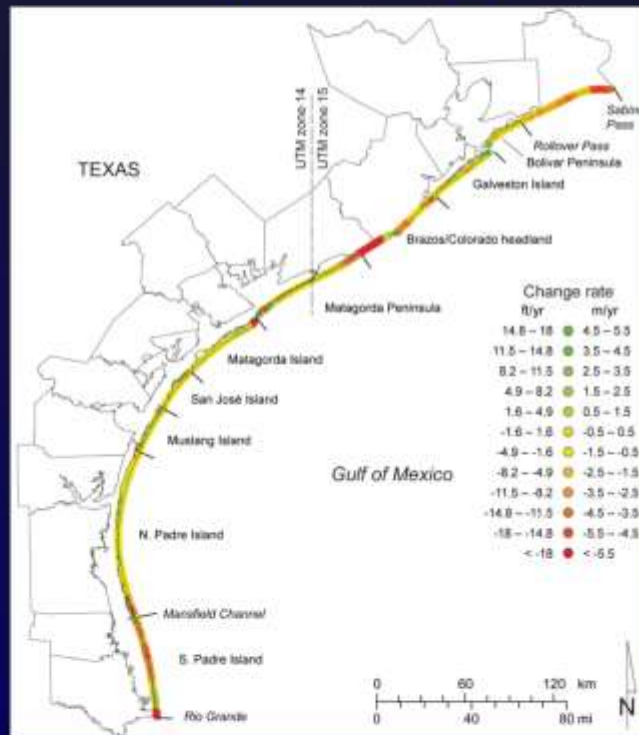


Historical and Short-Term Shoreline Change, Texas Gulf Coast: Rates, Contributing Causes, and Postglacial Context

Jeffrey G. Paine, Tiffany Caudle, and John Andrews



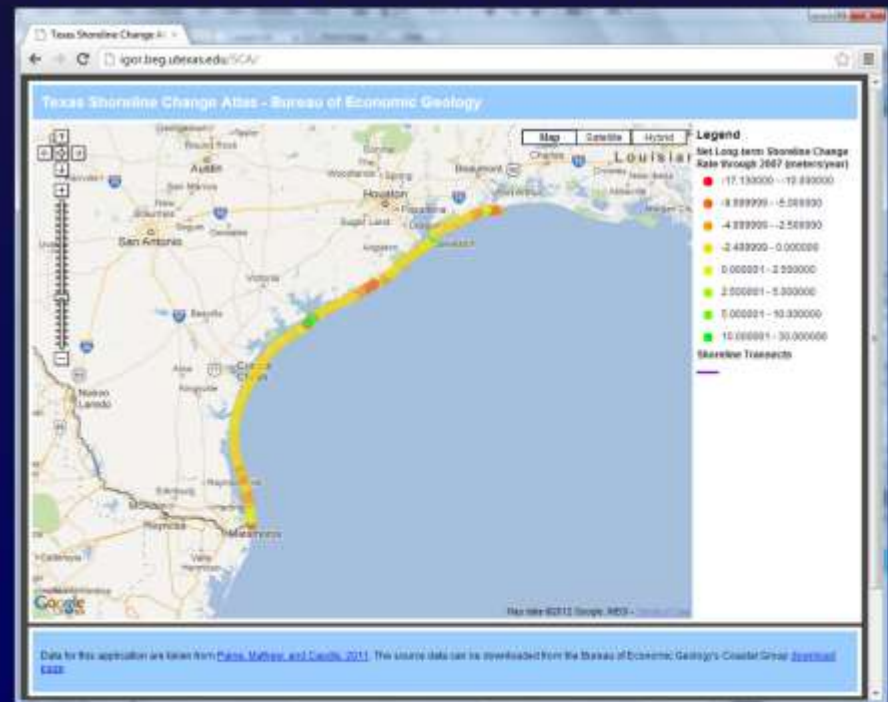
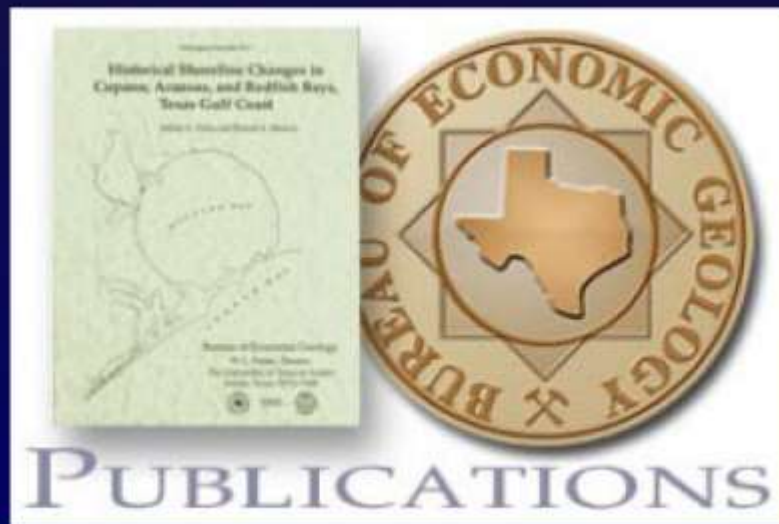
BUREAU OF
ECONOMIC
GEOLOGY



THE UNIVERSITY OF TEXAS AT AUSTIN
JACKSON
SCHOOL OF GEOSCIENCES

Historical Shoreline Change Studies at BEG

- Gulf and bay shoreline change studies began in early 1970s along with new emphasis on coastal environmental mapping
- By Texas Statute, the Bureau is the provider of shoreline change data for Texas (publications, Google-based web server)
- This is the latest update of long-term Gulf shoreline change rates (through 2007), shorter-term change between 2010 and 2012, and the postglacial context of change



Shoreline Monitoring Data Sources

**U.S. Coast & Geodetic Survey Topographic Charts
(mid-late 1800s)**



**Aerial Photography
(late 1920s to present)**



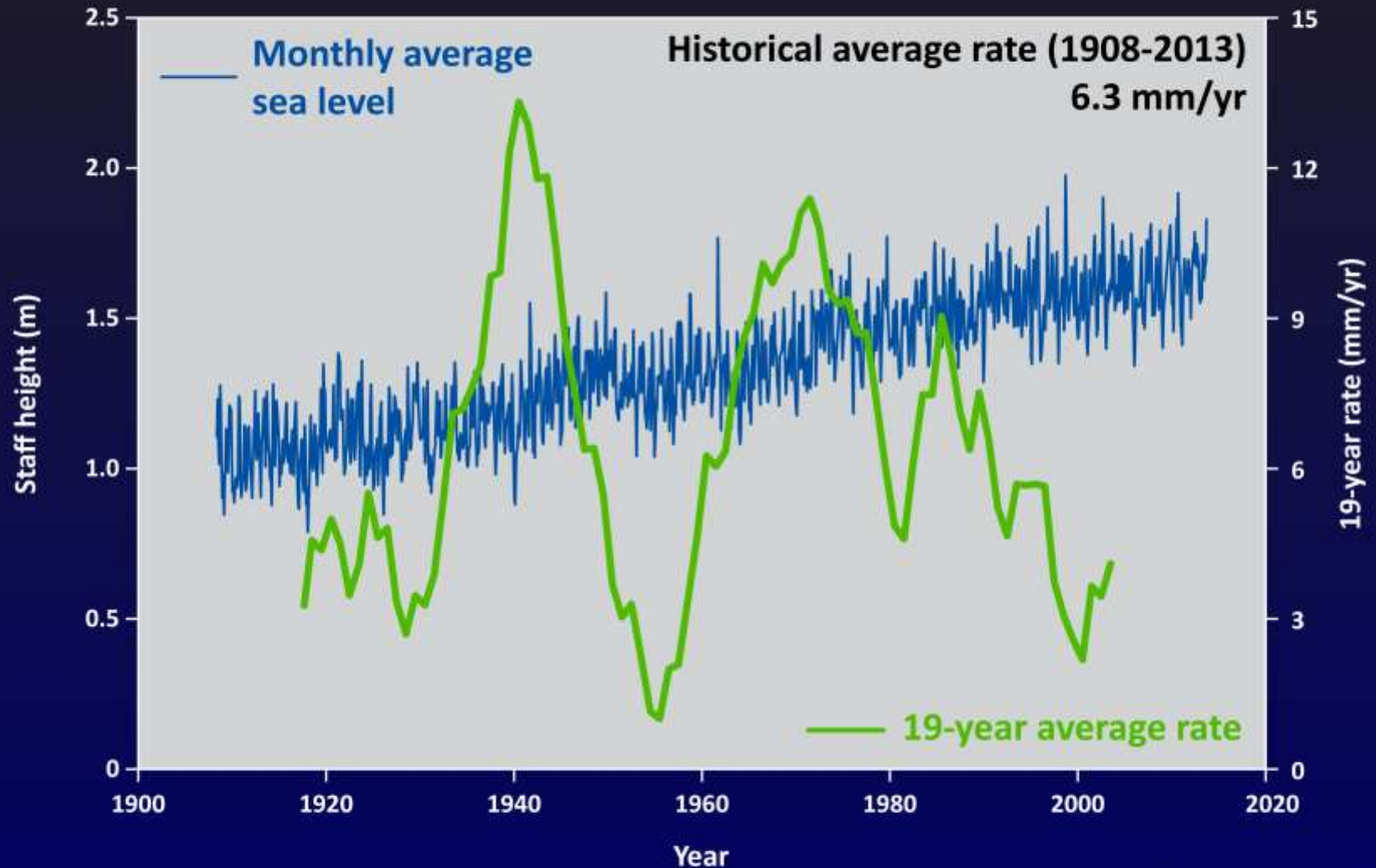
**Global Positioning System Surveys
(1990s to present)**



**Airborne Lidar
(late 1990s to present)**



Tide-Gauge Record, Pier 21, Galveston



Raw data from NOAA



Tropical Cyclones Affecting Texas, 1990 - 2013

<u>Year</u>	<u>Category</u>	<u>Name</u>	<u>Landfall area</u>
1993	TS	Arlene	North Padre Island
1995	TS	Dean	Freeport
1998	TS	Charley	Aransas Pass
1998	TS	Frances	Matagorda Island
1999	H4	Bret	Padre Island (weakened)
2001	TS	Allison	Freeport
2002	TS	Bertha	North Padre Island
2002	TS	Fay	Matagorda Peninsula
2003	H1	Claudette	Matagorda Peninsula
2003	TS	Grace	Galveston Island
2005	H5	Rita	Sabine Pass (H3 at landfall)
2007	TS	Erin	San Jose Island
2007	H1	Humberto	Upper Texas coast
2008	H2	Dolly	South Padre Island
2008	TS	Edouard	Upper Texas coast
2008	H4	Ike	Galveston (H2 at landfall)
2010	TS	Hermine	Rio Grande area
2011	TS	Don	Baffin Bay area

Since 1850
 64 hurricanes
 57 tropical storms
 (avg. 4/decade ea.)

1990-2007
 4 hurricanes
 (2/decade)
 9 tropical storms
 (5/decade)

2008-2013
 2 hurricanes
 (3/decade)
 3 tropical storms
 (5/decade)



Long-term Shoreline Change Rates through 2007

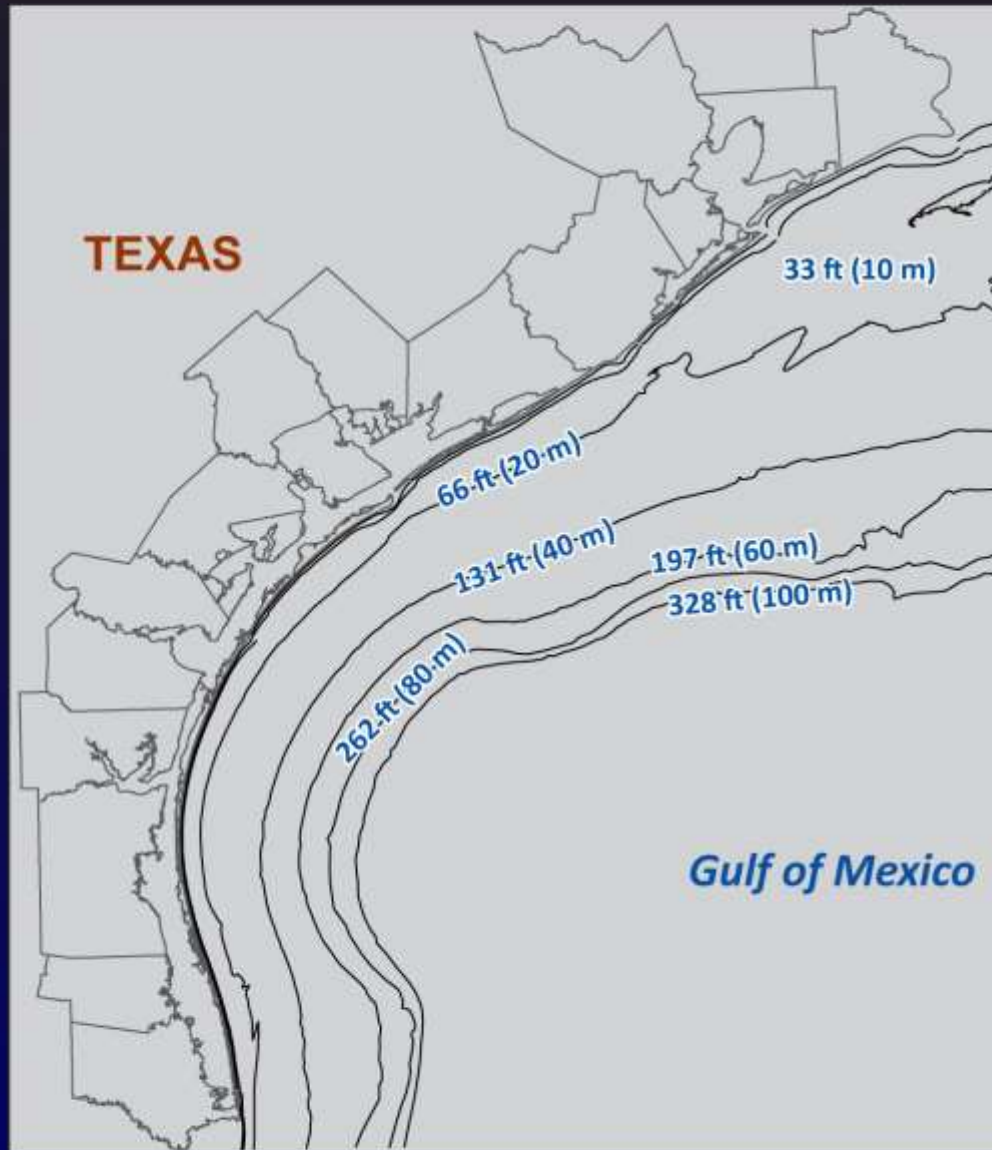


Change rate

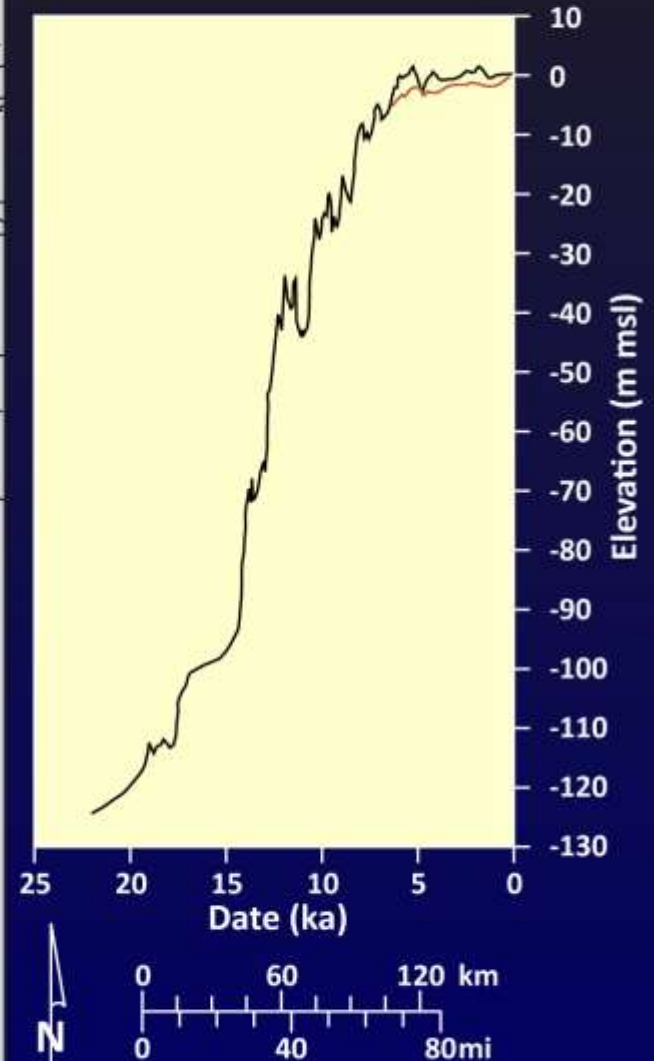
ft/yr		m/yr
14.8 – 18	●	4.5 – 5.5
11.5 – 14.8	●	3.5 – 4.5
8.2 – 11.5	●	2.5 – 3.5
4.9 – 8.2	●	1.5 – 2.5
1.6 – 4.9	●	0.5 – 1.5
-1.6 – 1.6	●	-0.5 – 0.5
-4.9 – -1.6	●	-1.5 – -0.5
-8.2 – -4.9	●	-2.5 – -1.5
-11.5 – -8.2	●	-3.5 – -2.5
-14.8 – -11.5	●	-4.5 – -3.5
-18 – -14.8	●	-5.5 – -4.5
< -18	●	< -5.5



Shelf Bathymetry and Postglacial Sea Level



Sea Level, Gulf of Mexico
(Balsillie & Donohoe, 2009; Milliken & others, 2008)



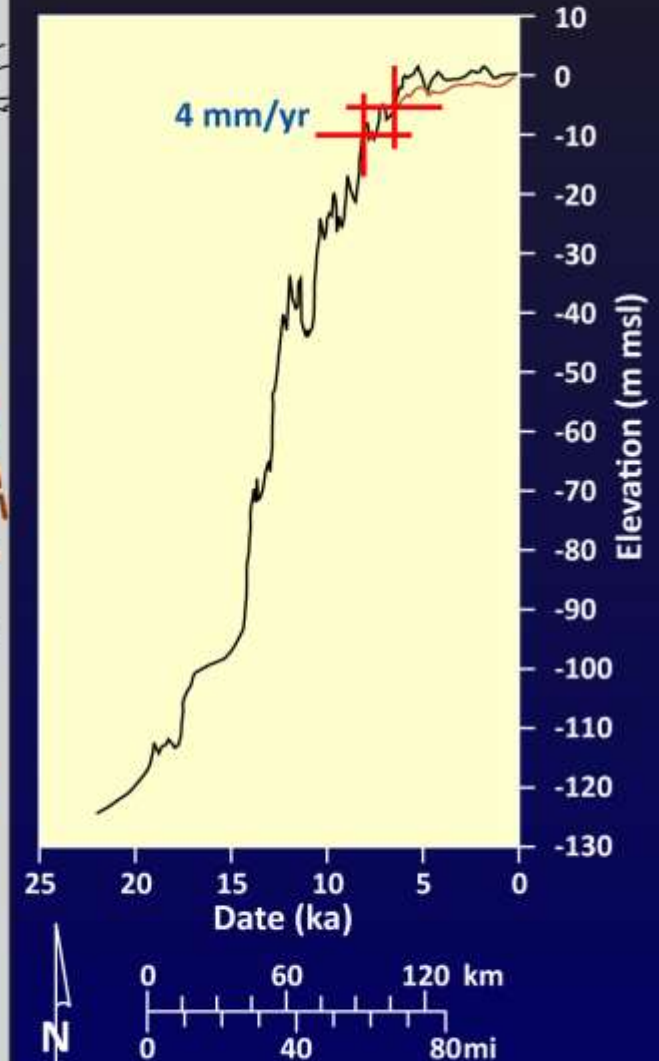
Bathymetry from Holcombe & Arias (2009)



Shoreline Change and Rates, 8 ka - 7 ka



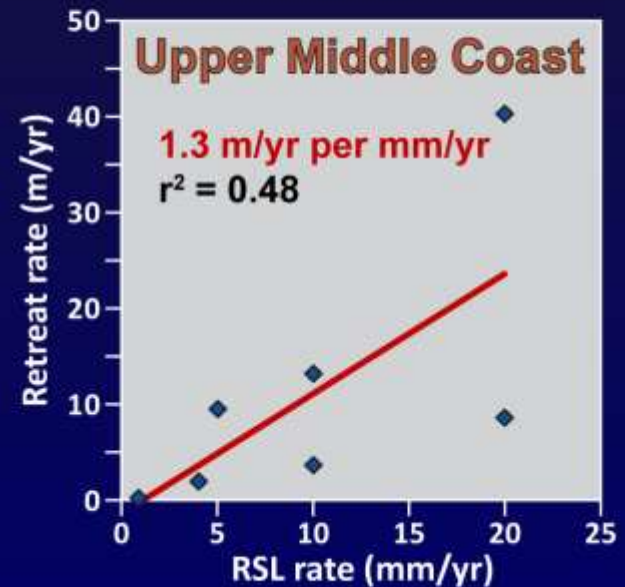
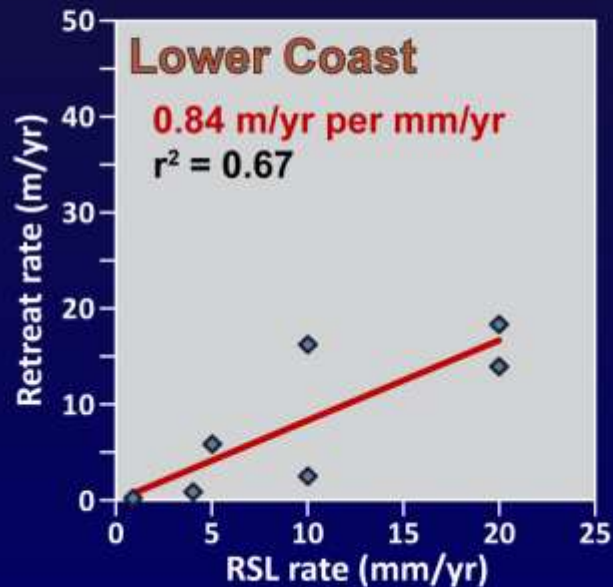
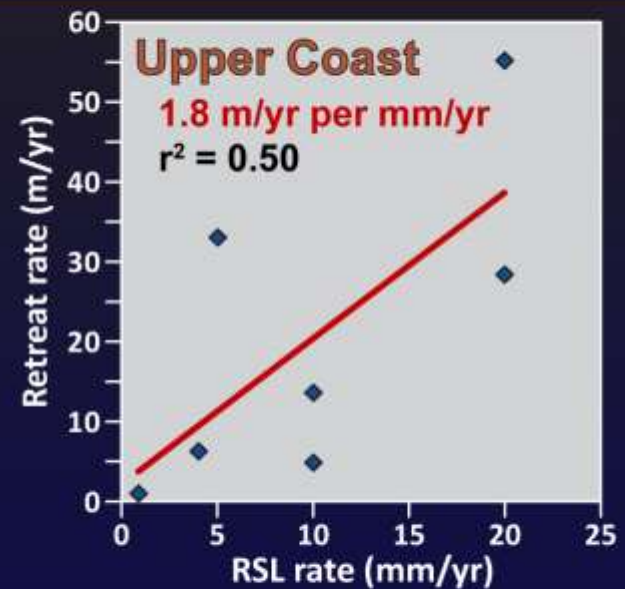
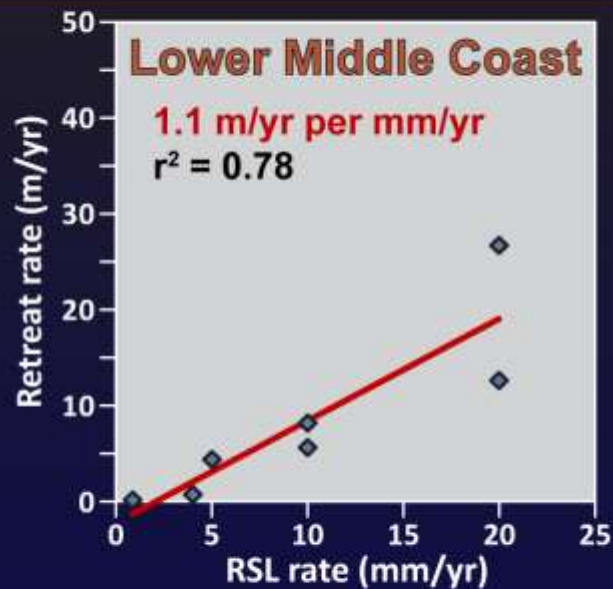
Sea Level, Gulf of Mexico
(Balsillie & Donohoe, 2009; Milliken & others, 2008)



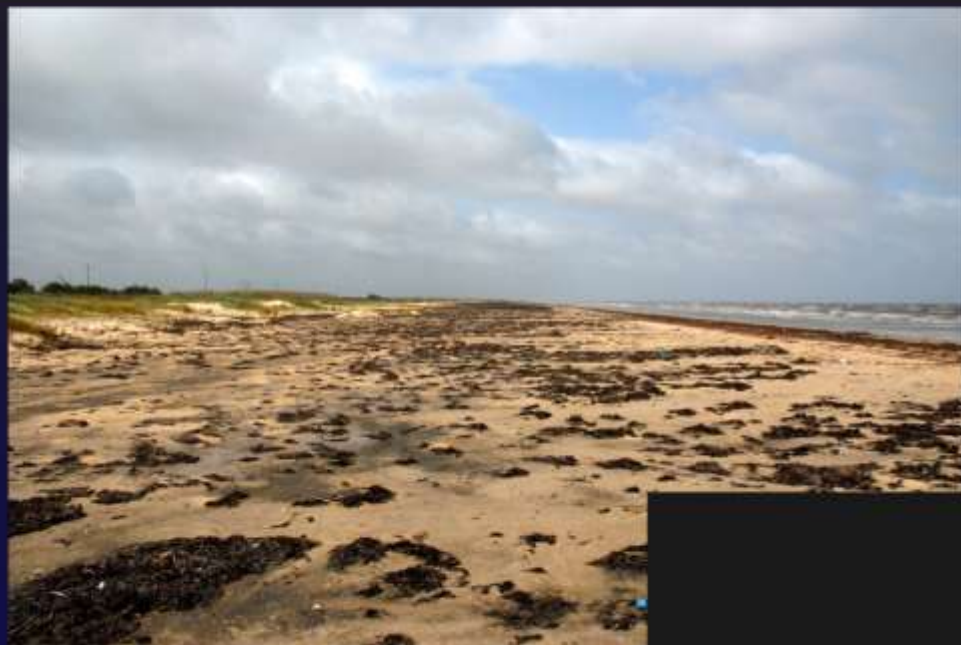
Bathymetry from Holcombe & Arias (2009)



Relative Sea-Level Rise and Erosion Rates

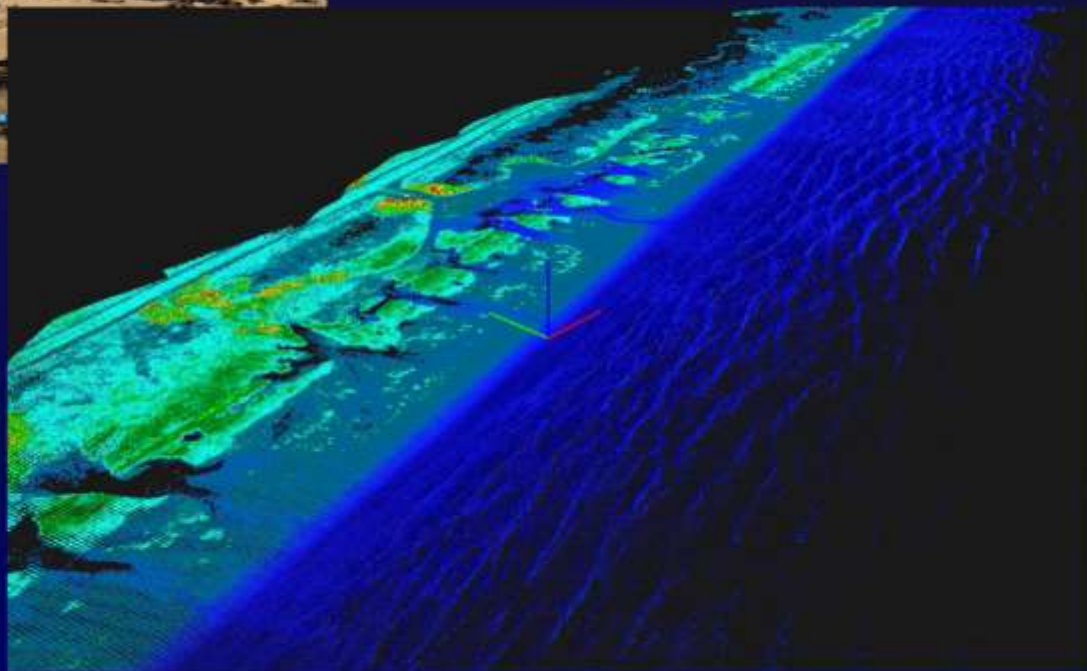


Sea Rim State Park Area, Upper Texas Coast



May 2011

Lidar Point Cloud, Feb 2012



Short-term Shoreline Change, 2010 - 2011



Change

ft		m
>118	●	>36
66 – 118	●	20 – 36
39 – 66	●	12 – 20
26 – 39	●	8 – 12
13 – 26	●	4 – 8
0 – 13	●	0 – 4
-13 – 0	●	0 – -4
-26 – -13	●	-4 – -8
-39 – -26	●	-8 – -12
-66 – -39	●	-12 – -20
-118 – -66	●	-20 – -36
< -118	●	< -36



Short-term Shoreline Change, 2011 - 2012

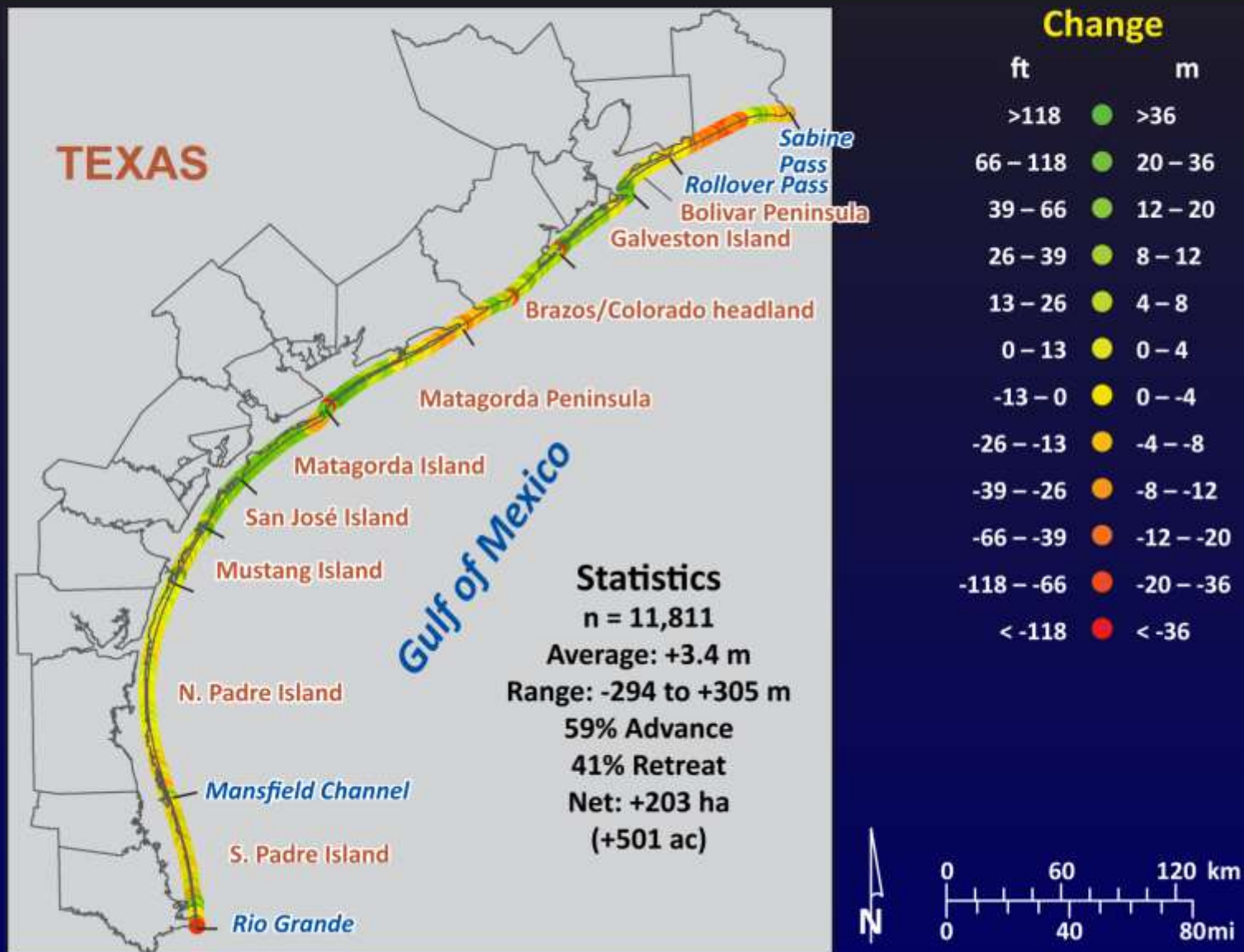


Change

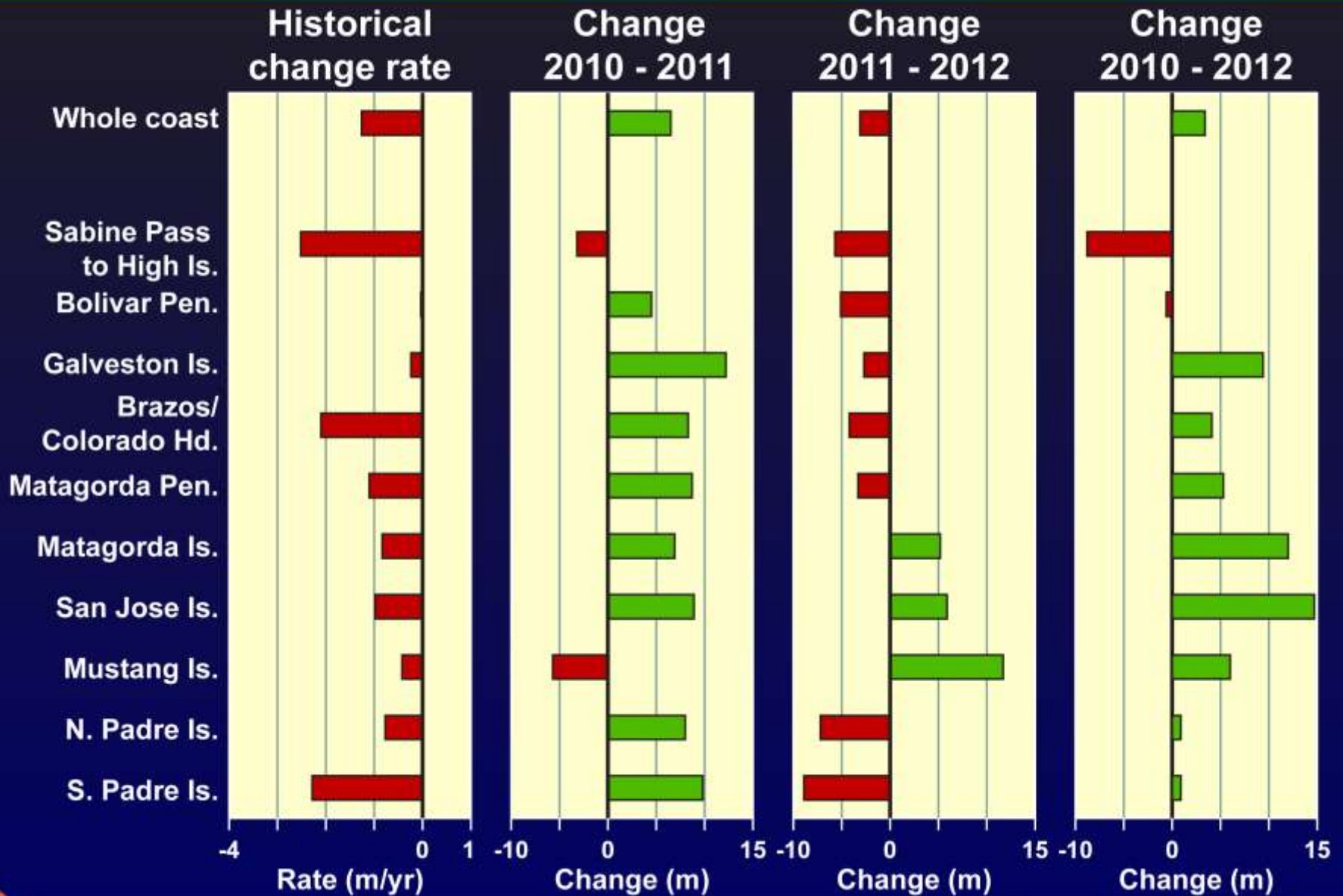
ft		m
>118	●	>36
66 – 118	●	20 – 36
39 – 66	●	12 – 20
26 – 39	●	8 – 12
13 – 26	●	4 – 8
0 – 13	●	0 – 4
-13 – 0	●	0 – -4
-26 – -13	●	-4 – -8
-39 – -26	●	-8 – -12
-66 – -39	●	-12 – -20
-118 – -66	●	-20 – -36
< -118	●	< -36



Short-term Shoreline Change, 2010 - 2012



Long- and Short-Term Shoreline Change

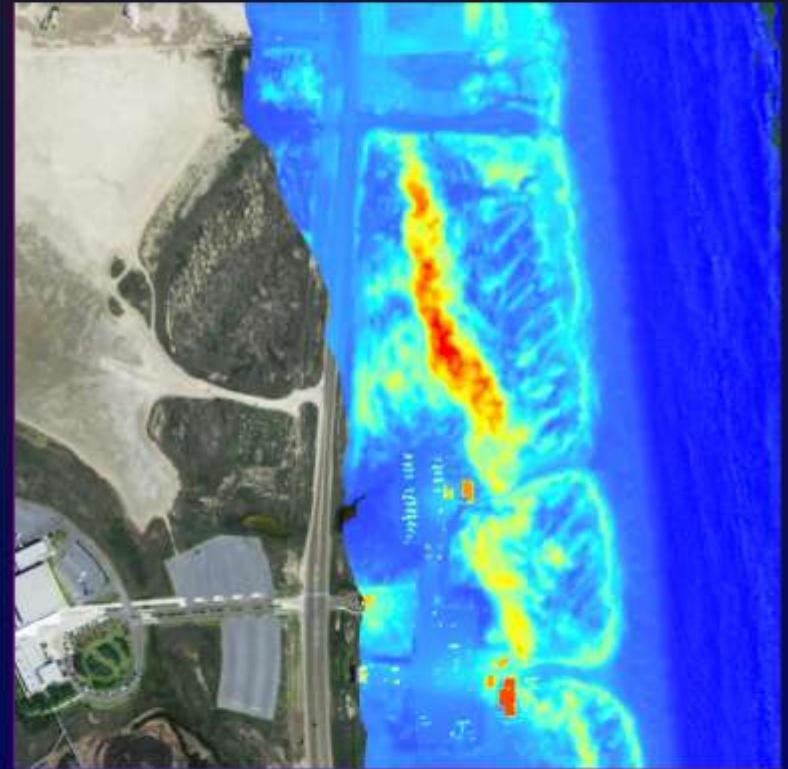


Elevation Thresholds, S. Padre Is. (2/2012)

2012 NAIP Imagery



DEM (1 m), 2/2012



0 200 m
0 600 ft

10
Elev.
(m)
0



Elevation Thresholds, S. Padre Is. (2/2012)

2012 NAIP Imagery



Elev. > 2 m, 2/2012



0 200 m
0 600 ft



Elevation Thresholds, S. Padre Is. (2/2012)

2012 NAIP Imagery



Elev. > 4 m, 2/2012



0 200 m
0 600 ft

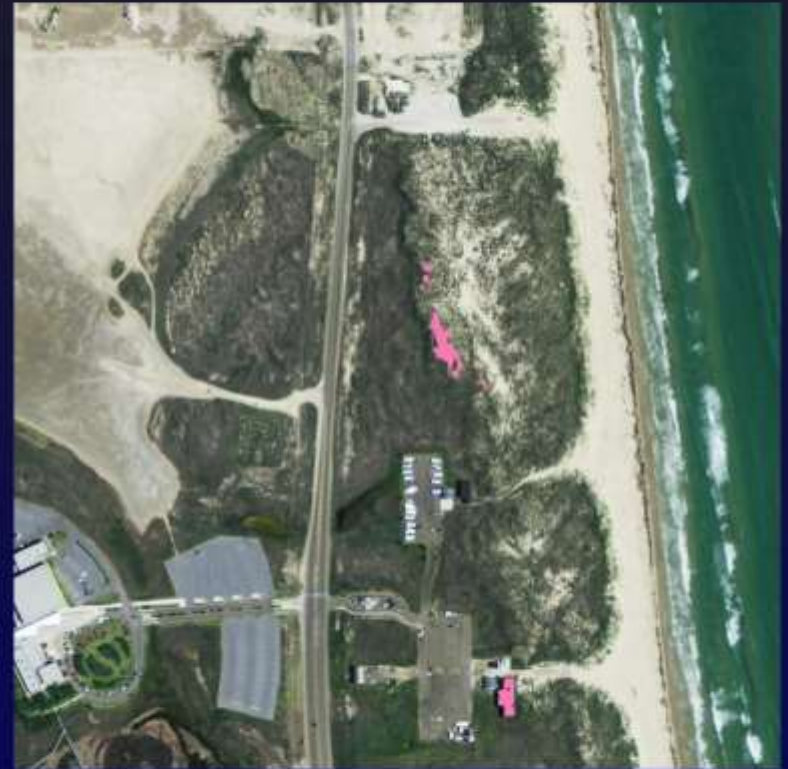


Elevation Thresholds, S. Padre Is. (2/2012)

2012 NAIP Imagery



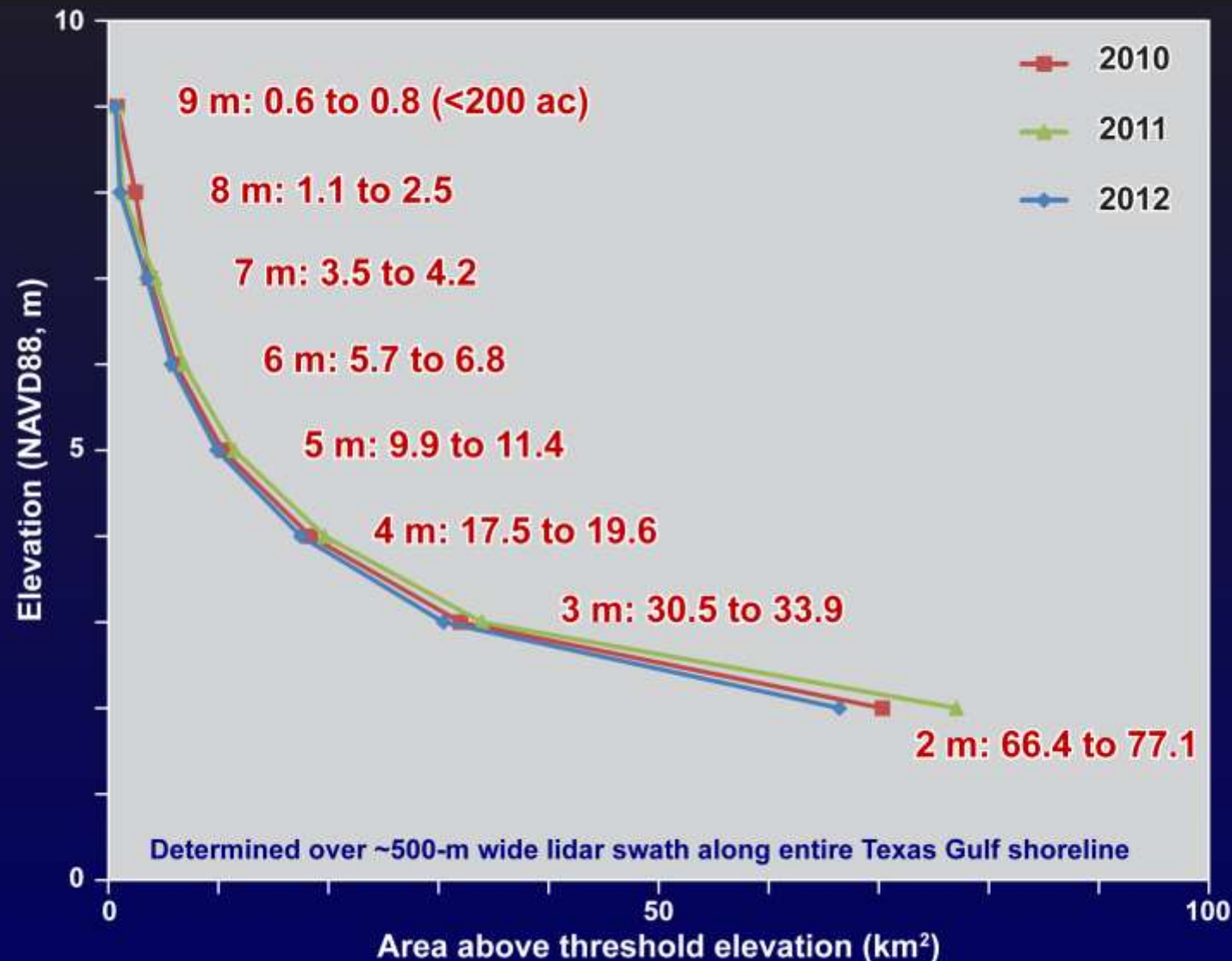
Elev. > 9 m, 2/2012



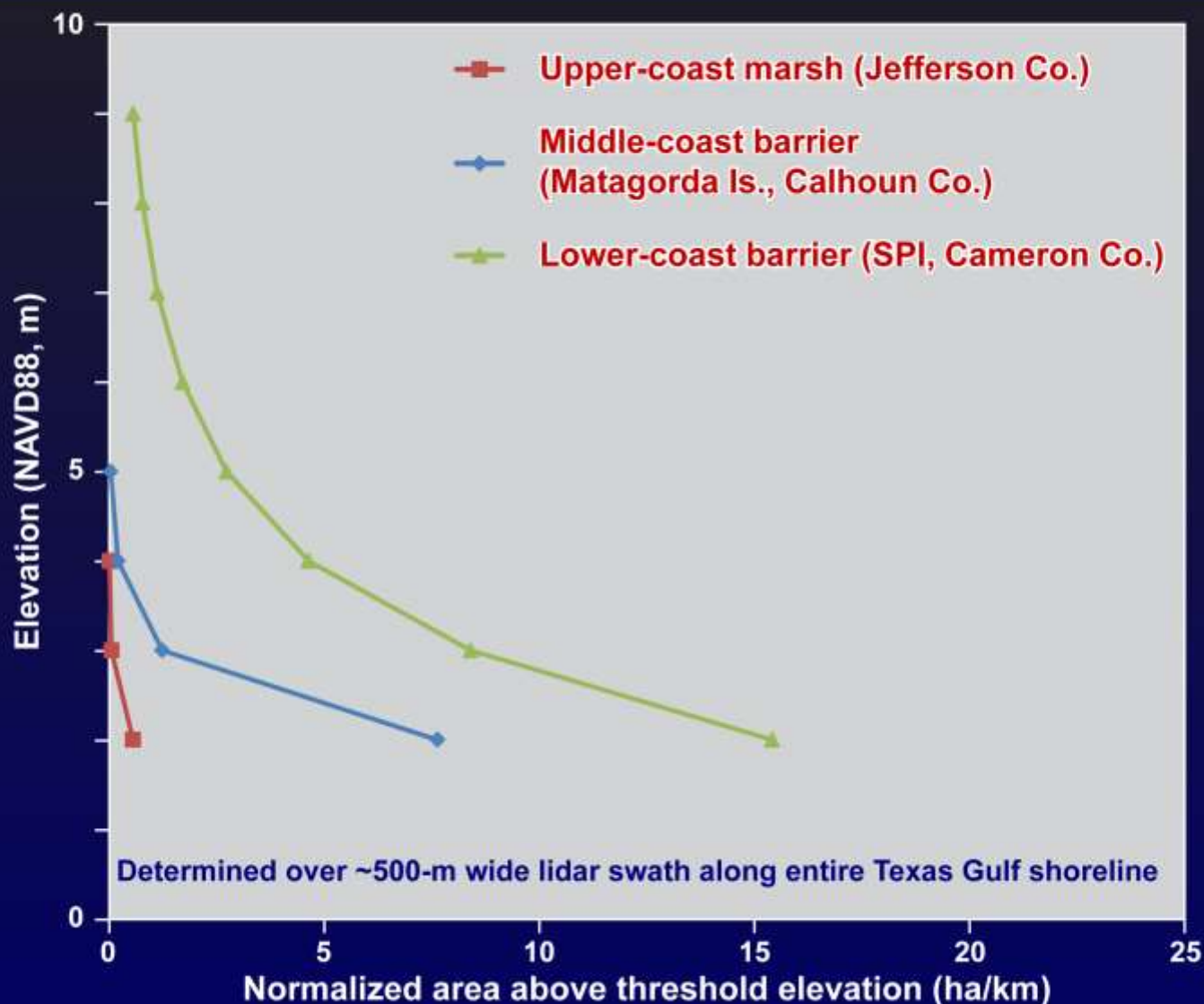
0 200 m
0 600 ft



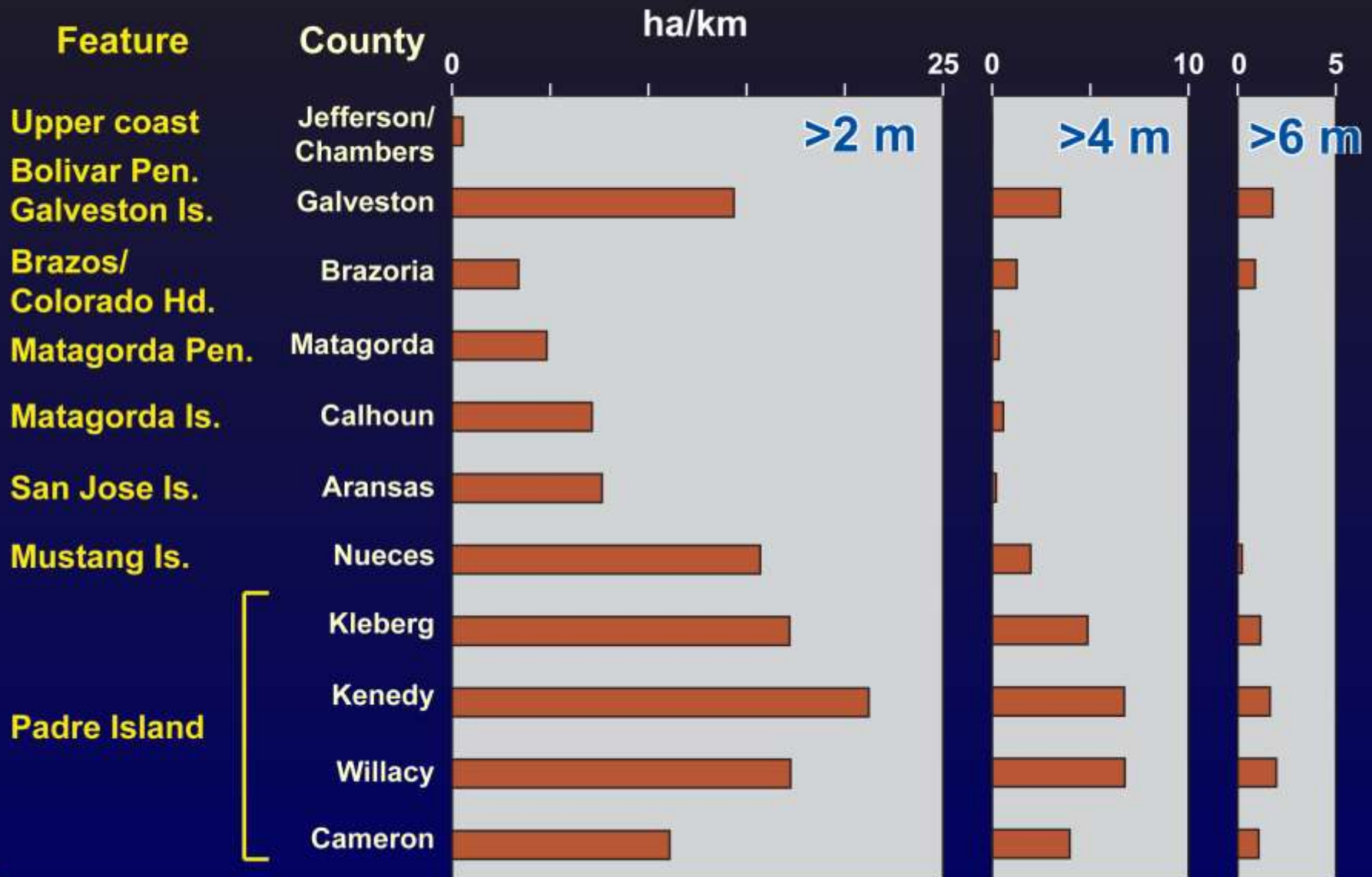
Area above Threshold Elevations, 2010-2012



2012 Threshold-Area Curves, Texas Gulf Coast



Area above Threshold Elevation

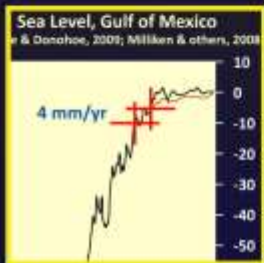


Conclusions



Historical shoreline change: -1.2 m/yr; 84% of sites

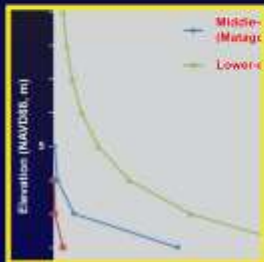
- Land loss averages 73 ha/yr (180 ac/yr) since 1930
- Average storm frequency and at least locally lower rates of RSL rise



Historical retreat rates and RSL rise are well below early to middle postglacial (16 to 8 ka) estimates, similar to middle Holocene (8 to 7 ka) estimates



2010 to 2012: Net shoreline advance (+3.4 m; 59%) during a period of low tropical storm incidence



Elevation-threshold-area curve: a promising, readily obtained parameter for surge susceptibility, sand storage, and geomorphic classification

