Introduction

Stephen M. Dickson, Co-Chair STS
Maine Geological Survey

Susie Arnold, Co-Chair STS
Island Institute

Ivan J. Fernandez, Co-Chair STS
School of Forest Resources, Climate Change Institute
University of Maine

Sea Level Rise and Marine | **June 5, 2024**

Maine Climate Council

The **39-member Maine Climate Council**, an assembly of scientists, industry leaders, bipartisan local and state officials, is responsible for **developing a Climate Action Plan** for Maine.

An expert **Scientific and Technical Subcommittee** is responsible for identifying the impacts of climate change in Maine.

An **Equity Subcommittee** will support planning and implementation of climate strategies to ensure benefits across diverse populations of Maine people.

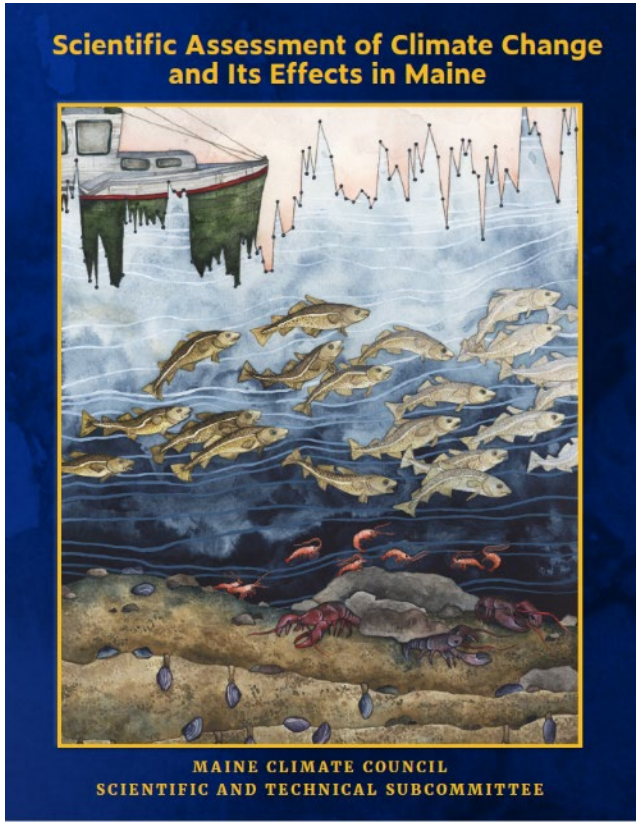
Six working groups comprised of 230+ volunteer members recommend strategies to the Council for achieving Maine's climate goals.

The Maine Climate Council Scientific and Technical Subcommittee

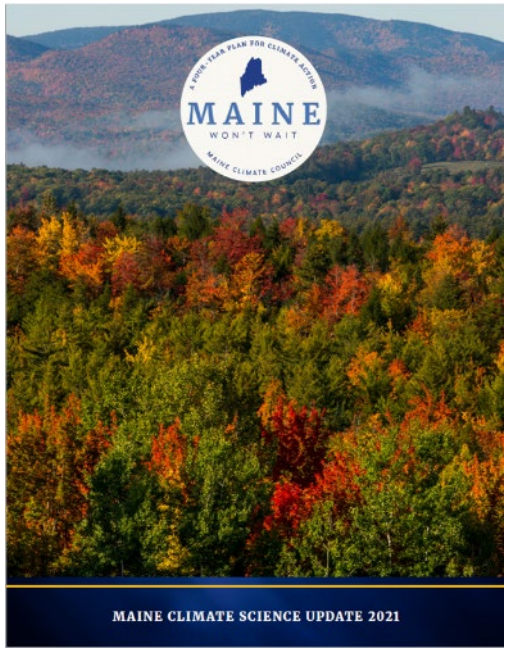
What do we do?

In 2019, Public Law Chapter 476 established the Maine Climate Council and the Scientific and Technical Subcommittee (STS) within the Council **"to identify, monitor, study and report out to the council and to the working groups…findings and recommendations related to climate change in the State and its effects on the State's climate, species, marine and coastal environments and natural landscape and on the oceans and other bodies of water."**

Maine Climate Science Assessment



2020



2021

Scientific Assessment of Climate Change and Its Effects in Maine

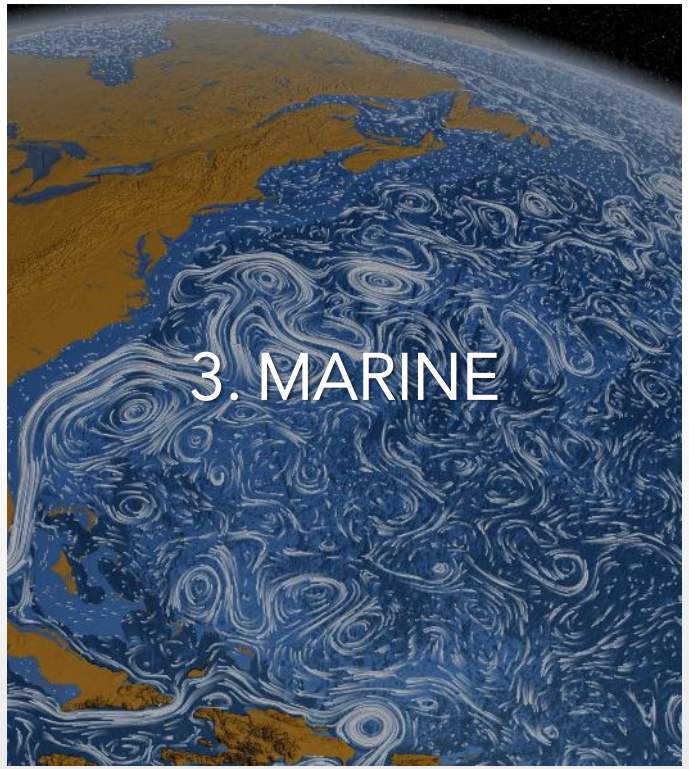
2024

www.maine.gov/future/climate/council/sts

climatechange.umaine.edu/climate-matters/maines-climate-future/

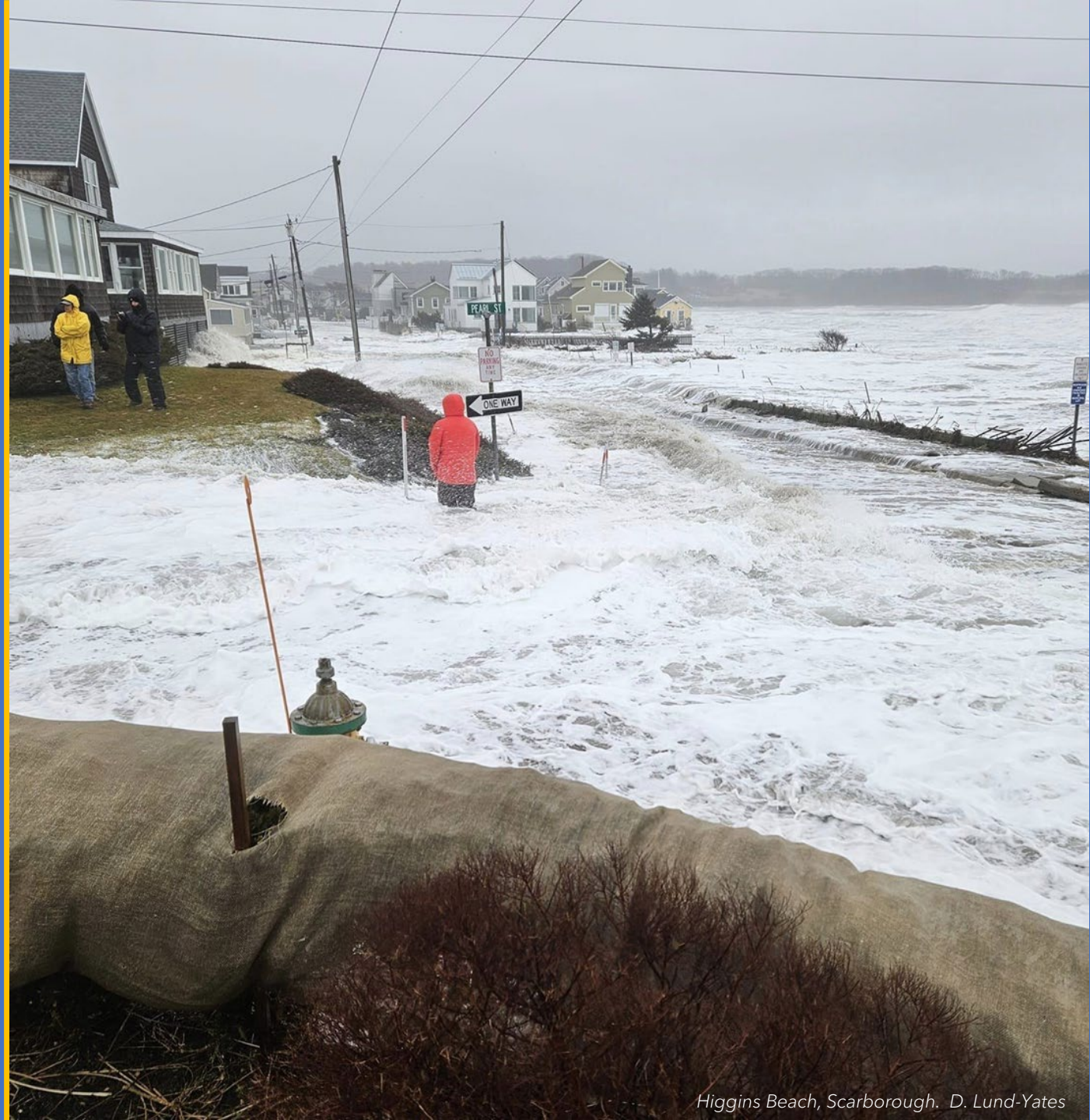

1. SEA LEVEL RISE


2. STORM SURGE


3. MARINE

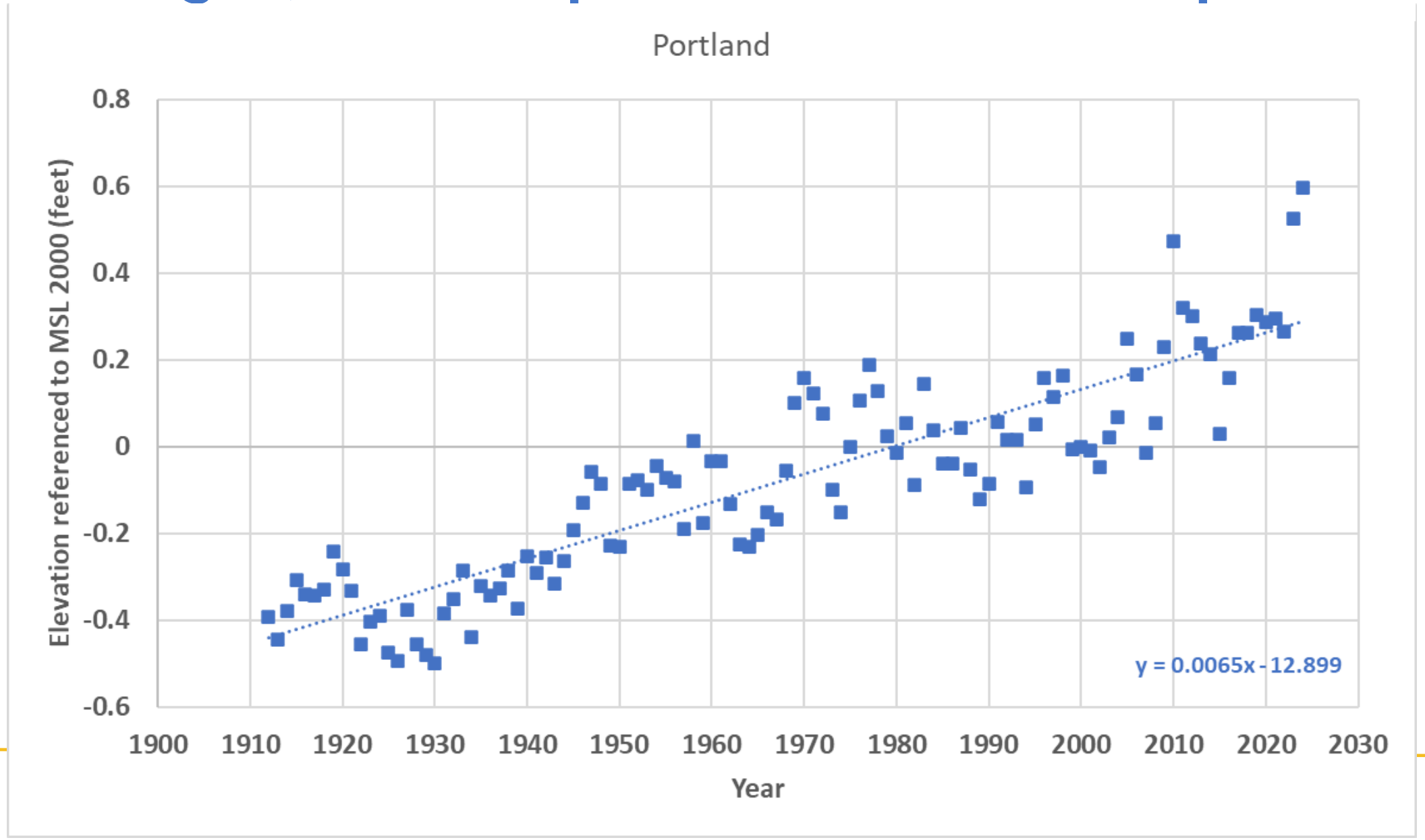
Sea Level Rise & Storm Surge

Peter Slovinsky, MGS
Hannah Baranes, GMRI
Nick Whiteman, MGS

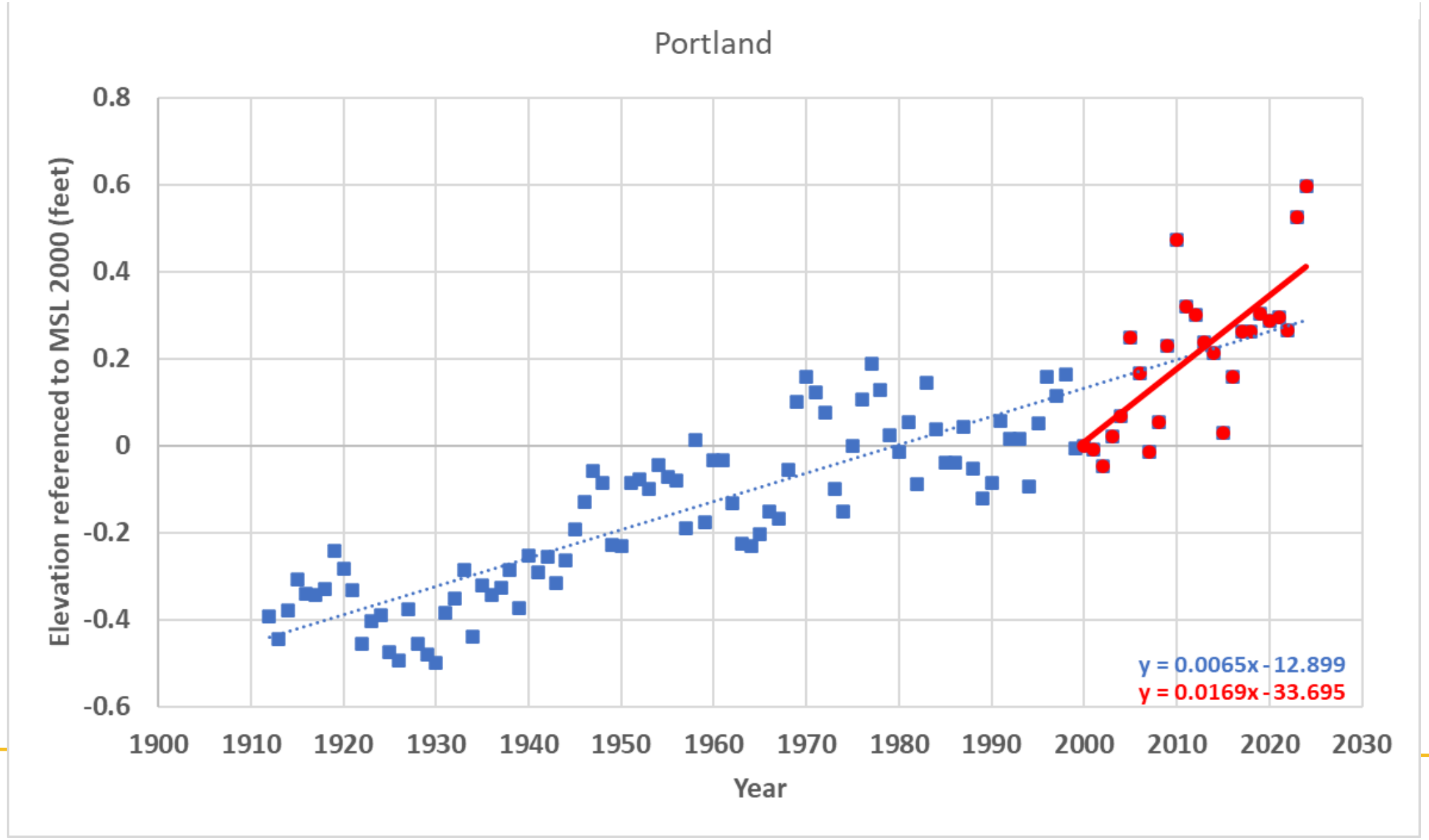


Higgins Beach, Scarborough. D. Lund-Yates

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



Over the past 23.3 years, the rate of rise has increased by about 2.5x (to 0.169 feet per decade, or 2.0 inches 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)

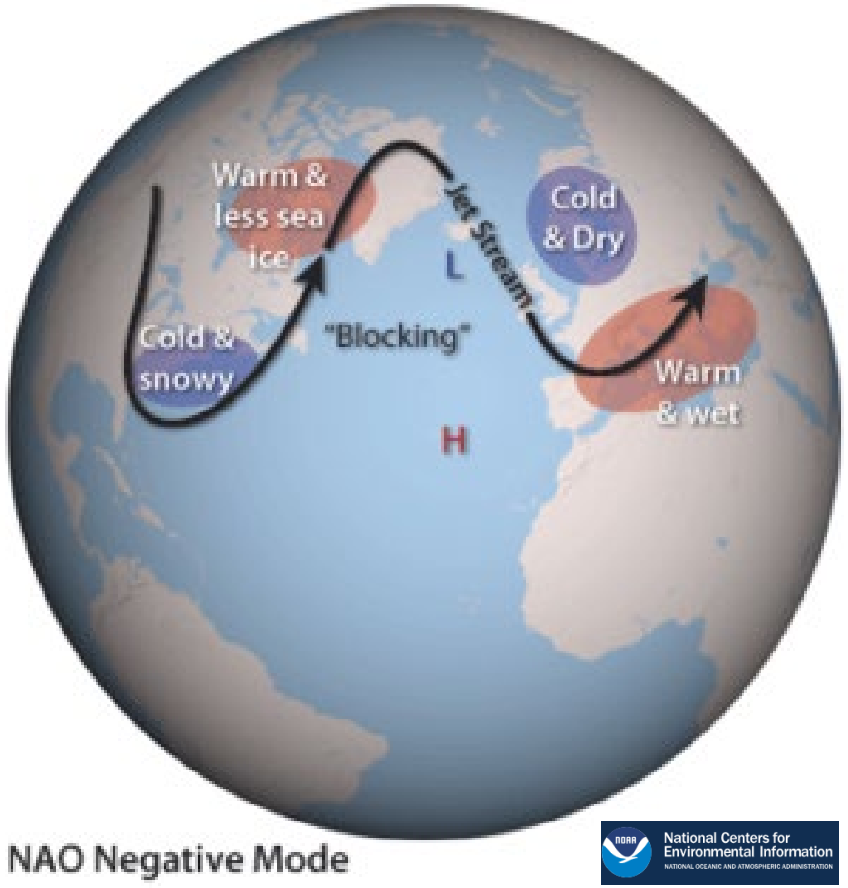
2024 Monthly Mean Sea Level Rankings			
Month	Portland	Bar Harbor	Eastport
	1912-2024	1947-2024	1929-2024
January	1st	1st	1st
February	2nd	1st	1st
March	5th	3rd	4th
April	1st	1st	1st
May			
June			
July			
August			
September			
October			
November			
December			

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

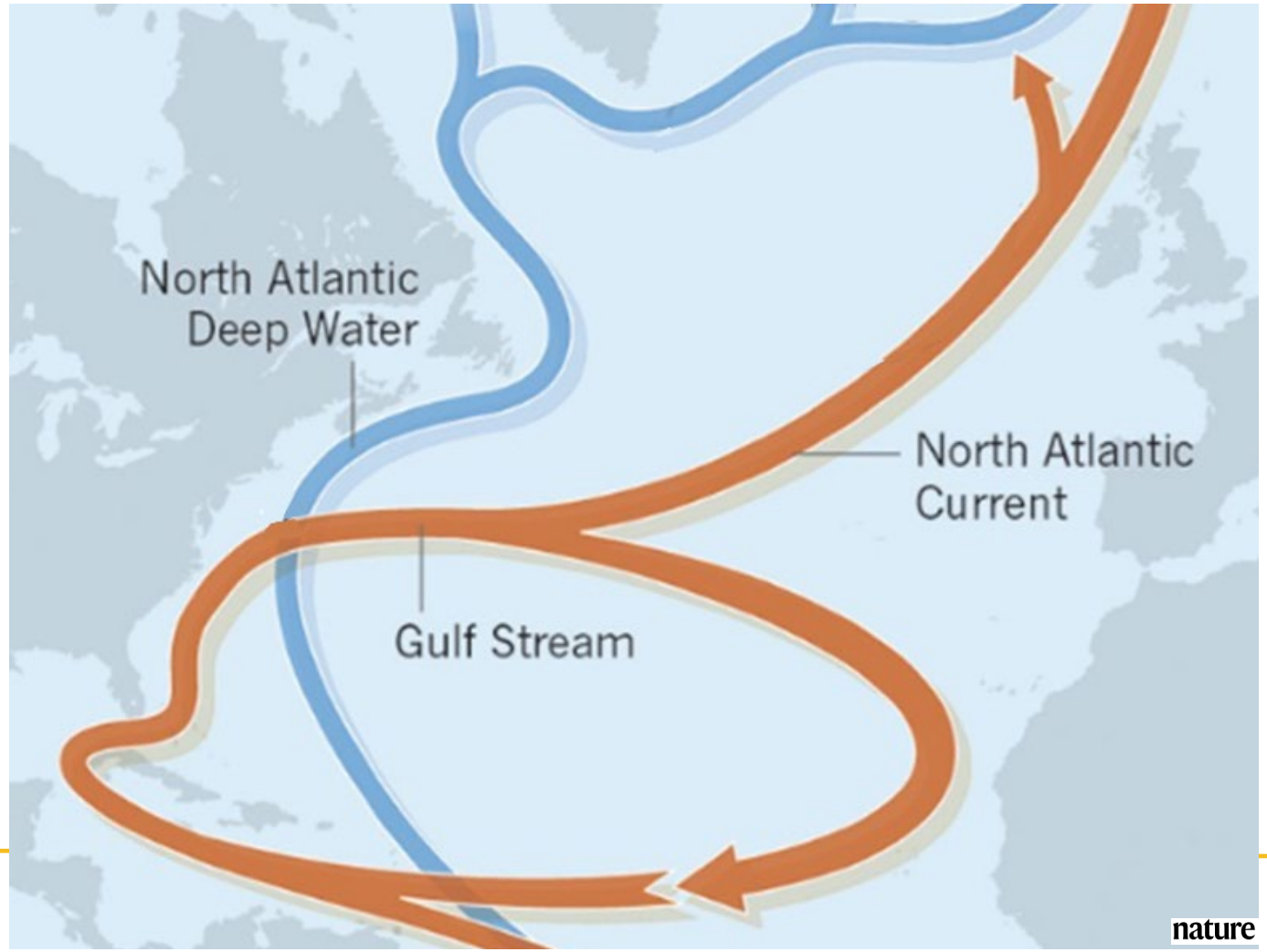
2024 monthly water level is the 1st for that month (Chart by P.Slovinsky, MGS)

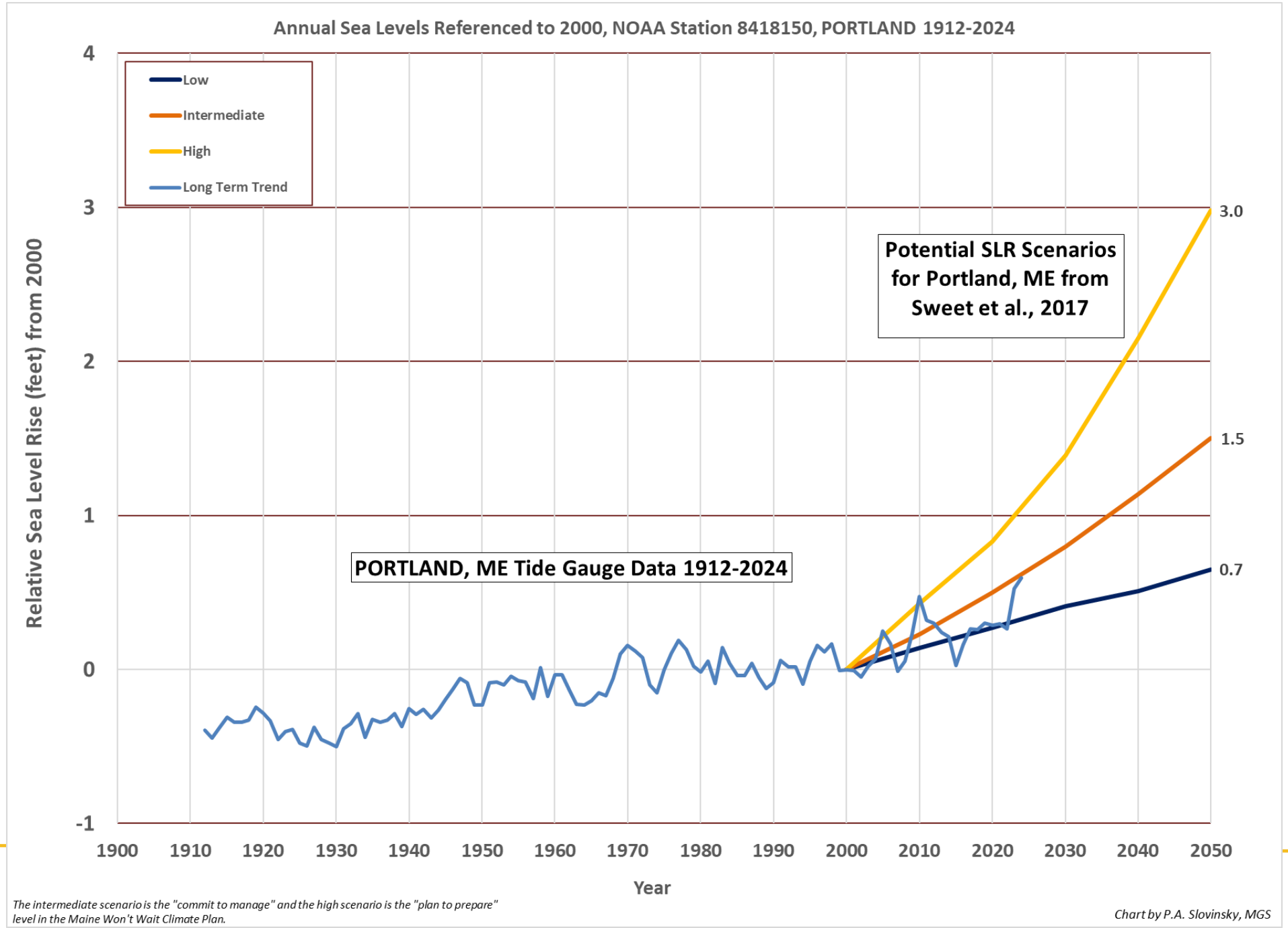
Higher than normal mean sea levels in 2023 and 2024…a repeat of 2010?

North Atlantic Oscillation (NAO)



Atlantic Meridional Overturning Circulation (AMOC)





The intermediate scenario is the "commit to manage" and the high scenario is the "plan to prepare" level in the Maine Won't Wait Climate Plan.

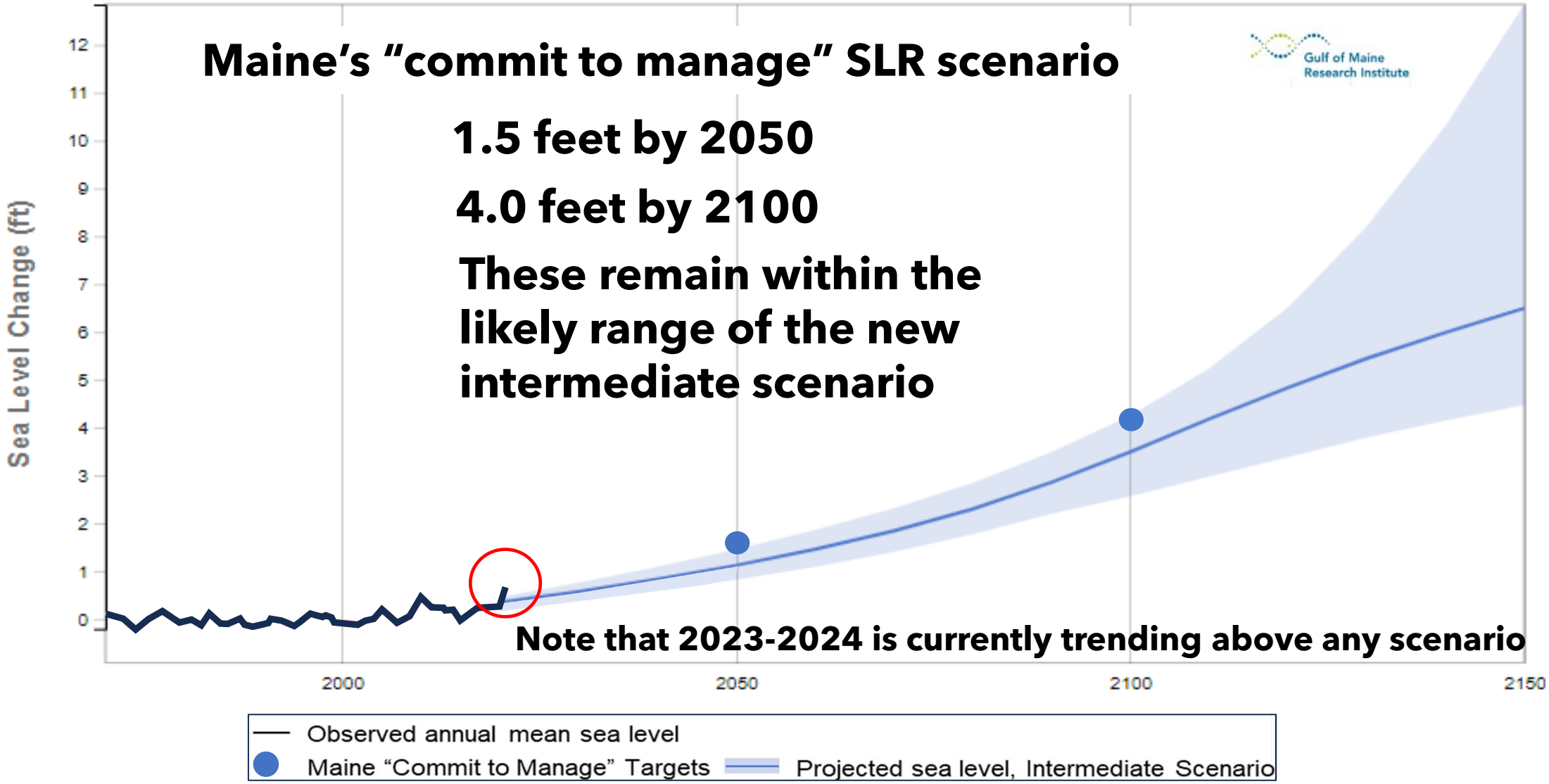
Chart by P.A. Slovinsky, MGS

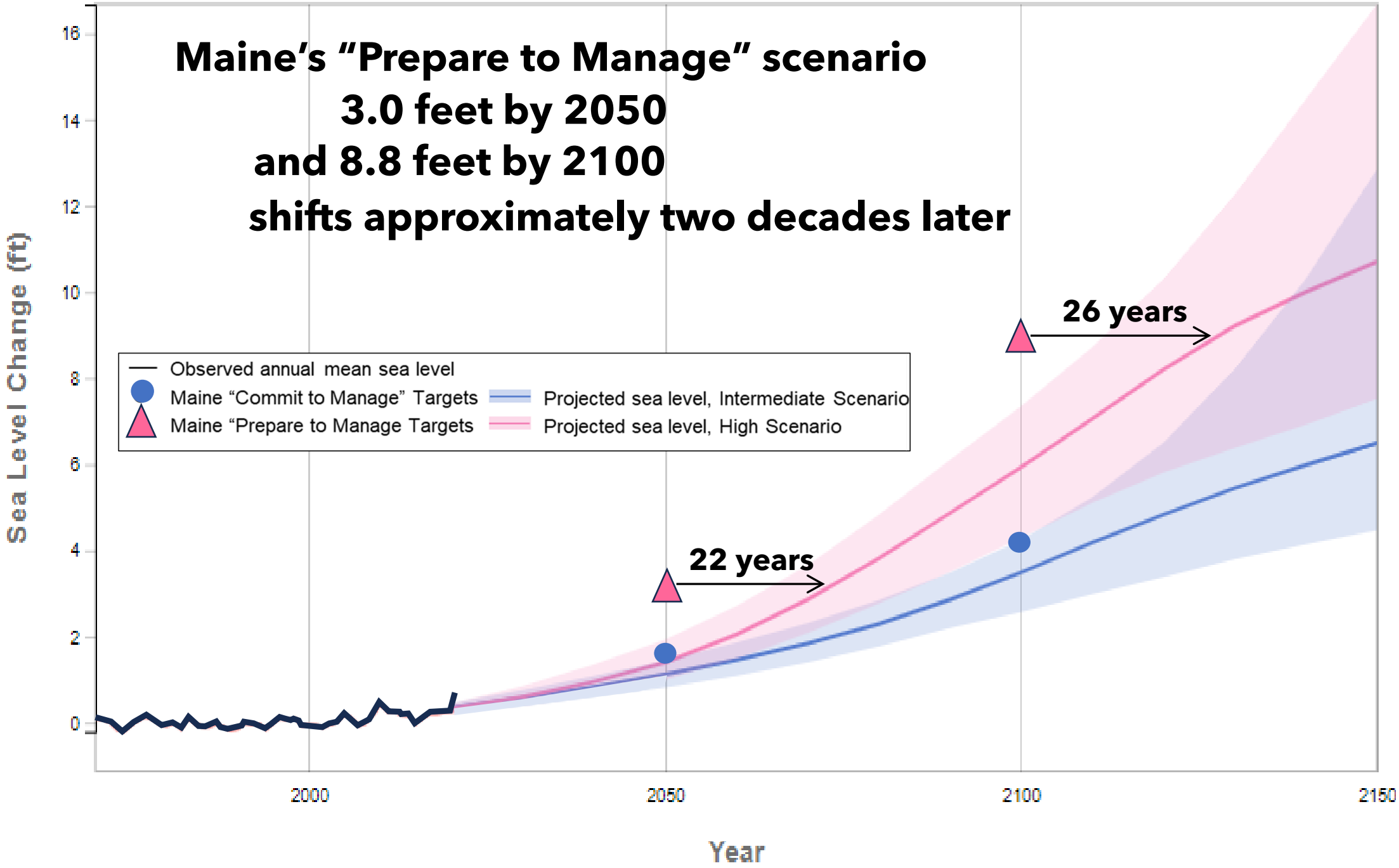
Current SLR is matching the *intermediate* SLR scenario adopted by the Climate Council in 2020

(1.5 feet by 2050, 4 feet by 2100)

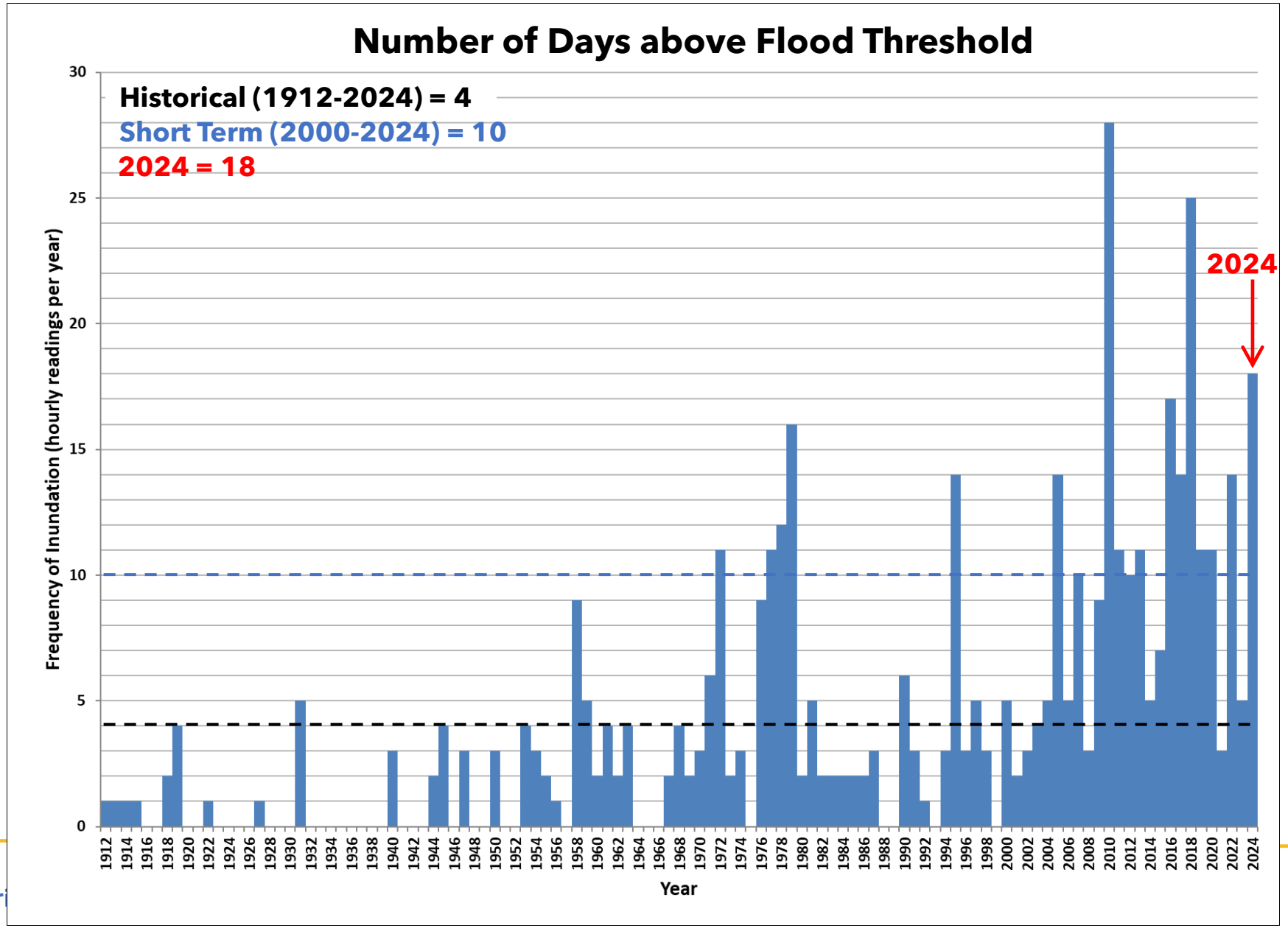
MAINE WON'T WAIT
A FOUR-YEAR PLAN FOR CLIMATE ACTION
MAINE CLIMATE COUNCIL

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

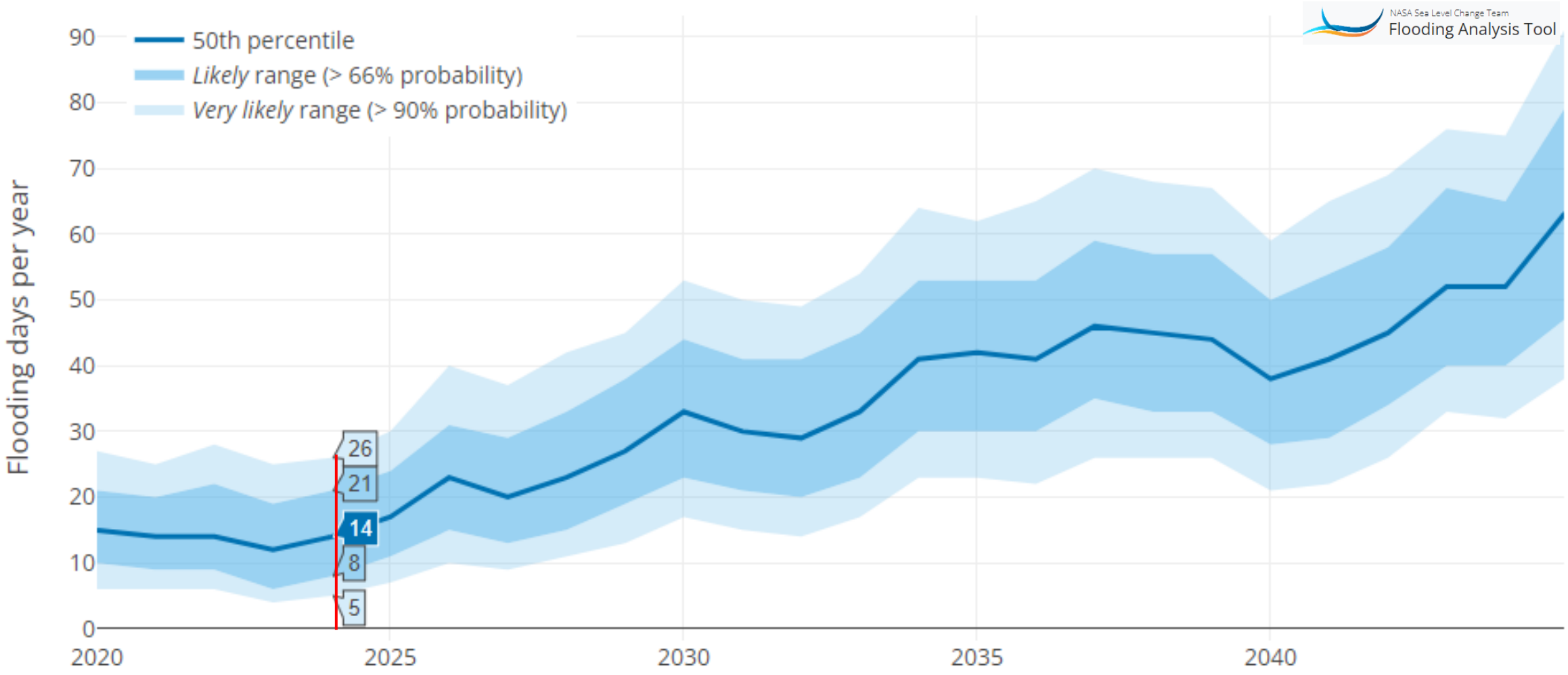



Maine's "Prepare to Manage" scenario
3.0 feet by 2050
and 8.8 feet by 2100
shifts approximately two decades later
26 years
22 years
Observed annual mean sea level
Maine "Commit to Manage" Targets
Maine "Prepare to Manage Targets
Projected sea level, Intermediate Scenario
Projected sea level, High Scenario
Sea Level Change (ft)
0
2
4
6
8
10
12
14
16
2000
2050
2100
2150
Year

High Tide Nuisance Flooding along the Maine coast has increased, especially over the last 20 years. So far, 2024 is setting records.



Nuisance Flooding will continue to increase with sea level rise and a lunar nodal cycle, with a peak of the cycle in 2037.



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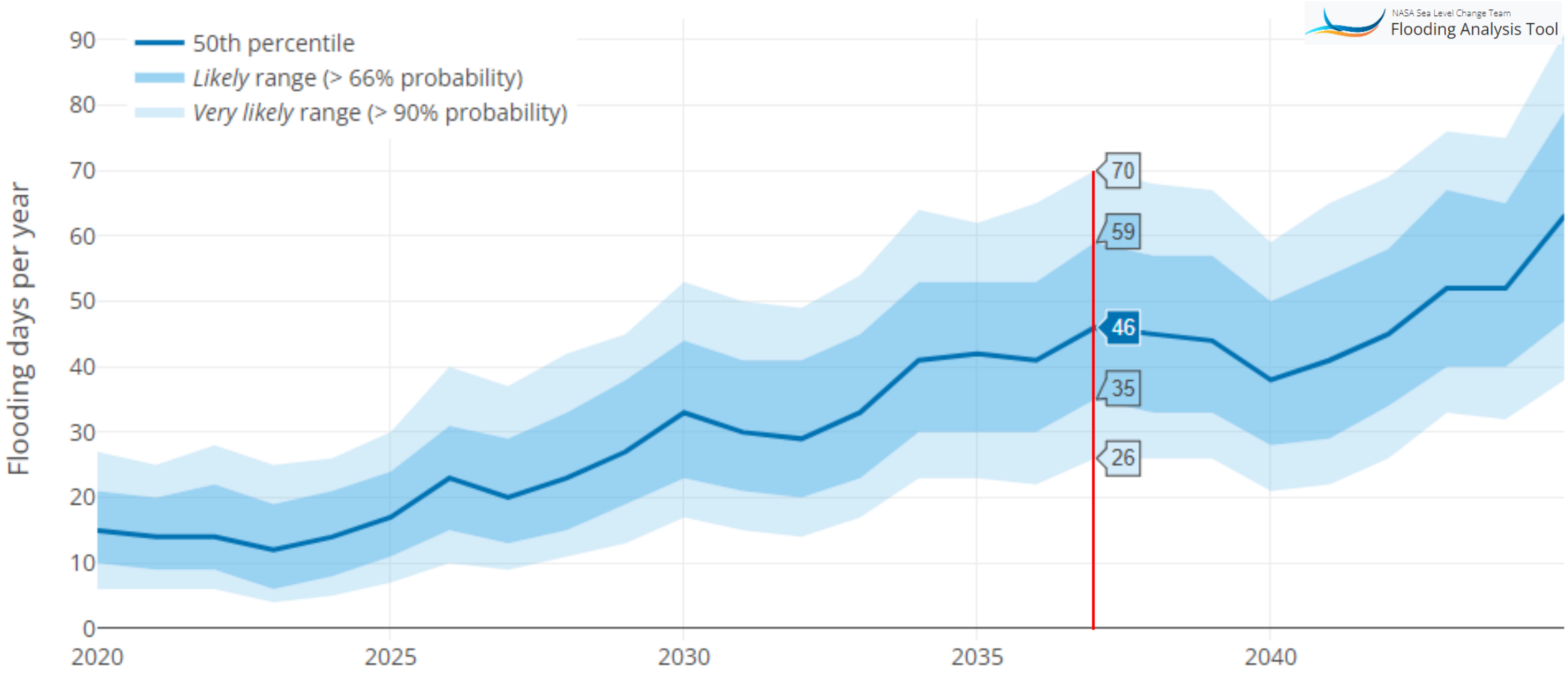
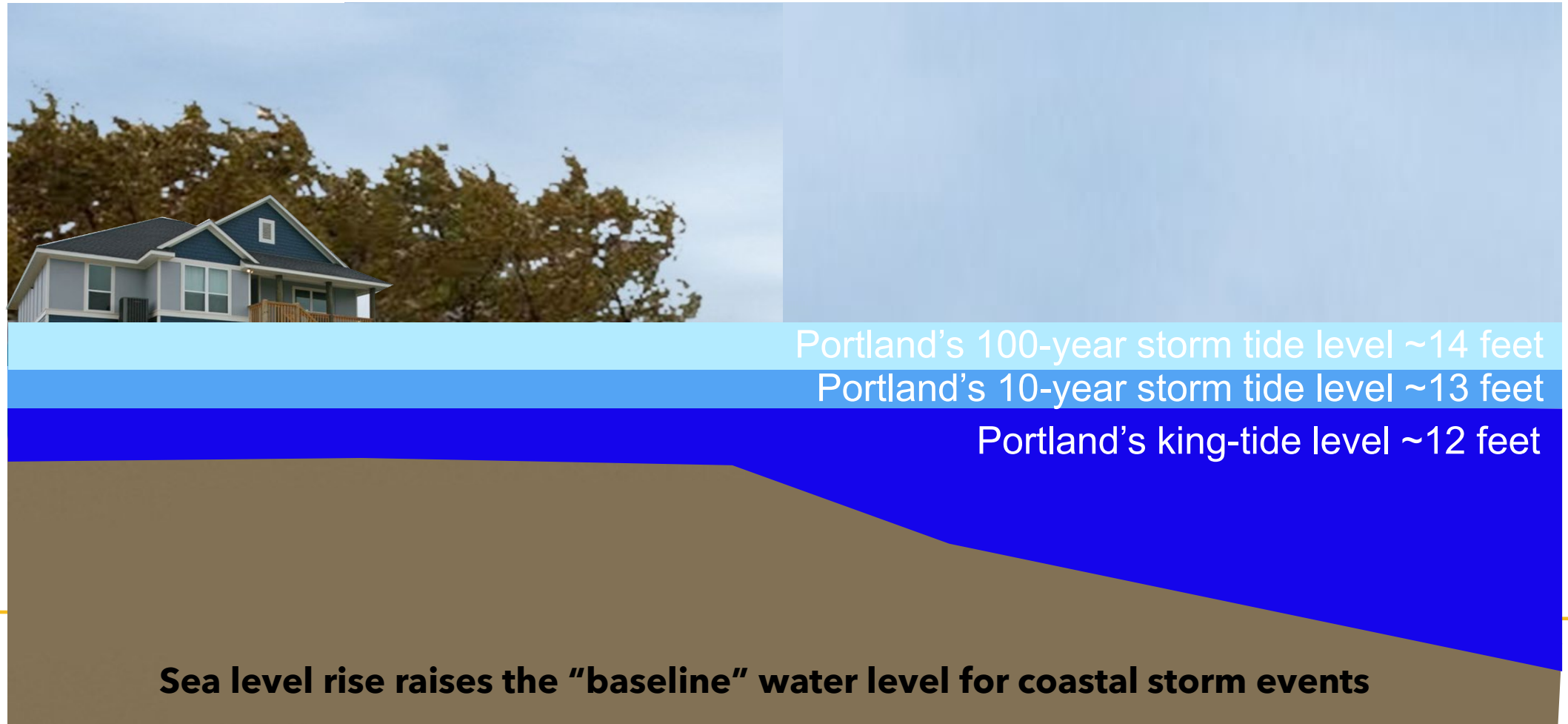


Sea level rise is exacerbating coastal flooding impacts from storms

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

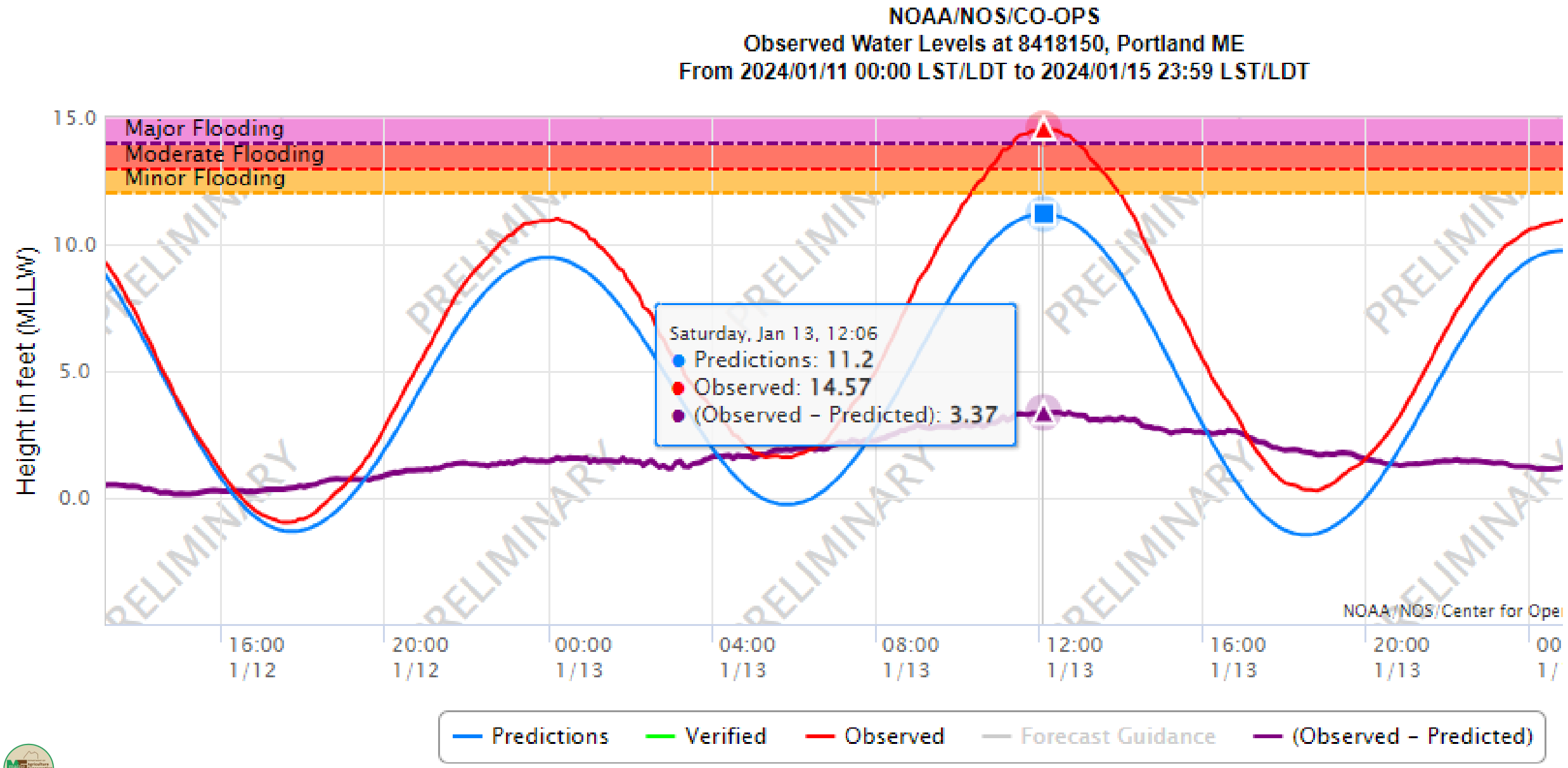
There is only about a 1-foot difference between the "king tide" and a "10-year" storm water level.

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

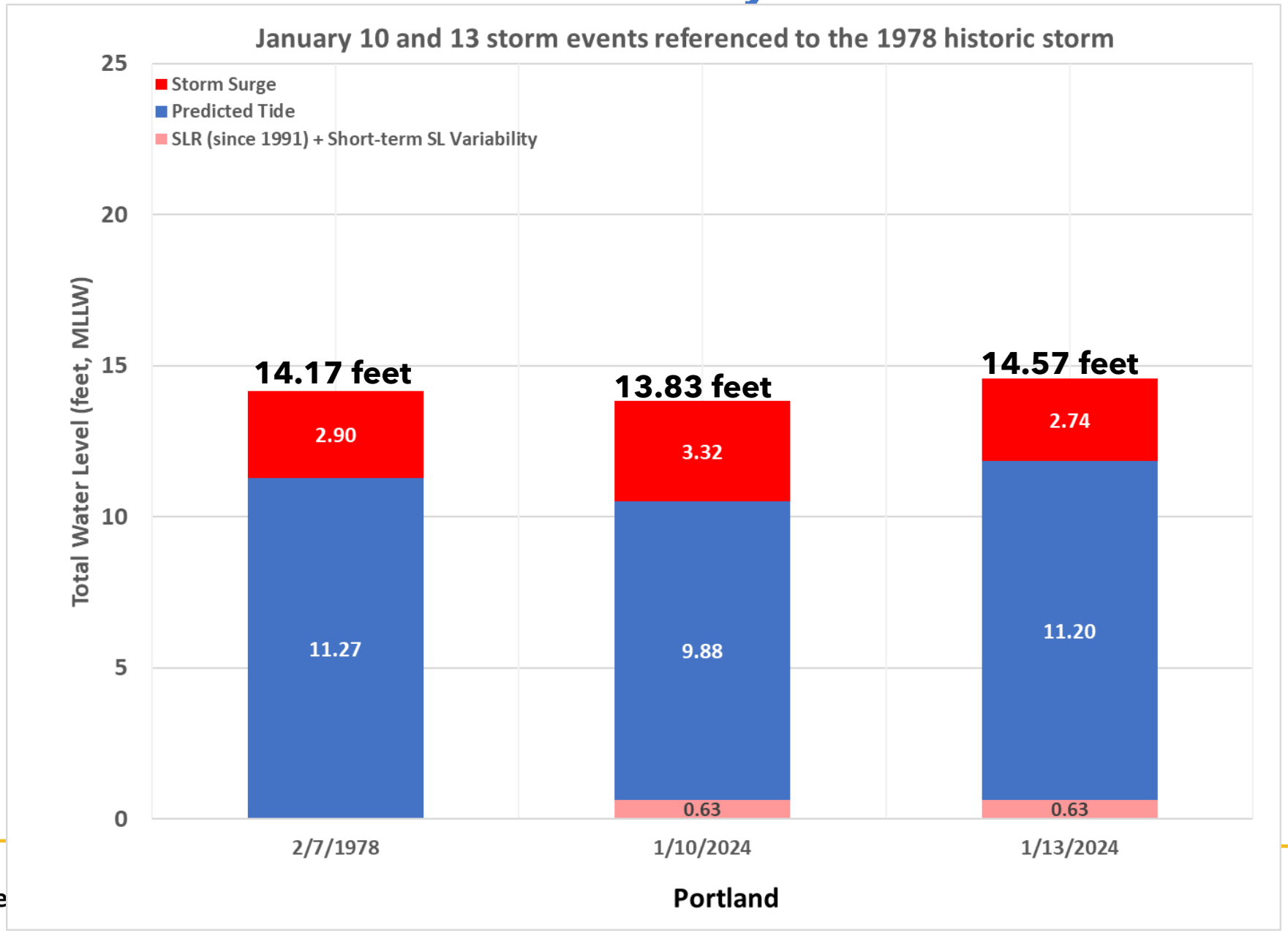
Water levels associated with the record-setting January 13, 2024 Storm in Portland



Data courtesy of NOAA CO-OPS, www.tidesandcurrents.noaa.gov

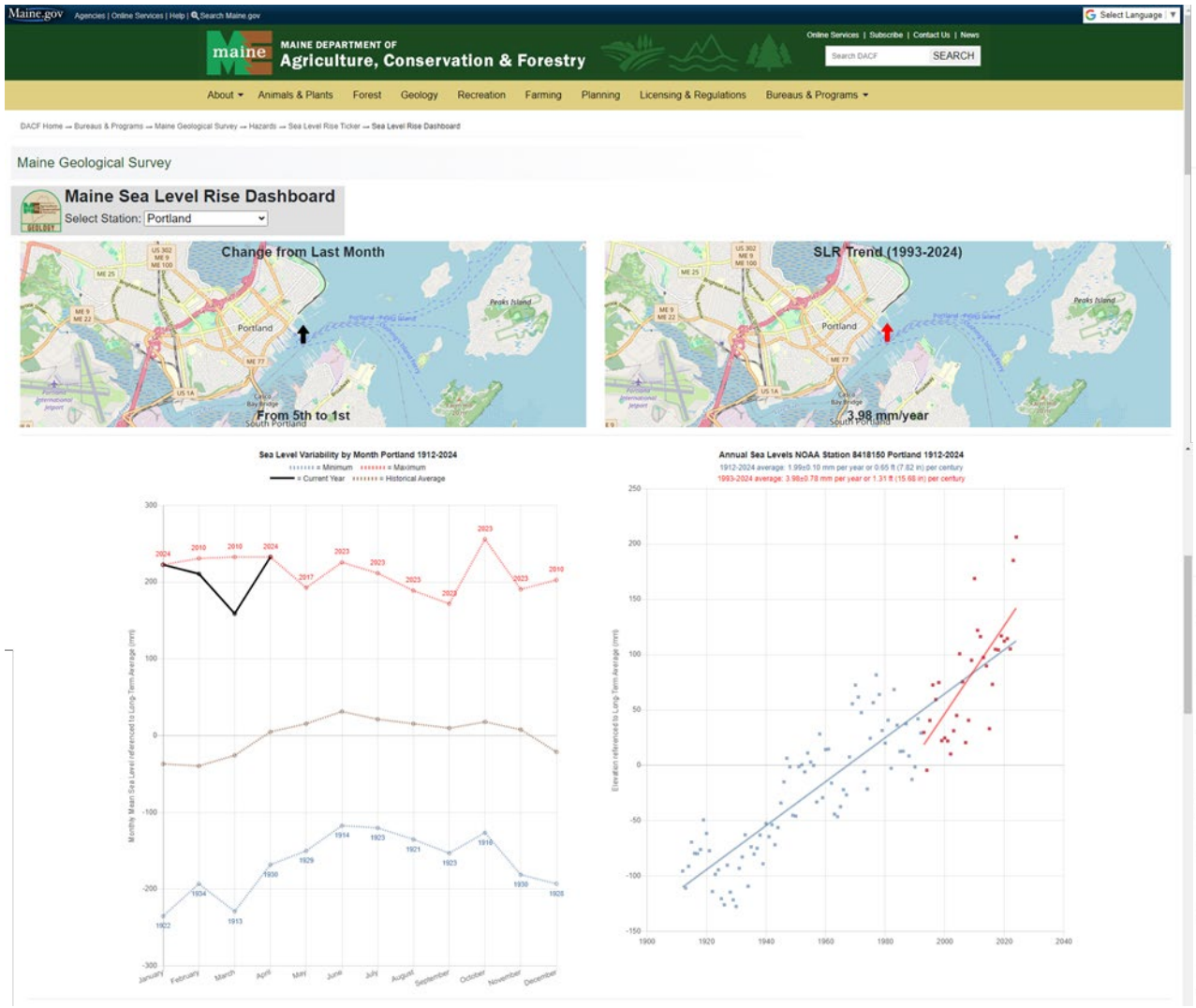
P.A. Slovinsky, Maine Geological Survey, 6/5/2024

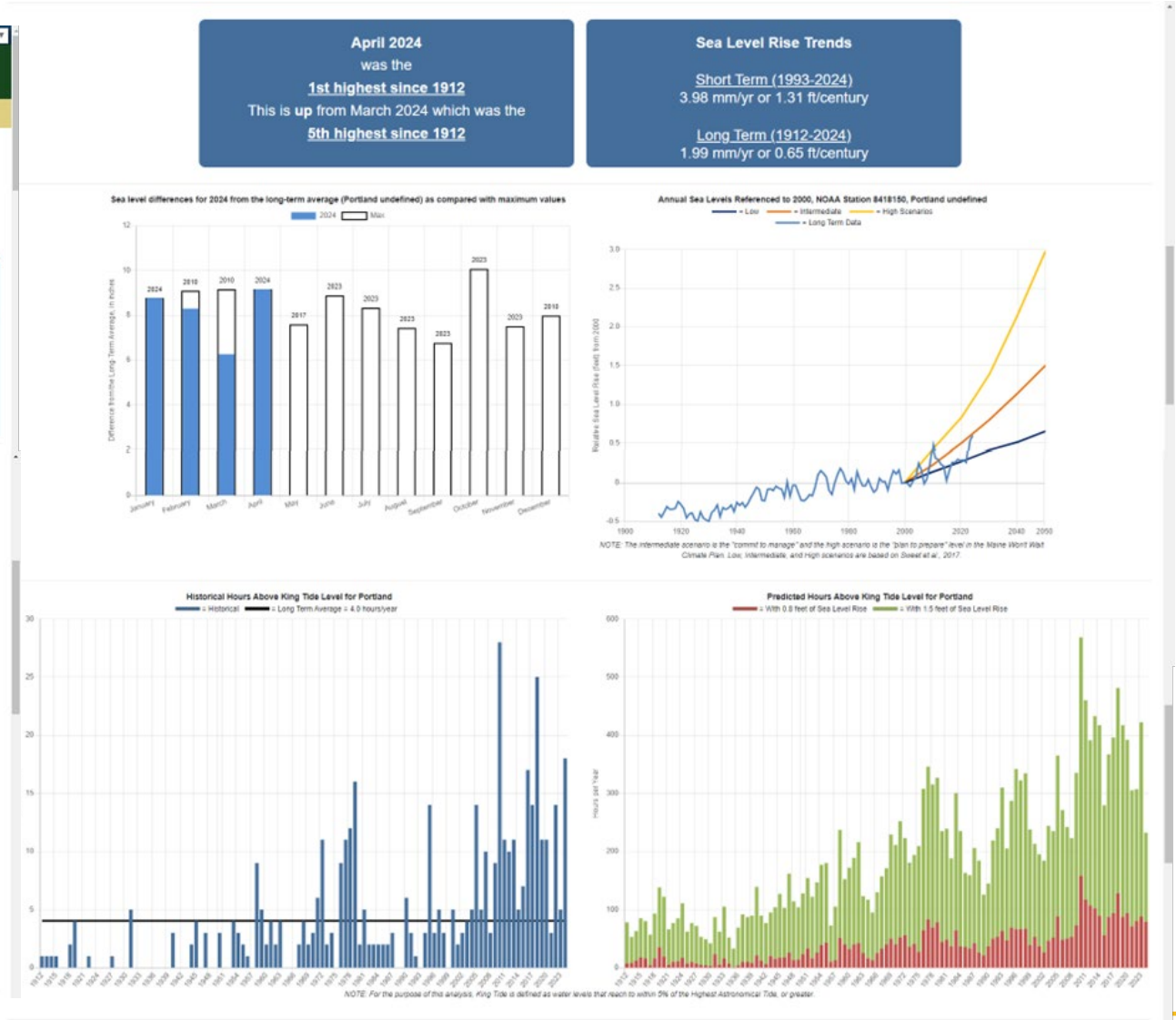
The January 10th and 13th storm events set records along the Maine coastline, and were *enhanced by sea level rise*



For more information on tracking water and sea levels in Maine

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



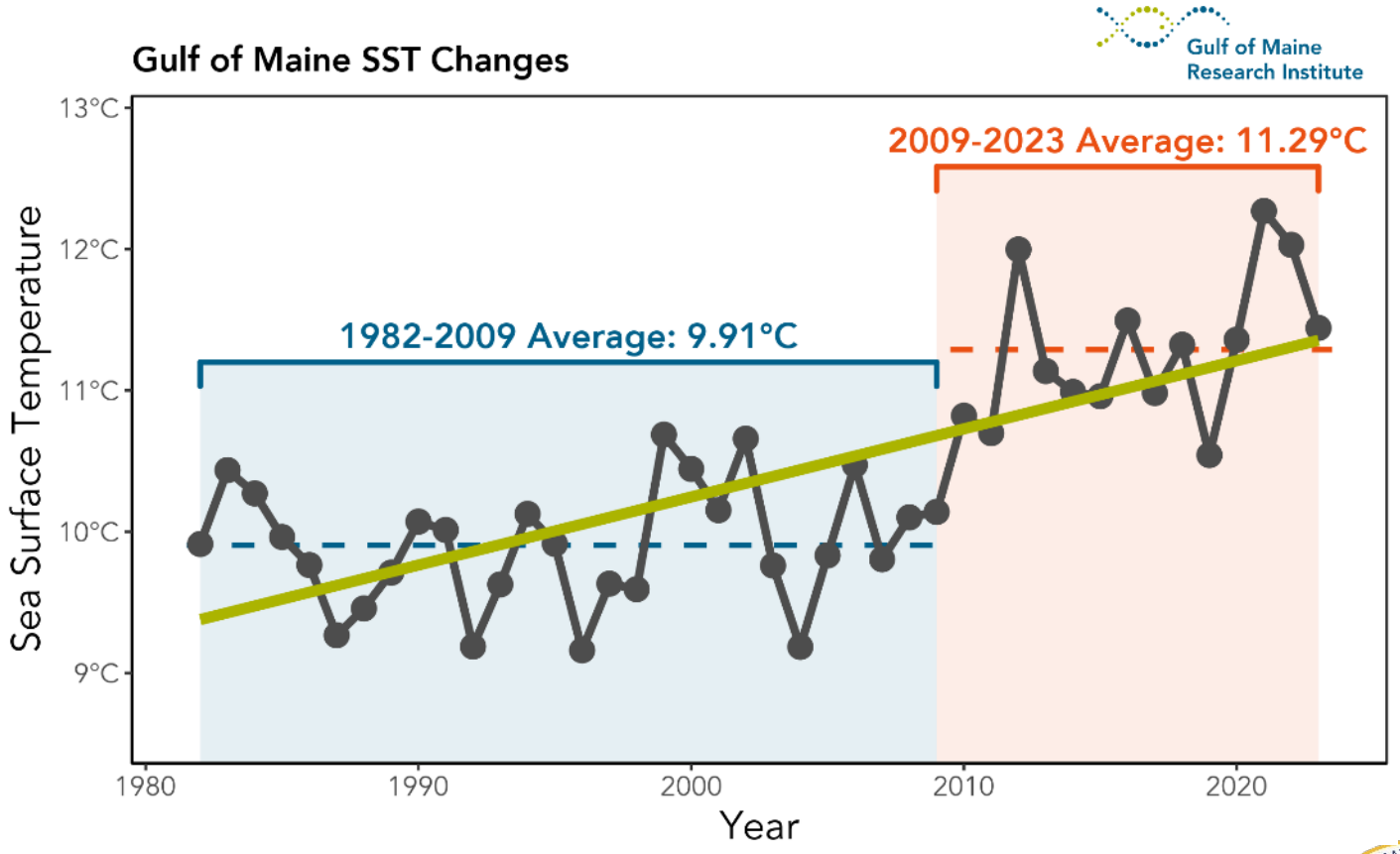


Marine

Nichole Price
Bigelow Laboratory for Ocean Sciences

Sea Surface Temperature (SST) Trends

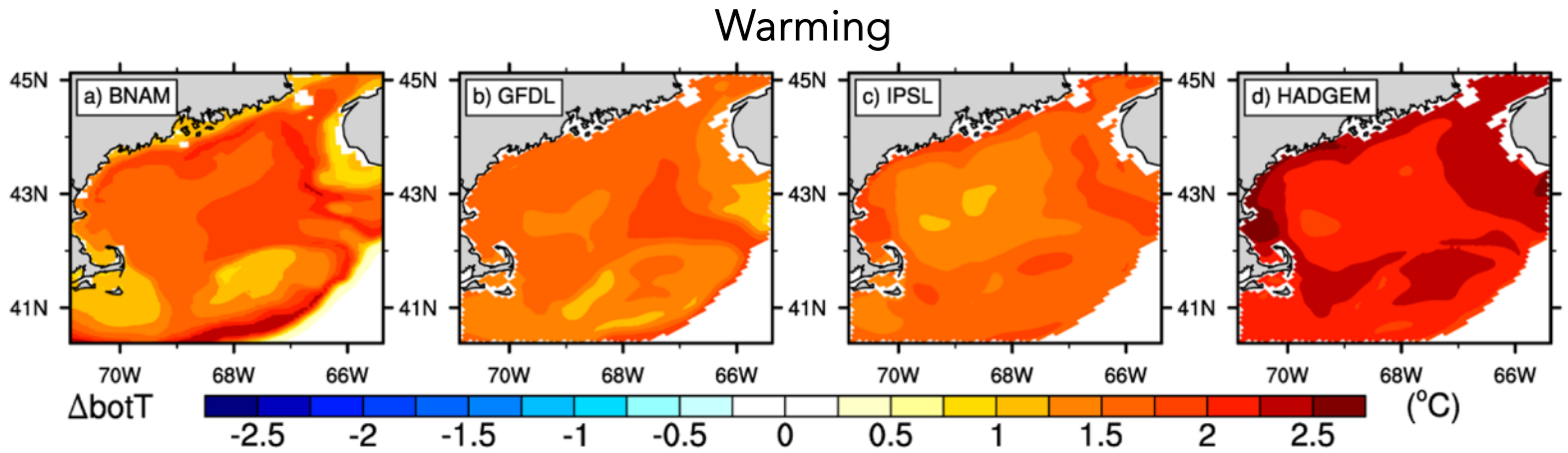
- In 2021 and 2022, temperatures **were the warmest** since records began
- Since 1982, the Gulf of Maine has **warmed 3 times faster** than the global average (0.48°C / decade)
- Maine has entered a new regime from 2010, with temperatures now 1.38°C higher
- In 2022, GOM met marine heatwave criteria for 97% of the year



GMRI 2024, with help from Adam Kemberling

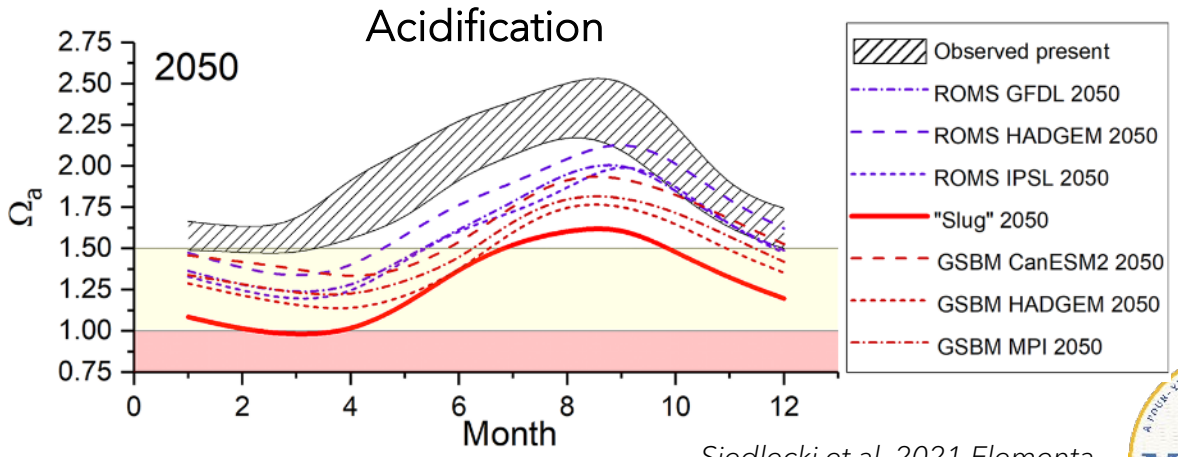
Acidification & Seawater Warming by 2050

- Updated models project seafloor warming of up to 2.75 °C by 2050
- These same new models now project that aragonite saturation state will be below critical thresholds for shellfish for most of the year by 2050
- These projections for the STS 2024 report are more extreme that reported previously, particularly for acidification



Brickman et al. 2021 Elementa

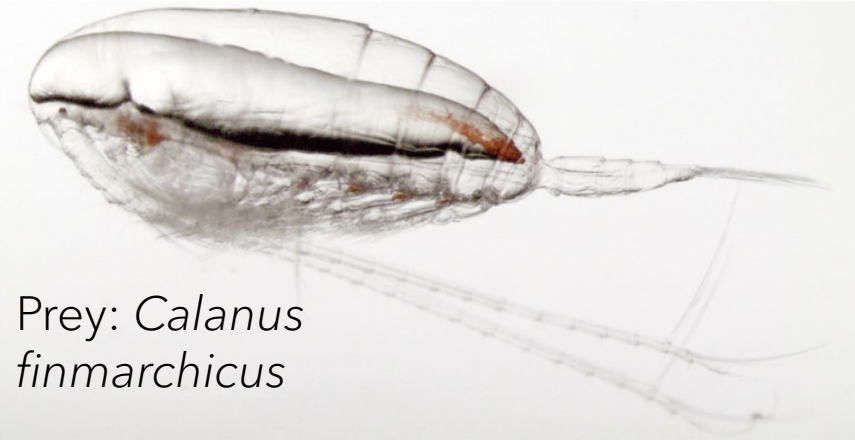
Shellfish Calcification Potential



Siedlecki et al. 2021 Elementa

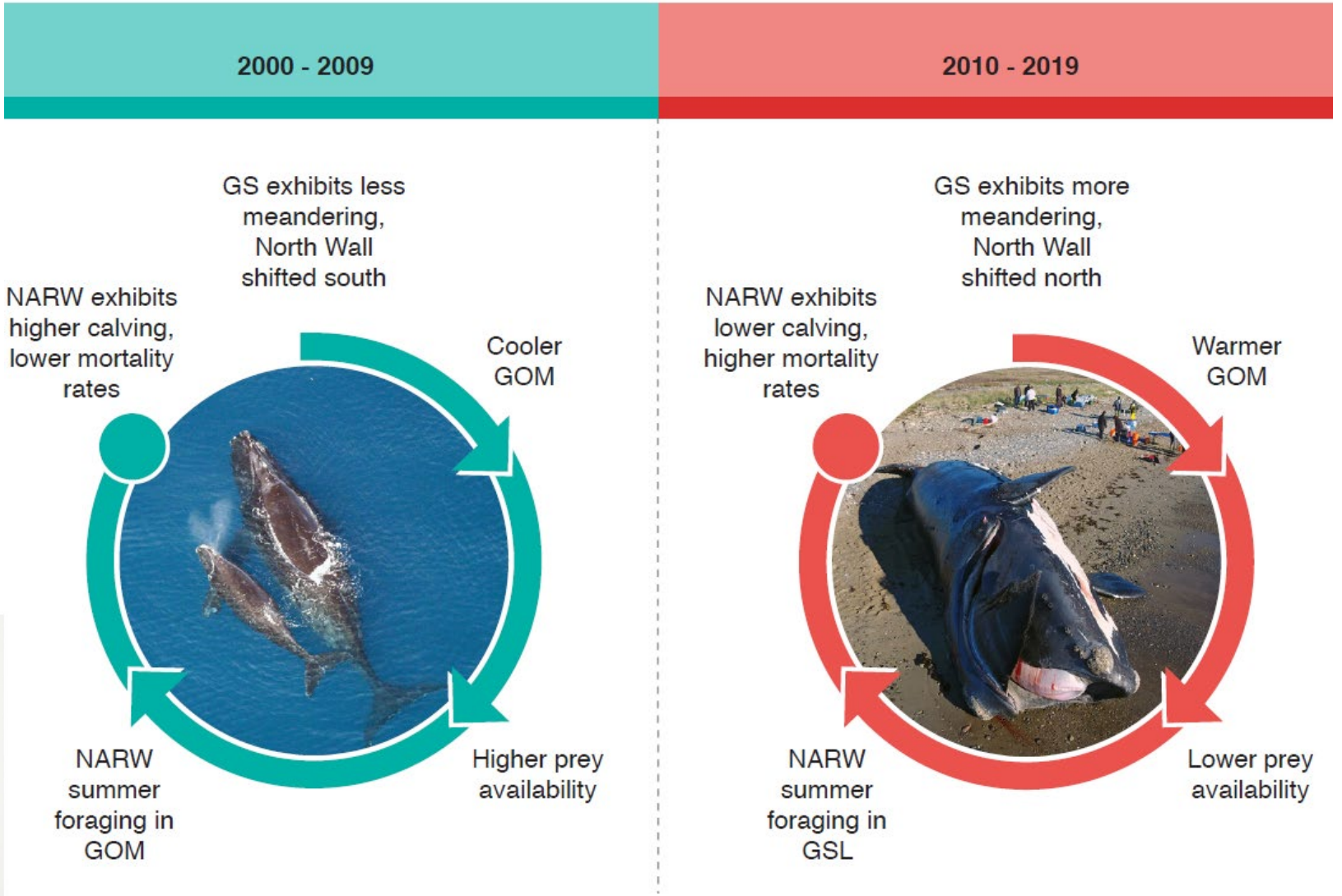
Right Whales

- Higher extinction risks are associated climate-driven changes in foraging environment and habitat use
- Modeling efforts to understand prey re-distribution patterns are now used to evaluate likelihood of strikes and entanglement in particular regions



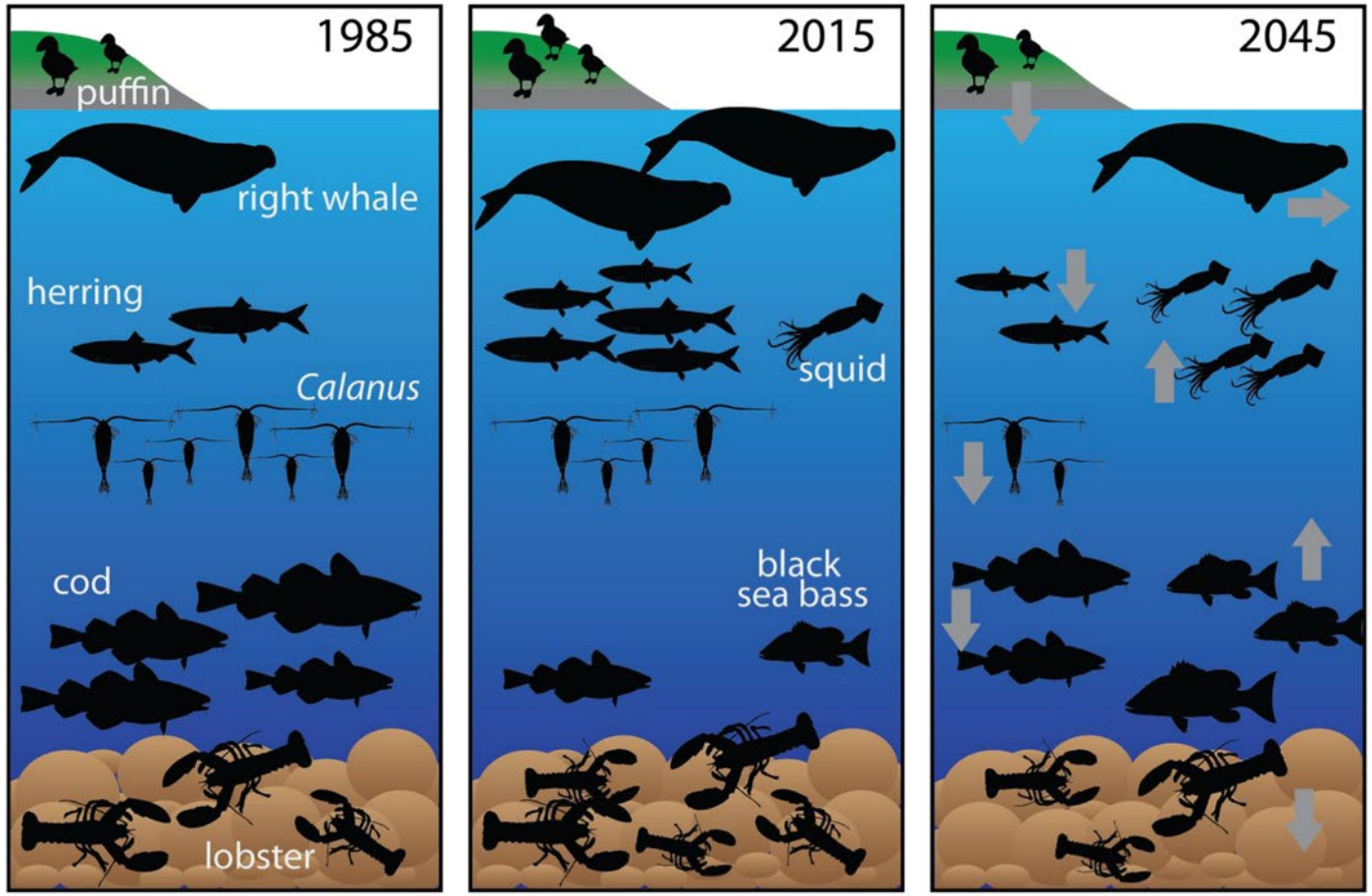
Prey: *Calanus finmarchicus*

Ross et al. 2023 Marine Ecology Progress Series



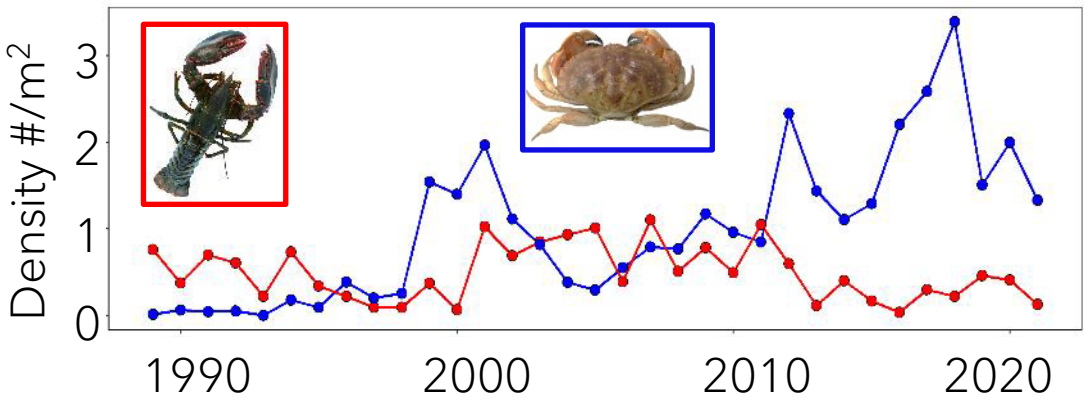
Meyer Gutbrod et al. 2021 Oceanography

Wild Capture Fisheries



Pershing et al. 2021 Elementa

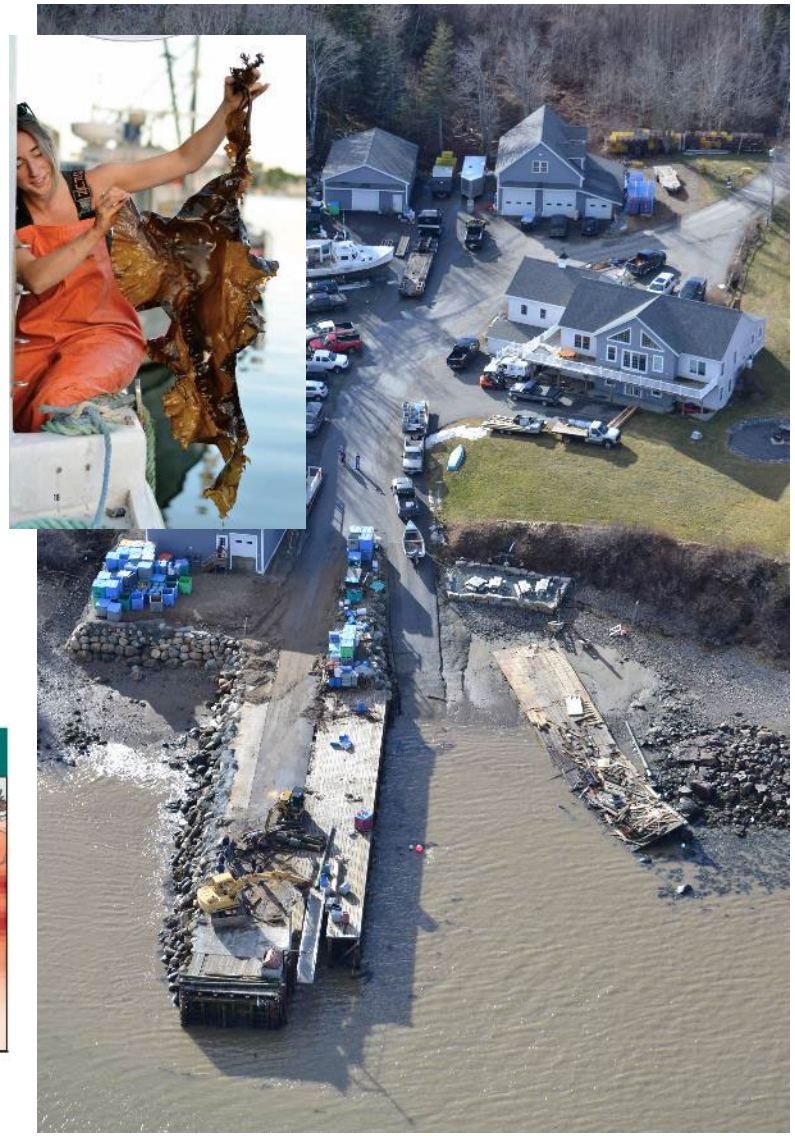
- Lobster fisheries continue to report relatively slowed landings, consistent with climate-driven predictions
- The timing of lobster egg hatch and zooplankton seasonality has become mismatched; shifted phenologies contribute to other species losses
- Subpolar species are projected to continue to decline, but certain valuable temperate species are rising in abundance, as predicted (e.g., squid, sea bass, Jonah crabs)



MacManus et al. 2023 Frontiers in Marine Science

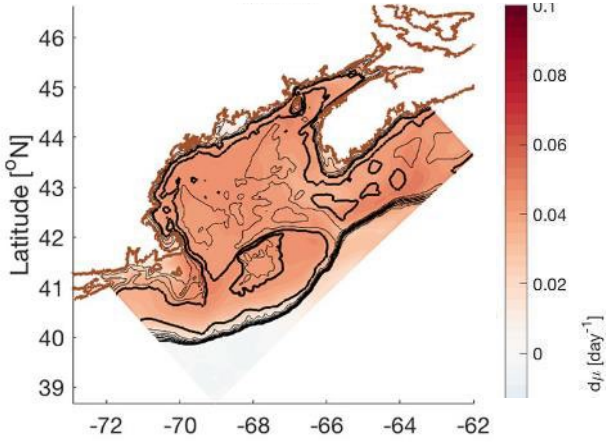
Aquaculture

- Storm Damage:
  - January storms caused significant flooding and surge along coastal Maine
  - $70.3 million in public infrastructure damage, largely working waterfront
- Heat Waves:
  - Further, sustained exposure to marine heat waves is impacting seaweed brood stock resources for seaweed nurseries
  - Harmful Algal Blooms (HAB) becoming more frequent, last longer, and shifting seasonality

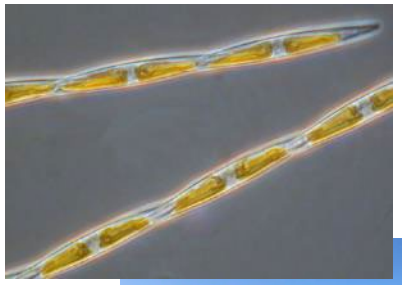


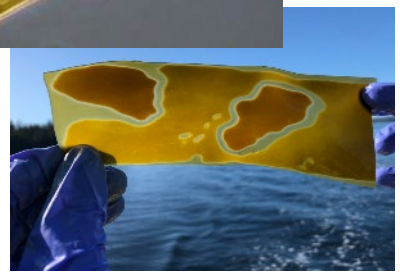
GMRI Annual Report

Projected HAB Growth

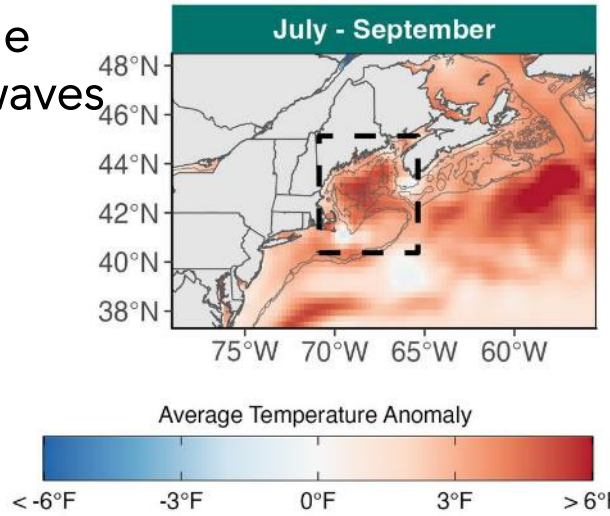


Clark et al. 2022 J. Marine Science



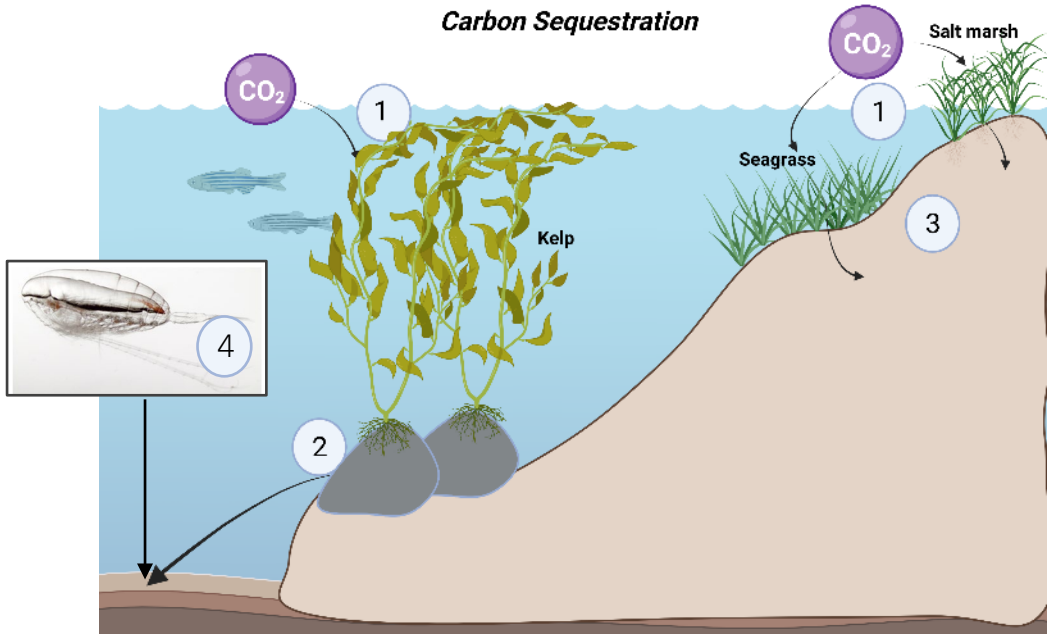


Marine heatwaves



Ocean Climate Mitigation Strategies

- Substantive research underway to establish requisite baselines
- Several funded projects underway to develop or apply tools to assess efficacy
- Continued evaluation of the carbon footprint of fisheries and aquaculture underway



1. Submerged aquatic vegetation captures carbon

2. Seaweed fragments *may be* stored in marine sediments

3. Sea plants transfer carbon to sediments via roots

4. Zooplankton *may* contribute to carbon storage

- **Ongoing exploration of potential ecosystem impacts**
- **Building evidence soundscapes will not disrupt fisheries**
- **Any impacts are likely to be extremely site specific and need to be evaluated case-by-case**

Maine Climate Council – Upcoming Webinars

Maine DEP Greenhouse Gas Emissions Inventory

Tuesday, June 11, 12-1PM

Registration link: https://mainestate.zoom.us/webinar/register/WN_VRI217gmTHqq3ZX-65h2LA#/registration

Lunch and Learn: An Update to the Maine Social Vulnerability Index

Friday, June 14, 12-1PM

Registration link: https://mainestate.zoom.us/meeting/register/tZ0pc-uhqDIjHdVyrmTQTdpTs-gGn1UotFSf#/registration

See all upcoming webinars and meetings at:

https://www.maine.gov/future/meeting-calendar