

Precipitation may brighten Colorado River's future, says modeling study

May 1 2024



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The Colorado River's future may be a little brighter than expected, according to a new modeling study from CIRES researchers. Warming temperatures, which deplete water in the river, have raised doubts the

Colorado River could recover from a multi-decade drought. The new study fully accounts for both rising temperatures and precipitation in the Colorado's headwaters, and finds precipitation, not temperature, will likely continue to dictate the flow of the river for the next 25 years.

Precipitation falling in the river's headwaters region is likely to be more abundant than during the prior two decades. The work, [published](#) in the *Journal of Climate*, comes as policymakers, water managers, states, and tribes look for answers on how to govern the Colorado River's flows beyond 2025.

"It's a sort of nuanced message," said Balaji Rajagopalan, CIRES Fellow and co-author of the study. "Yes, the temperature is warming, but that's not the full story—you add [precipitation](#) and you get a fuller picture."

CIRES affiliate Martin Hoerling and Fellow Balaji Rajagopalan worked with colleagues from several other institutions to analyze data from a suite of models, including climate projections from the Intergovernmental Panel on Climate Change (IPCC). They determined that while warming temperatures have depleted Colorado River flows in recent decades, precipitation variations have mostly explained the swings between wet and dry periods since 1895.

Because precipitation has explained the vast majority of the ups and downs of the Colorado River's flows in the last century, [climate models](#) forecasting a 70% chance of increased precipitation offer hope that the river's near-term future is not necessarily drier than the last two decades.

"We find it is more likely than not that Lee Ferry flows will be greater during 2026-2050 than since 2000 as a consequence of a more favorable precipitation cycle," said Martin Hoerling, the paper's lead author. "This will compensate the negative effects of more warming in the near term."

The authors analyzed [flow](#) records at Lee's Ferry, the dividing point of the river's upper and lower basins, dating back to 1895. They confirmed natural changes in precipitation have ebbed and flowed over the century, dictating extreme wet and dry periods for the river, when flows exceeded 15 million acre-feet or dropped well below that key figure. For example, the current megadrought that began in 2000 has resulted mostly from low precipitation which left the river at about 12.5 million acre-feet reducing it to dry sandy river beds in Mexico.

Looking ahead, the team used climate models, including the latest [climate projections](#) from the IPCC, to predict the river's flow 25 years into the future. Most of the water that feeds the Colorado River begins as snow in the region's headwaters—mountains above 10,000 feet in Colorado and Wyoming.

The area represents a small slice of the basin's geography, about 15%, but generates 85% of the water that flows through seven states. So precipitation in this "upper basin" is integral to flows in the entire river system. And the team found it is likely to increase, partially offsetting further declines linked to rising temperatures.

While an increase in precipitation is likely, the study finds a low probability that precipitation might not recover and could decline even further. If this happens, ongoing warming would further reduce [water resources](#), resulting in even lower flows at Lee's Ferry than those that have led to today's crisis.

"There's roughly a 4% chance that Lee Ferry flows could decline another 20% in the next quarter century compared to the last 20 years," Hoerling said. "So, policymakers who must especially take into account risks of extended dry times, might consider this non-zero threat that the river could yield only 10 million acre-feet a year during 2025-2050."

As the deadline slowly approaches to determine the next set of guidelines that will govern the river for the next 25 years, the new forecast may shed new light on the future

"Decision makers are confronted with a more optimistic vision of the available supply in coming decades than might have generally been foreseen previously," Hoerling said, "but also confronted with a small, but perhaps unacceptable, risk for historically low flows."

More information: Martin P. Hoerling et al, Critical Effects of Precipitation on Future Colorado River Flow, *Journal of Climate* (2024). DOI: [10.1175/JCLI-D-23-0617.1](https://doi.org/10.1175/JCLI-D-23-0617.1)

Provided by University of Colorado at Boulder

Citation: Precipitation may brighten Colorado River's future, says modeling study (2024, May 1) retrieved 22 May 2024 from <https://phys.org/news/2024-05-precipitation-brighten-colorado-river-future.html>

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