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Effects of Ionic Liquid Immobilization on Gadolinium (Gd(III)) Recovery

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Early Career Researcher, EPSCoR Research Fellows (#2531850)

Ionic liquids (ILs) offer a sustainable framework for recovering critical elements like gadolinium [1]. However, their extraction efficiency is limited by high viscosity, which induces mass transfer limitations and phase separation challenges [2]. To address these limitations and elucidate the effects of immobilization, an immobilized IL (IIL) was prepared by covalently linking betainium bis(trifluoromethylsulfonyl)imide ([Hbet][Tf2N]) onto a polystyrene-divinylbenzene matrix. Kinetic and thermodynamic properties of this IIL were evaluated, and overall Gd(III) extraction performance was compared against pure water-saturated IL, [Hbet][Tf2N]. Batch extraction studies were conducted using nitrate Gd feed solutions to evaluate both systems at 298 K. The IIL extraction kinetics followed a pseudo-second-order model, reaching equilibrium in less than 5 minutes. Equilibrium studies suggested homogeneous, monolayer adsorption with a maximum loading capacity of 0.83 mmoL/g. At an equivalent [Hbet] to Gd(III) molar ratio, the pure IL system exhibited limited extraction, while the covalently linked IIL achieved 89% Gd(III) extraction. This study demonstrates that solid–liquid extraction via covalent immobilization provides an efficient alternative to liquid–liquid extraction.[1] F.J. Alguacil, J.I. Robla, O. Rodriguez Largo, Minerals 2024, Vol. 14, Page 734 14 (2024) 734.[2] T. Behrsing, V.L. Blair, F. Jaroschik, G.B. Deacon, P.C. Junk, Molecules 2024, Vol. 29, Page 688 29 (2024) 688.

Effects of heat treatment on the microstructure and mechanical properties of LPBF printed Ti6Al4V

Bernice Addai, Southern University System
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Additive manufacturing (AM) has become an essential technology for producing complex metal components with high precision and design flexibility. Among these materials, the alloy Ti-6Al-4V is widely used because of its excellent strength, corrosion resistance, and biocompatibility. However, parts made with LPBF contain internal defects that weaken their mechanical performance. Typical issues include small irregular shaped pores, incomplete fusion between layers, and residual stresses formed during rapid solidification. The fast-cooling rate also produces a hard but brittle martensitic alpha prime (α') phase that limits ductility and fatigue strength. To address these defects, different heat treatment methods have been developed to refine the microstructure and heal internal defects. This study explores spark plasma post-treatment as a cost-effective alternative to HIP. The method is based on the spark plasma sintering (SPS) technique commonly used in powder metallurgy but adapted here for treating LPBF Ti64 parts. Afterward, multi-step annealing was applied to relieve stress and stabilize the alloy's microstructure. The SP-treated samples showed significantly reduced porosity and more spherical pore structures. Mechanical testing revealed increase in both strength and ductility, demonstrating an improved balance between toughness and flexibility

DFT Study of Thermodynamic Stability in Novel High Entropy MAB Phases Based on the Cr_4AlB_4 Structure

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Early Career Researcher

High Entropy Alloys (HEA) represent a new materials design approach with unique properties stemming from Configurational Entropy (CE) that stabilizes solid solution phases. We explore applying the HEA concept to MAB phase materials, which combine metallic and ceramic properties. Our target is Cr_4AlB_4, a MAB phase exhibiting excellent mechanical strength, thermal stability, and electrical conductivity. We substituted Cr atoms with transition metals to examine thermodynamic stability of multi element MAB phases using first principles Density Functional Theory (DFT) calculations. By computing 0 K energy above hull (ΔHhull), we assessed stability of multi element systems containing Cr, Ti, W, Mn, Mo, and Fe by comparing each composition's DFT calculated formation energy with the convex hull of all known competing phases. Our findings show certain elemental combinations yield thermodynamically stable or nearly stable phases. Notably, stable ground states are predicted for elements like Cr3WAlB4 (ΔHhull = +0.003 eV/atom) and Cr_3MnAlB_4 (ΔH_{hull} = -0.0001 eV/atom). We also examined CE effects on phase stability at high temperatures, proving that several metastable compositions, including $Cr_{1.33}Mo_{1.33}W_{1.33}AlB_4$, become thermodynamically stable at experimentally relevant synthesis temperatures through Gibbs Energy Above Hull calculations. These results provide vital theoretical guidance for targeted synthesis of a novel family of stable HE-MAB phases for extreme environment applications.

Advancing Sono-Electrochemical Adv. Oxidation for Wastewater Treatment & Water-Energy Sustainability

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Early Career Researcher

Water pollution remains a significant global challenge. The World Health Organization estimates that around 1.8 million deaths occur each year due to water-related issues, contributing to the global burden of chronic diseases. This problem has worsened as the prevalence of emerging contaminants resistant to traditional water and wastewater treatment methods has increased. These contaminants pose serious risks to both human health and the environment. Our research goal is to advance a sustainable, effective unit-treatment-process strategy for treating wastewater that addresses emerging contaminants, including refractory pollutants and forever chemicals. This study investigates a hybrid Advanced Oxidation Process (AOP) aimed at the sustainable degradation of stubborn pollutants. A significant limitation of conventional AOPs is their tendency to result in incomplete mineralization, leading to the formation of intermediate byproducts. To tackle this issue, we propose integrating ultrasound with electrochemical oxidation to create a synergistic Sono-electrochemical Advanced Oxidation Process (SEAOP) that is expected to improve mass transfer, enhance the generation of hydroxyl radicals and mixed oxidants, and accelerate the kinetics of pollutant degradation. We will discuss improvements in process performance by systematically optimizing operating parameters and developing innovative mixed-metal oxide anode materials to enhance the efficiency, stability, and scalability of SEAOP.

Trend of In-Hospital Mortality in Heart Failure with Reduced Ejection Fraction (HFrEF) in the US

Bernice Akinwande, The University of Southern Mississippi
Early Career Researcher

Background: Heart failure with reduced ejection fraction (HFrEF) remains a major cause of hospitalization and mortality in the United States. Further evaluation of contemporary national trends in in-hospital mortality and demographic disparities is necessary, as sociodemographic disaggregation has not yet been characterized. Methods: We conducted a retrospective serial cross-sectional study of HFrEF hospitalizations from 2016 to 2022 using the Healthcare Cost and Utilization Project database. Annual in-hospital mortality rates were calculated as the proportion of hospitalizations resulting in death. Multivariable logistic regression determined mortality predictors, while segmented logistic regression evaluated temporal breakpoints in mortality trends over the study period. Results: In-hospital mortality was stable from 2016 to 2019 at 6.8-6.9%, rose to 8.5% in 2020, reached a peak of 9.1% in 2021, and fell to 8.3% in 2022. Segmented logistic regression identified 2020 as a significant temporal breakpoint ($p < 0.001$). Multivariable logistic regression showed that age (OR:1.03; 95% CI: 1.030-1.032), female was associated with lower mortality odds compared to male patients (OR: 0.87; 95% CI: 0.86-0.87), patients in the highest quartile income had 18% lower odds than those in the lowest (OR: 0.82; 95% CI: 0.81–0.82). Hospitalization in the South was associated with the highest regional mortality odds compared to the Northeast (OR: 1.41; 95% CI: 1.40–1.42)

Bio-Derived Carboxylates for Decalcification and Silica Enrichment of Concrete Waste.

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Early Career Researcher, Focused EPSCoR Collaborations (FEC) (#2418355)

Ordinary Portland cement is widely used in construction, but its production contributes to about 7–8% of global anthropogenic CO_2 emissions. This highlights the need for practical, low-carbon alternatives. A promising alternative is to convert industrial and biomass waste into supplementary cementitious materials (SCMs) using selective chemical activation. This study introduces an Integrated Capture and Activation Process (IC2MAP) that produces reactive silica by carefully removing calcium from cementitious and industrial byproducts. Central to this process is acid leaching, which uses bio-based carboxylic acids to dissolve calcium compounds while preserving the silicate structure. Fermented liquids rich in volatile fatty acids, including valerate, propionate, acetate, butyrate, isobutyrate, and caproic acids, were produced from wastewater treatment process-derived primary solids and potato waste at retention time of 5, and 4 and 8 days respectively. The potato-fermented liquid reached carboxylate concentrations up to 1.16 M at pH ≈ 4.0. Such strong organic acids help dissolve portlandite and partially decalcify C–S–H efficiently. The process is expected to yield a silica-rich residue with improved polymer structure and increased pozzolanic reactivity. This approach would offer a practical circular solution by integrating biomass waste fermentation with the development of sustainable cement materials, offering a pathway toward reduced reliance on clinker-intensive binders.

Time-Series Clustering of Solar PV Output for Enhanced LOLP Estimation

Demy Alexander, Wichita State University
Early Career Researcher, Track-I (#2148878)

The rapid integration of solar photovoltaic (PV) resources complicates power system reliability assessments due to their high variability. Specifically, calculating Loss of Load Probability (LOLP) has become computationally prohibitive, as traditional methods require analyzing massive volumes of chronological generation data. To address this bottleneck, this paper proposes a time-series clustering framework to efficiently aggregate solar PV output data while preserving critical variability patterns.The methodology transforms granular hourly solar generation data into daily temporal profiles. A two-stage clustering approach is applied: initial hierarchical clustering identifies optimal profile groupings, followed by K-Medoids clustering using Dynamic Time Warping (DTW). DTW is vital, as it aligns time-shifted profiles to capture both typical seasonal behaviors and rare high-impact, low-frequency events that threaten grid stability. The highly representative profiles generated are then integrated into a non-sequential Monte Carlo simulation to evaluate the system's LOLP. Results demonstrate that the proposed framework significantly reduces computational time without compromising the accuracy of reliability metrics when compared to full-data simulations. This approach offers a scalable, efficient tool for future renewable-rich grid planning.

An Automated Rotational Imaging System for Photogrammetric 3D Reconstruction of Root Architecture

Nestor Alvarez-Rodriguez, Louisiana State University
Early Career Researcher (#2418232)

Quantification of physical features found in root architecture is vital to understanding plant nutrient uptake, drought resilience, and overall performance. Scalable and affordable imaging of complex root systems remains a technical challenge, with current methods requiring CT, MRI, or are limited to two dimensions, sacrificing structural detail. This study develops a controlled imaging system for photogrammetric 3D reconstruction of root systems for quantitative feature extraction. Mature soybean plants are grown and harvested by LSU AgCenter's Red River Research Station. The root system is suspended from a rotating stage within an enclosed imaging box for customized lighting and background. Two cameras are configured as a stereoscopic pair and are triggered synchronously by a computer that controls discrete stage rotation. Stereoscopic imaging provides offset paired views, improving image correspondence, and depth representation for reconstruction. As the sample rotates, image pairs are captured from multiple angles to generate point clouds, which are then merged, and a surface mesh is derived to produce a complete 3D reconstruction, enabling network connectivity and architectural analysis on the model. Expected outcomes include a repeatable imaging workflow and extraction of quantitative traits such as root branching characteristics. This work provides an engineering framework for comparing root systems and advances imaging system design for plant phenotyping applications.

Community Needs Assessment of Microplastics Exposure and Health Disparities in the Gulf South

Sermin Aras, The University of Southern Mississippi
E-CORE RII, General Session (#2316351)

There is limited knowledge about how microplastics exposure affects human health, particularly in Gulf South communities that are disproportionately impacted by environmental burdens, climate vulnerability, and health disparities. Despite detection of microplastics in humans, their community-level health impact remains unclear. The Advancing Social and Environmental Equity through Plastics Research: Education, Innovation, and Inclusion is an interdisciplinary project with an overall theme to address plastic waste challenges and their climate and health impacts. One of its scientific goals focuses on investigating microplastics exposure and its impact on human health and behavior in Gulf South populations. The project utilizes a cross-sectional survey design to conduct a needs assessment study covering three counties in Mississippi and one in Alabama. The needs assessment surveys aim to investigate whether coastal communities experience elevated microplastics related health risks, assess potential disparities and evaluate the role of diet and physical activity in health outcomes. Data collection is ongoing (N = 214). A predominantly African American (56%), racially diverse sample with relatively high educational attainment (36% bachelor's degree or higher) and largely low-to-moderate income household conditions (53%). Approximately 60% of participants perceive microplastics as a legitimate health threat. Dietary assessment shows a mean Healthy Eating Index score of 57.64.

Developmental Stage Drives Soybean Microbiome Succession Despite Transient Effects of BTH Priming

Francella Arce, Louisiana State University
Early Career Researcher (#2418232)

We investigated how the defense inducer 2,1,3-benzothiadiazole (BTH) influences soybean root-associated microbiota across root compartments (endosphere and rhizosphere) at early vegetative (V3-V4) and late reproductive (R5-R6) stages under field conditions without any other management besides herbicide control. Diversity and differential abundance analyses revealed that plant developmental stage was the main driver of microbial succession, with both root compartments showing temporal shifts in community composition. In the endosphere, early communities were enriched with genera such as Amycolatopsis, Streptomyces, and Niastella, whereas late communities were dominated by taxa commonly associated with root colonization and plant-microbe interactions, including Pseudomonas, Janthinobacterium, Flavobacterium, and Stenotrophomonas. Temporal restructuring was also observed in the rhizosphere, with early enrichment of Azoarcus and Defluviicoccus, and late enrichment of Bradyrhizobium, Paenarthrobacter, and Bacteroides. BTH treatment effects were compartment-specific and most pronounced during early growth, where endosphere alpha diversity decreased, but such effects diminished at late stage when community structure resembled untreated plants. These findings highlight the dominant role of plant developmental stage in shaping soybean microbiota and suggest a transient and compartment-specific influence of chemical priming on microbial community structure.

Pollinator Visitation on Nebraska Native Plants

Alexa Armendariz, Central Community College
Early Career Researcher, EPSCoR Graduate Fellowship Program (EGFP) (#2044049)

This 16-week study examined pollinator visitation across ten native Nebraska plant species in four Central Community College (CCC) pollinator gardens. Using standardized

Flower-Insect Timed (FIT) Counts, student researchers documented insect activity and bloom dynamics. Observations were conducted four days per week, capturing data on bees, butterflies, and hoverflies. The findings highlight species-specific pollinator preferences and support conservation strategies for native flora and pollinators in Nebraska ecosystems.

Modeling Nano- and Microplastic Transport in Narragansett Bay: Hydrodynamic and Ecological Fate

Adam Ayouche, Brown University
E-RISE RII, Early Career Researcher (#2438542)

Nano- and microplastics (NMPs) pose growing threats to coastal ecosystems, yet their transportpathways from land to sea remain poorly constrained. Within SIMCoast (E-RISE RII), Research Theme2 is developing a coupled modeling framework — the Ocean State Ocean Model (OSOM) — to quantifyNMP distribution, transport, and fate across Rhode Island's coastal watershed. We are integratinghydrodynamic (ROMS), terrestrial hydrology (SWAT), wave transport, and lower trophic level (NPZD)models with Lagrangian particle tracking and Bayesian source attribution to simulate NMP pathwaysfrom riverine inputs to coastal sinks. Data assimilation techniques and Observing System SimulationExperiments (OSSEs) are being developed to enable real-time NMP forecasting. This presentationdescribes the modeling architecture, current development status, and the scientific challenges beingaddressed, with a focus on coupling wave dynamics, ocean circulation, and NMP transport in a coastalsetting prone to extreme weather events.

A Multi-Jurisdictional Initiative for Climate-Resilient Water Management and Community Partnerships

Raju Badireddy, University of Vermont
Focused EPSCoR Collaborations (FEC), General Session (#2418750)

Climate resilience is an urgent and growing challenge for watersheds across the United States, particularly in regions increasingly affected by droughts, flooding, and water quality degradation. To address these threats, an NSF-supported effort brings together regional leaders from Vermont, South Dakota, and New Mexico through the Advancing QUAlity and CLimate-ResIlent Water Management with Community Partnerships and Enhanced Sensor Network (AQUA-CLIME) initiative. AQUA-CLIME seeks to transform watershed-scale monitoring and management by integrating affordable, readily deployable intelligent sensor networks, advanced modeling, and strong community partnerships. The project focuses on predicting and managing the spatiotemporal dynamics of contaminants of emerging concern across diverse hydroclimatic settings under both current and future climate conditions. This abstract summarizes two years of progress from this nationwide collaboration, highlighting outcomes from three model watersheds that span a broad range of climate–social–ecological contexts, from precipitation-rich systems challenged by nutrient runoff to arid regions facing severe water scarcity. By emphasizing community engagement, innovative sensing technologies, data-driven decision-support tools, and workforce development, AQUA-CLIME is laying the scientific, technological, and educational foundations needed to advance climate-resilient water management and inform future national policy.

Plant-Derived Arabinoxylan Scaffolds for Breast Cancer Cell Growth: Sustainable and Cost-Effective

Md Abdur Rahim Badsha, Maryville State University
General Session, Track-I

Arabinoxylan (AX), a natural polysaccharide from plant sources, has emerged as a promising biomaterial for tissue engineering due to its biocompatibility and sustainability. In this study, we developed and evaluated AX-based scaffolds derived from nine different plant sources, for example, wheat bran, sugar beet pulp, sugar cane baggage, jute fiber, cattail, quinoa plant, western Giant Puffball mushroom, Chicken of the Woods mushroom, and Turkey tail mushroom, blended with sodium alginate (SA) and collagen (C) in a 1:1:1 ratio, as eco-friendly and cost-effective platforms for breast cancer cell culture. All scaffolds were successfully fabricated and characterized for their physicochemical and structural properties, showing uniform porosity, suitable mechanical strength, and biodegradability. Biological assessments revealed that the AX:SA:C scaffolds supported adhesion, proliferation, and growth of both MDA-MB-231 and patient-derived xenograft (PDX) breast cancer cells. Comparative analysis indicated subtle differences in cell response depending on the plant source, yet all scaffolds demonstrated promising biocompatibility. These results highlight the potential of plant-derived AX:SA:C scaffolds as sustainable, low-cost alternatives for in vitro breast cancer studies and tissue engineering applications. Future work will focus on optimizing scaffold properties to enhance long-term cell culture performance and applicability in drug screening platforms.

Submarine Groundwater Contributions to Nutrients and Potential Hypoxia in the Mississippi Bight

Wokil Bam, The University of Southern Mississippi
EPSCoR Research Fellows, General Session (#2531603)

Submarine groundwater discharge (SGD) refers to the movement of fluid from benthic sediments into coastal water bodies. This process includes both marine sources, such as recirculated seawater, and terrestrial sources, such as freshwater and nutrient-rich groundwater, exhibiting a wide range of scales, flow rates, and chemical compositions. Despite often being overshadowed by surface runoff and riverine inputs, SGD is increasingly recognized as a vital and dynamic pathway for the transport of nutrients, trace metals, and anthropogenic pollutants to coastal ecosystems. SGD plays a pivotal role in the biogeochemical functioning of coastal waters, influencing primary productivity, nutrient cycling, and carbon sequestration. In particular, its nutrient delivery mechanisms can have profound ecological impacts, contributing to detrimental phenomena such as hypoxia (oxygen depletion) and harmful algal blooms. This research seeks to address this critical gap by investigating the role of SGD as a vector for nutrient transport and its subsequent influence on aquatic systems. The overarching hypothesis is that groundwater-seawater interactions within the Mississippi Bight play a significant role in shaping the region's aquatic chemistry. These interactions introduce substantial amounts of nutrients and low pH groundwater, thereby influencing its biogeochemical cycles.

Equitable Nature-Based Solutions: AR Co-Creation of Community Stormwater Design for Resilient Cities

Johanna Barthmaier-Payne, Rhode Island School of Design
Focused EPSCoR Collaborations (FEC), General Session (#2418379)

Nature-based solutions (NbS) are recognized as effective strategies for addressing urban flooding and extreme heat. However, conventional planning and design processes often limit meaningful participation from communities most impacted by climate change, creating barriers to equitable implementation. As part of the Equitable Nature-Based Climate Solutions project, this activity explores how augmented reality (AR) can support more inclusive, community-driven approaches to stormwater design.Through a series of co-creation workshops in three living hubs, Providence, RI; Manchester, NH; and Louisville, KY, community participants engaged with site-specific AR visualizations of potential nature-based stormwater interventions. Using accessible AR tools, participants co-created landscape design scenarios in situ, including hybrid recreational elements and green stormwater infrastructure. Participants proposed new ideas based on lived experience, neighborhood priorities, and environmental concerns.The workshops combine visualization with participatory design methods, including skill sharing, discussions, and think-aloud surveys. Through this approach, participants understand stormwater dynamics, assess tradeoffs, and contribute to potential interventions. By bridging technical expertise and community knowledge, this work demonstrates how immersive technologies can help co-produce responsive, place-based nature-based solutions and advance community-engaged climate resilience.

Streamflow Trends and Flood Inundation Modeling: Supporting Restoration of the Fort Hall Bottoms

Sagar Bhusal, Idaho State University
Early Career Researcher

The Fort Hall Bottoms area along the Snake River in southeast Idaho is a regulated river–floodplain system currently undergoing active restoration planning by I'CREWS. Altered flow regimes and reduced peak discharges have likely limited floodplain connectivity. This study aims to understand how streamflow patterns have changed over time to support inundation modeling for restoration design. Long-term hydrologic trends across Idaho are evaluated by dividing the state into HUC-8 watersheds and analyzing Annual Maximum discharge series from 77 USGS stream gauges. About 30 gauges with records ≥50 years were selected for detailed analysis using the Mann–Kendall test for trend detection and Log-Pearson Type III distribution for flood frequency analysis. Preliminary results point to notable spatial variability across the state, with some areas seeing higher peak flows and others trending downward. The Snake River near Blackfoot (USGS 13069500) is a good example of the latter — annual peak flows have dropped by roughly 2.69 m^3/s/yr over five decades, though this isn't statistically significant ($p = 0.18$). From here, the focus shifts to Fort Hall Bottoms, where screened peak flow records and high-resolution elevation data will be used for two-dimensional hydraulic modeling and flood inundation mapping. This work aims to give restoration planners regional context for how reservoir regulation, snowmelt shifts, and climate variability are affecting hydrology across the western US.

AK NSF EPSCoR Workforce Development, Education and Broadening Participation (WEB) Activities

Tara Borland, Alaska EPSCoR
General Session, Track-I

AK NSF EPSCoR Track 1 Interface of Change (IoC) Workforce Development, Education, and Broadening Participation (WEB) activities are grounded in the livelihoods and communities of coastal Alaska. WEB adopts a place-based approach aligned with IoC research. WEB's goals are to use place-based methods to 1) catalyze formal and informal STEM and IoC learning opportunities for an array of Alaskan groups; 2) facilitate increased engagement with STEM activities in IoC communities; 3) foster entrepreneurship connected to IoC activities and findings; and 4) create programming that contributes to the wellbeing of all groups across the IoC communities. The IoC Workforce Development team fosters entrepreneurship connected to IoC activities and findings by providing opportunities for innovation and entrepreneurship training, academic professional development, and mentorship for both IoC researchers and communities. IoC also supports our early career faculty and students with a suite of professional development and mentoring activities. The IoC education team implemented a series of place-based, formal, and informal science learning experiences for communities throughout the IoC project regions. IoC incorporates NSF's mission to broaden participation in STEM by creating programming that contributes to the wellbeing of all groups across the IoC communities.

AK Science Olympiad STEM Education Program: Engaging Alaska youth through STEM competition models

Tara Borland, Alaska EPSCoR
General Session, Track-I

External engagement in STEM activities is necessary for many youth to consider STEM as a career option. For 4 years AK NSF EPSCoR has hosted the Alaska Science Olympiad state competition at UAF for middle school students. This competition challenges Alaska's youth in a variety of STEM fields including biology, chemistry, coding and engineering. A huge barrier to participation is the size of our state and the cost of travel for teams to compete. This is especially challenging for students from rural communities off the road system. In 2024 we developed a mobile, hands-on version of the competition that we could bring directly to rural communities. We successfully piloted these mobile STEM competitions at three rural Alaska schools in the fall of 2024 as miniature versions of the Alaska State Science Olympiad. EPSCoR community partners helped us coordinate with rural schools interested in participating. The mini Science Olympiads are held over the course of one school day. The entire school, K-12, competes in 3 STEM events that are followed by medal ceremonies giving the kids a chance to celebrate their STEM achievements. Schools are also provided with a reusable STEM activity kit and teacher training that corresponds with one of the flagship Science Olympiad events. Since its inception, we have now held 10 mini Science Olympiads at 8 different rural AK schools while continuing to offer the annual state event. Two of these schools now also participate in the state competition.

Real-Time Interactive Wildfire Simulation: A GPU approach in Unreal Engine

Jake Bova, University of Montana
Early Career Researcher

This project is a real-time, interactive wildfire simulation framework developed on the GPU using the Unreal Engine Niagara system. The architecture features two primary components: a surface fire spread solver and a 3D computational fluid dynamics (CFD) wind field. Fire spread is driven by custom high level shader language implementing a modified 2D Rothermel model, which calculates vector-summed elliptical propagation while accounting for dynamic moisture evaporation, slope, and fuel-dependent burnout. Simultaneously, a modified Niagara Grid 3D CFD solver computes the surrounding wind field. These systems are coupled at every simulation step. Combustion releases thermal energy, creating vertical velocity in the 3D gas volume. Application of mass and momentum conservation provide solutions for local wind turbulence and vorticity. The resulting dynamic wind vectors are immediately fed back into the spread model to direct the fire's continuous movement. By executing both the cellular automata fire spread logic and the CFD wind solver entirely on the GPU, the framework eliminates CPU-to-GPU data transfer bottlenecks. This approach achieves real-time, interactive, and immersive levels of performance offering a highly responsive tool for visualizing complex fire behavior and environmental feedback. The use of Unreal Engine provides an exciting opportunity for extension to a variety of possible systems, from firefighter training platforms to immersive wildfire exploration.

From Vision to Foundation: Building the CAPTIVATE KY Research Databank

Hunter Brogna, Kentucky Science & Engineering Foundation
E-CORE RII, General Session (#2438201)

The CAPTIVATE KY databank was designed as a centralized infrastructure for housing and delivering petabyte-scale research datasets to stakeholders across Kentucky. However, the path from concept to implementation was far from straightforward. This flash talk chronicles the challenges our team faced by procuring the hardware and services needed to build the databank—and the decisions that led us to a viable solution.With a constrained budget, rising hardware costs, and demands for AI-ready scalability, we explored multiple procurement avenue-direct vendor purchases, cloud-based alternatives, and hybrid modelsThis talk addresses the trade-offs we made, components we deferred, including GPUs and expanded storage—and the phased strategy we adopted to launch with a strong foundation while remaining positioned for growth. Attendees will gain practical insight into navigating infrastructure procurement while staying within budget.

Trapping a Catalytic Intermediate Produces Force Outcomes Affecting Multi-Motor Kinesin Ensembles

Rebecca Buckley, LSU Health Sciences Center New Orleans
General Session (#2538311)

Cells rely on tiny molecular machines to generate and respond to forces, but how these machines adapt to mechanical stress is not fully understood. One such machine, a motor protein called kinesin-5 (Eg5), plays a critical role in cell division by helping organize and move cellular structures. In this study, we use small molecules as tools to explore how Eg5 behaves under force similar to conditions it experiences when working alongside other motors. We find that one small molecule stabilizes the motor in a catalytic state that permits it to resist force rather than adopting a passive, non-resistive state. These findings reveal how the function of Eg5 can be tuned within groups of motors to adjust force production. In living cells, this type of tuning could influence processes such as the separation of chromosomes during cell division or the organization of structural elements in neurons. More broadly, our findings show that targeting a single step in a molecular machine’s catalytic cycle is enough to reshape its collective behavior, offering a general strategy for studying and controlling force-generating systems in biology.

USD HPGe Detector Capabilities and an R&D Path to Orthogonal-Strip Ge for Medical Imaging

Patrick Burns, University of South Dakota
Early Career Researcher (#2437416)

We summarize the end-to-end high-purity germanium (HPGe) detector capabilities at the University of South Dakota and outline a measured path toward an orthogonal-strip Ge radiation detector for medical imaging. Using USD-grown single-crystal Ge, our group has fabricated and tested planar, PPC, mini-PPC, mini-ICPC, and hybrid-planar test devices. Standardized process flows (lithography, contact formation, passivation) are coupled to cryogenic I–V, C–V, and γ-ray spectroscopy to benchmark leakage, depletion, and energy response, providing a reproducible baseline for strip detectors. On the design side, finite-element field and capacitance simulations inform strip pitch, edge termination, and guard structures to control interstrip capacitance and charge sharing.This poster reports the first step toward an orthogonal-strip prototype: (i) simulation-driven geometry selection, (ii) small-area test layouts exploring pitch and termination options, and (iii) a focused measurement plan using collimated sources to map charge sharing, cross-talk, and position response. Near-term milestones include locking process recipes, stabilizing cryogenic readout for multi-channel operation, and fabricating a coupon with a few orthogonal strips to establish noise, capacitance, and energy-resolution targets. These results establish the technical basis and performance metrics for scaling to larger-format orthogonal-strip HPGe suitable for high-fidelity medical imaging.

Maine-Bridge: Connecting Maine Teachers and Scientists

Emma Carey, Maine Mathematics and Science Alliance
E-CORE RII, General Session (#2412132)

In the summer of 2025, Maine Mathematics and Science Alliance (MMSA) matched 17 middle and high school teachers with scientists across the state as a part of the Maine-Bridge program. The goal of the program was for teachers to learn more about the STEM work happening in Maine through externships, and bring their experiences back to their classrooms. Prioritizing rural and underserved communities, MMSA surveyed educators to identify topics of interest before pairing teachers with scientists whose expertise aligned with those interests. Once paired, participating teachers deployed oceanic research buoys, sampled eDNA and soil carbon, investigated early-stage cancer cells, explored AI-based forest mapping, and collected plankton samples. Professional learning events bookended the summer. Scientists and teachers were introduced to the project and each other at the Kickoff Event held in the spring. Teachers translated their experiences into NGSS-aligned lesson plans at the Summer Writing Retreat. Newly-designed lesson plans included immersive labs, hands-on projects, and phenomena-based units that all centered around Maine-based science. T-STEM and S-STEM surveys measured program impact on teachers and students.

Multi Parameter Neural Architecture Discovery for Resource Constrained Applications and Devices

Prabuddha Chakraborty, University of Maine
E-RISE RII, General Session (#2416915)

This poster presents LEMONADE, a multi-parameter neural architecture discovery framework that combines a large language model with a rules-driven expert system to generate and refine neural network architectures automatically. The project addresses a major limitation of conventional neural architecture search: most existing methods rely on predefined search spaces, emphasize final accuracy more than deployment realism, and often require substantial compute and expert effort. LEMONADE instead treats architecture design as an iterative closed-loop process in which user-defined requirements, LLM-based architecture generation, model training, and multi-parameter evaluation continuously inform one another.In the framework, a user specifies task constraints and priorities such as validation accuracy, inference speed, and energy usage. The expert system translates these goals into structured instructions for the LLM, which generates candidate model code. Each candidate is then trained, evaluated, and scored using a combined metric that rewards accuracy and speed while penalizing energy cost. The resulting measurements are fed back into the next iteration. Experimental results across CIFAR-10, CIFAR-100, ImageNet16-120, EuroSAT, Malaria Parasite, and IMDb show that LEMONADE can produce high-performing and application-specific models. The project's main contribution is not just stronger models, but a more flexible and deployment-aware way to design them.

Automated Multimodal Spectro-microscopy and its Application for Halide-based Solid-state Batteries

Dongchang Chen, The University of New Mexico
EPSCoR Research Fellows, General Session (#2429078)

In this presentation, we present our progress of the EPSCoR Research Fellow project, No. 2429078, in constructing a coupled optical and photoluminescence platform, specifically designed for halide-based solid-state batteries. The platform allows microstructural properties, measured via bright-field microscopy, and chemical properties, measured via photoluminescence spectro-microscopy, of Li-SSE interphase/interface studied all together in an automated fashion. Relying on such a capability, we can obtain the evolution of the SSB interphases from different perspectives as a function of various electrochemical parameters, allowing us to understand the correlation factors between microstructural features with chemical properties. Combining this capability with the rich chemistry of halide SSE, we can obtain a unique set of structure-chemistry-property relationships. The technique developed in this study is enriched with great opportunities to be applied in other solid-state energy storage/conversion systems and drive a transformative impact for this field.

Biomolecular-Regulated Carbonation of Recycled Concrete Fines Using Douglas Fir Bark-Derived Tannin

Xi Chen, The University of Alabama
Early Career Researcher (#2418356)

Recycled concrete fines (RCF) carbonation is a promising pathway for CO_2 sequestration; however, its efficiency is limited by slow reaction kinetics. This study explores a biomolecular-regulated carbonation (BioCarb) approach using a Douglas-fir bark–derived tannin (DFB) as a natural regulator to enhance aqueous carbonation of RCF. DFB, rich in phenolic hydroxyl groups, was obtained via hot water extraction and characterized by FTIR, 13C NMR, and ESI-MS.Carbonation was conducted at a liquid-to-solid ratio of 3.33 with 0.8% DFB for 60 min. Results show that DFB significantly accelerates carbonation kinetics, with rapid Ca^{2+} depletion within the first 10 min and enhanced early-stage carbonation. FTIR confirms accelerated carbonate formation and an increased degree of carbonation. Despite a similar final carbonation plateau, DFB enables a more efficient reaction pathway. The phenolic structure facilitates chelation with calcium ions, influencing hydration and carbonation processes.DFB-modified systems exhibit improved compressive strength, with a maximum increase at 7 days and a sustained 16% improvement at 28 days, indicating a synergistic interaction between carbonation and biomolecular regulation. This work demonstrates the potential of biomass-derived tannins for accelerating carbonation and improving material performance.

Probing Low-Mass Dark Matter (Sub-MeV to Sub-GeV) with Germanium-Based Quantum Phononic Spectroscopy

Sunil Chhetri, University of South Dakota
E-RISE RII, Early Career Resarcher (#2437416)

The search for low-mass dark matter in the sub-MeV to sub-GeV regime, together with the real-time detection of solar neutrinos via coherent elastic neutrino–nucleus scattering (CEvNS), demands detectors with extremely low energy thresholds and exceptional sensitivity. We present GeQuLEP (Germanium-based Quantum Sensors for Low-Energy Physics), a conceptual design for an advanced quantum sensing platform that integrates high-purity germanium (HPGe) crystals with engineered phononic crystal (PnC) cavities. At cryogenic temperatures (~4 K), naturally occurring dipole-bound states arise from major impurities (B, Al, Ga, and P) in germanium under freeze-out conditions. These phononic cavities host dipole-bound states, forming quantum-dot-like systems that can be coupled to radio-frequency quantum point contact sensors (RF-QPCs) readout architectures. This enables highly sensitive phonon-mediated charge detection through phonon-induced charge displacement, providing a pathway for detecting extremely small energy depositions. GeQuLEP is designed to achieve single primary phonon sensitivity at energies as low as 7.45 meV. To realize this, we employ zone refining followed by crystal growth through Czochralski method, achieving impurity levels of (~10^{10}/cm^3) at the University of South Dakota. This approach enables scalable next-generation cryogenic detectors for low-mass dark matter and solar neutrinos studies.

A weathered polymer reference library for analysis of microplastics using LDIR spectroscopy

Mc Cicenia, University of Rhode Island
E-RISE RII, Early Career Researcher (#2438542)

Microplastics (MPs) pose significant ecological and human health risks and documenting their distribution in the environment is critical for monitoring efforts and identifying exposure pathways. The environmental weathering of MPs not only accelerates breakdown but also produces toxic transformation products. Since all MPs are subject to weathering once in the environment, the inclusion of weathered plastics as reference materials for instruments that identify unknown MPs is critical for reliable analysis. Laser direct infrared (LDIR) spectroscopy can be used to detect, quantify, and characterize MPs, and its capability to detect changes in functional groups induced by weathering in tandem with its ability to detect small particles (i.e., >20 μm) makes it a powerful tool for MP research. Like other plastic identification techniques, LDIR spectroscopy requires an extensive reference library to accurately identify unknown materials. Although reference libraries have been developed for the LDIR, they are limited by only containing pristine (i.e., virgin) polymer spectra, greatly reducing the quality and reliability of matches to MPs originating from environmental samples. A more robust LDIR-specific reference library is therefore needed to allow for reliable, reproducible MP analysis. We created a novel database of pristine and field-collected, environmentally weathered polymer spectra using LDIR which will be overviewed in this poster.

Early Detection of Soybean Drought and Heat Stress Using Hyperspectral and Thermal Imaging

Sachin Cooray, Mississippi State University
E-CORE RII, Early Career Researcher (#2418231)

Early detection of drought and heat stress before visible symptoms appear is essential for improving soybean growth and resilience under changing environmental conditions. Abiotic stresses such as drought and heat disrupt key physiological processes, resulting in reduced plant development and yield. With increasing climate variability, the frequency and intensity of these stresses are expected to rise, highlighting the need for rapid and non-destructive stress detection methods, as traditional phenotyping approaches often identify stress only after significant physiological damage has occurred. This study proposes a multimodal data fusion strategy integrating hyperspectral and thermal imaging to enable early prediction of drought, heat, and combined stresses in soybean. Experiments were conducted under controlled greenhouse conditions with four treatments: control, drought, heat, and combined heat and drought stress. Three soybean genotypes (DS25-1, Williams 82, and DT97-4290) were monitored over six weeks using weekly imaging to capture temporal physiological and spectral responses. Thermal imaging quantified canopy temperature patterns linked to stomatal regulation, while hyperspectral data captured reflectance changes associated with pigment composition and leaf water status. The integration of these sensing approaches demonstrates strong potential for early, high-throughput stress detection to support breeding and precision crop management.

Community-Centric Distributed Generation Planning in Power Grids

Prudhviraj Dhanapala, Kansas State University
Early Career Researcher, Track-I (#2148878)

This work presents a constrained optimal transport (COT)-based distributed generation (DG) planning framework that jointly considers power grid operational objectives and community-level priorities. Conventional DG planning methods primarily focus on enhancing grid reliability and efficiency, often relying on aggregate metrics such as average or total consumer costs, thereby overlooking distributional inequities across households. The proposed approach models household energy costs as a distribution and employs COT to derive a cost-effective transformation toward a target energy burden allocation. The equal-distribution equivalent (EDE) is adopted as a fairness-driven target to systematically guide burden redistribution. By parameterizing the COT formulation, the framework enables systematic exploration of trade-offs between network loss minimization and equitable energy burden allocation. Simulation results on a 559-node distribution system demonstrate that the proposed method significantly reduces high-percentile energy burden and the Gini coefficient while maintaining low active power losses. Furthermore, the approach achieves improved computational efficiency compared to conventional optimal power flow-based methods, highlighting its scalability and suitability for large-scale, community-centric DG planning.

Advancement of Microbial Technologies for Sustainable Agriculture (AMiTSA)

Prasoon Diwakar, South Dakota School of Mines and Technology
Focused EPSCoR Collaborations (FEC), General Session (#2316502)

Crop production's dependence on synthetic fertilizers has become increasingly costly, driven by high energy demands and poor nutrient-use efficiency. AMiTSA, supported by NSF EPSCoR RII Track-2, is a multi-institutional collaboration between South Dakota State University, SD Mines, North Dakota State University, and Sitting Bull College, developing microbial alternatives to chemical inputs that maintain crop yields while enhancing soil nutrient cycling.The AMiTSA framework spans three research thrusts: · Identification and Evaluation: Using genomic tools to isolate native microbial consortia from regional soils and rhizospheres with capacity for nitrogen fixation, carbon cycling, phosphorus solubilization, and mineral dissolution. · Systems Characterization: Using sensor networks and modeling to quantify how soil conditions govern microbial establishment, persistence, and agronomic performance. · Scalable Delivery Systems: Engineering biopolymer formulations—including biodegradable beads from regional feedstocks—to protect microbial viability and optimize nutrient provision.The project examines adoption pathways and socioeconomic factors affecting technology uptake in rural communities. By combining microbiology, precision engineering, and field-scale analysis, AMiTSA aims to improve crop productivity and build a regional circular bioeconomy. Graduate students, undergraduates, and early-career faculty gain hands-on experience across the full scientific pipeline.

Tracing histories of disproportionate flood outcomes through document analysis

Simone Domingue, Tulane University
Focused EPSCoR Collaborations (FEC), General Session (#2418434)

The broad goal of HydroRISE project is to produce actionable knowledge to reduce future flood risks for communities in Acadiana, Louisiana; the City of Mobile, AL; and the City of Jackson, MS. As a subtask, this document analysis traces disproportionate outcomes through collection and coding of historical documents and other texts. More specifically, we identify historical factors influencing current distribution of water system hazards and infrastructure investment, and characterize planning trends and gaps in terms of distribution of water and climate hazards, and proposed and implemented mitigation measures and projects. To accomplish these research objectives, we employed a method for analyzing the content of historical documents, plans, studies, and other texts called Qualitative Content Analysis. This approach reduces numerous volumes of textual data into categories and themes that can be used to identify patterns across cases and research sites. This method is ultimately a tool that can combine with other empirical and analytical tools, as well as theoretical frameworks, to work generate new knowledge. Results from this analysis will produce information to the wider team to test modeling assumptions and generate in-depth knowledge on the diversity of drivers of flood hazard vulnerability considering unique community contexts.

Proton tunneling across Zundel cation waters occur in the transition state of kinesin ATP hydrolysis

Micquel Downs, Louisiana State University Health Services Center New Orleans
General Session (#2538311)

Proton transfer reactions within hydrogen-bonded networks of polar residues and water molecules are central to biological energy conversion and transduction, and here we investigate their role in ATP hydrolysis by kinesin motor proteins. Magnitudes of the kinetic isotope effect, temperature-independent Arrhenius prefactors, activation energy analysis, and proton inventory data together point to a mechanism in which proton quantum tunneling--rather than the classical over-the-barrier process long assumed in enzymology--generates the hydroxide nucleophile that attacks the γ-phosphate. A second proton transfer to the salt bridge completes the rate-limiting step. Together, these findings provide the first evidence of proton tunneling in an ATPase. We argue that such quantum mechanical effects may be widespread in biomolecules and offering an alternative to classical transition-state stabilization as an explanation for the rapid catalysis and mechanotransduction of motor proteins. Understanding how biological systems reliably exploit tunneling at physiological temperatures is of key importance to quantum computing science where current systems need to be cooled to cryogenic temperatures to reduce errors.

Structural and Functional Heterogeneity of Biofilm Cellulose in Uropathogenic Escherichia Coli

Pu Duan, Louisiana State University
EPSCoR Research Fellows, General Session (#251183)

Bacterial biofilms contribute to persistent infections through antibiotic resistance and evasion of host defenses, driven largely by the structural strength of their Extracellular Polymeric Substances (EPS). Despite their importance, EPS remains poorly understood at the molecular level. This study characterizes the composition, assembly, and segmental dynamics of EPS extracted from uropathogenic Escherichia coli (UPEC) biofilms using solid-state NMR (ssNMR). One-dimensional CP spectra quantified major insoluble EPS components, while 2D J-INADEQUATE established carbon–carbon connectivity enabling unambiguous cellulose assignments. 13C–31P REDOR and long-range 13C–13C correlations confirmed phosphoethanolamine-modified cellulose uniquely in wild-type UPEC. To probe macromolecular organization, we compared EPS from wild-type and ΔcsgA (curli-deficient) strains. DIPSHIFT experiments revealed site-specific cellulose chain rigidity, and relaxation measurements assessed mobility across timescales. Loss of curli altered cellulose assembly, reflected in differences in chain bundling and water accessibility.

Estimating Water Turbidity from Planet Lab's Dove/SuperDove Satellite Imagery

Shayde DuBey, University of Alaska Anchorage
Early Career Researcher, Track-I (#2344553)

The continuing melting of glaciers presents not just a problem for humans, but the animals humans rely on culturally for sustenance. The turbidity, or the measured sediment load in bodies of water, increases as glacial ice melts and carries silt into the lakes and estuaries of Alaska. This could affect the breeding rates of our salmon, arguably Alaska's most important and iconic animal. Studying variation in turbidity is difficult since Alaska spans a large area, much of which is difficult to access. In this study, we use data from the Planet Labs Dove and SuperDove satellites and calibrate the reflectance values to field data from select water bodies. We then apply these calibrated models to estimate turbidity across large regions within the Gulf of Alaska and improve salmon survival models. Understanding this linkage matters critically for fisheries management and Indigenous food security, as glacial melt accelerates and threatens traditional subsistence ways of life. To generate the necessary dataset, we developed an automated Python workflow that searches Planet's archive, filters imagery by cloud cover and season, and downloads only suitable scenes. We then extract pixel-level reflectance values from within our study polygons using a custom raster extraction tool. This approach enables us to scale local field measurements to regional turbidity patterns that directly inform salmon habitat models.

Wide-Angle Light Scattering of Irregular Aerosols: Insights from θ-Space and Q-Space Analysis

Pubuduni Ekanayaka, Desert Research Institute
Early Career Researcher, Focused EPSCoR Collaborations (FEC) (#2521432)

We present comprehensive laboratory measurements of angular light scattering by aerosolized, micron-sized, irregular particles, including aluminum oxide (Al_2O_3) abrasive powders, hematite aggregates (�-Fe_2O_3), and Arizona Road Dust (AZRD), measured over an exceptionally wide angular range (0.32°–178.6°). Scattering-derived particle diameters are shown to be consistent with intensity-weighted mean sizes, reinforcing the critical role of intensity-weighted size distributions in optical characterization. To fully resolve angular scattering behavior, we employ complementary analysis methods in θ-space (plotting scattered intensity vs. linear scattering angle) and Q-space (plotting scattered intensity vs. the magnitude of the scattering wave vector q, given as $q=2k\sin(\theta/2)$, where $k=2\pi/\lambda$, with λ being the wavelength, on a log-log scale), enabling clear identification of scattering features across forward, side, and near-backscattering regimes. Comparisons with Mie theory, based on volume-equivalent size distributions from aerodynamic measurements, demonstrate strong agreement in the diffraction-dominated forward regime but pronounced discrepancies in side- and back-scattering. These deviations highlight the influence of particle irregularity, internal structure, and absorption—particularly for hematite and mineral dust—and underscore the limitations of spherical approximations in representing real atmospheric aerosols.

Beyond the Plan: How Practitioners Navigate Prescribed Fire Decisions

Jazzelle Elias, University of Montana
Early Career Researcher, Track-I (#2242802)

Prescribed fire is widely recognized as essential for reducing wildfire severity and supporting ecological resilience, yet its use remains limited across much of the western United States. Existing research tends to frame constraints as isolated and treats risk as a technical variable, offering limited insight into how decision-makers navigate prescribed fire in practice.This study examines how land managers in Western Montana interpret and manage prescribed fire within real-world contexts. Using in-depth, semi-structured interviews with practitioners across agencies, this research explores how organizational dynamics, norms, and relationships shape decision-making. Data were analyzed using an iterative, grounded theory–informed approach.Findings suggest that prescribed fire implementation is shaped less by discrete constraints and more by ongoing processes of negotiating risk across institutional, social, and operational contexts. Decision-making involves collective risk management, strategic use of partnerships and resources, and active attention to public and organizational expectations. Participants also described a broader cultural shift toward normalized fire use, supported by peer networks.This study develops a practitioner-centered conceptual framework that positions risk as socially mediated and embedded within complex systems. The findings highlight the importance of relational and institutional dynamics in expanding prescribed fire use.

Do We Really Need LLMs for Every Case? A Resource-Optimized Hybrid System for ADRD Phenotyping

Akinwale Famotire, Medical University of South Carolina
Early Career Researcher (#2242812)

Accurate identification of ADRD patients in electronic health records is critical but demands labor-intensive manual chart review. LLMs show great promise but require labeled training data, fine-tuning, and GPU infrastructure, which are unavailable in many clinical settings. We developed a zero-training hierarchical pipeline combining UMLS semantic enrichment with evidence-based rules and LLM reasoning.Our pipeline processes clinical notes through four stages: (1) concept extraction using UMLS, (2) semantic enrichment for negation, temporal status, and experiencer identification (3) UMLS-based relevance scoring, and (4) hierarchical classification using three tiers: high-confidence positive, high-confidence negative, and LLM reasoning on ambiguous cases. We evaluated on 164 manually reviewed notes (gold standard) and 253 ICD-10-retrieved notes (silver standard), comparing against QLoRA fine-tuned Llama 3.1-8B and MedGemma-4b.Fine-tuned models performed strongly (gold AUC=0.926–0.943, F1=0.927–0.945) but demanded ~8.4 hours training and 55GB GPU memory. Our pipeline showed lower performance (AUC=0.736–0.776, F1=0.735–0.793) yet preserved high sensitivity (0.897–0.944) with no training, 0.25GB memory, no GPU, and 0.47–1.05 hours. Deterministic rules resolved >53% of notes at near-equivalent performance (AUC=0.857–0.946). Next steps include graph propagation, concept similarity search, and prompt optimization for ambiguous cases.

Advancing R&D Capacity for Space-Based Power Systems through Digital Twinning and Autonomy

Farzad Ferdowsi, University of Louisiana at Lafayette
EPSCoR Research Fellows, General Session (#2429557)

To support the long-term sustainability of humans in deep space, there is a critical need for autonomous, reliable, and resilient space-based power systems. Traditional power management faces significant hurdles due to the extreme environments of space, where communication delays and limited hardware access make manual troubleshooting nearly impossible. This project, funded by the NSF EPSCoR Research Fellows program, establishes a transformative research trajectory at the University of Louisiana at Lafayette by developing a high-fidelity "Digital Twin" (DT) framework for space-based microgrids. Unlike static simulations, this framework utilizes live, synchronous twinning to replicate physical hardware dynamics in real-time.The methodology integrates physics-informed modeling with AI-driven techniques, and Entropy-driven signal processing, to detect and diagnose faults that may occur across the system. Preliminary results demonstrate a significant improvement in known-fidelity twining as well as feature separability compared to raw sensor data. This initiative not only advances autonomous health management for space applications but also builds critical R&D capacity within the jurisdiction by training students and expanding the University's aerospace research profile.

Stabilizing Titanium Carbide MXene in Water with Montmorillonite Heterostructures

Ashan Fernando, University of North Dakota
Early Career Researcher

While $Ti_3C_2O_2$ MXenes are highly promising for energy storage, electronics, and biomedical technologies, their practical utility is limited by rapid water-driven oxidation. This study uses ab initio molecular dynamics to resolve the atomistic pathways of water attack on $Ti_3C_2O_2$ and evaluates mitigation via $Ti_3C_2O_2$–clay heterostructures with tunable compositions and interlayer counterions. Simulations reveal that bilayer $Ti_3C_2O_2$ undergoes irreversible damage initiated by water oxygen chemisorption at basal Ti sites, followed by local surface reconstruction. In clay-supported systems, the outcome is governed by interfacial electrostatics and ion–water structuring. While a Mg-substituted clay model without interlayer ions (Mg-Clay) enhances interfacial polarization and accelerates Ti–O chemisorption, a neutral Al-only clay reference (Clay) suppresses stable adsorption. Crucially, the Na-containing Mg-substituted heterostructure (Mg-Clay-Na) inhibits degradation because interlayer Na^+ forms persistent hydration shells that sequester water away from reactive basal Ti sites. Charge-density-difference maps and Bader analysis confirm a strong reduction in charge rearrangement at Ti attack sites in Mg-Clay-Na compared to bare $Ti_3C_2O_2$. These results establish a design principle for aqueous-stable MXenes: controlling interfacial ion–water organization can suppress basal-plane oxidation while preserving essential MXene functionality.

Cropland Changes and Associated Climate Feedbacks in the Mississippi Delta: Panacea or Peril?

Boniface Fosu, Mississippi State University
Focused EPSCoR Collaborations (FEC), General Session (#2316382)

The Yazoo–Mississippi Delta has experienced major land-use and land-cover (LULC) changes over the past century, with cropland expansion peaking in the mid-twentieth century followed by decline and partial reforestation. These transitions alter surface properties and may influence regional hydroclimate through land–atmosphere interactions. We combine satellite observations (MODIS), historical reconstructions (LUH2), reanalysis data (ERA5), and high-resolution PRISM temperature data to quantify cropland trends and associated changes in vegetation structure, surface energy fluxes, boundary layer dynamics, and convective potential from 2001–2022, with historical context extending to 1850. To characterize local land-surface forcing from large-scale climate variability, we conduct idealized WRF experiments in which cropland is progressively replaced with deciduous broadleaf forest under identical atmospheric boundary conditions. Observations indicate ~5% cropland decline since 2001 alongside increases in woody vegetation. Both observations and simulations show enhanced latent heat flux, reduced sensible heat flux, lower boundary layer height, and modest growing-season cooling. Convective potential increases locally, while precipitation responses remain heterogeneous and largely controlled by larger-scale atmospheric forcing.

Measuring Stream Biogeochemistry in Salmon and Non-Salmon Streams in Southeast Alaska

Elizabeth Fruechtnicht, University of Alaska
Early Career Researcher (#2344553)

This study examined nutrient stoichiometry and dissolved organic carbon characteristics across 13 streams around Juneau, Alaska, to better understand how salmon presence influences stream biogeochemistry. We used dissolved organic carbon (DOC) concentration, UV absorbance, and laboratory bioassays to evaluate temporal variability in DOC composition and bioavailability between streams with and without salmon. We quantified DOC, total dissolved nitrogen (TDN), and soluble reactive phosphorus (SRP) ratios to determine how nutrient stoichiometry differs across watersheds and over time. Streams were grouped based on observed adult salmon presence, and water samples were collected across three sampling dates during summer and fall. Laboratory incubations assessed bioavailable dissolved organic carbon (%BDOC), and absorbance was measured to estimate dissolved organic matter aromaticity (SUVA254). Nutrient stoichiometry was evaluated using ternary plots of DOC, TDN, and SRP ratios. Streams where spawning salmon were observed showed elevated nitrogen and phosphorus concentrations relative to streams without salmon, resulting in more balanced nutrient stoichiometry during peak salmon presence. %BDOC showed minimal variation between stream types. However, SUVA254 decreased significantly during incubations when salmon were present, indicating a shift in dissolved organic matter quality.

Using survival analysis to examine mortality patterns in restored Acropora species in Guam

Mark Ira Galang, University of Guam
E-RISE RII, Early Career Researcher (#2438132) (#2445825)

Coral reefs are vital marine ecosystems that provide coastal protection, biodiversity, and economic benefits, however they are experiencing rapid global decline driven by climate change, disease, and other anthropogenic stressors. This study evaluates the survival of outplanted Acropora corals in Guam as part of ongoing restoration efforts led by Laurie Raymundo, PhD at the University of Guam Marine Laboratory. From 2021 to 2025, over 3,000 coral fragments representing seven Acropora species were outplanted at sites in Piti and Merizo using rope, pavement, and C-frame methods. We applied three survival analysis approaches—Kaplan–Meier for right-censored data, Turnbull for interval-censored data, and Cox proportional hazards modeling to incorporate species, site, and method as covariates to estimate survival probabilities and identify factors influencing mortality risk. Results show substantial early mortality within the first year post-outplanting, with pronounced differences between species and locations. Piti corals exhibited generally higher survival than those in Merizo, and hazard ratios from the Cox model quantified relative risks among species, highlighting both resilient and vulnerable taxa. These findings offer critical insights to optimize species selection, site choice, and restoration strategies to enhance the success of coral restoration initiatives on Guam.

Biomass to Toughness: Scalable Core-Shell Strategy for End-of-Life Compostable PLA Blends

Vivek Garg, Iowa State University
Early Career Researcher, Track-I (#2242763)

Most plastics remain petroleum-derived because they are inexpensive and high-performing, but their chemical inertness and limited recyclability drive long-lived environmental accumulation. Polylactic acid (PLA) is a leading bio-based, industrially compostable alternative; however, its brittleness and low impact strength limit durable applications. Most commercial impact modifiers are petroleum-based and non-compostable, creating a performance–compostability trade-off.Here we demonstrate a scalable rubber-toughening strategy for PLA using fully bioderived core–shell polymers (CSPs). The CSPs comprise a crosslinked, rubbery acrylate core derived from glycerol and a (meth)acrylate shell engineered to promote compatibility with the PLA matrix. Both core and shell incorporate cleavable linkages designed to break down under composting-relevant conditions, enabling toughening without compromising compostability goals. CSPs were synthesized via an energy-efficient, scalable emulsion-based process from biomass-derived precursors and processed into blendable particles.When incorporated into PLA at low loadings, CSPs produce substantial improvements in mechanical performance, increasing toughness and impact resistance relative to neat PLA. This bioderived, scalable additive platform addresses the performance–compostability trade-off and provides a practical pathway to broaden PLA adoption in mechanically demanding applications while reducing dependence on petroleum-based plastics.

STRENGTHENING OUR COMMUNITIES THROUGH SMARTER, MORE RESILIENT NETWORKS: A GRAPH LEARNING PERSPECTIVE

Priyanka Gautam, Kansas State University
Early Career Researcher, Track-1 (#2148878)

Critical infrastructure — power, water, stormwater, and transportation — forms interconnected networks vital for public safety. Failure in one cascades across others, threatening hospitals and communities. Traditional approaches analyze systems in isolation, overlooking interdependencies, network evolution, and causal failure drivers. This research develops a scalable framework addressing: 1) representing infrastructure and identifying critical components; 2) capturing network evolution; 3) understanding causal drivers of failure propagation; and 4) building explainable models for actionable interventions. We combine Graph Neural Networks (GNNs) and Hetero-Functional Graphs (HFGs). HFGs model interdependencies across infrastructure systems from operational data, while GNNs capture network structure. We developed GP-GNN for critical node identification and CO-GNN for link classification, scalable across large networks. A GNN–BiLSTM tracks temporal evolution, while Wasserstein-based embeddings (WEGL) detect structural shifts, triggering reanalysis only when behavior changes.GP-GNN and CO-GNN achieve 97–99% node accuracy and 98–99% link accuracy, at twice the speed of simulation. WEGL reduces recomputation by 65–95%. Causal methods identify root failure drivers and counterfactual explainability yields minimal-change operator recommendations — enabling planners to anticipate failures, understand root causes, and implement targeted interventions for resilient communities.

Development of Energy Engineering Solutions for Tribal and Similar Rural Communities

Adam Gladen, North Dakota State University
Focused EPSCoR Collaborations (FEC), General Session (#2316355)

Tribal and surrounding communities often consist of rural, spread-out populations, leading to energy systems that may be less resilient and more costly. This project works with tribal communities to develop energy solutions that reflect the values and needs of these rural communities. An inter-related suite of technologies are being explored to provide potential solutions for tribal and similar rural communities, including scalable photovoltaic-thermal systems for heat and power; renewable fuels and power production from waste materials and non-food agricultural resources in small scale systems; and power microgrid technologies with on- and off-grid modes depending on demands and surpluses. Surveys have been conducted of communities to provide guidance on community values for energy solutions. Developments include new designs for transcritical CO2 PV heat pump evaporators and systems, a model of microgrids of tribal community with various energy systems, and designs for skid-mounted demonstration units for renewable fuel systems. Surveying efforts have provided insights, such as preferences for low-cost, high reliability solutions. Future outcomes are expected to include TEA of the technologies, advanced microgrid planning, and technology roadmaps for the communities. This work includes an array of broader activities designed to increase the success of rural and native students at mainstream research universities, and professional development for K-12 teacher.

Beeting the heat: Inside look of irrigation and digital Ag intern

XayVian Gonzales, University of Nebraska-Lincoln
Early Career Researcher, Focused EPSCoR Collaborations (FEC) (#2420405)

My poster highlights my internship experience at the Panhandle Research & Extension Center with the Irrigation and Digital Agriculture Lab. Over the summer, I developed hands-on skills in agricultural technology, focusing on the assembly, operation, and troubleshooting of thermal and RGB camera systems used to monitor sugar beet crops. I assisted in building and maintaining these systems through soldering, circuit assembly, 3D printing custom components, and diagnosing issues in both lab and field settings. In addition to research support, I contributed to irrigation system labor, working with both drip and linear systems to identify and resolve mechanical issues. Fieldwork included maintaining irrigation infrastructure and assisting with crop upkeep. These experiences strengthened my perseverance and deepened my respect for agriculture and food production. They also prepared me for a future in mechanical engineering by strengthening my problem-solving skills and ability to work through complex, real-world challenges. Additionally, collaborating with a team helped me develop stronger communication and teamwork skills, which I will carry with me into my future career. This internship enhanced my technical skills in electronics, data analysis, and coding while providing valuable insight into agricultural research. I am grateful for the support of EPSCoR, which made this opportunity possible and allowed me to grow both professionally and academically.

High-Resolution Root Imaging Shows Bacterial Seed Consortium Improves Soybean Roots Under Drought

Sandeep Gouli, Louisiana State University AgCenter
Early Career Researcher (#2418232)

Drought resilience in soybean is strongly constrained by the plant's ability to sustain root growth and biomass under water limitation. We evaluated a multi-strain bacterial seed consortium (Setm4) through seed treatment as a drought mitigation strategy based on greenhouse trials and high-resolution root imaging along with microbiome profiling to provide supporting context. Under controlled drought conditions (15-20% soil moisture), Setm4-treated plants maintained greater shoot biomass than untreated and carrier controls. High-resolution root imaging showed significant increases in total root length, root tips, root perimeter, surface area, and root volume, indicating enhanced soil exploration and resource acquisition, while root diameter and branching frequency remained largely unchanged. Growth-chamber experiments using 'rhizoboxes' at the drought condition (10-15% soil moisture) further confirmed increased secondary root formation and stem thickening in treated plants. Microbiome network analysis revealed stronger positive bacterial interactions and a higher positive-to-negative interaction ratio in seed treated conditions under drought, suggesting improved microbial network stability. Overall, root imaging-guided phenotyping provides a robust framework to validate microbial seed consortia that enhance soybean drought resilience through improved root system architecture and cooperative rhizosphere and endosphere microbiomes.

A Behavioral Framework for Informing Infrastructure Planning and Hazard Resilience

Madison Graham, The University of Kansas
Early Career Researcher, Track-I (#2148878)

Infrastructure planning for tornado resilience requires integrating insights from both physical systems and human behavior. Behavioral data can provide empirical insights into protective action decisions under varying accessibility constraints. We present findings from a statewide survey of Kansas residents examining how access to community tornado shelters influences protective action decisions. Using a behavioral decision task, participants evaluated sheltering choices as travel distance to a community shelter increased from 1 to 30 minutes. Results indicate that increasing distance reduces the likelihood of traveling to a community shelter, illustrating how behavioral responses change under increasing constraints (i.e., accessibility). These behavioral insights are being used to inform interdisciplinary resilience efforts within the ARISE project, including agent-based modeling approaches used to evaluate community shelter planning strategies. Our work highlights the value of integrating behavioral data into infrastructure modeling to support effective hazard preparedness planning.

The Effect of powder cross-contamination in dissimilar Multi-Metal LPBF printing

Michael Gyan, Southern University System
Early Career Researcher, Focused EPSCoR Collaborations (FEC) (# 2118756)

Laser Powder Bed Fusion (LPBF) has proven effective for fabricating single-material components. However, extending the process to multi-material systems remains challenging due to issues such as dissimilar material compatibility, interfacial bonding, and thermal mismatch. This study investigates Multi-Material LPBF (MM-LPBF) for producing dissimilar joints between a 316L stainless steel lattice structure and a CuCrZr alloy. A vertical interfacial bonding strategy was attempted by fabricating a 316L plate directly beside a CuCrZr plate. Under the current processing parameters, successful metallurgical bonding was not achieved. During fabrication, noticeable cross-contamination occurred between the two powder materials. The influence of this cross-contamination was systematically analyzed, focusing on (i) mechanical behavior of 316L regions affected by CuCrZr contamination and (ii) thermophysical properties of CuCrZr regions influenced by stainless-steel particles. The findings highlight the significant role of powder cross-mixing control in determining joint integrity and overall material performance. Based on the study results, two targeted adjustments are proposed: reducing fume extraction speed to limit cross-mixing and removing the contour-offset strategy to improve interfacial bonding. These insights provide guidance for optimizing MM-LPBF processing parameters and improving the printability of dissimilar 316L-CuCrZr material systems.

Effects of Biochar Application on Peanut Physiology and Yield Under Field Conditions

Sajid Hanif, Auburn University
Early Career Researcher, EPSCoR Research Fellows (#2316278)

Biochar is progressively being explored as a soil amendment due to its potential to improve soil properties and plant performance under different environmental conditions. This study evaluated the effects of biochar application on peanut physiology and yield under field conditions. The experiment was conducted during the 2024 and 2025 growing season at the WGREC in Headland, Alabama. Six peanut genotypes were planted using a randomized complete block design with three replications. Four biochar rates were evaluated: 0, 3, 6, and 12 tons ha^{-1}. Several physiological and agronomic measurements were collected to determine plant responses to biochar application. Gas exchange measurements were used to assess leaf photosynthesis and stomatal conductance during the growing season. Peanut yield was measured at harvest to evaluate treatment effects on productivity. Biochar application enhanced key physiological processes in peanut plants. Plots receiving biochar generally showed higher photosynthetic rates and greater stomatal conductance compared with the control treatment, but different cultivars responded similarly. These improvements in gas exchange were associated with increased peanut yield. Although biochar treatments improved plant performance relative to the control, differences among the tested application rates were relatively small. Overall, the results suggest that biochar has the potential to enhance peanut physiological activity and yield under field conditions.

The Role of the State in Co-Opting Environmental Justice Narratives in the Yazoo Pumps Project

Dean Hardy, University of South Carolina
Focused EPSCoR Collaborations (FEC), General Session (#2316382)

The Yazoo Pumps Project is part of a broader flood mitigation infrastructure project proposed in the Yazoo-Mississippi Delta under the 1941 Flood Control Act by US Congress following the Great Mississippi Flood of 1927. Since the 1970s, the US Environmental Protection Agency denied the US Army Corps of Engineers a build permit citing significant environmental impact that would occur to wetlands in the study area on three final Environmental Impact Statements (EIS). Yet, in January 2025, the USEPA announced an affirmative record of decision for the 2024 EIS. Interestingly, since 2018 many project proponents have framed the pumps as an environmental justice (EJ) issue, citing the disproportionate population of low income, African American residents in the region. However, anti-build environmental organizations and some journalists have framed the issue as one of environmental justice since at least the early 2000s by arguing the project would reduce flooded land thereby increasing arable land and associated pesticide use, in turn leading to increased health issues for Delta residents. Given these contradictions, we focus this paper on the state, specifically the Corps, and ask how does it define and operationalize EJ? Here we present preliminary results from content and discourse analysis of the final EISs. We identify and define several rhetorical EJ categories used by the Corps in their EIS language and contrast these categories against those defined within EJ Scholarship.

A Roadmap for Coastal Careers: Designing an Interactive Tool to Explore Workforce Pathways

Matt Henderson, University of Delaware
E-RISE RII, General Session (#2446056)

As the lowest lying state in the US, Delaware is a hotbed for coastal ecosystem transformation, with recent years seeing increased salinity in surface water, groundwater, and soils. Considering this change and its threat to our land and natural resources, it is critical to attract, train, and retain a cross-disciplinary workforce capable of implementing measures that combat the worst effects of saltwater intrusion. However, the pipeline driving STEM students into relevant professions is often described as “leaky,” especially for students from underrepresented communities (Bennett et al., 2020).In this presentation, we describe the efforts and resources informing the development of an interactive online tool that shows career pathway options for students across Delaware’s five colleges and universities, using existing degree programs as on-ramps for jobs addressing intrusion issues. We draw from information in state labor reports and data from the Steppingblocks, an evidence-driven tool that compiles institutional data and graduate outcomes. We will share how we will leverage existing research infrastructure to build a stronger, broader workforce, and our plans to disseminate this tool across institutions and relevant events. In alignment with our project's vision, this tool will help develop a workforce knowledgeable on SWI and climate issues, helping generate meaningful, transformative outcomes for Delaware's coasts and a sustainable future for its adjacent communities.

Co-Producing a Flood Hazard Social and Environmental Vulnerability Index for South Central Louisiana

Selena Hinojos, University of Louisiana at Lafayette
Early Career Researcher, Focused EPSCoR Collaborations (FEC) (#2418434)

Flooding is a recurring and intensifying hazard in South-Central Louisiana. This region presents a complex environmental and socioeconomic landscape that amplifies the impacts and burdens experienced by residents during floods. Therefore, measuring how different communities can prepare for, respond to, and recover from floods is critical to informing more equitable risk assessments and adaptation plans. While approaches to incorporating social vulnerability into flood hazard mitigation plans and risk assessments vary, a common approach is to use social vulnerability indices generalized across multiple hazards and broad geographic extents. Recognizing these limitations, this research co-created a Flood Hazard Social and Environmental Vulnerability Index (FH-SEVI) with local non-profits, community groups, and regional-to-state stakeholders across South-Central Louisiana. Through a collaborative workshop and focus group discussions, participants identified and weighted flood-specific social and environmental characteristics to develop a regionally relevant FH-SEVI. The index was further refined with participant input and compared with other widely used SVIs. This research highlights key themes in flood vulnerability and demonstrates an approach to calculating and translating this information into a usable format for stakeholders. Overall, the FH-SEVI demonstrates how local knowledge can help address vulnerabilities and support more targeted, effective adaptation strategies.

Investigating Root System Architecture and Grain Quality with Image Processing and Analysis

Kevin Hoffseth, Louisiana State University AgCenter
Focused EPSCoR Collaborations (FEC), General Session (#2418232)

In order to better understand the effect of drought and heat related stressors on soybean crops, next-generation, non-invasive digital imaging and image processing examines the dynamics of root system architecture (RSA) at various stages of soybean growth, along with post-harvest grain quality. The sample (root system) was fastened in a custom holding fixture for imaging, allowing variable rotation under stereoscopic imaging, using two computer-controlled cameras with controlled lighting. This enabled both 2D imaging and reconstructed 3D imaging. Multiple grain samples were semi-autonomously imaged rapidly and repeatably on a custom fabricated rapid imaging machine. After grain segmentation, quality and trait measurement was assessed from measures based on color, shape, and texture. Visual soybean grain quality and RSA analysis results were obtained from imaging of Louisiana soybeans. Haralick texture values were calculated along with shape and color factors to quantify the visual damage and economically linked quality of soybean grains. For RSA analysis, processing of the image and segmentation of the root system preceded skeletonization. Skeletonization enabled analysis of the extent and connectivity of the root network, along with select features. High-quality imaging of soybean RSA and grains paired with development of semi-automated image processing and analysis tools shows promise in future comparison of soybean cultivar phenotypes in response to HS and DS.

Industrial Byproducts, Advanced Manufacturing and Multiscale Modeling for Next-Gen Construction

Maryam Hojati, University of New Mexico
Focused EPSCoR Collaborations (FEC), General Session (#2418357)

This project presents an integrated approach to convert industrial byproducts, including calcium-rich residues and CO_2 streams, into engineered materials for construction applications. The research combines material synthesis, additive manufacturing, multiscale modeling, and building-scale implementation to create a unified framework linking material development to real-world use. At the materials level, calcium is extracted from industrial residues and reacted with CO_2 to produce carbonate-based materials with controlled properties. These materials are characterized and evaluated as functional components in cementitious systems, and their integration into extrusion-based 3D printing is investigated, with emphasis on controlling rheological properties. A multiscale modeling framework is developed to predict material performance by linking thermodynamic hydration simulations to mechanical behavior. This enables estimation of strength and stiffness based on composition and reaction progress. At the implementation level, building-scale energy modeling is conducted using residential case studies in New Mexico to evaluate potential applications in retrofit strategies. The project delivers new material formulations, validated manufacturing approaches, predictive modeling tools, and application-driven insights, providing a comprehensive pathway for integrating industrial byproducts into advanced construction systems.

Multi-Hazard Socio-Ecological Vulnerability in the Yazoo-Mississippi Delta

Md Shahnewaz Hossain, Mississippi State University
Focused EPSCoR Collaborations (FEC) (#2316382)

The Yazoo-Mississippi Delta (YMD) faces an intricate set of multi-hazard risks, including flooding, drought, tornadoes, and severe winter events, compounded by entrenched socio-economic inequalities. This study introduces a novel multi-hazard, socio-ecological vulnerability framework, leveraging the Global Delta Risk Index (GDRI) to integrate social, ecological, and hazard exposure dynamics across multiple scales. Using census tract-level socio-economic data and watershed-scale ecological metrics, vulnerability is assessed through dimensions of susceptibility and adaptive capacity or resilience. Hazard exposure, incorporating flooding, drought, tornadoes, and winter events, is mapped using spatial datasets on event frequency and intensity.The framework synthesizes these components into a composite vulnerability index, followed by spatial hotspot analysis to identify critical clusters of elevated risk. A key innovation is the explicit examination of the convergence and divergence between socio-economic and ecological vulnerability surfaces. Preliminary results reveal hotspots in counties like Washington, Leflore, and Bolivar, where high socio-economic susceptibility converges with ecological degradation and frequent hazard exposure, exacerbating risks. In contrast, areas of divergence highlight regions where social and ecological vulnerabilities do not spatially align, challenging traditional risk assumptions and revealing pockets of resilience.

Community Engagement, a Key for Weather Resilience

Nur Hossain, University of Iowa
Early Career Researcher (#2420405)

Iowa, located in the Corn Belt region, is home to some of the most fertile agricultural land in the world. However, agriculture-based communities in the state are increasingly experiencing extreme weather events, including intense rainfall, prolonged droughts, severe storms, stronger winds, and shifting seasonal patterns. These climate-related challenges threaten agricultural sustainability and require community-based approaches to strengthen weather resilience. In response, the social science team of the DARE (Data-Advanced Research and Education) project has implemented multiple community engagement initiatives in Iowa, including summer camps, qualitative research, town hall meetings, and weather and soil sensor deployment across farmlands.The DARE summer camp engages students from Iowa, Kansas, Nebraska, and Arkansas in learning about weather, technology, agriculture, community-based scientific research, and advocacy. To assess learning outcomes, surveys are conducted before and after camp participation. Findings from last year's survey (N = 29) showed notable improvements in participants' technical and professional skills, particularly in irrigation scheduling, weather and agricultural knowledge, soil moisture monitoring, career awareness, and understanding of community resilience. Additionally, a qualitative study explored how individuals involved in agricultural production perceive and respond to extreme weather through 22 semi-structured interviews conducted in Iowa. Participants described increasingly unpredictable weather, particularly stronger winds, tornadoes, derechos, inconsistent rainfall, drought, and declining snowfall, as major concerns. In response, farmers adopted both short-term adaptation strategies, such as irrigation and rainwater capture, and long-term approaches, including regenerative farming and crop diversification. Farmers primarily relied on peer networks, farmer organizations, and digital platforms to obtain weather-related knowledge and make farming decisions.

Advanced Wireless - Integration with Infrastructure System

Dryver Huston, University of Vermont

Focused EPSCoR Collaborations (FEC), General Session (#2119485)

This poster summarizes a five-year effort to research advanced wireless methods to sense, assess and manage large built infrastructure. This is a collaborative effort with the University of Vermont, University of Maine, and Vermont State University. The vision is to conduct combined research and capacity building effort addressing the use of through research into Advanced Wireless interactions with Internet of things (IOT) Sensing and engineered Infrastructure (AWISI) and micro-robotic techniques. This project combines expertise in collaborating institutions to engage in fundamental research with infrastructure development to address critical and under-explored issues of importance to the region by focusing on three main areas: 1. Advanced wireless research enabled by AI, IOT and micro-robotics, 2. Infrastructure use cases covering coastal structures, underground infrastructure, highway structures, rapid prototype evaluation of new structures, and geotechnical formations. The goal is to develop these use cases into Engineering Infrastructure Testbeds (EITs) that support research of advanced wireless methods. And 3. Workforce development and outreach that integrates stakeholders, students at K-12 up through postdoc levels, and junior faculty in all aspects of the research efforts.

Teleport to Kachemak Bay: the Bay of Abundance

Naomi Hutchquist, Alaska EPSCoR
General Session, Track-I (#2344553)

Dive into the cold waters of Kachemak Bay and race against the clock to find as many clams as possible! The data visualization team with the Interface of Change (IoC) project is developing a virtual reality game that takes the user to a remote beach in Kachemak Bay, where the user will do just that. This simulation supplements traditional printed education materials, providing an interactive, immersive platform for the user to explore site-specific research through experience. The data visualization team develops creative strategies to showcase IoC activities and research findings. Target audiences include K-12 students, communities in research areas, and the public. This simulation is used in education and outreach events by a varied demographic; adults and children, people with no prior knowledge of the project, as well as project members and EPSCoR affiliates.We modeled an immersive research site based off of Port Graham, Alaska, one of the project sites in Kachemak Bay. The game environment is a 360 photo taken at the site and the beach is hand textured to look as realistic as possible. IoC research experts weighed in on aspects of the game, and we plan on incorporating a feedback question at the end of the game to gather information on the usefulness of the game as a STEM learning tool. The game has been an inspiration to students interested in technology and game-based learning, and could prove more effective and memorable than non-immersive education materials.

From Documents to Discovery: AI for Research Intelligence and Collaboration Mapping

Raisa Islam, New Mexico Tech
E-CORE RII, Early Career Researcher (#2435071)

This work presents an integrated AI-driven framework for transforming fragmented research documents into structured, queryable knowledge to support scalable discovery and collaboration. Within the RIO-NM initiative, the system addresses a key limitation in research ecosystems: the manual and inefficient identification of related work and collaborators across distributed, unstructured sources.The developed pipeline automates the lifecycle of research intelligence, including author and institute-based paper discovery, automated document acquisition, retry scheduling for failed downloads, and email notifications for inaccessible content. Extracted documents undergo metadata parsing and normalization into structured representations stored in a database for indexing, querying, and analysis. Building on this foundation, the framework integrates large language model adaptation and retrieval-augmented generation (RAG) to support semantic search and question answering over institutional research corpora.By converting static documents into dynamic knowledge bases, this system improves research visibility, reduces manual effort, and enhances interoperability across institutions, establishing a scalable foundation for AI-assisted research intelligence and collaboration mapping.

Economics of Coastal Climate Adaptation in Atlantic Coastal Communities

Herbert Jenya, University of Rhode Island
Early Career Researcher, Focused EPSCoR Collaborations (FEC) (#2418394) (#2418395) (#2418396)

Coastal communities across the Atlantic face mounting economic pressures from flooding, sea level rise, and groundwater salinization. Yet local planners often struggle to identify adaptation strategies acceptable to diverse stakeholders. As part of the RISCC project, our team quantifies the economic impacts of coastal hazards, examines public preferences for adaptation in urban and rural contexts, and explores alternative incentive designs. First, using a hedonic pricing model, we estimate how flood risk and salinization affect residential property values and local tax bases, with attention to equity across income and demographic groups. Second, we use a discrete choice experiment administered to coastal residents in Delaware, South Carolina, and Rhode Island to measure willingness to pay (WTP) for adaptation strategies including managed retreat, natural infrastructure, and engineered structures. Third, economic laboratory and field experiments examine how incentive designs shape homeowners' and farmers' decisions to participate in voluntary adaptation programs. Expected outcomes include property value loss estimates from flood exposure, WTP for risk reduction across socioeconomic groups, and behavioral insights into participation in adaptation programs. Findings will inform equity trade-offs and community-specific preferences, supporting effective, equitable coastal resilience strategies.

A Multi-Channel Approach to Participant Recruitment: The ASPIRE Health Scholars Model

Lanena John, Gulf South Center
E-CORE RII, General Session (#2316351)

The NSF Track II ASPIRE Project includes a community-centered research effort focused on understanding microplastic exposure and its potential impacts on health and the environment in the Gulf South, including health conditions, lifestyle behaviors, and environmental factors among adults in designated regions of Mississippi and Alabama. To empower communities and foster participatory research, the Health Scholars program was established to facilitate survey distribution and develop community scholars. The five-month program accepts three to four scholars annually who are recruited via social media outreach, community events, and institutional and external listservs. Following recruitment, scholars completed structured training to support human subjects research involvement, including active and passive recruitment strategies. Scholars completed monthly activity logs for accountability and to assess reach and engagement. Preliminary data will describe scholar recruitment by strategy and their contributions to survey dissemination, providing insight into the utility of different recruitment approaches and the feasibility of a decentralized, scholar-supported model. To date, direct mail outreach reached 2,557 individuals, while Health Scholars engaged 2,462 individuals. Completed surveys included 39 participants recruited via direct mail and 170 via Health Scholars. Findings from this study highlight the role of community members in supporting research participation.

Scaling Predictive Models for Germanium Crystal Growth

Mahesh Kamepalli, Dakota State University
E-RISE RII (#2437418), Early Career Researcher

Machine Learning (ML) is widely used across scientific and engineering domains, yet most models fail to reach production, highlighting the need for Machine Learning Operations (MLOps) to manage the end-to-end lifecycle. This need is especially critical in scientific ML, where data is limited, noisy, and costly, and results must remain reproducible and auditable. This work proposes a scalable MLOps framework for germanium crystal growth research that unifies data ingestion, preprocessing, model training, experiment tracking, and deployment into an automated workflow, incorporating version-controlled preprocessing, MLflow-based experiment tracking, modular training pipelines, automated model selection and registry management, and an API-driven interface for domain scientists.

A Low-Cost Lorawan-Based Iot System For Real Time Soil Moisture Monitoring In Crop Field

Suraj Karkee, Kansas State Unviersity
Early Career Researcher (#2420405)

Efficient water management in agriculture is limited by the lack of real-time soil moisture data. Advances in IoT and wireless technologies offer solutions, but challenges like cost, energy use, range, and durability remain. Low-power, long-range LoRaWAN networks combined with low-cost soil moisture sensors provide reliable, energy- and cost-efficient data collection for agricultural and remote environments.Calibrated low-cost VH400 soil moisture sensors, connected to an Arduino with a Bosch BME280, formed the system I Canopy for real-time soil moisture monitoring. Data from the sensor nodes is transmitted via LoRaWAN to a Sentrius™ RG1xx LoRaWAN-enabled gateway, which forwards the data to The Things Stack.The system allows continuous, real-time monitoring of soil moisture and environmental conditions. Calibrated sensors provided accurate and real-time soil moisture measurements across different soil type. The use of LoRaWAN enabled low-power data transmission while maintaining stable long-range connectivity. The system successfully transmitted data from remote field locations to The Things Stack without interruption, allowing continuous real-time monitoring on local devices. This study demonstrates a reliable, low-cost, and energy-efficient IoT solution with integrated soil moisture sensors for real-time monitoring, offering potential to improve water use efficiency and support scalable precision agriculture practices.

Lithium Diffusion in High-Purity Germanium for Advanced Detector Fabrication in Rare-Event Searches

Anupama Karki, University of South Dakota
E-CORE RII, Early Career Researcher (#2437416)

Lithium-diffused n+ contacts are widely used in high-purity germanium (HPGe) detectors, yet precise control of lithium transport and long-term stability remain key challenges for advanced detector geometries. Previous measurements of lithium diffusion in germanium were primarily performed on non-high-purity material, limiting their applicability to modern detector-grade crystals.In this work, we revisit the lithium diffusion coefficient in USD-grown p-type HPGe using controlled deposition and thermal processing. Depth-resolved Hall measurements are used to extract carrier concentration profiles and determine the diffusion coefficient as a function of temperature. The resulting parameters provide updated guidance for controlling diffusion depth, annealing conditions, and etch-back processes in detector fabrication.Using these optimized diffusion conditions, we fabricated an inverted coaxial point-contact (ICPC) HPGe detector and performed initial electrical and spectroscopic characterization. In addition, a long-term study of the room-temperature evolution of lithium-diffused layers is underway to evaluate contact stability over time.These results provide practical insight into achieving reproducible, low-leakage lithium contacts and demonstrate their applicability in advanced detector geometries for next-generation rare-event experiments.

Libraries as Resilience Infrastructure: Reducing Heat-Related Mortality Across U.S. Counties

Ali Khaleghinia, University of Kansas
Early Career Researcher, Track-I (#2148878)

Extreme heat is the deadliest weather-related hazard in the United States. In the U.S., the elderly, homeless, and Black populations are among those most at risk of heat-related mortality. U.S. municipalities often utilize short-term, formally designated cooling centers as interventions to mitigate risk, but these facilities can be difficult to access and are often underused. This study evaluates whether public libraries, free, familiar, climate-controlled spaces with predictable hours, function as everyday “cooling infrastructure” that reduces heat-related mortality. We assemble a national county-level panel covering 3,009 U.S. counties from 2018–2023, linking heat deaths from CDC WONDER with facility-level Public Libraries Survey data. We operationalize library availability as total library square footage multiplied by annual operating hours, aggregated to the county, and estimate a correlated random effects model, controlling for demographic vulnerability, socioeconomic capacity, political context, and annual extreme-heat exposure. Results indicate that greater library availability is significantly associated with fewer heat-related deaths. Substantively, increasing library availability by the equivalent of keeping 100,000 square feet open for an additional 1,000 hours annually is associated with approximately 35.5 fewer heat deaths per year nationwide, about a 3.7% reduction relative to the 2018–2023 annual average.

Community Preferences for Forest Fuel Reduction and Restoration : A Meta-Analysis

Abdul Khaliq, New Mexico State University
E-RISE RII, Early Career Researcher (#2445934)

Forest fuel reduction and ecological restoration are widely implemented in the United States to reduce wildfire risk, improve watershed conditions, and strengthen ecosystem resilience. However, practices such as thinning, prescribed burning, mastication, and lop-and-scatter require substantial public investment and may involve trade-offs affecting nearby communities. This study conducts a meta-analysis of economic valuation estimates related to forest fuel reduction and restoration programs in the United States. A systematic review identified 20 peer-reviewed studies that report willingness to pay (WTP) for restoration programs or willingness to accept (WTA) compensation for potential management impacts. From each study, information was extracted on valuation method, treatment type, ecosystem services considered, geographic location, and reported monetary estimates. The synthesis reveals substantial variation in valuation outcomes depending on treatment attributes, perceived wildfire risk reduction, and ecosystem services such as improved wildlife habitat, watershed protection, and landscape quality. Differences in valuation methods and program design also influence estimated WTP and WTA values. By consolidating existing evidence, this study provides an understanding of public economic preferences for forest fuel reduction strategies and offers insights that can support policy evaluation and restoration investment decisions in fire-prone landscapes.

Android Malware Detection: Opcode analysis, Data Augmentation, and Zero-Day Evaluation in Real-Time

Donghoon Kim, Arkansas State University
E-RISE RII, General Session (#1946391)

Android malware has significantly evolved, becoming more sophisticated and widespread. Its growing complexity presents a major challenge for real-time detection and zero-day

threat mitigation, requiring advanced approaches like machine learning-driven methods. The advancement of machine learning has improved Android malware detection performance; however, deep learning models often demand large training datasets and extended training times, posing challenges for computational power and real-time detection feasibility. To address these challenges, this study proposes opcode-based features and data augmentation techniques to enhance preprocessing efficiency and detection performance. Furthermore, custom ransomwares are developed and evaluated within our real-time detection framework to assess the proposed model's effectiveness in mitigating zero-day attacks. The experiments perform multi-class classification using the publicly available CICMalDroid2020 dataset. The results demonstrate that the proposed opcode-based features and data augmentation techniques, when combined with machine learning models, enhance detection performance while reducing preprocessing time for effective Android malware feature extraction. Furthermore, the proposed models show strong resilience against zero-day attacks, enhancing their applicability in real-world environments and real-time.

Indigenous Oral Histories and Climate Modeling Yield New Perspectives on the Oklahoma Dust Bowl

Farina King, University of Oklahoma
Focused EPSCoR Collaborations (FEC), General Session (#251432)

This study challenges dominant Dust Bowl histories that center on white settler narratives and overlook the experiences and ecological knowledge of Oklahoma Tribal Nations. We integrate Indigenous oral histories with climate modeling to develop a more inclusive understanding of the event. Archival materials, interviews, and traditional ecological knowledge (TEK) from Native communities are compared with mainstream accounts, while reconstructed climate fields, including wind intensity, drought indices, soil moisture, and dust flux, are used to assess how atmospheric conditions align with reported experiences. By adjusting anthropogenic land-use factors in the model, we examine how land degradation and dust emissions may have shaped local conditions described in Indigenous narratives. These accounts reveal distinct themes, including culturally informed land-stewardship practices, differing perceptions of dust severity, and disproportionate impacts on health, mobility, and cultural lifeways. Integrating lived experience with modeled climate conditions highlights both convergence and divergence between Tribal and settler perspectives. More broadly, this framework demonstrates the value of TEK in reconstructing historical climate events and underscores the need for more inclusive environmental histories.

The Open Newsroom: Engaging STEAM undergraduates in an inquiry-based experience via local news

Shaun Kirby, Rhode Island EPSCoR
E-CORE RII, General Session (#2433276)

Student reporters across the U.S. are solving the information needs of local communities, but no such endeavor dedicated specifically to issues around science exists in RI. The Open Newsroom, organized by RI-NEST and URI's Metcalf Institute, seeks to fill this gap. Working as local journalists, students in this intensive 12-week, paid fellowship select a scientific topic/issue of interest and report on its relevance among Rhode Island communities. Engaging with a variety of academic, governmental, and non-profit organizations to capture how science and research relate to, and impact, local communities, giving voice to members of the public who otherwise are left out. In our first cohort, students engaged with a dozen local organizations and reported on issues such as brownfield sites in urban communities and how air quality impacts youth in the Providence area. The Open Newsroom has been designed within an inquiry-based learning framework. Our focus is not to train students as future journalists, but to offer an immersive experience from which students gain important skills: evaluating credibility of information, interviewing professionals and community members, and developing transparent yet engaging ways of communicating science to multiple public audiences. Students develop critical inquiry skills that support transdisciplinary, use-inspired research collaborations into the future, as well as deep connections with communities that may foster future research partnerships.

Deformation Field Assisted Laser Directed Energy Deposition to Tune Material States in Nitronic 60

Uday Venkat Kiran Kommineni, Iowa State University
Early Career Researcher, EPSCoR Research Fellows (#2332471)

Laser-directed energy deposition (L-DED) is particularly attractive because of its high deposition rates, design flexibility, and scalability to large-scale structural components, but repeated thermal cycling can lead to detrimental residual stresses and heterogeneous microstructures. In this work, interlayer ultrasonic impact peening (UIP)- deformation field-assisted L-DED was employed to develop nitrogen-strengthened austenitic stainless steel (nitronic 60), and residual stress mapping was conducted along the build height in all three orthogonal directions using neutron diffraction. The as-printed sample at the top of the build showed high tensile residual stresses in the in-plane directions ($\sigma_{xx} \approx 283$ MPa; $\sigma_{yy} \approx 284$ MPa) and slight compressive stress in the build direction ($\sigma_{zz} \approx -20$ MPa). In contrast, UIP-assisted L-DED reduced the in-plane tensile stresses ($\sigma_{xx} \approx 185$ MPa; $\sigma_{yy} \approx 195$ MPa) and generated strong compressive stress along the build direction ($\sigma_{zz} \approx -105$ MPa). EBSD revealed grain refinement, an increased fraction of low-angle grain boundaries, and an increased dislocation density in the topmost layer, indicating severe surface plastic deformation (S2PD). Micro-indentation and fretting wear tests further showed improved mechanical response and wear resistance. Together, these results establish interlayer UIP as an effective strategy for tailoring residual stress, microstructure, and fretting wear performance in additively manufactured nitronic 60.

Research Overview of Alaska's EPSCoR Track-1 Project: Interface of Change

Brenda Konar, University of Alaska Fairbanks
General Session, Track-I (#2344553)

Harvesting and farming of marine resources are vital to the economy and way of life for Alaskan coastal residents. The Alaska EPSCoR Track-1 project, Interface of Change (IoC), prioritizes collaborations among academics, community residents, industry, and agency partners to determine how freshwater and material export into the Gulf of Alaska alters species of economic, subsistence, and cultural importance. Our goals include building collaborative research capacity to assess how environmental characteristics affect marine resources on which residents are reliant and generating environmental data and web-based tools to inform adaptive community solutions to sustainably harvest and farm marine resources. We have 5 questions: each of which relates to how land-to-ocean linkages influence important marine resources. As a place-based study, the questions and taxa selected were dependent on community input. Question 1 focuses on red seaweeds in Southeast Alaska. Question 2 focuses on mariculture in Prince William Sound and the northern Gulf of Alaska. Questions 3 and 4, which involve bivalves and fish span multiple communities. Question 5 is community based and not focused on specific taxa. For this, we will determine if access, harvest, cultivation, and use of marine species influence the health and social, cultural, and economic well-being in rural coastal communities, and how access and use are affected by environmental characteristics.

Association between Neighborhood Walkability and Perceived Sleep Quality: Findings from ASPIRE Study

Gayathri Kongara, The University of Southern Mississippi
E-CORE RII, Early Career Researcher (#2316351)

Sleep plays an important role in overall health and well-being, and environmental factors such as neighborhood infrastructure may influence sleep. Prior research suggests that features like sidewalks, street lighting, and pedestrian safety are associated with better sleep. However, limited research exists in the Gulf South, where many communities have poor infrastructure. This study examined the association between neighborhood walkability infrastructure and sleep. The cross-sectional study included 214 participants from the ASPIRE (Advancing Social and Environmental Equity through Plastics Research: Education, Innovation, and Inclusion) dataset. Walkability infrastructure was assessed using three Neighborhood Environment Walkability Scale items (street lighting, pedestrian visibility, and crosswalk availability; 1–4 scale), averaged into a mean score. Sleep was measured using six Brief Pittsburgh Sleep Quality Index items, summed to a total score (0–15), with higher scores indicating poorer sleep. Multiple linear regression examined associations, adjusting for age, sex, education, income, and employment. The mean age was 40.1 years (SD = 14.7); 82.1% were female, and 56.1% were African American. Better walkability infrastructure was associated with improved sleep in unadjusted ($\beta = -0.44$, $p = 0.0219$) and adjusted ($\beta = -0.53$, $p = 0.0106$) models. Findings suggest built environment features may improve sleep and overall health.

Cumulative Socio Environmental Impacts of Flood Control and Agriculture in the Yazoo Delta

Nelson Kowu, University of South Carolina
Early Career Researcher, Focused EPSCoR Collaborations (FEC) (#2316382)

This study examines the cumulative socio-environmental impacts of flood control infrastructure and agricultural development in the Yazoo-Mississippi Delta. It asks how historically rooted approaches to flood control and agricultural practices continue to shape contemporary governance practices and reconfigure nature-society relations in the region. Drawing on a political ecology framework, the study analyzes how environmental decision-making processes mediate interactions among state agencies, agricultural stakeholders, and local communities in the evaluation and governance of cumulative socio-environmental impacts. The study integrates historical analysis of flood control policies, review of environmental impact assessments, and an examination of frameworks influencing land and water management. Specifically, we focus on how cumulative impacts are assessed, represented, or obscured within the formal decision-making process. We find that although the National Environmental Policy Act (NEPA) process provides a formal mechanism for environmental review, its procedural structure fragments cumulative impacts and constrains substantive engagement with long-term socio-environmental change, while political interests tied to agriculture and regional economic priorities play a significant role in shaping which management strategies are advanced or constrained.

Understanding Co-Transport And Retention Of Nitrate-Phosphate In Biochar-Mediated Saturated Porous Media

Rakesh Kumar, Science of the Total Environment (STOTEN)
Early Career Researcher

Rakesh Kumar1, Jasmeet Lamba1, Sushil Adhikari1, Henry Allen Torbert21Department of Biosystems Engineering, Auburn University, Auburn, AL 36849, USA2United States Department of Agriculture-Agricultural Research Service, National Soil Dynamics Laboratory, Auburn, AL 36832, USAAbstractNutrients, such as nitrogen and phosphorus, are prevalent in soil and water ecosystems. This research aims to investigate the co-transport and retention of nitrate and phosphate in different biochar-mediated columns. We developed protocols for conducting fixed-bed column experiments to understand the implications of biochars for the co-transport and retention of nutrients. In these experiments, firstly, different biochars, such as raw biochar (BC), and two modified biochars, such as iron-modified biochar (Fe-BC) and magnesium-modified biochar (Mg-BC), were injected into saturated porous media (quartz sand) at neutral pH (7 ± 0.1) and two ionic strengths, IS (0 and 10 mM) to mimic natural conditions. Equilibrium sorption experiments were also performed to determine the optimal adsorption of nitrate and phosphate using pristine BC, Fe-BC, and Mg-BC. The results showed that Mg-BC was deposited in greater amounts onto porous media at 10 mM, followed by Fe-BC and BC, due to anionic effects, electrostatic attraction, and particle aggregation. Considering co-transport, solutions of 10 mg/L phosphate and 100 mg/L nitrate have been transported through biochar-mediated saturated porous media. Thus, Mg-BC has shown the maximum nitrate adsorption, followed by Fe-BC and BC, at pH 7 ± 0.1 and IS 10 mM, compared to the

control transport in saturated porous media. Similar trends have also been observed for phosphate, with maximum adsorption observed using Mg-BC, followed by Fe-BC and BC. Ultimately, Mg-BC has shown potential to adsorb nutrients, which could be helpful for nutrient management.

Optimizing Soybean Drought Thresholds Reveals Trait-Specific Responses to Beneficial Bacteria

Emmanuel Lacueva, Louisiana State University
Early Career Researcher (#2418232)

Reliable evaluation of drought mitigation strategies requires reproducible and meaningful plant response indicators. In this study, soybean seedlings were used to determine a drought stress threshold and evaluate beneficial bacterial inoculants (Azospirillum sp. and Bradyrhizobium sp.) under water deficit. Drought optimization trials in greenhouse and growth chamber environments showed soil moisture in water-withheld pots declined to ~20% within two days, while plant responses became apparent after about four days. Drought significantly reduced plant height and biomass accumulation, identifying these traits as sensitive indicators of stress. Using this drought threshold, a second experiment evaluated microbial inoculation effects on soybean seedlings under well-watered and water-deficit conditions. Microbial treatment significantly increased nodulation, particularly in Azospirillum-inoculated plants, whereas water availability remained the dominant factor influencing shoot and root growth. A significant response was observed for root dry weight, with Bradyrhizobium-inoculated plants exhibiting the highest values across water conditions. These findings indicate that a soil moisture threshold of approximately 20% provides a practical benchmark for soybean drought screening and that beneficial bacterial inoculants confer selective benefits, particularly in nodulation and root-associated traits under drought conditions.

Application of Novel Gap-Filled AOD and Data Fusion Techniques for Enhanced Surface PM2.5 Estimates

Jeffrey Lee, The University of Oklahoma
Early Career Researcher, Focused EPSCoR Collaborations (FEC) (#2418311)

The rise in natural aerosol emissions and increasingly variable anthropogenic trends has heightened the need for approaches that can accurately model the spatiotemporal distribution of atmospheric aerosols. Chemical transport models such as CMAQ offer physically based simulations but are computationally intensive and often struggle to reproduce surface $PM_{2.5}$ concentrations, a major driver of poor air quality. We present a data-driven framework for reconstructing historical $PM_{2.5}$ across the continental United States (CONUS). Our approach first gap-fills satellite-retrieved Aerosol Optical Depth (AOD) using a deep-learning U-Net 3+ model that reconstructs AOD in an autoregressive manner. We then integrate the completed AOD fields with meteorological and land-use predictors in a statistical data-fusion model to estimate daily surface $PM_{2.5}$. The resulting spatially complete fields enable reconstruction of a daily $PM_{2.5}$ record across CONUS and address the sparse, uneven coverage of ground-monitoring networks. This dataset supports improved analysis of long-term exposure, regional pollution trends, and episodic events such as wildfire smoke. More broadly, the results demonstrate that deep-learning-based satellite gap-filling combined with statistical data fusion offers a scalable approach for reconstructing historical air-quality fields while avoiding the computational cost of traditional chemical transport models.

Tri-State Collaborative for Defluorination of PFAS: Alabama Update

Yu Lei, The University of Alabama in Huntsville
Focused EPSCoR Collaborations (FEC), General Session (#2521376)

Per- and polyfluoroalkyl substances (PFAS) are persistent environmental contaminants linked to significant human health and ecological risks. The Tri-State Collaborative for Defluorination of PFAS brings together multidisciplinary teams to develop scalable technologies for PFAS destruction and to build a skilled workforce to address emerging environmental challenges. As the Alabama lead, this project integrates advanced research on PFAS degradation with targeted workforce development initiatives across the state.Our research focuses on novel defluorination strategies, including catalytic, electrochemical, and thermal processes, to break strong carbon–fluorine bonds and achieve complete mineralization of PFAS compounds. Parallel efforts emphasize workforce training through partnerships with universities, community colleges, and industry stakeholders, preparing students and professionals for careers in environmental remediation and sustainable technologies.This work addresses critical regional and national needs by advancing solutions to PFAS contamination while strengthening Alabama’s research infrastructure and talent pipeline. Outcomes include new treatment methodologies, trained personnel, and collaborative networks that enhance scientific innovation and economic competitiveness. The project contributes to long-term environmental sustainability and public health protection while positioning Alabama as a leader in PFAS remediation research and workforce development.

Digital Twin-Enabled Real-Time Control for Robot Arm-based Manufacturing via Reinforcement Learning

Sen Liu, University of Louisiana at Lafayette
E-RISE RII, General Session

This research presents an innovative approach that integrates Soft Actor-Critic (SAC) Reinforcement Learning (RL) algorithm with Digital Twin (DT) technology to enable real-time adaptive control in robotic manufacturing. Our experimental setup consists of a ViperX robot arm, and two distinct Tasks: 1) static target reaching and 2) dynamic target following were implemented for simulating adaptive control of additive manufacturing (AM). The innovative system architecture combines Unity game engine's simulation with ROS2 for seamless and robust DT synchronization. We implemented a hierarchical reward structure to address common RL challenges, including local minima avoidance, convergence acceleration, and training stability, while leveraging transfer learning to adapt trained models across tasks. Experimental results demonstrate rapid policy convergence and robust task execution, with performance metrics including cumulative reward, value loss, policy loss, and entropy validation. Unlike prior works limited to offline or low-frequency simulations, our framework achieves stable 20 ms joint-level synchronization, enabling deployment of learned behaviors directly to physical robotic systems. This work advances the integration of RL with a realistic DT framework for industrial and manufacturing robotics applications, providing a framework for enhanced adaptive real-time control in intelligent manufacturing processes.

E-RISE RII: Maine Algal Research Infrastructure & Accelerator (MARIA) Project

Michael Lomas, National Center for Marine Algae & Microbiota and the Bigelow Center for Algae Innovation
E-RISE RII, General Session (#2436200)

The Maine Algal Research Infrastructure and Accelerator (MARIA) project is designed to move algae research from laboratory discovery to scalable, market-ready products while strengthening Maine's innovation economy. It brings together research institutions, colleges, and business development organizations to create both advanced research infrastructure and a collaborative expert network that can accelerate algae-based innovation. The project supports commercial development across multiple sectors, including aquaculture, agriculture, biochemicals, heritage industries, and healthy aging, while also building a sustainable model through fee-for-service activities and value generated from knowledge and business development outputs. A core scientific contribution of MARIA is its focus on unlocking the largely underused diversity of microalgae and macroalgae. By expanding infrastructure for biochemical, functional, and scalability studies, and linking these findings with other algal datasets, MARIA will deepen scientific understanding of algae as biofactories for high-value products. At the same time, the accelerator emphasizes workforce training for undergraduates, career transitioners, and individuals from diverse backgrounds, including first-generation and rural learners. Overall, MARIA is positioned as a statewide engine for research, workforce development, and business creation that could expand economic opportunity across Maine’s rural, coastal, and urban communities.

Characterizing Horizontal Gradients of Aerosol Pollution and Chemical Speciation Across Oklahoma

Sandra Marcela Loria-Salazar, The University of Oklahoma
Focused EPSCoR Collaborations (FEC), General Session (#2418311)

Ambient particulate matter pollution remains a significant public health issue across the U.S., with disproportionate effects in some regions. This study explores the spatial distribution and chemical composition of aerosol pollutants in Oklahoma, focusing on horizontal gradients and their implications for environmental health. Disability-Adjusted Life Years data show that Oklahoma experiences a modest yet statistically significant rise in the share of deaths linked to ambient PM pollution compared to the national average, emphasizing the need for region-specific air quality assessments and targeted mitigation efforts. To support this, we utilize data from the U.S. Environmental Protection Agency’s Interagency Monitoring of Protected Visual Environments and Chemical Speciation Network stations, combining these datasets with detailed chemical analyses to identify primary aerosol sources, assess spatial differences, and examine pollutant movement across the Southern Great Plains. A key part of this work involves understanding community perspectives on air quality exposure, with a focus on equitable engagement with Tribal Nations. These collaborations aid in co-developing monitoring strategies, upholding Indigenous data governance principles, and ensuring research outcomes align with community priorities. This integrated approach promotes environmental health equity and informs science-based policy actions across Oklahoma and similar regions.

Smoke, Dust, and Resilience: Unraveling the March 2025 Oklahoma Compound Hazards

Sandra Marcela Loria-Salazar, The University of Oklahoma
Focused EPSCoR Collaborations (FEC), General Session (#251432)

On March 14, 2025, an intense low-pressure system over the Southwest U.S. collided with humid air masses, triggering a severe weather outbreak across multiple states. Texas and Oklahoma were hit particularly hard, experiencing destructive winds up to 85 mph, widespread dust storms, and rapidly advancing wildfires. Satellite imagery captured extensive dust plumes and smoke emissions, especially near wildfire zones in Oklahoma. The extreme conditions led to over 170,000 acres burned, more than 400 structures damaged or destroyed, widespread power outages, and multiple fatalities, prompting a state of emergency.This study examines the intricate relationships between meteorological drivers and aerosol behavior during this multi-hazard event. Leveraging a suite of satellite and ground-based remote sensing tools, in situ observations, back trajectory analyses, and meteorological reanalysis data, we assess how aerosol physical, optical, and chemical properties evolved throughout the event. We also examine the atmospheric conditions that facilitated long-range dust transport and the ignition of wildfires. Our findings provide critical insights into the growing threat of compound hazards in the Southern Great Plains and underscore the importance of integrated observational strategies for enhancing regional resilience and air quality management

Square-Wave Voltammetry Evaluation of Poly-Histidine Stability for Bioconjugation Applications

Kate Lussier, University System of New Hampshire
Early Career Researcher, EPSCoR Research Fellows (2119237)

Bioconjugation strategies rely on robust linkers that enable selective, oriented, and stable attachment of biomolecules on interfaces. Among these, polyhistidine tags (Histags) are widely used because they coordinate selectively with divalent metal ions, providing a convenient route for affinity-based immobilization. Despite their prevalence in protein purification and surface functionalization, the electrochemical and physiological stability of Histag–mediated conjugation is not robustly explored. In this work, we investigated the stability and degradation behavior of Histag binding on a modified glassy carbon surface under varying conditions. Surfaces were prepared by forming a benzoic acid layer on glassy carbon, followed by EDC/NHS activation to couple amino-nitrilotriacetic acid (NTA), a chelating ligand capable of binding to Ni^{2+} for Histag coordination. A ferrocene modified Histag was used as a redox active reporter to monitor conjugation integrity via square wave voltammetry at 100 Hz over a potential range of 0 V to 0.5 V vs Ag/AgCl. Initial measurements confirmed successful binding; however, the signal diminished within hours, indicating rapid loss of the Histag from the surface. These results reveal instability of Histag bioconjugation as a function of time or exposure to electrochemistry.

TPE-End-Capped Hyperbranched Poly(silyl ether) Nanoparticles for FRET-Based Cellular Imaging

Chiranthi Mahadurage, University of North Dakota
Early Career Researcher, Track-I (#1946202)

Fluorescence resonance energy transfer (FRET) enables sensitive ratiometric measurements via nonradiative energy transfer from an excited donor to a nearby acceptor. However, many traditional fluorophores exhibit issues such as aggregation-caused quenching and photobleaching when incorporated into nanoparticle formats. To overcome these challenges, we developed a degradable, aggregation-induced emission (AIE) donor platform based on Tetraphenylethylene (TPE) endcapped hyperbranched poly(silyl ether) (TPE–HBPSE), where restricting intramolecular motion upon aggregation enhances strong emission. Nanoparticles were formed by adjusting the donor/acceptor ratio with poly[2-methoxy-5-(2-ethylhexyloxy)-1,4-phenylenevinylene] (MEH-PPV) and Poly(styrene-co-maleic anhydride) (PSMA) as stabilizers. Optical spectroscopy revealed composition-dependent energy transfer from emission spectra. Dynamic light scattering measured particle sizes around ~30 nm and zeta potentials near −30 mV, indicating colloidal stability and suitability for FRET. In BEMVEC cells, the nanoparticles exhibited minimal cytotoxicity up to 1000 μg/mL. Ongoing experiments include degradation testing and confocal imaging to confirm effective cellular labeling and the presence of an intracellular FRET signal.

Thermo-Electro-Mechanical Finite Element Modeling of mCF-Based Self-Sensing Cementitious Composites

Shezan Mahmud, Louisiana State University
Early Career Researcher, EPSCoR Research Fellows (#2429761)

Structural Health Monitoring (SHM) is essential for the longevity of civil infrastructure. However, most monitoring systems rely on external sensors that are expensive, difficult to install, and often fail long before the structures they serve. To reduce costs and environmental impact, researchers are developing intrinsic self-sensing cementitious composites (SSCCs) that incorporate conductive fillers to achieve piezoresistive capability. In this study, recycled milled carbon fiber (mCF) is used as the sustainable filler. The inclusion of mCF enables the concrete to track internal strain through fractional change in resistivity (FCR), allowing the material to function as a sensor and reduce reliance on traditional systems. In the field, however, thermal stress complicates the electrical signal. Temperature changes can obscure the true piezoresistive response, making it difficult to distinguish heat effects from mechanical strain. This study develops a multi-physics finite element model in COMSOL Multiphysics to address this issue. The simulation employs a coupled thermoelectromechanical framework that links thermal expansion in the cement matrix to changes in the resistance of conductive paths. By incorporating temperature-dependent conductivity, the model separates environmental effects from strain-related signals. This approach clarifies how temperature, stress, and mCF content interact and provides a physics-informed basis for sensor calibration in extreme environments.

Drying the Delta: Flood Control, Agriculture, and Land Investment in the Yazoo-Mississippi Delta

Bianca Malkoc, University of South Carolina
Early Career Researcher, Focused EPSCoR Collaborations (FEC) (#2316382)

The landscape of today's Yazoo-Mississippi Delta—a region of over 7,000 square miles of fertile land between the Mississippi and Yazoo Rivers—is the outcome of centuries of political decisions regarding flood risk, environmental preservation, agricultural development, and socio-economically fraught constituencies. Despite relative economic wealth derived from agriculture, the region contains some of the highest concentrations of impoverished African American households in the United States. Since the 1970s, the U.S. Army Corps of Engineers (USACE) has built canals, levees, and drainage control structures throughout the Yazoo Backwater Study Area to mitigate flood risk, and the Yazoo Pumps remain the sole unfinished component. USACE and pro-agricultural actors frame the Yazoo Pumps Project as an environmental-justice initiative, even though the primary beneficiaries of reduced flooding are large agricultural producers. This case demonstrates how environmental screening and mapping (ESM) tools, alongside flood models, perform the political work of statecraft by reifying particular futures of flooding and land use. We present preliminary findings from qualitative discourse analysis of Environmental Impact Statements and archival documents to show how actors like USACE mobilize ESM tools to recast floodplains as hydrologically stable spaces destined for intensified agricultural production, maximizing land as a resource rather than prioritizing environmental protection or justice.

Kinship for Climate: Shaping Resilient Futures

Elinor Martin, South Central CASC
Focused EPSCoR Collaborations (FEC), General Session (#2418311)

This EPSCoR funded project is a collaboration between the University of Oklahoma, the University of New Mexico, and the Chickasaw Nation. The project objectives are to collaboratively develop research related to air-water-land climate and environmental change that is relevant to Tribal and Indigenous communities; recognize and support the role of indigenous knowledges related to climate and environmental change in Tribal and Indigenous planning; inspire students to pursue higher education in fields related to the environment and resilience; empower educators to braid Indigenous knowledges and Western science in their teaching; and build and sustain trusting relationships between universities and Tribes, Nations, and Pueblos and their partners. Relationships are at the heart of this project, and in this presentation, we describe the project process and objectives in more detail as well as sharing early results, successes, and challenges in building resilient futures in partnership with Tribes, Nations, and Pueblos in Oklahoma and New Mexico with a focus on air and water research and resilience. We also describe our summer program "Indigenous Kinship Circle for Climate Futures" where, undergraduate and graduate students from Oklahoma and New Mexico embarked on a learning journey to explore climate science, Indigenous planning and design, and community-based adaptation practices guided by the Two-Eyed Seeing framework and supported by PhotoVoice and community partnerships.

Dust Optics Models as Community Resources for Research and Education

Susan Mathai, University of Wyoming
Early Career Researcher, Focused EPSCoR Collaborations (FEC) (#2521434)

Dust impacts our daily lives, such as agricultural activities, road transportation, aviation safety, and human health. It also impacts the future Earth's climate by modulating the solar radiation and changing cloud properties through physical processes. Dust storm monitoring can be achieved by remote sensing techniques that utilize either ground-based cameras or spaceborne sensors to measure radiometric signals that are interpreted for the detection of dust storms. The dust optics models are essential resources for remote sensing techniques as they enable us to interpret radiometric signals. Historically, a spherical dust model has been used for remote sensing applications due to the simplicity of the solution for the electromagnetic scattering problem through the Mie theory. However, dust particles are exclusively nonspherical. While several community-available nonspherical dust optics models have been developed, these were developed based on idealized nonspherical particle geometries. In this project, we will develop a new community-available dust optics model by utilizing laboratory measurements of dust particle geometry information. This would improve the accuracy in the applications to remote sensing and radiative transfer modeling. We also plan to use the dust optics model as an educational tool. We will present a brief overview of the recently funded NSF EPSCoR project and discuss the prospects of the project.

Equity-Aware Load Prioritization and Planning Strategies to Improve Power System Resilience During HILF Events

Adithya Melagoda, Wichita State University
Early Career Researcher, Track-I (#2148878)

Power systems and other interdependent infrastructures are increasingly exposed to high impact low frequency (HILF) events, which can cause severe generation inadequacy and load curtailments that disproportionately affect vulnerable populations. However, with the increase of distributed energy resources (DERs) at present, restoration can be acquired using these resources by forming possible microgrids and supplying critical loads that are present in the system. Hence, this work proposes an equity-aware optimal restoration and planning strategy applicable to any power network during an HILF event. First, a load prioritization framework is developed that incorporates customer criticality and social equity. The framework first allocates power to critical loads and non-critical loads are ranked using their economic value, social equity and load criticality. Secondly, an equity-oriented optimal switch placement framework is proposed as a long-term planning strategy to reduce disparities in post-event distribution system restoration across vulnerable communities. The framework is tested in a developed test system with actual data in a rural city in Kansas which is publicly available, and the results show both the significances of priority and equity-based power system restoration and planning for future events.

Ion-Conducting Polymeric Coatings for Protection of Lithium Metal Anodes

Xiangbo Meng, University of Arkansas
EPSCoR Research Fellows (#2429581)

Lithium (Li) metal has been highly regarded as an ultimate anode for high-energy rechargeable batteries, ascribed to its extremely high capacity (3860 mAh/g) and the lowest negative electrochemical potential (-3.04 V versus the standard hydrogen electrode). However, Li metal suffers from two main serious issues: (1) continuous formation of unstable solid electrolyte interphase (SEI) and (2) Li dendritic growth. These issues have their roots in Li corrosions chemically and electrochemically. To this end, uncountable efforts have been invested to address these issues, and they can be categorized into several strategies. Recently molecular layer deposition (MLD) has emerged as a new interface engineering tool for Li metal protection, featuring its unrivaled capabilities for growing polymeric films in an accurately controllable mode at the molecular level. To this end, recently we have developed several novel Li-containing polymers via MLD, showing excellent ionic conductivity, high flexibility, and exceptional chemical/electrochemical stability. Depositing them on Li metal directly, consequently, we found that these MLD-protected Li metal anodes showed compelling long-term cyclability in Li||Li symmetric cells and dramatically boosted the performance of Li||NMC811 ($LiNi_{0.8}Mn_{0.1}Co_{0.1}O_2$) cells, in terms of sustainable capacity and capacity retention. Our studies demonstrated that ion-conducting polymer coatings via MLD are promising for addressing the issues of Li metal.

A Qualitative Assessment of Pesticide Drift and Health Perception in the Yazoo Mississippi Delta

Joe Mensah, Mississippi State University
Early Career Researcher, Focused EPSCoR Collaborations (FEC) (#2316382)

Airborne pesticide drift from widespread row crop farming in the Yazoo Mississippi Delta stands out as a considerable yet underexplored risk to human health, particularly in relation to non-communicable diseases (NCDs), such as asthma, obstructive chronic pulmonary disease (COPD), cardiovascular diseases, and certain cancers. Though the gains from agricultural productivity in this region are enormous, environmental changes surrounding the use of pesticides, such as Glyphosate, should also be considered. This is because, according to the Pesticide Residue Monitoring Program report for 2023, the Food and Drug Administration ranked Glyphosate to be among the top 30 most prevalent pesticide residues in human food and number one in animal food. Using a qualitative framework of field observations and interviews, this study documents residents' lived experiences of pesticide drift and their perceptions of health decline linked to drift exposure in the Yazoo Mississippi Delta. Preliminary findings suggest that some participants were of the view that exposure to pesticides could be linked to cancer, with some participants identifying allergies and sinus issues as some health problems linked to their exposure to pesticide drift in the Yazoo Mississippi Delta. To further investigate these reported experiences, additional interviews and broader community surveys are planned to explore potential relationships between Glyphosate exposure and chronic diseases.

Kinesin-5 Inhibition Alters Cortical Neural Network Dynamics and Spatial Activity Propagation

Jason Middleton, Louisiana State University Health Sciences Center
E-CORE RII, General Session (#2432859)

Kinesin-5 (KIF11) is a microtubule-based motor protein implicated in cytoskeletal organization and dendritic structure, but its acute effects on neuronal network activity remain poorly understood. Here, we investigated how pharmacological inhibition of KIF11 influences stimulus-evoked activity in cortex using flavoprotein autofluorescence (FA) imaging in acute brain slices. Electrical stimulation was delivered to layer 5, and evoked responses were measured locally and across supragranular regions over repeated trials. Stimulation of layer 5 reliably evoked FA signals in both infra and supragranular layers. KIF11 inhibition enhanced the amplitude and spread of stimulation-evoked neural network activity. FA imaging enabled stable, repeated measurements of evoked responses over extended timescales, revealing a temporal evolution of drug effects. Specifically, KIF11 inhibition produced an initial increase in stimulus-evoked activity emerging within approximately one hour of application, followed by a subsequent reduction in response magnitude at later time points. These findings indicate that KIF11 inhibition modulates cortical network dynamics in a time-dependent manner, transiently enhancing the propagation of activity before longer-term suppression. This work highlights the utility of FA imaging for tracking network-level responses over time and supports a model in which cytoskeletal regulation influences the spatial and temporal structure of cortical activity.

Estimating Canopy Stomatal Conductance Across U.S. Corn Belt Agroecosystems Using Flux Observations

Rajendra Mishra, Kansas State University
Early Career Researcher

Canopy stomatal conductance (gc) regulates crop water use and carbon exchange, yet its variability across ecosystems remains poorly constrained. This study quantifies gc across six AmeriFlux sites in U.S. Corn Belt representing irrigated and rainfed maize-soybean systems. Using long-term ecosystem observations, gc is evaluated against environmental drivers, including vapor pressure deficit (VPD), incoming radiation, soil moisture, air temperature, and atmospheric CO2. To characterize stomatal behavior, two widely used formulations- the Medlyn optimal model and the Ball-Berry model are applied. Model parameters are calibrated against simulated gc, and performance is evaluated across sites, crop types. Linear regression is further used to quantify the relative importance of environmental controls and to assess differences between maize and soybean as well as irrigated and rainfed systems. Results show strong sensitivity of gc to atmospheric demand and water availability, with declines under increasing VPD and enhanced conductance under favorable radiation and soil moisture. Both models captured gc variability, although their parameterization and performance vary across sites and environmental gradients. These findings provide a multisite assessment of gc dynamics across major U.S. cropping systems and improve representation of plant-atmosphere interactions in agroecosystem models.

Hydrological Impacts of Land Use Alteration in St. Croix Watersheds

Addisalem Mitiku, University of the Virgin Islands
Early Career Researcher, EPSCoR Research Fellows (#1946412)

Saint Croix has experienced significant land use alterations over the past decades, transitioning from tropical vegetation to sugarcane farming, followed by an increase in shrubland and, more recently, the expansion of urban areas. This study considers 33 years of climatological data along with successive surface cover changes, using land use maps from 1985, 1992, 2004, and 2018. It then investigates the implications of land use evolutions together with climatic variations on watershed hydrological responses, particularly on flow in the streams. A hydrological modeling approach was implemented to quantify and assess these impacts. The results revealed that the northwestern vegetated region of the island exhibits better performance in reducing runoff generation and, consequently, the streamflow reflecting the area's high water-retention capacity. On the other hand, areas with significant urban expansion show a progressive increase in streamflow, particularly in the middle and lower sections of the Bethlehem watershed. The increase in impervious surfaces across the island is likely to increase streamflow. And this effect can be amplified when it is combined with regional monsoonal rain. Therefore, effective watershed and water management should be integrated with urbanization programs of the island to mitigate the associated risks such as flooding and erosion.

Chemical and Entrainment Properties of Post-Fire Dust

Hans Moosmuller, Desert Research Institute
Focused EPSCoR Collaborations (FEC), General Session (#2521432)

Wildfires have intensified over the past few decades, resulting in significant health, ecological, and economic impacts worldwide, particularly in western North America. Despite the increasing frequency of wildfires, post-fire emissions, especially entrained dust, remain poorly characterized. Residual ash, dust, and soil from burned areas can be resuspended and transported downwind over hundreds of kilometers, posing risks to environmental and human health on timescales ranging from months to years. However, the roles that these resuspended particles play in air quality, toxicity, and broader environmental impacts remain insufficiently understood.The goal of this project is to address these knowledge gaps by investigating the chemical and physical properties of post-fire particles, assessing their potential for atmospheric entrainment and toxicity, and evaluating how these properties evolve over a 2–3 year period.Specifically, we will quantify toxic inorganic elements and organic pollutants (e.g., polycyclic aromatic hydrocarbons, PAHs) in surface dust and respirable particulate matter (PM10 and PM2.5), with an emphasis on entrainment and inhalation risk. The entrainment properties of post-fire ash, soil, and dust will be analyzed using PI-SWERL. Our research will generate a critical dataset on the speciation and behavior of post-fire particles, enabling improved predictive modeling of particle transport, atmospheric residence time, and environmental and health impacts.

Continental-Scale, High-Spatial-Resolution Ice Flow Modeling Based on Graphics Processing Units

Kenneth Mosley, University of North Dakota
Early Career Researcher, EPSCoR Research Fellows (#2327095)

Global mean sea level is rising at an unprecedented rate, posing a significant threat to coastal communities and ecosystems worldwide. The ice discharge from the Antarctic Ice Sheet (AIS) contributes significantly to sea-level rise; however, its dynamic response to climate change remains a fundamental uncertainty. Quantifying uncertainties in future Antarctic ice-sheet evolution requires running high-fidelity simulation ensembles; however, conventional central processing units (CPUs) limit the time available. Solving time-independent stress-balance equations to predict ice velocity is the most computationally expensive part of ice-sheet simulations in terms of memory and execution time.Here, we develop numerical algorithms for graphics processing unit (GPU) acceleration of the Ice-sheet and Sea-level System Model's (ISSM's) stress balance module and compare them with a standard CPU implementation. The performance metrics include predictive accuracy, speedup, and scalability. The overarching goal is to enable high-fidelity ensembles of Antarctic Ice Sheet simulations to better quantify uncertainties in sea-level rise projections.

GeoAI-Driven Climate Resilience Using LiDAR Urban Morphology and Spatial Deep Learning

Mirza Md Tasnim Mukarram, University of Iowa
Focused EPSCoR Collaborations (FEC), Track 2 (#2420405)

Climate variability and increasing extreme heat events pose growing risks to urban and rural communities across the Midwest, affecting public health, energy demand, agricultural productivity, and infrastructure resilience. In alignment with the EPSCoR Weather Pattern Resilience initiative, this study develops a GeoAI-driven framework for climate-resilient urban cooling using green roof deployment in downtown Iowa City, Iowa, as a community-scale demonstration for regional climate adaptation. Airborne LiDAR point cloud data were processed to derive three-dimensional urban morphology, including building height, building volume density, sky view factor, and solar radiation. Environmental indicators including NDVI, NDBI, and water body distance were derived from Sentinel-2 imagery, while daytime land surface temperature was retrieved from Landsat 9. Six predictive models were evaluated, including ANN, Random Forest, XGBoost, Spatial CNN, CNN-LSTM, and Vision Transformer. The Spatial CNN achieved the best performance (Test R^2 = 0.974; RMSE = 0.842°F). SHAP analysis identified built-up intensity and water proximity as dominant thermal drivers. Green roof simulations targeting the top 15% thermal hotspots produced a mean cooling of 6.37°F and maximum reduction of 10.27°F.An interactive web application enables real-time cooling simulations and supports scalable, transferable climate-resilient planning for Midwest communities.

Microplastic Pathways in Coastal Food Webs: Experimental Evidence and Field-Directed Studies

Carla Narvaez Diaz, Rhode Island College
E-RISE RII, General Session (#80001222)

Nano- and microplastics (NMPs) are pervasive contaminants in coastal marine ecosystems, yet their movement across trophic levels remains poorly understood. Part of the E-RISE SIMCoast project investigates NMP trophic transfer through food webs in Narragansett Bay (RI). Here, we present preliminary experimental results and the research framework designed to trace NMP pathways from gelatinous zooplankton to benthic invertebrates and their predators. Mnemiopsis leidyi ctenophores ingested polyethylene microspheres, encapsulated them in mucus, and egested them within 48 hours, with the particles sinking to the bottom of the tank. Thus, ctenophores may serve as vectors for NMP transport from the water column to benthic sediments, potentially contributing to the elevated NMP loads documented in Narragansett Bay. Although MPs exposure did not reduce prey consumption, repeated ingestion-egestion cycles also resulted in co-egestion of prey, which may impose long-term energetic costs on the animals. We will conduct field-based recordings to survey the predator community of tethered sea urchins (Arbacia punctulata) across diel cycles and all four seasons. This information will directly inform laboratory microcosm experiments in which NMP-fed urchins will be exposed to fish predators. Gut content analyses will determine whether microplastics transfer from prey to predators, providing critical data on the potential for NMP bioaccumulation in coastal food webs.

AI-enabled Fabrication of Next Generation Two-photon Scaffolds

Wesley Nichols, Clemson University
Early Career Researcher, Track-I (#2242812)

Collagen provides the structural backbone of soft tissues throughout the body with collagen type 1 making up a majority of fibrous collagen at about 85% of the constituents in skin, 90% in bone, and 80% of the dry mass in tendon (Amirrah et al., 2022). Currently, grafts or decellularized xenogeneic tissues are used for wound healing and various interventions; however, these may result in complications due to foreign-body responses and mechanical degradation (Cramer et al., 2020). Our solution seeks to remedy this by providing a two-photon AI-enabled fabrication framework to generate personalized, tissue-specific scaffolds.Scaffolds made of type I rat tail tendons collagen are fabricated using an 80MHz femtosecond Ti:sapphire laser (Spectra) and an A3200 motorized stage (Aerotech) within a custom well. The laser is scanned through the PDMS well plate according to tissue specific patterns. Currently, a phase-contrast-based image segmentation has been implemented, which will later enable future AI-driven pattern generation from morphologies in native tissues. We demonstrate the ability to replicate the patterns in phase contrast images of collagen and the viability of scaffolds through characterization of NIH-3T3 Morphologies. Our work establishes a unique computation-to-physical pipeline for AI-guided collagen scaffold fabrication. This provides a foundation for data-driven, patient and tissue-specific tissue engineering.

ACREE: Advancing Smart Farming with IoT, AI, and Imaging for Scalable Monitoring and Decision-Making

Joseph Oboamah, University of Nebraska- Lincoln
Early Career Researcher, Focused EPSCoR Collaborations (FEC) (#2420405)

Aligning with the DARE project's mission to increase climate resilience in agriculture, this poster presents ACREE (Applied Collaborative Research, Extension, & Education). While many smart farming tools remain fragmented, ACREE unifies the Internet of Things (IoT), AI, and advanced imaging to deliver actionable, commercial-scale decision support for growers. A core feature of ACREE is assisting growers with irrigation decisions by visualizing soil water depletion without physical soil moisture sensors. By integrating agronomic and AI models, the platform summarizes weather events and provides predictive analytics. It also integrates a self-powered, variable-rate irrigation system via industry collaboration with KZValve. Specialized camera systems monitor crop canopy temperature, cover, weeds, and disease. Advancing DARE’s objective of improving water use efficiency, ACREE features intuitive web and mobile apps powered by multi-protocol IoT networks (LoRaWAN, NB-IoT, cellular, and Wi-Fi). The system currently serves over 40 active growers across 10,000 acres of commercial farms, plots, and lawns, demonstrating a highly adaptable framework for next-generation precision agriculture. This project was funded by EPSCoR with award number 2420405.

Mechanical behavior of sintered cross-shaped fivefold twinned Ag nanowires: MD insights

Prabesh Ojha, University of Mississippi
Early Career Researcher, EPSCoR Research Fellows (#2429027)

This study presents a molecular dynamics investigation of the sintering behavior and mechanical properties of cross-shaped fivefold twinned silver nanowires (FTNWs). Two FTNWs intersecting at 90° were sintered at 698, 898, and 1098 K using heating rates of 1.0, 0.1, and 0.01 K/ps, followed by high-temperature relaxation, cooling, and room-temperature equilibration with varying relaxation times and random seeds to ensure statistical independence. Uniaxial tensile tests were performed at strain rates of 1.0×10-3, 5.5×10-4, and 1.0×10-4 ps-1. Results show that lower sintering temperatures and higher heating rates preserve fivefold twin boundaries, limit atomic diffusion, and increase yield strength. Higher strain rates also enhance tensile strength. During deformation, stacking faults evolve into twin boundaries, often forming paired quasi-icosahedral (QI) structures during necking and fracture, linked to secondary fivefold twin formation. Statistical analysis shows that under uniaxial loading, QI formation shifts the fracture away from the connection region, whereas biaxial loading is dominated by fracture of the z-direction nanowire near the connection. In biaxial loading, strength and toughness decrease with temperature but increase with strain rate, while strain at UTS remains stable. For comparison, cross-shaped single-crystalline nanowires under the same uniaxial loading conditions show ~16% lower strength but four times higher ductility than FTNWs, without QI formation.

Carbon Quantum Dots-Based Sensors for Detection of Heavy Metals and PFAS

Dauda Oyebanji, Louisiana Tech University
Early Career Researcher, Focused EPSCoR Collaborations (FEC) (#2418390)

Carbon quantum dots (CQDs) are carbon nanoparticles with an average size of 5 nm or smaller that emit superior fluorescence. With rich surface functional groups, CQDs can selectively conjugate with heavy metal ions and polyfluorinated substances (PFAS), resulting in the intensity quenching of the fluorescence signal. In this project, CQDs of different types were synthesized using bottom-up hydrothermal and solvothermal methods from different precursors to receive products that are rich in certain functional groups. CQDs were then introduced to solutions of either lead (II) ions and/or perfluorooctanoic acid (PFOA) with a concentration of pM- μM ranges. Under optimized conditions, the quenching effect of CQDs with solvothermal synthesis was found a linear relationship against the concentration of Pb^{2+} from 0.4-60 μg/L and a detection limit of 0.12 μg/L in aqueous solution. The hydrothermally synthesized CQDs are more effective in detecting PFOA with a broad concentration range. Our results demonstrate that CQDs could provide quick and accurate measurement of trace amounts of heavy metal ions and PFOAs in polluted water, which provides residences a convenient way to monitor water contamination of these toxins to reduce health risks for communities.

Talent Bridge from Minority-Serving Institutions to Graduate School and Energy Industry

Shanlin Pan, The University of Alabama
General Session, Track-I (#2225852)

The goal of the program is to address the critical needs of STEM students at three Historically Black Colleges and Universities (HBCUs): Stillman College, Fort Valley State University (FVSU), and Jackson State University (JSU), whose STEM education was negatively affected by the global pandemic. These needs are addressed through a collaboration with the University of Alabama (UA) that provides support for improving chemistry laboratory courses and chemistry research experiences each semester and over the summer. Stillman College students participate in ten supplemental labs during regular course time and take a field trip to tour UA research facilities yearly. Eight to twelve students are selected to participate in the summer research program each year. Beyond technical skills, the program integrates comprehensive professional development to prepare students for the workforce. This bridge program serves as a vital pipeline, equipping minority students with the high-level research expertise and professional credentials necessary to lead in the energy industry.

HPGe Detectors with Thin a-Ge Contacts: ICPC and Ring-Contact Designs Using USD-Grown Crystals

Shasika Panamaldeniya, University of South Dakota
Early Career Researcher, Track-I (#2437416)

Detecting radiation and rare-event signals, such as those expected from low-mass dark matter, requires detectors with low noise and high energy resolution. Germanium-based semiconductor detectors are particularly attractive due to their small bandgap (~0.67 eV at 300 K) and achievable high material purity. At the University of South Dakota, high-purity germanium crystals are produced via zone refining and crystal growth for in-house detector fabrication. This work explores thin amorphous germanium (a-Ge) surface contacts as an alternative to lithium-diffused contacts, which introduce thick dead layers and complicate detector refabrication. Multiple geometries were fabricated using USD-grown crystals, including planar, point-contact, inverted coaxial point contact (ICPC), and ring-contact designs, processed through mechanical shaping, chemical etching, and a-Ge/Al contact deposition, and tested cryogenically at ~76 K. The ICPC detector shows stable operation with leakage current < 5.0 pA, capacitance ~0.53 pF, and energy resolutions of 2.42% at 59.5 keV and 0.36% at 662 keV. The ring-contact detector, operated at 380 V, shows a leakage current of ~9.1 pA and resolutions of 4.10% at 59.5 keV and 0.65% at 662 keV. The ~35 g ring-contact detector serves as a prototype, demonstrating the feasibility of this geometry and supporting future scaling to kilogram-scale HPGe detectors.

Dissolution and Regeneration of Cellulose Fibers via Wet Spinning

Binayak Raj Pandey, Iowa State University
Early Career Researcher, Track-I (#2242763)

Bacterial cellulose (BC) and plant nanocellulose (NC) are biodegradable, biocompatible alternatives to petroleum-based polymers for advanced biomedical and functional biotextile applications. However, scalable cellulose processing is limited by poor solubility and difficulty in forming continuous fibers. This study investigated direct dissolution and wet spinning as a route to regenerate cellulose filament fibers from high-concentration BC and NC dopes. BC and NC were directly dissolved at 10 wt% and 20 wt%, respectively, using ionic liquid solvents, followed by regeneration through wet spinning in a water bath. The resulting fibers were characterized by scanning electron microscopy, diameter measurement, and single-fiber tenacity testing in accordance with ASTM D1776-20 and ASTM D3822-14. Uniform cylindrical filament fibers were produced from both cellulose sources. BC fiber diameters ranged from 249-292 μm and NC diameters from 392-453 μm. Among the tested systems, 1-ethyl-3-methylimidazolium propionate produced the highest tenacity for both BC and NC fibers, reaching 75.0 ± 2.5 mN/Tex and 58.3 ± 2.4 mN/Tex, respectively. These findings demonstrate that solvent selection strongly influences regenerated cellulose fiber properties and supports future development of functional cellulose-based textiles and composite materials.

Mechanical Performance of Lunar Regolith-Based Construction Materials

Sabal Panthee, The University of Mississippi
Early Career Researcher, EPSCoR Research Fellows (#2429027)

This study investigates the mechanical performance of lunar regolith-based construction material mixtures through computational and experimental approaches. First, a numerical investigation was conducted using the commercially available Abaqus finite element software to simulate clay–regolith brick mixtures with varying infill patterns for lunar construction applications. Three configurations, solid, 80% infill, and 60% infill, were evaluated under uniaxial compression and three-point bending. The material was modeled using the Concrete Damaged Plasticity (CDP) model, calibrated with available experimental peak compressive strength data and a constitutive stress–strain relationship derived from the Kent–Park model. The numerical results validate the experimentally observed compression behavior and show that the 80% infill configuration exhibited the highest compressive strength due to improved load distribution, whereas the solid configuration showed superior flexural strength due to its continuous material distribution. Additionally, experimental tests were conducted on another mixture sample composed of Ordinary Portland Cement (OPC), Lunar Regolith Simulant, and Basalt Fibers with varying compositions (M1–M6), along with corresponding numerical analyses. Mechanical performance was evaluated through uniaxial compression and four-point bending tests. Among the tested mixes, M3 exhibited the highest compressive strength, while M5 showed the highest flexural strength.

Circular Waste Resource Recovery and Water Reuse in Great Plains Rural Communities

Prathap Parameswaran, Kansas State University
Focused EPSCoR Collaborations (FEC), General Session (#2521392)

The Circular Waste Recovery and Water Reuse project aims to achieve sustainability in Great Plains rural communities by advancing existing anaerobic bioprocess platforms used to treat livestock waste. Motivating the interest are two key drivers: repurposing livestock waste generated in the Great Plains and capturing and cleaning water from waste to add to the region's water supply. Three major objectives drive the project. First, convert livestock waste into methane and novel products (e.g., organic acids, hydrogen peroxide, tunable-release fertilizers, treated water). Second, further clean treated water to be suitable for livestock consumption. Third, create beneficial impacts for the rural communities. Research supported by the project will develop the anaerobic sequencing batch reactor and anaerobic membrane bioreactor platforms. Advancements in separation science will be made through designing novel membranes. For polishing treated water, the project will incorporate membrane and advanced oxidation processes. Life cycle assessment, techno-economic analysis and stakeholder engagement will articulate the feasibility, value and acceptance of these platforms and products.Although workplan implementation only recently began, broader impacts expected from the four-year project include generating high-quality water in areas where water reserves and quality have declined and producing novel co-products from wastewater.

Life on this Land: Access, Belonging and Persistence in the Yazoo-Mississippi Delta

Taylor Patterson, Mississippi State University
Early Career Researcher, Focused EPSCoR Collaborations (FEC) (#2316382)

This poster examines residents' experiences with the land and landscape of Issaquena and Sharkey County, Mississippi. Utilizing the frameworks of Black Geographies and Black Ecologies, this project investigates how historical and contemporary land usage influences residents' access to and relationship with land. Furthermore, it explores why residents choose to remain in or return to the area, and how their relationship with place shapes how they navigate the region's frequent natural disasters and hazards.

Constructing Research Capacity via Lake Sediment Paleoclimate Reconstructions in New Hampshire

Simon Pendleton, Plymouth State University
E-CORE RII, General Session (#2229696)

The retreat of the Laurentide Ice Sheet (LIS) in the northeastern US following the Last Glacial Maximum (LGM) is well constrained, there is a dearth of climate records over this time. Without these longer records it is challenging to 1) understand the climatic evolution from deglaciation to present, and 2) evaluate the relationship between climate and LIS behavior immediately following deglaciation – which has implication for our modern and future world.To address these questions, we developed a collaboration with partner institutions with the goal of 1) learning new biogeochemical analysis techniques, 2) building similar research capacity at our home institution, 3) providing hands-on research experience to Primarily Undergraduate Institution (PUI) students, and 4) generating a more complete reconstruction of climate throughout the Holocene.We analyzed biomarkers from a lake sediment core from the White Mountains of New Hampshire that extends back ~12,600 years – just after deglaciation of the landscape. We reconstructed temperature and hydroclimate using branched glycerol dialkyl glycerol tetraethers (brGDGTs) and the hydrogen isotopic composition ($\delta 2H$) of preserved plant waxes, respectively. During this project we developed partnerships with CU Boulder and the Univ. of Wyoming. The project team members learned techniques, how to establish similar capacities at their home institution, and fostered networks for future research collaborations.

Environmental hazards in rural Arkansas: Flood exposure and tick-borne disease

Brad Peter, University of Arkansas
Focused EPSCoR Collaborations (FEC), General Session (#2420405)

Environmental hazards pose a significant risk to both rural and urban communities across Arkansas. This work investigates two distinct hazards, i.e., floods and tick-borne disease (TBD), and identifies the spatial intersection with socioeconomic indicators across the state to map the risk landscape. A 100-year floodplain was used to identify at-risk infrastructure and flood-prone populations, and a species distribution model was used to identify regions exposed to TBD via tick presence. The work integrates multiple datasets including elevation, land-use/land-cover, climate and vegetation metrics, and socioeconomics to analyze hazard susceptibility. Spatial statistics were used to elucidate local-scale clustering of flood/TBD vulnerability to address concerns surrounding exposure and recovery capacity. Findings indicate that urban centers, such as Little Rock, Fayetteville, and Fort Smith contain substantial development in flood-prone zones, though the majority of flood domain intersects with rural and agricultural areas. Similarly, high probability of tick presence is concentrated in rural areas with limited medical access, though exposure is prevalent throughout the state. Ultimately, this research contributes to a broader understanding of flood/TBD risk in Arkansas and facilitates resilience planning by integrating spatial analysis with socioeconomics, providing priority intervention area maps that are driven by spatial data.

Photosynthetic and Yield Variation among Peanut Genotypes to Biochar Amended-Soil Conditions

Fritzner Pierre, Auburn University
Early Career Researcher, EPSCoR Research Fellows (#2316278)

Biochar, a carbon-rich amendment derived from the pyrolysis of organic material, has demonstrated potential to improve soil physical properties, water retention, nutrient holding capacity, and overall plant productivity. This study aimed to understand the physiological and yield responses of peanut to biochar application. The study included 214 peanut genotypes derived from 6 botanical families, one water-saver (AU16-28), and one water-spender line (AU-NPL-17). The biochar was applied at a rate of 6 tons/acre. The experiment was conducted at the Wiregrass Research and Extension Center using a split-plot block design with two replicates in 10-ft double-row plots. The treatments biochar and non-biochar constituted the main plots, and the peanut genotypes were randomized within the main plots. Net photosynthetic rate, stomatal conductance, intrinsic water-use efficiency, and stomatal limitation were measured at 70–80 days after planting, along with pod yield. The results revealed significant genotype and treatment effects, as well as genotype-by-treatment interactions, for all measured traits. Biochar application boosted physiological performance by improving soil properties, thereby positively influencing root development and water uptake. Although no overall biochar effect on yield was observed, genotype-specific yield responses to biochar were observed. Further research is needed to elucidate the mechanisms driving differential cultivar responsiveness to biochar application.

Targeted Defect Passivation in Perovskite Solar Cells by Ammonium Salts with Different Alkyl Chains

Yifang Qi, Jackson State University
Early Career Researcher, Focused EPSCoR Collaborations (FEC) (#2418390)

This work investigates the defect passivation effects of ammonium salts with different alkyl-chain structures and halide anions in perovskite solar cells, aiming to establish a targeted passivation strategy for specific defect types. Four ammonium salts were introduced as interfacial passivators, and their structure–property relationships were examined using morphology characterization, spectroscopic analysis, electrical measurements, and density functional theory (DFT) calculations. The results show that branched alkyl-chain ammonium salts provide more effective passivation than linear analogues, while alkyl-chain structure has a greater impact on device performance than halide identity. DFT analysis further reveals that branched alkyl chains are more effective in passivating lead vacancies (VPb) and formamidinium vacancies (VFA), whereas iodide is more effective than bromide and chloride for passivating iodide vacancies (VI). Among the tested materials, tert-octylammonium iodide (tert-OAI) delivered the best performance, achieving a champion power conversion efficiency of 25.49% with improved open-circuit voltage, reduced defect density, and enhanced stability. These findings clarify the relationship between ammonium salt structure and defect-selective passivation, and provide guidance for the design of efficient and stable perovskite solar cells.

Advancing Society and Environment through Plastics-centered Research

Zhe Qiang, The University of Southern Mississippi

Focused EPSCoR Collaborations (FEC), General Session (#2316351)

Plastic pollution and microplastic contamination are growing environmental and public health concerns, especially in coastal regions such as Mississippi and Alabama. The ASPIRE (Advancing Social and Environmental Equity through Plastics Research: Education, Innovation, and Inclusion) project addresses these challenges through an interdisciplinary program that integrates polymer science, environmental monitoring, engineering, and public health. The project focuses on three main areas: understanding the presence and impacts of microplastics in aquatic systems and communities, improving recycling strategies for mixed polyolefin plastics such as polypropylene and polyethylene, and developing sustainable bio-based polymer materials from agricultural byproducts. ASPIRE has developed an advanced fluorescence-based flow cytometry method to detect and characterize micro- and nano-plastics in environmental samples with high sensitivity and throughput. At the same time, the project is creating new compatibilization and processing strategies to improve the recyclability and performance of mixed plastic waste. It also explores the use of pecan shell-derived lignin to create recyclable polymer networks as renewable, high-performance materials. Beyond research, ASPIRE supports workforce development, student training, and community engagement through outreach, sustainability education, and regional partnerships.

Thermophysical behavior of AL6061/AL7075 joints fabricated with Additive Friction Stir Deposition

Caleb Quantson, Southern University System
Early Career Researcher, Focused EPSCoR Collaborations (#2118756)

This study investigates the thermophysical behavior of dissimilar Al6061 and Al7075 joints fabricated using Additive Friction Stir Deposition (AFSD), a solid-state additive manufacturing process. These lightweight alloys are widely used in aerospace and automotive applications, but mismatched thermophysical properties can challenge joint integrity and thermal management. Al6061 and Al7075 substrates were joined using AFSD under controlled parameters, with material flow, interface bonding, and thermal cycles characterized. Thermophysical properties, including thermal conductivity, specific heat capacity, and thermal diffusivity, were evaluated up to 250°C using laser flash analysis. Results showed a slight decrease in thermal diffusivity after T6 heat treatment due to microstructural homogenization, a consistent increase in specific heat capacity with temperature that converged after aging, and an increase in thermal conductivity post-heat treatment due to reduced defects and precipitate redistribution. These findings demonstrate AFSD's effectiveness in producing dissimilar aluminum structures with tailored thermal properties for advanced applications.

Soil Hydraulic Behavior as Influenced by Long-term Tillage and Nutrient Management

Md Jiad Ur Rahaman, Western Kentucky University
Early Career Researcher

Farmers face critical decisions regarding tillage and fertilizer combinations, as these practices substantially impact soil structure, hydro-physical characteristics, and crop performance. To optimize these decisions, a long-term (20-year) field experiment is being conducted at Western Kentucky University's Agricultural Research and Education Complex to evaluate how different tillage practices and nutrient sources influence soil structure and hydro-physical properties of a Crider silt loam soil. The study utilizes a randomized complete block design with four replications and a 2×3 factorial arrangement: two tillage types (conventional, no-till) and three nutrient sources (inorganic fertilizer, half poultry litter and half inorganic, full-rate poultry litter). Following corn harvest in fall 2025, undisturbed soil cores (8 cm diameter and 5 cm height) were collected from the experimental plots at 0-5 cm depth. These samples are being analyzed for soil physical and hydraulic attributes such as soil moisture characteristics, plant available water, and saturated hydraulic conductivity. Results will provide insights into how different tillage practices and nutrient sources affect soil structure, informing sustainable management practices to optimize soil physical health and long-term crop productivity.

Assessing Land Use Change, Nutrient Export, and Fish Assemblages in Upper Barataria Basin

Taherunnesa Rahi, Louisiana State University
Early Career Researcher, Focused EPSCoR Collaborations (FEC) (#005506)

Inland fisheries contribute to Louisiana's economy, yet are threatened by water quality degradation driven by anthropogenic activities. One such system is Lac des Allemands, which is impaired by low dissolved oxygen and considered hypereutrophic and lacks comprehensive baseline studies. This study integrates recent water quality and fish community assemblages and floating vegetation extent alongside land use change analysis and the InVEST Nutrient Delivery Ratio model to estimate nutrient export and retention and stream and canal density assessments to evaluate hydrological connectivity. Results demonstrate urban expansion (+2,934 ha) largely replacing cropland, while woody wetlands also declined (−415 ha). Nutrient-export hotspots are concentrated in developed and agricultural areas along levee margins, and canalization disrupts natural hydrological connectivity, reducing wetland nutrient retention. Lake observations indicate persistent hypereutrophic conditions, with elevated TN (1.39–1.55 mg L^{-1}), TP (0.13–0.28 mg L^{-1}), and cyanobacteria exceeding harmful bloom thresholds (>100,000 cells mL^{-1}). Dissolved oxygen showed seasonal variability with hypoxic spring conditions, while fish abundance declined after 2022. Floating vegetation cover remained low (<1%) throughout the study period. Together, these results provide a recent baseline for Lac des Allemands and highlight the need for watershed nutrient management and restored hydrological connectivity.

Pinewood engineered biochar as a solution to trace metal leaching management: Mitigating Cu (II) and Zn (II) from poultry litter under saturated porous conditions

Atiqur Rahman, Auburn University
Early Career Researcher (#2316278)

Trace metal transport from agricultural landscapes via surface runoff and leaching to waterbodies can degrade water quality and ultimately threaten aquatic organisms. Innovative strategies need to be developed that can prevent the off-site transport of trace metals in agricultural soil. Therefore, this study aims to investigate the immobilization of trace metals (e.g., copper (Cu) and zinc (Zn))leached from extracted poultry litter (PL) solution using raw and engineered biochar in saturated porous media. The specific objectives include: (i) to assess the dose-response relationship between the biochar doses and PL and the extent of trace metal immobilization, and (ii) to evaluate the influence of different biochar types on trace metal immobilization. The treatments include (a) raw biochar (PBC) with different application rates (2.5 and 5% of total weight of the sand) (b) Mgmodified biochar (Mg-PBC) with different application rates (2.5 and 5% of total weight of the sand) (c) Fe-modified biochar (Fe-PBC) with different application rates (2.5 and 5% of total weight of the sand), and (d) control. Results showed that Cu and Zn deposition increased with biochar application rate. Overall, Mg-PBC showed the maximum Zn retention in saturated porous columns, while Cu retention was enhanced with PBC, Fe-PBC, and Mg-PBC, particularly at the 5% application rate. These results show that metal–modified biochars enhance metal immobilization and reduce leaching from PL-amended soils, supporting sustainable soil and nutrient management practices in poultry-based agriculture.

I-Canopy: A Scalable IoT Sensor Platform for High-Resolution Microclimate Monitoring

Rafael Rangel de la Tejera, University of Iowa
Early Career Researcher, Focused EPSCoR Collaborations (FEC) (#2420405)

We present the I-Canopy system, a low-cost, solar-powered Internet of Things (IoT) sensor platform designed for high-resolution monitoring of environmental conditions. The sensors measure air temperature, humidity, and pressure, as well as soil temperature and moisture, in real time, with data transmitted via Wi-Fi or Long-Range (LoRa) communication, for deployment in both rural and urban areas. The main goal is to capture microclimate variability and develop ground-measured datasets for environmental monitoring, agricultural decision-making, and data-driven modeling. Preliminary results show that the system can reliably capture environmental variability year-round across different conditions. This platform enables scalable environmental monitoring for machine learning applications, while also contributing to research infrastructure, STEM education, and community-focused initiatives.

Generative Engine Optimization (GEO) to enable Research Visibility for Grant Projects and Teams.

Emily Regalado, Montana State University
Early Career Researcher, Track-I (#2242802)

Many grant and project teams within EPSCoR struggle with communication and dissemination of grant and project work within search engines and other modern retrieval interfaces. A lack of visibility in these systems can mean that grant and project work is not understood or even unknown. Our current research looks at how grants and project teams can start to address these questions using emerging optimization techniques.Generative Engine Optimization (GEO) is a discipline within Search Engine Optimization (SEO) with a focus on the methods of how Large Language Models(LLM) gather and distribute data to public users. With AI-generated responses capturing a growing share of search engine queries, there are concerns of the effectiveness of traditional SEO and specifically how AI Overviews impact the web pages visited. Concerns of decreased research visibility have driven this study and how projects within academic spaces are perceived between scholars and the connections provided through accessible searches. This research examines the mechanisms by which LLMs aggregate data and the resulting impact on organic search visibility, including the use of structured data, external source preparation, and altered site architecture. These methods provide actionable frameworks for grant and project teams to use within research projects for application and contribute to the evolving discourse on the future of SEO operations with the purpose of increasing researcher and project visibility.

Leveraging AI Systems in the Prewriting Process for NSF Grants

William Repetto, University of Delaware
E-CORE RII, Early Career Researcher (#2438144)

This poster presents a step-by-step process for using Generative AI (GenAI) tools in the prewriting process for NSF Grants. Specifically, it shows how researchers can use Atlas.ti and ChatGPT, two popular GenAI tools, to build a comprehensive understanding of how previously funded projects have discussed methods, outcomes, and broader impacts. Researchers will leave this poster knowing how to distill these insights into a single, brief document. Crucially, researchers will learn how to create these documents using only Security Level 1 information, meaning all the data is publicly available and no personal information about the researcher or their work needs to be disclosed.The poster also explores the importance of leveraging this technique within EPSCoR jurisdictions, at minority serving institutions, and in the mission of advancing science in society. It concludes with a section exploring the future implications of deploying AI systems in the research development process.

Expanding Pathways for Rural Students into Engineering

Julie Robinson, University of North Dakota
EPSCoR Research Fellows, General Session (#2531729)

To meet future challenges, North Dakota (ND) and the wider region must develop a strong STEM workforce that draws on the under-utilized strengths of rural communities. Community-Based Participatory Research (CBPR) across all levels of engineering education, particularly K - 12, can create findings that open pathways into engineering and foster ND's next generation of engineers committed to improving their communities. This Research Fellows program aims to enhance the research capacity of PI Robinson and the Center for Engineering Education Research at the University of North Dakota (UND), develop individual and collaborative research that advances the engineering education field, and promote improved engineering education for ND students. A pilot study will investigate how a collaborative, community-based engineering learning experience that connects to local contexts and knowledge impacts teachers' self-efficacy to teach engineering. A partnership with Montana State University faculty will provide mentorship for the Research Fellows in CBPR in STEM, support implementation of a pilot study in a rural ND school using CBPR to co-create a community engineering learning experience, and develop inter-institutional partnerships for future shared research in engineering education. PI Robinson will bring knowledge and application of CBPR to the UND research community to support STEM faculty in expanding their engagement with rural communities through research.

Spatial And Temporal Patterns And Contributing Factors To Crash Severity in Minnesota

Navodi Rodrigo, University of North Dakota
Early Career Researcher

Vehicle crashes remain a major global concern, causing substantial loss of life, injuries, and wide-ranging economic and social consequences. To address this issue, governments are implementing policies aimed at improving road safety and advancing sustainable transportation systems, with the long-term goal of achieving zero fatalities and injuries. A critical step in these efforts is understanding the underlying causes of crashes. This study examines the spatial and temporal patterns of vehicle crashes in Minnesota, with a focus on factors influencing crash severity. Spatial analyses, including global Moran's I, Getis–Ord Gi* hotspot analysis, and kernel density estimation conducted in ArcGIS Pro, reveal significant crash concentrations near metropolitan areas such as the Twin Cities and Duluth. Additionally, ordinal logistic regression identifies key factors associated with increased crash severity, including impaired driving due to alcohol or drugs, physical disabilities, clear weather conditions, and speeding. The findings contribute to the development of a robust crash prediction model, supporting strategies to reduce the socio-economic impacts of fatal crashes and enhance road safety in Minnesota.

Lessons Learned by Bridging E-CORE and E-RISE RII Themes through Partnerships in Public Education

Kennedy Rubert-Nason, University of Maine at Fort Kent
E-CORE RII, General Session, (#2412131, 2416915)

In 2024, the University of Maine System and partnering organizations initiated E-RISE RII (Maine-FOREST) and E-CORE RII (Maine-SMART) projects. Both support rural and tribal resilience through interventions in education. This initiative connects Theme 3 of Maine-FOREST (Rural & Tribal Resilience) and Core 3 of Maine-SMART (STEM Education and Workforce Readiness) by developing and testing innovative approaches to education that empower people in rural and tribal communities with STEM, multicultural, and leadership skills to build economic and social resilience. Collaboration with Wabanaki cultural knowledge sharers and a transdisciplinary team of scholars informed development of a critical learning framework termed the "ecopedagogy of human-Earth relationships." The Maine-BRIDGE program, developed by the Maine Math and Science Alliance to pair university scholars with secondary school teachers, facilitated dissemination of this learning framework and salient workforce skills in technology, multiculturalism, research and leadership to teachers and youth. Challenges included communication, implementing protocols and training over long distances separating Maine's rural communities. By bridging themes across EPSCoR RII projects, this initiative leverages a novel variant of ecopedagogy to empower secondary school teachers to train their students in technologies, multicultural and leadership skills that support economic and social resilience in rural and tribal communities.

Understanding Coral Disease Across Scales: From Reef Ecology to Microbial Genomics

Ewelina Rubin, University of Guam
Early Career Researcher, Track-I (#1946352)

Coral diseases characterized by rapid tissue loss are increasingly reported across Indo-Pacific reefs, yet their causation remains poorly understood. My research integrates disease ecology, microbial community analysis, and comparative genomics to investigate microbial drivers of coral disease in reef ecosystems. Long-term monitoring and lesion tracking show that disease dynamics vary across reef environments and are influenced by host population structure and local conditions. Microbiome analyses of diseased corals, including Porites cylindrica and Acropora pulchra, reveal a shift from stable communities dominated by Endozoicomonas in healthy tissue to highly variable assemblages enriched in opportunistic taxa. Comparative genomic analyses of coral-associated Vibrio isolates further demonstrate diverse virulence gene repertoires and mobile genetic elements, highlighting the role of horizontal gene transfer in shaping pathogen potential. Together, these results support a framework in which coral disease emerges from interactions among host biology, environmental conditions, and dynamic microbial communities rather than from a single pathogen. Future work will integrate reef-scale monitoring, microbiome dynamics, and pathogen genomics to advance understanding of coral disease and support collaborative reef health research in Pacific island ecosystems.

Diffusion-Driven State Space Models

Jack Ruder, Montana State University – Bozeman
Track-I (#2242802)

In many domains, practitioners seek models that produce accurate forecasts while faithfully capturing latent system dynamics.Existing approaches typically sacrifice one of these goals: deep state space models often assume Gaussian latent transitions, limiting fit and forecasting, while diffusion models are highly expressive but lack principled inference for the underlying dynamics.To combine the strengths of both, we introduce the Diffusion-Driven State Space Model (DDSSM), which replaces the conventional Gaussian transition distribution with a diffusion model.Our DDSSM resolves the open problem of how to jointly train an autoencoder and a diffusion model on sequential data, thereby extending the literature on latent diffusion models for time series.Moreover, we find that the DDSSM empirically outperforms a state-of-the-art deep SSM at fitting and forecasting a simulated time series with multimodal transitions.We outline in-progress applications of our work to modeling wildfires and controlled burns. Our model is well suited to this setting: fire-spread data is spatio-temporal, exhibits highly complex dynamics, and has noisy/occluded observations.

Terrestrial Groundwater Flux Supplies Significant Nutrient Loads to Gulf of Alaska Estuaries

Aeon Russo, University of Alaska
Track-I (#2344553)

Coastal aquifers are critical to marine ecosystems, supplying disproportionately large fluxes of nutrients and solutes through groundwater discharge. Yet these contributions remain poorly quantified in high-latitude regions undergoing rapid deglaciation. This study integrates high-resolution geophysical surveys, continuous groundwater monitoring, and seasonal water sampling to quantify nutrient delivery from terrestrial groundwater to the Gulf of Alaska. We find that groundwater contributes roughly 28% of the nutrient budget to Kachemak Bay, a highly productive estuary of major economic importance. Localized hotspots of concentrated discharge likely enhance species abundance, biomass, and overall productivity, underscoring the need to incorporate groundwater-driven inputs into future ecological models and mariculture site-suitability assessments.

Co-producing a Climate Futures Assessment for the Snake River Headwaters in Wyoming

Caitlin Ryan, University of Wyoming
Track-I (#2149105)

The Wyoming Anticipating the Climate-Water Transition (WyACT) project at the University of Wyoming aims to enable communities to anticipate and prepare for future changes in water availability. Climate projections signal unprecedented challenges for the Snake River

Headwaters in northwest Wyoming, demanding proactive decision-making. To support local adaptation planning, a team of more than 40 WyACT researchers from a dozen disciplines is developing the Snake River Headwaters Futures (SRHF) Report — a resource designed to help community partners in the Upper Snake understand the range of possible futures that could characterize the system by mid-century.The SRHF Report examines the region's linked socio-ecological system across three sections. First, it documents how climatic, hydrological, ecological, and socioeconomic conditions have changed in recent decades, synthesizing new and existing research to establish a baseline for contextualizing future change. Second, downscaled climate model projections characterize plausible futures with respect to precipitation, temperature, and seasonal snowpack, informing scenario narratives that help partners envision and plan for mid-century conditions. Finally, a forward-looking roadmap supports the transition from scientific insight to informed, community-led decision-making and adaptation.

Satellite Calibration of Water Turbidity in Glacial Watersheds in the Gulf of Alaska

Muhammad Saffiullah, University of Alaska Anchorage
Track-I (#2344553)

Suspended glacial sediment increases turbidity in river networks and proglacial lakes across the Gulf of Alaska. This sediment disrupts aquatic food webs by reducing feeding rates of visual predators like salmon. The Gulf of Alaska supports one third of the world's wild salmon and is highly glacierized, resulting in high turbidity variation across rivers and coastal margins. We address this by estimating turbidity using Landsat and Sentinel-2 imagery at two glacial estuary sites in Southeast Alaska: Mendenhall Lake and the Herbert-Eagle Estuary. Using Google Earth Engine, we develop an automated scene-filtering pipeline that removes cloud-contaminated imagery, supplemented by targeted manual removal of low-tide scenes for the Herbert site. We then calibrate regression models that link field turbidity measurements to satellite-derived spectral indices. The Normalized Difference Turbidity Index (NDTI) predicts log-transformed turbidity best at both sites, explaining 73% of variance at Mendenhall and 76% at Herbert. These calibrated models enable historical reconstruction of turbidity over larger spatial extents than field sampling alone allows, with implications for understanding how glacially-driven turbidity affects salmon feeding behavior and the fisheries communities depend on.

Louisiana Bio-Electric Fuel Incubator: Liquid Transportation Fuels from Agricultural Residues

Ingmar Schoegl, Louisiana State University
E-RISE RII (#2446177)

The project "Use of a Louisiana Bio-Electric Fuel Incubator to Create Liquid Transportation Fuels from Agricultural Residues" establishes a statewide initiative to convert agricultural residues into liquid transportation fuels using electricity-enhanced processes. Louisiana produces abundant biomass byproducts that are currently underutilized, while demand for sustainable, domestic fuels continues to grow. The project integrates thermochemical conversion with electrocatalytic upgrading to improve carbon utilization and overall process efficiency. Electricity is used to transform liquid and gaseous intermediates into higher-value fuel components, enabling more complete use of biomass-derived streams.Bench-scale experiments provide rapid data generation, while data-driven modeling and machine learning guide process optimization and accelerate discovery. Techno-economic analysis evaluates cost, scalability, and market potential to identify viable deployment pathways. The effort is supported by a coordinated, multi-institutional collaboration of Louisiana universities and community colleges.In parallel, the project expands research infrastructure, supports faculty development, and integrates workforce development with hands-on education and STEM outreach. By linking research, education, and industry outreach, this initiative builds capacity for bio-electric fuel technologies and positions Louisiana as a leader in sustainable energy innovation.

Enhanced thermal and mechanical properties of PE and PP blends using self-assembling small molecules

Armin Seyedesfahani, Auburn University
Focused EPSCoR Collaborations (FEC) (#2316351)

Polyethylene (PE) and Polypropylene (PP) are widely used plastics. Their similar physical properties make them difficult to separate during recycling, often end up in a combined waste stream. Moreover, they are thermodynamically incompatible, resulting in products with poor properties. In this study, a self-assembly mechanism of a sorbitol derivative is used to improve thermal and mechanical properties of PE/PP blends. One of the characteristics of sorbitol derivatives is that they can form a fibril network structure during the cooling process after melting. Differential scanning calorimetry (DSC) thermograms demonstrated that sorbitol derivatives disrupt the co-crystallization in PE/PP blends and exhibited distinct and individual crystallization behavior. The incorporation of sorbitol derivatives increases the crystallization temperature of PP regardless of mixing order, confirming their role as nucleating agents and enhancing PP crystallinity. Rheological measurements show distinct increases in viscosity during the cooling process that align with the DSC crystallization behavior and confirm the nucleating effect of sorbitol derivatives in PP. Moreover, mechanical measurements show that the incorporation of sorbitol derivatives improves Young's modulus and yield strength, and samples with higher PP indicates higher Young's modulus and yield strength. Overall, both sorbitol derivatives and PP content play key roles in improving blend performance.

Is lower physical activity associated with higher perceived stress and poor sleep in the Gulf South?

Bindu Sharma, The University of Southern Mississippi
E-CORE RII (#2316351)

Poor sleep quality, low physical activity, and high perceived stress are common among U.S. adults and increase the risk of chronic disease and early mortality. Physical activity supports mental health and sleep, but findings are inconsistent and limited to specific groups, highlighting the need for research across U.S. regions. This study aims to examine the associations among physical activity, perceived stress, and sleep quality among adults in the Gulf South. A quantitative cross-sectional study was conducted as part of the Advancing Social and Environmental Equity through Plastics Research: Education, Innovation, and Inclusion (ASPIRE) project. Data were collected using online surveys through REDCap. A total of 214 adults aged ≥18 years were included. Physical activity, perceived stress, and sleep quality were measured using the IPAQ, PSS, and PSQI. Participants had a mean age of 40.1 years (SD =14.79), and 82.2% were female. The mean perceived stress score was 18.32 (SD = 6.41), indicating moderate stress. The mean sleep score was 5.83 (SD=3.27), indicating poor sleep. Mean physical activity was 3378.91 MET-minutes/week, indicating a high level of activity. No significant associations were found between physical activity and sleep quality ($r = -0.037$ $p = 0.582$) or perceived stress ($r = 0.096$, $p = 0.164$). Together, these findings suggest that physical activity was not significantly associated with stress or sleep; additional studies are needed.

Sagebrush-Derived and Task-Specific Molecular Scaffolds for Extraction of Critical Materials

Kavita Sharma, Idaho State University

Securing a domestic supply of critical materials is essential for U.S. energy independence and national security. Lanthanides such as neodymium (Nd), yttrium (Y) and dysprosium (Dy) are vital for advanced technologies, yet the United States remains heavily dependent on foreign sources. This project focuses on developing sustainable, bio-derived materials for the selective extraction of these elements from Idaho-based waste streams, including industrial waste, mining tailings. A key innovation of this work is the use of Artemisia tridentata (big sagebrush), an abundant native shrub rich in bioactive compounds such as sesquiterpene lactones, flavonoids, and phenolic acids. Prior studies have identified major lactones, including leucodin, matricarin and desacetylmatricarin, which contain oxygen-rich functional groups suitable for metal coordination. Building on this foundation, we will synthesize sagebrush-derived biopolymeric frameworks with tailored oxygen- and nitrogen-donor ligands to enable selective binding of lanthanides.In parallel, task-specific ionic liquids (TSILs) with carbamate- and carbonate-functional groups will be developed to enhance extraction efficiency and selectivity. The performance of these materials will be evaluated through systematic extraction studies, including metal binding capacity, selectivity in complex mixtures, and reusability. This work transforms an abundant regional biomass into a high-value platform for critical mineral recovery.

Water Yield Trends in The Red River Basin: Implications for Climate Resilience in Oklahoma

Sharmin Siddika, Louisiana State University
Focused EPSCoR Collaborations (FEC) (#2316367)

Water availability in semi-arid regions is threatened by climate variability, land use dynamics, and growing water demand, highlighting the need for long-term, spatially explicit management planning. This study applies the InVEST model to the North Fork Red River Basin draining to Lake Lugert-Altus, the main water source for Jackson County, Oklahoma. Using multi-decadal climate and land use data for five representative years (1985, 1995, 2005, 2015, and 2023), we analyzed hydrologic responses to climate variability and identified priority sub-watersheds relevant to regional water management. Model calibration and sensitivity analyses highlighted the strong influence of subsurface routing parameters on baseflow estimation. Validation against observed streamflow demonstrated robust model performance, with simulated quickflow corresponding with observed discharge (R^2 = 0.86–0.91) and Nash–Sutcliffe efficiency values between 0.71 and 0.88. Baseflow separation (α = 0.850, BFI_{max} = 0.20) using the Eckhardt method indicated that streamflow in the basin is predominantly runoff driven, with limited groundwater contributions consistent with semi-arid hydrologic behavior. Results demonstrate strong spatial variability in water yield components, with higher quickflow, baseflow, and recharge concentrated in downstream and southeastern sub-watersheds contributing to the Lugert-Altus reservoir.

Toward Simulating Soil Water Dynamics Under Sprayable Biodegradable Mulches

Manavjot Singh, Kansas State University
Early Career Researcher (#2119753)

The FAO has formally recommended replacing conventional plastic mulches with biodegradable alternatives to curb persistent plastic waste in farmland. Over the past decade, the interest has shifted towards biodegradable films and, more recently, the sprayable biodegradable mulches (SBM). The present study investigates the impact of a novel SBM, BioWRAP, on soil moisture and evaporation using soil column experiments and aims to simulate this impact using mechanistic approaches. First, we used the HYDRUS-1D model to represent the mulch by replacing the surface layer with a material whose hydraulic parameters replicate the effect of BioWRAP on moisture. The calibrated model performed well under bare-soil conditions (Nash-Sutcliffe efficiency of ~0.9) and predicted evaporation under SBM ($r2 > 0.95$). The SBM reduced the cumulative soil evaporation by ~40% compared to bare soil over the study period, thereby retaining more moisture. In the second approach, a numerical solution to the Richards equation for water movement under variably saturated conditions was developed, utilizing Crank-Nicolson implicit linearization approximation to incorporate SBM as a boundary condition. This more detailed approach aims to capture SBM-specific properties. Together, these modeling efforts highlight the need for specialized modeling frameworks to account for interactions between SBMs and soil and lay a foundation for further research to optimize biodegradable sprayable technologies.

Materials Innovation for Arkansas Priorities: Energy, Health, and Workforce Development

Noureen Siraj, University of Arkansas at Little Rock
Focused EPSCoR Collaborations (FEC)

The Siraj Research Group at the University of Arkansas at Little Rock focuses on the design and development of advanced materials for applications in energy, electronics, and biomedicine. Our research primarily centers on two classes of materials: ionic materials/nanomaterials and conductive carbon-based materials. These materials are engineered for diverse applications, including electrodes and separators for next-generation batteries, stretchable and conductive electrodes for biocompatible flexible electronic devices, and highly selective nanomaterials for targeted tumor therapy to reduce the adverse side effects of chemotherapy.These research efforts align closely with the 2024 Arkansas Science & Technology Plan, which identifies lithium, population health, and advanced energy as key priority areas for statewide growth. A central mission of the Siraj Lab is to train, educate, recruit, and retain a diverse workforce through effective workforce development initiatives. By integrating research and education, we aim to strengthen STEM capacity, cultivate a next-generation workforce, and deliver innovative technologies.Ultimately, our work supports Arkansas's strategic vision by fostering technological advancement and contributing to economic growth at both the state and national levels. This poster highlights our ongoing projects and seeks to establish new collaborations, particularly with EPSCoR states.

Air, Water, and Land Perceptions, Resilience, and Data on Tribal Lands

Zane Smith, University of Oklahoma
Focused EPSCoR Collaborations (FEC) (#2418311)

Variations in climatology present uneven and often asymmetrical risks to communities across different geographies. These risks may be physical, such as extreme weather and natural disasters, or social, including disparities in infrastructure, resources, and adaptation. This project examines risks experienced by Pueblo tribes in New Mexico and the Chickasaw Nation in Oklahoma, with broader applications across the U.S. This study is guided by two primary questions: (1) How do air, water, and land-related concerns vary across communities, and (2) how do these concerns compare to observed environmental conditions? To address these questions, this project integrates geospatial analysis with survey data. Air and water observation networks are mapped relative to tribal boundaries to assess coverage. Multi-wave survey data from MSIS-Net in Oklahoma are analyzed to evaluate patterns in air, water, and land concerns (including extreme weather), as well as prioritization across respondents and regions, focusing on participants self-identified as American Indian/Alaska Native and/or residing within federally recognized Tribal jurisdictions. Together, these approaches link environmental information access with perception and decision-making. Preliminary results suggest meaningful spatial variation in both observational coverage and reported concerns. Anticipated outcomes include data visualization tools to support informed, locally relevant decision-making and improve resilience.

The Virgin Islands Center for Autonomous Research

Tyler Smith, University of the Virgin Islands
E-RISE RII (#2446008)

This E-RISE RII project will establish the Virgin Islands Center for Autonomous Research (VICAR) at the University of the Virgin Islands (UVI) and builds research capacity in the U.S. Virgin Islands (USVI) as a leader in automated marine ecosystem research, education, and workforce development. The project goals are: (1) build infrastructure supporting automation in marine ecological and physical research; (2) accelerate research, restoration, and management of coral reef, mangrove, and pelagic ecosystems; and (3) develop a sustainable STEM ecosystem across all educational levels in the USVI. Research will develop automated survey techniques using autonomous underwater vehicles (AUVs), 3D modeling, and artificial intelligence (AI) -based classifications to address timely hypotheses of reef function and stability. This research will underpin the staged development of VICAR's Integrated Undersea Survey (VICARIUS) platform, a core knowledge base designed to evolve with emerging technologies. Once developed, VICARIUS' increased resolution and throughput capabilities will be directed towards reef surveillance and research of mangrove forests and open ocean. Come join me to discuss these exciting development in the first year of the program and see other presentations on output from the USVI's current E-RISE project.

Building Microbial Factories For Synthesizing Trifunctional Fatty Acids

Tim Stanley, Iowa State University
Track-I (#2242763)

Many economically and chemically significant molecules are difficult to synthesize using traditional chemical techniques. One example is trifunctional fatty acids (TFAs), a class of molecules that are difficult to traditionally synthesize but have utility in polymer synthesis. The three functional groups provide a variety of chemically active sites that can be utilized in radical polymerization. Biosynthesis in microbial chassis is emerging as a tractable method to manufacture these chemicals. TFAs can be manufactured in E. coli through the expression of heterologous genes encoding a fatty-acyl desaturase, a ferredoxin, and a cytochrome P450 monooxygenase. TFA chain length can be controlled by expression of a heterologous thioesterase. Further genetic engineering of related pathways can increase

TFA production to appreciable levels. Engineering trifunctional fatty acid-producing strains of E. coli could provide an economically viable and renewable source of monomers for additive or bioplastic manufacturing.

Drone Interception via EDMDc-Based Model Predictive Control

Adrian Stein, Louisiana State University
E-CORE RII (#2437963)

This work presents a data-driven control framework for real-time UAV trajectory tracking and autonomous interception using Extended Dynamic Mode Decomposition with control (EDMDc) and model predictive control (MPC). A lifted linear model is identified from nonlinear quadcopter data using a structured set of observables, enabling accurate prediction of system dynamics while retaining computational efficiency. The learned model is embedded within a constrained MPC formulation, allowing real-time optimization under actuator limits.Simulation results demonstrate that EDMDc-based MPC significantly improves tracking accuracy and reduces interception time compared to classical PID and linearized MPC approaches, particularly in nonlinear and aggressive maneuvering scenarios. Preliminary software-in-the-loop validation further confirms the feasibility of the approach for practical deployment. These results highlight the potential of data-driven predictive control to enhance performance and reliability in autonomous UAV applications.

Advancing Kentucky's Climate Services Through Service Learning and EPSCoR Supported Research

Zachary Suriano, Western Kentucky University
Track-I (#2344533, 2438270)

Climate services, the building and applying an understanding of the climate system to inform community-driven needs, is a growing focus within the climatological discipline. Decision makers across sectors increasingly require climate data and products to inform their actions, giving rise to the need for climatologists to develop and curate this information. Here we present a synopsis of ongoing climate service efforts at the Kentucky Climate Center at Western Kentucky University that are being enhanced through the research and development supported by NSF ESPCoR: Kentucky's Track 1 award "CLIMBS" and a co-funded NSF CAREER award. Efforts, to-date, have focused on three complementary but distinct realms of (a) service learning for climate services, (b) dataset development and curation, and (c) transformative research. The synergistic interaction of these realms has greatly enhanced the development of the climatological understanding necessary for building the tools and products that inform decision-makers actions. Further, this approach has led to greater student engagement in the process, providing a more enriching experience for both undergraduate and graduate students training in the atmospheric, environmental, and disaster sciences.

Spatiotemporal Interactions: Social Vulnerability and Land Use Change in Gulf Coast Communities

Annyca Tabassum, The University of Alabama
E-RISE RII, 330362-05

Understanding the interplay between social vulnerability and land use/land cover (LULC) change is critical for effective flood risk mitigation in coastal regions facing environmental stress from urban expansion, flood frequency, and coastal proximity. This study examines how shifts in the Social Vulnerability Index (SoVI) correspond with LULC transformations across eight counties and parishes in three Gulf Coast states: Mississippi (Hinds, Rankin), Louisiana (Lafayette, Vermilion, St. Martin, Iberia), and Alabama (Mobile, Baldwin). Employing a multi-temporal framework, SoVI scores are calculated at five-year intervals from 2005 to 2023 using U.S. Census and American Community Survey data. LULC classifications derived from the National Land Cover Database (NLCD) capture changes in urban cover, impervious surfaces, wetlands, and forest extent. Principal Component Analysis (PCA) generates SoVI scores, while GIS-based spatial analysis and change detection techniques quantify LULC trends. This cross-state comparative analysis identifies spatial patterns linking land use development to shifts in community vulnerability, highlighting critical zones where environmental transformation amplifies social risk. Findings aim to inform regional flood mitigation strategies and advance resilience planning across Gulf Coast communities.

Hydrometeorological Controls on Streambank Movement along the Smoky Hill River, Kansas

Maryam Tahmasebi Kalesar, Kansas State University
Focused EPSCoR Collaborations (FEC) (#2420405)

Channel margin change can threaten infrastructure, agricultural land, and river corridor stability, but it is still often interpreted mainly in terms of peak flow. In this study, we examine whether event-scale hydrologic conditions derived from sub-daily discharge data help explain observed bankline movement along a short, regulated reach of the Smoky Hill River near Salina, Kansas, and whether antecedent wetness also affects bank sensitivity. Signed bankline change was mapped from NAIP imagery for 2010, 2014, 2019, and 2023 along 100 fixed transects and linked to 15-minute USGS discharge data and NOAA daily precipitation records. High-flow events were identified using a Q90 threshold, and event-scale metrics included excess discharge, hours above threshold, event count, peak discharge, and rising-limb rate. Antecedent conditions were represented using API7, API30, and 72-hour precipitation totals. Bankline change was not unidirectional; movement was small in 2010-2014, strongly outward in 2014-2019, and net inward in 2019-2023. The middle interval also had the strongest discharge forcing, while antecedent wetness indicators showed mixed patterns across intervals. Overall, the results suggest that sub-daily discharge forcing was the main control on bankline movement in this reach, while antecedent wetness likely played a secondary, scale-dependent role.

Humidity and Temperature Effect on the 3D Printed Smart Concrete Columns

Khalilullah Taj, Louisiana State University
EPSCoR Research Fellows (#2429761)

This study investigates the influence of environmental factors on the self-sensing performance of 3D-printed cementitious composites for structural health monitoring. Square 3D printed column samples containing control mortar and self-sensing cementitious composite (SSCC) were fabricated and cured, then exposed to controlled drying cycles and temperature variations from room temperature to 60 °C. Under cyclic compressive loading, changes in electrical resistance were monitored to evaluate the fractional change in resistivity (FCR) and stress sensitivity. The results demonstrate that both internal moisture variation and elevated temperature significantly affect the piezoresistive sensitivity. Although resistance decreased with an increase in humidity and temperature, a better piezoresistive response was captured at the oven-dried low temperature state. The highest stress sensitivity of 1.805 %/MPa at 22.5 C at the lowest water saturation. This study highlights the critical role of environmental effects in the deployment of smart 3D-printed concrete for the monitoring of durable infrastructure.

Using Automated Imaging to Assess Coral Morphology Changes in the USVI

Alexandria Tennant, University of the Virgin Islands
E-RISE RII (#2446008)

Caribbean reefs have been severely impacted by coral bleaching and disease outbreaks. These disturbances have led to an emerging interest in whether coral morphologies resulting from stress and partial mortality influence recovery over time. Coral morphologies range from fragmented, branching, patchy, encrusting, globose, and irregular. These patterns may help predict species-specific resilience after disturbance events. The Virgin Islands Center of Autonomous Research (VICAR) is currently applying several state of the art tools, including Meta's SAM3 and Ultralytics YOLO model frameworks, to label and train AI models to classify coral species. These models are being used to estimate coral abundance from historical imagery across 34 sites in the United States Virgin Islands (USVI) Territorial Coral Reef Monitoring Program (TCRMP). Advanced technology will help evaluate trends in species-specific aspects of coral morphology and partial mortality since 2001. While TCRMP is extensive, this program is limited by the efficiency of image analysis, resulting in coarse metrics and a lack of understanding of coral morphological changes over time. A beneficial byproduct of utilizing SAM3 to assess coral reef relationships over an extended time series is increased efficiency in analyzing large datasets. As a result, it will improve the ability to understand past and future changes in the USVI's coral reef ecosystems and can be applied to coral ecosystems globally.

Machine learning techniques for flood susceptibility mapping in the Rhode Island

Pratik Singh Thakuri, University of Rhode Island
Focused EPSCoR Collaborations (FEC) (#2418378)

This study evaluates the flood susceptibility prediction efficiency of the three different machine learning/bivariate models namely Random Forest, Support Vector Machine and Frequency Ratio. Sentinal-1 SAR imageries before and after floods were processed in the Google Earth Engine following the protocol of UN-SPIDER to generate 2020-2024 flood inventory of the Rhode Island. Sixteen flood causative factors grouped in 4 categories namely topographic, climatic, river and coastlines, vegetation and soil moisture. Spatial data were resampled to 4m resolution to balance the uniformity, details in the ground and the computational load. Several evaluation metrics were employed to assess the model efficacy to model in prediction of flood susceptibility aiming for the robustness of model validation. The evaluation metrics are namely, F1 score, Precision, Accuracy, Recall, Specificity, Kappa coefficient and AUC value and curve. All the models have predicted the flood susceptibility reasonably well. However, among them Random Forest, which is considered as simplistic tree-based machine learning model outperformed others. Although these metrics value are excellent, upon the visual inspection of the flood susceptibility map, a slight overprediction of the flood can be observed specially in flood dense urban areas.

Metabolomics Of Harvested Marine Species Across Environmental Gradients In Alaska

Patrick Tomco, University of Alaska Anchorage
Track-I (#2344553)

In coastal regions of Alaska, harvesting of marine resources is a vital way of life. The continued sustainability of these resources depends largely on our ability to understand and adapt to challenges as they occur, requiring an integrated understanding of the marine species' health and the environmental conditions under which they subsist. The first question that this study helps address is: How do environmental properties associated with land-ocean connections affect the quality of harvested red seaweeds used for personal consumption and trade? To do this, we employed a metabolomics approach to detect and identify the levels of extractable phytochemicals and primary metabolites in red seaweeds collected across field sites in Southeast Alaska. We demonstrate a strong dependence of metabolites linked to amino acid metabolism and protein synthesis on nitrogen bioavailability. We relate metabolite levels to water quality and other physical-chemical parameters at these sites. Secondly, we assess how environmental properties associated with land-ocean connections affect the metabolic health of hardshell clams. To address this, we compared the detectable metabolites in harvested clams across sites that span a gradient of glacial coverage and landscape physical-chemical in Kachemak Bay, Alaska. These studies reinforce the potential of metabolomics as a tool in environmental studies to detect changes in marine species' environmental condition.

CAI-SMART: Collaborative AI-guided Small Molecules Analysis Research and Translation

Boo Shan Tseng, University of Nevada Las Vegas
Focused EPSCoR Collaborations (FEC) (#2521343)

Resulting in an annual loss of trillions of dollars globally, microbes damage infrastructure, contaminate food, and outpace current antibiotics. Discovering new molecules to control microbes remains slow and inefficient. Our EPSCoR-funded collaboration among South Dakota State University, South Dakota School of Mines and Technology, and the University of Nevada Las Vegas is developing an AI-guided platform to accelerate small-molecule discovery to address these challenges. The project integrates computational modeling, mathematics and statistics, AI/ML, and experimental validation to identify compounds that induce bacterial cell death, disrupt biofilm maintenance, and neutralize fungal aflatoxins. A key success has been the establishment of a cross-institutional AI/ML screening pipeline that enables rapid prioritization of candidate molecules for experimental testing. A major ongoing challenge is bridging predictions from computational models into the biological complexity of living systems, particularly for biofilms and toxin-producing fungi. By combining interdisciplinary expertise and shared infrastructure, this project is building scalable approaches for antimicrobial discovery while training students and researchers in AI-enabled biology. These efforts lay the groundwork for new strategies to control harmful microbes and address critical economic and public health challenges.

Nocturnal Physiological and Phytohormone Adjustments of Soybean to Heat and Drought Stress

Lekshmy V Sankarapillai, Mississippi State University
E-CORE RII (#2418231)

Hot and dry conditions are increasingly prevalent in soybean-growing regions, threatening crop productivity. Although these stresses are gaining research attention, their duration-dependent impacts and reproductive potential remain poorly understood. We hypothesized that extended nocturnal physiology and phytohormone adjustments contribute differentially to short-and long-term stress tolerance. To understand these mechanisms, three soybean genotypes were subjected to heat (HS; 38°C, full irrigation), drought (DS; 32°C, 40% irrigation), combined stress (HS+DS; 38°C, 40% irrigation), and control conditions (CNT, 32°C, full irrigation) from full bloom (R2) through seed development in a split-plot design. After 14 days of HS, gas-exchange traits decreased by 15–34%, whereas long-term exposure under HS+DS further decreased by >70%, resulting in a >80% decline in photoassimilation after 42 days. Nocturnal respiration was initially maintained under HS but declined by >30% under prolonged stress, similar to DS and HS+DS. Abscisic acid increased sixfold under DS and HS+DS, while remaining comparable to the control under HS. These changes increased the number of unfilled pods (149%) and reduced yield (89%) under HS+DS. Genotype DS25-1 maintained short-term physiological stability; however, prolonged stress reduced overall performance. All genotypes exhibited susceptibility to combined stress, highlighting the need to improve soybean tolerance to short- and long-term combined stress.

FEC: Empowering Community Resilience with Sustainable Energy and Water Reuse System

Shengnian Wang, Louisiana Tech University
Focused EPSCoR Collaborations (FEC) (#2418390)

The goal of this project is to develop Mobile Energy-Water Reuse Systems (MEWRS) that leverage our research advances in nanomaterials and electrochemistry to provide a safe and reliable water and energy supply at the community level with decentralized systems. Specifically, we are (1) developing a portable energy generation system with a new class of perovskite solar cells with excellent stability and high-power conversion efficiency promoted by the involvement of carbon quantum dots and phase stabilization molecules; (2) designing, fabricating, and testing an energy-efficient, water purification treatment train with an innovative and synergistic combination of sonochemical and electrochemical advanced oxidation process without costly and unsafe added chemicals; (3) integrating and deploying MEWRS for on-site delivery of energy and high-quality potable water to help communities precise and timely adaption to drastic changes. Our education/outreach efforts include (1) recruiting, training, and mentoring junior faculty, postdocs, and graduate/undergraduate students; (2) promoting the participation of students for immersive workshops and camps; (3) transferring technologies through industry and community engagement. These research and education efforts are expected to help improve the vulnerable power and water supplies of communities, thereby enhancing their resilience.

Harnessing Controlled Environment Agriculture to Secure Sustainability and Economic Growth

Jingjing Wang, University of New Mexico

Focused EPSCoR Collaborations (FEC) (#2418345)

Extreme climate events are increasing in frequency and negatively impacting crop production in both industrial and smallholder systems. These events threaten food security and the viability of rural communities. Building community resilience requires technological innovation in crop production. Controlled Environment Agriculture (CEA) offers a promising pathway to enhance food and economic resilience in rural communities. Compared to conventional agriculture, CEA enables year-round production, reduces water use, and shortens supply chains, thus improving food security.However, broader adoption of CEA is constrained by three key gaps: 1) limited foundational knowledge of environment–plant–microbe interactions in CEA systems, 2) insufficient analysis of socioeconomic impacts of CEA, and 3) a lack of a skilled workforce. This project aims to address these gaps with three objectives: identify best practices for secure CEA food production, quantify its socio-economic impacts on our partner tribal communities, and develop novel curricula to prepare a skilled CEA workforce. Our collaborating EPSCoR jurisdictions of New Mexico, South Dakota, and Wyoming include 36 federal reservations, representing some of the most disadvantaged regions in the United States. The project integrates expertise in plant physiology, microbiology, horticulture, engineering, environmental economics, sustainability science, and the applied knowledge of tribal community members and industry partners.

Assessment of Air Quality and Health Disparities in the Rural Mississippi Delta

Serethra Ware, Mississippi Valley State University
Focused EPSCoR Collaborations (FEC) (#2316382)

Climate change presents numerous health-related challenges for rural communities with high levels of agricultural and industrial activity, particularly those associated with cotton ginning. Residents living in proximity to cotton gins may experience increased exposure to airborne particulates (PM2.5 and PM10) from industrial and agricultural sources. These airborne contaminants, combined with emissions from agricultural sources and cotton gins, can contribute to declining air quality and elevate the risk of respiratory issues.This study examines the relationship between proximal location to the local cotton gin and air quality, with a focus on particulate matter and residues released during the process. We aim to identify potential health risks and improve public awareness associated with climate change and air quality.A survey assessment was conducted with 25 participants to assess their knowledge and perceptions of air quality and potential health impacts associated with living near a cotton gin. A qualitative approach was employed to analyze the survey responses. A significant number of the residents suffer from allergies (80%), coughing (60%), and wheezing (52%), shortness of breath, asthma (32%), and bronchitis (23%). These findings reveal the urgent need for long-term air quality monitoring and public health initiatives to enhance knowledge and public health awareness to improve the quality of life for residents who reside in agricultural and high-risk communities.

Developmental Lead (Pb) Exposure Alters Noradrenergic Regulation Of Stress Behavior In Zebrafish

Melanie Wilson, Louisiana State University
Early Career Researcher

Developmental lead (Pb) exposure disrupts stress regulation, yet mechanisms remain unclear. Prior work shows Pb-induced alterations in stress response and noradrenergic (NA) signaling, implicating the locus coeruleus (LC) as a target of Pb. This study investigates how developmental Pb exposure alters LC structure and NA-mediated stress responses. Zebrafish exposed to 75 – 750 µg/L Pb were assessed using behavioral assays. LC morphology and projections to the dorsal telencephalon (DT) were quantified via in vivo fluorescence imaging. Pharmacological challenges using α1- and α2- antagonists evaluated receptor-specific contributions to stress behavior. RNA sequencing of behaviorally stratified larvae examined transcriptional mechanisms underlying phenotypic variability. Pb exposure disrupted LC organization, increased neuron number, and reduced DT innervation. Pharmacological manipulation confirmed conserved NA regulation, with α1 suppressing and α2 antagonism increasing stress responses, indicating receptor subtype-specific sensitivity to Pb. Transcriptomic analysis revealed targeted adaptations in normoactive larvae, including upregulation of immune and adrenergic pathways. These findings demonstrate that developmental Pb exposure disrupts LC/NA circuitry across structural, functional, and molecular levels while revealing compensatory mechanisms that preserve behavioral function. This work provides insight into potential biological mechanisms for therapeutic targets.

Transdisciplinarity, Collaboration, & Communication: Tenets for a New Career Development Program

Jaclyn Witterschein, University of Rhode Island
E-CORE RII (#2433276)

The RI-NEST Career Development Program (CDP) supplements professional development opportunities already available at Rhode Island academic institutions, aiming to strengthen use-inspired research, meaningful science communication, and transdisciplinarity with undergraduates, graduate students, and early career professionals. CDP is a free online program, asynchronous and self-paced, offering a unique collection of modules and badges to build knowledge and encourage collaboration across institutions. Core Competencies include two modules, "Transdisciplinary Ways of Knowing & Being: Art and Science Collaborations" and "Introduction to Science Communication". Additional online modules are in development to earn badge competencies: Art & Design, Scientific Thinking, Communication & Engagement, Leadership & Career Development, and Social Impact & Use-Inspired Research. CDP will strengthen jurisdiction-wide expertise, focusing holistically on aspects critical to developing, applying, and implementing successful projects for a thriving and sustained research ecosystem.

A Collaborative and Interdisciplinary REU Site to Address Microplastics in the Gulf Coast Region

Shenghua Wu, University of South Alabama
EPSCoR Outreach and Workshops (#2450141)

This poster presents an overview of a 10-week summer Research Experiences for Undergraduates (REU) program focused on addressing microplastic pollution in the Gulf Coast region. By adopting a collaborative and interdisciplinary model, the program integrates diverse fields—including materials science, sensor technology, civil infrastructure, biology, marine science, and environmental engineering—to develop practical solutions to regional environmental challenges. Under the guidance of faculty mentors and graduate students, undergraduate researchers engage in hands-on projects complemented by coordinated cohort activities designed to strengthen technical, professional, and interpersonal skills. These experiences include technical writing workshops, industry site visits, guest speaker sessions, and several field trips, all culminating in a final research symposium. Ultimately, by fostering a culture of interdisciplinary collaboration and community engagement, this REU program not only enhances the research experience of participants but also builds meaningful connections with local industries and stakeholders committed to Gulf Coast sustainability and environmental stewardship.

Workshop on Tackling Microplastics and Nanoplastics Challenges in Coastal Ecosystems

Shenghua Wu, University of South Alabama
SSA-Special Studies & Analysis, EWFD-Eng Workforce Development (#2348977)

Microplastics and Nanoplastics (MNPs) are a pervasive and emerging class of environmental pollutants that infiltrate aquatic, terrestrial, and atmospheric habitats, posing a significant risk to ecological stability and human health. Despite growing efforts to identify, monitor, and mitigate these ubiquitous particles, major challenges such as the lack of standard methods for detecting and measuring MNPs, insufficient understanding of the pathway, health, and environmental impact, and weak pathways for translating recent research findings into practical solutions have hindered progress. These challenges are particularly complex in coastal regions such as the Gulf Coast, where environmental exposure pathways and socioeconomic impacts are closely intertwined. This project establishes a multi-state research and workforce development platform through a scientific workshop to identify critical challenges limiting the understanding, detection, characterization, and mitigation of MNPs across the Gulf Coast region. Bringing together experts from multiple disciplines, the project will develop a unified research agenda, standardized methods, and educational resources to improve scientific understanding, support environmental protection, and build workforce capacity. This effort strengthens national readiness to address MNP pollution and contributes to long-term environmental sustainability and technological resilience.

From Classroom to CRISPR: Connecting Teachers with Agriscience and Biotechnology

Mike Wyss, University of Alabama at Birmingham
E-CORE RII (#2418230)

Preparing secondary science teachers to effectively teach modern biotechnology is essential for expanding student access to emerging STEM fields. However, many educators lack the training to implement biotechnology instruction. The iPACERS Teacher Professional Development program addressed this gap through a one-week workshop focused on the integration of agriscience into biology standards using plant genetics and biotechnology applications. The program integrated hands-on laboratory experiences—including gel electrophoresis, CRISPR-Cas9 guide RNA design, bacterial transformation, and endophytic bioassays—with content sessions and curriculum planning. Program effectiveness was evaluated using pre/post surveys measuring teacher self-efficacy, familiarity with biotechnology content, environmental attitudes, and qualitative feedback. Results indicated significant increases ($p < .05$) in teachers' self-efficacy and perceived importance of incorporating current scientific research into instruction. Teachers also demonstrated significant gains in familiarity with key workshop topics and intent to incorporate content into curriculum. Participant feedback was overwhelmingly positive, highlighting participants' value of hands-on learning, collaboration, and exposure to current research. Expanding such programs may improve integration of industry topics into secondary classrooms and broaden student pathways into STEM careers.

Satellite ET vs. Soil Sensors for Zone-Based Irrigation Management in a Dry Bean Field

Shuhua Xie, University of Nebraska-Lincoln
Focused EPSCoR Collaborations (FEC) (#2420405)

Accurate estimation of daily crop evapotranspiration (ET) at the sub-field level is critical for precision irrigation, yet few studies have evaluated whether satellite ET products can resolve soil-driven spatial variability within a field. This study compared three ET estimation approaches - Two-Source Energy Balance (TSEB) with ground-installed infrared radiometer thermometers (IRT) as the reference, soil water balance (SWB) from soil moisture sensors, and satellite-based ET from OpenET - across three zones in a dry edible bean field in western Nebraska in 2023. The zones exhibited significant differences ($p < 0.05$) in available water, vegetation indices, and yield. The OpenET ensemble showed moderate daily agreement with TSEB ($R^2 = 0.33–0.52$, RMSE = 1.0–1.2 mm/day), whereas SWB showed poor agreement ($R^2 = 0.01–0.05$, RMSE = 3.1–6.8 mm/day). Among six individual, OpenET models, eeMETRIC achieved the highest correlations ($R^2 = 0.38–0.60$) but failed to differentiate ET among zones, while SIMS and SSEBop combined relatively high correlations ($R^2 = 0.35–0.58$) with the ability to detect significant zone-level ET differences ($p < 0.05$). These findings highlight the limitations of capacitance soil moisture sensors for daily ET estimation under typical commercial conditions and demonstrate that OpenET can capture sub-field ET variability, supporting their integration into zone-level irrigation scheduling for spatially heterogeneous fields.

Electron Delocalization In Carbonyl-Functionalized Oligo(P-Phenylene)S

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Although a record-high power conversion efficiency of ~21% has been achieved, there is still a long way to go before all-polymer solar cells can be fully commercialized. The bottleneck is, in part, due to a lack of understanding and control over the movement of localized electrons in donor-acceptor-type conjugated polymers. In our prior work, we synthesized ladder-type, nitrile-functionalized oligo(p-phenylene)s and used pulse radiolysis coupled with nanosecond time-resolved infrared spectroscopy (TRIR) to probe electron delocalization. Although it offers a superb infrared reporter for probing electron delocalization, nitrile is not commonly incorporated in the solar-relevant polymers. We hypothesize that carbonyl groups could serve as a new infrared reporter for this purpose. In this poster, we will discuss the design and synthesis of ladder-type, carbonyl-functionalized oligo(p-phenylene)s, preliminary TRIR results, and theoretical calculations using density functional theory to examine structure-property relationships. We thank the Department of Energy Office of Science, Basic Energy Sciences, for financial support under award number DE-SC0023329.

Security-Constrained Hosting Capacity Assessment for Data Centers at Multi-Transmission Nodes

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Track-I (#2148878)

Hyperscale data centers are driving a rapid increase in transmission-level interconnection requests, creating highly concentrated and spatially dispersed loads that challenge grid security, particularly in the sparse networks common across the U.S. Midwest. These challenges intensify when multiple nodes request interconnection simultaneously, requiring assessment of simultaneous hosting capacity under uncertainty. Because both renewable generation and data-center demand vary over time, probabilistic methods are essential, and the large size of these loads necessitates explicit security analysis, including N-1 contingencies. This work presents a two-stage security-constrained probabilistic framework to determine optimal simultaneous hosting capacities across multiple transmission nodes. Stage 1 identifies critical lines whose overload probability exceeds 1% across contingencies and loading conditions. Stage 2 applies a heuristic search to determine the maximum jointly feasible data-center capacities while ensuring all critical lines remain within acceptable limits under all N-1 contingencies. Using a modified system from a Midwestern utility, multiple location combinations are evaluated. Results show that the proposed framework maintains line-overload risk below 1% while enabling higher, jointly feasible hosting capacities for data-center interconnections.

Aerosol Optical Depth Retrieved from PACE Polarimetric Measurements

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This study applies the PACE-MAPP retrieval algorithm in three measurement configurations for the NASA PACE mission: HARP2 observations only, SPEXone observations only, and HARP2 and SPEXone combined observations. The collocated PACE-MAPP AOD retrievals are compared to ground-based measurements available made by the NASA AERONET WaveCIS_Site_CSI_6 site in Louisiana from March 2024 through December 2024. The performance is evaluated using standard assessment metrics such as the Root Mean Square Deviation (RMSD). The AOD retrievals performed using combined measurements of HARP2 and SPEXone compared to HARP2-only measurements lead to improved agreement with ground-based AERONET measurements for AOD. In addition, the performances of the HARP2-only and SPEXone-only configurations illustrate the importance of multangular and hyper-spectral polarimetry for accurate aerosol optical and microphysical property retrievals over coastal waters. Overall, the PACE-MAPP retrieval algorithm demonstrates the capability to fit the wavelength and viewing-angle dependent variations in the intensity and degree of linear polarization (DoLP) measured by the polarimeters on PACE. Future work involves the development of improved coastal aerosol models for the retrieval of aerosol properties from NASA PACE polarimeters over the Gulf of Mexico.

A Smörgåsbord of Stories: Meaning Construction at all Scales, from LLMs to Literary Universes

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Track-I (#2242829)

Our thesis is that the conjunction of language statistics and sociological theories can illuminate fundamental mechanisms of meaning construction, bridging the micro- and macrostructural. Much current computational social science work leverages distributional semantics, but little additional theory; we view this as an underexploited opportunity. LLMs are tantalizing tools for this approach. As a concrete example, there is a promising connection between natural language processing (NLP) techniques, sociolinguistic enregisterment, and sociological interaction orders (Goffman, 1983). These orders are encoded partially through linguistic associations -- multi-level indices (Agha, 2003; Eckert, 2008; Silverstein, 2003; Peirce, 1931). The more the socioindices change based on the speaker, the less a shared meaning exists. This provides an operationalizable bridge between statistical word co-occurrences and the theoretical fabric of society. Furthermore, as the stranger is a valuable, fungible unit (Simmel and Mosse, 2016), we argue that the concepts of "intimate" and "stranger" function in society by exploiting the same fungible-grounded tradeoff underlying many information-exchange- ("story-") related observations from Zipf's law to metaphor (Zimmerman, 2025), allowing us to connect this context (from our Identity & AI Indexicality projects) to this emergent theory (from my thesis; LLM Tokenization & Conversation projects), tackling meaning construction via multiple angles.