

Socio-economic Impact of Sea Level Rise in Galveston Bay, Texas

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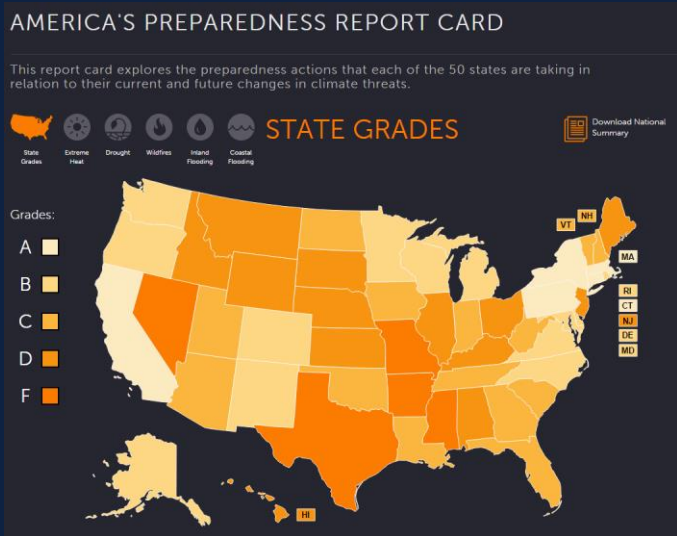
Coastal & Marine Geospatial Lab

Harte Research Institute for Gulf of Mexico Studies



Background

States at Risk: State Grades



Galveston Bay Report Card

OVERALL HEALTH OF THE BAY

Galveston Bay is resilient, but faces an uncertain future. The Bay's watershed is home to the fourth- and ninth-largest cities in the U.S., Houston and Dallas. It's also home to three ports, and remains a hub for the manufacturing and refining of chemicals and petroleum products. But people, industry, and commerce often come with environmental challenges. Galveston Bay's most significant problems are tied to pollution, declines in habitat acreage, and to the impacts of climate change, like sea level rise.



That Galveston Bay could receive C for overall health despite facing these monumental issues shows how resilient it is. This offers hope that we can change our negative impact on water quality, wetlands, seagrasses, and wildlife. But a healthier Galveston Bay is in everyone's interest.

(About the grade: The combined GPA for all six categories together is a 2.1, which registers in the low C range. Unfortunately, the combined grade does not include grades for three of our indicators: Toxics in Sediment, Litter and Trash, and Oyster Reef Acreage* - There was not enough data available on these indicators to include them in the overall grade. We hope you will join us in encouraging local, state, and national leaders to pass legislation, and address these issues.

Galveston Bay Sea Level: F (Critical)

The Galveston Bay region has a long history of sea level rise, subsidence, storm surges, and flooding. As sea level rise continues, periodic flooding from storm surges and rain events is likely to get worse. Floods can be very dangerous, and the resulting damage is extremely expensive. Human communities are not the only ones at risk from sea level rise.



Wetlands exist at the water's edge, and they naturally migrate inland as sea level rises. But in most areas of Galveston Bay, there is no place for them to go. As a result, they become permanently flooded and the vegetation dies, effectively destroying the wetlands. Planning for sea level rise should include changes to human communities and infrastructure. But it should also take into account where vital coastal habitats like wetlands, seagrass beds, mud flats, and sand dunes exist when water levels rise.

Drought D-

Wildfires D

Inland Flooding n/a

Coastal Flooding D+

Project Overview

Problem:

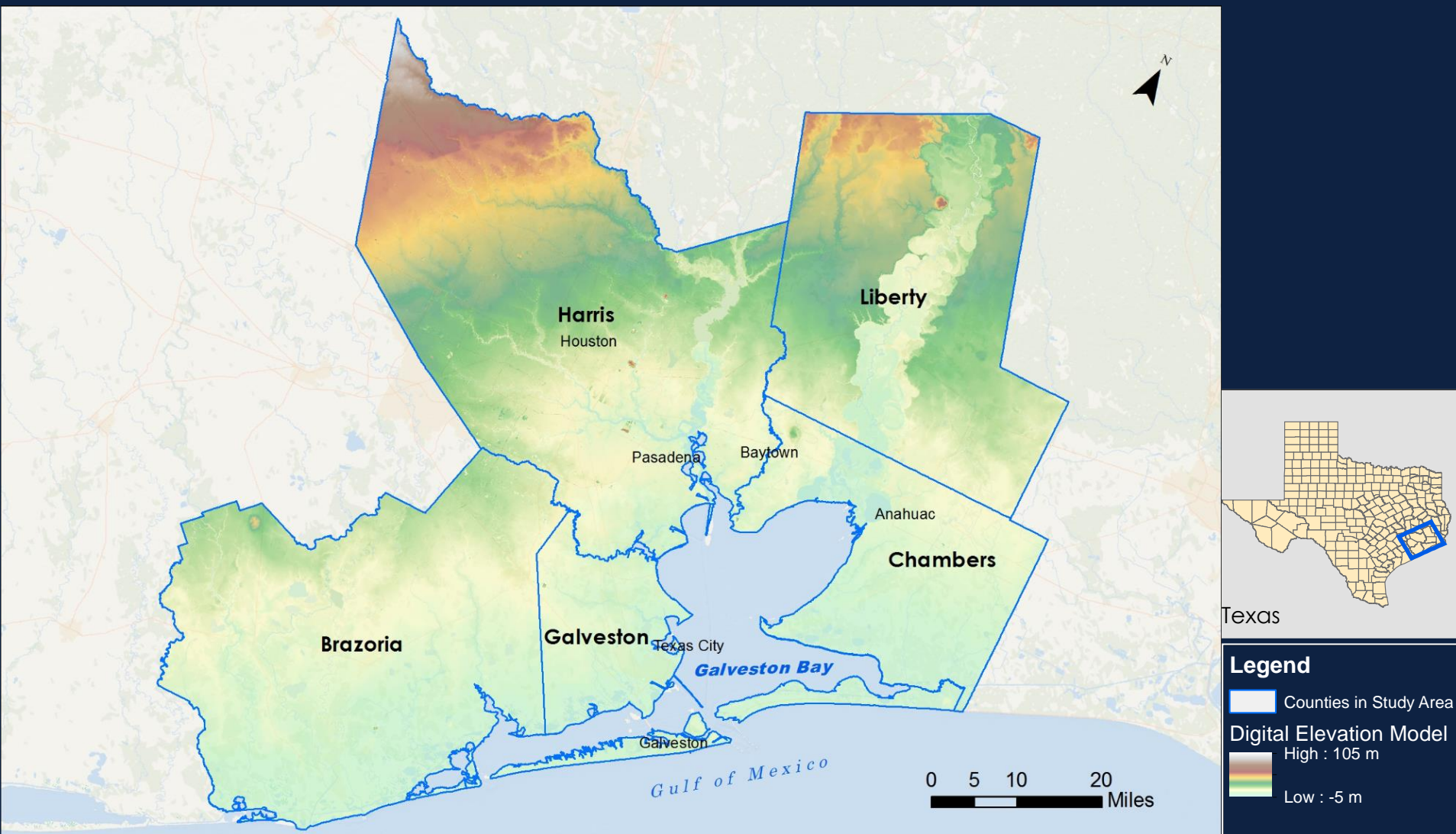
Population of the greater Houston area has **incomplete information** on the extent of **projected SLR** and its **social** and **economic impacts**.

Objective:

An assessment of the impacts of SLR to provide knowledge to mitigate and adapt to higher sea level during the **next 50 to 100 years**.

1. Projecting geographic changes that SLR is expected to cause
2. Economic impact on the natural and built environments
3. Analysis of current policies and opportunities for coastal zone management with respect to SLR.

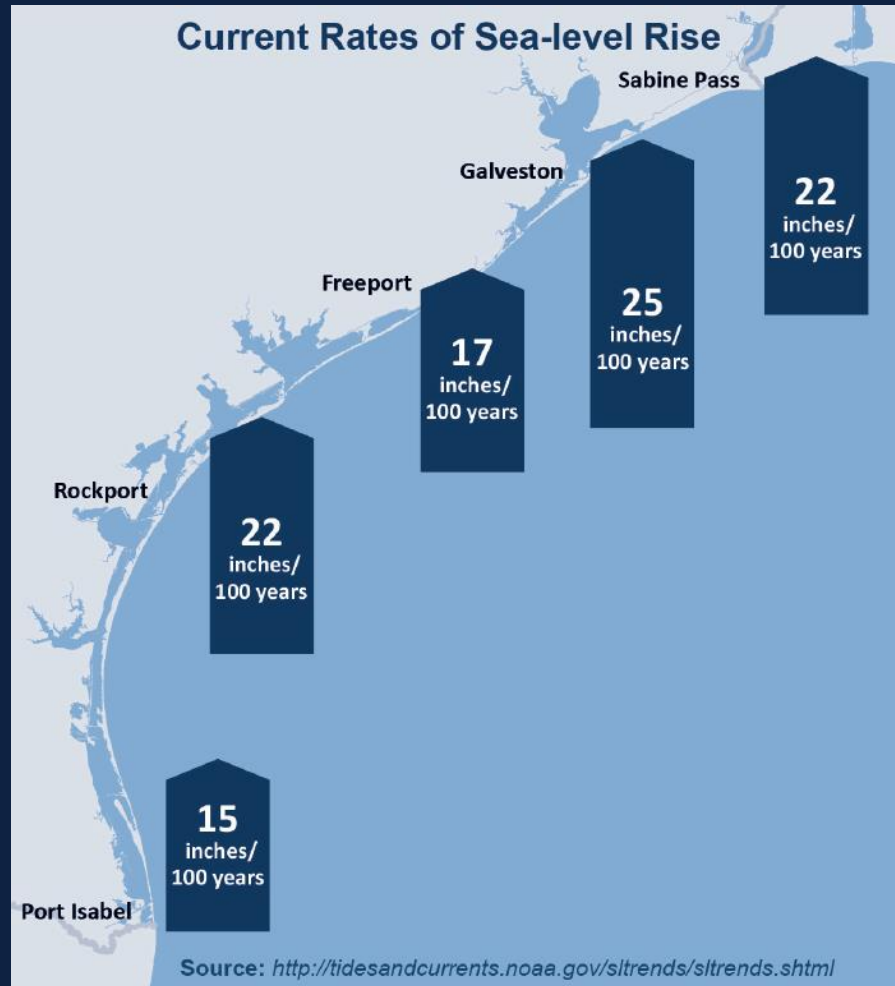
Study Area



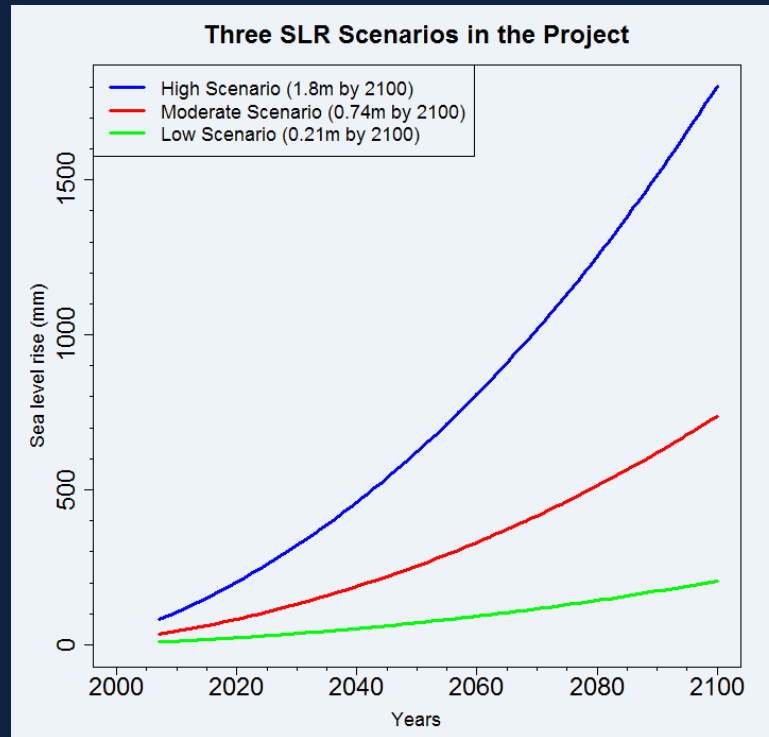
Study Area Demographics

	Study Area	Texas
<i>People Quick Facts</i>		
Population, 2010	4,732,030	25,145,561
Population Change, 2010 - 2014	8.3%	7.2%
Number of Household, 2013	1,664,590	8,886,471
Median Household Income, 2013	\$63,777	\$51,900
Per Capita Income, 2013	\$29,512	\$26,019
Total Number of Firms, 2007	419,680	2,164,852
Land Area (sq. mile), 2010	4,036.68	261,231.71
Person per Sq. Miles, 2010	865.45	96.3

Sea Level Rise in Texas



Sea Level Rise Scenarios

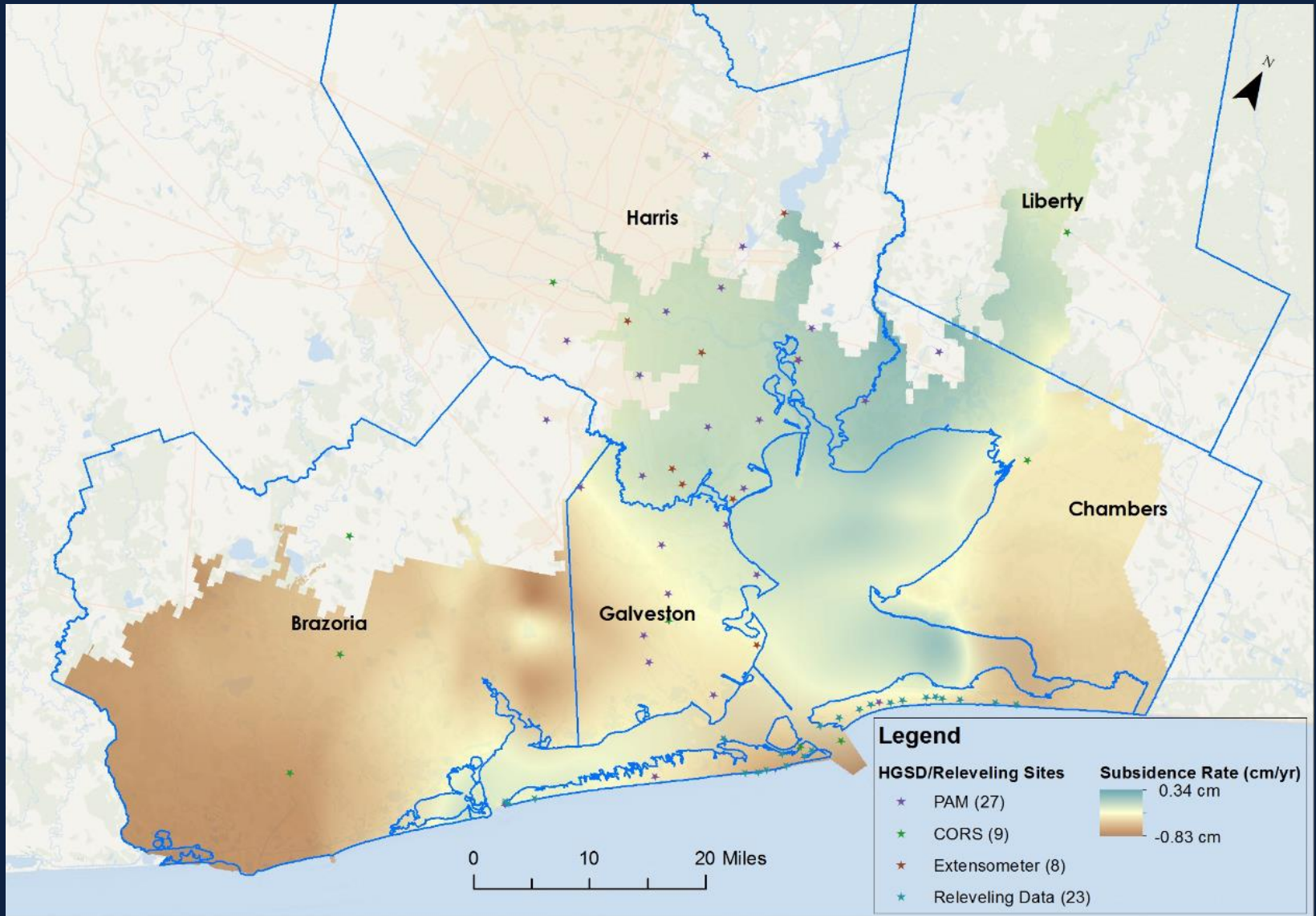


Low Scenario (Satellite Altimetry): from the TOPEX and Jason series of satellite radar altimeters, across Texas Coast (1992 – 2014)

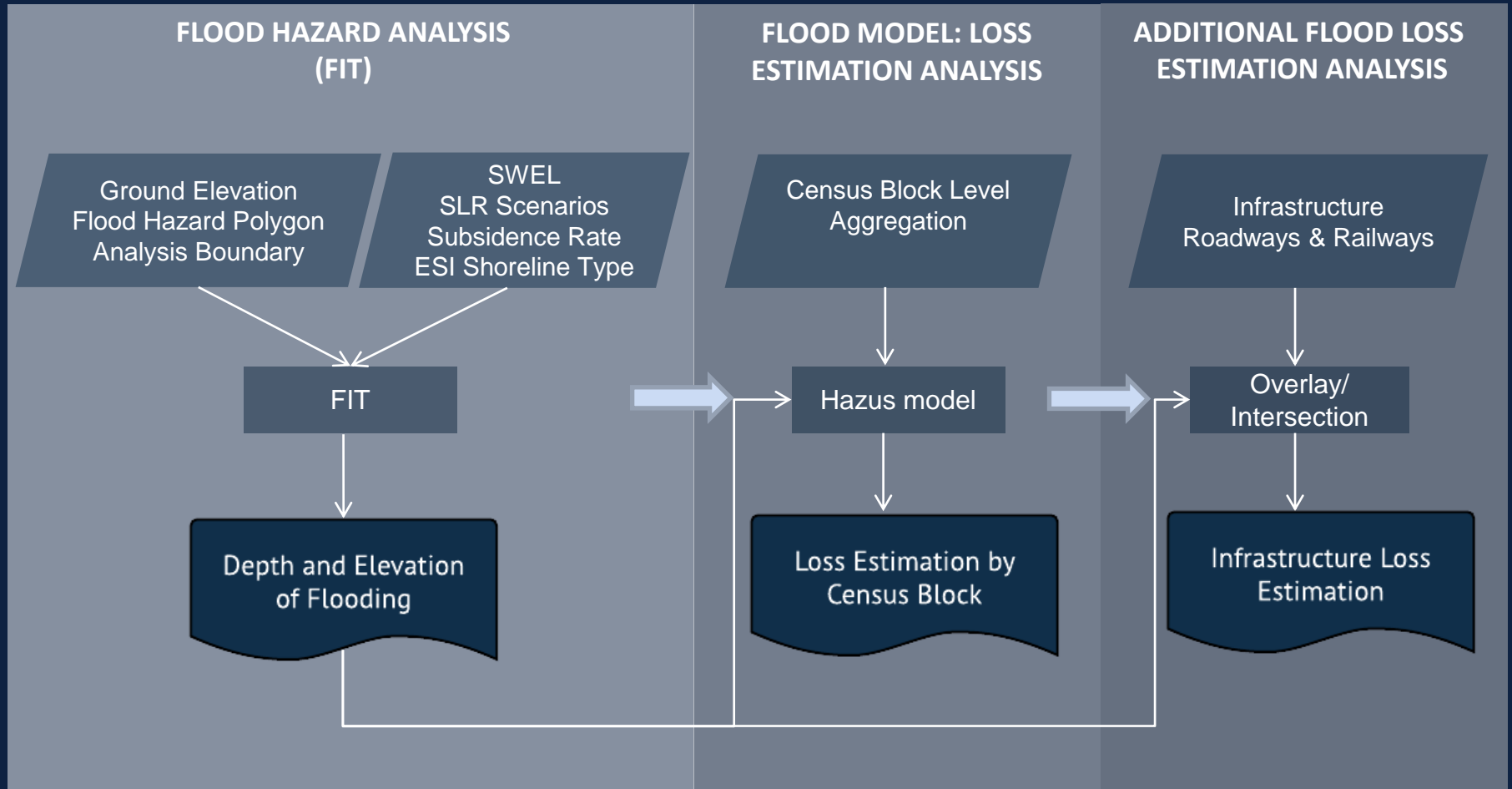
Moderate Scenario (IPCC RCP 8.5): the highest IPCC AR5 scenario, defined by cumulative measure of human emissions of GHGs

High Scenario (Jevrejeva et al. (2014)*): there is a 95% chance that mean sea levels will not exceed 1.8 m above those at present, based on both expert opinion and process studies

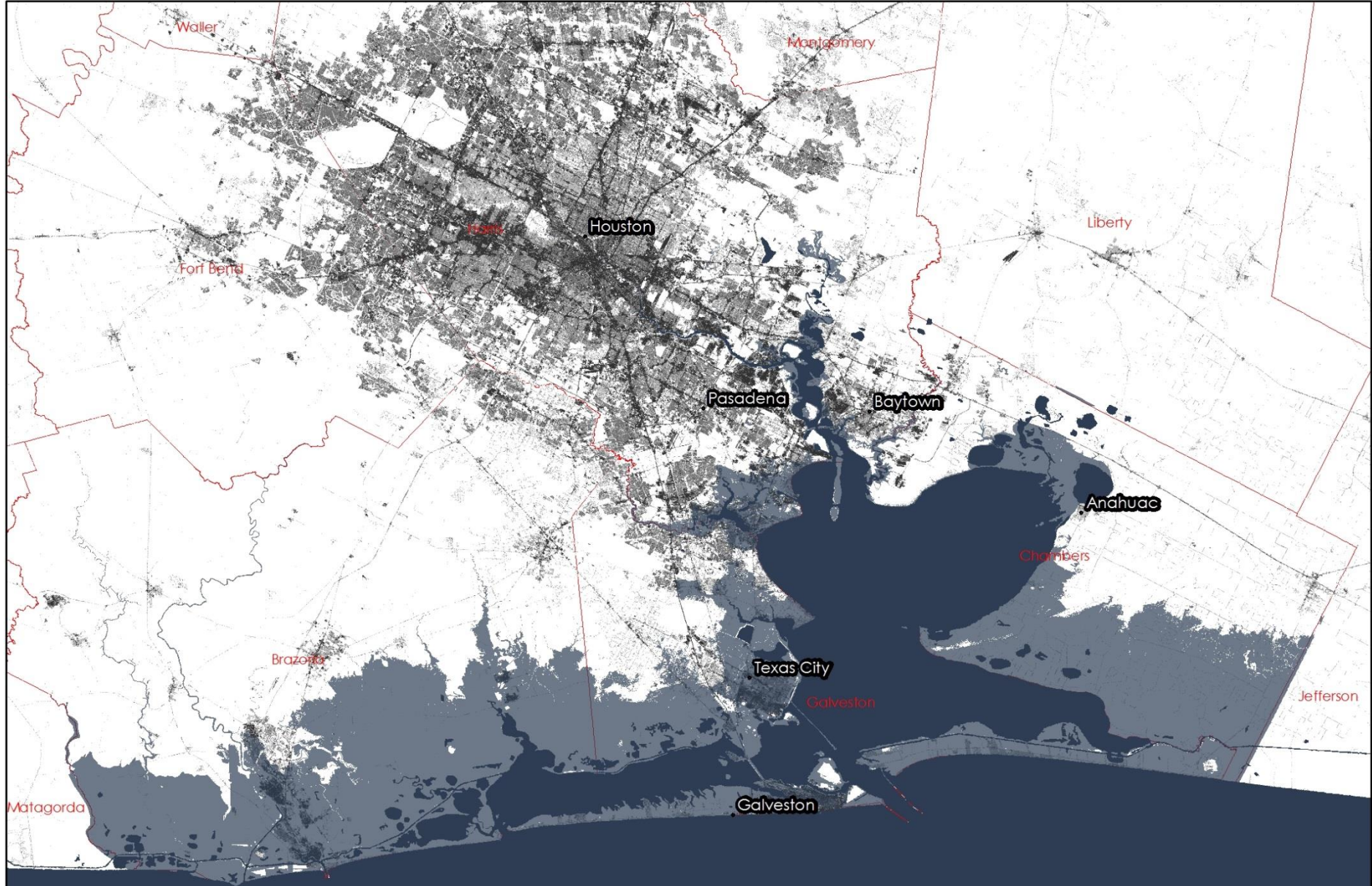
Subsidence



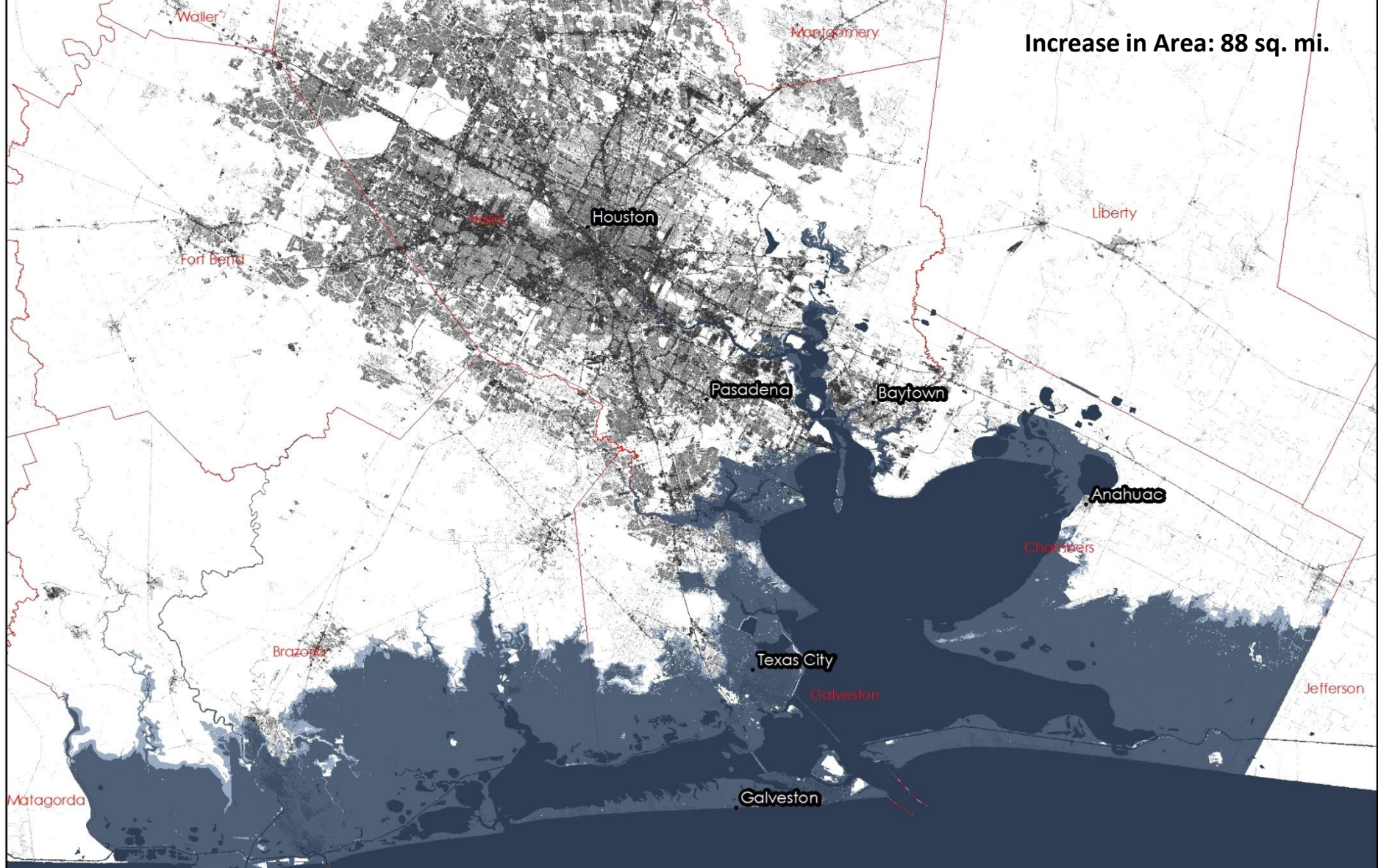
Methods







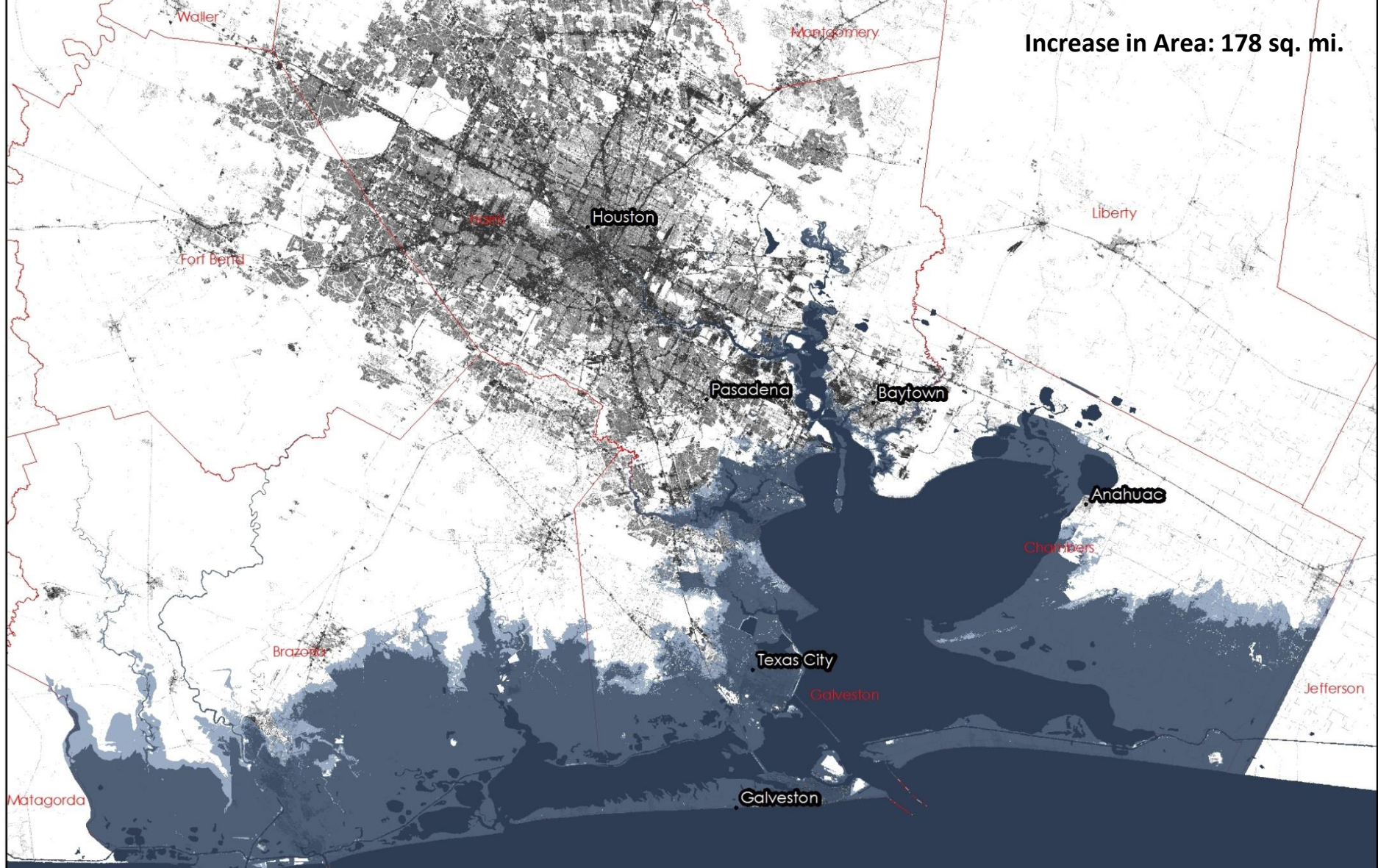
Current Risk: 100-yr Coastal Flood



Increase in Area: 88 sq. mi.

Low Scenario

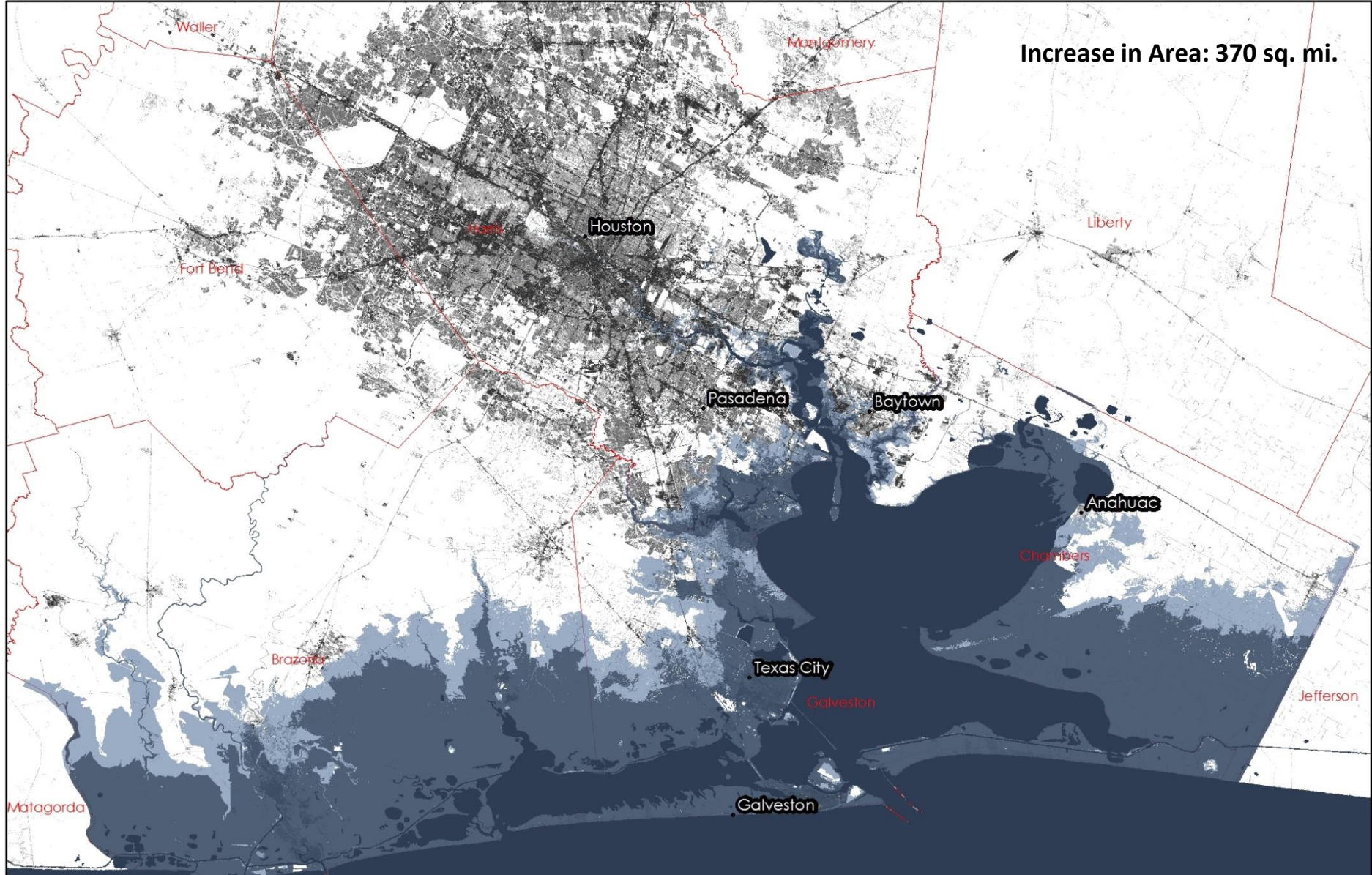
Satellite Altimetry: 0.21m SLR by 2100



Increase in Area: 178 sq. mi.

Moderate Scenario

IPCC RCP 8.5: 0.74m SLR by 2100

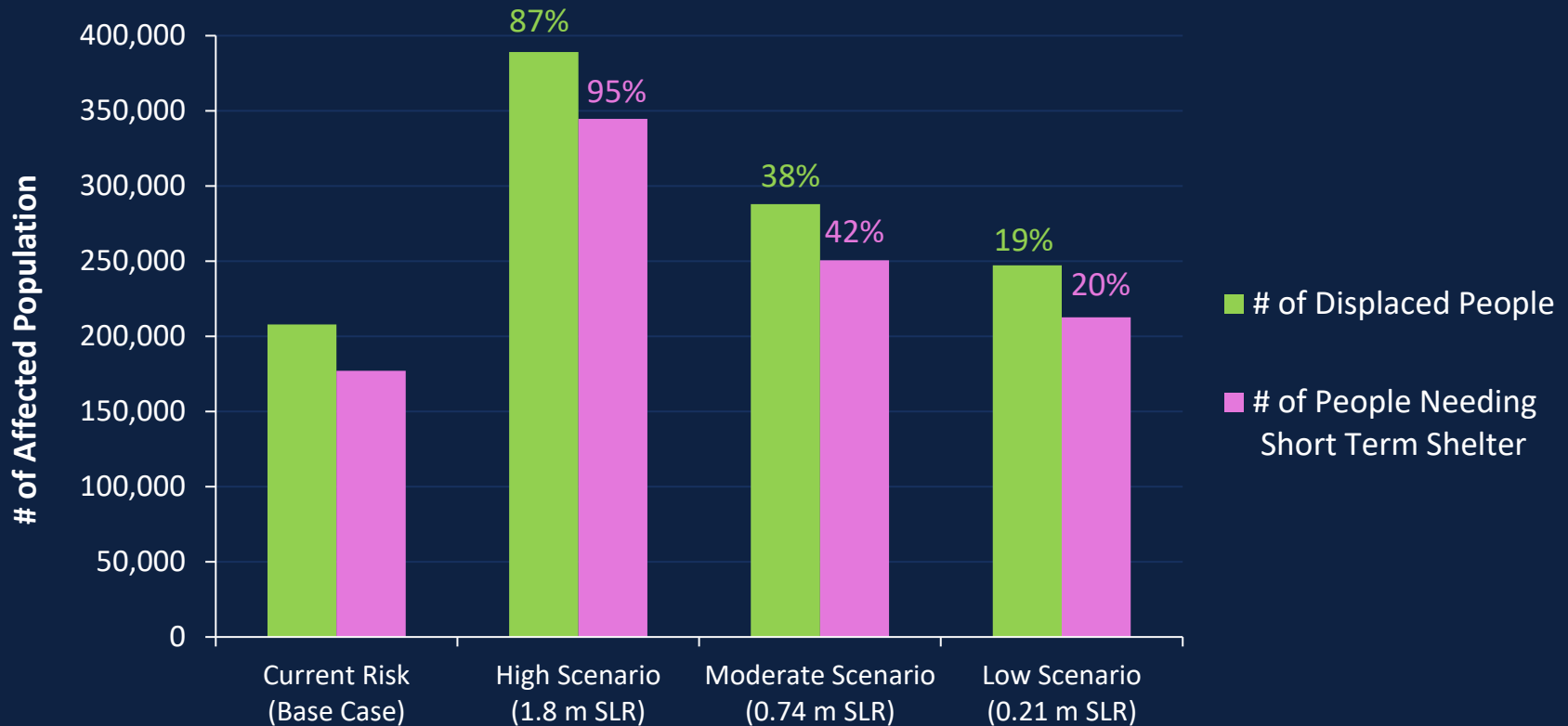


Increase in Area: 370 sq. mi.

High Scenario

Jevrejeva et al.: 1.8m SLR by 2100

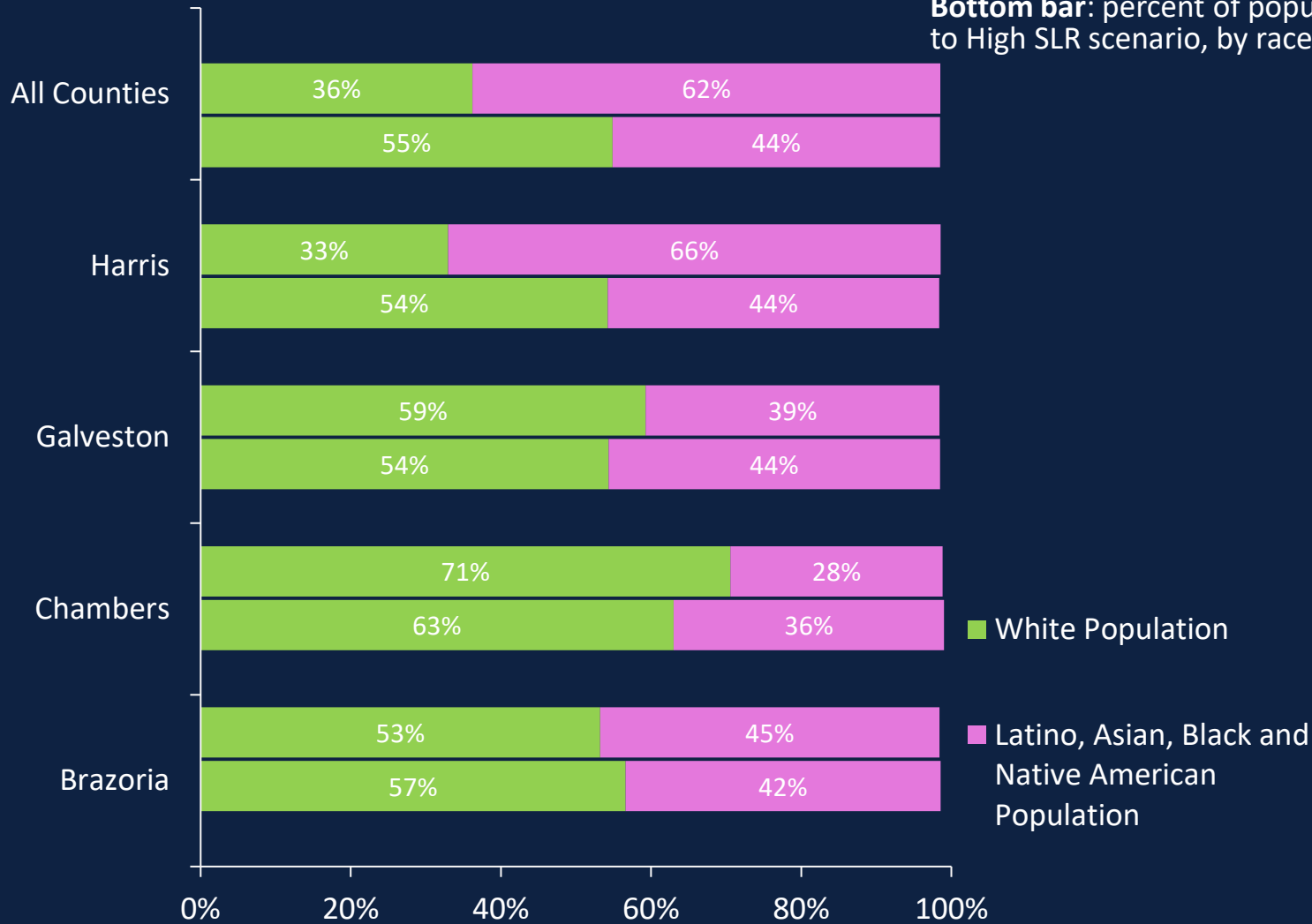
Population at Risk



Percent number shows percentage increase from the Current Risk.

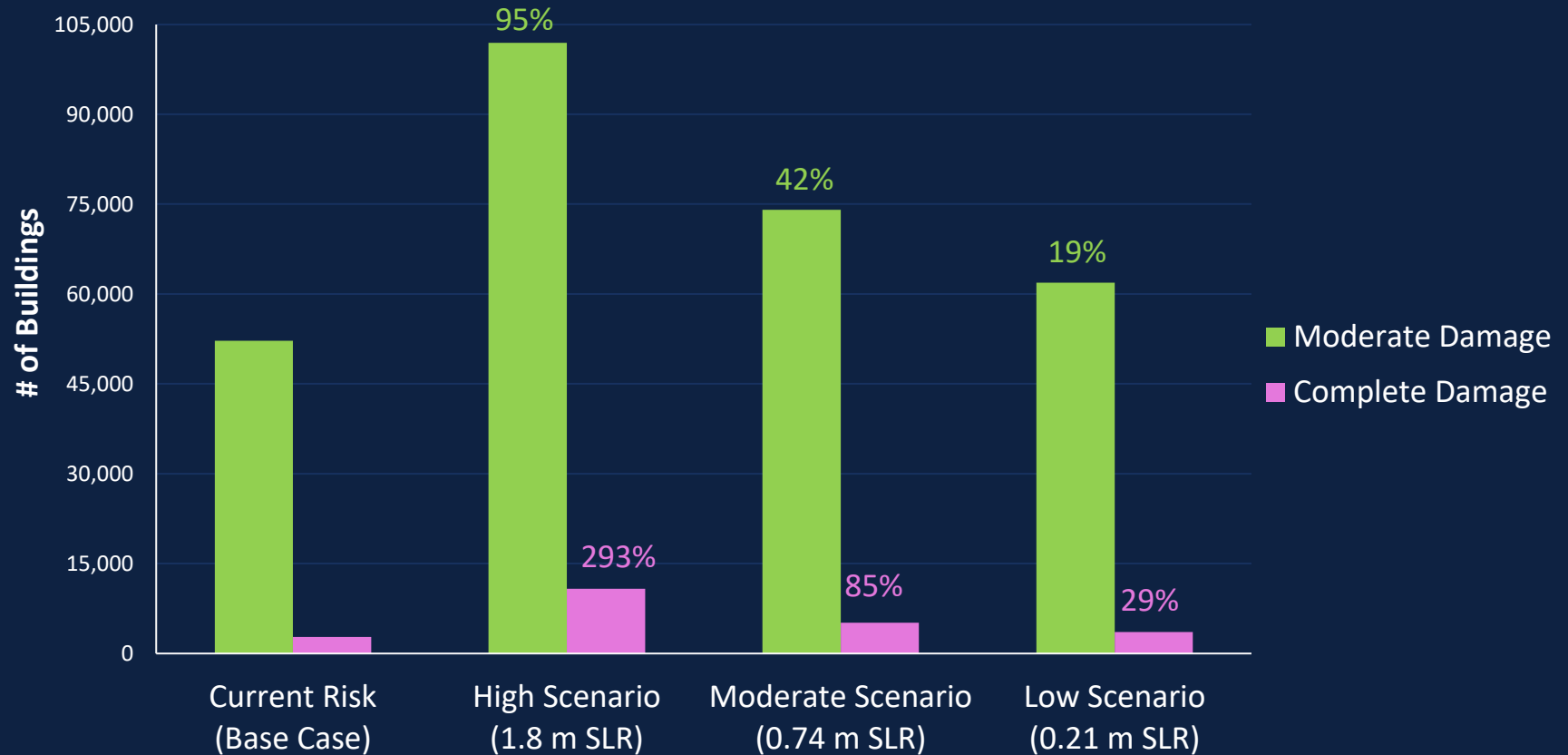
Racial Demographics

Top bar: percent of county population, by race
Bottom bar: percent of population vulnerable to High SLR scenario, by race



Property at Risk

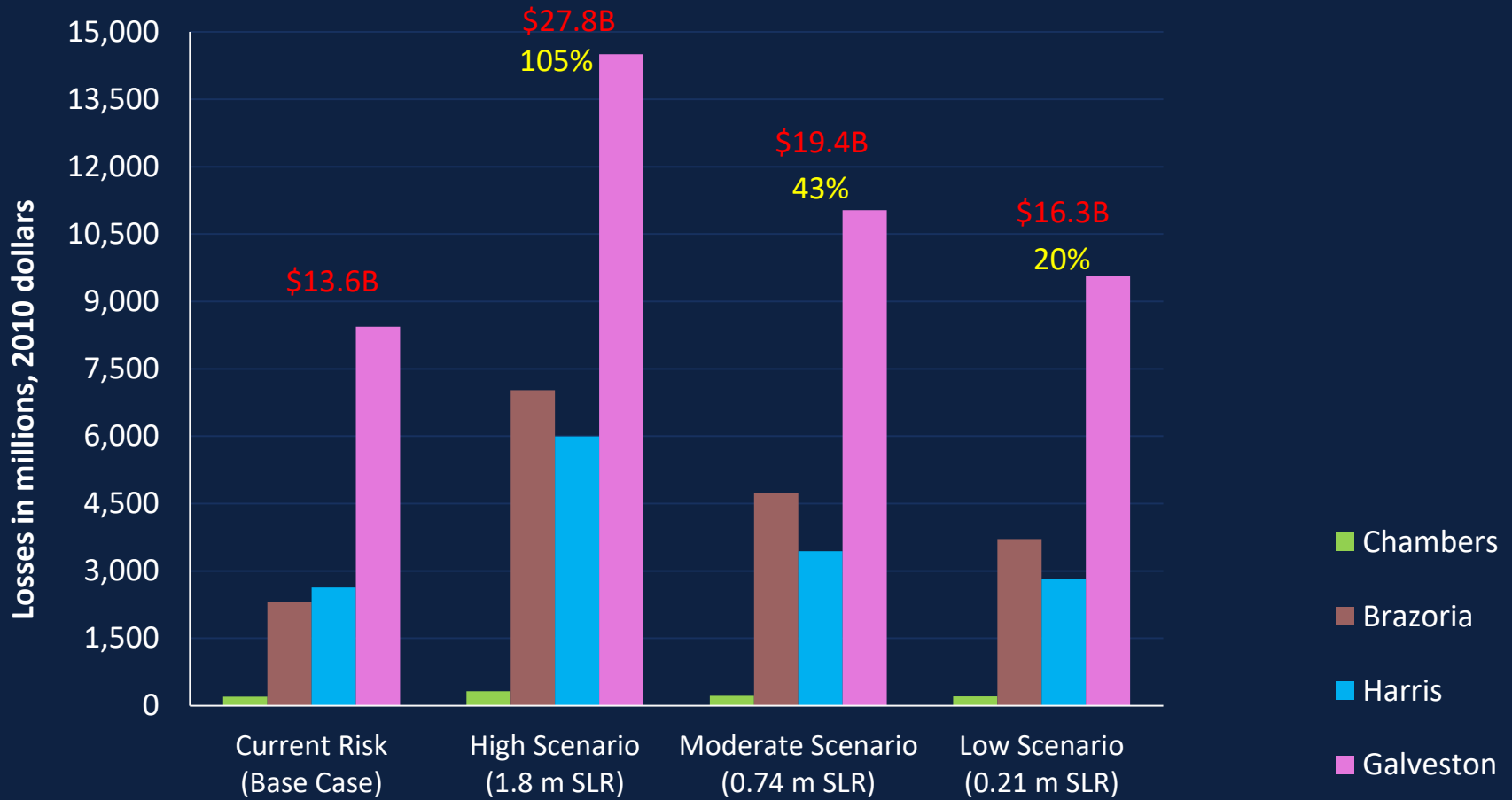
Expected Building Damage Count



Percent number shows percentage increase from the Current Risk.

Property at Risk

Expected Building Related Losses

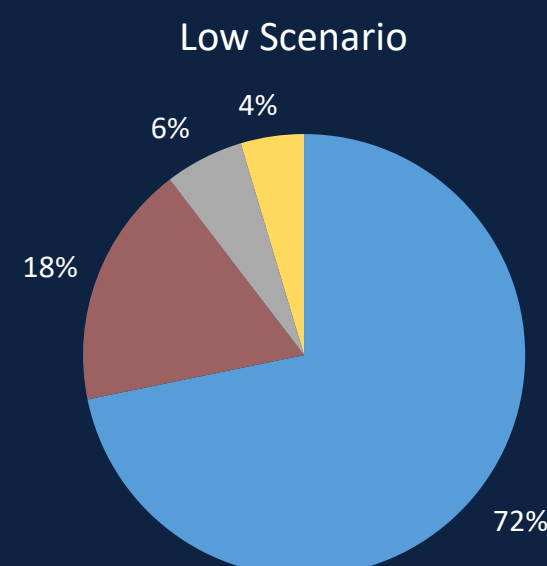
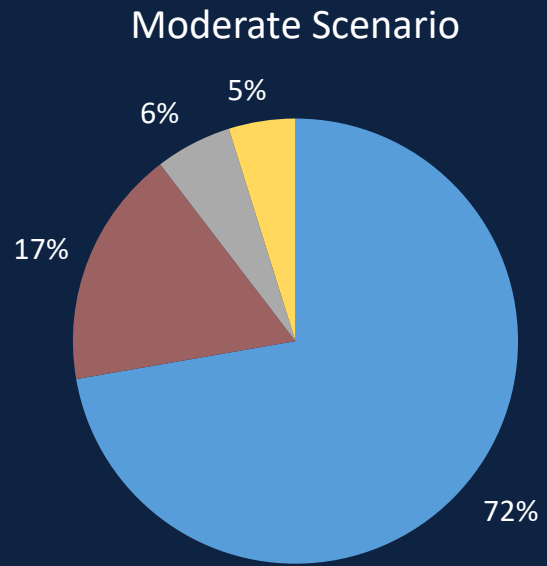
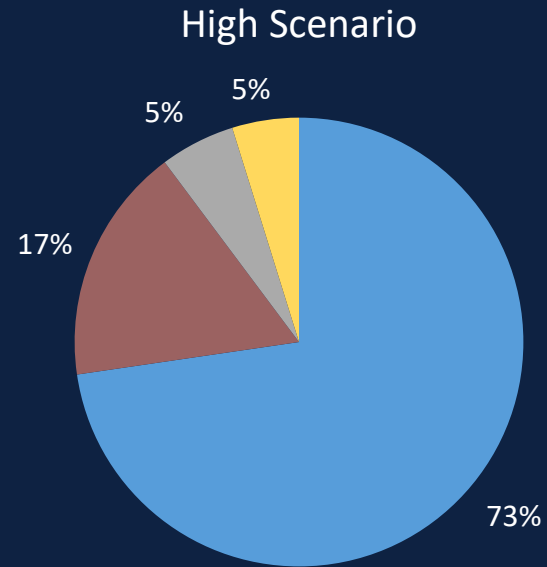
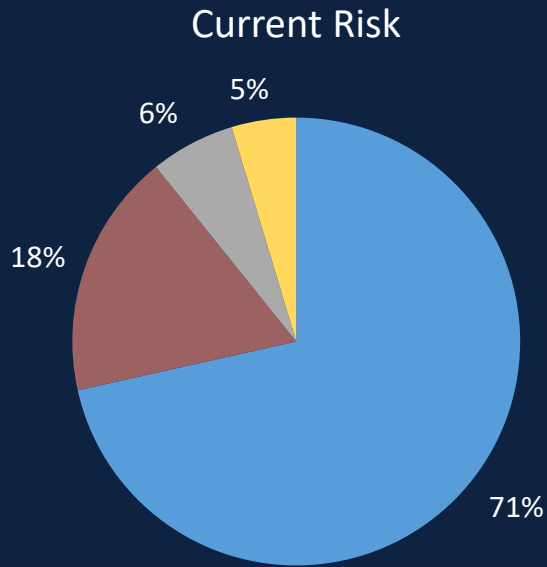


Percent number shows percentage increase from the Current Risk.

Number in red is the total losses in billions, 2010 dollars.

Property at Risk

Expected Building Related Losses by Occupancy Type



- Residential
- Commercial
- Industrial
- Others

Essential Facility at Risk

Facility	Current Risk	Risk with sea-level rise in 2100		
		High Scenario	Moderate Scenario	Low Scenario
Fire Stations	14	27 (93%)	24 (71%)	19 (36%)
Hospitals	0	6	4	2
Police Stations	20	37 (85%)	31 (55%)	25 (25%)
Schools	84	147 (75%)	117 (39%)	99 (18%)

Percent number shows percentage increase from the Current Risk.

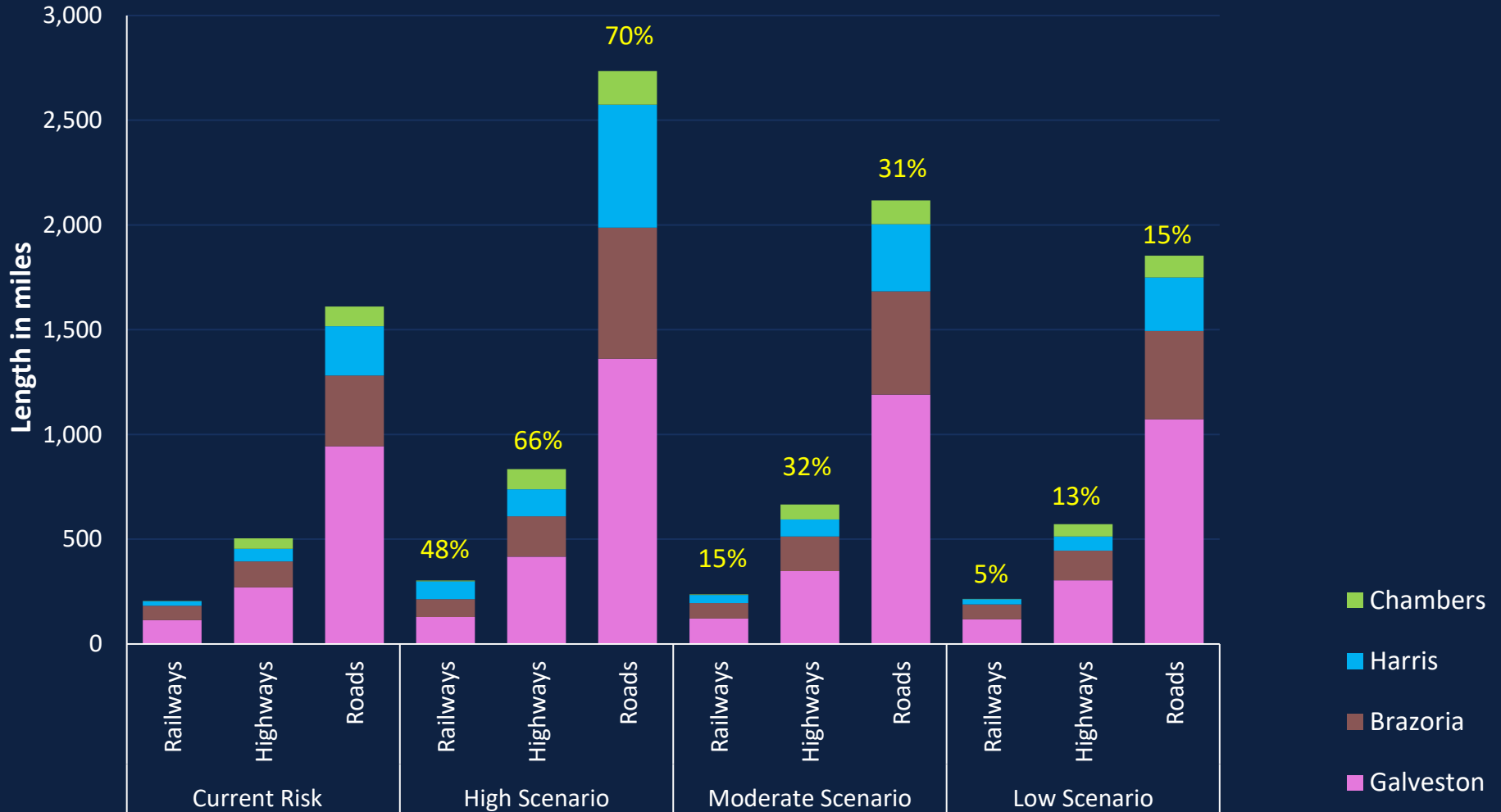
Infrastructure at Risk

	Current Risk	Risk with sea-level rise in 2100		
		High Scenario	Moderate Scenario	Low Scenario
Waste Water Treatment Plant	36	53 (47%)	45 (25%)	40 (11%)
Oil Refineries	16	20 (25%)	18 (13%)	18 (13%)
Power Plants	4	9 (125%)	6 (50%)	4 (0%)

Percent number shows percentage increase from the Current Risk.

Infrastructure at Risk

Vulnerable Railways, Highways and Roads in Miles



Percent number shows percentage increase from the Current Risk.

Conclusion

- SLR significantly increases the risk to population (20 – 87%), property (19% – 105%), essential facility (23% – 84%), and transportation system (15% – 69%).
- Total building-related losses due to SLR are expected to be \$16.3B for our Low SLR, \$19.4B for Moderate SLR and 27.8B for High SLR Scenario.
- Results are based on the current socio-economic environment, and are conservative.
- Impacts due to long-term coastal erosion and habitat losses by SLR are not covered.
- Time is the uncertainty, not the level of sea level rise!

Thank you!

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