



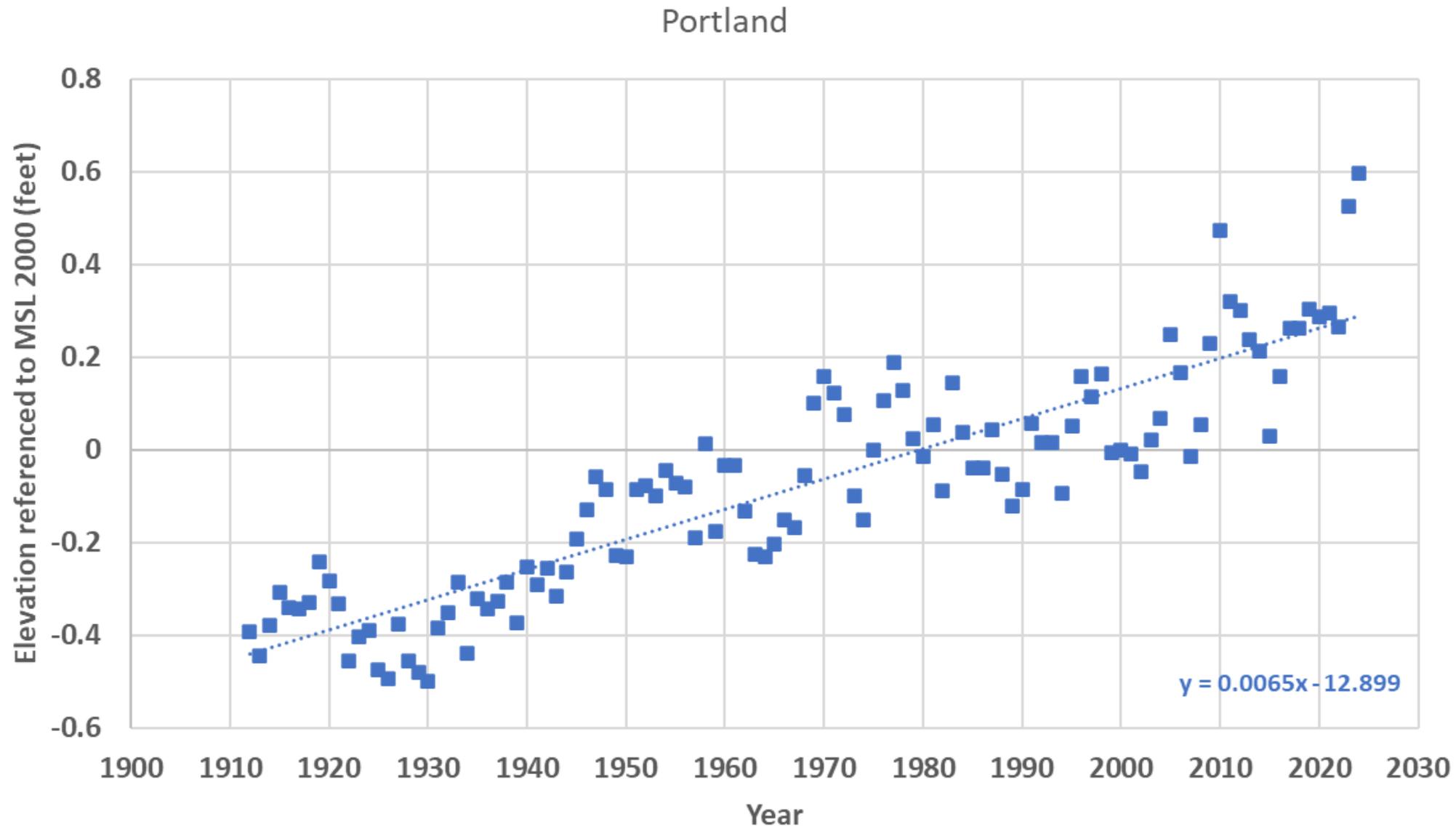
Sea Level Rise & Storms in Maine

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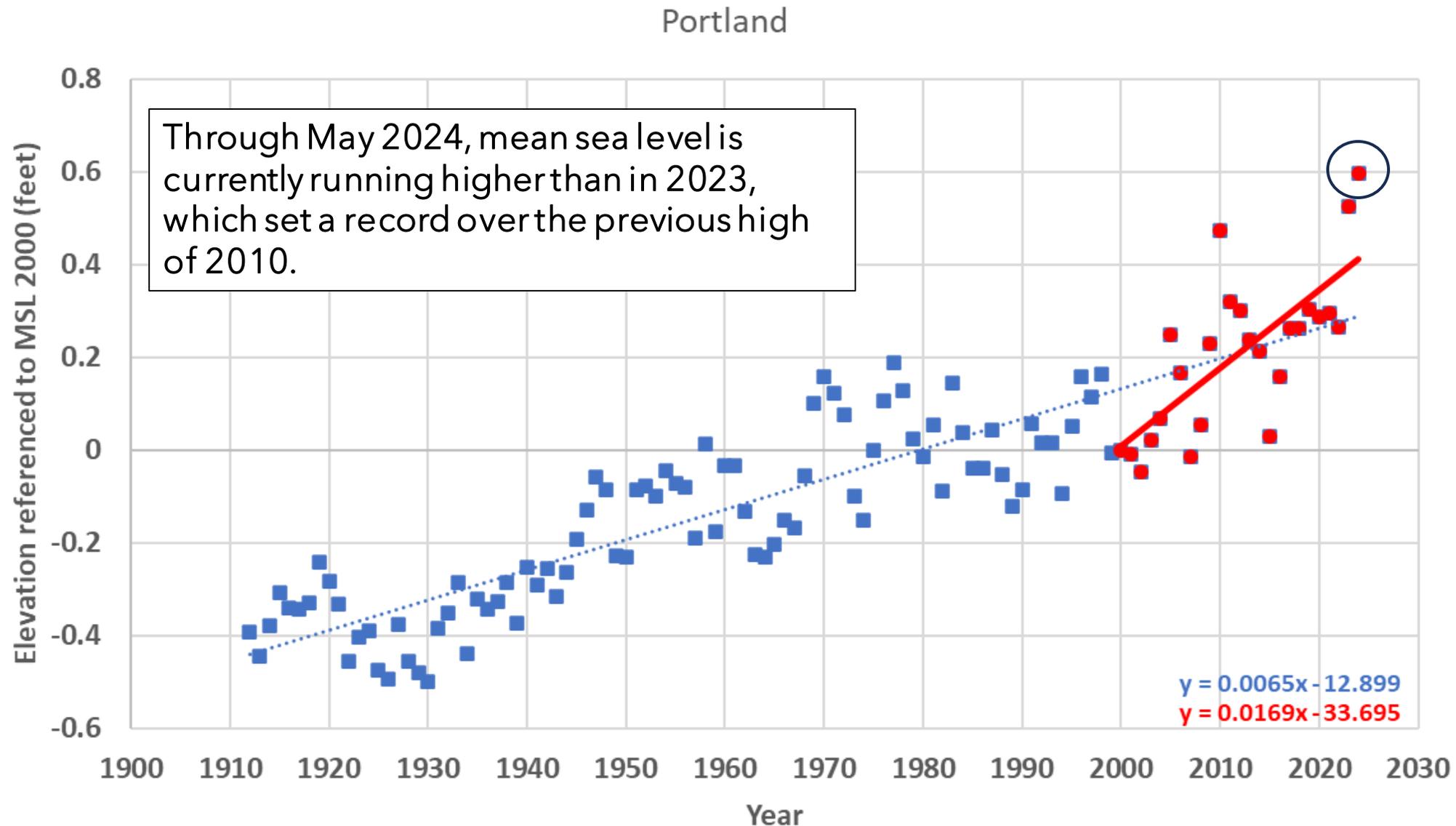


Higgins Beach, Scarborough. D. Lund-Yates

Long-term (century-scale) sea level rise in Maine matches global changes (0.8 inches per decade or 0.065 feet per decade)



Over the past 23.4 years, the rate of rise increased by about 2.5x (to 2.0 inches per decade or 0.169 feet per decade)



Mean sea levels set numerous records in 2023

...and that trend continues so far in 2024

2023 Monthly Mean Sea Level Rankings

| Month | Portland | Bar Harbor | Eastport |
|-----------|-----------|------------|-----------|
| | 1912-2023 | 1947-2023 | 1929-2023 |
| January | 2nd | 1st | 3rd |
| February | 5th | 3rd | 3rd |
| March | 3rd | 1st | 1st |
| April | 3rd | 3rd | 3rd |
| May | 3rd | 2nd | 2nd |
| June | 1st | 1st | 1st |
| July | 1st | 1st | 1st |
| August | 1st | 1st | 1st |
| September | 1st | 2nd | 2nd |
| October | 1st | 1st | 1st |
| November | 1st | 1st | 1st |
| December | 2nd | 2nd | 2nd |

2023 monthly water level is in the top 3 for that month

2023 monthly water level is the 1st for that month (Chart by P.Slovinsky, MGS)

2024 Monthly Mean Sea Level Rankings

| Month | Portland | Bar Harbor | Eastport |
|-----------|-----------|------------|-----------|
| | 1912-2024 | 1947-2024 | 1929-2024 |
| January | 1st | 1st | 1st |
| February | 2nd | 1st | 1st |
| March | 5th | 3rd | 4th |
| April | 1st | 1st | 1st |
| May | 1st | 1st | 1st |
| June | | | |
| July | | | |
| August | | | |
| September | | | |
| October | | | |
| November | | | |
| December | | | |

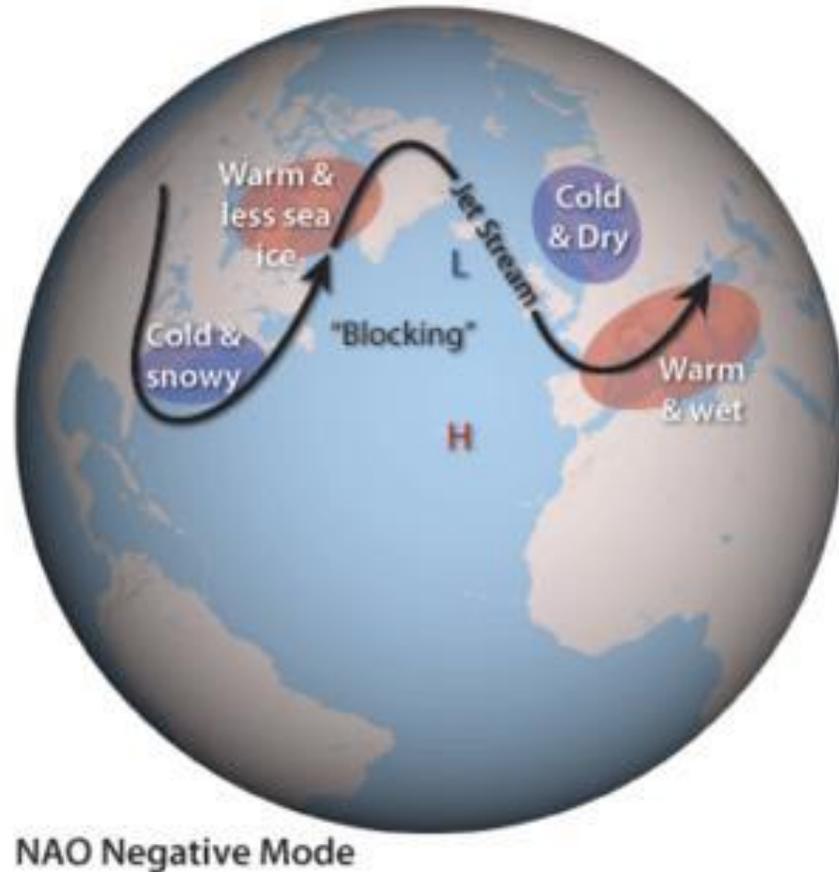
2024 monthly water level is in the top 3 for that month

2024 monthly water level is the 1st for that month (Chart by P.Slovinsky, MGS)

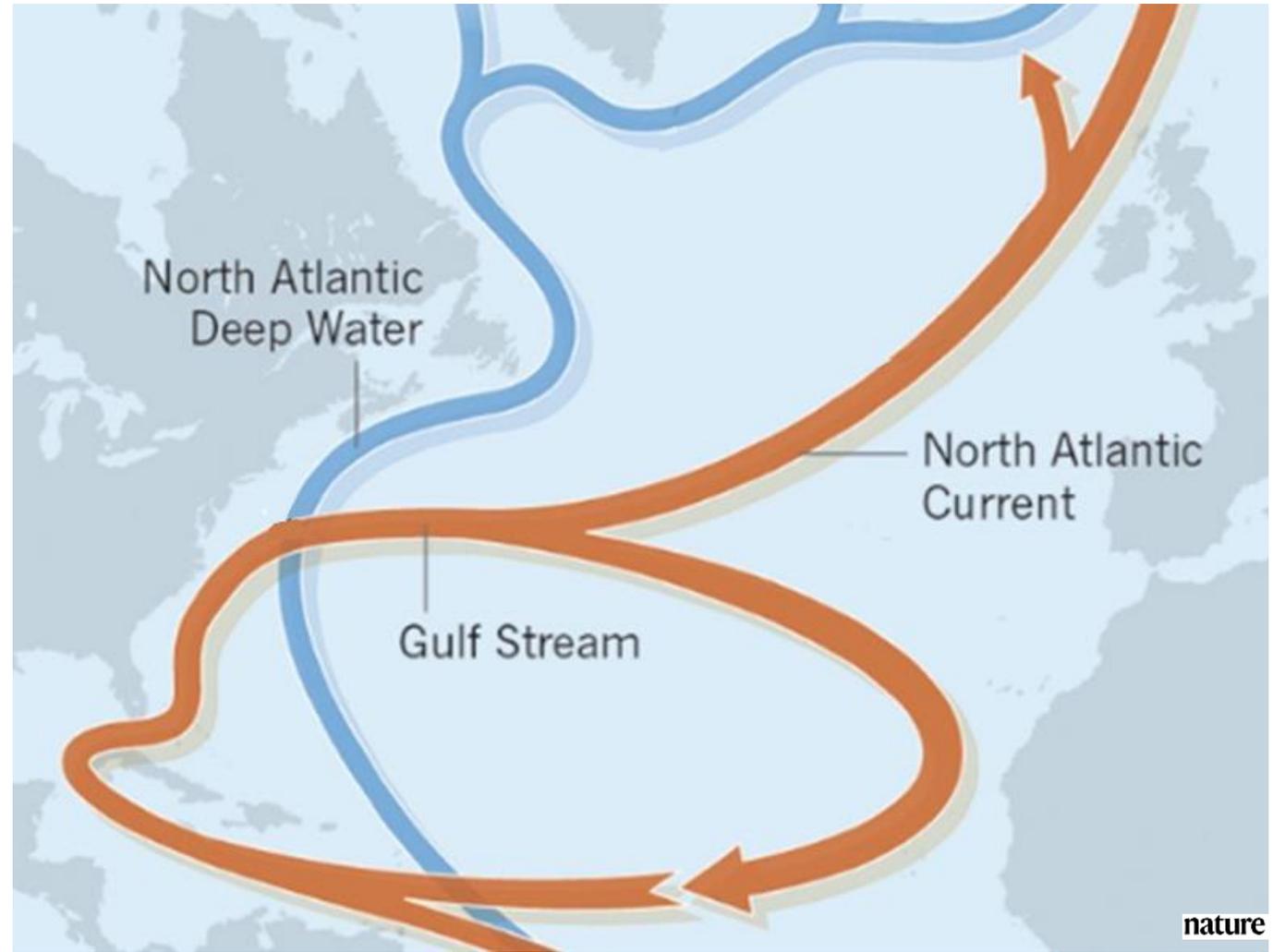


Higher than normal mean sea levels in 2023 and 2024...a repeat of 2010?

North Atlantic Oscillation (NAO)



Atlantic Meridional Overturning Circulation (AMOC)

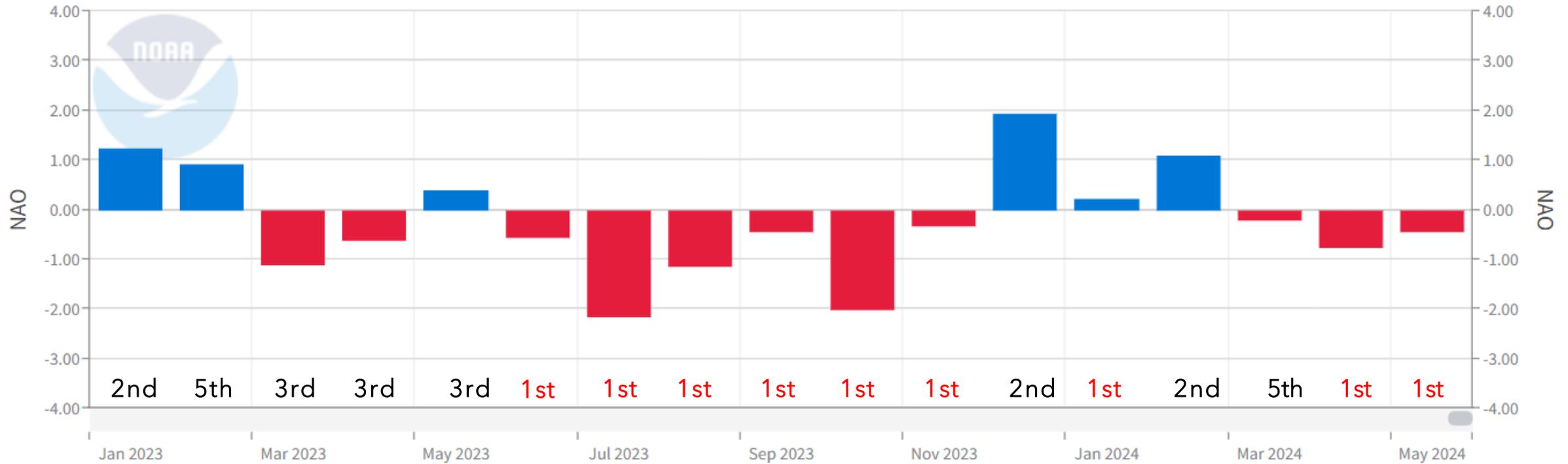


A strongly negative NAO + shifts in the Gulf Stream/AMOC strength and position can result in anomalously high short-term sea level changes along the US East Coast and in the Gulf of Maine.



2023 and 2024 Mean Sea Levels at Portland, ME in relation to the North Atlantic Oscillation

North Atlantic Oscillation (NAO)

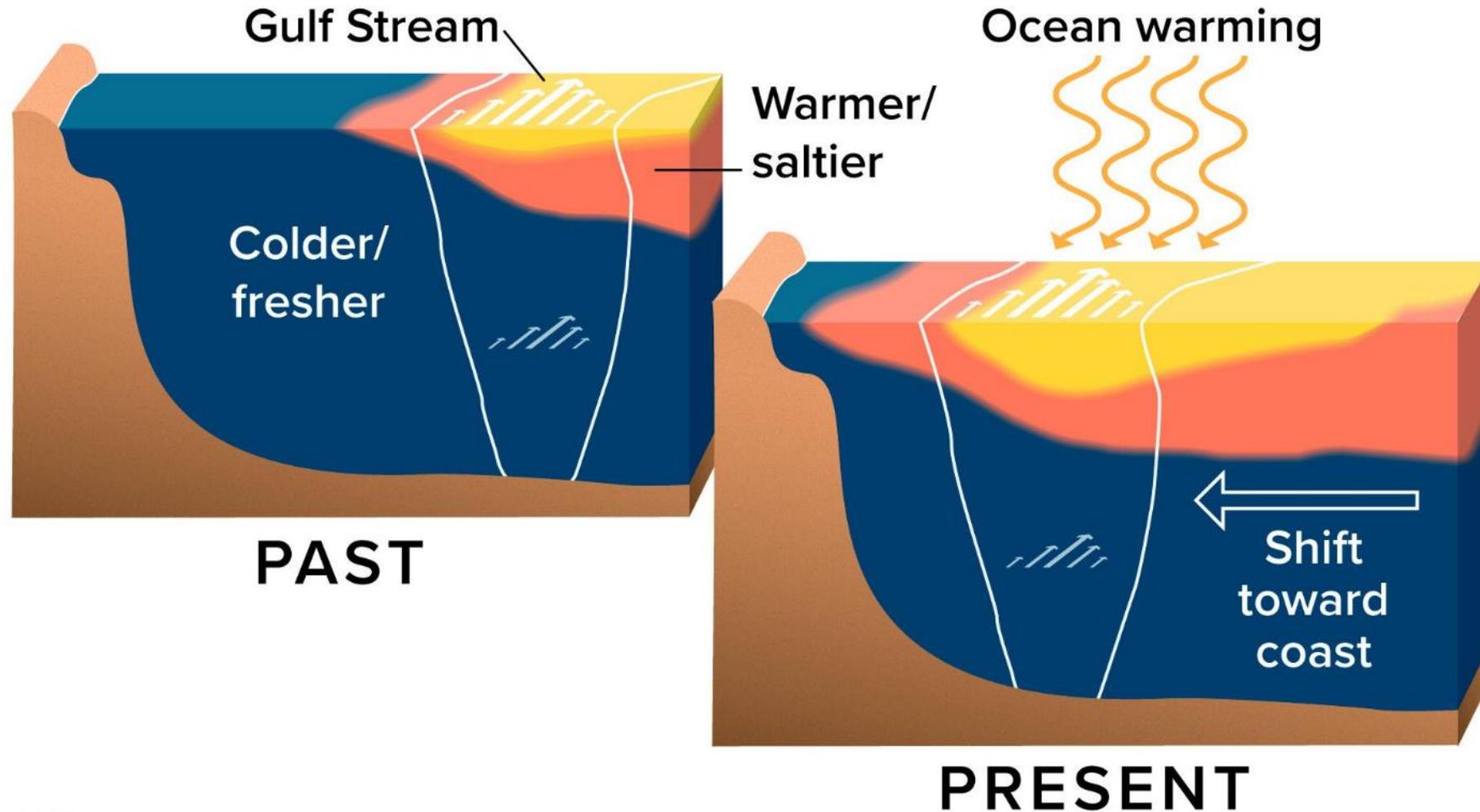


Source: <https://www.cpc.ncep.noaa.gov/products/precip/CWlink/pna/norm.nao.monthly.b5001.current.ascii.table>

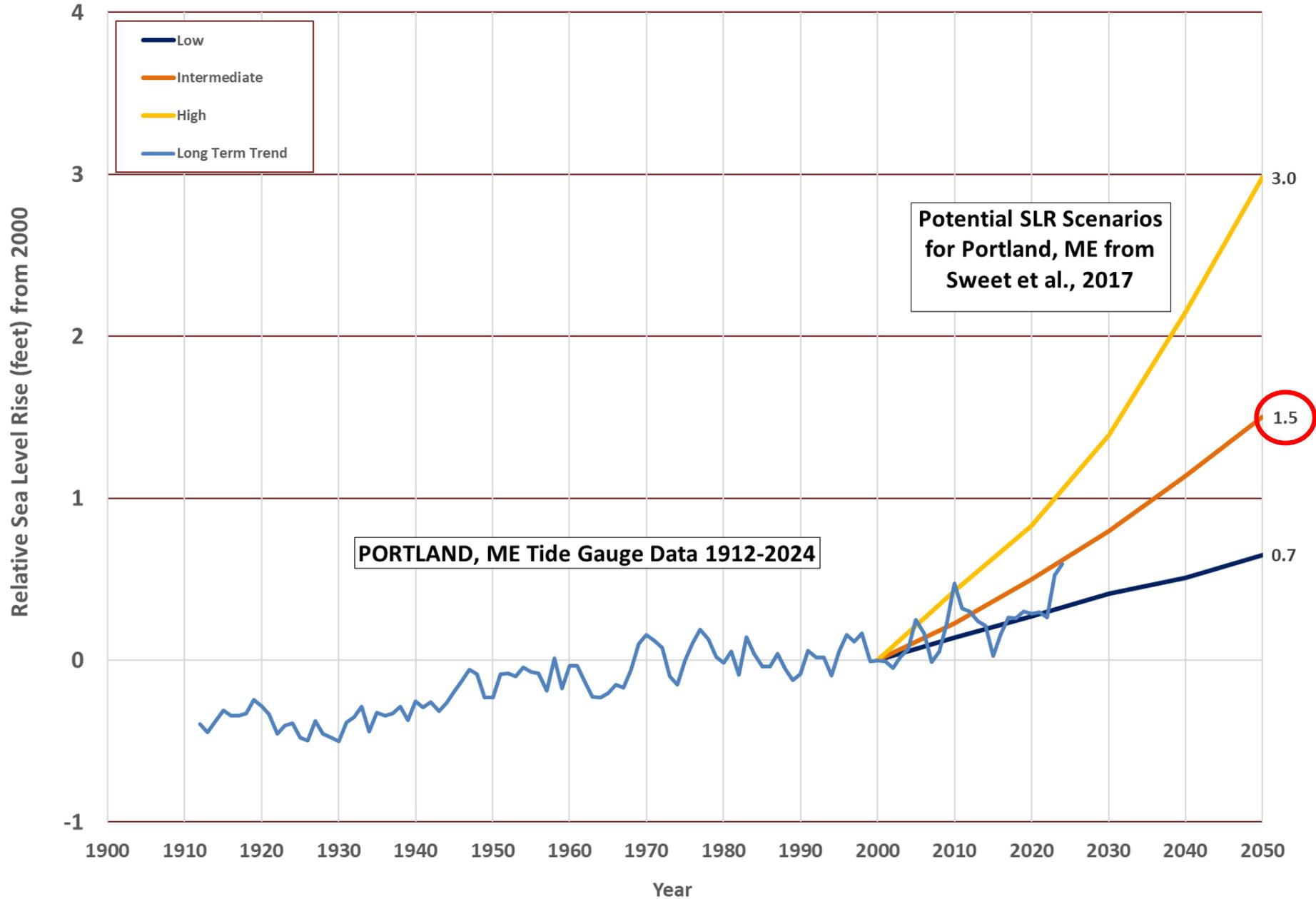
Powered by ZingChart



A 2023 study by the Woods Hole Oceanographic Institute (WHOI*) found that over the last 20 years, the Gulf Stream warmed by about 2 degrees F and shifted west, closer to the East Coast. How this may exactly influence local sea level rise is still not certain but it is likely responsible for some of the warming in the Gulf of Maine.



Annual Sea Levels Referenced to 2000, NOAA Station 8418150, PORTLAND 1912-2024

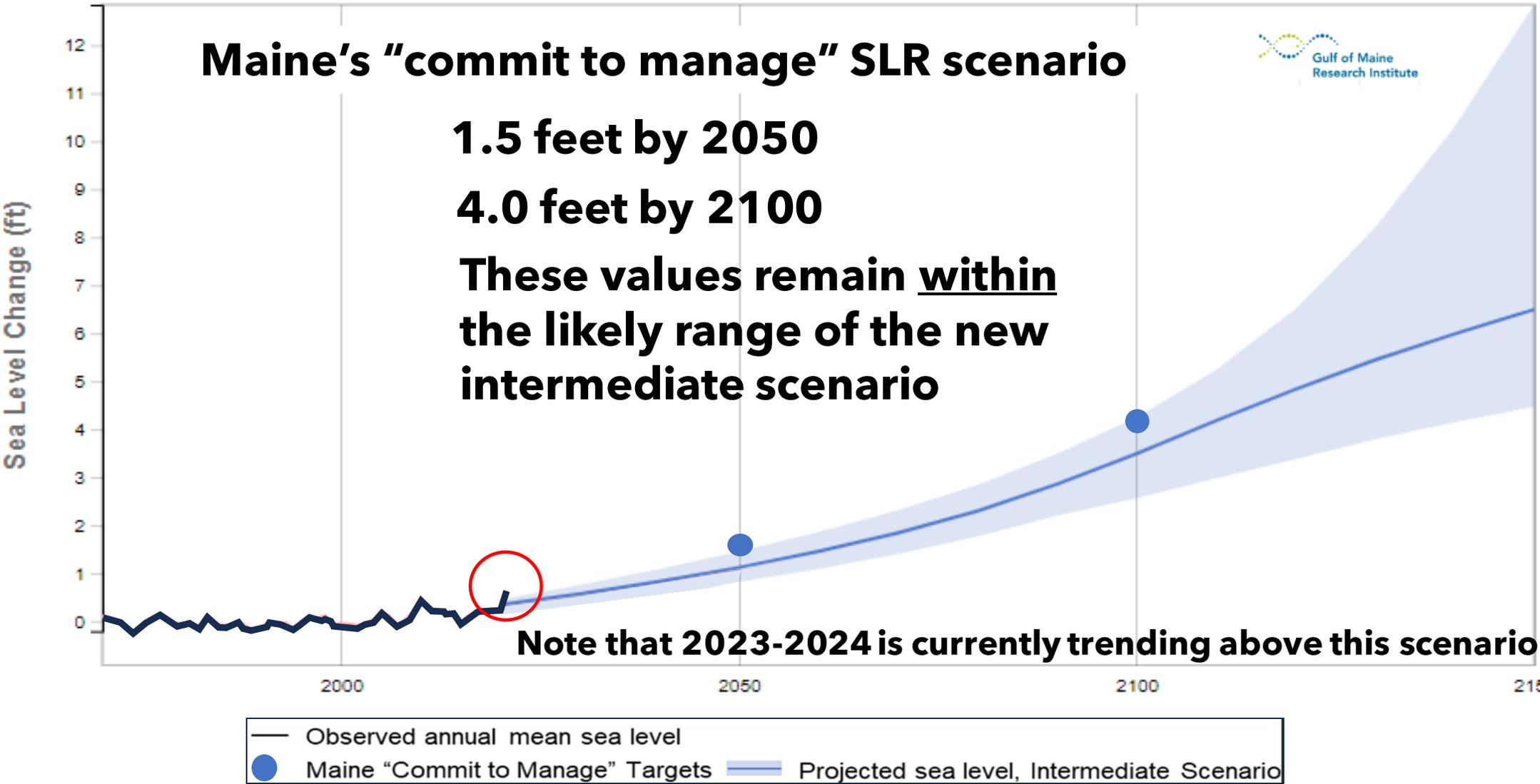


**Current SLR in
Maine is
matching the
intermediate
"commit to
manage" SLR
scenario
adopted by the
Climate Council
in 2020**

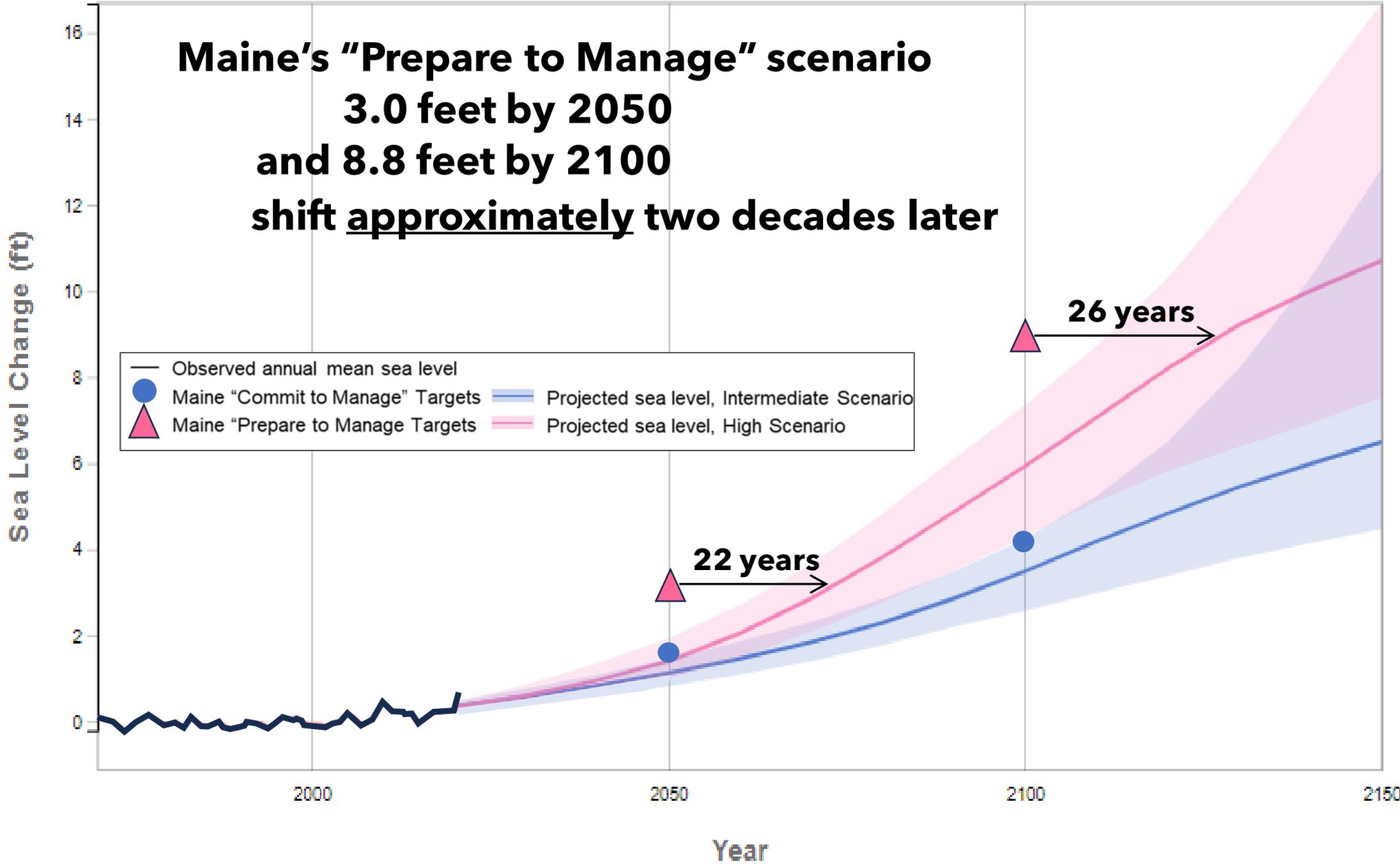
**(1.5 feet by
2050, 4 feet by
2100)**



New potential sea level rise scenarios were released in 2022 (ITF 2022) and now provide scenarios out to the year 2150.



**Maine's "Prepare to Manage" scenario
3.0 feet by 2050
and 8.8 feet by 2100
shift approximately two decades later**



Sea level rise is exacerbating coastal flooding impacts from storms

For example, in Portland, minor coastal flooding starts at the “king tide”, which is 12 feet MLLW.

There is only about a 1-foot difference between the “king tide” and a “10-year” storm water level.

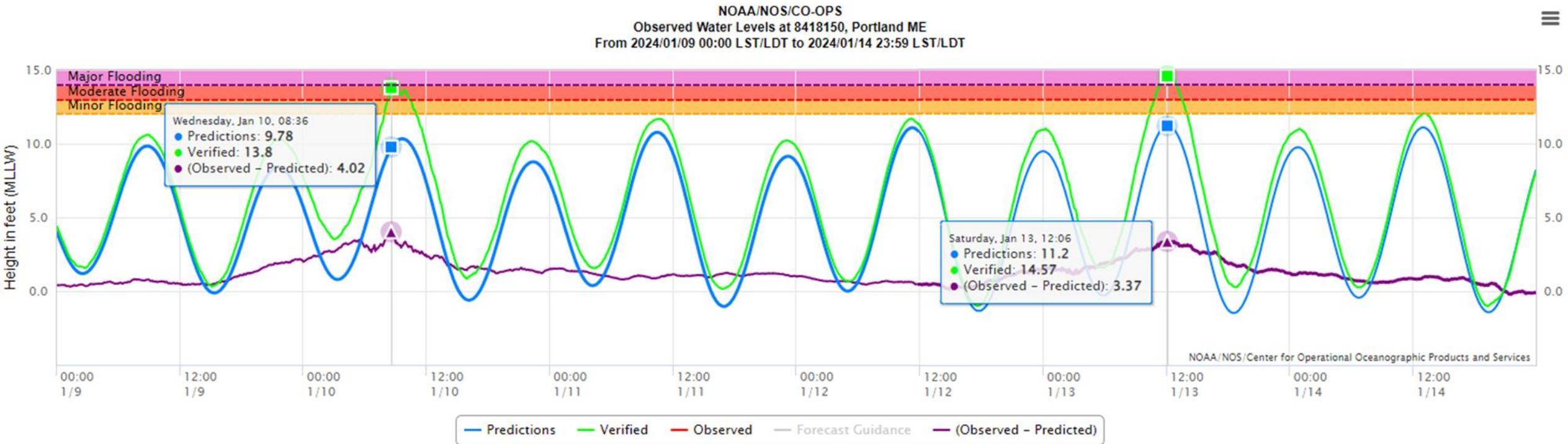
Similarly, there is only a 1-foot difference between the “10-year” and “100-year” storm water levels.



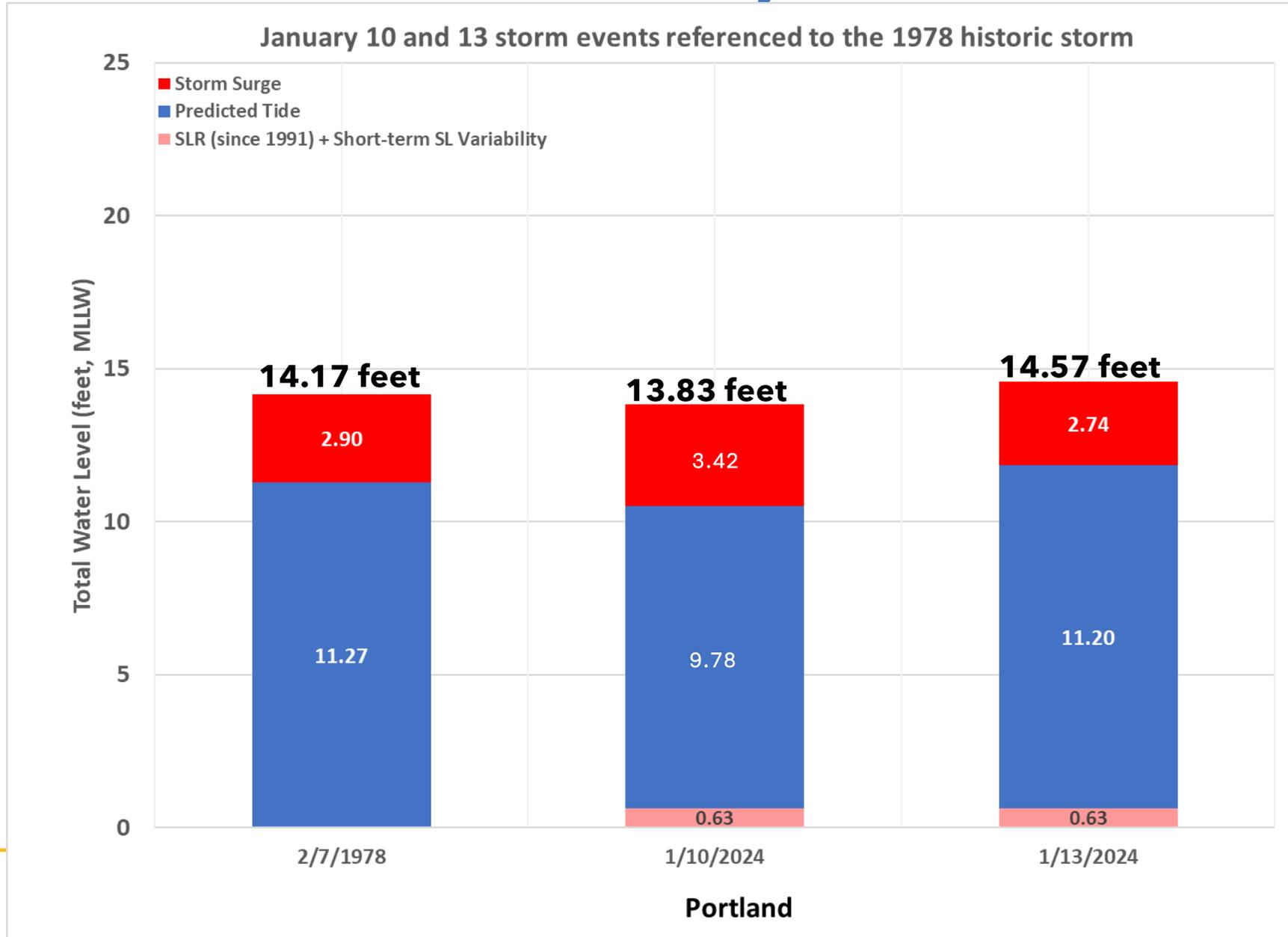
Sea level rise raises the “baseline” water level for coastal storm events

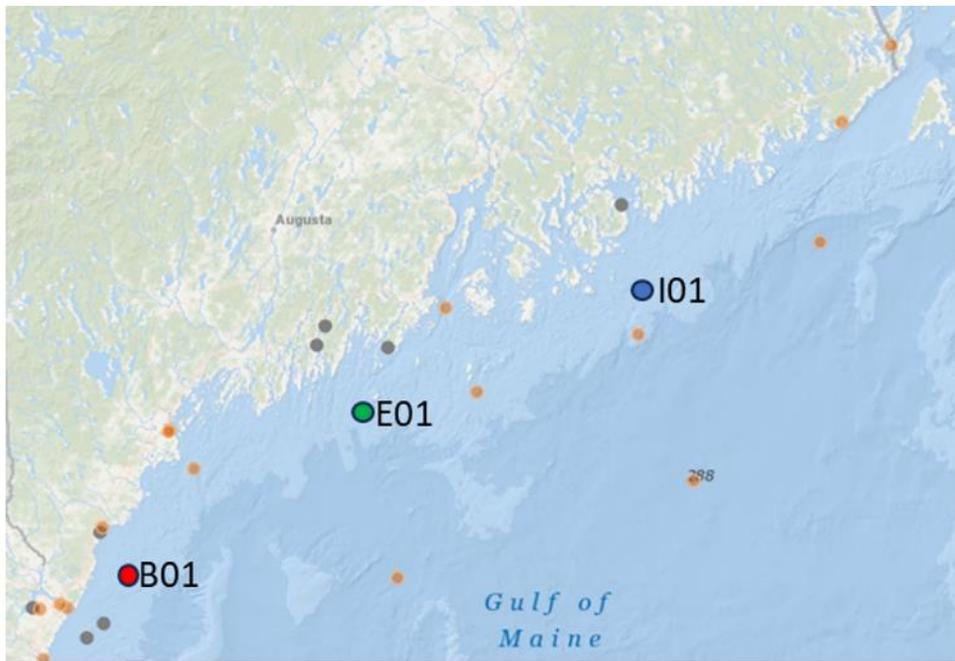


Water levels associated with the January 10 and record-setting January 13, 2024 storms in Portland

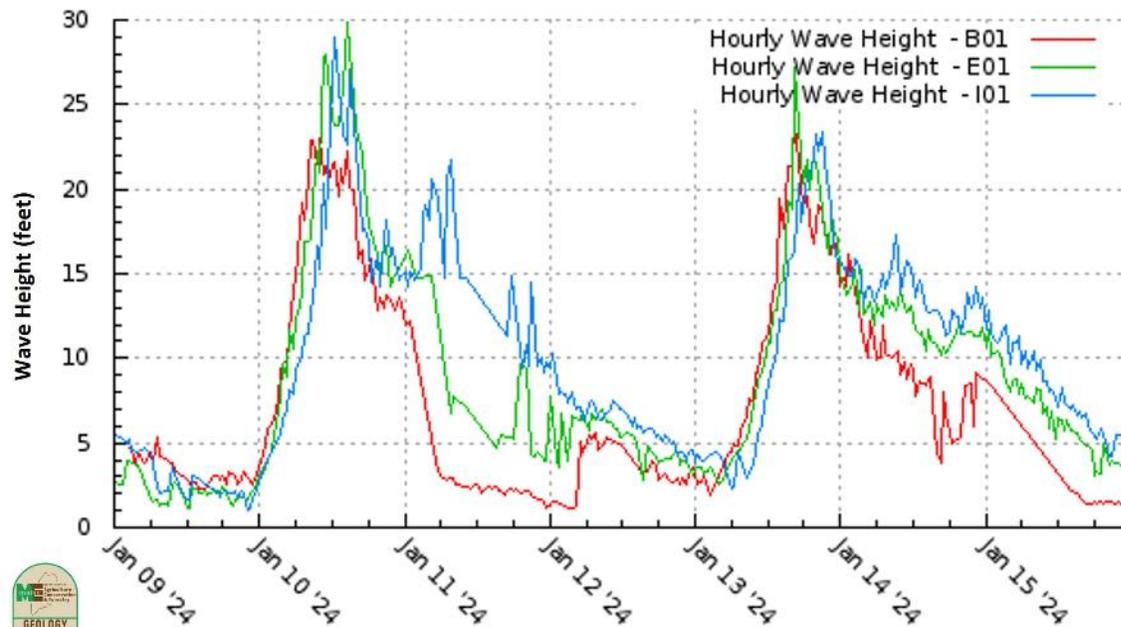


The January 10th and 13th storm events set records along the Maine coastline, and were enhanced by sea level rise





Hourly Wave Heights

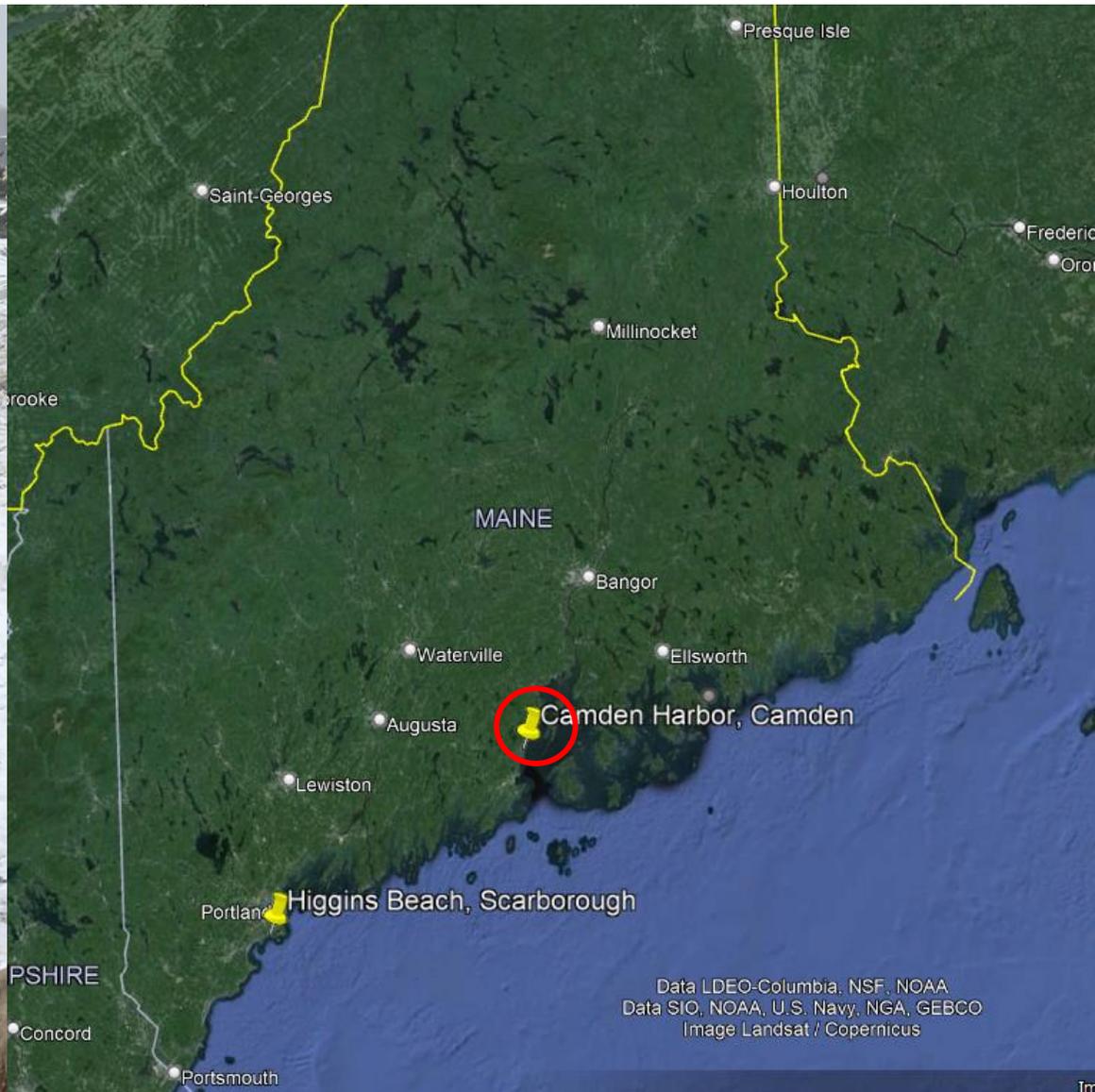


Wave heights during the January 10 event were generally higher than January 13, especially along the mid-and-downeast coastlines. This led to extensive wave damage for exposed areas of the coastline.

For reference the 100-year wave height is between 28-30 feet along the Maine coastline (NACCS).

Thus, the January 10 event met the 1% wave height for the mid-and-downeast coastlines.

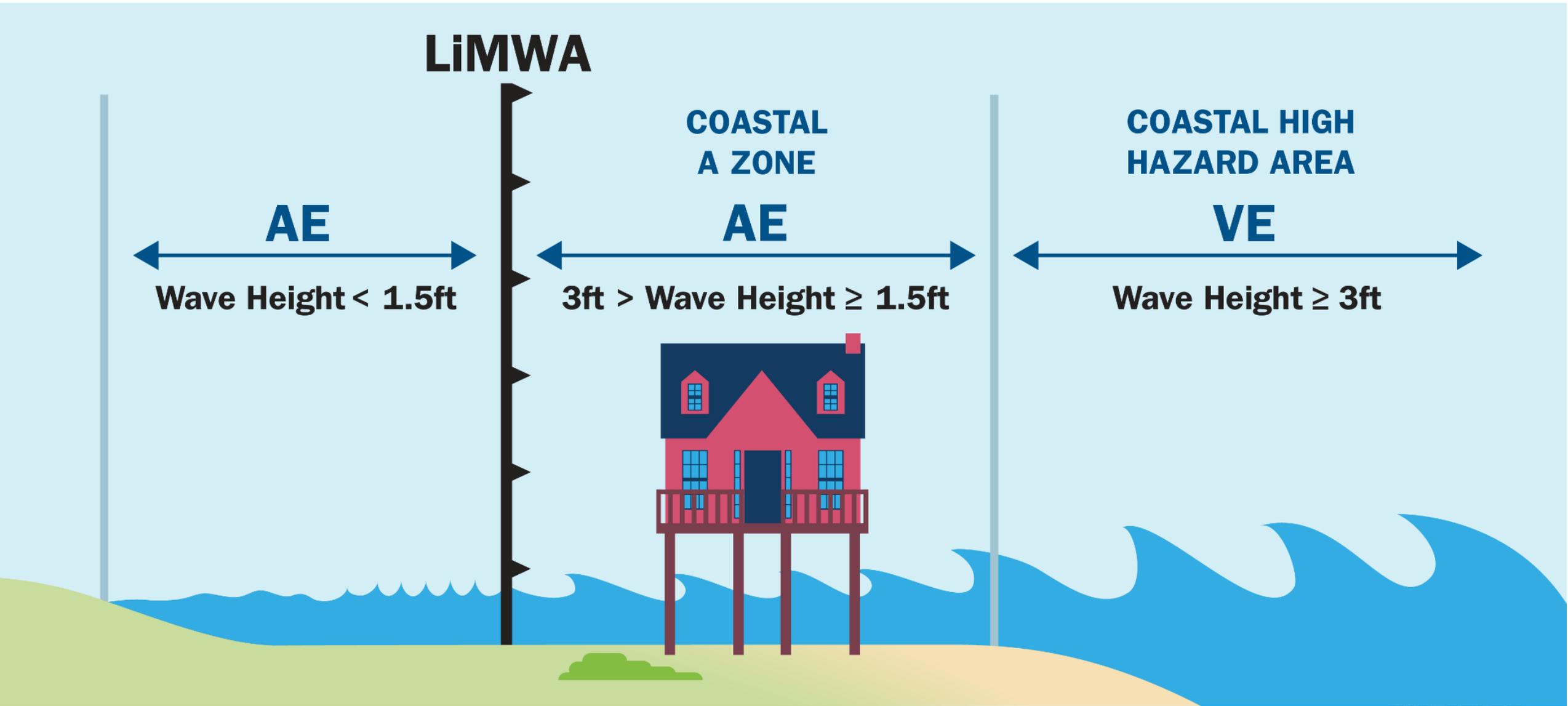
Impacts from these storms were devastating, but not unexpected. FEMA flood mapping was quite accurate in depicting areas that would be inundated. We will look at Camden Harbor, Camden, a southeast facing harbor.



Higgins Beach, Scarborough D. Lund-Yates

Data LDEO-Columbia, NSF, NOAA
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus

FEMA Special Flood Hazard Area Designations





Zone AE
(EL 11)

Zone VE
(EL 19)

Zone AE
(EL 10)

Wayfarer
Marine

Zone AE
(EL 12)

Zone AE
(EL 11)

Zone VE
(EL 16)

Zone OPEN
WATER

Camden Harbor, Camden







Atlantic Ave

Arey Ave

Zone VE
(EL 19)

Zone AE
(EL 11)

B

Zone AE
(EL 10)

Wayfarer
Marine

Sea St

Steamboat Lndg

Ocean Way

Zone OPEN
WATER

Zone AE
(EL 12)

Zone AE
(EL 11)

Zone VE
(EL 16)

Frye St



Chestnut

Bay View St







Harbor Park, A. McKellar

For more information....

On tracking water and sea levels in Maine

https://www.maine.gov/dacf/mgs/hazards/slr_ticker/slr_dashboard.html

On Flood Maps in Maine

<https://www.maine.gov/dacf/flood/mapping.shtml>

On the Maine Climate Council

<https://www.maine.gov/future/climate/council>

On the newly released 2024 Scientific Assessment of Climate Change and Its Effects in Maine

Executive Summary https://www.maine.gov/future/sites/maine.gov.future/files/inline-files/STS_EXSUM_2024.pdf

Full Report https://www.maine.gov/future/sites/maine.gov.future/files/inline-files/STS_2024_digital.pdf

