



ASU Flow 2026

Student Poster Session Abstract Booklet

Date	Time	Location
Wednesday, October 14, 2026	3:00 p.m. to 8:00 p.m.	ASU SkySong, Synergy I and II

This booklet includes the poster abstracts for ASU Flow 2026, a student poster session organized by the ASU Center for Hydrologic Innovations and the Arizona Hydrological Society. The session features 21 posters highlighting hydrology, hydrogeology, water resources, and related water and environmental science research.

Event Schedule

Time	Program
3:00 to 4:00 p.m.	Registration and poster setup
4:05 to 4:15 p.m.	Welcome remarks
4:15 to 5:15 p.m.	Poster viewing and judging
5:15 to 6:30 p.m.	Water industry career panel
6:30 to 7:30 p.m.	Networking dinner
7:30 to 7:45 p.m.	Poster awards
8:00 p.m.	End

Improving Local Groundwater Monitoring with High-Resolution Downscaling of GRACE Data in Arizona

Presenter	Md Rayhan
Program	Arizona State University

Abstract

Spatial scale mismatch between coarse-resolution satellite observations and local-scale environmental assessments usually interferes with the successful management of groundwater resources in Arizona. Although the Gravity Recovery and Climate Experiment (GRACE) and its successor, GRACE-FO, offer essential data about Total Water Storage Anomalies (TWSA), they have an original resolution (~25-100 km), which is too coarse to observe localized changes in groundwater in urban and agricultural environments such as Phoenix.

This study presents a machine-learning-based, physically consistent framework to reduce the resolution of GRACE TWSA data, downscaling from 25km to 1km. The research model is based on a Random Forest (RF) model that incorporates high-resolution environmental predictors, which are PRISM Precipitation, MODIS NDVI, OpenET Evapotranspiration, WLDAS Soil Moisture Content and WLDAS Runoff. The methodology of downscaling with residual was used to make sure that the final 1-km TWSA product maintains the actual hydrological variability and that it reveals much more detailed patterns of water stores in comparison to the original coarse-resolution datasets.

The performance of the model was rigorously evaluated and the predictive accuracy was good with a correlation (r) of 0.96 and correlation (r) of 0.81 between the training and the test data respectively and an overall RMSE of 15.11 mm was obtained during training. Additionally, Groundwater Storage Anomalies (GWSA) were calculated by de-aggregating the downscaled TWSA into its sub-elements, including soil moisture and surface water. It was validated by comparing the high-resolution GWSA data to the in-situ groundwater well measurements in the Active Management Areas (AMAs) within Arizona that the high-resolution GWSA data are hydrologically consistent and capture the spatial storage variability at local scales.

Its results suggest that this 1-km downscaled product is able to capture regional information and sub-grid heterogeneity that is lost in original GRACE observations. This framework is an effective tool in enhancing local groundwater monitoring and data-driven water innovation efforts in Arizona because it is a more accurate depiction of water mass changes. Such findings are critical to support the making of informed decisions and sustainable water management in arid areas.

Can AI Weather Models Predict Tropical Cyclone Tracks and Identify System Sensitivity for Targeted Observation and Potential Intervention?

Presenter	Qin Huang
Program	Arizona State University; SCAS

Abstract

Tropical cyclones are among the most damaging hydroclimate extremes, bringing intense rainfall, storm surge, flooding, and cascading infrastructure impacts to coastal communities. This study asks whether AI weather models can do more than predict a storm track: can they also reveal where the atmosphere is most sensitive, and therefore where additional observations or future intervention strategies may matter most? Using Hurricane Sandy (2012) as a case study, we apply the Aurora AI weather model initialized from ERA5 to test localized thermodynamic perturbations in two regimes: FTLE-guided sites in the Caribbean steering flow and a remote Pacific corridor linked to Rossby-wave propagation. Results show that both pathways can produce substantial Sandy track deviations in Aurora, shifting the modeled track by hundreds of kilometers after seven days. These changes occur because small early track offsets are amplified near Sandy's recurvature region, where interaction with the midlatitude circulation becomes highly sensitive. For the hydrologic, climate, and water-resources community, this work highlights a potential new role for AI weather models as fast experimental laboratories for extreme-event prediction, targeted observation design, and long-term risk reduction planning.

Does Forest Thinning Enhance Water Availability in Semiarid Forested Headwaters? A Modeling Study from Central Arizona

Presenter	MD Akram Hossain
Program	Arizona State University; PhD in Civil, Environmental and Sustainable Engineering

Abstract

In recent decades, forest thinning has emerged as a widely implemented strategy across the southwestern United States to mitigate the increasing risk of wildfires. While its primary objective is to reduce the potential for severe wildfires, several studies have shown that thinning can simultaneously enhance water yields at the watershed scale. In water-scarce regions such as Arizona, accurately predicting the water benefits of forest thinning is of growing interest to forest and water managers and policymakers seeking sustainable water solutions. In this study, we employed the TIN-based Real-Time Integrated Basin Simulator (tRIBS), a physically based, distributed hydrologic model, to simulate the hydrologic effects of forest thinning across multiple forested headwater catchments in central Arizona, collectively referred to here as the Middle Sycamore catchments. We evaluate hypothetical treatment designs developed following forest management guidelines. Simulations are conducted under pre- and post-thinning conditions to quantify changes in the watershed water balance and examine the processes controlling the magnitude and spatial distribution of water benefits. Preliminary results indicate that thinning reduces watershed-scale evapotranspiration, but the distributed response is considerably more complex than the basin-average change alone suggests. Within thinned stands, reductions in canopy cover decrease transpiration, canopy interception losses, and snow-related vapor losses. These reductions are partially offset by increased soil evaporation from newly exposed surfaces and increased transpiration from adjacent or retained trees with greater access to soil water. As a result, local water savings do not translate uniformly into watershed-scale gains. The water benefit of thinning therefore cannot be inferred from reductions in vegetation cover alone but instead reflects a redistribution of water among atmospheric loss pathways across the landscape. Resolving these compensating responses provides a more mechanistic understanding of how forest thinning influences water availability and underscores the value of physically based distributed hydrologic modeling for evaluating the potential water benefits of forest management in semiarid headwater systems.

Clean at the source, contaminated in storage: testing ceramic filters to close the gap in a Wayúu community

Presenter	Maria Jose Uribe Perez
Program	Northern Arizona University; PhD Earth Science & Environmental Sustainability

Abstract

Water that passes a source-level quality test can still be unsafe by the time it is drunk, and standard monitoring rarely captures that gap. In Yawaka, a Wayúu settlement in La Guajira, Colombia, we sampled source water and household water across 25 households (88 samples in total) to identify where contamination enters the supply chain. Source water met Colombian drinking water standards and contained no *E. coli*. However, 86% of household samples showed bacterial contamination, and *E. coli* was found only in stored household water. These results indicate that contamination occurs between source and point of consumption, in household storage, which shifts the intervention target from source protection to storage and point-of-use treatment.

To test a storage-stage intervention, we delivered point-of-use ceramic filters to 10 households. Two months after delivery, we sampled six of the eight filters that were in use at the time of the visit and compared the results to the household storage containers (the seventh and eighth households could not be sampled because no one was home). Water stored in the household tanks contained coliform bacteria in four of the six households, and *E. coli* in two of the six. However, the filter samples were free of bacteria in five of the six households sampled, and in the remaining household the filter contained only total coliforms at a substantially lower level than its storage tank. No *E. coli* was present in any of the filter samples.

Many residents doubted the initial safety assessment because their water had never made them ill. Closing the source-to-use gap therefore requires pairing engineering measurements with community knowledge. This work builds on findings published in *Frontiers in Water* (Uribe Perez et al., 2026).

Surface Water Detection in Dryland Playas using CubeSats and Deep Learning

Presenter	Jessie Salinas
Program	Arizona State University; Civil, Environmental and Sustainable Engineering, MS

Abstract

Monitoring the presence of surface water in dryland playas remains a challenge because inundation events are infrequent, brief, and often remote. Near-daily, 3-m imagery from commercial CubeSat constellations, combined with long-term field observations, offers a promising opportunity to capture these transient inundation events. The Jornada Basin in southern New Mexico contains playas formed under a range of geomorphic conditions, resulting in a substantial variation in playa size, soil properties, and inundation dynamics. This diversity, combined with water-level and rainfall observations from 2016 through 2026 and PlanetScope imagery, provides a robust dataset useful for training and testing deep learning (DL) models to detect surface water from satellite imagery. Previous studies have relied on changes in near-infrared (NIR) surface reflectance to detect transient surface water. While effective under many conditions, this approach has limitations when distinguishing shallow water from wet soils and vegetation. In this study, we develop a DL approach using a Long Short-Term Memory Convolutional Neural Network (LSTM-CNN) trained on PlanetScope imagery and validated against playa water-level and rainfall data. The model is trained on observations from eighteen instrumented playas and independently evaluated on twelve additional playas, providing an evaluation across thirty Jornada playas with diverse geomorphic characteristics. Model performance is evaluated using metrics such as precision, recall, F1-score, and intersection over union for surface water classification. Model performance may encounter limitations during periods of cloudiness and mixed wet-soil conditions. We evaluate the added value of temporal memory and spatial features in improving detection accuracy under vegetation cover and during transitional hydrologic conditions. This study aims to develop a transferable, scalable method for detecting transient surface water in drylands with minimal calibration. If successful, this framework will provide a novel approach for monitoring dryland surface water bodies, helping improve hydrologic connectivity assessment, streamflow regime classification, and water-resource management.

Probabilistic Attribution of Flood-Generating Mechanisms for Peaks-Over-Threshold Flood Frequency Analysis

Presenter	Upeakshika Bandara
Program	Arizona State University; PhD in Hydrosystems Engineering

Abstract

Peaks-over-threshold (POT) flood series often comprise events generated by multiple flood-generating mechanisms (FGMs), including intense rainfall, snowmelt, and rain-on-snow. Conventional flood frequency analyses either assume a single homogeneous population or rely on deterministic FGM classifications, potentially biasing estimates of extreme flood behavior. We develop a Bayesian hierarchical mixture model for POT exceedances that jointly infers, for each exceedance, the probability that it was generated by each FGM together with the parameters of the corresponding process-specific generalized Pareto (GP) distributions. Hydrometeorological indicators describing precipitation, antecedent wetness, snow contribution, and seasonality are incorporated as covariates governing these event-level probabilities. We first test the framework using synthetic experiments under controlled conditions to quantify its ability to recover the true FGM assignments and GP parameters across varying levels of FGM overlap. The framework is then applied to 700 near-natural stream gauges spanning diverse hydroclimatic settings across the contiguous United States, with hydrometeorological covariates derived from the National Water Model. By replacing deterministic event classification with probabilistic process attribution and explicitly accounting for process heterogeneity, the proposed framework addresses the long-standing disconnect between flood typing and flood frequency analysis.

Utility of modelling extreme precipitation using mixed distributions

Presenter	Debarghya Bhattacharyya
Program	Arizona State University; Civil and Environmental Engineering

Abstract

Extreme precipitation is generated by multiple atmospheric mechanisms with distinct statistical characteristics, yet conventional frequency analyses often treat precipitation extremes as a single homogeneous population. This study develops a mechanism-based mixture framework for modeling daily precipitation extremes across the contiguous United States (CONUS). Daily precipitation observations from the Global Historical Climatology Network for 1980–2018 are classified according to major precipitation-generating mechanisms, including fronts, extratropical cyclones, atmospheric rivers, tropical cyclones, mesoscale convective systems, and the North American monsoon. Generalized Pareto distributions are fitted to mechanism-specific precipitation using the Metastatistical Extreme Value framework, with regionalization used to improve estimation of shape parameters where local samples are limited. At each station, the two dominant mechanisms are represented using a weighted mixture distribution and compared with a conventional single-distribution model. Statistical testing and Monte Carlo experiments are used to evaluate differences among mechanism-specific distributions and assess the reliability of parameter estimation. Return levels across multiple recurrence intervals are then compared between single and mixture models. The framework provides a physically interpretable approach for quantifying precipitation extremes and examining how distinct generating mechanisms influence estimates of rare hydrologic events across different climatic regions of CONUS.

Robustness of the Western U.S. Networked Water Supply System under Drought and Demand Scenarios

Presenter	Kyungmin Kim
Program	Arizona State University; Hydrosystems Engineering

Abstract

Large-scale water infrastructure, from reservoirs to aqueducts, has enabled a reliable water supply across the western United States. The Western U.S. water network is centered on the Colorado River, supplying water eastward to the Rio Grande Basin and westward to Southern California to mitigate water stress of each region. While such infrastructure systems are effective in reducing local water shortage risks during most drought events, their interconnectedness can introduce unintended vulnerabilities under prolonged or widespread drought conditions, including cascading failures. This is particularly concerning because these systems have been historically optimized based on past streamflow variability, without accounting for the possibility of unprecedented infrastructure failures driven by conditions beyond historical experience. Therefore, there is a growing need to prepare these systems for future uncertainties, including climate change and shifting water demand. However, our understanding remains limited regarding how future changes in climate and demand may affect such networked water supply systems, and how adjustments in operating rules could help mitigate these impacts. To address this gap, this study evaluates the robustness of the networked water supply system in the western U.S. under various drought and demand scenarios. Using a simplified yet representative modeling approach that incorporates key infrastructure, water demand, and major operational rule sets, we address two key research questions: to what extent can the system tolerate changing hydroclimate and demand conditions, and which operating rules might improve system robustness under such conditions. We propose performance metrics at both local and system levels to assess robustness and identify potential vulnerabilities and critical weak points within the network. The findings are intended to inform the design of more resilient operating strategies and support decision-makers in preparing interconnected water systems for future climate uncertainty.

Testing Distributed Simulation of an Ephemeral Snowpack Against Airborne LiDAR Snow Surveys in Arizona's White Mountains

Presenter	Luke Fredenberg
Program	Arizona State University; PhD Geological Science

Abstract

Snowpacks in the southern margin of the Colorado Plateau persist for brief periods and lie near the rain-snow transition line such that a warm spell can rapidly deplete snow water equivalent (SWE). In this study, we determine the controls on the spatial distribution and ablation of snowpack in a representative basin of this region, and if a distributed hydrologic model can reproduce the observed snow patterns. We apply the TIN-based Real-time Integrated Basin Simulator (tRIBS) to the Upper Black River (1,440 km²), a forested sub-basin of the Salt River. The model is parameterized with LiDAR-derived terrain and vegetation data and driven by gridded meteorological forcing, with bias-corrected temperatures and precipitation used to support SNOTEL simulations. The snowpack physics were first tested against 10 years of observed SWE at four SNOTEL stations spanning a ~400 m elevation range, including the rain-snow transition. Simulations captured both the seasonal snowpacks at higher elevation sites and the intermittent, shallow snow near the transition. This indicates that lapse rate-driven precipitation partitioning exerts a dominant control on snow accumulation. Basin simulations in the Upper Black River were then evaluated against three Airborne Snow Observatories, Inc. (ASO) LiDAR snow surveys from January through March of 2026. ASO products provided snow depth at 3 m resolution and SWE at 50 m using density modeling constrained by field measurements. The surveys captured a relatively dry winter, with measured SWE peaking at 9.5 ± 0.4 thousand acre-feet in late February, then declining by over 90% in under three weeks. The surveys provide a high-resolution benchmark for testing if the model captures snow accumulation and ablation processes across the basin. Comparison of the model to the LiDAR snow surveys and stream discharge will aid in identifying the processes limiting snowmelt and runoff forecast skill in marginal snow climates, including the Salt and Verde River systems supplying central Arizona.

The Coupling between Spring Precipitation and Temperature Helps Improve Seasonal Streamflow Forecasts in the Upper Colorado River Basin

Presenter	Xinyu Chen
Program	Arizona State University

Abstract

During the megadrought in the Colorado River basin, the consequences of seasonal streamflow forecast error have grown, so accurate forecasts have become more important than ever. According to a recently proposed theory, there is a thermodynamic coupling between spring temperature and spring precipitation in the Upper Colorado River basin (UCRB). In this study, we test whether the coupling can be exploited to improve streamflow forecasts in the UCRB. A Gaussian Bayesian network was built as a forecast model for the UCRB over water years 1984 to 2024. The results indicate that incorporating the coupling significantly improved the January forecast of April–July streamflow, raising the Nash-Sutcliffe efficiency (NSE) from 0.49 to 0.53 and the Kling-Gupta efficiency (KGE) from 0.43 to 0.51. The North American Multi-Model Ensemble temperature forecast routed along the coupling added further skill, while the precipitation forecast from the same ensemble added none. Against the two forecasts issued operationally, the model raised the NSE by 11% to 15%, and the KGE by 15% to 35%. It came closest to observation in the five driest years, overshooting the observed flow by 80% where the operational forecasts overshoot by 110% to 119%. In water year 2021 it overestimated the observed April–July flow only by 32%; the operational forecasts overshoot by 96% to 112%.

Evaluating the performance of climate model-based covariates for nonstationary extreme precipitation modeling

Presenter	Jaya Bhatt
Program	Arizona State University; Postdoctoral Research Scholar

Abstract

Projections of extreme precipitation under climate change are essential for water infrastructure design and risk assessment. These projections often rely on nonstationary models with covariates representing thermodynamic and large-scale circulation controls. The latter can be derived from outputs of Global Climate Models (GCMs), but they must be properly evaluated. In this study, we use a multi-metric framework to evaluate GCM-simulated covariates during the historical period (1950-2014) against ERA5 reanalysis for five candidates: near-surface air temperature, precipitable water, dew point temperature, 500-hPa geopotential height, and 500-hPa vertical velocity. Annual time series were evaluated at global, continental (the U.S.), and local (Missouri) scales, using several metrics that quantify trend behavior, short- and long-term memory, distributional similarity, and L-moment ratios. The metrics were combined into a composite score to rank models and discard low-performing GCMs. The ensemble means with the retained GCMs were then compared using the same weights and performance-based weights. Results showed that the retained GCMs ensemble mean generally improved agreement with ERA5. For all covariates, performance is relatively lower at the local scale. In addition, precipitable water and 500-hPa vertical velocity are poorly represented at the global scale. The framework provides a systematic basis for selecting climate model covariates for nonstationary modeling.

Stochastic Simulation of Peaks-Over-Threshold Flood Events Preserving Occurrence, Magnitude, and Timing Seasonality for Managed Aquifer Recharge Assessment

Presenter	Suraj Tiwari
Program	Arizona State University; PhD

Abstract

High-flow events provide important opportunities for managed aquifer recharge (MAR), but assessing their availability requires information not only on flow magnitude but also on event frequency, timing, duration, and temporal spacing. This study develops a calendar-aware stochastic framework for generating synthetic peaks-over-threshold (POT) flood-event catalogs while preserving occurrence and magnitude seasonality. POT events are extracted from long-term daily streamflow records using a Q90 threshold and characterized by event duration, peak discharge, volume, and inter-event duration. Annual event occurrence is modeled probabilistically, and simulated annual events are distributed among months using observed monthly occurrence patterns to preserve occurrence seasonality. One-day and multi-day events are treated separately, with multi-day duration, hydrograph shape, and peak discharge generated jointly using fitted marginal distributions and a copula to preserve their multivariate dependence. Generated events are assigned to monthly occurrence slots based on their multivariate characteristics while keeping each generated event vector intact. A calendar-aware procedure then accounts for event duration, minimum inter-event spacing, month-to-month transitions, and calendar constraints to generate physically feasible event start and end dates. The framework was evaluated at 701 Hydro-Climatic Data Network (HCDN) stream gages across the conterminous United States using 1,000 Monte Carlo realizations per gage. Cross-gage evaluation showed strong agreement between observed and simulated annual and seasonal statistics of event occurrence, volume, peak discharge, duration, inter-event duration, and dependence among event characteristics, demonstrating the framework's ability to reproduce key features of POT events across diverse hydrologic regimes. The resulting synthetic catalogs provide probabilistic sequences of high-flow event occurrence, magnitude, duration, and timing that can be used to estimate the frequency and volume of surface water potentially available for MAR, while also supporting broader applications such as reservoir operations, flood-management planning, and hydraulic infrastructure assessment.

Advancing Urban Flood Management and Design through Coupled Infrastructure and Storm Modeling

Presenter	Nehal Ansh Srivastava
Program	Arizona State University; PhD

Abstract

The effective management and design of stormwater infrastructure requires modeling tools that capture the impacts of spatiotemporally variable storms on the entire stormwater drainage network. This includes the representation of wind-induced power outages that can trigger pump failures. We addressed this gap by developing (1) a coupled mechanistic model of stormwater and power networks, named PSI-Cascade, and (2) frameworks to generate high-resolution precipitation and wind fields. After describing the model structure, we showed its capabilities in Phoenix, AZ, for a set of historical storms with documented street flooding impacts. We devote particular attention to generating realistic wind gust fields that cause power outages, a challenging task due to the lack of dense observations and the isolated nature of strong windstorms. We then demonstrate how PSI-Cascade can be utilized to first identify areas with a higher risk of flooding associated with significant disruptions to transportation infrastructure, and subsequently test various flood mitigation solutions.

Explaining Performance Differences Across U.S. Drinking Water Systems: The Roles of Scale, Ownership, Source, Socioeconomic Conditions, and Financial Capacity

Presenter	Mengling Qiao
Program	Arizona State University

Abstract

The U.S. drinking water sector is highly fragmented, with tens of thousands of systems varying substantially in size, ownership, source water, financial capacity, and the socioeconomic characteristics of the communities they serve. Yet these dimensions are often studied separately, limiting our understanding of why some utilities provide affordable and reliable service while others experience persistent performance challenges. This study develops an integrated national assessment of U.S. community water systems to examine how utility characteristics and community context jointly relate to water charges, drinking-water violations, and financial performance.

We integrate multiple national and utility-level datasets covering public and privately owned systems, linking system characteristics and population served with drinking-water violations, household socioeconomic indicators, water charges, and available financial measures. Statistical regression, comparative analysis, and machine-learning methods are used to identify both average relationships and nonlinear interactions among utility scale, ownership, water source, community income, financial condition, and geographic context.

Results show that utility performance cannot be explained by ownership or scale alone. Larger systems and groundwater-supplied systems generally exhibit lower violation rates, while socioeconomic conditions are systematically associated with both water charges and regulatory performance. After accounting for observable system and community characteristics, privately owned systems generally exhibit violation rates comparable to or lower than locally owned systems, while differences in water charges are relatively modest and vary with system size and community income. Financial indicators are also associated with regulatory performance, suggesting that the capacity to generate and sustain revenues may be an important component of service quality. Substantial state-level differences remain after controlling for observed utility characteristics, pointing to the potential importance of regulatory and institutional context. Machine-learning models further reveal interactions that are obscured by average effects, particularly among ownership, system scale, and community income.

These findings suggest that improving drinking-water performance requires moving beyond simple public-private or small-large classifications toward multidimensional, like-for-like assessment of utilities. The resulting framework provides a basis for benchmarking water systems, identifying utilities facing structural constraints, and informing decisions about financing, governance, consolidation, and infrastructure investment.

Are seasonal geochemical patterns in agreement between a Yellowstone National Park hot spring and a river in the same watershed?

Presenter	R. Vincent Debes II
Program	Arizona State University; Geological Sciences PhD

Abstract

Hydrothermal ecosystems (hot springs) occur where interactions among groundwater, precipitation, subsurface geological processes, and volcanic activity support microbial life. In Yellowstone National Park (YNP), snowmelt interacting with rocks at high temperatures, and undergoing phase separation, mineral deposition, and mixing with groundwater, leads to surficial hot springs ranging in pH from about <2 to >9 with temperatures up to 95°C. Over a century of research using geochemical tracers (e.g., chloride, sulfate, $\delta^{18}\text{O}$, $\delta^2\text{H}$, and trace solutes) reveals that YNP hot springs are mixtures of deep hydrothermal (DH) fluids, with likely residence times of hundreds of years, and fluids preserving more recent shallow meteoric signatures (SM). Despite this progress, it remains uncertain how hot springs of differing fluid signatures change over time.

We used multiyear trends to select hydrothermal fluid types for finer temporal resolution sampling (approximately monthly) which allows identification of shorter-term geochemical behavior. DH-signature fluids remain geochemically consistent across 16 months while some SM-signature fluids exhibit seasonal cyclic behavior. These patterns persist years after initial documentation.

We compare seasonal geochemical behavior of a SM-signature hot spring with concurrent samples (and continuous monitoring station data) of the Firehole River, which are both at the SE edges of the Missouri Headwaters Basin. The comparison reveals some hot spring geochemical analyte patterns are shared, with an approximate 4-month attenuation from Firehole peak flow, while others have opposite trends. These results demonstrate that hot springs can have a seasonal component to their geochemical composition with similarities to and differences from the cold-water hydrologic system.

Evaluation of Analysis of Record for Calibration (AORC) Precipitation Products in Arizona Supporting Water Resources Planning and Management

Presenter	Binaya Parajuli
Program	Arizona State University; Masters

Abstract

Reliable long-term, high-resolution precipitation estimates are essential for water-resources planning and management in Arizona, where prolonged drought and reductions in Colorado River supplies have intensified the need for robust hydrologic information. Rain gauges provide the most direct precipitation measurements, but each gauge represents only a single location. Gridded products combine gauge, radar, satellite, and model-based information to better characterize precipitation across space and time.

This study evaluates version 1.1 of NOAA's Analysis of Record for Calibration (AORC) precipitation product, which provides hourly estimates at approximately 1-km resolution for 1979–2023. Because AORC was constructed using different source datasets and adjustment procedures over time, its accuracy may vary among periods and hydroclimatic conditions. We compiled and rigorously quality-controlled observations from 568 hourly and subhourly gauges representing nine networks; each gauge had at least 15 years of nonmissing data. These observations, which are largely independent of the datasets used to construct AORC, were used to assess performance at monthly, daily, and hourly scales and across seasons, precipitation intensities, physiographic regions, and AORC construction periods.

Results indicate that AORC overestimates gauge-measured precipitation, with the largest wet bias during 1979–2009; however, performance varies substantially with temporal scale, season, intensity, region, and construction period. The findings identify when and where AORC is most reliable and will guide the development of targeted bias-correction approaches. This work will provide Arizona water agencies and practitioners with clearer guidance for using AORC in water-resources assessment, hydrologic modeling, and flood and drought applications, including applications of the National Water Model.

A Multi-Scale, AI-Augmented Analysis of the 2026–2027 El Niño and Its Hydroclimatic and Societal Impacts

Presenter	Jinal Vyas
Program	PhD, Complex Adaptive Systems, Arizona State University

Abstract

The 2026–2027 El Niño, among the strongest on record, offers a timely opportunity to examine how ENSO anomalies propagate from ocean–atmosphere dynamics to regional rainfall and then to agricultural, economic, and disaster outcomes. We present an integrated research framework, developed alongside a public ENSO-monitoring dashboard (https://jinal4502.github.io/ENSO_TRACKER/index.html), that links these scales. At the hydroclimatic level, we analyze how ENSO interacts with the Indian Ocean Dipole (IOD). We quantify lagged relationships between ONI/Niño-3.4, the Dipole Mode Index, and gridded rainfall across Asia. We focus on how co-occurring or opposing IOD phases amplify or dampen El Niño's rainfall signal, and on whether these teleconnections have been stable over recent decades. At the impact level, we compute lagged correlations between ENSO indices and regional time series across four domains: agriculture, disasters, economic growth, and commodity prices. We flag periods that overlap major non-ENSO shocks (recessions, geopolitical conflict) to separate ENSO-driven signal from confounded variation. Subnational impact data are sparse and inconsistent, especially in the low- and middle-income regions most exposed to ENSO teleconnections. We therefore test whether large language model-based soft classification of over 900 contemporaneous news articles and research publications can recover regional and sectoral impact signals that complement traditional indicators. We hypothesize that text-derived ordinal severity and direction classifications capture real-time, spatially disaggregated signals that lagged administrative statistics miss. By connecting ocean-basin drivers, regional precipitation response, and downstream societal impacts in one framework, this work aims to support low-cost, publicly accessible tools for water resources, food security, and climate-risk communication.

Ozone Nanobubbles Outperform Hydrogen Peroxide Through Rapid Cell Disruption and Photosynthetic Dysfunction in *Microcystis aeruginosa*

Presenter	Asma Sattar
Program	Arizona State University; PhD

Abstract

Cyanobacterial harmful algal blooms (HABs) pose escalating threats to freshwater ecosystems, drinking water supplies, and public health, demanding rapid and scalable mitigation solutions. Conventional oxidants such as hydrogen peroxide (H₂O₂) are commonly explored for bloom control but are constrained by slow reaction kinetics and diminished performance in complex aquatic environments. This study evaluates ozone nanobubbles (O₃-NBs) as an emerging advanced oxidation approach for cyanobacterial mitigation, with emphasis on improving oxidant stability, delivery efficiency, and reactivity in freshwater matrices. Nanobubble generation in synthetic freshwater produced stable concentrations of approximately 108 particles per milliliter, providing a high surface-area-to-volume ratio that improves oxidant-cell contact. Under equivalent treatment conditions, O₃-NBs achieved approximately 50% reduction in *Microcystis aeruginosa* abundance within 1-3 hours at low ozone concentrations (≤ 1.5 ppm), substantially outperforming H₂O₂, which required 6-9 hours and approximately fourfold higher concentrations (~ 6 ppm) to achieve comparable inhibition. Mechanistic investigation revealed that O₃-NBs treatment induced extensive cellular disruption, as evidenced by the release of intracellular organic matter and pronounced changes in cell size distributions. Elevated antioxidant enzyme activity further confirmed intensified oxidative stress at the cellular level. By contrast, H₂O₂ produced a markedly milder cellular response, suggesting a less efficient mode of action for cyanobacterial inactivation. Collectively, these findings indicate that O₃-NBs provide a more efficient oxidative treatment than H₂O₂ under the tested conditions, combining rapid cyanobacterial inactivation with controlled ozone delivery at comparatively low doses. This technology represents a promising, scalable intervention for HABs mitigation in drinking water sources and recreational water bodies affected by increasingly severe and frequent bloom events.

Modeling Flashy Desert Flows: Building a Transferable tRIBS Workflow for Arizona Watersheds

Presenter	Tracy Langston
Program	University of Arizona 1-yr M.S. Hydrogeology

Abstract

Flash floods are a major hazard in the largely ungauged Salt-Verde watershed (13,000 square miles). Physically based models like tRIBS could predict floods without gauges if their parameters can be constrained. Using noise-free synthetic "truth" hydrographs on South Mountain Fan, we tested which parameters Latin Hypercube ensembles can recover, scoring runs with Kling-Gupta Efficiency (KGE) and other metrics. Saturated hydraulic conductivity and its decay with depth control volume, but trade off along a ridge of near-equivalent solutions; however, adding storms narrowed that band about eightfold. The hillslope velocity exponent controls timing and shape, while channel roughness affects timing only and is invisible to composite KGE. No single metric captures every parameter. Next steps include varied "truth" parameters, different storm inputs, added noise, and a Pareto-style multi-objective investigation, with the goal of designing a transferable calibration workflow for Lower Sycamore Wash and beyond.

Thermal and Moisture Response of Fungal-Treated Unsaturated Soils Under Simulated Surface Heating

Presenter	Anna Kwablah
Program	Arizona State University; PhD in Civil, Environmental and Sustainable Engineering

Abstract

Evaporation from the near-surface unsaturated zone controls how soils lose water to the atmosphere, especially under the intense surface heating common in the arid Southwest. Classical soil physics describes this process with abiotic, homogeneous pore structures. However, fungal networks in natural and bio-amended soils can physically restructure pore space and change how water is held and transported. This study examines how fungal colonization alters evaporative drying, soil water retention, and thermal conductivity in unsaturated sand exposed to controlled surface heating. Ottawa 20/30 sand was treated at two fungal biomass levels (10% biomass, 9-day incubation; 15% biomass, 30-day incubation) and compared against the sterile response. Instrumented soil columns combining METER Group's HYPROP and VARIOS systems recorded evaporative mass loss, matric suction, volumetric water content, and thermal conductivity simultaneously as the columns dried from the heated surface. Surface heating accelerated drying in all cases but did not change the relationship between thermal conductivity and water content. Low biomass produced little difference from the sterile response. High biomass shifted the drying pathway in several ways. It widened the effective saturation range, kept matric suction low over a broader moisture interval, and held markedly higher water content across the measured suction range. It also increased the sensitivity of thermal conductivity to water content. These effects are consistent with hyphal bridging and stabilized water films that maintain hydraulic connectivity within the pore network during drying. The results show that thermal forcing controls how fast soils dry, while fungal networks control how soils lose connectivity. They point to biological structure as a factor in soil-atmosphere water exchange and to fungal treatments as a potential way to conserve near-surface soil moisture in hot, water-limited environments.

Translating Colorado River Shortage into Groundwater Impacts at the Water Service Area Scale in the Phoenix Active Management Area

Presenter	Mohsen Shahbaznezhadfar
Program	Arizona State University; PhD student

Abstract

In August 2026, the U.S. Department of the Interior adopted new Colorado River operating guidelines. They reduce Arizona's Colorado River supply by 760,000 acre-feet per year (AFY) in 2027 and 2028. A new 10-year framework allows deeper reductions in later years. Most of this reduction falls on the Central Arizona Project (CAP). In 2027 and 2028, CAP's supply could be cut by close to half of its full (non-shortage) delivery of about 1.5 million AFY. CAP water serves central Arizona, including the Phoenix Active Management Area (AMA). It is used for direct supply and for recharge, either directly at underground storage facilities (USFs) or indirectly at groundwater savings facilities (GSFs). CAP water has supported groundwater recovery in this region in recent decades. A reduced CAP supply will therefore shift pressure to groundwater in two ways: more groundwater will be pumped to replace lost deliveries, and less water will be available for recharge.

This study evaluates CAP shortage impacts on groundwater in the Phoenix AMA at the water service area scale. This scale matters because water rights, supply portfolios, and shortage responses are specific to each provider, making groundwater conditions in its service area important to that provider. We use the Arizona Department of Water Resources' Phoenix AMA groundwater model (MODFLOW) to simulate CAP availability scenarios from 1,000,000 to 100,000 AFY over 50 years (2027–2076). In each scenario, additional pumping is assigned to water providers based on their water rights. The remaining CAP water is distributed among USFs and GSFs based on historical patterns. Drawdown and water budget components are evaluated for each service area and compared across scenarios. Results indicate that groundwater conditions respond differently across service areas. This highlights the need for provider-level assessment of shortage impacts. The findings can help providers and regulators prepare for deeper and longer Colorado River shortages.