

MassDOT-FHWA Climate Resilience Pilot Project

Modeling Overview and Frequently Asked Questions

Overview

The Massachusetts Department of Transportation (MassDOT) and the Federal Highway Administration (FHWA) have commissioned a pilot project to assess and improve the resiliency of the Central Artery and Tunnel System (CA/T) by analyzing its vulnerability to sea level rise and extreme weather events, investigating options for adaptation to the identified vulnerabilities, and establishing an emergency response plan for tunnel protection. A major component of the pilot project is a detailed modeling effort that simulates extreme weather events under both present and future climate conditions. The project is being managed by the MassDOT Highway Division Environmental Services Section and being executed by UMass-Boston, Woods Hole Group, Inc. and University of New Hampshire. The MassDOT Boston Harbor Flood Risk Model (BH-FRM) model is being developed and used to determine inundation risk and flooding pathways; and to simulate the dynamic nature of flooding in the City of Boston that serve as flood pathways affecting the CA/T. BH-FRM is an advanced model that simulates the effects of tides, storm surge, wind, waves, wave setup, river discharge, sea level rise, and future climate change scenarios.

FAQ

Are the results of the BH-FRM applicable to the entire City of Boston and City of Cambridge?

Yes, flood risks results will be available throughout the City of Boston and Cambridge. All parts of the City of Boston and Cambridge that are at an elevation low enough for storm surge-induced flooding to occur are included.

Why does the BH-FRM model include detailed results in the City of Cambridge?

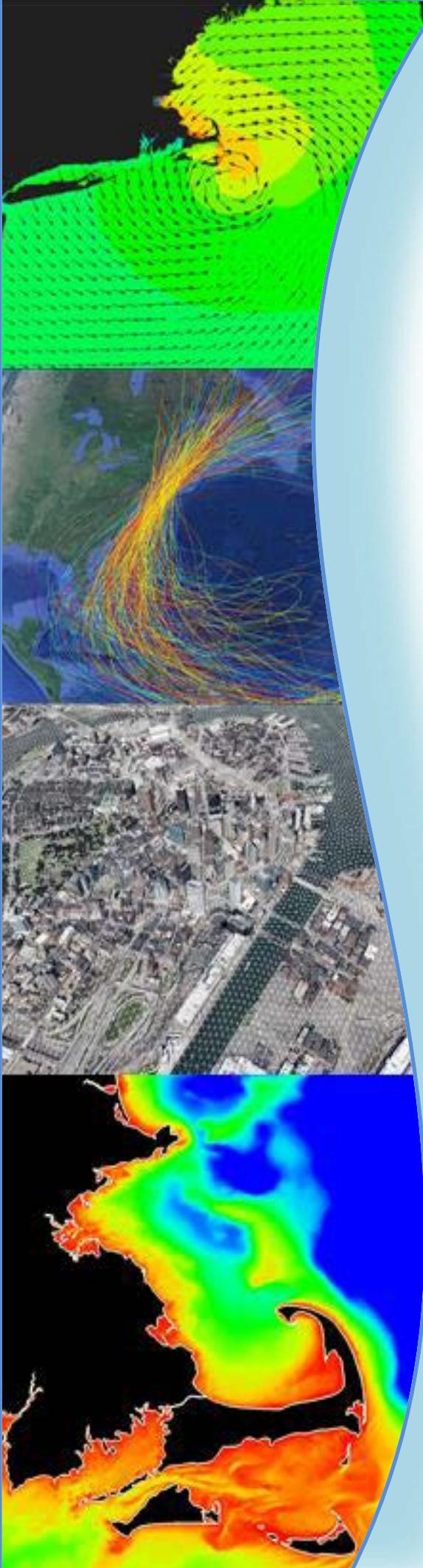
The City of Cambridge provided additional funding to extend the focus area of the BH-FRM model.

Are the BH-FRM results applicable to a specific building or structure located in Boston or Cambridge?

Yes.

Are the results of the BH-FRM applicable to the areas outside the Boston and Cambridge?

BH-FRM provides information for adjacent areas in Massachusetts, as well as Rhode Island, New Hampshire, Maine, and Connecticut, but will not be able to identify risk associated with specific assets for locations outside of the focus area (Boston & Cambridge). However, the model can be extended to do so in the future.



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What is the resolution of the BH-FRM model grid?

BH-FRM uses an unstructured grid that allows for the grid resolution to vary across the model domain. In the BH-FRM focus area (Boston, Cambridge and Boston Harbor), the model resolution ranges from five to thirty meters for both inland areas and coastal waters. In areas beyond the focus area (Atlantic Ocean), the resolution increases to 100 to 500 meters. Most of the coastal areas in New England have a resolution between 50 to 100 meters.

What is the complete extent of the BH-FRM model domain?

The BH-FRM domain extends from the Gulf Coast to Newfoundland (see attached map).

What is the specific extent of the BH-FRM and the detailed focus area?

See the attached map.

What types of storms does BH-FRM simulate?

BH-FRM simulates storm surge induced flooding that could occur from both tropical (hurricanes) or extra-tropical (nor'easter) storm events. The model also includes climate-change induced increases in river discharge from precipitation and storm water run-off. A statistically robust approach is used to capture variations in storms.

Does the BH-FRM include freshwater flooding?

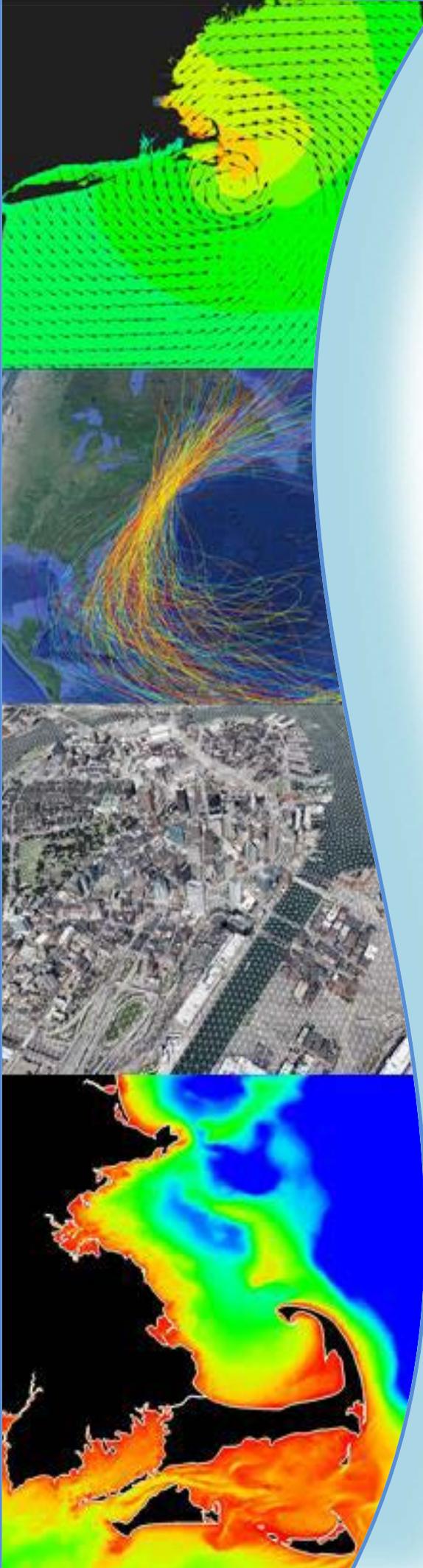
To some extent the Charles and Mystic Rivers are incorporated into the BH-FRM because the freshwater outflows of the rivers interact with storm-surge induced flooding. However, freshwater storm flooding events that have no ocean-based component are not included in the risk analysis (for example, while the flow contribution of precipitation in the upper reaches of the Mystic to flooding in the coastal area are included, the local freshwater flooding in the upper Mystic is not).

Are the Charles River Dam and Amelia Earhart Dam included in the model?

Yes.

What makes BH-FRM more accurate than other inundation models and flood maps that have been created for the region?

The BH-FRM is a more accurate representation of flooding risk because it is (1) a dynamic model that includes the critical processes associated with storm induced flooding (winds, waves, wave-setup, storm surge, river discharge, etc.), (2) calibrated to historical storm events with observed high water data, (3) high enough resolution to capture flood pathways in the complex urban topography of Boston and Cambridge, and (4) able to capture the net effect of varying storm types, magnitudes, and parameters.



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How do BH-FRM results relate to other existing Sea Level Rise inundation maps (e.g., The Boston Harbor Association flood maps)?

BH-FRM is a dynamic model that includes relevant flooding processes and their interaction. The model includes the dynamic effects of tides, storm surge, land effects, winds, waves, wave setup, etc. Results also include changes in climate to assess variations in storm intensity, etc. These processes can result in significant differences in the magnitude and extent of flooding throughout a region. For example, flooding caused by tropical storm events (such as Hurricane Sandy) are typically not well represented by non-dynamic models based on the expected water surface elevation overlain on land elevation. Flood mapping approaches, such as the TBHA bathtub flood maps, do not include the influence of the storm track, winds, and waves.

How do BH-FRM results relate/compare to the recently released FEMA Preliminary Flood Insurance Rate Maps (FIRMs)?

BH-FRM results are focused on present and future flooding projections, while FEMA results estimate present flood risk based on historical events. The methods used to produce the FIRMs are also substantially different. BH-FRM is also being used to assess present day conditions, simulate historic storm events, and can potentially provide improved input to the FEMA models and mapping.

Will the BH-FRM model show flooding propagating down streets and through buildings?

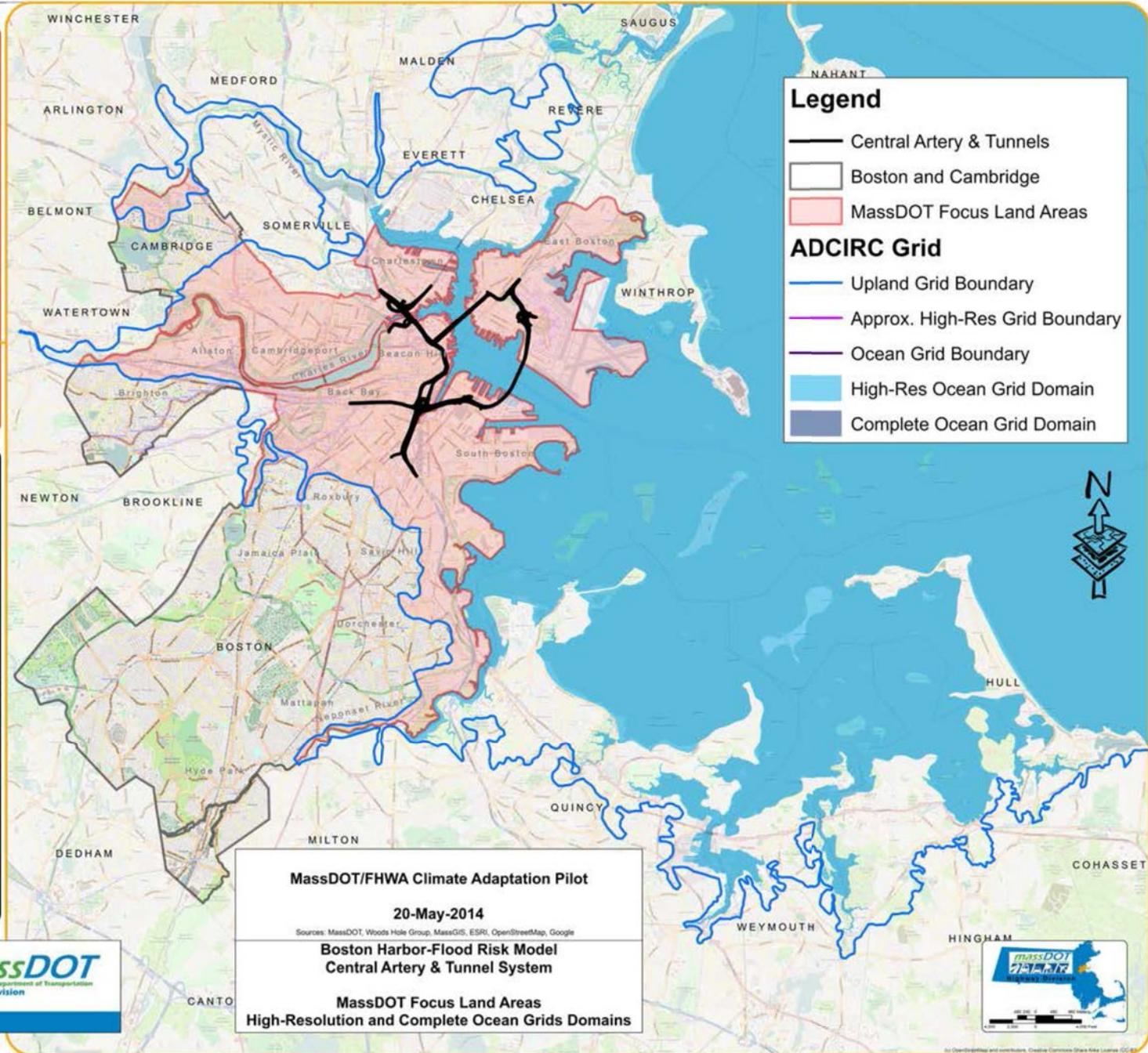
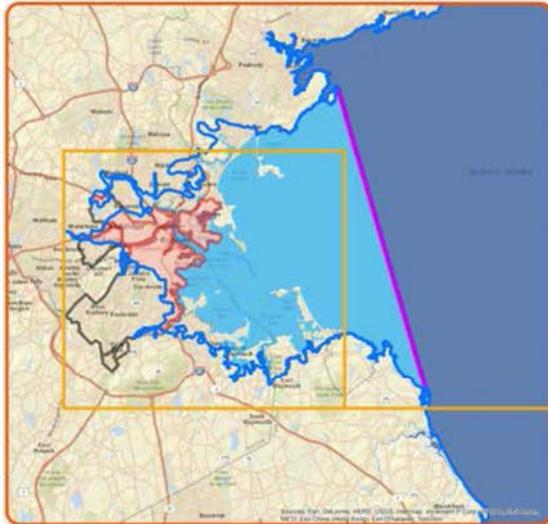
Flood risk and water depths will be available for individual buildings and streets with this model. However, the model does not currently intend to show flooding into buildings or the detailed flow down every street. An extension to the model is being considered to provide visualizations of flood propagation down streets and flood pathways, but it will not model flooding into structures.

Will the BH-FRM results of flooding risk be publically available?

Yes. Full model results for the focus area (Boston and Cambridge) will be publicly available.

What is needed to extend the BH-FRM focus area to my town/area?

To extend the BH-FRM into any specific area requires additional grid development and may also require additional climate input conditions determined by your project requirements.



Legend

- Central Artery & Tunnels
- Boston and Cambridge
- MassDOT Focus Land Areas

ADCIRC Grid

- Upland Grid Boundary
- Approx. High-Res Grid Boundary
- Ocean Grid Boundary
- High-Res Ocean Grid Domain
- Complete Ocean Grid Domain

MassDOT/FHWA Climate Adaptation Pilot
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Sources: MassDOT, Woods Hole Group, MassGIS, ESRI, OpenStreetMap, Google
Boston Harbor-Flood Risk Model
Central Artery & Tunnel System
MassDOT Focus Land Areas
High-Resolution and Complete Ocean Grids Domains

