Sea Level Rise in Monroe County

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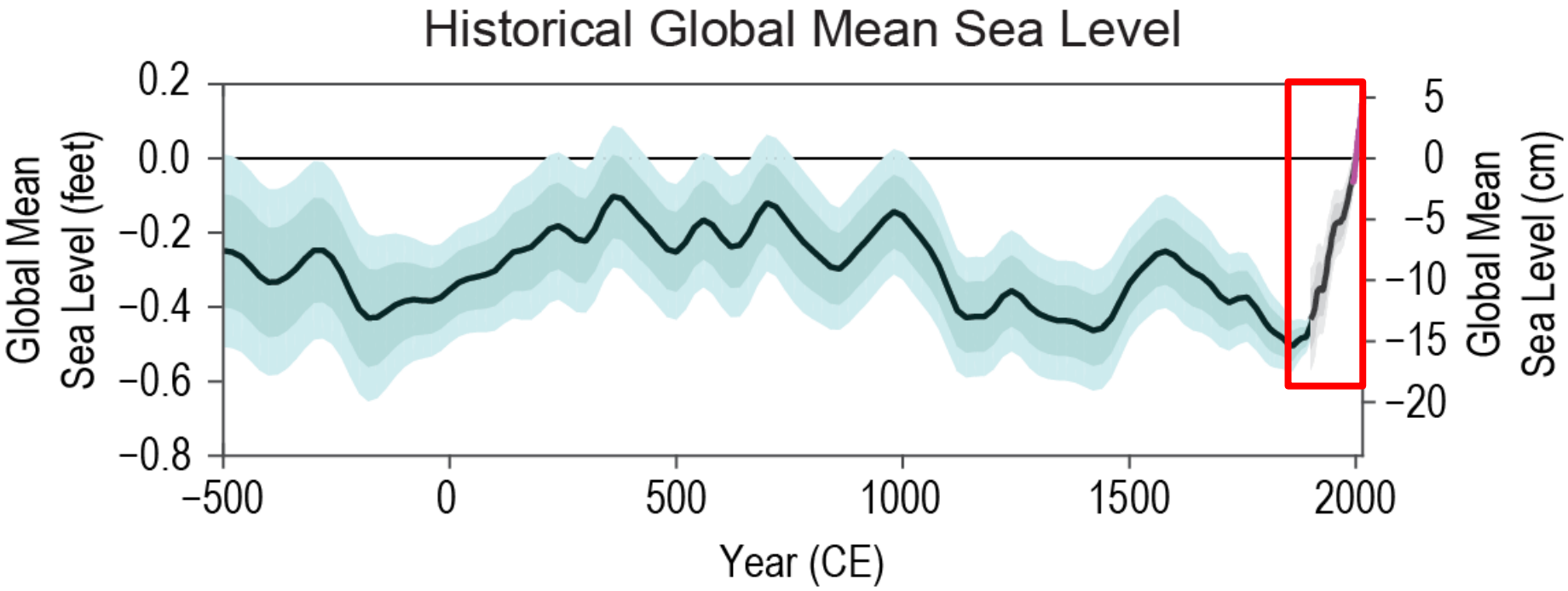
OUTLINE

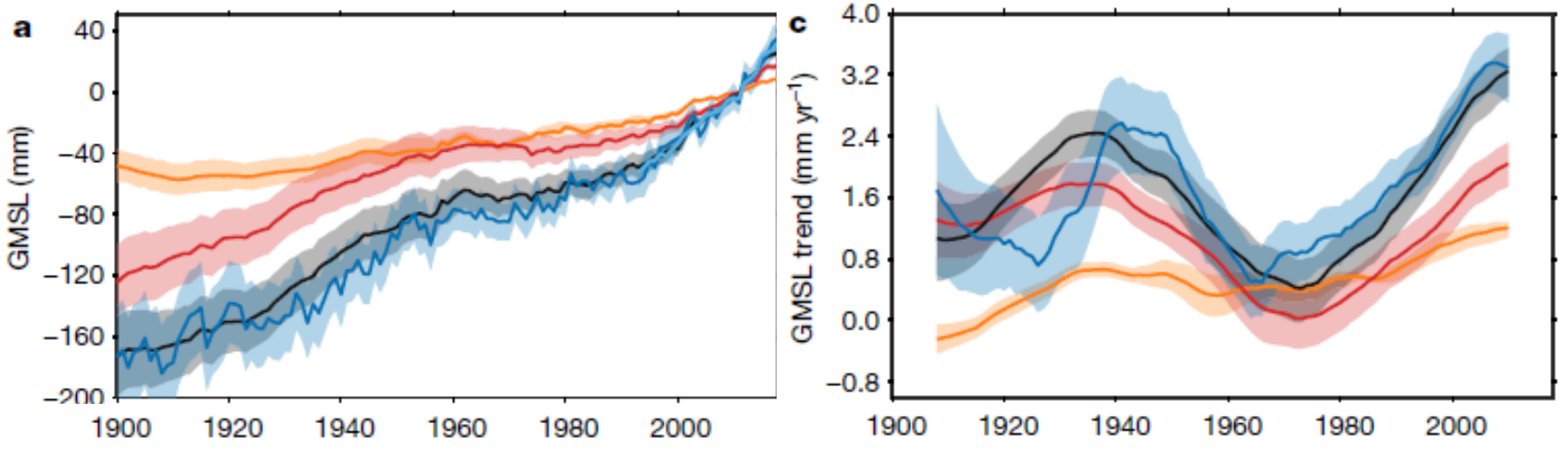
- Drivers of Sea Level Rise (SLR)
- Global SLR Curves
- Regionalized Projections
- Risk management
- Q&A

Increasing Sea Level



Sweet et al. (2017): Chapter 12 (Sea Level) in the NCA4 Volume 1: Climate Science Special Report

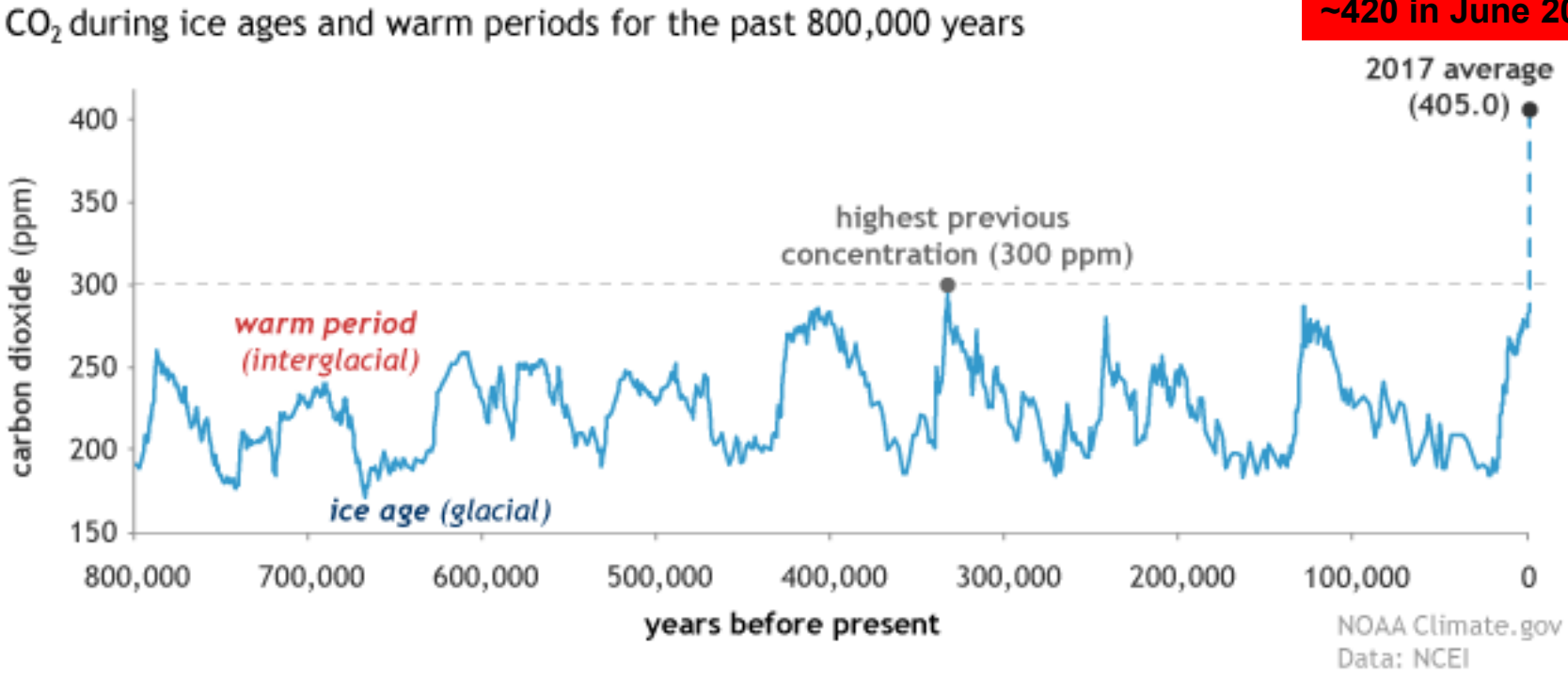
Increasing (Accelerating) Global Sea Level



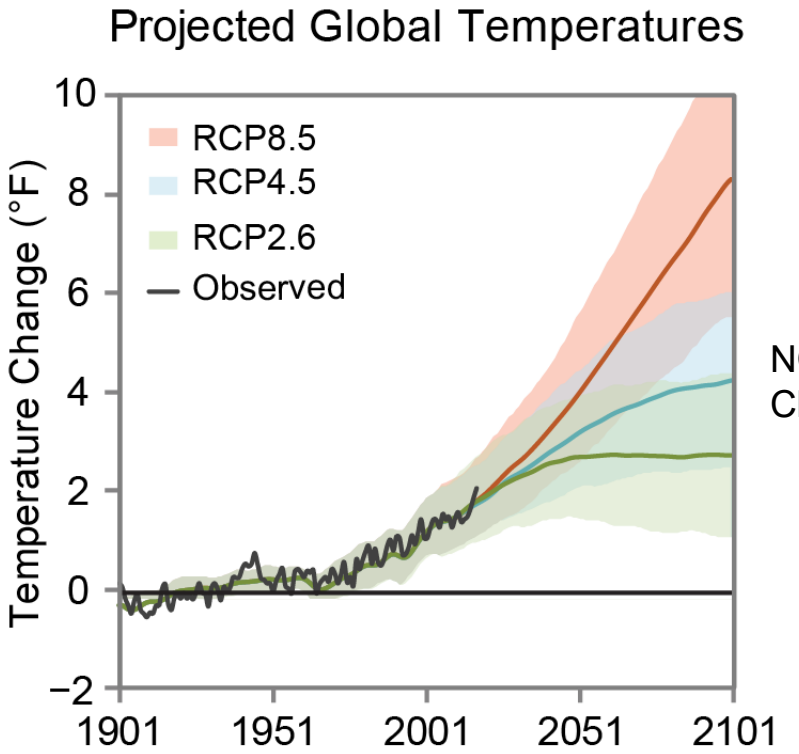
Frederikse et al. (2020): The causes of sea-level rise since 1900

Increasing Carbon Dioxide (ppm)

~420 in June 2021

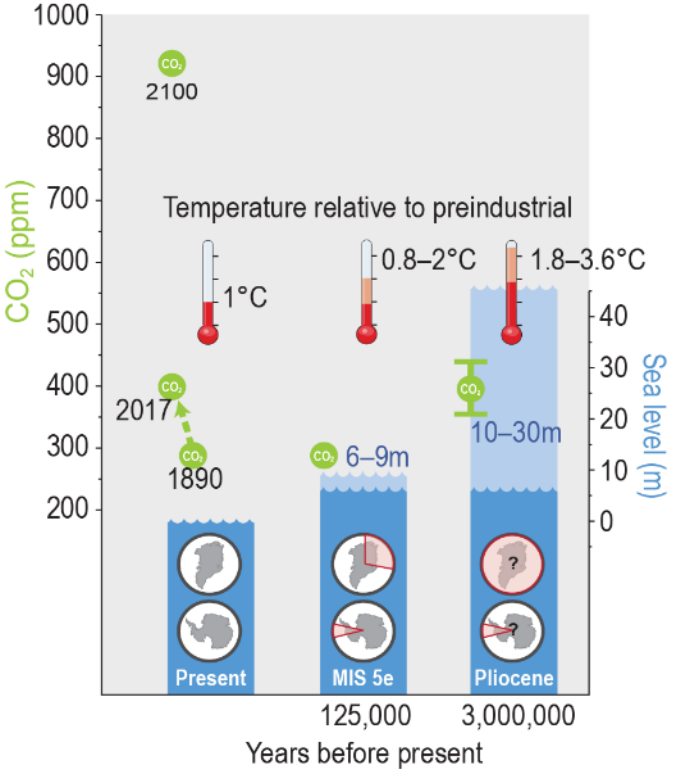


Increasing Temperatures



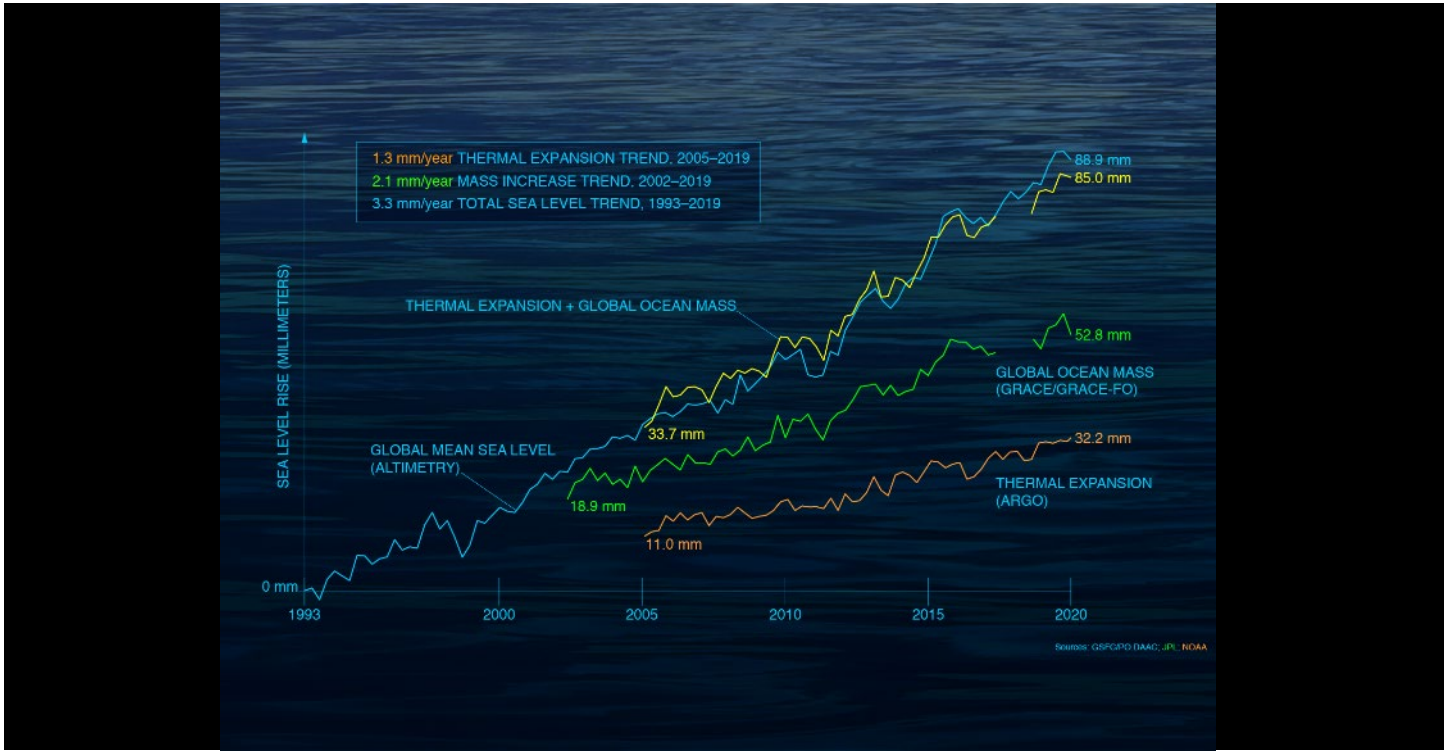
NCA4 Volume 1:
Climate Science Special Report

SLR, Carbon Dioxide, & Temperature

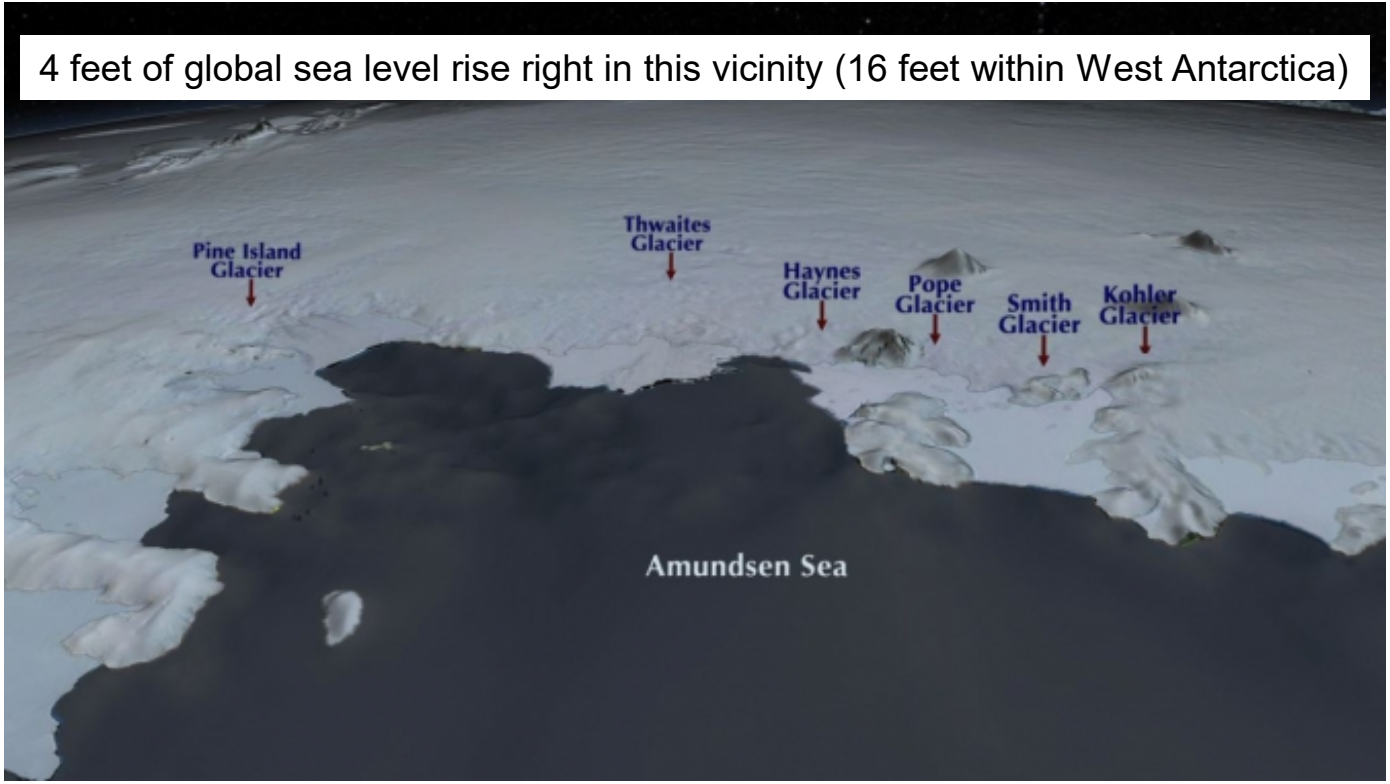


Sweet et al. (2017):
Chapter 12 (Sea Level) in the NCA4 Volume 1:
Climate Science Special Report

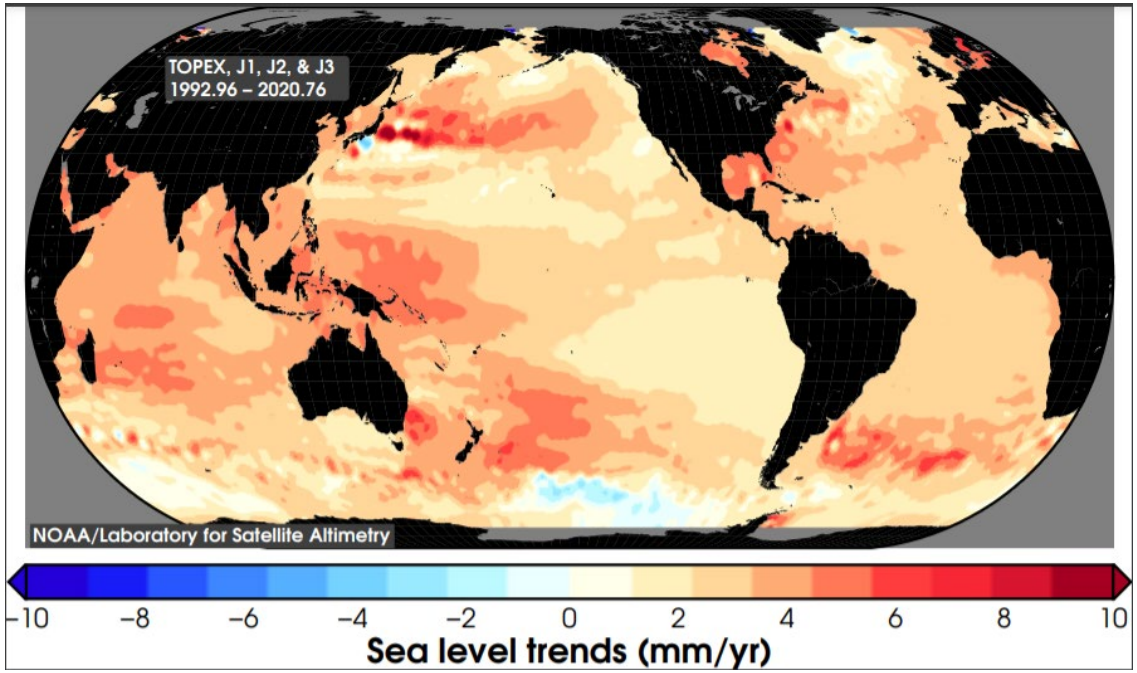
Primary Causes of Water/Sea Level Rise



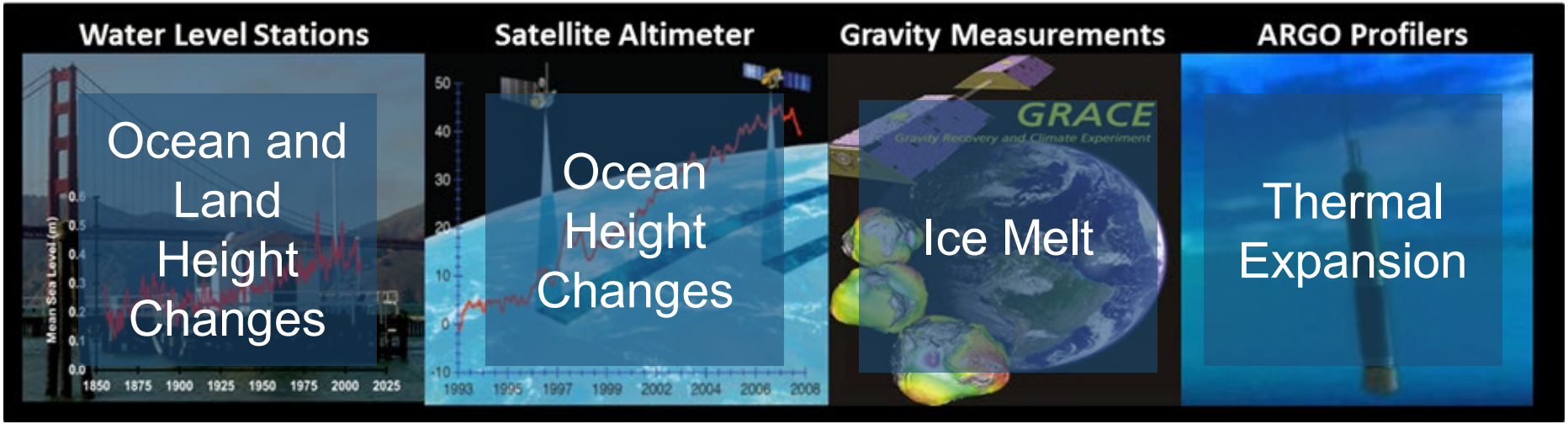
Future Uncertainty: Antarctica



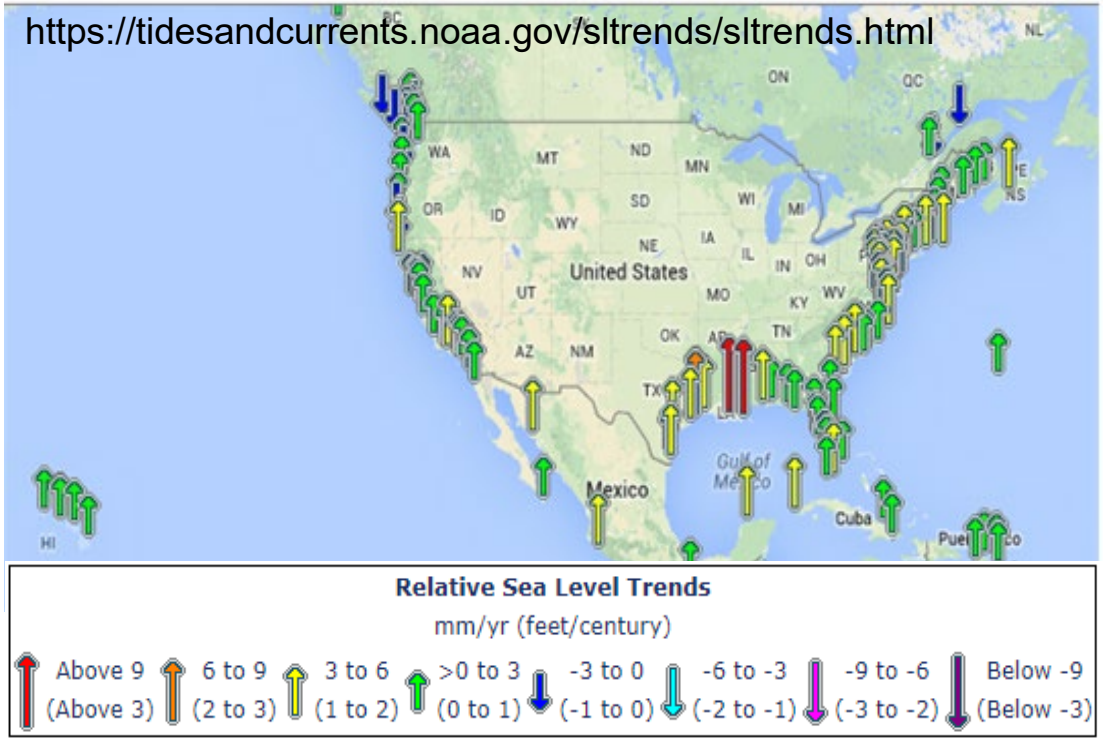
Sea Level is Not Rising at the Same Rate Everywhere



Measurement of Sea Level Rise



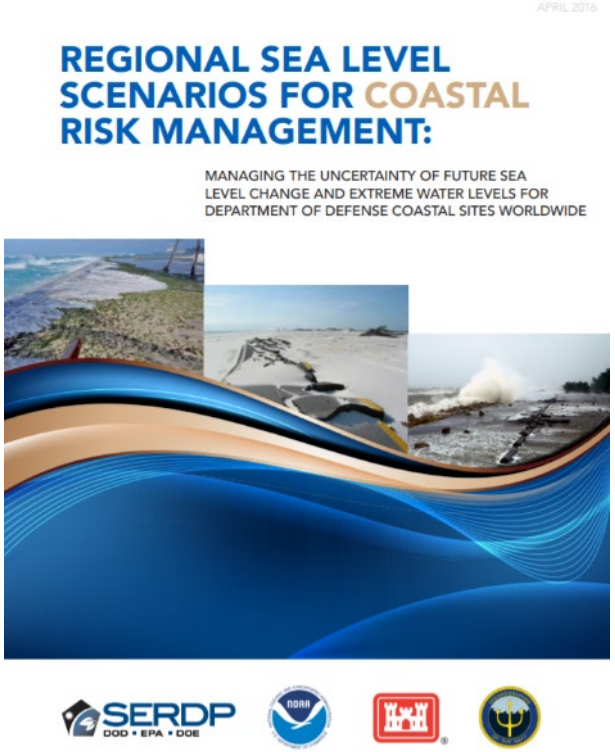
Measurement of Relative Sea Level Rise (including land motion)



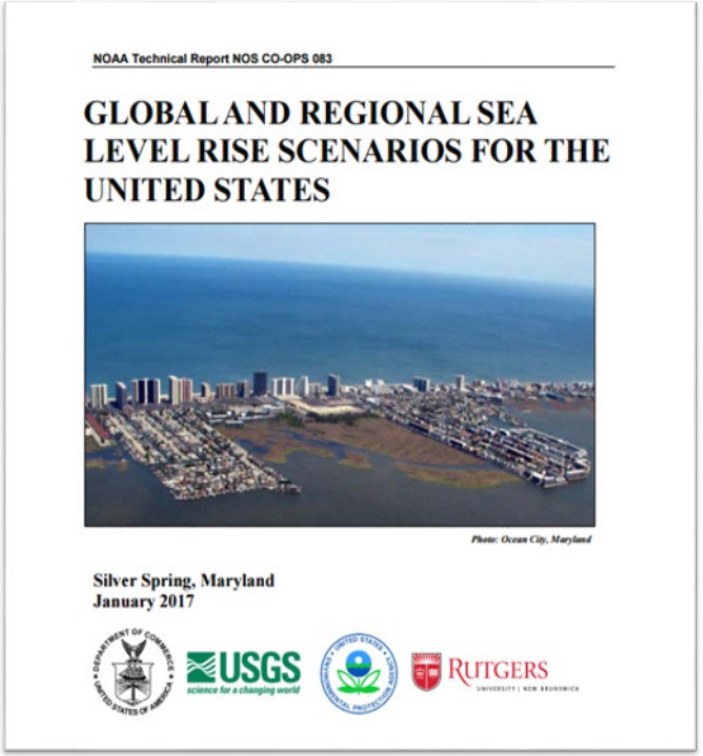
Subsidence contributes about 0.5 mm/yr to sea levels in South Florida

Global Sea Level Rise Curves

Hall et al. (2016)



Sweet et al. (2017)



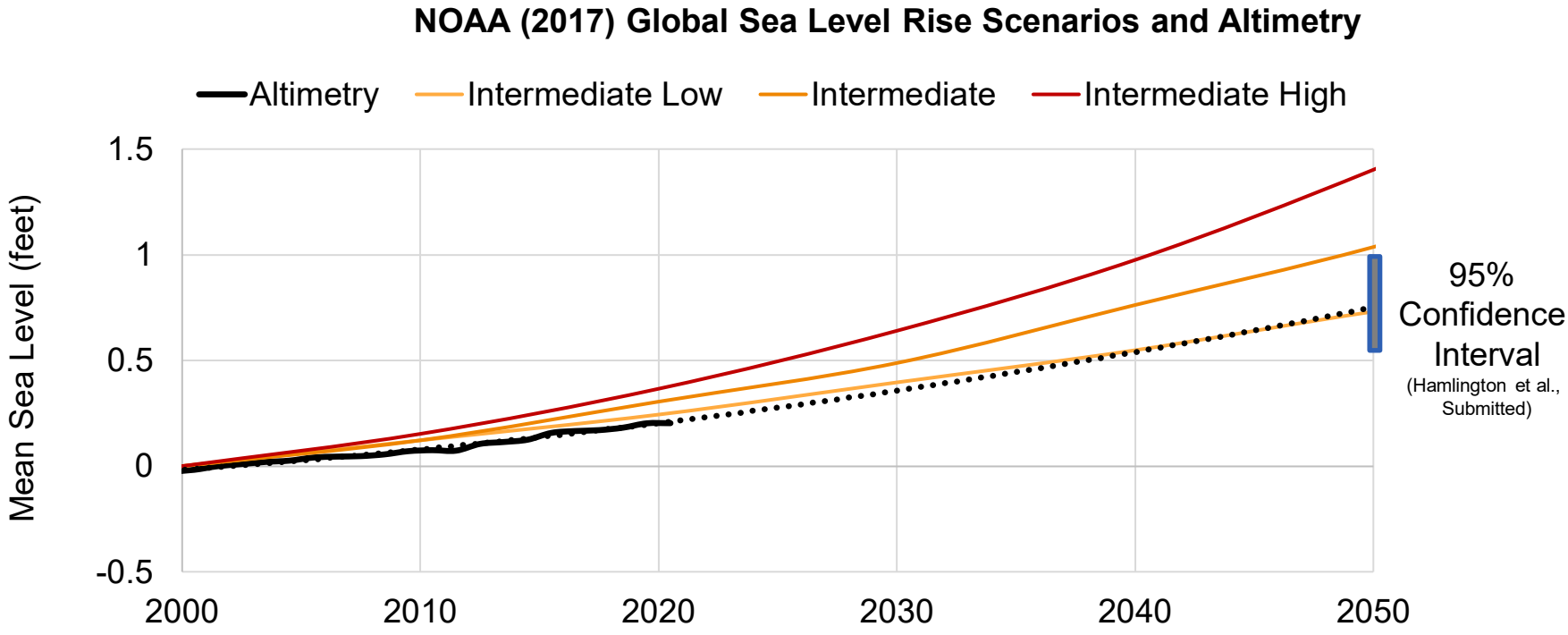
Global Sea Level Rise Curves

Table 4. Probability of exceeding GMSL (median value) scenarios in 2100 based upon Kopp et al. (2014).

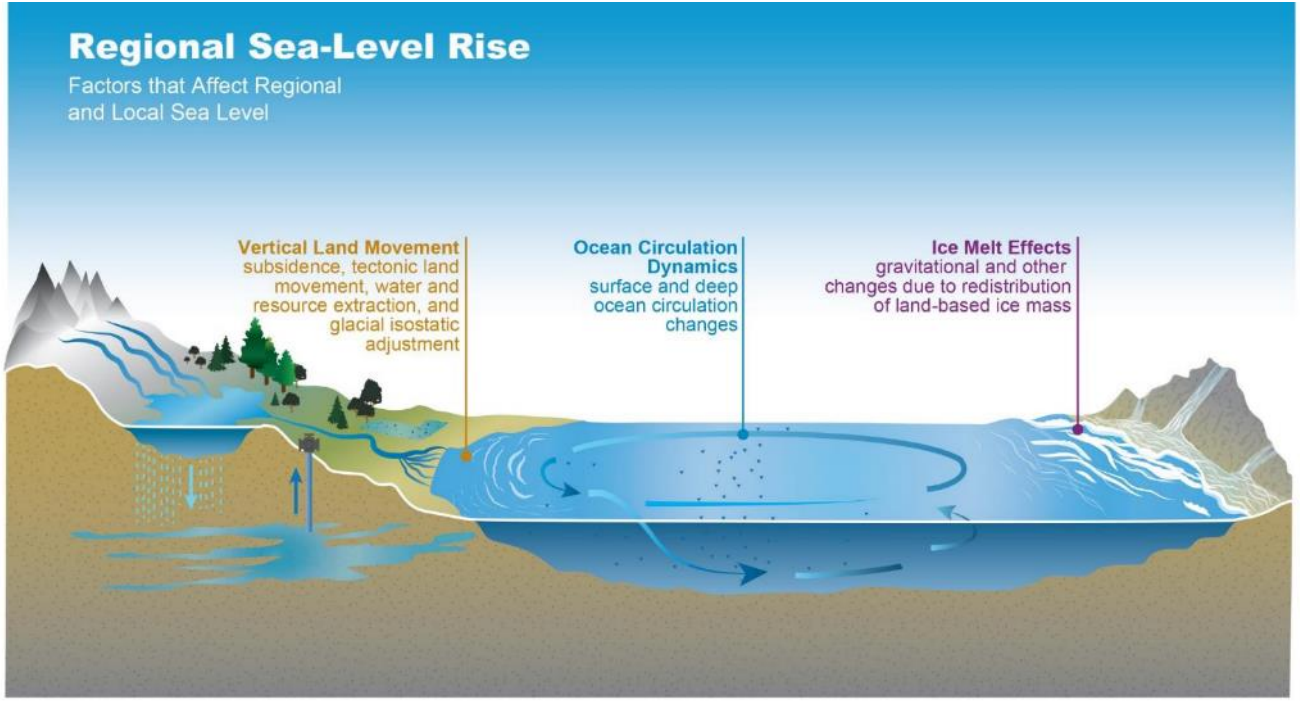
GMSL rise Scenario	RCP4.5	RCP8.5
Low (0.3 m)	Considered 'likely' under NCA4 lower & higher emissions	
Intermediate-Low (0.5 m)	73%	96%
Intermediate (1.0 m)	3%	17%
Intermediate-High (1.5 m)		
High (2.0 m)		
Extreme (2.5 m)		

Sweet et al. (2017)

Global Sea Level Rise Curves

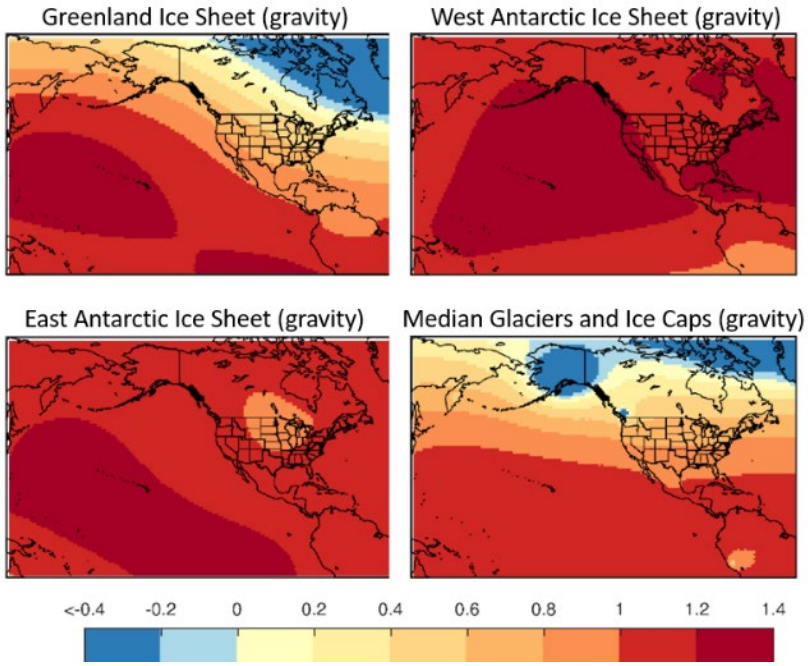


Relative Sea Level Rise Projections

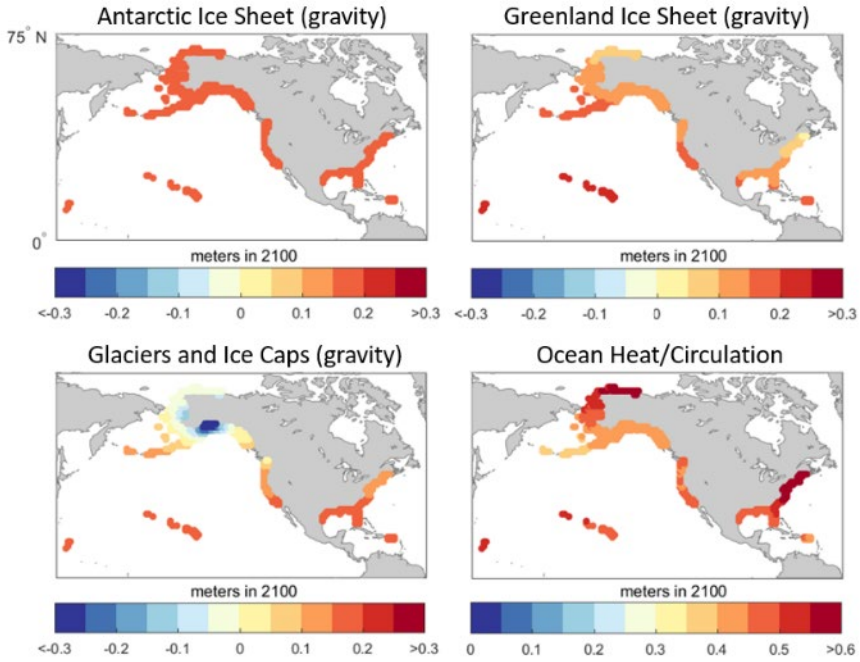


Relative Sea Level Rise Projections

Ratio of regional rise associated with global contribution (e.g., meters)

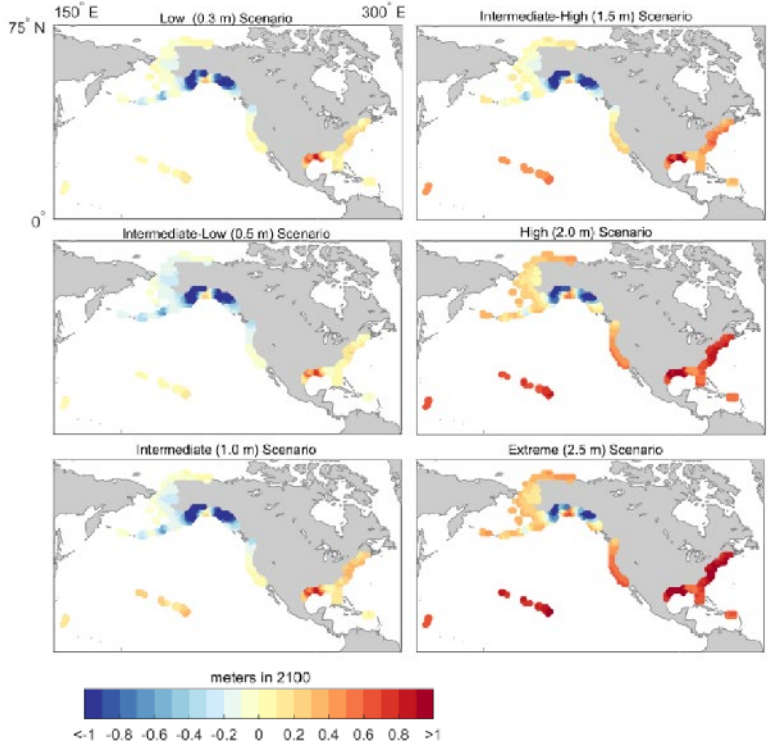


Components inherent to the Intermediate Scenario (1 m by 2100)



Sweet et al. (2017)

Relative Sea Level Rise Projections

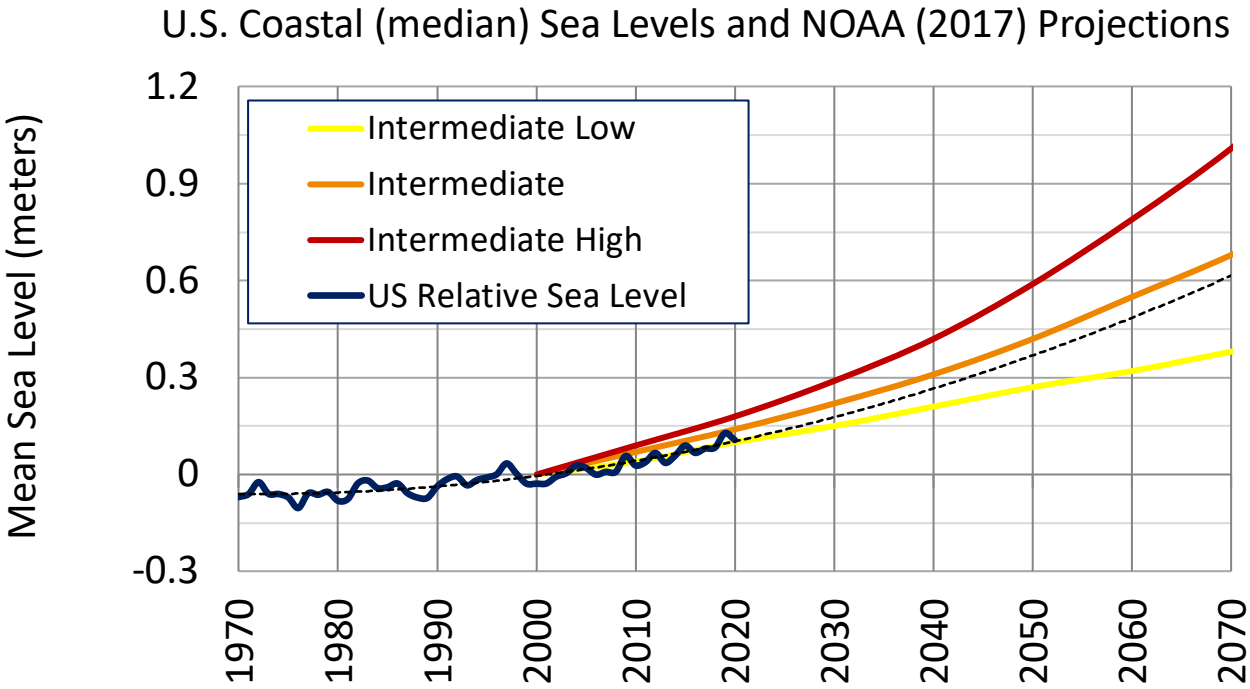


Adjust Global SLR for:

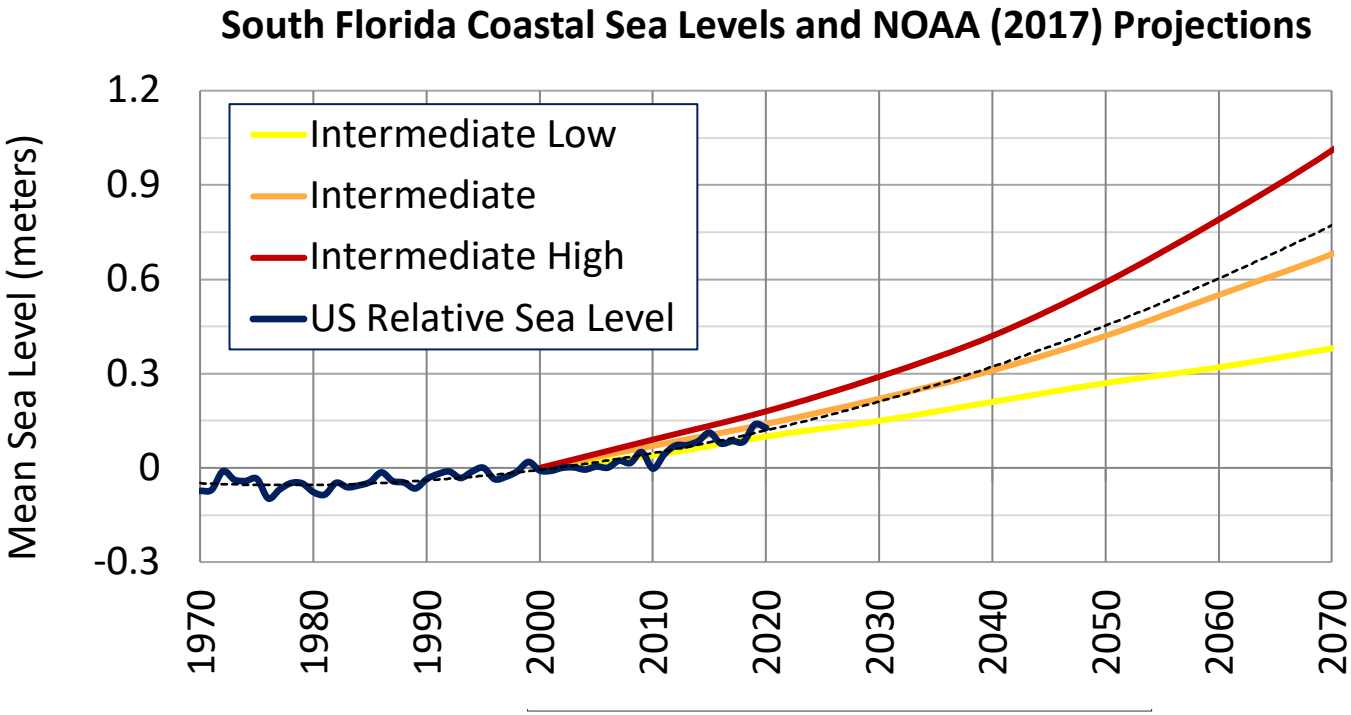
1. Ocean Circulation
2. Earth's Gravitational Field & Rotation
3. Vertical Land Movement

Sweet et al, 2017

Regional Sea Level Rise (Now Accelerating)



Regional Sea Level Rise



South Florida Locations'

- Virginia Key
- Vaca Key
- Key West
- Naples

projections are nearly identical to national median

Future Impacts of Sea Level Rise

- SLR increases perennial inundation
- SLR exacerbates extreme probabilities
- SLR intensifies high tide flooding

How Will Coastal Risk Change with SLR?

Sweet et al. (2018)


NOAA Technical Report NOS CO-OPS 086

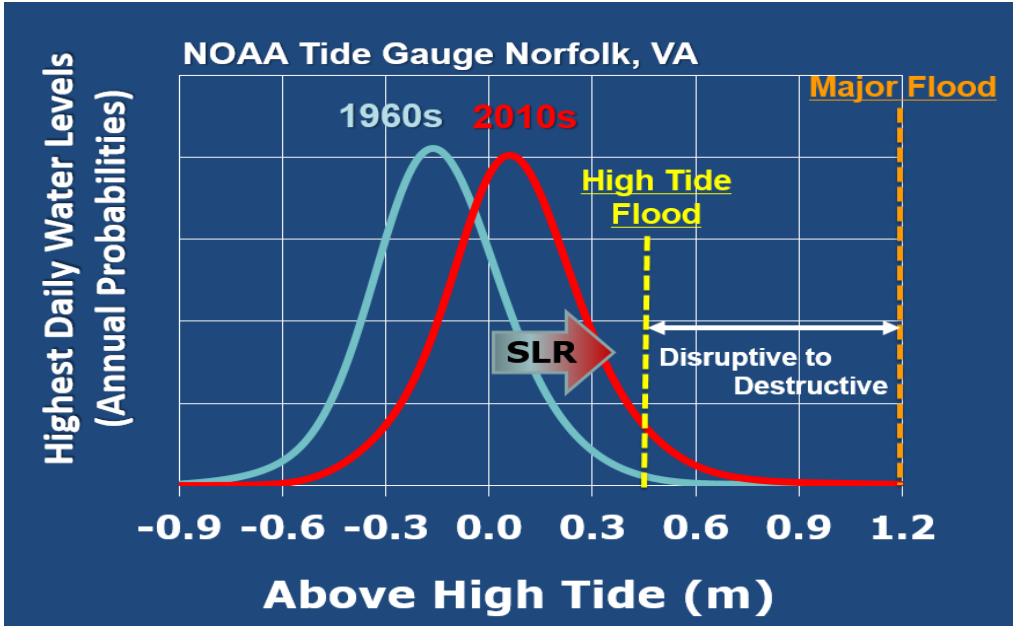
PATTERNS AND PROJECTIONS OF HIGH TIDE FLOODING ALONG THE U.S. COASTLINE USING A COMMON IMPACT THRESHOLD

Photo: New York City Harbor

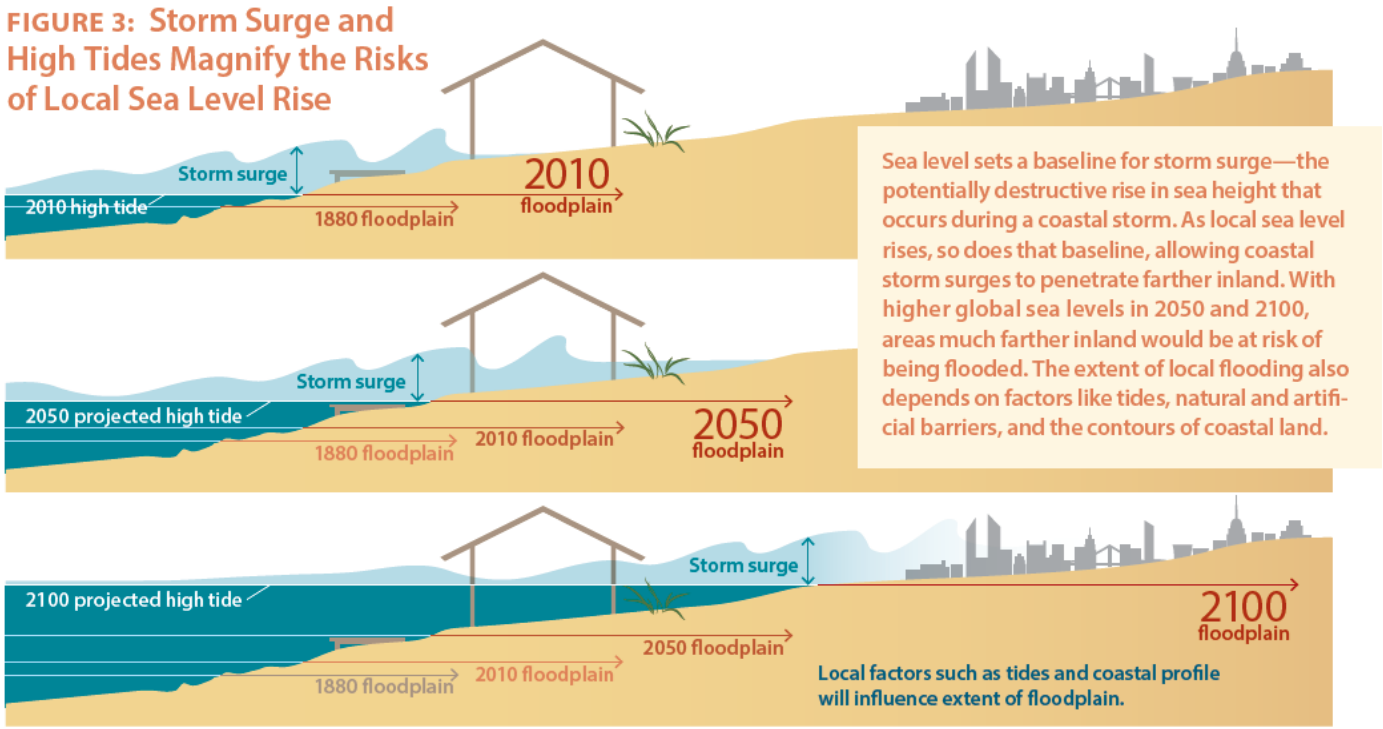
Silver Spring, Maryland
February 2018

noaa National Oceanic and Atmospheric Administration

U.S. DEPARTMENT OF COMMERCE
National Ocean Service
Center for Operational Oceanographic Products and Services



SLR Will Make Future Storms Worse



Coastal Flooding Thresholds

National Weather Service Wakefield, Virginia

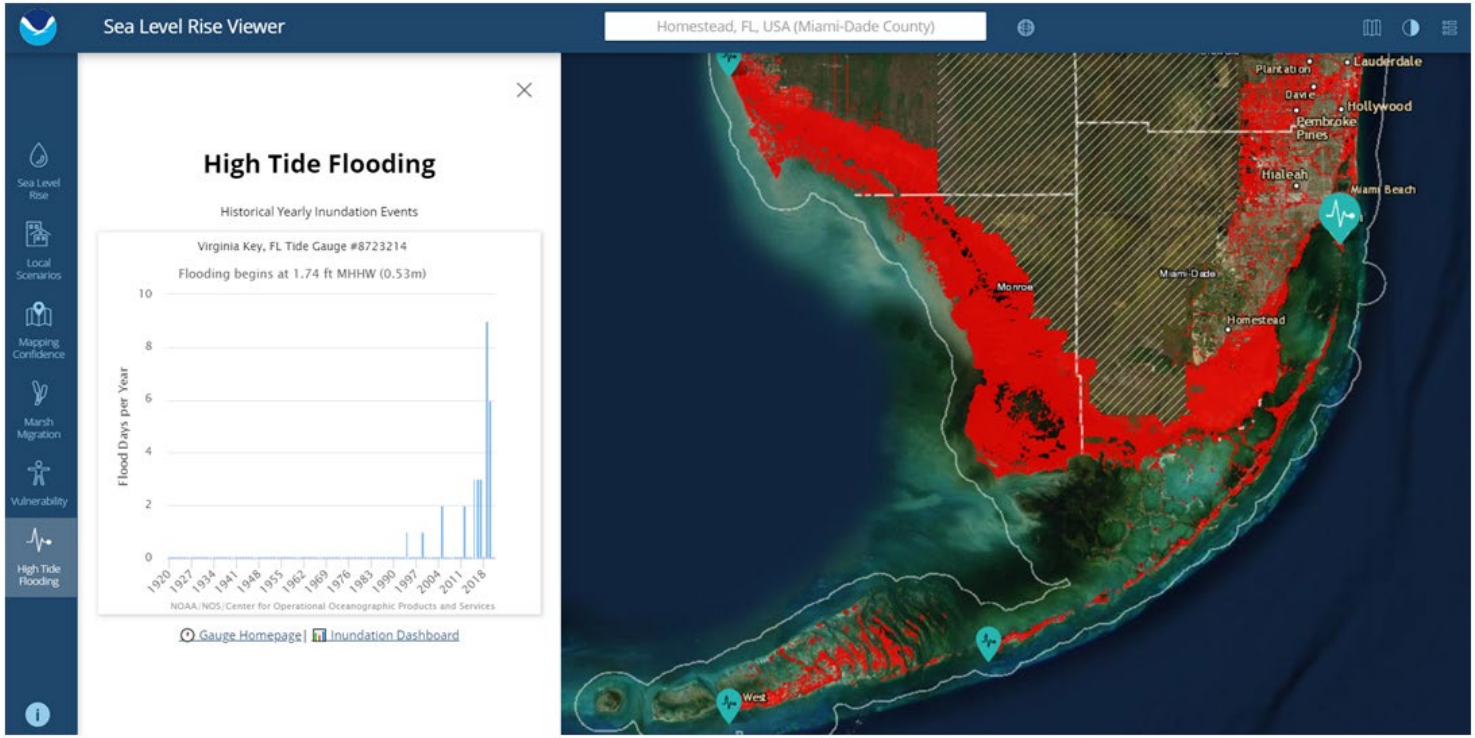
	Minor	Moderate	Major
Picture			
Hazard	➢ **Shallow flooding** in the most vulnerable locations near the waterfront and shoreline resulting in a **low threat of property damage.** ➢ **Up to 1 foot of inundation** in shoreline and vulnerable areas.	➢ **Widespread flooding** of vulnerable areas will result in an **elevated threat of property damage.** ➢ **1 to 2 feet of inundation** primarily in shoreline and vulnerable areas.	➢ **Severe flooding** will cause extensive inundation and flooding of numerous roads and buildings resulting in a **significant threat to property and life.** ➢ **2 to 3 feet or more of inundation.**
Impact	➢ A few shoreline and vulnerable roadways and adjacent properties will experience shallow flooding. ➢ Minor beach erosion with possible erosion to the front of vulnerable dune structures.	➢ Inundation of roads and low lying property near the waterfront. ➢ Flooding will extend along tidal rivers and creeks resulting in some road closures, flooding of vehicles, and some property. ➢ Severe beach erosion and considerable erosion of dunes, especially during long duration events.	➢ Numerous roads will be impassable, with many unprotected cars submerged. ➢ Evacuations will be necessary for the most vulnerable areas. ➢ Flood waters may extend well inland. ➢ Substantial coastal damage and severe erosion of dunes.

In South Florida: these heights (above high tide) are:

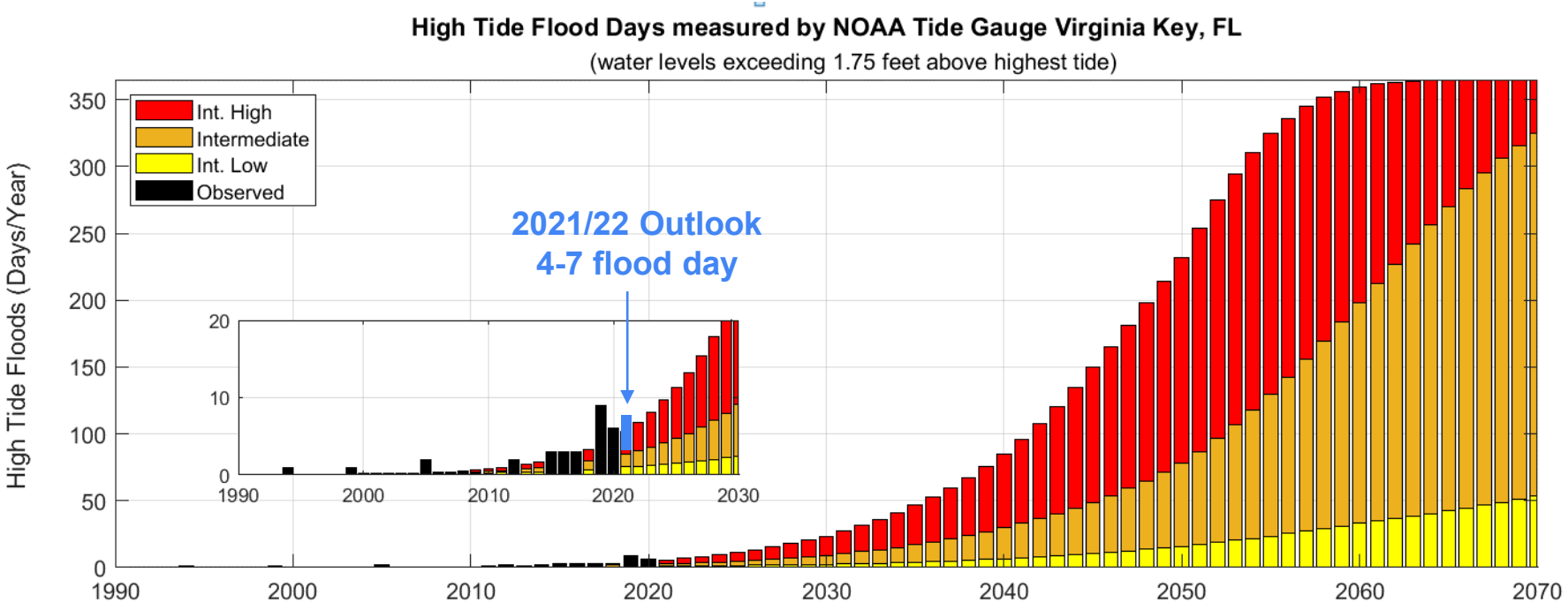
- Minor: 0.5 m
- Moderate: 0.8 m
- Major: 1.2 m

Some **surface** flooding occurs about 0.3-0.4 m above high tide.

Critical Thresholds Reached More Often

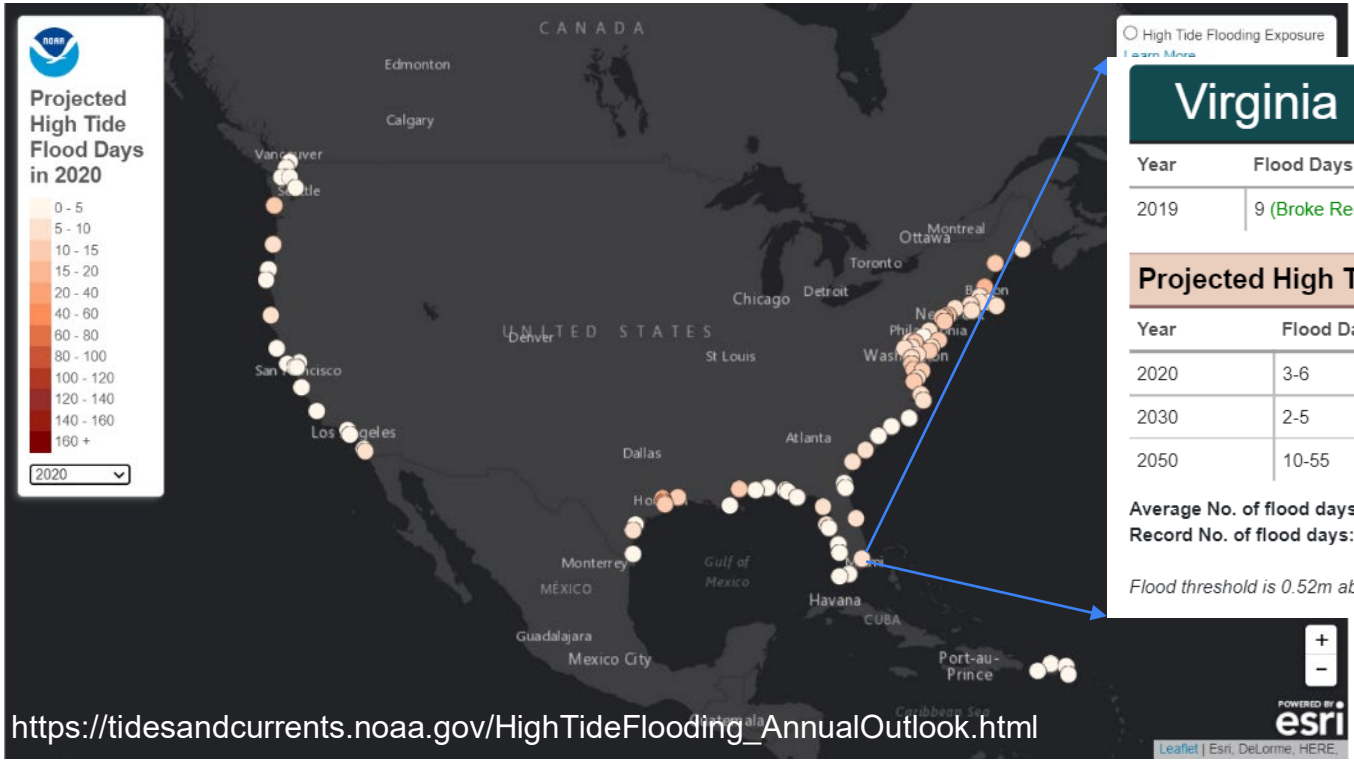


How Will Coastal Risk Change with SLR?

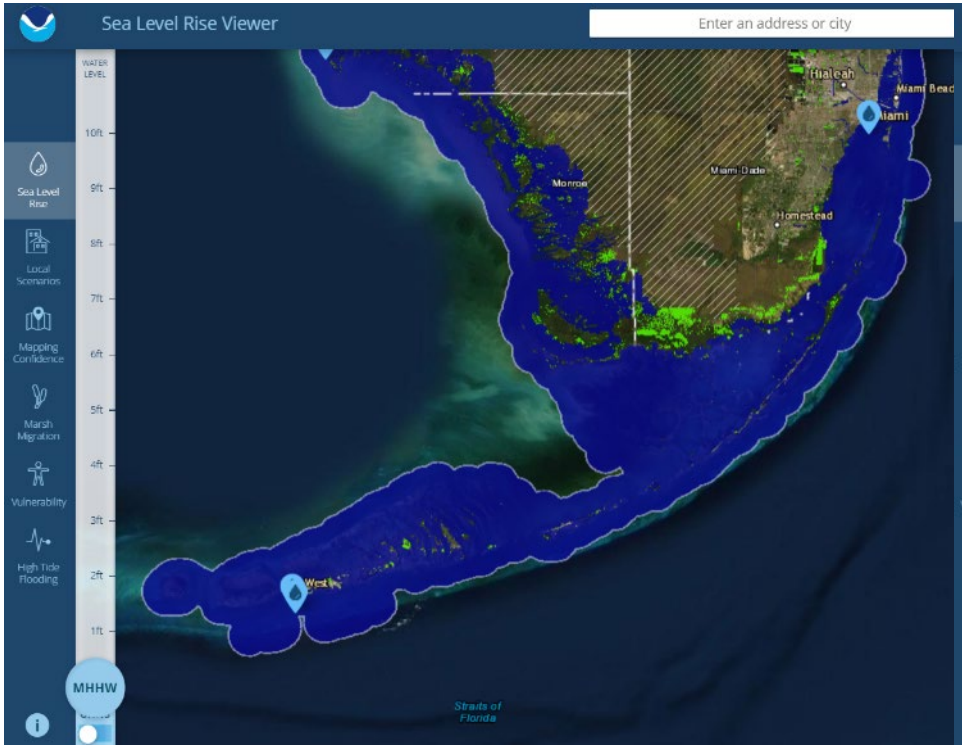


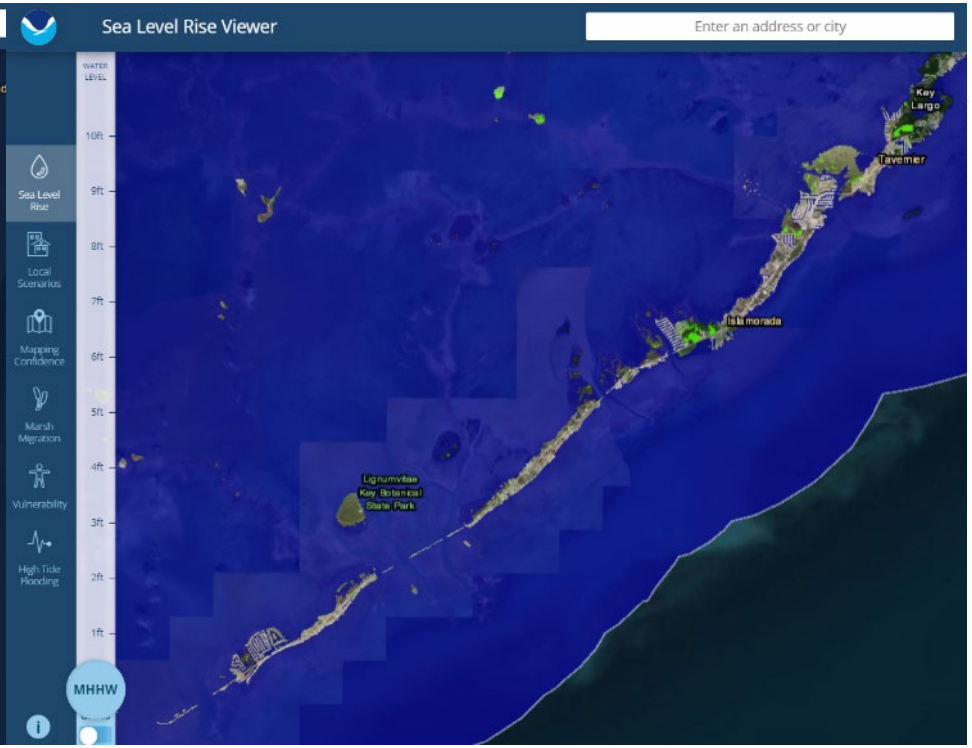
NOAA/Sweet et al. (In Press). U.S. State of High Tide Flooding with a 2021 Outlook

How Will Coastal Risk Change with SLR?



A (realtime) Baseline to Assess Future Impacts





Drivers of SLR | Global SLR Curves | Regionalized Projections | Risk Management

How Will Coastal Risk Change with SLR?

Annual Event **(~2 days/event)** Frequency in 1990, 2020, **likely** by 2050 (NOAA/Sweet et al., In Prep)

	1990			2020			2050		
NCA5 Region	Minor Flood	Moderate Flood	Major Flood	Minor Flood	Moderate Flood	Major Flood	Minor Flood	Moderate Flood	Major Flood
National	1.2	0.2	0.03	2.7	0.3	0.04	>10	2 to 5	0.1 to 0.3
Pacific Is.									
NE US									
SE US	0.9	0.2	0.05	2.0	0.3	0.07	>10	2 to 5	0.2 to 0.3
S.Great Plain									
SW US									
NW US									
Alaska									
US Carib									

Once in 5 years

Once in 3 years

2-5 per year

To Conclude:

Already flood risk from compounding factors (e.g., sea level, groundwater, rainfall) is increasing in many locations like South Florida.

Annual variability is now affecting flood risk, commerce & budgeting.

Stay tuned on ice sheet science and emissions:

- **The exact future is unknown, but 'when not if' scenario planning can help frame 'futures'.**

To manage risk, multiple SLR scenarios can help communities think about their risk tolerance:

- **If low cost, short-lifetime asset, Intermediate Low curve might be fine**
- **If high cost, long-lifetime/critical asset, Intermediate-Int. High projections can help minimize risk and add protection from compounding risks**

Questions?

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