



Coastal Climate Impacts & Resilience in Casco Bay

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**Gulf of Maine
Research Institute**

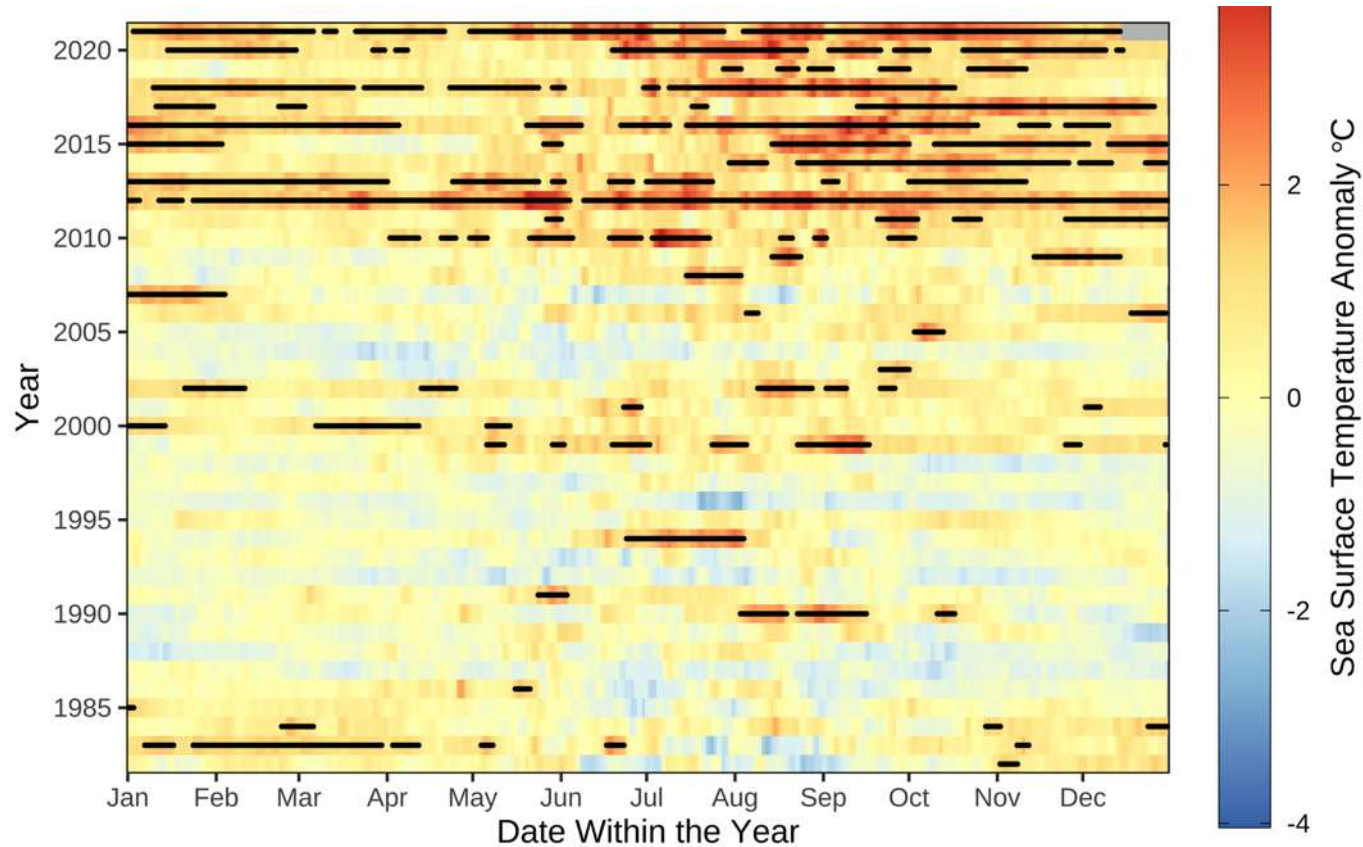
Science. Education. Community.

All You Need to Know About Climate Change in 10 Points

1. Climate impacts are occurring now
2. All aspects of livelihoods and well-being are affected
3. There is the potential for significant (and unequal) negative consequences
4. There is also the potential for some positive (and unequal) consequences
5. We know what the causes of the problem are
6. We know what the response options are
7. (Some large) Uncertainties remain
8. But we know enough to act
9. And we know the costs of inaction far outweigh the costs of action
10. It's a matter of mustering the will to act on a scale that meets the challenge

Climate Risks & Impacts in Casco Bay:

Ocean Warming



Early data suggest 2021 was one of the hottest years on record in the Gulf of Maine

Maine Public | By Fred Bever
Published January 12, 2022 at 7:51 AM EST



LOCAL & STATE > Posted Yesterday at 1:16 PM | Updated at 8:24 AM

Gulf of Maine waters warmed to highest fall temperatures on record

The Gulf of Maine Research Institute reports that average sea surface temperatures in the gulf were more than 4 degrees above the long-term average.

BY COLIN WOODARD STAFF WRITER



Capital Weather Gang

Gulf of Maine waters spiked to record warm levels in fall 2021

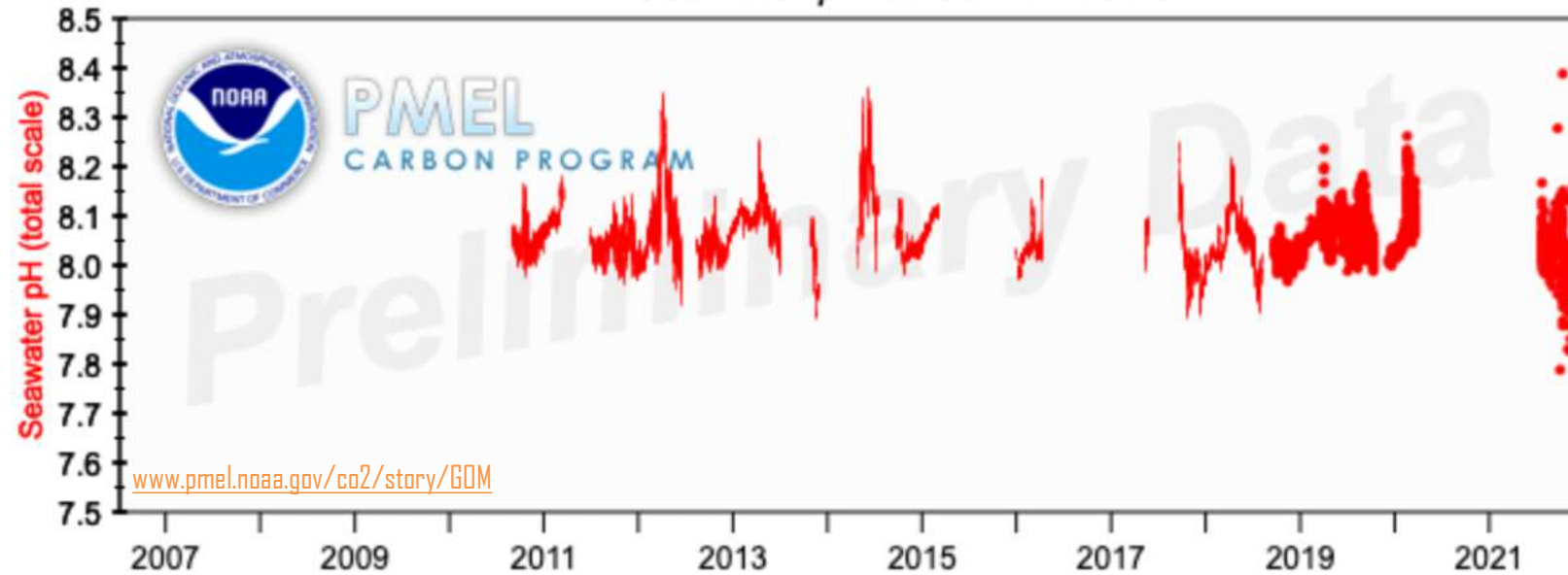
The gulf has seen an onslaught of marine heat waves and is warming faster than 96 percent of the world's oceans

Warming Leads to:
Deoxygenation, Stratification, Freshening, Phenological & Productivity Changes, Species Shifts, Emergent Invasives...

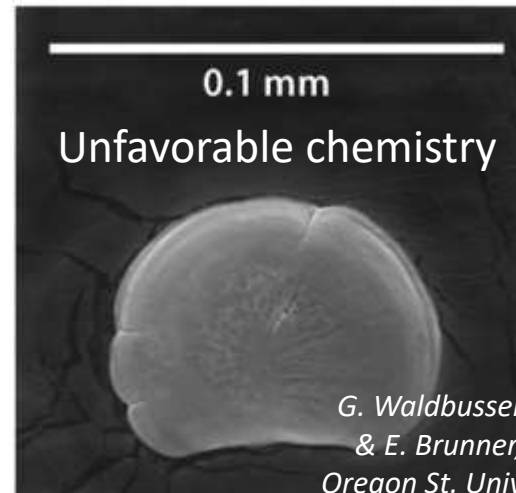
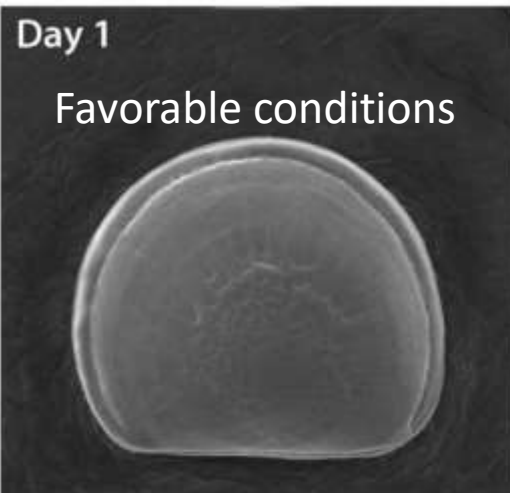
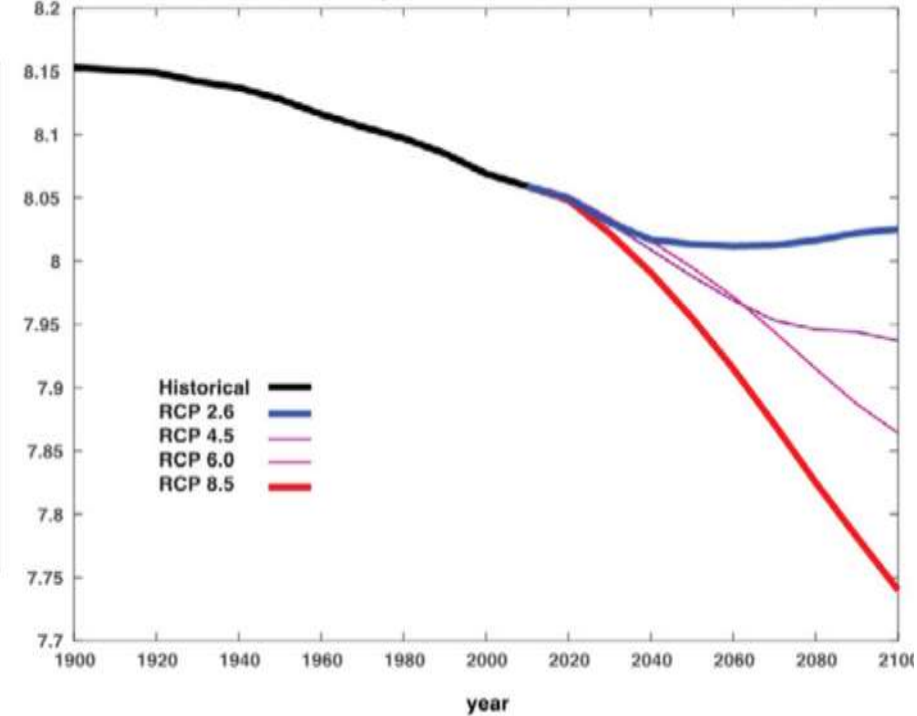
Climate Risks & Impacts in Casco Bay:

Ocean Acidification

Seawater pH at Gulf of Maine



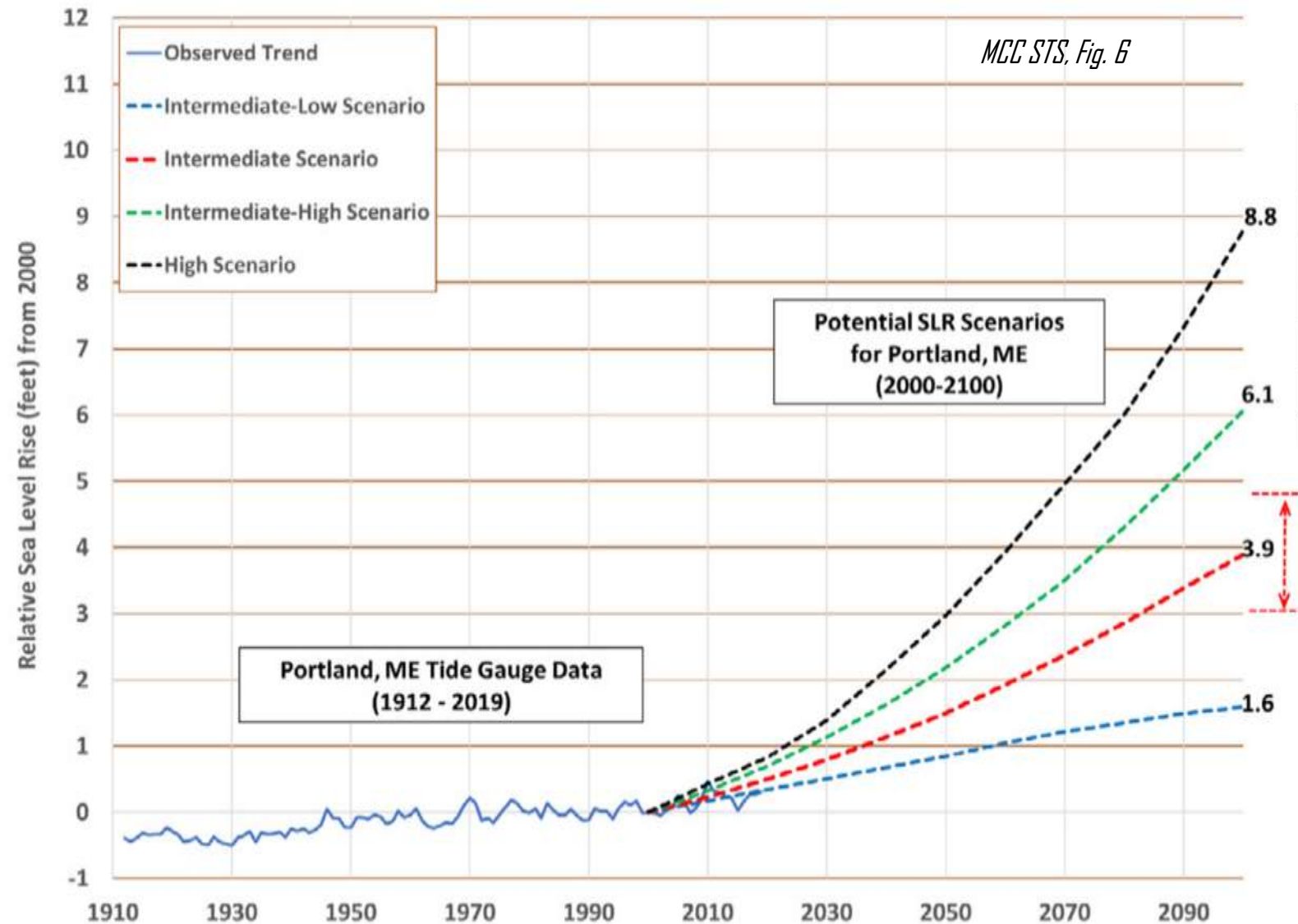
Global surface ocean pH over time with future IPCC scenarios



Dabob Bay, WA Pacific Oyster Larvae reared with natural waters from shallow (left) and deep (right) water intakes at Taylors Shellfish Hatchery

Climate Risks & Impacts in Casco Bay:

Sea Level Rise



Planning Scenario	"Commit to Manage"	"Prepare to Manage"
Year	Intermediate Scenario	High Scenario
2030	0.8	1.4
2050	1.5	3.0
2070	2.4	5.0
2100	3.9	8.8

Relative Sea Level Rise (feet) from 2000

MCC STS, Table 7b

Impacts from SLR:
Flooding, Erosion, Inundation /
Salinization, Displacement &
Migration...

Climate Risks & Impacts in Casco Bay: *Stronger Coastal Storms*

Winter Storm Riley (March 2018)

2' storm surge w/ of 11.15' high tide → 13.15' storm tide



This is similar to what we can expect to experience during high-high tides
with a SLR of 1.2 feet...
or the "Commit to Manage" scenario by ~2040.

Climate Risks & Impacts in Casco Bay: *Heavier Rainfall Events*



Heavy rainfall leads to runoff...



... which can trigger HAB formation...

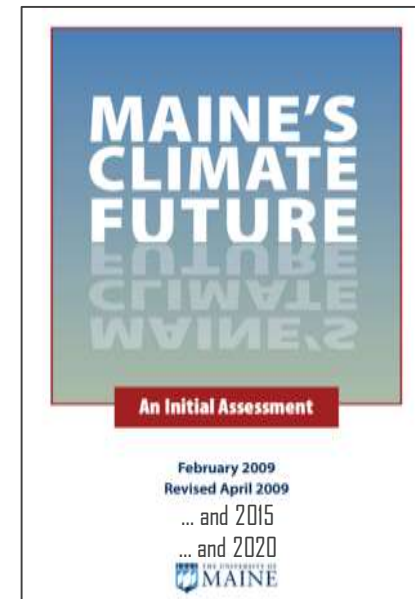
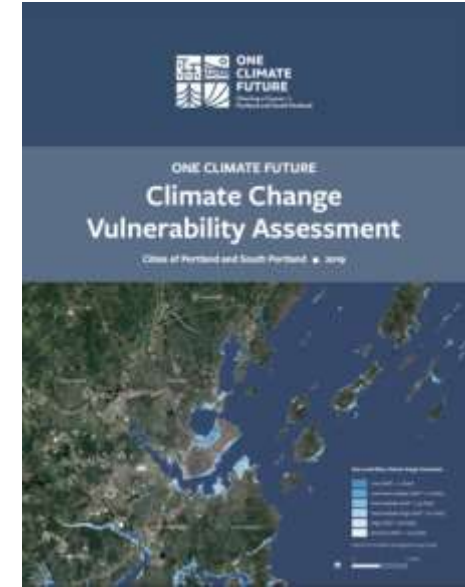


... and lead to fish kills.



Climate Risks & Impacts in Casco Bay: *Many, Many More*

- Freshwater Quality & Quantity (Drought)
- Ecosystems & Biodiversity (incl Forests)
- Agriculture
- Transportation, Built Environment, & Critical Infrastructure
- Public Health (Air Quality, Pests)
- Tourism & Recreation
- Economic Growth, Tax Bases, etc.
- Compound Extreme Events, Multiple Stressors, & Cascading Impacts / Interacting Systems



... and 2021 update

Citizen Science through Coastal Flooding

What water level and weather conditions lead to local flooding?

https://investigate.gmri.org/project/coastal_flooding/



Ecosystem Investigation Network — Projects — About — FAQ — Partners

Public

Coastal Flooding: Storms and Sea Level Rise

What areas of our shoreline are most vulnerable and most important to us?
What weather and tidal level conditions are associated with coastal flooding in our community?

Why this matters

Sea levels are rising, storms are intensifying, and coasts are flooding more frequently. The goal of this project is to help coastal communities gather data to understand their unique risks and begin to identify priorities for building resilience.



How healthy is Casco Bay? How is Casco Bay changing?

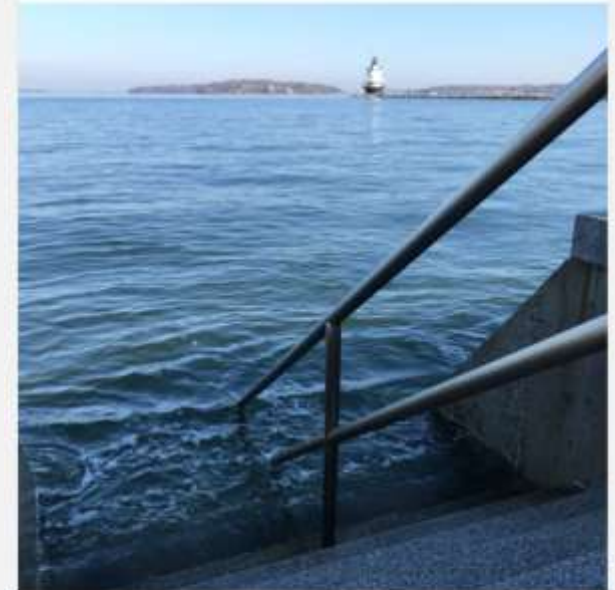
cascobay.org/water-reporter



WATER REPORTER

 Delia Dawson

Nov 26, 2018



10:20 am EST Spring Point, South Portland, Maine #sealoveelse #friendsofcascobay

Photo posted by Delia Dawson

High Water Marks

High Water Marks in Portland and South Portland show where flood levels for a historic storm, like the Blizzard of 1978, could be in the future without significant climate action.

Portland High Water Marks: Fore River, Back Cove, Eastern Prom Trail, Portland Pier

South Portland High Water Marks: Mill Creek, Bug Light Park, Willard Beach





Thank You!

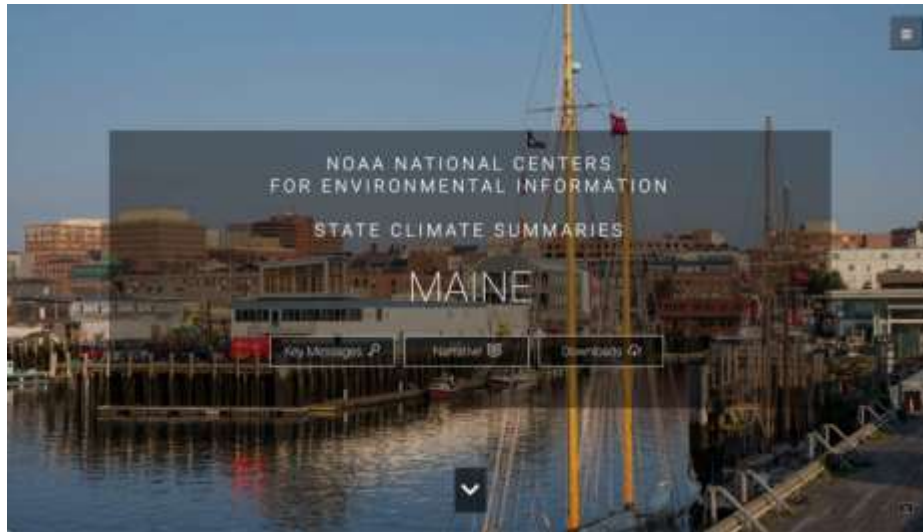
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**Gulf of Maine
Research Institute**

Science. Education. Community.

Federally-Produced State & Local Information



statesummaries.ncics.org



toolkit.climate.gov

United States Environmental Protection Agency

August 2016
EPA 430-F-16-021

What Climate Change Means for Maine

Maine's climate is changing. The state has warmed about three degrees (F) since the year 1900. Throughout the northeastern United States, spring is arriving earlier and bringing more precipitation, heavy rainstorms are more frequent, and summers are hotter and drier. Sea level is rising, and severe storms increasingly cause floods that damage property and infrastructure. In the coming decades, changing the climate is likely to increase flooding; harm ecosystems; disrupt fishing, agriculture, and winter recreation; and increase some risks to human health.

Our climate is changing because the earth is warming. People have increased the amount of carbon dioxide in the air by 40 percent since the late 1700s. Other heat-trapping greenhouse gases are also increasing. These gases have warmed the surface and lower atmosphere of our planet about one degree during the last 50 years. Evaporation increases as the atmosphere warms, which increases humidity, average rainfall, and the frequency of heavy rainstorms in many places—but contributes to drought in others.

Greenhouse gases are also changing the world's oceans and ice cover. Carbon dioxide reacts with water to form carbonic acid, so the oceans are becoming more acidic. The surface of the ocean has warmed about one degree during the last 80 years. Warming is causing snow to melt earlier in spring, and mountain glaciers are retreating. Even the great ice sheets on Greenland and Antarctica are shrinking. Thus the sea is rising at an increasing rate.

Increasing Temperature and Changing Precipitation Patterns

Rising temperatures and shifting rainfall patterns are likely to increase the intensity of both floods and droughts. Average annual precipitation in the Northeast increased 10 percent from 1895 to 2011, and precipitation from extremely heavy storms has increased 70 percent since 1958. During the next century, average annual precipitation and the frequency of heavy downpours are likely to keep rising. Average precipitation is likely to increase during winter and spring, but not change significantly during summer and fall. Rising temperatures will melt snow earlier in spring and increase evaporation, and thereby dry the soil during summer and fall. So flooding is likely to be worse during winter and spring, and droughts worse during summer and fall.



The Sandy River flooded Farmington in January 2006. Credit: Franklin County Emergency Management Agency.

Sea Level Rise, Wetland Loss, and Coastal Flooding

Rising sea level erodes wetlands and beaches and increases damage from coastal storms. Tidal wetlands are inherently vulnerable because of their low elevations, and shoreline development prevents them from migrating inland onto higher ground. Human activities such as filling wetlands have destroyed about one third of New England's coastal wetlands since the early 1800s. Wetlands provide habitat for many bird species, such as osprey and heron, as well as several fish species. Losing coastal wetlands would harm coastal ecosystems and remove an important line of defense against coastal flooding.

Coastal cities and towns will become more vulnerable to storms in the coming century as sea level rises, shorelines erode, and storm surges become higher. Storms can destroy coastal homes, wash out highways and rail lines, and damage essential communication, energy, and wastewater management infrastructure.



Temperature change (°F):
-1 -0.5 0 0.5 1 1.5 2 2.5 3 3.5

Rising temperatures in the last century. Maine has warmed twice as much as the rest of the contiguous 48 states. Source: EPA, Climate Change Indicators in the United States.

https://19january2017snapshot.epa.gov/climate-impacts/climate-change-impacts-state_.html

THE PROCESS

Delivering climate services to coastal & marine stakeholders

ENGAGEMENT

STAKEHOLDERS

SCIENCE

SOLUTIONS

THE PROBLEM

Climate change is an existential threat to coastal communities as we know them.

THE OUTCOME

Local, state, national, and global climate actions empower coastal communities to thrive in a warmer world.

SCIENCE

- Fisheries Ecology
- Resource Economics
- Learning Sciences
- Sea Level Rise
- GHG Emissions
- Blue Carbon / Coastal Ecology
- Physical Oceanography
- Biological Oceanography
- Decision Science

ENGAGEMENT

- Fishermen
- Farmers
- Fisheries Managers
- Students
- K-12 teachers
- Informal Educators
- Municipal Leaders
- Elected Officials
- Marine Businesses

SOLUTIONS

- Ocean Data Products
- Sustainable Seafood
- Aquaculture
- Climate Finance
- Climate Risk
- Ocean Climate Policy
- Adaptation Engineering / Coastal Planning
- Climate Tech / Ventures