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OKLAHOMA EPSCoR

RESEARCH RETREAT POSTER SESSION

Spotlighting S³OK Student Researchers

ABSTRACT BOOK

Lead presenters are indicated with an asterisk.

Abstracts have been printed as submitted.

RESEARCH RETREAT POSTER SESSION
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POSTER #1

Influence of Seasonal Changes in Moisture Content on Shear Wave Velocity of Soils

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Changes in dynamic soil properties (i.e., shear wave velocity, shear modulus, and damping ratio) due to wetting and drying cycles in the field are an important aspect to consider in earthquake engineering design. Shear wave velocity is used in classifying the soil into site classes based on their expected seismic performance during ground motion. The influence of seasonal changes on shear wave velocity in unsaturated soils was investigated in the laboratory. Three soil mixtures were prepared for testing using a 1:1, 9:1, and 1:9 kaolin/sand ratio by dry weight. Soil samples prepared at various initial moisture contents and dry densities were subjected to wetting and drying using the vapor equilibrium suction control method. Shear wave velocity measurements were taken along the wetting and drying paths using a modified triaxial cell equipped with GCTS piezoelectric bender element embedded in the end platens. Suction measurements were taken using the WP4-T device, and the Soil Water Characteristic Curves (SWCC) were plotted to show the changes in soil suction during wetting and drying. Results of shear wave velocity measurements under different moisture contents and suctions show that as water content increases, suction and shear wave velocity decreases. The data obtained during testing demonstrates that the shear wave velocity is primarily influenced by changes in suction rather than moisture content during the wetting and drying cycles. Additionally, soil hysteresis during wetting and drying was shown to have an effects on the behavior of shear wave velocity; higher shear wave velocities were observed along the drying path. Finally, a strong relationship was found to exist between shear wave velocity and suction for the tested soils.

POSTER #2

Making Every Drop Count: Reimagining Produced Water as a Resource Through Bioremediation

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Oil and natural gas production operations generate large quantities of polluted wastewater known as produced water (PW), with approximately 21 billion barrels of PW generated annually in the United States alone. With rising energy demand, combined with recent drought and water scarcity episodes, the need to treat PW for beneficial re-use has become increasingly important. However, due of its toxic and carcinogenic constituents (hydrocarbons, phenols, benzoates, heavy metals, radionuclides) and high salinity, it is difficult to treat PW cost-effectively using traditional technologies. Hence, the primary goal of our research is to explore the cleanup of PW using salt-loving microorganisms (halophiles). We enriched and isolated several hydrocarbon-degrading halophilic microorganisms for this purpose, including *Modicisalibacter* sp. strain Wilcox, which was isolated from the PW from Wilcox formation in Oklahoma. We set up microcosms containing mineral salts medium and 2.5 M NaCl and inoculated with strain Wilcox to study the hydrocarbon-degrading ability and heavy metal resistance of the strain. Laboratory experiments showed that the strain can degrade a variety of aliphatic and aromatic compounds typically found in PW at salinities as high as 4.0 M NaCl (>23% salinity). Genome analysis of the organism predicted the presence of a repository of protein-encoding genes for hydrocarbon metabolism and heavy-metal resistance. Using the organism's genome as a guide, we investigated the strain's tolerance to several heavy metals found in PW. Our results indicate that strain Wilcox has high tolerance to many heavy metals (single or multi-metals) including Arsenic (100 mM), Manganese (100 mM), Cadmium (12.5 mM), Zinc (7 mM), and Lead (3 mM). Further experiment showed that strain Wilcox can remove metals like lead, zinc, chromium, and selenium from samples through bioaccumulation and biosorption mechanisms. These findings suggest that strain Wilcox has the potential to cleanup PW. The bioremediated PW can then be desalinated using a low-cost membrane system to generate clean water. This clean water will be subjected to toxicity testing using the freshwater crustacean, *Daphnia magna*. Treated PW can be reused for fracking, nuclear plants cooling, irrigation of marginal crops like switchgrass for biofuel production etc.

POSTER #3

Reduction of Methane Emission in Oil Well by Methanotrophic Microbial Community

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Methane is an important greenhouse gas projected as 28-fold more potent than CO_2 and contributing to about 20% of global warming potential. Anthropogenic sources of methane emissions are more concerning as majority of naturally produced methane is mitigated by microbes. This study focuses on methane emission by abandoned gas and oil wells (AOG) which are often high in salinity, providing additional challenge for microbial methane oxidation (MMO). In the US alone, more than three million AOGs were estimated to be responsible for the emission of 0.28 million metric tons of methane into the atmosphere in 2018, which is about 13% of the total emissions from the oil and natural gas sector. Despite being a significant source of methane, no effective strategy for mitigation by MMO have been proposed. This study aims to identify and characterize microbes that can effectively oxidize methane under hypersaline condition typically found in oil wells.

Sediment samples were collected from Zodletone spring, a sulfur-rich spring in southwestern Oklahoma which contains a mix of gaseous hydrocarbons such as methane, ethane, propane etc. Microcosms containing sediment samples and mineral salts medium (MSM) were set up to enrich aerobic methane oxidizing community by spiking the headspace with 1% (v/v) of methane. Headspace methane was measured periodically using gas chromatography. The enrichment culture degrades methane at 0 M to 2.5 M salinity, with the highest rate of MMO (111.6 µmol bottle^{-1} day^{-1}) at 1 M salinity. We extracted genomic DNA from the original sediment sample along with the enrichment culture maintained at 2.5 M salinity. Amplicon sequencing of 16S rRNA-gene revealed that the phylum *Balneolota* (64%) and *Proteobacteria* (28%) are most abundant in the enrichment, while in the original sediment their abundance was 18% and 13% of the total microbial population, respectively. Among the *Proteobacteria*, the most abundant known methane oxidizer was *Methylohalobrius* (31% of *Proteobacteria*). In conclusion, the enrichment process resulted in the enrichment of microbial community involved in aerobic oxidation of methane which are also common in halophilic environment. The currents efforts are directed towards isolating the above organism and its methane oxidation potential in various produced waters.

POSTER #4

Analytical Fragility Curves for Trees Subject to ice Loading Considering Climate Change

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Recent severe ice storms across the United States, namely, in Oklahoma and Texas, severely deformed and damaged trees resulting in extensive electrical power outages. The damage caused by fallen tree limbs can be costly to electrical power utilities due to the repair or replacement of damaged electrical powerlines and poles. Furthermore, trees can fall on nearby roads which introduces a new hazard and blocks traffic flow and reduces the safety of drivers. Assessing the risk of tree limb failure and its potential to damage powerlines can better assist in the preparation of safety measures before a major ice storm and develop resilience strategies and frameworks. In this study, trees subjected to ice loads were analyzed using the finite element method and a Monte Carlo simulation to develop analytical fragility curves. Two-dimensional, fractal trees were constructed with randomly generated geometric and mechanical parameters for four deciduous tree species: *Acer saccharum*, *Tilia americana*, *Fagus grandifolia*, and *Quercus alba*. Two load case scenarios were considered—one with the effects of leaves and one without the effects of leaves—which were then subjected to varying ice accumulation thicknesses. The resulting fragility curves suggest that leaves have a substantial impact on tree limb damage under ice loads, which is significant because of the increase in unseasonably early ice storms due to climate change.

POSTER #5

Satellite-Based Modeling of Gross Primary Production and Transpiration of Native Prairie, Alfalfa, and Winter-Wheat in Oklahoma

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Croplands have large CO_2 offset capacity and yet there is high uncertainty in the CO_2 stabilization under different management practices. Gross primary production (GPP) represents carbon used to build biomass and support plant processes. Evapotranspiration (ET) important for the land surface freshwater availability returns to the atmosphere more than 60% of the precipitated water. Transpiration (TR) is the largest ET component in crops and can be used to improve water use efficiency (WUE) and irrigation, reducing production cost, and supporting food security. GPP is used as an indicator of crop production is important for agricultural resiliency. However, most GPP and TR data are available only at moderate spatial resolution (MSR), limiting the accurate representation of the carbon and water fluxes at the field-level. Furthermore, severe weather events and climate change pose a threat to crop productivity, food security, and the offset of carbon emissions. Therefore, it is important to reduce the uncertainty on the CO_2 sink capacity and WUE of crops under different management and their response to environmental conditions.

This study focused on prairie, alfalfa, and winter-wheat sites in central Oklahoma. These crops have an important role in food security and carbon sequestration. Prairie for livestock, alfalfa used worldwide as a forage crop, and wheat one of the world's most widely grown grain crops. The vegetation photosynthesis model (VPM) and vegetation transpiration model (VTM) were used to produce daily GPP and TR field-level estimates for the three sites respectively. We evaluated the consistency and advantages of vegetation indices (EVI and LSWI) from MSR (MODIS) and HSR (Landsat and Sentinel-2) in tracking field land surface phenology. GPP_{VPM} and TR_{VTM} estimates accuracy at different spatial scales were evaluated using each site's eddy covariance tower data. Results highlight the VPM and VTM models' capacity to represent the field-level carbon and water vegetation dynamics and its responses to weather conditions. The study highlights the importance of HSR GPP estimates to reduce uncertainty in quantifying the CO_2 flux in crops and the capabilities of the models to represent the field-level vegetation carbon uptake and water use in agroecosystems under different management practices.

POSTER #6

Climatology of Wet Bulb Globe Temperature Heat Waves in the United States Great Plains

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Extreme heat like that seen in the US and Europe in summer 2022 can have significant impacts on human health and infrastructure. Organizations such as OSHA and the US Army use Wet Bulb Globe Temperature (WBGT) to quantify the impact of heat on workers and inform decisions on workload. WBGT is a weighted average of air temperature, natural wet bulb temperature, and black globe temperature. WBGT can be adjusted based on activity level, clothing, and acclimation to evaluate situational heat risk based on standard risk categories. Most WBGT studies focus on the physical effects of WBGT on humans or the long term trends in average, or maximum daily WBGT rather than the local climatology. A local climatology with hourly, daily, and monthly frequency will allow those planning outdoor work to minimize the likelihood of heat related disruptions.

There are 3 goals to this study 1) Demonstrate consistency between WBGT calculated from ERA5 reanalysis and WBGT from the Oklahoma Mesonet 2) Generate a climatology of WBGT for the United States Great Plains, and 3) Create a climatology of heat wave characteristics using a WBGT based definition. While natural wet bulb and black globe temperatures are not commonly reported, the Oklahoma Mesonet reports empirical approximations along with the WBGT. For consistency, this study utilizes the same formulations when calculating WBGT from ERA5.

Bias corrected ERA5 WBGT is shown to be consistent with the OK Mesonet WBGT (RMSD <1 ˚C). Therefore, A WBGT climatology is generated for the period 1960-2020 using ERA5 reanalysis. Due to the east-west and north-south gradients in WBGT across the USGP the Oklahoma Mesonet category thresholds are insufficient to capture heat events in the northern Great Plains. As a result, additional climatologies are calculated using uncategorized WBGT and spatially varying category thresholds adjusted for local climate normals. Heat wave definitions based on maximum, minimum, and mean WBGT (category) are tested for each climatology. Within each climate scheme, the 3 definitions often identify different events, suggesting that using more than one definition may be beneficial. This work furthers our knowledge of WBGT climatology that can be applied to human safety.

POSTER #7

Research Plan for Understanding Wildfire Occurrences, Behaviors, and Impacts on the Terrestrial Ecosystems in the Southern Great Plains

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With the rapid climate change and land cover change over the past several decades, the frequency of wildfires, particularly megafires, has been increasing across world land areas. While wildfire is a natural phenomenon in the Southern Great Plains, the increased wildfires are still causing a series of ecological consequences, such as enhanced carbon emission, land degradation, and water pollution. Moreover, we still lack a comprehensive understanding of the underlying mechanisms controlling the increased wildfires and the knowledge of wildfire impacts on the terrestrial ecosystem functions and structure. To fulfill these knowledge gaps, we will integrate remote sensing observations and ecological modeling to systematically investigate wildfire occurrences, behaviors, and their relationship with the tree-grass complex ecosystem. First, we will compile remote sensing-based fire product and wildfire records from the reporting systems of federal, state, and local fire organizations, and develop machine learning strategies to evaluate wildfire risks and changing trends. Second, we will improve the parameterization of megafires in the FARSITE model and use this model to understand the impacts of climate change and land cover change on wildfire behavior. Finally, we will use satellite observations to evaluate postfire trajectories of vegetation composition and carbon and water dynamics. These results will improve our ability to predict wildfire occurrences and understand ecological impacts of wildfires. This work will be critical for reducing economic loss from wildfires, designing land management plans for postfire ecosystem restoration, and enhancing ecosystem resilience to wildfires in the Southern Great Plains.

POSTER #8

Abrupt Flash Drought: Investigating Flash Drought Occurrence over Vital Agricultural Regions

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Within the past 20 years, research started to focus on the newly defined phenomenon of flash droughts. Differing from normal droughts, these events occur rapidly over subseasonal to seasonal timescales, and have considerable impacts over affected regions. Given the devastating impacts that can be experienced by stakeholders, including agriculturists, greater understanding and further analysis of this type of event is important.

The purpose of this research was to focus on flash drought characteristics in two main regions of crop production in the United States: One area centered over winter grain production in the Southern Great Plains and another focused on corn and soybean production in the Midwest. Flash drought events were investigated over both defined regions using a previously defined methodology. Temporal analysis revealed shifts in the seasonal occurrence of flash drought events over both regions in the past 20 years that may have harmful impacts for farmers. Spatial analysis then revealed that some of these flash drought episodes occur simultaneously over large parts of the region. We defined these unique events that occur rapidly and simultaneously across a large area as **abrupt flash drought events.**

Synoptic scale analysis on the atmospheric environment before and during 4 abrupt flash drought events in the Southern Great Plains region was developed to confirm whether there are specific atmospheric patterns that favor the development of these events. The analysis included 300 hPa geopotential height anomalies, precipitable water anomalies, and 300 hPa omega anomalies. Preliminary results show prominent anomalous troughing off of the west coast of the United States synchronous with these events, creating a favorable height pattern that drives ridging to occur over the central United States. Moreover, precipitable water and omega anomalies reveal that less precipitable water and anomalous subsidence are present in the atmosphere over the Great Plains at similar times.

POSTER #9

Influence of Silica Shape and Structure on the Demulsification of Oil-in-Water Emulsions

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Liquid-liquid separation is a challenge faced by many industries. One of the more common phase separation challenges is the separation of oil and water. Some of the industries that deal with these complications include food, metallurgy and petroleum industries. In the petroleum industry, one of the biggest applications of oil/water separation occurs during produced water treatment. Produced water is a stream of wastewater that accompanies the production of crude oil. The mixture of oil and water has the potential to form emulsions. This emulsion production is further aided by the presence of naturally occurring surfactants and surfactants added during EOR (Enhanced oil recovery). The presence of surfactants increases the chances of having stable emulsion formation. These emulsions pose a significant challenge to the process of oil-water separation. Conventional methods have relied on the density difference of the phases and the usage of gravity to carry out the separation processes, but this may be time-consuming and inefficient. This work addresses these challenges by using silica particles to carry out demulsification in surfactant-stabilized emulsion systems with a particular focus on the influence of the structure and size of silica particles on the demulsification of oil-in-water (O/W) emulsions. Silica particles of different sizes were chosen and modified to achieve a varied range of wettability. Fumed silica and spherical silica were chosen as the two forms of silica varying greatly in shape and size. The hydrophilicity of the silica nanoparticles was used as an indication of the wettability of the silica particles. Emulsion properties were analyzed with and without the addition of modified silica particles over time and were found to remain constant over the experimental time without the addition of nanoparticles. Bottle tests were used to understand the macroscopic separation of oil and water. Microscopic coalescence behaviour was probed by optical imaging techniques.

POSTER #10

A Statistical Analysis Toward the Development of a Heat Wave Definition in the Southern Great Plains

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Extreme heat wave events have tremendous impacts on several socioeconomic sectors. Infrastructure, health care, energy, and transportation is just a short list that experience stress during extreme heat events within Oklahoma. Climate projections have signaled an increase in frequency, longevity, and intensity of future extreme heat events due to global climate change. These models highlight several hotspots across the Contiguous United States (CONUS), with the Southern Great Plains (SGP) being highlighted. While heat waves continue to be defined through a variety of methods, this study aims to utilize a heat wave methodology across the SGP that connects previous heat wave definitions and incorporates an enhanced statistical standpoint. Two reanalyses (ERA-5 and MERRA-2) and one re-gridded observational (Daymet) dataset from 1980 through 2020 were utilized. Daily maximum and minimum standardized temperatures are fitted to gamma, normal, and skewed normal probability distribution functions across each grid point, further split into seasonal (i.e., Winter, Spring, Summer, and Fall) time periods. Inherently, heat waves have been classified as most detrimental during the warm season, yet winter season extreme heat events yield significant, albeit different, impacts. Executing the Kolmogorov-Smirnov test, each grid point probability distribution function was examined for goodness of fit, and the results suggest that the normal distribution is sufficient for both variables across most of the SGP. This study aims to tackle the gap in heat wave definitions from previous studies to begin to further understand large-scale drivers of heat wave events across the SGP in order to increase predictability.

POSTER #11

Tree Classification and Tree Failures from Ice StormsUsing High-Resolution Satellite Imagery and Hybrid Change Detection Technique

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Severe and extreme events such as flooding, drought, heat and cold waves, as well as ice storms, occur on a more frequent basis due to climate change. Due to their interdependencies, these events usually cause major infrastructure-related problems and societal disruptions. An ice storm in October 2020 caused cascading effects in Oklahoma. It resulted in major power outages due to fallen trees on power lines and damage to roadways and water line systems. This paper presents a study for estimating tree damage caused by the 2020 ice storm by utilizing high-resolution imagery. It employed a hybrid change detection technique using high-resolution satellite data. The composite mosaic dataset of the integrated vegetation index, green, and blue bands can produce an effective approach for tree damage detection. Mean shift, a smoothing technique, was employed to minimize noise before further classifications. The Random Forest classification technique is used to distinguish between trees and other objects in digital images. The post-classification comparison detects tree damage using the detailed 'from–to' change approach. The results show that the hybrid detection approach has the highest prediction accuracy in estimating the likelihood of failure of the trees during the storm.

POSTER #12

Translating Social Media Crisis Narratives into Road Network Utilization Metrics: The Case of 2022 Dallas Flash Flood

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Risk communication in times of disasters is complex, involving rapid and diverse communication in social networks (i.e. public and/or private agencies; local residents) as well as limited mobilization capacity and operational constraints of physical infrastructure networks. Despite a growing literature on infrastructure interdependencies and co-dependent social-physical systems, an in-depth understanding of how risk communication in online social networks weighs into physical infrastructure networks during a major disaster remains limited, let alone in compounding risk events. This study analyzes large-scale datasets of crisis mobility and activity-related social interactions and concerns available through social media (Twitter) for communities that were impacted by sudden flash flooding (August 2022) in Dallas, Texas. After months of drought, the severe flash flood hit the areas (estimated 1000 years return period event for Fort-Worth) causing devastating impacts on infrastructures. In particular, the transportation and power systems are the most affected infrastructures where the functionality have been disrupted. During this crisis, agencies and users of social media are observed to communicate for weather-watch, information, response, and recovery which follow the complex pattern of risk communication linked to limited mobility and capacity constraints. By using Twitter's recently released academic Application Programming Interface (API) that provides complete and unbiased data, geotagged tweets are collected covering the entire impacted area of Dallas and flash flood related tweets are considered with proper sampling. First, the study uses natural language processing and text quantification techniques to translate crisis narratives (i.e. tweets). Next, geo-tagged tweets are mapped into co-located road networks using GIS techniques. Finally, insights are generated using network science theories and quantified social narratives to interpret different elements of road networks (e.g. local roads, freeways, etc.) for the Dallas communities that were impacted by the devastating flash flood.

POSTER #13

Exploring the Interdependencies between Transportation and Stormwater Networks: The Case of Norman, Oklahoma

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The functionality of infrastructure systems is crucial for social lifeline and productivity; however such systems are vulnerable to external disruptions and cascading failures. Instead of functioning in isolation, physical infrastructures (i.e. roads or stormwater) act as a large and complex connected systems. The interdependence between transportation and stormwater systems is particularly important due to the recent rise in flooding events leading to adverse traffic impacts. To explore the extent and identify the critical locations where such interconnectedness exists, this study examines the transportation and stormwater systems in the city of Norman, Oklahoma. Using network science theories and concepts of multi-layered networks, the study analyzed these networks, both individually, and in combination. The study first considered a spatial autocorrelation metric (Moran's I) to identify the locations where the road and stormwater network components are closely located. Next, the physical shape of these networks was represented in a graph format to investigate the topological credentials (i.e. rank of relative importance) of the network components (i.e. water inlets as nodes and conduits as edges in stormwater networks; intersections as nodes and segments as edges for roads). Moreover, such credentials further change by considering the weights of component level attributes (i.e. AADT for the road segments and conduit capacity for stormwater) that correspond to each network. To establish connections between the two layers based on proximity, interlayer edges were generated based on Moran's I significance. The study reveals new insights and understudied factors that govern how transportation systems critically depend on neighboring stormwater systems.

POSTER #14

The Effect of Soil pH on the Ratio of Denitrification End-products

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Nitrous oxide (N_2O) is a potent greenhouse gas that contributes to stratospheric ozone depletion and global climate change. Denitrification has two potential end-products, N_2O and dinitrogen (N_2), and the ratio of these end-products is controlled by various factors. Soil pH is one factor that has biological, chemical, and physical effects on denitrification. This study aims to quantify the influence of soil pH on the ratio of denitrification end-products in diverse Oklahoma soils. Three different field soils were incubated in the lab under natural pH, more acidic pH (amended with sulfuric acid), and more basic pH (amended with potassium hydroxide), with an overall tested pH range of 2-10. The relation between soil pH and denitrification end-products was investigated in the lab using the acetylene inhibition technique and further estimated using a process-based biogeochemical soil model. Both the lab and model results showed that soil pH plays a role in the ratio of the denitrification end-products, here referred to as the N_2O:(N_2O+N_2) ratio. Generally, as soil pH increased the N_2O:(N_2O+N_2) ratio decreased. Although, both lab and model results indicated that this relationship was not strictly linear. In conclusion, soil pH is a controlling factor in the ratio of denitrification end-products and warrants further research to sufficiently quantify this nonlinear relationship across diverse soil conditions.

POSTER #15

How Predictable was the February 2021 Great Plains Cold Air Outbreak?

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Wintertime cold air outbreaks (CAOs) are extreme and high-impact events that involve the movement of cold air from the polar regions to the lower latitudes. The two-week-long February 2021 Great Plains CAO is a key example of this, which led to widespread power outages, traffic incidents, and unfortunately loss of life. The ability to provide better extended-range predictions of these events is therefore of high importance. We use data between 1950-2021 to show that anomalously high pressure in two key regions are leading patterns for Great Plains CAOs: one in Alaska and another in northern Canada/Greenland. The presence of these persistent high pressure areas is crucial in enabling the movement of cold air, and they can develop from a process called "Rossby wave breaking", whereby the upper-level atmospheric flow can become wavier in nature. We use reanalysis data to show that the February 2021 CAO featured anomalously high pressure first in Alaska and later in northern Canada/Greenland, alongside two wave breaking events prior to the February 2021 CAO. The first of these wave breaking events took place to the northwest of Alaska and the second occurred to the northeast of Canada. We examine two forecast models to assess the effect that these wave breaks had on their forecasts ~2-3 weeks out. We conclude that simulations capturing these features produce colder temperatures in the Great Plains, linked to better positioning of these high pressure regions. These results reiterate the importance of correctly simulating wave breaking events for skillful and reliable long-lead forecasts of extreme weather events.

POSTER #16

Solar PV Hosting Capacity Analysis in an Existing Distribution System

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Integration of renewable energy resources (RER) in the distribution grid is one of the key aspects in enhancing the resiliency of the power system. High penetration of solar photovoltaic (PV) resources can cause voltage deviations, line overloading and voltage unbalance, etc. Maximizing the utilization of the RER while adhering to stringent grid standards have become a crucial technical challenge in distributed power systems. The analysis of overall network performance and hosting capacity limitations is essential before the installation of a PV source in a distribution feeder.

This poster highlights the impacts of integrating a single large central PV plant to the distribution system. A violation index, consisting of the voltage and thermal violations which are the critical impact to the system, is used to determine the install capacity of the PV throughout the feeder region. A real distribution feeder from Oklahoma is chosen to analyze future PV hosting capacity issues. This 24.9 kV feeder consists of 570 three phase nodes, located in a suburban area with the peak load capacity of 5.2 MW.

OpenDSS, an open-source three-phase distribution system simulation program and MATLAB are used to carry out the analysis. A PV system operating at unity power factor is first considered. Then a PV system with Volt-Var control is considered and compared to the performance with the previous system. The PV plant capacity is increased from 0 to 7.5 MW and tested at every possible node in the feeder. For each scenario, the node voltages and line loadings were checked for any violations exceeding regulatory or capacity limits. If the index shows either parameter exceeding the ratings, then the scenario is considered a violation. Finally, PV integration capacity of each feasible location and the best possible region of the feeder for a certain PV capacity can be identified. This analysis can also be extended to identifying the strategies to increase the high PV capacity of the existing system.

POSTER #17

Cross Stakeholder Assessment of Causes and Consequences of Environmental Problems in Oklahoma

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OBJECTIVES

We examine mental models refined through Group Model Building (GMB) during the Year 2 S3OK Academy hosted by the Social Dynamics Team in May 2022. During GMB, representatives from the Opinion Leader Advisory Network, Extended Peer Science Advisory Network, and Social Dynamics Team collaborated to refine mental models concerning Eastern Red Cedar Encroachment, Grid and Infrastructure Resilience, and Marginal Water Use and Reuse in Oklahoma. ***We ask: how do individuals from diverse stakeholder groups describe causes and consequences of key environmental problems in Oklahoma?*** Anchored in alignment with S3OK project goals, results from this analysis advance efforts toward developing socially sustainable solutions for environmental problems in Oklahoma.

RESEARCH DESIGN

Utilizing qualitative content analysis and iterative narrative coding on data collected at the Year 2 academy, we are able to review co-developed understanding of causes and prospective solutions to Eastern Red Cedar Encroachment, Grid and Infrastructure Resilience, and Marginal Water Use and Re-Use in Oklahoma. We use a robust, qualitative dataset as the foundation for this project based upon adapted mental models developed from Year 1 academy transcripts, detailed scribe notes, and GMB annotations.

FINDINGS

Analysis of GMB with mental models representing Eastern RedCedar Encroachment, Grid and Infrastructure, and Marginal Water Use and Re-Use illustrates the diverse ways that EPSCoR Stakeholder Groups understand and define problem areas and prospective solutions with four themes emerging across the data. First, S3Ok stakeholders emphasized the role of Regulations and Regulatory Structure throughout each breakout group discussion. Second, stakeholders prioritized discussion of the need to enhance public awareness via education and engagement was emphasized throughout all three breakout group discussions during the Year 2 academy. Third, S3OK stakeholders emphasized the importance of meaningful Tribal Involvement in generating sustainable solutions across various topic areas at the Year 2 Academy. Finally, in the spirit of the EPSCoR project, stakeholders at the Year 2 Academy emphasized the importance of Expert-Industry-Public collaborations to address key problem areas in Oklahoma. These findings can guide the development of an initial framework for addressing wicked problems at the intersection of changing weather, water and land use, and infrastructure resilience in Oklahoma.

POSTER #18

Precipitation Whiplash Events Across the Southern Great Plains of the United States

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The Southern Great Plains is a region that is prone to precipitation extremes and transitions between them which have direct impacts on agriculture, infrastructure, water quality and water quantity. However, current understanding of transitions between precipitation extremes, including seasonal and annual characteristics as well as spatial and temporal patterns across the Southern Great Plains (SGP) is lacking. Most previous research has focused primarily on the characteristics and impacts of transitions on the annual scale, and those that have investigated shorter timescales have not completed an analysis across the Southern Great Plains. In this study, the characteristics and climatology of transitions between precipitation extremes on the subseasonal-to-seasonal (S2S) scale across the Southern Great Plains between 1981 and 2018 were examined. Transitions between precipitation extremes were defined using a percentile method where S2S precipitation totals at individual grid points are ordered. A transition from the low (high) percentile threshold to the high (low) percentile threshold from one period to the next were defined to be a drought-pluvial (pluvial-drought) transition. At least one transition event was found to occur somewhere within the Southern Great Plains every year between 1981 and 2018, with the Fall season being the time of year when these events are most likely to occur. The months of September and October are the most common months to be drought and pluvial months suggesting that the secondary peak in annual precipitation that is observed during the Fall is important in driving transitions in precipitation extremes across the SGP. One such example of a precipitation whiplash event occurred across the SGP in 2017. Above average precipitation totals throughout the year fell below average during the Fall period and the region transitioned from pluvial to drought conditions during the months of September to October. The insight this study gives into the climatology of transitions in precipitation extremes on the subseasonal scale will greatly enhance the understanding of these events allowing for better predictability and preparedness into the future.

POSTER #19

Encroaching Eastern Redcedar (*Juniperus virginiana*) Increases Soil Organic Carbon Concentrations in Grasslands Across a Precipitation Gradient

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In the Southern Great Plains of North America, *Juniperus virginiana*, hereafter eastern redcedar, is rapidly expanding into native grasslands due to fire exclusion. Grassland ecosystems are an important component of the global carbon cycle as they store large quantities of carbon belowground. Eastern redcedar encroachment increases aboveground net primary production, but belowground impacts on carbon dynamics remain unclear. To understand how soil organic carbon (SOC) storage changes under eastern redcedar encroachment, we sampled soils at 9 sites across Oklahoma's wet to dry precipitation gradient. Soil cores were extracted from two depth intervals, (0-10 cm) and (10-30 cm) under eastern redcedars and adjacent grassland, respectively. Soil samples were homogenized and analyzed for percent SOC using a loss on ignition method. Vegetation samples were clipped, dried, and weighed to estimate aboveground herbaceous biomass. We hypothesized that historic grasslands would have greater SOC stocks relative to encroaching eastern redcedar woodlands.

Preliminary results did not support our hypothesis, as greater SOC concentrations were observed under eastern redcedar trees (2.19%) compared to adjacent grasslands (1.61%) in the upper soil layers (0-10 cm). We found a significant negative relationship of increasing understory biomass on SOC stocks for encroached areas. Surprisingly, these results indicated the precipitation gradient had no effect on SOC concentration in the upper soil depth (0-10 cm). However, we found an opposite effect in 10-30 cm soil depth where precipitation was the sole variable driving a negative SOC relationship. This suggests SOC accumulates to a greater extent under dry conditions, possibly due to decreased decomposition, regardless of vegetative cover. These findings do not support previous studies indicating grasslands have greater SOC concentration relative to forests. Our results suggest that SOC concentration dynamics may not be easily broken into forest versus grassland and point to the complexity of managing transitioning ecosystems for soil carbon storage. While carbon storage is an important ecosystem service, multiple important grassland ecosystem services, such as meat and dairy production, pollinator food sources, aquifer recharge, and climate regulation could be lost following establishment of eastern redcedar, therefore, we caution against conversion of grassland to forest ecosystems.

POSTER #20

Effect of Biosolid and Soil Carbon Addition on Nitrous Oxide Production Potentials

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Nitrous oxide (N_2O) is a potent greenhouse gas that can destroy the ozone layer. N_2O is one potential end-product of denitrification, where microorganisms reduce nitrate (NO_3-) to dinitrogen (N_2) under anaerobic conditions. This study aimed to quantify the effect of biosolid addition and experimental carbon addition on soil N_2O production and denitrification potential. Soil samples were collected on two dates from the Stillwater Wastewater Treatment Plant where biosolids were land applied to soils. The acetylene inhibition technique and gas chromatography were used to run laboratory assays and quantify N_2O production and denitrification potential under different experimental carbon addition levels. Results showed that soil biosolid amendment had variable effects on denitrification potential but always increased the proportion released as N_2O. Denitrification potentials differed with time since biosolid application, and similarly, biosolid amendment and time influenced soil nitrogen and carbon. The experimental addition of carbon to soil assays decreased the proportion of N_2O produced during denitrification. Therefore, although biosolid amendments to soils have the potential to increase denitrification and the proportion released as N_2O, additional carbon amendments to soil could decrease overall N_2O production from denitrification.

POSTER #21

Combination of Climate Change and Increased Woody Plant Coverage May Worsen Water Scarcity in the Southern Great Plains

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The increase in woody cover or reforestation of under-stocked forests can sequester a significant amount of atmospheric carbon into woody biomass. However, increasing woody canopy cover will increase water use, especially for water-limited regions in the southern Great Plains. Here we reported a modeling study comparing the impact of increased woody coverage on evapotranspiration (ET) and water yield in a sub-humid partially forested watershed (30% woody canopy cover, mean annual precipitation, MAP, 913 mm) and a humid forest watershed (MAP 1358 mm) under the current climate and a prevailing climate change scenario (2 ^{o}C increase in temperature and 10% decrease in MAP) using the Soil & Water Assessment Tool (SWAT).

Our results showed that under current climate conditions, runoff would decrease by about 37% with an increase of woody coverage from 30% to 80% in a sub-humid rangeland watershed but decrease by 11% with a 30% increase in tree cover in a humid forest watershed. However, under the climate change scenario, the same increase in woody cover will result in an over 50% decrease in runoff in the sub-humid watershed and about a 32% decrease in the forested watershed. ET increased in both watersheds with more woody cover under current climate conditions but increased much less under climate change scenarios, mainly due to less precipitation.

Our study suggests that the impacts of land cover change on regional water yield must be carefully considered when considering afforestation and designing management strategies to control woody plant encroachment in Oklahoma. More woody coverage in drier regions of Oklahoma may result in a more significant loss in water yield.