Drought in the Colorado River Basin

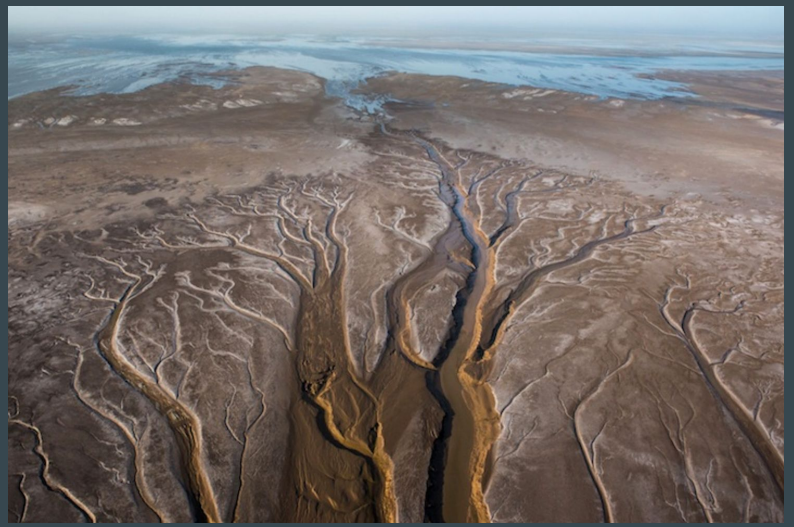
Background

The Colorado River supports the livelihood of roughly 40 million people

- Denver, CO
- Phoenix, AZ
- Los Angeles, CA

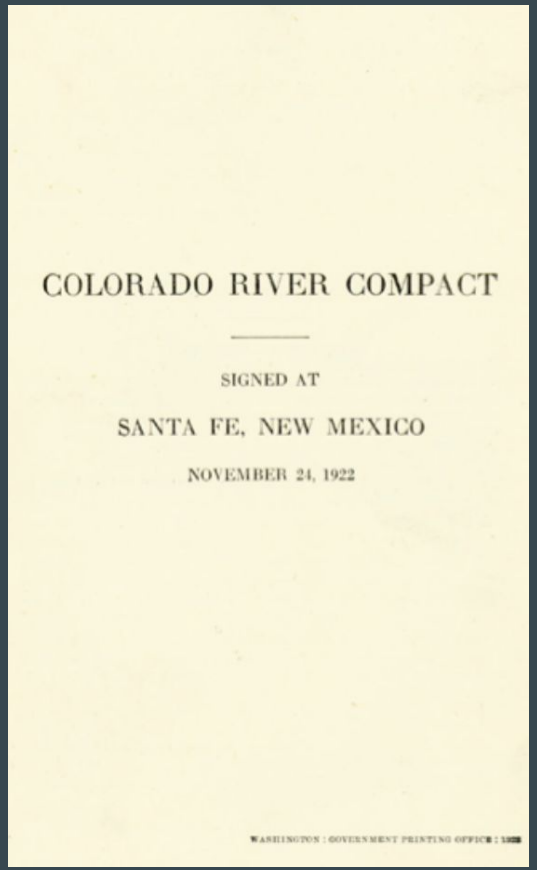
Providing 17 million acre-feet of domestic water every year for municipal, industrial, and agricultural use

- Irrigation of ~6 million acres
- Hydropower
- Habitat and recreation
- 22 tribes



Colorado Basin “Law of the River”

- **1922 Colorado River Basin Compact**
- 1928 Lower Basin Boulder Canyon Project
- 1944 Treaty with Mexico
- 1948 Upper Basin Compact
- 1968 Central Arizona Project
- **2019 Drought Contingency Plan**


COLORADO RIVER COMPACT

SIGNED AT

SANTA FE, NEW MEXICO

NOVEMBER 24, 1922

Water Allocation

Lower Basin Allocations

- California = 59%
- Arizona = 37%
- Nevada = 4%

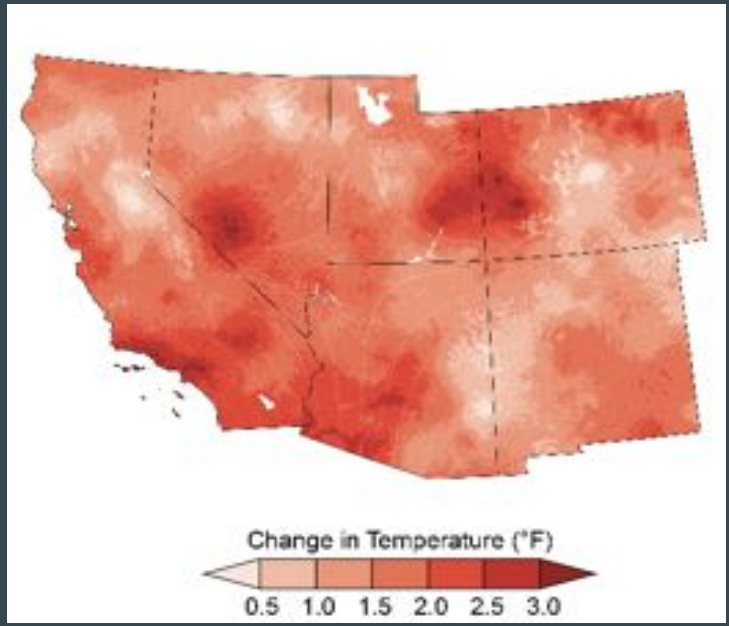
Upper Basin Allocations

- Colorado = 52 %
- Utah = 23%
- Wyoming = 14%
- New Mexico = 11%

Mexico = 1.5 million af/yr

Severe Drought

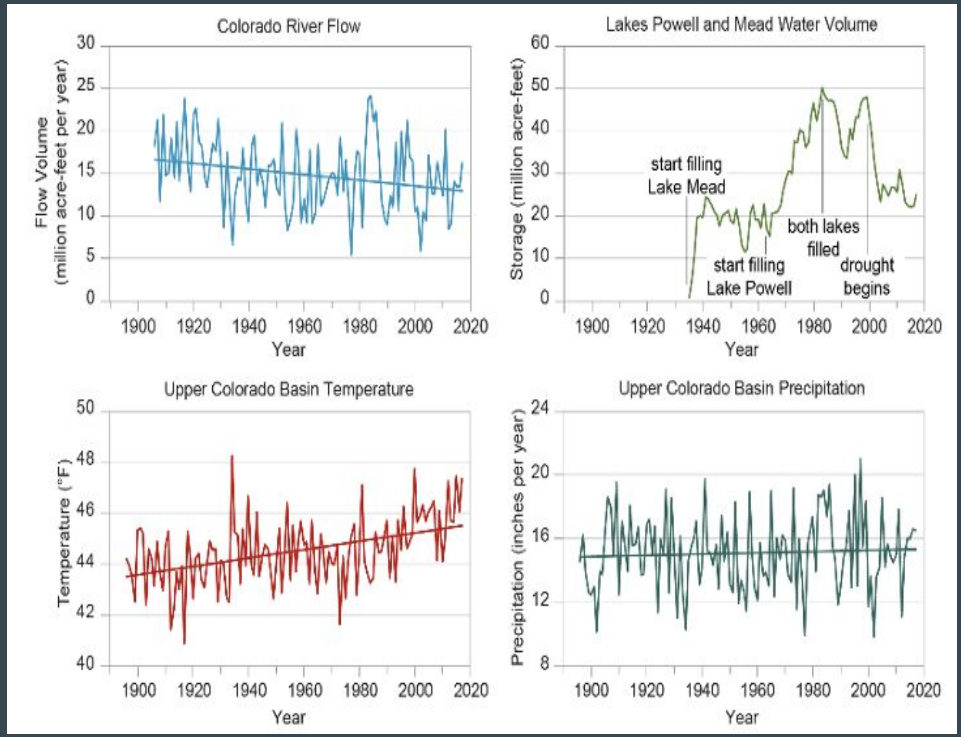
- Temperatures greatly increased across the southwest from 1901 to 2016
- Unprecedented 2000-2014 drought
- Climate change
- Higher temperatures
- Decreased flow
- Global climate model projections



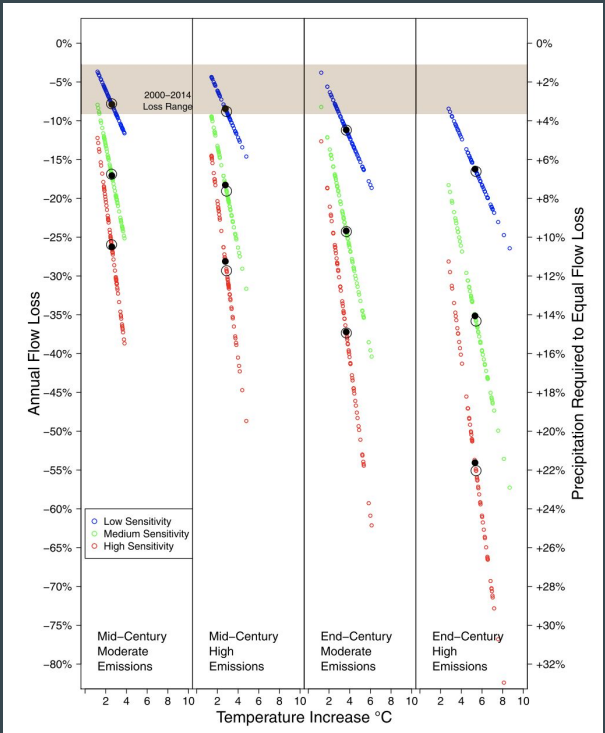
Difference between the 1986-2016 average temperatures and 1901-1960 average temperatures

Reservoir Reduction

- Reduced streamflow
- Lake Powell and Lake Mead
- Upper Colorado River Basin Temperatures
- UCRB annual temperature
- UCRB annual precipitation



Temperature v. Precipitation



Temperature sensitivity

- Studied only for temperature increases

Precipitation elasticity

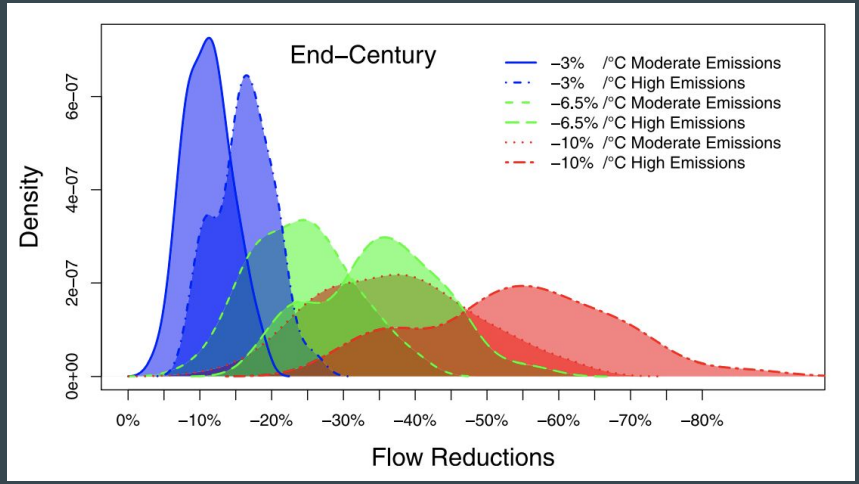
- Studied for both increases and decreases

There are large differences in certainty of future changes in the two variables

- Temperature will surely rise
- Precipitation may increase or decrease

Flow Response

- Temperature sensitivities imply much greater temperature-induced losses
- An average sensitivity of -6.5%/°C warming was reported
- Recent warming of 0.9°C has likely already reduced river flows from -2.7% to -9%
- Climate model outputs
  - RCP 8.5 & RCP 4.5



Precipitation and Megadrought

Photograph: Justin Sullivan/Getty Images

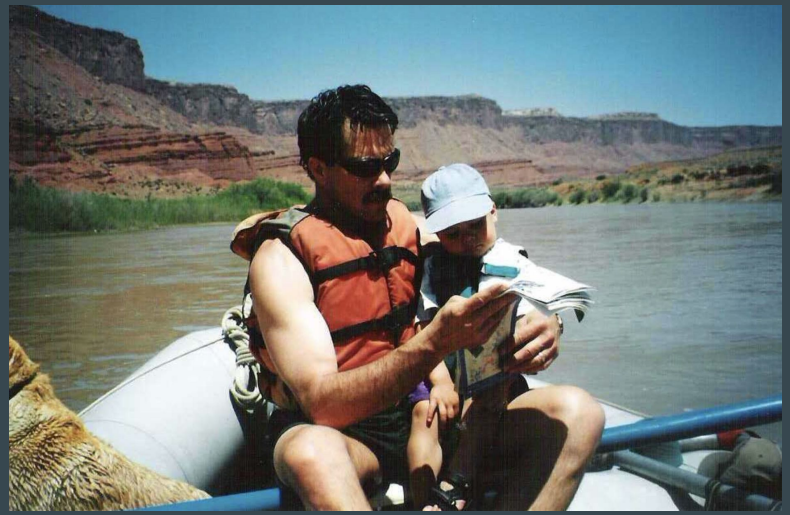
- More precipitation can reduce flow loss, but there is a lack of increase to date
- Megadroughts have occurred in the past
- The risk of a multidecadal megadrought in the Southwest is over 90% this century
- Changes in precipitation would need to be huge and would still only educe megadrought risk below 50%

Takeaway

- There is high confidence that temperatures will continue to rise
- There is also high confidence river flows will continue to decline as a result, ranging from -11% to -55% by the end of the century
- There is low confidence that precipitation will increase enough to offset the temperature-driven declines in streamflow
- The risk of megadrought is already significant but increases substantially with continued global warming
- Anomalously low runoff is likely to occur even if there is an increase in precipitation

Questions / Raising Awareness

- Were you aware of this situation, if so, to what extent?
- How do you feel about the Colorado River being managed by agreements derived from the twentieth century?
- Besides lowering emissions, what policies can be enacted to help maintain streamflow (converse water) and influence water policy?
- Do you feel like using less water is enough to help?
- Any other policies that you think will help mitigate streamflow loss?



Encourage your family and friends to take action, explore the outdoors and try new adventures like rafting and fishing!

References

Barnett, T. P., & Pierce, D. W. (2009). Sustainable water deliveries from the Colorado River in a changing climate. Proceedings of the National Academy of Sciences, 106(18), 7334-7338.

Berggren, J. (2018). Utilizing sustainability criteria to evaluate river basin decision-making: the case of the Colorado River Basin. Regional environmental change, 18(6), 1621-1632.

Christensen, N. S., Wood, A. W., Voisin, N., Lettenmaier, D. P., & Palmer, R. N. (2004). The effects of climate change on the hydrology and water resources of the Colorado River basin. Climatic change, 62(1), 337-363.

Davidson, J. (2020, February 21). Colorado River has lost 1.5 billion tons of water to the climate Crisis, 'severe water SHORTAGES' may follow. Retrieved April 15, 2021, from https://www.ecowatch.com/colorado-river-climate-crisis-shortage-2645215776.html

Harding, B. L., Wood, A. W., & Prairie, J. R. (2012). The implications of climate change scenario selection for future streamflow projection in the Upper Colorado River Basin. Hydrology and Earth System Sciences, 16(11), 3989-4007.

Joe Gelt Water Resources Research Center (WRRC), Gelt, J., & (WRRC), W. (2020, May 05). Sharing Colorado River Water: History, public policy and the Colorado River Compact. Retrieved April 15, 2021, from https://wrrc.arizona.edu/publications/arroyo-newsletter/sharing-colorado-river-water-history-public-policy-and-colorado-river

Udall, B., & Overpeck, J. (2017, March 24). The twenty-first century Colorado River hot drought and implications for the future. Retrieved from https://agupubs.onlinelibrary.wiley.com/doi/pdfdirect/10.1002/2016WR019638

US south-west in grip of historic 'MEGADROUGHT', research finds. (2020, May 29). Retrieved April 15, 2021, from https://www.theguardian.com/environment/2020/may/29/megadrought-us-south-west-fires-water-research

Kahoot Sources

Brean, H. (2019, June 21). Lake Mead forecast continues to brighten as water cuts are modeled. Retrieved April 15, 2021, from https://www.reviewjournal.com/local/local-nevada/lake-mead-forecast-continues-to-brighten-as-water-cuts-are-modeled-1690850/

Colorado River flow shrinks from climate crisis, risking 'severe water shortages'. (2020, February 20). Retrieved April 15, 2021, from https://www.theguardian.com/environment/2020/feb/20/colorado-river-flow-shrinks-climate-crisis

Facts about the shrinking colorado river. (n.d.). Retrieved April 15, 2021, from https://www.seametrics.com/blog/colorado-river-facts/

Jim Robbins / Photography by Ted Wood • January 22. (n.d.). On the Water-Starved Colorado river, Drought is the New Normal. Retrieved April 15, 2021, from https://e360.yale.edu/features/on-the-water-starved-colorado-river-drought-is-the-new-normal

Once-in-a-lifetime photos of the colorado river kissing the sea. Retrieved April 15, 2021, from https://mymodernmet.com/colorado-river-gulf-of-mexico-photos/

Press, A. (2020, April 17). Warming makes U.S. West megadrought worst in modern Age, study finds. Retrieved April 15, 2021, from https://www.nbcnews.com/science/science-news/warming-makes-u-s-west-megadrought-worst-modern-age-study-n1186061

With Drought Plan in Place, Colorado River Stakeholders Face Even Tougher Talks Ahead on the River's Future. (n.d.). Retrieved April 15, 2021, from https://www.watereducation.org/western-water/drought-plan-place-colorado-river-stakeholders-face-even-tougher-talks-ahead-rivers