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The Effects of Sea Level Rise on Coastal Habitats and Vulnerable Species at Six of Florida’s Gulf Coast Estuaries

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Gulf of Mexico Program

National Oceanic and Atmospheric Administration, U.S. Department of Commerce, NOAA

EPA United States Environmental Protection Agency

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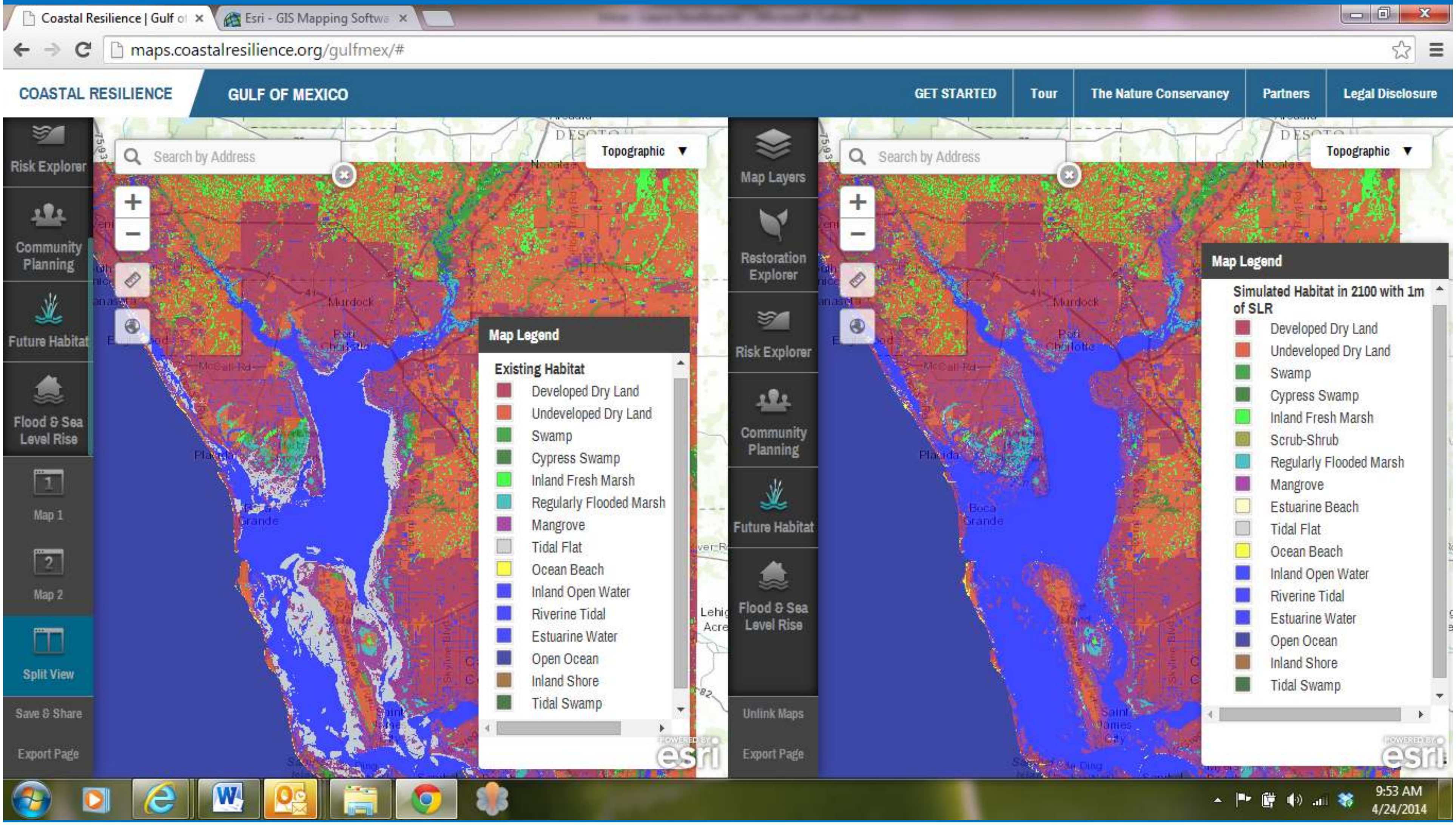
Maps.CoastalResilience.org

Charlotte Harbor current conditions and under 1 m SLR



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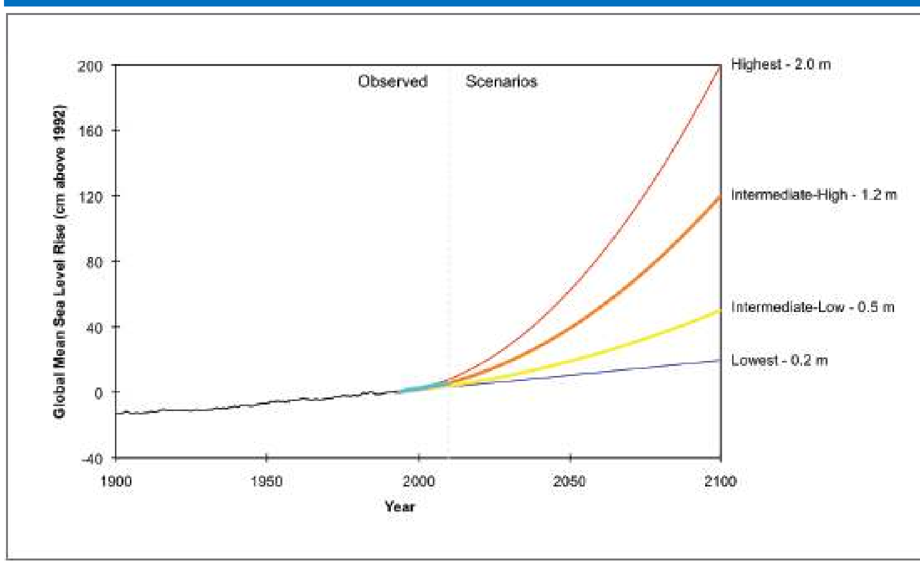
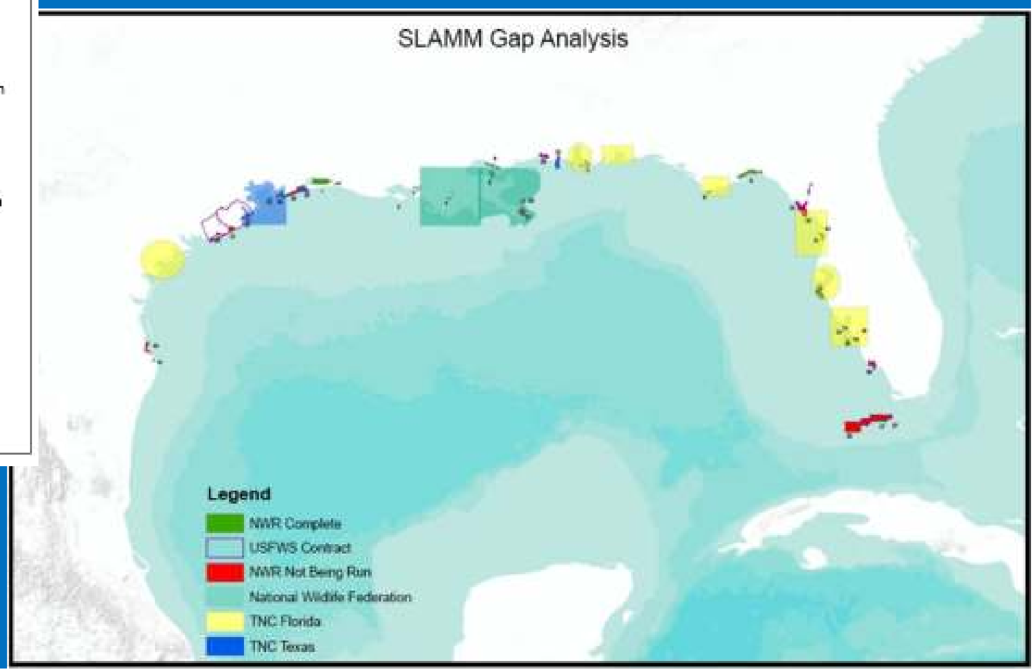
What We Did

- Modeled Sea Level Rise Impacts on Coastal Wetland Systems at 6 Florida Gulf estuaries using the Sea Level Affecting Marshes Model (SLAMM) under three sea level rise scenarios: 0.7, 1 m and 2 m
- Part of a larger body of work across the Gulf of Mexico
- Other partners have modeled other GOM sites



From: Parris, A., P. Bromirski, V. Burkett, D. Cayan, M. Culver, J. Hall, R. Horton, K. Knuuti, R. Moss, J. Obeysekera, A. Sallenger, and J. Weiss. 2012. Global Sea Level Rise Scenarios for the US National Climate Assessment. NOAA Tech Memo OAR CPO-1. 37 pp.



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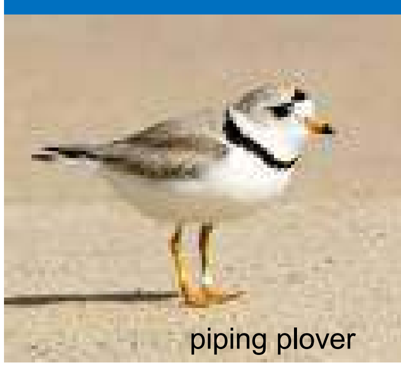
Why We Did It

- <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.


piping plover


Nueces Delta

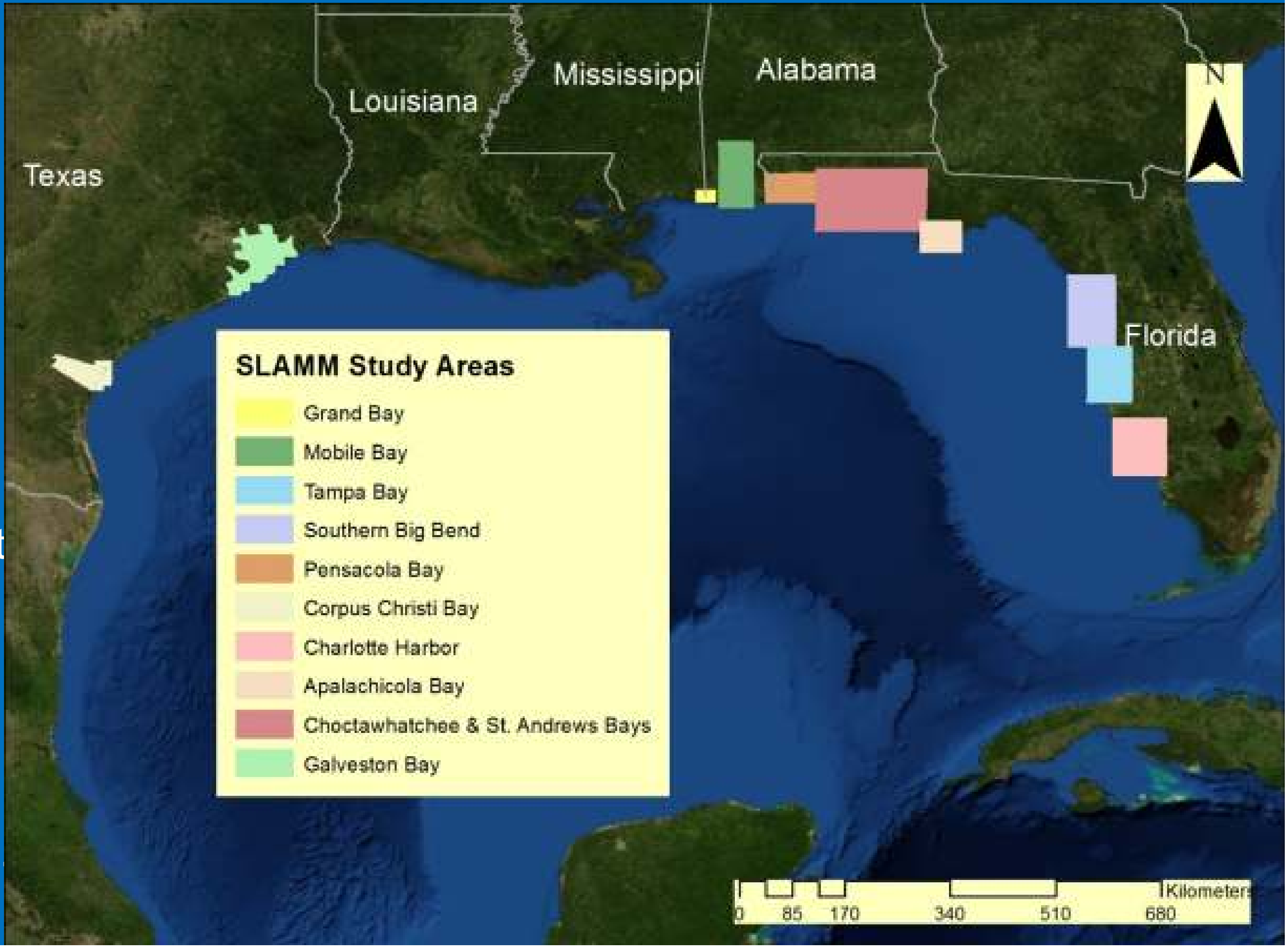

Corpus Christi


Green sea turtle

TNC's SLR Modeling in the Gulf of Mexico

10 Study Areas;
3 SLR scenarios:
0.7, 1 & 2 m

Potential future impact on coastal wetlands, dependent species and human communities.



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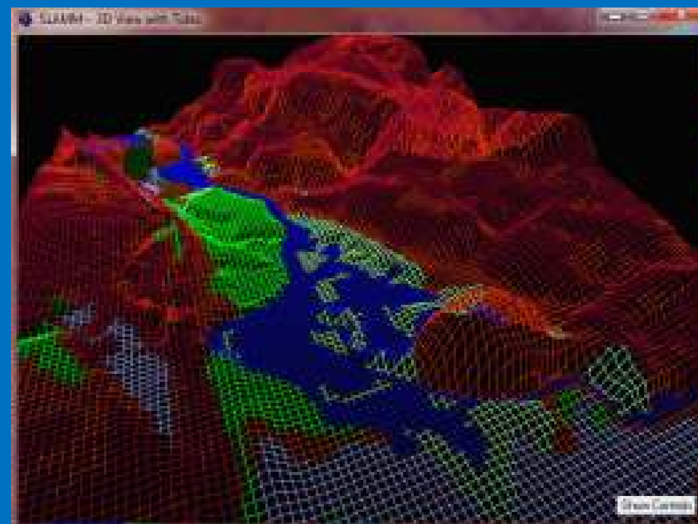
How We Did It

Using SLAMM, we modeled SLR impacts on coastal wetland systems under 3 SLR scenarios (IPCC A1B max (0.69 m), 1 m, 2 m) and examined the impacts on coastal wetland systems, associated vulnerable species and adjacent dry land areas.



3-D representation of wetland distribution

Why SLAMM:

- Relatively easy to use;
- In wide use (USFWS, NGOs, NEPs);
- Developed by EPA
- Open source
- Available at: http://warrenpinnacle.com.

How We Did It, cont'd

How SLAMM Works

Simulates five primary processes that affect wetland fate under different scenarios of sea-level rise:

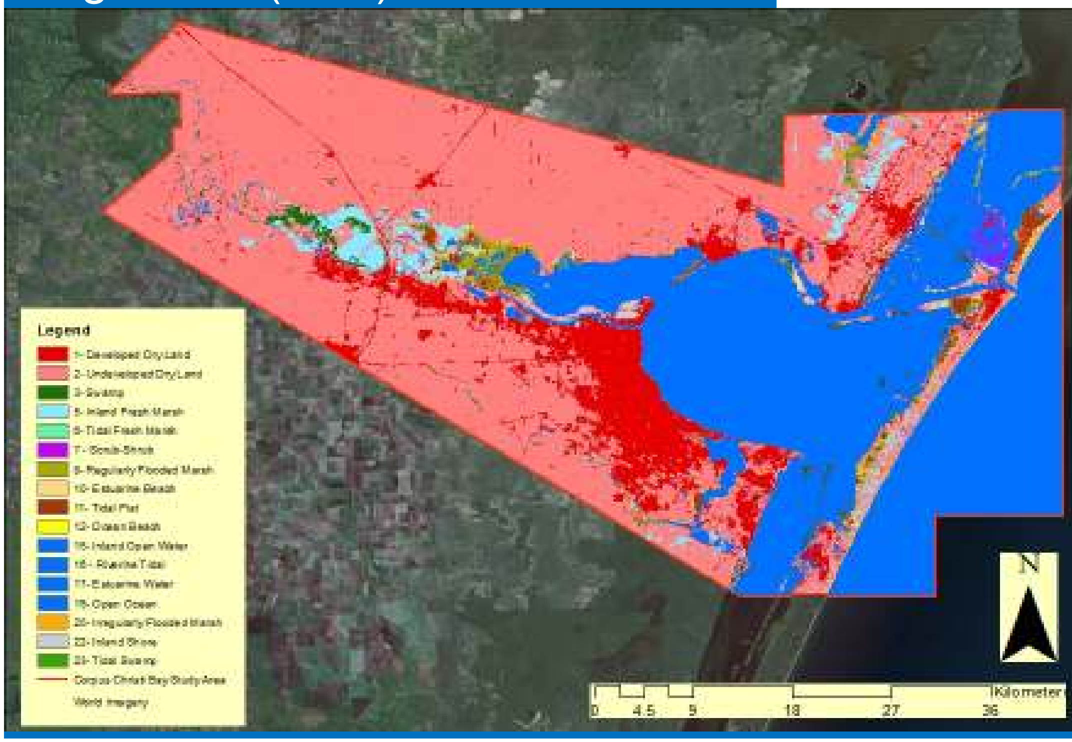
- Inundation,
- Erosion,
- Overwash,
- Saturation,
- Accretion.

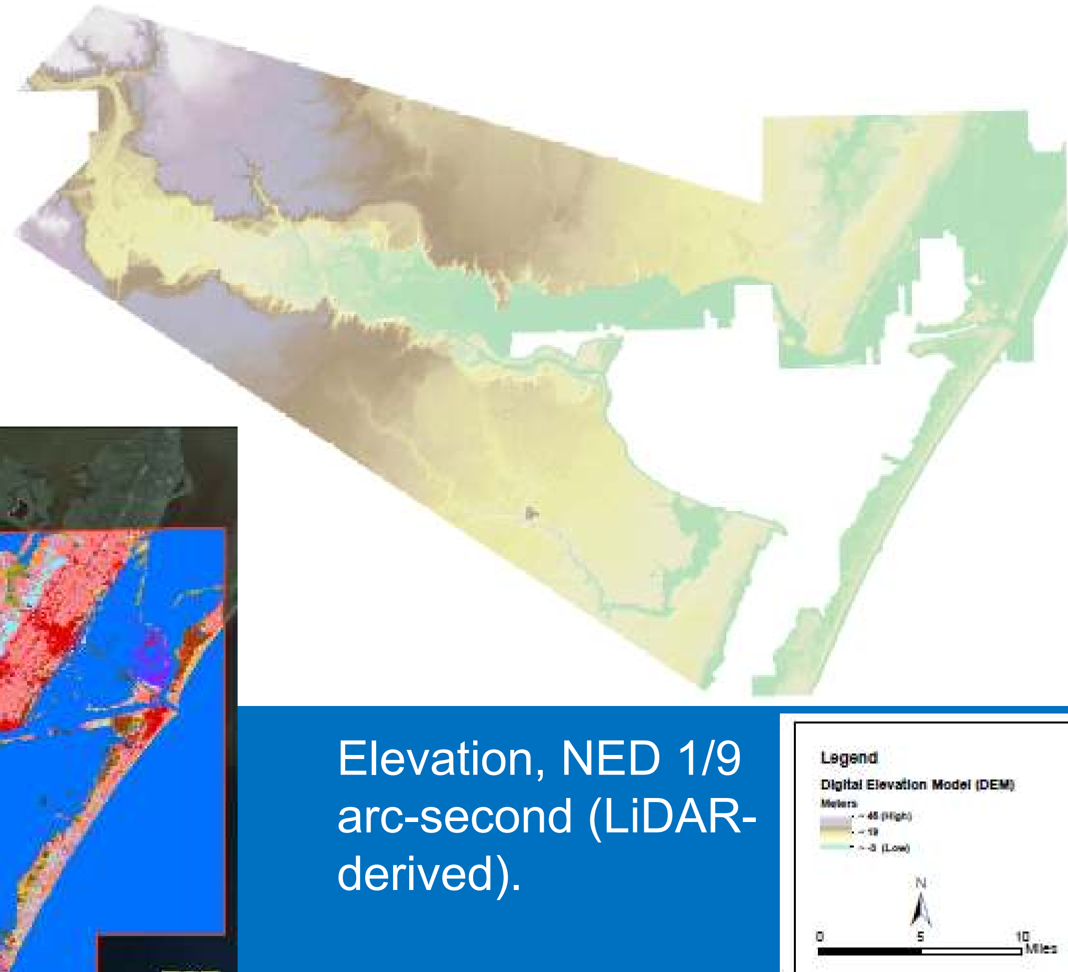
As with all models input data is very important and outputs need to be assessed with a critical eye.

How We Did It, cont'd
SLAMM Inputs

Raster input files

Vegetation (NWI)





Elevation, NED 1/9 arc-second (LiDAR-derived).

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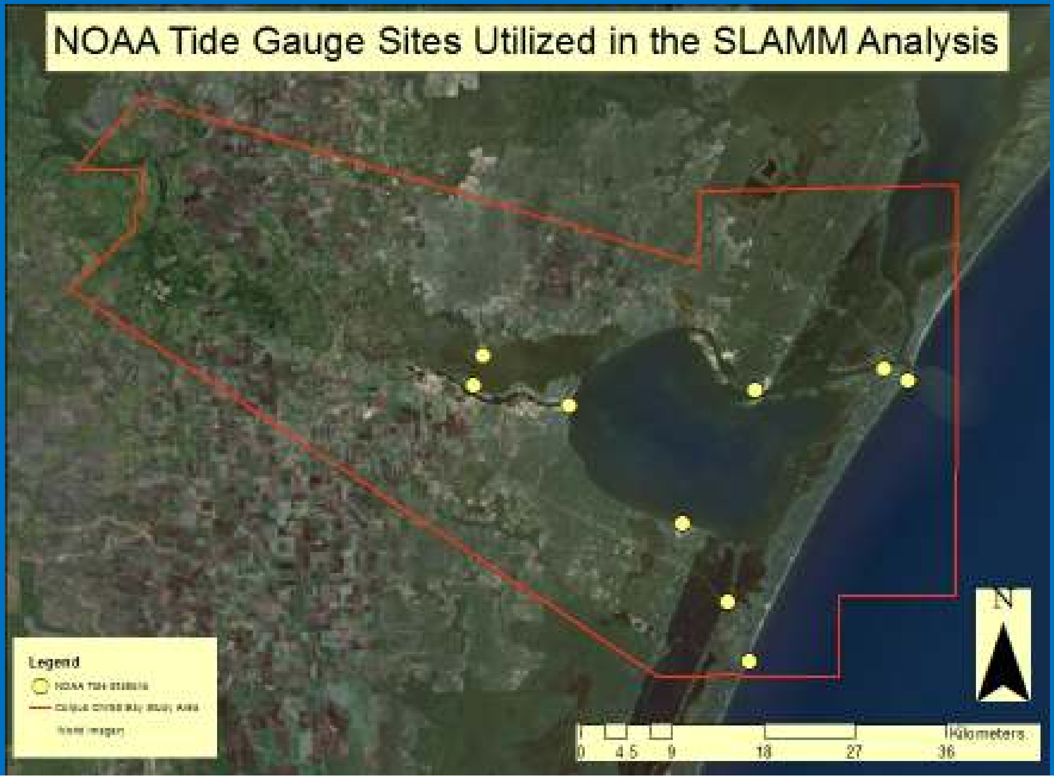
How We Did It
SLAMM Inputs, cont'd

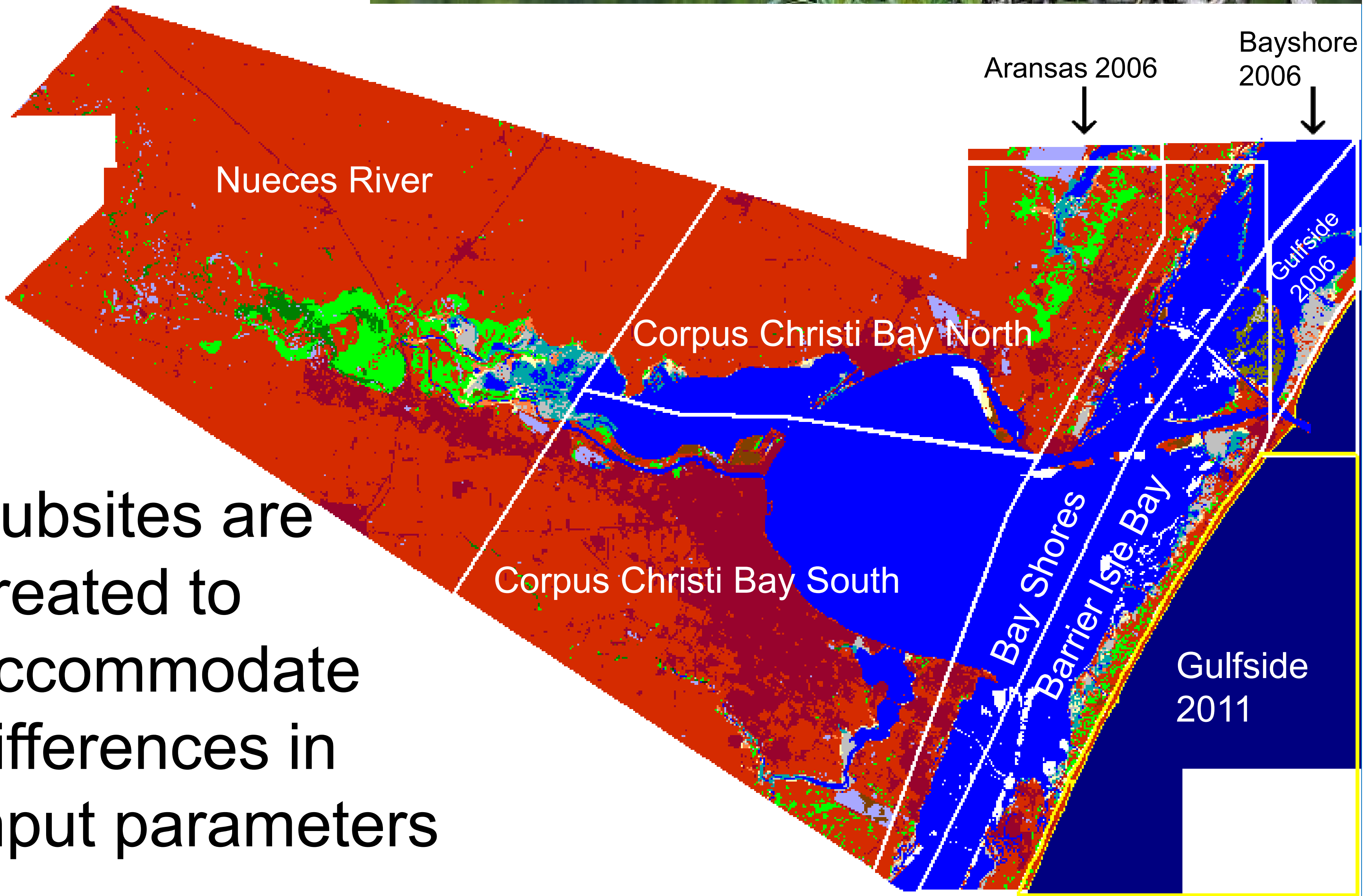
Tidal Elevation and Salt Elevation input parameters:

- All from data on NOAA Tides website[1]
- Historic trend in sea level rise, (3.5 mm/yr)
- Great diurnal tide and NAVD88 correction
- Salt elevation (m above MTL; elevation boundary between saline wetlands and dry land or freshwater wetlands; calculated from NOAA data).



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

Subsites



Subsites are created to accommodate differences in input parameters

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SLAMM Inputs, cont'd

Other Input Parameters: Accretion, Erosion and Sedimentation Rates

- Accretion rate (vertical mm/yr) salt marsh and brackish marsh (Radosavljevic, Gibeaut, Tissot 2012); tidal freshwater marsh (Warren Pinnacle, 2011)
- Erosion rates (horizontal m/yr) for marsh, tidal flats (Morton & Paine, 1984); for Nueces River site it was Tremblay et. al. 2008; swamp, little, used general erosion rate from: Nueces County/Corpus Christi Erosion Response Plan, 2012.
- Sedimentation rate for tide flat and beach are the same. Source is: Radosavljevic, Gibeaut, Tissot 2012.

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How We Did It, cont'd

Model Runs

- 3 SLR scenarios through year 2100:
  - IPCC A1B maximum (0.69 meters),
  - 1 meter,
  - 2 meters
- 2 protection scenarios:
  - Protect Developed Dry Land
  - Developed Dry Land Unprotected

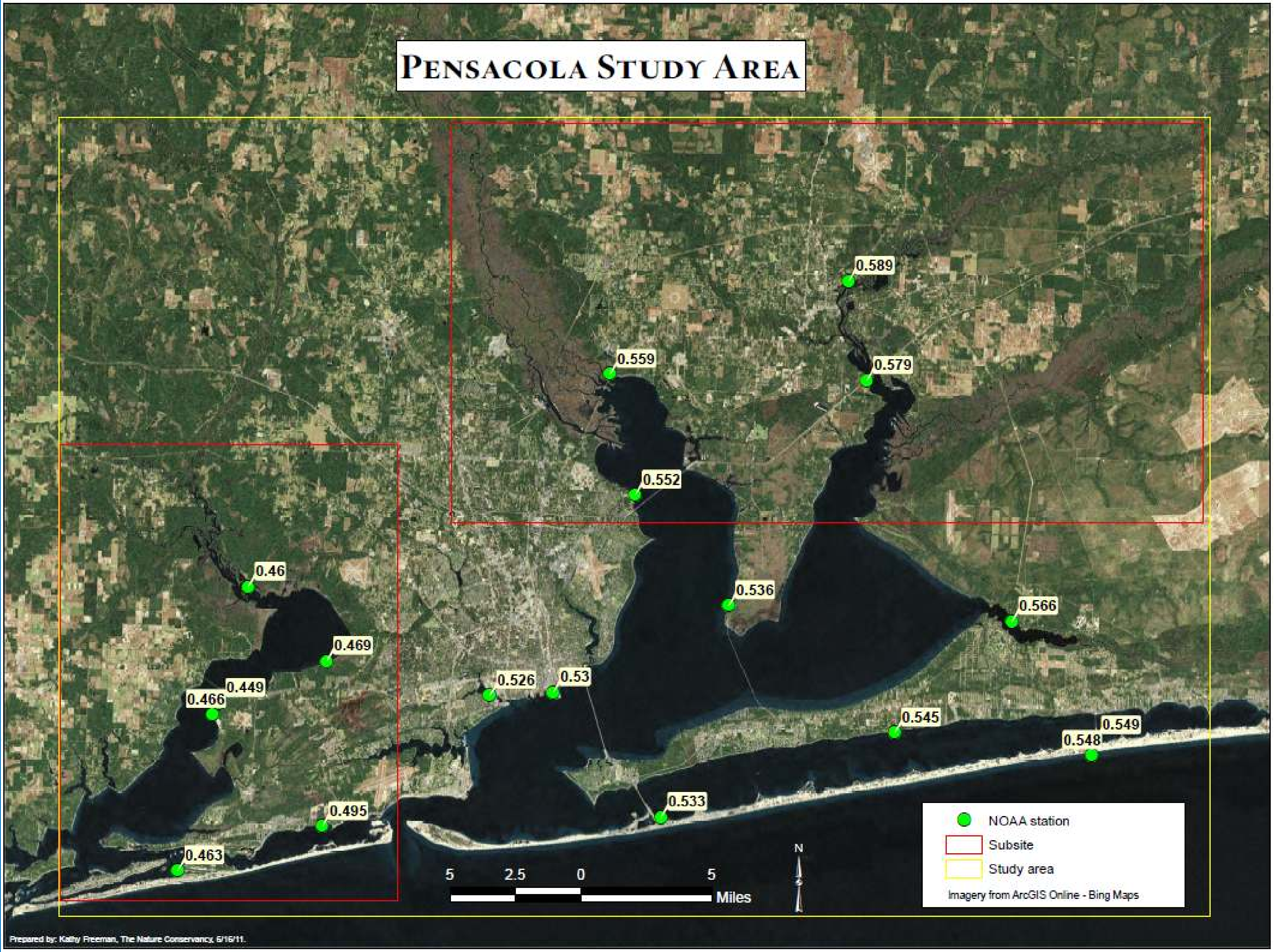
Model Output

- Graphic depiction of 2100 conditions
- Tabular quantitative results

Output examples

SLAMM Category	Condition (ha)	Total	from Initial Condition	from Initial Condition
Undeveloped Dry Land	235,804	233,146	-2,658	-1.1%
Estuarine Open Water	121,109	127,663	6,554	5.4%
Swamp	83,845	42,658	-41,187	-49.1%
Developed Dry Land	51,707	51,689	-18	0.0%
Open Ocean	13,423	13,583	160	1.2%
Irregularly Flooded Marsh	7,970	16,323	8,353	104.8%
Inland Open Water	6,282	4,695	-1,587	-25.3%
Inland Fresh Marsh	3,087	2,946	-141	-4.6%
Riverine Tidal Open Water	2,088	577	-1,511	-72.4%
Estuarine Beach	927	273	-654	-70.5%
Cypress Swamp	814	193	-621	-76.3%
Transitional Salt Marsh	717	1,795	1,078	150.5%
Regularly Flooded Marsh	570	20,475	19,905	3489.5%
Ocean Beach	298	162	-136	-45.7%
Inland Shore	253	244	-9	-3.7%
Tidal Swamp	250	3,380	3,130	1253.8%
Tidal Fresh Marsh	182	4,743	4,562	2509.1%
Tidal Flat	24	4,804	4,780	19524.3%

Pensacola Bay Study Area



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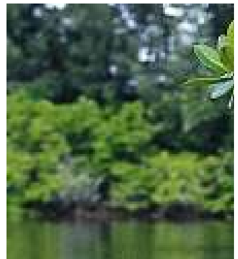
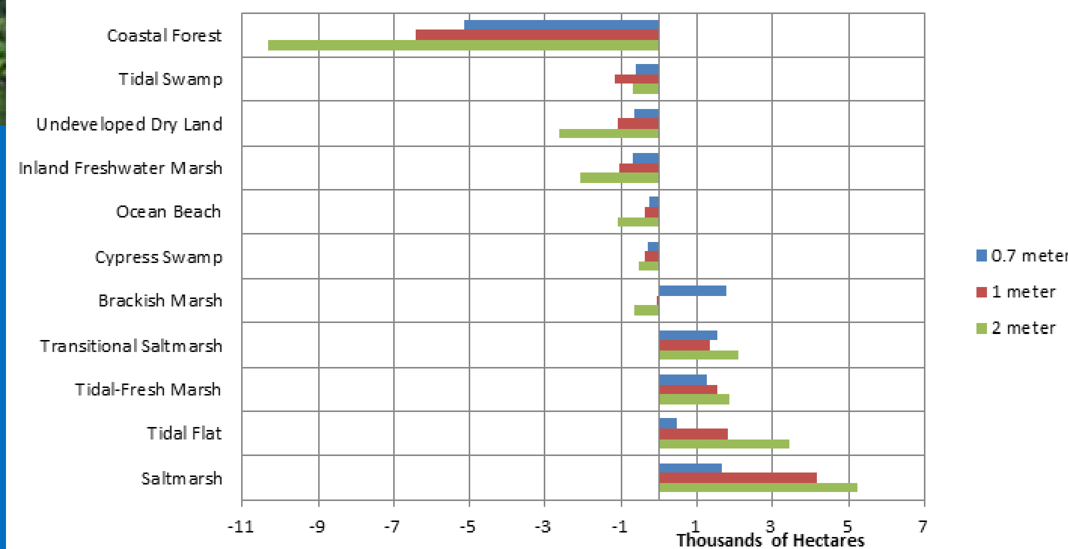


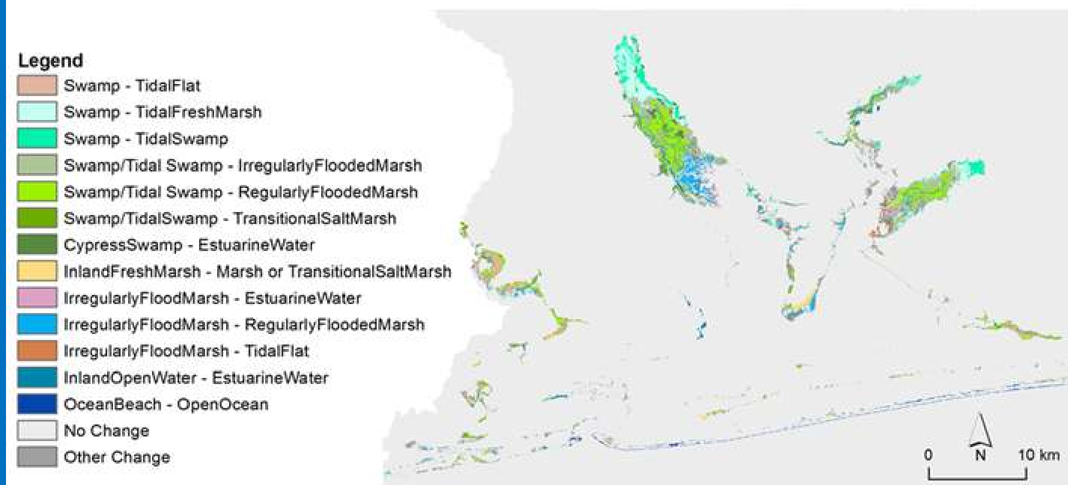
Pensacola Bay Results

Reference: Geselbracht et al. 2013.
Full report and appendices available at:
http://coastalresilience.org/resources

Pensacola Bay Study Area
Simulated Loss/Gain in Coastal Ecosystems from Initial Condition through the year 2100 under 3 Sea Level Rise Scenarios



Pensacola Bay Study Area Change in Coastal Ecosystems from/to with 1 m SLR by the year 2100



Pensacola SLAMM Results

Available on coastalresilience.org

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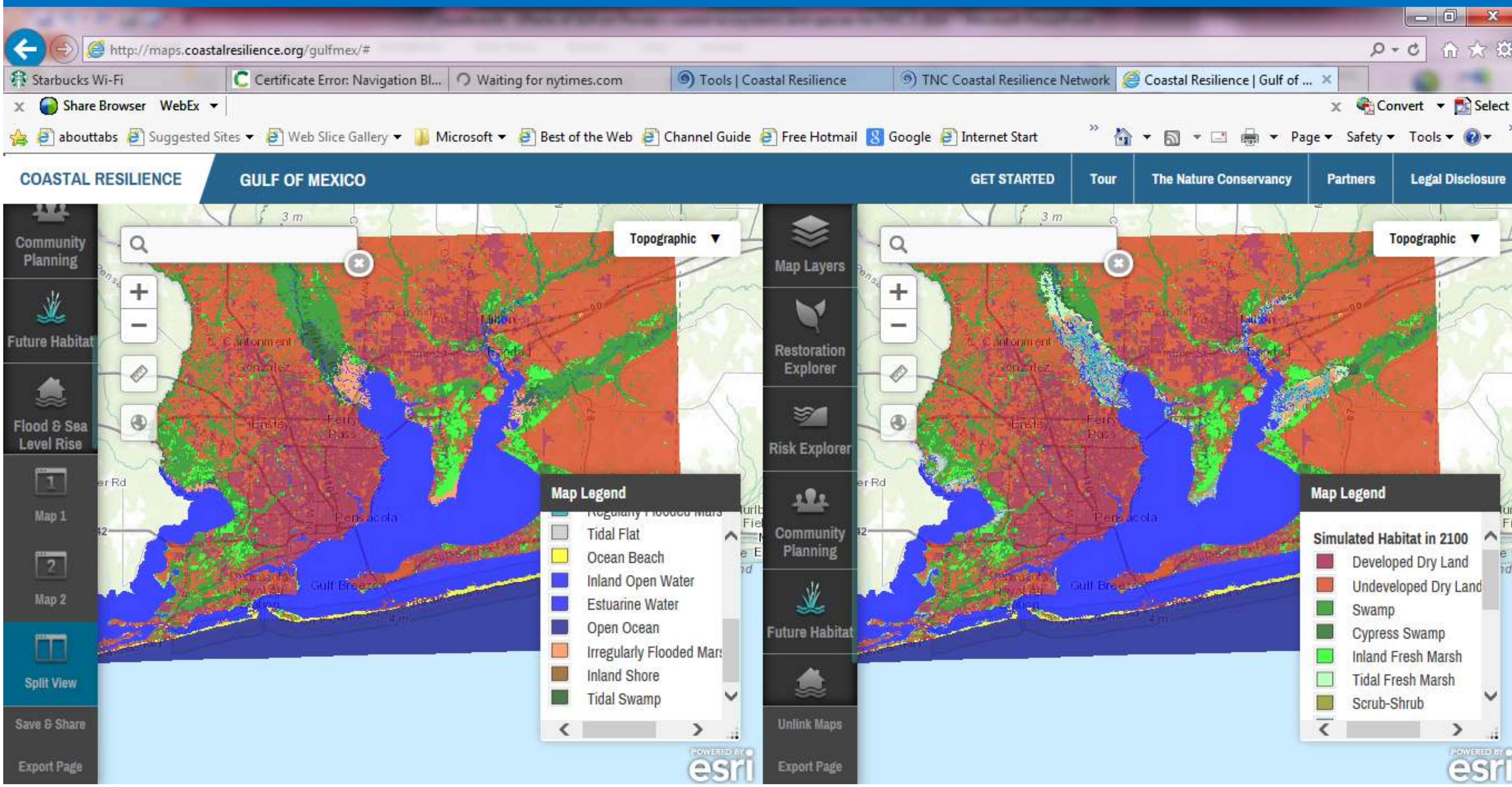
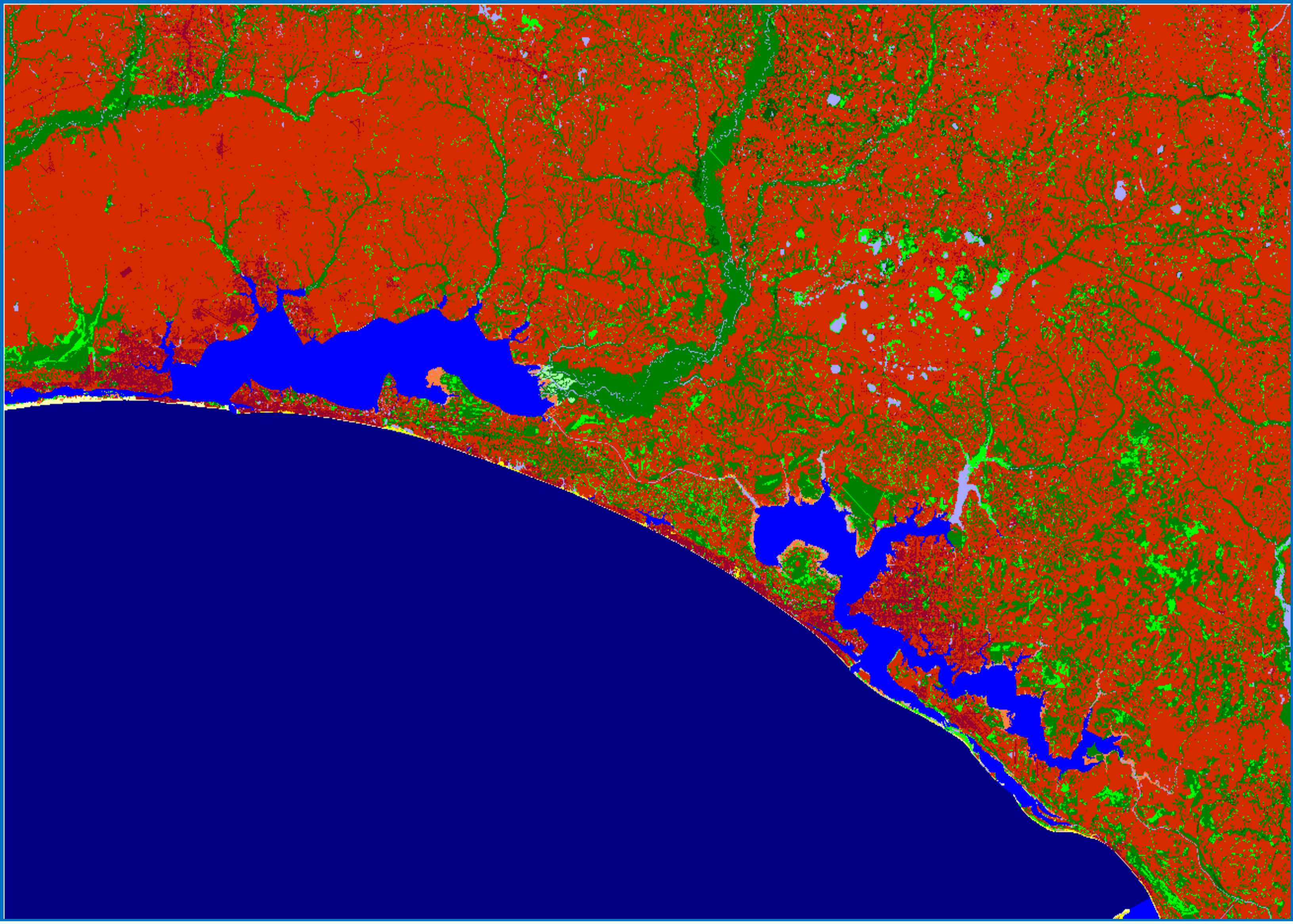
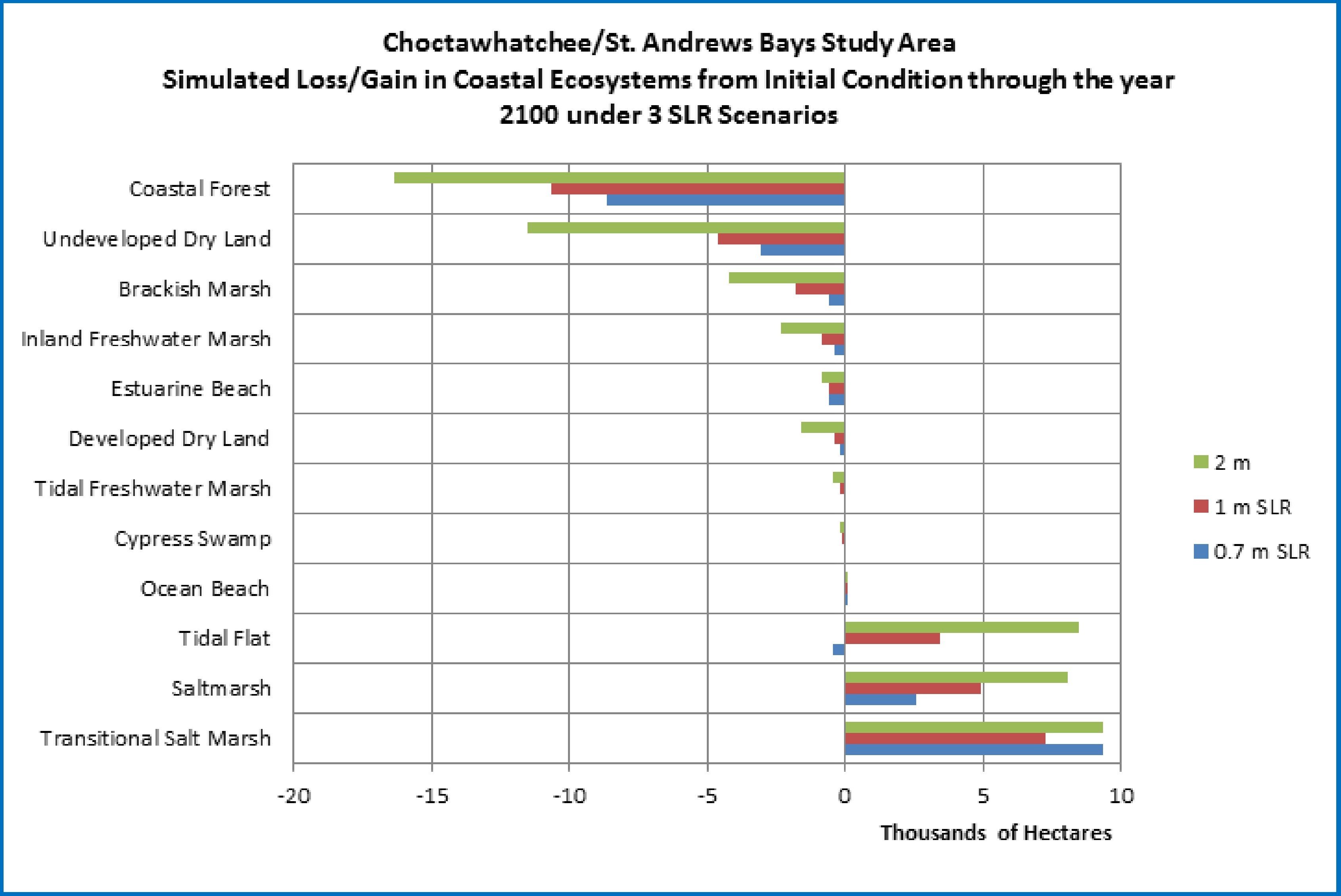
Existing Condition | Year 2100 with 1 m SLR



Choctawhatchee/St. Andrews Bays Study Area

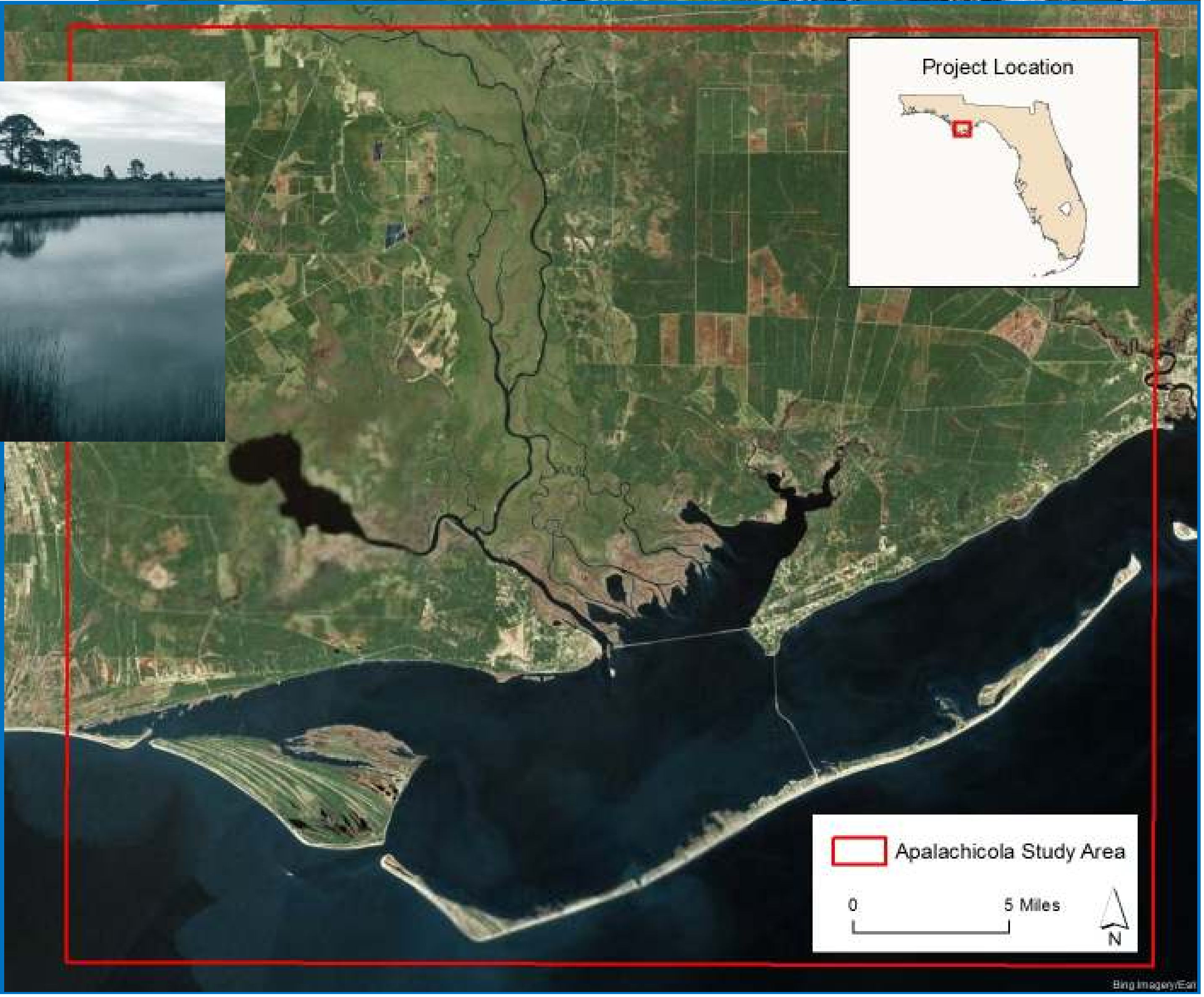


Choctawhatchee/St. Andrews Bays Results

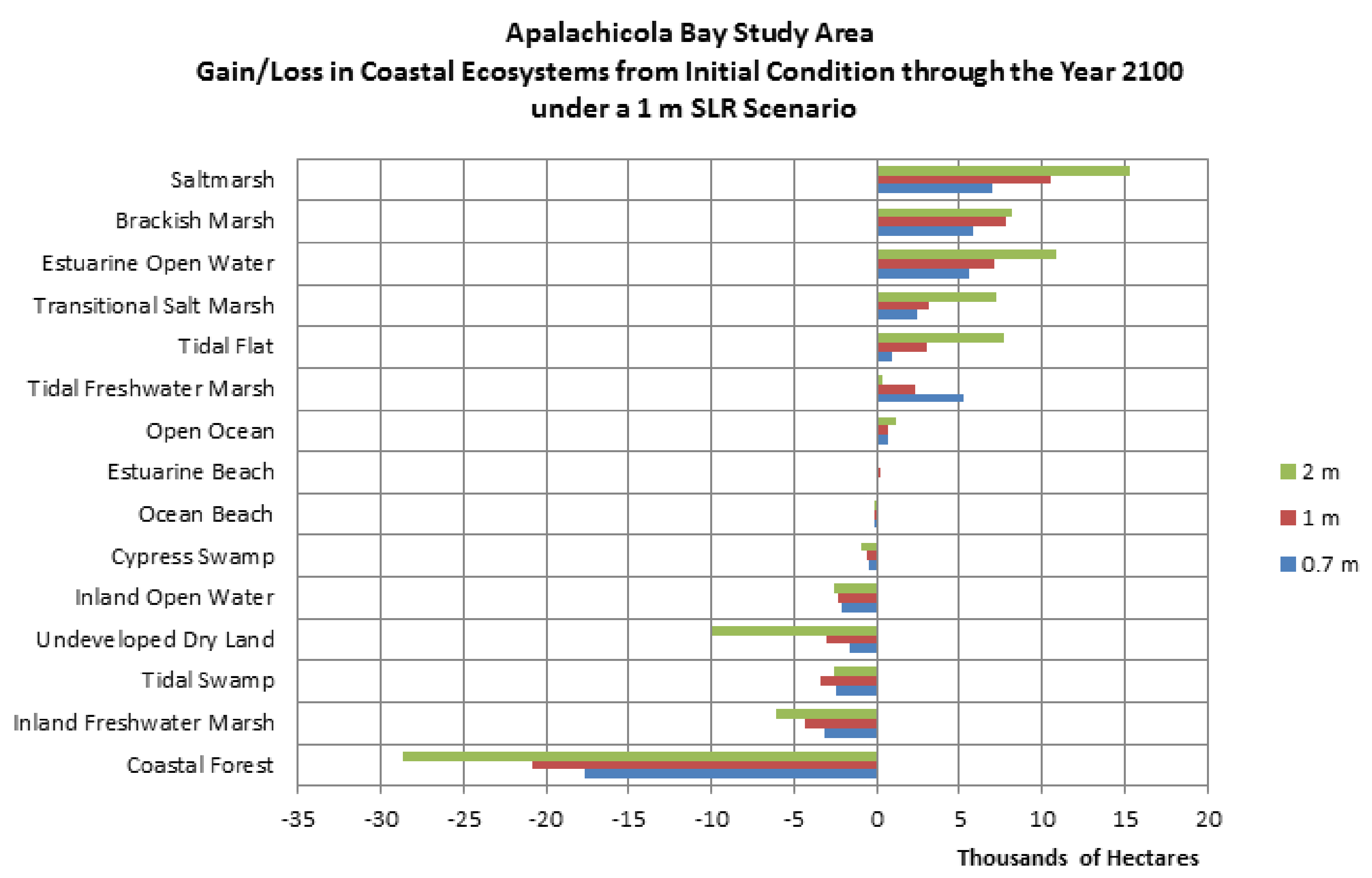


Apalachicola Bay Study Area

Extensive undeveloped dry land, swamp and inland fresh-water marsh



Apalachicola Bay Results



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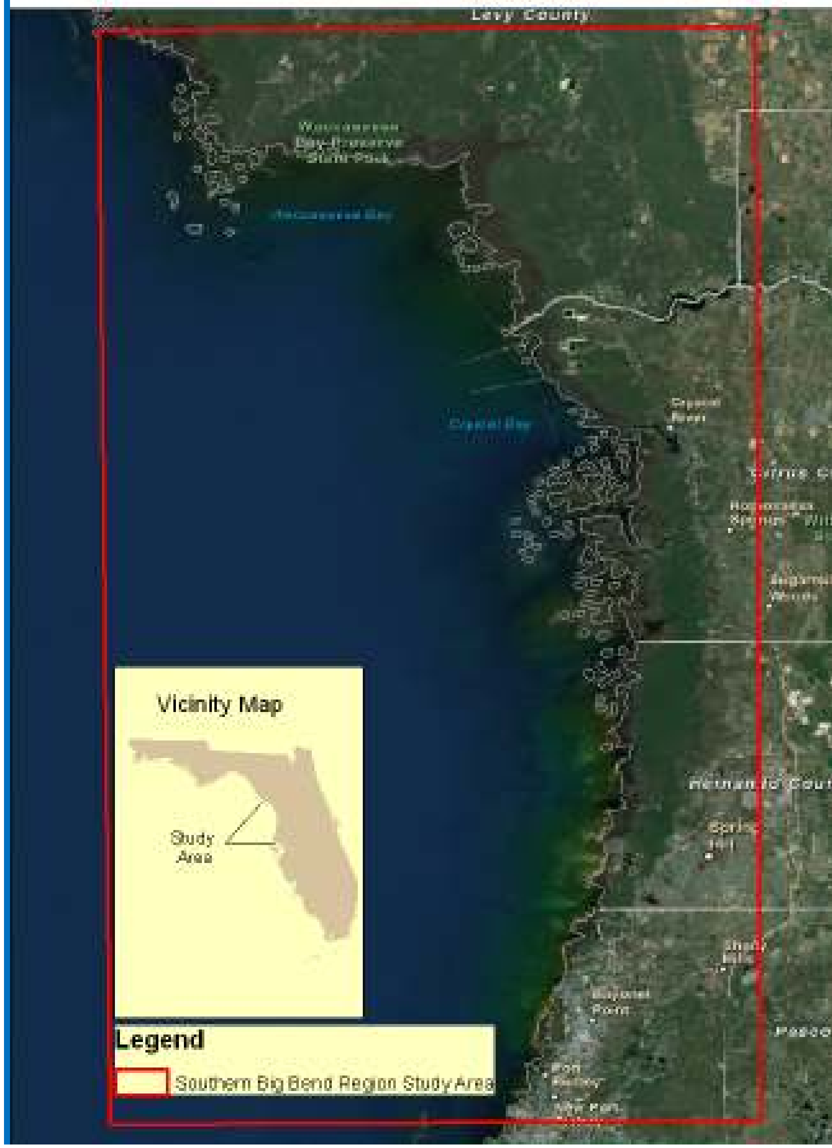
Southern Big Bend, FL

Southern Big Bend SLAMM Analysis Study Area



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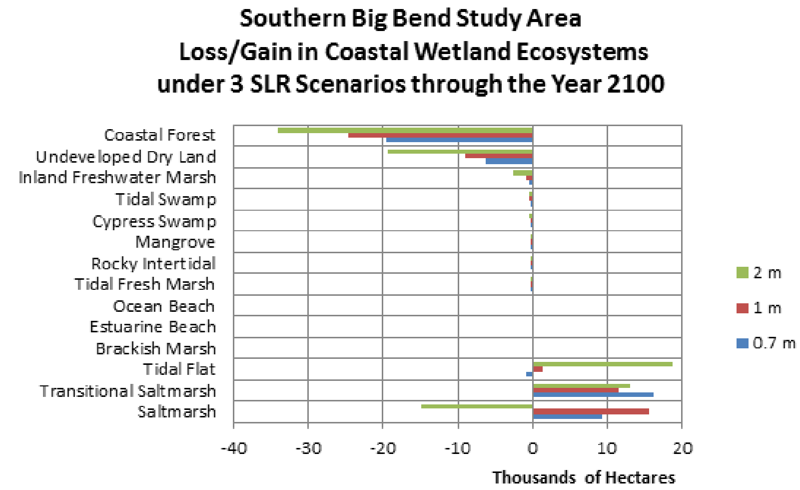
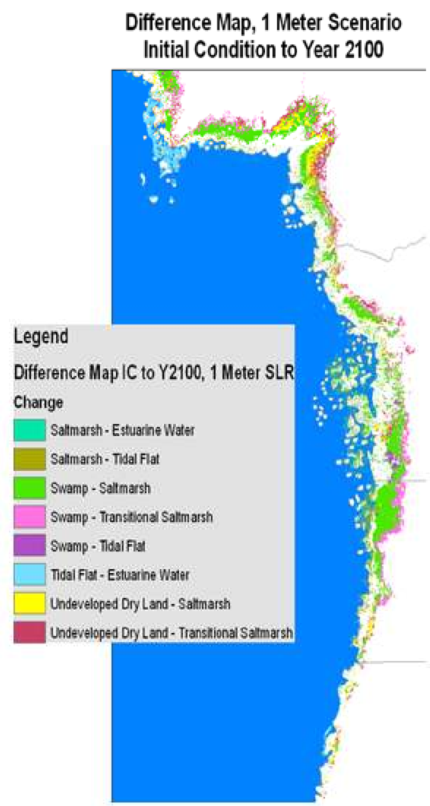
Southern Big Bend Results





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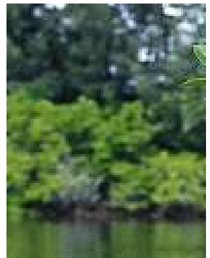
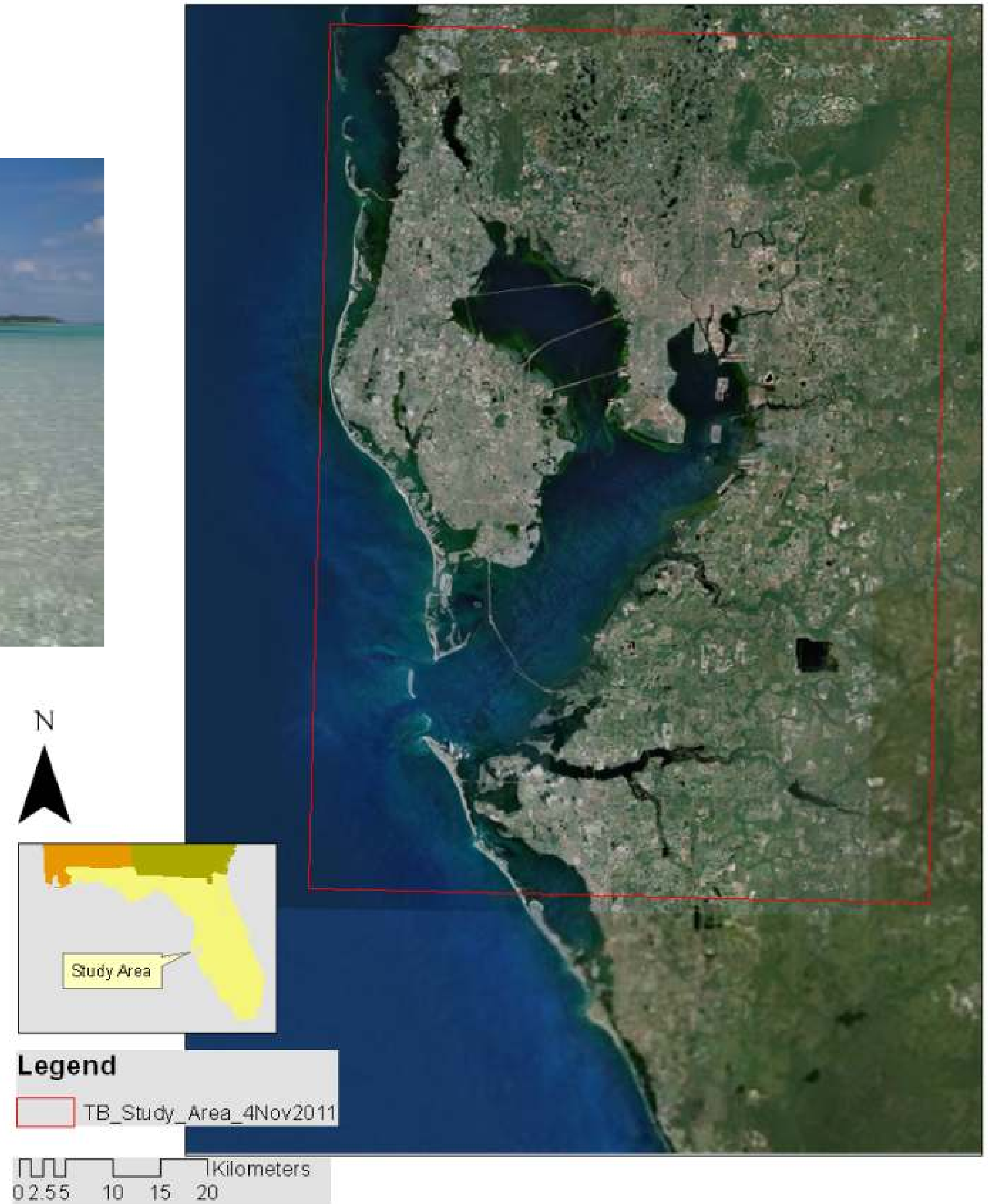
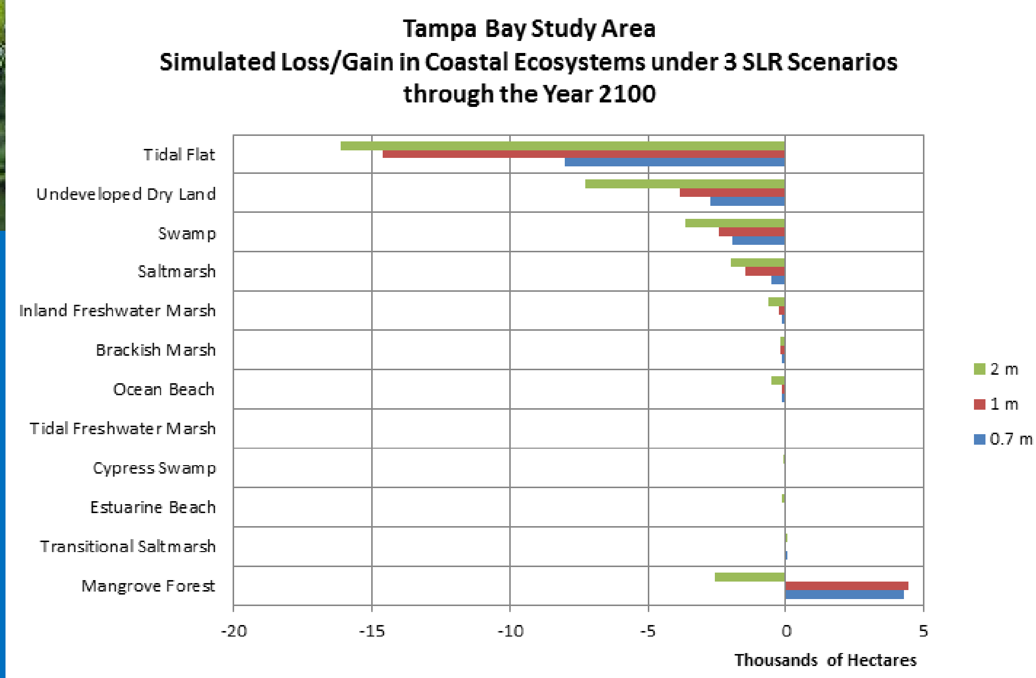
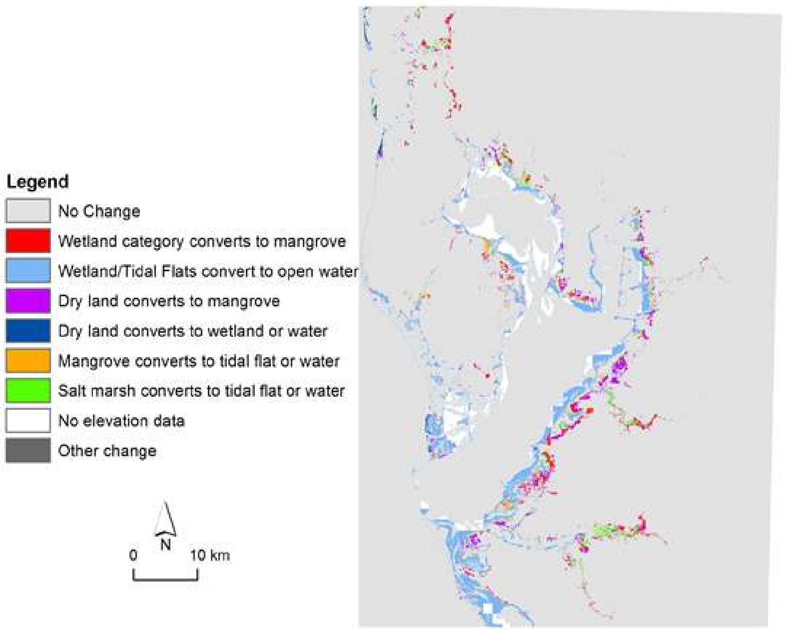


Tampa Bay Area SLAMM Study Area



Tampa Bay Results





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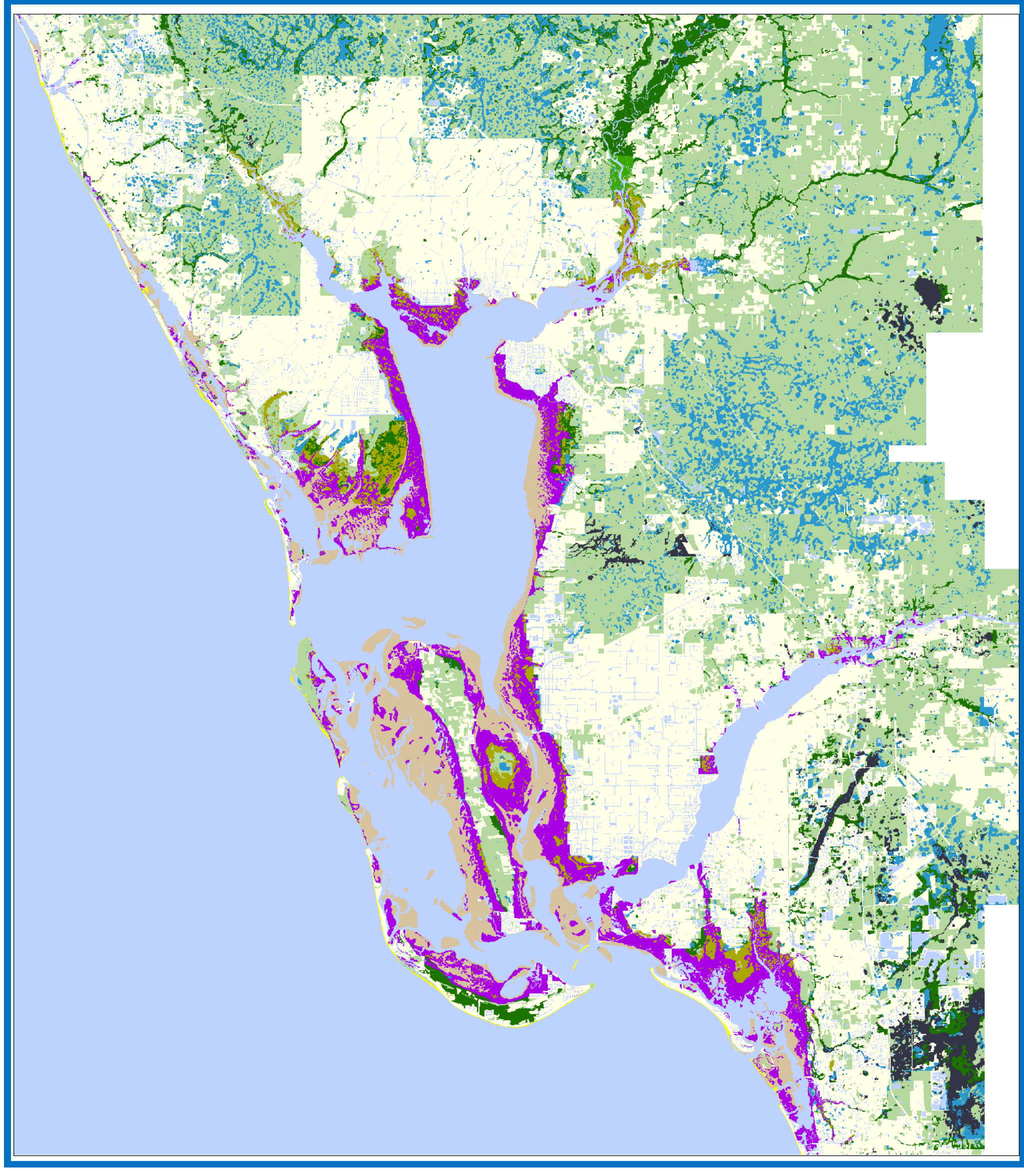
Charlotte Harbor Study Area



Extensive mangroves, tide flats and inland freshwater marsh

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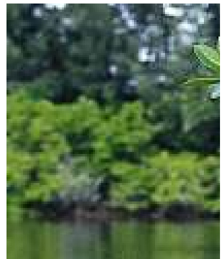
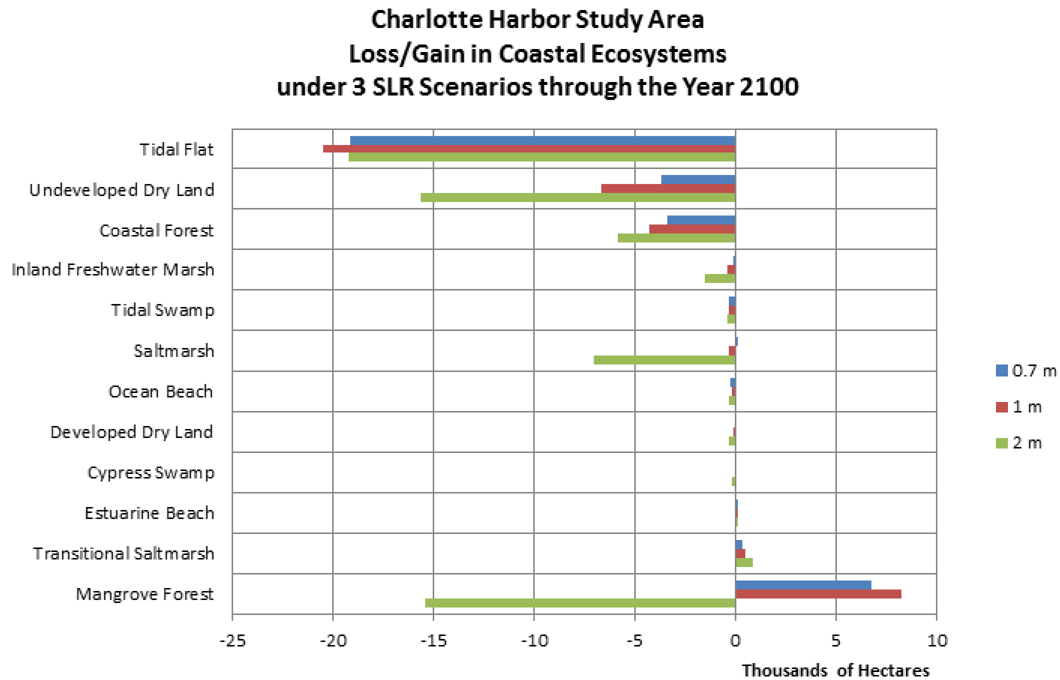
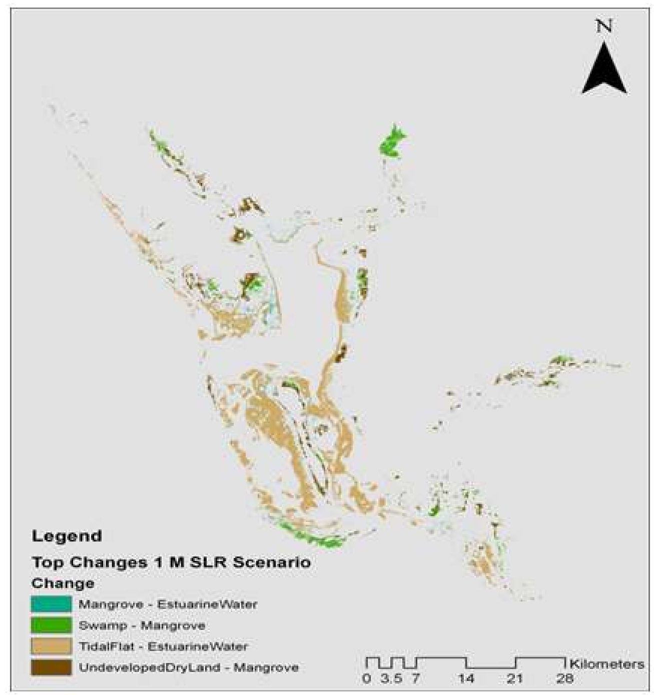


Charlotte Harbor Results





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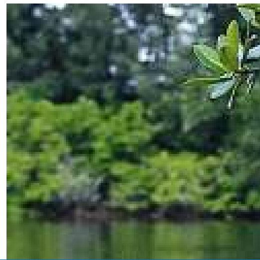
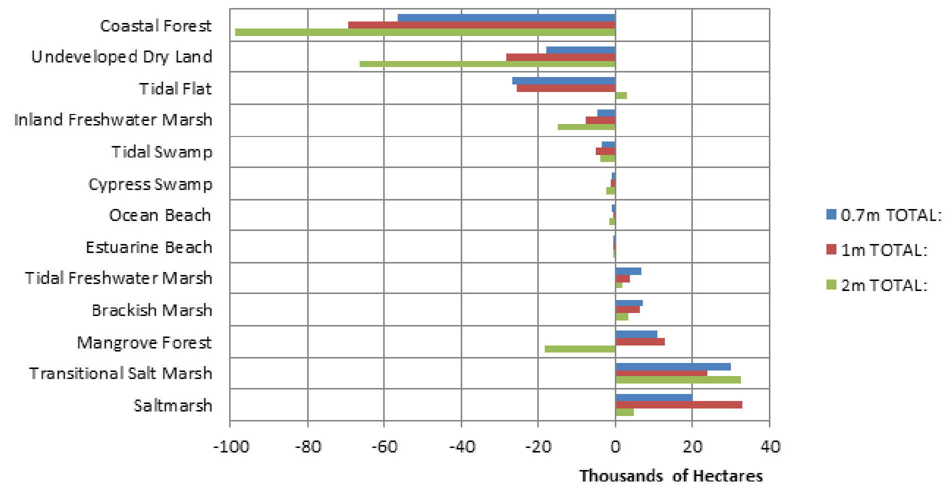
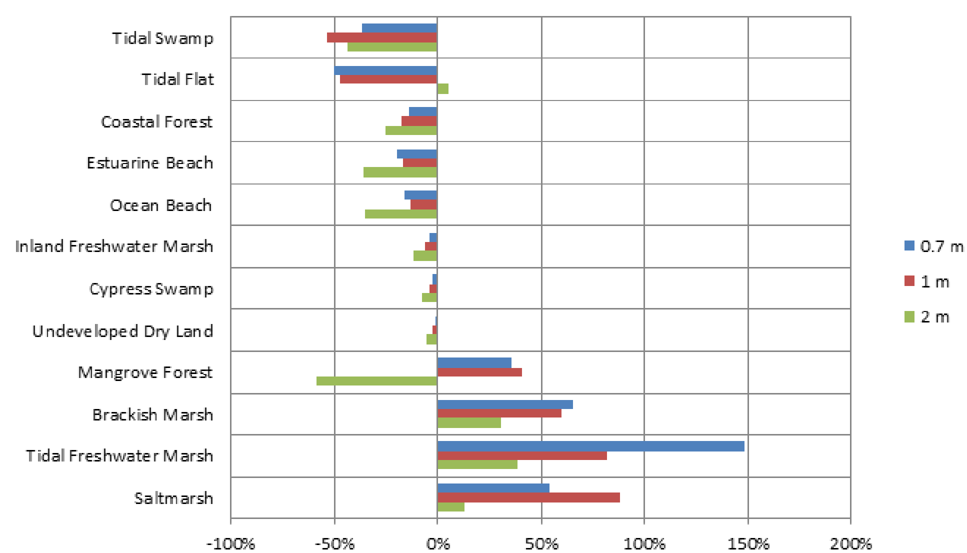


Results, All 6 Sites

Predicted Change in Wetland System Cover at the Six Study Sites under 3 SLR Scenarios through the year 2100



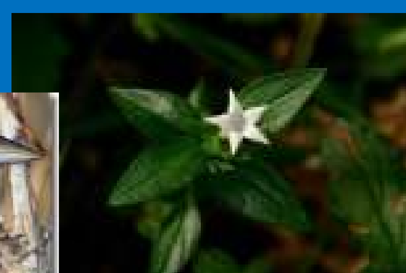
Predicted Percent Change in Coastal Ecosystems at the Six Study Area Sites under 3 SLR Scenarios



Vulnerable Species Analyses Conducted at 4 of 6 sites

Jon Oetting, Mike O'Brien and Amy Knight, FNAI

Scott's Seaside Sparrow - ©2011 Photo courtesy of David Laliberte



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Stakeholder engagement/ Community involvement

- Engage stakeholders in development of adaptation strategies based on the science;
- Work with communities to implement adaptation strategies

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	Adaptation Type
A	Land use planning and building regulation
B	Emergency response planning
C	Tax and Market-based approaches
D	Conservation of species
E	Land protection
F	Conservation of natural areas
G	Conservation of marine life
H	Water supply and delivery; water resources
I	Transportation and infrastructure
J	Beaches, beach and shoreline management
K	Research needs
L	Miscellaneous/General Comments
M	Education, outreach and communication

Lessons Learned

- All systems are unique
- Model calibration is key
- Many areas do not have recent and/or proximate accretion, erosion and sedimentation rate data. Monitoring should be begun where absent to collect this information.
- Maintaining freshwater inputs into the systems is critical for minimizing the effects of SLR.
- Communities are ready to begin implementation of adaptation strategies.

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Any questions?