Before the United States House of Representatives
Committee on Science, Space, and Technology
Subcommittee on Environment

"Recommendations on the Federal Role in Addressing Climate Impacts"

Written Testimony of Liz Williams Russell
Climate Justice Program Director, Foundation for Louisiana
April 21, 2021

Chairwoman Johnson, Ranking Member Lucas, and members of the committee, thank you for the opportunity to testify regarding the need for a strengthened Federal role in addressing climate change. I want to encourage thoughtful investment and provision of authority for coordinated risk information and climate services that center the needs of the nation's most impacted communities while creating equitable and sustainable pathways to holistically address climate impacts. It is critical that we enhance and develop replicable and scalable approaches while building generational capacity for long term positive change.

I am the Climate Justice Program Director at Foundation for Louisiana (FFL). FFL was initially founded as the Louisiana Disaster Recovery Foundation in the days following Hurricane Katrina, meant to be a philanthropic intermediary that could distribute resources on the ground to communities that are typically unreached by traditional philanthropy and by our institutional responses to disaster. The Foundation for Louisiana is a catalyst for justice. FFL invests in communities and ideas, builds partnerships, and transforms policies and systems for an equitable, stronger Louisiana.

Louisiana is on the frontlines of climate change and is necessarily developing solutions to address the climate crisis, both through climate adaptation and emissions mitigation measures. Due to the management and mismanagement of the Mississippi River and myriad human and natural causes, Louisiana has lost over 2,000 square miles of land since the 1930s. Ongoing land loss and an increasing number of extreme weather events ensure that climate change is not a future scenario here. Since 2005, Louisiana has endured Katrina, Rita, Gustav, Ike, Isaac, the Deepwater Horizon drilling disaster, two extreme precipitation events, Laura, Delta, and Zeta, among other disasters. Every one of our 64 parishes has been under at least one if not four, five, or six federal flood declarations. Residents with resources are moving to areas they perceive as higher and safer grounds, shifting local tax revenue and influencing a vast manifestation of rippling climate impacts in our communities. (Appendix 1) Within areas losing population, amidst depreciating property values and loss of amenities, we see a decline in ability to maintain social services and lost capacity to invest in the maintenance of existing infrastructure that supports communities or mitigates risk, much less the revenue for completion of future investments to reduce increasing risk over time. In areas gaining population, schools and traffic swell while new development is permitted and expands without

any regard for current and future sea level rise and flood risk projections. These are mere entry points into a dialogue of climate impacts already being faced by our communities.

At the Foundation for Louisiana, we approach climate justice strategically, through our values to achieve outcomes. We invest and act:

- to build people power by strengthening civic infrastructure and capacity,
- to advance just climate policies through analysis, recommendations, and advocacy that activate and strengthen resident leaders and communities, and
- to cultivate a new narrative by developing effective communications tools and strategies that energize statewide climate action.

(More information on our Climate Justice Program Strategy can be found at https://www.foundationforlouisiana.org/climate-justice/)

The 2017 update to Louisiana's Coastal Master (2017 CMP) developed by the Coastal Protection and Restoration Authority (CPRA) puts forward a multiple-lines-of-defense strategy for reducing flood risk to communities and economies throughout coastal Louisiana. The CMP's future scenario maps illustrate that over a fifty-year time horizon, the state stands to lose more land than can be rebuilt even with $50 billion in investments in protection and restoration. This reality has vast implications across sectors that have not yet begun planning for a future with a smaller land footprint. Louisiana has already taken steps to address these challenges by piloting innovative approaches for helping communities weather these transitions. Through the Louisiana's Strategic Adaptations for Future Environments (LA SAFE) program, the state's Office of Community Development-Disaster Recovery Unit and FFL partnered to facilitate inclusive community engagement processes to develop projects to help transition communities facing physical threats from land loss and climate change across a spectrum of "resettlement" to "receiving" communities. The learnings from these projects provide a strong foundation for developing more holistic, cross-sectoral strategies for addressing these challenges at a broader scale. (More information on the LA SAFE program can be found at lasafe.la.gov)

Now, there is also an effort to improve outcomes for resilience through facilitated and improved cross-sector coordination to address climate impacts within the mission and administration of each state agency. I mention this array of work that has occurred and is ongoing at the state level because Louisiana has already invested decades of effort and billions of dollars in developing pathways to address the impacts of coastal and climate change. We provide, in many ways, a litmus test to investigate the effectiveness of projects, programs, and policies that could and should be part of a national deployment of resources for communities on the frontlines of our changing world.

Without strategic and intentional action, climate change and our institutional responses to it will exacerbate existing inequities solidified within our built environment and through the policies and practices that maintain and develop it.

Black, Indigenous, Communities of Color, and low-income communities are:

- More likely to live and work in places where toxic petrochemical and industrial facilities have been placed and continue to expand, emitting pollutants that shorten and impact the quality of life.
- More likely to live in areas where there is more flooding, often because of racialized real estate valuation, predatory land acquisition, and variances in infrastructural investment.
- More likely to receive inadequate infrastructure investment to mitigate risks and prevent disasters and then also more likely to experience delayed and insufficient response and recovery investments and resources during and after emergencies.

Drawing on my experiences and those of the communities that I and we serve in Louisiana, I believe specific items need to remain center of focus with the design and deployment of future Federal resources and actions.

Access to localized information and technical assistance varies dramatically across jurisdictions. This access is dependent on local revenue streams and socioeconomic conditions with a tendency to manifest institutionalized disparities as variances in local capacity to address challenges or create opportunities. **To reduce the variances in localized technical assistance, the Federal government must develop pathways to prioritize and invest in the places that have seen systematic disinvestment and underinvestment – leveraging resources across all sectors impacted by the evolving and rippling climate crisis.**

Localized information and tools presented to people already being or soon to be impacted by the levels of risk indicated by those tools can fall unheard for several reasons. Under resourced communities have less financial capacity to adapt or address the risks that are often revealed by said tools. Each time a seemingly helpful government official or entity shows up to share depictions and projections of a given existential crisis, residents and constituencies without the financial means to address those calamities can often feel increasingly helpless. Communities may feel powerless with increased exposure to information regarding their own vulnerability to a predicted hazard when there is no pathway indicated or provided through which they might address a given risk. Often, this unclear or impossible route to attend to a risk or impact presents as apparent community apathy or indifference to the actual risk or hazard discussed. In actuality, what are those under resourced residents supposed to do to surmount the challenge? **The Federal government should take steps to ensure any information regarding climate hazards that is brought to constituents or local decisionmakers is presented alongside tangible pathways to tackle the risks indicated by the information or tool, including identifying which government entity at which level of government provides the appropriate pathway to mitigate said risk.**

With the notorious image of a government official who arrives communicating some version of "I'm from the government and I'm here to help," even the most well-intentioned bureaucrat still generates distrust from communities that have, for decades and generations, seen commitments from government dissolve, benefit the neighborhood up the road, catalyze rewards for those who move in later, or actively bring harm to their communities. Thus, pathways to address change need to be institutionalized in a way that establishes and grows

trust in government over time. **Ensure that federal practices, including projects that will evolve through adaptive management and in concert with evolving environmental circumstances, illustrate government follow through. Government officials and investments need to visibly "do what they say they were going to do."**

Typically, state and federal efforts are operationalized by the staff of government contractors or researchers from elsewhere. These individuals and entities usually have minimal responsibility regarding the effectiveness of given work in a community over time or little concern regarding whether the actual benefits will be experienced by the people in that place. As activities expand in an area, planning fatigue and confusion abound regarding where the last folks went after they came into a community with calls for interviews, grant funding, and requests for time and energy from residents. There is a lack of consistency amongst research, activities, planning, and implementation efforts that start and stop within a given impacted area. Moreover, private entities procure handsome contracts to complete work in alignment with Federal and state deliverables for funding with very little impetus or accountability for seeing long term positive outcomes in a community. Unless those organizations are based in or have a long-term commitment to a place, they are unlikely to center the needs of the people there.

Created by the Foundation for Louisiana, LEAD (Leadership Education Advocacy Development) the Coast is a comprehensive leadership, education, and advocacy development program designed to equip the resident leaders of Louisiana with tools they need for effective civic engagement to address coastal and climate change. The program is designed to empower community leaders through shared learning sessions that enable residents to connect their own personal experience to technical information; to understand pathways by which decision making occurs; to consider past, present, and future intersections of climate change impacts to communities; and to develop networks through which to build power across Louisiana. This program creates space for community leaders to meet and learn from others, share their stories, and connect their personal, local knowledge and expertise regarding coastal and climate change and environmental justice to actionable pathways to address the impacts experienced in their communities.

Building on the lessons learned through FFL's Together Initiative founded in 2008, LEAD the Coast was launched in 2016 and revamped in 2019 in partnership with nine grantee partners. While facilitating over 70 meetings with people across six Louisiana parishes to draft community envisioned and prioritized plans for LA SAFE in 2017, one constant message received was that frontline communities do not want people not representative of them trying to control their community actions and reactions around tough topics like climate. For far too long, they've felt under- and misrepresented by individuals who come in and either judge their decision making or attempt to act on their behalf. This frustration sparked the idea to deepen the effectiveness of the program by partnering with our community-based organization (CBO) grantees to host cohorts of LEAD the Coast in parishes across Louisiana.

As of today, the program has had 6 cohorts across 10 parishes and more than 125 graduates. LEAD the Coast continues to deepen relationships and work toward an expanded network with its Inaugural LTC Fellowship Class in 2020 and ongoing coast-wide expansion. The majority of program participants have been from Communities of Color, and more specifically Black and Indigenous communities, and the program continues to influence progress in diversifying coastal and climate leadership so that communities most impacted are more appropriately represented in decision-making. The program would not be possible without deep trust and relationships that continue to be established and deepened to ensure that our institutions are accountable to the communities they serve.

Part of the Federal role should be to utilize and develop funding mechanisms to invest in the capacity of local people and institutions most impacted by climate change. Develop and grow practices that center the expertise of the people most impacted as leaders, designers, and decision makers to cultivate innovative and sustained responses for generational challenges. Support networks of local people to develop regional relationship infrastructure that lends to decision making influence to demand and advance adaptive and positive change in those areas over time.

Further, Federal agencies can better serve communities that have faced historic and ongoing disinvestment and underinvestment by removing discriminatory metrics in valuation tools for project prioritization, removing barriers to resources that are embedded within policies and procedures, prioritizing intentional investment in communities that have been harmed by the implementation of previous government practices, and requiring meaningful participation across all infrastructural, development, and investment decision processes. When considering siting of future investments to reduce risk and improve adaptive capacity for communities, many Federal agencies predominately utilize cost benefit analyses that rely heavily on racialized real estate valuation practices which improperly tip the scales regarding who experiences the costs and the benefits. These calculation processes Inherently prioritize investments to mitigate risk and of adaptation and resilience measures to wealthier, typically whiter, communities which have received decades and generations of sustained infrastructure investment that already ensure that they fare better in the face of acute and chronic disasters. **Using detailed analysis and surgical precision, replace metrics that, however unintentionally, exacerbate the existing imbalance of government resource distribution. Develop metrics that prioritize the communities that have experienced decades and generations of disinvestment and underinvestment.** More information can be found in appendices 2 and 3.

Federal climate services can better bridge information gaps by developing ways to incorporate anecdotal personal experiences of ongoing climate impacts at scale, environmental harm and change, and traditional ecological knowledge. Federal climate services can also bridge these gaps by developing iterative communication and coordination practices between the agencies that reveal and project ongoing environmental change, those that work to address those impacts across environmental fields, and those that typically don't consider themselves environmental such as housing and development, transportation, education, economy and jobs, and public health.

For example, the aforementioned LA SAFE program allocated federal dollars to provide expanded support to address mental health care needs in a parish with extensive ongoing land loss and increased trauma to residents from repeated disaster events. With the stress of recovering and rebuilding after multiple storms, ongoing outward migration, and the closure or disappearance of facilities and services, Plaquemines Parish experienced an uptick in suicide rates and a surge in demand for mental healthcare services. Still, coastal and climate change had been considered a primarily environmental challenge. At the time, the Louisiana Department of Health was not monitoring health impacts or considering evolving programmatic needs in alignment with acute and chronic climate impacts at an institutional level. Perhaps more accessible, the agency is only beginning to consider how to invest in existing and future asset management with an analysis of climate event vulnerability and projected land loss. The state agency charged with visualizing and addressing current and future coastal land loss and flood risk has not been systematically collaborating with the department that administers healthcare services for residents. The requirement for coordination and collaboration is apparent in this example for state government and could also be pursued through Federal leadership, funding, and accountability.

For an additional example of a sector typically viewed as non-environmental with substantial impacts from climate change, economic opportunity and development are being influenced by environmental shifts and should help to catalyze inclusive adaptation practices. Many residents of south Louisiana that evacuated for Hurricane Katrina to end up displaced for weeks, months, or years came back to find that their employer had since supplanted their job with other labor, typically a working person from elsewhere. Thus, we need to design Federal practices and policies with a consideration for relationships between job access and business development and ongoing climate impacts. People with resources are more financially able to recover from disaster or to adapt over time. Ongoing climate induced migration is also influenced by economic opportunity and the availability of "good jobs" in each community. Thus, inclusive economic development could be coordinated with an understanding of current and projected climate risk, prioritizing investments to ensure inclusive and affordable growth and economic opportunity in areas poised to remain high and dry (or insert a relevant climate impact benefit here). Moreover, as we invest in projects to help communities adapt and mitigate risk, Federal funding practices can ensure that those projects include resources for the development of working people, small business support, and accessible procurement policies so that the resources can also leverage inclusive economic opportunity in the areas receiving investment. The design of these resources and practices can intentionally prioritize communities that have historically been left out of economic opportunity and catalyze pathways to build wealth in underserved and marginalized communities to advance equitable economic opportunity in the face of climate change.

Expanding and developing pathways to incorporate the many scales of change into our understandings of risk and climate impacts is critical to developing a more comprehensive Federal response to climate change. Understanding the nuances in capacity of local and state government is also vital to the effectiveness of any tool or the impact of Federal programs and policies over time. We can also leverage resources to catalyze inclusive economic

opportunity in areas receiving investments to mitigate and address evolving climate risks, enhancing the capacity of residents and communities to adapt over time.

Importantly, improving direct communication, coordination, and collaboration between data, science, and modeling entities and those who provide services to communities and local and state government via Federal investment will be crucial to effective climate response. Logistically, the Federal role will also include the development of a sophisticated architecture of staffing, funding, and decision-making authority for that response over time. **A convening and coordinating body with the capacity and authority to develop iterative future modeling expertise between agencies is required to tackle the disconnected production of data and tools and the siloed nature of emerging and evolving climate work**. Agencies most familiar with climate change and impacts don't systematically engage with agencies whose assets, current and future programming, and future needs or investment decisions might be relevant. **Thus, the need for iterative and cyclical communication, coordination, and collaboration between data and services development and deployment is apparent. Improved coordination should be facilitated – and staffed and resourced – in a way that is recurrent at key intervals and ongoing so that tools and modeling capacity can advance with evolving experience of impacts on the ground to meet the challenge and even get ahead of projected future impacts.**

To close, I would like to acknowledge that I am from New Orleans and my family is spread across south Louisiana. My deep roots here engender a passion and a commitment to defend and champion the places I love – the ongoing and evolving impacts are real, personal, and vast while the stories of past, present, and future give us the clarity and strength to advance outcomes towards a more healthy, just, and vibrant future. My family knew how high the water rose in Katrina because my great grandmother's "Sweet-N-Low" packets were stuck to the wall amidst leaves and storm debris, inches from the ceiling. The molded, soggy scrapbooks are forever seared into my memory. In Louisiana, residents from across the political spectrum acknowledge and appreciate ongoing climate change and the effects it brings; still, few Americans understand or are grappling with the depth and breadth of climate impacts to everything we care about. Climate change is not a future scenario here, across our country, or around the world. I want to encourage you to do everything in your power to advance efforts and investments that treat your constituents with dignity and acknowledge the humanity in all of us. I appreciate this opportunity to articulate and underscore the need for a strengthened, coordinated Federal role and response as we interpret and address the many facets of the climate crisis. Thank you for your time, consideration, and ongoing work.

Appendix 1

LASAFE Final Report

Conclusions and Recommendations

As climate change, sea level rise, and coastal erosion continue to impact South Louisiana, more frequent and intense flooding events are contributing to population shifts as people move away from vulnerable areas. These population movements are driven by middle class residents who, faced with escalating flood insurance and other costs, use their assets and social networks to support a move elsewhere. They leave behind poorer residents and the elderly who often do not have the extended social networks or income to support such a move. The other remaining residents tend to be wealthier and can afford to self-insure, making it easier to retain their coastal residence. (See Colten, Simms, Grismore, & Hemmerling, 2017; Hobor, Plyer, & Horwitz, 2014; Smith, Carbone, Pope, Hallstrom, & Darden, 2006.)

Despite significant land loss, each of the six LA SAFE parishes (St. Tammany, Plaquemines, Jefferson, St. John, Lafourche, and Terrebonne) have gained population since 1960. In Plaquemines Parish, where land loss has been arguably most severe, the population grew from 22,545 in 1960 to a peak of 26,757 in 2000, before declining to 23,042 by 2010. But in Terrebonne and Lafourche Parishes, where land loss has also been quite severe, the population has grown steadily from 55,381 in 1960 to 96,318 in 2010 (Lafourche) and from 60,771 to 111,860 (Terrebonne). Many of these parishes are losing population from their most vulnerable areas, while population is growing in less flood-prone parts of the parish. These data highlight the importance of gathering data for sub-parish areas rather than for parishes as a whole.

Although anecdotes of these trends abound in coastal communities, compiling population data that illustrates these trends is challenging as population counts at the census tract level are available only once every ten years and is subject to boundary changes that distort conclusions about increases or declines. Initial attempts by LA SAFE partners to display census data and commercial population estimates indicated sub-parish population gains where declines were more likely. These results were often artifacts of boundary changes rather than actual population increases. The Data Center was able to identify the most reliable data sets to represent actual population shifts and worked with LA SAFE partners to effectively present this data for meetings that took place across the six LA SAFE Southeast Louisiana parishes in 2017.

The data presented in these meetings depicted changes for roughly 30 sub-parish areas across the six parishes. We relied on special compilations of census data for which boundary changes had been normalized along with USPS counts of residences receiving mail (the foundational data set for all census data products) to update trends since 2010.

LA SAFE partners specified the census tracts and ZIP codes that best represented each community with whom they were working. Then, these data were presented in simple, compelling graphics indicating population decline or gain for each sub-parish area in the six LA SAFE parishes. This data revealed that the most vulnerable parts of the six LA SAFE parishes have lost population, experienced declines in school enrollments, and in some cases have closed schools. In addition, remaining residents of these communities are more likely to be poor and/or elderly.

We examined job trends in these vulnerable communities and found mixed results. For example, from 2004 to 2014, while jobs in Chauvin and Cocodrie decreased by 50 percent, jobs in Dulac increased by 35 percent. This reveals an important trend to consider in coastal Louisiana. Because our coast is host to a great deal of economic activity, including fishing and oil and gas exploration, there will likely always be some demand for access to vulnerable areas close to these economic assets. Certainly, businesses will balance the cost of potential flood risk against the cost of operating farther from the Gulf resources they must reach, and workers will be drawn to live near work opportunities when feasible. We also supplied data about the number of workers commuting from outside each parish to work within the parish, and we found that thousands of workers who live outside of Louisiana are commuting to jobs in the LA SAFE parishes. These parishes have economic activities that draw workers living in Mississippi, Texas, and Alabama, in particular. In short, regional populations will grow and decline in relationship to jobs and understanding those patterns will continue to be important for future development needs.

The Data Center acquired special population projections (from Dr. Matt Hauer, applied demographer at the University of Georgia) of the number of residents who may, in future years, live in areas that are projected to be inundated if sea levels rise three feet by 2100. Dr. Hauer's research also calculated migration patterns if these residents move away from inundated areas. The estimates indicate that many inland parishes will receive substantial population influxes in the future. As such, these estimates provide important information to state officials considering how adaptation efforts affect inland communities as well as coastal communities.

The LA SAFE project was a ground-breaking effort to execute extensive community engagement activities to co-design resilience projects for six parishes in Southeast Louisiana. Data was essential to these conversations because it allowed residents to shift away from substantiating problems through anecdote to refocusing on solutions. As Foundation for Louisiana considers expanding resilience planning efforts to the rest of South Louisiana, The Data Center recommends compiling and displaying sub-parish population and jobs data in much the same way that was done for the six LA SAFE parishes. The Data Center attended many of the meetings where this data was presented and interviewed LA SAFE partners after the meetings to assess their effectiveness. The

maps developed by LA SAFE partners were found to be compelling and effective and should be used as a template for future such engagements. Depicting simple population percent increases and declines proved to be a very effective way to quickly communicate the overarching trends in this data set. The only data we would recommend displaying differently is jobs data which could be shown as a year-by-year trend (similar to how school enrollment trends were displayed). Residents are keenly aware of the ups and downs of job trends in their area and would more readily relate to year-by-year job trends, rather than a single percent change over a decade.

References:

Colten, C. E., Simms, J. R., Grismore, A. A., & Hemmerling, S. A. (2017). Social justice and mobility in coastal Louisiana, USA. *Regional Environmental Change 18*(2), 371-383.

Hobor, G., Plyer, A., Horwitz, B. (2014). The coastal index: the problem and possibility of our coast. The Data Center, New Orleans.

Smith, K., Carbone, J., Pope, J., Hallstrom, D., & Darden, M. (2006). Adjusting to natural disasters. *Journal of Risk and Uncertainty 33* (102): 37-54.

Appendix 2

Predicting the Future of Coastal Communities: Toward Fairness and Equity in Coastal Planning

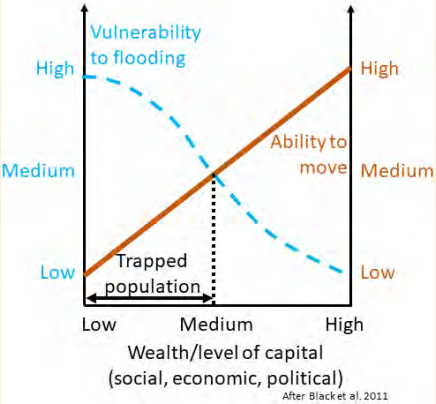
The land loss crisis on Louisiana's coast, compounded by the periodic impact of tropical storms and hurricanes and ever rising sea levels, affects all aspects of life for coastal communities. The State of Louisiana aims to address some of these impacts by restoring wetlands and providing for risk reduction using both structural (e.g., levees, floodwalls) and nonstructural (e.g., floodproofing, elevating) approaches. Plans are based on extensive analysis. However, the focus for risk reduction projects is on their ability to reduce economic damages and their cost-effectiveness. Social and economic differences that could be reflected in existing and future inequities within and among coastal communities are not currently considered. In large part this is due to the lack of proven tools for modeling how community dynamics change in the future.

A fuller appreciation of how communities and economies may change over time in response to a variety of potential forces is needed. The ability to incorporate knowledge of 'disadvantaged communities' or 'economically distressed areas' into future planning analyses could allow investments in risk reduction to consider existing and future inequity and enable supportive holistic planning for future adaptation. ***Taking a more holistic approach in coastwide planning requires the development of new tools that enable analyses of equity and fairness as considerations in coastal adaptation planning***.

This paper identifies three areas where near-term progress can be made concurrently:

- **External Influences**
  Accounting for the potential effects of factors such as flood insurance policy and national economic trends
- **Predicting Change in Coastal Communities and Economies**
  Developing new projections of population and employment to identify who might migrate and to where
- **Measures of Fairness in Flood Risk Decisions**
  Considering who is benefiting from flood risk reduction projects, not only what costs are reduced

Impoverished people are unable to move away from flooded areas, the low value of their homes makes them less likely to meet cost-benefit standards for flood protection, and their lack of capital makes them more vulnerable. Unless deliberate action is taken, ***impoverished communities can become trapped.***



Each of these areas links directly to the existing planning process used in coastal Louisiana; however, making progress in these areas is of broad application. ***The existing framework for coastal planning used in Louisiana provides an ideal testbed for improved consideration of fairness and equity on coastal adaptation planning that can be applied across other coastal systems.***

The discussion and recommendations presented here were developed during a workshop supported by the Foundation for Louisiana and the Environmental Defense Fund: *Toward Holistic Planning for Community Adaptation on the Louisiana Coast.* The Workshop was convened and facilitated by Denise Reed, University of New Orleans, and Allison Plyer, The Data Center (New Orleans). The following participants contributed: Stephen Barnes, Louisiana State University; Stuart Brown, Coastal Protection and Restoration Authority; Astrid Caldas, Union of Concerned Scientists; Steve Cochran, Environmental Defense Fund; Craig Colten, Louisiana State University; John Cooper, Jr., Texas A&M University; Liza Cowan, Center for Community Investment; Susan Cutter, University of South Carolina; Lamar Gardere, The Data Center (New Orleans); Andrew Greenlee, University of Illinois; Robert Habans, The Data Center (New Orleans); Matt Hauer, Florida State University; Elizabeth Jarrell, Coastal Protection and Restoration Authority; Sallie Keller, University of Virginia; Samantha Medlock, Willis Towers Watson; Allison Reilly, University of Maryland; Liz Williams Russell, Foundation for Louisiana; A.R. Siders, Harvard University; Margaret Walls, Resources for the Future.

Foundation for Louisiana EDF Environmental Defense Fund THE DATA CENTER

External Influences

Precisely predicting future socioeconomic conditions is impractical if not impossible. However, it is possible to identify principle drivers and future scenarios that would affect coastal population growth patterns and risk exposure. National policy, economy, and investment practices are three areas that could be the foundation for future scenarios. Such scenarios could support prediction of the range of effects that economic conditions and policy choices may have on coastal demographics and thus the effectiveness of risk reduction measures.

- **Policy**: Local, state, and federal policies influence where people live, insurance costs, and who pays to reduce risk and provide recovery resources after a disaster.
- **Economic**: Economic trends impact community dynamics and funding for risk reduction. Regional job availability affects where people live, and overall economic growth affects funding sources available to shape coastal resilience.
- **Investment**: Policy reform can reduce risk and therefore increase capacity to attract and absorb private capital for resilience activities (i.e., insurance & municipal bonds).

Key issues and challenges involved in developing policy, economic and investment scenarios include:

Multiple levels of policy intervention – there are many levels to consider - local, state, and federal – and different interventions could result in different benefits: some may reduce overall risk, whereas others could reduce overall cost.

Many potential drivers - some, such as the national economy, are outside the control of local stakeholders or decision-makers but understanding them is important for predicting future coastal changes. Other drivers relevant to flood risk are within local control, e.g., changing local zoning, strengthening building codes.

Identifying appropriate drivers – it is necessary to ensure that the changes affected by the drivers can be reflected in the analytical models of social change and that model results are sensitive to changes in the drivers.

Proposed Near-Term Steps

1. **Identify potential drivers.** Convene small groups to identify drivers and develop solid reasoning for the relationships between the drivers and social change. Ultimately, the drivers must have well defined links to their consequences to be usable.
2. **Refine based on Application Framework.** It is important to articulate the drivers in a way that can be used in modeling or other aspects of a planning framework. Different drivers may influence different aspects of the process. For example, change in a driver that influences the availability of funding could make more/less funding available for projects over time. The 2017 Coastal Master Plan data could be used as a testbed for considering driver selection.
3. **Test.** It is important that scenarios used influence plan development in ways which are meaningful. Testing the sensitivity of model outputs to scenario drivers is important. For example, what are the plausible changes in NFIP, how much would they each impact the value of residences within coastal communities, and what difference does that make in future damage or migration estimates?

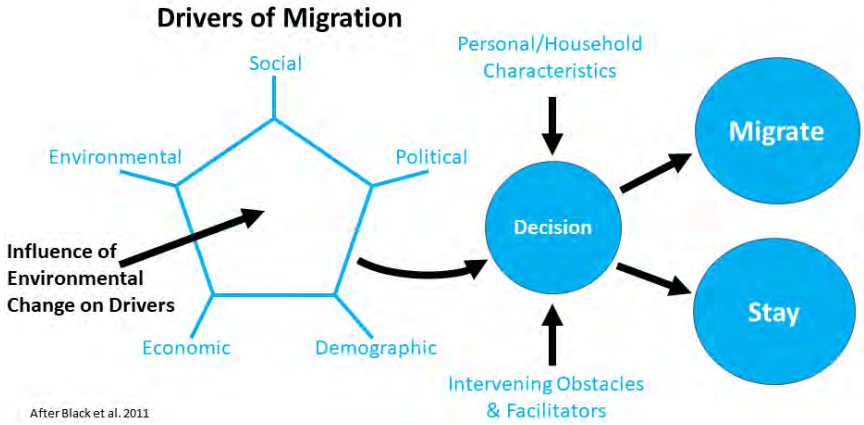
Moving Forward - Expected Duration: 9-12 months
Convene a small but diverse group of experts to identify potentially important drivers and scenario values for those drivers. Develop a conceptual model of how each driver influences equity issues in coastal flood risk planning. Coordinate with Louisiana Coastal Protection and Restoration Authority to identify opportunities to test sensitivity of 2017 Coastal Master Plan outputs and decisions to potential drivers

Predicting Change in Coastal Communities and Economies

A variety of demographic and economic models of climate-change migration exist, but an integrated approach at an appropriate scale for planning has yet to be identified. Models of climate-change driven demographic change have been developed for states along the Gulf and Atlantic coasts and provide a solid foundation. Migration can change wage rates and housing prices in turn influencing migration decisions but integrating economic factors is challenging.

Key questions:

- ***How many people will migrate from where to where?***
- ***Who will be left behind?***
- ***How does migration respond to economic growth and flood risk?***
- ***Where will receiving communities be located?***



Key challenges to advancing an integrated approach to considering population migration and economic factors in flood risk planning include:

Trends vs. Events - push factors such as land loss, severe weather events, and frequent flooding may all trigger migrations and add complexity to socio-demographic changes driven by age, gender and race.

Spatial Resolution – projections at subcounty scale are needed to effectively plan flood risk reduction measures

Migration To and From - to be useful in a coastal planning process, models should consider interaction of demographic characteristics and factors such as wage rates and housing process to identify who will be moving to and from different communities

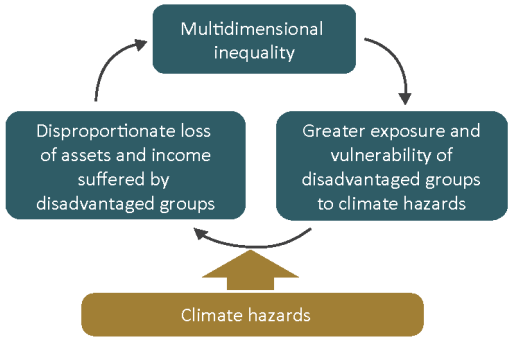
Proposed Near-Term Steps

1. Migration Models.
   - Improve existing models by integration of migration data that more fully reflects low-income households' social networks (e.g. data from HUD, USDA and IRS), as well as more nuanced data about projected chronic and acute flooding.
2. Employment and Commuting
   - Historical sub-county business establishment data and regional projections could be used to generate local job projections. These could then be paired with local commuter patterns based on data generated by the U.S. Census Bureau to project the distances that coastal workers may commute in future.

Moving Forward - Expected Duration: 9-12 months
Enhance migration models to incorporate income and flooding data Test the downscaling of models that project characteristics of age, gender, race/ethnicity, and educational attainment at sub-county scale. Identify available modeling techniques to link local employment with regional economic models

Measures of Fairness in Flood Risk Decisions

It is widely recognized that social impacts of hazard exposure, including coastal flooding, often fall disproportionately on society's most vulnerable populations, including those with low income, minorities, children, the elderly, and the disabled. However, the vulnerability of the population affected is rarely a central consideration in planning to address coastal flood risk. Not proactively addressing inequity in decisions on how to address flood and other climate hazards, can exacerbate vulnerability and increase inequity.



Source: UN/DESA.

Key Questions:

- ***How can we integrate social and economic measures of flood risk reduction?***
- ***What data is available to be used?***
- ***What barriers need to be overcome?***

Key challenges in advancing the use of a broader set of measures in assessing flood risk reduction include:

Data sources - use of publicly available data (e.g., U.S. Census, American Community Survey) allows consistent application across geographies. However, issues arise in relation to temporal and spatial resolution, e.g., the census is decennial.

Spatial Resolution - the spatial resolution of the data and derived metrics should be appropriate to the decision they are expected to inform.

Responsiveness - to be useful to a planning process metrics must be sensitive to changes over time, e.g., in economy or population distribution, and responsive to the interventions that are being evaluated.

Proposed Near-Term Steps

1. Data Discovery.
   - Convene a core group of researchers, local governments, and others who generate or use relevant data to identify data sources including an initial assessment of strengths, weaknesses, gaps, challenges and access issues, and receive input and feedback from stakeholders to ensure consideration of factors important to communities.
2. Develop and Test New Measures using Available Data
   - Researchers, working with decision-makers, consider and test methods to adjust spatial/temporal resolution, evaluate options for index development, how variables are combined, etc. Identify a varied set of candidate metrics that reflect different social and economic aspects of communities.
3. Compare New Metrics to Existing Approaches
   - Researchers explore how the candidate metrics perform in comparison to existing metrics (such as expected annual damages) and assess how different decisions might be made if wider measures of vulnerability were included.

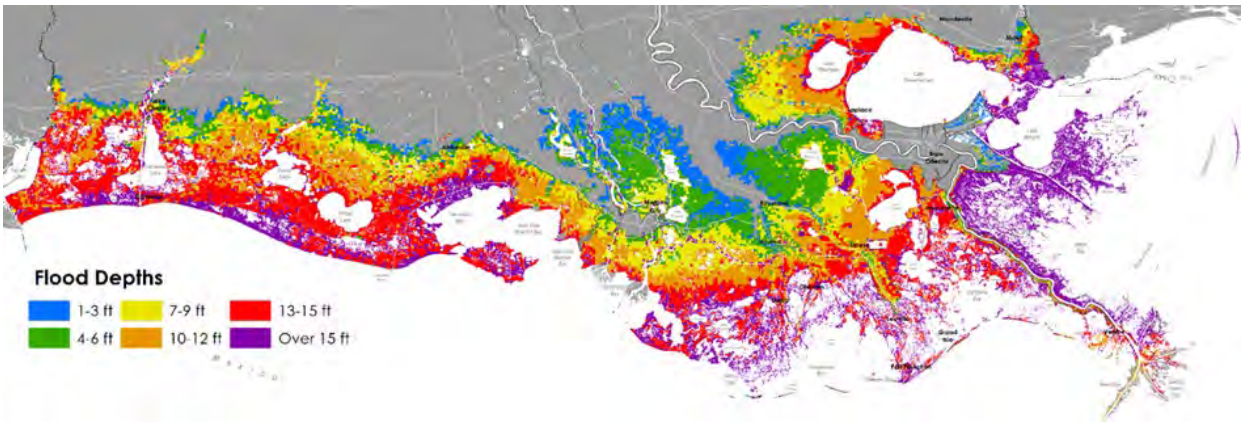
Moving Forward - Expected Duration: 6-9 months
Support a core group of researchers to plan and execute data discovery and initial metric development and testing, around two to three variables that reflect inequity and lack of social justice, e.g., income distribution, education levels, race/ethnicity. Coordinate with Louisiana Coastal Protection and Restoration Authority to utilize existing economic analysis for comparison Assess the feasibility of applying a wider array of measures in flood risk planning including the benefits and challenges.

For more information contact:			
Liz Williams Russell	lwrussell@foundationforlouisiana.org	Steve Cochran	scochran@edf.org
Allison Plyer	allisonp@datacenterresearch.org	Denise Reed	djreed@uno.edu

Appendix 3

Toward Holistic Planning for Community Adaptation on the Louisiana Coast

Workshop Report



Prepared by:
Denise Reed, University of New Orleans
Allison Plyer, The Data Center

Supported by:
Foundation for Louisiana
Environmental Defense Fund

April 2019

Foundation for Louisiana

EDF Environmental Defense Fund

Contents

List of Tables iii
List of Figures iii
Foreword iv
Preface vi
Introduction 1
Context 1
Goals and Objectives 2
Approach 4
Scoping the Problem 4
Potential Approaches 7
New Concepts and Ideas 7
Ideas for Application 8
Concept Development 9
Expanding the Use of Scenarios 10
Background and Context 10
Key Issues and Challenges 11
Proposed Approach 11
Modeling Future Demographic and Economic Conditions 12
Background and Context 12
Key Issues and Challenges 12
Proposed Approach 13
New Metrics to Inform Flood Risk Reduction Decisions 14
Background and Context 14
Key Issues and Challenges 14
Proposed Approach 15
Summary/Concluding Thoughts 17
References Cited 18
Appendix 1. List of Workshop Attendees 20
Appendix 2. Examples of Drivers and their Potential Use in Scenarios 21

List of Tables

Table 1. Results of brainstorming exercise on Future Coastal Outcomes..... 4
Table 2. Categorization of the Drivers of Change in Community and Economy 6

List of Figures

Figure 1. Initial ideas on how to apply new concepts and approaches to coastal Louisiana..... 9
Figure 2. Illustration of how concepts proposed mesh with the existing planning framework….17

Foreword

Foundation for Louisiana is a statewide philanthropic organization that works in the service of Louisiana's people, tackling the issues that most deeply impact our communities in collaboration with a wide array of partners. Founded in the traumatic wake of Hurricane Katrina, the work of our organization is rooted in an understanding of the impacts of climate change and coastal land loss to communities and businesses. This work of the foundation is built on the reality that acute and chronic environmental disasters – whether natural or human-caused – exacerbate existing social inequities solidified in policies and practices across sectors. Without purposefully acknowledging injustices and implementing programs to ensure equity, Louisiana will uphold existing systems of oppression as we adapt to environmental change.

Our current condition is this: Louisiana is experiencing the effects of sea level rise and coastal land loss more imminently than other parts of the Gulf South, the nation and the world. Thus, practices and experience developed with and for Louisiana are relevant to allies across the globe expecting to see similar challenges in the coming years, rendering Louisiana a litmus test and incubator for emerging practices, programs and policies.

Louisiana has taken tremendous steps to understand the realities of our changing coast and has established effective methods to restore some of what has been lost across the last century. The state now has tactics to combat the impacts of sea level rise through the reestablishment of a dynamic deltaic system. As actors across the state address the impacts of having already lost more than 1,800 square miles of land, the potential of losing another 2,250 square miles of land over the next 50 years as is currently predicted increases tensions. Migration induced in part by these changes creates ripple effects among communities and economies that must be incorporated into planning for a future with less land and increased flood risk. In terms of the physical landscape, we have tools for prioritizing restoration projects that sustain and build the most significant and ecologically vibrant wetland acreage. To address the ripple effects of environmental change we must continue to expand our methods to measure reduced risk to humans, and specifically, the effects and implications of flood risk.

Valuation practices used by decision-makers to prioritize flood risk reduction, resilience and adaptation investments in an array of sectors are often determined by relatively traditional cost-benefit analyses (at best supplanted with an overlaid index of social vulnerability). These analyses are generally designed to give value to economic risks alone, and inherently prioritize industrial assets as well as wealthier areas with more high-value real estate. Built on historic principles of value that are often racialized or determined by existing wealth, these methods of valuation are themselves flawed and insufficient for appropriately illustrating risks, rewards, priorities and loss. As a result, they can also effectively lock in historical inequities, by extending their valuations into future decisions based on these flawed approaches. Across sectors, new approaches to equitably prioritize projects across sectors are required. As a pinnacle of culture and community, Louisiana can innovate to lead in the development of more comprehensive and just practices that support our decision-making. This report is a hopeful, foundational step in that direction.

Furthermore, given our expectations of sea level rise and the effectiveness of keystone restoration projects, we are beginning to ponder the implications of future environmental scenarios across a wider set of spheres. Conversations are emerging that consider not only the

impacts of these changes to our existing housing stock, but that also examine a swath of development practices that could reduce our risk of flooding while ensuring that the most vulnerable amongst us are not forced to reside in the areas most likely to be under water. As the state of Louisiana determines contracting practices for and allocations of billions of dollars in coastal restoration and water management resources for the next decade and beyond, a dialogue is developing surrounding inclusive access to healthy, green economies. We must deeply consider how economic development can influence community growth, ensuring areas poised to remain high and dry are accessible to all and supporting residents in the freedom to dream and be financially secure. The sustainability of local revenue streams for social services and infrastructure in Louisiana is shifting in relation to disaster-induced migration, impacting access to healthcare, transit, education and other community needs. Thus, measuring, communicating, determining funding for and prioritizing risk reduction measures should expand to fully encompass the range of risks facing our state. The findings in this document are meant to supplement state agency efforts for planning, program and project design and development by offering a set of practices that provide a more representative understanding of the conditions and variables that are incorporated into valuation metrics to better serve the citizens of Louisiana. These opportunities and challenges will continue to arise and evolve in the years and decades ahead, creating further opportunities to build an environmentally and economically vibrant, healthy, equitable and just future for Louisiana.

With ever-evolving conditions and as a necessarily global leader in solving for the climate crisis, Louisiana requires intuition, critical thought and innovation to balance the array of needs and actors. We must be clear and open about these efforts as we design the next steps and implement the former. We must learn from the wisdom of our communities and incorporate that knowledge into the next phases of the work, supporting our leaders in creating positive change. We must hold ourselves accountable to our communities and to each other as Louisianans. We must remove barriers and create paths to resources and opportunities as we take steps to revitalize a dynamic coastal system and reduce our vulnerabilities. We must support the right of residents and families to flourish in the everyday, amidst both natural and man-made disasters. With the courage and leadership of our partners and allies, Foundation for Louisiana will continue to support steps to ensure the freedom to thrive and prosper for all Louisianans. This report provides a window into the dialogue, the decision points, the determining factors and the prospects of addressing these changes, should Louisiana and its allies elect to enhance our investments and holistically and equitably reduce risk to our communities and economies – as one step amongst many.

Liz Williams Russell
Coastal and Climate Program Director
Foundation for Louisiana

Preface

In January 2019, a group of experts gathered to identify state-of-the-science approaches for considering future socio-economic dynamics of coastal communities in Louisiana and in other threatened coastal areas. Support was provided by the Foundation for Louisiana in partnership with the Environmental Defense Fund and The Data Center. Dr. Allison Plyer and Dr. Denise Reed planned the workshop to take the first step toward quantitative integration of equity and related issues into coastal adaptation processes.

The following report details the process and outcomes of this convening, summarizes the challenges of predicting how coastal communities and economies may change over time, and presents three expert-informed, integrative approaches that can be further developed to provide quantitative representations of socioeconomic futures. This report also describes potential next steps for development and testing of these approaches. It is intended to be circulated among coastal decision-makers and stakeholders to help advance these issues and ultimately inform key coastal adaptation processes, both within Louisiana and among scholars and decision-makers nationally.

Introduction

It is now well documented and understood that Louisiana is confronting a coastal crisis: it is losing land and flood risk is increasing. The State's Coastal Master Plan presents a 50-year strategy to sustain the coastal ecosystem and reduce flood risk, selecting coastal restoration and flood risk reduction projects based on available science. Models are used to predict changes in landscape configuration and economic damages from coastal storms as sea-level rises and wetlands degrade. However, the breadth of effects of this future land loss and flood risk on coastal communities is difficult to incorporate into models due to the lack of tools to predict social and economic change on the coast decades into the future. Such tools are critically important because prioritization based largely on economic damages is likely to create or exacerbate wealth inequality (Howell and Elliott 2018a, b).

Development of "next generation tools" that predict future socioeconomic states is a critical, informative next step in a range of impending coastal planning efforts. This report, based on a workshop held in January 2019, aims to demonstrate that a more holistic view of coastal change could be incorporated into future planning efforts and identifies some near-term actions to advance that goal. While the ideas developed here focus on coastal issues, flood risk is present in all 64 Louisiana parishes, not just those on the coast. Since 2005, each of the 64 Louisiana parishes have received a flood declaration. The broad-based approach to flood risk planning in this report should be of application in the state of Louisiana and beyond.

Context

Louisiana's coastal land loss crisis, compounded by the periodic impact of tropical storms, hurricanes and ever-rising sea levels, affects all aspects of life for coastal communities. The State of Louisiana's 2012 and 2017 Coastal Master Plans aim to address some of these impacts by restoring wetlands, sustaining habitats in some areas for harvest species and providing risk reduction using both structural (e.g. levees, floodwalls) and nonstructural (e.g. floodproofing, elevating) approaches. The modeling approach developed and utilized for the 2012 and 2017 Coastal Master Plans provided a coastwide, forward-looking platform for projecting the effectiveness of coastal restoration and risk reduction projects. Risk reduction projects were assessed on their ability to reduce economic damages. They were selected for inclusion in the plan based on the magnitude of this projected reduction and their cost-effectiveness. Only economic damages due to flooding associated with storm surge and waves were considered. Some metrics were developed to allow consideration of other aspects of the coastal system (e.g. effects on traditional fishing communities), but most of these were based on a limited set of ecosystem and landscape information derived for other purposes.

Existing and future social and economic inequities within and among coastal communities were not considered in the 2017 Coastal Master Plan[1]. In large part this was due to the lack of proven tools for modeling how community dynamics may change in the future. The Coastal Master Plan did incorporate one method to estimate change in future population patterns across the coast, which utilized historic growth rates, current population density and expected response of the

[1] One exception was exploration of how consideration of regions with a high proportion of low-to-moderate income (LMI) households influenced the selection of non-structural risk reduction projects.

population to risk and land loss. These future population changes were used to estimate changes in asset distribution and expected economic damage across the coast; however, prioritizing projects based on asset distribution and estimated reduction of economic damages is likely to create or accelerate inequities, albeit unintentionally (Howell and Elliott, 2018a, b). Many important questions remain unanswered: who will move and who will be left in higher risk areas? Where will they go and will there be employment and services for those left behind? How could economic activity and employment opportunities change in response to land loss and flood risk?

While the analyses conducted have been useful in developing the Coastal Master Plan, a more thorough understanding of how communities and economies may change over time in response to a variety of potential forces including land loss is needed. The ability to incorporate knowledge of "disadvantaged communities" or "economically distressed areas" into future planning analyses could allow investments in risk reduction to consider existing and future inequity and to enable more holistic planning. There is a need to develop tools that can help address adaptation questions such as: Where should we plan for future affordable housing? Where will new roads, sewers and water systems be needed, and when and where should others be no longer maintained? In the context of climate change, continuing land loss, and increased flood risk, how do we plan for the future needs of communities in terms of access to healthcare services and providers, educational and job training needs, mental and addiction support needs, and amenities such as groceries and service stations,? Not considering questions such as these could lead to further inequity, as well as increased social and potentially economic costs. Finally, new insights about the risks facing "disadvantaged communities" and "economically distressed areas" can inform the development of future plans.

Taking a more holistic approach in coastwide planning requires the development of new tools that enable analyses of equity and fairness as considerations in coastal adaptation planning (see, for example, Cooper & McKenna, 2008; Siders, 2019). Such tools will fortify the ability of state planners and policymakers to gauge the equity and fairness of implementing restoration and risk reduction projects and will enable the development of alternative policy responses to mitigate risks. With many efforts to address coastal land loss and flood risk underway, time is of the essence to create new tools that can predict these plans' effects on communities before inequity is exacerbated.

Goals and Objectives

The overarching goal of this report, and the workshop on which it is based, is to chart a path toward analyses and tools that can be used to incorporate issues of equity, displacement, and social justice (see text box below) into coastal planning efforts. Given the massive changes expected to occur on the coast in the future, the current and historical character of communities is not an adequate predictor of future status. The creation of new analytical approaches is challenging but essential to advancing holistic coastal adaptation planning in Louisiana and elsewhere.

This goal requires several objectives:

- Identify important characteristics of the future coastal communities and economies and the drivers of change for these communities and economies. This helps to "scope"

the issues that influence social and economic changes and the new tools needed to quantify these changes.

- Find new and emerging approaches and tools that could be of use in projecting changes in future coastal communities and economies. Ideas and approaches as well as lessons learned from other systems that enable consideration of equity and social justice can provide examples to build from in Louisiana.
- Develop strategies to broaden the current planning process to consider an array of social issues, including defining appropriate next steps for development and testing of tools that can be integrated into planning frameworks.

Defining Terms

Equity is defined as "the state, quality or ideal of being just, impartial and fair." The concept of equity is synonymous with fairness and justice. It is helpful to think of equity as not simply a desired state of affairs or a lofty value. To be achieved and sustained, equity needs to be thought of as a structural and systemic concept. Equity involves trying to understand and give people what they need to enjoy full, healthy lives. Equality, in contrast, aims to ensure that everyone gets the same things in order to enjoy full, healthy lives. Like equity, equality aims to promote fairness and justice, but it can only work if everyone starts from the same place and needs the same things (Annie E. Casey Foundation. 2014. *Race Equity and Inclusion Action Guide*).

Displacement of people refers to the forced movement of people from their locality or environment and occupational activities. It is a form of social change caused by a number of factors including natural disasters and economic changes. There are two types of population displacement: direct displacement, which leads to actual displacement of people from their locations, and indirect displacement, which leads to a loss of livelihood. (UNESCO - http://www.unesco.org/new/en/social-and-human-sciences/themes/international-migration/glossary/displaced-person-displacement/)

Social justice follows the principle that all individuals and groups are entitled to fair and impartial treatment and is based on notions of equality and equal opportunity in society. It focuses on the full and equal participation of all citizens in economic, social and political aspects of society. Social justice can also refer to advantages and disadvantages distributed in a society. (USLegal https://definitions.uslegal.com/s/social-justice/)

Approach

The workshop convened to bring new ideas to the coastal planning process in Louisiana. Invited scholars represented a cross-section of disciplines and institutions at the cutting edge of predictive demography, land use planning, hazards vulnerability, economics, law and the environment (see Appendix 1 for list of participants). Most participants were from out of state and were provided with background on the 2017 Coastal Master Plan and a study on migration in coastal communities produced for the LA SAFE[2] community-based planning program. Over a one and a half days, participants shared their related research and brainstormed potential new approaches to support Louisiana's coastal planning to include socioeconomic futures. In the course of the workshop, participants were asked to:

- Identify one or more integrative approaches that consider issues such as population change, migration, employment, service provision and access, etc., which could be developed to provide quantitative representations of potential future socioeconomic states;
- Characterize the ways in which such approaches could be used in conjunction with models of coastal hazard and other aspects of future change;
- Lay out potential next steps for development and testing of the approaches, including timelines, types of expertise required, data needs, resources, and expectations.

The workshop provided an opportunity for participants to present 'rapid fire' short presentations about relevant aspects of their own work. However, the majority of time was spent in work sessions. These included:

- Brainstorming to identify and group important characteristics of future coastal communities and their drivers of change;
- Individual work sessions to chart out promising ideas and concepts;
- Small group discussions to flesh out selected concepts and develop next steps.

Scoping the Problem

Selection of appropriate predictive approaches for coastal planning must be informed by the desired outcomes and the mechanisms that will drive future change. In the context of coastal Louisiana, future increases in flood risk — in part due to coastal land loss — are a crucial, but not sole, driver of social change. The challenge is to identify elements precipitating change in coastal communities and economies, and how the change is responsive or unresponsive to flood risk and other coastal changes. Thus, to set the stage for the development of new tools, participants were asked to brainstorm the characteristics of the future coast that they think are important to consider in coastal planning. The ideas contributed were then grouped into categories of population mobility/characteristics; income & employment; business; access to services; infrastructure; housing; governance; and quality of life. The brainstorming results show a convergence amongst participants on some key concepts, as well as some interesting nuances (Table 1).

[2] The Louisiana Strategic Adaptation for Future Environments (LA SAFE) is a resilience planning process that supported investment in holistic adaptation projects as well as the development of a regional policy framework focused on helping communities plan for – and implement – safer, stronger, and smarter land use and development strategies. The LA SAFE planning process supported intensive grassroots engagement and outreach to drive the goals and objectives of its plan-making process. See https://lasafe.la.gov/

Table 1. Results of brainstorming exercise on Future Coastal Outcomes

Outcome Category	Brainstorming Results
Population mobility/ characteristics	Education, Resources to relocate, Population, Mobility cost, Social organization, Mobility self-selection, Age, Inter-generational mobility, Population age groups, Educational attainment, Race & ethnicity, Family structure, Social networks valuation, Migration, Geography of population loss/growth by income
Income & employment	"Just transition", Income, Income polarization, Poverty, Low income, Social inequality, Livelihoods, Wages by sector, Income distribution (including % in poverty), Vulnerability hot spots, Unity of vision, Inequity, Neighborhood level equity, Injustice, Community resilience, Unemployment rate, Employment to population ratio, Trapped populations
Business	Working coast needs, Economic development benefits through restoration economy, Employment, Local hiring, Workforce training, Jobs by industry sector, Number of establishments by industry sector, Clean energy as an economic stimulus, Future industry development/growth, Natural resource dependence, Business assets – structures by type, equipment, inventories
Access to services	Access to water, Food security, Healthy food & urban agriculture, Trade-offs: efficiency v. equity, Housing accessibility, Disruption, Location (people), Distance traveled to amenities, Place, Distance traveled to work, Access to healthcare, Access to public health, Location of support infrastructure, Disruption, Location, Access to social services, Evacuation, Reactive services – Emergency management, jails, Education – Community colleges, Health outcomes, Equal resources
Infrastructure	Transportation availability/cost/efficiency, Public infrastructure – roads, bridges, public buildings, Broadband & communications, Maintenance costs, Education infrastructure, Communications infrastructure, Transportation infrastructure, Quality of storm infrastructure, Clean energy for all, Infrastructure planning that recognizes climate realities, Equal access to quality & efficient infrastructure, State & federal support in planning and maintaining infrastructure
Housing	Housing quality, Housing stock including rentals, Property values (house prices), Geography of real estate speculation, Property abandonment, Foreclosure rates, Changes in real estate value, Residential property, Property rights, Housing needs across risk levels, Loss of tax base
Governance	Access to finance, Political units (geography), Governance, Fiscal dynamics, Managed retreat $, Lack of federal funds, Redistricting, Non-profit capacity, Tax revenue, Political structure
Culture/environment (quality of life)	Avenues for participation, Cumulative toxicity, Non-flood risk, Neighborhood interdependence, Place-based goals & objectives, Cultural values, Wildlife protection, Sense of place, Historic building preservation, Access to outdoor recreation, Environmental quality, Coastal access

After identifying the outcomes that could potentially influence coastal planning, participants were asked to brainstorm the expected drivers of social and economic change over the next 50 years. Drivers aligned in the following categories: policies regarding allocation of resources; other policies; access to capital; business/employment trends & transitions; governance & civil society; community dynamics & preferences; and climate & environment (Table 2).

Table 2. Categorization of the Drivers of Change in Community and Economy

Driver Category	Brainstorming Results
Policy - $$	Federal funding levels/appropriations, Support for affordable housing, Carbon tax/carbon credits, Access to federal money (e.g. HMBG), and Revenue streams i.e. property tax, State incentives, Local gov't incentives, Fed disaster relief funding, NFIP/CRA, Flood insurance (NOT NFIP), NFIP, Federal taxes/policy changes
Policy – other	Continuing criminal justice reform, Political will/pressure, Change in federal flood policy, Tax & health policy, Policy framing, Increased insurance, Land use regulations, Eminent domain, Regulatory changes, Building codes, Easements, Public trust doctrine, Condemnation, Zoning, Setbacks, 2020 election, State/local economic development strategies, State & local tax policy environment
Access to economic resources	Venture capital, Credit rating, Credit risk, Access to capital, Attract private capital, Availability of insurance
Business/Employment trends & transitions	Future of work, Industry change, Retraining workforce, National/global industry shifts, Private sector locations, Oil & gas forecast v. overseas, Natural gas, LA firms get access to restoration & water economies, Natural resource availability/distribution, Private sector cooperation, Workforce training, Higher education, Market failures, Macroeconomic factors (external to Louisiana – seafood imports/prices, oil and gas), Financialization, Agriculture trade, Economic trends, Technology/innovation, Job access, Oil/gas stocks; oil/gas prices, Public transit investments, Success getting emerging economies into school system, Energy mix & transition, Spillovers & multipliers, Uneven economic geography, Aging infrastructure, New technology: microgrids, Autonomous vehicles, Trend toward independent contractors, Automation in industry
Governance & civil society	Litigation, Professional commitment and competency, Professional liability/standards, Voting rights/rates, Governance, Trust, Systems failure, Citizen activism, Stakeholder engagement, Engaged scholarship, Regionalism vision and leadership, Capacity to address systemic racial inequalities, Capacity to transition LA economy, Feds/states "giving" roads to locals, Regional cooperation, Brave and honest legislation/government, Social media, +/- civic engagement, Government follow through on stated plans, Consistent, aligned government action to address environmental change, Lobbying/advocacy, Stakeholder engagement, Marketing
Community dynamics & preferences	Intentionality, Risk analytics, Plan integration, Implementation of Coastal Master Plan, Gentrification tipping point, Attractiveness of other regions, Mortgage access and terms/blue lining, Public health services accommodate migration & resource shifts, Services availability, Account for equity, Migration/mobility trends, Ambition, Faith, Birth rate, Income, Cultures of risk assessment, Land market valuation/governance, Familiarity, Community embeddedness, Successful migration, Urbanization, Social mobility, Aging of population, Acceptance of risk, Demographic changes, Access to low risk (flood & environmental) housing, Cultural values, Health & well-being, Illness, Hunger, Acceptance of risk, Performative analysis/projection, Incorporate SoVI into C/B analysis, Longitudinal data, Risk disclosure, Risk awareness, Housing stock, Demographic shift in population, Generational trends – mobility, behaviors, Social networks, Removing prejudiced valuation of assets
Climate & environment	Storm events, Climate adaptation progress v. mitigation, Solar rates, Translation, Access to relevant science, Reliable data, Research partnerships, Disruptions (flood, recession), Access to clean drinking water, Heat/cold, Wet/dry, Disasters, Extent of sea level rise/subsidence, Temperature increased (extremes), Change in storm frequency and severity, Multiple impacts of climate change

Potential Approaches

Louisiana is not the only area facing change and planning for the future. One of the aims of the workshop was to gather ideas that are being tested or applied in other areas, and the experts engaged in that work.

New Concepts and Ideas

Workshop participants shared new ideas, approaches and findings through rapid-fire presentations. Brief summaries of key points are included below.

Astrid Caldas: Mapping Chronic Inundation

- Union of Concerned Scientists has mapped chronic inundation (at least 26x/year due to high tide alone) for the entire lower 48 coast of the U.S.
- Uses information from tide gauges, sea level rise projection, digital elevation models and property data from Zillow[3]
- An interactive map allows the user to see predictions for area to be inundated, the number of homes at risk of chronic flooding in 2045 and 2100, their current worth, the population impacted, and their contribution to the local tax base

Sam Medlock: Risk Analytics, Risk Transfer & Accessing Capital for Resilience

- Federal policy is shifting greater responsibility to state, local, tribal and territorial governments and prioritizing private sector engagement
- Municipal credit rating agencies are integrating climate resilience into their factors (liquidity, tax value, planning, land use, deferred expenses) impacting the cost of capital
- More than half of large U.S. cities are heading to capital market for climate action
- Investors prioritize sustainability, resilience and equity

Craig Colten: Historical Analogs and Adaptive Transitions

- Typically, adaptations are time & place dependent, but for a comparable situation, examples can reveal how adaptations work
- Adaptations are often single purpose but need to be considered as parts of longer transitions
- Sometimes adaptations work against each other. Not all adaptations are successful – some are deleterious

Matt Hauer: Population Projections for U.S. Counties by Age, Sex and Race

- Complete set of county-level population projections for 2020-2100 by: 18 five-year age groups (0-85+), Male/Female, and 4 race/ethnic groups (White NH, Black NH, Other NH, Hispanic)
- Complete ex-post-facto analysis of the error
- Data is freely available.[4]

Susan Cutter: Moving from Vulnerability Indicators to Community Resilience Indicators

- Reframe resilience concept to include all of its capitals/domain areas (*natural, infrastructure, political, social, economic, human well-being*) and their interactions
- Develop baselines for measuring existing assets, capacities and processes, monitor and adjust for interventions, stresses or shocks and predict different outcome scenarios
- Longitudinal and spatially-explicit data to monitor change over time and across space is especially important

John Cooper: Evaluating Networks of Plans Using a Resilience Scorecard

- Communities adopt a plethora of plans that require collaboration

[3] Zillow Transaction and Assessment Dataset (ZTRAX). More information on accessing the data can be found at https://www.zillow.com/ztrax

[4] Population projections for U.S. counties by age, sex, and race controlled to shared socioeconomic pathway. More information on accessing the data can be found at https://www.nature.com/articles/sdata20195

- Mitigation planning often at odds with other plans that influence development, e.g. hazard mitigation, suggests decrease development while comprehensive plan suggests increase development
- Mitigation plans are often short-sighted – looking to build back status quo when status quo isn't equitable

Andrew Greenlee: Predicting Household Movement

- Predict potential location choices for a population of interest using the location choices associated with prior movers as a guide
- Analyze the potential tradeoffs that households are likely to make in selecting a new residential location
- Foundational assumption that households share some level of preference with other households who have similar characteristics

Robby Habans: Variation in Local Economic Change

- Shift-share decomposes raw employment change into Reference Shift (reference region growth), Industry Mix Shift (growth due to changing mix of industry) and Local Shift (residual due to local competitiveness or other contextual factors)
- Economy function of national, industry, local dynamics
- Regional economy has interdependence – and labor market intersects with housing market, etc.

Allison Reilly: Statistical Learning Methods

- A category of algorithms that "learns" from data sets in order to make predictions
- Advantages: suitable for environments that are highly non-linear, fully validated, find relationships that can spur interdisciplinary research
- Requires a "significant" number of observations
- Many models are semi-parametric or non-parametric, making interpretation challenging

Sallie Keller: Harnessing the Power of Local Data

- Repurposing of local, state, and federal data including designed data, administrative data, opportunity data, and procedural data
- Issue: data does not always align with geographies of interest
- Solution: use data direct aggregation. If possible, alternatively develop synthetic information based on data and redistribute
- Synthetic re-distribution based on variables of interest (e.g. multivariate imputation approaches, Iterative Proportional Fitting)

Ideas for Application

Ideas were generated by each participant on what they considered the most promising approaches to applying new concepts and methods to coastal Louisiana. Figure 1 highlights some of the points raised. Several participants noted the promise of combining different approaches to provide a more holistic view of future coastal change.

Figure 1. Initial ideas on how to apply new concepts and approaches to coastal Louisiana

Concept Development

Further discussion of new approaches and ideas highlighted several areas where progress could be made. Notably, the planning framework used in the 2012 and 2017 Coastal Master Plans

applies three tools in project evaluation: scenarios, analytical models, and decision metrics. For this reason, furthering these tools' capacity for addressing equity issues could be an effective and relatively seamless approach to forwarding Louisiana's coastal planning process. This section provides more context on the need for expanding each tool, issues that need to be considered and potential next steps.

Expanding the Use of Scenarios

Background and Context

The Coastal Master Plan used three scenarios to reflect uncertainty about future environmental changes and future residential and commercial growth. This approach could be expanded to create additional scenarios for key policy, economic and investment drivers of future social change[5] (Appendix 2). These scenarios could support prediction of the range of effects that economic conditions and policy choices may have on coastal demographics and thus the effectiveness of risk reduction measures.

Precisely predicting future socioeconomic conditions is impractical if not impossible. However, it is possible to identify some drivers and future scenarios that would affect Louisiana's population growth patterns and risk exposure. Policy, economy and investment practices are three main areas that could be the foundation for future scenarios, although others might be identified.

- **Policy**: local, state and federal policy influence where people live, how much they pay in insurance, economic activity and who pays at what cost to reduce risk and provide recovery resources after a disaster
- **Economic**: both national, state and local economic trends can impact community dynamics and funding availability. Regional industry and job availability affect where people want to live, while overall economic growth can affect the funding sources available to shape coastal resilience
- **Investment**: capacity to attract and absorb private capital for resilience activities (e.g. insurance and municipal bonds) is driven in part by policy. Private capital also has different implications than public post-disaster recovery funding and may reduce risk over time

For drivers such as these to be used in scenarios that influence planning and analysis, it is necessary to identify how they influence the dynamics of the system. For example:

- If the Louisiana oil and gas economy declines, then:
  - Louisiana loses $x of GOMESA funding to support restoration
  - # of residents lose employment and may relocate
- If receiving communities begin planning for growth, then:
  - Affordable and low-risk development can be ensured in target communities
  - Infrastructure can be adequately designed for population growth
  - Areas for potential growth can be protected from industrial pollution

[5] For example, the U.S. Energy Information Administration's Annual Energy Outlook includes different futures under different price/policy combinations. (See https://www.eia.gov/outlooks/aeo/ppt/aeo2019.pptx. The full Annual Energy Outlook is available at: https://www.eia.gov/outlooks/aeo/)

- If the National Flood Insurance Program is reformed, then:
    - # homes in a community are rendered no longer valuable
    - Tax base in community is reduced, municipal credit rating may decline reducing capacity to access private capital
    - Future development will be constrained by actuarial risk

Further examples of potential drivers and ways they can vary across scenarios are included in Appendix 2.

Key Issues and Challenges

- Scenarios must consider multiple levels of policy intervention (local, state, and federal) and must also consider that different interventions could result in different benefits; some may reduce overall risk, whereas others could reduce overall cost
- While some drivers such as the national economy are outside of the control of local stakeholders and decision-makers, understanding them is still important for predicting future changes in Louisiana. Other drivers that can help local communities reduce risk are within local control, such as consolidating government, changing local zoning, and strengthening building codes
- The scenarios could help to make an economic case for policy reforms that position the region to take advantage of certain investment opportunities. For example, through the planning process, these scenarios could help policymakers understand the economic and resilience effects of implementing or not implementing building code or land use policies
- Identifying the appropriate drivers to include in scenarios and understanding their effect on the Coastal Master Plan modeling and regional resilience will require research and discussion. It could be informed by community engagement to more fully understand whether/how the responses within the system would manifest (NASEM, 2019). Dialog with modelers (see Modeling section) would also be necessary to ensure that the changes affected by the drivers can be reflected in the models and that model results are sensitive to changes in the drivers
- Note that while the use of scenarios provides insight into uncertainty bounds, uncertainty in model outputs will still be present

Proposed Approach

For scenarios to guide planning, they need to be integrated into the overall planning framework. Three steps are proposed:

1. **Identify potential drivers.** Additional discussion is needed to expand and validate the drivers. Such a discussion could utilize small groups to identify additional drivers and to develop solid reasoning for relationships between drivers and resulting change. Ultimately drivers used must have well defined links to their consequences in order to be usable
2. **Refine based on model/decision framework.** It is important to articulate the drivers in a way that can be used in the modeling or other aspects of the decision framework. Understanding how the drivers can be reflected in the analysis will require interaction with modeling teams and iteration. This will lead to refinement of some of the relationships between the drivers/consequences shown in Appendix 2. Some drivers may influence other aspects of the planning process; for example, change in a driver that influences the availability of funding could make more/less funding available for

different implementation periods. In the 2017 Coastal Master Plan, funding is a constraint that is applied for three separate time periods. The "stream" of funding could change for different scenarios

3. **Test.** Adding new scenarios makes communication with the public about the development of plans more challenging; thus, it is important that scenarios implemented actually influence plan development in meaningful ways. Testing the sensitivity of model outputs (e.g. risk) and population migration (assuming model expansion beyond the existing approach – see next section) to scenario drivers and how their range is characterized enables the development of scenario assumptions that steer the planning effort variously. For example: what are the plausible changes in NFIP, how much would they each impact the value of residences within coastal communities, and what difference does that make in future damage or migration estimates?

Modeling Future Demographic and Economic Conditions

Background and Context

A dearth of proven tools hindered CPRA's ability to take into account projected demographic and social characteristics when assessing the effectiveness of future coastal restoration and risk reduction projects. Indeed, while a variety of demographic and economic models of climate-change migration exist, an integrated approach at an appropriate scale for planning has yet to be identified.

Key Issues and Challenges

Robust models of climate-change driven demographic change have been developed for states along the Gulf and Atlantic coasts (Hardy and Hauer, 2017). These models rely on the theoretical framework of demographic metabolism, which argues that demographic characteristics can be reliably forecasted by adjusting for birth, deaths, and migration. Age, gender, race/ethnicity, and even educational attainment are established at a young age (for example, educational attainment is often established by age 25). In addition, socio-demographic changes such as mobility and earnings are embedded in the age-structure; for example, likelihood of relocation declines with age. Using such models, the demographic make-up of future generations can be forecasted at sub-county scale with a good degree of reliability (Hauer, 2019). However, modeling how many people will migrate, how departures are tied to disruptive events, where they will resettle and who will be left behind could benefit from further refinements.

Qualitative research in coastal Louisiana has uncovered trends that hew to demographic research with younger people, leaving at-risk areas and older people remaining as long as possible (Colten et al 2017). Certainly, push factors such as land loss, severe weather events and frequent flooding may all trigger additional migrations. Projections, at sub-county scale, of populations in at-risk areas could be improved through greater understanding of how households respond to push factors including incorporating qualitative and quantitative research on critical tipping points (such as repeat flooding and loss of septic-system viability) and the role of local social networks in modulating that response. Importantly, models should distinguish between local mobility within the same labor market and regional migration to new labor markets.

Migration itself can also contribute to changes in wage rates and housing prices in both at-risk and receiving areas. These effects, in turn, may influence migration decisions (Fan et al, 2018).

Some research suggests that climate push factors have resulted in the migration primarily of middle-income households out of at-risk areas, while higher-income households that can self-insure. In addition, lower-income households remain due to financial limitations, or even move into risky areas as housing prices fall (Smith et al, 2006). As population thins, the tax base and local government's capacity to provide services including future storm protection may be impacted. Fewer government services, in turn, may trigger additional migrations. These dynamics are important to consider when projecting future settlement patterns for coastal Louisiana.

In addition, an important consensus from the workshop was that planning for both at-risk and receiving communities will be essential for increasing equitable outcomes. Some migration models predict that populations will move to destinations in proportion to recent historical migration flows (Hauer, 2017). While social networks may make such flows the preferred routes for many migrants, increasing housing prices may serve as a barrier in these destination locations (Fan et al., 2018). Moreover, equity issues in receiving and at-risk communities may be exacerbated by transportation costs. Movers who seek out more affordable housing options often fail to adequately account for greater transportation costs associated with commuting from more affordable yet distant locations (Greenlee and Wilson, 2016). Longitudinal business establishment data paired with employee residential patterns offers the possibility of new knowledge about changing business location decisions along the coast and changes in commuting patterns over time.

While opportunity exists to make progress in this area, model integration is challenging. Integration methods have been in existence for some time, and the current Coastal Master Plan approach uses elements with rich data sets and analyses that can be conducted at similar spatial scales and where the links and feedbacks among elements are somewhat established (e.g. a surge model may report 3' of water, and from that, a reasonable estimate for housing damage can be made). For the new approaches described here, spatial resolution may be a limiting factor to integration as well as the need to reflect complex interactions and feedback between economy and society.

Proposed Approach

The approaches identified focused primarily on improving existing models or proposed research.

1. Projections of total population could be developed in a general framework that accounts for major drivers of population and the regional economy. Models of projected characteristics of age, gender, race/ethnicity, and educational attainment at sub-county scale could be very valuable in increasing equitable outcomes of the prioritization of flood-risk reduction projects in Louisiana. Current migration models could be improved with the integration of migration data that more fully reflects low-income households' social networks (e.g. HUD and USDA migration data in addition to IRS migration data) as well as more nuanced data about projected chronic and acute flooding events. Local research on perceptions of risk and decision-making processes of those who have moved would improve understanding of migration triggers.
2. A future projection of economic activity should also be created within a general framework that is sensitive to aggregate economic trends and workforce availability. Historical sub-

county business establishment data could be used to generate job projections controlled by state-generated regional area job projections. Such projections could be paired with small-area commuter patterns represented in employee residential patterns[6] to project the distances that coastal workers may commute in the future. Specific modeling techniques would need to be identified or developed.

These models will be valuable for increasing equitable outcomes of planning efforts for both at-risk communities and receiving communities. Identification of low-risk, likely receiving communities and identification of policy drivers to maintain or generate affordable housing in these communities will be critical to ensuring vulnerable populations can resettle without exacerbating inequities. Moreover, this information can be used to plan for needed infrastructure and services in receiving communities and can help communities prepare for the benefits and challenges of the impending influxes.

New Metrics to Inform Flood Risk Reduction Decisions

Background and Context

It is widely recognized that social impacts of hazard exposure including coastal flooding often fall disproportionately on society's most vulnerable populations (Emrich & Cutter, 2011). Furthermore, analysis has shown that minority populations in Louisiana may be more exposed to flood risk (Colten et al., 2017; Dalbom et al., 2014). For social justice to be considered, coastal adaptation planning must assess demographic and social characteristics of residents such as age, gender, race, socioeconomic status and special needs populations, including the disabled.

The 2017 Coastal Master Plan uses reduction in expected annual damages (EAD) as the main decision driver for flood risk reduction projects. Damages are based on the probability distribution of flood depths (based on tropical cyclone events) and the depth-damage relationship between flood depths and the extent of damage to assets (Fischbach et al., 2017). Some of the costs experienced by those using the assets such as lost income, lost wages, lost sales, disruption costs, relocation rental costs are included as part of the asset damage values. A variety of additional factors need to be considered in order to increase equitable implementation of risk reduction projects – for example, EAD could be calculated as a proportion of a property's value, and the number of people impacted could be included as a metric. The challenge is to identify available data and techniques that can be used to quantitatively assess how flood risk reductions affect outcomes other than just reducing economic damages[7].

Key Issues and Challenges

- **Data Sources**: use of publicly available data (e.g. U.S. Census, American Community Survey) allows consistent application across geographies. However, issues arise in relation to temporal and spatial resolution; for example, the census is decennial and the ACS relies on sampling and reports at the census tract and block group levels. An active

[6] Such as, from the U.S. Census Bureau's Longitudinal Employer-Household Dynamics

[7] Scholars in other fields, such as tax policy, employ Social Welfare Functions to determine policies' effects on health, longevity and income (Adler 2008).

data discovery process could explore sources of data including other 'designed' data collection[8] (e.g. state level data assets), administrative data (e.g. local tax and property assessments), opportunity data (e.g., local social media), and procedural data (e.g. local policies and governance actions) (Keller et al., 2018).

- **Spatial Resolution**: the spatial resolution of the data and derived metrics should be appropriate to both the decision they are expected to inform, and other key inputs to that decision. For the Louisiana Coastal Master Plan, flood depths are calculated at the census block or $1km^2$ resolution (whichever is finer). Imputation or other techniques for adjusting resolution or ensuring consistent coverage (e.g. generating synthetic data) can be used.
- **Indices vs. Individual Variables**: the Louisiana Coastal Master Plan has used a series of index metrics in previous work, and indices such as the SoVI (Emrich and Cutter, 2011) have proven useful in presenting a multidimensional view of the factors influencing vulnerability. However, indices may compress important information and limit decision-makers' ability to identify what is and is not being addressed (or who is and who is not benefiting). On the other hand, a potential disadvantage of expanding the number of metrics is that decision-makers may be selective in which ones they use to justify a decision. Louisiana should be cognizant of this as it moves forward.
- **Responsiveness to Changing Flood Risk**: to be useful to a planning process, metrics must be sensitive to changes over time (e.g. in economy or population distribution) and responsive to measures that are being evaluated. For household or community-based metrics in Louisiana, the mechanistic relationship between the metric (or one or more of its component variables) and coastal land loss and/or flood depths should be well understood and preferably quantifiable.

Proposed Approach

The approach identified could be applied to a number of different aspects of community resilience including, for example, the six capitals: natural, built, financial, human, social, and political (NASEM, 2019). Key elements of the proposed approach include broad based data discovery, stakeholder input/feedback, and testing of metric performance vs. existing tools (Keller et al., 2017).

1. **Initiate active data discovery.** This step could be focused on particular issues related to equity and social justice (e.g. wage and non-wage income distribution, poverty rates, education levels, share of population on disability, % senior citizens, etc.) and address what data could be useful and why, what data is available, and what could be accessed.
    a. *Who should be involved?* The core group would be researchers, local governments and others who generate or use. There also needs to be a process for stakeholder input on what is important to communities.
    b. *What is produced?* A list of data sources appropriate for the topical domain including an initial assessment of strengths, weaknesses, gaps, challenges and access issues.

[8] Designed Data are generated in the pursuit of scientific discovery. Designed data include statistically designed data collections, such as data generated from surveys, experimental designs, registries, and intentional observational collections (Keller et al., 2017)

2. **Develop and test metrics using data reflecting current conditions.** While the overall goal is to develop metrics that reflect the future condition of coastal communities, tests should be conducted with current data. If a metric does not perform well (i.e., is insensitive to spatial patterns, provides few insights beyond existing metric) then it is unlikely to perform well with future data. To the extent possible, tests could be conducted with current and recent past data to assess the metric's accuracy in reflecting a changing coast.
    a. *Who should conduct the work?* A small team of researchers working with decision-makers or their representatives undertaking the detailed analysis with periodic input and feedback from the data discovery team.
    b. *What type of activities are included?* The research team will consider and test methods to adjust spatial/temporal resolution, evaluate options for composite index development (including weighting, how variables are combined, etc.) The data discovery team will be asked to provide feedback on different approaches.
    c. *What is produced?* A varied set of candidate metrics that reflect different aspects of the capital/domain of interest.
3. **Compare/combine metrics to current approach.** The research team will explore how the candidate metrics perform in comparison to existing metrics. This step may involve combining existing metrics such as EAD into a composite or parsing the calculation of EAD (i.e., expected annual damages for communities with certain characteristics). The potential user of the metrics (e.g. CPRA) should be engaged with the Research Team on this step in order to focus on areas of interest, and to test sensitivity to decisions.

Summary/Concluding Thoughts

The 2012 and 2017 Coastal Master Plans established a way of thinking about the future of coastal Louisiana based on the application of science and across a range of potential futures. This foundation provides both an opportunity and a challenge for incorporating social and economic aspects of the coastal system into the planning process.

Workshop discussions revealed a number of important issues:

- Experts are enthusiastic about the opportunity to enhance the approaches used in coastal planning in Louisiana and to see several potential openings where new ideas could be brought to bear in improving tools.
- There is already progress in many systems using population prediction, data repurposing and integration, advanced statistical techniques, and other strategies to consider future coastal conditions in ways that are relevant to decision-makers.
- There are available data of many types and from diverse sources which can be leveraged to support advances in predicting social and economic aspects of coastal change.

The concepts developed in the workshop, and for which potential next steps have been proposed, address scenarios, modeling and metrics. These are three elements of the existing planning framework used in Coastal Master Plan analysis (Figure 2). Because these elements interact as part of the planning framework — with scenarios providing boundary conditions for models that provide inputs to metrics — their further development would need to be conducted interactively. Determining how to utilize policy and economic scenarios relies on the models' ability to incorporate the scenarios' effects on socio-economic dynamics. Similarly, adjustments in metrics require that information is generated by models that can be used in metric calculations. However, some testing of approaches for scenarios and metrics may be possible before modeling tools have been fleshed out.

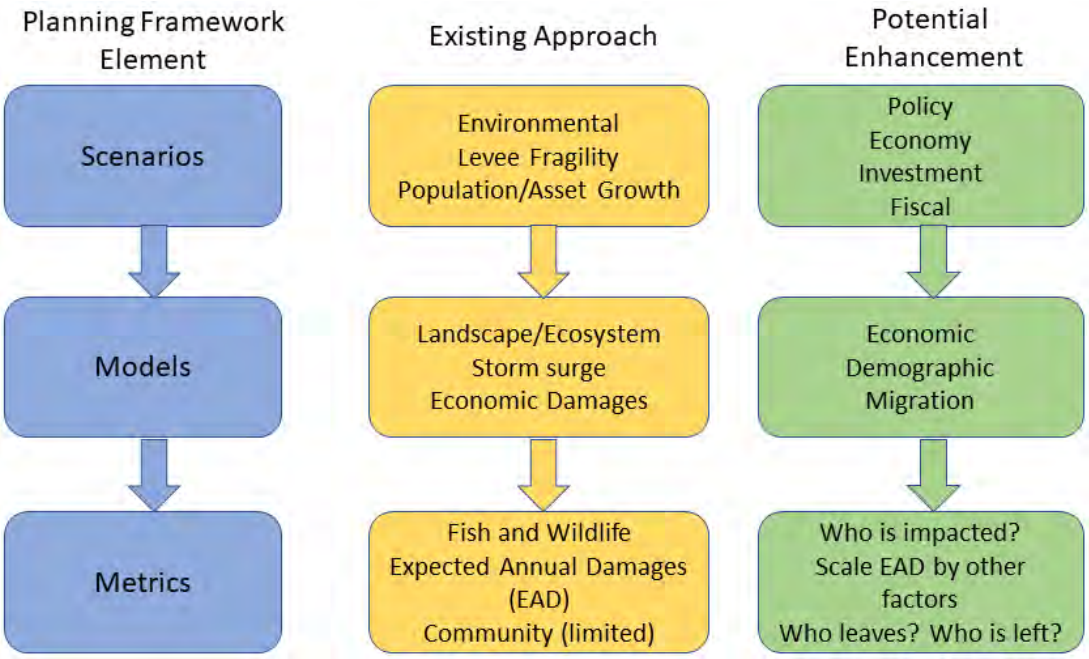


Figure 2. Illustration of how concepts proposed mesh with the existing planning framework

The current master plan process thinks 50 years into the future but is updated every five years, providing an opportunity for enhancements in the approach as tools and methods improve, and strengthening the planning process over time. Making predictions about highly uncertain factors 50 years into the future is a challenge when there are emerging issues such as the "future of work," and rapid technology development, such as autonomous vehicles, that can dramatically change future infrastructure and work. However, models and approaches will always be improving and responding to knowledge development and increased understanding. The coastal master plan process in Louisiana has already demonstrated this through the great improvements made in landscape and ecosystem modeling between the 2012 and 2017 plans. That tools are currently imperfect and processes somewhat uncertain are not legitimate reasons for delaying progress in broadening the consideration of economic and social aspects of the coastal system in future planning efforts.

Notably, the tools proposed here could be used for a variety of planning purposes beyond Louisiana's Coastal Master Plan iterations. These tools could be used by FEMA, the U.S. Army Corps of Engineers and other decision-makers who largely prioritize flood risk reduction decisions based on economic damages. Moreover, many of these tools could be used by communities to expand upon the work of LA SAFE for resilience measurement and planning at a local scale (NASEM, 2019). With so many potential uses, the benefit of developing these tools could be significant.

References Cited

Adler, M. (2008). Risk equity: A new proposal. *Faculty Scholarship at Penn Law. 150.* Retrieved from https://scholarship.law.upenn.edu/faculty_scholarship/150/

Colten, C. E., Simms, J. R., Grismore, A. A., & Hemmerling, S. A. (2017). Social justice and mobility in coastal Louisiana, USA. *Regional Environmental Change 18*(2), 371-383.

Cooper, J. A. G., & McKenna, J. (2008). Social justice in coastal erosion management: The temporal and spatial dimensions. *Geoforum 39*(1), 294–306. https://doi.org/10.1016/j.geoforum.2007.06.007

Dalbom, C., Hemmerling, S. A., & Lewis, J. (2014). Community resettlement prospects in southeast Louisiana: a multidisciplinary exploration of legal, cultural, and demographic aspects of moving individuals and communities. *New Orleans: Tulane Institute on Water Resources Law & Policy, 49p*.

Emrich, C.T., & Cutter, S.L. (2011). Social vulnerability to climate-sensitive hazards in the Southern United States. *Weather, Climate, and Society 3*(3): 193-208.

Fan, Q., Fisher-Canden, K, & Klaiber, H. (2018). Climate change, migration, and regional economic impacts in the United States. *Journal of the Association of Environmental and Resource Economists 5* (3).

Fischbach, J.R., Johnson, D.R., Kuhn, K., Pollard, M., Stelzner, C., Costello, R., Molina, E., Sanchez, R., Syme, J., Roberts, H., & Cobell, Z. (2017). *2017 Coastal Master Plan Modeling: Attachment C3-25: Storm Surge and Risk Assessment*. Version Final. (pp. 1-219). Baton Rouge, Louisiana: Coastal Protection and Restoration Authority.

Greenlee, A., & Wilson, B. (2016). Where does location affordability drive residential mobility? An analysis of origin and destination communities. *Housing Policy Debate 26*(4-5): 583-606.

Hardy, R., & Hauer, M. (2017). Social vulnerability projections improve sea-level rise risk assessments. *Applied Geography 91*: 10-20. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S0143622817309189?via%3Dihub

Hauer, M. (2017). Migration induced by sea-level rise could reshape the U.S. population landscape. *Natural Climate Change 7*: 321-327.

Hauer, M. (2019). Population projections for U.S. counties by age, sex, and race controlled to shared socioeconomic pathway. *Scientific Data*. Retrieved from https://www.nature.com/articles/sdata20195

Howell, J. & Elliott, J. (2018a). As disaster costs rise, so does inequality. *Socius: Sociological Research for a Dynamic World.* Retrieved from https://journals.sagepub.com/doi/full/10.1177/2378023118816795

Howell, J., & Elliott, J. (2018b). Damages done: The longitudinal impacts of natural hazards on wealth inequality in the United States. *Social Problems* spy016. Retrieved from https://academic.oup.com/socpro/advance-article/doi/10.1093/socpro/spy016/5074453

Keller, S., Lancaster, V., & Shipp, S. (2017). Building capacity for data-driven governance: Creating a new foundation for democracy. *Statistics and Public Policy 4*(1): 1-11.

Keller, S., Shipp, S., Korkmaz, G., Molfino, E., Goldstein, J., Lancaster, V., Pires, B., Higdon, D., Chen, D., & Schroeder A. (2018). Harnessing the power of data to support community-based research. *WIREs Computational Statistics.* https://doi.org/10.1002/wics.1426

National Academies of Sciences, Engineering, and Medicine (NASEM). (2019). *Building and Measuring Community Resilience: Actions for Communities and the Gulf Research Program*. Washington, DC: The National Academies Press. https://doi.org/10.17226/25383.

Siders, A. R. (2019). Social justice implications of U.S. managed retreat buyout programs. *Climatic Change 152*(2), 239-257.

Smith, K., Carbone, J., Pope, J. Hallstrom, D, & Darden, M. (2006). Adjusting to natural disasters. *Journal of Risk and Uncertainty 33* (102): 37-54.

Appendix 1. List of Workshop Attendees

Toward Holistic Planning for Community Adaptation on the Louisiana Coast:

Next Generation Tools

22-23 January 2019

New Orleans, LA

Name	**Organization/Institution**
Conveners	
Allison Plyer	The Data Center (New Orleans)
Denise Reed	The University of New Orleans
Participants	
Stephen Barnes	Louisiana State University
Stuart Brown	Coastal Protection and Restoration Authority
Astrid Caldas	Union of Concerned Scientists
Craig Colten	Louisiana State University
John Cooper, Jr.	Texas A&M University
Susan Cutter	University of South Carolina
Lamar Gardere	The Data Center (New Orleans)
Andrew Greenlee	University of Illinois
Robert Habans	The Data Center (New Orleans)
Matt Hauer	Florida State University
Elizabeth Jarrell	Coastal Protection and Restoration Authority
Sallie Keller	University of Virginia
Samantha Medlock	Willis Towers Watson
Allison Reilly	University of Maryland
A.R. Siders	Harvard University
Margaret Walls	Resources for the Future
Supporters	
Liz Williams Russell	Foundation for Louisiana
Steve Cochran	Environmental Defense Fund
Rapporteur	
Liza Cowan	Center for Community Investment

Appendix 2. Examples of Drivers and their Potential Use in Scenarios

Policy Scenario examples

Scenario	NFIP Reform	FEMA AID Reform	Development Regulations	Building Codes	Consolidated Gov / Comm Planning / Region
Low	None	As usual	As usual	Current	As usual
Med	Ins more $$; fewer insured properties;	Less fed $ (hard to rebuild)	Little (e.g. not in 100-yr floodplain)	Int'l Standards	
High	Ins more $$; fewer insured properties	Much less fed $ (harder to rebuild)	No dev in coastal	IBHS fortified	Access capital (engaging markets); Higher capacity to use; More willing to discuss retreat

Economic Conditions Scenario examples

Scenario	US	LOUISIANA
Recession	Much less fed $	Less $ for invest/recovery
As usual	Slightly less fed $	As usual
Growth	Similar fed $ (Fed infra bill?)	More $ for invest/recovery

Infrastructure Investment Scenario examples

Scenario	Development Effects
Build more	More development behind levees
Maintain existing	Continued development behind levees
Disinvest	Reduced development in at-risk areas

Receiving Community Investment Scenario Examples

Scenario	Migration Effects
None	Coastal migration stresses services
Medium	Coastal migration accommodated
High (comm led)	Coastal migration thrives

Municipal Credit Rating Scenario Examples

Scenario	Investment
Weak	Less $ for investment
Medium credit	Similar $ for investment
High credit (take control + manage risk)	More $ for investment