Texas Water Research Network

12th Meeting | 7-8 May, 2025 | UT-Austin Campus

Texas Water Resilience: Climate Impacts, Emerging Contaminants, and New Methodologies

The University of Texas at Austin, Legislative Assembly Room (WCP 2.302)

Event organized by the

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Introduction

We are happy to welcome you to the 12th meeting of the Texas Water Research Network, *Texas Water Resilience: Climate Impacts, Emerging Contaminants, and New Methodologies*, organized by the Environmental Science Institute.

The meeting is aimed to foster meaningful networking, encourage collaboration among researchers, stakeholders, and policy influencers, and provide valuable learning opportunities on the most pressing issues in Texas water resources. We extend our sincere gratitude to our generous sponsors and in-kind supporters—your contributions have been instrumental in making this event possible.

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Agenda

Wednesday May 7, 2025

11:30 am Lunch Social

12:00 pm Welcoming Remarks

- Jay Banner, Jackson School of Geosciences, University of Texas at Austin
- Michael Young, Dean of Research, Jackson School of Geosciences, UT-Austin.

12:30 pm Session 1: Emerging Contaminants, Water Quality, and Pollution

- "Water Quality, Emerging Contaminants, and One Health", Bryan Brooks, Distinguished Professor, Baylor University. Invited speaker.
- "Towards a Holistic Understanding of Urban Cycling of PFAS in Texas and Beyond", Helen Siegel, Postdoctoral Researcher, UT-Austin.
- "Clean Energy vs. Environmental Pollution: Environmental Release of PFAS Used in Lithium-Ion Batteries", Jennifer Guelfo, Associate Professor, Texas Tech University. Invited speaker.
- "Unlocking the Power of Electrochemical Oxidation for PFAS Destruction: Practicalities and Pathways" Louis LeBrun, Vice President of Sales for Axine Water Technologies, Inc.

2:30 pm Coffee Break

2:45 pm Session 1: Emerging Contaminants Panel Discussion

3:15 pm Session 1 Lightning talks

- "Community-Based Water Quality Monitoring in Suburban Neighborhoods in Texas: The Case of Austin's Colony", David Bahamón-Pinzón Postdoctoral Researcher, UT-Austin.
- "Tree-Based Machine Learning for Predicting Microalgae Biomass Production and Nutrient Removal in Wastewater Treatment" Atikur Rahman, Research Assistant Professor, Prairie View A&M.
- "Quantifying Surface Water Quality under Environmental Change Scenarios in the Bosque Watershed, Central Texas of United States". Ram Ray, Professor, Prairie View A&M University.

4:00 pm Student Poster Session and Networking

6:30 pm End of day

Thursday May 8, 2025

7:30 am Breakfast

8:30 am Session 2: Climate and Water Resilience in Texas

- "Projected Runoff Changes: The Full Spectrum", John Nielsen-Gammon, Texas State Climatologist, Regents Professor, Texas A&M. Invited Speaker.
- "Future Flood and Drought Shifts in the Cypress Creek Watershed Using CMIP6 Projections" Nimal Shantha Abeysingha, Prairie View A&M.
- "Understanding Climate-Water Nexus in Southeast Texas" Venki Uddameri, Professor, Lamar University.
- "Traditional and machine learning techniques to predict intensity-duration-frequency curves based on climate projections in Texas", Fouad Jaber, Professor, Texas A&M.
- "Abrupt Shifts in Precipitation Recorded by Bald Cypress (*Taxodium distichun*) False Rings". Jose Abella-Gutiérrez, Research Associate, UT-Austin.

10:20 am Break

10:30 am Session 2: Climate and Water Resilience in Texas

- “Understanding Groundwater Hydrology with Seismic Sensing” Shujuan Mao, Assistant Professor, UT-Austin. Invited speaker.
- “Chemical and Physical Controls on Groundwater Evolution in the Middle Trinity Aquifer of Central Texas” Lamine Boumaiza, Postdoctoral Researcher, UT-Austin.
- “Projections of Meteorological and Groundwater Droughts Using Artificial Intelligence and Statistically Downscaled Climate Data”, Hakan Başağaoğlu, Associate Director, Edwards Aquifer Authority. Invited speaker.

12:00 am Lunch

12:40 pm Session 2: Climate and Water Resilience in Texas

- “Drought Impacts to Hydrologic Systems in the Texas Hill Country” Justin Thompsom, Research Assistant Professor, UT-Austin. Invited speaker.
- “Water Sustainability and Resilience in Texas: Integrating Planning, Data Centers, and Nature-Based Solutions” Stephanie Glenn, Vice President of Research, Houston Advanced Research Center.
- “Desalination and the Future of Texas Water” Travis Pruski, Chief Operations Officer, Nueces River Authority. Invited speaker.

2:10 pm Coffee Break

2:25 pm Lightning talks

- “Integrating Multi-Criteria Decision Analysis and Geospatial Data for Flood Susceptibility Mapping in Texas, USA”, Birhan G. Tikuye, Postdoctoral Researcher, Prairie View A&M University.
- “Reconstruction of a Century of Urban Water Infrastructure Degradation”, Joshia Sananda, PhD. Student, UT-Austin.
- “Water-Energy-CO_2 Nexus for Turfgrass Irrigation in the Four Urban-Dominated Counties of Texas”, Anwar Adem, Postdoctoral Researcher, Prairie View A&M
- “Greenhouse Gas Dynamics from Abandoned Distributaries of the Rio Grande River”, Siena Stasi, MSc. Student, UT-Rio Grande Valley.
- “Threshold Soil Moisture Levels Influencing Soil CO_2 Emissions: A Machine Learning Approach to Predict Short-Term Soil CO_2 Emissions from Climate-Smart Fields”, Anoop Veettil, Research Associate Professor, Prairie View A&M University.

3:40 pm Roundtable: Current synergies and future initiatives

5:00 pm Adjourn

Posters

Reconstructing Climate Variability in the Pedernales River Basin. W. H. Eagle, J. Abella-Gutiérrez, A. J. Janelle, J. L. Banner.

Three-Dimensional Numerical Analysis of Skin Layers' Influence on Leakage Flow Dynamics Between Aquifers Under Variable Subsurface Conditions. J. Ding, H. Zhan.

A Novel Application of Horizontal Wells in Aquifer Thermal Energy Storage System: Geothermal Potential in Texas. Yinuo Wang, Hongbin Zhan, Junyuan Zhang, Zehao Chen.

The Impact of Clogging in Aquifer Thermal Energy Storage (ATES). Zehao Chen, Junyuan Zhang, and Hongbin Zhan

Integrating Remote Sensing and Weather Data using Machine Learning to Evaluate Drought Impacts on Agricultural Production and Water Footprints in Texas. Md Symum Islam, Ali Fares, Anoop Valiya Veettil.

Regulatory Framework and Policy Outlook for Produced Water Reuse for Hydrogen Production in Texas. Sandra Banda, Grace Childers Dr. Emily Beagle, Dr. Yael Glazer, Michael Lewis, Dr. Vaibhav Bahadur, Shanthanu Katakam, Dr. Michael Webber.

Water-Energy-Food Nexus in Texas: Exploring Impacts of the Energy Transition on Water Usage and CO_2 Emissions. Kinza Akhtar, Ripendra Awal, Ali Fares, Anoop Valiya Veettil, and Atikur Rahman.

Development and Application of a SWAT+ Framework to Simulate Hydrological Processes and PFAS Contaminant Transport in the San Antonio River Watershed, Texas. Himmat Basne, Cho Eunsang, Sangchul Hwang.

Hydrological Responses and C-N Pools of Two Watersheds to Shrub Management. Gurau, S., Ray, R.L and Tikuye, B.G.

Hydrodynamic Simulation of Coastal Flooding to Determine the Vulnerable Hotspots of Galveston, Texas. Md Shah Mominul Islam Momin, Eunsang Cho, Eunsaem Cho, Subasish Das.

Analysis of Hydrologic Properties of Sands Amended with Different Levels of Biochar. M. Celestine, A. Elhassan, A. Rahman, A. Veetil, R. Awal, and A. Fares

Investigating the Sources of Nitrogen in the Brazos River Watershed. Hunter Cassidy, Braden Smith, Garrett McKay, Bahngmi Jung, Peter S. K. Knappett, Reid E Buskirk.

Quantifying Riverbank Denitrification Losses In Response to Flood Events on the Brazos River, Texas. Reid E Buskirk, Bahngmi Jung, Blake Lawson, Riya Tom, Audrey Wertz, Garrett McKay, Peter S. K. Knappett.

Abstracts
Invited Speakers

Water Quality, Emerging Contaminants, and One Health

Daniel Brooks

Distinguished Professor at the College of Arts and Sciences, Environmental Science. Baylor University.

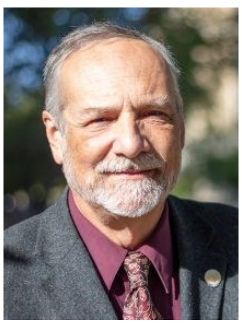
We are currently observing unprecedented biodiversity losses and increases in non-communicable diseases, resulting from complex and interacting forcing factors, including global pollution. Global chemicals production continues to outpace implementation of technologies and environmental management systems aimed at mitigating the impacts of chemicals and waste and achieving sustainable remediation activities, especially in urban regions around the world. These realities, exemplified by emerging contaminants, are challenging conventional environmental assessment and management strategies. For example, common protection goals in environmental risk assessment include public health, biodiversity and ecosystem services, but our future ability to meet these goals will rely on systems-based approaches where we leverage the genetics and informatics of species to better understand and manage the risks of global aquatic pollution. We need to develop precision-based efforts that extend beyond traditional predictive tools. Advances in exposure science, exposomics, and comparative toxicology promise to accelerate development of precision approaches and associated interventions, including green and sustainable chemistry and engineering, to advance the science and improve the practice of environmental science and technology. Doing so further promises reciprocal benefits to aquatic ecosystems and public health, particularly by embracing One Health.

Clean Energy vs. Environmental Pollution: Environmental Release of PFAS Used in Lithium-Ion Batteries

Jenifer Guelfo, Ph.D.

Associate Professor at the Department of Civil, Environmental, and Construction Engineering. Texas Tech University.

Lithium ion batteries (LiBs) are used globally as a key component of clean and sustainable energy infrastructure. Emerging LiB technologies have incorporated a novel class of per- and polyfluoroalkyl substances (PFAS, i.e., "forever chemicals") known as bis-perfluoroalkyl sulfonimides (bis-FASIs). PFAS are recognized internationally as recalcitrant, mobile, and toxic environmental contaminants. Despite this, virtually nothing is known about environmental impacts of bis-FASIs released during LiB manufacture, use, and disposal. Here we demonstrate that occurrence, ecotoxicity, and treatability of this novel class of PFAS are comparable to PFAS that are now prohibited and highly regulated worldwide and confirm the clean energy sector as an unrecognized and growing source of global PFAS release. Project sampling efforts in the US and internationally resulted in bis-FASI detections in soil, sediment, surface water, landfill leachate, and wastewater influent. Toxicity data demonstrated effects on swimming behavior in *Daphnia magna* at bis-FASI exposures of 10 ppt and swimming behavior. Although fully recalcitrant to advanced oxidation processes, select bis-FASIs were removed from water during adsorptive treatment with similar or better efficiency as more hydrophobic PFAS such as perfluorooctane sulfonate (PFOS). LiB use is anticipated to increase globally over the next decade, and 8 million tons of LiB waste are projected by 2040 as a result of low recycling rates. This suggests that environmental exposure to this novel, unregulated class of PFAS will increase with time and will be relevant to the majority of the world's population. Results underscore that environmental impacts of clean energy infrastructure merit scrutiny to ensure that reduced CO2 emissions are not achieved at the expense of increasing global releases of persistent organic pollutants.



Projected Runoff Changes: The Full Spectrum

John Nielsen-Gammon

Regents Professor at the College of Arts and Sciences, Atmospheric Sciences. Texas A&M University. Texas State Climatologist

While climate model projections of soil moisture consistently show a decrease, projections of runoff have considerable inter-model variability. We explore the drivers of runoff trends using monthly output from a subset of CMIP5 LOCA-VIC downscaled hydrologic simulations and an analysis approach based on quantile regression. We find that most models consistently project a decrease in total runoff for low and middle runoff percentiles in all Texas drainage basins but tend to project an increase for the top 2% of monthly runoff values. These extreme runoff values drive the average runoff projection variability, with average runoff projections generally more negative than extreme runoff projections. Projected trends in extreme runoff in turn are closely tied to projected trends in extreme precipitation, but are generally more negative, apparently due to negative trends in soil moisture.

Understanding Groundwater Hydrology with Seismic Sensing

Shujuan Mao, Ph.D.

Assistant Professor at the Jackson School of Geosciences. The University of Texas at Austin.

The fast-growing population and intensifying weather extremes in Texas call for sustainable and resilient management of water resources. Tackling this challenge requires cost-effective and high-resolution tools for monitoring the spatiotemporal changes in aquifer systems hidden in the shallow subsurface. In this seminar, I will introduce a novel technique for aquifer monitoring using data from seismograph arrays. I will demonstrate the promise of this approach with pilot applications to monitor the aquifers in Greater Los Angeles from 2000 to 2023. I will validate the effectiveness and unique advantages of seismic sensing by comparing it with hydraulic head, satellite remote sensing, and hydrological simulations. I will then explore how this seismic method offers new insights into depth-dependent changes in aquifer storage over event to decadal timescales with high spatial resolution. These pilot applications highlight the potential of leveraging the seismic network in Texas to quantitatively assess the spatiotemporal changes in aquifer systems under weather extremes and anthropogenic activities.

Projections of Meteorological and Groundwater Droughts Using Artificial Intelligence and Statistically Downscaled Climate Data

Hakan Başağaoğlu, Ph.D.

Associate Director, Modeling. Edwards Aquifer Authority, TX, USA

As of March 2025, the Edwards Aquifer Region (EAR) is in the midst of the most intense groundwater drought, as measured by departure of groundwater levels from normal, since the 1940s. The severe groundwater drought has been driven by a combination of factors, including low annual precipitation totals, the highest annual-average daily temperatures, record-breaking summer temperatures, the second highest annual-average daily temperatures, and the longest streak of triple-digit heat in decades. In the absence of significant precipitation events by the second week of March 2025, the current drought would also be the second-longest groundwater drought in the EAR since the 1940s, eclipsing the duration of the 2011–2014 drought.

To assess the characteristics of future droughts in the EAR, we developed an artificial intelligence (AI)-driven modeling framework to project meteorological and hydrological droughts through the end of the 21st century. The framework utilizes a customized downscaling model that derives daily minimum and maximum temperatures, and precipitation totals from global climate models

(GCMs). The modeling framework characterizes the intensity, duration, and frequency of future high temperature- and precipitation deficit-driven meteorological droughts.

Meteorological drought intensity was computed based on the time-average exceedance of temperatures above a critical threshold and accumulated precipitation deficits below the critical level over the duration of a drought period. The resulting historical and projected duration-intensity envelopes revealed the severity of projected meteorological droughts in comparison to historical events and established uncertainty bands associated with different GCMs and future carbon emission scenarios. The AI model was then used to calculate the intensity, duration, and frequency of groundwater droughts by defining a critical groundwater level for drought onset, based on regional conservation measures.

The framework was used to assess the likelihood of recurring droughts similar to the 1950s drought (the current drought of record for the EAR), as well as other extreme drought events, considering various GCMs and future carbon emission scenarios. Our preliminary results indicate that the region is likely to experience longer (>200 days) and more intense temperature-driven meteorological droughts compared to historical events. Additionally, higher intensity precipitation-driven meteorological droughts with both short (<1,500 days) and prolonged (>1,750 days) durations, exceeding the intensity of the 1950s drought are expected. Groundwater droughts with both short (<1,000 days) and long durations (>1,500 days) are projected, with some events, like the current groundwater drought, exceeding the intensity of the 1950s drought, but with none surpassing the duration of the 1950s drought.

Drought Impacts to Hydrologic Systems in the Texas Hill Country

Justin Thompsom

Research Assistant Professor. Bureau of Economic Geology. University of Texas at Austin.

Texas now has an abundance of data describing our hydrologic systems. However, that data is siloed, disparate, and relatively inaccessible to decision makers. Expertise and resources are required to transform the available date into actionable information. Furthermore, despite the focus on drought-of-record conditions in Texas water management and planning processes, the full impact of drought on water systems and how those system impacts are interrelated is poorly understood. To better understand drought impacts and responses, this research program is integrating historical and newly collected data describing all forms of water (groundwater, surface water, soil water, and precipitation) into novel analyses of hydrologic processes to provide a holistic understanding of natural and human-manipulated water systems. The research program is organized into three components and related tasks focused on the Texas hill country study area. The first component is a foundational effort to better integrate and harmonize existing and future water system data from multiple sources and scales. The second component applies the assembled data to better understand and characterize drought impacts to various water systems. Here, the 2011-2015 drought is being analyzed using physics-informed machine learning (ML) and advanced analytical techniques to generate impact metrics that can then be applied to prospective drought scenarios to better understand potential water system impacts. The third component explores and demonstrates how the assembled water system and drought impact data can be leveraged to assess drought risk and resilience.

Desalination and the Future of Texas Water

Travis Pruski

Chief Operations Officer at the Nueces River Authority

South Texas faces escalating water scarcity driven by population growth, industrial demands, and recurrent droughts, straining traditional freshwater sources like the Rio Grande, Nueces Rive Basin and groundwater aquifers. Regional large-scale desalination offers a sustainable solution to address these challenges. By leveraging the Gulf of Mexico's abundant seawater, desalination can provide a reliable, drought-resistant water supply for municipal, agricultural, and industrial use. Current small-scale desalination efforts in the region are insufficient to meet projected demands, with the Texas Water Development Board estimating a potential water deficit of 1.5 million acre-feet by 2070 in the Coastal Bend area alone. Large-scale facilities, capable of producing 100 million gallons daily, could bridge this gap, utilizing advanced reverse osmosis technologies to ensure energy efficiency and cost-effectiveness. Environmental concerns, such as brine disposal, can be mitigated through off Shore Discharge. Additionally, regional collaboration among counties, supported by public-private partnerships, can distribute costs and benefits equitably, fostering economic resilience.

Speakers

Towards a Holistic Understanding of Urban Cycling of PFAS in Texas and Beyond

Helen G. Siegel[1], Jay Banner[2], Alexander Janelle[1]

1. Department of Earth & Planetary Sciences, University of Texas at Austin, Austin, TX 78712
2. Environmental Science Institute, University of Texas at Austin, Austin, TX 78712

Per- and polyfluorinated substances (PFAS) are emerging contaminants of concern in Texas, because of their environmental persistence, widespread distribution, and potential health risks. These chemicals are increasingly impacting water, soil, and air quality, particularly in the states' rapidly growing urban centers and industrial regions. A multitude of PFAS sources exist in urban systems, including industrial discharges and wastewater treatment facilities to consumer products such as non-stick cookware, stain-resistant fabrics, and food packaging. These substances can enter the environment through direct releases during manufacturing or wastewater treatment, leaching from products in landfills, or runoff from urban areas where PFAS-containing materials are commonly used. Despite growing regulation and awareness of PFAS, there is limited understanding of their movement, mobility, and fate in urban systems, particularly in regions of the state with diverse industries and rapidly growing urban populations. As urban centers in Texas continue to grow, it becomes increasingly important to understand the magnitude of urban releases, exports of PFAS to downstream users and ecosystems, and the effectiveness of existing green infrastructure strategies at reducing PFAS mobility. This presentation explores the complexities of urban cycling of PFAS, focusing on understandings of urban sources, transport, and potential strategies for future research and collaborative partnerships.

Unlocking the Power of Electrochemical Oxidation for PFAS Destruction: Practicalities and Pathways

Louis LeBrun, PE

Axine Water Technologies, Inc.

As regulations around PFAS tighten, the need for effective destruction methods is critical. While granular activated carbon (GAC), ion-exchange (IX), reverse osmosis (RO), and foam fractionation (FF) have all emerged as effective means of capturing or concentrating PFAS compounds to produce safe drinking water or wastewater effluent. Unfortunately, all these technologies produce a residual spent media or concentrated fluid that is usually sent to the local landfill where PFAS finds its way into the leachate stream. With both increasing demand regulations on PFAS discharges to the environment and demand for treatment, many facilities are finding offsite disposal to be increasingly complex and expensive. Fortunately, a electrochemical oxidation has been demonstrated to achieve 3-5 log (99.9%-99.999%) onsite destruction of liquid PFAS waste to completely eliminate the issue. This session will provide an overview of the simplicity and cost-effectiveness of this technology, making it ideal for onsite PFAS management and compliance with emerging standards.

Participants will also delve into the electrochemical oxidation processes with an overview of how both long and short-chain PFAS compounds are effectively destroyed without harmful by-products. Real-world lab and field-scale data will illustrate the pathways to PFAS destruction, providing a comprehensive understanding of the steps involved.

By bridging theoretical knowledge with practical application, the session highlights success stories and real-world applications, offering actionable strategies to address PFAS challenges. Join us for an in-depth look at innovative technologies and gain the tools needed to develop robust, compliant PFAS management strategies.

Community-based water quality monitoring in suburban neighborhoods in Texas: The case of Austin's Colony

David Bahamón-Pinzón[1,2], Helen G. Siegel[1,2], Alexia Leclercq[3], Jay Banner[1,2], Carlos Pinon[3], Susana Almanza[3], Kelly Haragan[4], Laura Mullins[5], Fernando Pagán[1], Nabeeha Siddiqui[1,2] Didey Montoya[2]

1. Department of Earth & Planetary Sciences, University of Texas at Austin, Austin, TX 78712
2. Environmental Science Institute, University of Texas at Austin, Austin, TX 78712
3. People Organized in Defense of Earth and Her Resources, Austin, TX 78762
4. School of Law, University of Texas at Austin, Austin, TX 78712
5. Far East Community Development Corporation (CDC), Austin's Colony, TX 78725

Central Texas suburban communities face water scarcity challenges. Austin's Colony residents have received hard water and intermittent discolored water events. Residents face economic burdens from purchasing bottled water and replacing water treatment systems. Academics partnered with a community organization, People Organized in Defense of Earth and Her Resources, and community members to investigate water issues in Austin's Colony. We conducted community meetings, household surveys (n=100), and tap water sample (n=69) analyses (bacteria, cations, and anions) from 2021-2025. Community engagement was essential for defining objectives, accessing sampling points, and collecting one discolored water sample. Most survey participants (70%) reported discolored water events, and only 7% drink tap water without treatment. Pb concentrations in three untreated water samples, and Mn and Fe in two samples, exceeded regulatory limits. Water treatments reduced Pb concentrations and other elements to below regulatory standards. Several metal concentrations in the discolored water sample exceeded regulatory limits, including Al (142.9 ppb), Mn (1,026 ppb), Fe (4,540 ppb), Cu (1,156), and Pb (29.3 ppb). Water chemistry modeling indicates the water composition at each household is accounted for varying mixing between three groundwater sources, which could contribute to water discoloration. Our research highlights the importance of establishing adequate monitoring systems in suburban areas.

Tree-Based Machine Learning for Predicting Microalgae Biomass Production and Nutrient Removal in Wastewater Treatment

Atikur Rahman, Anoop Veettil, Madison Rena Celestine, Ripendra Awal, and Ali Fares

College of Agriculture, Food, and Natural Resources, Prairie View A&M University, Prairie View, TX 77446

Microalgae-based wastewater treatment presents a viable strategy for simultaneous nutrient remediation and biomass generation. The efficiency of microalgal growth and nutrient removal is governed by complex interactions among multiple process parameters, including nutrient concentrations, carbon availability, microbial community dynamics, temperature, pH, and hydraulic retention time (HRT). A comprehensive understanding of these interactions is critical for optimizing cultivation conditions to enhance both wastewater treatment efficacy and biomass productivity. This study employs decision tree-based machine learning, specifically Classification and Regression Tree (CART) models, to identify key cultivation parameter combinations that maximize nutrient removal and biomass yield. Experimental data were obtained from four photobioreactors operated in a semi-continuous mode over 30 days, with varying HRTs and influent characteristics. One reactor was maintained at an HRT of 10 days with 2:1 diluted wastewater, while the remaining three were operated at HRTs of 10, 8, and 6 days with undiluted sewage. A total of 18 parameters, encompassing influent and effluent composition, microalgal species distribution, and physicochemical conditions, were analyzed to develop predictive models. CART analysis identified several optimal parameter combinations for high biomass productivity, and maximizing nitrogen and phosphorus removal efficiencies. These findings provide a data-driven framework

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Quantifying Surface Water Quality under Environmental Change in the Bosque Watershed, Central Texas of United States

Gebrekidan W. Tefera[1], Ram L. Ra[1], Vijay P. Singh[2]

1. Cooperative Agricultural Research Center, College of Agriculture, Food and Natural Resources, Prairie View A&M University, Prairie View, TX 77446
2. Department of Biological and Agricultural Engineering & Zachry Department of Civil & Environmental Engineering, Texas A&M University, College Station, TX 77843

This study integrates robust environmental change scenarios and hydrological modeling to assess the impacts of environmental change on streamflow and nutrient concentrations, including Organic Nitrogen (ORGN), Organic Phosphorus (ORGP), Mineral Phosphorus (MINP), and Nitrate (NO3) concentration in the Bosque watershed in Central Texas, USA. A multi-site and multi-variable calibration/validation and Differential Split Sampling approach was used to calibrate and validate the SWAT model. Under future environmental change scenarios, a steady decline in organic nitrogen, organic phosphorus, and mineral phosphorus was observed, primarily linked to reduction in precipitation and streamflow. Conversely, hotter and drier scenarios were projected to cause a statistically significant increase in nitrate concentrations (ranging from 61 to 104%). Notably, water quality changes were more pronounced under the

RCP4.5 emission scenario compared to RCP2.6 and RCP8.5. This study underscores the dire effect of environmental change on the NO3 concentration, which requires urgent water management interventions to mitigate detrimental repercussions for watershed health.

Future Flood and Drought Shifts in the Cypress Creek Watershed Using CMIP6 Projections

N.S. Abeysingha and Ram L. Ray

College of Agriculture, Food, and Natural Resources, Prairie View A&M University, Prairie View, TX 77446

Quantifying the intensity and frequency of extreme weather under the impacts of environmental/weather change is crucial for effective water resource management. The study was conducted in Cypress Creek watershed in northwest Harris County, Texas. Our analysis employed soil and water assessment tool (SWAT +) and indices such as the Standardized Precipitation Index (SPI), Standardized Precipitation Evapotranspiration Index (SPEI), and Streamflow Drought Index (SDI) to evaluate the future meteorological and hydrological status of Cypress Creek watershed. We utilized the NASA Earth Exchange (NEX) Global Daily Downscaled Projections (GDDP) dataset (NEX-GDDP-CMIP6), incorporating four Global Circulation Models under two shared socioeconomic (SSP2-45 and SSP5-85) pathways. Based on the ensemble results, the basin is projected to experience increases in maximum temperature ranging from 2.45 to 2.78°C, alongside increases in minimum temperature between 2.18 and 2.58°C. Precipitation is expected to decline by 6.12% under the SSP2-45 scenario and by 4.42% under the SSP5-85 scenario. Both SPI and SPEI show declining trends across both scenarios, indicating an increased likelihood of drought conditions. Analysis of SDI indicates that hydrological drought events are projected to occur with frequencies of 2.56 and 2.12% under the SSP2-45 and SSP5-85 scenarios, respectively. Findings reveal considerable hydroclimatic variability in the future of Cypress Creek watershed.

Understanding Climate-Water Nexus in Southeast Texas

Venki Uddameri, E. A. Hernandez, R. Shreshta, A. S. Kafle, Kushum KC, J. Davis, T. Syed.

Department of Civil and Environmental Engineering, Lamar University, Beaumont, TX 77701

Southeast Texas lies at the cusp of more arid high plains and humid southeast climate zones. While precipitation in this area is higher than most parts of Texas, there is considerable variability with climate states fluctuating between wet and dry regimes. The Big Thicket region is referred to as the ‘biological crossroads of North America”’ where multiple ecosystems – Eastern hardwood forests, Gulf Coastal Plains, Praries, Piney Woods and Swamplands can be found in one area. This area therefore provides a unique living lab to understand climate change impacts on diverse ecosystems within one area. Using climate extremes noted in the last decade (e.g., the drought of 2011 and the Hurricane Harvey in 2017) as well as other

historical information, the goal of this study was to understand how wet and dry meteorological states propagate through hydro-ecological systems. Satellite remote sensing, copula theory and water balance modeling approaches have been used to understand historical and future climate impact on hydrological fluxes. Wetland and riparian vegetation are noted to be most susceptible to droughts, while upland forests comprising of piney oaks depict greater resiliency. Understanding multivariate risks indicated that while upland vegetation exhibited tolerance to small to moderate droughts, the drought of 2011 had significant impact. The prognosis of such extreme climate events in the future has implications on ecological biodiversity and vegetative makeup of this region.

Traditional and machine learning techniques to predict intensity-duration-frequency curves based on climate projections in Texas

F.h. Jaber[1], B.H. Heidari[1], H. Niu[2], S. Murray[1], and N. Duffield[2]

1. Texas A&M AgriLife, Texas A&M University, College Station, TX 77843
2. Texas A&M Institute of Data Science, Texas A&M University, College Station, TX 77843

There is a growing scientific and public consensus about the impact of changing climatic patterns on the intensification of extreme rainfall events. Existing stormwater infrastructure systems fail to adequately respond to the changing extreme storm events since they are designed with older manuals based on historical rainfall records. Thus, there needs to be a re-examination of the frequency and intensity of rainfall projections. Precipitation projections are generally conducted under Global Climate Models (GCMs) or Regional Climate Models (RCMs). To determine the frequency and intensity patterns for different rainfall events and update their parameters for Intensity-Duration- Frequency (IDF) curves, precipitation projections from GCMs and RCMs need to go through several stages: spatial downscaling, bias-correction, temporal disaggregation, extreme value analysis, and uncertainty quantification. Current projection frameworks already incorporate some, but not all, of the processes. Therefore, infrastructure design and management need a comprehensive, reproducible, and consistent methodology to process the projections and develop updated IDFs. The state of Texas is among the areas that require such an insight into the IDF projections for the future, considering the climatic variability within the State and the pressure of urbanization leading to a more urgent need to serve the growing population. The study will apply an array of traditional statistical methods and machine learn

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Abrupt Shifts in Precipitation Recorded by Bald Cypress (Taxodium distichun) False Rings

Jose Abella-Gutiérrez[1], Bryan B. Black[2], Jay L. Banner[1]

1 Jackson School of Geosciences, University of Texas at Austin, Austin, TX 78712
2 Laboratory of Tree Ring Research, University of Arizona, Tucson, AZ 85721

Abrupt shifts in weather patterns have become a growing concern due to their projected increase under climate change. Central Texas, a region naturally prone to both drought and

flooding, has experienced significant impacts from sudden changes in precipitation. Tree-ring chronologies have long been used to reconstruct past climate variability, and more recently, the study of false rings has gained attention as a valuable proxy for identifying short-term climatic anomalies. False rings typically form when trees experience a transition from stressful to favorable growing conditions, allowing for a temporary resumption of growth within a single year. In bald cypress (Taxodium distichum), false rings have often been linked to tropical storms and intense summer rainfall. In this study, conducted in the driest region of bald cypress's natural range, we find that false rings tend to form when substantial early summer rainfall (exceeding 5 inches) follows a period of dry conditions. Our reconstruction suggests that these abrupt precipitation shifts have been relatively rare since 1963, with only six such events—including the catastrophic floods of 2002 that inundated the Hill Country and South-Central Texas, resulting in billions of dollars in damage and the loss of lives. However, prior to 1963, these precipitation swings were more frequent, pointing to the role of decadal climate variability in shaping the hydroclimatic history of the region.

Chemical and Physical Controls on Groundwater Evolution in the Middle Trinity Aquifer of Central Texas

Lamine Boumaiza[1], Vivian E. Yale[1], Daniella M. Rempe[1], Jay L. Banner[1], Brian B. Hunt[2]

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The Middle Trinity aquifer (MTA) of central Texas exemplifies challenges to the sustainability of Texas' water resources, including rapid population growth and climate change. In western Travis and northern Hays Counties, drought and pumping from the MTA have led to diminished springflows. Potential mitigation strategies include artificial recharge from surface water bodies. However, there are uncertainties associated with injecting water of different chemical composition as it can potentially mobilize naturally occurring contaminants, making it critical to understand the processes governing the groundwater chemistry within the MTA. Groundwater levels indicate a groundwater divide that separates eastward and westward flowing water. West of the divide, the MTA is unconfined, allowing recharge to directly infiltrate, while east of the divide, the MTA is confined by the Upper Trinity unit, suggesting an indirect recharge. West of the divide, there is fresh Ca-HCO3-type water; whereas groundwater to the east is a predominately brackish Ca/Mg-SO4 type. This reflects the hydrostratigraphic changes occurring across the divide. Groundwater east of the divide has lower tritium activity than that in the west, suggesting more a local and recent recharge contribution west of the divide. Future work will include an integrated isotope study of the groundwater, rocks and soils to build an understanding of groundwater evolution processes in the MTA to help inform water management strategies.

Water Sustainability and Resilience in Texas: Integrating Planning, Data Centers, and Nature-Based Solutions

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Water sustainability and resilience are critical challenges for Texas, where droughts, population growth, and increasing demand for water are exacerbating pressures on the state's water resources. As Texas continues to expand, especially in urban areas and technology hubs, the need for integrated solutions that address water management, infrastructure, and environmental impacts has never been more urgent. This presentation will explore innovative approaches to improving water sustainability in Texas, with a particular focus on data centers, one of the state's largest and fastest-growing consumers of water. While data centers are essential to the state's digital economy, their heavy reliance on water for cooling presents a unique challenge in a region experiencing both water scarcity and climate uncertainty. By integrating strategic planning with nature-based solutions, this session will highlight how data centers and other critical infrastructure can adopt sustainable practices that enhance water resilience. This includes the use of rainwater harvesting, efficient cooling technologies, green infrastructure, and the incorporation of ecosystem-based approaches to water management. Nature-based solutions such as wetlands restoration, permeable surfaces, and riparian buffer zones can complement traditional water infrastructure and improve.

Integrating Multi-Criteria Decision Analysis and Geospatial Data for Flood Susceptibility Mapping in Texas, USA

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Floods are among the most prevalent and destructive natural hazards worldwide, necessitating accurate risk assessment and effective mitigation strategies. This study developed a flood susceptibility map for Texas, USA, using a Multi-Criteria Decision Analysis framework. A weighted overlay technique was applied to integrate diverse geospatial datasets, including global surface water extent, vegetation indices, terrain characteristics, elevation, and precipitation data. The Global Surface Water dataset helped delineate permanent water bodies. At the same time, Landsat 8 imagery was utilized to derive the Normalized Difference Vegetation Index and Normalized Difference Water Index, indicating vegetation cover and surface moisture—both key to flood vulnerability. Elevation and the Topographic Position Index, derived from Shuttle Radar Topography Mission data, were used to evaluate topographic influence on flood susceptibility. Proximity to rivers and precipitation data from the Climate Hazards Group InfraRed Precipitation with Station data further enhanced spatial risk characterization. All factors were classified into five very low to very high-risk categories based on their relative influence on flood susceptibility. The resulting flood susceptibility map achieved

an Area Under the Curve (AUC) of 0.87, indicating high predictive accuracy. Spatial analysis revealed that approximately 20,983 km² of the area is at high risk, and 589 km² is at very high flood risk.

Reconstruction of a Century of Urban Water Infrastructure Degradation

Sananda, J.[1], Banner, J.[1], Nachimuthu, S.[1], Black, B.[2], Abella-Gutierrez, J.[1], Faust, K[3].

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The input of municipal water into natural streams impacts freshwater resources that support riparian ecosystems and provide essential services in urban environments. This input occurs in cities via degradation and unintended leakage of municipal water infrastructure and/or deliberate irrigation. Climate extremes and water scarcity will continue to exacerbate water quality challenges through the 21st century, notably in drought- and flood-prone regions like central Texas. Water quality assessments rely on monitoring of modern urban watersheds but understanding historical interactions between human and natural stream systems requires long-term analysis. To address this need, we develop an extended tree-ring-based water quality record for streams around the city of Austin, where strontium isotopes (87Sr/86Sr ratio) serve as a robust tracer for identifying municipal water input and sources of dissolved ions. We analyze the Sr isotope ratio in bald cypress tree rings from three watersheds with varying degrees of urban development as a novel proxy to reconstruct historical water quality changes. Our results extend as far back as the mid-1800s, allowing comprehensive analysis of streamwater chemistry from pre-industrialization, and throughout developmental stages. In the most extensively urbanized watershed, high tree-ring 87Sr/86Sr values reflect a significant municipal water contribution of up to 90%, as far back as 1930, while a rural watershed maintains relatively low and unchanging 87Sr/86Sr values back through the 1840s, indicative of little to no municipal contribution. Tree-ring 87Sr/86Sr values from a watershed rapidly urbanized to an intermediate extent over the past 40 years, reflect an intermediate extent of municipal water input (<5%) that was initiated at the same time as the watershed's rapid increases in urban development and population density. These findings highlight the correlation between municipal water contributions to urban stream networks and the degree of development of watersheds, providing insights for the future of urban planning and infrastructure management in urban environments.

Water-Energy-CO_2 Nexus for Turfgrass Irrigation in the Four Urban-Dominated Counties of Texas

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Dallas, Harris, Bexar, and Travis counties are among the most populous in Texas, known for their rapid population growth and urban development, and are home to the major cities. In the U.S., approximately 30% of household water is used for gardening and landscape irrigation, contributing significantly to water and energy losses and increased CO_2 emissions. This study aimed to estimate the potential savings in water, energy, and CO_2 emissions through optimal turfgrass irrigation. The IManSys model was employed to calculate irrigation water requirements (IWR) using daily climate data from 1981 to 2024, along with soil hydrological properties and crop parameters. Texas's energy usage profiles and the counties' calculated IWR were used to estimate water and energy losses and associated CO_2 emissions. Results indicated that the optimum annual average IWR for irrigated areas in Bexar, Dallas, Harris, and Travis counties were 123, 91, 73, and 114 million cubic meters, respectively. If annual irrigation water use in each county exceeds the optimum level by 25 mm, it would lead to water losses of 3-11 Mm3, equivalent to the annual water use of 8,333-32,169 single-family households. This overuse would also result in energy losses of 3,387, 2,761, 4,799, and 1,504 MWh, along with CO_2 emissions of 1,298, 1,058, 1,840, and 577 metric tons in Bexar, Dallas, Harris, and Travis counties, respectively.

Greenhouse Gas Dynamics from Abandoned Distributaries of the Rio Grande River

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There are distinct gaps in knowledge for greenhouse gas (GHG) estimation for inland water bodies, and accounting for small-scale systems globally is of utmost importance and will eventually aide in sustainability efforts of anthropogenically managed water bodies. There is a unique system of abandoned distributaries and their associated ox-bow lakes in South Texas, commonly known as resacas. These systems are characterized by their shallow depth and were once naturally flooded but are now artificially sustained due to anthropogenic intervention. This study quantified the magnitude, temporal variation, and limnological drivers of GHG fluxes using portable GHG analyzers, diffusive fluxes of carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) were measured at each site. Ebullitive measurements of CH4 were also quantified using bubble traps. Water quality and surface water samples were collected in tandem with gas measurements. While the resaca systems displayed high nutrient concentrations and chlorophyll levels, their CH4 emissions were relatively low compared to global averages for inland water bodies (range: -4.3 – 9.7 mg CH4 m-2 d-1). This is thought to be linked to their elevated conductivity values that indicate mildly brackish conditions. CO2 emissions were

substantial (range: -540 – 3015 CO2-C mg m-2 d-1) when compared to multiple, inland freshwater bodies. Overall, the resacas have intriguing GHG dynamics, which offer new insight into these unique systems.

Threshold Soil Moisture Levels Influencing Soil CO_2 Emissions: A Machine Learning Approach to Predict Short-term Soil CO2 Emissions from Climate-smart Fields

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Management practices, such as organic amendment applications (e.g., dairy manure, chicken manure, biochar), are critical pillars of Climate-Smart Agriculture (CSA) strategies that mitigate GHG emissions while maintaining adequate crop yields. This study investigated the critical threshold of soil moisture level associated with soil CO2 emissions from organically amended plots using the Classification and Regression Tree (CART) algorithm. Also, the study predicted the short-term soil CO2 emissions from organically amended systems using soil moisture and weather variables (i.e., air temperature, relative humidity, and solar radiation) using multilinear regression (MLR) and generalized additive models (GAM). The different organic amendments considered in this study are biochar, chicken, and dairy manures under a sweet corn crop in the greater Houston area, Texas. The results of the CART analysis indicated a direct link between soil moisture level and the magnitude of CO2 fluxes emission from the amended plots. A threshold of 0.103 m3m-3 was calculated for treatment amended by biochar level I (2.5 t ha-1) and chicken manure at the N recommended rate (CXBX), indicating that if the soil moisture is less than 0.103 m3m-3 threshold, then the median soil CO2 emission is 142 kg ha-1 d-1. Additionally, the results demonstrate that GAM outperformed MLR, exhibiting the highest performance under the combined effect of chicken and biochar.

Student Posters

Reconstructing Climate Variability in the Pedernales River Basin

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Droughts increase stress on water resources, an issue that is compounded by increased water demand in areas with rapidly growing populations such as Central Texas. Information about climate provided by the instrumental record does not capture its full variability, as reliable data are only available for the past 100 to 150 years. To overcome this issue, we are using bald cypress tree cores to reconstruct environmental conditions in the Pedernales River Basin and evaluate long term trends in drought and extreme precipitation dynamics in Texas. We hypothesize that there will be significant spatial heterogeneity in drought intensity and duration. We have collected 39 tree cores with preliminary ages ranging from 100 to 560 years (median: 164 years). 43% of the trees are younger than 170 years, most likely to be a result of historic logging and destructive floods in the Pedernales River basin. We discuss how droughts vary across the Texas Hill Country, including their periodicity, intensity, and duration.

Three-Dimensional Numerical Analysis of Skin Layers' Influence on Leakage Flow Dynamics Between Aquifers Under Variable Subsurface Conditions

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Abandoned wells present considerable environmental and health risks due to their potential to serve as conduits for vertical leakage between aquifers. This study focuses on the role of skin layers, which are low-permeability zones surrounding abandoned wells, in regulating such leakage under varying subsurface hydrological conditions. A three-dimensional numerical model was developed using COMSOL Multiphysics to simulate flow through fully penetrating abandoned wells. The model was validated against established analytical solutions and used to assess the impact of several key factors including skin layer thickness, skin permeability, aquifer permeability, aquifer thickness, aquitard thickness, and injection rate. Results demonstrate that thicker or less permeable skin layers significantly reduce leakage by increasing flow resistance, while higher injection rates and reduced aquitard resistance intensify vertical flow due to enhanced hydraulic gradients. These findings emphasize the importance of accounting for abandoned well skin effects in groundwater protection and aquifer management practices.

A Novel Application of Horizontal Wells in Aquifer Thermal Energy Storage System: Geothermal Potential in Texas

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Aquifer Thermal Energy Storage (ATES) systems are gaining popularity globally as a sustainable method for storing excess thermal energy in groundwater aquifers over extended periods. While more than 3,000 ATES systems are in operation worldwide, commercial deployment in the United States has not yet taken place. Nonetheless, interest in ATES as a tool for supporting the energy transition is growing. This research provides a novel approach of using horizontal wells in the ATES system and its potential application in Texas, U.S. To maximize the utilization of the subsurface and energy, numerical, analytical, and field experiments have been employed to improve the system design. However, existing systems and research only consider using vertical wells in the ATES system, which limits the scope of the system application. This study analyzes the simplest version of ATES system, where a horizontal well doublet is built in COMSOL Multiphysics. The three-dimensional (3D) model is run for 20-years to examine the long-term thermal behavior and recovery efficiency of the system. Both cyclic and continuous system operations are accounted in simulations. Additionally, the model is tested with hydrogeological parameters from the Queen City Aquifer to evaluate the feasibility of implementing ATES systems with horizontal wells in Texas for storing thermal energy collected during the summer.

The Impact of Clogging in Aquifer Thermal Energy Storage (ATES)

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Well-clogging is a prevalent issue that significantly affects the efficiency and functionality of wells, including those used for aquifer thermal energy storage (ATES). This clogging leads to reduced permeability in the well's immediate vicinity, which in turn impacts the performance of ATES systems. Despite its importance, this phenomenon has not been extensively studied. In this research, site-specific values for hydrogeological and heat transport properties/parameters are based on the Queen City Aquifer in Texas, which is a shallow aquifer (at a depth of 140 feet) and is not the source of drinking water (primarily used for livestock, farming, and domestic consumption), so it is suitable for ATES. This study examines the effects of clogging-induced permeability reduction on the recovery efficiency of ATES systems using both analytical and numerical models. The analytical model is based on heat transfer with a time-dependent hydraulic conductivity function and is proposed for constant-rate injection scenarios. Complementarily, numerical models developed with COMSOL Multiphysics evaluate the

impacts on thermal transport and recovery efficiency across various operational scenarios. The objectives of this paper are to: (1) compare the analytical and numerical solutions to verify the models' reliability, (2) quantify the impacts of clogging on ATES processes, and (3) discuss further environmental impacts and provide effective recommendations.

Integrating Remote Sensing and Weather Data using Machine Learning to Evaluate Drought Impacts on Agricultural Production and Water Footprints in Texas.

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Background: Texas leads the U.S. in the number of farms (12%), generating over $30 billion in agricultural revenue in 2022. However, recurring severe droughts, such as those from 1933 to 1940, 1950 to 1957, and the economically devastating 2010 to 2011 event, continue to challenge water availability. The year 2022 was the state's 11th driest in 128 years, exacerbating agricultural vulnerabilities. Methods: Traditional drought assessments rely on historical climate data and field observations, often lacking the spatial and temporal precision needed for accurate predictions. Machine learning (ML) techniques offer an advanced approach by capturing complex relationships between weather variables and drought conditions. This study employs Random Forest (RF) and Long Short-Term Memory (LSTM) models to analyze drought patterns and their agricultural impacts in Texas. Satellite remote sensing datasets, including MODIS, SMAP soil moisture, PRISM, and NCEI weather variables, are integrated into the models. Objectives: The specific objectives are (i) to determine the importance of remote sensing and grided weather products in spatiotemporal drought quantification using ML techniques; (ii) to compare the model-predicted drought indices with ground-based agricultural drought indices; (iii) to investigate the relationships between model-predicted indices with the crop water footprint and yield for the major crops in Texas.

Regulatory Framework and Policy Outlook for Produced Water Reuse for Hydrogen Production in Texas

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As hydrogen production scales up in Texas, securing water sources is crucial for long-term viability, particularly in key hydrogen-producing regions like the Permian and Eagle Ford Basins, which face significant water shortages. Produced water presents a potential alternative to

freshwater but requires advanced treatment to meet purity standards for hydrogen production. This work is part of a larger research initiative focused on a techno-economic analysis (TEA) of various water sourcing and treatment options for expanding hydrogen production in Texas. Our section of the research focuses on two areas. First, we assess future water availability in the Permian basin. Given the varying degrees of water stress in this region, understanding long-term water resource constraints is crucial for evaluating large-scale hydrogen production feasibility. Second, we examine the policy and regulatory landscape surrounding produced water reuse for hydrogen production. By reviewing hydrogen and water policies across Texas and the U.S., we aim to identify governance challenges and opportunities that affect the integration of treated produced water into hydrogen production. Our findings will inform both policy decisions and industry practices, offering insights to help guide the development of a reliable, scalable hydrogen infrastructure while addressing the critical water resource challenges faced by the state.

Water-Energy-Food Nexus in Texas: Exploring Impacts of the Energy Transition on Water Usage and CO_2 Emissions

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This study examines the Water-Energy-Food (WEF) Nexus within Texas's energy transition from 2007 to 2023, focusing on its impacts on water usage and CO_2 emissions. Using the Energy Portfolio Assessment Tool (EPAT) and historical data, the research explores how the shift from coal to renewable energy sources, particularly wind and solar, has helped reduce water withdrawals and CO_2 emissions in the state. The rapid growth of wind energy and the expansion of solar power have been the major renewable energy drivers in lowering the environmental footprint water dependency of the state's energy sector. The study also highlights how the WEF Nexus framework with an understanding of the interconnected impacts of energy production on water resources, agricultural systems, and the broader environment. By evaluating the changes over the past 17 years, the initial results indicated a significantly increasing trend for the state's renewable energy sources (e.g., solar and wind). In addition, we noticed a strong relationship between annual precipitation and hydro-energy production in the state. The energy production from wind and solar reduced the water footprint to 3614 million households. That represents a reduction of 32% in the water footprint for the year 2023. The research underscores the importance of continued innovation in water-efficient energy technologies and resource management to ensure a balanced approach to energy production, water conservation, and environmental protection.

Development and Application of a SWAT+ Framework to Simulate Hydrological Processes and PFAS Contaminant Transport in the San Antonio River Watershed, Texas

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Per- and polyfluoroalkyl substances (PFAS) are synthetic compounds extensively used in industrial and household products due to their exceptional chemical and thermal stability. Consequently, PFAS have become pervasive environmental contaminants, detected in various ecosystems and human societies, and transported via hydrological systems and land-atmospheric interactions. Evaluating PFAS transport and fate within watersheds is essential for tracking their distributions, particularly concerning human activities and climate variability. This research focuses on simulating regional hydrological processes and the fate and transport of PFAS within the San Antonio River Watershed, Texas, from 2005 to 2024 using the advanced Soil and Water Assessment Tool (SWAT+), a hydrological model. Model calibration and validation are performed using observed USGS streamflow data within the SWAT+ Toolbox to ensure accuracy. Our results showed the SWAT model's ability to satisfactorily simulate the daily hydrological process within the watershed (NSE > 0.35, R2 > 0.4). The study also benchmarked pesticide applications on agricultural lands for PFAS modeling, leveraging the pesticide module in SWAT+ as demonstrated in previous research. This methodology facilitates the assessment of PFAS transport mechanisms, including surface runoff, infiltration, and distribution within the hydrological system. We found a direct correlation between the ratio of inflow to streams and aquifers and the correspond

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Hydrological Responses and C-N Pools of Two Watersheds to Shrub Management

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Investigating the effects of shrub management on hydrologic fluxes in the parts of Texas where the shrub is a dominant component of the landscape is essential for the State of Texas’s water management strategy and planning. The main goal of this study is to test the performance of shrub management as an effective approach for protecting soil quality (carbon and nitrogen pools), as well as water resources management and planning. Specifically, this work reports on the potential i) hydrological response and ii) carbon and nitrogen pools of two watersheds, one in Colorado River Basin (arid) and the second one in Neches River Basin (humid), to shrub management (uniform thinning vs. clear cutting) simulated using Soil Water Assessment Tool (SWAT) and Regional Hydro ecological Simulation System (RHESSys) models and site-specific input data. The selected watersheds have similar potential evapotranspiration levels, but their average elevations are 600 m and 250 m for the arid and humid watersheds, respectively. Results show that light thinning alone may not significantly impact water yield and soil quality. They further indicate that the streamflow response to shrub reduction is a non-linear positive response. Keywords: Shrub management, Hydrologic fluxes, Water yield, SWAT model,

RHESSys model.

Hydrodynamic Simulation of Coastal Flooding to Determine the Vulnerable Hotspots of Galveston, Texas

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Coastal flooding is a significant threat to the durability and resilience of various infrastructures, especially transportation systems in coastal regions. Extreme weather events, such as hurricanes and storm surges, can inundate roads, bridges, and railways, leading to structural damage and service disruptions in coastal communities. While coastal flooding is recognized as a significant threat to transportation systems, there is a limited body of research specifically examining its impact on road network durability and community accessibility. This study aims to address this gap by developing a dynamic coastal flood simulation for Galveston, TX, using an advanced hydrodynamic model, the Hydrologic Engineering Center's River Analysis System (HEC-RAS), developed by U.S. Army Corps of Engineers, to model historical hurricane event like Hurricanes Ike (2008). The simulated flood map was validated using available data sources, including high water mark data from FEMA and local county flood maps. This study also incorporates detailed highway network data to quantify how the roadways are affected due to coastal floods. This work offers critical insights into enhancing coastal community resilience through the optimization of transportation systems and emergency response strategies.

Analysis of Hydrologic Properties of Sands Amended with Different Levels of Biochar

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Biochar, a charcoal-based soil amendment derived from biomass, has gained significant global attention for its positive impact on soil health. One key aspect of soil health that biochar enhances is soil physiology, particularly its hydrologic properties. Biochar improves soil aggregate formation and stability, impacting soil's physical and hydrologic parameters. These enhancements in physical soil properties affect the many facets of agriculture. As such, this study aims to evaluate the effects of various sand grain sizes (coarse (CS), medium (MS), and fine (FS)) and different biochar (BC) levels (5%, 10%, and 15%) on soil hydrological properties, specifically saturated-hydraulic conductivity (Ksat), bulk density (BD), porosity (P), and water holding capacity (WHC). The Ksat, bulk density, porosity, and water holding capacity were then analyzed following the standard procedures. Ksat of the samples were measured using two

measurement methods: falling head (FH) and constant head (CH). Based on sand grain size, Ksat values ranged from 150 to 2,134 cm hr-1 using the falling head method, while those using the constant head method ranged from 171 to 445 cm hr-1. The bulk density value for each sample ranged from 0.994 g/cm3 to 0.929 g/cm3, while porosity percentages fell between 24.75% to 63.18%. The study demonstrates that biochar application influences soil hydrologic properties, particularly saturated hydraulic conductivity.

Investigating the Sources of Nitrogen in the Brazos River Watershed

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Excess dissolved nutrients degrade water quality and cause eutrophication. Measuring the contribution of nutrients in tributary baseflow to larger order rivers is important for estimating nutrient loads. Flooding stores “event” water in permeable riverbanks, which provide baseflow for Texas Rivers. The joint contribution of nitrogen from tributaries is not regularly investigated, especially during drought. The objective of this study is to investigate how nitrogen sources and sinks evolve over the course of the 5 month 2024 Fall drought period along a 24 km reach of the Brazos River using bi-weekly water sampling. It is hypothesized that: (H1) local groundwater will replace stored water in riverbank storage; and (H2) as the groundwater proportion increases and river discharge recedes, agriculturally sourced NO3- concentrations in the Brazos will increase. The study reach included the Brazos River and three tributary stems that entered the river between US HW 21 and FM-60 bridges. Samples were collected from seven locations (three tributaries, upstream and downstream Brazos river at each bridge, and two groundwater wells). We will generate a mixing model to parse groundwater and surface water contributions to baseflow. Net nutrient fluxes will be calculated with differential gauging. We expect the study to help quantify the contribution of nutrients derived from groundwater baseflow versus runoff from tributaries to larger order rivers.

Quantifying Riverbank Denitrification Losses In Response to Flood Events on the Brazos River, Texas

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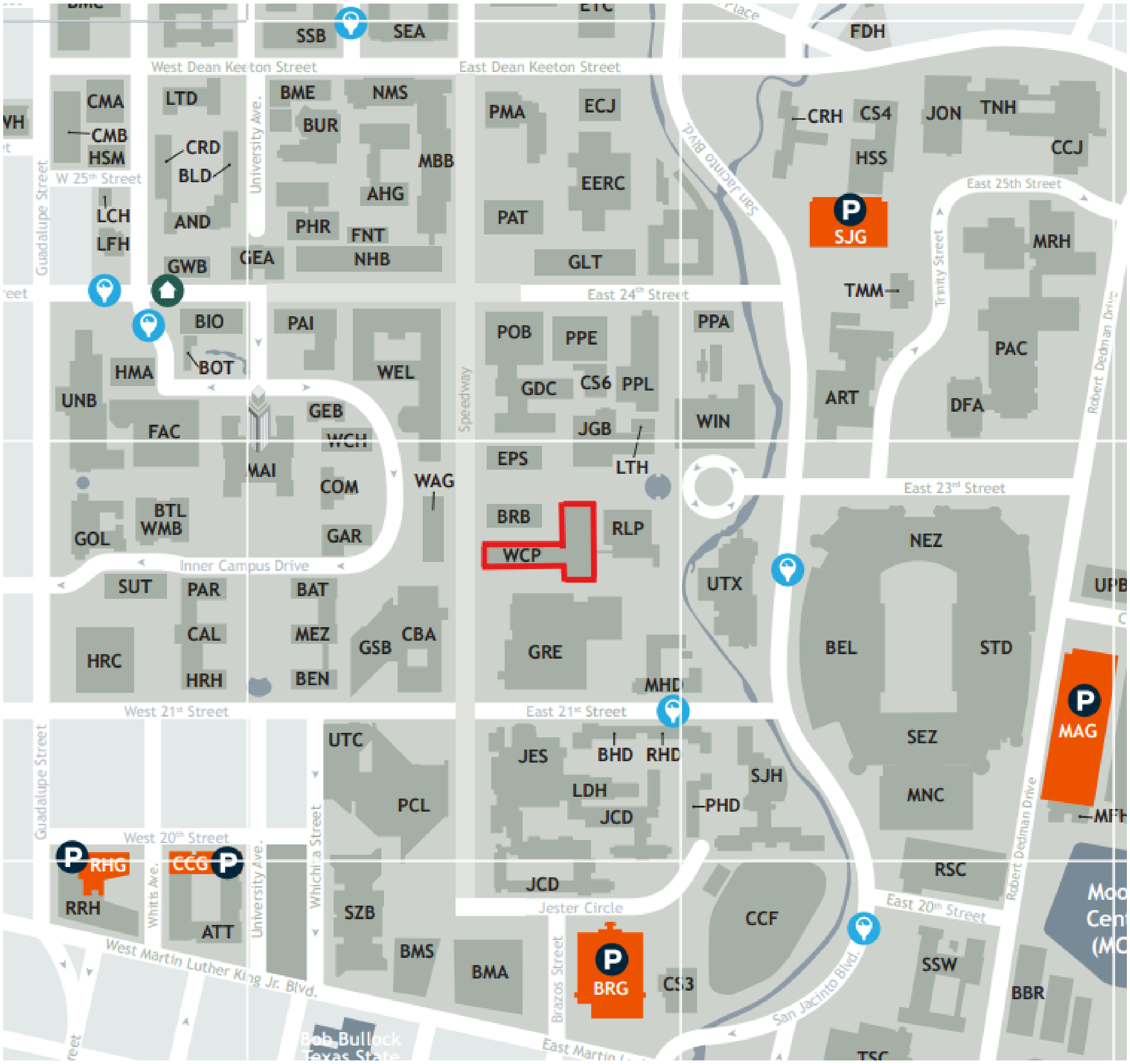
Nonpoint source nutrient contamination degrades United States (US) and worldwide water quality. This endangers drinking water supplies and aquatic ecosystems by triggering eutrophia and causing aquatic biodiversity loss. Riverbank denitrification may reduce nutrient loads in

Texas and Gulf Coast Rivers when flood events mix groundwater and flood waters. During denitrification, microbes respire flood sourced nitrate to N2 gas and DOC from more labile to more recalcitrant forms. Our objective is to measure nitrogen attenuation and accompanying DOC transformations along a segment of the Brazos River using differential gauging paired with high frequency water chemistry sampling during and after river flooding events. We hypothesize that: (H1) flooding events inject river water and nutrients into riverbank aquifers; (H2) these nutrients are denitrified and accompanied by DOC transformation from labile to recalcitrant forms; and (H3) return flow from the riverbank to the Brazos River will have lower nitrate (NO3-) concentrations than flood waters, accompanied by increased recalcitrant DOC Our study site spanned a 15 km reach of the Lower Brazos main stem and tributary streams. (Between US Hw 21 and FM-60 bridges) Discharge was measured at 15 min intervals at US-21 using the USGS Stream gauging monitoring station (ID# 08108700), and at FM-60 using Texas A&M's RQ-30 (Sommer Gmbh) radar measurement system. Dissolved major ions and nutrients were measured with IC and ICP-MS.

Maps

UT Austin Campus Map showing WCP building in red



2nd Level of William C. Powers, Jr. Student Activity Center (WCP) Map