Climate Change in Massachusetts

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Climate Change Clearinghouse for the Commonwealth

Maps Data Documents

Executive Office of Energy and Environmental Affairs

Mass Audubon

Massachusetts Observed Climate Changes

Temperature: 2.9°F
Since 1895 (Statewide)

Growing Season: 15 Days
Since 1950

Sea Level Rise: 11 inches
Since 1922 (Boston)

Heavy Precipitation: 55%
Since 1958

Source: Climate Science Special Report, 2017; NOAA NCEI nClimDiv; NOAA Ocean Service

Massachusetts Climate Changes Projected by the 2090s

Temperature — **7.2°F**
Average Annual; Range: 4 to 11 °F

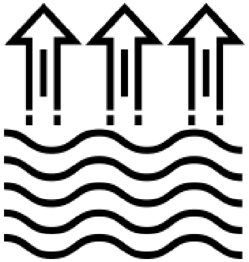
90°F Days — **34**
Annual; Range: 11 to 64 days

Sea Level Rise — **4 to 10.2 feet**
Relative to mean sea level in 2000

2” Precipitation Days — **47%**
Annual

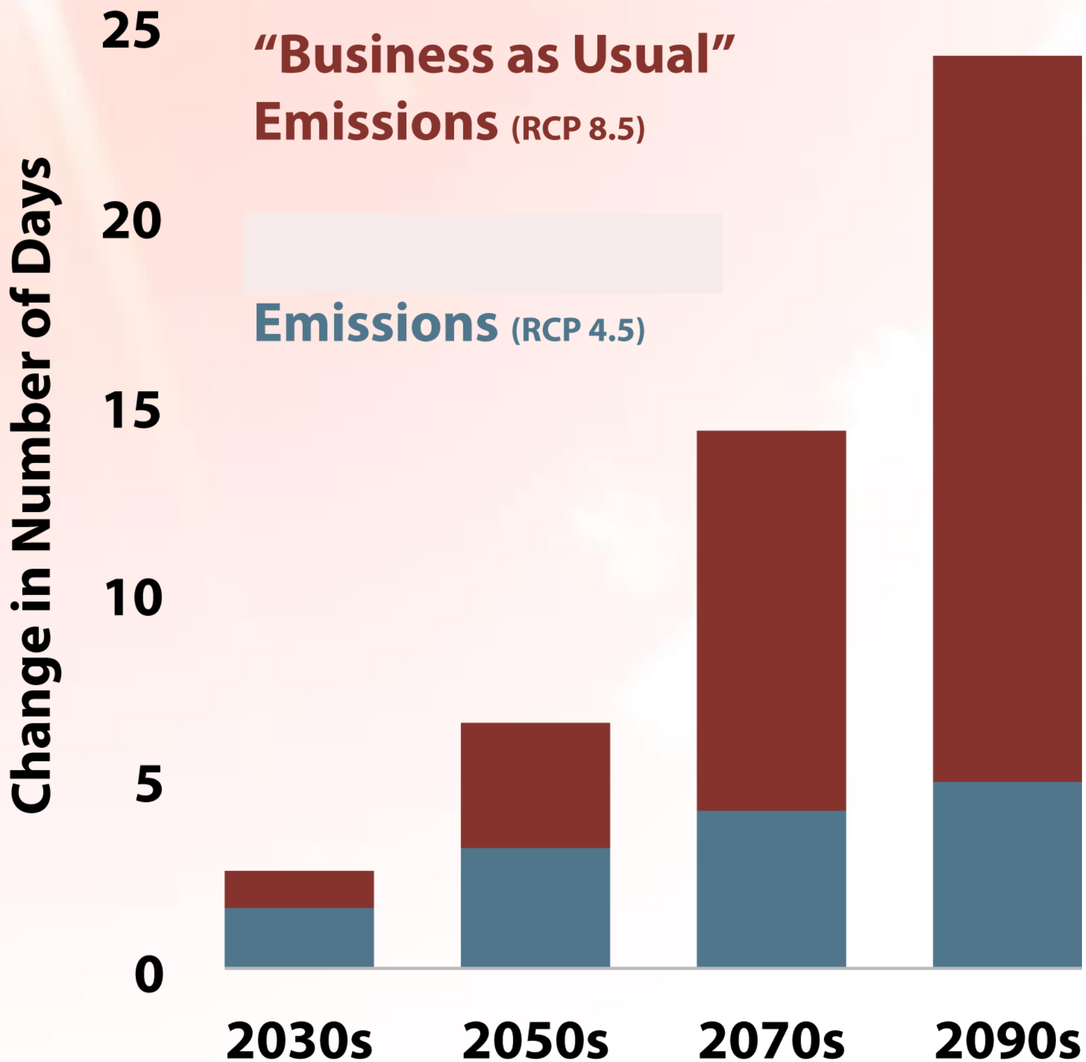
Source: Northeast Climate Adaptation Science Center

Primary Climate Change Indicator	Natural Hazard	Other Climate Change Interactions
Rising Temperatures	Average/Extreme Temperatures	N/A
	Wildfires	Changes in Precipitation
	Invasive Species	Changes in Precipitation, Extreme Weather
Extreme Weather	Hurricanes/Tropical Storms	Rising Temperatures, Changes in Precipitation
	Severe Winter Storm / Nor'easter	Rising Temperatures, Changes in Precipitation
	Tornados	Rising Temperatures, Changes in Precipitation
	Other Severe Weather (Including Strong Wind and Extreme Precipitation)	Rising Temperatures, Changes in Precipitation

Primary Climate Change Indicator	Natural Hazard	Other Climate Change Interactions
 **Changes in Precipitation**	Inland Flooding	Extreme Weather
	Drought	Rising Temperatures, Extreme Weather
	Landslide	Rising Temperatures, Extreme Weather
 **Sea Level Rise**	Coastal Flooding	Extreme Weather
	Coastal Erosion	Changes in Precipitation, Extreme Precipitation
	Tsunami	Rising Temperatures

Summer Days Over 95°F

Massachusetts



The number of dangerously hot days could see a dramatic increase in the future.

Data courtesy A. Karmalkar, Northeast Climate Adaptation Science Center. Figure by D. Brown

Changing Energy Use and Demand

More Warm Winter Days, Less Heating Demand

(based on annual Heating Degree-Days, base 65)

26.2%

by the 2090s

1971-2000 Average:
6839 Heating Degree-days

More Warm Summer Days, More Cooling Demand

(based on annual Cooling Degree-Days, base 65)

178%

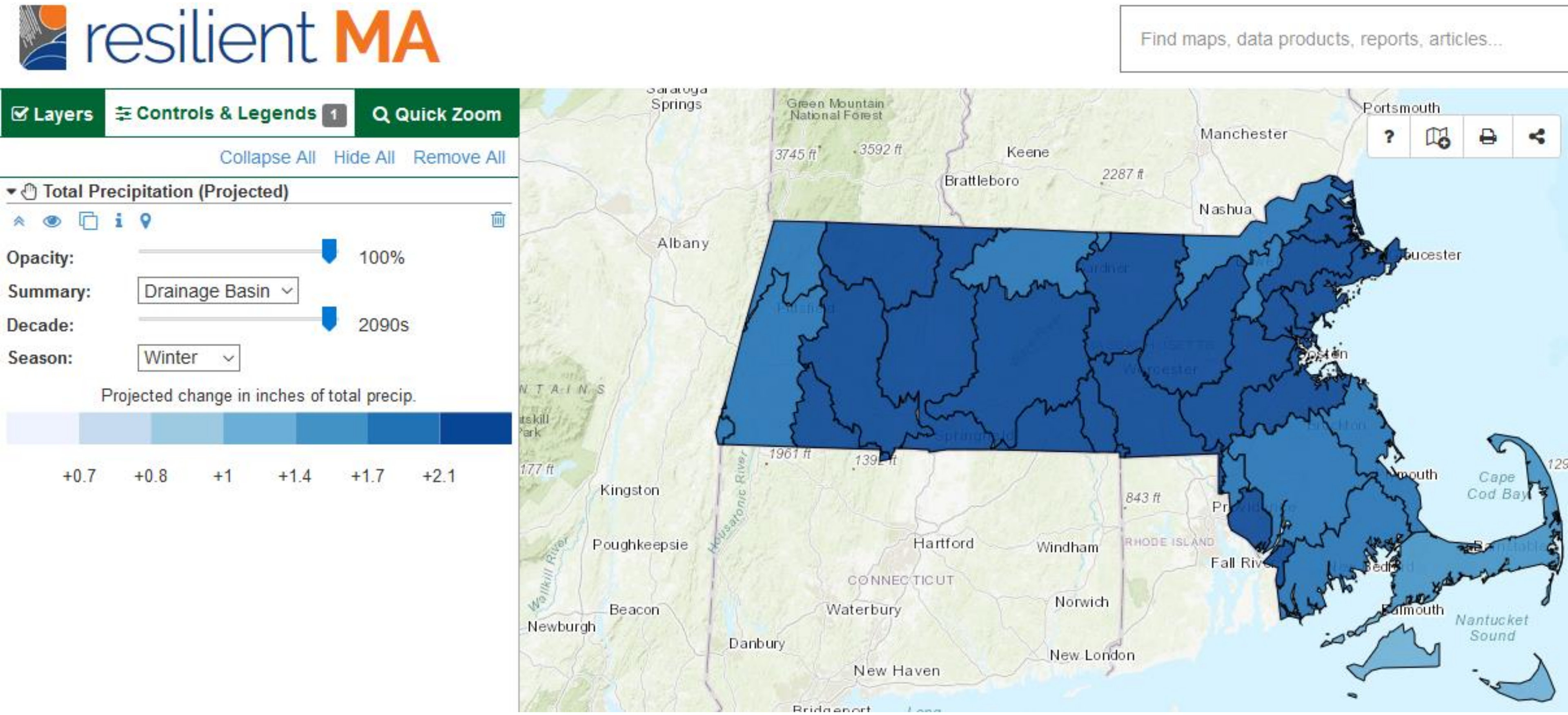
by the 2090s

1971-2000 Average:
457 Cooling Degree-days

Source: Northeast Climate Adaptation Science Center, ResilientMA.org, accessed 2018.

Impacts from Increasing Temperatures

- Public health
  - Increase in heat-related illnesses and mortality
  - Urban residents face greater risks
- Health of plants, animals, and ecosystems
  - Increased pests
  - Changes to growing seasons
- Economic sectors
  - More sick days due to heat-related illnesses
  - Reduced crop production and impacts to livestock and fisheries
- Infrastructure
  - Larger demands on energy systems
  - Stress on train tracks, roads and bridges, and other critical infrastructure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Find maps, data products, reports, articles...
Layers
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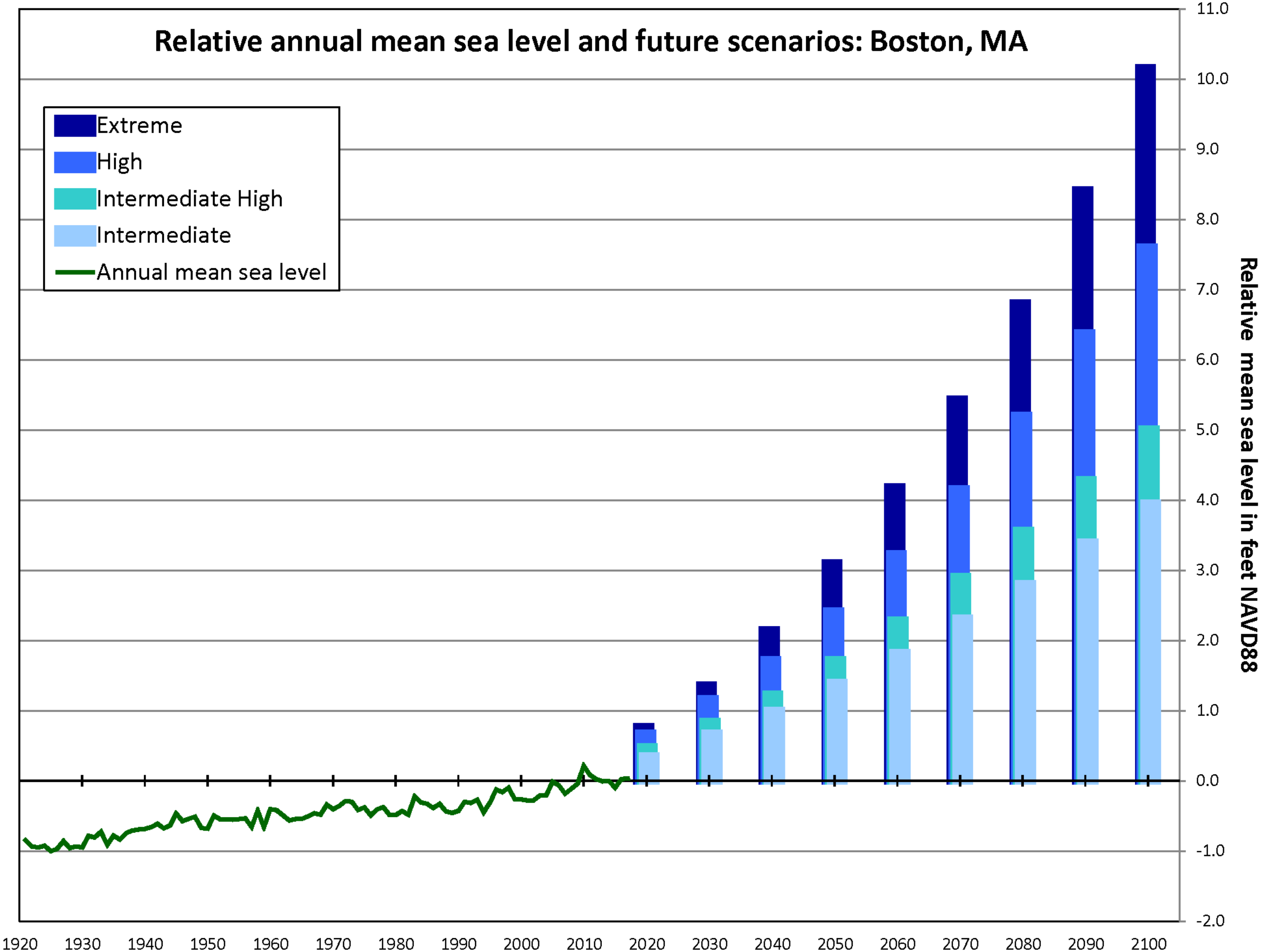
Total Precipitation (Projected)
Opacity:
100%
Summary:
Drainage Basin
Decade:
2090s
Season:
Winter
Projected change in inches of total precip.
+0.7
+0.8
+1
+1.4
+1.7
+2.1
Springs
Green Mountain National Forest
3745 ft
3592 ft
Keene
Brattleboro
2287 ft
Manchester
Portsmouth
Nashua
Albany
Kingston
Poughkeepsie
Beacon
Newburgh
Danbury
Hartford
Windham
CONNECTICUT
Waterbury
Norwich
New London
New Haven
RHODE ISLAND
Fall River
1961 ft
843 ft
Housatonic River
Wallkill River
Cape Cod Bay
Nantucket Sound

Impacts from Changing Precipitation Conditions

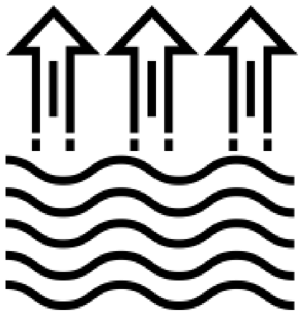
- Increased total rainfall
  - Impact on the frequency of minor but disruptive flooding events
  - Impact agriculture, forestry, and natural ecosystems
- More intense downpours
  - Increased risk of flooding
  - Increased damage to property and critical infrastructure
  - Impacts to water quality
- Changes to rainfall and snowfall patterns
  - Impacts to certain habitats and species with specific physiological requirements
  - Reduced snow cover for recreation and tourism
  - Potential increase in frequency of episodic droughts



Data courtesy Northeast Climate Adaptation Science Center

Boston Relative Mean Sea Level (feet NAVD88)									
Scenario	**Summary**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
Intermediate	Intermediate scenario primarily based on medium and high emissions scenarios and accounts for possible higher ice sheet contributions to sea level rise (Unlikely to exceed 83% probability given a high emissions pathways)	0.7	1.0	1.4	1.8	2.3	2.8	3.4	4.0
Intermediate-High	Intermediate-high scenario primarily based on high emissions scenarios and accounts for possible higher ice sheet contributions to sea level rise (Extremely unlikely to exceed 95% probability given a high emissions pathway)	0.8	1.2	1.7	2.3	2.9	3.6	4.3	5.0
High	High scenario primarily based on high emissions scenarios and accounts for possible higher ice sheet contributions to sea level rise (Extremely unlikely to exceed 99.5% probability given a high emissions pathway)	1.2	1.7	2.4	3.2	4.2	5.2	6.4	7.6
Extreme (Maximum physically plausible)	Highest scenario primarily based on high emissions scenarios and accounts for possible higher ice sheet contributions to sea level rise and consistent with estimates of physically possible "worst case" (Exceptionally unlikely to exceed 99.9% probability given a high emissions pathway)	1.4	2.2	3.1	4.2	5.4	6.8	8.4	10.2

Data courtesy Northeast Climate Adaptation Science Center

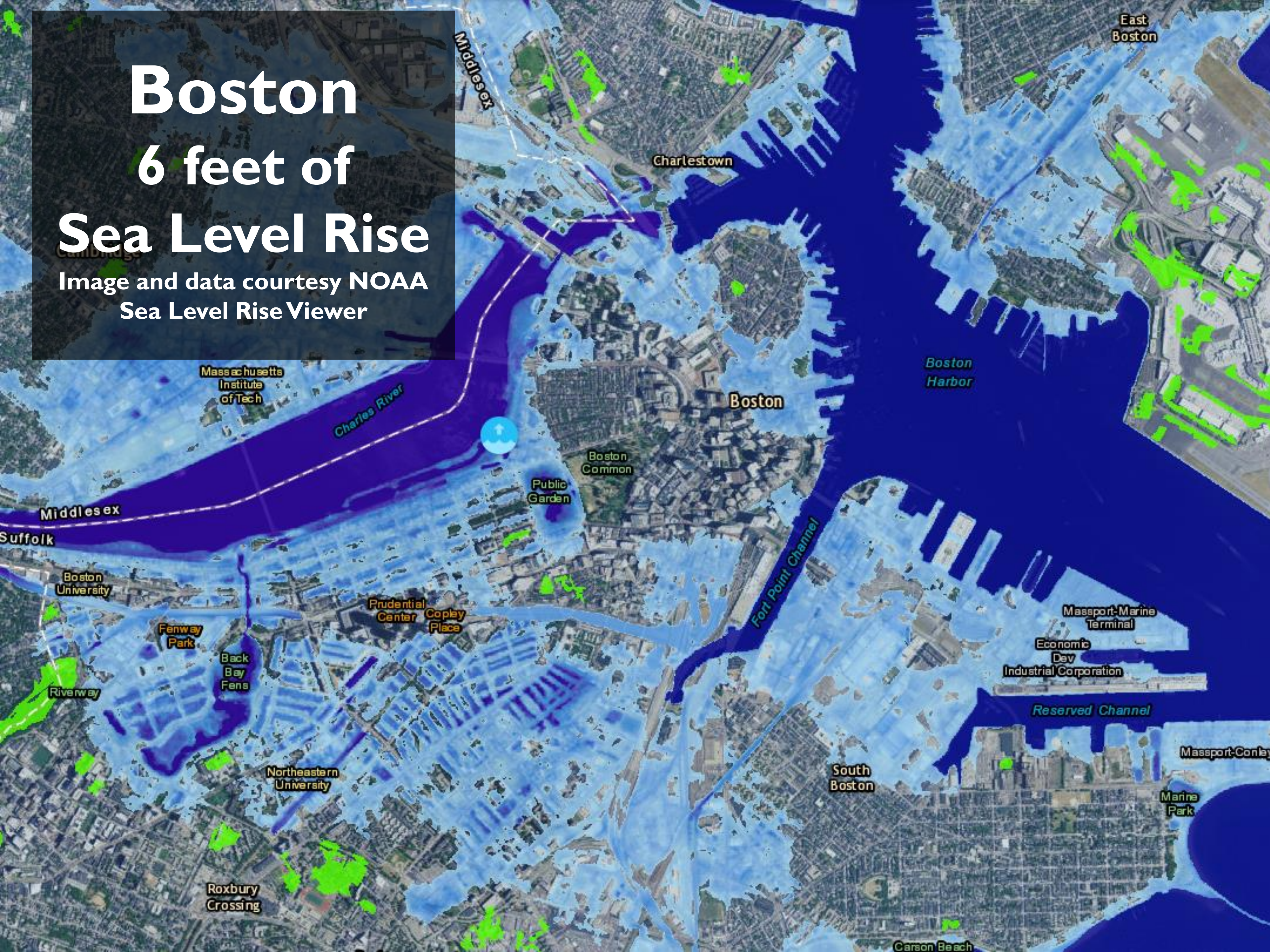


Impacts from Sea Level Rise

- Local impacts shaped by:
  - Ocean currents
  - Wind patterns
  - Land and shoreland elevations
  - Subsidence and accretion rates
  - Tidal zones
- Will exacerbate many existing coastal hazards including:
  - Severe storms and storm surge
  - Tidal inundation
  - Salt water intrusion
- More regular flooding of developed and natural low-lying coastal areas
- Increased erosion of existing coastal landforms
- Damage to coastal buildings and infrastructure

Boston
6 feet of Sea Level Rise

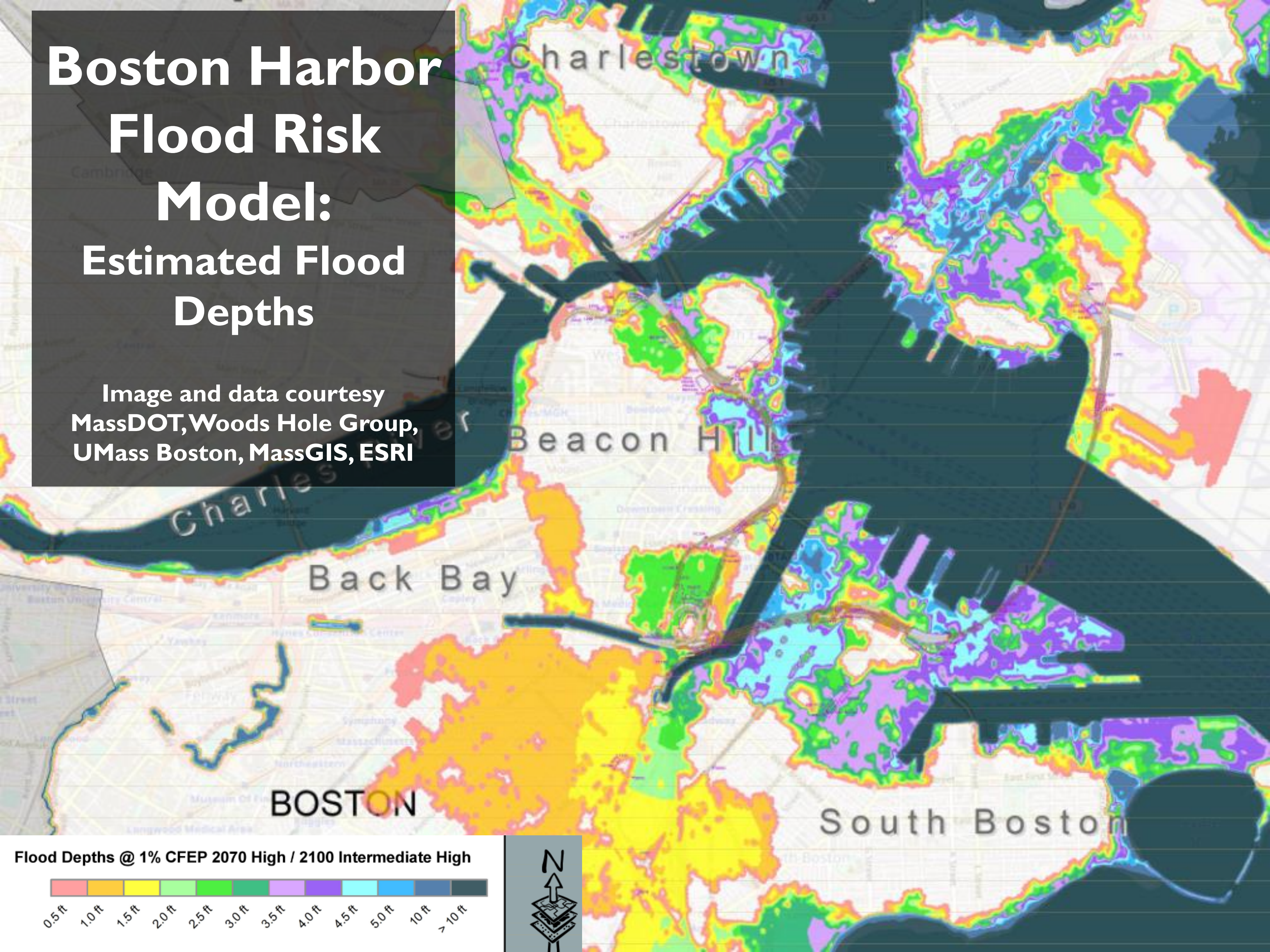
Image and data courtesy NOAA Sea Level Rise Viewer



Boston Harbor Flood Risk Model:

Estimated Flood Depths

Image and data courtesy MassDOT, Woods Hole Group, UMass Boston, MassGIS, ESRI



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Explore Sectors | Identify Changes | Take Action

Maps Data Documents

Search for resources... Search

Municipal Vulnerability Preparedness

Photo: Scituate, Mass. Released photo by U.S. National Guard

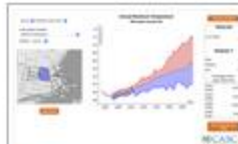
The Baker-Polito Administration's Municipal Vulnerability Preparedness (MVP) grant program provides support for cities and towns across the Commonwealth to identify climate change vulnerabilities, prioritize critical actions, and build community resiliency.

Building on the Administration's approach to state and local partnerships, the MVP program awards municipalities with funding and technical support to complete a community-led planning process to:

- Define extreme weather and natural and climate change related hazards
- Identify existing and future community vulnerabilities and strengths
- Develop and prioritize actions and opportunities to reduce risk and build resilience

Once a municipality has completed the planning process they become eligible for follow-on funding opportunities, including MVP action grants, and advanced standing in other grant opportunities.


View Map For This Sector


View Datagrapher

- Showcased Resources
- How do I become an MVP community?
- Do you live in an MVP community?
- Funding Opportunities for MVP Communities

Resources for MVP Communities


Municipal Vulnerability Preparedness (MVP) program

Community Resilience Building Workshop Guide

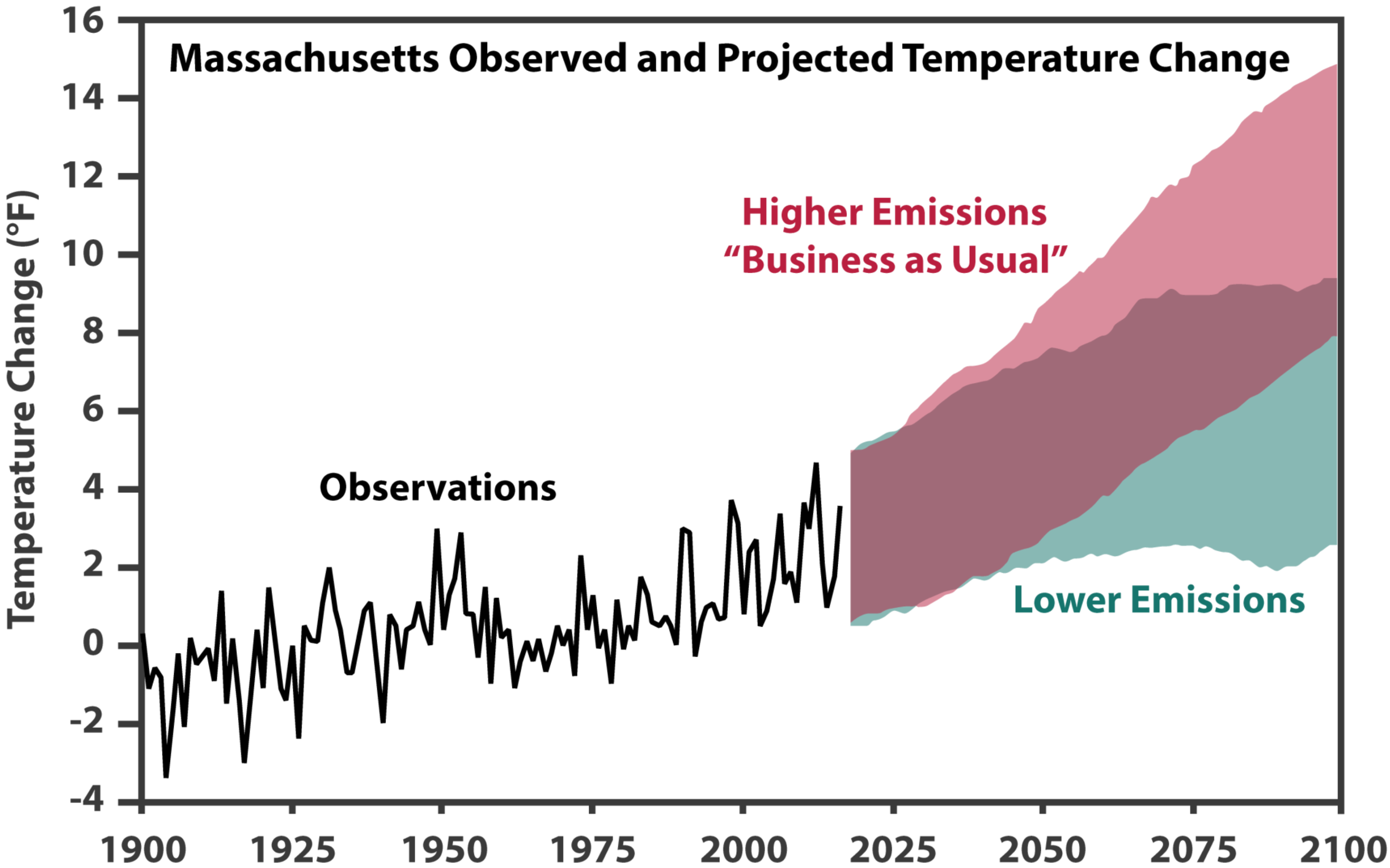
Ensuring Success Webinars — Massachusetts Municipal Vulnerability Preparedness (MVP) Program's Tool Box


Massachusetts Climate Change Projections - Statewide and for Major Drainage Basins


Massachusetts Municipal Vulnerability Preparedness (MVP) program resources

Climate Data Scale and Planning

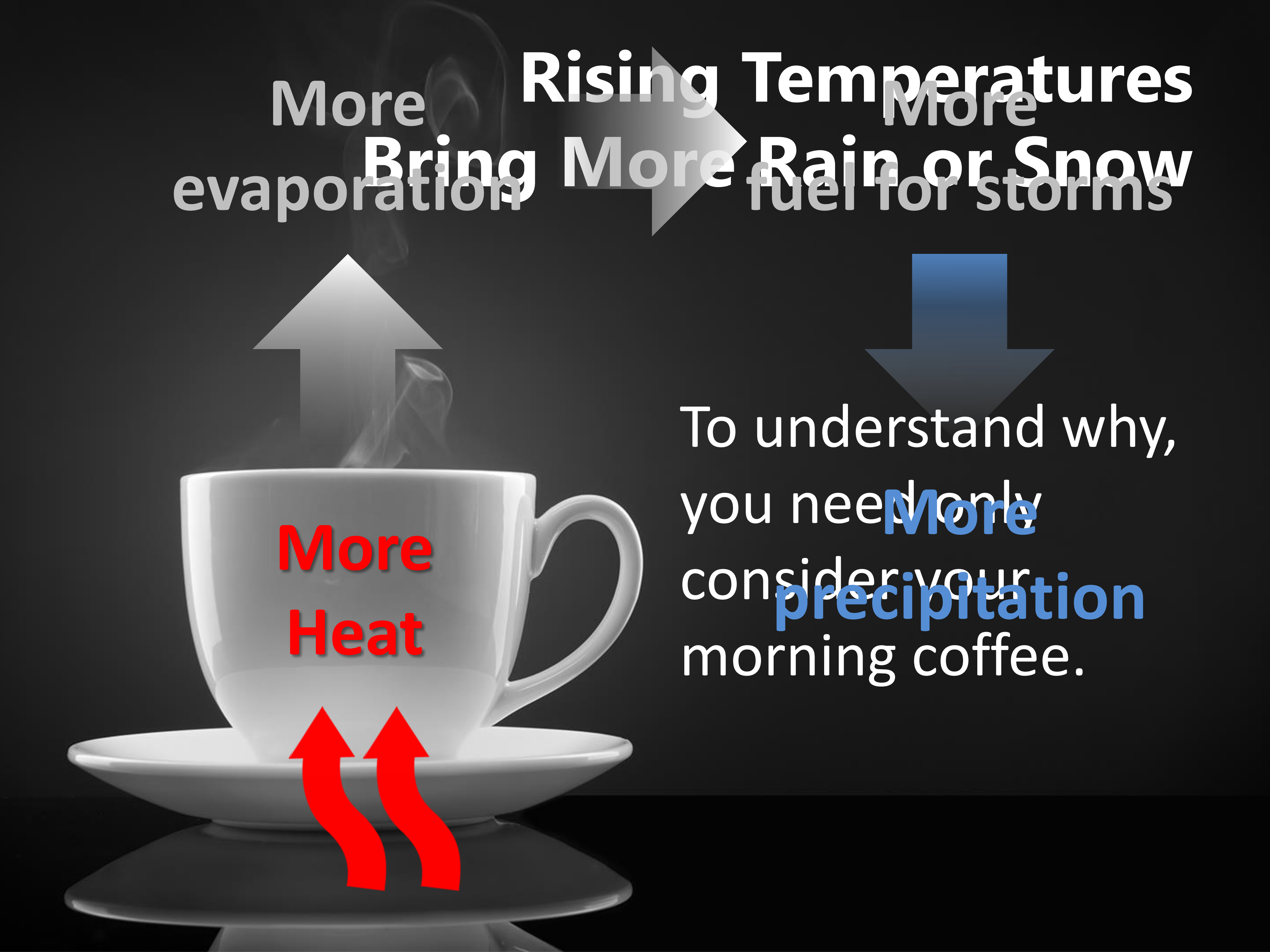
- Hyperlocal variations in climate change projections are most often within the projected margin of error of models.
- Climate data at a regional scale is most appropriate for planning. Climate projections for Massachusetts is available at the watershed and county scale.
- The resolution of climate data is not usually a limiting factor in planning. At the local scale, other factors may play a larger role.



Source: NCICS State Climate Summaries. Observational data from NOAA nClimDiv dataset. Accessed 2017. Figure by D. Brown

What's in a degree?

During the last ice age, temperatures were 9°F cooler than today.



Rising Temperatures Bring More Rain or Snow
More evaporation
More fuel for storms
To understand why, you need only consider your morning coffee.
More Heat
More precipitation

More Precipitation

Total annual precipitation has increased by:

15%

1.2 trillion more gallons **of water equivalent falling on Massachusetts each year.**

~9,700 filled Prudential Towers

Changes are calculated from a linear regression of annual totals from 1895-2015, 1901-2000 reference period.

Source: NOAA

Change in 24-hour, 100-year Design Storms (inches)

	NOAA TP-40	NOAA Atlas 14	Change
Taunton	6.9”	7.7”	**12%**
Boston	6.6”	7.8”	**18%**
Worcester	6.5”	7.6”	**17%**

NOAA Atlas 14: http://hdsc.nws.noaa.gov/hdsc/pfds/

Impact Example: Water Infrastructure
Freeze Vulnerability

Rising winter temperatures reduce spring snow cover.

+

Risk of spring cold snaps remains relatively stable.

=

Increased subsurface freeze risk

Impact Example: Public Health
Algal Blooms


West Monponsett Pond, Halifax, Massachusetts