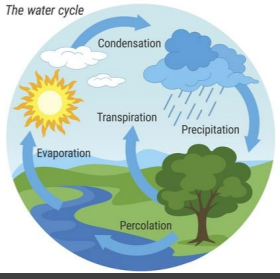
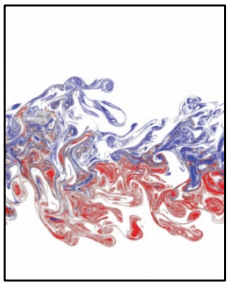
Boase Seminar Series in Hydrology and Water Resources Engineering

Department of Civil, Environmental and Architectural Engineering





Retroactive and Future Vulnerability of Lake Mead Operating Policies to Uncertainty in Water Supply, Demand and Storage

Mr. Nathan Bonham, PhD Candidate

Department Civil, Environmental and Architectural Enggineering

University of Colorado, Boulder, CO

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Zoom: https://cuboulder.zoom.us/j/95668504496

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Abstract:

This research analyzes the robustness of reservoir operation policies, identifies vulnerability scenarios where policies of interest fail performance thresholds, and establishes a signpost monitoring system to inform when adaptive action is required to avoid system failure. Robustness is the ability of a policy to perform well when tested in many plausible future States of the World (SOW), where each SOW samples from the future uncertainty space. Scenario Discovery is a statistical classification analysis that identifies concise descriptions of uncertainty where policies of interest tend to fail performance thresholds. We perform a case study on operation policies for Lake Mead, the largest reservoir in the United States and the backbone of the Colorado River Basin (CRB). We stress-test 463 policies in 500 SOW each using the Colorado River Simulation System, where each SOW samples uncertainty in future hydrology, water demand, and initial water storage. Next, we perform a multi-metric, multi-objective robustness tradeoff analysis from which a small, diverse subset of operation policies are identified. We then perform Scenario Discovery on the robust policies using uncertainty metrics that quantify the average annual streamflow over the previous W years, where W ranges from two to twenty. These metrics are retrospective, meaning the resulting scenarios are directly observable in real time. Lastly, we compare the vulnerability scenarios to the historical streamflow record and future streamflow projections, demonstrating how Scenario Discovery performed with retrospective metrics can inform when adaptive intervention may be required to meet CRB water storage, water delivery, and hydropower requirements. Preliminary results suggest that robust policies commonly implement water delivery shortages larger than one million acre-feet (MAF) and occasionally larger than two MAF. Scenario Discovery results indicate that vulnerabilities occur when average flow over a two and twenty-year period is less than 57% and 91% of the historical average, respectively. These vulnerability scenarios have been observed in two general eras of the historical record: 1964 to 1979 and 2002 to present.

Speaker Bio: Nathan is a third year PhD student at the University of Colorado Boulder in the Civil Engineering program with a focus on Hydrology, Water Resources, and Environmental Fluid Mechanics. He is co-advised by Dr. Joe Kasprzyk and Dr. Edith Zagona. His research focuses on bottom-up decision making frameworks for improved management of water supply in the Colorado River Basin. This research is funded by the U.S. Bureau of Reclamation, with extra support from the GAANN fellowship program on revitalizing U.S. infrastructure. In 2021, Nathan was awarded the NSF Graduate Research Fellowship, where he will continue his research in the Colorado River Basin and integrate his experience into post-conflict water management research in the Orontes River Basin, Syria. Nathan enjoys hiking and cooking with his wife, spending time with his church family, playing frisbee with his dog, and running.