Louisiana's 2012 Coastal Master Plan

committed to **our coast**

Eco-Hydrology Modeling in Coastal Louisiana to Assess Project Effects on the Landscape

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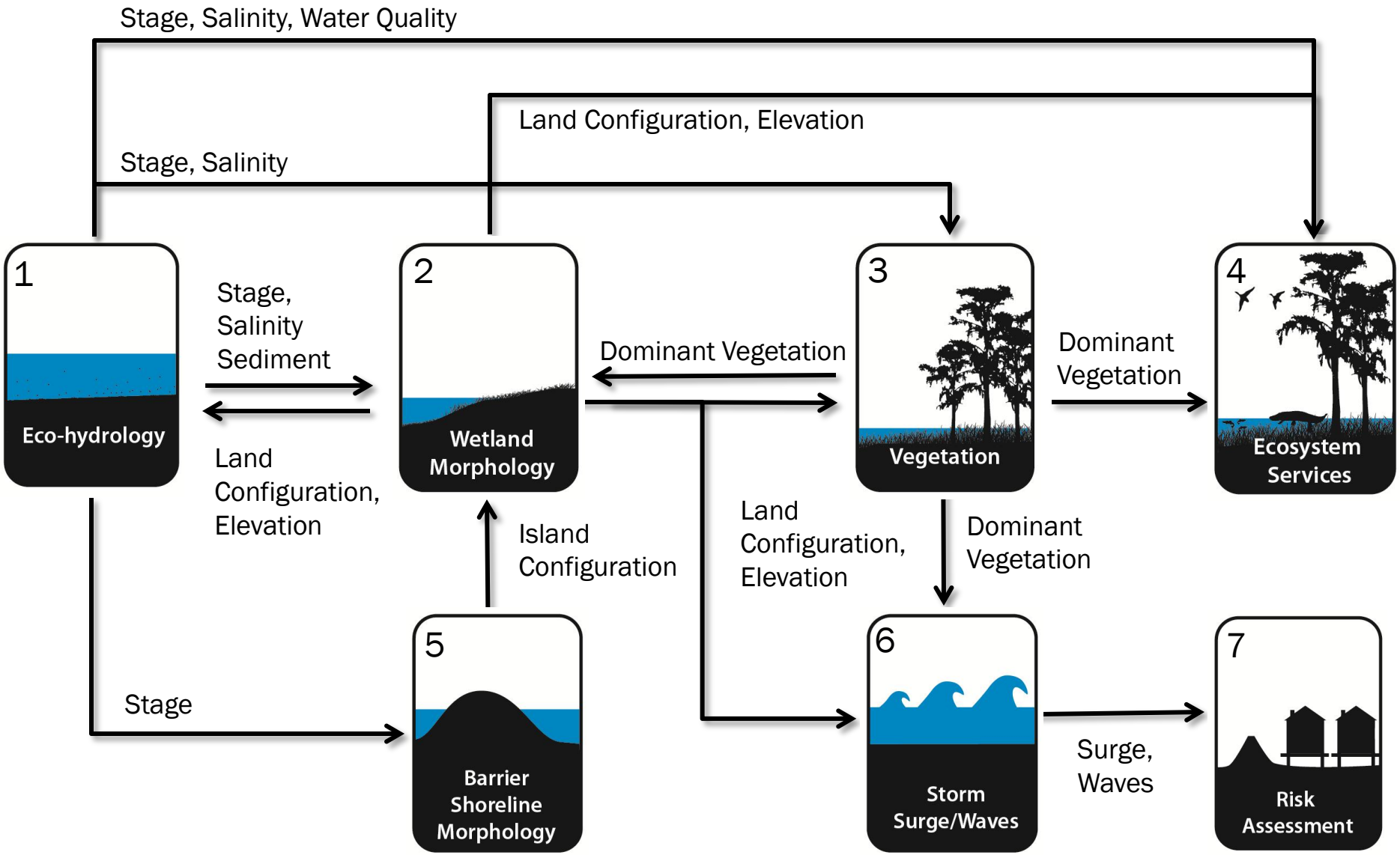
Team Members

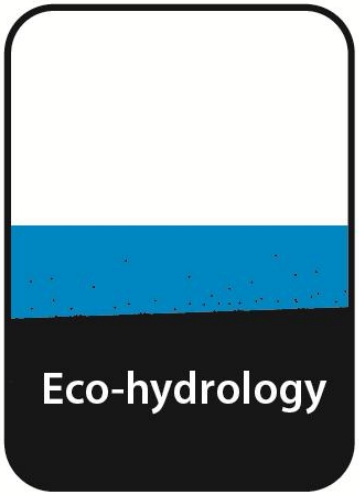
Member	Affiliation	Title	Sub-Model
Ehab Meselhe	Water Institute, University of Louisiana Lafayette	Work Group Leader, Sub Group Leader	Chenier Plain
Alex McCorquodale	University of New Orleans	Water Quality Specialist, Sub Group Leader	Pontchartrain-Barataria
Jeff Shelden	Moffat & Nichol	Sub-Group Leader	Atchafalaya Basin
Mark Dortch	Moffat & Nichol	Water Quality Specialist	Atchafalaya Basin
Gerald Duszynski	Fenstermaker	Technical Advisor, QA/QC	--
Stokka Brown	Fenstermaker	Point of Contact, Modeler	Chenier Plain
Mallory Davis	Fenstermaker	Modeler	Chenier Plain
Peter Elkan	Moffat & Nichol	Modeler	Atchafalaya Basin
Jonathan Wang	Moffat & Nichol	Modeler	Atchafalaya Basin
Jenni Schindler	University of New Orleans	Modeler	Pontchartrain-Barataria

Modeling in a Systems Context

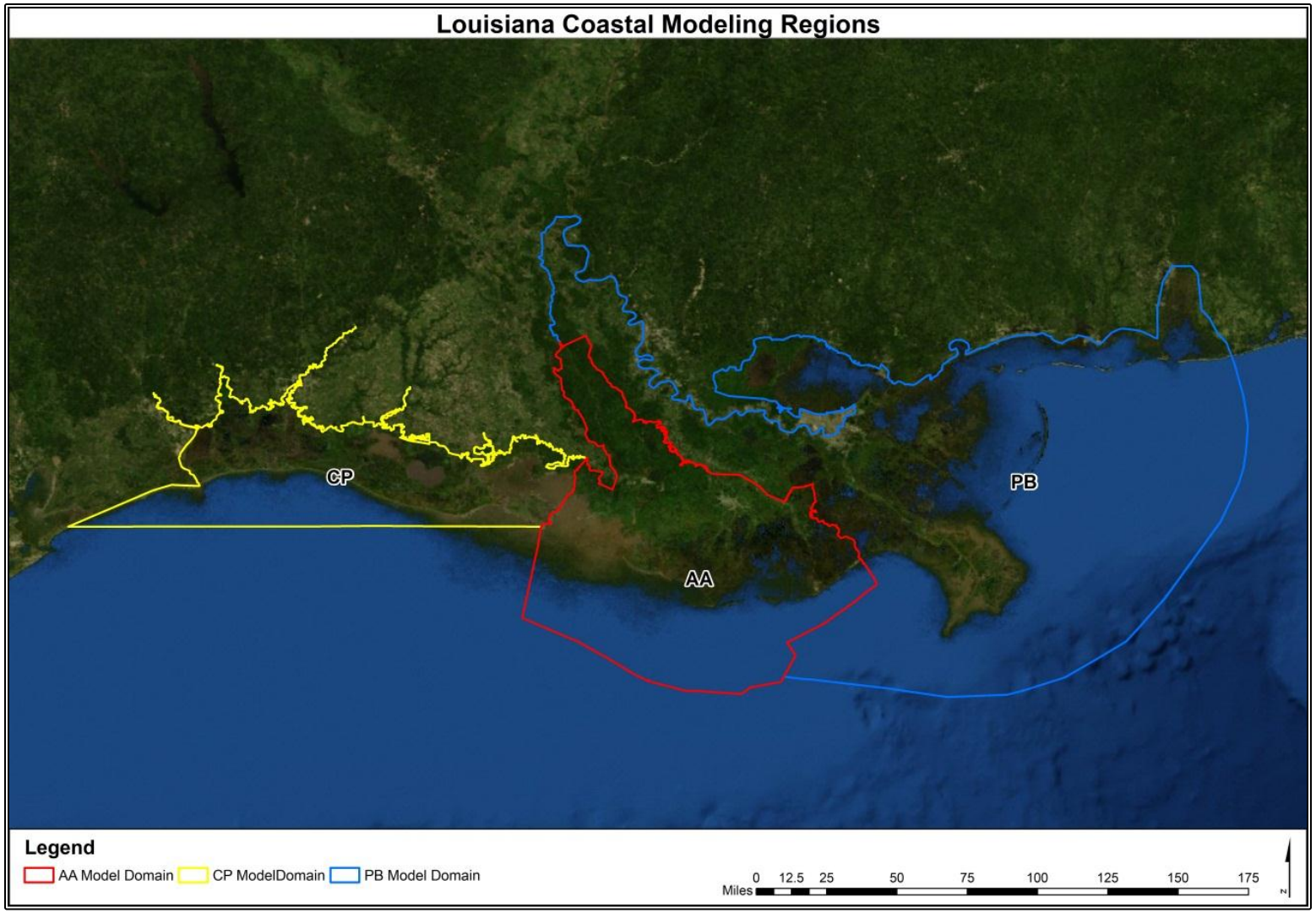


Outline

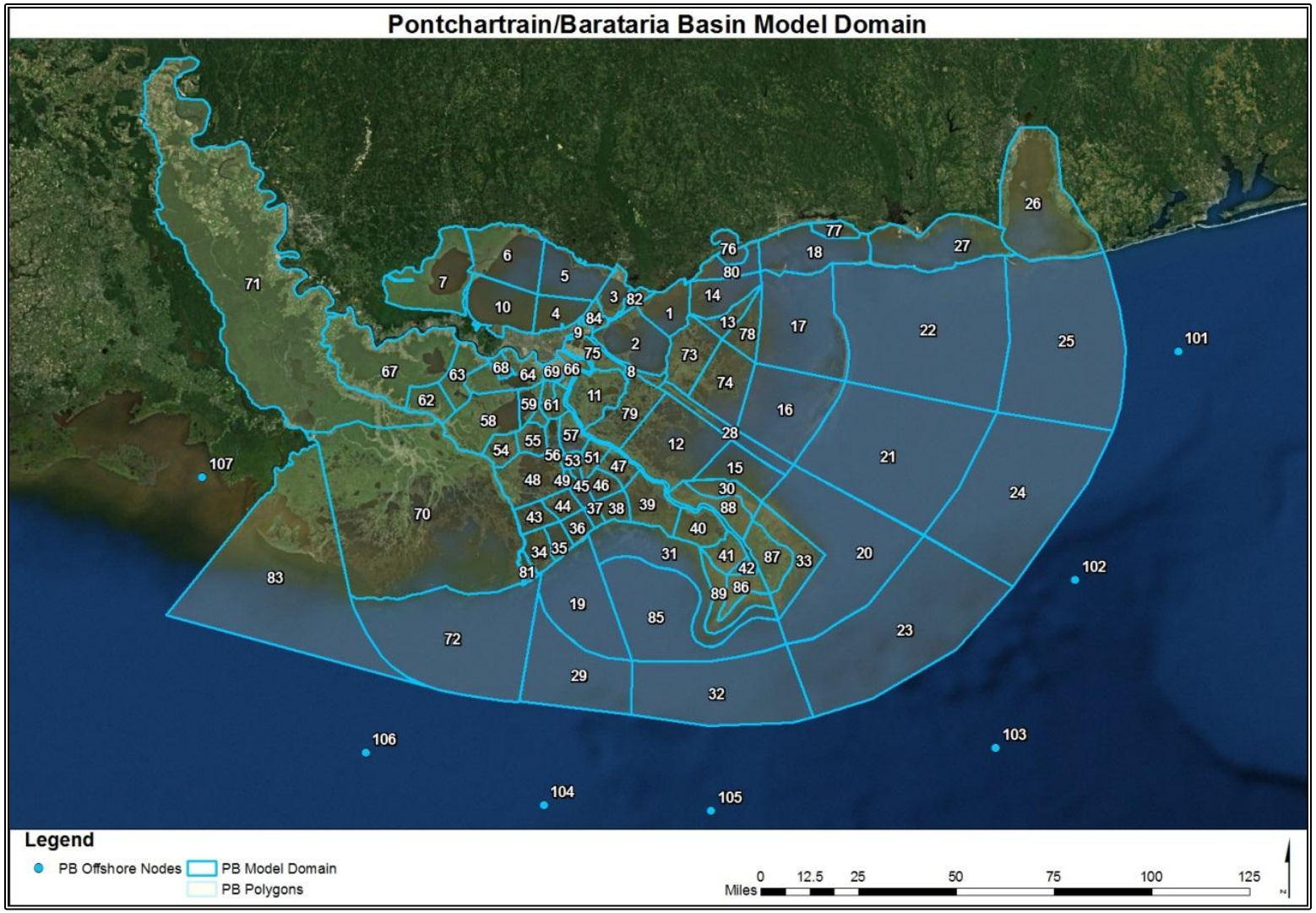
- **Model Domain**
- **Model Setup**
  - Input & Output
  - Assumptions
  - Mechanics
- **Model Testing**
  - System Quality
  - Calibration & Validation
- **Model Simulation Process**
- **Master Plan Results**



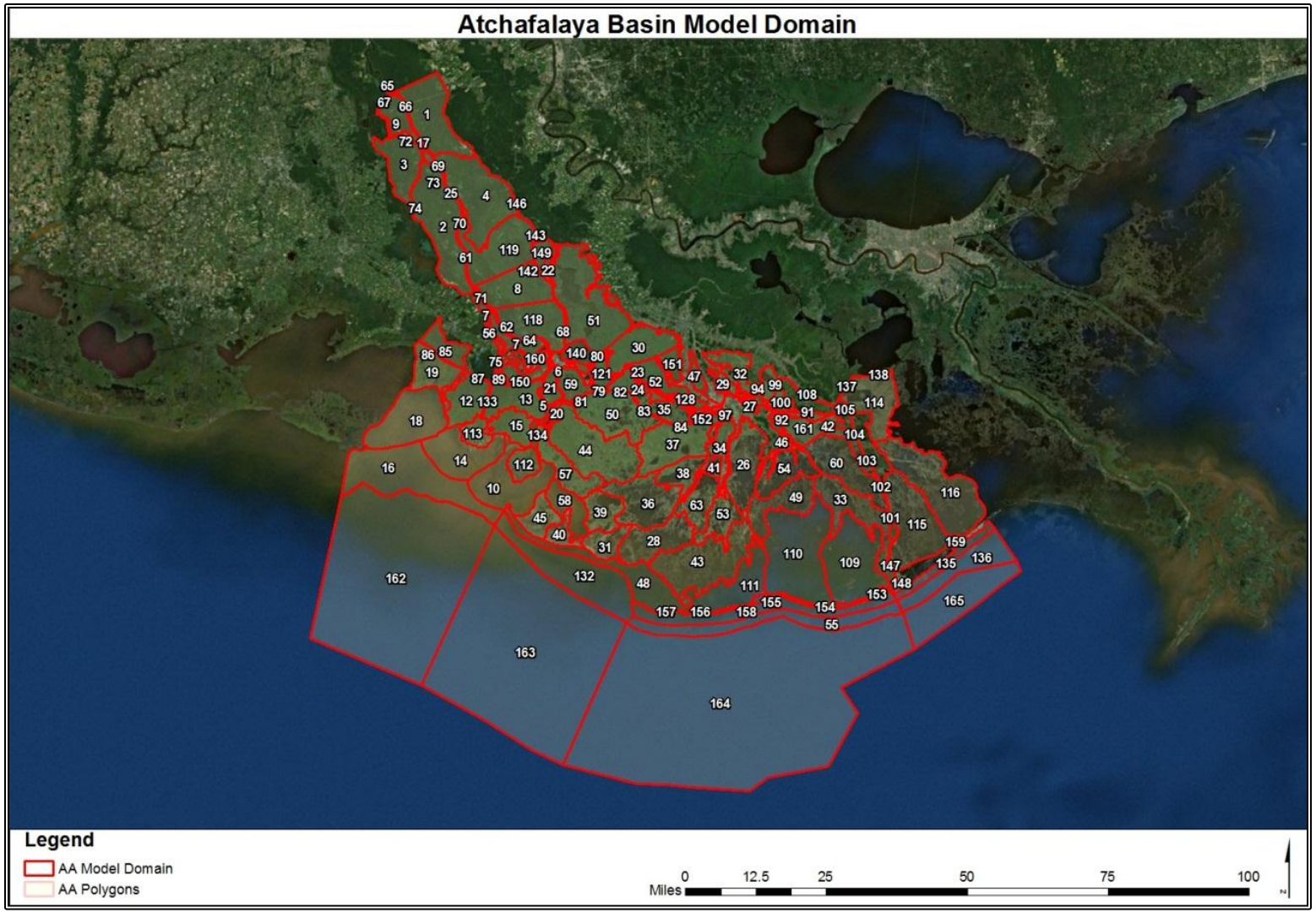
Outline of Model Domain



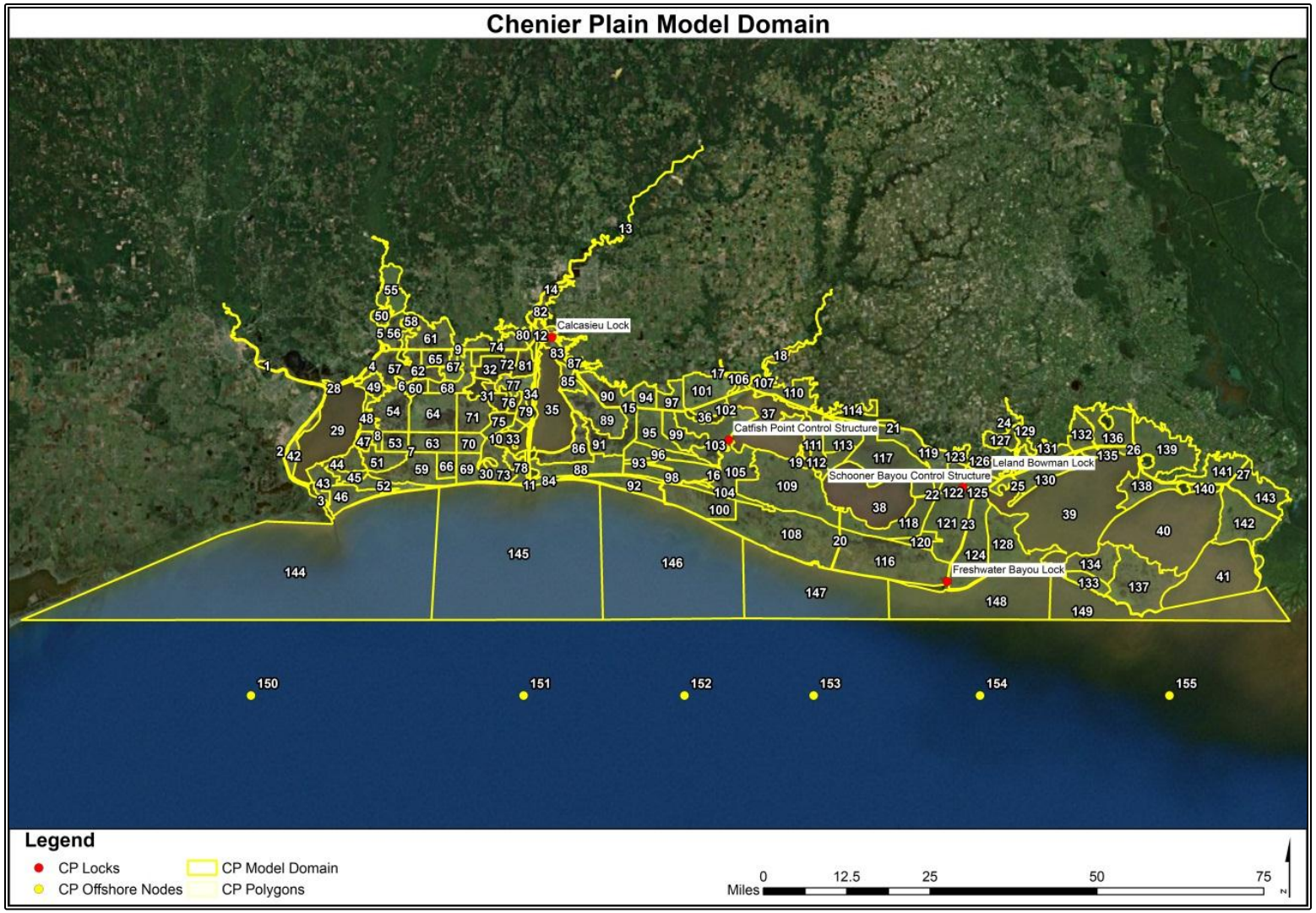
Region	Channel	Open Water	Marsh	Upland	Offshore	Total	Surface Area Ranges in km^2 (Average)
PB	-	89			7 Nodes	89	2.2 – 5844 (716)



Region	Channel	Open Water	Marsh	Upland	Offshore	Total	Surface Area Ranges in km^2 (Average)
AA	74	21	70	-	4	169	0.04 – 3361 (118)



Region	Channel	Open Water	Marsh	Upland	Offshore	Total	Surface Area Ranges in km^2 (Average)
CP	33	19	105	-	6 Nodes	157	0.6 – 1844 (86)



Model Input and Output

Model Input
Wind Speed
Water and Air Temperature
Gulf Stage, Salinity, and Nutrients
River Discharge, Sediment, and **Nutrients**
Diversion Discharge, Sediment, and Nutrients
Atmospheric Deposition
Precipitation and Runoff
Evapotranspiration

Model Output	Symbol	Interval
Stage	STG	Daily
Salinity	SAL	Monthly
Sediment Retention	TSS	Monthly
Accretion	ACC	Yearly
Total Kjeldahl Nitrogen	TKN	Monthly
Tidal range	TRG	Monthly
Nitrate + Nitrite Nitrogen	NO3	Monthly
Water Temperature	TMP	Monthly
Ammonium Nitrogen	NH4	Monthly
Dissolved Organic Nitrogen	DON	Monthly
Total Phosphorus	TPH	Monthly
Soluble Phosphorus	SPH	Monthly
Phytoplankton as Chlorophyll-a	ALG	Monthly
Detritus	DET	Monthly
Water Age	AGE	Monthly
Nitrogen Removal Rate	NRM	Yearly

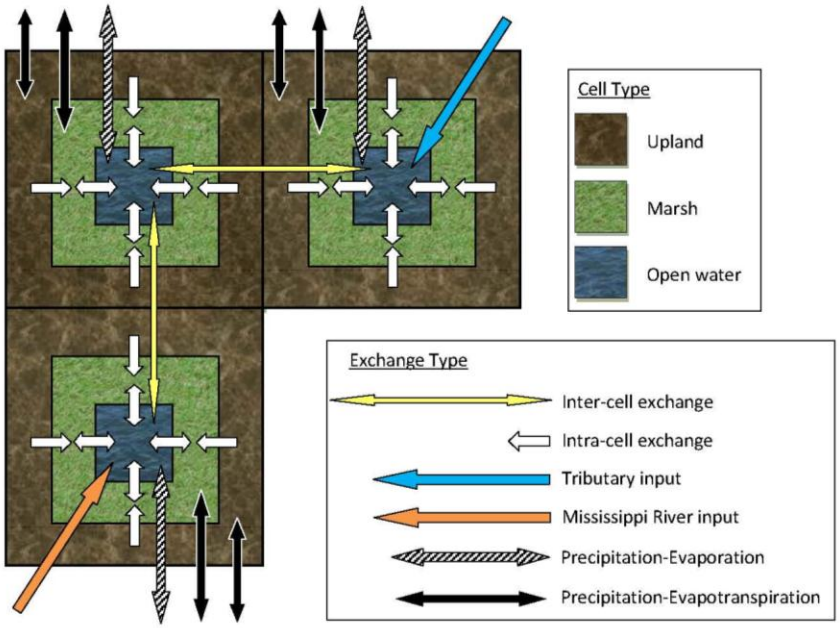
*Bolded, Red Inputs are varied based on scenario

Model Assumptions

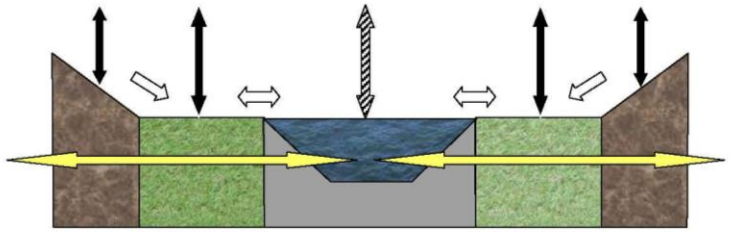
- Modeling approach based on conservation of mass
- Momentum/dynamic exchange not included
- Hydrology and constituents semi-coupled
- Flow variables spatially averaged over each compartment
- Water column fully mixed and aerobic at all locations and times
- Transfer of nutrients from bed to water column not included
- Compartments prevented from filling up due to deposition (AA model only)
- Sediment accretion in channels is not included

Model Mechanics

PB

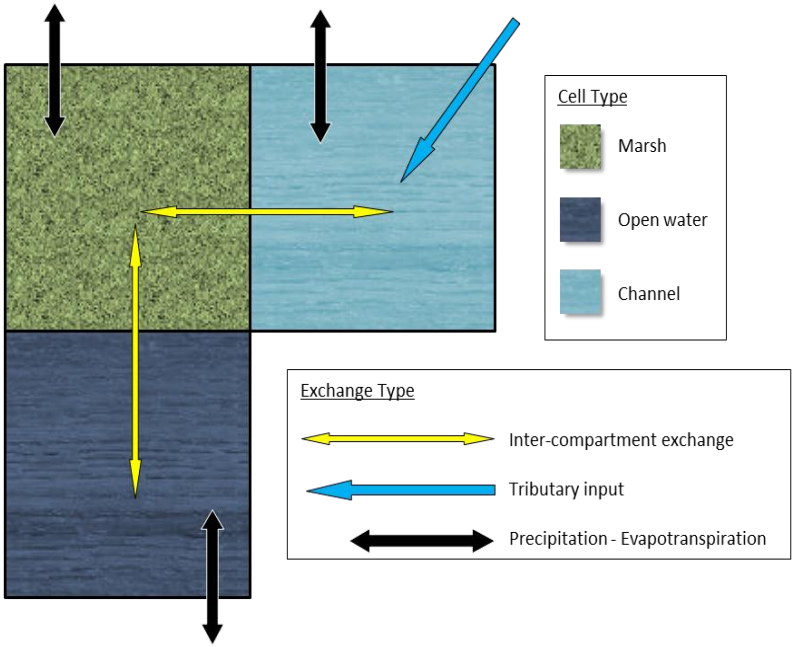


a. Plan view of PB model dynamics

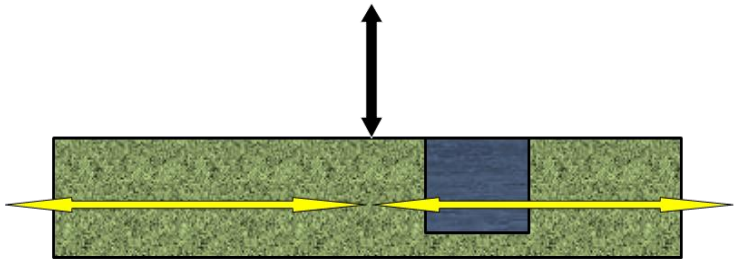


b. Cross-section view of PB model dynamics for a generalized interior cell

AA & CP

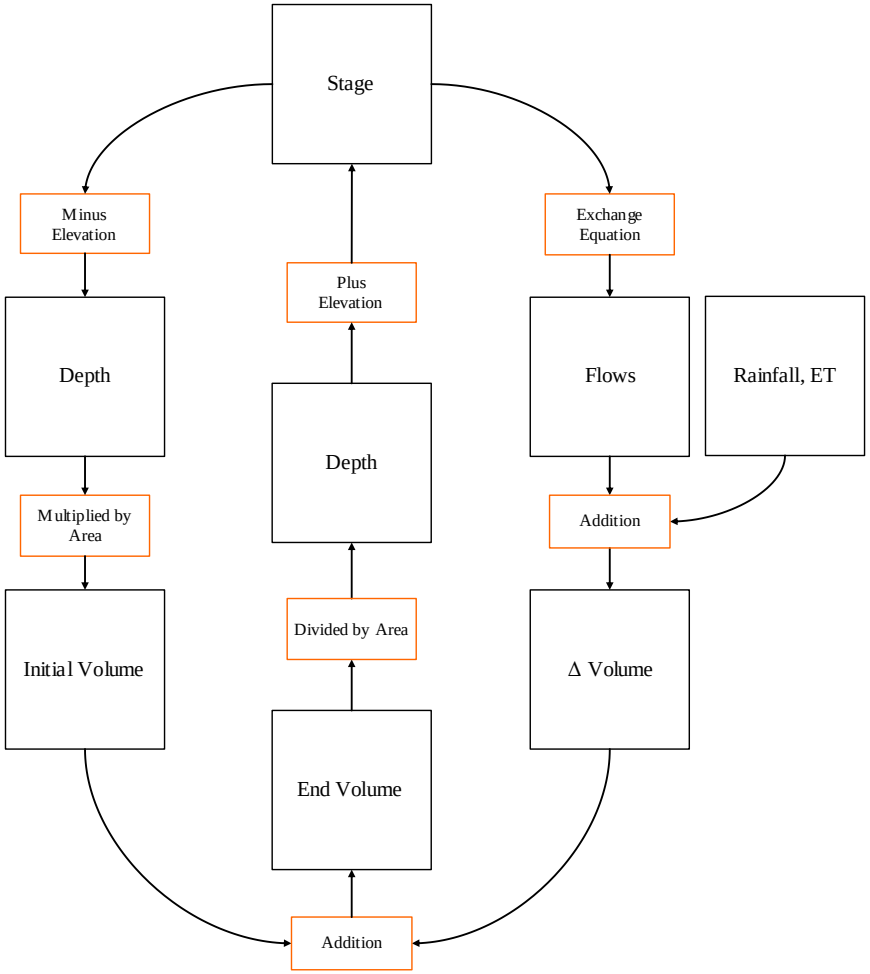


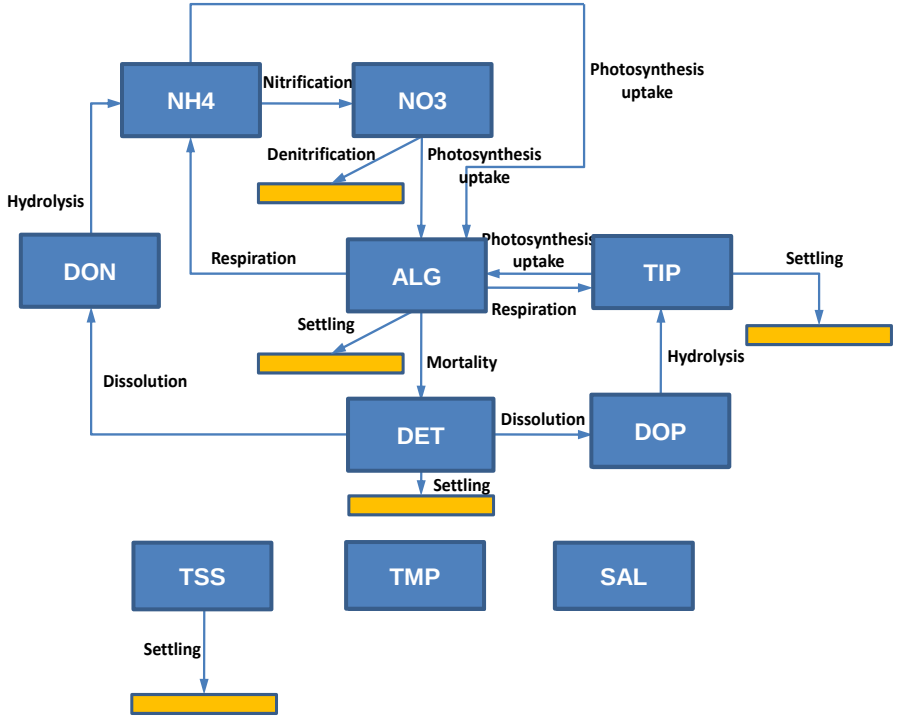
a. Plan view of AA and CP model dynamics



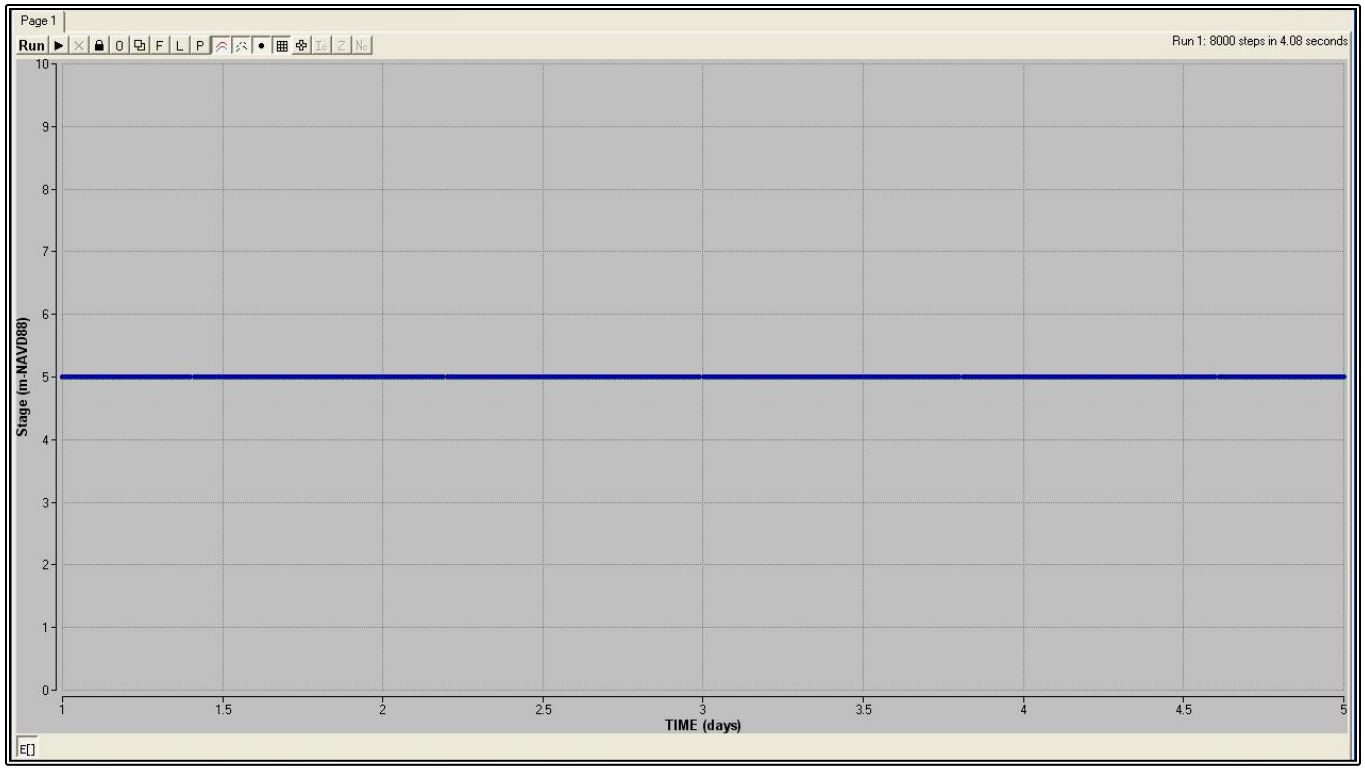
b. Cross-section view of AA and CP model dynamics for a generalized interior marsh compartment

Mass Transfer

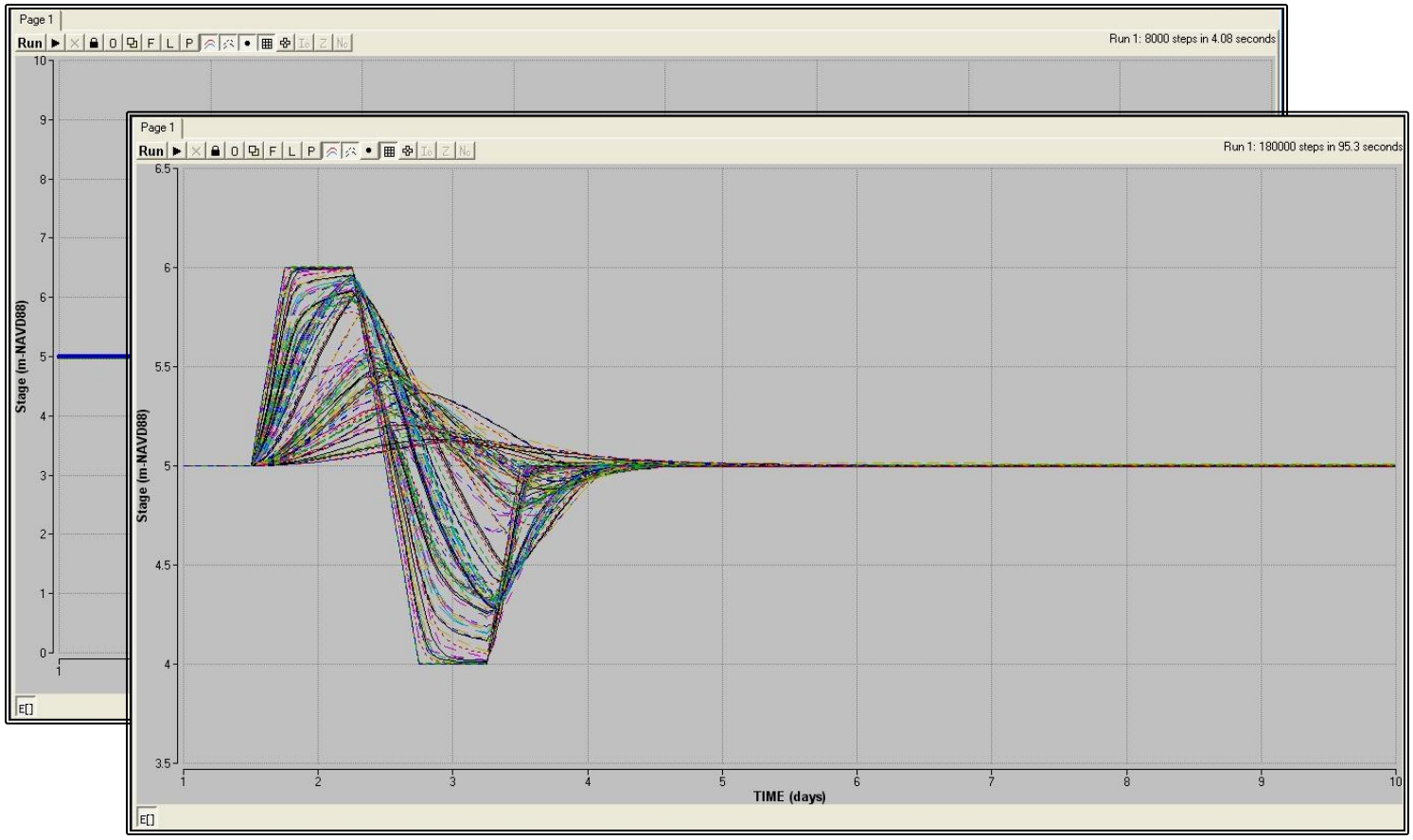




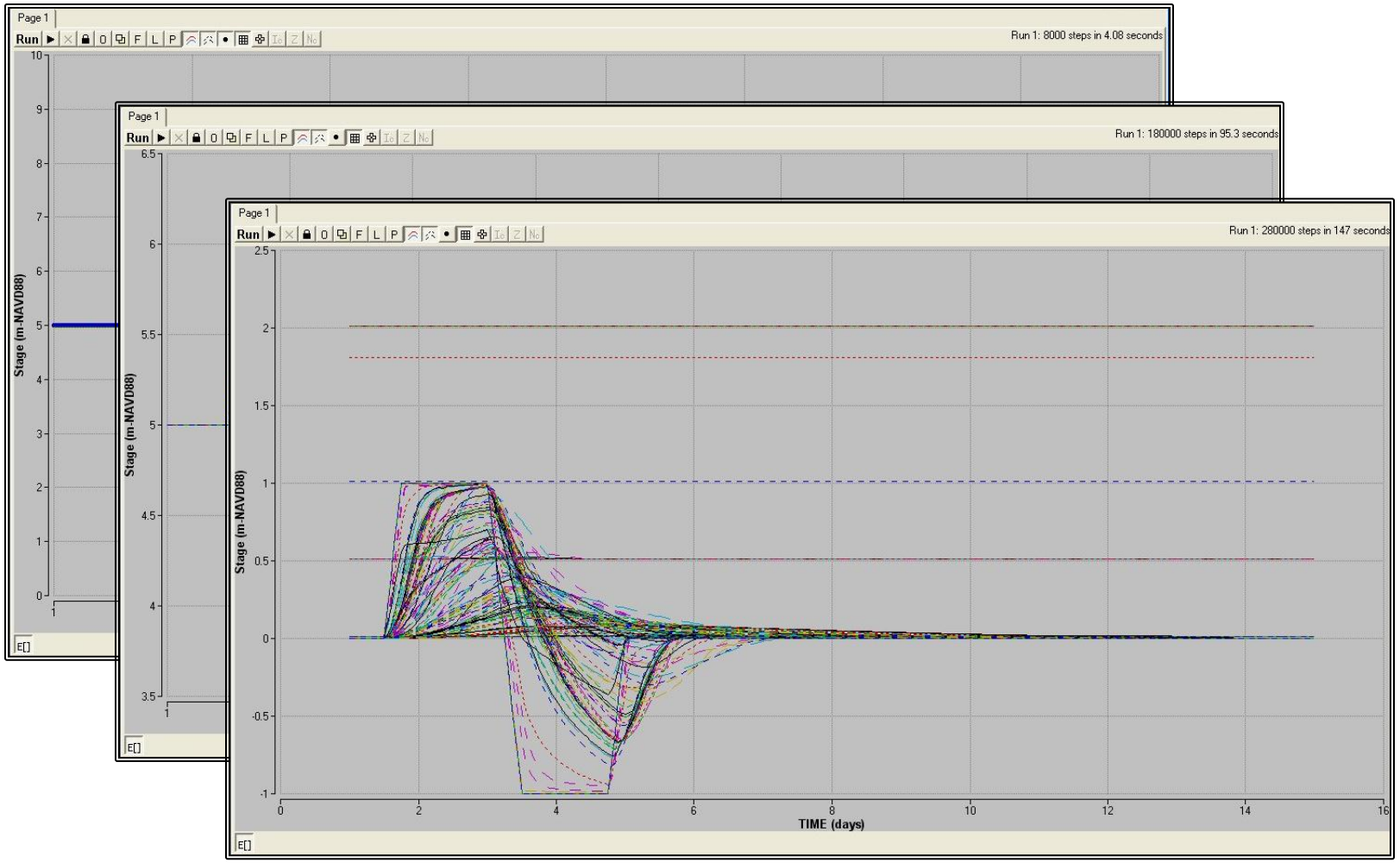
System Quality



System Quality



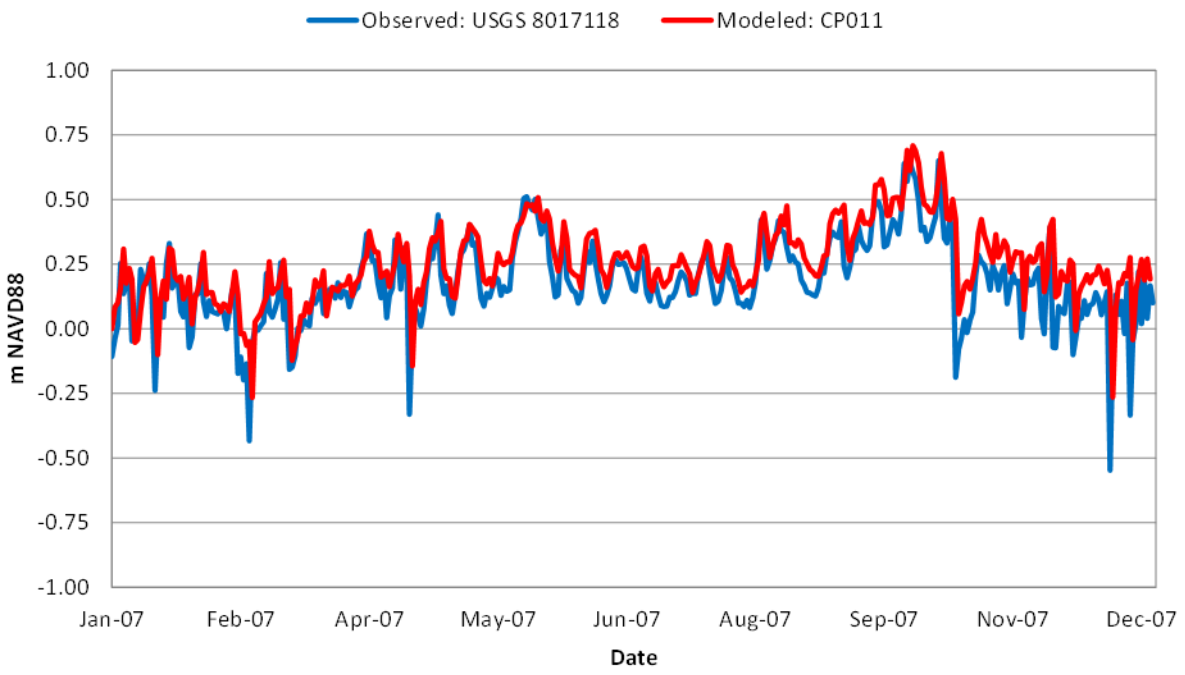
System Quality



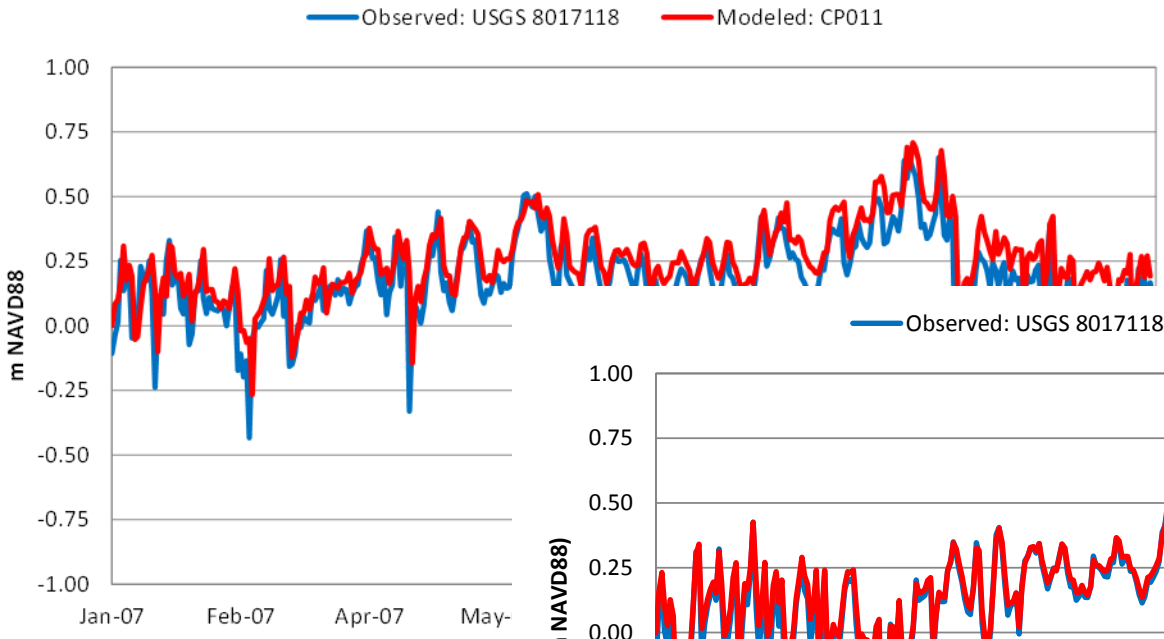
Calibration and Validation

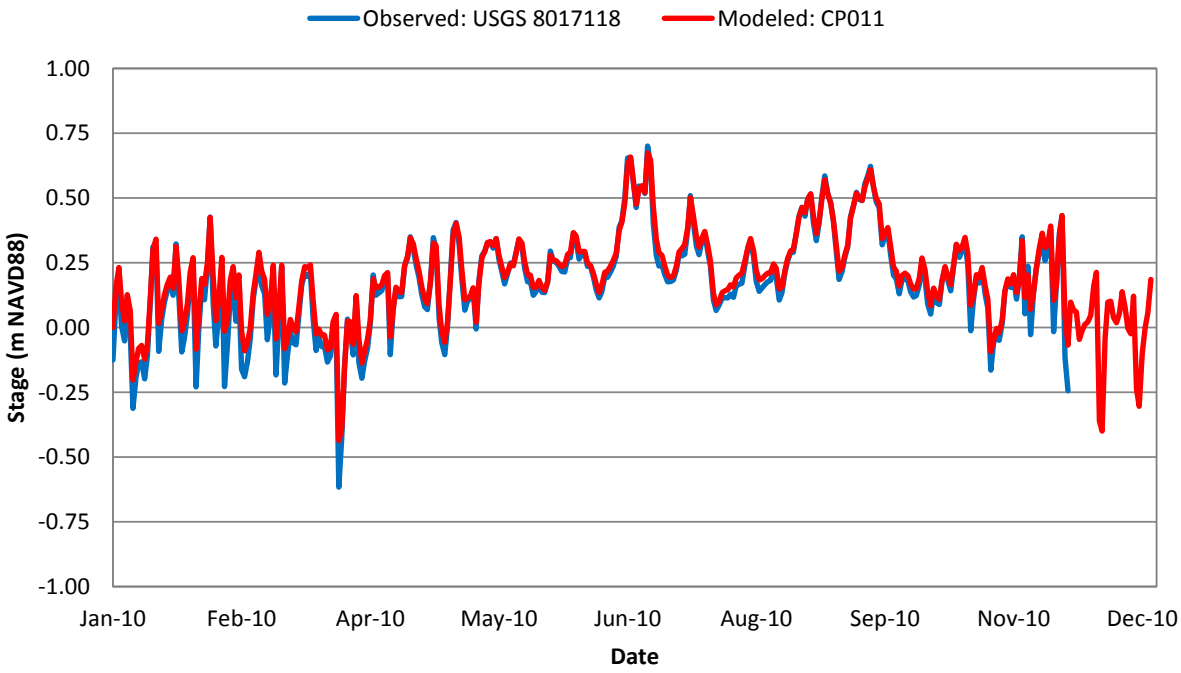
Model	Calibration Year(s)	Validation Year(s)
PB	1990 - 2009	
AA	2007	2008 - 2009
CP	2007	2010

Calibration and Validation



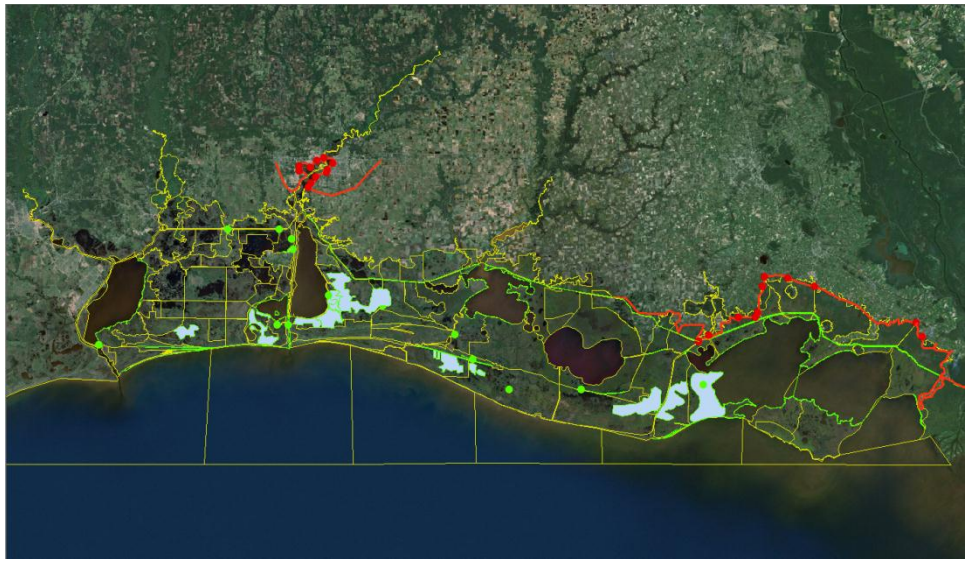
Calibration and Validation



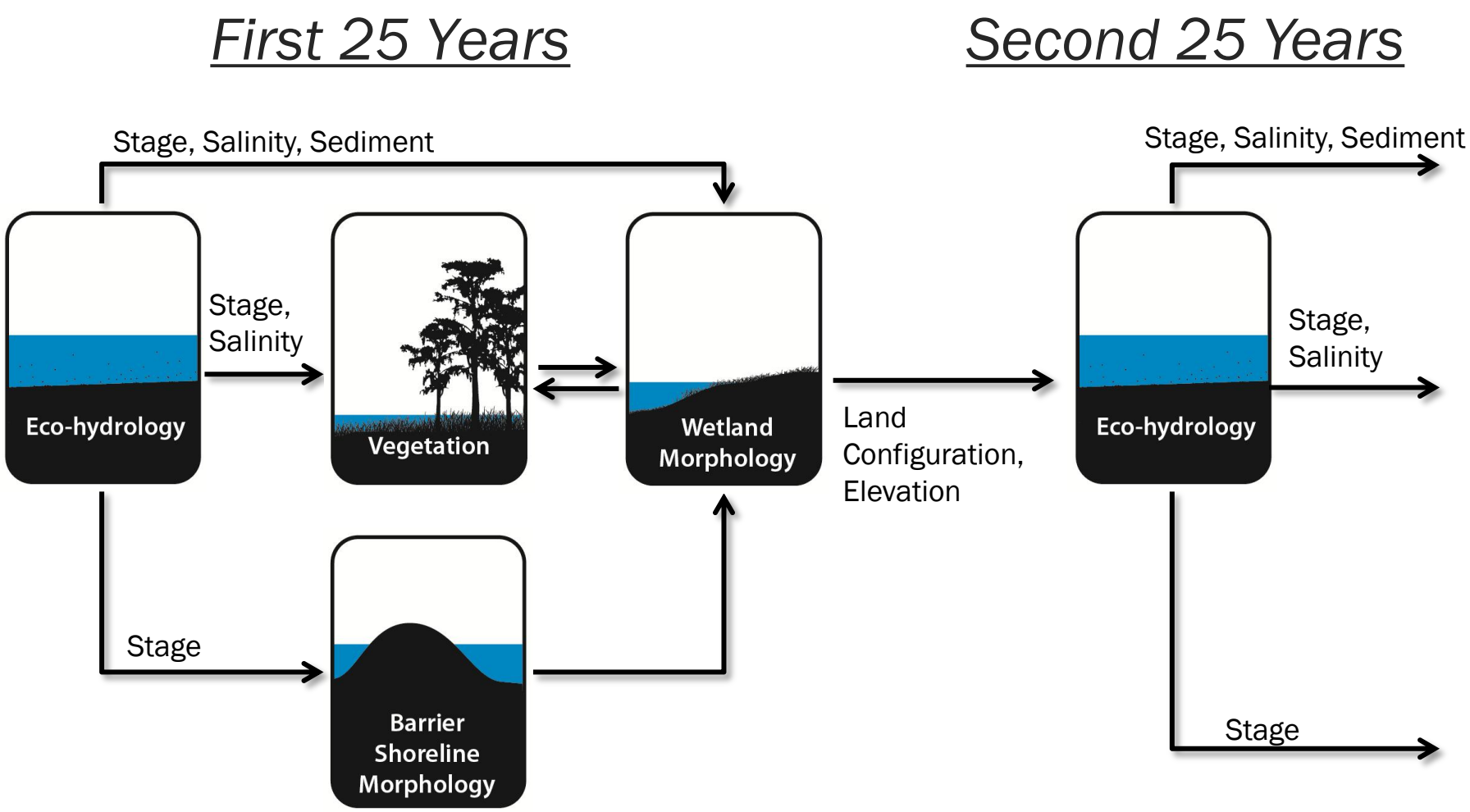


Project Types

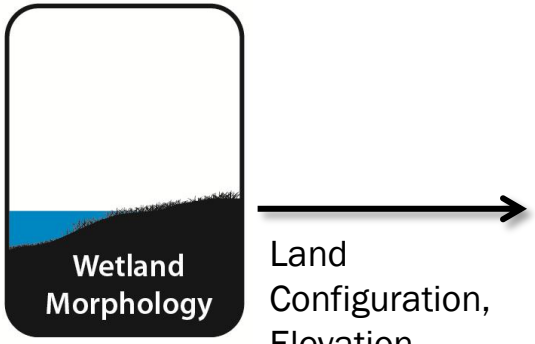
- Marsh Creation
- Hydrologic Restoration
- Diversion
- Channel Re-alignment
- Ridge Restoration
- Barrier Island Restoration
- Oyster Reef Development
- Hurricane Protection



Simulations



Output from Wetland Morphology



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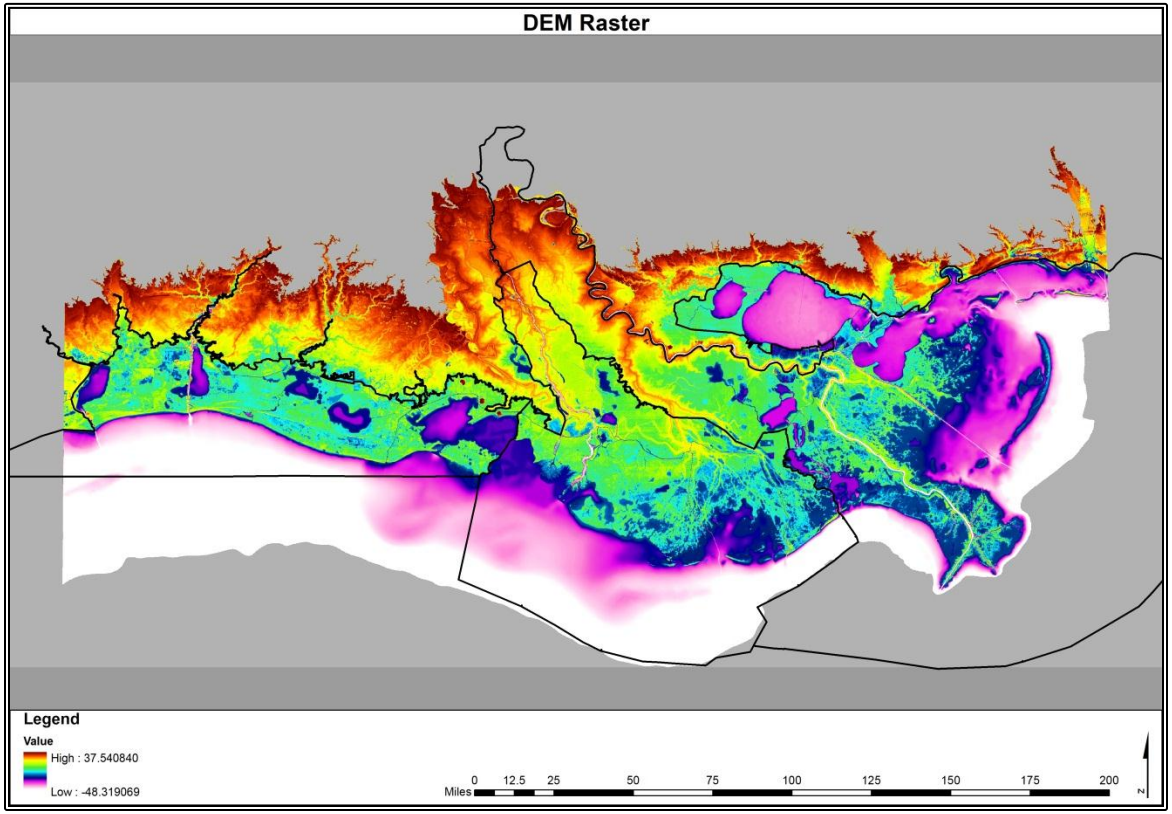

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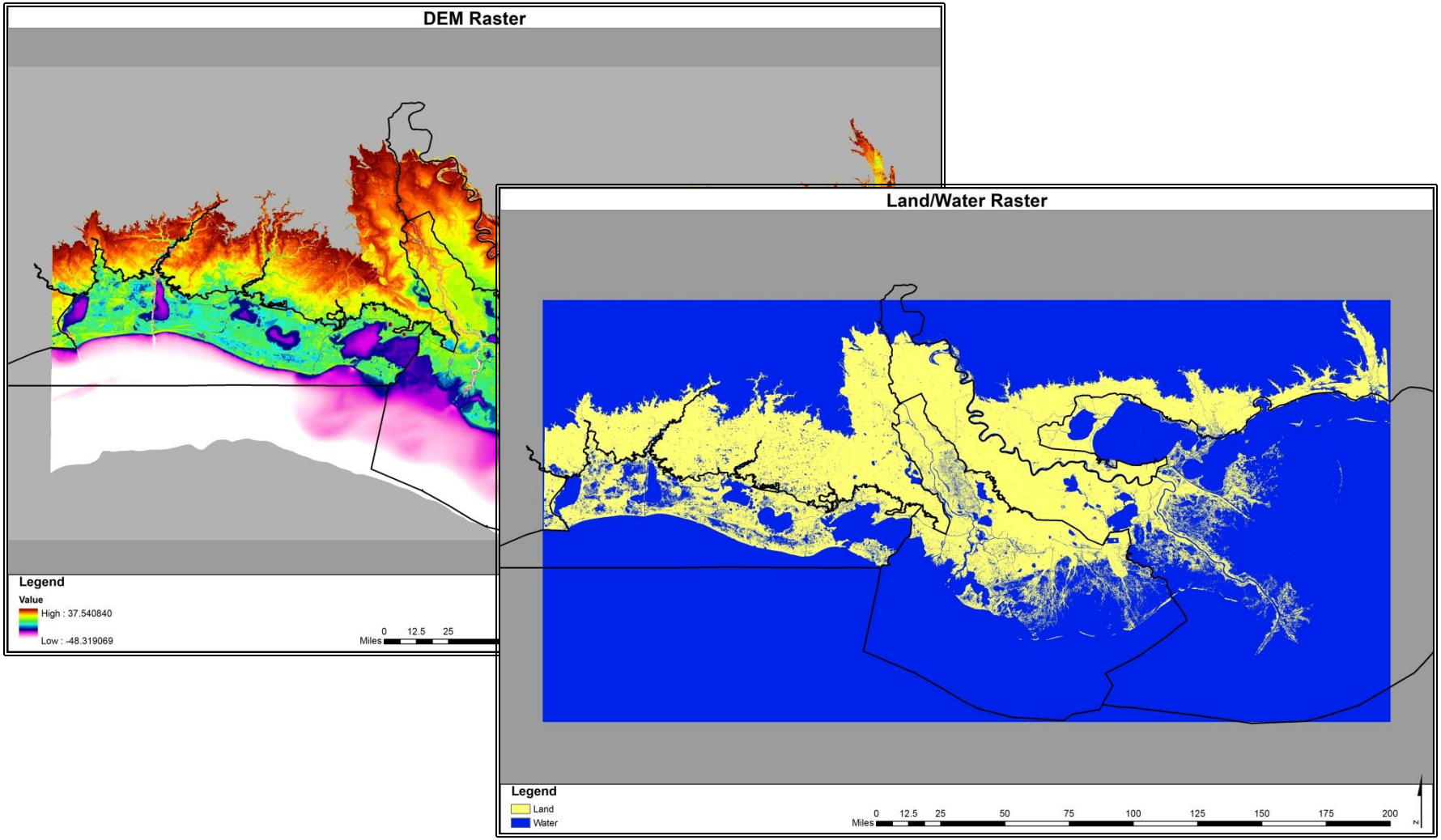


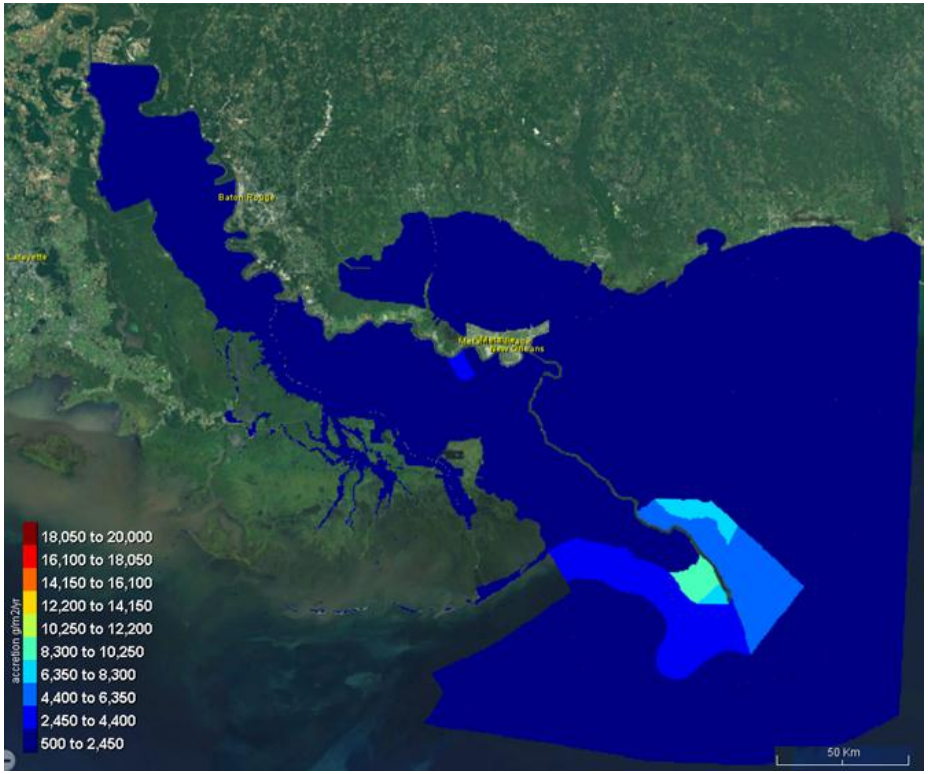
Master Plan

Primary Concerns

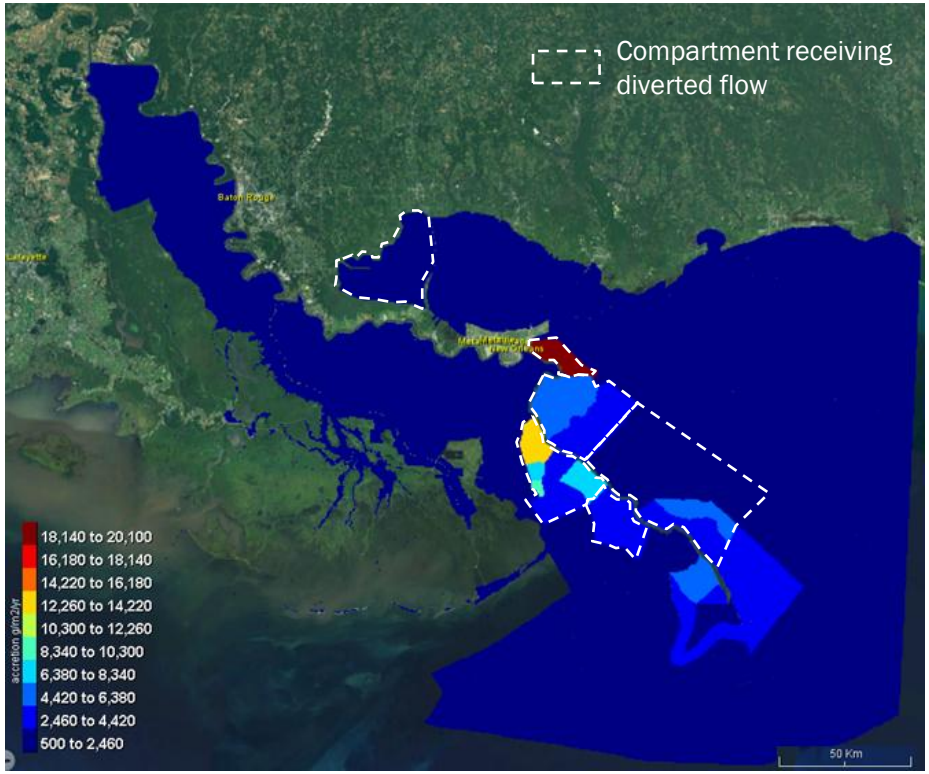
- PB region – Sediment Accretion
- AA region – Salinity and Sediment Accretion
- CP region – Salinity

PB Results - Cumulative Accretion over 50 years

Future Without Action
Less Optimistic Scenario

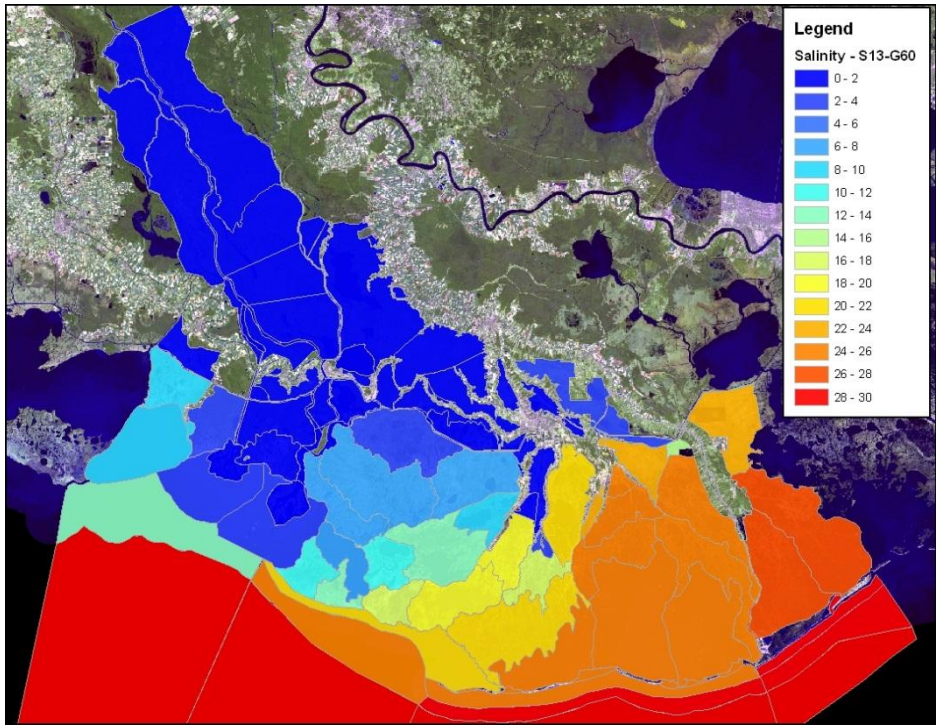


Master Plan
Less Optimistic Scenario

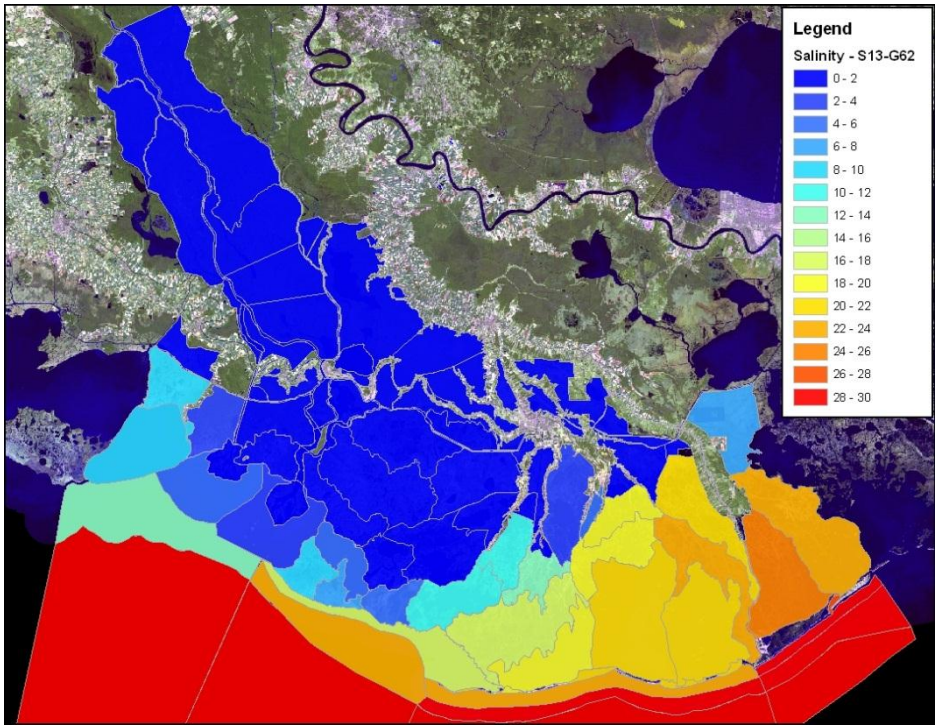


AA Results - Average Annual Salinity for 2nd 25 years

Future Without Action
Less Optimistic Scenario

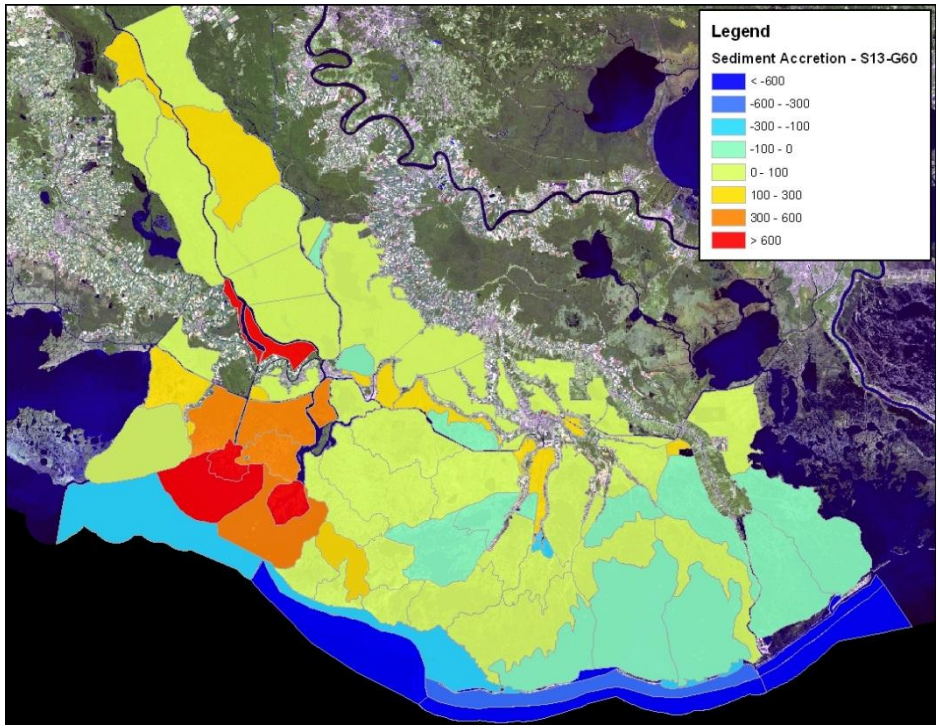


Master Plan
Less Optimistic Scenario

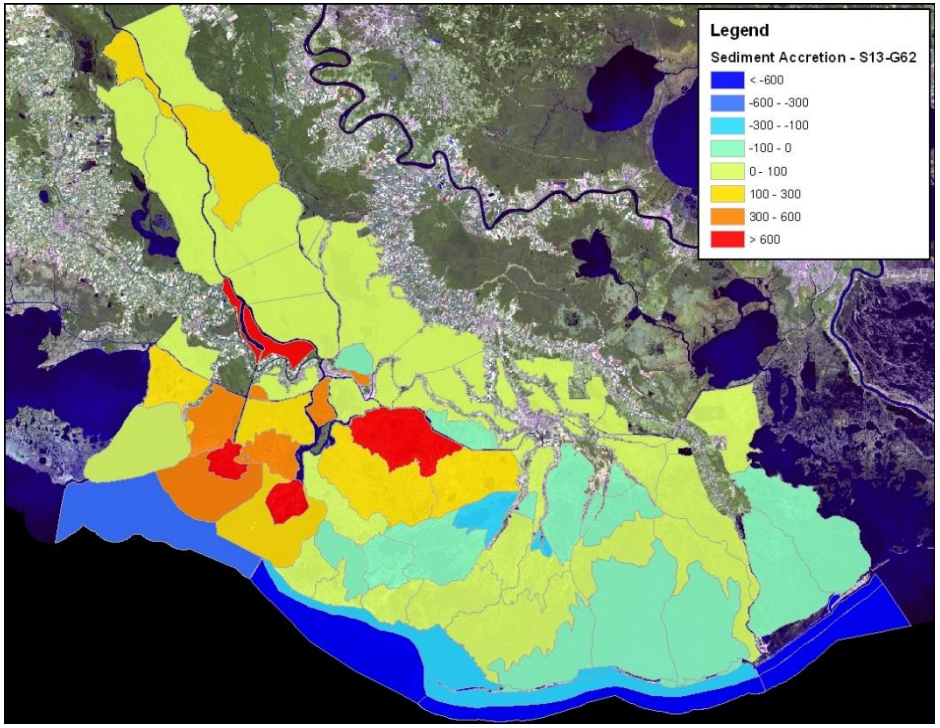


AA Results - Cumulative Accretion over 50 years

Future Without Action
Less Optimistic Scenario

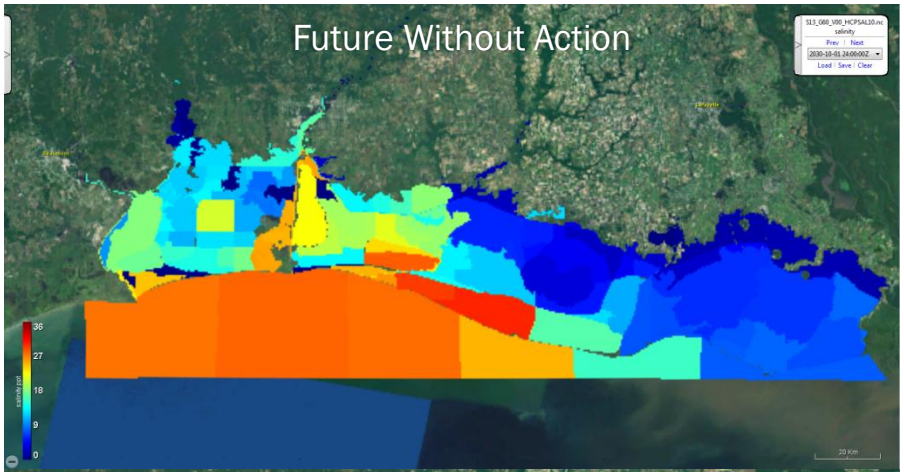


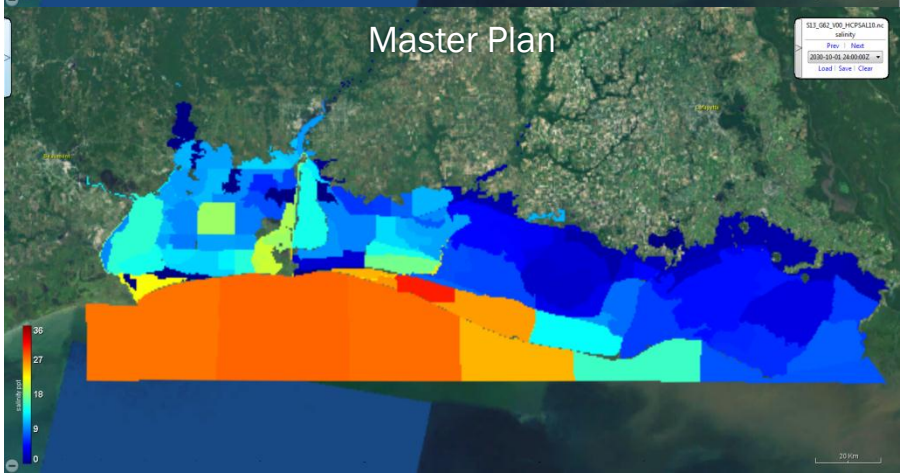
Master Plan
Less Optimistic Scenario



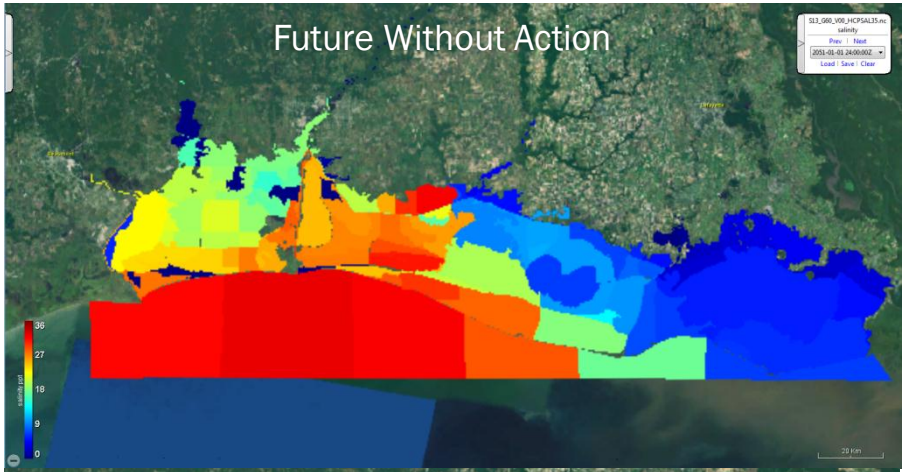
CP Results - Monthly Averaged Salinity

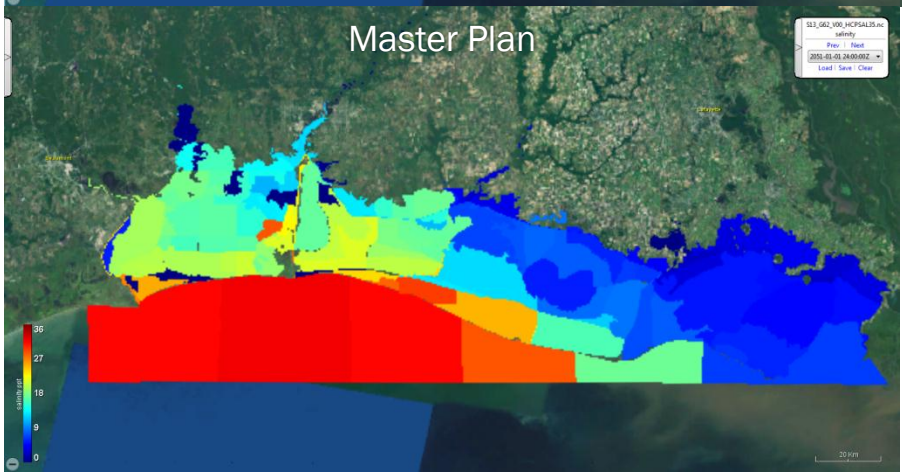
October 2030
Less Optimistic Scenario





January 2051
Less Optimistic Scenario





- **Eco-Hydrology group designed computationally efficient tools/models for the Louisiana Coast**
- **Models functioned as a component of integrated analysis approach**
- **A 50-year analysis was performed with a full landscape update at year-25**
- **Eco-Hydrology models provide assessment of relative project effects on the ecosystem hydrology**

For more information on these models, please visit the Master Plan website: http://www.coastalmasterplan.louisiana.gov/2012-master-plan/draft-2012-master-plan/


Thank You!