UC Berkeley College of Computing, Data Science, and Society

Impacts of Operational Decisions and a Changing Climate on California's Water Future

Isabelle Wang, Rain Zou, Isabelle Goebel, Sabi Can Ruso
Supervisors: Dino Bellugi, James Gilbert, Laurel Larsen

COEQWAL
COLLABORATORY FOR EQUITY IN WATER ALLOCATION

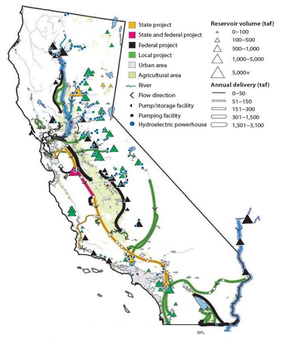
Introduction

The **Collaboratory for Equity in Water Allocations** (COEQWAL) is a research initiative led by experts from six UC campuses and CSU Sacramento. COEQWAL collaborates closely with state and federal agencies, Native American tribes, community groups, water districts, and NGOs to address California's water challenges. The project emphasizes creating **equitable and resilient water management strategies** that consider the diverse needs of agricultural, urban, and environmental stakeholders. As **climate change** alters our system, we must tackle an increasingly **urgent** question about how water is allocated and where it gets distributed. COEQWAL aims to address this by developing an **accessible**, **data-driven water planning** platform, enabling stakeholders to explore **solutions** for water scarcity, water justice, **sustainable resource distribution**, and **ecosystem preservation**.

Objective

CalSim3 is a water resources planning tool developed by state and federal agencies to facilitate **modeling our water system**. It has strictly been the domain of experts due to the difficulty of managing datasets of this size and nature.

We previously created an **open-source repository** for **hydrological data processing**, visualization, and metric calculations that enables people with minimal programming knowledge to develop sophisticated plots and analyses.



Hanak et al. (2011). Managing California's Water: From Conflict to Reconciliation

This semester, our goal was to improve our existing plots and workflow, and make the **complex data easier to analyze, visualize, and understand**. We focused on exploring impact of operational changes on current operations. in particular we explore the impacts of varying climate scenarios on both current and alternative operations.

Variables and Scenarios

Here we analyze six scenarios that contrast current climate with two future climate realizations, combined with one example change in operations - imposing groundwater pumping limits. We focus on three representative variables:

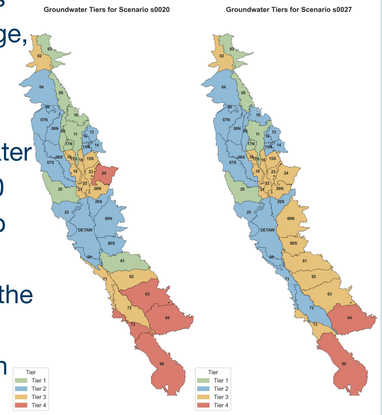
- **Delta salinity**: Salt concentration in the Sacramento Delta
- **Deliveries**: Water for agricultural, urban, and environmental deliveries through the State Water Project (SWP) and Central Valley Project (CVP)
- **Storage**: Reservoirs

Climate	Scenarios
Adjusted Historical (**Baseline**)	**20 -** current operations **27 -** groundwater pumping limits
DWR's 2023 DCR climate change "50% level of concern" (Moderate climate change)	**47 -** current operations **62 -** groundwater pumping limits
DWR's 2023 DCR climate change "95% level of concern" (Severe climate change)	**56 -** current operations **63 -** groundwater pumping limits

Tier Assessments

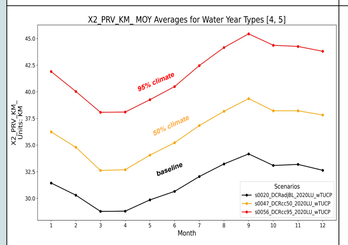
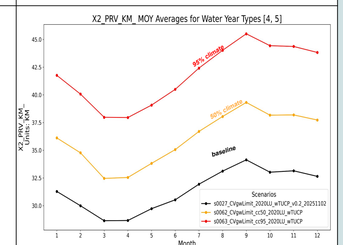
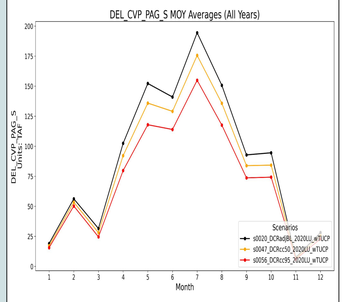
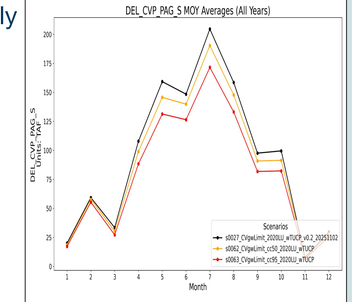
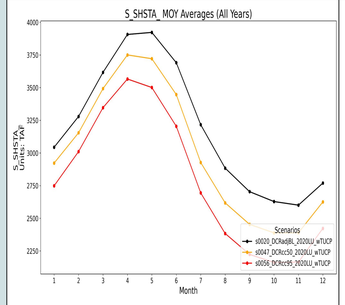
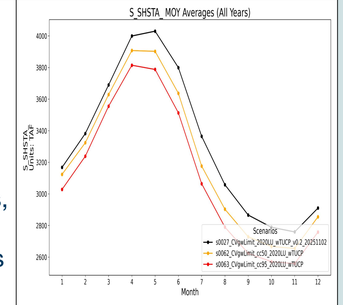
We assign tiered assessments for multiple variables such as groundwater, reservoir storage, and salinity levels in order to educate the general public.

Here, we focus on groundwater storage tiers for scenarios 20 and 27. The scenario 27 map shows how groundwater pumping restrictions across the Central Valley affect groundwater storage levels in California.



100 years of simulation results in each region are categorized into a single tier assignment. Tier 1 represents improving conditions, while Tier 4 indicates extreme groundwater decline. The current pumping limits shown are insufficient. While some areas show improvement, others may need additional interventions to improve groundwater conditions.

Results and Discussion

Scenarios: Climate change (no pumping restrictions)	Analysis	Scenarios: Climate change (with pumping restrictions)
	• Salinity levels increase from the baseline as climate change becomes more extreme, especially in dry years • Groundwater pumping restrictions have little effect on salinity	
	• Water deliveries, especially for CVP agricultural contractors, decrease as climate change becomes more extreme • Groundwater pumping restrictions increase deliveries for all three climates, and lessen differences between climate scenarios	
	• Reservoir storage levels in Lake Shasta decrease as climate change becomes more extreme • Groundwater pumping restrictions raise storage levels for all three climates, and lessen differences between climate scenarios	

Summary and Next Steps

- Climate change decreases the amount of water, which **increases salinity** and **decreases deliveries** and **reservoir storage.**
- **Future climate** is the **biggest driver** of change in these variables, the effects of groundwater pumping are small in comparison.
- This has implications for **decision-making** for farmers and water resource managers.
- We are exploring a vast array of operational changes and climates, such as modified land use, environmental flows, infrastructure changes, and regulatory limits.
- Information will be made **available to the public** on our interactive website, with the goal of supporting broader conversations about water management in California.