Coastal Studies Group

USING LIDAR-DERIVED DIGITAL ELEVATION MODELS TO PROJECT FUTURE BARRIER-ISLAND CHANGE CAUSED BY RELATIVE SEA-LEVEL RISE

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Funding Sources

Galveston Bay Estuary Program

NOAA through the Texas Coastal Coordination Council

Texas General Land Office

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NASA

U.S. Geological Survey

City of Galveston

Collaborators

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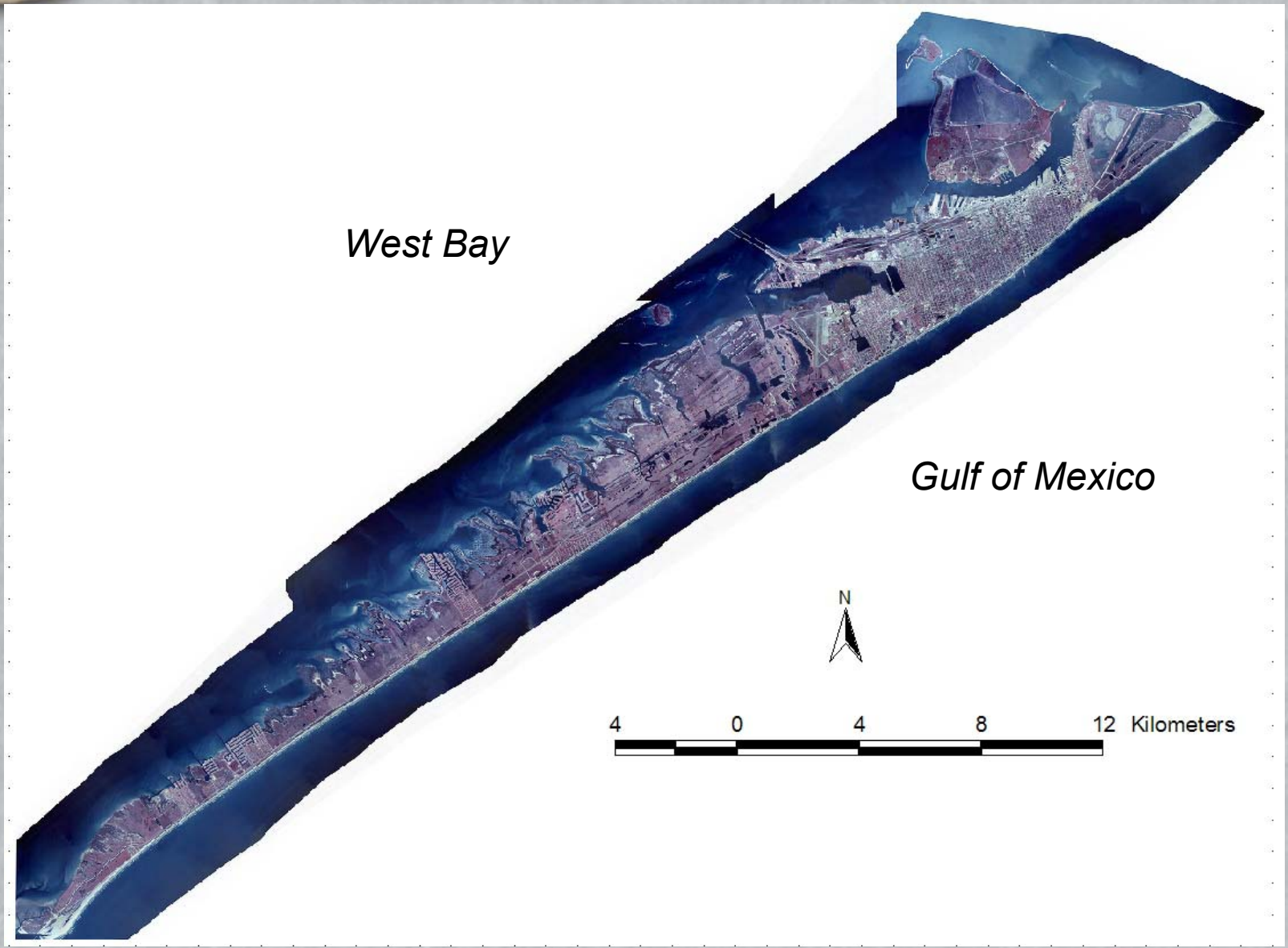
Rachel Waldinger

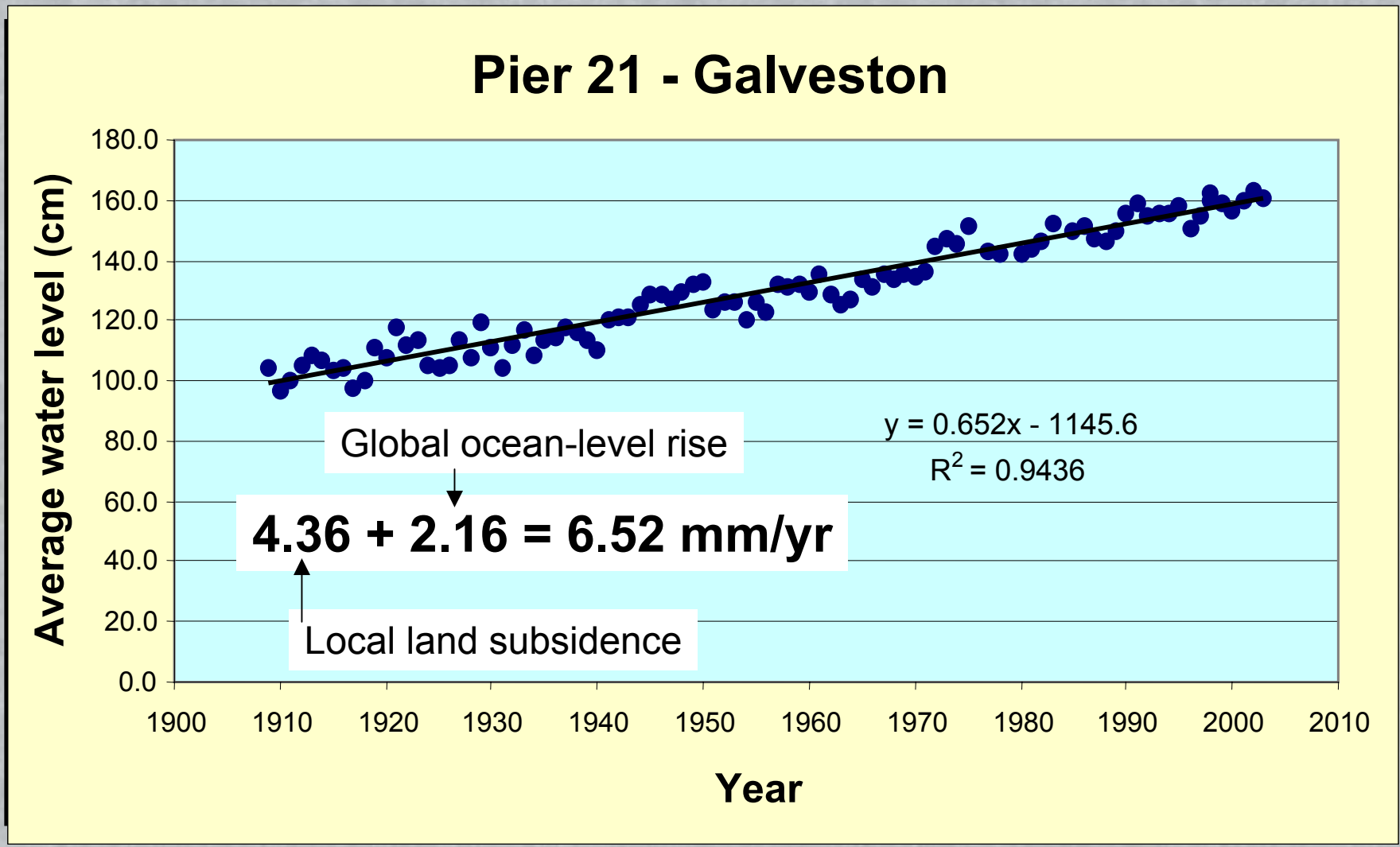
XIII Simposio Brasileiro de Sensoriamento Remoto, Florianopolis, Brazil, April 21 to 26, 2007

Texas Coast

Galveston Island, Texas

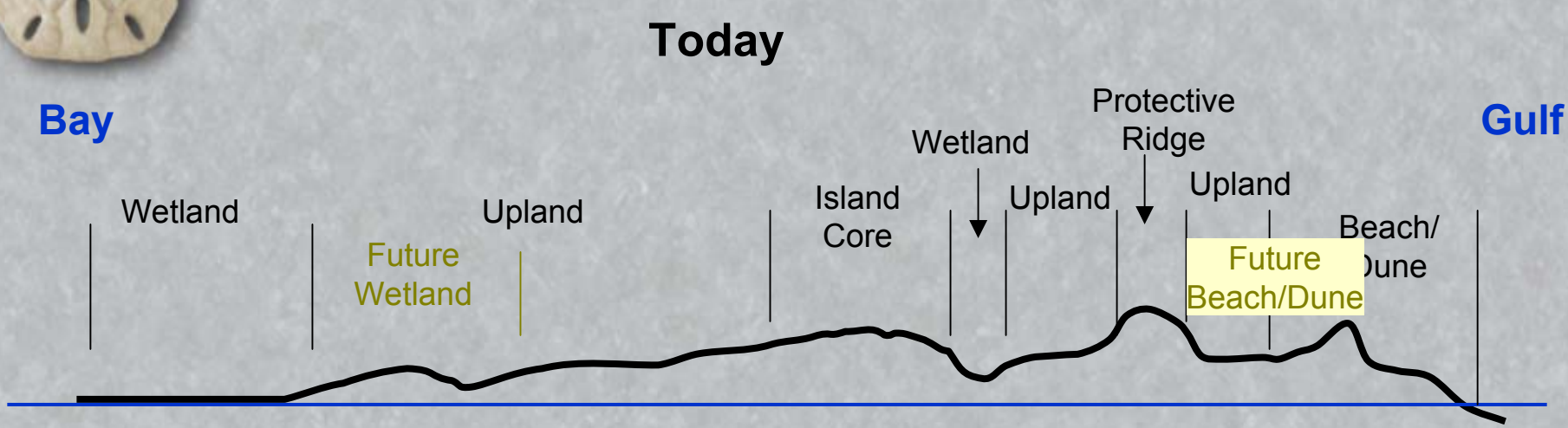


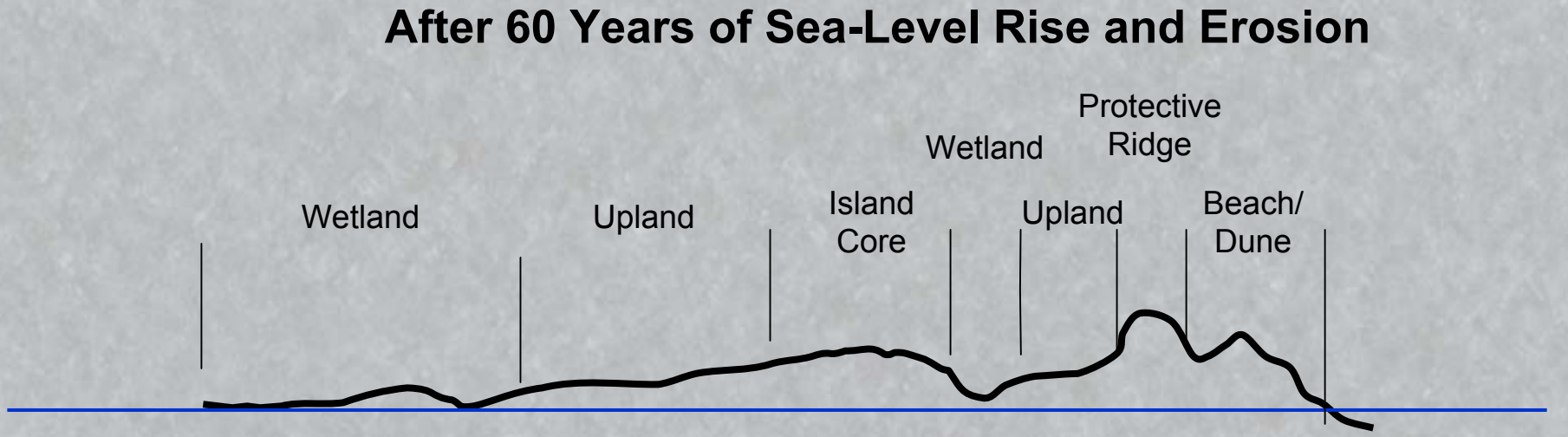
Relative Sea-Level Change
Galveston Island, Texas



2060 Projected Shoreline

Barrier Island Cross Section

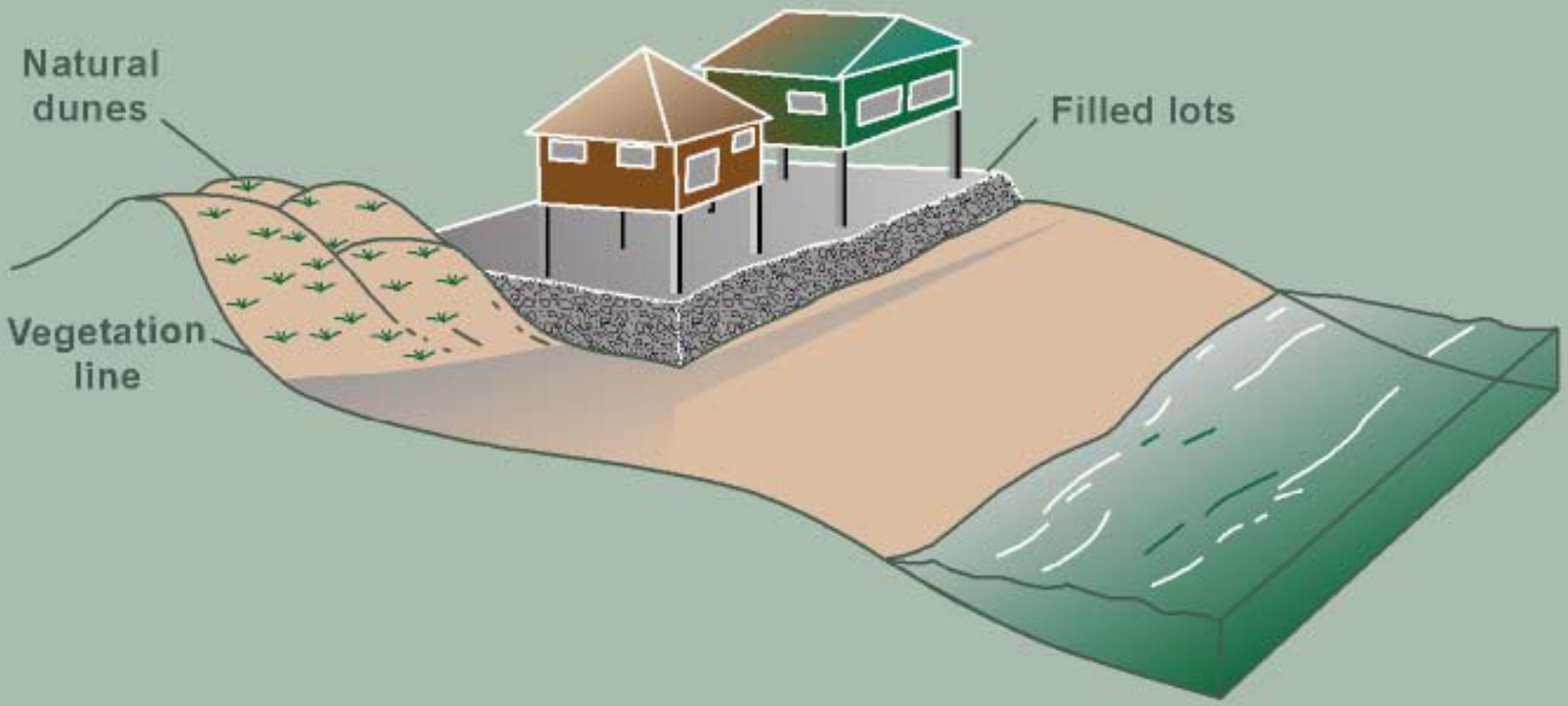




Galveston Island

Matagorda Peninsula

POST-STORM BEACH MORPHOLOGY IN DEVELOPED & UNDEVELOPED AREAS



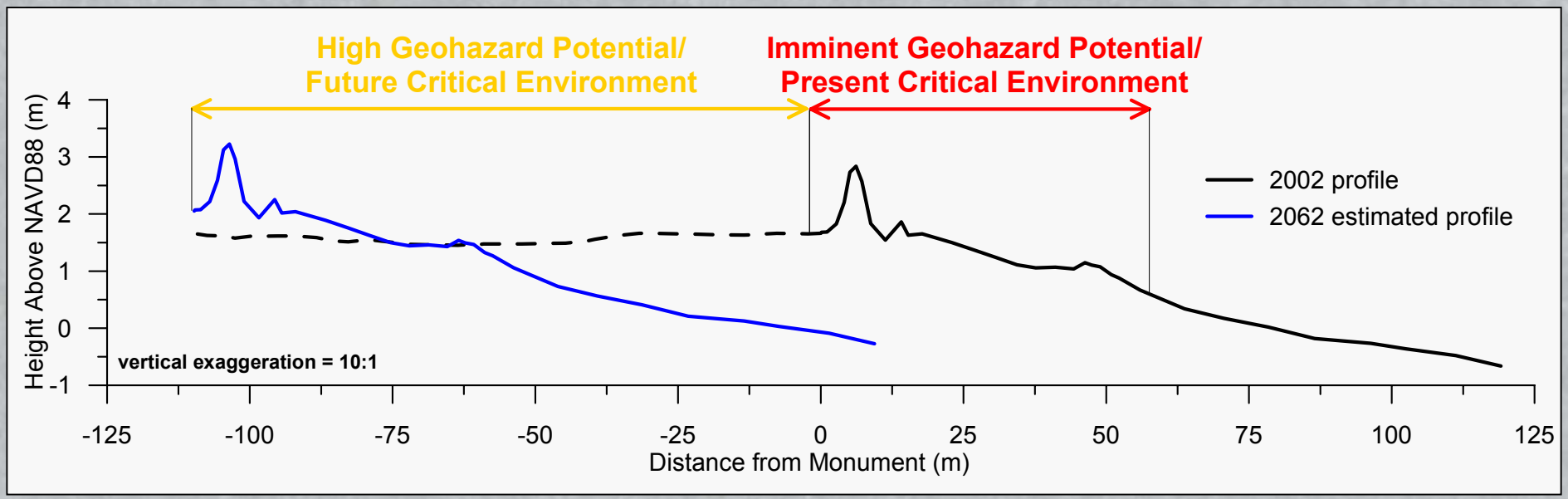
Bureau of Economic Geology

Morton, Paine, & Gibeaut, (1994)

QAc4841(b)c

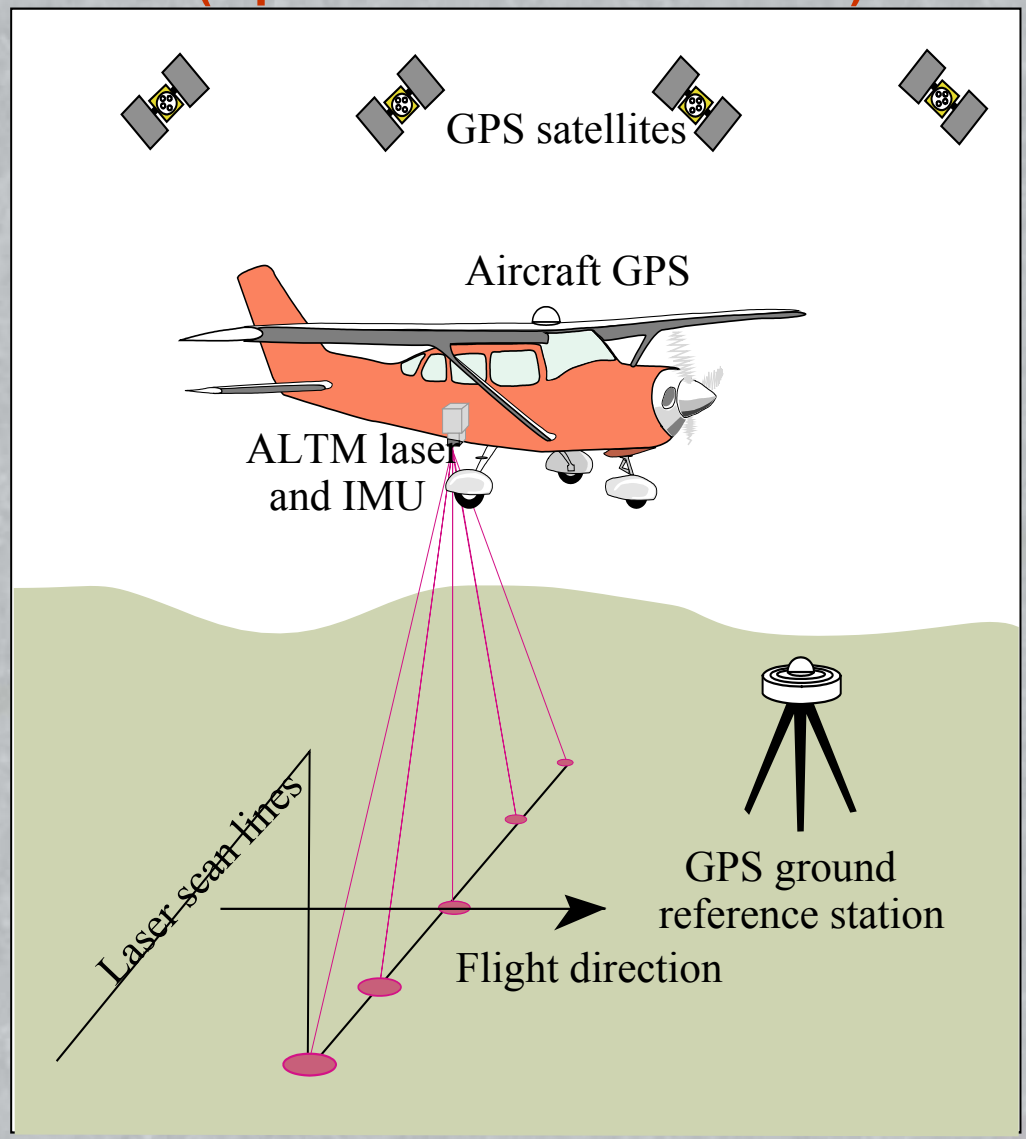

2005/09/29

Beach/Dune Profile Translation

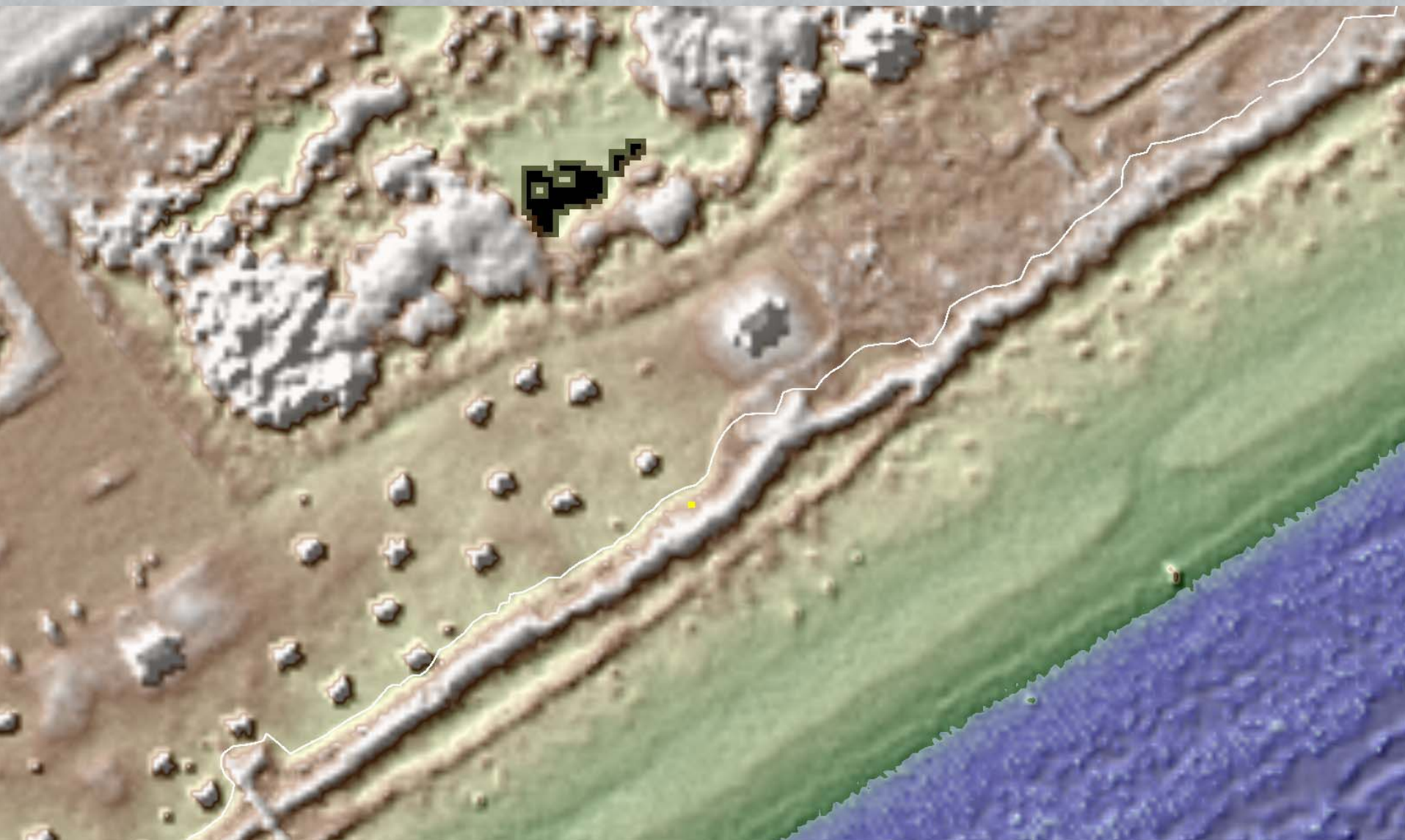


University of Texas Airborne Topographic Lidar System

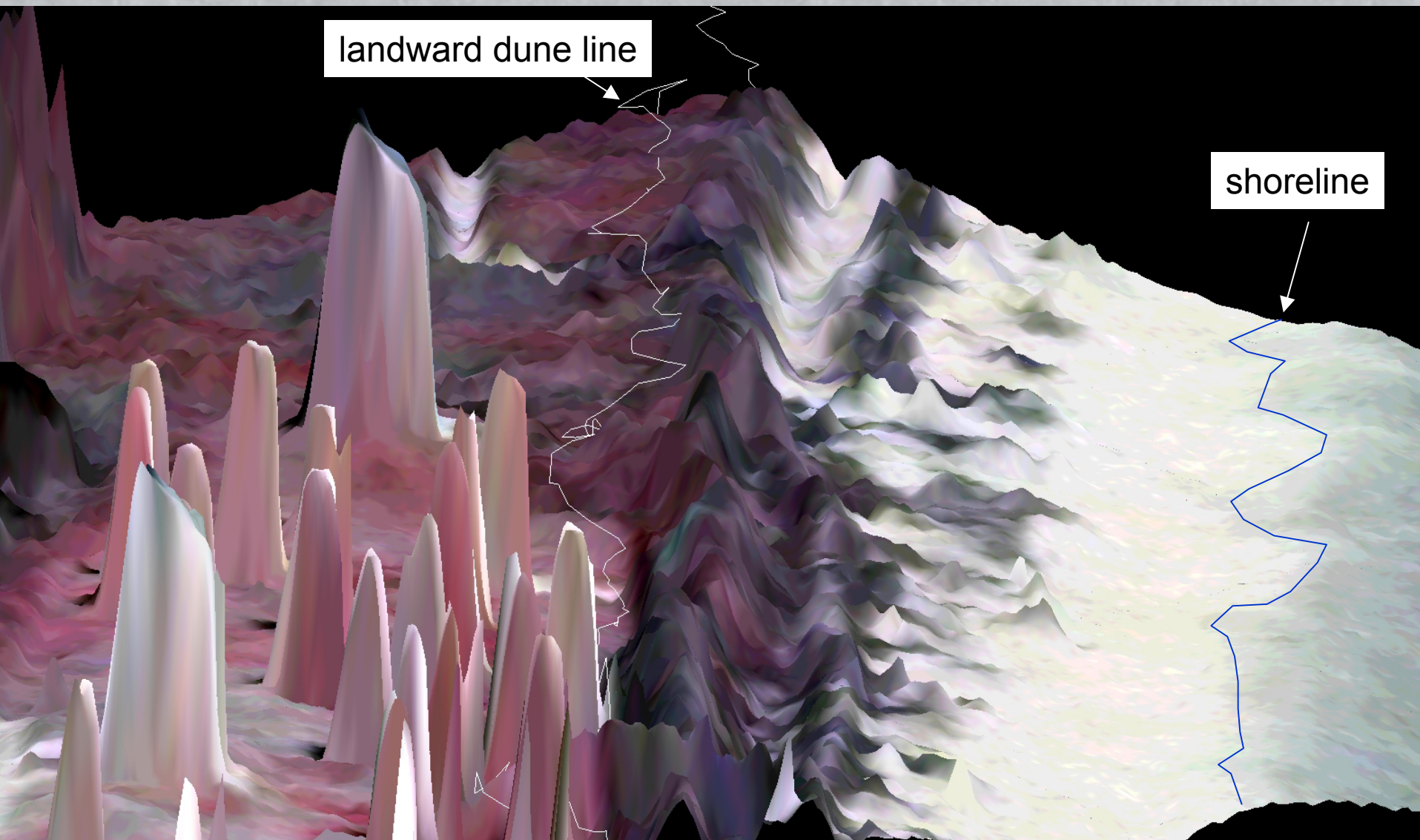
(Optech model ALTM1225)



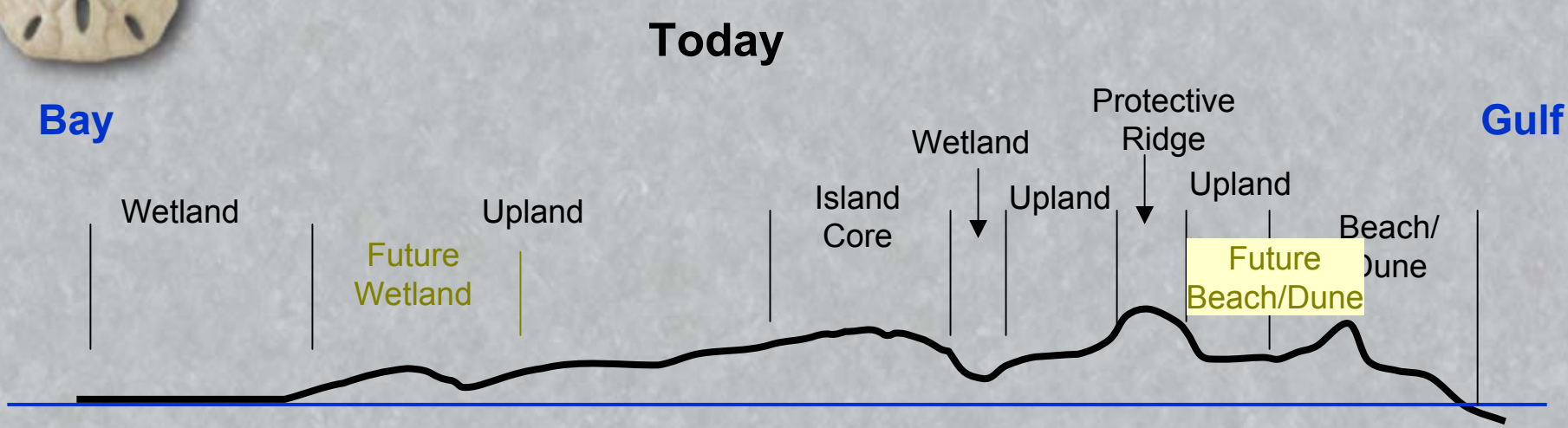
Foredune Mapping
Lidar Topographic Image

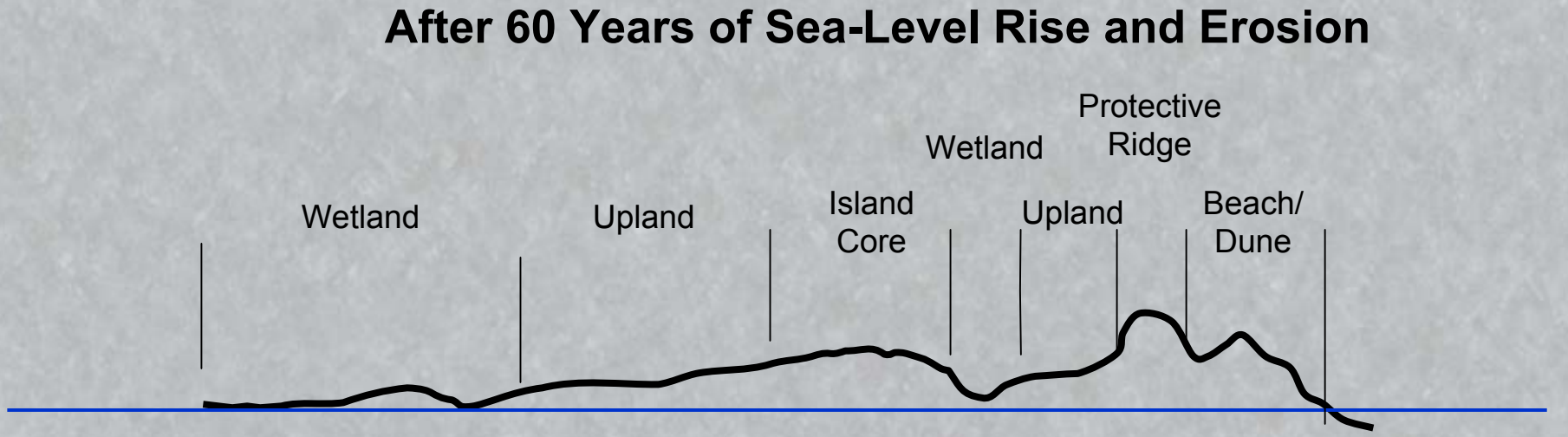


Foredune Mapping

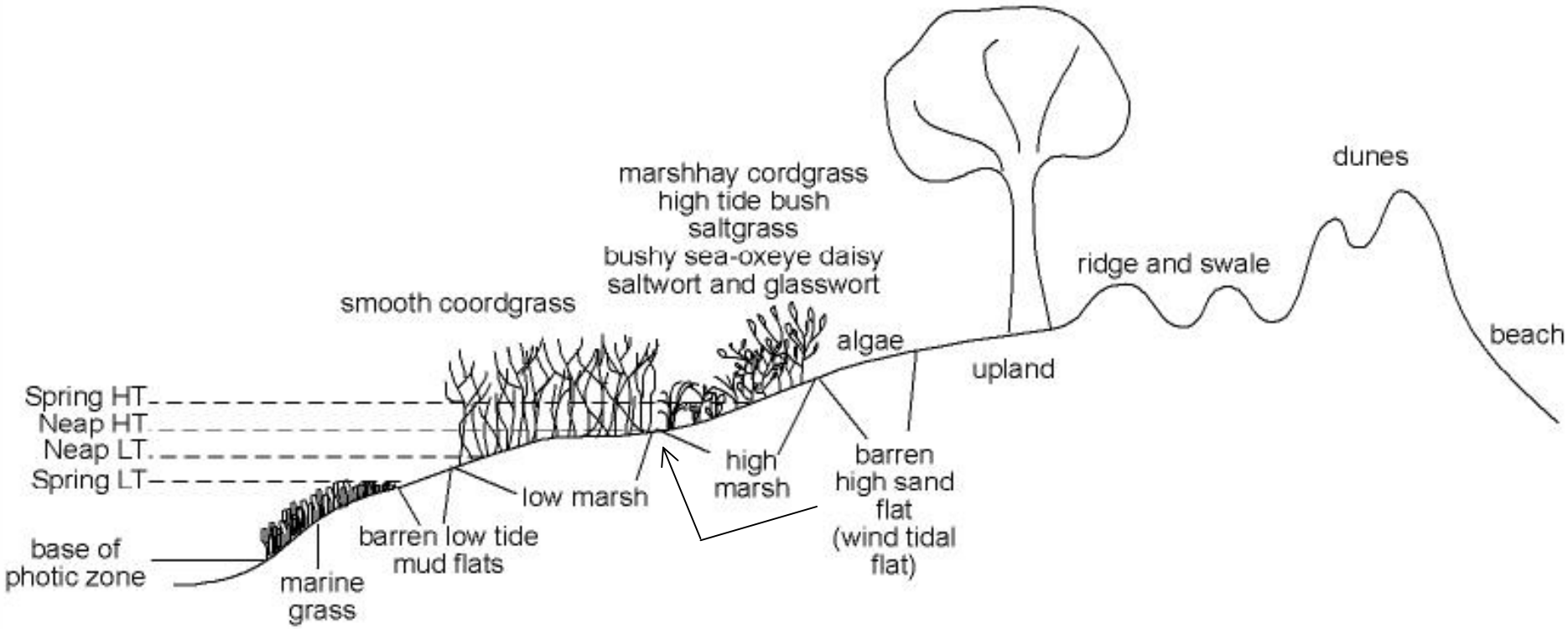


Barrier Island Cross Section

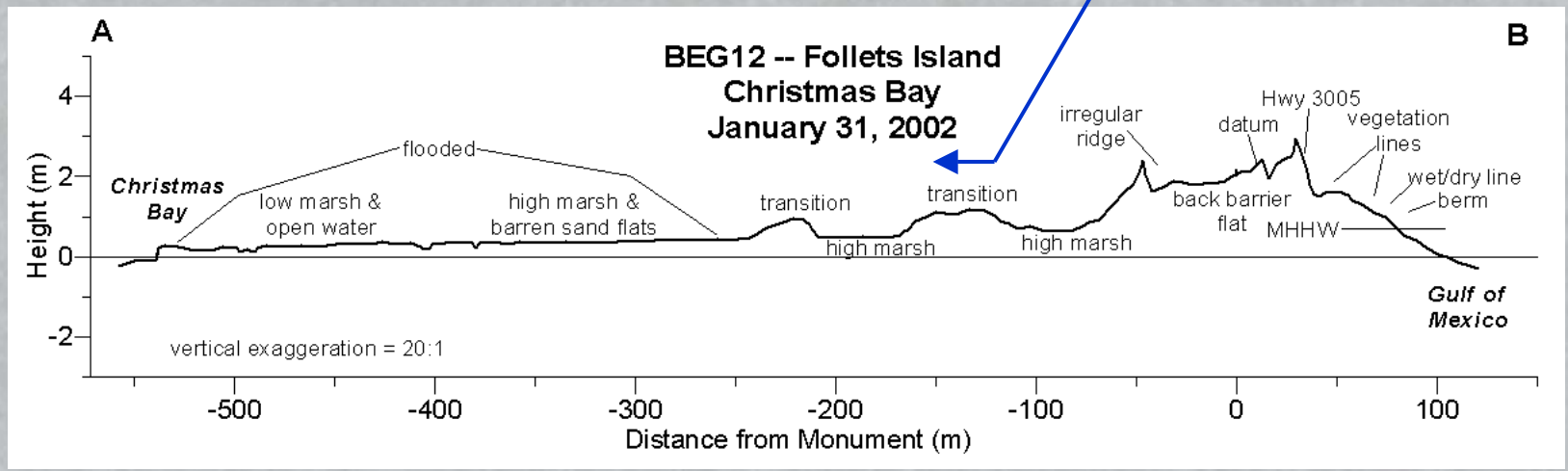




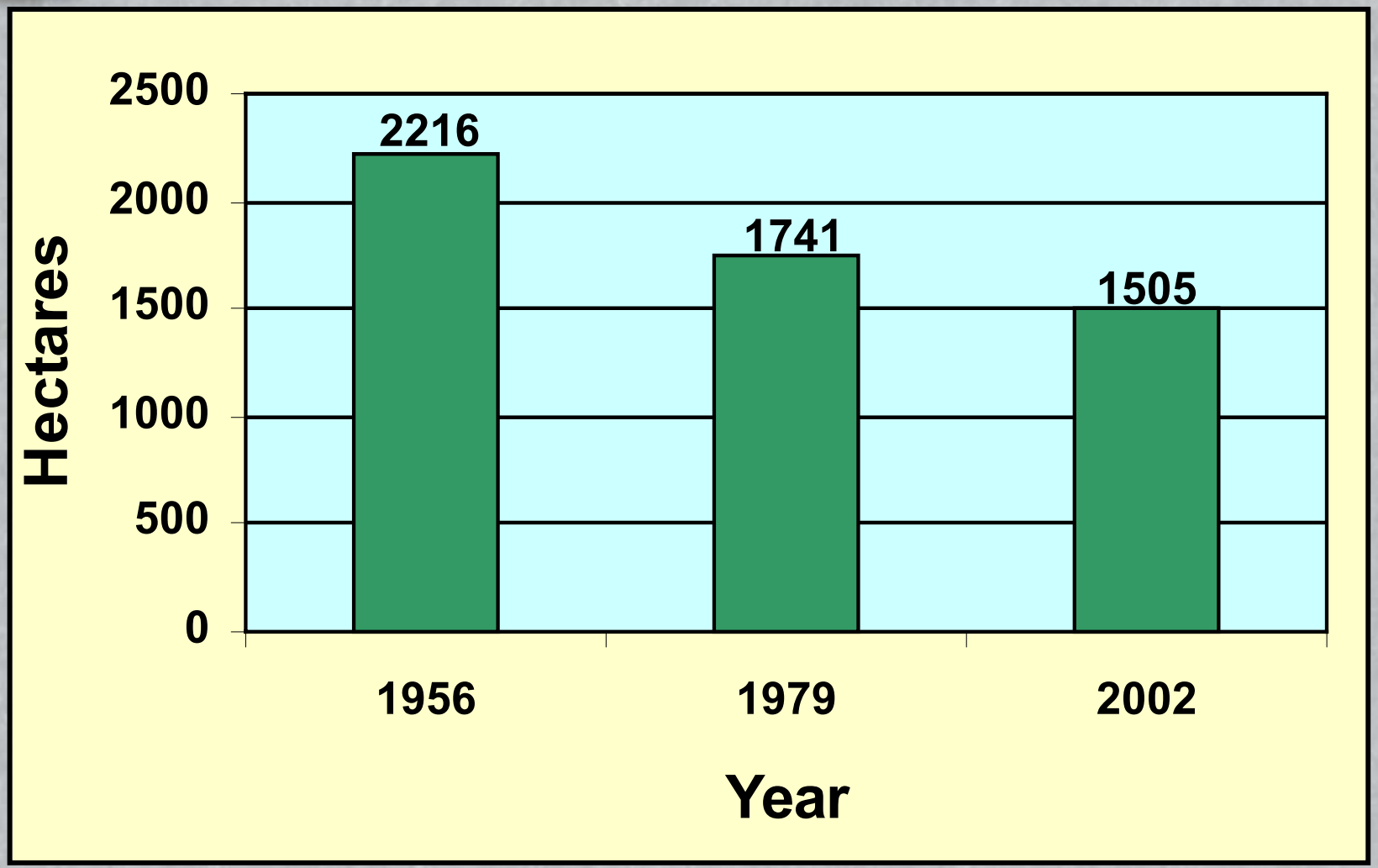
Barrier Island Environments



Topographic Profile



Total Estuarine Marsh Area
Galveston Island, Texas

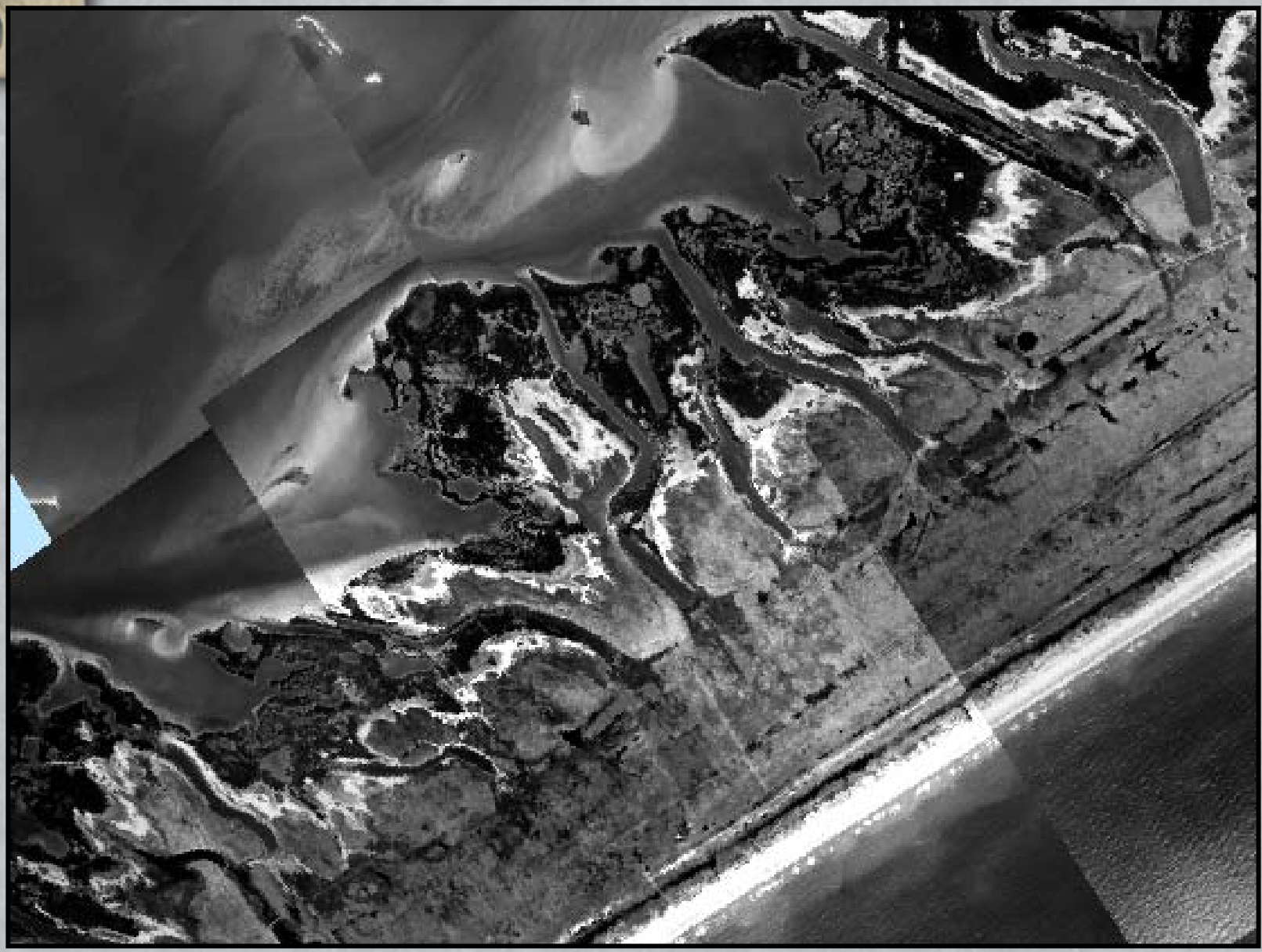


From White et al., 2004

Causes of Wetland Loss

- Development/Land Use
- Global Sea-Level Rise
- Land Subsidence
- Topographic/Morphology Effects
- Sediment Deficit
- Marsh Edge Erosion by Waves and Currents

Development

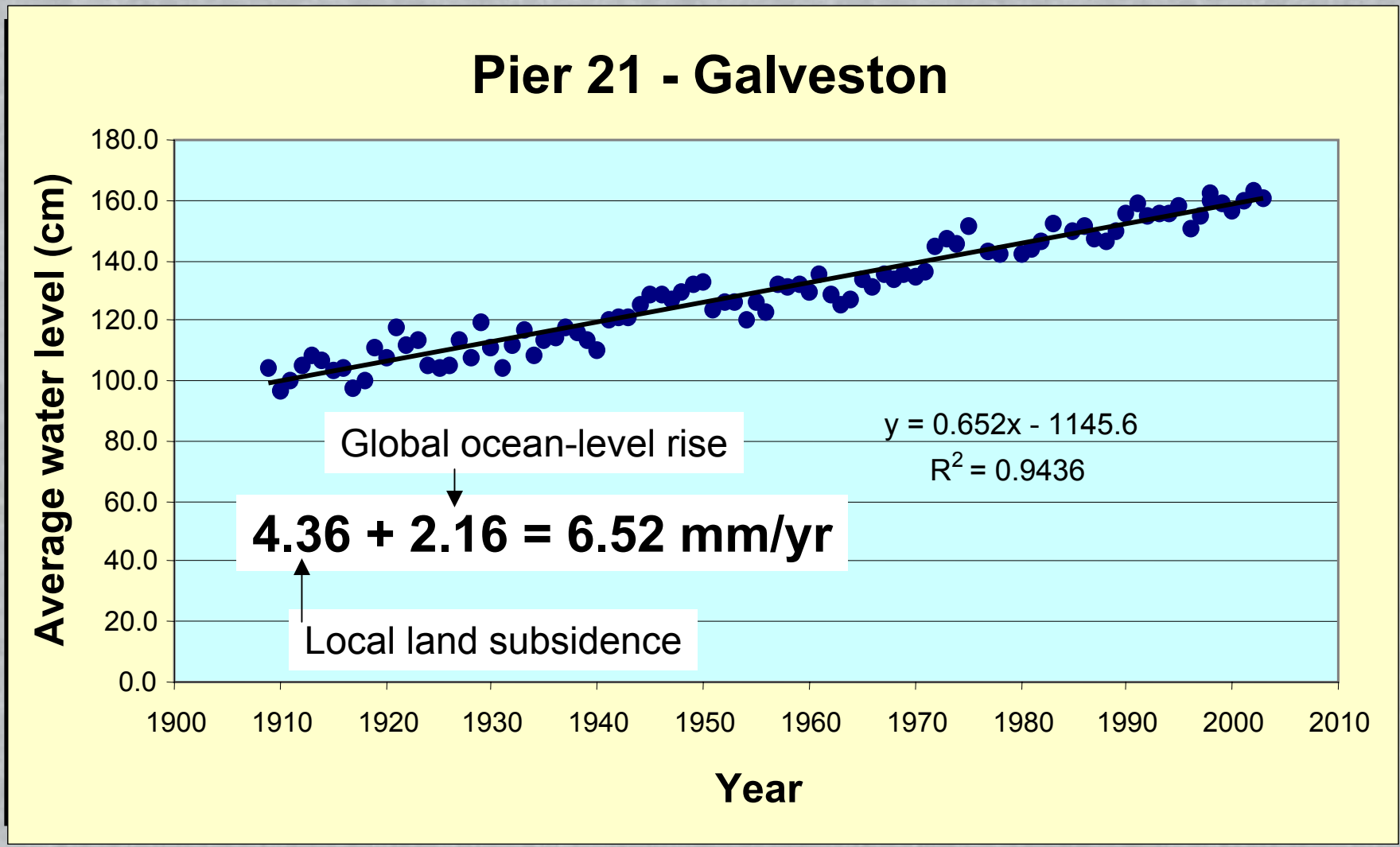


1956

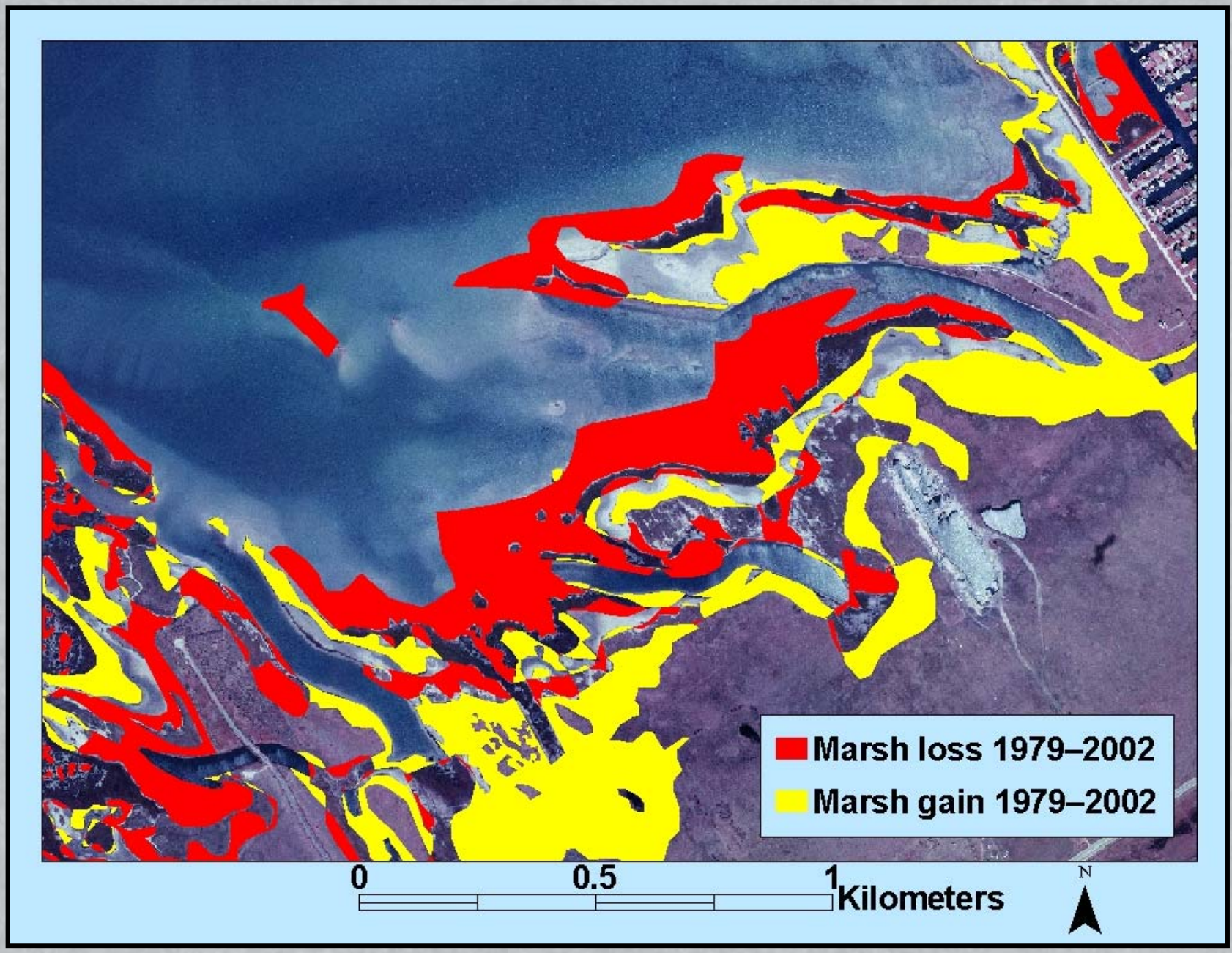
Development

1979

Relative Sea-Level Change



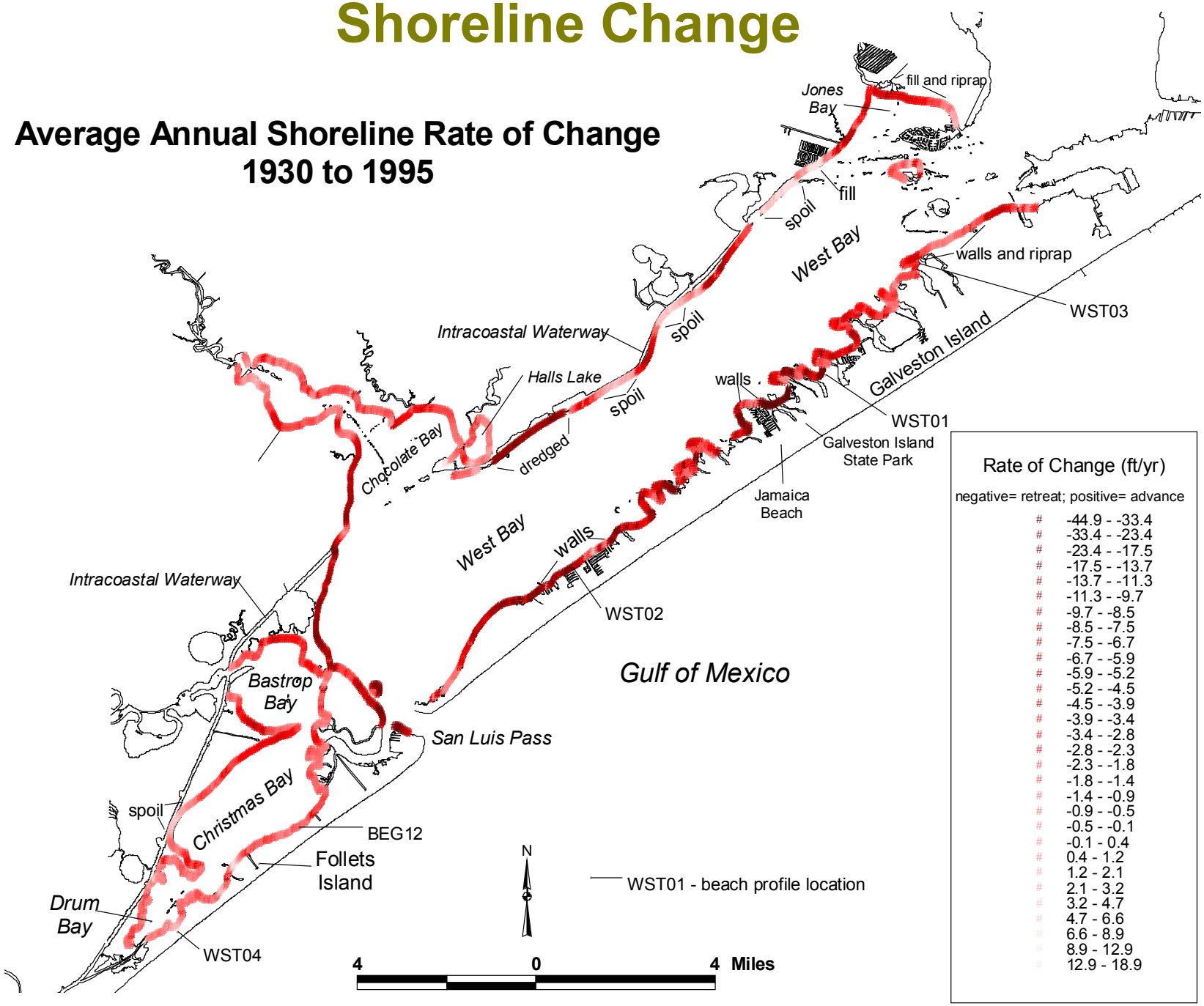
Changes Due to Relative Sea-Level Rise




2005/09/29


2005/09/29

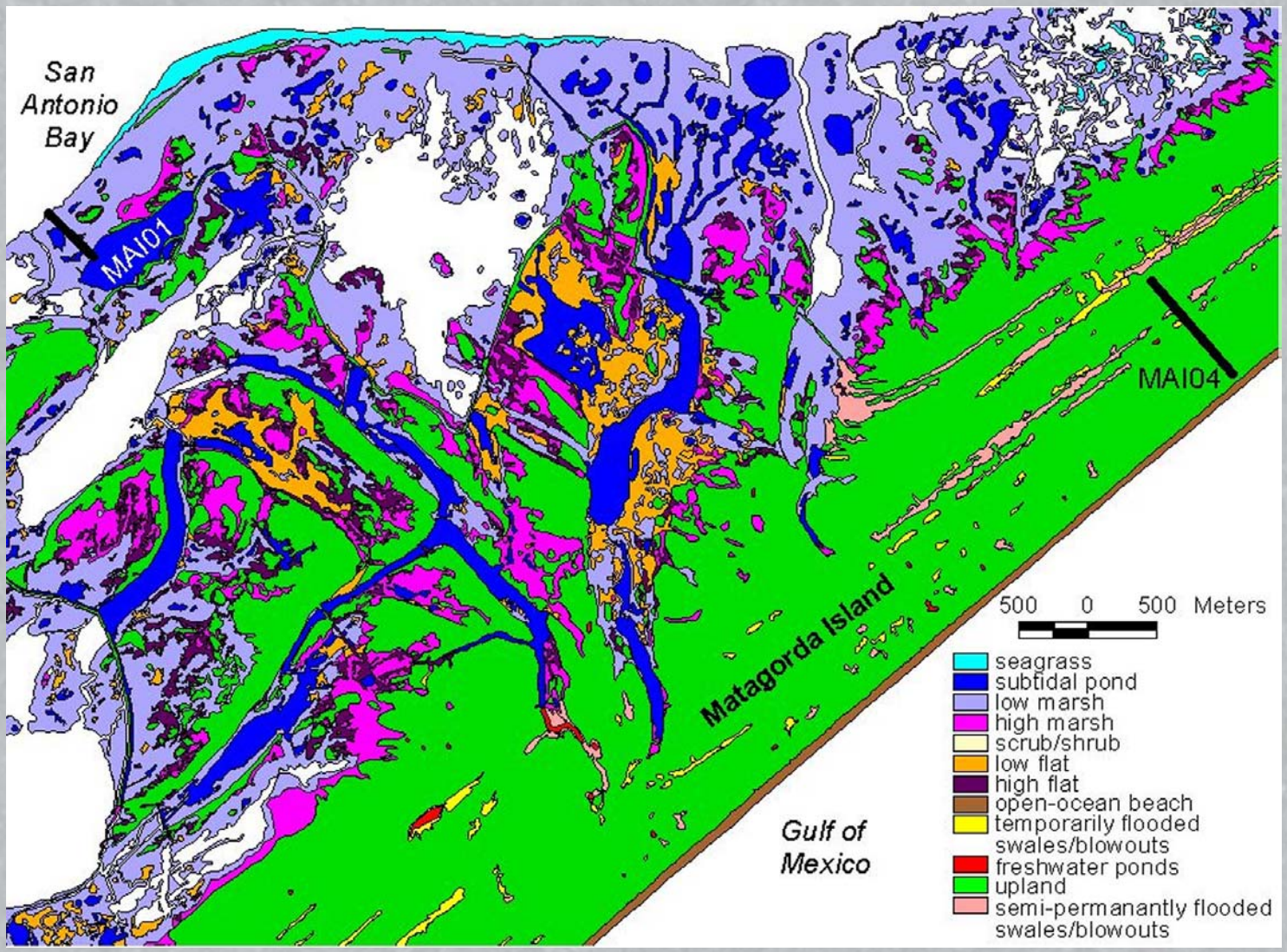
Shoreline Change



From Gibeaut et al., 2003


Color IR
Mosaic
Gulf of Mexico

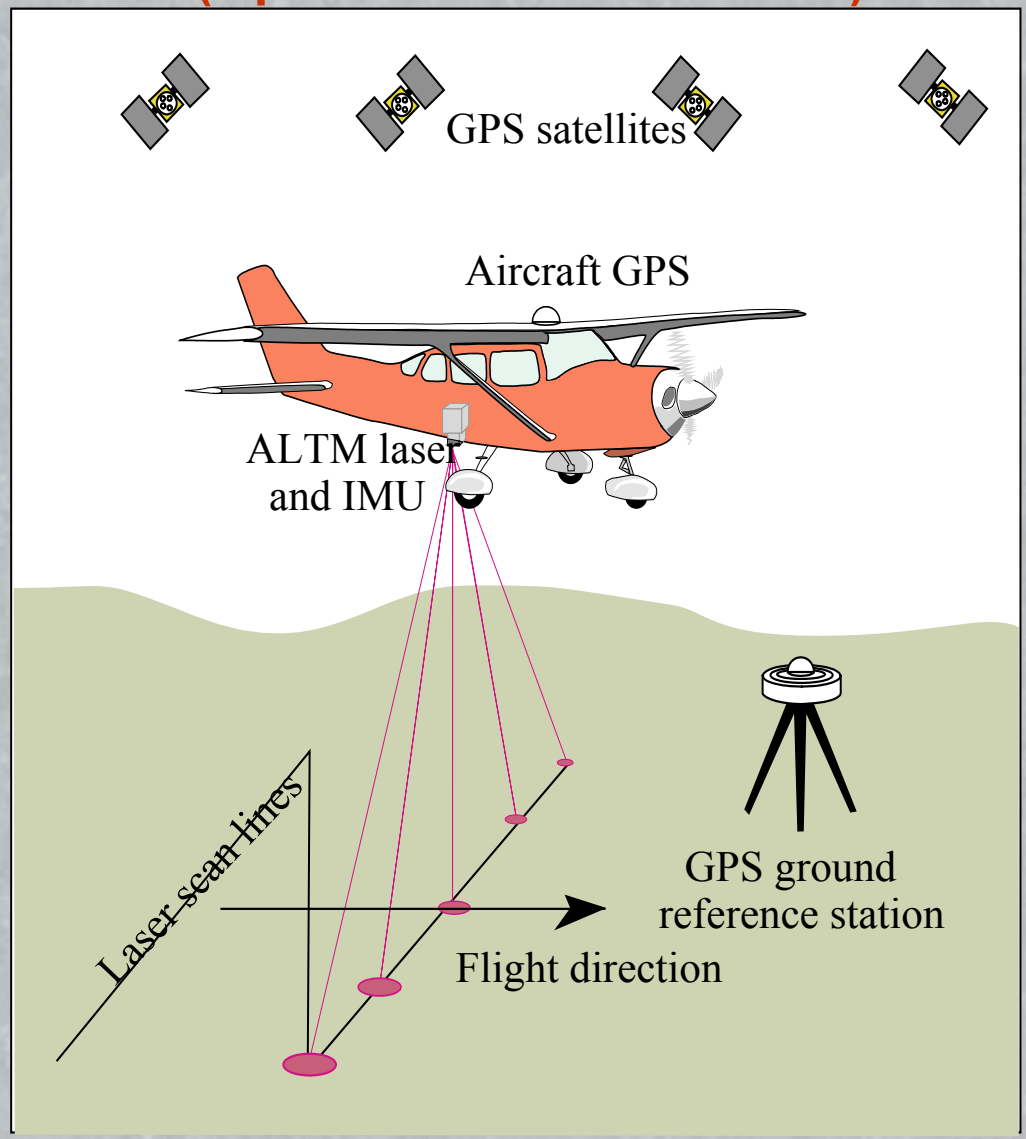
Habitat Classification Map From Color IR Photography



Data from White et al., 2002

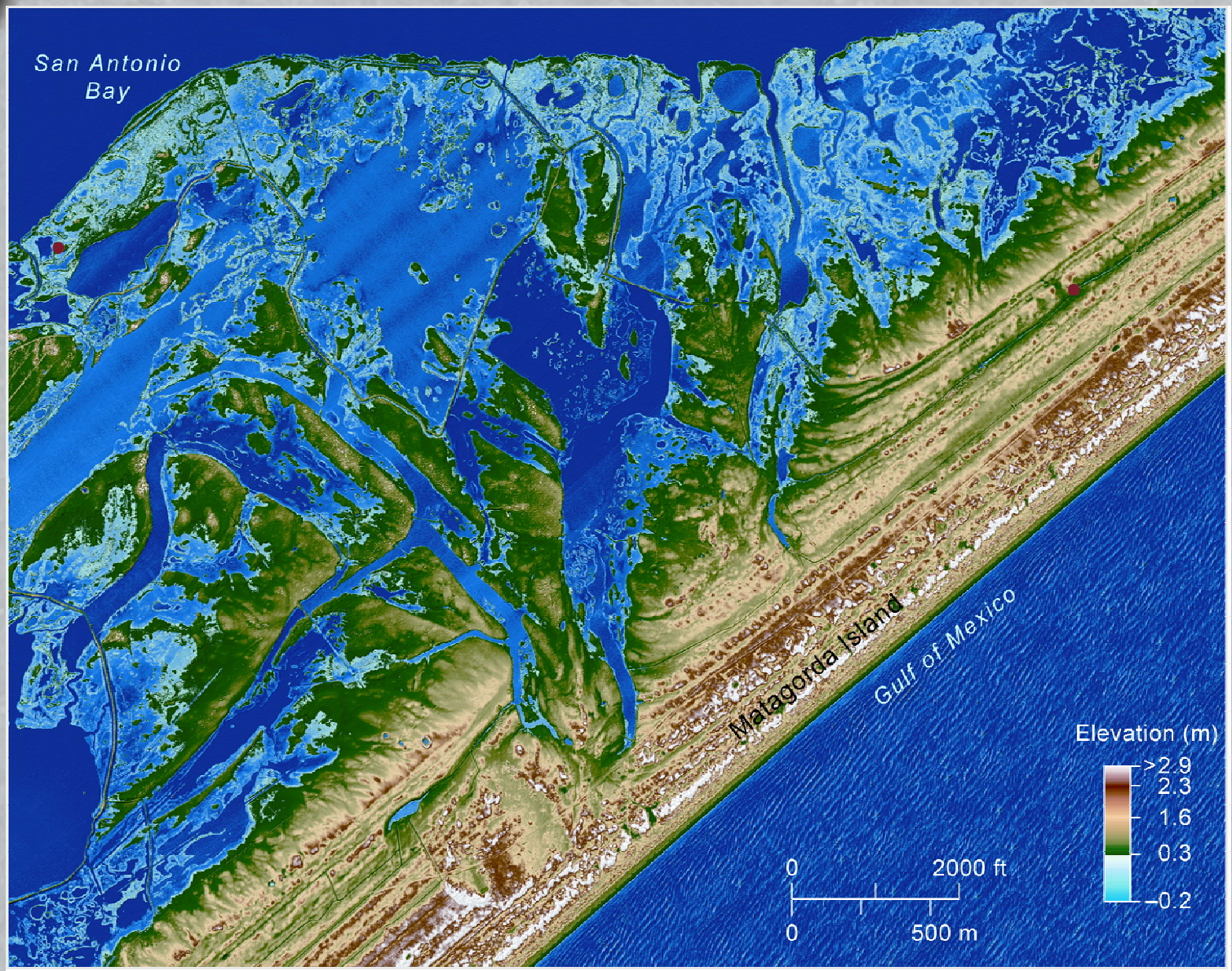
University of Texas Airborne Topographic Lidar System

(Optech model ALTM1225)

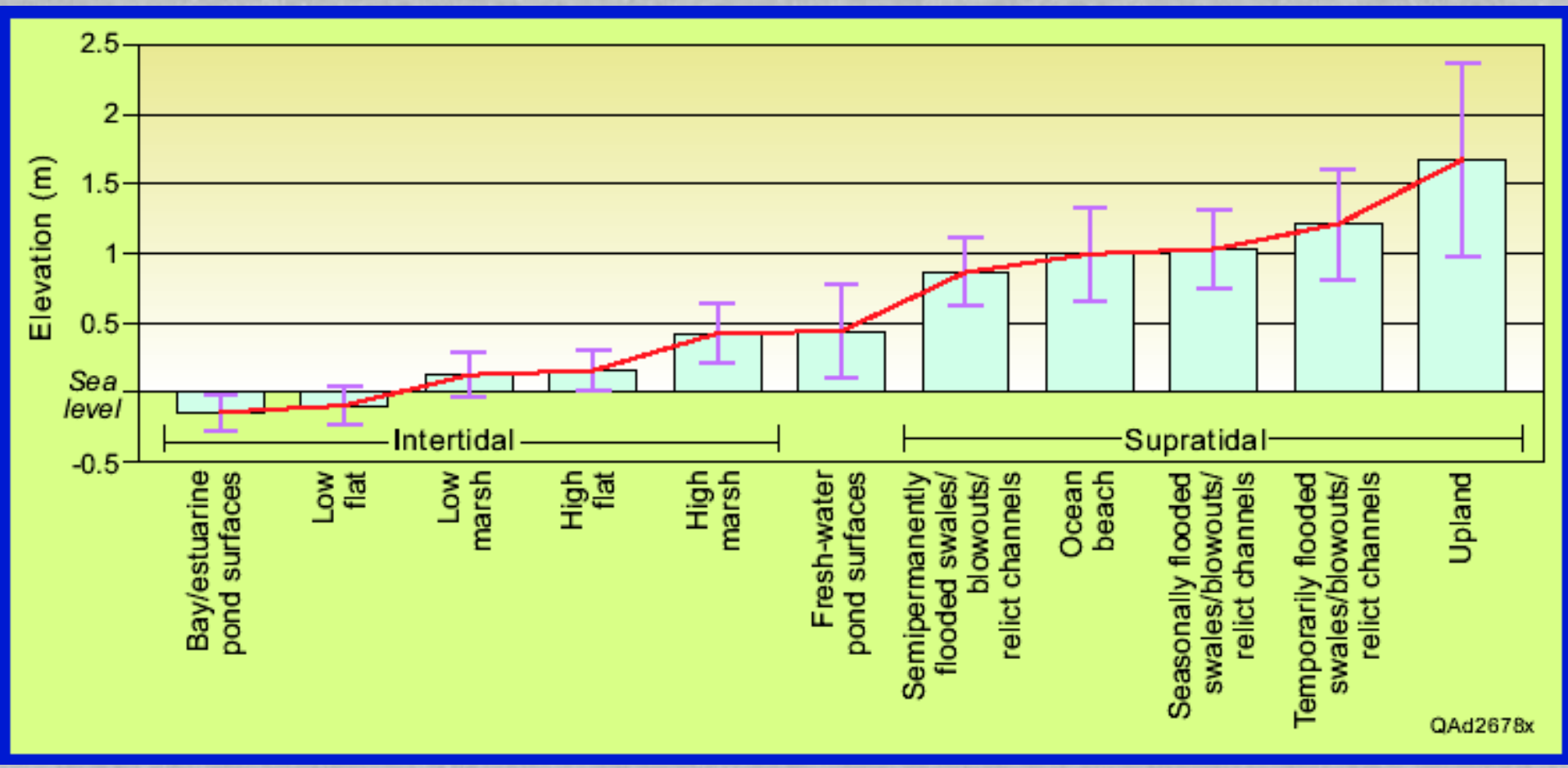


DEM, 30 X 30 m
From National Elevation Data

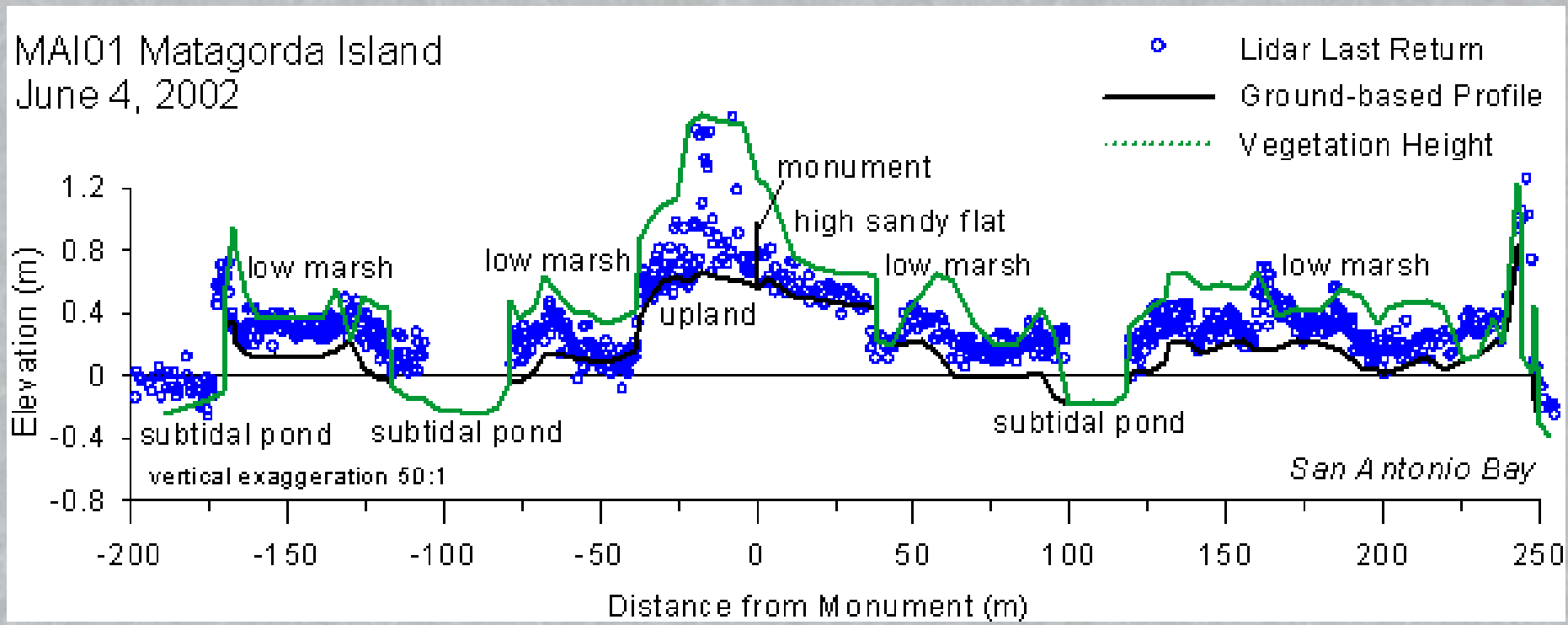
1 – Meter Lidar Digital Elevation Model



Average Heights and Standard Deviations of Barrier Island Habitats

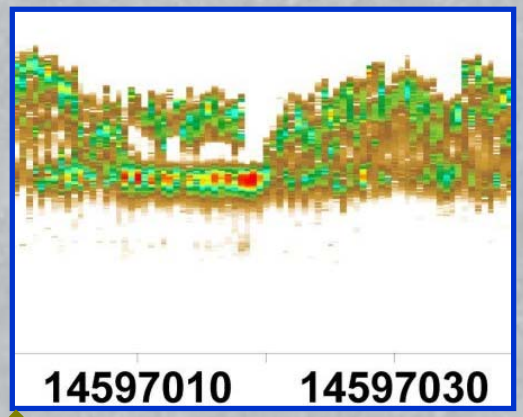


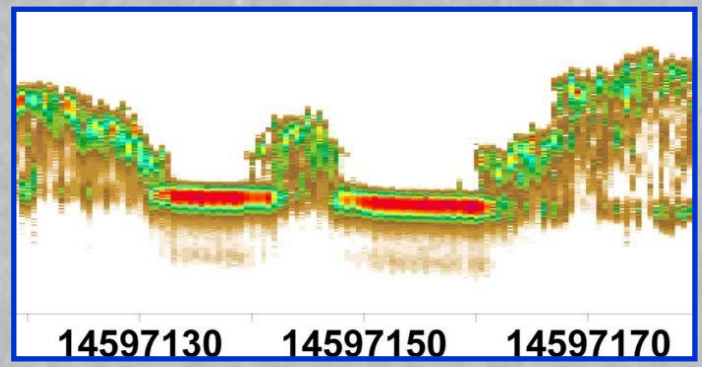
Ground and Lidar Profiles

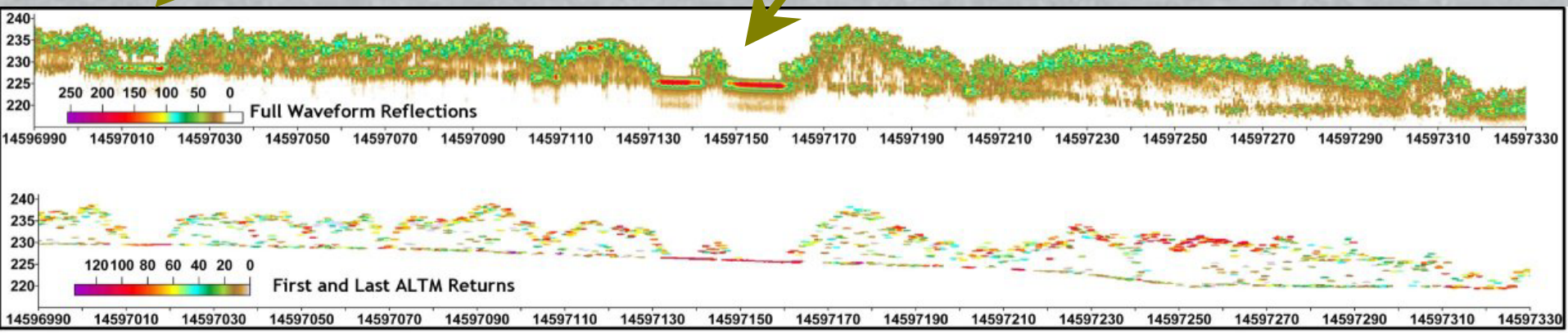


View Bayward along Transect

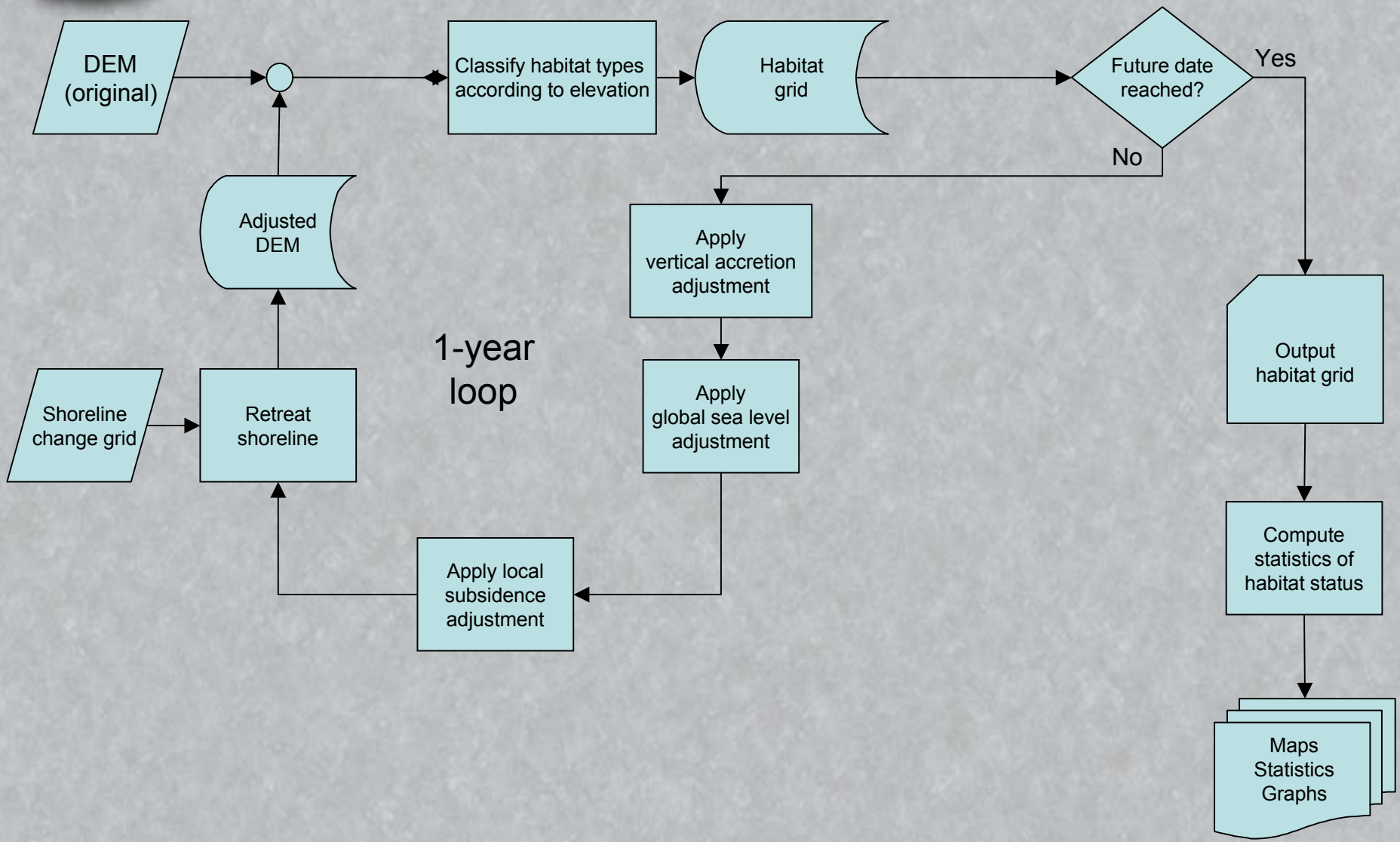
Waveform versus Discrete Return

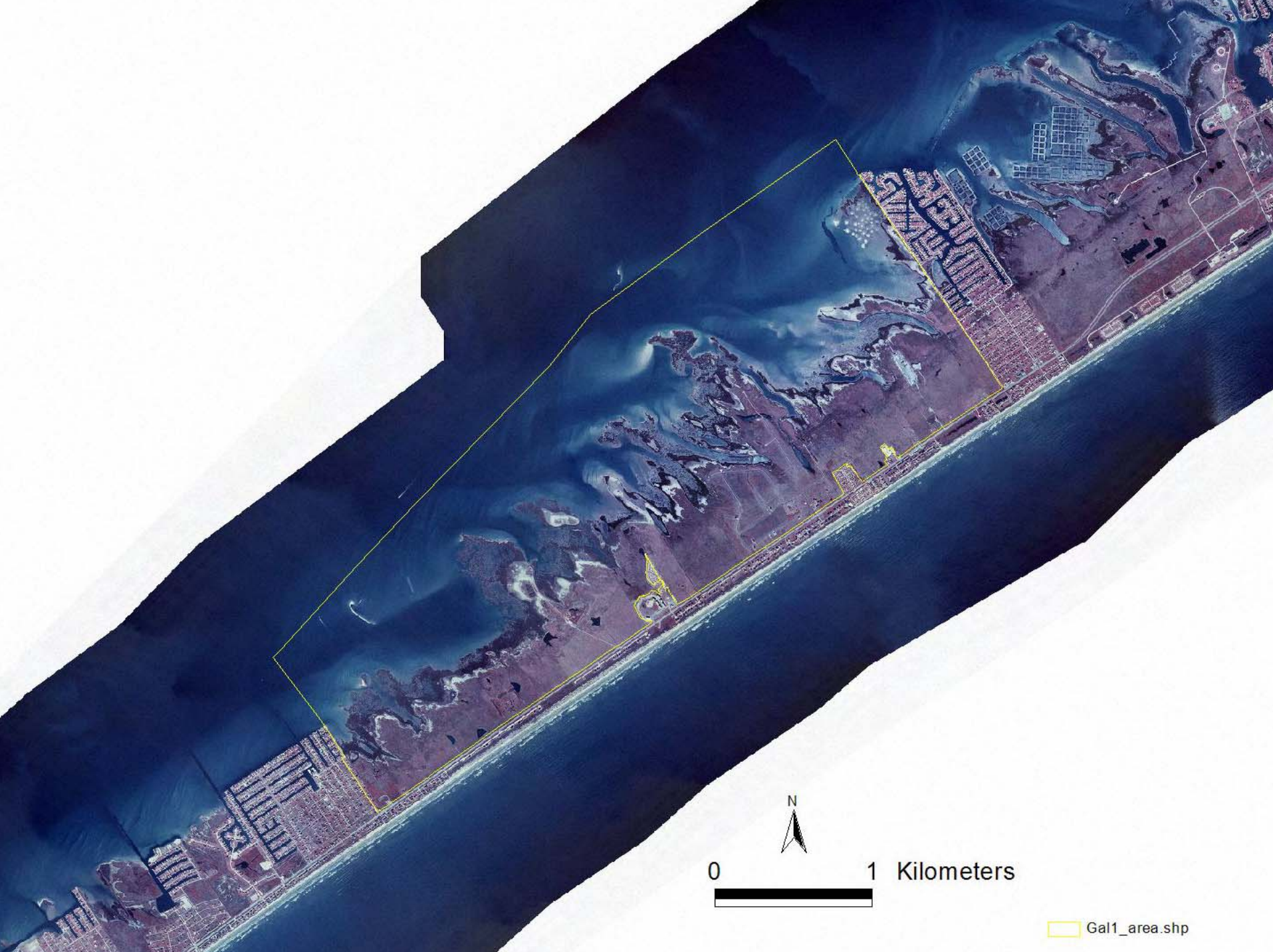


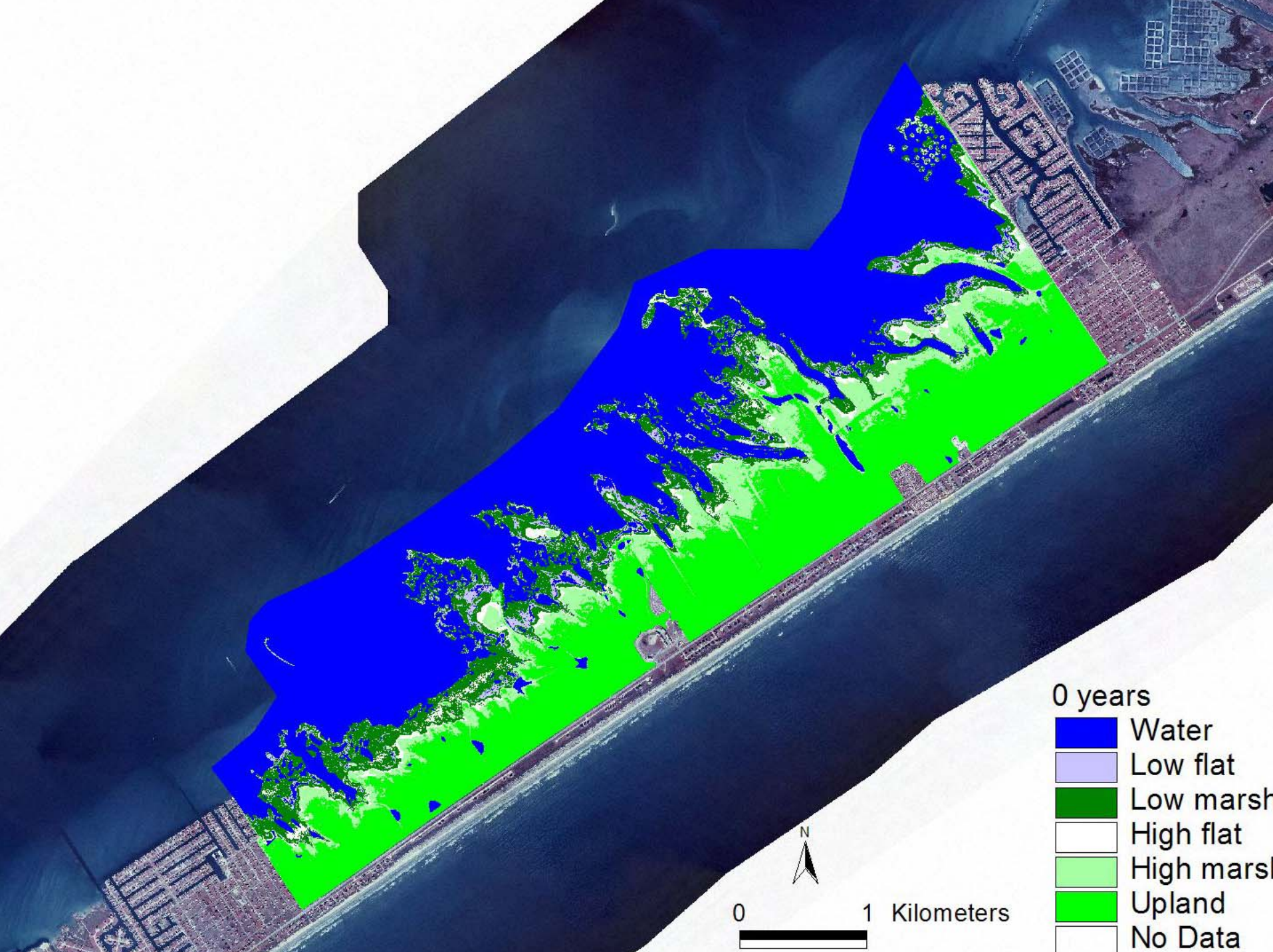


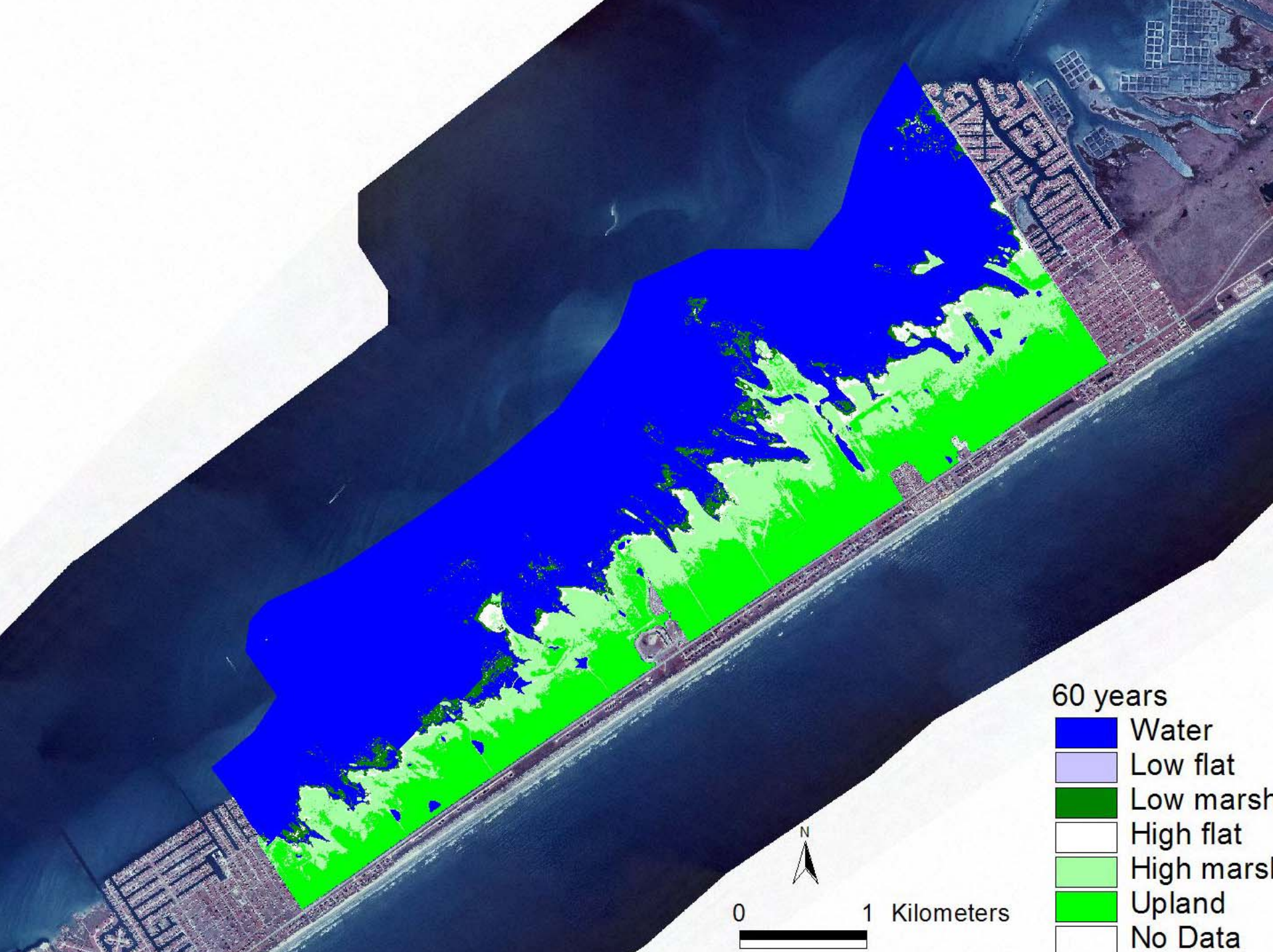


Model Flow

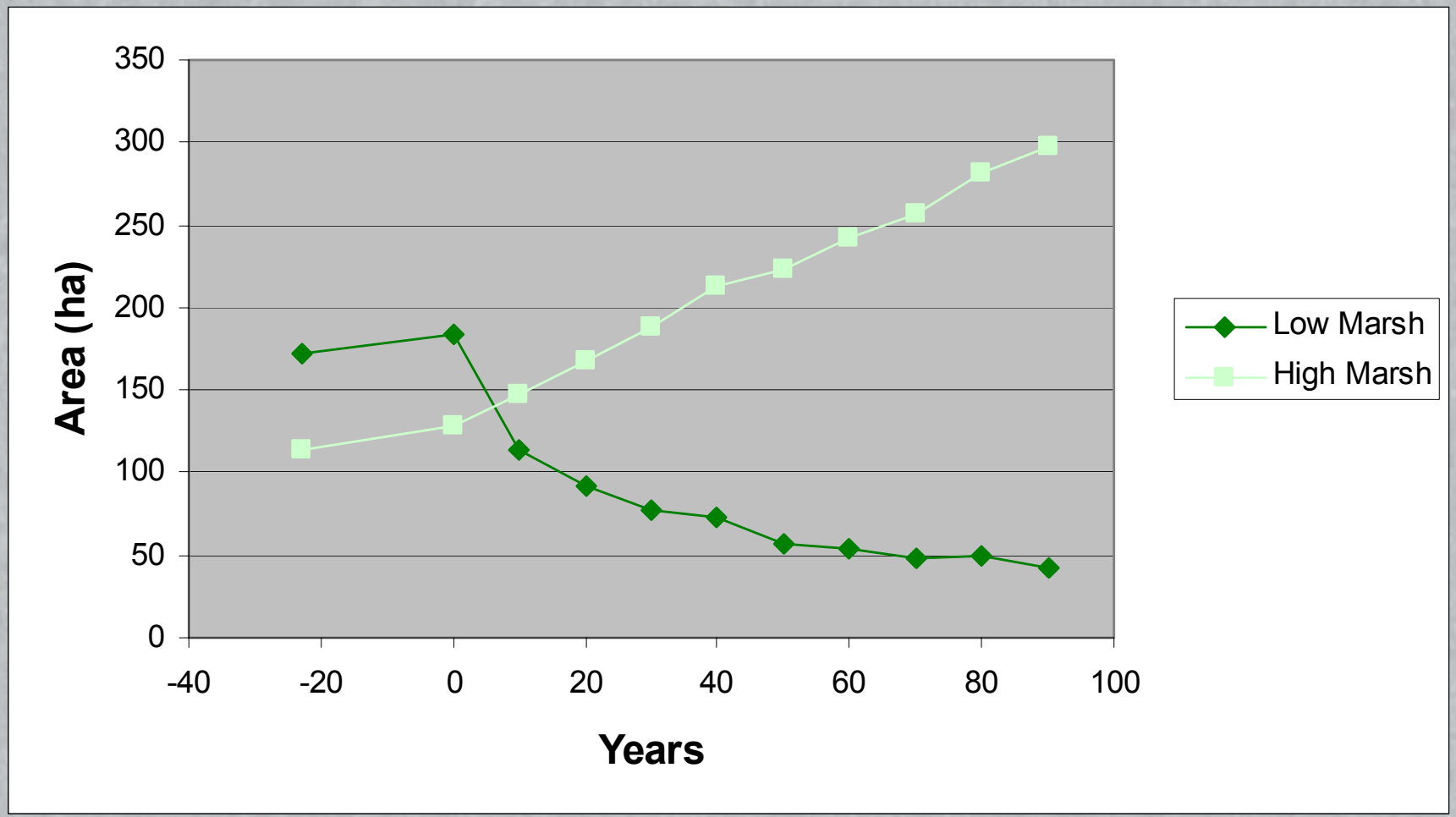

DEM (original)
Classify habitat types according to elevation
Habitat grid
Future date reached?
Yes
No
Adjusted DEM
Apply vertical accretion adjustment
1-year loop
Output habitat grid
Shoreline change grid
Retreat shoreline
Apply global sea level adjustment
Compute statistics of habitat status
Apply local subsidence adjustment
Maps
Statistics
Graphs


N
0
1 Kilometers
Gal1_area.shp

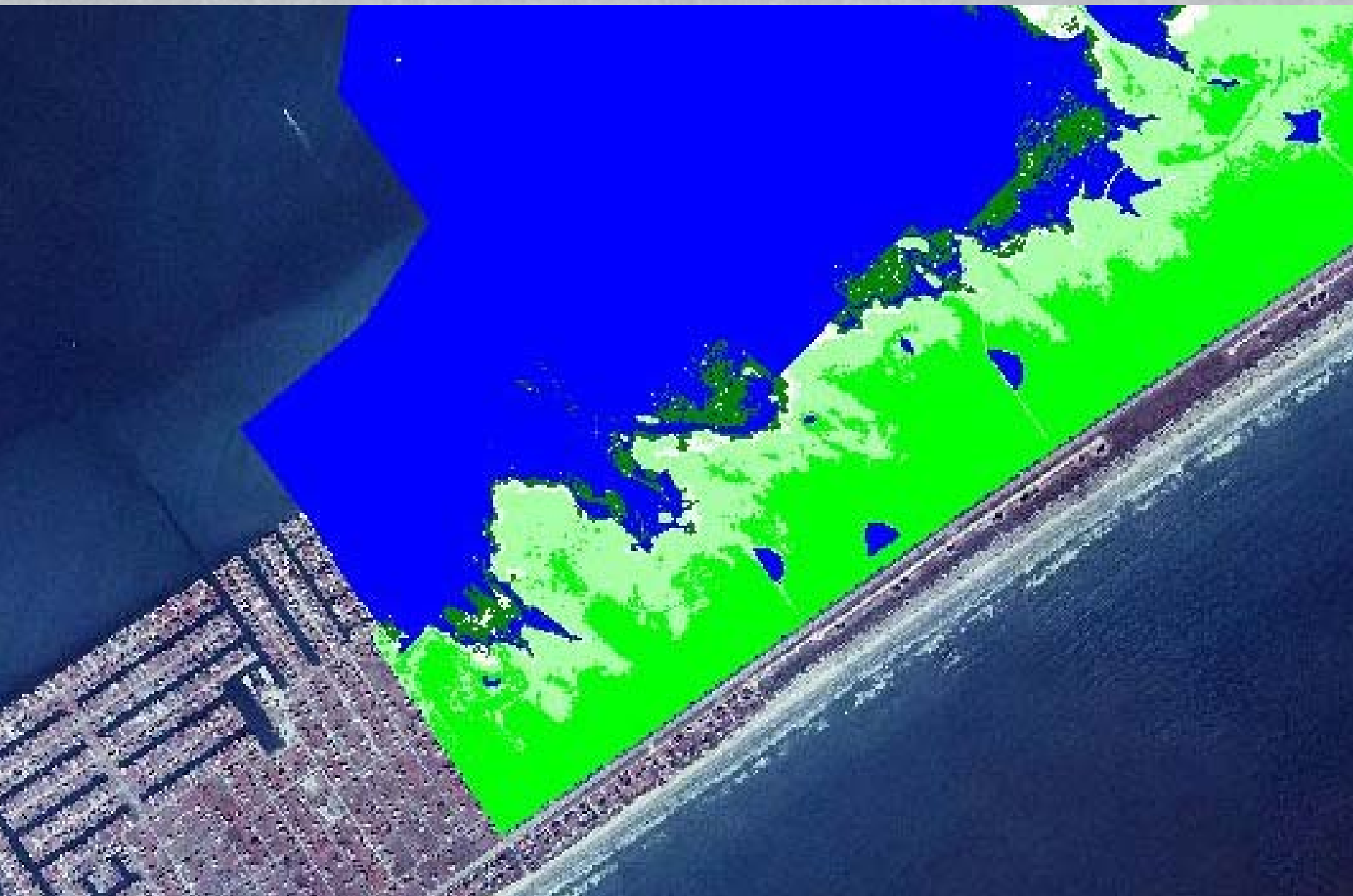

0 years
Water
Low flat
Low marsh
High flat
High marsh
Upland
No Data
N
0
1 Kilometers

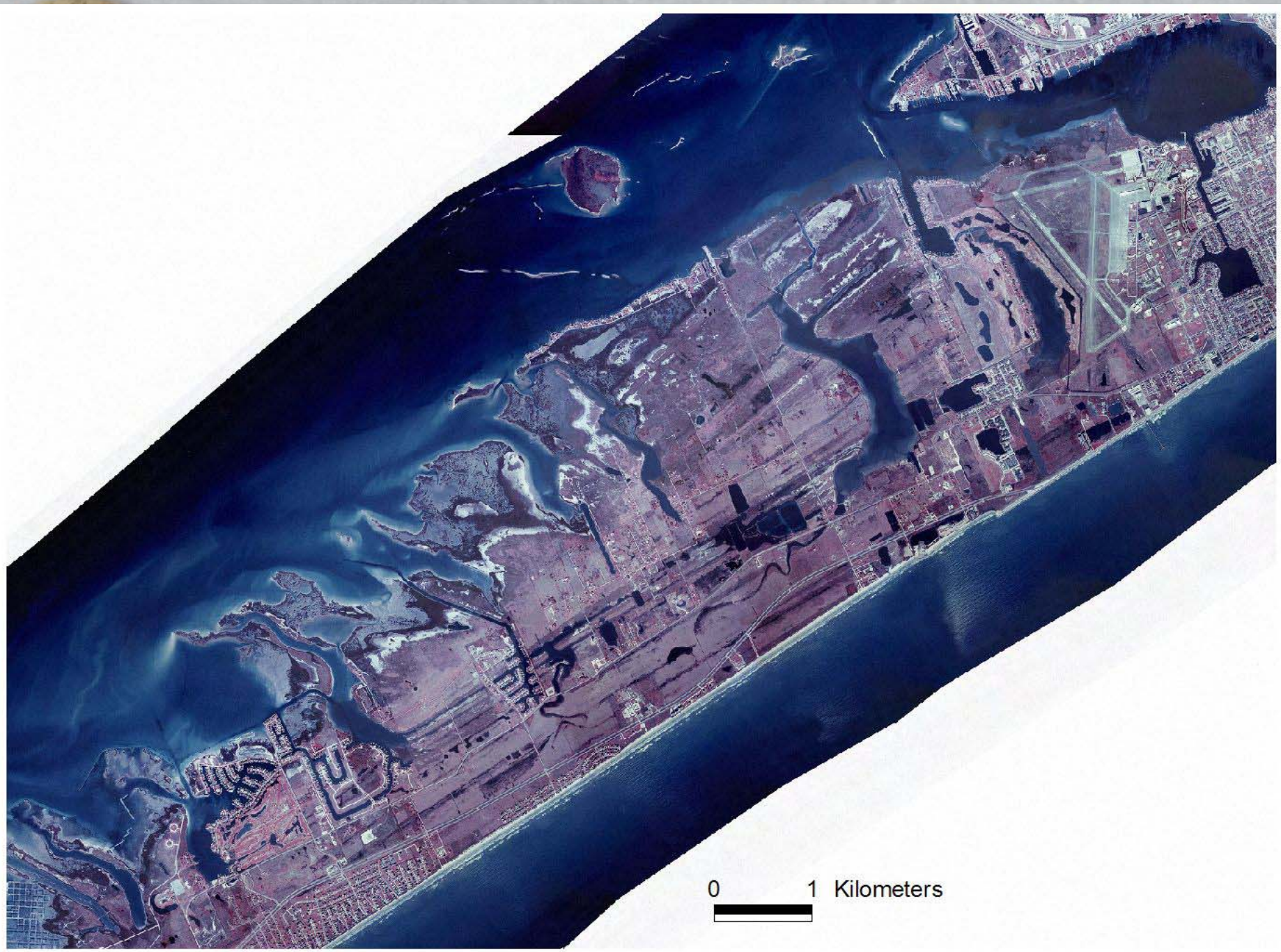

60 years
Water
Low flat
Low marsh
High flat
High marsh
Upland
No Data
N
0
1 Kilometers

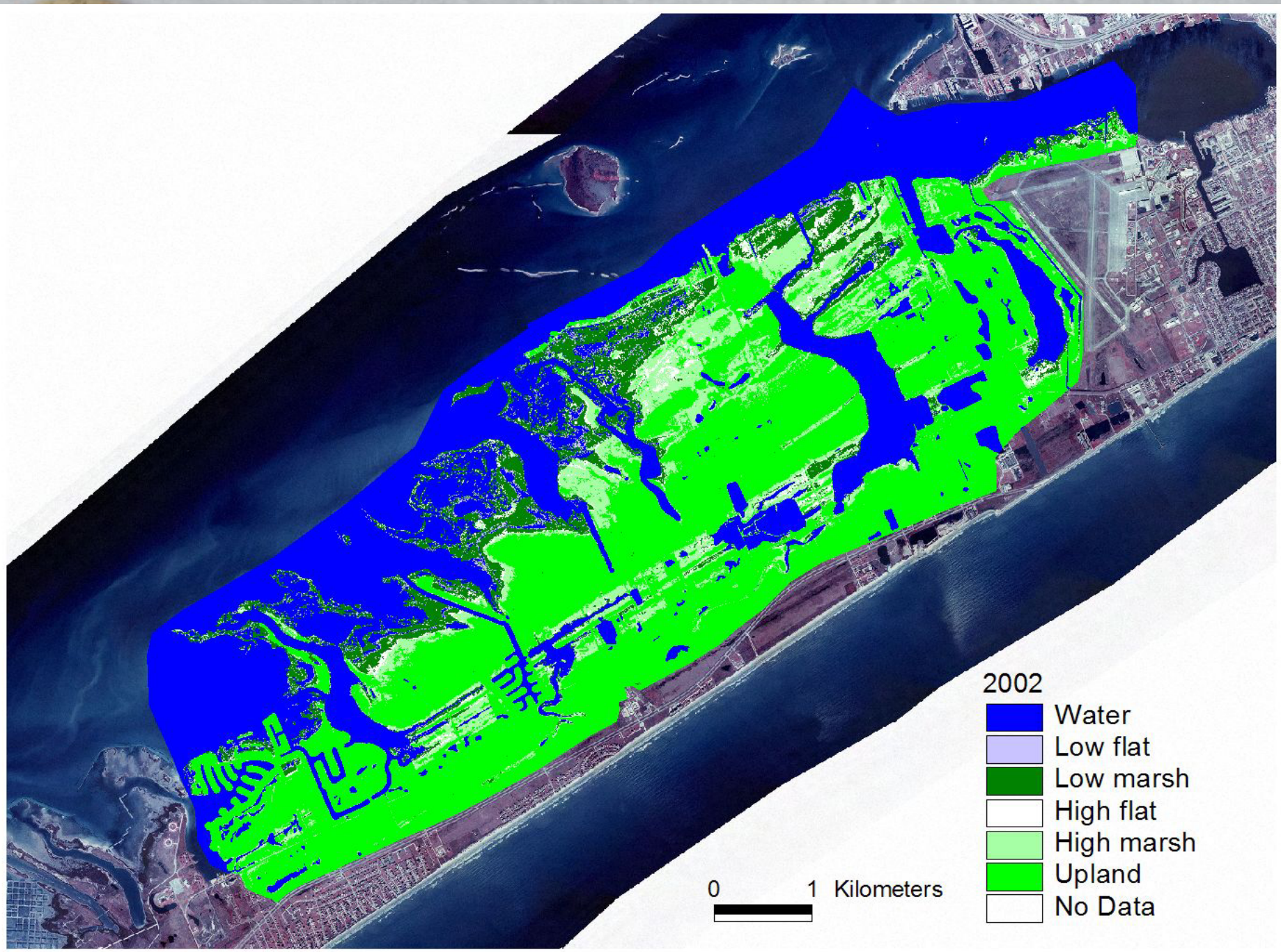
Projected Marsh Change

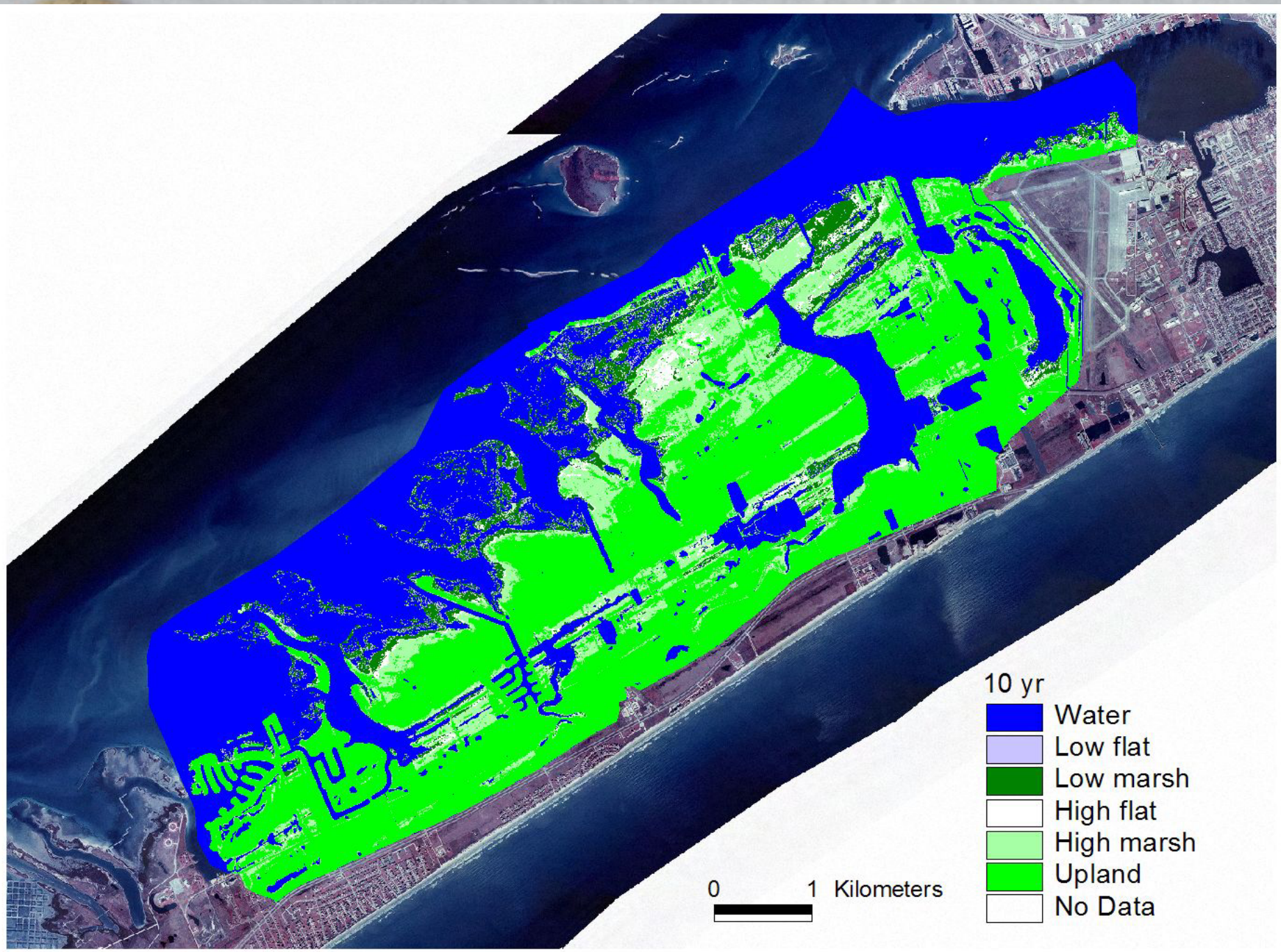


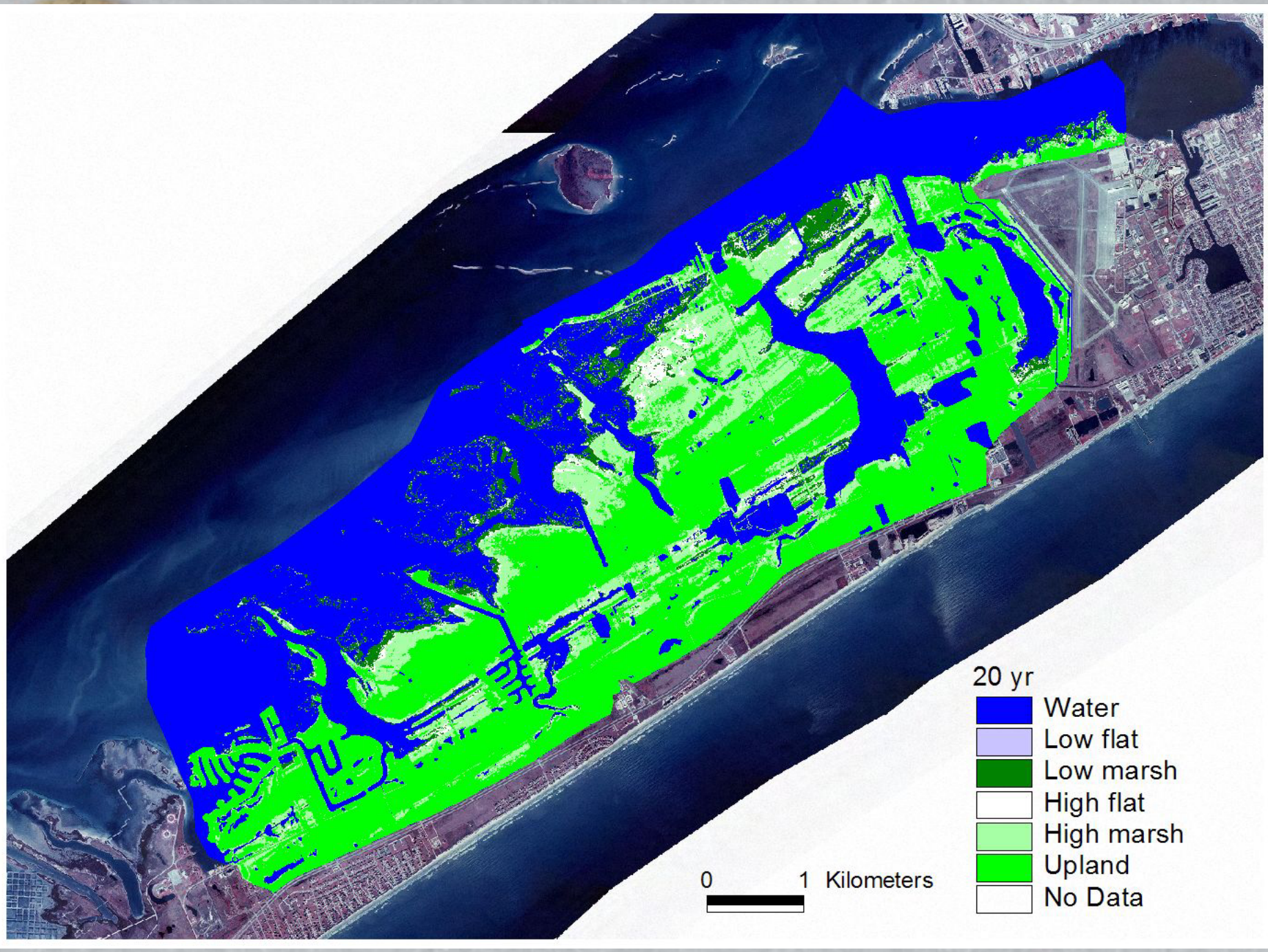
New Development
(post geohazard mapping)

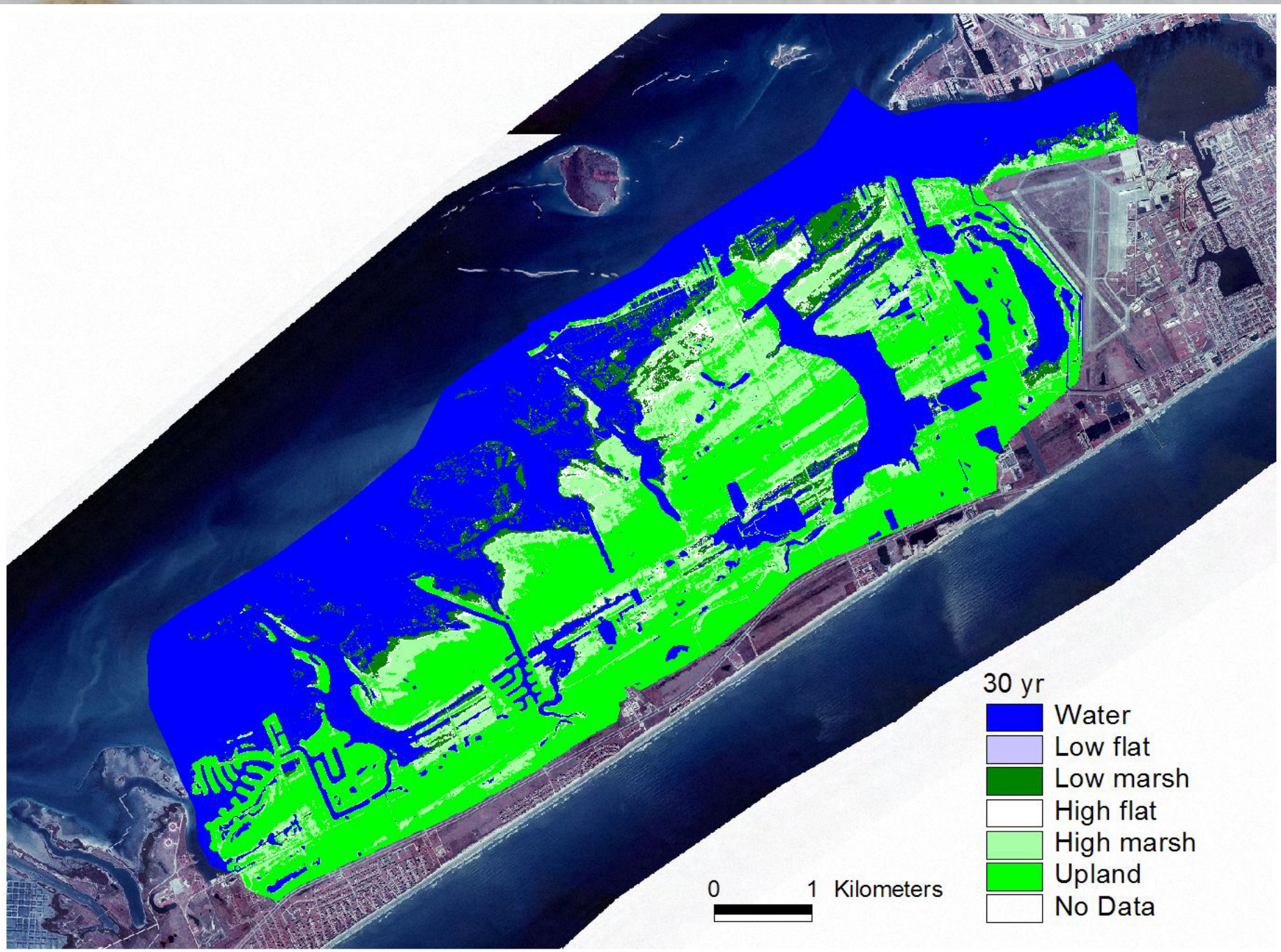


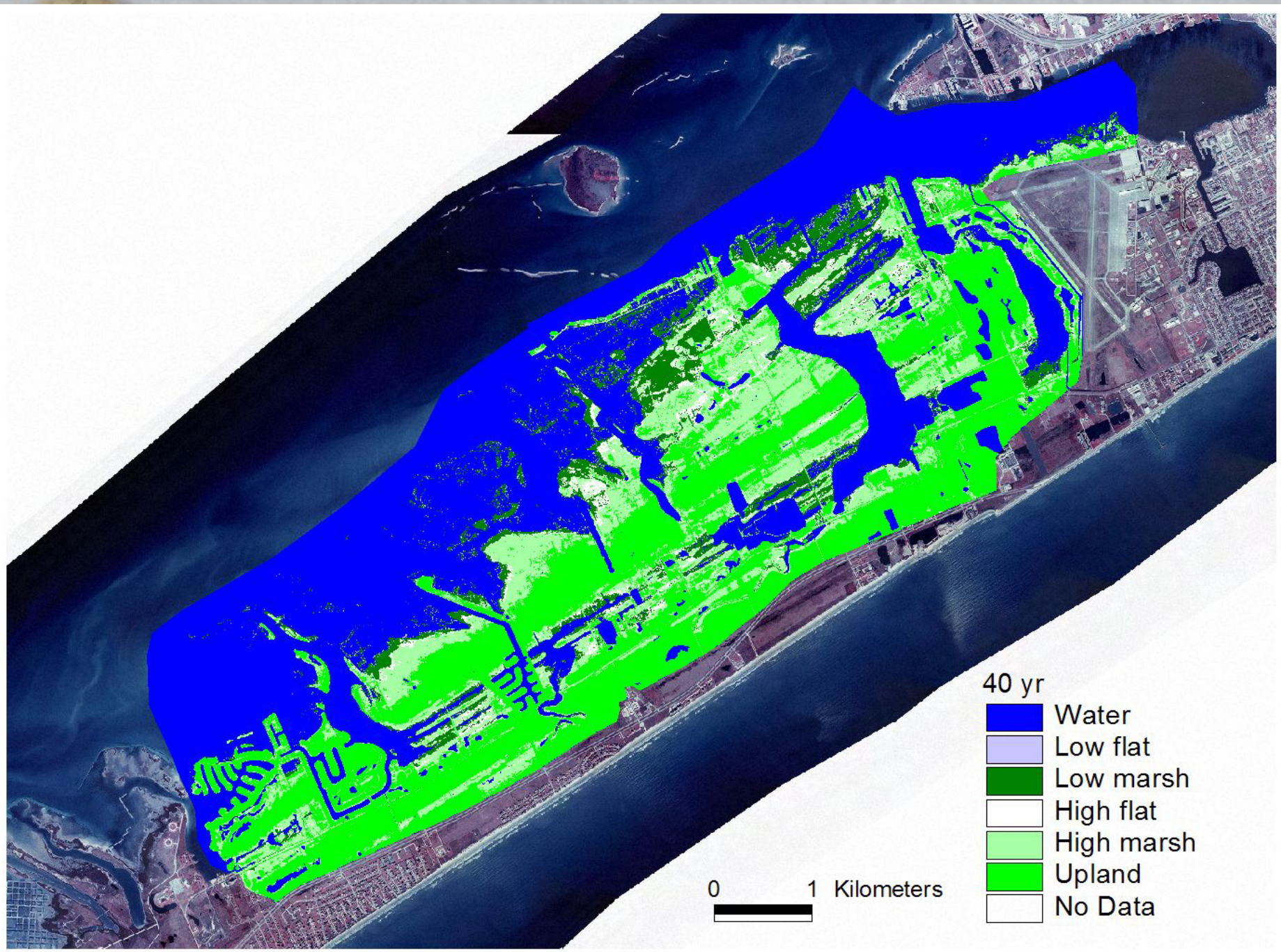

0
1 Kilometers

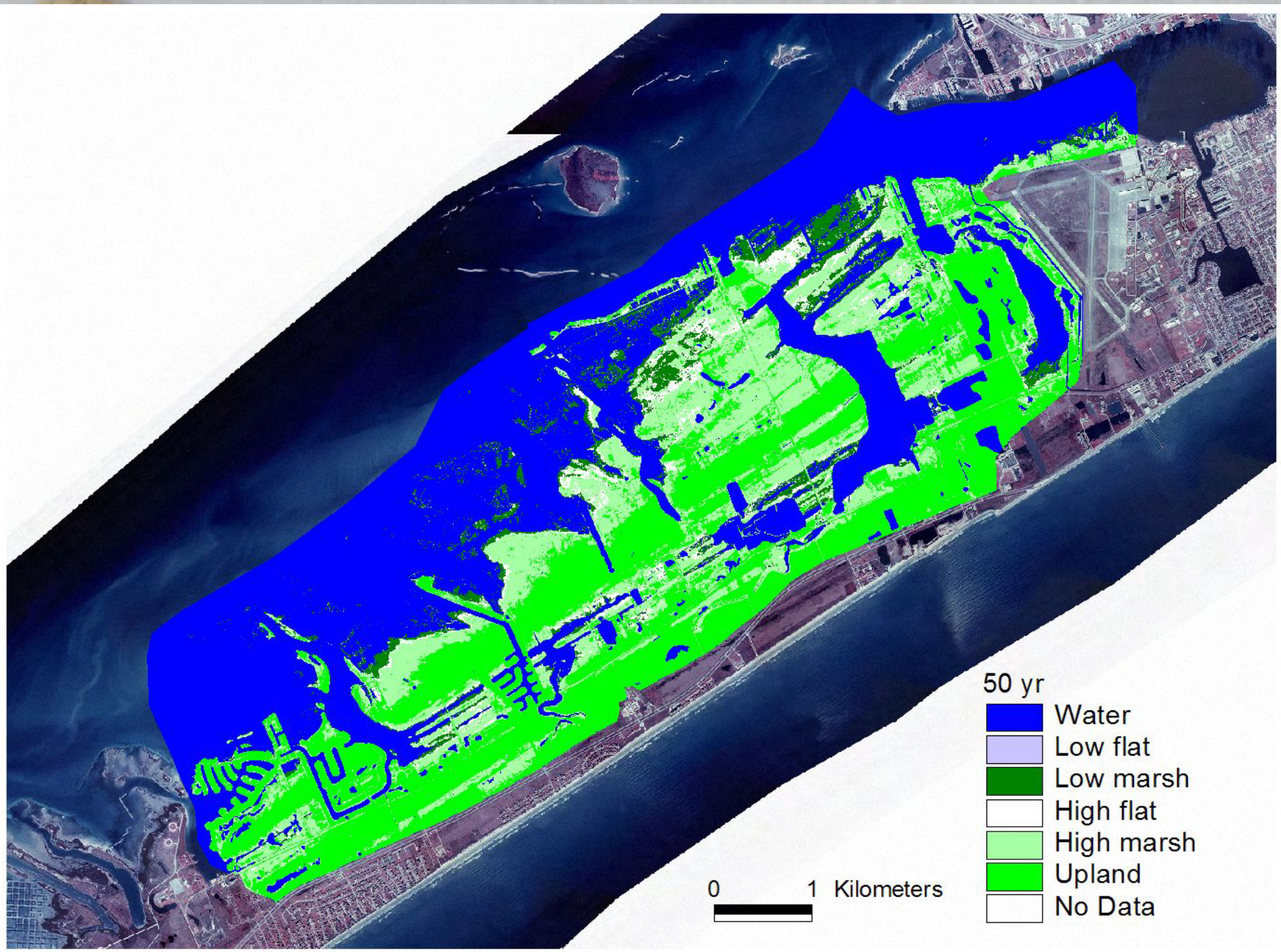

2002
Water
Low flat
Low marsh
High flat
High marsh
Upland
No Data
0
1 Kilometers

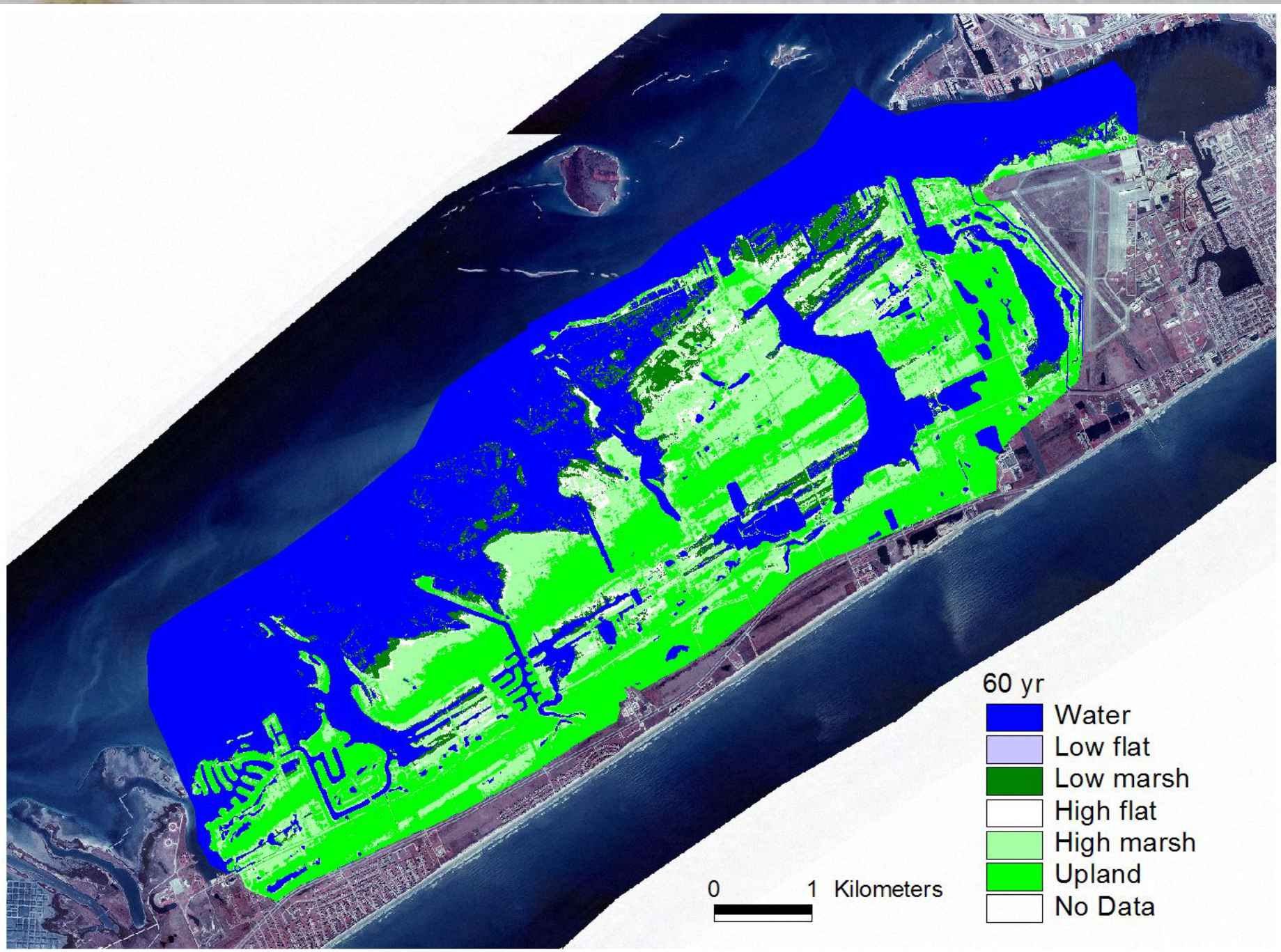

10 yr
Water
Low flat
Low marsh
High flat
High marsh
Upland
No Data
0
1 Kilometers

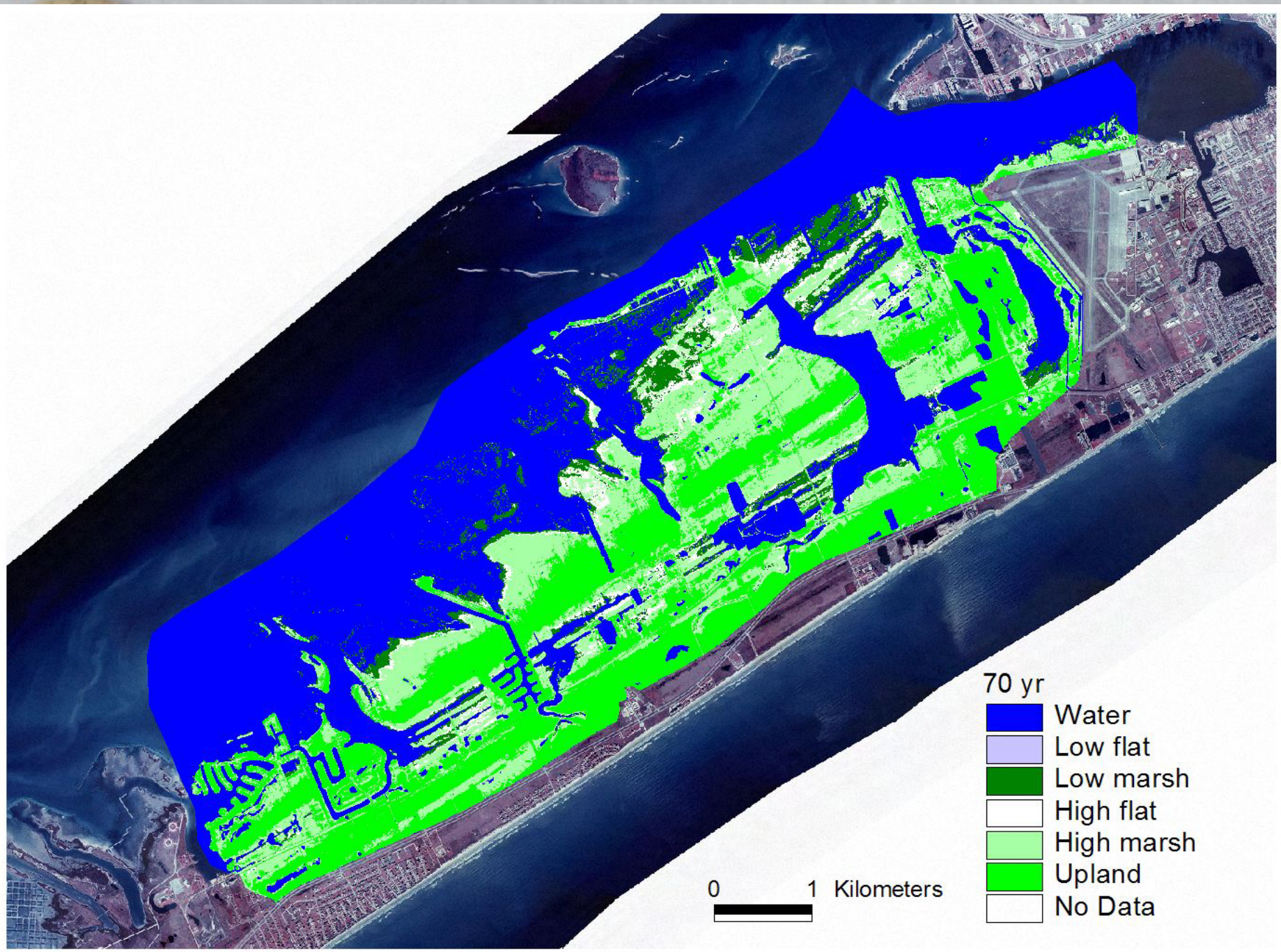

20 yr
Water
Low flat
Low marsh
High flat
High marsh
Upland
No Data
0
1 Kilometers

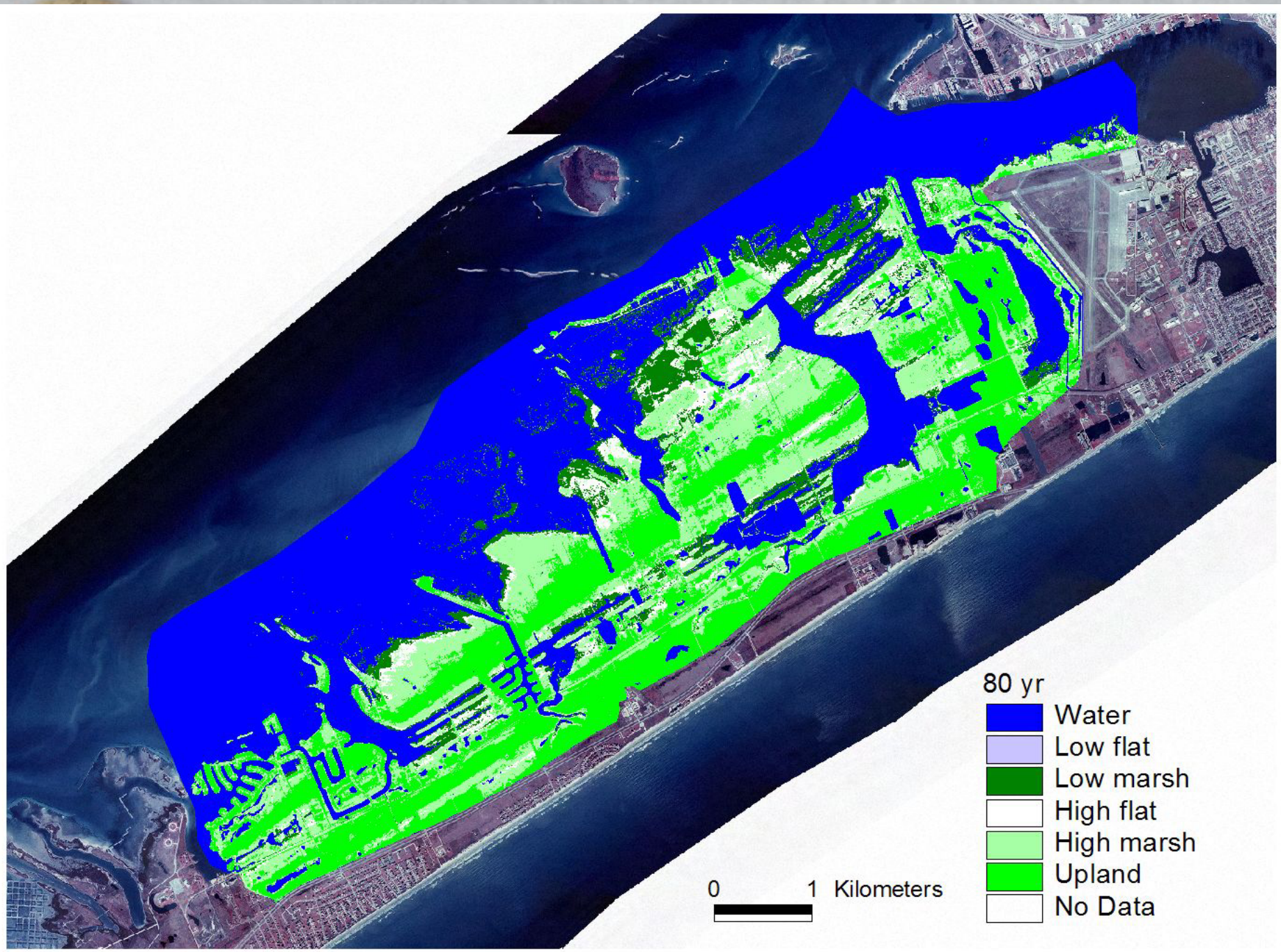

30 yr
Water
Low flat
Low marsh
High flat
High marsh
Upland
No Data
0
1 Kilometers

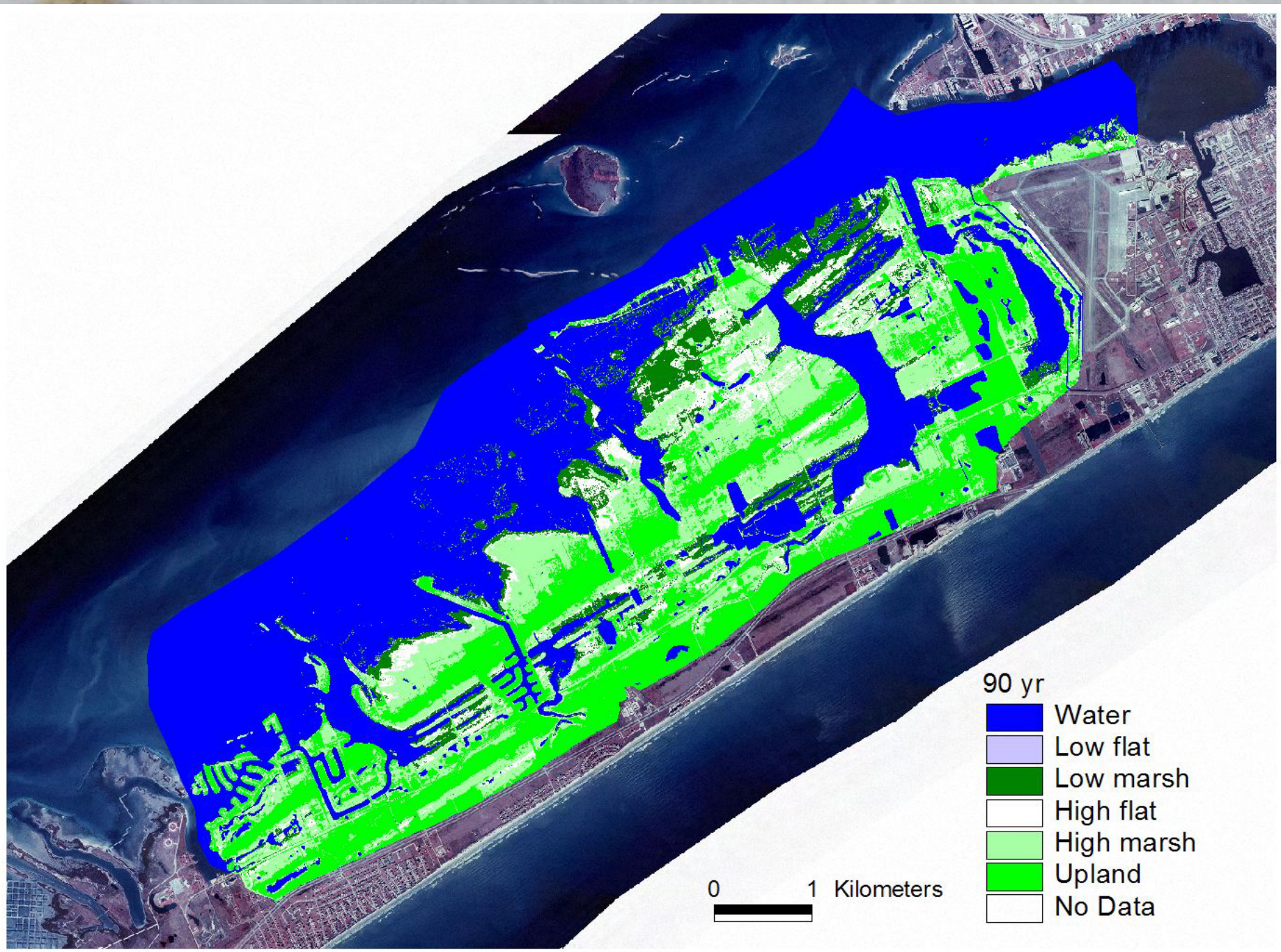

40 yr
Water
Low flat
Low marsh
High flat
High marsh
Upland
No Data
0
1 Kilometers


50 yr
Water
Low flat
Low marsh
High flat
High marsh
Upland
No Data
0
1 Kilometers

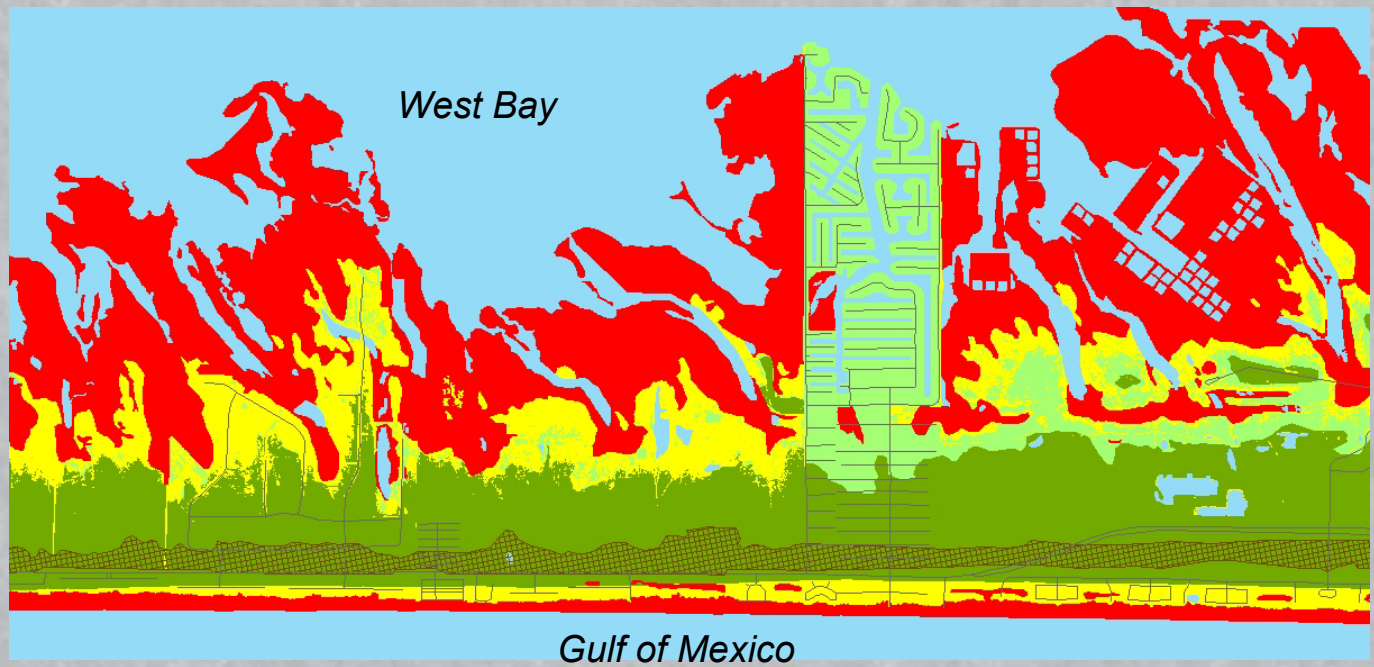

60 yr
Water
Low flat
Low marsh
High flat
High marsh
Upland
No Data
0
1 Kilometers


70 yr
Water
Low flat
Low marsh
High flat
High marsh
Upland
No Data
0
1 Kilometers


80 yr
Water
Low flat
Low marsh
High flat
High marsh
Upland
No Data
0
1 Kilometers

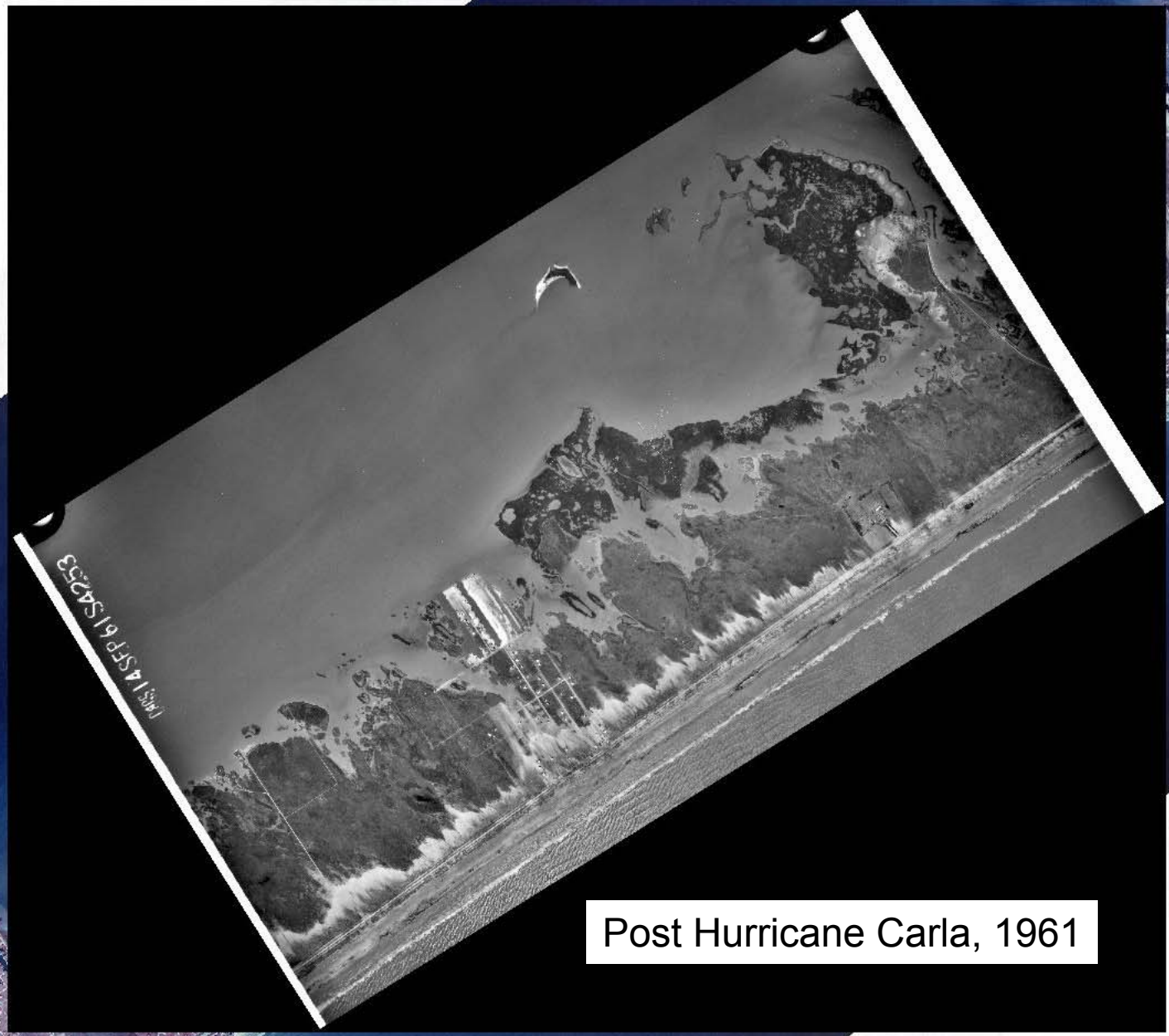

90 yr
Water
Low flat
Low marsh
High flat
High marsh
Upland
No Data
0
1 Kilometers

Geohazards Map Units



Open Water	Bay, ocean, natural or excavated ponds and swales that are always inundated.
Low Geohazard Potential	Island Core Upland: Centrally located upland areas generally more than 5 feet above sea level and not expected to become critical environments in 60 years' time (2062).
Moderate Geohazard Potential	Upland: Upland areas generally less than 5 feet above sea level that are not expected to become critical environments during the next 60 years (2062) (see above) but may be affected by storm surge caused by typical tropical storms or category-one hurricanes.
High Geohazard Potential	Future Critical Environments: Areas expected to become critical environments (see above) in 60 years' time (2062) if historical rates of relative sea-level rise and shoreline change continue and if development or restoration projects do not affect natural processes.
Imminent Geohazard Potential	Present Critical Environments: Salt and freshwater wetlands, including beaches, tidal flats, and marshes. Along Gulf of Mexico shoreline, including beaches and fore dunes.

Coastal Studies Group



Post Hurricane Carla, 1961


Area of enhanced potential for washover
Natural protective ridge
Storm washover paths

Barrier Island Cross Section