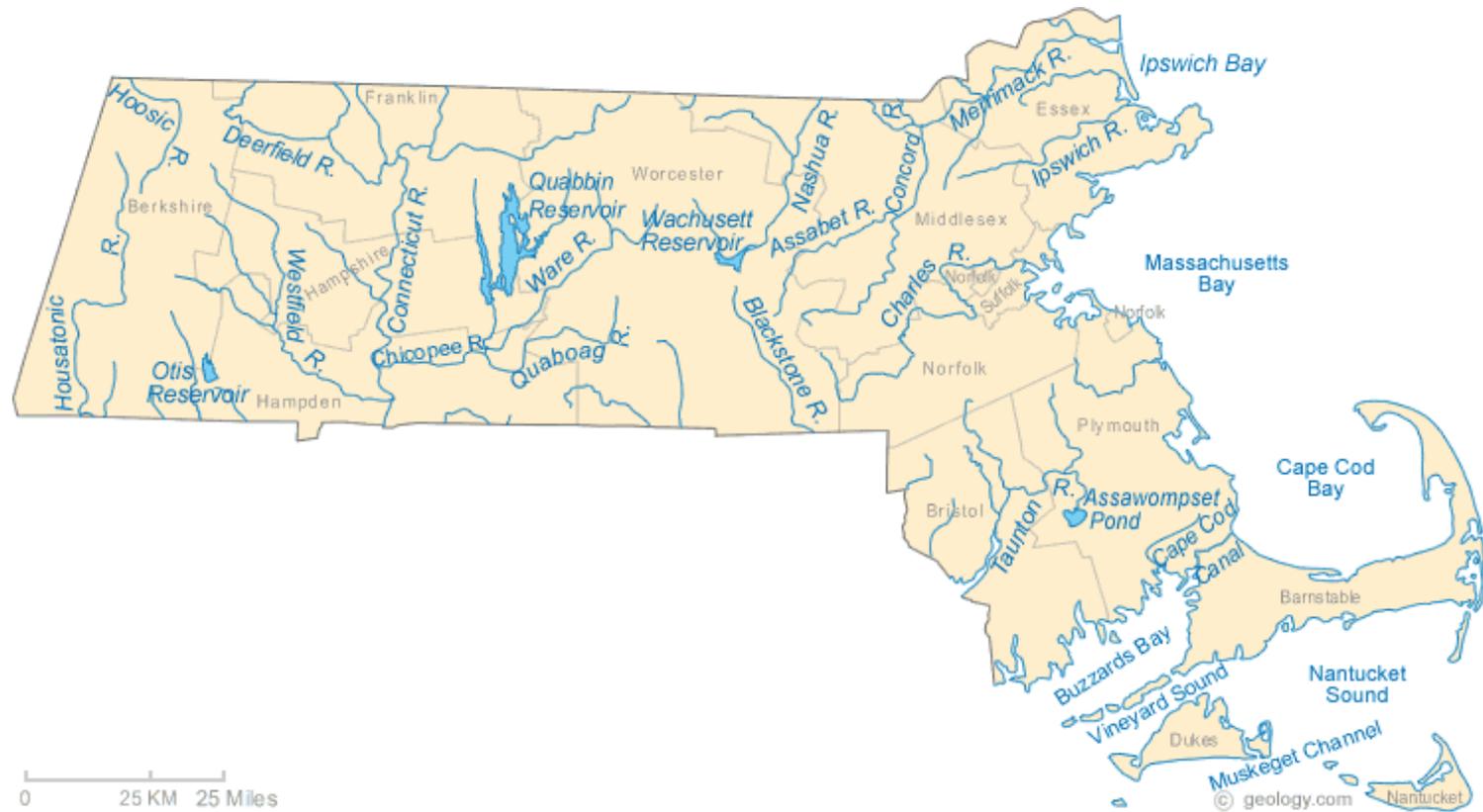


# How will global warming of 2°C affect Massachusetts?



**Observed and projected changes  
in climate and their impacts**

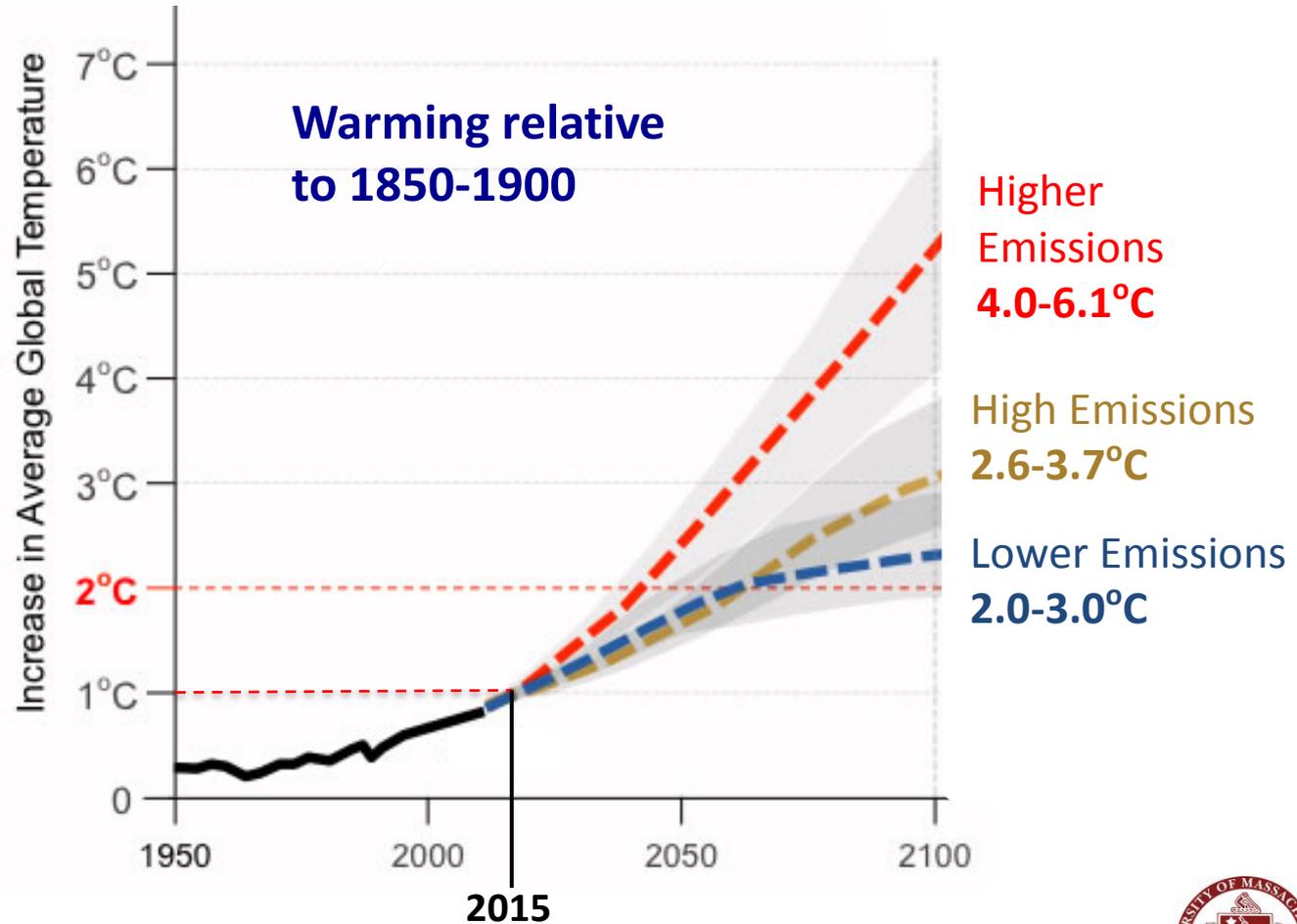
***“To prevent dangerous interference with the climate system, the scientific view is that the increase in global temperature should be below 2°C [relative to pre-industrial levels]”.***

- United Nations Framework on  
Climate Change, 2010

# How will global temperatures change in the future?

The global average temperature has already increased by about 1°C (1.8°F) relative to pre-industrial levels.

Current CO<sub>2</sub> emissions are tracking the 'higher emissions' scenario; unless emissions are reduced, the 2°C threshold will be crossed before 2050.

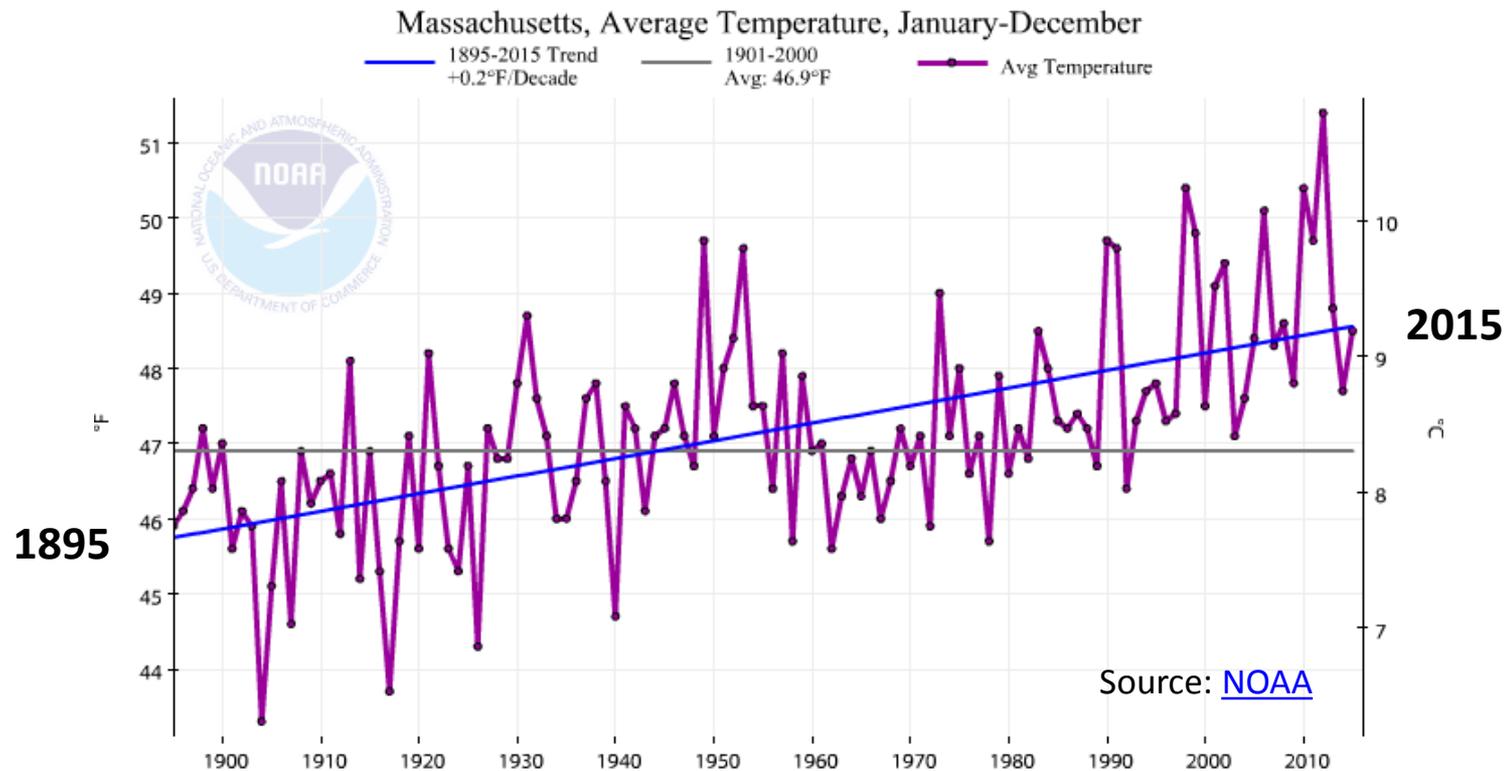


# Warming in Massachusetts



## OBSERVATIONS

The annual mean temperature in MA has already increased by about 2.4°F (1.3°C) since 1895 – faster than the rise in global mean temperature.



***The annual mean temperature in MA exceeded the 20th-century average every year since 1993 (the last 22 years).***

# Warming in Massachusetts

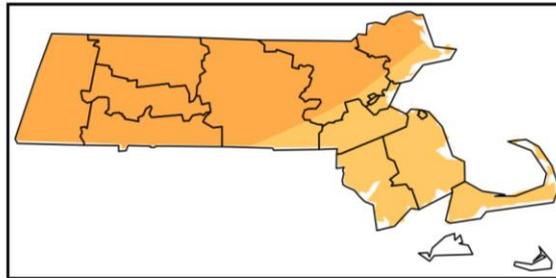


## PROJECTIONS

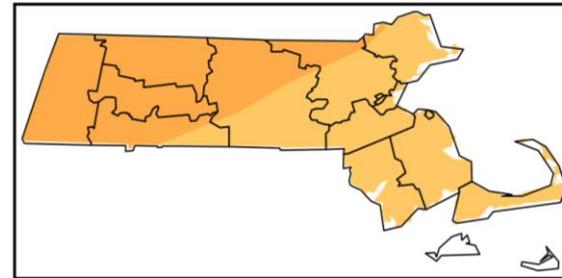
In the next 50-60 years, when global warming crosses the 2°C threshold, MA average summer and winter temperatures are projected to increase by over 6°F (3.3°C) relative to pre-industrial levels.

Lower Emissions

Winter

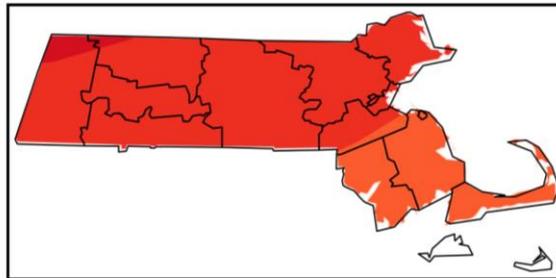


Summer

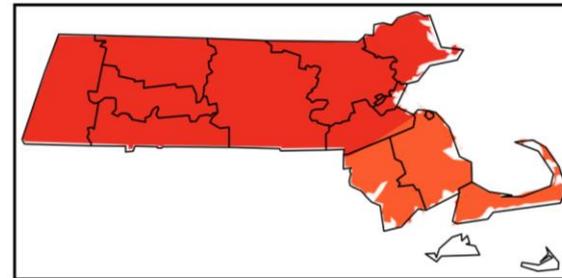


Higher Emissions

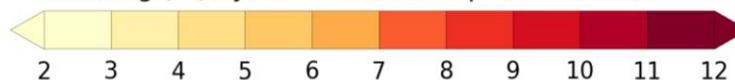
Winter



Summer



Warming (°F) by 2070 relative to pre-industrial levels



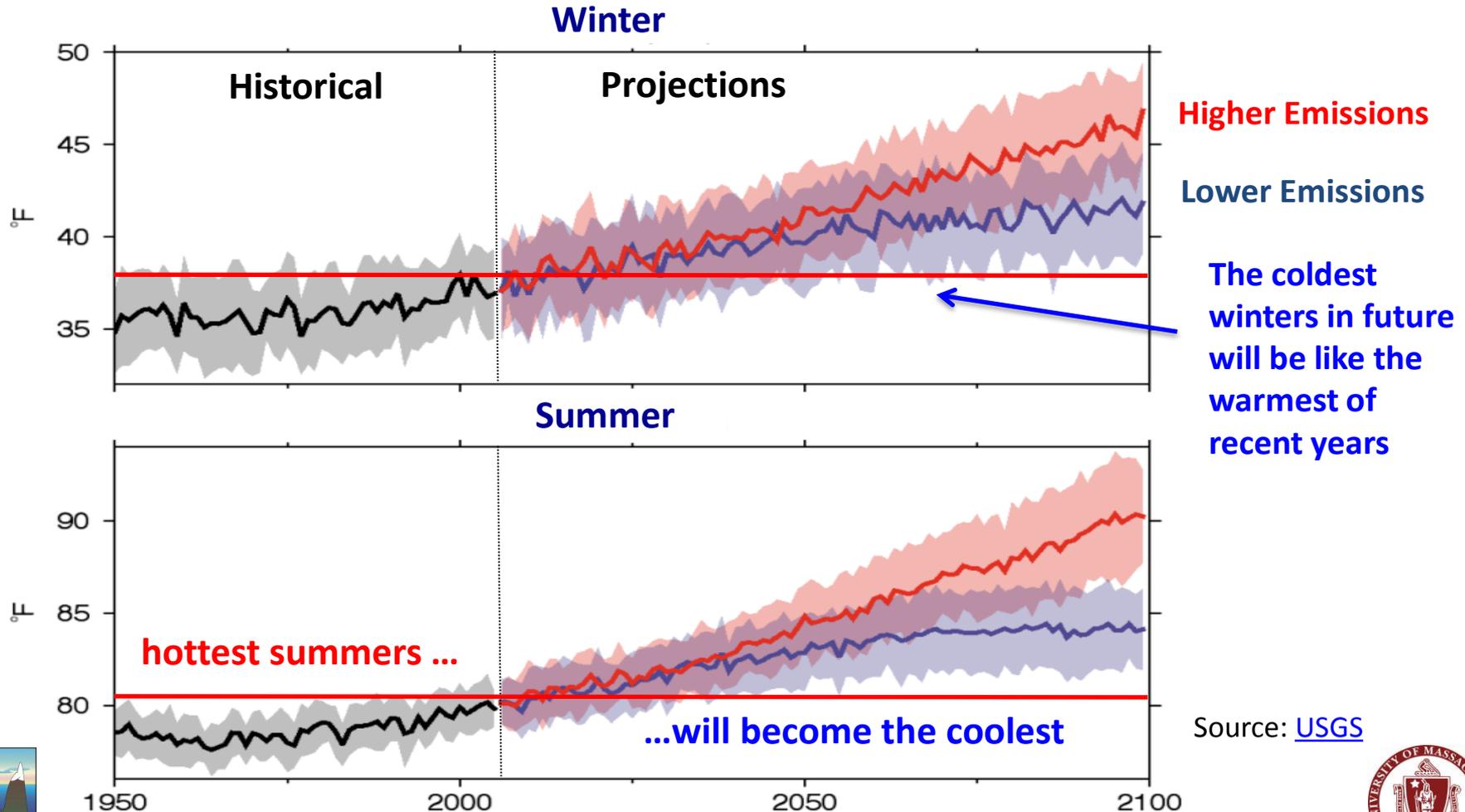
Source: produced by CSRC, UMass Amherst

# Warming in Massachusetts



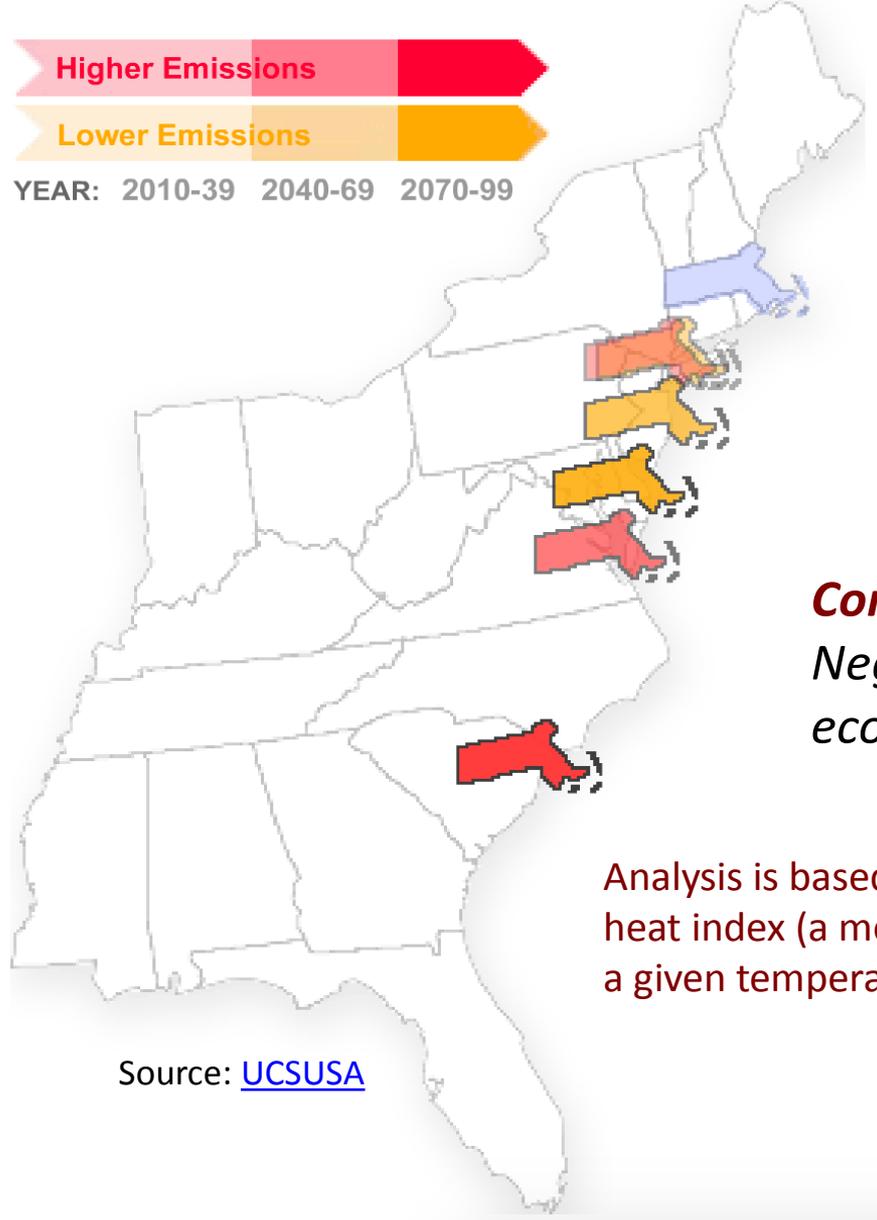
## PROJECTIONS

How warm will Winter and Summer temperatures become?



Source: [USGS](#)

# Migrating Massachusetts Climate



## PROJECTIONS

Summer in Massachusetts by the end of this century could feel like a present-day typical summer in South Carolina.

### *Consequences:*

*Negative impacts on human health, ecosystems, and the economy.*

Analysis is based on changes in average summer heat index (a measure of how it actually feels for a given temperature and humidity).

Source: [UCSUSA](https://www.ucsusa.org)

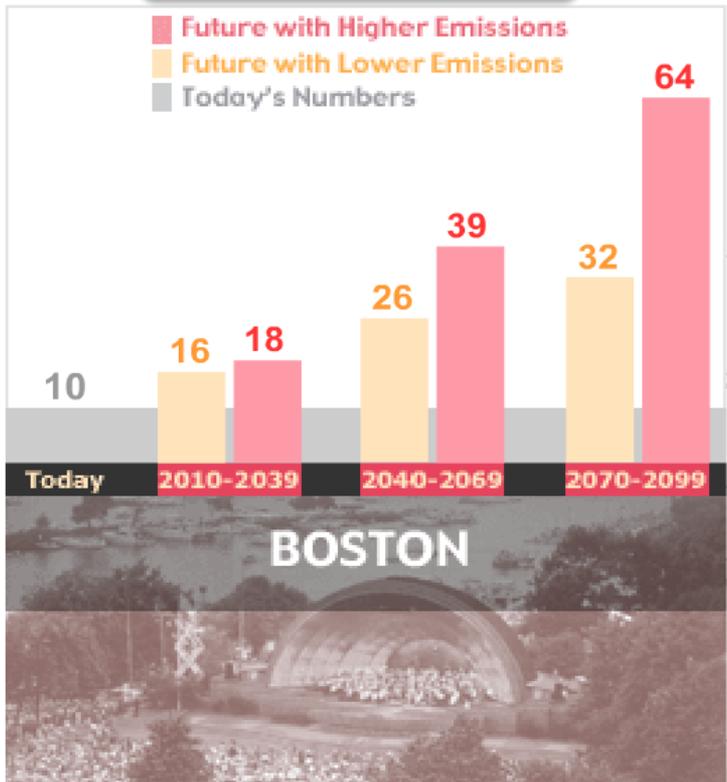
# Extreme Heat



## OBSERVATIONS

Summer daytime high temperatures in Boston rarely go above 90°F in today's climate.

### Days over 90°F



### Days over 100°F

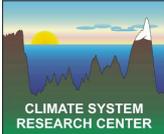
Today	2070-2099	
1	6	24

↑ Lower Emissions    ↑ Higher Emissions

## PROJECTIONS

The number of days with dangerously high temperatures (above 100°F) is projected to increase significantly in the future.

Source: [UCSUSA](http://UCSUSA)

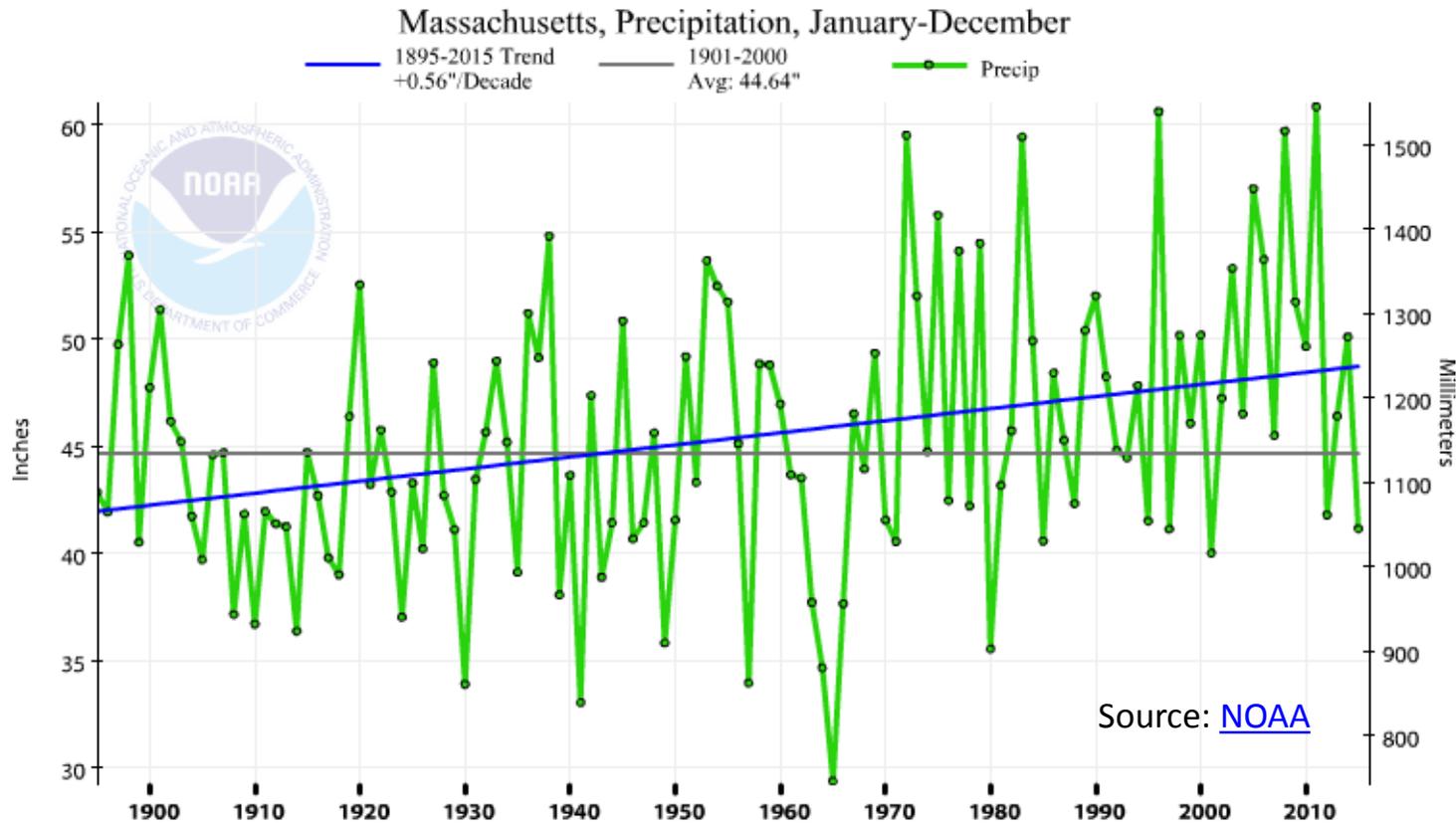


# Rain and Snow in Massachusetts



## OBSERVATIONS

Annual total precipitation (rain + snow) has increased over the last few decades.



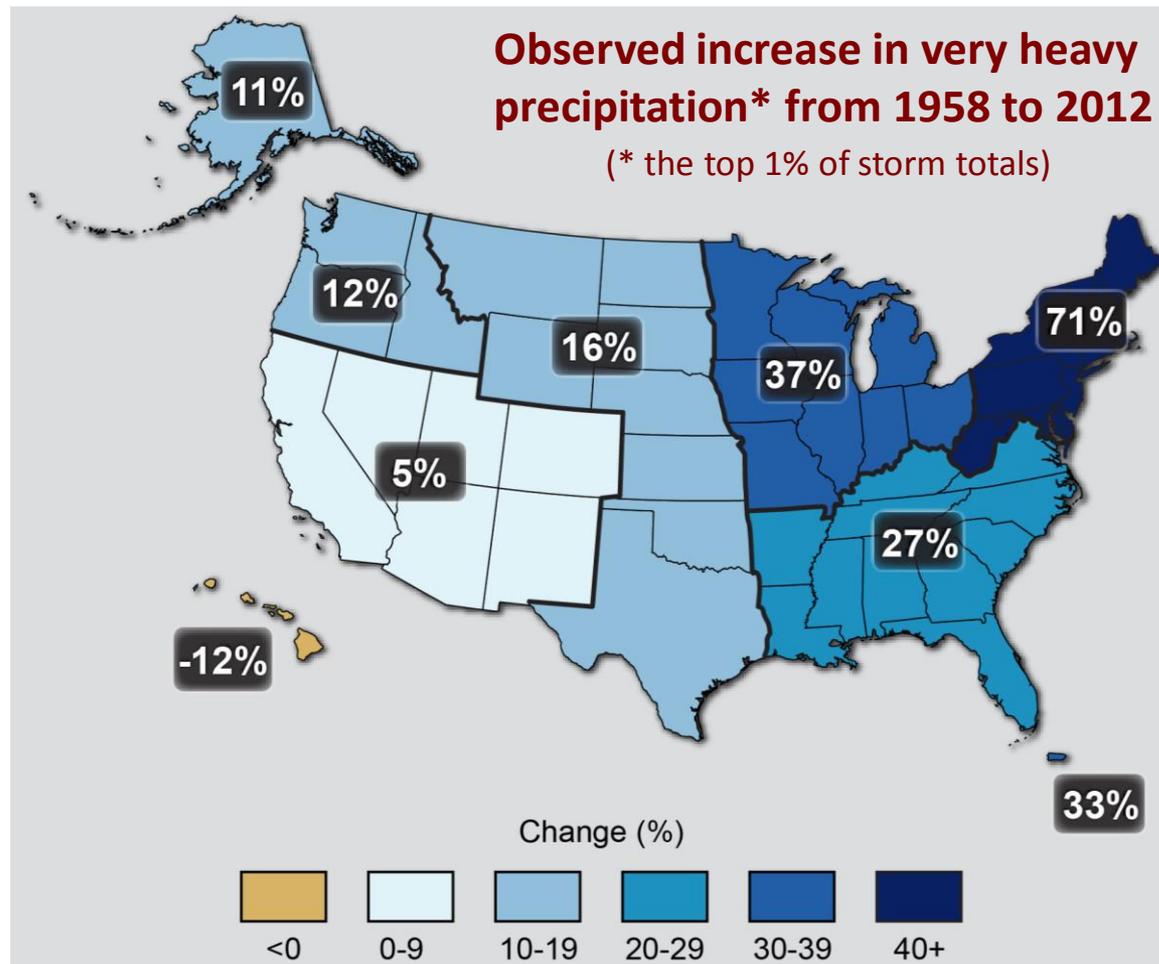
*In 8 out of the last 10 years, Massachusetts received more precipitation than the 20<sup>th</sup> century average.*

# Very Heavy Rainfall

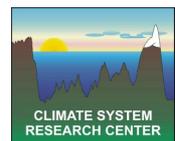


## OBSERVATIONS

The amount of precipitation falling during intense multi-day events has increased significantly in the Northeast US.



Source: [NCA](#)  
[2014](#)



# Devastating floods in recent years



Taunton River flood in Taunton MA, March 2010



Floodwaters in Shelburne, MA after hurricane Irene, Aug 2011



Coastal flooding in Scituate, MA after winter storm Juno, Jan 2015

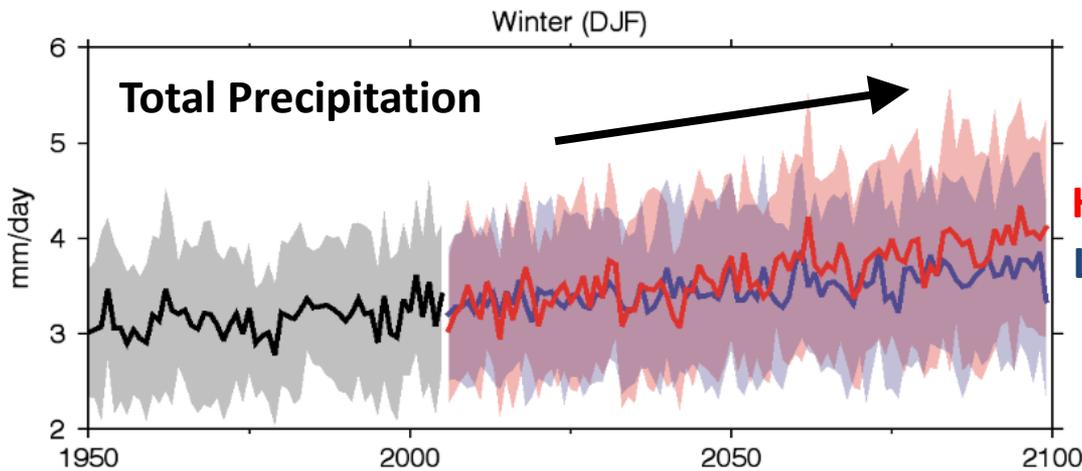
Source: <http://solutionaries.net/>

# Rain and Snow in Massachusetts



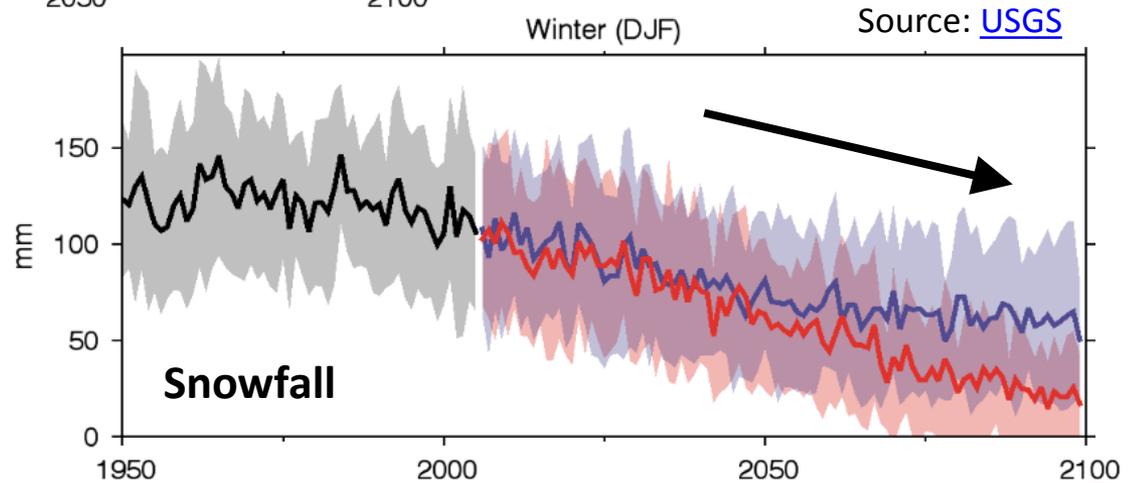
## PROJECTIONS

Winter precipitation is projected to increase through the 21<sup>st</sup> century.



Higher Emissions  
Lower Emissions

Due to increasing temperatures, there will be more rain and less snow.



Source: [USGS](#)

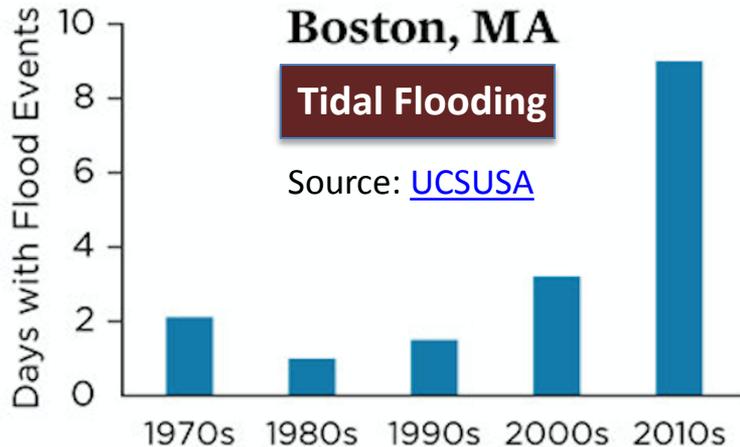
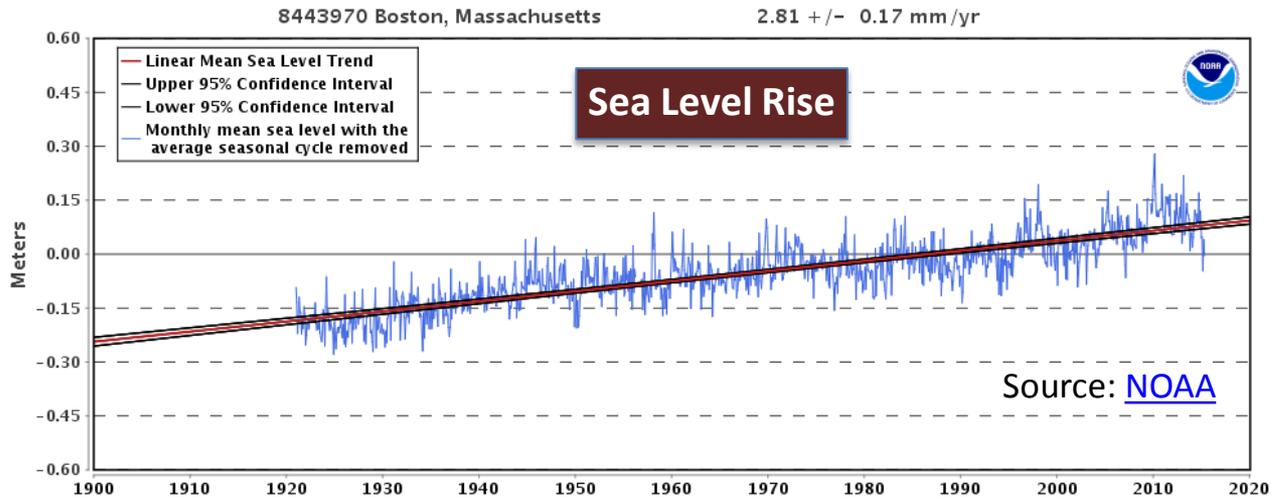
Projected changes in rainfall in summer are uncertain.

# Sea Level Rise



## OBSERVATIONS

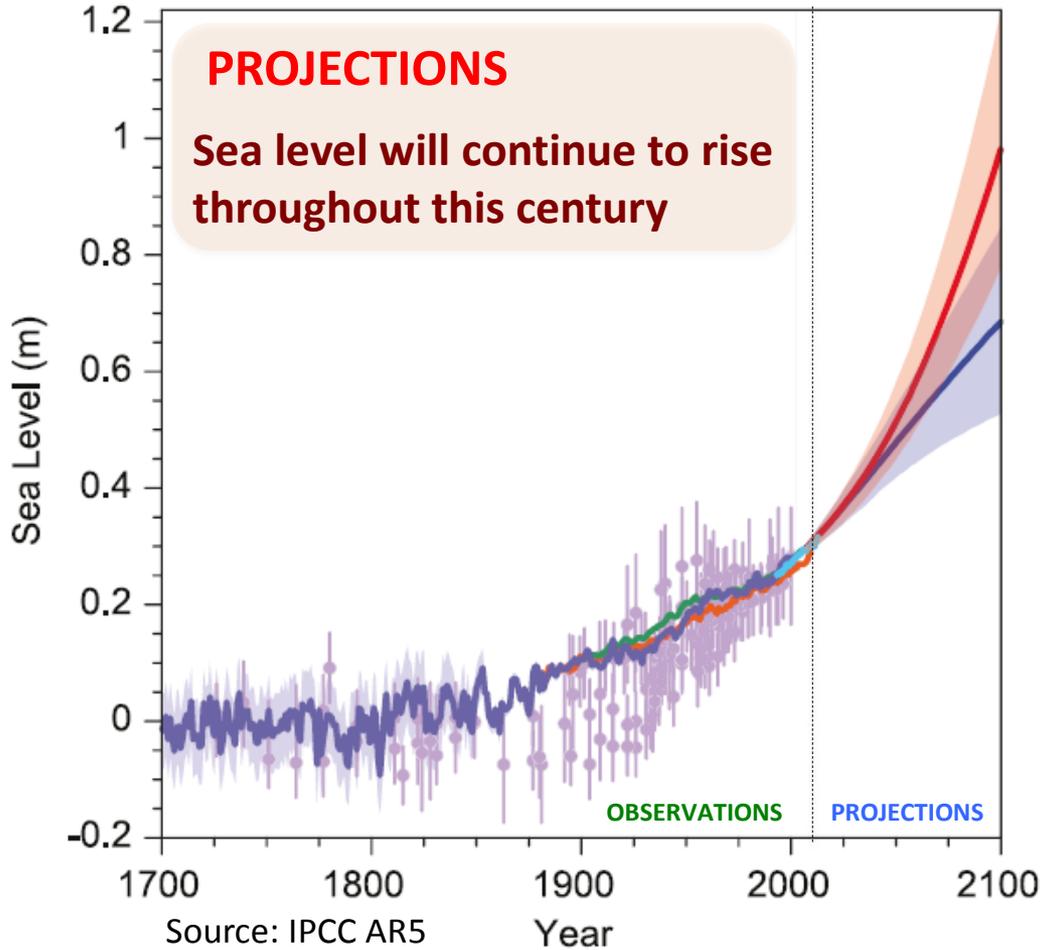
Over the last century, sea level has risen by about 0.9 feet around Boston MA.



*Seemingly small increases in sea level can have large impacts along the coast due to storm surges and exceptionally high tides.*

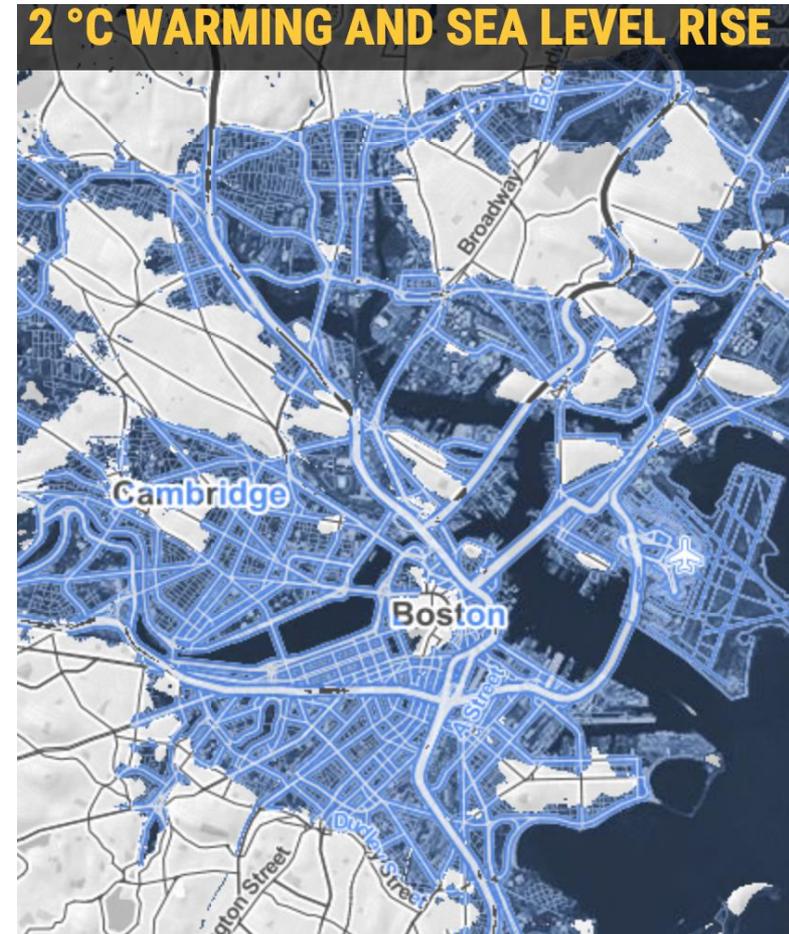
Communities in Boston are now seeing more days with tidal flooding.

# Sea Level Rise

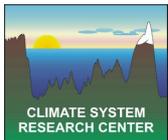


Recent studies indicate that we are likely to experience more than 1m (3.3ft) of sea level rise by 2100

Projected inundation around Boston



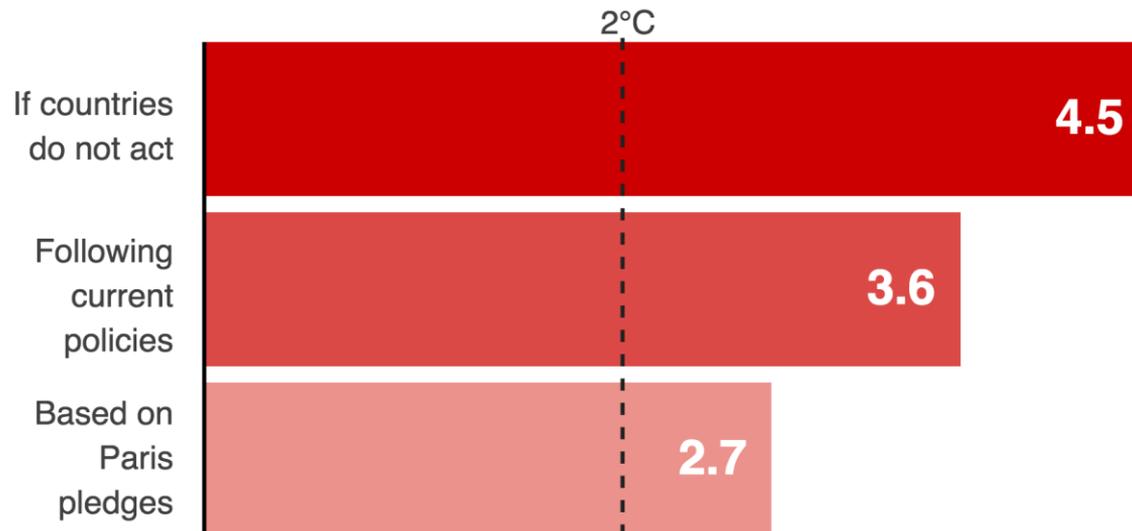
Source: [Climate Central](https://www.climatecentral.org/)



# Climate Summit in Paris [COP21]

Immediate action on local and global scales is required to limit the global mean temperature increase to 2°C (3.6°F).

Average warming (°C) projected by 2100



Source: Climate Action Tracker, data compiled by Climate Analytics, ECOFYS, New Climate Institute and Potsdam Institute for Climate Impact Research.

# Strategies and Actions

## National Climate Assessment:

*The NCA summarizes the impacts of climate change in the US, now and in the future.*

## **Integrating Climate Change into State Wildlife Action Plan (SWAP):**

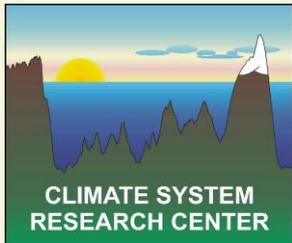
*The goals of SWAP are to generate proactive, comprehensive wildlife conservation strategies that assess the health, challenges, and potential actions each State would like to accomplish during the coming decade and beyond.*

## Massachusetts Fish and Wildlife Climate Action Tool:

*Designed to inform and inspire local action to protect the Commonwealth's natural resources in a changing climate.*

## Climate and Health Assessment:

*This scientific assessment examines how climate change is already affecting human health in the US and the changes that may occur in the future.*



This report was created by Prof. Raymond Bradley,  
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[Climate System Research Center \(CSRC\)](#)  
University of Massachusetts Amherst

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