as the snow level elevation rises from 4,500 feet to 5,000, 6,000 or 7,000 feet, the peak runoff in a winter storm increases by 23%, 83% and 131%m, respectively.
- Population growth and urban development in the floodplain interact with climate change to create large potential damages from flooding.

Inflow to reservoirs

Two methods used to project effects on stream flow and reservoir inflow:

- "Perturbation ratio" approach (CALSIM)
  Take baseline sequence 1922-1974 and modify it by the ratio of new to baseline monthly flow.
- Water Evaluation and Planning (WEAP) Model Raw time series of precipitation and temperature applied to watershed hydrology model directly generates streamflow

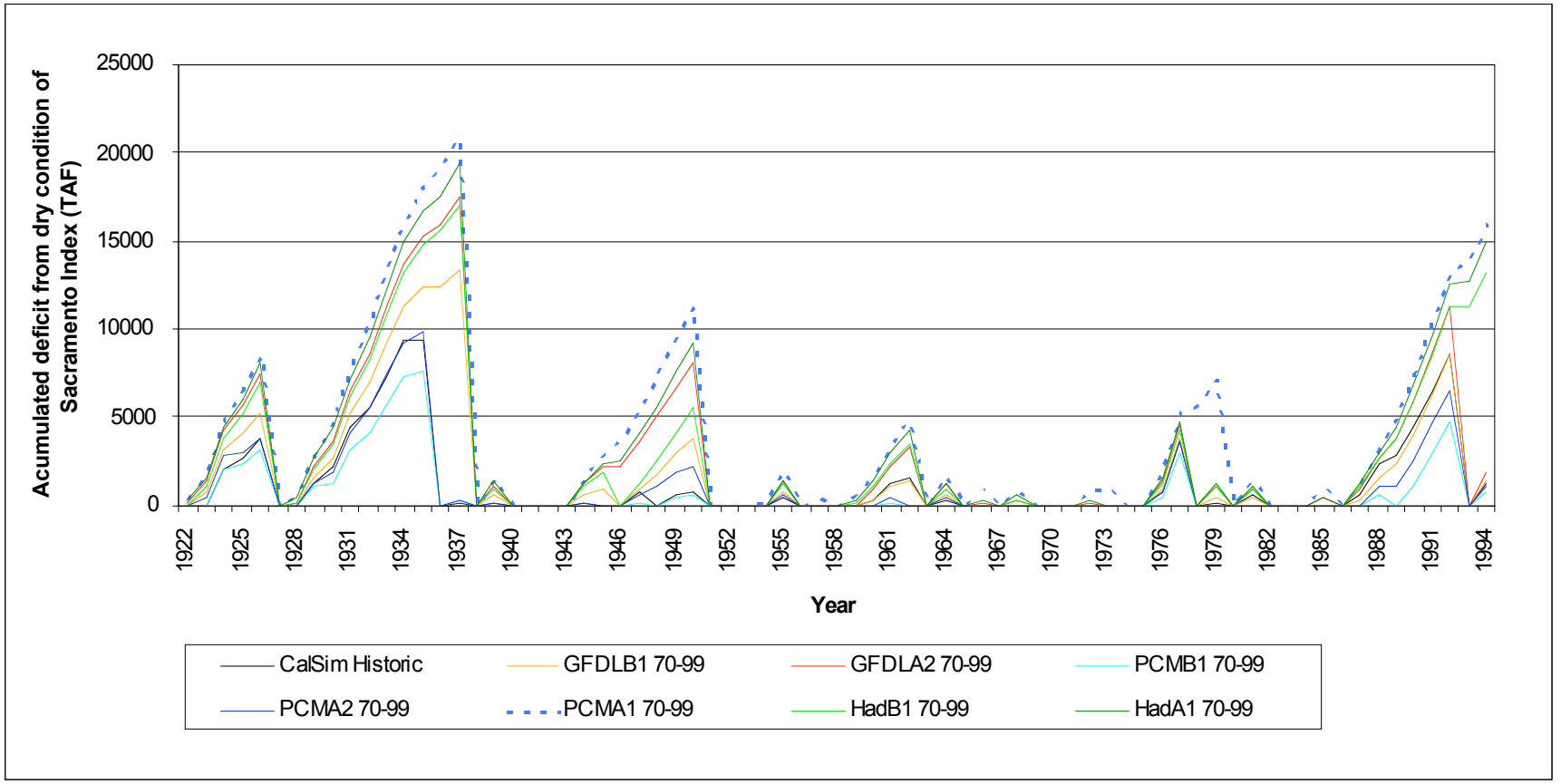
Results: Reservoir Inflow

- Both approaches project streamflows to decrease slightly by mid-century with more dramatic changes by the end of the century.
- Flows into the major Sierra Nevada reservoirs could decline between 25%-30% under the medium temperature scenario—almost double the decrease projected under the lower temperature scenario.

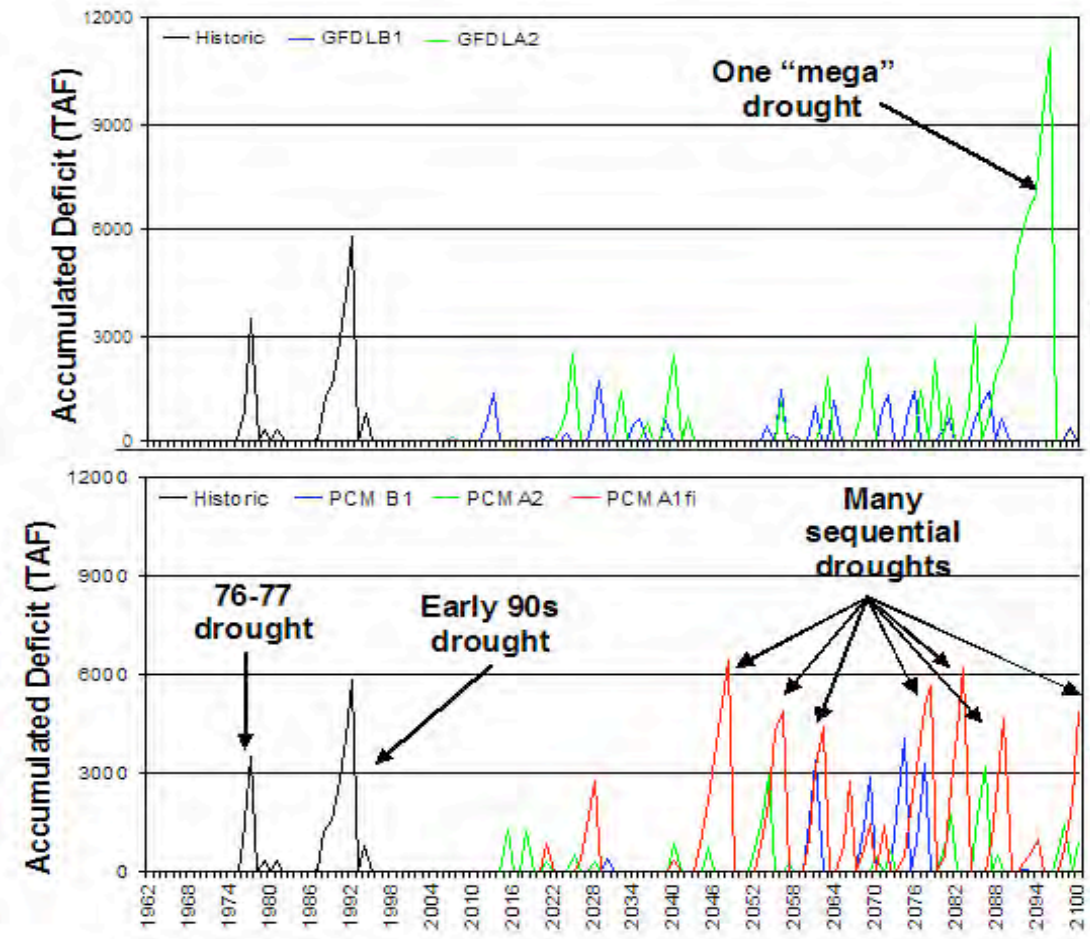
Results: Drought Persistence

- Using the 40-30-30 Sacramento Four River Index, a drought is considered to occur in a if the index for that year falls below the dry threshold.
- An accumulated deficit representing the positive difference between the “dry” threshold and the 40-30-30 Index is calculated for each year, and is reset to 0 whenever the index is above the “dry” threshold.
- Drought conditions better than the historic case for the PCM scenarios but worse for all the other scenarios, where the magnitude and duration of droughts are exacerbated.

Drought persistence (CALSIM)



Drought persistence (WEAP)



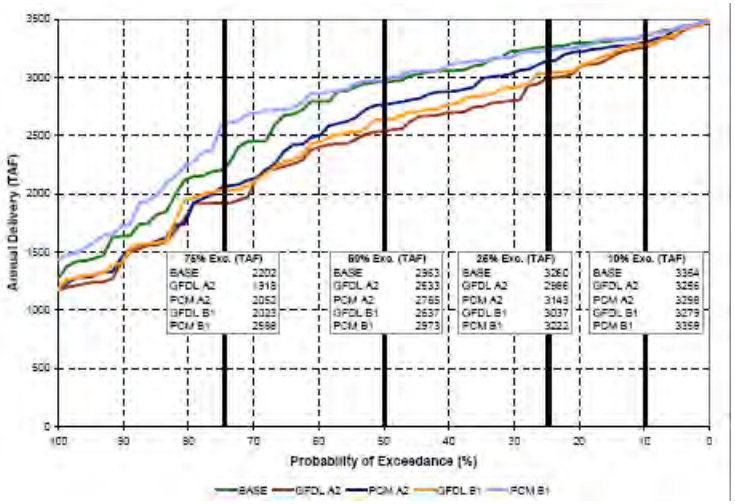
Results: CVP and SWP deliveries

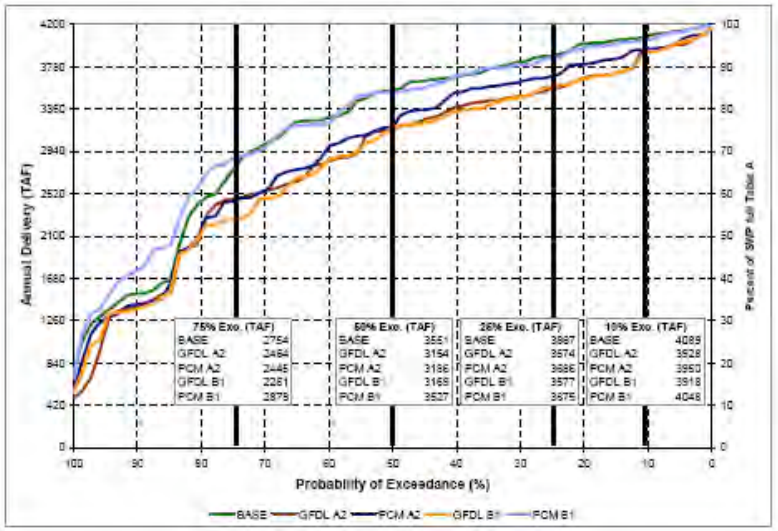
- Toward end of century, the change in runoff reduces the ability CVP and SWP to deliver water to users south of the Delta; deliveries fall by 15%-30% under the lower temperature scenario and 40%-50% under the medium and higher temperature scenarios.
- These changes may be exacerbated by increased demand due to warmer temperatures; these increase the crop demand by 2 - 13% by the end of the century; similar effect on urban demand for outdoor lawn watering.

Probability plots of South of Delta CVP and SWP Annual Deliveries

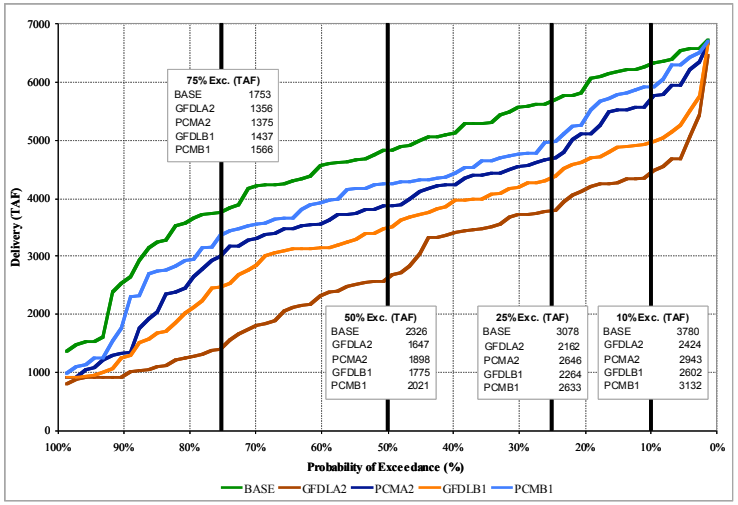
CVP **SWP**

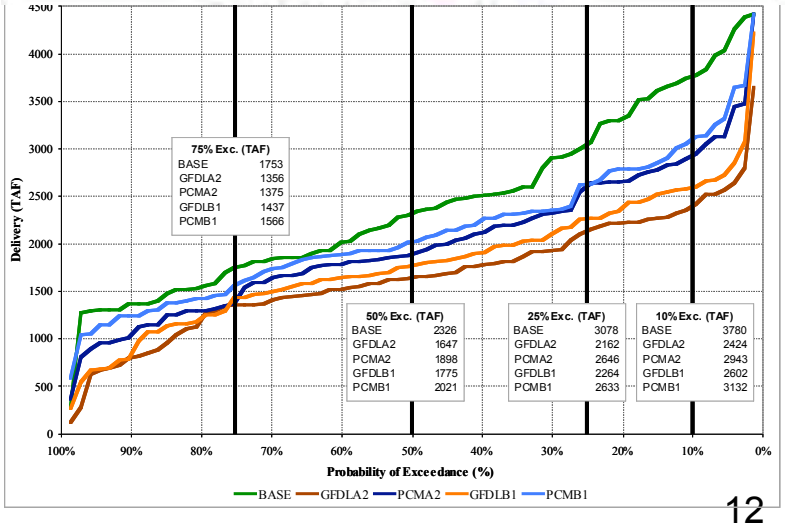
2035-2064





2070-2099





Potential Adaptation Strategies

- To compensate for the loss of snowpack, existing man-made storage capacity will have to be managed more effectively.
- Modern probabilistic hydrology forecasting methods and decision algorithms could help.
- Some additional storage will eventually be needed, whether above ground or below ground in the form of enhanced conjunctive use.
- The state's water transmission system will need to be firmed up (eg in the Delta) and also enhanced to provide greater flexibility and connectivity in meeting users' demands.
- Water conservation and management become even more important.