STATE OF THE COAST

MASTER COMPILATION OF ABSTRACTS

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SPEAKER ABSTRACTS

Stuart Brown, Coastal Protection and Restoration Authority

Session 1

2023 COASTAL MASTER PLAN FRAMEWORK – UNCERTAINTY AND ADAPTIVE MANAGEMENT

The Coastal Protection and Restoration Authority (CPRA) updates the State of Louisiana's coastal master plan every six years. In the face of continued coastal land loss and increasing flood risk, the master plan serves as a prioritization effort, utilizing numerical modeling to evaluate the effectiveness of risk reduction and restoration projects over a 50-year planning horizon. There is, of course, tremendous uncertainty surrounding such long-term projections, which can be influenced by a wide range of environmental, economic, and social factors. The periodic master plan updates create a framework in which CPRA and its partners continually reevaluate and seek to reduce uncertainty in the technical analysis and refine the plan development process. This presentation will focus on (1) identifying environmental and modeling uncertainties, (2) efforts to reduce that uncertainty, and (3) planning and decision making in the face of uncertainty.

The master plan uses an Integrated Compartment Model (ICM) for projections of landscape change and the evaluation of project impacts. The 2017 Master Plan - ICM Uncertainty Analysis identified and quantified uncertainties associated with the calculations of critical model variables such as organic matter accretion and marsh collapse threshold values, which were used to identify and prioritize model improvement efforts for 2023. The master plan cycle provides an opportunity to incorporate the best available science and reduce uncertainty with each iteration. New research, as well as the longer period of record now available for the coastwide reference monitoring system (CRMS) dataset, helps inform model improvements and reduce uncertainty associated with environmental drivers (e.g., eustatic sea level rise, subsidence, etc.).

Regardless of the improvements and new data, substantial uncertainties remain, especially in regard to climate change. The master plan seeks to account for this continued uncertainty by evaluating projects under multiple future scenarios and develop processes to prioritize projects that are effective under a range of future conditions.

Catherine Fitzpatrick, Coastal Protection and Restoration Authority

Session 1
2023 Coastal Master Plan Framework New Project Development

As coastal Louisiana responds to increasing threats from flooding and sea level rise, the 2023 Coastal Master Plan aims to build on past master plans to improve the effectiveness and efficiency of projects in terms of their ability to build or maintain land and reduce storm surge-based flood risk. The project development process for the 2023 Coastal Master Plan includes soliciting new project concepts and creating a list of candidate projects. Candidate projects will be evaluated based on how they impact the landscape of the coastal system using the Integrated Compartment Model (ICM) or based on how well they mitigate storm surge-based flood risk using the Coastal Louisiana Risk Assessment (CLARA) model.

This presentation will focus on three aspects of the new project development process for the 2023 Master Plan: public solicitation for new project concepts and development of project ideas with Regional Workgroups (RWs), project selection criteria for determining candidate projects, and examples of new projects under consideration for the 2023 Coastal Master Plan. In late 2018 and late 2019, CPRA held two public solicitations for new project concepts, and in parallel, five RWs were convened to assist with defining regionally specific priorities and issues, lending regionally specific expertise toward new project development, and helping to identify specific solutions at the regional-scale. One focus of the RWs has been to review more traditional project concepts for restoration (e.g., marsh creation, hydrologic restoration, shoreline protection, etc.) and discuss how to adjust or combine them to create Integrated Projects that have the potential to increase benefits at the regional scale. This presentation will discuss some examples of integrated projects that will be considered as candidate projects for the 2023 Coastal Master Plan.

Krista Jankowski, Coastal Protection and Restoration Authority

Session 1
2023 COASTAL MASTER PLAN – DEVELOPING SCENARIOS

Several landscape modeling tools were developed for the 2012 Coastal Master Plan, which were then integrated and improved for the 2017 Coastal Master Plan, resulting in the Integrated Compartment Model (ICM) of the coastal system. This analytical tool is used to model landscape processes throughout coastal Louisiana, both under current and projected future environmental conditions.

For the 2017 Coastal Master Plan, a variety of environmental scenarios simulated with the ICM in order to evaluate possible land loss/land gain and storm surge-based flood risk outcomes over the 50 year planning horizon, including comparisons between projected future outcomes with and without the impacts of the restoration and protection projects selected for the 2017 Coastal Master Plan. Environmental scenarios were comprised of component variable values including precipitation and evapotranspiration, storm frequency and intensity, and rates of eustatic sea level rise and subsidence. Low, medium, and high scenarios were developed with each variable treated independently so that low, medium, and high land loss outcomes were the result.

This presentation will cover planned changes to environmental scenarios for the 2023 Coastal Master Plan effort. Research published subsequent to the 2017 Coastal Master Plan informs refinement of scenario values including subsidence rates. By leveraging updated data analysis from global climate modeling efforts, scenarios will feature covariance of eustatic sea level rise rates and associated variables (e.g., precipitation, air temperature) which are driven by common climate forcings. This new approach to scenario selection will better reflect potential changes in external forcing of coastal conditions while providing different future landscapes against which to evaluate projects.

Denise Reed, University of New Orleans

Session 1

2023 COASTAL MASTER PLAN FRAMEWORK – SELECTING PROJECTS WITH THE PLANNING TOOL

The Coastal Master Plan decision-making framework combines two sets of analytic capabilities: integrated models of the coastal system and a decision support software system, referred to as the Planning Tool. Results from the models serve as inputs to the Planning Tool, along with planning constraints such as availability of sediment and funding over the 50-year planning horizon. The Planning Tool uses optimization algorithms to identify alternatives comprised of the projects that build the most land and reduce the most flood risk while meeting funding and planning constraints. The Planning Tool generates interactive visualizations that summarize information about individual projects and alternatives. In turn, these alternatives are evaluated by the coastal systems models. The Planning Tool was originally developed to support projects selection for the 2012 Coastal Master Plan and was similarly applied for the 2017 Coastal Master Plan with some differences in the projects considered and the constraints.

This presentation describes refinements to the Planning Tool and its expected use in selecting projects for the 2023 Coastal Master Plan. Two key changes have been explored using project information from the 2017 plan as test data - assessing project benefits over time (rather than twice during the 50-year period) and defining a robust plan based on a revised evaluation process of scenario-specific alternatives.

In the 2017 Master Plan, the assessment of projects only twice during the planning period provided little insight into the way in which benefit streams develop and accumulate over time. Integrating restoration benefits over time, based on data at 5-year intervals, resulted in some differences in the list of projects selected. For example, a project which provides substantial benefits until the last few years of the simulation was selected whereas previously, due to zero benefits at year 50, it was not. Results of similar tests for risk reduction projects using 2017 data will also be presented.

A robust plan could be identified by first identifying low-regret projects for near-term selection, based on which projects are selected in the near-term across all scenarios. These projects are then part of the landscape for later time periods, and the remaining projects are modeled on that basis. The Planning Tool can then identify which additional projects would be selected in later periods across the different scenarios. The selection of the most robust projects for later implementation can also utilize a regrets analysis. Tests of this procedure using data from the 2017 analysis will be presented along with plans for potential utilization of robust project selection for the 2023 Coastal Master Plan.

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Carol Parsons Richards, Coastal Protection and Restoration Authority

Session 5

RESTORE LOWERMOST MISSISSIPPI RIVER MANAGEMENT PROGRAM: OVERVIEW AND STATUS

The goal of the RESTORE funded large-scale program is to provide technical information to support a more holistic management scheme for the Lowermost Mississippi River (Baton Rouge to the Gulf of Mexico) to improve navigation, reduce flood risk, and provide for a more sustainable deltaic ecosystem. The program builds on the existing technical knowledge base for the Lowermost Mississippi River and will advance the science developed under the Louisiana Coastal Area (LCA) Mississippi River Hydrodynamic and Delta Management Study (MRHDMS) and other recent efforts.

The program includes five technical elements and a program management component. These elements are: 1) Mississippi River Modeling Tools; 2) Subsidence Investigations; 3) Impacts of Storm Surge within the Mississippi River; 4) Geomorphology of Lower Mississippi River Lateral Bars; and 5) Dredged Material Management. Since the $9.3 million grant was awarded to CPRA on April 18, 2018, significant progress has been made executing the approximately 20 tasks within the program. This presentation will provide an update and status on the execution of LMRMP tasks.

Presenter Bio: Carol has 20 years of experience with wetland ecosystems. She has planned and managed a variety of coastal Louisiana restoration studies, projects, programs and initiatives, which has involved extensive collaboration with many agencies and entities, especially the USACE. Carol is the program manager for the Lowermost Mississippi River Management Program.

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Kazi Sadid, Coastal Protection and Restoration Authority

Session 5

"WITH A LITTLE HELP FROM MY FRIENDS": USING NUMERICAL MODELS TO IMPROVE PHYSICAL MODELS AND VICE VERSA

The Lower Mississippi River Physical Model (LMRPM) is a novel science analysis and communication tool capable of mimicking the flow of water and sediment through the Mississippi River channel and into the proximal marshes and bays of Barataria, Breton, Terrebonne, and Pontchartrain Basins. As a hydraulic and mobile bed physical model, simulated properties of fluid and bulk bed sediment transport are physically realistic – but at the distorted scale represented in the model. The general impact of scale distortion on fluid flow is well understood while the impact of scale distortion on sediment transport is less well understood but improving; however, the assessment of distortion has been generally performed in simplified laboratory settings. The Lowermost Mississippi River, even in the simplified form incorporated into the LMRPM, contains a complex network of channels, passes, canals, and receiving basins and the impact of scale distortion in this setting is uncertain. In this presentation, we recap how numerical modeling has been used to help address and reduce this uncertainty. Further, we explore how the LMRPM is producing datasets that may be leveraged to generally improve our ability to numerically model the Mississippi River through improved calibration and validation.

The coastal Louisiana research community has produced an array of mature numerical models and numerically-derived datasets that have ready application to exploring and improving our understanding of the LMRPM capabilities. Many of these models were developed to support the Mississippi River Hydrodynamics and Delta Management Study and are currently being improved and archived, in an effort to make them more accessible to the research community, as part of the Lowermost Mississippi River Management Program.

The advantage of numerical modeling is that, as the modeling domain is virtual, the scale of the domain can be freely and systematically altered to isolate its individual effects, including that related to distortion. A disadvantage of numerical modeling is that the accuracy of the simulated physical processes is dependent on calibration, which is, in turn, dependent on the availability of observational datasets. Because observational datasets are typically capital and labor intensive to acquire, they generally cover limited geographic areas; thus, the LMRPM makes it possible to easily collect physically accurate, albeit 'distorted', data over its expansive domain and, once the impacts of the distortion are considered, be of use as numerical modeling calibration datasets. While scale distortion likely has significant impact on absolute values of hydrodynamic and sediment transport properties, general patterns of transport sources, sinks, and pathways may prove persistent through distortion. An objective of our work is to formalize a framework to compare LMRPM and numerical model output with each other to permit cross-calibration and to identify new insights on river processes that may not be perceptible from a single modeling methodology.

Travis Dahl, USACE-ERDC

Session 5

DESIGNING A REAL-TIME FORECASTING SYSTEM FOR NITROGEN AND SEDIMENT IN THE LOWERMOST MISSISSIPPI RIVER

The development of a Real-time forecasting (RTF) system for water, sediment, and nitrogen in the Lowermost Mississippi River would directly benefit the management of sediment diversion operations, as well as maintenance dredging operations in the navigation channel. Specifically, the model output could inform and guide the decision-making process for flood control structures and restoration projects. Such a system could also provide valuable information to prepare for and respond to riverine flood events. Estimates of the hypoxic zone development in the Gulf of Mexico may also be informed by the model outputs.

The U.S. Army Engineer Research and Development Center (ERDC) and collaborators are designing a RTF system driven by existing atmospheric models and meteorological forecasts. The RTF will provide a 7-day forecast for water discharge, sediment load, and nitrogen concentration. The team is evaluating existing real-time data sources along the Mississippi River, from Venice (Louisiana) to Memphis (Tennessee) to determine appropriate model boundaries. The need for additional data collection platforms and boat-based observations to provide necessary data to drive the model is also being assessed. The final system design will allow both semi-automated production of flow, sediment, and nitrogen forecasts on a daily basis and the use of the system for scenario evaluation.

Brendan Yuill, The Water Institute of the Gulf

Session 5
Multi-model investigation of sand transport patterns through the LMR

The bed and bars of the Lowermost Mississippi River predominately consists of medium to fine sand. Field observations over the last few decades suggest that the entrainment and transport of these sands are highly sensitive to discharge magnitude and source location within the channel, especially for sands that compose the large lateral bars that punctuate this river reach. This dynamism leads to uncertainty related to how these bars evolve through time (e.g., over the annual hydrograph) and serve as sources and sinks for sand traveling through the river channel at different time scales. Reducing this uncertainty will lead to better management of sand resources within the river, including the prediction of sand loads and sand recharge, either desired or undesired, at dredged channel locations.

This study consists of a numerical experiment where we simulate the transport of medium sand through a reach of the Lowermost Mississippi River channel. We record the source location of sand in the model, delineated in terms of relative position on a channel bar or the bed and depth below the bed surface, and trace the transport pathways and sinks for sand at each delineated source location. We identify how different sand sources become activated at different discharge magnitudes and differentially contribute to the downstream channel bed evolution. Evaluation of bulk transport fluxes through the study reach identify the dependence of individual bar sand dynamics on sand dynamics of proximal bars relative to the supply of sand into the channel reach. Results provide estimates of the distribution of sand transport/residence times through/in the study reach. Our results have implications for management of dredging and diversion operations in the Lowermost Mississippi River that require a relatively granular understanding of sand transport patterns both temporally and spatially. Additionally, our predicted bed material transport sources, sinks, and pathways have utility in the calibration of the Lower Mississippi River Physical Model, which is a novel scientific tool capable of investigating and visualizing the interconnectivity of flow and sediment throughout coastal Louisiana.

Thomas McLain, Coastal Protection and Restoration Authority

Session 8
IMPROVEMENTS AND INNOVATIONS IN MARSH CREATION DESIGN

As part of the Louisiana Coastal Protection Restoration Authority's (CPRA) mandate, the CPRA has oversight over all matters relating to the study, planning, engineering, design, construction, extension, improvement, repair, and regulation of integrated coastal protection projects and programs. For decades, the State of Louisiana has successfully designed and implemented marsh creation projects within the Louisiana Coastal Zone in an attempt to restore degrading coastal habitat, restore wetlands, and rebuild degraded land-bridges. The CPRA has utilized the expertise gained from the in-house design of marsh creation projects, and the experience from construction contractors, field engineers, scientists, engineering consultants, and others to improve and develop innovative approaches to the design and implementation of marsh creation projects within the Louisiana Coastal Zone. Streamlining and improving the design processes is critical since it is anticipated that as many as 15 marsh creation projects will be under construction in the next 3 years.

The overall goal of this session is to provide participants with the most current CPRA marsh creation design practices and methodologies. Topics to be discussed include data collection standards (geotechnical, geophysical, surveying), permitting, computation of marsh fill volume calculations, derivation of cut-to-fill ratios, cost estimating, marsh creation site vegetative plantings, and the use of instrumented settlement plates.

Rudolph Simoneaux, Coastal Protection and Restoration Authority

Session 8
HISTORICAL OVERVIEW OF PAST MARSH CREATION DESIGN AND CONSTRUCTION EFFORTS

Marsh Creation is defined as an ecosystem restoration strategy that establishes new wetlands in open water areas such as bays, ponds, and canals through hydraulic sediment dredging and placement. Over the past several decades, the Coastal Protection and Restoration Authority (CPRA) and its partnering agencies have planned, designed, and constructed more Marsh Creation projects than any other project type in the Coastal Master Plan. Furthermore, the latest version of the Coastal Master Plan includes more funding for Marsh Creation, over $18 billion, than any other restoration project type. In the spirit of adaptive management, it is critical that we properly analyze the data from past projects and apply that data to the current and upcoming projects.

All presentations in this session are dedicated to demonstrating how engineers, scientists, and construction personnel are taking the lessons-learned from past projects to improve and streamline the planning, design, and construction processes for Marsh Creation Projects. This presentation, which has a “the way things used to be” feel, will give attendees a perspective on how some of the first Marsh Creation projects were delivered, and how key projects elements and processes have evolved as the Louisiana’s restoration program has grown over the past two decades. The presentation will also provide an overview of several of the past benchmark Marsh Creation projects and a summary of their performance to date.

Kevin Roy, U.S. Fish and Wildlife Service

Session 8
PLANNING AND DEVELOPMENT OF MARSH CREATION PROJECTS

A broad range of considerations is factored into the conceptualization of marsh creation projects and in developing project goals and objectives. First and foremost is consistency with the Louisiana Coastal Master Plan which prioritizes restoration features and provides geographic boundaries for marsh creation. After 30 years of restoration in some programs (i.e., CWPPRA) and the emergence of multi-billion dollar funding sources (i.e., Deepwater Horizon Oil Spill) project/program synergies are also considered. Achieving project synergy is often a project goal and promotes benefits beyond project footprints.

Considerations to address marsh functionality include vegetative cover and percent inundation while historical wetland loss rates are examined to address need and longevity/sustainability. Feasibility of planning level concepts includes willing landowners, regional sediment management, cost and design implications of the borrow site location, dredge pipeline layout, oyster leases, oil/gas infrastructure, containment features, fill height as it relates to water depth, and elevation of the marsh platform. All are given considerable attention during the planning phase.

While these considerations are examined in much greater detail during formal engineering and design, the planning process involves a critical first look in the development of marsh creation projects.

Venu Tammineni, Adaptive Management and Engineering, LLC

Session 8
IMPROVEMENTS IN DREDGE SLURRY AND FILL MONITORING AND ANALYSIS

One of the primary missions of the Louisiana Coastal Protection and Restoration Authority (CPRA) is to restore thousands of acres of wetlands through hydraulic dredging and marsh creation. In order to achieve this mission, CPRA developed the "Marsh Creation Design Guidelines" (MCDG) which provide minimum standards for engineering design. The MCDG will continue to evolve as improvements are made to design methodologies and technologies.

The current contracting mechanisms utilized by CPRA require that the design and construction phases of marsh creation projects be siloed, therefore, assumptions made during design may not align with outcomes during construction. For example, the difference between the estimated verses constructed quantity of marsh fill has historically varied by an order of magnitude. This difference can be attributed to assumptions on the target fill elevation of the constructed marsh platform and settlement of the marsh fill and subgrade. The complexity of the process stems from numerous factors that influence the behavior of the dredge slurry and marsh fill including, but not limited to:

- Borrow material composition (sand, silt, clay, organics, shell etc.) and spatial distribution;
- Borrow material stress-history;
- Grain size distribution;
- Material properties;
- Size and performance of the hydraulic dredge;
- Conveyance distance;
- Duration of hydraulic dredging;
- Concentration of dredge slurry;
- Existing elevation of the marsh platform;

• Water and dredge slurry elevation;

• Geometry of the marsh creation area.

CPRA is striving to strengthen the relationship between the design and construction phases of marsh creation projects through the development and use of Instrumented Settlement Plates (ISPs). ISPs allow for real-time monitoring of the dredge slurry during placement such that construction can be adaptively managed, and outcomes are achieved as designed. The observations and data obtained from the ISPs can help optimize the performance of the dredging equipment used and improve our ability to meet the projects' goals and objectives. Additionally, post-construction monitoring of ISPs will allow past designs to be validated and future designs to be adjusted for optimal reliability.

David Lindquist, Coastal Protection and Restoration Authority

Session 9

HABITAT SUITABILITY MODELS FOR THE 2023 COASTAL MASTER PLAN

Habitat suitability index (HSI) models have a long history in water resource and restoration planning for describing the quality or capacity of habitats to support fish and wildlife species. HSI models consist of functions that relate key environmental variables to the quality or suitability of the habitat for a species. The individual relationships for each environmental (habitat) variable are called suitability indices (SI), which are derived using statistical analyses, literature, and professional judgment. The SIs are standardized to a 0 to 1 scale, with 0 defined as unsuitable and 1 defined as most suitable or optimum.

The Louisiana Coastal Master Plan has used species-specific HSIs for key fish and wildlife since 2012. As part of the modeling updates for the development of the 2023 Coastal Master Plan, several improvements were made to the existing HSIs, and new HSIs were developed for the bald eagle and seaside sparrow. The species-specific HSIs will be run within the Integrated Compartment Modeling (ICM) framework to evaluate how the coastal master plan projects affect species' habitat suitability across the coast. The HSIs will be run in each of the cells of the coastwide model grid, and will be differentially driven by monthly and annual habitat and environmental conditions generated by the ICM.

The HSIs that will be used for the 2023 Coastal Master Plan include the eastern oyster, brown shrimp, white shrimp, blue crab, crayfish, gulf menhaden, spotted seatrout, largemouth bass, American alligator, gadwall, mottled duck, seaside sparrow, brown pelican, and bald eagle. The HSIs for the eastern oyster, crayfish, alligator, ducks, and brown pelican were updated and adjusted based on recent data and literature. For fish, shrimp, and blue crab, the statistical-based water quality suitability indices used in the 2017 Coastal Master Plan were re-examined using generalized linear and additive modeling to describe how species catch varies with salinity and temperature in the Louisiana Department of Wildlife and Fisheries long-term seine and trawl data. For these same species, a meta-data analysis of over 40 field studies was performed to determine the relative suitability of marsh interior, marsh edge, submerged aquatic vegetation, shallow non-vegetated bottom, and oyster reef for supporting shrimp, crab and fish density. The new bald eagle HSI was adapted from the Audubon Society's boosted regression tree model, and a seaside sparrow HSI was developed based on marsh area, vegetation types, and elevation.

Eric White, Coastal Protection and Restoration Authority

Session 9
2023 Coastal Master Plan Integrated Compartment Model – Hydrology

A suite of individual modeling tools was developed for the 2012 Coastal Master Plan and integrated and improved for the 2017 Coastal Master Plan, resulting in the Integrated Compartment Model (ICM). The ICM is the primary analytical tool used to simulate water, salinity, and sediment dynamics throughout the coastal wetlands of Louisiana; other modeling tools are also used to assess habitat suitability, hurricane storm surge and waves, and flood risk. These simulated hydrologic and water quality dynamics are then used to provide inputs to vegetation and wetland elevation change models, which are used to examine possible scenarios of future wetland vegetation change and wetland loss or gain under a variety of future environmental conditions. Extensive application of the ICM for the 2017 Coastal Master Plan and subsequent studies resulted in the modeling team identifying several areas of improvement to be made to the hydrologic modeling components of the ICM.

The ICM-Hydro model subroutine discretizes coastal wetlands into idealized 'compartments' that include open water areas surrounded by a tidally-connected marsh component and, in some cases, upland area that is above the normal tidal range. The spatial resolution of this discretization routine underpins all other model processes in the ICM, and a concerted effort was undertaken to improve this aspect of the ICM for use in the 2023 Coastal Master Plan. This improved spatial resolution results in better representation of water level and salinity dynamics particularly in forested wetland areas of the model domain. Additional advancements are realized by better enforcement of topographically isolating features (e.g., canal spoil banks) as well as more refined representation of hydraulic control structures (e.g., culverts, pumps, gates).

The aforementioned discretization works well in marsh and open water areas; however, the geometric simplifications were least representative of channelized flow areas such as navigation channels, bayous, rivers, and canals. A 1D channel routing algorithm was added to the ICM to better represent these channelized flow regimes. All algorithms included in the original ICM-Hydro subroutine for simulating salinity and sediment dynamics were included in this new 1D channel algorithm.

This presentation will cover the procedures followed to implement these model updates as well as to present model outputs of water level, flow, and salinity results from the model calibration and validation exercise. Focus will be given to specific locations in the Eastern region (Breton and Barataria), the Central coast (Terrebonne and Atchafalaya), and the Western region (Mermentau and Calcasieu basins).

Christopher Esposito, The Water Institute of The Gulf

Session 11

RAPID CHANGES TO CONTROLS ON SEDIMENTATION IN A RIVER-DOMINATED MARSH

The seasonal regrowth of submerged and herbaceous vegetation is a primary control on the physical environment in deltaic marshes, driving both the connections with the channel and the transport environment on the marsh. The revegetation event and the spring flood are not synchronized in the same way each year, a fact that lends complexity to our understanding of delta geomorphology, and uncertainty to operation plans for diversions and managed marshes.

We used drone-photographed dye injections, hydroacoustic instrumentation, sediment traps, water samples, and monthly vegetation surveys to link the rapidly changing vegetation conditions throughout the spring flush with flow and velocity on the marsh, and monthly sediment deposition. Our data were collected in a freshwater marsh (dominated by Typha, Colocasia, and Alternanthera) in the Mississippi River Delta during the Mississippi River floods of 2018 and 2019. The 2019 flood is notable as a long event that kept water level and incoming flow conditions nearly constant, allowing observations to isolate changes resulting from the vegetated area.

This novel data set to documented profound changes in flow conditions and sediment deposition during the flood season. The growth of submerged aquatic vegetation (SAV) on the marsh during the late spring led to a dramatic decrease in flow as well as sedimentation on the marsh. This suggested that the most important consequence of SAV growth was to restrict sediment supply to the marsh. In the summer, when the SAV died off and was no longer present, flow velocity, sediment supply, and deposition all increased again. These results have immediate relevance to operation and optimization strategies for managed marshes and river diversions.

Kelin Hu, Tulane University

Session 11

Modeling the effect of Roseau Cane Dieback on navigation dredging in the mississippi river bird's foot delta

Roseau Cane (Phragmites australis) influences the distribution of water and sediment in the Mississippi River Delta. It confines flow through distributary passes and thus increases flow in navigation channels, which in turn may reduce navigation dredging. In the fall of 2016, wetland managers noticed that Roseau Cane was dying in the Bird's Foot Delta. By spring of 2017, the dieback was apparent to recreational fishers and then was noted in the popular press. Roseau Cane dieback is increasing open water rather than protecting desirable wildlife habitat. The purpose of this study is to determine if navigation dredging in the Bird's Foot Delta is resilient or sensitive to Roseau Cane dieback. Various degrees of Roseau Cane dieback lead to different levels of channel complexity. A series of idealized delta configurations with comparable spatial scales to the channels in the Bird's Foot Delta were designed to represent different extents of Roseau Cane. In addition, a simple complexity index was proposed to quantify topologic channel complexity. After that, we applied an open-sourced process-based model program, Delft3D-FLOW Flexible Mesh (D-FLOW FM), to each delta configuration for simulations of hydrodynamics, sediment transport and decadal morphological change under the forcing of riverine input and offshore tides. A scaling factor of 10 was adopted to speed up the morphological processes. After examining the modeled sedimentation results for various scenarios, it can be seen that delta configuration represented through topologic complexity affects the efficiency of conveying water and sediment through the distributary system to open water. Preliminary findings show that the increase of delta topologic complexity decreases channel sedimentation and thus might benefit navigation dredging. Physical processes (e.g., Coriolis forces, tides, wind, water hydrographs and sediment fractions), however, should be further explored to understand the system response to the presence of Roseau Cane.

Ehab Meselhe, Tulane University

Session 11

UTILIZING UPPER DIVERSIONS IN RIVER WATER MANAGEMENT CASE STUDY: 2019 MISSISSIPPI FLOOD EVENT

The flood of 2019 has shown us, through unprecedented levels and duration of high water, that rethinking the lowermost Mississippi River water management is crucial for building resilient coastal communities and better management of river floodwaters. The 2019 flood events have also revealed that utilizing only the Bonnet Carré Spillway as an outlet to manage unprecedented high water levels has led to multitudes of issues that have affected not only our state but also the states of Mississippi and Alabama. These include, among others, the reported decline in fisheries and oyster production from the freshening of Lake Pontchartrain, Lake Borgne and Mississippi Sound. An 'Unusual Mortality Event' for bottlenose dolphins, with yet to be known causes, has also been attributed to this event in the news. If more of that water had been released upriver of the Bonnet Carré Spillway, impacts of this magnitude may have been avoided or reduced.

The prolonged opening of Bonnet Carré (BC) spillway provides us with an opportunity to model and validate results based on the effects of 37.9 Billion cubic meters of fresh water that passed through the BC spillway in the 120 days it remained open. We have estimated the sediment carried by this discharge to be about 6.3 million Metric Tonnes. These numbers also highlight the missed opportunities of providing fresh water and sediment where they are actually needed – in the Maurepas Swamp, the Manchac Landbridge and upper Barataria Basin.

The 2017 Coastal Master Plan identified a number of freshwater and sediment diversions from the Mississippi River to support land building and wetland sustainability. These diversions have been proposed for their capacity to build land, reduce salinity, and change nutrient distribution. The upper river diversions, namely, Union, Ama, Manchac Land Bridge, have yet to be considered for feasibility analyses. These upper diversions may offer unique opportunities that are vital for better river water management and coastal restoration. The numerical model analysis we performed offers insights on the possibility of meeting the flood control targets while distributing floodwaters through the upper diversions. This proposed system might reduce negative ecological impacts associated with events similar to the 2019 flood while providing positive ecological benefits to degraded swamps, protecting populated areas from flooding, and providing reliable navigation activities.

Nan Walker, Louisiana State University

Session 11

SATELLITE REVIEW OF THE KINEMATICS AND FATE OF MISSISSIPPI RIVER FLOOD WATERS DURING THE 2019 FLOOD PERIOD

It is a curious fact that the Louisiana coastline receives more river sediments annually than any other state and yet, at the same time, suffers from the nation's highest land loss rates. Many causes have contributed to this fact including the construction of levees along the Mississippi River and other conveyance channels, the digging of oil & gas canals, storm erosion, salt water intrusion, and even shoreline erosion from boat wakes. Satellite surveillance of surface suspended sediments and chlorophyll a has become an operational tool that can assist scientists in the understanding of the motion, transport pathways and fate of river water, especially during major floods. Each NASA sensor in orbit such as the 2 operational MODIS (Moderate Resolution Imaging Spectroradiometer) sensors as well as the 2 VIIRS (Visible Infrared Imaging Radiometer Suite) sensors can provide imagery of the Louisiana coast on a quasi-daily basis, barring thick cloud cover or sunglint contamination. Daily activities at the LSU Earth Scan Laboratory (ESL) include the surveillance of the Louisiana coastal zone including its lakes, bays, continental shelf, and offshore areas including the Loop Current and its associated deep water eddies (www.esl.lsu.edu).

This talk focuses on the analysis and interpretation of time-series images from the MODIS and VIIRS sensors during the lengthy period of Mississippi River flooding from February through July in 2019. The motion, transport pathways and fate of river water discharged through the Bonnet Carre spillway into Lake Pontchartrain will receive close attention. The bio-geo-chemical characteristics of the shallow Mississippi shelf and the oyster areas along the west side of the Chandeleur-Breton Sound are potential areas of impact from flood waters. Widespread shelf hypoxia was measured in this region during the summer following the winter flood of 2016. Several field trips to Lake Pontchartrain were taken in winter 2016, spring 2018, and spring 2019 to collect surface water samples to enable determining inorganic sediment concentrations from satellite images. This methodology requires the near-simultaneous overpass of the chosen satellite sensor with water sample collection. A sequence of atmospheric correction steps were used to remove Rayleigh and Aerosol scattering contamination using NASA SeaDAS software before developing and applying the algorithm. Time-series of sediment concentrations, so determined, were evaluated and interpreted in tandem with images of chlorophyll a, since the pigment measurements enable tracking river water farther from its source. Wind and eddies were evaluated as major forcing factors for river water motion onto the shelf and into deep water.

Carolina Bourque, Louisiana Department of Wildlife and Fisheries

Session 13

CURRENT STATUS OF OYSTERS IN LOUISIANA AND A PATH FOR RECOVERY

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Louisiana's vast coastal wetlands provide ample habitat where Eastern oysters (Crassostrea virginica) thrive under a variety of environmental conditions. Louisiana has one of the largest oyster resources in the nation, supporting one of the state's largest and most valuable fisheries and providing important ecological services to the state. The Louisiana Department of Wildlife and Fisheries (LDWF) is charged with managing the state's oyster resource by monitoring, conserving,
and enhancing the size and health of oyster populations on nearly 1.7 million acres of public oyster
areas, as well as setting oyster seasons, monitoring harvest, and enhancing habitat. Historically, Louisiana's public oyster areas were a significant contributor to overall Louisiana oyster landings each year, while also supplying seed oysters transplanted to private leases for grow-out purposes. However, public area harvest has been decreasing since 2009, and only 2% of all oysters landed in Louisiana came from public areas in 2020. The most recent oyster stock assessment indicates public oyster areas are experiencing the lowest stock size ever recorded. This observed decline is not a result of any single event, but reflects the effects of a myriad of population stressors, including, but not limited to, changes in hydrology, extreme weather events, the Deepwater Horizon oil spill/response activities, harvest pressure, and the 2019 Mississippi River flooding event. Rehabilitation of this valuable economic and ecological resource is needed. LDWF is providing a path for recovery and maintenance of Louisiana's oyster resources, as well as assistance with industry adaptation and development, while reducing conflicts in the coastal zone through initiatives described in the Louisiana Oyster Management and Rehabilitation Strategic Plan. These initiatives require a bold commitment of implementation and funding in order to promote and maintain a thriving oyster resource and industry in Louisiana, and to allow for the most efficient utilization of coastal areas.

Presenter Bio: Carolina Bourque is currently the Oyster Program Manager at the Louisiana Department of Wildlife and Fisheries, and has been at this position since December of 2017. Prior to accepting the program manager position, she was a field biologist in a coastal study area that encompasses Vermilion Bay/Atchafalaya areas. She has also been active in studying reptiles, physiological ecology, and natural history work prior to LDWF.

Earl Melancon, Louisiana Sea Grant

Session 13

SALINITY AND HOW OYSTERMEN HAVE TRADITIONALLY RESPONDED TO IT'S STOCHASTIC, YET SOMEWHAT PREDICTABLE NATURE, IN MANAGING THEIR PRIVATE LEASE FISHERY IN BARATARIA BAY

This presentation will weave several prior studies into a portrait of how oystermen have traditionally managed their fishery in the Barataria estuary as it relates to changing salinity habitats. The first part of the presentation will identify the generalized oyster salinity habitats that exist within the Barataria estuary and how oystermen have traditionally used their knowledge to manage their natural and bedded reefs. Those reefs that have recurring natural populations that can survive to commercial harvest occupy a relatively narrow swath through the estuary and oystermen have learned how to strategize based on changing salinity patterns within that narrow zone, assuming that a spat set will occur each spring and fall. Farther down-estuary, where salinities are traditionally too high for natural survival to commercial size, the habitat has been used for bedding purposes, but with the lack of seed to bed and prohibitive expenses those leases are now mostly fallow.

Secondly, the presentation will focus on how lower salinity habitat that is still conducive to oyster recruitment and survival can potentially create conditions that allow hooked mussels to invade and infest a reef. Oystermen have traditionally relayed mussel-covered oysters to higher salinity to allow predators to feast and remove the mussels. This too has become a rare management strategy because of the expense involved.

Thirdly, the presentation will reflect on conversations with Barataria oystermen on how they have currently modified their strategies, and how they view their future fishery's status.

Rebecca Snedeker, Tulane University

Session 13
The Anthropocene in Louisiana

First coined in 2000, the term Anthropocene—or the "Age of Humankind"—is a useful concept recognizing the present era in which human-generated forces have dramatically altered the earth's surface, atmosphere, and planetary patterns. The Anthropocene Working Group, a group of scientists from several nations, is conducting and compiling stratigraphic research to forge a proposal to formalize the Anthropocene as a new geological epoch. While controversial, many theoreticians and researchers across disciplines have found the Anthropocene to be a useful framework for understanding local and global environmental change.

In November 2019, the New Orleans Center for the Gulf South hosted the 5th meeting of the Anthropocene Working Group and the Anthropocene River Campus, an immersive, interdisciplinary week-long gathering where participants experimented with new methods of knowledge production and public outreach. Anthropocene River Campus was the culmination of Mississippi. An Anthropocene River, a two-year study of the Mississippi River instigated by the Haus der Kulturen der Welt and the Max Planck Institute for the History of Science, Berlin as part of their world-wide project Anthropocene Curriculum. Over 200 people from Louisiana, upriver, and international perspectives participated in the Anthropocene River Campus, and the week included plenary talks and public programming, reports from five upriver Field Stations, and six 2-day seminars exploring themes that play out along the river.

Seminar themes included Commodity Flows, Clashing Temporalities, Un/Bounded Engineering and Evolutionary Stability, Risk/Equity, and Exhaustion and Imagination.

In this talk, Anthropocene River Campus local project director Rebecca Snedeker will address how engaging the Anthropocene framework and experiencing the Anthropocene Working Group meeting, Anthropocene River Campus, and River Journey canoe trip impacted her and others' understandings of the Mississippi River and Louisiana coastal conditions and how these systems relate to other river and coastal regions globally. She will also report on how designing and participating in these gatherings have impacted her and others' research methods and public outreach practices.

Lindsey Walsworth, HNTB

Session 13
Preservation Potential of Louisiana's 2017 Coastal Master Plan Restoration Projects and Historic Third System Forts

The Third System of American fortification was the first cohesive network of military protection for the United States. From 1816 to 1867, 42 all-masonry forts were built to protect America's major ports and coastal cities. New Orleans, highly valued due to its position at the mouth of the Mississippi River, received more protection than any other city: five forts and three subsidiary structures. Military technology of the time required that the forts be built in extreme coastal locations, often right at the water's edge. These locations have put the majority of America's Third System forts on the frontlines of climate change, with forts in Louisiana facing the highest rates of sea level rise, land subsidence, and storm damage in the nation.

With the ongoing loss of natural coastal buffers and the threat of stronger storms, Louisiana's forts are increasingly vulnerable to potentially devastating losses. In 2005, Forts Jackson, Macomb, and Pike were significantly damaged and one subsidiary structure, Tower Dupre, was entirely destroyed by a direct hit from Hurricane Katrina. It was the single most damaging event in the forts' nearly-200 year history. In the years since Katrina, each of the state's Third System forts has been impacted by hurricanes, tropical depressions, land loss, and water intrusion. Without significant investment in their preservation, Louisiana's forts will be lost.

In response to the unprecedented cultural, environmental, and financial losses that resulted from Hurricanes Katrina and Rita, the State of Louisiana created the Coastal Protection and Restoration Authority (CPRA) and tasked it with drafting the state's first Coastal Master Plan with the goal of "achieving a sustainable coast through the integration of coastal protection and restoration projects and programs based on the best science and engineering available." Since the inaugural 2007 Plan, two updated and expanded Plans have followed, each with a greater focus on coastal restoration. This presentation examines the potential of various 2017 Coastal Master Plan projects to protect and preserve Louisiana's Third System forts from the impacts of sea level rise, land subsidence, and storm damage. It shows that due to their locations outside the structural protection of levee improvements and floodgates, the forts' continued preservation is based almost entirely on the success of large-scale coastal restoration projects. Analysis is focused on which projects will be the most beneficial and which forts have the most potential for long term preservation.

Jeannette Dubinin, Center for Planning Excellence

Session 15
Advancing Community Adaptation: A Framework For Project Prioritization and Decision Making

Robust planning efforts are needed to ensure that Louisiana's people and its resources, both natural and cultural, have the proper conditions to thrive. Proactive planning and a holistic definition of resilience must be cornerstones in the state's framework for the future. Part of that framework is Louisiana's Comprehensive Master Plan for a Sustainable Coast. Led by the Coastal Protection and Restoration Authority, the Coastal Maser Plan recognizes that the state cannot stop land loss and eliminate flood risk entirely, but It can mitigate the worst impacts of it. The plan calls for a combination of structural protection and restoration projects, as well as the Flood Risk and Resilience Program to develop and implement nonstructural projects.

Louisiana has made great strides in developing the science and engineering of protection and restoration projects but nonstructural projects must be approached differently. While structural and restoration projects involved large engineering and design efforts, nonstructural projects take place within communities where social and community impacts of the projects are complex and require ongoing discussion of problem solving as conditions continue to change. It also requires that aspects and elements that make a community are taken into consideration during project development. To incorporate these aspects and elements and advance community adaptation, Center for Planning Excellence developed a framework for project prioritization and decision making.

As the Flood Risk and Resilience Program is being refined and nonstructural project are developed by local governments, the framework proposed here provides additional elements to expand the factors used to evaluate investment impacts of nonstructural projects. These elements take into account the particularities of community context and ongoing or planned projects that may affect community resilience. The framework defines the elements of both near-term and long-term resilience, acknowledging that meeting immediate community needs and planning for the future requires different decision-making processes and may entail different priorities.

Joni Hammons, Center for Planning Excellence

Session 15
PLANNING FOR COASTAL COMMUNITY RESILIENCE: A GUIDE

Coastal communities are dynamic. The natural, built, and socioeconomic environments all contribute to and influence community resilience. They comprise an interrelated system in which changes to one aspect of the community can and will impact the others. Understanding these changes and anticipating future changes is key to effectively using resources and leveraging efforts to improve community resilience over the long-term. Building resilience in these places will require a supportive cycle of assessment, planning, implementation, and evaluation. The Coastal Community Resilience Planning Guide is designed to enable coastal communities to envision what a changing climate means for their community and to lay the foundation for developing strategies to address emerging challenges.

Many federal and state agencies, academic institutions, and non-profit organizations have developed sea level rise, storm surge, and flood risk viewers that estimate current and future scenarios based on different climate change projections. However, planning with and guidance in using these tools to inform decision making is often left to local governments. This can be a challenge for smaller communities which often have limited resources to develop and implement climate change-related adaptation and mitigation plans, staff capacity, and a lack of expertise and experience with using available data to understand their vulnerabilities and the long-term impacts of climate change on their communities. Lacking this critical information undermines decision making and the ability to plan long-term. There is an immediate need to structure decision-making and land use planning around climate change projections in coastal jurisdictions.

This guide aims to bring good data and local knowledge together so communities can develop their own effective, relevant resilience plans. It is intended for use by local officials and government staff, community groups, and other stakeholders in incorporated and unincorporated coastal communities. Working through the assessment process outlined in the guide establishes a foundation for current and future conditions upon which a community resilience strategy can be formed. Establishing a climate-aware plan for future development and redevelopment enables a community to understand the opportunities and tradeoffs inherent in a changing climate, allows for a coordinated, planned response to disasters, and helps focus efforts and prioritize resilience strategies as funding becomes available.

Camille Manning-Broome, Center for Planning Excellence

Session 15
ADAPTING TO CLIMATE CHANGE IN LOUISIANA

According to the National Climate Assessment, increased temperatures, sea level rise, extreme heat events, hurricanes, and variable water availability have and will continue to impact the southeast United States. Louisiana has already experienced significant wetland loss and coastal erosion, which is leading to inundation of roads and facilities that deliver critical resources to the nation, the need for reconfiguration of ports, harbors, and roads, and notable population shifts away from coastal communities. Looking to the future, these impacts will worsen as global average projections for sea level rise range from 20 to 80 cm by 2100 (Church et al., 2011). In Louisiana approximately 2 million people live and work in coastal areas, contributing to the state's and national economy. There is a clear need for coastal populations and state government to plan for a future with higher seas and increased risk to life, property, and infrastructure.

As a first step, CPEX brought together residents from three communities in south Louisiana facing different risk levels and land loss projections to uncover key challenges and explore options that can lead to resilience via adaptation. During the Rising Above Symposium, the community experience that was shared revealed that state agency programs and policies are not agile and proactive enough to meet the growing and diverse needs of communities affected by land loss and climate change. Following up on these findings and to carry out an action item developed during the Rising Above Symposium, CPEX conducted interviews and research on Louisiana's current system of governance at the state level and its ability to make progress towards climate change adaptation. All of our findings indicate that only CPRA is planning for the future of Louisiana's environment and thus economy; that state agencies look to CPRA to "solve" all the problems of the coastal crisis; that all state agencies are impacted by coastal erosion and land loss; and that agencies are not proactively planning for the impacts of climate change on their assets, programs and target populations. They are currently not able to adapt to the changing needs of coastal and inland communities and address the multiple threats of climate change, land loss, and growing disparities.

To further understand our findings and begin to explore possible solutions, CPEX designed the State Agency Resilience Workshop to engage top staff from each state agency over the course of two days of facilitated activities that resulted in a shared understanding of the full breadth, depth, and complexity of the coastal crisis and the implications for each of their agencies and the populations they serve. The latter part of the workshop engaged participants in developing strategies and priorities for transitioning to the collaborative, data-driven governance model needed to provide a comprehensive approach to land loss and climate change. The workshop garnered consensus among top state leadership that available climate change data needs to be incorporated into agencies' decision-making and program and policy development, and coordination of all agencies' efforts is required to adequately address the breadth and depth of the coastal challenges and to ensure that the Coastal Master Plan achieves the desired results. Participants also came to a shared understanding that all agencies' work will be directly and indirectly impacted by land loss and climate change.

Charles Sutcliffe, Governor's Office

Session 15
Current State Efforts towards Adaptation and Resilience

Over the past several years there has been a growing realization that Louisiana's coastal change has much broader consequences than the Coastal Master Plan and sporadic, post-disaster resilience funding can address. Given the magnitude and urgency of the needs and the scarcity of resources, every available dollar and effort must be leveraged to holistically address coastal changes and impacts. To that end, the administration created the Chief Resilience Officer position to facilitate the coordination of agencies and collectively identify pathways and structures through which available coastal change data can be incorporated and used to update and develop programs and policies that will continue to serve the residents of Louisiana. Specifically, over the next 18 months, this work includes the evaluation of agencies programs, policies, and operations to further understand how coastal change is impacting the assets and services state agencies provide, identifies the gaps and opportunities to leverage efforts and resources, works with agencies' representatives to develop catalytic projects, and develops a framework to institutionalize a collaborative, comprehensive, and proactive approach to continue to provide the services the state provides for Louisiana's economy, environment, and communities.

Rick Johnson, Entergy

Session 16
CLIMATE CHANGE COASTAL IMPACT MITIGATION: ENTERGY'S EFFORTS TO DECARBONIZE THE GULF SOUTH ECONOMY AND ADDRESS WETLANDS LOSS

Some of the territories and communities in which Entergy operates face significant physical risks as the result of increases in global average temperature. While various impacts are predicted throughout the company's service territory, they are especially pronounced in coastal Louisiana and Texas. These risks generally include wetlands loss, sea level rise and coastal erosion/land loss and the risk of increased damage from tropical weather systems to territory along the Gulf Coast. Businesses in the Gulf Coast region are increasingly motivated to reduce carbon emissions because the coastal area is uniquely vulnerable to the physical risks posed by climate change. Stakeholders also are increasingly interested in how business and industry will respond to these challenges.

Mitigation of these physical risks can be achieved through carbon emission reduction efforts. Various industry group and think tank studies find that decarbonization of the economy requires collaboration across and between sectors. Entergy Corporation and the US Business Council for Sustainable Development invited businesses from a wide range of sectors to create the Gulf Coast Carbon Collaborative, a cross-sector platform aimed at reducing the region's carbon emissions using all solutions, including natural solutions to restore coastal wetlands that absorb carbon.

Challenges to the reduction of carbon emissions include access to technology, information and capital to fund change. This ongoing cross-sector collaboration structure specific to our region will address these challenges and empower managers and decision-makers to create strategies through shared experiences that will help protect regional assets and economic opportunity.

Establishing and supporting this collaborative is part of Entergy's long-term commitment to the sustainability of its communities and operations. Entergy leaders understand that the company's growth potential depends on the health and sustainability of the four-state area it serves. This region offers a rare combination of resources: a business-friendly, central U.S. location with direct access to raw materials and markets; an expansive infrastructure; and a skilled, affordable workforce. Entergy intends to reduce the overall carbon emissions from and impacts to its region and help businesses thrive in a responsible, sustainable way. Other energy utilities and solution providers in the region are participating and invited to participate.

The US BCSD is an action-oriented and member-led nonprofit business association, founded in 1992, to give leading US businesses a shared space to design, implement and scale sustainability solutions. US BCSD collaboration platforms provide ongoing venues for stakeholders to act together on issues of common concern.

Karly Kyzar, Louisiana Sea Grant

Session 16
LEGAL CONSIDERATIONS FOR BLUE CARBON

Demand for blue carbon credits will likely increase into the future, and the high cost of coastal restoration is often a barrier to private landowners conducting blue carbon projects on their property. State funding could serve to fill the need for carbon credits from blue carbon projects and serve as a potential funding stream to increase the capabilities of the state to engage in needed – but expensive – actions, such as long-term monitoring of projects. For example, a significant funding stream is the BP settlement, and it may be possible to leverage some of those funds for carbon credit projects, maximizing the benefits gained from the restoration.

Louisiana Sea Grant is working with Tierra Foundation on a research project aimed at examining the legal considerations encountered when utilizing restoration funding for the development of blue carbon projects. This presentation will examine preliminary research findings related to several questions, including: what sources of restoration funding can be leveraged for the development of projects that would meet eligibility requirements in the carbon market, what considerations should be given when drafting landowner agreements, and what concerns are there to related to long-term monitoring, maintenance, and liability.

Robert Lane, Comite Resources

Session 16

THE WORLDS FIRST WETLAND CARBON PROJECT

Wetlands were first introduced to carbon markets in 2012 when the American Carbon Registry (ACR) certified the methodology, Restoration of Degraded Deltaic Wetlands of the Mississippi Delta, which was developed by Tierra Resources to transact wetland carbon credits derived from wetland restoration. The ACR methodology, Restoration of Degraded Deltaic Wetlands of the Mississippi Delta, provides a rigorous scientific framework for project development and aims to give offset credit for a wide range of restoration techniques including hydrologic management as well as reforestation with a variety of species. The methodology addresses each aspect of the project from establishing a baseline, monitoring of eligible carbon pools, and estimating carbon offsets that can be transacted as carbon credits.

The first wetland restoration carbon credit pilot project, located in St. Charles Parish approximately 19 miles from New Orleans, was launched in 2012. This was the first wetland offset pilot project to demonstrate a public private partnership that leverages carbon finance. The objective of this pilot project was to deliver a proof-of-concept carbon offset project at the wetlands near Luling, Louisiana, to address science gaps, “road test” the developed methodology, determine costs, benefits, and barriers to implementation, identify cost-saving measures, and potentially produce commercially viable offsets. The presentation will provide a detailed description of project results including monitoring efforts, carbon modeling, carbon quantification, challenges and lessons learned. This project was recently third-party verified and is anticipated to be the first wetland restoration carbon offset project to be transacted globally. Transacting the first wetland restoration carbon project opens the door to wetland carbon finance. The results will inform managers and developers on how to develop wetland carbon credits that are compliance eligible, and scientifically defensible.

Sarah Mack, Tierra Foundation

Session 16
Status and Challenges of Wetlands in Carbon Markets

Global, national, regional and state-level governmental participation in the stabilization of atmospheric greenhouse gases has facilitated several emissions trading market initiatives. Wetland restoration techniques have proven to be effective climate change mitigation strategies that promote enhanced carbon sequestration via increased vegetative productivity and carbon burial, as well as avoided carbon release when wetlands are lost. A carbon market that facilitates financial investment into wetland restoration can potentially create offsets that provide a wealth of co-benefits such as storm surge reduction, fish and wildlife habitat, recreation, job creation, and economic development that are vital to the sustainability of coastal Louisiana.

Wetlands were first introduced to carbon markets in 2012. To-date the only wetland carbon projects that have transacted globally were a handful of projects that are classified under forestry. The world's first sectoral carbon market that will apply to all international air travel will be launching in 2020. With an increasing focus on nature-based solutions to climate change there has never been a more important time to prove wetlands viability in carbon markets.

This presentation will provide an update on regulatory and voluntary emissions trading markets with an emphasis on wetland carbon offset development. International market trends, emerging new markets, and evolving industry commitments will also be explored. Louisiana's wetlands will be discussed within the broader context of the opportunities and challenges that wetlands face within current carbon markets. Findings from the Luling Wetland Carbon Pilot that has recently been third-party verified and is awaiting transaction as the first wetland restoration carbon offsets globally will be detailed.

Sam Martin, Coastal Protection and Restoration Authority

Session 17
2024 Coastal Master Plan Risk Assessment – Community Outreach Plans

The impacts of coastal land loss and increased storm surge-based flood risk in Louisiana present a shared challenge, and opportunity, that has the potential to affect communities and individuals in Louisiana for generations into the future. As part of the 2023 Coastal Master Plan outreach and engagement efforts, CPRA recognizes that in order to be successful we need to incorporate local knowledge and priorities into our planning process. This effort involves multiple levels of engagement, including development of a Community Engagement Workgroup and planning for public outreach efforts that focus on articulating a vision for the future of coastal Louisiana that is relatable to Louisianans. At each level of engagement, CPRA will focus on incorporating community priorities and concerns, facilitating an increased understanding of future risk, improving the clarity and utility of model outputs, and being a resource to support the use of master plan data for informed decision-making by communities and individual citizens. This presentation will focus on CPRA's current community-based outreach efforts for the 2023 Coastal Master Plan, how community leaders are informing both the planning and outreach efforts, and other shifts in outreach methods since the 2017 Coastal Master Plan.

Zachary Cobell, The Water Institute of the Gulf

Session 17
Storm Surge and Wave Model Updates for the 2023 Coastal Master Plan

Prior to conducting the storm surge modeling for the 2023 Coastal Master Plan, two important initiatives have been undertaken as part of the model improvements process.

Historically, multiple parameterizations have been proposed to represent the interaction of air-sea drag and bottom friction within the ADCIRC model. Different values have been used for FEMA studies, the Coastal Master Plan analyses, and engineering and design work. Recent studies have shown that though some parameterization schemes have demonstrated high model skill in certain respects, they have the potential to dampen certain physical processes in the model. Likewise, some parameterizations best capture the appropriate processes for tropical events but are not applicable for non-tropical events and limit the useful range of conditions the hydrodynamic model can reliably predict. A team consisting of scientists from The Water Institute of the Gulf and United States Army Corps of Engineers have developed a storm surge validation suite consisting of eight events, including major storms like Hurricane Katrina and less intense events like Hurricane Nate. The goal of this work is to determine a broadly applicable set of model parameters for use in Louisiana ADCIRC modeling, including but not exclusive to modeling for the 2023 Coastal Master Plan. Preliminary recommendations from this work will be shown.

Second, an updated suite of synthetic hurricane events has been developed in cooperation between the Coastal Protection and Restoration Authority and United States Army Corps of Engineers. This suite of storms will account for new events in the historical record since the original synthetic storm suite was developed in 2007. These storms can be used to evaluate annual exceedance probability flood elevations between the 10% (10-year) and 0.01% (10,000-year) events. Details on the updated storm suite and its upcoming applications in Louisiana-based studies will be shown.

Nathan Geldner, Purdue University

Session 17
2023 COASTAL MASTER PLAN – RISK ASSESSMENT: SOCIAL VULNERABILITY AND OTHER METRICS

In the 2012 and 2017 Coastal Master Plans, storm surge-based flood risk reduction projects were evaluated and selected primarily on the basis of cost effectiveness, represented by the reduction in expected annual damage (EAD) per dollar of cost of a project. Cost effectiveness was explored over a range of uncertain environmental and planning conditions, such as sea level rise, subsidence, economic growth rate, and project costs. The planning process did not explicitly include analysis of how different populations might be impacted by planned projects based upon socio-demographic and economic differences.

However, there is a large and growing literature studying the relationships between socioeconomic factors, race and ethnicity, and social vulnerability to environmental hazards that suggests low-income or underrepresented communities have historically faced a disproportionate share of risk. For the 2023 Coastal Master Plan effort, additional data-driven metrics of social vulnerability are being considered for assessing and communicating outputs of risk assessment analyses (e.g., identifying economic risk to socially vulnerable subpopulations, determining the number of people or households living within the 100-year floodplain, etc.). In this talk, we will describe recommendations for metrics addressing social vulnerability with regard to geographic and economic variations across coastal Louisiana.

Kevin Conrad, Ochsner Health Systems

Session 18

DEEP WATER HORIZEN OIL SPILL: AN UPDATE ON THE LONG TERM HUMAN HEALTH CONSEQUENCES FOR RESIDENTS OF COASTAL LOUISIANA

Kevin Conrad, M.D.MBA

Perhaps the greatest danger of an oil spill on human health is the long term affects, an area that has not adequately been studied. Oil spills pose many theoretical dangers but none that have been definitively identified through epidemiological studies. The magnitude, confined locality, and aggressive response to the Deep Water Horizon spill created a unique opportunity to examine the long term impact of oil spills in oceans on human health.

With this in mind several long term studies have been undertaken. This talk will present the data from these ongoing studies as well as the timetable for their completion. These studies are the most extensive studies to date on the long term affects of oil spill exposure.

This includes the 2010 The National Institute of Health (NIH) Gulf Long Term Follow Up Study (GuLF) study. This study follows the health of workers and volunteers who responded to the 2010 Deepwater Horizon oil spill in the Gulf of Mexico. This is the largest study to date in this field.

The GuLF study has and will examine over an extended period how the health of people involved in different aspects of oil-spill response and cleanup may be affected. The study is examining not only physical health but also mental health and social factors such as job loss. The study will compare workers doing specific clean up jobs to others who did not do those jobs. The first follow-up by the NIH was carried out from 2013 to 2016.

A 2011 study, looking at Florida and Alabama communities will be presented as well. This study focused on health care disparities as a key factor in the human health response to oil spills.

Presenter Bio: Dr. Conrad serve as Medical Director of Community affairs and Health Policy at Ochsner Health systems in New Orleans. His research interests include socioeconomic determinants of health and health care disparities.

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Jakevia Green, Institute of Women & Ethnic Studies, UNO

Session 18

CARING FOR THOSE WHO CARE FOR US: EXAMINING MENTAL AND EMOTIONAL IMPACTS OF THE COVID-19 PANDEMIC ON ESSENTIAL WORKERS

The COVID-19 pandemic has ravaged the New Orleans metropolitan area and exacerbated elevated levels of psychological and emotional distress attributable to repeated environmental disasters experienced by the Gulf Coast region. At the forefront of the present global public health crisis and other emergencies are frontline workers who perform their jobs despite worry, risk of harm, and their own suffering. Recognizing that frontline workers experience a range of mental and emotional challenges that place them at risk for unfavorable mental health outcomes if unaddressed, the Institute of Women & Ethnic Studies (IWES) has developed a questionnaire to assess the impacts of COVID-19 on conditions at work and home, securing personal health care and care for family, perceptions of risk of contracting or transmitting the virus, perspectives on workplace safety, personal resilience, and symptoms of common mental health disorders--anxiety, depression, and post-traumatic stress disorder (PTSD).

Data collection for the IWES Mental and Emotional Wellness Screener for Essential Workers is ongoing, however this descriptive, cross-sectional study examines results from a subset of screeners completed between October 2020 and March 2021 by people working in education (n=180). Teachers and other school personnel have played especially critical roles in reducing harm to children and supporting families while enduring their own stress, anxiety, and trauma amid the pandemic. Survey respondents working in education cite increased stress, worry, and burden with having had to very quickly adapt in-person engagement to completely virtual or to a hybrid of in-person and virtual engagement with students and families while also managing fear and concern of potentially contracting or transmitting the coronavirus. Symptoms of anxiety, depression, PTSD were endorsed by 23.9%, 26.1%, and 23.3% of the sample population, respectively. In effort to bring about data-driven, trauma-informed, and holistic multi-tiered systems of support in schools that not only address students' needs but the needs of those who engage them, IWES uses findings from the essential worker screener to inform the development of tailored trauma-informed support for educators, helping them to enhance their professional effectiveness by building resilience and deepening self-care.

Adrienne Katner, LSUHSC

Session 18

IDENTIFYING AND ADDRESSING DRINKING WATER CHALLENGES IN WELL-RELIANT COMMUNITIES AFTER NATURAL DISASTERS: LESSONS FROM A LOUISIANA FLOOD

The summer 2016 flood in Louisiana marked the second 500-year flood in the state in one year. In addition to the extensive structural damage to community water systems, private drinking water wells were submerged under several feet of contaminated surface water for days to weeks. While extensive support is provided to communities on public water systems in the aftermath of a disaster, well-reliant communities are solely responsible for ensuring the safety of their water. The aims of this study were to evaluate private well user preparedness and recovery, and to develop disaster planning and recovery recommendations for flood-prone well-reliant communities. A convenience sample of flood-impacted well owners was surveyed and offered free well water testing, nine to ten weeks after flood waters subsided. Surveys and water test kits were distributed at road-side flood response and recovery stations in French Settlement, Livingston Parish, Louisiana, an area at the epicenter of the flood-impacted area. Surveys collected information to characterize knowledge gaps, risk perceptions, flood impacts, resource accessibility, and well maintenance barriers; while well water tests evaluated total coliform and E. coli (n=106). Surveyed well owners indicated a need for information on well testing labs (90%), water contamination (77%), and water treatment (78%). Of the survey respondents with flooded wells (n=75), one-third resided in low flood risk zones, indicating a need for improved risk determinations. After the flood, over half (57%) of flood-impacted well users (n=75) continued consuming well water after the flood; yet, 26% had water which tested positive for total coliforms. Of well users who resumed well water consumption (n=43), 69% disinfected their water, but microbial testing results suggest that even after disinfection, microbes can regrow or re-enter wells. When asked about well depth, over one-third of well-reliant participants did not know their well depth, a necessary component of proper well water disinfection. Thus, disinfection methods are either insufficient, will not work due to well system failures, or are conducted incorrectly. Results suggest that well owners lack the technical knowledge, means, resources, or motivation to protect well water and treat water adequately after floods. Given that at least 13% of Louisiana residents rely on private wells, the evidence suggests that such disasters may exacerbate health disparities in rural, low-income well-reliant communities. Recommendations are made to enhance emergency response communications, and to improve well water surveillance. As the likelihood that more frequent and severe flooding events will increase, government officials need to update and enhance technical resources, and provide well user training to facilitate well user preparedness, self-reliance and resilience.

Kim Mosby, Louisiana State University

Session 18

FRAMEWORKS OF RECOVERY: HEALTH CAUGHT AT THE INTERSECTION OF HOUSING, EDUCATION, AND EMPLOYMENT OPPORTUNITIES AFTER HURRICANE KATRINA

Experiencing disasters and traumatic events oftentimes affects mental and behavioral health. Some individuals may view themselves as more resilient after a disaster if they develop skills or knowledge that increases their ability to cope during stressful times. Other individuals struggle with negative mental health outcomes after living through disaster-related trauma. Research suggests that rates of mental disorders, such as anxiety, depression, and post-traumatic stress disorder (PTSD), rise after a disaster but return to normal within a year or two. Studies on Hurricane Katrina, which struck New Orleans, Louisiana, in 2005, found mental health disorders remained elevated instead of returning to pre-storm levels within a few years after the storm. However, these studies did not examine longitudinal mental and emotional health in long-term displacement in light of recovery policies that permanently changed housing, education, employment, and healthcare options in New Orleans after Hurricane Katrina.

This longitudinal study uses qualitative interviews and a content analysis of Times-Picayune and New York Times news articles to explore the impact of recovery policy on mental health as framed by African Americans displaced from New Orleans, by the 2005 federal levee failure and Hurricane Katrina. The findings show both residents and the media framed post-Katrina policy change as compounding resident vulnerability by restricting access to resources. These policy decisions exacerbated the negative mental and emotional outcomes with many participants continuing to report struggling with depression, anxiety, and PTSD nearly 15 years after Hurricane Katrina. Participants framed their mental health as caught in the intersection of policy changes that reshaped housing, education, and employment opportunities in post-Katrina New Orleans. Meeting their needs amidst the changing landscape increased their stress, which deteriorated their mental health. In order to improve behavioral health outcomes following future disasters, several recommendations are suggested. These recommendations include: keeping families and social networks intact during response and recovery, offering mental healthcare services for several years after a disaster in locations where people typically gather, and providing home healthcare assistance for those that experience extreme negative consequences.

Diana Di Leonardo, The Water Institute of the Gulf

Session 19

ROLE OF NEOTECTONICS IN MISSISSIPPI RIVER DELTA PLAIN EVOLUTION AND IMPLICATIONS FOR MANAGEMENT: UPDATE FROM EXPERT PANEL WORKSHOPS

The Water Institute of the Gulf, with the Louisiana Coastal Protection and Restoration Authority (CPRA), has assembled an expert panel that is charged with reviewing the role of active tectonics in Louisiana's coastal zone. Three panel workshops provide a forum for the open discussion of neotectonics and its potential impacts on the management of coastal natural resources at the planning timescale. This effort will attempt to better understand the relative contribution of the various drivers of subsidence in Louisiana.

The panel consists of 3 experts charged with weighing the data, interpretations, and conclusions presented to them by regional scientists. The experts making up the panel are John Anderson, Elizabeth Hajek, and David Mohrig. Their extensive expertise includes the study of sedimentology, marine geology, quantitative stratigraphy, sedimentary basin analysis, seismic interpretation, deltas, coastlines, and geohazards. After the three workshops, the panelists will author a white paper of findings and recommendations to be available to restoration planning, monitoring, and adaptive management efforts. The white paper will address questions such as:

-What are the risks (temporally and spatially) to coastal Louisiana related to subsidence and neotectonics?

-Are the risks accounted for in existing 50-year coastal management plans?

-What is the likelihood, if any, of negative impacts due to projects by type (i.e., marsh creation is fundamentally different than infrastructure projects)?

-What are the recommendations from the panel for future research and planning?

During the first workshop the panel heard from four local experts: Briana Lezina, Division Chief of Planning and Research at CPRA; Torbjörn Törnqvist, geology professor at Tulane University; Bryan Stephens, Geologist with the Bureau of Ocean Energy Management; and Mark Kulp, geology professor at the University of New Orleans. The topics discussed included incorporation of geoscience into the coastal program, the different components of subsidence in Louisiana, the deep-seated geology of Louisiana and its effect on subsidence, and ongoing investigations in Louisiana fault systems. The second workshop will be held in early March and will focus on the research in Louisiana into rates of fault related subsidence. The third workshop will likely be held later in the spring, and the final white paper is expected in the fall.

Trung Do, University of Louisiana at Lafayette

Session 19

FRAGILITY METHODOLOGY FOR FLOOD RISK AND LOSS ASSESSMENT UNDER FUTURE CLIMATE PROJECTIONS– A CASE STUDY IN THE VERMILION RIVER WATERSHED

Recent research indicates that damage to coastal communities is anticipated to increase due to climate change and the expected sea-level rise. In 2016, an extreme rainstorm event developed across south Louisiana and flooded about 5,000 residential structures located within the Vermilion Watershed, with 51% of these structures located outside the FEMA-designated Special Flood Hazard Areas. This study proposes a new methodology for flood loss assessment based on the component fragility model. The assessment classifies the flooded buildings into independent components and assign each component to predefined damage states corresponding to the percentage of loss due to flood, thus obtaining the intermediate damage states fragilities. The study uses a high-resolution hybrid 1D/2D hydrodynamic model developed and calibrated for the Vermilion river system to produce the hydraulic simulations required for performing the loss assessment. Detailed flood inundation maps for the study region were developed based on topographic information derived from bathometric surveys integrated with 5-m resolution LIDAR data and the hydrodynamic model results. The model is first used to simulate the 2016 event as a test case, and is then extended to include several future-projected scenarios of sea-level rise in the Gulf of Mexico. Loss assessment in the Vermilion Watershed was conducted by integrating the spatial building fragilities with the flood elevation and risk maps. This effort provides useful information that can help homeowners estimate the degree of damage caused by different flood scenarios to their properties and develop structural and non-structural flood mitigation strategies. The study also supports the Louisiana Coastal Master Plan efforts through providing enhanced multi-criteria flood risk maps for focusing and refining the coastwide strategies and enhancing resiliency for coastal communities.

Mikaela Meyer, Carnegie Mellon University

Session 19

Analyzing the Variability of Best-Estimate Coastal Flood Depth Return Periods in Louisiana

Estimates of surge-based flood depth exceedance curves are useful to inform coastal flood risk management strategies. Return period estimates associated with flood depth exceedances naturally vary over time, even under assumptions of stationarity. This variability is due to the irreducible randomness associated with storm events as new observations accrue with each passing year. We empirically examine the degree to which best-estimates of coastal Louisiana floodplains have changed over time and consider implications for risk management policies. We generate annual variation in estimated 100-year flood depths by truncating a historical data set of observed tropical cyclones to end in years ranging from 1980 to 2016. Then, we utilize three procedures for updating various inputs to an existing flood risk model, the Coastal Louisiana Risk Assessment (CLARA) model, using the truncated data set to identify which factors are most important in driving variation in risk estimates over time. The landscape used for modeling hydrodynamics is held constant, allowing us to isolate the impacts of randomness in storm occurrence from other factors. Our findings indicate substantial expansion in the 100-year floodplain extent in populated areas attributable to these effects. Due to this growth, and the low frequency at which flood maps are updated, it is possible that thousands of coastal residents are misclassified as being outside of the 100-year floodplain relevant to flood insurance rates and other regulations.

Jingya Wang, Purdue University

Session 19

AN EFFICIENT MODEL TO INFORM RISK-BASED LEVEE DESIGN STANDARDS

Design standards for structural flood protection systems, such as levees and floodwalls, treat all points along a levee centerline independently. The design heights of protection features are set at each point based on estimating surge and wave exceedances; most commonly, features are elevated so that only a negligible volume of water would overtop the system from a “100-year” surge event (i.e., the surge level with a 1-in-100 chance of occurring in any given year). However, this practice of basing design heights on the probability of experiencing surge along the system boundary, ignores the residual risk on the system interior. It is possible for a ring levee system with 100-year design heights to have a greater than 1-in-100 chance of experiencing flooding on the interior. Achieving a desired level of protection requires us to account for spatial relationships and interior system dynamics; we cannot identify risk-based design standards by treating points on the system boundary independently, posing a difficult computational challenge.

We present a new, computationally-efficient model of surge-based flood risk suitable for enabling risk-based design standards. Our model is a simplified, but well-calibrated, representation of the Larose to Golden Meadow Hurricane Protection Project, a ring levee and floodwall system in Lafourche Parish. This new model is based upon the Coastal Louisiana Risk Assessment model (CLARA) used by Louisiana’s Coastal Master Plan.

Flood depth and damage exceedances, as well as the expected annual damage, are calculated under a large set of uncertain future scenarios. The model’s flexibility and high speed allow us to evaluate interior risk for any combination of reach heights. As a result, risk-based design standards, which simultaneously minimize the cost of upgrading the system and the expected residual flood losses, can be developed under different future scenarios. At the same time, the surge-based flood risk and the expected annual damage (EAD) in varying future scenarios can be evaluated more quickly and minimized accordingly.

In this presentation, we will talk about the main structure and components of this new model, the updated assumptions made along the whole process, the improvement of mathematical sub models, the development of risk-based levee design heights and also the overall results and estimation of the flood risk in the specific area. This new light-weight model can be adapted to other locations to minimize the flood risk in a ring levee system and make decisions about risk-informed, optimal design standards.

Jeffrey Danielson, U.S. Geological Survey

Session 20

THE USGS COASTAL NATIONAL ELEVATION DATABASE (CONED): INTEGRATED TOPOBATHYMETRIC MODEL FOR THE NORTHERN GULF OF MEXICO (NGOM2)

The USGS Coastal National Elevation Database (CoNED) Applications Project develops enhanced topographic (land elevation) and bathymetric (water depth) datasets that serve as valuable resources for coastal hazards research. These datasets are used widely for mapping inundation zones from riverine flood events, hurricanes, and sea-level rise and for other Earth science applications, such as sediment transport, erosion, and storm impact models. As part of the vision for a 3D Nation, the CoNED Project is working collaboratively with the USGS National Geospatial Program, the National Oceanic and Atmospheric Administration, and the U.S. Army Corps of Engineers through the Interagency Working Group on Ocean and Coastal Mapping to build integrated elevation models in the coastal zone by assimilating the land surface topography with littoral zone and continental shelf bathymetry. The CoNED methodology improves and implements techniques for the integration of coastal topobathymetric mapping data, such as with land water masking algorithms and complex geospatial multitemporal frameworks. In partnership with Louisiana Coastal Protection and Restoration Authority (CPRA), a 1-meter topobathymetric digital elevation model (TBDEM) is being developed for the Northern Gulf of Mexico (NGOM2) that will support regional storm surge and flood risk modeling. This new TBDEM incorporates many new high-resolution data sources, such as USACE eHydro navigation channel bathymetry, LA CPRA bathymetry in swamps and back bays, NOAA offshore bathymetry, and finally updated topography (lidar) data from the 3D Elevation Program (3DEP) for the coastal zone of NGOM2.

Chris Massey, US Army Eng. Research & Development Center

Session 20

AN OVERVIEW OF ERDC'S COASTAL STORM MODELING SYSTEM, CSTORM, AS APPLIED TO THE COAST OF LOUISIANA FOR COMPUTING ANNUAL EXCEEDANCE PROBABILITIES FOR STORM WATER LEVELS AND WAVE HEIGHTS

The U.S. Army Corps of Engineers Engineer Research and Development Center's Coastal Storm Modeling System (CSTORM-MS) is a system of highly-skilled, highly-resolved numerical models integrated in a comprehensive workflow used to simulate coastal storm surge and waves in order to accurately assess flood risk to coastal communities. The CSTORM-MS makes use of nonlinear physics-based models and high performance computing (HPC) systems to support a wide range of coastal engineering needs for simulating tropical and extratropical storm wind, wave and water levels and for representing the coastal response due to the storms. The CSTORM-MS has been applied to several large-scale USACE projects including the North Atlantic Coast Comprehensive Study (NACCS) in 2015, the Coastal Texas Comprehensive Study (CTXCS) in 2018 and is now being applied to the South Atlantic Coastal Study (SACS) and for the State of Louisiana in direct support of the Lowermost Mississippi River Program for the Louisiana Coastal Protection and Restoration Authority (LACPRA).

This presentation describes the current state of practice capabilities of the CSTORM-MS in the context of its application to ongoing studies. It will included a summary of the details for its application to the LACPRA. Furthermore, potential future uses for the resulting data sets for additional purposes in the engineering and planning communities will be explored.

Joseph French, Mississippi State University

Session 21

THE EFFECT OF TROPICAL STORM AND FRONTAL PASSAGE ON MARSH TERRACE EFFICACY IN COASTAL LOUISIANA

Marsh terracing is a wetland restoration technique commonly used in coastal Louisiana and Texas since the 1990s. Marsh terraces are segmented ridges of sediment constructed within open water areas of coastal wetlands, which typically become fully vegetated within 1 year of construction. A primary restoration objective of marsh terrace construction is the mitigation of marsh platform erosion through the reduction of wave fetch and resulting incident wave energy. Accordingly, efficacy of terraces is a function of the capacity of the structures to reduce erosion from wind driven waves relative to the mechanical strength of soils composing the adjacent marsh platform as well as the terraces themselves. Herein, we report results from an extensive and integrated field effort to assess the spatiotemporal relationship between wind conditions, wave parameters, water level, soil shear strength, and suspended sediment concentration, in two marsh terrace sites in southwestern Louisiana. We used a sonic anemometer and wave spectra to collect time series of wind vectors, and water levels collected with four acoustic Doppler profilers and a wave buoy, from November 2018 through August 2019. Additionally, soil shear strength was evaluated with over 141 in situ soil vane shear apparatus measurements as well as SEDFlume testing of sediment cores. Results indicate that the periods of greatest wave erosion and sediment transport potential, based upon soil shear strength, occurred during the passage of strong cold fronts in the fall, winter, and spring. The highest winds, largest waves, and highest suspended sediment concentrations were associated with the passage of cold fronts, which occurred with a frequency of approximately 4–7 days. These results suggest that the optimal orientation for terraces, with regard to reducing wave fetch and mitigating resultant erosion, is perpendicular to the two prevailing wind directions associated with cold fronts.

\Marie Mathews, Tulane University

Session 21

The sedimentary effectiveness of marsh terracing as a restoration technique in coastal marshes in southeastern Louisiana

The coastal marshes of the Gulf Coast are transformed every year by erosional and relative sea level rise-driven land loss, as well as by significant restoration initiatives to restore and protect these vulnerable environments. Within the last three decades, marsh terracing – creating ridges from excavated subtidal substrate with marsh vegetated perimeters in open water basins (estuaries or subsidence ponds) – has increased in popularity and prevalence as a restoration and protection technique along the western Gulf coast. However, the majority of the research conducted to date to examine these projects has focused on their potential ecological benefits and has neglected sediment issues. In this study, we investigated the effectiveness of newly vegetated terraces (1) as sediment traps on their surfaces and in adjacent submerged areas including excavation pits, (2) for their effectiveness in reducing bounding water body shoreline erosion, and (3) the impact of different terrace geometries on (1) and (2). We used sediment coring, radiotracer and stratigraphic analysis, remote sensing change detection, and numerical modeling (Delft3D) to address these objectives. Three semi-enclosed terraced basins, with a variety of connectivity to suspended mineral sediment, were studied and an idealized estuary domain was used in the model to test the impact of various terrace geometries and orientations on local hydrodynamics. Adjacent to terraces, subaqueous accumulation is focused in the excavation trenches at rates above that of distal areas of the

water body. Terrace surfaces are also serving as sediment traps after they are fully vegetated. The character of trapped material is dependent on mineral sediment availability; in isolated water bodies, trapping is limited to allochthonous organic matter, likely carried off surrounding marsh surfaces by tidal processes. Initial remote sensing change detection analysis suggests most terrace fields are in water bodies that are too small to experience fetch-driven wave edge erosion. This may suggest terrace effectiveness is limited for this purpose until water bodies are further enlarged by relative sea level rise. Model outputs show increased fine-grained sediment deposition within the terrace fields, as bed levels in and adjacent to the terraces raised at a higher rate than bed levels in areas without terraces. Decreased velocity and bed shear stress within the field also supports increased deposition as more material drops from suspension when these forces are reduced. This indicates that when sediment is available, marsh terraces can improve trapping efficiency.

Madelyn McFarland, Mississippi State University

Session 21

AN EVALUATION OF AVIAN USE OF MARSH TERRACES IN GULF COASTAL WETLANDS

Louisiana's coastal wetlands support millions of resident and migratory birds annually. However, Louisiana has experienced 90% of the total decline of coastal wetlands within the continental United States, accounting for most loss among all Gulf Coastal wetlands. Marsh terracing is one method used to combat coastal wetland loss. The restoration technique uses in situ sediment to construct segmented ridges in open water areas of coastal wetlands. An objective of marsh terracing is to improve marsh conditions and habitat for a diversity of species. Despite terraces being an increasingly useful component of coastal restoration efforts, previous research on their value as waterbird habitat is limited in spatial and temporal scale. Using both ground and aerial surveys, our study evaluates avian use of marsh terraces across multiple paired sites (terraced and non-terraced) in coastal Louisiana. Avian monitoring efforts focus on two primary guilds of birds, breeding secretive marsh birds and wintering waterfowl. Results from the first field season indicate that: 1) terraced sites were used predominately by non-focal species such as red-winged blackbirds, 2) there was low use of terraced sites by focal species such as rails, 3) and there was generally low use of both terraced and non-terraced sites by wintering waterfowl, although species abundances varied in space and time. Field efforts are ongoing, and data collection will be completed by July 2020. Future analysis will examine relationship between avian use and habitat characteristics of study sties (e.g., submerged aquatic vegetation, diversity, and structure of emergent vegetation).

Presenter Bio: Madelyn McFarland is a graduate student at Mississippi State University pursuing her master's degree in the Department of Wildlife, Fisheries and Aquaculture. She hails from Baton Rouge where she completed her undergraduate degree at Louisiana State University in natural resources, ecology, and management. Her career interests are wetlands and waterfowl conservation.

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Raul Osorio, Mississippi State University

Session 21

MARSH TERRACES ASSESSMENT USING A REMOTE SENSING APPROACH AND A WAVE MODEL

The Northern Gulf of Mexico is facing high rates of wetland loss due to subsidence and sea level-rise. Marsh terracing is a relatively new coastal restoration technique that has been implemented in Louisiana and Texas for almost 30 years; however, little research has been conducted to determine their effectiveness. Marsh terraces are segmented berms of soil that are built in inland, shallow coastal ponds. Objectives of this restoration technique are to create new marsh, reduce fetch, and dissipate wind-driven waves which cause land erosion. Specifically, marsh terraces are hypothesized to slow down marsh platform erosion and reduce pond expansion by reducing wave energy. This study has two main objectives: 1) Assess the change in marsh terrace area over time through remote sensing and change detection analysis, and 2) Assess which terrace design (rectangular or chevron) is more effective at reducing wind-driven wave energy.

For the first objective, our analysis was conducted using 1-meter resolution imagery from the National Agriculture Imagery program covering the period 2003-2017 from five Louisiana coastal Parishes. Marsh terrace sites of 10-14 years old were selected randomly within each Parish. Results show more cumulative deposition than erosion in marsh terraces. A relationship was found between geomorphological area, sediment supply, and adjacent or connecting channels with terrace fields of study performance. High density of channels surrounding or adjacent to the terrace fields and external sources of sediment loading are likely important drivers encouraging deposition. However, further analysis is necessary to understand the reasons for differences in performance across terrace sites.

For the second objective, our analysis was performed using the Simulating Waves Nearshore (SWAN) model to simulate wind-waves at two terrace fields in coastal Louisiana. Simulations were based on field conditions with and without terraces. Model input parameters included bathymetry, water level, and wind and wave characteristics. Model validation was done using in situ measurements collected for five months at each study site by an acoustic anemometer (wind time series), four doppler profilers, and a wave buoy (wave data). Results help us understand the dynamics of wave energy related to the erosive forces exerted in two 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, and thus reducing marsh erosion and encouraging marsh sustainability or creation.

Tim Carruthers, The Water Institute of the Gulf

Session 22
IMPROVING RESTORATION PROJECT ADAPTIVE MANAGEMENT: PRACTICAL STEPS

Louisiana has a long history of coastal management and restoration actions with multiple projects implementing common approaches. The Coastal Protection and Restoration Authority (CPRA) has practiced informal adaptive management as key personnel pass on accumulated wisdom and lessons learned. There is currently an increased need for large-scale restoration, due to ongoing land loss, as well as major new restoration funding entities resulting from the Deep Water Horizon (DWH) oil spill. As a result of this large need matched with funding availability, there is increased incentive to develelop effective and practical processes that formalize common learning to improve decision making and maximize the benefits of restoration effort.

Adaptive management can be defined as a systematic process to incorporate new and existing knowledge into management decisions. It is a learning based, iterative process to improve management decisions, and actions, based on increasing understanding and feedback between this learning and subsequent decision making. While a great deal of thinking has gone into the theory of adaptive management, resulting in a large number of frameworks and terminologies, affecting practical change in day to day project implementation has proven challenging. Even when essential lessons learned and knowledge gaps are captured, they are rarely discoverable and searchable by those implementing future projects. The result is that adaptive management remains an informal or social process, reliant on interpersonal communications with certain individuals that hold project implementation knowledge.

This presentation draws on extensive input and engagement from many staff at the CPRA, as well as representatives from the Louisiana Trustee Implementation Group (LA TIG), and in particular the Monitoring and Adaptive Management representatives from the LA TIG over an 18 month period. A detailed description of adaptive management within a typical restoration project cycle will be presented, highlighting practical steps for improving adaptive management through either utilizing or capturing lessons learned, decision justification, or gained knowledge. Specific and implementable practical steps to help improve project adaptive management, developed collectively with the 60+ coastal restoration practitioners, will be presented. These include development of a dynamic and searchable ‘lessons learned database’ and a dynamic ‘electronic restoration handbook’ to summarize when and how different personnel implementing restoration projects should accomplish adaptive management tasks.

Whitney Thompson, APTIM

Session 22

Golden Triangle Marsh Creation Project-Studying the Effects of Marsh Construction Using Delft3D

As part of the 30% Design Report for the Golden Triangle Marsh Creation Project, APTIM was contracted by the Louisiana Coastal Protection and Restoration Authority (CPRA) to perform comprehensive numerical modeling to evaluate the effects that Golden Triangle marsh creation and associated Lake Borgne borrow area dredging may have on coastal processes and adjacent habitat. The Golden Triangle project area is bound between the Mississippi River Gulf Outlet (MRGO), the Gulf Intracoastal Waterway (GIWW), and the Inner Harbor Navigation Canal (INHC) Storm Surge Barrier. Processes evaluated for both marsh creation and borrow area dredging effects include waves, currents, water levels, and morphology. Additional processes evaluated for borrow area dredging effects include residence time (flushing), dissolved oxygen concentration, and infilling rates. The tool selected for the modeling efforts was the Delft3D process-based model, specifically designed to simulate coastal processes forced by a combination of waves, tides, and winds.

The study initially required comprehensive research and field data collection to accurately populate model parameters and ultimately simulate the conditions in the area. Flow and wave model calibration were performed utilizing the data collected by APTIM with three Acoustic Doppler Current Profilers (ADCPs) along with the historical data gathered from nearby gauges. The morphology and dissolved oxygen models were calibrated using the infilling rates and dissolved oxygen concentrations measured at the Goose Point borrow area located in Lake Pontchartrain due to the proximity and similarity of bathymetric conditions.

Once all models were calibrated, waves, flows, and morphology of the marsh and borrow area design alternatives were analyzed under average conditions as well as two storm conditions (Hurricanes Katrina and Isaac). Three borrow area dredging scenarios were evaluated (-10 ft, -20 ft, and -24 ft NAVD88) and three marsh creation scenarios were evaluated. Residence time and dissolved oxygen concentrations were evaluated for the borrow area dredging scenario of -24 ft NAVD88 assuming the greatest depth would yield the most critical results. Potential effects of the construction of the marsh and borrow area were estimated by comparing the project scenario simulation results with the no action (i.e. baseline) scenario.

This modeling effort performed a thorough assessment of the effects on the adjacent coastline and nearby tributary channels due to construction of the Golden Triangle project. Overall, the marsh creation area and borrow area did not generate significant impacts to the surrounding areas with respect to waves, flows, and morphology under average conditions, and the dissolved oxygen modeling results showed that the borrow area placement near Chef Menteur Pass is likely optimal as the dynamic conditions present result in short flushing time. However, this study shows that restoring this marsh platform would result in a significant reduction in wave heights and surge during extreme storm events.

Joel Tillery, Duplantis Design Group, PC

Session 22

USE OF REMOTE SENSING AND GEOSPATIAL ANALYSIS TO ENHANCE DESIGN OF THE LAKE BORGNE MARSH CREATION INCREMENT ONE (PO-0180) AND APPLICABILITY TO FUTURE LARGE-SCALE MARSH CREATION PROJECTS

The Lake Borgne Marsh Creation Project (Project) is a large-scale restoration strategy for the southwestern shoreline of Lake Borgne that will restore degraded intertidal marsh habitat through strategic placement of dredge material. The Project, funded through the DWH Oil Spill Natural Resources Damage Assessment (NRDA) will focus on the implementation of an estimated 2,922 acres of marsh creation and nourishment with a total construction cost exceeding $100 million dollars.

The primary goal of a marsh creation project is to establish a sustainable marsh platform through strategic placement of dredged material. A sustainable marsh platform is one that is able to withstand the combined effects of sea level rise and subsidence over a desired timeframe or design life. Maintaining a particular marsh elevation relative to the tidal range ensures that the vegetation productivity is at optimal levels. A marsh platform that is too high or too low will decrease the health of vegetation and result in lower value habitat (high marsh / upland) or be susceptible to inundation and marsh collapse.

The Coastal Protection and Restoration Authority of Louisiana pioneered the design and implementation of marsh creation projects dating back a quarter century as documented in CPRA's Marsh Creation Design Guidelines (MCDG.V1) dated May 2017. These procedures were used as the basis of design; however, the unprecedented size and scale of this Project provided opportunities for new and innovative approaches to planning and design, primarily focused on estimating the volume of fill material required to achieve the desired marsh elevation.

Typical survey density for marsh creation fill areas, according to the MCDG.V1, is 250 feet spacing with shots a maximum distance of 25 feet apart. Survey data was post-processed using Civil 3D to create an existing topobathy surface following CPRA standard procedures. An alternative to this standard approach was developed that utilized multispectral orthoimagery to conduct a land-water analysis and generate breaklines associated with marsh edges. Average marsh elevations based on the collected topographic data were assigned to these breaklines to improve the accuracy of the topobathy surface. In comparing the results of the standard approach using transect data to the geospatial approach, it was shown that the computed marsh fill volumes were similar and that the amount of data required to develop an accurate surface was considerably less. Applying this new geospatial approach to future projects could result in significant savings in survey costs as well as improved accuracy of fill volume estimates. The geospatial analysis used for the Lake Borgne Project was extended to other recent marsh creation projects to demonstrate the robustness of the technique.

Pamela Jenkins, University of New Orleans

Session 23
CLIMATE CHANGE AND ADAPTATION: CAN WE WALK THE WALK NOT JUST TALK THE TALK?

The session provides a context for how we go forward facing the increased consequences from climate change. Through funding from the Rockefeller Foundation, UNO-CHART, Concordia, and the Foundation for Louisiana created a collaborative effort that sponsored five convenings focused on climate change and adaptation with more than 100 individuals participating from across the country and the world. Using the convenings' major themes, the workshop asks the participants to engage in an analysis of the major themes and how these themes might be implemented.

We would hope that a variety of participants would engage in this conversation-- scientists, community advocates, policy personnel, and local/state officials-- the range of individuals who attend this conference. We have used this process in the five convenings. At the beginning of the workshop, we will present our findings from the five convenings to set the context for the proposed workshop.

These convenings used an iterative process to share knowledge from international, national and local perspectives to create a vision for the future of Louisiana that can inspire innovation and create a model. The third convening, held at the Rockefeller Bellagio Center in Italy, resulted in defining three major areas that included: The Blue/Green Economy, Climate Mitigation & Resilience Hubs, and a Transformative Governance Model. Three pathways were identified to support implementation: Restorative Community Development, Leveraging Funding to Support the Blue/Green Economy, and Community Led Policies.

The workshop will build on the findings from the five convenings. The workshop discussion will focus on questions that will illicit their views on the major trends developed from the convenings. In small groups, we will ask each participant to comment on the value of these findings, plus their challenges. Also, we will ask if there are other areas that should be included. At the end of the workshop, we will bring the group back together, and discuss the most important ideas and challenges that emerge working towards a synthesis. As with all our convenings, the participants will be provided a summary and analysis of the workshop.

David Culpepper, The Culpepper Group, LLC

Session 24

SYNTHESIS OF FAULT TRACES IN SOUTHEAST LOUISIANA RELATIVE TO INFRASTRUCTURE

Geological faulting has been implicated as a contributor to subsidence, coastal land-loss and submergence of marshlands in southern Louisiana. The impact of surface, or near-surface geologic faulting on critical infrastructure is insufficiently documented in southeastern Louisiana; however, the state has a vast amount of energy-sector subsurface data that can be utilized for transportation and other near-surface engineering applications.

Recent and on-going work by research groups at the University of New Orleans, Tulane University and University of Louisiana at Lafayette use energy industry subsurface data, including well data, and 2D and 3D seismic reflection data to map and project deep-seated faults to create potential surface fault deformation zone maps. Accurate characterization of fault locations and effects using both subsurface and surface methods will aid in the design and placement of infrastructure, as well as in developing appropriate mitigation methods.

Descriptive criteria for reliability of fault locations were developed and are based on resources used in the interpretation and map scale: Level 1 suspected faults – described in the literature and included here from georeferenced maps; Level 2 identified faults – those observed on 2D or 3D seismic and mapped in a geographic reference system; Level 3 confirmed faults – mapped on seismic and ground-truthed with field methods including age-dated sediment borings and high-resolution seismic. We have compiled data resources in a GIS-based system for simple retrieval and map-based review so that additional work specific to critical infrastructure projects can be prioritized. The end objective of this research effort is to provide stakeholders ranging from policy makers, engineering designers, coastal restoration planners and the public with site-specific information so that the importance of faulting may be professionally assessed for many types of projects in coastal areas.

Elizabeth Mcdade, Chinn-McDade Associates LLC

Session 24
Geology of the Biloxi Marsh Complex: Implications for Stabilization & Restoration

The Biloxi Marsh Complex (BMC) was formed by the Mississippi River over 4000 years ago and at times, was the location of one of the river's primary ancient deltaic outlets. Today the marshes and natural levees of the BMC act as a land barrier to provide regional protection and shelter from storm surge and waves for the rest of the Pontchartrain Basin, including the major population center of New Orleans. A review of the geological history and tectonic setting of the BMC proves to be beneficial in considering how certain attributes of its geologic setting differ from that of other coastal marshes and how geology influences the long-term stability of the complex relative to other areas of southeast Louisiana (Day et al. 2019). Adding geological context contributes to our understanding of recent subsidence, deposition, and erosive marsh loss in the complex. This in turn leads to improved prediction of success of certain coastal restoration methods. Coastal science in Louisiana can clearly benefit from analysis and understanding of subsurface processes using energy industry data sources. Resources are abundantly available and include 2D and 3D seismic, well log data, and regional to sub-regional interpretations based on these data in the energy industry literature.

The long-term depositional history of the BMC through the present is characterized by the buried Cretaceous shelf edge, thin original salt, and lack of mobile salt-related geologic structures. Long-term stability of the platform has resulted in deposition of thin sedimentary strata across the complex during ancient times and continuing through the Holocene. While other southeast coastal marshes of Louisiana share similarities at the surface, the underlying geology is very different, with a result that the Holocene is thicker south and southwest of the BMC. Thicker Holocene in lower Plaquemines, for instance, leads to more rapid subsidence rates compared to those measured in the BMC.

Recent land loss in the BMC is primarily due to peripheral and internal erosion attributed to changes in Lake Borgne's salinity during decades of operation of the Mississippi River Gulf Outlet (MRGO) and the loss of the natural protective Rangia shell beach berm (Day et al., 2019). We conclude that the BMC is one of the most sustainable and resilient coastal marshes of Louisiana. With proper management, its natural resiliency will be an asset that will help the BMC to recover from the detrimental effects of MRGO.
Chris McLindon, McLindon Geosciences, LLC
Session 24
Geological assessment of the vicinity of the proposed Mid-Barataria Sediment Diversion

Scientific investigations of the Mississippi River delta plain have provided a wealth of new data over the past few years. Rates of subsidence have been measured at CPRA/NGS benchmarks, CORS, and USACE/USGS/NOAA water-level gauges. Rates of accretion, surface elevation change and land area change have been measured at CRMS sites. Geological interpretations of the neo-tectonic framework of the delta plain have been undertaken at UNO, Tulane and ULL using 3-D seismic data. Sediment cores, borings and cone penetrometer testing at numerous CPRA and DOTD infrastructure projects have provided data that can be used to estimate the age, composition and thickness of the Holocene deltaic

sediments.

These data and interpretations can be combined to provide valuable insights into the sustainability of the coastal wetlands. Rudimentary predictive models are constructed from subsidence data and maps of the thickness and composition of the Holocene sediments. These are combined with grid surface models of the rates of accretion and surface elevation change from CRMS to evaluate the sustainability of the intermediate to saline marshes of the delta plain.

A review of these data and modeling techniques will suggest processes of submergence, erosion and accretion that explain recent patterns of land area change. This review will further suggest that long-term sustainability is an achievable objective.

Robert Mohollen, University of New Orleans

Session 24

RATES OF DISPLACEMENT AND LATERAL CONTINUITY OF THE BATON ROUGE FAULT SYSTEM SEGMENTS: EVIDENCE OF HOLOCENE DISPLACEMENT NEAR THE EAST ORLEANS LAND BRIDGE?

The Baton Rouge Fault System (BRFS) is a series of deep-seated, east-trending, down-to-the-south normal faults that define a portion of the present-day northern physiographic boundary of the Pontchartrain Basin. Analysis of a 2D industry seismic dataset in Lake Pontchartrain and two, 3D industry seismic datasets in Lake Borgne, revealed three faults (two identified as part of the BRFS) that may laterally link beneath the East Orleans Land Bridge with three Lake Borgne Fault System (LBFS) segments. The South Point Fault of the BRFS, partially visible in 2D data, has been suggested to be actively displacing Holocene strata causing infrastructure damage to the Highway 11 Bridge. Biostratigraphy from 33 oil/gas industry well logs, provided by SONRIS online database and Paleo Data Inc., were used for correlation with deep seismic data. BasinMod was used to generate a burial history of the Cenozoic strata within the study area and to calculate the effects of decompaction on displacement of shallow stratigraphy within the Pontchartrain Basin. A grid of shallow, high-resolution Chirp seismic lines and 22 shallow vibracores were collected for analysis of shallow strata. Stratigraphic cross sections of vibracores with 500 yr BP interval isochron estimations, calculated from 17 samples of radiocarbon dated (C14) relict marsh organics and Rangia cuneata shells collected from the vibracores, show fault displacement in Holocene stratigraphy. Chirp seismic data shows visible offset of strata during the Late Pleistocene and Holocene.

Jeff Andrews, APTIM

Session 25

BUILDING A COMPREHENSIVE SEDIMENT DATABASE FOUNDATION TO SUPPORT LOUISIANA BARRIER ISLAND AND MARSH RESTORATION

Restoration efforts to mitigate land loss in coastal Louisiana, have been ongoing for more than two and half decades. In the early days there were no comprehensive guidelines for conducting an offshore or riverine sediment search and limited historic data were available. Protocols developed for east coast sedimentary environments were broadly applicable in a conceptual sense but needed to be adapted to deltaic coastal frameworks in Louisiana. In response, the Delta Sand Search Model (DSSM), a systematic approach to offshore sediment searches, was developed and adopted.

In many ways, Louisiana's early restoration projects laid the foundation for the states regional sediment management program. Sediment is critical to the sustainability of coastal Louisiana, and being sediment-limited, proper management of sediment resources is important. Louisiana has developed a comprehensive Louisiana Sediment Management Plan (LASMP) to help manage sediment resources. It is a comprehensive sediment management plan that identifies and inventories sediment resources. It is also a tool and an opportunity to proactively identify and minimize conflicting uses for sediment, such that more sediment is made available efficiently and cost-effectively, through proper management. The Louisiana Sand Resources Database (LASARD), as well as monitoring, assessment and adaptive management programs like the System Wide Assessment and Monitoring Program (SWAMP), the Borrow Area Management and Monitoring (BAMM) program, Coastwide Reference Monitoring System (CRMS), and Barrier Island Comprehensive Monitoring (BICM) Program are a part of LASMP.

Louisiana initially developed the LASARD program to manage all of the geological, geophysical, geotechnical, and other data collected during offshore sand searches. It was designed to archive historical and current geoscientific data that could be queried by state, federal, and private entities for planning and executing restoration projects. LASARD, which initially contained only data relevant to offshore sand searches, was expanded to include geoscientific data pertaining to the exploration of any sediment resources in offshore coastal Louisiana and the Lower Mississippi River. The goal of the LASARD program is to centralize relevant data from various sources for better project coordination and to facilitate future planning for delineating and using sediment resources for restoration in coastal Louisiana. CPRA is using the LASARD program to archive relevant data collected through the state's rapidly expanding monitoring, assessment, and adaptive management programs like SWAMP and BAMM.

This talk will explore the evolution of restoration projects in Louisiana and how they led to the development of a robust regional sediment management program that includes system wide monitoring programs like SWAMP, BAMM, CRMS and BICM. We will also discuss how the data generated by these programs are maintained and disseminated.

Ben Beasley, Applied Coastal Research and Engineering

Session 25

USE OF AN OPERATIONAL SEDIMENT BUDGET FOR PLANNING, MANAGEMENT, AND EVALUATION OF BARRIER ISLAND RESTORATION IN SOUTH LOUISIANA

Barrier island and headland beaches along the deltaic plain in south Louisiana have been eroding, migrating landward, and diminishing in size, thereby reducing their capacity to protect interior wetlands and infrastructure. As islands and beaches transform via barrier beach rollover, gulfside and bayside erosion, and breakup from inadequate sediment supply, relative sea level rise, and erosive wave processes, wetland habitat and deltaic plain communities become increasingly vulnerable to storm energy and flooding. As such, State and Federal agencies have allocated considerable resources to restore and manage habitats in the coastal zone.

The primary goal of this project was to analyze existing survey data to improve knowledge of regional sediment transport controls on barrier island system evolution and to develop an operational sediment budget for the barrier island coastline (littoral transport zone) between Raccoon Point and Sandy Point. Effective design and management of beach restoration projects benefit from reliable net sediment transport estimates (e.g., operational sediment budget) for predicting project longevity and planning for future restoration needs. Analysis of island and seafloor change patterns (erosion and deposition zones) for the periods 1930s to 1980s, 1980s to 2010s, and 1930s to 2010s revealed net sediment transport quantities and pathways. Erosion and deposition volumes define the magnitude of sediment exchange associated with transport pathways, and they were used to develop a littoral sediment budget for the period 1985-89 to 2013-16, a time when beach and island restoration was active.

Based on our littoral sediment budget analysis, total sediment losses from the littoral zone equaled approximately 7.3 million m3/yr. Surface sediment samples and cores from the Louisiana Sand Resources Database for areas adjacent to the littoral sediment budget boundaries documented about 10-20% seafloor sand content, the exception being west of Raccoon Point where sediment samples indicated 70-80% sand. This suggests that approximately 1.0 to 1.7 million m3 of sediment lost from the littoral system annually is sand. Restoration efforts over the last 30 years have offset these losses at a rate of approximately 570,000 m3/yr of additional sand from outside of the littoral zone, resulting in a sand deficit of about 0.4 to 1.1 million m3/yr. Comparing average losses and gains over the 30-yr analysis period illustrates that restoration with sand from outside the system should take place at approximately 1.5 to 3 times the existing rate to keep pace with historical sand losses from the littoral zone. Restoration sediment dredged from within the littoral zone, but buried below the active sand transport layer, is also important for maintaining the subaerial portion of the coast. For example, migrating inlet channels are depocenters for littoral sand eroded from subaerial beaches. Approximately 18 million m3 of predominantly sand was deposited in the old location of Cat Island Pass channel during the sediment budget analysis period. Mining sand from this deposit for restoring updrift Timbalier Island could be an important strategy (sand recycling) for maintaining island continuity into the future. This is just one example of how the sediment budget can assist in maximizing the effectiveness of future restoration strategies.

Soupy Dalyander, The Water Institute of the Gulf

Session 25

A Structured Decision-Making Approach to Regional Sediment Management: Informing Louisiana's Barrier Island System Management (BISM) Program

Barrier island restoration in Louisiana has historically been implemented on a project-by-project basis, leading to successful restoration of most of the barrier islands along the south-central coast. However, this approach considers the islands as individual features and not as a continuous system within which sand is exchanged on a regional scale. To improve system management over a project-scale approach, the Water Institute of the Gulf is working with the Louisiana Coastal Protection and Restoration Authority (CPRA) to develop a strategic framework for barrier island system management that identifies sources of sand and addresses environmental considerations programmatically so that: 1) projects can be integrated components of a long-term, system-wide restoration strategy and 2) shorelines can be rapidly restored after a storm event if needed. This programmatic approach is a component of regional sediment management (RSM), which will be used to optimize the use of fill material from a variety of source sites to support multiple coastal restoration projects.

In the current study, structured decision-making (SDM) is applied to develop an RSM framework for barrier island restoration and maintenance. SDM is an objectives-orientated approach for evaluating the benefits and tradeoffs of different courses of action that includes process steps of articulating issues and goals, identifying alternate solutions, and modeling the probable outcomes of those alternatives in the specific context of the underlying objectives. SDM is particularly beneficial when decision-makers and stakeholders have multiple, potentially competing objectives, such as in coastal restoration and RSM (for example, minimizing cost; meeting habitat creation targets; or increasing the longevity of fill placed for coastal protection or to maintain amenity beaches for tourism).

The SDM-based, RSM approach developed here is being applied to barrier island restoration and maintenance in Louisiana as part of the Barrier Island System Management (BISM) project. Initial steps include developing a comprehensive “database of databases” that identifies existing data and model output that can be used in alternative evaluation; inventorying stakeholder concerns to refine issues and objectives; identifying a confined suite of barrier island integrity metrics (e.g., height, width, breaching potential) that can be quantified through project monitoring and directly link to project goals; and developing a conceptual RSM model that accounts for system connectivity (e.g., natural sediment pathways) and uncertainty in environmental drivers (e.g., storm events). The framework that will be presented can be readily adapted to other locations for management of sediment across a variety of coastal environments.

Andrew McQueen, US Army Corps of Engineers

Session 25

Restoring Coastal Louisiana Marsh Habitat in West Bay Employing Beneficial Use of Dredged Sediment and Engineering With Nature Principles

Using dredged sediment from riverine environments is a critical component of large-scale (projected multi-billion dollar) restoration efforts in coastal Louisiana (USA) to decrease losses sustained from coastal land loss. West Bay (Louisiana) USA is a 12,000 acre sub-delta adjacent to the Mississippi River that typifies risks of coastal land loss (e.g., loss of critical marsh habitat and threatened navigation banklines), with approximately 70% (ca. 8,000 acres) conversion from marsh to open water since the 1950s. To restore habitats at the scale of projects like West Bay, sustainable approaches are needed. Recently, there has been significant progress in using restoration strategies which align with Engineering with Nature® (EWN®) principles, a U.S. Army Corps of Engineers (USACE) initiative supporting more sustainable practices for delivering economic, environmental and social benefits through collaborative processes.

This study documents the progress of restoring marsh habitat in West Bay through an uncontrolled sediment diversion and a series of sequenced dredging events to inform future projects aimed to strategically place dredged sediment via application of EWN principles. To achieve this objective, we document the historical context and successes of the restoration strategies in West Bay from 2002-2019. The creation of a large uncontrolled diversion (20,000 cfs) in 2003 in combination with sediment retention enhancement devices (SREDs; created in 2009, 2013, 2015) were successful in using sediment-laden water from the Mississippi River to promote marsh creation. In addition to the sediment diverted from the river, over 37 MCY of sediment placed from dredging projects from 2002-2019 facilitated the creation of over 2,400 acres of new land in the formerly open waters of West Bay. Documenting progress and lessons learned of large-scale restoration projects like West Bay are crucial to the success of future restoration investments.

Jim Keith, Freese and Nichols, Inc.

Session 26
THE PROBLEM WITH 'UNPRECEDENTED': MITIGATING MISINFORMATION & IMPROVING RISK COMMUNICATION

When floods occur, we are quick to define them with terms like "natural disaster", "catastrophic", "unprecedented", "100-year", or even "1000-year". These terms are often widely misunderstood by the public, or simply buzz words that fit into the daily news cycle but provide no value. Meanwhile, better data and modeling tools have given us powerful insights into flood risk, but behind the curtain there is still a great deal of uncertainty that is inherent to flood risk analysis and the ever-changing climatological and environmental conditions that contribute to flooding in a community. With several states including Texas and Louisiana embarking on statewide flood planning initiatives, the time is right for changing our approach to risk communication with community leaders, stakeholders, and the public.

This presentation will discuss the drivers for change and concepts for better defining and communicating flood risk, moving from convincing (science) to persuading (psychology) in order to change behavior. Topics will include storm nomenclature (e.g. 100-year versus 1% annual chance), comparison of hypothetical events to historical events, flood risk mapping challenges (e.g. pluvial versus fluvial flooding), and case studies of flood risk communication tools from other countries. Discussion will cover specific challenges in Louisiana relating to stakeholder perception and understanding of pluvial and fluvial flood risk, along with strategies to mitigate this knowledge gap as part of the broader Louisiana Watershed Initiative. The outcome will be clear communication achieved through new tools for local floodplain managers to use as they mitigate misinformation in their own communities.

Q. Jim Chen, Northeastern University

Session 28

INTEGRATING HIGH-FIDELITY MODELS WITH FIELD OBSERVATIONS TO PREDICT STORM IMPACTS ON LOUISIANA BARRIER ISLANDS AND WETLANDS: CAMINADA HEADLANDS

The successful implementation of the Louisiana Coastal Master Plan depends on (1) a thorough understanding of the deltaic system dynamics of barrier islands, shallow estuaries, and coastal wetlands as well as their connection in order to manage sediment budgets, and (2) the development of the modeling capability to quantify the effectiveness of these natural landscapes in mitigating storm-induced waves and surges, and thus reduce hydraulic loads on flood defenses. The effectiveness of the deltaic system in flood risk reduction has thus far been difficult to quantify accurately. An outstanding issue is that state-of-the-art numerical models need spatially- and temporally-varying input parameters of vegetation biophysical properties, that are not easily obtained in-situ for large areas and at regular time intervals, and both remotely-sensed parameters and numerical models require validation by field measurements in coastal Louisiana. Moreover, the sediment fluxes during storms between the barrier islands, back-barrier wetlands, shallow lakes and open bays, and the marshes are not well understood. To address both issues, this project has developed an innovative model system, which integrates state-of-the-art numerical modeling of physical processes and in-situ measurements. The key components are (1) a set of integrated open-source, process-based models (Delft3D and XBeach), which operate at different spatial scales for complex barrier/marsh systems; and (2) algorithms that derive model input of vegetation properties from remotely-sensed (satellite) data ground-truthed by in-situ observations. The cooperative research results in the following products: (a) a database of remotely-sensed and ground-truthed biophysical information for the Mississippi River Delta with high resolution in time and space, which can be used as input into computer models and for monitoring and evaluating the status of the salt marshes (see Dijkstra et al. in this session); (b) a high-fidelity hydrodynamic and morphodynamic modeling system for Barataria Bay and Terrebonne Bay that can be used in assessing the effectiveness and interdependency of barrier islands and wetlands, and evaluation and management of large-scale restoration projects; and (c) conceptual strategies to maximize sediment retention of barrier island restoration. These products and knowledge will have direct applicability and utility in support of the implementation of the Coastal Master Plan. Application of the modeling system to the Caminada Headlands will be shown.

Scott Hagen, Louisiana State University

Session 28

A PATH TO ASSESSING RISK IN FLOOD TRANSITION ZONES OF COASTAL LOUISIANA

Flood risk at the coastal land margin is influenced by both hydrologic and tidal processes, especially in deltaic flood plains, which leads to the realization that there exist transitional zones of flood hazard and risk [Bilskie and Hagen, 2018]. This coastal flood plain phenomena can be better understood by delineating dominant contributors to flood hazard and risk as they move from surge-only (in the immediate coastal flood zone) to hydrologic and tidal (including both low impact, high frequency events such as winter storms and higher impact lower frequency events such as storm surge) to rainfall-induced-only further from the coast. While this transitional flood risk zone retreats towards populated areas with coastal land loss, it can also be advanced away from urban centers with the aid of Louisiana Coastal Master Plan projects. The aim of the overall research is to address these fundamental issues by defining regions where both rainfall runoff and storm surge (both winter and tropical storms) overlap through development of a coupled hydrologic and hydrodynamic model to enable more comprehensive enhanced flood risk assessments and more. The intent of this talk is to continue a discussion of how and provide examples of what has been accomplished through recent research.

The examination of proposed Coastal Master Plan projects in terms of their potential long-term benefits in southern Louisiana are enabled by identifying transition zones. Currently, such considerations are often inadvertently omitted or included in very qualitative, deterministic terms. The approach discussed during this talk will provide the framework for the development of rigorous tools that can be used to improve long-term planning capabilities within all of the natural variability faced by these vulnerable communities. A result is clear objective guidance for decision-makers faced with difficult choices.

The talk will conclude with discussion of an improved capability to evaluate flood hazard and risk, and associated infrastructure impacts under present and future conditions. The developed hydrologic and coastal hydraulic flooding process-based and statistical models can serve as predictive instruments for physical climatic processes that will lead to a better understanding of coastal storms and their effects on the coastal landscape. This enhanced capability will result in refined storm surge analyses that will inform future project planning and design. These forecasting tools will establish the relative contribution of mechanisms that drive coastal change including storms, both hydrologic and coastal.

References: Bilskie, M. V., and S. C. Hagen (2018), Defining Flood Zone Transitions in Low-Gradient Coastal Regions, Geophysical Research Letters, 45(6), 2761-2770.

Claire Jeuken, Deltares USA

Session 28

LOUISIANA STORM SURGE EFFECTS PREDICTED BY HIGH-RESOLUTION VEGETATION COVER DERIVED FROM SATELLITE REMOTE SENSING

Wetlands are considered to play an important role in the coastal flood defense system, by protecting levees against waves and by reducing storm surge levels. The effectiveness of wetlands in mitigating hazards depends both on their extent and their ecological condition, e.g. vegetation cover and species composition. The extent of wetlands varies over time as a result of sea level rise, subsidence, sediment supply and erosion. The vegetation cover varies both seasonally and as a result of growth, stress, succession and competition. Existing models of the Louisiana coast used to assess storm surges regard vegetation presence and cover as constant over time and with limited spatial variation. This simplification is logical given the effort in acquiring accurate data on vegetation cover in this large area but does not accurately represent real conditions.

To overcome this, we integrated freely available high-resolution satellite data of vegetation into a hydrodynamic model system for the Louisiana coast. A neural network combines information from different observed wavelengths from the Copernicus Sentinel 2 MSI sensor into a Leaf Area Index (LAI) at a spatial resolution of 10x10m. Likewise, broad vegetation types can be derived from such sensors. Combined with field observations on vegetation properties -partly existing CRMS stations, partly dedicated sampling- the LAI can be transformed into plant properties that can be used to specify hydraulic drag in a hydrodynamic model: spatial density, diameter, height and percentage cover. The resulting roughness is more heterogeneous than the presently used schematizations, which results in a different surge level pattern.

The model can be used to inform decisions about where marsh restoration or protection efforts would be most effective in surge level reduction. Also, the combination of remote sensing and the hydrodynamic model can be used to assess not only the extent of gradual or storm-induced wetland loss over time but also the consequences of that change for storm surge levels.

Frank Tsai, Louisiana State University

Session 28

IMPACTS OF GROUNDWATER DYNAMICS ON MISSISSIPPI RIVER DELTA DURING SEVERE HYDROLOGIC EVENTS

This study investigates the upper 50-m stratigraphy and groundwater dynamics of Mississippi River Delta (MRD). Groundwater is a major component of the water cycle in the MRD, but its interactions with Mississippi River and surrounding interdistributary bays remain an open question. Implications of groundwater dynamics on Louisiana's coastal protection and restoration are seldom discussed. To better understand MRD stratigraphy and groundwater flows, 619 geotechnical borings were interpreted throughout the area. A three-dimensional groundwater model from the Head of Passes (River Kilometer 0) to Jesuits Bend (River kilometer 108), an area approximately 1,800 km2 ranging in elevation from 3 to -46 m, was constructed. The model showed typical basal coarse-grained sand bodies overlain by 10-m blanket clay, which is interbedded frequently with silty and sandy sediments and occasionally with peat and organic clay. Sands are mostly abundant between -10 m and -35 m. The Mississippi River main channel incises the underlying sands, thereby providing pathways for river-groundwater interchange. By investigating the 2012 hydrologic year, the study found that groundwater discharge and recharge rates to the river and surrounding bays were estimated 3 or 4 orders of magnitude smaller than Mississippi River discharge rate to the Gulf of Mexico. However, the modeling result showed strong surface-groundwater interactions controlled by local hydraulic gradient at the river and bay interfaces during severe hydrologic events. Pore water pressure could be increased 4-6 times higher than the normal condition by hurricanes. As a consequence, the MRD is likely exposed to harmful high pore water pressure and low factor of safety condition, which would destabilize sediments, enhance erosion, and compromise safety of coastal infrastructures such as the ring levees.

Giulio Mariotti, Louisiana State University

Session 29
THE MANY FACES OF MARSH LOSS (AND GAIN)

The morphological evolution of tidal marshes is investigated using a model (MarshMorpho2D) that simultaneously simulates 2D tidal dynamics, mass-conserving sediment transport, wave dynamics, marsh edge erosion, pond dynamics, and marsh upland migration. By only changing tidal range, sediment supply, and RSLR rate, the model is able to reproduce a great variety of spatial patterns in marsh loss. For all tidal ranges, an increase in RSLR causes channel widening, whereas a decrease in sediment supply causes marsh edge erosion. Marsh loss by pond runaway dominates for intermediate RSLR rates, especially for small tidal ranges and for small sediment supply. For very high RSLR, drowning occurs in the marsh interior and resembles pond runaway, yet lacks the variety of spatial scales associated with ponding. The rate of marsh edge erosion decreases for larger tidal ranges because the unvegetated bed in front of the marsh becomes intertidal. For a larger tidal range, the amount of marsh loss by drowning and pond runaway decreases, thus increasing the relative importance of edge erosion and channel widening. Upland migration, which is substantial only for high RSLR rates, compensate marsh loss only for large tidal ranges or when sediment supply is high. Marsh loss is highly heterogeneous, and the all-or-nothing dichotomy between marsh survival and marsh loss based on a single threshold does not well represent marsh dynamics. The major mechanism of marsh loss depends on the specific environmental settings, and is thus difficult to generalize the future of marshes.

Brian Roberts, Louisiana Universities Marine Consortium (LUMCON)

Session 29

OILING IMPACTS ON SALT MARSH ECOSYSTEM PROCESSES: INSIGHTS FROM A LARGE-SCALE MARSH MESOCOSM EXPERIMENT

Coastal wetlands straddle the land/ocean interface, providing myriad ecosystem services yet are also especially vulnerable to disturbances across a range of time and space scales. Most disturbance studies rely on either large-scale comparisons between disturbed and undisturbed sites that may have other uncontrolled, underlying differences or on small-scale manipulations of individual processes in isolation from other relevant processes. Here we report results from a large-scale experiment using a salt marsh mesocosm facility capable of testing the impact of disturbances on intertwined ecosystem-scale processes against a backdrop of controlled and uniform environmental conditions. The facility consists of 12, hydrologically independent Spartina alterniflora marsh mesocosms (3m diameter) each with its own paired tidal surge tank capable of generating tidal cycles with ranges up to 50cm via an automated water control system of blowers and airlifts. Specifically, we report results on how oiling impacts salt marsh plant dynamics; soil biogeochemistry; and microbial abundances and composition by assigning three marsh tanks to each of four treatments: control plus light, moderate and heavy oiling levels scaled to the SCAT categories observed following the DWH spill. Measurements were made every 1-2 months for 1+ year prior to oiling in July 2019 and were made at increased frequency after. Water level, temperature, and salinity and soil temperature and redox potential are logged continuously. Other regular baseline measurements include: 1) soil physical and chemical properties; 2) porewater chemistry; 3) oil characterizations; and 4) faunal abundances. This yearlong pre-oiling time series in a large-scale, highly monitored and controlled experiment provides a baseline against which we will track short- and long-term responses of marsh ecosystem processes to a gradient of oil exposure. Surface soil TPH concentrations didn't significantly drop over the first 3 months post-oiling with high treatment concentrations ~10 and 40 times higher than moderate and low oil treatments. Live plant stem densities were lowest in high oil treatments with decreases in moderate and low treatments observed by November 2019. Dead stems were significantly higher in high oil treatments within 2 months with moderate treatments reaching similar dead stem densities within 4 months post-oil. The number of live leaves in high oil treatments has been lower than in all other treatments. High treatments also had significantly less new growth (stems 10cm) than all other treatments. Belowground plant biomass was also significantly impacted by oil exposure. Oil exposure temporarily increase methane fluxes. Only high oil treatments had a prolonged decrease in gross CO2 uptake after oil exposure and this decrease was driven by a decrease in the number of live leaves. Soil nitrification rates were shut down in high oil treatments, reduced in moderate oil treatments and exhibited short term reductions in low oil treatments over the first several months post-oiling.

Yadav Sapkota, Louisiana State University

Session 29

MECHANISM OF WETLAND LOSS VIA MARSH EDGE EROSION IN COASTAL LOUISIANA: IMPLICATION FOR RESTORATION

Coastal wetland loss is a serious problem in Louisiana. The loss is chronic from the edge of the marsh through erosion followed by submergence. The majority of studies on coastal land loss use aerial and satellite photographic analysis while field and site-specific measurements are limited. The aim of this study was to spatially and temporally measure coastal marsh edge erosion, investigate factors responsible for differences in erosion including shoreline orientation, soil physio-chemical properties, and wind speed and duration, and to understand the mechanism of erosion. A total of 33 transects over six island sites in the Barataria Basin were monitored for edge erosion at least once every three months for up to 3 years. Transects were established on shorelines facing different compass directions. Soil cores (~40 cm) were collected from the marsh edge of 27 transects and analyzed for physiochemical properties including bulk density, % organic matter, and total carbon. A bathymetric survey was conducted to determine the bay bottom profile. The erosion rates ranged from 49– 324 cm yr-1 with a mean value of 142 ± 22 cm yr-1. As expected, erosion rates were significantly different (p 0.001) between protected and unprotected sites. The erosion rate was not correlated with wind speed (r=-0.07), weakly correlated with compass direction of shoreline (r=0.25) and water level (r=0.25) but strongly correlated with duration of wind (r=0.60). The erosion rate was negatively correlated (r=-0.45) with bulk density and positively correlated with organic matter content (r=0.42) of the soil. The erosion occurs by the undercutting of the marsh edge below the root zone followed by the slumping of the rooted soil and submergence of the zone below the undercut. Small waves continuously scour the unconsolidated submerged marsh until the bottom of the estuary attains the equilibrium bay profile. These findings can help inform coastal managers as to the most vulnerable marshes to erosion and can help target restoration efforts. Since the edge erosion is taking place all over the Barataria Basin, restoration techniques like the creation of barriers may not be efficient in reducing land loss. Large scale sediment diversion projects could potentially cover a large area, supply sediments, increase bulk density, reduce fragmentation and may slow wetland loss via marsh edge erosion in addition to building new land.

Carol Wilson, Louisiana State University

Session 29

THE ROLE OF SHORELINE CANNIBALIZATION FOR SUSTAINING LOUISIANA MARSHES: LAND LOSS TO LONG-TERM ACCRETION AND MINERAL ACCUMULATION IN BARATARIA BASIN

While Louisiana wetland loss rates are among the highest in the world, inorganic material yielded from shoreline erosion could help remaining marshes maintain elevation with respect to rising water levels in the absence of fluvial input (commonly referred to as marsh 'cannibalization'). Here we analyzed 40 locations across Barataria Basin for vertical accretion and mass accumulation, and compared to land loss, elevation, and subsidence in the region. Long-term vertical accretion rates agree with previous work spaced throughout the basin (averaging 0.67 ± 0.14 cm yr-1), and exhibited no clear spatial trend across the estuarine salinity gradient. There is, however, a clear north-south trend in organic content (north/fresh = 67 ± 14% vs south/saline =23 ± 6%), mass accumulation (north/fresh = 0.84 ± 0.55 kg m-2 yr-1 versus south/saline = 1.97 ± 0.83 kg m-2 yr-1), and mineral mass accumulation (north/fresh = 0.37 ± 0.60 kg m-2 yr-1 vs south = 1.56 ± 0.69 kg m-2 yr-1). Elevated mineral accumulation rates in southern (saline and brackish) regions of Barataria coincide with areas that have historically experienced the greatest land loss, suggesting advected former marsh edge material is the likely source. While marsh cannibalization may maintain elevation in these areas (evidenced by vertical accretion rates that balance subsidence and relative sea-level rise), mass balance calculations show capture efficiency of inorganic material remains very low (average 10-35%), suggesting much sediment is either accommodated within subsidence basins of local water bodies (i.e., the 'Terrebonne Trough') or exported to the coastal ocean. To maximize subaerial wetland restoration, future projects that will increase mineral sediment influx to the basin need to take into account local subsidence and sediment trapping.

John Day, Louisiana State University

Session 30

CAN DENITIRIFICATION EXPLAIN COASTAL MARSH LOSS: A REVIEW OF CASE STUDIES IN THE MISSISSIPPI DELTA AND NEW ENGLAND

There has been considerable discussion over the past several years about the potential negative effects of nutrient loading on coastal wetland stability. In particular, there have been concerns that high nitrate concentrations can fuel denitrification that can lead to soil organic matter loss and wetland deterioration. We review these issues for three case studies where there have been elevated levels of dissolved inorganic nitrogen, especially nitrate, coincident with wetland deterioration. These case studies include the Breton Sound estuary that receives diverted Mississippi River water at Caernarvon LA, a freshwater assimilation wetland that receives treated municipal effluent from a wastewater treatment plant at Hammond, LA, and a tidal creek in the Plum Island Sound estuary of northeastern Massachusetts where nitrate was introduced on each flood tide during the growing season for nearly ten years. We review the physical setting, ecology and biogeochemistry of these sites and use stoichiometric calculations to estimate how much soil organic matter decomposition could be accounted for by denitrification. Results of these calculations show that denitrification rates could not have caused the observed marsh deterioration at the two LA marshes. Denitrification may play a significant role in marsh loss at the MA site, however due to the unique hydrology of this site, denitrification rates induced by very high nitrogen loading rates in concert with the hydrology of the site may play a more significant role in marsh deterioration.

Tracy Quirk, Louisiana State University

Session 30

MISSISSIPPI RIVER SEDIMENT DIVERSIONS AND COASTAL WETLAND SUSTAINABILITY: SYNTHESIS OF RESPONSES TO FRESHWATER, SEDIMENT, AND NUTRIENT INPUTS

Although wetland loss is a global problem, it is particularly severe in the world's deltas. In the Mississippi River Delta Ecosystem, for example, conversion of coastal habitat to open water between 1932 and 2016 accounts for approximately 90% (~ 4,833 km2) of the total coastal wetland loss in the continental United States. The construction of flood control levees, which has hydrologically isolated the lower Mississippi River from its floodplain-wetlands, is a major cause of this wetland loss. This land loss crisis has prompted the State of Louisiana to develop a comprehensive restoration strategy that includes a series of large-scale diversions of nutrient-enriched Mississippi River water and sediment into adjacent receiving basins including coastal bays, estuaries, and wetlands. While sediment loading through diversions is predicted to enhance the long-term sustainability of deltaic coastal wetlands, the combined influence of greater sediment supply along with increased inundation, reduced salinity, and high nutrient loads on wetland condition is uncertain. This review synthesizes existing information to inform predictions of the combined effects of fresh water, inundation, nutrient loading, and sedimentation on marsh plant productivity, decomposition, accretion and elevation change. The data suggest that sediment input will increase the overall primary productivity of existing wetlands, where prolonged flooding does not counter this effect by stressing plants. Nutrient-loading is predicted to lead to greater aboveground productivity, which, in turn, can facilitate additional sediment trapping. In contrast, the belowground biomass response will likely depend upon concurrent sedimentation. In marshes experiencing net sediment deposition, nutrient-enrichment is predicted to enhance belowground growth into new substrates contributing to soil organic matter accumulation, accretion, and positive elevation change. However, belowground biomass will probably decline in sediment limited areas, although the longer-term effect on soil carbon accumulation and accretion is still unknown. These conclusions are generally supported by the biophysical feedbacks occurring in existing prograding deltas of the Mississippi River Delta complex.

ROBERT TWILLEY, Louisiana State University

Session 30

ECOGEOMORPHOLOGY OF COASTAL DELTAIC FLOODPLAINS AND ESTUARIES IN AN ACTIVE DELTA: INSIGHTS FROM THE ATCHAFALAYA COASTAL BASIN

We present here an integrated analysis of coastal deltaic floodplains in the active Atchafalaya Coastal Basin coupled to downstream deltaic estuaries to review how ecosystem properties self-organize around fluvial processes during river re-occupation as part of the delta cycle. The flood pulse of the river is critical to providing autogenic feedbacks between flow patterns, sediment delivery, vegetation productivity, and organic/inorganic accretion that produce spatial patterns of land elevation, habitat diversity, and estuary dynamics. Coastal deltaic floodplains form in the proximal region of an active delta as bar-shaped islands with interdistributary bays shape hydrogeomorphic zones influenced by both geophysical and ecological processes. Hydrogeomorphic zones in coastal deltaic floodplains of the proximal sedimentation zone can also be defined by time since subaerial emergence to account for variability in vegetation community composition and soil successional development. The reduction in sedimentation and increase in both above- and belowground biomass associated with formation of hydrogeomorphic zones results in significant increase in organic matter density in soils, with higher N:P ratios reflecting the biotic feedback of ecological succession on delta floodplain development. In both the proximal and distal sedimentation regions, episodic events, such as river floods and cold fronts, control seasonal water levels, marsh platform inundation, and increase in elevation capital. In coastal deltaic floodplains, an increase in vegetation height and density has a twofold effect: it favors trapping of sediment on the islands; whereas an increase in roughness deflects water flow and sediment into the channels thus bypassing the marsh surface. There is evidence that this is in contrast to more constant positive feedback of vegetation on sedimentation in distal estuarine marsh platforms. Delta estuaries go through a transformation from a near-riverine estuary in the winter-spring season to a near-marine lagoon in the summer-fall season. Geomorphological displacement of vegetation types occurs as platform elevation increases in the proximal sedimentation zone as delta landform emerges, with specific vegetation dominating the respective subtidal, intertidal and supratidal hydrogeomorphic zones. This does not occur in the distal sedimentation zone that lack sediment input as marsh platform elevation decreases. This is due to presence of salinity and H2S limit the capacity of biotic feedbacks to contribute to marsh stability. The growth of a coastal deltaic floodplains in the proximal sedimentation region of Atchafalaya Coastal Basin along with stable estuarine marshes in distal sedimentation region demonstrate the value of long-term riverine influence by preventing loss of wetland platform elevation.

John White, Louisiana State University

Session 30

CONSEQUENCES OF MISSISSIPPI RIVER DIVERSIONS ON NUTRIENT DYNAMICS OF COASTAL WETLAND SOILS AND ESTUARINE SEDIMENTS

Coastal Louisiana is dominated by the Mississippi River Deltaic Plain, which is composed of a series of overlapping and truncated sub-delta lobes that formed an extensive coastal wetland – open water shallow bay and low relief upland mosaic across the entire coastal zone (~25,000 km2). These coastal wetlands have been eroding at an increasing rate during the past century, coincident with major modifications to the deltaic landscape. One of these former modifications included extensive leveeing of the Mississippi River, essentially isolating the river from the adjacent coastal basins. One restoration technique involves re-connecting the previously isolated coastal basins to the river via diversions, which would once again allow the historical influx of freshwater, sediments and nutrients into the coastal basins. We examine a number issues on potential impacts of nutrient loading from the Mississippi river as a consequence of river diversions, focused on nitrogen (N) and phosphorus (P) dynamics including denitrification related to carbon dynamics and changes in P forms. We also examine how warmer and shallower coastal basins of the Mississippi River delta with large expanses of surrounding wetlands have comparatively larger N

removal potential under similar water residence times compared with the more northern, cooler, deeper and more stratified estuarine systems in the context of a large-scale river diversion helping to reduce N transport to the coastal ocean and trapping of particulate inorganic P. An additional benefit of river reconnection leads to an immediate, significant reduction of the bioavailable N load currently reaching the coastal ocean tied to annual hypoxia.

Kim Mosby, Louisiana State University

Session 31

DESIGNING RESILIENT COMMUNITIES IN AN ERA OF CLIMATE CHANGE: THE MULTI-SCALAR CONNECTION BETWEEN GOVERNMENT POLICIES, LOCAL DEVELOPMENT PRACTICES, AND COMMUNITY WELLBEING

In August 2016, a low-pressure system dropped 30+" of rain across the Baton Rouge region over two days. Resultant flooding took thirteen lives and damaged 156,000+ structures. Touted as a one-in-1,000-year flood this was the third such event to hit the southeastern US in 2016, and one of ten since 2010. The increasing convergence of inland and coastal communities through coastal erosion, sea level rise, rural to urban migration, and other factors is a phenomenon Louisiana is experiencing on an unparalleled scale although the issue is not unique to the state. Following recent storms, such as the 2005 hurricanes, and aided by federal disaster funds, many residents moved away from the coast to reduce their risk—only to be flooded repeatedly from rain events over inland watersheds.

While regional recovery is underway, the 2016 floods exposed significant vulnerabilities that inland-coastal regions face due to climate change. Top-down policy solutions often create gaps in recovery assistance that exacerbate social and economic vulnerabilities. Strengthening community resilience requires policy-makers to incorporate strategies that emerge from local communities into decisions made at the federal and state levels. This study seeks to understand the multi-scalar connection between government policies and local adaptation practices by asking: 1) How do government policies, like the National Flood Insurance Program, influence local building practices and community wellbeing in southeast Louisiana? 2) How can a greater understanding of environmental risk and wellbeing increase adaptive capacity in coupled inland-coastal regions? and 3) How can wellbeing and adaptation scholarship be better incorporated into development decision-making at all levels to bolster community resilience?

To answer these questions the study uses: policy and document analysis, focus groups, and interviews with residents, elected officials, and design professionals in the Baton Rouge region. The project also incorporates community-based planning and design processes that allowed residents to prioritize elements necessary for wellbeing to improve resilience even as climate risks increase. Initial findings show stakeholders view government policy as increasing future flood risk for inland communities by incentivizing development practices that can be detrimental to pre-existing neighborhoods. This suggests the need for aligning government policies with development practices that can bolster long-term community resiliency in floodplains. This research was funded by the University of New Orleans and the Gulf Research Program of the National Academies of Sciences, Engineering, and Medicine and the Robert Wood Johnson Foundation under award number 2000008299.

Ria Mukerji, Louisiana State University

Session 31

Changing Geographies of Flood Mitigation Policies -- A Case Study of Central, Louisiana

While residents of coastal regions are often aware of the risk they undertake by settling in these areas, issues of flooding are also a monumental problem in inland communities. The city of Central, Louisiana is one that will quickly see the effects of an inwardly moving coastline. Previously a part of Baton Rouge, Central is a relatively new development that expanded into the 100 year floodplain in 2005. This paper will present the changing geographies of flood mitigation policies since a major flood in 1983 to the present, with particular focus on the lead up and immediate aftermath of catastrophic flooding events that occurred in 2016. Drawing upon interviews and review of public policies the paper will show the paradoxes in government planning when it comes to safe versus economic development, summarize expressions of community opinion and input in flood planning, and compare them with policy change in recent decades. A changing coastline can put major stress on both the communities that are being lost and on those that are morphing into their new roles, and they must be given the proper resources to be able to succeed in leading the way into a more fluid policy arena. The results of this comparative analysis indicate a lack in evolution of government policy to match the speed of development into flood-prone areas, the recent growth in public expressions about flood safety and the lack of prior adaptations taking coastal encroachment into consideration when planning adaptation and mitigation strategies, particularly at the local level.

Jessica Watts, CDM Smith

Session 31
NEW ORLEANS GREEN INFRASTRUCTURE – FROM CONCEPT TO CONSTRUCTABILITY

The purpose of this presentation is to share issues and potential solutions for the implementation of Green Infrastructure as a means of flood risk reduction in urban environments across the coast. Understand the innovative landscape of $200 million in Green Infrastructure design and construction in New Orleans, including the Pontilly Stormwater Hazard Mitigation Grant Program (HMGP) Project and the DPS01 Watershed Drainage Upgrades and Green Infrastructure Project.

ABSTRACT:

A properly sized and functioning stormwater system is essential to the protection of public, property, and infrastructure in any metropolitan area. This is especially true in the City of New Orleans (City) where local topography presents a unique challenge for stormwater management.

The approach to addressing localized flooding in the two city areas of the Pontilly and Drainage Pump Station 01 Watershed projects was to design a distributed Green Infrastructure system using public open space and City right-of-way to manage stormwater runoff volumes. The methodology employed to achieve optimal solutions was highly iterative and involved considerable collaboration among engineering, landscape architecture, and public works professionals working as a team.

Green Infrastructure locations and preliminary water detention capacities were input into SWMM models for each neighborhood area. Models were run for multiple storms, and resultant flood levels were mapped. The facilities with the greatest benefits and fewest potential conflicts were chosen, as well as other pilot projects that could change the paradigm on how the City develops in the future.

It is within these pilot projects that the City and design team faced the challenges of integrating Green Infrastructure into the built-out urban environment, including:

1. Developing design practices, specifications, and construction quality control for Green Infrastructure

2. Incorporating new infrastructure into historic districts

3. Construction vibration mitigation

4. Design at the intersection of standard practices and Green Infrastructure

5. Long-term maintenance of Green Infrastructure system

These challenges can be mitigated by adapting current technologies, communication, coordination, and changing standard practices and specifications.

Todd Baker, Coastal Protection and Restoration Authority

Session 32
Addressing Habitat Needs and Threats for Brown Pelicans and Other Colonial Nesting Water Birds

Most terrestrial wildlife habitat in coastal Louisiana is disappearing at a rapid rate due to erosion, subsidence, and a host of anthropogenic reasons. This habitat loss is resulting in the decline of many wetland dependent wildlife species across the coast including those considered "common." The impacts of the 2010 Deepwater Horizon Oil Spill accelerated losses of key sensitive wildlife habitats and the species that depend on them.

Colonial nesting waterbirds are a suite of species that congregate and nest each summer on small remote islands throughout coastal Louisiana. Birds that comprise this group include Brown Pelicans, Black Skimmers, and various species of egrets, herons, terns and gulls. Many of these birds are considered "species of greatest conservation need" in Louisiana as identified by the Louisiana Wildlife Action Plan. Since 2010, Louisiana has lost over 50% of its Brown Pelican colonies and there does not appear to be any natural creation of suitable habitat to replace them. As a result, Brown Pelicans and other colonial nesting water birds are demonstrating more dependence on habitats that have recently been restored through various restoration programs.

Not all colonial nesting waterbird habitat is the same. Each species requires select niches to nest and raise young. Some species, such as Black Skimmers and terns, require bare ground habitat such as sandy beaches. Others, like Brown Pelicans, egrets, and herons prefer woody vegetation. Still others, such as Tri-colored Herons and Laughing Gulls, nest in herbaceous marsh. However, two requirements that are generally consistent for these species to nest successfully include the necessity of 1) remote, small islands, and 2) non-tidal habitats during the nesting season.

The Natural Resource Damage Assessment (NRDA) fund from the Deepwater Horizon Oil Spill has provided Louisiana with over $220 million in funding to restore bird impacts associated with the 2010 oil spill. The Louisiana Trustee Implementation Group (LA TIG) has invested some of that money towards restoring existing bird colonies throughout the coast, but more work is needed in order to reverse or stabilize the loss of key bird habitat in coastal Louisiana.

Collaboration among Louisiana's avian experts and restoration is needed. Many lessons will be learned from the ongoing projects which will be important to document for future endeavors. Funding for large-scale bird habitat projects is rare, which makes smart investment of each dollar crucial to ensure it meets landscape scale needs and addresses as many species as practicable. Investment in habitat restoration also needs to be paired with future opportunities for colony stewardship and maintenance events. This long term funding commitment will continue to increase in importance as colonial water birds become more dependent on fewer and smaller islands.

Katie Freer, Coastal Protection and Restoration Authority

Session 32
CASE STUDY: QUEEN BESS ISLAND RESTORATION PROJECT

Located 2.5 miles northeast of Grand Isle, Louisiana, the Queen Bess Island Wildlife Refuge supports an average of 4,500 nests per year. An average of 3,000 of those nests belong to Brown Pelicans. In addition to Brown Pelicans, three other LDWF-designated Species of Greatest Conservation Need nest there annually: Roseate Spoonbills, Royal Terns, and Reddish Egrets. At least eight other species nest in this refuge, including wading birds, gulls, and marsh nesting birds. There were five Brown Pelican nesting colonies in the Barataria Basin in 2010, yet today Queen Bess Island is the only one that remains. Due to subsidence, sediment removal during overwash, and impacts from the Deepwater Horizon Oil Spill, only around five acres of the thirty-six within the island's protective rock revetment were suitable for nesting in 2018.

CPRA, with LDWF, USFWS, and C. H. Fenstermaker & Associates, L.L.C., began engineering and design of the Queen Bess Island Restoration Project in the summer of 2017 with funding from the Deepwater Horizon oil spill Natural Resource Damage Assessment (NRDA) settlement. Construction began two years later, in August of 2019, and ended as the 2020 nesting season began. After elevating the rock revetment that surrounds the island, approximately 150,000 cubic yards of sand barged from a previously permitted Mississippi River sand pit were used to raise the majority of the island to elevations ranging from +1.5 feet to +4 feet NAVD88. A small portion of the island will remain intertidal to continue to support fish and Mangroves suitable for waterbird nesting. Almost 20% of the island is dedicated to the bare-ground nesting requirements of terns and skimmers. The rest of the island includes plantings of the scrub-shrub vegetation that birds like pelicans and herons prefer for nesting. Breakwaters provide a calm-water area adjacent to the island and bird ramps facilitate young birds' access to the water; both are novel features for bird colonies.

Brown Pelicans' high site fidelity for nesting requires construction activities to be prohibited during nesting season, from February 15 through September 15. The rigid construction window and atypical fill material quantity, sourcing, and transport increased construction cost and schedule estimation uncertainty and have yielded multiple lessons for future efforts with similar restrictions. These lessons, along with a wide range of others have been learned from the Queen Bess Island Restoration Project's planning, engineering and design, and construction processes. Some lessons have relevance to future restoration efforts targeting bird nesting habitats and others have broader applications. Applying these lessons and those learned through implementation of the project's operations, maintenance, monitoring, and adaptive management plans over the next ten years will further increase the effectiveness of future coastal habitat restoration efforts, especially for colonial waterbirds.

Paul Leberg, University of Louisiana at Lafayette

Session 32

TRENDS AND CHALLENGES FACED BY BROWN PELICANS AND OTHER SEABIRDS NESTING ON LOUISIANA'S COASTAL ISLANDS

Louisiana's coastal islands support significant proportions of the U.S. nesting populations of several seabirds, including the Eastern brown pelican, classified as a species of greatest conservation concern by the state. We review population trends of the species on our coast, responses of pelicans and other seabirds to restoration efforts, and future management challenges. More than many seabirds, brown pelicans have been the subject of intensive management in Louisiana, following their extirpation in the early 1960s due to food web contamination by pesticides. With regulation of pesticides, improvement of environmental conditions, and the reintroductions of young birds between 1968 and 1980, pelicans were restored to the state. Following the re-establishment of breeding activity, pelican nesting spread to other sites thorough assisted and natural dispersal, reaching a peak number of breeding islands in 2010. Due to population expansion throughout its range, the bird was delisted in 2009. However, since that time, the number of pelican breeding sites in Louisiana has declined dramatically as a result of island loss due to erosion and sea level rise, magnified by oil spill and storm damage. Other seabirds are suffering from similar habitat loss. Nesting islands located on marsh fragments appear to be especially vulnerable to these forces. Today, seabirds nest on only a small number of islands, most of which are heavily dependent on restoration for their continued existence.

There is only a limited understanding of the efficacy of coastal restoration approaches in providing seabird habitat and we have only a partial understanding of why birds use some restored islands and not others. Behavioral differences play a role; some species of terns respond more quickly to changes in habitat quality than brown pelicans. In spite of the success of translocations in the re-establishment of pelicans, similar actions, as well as other techniques, have recently failed to establish new breeding populations on other islands. It is also unclear whether pelicans born on islands that are subsequently lost relocate nearby or leave the region, placing a high premium on preserving existing nesting islands. Several restoration decisions might also influence seabird use. Vegetation succession and community composition can influence island resistance to storms and erosion. The presence of woody vegetation and an increase in island elevation can reduce pelican nest loss due to overwash, but might restrict use by other seabirds. There is also evidence that increased island size, elevation, and vegetation complexity are associated with mammalian predator occupancy on barrier islands. It is unclear whether fire ants, another nest predator, may also benefit from increases in island elevation or vegetative cover. As seabirds become dependent on just a few restored sites with little evidence of expansion to other islands, the location of remaining breeding sites relative to foraging resources also becomes an important consideration. Continued research and adaptive management have a major role to play in the long-term viability of seabird populations in the region.

T. Mitchell Andrus, Royal Engineers and Consultants

Session 33

PROJECTED LONG-TERM DELTA BUILDING RESPONSES TO POTENTIAL FLOW MODIFICATIONS AT THE MISSISSIPPI-ATCHAFALAYA BIFURCATION

The most recent and currently active delta lobe of the Mississippi River (MR) is the Atchafalaya-Wax Lake lobe, which was initiated approximately 400 years ago and is the result of ongoing MR stream capture by the Atchafalaya River (AR). This capture process accelerated in the early to mid-1900s but further progress was prevented by construction and operation of the Old River Control Structure (ORCS) Complex. Many recent studies have indicated that MR system below the ORCS is on a retreating geologic trajectory due to contributing factors such as sea level rise, subsidence, faulting, declining hydraulic stream power, and increased sand storage between the MR levees resulting in higher flood stages and delta backstepping. Diversions along the Lower MR currently being planned would partially alleviate these risks by altering the Lower MR hydraulics and capturing land-building sediment. The purpose of this study is to use various modeling techniques to alternatively explore the long-term land-building potential of progressively continuing the avulsion at the MR-AR bifurcation in a controlled manner through the ORCS. While abandoning Lower MR restoration efforts is not an option, results could give planners and policy makers another complimentary river management strategy to consider.

This study uses both 1D and 2D numerical modeling techniques to evaluate the long-term effects of current water and sediment regulation mandates and test alternative regulation strategies with respect to delta-building goals. Riverine hydraulic and sediment transport modelling was performed using the Delft 3D modelling software suite and was coupled with a spreadsheet which used a 1D spatially averaged equation developed by Dean et. al. (2012) to calculate delta growth. A 150-year model duration was used to account for flow and system adjustments, implementation of current restoration plans, and to sufficiently analyze delta response trends into the future. The study tests 12 scenarios (1 No Change scenario, 8 increased AR flow scenarios, and 3 increased MR flow scenarios) where flow adjustments are made gradually over time in 5% increments.

The main goal of this study is to compare the land building capacity of the MR vs. the AR along their current alignments, gradients, and receiving area conditions at various flow regulation percentages. The 150-year resulting land areas built for each the MR vs. the AR at discrete flow percentages demonstrate a clear land-building capacity advantage in the AR. For common flow percentages the AR builds 1.7 times more land at 30% of the total river flow and 3.0 times more land at 70% of the total river flow. Ongoing work includes a cost impact analysis on river levees and navigational dredging to accommodate flow, stage, and sediment load alterations. While there would undoubtedly be much broader socio-economic impacts to address, the conclusions will initially assess whether or not any MR/AR flow split alteration scenarios could be a cost-effective, long-term ecosystem sustaining strategy.

Gary Brown, USACE ERDC

Session 33

NUMERICAL MODEL ANALYSIS OF PROPOSED LATERAL BAR DREDGING ON SEDIMENTATION IN THE LOWERMOST MISSISSIPPI RIVER

The Coastal Protection and Restoration Authority (CPRA), along with various federal partners, are undertaking a marsh restoration project: the BA-203 Barataria Basin Ridge and Marsh Creation - Spanish Pass Increment. This work is being implemented through the Natural Resource Damage Assessment (NRDA) restoration planning effort. The scope of the project involves the restoration of approximately 120 acres of historic ridge and 1,134 acres of marsh that have been degraded due to various causes, including eustatic sea-level rise, high subsidence rates, diminished sediment supply, and extreme storm events.

To construct the project, it is proposed to dredge the sediment needed for the restoration from sediment sources in reasonably close proximity to the project site. After consideration of several candidate sites, two were selected for final evaluation. These are shoals (submerged lateral bars) located in the lowermost river. The first site is located at the Venice Anchorage, on the left descending bank of the river just downstream of Baptiste Collette. The second site is located at the Pilottown Anchorage, on the right descending bank of the river in the vicinity of the West Bay Diversion. It is proposed to dredge the sediment from these sites, convey it to the project site, and place it in fill areas to pre-determined planform dimensions and elevation.

In order to analyze the potential effects of dredging these sites on sedimentation in the Mississippi River Ship Channel, it is useful to employ a numerical model. The Coastal and Hydraulics Laboratory (CHL) has previously developed and utilized an Adaptive Hydraulics AdH/SEDLIB model of the Lowermost Mississippi River. This model application has been used for several river morphology studies in the Lowermost Mississippi River, including sediment diversion studies.

This numerical model was applied to evaluate the effects of dredging each of these candidate sites on sedimentation patterns in the Lowermost Mississippi River, with emphasis on the impacts to dredging in the Mississippi River Ship Channel. This presentation will discuss the results of these simulations, and will also address some general sedimentation trends in the Lowermost Mississippi River that can be inferred from these model results.

Ming Tang, Louisiana State University

Session 33

Channel deformation in the lower Atchafalaya River from 1977 to 2006

The Atchafalaya River is the largest distributary of the Mississippi River, carrying approximately 25% of the Mississippi River water and the total flow of the Red River. The river flows southwards for about 230 km and empties itself into the Northern Gulf of Mexico through two outlets, Morgen City and Wax Lake Outlet. In the early 1970s, new deltaic land emerged at the outlets. Since then the two deltas have been growing, making them the only area along Louisiana's coast where noticeable new land is being created. Sediment yield from the lower Atchafalaya River is crucial to the deltaic development, but sediment transport in the heavily braided Atchafalaya is very complex. In this study, we aimed to investigate riverbed erosion and sedimentation in the lower Atchafalaya in the recent decades in order to discern sediment sources to the Atchafalaya Bay. Specifically, our objectives were to 1) quantify the changes across the entire riverbed from Butte La Rose to Wax Lake Outlet and Morgan City during the period from 1977 to 2006; and 2) analyze changes in hydraulic head for the 174-km river reach in order to glimpse the long-term trend of channel dynamics in the lower Atchafalaya River. For the past nearly 30 years, we estimated a total volume of approximately 120 million cubic meters (m3) of net riverbed erosion in the lower Atchafalaya River channels. Assuming a bulk density of 1.4 ton/m3 for the riverbed material, the eroded volume of sediment is equivalent to 168 million tons, representing an average erosion rate of 5.8 million tons per year. This quantity of eroded riverbed material may have greatly contributed to the deltaic growth at the mouth of the Atchafalaya River. Furthermore, we found that, on average, the thalweg elevation of the main channel deepened by more than 2 m in the first 40 kilometers, but elevated by more than 1 m in the final 40 kilometers, indicating that the channel erosion mainly occurred in the upstream while the downstream channels experienced aggradation. The channel erosion of the lower Atchafalaya River in its upstream reach will likely continue with the river discharge being projected to increase, and deposition in the downstream reach may accelerate because of sea lever rise. Our study demonstrates that understanding deformation mechanism of the lower Atchafalaya River has crucial implications for future prediction and management of the coastal land creation and regional sediment sources.

Bo Wang, Louisiana State University

Session 33

LARGE RIVER DIVERSION EFFECTS ON DOWNSTREAM CHANNEL DYNAMICS – A CASE STUDY OF THE UPPER ATCHAFALAYA RIVER

Combining the total flow from the Red River and approximately 25% of the Mississippi River water, the Atchafalaya River flows for 230 km and discharges 199 km3 of water each year into the Northern Gulf of Mexico. The large quantity of discharge has strongly affected coastal processes, among which sediment transport and deltaic progression are of great importance to the U.S. national energy industry and wetland ecosystems. Human interventions on the river in the 18th and 19th centuries have largely increased the river's bankfull discharge from 850 to 13000 cubic meters per second (cms) from 1855 to 1950. To prevent further discharge increase and the potential of a river avulsion, a diversion control complex, the Old River Control Structure (ORCS), was built in 1963 for regulating the Mississippi River flow into the Atchafalaya. Previous studies reported channel degradation downstream of the ORCS, but aggradation in the lower Atchafalaya River Basin. However, our knowledge is very limited about how the river channel has changed in recent decades. Such information is crucial to assessing the long-term stability of the river diversion as well as downstream geomorphologic and sedimentary dynamics.

In this study, we investigated riverbed changes of the upper 69-km Atchafalaya from the Red River – Mississippi River confluence to Krotz Springs. Thalweg elevation, average riverbed elevation, and the amount of sediment deposition/erosion on the bed were estimated using hydrologic survey data in 1977, 1998, and 2006. Long-term changes in river stage and discharge at three gauging stations along the study reach were analyzed for the period from 1936 to 2016. Preliminary results show that the uppermost 69-km reach of the Atchafalaya River had strong channel degradation. The average bed elevation of the channel reduced by 1.9 m from 1998 to 2006, resulting in a total erosion of about 80 million tons of sediment from the riverbed. River stage analysis at given discharge (i.e. specific discharge) also shows a water level reduction at the three gauging stations during 1935 – 1986 (on average, 5.6 m). However, channel degradation seems to be approaching an equilibrium state after 1986. Over a long-term period (i.e., 1935-2016), a considerably large amount of likely coarse sediment (i.e., 2700 MT) may have been scoured from the channel and transported downstream.

The quantitative information on bed deformation can be important for understanding the long-term coarse sediment budget of the Atchafalaya River. Further studies are needed to determine how much of the eroded sediment has been trapped downstream and/or delivered to the river mouth for the Wax Lake Outlet and Atchafalaya deltas.

Daniel Bosch, LSU Paul M. Hebert Law Center, Advocacy Programs

Session 35

LOUISIANA'S 'ELEPHANT IN THE ROOM': WHAT LEGAL REMEDIES WOULD BE AVAILABLE AMID FAILURE OF THE OLD RIVER CONTROL STRUCTURE

In 1963, the U.S. Army Corps of Engineers constructed the Old River Control Structure (ORCS) at Vadalia, Louisiana. It was constructed to contain an avulsion node, or an area of the river where the rapid abandonment of the existing river channel occurs in favor of a new channel. Since, ORCS has functioned to contain the river to its existing channel, but not without complications and difficulty. The Mississippi River Flooding of 1973 almost caused the structure to fail. In light of these events, it has left many to wonder what would happen in the event of the failure of the structure to contain the river and what the legal implications would be.

This paper will seek to address what, if any, legal tools would be at the disposal of affected property owners, residents, and businesses if and when Old River fails. In general, actionability against the federal government for flood related damage is not possible under the Federal Tort Claims Act and the Flood Control Act due to both sovereign immunity and specific immunity granted explicitly under the ambits of the two statutes. Thus, the only way to succeed on a claim against the federal government for flooding is to prove that an improper taking occurred under the Takings Clause of the Constitution. However, even this remedy proves difficult.

Part I addresses the background of the ORCS. Part II addresses economic and normative consequences of the failure of ORCS. Part III surveys legal standards and the degree of success in cases tried for seeking relief from the federal government for the failure of ORCS. Finally, the paper will present a conclusion that, while successful actionability under the Takings Clause and pertinent federal statutes is conceivable, it is not probable. The more likely solution will not be legal at all, but will rather be political pressure to ask for special appropriations from Congress.

Naomi Yoder, Healthy Gulf

Session 35
RESEARCHING LNG DEVELOPMENT IN LOUISIANA AND TEXAS

Liquefied Natural Gas (LNG) production and export facilities for international markets are being proposed and approved at staggering rates in North America. Nowhere is this trend more clear than in coastal Louisiana and Texas. This "build-out" is so far virtually unchecked when it comes to states and federal governments issuing permits to construct facilities. In coastal Louisiana and Texas, when large LNG export facilities are built, wetlands and ecologically important areas are destroyed. In Louisiana where coastal land loss is occurring at an unprecedented rate, it is essential to think through very carefully which projects we build that eliminate wetlands.

Furthermore, LNG facilities contribute greenhouse gas (GHG) emissions through their construction, feedstock material and drilling, facilities footprints, and operation among others. Plus, LNG facility ownership and long term viability sheds light on the vulnerability of this industry. Louisiana and Texas seem to have been appointed as sacrifice zones for LNG export. This study aims to answer the questions, why here? Why now? Who stands to benefit? Who stands to lose? Recommendations include evaluating necessity and climate impact thoroughly, including full GHG lifecycle analyses for each new plant, port and pipeline facility. LNG projects should only be approved after the companies prove the need and communities they impact agree on genuine mitigation for climate and environmental destruction caused by the construction and operation of the facilities.

HOONSHIN JUNG, The Water Institute of the Gulf

Session 37

EVALUATION OF POTENTIAL IMPACTS OF NUTRIENTS AND PRIMARY PRODUCTION IN THE BARATARIA BASIN IN RESPONSE TO PROPOSED THE MID-BARATARIA SEDIMENT DIVERISON

Mid-Barataria Sediment Diversion on the lower Mississippi River is proposed as a large-scale restoration strategy to create new wetlands and sustain existing wetland areas in Barataria Basin, Louisiana, USA. The diversion will deliver suspended sediment along with significant amount of nutrient-rich freshwater to the receiving basins that include estuarine open water and herbaceous vegetation habitats. Introduction of the turbid and nutrient-rich freshwater into the basins will likely drive changes in light and nutrient dynamics, resulting in ecosystem-level changes.

In order to understand nutrient dynamics in Barataria Basin due to large scale coastal restoration practices, the TN and TP budgets were calculated from outputs of the Integrated Biophysical Model, which is based on the existing Delft3D hydrological model (D-FLOW) coupled with a water quality model (D-WAQ). The simulated model results showed that a major source of nitrogen and phosphorus in the current system was a release of organic materials driven by wetland vegetation. Settling of organic materials produced from phytoplankton and vegetation were also a major sink of nitrogen and phosphorus. In the soils, inorganic forms were consumed by wetland vegetation for growth. Denitrification was also an important process to remove nitrate in soils. The interaction between freshwater inflows and Mississippi River was related to the magnitude and direction of the net nutrient fluxes between the basin and the Gulf of Mexico. Operation of the Mid-Barataria Sediment Diversion elevated TN and TP concentrations compared to the present condition. But the rate of nutrient load increase was controlled by increased physical processes (i.e., fast flushing rate and settling) and removal processes (i.e., assimilation and denitrification).

These model results will help better understand how proposed sediment diversions on the lower Mississippi River may change the future ecological conditions of open water in coastal estuaries of Louisiana.

Bingqing Liu, Louisiana State University

Session 37

MULTI-DECADAL ENVIRONMENTAL AND LAND COVER CHANGE iMPACTS ON DISSOLVED ORGANIC CARBON DISTRIBUTION IN THE BARATARIA BASIN, LOUISIANA FROM IN-SITU AND SATELLITE OBSERVATIONS

Dissolved organic matter (DOM) and its major fraction –dissolved organic carbon (DOC) play an important role in the global carbon cycle via the microbial loop. The cycling of DOC in the northern Gulf of Mexico (nGOM) is governed not only by the Mississippi River (MR) but also by the highly productive marshes in the region. Further, many estuarine-coastal systems in the nGOM are continuing to experience significant wetland loss and variations in land cover type, leading to more complex nature of carbon cycling in the region. The Barataria Basin, is an example of such a dynamic wetland-estuary system (80 km to the west of MR delta) that is undergoing constant landscape change due to the combined effects of physical, geological, climatic and anthropogenic influences. it is thus essential to investigate the effects of these natural and anthropogenic disturbances on the DOC distribution and abundance at least from a regional perspective over various spatio-temporal scales.

In this study, field measurements and satellite data (Landsat/MODIS) spanning across different seasons between 2008 and 2011 were used to develop DOC empirical algorithms to obtain long-term (1985-2012) DOC estimations in Barataria Basin; overall, satellite-derived DOC agreed reasonably well with in-situ measured DOC (averaged R2 = 0.71; RMSE = 2.13). Although the time-series DOC showed seasonality and decreasing gradients from the upper to lower basin, an overall increase in DOC was observed in the upper and middle basins from 1985 to 2012. However, in the lower basin adjacent to shelf waters of nGoM, DOC increased from 1985 to 2006 but decreased from 2007 to 2012; this increase appears linked to the impact of the two major hurricanes in 2005. Furthermore, relationships between satellite-derived DOC and land cover variations (1985–2011) along the wetland-estuary interfaces derived from Landsat-5 TM supervised classification showed an increase in DOC with corresponding increase in developed area in the upper basin, while in the lower basin, DOC increased by 41% (R2 = 0.54) between 1985 and 2006 corresponding to a 17% decrease in salt marsh area, suggesting strong land use/land loss impact on the long-term DOC trends in Barataria Basin. This study demonstrates that satellite-retrieved spatio-temporal distribution of biogeochemical variables such as DOC maybe used to develop a monitoring system based on remote sensing data for fisheries, aquaculture, and coastal management.

Peter Mates, Louisiana State University

Session 37

Wetland Soil Phosphorus Forms and Cycling in the Barataria Basin Within the Area of Impact of the Planned Mid-Barataria Sediment Diversion

Abstract: Man-made levees along the lower Mississippi river prevent natural sediment supply from enriching Louisiana coastal wetlands. Sediment diversions introduce Mississippi river water, sediment, and nutrients into sediment-starved Louisiana coastal wetlands. Phosphorus is a vital macronutrient that can severely limit primary production in coastal marine ecosystems. Wetlands can serve as a sink or source for phosphorus to the overlying water column, dependent on concentration, through various retention and release processes. Louisiana wetland systems are primarily phosphorus limited due to higher concentrations of bioavailable N in river water that can trigger algal blooms. This condition has been linked to coastal hypoxia in the Gulf of Mexico. In this study, we examine potential availability of organic and inorganic pools of P in wetland soil of the Barataria basin that will be directly influenced by the Mid-Barataria, Mississippi River Sediment Diversion. The high soluble molar N:P (50:1) ratio in the river water is balanced by the high sediment TP load. The wetland soil P flux has the potential to decrease the N:P ratio of the surface water creating an optimum nutrient condition for increased algal bloom formations. We have analyzed soil characteristics from 60 wetland stations including vegetated marsh and open water stations. Total P and organic P was significantly higher by 11% in the marsh sites compared with the open water sites. A representative 20 sampling sites were subjected to a P fractionation scheme to delineate the abundance of available P in inorganic and organic pools. Marsh sites had a higher alkali organic P pool while open water sites had higher Fe-Al bound P. Preliminary results indicate that both sites have relatively low equilibrium P concentrations suggesting low flux of P to the water column. This research can help inform ecosystem modelers in accurately predicting diversion effects on the nutrient status of the coastal basin as well as serving as a wetland soil baseline condition prior to river reconnection for coastal restoration. Future research will explore P flux dynamics in area of influence of the planned Mid-Barataria sediment diversion.

Alan Shiller, University of Southern Mississippi

Session 37

USE OF STABLE ISOTOPES TO TRACE MISSISSIPPI RIVER DISCHARGE IN LOUISIANA AND MISSISSIPPI COASTAL WATERS

The northern Gulf of Mexico is a complex and productive coastal river-dominated system that receives freshwater from numerous sources including the Mississippi River. The dynamics of coastal ecosystems in the northern Gulf of Mexico are greatly influenced by the freshwater discharge but also by the high nutrient loads carried by the Mississippi River that lead to the seasonal development of hypoxia. Constraining the origin and fate of the freshwater inputs in the northern Gulf of Mexico will help increase understanding the physical and biogeochemical processes occurring in this region. Here, we focus on investigating the extent of the Mississippi River plume on both sides of the Mississippi River Delta: to the east in the Mississippi Bight, and to the west over the Louisiana Shelf. We determined the water isotopic signature ($\delta^{18}O$ and δD) along with salinity of the different river plumes and performed a river mixing model on the coastal waters. Our findings provide useful information to better understand the functioning of the northern Gulf of Mexico ecosystem. In particular, the development of hypoxia is often attributed to the nutrient load of the Mississippi River, yet the Mississippi River seemed to have a limited influence on the Mississippi Bight. That is, the dominant source of freshwater in the Bight was supplied by local Mississippi/Alabama rivers. Furthermore, the water isotope mixing model showed that the source of freshwater to the Louisiana Shelf was dominated by the Atchafalaya River in summer, and by the Mississippi River during non-summer seasons. This pattern is consistent with the general shelf circulation that reverses in summer, but could not have been shown solely by the use of salinity. Application of this approach to waters of the Mississippi Sound during last year's opening of the Bonnet Carré Spillway reveals the temporal and spatial influence of Spillway waters in the Sound.

Sibel Bargu, Louisiana State University, Department of Oceanography and Coastal Sciences

Session 38

MISSISSIPPI RIVER DIVERSIONS AND PHYTOPLANKTON DYNAMICS IN DELTAIC GULF OF MEXICO ESTUARIES: A REVIEW

River systems worldwide have become substantially influenced by human activities, including land use changes, river diversion operations, and flood control measures. Some of the unambiguous and best studied examples of effects of enhanced eutrophication on biotic resources can be found in Louisiana estuaries at the terminus of the Mississippi-Atchafalaya River system. The Mississippi River delta has experienced large losses of coastal wetlands due to a combination of human impacts and sea-level rise. State and Federal agencies are moving ahead with plans for building large-scale river sediment diversions, which will capture maximum sediment during spring flood pulses and direct a sediment subsidy into the eroding coastal basins. These large-scale river sediment diversions will also substantially increase freshwater and nutrient inputs and are likely to affect algal bloom formation, including harmful cyanobacterial blooms. There are concerns that discharge of river water containing high concentrations of N, P and Si may trigger algal blooms in the coastal receiving basins. River sediment diversions, as any other flood pulsing, will likely be disruptive to the coastal ecology and so balancing the benefits of slowing coastal land loss against potential negative effects on water quality remains formidable management challenge. We review here the physical, chemical and biological factors affecting primary production in shallow coastal systems and provide known data on ecosystem response to freshwater diversions, large and small. We also discuss potential management approaches to mitigate the negative impacts of the diversions on the health and stability of the coastal food webs.

Sam Bentley, Louisiana State University

Session 38

DELTAIC MORPHODYNAMICS AND STRATIGRAPHIC EVOLUTION OF MIDDLE BARATARIA BAY AND MIDDLE BRETON SOUND REGIONS, LOUISIANA, USA: IMPLICATIONS FOR RIVER-SEDIMENT DIVERSIONS

River-sediment diversions have been recognized as a key strategy for offsetting land loss in coastal Louisiana. Recently, much attention has been focused on sediment capture from the main stem river and conveyance of that material through diversion outflows. Yet, the performance and long-term feasibility of diversions as land-building agents also hinge upon the subsurface stratigraphic architecture of receiving basins, a concept that has largely been unexplored. A major core collection and analysis program was undertaken to study the geological properties of substrates in the Middle Barataria Bay and Middle Breton Sound diversion receiving basins, Louisiana, USA. Over a region of ~200 square kilometers in both basins, 50 vibracores up to 5.5 m in length were collected in spring and summer of 2015. Cores were logged for bulk density and imaged with a Geotek Multi Sensor Core Logger. Split cores were then subsampled for granulometry, organic content, and 14C dating. Both receiving basins are characterized by 1–2 m of organic-rich surficial strata, underlain by 2 m of mineral-rich sand and silt beds that display a greater bulk density. Additionally, some cores contain deeper peaty strata intercalated within muds and sands. 14C dates of these buried peats range between 1910 and 3203 calendar years before present demonstrating that relatively old deltaic strata exist at shallow depths. Age comparisons of stratigraphically-similar peat beds from this study and previous delta-lobe chronological models indicate that the St. Bernard lobe prograded eastward at a time-averaged rate of 75 m/yr. From a geotechnical standpoint, the surficial, uncompacted (2 m depth, average 1.15 g/cc bulk density) peaty strata in both basins are likely to erode and/or compact under the influence of diversion flows, but deeper consolidated mineral-rich strata (average 1.85 g/cc bulk density) are likely to be more resistant. Hydrodynamic models that predict the erosion associated with river-sediment diversion outflows in this region would benefit from incorporating a two-layer subsurface configuration, with a weaker, peat-like layer overlying a stronger, mineral-rich layer. The results of our study suggest that regions with an abundance of clastic strata at depth should be sought out when planning coastal restoration methods such as river-sediment diversions.

Navid Jafari, Louisiana State University

Session 38

Wetland Soil Strength with Emphasis on the Impact of Nutrients and Sediments of Case Studies in the Mississippi Delta and New England

A review is presented of shear strength measurements in wetland soils, which can be used to make inferences of the influence of nutrients and sediments on wetland health. Ecosystem restoration is increasing across the Gulf of Mexico and in other coastal systems, with management questions related to soil strength among the most critical to address for the sustainability of restoration programs. An overview of geotechnical engineering principles is provided as a starting point to understand basic soil mechanics concepts of stress, effective stress, pore-water pressure, unit weight, and shear strength. The review of wetland shear strength measurements focuses on the hand-held vane shear, torvane, cone penetrometer, and wetland soil strength tester. This synthesis shows that vane shear measurements can identify the shear strength trend in horizontal and vertical spaces and may be an indicator of wetland soil strength. However, the significant un-certainty of the vane shear measurements may preclude making conclusions about shear strength values without further testing and calibration of the devices. The torvane results show considerable scatter such that it is not recommended for quantitative shear strength measurements. The cone penetrometer represents a technique that is independent of operators and provides a high density of measurements with depth. It signifies the state-of-practice of wetland shear strength testing and is a reasonable tool to measure spatial and temporal variations in soil strength and other geotechnical properties (e.g., pore-water pressure, soil moisture, resistivity, and temperature) in wetlands. The wetland soil strength tester provides insight into the wetland soil resistance in the first 15 cm, which is the zone where most belowground biomass is present. Recommended future research includes evaluating the uncertainty in all in-situ soil strength testing methods, developing relationships between different field instruments, and establishing consistent statistical methods and field-testing procedures to make inferences and assessments.

Kehui Xu, Louisiana State University

Session 38

A REVIEW OF SEDIMENT DIVERSION IN THE MISSISSIPPI RIVER DELTAIC PLAIN

One of the proposed methods for restoring the disappearing Mississippi Delta is sediment diversion which uses channels and structures to divert water and sediment from the Mississippi and Atchafalaya Rivers into adjacent basins. This study presents a comprehensive review of geological and physical aspects of sediment dynamics in the Mississippi River Deltaic Plain (MRDP), with special reference to diversion studies over the past two decades. We synthesize these studies, present the current understanding of sediment diversions in the context of sediment dynamics, identify multiple key knowledge gaps, and make recommendations for future studies.

To maximize net land building in the MRDP, management strategies should be focused on (a) enhancing river sediment delivery (both mud and sand), (b) increasing sediment retention in receiving basins and (c) minimizing erosion in bays and estuaries. Compared with extensive studies of land building, there have been relatively fewer studies of erosional processes. A heterogeneous coastal geological framework, cohesive sediment erodibility and subsidence together play complicated yet critical roles in future sediment dynamics in bays and estuaries of the MRDP. Sediment retention rates are highly sensitive to spatial and temporal scales, types of sediments and delivery season. Sediment diversions to seaward receiving basins provide more surge protection but tend to have lower sediment retention due to active coastal processes. Structures and devices that improve sediment retention, trap sediments, dissipate waves, and build living shorelines should be explored and cost-to-benefit analysis is needed. Long-term planning should consider more landward diversions, strategic community relocation, and nonlinear response of the complex sedimentary system of the MRDP.

Presenter Bio: Dr. Kehui Xu is an associate professor of Department of Oceanography and Coastal Sciences and Interim Director of Coastal Studies Institute of Louisiana State University. His research areas are geological oceanography, coastal morphodynamics, observation and numerical modeling of sediment transport, bottom boundary layer, sedimentary geology, and coastal processes.
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Adam Hosking, Jacobs

Session 39
INTEGRATED SOLUTIONS FOR COASTAL CITY CLIMATE RESILIENCE

Coastal cities globally face many challenges in delivering a safe, affordable and resilient environment for their residents and economy. Added to the pressure of increasing populations and aging infrastructure, is the accelerating impact of climate change, which in the coastal context includes the challenge of sea level rise and storms. Whilst these are essentially independent challenges, they manifest in impacts, such as flooding, to the places and assets used by communities and businesses. Focusing on resilient outcomes for these places, drives us towards a more integrated approach whereby these challenges are addressed in the context of the wider needs and objectives of the affected areas. Solutions take different forms dependent on the nature of the area, it's uses and the hazards it faces. Recent and ongoing examples around the globe, which the authors are engaged in, provide a good illustration of some of the key features

• Spatial Planning - central to the integrated approach is consideration of the 'space' as a whole, rather than individual component parts. The San Francisco 'Seawall Earthquake Safety and Disaster Prevention Program' is developing holistic solutions integrating future use of the waterfront into management of seismic, flood and sea level rise risks, including emergency management.

• Resilient Infrastructure - infrastructure systems underpin all urban spaces and public services. For Miami, Florida, resilience strategies are improving continuity and resilience of critical public services including roads and water and wastewater systems, and managing flooding risks to community infrastructure systems.

• Adaptable Flood Protection - recognizing that the city itself, and the hazards it faces, are not static is crucial. Developing solutions that maintain their performance standards into an uncertain future, requires the capacity to adapt. Thames Estuary 2100 (UK) sets out 'adaptive pathways' to pro-actively address all potential future conditions.

• All Hazards - delivering resilient coastal spaces requires the range of hazards that may affect an area to be understood and addressed, in order that all risks are managed to an acceptable level. The Christchurch (NZ) Multi-Hazard study has defined present and future seismic, coastal and flood risks to underpin development of their resilience strategy.

• Integrated Green Infrastructure - this takes many forms and provides a highly effective approach to resilience for coastal cities, bringing multiple benefits. The New York City resilience strategy has a dedicated green infrastructure program identifying opportunities to integrate green solutions into the city fabric, including stormwater GI, along with nature-based coastal solutions.

Effective delivery of coastal climate resilience requires a shift from a sectoral approach to integrated place-based approaches. Drawing lessons from major coastal city resilience programs around the world, the presentation describes how multi-disciplinary approaches, integrating community engagement, can support the delivery of comprehensive resilience outcomes.

Chris Levitz, AECOM

Session 39
COASTAL RESILIENCY PLANNING: DEFINING & MOVING TOWARDS RESILIENCE ON THE COAST

One of the focuses of the 2019 Texas Coastal Resiliency Master Plan (Resiliency Plan) is to accurately and realistically describe possible future scenarios on the coast related to expected climate- and environment-related changes. Quantifying and characterizing these changes are critical for planning coastal projects and ensuring that state funds are used strategically and effectually to benefit coastal resilience. To achieve this, the Texas General Land Office (GLO) worked with AECOM to define what 'resiliency' entails, as well as steps that are currently underway or planned for the future that can help achieve greater levels of resilience. The first step in this process is understanding why resiliency is needed (for instance, due to what physical or environmental processes) and where the largest or most pressing areas of need exist. Although a long-term planning effort, the Resiliency Plan considers short-term vulnerabilities, such as those driven by coastal storms, as well as long-term vulnerabilities.

Specific to the 2019 planning process, a series of recommendations for relative sea level rise planning estimates to be used along the Texas coast when implementing resiliency projects. This presentation will describe some of the coastal modeling that was used to identify future vulnerabilities of land loss, storm surge inundation, and economic damages due to storm-induced flooding—all including the potential future effects of sea level rise—focusing on the practical implementation of these results. Building knowledge of future conditions allows promotion of proactive measures rather than traditional reactive efforts, creating greater possibilities for cost-efficient programs that have significant long-term benefits. The presentation will also discuss how resiliency is incorporated into program-level project recommendations and other prioritized 'Tier 1' projects presented in the Resiliency Plan.

The GLO has identified several areas of growth to continue to make the Resiliency Plan a useful tool for project managers overseeing project implementation using funds provided or administered by the GLO. Included in this goal are developing templates and standard operations to assist the GLO and interested coastal stakeholders in designing and constructing more resilient projects under the umbrella of adaptive management. It also includes helping progress prioritized, but highly conceptual coastal resilience projects into initial design and permitting phases. From a data collecting and monitoring standpoint, improving models that characterize "future with-project" scenarios at mitigating the effects of sea level rise will give additional justification for project construction and provide tangible goals for how projects should incorporate the predictions generated by these models during design.

The GLO coordinates its resiliency planning efforts with a wide array of coastal stakeholders. Part of the GLO's focus on resilience includes fostering open communication and provide useful tools to improve how the coast is managed across diverse perspectives. From a stakeholder and community engagement standpoint, the GLO is developing enhanced coastal hazard mapping tools to better inform local coastal management and development planning, among other ongoing outreach and coordination activities.

Amanda Taylor, Geosyntec Consultants

Session 39
Coastal Watershed Planning and Climate Change

According to the Intergovernmental Panel on Climate Change (IPCC), as the global temperatures and sea levels rise, the extent of the effects of climate change on individual communities will vary over time depending on the community's ability to mitigate or adapt to change. The effects of climate change are often observed at the local level and therefore require local input and action. Many communities utilize watershed management plans to provide a framework for restoration of water quality in degraded areas and to protect overall watershed health, but these plans rarely address how climate change will affect the watershed and how to increase resiliency to coastal hazard events. The effects of climate change, and more specifically the effects of sea level rise, have been studied with regards to future land use and existing infrastructure. In addition to utilizing the results of previous studies to identify environmental areas more vulnerable to climate change, tools such as the community scorecard serve as a self-assessment guide to identify those areas within the community such as people and property, infrastructure and critical facilities, and societal and economic impacts that are vulnerable to coastal hazard events. These tools serve as the foundation to plan future restoration and protection projects to better protect a community's resources.

This presentation will focus on the resources available to identify vulnerable areas within a community, discuss the current climate change projections for the Gulf Coast, and discuss steps to develop a watershed management plan incorporating the effects of climate change. Examples from recent coastal watershed plans along the Gulf will be discussed.

Rachelle Trahan, Rachelle Trahan Design

Session 39

INLAND FROM THE COAST: CAPTURING LOCAL KNOWLEDGE THROUGH VISUALIZATION TO INCREASE ADAPTATIVE CAPACITY IN COMMUNITIES FACING CLIMATE CHANGE

Local knowledge from communities is often an undervalued resource in landscape planning and design because it is difficult to articulate, translate, and apply to traditional policy and research frameworks. However, for communities to successfully adapt to the increasing challenges of climate change, it is vital that this resource be integrated into these processes. By including participatory visualization strategies, it is possible to document, analyze, and synthesize the complex information related to climate impacts, locally acceptable risks, and community adaptation measures to improve a community's adaptive capacity. These visualization techniques go beyond typical participation and consensus building tools to educate researchers, design professionals, and community members of climate issues, and also to translate local knowledge in a way that is meaningful to landscape planning and design efforts.

Funded by the Gulf Research Program of the National Academies of Sciences, Engineering, and Medicine and the Robert Wood Johnson Foundation (#2000008299), this multi-disciplinary and multi-scalar research project engaged local communities affected by the devastating impacts of severe flooding in Louisiana's capital region. Due to a retreating coast and increased rainfall, climate change undermines the stability of communities, such as the capital region. Located further inland, these communities have traditionally been viewed as safe from coastal issues are becoming increasing vulnerable. Using a participatory planning framework, this research brought community members and local officials together with researchers, government agencies, and design professionals to address these complex issues around climate change. Researchers and designers held workshops, focus groups and interviews with residents and local officials using visualization techniques to document local observations of environmental changes, their interpretations of the causes of these changes, and their ideas about how to address the issues. Using additional visualization techniques, community input was analyzed, synthesized, and integrated with environmental and well-being research along with professional design to develop recommendations at multiple scales.

By using participatory visualization techniques during this process, resulting recommendations are not only more accepted by the community, but also more feasible, implementable, and manageable. Through this participatory process, researchers forged strong and ongoing relationships with and between community stakeholders who are now taking steps to implement the plans that emerged. This framework shows that including participatory visualization in the landscape planning and design process can vastly increase adaptive capacity and resiliency in communities even as climate change brings greater risk.

Amanda Anderson, U.S. Geological Survey

Session 40
Evaluating the Efficacy of Barrier Island Restoration for Coastal Birds

Louisiana's coastal ecosystems provide resources and ecological services that are integral to economic and environmental interests, such as protection of coastal infrastructure and providing unique habitat for wildlife. In terms of wildlife, Louisiana's coast hosts up to 73% of the regional and global abundance of coastal bird species, and near-shore habitats such as barrier islands are vital for sustaining robust populations. Louisiana barrier islands, for example, provide critical wintering and migratory habitat for federally listed species including Piping Plover and rufa Red Knot, and breeding habitat for species of conservation concern such as Wilson's Plover.

The structural integrity of barrier islands are constantly threatened by a combination of erosion, sea-level rise, and other factors, which alter habitat availability and suitability for avian species. Therefore, it is imperative that barrier island systems are managed in a way that ensures these systems remain resilient. The NRDA Caillou Lake Headlands Restoration Project (TE-0100) was completed in 2018 to restore the ecological function of Whiskey Island and preserve interior coastal areas from further deterioration. The project involved dredging of 10.45 million cubic yards of offshore sediment to create 954 acres of beach, dune, and marsh habitats and subsequent vegetation plantings. Evaluating whether restoration for structural integrity can also provide natural habitat that enhances community resiliency is pertinent for benefiting a variety of stakeholders and species of conservation concern.

Avian species presence at Whiskey Island is dependent on the timing of the annual cycle and life history requirements, and many species that use the island require a mosaic of habitats to fulfill their energetic and reproductive demands. We monitored abundance, habitat use, and behavior for species of conservation concern at Whiskey Island prior to, during, and following restoration activities from 2015 to 2020. We modeled species density and abundance, habitat use, and seasonality to determine if habitat and use changed between restoration phases for a variety of avian species. The community-level inferences we identify will document avian response to restoration activities that could inform future restoration projects in coastal Louisiana and beyond.

Erik Johnson, National Audubon Society

Session 40

HABITAT ASSOCIATIONS OF BLACK RAIL IN COASTAL LOUISIANA MARSHES – IMPLICATIONS FOR PERMITTING AND RESTORATION

The enigmatic Eastern Black Rail (Laterallus j. jamaicensis) remains poorly known, and even basic life history data like its distribution and habitat relationships remain poorly understood. Over the last 20 years, repeated surveys in the mid-Atlantic have demonstrated a rapid contraction of the bird's distribution with population declines estimated around 90%. Because of these apparent rapid population declines and rarity of the species across the southeastern Atlantic and Gulf Coasts, it has been proposed for listing as Threatened under the Endangered Species Act. Prior to May 2017, the Louisiana Ornithological Society had records of 13 well-documented Black Rail reports ever in Louisiana, although many additional unconfirmed reports suggested a more regular occurrence, which if true, had remained elusive to the research and conservation community. This project's goal was to document the status of Black Rails across Louisiana's coastal zone between May 2017 and April 2019 by focusing on potentially suitable habitat, as recently described in Texas. We did this by utilizing two survey methods: A) point counts (at 33 sites) and B) drag-line surveys (at 16 sites), the former during breeding season (April-July) and both during the non-breeding season (November-March). We tallied a total of 38 detections at 21 of 152 point count locations (among 11 of 33 sites) primarily during the breeding season, but also during the non-breeding season. Occupancy analyses considering a variety of habitat variables measured using SHARP protocols from 1,239 point count surveys indicated a strong positive relationship with Spartina spartinae cover. Predicted Black Rail occupancy exceeded 50% above 32% cover of S. spartinae. Among 61 drag-line surveys, we tallied 36 detections, including 28 Black Rail captures of 25 individuals across 7 of 16 survey locations. We deployed 0.9-g VHF radio transmitters on 16 birds, and among 13 with sufficient data (13 to 84 location estimates), we estimated the 95% minimum convex polygon home range size to be 0.71 ha (± 0.13 ha; range 0.22 – 1.59 ha). Our surveys efforts, funded by Louisiana Department of Wildlife and Fisheries and U.S. Fish and Wildlife Service, have demonstrated that the Black Rail is part of the core Louisiana avifauna, which has potential implications for coastal restoration, wetland mitigation, and land management activities in a landscape threatened by sea level rise, subsidence, and coastal wetland loss.

Kiah Williams, Tulane University

Session 40

NEST SUCCESS AND BEACH RENOURISHMENT: A COMPARISON OF THREE BEACH-NESTING BIRDS IN COASTAL LOUISIANA

Louisiana is losing land at an alarming rate, and beach-nesting birds are on the front lines. The Coastal Protection and Restoration Authority has begun implementing beach renourishment programs to protect communities from the detrimental effects of erosion and flooding from storm surge as well as create new habitat for wildlife.

In order to evaluate the effects of beach renourishment on reproductive success, we followed the nests of 239 Wilson's Plover (Charadrius wilsonia), 1373 Least Tern (Sternula antillarum), and 144 Common Nighthawk (Chordeiles minor) to their fates in southeast (SE) and southwest (SW) Louisiana from 2016 to 2019. We calculated daily nest survival (DNS) estimates using the 'RMark' package in R and compared fates between three restored and six unrestored sites. Known causes of nest failure included predation, human-caused failure (stepping on or driving over nests), abandonment, cattle trampling, and washout. Nests with unknown fates were excluded from analyses.

Tropical Storm Cindy in 2017 and Hurricane Barry in 2019 caused an increase in "washout" nest fates in both of our study regions. Thus, we included "years with storms" in our candidate models in addition to "region", "year", and "restoration" as independent variables, and tested models with all combinations of variables and their interactions against DNS. We did not include confounding variables such as "year" and "years with storms" in the same models. Models of best fit for Wilson's Plover and Least Tern included effects of years with storms, restoration, and region, while the Common Nighthawk model included effects of year and region.

For Wilson's Plover, in SW Louisiana during years when storms occurred, DNS at restored sites was higher than at unrestored sites. For Least Tern, in SE Louisiana during years where storms did not occur, DNS at unrestored sites was higher than at restored sites. The low number of Least Tern nests at SE unrestored sites, coupled with high predation and low hatch success in SE restored sites supports this result. While Common Nighthawk DNS estimates in SE and SW Louisiana were not significantly different from each other, lower DNS estimates were still seen in both regions in 2017 and 2019, suggesting the same effect of storms on daily nest survival. These results suggest that beach renourishment helps to mitigate the impacts of storms, but in providing more nesting habitat for birds it may also provide habitat for predators. Least Tern nests experienced the highest percent of nest predation at 28%, followed by Wilson's Plover at 13% and Common Nighthawk at 9%. Least Terns are the only colonial-nesting species of the three, while Wilson's Plovers are solitary nesters with group defense, and Common Nighthawks are fully solitary nesters. Thus, in future analyses we will determine whether differences in breeding sociality should be included in models to predict daily nest survival estimates.

Bruce Lelong, AECOM

Session 41

DESIGN OF THE MID-BARATARIA SEDIMENT DIVERSION PROJECT

Sediment diversions are cornerstone projects of the Louisiana's Coastal Protection and Restoration Authority's Master Plan, as the state firmly believes, and has science-based evidence to support, that they are critical components of a holistic plan to restore and sustain Louisiana's coastline. Due to the complexity of the projects, CPRA is developing robust and extensive engineering and design plans to ensure the most effective and efficient projects are ultimately built. The proposed Mid-Barataria Sediment Diversion, planned for the west bank of the Mississippi River in Plaquemines Parish, LA, is the first of two sediment diversion projects that has been prioritize for implementation.

This presentation will discuss the current design phase of the project and project timeline, as well as a review the design of several project aspects, including the intake structure, gate complex, guide levee, and outfall structure. Additionally, presenters will discuss additional considerations and challenges related to project design, including local drainage, Highway 23 and railroad relocation, NOV levee alignment impacts, utility relocations, and the beneficial incorporation of dredge material into project design.

Scott Peyton, Stantec Consulting Services, Inc.

Session 41
DESIGN OF THE MID-BRETON SEDIMENT DIVERSION PROJECT

Sediment diversions are cornerstone projects of the Louisiana's Coastal Protection and Restoration Authority's Master Plan, as the state firmly believes, and has science-based evidence to support, that they are critical components of a holistic plan to restore and sustain Louisiana's coastline. Due to the complexity of the projects, CPRA is developing robust and extensive engineering and design plans to ensure the most effective and efficient projects are ultimately built. The proposed Mid-Breton Sediment Diversion, planned for the east bank of the Mississippi River in Plaquemines Parish, LA, north of the Mid-Barataria project site, is the second of two sediment diversion projects detailed in CPRA's Coastal Master Plan that has been prioritized for implementation.

This presentation will discuss the current design phase of the project and project timeline, as well as a review the design of several project aspects, including the intake structure, gate complex, guide levee, and outfall structure design. Additionally, presenters will discuss several considerations and challenges related to project design, including local drainage considerations, highway relocation, and the beneficial incorporation of dredge material into project design.

Jessica Simms, Office of Community Development

Session 42
MULTI-DIMENSIONAL CONSIDERATIONS IN PLANNING FOR MANAGED RETREAT

The effects of climate change are propelling us beyond historical frontiers – fiercer, wetter storms, longer and dryer droughts, larger and longer-burning fires, hotter and more oppressive temperatures. In Louisiana, slow-onset events, such as coastal erosion, are conjoining with rapid-onset disaster events, such as hurricanes and together they are amplified by climate change. Many Louisiana residents, particularly coastal, are familiar with ongoing disruptive displacements and are increasingly compelled to relocate as a form of climate adaptation. These relocations are interconnected with land loss, livelihood shifts, breakdowns of social networks, and more. Local sentiment, while often vocally opposing relocating away from the coast, has been engaged in an uncoordinated retreat, which weakens local culture, for decades. When combining vulnerabilities correlated with age, ethnicity, and poverty, the layers of multi-disasters are even more acute. In turn, cultural restoration can benefit from an equitably funded and government assisted “inland advance” that embodies the fundamental component of sustainability of social justice. Indeed, there is no doubt that climate-related managed retreat is an enormous socio-economic challenge. As such, this panel will engage with a number of the related themes to planning for managed retreat, including inquiries into social justice as part of a sustainable future for coastal Louisiana, unpacking the tradeoffs residents negotiate when it comes to hazard risk and risks to livelihood, social capital, culture, sentiments, and history, how prioritization of hazard risk changes over time and how this affects the impetus for relocation. Finally, panelists will elucidate how planners and state officials are contending with these risk tradeoffs, and how this affects relocation processes and outcomes, including the current resettlement of Isle de Jean Charles.

Beaux Jones, The Water Institute of the Gulf

Session 43
EDUCATING LOUISIANA'S NEXT GENERATION OF COASTAL AND ENVIRONMENTAL LAWYERS

Louisiana's coastal zone is considered by many to be the front lines of the fight to understand, mitigate and adapt to the impacts of global climate change and sea level rise. Our geography, geology and hydrology lead to a host of unique legal challenges that Louisiana lawyers are forced to confront regardless of whether they choose a path in traditional environmental of mineral law fields or opt instead for a career in transactional, commercial, or real estate law.

Environmental and coastal law is hard to avoid in Louisiana. In the last several decades, many Louisiana attorneys have unwittingly ended up in cases or transactions hinging on matters of coastal and environmental law. And many more are seeing the opportunity to develop a robust practice in these fields. These opportunities and necessary competencies have been steadily increasing as Louisiana has also become home to some of the most intriguing and controversial large-scale environmental legal battles in the country. These matters include the Deepwater Horizon oil spill disaster and companion litigation, the Hurricane Katrina flood damage cases, the coastal pipeline damage suits and existential challenges to the Endangered Species Act.

This panel brings together a group of highly-respected academics and practitioners with wide-ranging experiences in the legal field to engage in a robust discussion about what the next generation of lawyers should be focusing on in their education and how current lawyers can expand their practice and skill sets to better meet the challenges presented in coastal Louisiana.

Angelina Freeman, Coastal Protection and Restoration Authority

Session 44

IMPLEMENTING AGENCY-COORDINATED WATER QUALITY MONITORING IN COASTAL LOUISIANA: CHALLENGES AND LESSONS LEARNED

Ecosystem restoration efforts are increasing across the Gulf of Mexico region, and a large-scale effort to restore coastal Louisiana is underway, guided by Louisiana's Comprehensive Master Plan for a Sustainable Coast. Critical to successful management is quantifying coastal water quality conditions and evaluating change over time, and in response to management actions, to support the strategic implementation and adaptive management of restoration projects.

The Louisiana Coastal Protection and Restoration Authority has developed a System-Wide Assessment and Monitoring Program (SWAMP) to monitor and assess both natural and human systems in coastal Louisiana. The SWAMP water quality network leverages existing long-term water quality programs (e.g., Louisiana Department of Environmental Quality, Louisiana Department of Wildlife and Fisheries, and United States Geological Survey), combined with the establishment of new water quality stations to fill data gaps. Water quality parameters measured include nitrogen, phosphorus, silica, chlorophyll a, total suspended solids, total volatile solids, turbidity, dissolved oxygen, temperature, salinity, and pH.

Through SWAMP, water quality monitoring was planned and implemented in Barataria Basin west of the Mississippi River, and in Lake Pontchartain and Breton Sound Basin east of the Mississippi River, with plans to expand the program coast-wide. Data collection and collation of ongoing monitoring data started in 2015 to understand system conditions and dynamics at the basin and coast-wide scales. There have been a number of challenges in implementation, including State boundaries and funding constraints, a dynamic deltaic setting, historical data collection and processing methodology, and data distribution. Lessons learned from implementation of this State-wide coastal water quality monitoring program will be shared, and an initial analysis of water quality conditions from the dataset will be presented.

Josh Carter, Mott MacDonald

Session 44
COASTAL ANALYSIS AND RESTORATION APPLICATIONS OF MACHINE LEARNING METHODS

Machine Learning (ML) methods can be utilized to analyze and solve a wide range of problems in the field of coastal engineering. ML can be used to accelerate traditional process-based numerical models, quickly generate longer duration hindcast or forecast simulations built on historical observations or existing predictions, build predictive tools based complex interdependent relationships in data, and in some instances replace process-based numerical models to develop predictions based on existing data. This presentation will provide examples of each of these as applied to coastal restoration projects, highlighting the advantages as well as limitations of the ML methods.

In the first example, a project required water level at a historically un-monitored site over a long duration to determine how water level influences marsh erosion. Development and simulation of water levels with circulation models over a long-duration was financially and computationally prohibitive. A recurrent neural network (RNN) was trained using a short period of measured data at the project site correlated to nearby wind and water level gauges. The trained RNN accurately predicted water levels at the site quickly and accurately without the effort to develop a circulation model.

In the second example, a project required predicting currents at proposed structures in a large area that required high resolution and long duration results. This is computationally expensive for a process-based models. A RNN was used to correlate the input boundary conditions for the process-based model Delft-3D FM to the global output of the numerical model for a limited output duration. The trained RNN surrogate simulated tidal hydrodynamics in place of Delft-3D in seconds with the same fidelity and can produce long-duration simulation results with trivial computation effort to develop accurate design parameters.

The third example involved simulating historical water levels in a marsh to compute marsh inundation. Process-based models were unable to simulate long durations with reasonable computation time. A convolutional neural network (CNN) was used to correlate measured data (tide, precipitation, structure operations) to the water levels measured in the marsh. The trained CNN computes water levels in the marsh with a RMSE of 2.75 inches and is thousands of times faster than the numerical model.

The fourth example generates hydrodynamics as inputs to drive water quality (WQ) modeling to compute the WQ for a multitude of conditions. The WQ model is fast, but the driving hydrodynamic model is slow. A RNN was used as a surrogate model of hydrodynamics to force the WQ model. This method provided the ability to quickly simulate hundreds of scenarios.

The fifth example uses a ML method to predict favorable locations for seagrass habitat. Physical characteristics along with modeled hydrodynamics are used to train a random forest classifier, which predicted existing seagrass habitat with a 90% accuracy. This ML tool is used to

develop habitat creation projects by testing results of numerical models with proposed features with the ML habitat predictor tool to develop successful habitat restoration.

Shaye Sable, Dynamic Solutions, LLC

Session 44

THE CASM FOOD WEB MODEL FOR EVALUATING BIOMASS RESPONSES AND ENERGY CYCLING IN LOUISIANA'S ESTUARIES

The Comprehensive Aquatic Systems Model (CASM) has been used to characterize the estuarine food web and evaluate key fish and shellfish biomass responses to changing environmental conditions and large-scale restoration projects in Pontchartrain Basin, Breton Sound, and Barataria Basin. The current food web model version is comprised of 34 taxa including phytoplankton, periphyton, zooplankton, benthic infauna, grass shrimp, brown and white shrimp, blue crab, bay anchovy, gulf menhaden, Atlantic croaker, largemouth bass, red drum and spotted seatrout. Multiple life stages in the estuary are simulated for many species. Bioenergetics-based equations are used to simulate daily biomass change for each consumer population within the food web. Daily temperature, salinity, chlorophyll a, and marsh and/or open water habitat drive the primary producer and detrital biomasses, as well as the consumer bioenergetic growth processes. The CASM food web model is run in spatial polygons to predict the distribution of biomasses within the estuaries, and the daily biomass results of each spatial polygon are combined to produce basin-wide biomass estimates over simulated years.

For the three coastal basins, monthly biomasses were calibrated to biomasses estimated from the Louisiana Department of Wildlife and Fisheries and National Oceanic and Atmospheric Association sampling programs. Changes in key species biomass spatial patterns and annual basin-wide trends were evaluated for large-scale river diversion scenarios. The predicted biomass changes between diversion scenarios and no action were primarily dependent upon the lower trophic level prey that changed over space and time in and over years. These bottom-up food web responses were most evident in the shrimps, crabs, and forage fish feeding on the phytobenthos or phytoplankton, and benthic infauna and epifauna or zooplankton. Prey-dependent responses in the larger predator species like seatrout, drum and bass were harder to resolve and complicated by salinity and habitat structure affecting daily growth.

The calibrated CASM for Barataria Basin was recently used to output several ecosystem indicators that characterize the structure of the food web and how well energy flows from the primary producers and detritus up the food web through different connected species and pathways. The CASM indicated that detritus accounted for approximately 10% of all flows in the food web, while 53% of the flows originated from primary producers. The indicators also suggested the modeled food web was resilient with multiple trophic pathways, and that opportunistic predators such as seatrout, drum, and bass feeding on shrimps, crabs, forage fish and smaller conspecifics were unlikely to show effects of prey limitation.

Torbjorn Tornqvist, Tulane University

Session 44

TIPPING POINTS OF LOUISIANA'S COASTAL MARSHES DUE TO ACCELERATED SEA-LEVEL RISE – HAS THE SHIP SAILED?

Coastal marshes are threatened by relative sea-level (RSL) rise and other human impacts, yet recent studies predict marsh survival even under the high rates of RSL rise expected later in this century. However, since these studies are mostly associated with short instrumental records, uncertainty persists about the longer-term vulnerability of coastal marshes. Here we present an 8500-year-long marsh record from the Mississippi Delta, showing that when RSL rise exceeds ~3 mm/yr with respect to the pre-existing land surface, marsh drowning occurs within a few centuries. When rates increase to 6-9 mm/yr, a plausible condition within the next 80 years, drowning occurs in about half a century. Since the ~3 mm/yr threshold rate has already been surpassed by the present-day rate of global sea-level rise, submergence of the remaining ~15,000 km2 of marshland in coastal Louisiana has probably become inevitable. Given the sediment deficits in the Chenier Plain, it is likely that southwest Louisiana is even more vulnerable to accelerated RSL rise and may be converted to open water at a more rapid pace than the Mississippi Delta. Specific marsh tipping points due to RSL rise vary geographically and threshold rates for the microtidal Louisiana coast may be lower than elsewhere. This is due to the low elevation capital in this region, with marsh platforms less than a few decimeters above the mean tide level. Our findings highlight the need for studies that consider longer time windows to determine whether coastal marshes worldwide may be more vulnerable than commonly recognized.

Alexandra Christensen, Jet Propulsion Laboratory

Session 45

MULTI-SOURCE REMOTE SENSING OF VEGETATION DYNAMICS IN THE MISSISSIPPI RIVER DELTA

Alexandra Christensen1, Marc Simard1.

Sustainability of coastal wetlands will depend on relative sea level rise, consequent increases in flooding, salinity, and edge erosion, and frequency and intensity of storm events such as hurricanes. In coastal Louisiana, wetlands are particularly vulnerable due to decreasing sediment deposition and increasing subsidence, which control marsh elevation and therefore the resilience of marshes under climate change scenarios. In southeast Louisiana, the Atchafalaya and Terrebonne basins represent distinct coastal environments, the first maintains a strong river connection, which provides sediment supply to wetlands, whereas the second is disconnected and sediment starved. Differences in landscape of these two basins are dramatic with the land growth in Atchafalaya basin and significant land loss and marsh fragmentation in the Terrebonne. These two systems are the experimental units of Delta-X, a 5-year NASA Earth Venture Suborbital program and are used to study interactions between vegetation, hydrology, and geomorphology in coastal wetlands. As part of this program, we use optical (Sentinel-2) and C-Band and L-Band radar satellites (Sentinel-1 and ALOS2) to classify the Atchafalaya and Terrebonne basins into vegetation functional groups. Vegetation structure and chemical content, which are often controlled by salinity, flooding frequency and duration, and sediment delivery, produce different signals that are detected by each satellite. Our classification focuses on plant phenology by incorporating winter, spring and fall images to capture differences in plant emergence, die-off, and peak biomass among species. Through this method, we identify 8 major vegetation functional groups: dense and sparse forest, freshwater broadleaf marsh, freshwater grass marsh, freshwater floating leaf marsh, intermediate marsh, brackish marsh, and saline marsh. With two satellites each, Sentinel-1 and Sentinel-2 have high revisit times (6 and 5 days, respectively) and moderate spatial resolution, providing ample data for time series vegetation analysis. From these time series we can detect changes in vegetation, especially changes due to large storm events such as Hurricane Barry in 2019, and monitor vegetation loss and recovery. Specifically, we can identify areas that experience severe damage and track recovery rates compared to areas with less severe damage. In this presentation, we will discuss results of seasonal and event-driven vegetation change from 2017-2020 and highlight methods for applying and optimizing satellite remote sensing in monitoring vegetation dynamics. In addition, we will discuss how Sentinel-1 and Sentinel-2 data can complement airborne instruments utilized in the Delta-X campaign (April and September 2021). These airborne instruments have higher spatial resolution, but limited revisit times and will be calibrated using in situ field measurements.

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Presenter Bio: Alexandra Christensen is a NASA Postdoctoral (NPP) Researcher at the Jet Propulsion Laboratory. Her research focuses on hydrodynamics of coastal deltas using numerical modeling and satellite remote sensing to study the interaction of vegetation and surface water hydrology.

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Natalie Snider, Environmental Defense Fund

Session 46
INTEGRATING SOCIAL SCIENCE WITH NATURAL SCIENCES IN GULF COAST COMMUNITIES AND BEYOND

Louisiana has advanced the natural science of coastal land loss and restoration but has yet to fully integrate social sciences in these efforts. As communities face mounting threats to their homes, health, and livelihoods from climate change, scientific analysis of how social systems perceive, respond, and adapt to extreme ecological changes on a broad scale is needed. Ongoing research can inform community adaptation efforts to generate more effective and scalable solutions with broad support.

Panelists are conducting various research to assist decision-makers in understanding and integrating the socio-ecological system. Research includes (1) a risk behavioral study on how Louisiana residents understand and react to perceived risk now and in the future, (2) a physical and mental health study as consequences of environmental coastal threats in the Gulf of Mexico and human responses, (3) a study exploring the institutional and cultural forces shaping organized risk reduction efforts in coastal areas, (4) a cultural consensus analysis to identify common or disparate beliefs and values among stakeholder groups, and (5) a pilot study to identify social science indicators to incorporate into socio-ecological models.

Dan Grandal, Stantec

Session 47
BLUE AND GREEN INFRASTRUCTURE FOR A RESILIENT FUTURE IN NEW ORLEANS

Throughout history, New Orleans has dealt with its share of flooding and disasters. New Orleans is surrounded by water in every direction. Elevations throughout the City are below sea level. The City currently provides flood and hurricane protection with levees and floodwalls and employs a series of large pumping stations to remove water from the floodplain as quickly as possible during wet weather events. The City's pumping facilities are some of the largest in the world but are still overwhelmed by large storm events. Building a resilient system that accounts for climate change, subsidence and sea level rise is a difficult challenge. The Blue and Green Corridors project aims to provide an example of a path to success to communities aspiring to resilient and sustainable living in the face of flood risk and natural disasters.

New Orleans is developing a long-term plan for a sustainable, resilient utility that elevates the level of service and protects its residents from natural disasters. As part of this plan, the City is studying the effects of subsidence, sea level rise and increased intensity of storm events over the next 100 years. The City must evaluate the condition of their aging infrastructure and create a system with reliability and redundancy that helps reduce future risk. Supported by over $141 million in funding from the U.S. HUD, the City developed its resilience district within the Gentilly neighborhood of New Orleans. The Gentilly Resilience District (GRD) represents a combination of improvements to reduce flood risk and slow land subsidence and improve quality of life for the residents through innovative water management, recreational, landscaping and complete streets improvements. When implemented together, these approaches are intended to beautify neighborhoods, improve health, raise environmental quality and improve property values. These projects are a model for urban adaptation practices in New Orleans and other delta communities around the world.

Blue and Green Corridors aims to not only reduce flood risk, slow land subsidence, but become the backbone that unites the Gentilly community. Ultimately, the project will encourage neighborhood revitalization and help Gentilly's economy. This will be accomplished by creating a network of recreational waterways, neighborhood parks, community spaces and other amenities along major boulevards of the public right-of-way. Community health is strengthened with access to safe recreational facilities like bikeways and walking trails. Also, the project aims to reduce heat island effect lowering temperatures with a combination of landscaping, green and blue infrastructure to improve conditions for outdoor exercise. To reduce flood risk, the project employs the "living with water" approach in which stormwater runoff is collected and managed where it falls through infiltration-based practices and strategic storage systems. This nature-based approach provides relief to the City's existing drainage system by giving the drainage basin storage to reduce peak flows at the pump stations and to help optimize the system. This also provides opportunities for residents to interact with water in their daily lives and connects the community with safe access to waterways, streams and natural wetland areas. Blue Green Corridors utilizes nature based and complete streets solutions to build community. It provides social, economic, and environmental benefits – or the Triple Bottom Line.

John Malueg, Stantec

Session 47
Community Shift from Disaster Response to Damage Prevention

As communities strive to build resilience to the growing social, economic, and physical challenges of the 21st century, we need to apply holistic thinking and embrace our responsibility in identifying and advancing resilient solutions. This session will focus on the shift in attitudes and approaches of coastal communities from simply reacting to disasters to proactively taking steps to address the threats of climate change and enhance resilience. Participants will learn of the:

1. Broad range of influences that are incentivizing this shift ranging from real-life observations, expanded public awareness, increasing financial risks, evolving regulatory environment and politics,

2. Importance to achieving broad benefits beyond avoiding future damages addressing design with community in mind social, economic and environmental considerations,

3. 10-steps to advancing the sustainabilty and resilience of your community,

4. Specific case studies / actions coastal communities are taking to address climate change.

During the session, case studies will be presented including transformational projects from Louisiana, New York and Puerto Rico to Hawaii. Session will discuss the role and benefits of industry leading resilience planning and design tools including Envision, PIEVC Protocol and the Automated Mitigation Project Identifier (AMPI) to assess risk, evaluate mitigation options and prioritize actions.

Finally, this session will discuss the importance of partnering and associated opportunities to leverage limited local budgets to advance your community's resilience.

Brian Snyder, Louisiana State University

Session 47
Preparing Coastal Communities for Decarbonization-Induced Socio-Ecological Stress

Scholars have understood that ecosystems have value for humans for nearly 2500 years, and for nearly 50 years, scholars have attempted to place a monetary value, called an ecosystem service valuation, on these ecosystem values. However, the quantification of ecosystem services is subject to significant uncertainty. Here, we first provide a meta-analysis of coastal ecosystem service valuation studies to illustrate this uncertainty and find that in many cases, ecosystem service valuations can range over several orders of magnitude for the same service in similar ecosystems. We then conduct an updated reanalysis of one well-cited ecosystem service valuation study by Costanza et al. which found that coastal wetlands had high and statistically significant ecosystem service values for storm mitigation purposes. Contrary to our a priori expectations, using similar but not identical methods and datasets, we failed to replicate Costanza et al.'s findings. This suggests that minor changes in the data sources or methods can lead to major differences in results, implying that ecosystem service valuations may not be as robust as we might hope.

Given these results, we propose that there are two mechanisms for thinking and talking about the value that coastal ecosystems have for humans. The ecosystem service valuation approach represents an economic-quantitative method for which fits well with the quantitative, analytic, and objective nature of cost-benefit analysis, but may appear more rigorous and useful than it is. The ecosystem values approach is a more qualitative-ethical means for communicating value. Because it is qualitative and ethical, the ecosystem values approach has, in recent decades, been less in vogue for policymaking. However, we note that the qualitative-ethical approach was the dominant means of communicating the value of natural systems during the passage of much of the U.S.'s landmark environmental legislation and we wonder if it might remain a useful tool for communicating the value of the coastal zone.

Marius Sokolewicz, Royal HaskoningDHV

Session 47
INNOVATIVE APPROACHES IN COASTAL FLOOD PROTECTION TO INCREASE EFFICIENCY AND REDUCE COSTS

The Netherlands is a low-lying country bordering the North Sea. With 30% of the country below the sea level, the Dutch have a several centuries long tradition of developing water management solutions to keep water out and their feet dry. With the projected climate change this task has become even more challenging. At the same time, there is a call from society to safeguard natural values. Within this context, many coastal innovations have been developed. New approaches to coastal flood risk mitigation like Building with Nature lead to more flexible solutions, with reduced costs and larger social acceptance.

The Dutch sea dikes are generally very high. According to new insights, this height is often not sufficient, and the dikes need to be strengthened. Further increase in height meets a lot of social resistance and is to be limited as much as possible. New methods have been developed to reduce overtopping (innovative rough revetments, wave-damping vegetation, natural foreshores), to accept more overtopping (stronger grass cover of inner slopes, collection of overtopping water), or to increase geotechnical stability (special structures inside the dike). With the new computational methods, wave overtopping and storm surge levels can be estimated more accurately, allowing reduction of the uncertainty margins in the design and therefore reduction of their cost. Probabilistic design allows to fully account for uncertainties while not sacrificing the provided safety.

A large part of the Dutch coast consists of sandy beaches and large dunes. These dunes are primary flood defenses. It has been accepted that dunes can erode during storms, as long as the volume of sand in the beach profile is sufficiently large to guarantee that the dune would not be breached even during a 1 in 10,000 years storm. This minimum volume is sustained by regular nourishments. The Sand Engine is a Building with Nature innovation replacing yearly nourishments by one mega-nourishment of 23 Mm3 sand, spread along the coast by waves and tides, which will provide protection for 25-30 years, reducing cost but also reducing impact on beach ecosystems while enhancing recreation.

With a limited space for coastal defenses and growing demand for space from the society, combination of functions can be a solution. Example are an underground carpark inside the dike, a sea boulevard combined with a sea wall, a hard defense (dike) covered with a dune. This in turn, allows for economic development along coastal shores which can be part of the business case.

Flood risk is being used as basis for planning of flood resilient designs of areas outside the primary flood defenses (e.g. Port of Rotterdam). In this approach, some level of flooding of land is accepted in extreme events while the critical assets are made floodproof, and evacuation measures and other non-structural emergency responses are clearly defined.

These innovations are to be tailor-made for each situation, the technology is available, and could be applied on the Gulf of Mexico coasts.

Katie Percy, National Audubon Society

Session 48

CAN COASTAL RESTORATION PROJECTS PRESERVE BALD EAGLE (Haliaeetus leucocephalus) BREEDING HABITAT IN COASTAL LOUISIANA?

The Louisiana Coastal Master Plan has used species-specific habitat suitability index (HSI) models for key fish and wildlife since 2012, yet the 2017 Master Plan did not include a bird species that is representative of the upper estuary. Our objective was to evaluate potential for the Bald Eagle (Haliaeetus leucocephalus) to serve as a useful indicator of freshwater wetland health, and to develop a model that could be used to evaluate bird response to future land change scenarios. For this, we used aerial nest survey data collected by the Louisiana Department of Wildlife and Fisheries and initially restricted the dataset to the Barataria Basin. We modeled the relationship between Bald Eagle nest occurrence and landcover using boosted regression trees (BRTs) – a machine learning approach that is ideal for modeling complex curvilinear relationships with multiple, and often highly correlated, environmental variables.

Model performance was strong (BRT models explained a mean 54.4 ± 0.1% of the deviance in nest occurrence) indicating positive associations of eagle nesting sites with fresh forested wetlands, freshwater marsh, and flotant marsh. The remaining landcover types (i.e., intermediate marsh, salt marsh, brackish marsh, upland, and developed) each explained 10% of the model variation, with brackish marsh and developed each explaining 1%, and salt marsh showing no relationship with probability of nest occurrence. Projected into the future, the suitability of Barataria Basin for nesting Bald Eagles was higher in 20 and 50 years with restoration action compared to without restoration action, although suitability decreased between 20 and 50 years both with and without restoration action. Reduced suitability is likely due to the substantial predicted loss of fresh forested landcover over time.

Because our results indicate that the Bald Eagle is a good indicator of fresh forested wetlands, we are currently extending the model to evaluate habitat use across coastal Louisiana. This extended Bald Eagle habitat model will be used to evaluate the ecosystem effects of coastal protection and restoration projects during the development of the 2023 Coastal Master Plan.

Victor Rivera-Monroy, Louisiana State University

Session 48

"LOUISIANA'S MANGROVES CARBON STORAGE CAPACITY IN THE CONTEXT OF INCREASING SUBSIDENCE AND SEA LEVEL RATES: MANAGEMENT CONSTRAINTS AND ECONOMIC IMPLICATIONS"

Coastal Louisiana saline wetland habitats comprise ~7.3% of the 4,062,875 ha in total wetland area. Within this category, Spartina alterniflora saltmarshes are predominant, whereas the mangrove species Avicennia germinans mangroves is more sparsely distributed. A. germinans is one the most common neotropical mangrove species and is geographically widespread along coasts from Brazil and Ecuador to the northern Gulf of Mexico (GoM). This species is also more resilient to cold-stress than other mangroves in the GoM (i.e. Rhizophora mangle and Laguncularia racemosa) and is the only species present in the Mississippi delta. Mangrove abundance and spatial distribution closely follows climate in Louisiana as indicated by contractions with severe cold and expansions with more mild winters. Following freezes, the reestablishment of mangroves is further interrupted by coastal erosion and habitat loss. As Louisiana's climate becomes more hospitable to mangroves with warming, forecast models predict a 90% increase in mangroves relative to temperate saltmarshes. This projection has major ecological and economic implications due to the carbon sequestration capacity of mangrove forest. Yet, it is not clear if this capacity can be realized based just on regional climate statistical models given the current wetland loss rates along the coast, particularly in hot spot regions with high mangrove density, but low mineral sediment input. Here we analyzed the potential soil and above carbon storage capacity taking into consideration the modulating effect of high sea level rise (4-9 mm y-1) and subsidence (10-30 mm y-1) in regulating wetland loss in the Port Fourchon (PF) area where 50% of Louisiana mangrove forest is located. Although recent total carbon reservoirs estimates (Aboveground + Soil; range: 149.4 to 395.7 Mg ha-1) are relatively high in PF, when compared to saltmarshes and other mangrove ecotypes in the Northern GoM and Caribbean region, there are major uncertainties in achieving projected expansion and carbon storage just based on predicted changes in climate variables like temperature and precipitation. Thus, the mangrove carbon storage economic value as ecosystem service in the long term might not be archived and probably hard to explicitly include in management plans. This is due to the need to implement extensive sediment diversions associated to low salinity, a condition no conductive to natural mangrove wetland establishment, survival, and sustainability in the long-term.

Gary Shaffer, Southeastern Louisiana University

Session 48

Hydrologic Restoration of Two Baldcypress - Water Tupelo Swamps in Coastal Louisiana

The first two baldcypress – water tupelo swamp restorations in coastal Louisiana funded by CWPPRA (at $7-million each) were recently constructed. Both involve levee gapping, one along the Amite River Diversion Canal in the Maurepas and one in Lac des Allemands in the Barataria. Within a single year statistically significant improvements were measured. Percent canopy closure was nearly identical for pre-construction years of 2016 and 2017. During post construction in 2018, canopy closure increased by about 20 percent and averaged about 70%. Diameter differences differed across sites and species. Importantly, the reference site showed no change in diameter difference between 2017 and 2018, whereas six of eight sites in the des Allemands Swamp experienced an increase, presumably caused by hydrologic restoration (i.e., increased sheet flow and drainage). Similarly, all three of the dominant species experienced increased diameter differences in 2018 compared to 2017. According to Bonferroni-adjusted means, baldcypress had the greatest diameter differences, followed by water tupelo, and the midstory species had the least. Five of the seven des Allemands swamp sites produced more leaf material in 2018 than 2017. Taxodium distichum produced far more litter than Nyssa aquatica and both produced far more litter than midstory species. Overall, herbaceous cover has not been dramatically different over the 3 years. However, there is a clear pattern of the increased canopy closure in 2018 relating to reduced herbaceous cover. The 2019 data are currently being analyzed and these results will be presented.

Soroush Sorourian, FTN-Associates, Ltd

Session 48

HYDRODYNAMIC AND WATER QUALITY MODELING OF LAKE MAUREPAS FRESHWATER DIVERSION

A two-dimensional Delft3D hydrodynamic (Delft3D-FLOW) and water quality (DELWAQ) model is developed, calibrated and implemented to simulate effects of the proposed freshwater diversion on water levels, velocity, total nitrogen (TN), and total phosphorus (TP) in the Maurepas swamp project area. The overall geometry was developed using the LIDAR elevations from the 2012 and 2017 data sets. The bathymetry of the primary streams was based on the field topographic surveys.

The simulation shall be of a steady flow of 2,000 cfs of Mississippi River water introduced into the swamp via the Hope Canal. The results will include predictions for water surface elevation, velocity, and nutrients during summer and winter. The results from a “salinity flushing” scenario will also be included to demonstrate the effects of diversion flow on an initial saline condition in the swamp. The normal tidal water surface elevations will be specified for Lake Maurepas (at Pass Manchac) and historical mean discharge input boundaries will be specified for other streams such as the Blind River and the Amite River.

From the hydrodynamic point of view, the spatial distribution of the diversion water (percentage of the Mississippi River water) in the study area and the adjacent swamp will be simulated and the variation of water surface elevation and velocity at selected locations over the simulation period shall be calculated. Moreover, the freshening effect of the diversion on a swamp that has experienced a high salinity event due to a tropical storm will be predicted by using the salinity flushing simulation.

As for the riverine nutrients, the residence time and the overall loss of TN and TP from the water column will be quantified as the diversion water moves through the swamp. The TN and TP removal will further be compared with two previous modeling studies for the Maurepas swamp. Finally, a discussion will be performed based on the comparison of TN in the southern end of Lake with TN concentrations that were observed in Lake Pontchartrain after the Bonnet Carré Spillway was opened in 2008 and in 2011.

Based on the results from the projection simulations, the efficacy of the proposed diversion of Mississippi River water into the Maurepas swamp will be evaluated. It is expected that the diversion will provide beneficial freshening and nutrients to a large area of the swamp without causing large increases in nutrient concentrations in Lake Maurepas.

Windell Curole, South Lafourche Levee District

Session 50

EVACUATION, ELEVATION, AND INNOVATION: COMMUNITY SURVIVAL IN A SUBSIDING DELTA

The communities of South Louisiana exist on the great delta of North America. Like communities on other great deltas of the world, Louisiana's coastal communities have both great opportunity and great risk. The present-day communities in South Lafourche have dealt with, and continue to deal with, 60 inches of rainfall per year, hurricanes, subsidence, coastal erosion, and sea level rise.

Where the upper part of Bayou Lafourche was developed from Donaldsonville south to Lockport, the southern part of the Bayou Lafourche ridge was developed from people retreating north from the Hurricanes of 1893, 1909 and 1915. Even with this retreat, the communities have had to adjust economically, environmentally, and structurally with innovative and cost-effective strategies to avoid the fate of neighboring communities as the Gulf of Mexico overtakes marsh, dry land and fresh water.

To ensure the best flood protection as soon as possible, the South Lafourche Levee District learned to think about the core of the issue rather than to think solely about the structural solution to deal with the issue. The core issue and responsibility is to keep water out of people's homes and businesses. This thinking leads beyond traditional methods to the inclusion of supporting and promoting pre-WWII techniques of building above ground homes on high land and reestablishing natural landscapes like ridges and marsh.

All projects, whether infrastructure, economic or environmental were planned in consideration of the projects' comprehensive effects to the community. In 1980 the South Lafourche Levee District began to incorporate restoration projects which not only enhanced the environment but assisted in the maintenance of critical flood protection projects. Concepts such as marsh and terrace aprons were implemented to protect against erosion and some wave energy decrease during storm events. Partnerships with the state, parish, landowners, and nonprofits have produced increased wetland acreage for environmental projects that directly assist flood protection.

This process has maximized available funds for the benefit of the community to satisfy the need for flood protection and environmental enhancement.

John Doucet, Nicholls State University

Session 50

SEDIMENT, SETTLEMENT, AND CYCLONE: THE FALL AND RISE OF SOUTHEAST COASTAL LOUISIANA AT THE TURN OF THE 20TH CENTURY

Nineteenth century coastal Louisiana was home to a diversity of farming and fishing villages interspersed across marshes and along bayous. The Barataria-Terrebonne basin was home to the most heavily populated of these, including Cheniere Caminada at nearly 1600 persons by the 1890s. Cheniere Caminada rose atop the confluence of a series of chenieres that forms a geologic fan just west of Grand Isle, La. From this vantage, Cheniere Caminada served as the major supplier of seafood to the New Orleans market, which was accessible northward through Barataria Bay and confluent bayous. "Caminadaville" boasted a diverse, multi-ethnic population that melded into Francophone due, in part, to the influence of Acadians from the upper Lafourche whose third-and fourth-generation families migrated to the coast.

During the darkness of October 1st and 2nd, 1893, a late season hurricane (estimated Category 4) drawn rapidly across southeastern Louisiana along a low-pressure trough struck the cheniere peninsula without forewarning. Half the population of Caminadaville perished, including nearly all the women and children. All but a few of the village homes were destroyed, as was the entire fishing fleet. The village was never rebuilt. Before exiting the continent over the Carolinas, the storm killed an estimated 2000 persons. Village survivors of the "Great Cheniere Hurricane" resettled their families northward to found or joint extant villages, including Leeville, Golden Meadow (Canal Yankee), and Côte Blanche along Bayou Lafourche, as well as Salaville (Westwego) across Barataria Bay.

In September 1909, the "Grand Isle Hurricane" (est. Category 3) struck the coast and inundated post-Caminadaville settlements with a 10-15 foot tidal surge felt two miles inland. During this event, the village of Leeville was completely destroyed, and 350 lives were lost across the Gulf Coast. Six years later, the "New Orleans Hurricane of 1915" (estimated Category 4) again struck the coast near Grand Isle, pushing 12-foot tides and killing 275 along the coast. In the aftermath of these two hurricanes, families retreated farther from the coast to settle upstream along Bayou Lafourche and mostly at Golden Meadow, which sat atop a natural ridge above the surrounding marsh. After the 1915 hurricane, the entire coastal fishing fleet relocated to Golden Meadow, transforming it from a largely farming community to major shrimping and oystering community. About 15 years later, a further transformation occurred, as oil was discovered over salt domes underlying the lower Lafourche basin.

The villages destroyed and otherwise challenged by the triumvirate great hurricanes at the turn of the 20th century gave rise to the densely populated area of Louisiana known as South Lafourche. South Lafourche families are a people who have learned challenges of life on the Louisiana Gulf Coast over multiple generations, who know coastal life intimately, who have sustained and transformed traditional industries, and who avidly work to preserve their Cajun-Coastal heritage in the face of land loss. As we urgently face climate change and prospects of community resettlement, the fall and rise of southeastern Louisiana coastal settlements is an important illustration of community and familial resilience.

Gary LaFleur, Jr., Nicholls State University

Session 50
INTEGRATING THE LOUISIANA COAST INTO THE COLLEGE CURRICULUM

We have developed methods to integrate coastal ecology, coastal land loss, and coastal restoration into many of our biology courses at Nicholls. Here we provide three examples of this strategy.

In General Physiology (Biol 326), we normally present a range of mechanisms that can be explained from the molecular to the cellular to the organismal level, and this is where textbooks usually end their treatment of physiology. However, in BioL 326 and other courses, we expand this continuum to include anatomy and physiology of the larger ecosystem, using the boundaries of the Barataria-Terrebonne Estuary as a convenient functional unit. For example, as we discuss circulation in the vertebrate body, we extrapolate concepts to circulation of the watershed, explaining the allocation at the Old River Control Structure that results in 30% flow into the Atchafalaya and 70% into the Mississippi, eventually leading to the headwaters of Bayous Lafourche, Terrebonne, Dularge, Grand Caillou, Petit Caillou, and Pointe Aux Chenes. Similarly, while covering the physiology of how oxygen levels are regulated in body tissues, we expand this discussion to include how hypoxia can occur on an ecosystem level in the annual occurrence of the hypoxic zone in the Gulf of Mexico.

In Introduction to Marine and Environmental Biology (Biol 551), we introduce graduate students to the unique ecological issues that occur on the Louisiana coast. To achieve this, we have developed a collaboration with LDWF to conduct vegetative plantings on the Isle Dernieres Barrier Islands Refuge (IDBIR) during our annual Calypseaux Expedition. Each year we collect, pot, and grow black mangrove propagules at the Nicholls Farm for fall planting at the IDBIR. Over the years, more than 70 students have planted over 7000 mangroves on Raccoon Island, helping to stabilize this important barrier island that supports a diversity of species, including colonies of resting and nesting birds such as brown pelicans, reddish egrets, roseate spoonbills and many more.

In Biomarkers (Biol 575), we travel to the barrier island, Grand Isle, where students compare and contrast different habitats, from the high-energy beach on the front, to the calm chenier forest of the interior, to the saltmarsh at the back of the island. To customize this lesson, we have developed a collaboration with The Nature Conservancy where Nicholls students teach the basics of barrier island ecology to Grand Isle Elementary students. The Nicholls students are simultaneously introduced to the deep culture of a Louisiana barrier island community that has persevered through storms, oil spills, and coastal land loss for more than 200 years.

All three teaching efforts have resulted in impactful experiences for students at Nicholls, where universal biological lessons have been adapted to illustrate the majesty and significance of the Louisiana Coast as a location for in situ environmental education.

Susan Testroet Bergeron, Barataria-Terrebonne National Estuary Program

Session 50
Louisiana's Coastal Citizens: Looking Back, Adapting, and Moving Forward

Louisiana’s coastal land loss issues and the associated ongoing restoration efforts are uniquely tied to the people of the area. Stewards of the wetlands have opened the door to one of the most determined efforts to take on the effects of climate change, subsidence, sediment deprivation, and hydrologic modification. This presentation discusses the organizations, groups, and individuals that have continued to provide the ongoing resolve to keep this issue front and center of not only Louisiana citizens but to make sure that this issue remains a national and international topic of interest.

Explore how a shared experience has made unlikely partnerships that are now forged in a steadfast commitment to faithfully work toward ecosystem restoration. The allegiances formed over years of working together to understand the causes of the problems, the possible solutions, and financial promise make this one of the greatest estuarine ecosystem restoration experiments in human history. Learn why it is working.

Discover how protocols have been established to help people adapt to this ever-changing landscape. Learn why government, business and industry, environmental organizations, and local citizens continue to work together to create a path ahead despite the associated complications.

Join this session and explore how Louisiana continues to move forward and how you can continue to be part of the solution.

Nathan Lott, Preservation Resource Center

Session 52
CULTURAL HERITAGE TOOLS FOR COASTAL RESTORATION

The tools of historic preservation and cultural heritage management are invaluable to efforts to save Louisiana's coastal systems and communities. This panel examines ways planners and engineers can move beyond regulatory compliance to incorporate heritage as an intrinsic value in plans and built projects. Doing so can minimize conflicts and broaden support for coastal protection and restoration. Speakers working at the intersection of ecology and preservation will examine case studies and their own evolving approaches to resilience.

Drawing on decades of experience, including in post-disaster recovery, Nicole Hobson-Morris will outline the legal frameworks for protecting archeological and historic resources established by the National Historic Preservation Act for all projects using federal funds. She will also explain incentives available to properties on the National Register of Historic Places and evolving standards for risk mitigation at these sites. Using the New Canal Lighthouse as a case study, Chris Cook will give a first-hand account of adapting a culturally significant place for reuse as a public space on the shores of Louisiana's largest estuary. Nathan Lott, whose master's thesis produced a low-cost climate vulnerability assessment for managers of cultural heritage sites, will discuss the synergies between climate adaptation and historic preservation. Specifically, how each discipline approaches change-management by anticipating future conditions and prioritizing specific places or systems based on economic and other factors. Finally, drawing on her own experience across the resilience and preservation sectors, moderator Ella Camburnbeck will facilitate the discussion among panelists and a dialogue with the audience.

Randy Bushey, Jacobs Engineering Group

Session 53
WATERSHED-BASED FLOOD REDUCTION AND HABITAT RESTORATION LESSONS LEARNED

The State of Louisiana submitted to HUD a Master Action Plan on 23 December 2019 which implements the Louisiana Watershed Initiative (LWI), in fulfillment of the requirements of the Federal Block Grant allocation ($1,213,917,000) to the State. The LWI divides the state into 8 regions committed to "working in partnership with local communities statewide toward an integrated, regional watershed-based flood risk management approach to floodplain management that combines physical, biological, ecological, socioeconomic, and policy-based solutions emanating from a comprehensive scientific understanding of the state's hydrologic processes." The Master Action Plan identified example "capital projects that improve resilience to flooding, provide regional stormwater retention and detention, and other flood protection measures."

This presentation has two focuses, 1) the overview of lessons learned from a successful state-level watershed-based management of water resources with similar rainfall, acres of wetlands and extensive coastline estuary considerations as Louisiana, and 2) the use of reservoirs as major risk reduction components which can simultaneously address flood control, water supply (urban, agricultural, and environmental), water quality treatment, and ecosystem restoration. The State of Florida enacted the Water Resources Act in 1972 which delineated 5 water management districts, each with distinct watersheds, personnel resources, funding authority, and permitting capabilities to implement their objectives – flood protection, water supply planning, water quality, environmental protection and restoration, and scientific understanding of the watershed through monitoring, modeling, and research projects. Lessons learned will include discussion on multi-agency and stakeholder engagement, use of science in achieving project and program goals, periodic reporting and use of outside expert review, identifying various stakeholder needs and achieving a balance in flood protection, water supply, and environmental restoration.

Examples of the successful programs implemented within the water management districts (WMD) include the $12 billion Comprehensive Everglades Restoration Plan (CERP) and the Upper St Johns River Restoration Program.

Projects representative of these programs and applicable to the LWI approach will be addressed in the presentation and include:

• Development and management of the five WMDs

• Stormwater Treatment Areas – over 50,000 acres of natural stormwater treatment systems for water quality and flood risk management of agricultural stormwater runoff and Lake Okeechobee discharges released to the upper Everglades wetlands

• C-43 Reservoir – a 170,000 ac-ft (55 billion gallons) storage reservoir designed to reduce flood risk and enhance water supply, and manage water quality of stormwater runoff for agricultural lands and highwater releases from Lake Okeechobee

• Three Forks Marsh Conservation Area – a St Johns River headwater stormwater attenuation and flood risk management reservoir and wildlife habitat restoration

• L-8 Reservoir – a 46,000 ac-ft reservoir – flood protection, water supply, flow equalization

The presentation addresses Risk Reduction and Protection.

Thomas Douhat, Louisiana State University

Session 53
Analyzing the State of Multi-Jurisdictional Watershed Planning in the Upper Pontchartrain Basin

Multi-jurisdictional networks of regulations and collaboration are key to creating effective governance structures for flooding hazards mitigation and watershed planning. This is a key element of planning for coastal watersheds in the Louisiana Watershed Initiative (LWI), and for planning in the context of coastal environmental change. This presentation will address our process of supporting regional efforts at watershed planning in the Upper Pontchartrain Basin through a governance assessment. A first step in this process is systematically documenting existing watershed planning networks and analyzing how the existing patchwork of local land use regulations currently address multijurisdictional coastal problems, such as flooding, and where gaps may exist in multi-jurisdictional coordination.

Our methodology addresses the difficulty of representing and analyzing how individual plans and local regulations combine to create a governance structure within the watershed context. The incorporation of social network analysis, derived from data within existing planning documents, to characterize the level of multi-jurisdictional collaboration around issues of watershed hazards represents a novel contribution to existing plan evaluation techniques. We will also develop thematic mapping of regional land development zoning rules, and represent how they interact with the regional social network structures and most importantly with exposure to hazards, such as flooding and storm surge.

Legal authority over the development process is largely decentralized at parish and local levels, which means that understanding and representing how different jurisdictions rules relate on a landscape scale is challenging. This work represents our efforts to create a regionally standardized representations of land development regulations, and existing planning networks, for the Upper Pontchartrain Basin to inform the nascent process of coastal watershed planning in Louisiana.

Haihong Zhao, Arcadis U.S.

Session 53

STUDY OF THE COMBINED EFFECTS OF RAINFALL & STORM SURGE IN UPPER BARATARIA BASIN

A reanalysis of flooding dynamics in Upper Barataria Basin is being conducted to examine how rainfall and surge during tropical storms interact with each other and with existing water levels in the basin. Built upon the methodology and findings of a 2015 Barataria Basin risk reduction analysis, the present study will consider additional modeling strategies to provide improved understanding of flood risk in a coastal flood transition zone where tropical and non-tropical rainfall-making events as well as coastal storm surge may be dominant alternatively or additionally. The current study advances the H&H model system to evaluate the potential antecedent stage due to various rainfall intensities and to quantify how upper Barrier Basin responds a set of events combining coastal storms and associated rainfall runoff. This study is parallel and closely related to a similar study ongoing for Amite Basin.

The study area includes the upper reach of the Barataria Basin with extensive wetlands, bayous and canals, agriculture lands, communities surrounded by local levees, and communities on the high ground on both the western (near Bayou Lafourche) and eastern (near Mississippi River) portions of the basin. Many areas in the upper portion of the basin are only affected by rainfall, with little or no variation in peak stage with respect to different coastal storms at the basin's southern boundary, while the coastal storm surges control stage in the lower portion of the basin. From the mid to lower portion of the study area, a transition zone from surge-dominant to rainfall-dominant was observed, with some areas along the Mississippi River and Bayou Lafourche remaining affected by only rainfall. Antecedent conditions were observed from historical stage data, however the antecedent stages input as initial stages to the previously developed model system were shown to have minimal impact based upon observed gage measurements. The minimal influence of antecedent condition may be due to interference of local levees with the watershed conveyance or may be an artifact of model limitations. The current study is utilizing a more advanced model system, ADCIRC, that resolves the study area capturing the essential H&H characteristics of the region. The findings of this study will reveal the sensitivity of the basin to individual and combinations of various flood components, including river discharge, rainfall runoff that influence the flood risk.

Murt Conover, LUMCON

Session 54

AN INTRODUCTION TO LUMCON EDUCATION & OUTREACH PROGRAMS

The Louisiana Universities Marine Consortium (LUMCON) is a collaborative research and education Consortium for the engagement and benefit of Louisiana communities. LUMCON's Marine Education Program enables the next generation of marine scientists and ocean-literate citizens. The Program provides meaningful and relevant place- and skill-based experiences for all visitors and significantly impacts Louisiana's diverse citizenry, including those populations underrepresented and underserved in marine science. LUMCON's strengths include its facilities, vessels, and location. All these assets make LUMCON education and outreach (E&O) programs unique to the state. In this regard, we can provide student opportunities and experiences that many other institutions cannot. By merging the research programs and education programs, and fully leveraging the assets of LUMCON, all visitors are given a real-world experience in a functioning marine laboratory. The immersive skill-based nature that is the foundation of the E&O programs is decisive for helping to impact and retain students in STEM disciplines as they relate to marine science.

Marine Education at LUMCON specializes in designing powerful marine, environmental, and science learning experiences in the coastal setting surrounding the Marine Center. The Program focuses on scientific research at LUMCON, promoting awareness of marine and coastal environments and their connection to, and exploring the scientific process and its role in making environmental decisions.

The impact of the LUMCON E&O programs is difficult to measure, but for 30 years, LUMCON has educated an average of 3000-5000 people annually. The program serves a wide variety of audiences through many different types of programs. At the primary and secondary education levels, LUMCON offers unique field trip opportunities and activates, summer camps, mentorship, and outreach activities. A guiding principle is that, in order to support K-12 education, one must also support the advancement of educators. Because of this, LUMCON has a reputation for providing unique and in-depth teacher education and professional development activities both at the Marine Center and across the state. Undergraduate and graduate opportunities include field trip experiences, specialized programs, credit and non-credit courses, mentorship, and a Research Experience for Undergraduates (REU) program. LUMCON also offers free public marine science education activities. These activities include workshops, seminars, and special events like the LUMCON Open House and Meet the Fleet events. Through all these programs, UMCON gives back to the community by believing marine science educations should be accessible, inclusive, innovative, and meaningful.

Sarah DeBacher, Louisiana Endowment for the Humanities

Session 54
INCREASING COMMUNITY AWARENESS OF COASTAL IMPACTS THROUGH PRIME TIME FAMILY READING

“Increasing Community Awareness of Coastal Impacts through PRIME TIME Family Reading” will highlight one component of a three-year initiative of the Louisiana Endowment for the Humanities, “Coastal Impacts.” Funded by BHP, the initiative combines PRIME TIME Family Reading and Preschool, adult reading and discussion programming, Water/Ways traveling exhibits (presented by the Smithsonian’s Museums on Mainstreet), articles in LEH's 64 Parishes magazine, and documentary film-making--all focused on increasing childhood awareness, strengthening coastal literacy, and supporting the development of spaces where citizens have the opportunity to learn, discuss, and be part of the ongoing decision making about the fate of coastal communities. PRIME TIME Family Reading plays an integral part in that effort. The PRIME TIME Sustain book series, developed in collaboration with the Water Institute for the Gulf and Ripple Effect, features children's books whose content and themes explore our relationship with water, our changing coastline, and the lived experiences of children in the communities where those changes are most felt. Through her presentation, Sarah DeBacher, Director of Curriculum and Content Development at the LEH, will discuss the approach to building awareness that is at the heart of PRIME TIME Family Reading, the books and themes included in PRIME TIME Sustain, the results of the first two years of its implementation in Grand Isle, and Lafourche, Plaquemines, and Terrebone Parishes, and the future of the Coastal Impacts project.

Heather Fox David, Louisiana Department of Wildlife and Fisheries

Session 54
WETshop Talk

"WETSHOP is a coastal awareness, teacher stewardship project. The goals of WETSHOP are: 1) to provide teachers with a comprehensive, phenomena-based look at wetland issues related to history, fisheries management, wetland habitats, wetland ecosystems, coastal land loss and restoration, water quality and oil and gas exploration. 2) to educate a large population of Louisiana's citizenry about the serious issues that Louisiana is facing due to coastal land loss.

WETSHOP provides educators the rare opportunity to interact with scientists in a field environment and interface this experience with classroom activities, which provide the tools, needed to improve wetland education. These immersed teachers are encouraged to take their experiences back to educate their colleagues as well as create phenomena that are shared for teachers statewide via the Louisiana Environmental Phenomena Website. The most valuable long-term outcome is that trained teachers who have had Louisiana science standards experiences will educate our communities."

Brian Gautreau, LSU AgCenter

Session 54

TAKING COASTAL EDUCATION AND WATER LITERACY STATEWIDE THROUGH TEACHER TRAININGS AND FIELD EXPERIENCES.

There are several factors to consider when supporting environmental and outdoor education practice by teachers, including their self-efficacy, or perceived ability to teach environmental education, as well as their understanding of how well environmental education topics align with learning standards. Teacher trainings that include field experiences provide educators both with the content knowledge to bring back to their classrooms and the skills, or “know-how,” to be effective facilitators, while collaboration with other educators and natural resource professionals help to make connections between practice and the standards.

The Louisiana Coastal Fellowship Program immersed teachers from the 13-parish greater New Orleans area in a summer-long process of investigating wetland issues, developing field study skills, and developing phenomenon-based and 3-dimensional instructional and lesson writing strategies. The experiences were used to create phenomena that are shared for teachers state-wide via the Louisiana Environmental Phenomena website.

With support from NOAA, lessons learned from this process are being used to expand the fellowship program to an additional 26 parishes. Educators that participate in the fellowship are in a unique position to contribute to coastal education and water literacy across the state.

James McMenis, Coastal Protection and Restoration Authority

Session 56

WEST GRAND TERRE ISLAND AND THE NEED FOR BEACH NOURISHMENT AND STABILIZATION

The West Grand Terre Island Beach Nourishment and Restoration project (BA-0197) is located in Jefferson Parish immediately northeast of Grand Isle and extends from Barataria Pass eastward to Pass Abel. The West Grand Terre Island Beach Nourishment and Restoration project is a critical component of the State's efforts to restore its barrier islands. The Coastal Protection and Restoration Authority is implementing the project through the use of Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies (RESTORE) Act for the Engineering and Design phase and is in the process of securing approval for Natural Resource Damage Assessment (NRDA) construction funding through the Louisiana Trustee Implementation Group (LA TIG).

The Project is needed to address gulf shoreline erosion, diminished protection against storm surge, and subsidence of back-barrier marshes. Through the Engineering and Design Phase, a recommended plan has been identified to implement restoration features on the island. Once implemented, this project will restore and enhance the dune and back barrier marsh habitat to provide storm surge and wave attenuation, thereby addressing the issues of gulf shoreline erosion, diminished storm surge protection, and subsidence of back barrier marshes. These restoration measures will result in an increase in the island's longevity and sustainability of this valuable ecosystem.

The Project Plan will create approximately 200 acres of beach and dune habitat and 160 acres of intertidal marsh habitat and protect 9,000 linear feet of shoreline along Barataria Pass and Barataria Bay on the western side of West Grand Terre Island. In addition, an extension of the beach habitat along the gulf-front shoreline to the eastern end of the Island is included and consists of approximately 51 acres spanning 5,000 linear feet of shoreline. The Project Plan includes a bayside Rock Revetment feature to protect the marsh and is located along Barataria Pass beginning at the end of the Fort Livingston breakwater and continuing around the bayside of the Island and tying into the Chevron Pipeline Canal. On the gulf side of the island, the project will restore a 540-foot rock segment surrounding Fort Livingston that will connect to the shoreline. Another project feature is a 180-foot rock revetment spur that will capture sand transported by longshore currents. The spur will be situated along the historical shoreline alignments. The Borrow Area for the Project is located approximately 4.6 nautical miles away from West Grand Terre Island in State waters. Extensive geotechnical and geophysical surveying was performed during Data Collection Phase to identify sand suitable for use in the restoration of beach and dune habitat. Unique challenges during design included land rights complexities, sediment investigations, cultural resources, and necessary structure removal of the former Louisiana Department of Wildlife and Fisheries laboratory buildings.

Julie Bernier, U.S. Geological Survey

Session 56

LANDSCAPE EVOLUTION OF THE NORTHERN CHANDELEUR ISLANDS DRIVEN BY STORMS AND HUMAN MODIFICATION

Prior to 2010, the Chandeleur Islands were largely unaltered by human activities and sub-aerial island changes were primarily attributed to relative sea-level rise and extreme storm events, in particular Hurricanes Frederick (1979), Georges (1998), and Katrina (2005). Between 2010 and 2011, however, a 14-km long sand berm was constructed along the northern barrier platform following the Deepwater Horizon oil spill. Previous studies at the Chandeleur Islands addressed short-term land-area and habitat changes after extreme storms and berm construction separately, making it difficult to determine whether recent changes are the result of natural storm-recovery cycles or the addition of new sediment. To better quantify the effects of both natural and anthropogenic disturbances on barrier-island morphology, we expand the spatial and temporal breadth of the analysis relative to previous studies and measure landscape-scale changes since 1984 along the northern ~38 km of the Chandeleur Islands.

Building on existing methods for processing multispectral satellite data using automatic thresholding of spectral indices, four Landsat-derived land-cover classes were mapped: water, bare earth (i.e., sand), vegetated, and intertidal. To minimize effects of tidal water-level variations, land cover was mapped using 85 cloud-free, low-water images acquired between 1984 and 2019 and vector shoreline, sand, and vegetated feature extents were extracted for each image. This enabled us to quantify changes in areal extent of sandy, vegetated, and intertidal environments and characterize alongshore variability in land cover as well as beach, marsh, and island widths over a period of 35 years encompassing multiple storm-recovery cycles as well as the introduction of emplaced berm sediment.

The expanded spatial and temporal scope of this analysis allowed us to put storm response and recovery in historical context as well as assess spatially-variable trends. Consistent with earlier studies, we measure substantial decreases in total land-area following Hurricanes Georges and Katrina. However, our extended dataset highlights the interplay of multiple storm events and character of the vegetated back-barrier (e.g., marsh) in driving island stability and post-storm recovery. For example, in the northern part of the study area, a significant post-Georges decline in vegetated extent likely contributed to near-complete subaerial island erosion and submergence observed post-Katrina. Since 2013, results suggest that redistributed berm sediment accumulated within the pre-Katrina island footprint north of the original berm extent, forming newly emergent intertidal and sandy environments. In contrast, where vegetated areas became highly fragmented but were not completely eroded after Katrina, sandy and intertidal extents began to recover prior to berm construction and south of berm emplacement where berm sediment could not have contributed to continued land-area gains. This suggests that observed gains within the barrier system are likely related to a combination of natural recovery and berm sediment depending on marsh state and proximity to emplacement. Our results provide insight to decadal-scale landscape changes and can be integrated with morphologic and geologic data from both island and nearshore environments to better understand barrier-system evolution and resilience.

Jennifer Miselis, U.S. Geological Survey

Session 56

Natural and human-related variability in sediment flux at the Chandeleur Islands, LA

Quantifying barrier island sediment fluxes is required to improve natural hazard mitigation, coastal restoration, and habitat management. Complexities associated with measuring these fluxes result, first, from inherent temporal variability, such that fluxes derived from geologic or historic observations may not be relevant now, particularly if previous sediment sources have been exhausted, drowned, or modified. Second, alongshore or cross-shore fluxes are often considered in isolation, which does not accurately represent the natural system in which these two components interact. Finally, the use of either observational or modeling approaches to estimate fluxes can result in different sediment transport rate estimates, particularly if a mismatch exists between the time scale of observations and model inputs.

To address these challenges, we use a seven-year (2011-2018) bathymetric and geophysical time series to quantify erosion and deposition around the northern Chandeleur Islands, LA, where, in 2010, a sand berm was constructed along the northern 14 km of the island using sediment from the submerged barrier island platform. First, we track the magnitude of accumulation downdrift of the berm to assess the extent to which it altered barrier island sediment fluxes. Also, assuming the borrow site from which berm sediment was extracted is a closed system, we measure annual accumulation there as a proxy for longshore sediment transport (LST) and compare its magnitude to geological, historical, and numerically-simulated, fair-weather LST estimates. Lastly, we couple observations with LST estimates derived from scenario-based wave reconstructions and model simulations of storms to explore the role of storms and sediment availability (e.g., berm presence) in driving interannual variability in LST.

Over seven years, we find that berm-associated sediment is completely redistributed, resulting in intermittent sub-aerial re-emergence and accumulation in subaqueous environments north and west of the original berm footprint. Comparisons with prior estimates reveal that our seven-year average estimate of LST is statistically equal to the geologic estimate and is 5 times less and 3 times greater than estimates derived from historical observations and fair-weather modeling, respectively. Additionally, our results demonstrate the importance of both near-field and far-field tropical storms in driving annual variability in fluxes and exchanges between sub-aerial and subaqueous sediment reservoirs. Our targeted integration of observations and modeling quantifies year-to-year variations in coastal sediment transport and identifies possible drivers of that variability, both of which may be relevant to coastal restoration and adaptive management planning at the Chandeleur Islands and elsewhere in the Gulf.

Agnimitro Chakrabarti, FTN Associates, LTD.

Session 57

NUMERICAL MODELING OF HYDRODYNAMICS AND SEDIMENT TRANSPORT FOR SEDIMENT DIVERSION DESIGN: CHALLENGES AND LESSONS LEARNT FROM THE MID-BARATARIA SEDIMENT DIVERSION

The proposed Mid-Barataria Sediment Diversion, located near River Mile 60.7 the Mississippi River (MR) is a controlled lateral opening in the lower Mississippi River Levee. The Barataria Basin, is suffering from land loss, primarily due to hydrologic alteration, sediment deprivation, subsidence, sea level rise, tropical storms and saltwater intrusion. The purpose of the diversion complex is to divert sediment-rich peak flow of 75,000 cfs, when the MR flow is at or above 1,000,000 cfs. This is a first of its kind engineered diversion in the world, designed to mimic the natural action of crevasse splays to build deltaic land, albeit at a much larger scale. Unlike existing freshwater diversions, which mostly divert fine sediments (silt and clay with median size d50≤63 μ), this sediment diversion is being designed with an exclusive goal of diverting a proportionately higher sand fraction (d5063 μ) compared to the water volume diverted from the river. The ability to control the flow using gates is another important operational feature which enhances the adaptability of this diversion to future environmental and morphological responses in the basin.

This presentation will focus on the insights derived from the numerical modeling of the hydrodynamics, sediment transport and morphology in connection with the three main diversion components, the intake head-works, the conveyance channel and the outfall transition, each of which with its own design challenges. One of the unifying goals in the design of the components was to design them to be adaptable to future basin conditions in response to sea level rise and land-building. Similar to a crevasse splay that heals itself over time, the diversion was found to lose capacity as land-building and sea-level increased. Optimization of each of the design components was necessary on their own as well as in sync with the overall system to balance the need to maintain capacity in the future, maintain sediment load delivery, as well as divert coarser sand transport with the available energy gradient along an adverse bathymetric gradient from the river bed to the marsh platform. Various designs for the intake three components were screened through an extensive numerical modeling matrix which took into account sand capture efficiency, head loss, sediment load and adaptive management of the outfall. A multi-dimensional modeling approach combining state of art numerical models was selected. The three-dimensional FLOW-3D Computational Fluid Dynamics (CFD) model was used to model the non-hydrostatic, turbulent flow through the structures including Lagrangian particle tracking of sand transport. The two and three-dimensional hydrostatic Delft3D models with its proven sediment transport and morphology modeling capabilities were used to model bed load and suspended load transport from the river through the diversion and into the basin. Numerical models were independently calibrated with observed data for flow and sediment transport. The Delft3D model was further calibrated with FLOW-3D model for fluid-structure interaction induced energy losses. This presentation will describe development of the numerical models, calibration and validation procedure, numerical modeling challenges and solutions as well as the lessons learnt for future sediment diversion design.

Gongqiang He, FTN ASSOCIATES, LTD.

Session 57

FLOW-3D MODELING OF HYDRAULIC DESIGN OF SEDIMENT DIVERSIONS: THE MID-BARATARIA SEDIMENT DIVERSION

The Mid-Barataria Sediment Diversion (MBSD) complex was proposed by CPRA as a controlled lateral opening on the lower Mississippi River Levee (MRL) at an approximate river mile of 60.7. The sediment diversion, which unlike existing freshwater diversions, is designed to maximize sand capture, is one of the first of its kind in the world. The outfall area of the project, the Mid-Barataria Basin, is suffering from land loss due to a number of reasons such as hydrologic alteration, sediment deprivation, subsidence, sea level rise, and saltwater intrusion. By re-establishing a connection between the Mississippi River and the basin, the diversion complex would divert sediment and fresh water from the Mississippi River (MR) mimicking the historic deltaic sediment deposition. The diversion headwork section plays a key role in the flow diversion hydrodynamics and the sediment capture process. Currently, eight diversion intake designs have been proposed with different invert elevations and structure types, such as an U-Frame, an U-Frame with interior walls, an open channel and a submerged culvert. In order to better resolve the complex three-dimensional hydrodynamics of the intake dynamics, FLOW-3D, a fully non-hydrostatic, three-dimensional Computational Fluid Dynamics (CFD) software was used by the design team as the modeling tool. The primary design objective is to maximize the Sediment-Water Ratio (SWR) for sand at the peak diversion flow of 75,000 cfs at a river flow of 1,000,000 cfs. This presentation will focus on the investigation of the conveyance and sediment capture performance for each intake design and quantify the relative strengths and weaknesses of each intake design will be demonstrated. Lagrangian based mass-particle tracking method is used to model different size classes, representative of the natural sediment distribution in the river. In addition, the key near field fluid-structure hydrodynamic characteristic for each design such as flow-fields, total energy head, bed shear stress distributions and potential for sediment entrainment will be discussed.

Natalie Snider, Environmental Defense Fund

Session 57
Enabling Robust Adaptive Management for Sediment Diversions

Louisiana is embarking on one of the largest restoration programs in the county, for which sediment diversions are critical to restoring and sustaining the coast. These large-scale (75,000 cfs) and expensive ($1 billion) water infrastructure projects will reconnect the Mississippi River to its floodplain and deliver the much-needed sediment, nutrients and freshwater to the degraded wetlands. These projects are essential to our future but will alter some of the dynamics of the present-day estuary, returning it to a more natural system.

Adaptive management (AM) is a systematic decision-making process that seeks to improve management decisions in the face of uncertainties by using rigorous monitoring and evaluation methods to improve the effectiveness of management strategies in a continual learning process. Because sediment diversions include complex interactions between science, stakeholders and decision-making, AM can be a useful management tool to adjust operations of the structure over time.

Louisiana is currently in the process of developing a Draft Environmental Impact Statement (EIS) for the first of several planned sediment diversions, the Mid-Barataria Sediment Diversion. Our team has been working to develop detailed recommendations for consideration in the AM Plan for the Draft EIS. Through this work, we developed and prioritized multiple objectives at various temporal and spatial scales within an objectives hierarchy. We evaluated adaptive management actions and associated scientific and management uncertainties. We also identified key performance metrics for each objective and the methods by which to develop associated management benchmarks and triggers. The team has evaluated governance structures, as well as engaged a stakeholder focus group to provide input and develop communication strategies. The intent of this process has been to stimulate and enable a rigorous application of AM to the Mid-Barataria Sediment Diversion so managers can best understand how to operate it while also supporting some of the unique existing values of agencies and stakeholders within the Delta.

Grace Morris, Sierra Club

Session 58
Forever Home on the Frontlines of Louisiana's Coastal Crisis: Consideration for Implementation of Nonstructural Solutions

What does forever home look like in coastal Louisiana? This panel focuses on housing in the context of coastal communities' past, present and future roles in building local infrastructure. Centering Black and Indigenous knowledge, panelists will share the often overlooked insight of historical coastal communities and explore an expansive, inclusive discussion on solutions at the intersection of home, community, and economic justice.

'Nonstructural' in Louisiana's Coastal Master Plan currently refers to three tactics of risk reduction: floodproofing businesses, raising homes up to 14 feet, and acquisition (buyouts). As Louisiana sets out to ensure the endurance of coastal cultures, can traditional ecological knowledge offer additional options?

How can we best resource coastal residents on the frontlines of the coastal crisis to implement ideas? From identifying policy roadblocks to walking through what elevating a house entails to historical perspectives on using the environment to construct housing, this panel makes the case to put people first and prioritize home.

Craig Colten, Louisiana State University

Session 59
FLUID ENVIRONMENTS AND FIXED BORDERS: RECONCILING CHANGING ENVIRONMENTS AND FIXED BOUNDARIES INLAND FROM THE COAST

The Baton Rouge metropolitan region has long considered itself situated in an inland, riparian setting. With rising sea levels, elevated risk of storm surge in Lake Maurepas, increasing intensity of rain storms in the Amite River basin, and coastal migrants relocating to the capital region its insularity from coastal influences is diminishing. A review of historical flood management policies since the 1983 flood and a series of focus groups with local officials after the 2016 floods contrasts the riparian orientation of disaster risk reduction practices and policies with the emerging need for climate change adaptation approaches. The rapid growth of the region since the 1980s has placed more people at risk, and policy adjustments that have not sustained "flood memories" contribute to the perpetuation of risk in terms of riparian flooding. The political fragmentation of the basin reduces the likelihood of basin-wide planning and policies. There is only modest attention in policy discussions about the nature of increasing coastal risk tied to climate change.

Marla Nelson, University of New Orleans

Session 59
ASSISTING ADAPTIVE MIGRATION FOR JUST OUTCOMES

In response to environmental change and flooding hazards, residents in coastal communities can continue to live as they have, take adaptive measures to safely stay in place, or adapt through migration. When they stay in place, they must respond to climate related environmental changes such as stronger and more frequent severe storms. In recent decades, Terrebonne Parish, located in southern Louisiana, has experienced severe coastal land loss and is projected to lose more than half of the remaining marshes in the next fifty years. Land loss in conjunction with more severe storms threaten these coastal communities. If residents stay, they are at risk of danger and loss of assets and wealth. If they leave, they lose community and cultural ties, and attachments to people and places. What does climate justice look like in this circumstance?

Nonstructural policies to strengthen resilience, including flood proofing and home elevation, have focused heavily on interventions that help people stay in place. Increasingly, residents and local officials in Louisiana and elsewhere are discussing the possibility of relocating residents to reduce vulnerability. Analyses show that migration away from the Louisiana coast is already occurring and that the most advantaged residents have relocated at a faster rate leaving behind an increasingly poor and elderly population. Yet, surprisingly little is known about the factors that shape residents' decisions to migrate due to climate and hazard-induced vulnerability. How can justice and equity be centered in adaptation planning that must account for ways that people adapt when they stay and when they migrate, if, in both cases, residents feel that they have no choice? Adaptive migration in coastal Louisiana reveals the complexity of climate justice in coastal settlements and how questions of justice intersect with poverty, property valuation, historical and cultural ties to place, and community change.

Drawing on semi-structured interviews with 60 current or former residents of coastal communities in Terrebonne Parish and 30 community leaders, local officials and planning and zoning staff members from Louisiana, this presentation examines residents' adaptation efforts and priorities, interrogates climate justice in a situation with no fair outcomes, and explores how a climate justice framework can shape adaptation policy that addresses both relocation and living in high risk communities.

This project was funded by The Water Institute of the Gulf under project award #2000249131 . This project was paid for with federal funding from the Department of the Treasury through the Louisiana Coastal Protection and Restoration Authority's Center of Excellence Research Grants Program under the RESTORE Act of 2012. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the Department of the Treasury, CPRA or The Water Institute of the Gulf.

Niki Pace, Louisiana Sea Grant

Session 59
LOCAL GOVERNMENTS: BUILDING A SAFER FUTURE

The Louisiana coastline is a beloved but increasingly risky place to live. Flood risk from storm surge along the coast is increasing, and some residents along the coastal edge are migrating a little further inland, thinking this will help them avoid future flood risk. At the same time, these receiving communities are beginning to experience both coastal and riverine flooding impacts, as experienced by some communities during the 2016 flooding. Increased development in these transitional communities is placing greater stress on floodplain development. These pressures can place local governments in a tight spot, struggling to balance economic pressures with the need to protect their citizens and infrastructure from flood risks.

As part of the Inland from the Coast project, the Louisiana Sea Grant Law & Policy Program is providing legal and policy research on local government authority and responsibility to respond to floodwaters. Local governments have to balance economic concerns, National Flood Insurance Program participation requirements, and the safety of their residents when determining their stormwater management strategies. This presentation will explore strategies for building a safer community that accommodates growth while acknowledging risk.

Matthew Bilskie, Louisiana State University

Session 61

COASTAL FLOOD TRANSITION ZONE MODELING: AN HISTORICAL PERSPECTIVE TO FUTURE POSSIBILITIES

It is well known that coastal Louisiana is a hot-spot for high relative sea level rise that includes subsidence (topographic decreases) and eustatic sea level increases. Previous work extending back to 1970 [Gagliano et al., 1970] highlight the ever-encroaching Gulf of Mexico waters into Louisiana and the accompanying land loss. More recently, detailed numerical modeling studies have shown the impact of such historic (and future projection) land loss on coastal inundation events at statewide and local scales [Siverd et al., 2020; Siverd et al., 2019]. Since the historic August 2016 flood event much attention across the state of Louisiana has been focused on understanding the combined effects of extreme precipitation-driven rainfall excess and coastal inundation on total water levels (referred to as compound flooding). This lead to hypothesis of flood transition zones, which are defined as regions prone to both rainfall- and coastal-driven flooding [Bilskie and Hagen, 2018].

This presentation will focus on the evolution of coastal flood transition zones between 1850 and present day as well as future projections out to 2110. Efforts from pervious modeling studies are being integrated to assess how the flood transition zone has evolved as a function of land loss - with particular focus on the southeastern portion of the state. Understanding the linkage of the flood transition zone evolution to relative sea level rise and coastal land loss will better inform state officials on relevant and timely management of watersheds, particularly within the coastal zone.

Hugh Roberts, The Water Institute of the Gulf

Session 61
Louisiana Watershed Initiative: Flood Transition Zones

In low-gradient coastal regions and river deltas, flooding can emerge from extreme rainfall, coastal surges, or a combination occurring in tandem or in close succession. The transitional areas of the watershed, termed Flood Transition Zones, occur where inundation can occur, and is exacerbated by, compound flooding from coastal and inland processes (i.e. storm surge and rainfall-runoff) (Bilskie & Hagen, 2018). As part of the Louisiana Watershed Initiative (LWI), we are developing a modeling methodology for the flood transition zone that will be used to define water level flood profiles and annual exceedance probabilities (AEP) that consider coastal and inland flooding mechanisms.

The Coastal Master Plan uses the Advanced Circulation (ADCIRC) model to describe flood hazards in coastal zones because it reliably captures various coincident effects that contribute to the total flood hazard profile including tides and storm surge. For inland flooding, the LWI intends to use a common hydraulic and hydrologic model, HEC-RAS and HEC-HMS, to determine the AEPs. Both modeling frameworks have limitations in fully capturing the physical processes of compound flooding, however, by coupling these two models we aim to improve flood level predictions in the flood transition zone. The goal of this project is to develop and verify a methodology for creating flood profiles in the transition zones using numerical models within a Joint Probability Method with Optimum Sampling (JPM-OS) framework. This presentation focuses on the numerical modeling methodology and testing for a case study of the Amite River Basin.

One of the main challenges in coupling HEC-RAS and ADCIRC is defining the location of the interface between the models. We modeled both non-tropical and tropical events to evaluate the sensitivity of the water levels to various coincident conditions (i.e., wind, rainfall-runoff, riverine discharge, storm surge, tides) and model setup configurations (e.g., terrain, mesh, boundary location). The overall goal is to develop a methodology that can be implemented statewide that outlines the model and data resolution necessary to have a robust, reliable model for predicting compound flooding. The likelihood of coincident conditions and the sensitivity of the numerical model to these conditions are necessary to define the probability distributions and error statistics used in the JPM-OS framework. The JPM-OS will define a suite of coincident conditions that will be simulated in the coupled models to determine the flood profiles in the transition zones.

Felix Santiago-Collazo, Louisiana State University

Session 61

SIMULATION OF IDEALIZED COMPOUND FLOOD EVENTS IN LOW-GRADIENT COASTAL WATERSHEDS

Low-gradient coastal watersheds can be susceptible to flooding from numerous mechanisms such as rainfall, tides, and storm surge. When at least two of these mechanisms occur simultaneously or in close succession, compound flooding can be expected (Santiago-Collazo et al., 2019). Typically, a compound inundation model is developed to evaluate compound flooding. A compound inundation model may consist of different numerical models, observed data, and/or a combination of these that are linked through varying techniques.

Here we present a one-dimensional (1-D) compound inundation model, which is based on the shallow water equations, capable of simulating the variations of the free water surface at the ocean domain (i.e. storm surge modeling), the rainfall-runoff at the upland region of the watershed (i.e. hydrology/hydraulics modeling), and compound flooding within the transition zone (Bilskie & Hagen, 2018). To test this compound inundation model, a 1-D transect, representing a low-gradient coastal watershed, was developed and applied with numerous rainfall-runoff/tides/storm surge combinations. A wetting/drying algorithm was included to improve the simulations at the upland region of the watershed. Future research will focus on testing different wetting/drying algorithms at the upland region of the watershed and simulating a “more-realistic” compound flood event.

One of the main goals is to evaluate each flooding mechanism, separately and their combination, to aid in the identification of transition zones and enhance the production of compound flood maps for different regions of the coastal watershed. The relationship between rainfall-runoff, tides, and storm surge is nonlinear; therefore, adding the individual effects of these flooding mechanisms may overestimate the compound flood level at the transition zone. The desire is a more holistic compound inundation model that can be a critical tool for decision-makers, stakeholders and authorities by providing aid in disaster and evacuation planning to potentially save human lives and decrease property damage.

Clinton Willson, Louisiana State University

Session 61

INVESTIGATING DECADAL CHANGES ON AMITE RIVER BASIN HYDROLOGY & FLOOD ROUTING USING A BASIN-WIDE MODEL

The Amite River Basin is a ~2200 square-mile basin extending from southwest Mississippi through southeast Louisiana, including Baton Rouge and its suburbs, to Lake Maurepas and eventually to sea level at Lake Pontchartrain. The upland hills portion of the basin is at elevations of ~400 feet NAVD88 and is characterized by incised streams and narrow floodplains. In the middle terrace portion of the basin where the regional slope begins to flatten, the floodplains start to widen. The river and stream floodplains widen further with the transition into the southern portion of the basin, where the very shallow or no slope topography is governed by the historic Mississippi River floodplain and coastal wetlands. Over the years, the hydrologic and hydraulic characteristics of the basin have changed due to a number of man-made decisions, including: conversion of major portions of the upper basin from farmland to forest; sand-and-gravel mining along the rivers; channel modifications; channel aggradation and sedimentation due to mining, landscape changes, etc.; and urbanization and development spurred by economic and population growth in the Baton Rouge area following the oil boom of the 1970's, as well as later waves of migration following Hurricane Katrina. Thus, the rainfall-to-runoff characteristics, as well as the routing of flood waters through the major tributaries and rivers, have changed.

Over the past several decades, there have been several major flood events within the basin that have impacted tens of thousands of people and resulted in hundreds of millions of dollars or more of damages. Since 1973, the river has risen more than a foot above the Denham Springs flood stage over thirty times and, on several occasions, twice in one year. The massive flood of 2016 resulted in unprecedented flooding in the basin and pushed the state of Louisiana to initiate the Louisiana Watershed Initiative (LWI). One objective of the LWI is the creation of watershed models that can be used to test flood mitigation project concepts and the extent of their impacts up and downstream.

This presentation will evaluate how changes in the land use/cover in the basin and the reduction in length and sinuosity of the Amite and Comite Rivers have impacted the flood hazard. Land use/cover and Amite River planform geometry conditions from four periods of time, from the 1930's through today, were characterized and then used to modify the coupled HEC-HMS & 1D/2D HEC-RAS Amite River Basin Numerical Model, developed by Dewberry for the Louisiana Department of Transportation and Development. Flooding behavior (e.g., discharge, stages) under different storm events, land cover conditions, and river lengths/sinuosity is then quantified and used to examine the relative impacts of each.

Tina Freeman, Decatur Studio

Session 62
Lamentations: Water in Two Natural States

We know that the scientist's laboratory and the artist's studio are two of the last places reserved for open-ended inquiry, for failure to be a welcome part of the process, for learning to occur by a continuous feedback loop between thinking and doing." — John Maeda, Scientific American Tina Freeman knows artist's spaces, having masterminded the award-winning book, ARTIST SPACES (and exhibition) in 2014. Over the past seven years, Ms Freeman has turned her lens to the wetlands of Louisiana and the glacial landscapes of the Arctic and Antarctic. In LAMENTATIONS, she pairs images from these contrasting regions in a series of diptychs that function as stories about the sea level rise, ecological balance, and the symbiotic relationships between disparate environments over time. The large, color photographs in LAMENTATIONS (to be presented in a slide show at the conference) make plain the crucial global dialogue about water in two physical states. Ms Freeman will narrate the 27 images, and provide observations about the environments she photographed.

Jacques Boudreaux, Coastal Protection and Restoration Authority

Session 64
Rabbit Island Restoration: Mitigating Risks and Producing Solutions Through the E&D Phase

Rabbit Island is located in the southwestern portion of Calcasieu Lake in Cameron Parish, Louisiana and is the westernmost nesting ground for brown pelicans in the State.

In partnership with the Louisiana Department of Wildlife and Fisheries (LDWF), the Natural Resource Damage Assessment (NRDA) Trustee Implementation Group (TIG), and through collaboration with an array of world-class regulatory and avian habitat experts, CPRA has advanced the restoration of Rabbit Island through engineering and design (E&D) and has recently completed construction of the project.

A chronology of the E&D phase, with emphases on risk assessment and solution generation, will be presented, along with recent updates in the construction phase.

April Newman, Coastal Protection and Restoration Authority

Session 64
Scaling up: Combining Multiple Islands into One Project in the Terrebonne Basin

Restoration of barrier shorelines in Louisiana has grown in scale over time as project scopes and their corresponding budgets have increased. Barrier shoreline renourishment needs are often time-sensitive. A broader scale, system-wide approach provides for both proactive and reactive strategies that can reduce the time needed to go from concept to implementation. The Terrebonne Basin Barrier Island and Beach Nourishment Project is an example of a project using a large-scale, systems approach to address basin-wide restoration needs while reducing overall project costs as compared to multiple small projects constructed separately. In this presentation, we will give an overview of the evolution in scale that CPRA projects have demonstrated over the life of the agency, and we will discuss how the basin-wide strategy used for the Terrebonne Basin Barrier Island and Beach Nourishment Project can be used as a model for future barrier island renourishment.

Jessica Mallindine, Bureau of Ocean Energy Management

Session 64
The Marine Minerals Program: Supporting Coastal Restoration through Partnerships and Resource Management

The Bureau of Ocean Energy Management (BOEM) is responsible for issuing leases of offshore sediment resources in federal waters of the Outer Continental Shelf (OCS). This presentation will take a comprehensive look at the Bureau of Ocean Energy Management's (BOEM) Marine Minerals Program and some of the ongoing initiatives to improve Federal OCS sediment resource management. Topics will include discussion on the Bureaus increasing involvement in coastal restoration partnerships and the on-going management of conflicts of use on the OCS. This session will tie-in seamlessly with the State of Louisiana’s presentations on Coastal Restoration projects which utilized OCS material for construction.

Michael Poff, Coastal Engineering Consultants

Session 64

NORTH BRETON ISLAND RESTORATION: IT'S FOR THE BIRDS!

North Breton Island is the southern-most in a chain of barrier islands forming the Chandeleur Islands. The Island is approximately 19 miles east of the port city of Venice, LA and approximately 62 miles southeast of New Orleans, LA. Located within the southern portion of the Breton National Wildlife Refuge, it is a significant resource for breeding birds namely brown pelicans, terns, skimmers, and gulls. The Natural Resource Damage Assessment (NRDA) Trustees selected enhancement of the Island as part of the 2014 Deepwater Horizon NRDA Phase III Early Restoration Plan to help restore injuries to natural resources with the US Fish and Wildlife Service being the lead implementing agency. The purpose of the Project is to increase island longevity by enhancing beach, dune, and back-barrier marsh habitats on the island to promote and support nesting and foraging habitat for breeding birds.

During the Programmatic Environmental Impact Statement phase (PEIS), a conceptual design that would mimic the pre-Hurricane Katrina island land forms and anticipated subsequent island evolution pattern was developed. Conceptual design features included a total island width of 1,100 feet, an elevated dune platform, a beach berm extending from the gulf-side dune toe seaward, and a back-barrier marsh platform extending landward of the beach/dune platforms.

A detailed alternatives analysis was conducted as part of the plan formulation for the Project. The alternatives analysis included development of preliminary design plans for the Restoration Area and the performance evaluation of habitat sustainability included a detailed modeling program of the selected plan. In addition to evaluating the PEIS concept, the Project Team developed design templates to restore the Island's geomorphic and ecologic form and function with the emphasis on nesting bird habitat. Design approaches considered the Island's current habitat function and prior sediment management strategies performed at Breton Island.

The northern end of the Island is mostly vegetated with coastal flora such as black mangrove and marsh vegetation; which serves as nesting and foraging habitat for breeding birds especially brown pelicans. Protecting these existing habitats became a vital component of the design. Preservation of these existing habitats was critical so the birds would have nesting grounds throughout the construction period. Further, the existing vegetation would serve as a seed source for natural cultivation of plants for the restored platforms.

Another design option included a feeder beach to take advantage of coastal forcing functions by overfilling the northern end and allowing sediment transport to diffuse the sand and "feed" the shoreline to the south, mimicking prior beneficial use projects which placed sediment in the nearshore zone from Mississippi River Gulf Outlet maintenance dredging, allowing Mother Nature to rework the sediment and transport a moderate percentage onshore.

POSTER ABSTRACTS

Poster 1

Lindsey Lamana, Louisiana State University - Masters

SOCIO-ECOLOGICAL NETWORK ANALYSIS OF EXISTING WATERSHED PLANS IN THE UPPER PONTCHARTRAIN BASIN

Louisiana's efforts to create watershed planning under the Louisiana Watershed Initiative (LWI), suggests the need to evaluate existing systems of governance at the watershed level, including plans, policies, and collaboration. This is often accomplished through plan evaluation methods. However, these do not have mechanisms to measure relationships among different types of plans or the interrelationship of plans in different jurisdictions within the watershed. To address this gap in Upper Pontchartrain Basin (USGS Hydrologic Unit 0807) and its sub-basins, we will conduct a comprehensive review of environmental hazard mitigation plans and evaluate key planning governance networks within this watershed using network analysis methodologies.

The first step is collecting and inventorying all historical and present planning documents and ordinances in the Upper Pontchartrain parishes and municipalities. These documents include Comprehensive/Master Plans, Hazard Mitigation Plans, and Coastal Zone Management Plans. We will evaluate them using a "Plan Evaluation Coding Protocol" that was created based on an extensive literature review of existing plan evaluation tools, FEMA's Community Rating System, and CPRA's Flood Risk and Resilience Program. Will use social network analysis and document coding software to address three specific plan elements and code them as networks: 1) fact base, 2) policy tools and strategies, and 3) inter-organizational coordination and capabilities. Fact base includes practical information that can help identify if crucial hazard problems are identified and consistent across jurisdictions. Policy, tools, and strategies are the structural and nonstructural controls outlined in plans that affect location and type of development. Coordination and capabilities involve collaboration and conflict management between local, parish, and regional governments. Finally, we will layer the networks onto an ArcMap to visualize the relationships in the watershed.

The results of this study will illustrate shared watershed planning and policy networks, which will allow for preliminary observations about gabs in our coastal hazards planning networks. Our method presents a rapid means of assessing, analyzing, and visualizing existing patterns and gaps in policy and collaboration in the Upper Pontchartrain Basin.

Poster 2

Jennifer Irving, Louisiana State University - PhD

THE ROLE OF SOCIAL NETWORK ANALYSIS IN COASTAL WATERSHED PLANNING: A SCOPING REVIEW

Planning is a common approach used to address local and regional responses to natural resource management, climate change, hazard mitigation, and land-use and development. Many of the complex issues and "wicked problems" that planners are tasked with addressing are compounded by lack of "social-ecological fit," meaning that the scale of the planning or management response does not fit the ecological scale of the problem. For example, coastal environmental hazards are manifest at regional scales and cannot be adequately addressed by a single local jurisdiction. Instead, coastal and watershed planning requires collaborative responses from multi-jurisdictional networks of institutions, government actors and other stakeholders. The Louisiana Watershed Initiative and the Louisiana Coastal Master Plan are both examples of multi-jurisdictional collaborative planning efforts.

Planners and scholars have developed a set of core principles believed to contribute to high-quality plans as well as protocols for evaluating plans. While some plan evaluation protocols include criteria for inter-organizational coordination and capacity, most protocols are designed to evaluate individual plans, rather than networks of plans. We propose that a more robust method for evaluating networks of plans is needed to effectively understand and advance collaborative coastal and watershed planning in Louisiana. Social network analysis (SNA), which is commonly used to understand interactions among actors in governance and policy networks, could also be used to understand how individual plans combine to create a governance structure at ecologically relevant scales, such as a coastal regions or watersheds. However, SNA has not yet been integrated into plan evaluation protocols.

To better understand how SNA techniques could be integrated into plan evaluation protocols for coastal planning in Louisiana, we will conduct a literature review. Article searches with key terms such as "plan evaluation," "planning and networks," and "governance and networks" will be conducted in Web of Science. Search results will be restricted to categories related to environmental or natural hazards planning and management, screened for relevance, and evaluated. Articles included for full review will be categorized based on how social network analysis is used to measure networks and how the identified network metrics can be integrated into plan evaluation protocols. The results of this analysis will contribute to the creation of a standardized multi-jurisdictional plan evaluation protocol for coastal watershed planning that incorporates social network analysis.

Poster 3

Kacie Wright, Louisiana State University

Visualizing Complexity and Connections - A Systems Map of Louisiana's Land Loss Crisis

Sharing the complexity of Louisiana's coastal land loss to the public in an interesting and engaging yet clear and concise way has proven to be a great challenge to coastal outreach professionals. Historically, outreach organizations relied on print materials to share their message but with the increased reliance on technology, the desire for zero-waste, and the development of social media, organizations have transitioned to the use of visualization tools to engage and educate the public. Systems mapping is a useful, interactive visual mapping technique that shows interconnected variables and patterns of behavior to help untangle dynamic, complex problems. Seeing the complexity of coastal land loss broken down into individual factors and connections allows viewers to explore and understand the inner workings of the issue. A detailed systems map is also beneficial for coastal outreach organizations. Maps can highlight areas of priority where outreach organizations can engage to create a larger impact. By identifying the most influential variables, groups can understand the system and how to engage it effectively through specific target audiences and engagement strategies.

Poster 4

Victoria Sagrera, Nicholls State University

Changing COAST: Utilizing the Coastal Advocacy through Science Training program to Unify Restoration and Social Efforts in the Bayou Region by COAST Program Partners

The Coastal Advocacy through Science Training (COAST) program is a collaborative leadership development initiative for native communities in Lafourche and Terrebonne Parishes. The program links coastal restoration with coastal culture through an examination of restoration-related scientific and social impacts. The purpose of the COAST program is to bring together native communities in Lafourche and Terrebonne Parishes, and to connect them with coastal scientists to share knowledge and take action related to environmental restoration and cultural impacts. By bridging the concepts of traditional ecological and cultural knowledge with regional restoration efforts, project planners are able to consider community-guided, scientific based solutions benefitting native communities while maintaining strong connections to the coastal landscape. To do this, the COAST program brought together residents to map their community, both physically through community mapping workshops, as well as geo-spatial narrative sessions. This mapping process not only created a record of areas important to the community and those that are at risk, but helped the COAST team create a platform for bringing leaders from different native communities into conversations about coastal restoration. This approach resulted in shared perspectives and knowledge regarding restoration activities taking place around the community. Sessions occurred in the community—workshop sand site visits—designed for the whole family, as no input was considered too young. In lieu of in-person workshops following COVID-19 policies, the COAST team offered expert-led webinars relevant to the assistance, stewardship and progressive growth in connections and resources. The COAST program will ultimately end in a multifaceted restoration and resilience project designed by participants, which is the current stage of the program. Restore or Retreat, in partnership with Louisiana Sea Grant, The Water Institute of the Gulf and BHP, have guided the COAST program by providing support and training to members and native communities on mechanisms to achieve long-term sustainability of Louisiana's coast, benefiting community and culture.

Poster 5

Cody Facio, Nunez Community College - Graduate student

Advances in Reef Expansion, Spat Growing, and Off-Bottom culture is the future of Oyster Management

The oyster fisheries in Southeast Louisiana are one of the largest wild oyster fisheries in the world. Louisiana is the top harvester of oysters in the U.S. and has led the United States in oyster landings every year since 2000. These oysters do much more than just providing a delicacy at the table. They provide local jobs starting from the boat to the restaurant. They also serve as filters in the water area as well as form a hard bottom, which is crucial when trying to build up the coast. Furthermore, they serve as a living barrier in the form of reefs, and as long as the reefs thrive, they will multiply and spread seed that will extend the reefs hard bottom. Reefs provide living spaces and feeding grounds for thousands of species of fish and crustacean. Something must be done to advance and sustain the oyster fishery in Southeast Louisiana. To advance the oyster fisheries a plan must be created, and direct action will need to be taken. Making more grounds available to commercial fisherman and totally dropping the moratorium would greatly increase oyster production as well as provide income opportunities for fisherman who may not have had the opportunity to buy a lease before the moratorium was in place. Another idea would be to apply grant money to building up the rock piles that produced in the harvesting areas that produced the most sacks on state ground. Also planning the proper harvesting seasons and sack limits. Having more technology, more teams of researchers, and even volunteer oyster fisherman getting involved will be a great idea to gain knowledge on the fishery. It will give the fisherman a chance to help learn as well as shed knowledge gained from experience. Introducing new technology means a more sustainable harvest. The other idea that is already in place is off bottom oyster culture. The off bottom harvesting of oysters provides people, with good saline water property, the opportunity to grow oysters off the bottom in special containers that float. They will be able to harvest them from seedlings to market size within 6 months in the right conditions. Not only does this provide people with more income opportunity; it also can be a way to help keep the water filtered anywhere oysters can thrive. In the case that freshwater diversions take out the wild oyster reefs closer in, off bottom will be the adaptation and the way to "take action" to sustain the future oyster fishery. As the flood water settles in and causes large spread oyster fatalities the reefs still have a chance to recover. Producing spat and off-bottom culture will help negate the affects. Leaseholders can have a different area to harvest their off-bottom oysters. Spat can be placed as soon as saline levels are back to optimal to ensure a harvest in the next 12-20 months. This advantage that has been around for a while now and needs to be acted on. Having easier access to more seed, substrate, and area will provide the oyster fisheries in Louisiana a leap into the future when adaptation may be necessary.

Poster 6

Sofia Giordano, Coalition to Restore Coastal Louisiana

A Review of Oyster Shell Recycling Programs Across the Country

This study surveyed 15 oyster shell recycling programs in the United States and identified the top 5 based on volume of shell recycled per year. The goals of this national oyster shell recycling review are to improve shell recycling programs in Louisiana and build support for shell recycling to advance coastal restoration. Online questionnaires were distributed to 20 total oyster shell recycling programs in 17 states. A total of 14 programs responded from May 2020-March 2021. The top program respondents by volume of shell recycled annually include: Billion Oyster Project (NY), Galveston Bay Foundation (TX), Chesapeake Bay Foundation (VA/MD), North Carolina Coastal Federation (NC), and Gulf Coast Oyster Recycling and Renewal Program (FL). Programs were asked to report statistics, such as volume of shell collected annually, and annual budgets, based on their operations prior to the COVID-19 pandemic, which caused several programs to pause recycling. Respondents were also asked to describe how their programs handle cured shell, and whether any local or state legislation supports oyster shell recycling in their respective areas. Preliminary data shows that the top programs recycle an average of 105 tons of shell a year, with an average budget of $80,000. Additionally, the program with the highest budget recycled the highest amount of shell and has local legislative support through tax credits. Communication between oyster shell recycling programs is critical to increasing program efficiencies and ensuring oyster shells make it back into waterways to sustain resilient fisheries.

Poster 7

Daniel Jensen, NASA Postdoctoral Program Fellow

Leveraging the historical Landsat catalog for a remote sensing model of accretion in coastal Louisiana

Leveraging the historical Landsat catalog for a remote sensing model of accretion in coastal Louisiana: A wetland's ability to vertically accrete—capturing sediment and biological matter for soil accumulation—is a key process for maintaining elevation to counter soil subsidence and sea level rise. Wetland soil accretion is comprised of organic and inorganic components that are largely governed by net primary productivity and sedimentation rates. In coastal Louisiana, current analysis from 1988-2018 shows an estimated 1914.80 km2 of total loss at an average rate of 61.77 km2/yr. Sea level, land elevation, primary productivity, and sediment accretion are all changing in different parts of Louisiana's coastline, destabilizing much of Louisiana's coastal wetland ecosystems. The historical Landsat data catalog offers over 30 years of imagery that can be applied to tracking land extent changes throughout Louisiana's coast. The expansiveness of this dataset further allows it to be combined with the Coastwide Reference Monitoring System's (CRMS) point-based accretion data. To this end, we processed and downloaded normalized difference vegetation index (NDVI) and red-band surface reflectance data for every available Landsat 4-8 scene across the coast using Google Earth Engine. Water pixels from the red-band surface reflectance were transformed into estimates of total suspended matter (TSM) to represent sediment deposition—the inorganic accretionary component. NDVI values from the land pixels were used to estimate bioproductivity—with organic matter deposition representing accretion's organic component. With the timeseries of these remote sensing data temporally matched to the CRMS accretion dataset, we developed a machine learning algorithm that successfully predicts wetland accretion levels (cm/yr). This model can be applied to current remote sensing data to estimate future accretion rates and inform predictions of wetland loss.

Poster 8

Kelly Guilbeau, Cherokee Nation Technologies, U.S. Geological Survey, Wetland and Aquatic Research Center

Synthesizing Louisiana Management Plans to Inform Value-Based Restoration

Science-based decision making begins with establishing a clear set of objectives that reflect the values of stakeholders. Several methods exist for developing objectives, such as conducting workshops to elicit and prioritize values from relevant stakeholders or facilitating activities to translate broad goals into measurable objectives. The establishment of these objectives, however, is often constrained to a particular jurisdictional boundary, aligned to a management program or funding source, or scaled to an individual project. Because an ecosystem does not adhere to these boundaries and limitations, holistic ecosystem restoration will require a systematic approach to connect disjointed objectives in order to measure progress at broader scales.

Our solution to this challenge of aligning existing objectives across multiple scales and jurisdictions is to conduct a rigorous synthesis of existing objectives, beginning with values implicitly and explicitly described in state management plans, to develop a shared set of themes that reflect the values of stakeholders across Louisiana and the other Gulf states. These themes, or synthesized values, can contribute to a more holistic development of restoration objectives. We used an iterative qualitative coding process based in grounded theory and assessed the inter-rater reliability on a subset of management plans to reduce bias and subjectivity of the coding process. The iterative process allows us to fully capture the themes across all management plans and generate a collective set of Louisiana and Gulf Coast values. This method of synthesis has been historically reserved for research in the social sciences but may be an ideal approach for synthesizing cross-boundary values and objectives of ecosystem restoration programs.

This presentation will provide context for this Gulf-wide synthesis project, details on the qualitative research methods used, and provide preliminary findings on the synthesized values found in Louisiana management plans. We will discuss the overarching plan for the project, including incorporation of additional values or objectives across restoration projects or funding sources, outreach to restoration managers to further refine initial findings, and the development of interactive visualizations. This collaborative, innovative approach of aligning objectives has the potential to enhance our understanding of cross-boundary values throughout Louisiana and the entire Gulf Coast, improving our abilities to assess restoration progress holistically.

Poster 9

Ruth Daniel, Louisiana State University - PhD

RESILIENT COMMUNITIES = HEALTHY COMMUNITIES: EXPLORING APPROACHES TO RESTORATION TO MINIMIZE FISHERS RISK OF BIOLOGICAL HAZARDS

Inshore fisheries of the northern Gulf of Mexico surrounding Plaquemines Parish, Louisiana are a highly connected social-ecological system. Diversion of Mississippi River (MR) water into the marsh is one of the main strategies for reversing legacy land loss, current and future sea level rise, and as a strategy for preventing oil from impacting delicate marshes during man-made disasters. In this study, researchers will examine impacts of changes in salinity and introduction of MR water on the resilience of the local community through connecting fisheries to health. Few studies have examined the biological hazards associated with handling and consuming seafood in Louisiana and translated results to fishers. The team will conduct a longitudinal study examining attitudes toward and incidence of Vibrios and other pathogens following up on a 2008 survey. At the same time, researchers will examine oysters, shrimp, crabs and commercial in-shore fish (exterior and interiors) for pathogens, and their bacterial predators along the salinity gradient created by diversions.

Researchers will communicate and partner with local stakeholders, community members, and decision makers to explore ways to increase seafood safety through education. This study will provide the first-ever benchmark information about the presence/absence of Vibrios and other pathogens in seafood other than oysters from Louisiana. Preliminary DNA sequencing data have shown that oysters, red fish, and speckled trout may all harbor potential human pathogens in the bacterial families Enterobacteriaceae, Mycoplasmataceae, Pirellulaceae, and Vibrionaceae. Additionally, this work will raise awareness of fishers and decision makers about the impact of fresh water and sediment diversions on biological hazards and seafood poisoning along with methods for reducing human health risk.

Poster 10

Elsa Schwartz, Restore America's Estuaries

ONLINE RESTORATION PROJECT DEVELOPMENT TOOLKIT FOR NONPROFESSIONALS

Staff at public agencies and non-profit organizations often receive phone calls or applications from individuals outside the professional restoration community (e.g. NGOs, municipalities, or individuals) who have a sincere desire to restore local habitats, but have difficulties figuring out where to begin. Restore America’s Estuaries has developed an online “Toolkit” to support coastal residents and citizen scientists who identify problems with their local coastal environment and have an interest in transforming the idea into a project. The Toolkit enables community members who aspire to improve their local ecosystem, but who need the information and guidance to go from project idea, to design, to implementation. This talk will describe the process we went through to develop this tool, including listening sessions and focus groups around the country, and will debut the online toolkit, going through the different elements and modules and describing how it can be used to further restoration projects.

Poster 11

David Heap, Colorado State University - Graduate student

Microdiversions for Mississippi River Sediment Management

The Coastal Restoration and Energy Production System ("CREPS") is an innovative solution to coastal restoration because it uses the piping method without the need for outside power. It both replenishes eroded land while simultaneously generating electricity. It is unique in that there is no existing method of coastal restoration that has self-sustaining power capabilities. CREPS is similar in cost to install compared to existing methods, has fewer environmental hazards, resolves issues facing the maritime and fishing industries, and has a recurring return on investment. This poster shows the initial modeling results from a proposed pilot project

Poster 12

Raffaele Marino, Jacobs

PRACTICAL APPROACHES TO TRANSFER OR DECOMMISSIONING COASTAL ASSETS

The project is about ensuring that the “Right people, manage the right assets in the right way.” The Environment Agency in the UK and other international risk management authorities are looking at possible ways to ensure that resources are focused on maintaining existing flood and coastal erosion risk management assets. Such assets include embankments, walls and structures and are maintained where there are sufficient economic, flood/erosion risk or environmental justifications or legal reasons to do so. This means that, in some cases, maintenance of some assets may no longer be economically justifiable, or environmentally desirable, or have a high enough priority to attract funding in the longer-term. In these situations, the assets may be decommissioned (abandoned, removed or demolished) or transferred (via sale or handover) to others.

This project investigates the issues involved in transferring ownership and maintenance responsibility for assets to other authorities, local bodies or landowners. It also looks at the issues involved in decommissioning assets where transfer of responsibility is not possible. It looks at how this can be done in a way which minimizes impacts to flood/erosion risk and the environment (seeking to make environmental gains where feasible). The project also considers the importance of working with others locally to explore and implement changes to the current maintenance regime.

The goal of the project is to produce a practical guide for everyone involved in the transferal or decommissioning of assets, with the expectation that the guide will be useful to organizations and local authorities as well as by communities and landowners. The project focuses on the how to do when involved in decommissioning or transfer of assets to ensure that this happens in the best possible way.

Delivery of this research project is occurring in three stages:

Stage Tasks Timescale

1. Information gathering Gather information from existing literature and via discussions with a wide range of stakeholders on examples and experiences of asset transfer and decommissioning and capture views on the types of practical guidance needed. Completed in 2018

2. Identifying and capturing good Practice approaches. Draft Guidance Using real life case studies, identify and capture good practice for all the key elements associated with asset transfer or decommissioning, including legal; funding; environmental; impact/consequence and community/stakeholder engagement requirements. Produce draft user-focused guidance. Completed in 2019

3. Approval final practical user guide Approval final user focused guidance to assist everyone who is involved in the transferal or decommissioning of assets. Mid 2020

Poster 13

Rubayet Bin Mostafiz, Louisiana State University - Graduate student

Reduction in Housing Cost through Freeboard: A Flood Risk Webtool for Homeowners

Risk communication is one of the essential components for mitigating flood risk. One often underutilized form of communicating flood risk is through the use of technology, particularly through freely available, online decision-making tools that community stakeholders, and public service professionals can use that assess the costs and benefits of mitigating flood risk. Specifically, the public has limited access to this communication so it is frequently unaware of the degree to which flood damage can be reduced cost-efficiently by incorporating flood adaptation strategies such as freeboard, which refers to the elevation of a building's lowest floor above the Base Flood Elevation (BFE). Optimizing the level of freeboard against expected cost and savings is a crucial decision for communities, particularly flood-vulnerable residents. Moreover, while existing flood web portals provide helpful risk information, their information primarily focuses on flood forecasting or general risk information such as flood insurance and risk, historical flooding, and flood zoning, at global to regional scales. In other words, web-based flood risk information tools rarely consider micro-scale (i.e., parcel or individual building-level) economic loss or exposure to enhance decision-making. While these portals support assessing flood risk for existing buildings, they are limited to new residential developments. In this project, we propose an interactive decision-making tool, Flood Safe Home (https://floodsafehome.lsu.edu/), that helps individuals identify an optimal freeboard level by calculating its expected incentives and future savings based on their property information, for three parishes (i.e., counties) in Louisiana, U.S. Based on user inputs including location of interest (parcel, address, subdivision, and community), building square footage, and number of building stories, the tool calculates monthly savings information of installing freeboard by evaluating flood risk parameters such as freeboard construction cost, insurance premium savings, annual avoided loss, total benefit, and payback period, for multiple freeboard heights. Infographics are built using 'Django,' a Python programming language-based web framework that provides the web developing platform for communication between the interface and server database. This web-based decision making portal is expected to help potential homeowners to make risk-informed decisions with various economic analysis and benefit information, ultimately enhancing protection of life and property, and therefore long-term resilience, to the ever-present flood hazard in one of the most flood-prone U.S. states.

Poster 14

Nina Reins, Freese & Nichols

HARVESTING OF BEDLOAD MATERIAL IN RIVERINE AND MARINE SYSTEMS AND POTENTIAL APPICATIONS FOR COASTAL RESTORATION

The concept of Regional Sediment Management (RSM) is an integrated approach to sediment management strategies that enables agencies, communities, academia, and consultants to work together in leveraging financial and technical resources for the purpose of developing and promoting systemwide solutions and specialized tools; to facilitate the application of natural and generated sediment supplies to protect, restore, and conserve water and coastal resources infrastructure and ecosystem habitats. Based on RSM's strategies, it is the goal to employ alternative tools to harvest and deliver sediments for water and coastal resources restoration projects, which are cost effective and innovative.

An innovative sediment management technology, designated the Sediment Bedload Collector, has been developed that achieves sand harvesting by relying on natural physical processes to capture sediments by gravity as they are transported over the collector's embedded hopper. The sand harvesting system is a complimentary technology to dredging and excavating platforms that allows for targeted collection (or harvesting) of coarse-grained bedload in a non-disruptive, non-intrusive, and sustainable manner from within streams, rivers, coastal, and other dynamic aquatic environments.

The Sediment Bedload Collector is a stainless-steel hopper set into the waterbody bottom that collects coarse-grained sediment as it is moved by hydrodynamic forces. As material is continuously extracted material naturally replenishes from the constant movement of bed material traversing the embedded hopper. A manifold system then pumps sediment slurry via a pipeline to a placement area or re-handling station. This presentation will describe how the Sediment Bedload Collector system works, how it has been applied in riverine and marine environments, as well as how it was customized for each individual application, and how it is currently being explored for deployment for beneficial use of harvested materials and sediment removal respectively.

Poster 15

David Watt, Tulane University

Risk Analysis and Mitigation Strategies for Archaeological Sites along Louisiana's Gulf Coast

Anthropogenic disasters in the Mississippi River Delta have overwhelmed conventional resource management. Coastal erosion, subsidence, and sea-level rise are rapidly obliterating the archaeological record along Louisiana's Gulf Coast. A multi-institutional working group for Mississippi River Delta Archaeological Mitigation (MRDAM) has developed a risk assessment matrix to assess the impacts of coastal erosion, subsidence, and sea-level rise on at-risk cultural resource in the Coastal Zone. This work has resulted in strategies to stem the ongoing loss of cultural heritage in south Louisiana. Data recovery, salvage, site triage, regional sampling, mitigation banking, and creative mitigation represent alternative measures to be pursued in consultation and partnership with Native American tribes and coastal communities.

Poster 16

Darrah Bach, Coalition to Restore Coastal Louisiana

Shoreline Change and Reef Development of A Restored Oyster Reef in Biloxi Marsh, Louisiana

Oyster reefs are increasingly important to upholding Louisiana's coastal ecosystems, landmass, the livelihoods of thousands of farmers across the state, and local cultural tradition. Oyster reefs can reduce marsh erosion by interrupting the impact of waves, serving an important role as the Gulf Coast faces increasingly intense storms. Oysters are native to these waters, but natural reefs are in decline due to issues with water quality, unsustainable harvesting, dredging, and many other factors.

In 2016, the Coalition to Restore Coastal Louisiana (CRCL) built a half-mile reef in Biloxi marsh as part of the organization's habitat restoration program. The reef is comprised entirely of recycled oyster shells collected through CRCL's Oyster Shell Recycling Program, a community effort to recycle oyster shells from New Orleans restaurants. The recycled shells were placed in galvanized steel gabion baskets and placed along the shoreline where the shells will serve as a nursery habitat for new oysters.

Since the construction of the Biloxi reef, the CRCL monitoring division has been collecting data annually to assess the impact of the project. An additional .45 miles of shoreline was allocated as the control site with which we have compared the reef site. Since 2016, we have annually measured the shoreline erosion, water quality parameters, and oyster and other encrusting organism recruitment.

Analyses thus far suggest that the reef is having a positive impact on the health and longevity of the affected marsh area. Historic satellite imagery was analyzed to find shoreline erosion patterns since 1989. Since 2019, we have collected aerial imagery of the site using a Phantom Drone. We have found that the shoreline bordering the control reef has eroded about twice as much as the shoreline bordering the oyster reef. Annual oyster recruitment data suggest that the reef is serving as an effective nursery for new generations of juvenile oysters.

The analyses suggest that oyster reef construction can serve as an effective shoreline protection measure, as well as contribute to oyster regeneration and ecosystem health. The findings demonstrate that recycling oyster shells is not only sustainable, but potentially instrumental in upholding Louisiana's coast and oyster population.

Poster 17

Hoang Tao, University of New Orleans - Graduate student

The City Of New Orleans Repetitive Flood Loss Area Analysis

In 2005, Katrina flooded a large portion of New Orleans, which demonstrated the high flood risk within the city. Beyond hurricane-related flooding, everyday storms have shown that many local residents are victims of repetitive flood loss due to stormwater runoff and drainage issues. The Federal Emergency Management Agency (FEMA) defines a repetitive flood loss property as any insurable building for which two or more claims of more than $1000 were paid by the National Flood Insurance Program (NFIP) within any ten year period. There are 33,993 repetitive flood loss properties in Louisiana, resulting in more than $3.4 billion in damage payments since 1978. A better understanding of repetitive flood loss throughout Louisiana and the City of New Orleans is needed in order to assist in the development of best planning practices for the reduction of flood risk from both seasonal hurricanes and everyday heavy rainfall. In partnership with the City of New Orleans and HUD, UNO-CHART is conducting a repetitive loss area analysis for the entire City of New Orleans. This research uses FEMA repetitive flood loss data to create GIS maps to analyze flooding vulnerability. Additionally, CHART has collected data through the grading of more than 140,000 properties within the city. The goal of this repetitive loss area analysis is to help residents reduce their flood risk by providing a broader understanding of the flooding problems in their neighborhood, and the potential flood reduction solutions. The results of this analysis will inform mitigation planning and prioritization of mitigation projects, as well as provide education and outreach efforts focused on flood mitigation to address issues of equity in areas that experience repetitive flooding. This CHART research will ultimately improve residents' health, safety, and well-being by reducing repetitive flood loss in both costs of property damage and detrimental effect on residents' lives.

Poster 18

Kathryn Loomis, Coalition to Restore Coastal Louisiana

COMMUNITIES RESTORING URBAN SWAMP HABITAT (CRUSH) PROJECT OVERVIEW OF CONNECTING COMMUNITIES WITH COASTAL RESTORATION ACTIVITIES BY PLANTING NATIVE TREES IN THE PONTCHARTRAIN BASIN

As one of CRCL's newest restoration projects, the Communities Restoring Urban Swamp Habitat (CRUSH) project began in the winter of 2018 and extended through the winter of 2020 with the goal of planting 5,000 or more native trees and restoring 25 acres of swamp habitat within the Maurepas Land Bridge in Akers, LA and the Central Wetlands Unit in Violet, LA. This volunteer-driven coastal forest restoration initiative provided community members with opportunities to participate in on-the-ground work to restore some of Louisiana's coastal habitats that have been impacted by land loss. These tree plantings helped retain newly built land while also facilitating environmental stewardship by local industries, landowners, businesses, and communities.

Man-made changes to the lower Mississippi River Delta affected the heath and stability of the Lake Maurepas land bridge and the Central Wetlands Unit. Both areas were historically freshwater bald cypress swamps that were heavily over-logged in the early 1900's when demand for bald cypress lumber increased. Logging canals facilitated saltwater intrusion and impoundments. These permanently flooded conditions prevented natural regeneration as seeds need a period of draw down to germinate. The Mississippi River Gulf Outlet (MR-GO) was constructed in 1956-1968. This large shipping channel increased salinity in the Pontchartrain Basin and killing large areas of freshwater species. When the MRGO closed in 2009, the basin began to freshen enough to eventually support mass plantings in the areas.

The trees were sourced from local stock and grown by RES's Ecological Restoration Services, LLC nursery with an additional 300 trees donated by Apache and 600 trees donated by RES. The plantings took place in the late fall and winter of 2018-2020. The majority of the species planted were bald cypress with roughly a fifth of red swamp maple and water tupelo. The project consisted of a total of 18 days of plantings, more than 300 volunteers, over 35 acres impacted and 5,750 trees planted. The volunteers engaged during this project have come from all over coastal Louisiana with even some out-of-state volunteers. Some of the groups that have participated in the events include Tulane University, Shell, Madison Preparatory Academy, Belle Chasse High, New Harmony High, and the University of Louisiana at Lafayette. This two-year project was made possible thanks to the Environmental Protection Agency's (EPA) Gulf of Mexico Program, the Lake Pontchartrain Basin Foundation (LPBF), Entergy, Apache, Audubon Louisiana, and the Lower 9th Center for Sustainable Engagement and Development (CSED).

An additional aspect of the CRUSH project involved a series of community engagement events in the Lower 9th Ward of New Orleans. Working along with the CSED, we engaged a new community with coastal restoration activities by organizing a career and advocacy workshop, presentations to schools, a student speed networking event with coastal management professionals, and tours including educational bike tours. Volunteer opportunities haven't been accommodating to all of the communities of the areas we serve and these events, along with the plantings, provided an accessible platform to connect the local community.

Poster 19

Rebecca Aiken, Stantec

JEAN LAFITTE SHORELINE PROTECTION PROJECT FOR SAV HABITAT RESTORATION: NUMERICAL MODELING

The Jean Lafitte National Historical Park and Preserve (JELA or the Park) is located in the Barataria Basin and neighbors Lake Salvador and Lake Cataouatche. Due to natural processes, such as sea level rise, land subsidence, and anthrophonic influences, wetlands within Barataria Basin have been deteriorating. Rapid deterioration of 50 acres of submerged aquatic vegetation (SAV) was recently observed along JELA's shoreline following response activities to the Deepwater Horizon oil spill. Shoreline protection measures are necessary in order to restore the Park's damaged shoreline and preserve vegetation with the ultimate objective to restore the 50 acres of SAV that were lost during the Deepwater Horizon oil spill. Therefore, breakwaters with a 20-year design criteria are proposed along the southeastern shoreline of Lake Salvador to aid with wave attenuation and reduce nearshore currents in order to recuperate and preserve SAV along the shoreline.

The objective of this study is to determine the optimal breakwater configuration by evaluating the impacts on two-dimensional current and wave behaviors using a coupled Delft3D hydrodynamic and wave model. The model was validated against in situ water level measurements collected near Lake Salvador. Following model validation, four breakwater alignments were incorporated into the model and the corresponding changes in wave heights, currents, and bed shears stresses were evaluated and compared against the best available thresholds known for successful SAV establishment. The evaluations were performed for normal (non-storm) conditions, the 20-year design storm event, and non-storm conditions with the inclusion of relative sea level rise in 2040.

In general, results show that the proposed breakwaters reduce wave height, maximum currents, and bed shear stresses along the marsh edge during non-storm conditions to enable SAV growth. During the 20-year design storm event, the SAV bed shear stress threshold was exceeded, but the breakwaters provide protected areas where SAV thresholds are not experienced. Furthermore, in areas where maximum bed shear stress thresholds are exceeded, the breakwaters reduce exposure times to severe conditions. By comparing the results among four breakwater configurations, an optimal layout was identified. In addition to understanding the influence of the breakwaters on the hydrodynamic and wave behavior, an investigation of the breakwaters impact on marsh edge erosion was performed following the approach in Louisiana's Coastal Protection and Restoration Authority's (CPRA) Coastal Master Plan (2017). Results of this analysis illustrates the project is anticipated to reduce annual marsh edge erosion by more than 55% behind the proposed breakwaters.

Poster 20

Curt Riche', USDA NRCS

Development of Spartina spartinae Lines for Improved Seed Production and Viability for Restoration Along the Gulf Coast

Gulf cordgrass (Spartina spartinae) (Trin.) Merr. ex Hitchc. is a native, perennial grass that grows in coastal marshes above the intertidal zone in dense clumps along the Gulf Coast from Florida to Texas. More rarely, it can be found growing in saline soils associated with inland marshes and moist prairies.

Factors limiting the widespread acceptance of growing gulf cordgrass commercially as a conservation plant include poor seed production and having to rely on asexual production methods that are both labor intensive and expensive. Having a dependable seed source would greatly increase the ability to establish more acreage at a lower cost.

The objective of this study was to identify a vigorous, heathy, dependable seed producing vegetative line that originated from collections from Texas and Louisiana. Seed was harvested from the most vigorous and productive plants and a germination test was performed. One accession from Brazoria County Texas showed higher seed viability than others after a year-long germination study was completed. Due to the phenotypical appearance and seed germination potential is being considered for a vegetative release from the Golden Meadow Plant Materials Center (GMPMC). The breeder block will be maintained at the GMPMC and the plant propagules will be made available for commercial nursery producers for coastal restoration projects.

Poster 21

Matthew Petty, CDM Smith

COASTAL WETLAND RESTORATION: LESSONS LEARNED PLANNING AND DESIGNING WETLANDS IN GULF ISLANDS NATIONAL SEASHORE (MS)

Beginning in September 2018, CDM Smith wetland scientists and coastal engineers partnered with the Federal Highways Administration (FHWA) and US National Park Service (NPS), to plan, design, and obtain permits for constructed coastal wetlands and living shorelines in support of the Park Road Improvements Project in Gulf Islands National Seashore. The project entailed an existing conditions assessment (e.g., wetland delineation), reference wetland identification and field surveys, development of an approved mitigation plan, coastal wetland and living shoreline design, preparation of required permit applications, construction cost estimates, and development of adaptive monitoring and maintenance measures. Often, complex coastal wetland restoration projects involve multiple teams, each responsible for a major phase of the project: planning, design, construction, or monitoring. This unique opportunity, in which the same team was retained through several major project phases, provided valuable insight to the challenges and complexities involved with taking a coastal wetland design project from concept to conclusion.

The Mississippi areas of the Gulf Islands National Seashore include barrier islands and the coastal marshes and maritime forests of the Davis Bayou. The project is to mitigate for minor impacts to existing wetlands and tidal waters resulting from widening the existing Park Road to accommodate pedestrian and bike traffic. To compensate for these minor impacts, a total of 0.35 acres of estuarine emergent wetlands and living shorelines would be created in a cove that historically contained wetlands but was dredged in the 1950s. Project components also included enhancing 4.95 acres of estuarine emergent wetlands through hydrologic improvements and 59 acres of forested wetlands and uplands with prescribed and controlled burns.

This presentation will explore lessons learned within each major phase of this coastal wetland restoration design. In the planning phase, the team developed consensus with project proponents and stakeholders and identified appropriate reference wetland sites and available tidal data to inform advanced design. In the design phase, the project team addressed issues with the suitability of using dredged material for wetland creation, concerns about the underlying sediments and structural stability, and maintaining existing freshwater stream flow. Environmental compliance involved balancing the requirements of different agencies and subsequent updates to the various components of the mitigation plan: controlled burns of overgrown forested wetlands, improvements to essential fish habitat, and construction of emergent wetlands and living shorelines. Construction planning included securing accurate cost estimates, scheduling timely transport of dredged material to the restoration area, identifying a regionally appropriate source of plant material, and identifying appropriate staging and site access in an area where closing public access was not an option.

Poster 22

Tanvi Shah, Tulane University

Crossing Boundaries: Leveraging Collaboration in Policy, Research, and Design to Address Watershed Issues

The Amite River has garnered much attention in recent years from government, non-profits, researchers, and residents because of the river's role in the floods of 2016. However, the watershed issues that exacerbated flooding (floodplain deforestation, sand and gravel mining, and urbanization) have long been recognized. Prior to the floods, multiple efforts sought to spotlight these concerns – some as significant as the 1990 formation of the Interagency Task Force under Governor Roemer and a 2007 USACE report on fluvial instability; yet, these efforts produced little, decisive action.

In 2017, however, a chance conversation regarding floodplain sand and gravel mining along the Amite between a student at Louisiana State University (LSU) and the science director of Healthy Gulf cascaded into a series of collaborations that generated further research and research-based designs to offer additional perspectives to the renewed interest in the watershed's issues.

The initial partnership created opportunities for a research fellowship, sequenced landscape architecture and architecture design studios, and new collaborations between faculty in four academic departments, some of which had ongoing research in the watershed. Examples of collaboration include datasets acquired by Healthy Gulf from governmental agencies, which were utilized by the landscape architecture studio to develop regional and site plans, which architecture students then used to design floodable buildings. The process also engaged Healthy Gulf staff and LSU faculty from each discipline in enhancing site visits with policy knowledge and assistance in data collection, which were used in design development. These collaborations were further supported by the Coastal Sustainability Studio (CSS), an interdisciplinary institute that convenes researchers, engineers, and designers to develop solutions rooted in the shared knowledge generated by these different perspectives. CSS not only offered neutral space for this collaboration to occur, but also provided funding for publication and opportunities to communicate this research across the university and to other universities through a symposium. Over the course of two years, these combined efforts generated multiple datasets, spatial and numerical models, historical research, regional planning recommendations, site-scale designs, masters theses, publications, and awards.

This case study demonstrates the potential benefits of a concerted, sequential process engaging multiple entities that can efficiently leverage their combined financial and human capital to develop a nuanced and holistic understanding of prevailing issues and research-based, iterative solutions. These products can then supplement other, ongoing efforts by becoming solution-oriented calls-for-action to government and advocacy / education initiatives promoted by public interest groups.

Poster 23

Jonathan Willis, Nicholls State University

IMPACTS OF WEATHERED OIL ON BATIS MARITIMA AND AVICENNIA GERMINANS SEEDLINGS: A MESOCOSM STUDY

Oil spills are a significant stressor to coastal and maritime environments worldwide. This is especially true in areas where extensive petroleum exploration and transport occur, such as coastal Louisiana. The Deepwater Horizon oil spill, in which approximately 4 million barrels of oil were released over an 87 day period, highlights the potential scope of such incidents. Scientific understanding of the likely impacts of oiling on ecosystems, as well as the recovery of key ecological components and processes, is in part based on controlled oiling studies. Such controlled experiments provide key insights that can inform and complement field investigations of oiling impacts. Although the effect of oiling on many low marsh species, such as Spartina alterniflora, are well studied, less is known about the effects of oiling on high marsh species that experience oiling less frequently. To address existing data gaps regarding the impacts of oiling on Batis maritima and Avicennia germinans seedlings, a mesocosm study was initiated at the Nicholls State University Farm Facility. This mesocosm study utilized a completely randomized factorial design comprising the following treatments: 2 species (B. maritima, A. germinans) x 4 soil oiling levels (0 L m-2, 1 L m-2, 2 L m-2, 4 L -m-2) x 3 tissue oiling levels (0% of stem height, 50% of stem height, 100% of stem height), with 4 replicates for a total of 96 experimental units. Intact sods were employed for the study, with reservoir water maintained at 10 cm below the soil surface and salinity levels at 18 ppt. Both short-term and integrated measurements of vegetation growth were assessed during the study

Overall, growth metrics of B. maritima displayed much greater sensitivity to both tissue and soil oiling than A. germinans, which exhibited a relatively high tolerance to both routes of oiling exposure. Batis maritima in the 4 L m-2 soil oiling treatment demonstrated significant reductions in cumulative stem height and leaf number, whereas no significant effects of soil oiling on A. germinans was detected. This was reflected in end of the study biomass partitioning, where total aboveground and live aboveground biomass were significantly reduced for B. maritima with 4 L m-2 soil oiling, but no impacts to A. germinans were found. Tissue oiling of 100% did appear to initially reduce stem diameter for both B. maritima, A. germinans, but no effect of tissue oiling was discerned on biomass partitioning, suggesting that there were no impacts to long-term, integrated growth for either species.

These findings have added to the knowledge base regarding the impacts of oiling to Gulf Coast vegetation species, and suggest that B. maritima would be more severely affected by heavy soil oiling than A. germinans.

Poster 24

Hoang Tao, University of New Orleans - Graduate student

Freeboard Incentives & Barriers

Beginning with Hurricane Katrina in 2005, the National Flood Insurance Program (NFIP) has struggled with financial insolvency, an issue that has only been exacerbated by the growing frequency and mounting costs of damages of large flood hazard events in the time of heightened climate change and rising sea levels. The Congressional Budget Office estimated that the NFIP is expected to lose an annual $1.4 billion for the foreseeable future. Flooding is among the most frequent hazards affecting the Louisiana coast and results in some of the highest losses of human life and economic disruption. The Federal Emergency Management (FEMA) has encouraged state and local communities to remove these repetitively flooded properties from existing high hazard floodplains or mitigate these flood-prone structures by elevating them above the base flood elevation (BFE) or 100-year flood level (i.e., freeboard standard). Freeboard elevation is one of the most cost-effective mitigation tools in reducing flood loss. Flood risk and freeboard mitigation communication is an important tool in the decision-making process. Professionals, officials, and residents need the best available data to inform their decisions to enhance flood resilience. Access to data and information can increase the resiliency of residents within the Louisiana coast. In addition to existing methods of information delivery, resiliency can be enhanced through the implementation of an interactive decision-making web tool, which can calculate and communicate flood risk and optimal freeboard information. This research explores the qualitative data from local stakeholders' (e.g., officials, professionals, residents) views on incentives and barriers to implementing higher freeboard standards for three Louisiana parishes (i.e., Jefferson, St. Tammany, and Terrebonne). The findings showed the complex and divergent perspectives about the cost-benefit of freeboard elevation. The data from the multi-stakeholder governance model is used to identify potential solutions to enhancing flood resilience on the Louisiana coast.

Poster 25

Brandon Iglesias, Geaux Water

GEAUX WATER: INDUSTRIAL SCALE CLEAN WATER AND PROTECTED COASTS

Coastal land loss is the single largest problem facing our generation, our country, and our Louisiana. Corporations with coastal infrastructure and global population centers residing along earth's coastlines are severely threatened by this dangerous and urgent crisis.

Our story begins with a team of dedicated engineers and chemists focused on sustainable technologies actively working on processing clean water in parallel with capturing and converting carbon dioxide into useful products. Through our laboratory and field work we discovered that our clean water units could be modified and combined with our carbon dioxide capture units and electrochemical reactors to convert carbon dioxide and solids into limestone. Limestone is utilized today in large scale coastal restoration projects to dampen wave energy and reduce land loss resulting from wave energy erosion as well as flowing water erosion mechanisms. Not only can our rocks reduce land loss, but they can also protect valuable pipeline infrastructure that Shell operates within the Gulf of Mexico and wetland region. Our technology enables the conversion of liabilities, such as carbon dioxide, into assets, such as limestone to reduce land loss and possibly stop future land loss as we continue to mature the hard tech based technology driving our industrial clean water and protected coast solution.

Geaux Water's mission to the people of Louisiana and Shell Gamechanger is to build upon our clean water and carbon dioxide technology to produce rock materials for large scale coastal protection. We will accomplish this by first optimizing our rock materials at our land-based facility in Port Allen, LA then go through a process intensification step to ruggedize the process and deploy autonomous water robots that 3D print rocks with materials sourced from the local environment. Geaux Water's patent pending technology is based upon a combination of carbon capture, electrochemistry as well as geochemical processes that occur naturally in nature to produce limestone, accelerated through our integrated chemical engineering, electrical, material science and chemistry expertise, which enables the production of human made limestone and aggregate materials. Our internal laboratory saying is "rock your way through climate change".

Poster 26

Alexander Kolker, Louisiana Universities Marine Consortium

FROM THE GULF TO THE GLOBE: LOUISIANA'S RELATIONSHIP TO GLOBAL COASTAL CHANGE

Coasts across the world are experiencing an era of nearly unprecedented change, driven by global sea-level rise, changes in freshwater and nutrient inputs, fisheries harvests, and a wealth of other human impacts that occur on these naturally dynamics systems. Understanding how these changes are impacting coastal systems globally and the actions diverse regions are taking in the face of such changes is critical to evaluating the relative success of Louisiana's coastal restoration and protection efforts. Such information can help for identify new solutions to Louisiana's coastal challenges. This talk presents findings from a US State Department Fulbright scholarship to study North African coasts and compare results to coastal Louisiana, while also drawing on data from other coastal systems across the globe to provide insights that can be useful to Louisiana's coastal efforts.

This presentation will focus on one critical area facing all of these systems: sea-level change. It will show how interactions between short-term meteorological forcings and long-term climatic change and land movements function synergistically to increase flood risks and flood damage on a daily and yearly basis. Understanding flood regimes across systems globally thus requires coupling global weather and climate data with highly local information on coastal geomorphology. Globally, coastal flood risks are increasing, impacting some of the world's largest ports, beaches and wetlands, as well as culturally significant historical sites on every continent, and large cities and small villages. Such changes are felt in such diverse as places Morocco, Benin, Jordan, Japan and Cocodrie, Louisiana. One finding is that coasts that are geomorphologically different from the Mississippi River Delta, such as Morocco's rocky Atlantic coast, often face similar threats from sea-level change, storm-driven flooding, and coastal erosion.

Against this backdrop of global coastal change, Louisiana is in some ways well positioned for the future. The state's analytically sophisticated master plan and intense on-the-ground efforts provide a pathway to reduce flood risks and restore ecosystems. And yet, like coastal systems worldwide, the success or failure of these efforts are only partially controlled by local factors and local efforts. Some of the most important controls on coastal systems are global controls, notably globally accelerating rates of sea-level rise. Future planning efforts in Louisiana must continue to recognize the importance of global factors on local efforts and should engage expertise from practitioners across the world when planning for ecosystem development and long-term community sustainability.

Poster 27

Adam Gartelman, Louisiana State University - Undergraduate student

COASTAL PROCESSES NEAR A SANDY DREDGE PIT FOR RESTORATION EFFORTS ALONG THE LOUISIANA SHELF

Relative sea level rise, subsidence and storm-driven erosion are the leading causes of Louisiana coastal land loss. Anthropogenic changes have both negative and positive effects on the geomorphology of Louisiana's gulf coast. For thirty years, there has been a concerted effort to restore and protect coastal regions of Louisiana. Coastal Protection and Restoration Authority (CPRA) has identified obtaining high-quality sand from dredging as a focus in restoration efforts. Off-shore dredge pits (ODPs) are a cost-effective resource for obtaining high quality clean sand used in beach and dune restoration efforts along the Louisiana coast. However, the long-term morphological changes and coastal processes that occur is poorly understood as the utilization of this resource has only begun in the past couple of decades. Of recent, there has been extensive investigations into morphological changes that occur within the ODPs including the pit walls of the sites, but the duration of study needs to be extended as many of them are within a few years of the being utilized.

In this study, geophysical investigation of ODPs near Ship Shoal area, including bathymetric, side-scan, and sub bottom surveys, are used to monitor the infilling rates of the ODPs as well as changes to the walls of Caminada Pit which was dredged multiple times from 2016 to 2021. Sediment sampling is used to determine the infilling material along with providing physical evidence to confirm data obtained through geophysical readings. Literature search is utilized to compare new data and evidence with, in order to aid in understanding the changes occurring to the ODPs. Publications and open-source data from the Bureau of Ocean Energy Management (BOEM) as well as Louisiana Sand Resource Database (LASARD) are utilized. Sediment infilling rates, pit wall slope changes as well as the hydrodynamic conditions are synthesized to better understand the coastal processes.

Poster 28

Callie Snow, Louisiana State University - Bachelors

2019 Toxic Cyanobacteria Bloom Development in Lake Pontchartrain Estuary

Estuaries in the northern Gulf of Mexico (GoM) are undergoing significant transformations due to changes in climate and the implementation of coastal restoration activities which can lead to the increasing frequency of harmful cyanobacteria blooms (CyanoHABs). Through connected tributaries and the Bonnet Carré Spillway (BCS), the introduction of large volumes of nutrient-rich water into the nutrient-poor Lake Pontchartrain substantially changes the chemistry and ecology of the lake. In addition to the large input of nutrients, warm temperatures support the proliferation of CyanoHABs. The long-term duration of the BCS opening this past year introduced an excess of nutrients available for biological uptake in this estuary. However, the cyanobacteria bloom was limited to only the northern region of the lake. The overall research question is “What environmental factors influence the persistence and toxicity levels of the 2019 CyanoHABs in Lake Pontchartrain Estuary?”. To address our primary research question, our study has been divided into two primary objectives: (1) to determine the impact of certain environmental factors on CyanoHAB’s toxicity and prevalence; (2) to evaluate the timing and duration of the Bonnet Carré Spillway opening and nutrient dynamics on cyanobacteria species succession. Biweekly water samples were collected between June and October in Lake Pontchartrain using a historical transect stretching from the BCS to the Lake Pontchartrain Causeway. More sporadic sample collections have been in place from the start of November 2019 due to an unexpected bloom in the northern region of the lake. Collected water samples were processed for nutrients, pigments, microscopy, and “microcystin” toxin analyses. A ratio between the phycocyanin and the chlorophyll a concentrations was generated in order to analyze the relationship of cyanobacteria biomass with overall biomass of algae in Lake Pontchartrain Estuary. Preliminary results indicated that bloom development dynamics and toxin concentrations were found to be different during and after BCS opening, and before and after recent Hurricane Barry, possibly due to physical disturbances. Two different species of toxic cyanobacteria were seen to be dominant in different parts of the estuary. Microcystis was more abundant in the middle of the estuary, while Anabaena dominated the northern part of the estuary. The understanding and prediction of CyanoHABs in Lake Pontchartrain Estuary will greatly attribute to the overall future health and understanding of not just Lake Pontchartrain but the connected estuaries and lakes as well. Additionally, since the fate of CyanoHABs are reliant on this nutrient loading and physical dynamics, the future effects of sources like the Bonnet Carré Spillway and connecting tributaries have on water system’s quality and ecosystem can be further evaluated.

Poster 29

Wengiang Zhang, Louisiana State University - Graduate student

Morphodynamics and Sedimentation of Dredge Pits for Barrier Island Restoration

Global sea level rise, subsidence, decreasing river sediment supply and other factors have justified rapid land loss in many low-elevation coastal areas around the world in recent decades. Coastal restoration projects have become increasingly popular in the northern Gulf of Mexico due to high relative sea level rise rate and many vulnerable coastal lines. Both sandy shoals and paleo river channels have been used for the restoration of coastal barrier islands to protect and restore coastal systems. This study is focused on the morphodynamics, sedimentation, and geotechnical properties of several paleo-river dredge pits for barrier island restoration in Louisiana shelf. Raccoon Island dredge pit in central Louisiana shelf and Peveto Channel pit in western Louisiana shelf are two only known pits with 100% infilling after sand excavation and high sedimentation rates of 0.2-1.0 m/year. They provide a unique opportunity to study the “entire” life cycle of dredge pit infilling and very high temporal resolution of sedimentation. Both historical and new coring and geophysical methods from above two pits as well as Sandy Point pit in east Louisiana shelf were used to study the morphological change and quantify sediment accumulation rates. Vibra-cores and multi-cores were used to study grain size, radionuclide, organic matter, and lithological properties (e.g., compressibility, permeability, shear strength). Sub-bottom profiling, sidescan, and bathymetric data were utilized to quantify infilling rates, morphological evolution, pit slope stability, and impact to seafloor infrastructure. Our results help scientific community and decision makers to better understand the coastal processes and manage valuable sediment resources in coastal area.

Poster 30

Melissa Baustian, The Water Institute of the Gulf

CHALLENGES, OPPORTUNITIES, AND ACTIONS NEEDED TO IMPROVE WATER QUALITY IN COASTAL LOUISIANA

In coastal Louisiana, there are various challenging environmental conditions to be managed. From wetland loss, rising temperatures and sea levels to nutrient-rich waters, algal blooms, and Gulf hypoxia. Assessing current and future water quality conditions is important so that the negative impacts to Louisiana residents can be minimized and because improving water quality benefits Louisiana residents by supporting waters for recreational fishing/swimming, tourism, wetland restoration, and shrimp, crab, and oyster industries. Various opportunities currently exist to assess and manage the water quality conditions of nutrients, phytoplankton, and low oxygen, and some of these programs in the State of Louisiana are being leveraged and coordinated. For example, monitoring of estuarine water quality occurs though the System-wide Assessment and Monitoring Program (SWAMP) that is managed by Coastal Protection and Restoration Authority, which utilizes some of the Louisiana Department of Environmental Quality (LA-DEQ) and Louisiana Department of Wildlife and Fisheries (LDWF) sites. An annual NOAA-funded coastal water quality assessment is also led by Louisiana State University and Louisiana Universities Marine Consortium to measure the size of the Dead Zone. With all this in-situ monitoring data, analyses as well as models can be developed, calibrated, and validated to help inform current and future water quality conditions and help manage essential natural resources. Programs like the State of Louisiana's Water Quality Trading Program (initialized by LA-DEQ) and the State of LA Nutrient Reduction and Management Strategy all rely on water quality monitoring and modeling to make informed management decisions and recommendations. Effective partnerships among state and federal government, non-profits, academics, and NGOs are needed to continue coordination and leverage available and limited resources, especially when new opportunities arise, such as the Louisiana Watershed Initiative that is interested in water quality conditions. This presentation will focus on the challenges, opportunities, and actions needed to improve water quality in coastal Louisiana.

Poster 31

April Simmons, Nicholls State University - Graduate student

Comparison of larval and juvenile fish assemblage between newly created marsh terrace habitat and existing marsh habitat

Louisiana has lost roughly 25% of its coastal land since 1932 and is vulnerable to continued coastal land loss from anthropogenic activities and disasters, both human and natural. Prior to leveeing, the Mississippi River created millions of hectares of productive estuary habitats that supports 80% of the Louisiana economy and 60% of the national commercial fisheries. Marsh terracing is a restoration method that is used to enhance open water habitat for aquatic species. Marsh terraces have a high edge to area ratio with an extended littoral zone potentially creating high quality nursery grounds. I assessed the temporal and spatial use of newly created marsh terraces by larval and juvenile fish in an estuarine habitat using quatrefoil light traps deployed every other week from April to September 2019 and March to September 2020. In 2019, the larval and juvenile fish assemblage was significantly different between the marsh terraces and existing marsh habitat ($P = 0.0019$). In 2020, the assemblage was similar between the marsh terraces and existing marsh habitat ($P = 0.4589$). Habitat characteristics were also measured at the time of deployment. The marsh terraces were planted in January 2019 and the vegetation became similar to the existing marsh within 1 year and remained similar in 2020 ($P = 0.2420$). Water quality was similar between habitat types for the duration of the study (2019 $P = 0.5915$, 2020 $P = 0.4689$). Overall, my results indicate that marsh terraces produce nursery grounds that are functionally equivalent to natural marsh and encourages their continued use as a cost-effective restoration method.

Poster 33

Rachel Rhode, Environmental Defense Fund

BUILDING LAND IN COASTAL LOUISIANA: EXPERT RECOMMENDATIONS FOR OPERATING A SUCCESSFUL SEDIMENT DIVERSION THAT BALANCES ECOSYSTEM AND COMMUNITY NEEDS

Sediment diversions are currently one of the most talked about and most controversial restoration tools being considered to build and sustain coastal wetlands. If operated effectively, they will mimic and restore the natural processes of a riverine system and provide a regular supply of sediment and fresh water to wetlands. Sediment diversions, in conjunction with other restoration project types, hold promise for achieving landscape scale restoration of wetlands and stave off rapid habitat loss that threatens coastal Louisiana. The decisions about how a diversion will be operated will be very important not just for the near-term allowing the system and communities to adjust to changes in salinity, water level and habitat, but the long-term as well in order to build elevation and allow vegetation to establish.

The Environmental Defense Fund (EDF) and Restore the Mississippi River Delta formed an interdisciplinary Sediment Diversion Operations Expert Working Group (WG) to tackle complex topics related to operating a sediment diversion, specifically the Mid-Barataria Sediment Diversion. With each topic the team considered the state of the knowledge, trigger points, monitoring needs, potential data gaps, and how the issue would be affected by various methods of operation. The WG developed a series of recommendations such as operate to build and sustain land, develop secondary objectives to consider the needs of the ecosystem and the people, make operation plans living documents with monitoring and adaptive management, identify impacts to communities and industries and communicate them properly, monitor before and after construction, and define a clear governance structure. The WG also provided some key operational strategies to be considered. This includes using the higher river flows and sediment loads strategically, working with the geology of the receiving basin to build land, maintaining water quality and wetland health, balancing the needs of fish and wildlife species.

Poster 34

Craig Hood, Loyola University of New Orleans

SOUTHEASTERN LOUISIANA BAT MONITORING PROGRAM: A 8-PARISH MONITORING NETWORK TO DOCUMENT BAT BIODIVERSITY, DISTRIBUTION, POPULATION STATUS AND SEASONAL/NIGHTLY ACTIVITY PATTERNS IN COASTAL LOUISIANA

The SE Louisiana Bat Monitoring Program is a network of long term continuous (nightly, seasonal, and annual) monitoring stations documenting species diversity, activity and relative abundance of bat populations inhabiting SE Louisiana. Initiated in 2018, the network includes of over a dozen passive, electronic bat monitoring stations deployed and maintained in natural and urbanized sites in 8 SE Louisiana Parishes: Orleans, Jefferson, St. Bernard, Plaquemines, St. Charles, Lafourche, Terrebonne and St. Tammany. Sites for the long term monitoring stations include Jean Lafitte National Park, Bayou Sauvage National Wildlife Refuge, LUMCON, and state, parish, and city parks and nature centers, Conservation NGOs, as well as hosted by K-12 schools across the region. Active electronic bat detection (with handheld detectors) and mist-netting supplement the data collected with the long term passive, monitoring stations. Dr. Craig Hood, Loyola University New Orleans, serves as director of the program and coordinates with partners at the sites (e.g., NPS, USFWS, LUMCON, BITNEP, state/parish/city park or nature center staff) on deploying and maintaining the passive monitoring stations. The Program deploys detectors to K-12 partner schools, who host monitoring stations and interact with some of the data generated. Bat echolocation calls recorded nightly (dusk to dawn) are analyzed and identified to species following NaBAT (North American Bat Monitoring Program) protocols using locally developed bat call libraries developed by Hood (2012) and Hood & Nolfo-Clements (2019). The data generated are being added to the NaBAT database, which have very few bat records for Louisiana. Ten species, including Corynorhinus rafinesquii, Eptesicus fuscus, Lasiurus borealis, L. cinereus, L. intermedius, L. seminolus, Myotis austroriparius, Nycticeius humeralis, Perimyotis subflavus, and Tadarida brasiliensis have been recorded throughout our region to date. This is the first systematic, large scale monitoring project of bats in SE Louisiana. Although White Nose Syndrome (WNS) has not been documented in Louisiana to date (as of Jan. 2020), these datasets provide important baseline data on bat populations in our region, especially for populations of bat species (Perimyotis subflavus and Nycticeius humeralis) that are highly vulnerable to WNS in the WNS-affected areas of North America. The Program is also contributing both public outreach, providing bat educational programs and opportunities to participate in citizen science in Coastal Louisiana. Supported by a Society for Science and the Public STEM Research Grant, National Park Service grants (H21150300017, H7530100057) and Loyola University E.L. Beard Distinguished Professorship Fund.

References: Hood, C.S. and L. Nolfo-Clements 2019. Spec. Publ. Museum, Texas Tech Univ., 71: 713-745.

Poster 35

Emily Fromenthal, Nicholls State University

Scientific Illustration of Louisiana's Native Bees

Louisiana is home to over one thousand species of native bees. Like European honeybees, most of these bee species are efficient pollinators. However, unlike the non-native European honey bee, native bees are key to the health of the habitats that they live in, and most fill a unique ecological role in their environments.

Native bees, although immensely diverse, can be roughly divided into several categories including bumble bees, digger bees, carpenter bees, sweat bees, cuckoo bees, leafcutter bees, and mason bees. Although many different types of native bees call our state home, many of these species are under-researched and little-known outside of academia. For this reason, the main goal and purpose of this research project was to exhibit the anatomical and ecological diversity of our native bee species through scientific illustration. A total of nineteen female bees were illustrated using anatomical descriptions, reference photos, and observations. These drawings were combined in order to create a poster showcasing these species, their unique anatomy, and key traits.

Poster 36

Samuel Loftus, New Orleans Charter Science & Math High School

DOCUMENTING BAT BIODIVERSITY, SEASONAL AND NIGHTLY ACTIVITY PATTERNS AND POPULATION STATUS: A 15-MONTH MONITORING STUDY IN NEW ORLEANS, LOUISIANA.

This study reports the results of a 15-month, long term continuous (nightly) monitoring project documenting species diversity, activity and relative abundance of bat populations inhabiting Greater New Orleans. A passive, electronic bat monitoring station was installed and has been (and continues to be) maintained at New Orleans Charter Math & Science High School in uptown New Orleans beginning in November 2018. Bat echolocation calls recorded nightly (dusk to dawn) were analyzed and identified to species using call identification software (Kaleidoscope Pro 5.0), and manual vetting methods following NaBAT (North American Bat Monitoring Program) protocols using locally developed bat call libraries developed by Hood (2012) and Hood & Nolfo-Clements (2019). To date, six species, including Lasiurus borealis, L. cinereus, L. intermedius, Nycticeius humeralis, Perimyotis subflavus and Tadarida brasiliensis have been recorded, documenting their resident status, throughout the 15-month period at our study site (to date). This continuous monitoring dataset is the first systematic monitoring project of bats in Greater New Orleans. Together with studies at Jean Lafitte National Park (Hood & Clements, 2019) and other recently deployed monitoring stations in a 8-parish area, it provides the first baseline data for the ecological status of bat communities in coastal Louisiana. Although White Nose Syndrome (WNS) has not been documented in Louisiana to date (as of Jan. 2020), these datasets provide important baseline data on bat populations in our region, especially for populations of bat species (Perimyotis subflavus and Nycticeius humeralis) that are highly vulnerable to WNS in the WNS-affected areas of North America. This project is part of a wider network of bat monitoring sites, the SE Louisiana Bat Monitoring Program, hosted by Loyola University New Orleans, that is collecting seasonal and nightly bat species occurrence, habitat use, and population abundance data that is contributing to the NaBAT monitoring program. The current study, hosted and conducted by the New Orleans Charter Math & Science High School is a powerful example of engaging K-12 students and their faculty in conducting and meaningfully contributing to a long term environmental monitoring program in Coastal Louisiana. Supported by a Society for Science and the Public STEM Research Grant, National Park Service grants (H21150300017, H7530100057) and Loyola University E.L. Beard Distinguished Professorship Fund. References: Hood, C.S. 2012. Final Report, Re-survey and inventory of Mammals of Jean Lafitte National Historical Park, Barataria Preserve. NPS database. Hood, C.S. and L. Nolfo-Clements 2019. Mammals of Barataria Preserve, Jean Lafitte National Historical Park & Preserve, Louisiana: biodiversity, distribution and habitat use, pre- and post-Katrina. Spec. Publ. Museum, Texas Tech Univ., 71: 713-745.

Poster 37

Anastasia Konefal, University of New Orleans - Graduate student

Linking expression and productivity to environmental change for shoalgrass (*Halodule wrightii)*

LINKING GENE EXPRESSION AND PRODUCTIVITY TO ENVIRONMENTAL CHANGE FOR TWO SUBMERGED AQUATIC VEGETATION SPECIES

Anastasia Konefal1, Esra Ozturk-Yigit2, Just Cebrian3, T. Erin Cox1

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Seagrasses and other submerged aquatic vegetation (SAV) form productive ecosystems that are economically and ecologically valuable. Despite their importance, seagrass beds have historically declined, and bed production is further threatened by contemporary alterations to water quality. Seagrass can reallocate carbon and alter their photo-physiology, so declines in bed production can be delayed and by the time managers detect a problem it is often too late to mitigate.

Changes in gene expression related to survival in harsh environments could be used as an early indicator of bed stress. However, natural variation in gene expression in SAV is understudied and it remains unclear how quickly molecular and physiological responses are coordinated and whether specific genes are robust indicators of pending decline or stress. The goal of this study is to investigate in-situ the links between the expression of photosynthesis and stress associated genes to changes in the environment and relate these changes to bed production for two SAV species.

We visited two beds, one composed of Halodule wrightii ¬(shoal grass) and the other Vallisneria americana (wild celery) in the northern Gulf of Mexico from December 2019 to October 2020. At set hour or diel intervals, we collected the 2nd leaf from 3-6 shoots for gene expression analysis while simultaneously collecting measures of the physical environment (i.e. irradiance, temperature, salinity). On diel intervals, we also simultaneously assessed the efficiency of photosystem II in 2nd rank leaves using a diving-pulse amplitude modulated fluorometer. When conditions permitted, measures of plant metabolism (productivity and respiration) were collected concurrently. Metabolic metrics were determined from the change in oxygen content within in-situ incubations of plants enclosed in light and dark chambers.

We will present results on plant metabolism and fluorescence in relationship to the environment. In addition, we intend to present preliminary

results of RT-q-PCR expression of targeted genes compared to references for Halodule wrightii. Understanding these linkages will provide insight into the use of gene expression as an early indicator of productivity declines or environmental stress and its implications to aquatic vegetation management and conservation. This collaborative project will bring together molecular and physiological techniques to quickly and efficiently restore and conserve seagrass beds.

Poster 38

Casey Greufe, Nicholls State University - Graduate student

Examining dispersal in Apple snails Pomacea maculata with population genetics

Apple snails Pomacea maculata were first identified in Louisiana in Gretna in 2006 and have rapidly spread throughout the state. However, the mechanisms facilitating their rapid dispersal are not well understood but may be valuable in informing management strategies. We aim to characterize dispersal by analyzing the genetic structure of populations across Louisiana. Samples have been collected from Verret Canal and Bayou Chevreuil. Additional sampling will occur in Bayou Lafourche, the Vermillion River, the Calcasieu River, and Bayou Teche. Genetic structure will be assessed while taking environmental factors that affect connectivity into consideration, such as flow rates and distance between populations. We expect to find patterns indicative of continuously connected populations in waterways connected by the Intracoastal Waterway. We also expect to find patterns indicating flow-based resistance to dispersal within populations that are distributed longitudinally along individual waterways. These results will inform our understanding of the primary dispersal mechanisms driving the rapid spread of Apple snails throughout Louisiana, thereby enabling targeted containment strategies for the protection and betterment of Louisiana ecosystems.

Poster 39

Temitope D. Timothy Oyedotun, University of Guyana

Evaluation and Assessment of the State of the Guyana's Coastal Environment through SDG 14:1

Guyana's coastal area, as common with many other developing countries including Small Island Developing States and Island Territories, are heavily dependent on, for various marine-based economic activities. The coastal area of Guyana is noted to host various thriving economic sectors such as shipping, fisheries, tourism and of recent petroleum, thereby providing employment and means of livelihood for thousands and generating revenues for the country. However, this coastal environment remains most vulnerable to sea level rise because of its geographic conditions and the country's limited ability to respond to this 21st Century phenomenon. As much as these environmental and economic issues are of pressing concerns to the Government and the over 90% of the country' s population that reside in the coastal plain, the pressures of rapidly growing urbanisation and consumption patterns on the coastal-marine environment have not been given the kind of attention other issues command. The impacts of these land-based phenomena (growing urbanisation and consumption pattern) on coastal-marine environment are known to hinder the progress towards the achievement of the Sustainable Development Goals (SDGs) which Guyana and other countries have committed to aspire to. For the SDG 14:1, it is stated that by 2025, the signatory countries should prevent and significantly reduce the marine pollution of all kinds, from land-based activities, including marine debris and nutrient pollution. This study seeks to (i) assess the state of Guyana's coastal-marine environment with respect to the land-based sources of pollution; and, (ii) use the assessment to evaluate the country's closeness to meeting the SDG 14:1. With the launching of Guyana's Low Carbon Development Strategy (LCDS), the country has a strong policy context that will facilitate the achievement of the SDG 14. However, the findings from field survey and laboratory analyses of sediment and water within the marine-coastal environment suggest that the country is miles away from the 2025 targets. There is the need, therefore, to expedite the application of the established policy in various ways to ensure that the land-based pollutants, that wants to extend the target date and goal, are wholesomely addressed.

Keyword: Sustainable Development Goals; Marine Pollution; Land-based Sources; Sediment; XRF; Wastes.

***Brief Biography of Presenter, Temitope D. Timothy OYEDOTUN, PhD**

Dr Temitope Oyedotun is a graduate of the University College London (UCL) where he obtained his doctoral degree (PhD) in Physical Geography (Coastal Geomorpholgy). His first academic degree was in Geography (BSc), and later obtained two Masters of Science degrees in Geography (Hydrology Option) and Geographical Information System (GIS) respetively, from University of Lagos, Nigeria and University of Leeds, United Kingdom respectively. Dr Oyedotun has years of international academic engagements in different countries, and over 30 publications in diverse fields of Geography and Environmental Sciences, in reputable journals and conference proceedings. He is currently a Reader (Associate Professor) at, and the Dean of, the Faculty of Earth and Environmental Sciences, University of Guyana.

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Poster 40

Julie Torres, National Parks Service

GEOMORPHIC AND TEMPORAL EVOLUTION OF A MISSISSIPPI DELTA FLANKING BARRIER ISLAND: GRAND ISLE, LA

The fundamental processes driving long-term (millennial) and short-term (seasonal to annual) morphological changes within barrier island systems are well developed and understood. However, the details necessary to understand barrier evolution at decadal to centennial time scales are still lacking for most barrier systems, including those of Louisiana. One method for resolving barrier island growth over time makes use of optically stimulated luminescence (OSL) dating of beach ridge sediments. In Louisiana, while this method was used to document deltaic progradation, it has not been used extensively to better understand barrier island systems. Here, we use OSL to document the timing of beach ridge formation, rates of sediment transport, and the fundamental geologic framework of Grand Isle, the only inhabited barrier island in Louisiana.

Grand Isle is composed of beach ridges organized in distinct, unconformable sets. Ridges increase in spacing from west to east, likely due to decreasing accommodation space. Grand Isle began forming by accretion of beach ridges approximately 720 years ago. Progradation occurred northeastward until approximately 505 years ago when deposition ceased, the seaward portion of the ridges was eroded, and deposition resumed, albeit in a slightly more eastward direction. The island's central ridges formed between 370±30 and 170±10 years ago at an average rate of 13 yr/ridge or progradation rate of 14 m/yr. The sediment source for Grand Isle is the eroding beach ridge plain of the Caminada headland that, along with flanking barriers on either side, forms the Bayou Lafourche transgressive depositional system. We calculated the Grand Isle barrier lithosome at ~9.26x107 m3, which requires an average longshore transport rate of 128,625 m^3/yr available for deposition during the period of the barrier formation. This relatively large volume of sediment can be reconciled by the high rates of erosion and eastward transport of Caminada beach ridge sand.

These results demonstrate the utility of the OSL method for providing insights into the temporal evolution of beach ridge plain formation along the central Gulf Coast and expanding the current body of knowledge regarding the spatial extent and age of the Grand Isle barrier lithosome.

Poster 41

Lee Potter, Louisiana State University - Graduate student

Effects of the 2021 Polar Vortex on River Temperature and CO2 Outgassing in the Lower Mississippi- Atchafalaya River System

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Abstract

During January 2021, much of the continental United States was affected by a polar vortex, which led to record cold temperatures for many areas within the Mississippi River Basin. Little is known about how such an extreme weather event could affect water temperature and outgassing of carbon dioxide (CO2) from rivers downstream near their mouths. This study aimed to better understand the impacts of extreme winter weather on dissolved carbon transport and transformation in the lower Mississippi and Atchafalaya Rivers, which drain approximately 48% of the continental US. We intended to test the hypotheses that CO2 outgassing would decrease from the rivers due to a drastic decline in river water temperatures brought on by the polar vortex, and that the effect would be more apparent in the levee-confined Mississippi River (MR) than in the Atchafalaya River (AR) that flows through a large swamp area. In-situ measurements were taken from December 2020 to April 2021 in the MR at Baton Rouge and in the AR at Morgan City. The measurements included river water temperature, partial pressure of CO2 (pCO2), dissolved oxygen (DO), fluorescence, colored dissolved organic matter (CDOM), and turbidity. We found that following the polar vortex, water temperatures in the MR dropped rapidly down to 2.6 ºC and stayed below 5 ºC for consecutive 14 days, which were the lowest temperatures recorded in the past several decades. Water temperatures in the AR also declined but to a lesser magnitude with a low of 5 ºC. Consequently, pCO2 levels declined in both the MR and AR to 836 and 1200 µtam, respectively, which are significantly lower than the pCO2 levels recorded before and after the polar vortex. Our preliminary data analysis seems to confirm the validity of the initial hypotheses.
PRESENTER BIO: Lee is a Master's student at Louisiana State University with research focusing on dissolved carbon transformation and transport in large river systems.

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Temitope Dauda, Southern University and A&M college - Graduate student

EFFECT OF LAND USE/LAND COVER AND CLIMATE CHANGE ON COASTAL WETLAND VEGETATION COMMUNITY STRUCTURE

Coastal wetland vegetation community are important part of wetland ecosystem geomorphology. Submerged, emergent, meadows plants including shrubs and trees all play important role in coastal wetland's stability and resilience. Particularly, they are important drivers of fine sediment retention. However, land use/ land cover changes coupled with the wicked problems of climate change have threatened this vegetation community structure and thereby the ecological role they perform. Agricultural activities upstream have increased the rate of sedimentation of river as well as the nutrient load, while urbanization is driving coastal wetland loss. Also, sea level rise is facilitating saltwater incursion and overall inundation of river, ocean and streams, thereby altering hydrological cycles.

This have immense effect on the richness, abundance and composition of coastal wetland plant species. However, the actual dynamics of these on coastal wetland species composition, diversity and richness is relatively understudied and poorly documented. Thus, this paper synthesis existing literature on effect of land-use/land cover and climate changes on the vegetation community structure of wetlands. This is in order to provide the current state of art information on the impact of landuse-land cover changes and climate change on coastal wetland vegetation community structure.

Anthropogenic land use/land cover changes will alter vegetative community structure of coastal wetlands in numerous ways. Importantly, presence of excess nutrient load and sediments on water bodies will create enabling environment for non-native species which are mostly invasive. It may lead to increase species richness for coastal wetland initially, but out compete of native species eventually. Also, sea-level rise will cause a shift in species composition with submerged, emergent plants and meadows having higher species richness and eventually loss of upland plants species. Overall, losses are likely in coastal wetland plant communities, yet their species can adapt to if well managed and protected. It is recommended that intensification of human activities and alteration of natural environmental conditions associated with these factors should be discouraged to maintain plant species composition and functional structure for coastal wetland.

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Kelli Moran, Louisiana State University - PhD

MORPHOLOGICAL CHANGE AND SEDIMENT TRANSPORT OBSERVED IN A DREDGE PIT ON AN ENERGETIC SUBMARINE SHOAL OF THE LOUISIANA SHELF

Coastal barrier island restoration projects have become increasingly popular in recent years when dealing with rapid land loss and relative sea level rise. The demand to find high quality, large volume and locally available sediment resources has forced decision makers and managers to look for multiple types of sediments and dredging methods. Block 88 on Ship Shoal, centered on the Louisiana continental shelf, is the largest sand borrow area in Louisiana's history in terms of excavation volume, and has been identified as the primary borrow area for several nearby barrier island restoration projects. Approximately 10.5 million cubic yards of material has been excavated to construct the Caillou Lake Headlands (Whiskey Island) Beach and Marsh Restoration Project. For the project, a conveyance corridor was used to transport the sediment slurry from the Block 88 pit to the targeted coastal barriers and marshes. This study utilizes multiple geophysical methods including bathymetry, sidescan and subbottom profiling to study sediment transport and morphological change at Block 88 immediately-following, and one year post-dredging. Our objectives are to quantify the sediment infilling processes, characterize morphological evolution (e.g., dredge cuts, slopes, pit wall migration and stability) and investigate the relative contributions from proximal rivers (Atchafalaya/Mississippi), energetic waves, tides and longshore currents. The results will increase our decision making ability regarding sea floor stability and protection of both environmental and cultural resources as well as provide for better management of valuable sand resources.

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Le Zhang, Louisiana State University - Phd

MARSH GROWTH DYNAMICS MODELING ON AN EXPANDING DELTA USING THE COUPLED WAVE-FLOW-SEDIMENT TRANSPORT MODEL (COAWST)

Hydrodynamic, sedimentation and vegetation synergistically shape the evolution of a unique delta. The expanding Wax Lake Delta capture special characteristic in an overall subsiding Louisiana shoreline with copious land loss over the last decade. Despite heated investigation in terms of hydrodynamic pattern across the delta channels, around the nearby islands and within the wetlands, as well as sediment sampling, incubation and modeling, little is known on how the presence and thrive of salt marsh interact with sediment accumulation, hydrology and ecosystem nutrient cycling under forcing from river-runoff, strong convective weather, temperature changes, tide, etc. The vegetation component in a Coupled Wave-Flow-Sediment Transport Model (COAWST) has been developed to account for the subtle changes of flow dynamic as the sprout of marsh stem to reflect the over-time paradigm-shifting drive on the delta wetland evolution. The incorporation of marsh growth dynamic offers additional source to sediment catchment besides hydrodynamic factors, and addition of local carbon and nutrient pool from marsh detritus. Marsh modeling on Wax Lake Delta ideally provides information on ever-changing delta dimensions, island sizes, distribution of sediment fluxes under the influence of marsh growth and highlight the significance of marsh wetland in preserving land and reconstitute nutrient distribution in relation with carbon sequestration. Continuous improvement of this model will shed light on land loss problem among densely populated river deltas and wetland restoration with invaluable ecological services, and further optimize the prediction of delta morphology evolution with comprehensive input from hydrology, sedimentation and vegetation.

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Wes Bollinger, National Parks Service

RAPID HYDROLOGIC CHANGE IN THE BARATARIA PRESERVE: SURFACE WATER RISE OVER A FIVE-YEAR SPAN

Wesley J. Bollinger, Julie Torres, Julie L. Whitbeck | Jean Lafitte National Historical Park & Preserve, New Orleans, LA, USA

Just 70 miles Northwest of the mouth of the Mississippi River and outside the levee system, the Barataria Preserve- a unit of Jean Lafitte National Historical Park and Preserve- is on the front lines of Louisiana's battle against relative sea-level rise (RSLR). To advance understanding of changing hydroperiod within the Preserve, the Resource Management (RM) team established an array of hydrology monitoring wells. This array has been collecting spatially and temporally high-resolution data continuously over the last 7 years. Here we provide a preliminary analysis of this dataset.

From 2014 to 2018, the RM team installed more than 40 wells across the Preserve. Each probe records ambient pressure data on the hour which, once adjusted for topographic position, provides the elevation of the water table at each well location relative to the NAVD-88 vertical reference datum. Our analysis utilizes the data of 18 wells from the two longest transects that span the eastern natural levee ridge of Bayou des Familles.

We find that, at each of these well locations, water table height increased over a five-year period (2015-2019). Trendlines show hydroperiod rises from 1.8 to 11 cm per year (mean 4.3 cm/year, mode 3.7 cm/year). All values exceed the 0.9 cm/year RSLR rate recorded at Grand Isle. The lowest elevation wells on either side of the natural levee ridge show lowest increases overall and wells at the highest elevations show the second lowest overall increase.

These early findings raise our concern about the pace of hydrologic change at the Barataria Preserve and further study into this issue is urgently needed. Could site-specific factors like impoundment be contributing to the speed of hydroperiod increase? How closely do hydroperiod increases in the Preserve correspond with local storms or wind driven tides? Is flooding rate accelerating, decelerating, or steady? The answers to these questions will soon be significant factors in resource stewardship and park infrastructure decisions.

PRESENTER BIO: Wes Bollinger is a Tulane graduate in Ecology and Geology with experience in drone piloting, field work, laboratory research and scientific writing. He now works for The RESTORE Council as an environmental scientist.

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Ryan Clarke, Tulane University - Phd

BLUE CARBON STORAGE RATES IN A HOLOCENE SEDIMENT CORE FROM THE MISSISSIPPI DELTA: A PRELIMINARY ASSESSMENT

Interest in the role of blue carbon (organic carbon buried in coastal salt marshes, mangroves, and seagrass ecosystems) in the global carbon cycle has increased rapidly over the past decade. However, the context of large fluvio-deltaic systems is poorly quantified in the framework of blue carbon This project aims to describe organic carbon (OC) storage rates in the Mississippi River Delta by quantifying carbon storage within various depositional environments spanning several millennia preserved in a ~40-m-long sediment core from Myrtle Grove, Louisiana. We use elemental analysis to determine OC mass concentrations in combination with 14C and optically stimulated luminescence chronology to determine OC storage rates at this site during the entire Holocene (i.e., the past ~11,000 years). We connect OC storage rates to depositional environments through foraminiferal analyses. Ultimately, this work may shed light on OC storage rates in large sediment diversions such as the one planned near Myrtle Grove, as well as, more broadly, implications for delta's worldwide.

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Allison Scates, University of Louisiana at Lafayette - Masters

GEOMORPHIC AND SHALLOW SUBSURFACE EXPRESSION OF GROWTH FAULTS IN MISSISSIPPI RIVER DELTA QUATERNARY SEDIMENT; GOLDEN MEADOW, LOUISIANA

Louisiana houses 40% of the total wetland habitat of the United States, but 80% of the wetland losses (Couvillon et al., 2011). Fault activity is one of the most crucial factors which can cause wetland change by being the main source of subsidence (Gagliano, 2003). The Golden Meadow fault zone (GMFZ) is a small array of seaward facing normal faults in sediments and poorly lithified rock with slow displacement rates (Gagliano, 2005; Crone & Wheeler, 2000; Yuill, 2000). The GMFZ lies across Bayou Lafourche, which is the youngest abandoned delta complex of the Mississippi River, active from 2500 – 800 years before present (Coleman, 1998; Frazier, 1967; Roberts, 1997).

Faulting in the area is known to have control on the marsh sediment placement by creating accommodation space downthrown side. In multimillion-dollar marsh restoration efforts, fault placement may be important in the assessment of reconstruction efforts so that the sediment brought in does not move due to the proximity to the fault.

This project aims to identify and locate faults in Quaternary sediment and map predictions for fault presence on the surface. This will be done by doing shallow subsurface investigation using water well, geotechnical, geospatial, and chirp seismic data. Application of photogeologic and geomorphic aerial analysis techniques are used to characterize and describe how surface structures are affected by fault presence.

Based on basin delineation in ArcMap, faults appear to have some control on the placement of sub-basins and stream locations. Streams and channels appear to be redirected when crossing the downthrown side of the fault. Streams, however, do not conform to these rules based on their age or lifespan relative to fault activity and can be quantified by applying vector math to their directions and comparing magnitudes over the study area.

Conclusions from this project, along with projects from seven other Louisiana universities, will be used to aid the Louisiana Master Plan in picking sites of critical infrastructure and environmental restoration projects along the deltaic coast of the state (Kulp, 2018; The Water Institute of the Gulf, 2019).

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Michael Tritico, RESTORE

Migratory Clock Diagram for the Calcasieu Estuary

Aquatic organisms in Louisiana's estuaries migrate at different times in their lives from one part of the coastal ecosystem to another. Eggs are carried passively, planktonic forms such as larvae may have some self-motility, and juvenile and adult forms even more ability to get themselves from offshore to the bay to the tributary and into the wetland nursery or from that marsh or swamp back out and toward the Gulf. In the Calcasieu Ecosystem for example, there are three major times of year during which major migratory pulses occur, controlled by celestial and meteorological events. A "Migratory Clock" diagram facilitates understanding how to better sustain the aquatic organisms' populations by reducing adverse impacts (such as turbidity caused by dredging) during the pulses. Inclusion of migratory clock diagrams during preparation of environmental assessments would be a meaningful addition to the tools used by planners and decisionmakers.

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Garret Thomassie, USDA NRCS

EVALUATION OF LOUISIANA ECOTYPES OF SALTGRASS FOR SELECTION AND USE IN SALT MARSHES OF THE COASTAL ZONE OF LOUISIANA

Saltgrass (Distichlis spicata) is a mat-forming, strongly rhizomatous perennial grass that prefers moist, saline soils, and is often found in sandy, alkaline locations. It is important in salt marshes as nesting grounds for birds, fish and larvae of many species of marine invertebrate animals. Saltgrass persists in saline inundated ecosystems including marshes along the coasts of the Atlantic and Pacific Oceans, and the Gulf of Mexico. It is also one of the more drought-tolerant marsh grasses.

Saltgrass is a highly desired plant for coastal restoration projects and is frequently requested for re-vegetation contracts by conservation partners, including those representing federal, state and parish governments and private consultants. However, there is a lack of quality tested plants of this species, especially in sufficient numbers for growers to obtain for commercial production.

The Golden Meadow Plant Materials Center, Galliano, LA currently evaluating 25 accessions of saltgrass collected across coastal Louisiana. The objective of this study is to identify overall vigor, drought and flood tolerance, seed production and viability, plant density and cover and rhizomatous spread. The accessions were planted in a randomized complete block design consisting of three replications in a field where water levels can be managed and manipulated to simulate tidal flux, as in the marsh.

Initial evaluations have revealed that five of the 25 accessions out-performed others when these growth characteristics were analyzed. Final data was taken in the fall of 2019 and will move into an advanced study phase in 2020 using the five top performing accessions. These five accessions will be taken to field plantings and established in a randomized complete block design consisting of multiple replications. This study will ultimately allow for a commercial plant release of saltgrass for coastal use.

Poster 50

Jordan Logarbo, Louisiana State University - Masters

INCORPORATING MUSSELS INTO LIVING SHORELINES IN SOUTHEAST LOUISIANA: A DEMOGRAPHIC SURVEY

Louisiana wetlands provide beneficial ecosystem services such as storm protection, nutrient cycling, fisheries, and long-term carbon and nitrogen storage but are rapidly being lost due to natural and anthropogenic stressors. In Louisiana salt marshes two native ecosystem engineers commonly co-exist: smooth cordgrass, Spartina alterniflora, and the Gulf ribbed mussel, Geukensia granosissima. Ecosystem engineers modify, maintain, and create habitats by altering the availability of resources to other species and directly influencing local abiotic conditions. S. alterniflora and G. granosissima modify their environment through physical (roots and byssal threads) and physiological (mussel pseudofeces) mechanisms and may form a mutualistic relationship that could enhance marsh stability and living shoreline restoration efforts.

We evaluated the spatial distribution of mussels (and potential controls on that distribution) along the marsh edge of Sister Lake in the summer of 2019 by assessing mussel density as well as associated vegetation species, vegetation density, and marsh elevation at over 150 locations. There were 50 sites chosen at random on each of the north, west, and south shorelines of Sister Lake, with each site separated by a minimum of 50 m. Mussels were found throughout the marsh edge of Sister Lake, with the highest density (350 m2) on the north shore, and similar, but lower densities found along the south and west shorelines. All shorelines had a mean S. alterniflora cover of 50% but if another species was present it was often Juncus romarianus. We conducted a second survey in which we assessed above and belowground biomass, vegetation height and density by species, plant stoichiometry, soil C, soil extractable nutrients (ammonium, nitrate, and phosphate), and sediment shear strength at 21 sites stratified by no (0 m2), low (16-80 m2) and high (240-480 m2) mussel densities. We hypothesized that an increase in the presence of G. granosissima would lead to an increase of belowground productivity leading to a more stable shoreline. We found that live belowground biomass and soil shear strength were greater at high mussel densities.

This work characterizes G. granosissima habitat and quantifies the effect of G. granosissima presence and density on S. alterniflora primary production, soil characteristics, and shoreline stability. These findings will provide a better understanding of the potential benefits of using Gulf ribbed mussels in living shoreline restoration projects in southeast Louisiana.

Poster 51

Julie Whitbeck, National Parks Service

DESIGNING THE MONITORING AND ADAPTIVE MANAGEMENT PLAN FOR A PROJECT AIMING TO RESTORE SUBMERGED AQUATIC VEGETATION BY MODIFYING SHORELINE ENERGY CONDITIONS

Submerged Aquatic Vegetation (SAV) is an important component of the predominantly freshwater Lake Salvador and Cataouatche ecosystems. These estuarine lakes lie in the upper Barataria Basin of the Mississippi River's coastal delta, and they border Jean Lafitte National Historical Park and Preserve's Barataria Preserve on its west. SAV provides habitat and food for aquatic biota, and its productivity contributes to the robust fisheries in these deltaic coastal waters. SAV beds also attenuate storm energy and reduce erosive impacts on adjacent terrestrial wetlands. In the mid-2000's lush SAV beds dominated the shallows of Lake Catouatche and SAV also was present along the Preserve's Lake Salvador shoreline. During the 2010 growing season, park managers and others noticed substantial loss of SAV in these lakes, including in the Preserve's nearshore waters. The National Park Service (NPS) is pursuing a novel approach to restore this key vegetation. Whereas rubble-mound-breakwaters have a long history of use for shoreline protection, NPS plans to employ them to encourage SAV re-establishment and growth.

Despite the presence of nearby SAV beds that are reproducing via seeds and vegetative spreading, the SAV community has not recovered in the Preserve's nearshore waters. Regional SAV experts have documented that environmental conditions including water depth, salinity and turbidity are favorable for SAV growth, and they suggest that the habitat conditions within affected parts of Lake Salvador and Lake Cataouatche have shifted to a new state characterized by much lower SAV cover. They infer that natural recovery of SAV is unlikely in these areas because of present day exposure to wave energy and current velocity and the impacts of these forces on SAV plants and habitat conditions. Addressing the goal of restoring SAV to these shorelines, we have designed a rock breakwater that will reduce incident wave energy and current velocity conditions to levels supporting SAV establishment and growth. The breakwater also would provide long-term erosion protection for this shoreline.

Factors beyond easy management influence, such as physical hydrologic conditions, water quality, relative sea level rise, the presence of floating aquatic vegetation, and the frequency and intensity of tropical storms, could affect the ability of the project to achieve its restoration objectives. The NPS project team has developed a monitoring and adaptive management plan to measure the effectiveness of the structure in providing environmental and ecological conditions appropriate for SAV establishment and growth, and to inform the selection of corrective actions if the project is not meeting performance criteria. This presentation will describe the main elements of this monitoring and adaptive management plan, highlighting the project goals and objectives, monitoring parameters and methodologies, key uncertainties, performance criteria, and possible adaptive management strategies.

Poster 52

Alexandra Woods, Nicholls State University - Graduate student

THE EFFECTS OF VEGETATION ON REMOVAL OF MICROPLASTICS FROM SURFACE WATER

Alexandra R. Woods, Jonathan M. Willis
Nicholls State University, Thibodaux, LA, USA

Recent studies have found microplastic (100nm-500nm) and nanoplastic (<100nm) particles to be ubiquitous contaminants detectable in virtually all aquatic habitat types. A substantial body of research documenting the impacts of microplastics on faunal uptake and physiological function has emerged, which has led to considerable interest in the reduction of microplastic pollution in freshwater and marine systems. However, little information is available regarding the interactions of aquatic vegetation with microplastics. Mechanistic assessments are needed to determine if aquatic vegetation contributes to the reduction of microplastic particle concentration in surface waters. Wetland vegetation may represent an efficacious means of reducing microplastic pollution in surface waters through various mechanisms, including the interaction of microplastics with subaqueous tissues and their biofilms. However, microplastics may also alter aquatic plant growth by physically blocking stomata and impacting photosynthetic processes, among other mechanisms. A pair of mesocosm studies were implemented at the Nicholls State University Farm facility to elucidate these interactions. A controlled-conditions study was performed to assess retention of two microplastic size classes on vegetative surfaces of Panicum hemitomon. The study duration was 2.5 months, during which growth responses of Panicum hemitomon were measured. Significant retention of microplastics by Panicum hemitomon was observed in both 43-250µm and 250-500µm size classes at dosages ~250,000 particles m-3 (20mg) and ~170,000 particles m-3 (20mg), respectively. The mechanism for this retention is likely biofilm adhesion on submerged plant tissues. Importantly, no impacts to Panicum hemitomon survival or growth responses were found. A second controlled-condition study was undertaken to assess photosynthetic process impacts of surface water microplastic concentrations up to 770,000 particles m-3 on Panicum hemitomon, Typha latifolia, Juncus effuses, and Sagittaria latifolia. As ideal indicators of photosynthetic behavior in response to environmental influences, net CO2 assimilation and stomatal conductance measurements were performed using a LI-COR LI-6400 XT Portable Photosystem. No reduction in either net CO2 assimilation or stomatal conductance in any of the study species was detected. Although further research is necessary, these results point to the potential efficacy of common wetland vegetation in the amelioration of microplastics in surface water. By providing a mechanistic understanding of vegetation-microplastic interactions, this study will inform management strategies and enable future studies to refine nature-based microplastic pollution abatement strategies.

Poster 55

Robert Miller, Louisiana State University

Analyzing the Effects of Relative Sea Level Rise on Salinity Response in a Brackish Floodplain

We present a model-based assessment of the response of mean salinities to relative sea level rise (RSLR) in a brackish floodplain region. The study area is located on the Gulf coastal region of Louisiana which is experiencing some of the highest rates of relative sea level rise in the world. A two-dimensional nested hydrologic and hydrodynamic modeling approach is developed and the local hydrodynamic model is well calibrated for scenario testing purposes (mean skill = 0.95, 0.93 and RMSE = 0.11m, 0.60 for stage and monthly mean salinity respectively). A total of 77 alternative scenarios of RSLR provide a detailed investigation of the salinity response in both the open water as well as adjacent floodplain areas under broad range of wetland parameter combinations. The analysis reveals key insights on the mean salinity response patterns including the sensitivity to changes in the wetland characteristics and offshore boundary conditions and expressions describing the qualitative nonlinear response. The modeling analysis illustrates the potential role played by RSLR on salinity propagation during storm surge. The robust scenario analysis and findings of this study are widely applicable to the global challenge of coastal protection and sustainability.

Poster 56

Thomas McGinnis, Coastal Protection and Restoration Authority

STRUCTURE POROSITY ENHANCES SEDIMENTATION BEHIND SHORELINE PROTECTION ALTERNATIVES

As shoreline erosion pushes inland, the typical beach/berm setting suited for high exposure to wind and waves thins and disappears exposing the more fragile marsh edge to hydrologic forces. Shoreline protection becomes more complicated as the former marsh platform becomes the substrate upon which shoreline protection features are placed. This former marsh platform often has higher organic matter content and thick, soft clays which have a low weight-bearing capacity. The result is that the high-density rock rip-rap breakwaters traditionally used for shoreline protection sink into the weaker soils. As part of a CWPPRA demonstration project, LA-0016 Non-rock Alternatives to Shoreline Protection, we evaluated four manufactured shoreline protection structures in a highly erosive areas with low weight-bearing capacity along northwestern Vermilion Bay. Two structures allowed water to pass though (porous), Wave Attenuation Devices (WADs) and Wave Screen System (WSS), while two structures were barriers, Buoyancy Compensated Erosion Control Modular System (BCECMS) and Ecosystem Units (ECUs). We monitored structure stability, wave breaking performance (attenuation), shoreline movement, and soil volume change (determined from repeated elevation surveys) at and behind each structure and an unprotected reference area. While all of the structures attenuated waves by at least 65% and reduced shoreline erosion by at least 85%, structures that allowed waves to pass through (WSS and WADs) had less erosion than structures that acted as wave barriers (OB, ESUs, and BCECMS). The more porous structures actually gained sediment volume between the structure and the shoreline, and the WSS, which was suspended a couple feet above the bay bottom, gained soil volume on the bayside of the structure. A coast-wide synthesis of 12 shoreline protection alternatives (LSU Coastal Engineering Master's Thesis by Hunter Shows) revealed a positive relationship between structure porosity (potential for water to pass through the structure) up to 35% and soil volume change. Structure porosity was determined from design drawings by Shows, and soil volume change data was provided by CPRA project monitoring.

Poster 57

Ashleigh Lambiotte, Nicholls state university - Graduate student

Elucidating the potential effects of sediment diversions on three foundational marsh species (Spartina patens, Spartina alterniflora, Typha latifolia) in a mesocosm setting.

Southeastern Louisiana's intricate coastal wetland systems provide critical ecosystem services for both the state and the nation; however these areas are experiencing extreme rates of land loss. While a myriad of stressors contribute to this loss, one major contributor is the disconnection of annual floodwaters from the Mississippi River to the surrounding wetlands. River sediment diversions, large-scale restoration techniques, intended to reconnect the River to the wetlands via controlled, periodic floodings that mimic a natural flood pulse. This reintroduced flood pulse is intended to rehabilitate Louisiana's degraded deltaic wetlands by delivering fresh water, nutrients, and sediment to the subsiding wetlands, theoretically stimulating growth and building land. Effective use of such large-scale restoration techniques requires an appropriate knowledge base of vegetation growth and changes in soil biogeochemistry in response to the altered hydrologic conditions during diversion operation. In this research, sods of three foundational marsh species (Spartina patens, Spartina alterniflora, Typha latifolia) and an equal mixture of the three are being exposed to inundation depths (20 and 40 cm), durations (8 and 16 weeks), and salinities (0 and 5 psu) consistent with likely sediment diversion scenarios in a mesocosm setting. Vegetation growth responses and relevant soil processes, including primary phytotoxins, standardized decomposition, biogenic accretion, and nutrient status, are being routinely assessed. By understanding alterations to above- and below-ground plant growth and key soil biogeochemical status that are likely under river sediment diversion scenarios, more informed operation and management decisions can be made.

Poster 58

Andrew Wright, Louisiana State University

The Siltcatcher: A Sediment-Capture System for Wetland Creation and Coastal Protection in Western Lake Pontchartrain

The West Lake Pontchartrain region faces a number of long-term environmental challenges due to anthropogenic climate disturbance and landscape modification, including shoreline erosion, wetland degradation, sea level rise, and increased storm surge risk. In response, The Siltcatcher applies recent research in the fields of landscape architecture and civil engineering to propose a dynamic, natural-systems solution for wetland creation and coastal protection. The project envisions a series of breakwater-like structures in western Lake Pontchartrain positioned to slow water released from the nearby Bonnet Carré Spillway, causing suspended sediment to settle and create self-building and self-sustaining wetlands capable of keeping pace with future sea level rise. This hybrid grey-green system would provide a first line of storm protection for the communities of St. James and St. John the Baptist Parishes, reduce erosion of the western Lake Pontchartrain shoreline, create valuable wildlife habitat, and provide other ecosystem services and cultural opportunities. The proposal seeks to contribute to the ongoing discourse regarding “Engineering with Nature” principles and explore the interdisciplinary potential suggested by their implementation.

The project’s design methodology embraces a wide range of tools used by both landscape architecture and engineering, including field work, mapping, drawing, image-making, and modeling. The research identifies physical and numerical hydrodynamic modeling as key tools for the design of coastal infrastructure and integrates their use into a recursive, non-linear design process typical of architectural practice. In doing so, it seeks to expand the range of tools typically used by landscape architects for design ideation and visualization and posit alternative interdisciplinary workflows for the conceptualization and design of large-scale infrastructure.

The resulting proposal complements the already-planned West Shore Lake Pontchartrain Hurricane Protection Levee and Maurepas River Reintroduction projects, providing a forward buffer in keeping with the “Multiple Lines of Defense” strategy proposed by the Lake Pontchartrain Basin Foundation. In contrast with conventional monofunctional infrastructure, the proposed system provides multiple co-benefits for both human and non-human constituencies. Finally, the design strategies derived from this research represent a novel form of coastal infrastructure with potential applicability to a broad range of sites and scales along the Louisiana coast.

Poster 59

Sung-Gheel Jang, Stony Brook University

Mapping Dredging Intensity

Resource managers can finely characterize the sustainability of offshore sand reserves and the impact of their exploitation for coastal resilience using GIS and positioning data of dredging vessels. We present a GIS approach to deriving a measure of dredging intensity – the degree of disturbance of the seafloor due to the extraction of offshore sand resources, to better assess adverse impacts on benthic habitats. Dredging intensity has been defined as volume extracted/area/time (ICES 2014), but 'volume' can be an elusive parameter. Instead, we employed the aggregate 'time' spent dredging in a designated borrow site as a surrogate for volume/area/time using the vessel monitoring data. Not only are measurements of time/area likely to be more widely available, but also they are capable of locating areas of habitat disturbance that may be undetected in bathymetric surveys due to uncertainties in the measured water depth.

The GIS model to derive dredging intensity requires monitoring data of the dredger position, as from the automatic identification system (AIS), including speed and displacement, if available. We used data from an actual dredging operation over a six-month period after removing vessel identification, provided through the Bureau of Ocean Energy Management by the Navigation Data Center of the USACE Institute for Water Resources. Data were reported every five minutes identifying a load number, date and time, vessel longitude, vessel latitude, vessel speed in knots, vessel heading, vessel course, forward vessel draft, aft vessel draft and displacement in long tons (1,016 kg). 48,484 individual positions were originally provided. Of those, 8,732 positions, or 18% of the positions were in the hypothetical borrow area. The hypothetical borrow area was divided into predefined cells (e.g., 100 x 100 m) in ArcGIS. After converting the vessel coordinates to point features, the aggregate time raster that the dredge spent in each cell were derived using ArcGIS tools, given that each recorded position occupied a 5-min time period. The time the dredge spent in a single cell ranged from 5 to 120 min. Because sand dredging using a trailing hopper dredge is done at slow speeds (e.g., less than 2 knots), the aggregate time that a dredger spent in each cell can be modified by dredger speed which discriminates time spent actually removing sand from time spent in transit. If vessel displacements are also monitored, increases in displacement (e.g., 50 long tons) can also identify times and locations of active extraction. As result, we were able to successfully derive 'heat maps' presenting dredging intensity with different filtering options (e.g., speed and displacement), and could identify spatial extent with a higher dredging pressure.

Vessel monitoring data can be readily transformed into surrogates for dredging intensity at offshore borrow sites. The interpretation of these data in terms of the recovery and sustainability of the resource still requires careful considerations using multiple, site specific factors. However, the procedure presented here allows for comparison of usage between sites and for the targeting of subsequent environmental monitoring of site recovery.

Poster 60

Tessa Syvertsen, Mott Macdonald

COMPARISON OF EXTREME LOAD COMPUTATION METHODS ON COASTAL STRUCTURES

Extremal loading on coastal structures has traditionally been computed using the extreme values for water levels and wave heights derived from a single storm event (Design Storm Method). Joint Probability Method – Optimal Sampling (JPM-OS) is a modern analysis method traditionally applied for storm surge modeling and uses a probabilistic framework to evaluate a range of possible variations in the storm conditions. Typically, this method is used to compute extremal hydraulic parameters such as water surface elevation or wave height, which can then be used to compute the extremal loads (Extreme Value Method). This study further extends and improves on the use of the JPM-OS methodology to compute the 2% and 1% (50- and 100-year return period) Annual Exceedance Probabilities (AEP) extreme values for combined hydrostatic and hydrodynamic loading on a vertical wall structure (Probabilistic Method).

Storm surge modeling was conducted to generate the forcing conditions for loading analysis. Sensitivity testing was conducted to select a smaller suite of 63 representative storms to model from an available set of 446 synthetic storms used in the FEMA Flood Insurance Study for the project site. Time series of model results, including water level and wave conditions, were extracted on either side of each vertical wall structure in the model domain. These time series were used to compute hydrostatic and wave loads on the structure at each timestep of each storm simulation. Extreme value analysis of the maximum concurrent load - the combination of the hydrostatic load from head difference along with the wave load coincident in time from each storm - was performed using the JPM-OS method, from which the 1% and 2% AEP loads were determined at each extraction point. Design loading conditions were then derived by determining which modeled storms produced the maximum concurrent loads most similar to the probabilistic extremal loads. Sensitivity testing was conducted to select a subset of representative storms for each extraction point from the suite of the 63 modeled storms to characterize the variation in wave and water level conditions (and hence the variation in pressure distribution on the structure) which generate the extremal loads.

A comparison of resultant 1% AEP loads computed using various approaches at an extraction point show the loads for Extreme Value Method, Design Storm Method and Probabilistic Method as 702 psf, 363 psf, and 318 psf respectively. This demonstrated that the Extreme Value Method, though common, is often overconservative as it is unlikely that the extreme water level, wave height and corresponding low water on the back side of the wall would occur concurrently. The Design Storm Method is not able to capture the spatial variability of extreme conditions that may occur due to different storms (tracks and intensities) at different locations in the modeling domain as it uses a single (or series of subjectively selected individual) storm event for analysis. The advantage of using the Probabilistic Method for computing loads is that it considers the probabilistic nature of the storm events and therefore eliminates the over conservatism of the Extreme Value Method approach and the subjectivity resulting from a Design Storm Method approach.

Poster 61

Coral Foster, Nicholls State University – Masters

QUANTIFYING FRESHWATER INUNDATION DEPTH AND DURATION EFFECTS ON COASTAL MARSH VEGETATION GROWTH

Coastal Louisiana is experiencing catastrophic wetland loss due to a number of factors, including the loss of marsh elevation through the subsidence of deltaic sediments. One of the large-scale tools planned for restoration efforts in these coastal environments is the construction of sediment diversions. Pulsed operation of sediment diversions is intended to emulate the natural processes of deltaic formation and is anticipated to provide sediment in areas experiencing substantial land subsidence and saltwater intrusion. However, prolonged inundation and salinity alteration will occur in diversion outfall areas during sediment diversion operation. Routine inundation is an important component of coastal marsh sustainability; however, the effects of extended freshwater inundation during sediment diversion operation on the growth of key marsh vegetation species are not well understood. In particular, the lack of empirical data appropriate for modeling the effects of sediment diversion implementation on marsh vegetation species survival and growth limits the ability of coastal managers to quantitatively estimate likely outcomes of various diversion operation scenarios. To address this data gap, a large-scale mesocosm study has been initiated at the Nicholls State University Farm Facility to examine the effects of sediment diversion relevant inundation depths and durations on the survivorship and growth of four key marsh vegetation species. Specifically, four species,Spartina alterniflora, Spartina patens, Sagittaria lancifolia, and Typha latifolia, currently included in coastal modeling efforts will be subjected to differing inundation depths (0 cm, 20 cm, and 40 cm above the soil surface) and durations (2 weeks, 4 weeks, 8 weeks, and 12 weeks) and compared to control conditions (constant water depth 10 cm below the soil surface) for a variety of short-term and integrated growth indicators. These findings will enhance the ability of coastal managers to predict the likely effects of sediment diversions on the survivorship of and growth of key marsh vegetation species.

Poster 62

Yanda Ou, Louisiana State University - Graduate student

A Numerical Investigation of Salinity Variations in Barataria Estuary, Louisiana in Connection with the Mississippi River and Restoration Activities

A three-dimensional numerical model was applied to the Barataria Estuary in the Northern Gulf of Mexico to study its salinity variations as well as the impacts from the Mississippi River discharges and proposed river diversions. Model-observation comparison showed that the model was able to reproduce the hydrodynamic fields on subtidal to seasonal time scales. Salinity in the Barataria Estuary was high in fall and low in summer, with a greater variability in the lower estuary than the upper estuary. While salinity in the upper estuary was controlled by discharges from a local freshwater diversion, salinity in the lower estuary was mostly affected by the mixed Mississippi River water transported via the tidal inlets in the south. The correlation between Mississippi River discharge and estuarine salinity indicated that low salinity Mississippi River water could intrude into the estuary through the middle and east tidal inlets. Sensitivity tests were performed to assess the impacts from the Mississippi River discharges and proposed mid-Barataria Estuary sediment diversion. Model results illustrated that salinity in the estuary was more sensitive to an increase of Mississippi River discharge than a decrease. The proposed mid-Barataria sediment diversion was likely to induce a dramatic decrease of salinity in the lower estuary. The ecosystem consequences of the fluctuation of Mississippi River discharge as well as that of the proposed river diversions need further investigations.

Poster 63

Brian Harris, U.S. Army Engineer Research and Development Center - PhD

RE-ESTABLISHMENT OF WETLAND STRENGTH POST SEDIMENT NOURISHMENT

Coastal wetlands rely on a combination of plant production and sediment input to maintain structure, function, and soil stability. Due to rapid environmental change, brought on by the combined effects of sea-level rise and sediment deprivation, coastal wetlands are experiencing threats to their long-term sustainability. Current restoration and management strategies often include adding sediment to increase wetland elevation (i.e., thin layer placement (TLP) of dredge material). The sediment nourishment can stimulate plant-sedimentation-accretion feedback loops that increase resilience to sea-level rise; yet, determining wetland resilience using TLP is not fully defined. An investigation was conducted in 2019 to study the wetland re-establishment post-sediment nourishment using a modified cone penetrometer to measure belowground shear strengths. The root-structure was found to not be as strong when compared to a control plot, but the vegetation appeared to be slowly reestablishing from the outside inward, toward the areas of thickest application of dredged fill.

Poster 65

Jack Koban, Fugro

Techniques for Sampling and Testing Mudline Sediments

In 2015 Fugro was retained by Moffat & Nichol under their contract with the Louisiana Coastal Protection and Restoration Authority (CPRA) to provide geotechnical support of a project to excavate and construct a bypass channel south of the existing Bayou Boeuf Lock in St Mary Parish, LA. This project will result in a higher rate of flow in the Gulf Intracoastal Waterway (GIWW) through the lock than it currently experiences. Due to this change in flow parameters, Fugro was requested to collect and characterize soil samples in support of morphological modeling of the existing mudline.

The initial sampling and laboratory scope performed in 2015 consisted of the utilization of a Ponar Sampler also referred to as a “Clam Shell Sampler” to obtain mudline grab samples which were then tested for index classifications, grain size analysis, and remolded miniature vane shear strength. Samples from these methods yielded indeterminate results due to the inability of the Ponar sampler to extract an undisturbed specimen of the sediment-water interface. As a result, additional samples were requested to verify the mudline soils characterization.

In developing the scope for the additional samplings, Fugro proposed an alternative method for material acquisition: a Rocket Core Sampler designed to extract a small-diameter, “undisturbed geological core of the upper 30 cm of the sedimentary profile. The proposed sampling apparatus consists of a rocket-shaped, steel sampler equipped with a clear plastic core barrel at the tip and an in-line one-way valve to prevent loss of collected material upon retrieval. The sampler is deployed by allowing the flow-through tube to fill with water to reduce drag and allowing the apparatus to free-fall through the water column with vertical stability. Once embedded into the mudline, the one-way valve closes to create a vacuum for sample extraction, and the apparatus is then retrieved by a tether attached to the tail end.

In January 2019, Fugro collected a series of additional samples by deploying a rocket core sampler which was fabricated in-house. Using this method, far more reliable specimens for testing and classification were obtained than had been possible with the previously employed Ponar method. The Rocket Core technique yielded a cylindrical soil core, approximately 10 inches in length by 1.75 inches in diameter in a reasonably undisturbed state. The benefits of this method included providing visibility of the sample, facilitating visual confirmation of the intact sediment-water interface and in-situ soil structure allowing for identification of depositional patterns within the mudline. The sampling apparatus produced a testable miniature vane specimen and intact specimen for determination of specimen density. The uniformity of samples also allowed for increased reproducibility and thus reliability of data. The sampler itself was easily managed by a single person and was efficiently deployed with far less incurred cost than the Ponar Sampler. However, sample volume was limited and thus the number and variety of laboratory tests were also limited.

Poster 66

Hannah Cohen, Coalition to Restore Coastal Louisiana

CRCL's Student Engagement Programs: Inspiring and Educating Home-grown Coastal Leaders

The Coalition to Restore Coastal Louisiana has two tracks of student engagement programs: the Future Coastal Leaders program for high school students, and the Student Ambassador program for college and university students. Each program aims to inspire, motivate, educate and train passionate coastal advocates to become the restoration leaders of the future. Through education, experiential learning, and professional development, CRCL aims to provide access to the coastal field, seeking cohorts that reflect the diversity of our coastal communities.

The Future Coastal Leaders program aims to inspire the next generation of professionals working to fight coastal land loss and climate change by highlighting the plentiful careers and degrees that exist which address coastal and environmental issues, while helping youth to become informed coastal advocates for their communities, build leadership skills, and gain networking and real-world exposure to the coastal restoration field here in Louisiana. To meet these goals, the program includes educational workshops, trainings, college or career readiness resources, networking events and more each Spring semester.

CRCL's Student Ambassador program engages students from colleges and universities across Louisiana's coast, and encourages them to become ambassadors for coastal restoration on their campuses. Student Ambassadors are provided resources and support to dive into the issues facing our coast, proposed solutions, and potential career paths in restoration. Students meet peers from other institutions with similar interests through recurring program meetings and are encouraged to work collaboratively or individually on their own projects that broaden their understanding of the issues. Students are encouraged to become engaged members of their communities by volunteering, spreading awareness, and advocating solutions to our coastal challenges.

Challenges and lessons learned from recent cohorts will inform the future of these programs. From challenges of recruitment and virtual engagement, to ensuring that we evaluate the short and long-term impacts of the resources and events provided, CRCL is staying engaged with participants and monitoring outcomes to establish sustainability and value of the programs going forward.

Poster 67

Ryan Waldron, Stantec

DESIGN OF A BREAKWATER FOR SUBMERGED AQUATIC VEGETATION HABITAT RESTORATION AT THE JEAN LAFITTE NATIONAL HISTORICAL PARK

Activities associated with the Deepwater Horizon oil spill (DWH) resulted in a loss of a significant portion of the submerged aquatic vegetation (SAV) population in Lakes Salvador and Catouache in Jefferson Parish, LA. As SAV populations are an important component of the ecosystems in these Lakes, innovative engineering analyses and design have been implemented to provide for suitable habitat for this vegetation. The National Park Service (NPS) manages the Jean Lafitte National Historical Park and Preserve and its Barataria Basin Preserve unit. The unit's shorelines along these lakes was a key location of this SAV population loss, as well as high rates of shoreline erosion. Funding resulting from DWH has allowed for the process of designing a solution to restoring SAV population by providing suitable habitat.

Through literature review and workshops with leading experts in aquatic ecosystems in Louisiana, it was determined that the key factor to restoring SAV populations at this location was the reduction of bed shear stresses. Previously low, these stresses have increased with loss of previously existing vegetation and shoreline retreat. The key design criterion that resulted from the SAV research and workshops was that bed shear stresses should generally be below 1 pa. To accomplish this goal, it was determined that wave energies should be reduced in the habitat restoration area through wave energy attenuation structures. Product cost-value analyses combined with phase resolving wave modeling were developed to select a structure type. Traditional rubble mound breakwaters were selected, as they best achieve the shear stress reductions while maximizing the amount of area protected for the funding available.

To design an environment that is suitable for re-vegetation of 50 acres set as the design criteria, it was determined that no less than 100-acres of suitable habitat should be protected. To achieve this a breakwater baseline alignment was developed that is further from the shore in some locations than many traditional breakwaters would be located. To ensure that that the breakwater would still perform appropriately at the selected distance from the shoreline, coupled hydrodynamic/wave modeling was then performed to evaluate different configurations for the alignment. The modeling resulted in selecting a refined alignment and protecting gaps with elbows to ensure that stresses were reduced appropriately to maintain the design habitat area.

Wave modeling results were also used to size the armor stones. After stone sizing, geotechnical data revealed a large portion of the site had soils that were not suitable for a traditional rubble mound structure with a filter stone core. Thus, those segments were designed to have lightweight aggregate cores. Other design challenges included areas restricted from bottom disturbing activities, shallow water construction requirements, and soil stabilities that prevent floatation channel construction close to the structure.

Poster 68

Francesca Messina, The Water Institute of the Gulf

Morphological and ecological effects of Mid-Barataria Sediment Diversion in Coastal Louisiana

The Mississippi River Delta is one of the most complex ecosystems in the world. Louisiana coastal area is among the most productive and dynamic eco-geomorphic systems in the world. However, this unique natural environment has been altered by human activities and natural processes such as sea level rise, subsidence, dredging of canals, levee systems, etc.

The Louisiana's Comprehensive Master Plan for Sustainable Coast proposed different large-scale restoration efforts for sustaining and creating new wetlands in Louisiana. Two major sediment diversions are being considered and analyzed to reconnect the Mississippi River to the estuaries and to divert sediment, nutrients and fresh water to build new land, maintain existing marshes and increase habitat resiliency to sea level rise and storm events.

A comprehensive model which incorporates hydrodynamics, morphodynamics, nutrient dynamics, vegetation dynamics and their feedbacks has been developed (Baustian et al., 2018) and used to investigate and analyze the landscape evolution, the hydrodynamic and water quality changes, and the vegetation dynamic in the next 50 years considering different sediment diversion operations, and environmental scenarios such as sea level rise and subsidence.

Synergies with additional marsh creation projects in the diversion outfall area have also been considered and incorporated into the modelling efforts.

The model results will improve our understanding of the morphodynamic and ecological responses of the receiving basins. This analysis could assist in optimizing the planning and design one of the largest-scale restoration projects for coastal areas all over the world.

Poster 69

Pranav Jadhav, Baton Rouge Magnet High School - High School Student

APPLICATION OF NEURAL NETWORKS FOR FLOOD PREDICTION

Deep-learning architectures such as deep neural networks are part of a larger class of machine learning methods. This study investigated the use of deep neural networks for streamflow time series hydrograph prediction. Streamflow prediction is very relevant and critical in Louisiana which experiences frequent regional flooding resulting in significant economic damages. The threat of flooding makes it critical to have an efficient and quick flood prediction method. Traditionally, the physically based hydrologic and hydraulic models have been routinely used for streamflow and flood predictions. With the availability of a large amount of hydrologic observational data, algorithmic advances and computing power, the machine learning methods offer a promise of an efficient prediction tool. In this numerical experiment, two neural network architectures, the Long-Short Term Memory (LSTM) network and the Gated Recurrent Unit (GRU) network, were compared for streamflow prediction.
The study uses the Keras deep learning framework and the Catchment Attributes and Meteorology Attributes for Large-Sample Studies (CAMELS) dataset. The neural networks were defined with a simple structure of two hidden layers, and one output layer. The root mean squared error (RMSE) metric was used to evaluate the performance of the networks. Several settings and parameters were tested to minimize the RMSE. The lowest RMSE values were achieved on the LSTM network with the following settings: batch size of 50, linear output activation, mean squared error as loss function, RMSprop as optimizer, and 175 input neurons.
This application to the Tchefuncte River near Folsom, Louisiana, demonstrates that reasonable stream hydrograph predictions can be obtained rapidly with a simple neural network architecture. The application of neural networks offers a robust solution compared to the current physically based numerical models that require a long time to develop, calibrate and simulate. Further, the physically based models are site-specific and cannot be applied to other regions. On the other hand, the models based on neural networks are data-driven, making them suitable to apply to other regions of similar characteristics.

Poster 70

Juan Moya, Mott MacDonald

THE FAST ECO-GEOMORPHOLOGICAL TRANSFORMATIONS OF THE TEXAS RIVER DELTAS: THE CASE OF THE BRAZOS RIVER DELTA

The Texas River Deltas (TRD) are subject to natural and anthropogenic pressures due to changes occurring in the long-term environment (relative sea level rise, lack of sediment supply and Gulf shoreline retreat) and in the short-term environment (recent storms and anthropogenic development). These stressors have generated drastic transformations to the Texas deltaic environments, which can be seen by examining historical aerial photography over the last 80 years that exposes the implications of human-induced hydrologic manipulations. These changes have led to an imbalance of the water and sediment budgets (riverine and littoral), and salinity intrusions across the entire deltaic geomorphological systems.

Historically, salinity intrusions have been qualitatively measured by different agencies and the conversion of freshwater wetlands to brackish and saline marsh communities has been measured including drastic changes in fish habitat. For example, in Early 2010, Gulf salinity intrusions were measured on the main Brazos River Delta channel at the bridge of Brazoria County FM 1462, approximately 33 miles from the river mouth. Recently the U.S. Geological Survey measured high values of salinity intrusions 50 miles from the Gulf on the Brazos River. These salinity values are an example of how far inland the estuarine processes are occurring today, which are being monitored through all the Texas River Deltas.

Additional to the large-scale salinity intrusions, coastal and large-scale inland flooding are also controlling the dynamics of the Texas deltas. The concept of deltaic geomorphological evolution and coastal vulnerability after the impacts of Hurricanes Ike and Harvey and relative sea level rise scenarios have been applied to identify how these drastic changes are adversely impacting ecosystems, industrial and urban development and the maritime industry. We are presenting the case of the Brazos River Delta for this analysis showing the type of projects that federal and state agencies, local municipalities and the private sector are applying to respond to the deltaic changes and played with different scenarios. The data shows that some portions of the Old Brazos River Delta (OBRD) are undergoing a process called “reversed geomorphology”. The processes associated with reversed geomorphology include: rapid or transitional changes from fluvial dominated environments to intertidal dominated environments, rapid retreat of river banks, marsh disintegration, salinity intrusions on large channels and small intertidal creeks, migration of ecological habitats, increased coastal and inland flooding, and rapid gulf shoreline retreat. A preliminary hypothesis is that the recent drastic changes occurring on the OBRD, more than 50 miles from the river mouth are a response to the changes to relative sea level rise. Fast changes are occurring on specific Holocene eco-geomorphic features. The OCRV is going through regional geomorphological adjustments, which are perceived as catastrophic flooding forcing drastic adaptation of the coastal habitats and human infrastructure, creating a cycle of cause-effect processes that is constantly changing. Some of the changes on the OBRD are very similar to the ones occurring on some Holocene features on the Mississippi River Delta.