ResilientMass Climate Data

Key Resources from the EEA Office of Climate Science

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INTRODUCTION: When and How Do We Use Climate Data?

Designing an asset so it can withstand future climate risks

1. Determine the asset's useful life.
2. Use appropriate climate data tool(s) to determine project's climate hazard exposure:
   a. If the project involves only one asset*, use RMAT's Climate Resilience Design Standards (CRDS) tool to obtain asset's future climate risk rating and recommendations on the planning horizon, climate-informed design criteria, etc.
   b. If the project involves multiple assets**, use the asset's useful life as the planning horizon and estimate the asset's end of life. Subsequently, apply the estimated end of life as the target decade in the ResilientMass Maps and Data Center and evaluate the future climate hazards at the project's location.
   c. In any case, use the (recommended) planning horizon to determine a target decade in the Climate Change Projections Dashboard's "precipitation frequency table" and find the suitable⁺ design storm value projection at the project's location.

⁺There is no universal standard/recommendation for an optimal return period or annual exceedance probability. Many assets with high criticality and/or low risk tolerance (e.g., hospitals) use 100 or more years as the return period (i.e., 1% or less annual exceedance probability).

*Single Asset Example: A project to build a new culvert with a useful life of 65 years will start in 2024 and be completed in 2025 in Hadley, MA. RMAT's CRDS tool then should be used. The tool provides the climate hazard exposure rating and recommendations for the asset, including design criteria to consider and a planning horizon ending in 2090. The year 2090 can subsequently be used as the target decade in the Climate Change Projections Dashboard's precipitation frequency table to find the projected design storm value, which in the case of a 24-hour storm with return period of 100 years is 12.7 inches at Hadley.

**Multiple Assets Example: A project to improve electric grid resilience will start in 2025 and be completed in 2030. Multiple facilities with planned useful lives of 40 years will be constructed throughout MA. Because RMAT's CRDS tool cannot be applied to a project with multiple assets, the project team uses a planning horizon ending in 2070. The team then uses the Climate Change Projections Dashboard and sets the target decade to 2070 to obtain the projected cooling degree day and design storm values for all planned locations. At the Falmouth site, the projected annual cooling degree day value is 835 degree days, and the projected 24-hour design storm value with a return period of 100 years is 11.5 inches.

Users' Guide on What Climate Projection Tools to Use

What I want to do

Browse climate projection metrics by location

- ResilientMass Climate & Hazards Viewer
- ResilientMass Climate Change Projections Dashboard

See projected climate hazards with contextual information in a place or region

- ResilientMass Climate & Hazards Viewer
- CZM Sea Level Rise and Coastal Flooding Viewer

See projected hazards at a specific project site and understand what to do about them

- RMAT Climate Resilience Design Standards Tool

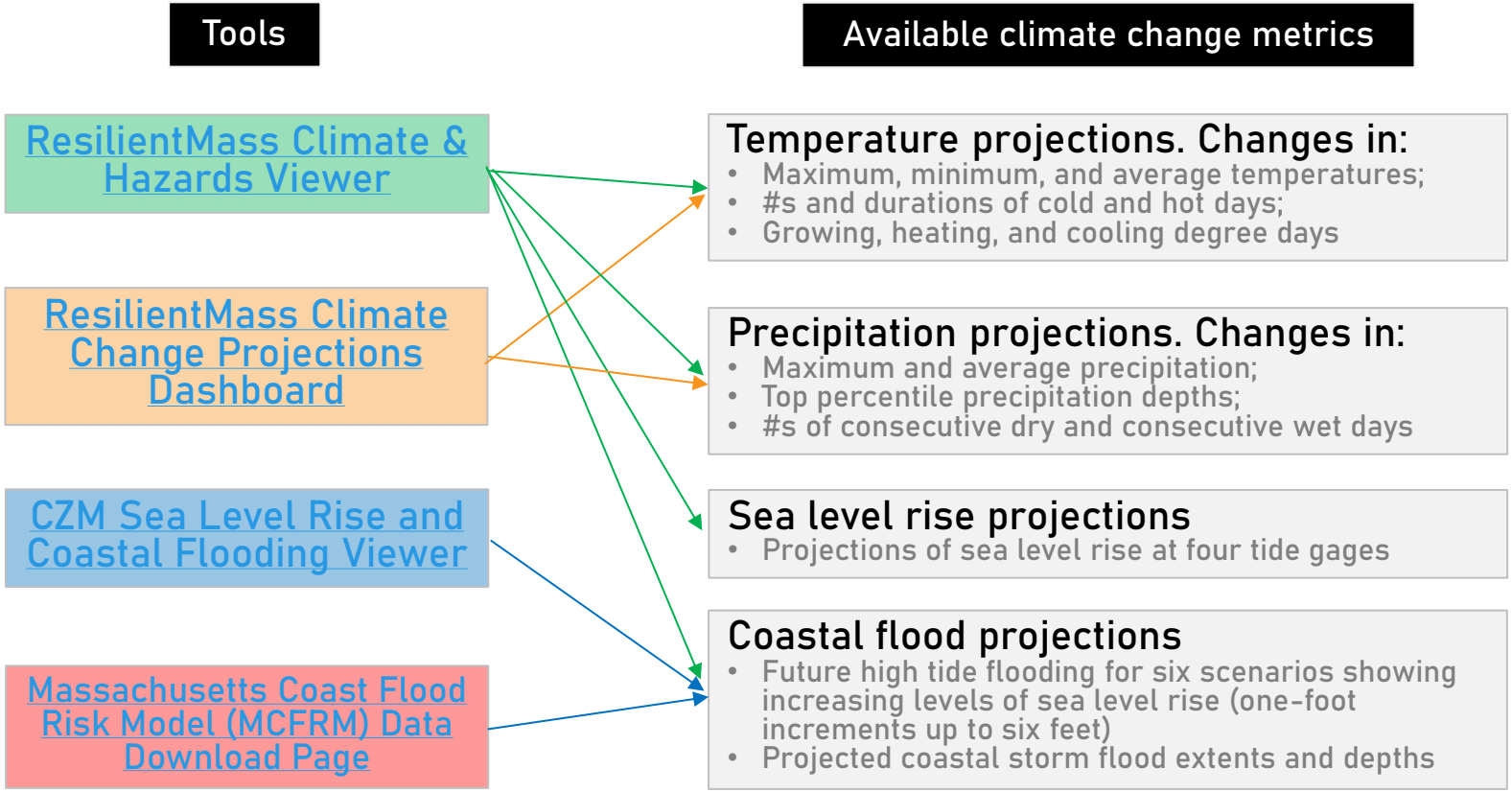
Still need more data?

- ResilientMass Climate Change Projections Dashboard
- Massachusetts Coast Flood Risk Model (MCFRM) Data Download Page

Webinar featuring these climate datasets and tools is now available on EEA's Youtube channel: MVP Winter Webinar Recording #2 (youtube.com)

YouTube
MassEEA
384 subscribers

List of Key MA Climate Projections Tools and What They Provide



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Centralized data hub at resilient.mass.gov

ResilientMass

TOOLS & DATA | LEARN | TAKE ACTION | ABOUT

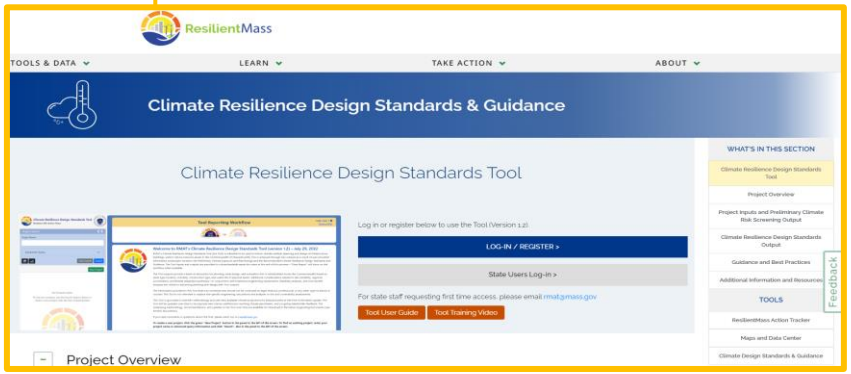
Climate Resilience Design Standards Tool
Apply statewide data to assess the climate resilience of your project site.
LEARN MORE >

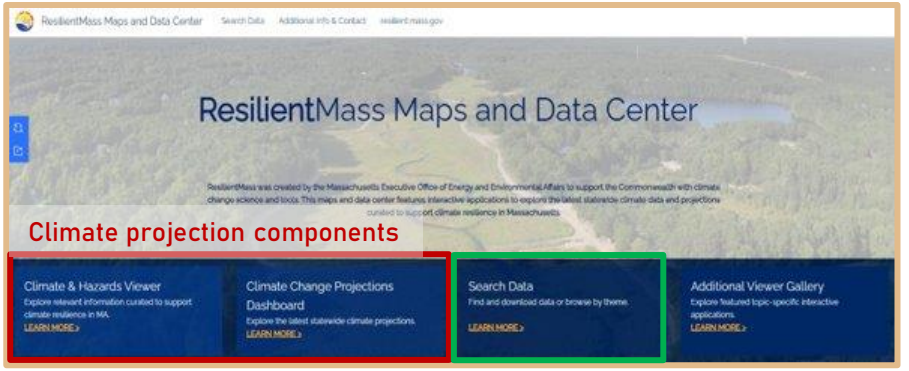
ResilientMass Maps and Data Center
Explore the latest statewide climate data and projections.
LEARN MORE >

Climate Resilience Funding
Learn about EEA's municipal grants supporting climate resilience.
LEARN MORE >

Feedback

Climate hazards exposure and risks screening tool



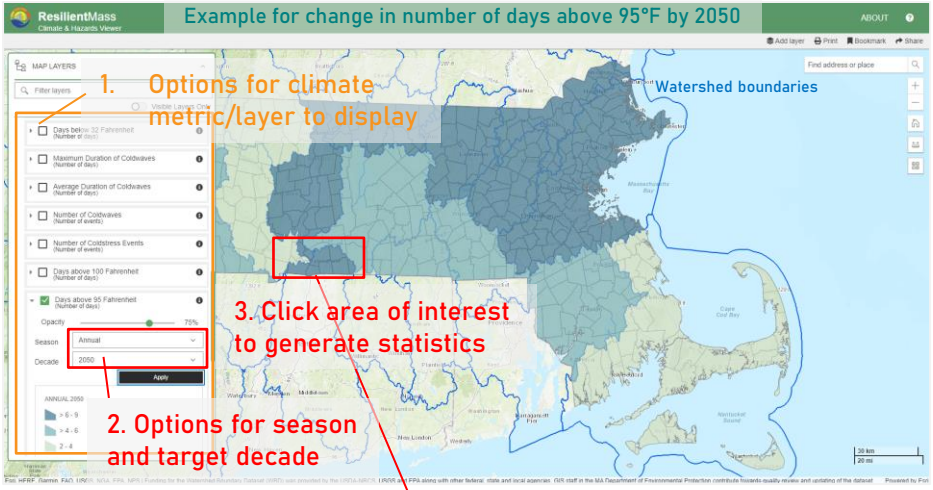


Data are available for download from the ResilientMass Maps and Data Center

Climate & Hazards Viewer on ResilientMass Maps and Data Center

Integrate extremes into planning and projects, based on state-of-the art method for developing local projections

Quick link: Climate & Hazards Viewer



Selected layer	Days above 95 Fahrenheit				
Watershed (HUC 8)	undefined	Example for Lower Connecticut Watershed			
Season	**Baseline**	**2030**	**2050**	**2070**	**2090**
ANNUAL	1	3 (1-7)	7 (3-16)	16 (7-30)	25 (12-43)
SPRING	0	0 (0-0)	0 (0-1)	1 (0-2)	1 (1-3)
SUMMER	1	3 (2-4)	6 (4-10)	13 (6-21)	21 (10-35)
FALL	0	0 (0-0)	0 (0-1)	1 (1-2)	2 (1-4)
WINTER	0	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)

Table shows the median (50th percentile) value by future target decade and season as compared to baseline values. Lower and upper bounds (the 10th-90th percentile range) is presented in parenthesis. Projected decreases are denoted by a minus (-) sign. The value highlighted in dark green is the value corresponding to the season and decade currently selected within the legend controls. Values are presented as absolute change.

Descriptions of what the numbers mean and what the unit is.

Tool goals:

- Map companion to the Climate Change Projections Dashboard
  - Display statewide temperature and precipitation projections at watershed* scale
  - Available for high emission scenario (RCP 8.5); target decades 2030, 2050, 2070, and 2090; annual and seasonal values.
- Additionally: display coastwide sea level rise layers
  - Inundation in one-foot increments above current Mean Higher High Water; up to six feet of sea level rise
  - Projections of sea level rise at tide gages (Boston, Woods Hole, Nantucket, and Newport, RI) through 2100.
- Additionally: provide relevant projections' statistics (available as a clickable feature)

When to use this tool:

- Exploring future climate hazards for adaptation planning
- Designing stormwater and other infrastructure to last
- Assessing future sectoral impacts of climate change (e.g., human, infrastructure, natural environment, etc.)

See the Climate Change Projections Dashboard section for an example of use case.

*Based on USGS Hydrologic Unit Code 8 (HUC 8) watershed boundary classification

Climate Change Projections Dashboard on ResilientMass Maps and Data Center

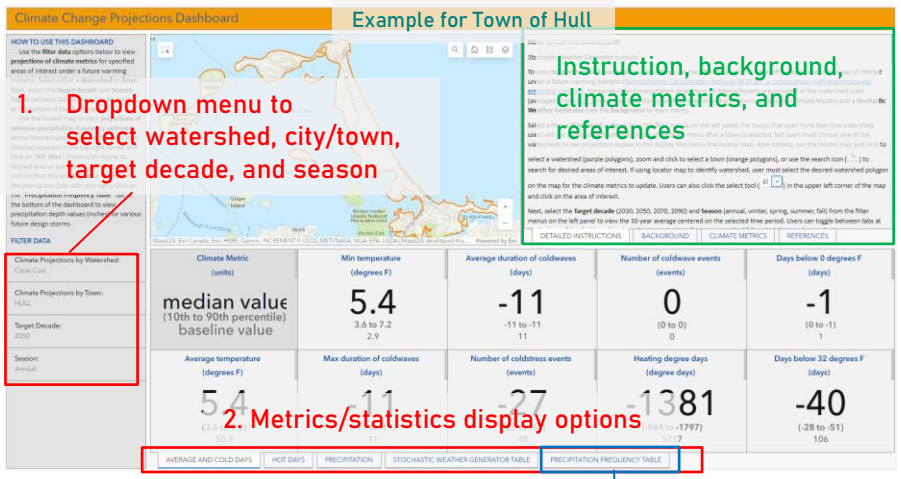
Applications could include engineering design, municipal codes, stormwater management

Quick link: MA Hydro Risk_Climate Dashboard (arcgis.com)

Tool goals:

- Tabular companion to the Climate & Hazards Viewer
  - Provide statewide temperature and precipitation projections at a select watershed*/municipality
  - Available for high emission scenario (RCP 8.5); target decades 2030, 2050, 2070, and 2090; annual and seasonal values.

- Additionally: provide projected precipitation frequency table at a select watershed/municipality
  - For storm durations of 5 minutes to 48 hours; for return periods of 1 to 1000 years
  - Available for the same emission scenario and target decades



When to use this tool:

EXAMPLE: Town of Hull's Climate Resilience Design Parameters
24-Hour Precipitation Frequency

Return Period (Annual Exceedance Probability, %)	NOAA Atlas 14 (Present)	2030	2050	2070
10-yr (10%)	5.20	6.0	6.4	7.1
25-yr (4%)	6.34	7.3	7.8	8.6
50-yr (2%)	7.19	8.2	8.8	9.7

Projected total precipitation depth (inches) provided by ResilientMass

Asset	Projected Total Precipitation Depth for 24-hr Design Storms (inches)
Pump Station	**7.8** (2050, 4%)
Park*	N/A
Residential homes	**6.4** (2050, 10%)
Roadways	**8.8** (2050, 2%)
Eastern Seawall	**8.8** (2050, 2%)

Roadways design consideration for 50-yr storms (8.8 in/day) with 2050 as planning horizon.

Precipitation Frequency Table

Site	Year	Duration	RI_1yr_50th	RI_2yr_50th	RI_5yr_50th	RI_10yr_50th	RI_25yr_50th	RI_50yr_50th	RI_100yr_50th	RI_200yr_50th	RI_500yr_50th	RI_1000yr_5...
Site 1	2050	24h	3.4 (3.1 - 3.7)	4.3 (3.9 - 4.6)	5.7 (5.1 - 6)	6.8 (6.1 - 7.3)	8.3 (7.5 - 8.9)	9.5 (8.6 - 10.2)	10.8 (9.7 - 11.5)	12.3 (11.1 - 13.2)	14.8 (13.4 - 15.8)	16.9 (15.3 - 18.1)
Site 1	2050	48h	3.8 (3.5 - 4.1)	4.9 (4.4 - 5.2)	6.6 (5.9 - 7)	8 (7.2 - 8.5)	9.9 (9 - 10.6)	11.3 (10.2 - 12.1)	12.9 (11.7 - 13.8)	15 (13.5 - 16)	18.3 (16.5 - 19.6)	21.2 (19.2 - 22.7)
Site 1	2070	05m	0.4 (0.4 - 0.5)	0.5 (0.5 - 0.6)	0.6 (0.6 - 0.7)	0.8 (0.7 - 0.9)	0.9 (0.9 - 1.1)	1 (1 - 1.2)	1.2 (1.1 - 1.3)	1.3 (1.2 - 1.5)	1.5 (1.4 - 1.7)	1.7 (1.5 - 1.9)
Site 1	2070	10m	0.6 (0.6 - 0.7)	0.7 (0.7 - 0.8)	0.9 (0.9 - 1.1)	1.1 (1 - 1.2)	1.3 (1.2 - 1.5)	1.5 (1.4 - 1.7)	1.6 (1.5 - 1.9)	1.8 (1.7 - 2.1)	2.1 (2 - 2.4)	2.3 (2.2 - 2.7)
Site 1	2070	15m	0.7 (0.7 - 0.8)	0.9 (0.8 - 1)	1.1 (1 - 1.2)	1.3 (1.2 - 1.5)	1.5 (1.4 - 1.8)	1.7 (1.6 - 2)	1.9 (1.8 - 2.2)	2.2 (2 - 2.5)	2.5 (2.3 - 2.9)	2.8 (2.6 - 3.2)
Site 1	2070	60m	1.2 (1.2 - 1.4)	1.5 (1.4 - 1.7)	1.9 (1.8 - 2.2)	2.2 (2.1 - 2.5)	2.7 (2.5 - 3.1)	3 (2.8 - 3.5)	3.4 (3.2 - 3.9)	3.8 (3.5 - 4.3)	4.3 (4.1 - 5)	4.8 (4.5 - 5.5)

Precipitation frequency data download button

Columns: site #, target decade, storm duration, and return periods

*Based on USGS Hydrologic Unit Code 8 (HUC 8) watershed boundary classification

ResilientMass Action Team's (RMAT's) Climate Resilience Design Standards Tool

Synthesizing available climate data for screening level climate hazard exposure and risk at the project level

Quick link: resilient.mass.gov

Tool goals:

- Make preliminary climate resilience analysis more broadly accessible
- Inform "climate smart" capital planning, design and procurement
- Provide recommendations based on consistent use of state's climate data
- Provide a unified planning and design support tool

When to use this tool:

- Project siting
- Project planning, design and/or procurement
- Improving a state grant application to incorporate relevant resilience design measures

Resources:

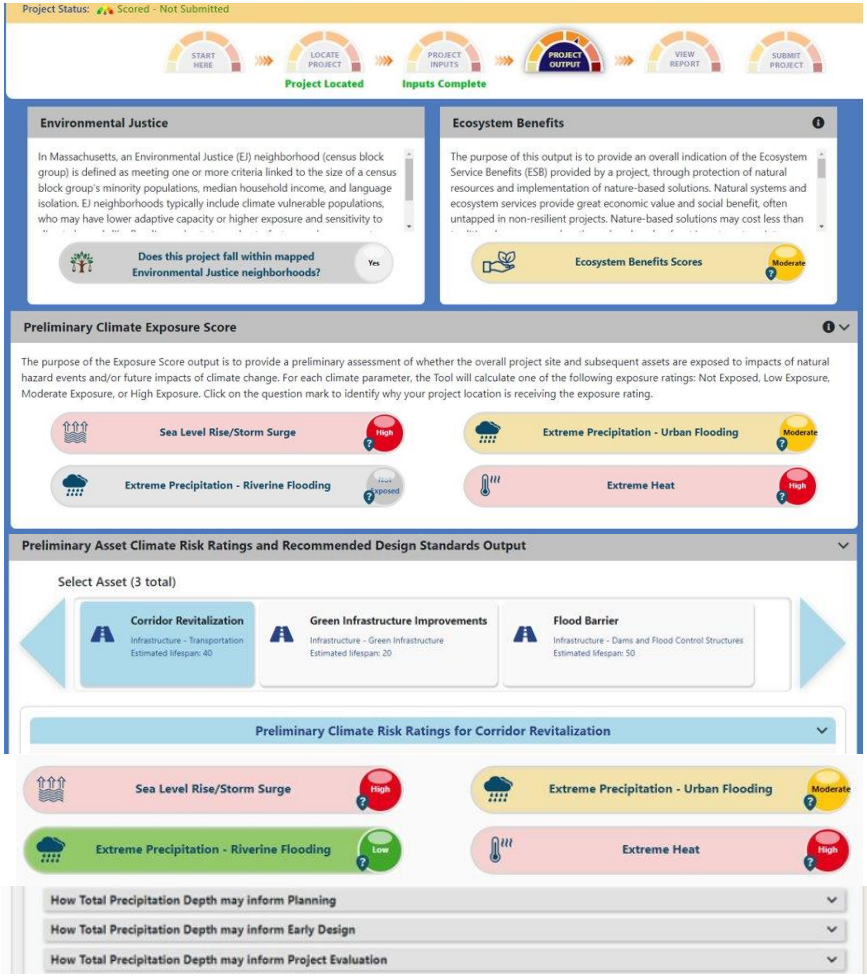
- User guide
- Training video
- Climate resilience design guidance and best practices
- Documentation and training for technical data inputs

Project scores for Environmental Justice and Ecosystem Benefits

Preliminary climate hazard exposure for the project footprint

Recommended standards and design criteria for each asset

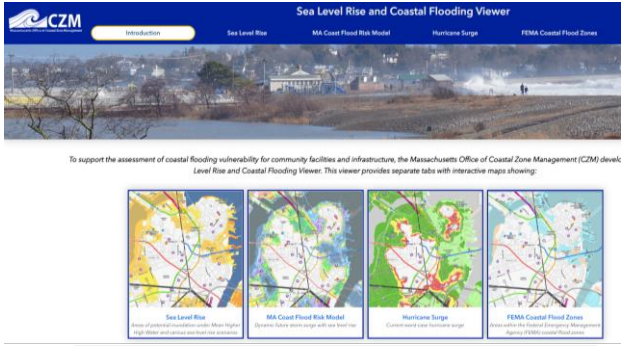
Guidance for how to consider outputs



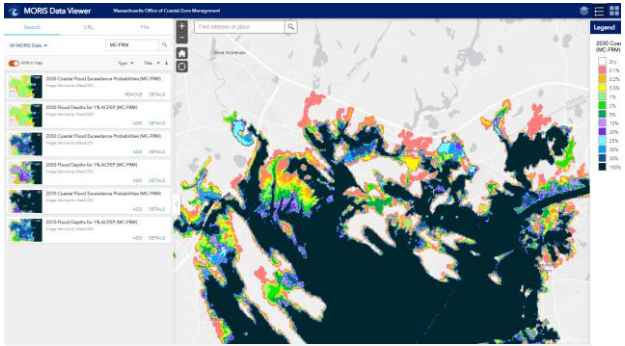
Massachusetts Coast Flood Risk Model (MC-FRM)

State of the art, analysis-ready probabilistic coastal flood data

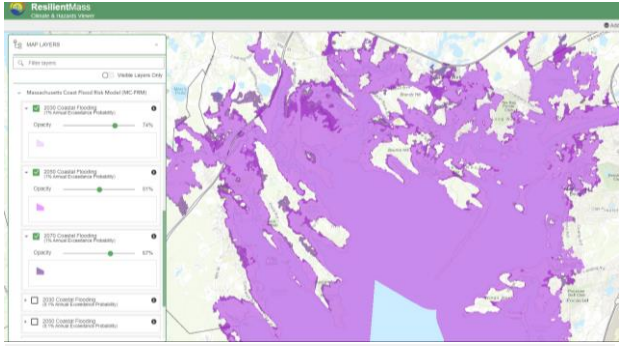
Data Viewers featuring MC-FRM layers



CZM's Sea Level Rise and Coastal Flooding Viewer



CZM's MORIS Data Viewer



ResilientMass Climate & Hazards Viewer

When to use these tools:

- To support the assessment of coastal flooding vulnerability for community facilities and infrastructure, this viewer provides separate tabs with interactive maps showing:
  - Areas of potential inundation under Mean Higher High Water and various sea level rise scenarios
  - Dynamic future storm surge with sea level rise (MC-FRM flooding probabilities and depths)
  - Current worst-case hurricane surge
  - Areas within the Federal Emergency Management Agency (FEMA) coastal flood zones

- Explore potential flooding from future coastal storms for a range of annual chance of occurrence
- Explore potential flood depths (relative depth of water above land) during a coastal storm with 1% chance of occurring every year
- Add other relevant coastal data of interest
- *Note: same MC-FRM layers as those featured in the Sea Level Rise and Coastal Flooding Viewer*

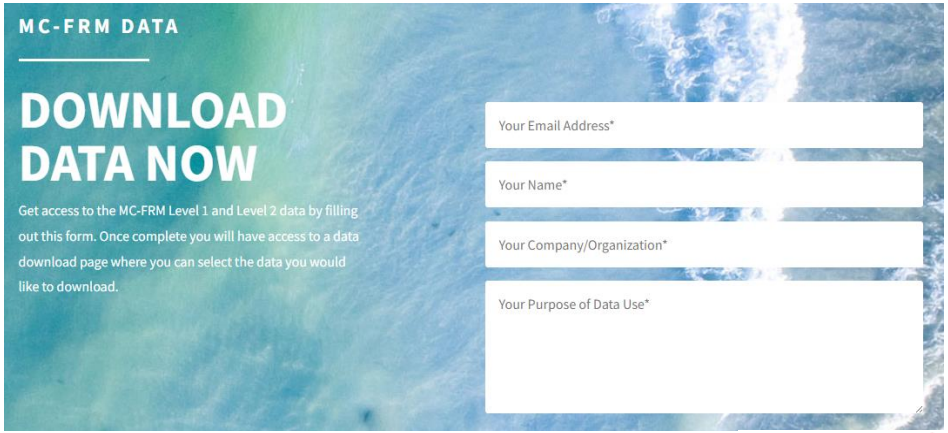
- Explore possible future flood exposure for extreme coastal storms
- *Note: these layers are also embedded in the Guides for Equitable and Actionable Resilience viewer and the Climate Resilience Design Standards Tool*

Massachusetts Coast Flood Risk Model (MC-FRM)

State of the art, analysis-ready probabilistic coastal flood data

Data Download

Woods Hole Group's data download page



When to use this tool:

- For advanced users, download GIS layers (rasters and shapefiles) of MC-FRM data (including level 2 elevation layers) to inform vulnerability assessments or preliminary design considerations.
- Recommended to watch MC-FRM training series first to understand data definitions, limitations and appropriate application.
- *Note: recommended to use CZM's MORIS viewer for exploring stitched coastwide versions of the flooding probabilities and level 1 flood depths.*

Massachusetts Coast Flood Risk Model (MC-FRM)

State of the art, analysis-ready probabilistic coastal flood projections

Training series (Spring 2023)

Learn about the state's coastal flood model, including key inputs (such as sea level rise), limitations and examples of application

Workshop 1: Overview and Level 1 (Basic) Data

Model Overview, Level 1 Data (For Entry Users)

- Key definitions
- Sea level rise inputs
- Model limitations
- How to interpret MC-FRM products in CZM's Sea Level Rise and Coastal Flooding Viewer

Workshop2: Level 2 Data (Advanced) and Application

Level 2 Data, Application, Usage (For Advanced Users)

- Key definitions
- Comparison to other models
- How MC-FRM is used in the Climate Resilience Design Standards Tool

Workshop 3: Technical Application

Technical Applications

- Review of Level 1 and 2 products
- Annual Exceedance Probability (AEP) exercise
- Technical examples

LINKS
Quick link: MC-FRM Training Series (YouTube)

Contact Us

Need technical assistance or feedback on climate-related project?

- Please do not hesitate to reach out anytime at climatescience@mass.gov. We are here to help!

- We have also launched office hours for MA agencies! Check out our availabilities and reserve a time slot on our Microsoft Bookings page.

Glossary

- Annual exceedance probability: the probability that a given event magnitude will be equaled or exceeded in any given year
- Climate hazard: climate-related events that can cause harm to humans, properties, livelihood, resources, and environment, such as extreme heat, floods, drought, etc.
- Climate impact: negative impacts of natural hazards (acute or chronic) which are exacerbated by climate change
- Extreme precipitation frequency: also known as design storm frequency—the average time interval between two precipitation events of similar magnitudes that fall within a given duration
- Mean higher high water: the average of the maximum water level in a tidal cycle over a period
- RCP: Representative Concentration Pathway—IPCC's future climate trajectory framing
- Return period: the average time interval between two events of similar magnitudes
- Useful life: the estimated number of years an asset is likely to remain in service