

Economic Impacts of Sea Level Rise and Coastal Storms in Dania Beach, Florida

Southeast Florida Economic Forecasting Partnership

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AECOM Sustainable Economics Practice

- Headquartered in San Francisco, works across the Americas
- Economic consulting on issues at the forefront of climate adaptation strategy and implementation
- Public, private and non-profit clients
- Specialties include:
 - Environmental and resource economics
 - Urban and real estate economics
 - Public funding and financing



Other Relevant Studies

- AECOM
 - Lower Manhattan Coastal Resiliency
 - San Francisco Flood Resilience
 - Port of Oakland, Port of Long Beach,
 - Multiple jurisdictions in California
- Other
 - Bay Area HayWired Scenario, Earthquake
 - Broward County, COAST
 - Tampa Bay, Sea Level Rise Cost of Inaction
 - Hillsborough County, Hurricane Analysis



Literature Review

- **Disaster Response:** Creative destruction, recovery to trend, no recovery
- **Reinvestment:** Only analyzing losses gives an unrealistic view of outcomes
- **Uneven Effects:** Responses vary by geography, community and household
- **Long Term Impacts:** Frequency of events influences levels of outmigration



Presentation Overview

- Background
- Analysis Part I: Before REMI
 - Physical Damages to Dania Beach Businesses
 - Selected Inputs
 - Selected Outputs
- Analysis Part II: REMI
 - Impacts to Broward County and the Rest of Florida
 - Selected Inputs
 - Selected Outputs
- Moving Forward
 - Policy Implications
 - Challenges and Lessons Learned

Background



Study Purpose

How can Dania Beach (and Broward County) support adaptation actions and redevelopment investments that promote economic resilience in the context of coastal hazards?

- For businesses in Dania Beach, estimate the economic costs from coastal storms and sea level rise (SLR) if no action is taken.
 - For businesses in Dania Beach, estimate the economic costs and benefits associated with common adaptation responses.
 - Recommend strategies to decrease vulnerability of the business community in Dania Beach and increase effectiveness of adaptation investments.
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Defining Resilience

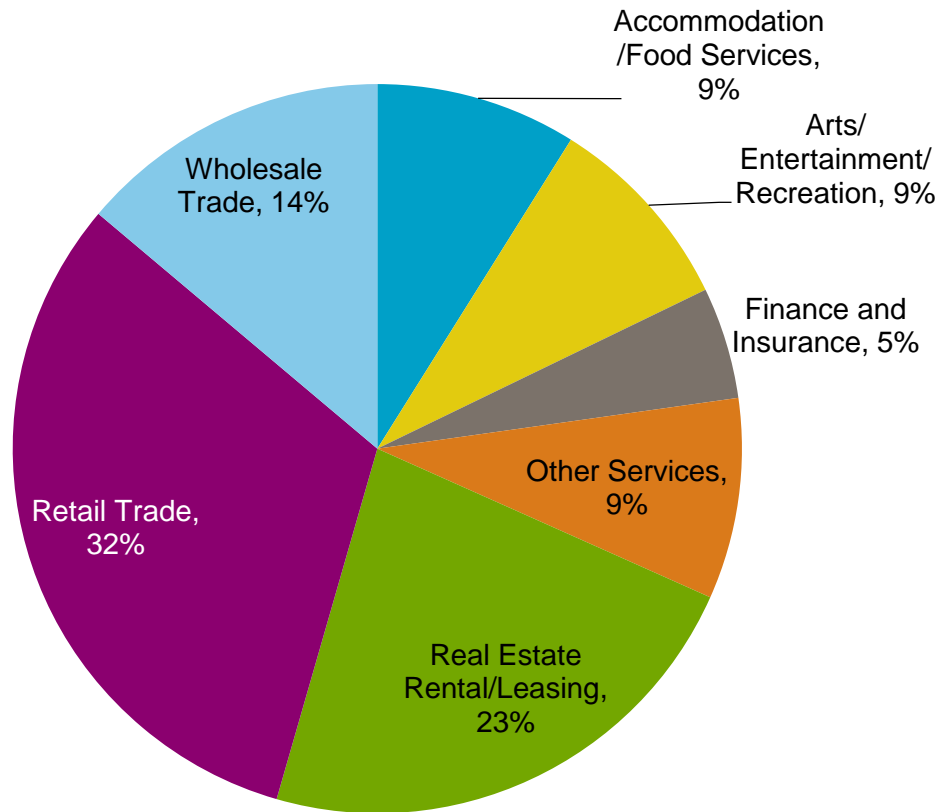
- **Resilience:** The ability to recover from or adjust quickly to changing circumstances.
- **Economic Resilience:** The ability of the economy to withstand and adapt to future coastal hazard conditions.

Key Concepts & Assumptions

- Risk assessment modeling
 - Deterministic vs. probabilistic
 - Impact types
 - Temporary vs. permanent impacts
 - One-time vs. recurring impacts
 - Results reporting
 - Single-event vs. cumulative
 - Static built environment
 - Economic evaluation methods
 - Economic damage
 - Economic impact
 - Fiscal impact
 - Economic value*
-

Business Community Context: Survey Findings

What services or products do you offer?



- Businesses are already impacted by severe weather events & are concerned about negative impacts resulting from an increase in storms and extreme rain events, less so for temperature
- Many businesses are dependent on goods, services, employees, and clientele from outside the City
- Low staff wages and profit margins limit employee and operational resilience
- Businesses have limited capacity to pay for special assessments or utility fees that could fund infrastructure improvements

Physical Scenarios Evaluated

Temporary Event-Based Coastal Storm Impacts (USACE)

- 3-year coastal storm, king tide and 1 foot of SLR in 2030 and 2040
- 3-year coastal storm, king tide and 2 feet of SLR and 2070
- 20-year coastal storm, king tide and ~2 feet of SLR in 2050

Permanent Progressive SLR Impacts (NOAA MHHW)

- Mean higher-high water with one foot of SLR in 2030
- Mean higher-high water with two feet of SLR in 2060



Analysis Part I: Before REMI

Physical Damages to Dania Beach Businesses

Physical (Direct) Damages to Dania Beach



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What are the physical impacts of SLR and coastal storms to business properties in Dania Beach?

– **Inputs**

- Property characteristics
- Business information
- Vulnerability

– **Outputs**

- Temporary damages to Dania Beach businesses
- Permanent damages to Dania Beach businesses

– **Tools**

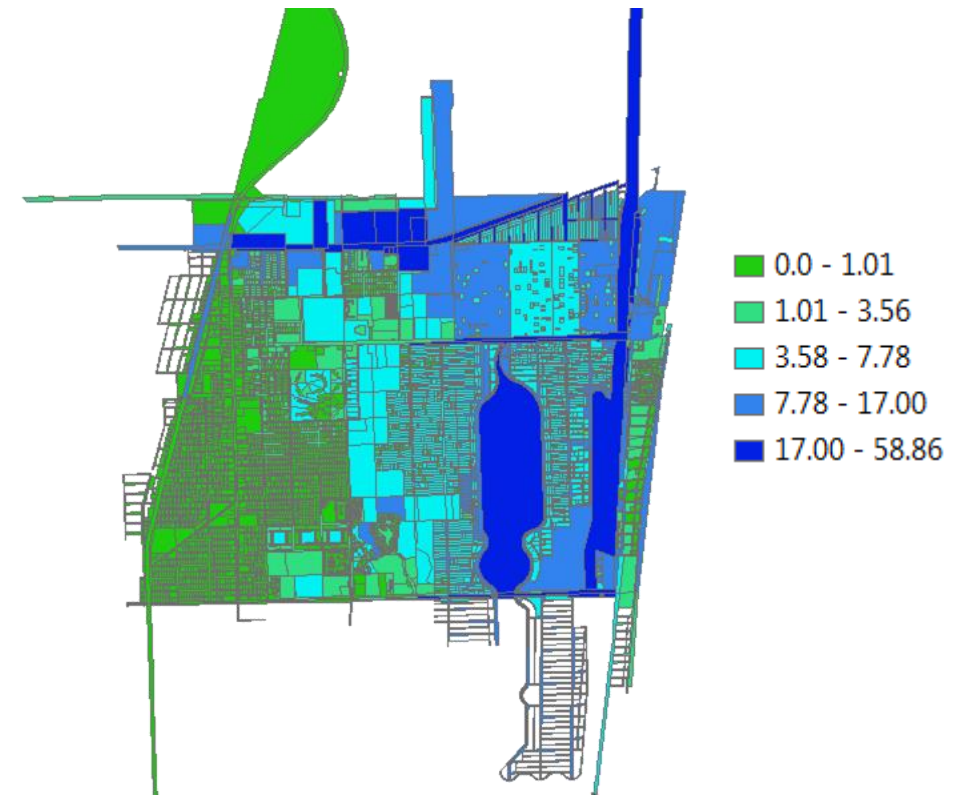
- Custom economic models built off of industry standards and tailored to local conditions

Selected Inputs

– Property and Business Information

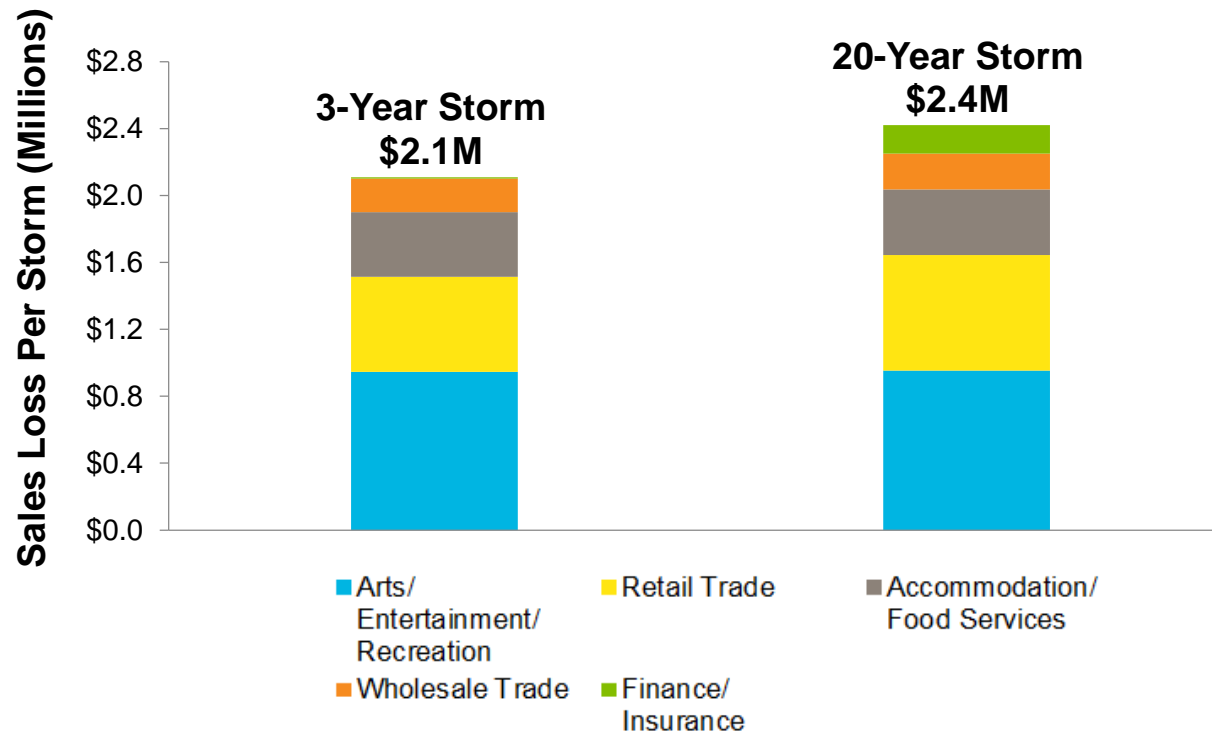
| Property | Business |
|----------------|-----------------------|
| Square footage | Industry |
| Land use | Annual Sales |
| Assessed value | Annual Wages/Salaries |
| Stories | Number of Employees |

– Vulnerability: Flood Depth & SLR Data



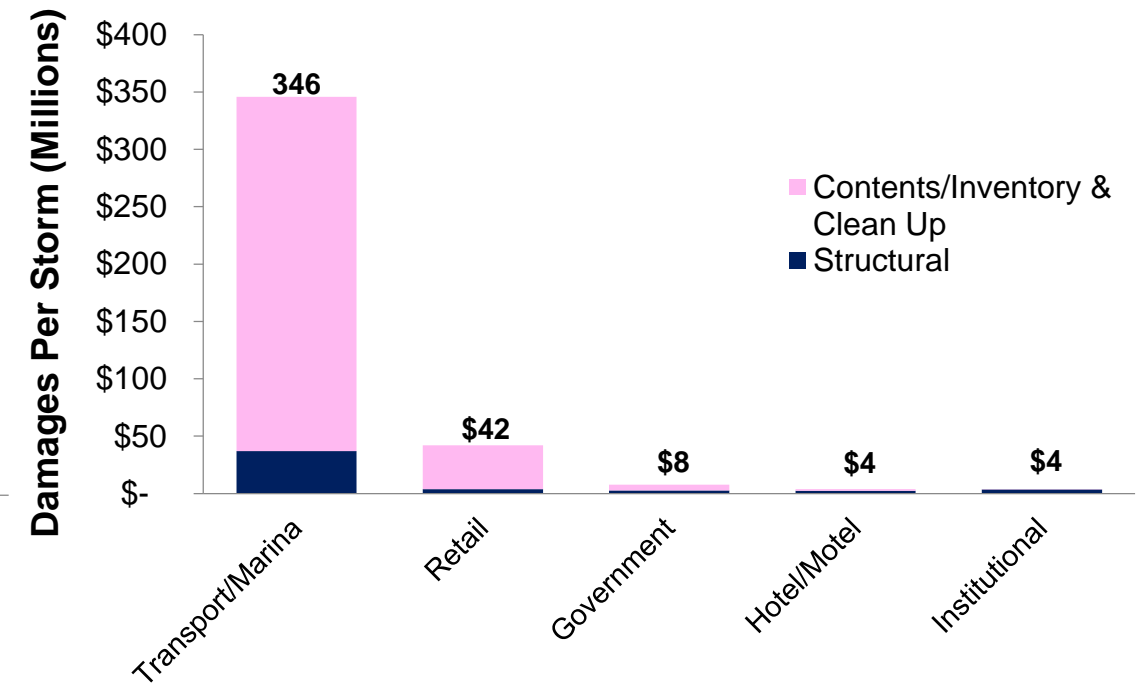
Selected Outputs: Damages per Storm

Business Sales Impacts from a 3-Year and 20-Year Storm*



*Five most impacted industries shown

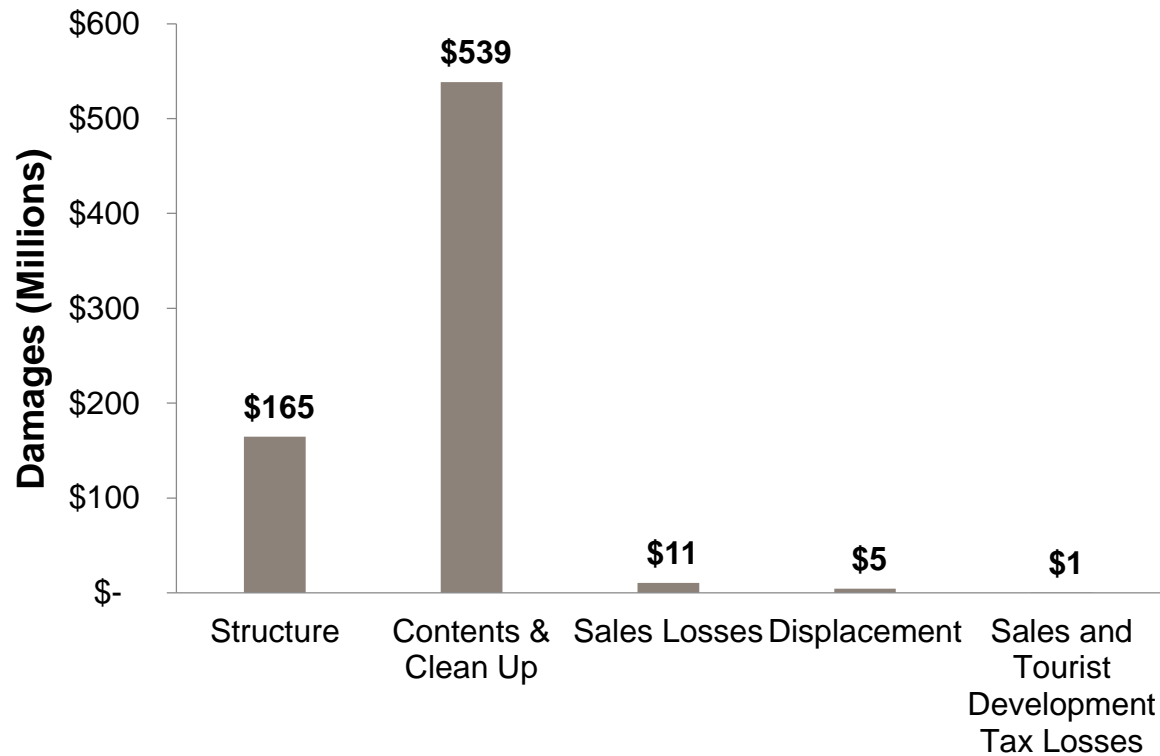
Direct Property Impacts from a 20-Year Storm*



*Five most impacted land uses shown

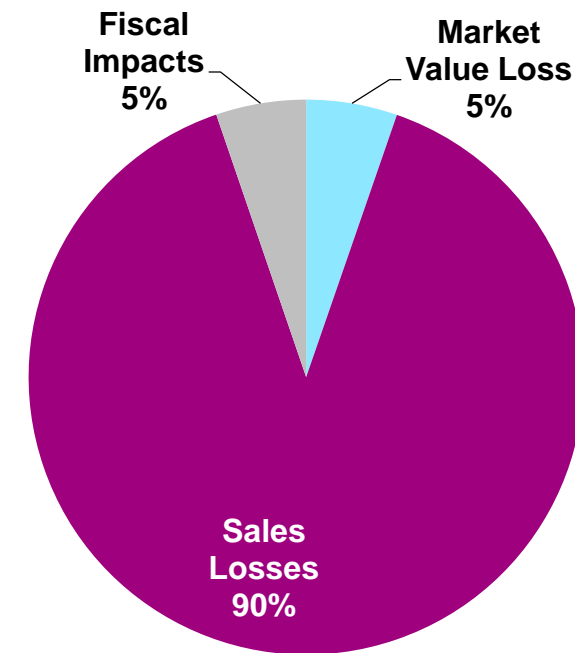
Selected Outputs: Cumulative Damages

Coastal Storm Events: Cumulative Damages*
2030-2070: \$719M



*Using assumed event occurrence

Sea Level Rise: Cumulative Damages
2030-2070: \$1.2B

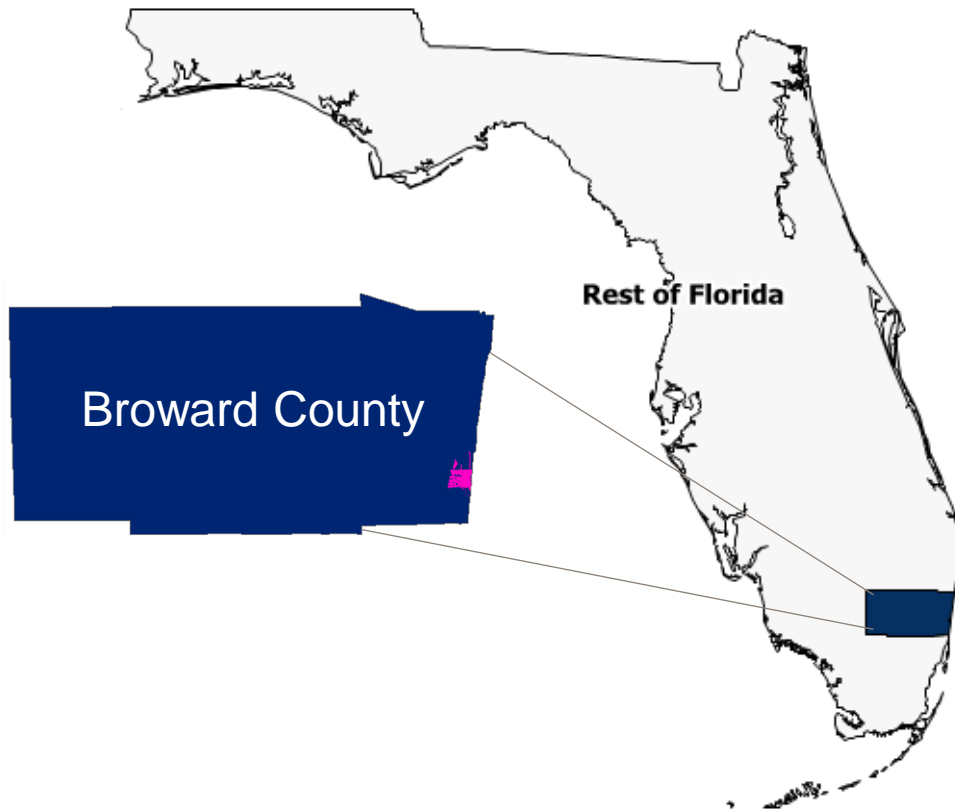




Analysis Part II: REMI

Impacts to Broward County and the Rest of Florida

Impacts to Broward & the Rest of Florida



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How will different response actions, or no action, affect the Broward County economy? How will they affect the rest of Florida?

– **Inputs**

- Response actions
 - Purpose, Beneficiaries and Physical Impacts, Costs and Sources of Funds, Involved Industries, Timeframe

– **Outputs**

- Impacts to Broward County
- Impacts to the Rest of Florida

– **Tools**

- REMI PI+

Selected Inputs: Response Actions

| Response Actions | Description | What damages are addressed? |
|-----------------------------|--|-----------------------------|
| No Preemptive Action | Nothing is done to mitigate future SLR and coastal storm conditions, but structures are rebuilt post-event | Temporary & Permanent |
| Relocate | Low-lying businesses subject to tidal inundation from SLR relocate to higher ground in Dania Beach or outside of the City boundaries | Permanent |
| Fortify | Construct a seawall to prevent low-lying business from being subject to tidal inundation from SLR | Permanent |
| Accommodate | Elevate structures so their first floor elevation is higher than the base flood elevations of modeled coastal storms | Temporary |

REMI Model Analysis Elements

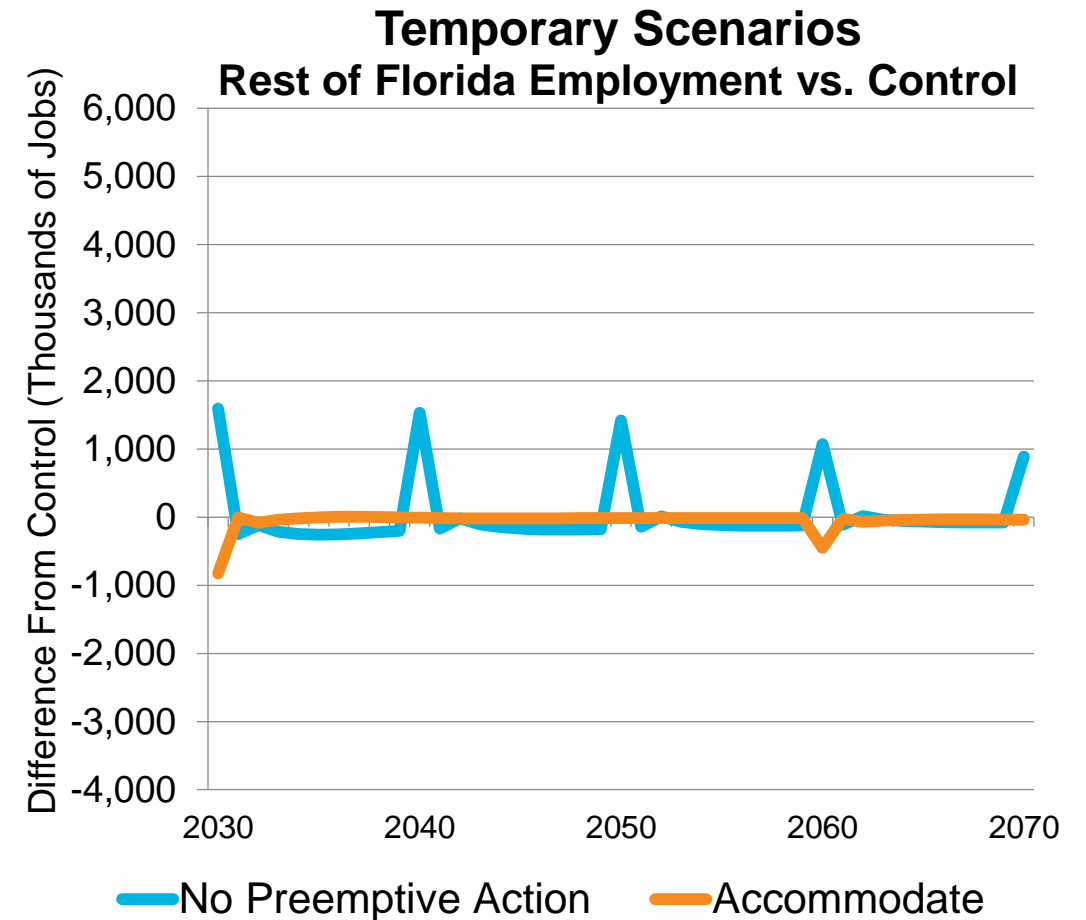
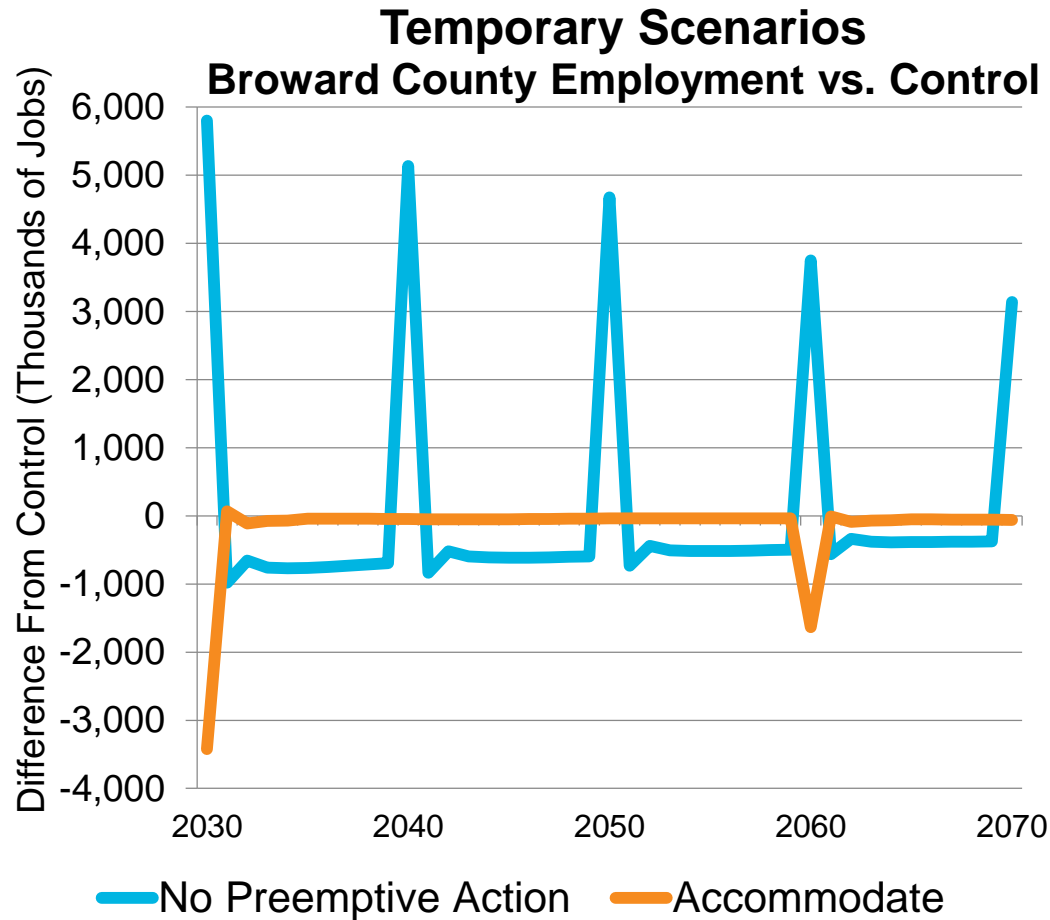
| Elements | Description |
|-----------------------------------|---|
| Capital Stock Loss | Businesses subject to damage from coastal storms and SLR |
| Output Loss | Direct output loss resulting from building, content, and inventory damage |
| Employment Change | Employment loss due to disruption, gains from recovery efforts to rebuild or relocation of vulnerable businesses |
| Population Change | Combination of direct loss from damage, indirect loss from employment loss and other migration |
| Government Spending | Funding for rebuilding or relocating businesses has some boosts to the economy, but may be offset by cuts in other public services |
| Government Revenue Sources | Simulate increases to property taxes, sales taxes, and tourist development taxes, but may be offset by decline in other consumer spending |

—Source: Adapted from Kroll et al. 2018

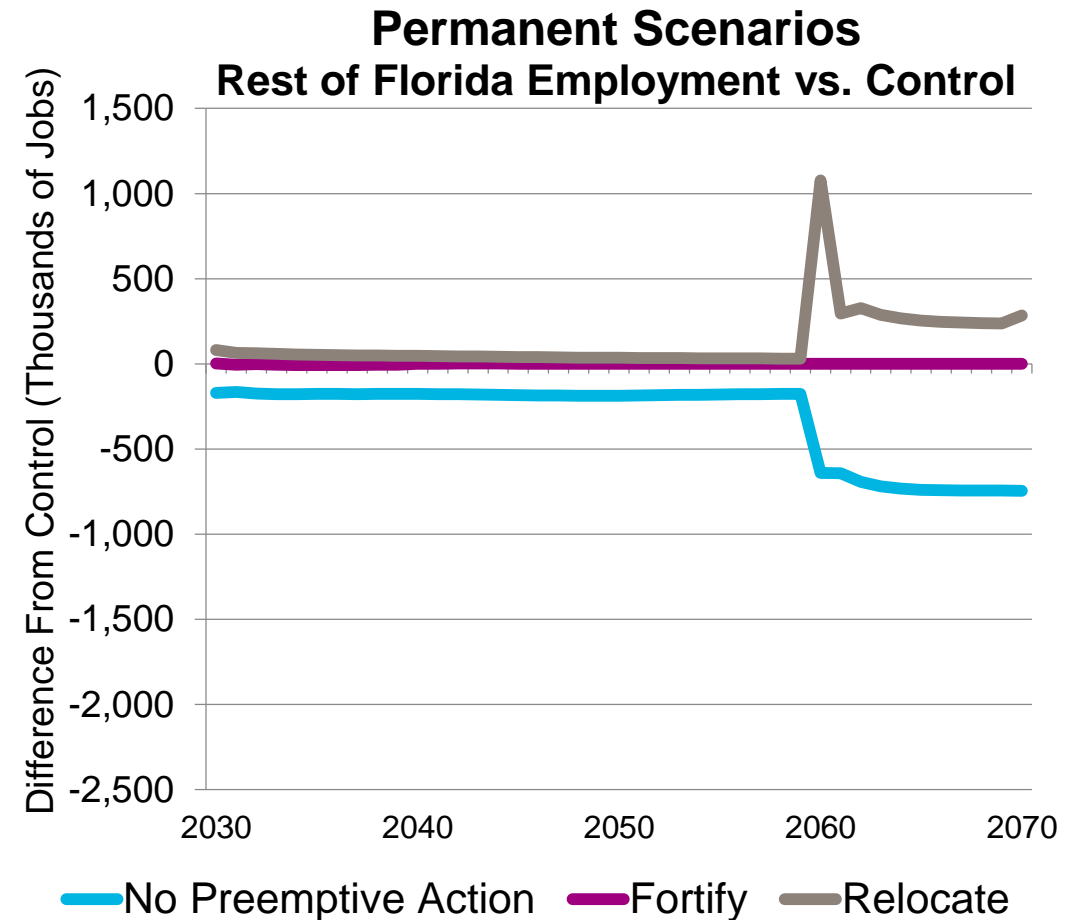
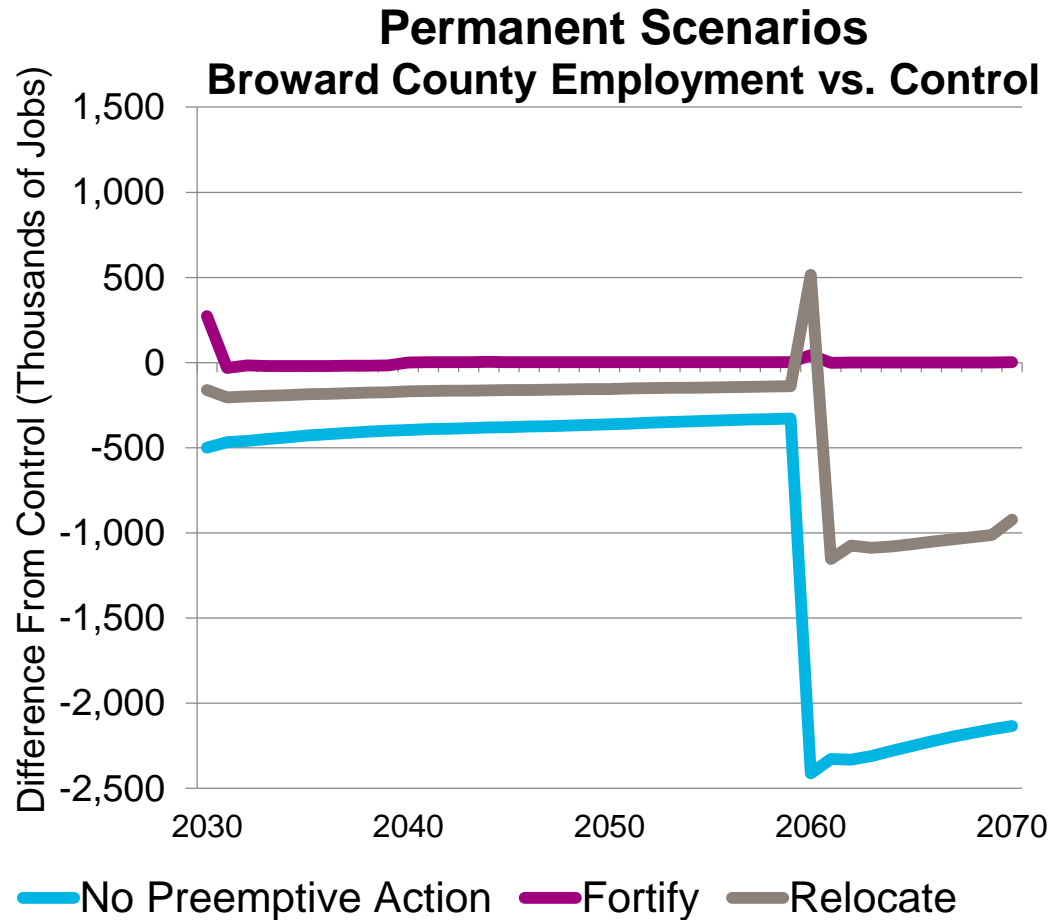
Selected Outputs: Summary Table

| | CONTROL | | TEMPORARY | | PERMANENT | | |
|------------------------|------------------|-----------|----------------------|-------------|----------------------|----------|---------|
| | Change 2030-2070 | Control | No Preemptive Action | Accommodate | No Preemptive Action | Relocate | Fortify |
| Broward County | Employment | 312,810 | 1,810 | -6,830 | -36,410 | -14,930 | 200 |
| | GDP (Millions) | \$131,150 | \$100 | -\$690 | -\$4,750 | -\$1,950 | \$20 |
| | Population | 584,770 | -8,580 | -10,350 | -41,210 | -16,780 | 270 |
| Rest of Florida | Employment | 1,758,020 | 1,720 | -2,060 | -13,260 | 5,080 | -30 |
| | GDP (Millions) | \$918,090 | \$120 | -\$240 | -\$1,700 | \$720 | \$0 |
| | Population | 3,520,990 | 1,140 | -2,500 | -18,800 | 5,560 | -90 |

Selected Outputs: Employment in Temporary Scenarios



Selected Outputs: Employment in Permanent Scenarios



Moving Forward

Key Public Sector Recommendations

- Prioritize phased adaptation investments with an eye toward long-term risk
 - Invest in regional strategies
 - Establish an accessible data platform to identify vulnerability
 - Improve disaster preparedness
 - Expand assessment of projected damages
 - Have standards in place to build back better in the event of disaster
 - Evaluate tradeoffs of response actions (e.g., built vs. natural environment)
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Key Private Sector Recommendations

- Develop business continuity plans
 - Evaluate vulnerability to future conditions both on-site and to suppliers
 - Consider how public infrastructure damages could affect employees' ability to work
 - Review insurance policies (e.g., indirect business interruption)
 - Work with others in the same industry to develop industry-wide preparedness and limit duplicate efforts
 - Work with public sector for data needs
 - Work with public sector to ensure business continuity is a key consideration in adaptation strategy development
-

Challenges

- City focused-analysis in a regional model is limited
 - Access to and interpretation of flood and sea level rise models
 - Data collection via survey considerations could be refined
 - Assumptions required for calculating physical (direct) damages and changes in damages overtime
 - Assumptions required for developing a set of adaptation strategies and response actions (e.g., level of adoption, who will pay, beneficiaries, effectiveness, etc.)
 - With broader geography, additional data cleaning and assumptions will be necessary to ensure consistency (e.g. assessor data between counties, handling of sales taxes between jurisdictions)
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Other REMI Factors to Consider in Future Studies

- Increased insurance to businesses
 - Increased construction costs
 - Assumed built-in resilience and ability for small businesses to weather impacts
 - Changes in property values
 - Non-pecuniary (amenity) impacts
 - Ability to effectively deploy funds
 - Timing of events (e.g., deterministic vs. probabilistic)
 - How to present sensitivity analyses (e.g., don't overwhelm the reader)
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Other Considerations



Paying for adaptation



Accounting for equity



Disadvantaged populations



Opportunity costs



Reputation risks and associated impacts

Q & A

Thank you for your time!

Questions?

Feel free to contact me:

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