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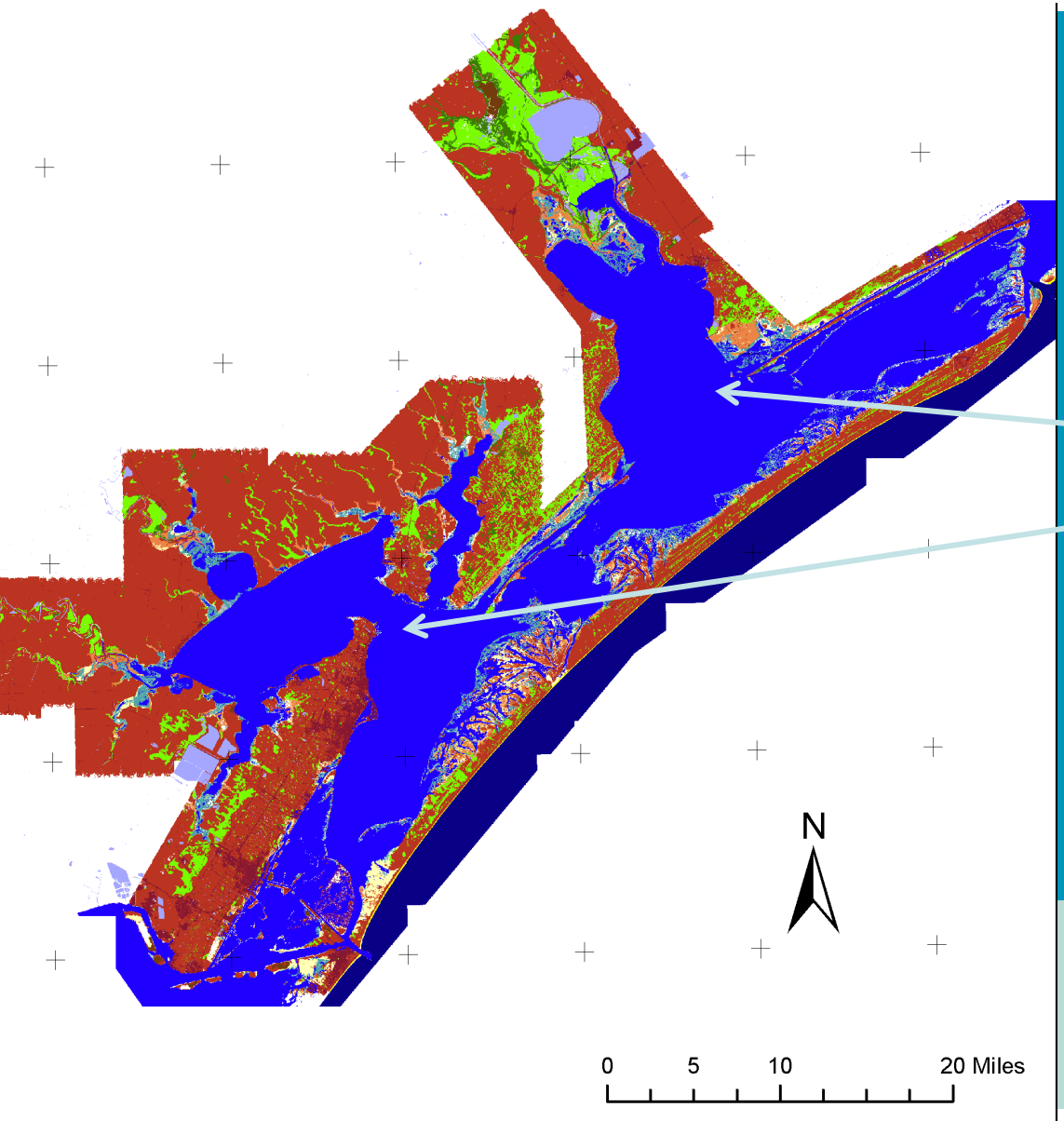
Prioritization of Critical Marsh Conservation and Restoration Areas based on Future Sea Level Rise Scenarios



Project Study Area:

- San Antonio Bay
- Copano Bay

Project Funded by the Coastal Management Program of the Texas General Land Office

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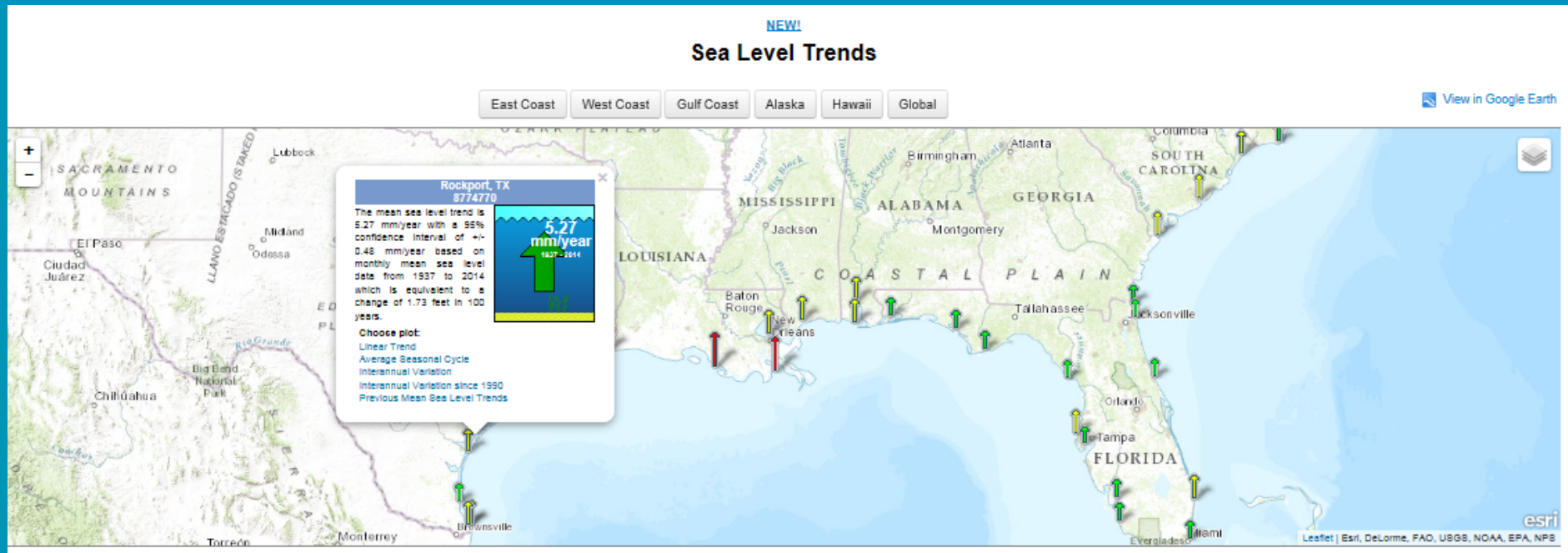
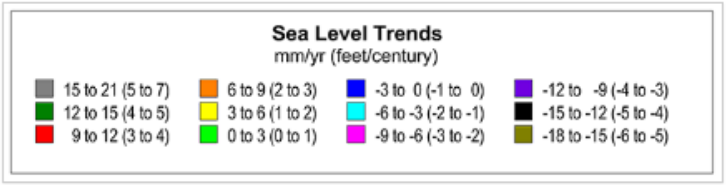
Why is Sea Level Rise Important?

Because it can be measured and trends are on the rise!



The map above illustrates regional trends in sea level, with arrows representing the direction and magnitude of change. Click on an arrow to access additional information about that station.



Corpus Christi 3.5 mm/yr
Freeport 4.3 mm/yr
Galveston 6.2 mm/yr

http://tidesandcurrents.noaa.gov/sltrends/sltrends.html

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Why is Sea Level Rise Important to us?

Sea Level Rise Will Affect You

- IPCC predicts increase of 26-98 cm by 2100 (not accounting for instability of marine ice sheets)
- NOAA accounts for max ice sheet loss, projecting a 200 cm rise by 2100.
- Future sea level rise will substantially alter the Gulf's coastal ecosystems, dependent species and human communities

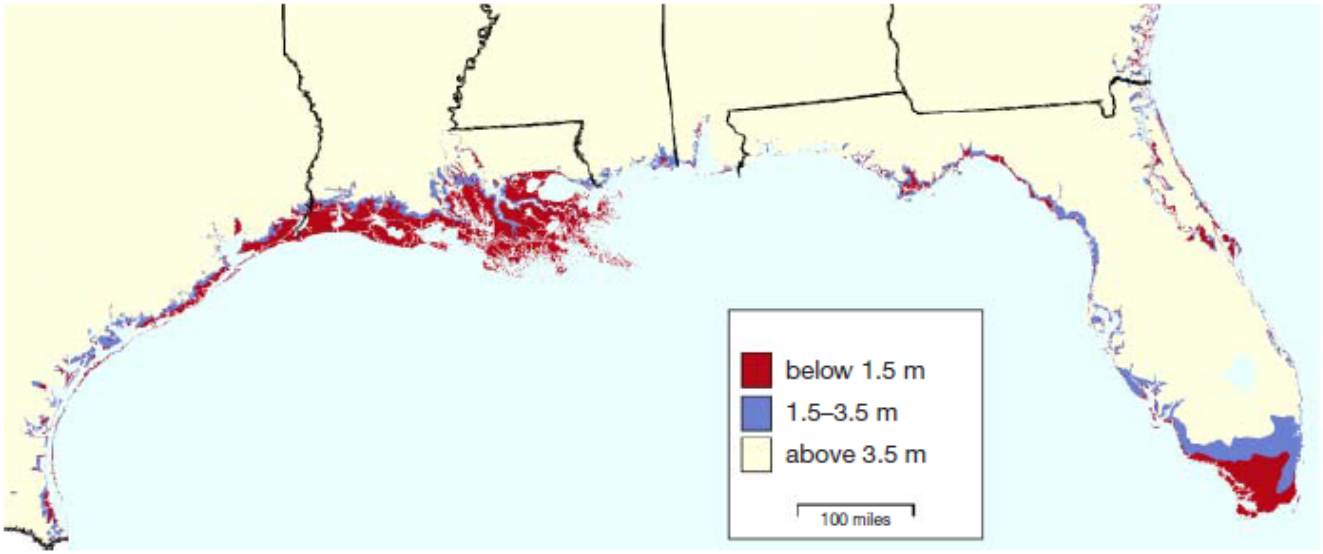


Fig. 4. Lands close to sea level: US Gulf Coast

Sources of SLR estimates: Mitrovica et al. 2009; Parris et al. 2012; Church et al. 2013.

SLAMM 6 Beta

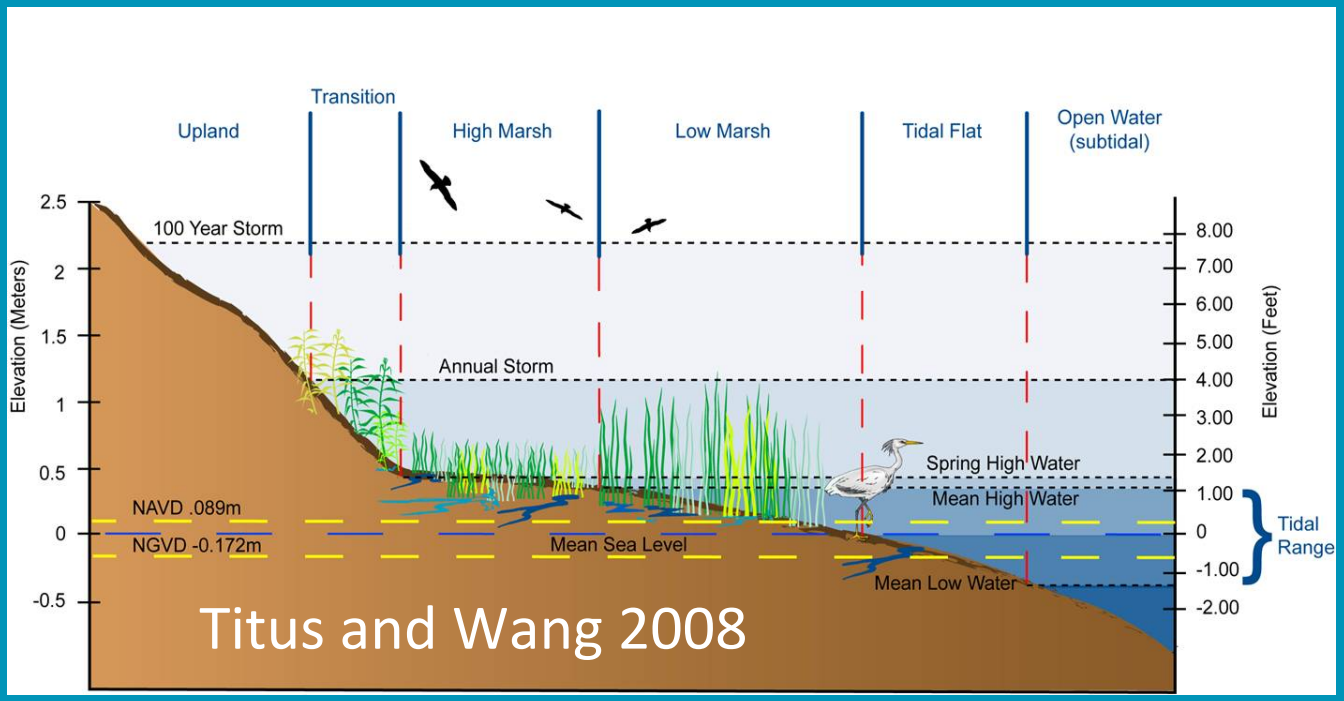
- Funded by the Nature Conservancy
  - Dynamic Accretion
  - Upgrade of Salinity Component (Bathymetry)
  - Open Source
  - Elevation Analyses
  - Increased Flexibility in Parameterization
  - Users Manual & Technical Documentation Update

Model Process Overview

Addresses Six Primary Processes –

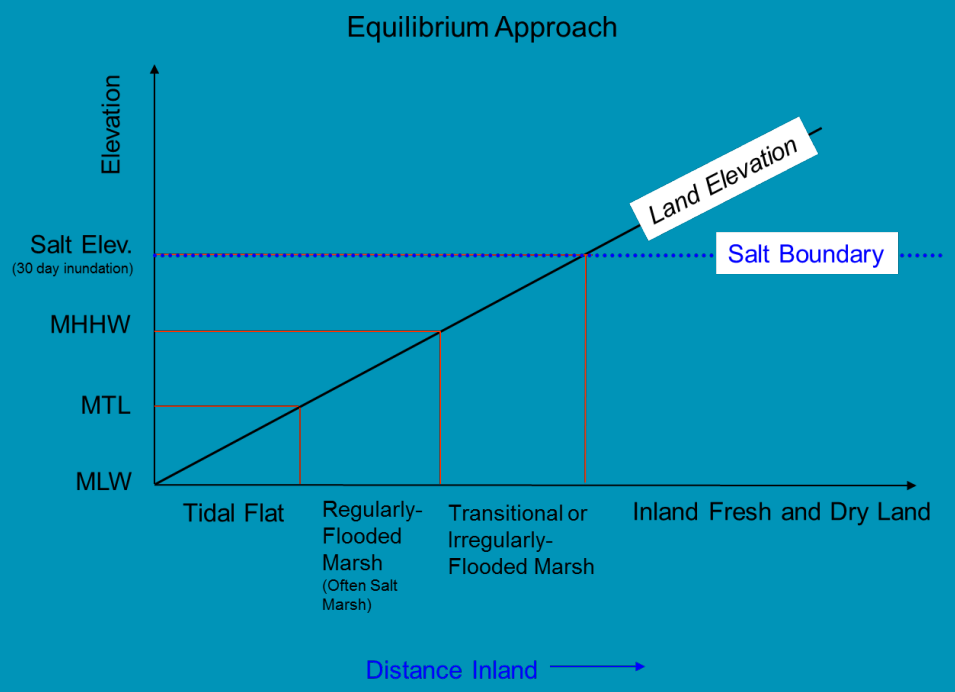
Inundation - Erosion - Saturation

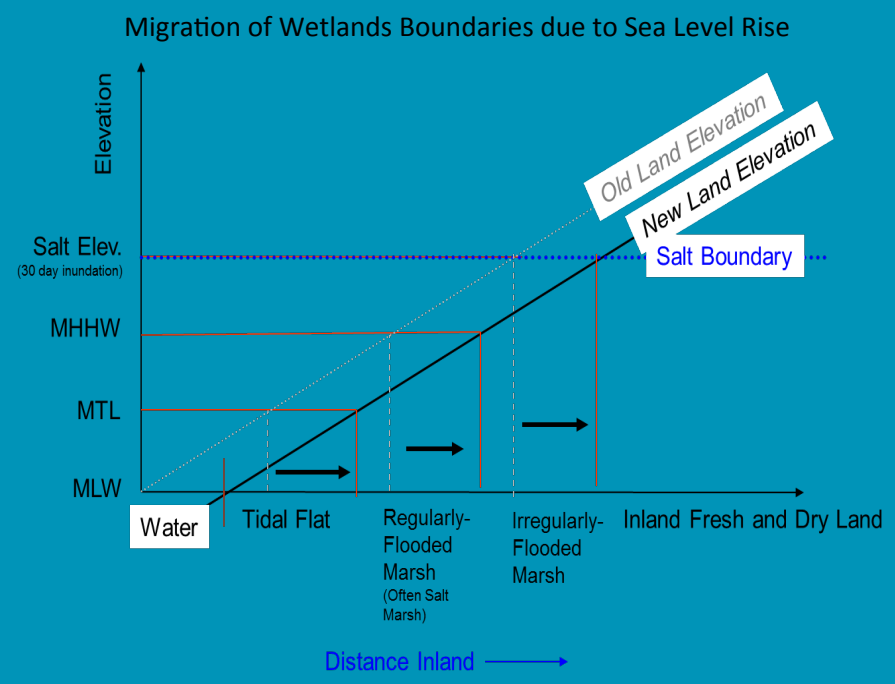
Overwash - Accretion - Salinity



Titus and Wang 2008

SLAMM Inundation Model





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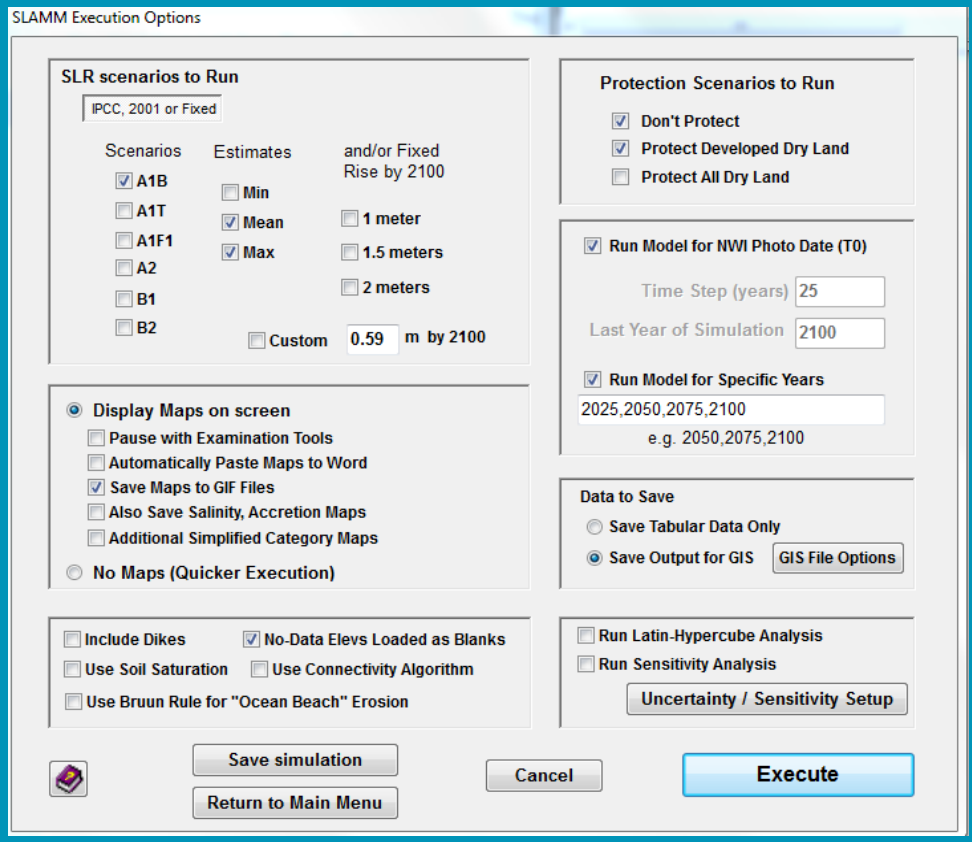
What We Did

- Modeled Sea Level Rise Impacts on Coastal Wetland Systems in the San Antonio and Copano Bay SLAMM
- Part of a larger study across the Gulf of Mexico
- Other partners are modeling other sites across the GOM



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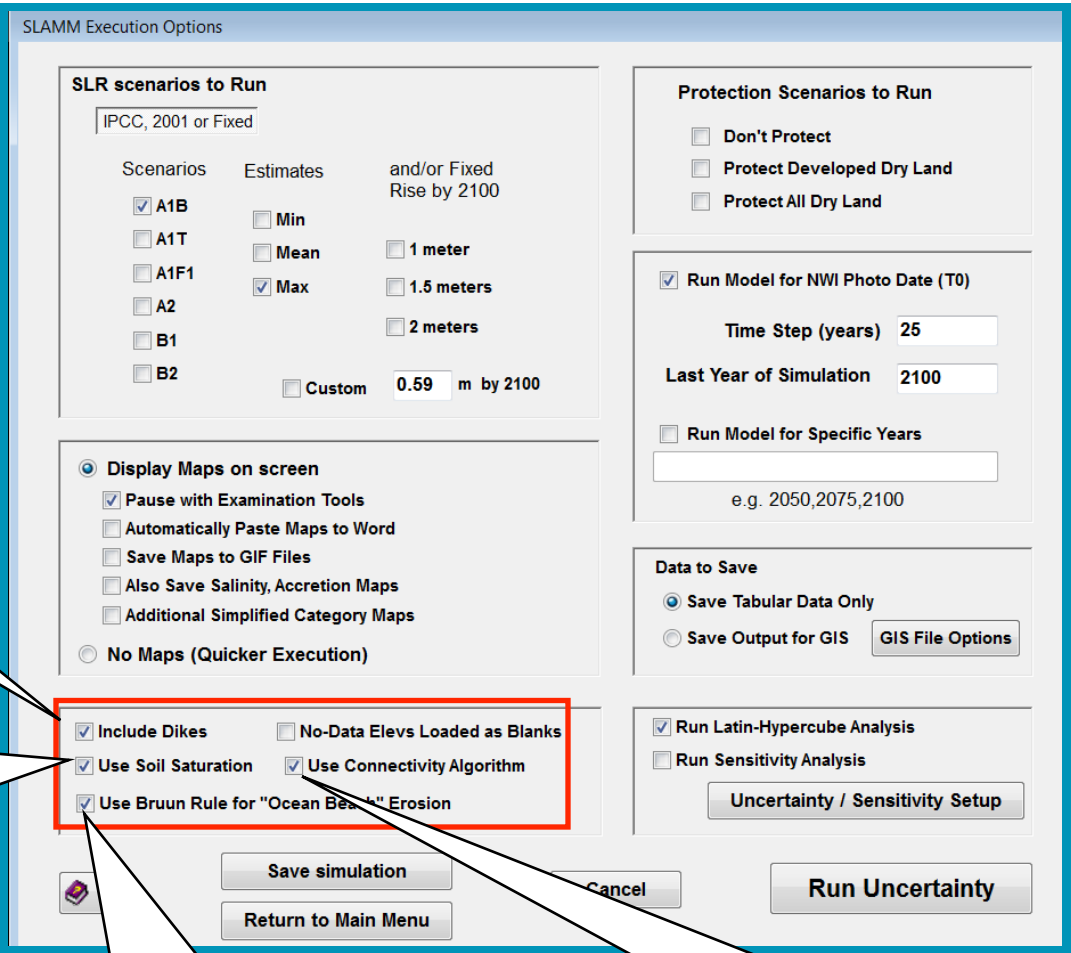
OPTIONAL SLAMM Capabilities
On / Off Switches



Include Dikes
Requires additional raster data layer

Soil Saturation
Models the conversion of dry land to freshwater wetlands due to changes in the water table. Does not affect Developed Dry Land.

Bruun Rule
Alternative implementation of beach erosion

Connectivity
When used, freshwater wetland and dry land categories will only become inundated with salt water if they are connected to a salt water source.

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SLAMM Inputs

Raster input files:

Elevation (LiDAR-derived, provided by Texas BEQ

Vegetation (NWI)

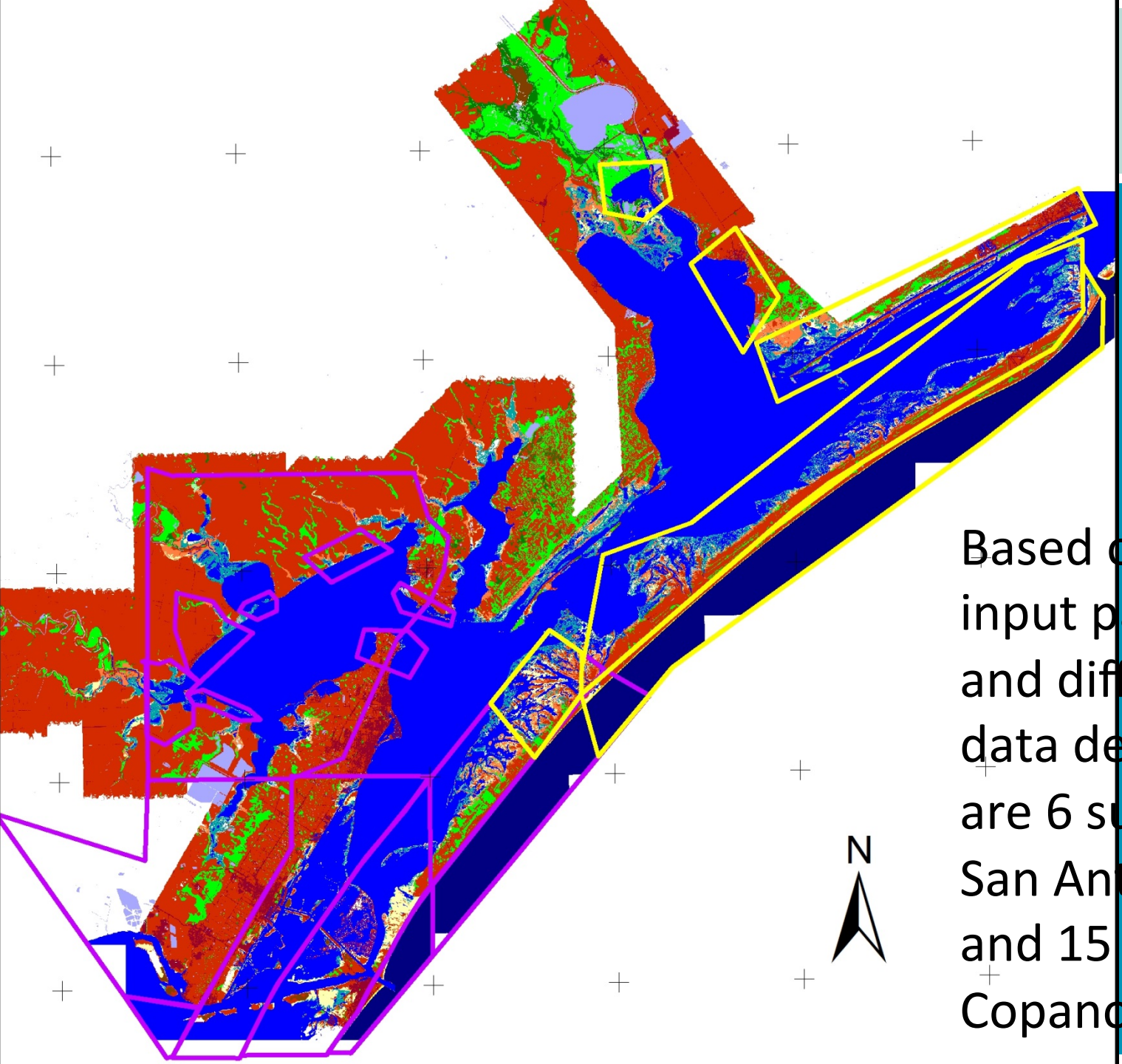
Tidal Elevation and Salt Elevation input parameters:

Historic trend in sea level rise (mm/yr).[1]

Great diurnal tide and NAVD88 correction.

Salt elevation (m above MTL), derived from data on NOAA Tides website (elevation boundary between saline wetlands and dry land or freshwater wetlands).

[1]NOAA Tides website: http://tidesandcurrents.noaa.gov/



Based on site input parameters and differences in data detail, there are 6 subsites in San Antonio Bay and 15 subsites in Copano Bay.

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How We Did It

Model Runs

5 SLR scenarios through year 2100:

- IPCC A1B mean (0.39 meters),
- IPCC A1B maximum (0.69 meters),
- 1 meter,
- 1.5 meters,
- 2 meters

- 1 protection scenario:
  - Protect Developed Dry Land

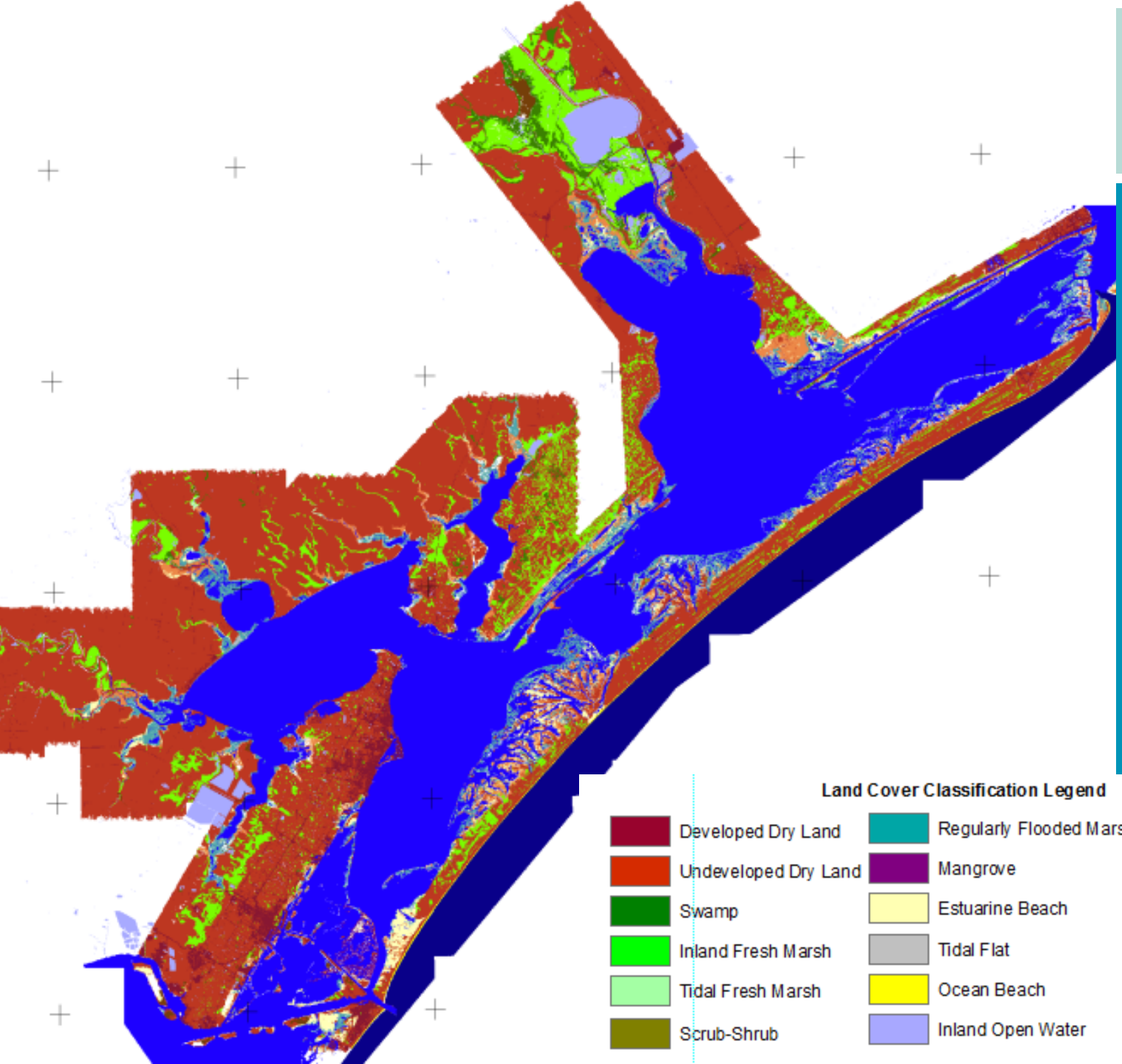
Model Output

- Graphic depiction of 2100 conditions
- Graphic depiction of difference
- Tabular quantitative results

Tabular Output examples

Scenario 1m (fixed) in San Antonio Bay	Year 2008	Year 2100	Change from	Percent Change
	(ha)	(ha)	2008 (ha)	(%)
Developed Dry Land	1,155.88	1,155.88	0.00	0.0
Undeveloped Dry Land	35,888.10	28,498.44	-7,389.66	(20.6)
Swamp	2,660.79	1,667.97	-992.82	(37.3)
Inland-Fresh Marsh	10,508.51	6,410.44	-4,098.07	(39.0)
Tidal-Fresh Marsh	5.98	0.88	-5.09	(85.2)
Trans. Salt Marsh	1,043.88	6,461.18	5,417.30	519.0
Regularly-Flooded Marsh	6,962.09	5,450.14	-1,511.95	(21.7)
Mangrove	118.21	87.84	-30.38	(25.7)
Estuarine Beach	2,900.81	70.44	-2,830.37	(97.6)
Tidal Flat	672.29	4,924.89	4,252.60	632.6
Ocean Beach	369.08	652.66	283.58	76.8
Inland Open Water	534.96	215.72	-319.24	(59.7)
Riverine Tidal	4.37	0.00	-4.36	(99.9)
Estuarine Open Water	239,168.16	249,984.33	10,816.17	4.5
Open Ocean	495.74	610.84	115.10	23.2
Irreg.-Flooded Marsh	4,119.38	459.75	-3,659.62	(88.8)
Inland Shore	475.04	431.83	-43.20	(9.1)

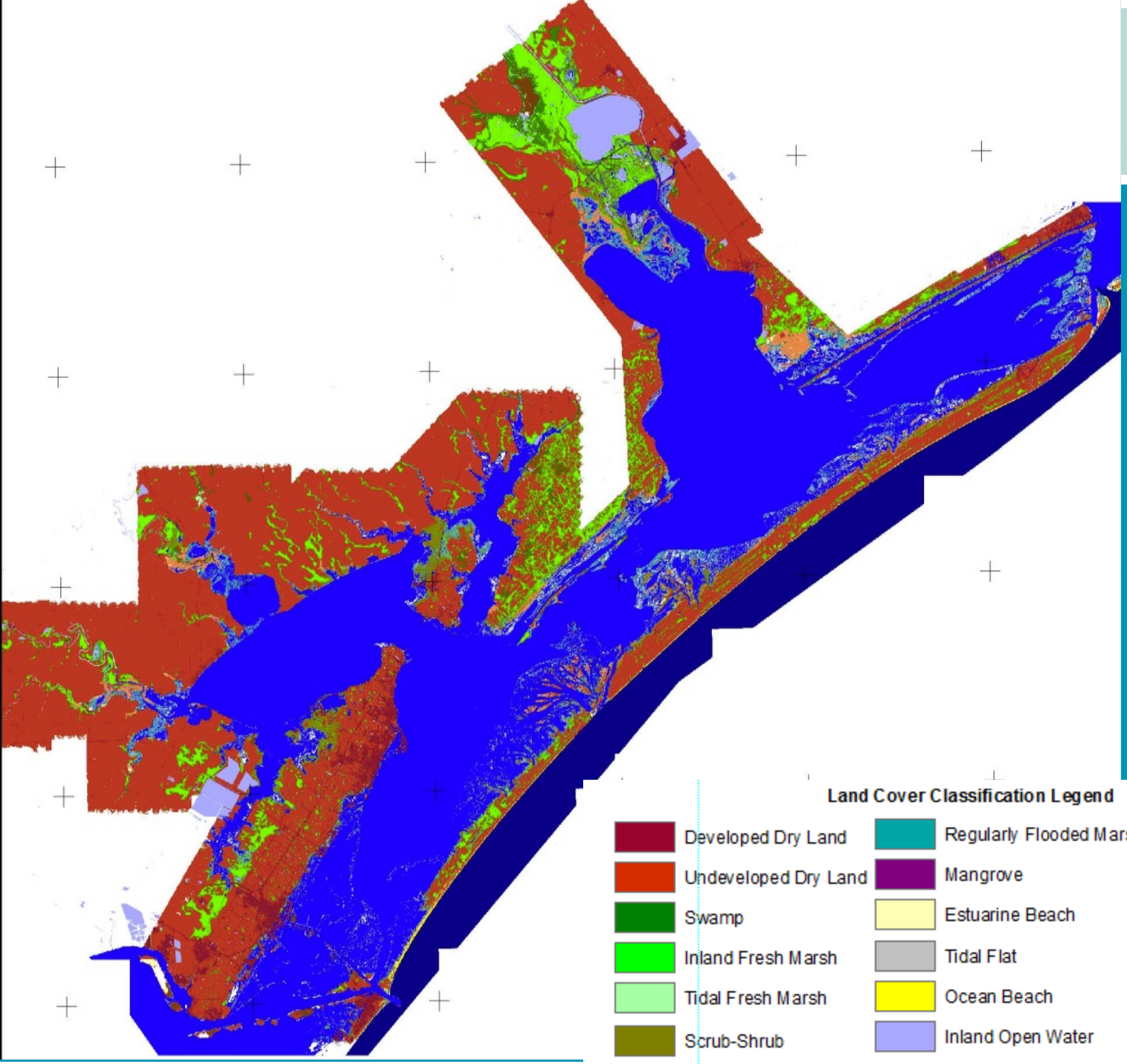
Initial Condition (2008)



Land Cover Classification Legend

- Developed Dry Land
- Undeveloped Dry Land
- Swamp
- Inland Fresh Marsh
- Tidal Fresh Marsh
- Scrub-Shrub
- Regularly Flooded Marsh
- Mangrove
- Estuarine Beach
- Tidal Flat
- Ocean Beach
- Inland Open Water
- Riverine Tidal
- Estuarine Water
- Open Ocean
- Irregularly Flooded Marsh
- Inland Shore
- Tidal Swamp

A1B Mean (0.39m) By 2100



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0.39 m SLR Scenario Results*

Lose:

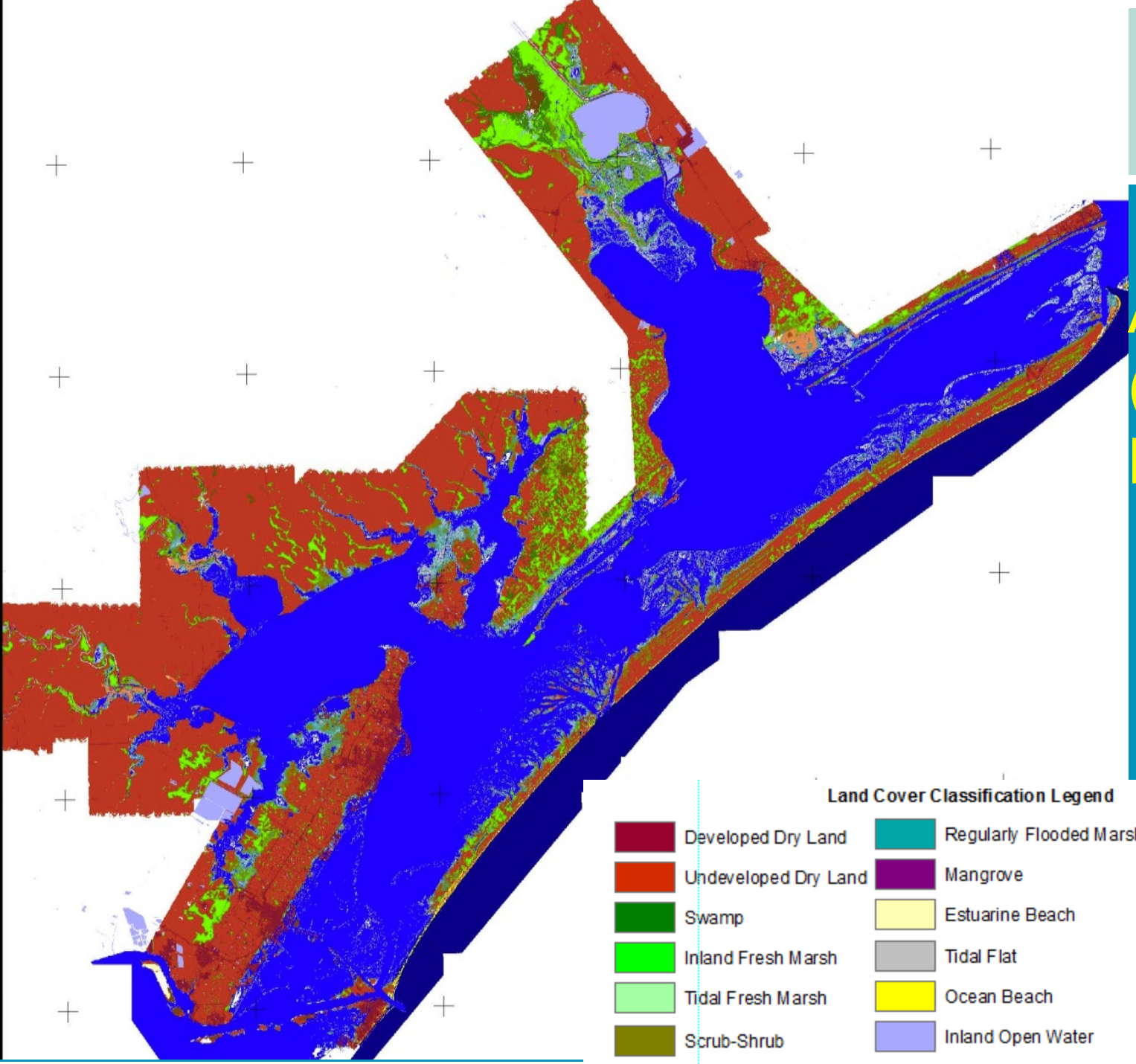
- Undeveloped dry land (-7.5%)
- Inland Fresh Marsh (-10.5%)
- Regularly Flooded Marsh (-29.6%)
- Estuarine Beach (-83.97%)

Gain:

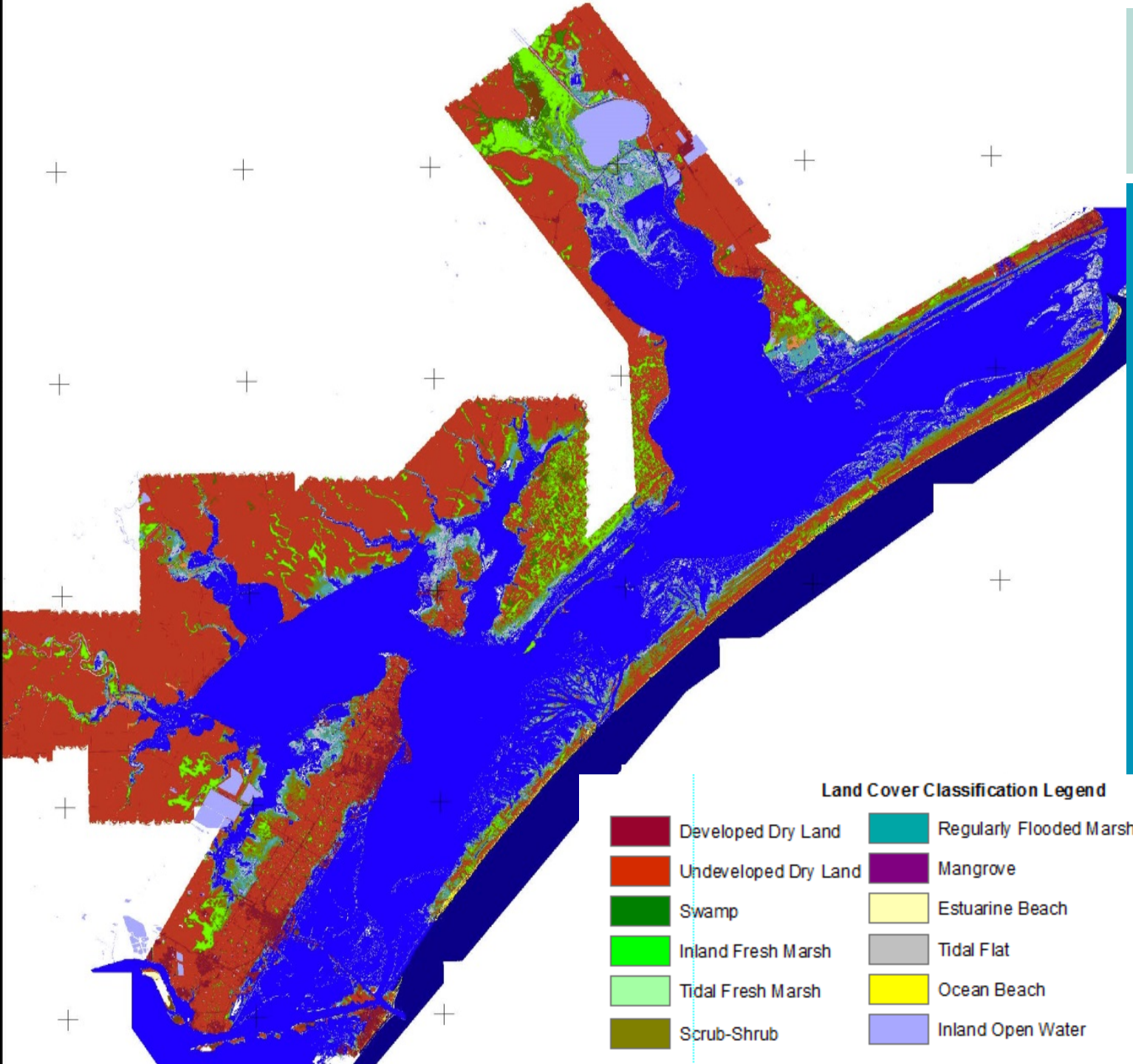
- Transitional saltmarsh (+309%)
- Tidal Flat (+227%)
- Estuarine Open Water (+2%)

Scenario	Year 2008	Year 2100	Chg. From 2008 (ha)	Change (%)
Developed Dry Land	1,155.88	1,155.88	0.00	0.00
Undeveloped Dry Land	35,888.10	33,202.46	-2,685.64	-7.48
Swamp	2,660.79	2,103.81	-556.98	-20.93
Inland-Fresh Marsh	10,508.51	9,405.18	-1,103.33	-10.50
Tidal-Fresh Marsh	5.98	4.94	-1.03	-17.31
Trans. Salt Marsh	1,043.88	4,273.38	3,229.50	309.37
Regularly-Flooded Marsh	6,962.09	4,901.54	-2,060.55	-29.60
Mangrove	118.21	117.81	-0.40	-0.34
Estuarine Beach	2,900.81	464.98	-2,435.83	-83.97
Tidal Flat	672.29	2,197.91	1,525.62	226.93
Ocean Beach	369.08	361.68	-7.39	-2.00
Inland Open Water	534.96	268.12	-266.83	-49.88
Riverine Tidal	4.37	0.01	-4.36	-99.83
Estuarine Open Water	239,168.11	244,213.08	5,044.97	2.11
Open Ocean	495.74	557.78	62.05	12.52
Irreg.-Flooded Marsh	4,119.38	3,405.23	-714.14	-17.34
Inland Shore	475.04	449.39	-25.65	-5.40

*Includes only changes of 1,000 ha or greater from San Antonio Bay



A1B Max (0.69m) By 2100



1 meter By 2100

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1.0 m SLR Scenario Results*

Lose:

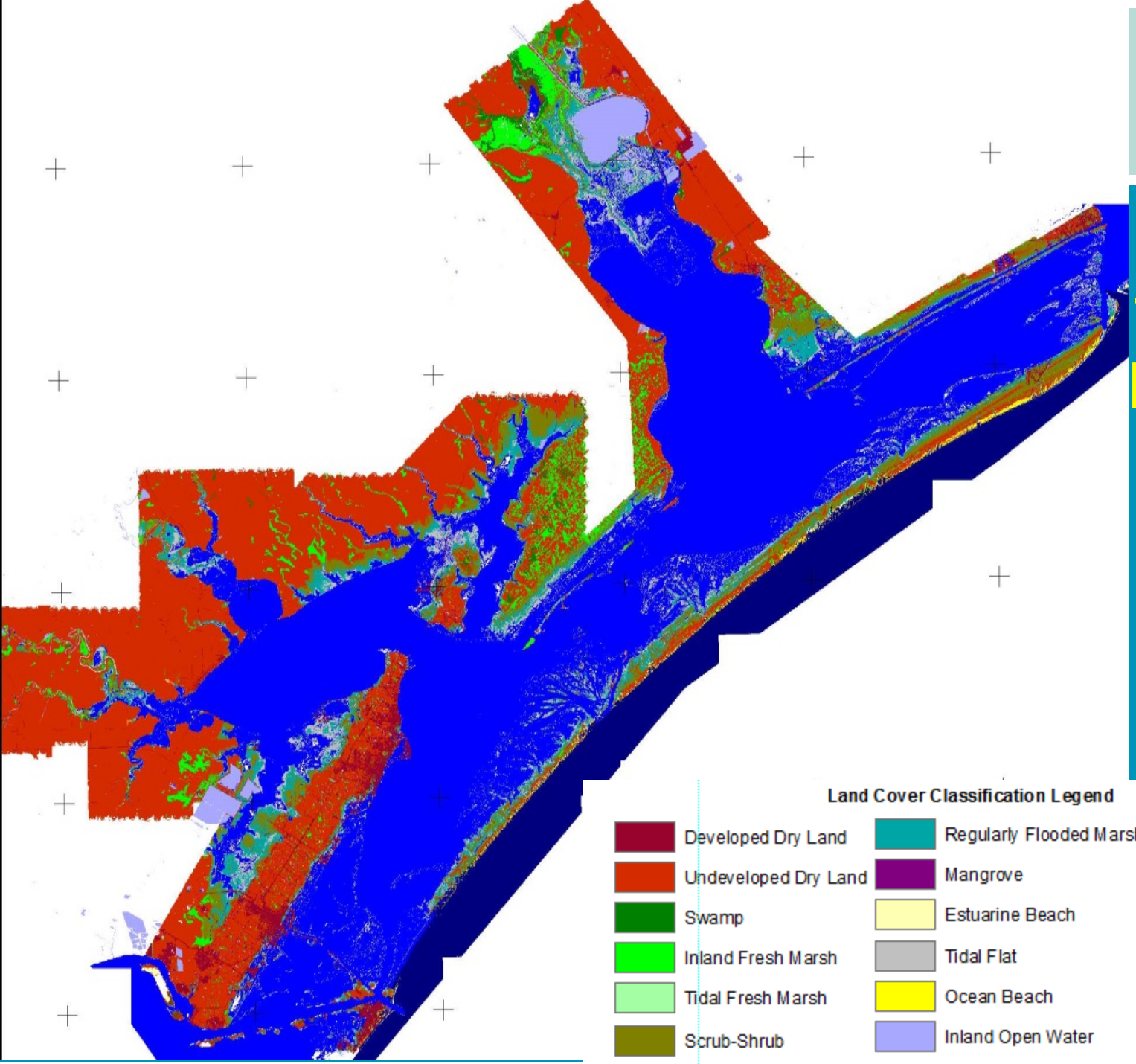
- Undeveloped Dry Land (-20.6%)
- Inland Fresh Marsh (-39.0%)
- Regularly Flooded Marsh (-21.7%)
- Estuarine Beach (-97.6%)
- Irregularly Flooded Marsh (-88.8%)

Gain:

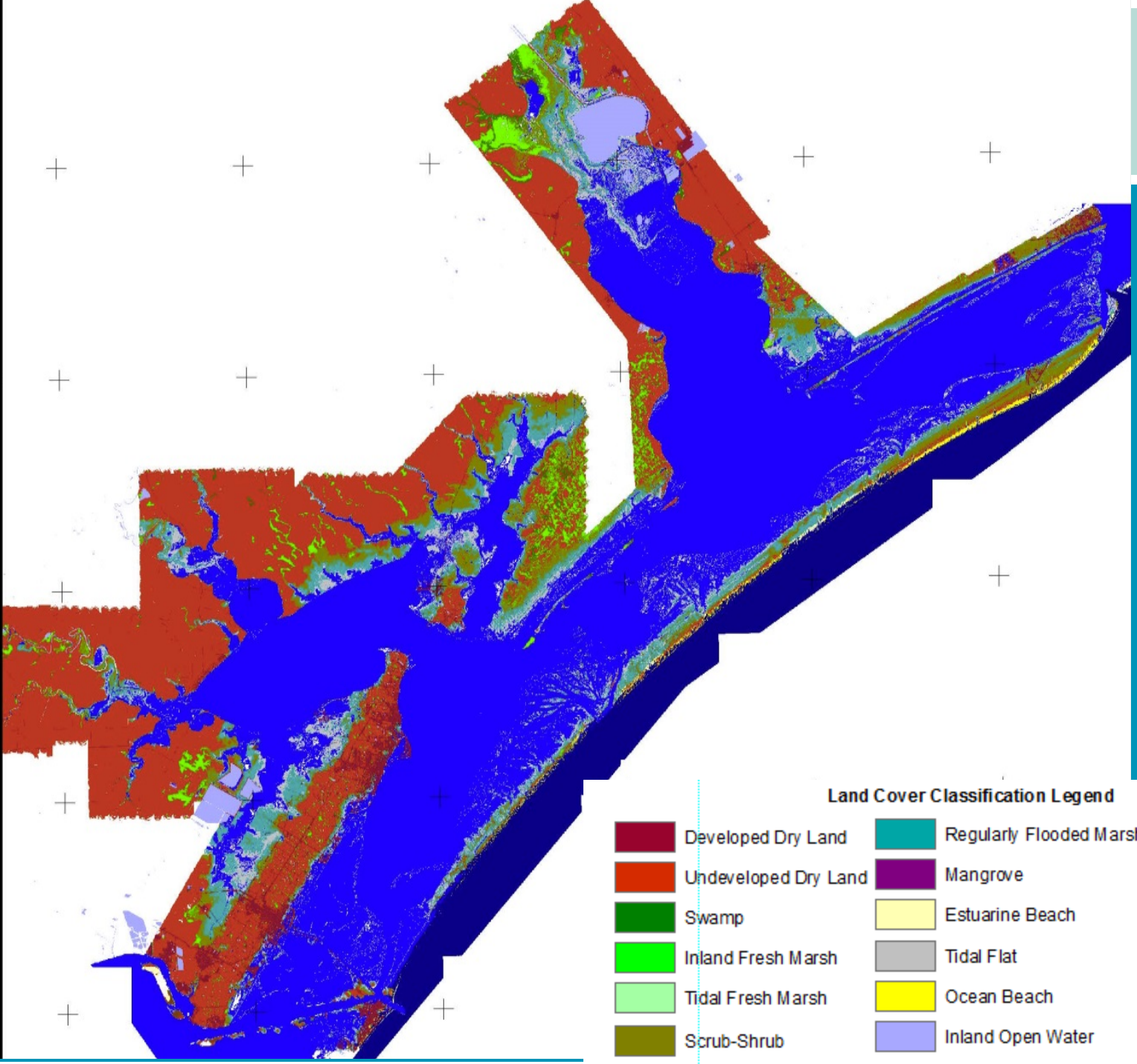
- Transitional saltmarsh (+519%)
- Tidal Flat (+632.6%)
- Estuarine Open Water (+4.5%)

*Includes only changes of 1,000 ha or greater for San Antonio Bay

Scenario 1m (fixed) in San Antonio Bay	Year 2008	Year 2100	Change from	Percent Change
	(ha)	(ha)	2008 (ha)	(%)
Developed Dry Land	1,155.88	1,155.88	0.00	0.0
Undeveloped Dry Land	35,888.10	28,498.44	-7,389.66	(20.6)
Swamp	2,660.79	1,667.97	-992.82	(37.3)
Inland-Fresh Marsh	10,508.51	6,410.44	-4,098.07	(39.0)
Tidal-Fresh Marsh	5.98	0.88	-5.09	(85.2)
Trans. Salt Marsh	1,043.88	6,461.18	5,417.30	519.0
Regularly-Flooded Marsh	6,962.09	5,450.14	-1,511.95	(21.7)
Mangrove	118.21	87.84	-30.38	(25.7)
Estuarine Beach	2,900.81	70.44	-2,830.37	(97.6)
Tidal Flat	672.29	4,924.89	4,252.60	632.6
Ocean Beach	369.08	652.66	283.58	76.8
Inland Open Water	534.96	215.72	-319.24	(59.7)
Riverine Tidal	4.37	0.00	-4.36	(99.9)
Estuarine Open Water	239,168.16	249,984.33	10,816.17	4.5
Open Ocean	495.74	610.84	115.10	23.2
Irreg.-Flooded Marsh	4,119.38	459.75	-3,659.62	(88.8)
Inland Shore	475.04	431.83	-43.20	(9.1)



1.5 meter By 2100



2 meters By 2100

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Why is this Important?

<u>Modeling Future Conditions Will:</u>

Give us insight on potential future impacts to coastal wetlands and dependent species;

Assist with development of strategies to facilitate adaptation of vulnerable species, habitats and human communities to new circumstances.