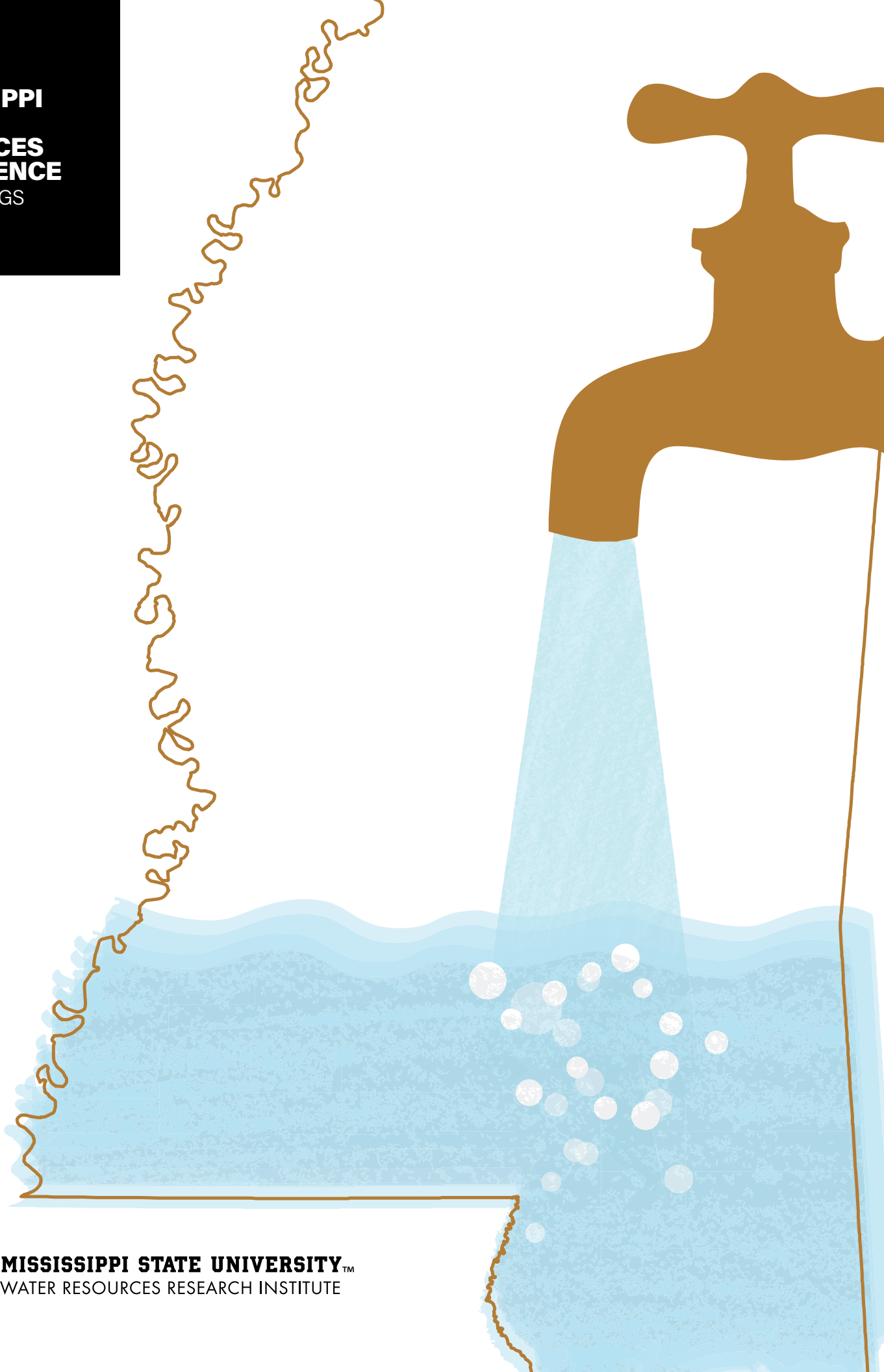
2020

MISSISSIPPI WATER RESOURCES CONFERENCE

PROCEEDINGS



MISSISSIPPI STATE UNIVERSITY™
WATER RESOURCES RESEARCH INSTITUTE

2020
MISSISSIPPI WATER RESOURCES CONFERENCE
PROCEEDINGS

CONFERENCE ORGANIZERS
Mississippi Department of Environmental Quality
Mississippi Water Resources Research Institute
U.S. Geological Survey

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Efficiency Analysis of Green Stormwater Infrastructure Practices for Runoff Reduction

ABERA L.E., SURBECK C.Q.

Increased impervious land surfaces due to urbanization, construction, and development cause excess stormwater runoff and result in urban areas experiencing flooding events and erosion. Installation of Green Stormwater Infrastructure (GSI) is one sustainable way of reducing flooding events and preventing damage. In this study, computer simulations were conducted to assess the efficiency of GSI practices in flood reduction. Life-cycle cost analyses (LCCA) of stormwater infrastructure are also being performed to determine the cost-effectiveness of GSI practices, considering capital and operation and maintenance (O&M) costs, which are costs borne by different stakeholders. A proposed development located in Oxford, MS was used as a model site to perform the assessments. The HydroCAD stormwater modeling tool was used to perform hydrologic modeling for two types of GSI practices, permeable pavement and rain garden. The site was modeled using the curve number reduction method, which reduces the weighted average curve number of the site by implementing GSI practices. For multiple scenarios, the volume of stormwater runoff was estimated based on the city's design storms. Depending on the type and size of the GSI and the storm intensity, the simulation results showed that applying GSI reduced the volume of excess runoff by 3 to 17% on average, therefore potentially reducing the volume requirement for underground storage. For the constraints at the modeled site, compared to a rain garden, pervious pavement resulted in a higher reduction in the volume of stormwater runoff. Life-cycle cost analysis was performed using the Water Environment Research Foundation (WERF) Low Impact Development Cost Analysis Tools. Results of the cost analysis, and what it means for stakeholders, will be presented.

Long-Term Soil Physical Responses from Integrating Cover Crops and No-Till Management to Agricultural Soils in the Mississippi Alluvial Valley

FIRTH A., BAKER B., BROOKS J., MORIN D., BROWN A., LOCKE M.

Agriculture is the greatest contributor to overall consumptive water use with deleterious effects seen in river depletion and groundwater over draft. Despite negative documented effects of agricultural land use (i.e. soil erosion, compaction, nutrient runoff) on critical natural resources (i.e. water), food production must increase in order to meet the demands of a rising human population. Given the environmental and agricultural productivity concerns of intensely managed soils, there is a growing interest in conservation practices that mitigate the negative effects of crop production and enhance environmental integrity. This study assed the long-term soil physical responses from integrating cover crop (CC) and no-till (NT) management to agricultural soils in the Mississippi Alluvial Valley region of Mississippi, USA. Bulk density, aggregate stability, water holding capacity and water infiltration were measured after 5 years of CC and NT treatments. It was hypothesized that the combination of a diverse CC mixture and NT management would provide more favorable soil physical properties compared with single CC mixtures or tillage treatments. Results of this study are expected to provide valuable information to producers in the mid-south region of the cost and benefits of CC/NT usage.

Assessing Nutrient Mitigation Potential of Short Rotation Woody Crops in Marginal Croplands of the Lower Mississippi Alluvial Valley

KYAW T.Y., SIEGERT C., RENNINGER H.

Agricultural runoff loaded with surplus nutrients contributes to degradation of water quality of the Lower Mississippi Alluvial Valley (LMAV). In the LMAV, marginal lands experiencing frequent floods and seasonally high water tables may be less suitable for conventional agriculture. In such riparian areas, planting short rotation woody crops (SRWCs) as feed stocks for bioenergy production and also as vegetation filter strips can meet complementary goals of income generation and nutrient mitigation. Considered as the nutrient concentration hotspot, the Mississippi Delta of the LMAV is both geographically and ecologically important for minimizing nutrient delivery to the Gulf of Mexico. Therefore, this study aims to quantify composition of nutrients (e.g., dissolved organic carbon, total phosphorus, ortho-phosphate, and inorganic nitrogen) in groundwater of a SRWC plantation and access survival during an exceptional flood year. In June 2018, 300 cottonwood (*Populus deltoides*) and 300 willow (*Salix nigra*) cuttings, and in November 2019, 300 sycamore (*Platanus occidentalis*) seedlings were planted in Sidon, MS adjacent to an oxbow of the Yazoo River. Groundwater samples were collected from 16 groundwater wells with a depth of approximately 2 m at the highest, lowest and midpoints in each of four replicated plantation blocks. Additionally, water level loggers were placed inside the groundwater wells to monitor water level changes. During the late growing season when water tends to be limiting in the region, groundwater levels were within 1 m of the surface in 2018 and 0.8 m in 2019, whereas the site was continuously flooded in the dormant season up to 1.2 m in 2018 and 3.9 m in 2019. Because of such exceptionally high flooding, survival of willows decreased from 98% in 2018 to 35% in 2019, and cottonwoods decreased from 62% in 2018 to 15% in 2019. Among the four replicates, no survival was found in the two blocks that were continuously underwater from January to August and had deeper floodwater (3.8 m) above them. Only the trees which had continuous but shorter floods (January to June) and less deep water (3.6 m in willows and 3 m in cottonwoods) survived. Besides flooding, beavers damaged 30% of the surviving willows, whereas no damage was found in cottonwoods. Analyses of water quality data are pending. Therefore, even though there were extreme floods in 2019, SRWCs could tolerate a continuous six-month flooding with a height of up to 3.6 m for willows and 3 m for cottonwoods.

A Study Case to Evaluate the Performance of the Agricultural Policy/Environmental Extender Model (APEX) in the Mississippi Delta Region

MENDEZ-MONROY J.F., RAMIREZ-AVILA J.J.

The use of computer programs to understand the dynamics and interactions of soil, hydrologic and crop production processes, have allowed scientists, researchers and farmers to facilitate and improve decision-making procedures. The Agricultural Policy/Environmental Extender Model (APEX) is a tool capable of performing long term simulations (1-4000 years) on a daily time step, for the managing of whole farms or small watersheds. APEX allows users developing analyses related to water balance, nutrient balance, and sediment transport. To highlight the potential of APEX in predicting soil, hydrologic and crop production processes of agricultural scenarios in the Mississippi Delta, a study was developed for two fields with soybean and cotton under reduced tillage and winter cover crop practices. Available information about runoff, sediment transport, soils, operation schedules and crop yield for a period of four years was used for the simulation. A sensitivity analysis (SA) and a calibration (CA) and validation (VA) process were carried out using the APEX Auto-Calibration and Uncertainty Estimator tool (APEX-CUTE) to compare observed and simulated runoff depths from the study fields. Four parameters associated to the prediction of soil evaporation (PARM17), runoff (PARM20 and PARM42), and potential evapotranspiration (PARM 34) were recognized as sensitive. To perform the CA-VA process, APEX-CUTE uses an objective function designed to maximize the model performance efficiency (NSE) and reduce the tendency of the simulated values to be larger or smaller than their observed values (PBIAS). The objective function was evaluated 1000 times resulting in optimized values of NSE>0.70 and PBIAS≦0.070, and NSE>0.90 and PBIAS≦0.449 for CA and VA, respectively. The best parameter set was used to simulate runoff that was compared with observed data. In general terms, APEX was successful in predicting daily runoff. For the monthly and annual runoff, some variations were noticed (under and overestimations). Despite this, the model had an optimal performance, and in future studies, it could potentially be used as an assistant tool for agricultural, research and engineering purposes.

The Performance of a Model Floating Breakwater for Embankment Protection

ROSSELL W., OZEREN Y., WREN D.

Wave erosion is a costly problem for many farmers that own irrigation reservoirs located in the Mississippi River Valley Alluvial Floodplain (Delta). Breakwaters are commonly used for shoreline protection in coastal areas. Fixed breakwaters, such as rubble mounds, are expensive to construct and maintain. A relatively cost-effective method for embankment protection is the use of a floating breakwater. This study utilized a 1:3 scale, model cylindrical floating breakwater that was subjected to waves of varying height, period, and still water depth in a laboratory wave tank. The results of this study will be used to design a prototype scale floating breakwater at a pilot reservoir in the Delta. The experiments were carried out at the USDA-ARS, National Sedimentation Laboratory in Oxford, MS. The model breakwater was made of a 69 cm long High Density polyethylene (HDPE) corrugated pipe section, filled with water and moored using steel wires attached to the floor of the flume. The resulting draft was approximately 90% of the outer diameter. The model was subjected to regular waves generated by a piston type wavemaker. Waves were measured using capacitance type wave staffs located both upwave and downwave of the breakwater. The resulting forces in the mooring cables were measured using a force gauge. This paper presents some of the key observations during these laboratory experiments.

Effects of Sensor Threshold Irrigation Scheduling on a Soybean-Cover Crop

RUSSELL D., SINGH G., KAUR G.

The Mississippi River Valley Alluvial Aquifer (MRVAA) is the main source for irrigation water supply for soybean production in the Mississippi Delta. However, MRVAA is depleting at a rate faster than it can be recharged. Decline in ground water levels in MRVAA necessitates the use of better agronomic practices and irrigation management for saving water and increasing water use efficiency. Research has been done in the past using various irrigation scheduling techniques on monoculture soybeans, but there is limited information available on irrigation scheduling of soybean with combination of winter cover crops. The goal of this study is to evaluate the effects of sensor thresholds for irrigation scheduling on soybean production, with and without cover crops on a sandy loam soil. This study also determines the effects of irrigation scheduling and cover crops on economic returns, soil available nutrients , irrigation water use, and water use efficiency. The field experiment was initiated in fall 2019 at the Delta Research and Extension Center in Stoneville, MS. The four cover crop treatments included in this study were: cereal rye, hairy vetch, a wheat-radish-turnip mix, and a no cover crop control. The three irrigation treatments used for irrigation scheduling were: a season-long single threshold (-85kPa), a dual threshold (-50 kpa at Tamax>=95°F and -85 kPa at Tamax<95°F), and a non-irrigated control. The baseline data was collected in fall 2019 including soil infiltration rates, bulk density, and penetration resistance. Soil samples were also collected in fall 2019 for soil health analysis. The results from this study will be presented at the conference.

Runoff Water Quality and Quantity in Conservation Management Systems under Simulated Rainfall

SPENCER D., KRUTZ J., GHOLSON D., LOCKE M., HENRY B., GOLDEN B.

Midsouthern USA silt loam soils are characterized by poor soil structure, which contributes to decreased rainfall capture and increased susceptibility to erosion and off-site nutrient transport. Conservation management practices such as cover crops and no-tillage may improve infiltration and decrease contaminant runoff, thus promoting the sustainability of regional waterbodies. The effects of cover crops and tillage system on runoff water quantity and quality under simulated rainfall were evaluated on a Commerce very fine sandy loam (fine-silty, mixed, superactive, nonacid, thermic Fluvaquentic Endoaquepts) at Stoneville, MS from 2017 to 2019. Neither cover crops nor no-tillage decreased runoff under simulated rainfall. In 2017 and 2018, cover crops did not have an effect on water quality. No-tillage improved turbidity, but also increased runoff water concentrations and loads of some nutrients. Water quality results from 2019 will be presented as well.

Estimating Streambed Hydraulic Conductivity For Selected Streams In The Mississippi Alluvial Plain Using Continuous Resistivity Profiling Methods

ADAMS R., MILLER B., KRESS W.H., MINSLEY B., RIGBY J.R.

The U.S. Geological Survey (USGS) is currently conducting a multi-year analysis and recharacterization of the Mississippi Embayment Regional Aquifer System (MERAS) groundwater flow model focusing on the water resources within the Mississippi Alluvial Plain (MAP). Part of this recharacterization was the evaluation of the existing model based on uncertainty and data worth analysis. These data quality measurements indicated that the MERAS model was sensitive to groundwater-surface water exchange, but this component was poorly constrained and the confidence in the model forecast was low.

To increase the density of data within the models' most sensitive rivers and streams, the USGS completed 900 kilometers (km) of waterborne resistivity surveys within Mississippi to characterize streambed lithology. This technique characterizes streambed itself and the near surface (upper 15-30 meters) of the streambed that controls the recharge to the alluvial aquifer. These data can be used to map changes in the lithology of the streambed and identify areas of potential groundwater-surface water exchange.

To map these sediments, electrical resistivity data was collected using a resistivity meter connected to floating multi-electrode cables. Information about the spatial location of each data point, depth of the water column, and electrical properties of the water column were also collected.

Five rivers in the Mississippi Delta region were the focus of this study: the Bogue Phalia, Quiver, Sunflower, Tallahatchie, and Yazoo Rivers. These rivers flow over a variety of fluvial and deltaic deposits. While streambed sediments show a strong correlation with surficial geology, changes in the vertical extent of those geologic features had a strong impact on the aquifer recharge potential expected for a given water body.

The inverted waterborne resistivity data were transformed to hydraulic conductivity using relationships derived from geophysical logs collected within the study area. Estimated hydraulic conductivity values generated from downhole nuclear magnetic resonance (NMR) data were compared to electromagnetic induction logs to generate a relationship between electrical resistivity and hydraulic conductivity.

The resistivity-derived estimates of hydraulic conductivity show a significant increase in magnitude and spatial variability as compared to the estimates derived from groundwater model parameter estimation. Some amount of this change was expected due to the increased sampling density and smaller footprint of the resistivity surveys. The remainder of the difference between the two estimates is likely due to the incision of river channels into and beneath the shallow 5-10 m confining unit that overlays a large portion of the MAP within Mississippi.

Fog Harvesting with Vertical Harp Structure

AZEEM M., WIENER J.

The shortage of clean water in some parts of the world has compelled the researchers to find the alternative fresh water resources. On the coastal side, fog stands out alternative water sources because fog water can be harvested in large quantity without consuming energy. However, fog collection has attracted the interest in recent years resulting in a large body of work focused on improving the design of fog collectors. We designed a two-layer harp structure in comparison with traditional Raschel mesh being used from many years. Polypropylene (PP) monofilament was used as collector element. It was reported that two-layer harp collectors can resolve many of the problem incorporated with single-layered collectors, including clogging. Fog water collection rate by this technique was measured double than Raschel mesh. The diameter of monofilament and distance between the two layers was also optimized with experimental and theoretical work. The results showed that, the distance between the adjacent elements of the harp was > 1mm to avoid from clogging. When optimized, the Raschel mesh collector yielded half of the fog water as compared to our two-layer harp design under laboratory conditions. The basic idea is to increase the efficiency of fog collector for commercial purpose; therefore it was proposed the cylindrical textile monofilaments.

Voluntary flooded agriculture systems generate macroinvertebrate food resources for waterbirds and shorebirds in the Lower Mississippi River Basin

BACON P., TAYLOR J.M., TESTA III S., RIGBY J.R.

Voluntary flooding of post-harvest agriculture fields is a management practice that can be utilized to help mitigate permanent loss of wetlands and decrease losses of fertile soil associated with heavy winter rainfall. These inundated fields may promote positive community responses that increase habitat suitability for wetland species such as migratory waterbirds and shorebirds. For many migratory shorebird species, aquatic macroinvertebrates are a primary diet component vital to meeting the energetic requirements necessary for daily activity, as well as seasonal migrations. In order to utilize crop systems as temporary seasonal conservation management units, aquatic macroinvertebrate community structure and trophic stability must be established quickly. The focus of this study was to evaluate and quantify macroinvertebrate community structure and secondary production in post-harvest voluntary flooded agriculture fields. Three post-harvest corn fields, located in the Mississippi Delta were selected, were inundated with surface water from a tailwater recovery storage reservoir. Macroinvertebrate diversity and richness along with secondary production of dominant taxa were investigated over a five month period. Macroinvertebrates were quantitatively collected weekly to bi-monthly. Samples were brought back to the laboratory for processing and identification to determine species richness and diversity. Secondary production estimates were calculated for the dominant taxa, nonbiting midge larvae (Diptera: Chironomidae), using the size-frequency method. Macroinvertebrate diversity, density, and overall production of dominant taxa greatly increased after two weeks, then stabilized over the remaining inundation period. The overall observed trends functionally represent the increased habitat value of controlled flooded post-harvest agriculture fields and demonstrate this management practice may provide a strong energetic contribution or "payoff" critical to wetland species at higher trophic levels.

Methods for Assessing the Impact of Soil Amendments and Cover Crops on Soil Health

CHANG T., PAUL V., FENG G.

Soil health assessment tools can help evaluate whether agricultural measures contribute to sustainable development. The indicators used to evaluate soil health are generally composed of soil physical (including hydrological), chemical, and biological properties. However, quantifying and integrating soil health indicators is a complex and time-consuming process. Currently, there are several methods available for assessing soil health, such as standard scoring functions (SSF) method, Cornell soil health assessment (CSHA) tool, Ontario soil health assessment method (OSHA), and soil management assessment framework (SMAF). However, some of these assessment tools have been shown to be inconsistent due to high variability in soil and climatic characteristics and the sensitivity of soil health indicators caused by different agronomic management methods. Therefore, the applicability of soil assessment methods should be evaluated locally, and include weighted calculations based on soil characteristics. This study selected three methods, SSF, CSHA, and OSHA, and included two methods of weight vector calculation: analytic hierarchy process and iterative algorithm. In total, six methods were employed to calculate the soil health scores. Soil data were obtained from a 7-year experiment conducted in the state of Mississippi, which consisted of four fertilization systems (unfertilized control, commercial inorganic N fertilizer, and pelletized poultry litter with/without flue gas desulfurization (FGD) gypsum) and two cover crop treatments (wheat winter cover crop and fallow). The objectives of this study are: 1) to quantify selected soil physical, chemical, and microbiological indicators in the upper 0-15 cm of soil; 2) to compare soil physical, chemical, and biological attributes between contrasting, innovative management practices; and 3) to assess the sensitivity of different soil health scoring methods. Preliminary analysis of soil physical, chemical, and microbial indicators in the study area showed that wheat winter cover crop and pelletized poultry litter, especially in combination with gypsum, can significantly increase soil health scores. The results are expected to determine which soil health assessment tools are more sensitive and help in showing numerical differences in soil health scores among different fertilization regimes and cover crops in the state.

Applying a Watershed Scale - Ecosystem Services Framework to Improve Stakeholder Engagement and Increase Participation of African Americans in Ecological and Environmental Sciences

DUGO M.A.

We introduce an exploratory science education research and watershed monitoring program, funded by the National Science Foundation, to improve stakeholder engagement and increase the participation of African Americans in ecological and environmental sciences. The curriculum will combine a citizen science engagement strategy with applied skills in environmental STEM disciplines, using both field and laboratory based research activities. Our place-based framework is designed to characterize watersheds at the basin level and is inclusive of socioeconomic integration. The ecosystem services framework will be utilized to highlight socio-environment interrelations, while concurrently emphasizing the importance of biodiversity and reinforcing cultural connections to the environment. A compliment of activities are proposed including, an undergraduate summer enrichment program, year round environmental monitoring for undergraduate and graduate students, and community outreach. Our curriculum will utilize publically available data sources including, Google Earth Pro, EnviroAtlas, 303d listed streams, TMDL reports, and census data, to identify relevant environmental, social and economic factors necessary for the holistic management of natural resources. Water quality will be correlated to biodiversity metrics obtained through field collections, the use of biological collection databases, and information for species of conservation concern. This project emphasizes the relationship between values, identity, and interest, to foster a deeper connection to the environment. In addition to impacting the STEM environmental workforce, the citizen science component of this project is predicted to empower student participants and proximal communities toward greater social justice and equity, as related to natural resources.

The Influence of Agricultural Water Management Practices on Groundwater Budget in Big Sunflower Watershed

HAN Y., FENG G., OUYANG Y., JIN W., LIU Z., JENKINS J.

The groundwater was heavily used for irrigating crops in Big Sunflower River Watershed (BSRW). Traditionally, many farmers chose to flood irrigation, which wasted large amount of groundwater and resulted in severe groundwater table declining. This study applied a coupled SWAT-MODFLOW model to investigate the influence of different agricultural water management practices on groundwater budget. The agricultural water management practices are composed of (1) pumping groundwater for irrigation based on farmers' conventional irrigation schedule. (2) Drafting groundwater for irrigation in terms of plant water demand (3) No irrigation on farmland. Comparing groundwater recharge, groundwater irrigation amount, groundwater return flow and groundwater ET to obtain the difference of groundwater budget in three agricultural water management practices. Cell-wise water table elevation for three agricultural water management practices will indicate the groundwater table spatial distribution characteristics. Results can assist with groundwater management.

Impact of conventional and water-saving irrigation schemes on soybean yield in Big Sunflower River Watershed

HENG T., FENG G., HE X., LI F.

Big Sunflower River Watershed (BSRW) is a high-yield agricultural area in the Lower Mississippi river. More than 81% of the total area of the BSRW (approximately 10,488 km^2) is agricultural land. Crop yields are often limited by extreme climate events and soil field capacity. Due to these factors, the yield of crops in different regions of BSRW is quite different. For example, in 2013, the soybean yield of Humphreys County, Mississippi was 10.12 bu/acre lower than that of Washington county. Reduction in yield and improving the sustainability of farmland ecosystem is continuous improvement of water use efficiency. However, the model of soybean yield in BSRW has not been calibrated and the effects of different irrigation schemes on soybean yield are rarely reported. In this study, the soil water assessment tool (SWAT model) was calibrated using 20 years (1998-2018) BSRW soybean yield data, then the soybean yield was employed to simulate under non-conventional irrigation schemes. The non-conventional irrigation schemes are the ET-based irrigation method. the amounts of irrigation were set to 50%, 60%, 70%, 80%, 90%, and 100% of crop evapotranspiration (ET). That is, When the soil water storage in 50 cm is lower than the design value of replacement percentage of ET, irrigation was triggered until the irrigation amount reached the ET percentage. The results indicated that soybean yield was positively correlated with ET (R2=0.83). The yield of soybean was 79.23 bu/acre under 80% ET, it was 3.27 bu/acre higher than conventional irrigation. For every 10% increase of ET (50~80%), the average increase of soybean yield is 5.41 bu/acre. Thus this study suggests that the ET irrigation scheduling method can close the gap of soybean yield, so as to make more effective use of irrigation water.

Integrating High-Resolution Remote Sensing Data for Improved Agricultural Soil Water Monitoring

LEI F., MOORHEAD R., CROW W.T., KURUM M.

Improving water usage efficiency is of critical importance for sustainable agriculture water management. Over the past few decades, extensive field investigations and numerical modeling have been conducted to quantify surface water and energy fluxes at different spatiotemporal scales. Meanwhile, with the development of satellite-based sensors, high-resolution land surface hydrological variables can be retrieved remotely to supplement ground-based observations. However, both models and remote sensing retrievals are subject to various sources of errors. An accurate and spatiotemporally continuous soil water monitoring at the subfield-scale is crucial for efficient agriculture water management. Particularly, data assimilation techniques can optimally integrate measurements acquired from various sources (including in-situ and remotely sensed data) with numerical models by considering different uncertainties. In this presentation, we present some recent work on monitoring soil water content over a vineyard in California. Specifically, high-resolution evapotranspiration estimates derived from satellite-based thermal imagery and surface soil moisture retrievals from synthetic aperture radar sensor are optimally incorporated into a Water-Energy-Balance Soil Vegetation Atmosphere Transfer (WEB-SVAT) model via data assimilation methods. Results demonstrate that the simulation of soil water content in the SVAT model can be enhanced through the assimilation of high-resolution remote sensing data with reduced errors compared to independent ground-based measurements. This work can foster improved irrigation strategies with the availability of continuous and accurate soil water monitoring at subfield-scale for agriculture.

Soil Water Characteristic in Relation to Textural Composition and Organic Matter Content Under Biochar Application

LI Y., FENG G., TEWOLDE H.

Estimating soil water hydraulic characteristics from readily available physical parameters has been a long term goal of soil physicists and engineers. Several equations were developed according to the relationships between soil water characteristics, soil texture and soil organic matter and commonly applied to hydrologic analyses. Especially the hydrological equations of Saxton et al. (2006) performed the best. BC, as is a valuable soil amendment, has been reported to have a positive effect on the soil health. Thus it may affect on soil water characteristics because of its inherent properties such as high pH, high cation exchange capacities (CEC), high specific surface area and soil organic matter. Thus, a hydrological equation for biochar addition to soil should be found or calibarated and then was compared to the hydrological equations of Saxton et al. (2006) to evaluate soil water infiltration, conductivity, storage, and plant-water after biochar addition. In this study, we collect 180 soil samples in four farmer fields applied biochar at 6.73 Mg/ha every year by spreading way on soil surface for almost 5-10 years. We will measure and get soil water characteristics curve; bulk densities; sand (S), silt and clay (C) particle sizes and organic matter of 0-5 cm (A), 5-10 cm (B) and 10-15 cm (C) layers. Then the regression equations were developed and the comparison between the new hydrological equations and hydrological equations of Saxton et al. (2006) will be analyzed. The experiment and result are still in progress.

Mississippi Water Stewards: Development of a Statewide Citizen Water Monitoring Program

LOGAN K., BAKER B., SPARKS E., DOMINGUEZ M., CORDOVA S.R., BRAMAN A.

Mississippi has ecosystems that reside in three Gulf of Mexico (GOM) watersheds; it also faces several environmental and economic barriers at local scales that limit water monitoring and protection capacity, including underserved populations and a thriving agricultural industry. To address the protection of Mississippi's local water resources and the GOM, Mississippi State Extension Service personnel have partnered with the Alabama Water Watch Program and the Pearl Riverkeeper program, with funding from the U.S. Environmental Protection Agency to develop infrastructure for the first statewide citizen based-water monitoring and education program. The Alabama Water Watch (AWW) and Global Water Watch (GWW) Programs have been successfully applying and refining their model of community-based watershed stewardship for more than 25 years, which has gained them national and international recognition in the realm of volunteer monitoring. The Mississippi Water Stewards (MSWS) program will implement EPA-approved quality assurance plans for water chemistry and bacteriological monitoring, as well as develop plans for biomonitoring and a youth education program in three pilot watersheds in Mississippi. The implementation of MSWS will be achieved by adopting the Alabama Water Watch model. Sound development and piloting of the MSWS program will include adaptation of an administrative infrastructure, development of MSWS water monitoring manuals, facilitation of four citizen monitor certification workshops, development of a Training of Trainer (TOT) manual and the facilitation of one TOT workshop. We anticipate outcomes of this project to include the certification of 60 trained monitors, 15 MSWS trainers, the collection and submission of approximately 1000 data records by citizen monitors, development of a youth monitoring curriculum, educator workshop, and engagement of youth in watershed stewardship and monitoring by trained educators using MSWS 4-H curriculum. Protection of water resources through education and outreach to citizens will build transparency and public participation in the protection of the states' unique water resources and ecosystems, thereby protecting the GOM, fostering community involvement, and water resource protection. The MSWS program will empower citizens to use their data to bring about positive changes in their communities by influencing water policy, implementing watershed management plans, and educating others.

Effects of Cover Crops on Edge-Of-Field Water Runoff in the Mid-South

LUCORE A., BAKER B., ALDRIDGE C.

Efforts to reduce nutrient transport from agricultural landscapes has led to research and implementation of numerous conservation practices. Cover crops have been widely documented in certain regions of the country, primarily the Midwest, to provide water quality, soil health, and wildlife benefits to the environment, as well as to the agricultural system in the form of weed and pest suppression. A lesser body of research exists in the mid-south, particularly in respect to water quality where the bulk of the research refers to the benefits to soil and soil structure while the effects on water quality are ancillary. This study investigated the effects of cover crops on runoff in row-crop production systems. This study was conducted on a working farm located in Tippah County, Mississippi, where six plots (0.7–6.5 ha [1.8–16.1 ac]) served as treatments and controls. Four plots were randomly selected and planted with cover crops and the remaining two plots served as controls, all plots had been under no-till for 20+ years. Water quality was monitored via automated storm-based sampling at all locations for two years prior to cover crop implementation at the treatment sites (2014-2015) and for four years post cover crop implementation (2016-2019). Water samples were analyzed for nitrate-nitrite, total nitrogen, orthophosphorous, total phosphorous, and total suspended solids within 48 hours of sample collection. Data analysis indicated reductions among all analytes besides orthophosphorous with nitrate-nitrite concentrations being the most pronounced reduction. Additionally, there was considerable variability amongst season, cover crop type, and cash crop species.

Estimating the Century-Long Precipitation Trends in Lower Mississippi River Alluvial Valley Using Nonparametric Analysis

OUYANG Y., FENG G., MORAN M.

Climate change is a natural phenomenon, but anthropogenic activities such as fossil fuel burning, industrial pollution, deforestation, and population growth have greatly accelerated the greenhouse gaseous emissions and have resulted in abnormal climate change patterns. Climate change over the last several decades has been linked to atmospheric water vapor content increase, precipitation pattern shifts, snow cover reduction and ice melt, and surficial hydrological process cycle changes. Lower Mississippi River Alluvial Valley (LMRAV) is an economic artery of Mid-south USA, which is prone to natural disasters from extreme climate events and is well known for cyclic flooding events, groundwater level decline, and surface water quality degradation. Currently, our knowledge on long-term precipitation trends in this region is fragmented. Using the past 100 years measured daily precipitation data from six watersheds within the LMRAV in conjunction with nonparametric analyses (i.e., Kruskal-Wallis, Dunn, Mann-Kendall, and Pettitt tests), we found that there were significant increasing trends ($p < 0.05$) in annual precipitations near the coastal area. A spatial variation in seasonality was also observed at the decadal scale. Results from this study are useful to water resource managers for adapting the changing climate conditions in the LMRAV.

Development of a Web-Based Agricultural Integrated Management System (AIMS) for Watershed Management: A Case Study for the Johnson Creek-Long Creek Watershed in Panola County, Mississippi

POPHET N., OZEREN Y., BINGNER R., YASARER L., SMITH P., RAMALINGAM V., YAFEI J.

The National Center for Computational Hydroscience and Engineering (NCCHE) and the USDA-ARS-National Sedimentation Laboratory have developed a web-based Agricultural Integrated Management System (AIMS) to provide a powerful watershed conservation management planning tool in easy to use technology. This technology provides modeling capabilities with automated data preparation from seamless geospatial data for use in evaluating runoff, sediment, and agro-pollutant loadings for any watershed in the U.S. via a Web-browser. The ultimate goal of AIMS is to provide capabilities such as (i) viewing and interacting with geospatial layers, (ii) acquiring information describing features from geospatial layers for a user-defined area, (iii) launching modeling tools for topographic landscape analysis (TopAGNPS) and agricultural watershed simulations (AnnAGNPS), and (iv) accessing various Decision Support tools to allow users to compare various simulated conservation planning scenarios. The beta version of AIMS is currently available and can be accessed via the address "aims.ncche.olemiss.edu." In order to evaluate AIMS for adequate input data preparation required for AnnAGNPS watershed simulations, a case study was performed on the Johnson Creek-Long Creek HUC 12 Watershed (155.85 km^2) located in northwest Mississippi. The input parameters required for use with the AnnAGNPS model includes soil, climate, land use, and crop data, which can be automatically prepared through AIMS. Soil information was prepared by AIMS from the USDA-NRCS Soil Survey Geographic (SSURGO) Database. The climate generator-GEM6 was used to generate climate data. Land use and crop data were obtained from the USGS 2016 National Land Cover Database (NLCD) and the USDA 2018 Crop Data Layer (CDL), respectively. The performance of the AIMS system to adequately describe this watershed was evaluated by comparing the observed runoff at an in-stream measuring station with the AIMS-AnnAGNPS simulated results.

Effects of Biochar Incorporation on Nutrients Leaching in a Soil of the Mississippi Delta

ORTEGA-ACHURY S.L., RAMIREZ-AVILA J.J., CHAVARRO-CHAUX L., ANAPALLI S., PINNAMANEANL S.

The effects of incorporating sugarcane biochar on soil's physical and hydrologic characteristics and leaching water quality is evaluated in the Mississippi Delta. The study has been advanced on ten rain fed corn production plots (1200 ft^2) receiving five levels of biochar application (0, 5, 10, 15, 25 Mg/ha). Potential effects on leaching water quality were evaluated by implementing two soil-water samplers on each plot, one at 6-in depth, the second at 12-in depth. Soil physical tests such as infiltration, aggregate stability and bulk density were completed before and after crop growth and harvest to determine potential changes in soil hydrologic response. Preliminary results indicate water transmission increased on amended soils when compared with the fields with no-biochar application. Reductions on total nitrogen and nitrate leaching concentrations ranged from 1.3 to 2.1 times the measured concentrations leached from unamended plots. Maximum measured concentrations observed after the first rainfall event next harvest were 45-mg/l and 27-mg/l for TN and nitrate, respectively. As leaching concentrations of nitrogen decreased in time for all the plots, no significant effect was observed on TN and nitrate concentrations among treatments during the winter period. Phosphorus leaching concentrations were lower on biochar treated plots, but a reduction trend with soil wetting during the wet season was not observed. Phosphorus concentrations on amended plots decreased, on average, from 1.7 to 2.0 times the concentrations observed on unamended fields.

A Preliminary Analysis of Soil Nutrients in Agricultural and Forest Habitats in the Mississippi Delta

STEVENS E., YASARER L.M. W., TAYLOR J., LOCKE M., MOORE M.

As a historical floodplain of the Mississippi River, MS Delta soils are anticipated to have high natural nutrient content. In addition, years of farming and fertilizer applications have altered natural nutrient compositions and potentially created a legacy storage of soil phosphorus on agricultural land. This study is a step in a series of analyses and experiments to characterize and quantify legacy soil phosphorus in a variety of common soil types found in either agriculture or forest habitats throughout the Mississippi Delta. Soil and sediment samples were taken from 73 locations comparing agriculture and forest environments within four different soil types: Dundee, Forestdale, Alligator, and Sharkey. Samples were taken in triplicate to total 219 samples, which were each homogenized in the laboratory. The field-moist samples were processed immediately, while the dried samples were air-dried, ground, and sieved to less than 2mm. Both field-moist and dried samples were extracted in aerobic environments. Extractions were performed on field-moist samples to extract water soluble phosphorus. Samples were analyzed for carbon, nitrogen and sulfur on an elemental analyzer. Mehlich-3 extractants were analyzed for phosphorus, potassium, calcium, magnesium, sulfur, sodium, iron, manganese, zinc, copper, boron, and aluminum using inductive coupled plasma (ICP) mass spectrometry. This initial analysis will compare soil phosphorus content in managed-agricultural vs. "natural" forest habitats, evaluate the spatial distribution of nutrient content throughout the Delta, and evaluate correlations amongst measured nutrient and mineral components. This work sets the stage for a deeper analysis of phosphorus availability in different soil types and development of predictive relationships to estimate phosphorus in soils throughout the Delta.

Rice Yield And Groundwater Level As Affected By Irrigation Management In Mississippi Delta

WANG M., FENG G., LI Y., WANG Y.

Traditional irrigation of rice, consume as high as 3.0 feet/acre, seriously threatens the sustainability of rice production and attributes to declining of groundwater level in the Big Sunflower River Watershed (BSRW). Non-traditional irrigation management, conjunctive use of surface water (in streams and ponds) and groundwater, potentially ensure the rice yield and the sustainable availability of groundwater. Nevertheless, the potential impact of non-traditional irrigation on rice yield and groundwater level were rarely reported. In this study, the Soil and Water Assessment Tool (SWAT model) was calibrated using 15 years (2000-2015) field data and was validated by 3 years (2015-2018) field data, then applied to simulate the future change trends of rice yield and groundwater level under conventional and non-conventional irrigation scheme, among which the non-traditional irrigation presented different ratios of surface water and groundwater for irrigation (setting up six scenarios: 0% (in entire planting season), 40% (in May), 20% (in June), 30% (in July), and 100% (in August) reductions in weekly pumping replaced by surface water, and a combination of the last four replacement). The results showed that traditional irrigation (0% replacement in entire planting season) would decrease groundwater level by 140-300 mm yr-1 and make rice yield drop by 5%-20% during 2019 to 2030. Compared with traditional irrigation, the combination of 40% (in May), 20% (in June), 30% (in July), and 100% (in August) reductions in weekly pumping replaced by surface water would more effectively mitigate the significant decrease of groundwater level and rice yield than the replacement in a given month. Additionally, rainfall in planting season was taken account into the demand of rice irrigation, since the results implied that the storage capacity of ponds has a distinct impact on the groundwater level. Overall, this study suggested that the non-traditional irrigation of combing surface water and groundwater could be a more sustainable way for future to continuously grow rice than the traditional irrigation of single groundwater resource in the Mississippi Delta.

Biobased Multifunctional Magnetic Absorbent From Forest Residues For Non-Point Pollution Water Treatment

ZHANG X., ZHANG J., MLSNA T.

Non-point pollution (NPP) has been recognized as the leading source of water pollution in the United States, especially Mississippi, threatening water safety and human health. NPP originates from the agriculture and urban stormwater runoff containing major contaminants like nutrients, pesticides, and heavy metals. Today, treatment of NPP water remains a challenge due to no single absorbent can be used to effectively remove all major water contaminants. In this study, we developed a multifunctional biobased magnetic absorbent (MA) from forest residues for the cleaning of various water contaminants including heavy metals (Pb and As) and nutrients (phosphorus and nitrate). The biobased MA was synthesized via a catalytic thermal conversion process with iron nitrate as a catalyst at 1000 °C using a tubular furnace. The structure and morphology of biobased MA were characterized by X-ray diffraction, scanning electron microscopy, X-ray photoelectron spectroscopy, and transmission electron microscopy. The performance of biobased MA was tested in terms of heavy metals and nutrients adsorption capacity as a function of time, concentration, and solution pH. This study demonstrates a multifunctional absorbent from renewable resources for NPP water treatment.

Impact Of Long-Term Organic Fertilizer On Soil Physical Health Of High Tunnels In The Southern United States

ZHANG Y., FENG G., BI G., YU S.

Soil health in agricultural production represents soil quality and productivity. Soil bulk density (BD), aggregates, particle size, porosity, saturated hydraulic conductivity, and field-saturated hydraulic conductivity (measured with the Guelph permeameter method) are important indicators of soil physical health. Previous studies show that compost and organic fertilizer can improve soil physical properties and reduce soil BD under high tunnels and outdoor conditions. However, a 3-year open-field study shows that different composts have different effects on soil physical properties (BD, aggregate stability, and saturated hydraulic conductivity). In addition, most studies are conducted in the open-field, or in pots and plots of the high tunnels. The environment between high tunnels and open field are quite different, which related to irrigation, fertilization, and weather conditions. The objectives of this study were: 1) using open-field soil as a control to determine whether the application of organic fertilizer affects soil BD, aggregate stability, particle size, porosity, total porosity and permeability in the high tunnels; and 2) to compare changes in soil physical health with the application years of organic fertilizer. The study quantified the effects of different application years of organic fertilizer on soil bulk density, aggregate stability, and permeability, which can provide fundamental guidance for growers to formulate fertilization systems to improve soil physical properties in the Southern United States.

MASTER'S ORALS

Exploring the Use of Synthetic Aperture Radar for Detecting and Monitoring Potariential Long-Term Subsidence in the Lower Mississippi River Valley: Preliminary Results

TERRACINA S., YARBROUGH L.D.

The Mississippi River alluvial plain (MRAP) is a geophysical province in North America extending from the bootheel of southeast Missouri south along the Mississippi River to the Gulf of Mexico. This study focuses on the lower Mississippi Valley portion of the MRAP that extends from Memphis, Tennessee to Vicksburg, Mississippi and bordered by the Mississippi River to the west. This subset of the MRAP, commonly known as the Delta, is an extensive, low, flat lying area that covers an area of approximately 7,000 square miles and serves as a vital economic resource to the state and region.

Because the Delta is comprised of low strength alluvium, low relief, abundant surface water and shallow groundwater resources, the region is suspectable to several geohazards including flooding, bank stability issues, regional and local subsidence, expansive soils, etc. The New Madrid Seismic Zone to the north also poses additional risk of seismic induced hazards (e.g. liquefaction). Characterizing potential subsidence is of great interest due to increased flood risk along low laying areas near water bodies and impact on levee elevations.

In this project, we investigate the use of the remote sensing technique, interferometric synthetic aperture radar (InSAR) to detect subsidence. InSAR uses waveform phase information of similarly polarized radar pulses from two different acquisition dates to detect displacement on the order of a few millimeters. Preliminary work resulted in the detection of the surface displacement in test locations in southern Louisiana. Our method of analysis was applied to the Delta using the Sentinel-1 satellite platform. The InSAR method relies on a temporal dataset and the greater the time between analysis images the more time is available for displacement to occur. Our initial results show regional subsidence rates are smaller than the detectable limits using InSAR. Additional range (e.g. continued acquisitions) in the temporal database and use of shorter wavelengths could lead to an improved method of subsidence detection and monitoring in the Delta.

Using Tritium and General Geochemistry to Constrain Recharge Estimates Within the Mississippi River Valley Alluvial Aquifer

WACASTER S.R., KNIERIM K.J., O'REILLY A.M.

The Mississippi River Valley Alluvial Aquifer (MRVAA), one of the regional aquifers within the Mississippi embayment, is a major source of groundwater for irrigation as well as some public supply use within the Mississippi Alluvial Plain (MAP). An aquifer-scale assessment of recharge processes (where water availability is significantly affected) is critical for the economic welfare of Mississippi, Louisiana, Arkansas, Missouri, Kentucky, and Tennessee. Using readily available recharge estimates and groundwater age will allow water quality and availability to be related.

Groundwater age represents the time required for water to travel from the point where infiltration reaches the saturated zone to a discharge point in an aquifer such as a water well. Groundwater age can be simulated with numerical groundwater flow models and characterized using environmental tracers. Tritium (a radioactive isotope of hydrogen) is one of several age-date tracers and can be used to qualitatively date groundwater—its presence in groundwater indicates that a component of young water (less than 60 years old) is present in an aquifer. This research compares various several regional estimates of recharge (from available datasets (soil water balance (SWB), empirical water balance (EWB)) and calculated estimates such as chloride mass balance (CMB)); recharge estimates will also be compared to groundwater geochemistry (major/minor ions, field parameters, and trace metals) and qualitative age from tritium dating. Results indicate that areas with higher EWB recharge rates were associated with the distribution of alluvial geomorphology. Pleistocene valley trains had higher EWB recharge rates and correspondingly higher tritium. This is likely due to differences in infiltration, where water is likely recharged more readily in the coarser-grained Pleistocene features. The CMB results indicated, however, that slightly greater recharge occurs in the Holocene alluvium. This was the opposite of what other studies found where CMB recharge was limited to the finer-grained sediments of the Holocene due to elevated chloride concentrations from little to no flushing of salts concentrated during evapotranspiration. The SWB will be incorporated to the overall assessment of recharge estimates and CMB estimates will be improved by using a continuous chloride grid to be included in the calculation. This will likely provide insight where high and low recharge values exist spatially, and which method provides the best overview of recharge in the MRVAA. This will improve confidence where water availability will be an issue—where recharge is relatively low in portions of the MRVAA.

Competencies and Training Needs in Water Resource Conservation for Southeastern Extension Agents

MCCRARY A., BAKER B., BURGER L., DOWNEY L.

Awareness and knowledge of conservation practices and programs play a major role in conservation practice adoption. The Extension Service is one of many agencies charged with increasing awareness and knowledge of research-based conservation practices, such as those designed to reduce water pollution and impairment. A regional survey of Cooperative Extension Service agents with agriculture and natural resource (ANR) responsibilities was conducted to assess the need for in-service training on water resource conservation topics. The survey was developed based on the Borich model of needs assessment. Landowner's expressed need, agent's perceived importance rating, and agent's perceived ability rating of eleven water resource conservation topics were collected from ANR Extension agents (N = 244) in seven southeastern states. Additional demographic data, including education and experience levels, were collected for comparison of competency ratings between groups. Overall, agents rated the perceived importance of all conservation topics greater than their perceived ability to educate landowners on the same topics, which indicates further need for professional development. Agents rated their perceived abilities highest for explaining fertilizer application and nutrient management, and lowest for pathogen pollution in waterways, soil loss from agricultural fields, and water quality in streams or ponds. Borich mean weighted discrepancy scores, calculated from the average difference between importance and ability ratings, were used to prioritize training needs of all topics for application in professional development initiatives. The highest priority training needs were for topics related to complex interactions and drivers of nonpoint source pollution, such as pathogen pollution in waterways and soil loss from agricultural fields.

Assessing Surface Water Use for Irrigation in the Delta and its Effects on Groundwater

BROCK M., TAGERT M.L., PAZ J.O., KRUTZ J.

Agricultural production in the Mississippi Delta region relies heavily on groundwater for irrigation due to insufficient rainfall during the summer growing season between May and September. As of 2019, more than 20,000 groundwater well permits for agriculture have been issued in the Delta. The Mississippi River Valley Alluvial Aquifer is the shallow subsurface aquifer underlying the Mississippi River Basin, and concerns persist over the dependence on and future supply of water in this aquifer. Surface water sources for irrigation include on-farm water storage (OFWS) systems implemented as a conservation practice for nutrient reduction with cost assistance from the NRCS Mississippi River Basin Healthy Watersheds Initiative. Consisting of storage ponds and tailwater recovery ditches that intercept irrigation and precipitation runoff from adjacent fields, these systems started being constructed in Mississippi in 2008 and have grown in prevalence in the following years. The goal of this study was to quantify the role of OFWS systems in irrigation and as an alternative to groundwater by examining the inventories of OFWS systems for selected years between 2007 and 2018. The size and number of OFWS systems were identified and recorded based on the geospatial data layers containing digitized polygons of the ditches and ponds that make up these systems. Inventory results show an increase in surface water storage from 22.37 ha in 2007 to 651.61 ha in 2018. Next, interpolated maps of saturated aquifer percentages were created using groundwater levels measured by the Yazoo Mississippi Delta Joint Water Management District and aquifer thickness values from the United States Geological Survey. These interpolated layers and inventories are being used to evaluate and define relationships and trends between surface water use and groundwater use for agricultural irrigation. This presentation will compare trends in groundwater decline between land with supplemental irrigation using surface water and land solely irrigated with groundwater.

A Crop Modeling Approach to Analyze In-Field Soil Moisture Variability

HODGES B., PAZ J.O., TAGERT M.L., REGINELLI D.

Site-specific irrigation decisions require information about variations in soil moisture throughout the rooting depth actively being used by the crop. An increasing number of producers are using soil moisture sensors to make irrigation decisions, and it has been shown that soil moisture sensors can reduce water usage without reducing yields, which also conserves money. This three-year study uses sensors and crop modeling to evaluate the spatio-temporal variability of soil moisture across an 18-ha production field in a corn/soybean rotation. A 55 m by 55 m grid was laid on the field, which resulted in 44 sampling points that fell either underneath the center-pivot irrigation or the end gun. At each point location, two Watermark granular matrix sensors were installed at depths of 30.5 and 61cm. Analysis of soil samples collected in year one of the project revealed fairly homogeneous soils across the field with silty clay loam as the major soil type and only eight percent silt loam. Plant height and leaf area index (LAI) were measured weekly at each of the 44 sampling points, which resulted in eight measurement dates during the 2018 growing season of the soybean crop. A digital elevation model was also used to log the elevation at each point location. The crop variables were inserted into the CROPGRO crop model in the Decision Support System for Agrotechnology Transfer suite of models to calibrate and predict soybean growth and water use in the field. The soil moisture values will also be inserted into the model when they are converted from soil matric potential to volumetric water content. The model will be run for every grid in the field to predict whether there should be a different irrigation schedule for parts of the field. In this presentation, the results from four grids will be discussed.

Phytoplankton Imaging Technology for Cell identification of Mississippi Coastal Waters Impacted by Cyanobateria During prolonged Opening of the Bonnet Carré Spillway in 2019

BOYETTE A.D.

The primary objective was to use an advanced plankton imaging system (FlowCAM®) to identify and count harmful cyanobacteria (CyanoHAB) and other phytoplankton cells in Mississippi coastal waters in response to prolonged opening of the Bonnet Carré Spillway (BCS) in 2019. A weekly sampling protocol was conducted from 16 surface stations in the Mississippi Sound from 09 July to 29 August 2019. Although mixed assemblages of diatoms and dinoflagellates were the predominant phytoplankton groups at all stations throughout the sampling period, CyanoHAB genera *Dolichospermum* sp. and *Microcystis* sp. colonies were present at elevated (>150,000 colonies L-1) concentrations in the western and central Mississippi Sound. Additionally, Chlorophytes, which tended to be freshwater genera (e.g. *Pediastrum*, *Actinastrum*), were relatively abundant at stations in the Western Mississippi Sound, but absent in the central and eastern portion of the Sound, suggesting influence of Mississippi River water via the Bonnet Carré Spillway. While the data presented here was useful in determining the extent and proliferation of CyanoHABs, it was not used by environmental managers in a regulatory capacity. However, the impact of CyanoHABs during the summer of 2019 was unprecedented in its extent and pervasiveness along coastal Mississippi. Despite the ecological impacts to Mississippi coastal communities, the BCS remains one of the primary flood control systems on the Mississippi River and will continue to be used as flood mitigation. This underscores the need for a long-term phytoplankton monitoring system to serve as an early warning indicator for harmful algal blooms and other eutrophication processes.

Development of a Boat Traffic Prediction Model Using an Artificial Neural Network

ROSSELL W., OZEREN Y., YASARER H.

Riverbank erosion is a major concern to neighboring inhabitants and the surrounding environment. Boat generated waves can significantly contribute to riverbank erosion in navigable rivers and waterways. Waves created by high-speed vessels can have wave heights large enough to cause significant damage to the riverbanks. A preliminary step to predicting the impact of boat generated waves is to predict local boat traffic. In this study, 8 models for predicting boat traffic along a reach of the Connecticut River were created using a Feed-Forward Artificial Neural Network, considering different combinations of a variety of inputs. Wave data was collected using four capacitance type wave staffs installed at three sites along the study reach, and processed in a deterministic identification model to define boat traffic counts. Weather conditions were categorized using time-lapse videos recorded at the study sites. Other variables for the development of the boat traffic prediction models were the month of the year, day of the month, day of the week, river stage, water depth, logger location, and measured temperature and precipitation data collected at a nearby weather station in Amherst, MA. 7 models were constructed to predict daily boat traffic. 1 model was constructed to predict hourly boat traffic for comparison. This paper presents a comparison of results and the performance of these various models.

PhD ORALS

Changes in Mississippi Sound Water Quality Due to the Opening of the Bonnet Carré Spillway

MOODY A., SHILLER A.M.

The Bonnet Carré Spillway, a structure that prevents flooding in New Orleans due increased water levels in the Mississippi River, was opened for a total of 122 days in 2019 from February to July. This resulted in a massive release of freshwater into Lake Pontchartrain, which was then funneled into the Mississippi Sound, causing significant chemical and ecological impacts there. Fortuitously, this event occur in the midst of our ongoing sampling campaign aimed at elucidating nutrient distributions and groundwater contributions in the Sound. The impacts from the influx of this freshwater event were mainly focused on the western half of the Sound, closest to outflow from Lake Pontchartrain. Water quality indicators from our time series as well as snapshots from before, during, and after the opening of the Spillway indicate that the western Sound experienced rapid changes in water chemistry. For instance, the average salinity of the Sound decreased from 20 to 5 after the opening of the Spillway. Application of an apparent age model using the ratio of short-lived radium isotopes indicates that the flushing rate of the western Sound during the Spillway opening increased dramatically, changing the physical characteristics of the Sound as well. The high levels of precipitation in the 2019 season led to some elevated nutrient levels across the Sound from increased river discharge.

Groundwater Age Dating with 14C, 3H, and SF6 to Investigate the Spatial Distribution of Recharge Rates to the Mississippi River Valley Alluvial Aquifer

GRATZER M., KNIERIM K., KINGSBURY J., WACASTER S.

The Mississippi Alluvial Plain (MAP) is the lower part of the Mississippi River floodplain; it overlies the Mississippi River Valley alluvial (MRVA) aquifer. Water-level declines in the MRVA aquifer are of concern. To better characterize the water availability of the aquifer, the spatial distribution of recharge must be well constrained. An approach to investigating the spatial distribution of recharge rates is groundwater age dating: determining the amount of time that has passed since the water became isolated from the unsaturated zone. The U.S. Geological Survey Lower Mississippi-Gulf Water Science Center collected groundwater samples from the MRVA aquifer, which were analyzed for age tracers (14C, 3H, and SF6); samples were also collected from the underlying Claiborne aquifer to investigate areas where water may be moving upward into the MRVA aquifer. These age tracer concentrations are used to estimate the distribution of groundwater age in the aquifer at each sample location using lumped parameter models. Multiple age tracers are used because a groundwater sample tends to contain a mixture of water of various ages and each tracer is appropriate for a different time range: up to 30,000 years before present for 14C, up to 60 years before present for 3H, and up to 67 years before 2020 for SF6. Historical atmospheric 14C activities range from 97 to 140 pmC. Groundwaters typically have 3H concentrations less than 10 TU. Historical atmospheric SF6 concentrations range from 0 to 8.5 parts per trillion (ppt). Generally, the higher the concentration of a given tracer, the younger the water. However, atmospheric 3H activity varies spatially and temporally, so groundwater 3H activities must be evaluated in terms of the historical atmospheric 3H activity of the recharge zone in order to estimate groundwater ages. Based on preliminary analysis, 14C activities (not corrected for dilution) in the MRVA aquifer range from 0.7 to 109.3 pmC; most of the MRVA aquifer has 14C activities above 60 pmC. Tritium concentrations in the MRVA aquifer range from 0 to 17 TU; most of the MRVA aquifer has 3H concentrations above 3.5 TU. Sulfur hexafluoride concentrations in the MRVA aquifer range from 0.4 to 9.4 parts per trillion by volume (pptv); most of the MRVA aquifer has SF6 concentrations above 2.4 pptv. The 14C activity in the MRVA aquifer is lowest in Mississippi County, AR, and highest in Butler County, MO, and Iberville Parish, LA. The spatial distributions of 3H and SF6 are very similar to each other. The spatial distribution of 14C is similar to 3H and SF6 except for a group of well locations, in a north-south orientation from the bottom of the Grand Prairie region of Arkansas to the top of Louisiana, where 14C is high and 3H and SF6 are low. The lowest (oldest) and highest (youngest) SF6 concentrations lie in areas with similar, relatively high (young) 14C activities, probably due to the finer temporal resolution of SF6 concentrations for young groundwater than that of 14C activities. The highest 3H activity lies in an area with high (young) 14C activity, and the lowest 3H activity is the same location as the lowest (oldest) 14C activity. The lowest (oldest) SF6 concentration was collected from a location with a low 3H activity and the highest (youngest) SF6 concentration was collected at a location with a high 3H activity. Results of the lumped parameter models will be presented.

Numerical Study of Pumping Induced Groundwater Flow in Vicinity of an Alluvial River

FANG J., JIA Y., RIGBY J.R.

Water resource shortage increasingly constraints the development and sustainability of agriculture. Over-pumping has resulted in severe depletions of groundwater (GW) in the Mississippi Delta. To mitigate the problem, an USDA experimental study was proposed to reduce groundwater depletion via pumping from a high-level aquifer and injecting to a lower one. The pumping sites are set to be near the Tallahatchie River in Money County, Mississippi, USA, to take the advantage of water supply from the surface water infiltration. A finite element based numerical model, CCHE3D-GW, was developed in this study to study the drawdown process of the GW affected by the heterogeneous aquifer and surface water in the alluvial river. The numerical model was verified with a vertically averaged 2-D analytical solution considering pumping and surface water infiltration. The model were verified with two sets of meshes, in which 4 and 12 layers were applied in z direction, respectively. A 3-day field pumping test was conducted. The area of the field simulation case is 20.3 x 28.6 km^2. In this area of the Mississippi Delta, a 40 m thick heterogeneous sandy aquifer is overlaid by a 10 m thick low-permeable aquitard, approximately. Calibrations were conducted using the data of the pumping well and multiple observation wells. The simulation results agree well with the measured pumping data. With the calibrated parameters, a long-term (17 years) pumping was then simulated to better understand the GW balance and distribution in response to the pumping. It is found that the sandy aquifer provides a large portion of the pumped water while the supply from river is limited in the study site.

Effects of Herbicide Management on Limnobium spongia and Water Quality

LAZARO-LOBO A., TURNAGE G., ERVIN G.N.

Limnobium spongia is a free-floating aquatic plant that can produce extensive floating mats and can cause negative ecological, social, and economic impacts. Literature describing effective control measures for *L. spongia* and possible changes in water quality following herbicide treatment of aquatic plants is minimal. We conducted a mesocosm study to assess the effect of seven herbicides at low and high doses in an effort to control *L. spongia* while minimizing negative impacts on water quality attributes. We found that low and high doses of imazamox, imazapyr, and flumioxazin herbicides effectively controlled *L. spongia* initially and during the next growing season, whereas 2,4-D at both rates, as well as high doses of glyphosate and triclopyr initially controlled the species but failed to contain the regrowth of the species during the next summer. Low doses of glyphosate and triclopyr gave poor control of *L. spongia*, and none of the florpyrauxifen-benzyl rates had any effect on the plants. Furthermore, we found that the increment in light availability after the herbicide-induced death of *L. spongia* promoted the growth of algae and other photosynthetic organisms in the mesocosms. This led to an increase in dissolved oxygen availability and water column pH. Decreases in plant cover in the mesocosms was correlated with increased electrical conductivity and nitrate concentrations during the first 4 months of the experiment, which potentially could lead to eutrophication issues during plant control efforts at a larger scale, without adequately short residence times in treated water bodies.

Response of the Aquatic Weeds Crested Floating heart and Watershield to Varying Herbicide Rate at Different Application Periods

TURNAGE G., BYRD J.

Watershield (*Brasenia schreberi*) and Crested Floating Heart (CFH; *Nymphoides cristata*) are two perennial aquatic plant species that are problematic/weedy in the Southeastern US. Watershield is a native species while CFH is an invasive species from Asia. Both species can negatively affect human and ecosystems processes in aquatic habitats. Both are capable of outcompeting and displacing native plant species for resources thereby disrupting ecosystem processes. Limited data exist concerning effective chemical control (herbicides) methods for both species. This project was conducted to 1) determine if a new liquid formulation of flumioxazin was effective at controlling either species at high and low rates and 2) determine if timing of herbicide application (early vs. late season) could enhance control of either species. Both WS and CFH plants were established in mesocosms at MSU and allowed to grow for one month prior to herbicide applications. Herbicide residues were in contact with target plants for 24 hours then herbicide treated water was drained off and mesocosm tanks refilled. At 4 weeks after treatment (WAT), none of the herbicide treatments had reduced aboveground (AG) biomass of watershield during both application trials when compared to reference plants. However, watershield belowground (BG) biomass was reduced by <90% by both granular rates in the early season trial; in the late season trial, the low rate of granular flumioxazin had an increase (573%) in watershield BG biomass while other treatments were not different from the references. Herbicide treatments had no effect on CFH biomass or propagule production (daughter plants) at either time period. However, there was a difference in CFH BG biomass among herbicide treatments (while none were different from the reference) at the early season application. Also, while not different from references there were no CFH propagules produced by either low flumioxazin treatment during the late season trial; lack of statistical significance is likely due to the low number of replicates (3) in each treatment used for this trial. Future work should utilize more replicates and herbicide rates as well as explore longer exposure times.

Effects of Low-External-Input and Conventional Rice Cultivation on Indicator and Pathogenic Bacteria Presence

FIRTH A., BAKER B., BROOKS J., DAVIS J.B., IGLAY R., SMITH R.

Over 800,000 ha of rice is planted in the Mississippi Alluvial Valley (MAV), making it a significant economic crop of the region. Additionally, recognized under the North American Waterfowl Management Plan and the Lower Mississippi Valley Joint Venture, winter-flooded rice fields provide critical habitat for migratory waterbirds. However, wintering waterbird use of flooded rice fields could facilitate pathogen transport in a low-external-input-sustainable-agriculture (LEISA) rice system in the MAV. This study compared two rice farms with different management histories during the winter (conventional and LEISA). Each farm selected for study and received two treatments: 1) unflooded or 2) winter flooded fields. Fecal indicator bacteria (*Enterococci, Clostridium perfringens, Salmonella, Campylobacter* and *Escherichia coli*.) were quantified in soil before and after winter flooding and bird fecal matter estimated. Water samples collected from winter flooded fields were tested for *Enterococci, C. perfringens* and *E.coli* before fields were drained. Soil analysis results indicated LEISA flooded fields had significantly greater detections of *C. perfringens* than non-flooded fields. No significant differences were detected between fields in water samples. All observed pathogen rates among treatment were also less than U.S. EPA standards. Results suggest that long-term waterbird stopovers can influence pathogen indicators in soil, however, not at a significant level to pose threat to human and environmental health standards. Nevertheless, because the study was only conducted over one season, it limits the conclusions drawn about wintering bird's potential to contaminate rice fields. Future studies should focus on long-term monitoring of rice fields that harbor wintering birds.

Investigation of Reduced Herbicide Rates and Tank Mixes Applied Via Submersed Injection for the Selective Control of Cuban Bulrush (*Oxycaryum cubense*)

TURNAGE G., BYRD J.

Cuban bulrush (*Oxycaryum cubense*) is a perennial invasive aquatic plant species native to South America that is spreading across the Southeastern US. Cuban bulrush can block boat launches, impede navigation along river channels, negatively affect drainage canals, and degrade fishery habitat by lowering dissolved oxygen under plant mats. Cuban bulrush is capable of outcompeting and displacing native and other invasive species for resources thereby disrupting ecosystem processes. During initial colonization, it exists as an epiphytic species utilizing other aquatic plants or structures for habitat. Limited data exist concerning effective chemical control (herbicides) methods for controlling Cuban bulrush. This project was conducted over two years to 1) screen potential herbicides for selective control of Cuban bulrush (year 1) and 2) investigate tank mixtures of herbicides active on Cuban bulrush for selective control (year 2). In year 1, herbicides were identified that provided short-term selective control of Cuban bulrush grown with American lotus; herbicides were applied at the maximum rate allowed. No herbicide provided long term reduction of Cuban bulrush or American lotus. In year 2, reduced rates (half the maximum label rate) and tank mixtures of two systemic (triclopyr and fluridone) and two contact (flumioxazin and carfentrazone-ethyl) herbicides from year 1 were examined for control of Cuban bulrush and two native plant species, cattail and hardstem bulrush. Emergent Cuban bulrush was reduced 92% by triclopyr, 88% by carfentrazone-ethyl, 100% by triclopyr+flumioxazin, and 100% by triclopyr+carfentrazone-ethyl when compared to reference plants at 8 weeks after treatment (WAT). At 44 WAT, all treatments deliver greater than 94% control of Cuban bulrush compared to reference plants. Submersed Cuban bulrush was reduced 86% by triclopyr and 93% by triclopyr+flumioxazin when compared to reference plants at 8 WAT. At 44 WAT, all treatments delivered greater than 93% control of Cuban bulrush when compared to reference plants. In year two, herbicides did not reduce biomass of native plants at eight weeks after treatment (WAT). Hardstem bulrush was not affected by herbicide treatments at 44 WAT while cattail biomass was reduced by multiple treatments. These data suggest that triclopyr alone and in combination with flumioxazin can selectively control both emergent and submersed Cuban bulrush tissues over the short-term, but any herbicide or herbicide combination used here can deliver long term control. These treatments provided selective long-term control of Cuban bulrush when growing with American lotus and hardstem bulrush but not cattail.

Runoff Water Quality Under Conservation Management in Mississippi Corn Production

SPENCER D., KRUTZ J., GHOLSON D., LOCKE M., HENRY B., GOLDEN B.

Row-crop agriculture in the delta region of Mississippi is a major contributor to groundwater decline and surface waterbody impairment. Conservation management practices such as cover crops and no-tillage may improve irrigation efficiency and decrease contaminant runoff, thus promoting sustainable stewardship of both ground and surface water resources. The effects of cover crops and tillage system on runoff water quantity and quality under simulated rainfall and furrow irrigation were evaluated on a Commerce very fine sandy loam (fine-silty, mixed, superactive, nonacid, thermic Fluvaquentic Endoaquepts) at Stoneville, MS from 2017 to 2019. Under furrow irrigation, no-tillage decreased runoff volume and increased furrow advance time in one of three and two of three years, respectively. Other than crimson clover in one of three years, cover crops did not reduce runoff under furrow irrigation. No conservation practice decreased runoff under simulated rainfall. In 2017 and 2018, cover crops did not have an effect on water quality. No-tillage improved turbidity, but also increased certain nutrient concentrations and loads. Water quality results from 2019 will be presented as well.

Effect of BMPs on Hydrology and Water Quality at Field Scale Watershed

RISAL A., PARAJULI P.

In order to implement and regulate water resource management plans in a watershed, it is required to apply some Best Management Practices (BMPs) and evaluate their effects on hydrologic behavior and water quality. Field scale watershed model such as Agricultural Policy/Environmental Extender (APEX) can be applied to access the effect of such BMPs. APEX was applied to a sub-basin of the Big Sunflower River Watershed (BSRW). Calibration and validation of APEX for streamflow was conducted using the flow output from the calibrated Soil and Water Assessment Tool (SWAT) model for BSRW and that for sediment yield, Total Nitrogen (TN), and Total Phosphorous (TP) were conducted using observed data obtained every fifteen days from 2014 to 2016 for two locations within the sub-basin. Modeling scenarios such as crop rotation, tailwater pond, and vegetative filter strips (VFS) were applied and their effects in reducing runoff, sediment yield, TN, and TP concentration were evaluated. A significant difference in the amount of surface runoff, sediment yield, and nutrients concentration were observed for different BMP scenarios. The simulation results obtained from this study will provide a better idea to other modelers and decision makers in formulating decision regarding BMP implementation and proposing a suitable field scale BMPs in the reduction of surface runoff, sediment, and nutrient yield.

STREAM HEALTH AND RESTORATION

Function-Based Assessments for Streams in Mississippi

RAMIREZ-AVILA J.J., ORTEGA-ACHURY S., CHAVARRO-CHAUX L.

The physical, chemical, and biological processes that create and support a stream system are known as stream function. Understanding how stream functions work together and which restoration techniques influence a given function is a necessary step to successfully restore stream corridors. A study was completed to determine the function-based watershed and reach level assessments, restoration potential, project goals and objectives, and preliminary designs for reaches along tributary streams of the Catalpa Creek in Mississippi. Rating of pre-restoration conditions for hydrology and hydraulics stream characteristics indicate all the streams are functioning at risk due to their flashy response, presence of point flow discharges and limited floodplain connectivity due to their degree of incision. The geomorphology level was rated as functioning at risk and not-functioning due to the limited presence of riparian vegetation and streambed material, and the presence of active streambanks along different segments of the study reaches. Assessment of water quality and macroinvertebrates evidenced that physicochemical and biological processes are functioning at risk due to the effect of seasonal variations in temperature, dissolved oxygen and nutrients contents of the stream water, the significant presence and predominance of macroinvertebrate communities tolerant to impaired water quality conditions, and the limited presence of favorable habitats for good water quality bioindicators. Watershed and reach assessments indicated the restoration potential for all the study reaches should focus on the uplift of hydrology, hydraulic and geomorphology processes. Following the natural channel design guidelines, all the study reaches, currently in a widening and degradation stage on the channel evolution sequence and categorized as Rosgen G stream type, could be restored to become stable Rosgen class C streams.

Water Quality Conditions Associated to Livestock Production in the Catalpa Creek

RAMIREZ AVILA J.J., CHAVARRO-CHAUX L., ORTEGA-ACHURY S., RICHARDSON B., CZARNECKI J., SCHAUWECKER T.

Physicochemical and biological assessments of stream water quality and health have been advanced along a 0.9-km reach located within the MSU Dairy Unit in northeast Mississippi. The reach, a tributary of the Catalpa Creek, directly receives surface and concentrated (gullies) runoff from the upper 0.52-km^2 livestock drainage area production. A bi-weekly grab sampling of the reach advanced during the summer and fall 2019 evidenced poor water quality conditions of the, in average, 0.4-m depth stream baseflow. The observed water quality impairment along the reach is apparently driven by the presence of cattle in the fields and their direct access to the stream, the potential nutrient enrichment of the shallow water table (which maintains the baseflow level during the dry months of the year), and the supply of sediment from active streambanks along the main stream and tributary gullies. Measured nutrient concentrations (Total Nitrogen: 1.2-2.2 mg/l; Total Phosphorus: 0.27-0.72 mg/l; NO_3>0.3-0.78 mg/l; Total Kjeldahl Nitrogen: 0.72-1.82 mg/l) exceeded the standard nutrient criteria proposed for Mississippi. Critical levels of dissolved oxygen (DO) (1.6-5.0 mg/l) and water temperatures of up to 34.3°C, exceeding the standard of 32.2°C, were also monitored. The use of macroinveretebrates assessment as indicator of water quality, revealed little macroinvertebrate diversity and also evidenced poor water quality conditions along the reach. Samples were dominated by midge larvae (Family: Chironomidae) and aquatic worms (Subclass: Oligochaeta), both considered indicators of poor water quality when dominant. Other indicators of poor water quality conditions were green blooms and floating cyanobacteria, the latter mostly present along the deeper segments of the reach containing low DO. Monitoring will continue through the implementation of stream crossings and riparian buffers, practices expected to improve stream health and water quality conditions along the monitoring reach.

AG WATER

Runoff Water Quality Under Conservation Management in Mississippi Corn Production

SPENCER D., KRUTZ J., GHOLSON D., LOCKE M., HENRY B., GOLDEN B.

Row-crop agriculture in the delta region of Mississippi is a major contributor to groundwater decline and surface waterbody impairment. Conservation management practices such as cover crops and no-tillage may improve irrigation efficiency and decrease contaminant runoff, thus promoting sustainable stewardship of both ground and surface water resources. The effects of cover crops and tillage system on runoff water quantity and quality under simulated rainfall and furrow irrigation were evaluated on a Commerce very fine sandy loam (fine-silty, mixed, superactive, nonacid, thermic Fluvaquentic Endoaquepts) at Stoneville, MS from 2017 to 2019. Under furrow irrigation, no-tillage decreased runoff volume and increased furrow advance time in one of three and two of three years, respectively. Other than crimson clover in one of three years, cover crops did not reduce runoff under furrow irrigation. No conservation practice decreased runoff under simulated rainfall. In 2017 and 2018, cover crops did not have an effect on water quality. No-tillage improved turbidity, but also increased certain nutrient concentrations and loads. Water quality results from 2019 will be presented as well.

Cover Crop and Tillage Influence on Growth, Yield, and Plant Water Status of Cotton and Sorghum

DHAKAL M., LOCKE M., REDDY K.

Improved and sustainable soil and crop management practices that reduce crop water use, optimize cotton and sorghum yields, and improve vadose zone water quality is a challenge in the Mississippi alluvial plain. A plot scale long-term agro-ecosystems research (LTAR) experiment was established in October 2018, Stoneville, MS, to examine the influence of tillage [no-tillage (NT) and conventional tillage (CT)], cover crop treatments [no-cover (NC) and cover crop (CC) (Austrian pea, *Pisum sativum* L.)], and crop rotation [cotton (*Gossypium hirsutum* L.) and sorghum (*Sorghum bicolor* L.) (monocultures and rotation)] on crop cover, biomass, yield, water use efficiency, and soil N and organic matter dynamics. Data were collected from June to October 2019 pertaining to canopy cover, leaf area, vegetative mass, yield, and leaf water potential. Soil-water monitoring using capacitance probes to a 122-cm depth was begun in December 2019 and will be continued throughout the 2020 cash crop season. In this establishment year, preliminary results showed no effect of CC and tillage treatments on crop ground cover during vegetative growth from June to August ($P > .05$), however, weed cover was greater in NT (6.4%) than CT (3.8%) treatments ($P < .05$). Also, LWP wasn't affected by CC and tillage treatments ($P > .05$). Although the panicle density of sorghum was greater in CT-NC (16 panicles m^{-2}) than CT-CC (11 panicles m^{-2}), grain yield did not differ between conventional (CT and NC) and conservational practices (NT and CC) ($P > .05$) with a mean yield of 6.6 Mg ha^{-1}. Similarly, cotton lint and seed yield ($P > .05$) were unaffected by the treatments, averaging 1.78 and 4.12 Mg ha^{-1}, respectively. No-till cotton and sorghum management practices in conjunction with CC system may sustain productivity by producing comparable biomass and yield to conventional methods, but these results are considered preliminary in this first year of establishment.

Competencies and Training Needs in Water Resource Conservation for Southeastern Extension Agents

MCCRARY A., BAKER B., BURGER L., DOWNEY L.

Awareness and knowledge of conservation practices and programs play a major role in conservation practice adoption. The Extension Service is one of many agencies charged with increasing awareness and knowledge of research-based conservation practices, such as those designed to reduce water pollution and impairment. A regional survey of Cooperative Extension Service agents with agriculture and natural resource (ANR) responsibilities was conducted to assess the need for in-service training on water resource conservation topics. The survey was developed based on the Borich model of needs assessment. Landowner's expressed need, agent's perceived importance rating, and agent's perceived ability rating of eleven water resource conservation topics were collected from ANR Extension agents (N = 244) in seven southeastern states. Additional demographic data, including education and experience levels, were collected for comparison of competency ratings between groups. Overall, agents rated the perceived importance of all conservation topics greater than their perceived ability to educate landowners on the same topics, which indicates further need for professional development. Agents rated their perceived abilities highest for explaining fertilizer application and nutrient management, and lowest for pathogen pollution in waterways, soil loss from agricultural fields, and water quality in streams or ponds. Borich mean weighted discrepancy scores, calculated from the average difference between importance and ability ratings, were used to prioritize training needs of all topics for application in professional development initiatives. The highest priority training needs were for topics related to complex interactions and drivers of nonpoint source pollution, such as pathogen pollution in waterways and soil loss from agricultural fields.

Resource-Cost Efficiency in Catfish Farming Practices

KUMAR G., HEGDE S.

Farm-raised catfish is an important agricultural commodity and an essential component of rural southern economies. Evolution of the U.S. catfish industry, forged by dynamic market forces, has resulted in the development of an array of farming practices. Recent research and commercial yield verification studies on intensive-production systems have identified cost-effective methods for increasing fish production. These systems involve various strategies by increasing aeration horsepower/acre in smaller production ponds as well as constructing new split-pond systems. The relatively high productivity and cost-efficiency of these systems are making them popular foodfish-production strategies in the industry. This comparative study evaluated the resource cost efficiency of nine different catfish production strategies using data from 325 ponds on 38 commercial catfish farms (AR, AL, and MS). The split-pond system using hybrid catfish was the least-cost production strategy, followed by intensively aerated ponds using hybrid catfish, and the multiple-batch system employing channel catfish with increased aeration rates. The results are suggesting that changes in cost structures and economic conditions have changed the degree of profitability of farming practices with more intensive production strategies being more productive and hence more profitable. Additionally, they are also more efficient in their use of land, water (Figure 1), capital, and labor. Although cost efficiency is the driving factor behind intensification, it also allows for achieving improved resource-use efficiency in the industry.

Effects of Low-External-Input and Conventional Rice Cultivation on Indicator and Pathogenic Bacteria Presence

FIRTH A., BAKER B., BROOKS J., DAVIS J.B., IGLAY R., SMITH R.

Over 800,000 ha of rice is planted in the Mississippi Alluvial Valley (MAV), making it a significant economic crop of the region. Additionally, recognized under the North American Waterfowl Management Plan and the Lower Mississippi Valley Joint Venture, winter-flooded rice fields provide critical habitat for migratory waterbirds. However, wintering waterbird use of flooded rice fields could facilitate pathogen transport in a low-external-input-sustainable-agriculture (LEISA) rice system in the MAV. This study compared two rice farms with different management histories during the winter (conventional and LEISA). Each farm selected for study and received two treatments: 1) unflooded or 2) winter flooded fields. Fecal indicator bacteria (*Enterococci, Clostridium perfringens, Salmonella, Campylobacter* and *Escherichia coli*.) were quantified in soil before and after winter flooding and bird fecal matter estimated. Water samples collected from winter flooded fields were tested for *Enterococci, C. perfringens* and *E.coli* before fields were drained. Soil analysis results indicated LEISA flooded fields had significantly greater detections of *C. perfringens* than non-flooded fields. No significant differences were detected between fields in water samples. All observed pathogen rates among treatment were also less than U.S. EPA standards. Results suggest that long-term waterbird stopovers can influence pathogen indicators in soil, however, not at a significant level to pose threat to human and environmental health standards. Nevertheless, because the study was only conducted over one season, it limits the conclusions drawn about wintering bird's potential to contaminate rice fields. Future studies should focus on long-term monitoring of rice fields that harbor wintering birds.

Improving Dryland Soybean Yield, Water Use Efficiency, and Health of Dominant Soils Across Mississippi

FENG G., REGINELLI D.

Cover cropping is considered to be an effective management practice for improving dryland soybean yield, water use efficiency (WUE) and soil health. There is a growing interest among producers to adopt cover cropping. However, research data comparing the effectiveness of cover cropping under diverse weather conditions are very limited, particularly in the southern United States. It is important because cover crop species provide specific benefits to crops and soils under various weather conditions. Therefore, both field trials and simulation studies were conducted to evaluated dryland soybean yield and water use, properties and water conservation of a silt loam soil from growing wheat cover crop (CC) followed by corn and soybeans under wet, normal and dry years in the northeast Mississippi. Annual total precipitation averaged 1,373mm in the past 8 decades of seasonal years (1938-2017). In wet years (0 < rainfall probability<25%), annual precipitation ranged from 1,562 to 2,053 mm, and from 1,120 to 1,545 mm in normal years (25% < rainfall probability≤75%), and from 821 to 1181 mm in dry years (75% < rainfall probability≤100%). Average annual precipitation across wet years was 35% (446 mm) higher than that across normal years, and 69% (701 mm) higher than across all dry years. An 80-yr of RZWQM-simulation demonstrated that, during autumn and spring (early October to early April) and compared to no CC scenario, planting CC reduced drainage deep percolation by 69 mm (11%), 53 mm (15%), and 51 mm (21%) and in wet, normal, and dry years, respectively. When averaged across 40 years and compared to no CC scenario, planting CC decreased surface evaporation by 38 mm (24%) and increased main crop soybean transpiration by 15%. Planting CC increased soybean yield by 41 kg ha^{-1}; and improved soybean grain WUE by 5%. Cover crops can increase soil organic matter by 15% and storage of rain water in soils by 13% during the crop growing season. Long-term use of winter wheat cover crop, if managed similarly, can reduce deep percolation and increase soil water storage, as well as improve precipitation use efficiency without sacrificing cash crop growth in maize and soybean crop rotations in subtropical agro-systems.

Passively Injected Air into Subsurface Drip Irrigation System: Plant Uptake of Pharmaceuticals from Human and Animal Recycled Water

D'ALESSIO M.

The need for alternative sources of water is dramatically increasing. With the increase in population, there exists a challenge to feed the people by producing crops with relatively less arable land and limited water resources. Where irrigation water is needed for crop production, wastewater (human and/or animal) treatment and reuse represents a challenging but viable alternative and may even lead to increased productivity of soils. Over the past few decades, there has been a significant shift in irrigation technology from surface to pressurized irrigation, including surface and subsurface drip irrigation (SDI). Passively injecting air into SDI systems increases crop yields and overcomes root zone wetting issues. The impact of passively injected air into SDI will be discussed in terms of i) plant growth, expressed in terms of weight, size, and development of the roots plant, ii) uptake of pharmaceuticals from human and animal recycled water, and iii) soil microbial activities. Results from greenhouse investigations and preliminary results from a field investigation will be presented.

Row Spacing of Alfalfa Interseeded into Native Grass Pasture Influences Soil-Plant-Water Relations

DHAKAL M., WEST C.P., DEB S.K., VILLALOBOS C., KHAREL G.

Interseeding alfalfa (*Medicago sativa* L.) can improve forage quality of grasslands by adding a high-protein species, but runs the risk of accelerating soil water depletion. The objective was to evaluate effects of cultivar and row spacing of alfalfa on soil water balance and plant water potentials (Ψ) of two upright-type cultivars, NuMex Bill Melton and WL 440HQ, and a prostrate-type Falcata-Rhizoma blend, interseeded into native grasses in October 2015 near Lubbock, Texas. Alfalfa was interseeded at 36-cm (narrow) and 71-cm (wide) row spacings. Soil volumetric water content (VWC) and midday Ψ_{stem} and Ψ_{leaf} were measured weekly in 2017 and 2018 growing seasons. Soil VWC was not affected by alfalfa cultivars ($P > 0.05$), whereas alfalfa row spacings differed ($P < 0.05$). Narrow spacing caused lower ($P < 0.05$) VWC than did wide spacing relative to the grass-only control in both the upper 40-cm and 40- to 100-cm layers of the soil. Wide row spacing had similar VWC to control in 2017 for both soil layers ($P > 0.05$). Soil water depletion increased with alfalfa crown density ($r = 0.60$, $P < 0.05$) in association with enhanced evapotranspiration and denser root mass below 30-cm soil depth. Grass and alfalfa Ψ_{stem} and Ψ_{leaf} were depressed in narrow rows relative to wide rows and control, indicating that presence of alfalfa intensified competition with the grass for soil water. The wide-row treatment seldom had adverse effects on grass water stress. Wide row spacing achieved a favorable compromise between enhanced water use and improved stand productivity.

A Comparative Study of Common Property-Based Management in Arizona and Private Property-Based Management in Mississippi for Sustainable Water Use

KO J.

Conflicts over surface and ground water resources in communities have been increasing. Additionally, inter-state disputes over the water resources passing the state borders also have increased, due to increasing water demands from the increasing population, expanding cash crop cultivation, and newly establishing manufacturing facilities in the Southern region including the State of Mississippi. The current water policy in the region is mainly based on the historical legacy of presuming limitless private property. For example, the State of Mississippi has been in legal disputes with the neighboring Tennessee over the groundwater flow near the state border to secure more groundwater. These cases show well serious challenges in designing programs for stabilizing water table in aquafer, and for sustainable water use in state. The presentation will contrast the common property-based management with the private property-based management in water management. The State of Arizona, which has been experiencing rapidly depleting groundwater, has adopted the common-property based water management, mandating estimation of safe-yield and preservation of groundwater for future use. The proposed study examines differences in water policy between Arizona and Mississippi as a way of exploring sustainable water use, while reducing conflicts over the valuable natural resource.

IRRIGATION TECHNOLOGY

Open-Source Hardware and Software Offer Options for Development of Monitoring Systems for Water Management, Agricultural, and Environmental Applications

FISHER D.K.

Information is needed in order to study, monitor, and understand any process or event. Advances in electronic technologies, software, and communications infrastructures have resulted in a variety of new and inexpensive monitoring capabilities for research and production applications. A new generation of microcontrollers offers high-speed, low-voltage, energy-efficient, 32-bit operation, and supports programming in multiple languages (C/C++, Python). The increasing variety of solid-state sensors (environmental, multispectral) and auxiliary components (data storage, GPS/RTK) enables development of unique automated sensing, monitoring, and control systems. Remote data communications are enhanced via communications (LoRa wireless, LTE Cat-M1 cellular) networks, and integration with internet-based services allows rapid data transfer and always-available access to and sharing of data. These emerging technologies are enabled by application of open-source hardware and software, which offer advanced tools and capabilities and are freely available for anyone to use, develop, and modify. Open-source hardware and software options will be discussed, and examples of monitoring systems that have been developed will be presented to demonstrate the accessibility and usefulness of these development tools.

Sensor-Based Irrigation Scheduling

SUI R.

Though annual precipitation in the Mississippi Delta is approximately 130 cm, only about 18% of the precipitation occurs during June to August when crops require a large quantity of water to grow. Furthermore, heavy rainfall in summer causes extensive amounts of runoff, resulting in only a small amount of the precipitation infiltrating into the soil for crop use. Uncertainty in the amount and timing of precipitation is one of the most serious risks to the crop production in this region. To reduce the risk and increase farming profit, irrigation acreage has been increasing. Groundwater pumped from Mississippi River Valley alluvial aquifer provided about 95% of the water used for irrigation and fish culture in the Mississippi Delta. Due to the large withdrawals, water levels of the aquifer have significantly declined. It is necessary to develop improved water management tools for sustainable agriculture in the region. Advanced irrigation scheduling technologies can increase water use efficiency and reduce the groundwater withdrawal in irrigation. A sensor-based irrigation scheduling (SBIS) method was developed and evaluated for irrigation management. Soil moisture sensors were installed in soil profile at three depths (15 cm,30 cm, 61 cm). Soil volumetric water content (VWC) was automatically measured by the sensors in a time interval of an hour during crop growing season. The VWC data were transferred through a wireless sensor network so that the data could be accessed online. Sensor-measured VWC at all the depths were interpreted using a weighted average method to reflect the status of soil water in plant root zone. Irrigations were triggered as the sensor-measured VWC dropped down to a threshold which was determined according to the soil properties. An antenna mounting device was developed and implemented to avoid the soil moisture measurement being interrupted by some agricultural activities such as applications of pesticide and fertilizer. The SBIS method has been used in cotton, corn, and soybean crops, and it indicated that this method could be a useful tool in irrigation management.

A Crop Modeling Approach to Analyze In-Field Soil Moisture Variability

HODGES B., PAZ J.O., TAGERT M.L., REGINELLI D.

Site-specific irrigation decisions require information about variations in soil moisture throughout the rooting depth actively being used by the crop. An increasing number of producers are using soil moisture sensors to make irrigation decisions, and it has been shown that soil moisture sensors can reduce water usage without reducing yields, which also conserves money. This three-year study uses sensors and crop modeling to evaluate the spatio-temporal variability of soil moisture across an 18-ha production field in a corn/soybean rotation. A 55 m by 55 m grid was laid on the field, which resulted in 44 sampling points that fell either underneath the center-pivot irrigation or the end gun. At each point location, two Watermark granular matrix sensors were installed at depths of 30.5 and 61cm. Analysis of soil samples collected in year one of the project revealed fairly homogeneous soils across the field with silty clay loam as the major soil type and only eight percent silt loam. Plant height and leaf area index (LAI) were measured weekly at each of the 44 sampling points, which resulted in eight measurement dates during the 2018 growing season of the soybean crop. A digital elevation model was also used to log the elevation at each point location. The crop variables were inserted into the CROPGRO crop model in the Decision Support System for Agrotechnology Transfer suite of models to calibrate and predict soybean growth and water use in the field. The soil moisture values will also be inserted into the model when they are converted from soil matric potential to volumetric water content. The model will be run for every grid in the field to predict whether there should be a different irrigation schedule for parts of the field. In this presentation, the results from four grids will be discussed.

Assessing Surface Water Use for Irrigation in the Delta and its Effects on Groundwater

BROCK M., TAGERT M.L., PAZ J.O., KRUTZ J.

Agricultural production in the Mississippi Delta region relies heavily on groundwater for irrigation due to insufficient rainfall during the summer growing season between May and September. As of 2019, more than 20,000 groundwater well permits for agriculture have been issued in the Delta. The Mississippi River Valley Alluvial Aquifer is the shallow subsurface aquifer underlying the Mississippi River Basin, and concerns persist over the dependence on and future supply of water in this aquifer. Surface water sources for irrigation include on-farm water storage (OFWS) systems implemented as a conservation practice for nutrient reduction with cost assistance from the NRCS Mississippi River Basin Healthy Watersheds Initiative. Consisting of storage ponds and tailwater recovery ditches that intercept irrigation and precipitation runoff from adjacent fields, these systems started being constructed in Mississippi in 2008 and have grown in prevalence in the following years. The goal of this study was to quantify the role of OFWS systems in irrigation and as an alternative to groundwater by examining the inventories of OFWS systems for selected years between 2007 and 2018. The size and number of OFWS systems were identified and recorded based on the geospatial data layers containing digitized polygons of the ditches and ponds that make up these systems. Inventory results show an increase in surface water storage from 22.37 ha in 2007 to 651.61 ha in 2018. Next, interpolated maps of saturated aquifer percentages were created using groundwater levels measured by the Yazoo Mississippi Delta Joint Water Management District and aquifer thickness values from the United States Geological Survey. These interpolated layers and inventories are being used to evaluate and define relationships and trends between surface water use and groundwater use for agricultural irrigation. This presentation will compare trends in groundwater decline between land with supplemental irrigation using surface water and land solely irrigated with groundwater.

NON-POINT SOURCE POLLUTION

Phosphorus Fluxes Resulting from Inundated Soils in an Agricultural Watershed

YASARER L.M W., STEVENS E., TAYLOR J., LOCKE M.

Wetting and drying of soils can alter chemical compositions and result in nutrient transformations that lead to more labile phosphorus. Mississippi Delta soils are generally high in phosphorus content and may experience several wet-dry cycles throughout the year, as well as periods of inundation due to flooding conditions. This study was designed to estimate the potential phosphorus fluxes that may occur when dry soils are re-wetted and remain submerged in water for various residence times. Soils/sediments were collected from two locations within five different habitats (cropland, restored cropland (i.e. CRP), forest/riparian wetland, sediment retention pond, and drainage ditches) within Beasley Lake Watershed, Mississippi. Sample locations were selected to include locations that typically experience ephemeral standing water, such as topographic depressions within the cropland, CRP, and forest areas. All soil/sediment samples were dried, ground, and sieved for consistency. Samples were inundated with water and incubated at 5, 15, 25 and 30°C to represent different seasonal temperatures throughout the year. Residence times of 4, 8, 12 and 48 hours were used to estimate the kinetic properties of the phosphorus fluxes. In addition, soils were analyzed for pH, bulk density, and totals of carbon, nitrogen, phosphorus, manganese, calcium, iron, aluminum, and sulfur. Sequential phosphorus extractions of dry, field moist, and flooded soils were also performed to determine how phosphorus was stored in the soil and potential conditions that would release phosphorus into the environment. Preliminary results indicated that forest soils had the highest phosphorus concentrations of all the habitats. Sequential extractions revealed that both drying and flooding the soils increased phosphorus availability.

Spatial and Temporal Patterns of Sediment Nutrient Fluxes in an Agriculturally-influenced Oxbow Lake

NIFONG R.L., TAYLOR J.M.

Oxbow lakes are an important but understudied component of river floodplain ecosystems and may serve as nitrogen (N) sinks in agricultural watersheds by creating conditions that promote hotspots and hot moments of denitrification. Denitrification can be an important pathway of reactive nitrogen removal, particularly in waterbodies receiving agricultural runoff. In order to examine seasonal and habitat specific patterns of denitrification and sediment oxygen demand, we collected dissolved gas and nutrient samples during 14 different flow-through intact core incubations over the course of a year within Beasley Lake, an oxbow located off the Sunflower River in the Lower Mississippi River Basin (LMRB). Concurrently, we collected field water samples to examine patterns in ambient water quality. We found that dissolved nutrient and nitrogen gas (N_2-N) fluxes varied in space and time while sediment oxygen demand occurred throughout the year. N_2-N fluxes were positive in at least one habitat during every sampling event. Dissolved nitrate (NO_3^--N) fluxes from cores were highest from the early summer through the fall, but became minimal during the winter and early spring. In addition to seasonal patterns of NO_3^--N fluxes, we observed positive fluxes of ammonium (NH_4^+-N) throughout the year and of phosphate (PO_4^{-3}-P) during late summer through the winter from sediments. Field water quality measurements were uniformly low with the exception of the planting season when total suspended sediments (TSS), NO_3^--N, soluble reactive phosphorus (SRP), and total organic carbon (TOC) peaked. Together, these results provide insight into spatial and temporal patterns of nutrient input and removal within agroecosystems in the LMRB.

Flume Experiments in Support of Multi-Beam Bed Load Measurement in Rivers

WREN D., KUHNLE R.A., MCALPIN T., JONES K., ABRAHAM D.

Measuring sediment transport in large rivers is problematic, due to high water depth and large bed forms that make it difficult to obtain accurate physical samples near the bed of the river, where most sediment is transported. Additionally, sediment transport is highly variable in space, which means that multiple physical samples must be collected to reach a reasonable estimate of load for a river cross-section. Another problem that compounds error is that bed forms are not consistent over a cross-section, which means that samples from a given cross-section will likely be collected over different parts of bed forms that will yield a wide range of sediment concentrations. In order to overcome these issues, repeated multi-beam acoustic surveys of bed topography can be used to arrive at reach-averaged sediment transport rates. This technique is relatively rapid, does not require physical samples, and accounts for the spatial variability inherent in sand transport. An established methodology for converting repeated bed topography measurements to sediment load is ISSDOTv2, which stands for Integrated Section, Surface Difference Over Time; however, there is a need for establishing error bounds and further developing the methodology. Since it is nearly impossible to collect enough physical samples to validate the method in a river, flume experiments at the National Sedimentation Laboratory were initiated to estimate error bounds for the ISSDOTv2 method, to continue development of the method, and to evaluate its performance in unsteady and spatially variable sediment transport scenarios. Results from the flume experiments, including independent measurements of bed load, suspended load, and bed topography will be presented.

Biobased Multifunctional Magnetic Absorbent from Forest Residues for Non-Point Pollution Water Treatment

ZHANG X., ZHANG J., MLSNA T.

Non-point pollution (NPP) has been recognized as the leading source of water pollution in the United States, especially Mississippi, threatening water safety and human health. NPP originates from the agriculture and urban stormwater runoff containing major contaminants like nutrients, pesticides, and heavy metals. Today, treatment of NPP water remains a challenge due to no single absorbent can be used to effectively remove all major water contaminants. In this study, we developed a multifunctional biobased magnetic absorbent (MA) from forest residues for the cleaning of various water contaminants including heavy metals (Pb and As) and nutrients (phosphorus and nitrate). The biobased MA was synthesized via a catalytic thermal conversion process with iron nitrate as a catalyst at 1000 °C using a tubular furnace. The structure and morphology of biobased MA were characterized by X-ray diffraction, scanning electron microscopy, X-ray photoelectron spectroscopy, and transmission electron microscopy. The performance of biobased MA was tested in terms of heavy metals and nutrients adsorption capacity as a function of time, concentration, and solution pH. This study demonstrates a multifunctional absorbent from renewable resources for NPP water treatment.

FLOODING EFFECTS

Yazoo Backwater Area Wetlands—What's New

JOHNSON D.R.

The historic 2019 Yazoo Backwater flood renewed interest in the Backwater Pump Project. Mississippi's Senators and Congressmen applied pressure to the EPA to reverse the 404 C veto. New information has greatly altered the extent and possible impacts to wetlands in the project area. The use of shallow ground water monitoring wells changed the source of water creating the wetlands, and the use of LIDAR DEM altered their extent.

The Effects of Backwater Flooding on Aquatic Health in the Yazoo Backwater Area From Low Dissolved Oxygen Concentrations

JOHNSON B.S.

Dissolved Oxygen (DO) has long served as one of the primary indicators of aquatic health in aquatic ecosystems. The EPA has defined adequate concentrations of DO for fish to be greater than 5.0 mg/L for warm water streams. A water quality monitoring program was initiated in 2004 in the Yazoo Backwater Area (YBA) by the Vicksburg District which extended through 2019. The program documented the reduction in DO in the lower Steele Bayou and Big Sunflower Basins for prolonged periods during backwater flood events. For the first few weeks of a typical backwater flood, diffusion becomes the principal mechanism for oxygen transfer into the water column at the surface. This DO transfer condition compounded with the increase Sediment Oxygen Demand (SOD) exerted on the unmixed water closer to the bottom allows for severe DO depletion. Because of this, limited fish species diversity has been observed in the YBA.

Can Volunteer Flooding of Cropland After Harvest Reduce Contaminant Export in the Mississippi Delta?

MOORE M.T., TAYLOR J.M., RIGBY J.R.

The Mississippi Delta is well known for its fertile landscape, helping to feed a growing nation and world. In addition, the Mississippi Flyway is a vital bird migration path for waterfowl enthusiasts. These two worlds often intersect about three months after harvest, as many farmers will voluntarily flood post-harvest fields for waterfowl habitat and hunting. Recent efforts have suggested that an earlier voluntary flood, within one month of harvest, provides critical stopover habitat for wading birds with an earlier migration pattern than ducks and geese. To that end, a collaborative research project was established on a farm in Sunflower County, Mississippi, in conjunction with Delta Windbirds. Six identical, adjacent fields (30 acres each) were chosen for this project. Three fields were flooded for migratory bird habitat in mid-September 2019, while the remaining three fields were left fallow and unflooded, post-harvest. Grab samples for water quality were collected weekly/biweekly on ten occasions in the flooded fields, while automated samplers collected any storm runoff from unflooded fields during the nearly five month project. A comparison of water quality parameters (nutrients and solids) in flooded fields suggests the mitigative capacity of the flooding practice, preventing excessive nutrients from entering receiving water bodies and further exacerbating downstream water quality impairments. Limited runoff data from unflooded fields corroborates this suggestion. While water quality is only part of this research assessment, taken in context with other study components, the practice of early volunteer flooding post-harvest can provide critical wetland functions from which farmers and conservation managers can utilize to improve water resources in the Mississippi Delta.

GROUNDWATER

Modifying the DRASTIC Method to Create an Aquifer Recharge Potential Map for Alabama

GUTHRIE G., HASTINGS PUCKETT M., HASTERT G.

The DRASTIC method was developed by the USEPA in 1985 to model groundwater contamination potentials for diverse hydrogeological regions. The method combines seven factors: *D*epth to water table, *R*echarge (net), *A*quifer media, *S*oil media, *T*opography, *I*mpact of vadose zone, and *C*onductivity (hydraulic), which are rated and weighted to produce a numerical value, the DRASTIC Index, which provides a relative assessment of an area's contamination potential.

The DRASTIC conceptual model contains an intrinsic component comprising relatively invariable factors (aquifer media, soil media, topography, and aquifer conductivity) and an acquired component comprising variable factors (net recharge and vadose zone impact). Land use/land cover was not included in the original DRASTIC method. A modification to the DRASTIC methodology has been used to produce an Aquifer Recharge Potential map for Alabama using an intrinsic/acquired factor model. The intent of the map is to show the potential of an area for groundwater recharge given a set of acquired conditions based on a Recharge Potential Index (RPI). The map combines intrinsic factors (soils, topography, and aquifer hydraulic conductivity) to create an intrinsic properties base map. Variable factors (net recharge, depth to water table, and land use) can then be added to create the potential recharge map. These factors to produce maps that reflect changing temporal conditions. The Analytic Hierarchy Process (AHP) is used to modify the weighting system to create a more accurate RPI. The AHP uses a pairwise comparison matrix to evaluate the relative importance of multiple criteria by generating a consistency index that measures the inconsistency of judgements used in the developmental model. The map is intended to provide stakeholders a tool for evaluating the potential effects of land use changes, drought, and flooding for groundwater availability in Alabama.

Field Testing and Simulation of Vadose-Zone Recharge Wells as an Artificial Recharge Method in the Mississippi River Valley Alluvial Aquifer

O'REILLY A.M., KWAK K., RIGBY J.R.

Past studies in the Delta region of Mississippi document substantial groundwater losses from the Mississippi River Valley Alluvial aquifer (MRVAA) and indicate limited potential for infiltration and recharge due to fine-grained, low permeability surficial sediments. An artificial recharge technique not dependent on permeable surficial soils is a vadose-zone well. A vadose-zone well is a borehole, which does not intersect the saturated zone, excavated through low permeability surficial sediments and completed as a dry well into underlying higher permeability sediments. Water directed to the well flows by gravity into the native sediments of the vadose zone.

Data were collected at a field site near Ruleville, Mississippi, consisting of four vadose-zone wells, six monitor wells, and one production well. From pumping test data, transmissivity of the MRVAA at the site is 5,700 m^2/day and storativity is 0.33. Despite being considered an unconfined aquifer, a distinct inverse correlation existed between barometric pressure and water level in the wells, indicating a barometric efficiency of approximately 60%. During a 50-hour injection test, well recharge caused small water-table rises ranging from 4 cm at the nearest monitor well (6.1 m) to 1 cm at the most distant well (35 m). Small rises likely are due to the high hydraulic conductivity of the MRVAA, vertical heterogeneity, screen location of the monitor wells, or some combination of these factors. Laboratory analyses included measurement of saturated hydraulic conductivity of vadose-zone soil cores. Additionally, wetting/draining curves were determined using the hanging water column method, representing some of the first measurements of capillary hysteresis in the Delta.

A three-dimensional numerical variably-saturated model of four vadose-zone wells was developed using HYDRUS-3D software. Pressure-head changes were reported at five observation nodes located 0.17 m below the water table. Head rise beneath the vadose-zone well was 2 cm and dropped to 0.6 cm at a distance of 6.3 m. Different water-table responses between the field test and model simulations are likely due to differences in the amount of injected water and lack of data on aquifer heterogeneity relative to monitor well screen locations. A total of 272 m^3/day of water was injected during the field test, whereas only 88 m^3/day was simulated in the HYDRUS model. This research provides understanding of the hydraulic properties controlling operation of vadose-zone wells. Challenges include clogging leading to limited well life and potential water-quality impacts caused by source water for the vadose-zone well bypassing shallow soil-aquifer treatment processes.

Evaluating the Influence of Geophysical Data Integration for the Shellmound Inset Groundwater-Flow Model of the Mississippi Alluvial Plain

GUIRA M.N., PETERSON S.M., TRAYLOR J.P.

The U.S. Geological Survey (USGS) Mississippi Alluvial Plain project has been updating groundwater-flow models of the Mississippi Embayment and Mississippi River Valley Alluvial aquifers to provide stakeholders with tools that can be used to support water resources management decisions. Groundwater withdrawals from the Mississippi River Valley Alluvial aquifer have been vital to support agricultural production in the region near Shellmound, Mississippi, but substantial groundwater-level declines in the region have caused concerns for long term sustainability of the aquifer. Stakeholders are considering a number of actions to mitigate the groundwater-level declines, including managed aquifer recharge through riverbank filtration, whereby groundwater will be extracted near the Tallahatchie River and injected into the aquifer. High resolution airborne electromagnetic (AEM) survey data were collected to improve the understanding of the subsurface hydrostratigraphy in the study area, and for integration into a groundwater-flow model. A transient groundwater-flow model was constructed using MODFLOW6, the latest USGS modular three-dimensional finite-difference groundwater-flow model. The active model domain covers an area of about 1,000 square kilometers in northwestern Mississippi. The AEM data were processed at multiple vertical resolutions to build MODFLOW6 models with various layering configurations, including a single layer, a 5-meter constant layer thickness, and a 10-meter constant layer thickness. All three versions of the model use the same hydrologic input data and are calibrated against equivalent calibration targets. Simulated outputs along with calibration data will be compared to determine the influence of increased layer detail on model calibration, to the extent supported by the available observation data.

Geochemical Assessment of Trace Metals from Varied Aquatic Systems in Southern USA

PAUL V., VATTIKUTTI S., SANKAR M.S., DASH P., BERRY M., ARSLAN Z.

Metal pollution in water bodies is a matter of international urgency, owing to the many associated toxicological and environmental issues. Sediments in water bodies serve as an important storage point for many of these metals and could release the adsorbed/absorbed ions back to the water under favorable conditions. Comparing the concentration of metals in different aquatic bodies will help to evaluate the accumulation and distribution characteristics within these systems. We investigated trace metal accumulation in sediments obtained from different aquatic systems in the state of Mississippi to evaluate and compare their pollution and enrichment indices. Sediments from five different aquatic systems; agricultural ponds, man-made reservoir, river, swamp and coastal marine environment including bay region, were collected. Following total digestion of the sediments, the concentrations of eleven trace metals (Cr, Co, Cu, Zn, As, Se, Cd, Sb, Hg, Pb, and U) were analyzed using Inductively Coupled Plasma-Mass Spectrometer (ICP-MS). The coastal and agricultural ponds samples showed the highest degree of anthropogenic modification (enrichment factor >10), especially for metals Se, U, Hg, and Pb. The metals Hg and Pb were highly enriched in sediment samples of all five environments. The pollution load index calculated for each system showed that the agricultural ponds were progressively deteriorated with respect to the sediment quality (value >1). The metals Cd and U showed high contamination factor (>6) in one agricultural pond sample, indicating moderate to severe contamination. Overall, our data indicate that sediments in the river, forest and man-made reservoir systems contain relatively fewer metal pollutants when compared to agricultural ponds and coastal regions. Both agricultural ponds and coastal regions serve as collection points for fertilizers, and other chemicals that contain metals, thereby explaining the trend observed. The research provides one of the first studies comparing sediment quality within different water bodies and will help in future studies to narrow remediation efforts.

Groundwater Quality and Age to Address Water Availability in the Mississippi River Valley Alluvial Aquifer

KILLIAN C., BUSSELL A., KNIERIM K.J., WACASTER S., GRATZER M.

Existing and newly collected water quality data has been used to better characterize sources of water and improve the hydrogeology of the Mississippi River Valley alluvial (MRVA) aquifer, located within the Mississippi Embayment (MISE). Groundwater with high concentrations of metals, including iron and manganese, and areas of high salinity limit groundwater availability for irrigation, public supply, and domestic use. Water-availability issues within the MRVA aquifer have generated the need to improve water-budget estimates of existing regional groundwater-flow and three-dimensional machine-learning models. Groundwater age tracers, including tritium, carbon-14 (^{14}C), sulfur hexafluoride (SF_6), and noble gasses, were collected as part of the United States Geological Survey (USGS) Mississippi Alluvial Plain (MAP) regional water availability study help characterize sources of water to the MRVA aquifer. Sources of water to the MRVA aquifer include surficial recharge and upwelling from saline water from deeper hydrogeologic units. To map surficial hydrogeologic units of the MISE, the USGS is conducting a regional Airborne Electromagnetic (AEM) survey to detect changes in resistivity of subsurface units; however, the spatial and vertical distribution of groundwater specific conductance must be characterized to accurately interpret changes in resistivity. Accurate characterization of hydrogeologic units, especially where MISE units subcrop beneath the MRVA, will help identify drivers of groundwater quality and recharge of the MRVA aquifer. The results from this effort will help interpret data from the AEM survey, support three-dimensional machine-learning models of specific conductance and recharge-rate estimates as a part of the water budget for the MAP, and help to characterize areas where potential upwelling from deeper saline units may impact the availability of fresh water in shallower aquifers.

DRINKING WATER

Lead Testing in Drinking Water at Child Care Facilities

BARRETT J.R.

Lead in drinking water has had heightened attention since the Flint Michigan crisis even though lead has been an issue for years. The EPA has passed the lead and copper rule that regulates and dictates testing for lead in drinking water systems but does not specifically address the most at-risk individuals which are youth under the age of six. This research focuses on child care facilities with a goal of determining best practices to reduce and/or eliminate the expose of lead in drinking water.

Mississippi citizens who acquire their drinking water from public water systems have the luxury of knowing the quality of their drinking water on a regular basis if they know who to contact and/or where to look. Approximately 90% of Mississippi citizens are served by one of the 1,200(+/-) public water systems which provide safe reliable water under the regulatory guidance of the Mississippi State Department of Health-Bureau of Public Water Supply. The regulatory oversight of public water systems should promote and produce a safer drinking water supply for Mississippi residents. Individual residents' plumbing and fixtures may contribute to lead leaching in drinking water regardless of the quality of the water produced and provided by the public water supply. As a result of knowledge gained from applied research, the adaption of best practices by practitioners, parents, and youth will increase the safety and reduce the expose of lead in drinking water for youths

What is the Value of Drinking Water?

BARRETT J.R.

There may be many perspectives on what is the true value of drinking water and how we quantify that value. One may feel there is no way to quantify the true value of water because it is essential to survive. On the other extreme, one may feel that water is free because you can find it in so many locations at little or no cost. Regardless of the perspectives that may exist, this project examines the realistic view of drinking water compared across the options in which people derive their drinking water. The three options that exist are community water systems, private wells, and bottled water. Community water systems are regulated at the state level by the Mississippi State Department of Health-Bureau of Public Water Supply with guidance from the Federal Safe Drinking Water Act. Private wells have very minimal regulatory oversight and are the complete responsibility of the well owner. Private well regulations are limited to the drilling codes enforced upon the well drillers. Bottled water is regulated by the Food and Drug Administration. Each of these options has its positives and its negatives. This study looks at the real costs to people of providing each of these options and the drawbacks from each option. The desire of the project is to inform citizens of the value of drinking water while considering the potential issues of private wells and the astronomical cost of bottled water.

Educational Engagement Surrounding Water Quality in Jackson, Mississippi

WILLETT K.L., OTTS S., SURBECK C., HOPPER T.

Through University of Mississippi (UM) Community Wellbeing Constellation funding, our team was able to develop three community engagement initiatives to enhance water quality education in the state. Educational activities included: 1) developing and teaching an honors experiential learning course on drinking water quality; 2) conducting community-based participatory research on residential drinking water; and 3) developing a story map highlighting the water infrastructure challenges in the City of Jackson. The course was designed to familiarize the students with timely issues in drinking water safety and distribution and to use a variety of literature, interviews and media reports to propose solutions to water issues in MS. The students toured and reflected on both the O.B. Curtis Water Treatment Plant and the UM Wastewater Treatment Plant. Two drinking water lead testing events were conducted in Jackson in collaboration with partners at Rosemont Baptist Church and the Mississippi Urban League Baby Café. Twenty-eight samples were tested, and two had concentrations of lead above 5 ppb, which is above the allowable level for bottled water set by FDA. Finally, the team is developing an ArcGIS Story Map outlining and explaining for a general audience the issues surrounding Jackson's drinking and wastewater infrastructure and how those deficiencies contribute to public health problems in the city. With these activities, the UM team continues to work with communities to uncover the link between water quality and health in Mississippi

Triennial Review of Mississippi's Water Quality Standards: Updates and Revisions

FELCH P.

Clean Water Act (CWA) requires each State to establish and maintain water quality standards (WQS) to meet the two objectives expressed in Section 101(a), which are as follows: (1) restore and maintain the chemical, physical, and biological integrity of the Nation's waters and (2) wherever attainable, achieve a level of water quality that provides for the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water. Consequently, WQS serve as the foundation for a wide range of water quality management programs under the CWA. WQS serve multiple purposes that include defining the water quality goals for a specific waterbody and providing the regulatory basis for establishing water quality-based effluent limits (WQBELs) beyond the technology-based levels of treatment required by CWA Sections 301(b) and 306. WQS also serve as a target for CWA restoration activities such as total maximum daily loads (TMDLs).

The CWA also requires that each state's WQS contain three components: (1) designated use(s) of the State's waterbodies; (2) the water quality criteria (narrative or numeric) necessary to protect those uses; and (3) antidegradation provisions to protect water quality. Every three years these standards must be reviewed, revised and adopted in a process known as the triennial review. The current triennial review process for revisions to MS's WQS is currently underway.

The proposed modifications are scientifically-based and will allow for effective and improved protection of the state of Mississippi's surface waters and ecosystems. All proposed modifications must have a public comment period and public hearing in order for MDEQ to receive any feedback and comments regarding the proposed revisions. Any proposed revisions to the WQS must be adopted by the Mississippi Commission on Environmental Quality and then approved by the Environmental Protection Agency before they are used by the state for any Clean Water Act programs.

MISSISSIPPI COASTAL HARMFUL ALGAL BLOOM EVENT 2019

Biogeochemical Impacts of Altered Freshwater Flow to the Mississippi Sound

DILLON K.S., MILROY S.P., SHILLER A.M.

The Bonnet Carré Spillway (BCS) is a flood control structure on the lower Mississippi River that is periodically opened at peak flow to prevent flooding in New Orleans and other municipalities. Since its construction in 1931, the spillway has only been opened fourteen times. However, in recent years, spillway openings have become more common with four openings since 2016. In 2019, the BCS was opened twice for a combined total of 123 days, sending large amounts of Mississippi River water into the Mississippi Sound resulting in large reductions in salinity, extensive algal blooms and nearly 100% mortality of oyster reefs. Weekly water quality assessments were conducted from June thru August 2019 to measure nutrients, dissolved organic carbon and nitrogen, chlorophyll a, and particulate organic matter as well as the stable isotopic composition of water ($\delta^{18}O$ and δD) for water source tracking. River water samples had high nitrate concentrations (92 µM) and low ammonium and soluble reactive phosphate (SRP) concentrations (<2 µM). Water isotope results show that water from some regions of the Sound was composed of nearly 50% Mississippi River water. Dissolved inorganic nitrogen (DIN) and chlorophyll concentrations increased by an order of magnitude compared to historical measurements and bottom water hypoxia was measured across large portions of the Sound. No significant increases in soluble reactive phosphate concentrations were observed resulting in high DIN:SRP ratios (50 - 70) in the western Sound. Under normal hydrological regimes, DON represents the largest nitrogen pool in the Sound; however, DON concentrations concurrently decreased with DIN increases while the BCS was open. After the BCS closure in late July, nutrient concentrations throughout the Sound returned to low background concentrations within several weeks.

Phytoplankton Imaging Technology for Cell identification of Mississippi Coastal Waters Impacted by Cyanobateria During Prolonged Opening of the Bonnet Carré Spillway in 2019

BOYETTE A.D.

The primary objective was to use an advanced plankton imaging system (FlowCAM®) to identify and count harmful cyanobacteria (CyanoHAB) and other phytoplankton cells in Mississippi coastal waters in response to prolonged opening of the Bonnet Carré Spillway (BCS) in 2019. A weekly sampling protocol was conducted from 16 surface stations in the Mississippi Sound from 09 July to 29 August 2019. Although mixed assemblages of diatoms and dinoflagellates were the predominant phytoplankton groups at all stations throughout the sampling period, CyanoHAB genera *Dolichospermum* sp. and *Microcystis* sp. colonies were present at elevated (>150,000 colonies L^{-1}) concentrations in the western and central Mississippi Sound. Additionally, Chlorophytes, which tended to be freshwater genera (e.g. *Pediastrum, Actinastrum*), were relatively abundant at stations in the Western Mississippi Sound, but absent in the central and eastern portion of the Sound, suggesting influence of Mississippi River water via the Bonnet Carré Spillway. While the data presented here was useful in determining the extent and proliferation of CyanoHABs, it was not used by environmental managers in a regulatory capacity. However, the impact of CyanoHABs during the summer of 2019 was unprecedented in its extent and pervasiveness along coastal Mississippi. Despite the ecological impacts to Mississippi coastal communities, the BCS remains one of the primary flood control systems on the Mississippi River and will continue to be used as flood mitigation. This underscores the need for a long-term phytoplankton monitoring system to serve as an early warning indicator for harmful algal blooms and other eutrophication processes.

Changes in Mississippi Sound Water Quality Due to the Opening of the Bonnet Carré Spillway

MOODY A., SHILLER A.M.

The Bonnet Carré Spillway, a structure that prevents flooding in New Orleans due increased water levels in the Mississippi River, was opened for a total of 122 days in 2019 from February to July. This resulted in a massive release of freshwater into Lake Pontchartrain, which was then funneled into the Mississippi Sound, causing significant chemical and ecological impacts there. Fortuitously, this event occur in the midst of our ongoing sampling campaign aimed at elucidating nutrient distributions and groundwater contributions in the Sound. The impacts from the influx of this freshwater event were mainly focused on the western half of the Sound, closest to outflow from Lake Pontchartrain. Water quality indicators from our time series as well as snapshots from before, during, and after the opening of the Spillway indicate that the western Sound experienced rapid changes in water chemistry. For instance, the average salinity of the Sound decreased from 20 to 5 after the opening of the Spillway. Application of an apparent age model using the ratio of short-lived radium isotopes indicates that the flushing rate of the western Sound during the Spillway opening increased dramatically, changing the physical characteristics of the Sound as well. The high levels of precipitation in the 2019 season led to some elevated nutrient levels across the Sound from increased river discharge.

COASTAL ISSUES

The Summer of 2019, A Harmful Cynobacteria Bloom that Affected Mississippi's Beaches

BEISER M., COTTON E.

The Mississippi Department of Environmental Quality (MDEQ) through its Beach Monitoring Program documented an algal bloom with the potential to become harmful on June 21, 2019. Salinities in the western Mississippi Sound had dropped to low levels---< 3 ppt beginning in March 2019 due to recent heavy rains, and the opening of the Bonnet Carré Spillway for an unprecedented second time in 2019. A *Dolichospermum* bloom was discovered offshore in mid-June by the Mississippi Department of Marine Resources (MDMR) which notified MDEQ as this bloom moved nearshore, and it was confirmed microscopically in the nearshore environment where it would come into contact with bathers on June 21, 2019 in Hancock County, in western MS. This resulted in a "Water Contact Warning" being issued the next day for Hancock County beaches. By June 24, 2019 both *Microcystis* and *Dolichospermum* were detected in Beach Monitoring Program samples. Within 2-3 days, the bloom consisted only of *Microcystis*. By July 7, a water contact warning had been issued for all MS beaches.

Tropical Storm Barry came ashore on July 13, 2019, dumping large amounts of freshwater over the area. By July 18, another *Dolichospermum* bloom was noted in Hancock County. Again, the *Dolichospermum* bloom persisted for only 2-3 days after which the bloom was exclusively *Microcystis*. Beaches were reopened on October 4, 2019 after little to no presence of *Microcystis* in water samples, and analytical results came back well below the EPA recommended Microcystin levels of 8µg/L.

Numerical Modeling of Flow and Salinity in Lake Pontchartrain and Mississippi Sound During the Bonnet Carré Spilling Flood Release

CHAO X., ZHANG Y., JIA Y.

The Bonnet Carré Spillway (BCS) of the Mississippi River was constructed from 1929 to 1936 for flood control. In order to protect the city of New Orleans, when the water stage of the Mississippi River approaches 5.18 meters, BCS will be opened to divert the excessive flood water into Lake Pontchartrain and the Gulf of Mexico. The distributions of salinity, sediment, nutrients, and aquatic habitat, in Lake Pontchartrain as well as the Northern Gulf of Mexico, especially the Mississippi Sound are strongly affected by these flood releasing events.

This research is about the application of a two-dimensional numerical model (CCHE2D) developed at the National Center for Computational Hydroscience and Engineering, University of Mississippi, on simulating the dynamic flooding process and associated temporal and spatial distributions of salinity in the Lake Pontchartrain and Mississippi Sound during these flood release events. The simulated results are compared with field measured data provided by USGS and Army Crop of Engineers, and good agreements were obtained. The flow patterns and salinities distribution processes in the lake and Mississippi Sound due to the BCS flood release events are discussed. In addition, the salinity recovery processes in the water were also simulated. The simulation results provides useful information to analyze the environmental impacts of the BCS opening flood events on aquatic ecosystems.

Microplastics in the Mississippi River System and at Oyster Reefs Along the Mississippi Coast: An Update

CIZDZIEL J., SCIRCLE A.

Microplastic (MP) concentrations along the northern Gulf of Mexico are among the highest levels reported globally. The most likely source of the plastic pollution is the Mississippi River (MR) which drains much of the central portion of the USA. Yet, surprisingly little is known about the concentrations, types, sizes, and loadings of MPs in the MR and its major tributaries. This lack of data is hindering our understanding of the magnitude and sources of the problem. Because the MR is an intricate system of waterways, tributaries, and commercial routes, an in-depth spatial study is needed to fully assess MP pollution in the system. Our research aims to systematically quantify the concentrations and loads of MPs in the MR system and at oyster reefs along the Mississippi Coast, and characterize their shapes, size distribution, and chemical composition. To that end, we developed and validated a one-pot method for the collection and preparation of water samples for microplastic analyses. The method prepares samples in the same vessel (Mason jars) that they are collected in right up until the MPs are transferred onto filters or spectroscopic windows for analyses. The method minimized contamination, degradation, and losses, while increasing recoveries and throughput when compared to conventional sieving. We applied it to surface grab samples collected from the Mississippi River and its major tributaries during and after historic flooding in 2019. Microplastics (>~30 µm) were detected by fluorescence microscopy and identified by Imaging Fourier Transform Infrared micro-spectroscopy (µFTIR-Imaging). Concentrations were lower during the flooding, likely due to dilution. Mean concentrations (counts/L) ranged from 14 in the Tennessee River during flooding to 83 in the Ohio River during low-flow (summer) conditions. Loads of MPs tended to increase down river and ranged from ~87 to ~129 trillion MPs/day near New Orleans. Most of the MPs (>60%) were in the lower size fraction (30-90 µm), consisted primarily of fragments (~85%), followed by fibers (~8%) and beads (~7%), with polyethylene, polyester, and polyacrylate as the primary MP type. Analyses of samples collected near Mississippi oyster reefs are underway and results will be presented at the meeting.

MODELING COASTAL PROCESSES

The Efficiency of High-Resolution Wave Dataset on the Performance of Wave Modeling

BAGHBANI R., LINHOSS A.

Coastal wind-driven waves play an important role in transportation and exchange of mass and energy. The amount and intensity of wave energy determines the rate of erosion and deposition in estuarine systems. Having a continuous spatial-temporal understanding of wave energy can provide a better understanding of coastal processes. Models are convenient tools for wave studies because of their temporal and spatial coverage and resolution.

The aim of this study was to develop and validate a wave model for the Back Bay Biloxi, Mississippi in the northern Gulf of Mexico. The SWAN software (Simulating Waves Nearshore; Delft University of Technology) coupled with ADCIRC (Advance Circulation) was used to simulate wave height and direction. SWAN input data includes: wind speed, wind direction, and a bathymetric mesh. Due to the complexity of the area, an unstructured bathymetric mesh was generated using SMS software (Surface-water Modeling System; US Army Corps of Engineers).

One limitation in many wave modeling studies is the lack of spatially robust wave measurements that can be used for validation. This is due to the fact that installing a large number of wave gauges, in any one site, is usually cost prohibitive. In this study we deployed 38 relatively cheap DIY wave gauges to comprehensively measure wave conditions in Back Biloxi Bay. Wave gauges were deployed three times between June and August 2019 for 7 days during each deployment. These data were used to validate the wave model. Consequently, this study provides a novel validation of a wave model by way of a spatially comprehensive wave measurement dataset.

Strategic Conservation Assessment Tool Suite: A Science-Based Conservation Framework for the US Gulf of Mexico Region

SAMIAPPAN S., SHAMASKIN A., EVANS K., LIU J.

The overwhelming consensus among the conservation experts is the immediate requirement for efficient science-based geospatial conservation tools that can help guide or optimize the dollars spent on conservation based on the ecological benefits. In this work, we demonstrate a suite of conservation tools for conservation prioritization and visualization that enables integration of 1) openly available peer-reviewed data from federal and state agencies, 2) the priorities and values identified in local and regional plans with those identified by stakeholders representing local and regional agencies and organizations, and 3) a multi-criteria decision analysis (MCDA) based optimization framework for assessing potential conservation projects. The framework developed as part of this work is implemented as geospatial web tools. The tool was developed and tested with five conservation goals proposed by the Gulf of Mexico (GoM) Restore Council and was used as a framework for grouping the identified conservation plans and projects. The goals are 1. Restore and Conserve Habitat, 2 Restore Water Quality, 3. Replenish and Protect Living and Marine Resources, Enhance Community Resilience, and Restore and Revitalize the Gulf Economy. The tool suite consists of three tools, 1) conservation inventory tool (CIT), 2) conservation prioritization tool (CPT) and 3) conservation visualization (CVT). The CIT is the first large-scale regional assessment of conservation planning efforts across governmental and non-governmental organizations encompassing all ecosystem types in the GoM. This comprehensive inventory tool is vital to understand the key factors that may drive existing conservation efforts, as well as identify potential gaps in conservation planning efforts. The CPT is using existing data with the MCDA to provide decision support to search for the project or ranking of all the alternatives based on decision-makers' preferences. Decision-makers prefer a decision support method that doesn't require explicit preference information from them due to several political and apolitical reasons. The CPT can provide decision support merely on potential land parcels and publicly available peer-reviewed or government-provided data can alleviate any bias and thereby provide purely science-based support. The CVT is developed to enable the users to explore the data behind CPT to identify potential regions using MCDA for conservation in the GoM. The CVT does not require potential project footprints to perform CPT like analysis rather it is performed on small hexagon parcels of 1 square km size spread across GoM.

Artificial Neural Networks for Filling Data Gaps and Improving Hydrologic Simulations in Coastal Watersheds

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The accuracy of streamflow measurements and models is very important in water-resources planning and management. Traditionally, streamflow is simulated using physically based hydrologic models such as the Soil and Water Assessment Tool (SWAT). Previous studies have also compared SWAT with Artificial Neural Network (ANN) models to understand which give the best results. Traditional hydrologic models have the advantage that they simulate mechanistic processes which enables users to understand and quantify physical components of the system. In some cases, physical processes of a system are either unknown or unimportant. Here ANN models have the advantage that they can predict the relationship between the inputs and outputs of a process without an understanding of the physical characteristics of the system. We propose to combine the SWAT model with an ANN model to improve stream?ow estimation. We employ each of these models according to their strengths. The ANN model was used to fill gaps in time series data and estimate unknown physical processes. The data developed by the ANN model was used as an input into the SWAT model to simulate streamflow. The models were developed for a coastal watershed in Florida, which drains to the Biscayne Bay. Biscayne Bay has been recently designated as one of ten habitat focus areas across the country by the National Oceanic and Atmospheric Administration (NOAA). The Biscayne Bay region is unique because of its karst geology, flat topography, system of regulated surface canals, and the oligotrophic nature of the Bay. In the future, the developed model will also be used to simulate water quality in Biscayne Bay, Florida.

Assessment of Wave Energy Reduction by Marsh Terraces Utilizing a Wave Model

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Wetland losses in the northern Gulf of Mexico are mainly due to subsidence, sea-level rise, and land erosion caused by wind driven waves. Marsh terracing is a relatively new coastal restoration technique implemented in Texas and Louisiana. Marsh terraces are segmented berms of soil that are built in inland, shallow coastal ponds. Marsh terraces are designed to create new marsh, reduce fetch and dissipate wind originated waves. Therefore, this restoration technique is hypothesized to slow down marsh platform erosion and pond expansion by reducing wave energy. Marsh terraces have been implemented for almost 30 years; however little research has been conducted to determine their effectiveness. The objective of this study was to assess which terrace design (rectangular or chevron) is most effective at reducing wind driven wave energy. This analysis was conducted using the Simulating Waves Nearshore (SWAN) model. The model simulated wind waves at two terrace fields in coastal Louisiana. Simulations were based on real terrace field conditions with and without terraces. Model input parameters included bathymetry, water level, as well as wind and wave characteristics. Model validation was done using in-field measurements collected for 5 months at each study field by an acoustic anemometer (wind time series), four doppler profilers, and a wave buoy (wave data). Results help us to understand the dynamics of wave energy related to the erosive forces exerted in two different marsh terrace designs under different field environments and weather conditions. At the end of this project we expect to identify the most effective terrace design for reducing wave energy which is related to marsh erosion, leading to marsh creation within these wetlands.

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