Megadrought in the Colorado River Basin: water supply implications for Phoenix Metro using WaterSim 5

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Background

- The Colorado River (and its tributaries) provide water to nearly 40 million people:
  - Municipal water use
  - Irrigation (5.5 million acres)
  - Supports 22 federally recognized tribes, 7 National Wildlife Refuges, 4 National Recreation Areas, and 11 National Parks
- Sixteenth year of drought in the Basin
- The likelihood of droughts lasting >35 yrs: 20% to 50%; the risk of an unprecedented 50-yr megadrought: 5% to 10% (Ault et al. 2014)
- Central Arizona – Phoenix – receives ~ 1.6 million acre-feet of water annually from the Colorado River to support ~ 4.4 million people

CO River Basin

Megadrought (historical)

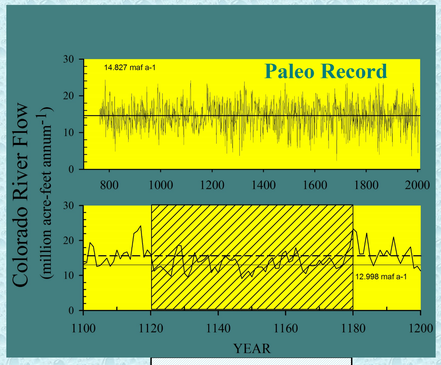
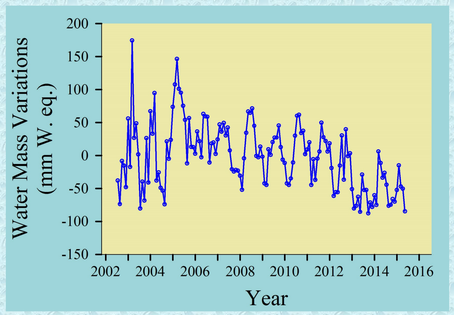


Figure 1. Paleo reconstruction of Colorado River flows using tree ring dendrochronology: from Meko et al. 2012

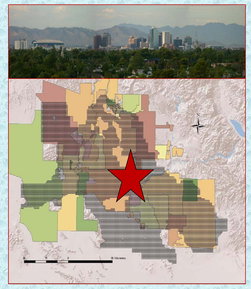
Figure 2. GRACE water mass variation[1] for the Colorado River Basin



[1]Regional average of water mass variations inside the Colorado River basin observed by Gravity Recovery And Climate Experiment (GRACE). Data from the processing center GFZ were decorrelated and smoothed using the method DDK3 [Kusche and Schrama, 2005] and a mean gravity field for the period 2003-2014 was removed.

Highlights

Phoenix Metro has a rich history in water management dating to 1883. Simulations suggest that reductions in personal water use required to adapt to mega drought conditions will help, but that other supply/demand policies will be needed to offset a 60-year drought.



Methods

WaterSim 5

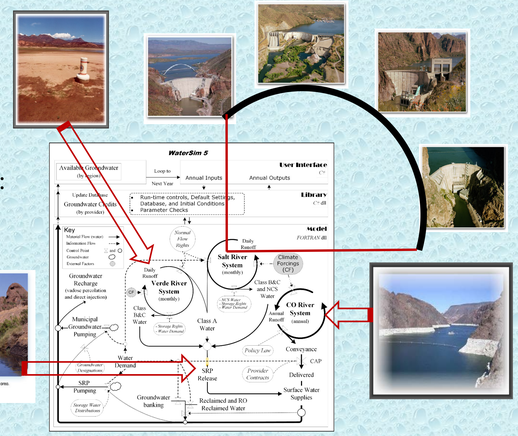


Figure 3. Water supply: Sampson et al. 2016

- A 60-year window from paleo reconstruction
- Proportional difference in median flow and the long-term record: potential drought reductions on riverine flows
- 12%, and 19% reduction in flows for the CO River and the Salt-Verde (SV) Rivers, respectively
- 1906-present: CO River (56 traces); 1945-present: SV Rivers (17 traces)
- Adjusted the trace flows using the drought reduction
- Conservation measures (1.25, 1.5. 1.75% per ammum^{-1}) starting in 2020

11,424 Scenarios 700 k observations

Results

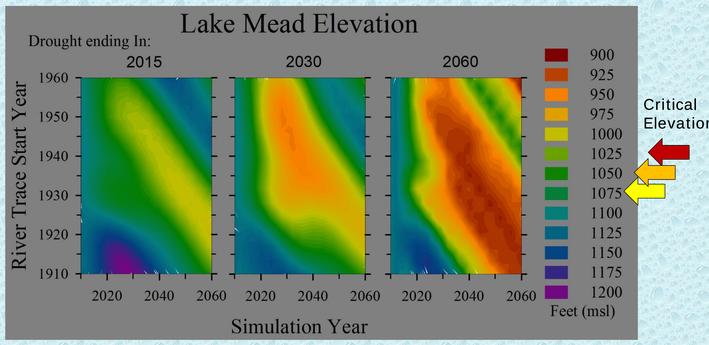


Figure 4. River Trace, drought length, and Lake Mead Elevation

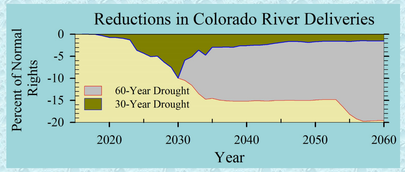


Figure 5. Reductions in total CO River deliveries from normal reservoir operations

No Conservation Measures

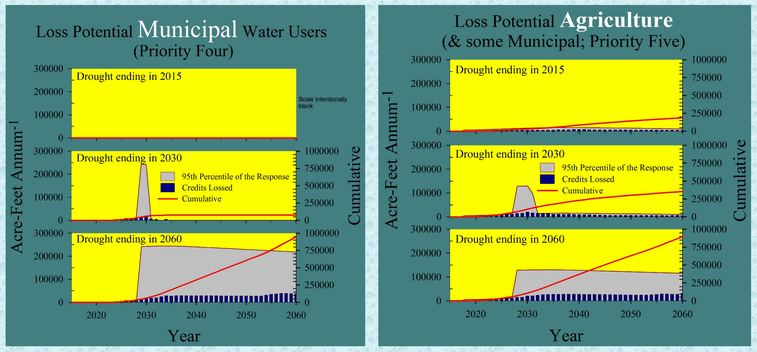


Figure 6. Loss potential for CO River water: water rights requested but not fulfilled

With Conservation

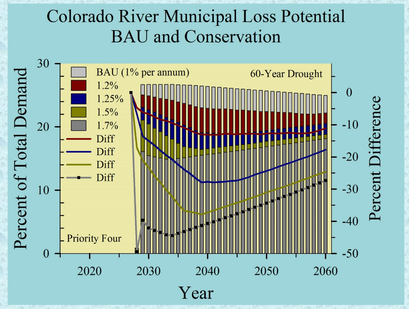


Figure 7. Recovered CO River water rights for the 95th percentile of the response with conservation measures

Conclusions

- The length of a megadrought strongly determines the overall impact on water supplies; a drought ending in 2030 has 1/12th the impact of a 60-year drought
- A 60-year drought created reductions in CO annual deliveries ~ 20%
- Municipal water losses approach 26% of total demand (60-year drought); conservation measures can reduce loss potential by 10% to 40% depending on measures enacted.

Acknowledgment

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