Pacific Northwest
NATIONAL LABORATORY

Sensitivity of Coastal Urban Areas to Extreme Sea-Level Events

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U.S. DEPARTMENT OF ENERGY BATTELLE

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Coastal Risk

Coastal Risk

Sensitivity of Impacts to Urban Morphology

Climate-Related Drivers of Flood Risk

- Shifting **climate**
- Storm **intensification**
- **Frequency** increase

Relative Surge Projections

- Relative **sea level** rise
- Astronomical **tides**
- **Meteorological surge**

Inundation Area

- **Inundation** area distributions
- Inundation area **sensitivities**

Direct Impacts

- **Population** Impacts
- **Land Use** Categories
- **Infrastructure** System Assets

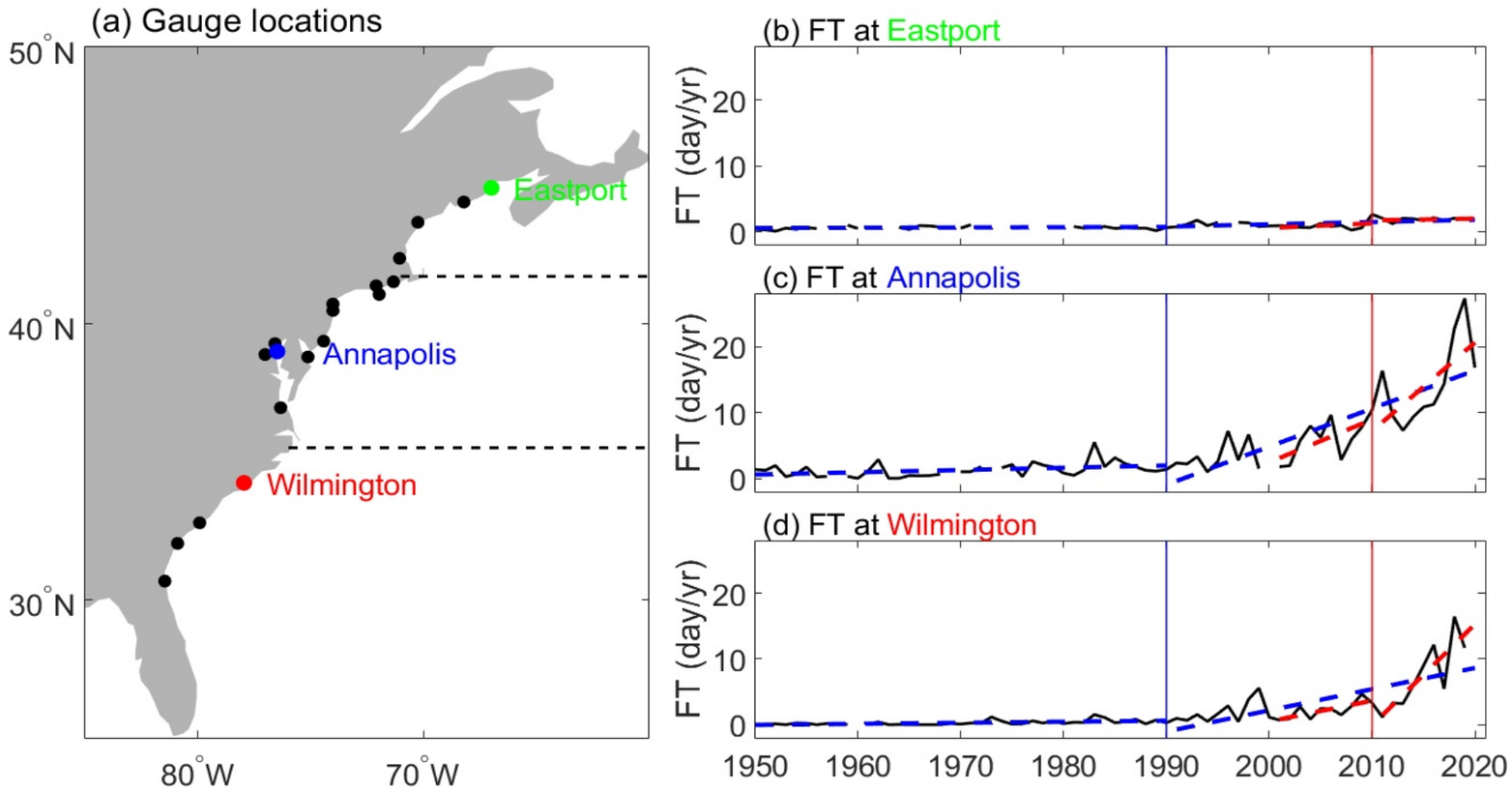
Potential Feedbacks

- Structural **damages**
- **Risk tolerance**
- **Zoning** restrictions
- **Insurance** premiums
- Flood **mitigation**

Climate Drivers of Shifting Flood Risk

Climate-Related Drivers of Flood Risk

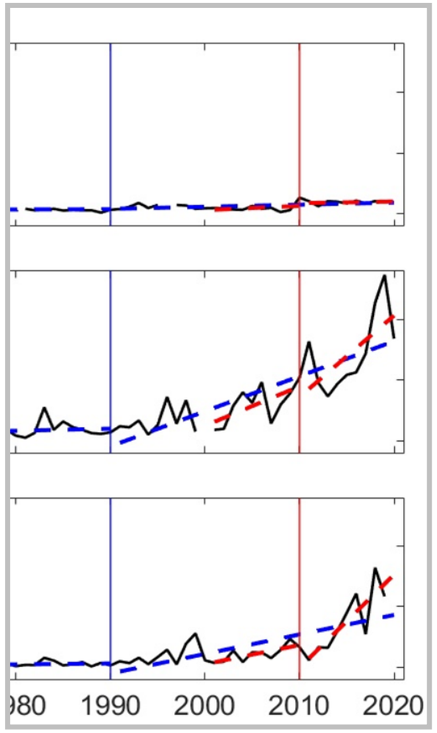
Current Trends in Flooding Along Atlantic Coast



Weiqing Han, CU Boulder

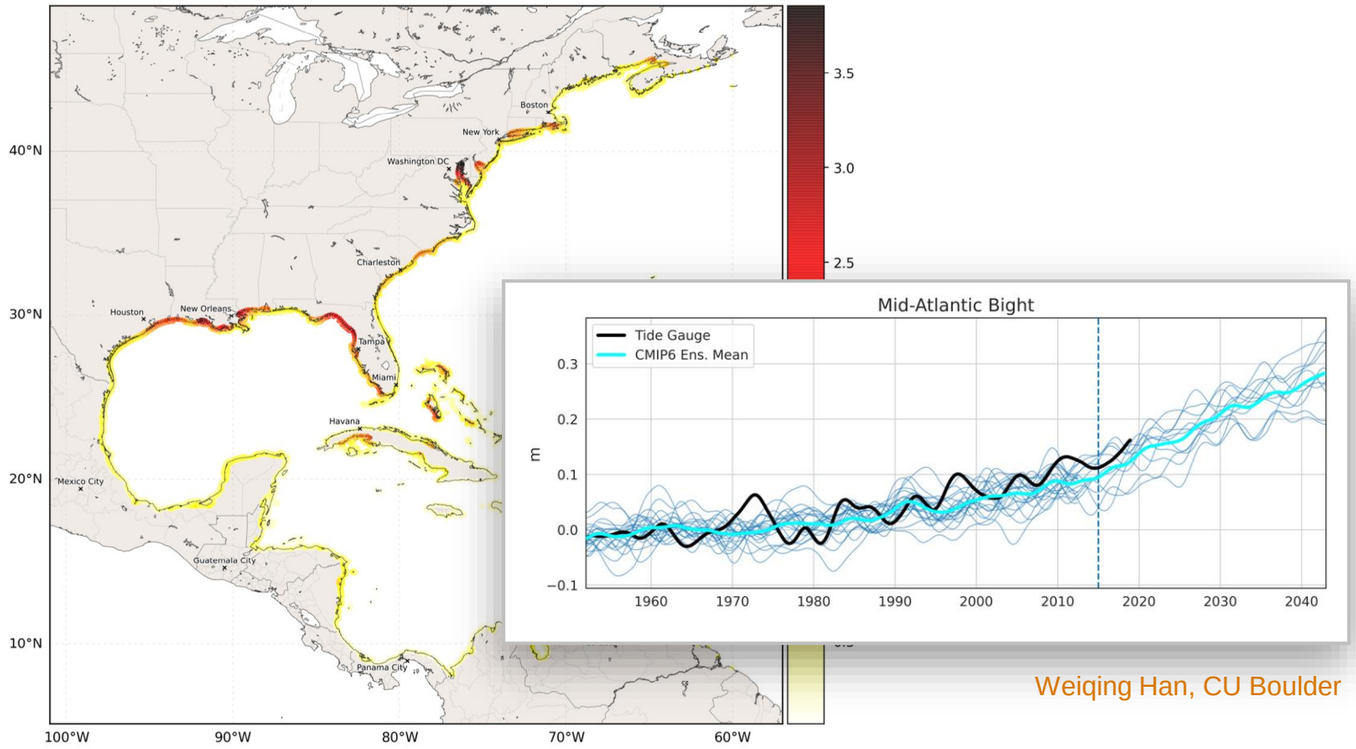
Propagation to Extreme Sea Level Events

Climate-Related Drivers of Flood Risk



Relative Surge Projections

Projected Surge Depths for 15-Year Events



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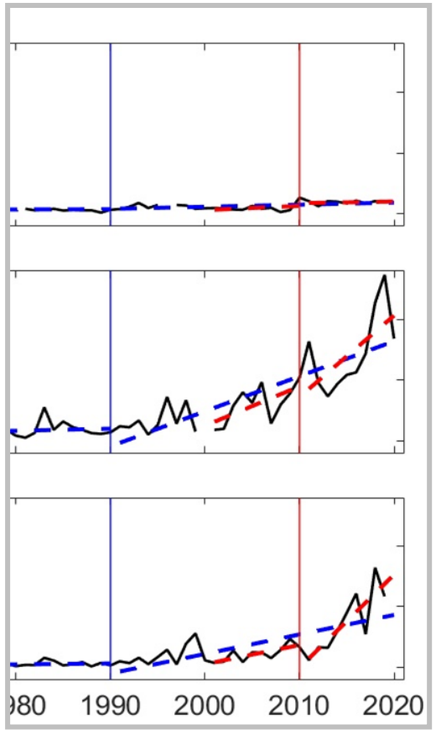
J. Rice, et al. “DeepSurge: A flexible and efficient deep neural network model for climate-scale storm surge risk assessment”

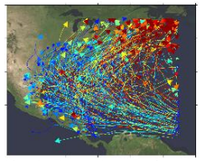
Feedback on Future Urban Morphology

Climate-Related Drivers of Flood Risk



Relative Surge Projections

Climate-Driven Shifting of Risks

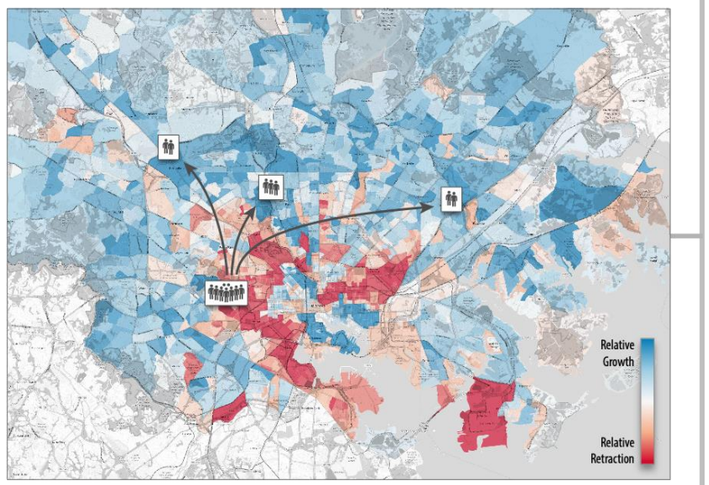


Climate-Driven Storm Tracks

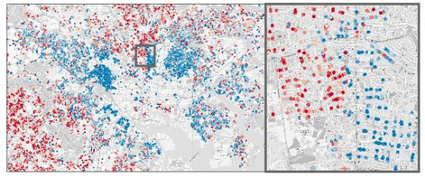
Probabilistic Distributions of Surge and Sea Level Rise

Spatial Distribution of Flood Inundation Risk

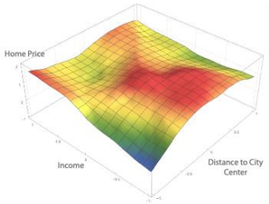
Future Coastal Development Dynamics



J. Yoon, *et al.* Computers, Environment, and Urban Systems 103, 101979



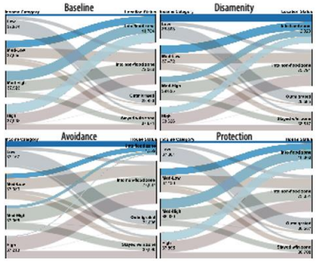
Property-Level Data on Home Characteristics and Purchases



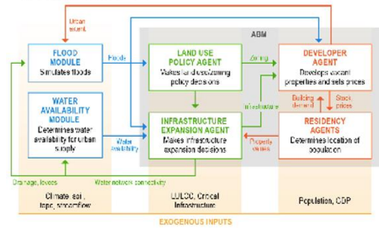
Neural-Network Characterization of Homebuyer Decision Metrics

Potential Feedbacks

Demographic Realignment



CHANCE-C

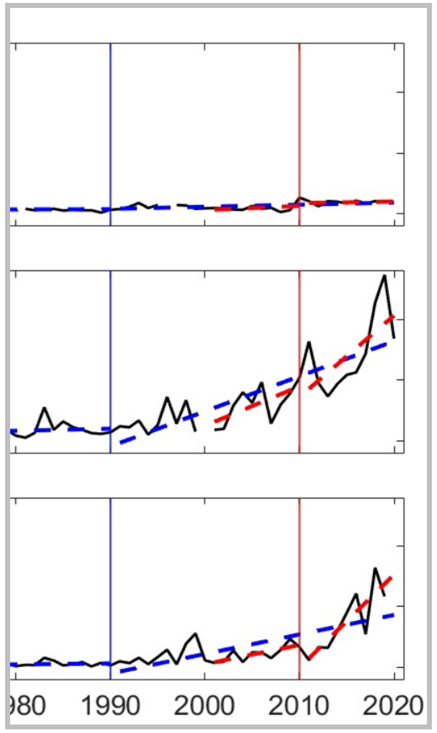


Citing climate change risks, Farmers is latest insurer to exit Florida

The move comes as insurance companies drop coverage in California, Louisiana and other states hit by disasters and high reconstruction costs

Sensitivity of Impacts to Urban Morphology

Climate-Related Drivers of Flood Risk



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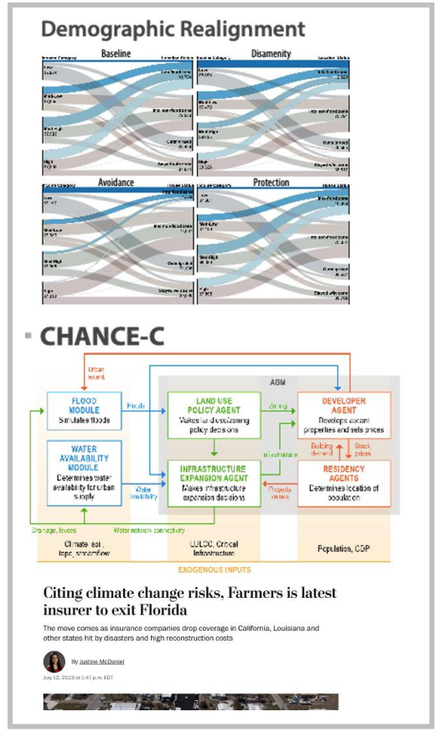
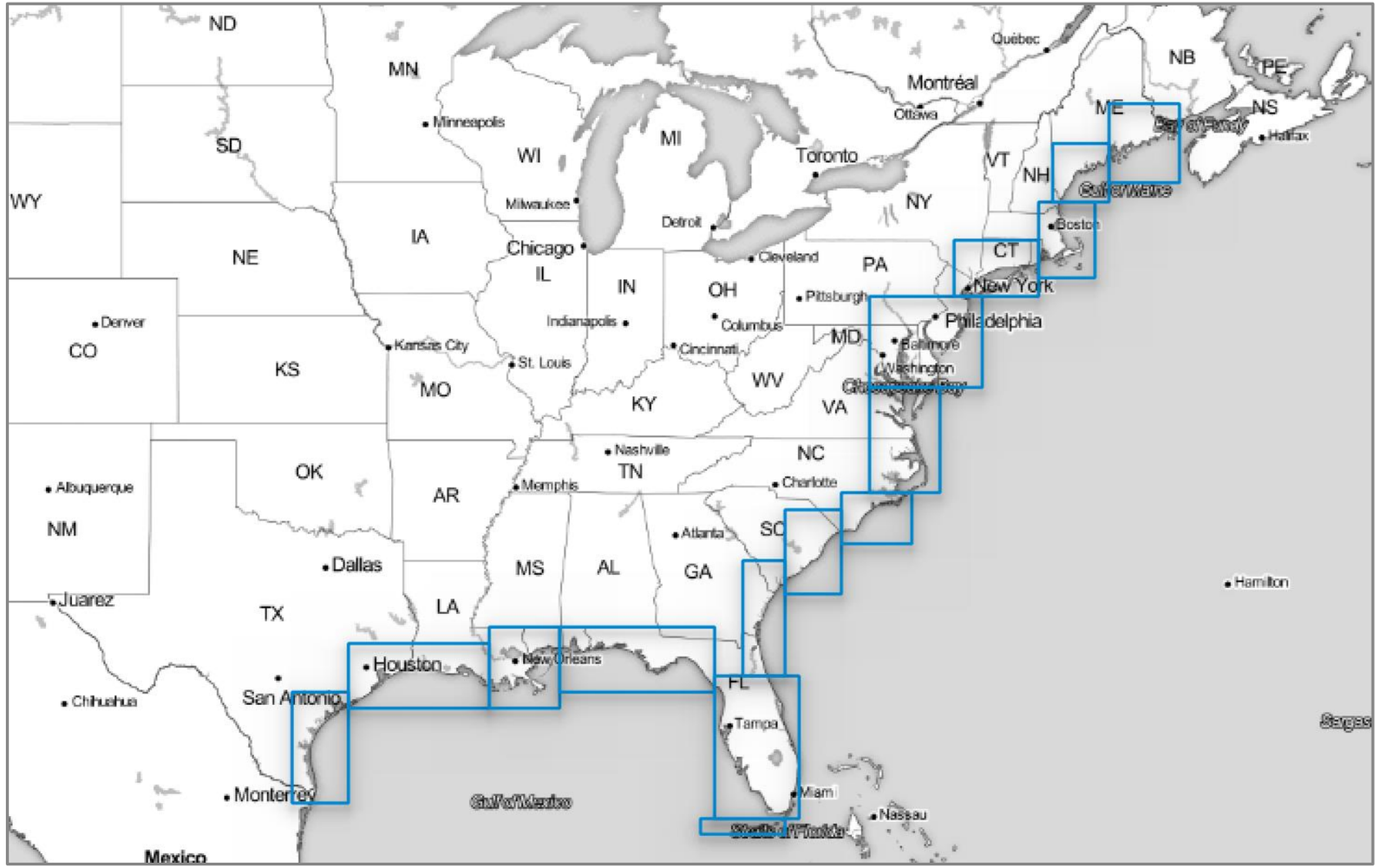


This presentation…

Coastal Storm Surge Risk and Sensitivity Analyses

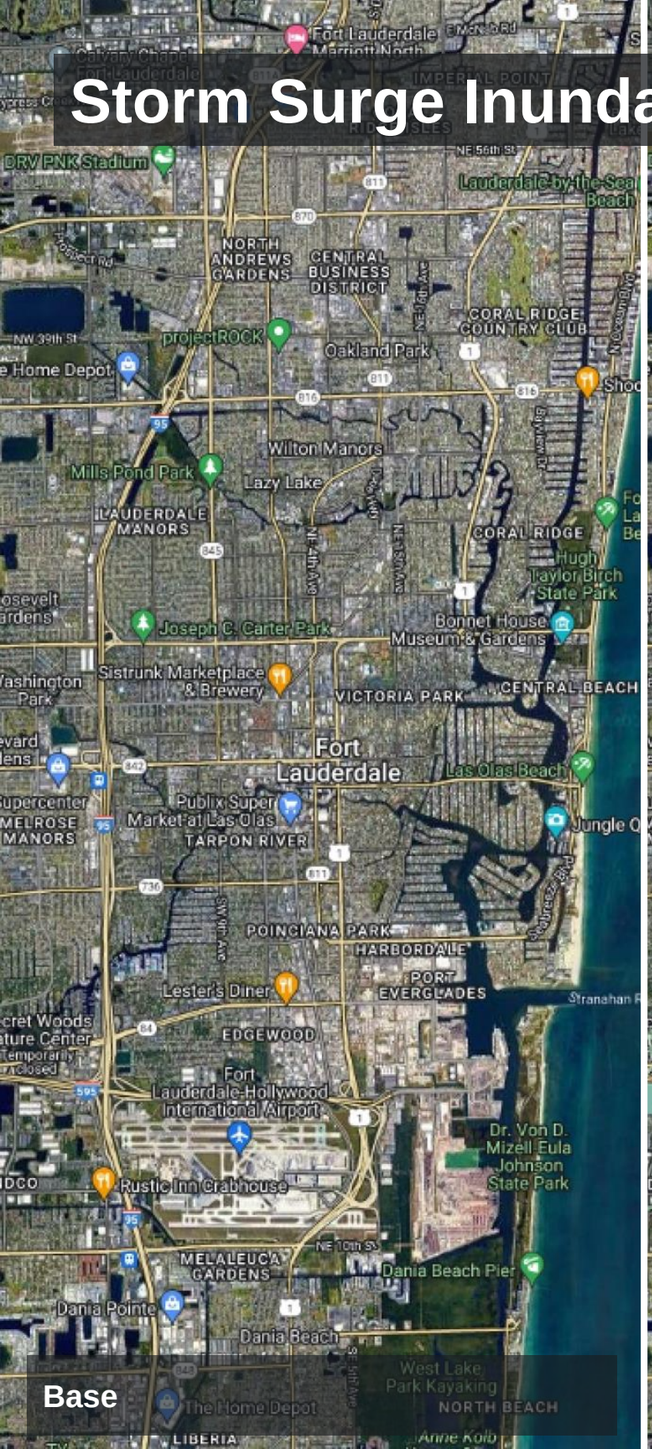
Simulating impacts of storm surge inundation on Gulf and Atlantic coasts:

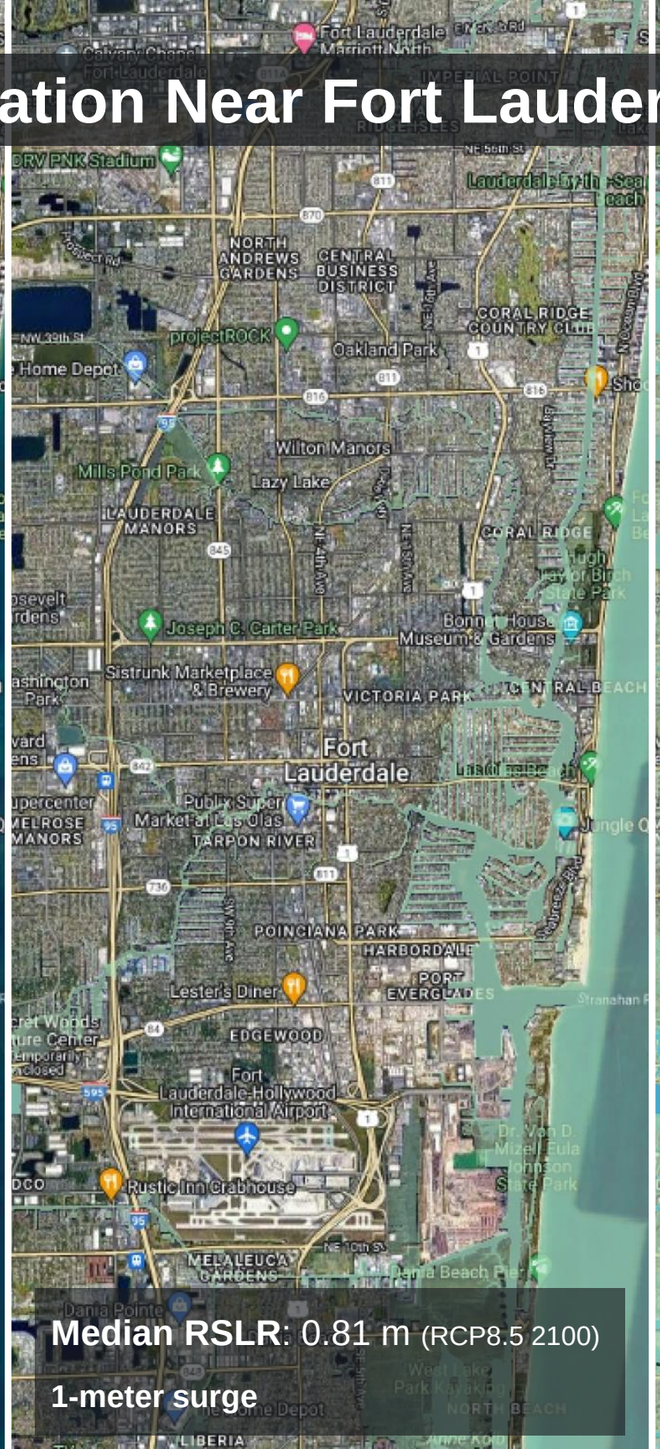
- Evaluating 0.5 m to 6.0 m surge in steps of 0.5 m to populate a **library**
- **Area**, **population**, and **building impacts**
- **DEM resolutions** of 10, 30, and 90 m
- DEMs of different **provenance**

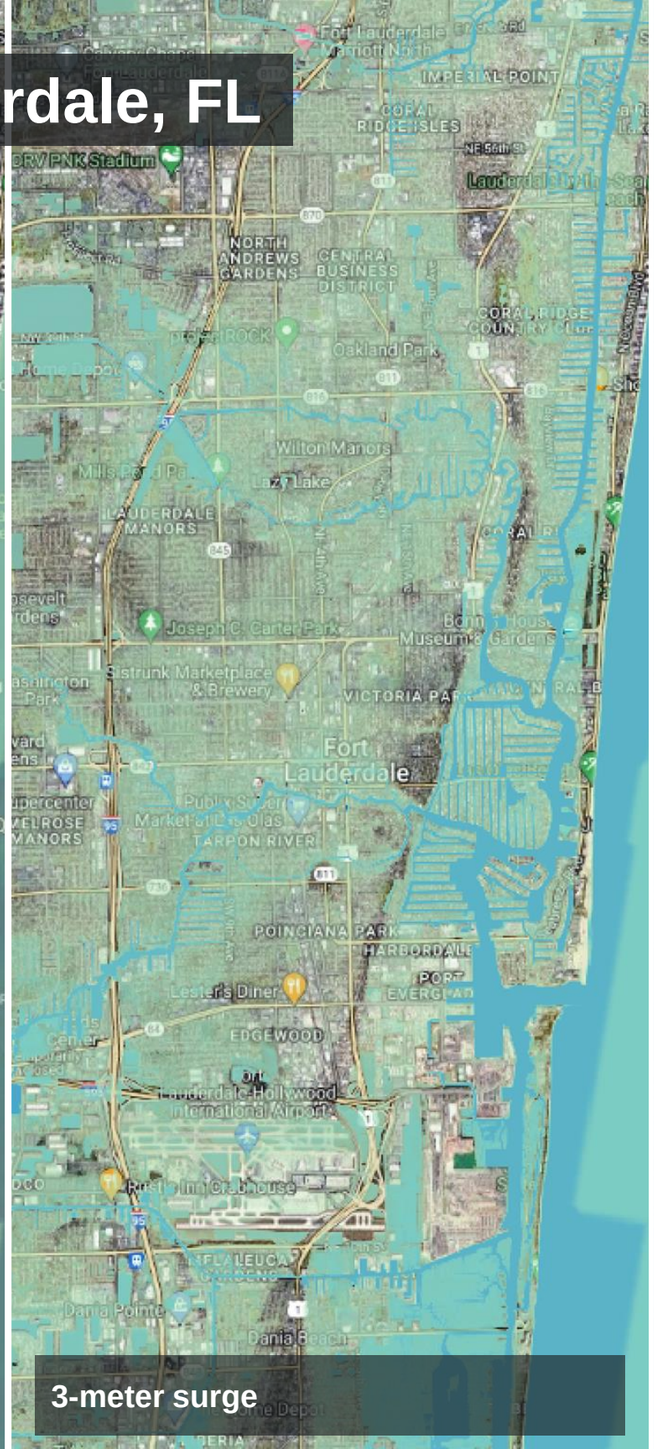


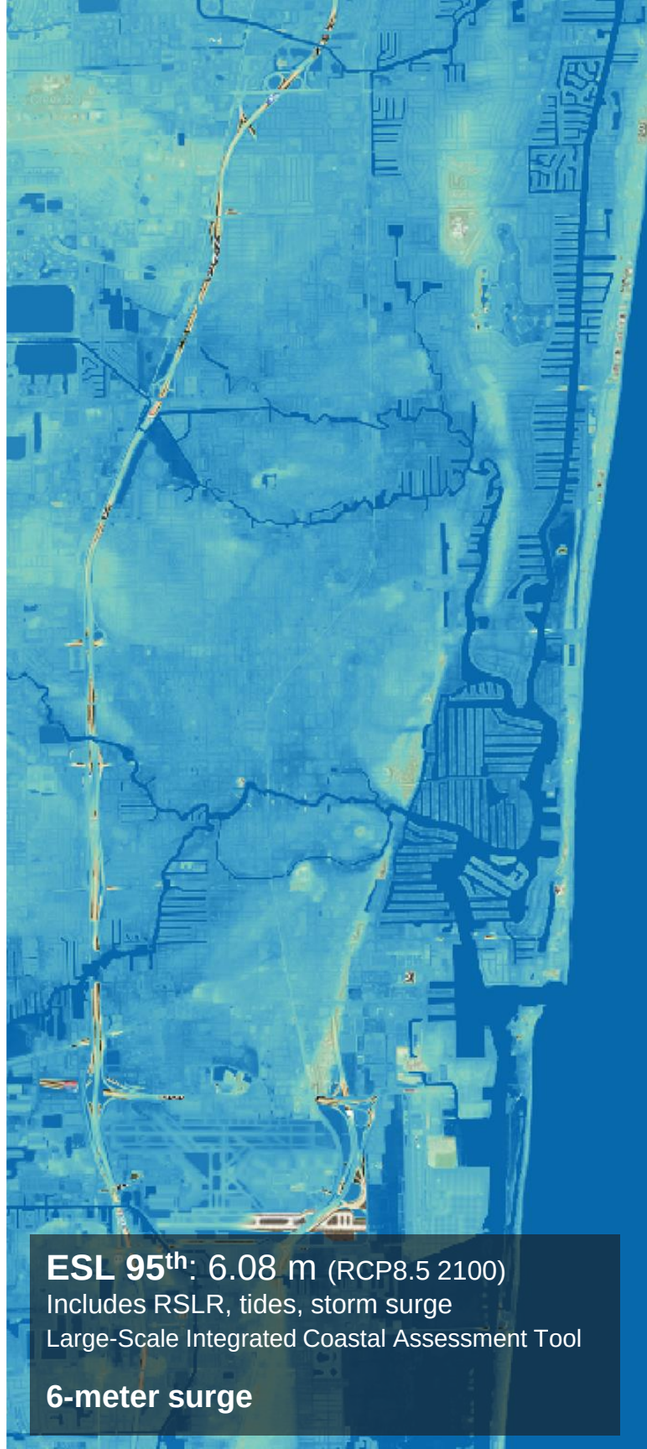
Coastal surge inundation areas of interest

Storm Surge Inundation Near Fort Lauderdale, FL

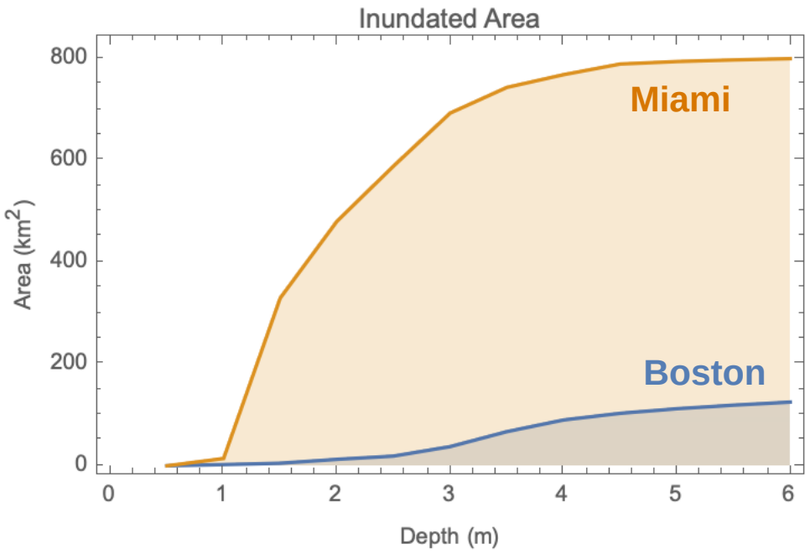


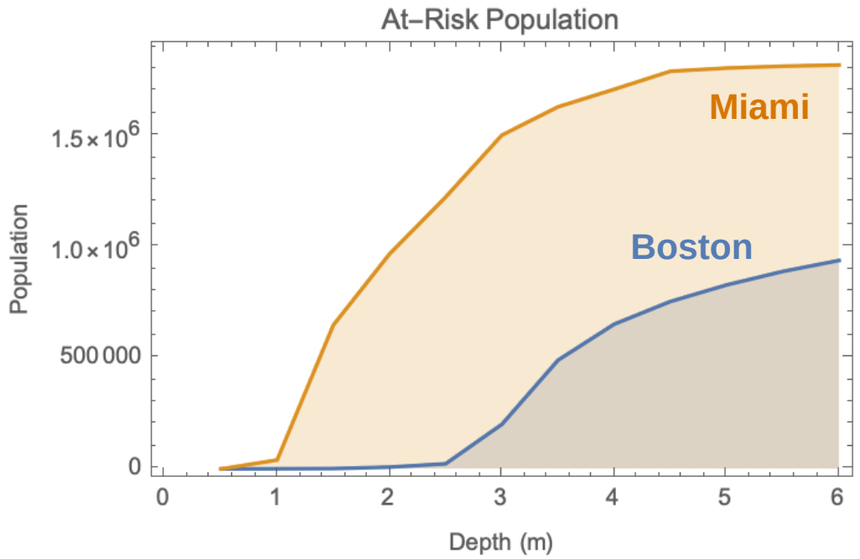


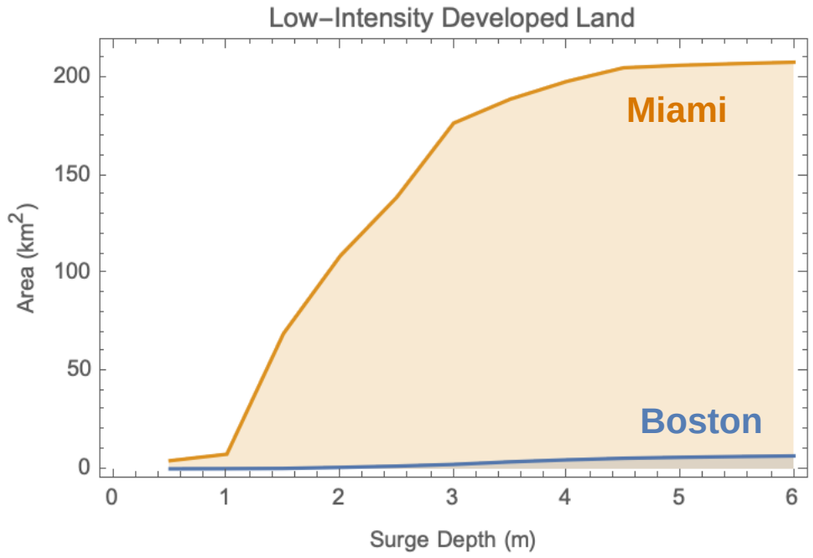


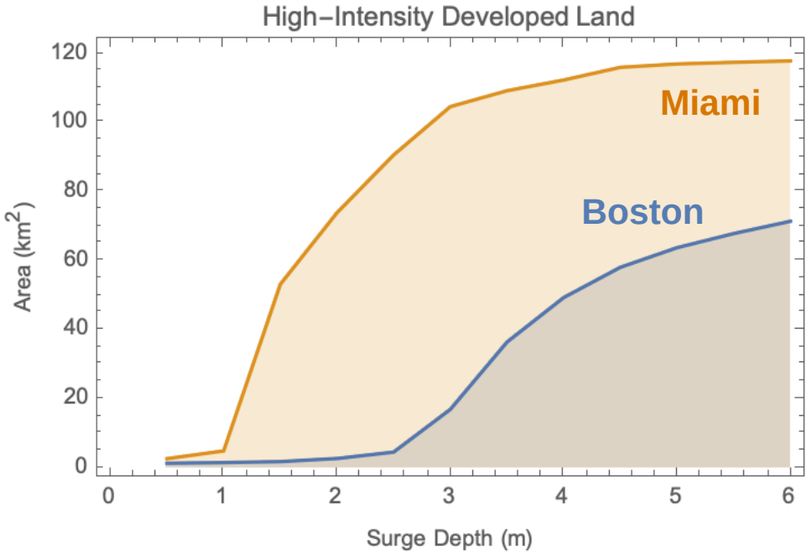


Sensitivity of Coastal Areas to Surge Depth









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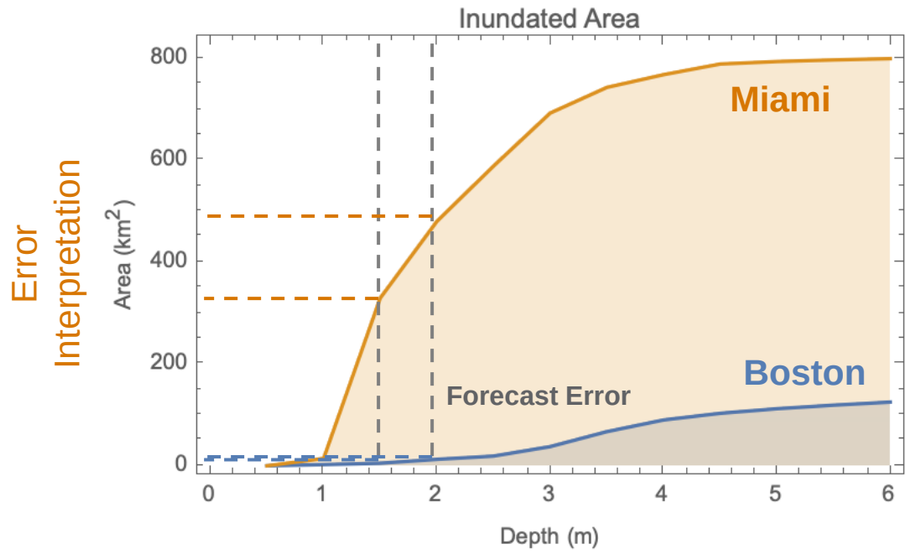
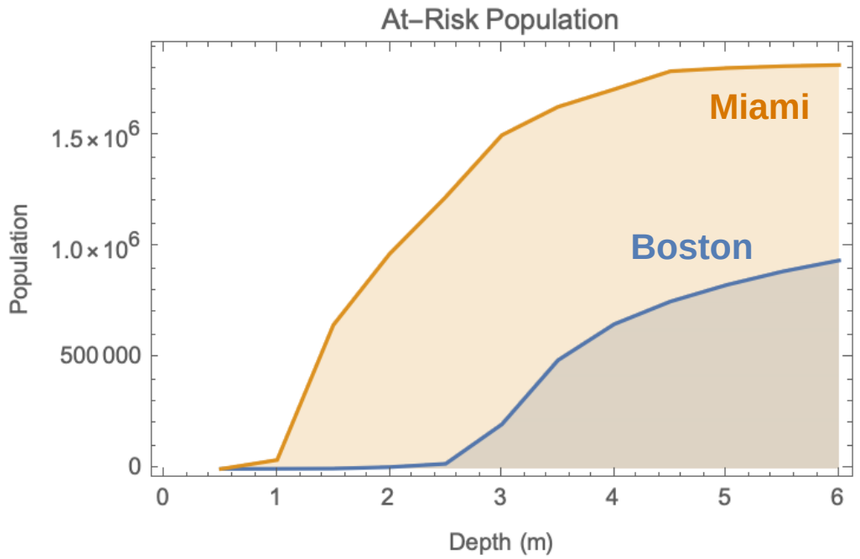
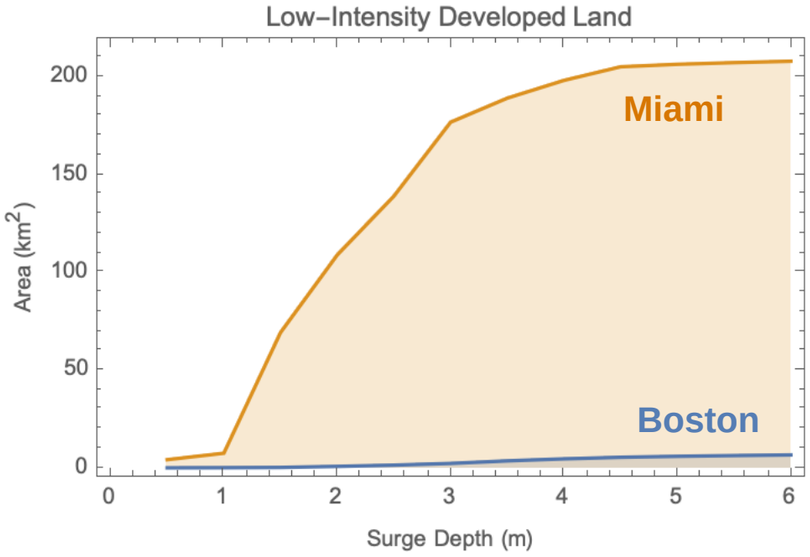
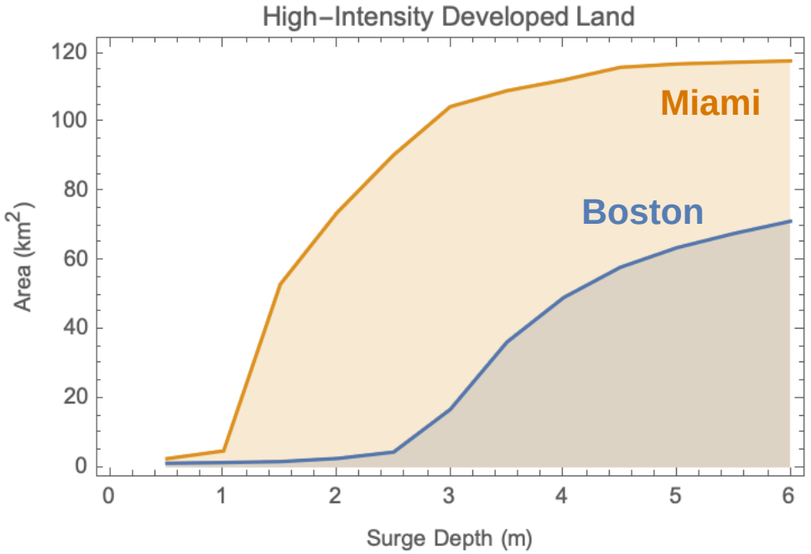


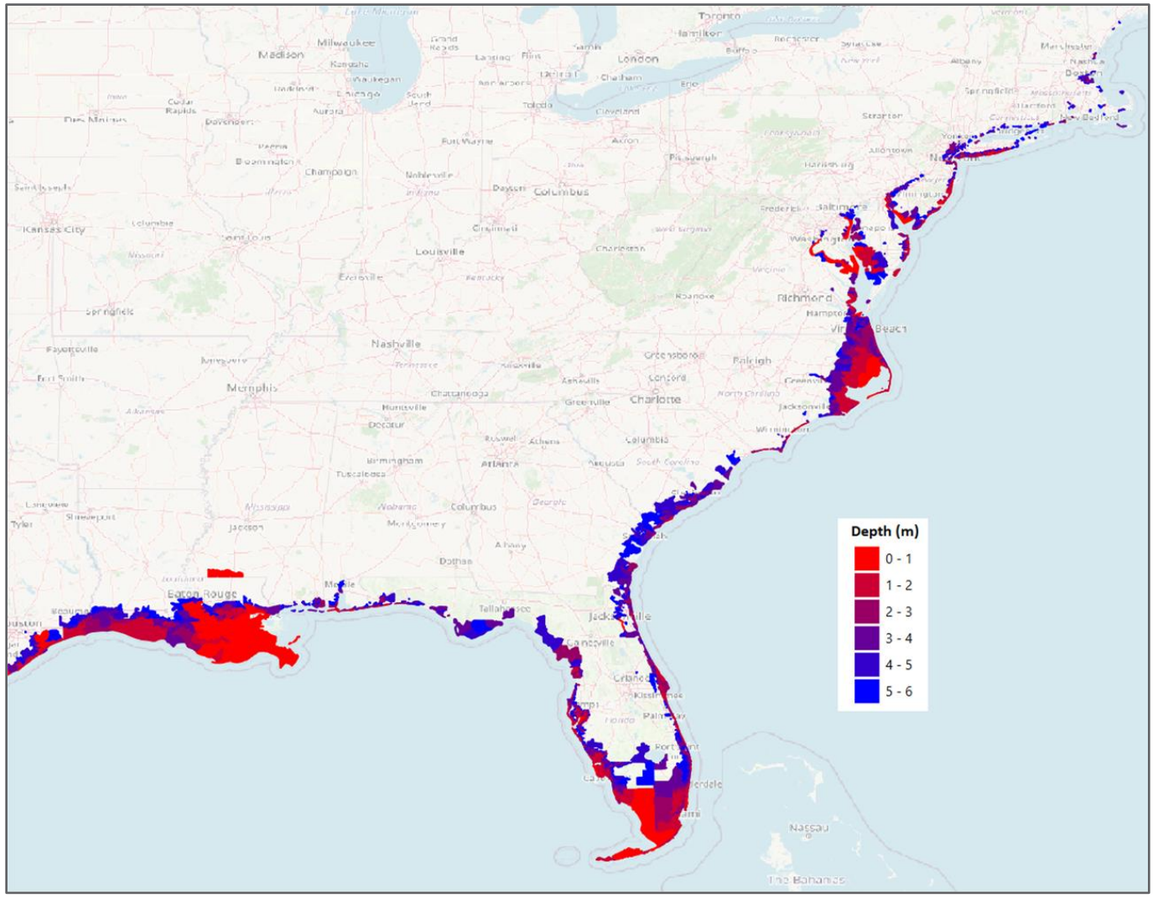






Gulf and Atlantic Coast Risks

Population Sensitivity to Surge Depth



ESL surge required to inundate 50% of the population

Gulf and Atlantic Coast Risks

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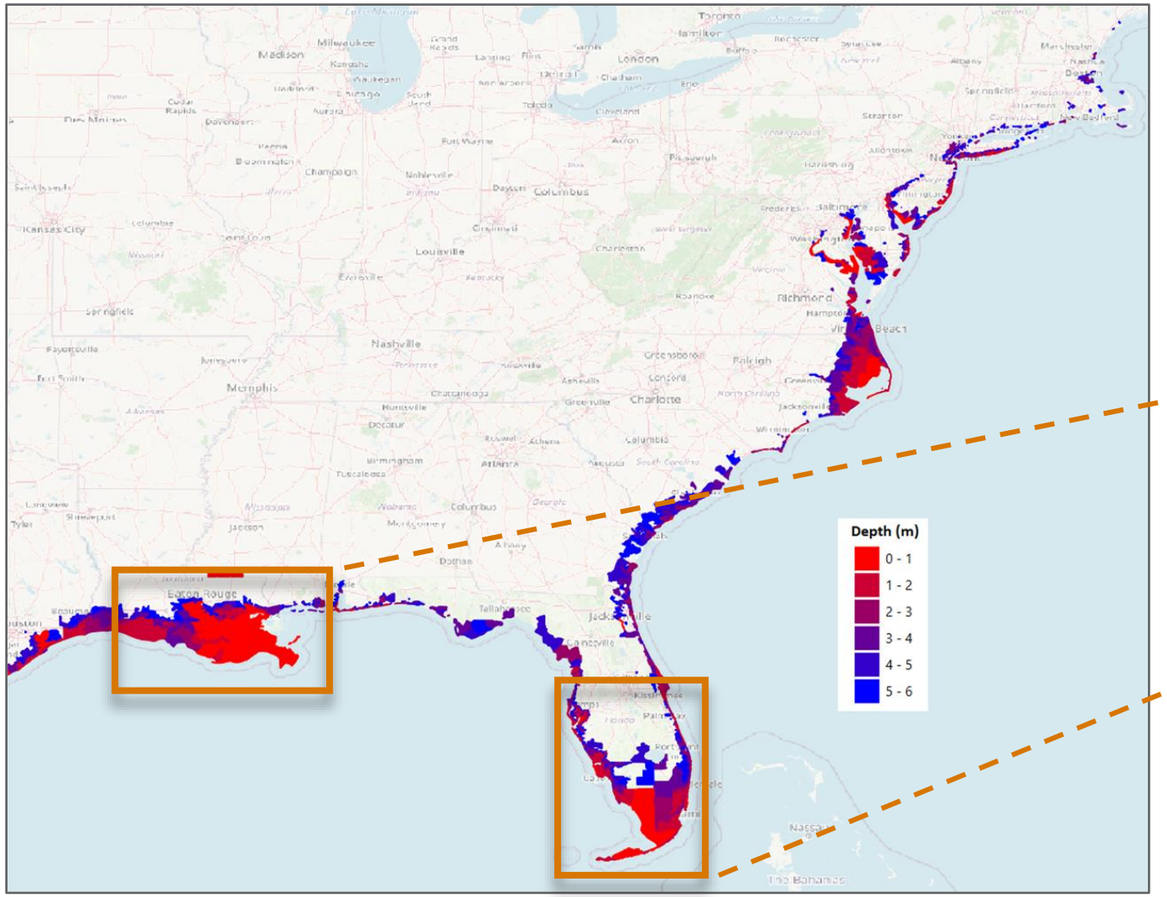
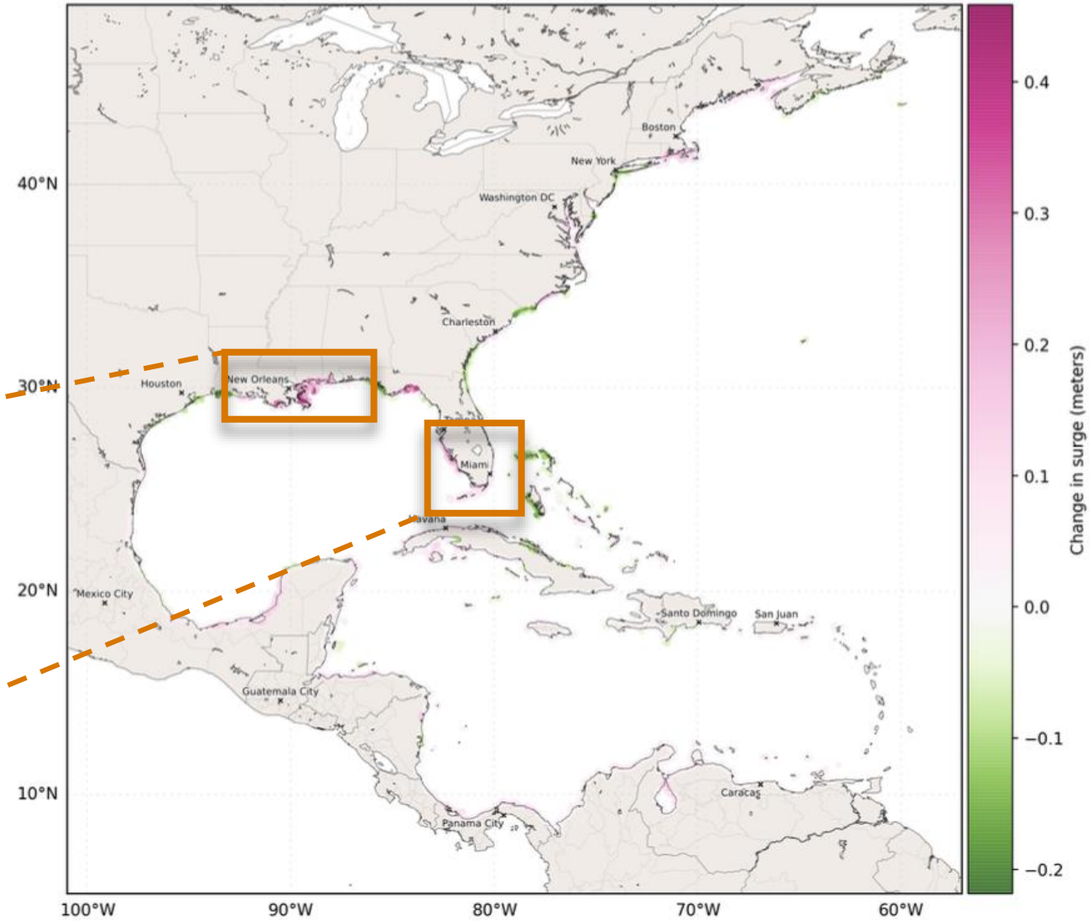


ESL surge required to inundate 50% of the population

Change in surge of 15-year events



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Future Directions

- Further integration of **surge inundation library** with **RAFT** outputs
- Utilization of inundation library to seed **CHANCE-C** spatiotemporal risk pathways
- **Integration** with **precipitation forecasts** from RAFT and flood pluvial flood simulations from **Torrent** to characterize the risks of **compound flooding events**
- Expansion to include **sensitivities of critical infrastructure** systems to compound flooding events