Findings of the UCLA Mono Lake Model

Dr. Alex Hall
Dr. Benjamin Bass
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UCLA Research Team

Dr. Alex Hall
Director, Institute of the Environment and Sustainability; Professor, Atmospheric and Oceanic Sciences

Dr. Benjamin Bass
Research Scientist, Center for Climate Science

Dr. Sara Graves
Lecturer, UCLA

Dr. Lei Huang
Data Scientist

Dr. Stefan Rahimi
Professor, University of Wyoming

Model Development Process

- UCLA was tasked with building a model and using it to represent Mono Lake water level response to climate change and exports.
- Developed the model in an iterative process over two years.
- Reached out to Mono Basin experts for continuous feedback and quality control, including:
  - State Water Resources Control Board staff
  - Los Angeles Department of Water and Power
  - CA Department of Fish and Wildlife
  - Mono Lake Committee
- Looked at a range of ways to build the water budget model. Outcomes presented here do not meaningfully change when the model is varied in plausible ways.
- Uncertainty in water levels are driven overwhelmingly by natural hydrologic variability, climate model selection, and future climate scenarios.

Key Takeaways

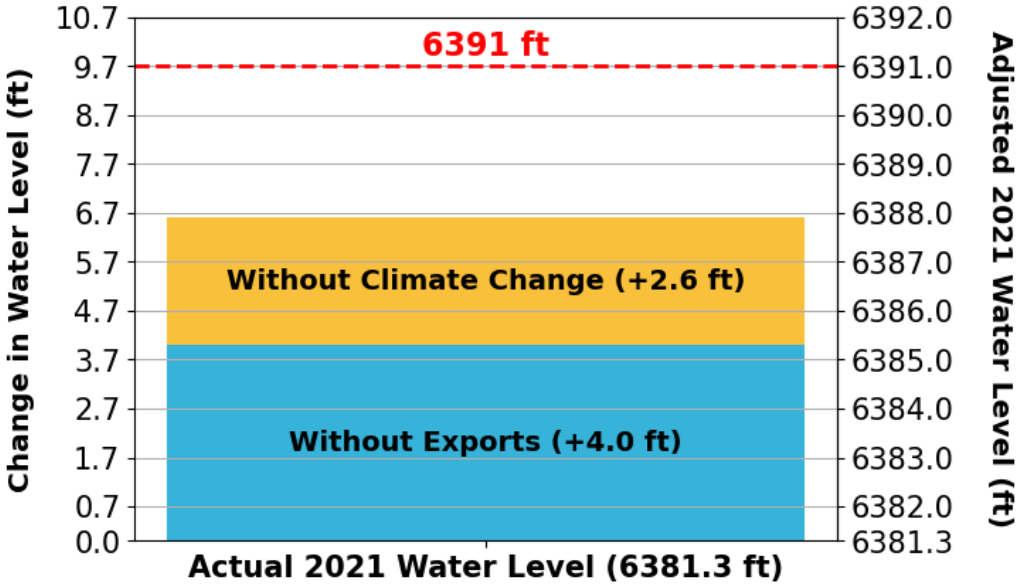
- Climate change has likely already reduced Mono Lake water level.
- Under existing export criteria, meeting lake level objectives unlikely.
- Export adjustments can improve recovery probabilities.

Climate change has likely already reduced Mono Lake water level

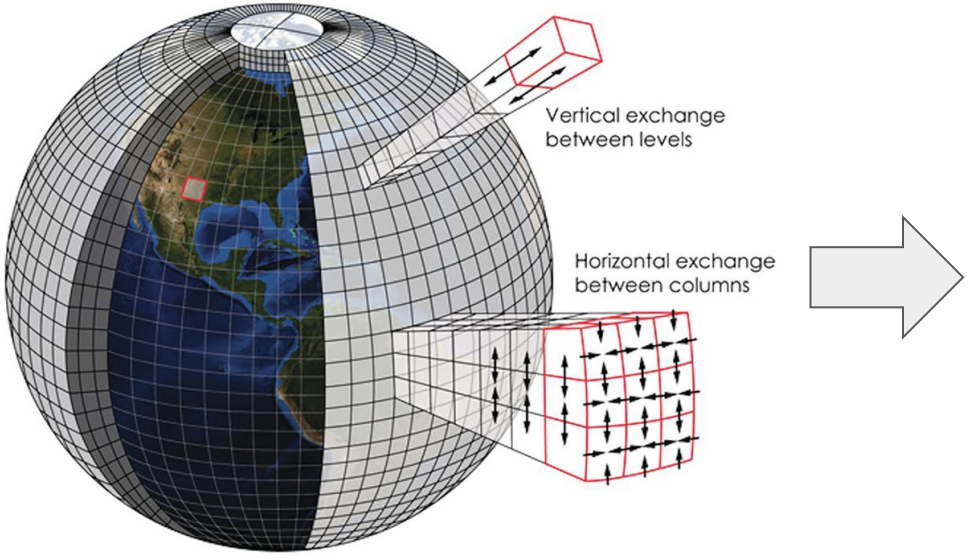
KEY FINDINGS

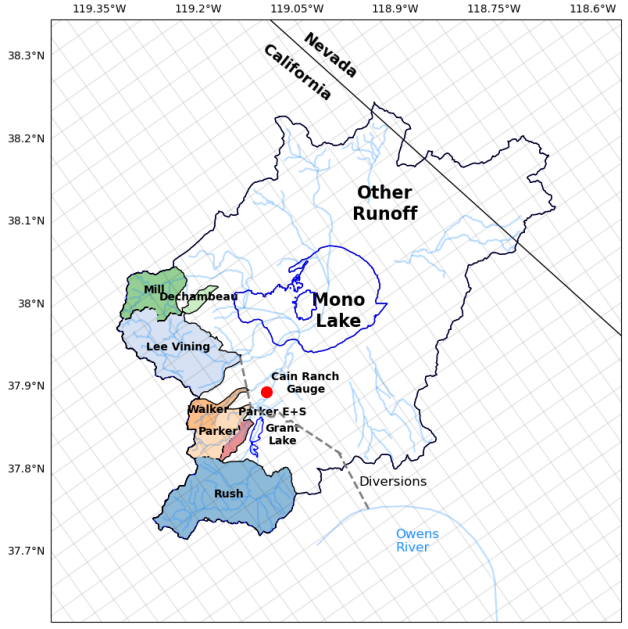
- Water levels would be higher without exports and would likely be higher without climate change.
- Over 1/3 of lake level decline since 1994 is due to climate change.
- Even without exports and climate change, the transition water level (6,391 ft) would not have been reached by 2021.

EST. WATER LEVEL IN 2021 WITHOUT CLIMATE CHANGE AND EXPORTS SINCE 1994 (D-1631)



Climate Simulations with Global Climate Models (GCMs)





- We **produced and used** California 5th Climate Assessment, state-funded, 3 km resolution data.
- Climate scientists always use an ensemble of GCMs to **account for uncertainty**.

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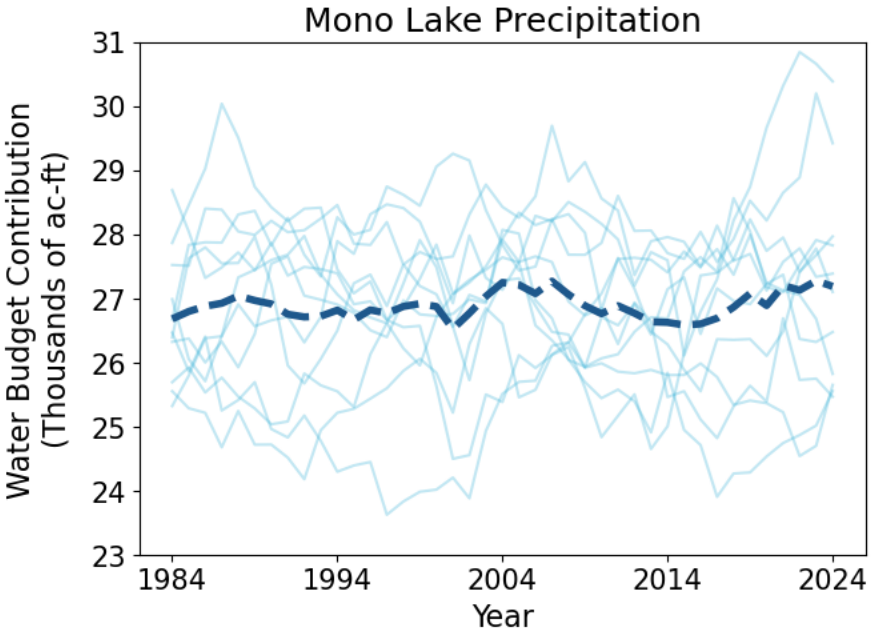
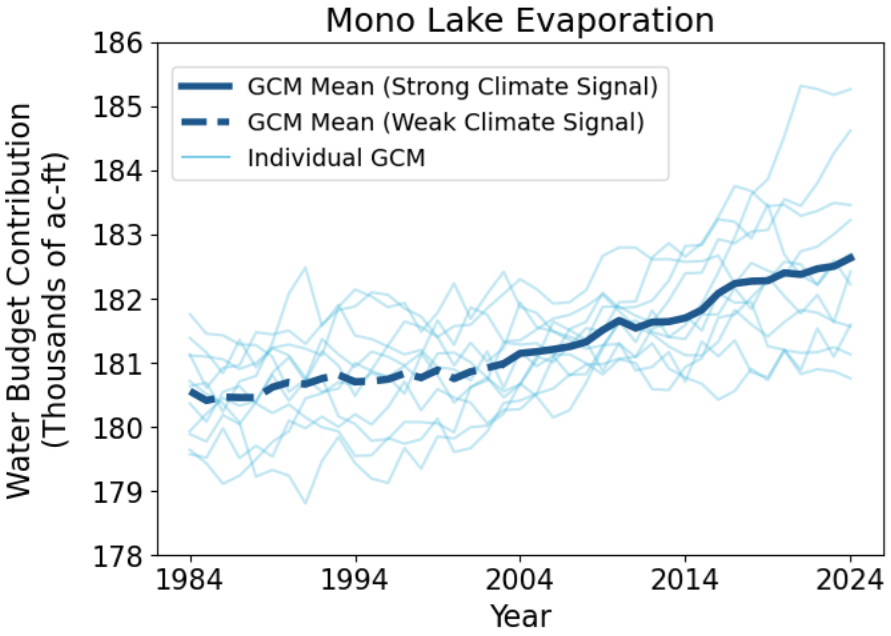
HISTORICAL CHANGES IN CLIMATE





KEY FINDINGS

- 100% of climate models show increasing trend in lake evaporation.
- Precipitation in the historical period is driven by internal variability (luck of the draw).
- Average of climate models (dark blue line) shows increasing trend and agreement in evaporation.

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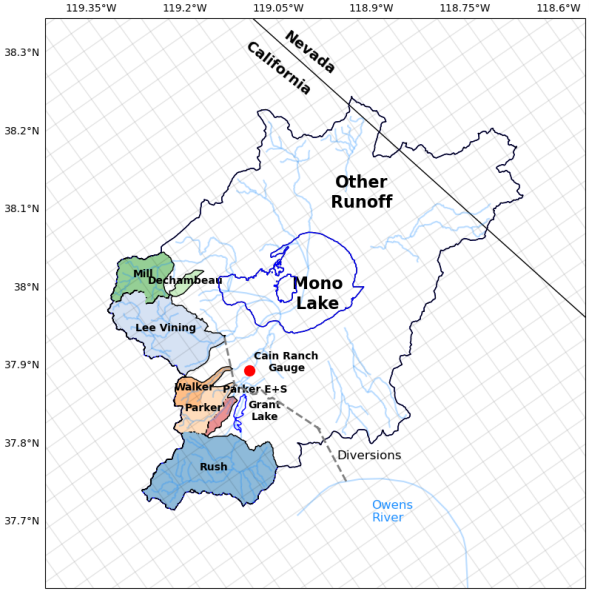
Mono Lake Model Overview



Inputs	Outputs
Precipitation	Evaporation
Sierra Nevada Runoff	LADWP Exports
Other Runoff	

Water Level = function(Storage)

$\Delta Storage_{April\ 1}$ = Runoff into Lake + Lake Precipitation - Lake Evaporation - Exports

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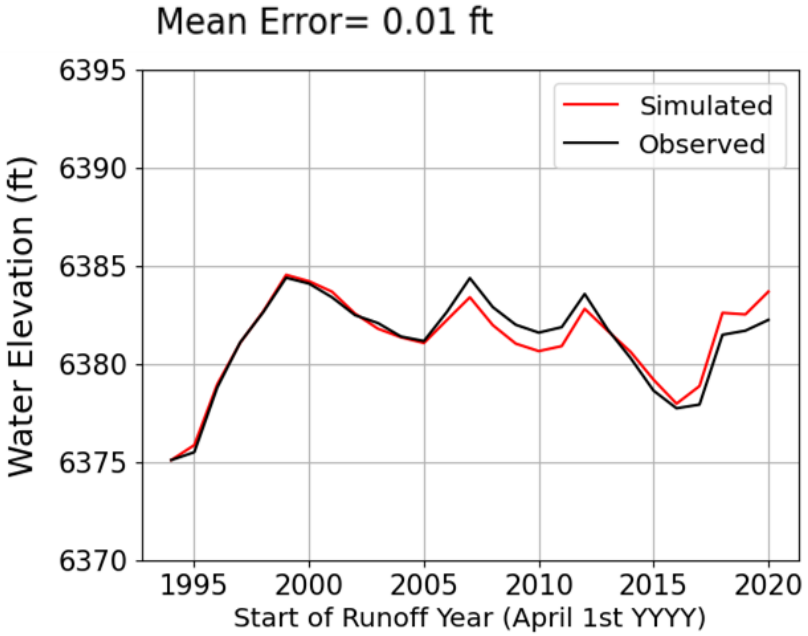
Mono Lake Model Overview

KEY TAKEAWAYS

- Water budget model performs well in representing observed water level.
- This can be simulated with any export criteria.
- And with different climate change scenarios.
- Comparable water level results to eSTREAM and Mono Lake Committee model.

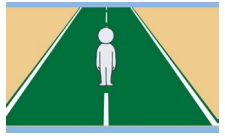


Under existing export criteria, meeting lake level objectives unlikely

Emissions Scenarios

- UCLA-Mono Lake Model can evaluate any emission scenario.
- Climate data produced for California's most recent Climate Assessment, funded by the State, was used.
- For each scenario, an ensemble of 11 global climate models are available.
- To account for uncertainty, we report:
  - ensemble mean (most likely outcome).
  - span of model outcomes (uncertainty range).
  - percent of climate models that agree on a given condition (e.g. water level being at or above 6,391 ft).

SSP2-4.5: Middle of the Road (Intermediate)



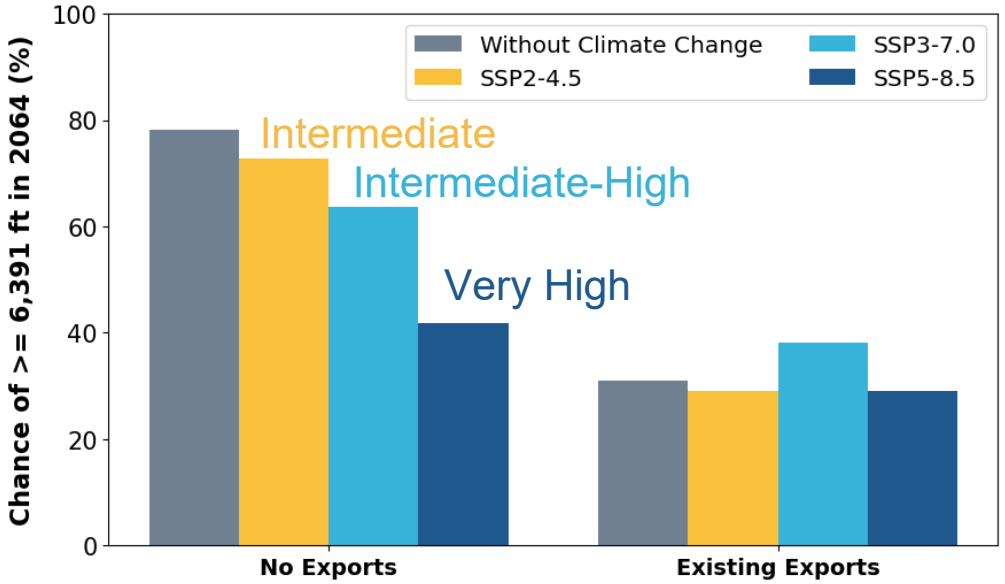
SSP3-7.0: Rocky Road (Intermediate-High)

SSP5-8.5: Fossil-Fuel Development (Very High)

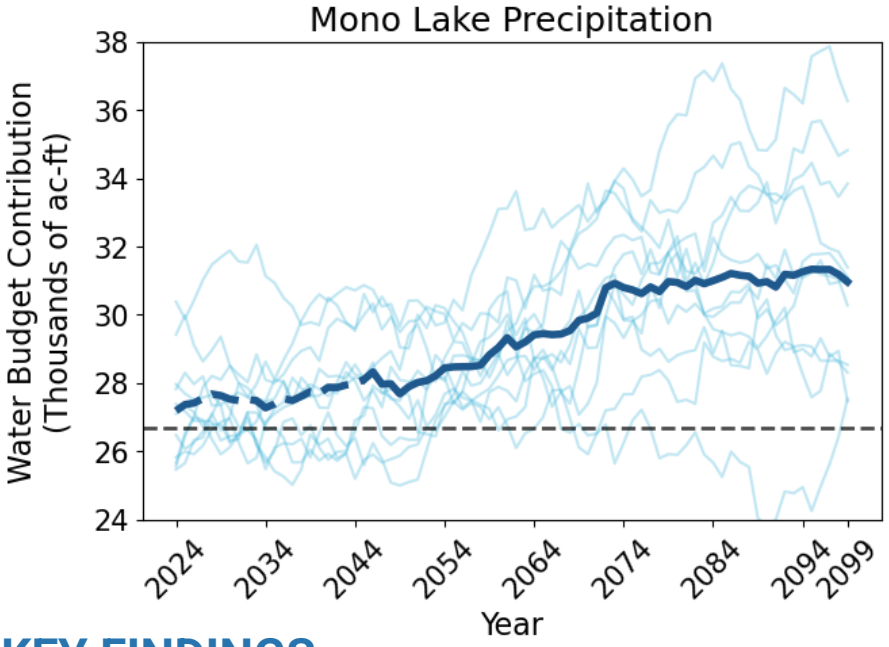
KEY FINDINGS

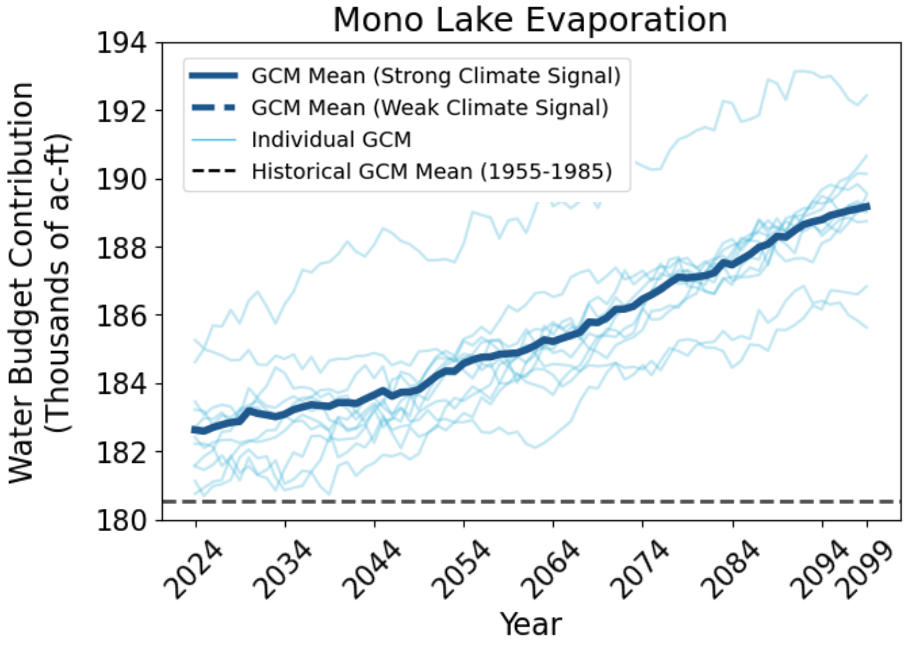
- Roughly 1-in-3 chance of being at or above 6,391 ft in 2064 under **existing export criteria**.
- Roughly 2-in-3 chance of being at or above 6,391 ft in 2064 with **no exports** (highly scenario dependent).

CHANCE >= 6,391 FT 40 YEARS INTO SIMULATION (2064)



PROJECTED CHANGES IN CLIMATE | INTERMEDIATE SCENARIO SSP2-4.5





KEY FINDINGS

- Evaporation increases continue in the future.
- Climate models agree that precipitation begins to increase in ~2050.
- Evaporation increase outpaces precipitation increase.

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Export adjustments can improve recovery probabilities

Analyzing Export Alternatives

- In our analysis of future scenarios, we consider a **transition** and a **post-transition** period.
  - The **transition period** ends when we reach **6,391 ft**, and we pivot to the **post-transition period**.

- For both the **transition period** and **the post-transition period**: the model allows us to examine a variety of export criteria and their implications under climate change.
  - For the **transition period**: We will talk about one of those criteria, **called "A6"**.
  - For the **post-transition period**: We will talk about one of those criteria, called **"PT3"**.

- **Important context:** If lake levels rise enough to permit exports, those exports are **more valuable** during dry years compared to wet years. In contrast, Mono Lake levels over time are determined by the sum of what has flowed into the lake over the past few years to decades, regardless of when those flows occurred.

TRANSITION PERIOD KEY FINDINGS

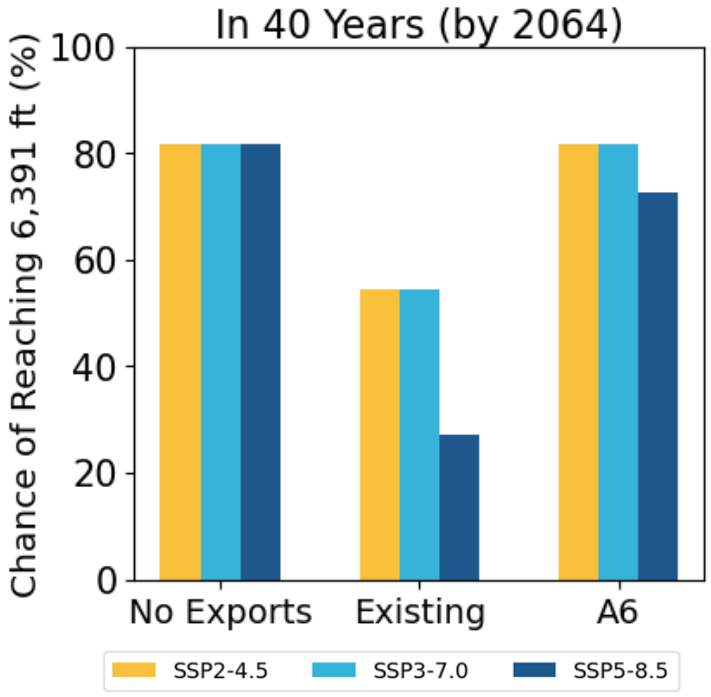
Objective: Reach 6,391 ft

- Relative to no exports, there is nearly a 30% reduction in the chance to reach 6,391 ft with **existing** export criteria.
- An alternative like **A6** provides similar chances as no exports to reach 6,391 ft.

ALLOWED EXPORTS UNDER A6

	Dry	Dry-Normal	Normal	Wet-Normal	Wet	Extreme-Wet
< 6,377 ft	0 ac-ft	0 ac-ft	0 ac-ft	0 ac-ft	0 ac-ft	0 ac-ft
6,377 -6,391 ft	4,500 ac-ft	4,500 ac-ft	4,500 ac-ft	0 ac-ft	0 ac-ft	0 ac-ft

CHANCE TO REACH 6,391 FT



POST-TRANSITION KEY FINDINGS

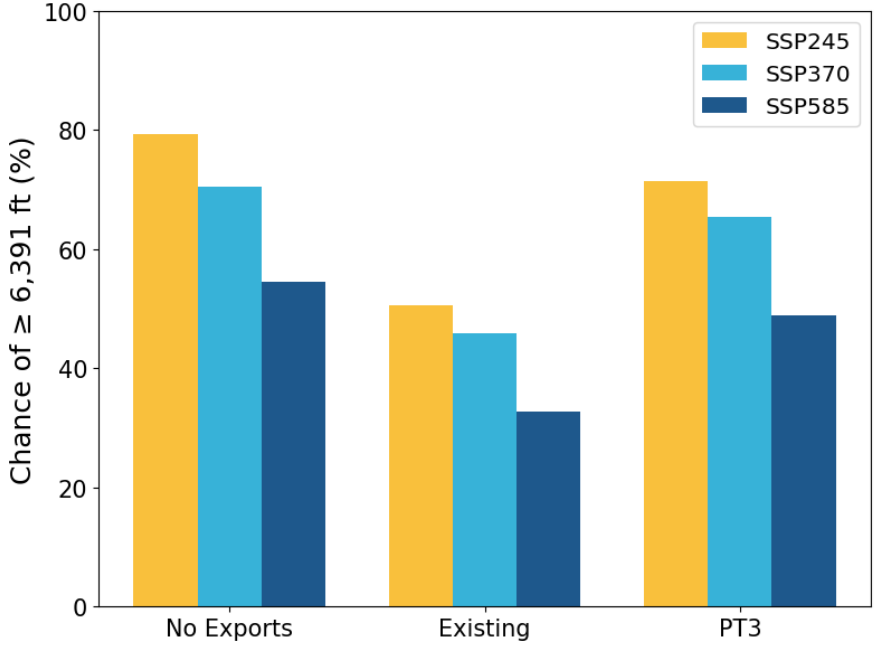
Objective: Maintain average levels of 6,392 ft

- Existing post-transition export criteria has <=50% likelihood of remaining at or above 6,391 ft in post-transition phase.
- An alternative like PT3 leads to improved performance relative to existing criteria.

ALLOWED EXPORTS UNDER PT3

	Dry	Dry-Normal	Normal	Wet-Normal	Wet	Extreme-Wet
< 6,391 ft	0 ac-ft	0 ac-ft	0 ac-ft	0 ac-ft	0 ac-ft	0 ac-ft
6,391-6,393 ft	4,500 ac-ft	4,500 ac-ft	4,500 ac-ft	0 ac-ft	0 ac-ft	0 ac-ft
> 6,393	Unlimited*	Unlimited*	Unlimited*	Unlimited*	Unlimited*	Unlimited*

CHANCE >= 6,391 FT IN POST-TRANSITION PHASE



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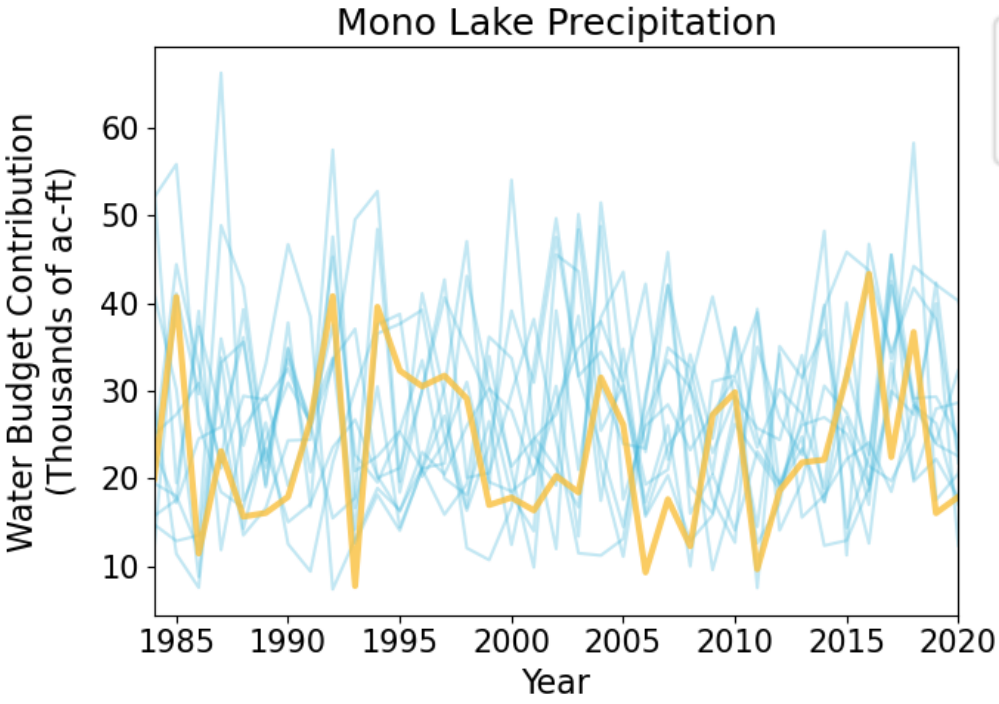
Overview of Export Alternatives

- We assessed **transition** and **post-transition** alternatives assessed based on water level objectives.
- We assessed several alternative **transition** and **post-transition** export criteria that **increase the chances** of meeting water level objectives.
- **Note:** these criteria require **reduced export amounts**.



Dynamic (periodically updated) export criteria may be considered to adapt under uncertainty.

- **Example:** U1-U4 in the report shows modified exports depending on Mono Lake's water level, assessed **every 5 years** until 6,391 ft is reached.

- This allows more flexibility to take into account uncertainties around sequencing of wet and dry years.

CLIMATE CHANGE HAS LIKELY ALREADY REDUCED MONO LAKE WATER LEVEL

- Increased evaporation led to a ~2.6 ft reduction in Mono Lake's present-day (2021) water level.
- Evaporation will continue to increase and likely outpace any increases in precipitation from climate change.

UNDER EXISTING EXPORT CRITERIA, MEETING LAKE LEVEL OBJECTIVES UNLIKELY

- **Existing Exports:** 1-in-3 chance of being **at** or **above** 6,391 ft in 2064.
- **No Exports:** 2-in-3 chance of being **at** or **above** 6,391 ft in 2064.

EXPORT ADJUSTMENTS CAN IMPROVE RECOVERY PROBABILITIES

- Careful assessment of the transition and post-transition export criteria and their objectives, and consider planned updates to transition export criteria, e.g. every 5 years.
- Decision making should account for uncertainty and future change, in addition to observed historical trends.

Thank you

Q & A