Assessing Flood Risk in a Low-Lying Coastal-Urban Catchment: A Case Study of East Boston

Sami Shokrana, Kenneth Strzepek, Katerina Boukin, George Remias, Sai Ravela, Anamitra Saha, Jiangchao Qiu, Miho Mazereeuw, Aditya Barve, Mayank Ojha

Center for Sustainability Science and Strategy

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Background & Motivation

- ❑ The recurrence of flood events has increased the vulnerability of major coastal cities to compound flooding
- ❑ We are unaware of the changing risks for specific regions
- ❑ Assessing compound flood (pluvial, fluvial, and coastal) risk under future climate extremes is required

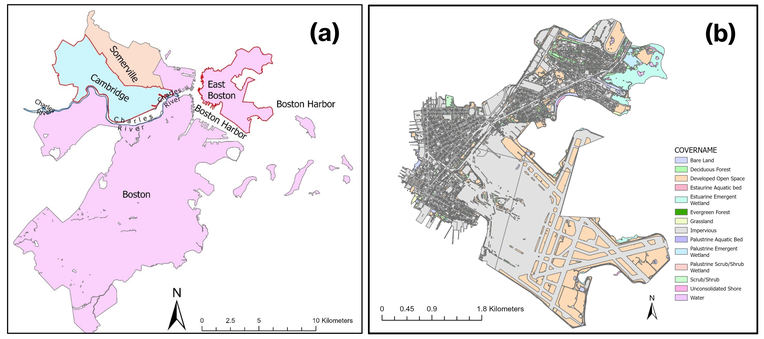
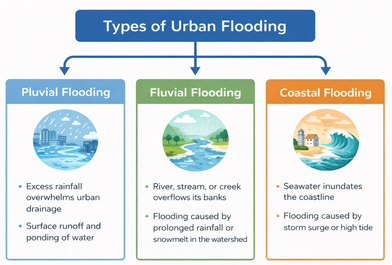


Fig 1. (a) Study site at East Boston, MA. (b) Impervious area covers 65% of the land use in East Boston



- ❑ Compound flooding is the simultaneous occurrence of two or more flood mechanisms at the same time
- ❑ East Boston is at a higher risk of compound flooding

Integrated Risk Assessment

- ❑ Employing modeling techniques to predict flood intensity is one of the pillars of comprehensive flood risk assessment
- ❑ Rain-on-mesh (ROM) approach allows for a more complete representation of the extent and propagation of flooding

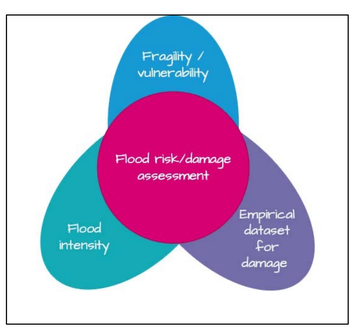


Fig 2. Comprising pillars of the flood risk assessment tools

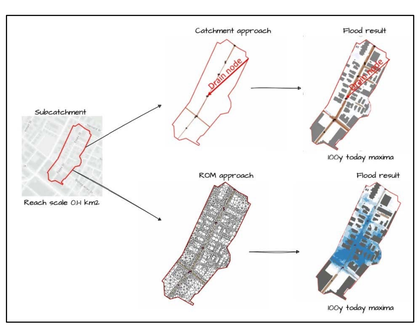
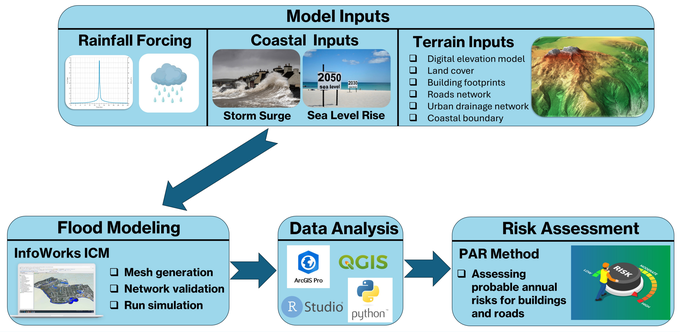


Fig 3. Visual difference in flood extent and propagation from pluvial flooding utilizing catchment (1D) vs. ROM (1D/2D) approaches

Model Workflow



Results: Pluvial Flooding

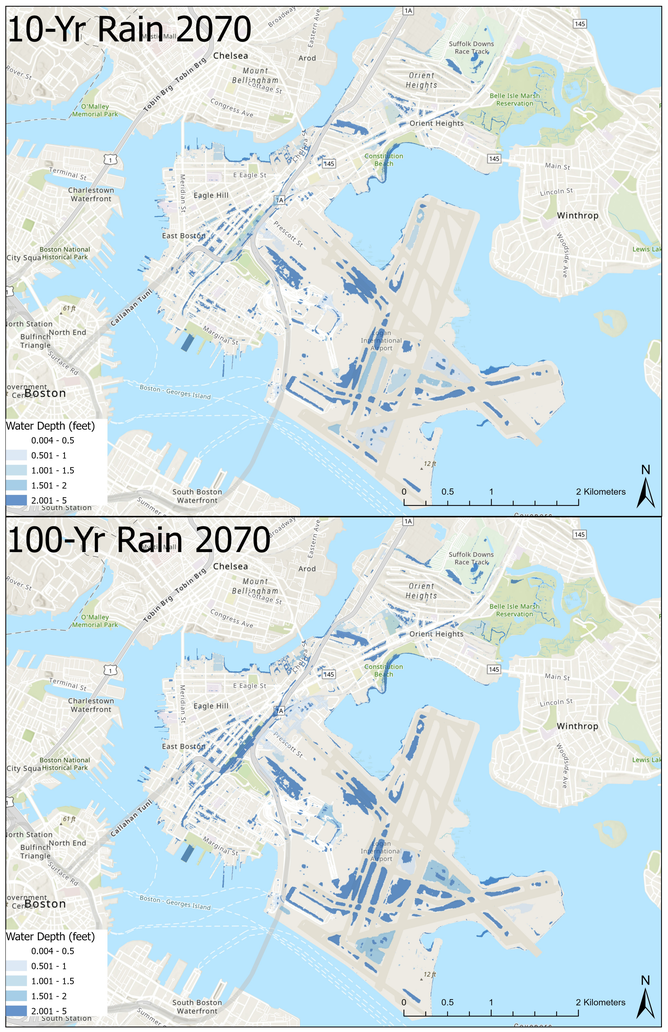


Fig 4. Comparing ICM-predicted flooding in East Boston across 10-year and 100-year design rainfall for 2070

Results: Compound Flooding

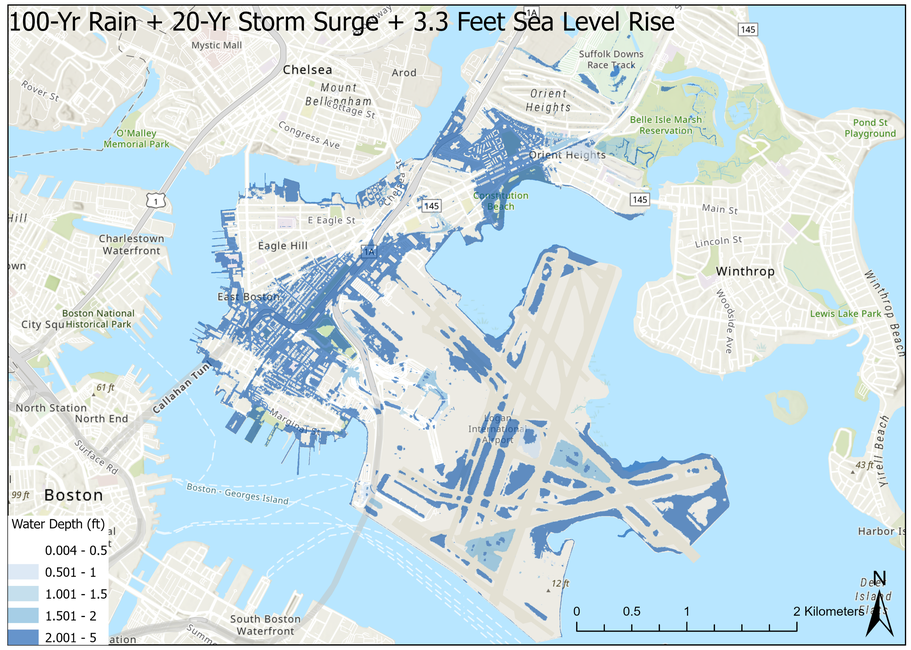


Fig 5. ICM-predicted compound flooding in East Boston for 100-Yr design rainfall in 2070 combined with 20-Yr storm surge and 3.3 feet sea level rise

Risk Assessment: PAR Method

- ❑ Probable annual risk (PAR) is calculated from the probability of design storms and business risk exposure (BRE) of assets
- ❑ Assets with a BRE>=20 is considered high risk

  BRE = Criticality * Condition Rating
- ❑ If BRE > acceptable level of risk (ALR), PAR is calculated as:

  $PAR = \sum (P_{DS} * ([BRE_{DS} - ALR]>=0))$

Key Findings

- ❑ East Boston areas downstream to the Orient Heights and Eagle Hill neighborhoods seems to be at a higher risk of pluvial flooding.
- ❑ Storm surge and sea level rise is predicted to greatly increase the impact of compound flooding in East Boston
- ❑ ICM-predicted flood depths were validated based on the 311 reports and BWSC reports and model accurately predicted most of the flood incidents

Acknowledgements

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