TETRA TECH

Yuchuan Lai, PhD, PE
Civil Engineer Researcher

EXPERIENCE SUMMARY

Dr. Lai has led several interdisciplinary studies related to climate and environmental data analytics, water resources management, and time series analyses. Key completed studies include extension of historical monthly runoff and climate change analyses for ten watersheds in the California's Central Valley, long-term climate change analyses on the Colorado River Basin, and modeling and analyzing temperature increases and related water quality implications in drinking water distribution systems. Dr. Lai is currently involved in several projects related to water resources management and data analytics including extreme rainfall statistics.

Dr. Lai completed a two-year postdoctoral research project at Carnegie Mellon University prior to joining Tetra Tech in 2022. Dr. Lai is a member of American Society of Civil Engineers Technical Committee on Adaptation to a Changing Climate (Future Weather and Climate Extremes) and is a registered civil engineer in the State of California. Dr. Lai was selected to 2026 40 Under 40 Recognition Program by the American Academy of Environmental Engineers and Scientists.

RELEVANT EXPERIENCE

Extreme Precipitation Analyses and Long-term Projections in Seattle

An analytical framework is being developed and used to estimate historical and project long-term changes in precipitation extremes in Seattle. This framework integrates extreme value theory with probabilistic descriptions of global and regional climate change to provide intensity–duration–frequency (IDF) projections. Leveraging Seattle's extensive network of rain gauges, the spatial variation and highly localized precipitation extremes (on scales smaller than 5 miles) are also being studied.

Long-term Hydrology and Water Delivery for the Colorado River Basin

Studies of historical and future hydrology in the Colorado River Basin are conducted, along with an impact assessment of regional water deliveries to key water rights holders. Historical and projected future Upper Basin flow volumes are analyzed with respect to the effects of regional temperature and precipitation changes. Historical observations are used to constrain the uncertainty of future projections using a statistical time-series model. A basin-wide system operation model (the Colorado River Simulation System model) is used to incorporate historical and future hydrology, water demand, and operational policies, providing probabilistic estimates of regional water supply. Short-term and long-term water deliveries and shortages under several historical and future scenarios are estimated for key water rights holders.

EDUCATION

Ph.D., Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, Pa, 2020

M.S., Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, Pa, 2016

B.S., Civil Engineering, Southeast University, Nanjing, China, 2015

AREA OF EXPERTISE

Climate Data Analytics and Services

Water Resources Engineering

Statistical Learning

REGISTRATIONS/ AFFILIATIONS

Professional Civil Engineer (California; license #: C 96399)

American Geophysical Union

American Society of Civil Engineers

Association of Environmental Engineering and Science Professors

CONTACT

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Extending the Central Valley 10-River Index Back to the 1870s Based on Bulletin 5 Data to Evaluate Historical Changes in Runoff Patterns

Historical weather and streamflow records, as well as documents provided by the 1923 report *Flow in California Streams*, are digitized, utilized, and assessed to extend the unimpaired flow series for 10 rivers in California's Central Valley region. Using a combination of modern NOAA and USGS databases and records from historical documents, temperature and precipitation series are constructed for water years 1872–1921 and further applied in a regression model to estimate unimpaired flow series for the historical period beginning in 1872. Changes in annual and seasonal flow patterns of the 10 rivers are analyzed, along with historical variability and long-term trends.

Salton Sea Management Program and Long-term Hydrologic Modeling

A hydrologic model for the Salton Sea Basin is developed based on the US Army Corps of Engineers' Hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS) to facilitate technical analyses of local restoration projects. The developed basin-wide hydrologic model provides continuous, long-term hydrologic simulations, such as various inflows to the Salton Sea, and will serve as a modeling framework for future analyses by the US Army Corps of Engineers. Additional technical analyses and tasks are performed for the Salton Sea Management Program, including project-level hydrologic modeling of wetlands, air pollutant emission analyses for proposed construction projects, and environmental data analytics, such as groundwater levels and quality.

Effects of Warming Climate on Drinking Water Temperature and Quality in Distribution Systems

Water temperature in drinking water distribution systems and associated impacts from warming air temperature were investigated for over 90 U.S. cities. An empirical model was developed and utilized to apply local ambient air temperature records to estimate daily drinking water temperature in distribution systems based on the heat exchange between air and soil and between soil and buried drinking water mains. The impacts on drinking water quality from projected increasing air temperature were analyzed and examined.

Climate Risk Assessments of Engineering and Environmental Projects

Long-term climate change risk assessments of various climate hazards and impacts were conducted for different engineering and environmental projects, including landfills and tailings storage facilities both in the U.S. and internationally. By synthesizing and leveraging state-of-the-art climate science and modeling, these projects translated climate projections into local, project-level risk indices—such as extreme precipitation and coastal flooding—and identified actionable items to mitigate climate risks faced by project facilities.

PEER-REVIEWED JOURNAL ARTICLES

Lai, Y., P.H. Hutton, and S.B. Roy. 2025. Inferring Trends and Temperature Sensitivities Using Regression-Based Unimpaired Runoff to San Francisco Estuary, 1872-2022. *Journal of the American Water Resources Association*. 61(5), e70057. https://doi.org/10.1111/1752-1688.70057

Lai, Y., B. Choi, and S.B. Roy. 2025. Bayesian inference of historical streamflow changes suggests further stress in the Colorado River Basin. *Journal of Hydrology: Regional Studies*, 61, 102619**.** https://doi.org/10.1016/j.ejrh.2025.102619

Lai, Y., P.H. Hutton, and S.B. Roy. 2024. Reconstructing Seasonal Unimpaired Runoff to the San Francisco Estuary: Extending the Available Record Back to Water Year 1872. *Journal of the American Water Resources Association*. 61(1) e13247. https://doi.org/10.1111/1752-1688.13247

Lai, Y. and M. Pozzi. 2024. Sequential Learning of Climate Change via a Physical-parameter-based State-space Model and Bayesian Inference. *Climatic Change*. 177(6), 99. https://doi.org/10.1007/s10584-024-03739-w.

Lai, Y. and D.A. Dzombak. 2023. Using Climate Model Decadal Predictions and Statistical Extrapolations of Location-Specific Near-Term Temperature and Precipitation for Infrastructure Engineering. ASCE OPEN: Multidisciplinary Journal of Civil Engineering: 1 (1). https://doi.org/10.1061/AOMJAH.AOENG-0015.

Lai, Y., T. Lopez-Cantu, D.A. Dzombak, and C. Samaras. 2022. Framing the Use of Climate Model Projections in Infrastructure Engineering – Practices, Uncertainties, and Recommendations. *Journal of Infrastructure Systems.* 28 (3), 04022020. https://doi.org/10.1061/(ASCE)IS.1943-555X.0000685.

Lai, Y. and D.A. Dzombak. 2021. Assessing the Effect of Changing Ambient Air Temperature on Water Temperature and Quality in Drinking Water Distribution Systems. *Water*. 13(14), 1916. https://doi.org/10.3390/w13141916.

Lai, Y. and D.A. Dzombak. 2021. Use of Integrated Global Climate Model Simulations and Statistical Time Series Forecasting to Project Regional Temperature and Precipitation. *Journal of Applied Meteorology and Climatology.* 60, 695–710. https://doi.org/10.1175/JAMC-D-20-0204.1.

Lai, Y. and D.A. Dzombak. 2020. Use of the Autoregressive Integrated Moving Average (ARIMA) Model to Forecast Near-term Regional Temperature and Precipitation. *Weather and Forecasting*, 35, 959–976, https://doi.org/10.1175/WAF-D-19-0158.1

Lai, Y. and D.A. Dzombak. 2019. Use of Historical Data to Assess Regional Climate Change. *Journal of Climate*, 32, 4299–4320, https://doi.org/10.1175/JCLI-D-18-0630.1.

PROFESSIONAL ACTIVITIES

Reviewers

Journals: Air Quality, Atmosphere and Health (Springer), Applied Ocean Research (Elsevier), Climatic Change (Springer), Earth and Space Science (Wiley), Earth Systems and Environment (Springer), Earth System Science Data (Copernicus Publications), Engineering Applications of Artificial Intelligence (Elsevier), Heliyon (Cell Press), Journal of Hydrometeorology (American Meteorological Society), International Journal of Climatology (Wiley), Urban Climate (Elsevier), Stochastic Environmental Research and Risk Assessment (Springer)