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Abstracts listed in alphabetical order of who is lead author for each paper. E-mail addresses appear only after the corresponding author, which can be someone other than the lead author

Characteristics of voluntary programs addressing nonpoint source pollution

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Nutrient and sediment runoff from agricultural lands is addressed across the nation mostly through voluntary programs while some states are moving toward other mechanisms such as nutrient trading, taxes and subsidies, enforcement, etc. Although the players in nonpoint pollution accept that voluntary practices along with other mechanisms are necessary to address water quality issues, there is still lack of information on programs that provide financial, educational, and research tools to achieve the environmental objectives. Environmental Quality Incentives Program is one such example of a targeted program to address water quality through a concentrated conservation effort. Knowledge gap can hinder the adoption of measures that can achieve progress on water quality improvements at local and regional scale. The current project is aimed to provide an assessment of programs and practices that addresses the need for necessary information to producers that ensures adoption of cost-effective management strategies and allows control over their production and pollution-control decisions.

Key words: nonpoint pollution, water quality, and voluntary programs

Lithological Influences on the Synthetic Precipitation Leaching Procedure Test and Implications to Assessment and Remediation at Southwest Foods Site in Lafayette, Louisiana (LDEQ Agency Interest no. 69569)

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Southwest Foods in Lafayette, Louisiana has multiple underground storage tanks that leaked petroleum products over a period of time, releasing numerous toxic constituents of concern into the surrounding soil and groundwater. During the assessment phase of risk evaluation, the Synthetic Precipitation Leaching Procedure (SPLP) test was used to measure the leaching potential of possibly contaminated soils and lithologies when exposed to acidic rainfall. However, during the site investigation, SPLP data produced erratic results that apparently are related to the type of geologic material ("soil") involved. These erratic results could have major implications for assessment, remediation, and the establishment of Risk Evaluation/Corrective Action Program (RECAP) standards in the state of Louisiana. Incorrectly applied RECAP standards could ultimately mean contaminants of concern could reach points of exposure (POEs), and potentially harm nearby residents and the environment. Previously, lithological composition had not been considered when evaluating the environmental impact of the test.

At the site, numerous geotechnical soil boring logs were completed, and soil samples were sent to analytical laboratories for analysis of contamination. Soil analytical data compiled by the laboratories along with samples acquired from multiple groundwater monitoring wells at the site provided an in-depth view into the degree of contamination at Southwest Foods and produced the first signs of erratic SPLP test results. Contour maps of contamination and groundwater potentiometric levels were created to show both the level of contaminants in soil and the possible migration paths of affected groundwater. The SPLP sample data were evaluated and categorized into lithological subgroups for further examination. The lithologies, or soil types (with USCS symbols), that produced erratic results (i.e., some "passed" and some "failed") for the SPLP analyses included "clay, high plasticity" (CH) and "clayey silt/sandy silt/silt" (ML). The results for "silty clay/sandy clay" (CL) were more consistent. The inconsistent SPLP data could result in incorrect application of site-specific RECAP standards and the subsequent cleanup at Southwest Foods and conceivably at other contaminated sites as well.

Key words: Ground Water, Remediation, Assessment, Lithology, and Louisiana

Groundwater extraction and allocation when there are stock externalities

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As of March 13, 2018 no abstract will be submitted later

Key words: groundwater, risk, allocation

An overview of trends within hydraulic fracturing in Haynesville Shale Gas Play, Louisiana

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For 70 years, hydraulic fracturing has occurred but has come to public attentions due the massive amounts of water used for development of unconventional hydrocarbon deposits with long horizontal holes in the last decade. A few general studies considered volumes of water used and chemistry of fracturing water throughout the United States. For these studies, periods considered are broad, decades. For this study, hydraulic fracturing trends are considered on a year-by-year manner and for within Haynesville Shale Gas Play (HSGP).

Data from two sources was analyzed. Louisiana Department of Natural Resources data of volumes of water used, source type and source location. Frac Focus has data for the chemistry of water used within the fracturing solution. Their chemical data, maximum concentrations, is split up by components of fracking by reason of use, such as: acid, acid/corrosion inhibitor, biocide, base carrier fluid (water), breaker, clay and shale stabilization control, crosslinker, friction reducer, gel, iron control, non-emulsifier, pH adjusting agent/buffer, propping agent, scale inhibitor, and surfactant. Often 10 to 20 different chemicals were used in addition to water and sand for each hydraulic fracturing job. Many of these are not identified for economic reasons. Within the HSGP there are over 100 different compounds used with fracking in solutions. However, for this study focus is on the thirty most commonly used compounds.

Throughout the past decade, the median volume of water used for hydraulic fracturing has increased. The source of that water is nearly always surface waters. Usually a natural or artificial pond is nearby. However, an increasing share of sources are larger water bodies, example Red River. This is contractor response to general agreements between LDNR and frackers to use more regional surface water sources moving frack water demand from groundwater to local small ponds, indirect withdrawals of local groundwater, and ultimately to regional water bodies supplied by distant groundwater baseflow.

In the past six years chemistry the fracture solutions are changing. Concentrations of hazard compounds methanol, naphthalene, or light/heavy petroleum distillates are decreasing. By contrast, concentrations of more benign compounds such as sand/quartz/silicon dioxide for propend or guar gum are increasing.

Key words: Hydraulic Fracturing, Trends of water use, and Trends of fracturing solution

Impacts of wildfire emission to water bodies in US

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Wildfire is a worldwide concern because of its significant impacts on air pollution, climate changes and also its pollutant deposition to water bodies. Weather Research Forecasting (WRF) model and Community Multi-scale Air Quality (CMAQ) model are applied in this study to simulate potential pollutant deposition due to wildfire in US 2011. Potential deposition of PM, nitride, sulfide and Ozone would be simulated. Contribution of pollutants deposition due to wildfire from modeling results provide for calculation on how water quality would be affected. Information of water bodies are extracted from Geographic Information System (GIS). Results of this study provide information for simulating effects of wildfire to pollutant deposition and help to improve wildfire and pollution deposition controlling managements.

Key words: wildfire, pollutant, deposition, PM2.5, and Ozone

Three-dimensional Underseepage Evaluation for Profit Island Vicinity Levee

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A levee reach at the west bank of Mississippi River near Profit Island experiences high underseepage during high river stage. The United Stated Army Corps of Engineers (USACE) constructed an array of relief wells along the levee to reduce hydraulic pressure and control sand boils. In order to evaluate the effectiveness of the relief wells, a three-dimensional USGS MODFLOW-USG (unstructured grid) model is developed to predict hydraulic pressure and seepage underneath the Profit Island vicinity levee. A locally dense grid mesh (3.125 m by 3.125 m) is built to keep a high resolution seepage simulation underneath the levee where relief wells are located while simulating subsurface flow in a large domain (4.5 km by 5.0 km). The model is calibrated with piezometric head data and relief well discharge data from the high water-level event in 1997. Relief well discharges are calculated through the calibrated model for the 2017 flood event and compared with qualitative classification of relief well discharge during five field trips in June 2017. Several relief wells in the north of the levee are shown with low to no discharges which is regarded as a concern effectiveness of relief wells, and may be due to the maintenance issue or local stratigraphy. A comprehensive evaluation of the performance of relief wells near the Profit Island vicinity levee and the techniques of subsurface modeling are described in this study.

Key words: Relief wells, Seepage, Levees, Alluvial aquifer, and Profit Island

A pilot study for assessing freshwater flow impacts to Louisiana estuaries

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The Water Institute of the Gulf (the Institute) has developed a framework to analyze available resources and demand for both surface water and groundwater across Louisiana, allowing researchers to analyze available water supplies and the consumption levels of various end users, including public supplies, agriculture, and industry. The research and data collected will help policymakers make informed decisions about water use and ensure that Louisiana will have an adequate supply of freshwater for public drinking as well as agricultural and industrial use.

One of the key uncertainties of the water resources framework was determined to be the quantity of freshwater necessary to be delivered to coastal estuaries by rivers. Freshwater input serves several essential ecological functions, including the regulation of salinity, and delivery of nutrients and sediments from the watershed. To begin quantifying these environmental flows, the Institute performed a pilot study to determine the effects of changing freshwater inflow of the Amite River to the marshes and swamps around Lake Maurepas. The Institute developed a state of the art computer model that has previously been used to determine the hydrologic, ecological, and land change effects of Louisiana coastal restoration projects from the Coastal Protection and Restoration Authority (CPRA) 2017 Coastal Master Plan. This project adapted that model to determine the ecological responses of the wetlands, swamps, and estuaries to variations in riverine freshwater input. It illustrated how variations in the flow of rivers such as the Amite can have effects on the suitability of habitats for key fish and wildlife species, as well as how it affects the distribution of wetland vegetation types over time. The methods developed in this pilot study can be adapted and used in coastal riverine systems across Louisiana, and around the world.

Key words: freshwater inflow, minimum flows, ecological flows, environmental flow, water budget, and estuary

Can Public Policy Perpetuate the Memory of Flood Disasters

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Two years after the tragic1983 flood along the Amite River in Louisiana (USA), Rod Emmer, a local floodplain manager, advised his peers that planners and policy makers needed to take steps to avoid a repeat of that event. Thirty years elapsed between his guidance and the next tragic flood in 2016. It produced even more devastating consequences, due in part to incomplete implementation of his recommendations and the extensive urban sprawl that took place between the floods. Local governments made adjustments in their floodplain policies in the interim, but sequestered the memory of the 1983 event as they prioritized development over safety. This paper examines the local policies enacted after 1983, considers their perpetuation during the intervening decades, and critiques the dismissal of risks in regional development.

Key words: floods, public memory, public policy, and Amite River

Intersection of Policy and Trends - Climate, Hypoxia, and Louisiana's Coast

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Louisiana is at the nexus of large natural systems, primarily the Mississippi River and Gulf of Mexico, and the convergence of a number of trends such as sea-level rise, hydrological cycle intensity, and habitat loss. There are also key policy efforts underway, such as the Gulf Hypoxia Action Plan and Louisiana Coastal Master Plan, which are attempting to achieve their goals on timelines that will be impacted by environmental trends and other factors such as fiscal limitations and legislative changes.

This presentation will examine the intersection of the trends and policy efforts underway, specifically the Gulf Hypoxia Action Plan target of achieving a 20 % reduction in nutrient loading (of nitrogen and phosphorus) to the Gulf of Mexico by 2025, the Coastal Master Plan's timelines, and changes in national climate policy, in light of current assessments of trends in river levels and sea-level rise, and also lay out the key legislative processes impacting policy, such as the Farm Bill, Water Resources Development Act, and others.

Key words: Gulf of Mexico, Mississippi River, hypoxia, and water quality

Advancing Irrigation for Agronomic Crops through STAMP

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Louisiana's agricultural producers have begun to search for education, tools, and resources to improve their irrigation methods as acreage under irrigation continues to rise, increasing from 31% in 2011 to 49% in 2017. Historically, irrigation was scheduled instinctually rather than based on plant moisture status. Thus, irrigation efficiency may be improved by using technologies to determine irrigation events based on estimations of crop water requirements. The objective of this project was to develop a simple decision tool to accurately estimate crop water requirements for agronomic crops. The decision tool relies on a soil water balance to keep track of water movement in the shallow soil area identified as the potential root zone. This simplistic tool was developed using a spreadsheet for ease of access and availability without internet. Calibration and validation of the tool was conducted by using irrigation data and soil moisture sensor measurements collected from research plots in 2015 and 2016. The decision tool worked well in identifying when deficit conditions occurred in the sandy clay loam soils. The volumetric water content sensors did not perform well in heavier soil types, so the data could not be used to validate the model in other locations. The soil water potential sensors had good performance in heavy soils, but more work must be done to convert the potential readings to volumetric water content using a soil water retention curve. In addition to the benefit of knowing when an irrigation event should occur, this spreadsheet can also act as a descriptive record that keeps track of water application and estimated efficiency.

Key words: crops, evapotranspiration, irrigation, scheduling, and soil moisture

Water and Salt Characteristic Changes of Ulungur Lake and the Corresponding Reason Analysis

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Based on the annual continuous Water level and salinity information systems (1958-2010) of Ulungur Lake obtained by multi-ways, the longer interannual and space changes of Water level and salinity are analyzed. The Results show that the water resource and salinity of Brenda lake and Jily lake have experienced three typical phases since 1958, synchrotron atrophy period(1958-1970), Sync atrophy period(19701-1986) and water-salt relations disorders period(1978-nowdays).The whole trends of Ulungur Lake ecologic include Brenda lake salinity further homogenizes, the fresh water ecological system of Jily lake is changing to the brackish system, and the overall ecologic condition of lake has the deterioration trend. The basic reasons, which have caused lake water and salinity systems changing and disordering , are excessive water use of lake watershed for a long time and unscientific scheduling and management of water resources, under the premise of water resources congenital deficiency in Ulungur Lake basin.

Key words: Ulungur Lake, water and salt characteristics, and reason analysis

Field Observations of Soil-Water Tension throughout a Capillary Fringe in New Iberia, Louisiana

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The need for an expedient and economical field method for identifying the upper boundary of the capillary fringe (CF) led to an investigation of the clay-rich surficial units of two sites in New Iberia, Louisiana. Tension-sensing instruments capable of indirectly measuring water content were installed to monitor changing subsurface conditions throughout the vadose zone in response to water table fluctuation and rainfall. Tension measurements of 10 kPa and 33 kPa, correlated with the agricultural concept of field capacity by previous studies, functioned as indicators of two possible upper capillary fringe surfaces. Interpreted tension boundaries were plotted at depth to outline temporal changes in capillary fringe thicknesses, which ranged from approximately 1-5 ft depending on rainfall rates.

A comparison of gravimetric water content profiles with interpreted tension boundaries suggested that CF thickness was heavily influenced by the presence and composition of surficial fill, root systems, and the depth of the shallow water table. Collected tension and water content measurements were plotted as water retention points onto a series of estimated soil water retention curves (SWRCs). The hysteretic nature of soil-water retention relationships of the clay-rich media, evidenced by several examples of near equivalent water contents corresponding to vastly different tension measurements, and vice versa, illustrated the potential errors in basing capillary fringe thickness solely on tension measurements. While tension measurements did prove useful in recording variable conditions in the vadose zone, further research into accounting for hysteresis is required before tension boundaries can be employed in capillary fringe surface identification.

Key words: Ground water, Capillary Fringe, Tensiometers, Water Content, and Hysteresis

Addressing Saltwater Intrusion in Baton Rouge, Louisiana

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The greater Baton Rouge metropolitan area is fortunate to have been blessed with an abundance of high-quality groundwater. This resource has been utilized since the time of Spanish and French explorers. Early wells were artesian in nature, free flowing and not requiring pumps. By the beginning of the twentieth century, the area was being industrialized due to its strategic location for the production of petroleum, natural gas, and salt. The quality, quantity and low cost of this resource led to its rapid development throughout the 20th century, providing a stimulus for both economic and population growth.

Groundwater in the Baton Rouge area is found in ten sands named after their depths in the industrial area north of downtown Baton Rouge along the Mississippi River: the “400-foot”, the “600-foot”, the “800-foot”, the “1,000-foot”, the “1,200-foot”, the “1,500-foot”, the “1,700-foot”, the “2,000-foot”, the “2,400-foot”, and the “2,800-foot” sands. Increasing groundwater withdrawals in southeastern Louisiana have caused saltwater to encroach into these freshwater sands. Groundwater investigations in the 1960's delineated a freshwater-saltwater interface located near the Baton Rouge fault. Generally, aquifers in the Baton Rouge area contain freshwater north of the fault and saltwater south of the fault. Chloride concentrations are generally less than 10 milligrams per liter in these aquifers north of the fault. Most saltwater north of the fault, with the exception of the "2,800-ft" sand, has been induced across the fault by withdrawals in the Baton Rouge area. Saltwater encroachment into freshwater areas north of the fault has been monitored in several aquifers using a network of observation wells. Saltwater was initially detected as early as the 1940's in the “600-ft” sand; by the 1990's saltwater had been detected in six aquifers north of the fault including the “600-ft,” “1,000-ft,” “1,200-ft,” “1,500-ft,” “2,000-ft,” “2,400-ft,” and “2,800-ft” sands. In some aquifers, production wells have been impacted.

The source of the salt is still being debated, with the two major schools of thought being, 1) that saltwater in the aquifers north of fault has migrated up fault planes from deeper, older halite formations (Stoessell and Prochaska (2005)) and 2) that the brine has migrated upward through fractures associated with salt domes south of the Baton Rouge Fault and migrated along the shallower Miocene sand layers to the fault (Windeborn and Hanor (2009)).

In 1974 a Bill was introduced to the Louisiana Legislature that created the Capital Area Groundwater Conservation District including the five parishes in the capital area (East Baton Rouge, West Baton Rouge, East Feliciana, West Feliciana and Pointe Coupee). The bill passed (RS 38:3071) and created a Board of Commissioners to administer the affairs of the District. An organizational meeting was held on January 14, 1975.

The Commission consists of sixteen members, one member from each of the parishes composing the district, three members representing the industrial users in the district, three members representing private or public water supply, one member representing the Louisiana Farm Bureau Federation and the Louisiana Cattlemen's Association, one member representing the

Louisiana Department of Environmental Quality, the director of the East Baton Rouge Parish Department of Public Works, or his designee, the commissioner of conservation, or his designee, and one member being the nominee of the board.

Since its creation, the Capital Area Groundwater Conservation District has been involved in the efficient administration, conservation, orderly development and supplementation of groundwater resources in the five-parish area. The CAGWCC has driven investigative efforts and policy changes and fostered an atmosphere of cooperation to promote the responsible development of the groundwater resources in the Baton Rouge area and to protect the quality of these resources. Numerous actions have been taken by the Commission to study, assess and address the matters of subsidence, salt water encroachment and water level decline in the district.
The "1,500-foot" and "2,000-foot" sand aquifers are important sources of groundwater for residents and businesses in the Baton Rouge area. Saltwater intrusion into the “1500-foot” and “2000-foot” sands has been specifically addressed by the CAGWCC. These actions include studies, models and mitigation. Shortly after the Commission was seated, it passed the first of several resolutions to address the saltwater encroachment issue:

1. Reserves the "1,000-foot", "1,500-foot" and "1,700-foot" sands for public-supply use. Drilling of industrial wells in the "1,500-foot" sand should be restricted to replacement wells in areas where interference with public-supply wells is minimal. (11/75)
2. Restricts construction of new wells in the "1,500-foot" sand south of the fault in West Baton Rouge Parish to public-supply usage because only a limited amount of fresh water is available from this aquifer. (7/88)
3. Prohibits multi-aquifer wells in the District, except as approved by the Commission and with variance granted by La. DOTD. (7/91)
4. Limits pumpage and water levels in the "2,000-foot" sand, with a moratorium on wells in "2,000-foot" sand in a designated area. (10/91)

It is important that the public have an appreciation for the fact that there are more than one water-bearing sand in Baton Rouge. Also, groundwater is available to all who will put it to a beneficial use. Beneficial use is defined in RS 38:3073 as “…the use of groundwater for domestic, municipal, industrial, agricultural, recreational, or therapeutic purposes or any other advantageous use.” Groundwater and drinking water are not necessarily the same.
Many observers feel that the solution to the saltwater intrusion problem in Baton Rouge is simple – force industry to wean themselves completely from groundwater and use the Mississippi River as their source of process water and cooling water. But public supply and industry take their water from different sands, and the main sand used for public supply, the “1,500-foot” sand, has effectively been declared “off-limits” to industry by the CAGWCC. Furthermore, as has been shown by the results of the USGS model, if industry ceases production from the “2,000-foot” sand in the industrial district, it will result in the movement of saltwater towards public supply wells screened in that sand. The CAGWCC is currently working toward a middle-ground solution that will help preserve all the freshwater sands in the Baton Rouge area for future generations.

Key words: groundwater, conservation, saltwater, and sustainability

Integration of Physically-Based Distributed Hydrologic model's into Local Flood Mapping Application

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In this study we explore the potential of using the runoff estimates from physically-based distributed hydrologic models such as, WRF-Hydro and the National Water Model (NWM) for local flood mapping application. We do this by feeding the hydrologic model's runoff estimates to local scale 1D hydraulic models (e.g., HEC-RAS) in order to obtain detailed flood inundation maps that correspond to either design storms or actual rainfall estimates. Moreover, we constructed an operational flood forecasting system that automatically generates inundation maps in real-time using the atmospheric forcings and rainfall forecasts from the High Resolution Rapid Refresh (HRRR) as an input to WRF-Hydro. We also perform separate runs for simulating the current flow conditions using the Multi-Radar/Multi-Sensor (MRMS) rainfall observation. We applied this forecasting framework to a medium sized basin called Coulee Mine located in South-West Louisiana. We hope that this framework will enable local engineering firms to make use to the large amounts of hydrologic data which is provided by the National Water Center (NWC) operationally.

Key words: WRF-Hydro, NWM, NWC, Flood Forecasting, HRRR, MRMS, and HEC-RAS

A Laboratory Study on Turbulent Flow around Various Breakwater Structures.

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The fragile system of Louisiana’s coastline is in urgent need for protection. Environmentally mild, submerged breakwaters could greatly contribute in preserving the state’s shores. This research aims to investigate turbulent flow surrounding such structures. Various permeable and non-permeable submerged breakwater designs were tested under steady flow in a water recirculating flume. The 3-dimensional velocity field was recorded whit an Acoustic Doppler Velocimeter (ADV) in the vicinity of the structures. Turbulent characteristics such as Reynolds Shear Stresses and Turbulent Strengths were derived out of these data and were compared with results obtained by numerical simulations. Flow around non-permeable breakwaters was in general more turbulent than that around permeable designs. Through detailed comparison between the different breakwater designs, the impact of their geometric characteristics on the generation of turbulence was quantified. This laboratory study could contribute towards the effective protection of the coast of Louisiana.

Key words: ADV, steady flow, Reynolds Shear Stresses, and Turbulent Strength

Mitigating Impact of Evacuation Waste on Vital Water Water Sources

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Unsecured surface and ground water sources are often vulnerable during catastrophe events due to raw human waste, generated during the mass evacuation of communities, which puts unprepared individuals on roadways and evacuation routes, minus appropriate waste facilities.

Consequently, raw biowaste, human and animal, is discarded randomly and recklessly in open, unguarded areas bordering evacuation roads or emergency routes, which are conveniently, but unfortunately, located near or adjacent to open, unguarded, and unprotected surface water or innocent, latent paths to ground water.

Such waste can contain bacteria, viruses, protozoa, and even helminths (worms) that are all deadly threats to the public health of individuals, even whole communities, plus temporary facilities for mass evacuees, when entering and contaminating water sources.

Inexpensive, convenient and safe methods for mitigating the threat of raw human excreta to surface and ground water are presented, including options for public-private partnerships.

Key words: minimizing bio-contamination of water sources, mitigating waterborne biowaste from evacuations, and contamination of surface and ground

Dieback of Roseau Cane (Phragmites Australis) in Coastal Louisiana

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Roseau cane (Phragmites australis) dieback was first noticed during the fall of 2016 in the Mississippi River Delta. By summer of 2017 dieback had been observed in several locations across coastal Louisiana and appeared to coincide with the infestation of a scale insect (Nipponaclerda biwakoensis). Roseau cane scale is native to Asia and was not previously reported in North America. The scale can be found below the leaf sheath of Roseau cane and feeds by sucking sap directly from the stem. Roseau cane found in other regions of North America is detested for its invasiveness which outcompetes beneficial native vegetation. However, throughout the Mississippi River Delta, Roseau cane provides important habitat for fish and wildlife and critical defense against salinity and wave action in water too deep for other plant species to tolerate. Roseau cane dieback in the Mississippi River Delta is resulting in patches of open water and poses a major threat to coastal integrity. Additionally, Roseau cane provides protection for oil and gas infrastructure, recreational camps, and crucial navigation channels. Loss of Roseau cane at the mouth of the Mississippi River probably will cause significant ecological and economic impacts not experienced elsewhere.

Key words: Insect outbreak, Invasive species, Mississippi River Delta, and Wetlands

Effects of climate change and emission scenarios on nitrate and sulfur deposition to surface water in Louisiana

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With the potential growth of industries and population in Louisiana, increase of air pollutants emissions is expected and will result in high pollution deposition levels in future in addition to climate change. This study investigates the effects of emission and climate change on nitrate and sulfur deposition to surface water body in 2050 using the Community Multi-scale Air Quality (CMAQ) model. The current meteorology will be generated using Weather Research and Forecasting (WRF) model version 3.7.1 and the future meteorology will be generated using the same model under the Representative Concentration Pathways (RCP) 4.5, 6.0 and 8.5 emission scenario. The future emission scenarios will be developed based on the projection of US emission inventory in 2011 with proper factors to reflect the growth of industry and population and control strategies. The difference in spatial and temporal variations of nitrate and sulfur deposition between 2011 and 2050 will be analyzed and the contributions of emission change and climate change will be quantified.

Key words: climate change, nitrate and sulfur, and deposition

Assessment of Effects of Climate Variability on Water Supply Stress in Louisiana: Opportunities and Implications for Sustainable Water Management

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Water resource systems are faced with meeting the challenge of growing demands coupled with the potential for added stress from climate change in the coming decades. Previous studies have used water stress indices to investigate the stresses on freshwater systems; however, the majority of these studies have focused on average annual water availability and demand conditions in calculating the stress metrics. Water supply is greatly impacted by both short-term and longer-term climate variability which may have substantial negative impacts on water system sustainability. Hence, with the multiple services provided by water resources systems, including drinking water, power generation, and ecological flows, it is crucial to understand how the stresses on the water system may change in response to variability in water supply and changing demand over timescales that are hidden by averaging. Addressing such variability in the analysis of water systems will be critical for building sustainable systems and enabling the successful regulation of water resources. In this study, we implement a water stress assessment analysis over the state of Louisiana on a watershed scale representing Hydrological Unit Code boundaries (HUC12). The hourly streamflow estimates from the second phase of the North American Land Data Assimilation System (NLDAS-2) dataset (available for 1979-present) are used to incorporate intra-annual and inter-annual variability in surface water availability and the impact on water stress calculations at different temporal scales (seasonal and annual). The results indicate that looking only at average annual stresses can substantially mask the impacts of climate variability reflected in the annual variability of water stress at a watershed scale. This study also revealed significant seasonal variability in the water stresses, especially in irrigation-dominated watersheds due to variability in both water supply and water demand. The results have important implications for water management decisions in Louisiana, and other similar regions in the US, in regards to planning for droughts and flooding, as well as opportunities for harvesting excess surface water and thus increasing the sustainability of the overall water system.

Key words: Climate Variability, Water Stress, Water Use, and Streamflow

Deposition of polycyclic aromatic hydrocarbons (PAHs) to China water bodies

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Dry and wet deposition of atmospheric pollutants is a dominant pathway for polycyclic aromatic hydrocarbons (PAHs) to aquatic ecosystems. As a group of ubiquitous semi-volatile organic compounds (SOCs), PAHs are of great environmental concern and seven of the sixteen unsaturated PAHs are probable human carcinogens and are designated as priority pollutants by the U.S. EPA. China is representing the largest PAHs emission in the world and has abundant water resources. The averaged annual water supply is approximately 600 billion cubic meter and most of them are from inner land water bodies. However, very few studies have been conducted to quantify the contribution of atmospheric deposition to PAH levels.

This study uses a source-oriented CMAQ model to simulate emission, formation, transport, and deposition of PAHs species in China. WRF is used to generate the meteorological inputs and Emissions Database for Global Atmospheric Research (EDGAR) was applied with MEGAN generating biogenic emissions and FINN for wildfire emissions. PAH emissions of 16 priority PAH species directly associated with health risks were generated from the global high-resolution PKU-FUEL-2007 inventory. The forms and quantities of PAHs deposition from wet and dry processes in China will be discovered. The spatial and temporal variations of deposition fluxes will be quantified and contributions of major source sectors or source regions will be quantified.

Key words: Deposition, PAHs, China, Source apportionment

Fresh and brackish groundwaters of the Louisiana continental shelf – do they exist?

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It is known that the use of fresh (TDS <1 g/L) to brackish (TDS <5 g/L) waters significantly improves the efficiency of the secondary recovery of hydrocarbons by waterflooding. It has been shown recently that groundwaters of such salinities exist in a number of passive margin continental shelf sediments in proximity to hydrocarbon producing facilities. These waters were introduced during times of lowering of sea level during the Pleistocene.

Do similarly low salinity waters exist in sediments of the Louisiana continental shelf, which is home to a large number of hydrocarbon production facilities? Two formation water dip sections of the Louisiana continental shelf were constructed as part of an earlier LSU study. The western section runs N-S from the coastline to the edge of the shelf through the Vermillion offshore areas. The eastern section runs N-S through the South Pelto and South Timbalier areas. Pore water salinities, temperatures, and pressures were calculated from spontaneous potential – resistivity logs in each transect. The Pleistocene to Upper Miocene sediments encountered in these transects were deposited in fluvial, deltaic, and open marine environments and hence contained waters of fresh to brackish to normal marine salinities, <1 to 35 g/L, at the time of their deposition. Most of these sediments, however, now contain hypersaline fluids having salinities as high as 170 g/L or more. Exceptions exist in localized areas of shallow Upper Pleistocene sediments that now contain fluids less saline than sea water, even though these sediments are now overlain by seawater. The minimum salinity observed was 15 g/L in the Vermillion and 8 g/L in the Timbalier transect. These shallow brackish fluids probably represent the remnants of fresh or brackish waters introduced during the last low-stand of sea level. The lack of true freshwater in the two transects may reflect: 1) retardation of down-dip freshwater penetration by dense formation waters formed by the subsurface dissolution of salt, subsequent salinization of freshwater lenses, and/or the fact that some of the logged intervals started at a significant depth below the seafloor. However, it is probable based on current onshore groundwater maps that sub-seafloor fresh waters exist in portions of the extreme eastern Louisiana and southeastern state of Mississippi continental shelf areas. Both areas lie to the east of the South Louisiana salt dome province.

Key words: Salinity, Louisiana, Continental shelf, Groundwater, and Waterflooding

Dissolved carbon and CO_2 outgassing dynamics in the freshwater-saltwater mixing zone of a coastal river entering the Northern Gulf of Mexico

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The delivery of dissolved carbon from rivers to coastal oceans is an important component of the global carbon budget. From November 2013 to December 2014, we investigated freshwater-saltwater mixing effects on dissolved carbon concentrations and CO_2 outgassing at six locations along an 88-km long estuarine river entering the Northern Gulf of Mexico with salinity increasing from 0.02 at site 1 to 29.50 at site 6 near the river's mouth. We found that throughout the sampling period, all six sites exhibited CO_2 supersaturation with respect to the atmospheric CO_2 pressure during most of the sampling trips. The average CO_2 outgassing fluxes at site 1 through site 6 were 162, 177, 165, 218, 126, and 15 mol m^{-2} yr^{-1}, respectively, with a mean of 140 mol m^{-2} yr^{-1} for the entire river reach. In the short freshwater river reach before a saltwater barrier, 0.079 $\times 10^8$ kg carbon were emitted to the atmosphere during the study year. In the freshwater-saltwater mixing zone with wide channels and river lakes, however, a much larger amount of carbon (3.04 $\times 10^8$ kg) was emitted to the atmosphere during the same period. For the study period, the river's freshwater discharged 0.25×10^9 mol dissolved inorganic carbon (DIC) and 1.77×10^9 mol dissolved organic carbon (DOC) into the mixing zone. DIC concentration increased six times from freshwater (0.24 mM) to saltwater (1.64 mM), while DOC showed an opposing trend, but to a lesser degree (from 1.13 mM to 0.56 mM). These findings suggest strong effects of freshwater-saltwater mixing on dissolved carbon dynamics, which should be taken into account in carbon processing and budgeting in the world's estuarine systems.

Key words: Dissolved inorganic carbon; Dissolved organic carbon; CO_2 outgassing; Calcasieu River; Gulf of Mexico

The tensile root strength of Spartina patens: response to flood duration and nutrient addition

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Spartina patens, a common coastal emergent macrophyte, may exhibit morphological, anatomical, and physiological adaptations to flooding that are related to aerenchyma formation. These adaptations may affect the biomechanical properties of roots and compromise soil stability and erosion rates. Nutrient addition may also lead to a reduction in root biomass and affect tensile root strength. We tested the hypothesis that the interactive effects of nutrient addition and flood duration reduce tensile root strength by conducting a 165 day greenhouse experiment using six levels of nitrogen and phosphorus addition and two different flood duration regimes. A one-way Welch's analysis of variance (ANOVA) revealed that the tensile root strength of S. patens was significantly reduced by 3.5-day and one-week flood duration regimes ($\rho < 0.0001$) and by all six levels of nutrient addition. The tensile root strength in the experimental treatments of both main effects was significantly lower than in the controls. The results of one-way ANOVAs of tensile root strength with one main effect segregated into subsets and tested using the other main effect demonstrated that there were interactive effects of nutrient addition and flood duration on tensile root strength. These results suggest that exposure to multiple natural and/or anthropogenic stressors can weaken the belowground biomass of macrophytes and decrease the resiliency of the emergent macrophytes in coastal ecosystems.

Key words: Wetlands, Flood duration, Nutrients, and Tensile root strength

Microbial community changes at the bottom sediments in tailwater recovery system influenced by the concentrated poultry feeding operations.

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This study aimed to observe how the effluents from a massive poultry farming facility influence the microbial community in the sediment of the nearby constructed wetland, which functions as a reservoir for poultry wastes. The microbial community structures and compositions in the two neighboring constructed wetlands of Louisiana (named Big Pond and Corner Pond) were characterized and compared through a metagenomics approach using the high-throughput sequence data of a conserved 16S rDNA region (V4 region) obtained from the sediment DNA samples and the metagenomics analysis tool QIIME. Big Pond is connected to a poultry farming facility, directly influenced by the poultry wastes, while its neighboring Corner Pond is separated from the poultry house. Results and discussion Among the 74 phyla of prokaryotes detected from the sediments of the two wetlands, four phyla (Acidobacteria, Chloroflexi, Euryarchaeota, and Proteobacteria) were predominant in both conditions. Proteobacteria, the most predominant phylum in both wetlands, was not significantly different in its relative abundance between the two conditions. However, Alphaproteobacteria one of the four major classes within Proteobacteria, was almost depleted in Big Pond. Within another major phylum Euryarchaeota, all the three classes known as methanogenic organisms (Methanobacteria, Methanomicrobia, and Thermoplasmata) were more abundant in BigPond. Also, the relative abundance of Acidobacteria was significantly reduced in Big Pond, while that of the class Dehalococcoidetes within the phylum Chloroflexi was significantly higher in Big Pond compared to Corner Pond. Wastes released from an intensive poultry farming facility change significantly the relative abundance of some taxonomic groups of microorganisms in the microbial community of the wetland sediment. This study provided valuable information about the global changes of microbial community in the wetland sediments caused by the infusion of poultry wastes at various taxonomic levels.

Key words: Constructed wetlands, High-throughput sequencing analysis, and Microbial community Sediment

Professional Ethics

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This is a professional ethics lecture that satisfies the ethics requirements for both geologists and engineers (it is LAPELS approved). It covers: professional obligations; required educations; philosophical requirements; keeping current; proper representation; licensing and/or certification requirements; obligations to avoid professional wrongdoing and to follow professional codes of ethics; obligations to use logic and caution; the obligation to be duly diligent; the obligation to never make a false statement; the obligation to avoid even the appearance of a conflict of interest; and the obligation to always be professional and professionally honest.

Key words: Ethics, Geologists, Engineers, and Business

Calibration and Water Budget Analysis of the Mississippi River Alluvial Aquifer Groundwater Model between 2004 and 2015

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The Mississippi River Alluvial Aquifer (MRAA) locates in the northeastern of Louisiana and is the second most pumped aquifer in the state. Groundwater withdrawals from MRAA is mainly used for irrigation. The demand and usage of the groundwater increases yearly such that high groundwater withdrawals cause decline in the MRAA groundwater level and induce saltwater intrusion to the aquifer. Therefore, proper management of MRAA is vital to maintain sufficient and necessary water to the fields. For this reason, MRAA hydrostratigraphy model was built by using nearly 8,000 drillers' logs and electric logs collected from Louisiana Department of Natural Resources (LDNR). An MRAA MODFLOW model was constructed with a grid generation technique based on the hydrostratigraphy model, river, recharge, pumping, general and changing head boundary packages. The Mississippi River was considered as a general head boundary of the MRAA because of the connection between the river and the alluvial aquifer. The objectives of this study include calibration of the MRAA groundwater model with USGS observation well data between 2004 and 2015 and evaluation of the water budget of MRAA to prepare for MRAA groundwater management plans. There were available 47 observation wells with 850 groundwater level observation data in MRAA between 2004 and 2015, which were used to calibrate MRAA groundwater model by a genetic algorithm code. The model output produces a good fit to the observation data with the root mean square error (RMSE) 1.05 m. The model simulation result shows average groundwater decline 10 ft in MRAA between 2004 and 2015.

Key words: Aquifer, MODFLOW 200, Calibration, Water Budget Analysis

3-D Modeling of Subsurface Stratigraphy in The Lower Mississippi River Delta Plain

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The Mississippi River Delta Plain (MRDP) is one of the largest delta plain in the world and is social-economically imperative to the Louisiana and the U.S. However, the delta plain has been suffering from a high rate of land loss due to multiple reasons, such as sea level rise, land subsidence and coastal erosion. Coastal protection and restoration projects have been planned and implemented to mitigate the land loss problem, such as sediment diversions, beach and dune restoration, and marsh creation. To understand physical processes and optimize the effectiveness of protection and restoration projects, a large number of studies have been conducted focusing on surface water and river diversion. However, the role of subsurface components, such as stratigraphy and groundwater, have been ignored. Subsurface stratigraphy is believed to be a key component affecting subsidence in the coastal area. This study uses geotechnical boring data collected by multiple agencies, such as USGS, USACE, LADNR and CPRA, and geostatistics method to regionalize data scattered in an area of ~1000 square kilometers and extended from 4 m to -65 m in elevation. The product of the study is a three-dimensional stratigraphy model to reveal spatial distribution of different types of soils in the delta plain. An integrated groundwater-subsidence model will later be constructed upon the stratigraphy model. The result can give insight into how subsurface stratigraphy connect river water with groundwater and how this process affect subsidence and land loss.

Key words: delta plain, stratigraphy, modeling, and geostatistics

Estimating Water Withdrawals from Principal Aquifers in the United States, 2015

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Documentation of groundwater withdrawals from principal aquifers in the U.S. is necessary to understand water uses, estimate water budgets, and manage these resources. Homes, businesses, industries, and farms rely on water from groundwater sources, including many principal aquifers of the United States. The intensity of groundwater withdrawals is increasing as populations increase and industrial and agricultural activities grow and change. In some areas, groundwater withdrawals have increased to offset surface-water supplies that have declined due to heavy use or drought conditions.

Sixty-seven principal aquifers have been identified and delineated in the United States, Puerto Rico, and the U.S. Virgin Islands. These aquifers are defined as regionally extensive aquifers or aquifer systems that have the potential to be used as sources of water of suitable quality and quantity to meet various needs. In 2000, withdrawals from the principal aquifers and 4 additional aquifers or aquifer systems for three major categories (public supply, self-supply industrial, and irrigation) accounted for more than 98 percent of all groundwater withdrawals for all categories in the U.S.

A long-term goal of the USGS is to report national groundwater use for all categories by principal aquifers at a high spatial and temporal resolution. Meeting this goal would provide crucial information to ongoing and future groundwater-availability studies for which regional groundwater models have been developed or are planned. For 2015, withdrawals from principal aquifers in each county are being estimated using reported or estimated groundwater withdrawals for various categories of use and a variety of ancillary data including water-well information and aquifer locations. Withdrawals will be estimated for uses including public supply, self-supplied domestic, industrial, thermoelectric power generation, mining, irrigation, livestock, and aquaculture. Results of this study are expected to be released in 2018 and will complement a national report documenting groundwater and surface-water withdrawals for various uses in each state, which also is expected to be

Key words: principal aquifer, water use, groundwater withdrawal, and United States

Contributions of air pollution and climate warming to tufa wetland degradation in Jiuzhaigou National Nature Reserve, eastern rim of the Qinghai-Tibetan Plateau, China

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Massive deposition of calcium carbonate in ambient temperature waters forms magnificent tufa wetlands, many of which are designated as protected areas and are popular tourist destinations. There is a tufa wetland belt along the Eastern Rim of the Qinghai-Tibetan Plateau (ERQTP), and many of them are experiencing degradation, such as nutrient enrichment and tufa degradation. Meanwhile, there is also an air pollution belt in the ERQTP. This study was made to understand the correlation of tufa wetland degradation with climate change and air pollution for Jiuzhaigou National Nature Reserve (hereafter Jiuzhaigou). Atmospheric changes were first studied. The results show that annual mean air temperature increased by 1.2 ^{o}C from 1951 to 2014. Anthropogenic emissions contributed to over 90 % annual wet deposition fluxes of reactive sulfur and nitrogen and caused acid rain (pH < 5.60). Wet deposition fluxes of reactive sulfur and nitrogen (including SO_4^{-2}, NH_4^{+}, and NO_3^{-}) were mostly from inter-regional transport of air pollutants. Then, the impacts of air pollution and climate warming on tufa wetlands were further investigated. We found that precipitation was calcite-unsaturated so it could dissolve exposed tufa and considerably reduce tufa deposition rate and even cause tufa dissolution in shallow waters. These effects enhanced as precipitation pH decreased. Annual volume-weighted mean concentration of reactive nitrogen in wet deposition and runoff were 26.1 and 14.8 μmol L^{-1}, respectively, both exceeding China's national standard of total nitrogen in runoff for nature reserves (14.3 μmol L^{-1}) and this suggested a nitrogen fertilization effect of wet deposition on green algae. As water temperature is the limiting factor of algal growth in Jiuzhaigou and temperature in the top layer (0-5 cm) of runoff (with a depth<1 m, no canopy coverage of trees and shrubs) was significantly higher at the sites with increased biomass of green algae ($\rho<0.05$), climate warming would favor the growth of green algae. In summary, this study suggests that climate warming and inter-regional transport of air pollutants have contributed to tufa wetland degradation in Jiuzhaigou, but in order to better quantify the contributions, further studies are needed, as many other anthropogenic and natural processes also influence tufa wetland evolution.

Key words: travertine, climate change, nutrient enrichment, acid rain, national park

Carbon Dioxide Emissions from the Lower Mississippi River

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In recent years, CO_2 outgassing from rivers, or release of CO_2 from the water column into the atmosphere, has been identified as a significant piece of the carbon cycle. This process has been attributed to an oversaturation of CO_2 in the water column in response to large fluxes of CO_2 derived from soil respiration and aquatic metabolism over-powering in-stream CO_2 removal mechanisms like photosynthesis. This oversaturation results in a current estimate of global CO_2 flux from rivers to the atmosphere around 0.8 Pg yr^{-1}. While it is believed many of the world's largest rivers consistently function as a source of CO_2 to the atmosphere, previous studies have consisted of a low-resolution sampling regime and calculated CO_2 values, rather than in-stream measurements. A higher resolution of data collection and direct measurements of partial pressure of carbon dioxide (ρCO_2) in streams, especially large rivers, will improve our ability to quantify this essential piece of the global and river carbon cycle.

This study aimed to fill in a critical knowledge gap: how much CO_2 does North America's largest river - the Mississippi River - emit? The study's specific objectives were to (1) analyze temporal trends in partial pressure of carbon dioxide (ρCO_2) and CO_2 outgassing in the lower Mississippi River (2) calculate the total amount of carbon outgassed from the lower Mississippi River annually (3) investigate the effects of hydrologic flood pulses on ρCO_2 and CO_2 outgassing. To achieve the above objectives, in-situ ρCO_2 measurements, dissolved inorganic carbon samples, and additional in-situ ambient environmental parameters were collected monthly from December 2015 to April 2016 and December 2016 to January 2018 at two locations on a 115 river-km stretch of the lower Mississippi River. Additionally, in-situ measurements and water samples were also collected over the rise, crest, and fall of a 64-day flood pulse from April to Jun 2017 to support the flood pulse assessment. The U.S.D.A. Farm Service Agency's National Agriculture Imagery Program (NAIP) aerial imagery was used to digitize and calculate the surface area of the Mississippi River study area, which in turn was used to calculate CO_2 outgassing.

Our preliminary data reveal that all samples at both study sites were super-saturated in CO_2 with respect to the atmosphere, suggesting the lower Mississippi River functions as a source of CO_2 to the atmosphere across all seasons. ρCO_2 measurements in the Mississippi had significant ($\rho<0.05$) correlations with temperature and discharge and significant inverse correlations with dissolved oxygen and δ13CDIC. The estimated annual flux of carbon to the atmosphere through CO_2 from the lower 115 km stretch of the Mississippi River was 9.96×10^7 kg C yr^{-1}, with a larger portion of the outgassing occurring during summer months. Analysis for the influence of the 2017 flood pulse on outgassing is currently underway.

Key words: carbon dioxide, Mississippi River, and dissolved carbon

High Resolution Modeling of Extreme Floods in Low-gradient urbanized environments: A case study in South Louisiana

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In August 2016, the city of Lafayette and many other urban centers in south Louisiana experienced catastrophic flooding resulting from prolonged rainfall. Statewide, this historic storm displaced more than 30,000 people from their homes, resulted in damages up to $8.7 billion, put rescue workers at risk, interrupted institutions of education and business, and worst of all, resulted in the loss of life of at least 13 Louisiana residents. With growing population and increasing signs of climate change, the frequency of major floods and severe storms is expected to increase, as will the impacts of these events on our communities. Local communities need improved capabilities for forecasting flood events, monitoring of flood impacts on roads and key infrastructure, and effectively communicating real-time flood dangers at scales that are useful to the public. The current study presents the application of the WRF-Hydro modeling system to represent integrated hydrologic, hydraulic and hydrometeorological processes that drive flooding in urban basins at temporal and spatial scales that can be useful to local communities. The study site is the 25- mile2 Coulee mine catchment in Lafayette, south Louisiana. The catchment includes two tributaries with natural streams located within mostly agricultural lands. The catchment crosses the I-10 highway and through the metropolitan area of the City of Lafayette into a man-made channel, which eventually drains into the Vermilion River and the Gulf of Mexico. Due to its hydrogeomorphic setting, local and rapid diversification of land uses, low elevation, and interdependent infrastructure, the integrated modeling of this coulee is considered a challenge. A nested multi-scale model is being built using the WRF-HYDRO, with 1000m and 50m resolutions for the NOAH land-surface model and diffusive wave terrain routing grids, respectively.

Key words: Flooding, 2D modeling, WRF-hydro, Low-gradient, and Urban environment

The Belowground Intersection of Nutrients and Buoyancy in a Freshwater Marsh

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An ogliotrophic coastal freshwater marsh converted to open water within months after receiving partially-treated sewage water in fall 2006. Rafts of the upper 50 to 60 cm of marsh soil were found throughout the area within two years, as parts of the 1,100 year-old marsh were re-distributed in the open water. We examined the marsh soils from 2009 to 2012 to determine some of the cause-and-effect consequences of their decomposition to the formation of these floating mats. There was a lack of herbivory damage in April 2009 where the outer boundary of the soil profile was weakened at 60 cm depth, and eventually converted to open water. A 2012 storm event flooded the area by 1.5 m, resulting in new marsh mat 'pop-ups' whose bottom underside was coincidental with the layer of maximum decline in soil strength in the sewage treated area. We conclude that the addition of partially-treated sewage weakened the soil structure during this high water event and others to allow for the vertical separation of the marsh as the buoyancy forces exceeded the marsh's anchor strength, thereby exposing the softer older peats to decomposition, and smothering marsh underneath the mat's new location. A chronic effect of eutrophication on these marshes was, therefore, revealed in a dramatic flooding event. A bottom up (nutrient addition), not top-down stress (herbivory) contributed to wetland loss in the area, and is a potentially significant chronic stressor for other eutrophied marshes with significant aboveground flooding.

Key words: eutrophication, freshwater marsh, Panicum, and buoyancy

Calibrating Chicot aquifer groundwater model: challenges and solutions

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Calibration is the last step and still most challenging part in building groundwater models. In this study, the calibration process for Chicot aquifer is elaborated. Chicot aquifer is the uppermost surficial groundwater system in southwest Louisiana and yet heavily pumped aquifer in the entire state. Observation data, pumping data, screen information, and geology of the aquifer systems play a vital role in Chicot aquifer model calibration. The geological model has been developed based on three sources of electrical logs, screen information, and drillers logs. The boreholes are almost uniformly distributed over the region and number of data points was sufficient to build the geological model. However, inaccuracy in measurements and descriptions associated with well log information as well as those with pumping rates and observations introduce uncertainties to the groundwater model. As a result, errors are created in calibrated model. Modifying geological structures is one of the options to overcome these errors. Considering lower depth for drillers' logs induces a geological structure with higher portion of clay which partially creates additional error to the model. Hence, filtering drillers logs based on a predefined depth may be part of initial calibration process. In addition, defining different parameter zones can reduce the difference between the observations and simulated values for groundwater head. In this study, prior-to-calibration model was layered almost equally into four layers. Various horizontal zones were defined based on concentration of pumping wells. Furthermore, boundary conditions were zoned around the aquifer region. The results demonstrate a significant drop in difference between the observation and simulated values comparing to the uniform boundary condition and unlayered model.

Keywords: Chicot aquifer, parameter zonation, geological model

Sediment availability in the middle Lower Mississippi River

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The Mississippi River Delta is experiencing rapid land loss. Restoration of the delta largely relies on available sediment in the Mississippi River. Channel bars are major sediment sources in large alluvial rivers. However, the knowledge about how much sediment was accumulated in large channel bars in the Lower Mississippi River has remained limited. In this study, we assessed 30-yr morphologic changes of 30 large emerged bars located in a 223 km reach of the Lower Mississippi River from Vicksburg, Mississippi, to the Mississippi-Atchafalaya River diversion. Landsat imagery and river stage data between 1985 and 2015 were utilized to characterize bar morphologic features and quantify decadal changes. Based on bar surface areas estimated with the satellite images at different river stages, a rating curve was developed for each of the 30 bars to determine their volumes. Results from this study show that the highly regulated river reach favored the growth of mid-channel and attached bars, while more than half of the point bars showed degradation. Currently, the mid-channel and attached bars accounted for 38 % and 34 % of the total volume of the 30 bars. The average volume of a single mid-channel bar is over two times that of an attached bar and over four times that of a point bar. Overall, in the past three decades, the total volume of the studied 30 bars increased by 110,118,000 m^3 (41 %). Total dike length in a dike field was found mostly contributing to the bar volume increase. Currently, the emerged volume of the 30 bars was estimated approximately 378,183,000 m^3. The total bar volume is equivalent to ~530 million metric tons of coarse sand, based on an average measured bulk density of 1.4 t/m^3 for the bar sediment. The findings show that these bars are large sediment reservoirs and could be a critical sediment resource for future delta restoration.

Key words: Channel bar, Sediment availability, River engineering, and Mississippi River

Sources of CO_2 over the Gulf Coast and the US using the CMAQ model during 2012

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Carbon dioxide (CO_2) emission comes from two ways, natural source, and human source. Over the past centuries, human activities have greatly influenced the exchange of carbon between the land, atmosphere, freshwater bodies, coastal areas and the open ocean (i.e., fossil fuel emission, land use changes). It is essential to understand the sources of CO_2 to the coastal area so that the effects can be understood and controlled in future. In this study, the air CO_2 is simulated using the Community Multi-Scale Air Quality (CMAQ) model during the year of 2012 over the Gulf Coast and the whole US. Model performance will be validated by comparing with the data collected by the Central Gulf of Mexico Ocean Observing System (CenGOOS) station CenGOOS-01 at the Coastal Mississippi Buoy (30°N, 88.6°W). The spatial distribution will be compared with OCO^{-2} level 2 data. The quantitative information about the sources of CO_2 to the coastal area would help understand the sources and regulate the carbon chemistry in the coastal ocean and reduce uncertainty global carbon budget.

Key words: Carbon dioxide, Coastal carbon cycling, Air-Sea exchange

Decadal changes in annual minimum and maximum river discharge from the continental United States to the Gulf of Mexico

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The impact of river freshwater flowing into estuaries on biological processes and ecosystem development has long been recognized. The magnitude, timing, and duration of freshwater can affect fluctuations in estuarine physical and chemical properties including temperature, salinity, turbidity, and concentrations of nutrients, sediment, and dissolved oxygen. This study analyzed discharge of 24 major rivers entering the Gulf of Mexico from the continental United States. Geographically, these rivers span from Florida in the east to Texas in the west. Quantitatively, they drain land surface areas ranging from approximately 500 square kilometers to over 3 million square kilometers. The discharge data covered a period from 2016 back to the early 20th century, allowing an assessment of their long-term variability and trends. The study found several interesting outcomes: 1) All rivers (eight) east of the Pearl River on the state borderline between Louisiana and Mississippi showed a significantly declining trend of discharge over the past century, with the Hillsborough River in Florida having the largest decline (nearly 40 %) in the past 30 years; 2) Most rivers (twelve) west of the Pearl River showed an increasing trend of discharge, with the San Antonio River in Texas having the highest increase rate (>30 %) in the past 30 years; 3) On average, the Mississippi-Atchafalaya River System (MARS) contributed nearly 83 % of the total river flow (i.e., 809 cubic square kilometers) from the U.S. continent into the Gulf of Mexico, playing a dominant role affecting coastal and marine environments of the world's ninth largest ocean; and 4) the MARS had a clear increase in discharge over the past century, both in extreme lows and in extremes highs. The findings indicate the effects of both climate change and human impact on freshwater resources across the large region.

Key words: continental river flow, hydrological drought and flood, Mississippi-Atchafalaya, and Gulf of Mexico

Biogeochemical connectivity of dissolved carbon across the waterscape of a low gradient watershed

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Lakes and rivers are increasingly being studied in the context of biogeochemical connectivity. In this study, we analyzed dissolved carbon along the Little River-Catahoula Lake in the subtropical southern United States to investigate carbon dynamics in such a river-lake continuum. Monthly in-situ measurements and water sample collections were made at four locations from April 2015 to February 2016 to determine riverine carbon into and out of the 119 km^2 lake with an average depth of approximately 11 meters. Field measurements included ambient water temperature, dissolved oxygen, pH, electrical conductivity, and chlorophyll a fluorescence. Water samples were analyzed for dissolved inorganic carbon (DIC), dissolved organic carbon (DOC), and their carbon-13 isotopes (δ13C). We found a significant, consistent decrease in DIC concentration from the river to the lake outflow (i.e., from 848 to 399 umol L^{-1}, $\rho = 0.035$) as well as from the lake inflow to outflow (i.e., from 482 to 399 umol L^{-1}, $\rho = 0.045$). This decreasing trend was most prevalent during the period when the lake was not affected by backwater flow from the downstream river, namely, riverine DIC concentrations declined by 27 % after passing through the lake ($\rho = 0.038$). The lake acted as a sink for DIC owing to a combined effect of aquatic metabolism and air-lake CO2 exchange. Significant decrease in DOC was also found from the river to the lake outflow (i.e., from 1213 to 969 umol L^{-1}, $\rho = 0.019$) as well as from lake inflow to outflow (i.e., from 1103 to 969 umol L^{-1}, $\rho = 0.043$). However, the lake functioned both as a sink and as a source for DOC - during much of the year, the lake reduced DOC from the river inflow water, but it switched to functioning as a source of DOC during the warm, dry September and October. The lake seemed to be most biologically productive during these two months, striking a balance of allochthonous organic inputs and lake metabolism. The finding suggests that aquatic bioactivity is important for the sink-source behavior of in-network lakes, which can be enhanced in subtropical and tropical environments due to higher temperature.

Key words: dissolved inorganic carbon, dissolved organic carbon, carbon isotope, and river-lake continuum

Hydraulic Modeling for Southwest Louisiana with Small River Systems

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Southwest Louisiana lakes, such as Calcasieu Lake and Sabine Lake, have marshes and wetlands covering its surrounding areas. The frequent floods through small rivers and streams are the major water sources of the wetlands. However, the storm surge floods through the rivers will also bring saline water from the Gulf to the area too, which is damaging and lead to deterioration of the health of the wetland vegetation. Therefore, hydraulic modeling is an critical tool to study and understand the dynamically changing conditions of the area. Regional scale hydraulic models usually has a relatively large grid resolutions comparing to the sizes of the small rivers, therefore, it is costly to include these small rivers in the model. In this study, an immersed boundary method (IBM) is used to implement the small rivers independent to the background grid. As the outcomes of the implementation, the flooding and water exchanges between the rivers and the wetlands can be realized. Due to the lack of measurement data, the "hard-coded" rivers with modified topography data to realize the rivers were also implemented to verify the IBM model results. Both results agree with each other thus prove the accuracy of the IBM model. Detailed physics were revealed based on the modeling results.

Key words: Hydraulic Modeling, Immersed Boundary Method, River 1D model, and Salinity

Solar Radiation Effects on Partial Pressure of Carbon Dioxide in Shallow Lakes

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Many freshwater systems are supersaturated with dissolved carbon dioxide (CO_2). These systems can act as a source of CO_2 to the atmosphere, which plays an important role in the global carbon cycle. Although previous studies have reported the effect of CO_2 partial pressure (ρCO_2) in a water body on CO_2 outgassing, it is not well known how ρCO_2 fluctuates daily and how this fluctuation could affect the outgassing process. This is especially true for urban lakes, which often receive excess organic pollutants and nutrients from the developed surroundings, and which could be photochemically more active during daylight change. In general, there is a knowledge gap about a possible relation between light condition and ρCO_2 concentration in water bodies and how this relation might affect CO_2 outgassing from lakes, streams and rivers. In this study, we conducted bi-weekly field measurements on ρCO_2 in two lakes with varied urban influences, the University Lake on the LSU campus and the Capitol Lake in downtown Baton Rouge, from November 2017 to February 2018. In each trip, ambient conditions including, in addition to ρCO_2, water temperature, dissolved oxygen, pH, and chlorophyll a fluorescence were recorded four time during the day (from sunrise to sunset). Additionally, water samples were collected for laboratory analysis of dissolved inorganic carbon (DIC), dissolved organic carbon (DOC), and their carbon-13 isotopes ($\delta 13C$), and climatic data including solar radiation were gathered from a nearby weather station. Our results showed a strong correlation between ρCO_2 concentration and solar radiation for the two studied lakes. At University Lake, a clear negative linear relationship was observed between ρCO_2 and solar radiation in November, January and February, but such a relationship was not apparent due likely to heavy rainstorms occurred in the month. At Capitol Lake, also a negative but weaker correlation between ρCO_2 and solar radiation was found in November and January, but such a relation could not be seen in December and February. The difference in the ρCO_2-solar radiation relationship between the two studied lakes may have been resulted from the lake trophic states.

Key words: dissolved CO_2, CO_2 outgassing, light-CO_2 emission relation, aquatic oxygen dynamics, trophic states, shallow urban lakes

Investigation of saltwater intrusion mitigation strategies for Baton Rouge multi-aquifer system

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Due to excessive groundwater withdrawals, many water wells in Baton Rouge, Louisiana experience undesirable chloride concentration because of saltwater intrusion. The study goal is to develop a management framework that takes advantage of the Baton Rouge multi-aquifer system to mitigate saltwater encroachment. Several hydraulic control techniques are being utilized in this management framework and their remediation effectiveness are assessed through the developed solute transport model of the Baton Rouge aquifer system. A connector well EB-1293 has been installed to draw native groundwater from the "800-foot" sand and recharge into the saltwater-intruded "1,500-foot"sand. A scavenging well EB-1424 has been in operation in 2014 to extract saltwater in the "1,500-foot" sand. Besides, it is necessary to predict other potential saltwater intrusion areas, such as the "1,200-foot" sand, "2,000-foot sand", "2,400-foot sand", and investigate the feasibility of several innovative mitigation techniques, such as freshwater injection from neighboring aquifers, relocation of pumping wells. Further, using the horizontal scavenger wells can be most attractive for the remediation but they have not been tested in the Baton Rouge aquifer system yet. This management framework serves as a scientific tool to assist policy makers to solve the urgent saltwater encroachment issue in the Baton Rouge area. The research results will help water companies as well as industries in East Baton Rouge Parish and neighboring parishes by reducing their saltwater intrusion threats, which would in turn sustain Capital Area economic development.

Key words: saltwater intrusion, hydraulic control design, and Baton Rouge aquifer system