2023 COASTAL MASTER PLAN
COMMITTED TO OUR COAST

PREDICTIVE MODELING 101

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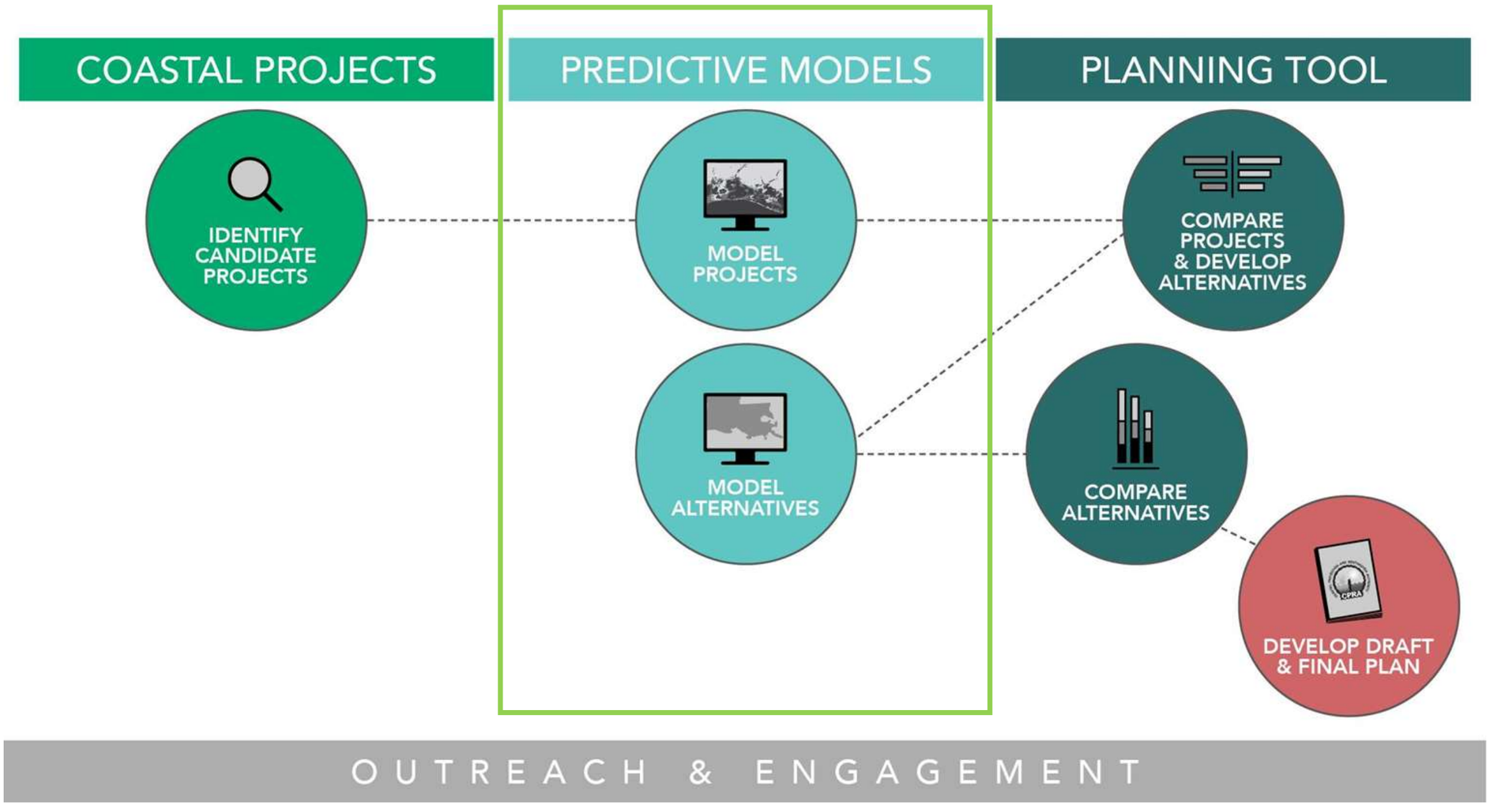
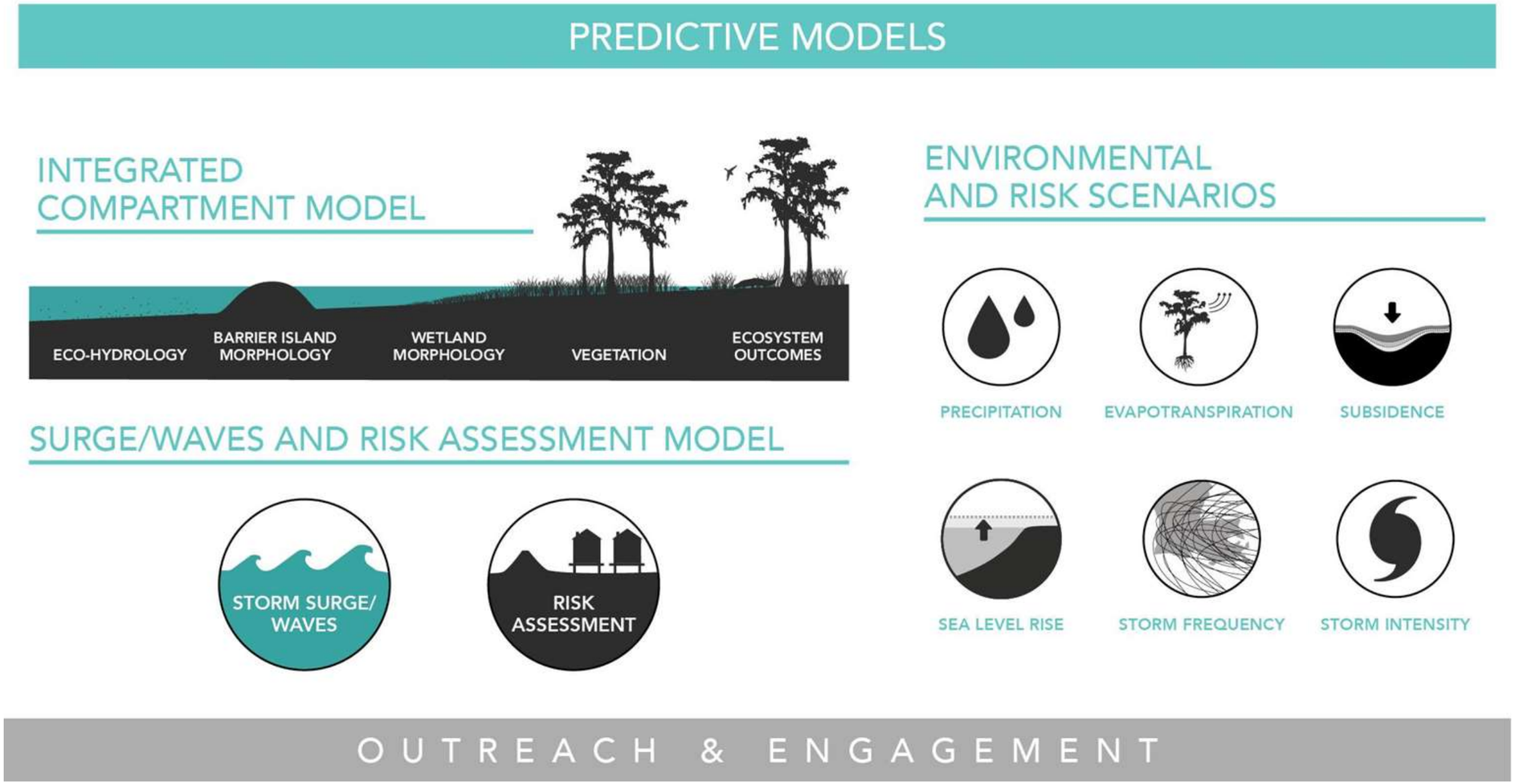
MODELS IN THE PLAN DEVELOPMENT FRAMEWORK

PLAN DEVELOPMENT FRAMEWORK



PREDICTIVE MODELING TOOLS



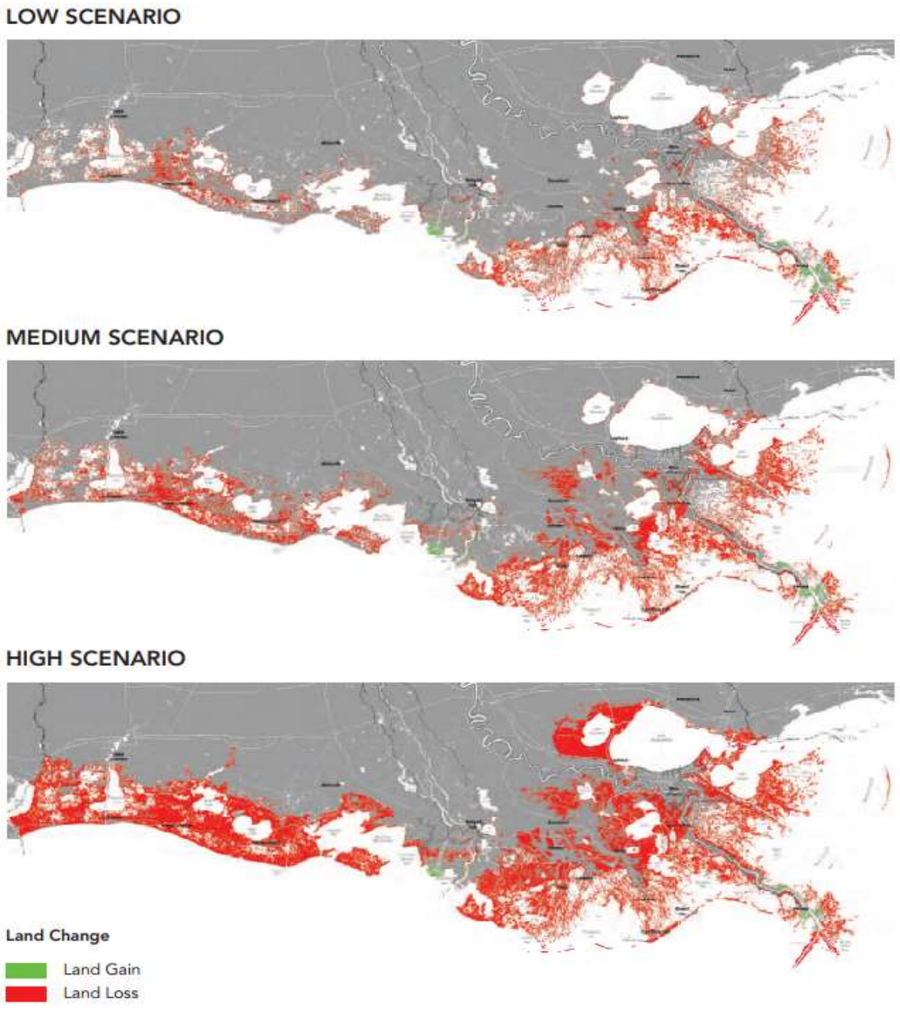
From 2017 Coastal Master Plan

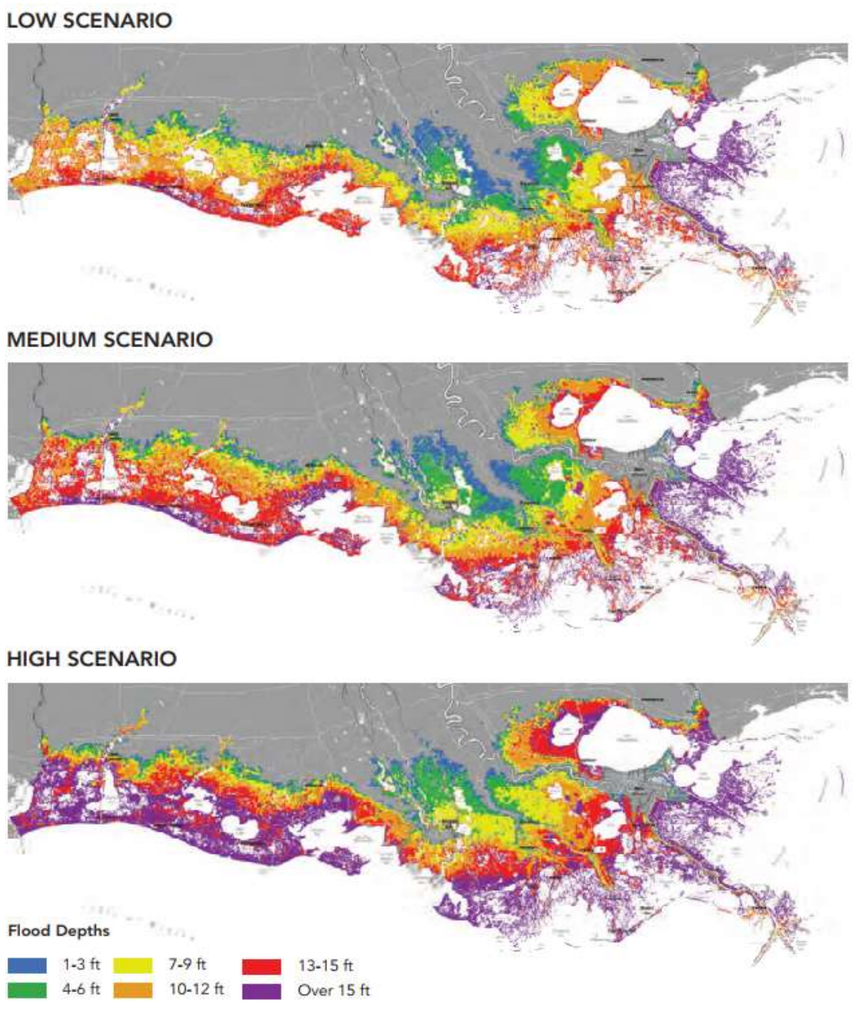
HOW WE USE PREDICTIVE MODELS

- Landscape evolution
  - Causes of future land loss
  - Vegetation and ecosystem changes
- Future risk
  - Frequency of flooding
  - Changes in flood depth
- Project Selection
  - Which projects are effective?
  - Where and when are benefits realized?

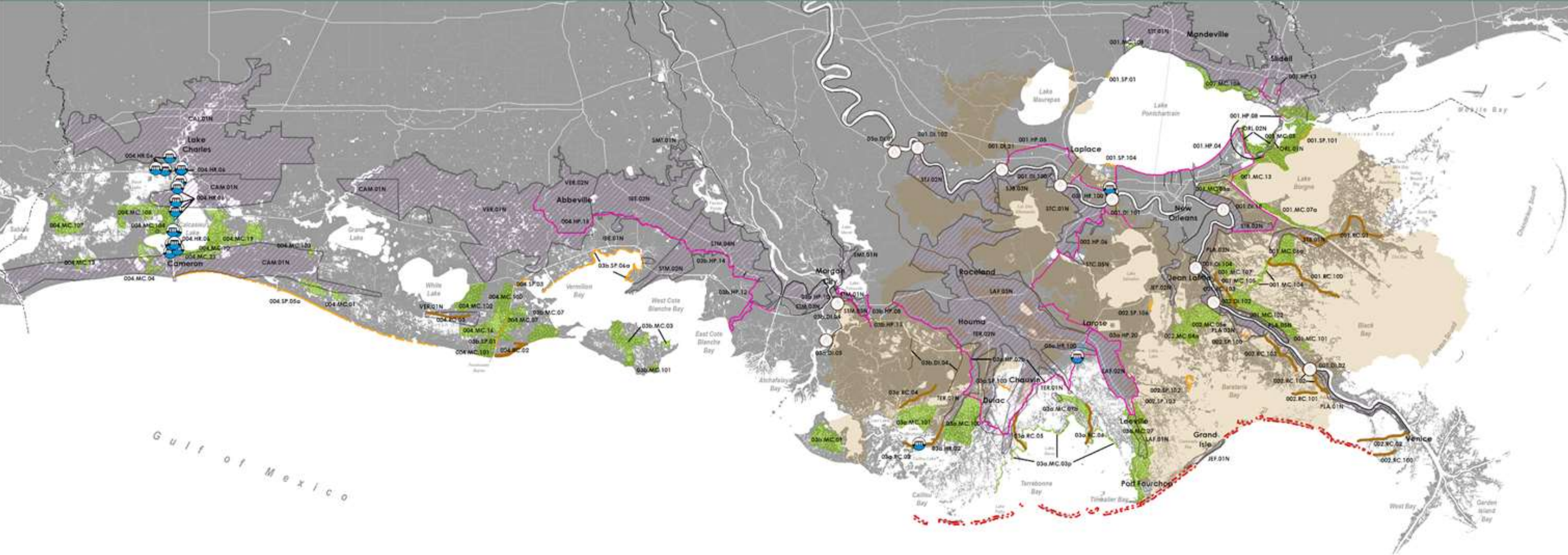
PREDICTING LANDSCAPE EVOLUTION AND FUTURE RISK

2017 COASTAL MASTER PLAN FUTURE WITHOUT ACTION MAPS





From 2017 Coastal Master Plan



PROJECT SELECTION

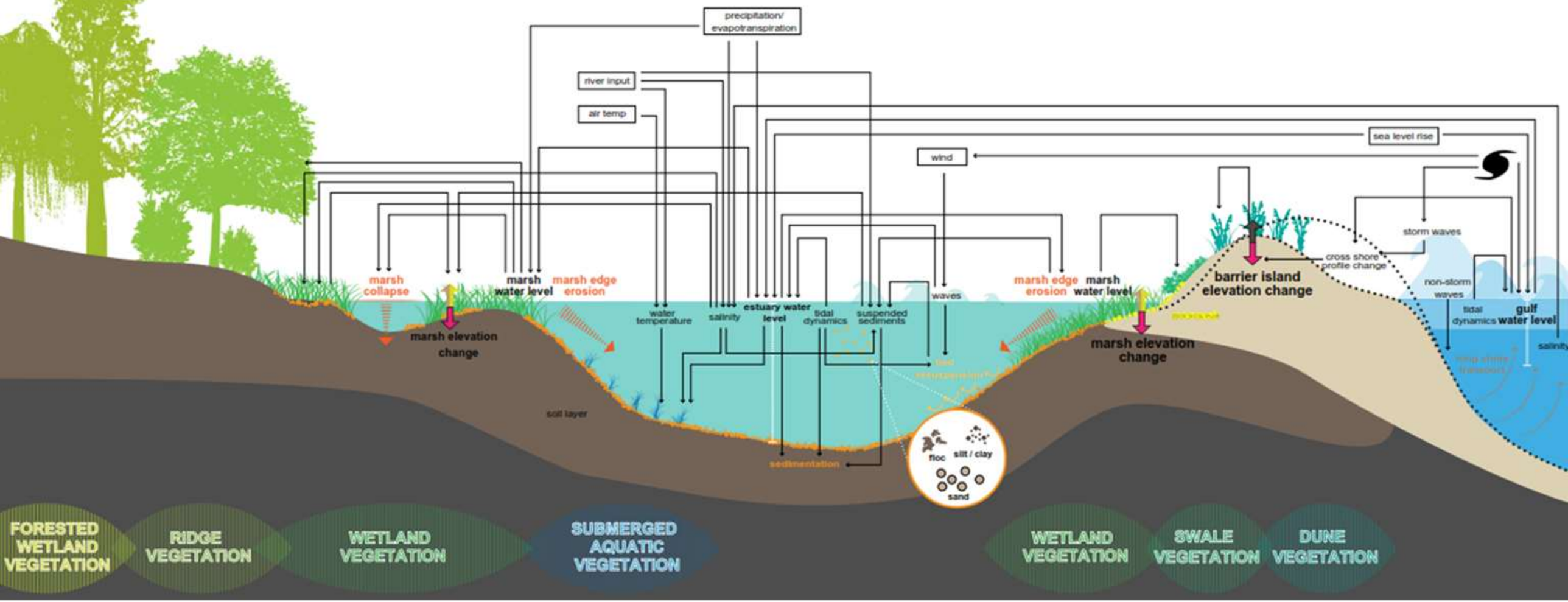
2017 COASTAL MASTER PLAN PROJECTS

PROJECT SELECTION

PLANNING TOOL

- Objective, transparent approach:
  - Compare projects based on common performance metrics and budget limits
  - Identify alternatives (groups of projects) for consideration by
    - Maximizing key decision drivers (land area and expected annual damage reduction)
    - Apply key constraints (funding, sediment, compatibilities, etc.)
  - Support discussion with iterative process including interactive visualizations

PREDICTIVE MODELING TOOLS

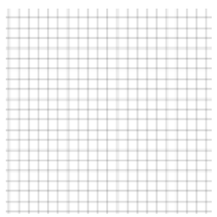


INTEGRATED COMPARTMENT MODEL (ICM)

ICM COMPARTMENTS AND GRIDS

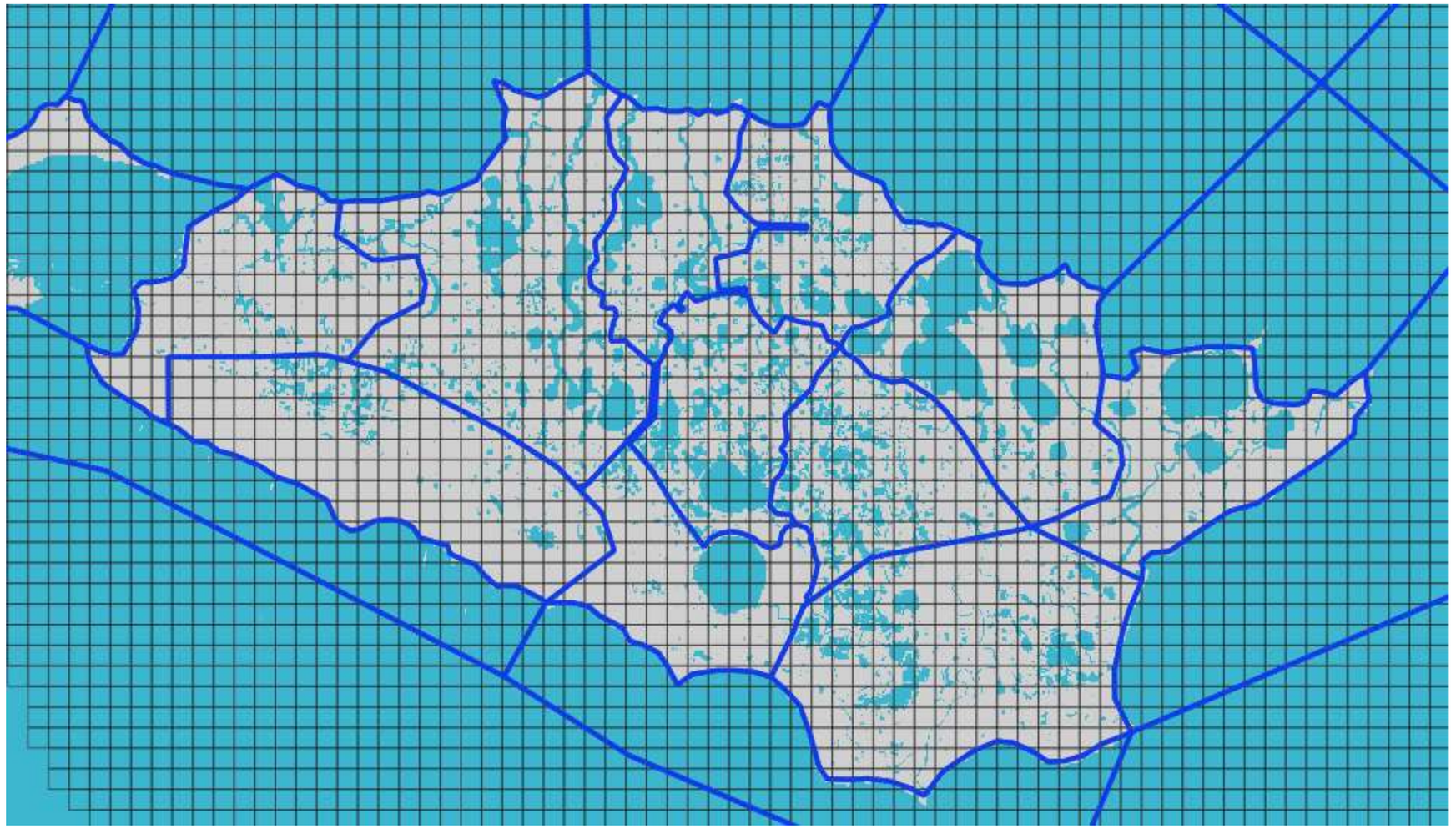
Legend

ICM-Hydro:
irregularly sized *compartment*



ICM-LAVegMod & ICM-HSI:
500-m *grid cell*

ICM-Morph:
30-m *pixel*



ICM resolution for Marsh Island in Vermilion Bay. Irregular polygons in dark blue are ICM-Hydro compartments; Orthogonal grid in black is the ICM-LAVegMod and ICM-HSI 500x500-m grid cells; Gray and teal landscape is the 30-m raster resolution of ICM-Morph.

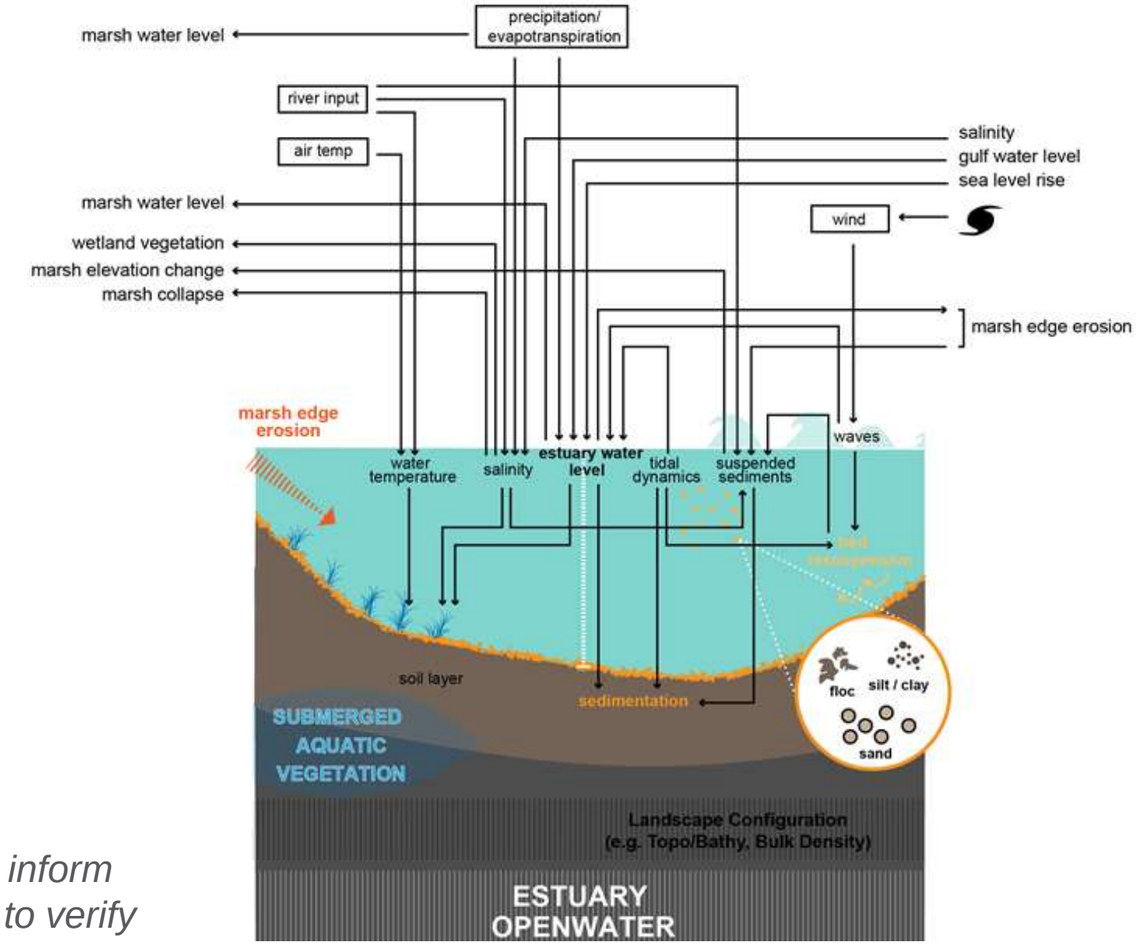
ICM INPUTS AND FUTURE CONDITIONS

- Model Inputs
  - Existing conditions maps (DEM and vegetation coverage)
  - Marsh edge erosion rates
- Future conditions
  - Mississippi River hydrograph (projected based on climate change conditions)
  - Subsidence rates (deep plus shallow)
  - Sea level rise (SLR) curves
  - Flows in coastal rivers, temperature, precipitation, and evapotranspiration (correspond with SLR curves)
  - Storm sequence (provides effects on water levels that are similar across the coast)

ICM-HYDRO

- Hydrodynamics
- Precipitation/Evapotranspiration
- Water quality*
  - Salinity
  - Temperature
- Sediment deposition
- Bed resuspension/erosion
- Sediment transport and distribution throughout estuary

**ICM-Hydro can also model nutrients; these will not be not be used to inform project selection for the 2023 Coastal Master Plan due to lack of data to verify model performance, but they can be used for exploratory analyses.*



Conceptual model of estuarine and open water processes.

ICM-HYDRO

OUTPUT VARIABLES USED IN OTHER SUBROUTINES

Salinity
Annual and Monthly Mean, Max 14-Day, Growing Season

Water Surface Elevation
Mean Annual, Monthly Max

Water Level Variability
Growing Season

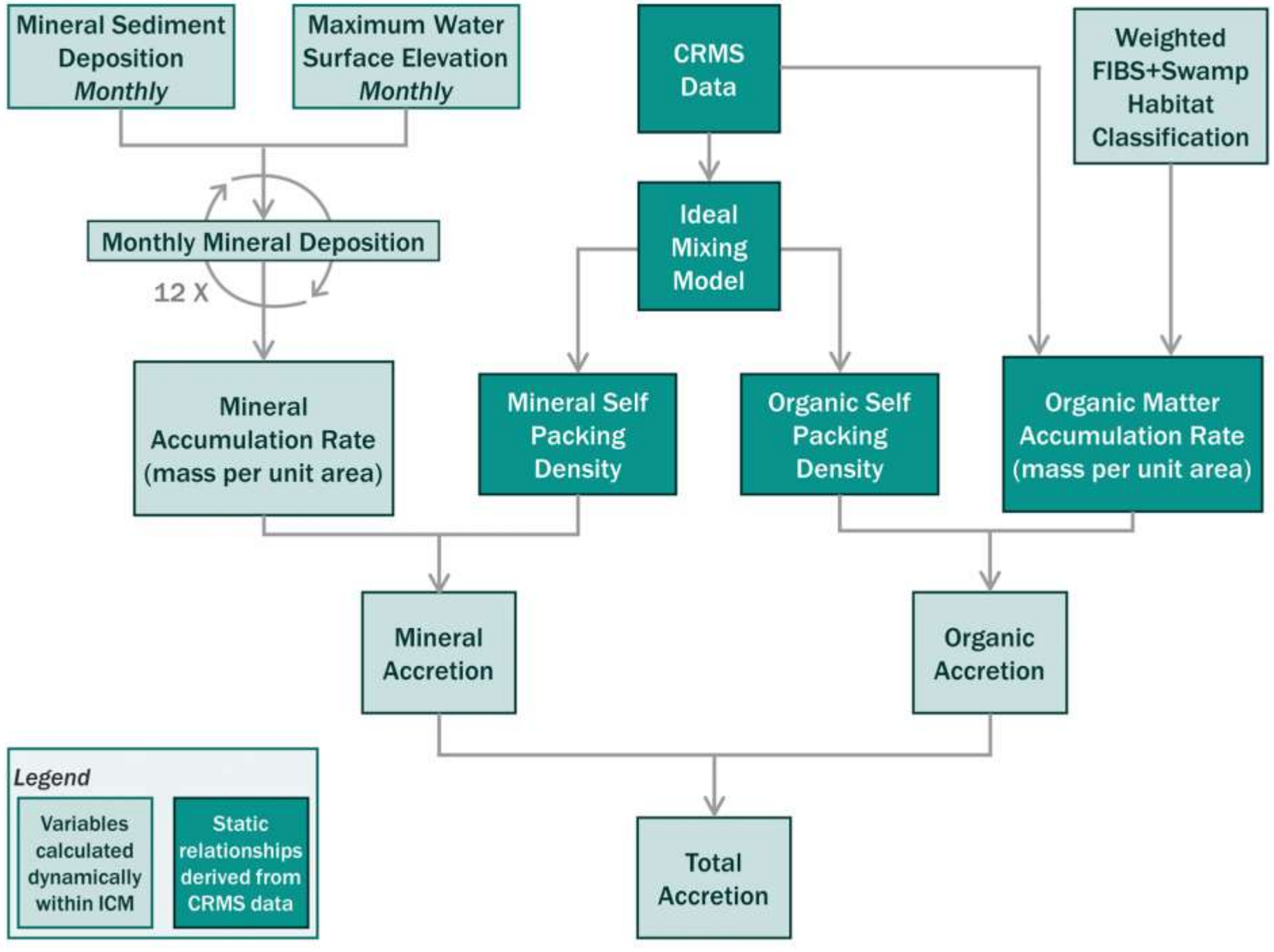
Mineral Sediment Deposition
Monthly

Tidal Prism Volume
Annual

Temperature
Monthly

ICM-MORPH AND ICM-LAVEGMOD

- Coastal vegetation
- Wetland elevation change
  - Mineral accumulation (sediment deposition)
  - Organic matter accumulation
- Wetland area change



ICM-MORPH AND ICM-LAVEGMOD

PRIMARY MODEL FEATURES

ICM-Morph

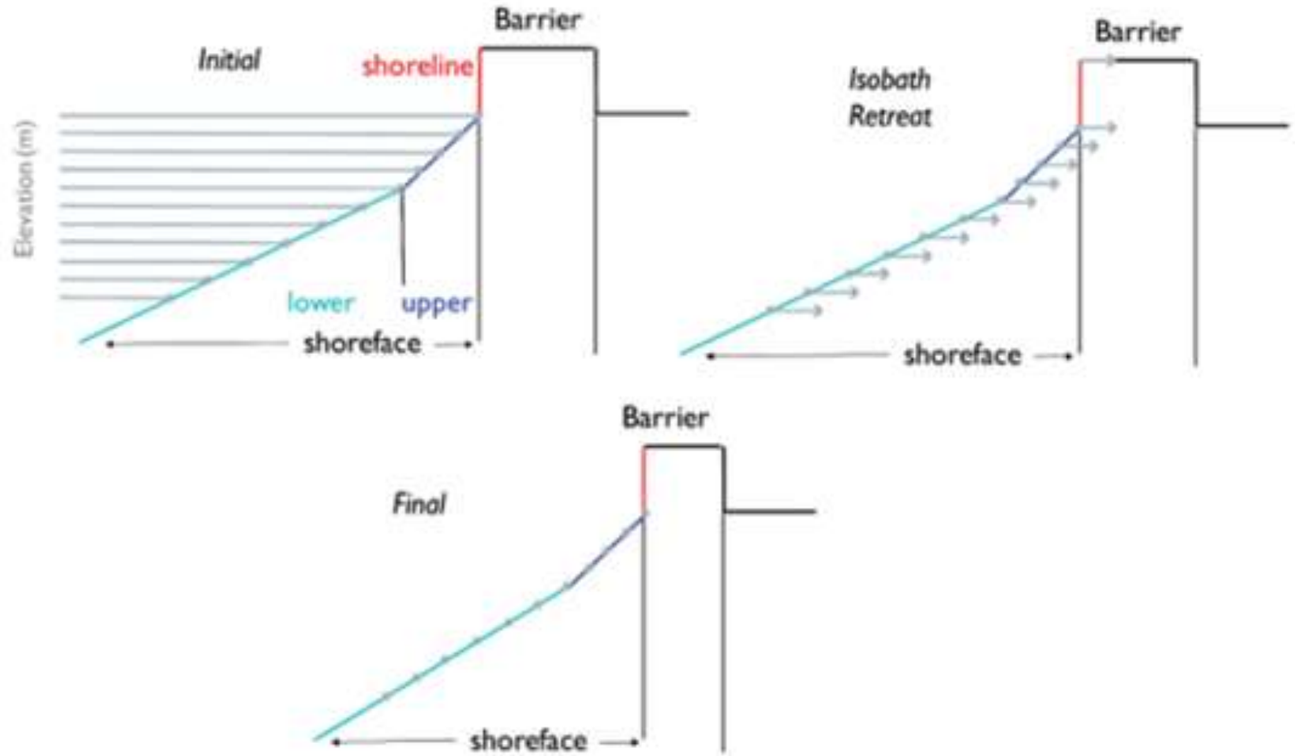
- 30 m grid
- Wetland elevation change
  - Increases - accretion
  - Decreases - soil lowering after vegetation loss and subsidence
- Wetland area change
  - Increases - new land formed from mineral sediment deposition
  - Decreases - edge erosion and excessive flooding levels that vary by salinity

ICM-LAVegMod

- 480 m x 480 m grid
- Calculate species coverage (%)
- 33 species, classified to habitat types
  - Forested wetland (9)
  - Fresh floating marsh (2)
  - Fresh attached marsh (5)
  - Intermediate marsh (9)
  - Brackish marsh (4)
  - Saline marsh (4)
- Barrier Island vegetation
- Submerged aquatic vegetation (SAV) in open water

ICM-BARRIER ISLANDS

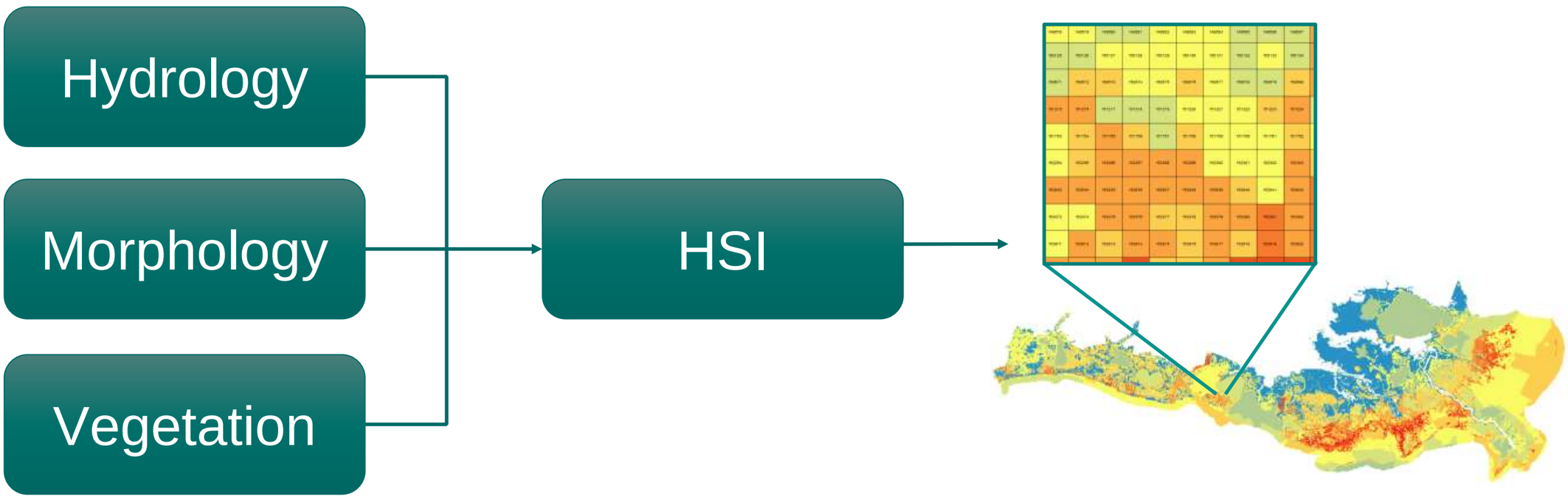
- Tidal Inlet Model (ICM-BITI)
  - Uses tidal prism from ICM-Hydro to adjust inlet size
- Digital Elevation Model (ICM-BI)
  - Evolves the shoreline and shoreface using historic rates
  - Each depth and profile has a unique retreat rate
  - Shoreface slope will change over time as a function of these retreat rates.
- Both are empirical, non-process-based models



Conceptual model of ICM-BI-DEM empirical processes.

ICM-HABITAT SUITABILITY INDICES (HSIs)

ECOSYSTEM OUTCOMES: NO FEEDBACK INTO LANDSCAPE MODEL SUBROUTINES



HSI map at bottom right indicates a higher habitat suitability (warmer colors) in more saline environments and a higher suitability in marsh areas as compared to open water areas.

ICM-HABITAT SUITABILITY INDICES (HSIs)

MODELED SPECIES

HSIs developed from literature review and expert opinion:

- American Alligator
- Bald Eagle+
- Brown Pelican
- Crayfish
- Eastern Oyster
- Gadwall
- Mottled Duck
- Seaside Sparrow+

HSIs developed from statistical analysis of LDWF data, literature review and expert opinion:

- Blue Crab (juvenile)
- Brown Shrimp (small and large juvenile)
- Gulf Menhaden (juvenile and adult)
- Largemouth Bass
- Spotted Seatrout (juvenile and adult)
- White shrimp (small and large juvenile)

+new HSIs for 2023

ICM

EXAMPLES OF UPDATES FOR THE 2023 ICM

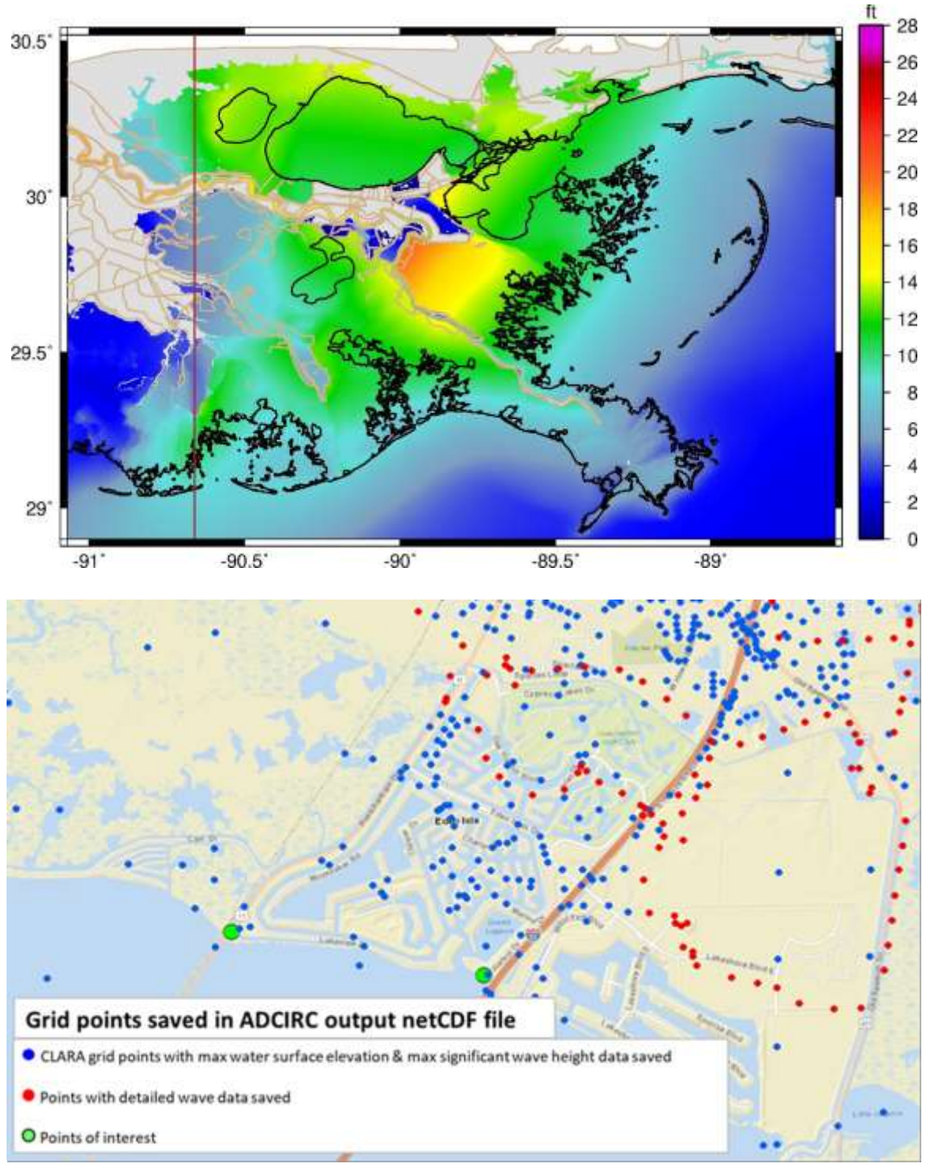
- Incorporate newly available data for model inputs and future conditions
- Extend ICM-Hydro domain and redefine compartments and links
- Couple 1D model for main channels and bayous with ICM-Hydro
- Adjust tidal signal in ICM-Hydro to improve water level variability predictions
- Calculate mineral sediment deposition on marsh monthly (vs. annually) in ICM-Morph
- Adjust habitat type classification, wetland transition rules, and calculations for organic matter accretion in ICM-Morph and ICM-LAVegMod
- Revised species lists for ICM-LAVegMod and ICM-HSIs
- Add tidal prism tracking (BITI) and auto-restoration for barrier islands in ICM-BI

STORM SURGE AND WAVES MODELS

ADCIRC + SWAN

- Physics-based models that represent water movement and wave propagation due to:
  - Astronomical tides
  - Riverine inflows
  - Wind/pressure
- Outputs:
  - Peak Water Levels*
  - Peak Wave Height*
  - Peak Wave Period
  - Timeseries**

**Water surface and wave height data generated for grid points used by risk assessment model*
***Timeseries data generated adjacent to levees to compute overtopping*



STORM SURGE AND WAVES MODELS

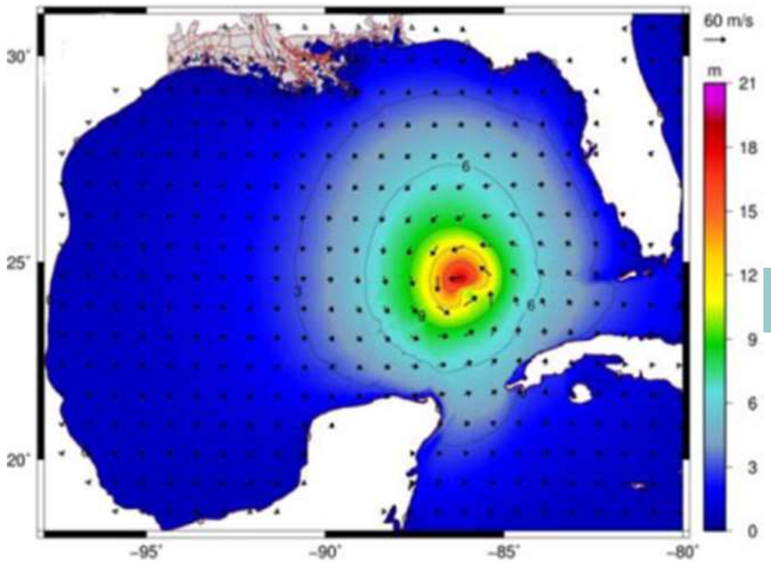
UPDATES FOR THE 2023 COASTAL MASTER PLAN

- Updated landscape
- New storm suite (446 storms in 2008 vs. 645 in 2020, shown below)
  - Subset of ~90 storms will be modeled for 2023 Coastal Master Plan analysis
- Updated parameter values developed in coordination with USACE to be consistent across uses

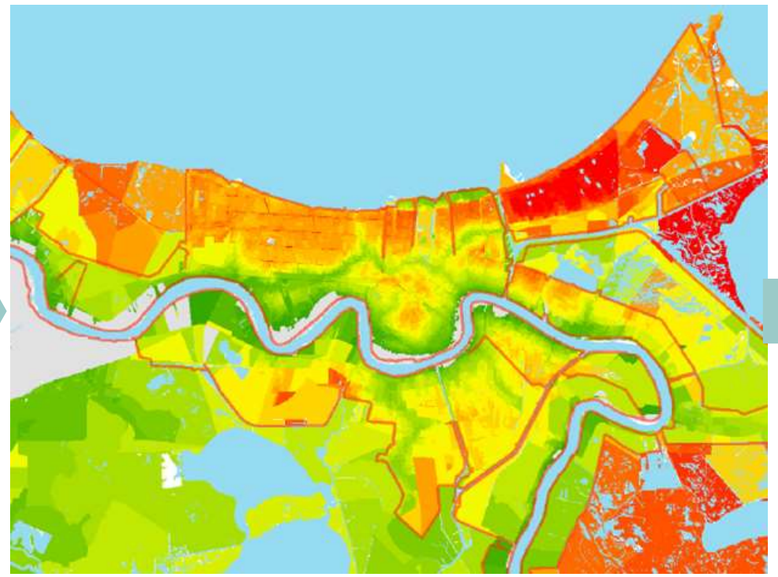
COASTAL LOUISIANA RISK ASSESSMENT MODEL (CLARA)

RISK ASSESSMENT MODULE

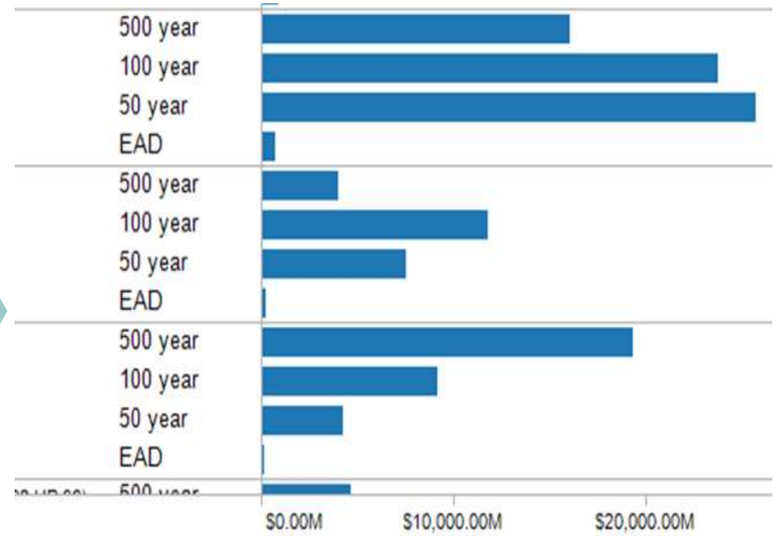
Statistical Pre-Processing



Flood Depth



Economic Damage



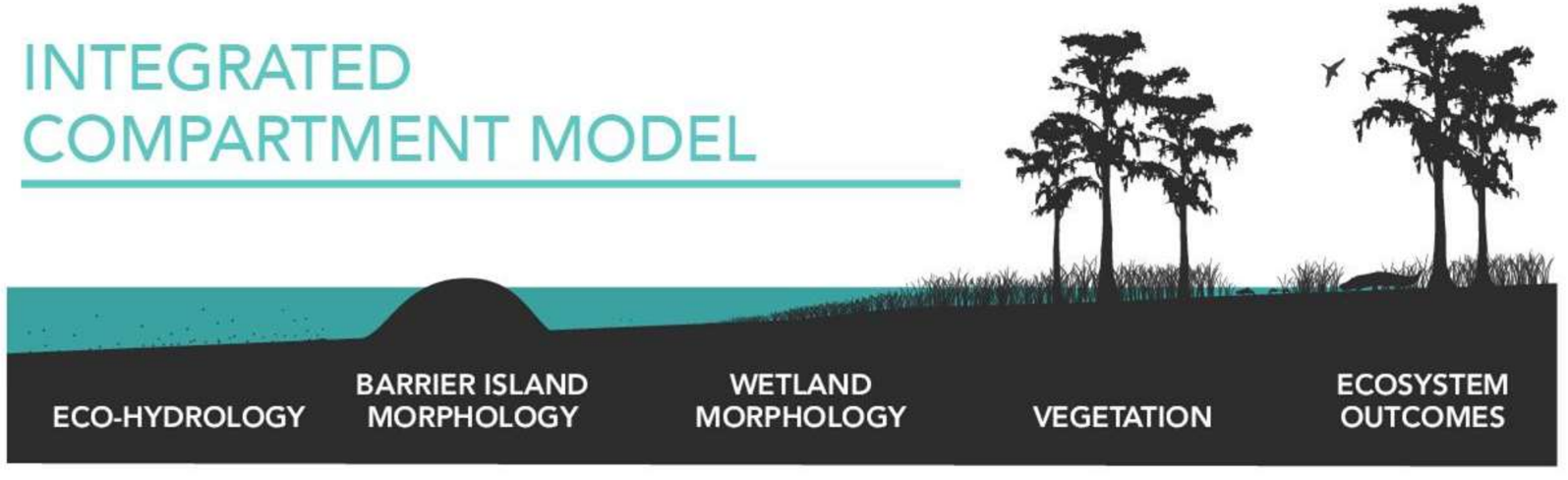
COASTAL LOUISIANA RISK ASSESSMENT MODEL (CLARA)

UPDATES FOR THE 2023 COASTAL MASTER PLAN

- Incorporate updated structure inventory data
- Use population projections for asset growth model
- Redefine community boundaries
- Develop new approach to identify and select non-structural projects
- Consider new metrics and add analysis for high tide flooding analysis

PREDICTIVE MODELING SUMMARY

INTEGRATED COMPARTMENT MODEL



SURGE/WAVES AND RISK ASSESSMENT MODEL

ACKNOWLEDGEMENTS

- Master Plan Team
  - Stuart Brown, Elizabeth Jarrell, Sam Martin, Eric White, Krista Jankowski, Ashley Cobb, Catherine Fitzpatrick, David Lindquist, Madeline LeBlanc, Forrest Town, Denise Reed
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