Climate change is already reducing flows in the Colorado River, scientists report

The Colorado River wraps around Horseshoe Bend in 2015 in Page, Ariz. The Colorado River Basin supplies water to 40 million people in seven western states. (Justin Sullivan/Getty Images)

The drought-stricken Colorado River Basin has gotten some temporary relief in the past few weeks after winter storms have pounded the region with fresh rain and snow. In fact, as the Los Angeles Times reported, the recent precipitation has caused federal water managers to lower their estimates of the risk of water shortage in the near future.

But while this is good news in the short term, experts are warning that the troubled Colorado River — which has been battling drought for the past 15 years — is still facing some serious long-term challenges. A new study, just

released last week in the journal Water Resources Research, suggests that future warming could cause the river's flow to decline by as much as 35 percent by the end of the century.

In fact, the authors point out, rising temperatures are likely already responsible for a substantial portion of the river's troubles today. Historical data indicate that the current drought has caused greater flow reductions in the Colorado River than previous droughts — yet the declines in precipitation associated with the current drought are not as severe as they've been in the past. According to Brad Udall, senior water and climate research scientist at the Colorado Water Institute and co-author on the new study, the major difference today is that the region is hotter than it used to be.

"We strongly believe — and the study supports the idea — that the reason these flows are down is because of these very warm temperatures," he told The Washington Post.

Between 2000 and 2014, Colorado River flows were about 19 percent below the century's average, and the researchers estimate that anywhere from one sixth to one half of these declines are due to the heat, which they note has been about 1.6 degrees Fahrenheit higher on average than in the previous century.

With this in mind, Udall and colleague Jonathan Overpeck of the University of Arizona decided to investigate what the river's future might look like under future warming scenarios, using climate models to make projections about how climatic changes might affect the river's flow.

They noted that there are some uncertainties about how climate change might affect the American West, particularly in terms of future rainfall — some models have suggested there will be an increase in precipitation and others have indicated declines. But an increase in temperature is one factor

that remains certain, as long as greenhouse gas emissions continue to occur. As a result, the researchers chose to examine the influence of temperature and precipitation separately on the river's flow.

"Previous studies have combined the two, and we actually think that when you do that, you provide information that isn't nearly as useful," Udall said. Instead, he said, the new study's approach can estimate with relative certainty how rising temperatures will affect the river in the future — then, afterward, a variety of less certain precipitation scenarios can be factored in to come up with a range of different possibilities for the region's climate future.

"What we tried to do is separate them out and say we're going to get large temperature-induced declines, and you may or may not get the precipitation that would balance out those temperature-declines," Udall explained.

Climate models suggest that a moderate greenhouse gas emissions scenario could lead to 3.6 degrees Celsius, or nearly 6.5 degrees Fahrenheit, of warming in the region by the end of the century — and a high emissions scenario could cause warming of up to 5.4 degrees Celsius, or a whopping 9.7 degrees Fahrenheit.

The study projects that the Colorado River's flow is likely to decline by about 17 percent by midcentury under either emissions scenario, and by 25 to 35 percent by the end of the century. These are somewhat conservative estimates, the researchers note — depending on precipitation patterns in the future, the projections indicate flow reductions could be as severe as 55 percent by the year 2100.

That said, they've noted that an increase in precipitation throughout the century could help to offset temperature-induced declines. The problem is that modeling studies disagree significantly on how precipitation may change in the future. The researchers say they feel that the increases in rainfall

needed to offset the effects of future warming are unlikely to occur, although it's not outside the realm of possibility either.

Udall notes that some studies have suggested rising temperatures could increase the probability of mega-droughts — droughts that last for decades, instead of just a few years. This means that even if there are stretches of time in the future where precipitation is high and river flow is healthy, they could be offset by long periods of intense aridity.

"This paper highlights the serious challenges water managers face," said Julie Vano, a researcher at the National Center for Atmospheric Research who was not involved with the new study, in an emailed comment to The Washington Post. "Water allocations were set too high (during an exceptionally wet period); tree-ring records show severe multi-decadal droughts in the past that will likely happen again; the population is growing; and the climate is changing. Hopefully this paper raises the awareness of the challenges to the broader community and can help provide the resources needed to help water management and water policy adjust in time."

In fact, future management of the Colorado River and its reservoirs is a serious issue for policymakers, given that the river supplies water to about 40 million people throughout the Western states. In recent months, water managers have been growing increasingly concerned about the possibility of a water shortage within the next few years, although the recent increase in precipitation has slightly allayed these fears for the time being.

While the river's importance to human communities is undisputed, there remain disagreements about how it should best be managed, especially with global warming in mind.

"First and foremost, the science continues to pound home the fact that climate change is real, is happening right now, is causing impacts right now,

and will get worse," said Gary Wockner, executive director of nonprofit Save the Colorado, in an emailed comment. "Second, the Colorado River is already completely used up and drained bone dry before it reaches the sea, and so as the amount of the water in the river decreases due to climate change, the Southwest U.S. will need to use less water in the future, not more."

A proposed drought contingency plan, which would call for greater water conservation measures even when a shortage is not occurring, has been in negotiations among lower Colorado River Basin states for several years, but an agreement has yet to be reached.

"Frankly, that drought contingency plan needs to be put in place just to deal with the river as it today," Udall said, although he added that states in the Colorado River Basin have come to other water management agreements in the past few years that have benefited the region. An initiative finalized in 2012 called Minute 319 involved an international agreement in which Mexico stores some of its excess water in the Colorado River Basin's Lake Mead and agrees to take part in both water surpluses and shortages as they occur. The agreement is set to expire at the end of 2017, and it's unclear for the time being whether it will be renewed.

While uncertainty remains about the region's future precipitation, the new study makes a case for caution in future management of the Colorado River. Udall noted that the region's current wet conditions are no cause to be lulled into a false sense of security.

"We will have these wet periods for sure, but the long-term trend and the long-term worry here has to be on the side of increasing drought," he said. "If you manage these systems conservatively and require conservation as a normal matter of day-to-day activities, as a normal matter of course, you actually buy yourself a lot of security."