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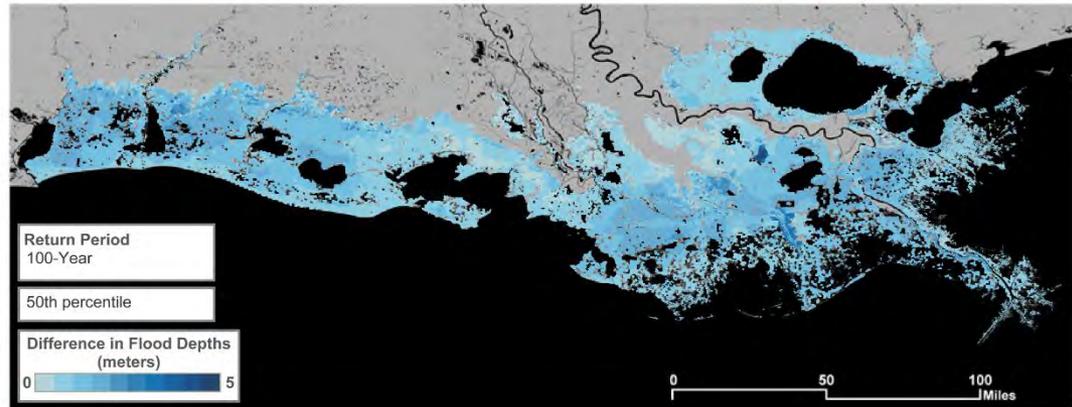
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Adjunct Mathematician
RAND Corporation

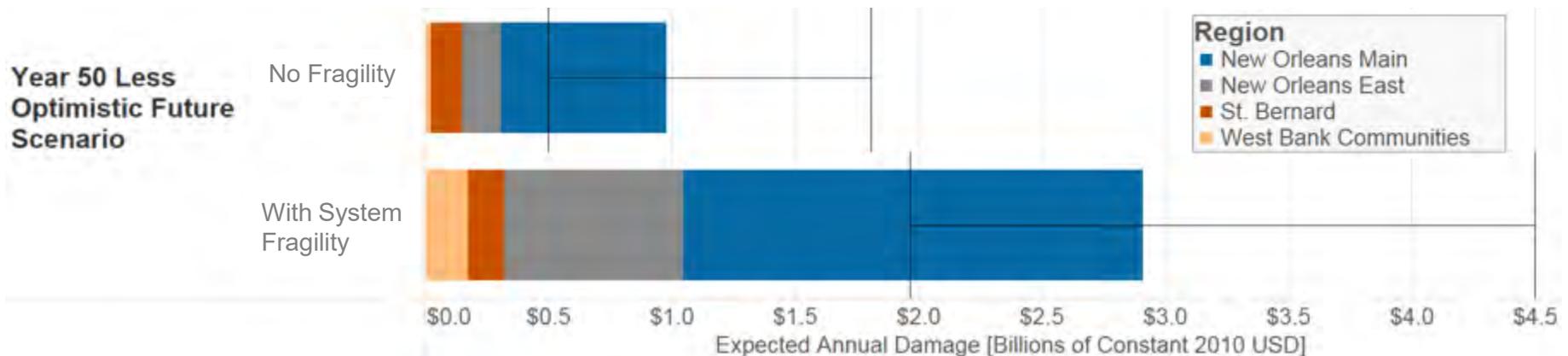
Simulation Modeling for Infrastructure Resilience Policy and Planning under Deep Uncertainty

Working with Louisiana's Coastal Protection and Restoration Authority since 2009 to manage flood risk

- Lead developer of the flood risk assessment model used to evaluate risk mitigation measures for the state's coastal master plan
- Includes levees and floodwalls as well as home elevations, flood-proofing, relocation, and restoration projects

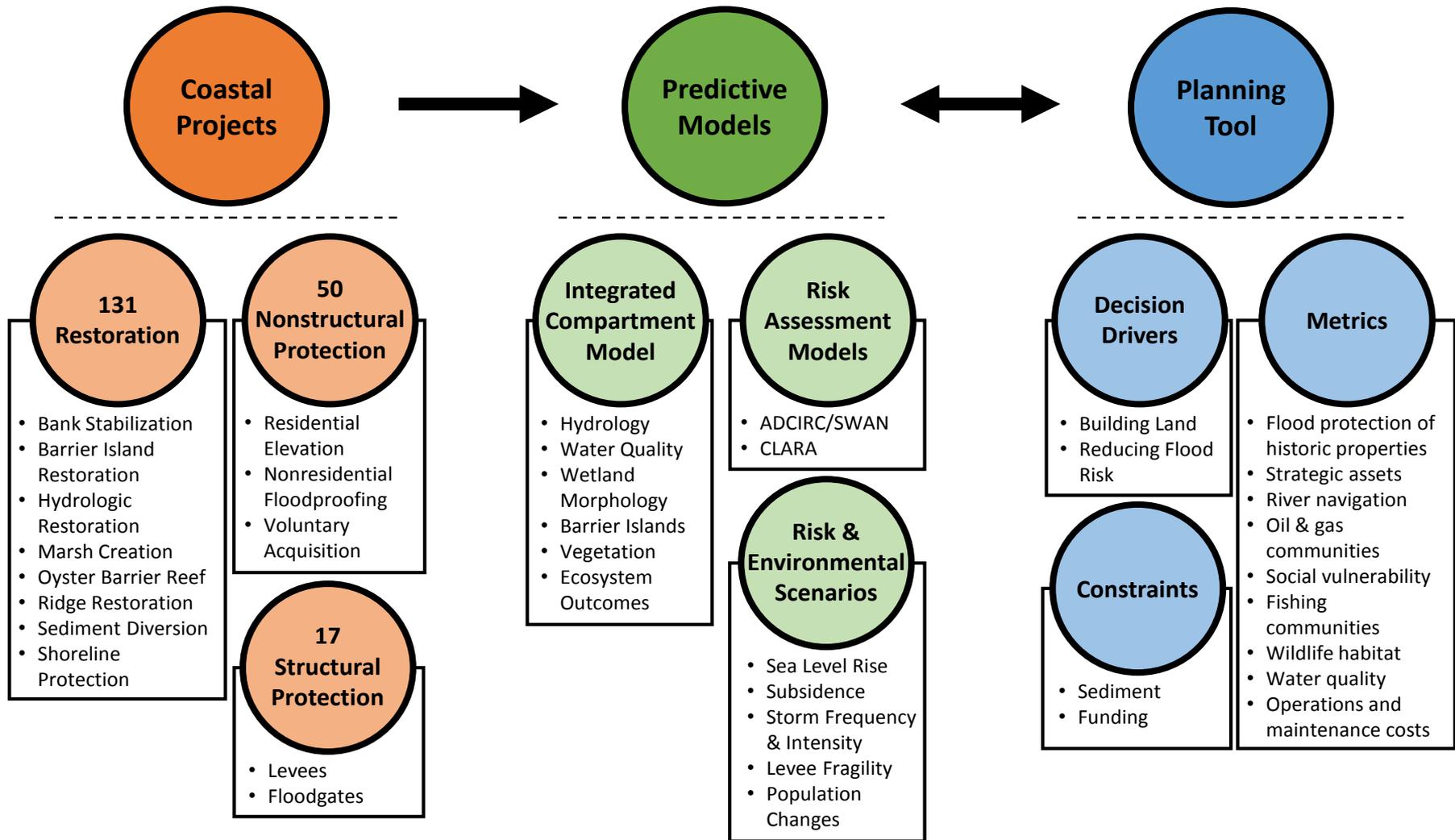


Increase in 100-year flood depths over the next fifty years, assuming high sea level rise, land subsidence, and increased storm intensity



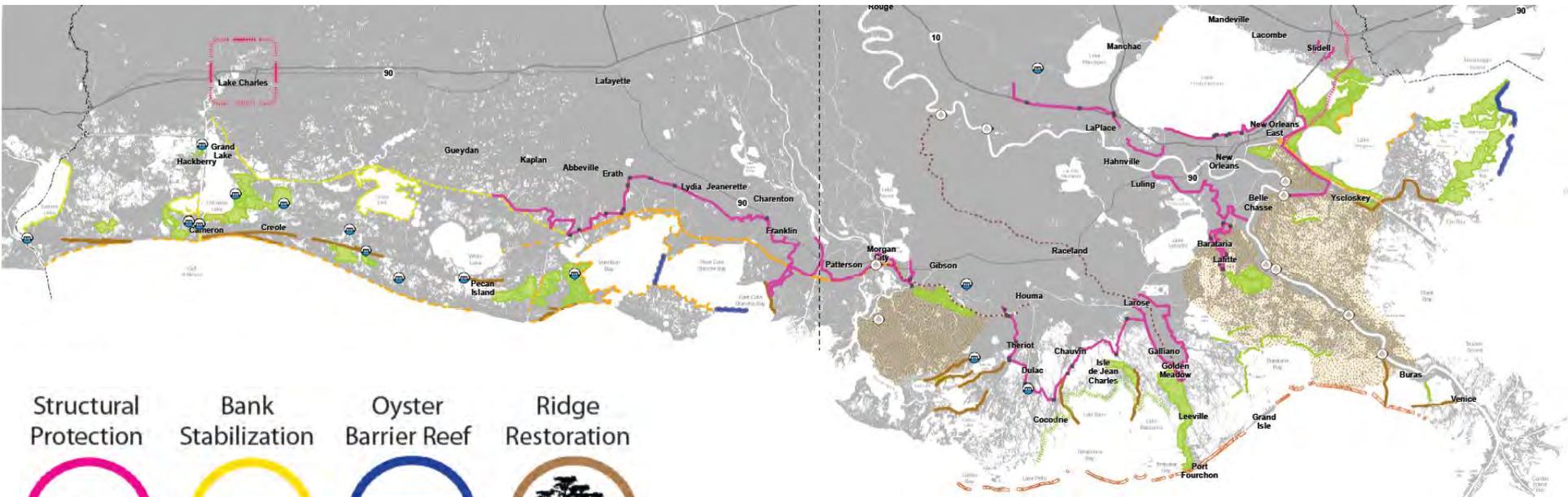
Expected annual damage from hurricanes to New Orleans (projected, 2065), with and without considering levee failures

Integrated Decision Support Systems for Improved Policy Making



Key Finding: comprehensive, objective, scenario-based planning requires considerable effort but helps to eliminate gridlock

Objective Analysis Organically Selects a Coastwide Suite of Varied Projects



Structural Protection



Bank Stabilization



Oyster Barrier Reef



Ridge Restoration



Shoreline Protection



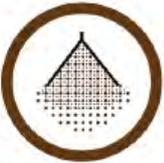
Barrier Island Restoration



Marsh Creation



Sediment Diversion



Hydrologic Restoration



- An iterative process was used to evaluate tradeoffs between metrics and explore the frontier of efficient project combinations
- For example, river diversions were reduced after noting an impact on shrimp habitat
- Results in a 50-year, \$50 billion plan

The CLARA Model Is Used to Assess Risk Impacts Under Future Landscapes

Estimates flood depths across the coast

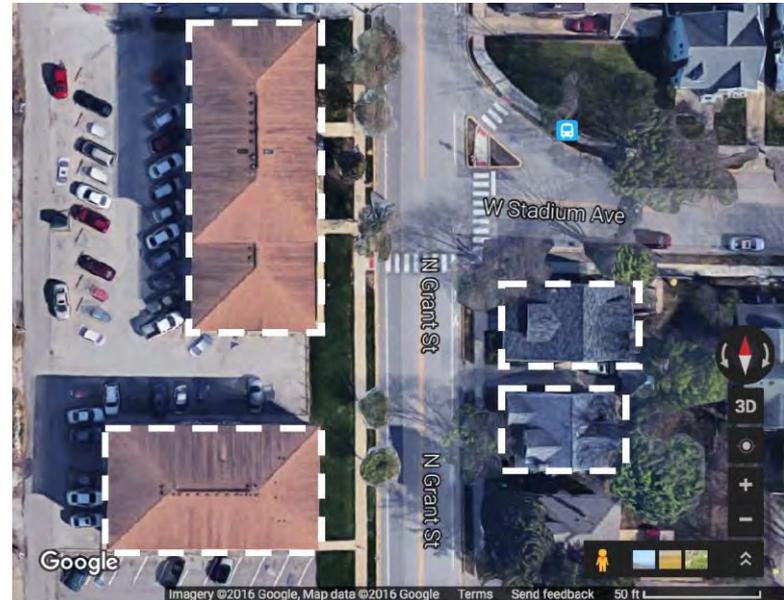


Determines damage to physical assets



- The Coastal Louisiana Risk Assessment (CLARA) model is used to evaluate risk reduction and inducement with various combinations of projects implemented on the landscape
- Includes environmental, operational, and economic uncertainties, as well as failure of protection system elements
- Current conditions and three future time periods
- Key finding from 2017 Master Plan is that coastal restoration projects can have significant positive interactions with risk reduction projects

We Are Using Machine Learning to Develop Automated Tools for Data Collection



- Decision makers are frequently hindered by lack of data about what structures exist
- Leveraging Google Street View, aerial and satellite imagery to catalog the inventory of assets at risk of flooding
 - Using image analysis to extract features that are relevant to flood risk, such as the height of foundations, square footage of footprint, structure type, etc.
- Developing decision support tools to help individual homeowners understand their risk and mitigation options
- Tools will be easily adaptable to other countries with similar construction techniques