



# The Future of Stormwater Management in Maine

Cody Obropta, PE  
Environmental Engineer  
Stormwater Engineering Team

MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION

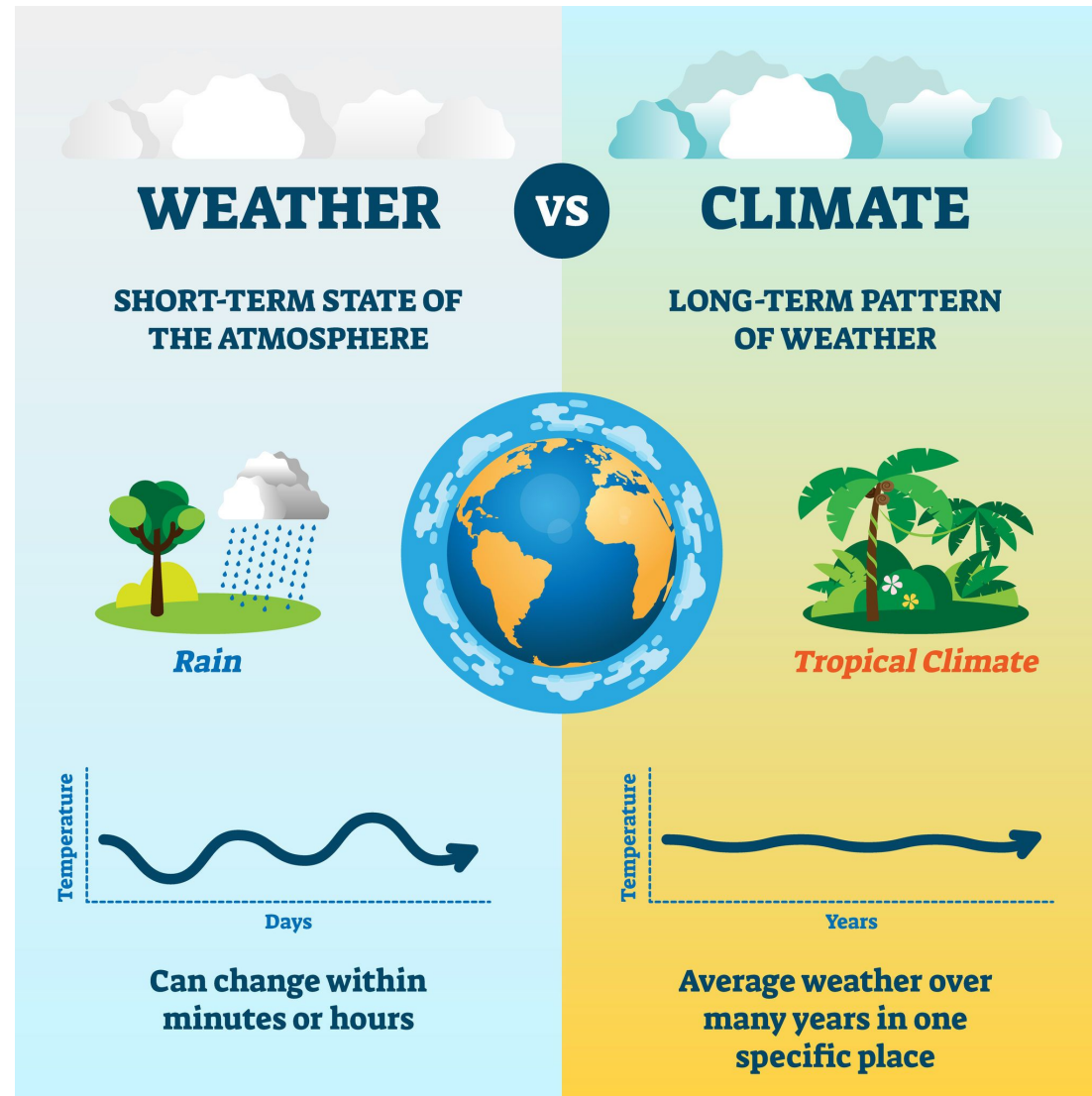
*Protecting Maine's Air, Land, and Water*

# Overview

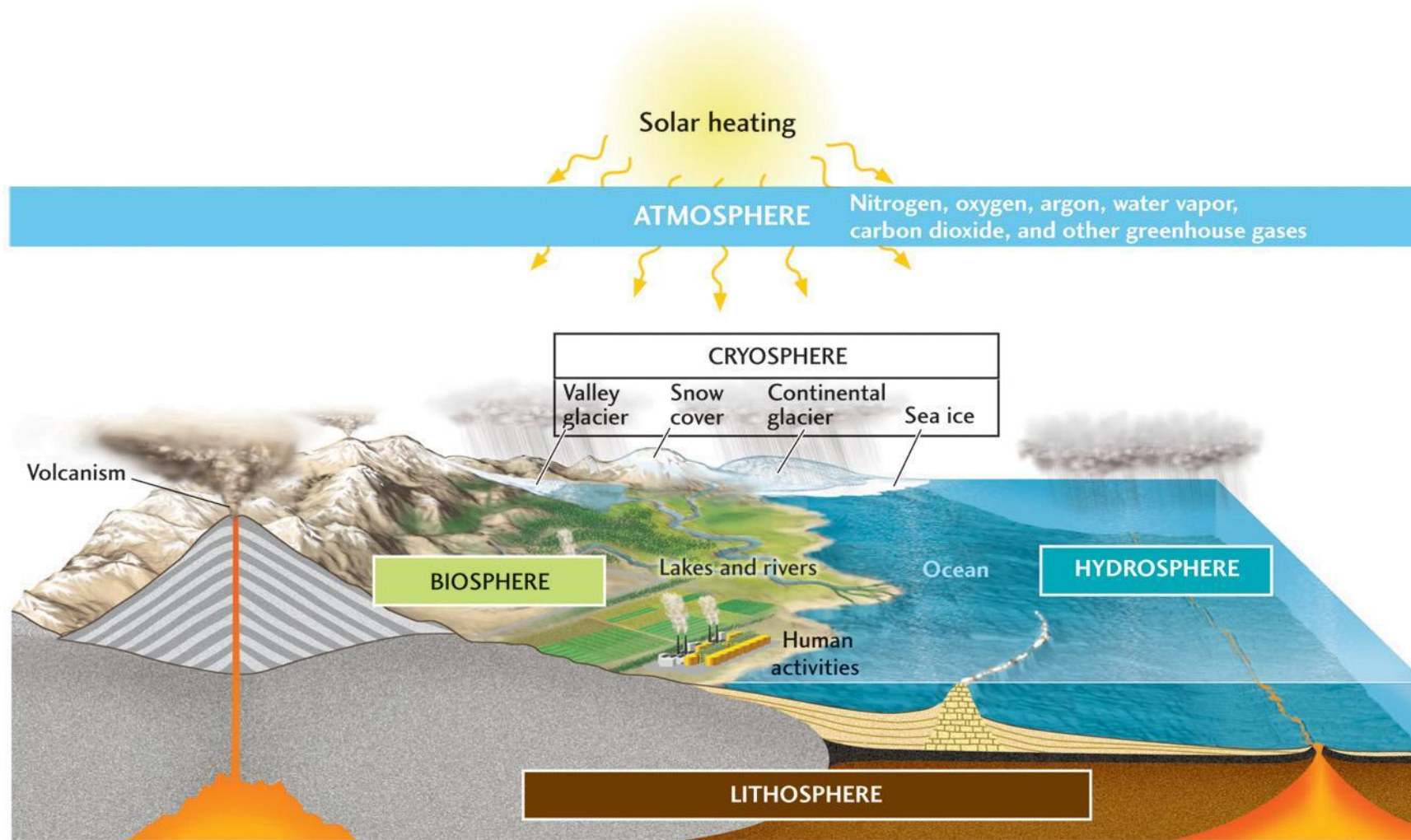
- Intro to Climate Change
- How It Impacts Maine
- Promoting Climate Resiliency
- Chapter 500 Update



# What is Climate?

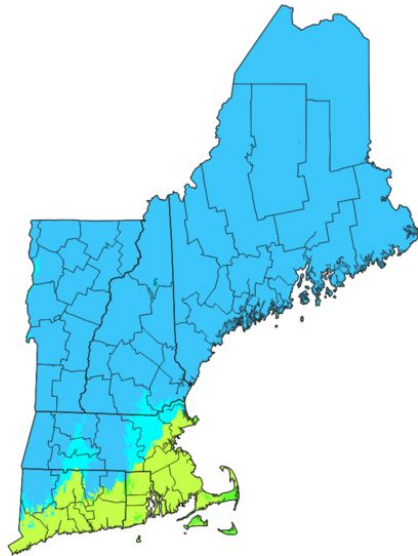


# What is Climate?



# Maine's Climate

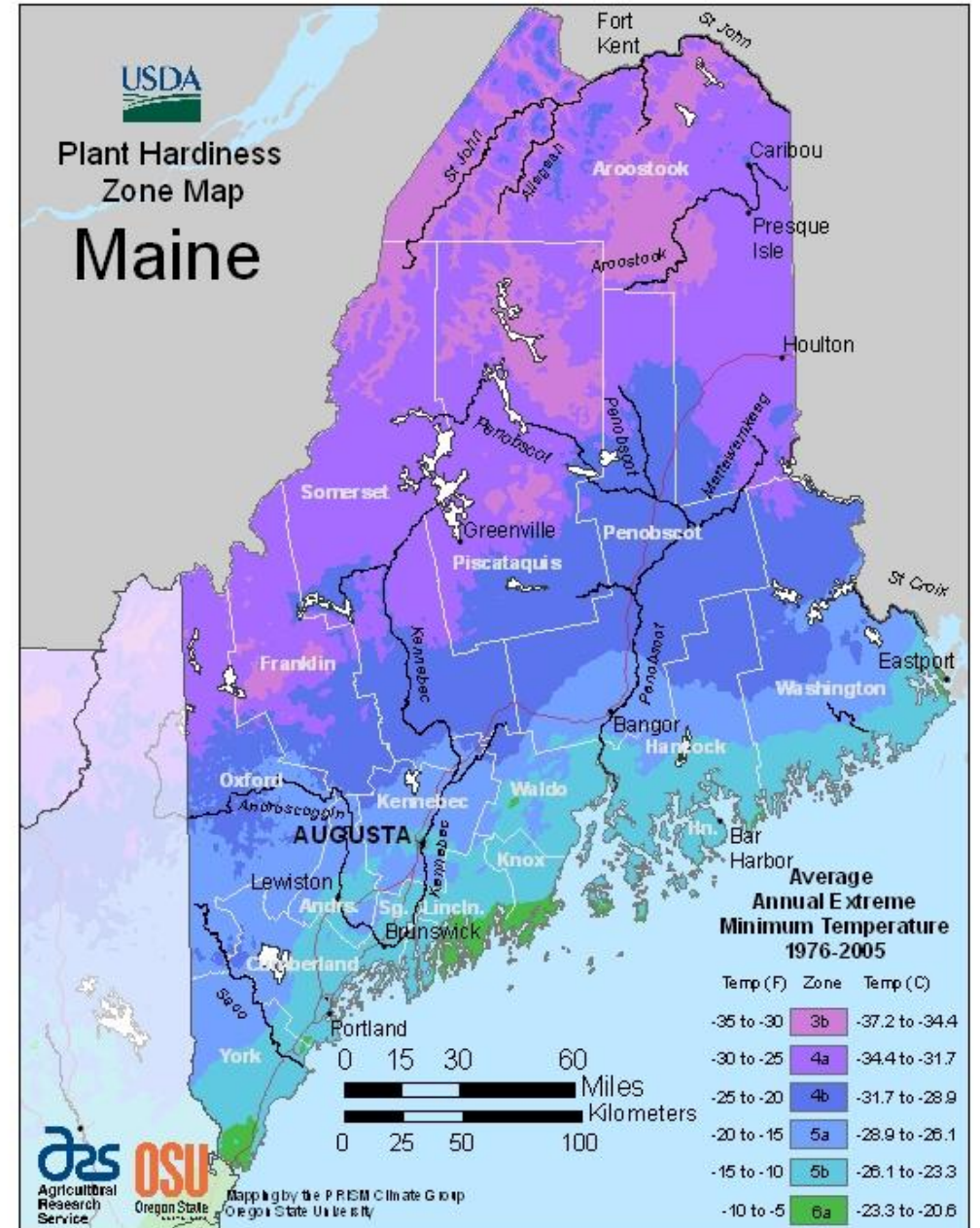
## Köppen Climate Types of New England



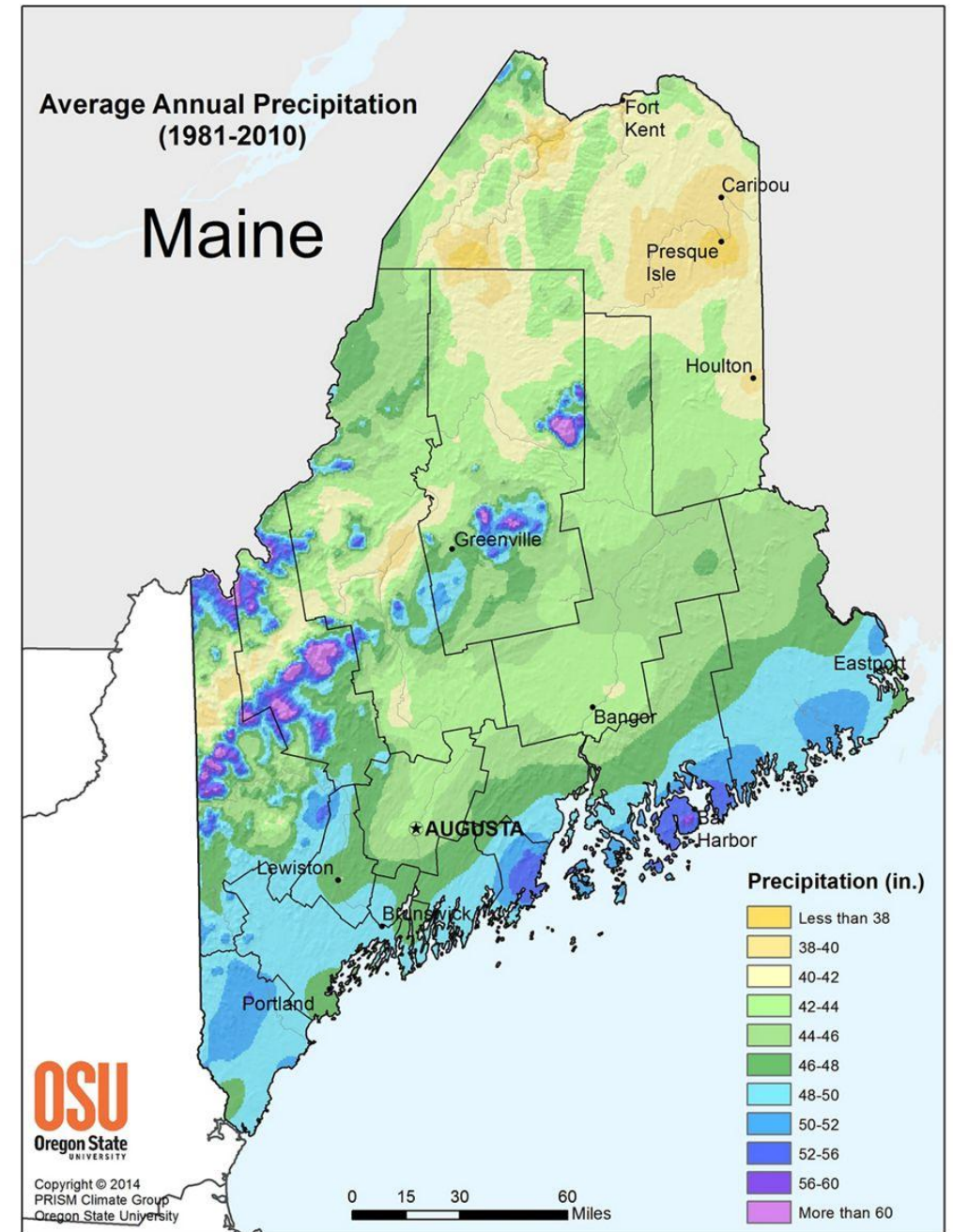
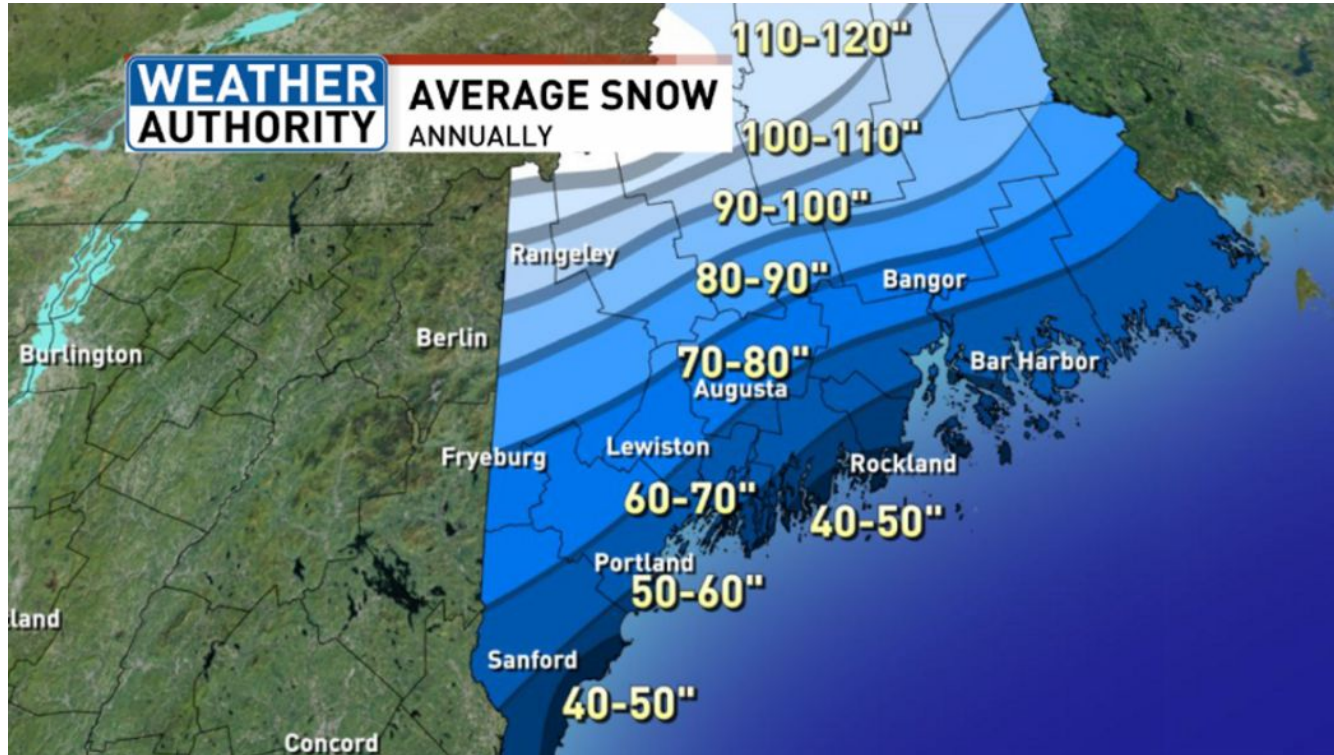
### Köppen Climate Type

- Cfa (Humid subtropical)
- Cfb (Oceanic)
- Dfa (Hot-summer humid continental)
- Dfb (Warm-summer humid continental)
- Dfc (Subarctic)

Data sources: 1991-2020 climate normals from PRISM Climate Group, Oregon State University, <https://prism.oregonstate.edu>; Outline map from US Census Bureau



# Maine's Climate

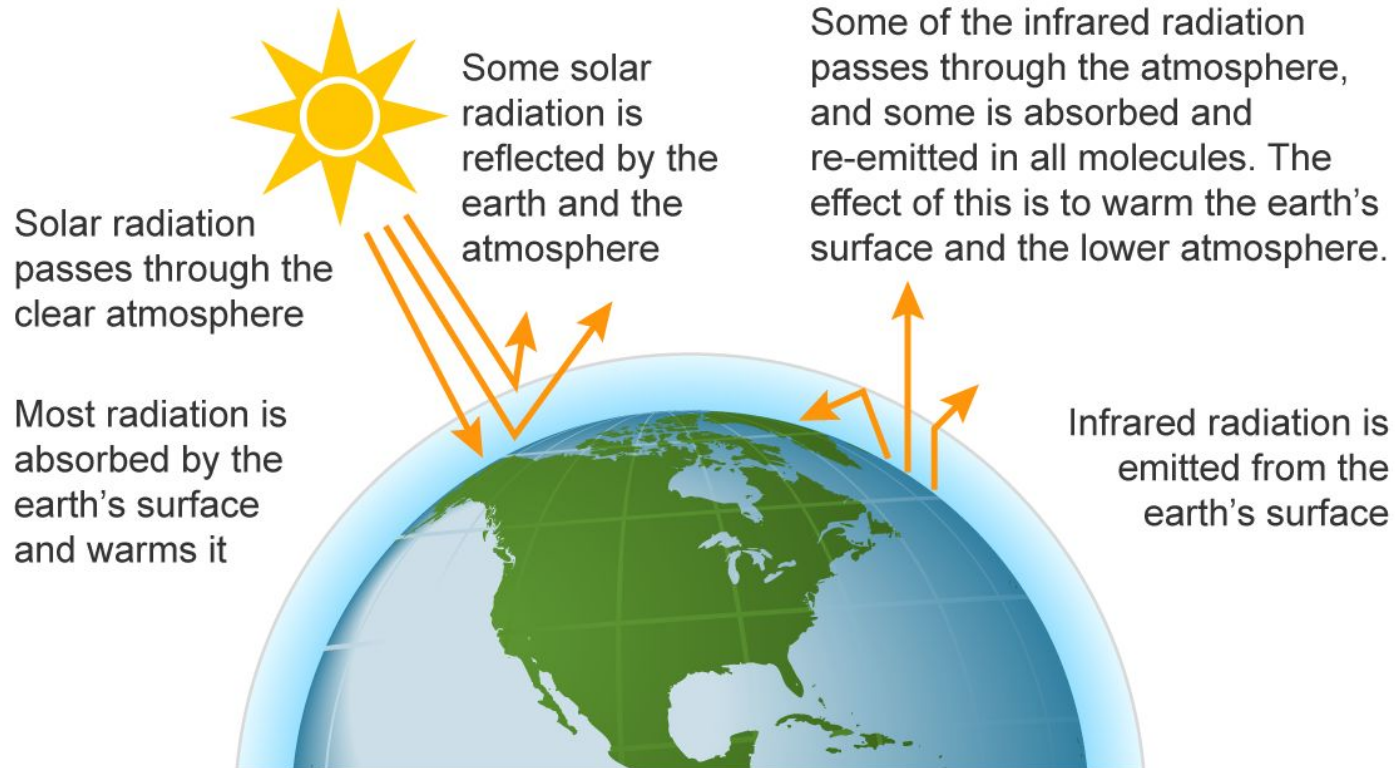


# Climate Change – How It Works



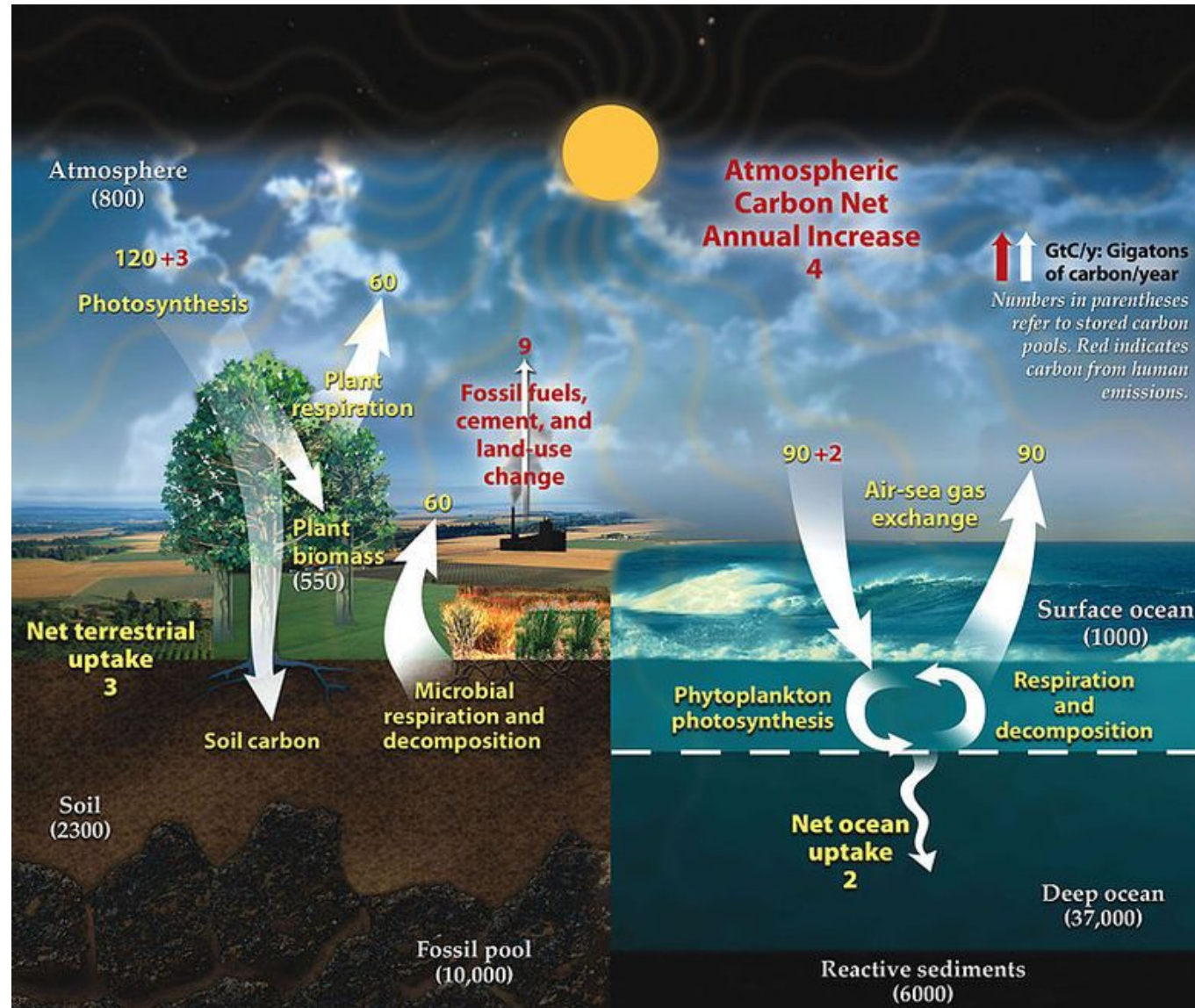
# Climate Change – How It Works

## The greenhouse effect



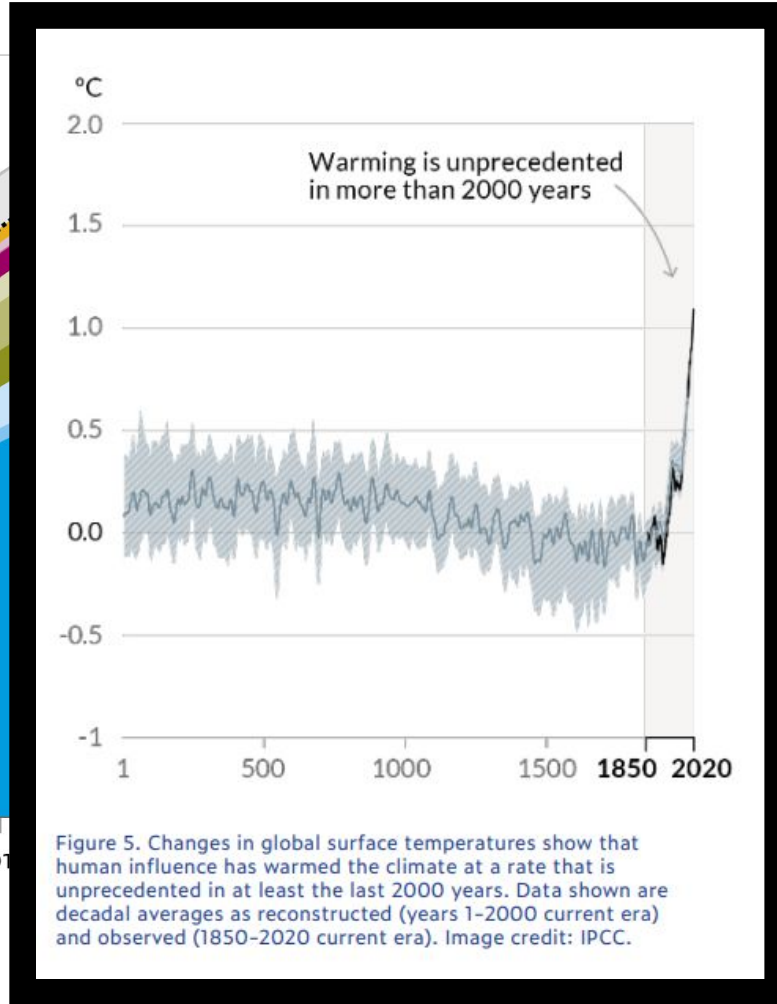
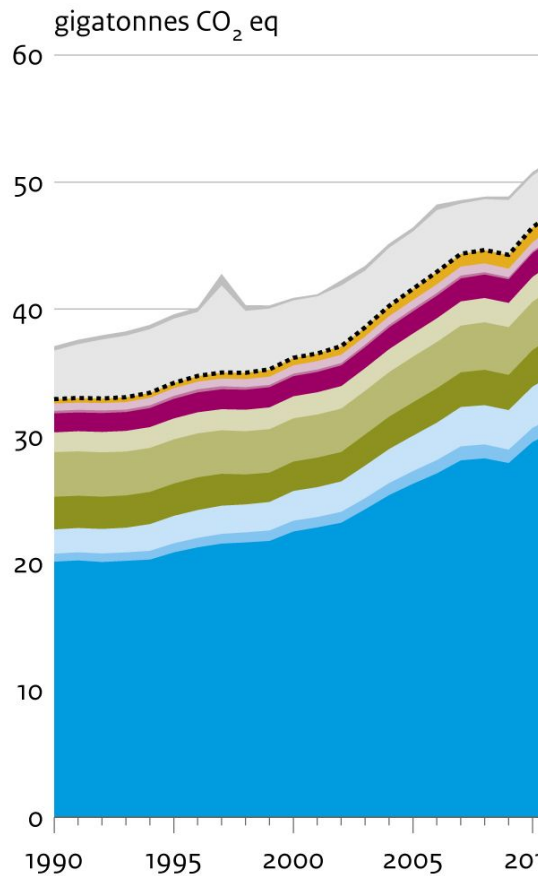


# The Carbon Cycle



# Greenhouse Gasses & Observed Warming

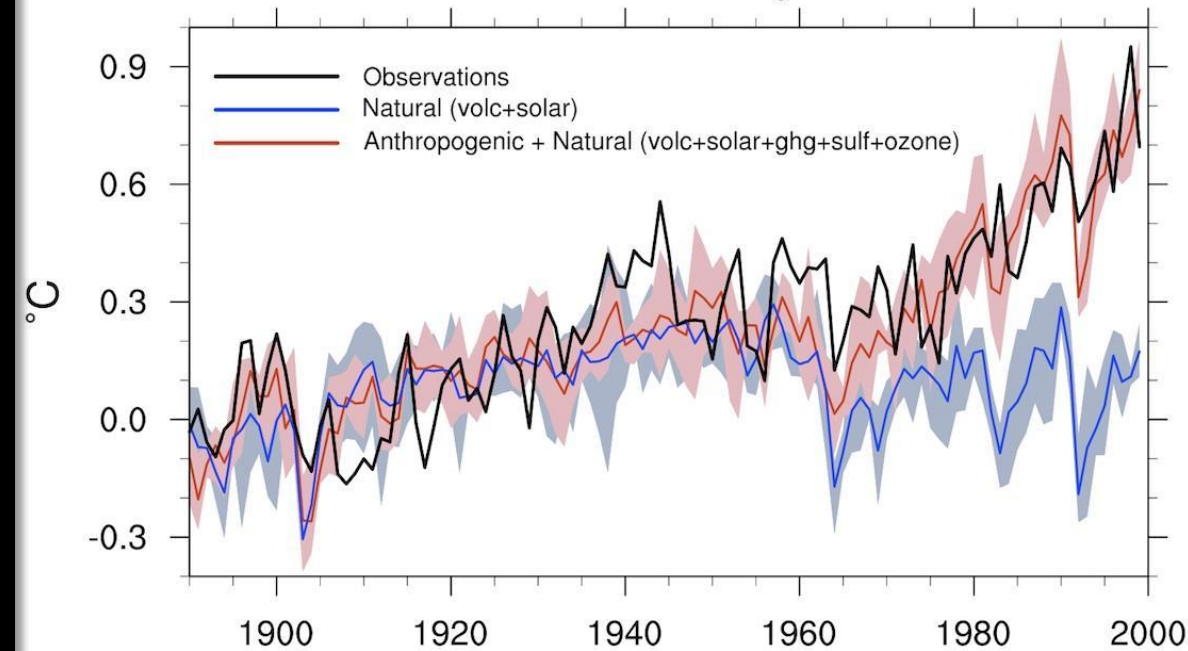
Global greenhouse gas emissions, per type of gas and source, including LULUCF



## Parallel Climate Model Ensembles

Global Temperature Anomalies

from 1890-1919 average



Source: EDGAR v5.0/v4.3.2 FT 2017 (EC-JRC/PBL, 2018); Houghton and Nassikas (2017)



# How Does Climate Change Affect Maine?

State of Maine  
Governor's Office of Policy Innovation and the Future

Contact Us | Sitemap

Search GOPIF

Home About Us Top Initiatives Upcoming Meetings Contact Us

[Home](#) → [Climate Change](#) → [Maine Climate Council Reports](#)

- Clean Transportation Roadmap
- Governor's Forest Carbon Taskforce
- Industrial Innovation Task Force
- Maine Climate Council Quarterly Meetings
- Contact the Maine Climate Council

## Maine Climate Council Reports

The Maine Climate Council is responsible to integrate and prioritize which strategies to move forward in the State Climate Action Plan that will be delivered to the Governor and Legislature by December 1, 2020. The State Climate Action Plan will be updated by the Maine Climate Council every four years moving forward.

### Maine Won't Wait One-Year Progress Report

Read the Progress Report: [\(PDF\)](#)

### Maine Won't Wait, A Four-Year Plan for Climate Action

Read the Plan: [\(PDF\)](#), [HTML5 Flipbook](#) ([Executive Summary](#), [PDF](#))

### Scientific Assessment of Climate Change and Its Effects in Maine


The Maine Climate Council's Scientific and Technical Subcommittee was responsible for delivering a report that summarizes the impacts of climate change in Maine and how it might impact our state in the future. Their final report is part of the State Climate Action Plan. The findings from this report informed the ongoing deliberations of the Maine Climate Council and have aided the Maine Climate Council's six working groups in the development of their draft recommended strategies. In addition, the Scientific and Technical Subcommittee identified critical scientific information gaps and needs to better understand and forecast potential future climate change impacts in the State.

- [Scientific Assessment of Climate Change and Its Effects in Maine \(PDF\)](#) -updated September 23, 2020
- [Read the report online as a flipbook by clicking here \(link\)](#)

**NEW:** Read the STS's [Maine Climate Science Update 2021 \(PDF\)](#)

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

**Scientific Assessment of Climate Change and Its Effects in Maine**



**MAINE CLIMATE COUNCIL  
SCIENTIFIC AND TECHNICAL SUBCOMMITTEE**

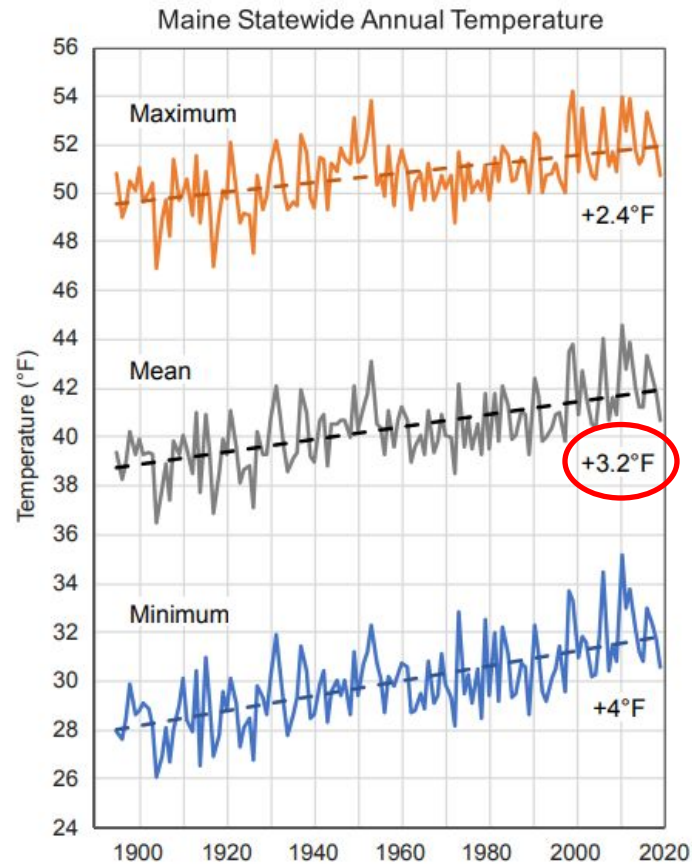
[https://www.maine.gov/future/sites/maine.gov.future/files/inline-files/GOPIF\\_STS\\_REPORT\\_092320.pdf](https://www.maine.gov/future/sites/maine.gov.future/files/inline-files/GOPIF_STS_REPORT_092320.pdf)



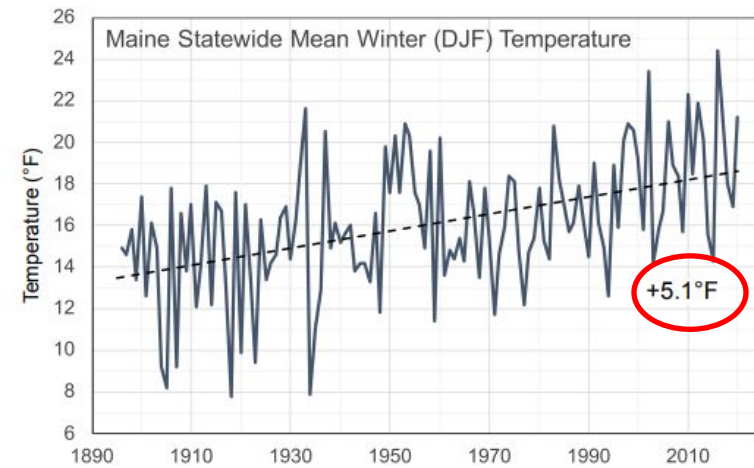
MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION

[www.maine.gov/dep](http://www.maine.gov/dep)

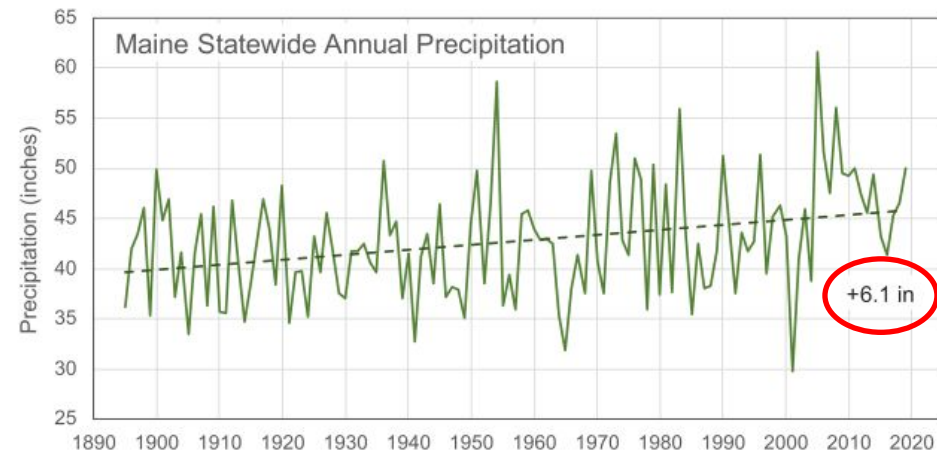
# How Does Climate Change Affect Maine?



**Figure 1.** Maine statewide annual temperature, 1895-2019, based on maximum (top), mean (middle), and minimum (bottom) daily temperature observations. The values at right below each curve show the amount of temperature increase since 1895 based on a linear trend. These values indicate that overnight lows (minimum daily temperatures) have warmed more than daytime highs over this period. Data from the [NOAA U.S. Climate Divisional Database](#).



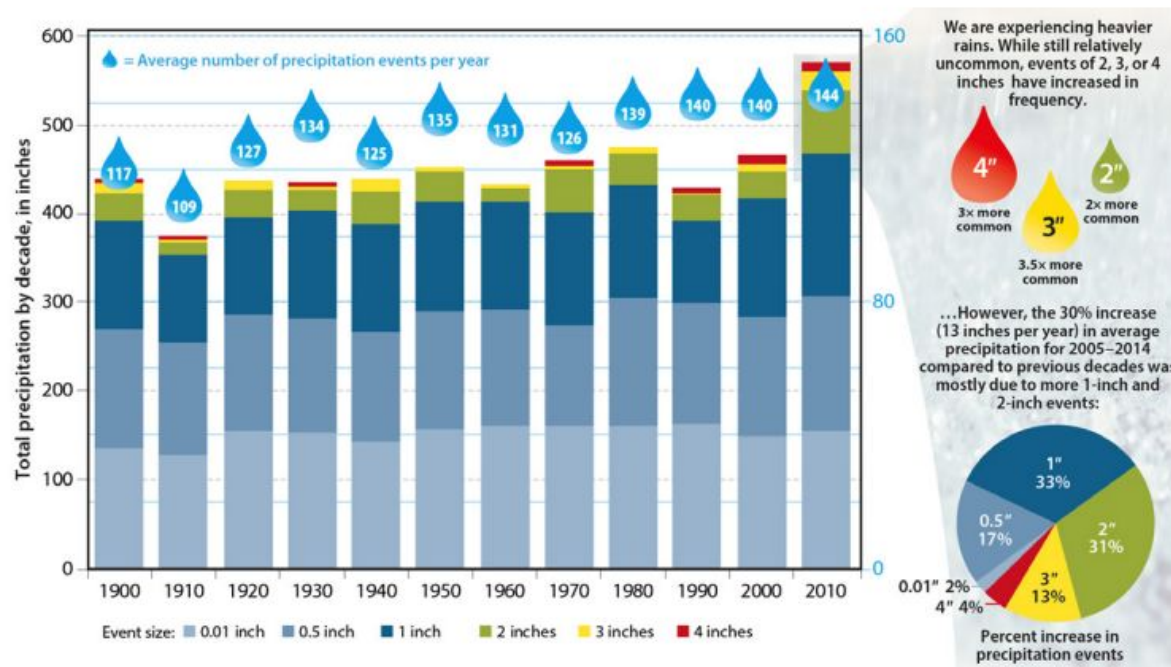
**Figure 4.** Maine statewide mean winter (December-February) temperature, 1895-2020. Data from the [NOAA U.S. Climate Divisional Database](#).



**Figure 2.** Total annual precipitation, 1895-2019, averaged across Maine based on monthly data from the [NOAA U.S. Climate Divisional Database](#). The linear trend shows an overall increase of 6.1 inches for the record period.



# How Does Climate Change Affect Maine?



**Figure 3.** Total decadal precipitation and mean annual number of precipitation events for Farmington, Maine calculated from daily precipitation values. Precipitation events are defined as days with measurable (>0.01 in) rain or water equivalent of snow. Data from the NOAA Global Historical Climatology Network. Figure and caption from Maine’s Climate Future 2020 Update (Fernandez et al. 2020).

- “More frequent and intense extreme precipitation events occurring primarily in summer & fall”
- Most of increase occurs in frequency of 1” and 2” storm events
- 3” and 4” events are increasing in frequency too



# Quotes From the Scientific Assessment:

- “There is high confidence that annual precipitation will increase in Maine in response to increasing greenhouse gas concentrations, particularly during winter and spring (Easterling et al. 2017)”
- “There is high confidence that extreme precipitation events will continue to increase in frequency.”
- “...the ratio of rain to snow events in winter generally increasing (Huntington et al. 2004).”



# How Changes Impact the State

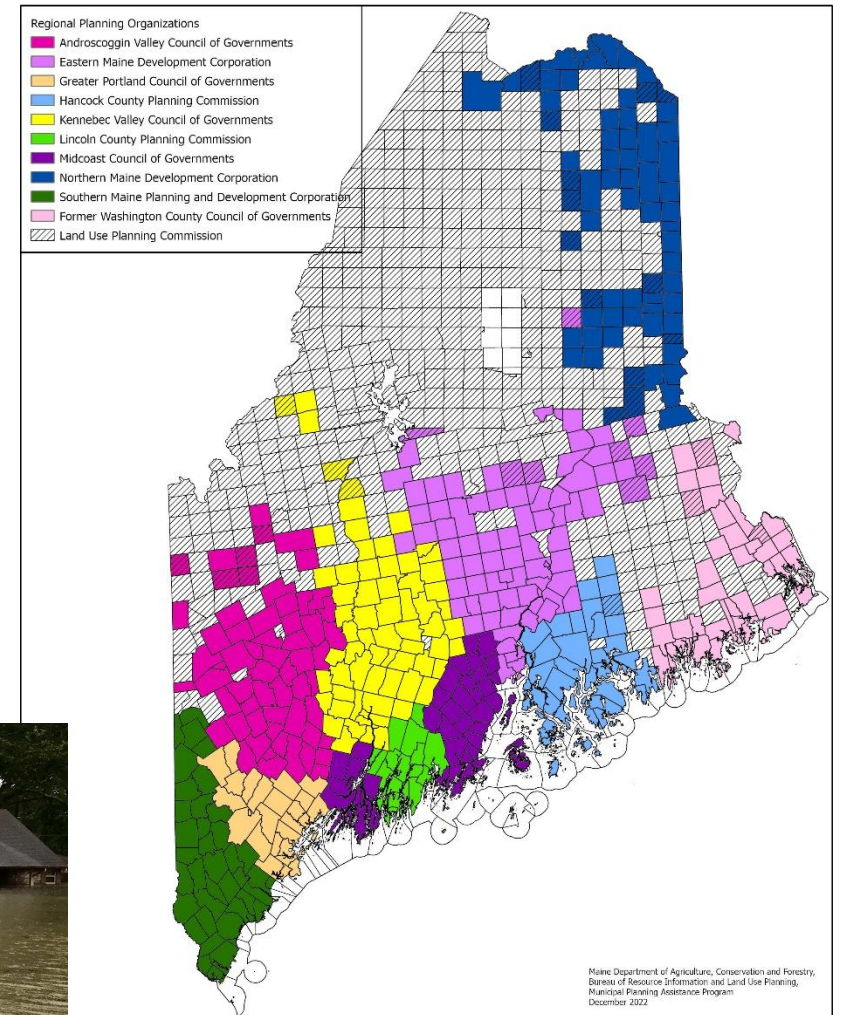
↑ Development = ↑ Flooding + ↑ pollutants

↑ Annual Rainfall = ↑ pollutant transport

↑ Frequency of Extreme Storms = ↑ Flooding



Maine Regional Planning Organizations 2022



Maine Department of Agriculture, Conservation and Forestry,  
Bureau of Resource Information and Land Use Planning,  
Maine's Planning Assistance Program  
December 2022



# How Changes Impact the State

↑ Temperatures = ↑ Water Temperatures

↑ Water Temperatures = ↑ Algal Growth

↑ Algal Growth = ↓ Water Clarity = ↓ Biodiversity

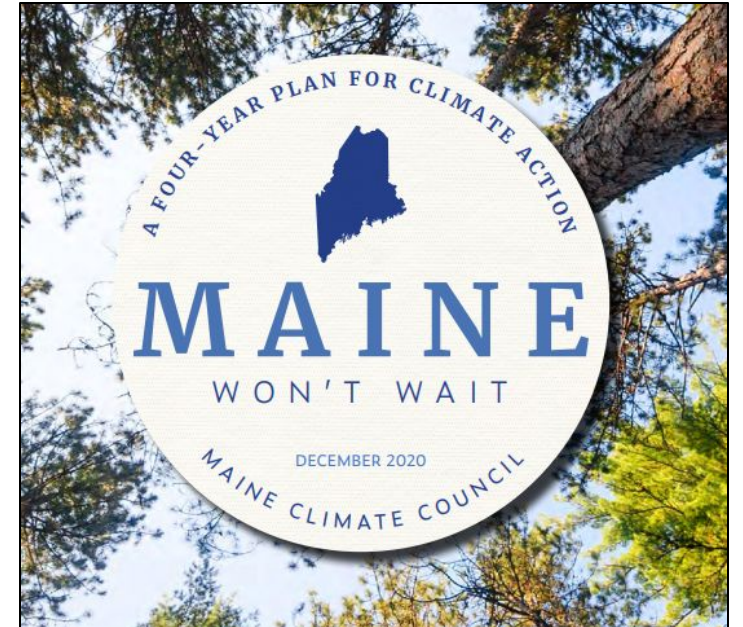
↓ Water Clarity = ↓ Property Values





# Maine Won't Wait Climate Goals

- Strategy E: Protect Maine's Environment and Working Lands and Waters
- Strategy F: Build Healthy and Resilient Communities
- Strategy G: Invest in Climate-Ready Infrastructure



# Strategy E: Protect Maine's Environment and Working Lands and Waters



- Land preservation reduces stormwater runoff
- Land preservation maintains water quality treatment and groundwater recharge



# Strategy F: Build Healthy and Resilient Communities

- Green Infrastructure Co-Benefits
  - Reduce air pollution
  - Reduce urban heat island effect
  - Stormwater quality treatment
  - Promote biodiversity
  - Aesthetic value



# Strategy G: Invest in Climate-Ready Infrastructure

- LID & GI often have lower maintenance costs
- Stormwater infrastructure can treat water quality, recharge groundwater, and control volume while also providing co-benefits
- Design infrastructure to handle increased rainfall frequency & volumes



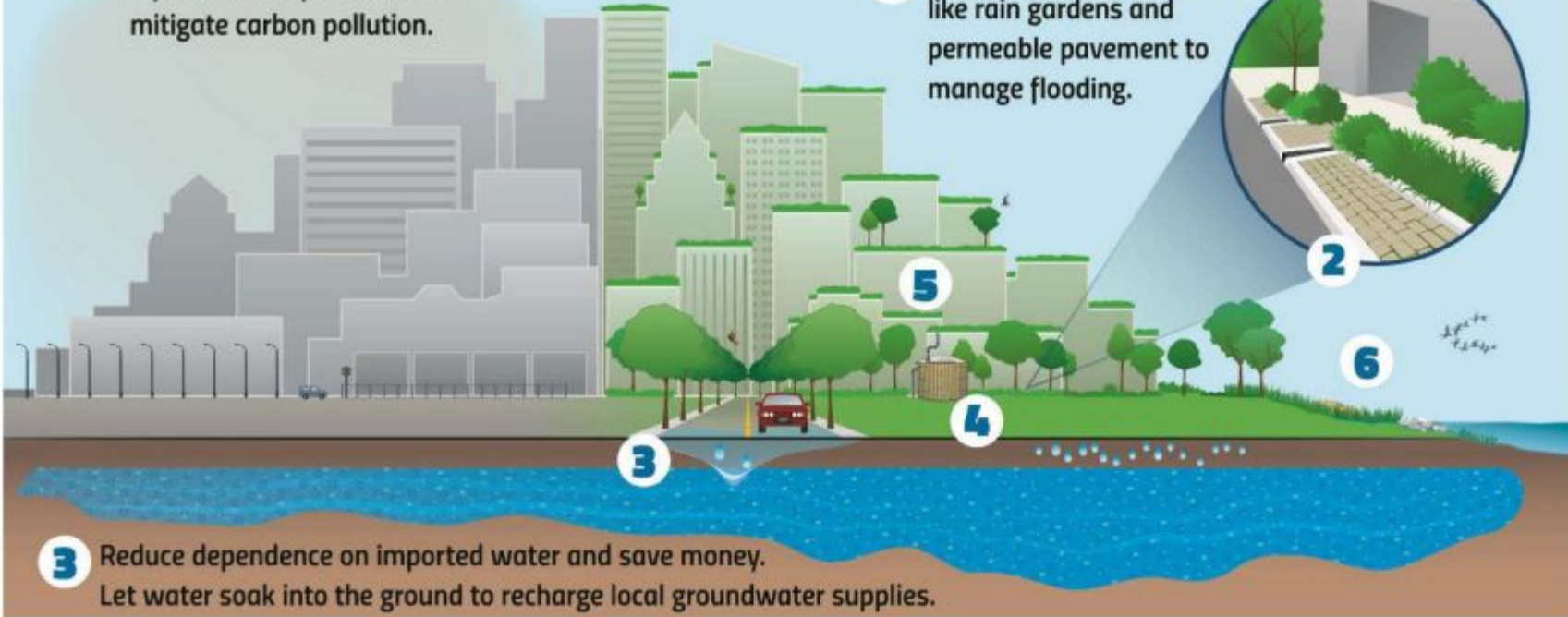
Urban green infrastructure



# Green Infrastructure Builds Resiliency

**1** Vegetation-based green infrastructure practices can mitigate carbon pollution.

**2** Build green infrastructure like rain gardens and permeable pavement to manage flooding.



**3** Reduce dependence on imported water and save money. Let water soak into the ground to recharge local groundwater supplies.

**4** Keep water local. Capture runoff in cisterns and rain barrels to reduce municipal water use.

**5** Plant trees and green roofs to mitigate the urban heat island effect.

**6** Use living shorelines, buffers, dunes and marsh restoration to reduce the impact of storm surges.

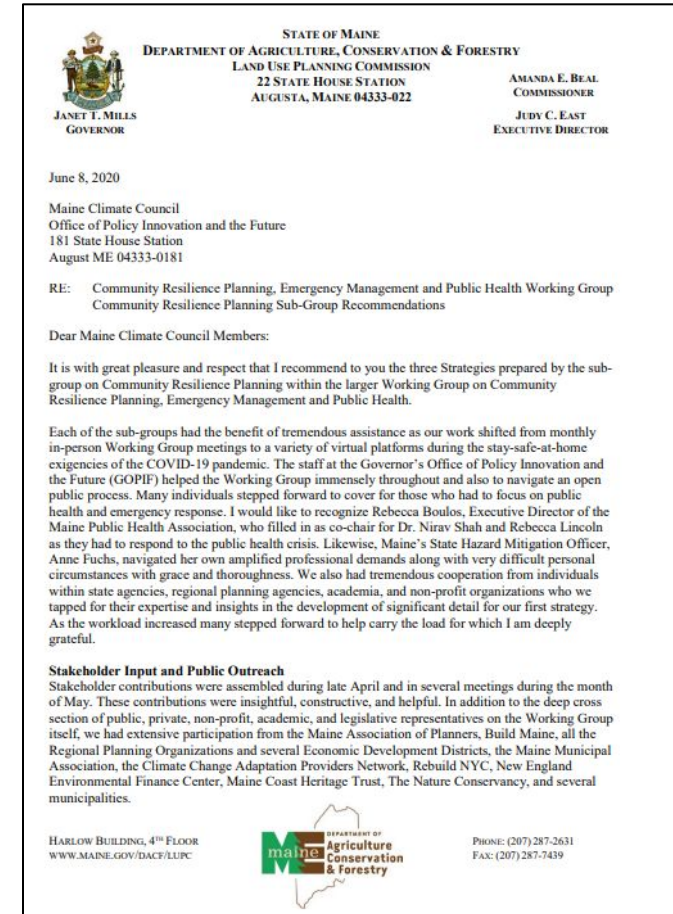


For more information on green infrastructure, see:  
[www.epa.gov/greeninfrastructure](http://www.epa.gov/greeninfrastructure)



# Resiliency Working Group Recommendations

- Recommends specific items to revise in the Chapter 500 Stormwater Rules
  - Adding stronger LID requirements
  - Strengthening flooding standard
  - Updating sizing of BMPs and erosion controls align with changing precipitation frequencies and intensities



[https://www.maine.gov/future/sites/maine.gov.future/files/inline-files/CommunityResiliencePlanning\\_FinalStrategyRecommendations\\_June2020.pdf](https://www.maine.gov/future/sites/maine.gov.future/files/inline-files/CommunityResiliencePlanning_FinalStrategyRecommendations_June2020.pdf)



# Maine Chapter 500 Updates

- Currently scheduling meetings for the stakeholder process
  - Target date: June
- Areas of focus:
  - Streamlining
  - Low Impact Development
    - Infiltration
    - Green Infrastructure
  - Climate Change



[https://public.govdelivery.com/accounts/MEDEP/subscriber/new?topic\\_id=MEDEP\\_56](https://public.govdelivery.com/accounts/MEDEP/subscriber/new?topic_id=MEDEP_56)



# Wrapping Up

- Climate change will increase the frequency and intensity of precipitation in the state.
- The Maine Won't Wait climate action plan and resiliency working group have recommendations to improve stormwater management to be climate resilient.
- Some recommendations & improvements will be included in the Chapter 500 update.





# Moving Forward





**Contact:**  
Cody Obropta, PE  
Stormwater Engineering Team  
207-356-1481  
[cody.obropta@maine.gov](mailto:cody.obropta@maine.gov)

*[www.maine.gov/dep](http://www.maine.gov/dep)*

