

NOAA Sea Level Rise and High Tide Flooding



**NOAA Eastern Region Climate Services Webinar
December 17, 2020**

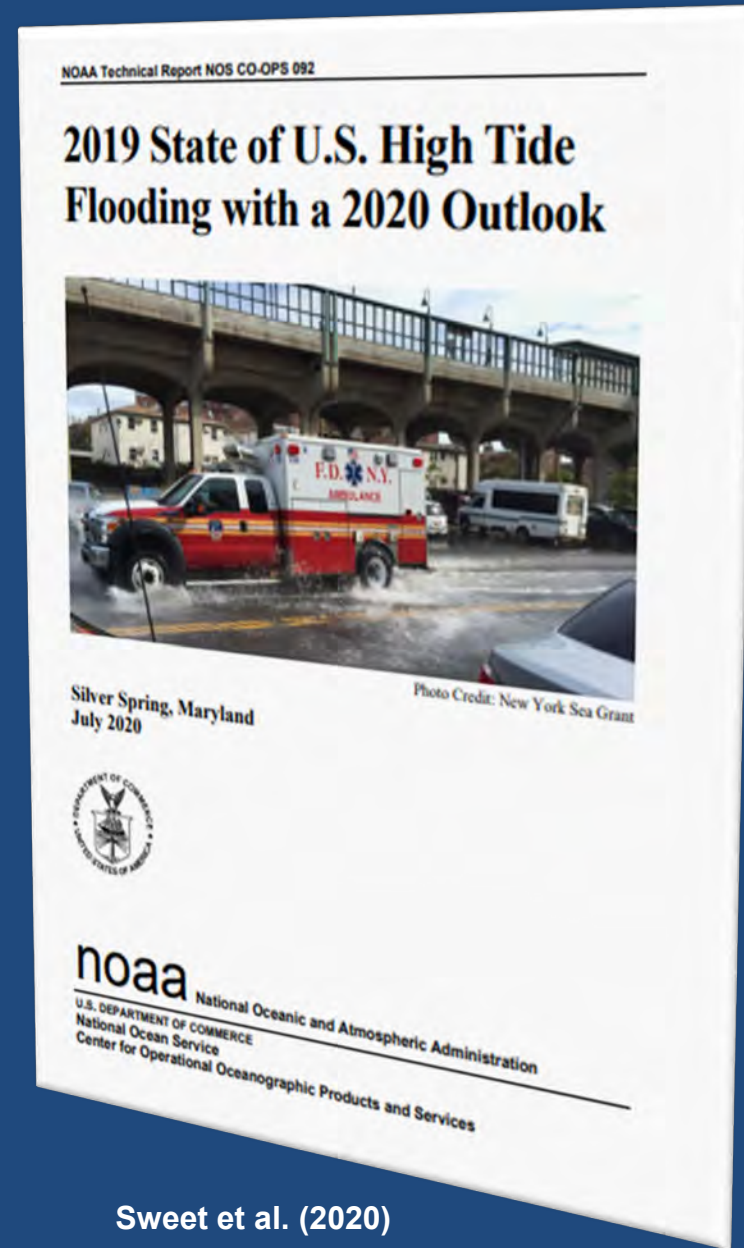
**Dr. William Sweet
NOAA's National Ocean Service**



NOAA's High Tide Flood Annual-Decadal Guidance

Due to sea level rise (SLR), planning requires height specific (e.g., municipal storm-wastewater systems and emergency responses):

- Decadal projections for major infrastructure upgrades
- Annual predictions for response budgeting

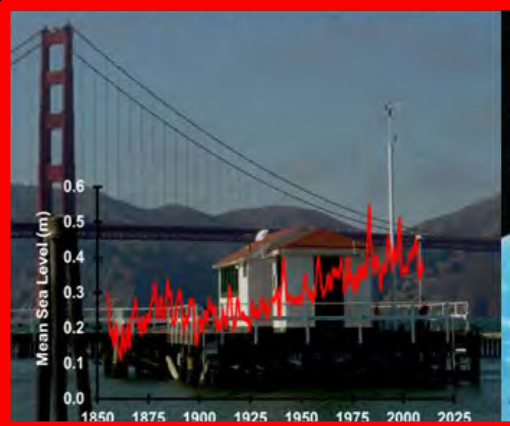


Sweet et al. (2020)

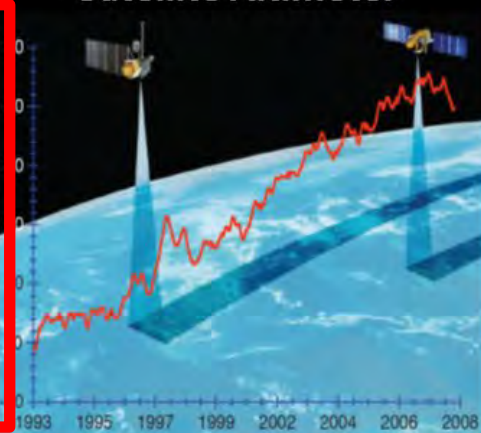


Sea Level Rise (SLR)

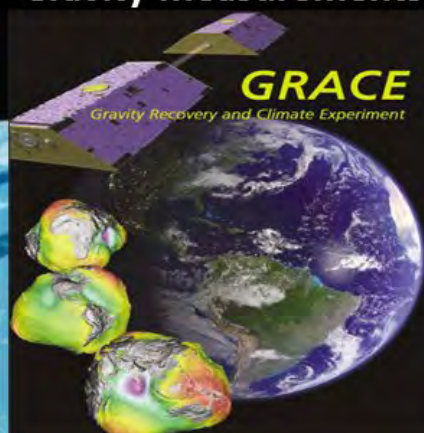
Water Level Stations



Satellite Altimeter



Gravity Measurements



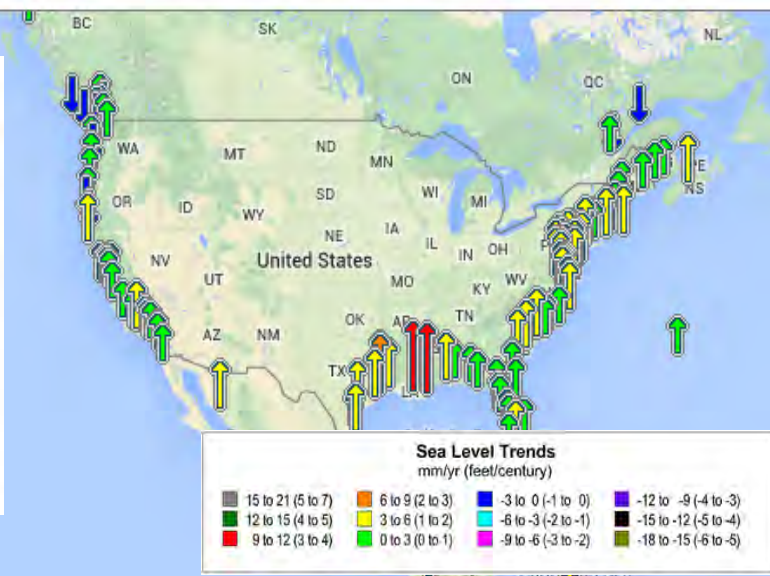
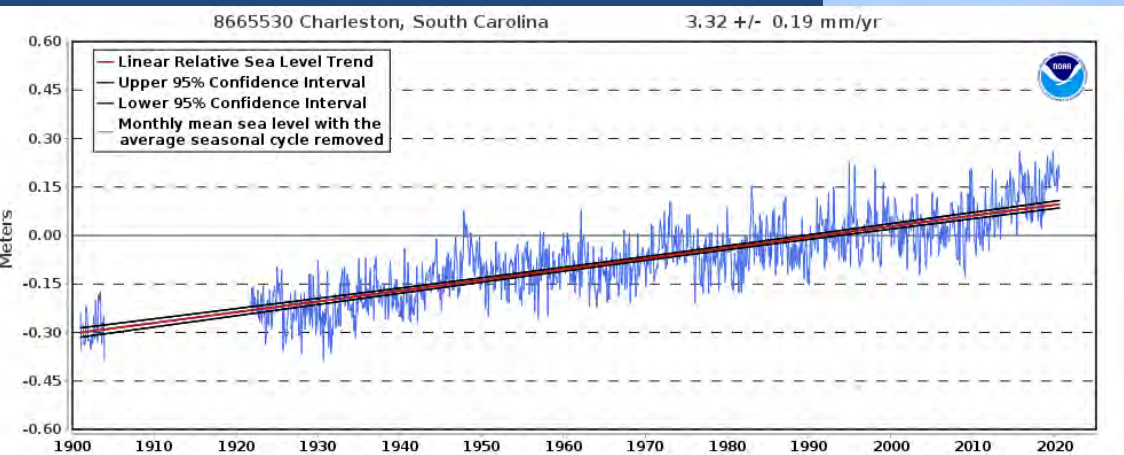
ARGO Profilers



<https://tidesandcurrents.noaa.gov/sltrends/sltrends.html>

NOAA Relative Sea Level Trends

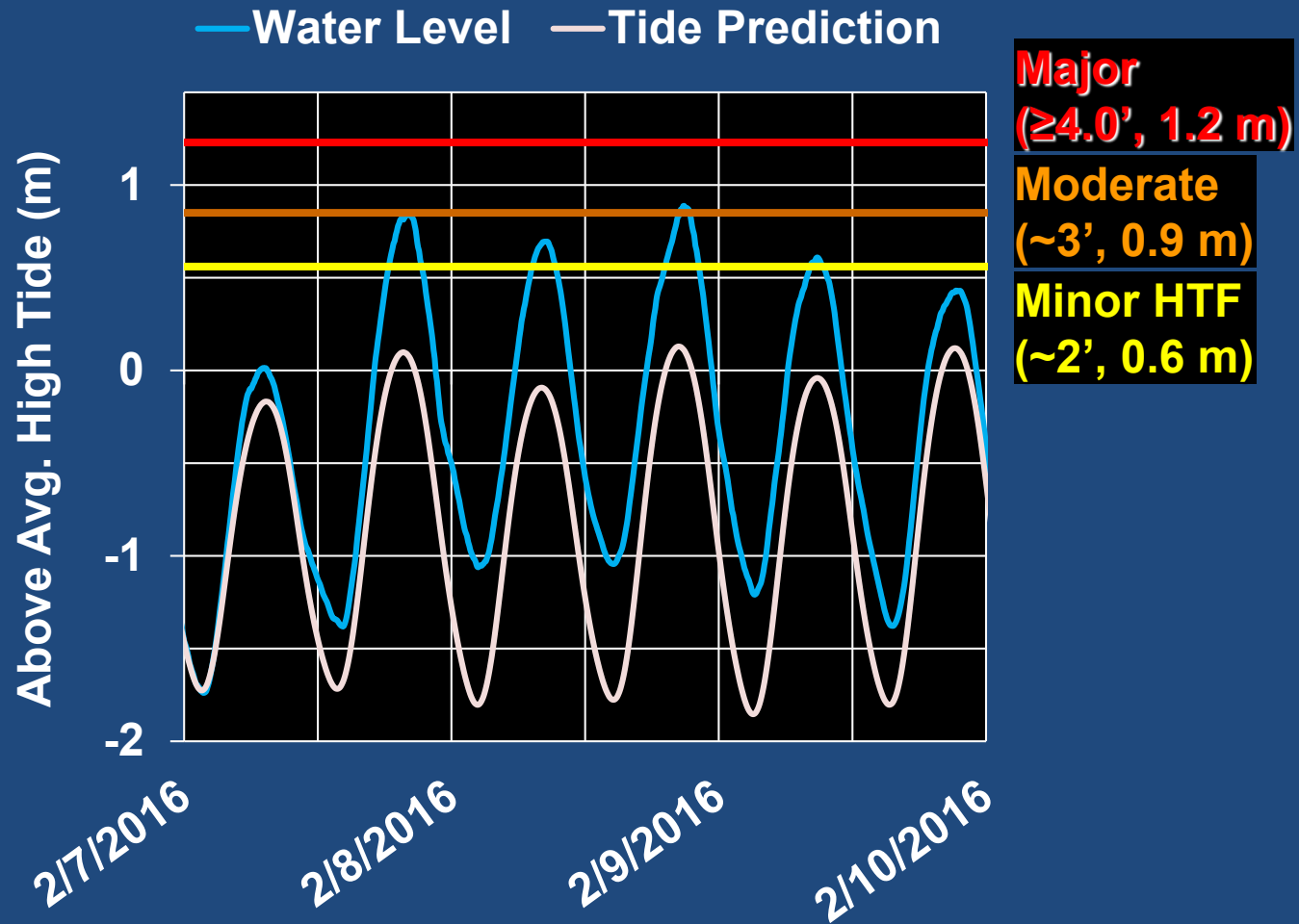
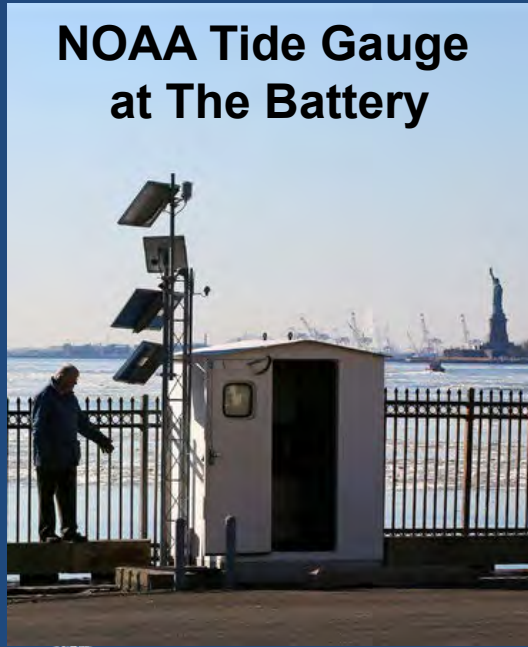
- East Coast
- West Coast
- Gulf Coast
- Alaska
- Hawaii
- Global



NOAA Tide Gauges and Coastal Flooding

Minor, moderate and major flooding occur at about 2', 3' and 4' above MHHW measured by NYC tide gauges.

NOAA Tide Gauge
at The Battery






NOAA Tidal-to-Storm Surge Flood Severity and Impacts



Coastal Flooding Thresholds



	Minor (CF Advisory)	Moderate (CF Warning)	Major (Warning)
Picture	<p>High Tide Flood (HTF)</p>  <p>Westport</p>	 <p>Lindenhurst</p>	 <p>New Haven</p>
Hazard	<ul style="list-style-type: none"> • Low threat of property damage...and no direct threat to life. • 1 to 2 ft of inundation in shoreline and vulnerable areas. 	<ul style="list-style-type: none"> • Elevated threat of property damage...with a risk to life if one places themselves in unnecessary danger. • 2 to 3 ft of inundation in shoreline and vulnerable areas. • Minor to no inundation of surrounding coastal communities. 	<ul style="list-style-type: none"> • Significant threat to life and property. • 3-5+ ft of inundation in shoreline and other vulnerable areas. • Minor to moderate inundation (1 to 3 ft) of surrounding coastal communities that rarely experience coastal flooding.
Impact	<ul style="list-style-type: none"> • A few shoreline and vulnerable roadways and adjacent properties will experience shallow flooding. 	<ul style="list-style-type: none"> • Several shoreline and vulnerable area home and businesses will experience water inside. • Several low-lying coastal and shoreline roads will be closed. • A few cars may take on water or even be destroyed. 	<ul style="list-style-type: none"> • Evacuations will be necessary for the most vulnerable shoreline and coastal areas. • Many coastal communities will experience damage...with some shoreline and flood prone homes and businesses being destroyed. • Many cars will likely be submerged or washed away. • Several sections of nearshore roads and escape routes will be impassable and a few could be washed out. • Flood waters may extend well inland in low lying areas.



High Tide Flooding in NYC Region

(From: Picasa, King Tide in the NY-NJ Harbor Estuary)



10/27/2011 10:21

Hudson Line, Marble Hill, NYC

Flooding in Jamaica Bay Region Feb 8-9, 2016

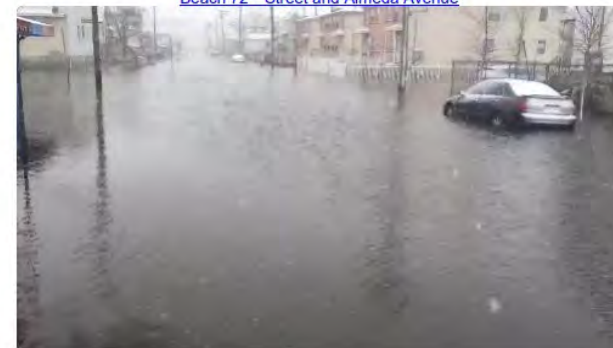
2 to 3 Ft of inundation in the most vulnerable sections of Brookville/Rosedale, Arverne/Edgewater, Howard Beach, Old Howard Beach, Far Rockaway, Hamilton Beach Broad Channel. (Morning high tides of 2/8/2016)

In Brookville/Rosedale: Moderate flooding on [Rockaway Blvd](#) and [Brookville Blvd](#)
In Rosedale: Moderate Flooding on [Hungry Harbor Road](#) and [Hook Creek Boulevard](#)
In Bayswaters: [Norton Drive from Westbourne Ave to Healy Ave.](#)
In Far Rockaway: Flooding on [Beach 26th and Seagirt Blvd](#)
In Edgemere/Arverne:
Minor Flooding on Beach 38th-60th and 67-72nd streets
Moderate Flooding on [Beach 58th Street](#) and [Rockaway Beach Boulevard](#)
Moderate Flooding on [Beach 59th Street](#) and [Rockaway Beach Boulevard](#)
In Broad Channel: Flooding on [Crossbay Blvd and East 9th Street](#)
In Howard Beach: Flooding on [102nd St and 160th Avenue](#)

[Arverne/Edgemere](#) in Rockaways



[Beach 72nd Street and Almeda Avenue](#)



[Broad Channel](#)

Water 2 ft deep on sidewalk on [14th Road in Broad Channel](#)

[Beach 36th Street](#)



[Old Howard Beach](#)



[Far Rockaway](#)



<https://www.weather.gov/media/okx/coastalflood/Jamaica>

<https://www.weather.gov/media/okx/coastalflood/Jamaica%20Bay%20at%20Inwood%20impacts.pdf>

Land Exposed to High Tide Flood Impacts



Sea Level Rise Viewer

Enter an address or city



Sea Level Rise

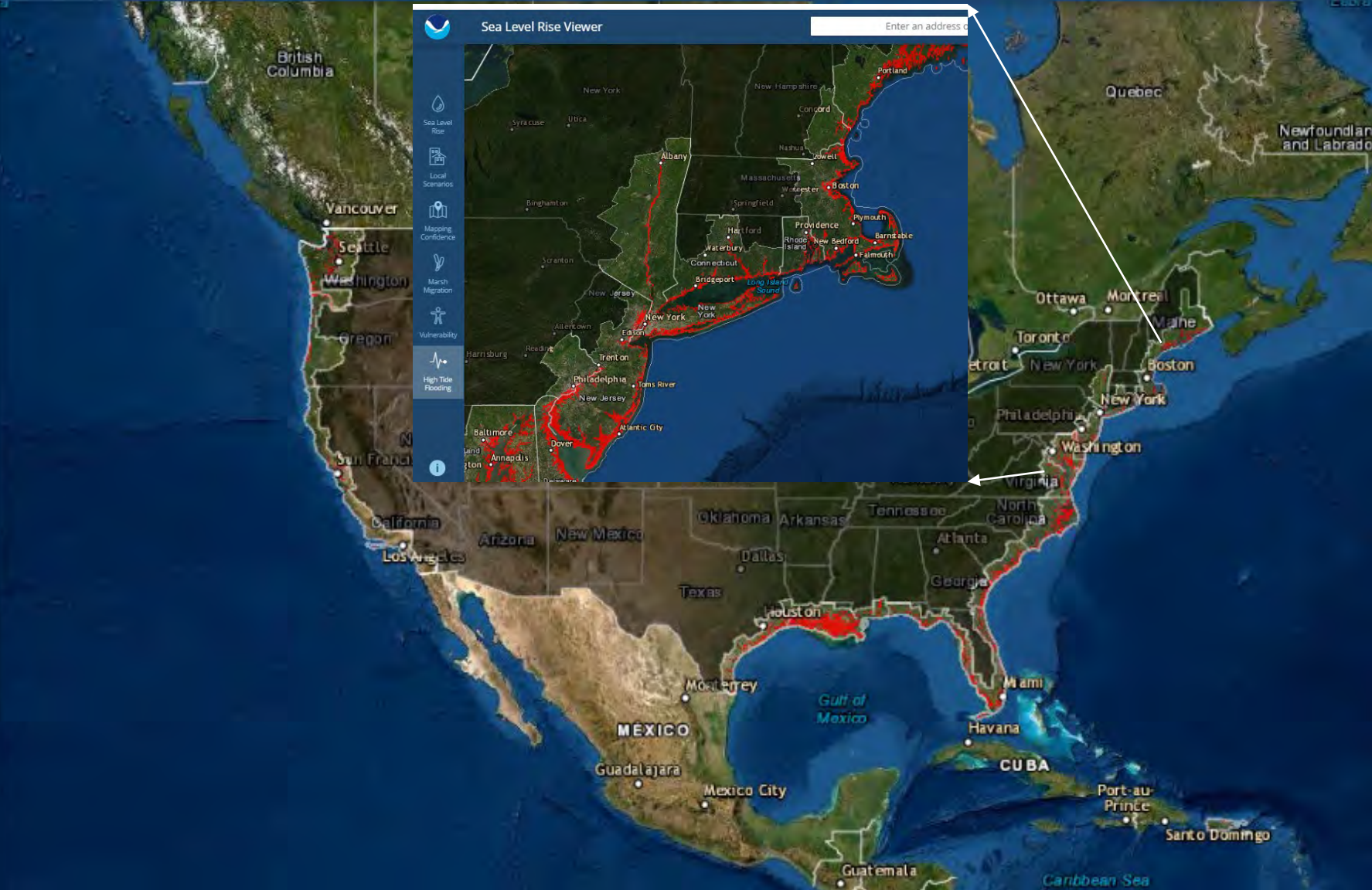
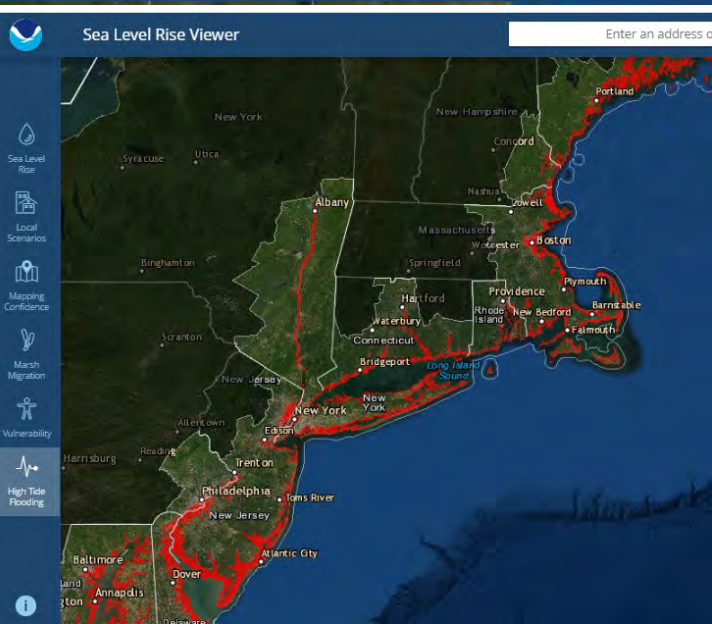
Local Scenarios

Mapping Confidence

Marsh Migration

Vulnerability

High Tide Flooding



Score Keeping: 2019 (May '19 - April '20) High Tide Flooding

In 2019, 19 locations tied/broke their historical flood records, e.g., in Chesapeake Bay, Oregon Inlet, NC, Charleston, SC, Savannah, GA, Miami, FL, Galveston Bay region.

a) Record HTF in 2019



Flood Days

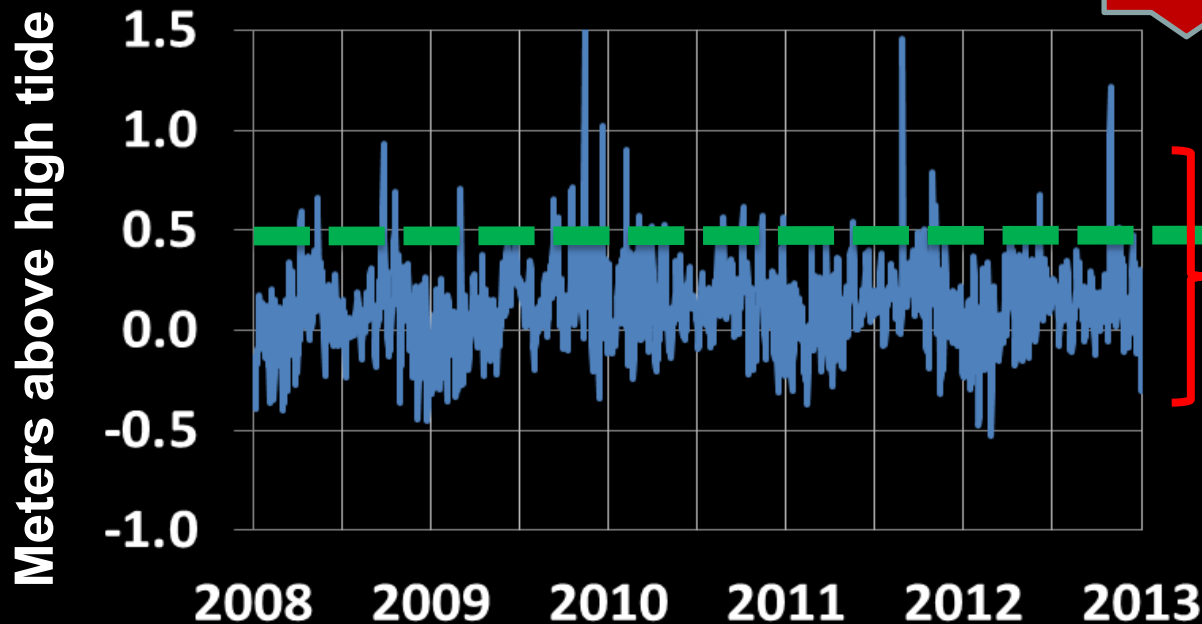


Bob Dylan B-side hit...the tides, they are a changing!

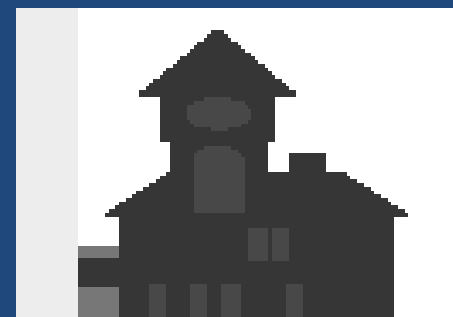
Years ago, flooding occurred during big storms.

Now, sunny day (nuisance) tidal flooding is rather common.

Daily Highest Water Levels



Typical reach of daily 'tides'



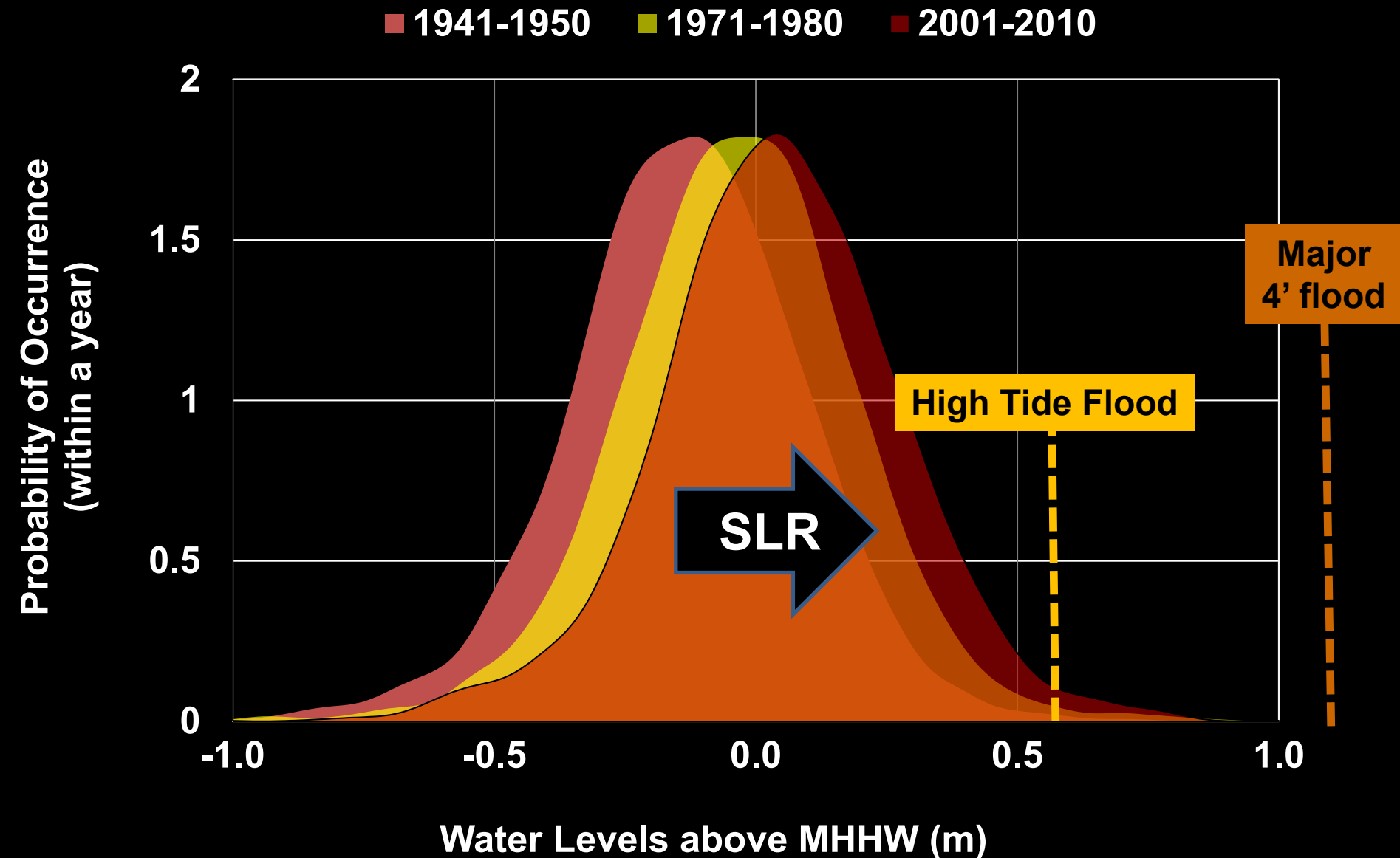
High Tide Flood Level

Example from Norfolk, VA



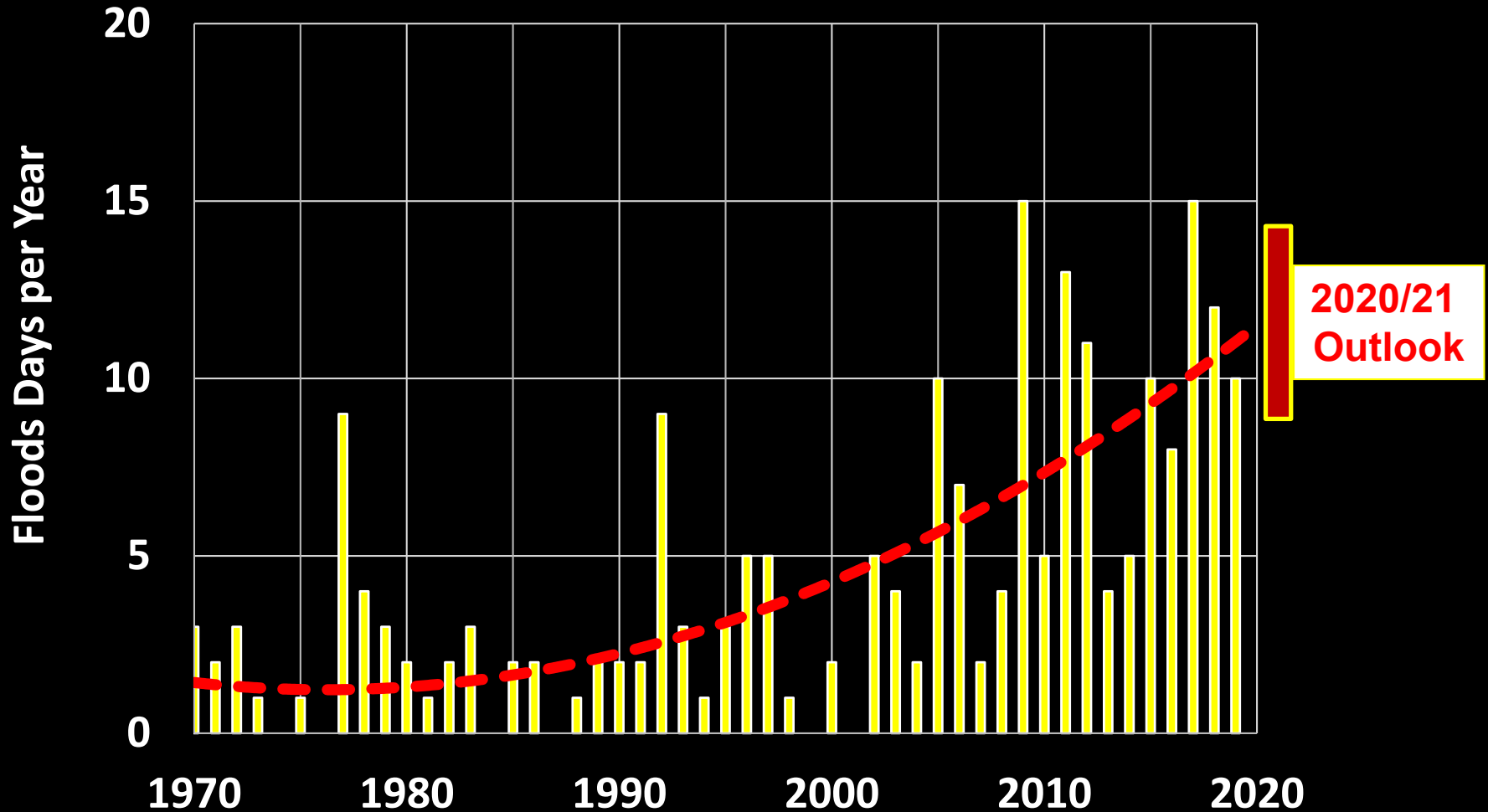
General Nature of the Problem: Shifting Geometry

Daily Highest Water Levels at NOAA Tide Gauge NYC



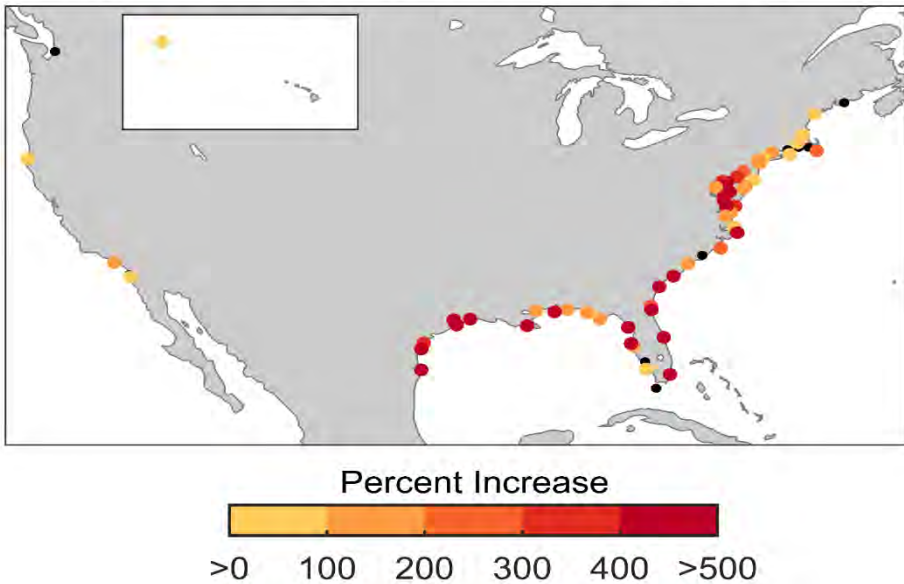
The Accelerating Nature of SLR-Tidal Flooding

Due to SLR, the number of days/year with high tide flooding is now accelerating on an annual basis.

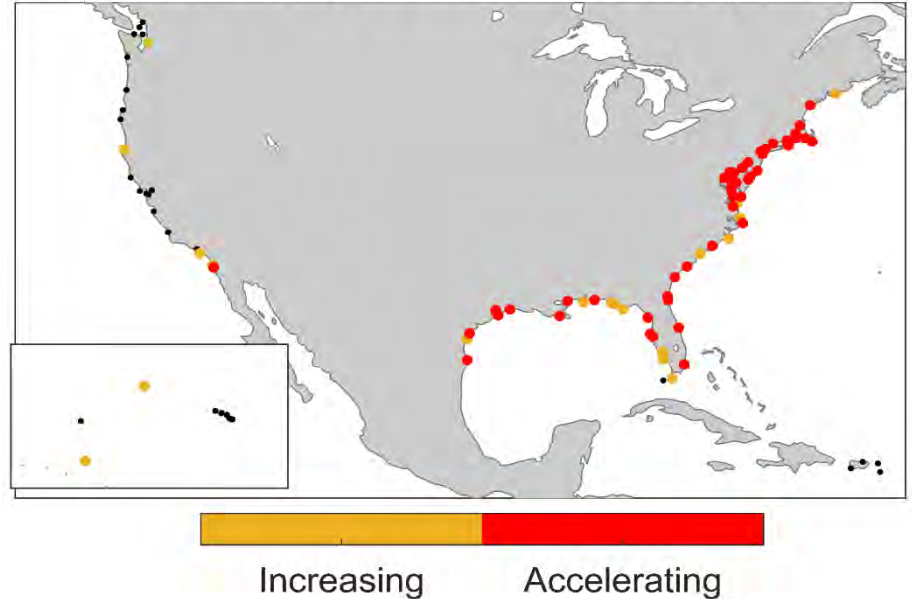


Tracking Changes in High Tide (Moderate) Flood Frequencies

b) HTF Increases in 2019 Compared to Trends in 2000



b. Decadal Trends in Annual Flood Frequencies

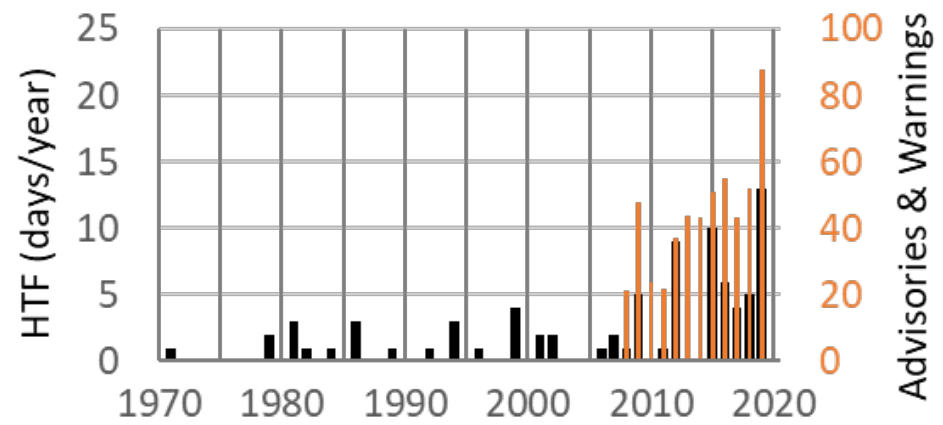


NWS Charleston

Weather Forecasting Office (WFO)



a) ■ Charleston HTF ■ Charleston WFO



NOAA (2017) Sea Level Rise Scenarios for the U.S. 4th National Climate Assessment

NOAA Technical Report NOS CO-OPS 083

GLOBAL AND REGIONAL SEA LEVEL RISE SCENARIOS FOR THE UNITED STATES



Photo: Ocean City, Maryland

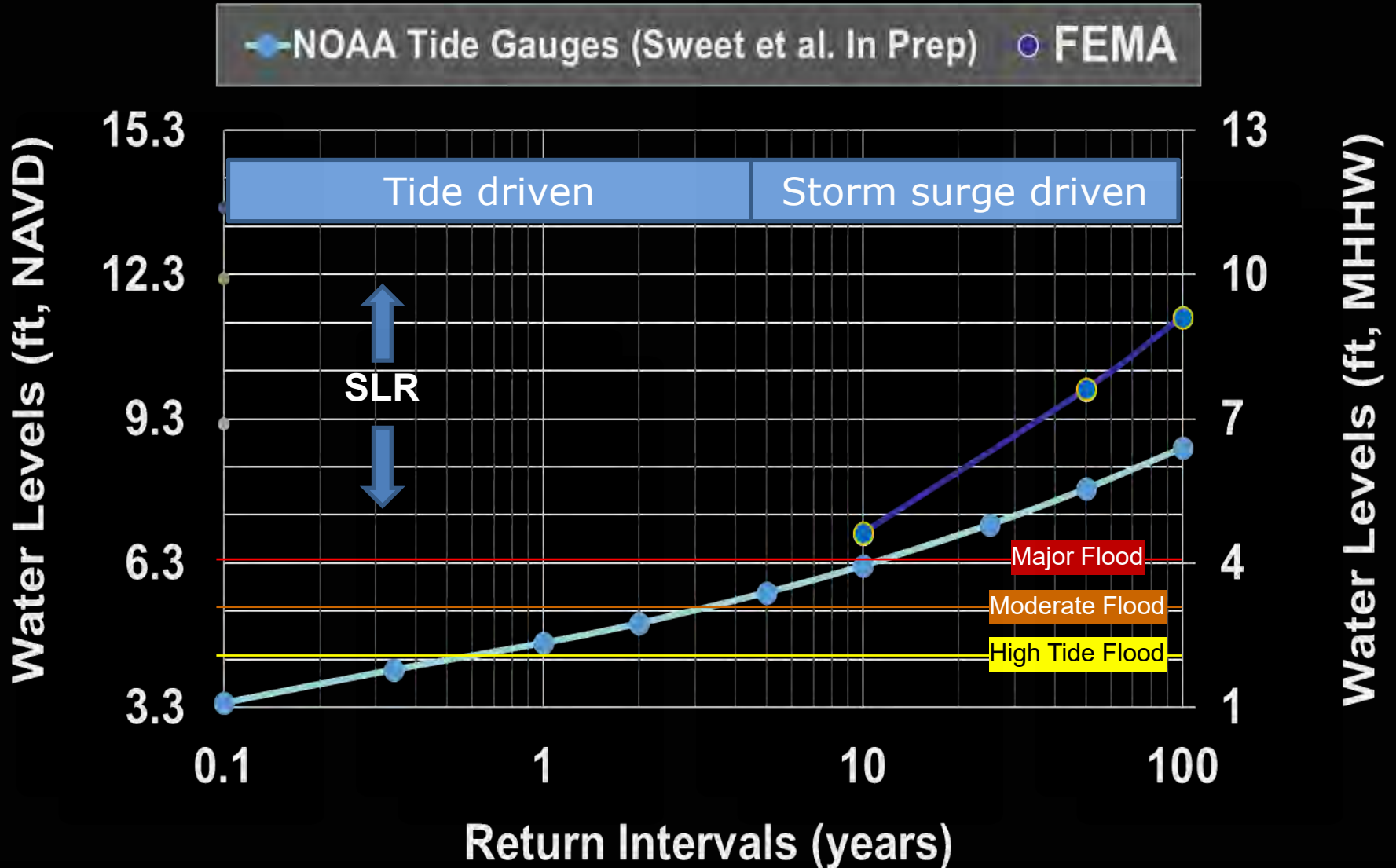
Silver Spring, Maryland
January 2017



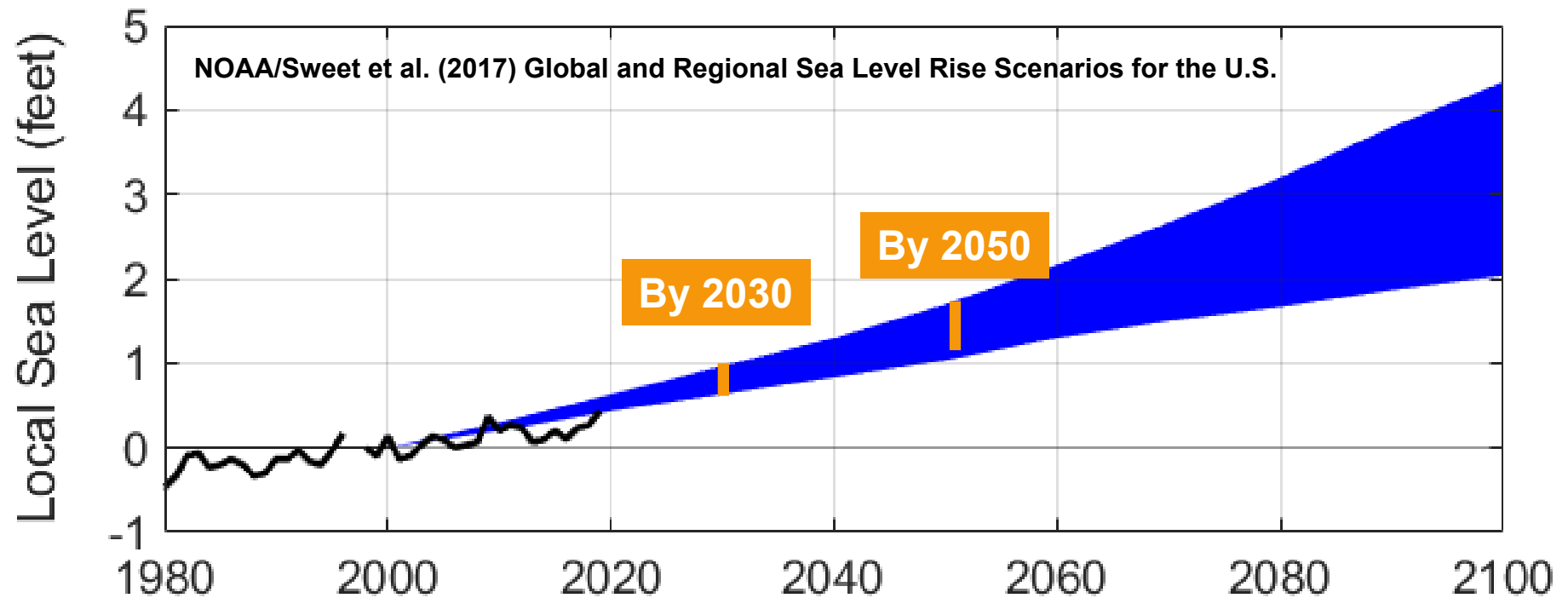
Sweet et al. (2017)

Current and Future (?) Flood Risk

Water Levels at NOAA Tide Gauge NYC (Battery)



Projections of 'likely' SLR (blue shade) for NYC Region




Projections of global rise that also incorporate regional changes due to:

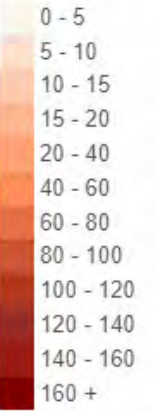
- 1) land elevation
- 2) gravitation/rotational effects from melting land-based ice circulation changes (e.g., the Gulf Stream)



NOAA High Tide Flood Outlook

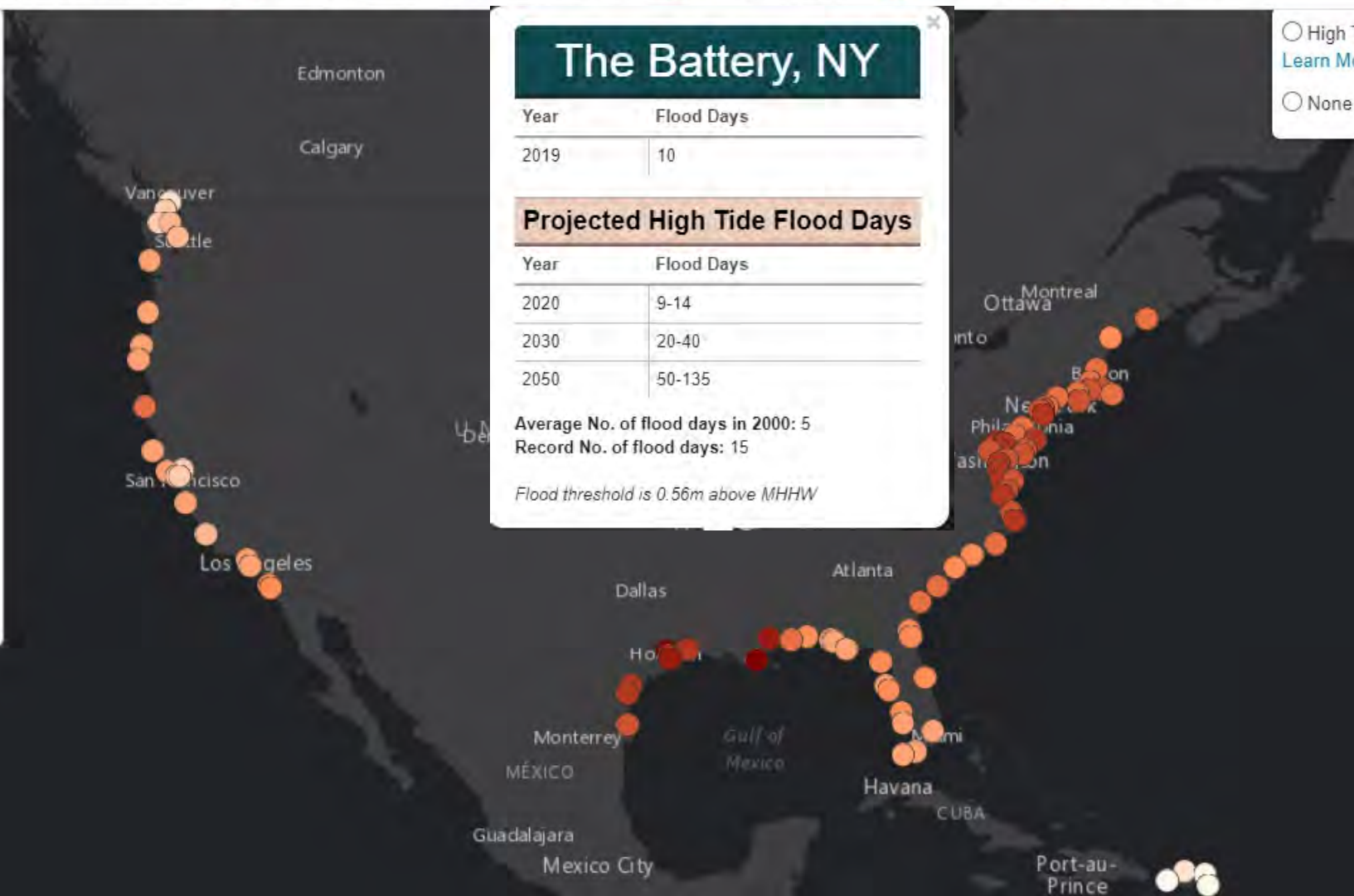


Projected High Tide Flood Days in 2050



0 - 5
5 - 10
10 - 15
15 - 20
20 - 40
40 - 60
60 - 80
80 - 100
100 - 120
120 - 140
140 - 160
160 +

2050



The Battery, NY

Year	Flood Days
2019	10

Projected High Tide Flood Days

Year	Flood Days
2020	9-14
2030	20-40
2050	50-135

Average No. of flood days in 2000: 5
Record No. of flood days: 15

Flood threshold is 0.56m above MHHW

- High T
- Learn Mo
- None



NOAA Coastal Inundation Dashboard



Coastal Inundation Dashboard

About



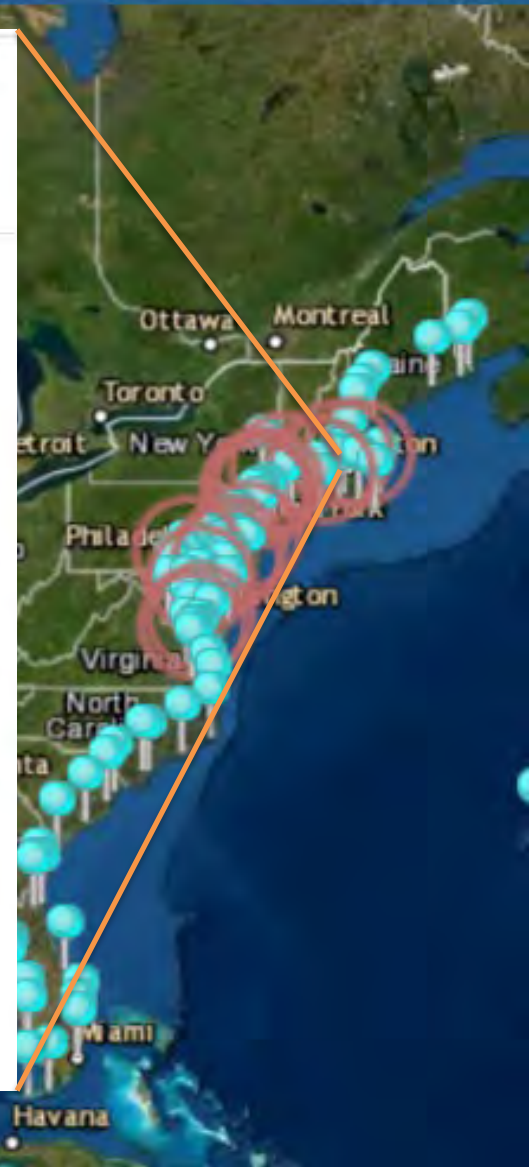
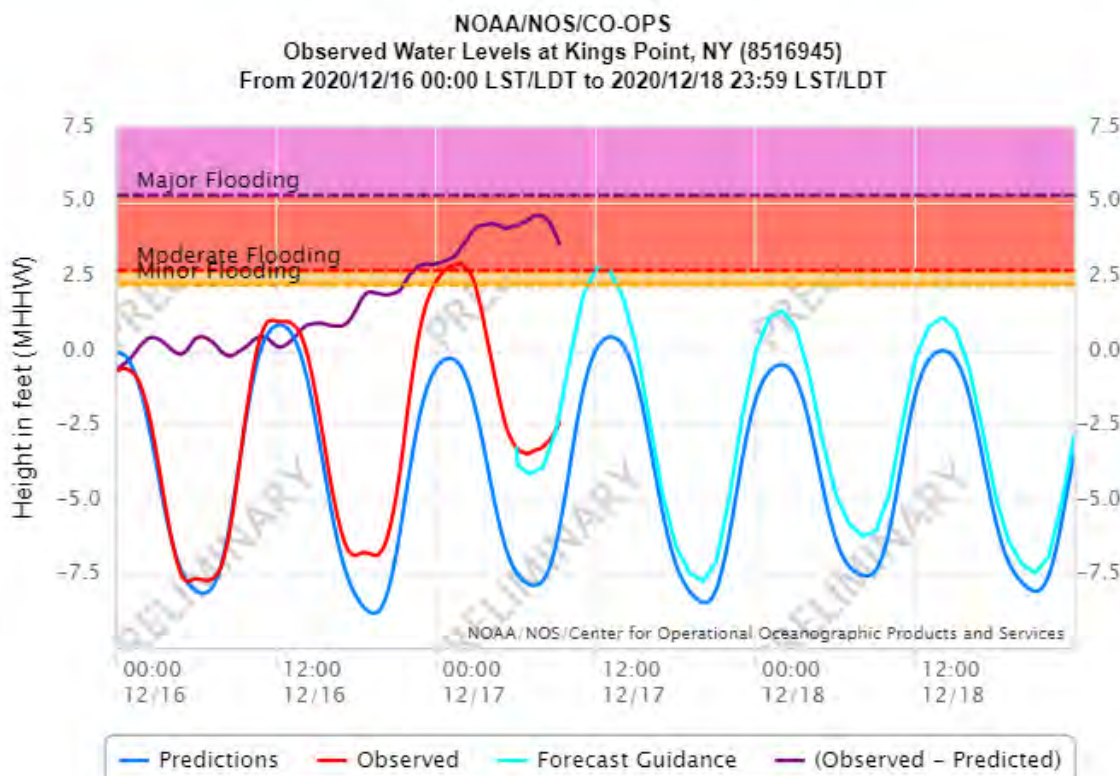
Station List



Select Area

Kings Point, NY (8516945)

Station may be experiencing flooding. See the [NWS home page](#) for National Weather Service coastal flood advisories.



NOAA High Tide Bulletin



National Ocean Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce



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High Tide Bulletin: Winter 2020

When you may experience higher than normal tides between December 2020 and February 2021.



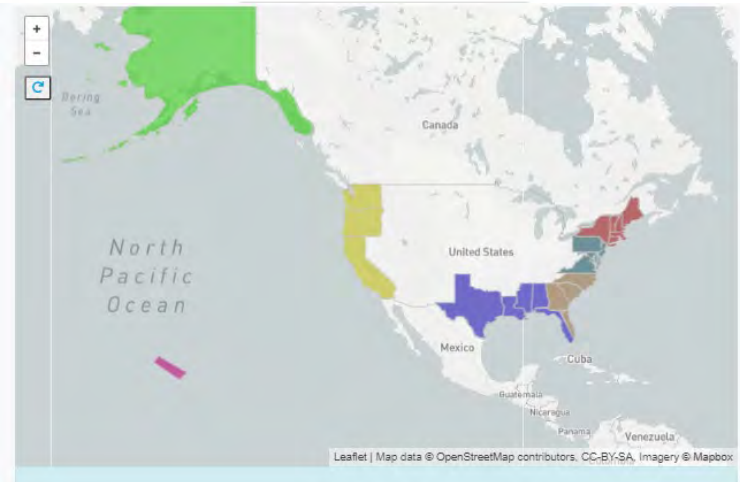
When will the tides be higher than normal?

- December 12 - 17
- January 11 - 13

Why will they be higher than normal?

- A perigean spring tide will be occurring in December. This is when the moon is either new earth. Higher than normal high tides and lower than normal low tides will occur.
- The increased angle of the sun relative to the Earth, which reaches a maximum during the Winter Solstice (December 21).

What kind of impact might I expect along the coast?



Questions?

Contact: William Sweet
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